

### General Description

The SLG46127 GreenPAK combines the functionality and versatility of a GreenPAK Programmable Mixed-signal Matrix with the capabilities of Renesas' CuFET technology. Capable of integrating a number common discrete ICs and passive components into a single device, the GreenPAK family's SLG46127M enables high power switching with dual 2 A P-Ch MOSFETs.

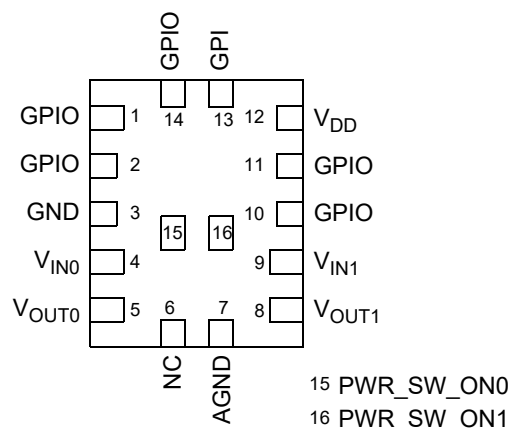
### Features

- Logic & Mixed Signal Circuits
- Highly Versatile Macrocells
- Read Back Protection (Read Lock)
- 1.8 V ( $\pm 5\%$ ) to 5 V ( $\pm 10\%$ ) Supply
- Operating Temperature Range -40 °C to 85 °C
- Dual 44 mΩ, 2 A P-Channel MOSFETs
- Package
  - 1.6 x 2.0 x 0.55 mm MSTQFN 16L package
  - Pb-Free / Halogen-Free / RoHS compliant

### Applications

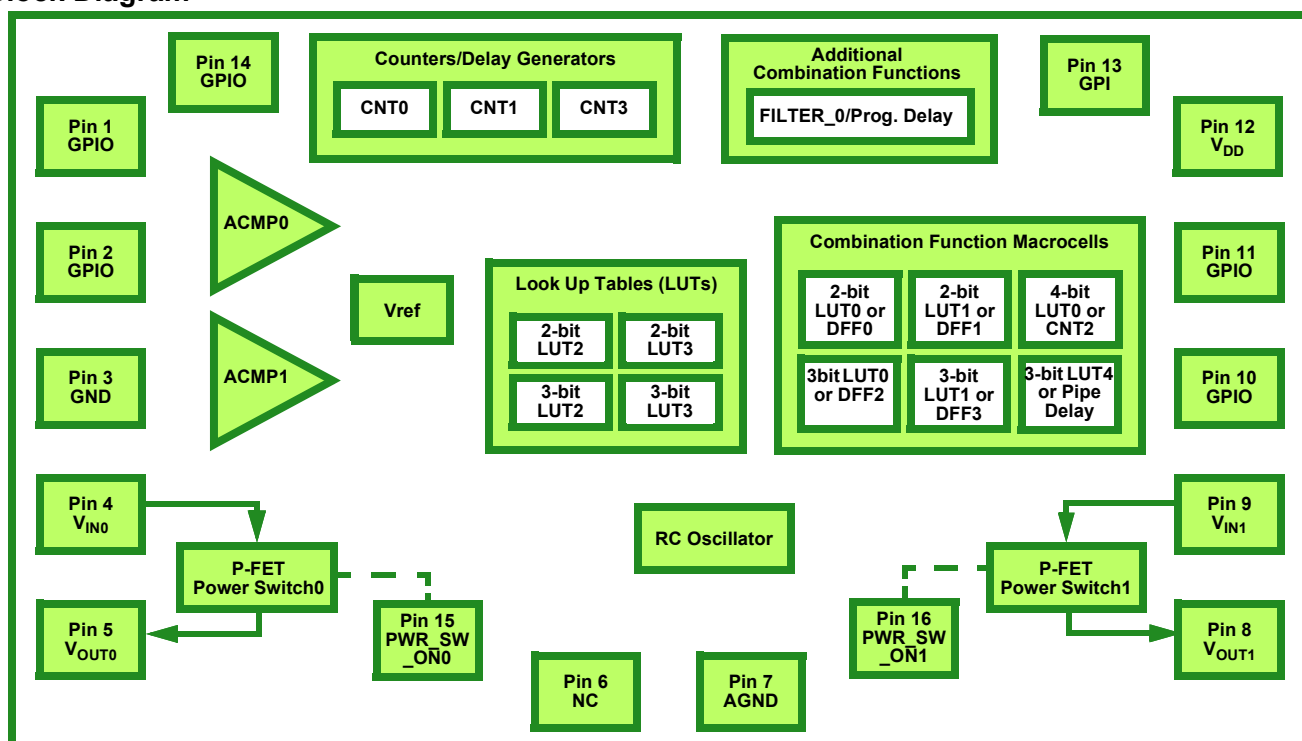
- Power Sequencing with Complex Analog Control
- Power Plane Component Size Reduction Project
- LED Driver
- Haptic Motor Driver
- System RESET with Power Switch

### Pin Configuration



**16pin MSTQFN  
(Top View)**

### Block Diagram



## 1.0 Overview

The SLG46127 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 SLG46127. 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 SLG46127 includes the following:

- Two Analog Comparators (ACMP)
- Voltage References (Vref)
- Four Combinatorial Look Up Tables (LUTs)
  - Two 2-bit LUTs
  - Two 3-bit LUTs
- Seven Combination Function Macrocell
  - Two Selectable DFF/Latch or 2-bit LUTs
  - Two Selectable DFF/Latch or 3-bit LUTs
  - One Selectable Pipe Delay or 3-bit LUT
    - Pipe Delay – 8 stage / 2 output
  - One Selectable Counter/Delay or 4-bit LUT
  - One Programmable Delay/ Deglitch Filter
- Three Counter / Delay Generators (CNT/DLY)
  - Three 8-bit counter/delays with external clock/reset
- RC Oscillator (RC OSC)
- Power On Reset (POR)
- P-FET Power Switch
  - Power Switch IDS: 2 A
  - $V_{IN}$ : 1.71 V to 5.5 V
  - Low RDSON
    - 44 m $\Omega$  @ 5.5 V
    - 58 m $\Omega$  @ 3.3 V
    - 110 m $\Omega$  @ 1.71 V

## 2.0 Pin Description

### 2.1 Functional Pin Description

| Pin # | Pin Name          | Function                                               |
|-------|-------------------|--------------------------------------------------------|
| 1     | GPIO              | General Purpose I/O or Analog Comparator 0 (-)         |
| 2     | GPIO              | General Purpose I/O or Analog Comparator 1 (+) with OE |
| 3     | GND               | Ground                                                 |
| 4     | V <sub>IN0</sub>  | P-FET Power Switch Input                               |
| 5     | V <sub>OUT0</sub> | P-FET Power Switch Output                              |
| 6     | NC                | No Connect                                             |
| 7     | AGND              | P-FET Power Switch Ground                              |
| 8     | V <sub>OUT1</sub> | P-FET Power Switch Output                              |
| 9     | V <sub>IN1</sub>  | P-FET Power Switch Input                               |
| 10    | GPIO              | General Purpose I/O with OE and Vref output            |
| 11    | GPIO              | General Purpose I/O or External Clock Input            |
| 12    | V <sub>DD</sub>   | Power Supply                                           |
| 13    | GPI               | General Purpose Input                                  |
| 14    | GPIO              | General Purpose I/O or Analog Comparator 0 (+)         |
| 15    | PWR_SW_ON0        | P-FET Power Switch On                                  |
| 16    | PWR_SW_ON1        | P-FET Power Switch On                                  |

### 3.0 User Programmability

Non-volatile memory (NVM) is used to configure the SLG46127's connection matrix routing and macrocells. The NVM is One-Time-Programmable (OTP). However, Renesas's 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 to integrate into the production process.

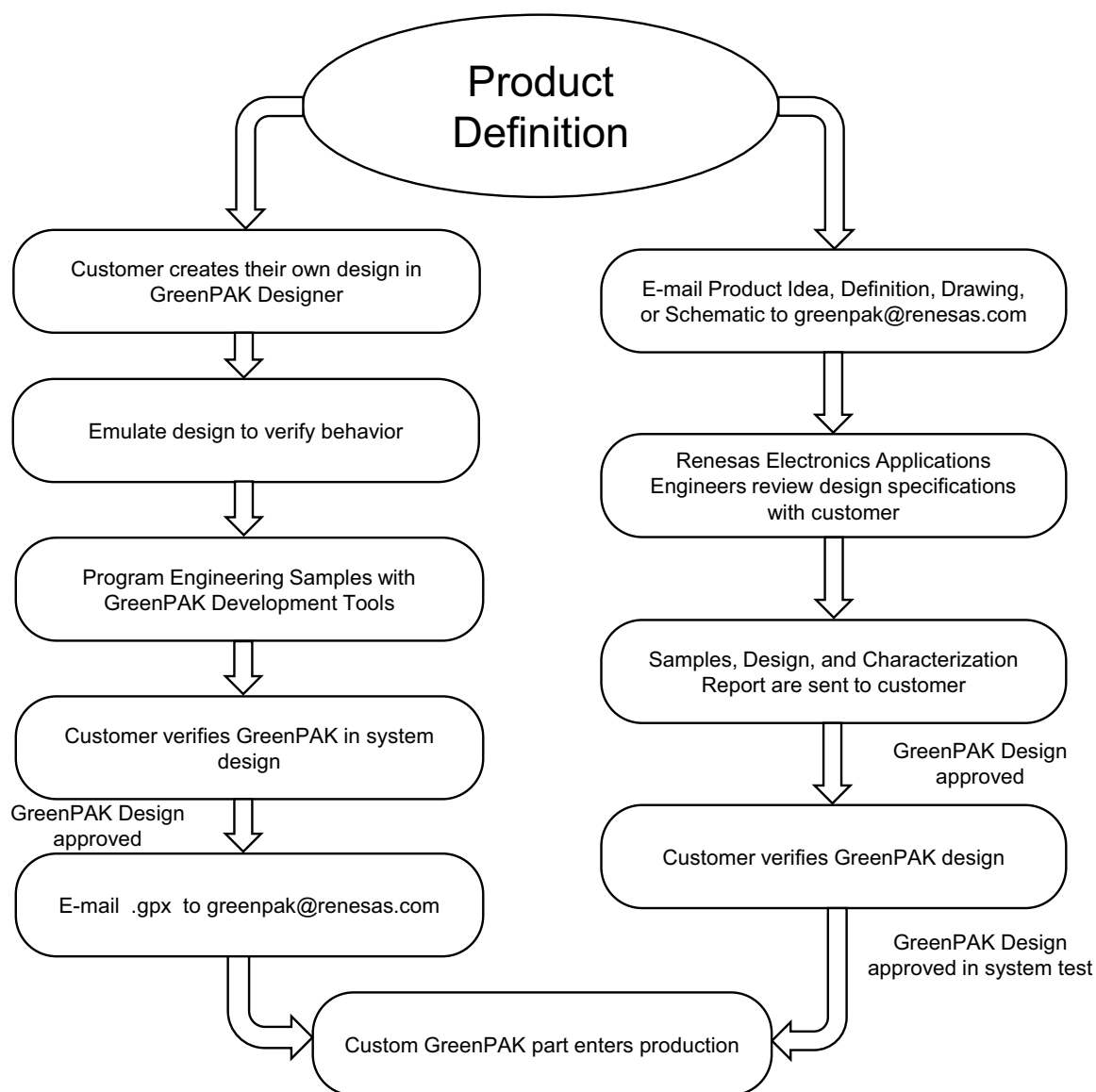


Figure 1. Steps to create a custom Renesas GreenPAK device

## 4.0 Ordering Information

| Part Number | Type                                  |
|-------------|---------------------------------------|
| SLG46127M   | MSTQFN 16L                            |
| SLG46127MTR | MSTQFN 16L - Tape and Reel (3k units) |

*Note 1: Use SLG46127M 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                                  | Condition/Description                               | 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    |
| 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         |                |      |
| $V_{IN}$                                   | P-FET                                               | 0.3       | $V_{DD}$       | V    |
| $\Theta_{JA}$                              | Thermal Resistance*                                 | --        | 99             | °C/W |
| $P_D$                                      | Maximum Power Dissipation,<br>$T_A = +25\text{ °C}$ | --        | 1.25           | W    |
| $T_{J,MAX}$                                | Maximum Junction Temperature                        |           | 150            | °C   |
| P-FET Power Switch $IDS_{CONT}$            | Total, $T_J < 150\text{ °C}$                        | --        | 2              | A    |
| P-FET Power Switch $IDS_{PK}$              | For no more than 1 ms with 1 % duty cycle           | --        | 2.5            | A    |

*Note\*: Mounted on 27.4 mm x 30.1 mm PCB (1.6 mm thick, 1 oz copper, FR-4 material).*

### 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                                        | --    | 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<br>(Absolute Value) |                                                                  | --    | 1     | 1000     | nA      |
| $V_{OH}$  | HIGH-Level Output Voltage         | Push-Pull 1X, Open Drain PMOS 1X,<br>$I_{OH} = 100\text{ }\mu A$ | 1.680 | 1.790 | --       | V       |
|           |                                   | Push-Pull 2X, Open Drain PMOS 2X,<br>$I_{OH} = 100\text{ }\mu A$ | 1.702 | 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>$V_{OH} = V_{DD} - 0.2$            | 1.040 | 1.400 | --           | mA         |
|              |                                                                                      | Push-Pull 2X, Open Drain PMOS 2X,<br>$V_{OH} = V_{DD} - 0.2$            | 2.150 | 2.710 | --           | 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 | 5.130 | --           | 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 $PON_{THR}$                                   | --    | 0.27  | --           | ms         |
| $PON_{THR}$  | Power On Threshold                                                                   | $V_{DD}$ Level Required to Start Up the Chip                            | 1.182 | 1.346 | 1.505        | V          |
| $POFF_{THR}$ | Power Off Threshold                                                                  | $V_{DD}$ Level Required to Switch Off the<br>Chip                       | 0.752 | 0.918 | 1.110        | 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 1, 2, 13 and 14 are connected to one side, pins 10, 11, 15 and 16 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                                 | --     | 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 (Absolute Value)                                                        |                                                           | --     | 1      | 1000                 | nA      |
| V <sub>OH</sub>  | HIGH-Level Output Voltage                                                             | Push-Pull 1X, Open Drain PMOS 1X, I <sub>OH</sub> = 3 mA  | 2.710  | 3.090  | --                   | V       |
|                  |                                                                                       | Push-Pull 2X, Open Drain PMOS 2X, I <sub>OH</sub> = 3 mA  | 2.870  | 3.190  | --                   | V       |
| V <sub>OL</sub>  | LOW-Level Output Voltage                                                              | Push-Pull 1X, I <sub>OL</sub> = 3 mA                      | --     | 0.180  | 0.280                | V       |
|                  |                                                                                       | Push-Pull 2X, I <sub>OL</sub> = 3 mA                      | --     | 0.090  | 0.130                | V       |
|                  |                                                                                       | Open Drain NMOS 1X, I <sub>OL</sub> = 3 mA                | --     | 0.090  | 0.130                | V       |
|                  |                                                                                       | Open Drain NMOS 2X, I <sub>OL</sub> = 3 mA                | --     | 0.050  | 0.070                | V       |
| I <sub>OH</sub>  | HIGH-Level Output Current (see Note 1)                                                | Push-Pull 1X, Open Drain PMOS 1X, V <sub>OH</sub> = 2.4 V | 5.830  | 10.180 | --                   | mA      |
|                  |                                                                                       | Push-Pull 2X, Open Drain PMOS 2X, V <sub>OH</sub> = 2.4 V | 11.264 | 19.660 | --                   | mA      |
| I <sub>OL</sub>  | LOW-Level Output Current (see Note 1)                                                 | Push-Pull 1X, V <sub>OL</sub> = 0.4 V                     | 4.060  | 6.440  | --                   | mA      |
|                  |                                                                                       | Push-Pull 2X, V <sub>OL</sub> = 0.4 V                     | 8.130  | 12.360 | --                   | mA      |
|                  |                                                                                       | Open Drain NMOS 1X, V <sub>OL</sub> = 0.4 V               | 8.130  | 12.410 | --                   | mA      |
|                  |                                                                                       | Open Drain NMOS 2X, V <sub>OL</sub> = 0.4 V               | 16.260 | 22.900 | --                   | mA      |
| I <sub>VDD</sub> | Maximum Average or DC Current Through V <sub>DD</sub> Pin (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 Current Through GND Pin (Per chip side, see Note 2)             | T <sub>J</sub> = 85 °C                                    | --     | --     | 92                   | mA      |
|                  |                                                                                       | T <sub>J</sub> = 110 °C                                   | --     | --     | 44                   | mA      |
| V <sub>O</sub>   | Maximal Voltage Applied to any PIN in High-Impedance State                            |                                                           | --     | --     | V <sub>DD</sub> +0.3 | V       |



| Symbol       | Parameter                       | Condition/Note                                                          | Min.  | Typ.  | Max.  | Unit       |
|--------------|---------------------------------|-------------------------------------------------------------------------|-------|-------|-------|------------|
| $T_{SU}$     | Startup Time                    | From $V_{DD}$ rising past $PON_{THR}$                                   | --    | 0.27  | -     | ms         |
| $PON_{THR}$  | Power On Threshold              | $V_{DD}$ Level Required to Start Up the Chip                            | 1.182 | 1.346 | 1.505 | V          |
| $POFF_{THR}$ | Power Off Threshold             | $V_{DD}$ Level Required to Switch Off the Chip                          | 0.752 | 0.918 | 1.110 | 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   | --    | $\mu F$    |

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 1, 2, 13 and 14 are connected to one side, pins 10, 11, 15 and 16 to another.

## 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                                 | --     | 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, $I_{OH} = 5\text{ mA}$  | 4.150  | 4.730  | --           | V           |
|           |                                                                                | Push-Pull 2X, Open Drain PMOS 2X, $I_{OH} = 5\text{ mA}$  | 4.300  | 4.860  | --           | V           |
| $V_{OL}$  | LOW-Level Output Voltage                                                       | Push-Pull 1X, $I_{OL} = 5\text{ mA}$                      | --     | 0.230  | 0.330        | V           |
|           |                                                                                | Push-Pull 2X, $I_{OL} = 5\text{ mA}$                      | --     | 0.120  | 0.160        | V           |
|           |                                                                                | Open Drain NMOS 1X, $I_{OL} = 5\text{ mA}$                | --     | 0.120  | 0.160        | V           |
|           |                                                                                | Open Drain NMOS 2X, $I_{OL} = 5\text{ mA}$                | --     | 0.070  | 0.090        | V           |
| $I_{OH}$  | HIGH-Level Output Current (see Note 1)                                         | Push-Pull 1X, Open Drain PMOS 1X, $V_{OH} = 2.4\text{ V}$ | 21.808 | 29.100 | --           | mA          |
|           |                                                                                | Push-Pull 2X, Open Drain PMOS 2X, $V_{OH} = 2.4\text{ V}$ | 40.598 | 56.080 | --           | mA          |
| $I_{OL}$  | LOW-Level Output Current (see Note 1)                                          | Push-Pull 1X, $V_{OL} = 0.4\text{ V}$                     | 6.010  | 9.730  | --           | mA          |
|           |                                                                                | Push-Pull 2X, $V_{OL} = 0.4\text{ V}$                     | 11.590 | 19.460 | --           | mA          |
|           |                                                                                | Open Drain NMOS 1X, $V_{OL} = 0.4\text{ V}$               | 11.760 | 19.460 | --           | mA          |
|           |                                                                                | Open Drain NMOS 2X, $V_{OL} = 0.4\text{ V}$               | 19.120 | 35.621 | --           | mA          |
| $I_{VDD}$ | Maximum Average or DC Current Through $V_{DD}$ Pin (Per chip side, see Note 2) | $T_J = 85\text{ }^{\circ}C$                               | --     | --     | 73           | mA          |
|           |                                                                                | $T_J = 110\text{ }^{\circ}C$                              | --     | --     | 35           | mA          |
| $I_{GND}$ | Maximum Average or DC Current Through GND Pin (Per chip side, see Note 2)      | $T_J = 85\text{ }^{\circ}C$                               | --     | --     | 92           | mA          |
|           |                                                                                | $T_J = 110\text{ }^{\circ}C$                              | --     | --     | 44           | mA          |
| $V_O$     | Maximal Voltage Applied to any PIN in High-Impedance State                     |                                                           | --     | --     | $V_{DD}+0.3$ | V           |

| Symbol                                                                                                                                                                                                                                                                    | Parameter                       | Condition/Note                                                          | Min.  | Typ.  | Max.  | Unit       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|-------------------------------------------------------------------------|-------|-------|-------|------------|
| $T_{SU}$                                                                                                                                                                                                                                                                  | Startup Time                    | From $V_{DD}$ rising past $PON_{THR}$                                   | --    | 0.27  | -     | ms         |
| $PON_{THR}$                                                                                                                                                                                                                                                               | Power On Threshold              | $V_{DD}$ Level Required to Start Up the Chip                            | 1.182 | 1.346 | 1.505 | V          |
| $POFF_{THR}$                                                                                                                                                                                                                                                              | Power Off Threshold             | $V_{DD}$ Level Required to Switch Off the Chip                          | 0.752 | 0.918 | 1.110 | 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 1, 2, 13 and 14 are connected to one side, pins 10, 11, 15 and 16 to another.</p> |                                 |                                                                         |       |       |       |            |

## 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                | 0.5                     | 0.8                     | 1.0                     | μA   |
|        |           | Vref                          | 56.9                    | 56.9                    | 63.3                    | μA   |
|        |           | Vref Buffer (each)            | 2.7                     | 13.0                    | 13.7                    | μA   |
|        |           | OSC 25 kHz, predivide = 1     | 3.1                     | 4.8                     | 6.4                     | μA   |
|        |           | OSC 25 kHz, predivide = 8     | 3.0                     | 4.5                     | 6.0                     | μA   |
|        |           | OSC 2 MHz, predivide = 1      | 27.4                    | 45.4                    | 67.4                    | μA   |
|        |           | OSC 2 MHz, predivide = 8      | 17.5                    | 23.7                    | 29.5                    | μA   |
|        |           | 1st ACMP used (includes Vref) | 60.6                    | 62.0                    | 68.4                    | μA   |
|        |           | Each additional ACMP add      | 3.7                     | 4.9                     | 5.1                     | 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        | 35.3                    | 34.4    | 14.5                    | 14.3    | 10.3                    | 10.5    | ns   |
| tpd    | Delay     | Digital Input with Schmitt Trigger - Push Pull           | 34.8                    | 32.9    | 14.2                    | 13.8    | 10.0                    | 10.1    | ns   |
| tpd    | Delay     | Low Voltage Digital input - Push Pull                    | 37.8                    | 450.0   | 15.0                    | 208.2   | 10.5                    | 142.3   | ns   |
| tpd    | Delay     | Digital Input without Schmitt Trigger -- NMOS            | —                       | 73.5    | —                       | 26.0    | —                       | 16.3    | ns   |
| tpd    | Delay     | Output enable from pin, OE Hi-Z to 1                     | 44.6                    | —       | 17.9                    | —       | 12.4                    | —       | ns   |
| tpd    | Delay     | Output enable from pin, OE Hi-Z to 0                     | —                       | 43.0    | —                       | 17.6    | —                       | 12.5    | ns   |
| tpd    | Delay     | 2-bit LUT (Latch shared macrocell inputs)                | 29.6                    | 24.8    | 11.5                    | 10.1    | 8.2                     | 6.9     | ns   |
| tpd    | Delay     | Latch (2-bit LUT shared macrocell inputs)                | 29.2                    | 31.5    | 11.8                    | 12.5    | 8.4                     | 8.4     | ns   |
| tpd    | Delay     | 3-bit LUT (LATCH shared macrocell inputs)                | 33.0                    | 27.4    | 12.8                    | 11.1    | 9.1                     | 7.5     | ns   |
| tpd    | Delay     | Latch with nRST/nSET (3-bit LUT shared macrocell inputs) | 29.9                    | 32.4    | 12.1                    | 13.0    | 8.7                     | 8.7     | ns   |
| tpd    | Delay     | 4-bit LUT (shared macrocell inputs)                      | 29.2                    | 27.2    | 11.2                    | 10.8    | 8.0                     | 7.3     | ns   |
| tpd    | Delay     | 2-bit LUT                                                | 19.4                    | 18.8    | 7.2                     | 7.4     | 5.1                     | 5.0     | ns   |
| tpd    | Delay     | 3-bit LUT                                                | 22.3                    | 22.7    | 8.3                     | 8.9     | 6.0                     | 5.9     | ns   |
| tpd    | Delay     | CNT/DLY                                                  | 38.4                    | 36.0    | 15.2                    | 15.1    | 10.8                    | 10.4    | ns   |
| tpd    | Delay     | CNT/DLY (shared macrocell inputs)                        | 41.0                    | 36.2    | 16.3                    | 15.6    | 11.5                    | 10.9    | ns   |
| tpd    | Delay     | CNT3/DLY3 Rising Edge Detect (shared macrocell inputs)   | 39.7                    | —       | 15.7                    | —       | 11.1                    | —       | ns   |
| tpd    | Delay     | CNT3/DLY3 Falling Edge Detect (shared macrocell inputs)  | —                       | 41.5    | —                       | 16.9    | —                       | 11.6    | ns   |
| tpd    | Delay     | CNT3/DLY3 Both Edge Detect (shared macrocell inputs)     | 39.7                    | 41.5    | 15.7                    | 16.9    | 11.1                    | 11.6    | ns   |
| tpd    | Delay     | Filter                                                   | 183.1                   | 186.2   | 73.5                    | 75.7    | 47.9                    | 50.2    | 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                  | 25kHz       | auto         | 19                      | 14                      | 12                      | μs   |
| offset                  | 2MHz        | auto         | 7                       | 4                       | 4                       | μs   |
| frequency settling time | 25kHz       | auto         | 19                      | 14                      | 12                      | μs   |
| frequency settling time | 2MHz        | auto         | 14                      | 14                      | 14                      | μs   |
| variable (CLK period)   | 25kHz       | forced       | 0-40                    | 0-40                    | 0-40                    | μs   |
| variable (CLK period)   | 2MHz        | forced       | 0-0.5                   | 0-0.5                   | 0-0.5                   | μs   |
| tpd (non-delayed edge)  | 25kHz/2MHz  | 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          | 272.4                   | 128.8                   | 97.5                    | ns   |
| time1  | Width, 2 cell | PDLY mode:(any)edge detect, edge detect output          | 582.7                   | 272.6                   | 205.1                   | ns   |
| time1  | Width, 3 cell | PDLY mode:(any)edge detect, edge detect output          | 893.4                   | 416.6                   | 312.9                   | ns   |
| time1  | Width, 4 cell | PDLY mode:(any)edge detect, edge detect output          | 1203.4                  | 560.6                   | 420.9                   | ns   |
| time2  | Delay, 1 cell | PDLY mode:(any)edge detect, edge detect output          | 39.3                    | 15.7                    | 10.9                    | ns   |
| time2  | Delay, 2 cell | PDLY mode:(any)edge detect, edge detect output          | 39.3                    | 15.7                    | 10.9                    | ns   |
| time2  | Delay, 3 cell | PDLY mode:(any)edge detect, edge detect output          | 39.3                    | 15.7                    | 10.9                    | ns   |
| time2  | Delay, 4 cell | PDLY mode:(any)edge detect, edge detect output          | 39.3                    | 15.7                    | 10.9                    | ns   |
| time1  | Delay, 1 cell | PDLY mode: both edge delay (shared macrocell inputs)    | 354                     | 161.5                   | 120.1                   | ns   |
| time1  | Delay, 2 cell | PDLY mode: both edge delay (shared macrocell inputs)    | 664.2                   | 305.2                   | 227.8                   | ns   |
| time1  | Delay, 3 cell | PDLY mode: both edge delay (shared macrocell inputs)    | 974.9                   | 449.1                   | 335.7                   | ns   |
| time1  | Delay, 4 cell | PDLY mode: both edge delay (shared macrocell inputs)    | 1284.8                  | 593.1                   | 443.6                   | ns   |
| time1  | Width         | CNT3/DLY3 Rising Edge Detect (shared macrocell inputs)  | 63.6                    | 32.4                    | 22.9                    | ns   |
| time1  | Width         | CNT3/DLY3 Falling Edge Detect (shared macrocell inputs) | 61.3                    | 31.1                    | 22.5                    | ns   |
| time1  | Width         | CNT3/DLY3 Both Edge Detect (shared macrocell inputs)    | 62.2                    | 31.6                    | 22.7                    | ns   |

## 5.9 Typical Deglitch Filter Pulse Width Performance

Table 5. Typical Deglitch Filter Pulse Width Performance at T = 25 °C.

| 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   |

## 5.10 Power Switch Electrical Characteristics (each P-FET)

Table 6. Power Switch Electrical Characteristics, T<sub>A</sub> = -40 °C to +85 °C (with typical values at T<sub>A</sub> = +25 °C), V<sub>DD</sub> = 5.5 V, unless otherwise specified

| Parameter                                                                                                                                                                                    | Description                                           | Conditions                                                                                                              | Min.  | Typ.  | Max.  | Unit |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|-------|-------|-------|------|
| R <sub>DS(ON)</sub>                                                                                                                                                                          | Static Drain-to-Source On-Resistance                  | T <sub>A</sub> = +25 °C, V <sub>GS</sub> = -5.5 V, I <sub>D</sub> = -100 mA (see Note 1)                                | --    | 44    | 50    | mΩ   |
|                                                                                                                                                                                              |                                                       | T <sub>A</sub> = +25 °C, V <sub>GS</sub> = -3.3 V, I <sub>D</sub> = -100 mA (see Note 1)                                | --    | 58    | 65    |      |
|                                                                                                                                                                                              |                                                       | T <sub>A</sub> = +25 °C, V <sub>GS</sub> = -1.71 V, I <sub>D</sub> = -100 mA (see Note 1)                               | --    | 110   | 119   |      |
|                                                                                                                                                                                              |                                                       | T <sub>A</sub> = +85 °C, V <sub>GS</sub> = -5.5 V, I <sub>D</sub> = -100 mA (see Note 1)                                | --    | 51    | 58    |      |
|                                                                                                                                                                                              |                                                       | T <sub>A</sub> = +85 °C, V <sub>GS</sub> = -3.3 V, I <sub>D</sub> = -100 mA (see Note 1)                                | --    | 69    | 77    |      |
|                                                                                                                                                                                              |                                                       | T <sub>A</sub> = +85 °C, V <sub>GS</sub> = -1.71 V, I <sub>D</sub> = -100 mA (see Note 1)                               | --    | 129   | 138   |      |
| V <sub>GS(th)</sub>                                                                                                                                                                          | Gate Threshold Voltage                                | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -1 mA                                                              | -0.48 | -0.61 | -0.72 | V    |
| I <sub>DSS</sub>                                                                                                                                                                             | Zero Gate Voltage Drain Current                       | T <sub>A</sub> = +25 °C, V <sub>DS</sub> = -4.0 V, V <sub>GS</sub> = 0 V (see Note 2)                                   | --    | --    | 0.4   | μA   |
|                                                                                                                                                                                              |                                                       | T <sub>A</sub> = +25 °C, V <sub>DS</sub> = -5.5 V, V <sub>GS</sub> = 0 V                                                | --    | --    | 1.0   |      |
|                                                                                                                                                                                              |                                                       | T <sub>A</sub> = +85 °C, V <sub>DS</sub> = -5.5 V, V <sub>GS</sub> = 0 V                                                | --    | --    | 3.4   |      |
| I <sub>GSS</sub>                                                                                                                                                                             | Gate-Body Leakage                                     | T <sub>A</sub> = +25 °C, V <sub>GS</sub> = ±5.5 V                                                                       | --    | ±5    | ±100  | nA   |
|                                                                                                                                                                                              |                                                       | T <sub>A</sub> = +85 °C, V <sub>GS</sub> = ±5.5 V                                                                       | --    | ±400  | ±2000 |      |
| G <sub>m</sub>                                                                                                                                                                               | Forward Transconductance                              | V <sub>DS</sub> = -5.5 V, V <sub>GS</sub> = -1.8 V, I <sub>D</sub> = -2 A (see Note 1)                                  | 4.5   | 5.4   | --    | S    |
| <b>Dynamic</b>                                                                                                                                                                               |                                                       |                                                                                                                         |       |       |       |      |
| R <sub>G</sub>                                                                                                                                                                               | Internal Gate Resistance                              |                                                                                                                         | --    | 200   | --    | Ω    |
| C <sub>iss</sub>                                                                                                                                                                             | Input Capacitance                                     | T <sub>A</sub> = +25 °C                                                                                                 | --    | 207   | --    | pF   |
| C <sub>oss</sub>                                                                                                                                                                             | Output Capacitance                                    | V <sub>DS</sub> = -5.5 V, V <sub>GS</sub> = 0 V                                                                         | --    | 122   | --    |      |
| C <sub>rss</sub>                                                                                                                                                                             | Reverse Transfer Capacitance                          | f = 1.0 MHz (see Note 3)                                                                                                | --    | 57    | --    |      |
| Q <sub>g</sub>                                                                                                                                                                               | Total Gate Charge                                     | T <sub>A</sub> = +25 °C                                                                                                 | --    | 1.45  | 1.55  | nC   |
| Q <sub>gs</sub>                                                                                                                                                                              | Gate-to-Source Charge                                 | V <sub>DS</sub> = -5.5 V, V <sub>GS</sub> = -5.5 V                                                                      | --    | 0.24  | --    |      |
| Q <sub>gd</sub>                                                                                                                                                                              | Gate-to-Drain Charge                                  | I <sub>D</sub> = -2 A (see Note 1)                                                                                      | --    | 0.24  | --    |      |
| t <sub>on</sub>                                                                                                                                                                              | Turn-On Time                                          | T <sub>A</sub> = +25 °C, V <sub>DS</sub> = -5.5 V, V <sub>GS</sub> = 0 to -5.5 V, I <sub>D</sub> = -1 A, Internal Drive | --    | 63    | --    | ns   |
| t <sub>off</sub>                                                                                                                                                                             | Turn-Off Delay Time                                   |                                                                                                                         | --    | 287   | --    | ns   |
| <b>Drain-Source Body Diode Characteristics</b>                                                                                                                                               |                                                       |                                                                                                                         |       |       |       |      |
| I <sub>S</sub>                                                                                                                                                                               | Maximum Continuous Drain-Source Diode Forward Current | T <sub>A</sub> = +25 °C, single channel operation                                                                       | --    | --    | -2    | A    |
| V <sub>DSF</sub>                                                                                                                                                                             | Diode Forward Voltage                                 | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 100 mA (see Note 1)                                                             | 0.63  | 0.75  | 0.87  | V    |
| <p>Note 1: Pulse test: f = 100 Hz, Duty cycle &lt; 2 %.</p> <p>Note 2: Measured to be less than 0.4 μA during production test.</p> <p>Note 3: R<sub>G</sub> influence has been excluded.</p> |                                                       |                                                                                                                         |       |       |       |      |

## 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 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

### 6.4 Voltage Reference

- Used for references on Analog Comparators
- Can also be driven to external Pin 10

### 6.5 Combinational Logic Look Up Tables (LUTs – 4 total)

- Two 2-bit Lookup Tables
- Two 3-bit Lookup Tables

### 6.6 Combination Function Macrocells (7 total)

- Two Selectable DFF/Latch or 2-bit LUTs
- Two Selectable DFF/Latch or 3-bit LUTs
- One Selectable Pipe Delay or 3-bit LUT
- One Selectable CNT/DLY or 4-bit LUT
- One Programmable Delay/ Deglitch Filter
  - 125 ns/250 ns/375 ns/500 ns @ 3.3 V
  - Includes Edge Detection function

### 6.7 Delays/Counters (3 total)

- Three 8-bit delays/counters with external clock/reset: Range 1-255 clock cycles

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

- 8 stage / 2 output
- Two 1-8 stage selectable outputs.

---

**6.9 RC Oscillator**

- 25 kHz and 2 MHz selectable frequency
- First stage divider (4): OSC/1, OSC/2, OSC/4, and OSC/8
- Second stage divider (8): selectable (OSC/1, OSC/2, OSC/3, OSC/4, OSC/8, OSC/12, OSC/24, or OSC/64)

**6.10 Power On Reset (POR)****6.11 Dual P-FET Power Switch**

- Power Switch IDS: 2.0 A
- $V_{IN}$ : 1.71 V to 5.5 V
- Low RDSON
  - 44 m $\Omega$  @ 5.5 V
  - 58 m $\Omega$  @ 3.3 V
  - 110 m $\Omega$  @ 1.71 V



## 7.0 I/O Pins

The SLG46127 has a total of 6 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). Refer to Section 2.0 *Pin Description* for pin definitions.

Normal Mode pin definitions are as follows and Programming Mode pin definitions are as follows according to section 2.1 *Functional Pin Description*.

Each of the six user defined I/O pins on the SLG46127 can serve as both digital input and digital output. But Pin 13 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 1, 2 and 14 can also be configured to serve as analog inputs to the on-chip comparators and Vref output. PIN10 can be used as Vref output.

### 7.2 Output Modes

Pins 1, 2, 10, 11 and 14 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 13, 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 2 and 10 of the SLG46127 can each be configured to build separate 3-state outputs using other components from these pins.

**Table 7. 3-State Output Mode Settings (for Pin 2 and 10)**

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

## 7.5 I/O Register Settings

### 7.6 PIN 1 Register Settings

**Table 8. PIN 1 Register Settings**

| Signal Function                             | Register Bit Address | Register Definition                                                                                                                                                                                                                                   |
|---------------------------------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PIN 1 Mode Control                          | reg <392:390>        | 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 1 Pull Up/Down Resistor Value Selection | reg <394:393>        | 00: Floating<br>01: 10 kΩ Resistor<br>10: 100 kΩ Resistor<br>11: 1 MΩ Resistor                                                                                                                                                                        |
| PIN 1 Pull Up/Down Resistor Selection       | reg <395>            | 0: Pull Down Resistor<br>1: Pull Up Resistor                                                                                                                                                                                                          |
| PIN 1 Driver Strength Selection             | reg <396>            | 0: 1X<br>1: 2X                                                                                                                                                                                                                                        |

#### 7.6.1 PIN 2 Register Settings

**Table 9. PIN 2 Register Settings**

| Signal Function                             | Register Bit Address | Register Definition                                                                                                                      |
|---------------------------------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| PIN 2 Mode Control (sig_PIN2_oe=0)          | reg <398:397>        | 00: Digital Input without Schmitt trigger<br>01: Digital Input with Schmitt trigger<br>11: Low Voltage Digital Input<br>10: Analog Input |
| PIN 2 Mode Control (sig_PIN2_oe =1)         | reg <400:399>        | 00: Push Pull 1X<br>01: Push Pull 2X<br>10: Open Drain NMOS 1X<br>11: Open Drain NMOS 2X                                                 |
| PIN 2 Pull Up/Down Resistor Value Selection | reg <402:401>        | 00: Floating<br>01: 10 kΩ Resistor<br>10: 100 kΩ Resistor<br>11: 1 MΩ Resistor                                                           |
| PIN 2 Pull Up/Down Resistor Selection       | reg <403>            | 0: Pull Down Resistor<br>1: Pull Up Resistor                                                                                             |

## 7.6.2 PIN 10 Register Settings

**Table 10. PIN 10 Register Settings**

| Signal Function                              | Register Bit Address | Register Definition                                                                                                                               |
|----------------------------------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| PIN 10 Mode Control<br>(sig_PIN10_oe =0)     | reg <419:418>        | 00: Digital Input without Schmitt trigger<br>01: Digital Input with Schmitt trigger<br>10: Low Voltage Digital Input<br>11: Analog Input / Output |
| PIN 10 Mode Control<br>(sig_PIN10_oe =1)     | reg <421:420>        | 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 <423:422>        | 00: Floating<br>01: 10 k $\Omega$ Resistor<br>10: 100 k $\Omega$ Resistor<br>11: 1 M $\Omega$ Resistor                                            |
| PIN 10 Pull Up/Down Resistor Selection       | reg <424>            | 0: Pull Down Resistor<br>1: Pull Up Resistor                                                                                                      |

## 7.6.3 PIN 11 Register Settings

**Table 11. PIN 11 Register Settings**

| Signal Function                              | Register Bit Address | Register Definition                                                                                                                                                                                                         |
|----------------------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PIN 11 Mode Control                          | reg <427:425>        | 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: Reserved |
| PIN 11 Pull Up/Down Resistor Value Selection | reg <429:428>        | 00: Floating<br>01: 10 k $\Omega$ Resistor<br>10: 100 k $\Omega$ Resistor<br>11: 1 M $\Omega$ Resistor                                                                                                                      |
| PIN 11 Pull Up/Down Resistor Selection       | reg <430>            | 0: Pull Down Resistor<br>1: Pull Up Resistor                                                                                                                                                                                |
| PIN 11 Driver Strength Selection             | reg <431>            | 0: 1X<br>1: 2X                                                                                                                                                                                                              |

## 7.6.4 PIN 13 Register Settings

**Table 12. PIN 13 Register Settings**

| Signal Function                           | Register Bit Address | Register Definition                                                                                                                  |
|-------------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| PIN 13 Mode Control                       | reg <380:379>        | 00: Digital Input without Schmitt trigger<br>01: Digital Input with Schmitt trigger<br>10: Low voltage digital input<br>11: Reserved |
| PIN 13 Pull Down Resistor Value Selection | reg <382:381>        | 00: Floating<br>01: 10 kΩ Resistor<br>10: 100 kΩ Resistor<br>11: 1 MΩ Resistor                                                       |

## 7.6.5 PIN 14 Register Settings

**Table 13. PIN 14 Register Settings**

| Signal Function                              | Register Bit Address | Register Definition                                                                                                                                                                                                                                   |
|----------------------------------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PIN 14 Mode Control                          | reg <385:383>        | 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 14 Pull Up/Down Resistor Value Selection | reg <387:386>        | 00: Floating<br>01: 10 kΩ Resistor<br>10: 100 kΩ Resistor<br>11: 1 MΩ Resistor                                                                                                                                                                        |
| PIN 14 Pull Up/Down Resistor Selection       | reg <388>            | 0: Pull Down Resistor<br>1: Pull Up Resistor                                                                                                                                                                                                          |
| PIN 14 Driver Strength Selection             | reg <389>            | 0: 1X<br>1: 2X                                                                                                                                                                                                                                        |

## 7.7 GPI IO Structure

### 7.7.1 GPI IO Structure (for Pin 13)

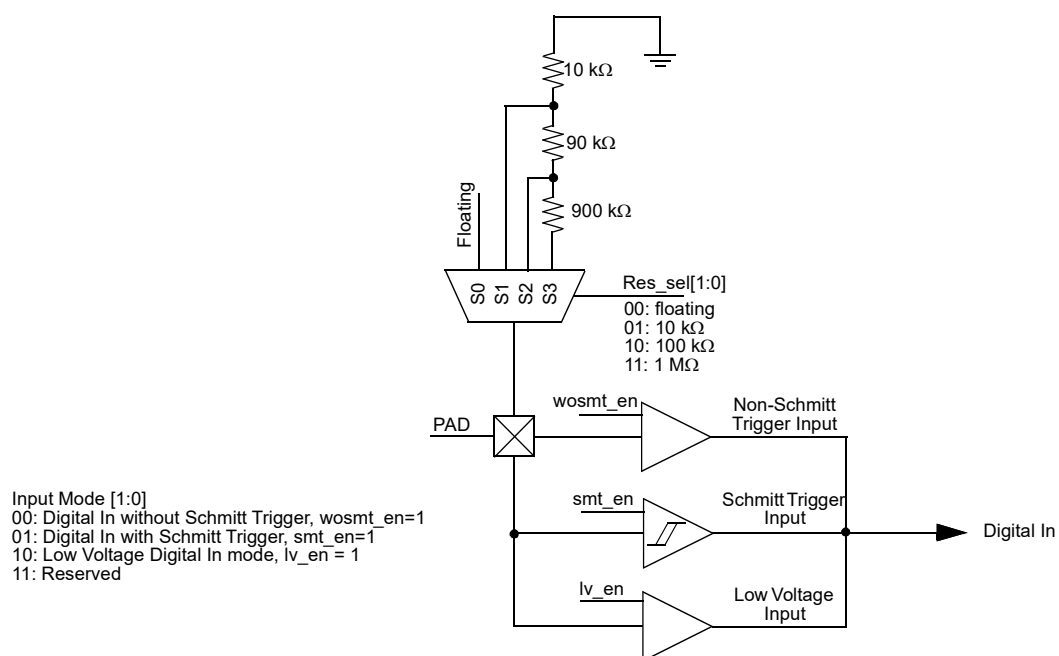


Figure 2. PIN 13 GPI IO Structure Diagram

## 7.8 Matrix OE IO Structure

### 7.8.1 Matrix OE IO Structure (for Pin 2, 10)

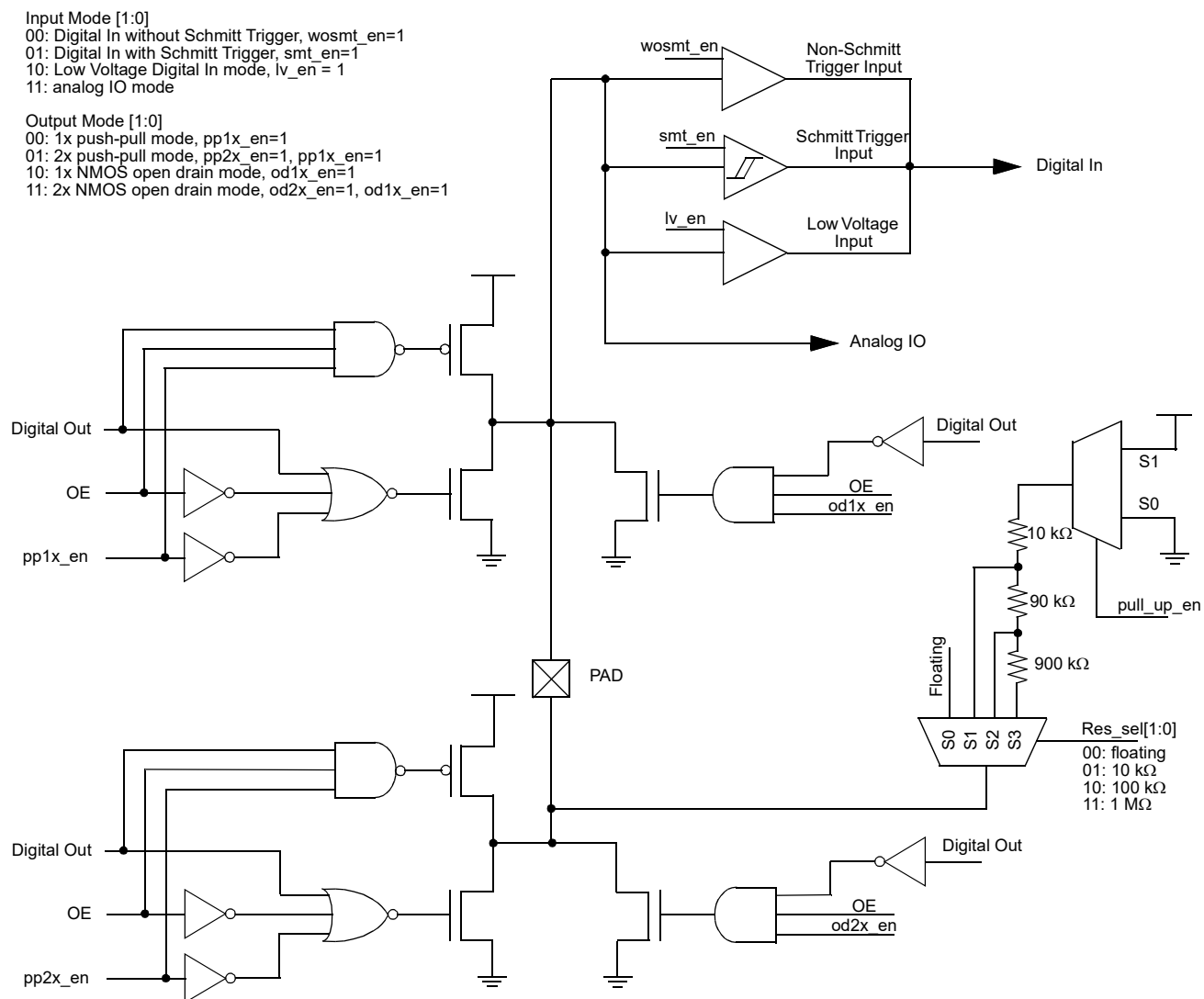
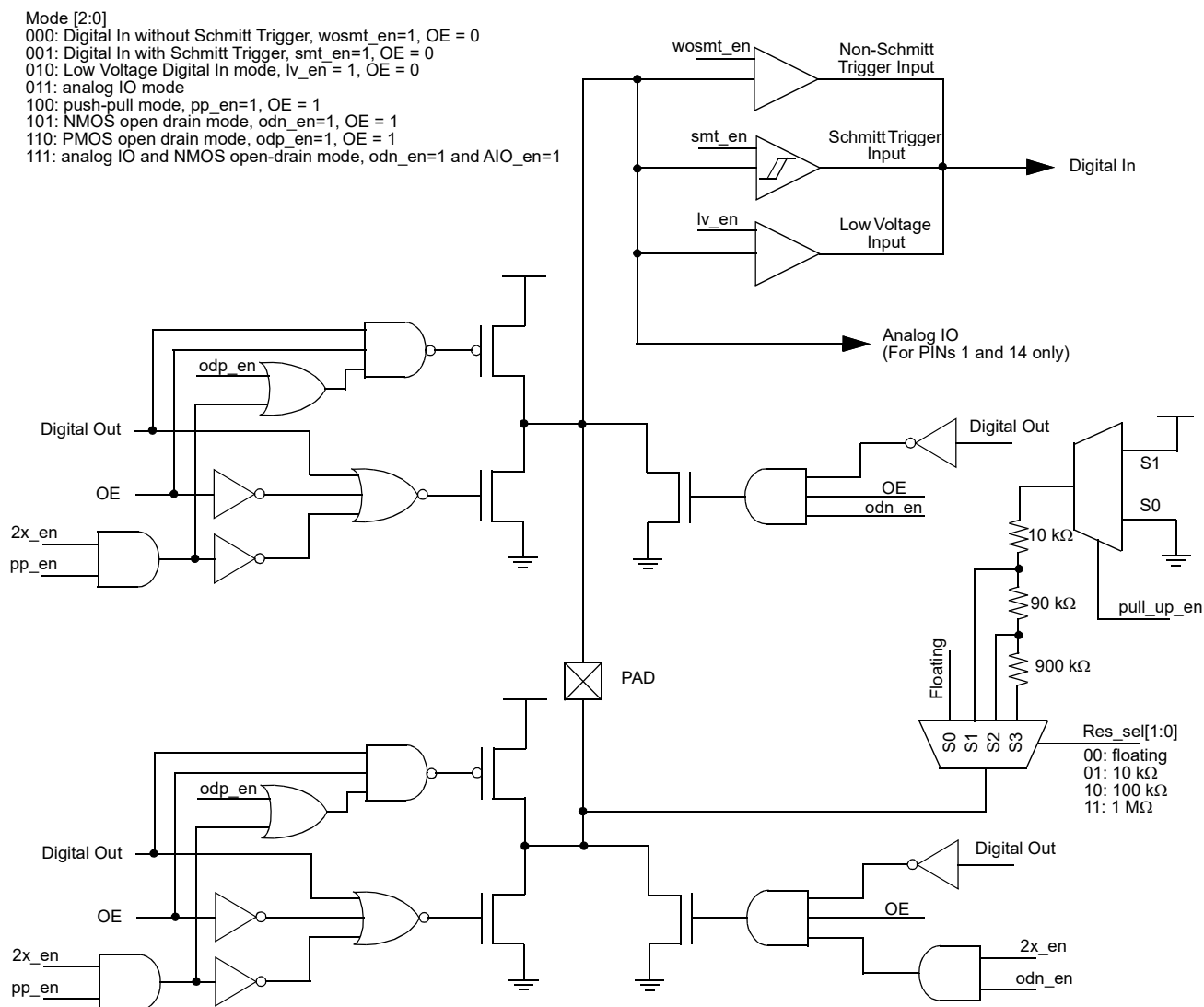


Figure 3. Matrix OE IO Structure Diagram

## 7.9 Register OE IO Structure

### 7.9.1 Register OE IO Structure (for Pins 1, 11, 14)



**Figure 4. Register OE IO Structure Diagram**

## 8.0 Connection Matrix

The Connection Matrix in the SLG46127 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 point for each logic cell within the SLG46127 has 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 512 register bits within the SLG46127 are programmed a fully custom circuit will be created.

The Connection Matrix has 32 inputs and 44 outputs. Each of the 32 inputs to the Connection Matrix is hard-wired to a particular source macrocell, including I/O pins, LUTs, analog comparators, other digital resources and  $V_{DD}$  and  $V_{SS}$ . The input to a digital macrocell uses a 5-bit register to select one of these 32 input lines.

For a complete list of the SLG46127’s register table, see Section 18.0 Appendix A - SLG46127 Register Definition.

| Matrix Input Signal Functions | N              |           |                             |                           |                            |       |                             |
|-------------------------------|----------------|-----------|-----------------------------|---------------------------|----------------------------|-------|-----------------------------|
| VSS                           | 0              |           |                             |                           |                            |       |                             |
| Pin 13 Digital In             | 1              |           |                             |                           |                            |       |                             |
| Pin 14 Digital In             | 2              |           |                             |                           |                            |       |                             |
| Pin 1 Digital In              | 3              |           |                             |                           |                            |       |                             |
| ⋮                             | ⋮              |           |                             |                           |                            |       |                             |
| PIN11 Digital In              | 30             |           |                             |                           |                            |       |                             |
| V <sub>DD</sub>               | 31             |           |                             |                           |                            |       |                             |
| Matrix Inputs                 | Matrix Outputs | N         | 0                           | 1                         | 2                          | ----- | 43                          |
|                               |                | Registers | reg <4:0>                   | reg <9:5>                 | reg <14:10>                | ----- | reg <219:215>               |
|                               |                | Function  | PIN14 Digital Output Source | PIN1Digital Output Source | PIN2 Digital Output Source | ----- | PIN11 Digital Output Source |

Figure 5. Connection Matrix

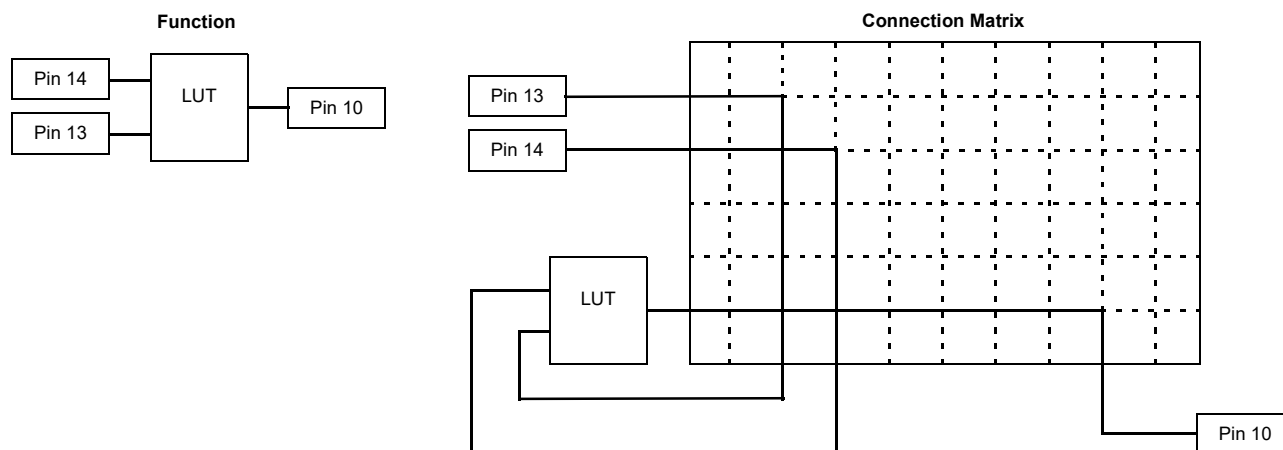


Figure 6. Connection Matrix Example



## 8.1 Matrix Input Table

**Table 14. Matrix Input Table**

| Matrix Input Number | Matrix Input Signal Function                                                    | Matrix Decode |   |   |   |   |
|---------------------|---------------------------------------------------------------------------------|---------------|---|---|---|---|
|                     |                                                                                 | 4             | 3 | 2 | 1 | 0 |
| 0                   | GND                                                                             | 0             | 0 | 0 | 0 | 0 |
| 1                   | pin13 digital Input                                                             | 0             | 0 | 0 | 0 | 1 |
| 2                   | pin14 digital Input                                                             | 0             | 0 | 0 | 1 | 0 |
| 3                   | pin1 digital Input                                                              | 0             | 0 | 0 | 1 | 1 |
| 4                   | pin2 digital Input                                                              | 0             | 0 | 1 | 0 | 0 |
| 5                   | 2-bit LUT0 output (DFF/LATCH_0 output)                                          | 0             | 0 | 1 | 0 | 1 |
| 6                   | 2-bit LUT1 output (DFF/LATCH_1 output)                                          | 0             | 0 | 1 | 1 | 0 |
| 7                   | 2-bit LUT2 output                                                               | 0             | 0 | 1 | 1 | 1 |
| 8                   | 2-bit LUT3 output                                                               | 0             | 1 | 0 | 0 | 0 |
| 9                   | 3-bit LUT0 output (DFF/LATCH_2 output with nRST or nSET)                        | 0             | 1 | 0 | 0 | 1 |
| 10                  | 3-bit LUT1 output (DFF/LATCH_3 output with nRST or nSET)                        | 0             | 1 | 0 | 1 | 0 |
| 11                  | 3-bit LUT2 output                                                               | 0             | 1 | 0 | 1 | 1 |
| 12                  | 3-bit LUT3 output                                                               | 0             | 1 | 1 | 0 | 0 |
| 13                  | 3-bit LUT4 output (pipe delay output0)                                          | 0             | 1 | 1 | 0 | 1 |
| 14                  | pipe delay output1                                                              | 0             | 1 | 1 | 1 | 0 |
| 15                  | 4-bit LUT0 output (CNT_DLY2 output (8 bit w/ ext CK, reset))                    | 0             | 1 | 1 | 1 | 1 |
| 16                  | CNT_DLY0 output (8 bit w/ ext CK (shared bottom delay/CNT), reset)              | 1             | 0 | 0 | 0 | 0 |
| 17                  | CNT_DLY1 output (8 bit w/ ext CK (from dedicated matrix output), reset)         | 1             | 0 | 0 | 0 | 1 |
| 18                  | CNT_DLY3 (8 bit) output                                                         | 1             | 0 | 0 | 1 | 0 |
| 19                  | ACMP_0 output                                                                   | 1             | 0 | 0 | 1 | 1 |
| 20                  | ACMP_1 output                                                                   | 1             | 0 | 1 | 0 | 0 |
| 21                  | Edge detect output                                                              | 1             | 0 | 1 | 0 | 1 |
| 22                  | Programmable delay with edge detector output (Deglitch filter output)           | 1             | 0 | 1 | 1 | 0 |
| 23                  | Internal oscillator output1 (one of /1,/2,/3,/4,/8,12,/24/,64/ selected by REG) | 1             | 0 | 1 | 1 | 1 |
| 24                  | Internal oscillator output2 (one of /1,/2,/3,/4,/8,12,/24/,64/ selected by REG) | 1             | 1 | 0 | 0 | 0 |
| 25                  | Bandgap OK signal                                                               | 1             | 1 | 0 | 0 | 1 |
| 26                  | POR output to matrix                                                            | 1             | 1 | 0 | 1 | 0 |
| 27                  | Power Switch ON0, pin15 digital Input                                           | 1             | 1 | 0 | 1 | 1 |
| 28                  | Power Switch ON1, pin16 digital Input                                           | 1             | 1 | 1 | 0 | 0 |
| 29                  | pin10 digital Input                                                             | 1             | 1 | 1 | 0 | 1 |
| 30                  | pin11 digital Input                                                             | 1             | 1 | 1 | 1 | 0 |
| 31                  | V <sub>DD</sub>                                                                 | 1             | 1 | 1 | 1 | 1 |

## 8.2 Matrix Output Table

**Table 15. Matrix Output Table**

| Register Bit Address | Matrix Output Signal Function                                              | Matrix Output Number |
|----------------------|----------------------------------------------------------------------------|----------------------|
| reg <4:0>            | Pin 14 digital out source                                                  | 0                    |
| reg <9:5>            | Pin 1 digital out source                                                   | 1                    |
| reg <14:10>          | Pin 2 digital out source                                                   | 2                    |
| reg <19:15>          | Pin 2 output enable                                                        | 3                    |
| reg <24:20>          | in0 of 2-bit LUT0 (Clock Input of DFF0)                                    | 4                    |
| reg <29:25>          | in1 of 2-bit LUT0 (Data Input of DFF0)                                     | 5                    |
| reg <34:30>          | in0 of 2-bit LUT1 (Clock Input of DFF1)                                    | 6                    |
| reg <39:35>          | in1 of 2-bit LUT1 (Data Input of DFF1)                                     | 7                    |
| reg <44:40>          | in0 of 2-bit LUT2                                                          | 8                    |
| reg <49:45>          | in1 of 2-bit LUT2                                                          | 9                    |
| reg <54:50>          | in0 of 2-bit LUT3                                                          | 10                   |
| reg <59:55>          | in1 of 2-bit LUT3                                                          | 11                   |
| reg <64:60>          | in0 of 3-bit LUT0 (Clock Input of DFF2 with nRST/nSET)                     | 12                   |
| reg <69:65>          | in1 of 3-bit LUT0 (Data input of DFF2 with nRST/nSET)                      | 13                   |
| reg <74:70>          | in2 of 3-bit LUT0 (nRST or nSET of DFF2 with nRST/nSET)                    | 14                   |
| reg <79:75>          | in0 of 3-bit LUT1 (Clock Input of DFF3 with nRST/nSET)                     | 15                   |
| reg <84:80>          | in1 of 3-bit LUT1 (Data input of DFF3 with nRST/nSET)                      | 16                   |
| reg <89:85>          | in2 of 3-bit LUT1 (nRST or nSET of DFF3 with nRST/nSET)                    | 17                   |
| reg <94:90>          | in0 of 3-bit LUT2                                                          | 18                   |
| reg <99:95>          | in1 of 3-bit LUT2                                                          | 19                   |
| reg <104:100>        | in2 of 3-bit LUT2                                                          | 20                   |
| reg <109:105>        | in0 of 3-bit LUT3                                                          | 21                   |
| reg <114:110>        | in1 of 3-bit LUT3                                                          | 22                   |
| reg <119:115>        | in2 of 3-bit LUT3                                                          | 23                   |
| reg <124:120>        | in0 of 3-bit LUT4 (Input of pipe delay)                                    | 24                   |
| reg <129:125>        | in1 of 3-bit LUT4 (nRST of pipe delay)                                     | 25                   |
| reg <134:130>        | in2 of 3-bit LUT4 (Clock of pipe delay)                                    | 26                   |
| reg <139:135>        | in0 of 4-bit LUT0 (Input for Delay2 ext. clock or Counter2 external Clock) | 27                   |
| reg <144:140>        | in1 of 4-bit LUT0 (Input for Delay2 or Counter2 reset input)               | 28                   |
| reg <149:145>        | in2 of 4-bit LUT0                                                          | 29                   |
| reg <154:150>        | in3 of 4-bit LUT0                                                          | 30                   |
| reg <159:155>        | Input for Delay0 or Counter0 reset input                                   | 31                   |
| reg <164:160>        | Input for Delay1 or Counter1 reset input                                   | 32                   |
| reg <169:165>        | Input for Delay0/1 ext. clock or Counter1 external Clock                   | 33                   |
| reg <174:170>        | Input for Delay3 or Counter3 reset input                                   | 34                   |
| reg <179:175>        | pdb for ACMP0                                                              | 35                   |
| reg <184:180>        | pdb for ACMP1                                                              | 36                   |
| reg <189:185>        | Input for programmable delay (deglitch filter input)                       | 37                   |

**Table 15. Matrix Output Table**

| Register Bit Address | Matrix Output Signal Function                              | Matrix Output Number |
|----------------------|------------------------------------------------------------|----------------------|
| reg <194:190>        | Power down for osc. (higher priority) (high = power down). | 38                   |
| reg <199:195>        | Pin15 digital out source and Input of Power Switch ON0     | 39                   |
| reg <204:200>        | Pin16 digital out source and Input of Power Switch ON1     | 40                   |
| reg <209:205>        | Pin 10 digital out source                                  | 41                   |
| reg <214:210>        | Pin 10 output enable                                       | 42                   |
| reg <219:215>        | Pin 11 digital out source                                  | 43                   |

## 9.0 Combinatorial Logic

Combinatorial logic is supported via four Lookup Tables (LUTs) within the SLG46127. There are two 2-bit LUTs and two 3-bit LUTs. The device also includes six 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 two 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.

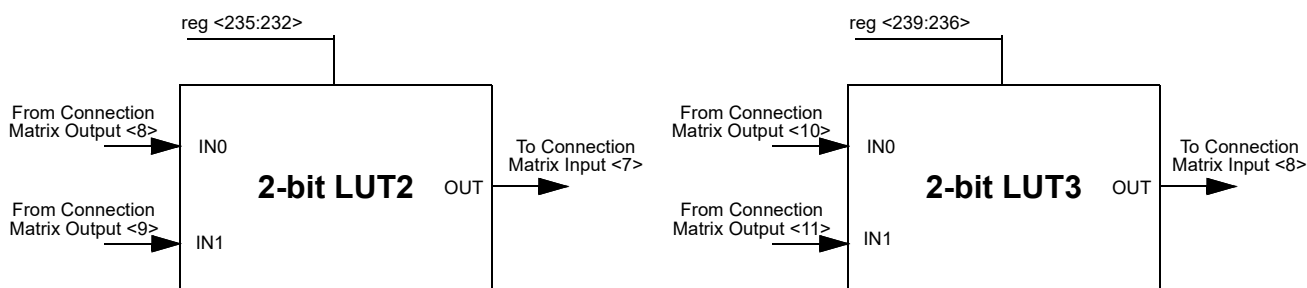


Figure 7. 2-bit LUTs

Table 16. 2-bit LUT2 Truth Table.

| IN1 | IN0 | OUT       |
|-----|-----|-----------|
| 0   | 0   | reg <232> |
| 0   | 1   | reg <233> |
| 1   | 0   | reg <234> |
| 1   | 1   | reg <235> |

Table 17. 2-bit LUT3 Truth Table.

| IN1 | IN0 | OUT       |
|-----|-----|-----------|
| 0   | 0   | reg <236> |
| 0   | 1   | reg <237> |
| 1   | 0   | reg <238> |
| 1   | 1   | reg <239> |

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

*2-Bit LUT2 is defined by reg <235:232>*

*2-Bit LUT3 is defined by reg <239:236>*

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 18. 2-bit LUT2/LUT3 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 two 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.

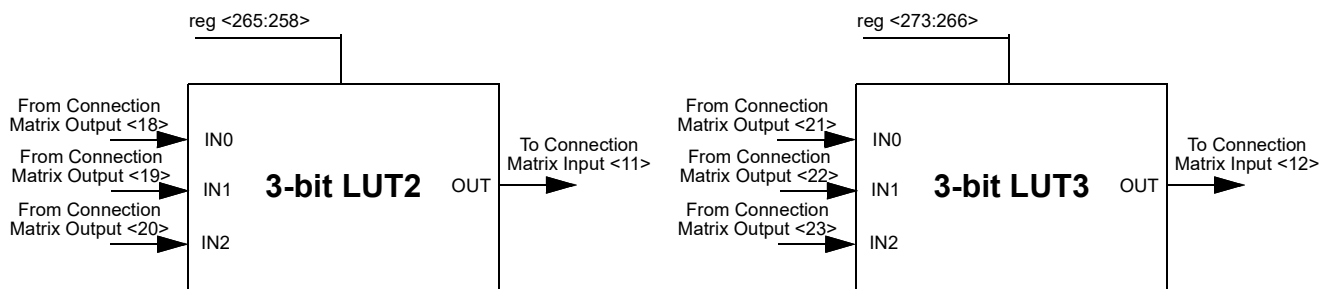


Figure 8. 3-bit LUTs

Table 19. 3-bit LUT2 Truth Table.

| IN2 | IN1 | IN0 | OUT       |
|-----|-----|-----|-----------|
| 0   | 0   | 0   | reg <258> |
| 0   | 0   | 1   | reg <259> |
| 0   | 1   | 0   | reg <260> |
| 0   | 1   | 1   | reg <261> |
| 1   | 0   | 0   | reg <262> |
| 1   | 0   | 1   | reg <263> |
| 1   | 1   | 0   | reg <264> |
| 1   | 1   | 1   | reg <265> |

Table 20. 3-bit LUT3 Truth Table.

| IN2 | IN1 | IN0 | OUT       |
|-----|-----|-----|-----------|
| 0   | 0   | 0   | reg <266> |
| 0   | 0   | 1   | reg <267> |
| 0   | 1   | 0   | reg <268> |
| 0   | 1   | 1   | reg <269> |
| 1   | 0   | 0   | reg <270> |
| 1   | 0   | 1   | reg <271> |
| 1   | 1   | 0   | reg <272> |
| 1   | 1   | 1   | reg <273> |

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

*3-Bit LUT2 is defined by reg <265:258>*

*3-Bit LUT3 is defined by reg <273:266>*

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 21. 3-bit LUT2/LUT3 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 SLG46127 has six combination function macrocells that can serve more than one logic or timing function. In each case, they can serve as a Look Up Table (LUT), or as another logic or timing function. See the list below for the functions that can be implemented in these macrocells;

- Two macrocells that can serve as either 2-bit LUTs or as D Flip-Flops.
- Two 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
- One macrocells that can serve as either 4-bit LUTs or as 8-Bit Counter / Delays

Inputs/Outputs for the six 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 nRST 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 two 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.

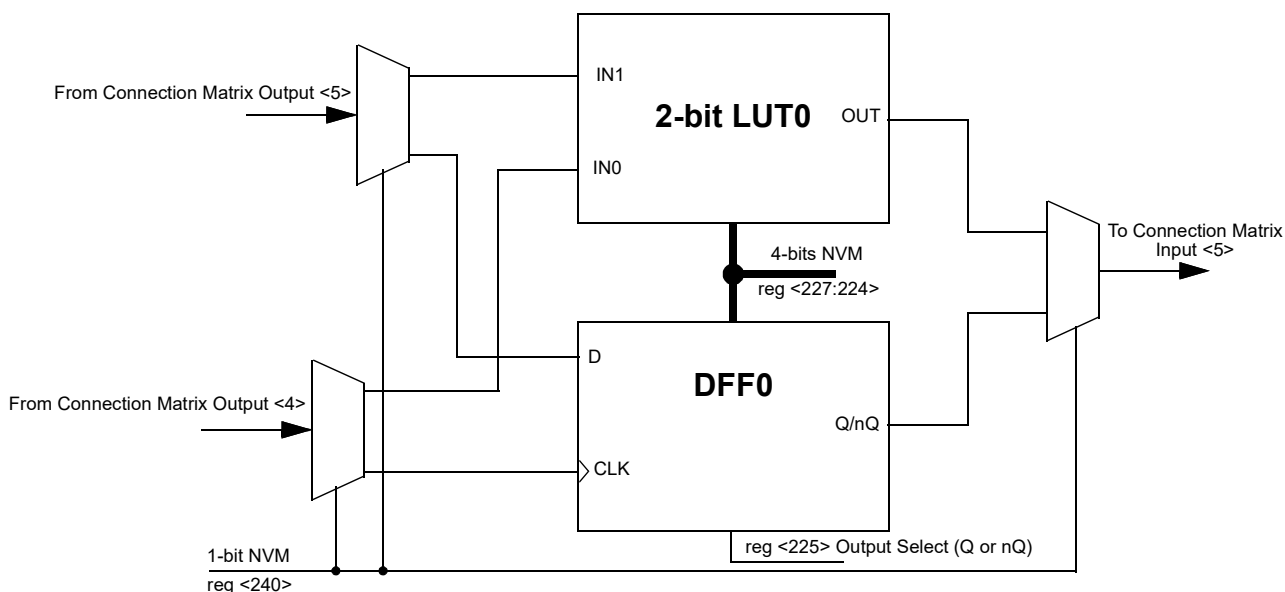


Figure 9. 2-bit LUT0 or DFF0

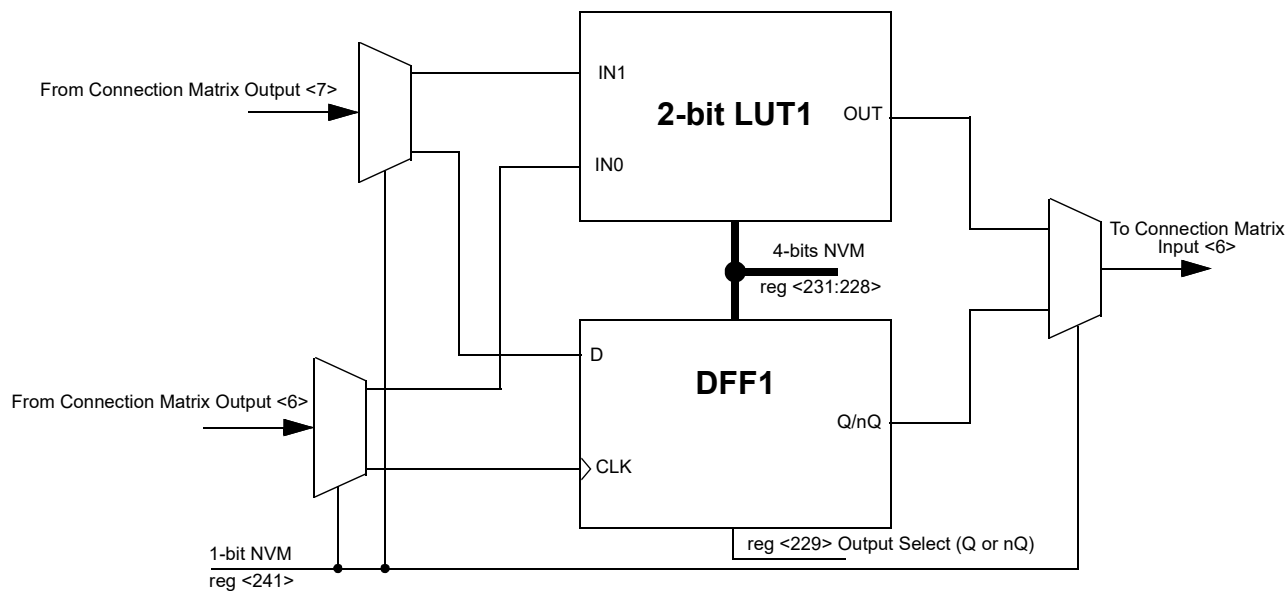


Figure 10. 2-bit LUT1 or DFF1

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

Table 22. 2-bit LUT0 Truth Table.

| IN1 | IN0 | OUT       |
|-----|-----|-----------|
| 0   | 0   | reg <224> |
| 0   | 1   | reg <225> |
| 1   | 0   | reg <226> |
| 1   | 1   | reg <227> |

Table 23. 2-bit LUT1 Truth Table.

| IN1 | IN0 | OUT       |
|-----|-----|-----------|
| 0   | 0   | reg <228> |
| 0   | 1   | reg <229> |
| 1   | 0   | reg <230> |
| 1   | 1   | reg <231> |

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 <227:224>*

*2-Bit LUT1 is defined by reg <231:228>*



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

**Table 24. DFF0 Register Settings**

| Signal Function              | Register Bit Address | Register Definition                  |
|------------------------------|----------------------|--------------------------------------|
| DFF0 or Latch select         | reg <224>            | 0: DFF function<br>1: Latch function |
| DFF0 output select           | reg <225>            | 0: Q output<br>1: nQ output          |
| DFF0 initial polarity select | reg <226>            | 0: Low<br>1: High                    |
| 2-bit LUT0 data              | reg <235:232>        | 2-bit LUT0 data                      |
| 2-bit LUT0 or DFF0 select    | reg <240>            | 0: 2-bit LUT0<br>1: DFF0             |

**Table 25. DFF1 Register Settings**

| Signal Function              | Register Bit Address | Register Definition                  |
|------------------------------|----------------------|--------------------------------------|
| DFF1 or Latch select         | reg <228>            | 0: DFF function<br>1: Latch function |
| DFF1 output select           | reg <229>            | 0: Q output<br>1: nQ output          |
| DFF1 initial polarity select | reg <230>            | 0: Low<br>1: High                    |
| 2-bit LUT1 data              | reg <239:236>        | 2-bit LUT1 data                      |
| 2-bit LUT1 or DFF1 select    | reg <241>            | 0: 2-bit LUT1<br>1: DFF1             |

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

There are two 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.

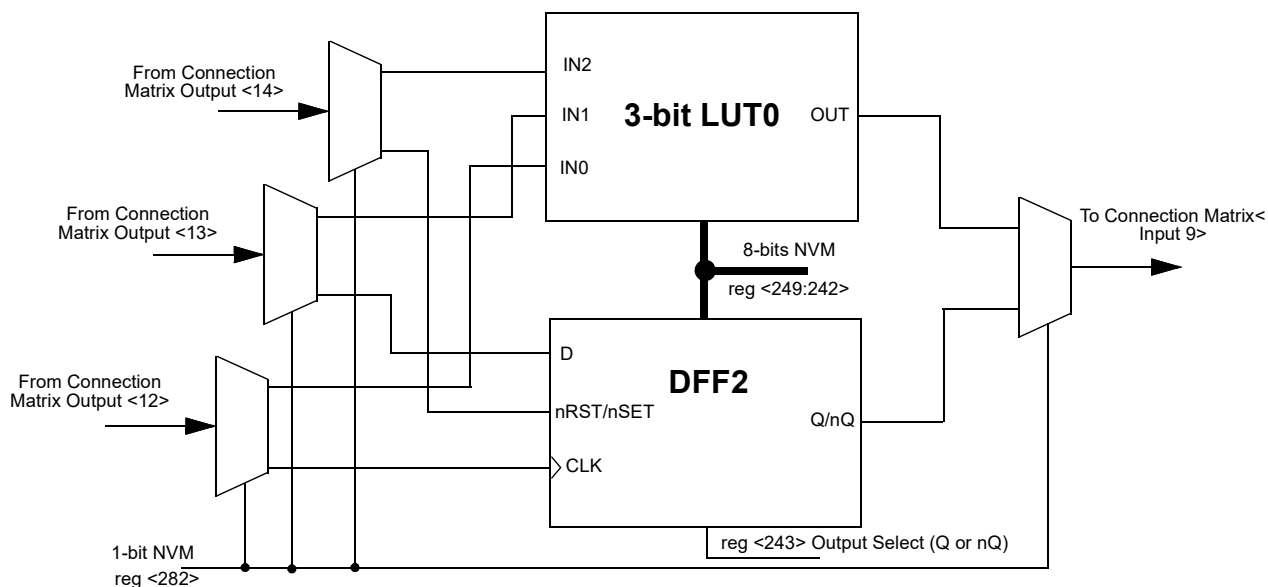


Figure 11. 3-bit LUT0 or DFF2

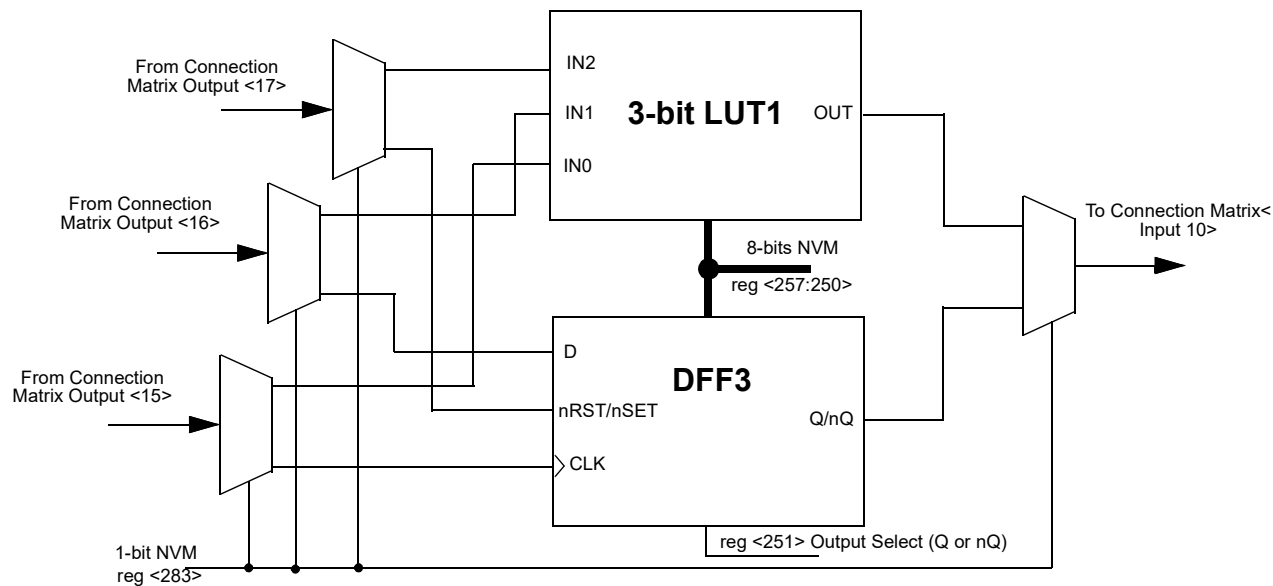


Figure 12. 3-bit LUT1 or DFF3

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

Table 26. 3-bit LUT0 Truth Table.

| IN2 | IN1 | IN0 | OUT       |
|-----|-----|-----|-----------|
| 0   | 0   | 0   | reg <242> |
| 0   | 0   | 1   | reg <243> |
| 0   | 1   | 0   | reg <244> |
| 0   | 1   | 1   | reg <245> |
| 1   | 0   | 0   | reg <246> |
| 1   | 0   | 1   | reg <247> |
| 1   | 1   | 0   | reg <248> |
| 1   | 1   | 1   | reg <249> |

Table 27. 3-bit LUT1 Truth Table.

| IN2 | IN1 | IN0 | OUT       |
|-----|-----|-----|-----------|
| 0   | 0   | 0   | reg <250> |
| 0   | 0   | 1   | reg <251> |
| 0   | 1   | 0   | reg <252> |
| 0   | 1   | 1   | reg <253> |
| 1   | 0   | 0   | reg <254> |
| 1   | 0   | 1   | reg <255> |
| 1   | 1   | 0   | reg <256> |
| 1   | 1   | 1   | reg <257> |

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

*3-Bit LUT2 is defined by reg <249:242>*

*3-Bit LUT3 is defined by reg <257:250>*

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

**Table 28. DFF2 Register Settings**

| Signal Function              | Register Bit Address | Register Definition                                |
|------------------------------|----------------------|----------------------------------------------------|
| DFF2 or Latch select         | reg <242>            | 0: DFF function<br>1: Latch function               |
| DFF2 output select           | reg <243>            | 0: Q output<br>1: nQ output                        |
| DFF2 initial polarity select | reg <244>            | 0: Low<br>1: High                                  |
| DFF2 nRST/nSET Select        | reg <245>            | 1: nSET from matrix out<br>0: nRST from matrix out |
| 3-bit LUT0 data              | reg <265:258>        | 3-bit LUT0 data                                    |
| 3-bit LUT0 or DFF2 select    | reg <282>            | 0: 3-bit LUT0<br>1: DFF2                           |

**Table 29. DFF3 Register Settings**

| Signal Function              | Register Bit Address | Register Definition                                |
|------------------------------|----------------------|----------------------------------------------------|
| DFF3 or Latch Select         | reg <250>            | 0: DFF function<br>1: Latch function               |
| DFF3 Output Select           | reg <251>            | 0: Q output<br>1: nQ output                        |
| DFF3 nRST/nSET Select        | reg <252>            | 1: nSET from matrix out<br>0: nRST from matrix out |
| DFF3 initial polarity select | reg <253>            | 0: Low<br>1: High                                  |
| 3-bit LUT1 data              | reg <273:266>        | 3-bit LUT1 data                                    |
| 3-bit LUT1 or DFF3 select    | reg <283>            | 0: 3-bit LUT1<br>1: DFF3                           |

### 10.3 3-Bit LUT or Pipe Delay Macrocell

There is one macrocell that can serve as either a 3-bit LUT or as a Pipe Delay.

When used to implement LUT functions, the 3-bit LUT takes in three input signals from the connection matrix and produces a single output, which goes back into the connection matrix.

When used as an 8-stage pipe delay, there are three input signals from the matrix, Input (IN), Clock (CLK) and Reset (nRST). The pipe delay cell is built from D Flip-Flop logic cells that provide the three delay options, two of which are user selectable. The DFF cells are tied in series where the output (Q) of each delay cell goes to the next DFF cell. The first delay option (OUT2) is fixed at the output of the first flip-flop stage. The other two outputs (OUT0 and OUT1) provide user selectable options for 1 to 8 stages of delay. There are delay output points for each set of the OUT0 and OUT1 outputs to a 3-input mux that is controlled by reg <666:663> for OUT0 and reg <670:667> for OUT1. The 3-input mux is used to control the selection of the amount of delay.

The overall time of the delay is based on the clock used in the SLG46127 design. Each DFF cell has a time delay of the inverse of the clock time (either external clock or the RC Oscillator within the SLG46127). The sum of the number of DFF cells used will be the total time delay of the Pipe Delay logic cell.

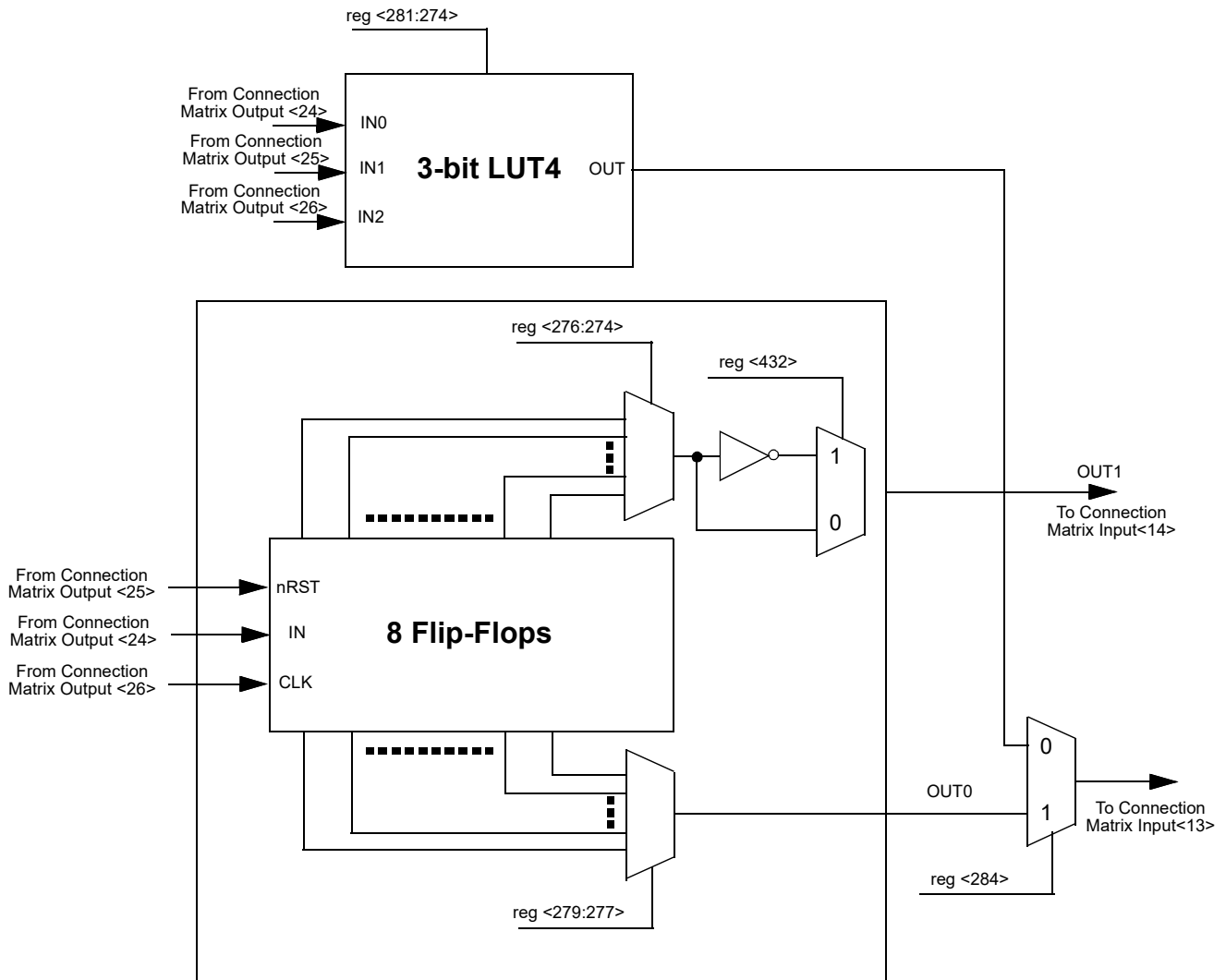


Figure 13. 3-bit LUT4 or Pipe Delay

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

**Table 30. 3-bit LUT4 Truth Table.**

| IN2 | IN1 | IN0 | OUT       |
|-----|-----|-----|-----------|
| 0   | 0   | 0   | reg <274> |
| 0   | 0   | 1   | reg <275> |
| 0   | 1   | 0   | reg <276> |
| 0   | 1   | 1   | reg <277> |
| 1   | 0   | 0   | reg <278> |
| 1   | 0   | 1   | reg <279> |
| 1   | 1   | 0   | reg <280> |
| 1   | 1   | 1   | reg <281> |

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

*3-Bit LUT4 is defined by reg <281:274>*

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

**Table 31. Pipe Delay Register Settings**

| Signal Function                        | Register Bit Address | Register Definition            |
|----------------------------------------|----------------------|--------------------------------|
| OUT0 select                            | reg <276:274>        | data (pipe number)             |
| OUT1 select                            | reg <279:277>        | data (pipe number)             |
| 3-bit LUT4 or pipe delay output select | reg <284>            | 0: 3-bit LUT4<br>1: pipe delay |

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

There is one macrocell 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\_in/CNT\_Reset) for the counter/delay, with the output going back to the connection matrix.

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

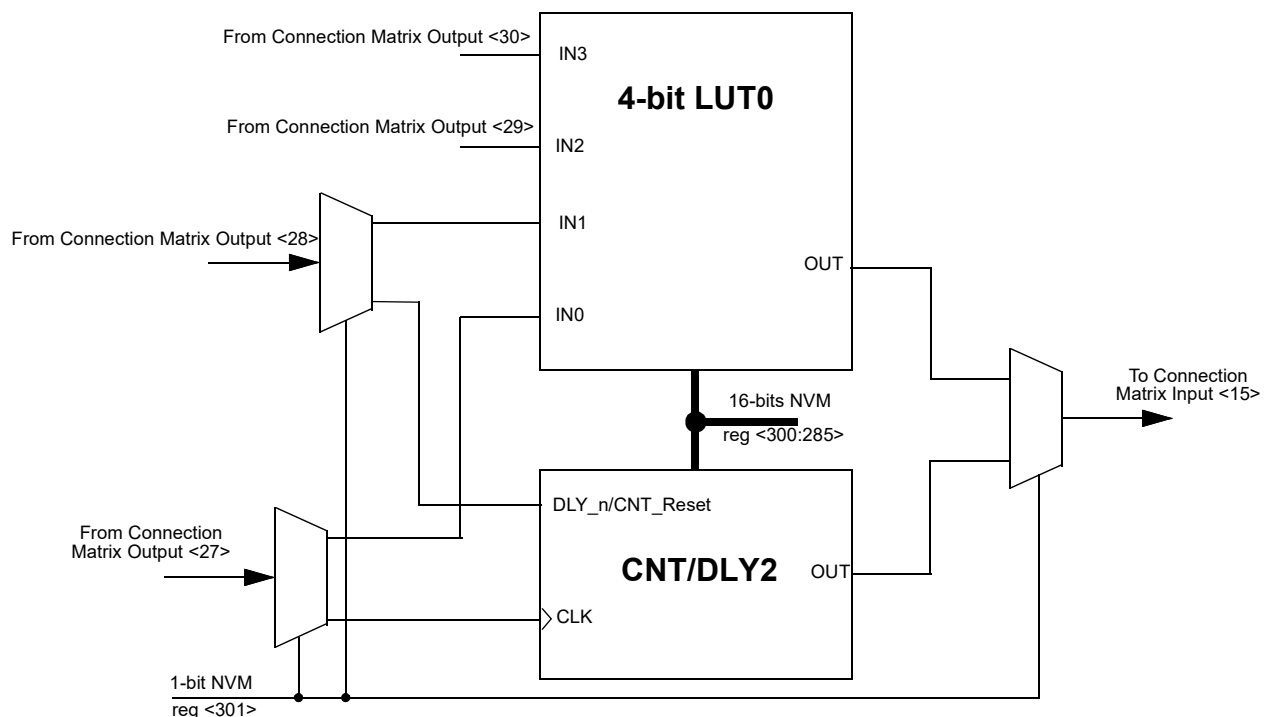


Figure 14. 4-bit LUT0 or CNT/DLY2

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

Table 32. 4-bit LUT0 Truth Table.

| IN3 | IN2 | IN1 | IN0 | OUT       |
|-----|-----|-----|-----|-----------|
| 0   | 0   | 0   | 0   | reg <285> |
| 0   | 0   | 0   | 1   | reg <286> |
| 0   | 0   | 1   | 0   | reg <287> |
| 0   | 0   | 1   | 1   | reg <288> |
| 0   | 1   | 0   | 0   | reg <289> |
| 0   | 1   | 0   | 1   | reg <290> |
| 0   | 1   | 1   | 0   | reg <291> |
| 0   | 1   | 1   | 1   | reg <292> |
| 1   | 0   | 0   | 0   | reg <293> |
| 1   | 0   | 0   | 1   | reg <294> |
| 1   | 0   | 1   | 0   | reg <295> |
| 1   | 0   | 1   | 1   | reg <296> |
| 1   | 1   | 0   | 0   | reg <297> |
| 1   | 1   | 0   | 1   | reg <298> |
| 1   | 1   | 1   | 0   | reg <299> |
| 1   | 1   | 1   | 1   | reg <300> |

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 <300:285>*



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

Table 33. CNT/DLY2 Register Settings

| Signal Function                                  | Register Bit Address | Register Definition                                                                                                                                                                                                                                                                        |
|--------------------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Counter/delay2 Mode Selection                    | reg <285>            | 0: Delay Mode<br>1: Counter Mode                                                                                                                                                                                                                                                           |
| Counter/delay2 Clock Source Select               | reg <288:286>        | 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 <296:289>        | 1-255: (delay time = (counter data + 2 + variable)/freq),<br>where 0 < variable < 1                                                                                                                                                                                                        |
| Delay2 Mode Select or asynchronous counter reset | reg <298:297>        | 00: Delay on both falling and rising edgeless delay & counter reset<br>01: Delay on falling edge only (for delay & counter reset Delay)<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 |
| 4-bit LUT0 or Counter2 select                    | reg <301>            | 0: 4-bit LUT0<br>1: Counter2                                                                                                                                                                                                                                                               |

# 11.0 Analog Comparators (ACMP)

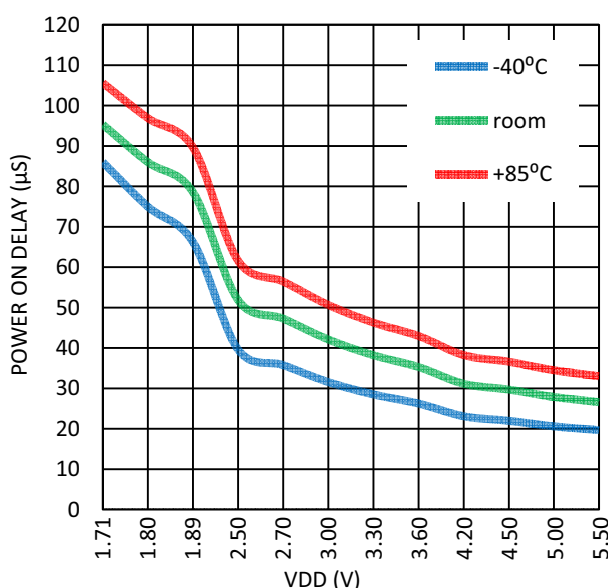
There are two Analog Comparator (ACMP) macrocells in the SLG46127. In order for the ACMP cells to be used in a GreenPAK design, the power up signals (ACMP0\_pdb and ACMP1\_pdb) need to be active. By connecting to signals coming from the Connection Matrix, it is possible to have each ACMP be on continuously, 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 15*.

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



**Figure 15. Maximum Power On Delay vs.  $V_{DD}$ .**

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 34*. IN- voltage range: 0 - 1.2 V. Can use Vref selection  $V_{DD}/4$  and  $V_{DD}/3$  to maintain this input range.

**Table 34. Gain Divider Input Resistance (typ).**

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

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 14,  $V_{DD}$ ;
  - ACMP1 IN+ options are PIN 2, ACMP0 IN+;
- IN- source:
  - ACMP0 IN- options are 24 internal reference sources (50 mV – 1200 mV) and  $V_{DD}/3$ ,  $V_{DD}/4$ , PIN 1;
  - 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 1 analog I/O connection.

### 11.1 ACMP0 Block Diagram

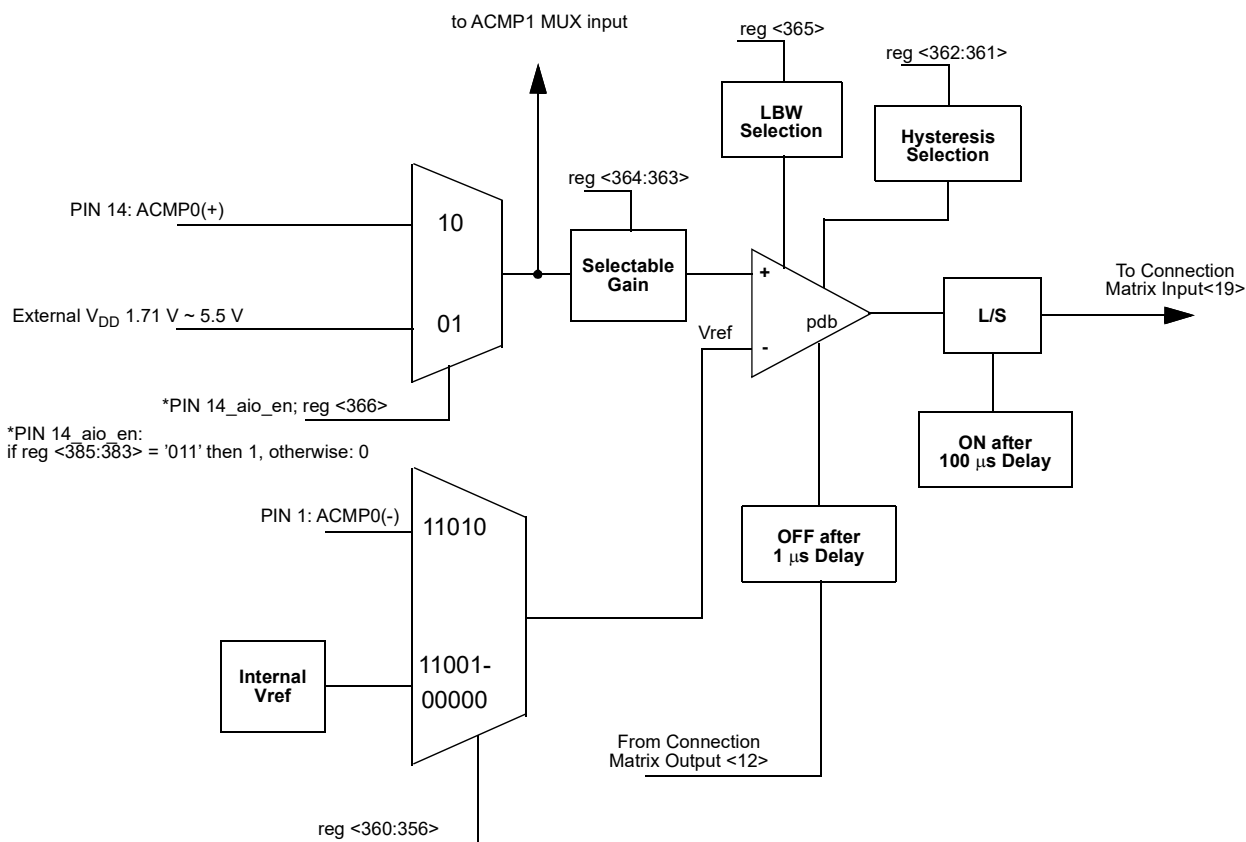


Figure 16. ACMP0 Block Diagram

**11.2 ACMP0 Register Settings**
**Table 35. ACMP0 Register Settings**

| Signal Function                                           | Register Bit Address | Register Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ACMP0 In Voltage Select                                   | reg <360:356>        | 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 (PIN1) |
| ACMP0 Hysteresis Enable                                   | reg <362:361>        | 00: Disabled (0 mV)<br>01: Enabled (25 mV)<br>10: Enabled (50 mV)<br>11: Enabled (200 mV)                                                                                                                                                                                                                                                                                                                                                                                         |
| ACMP0 Positive Input Divider                              | reg <364:363>        | 00: 1.00X<br>01: 0.50X<br>10: 0.33X<br>11: 0.25X                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| ACMP0 Low Bandwidth (Max: 1 MHz) Enable                   | reg <365>            | 0: Off<br>1: On                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| ACMP0 positive input source select<br>PIN 14 and $V_{DD}$ | reg <366>            | 0: PIN 14<br>1: $V_{DD}$                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

### 11.3 ACMP1 Block Diagram

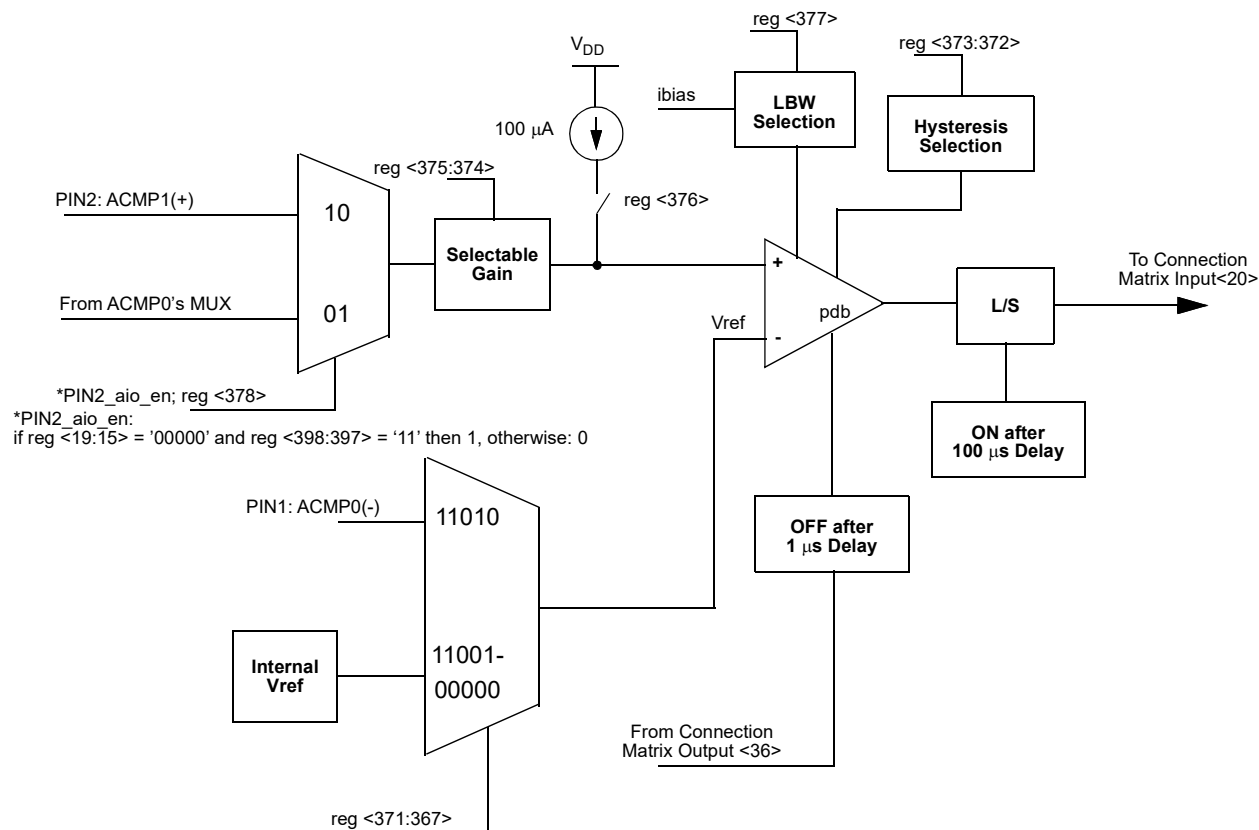


Figure 17. ACMP1 Block Diagram

**11.4 ACMP1 Register Settings**
**Table 36. ACMP1 Register Settings**

| Signal Function                                      | Register Bit Address | Register Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------------------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ACMP1 In Voltage Select                              | reg <371:367>        | 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 (PIN1) |
| ACMP1 Hysteresis Enable                              | reg <373:372>        | 00: Disabled (0 mV)<br>01: Enabled (25 mV)<br>10: Enabled (50 mV)<br>11: Enabled (200 mV)                                                                                                                                                                                                                                                                                                                                                                                         |
| ACMP1 Positive Input Divider                         | reg <375:374>        | 00: 1.00X<br>01: 0.50X<br>10: 0.33X<br>11: 0.25X                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| ACMP1 Low Bandwidth (Max: 1 MHz) Enable              | reg <377>            | 1: On<br>0: Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| ACMP1 positive input source select<br>PIN14 and Pin2 | reg <378>            | 0: Pin2<br>1: Pin14                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

# 11.5 Typical Performance Characteristics

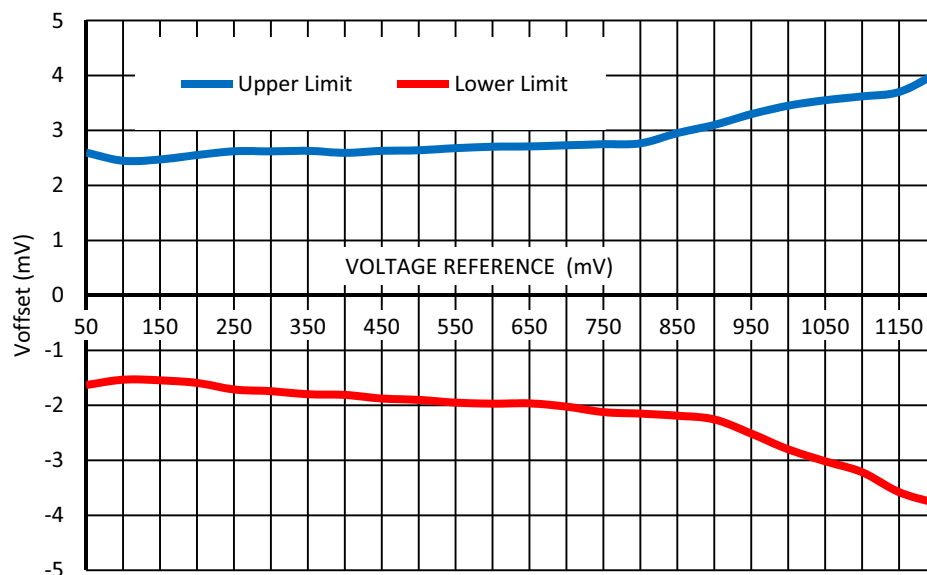


Figure 18. Typical Input Voltage Offset vs. Voltage Reference at room temperature, LBW Mode – Disable,  $V_{hys}=0$  mV,  $V_{DD}=(1.7 - 5.5)$  V.

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

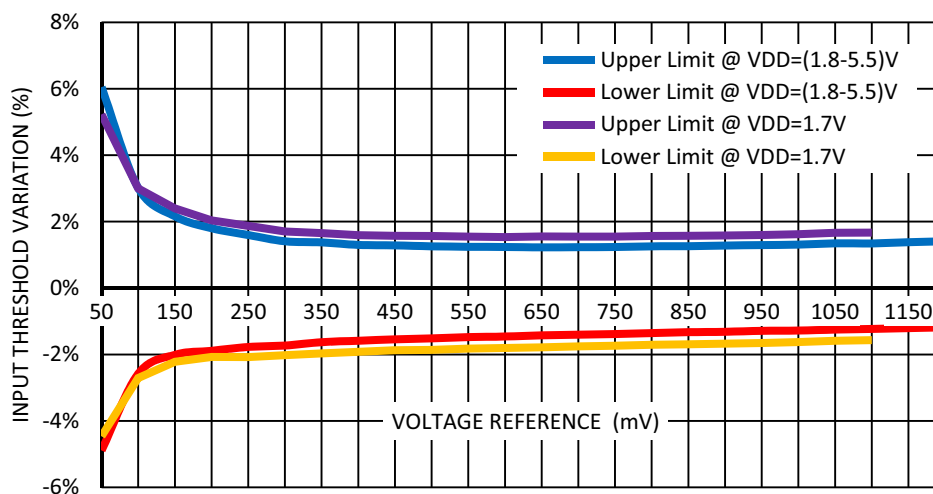


Figure 19. Typical Input Threshold Variation (including Vref variation, ACMP offset) vs. Voltage reference at room temperature, LBW Mode – Disable,  $V_{hys}=0$  mV.

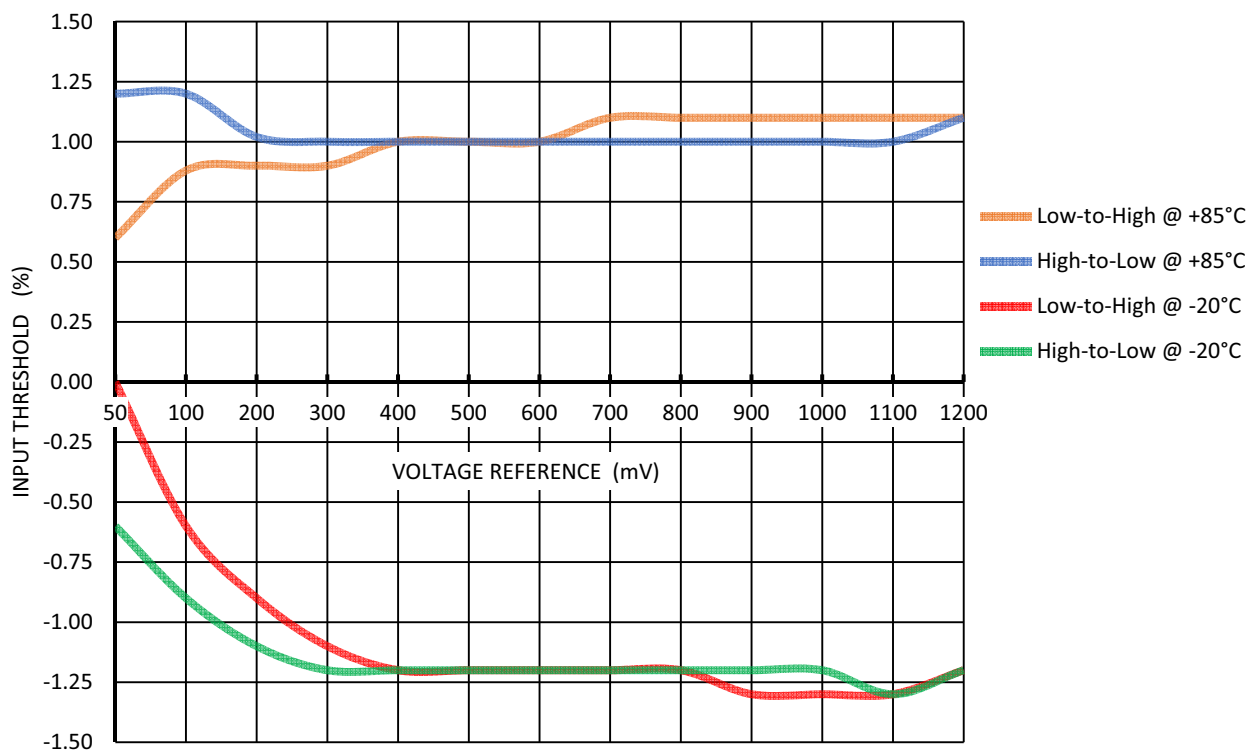


Figure 20. Input Threshold Ratio vs. Voltage Reference at  $V_{DD} = (1.71 - 5.5) \text{ V}$ ,  $V_{hys} = 0$ , Gain = 1

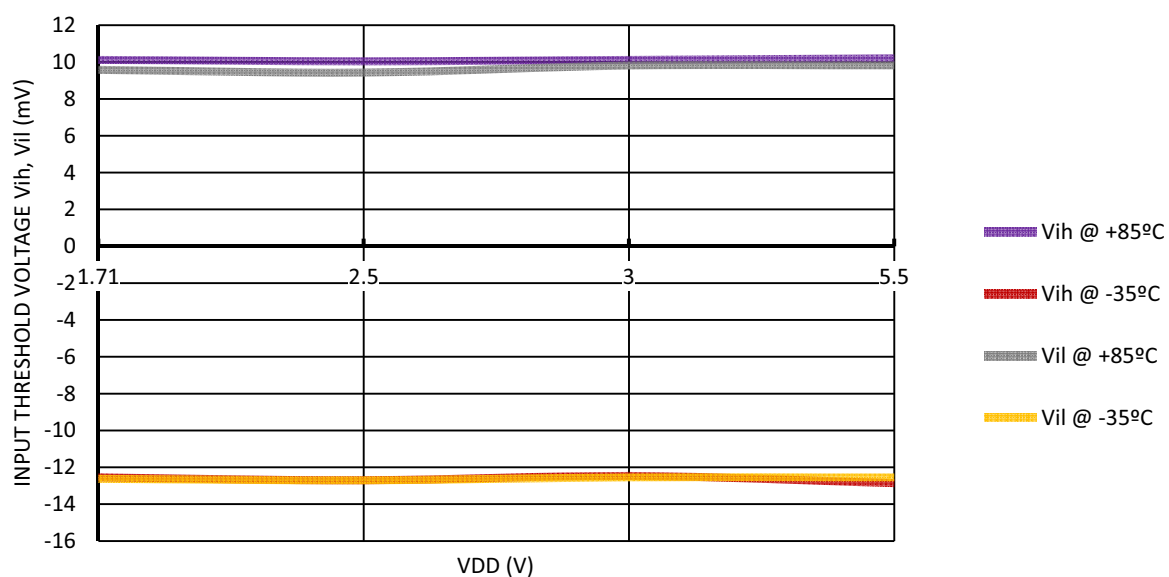


Figure 21. Input Threshold Voltage  $V_{ih}$ ,  $V_{il}$  vs.  $V_{DD}$  at  $V_{ref} = 1000 \text{ mV}$ , Gain = 1



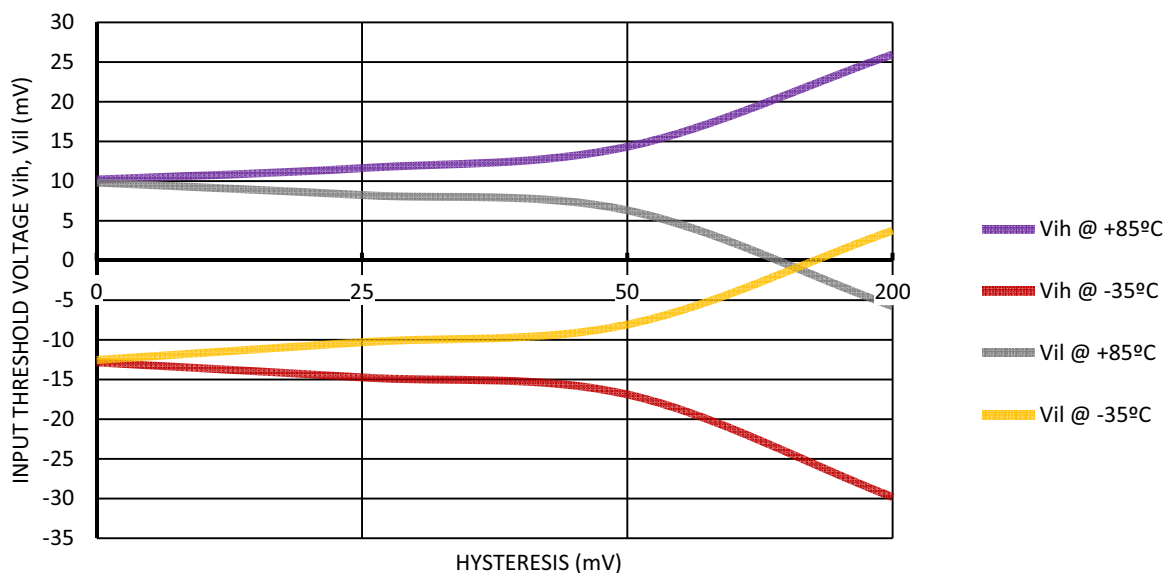


Figure 22. Input Threshold Voltage  $V_{ih}$ ,  $V_{il}$  vs. Hysteresis at  $V_{DD} = 5.5$  V,  $V_{ref} = 1000$  mV. Gain = 1

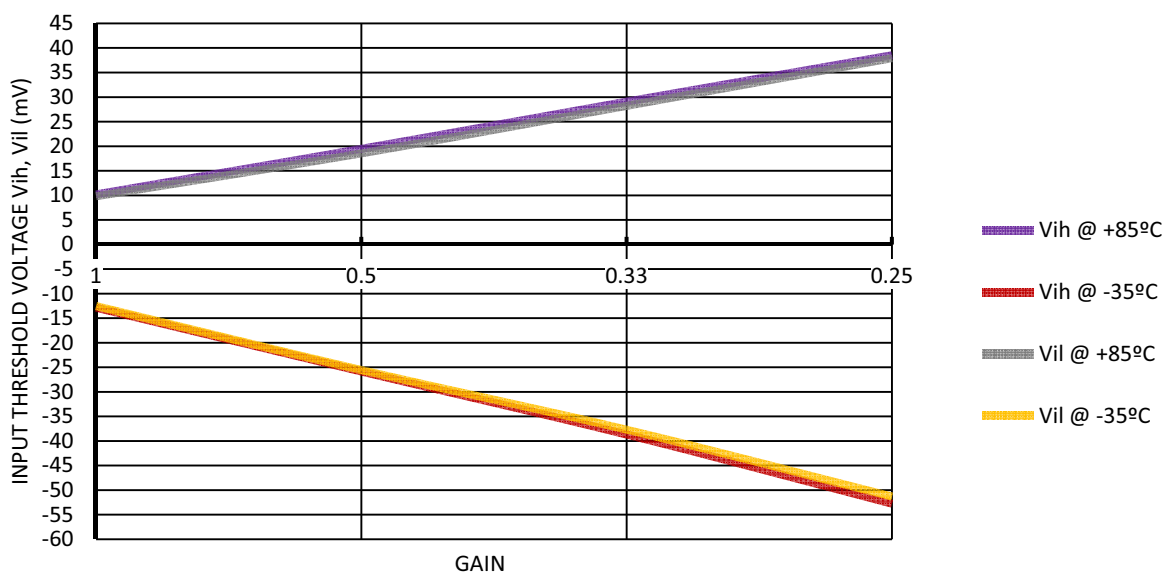
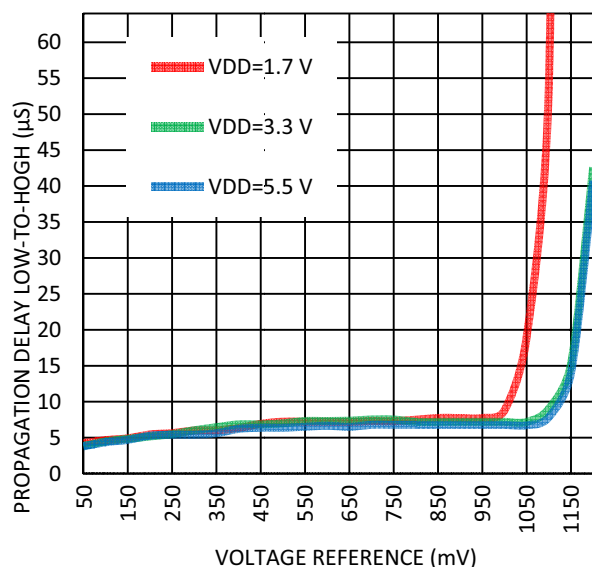


Figure 23. Input Threshold Voltage  $V_{ih}$ ,  $V_{il}$  vs. Gain at Hysteresis = 0,  $V_{DD} = 5.5$  V,  $V_{ref} = 1000$  mV

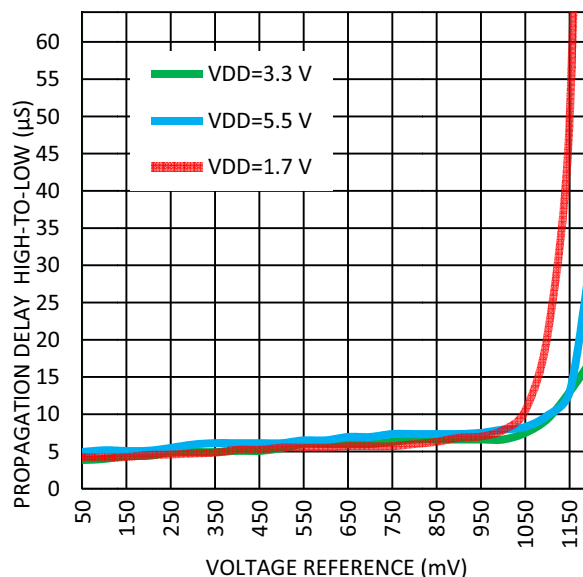
Table 37. Built-in Hysteresis Tolerance.

| $V_{hys}$ (mV) | $V_{DD}=(1.7-1.8)$ V    |       |                           |       |                            |       | $V_{DD}=(1.89-5.5)$ V   |       |                           |       |                            |       |
|----------------|-------------------------|-------|---------------------------|-------|----------------------------|-------|-------------------------|-------|---------------------------|-------|----------------------------|-------|
|                | $V_{ref} = (50-500)$ mV |       | $V_{ref} = (550-1000)$ mV |       | $V_{ref} = (1050-1200)$ mV |       | $V_{ref} = (50-500)$ mV |       | $V_{ref} = (550-1000)$ mV |       | $V_{ref} = (1050-1200)$ 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 |

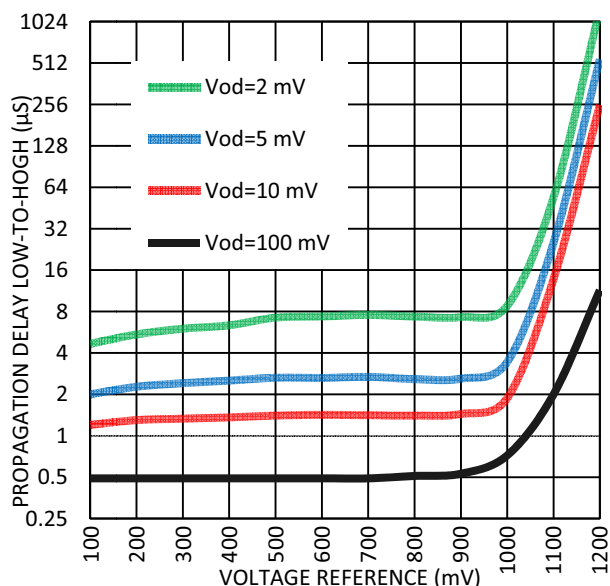
# 11.6 Timing Characteristics



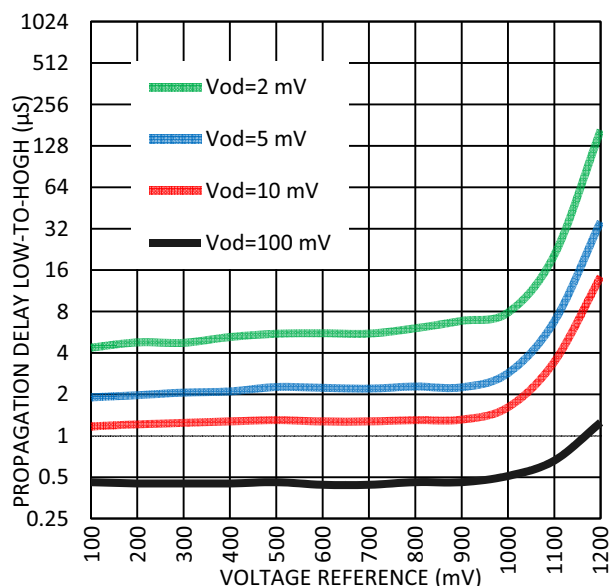
**Figure 24. Maximum Propagation Delay Low-to-High vs. Voltage Reference at Room Temperature,  $V_{od} = 2$  mV.**



**Figure 26. Maximum Propagation Delay High-to-Low vs. Voltage Reference at Room Temperature,  $V_{od} = 2$  mV.**



**Figure 25. Maximum Propagation Delay Low-to-High vs. Voltage Reference at Room Temperature,  $V_{DD} = (1.71 - 1.89)$  V.**



**Figure 27. Maximum Propagation Delay High-to-Low vs. Voltage Reference at Room Temperature,  $V_{DD} = (1.71 - 1.89)$  V.**

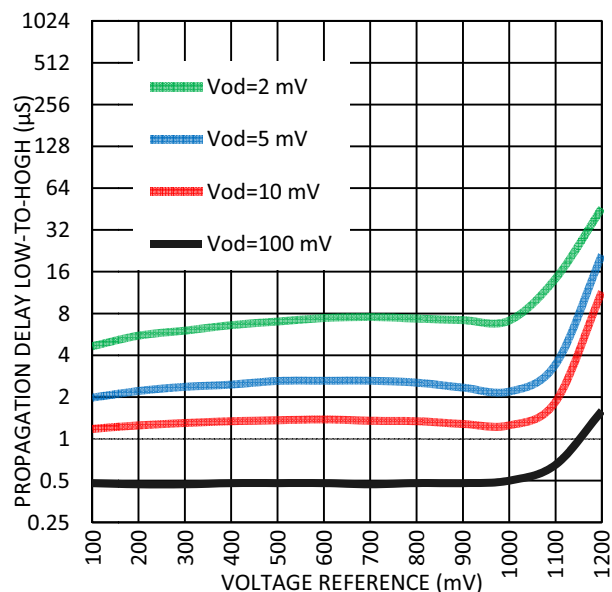


Figure 28. Maximum Propagation Delay Low-to-High vs. Voltage Reference at Room Temperature,  $V_{DD} = (1.89 - 3.6) V$ .

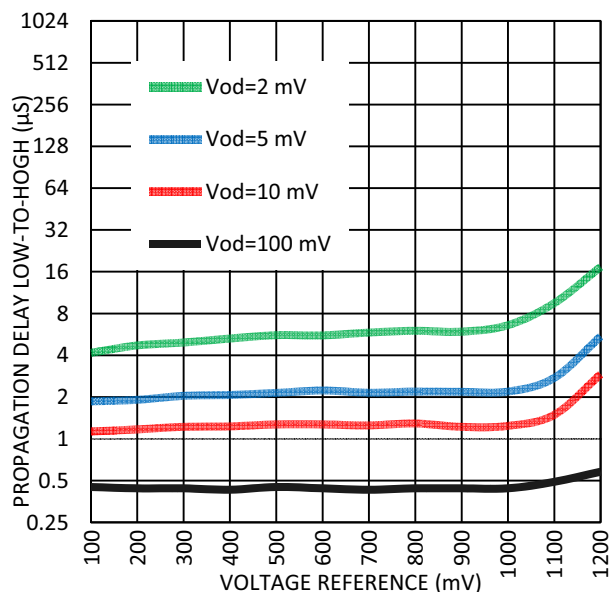


Figure 30. Maximum Propagation Delay High-to-Low vs. Voltage Reference at Room Temperature,  $V_{DD} = (1.89 - 3.6) V$ .

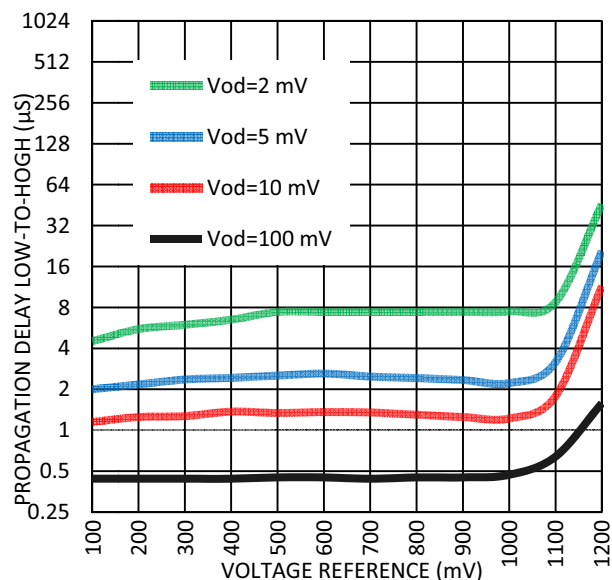


Figure 29. Maximum Propagation Delay Low-to-High vs. Voltage Reference at Room Temperature,  $V_{DD} = (3.6 - 5.5) V$ .

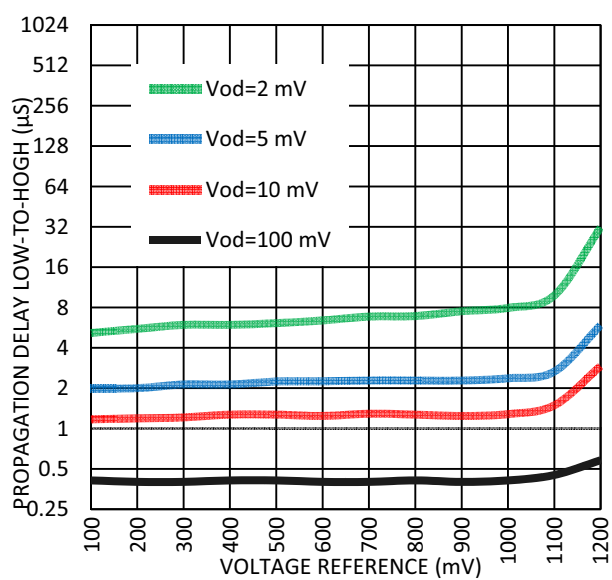


Figure 31. Maximum Propagation Delay High-to-Low vs. Voltage Reference at Room Temperature,  $V_{DD} = (3.6 - 5.5) V$ .

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

There are three configurable counters/delay generators in the SLG46127. The three counters/delay generators (CNT/DLY 0, 1, 3) are 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.

Two of the counter/delay generator macrocells (CNT/DLY0 and CNT/DLY1) have two inputs from the connection matrix, one for Delay Input/Reset Input (Delay\_In/Reset\_In), and one for an external counter/clock source. One of the counter/delay generator macrocells (CNT/DLY3) has one input from the connection matrix, which has a shared function of either a Delay Input or an external clock input.

Note that there is also one Combination Function Macrocells that can implement 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.*

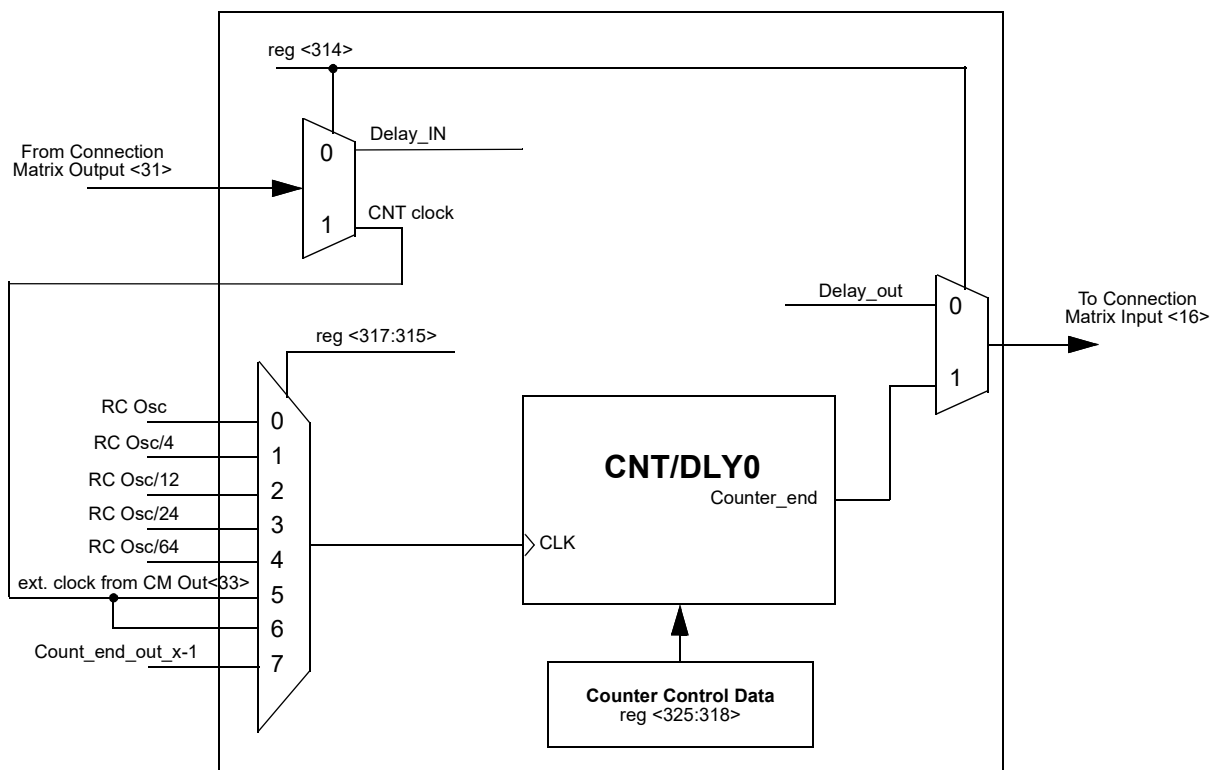


Figure 32. CNT/DLY0

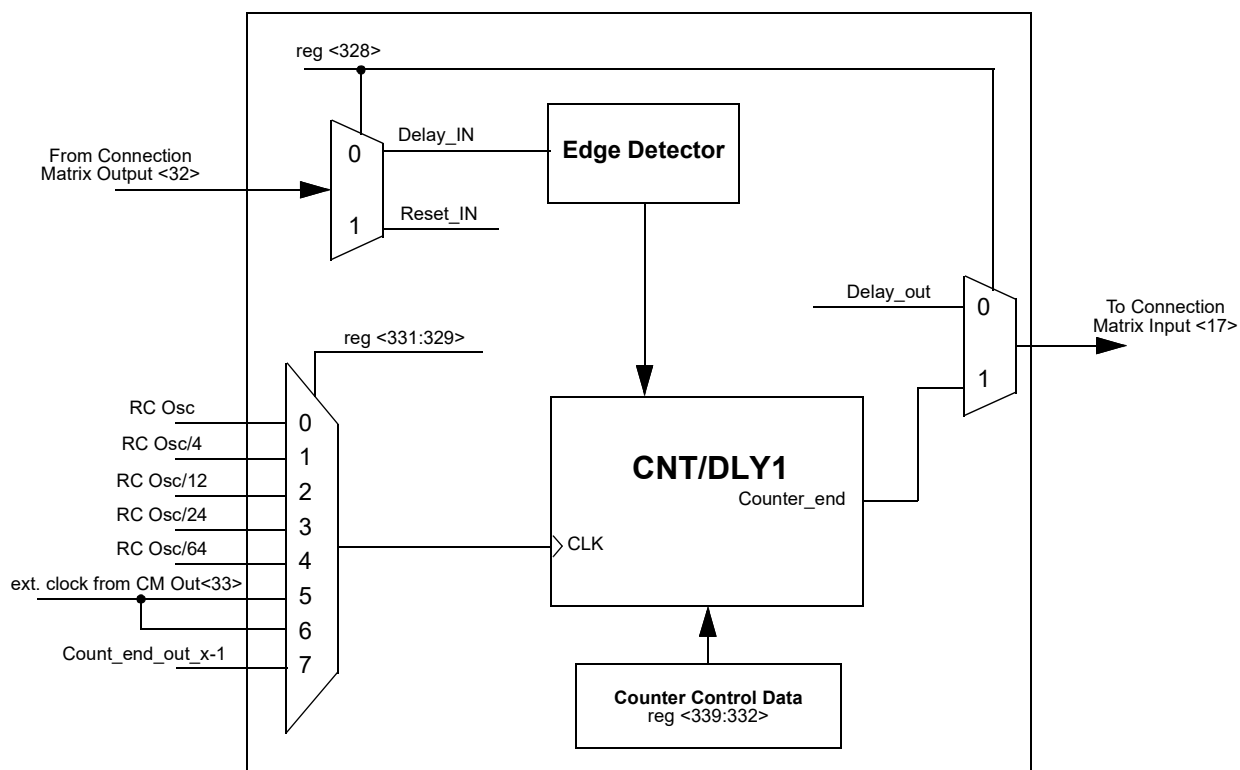


Figure 33. CNT/DLY1

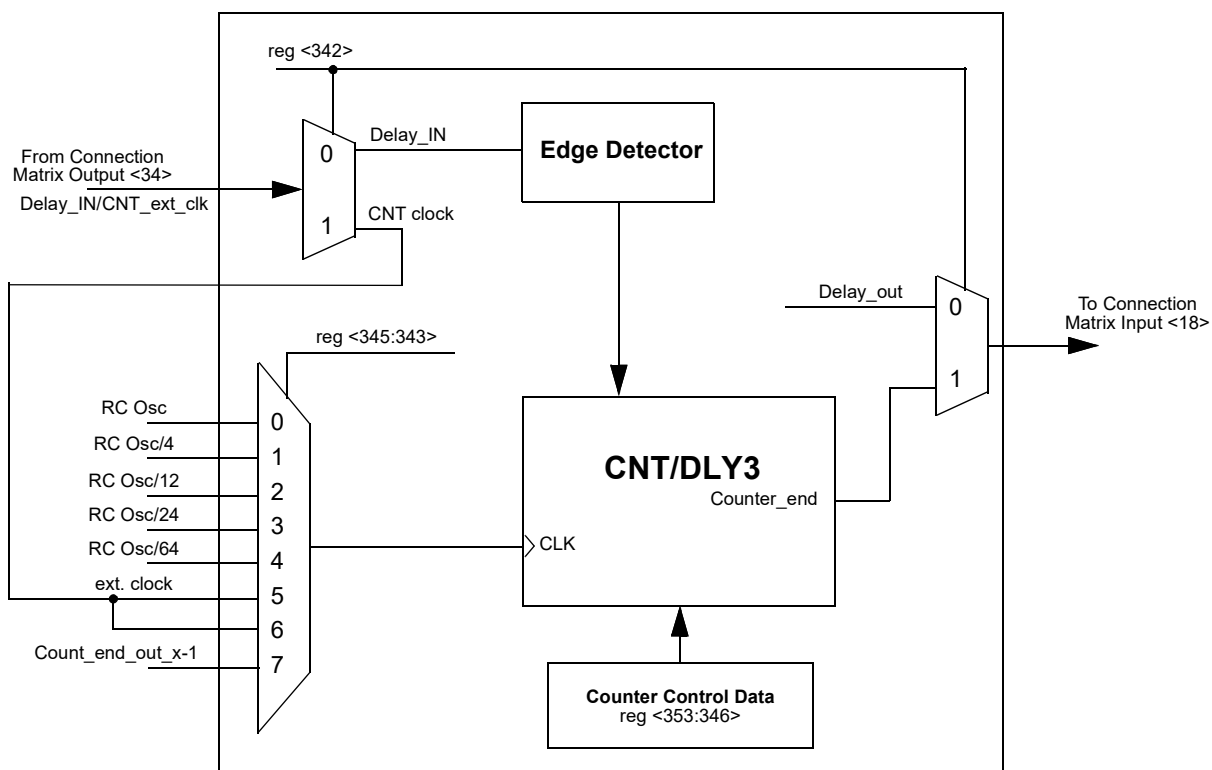


Figure 34. CNT/DLY3

## 12.1 CNT/DLY0 Register Settings

**Table 38. CNT/DLY0 Register Settings**

| Signal Function                                                              | Register Bit Address | Register Definition                                                                                                                                                                                                                                                                  |
|------------------------------------------------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Counter/Delay0 Mode Select                                                   | reg <314>            | 0: Delay Mode<br>1: Counter Mode                                                                                                                                                                                                                                                     |
| Counter/Delay0 Clock Source Select (external clock is only for counter mode) | reg <317:315>        | 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                                                                                                                                 |
| Counter0 Control Data/Delay0 Time Control                                    | reg <325:318>        | 1-255: (delay time = (counter data + 2 + variable)/freq), where 0 < variable < 1                                                                                                                                                                                                     |
| Delay0 Mode Select or asynchronous counter reset                             | reg <327:326>        | 00: Delay on both falling and rising edgeless 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 |

## 12.2 CNT/DLY1 Register Settings

**Table 39. CNT/DLY1 Register Settings**

| Signal Function                                                              | Register Bit Address | Register Definition                                                                                                                                                                                                                                                                  |
|------------------------------------------------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Counter/Delay1 Mode Select                                                   | reg <328>            | 0: Delay Mode<br>1: Counter Mode                                                                                                                                                                                                                                                     |
| Counter/Delay1 Clock Source Select (external clock is only for counter mode) | reg <331:329>        | 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 <339:332>        | 1-255: (delay time = (counter data + 2 + variable)/freq), where 0 < variable < 1                                                                                                                                                                                                     |
| Delay1 Mode Select or asynchronous counter reset                             | reg <341:340>        | 00: Delay on both falling and rising edgeless 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 |

## 12.3 CNT/DLY3 Register Settings

**Table 40. CNT/DLY3 Register Settings**

| Signal Function                                                                 | Register Bit Address | Register Definition                                                                                                                                             |
|---------------------------------------------------------------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Counter/Delay3 Mode Select                                                      | reg <342>            | 0: Delay Mode<br>1: Counter Mode                                                                                                                                |
| Counter/Delay3 Clock Source Select<br>(external clock is only for counter mode) | reg <345:343>        | 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            |
| Counter3 Control Data/Delay3 Time Control                                       | reg <353:346>        | 1-255: (delay time = (counter data + 2 + variable)/freq),<br>where 0 < variable < 1                                                                             |
| Delay3 Mode Select                                                              | reg <355:354>        | 00: Delay on both falling and rising edges<br>01: Delay on falling edge only<br>10: Delay on rising edge only<br>11: No delay on either falling or rising edges |

## 13.0 Programmable Delay / Edge Detector or Deglitch Filter (Part of Combination Macrocells)

### 13.1 Programmable Delay / Edge Detector

The SLG46127 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.*

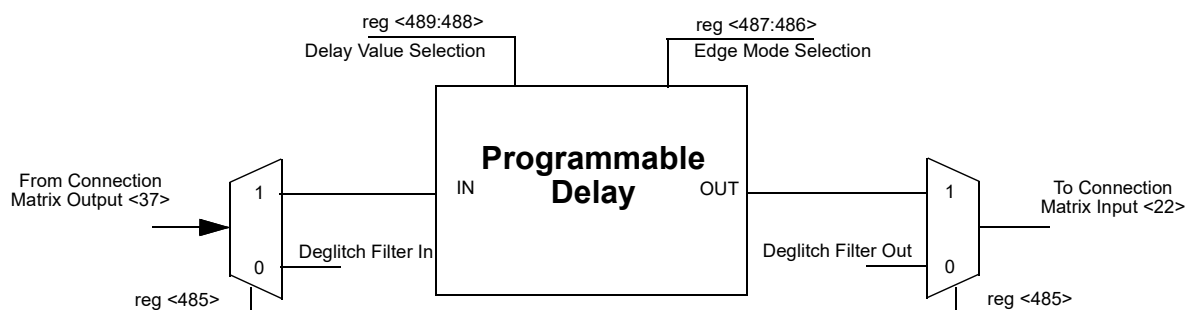


Figure 35. Programmable Delay

#### 13.1.1 Programmable Delay Timing Diagram - Edge Detector Output

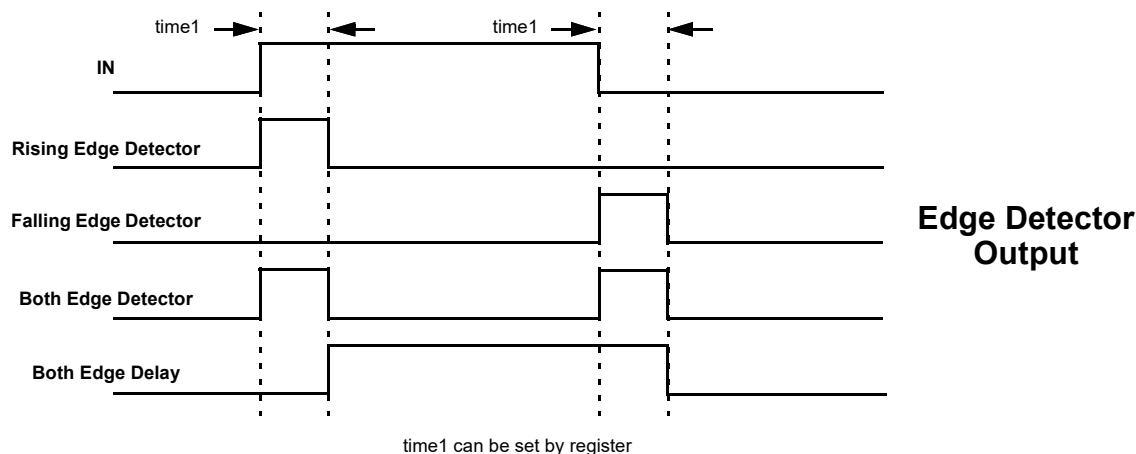


Figure 36. Edge Detector Output



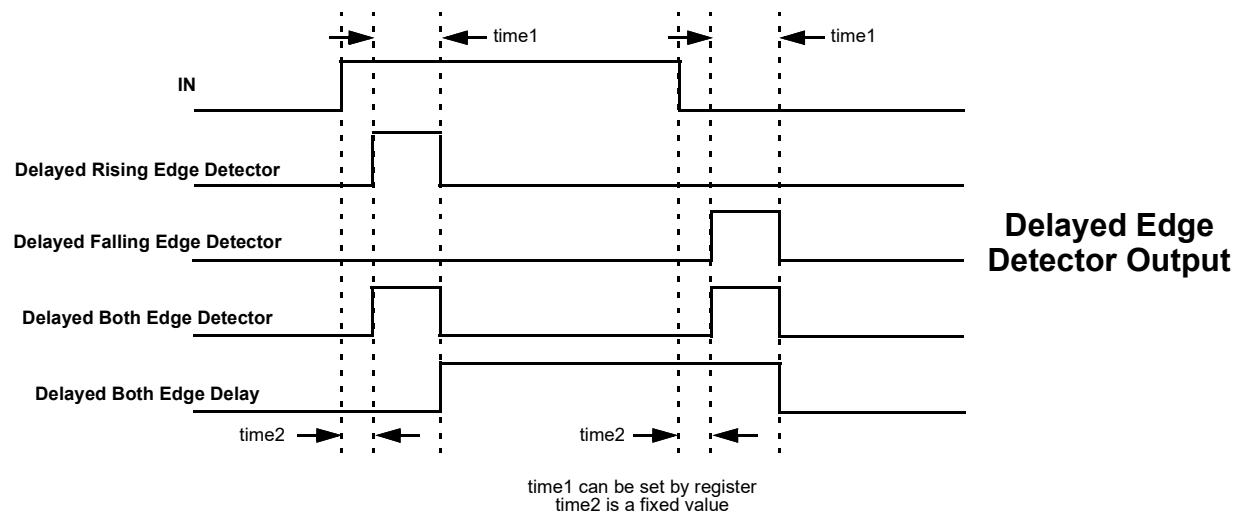


Figure 37. Delayed Edge Detector Output

Note: For delays and widths refer to Table 4.

## 13.1.2 Programmable Delay Register Settings

**Table 41. Programmable Delay Register Settings**

| Signal Function                                                                                          | Register Bit Address | Register Definition                                                                                    |
|----------------------------------------------------------------------------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------|
| Programmable delay or filter output select                                                               | reg <485>            | 0: programmable delay output<br>1: filter output                                                       |
| Select the edge mode of programmable delay & edge detector                                               | reg <487:486>        | 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 ( $V_{DD} = 3.3\text{ V}$ , typical condition) | reg <489:488>        | 00: 125 ns<br>01: 250 ns<br>10: 375 ns<br>11: 500 ns                                                   |

### 13.2 Deglitch Filter

The SLG46127 has an additional logic function that is connected directly to the Connection Matrix inputs and outputs. There is one deglitch filter.

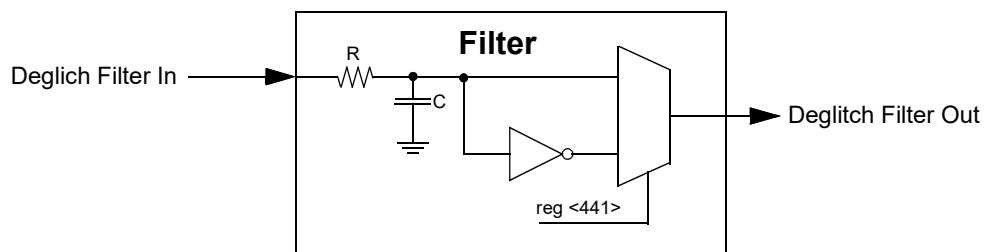


Figure 38. Deglitch Filter

## 14.0 Voltage Reference (VREF)

### 14.1 Voltage Reference Overview

The SLG46127 has a Voltage Reference Macrocell to provide references to the two 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 PIN1. The macrocell also has the option to output reference voltages on PIN10. See table below for the available selections for each analog comparator. Also see *Figure 39.* below, which shows the reference output structure.

### 14.2 VREF Selection Table

Table 42. VREF Selection Table.

| SEL<4:0> | ACMP0_VREF       | ACMP1_VREF       |
|----------|------------------|------------------|
| 11010    | ext. Vref (PIN1) | ext. Vref (PIN1) |
| 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         | Do not operate above 1.1 V |

### 14.3 VREF Block Diagram

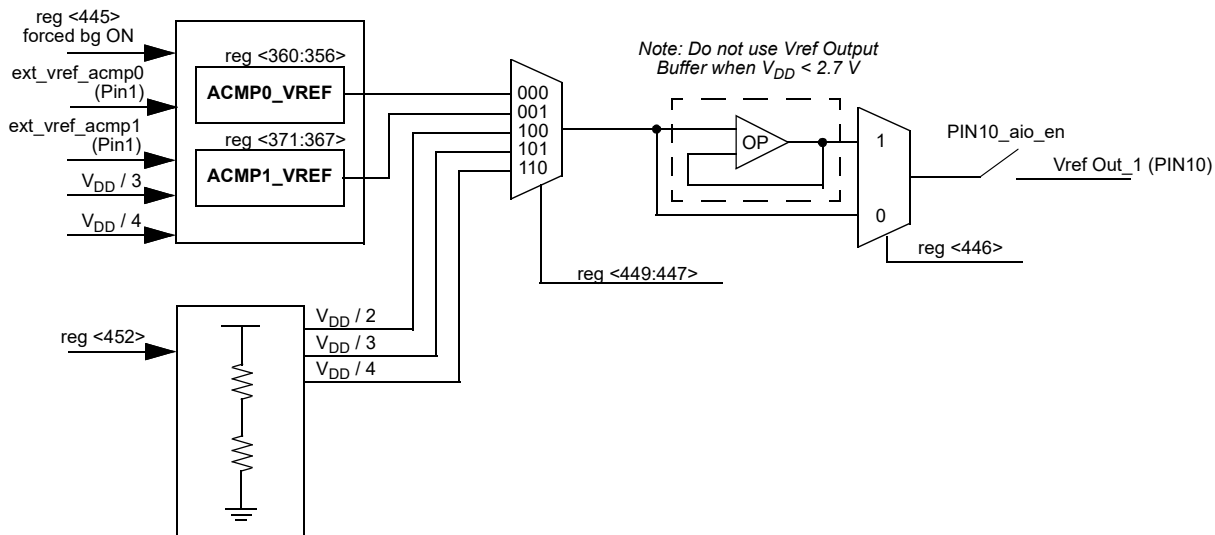


Figure 39. Voltage Reference Block Diagram

## 15.0 RC Oscillator (RC Osc)

### 15.1 RC Oscillator Overview

The SLG46127 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 40.* and *Figure 41.* show maximum power on delay vs.  $V_{DD}$ .

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

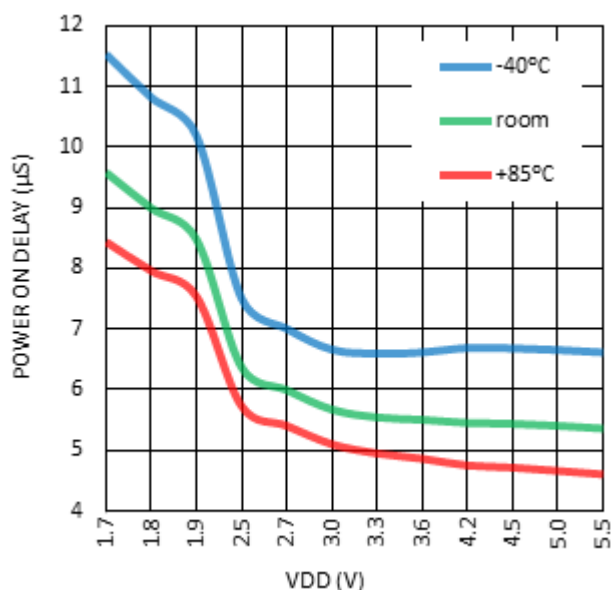


Figure 40. Maximum Power On Delay vs.  $V_{DD}$ , RC OSC = 2 MHz.

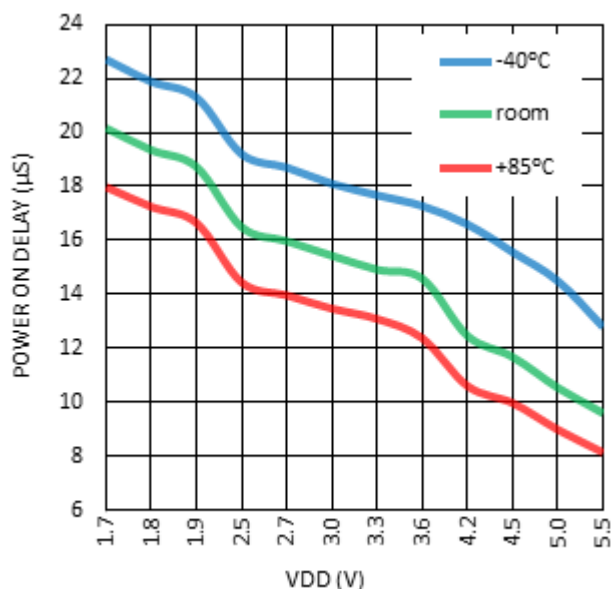


Figure 41. Maximum Power On Delay vs.  $V_{DD}$ , RC OSC = 25 kHz.

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 (PIN11). 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 five different frequencies on Connection Matrix Input lines <23>, and <24>. See *Figure 42.* 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.

## 15.2 RC OSC Block Diagram

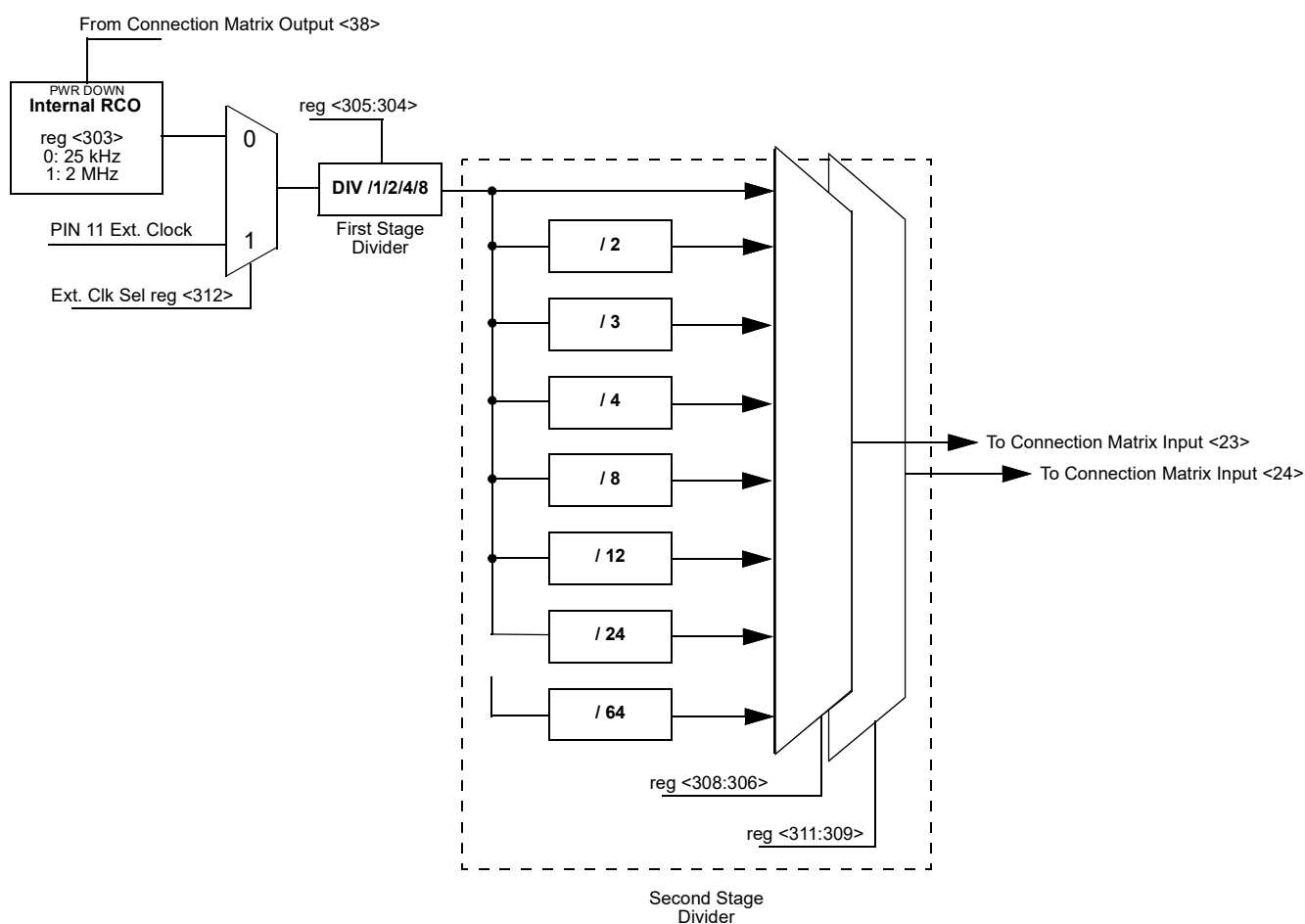


Figure 42. RC OSC Block Diagram

## 16.0 Power On Reset (POR)

The SLG46127 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.

### 16.1 General Operation

The SLG46127 is guaranteed to be powered down and nonoperational when the  $V_{DD}$  voltage (on PIN12) 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 SLG46127, 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 SLG46127 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 SLG46127 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.



## 16.2 POR Sequence

The POR system generates a sequence of signals that enable certain macrocells. The sequence is shown in *Figure 43*.

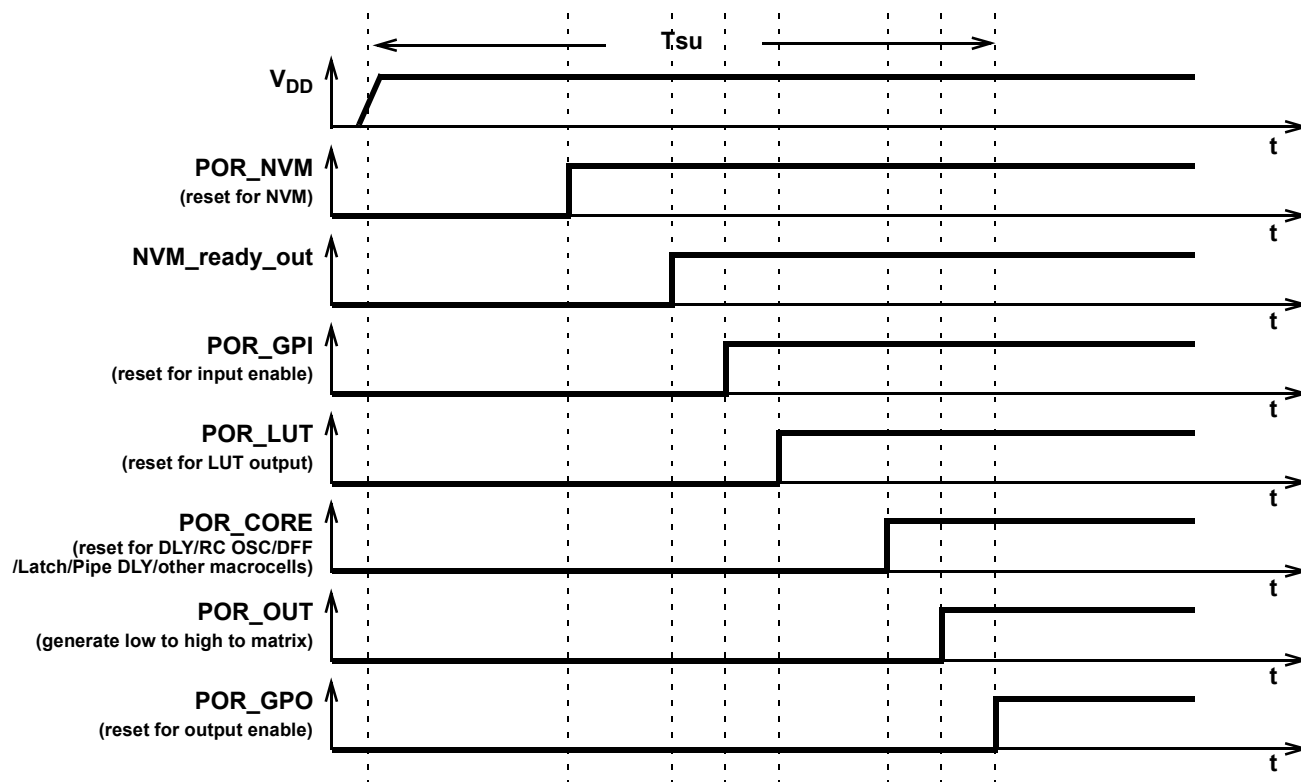


Figure 43. POR sequence

As can be seen from *Figure 43*, 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).

### 16.3 Macrocells Output States During POR Sequence

To have a full picture of SLG46127 operation during powering and POR sequence, review the overview the macrocell output states during the POR sequence (*Figure 44.* 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.

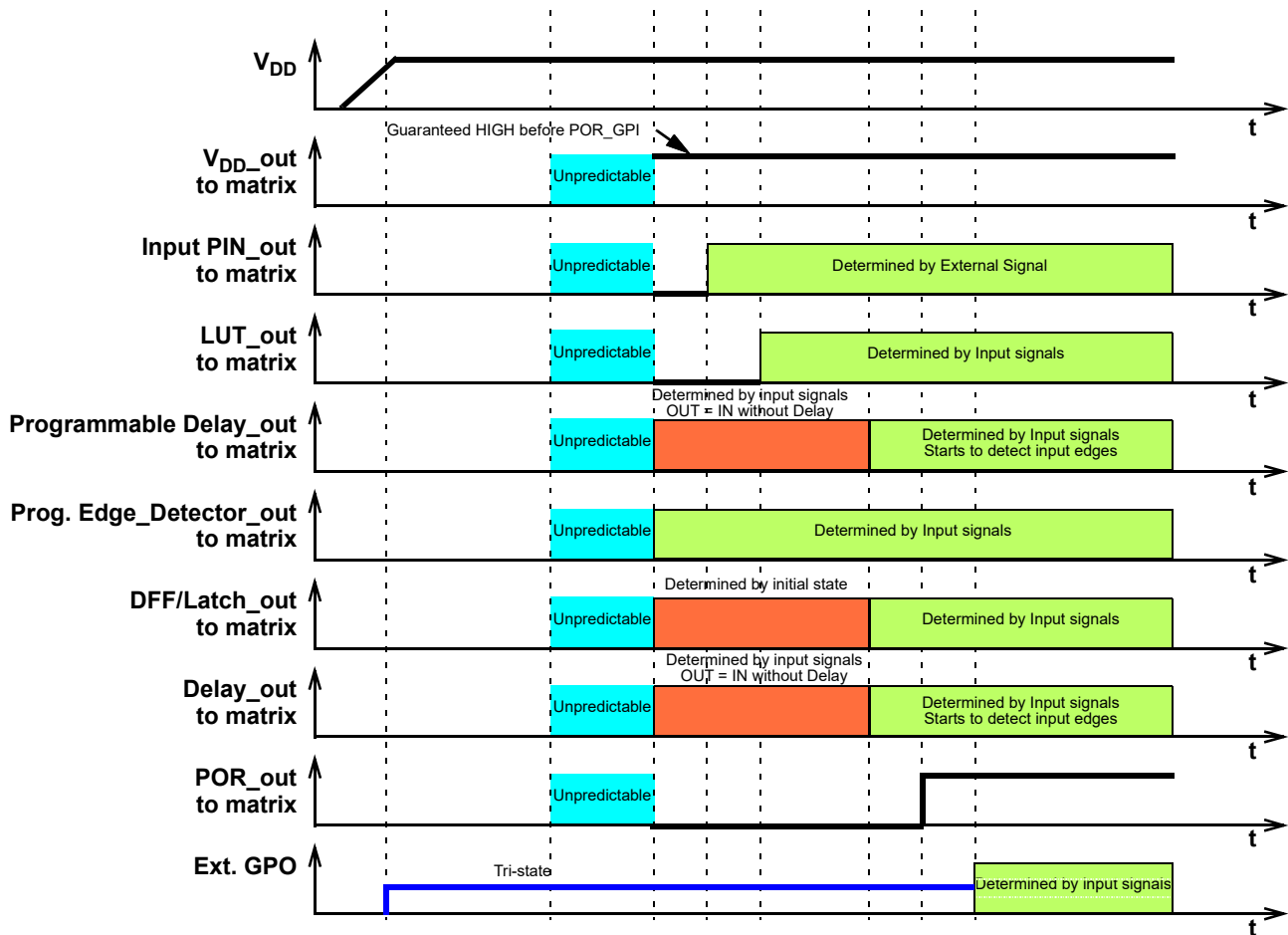


Figure 44. Internal Macrocell States during POR sequence

## 17.0 Dual, 2A P-FET Power Switches

### 17.1 Power Switches Overview

The SLG46127 has a dual-channel, 44 mΩ PMOS power switch designed to switch 1.71 to 5.5 V power rails up to 2 A per channel.

Each P-FET Power Switch can be controlled internally via the ONx digital input of the P-FET Power Switch component in GreenPAK Designer, allowing the user to generate integrated mixed-signal control circuits, or externally via PWR\_SW\_ONx.

Whether controlled externally or internally, a low signal on either ONx or PWR\_SW\_ONx will close the P-FET Power Switch.

Each P-FET Power Switch need not be used in the same voltage domain as  $V_{DD}$ . However, when  $V_{IN}$  is not tied to  $V_{DD}$ , using a large pull-up resistor on PWR\_SW\_ON0 and PWR\_SW\_ON1 is recommended to prevent current from flowing through the P-FET Power Switch while the device is not powered.

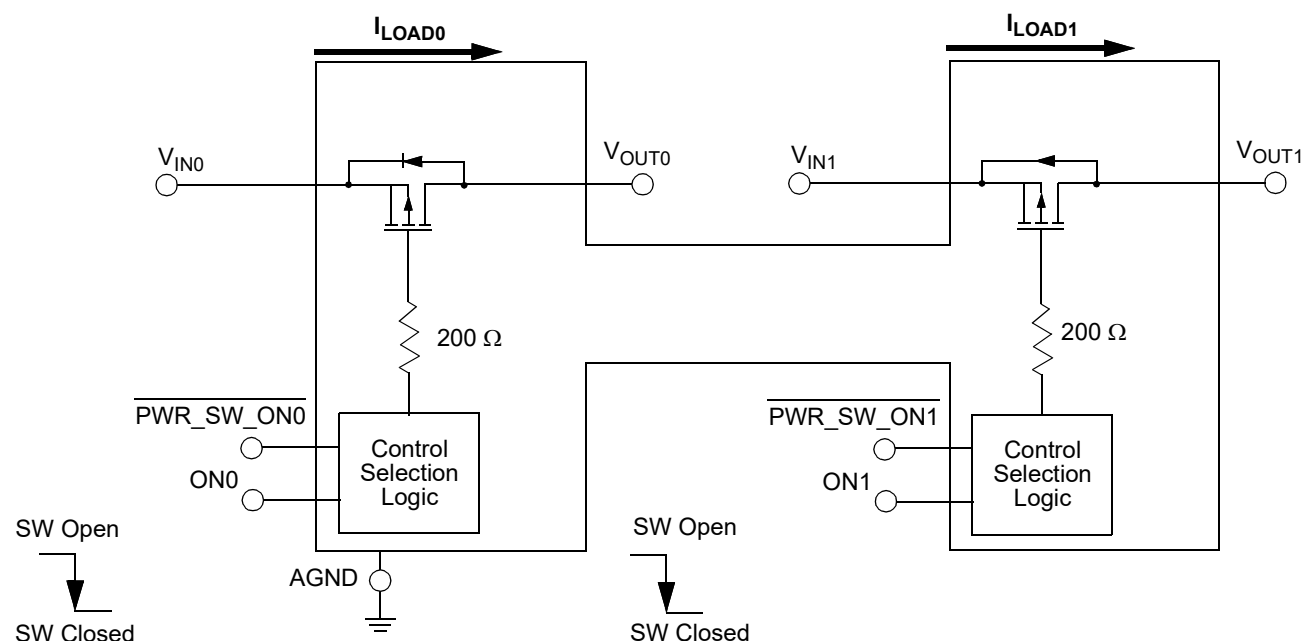
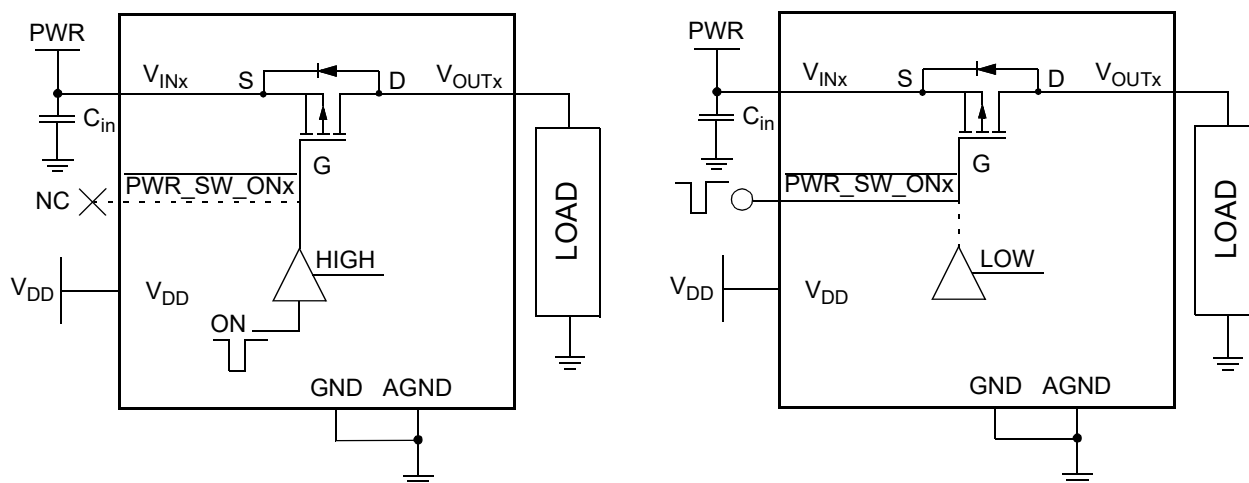


Figure 45. Dual P-FET Power Switch

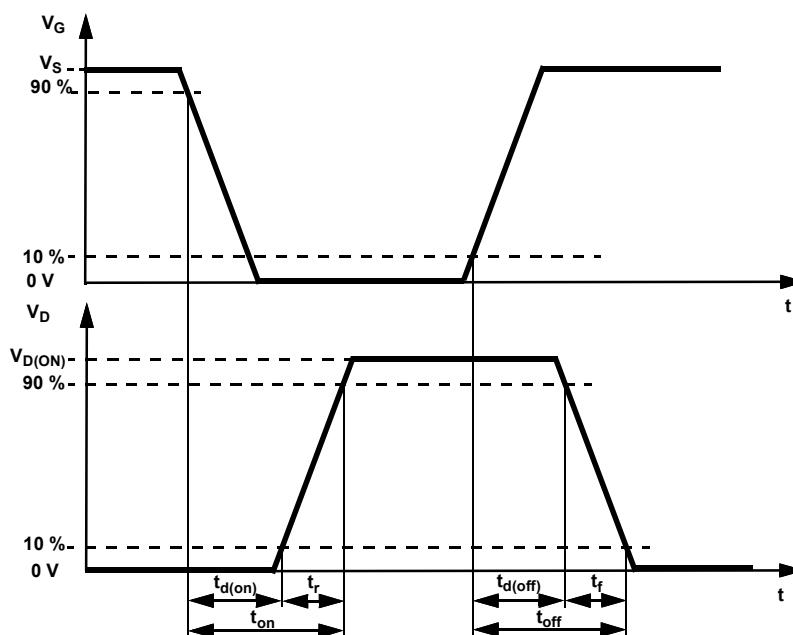
## 17.2 Driving the P-FET Switch

Gate of P-FET power switch can be driven by either internally generated signal or directly by external source connected to corresponding PWR\_SW\_ONx pin. Simplified circuit topologies are illustrated on *Figure 46*.



**Figure 46. Typical Circuit Topology for Internal (left) and External (right) drive modes**

Datasheet values for switching times are given for driving the resistive loads. The definitions of rise ( $t_r$ ), fall ( $t_f$ ) and delay times ( $t_{d(on)}$  and  $t_{d(off)}$ ) are given on *Figure 47*. To achieve highest switching performance circuit should be laid off using high speed PCB layout techniques.



**Figure 47. Definitions for Rise, Fall and Switching Delay Times**

Typical resistive switching waveforms are given on *Figure 49.* and *Figure 50.* Note that fall time is dependent on load current (see section 17.4 *Power Switch Typical Performance*). At low loads turn off process can be delayed, therefore discharge circuit should be provided to reduce load turn off time in that case.

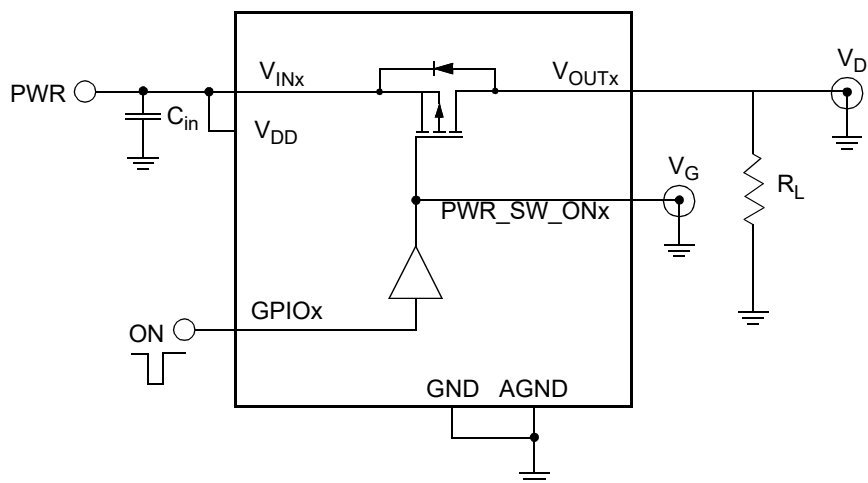


Figure 48. Test Circuit for Typical Switching Waveforms

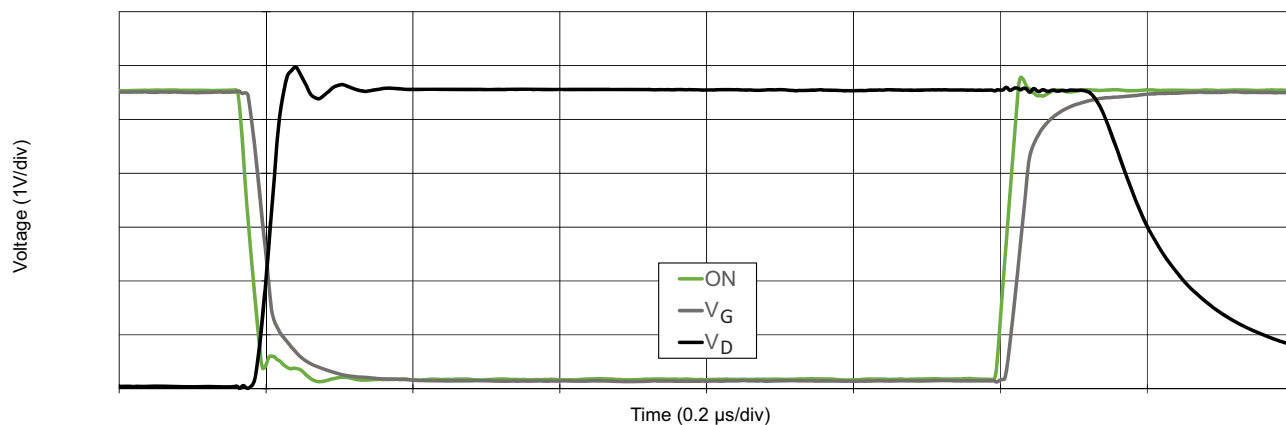


Figure 49. Typical Switching Waveforms (Internal Drive, Resistive Load,  $R_L = 100 \Omega$ ,  $V_{DD} = V_{IN} = 5.5 \text{ V}$ )

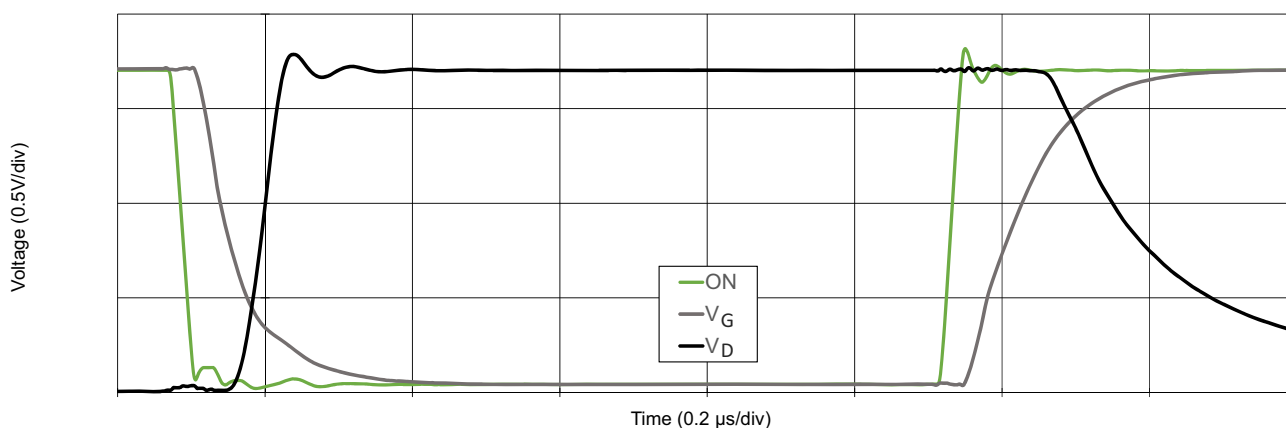


Figure 50. Typical Switching Waveforms (Internal Drive, Resistive Load,  $R_L = 100 \Omega$ ,  $V_{DD} = V_{IN} = 1.71 \text{ V}$ )

## 17.3 Power Dissipation

The junction temperature of the Power Switch depends on factors such as board layout, ambient temperature, external air flow over the package, load current, and the  $R_{DS_{ON}}$ -generated voltage drop across each power MOSFET. While the primary contributor to the increase in the junction temperature of the Power Switch is the power dissipation of its power MOSFETs, its power dissipation and the junction temperature in nominal operating mode can be calculated using the following equations:

$$PD_{TOTAL} = (R_{DS_{ON0}} \times I_{OUT0}^2) + (R_{DS_{ON1}} \times I_{OUT1}^2)$$

where:

$PD_{TOTAL}$  = Total package power dissipation, in Watts (W)

$R_{DS_{ON}}$  = Channel 0 and Channel 1 Power MOSFET ON resistance, in Ohms ( $\Omega$ ), respectively

$I_{OUT}$  = Channel 0 and Channel 1 Output current, in Amps (A), respectively

and

$$T_J = PD_{TOTAL} \times \Theta_{JA} + T_A$$

where:

$T_J$  = Die junction temperature, in Celsius degrees ( $^{\circ}\text{C}$ )

$\Theta_{JA}$  = Package thermal resistance, in Celsius degrees per Watt ( $^{\circ}\text{C}/\text{W}$ ) – highly dependent on pcb layout

$T_A$  = Ambient temperature, in Celsius degrees ( $^{\circ}\text{C}$ )

In nominal operating mode, the Power Switch power dissipation can also be calculated by taking into account the voltage drop across each switch ( $V_{INx}-V_{OUTx}$ ) and the magnitude of that channel's output current ( $I_{OUTx}$ ):

$$PD_{TOTAL} = [(V_{IN0}-V_{OUT0}) \times I_{OUT0}] + [(V_{IN1}-V_{OUT1}) \times I_{OUT1}] \text{ or}$$

$$PD_{TOTAL} = [(V_{IN0} - (R_{LOAD0} \times I_{OUT0})) \times I_{OUT0}] + [(V_{IN1} - (R_{LOAD1} \times I_{OUT1})) \times I_{OUT1}]$$

where:

$PD_{TOTAL}$  = Total package power dissipation, in Watts (W)

$V_{IN}$  = Channel 0 and Channel 1 Input Voltage, in Volts (V), respectively

$R_{LOAD}$  = Channel 0 and Channel 1 Output Load Resistance, in Ohms ( $\Omega$ ), respectively

$I_{OUT}$  = Channel 0 and Channel 1 output current, in Amps (A), respectively

$V_{OUT}$  = Channel 0 and Channel 1 output voltage, or  $R_{LOAD} \times I_{OUT}$ , respectively

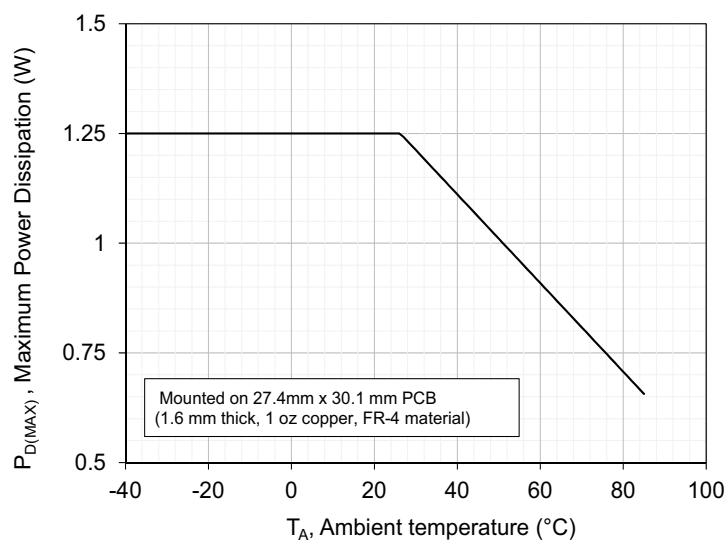


Figure 51. Power Dissipation Derating Curve

# 17.4 Power Switch Typical Performance

$T_A = 25\text{ }^{\circ}\text{C}$ ,  $V_{DD} = 5.5\text{ V}$ , unless otherwise noted.

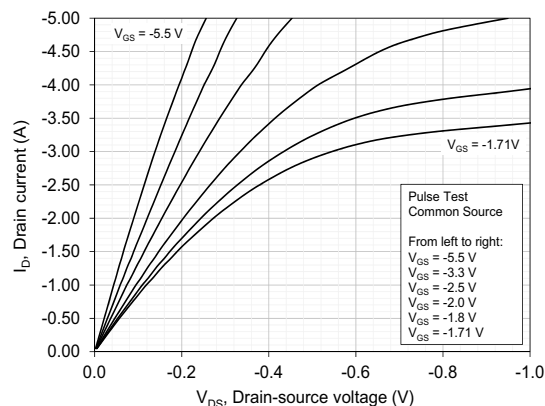


Figure 52. Typical Output Characteristics

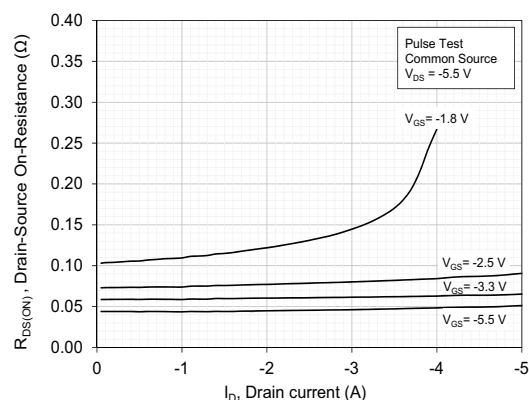


Figure 53. Drain-Source On-Resistance vs. Drain Current

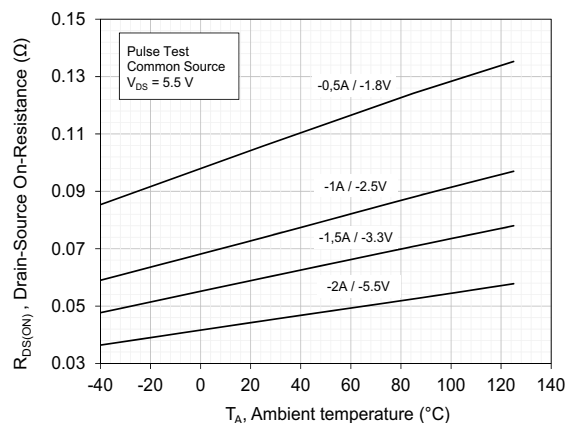


Figure 54. Typical Drain-Source On-Resistance vs. Ambient Temperature

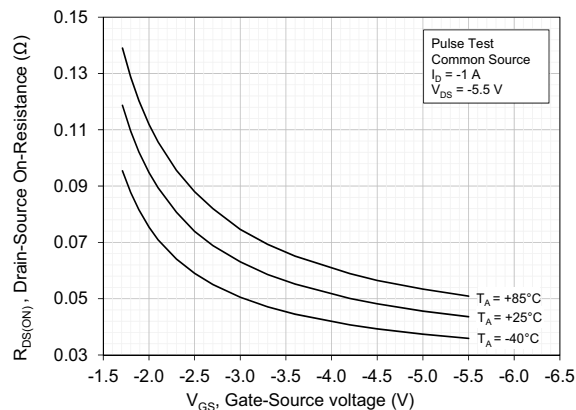


Figure 55. Gate-Source On-Resistance Gate-Source Voltage



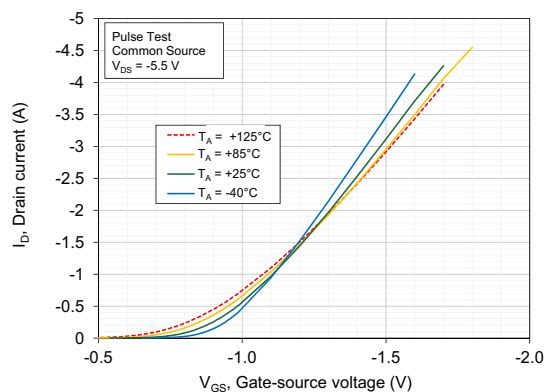


Figure 56. Drain Current vs. Gate-Source Voltage

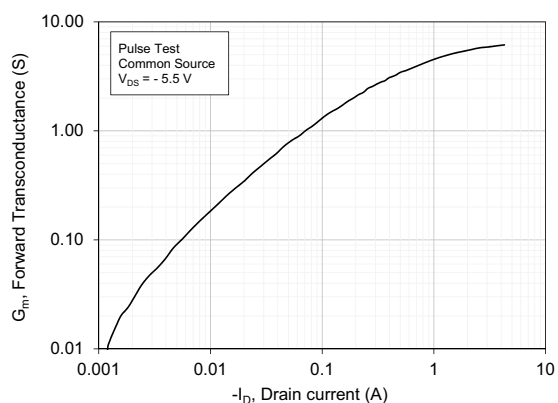


Figure 57. Typical Forward Transconductance

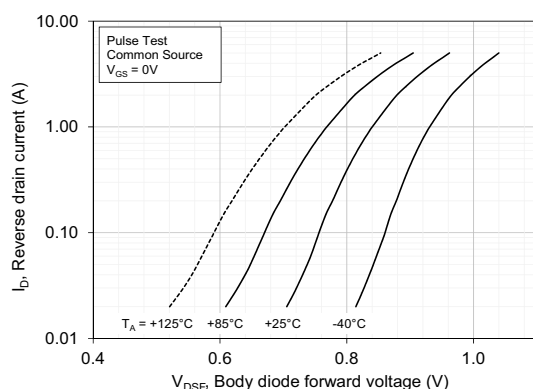


Figure 58. Typical Drain-Source Diode Forward Voltage

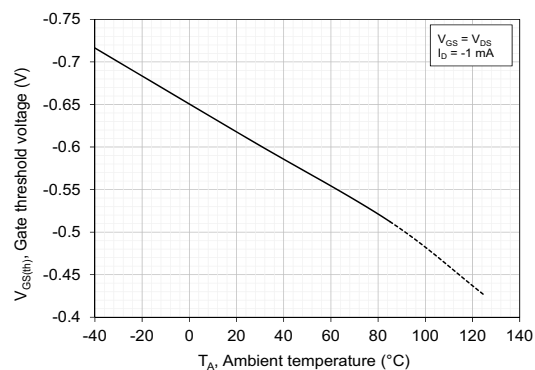


Figure 59. Gate Threshold Voltage vs. Ambient Temperature

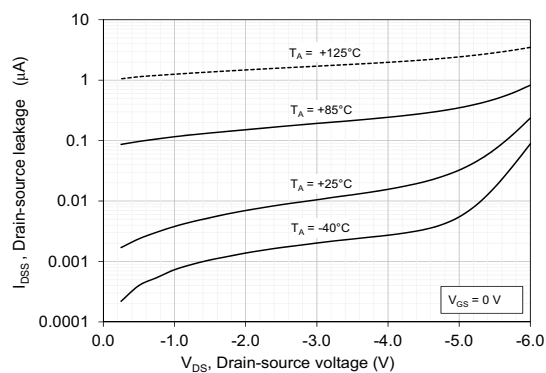


Figure 60. Zero Gate Voltage Drain Current

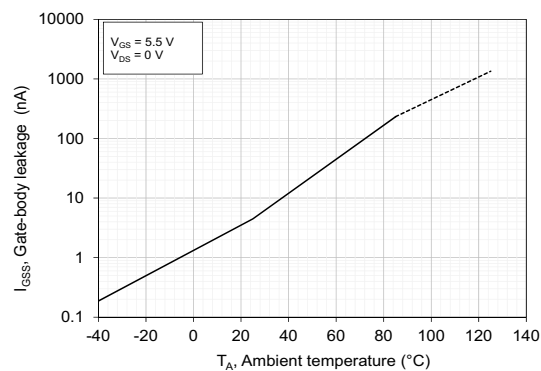


Figure 61. Gate-Body Leakage vs. Ambient Temperature

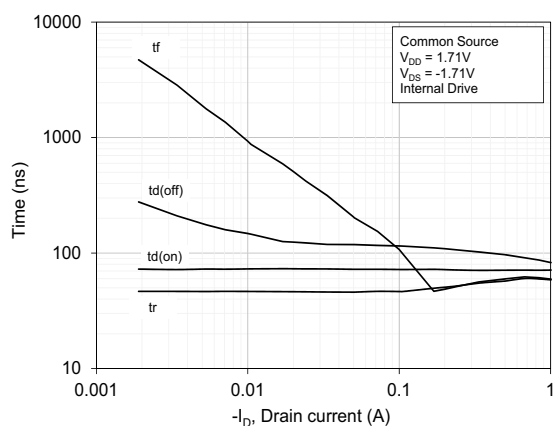


Figure 62. Typical Switching Time (Internal Gate Drive) at  $V_{DS} = 1.71 \text{ V}$

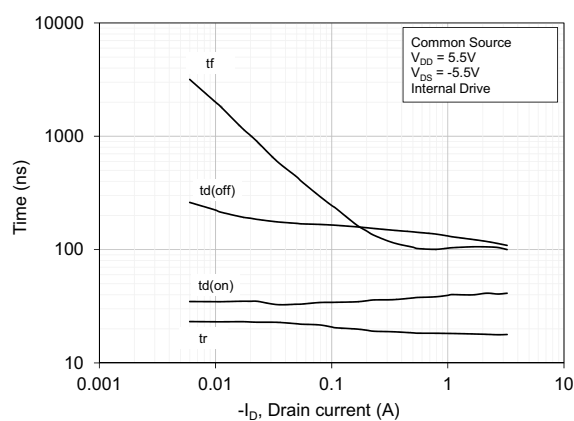


Figure 63. Typical Switching Time (Internal Gate Drive) at  $V_{DS} = 5.5 \text{ V}$

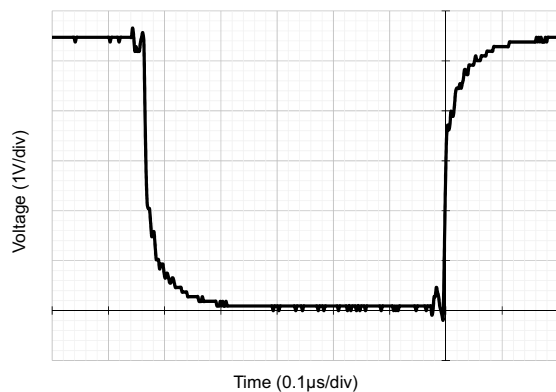


Figure 64. Typical Gate Input Waveform, Internal Gate Drive Source (Switching Time Test)

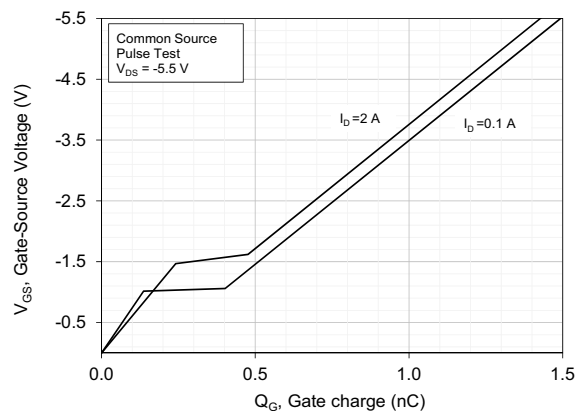


Figure 65. Typical Gate Charge vs. Gate-Source Voltage

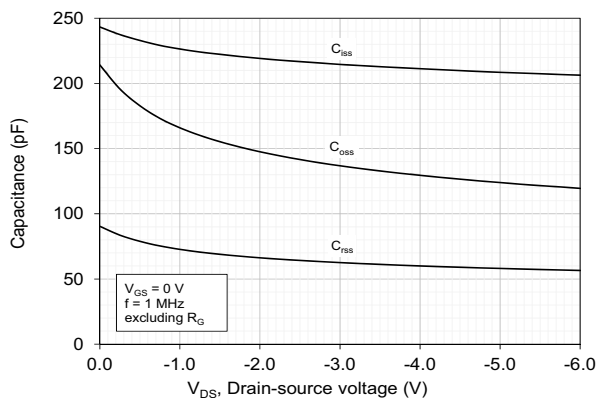


Figure 66. Typical Capacitance vs. Drain-Source Voltage

**18.0 Appendix A - SLG46127 Register Definition**

| Register Bit Address | Signal Function                                                             | Register Bit Definition |
|----------------------|-----------------------------------------------------------------------------|-------------------------|
| reg <4:0>            | Matrix Out: PIN14 Digital Output Source                                     |                         |
| reg <9:5>            | Matrix Out: PIN1 Digital Output Source                                      |                         |
| reg <14:10>          | Matrix Out: PIN2 Digital Output Source                                      |                         |
| reg <19:15>          | Matrix Out: Output Enable of PIN2                                           |                         |
| reg <24:20>          | Matrix Out: In0 of 2-bit LUT0 or Clock Input of DFF0                        |                         |
| reg <29:25>          | Matrix Out: In1 of 2-bit LUT0 or Data Input of DFF0                         |                         |
| reg <34:30>          | Matrix Out: In0 of 2-bit LUT1 or Clock Input of DFF1                        |                         |
| reg <39:35>          | Matrix Out: In1 of 2-bit LUT1 or Data Input of DFF1                         |                         |
| reg <44:40>          | Matrix Out: In0 of 2-bit LUT2                                               |                         |
| reg <49:45>          | Matrix Out: In1 of 2-bit LUT2                                               |                         |
| reg <54:50>          | Matrix Out: In0 of 2-bit LUT3                                               |                         |
| reg <59:55>          | Matrix Out: In1 of 2-bit LUT3                                               |                         |
| reg <64:60>          | Matrix Out: In0 of 3-bit LUT0 or Clock Input of DFF2                        |                         |
| reg <69:65>          | Matrix Out: In1 of 3-bit LUT0 or Data Input of DFF2                         |                         |
| reg <74:70>          | Matrix Out: In2 of 3-bit LUT0 or nRST Input of DFF2                         |                         |
| reg <79:75>          | Matrix Out: In0 of 3-bit LUT1 or Clock Input of DFF3                        |                         |
| reg <84:80>          | Matrix Out: In1 of 3-bit LUT1 or Data Input of DFF3                         |                         |
| reg <89:85>          | Matrix Out: In2 of 3-bit LUT1 or nRST (nSET) of DFF3                        |                         |
| reg <94:90>          | Matrix Out: In0 of 3-bit LUT2                                               |                         |
| reg <99:95>          | Matrix Out: In1 of 3-bit LUT2                                               |                         |
| reg <104:100>        | Matrix Out: In2 of 3-bit LUT2                                               |                         |
| reg <109:105>        | Matrix Out: In0 of 3-bit LUT3                                               |                         |
| reg <114:110>        | Matrix Out: In1 of 3-bit LUT3                                               |                         |
| reg <119:115>        | Matrix Out: In2 of 3-bit LUT3                                               |                         |
| reg <124:120>        | Matrix Out: In0 of 3-bit LUT4 or Input of Pipe Delay                        |                         |
| reg <129:125>        | Matrix Out: In1 of 3-bit LUT4 or nRST of Pipe Delay                         |                         |
| reg <134:130>        | Matrix Out: In2 of 3-bit LUT4 or Clock of Pipe Delay                        |                         |
| reg <139:135>        | Matrix Out: In0 of 4-bit LUT0 or Input for Delay2 (Counter2) external clock |                         |
| reg <144:140>        | Matrix Out: In1 of 4-bit LUT0 or Input for Delay2 data (Counter2 reset)     |                         |
| reg <149:145>        | Matrix Out: In2 of 4-bit LUT0                                               |                         |
| reg <154:150>        | Matrix Out: In3 of 4-bit LUT0                                               |                         |
| reg <159:155>        | Matrix Out: Input for Delay0 data (Counter0 reset)                          |                         |
| reg <164:160>        | Matrix Out: Input for Delay1 data (Counter1 reset)                          |                         |
| reg <169:165>        | Matrix Out: Input for Delay0/1 (Counter0/1) external clock                  |                         |
| reg <174:170>        | Matrix Out: Input for Delay3 (Counter3) external clock                      |                         |
| reg <179:175>        | Matrix Out: pdb (power down) for ACMP0                                      |                         |
| reg <184:180>        | Matrix Out: pdb (power down) for ACMP1                                      |                         |
| reg <189:185>        | Matrix Out: Input for programmable Delay (deglitch filter input)            |                         |

| Register Bit Address            | Signal Function                                         | Register Bit Definition                                  |
|---------------------------------|---------------------------------------------------------|----------------------------------------------------------|
| reg <194:190>                   | Matrix Out: Power down for OSC                          |                                                          |
| reg <199:195>                   | Pin15 Digital Output Source and Power Switch ON0 Source |                                                          |
| reg <204:200>                   | Pin16 Digital Output Source and Power Switch ON1 Source |                                                          |
| reg <209:205>                   | Matrix Out: PIN10 Digital Output Source                 |                                                          |
| reg <214:210>                   | Matrix Out: Output Enable of PIN10                      |                                                          |
| reg <219:215>                   | Matrix Out: PIN11 Digital Output Source                 |                                                          |
| reg <223:220>                   | Reserved                                                | Reserved                                                 |
| <b>DFF0/Latch</b>               |                                                         |                                                          |
| reg <227:224>                   | reg <224> DFF0 or Latch select                          | 0: DFF function<br>1: Latch function                     |
|                                 | reg <225> DFF0 output select                            | 0: Q output<br>1: nQ output                              |
|                                 | reg <226> DFF0 initial polarity select                  | 0: Low<br>1: High                                        |
|                                 | reg <227> Unused if DFF/Latch selected                  | Unused                                                   |
| <b>DFF1/Latch</b>               |                                                         |                                                          |
| reg <231:228>                   | reg <228> DFF1 or Latch select                          | 0: DFF function<br>1: Latch function                     |
|                                 | reg <229> DFF1 output select                            | 0: Q output<br>1: nQ output                              |
|                                 | reg <230> DFF1 initial polarity select                  | 0: Low<br>1: High                                        |
|                                 | reg <231> Unused if DFF/Latch selected                  | Unused                                                   |
| <b>2-bit LUT2 data</b>          |                                                         |                                                          |
| reg <235:232>                   | 2-bit LUT2 data                                         | 2-bit LUT2 data                                          |
| <b>2-bit LUT1 data</b>          |                                                         |                                                          |
| reg <239:236>                   | 2-bit LUT1 data                                         | 2-bit LUT1 data                                          |
| <b>2-bit LUT0/DFF0</b>          |                                                         |                                                          |
| reg <240>                       | 2-bit LUT0 or DFF0 select                               | 0: 2-bit LUT0<br>1: DFF0                                 |
| <b>2-bit LUT1/DFF1</b>          |                                                         |                                                          |
| reg <241>                       | 2-bit LUT1 or DFF1 select                               | 0: 2-bit LUT1<br>1: DFF1                                 |
| <b>3-bit LUT0 or DFF2/Latch</b> |                                                         |                                                          |
| reg <249:242>                   | reg <242> DFF2 or Latch select                          | 0: DFF function<br>1: Latch function                     |
|                                 | reg <243> DFF2 output select                            | 0: Q output<br>1: nQ output                              |
|                                 | reg <244> DFF2 nRST/nSET select                         | 0: nRST from matrix output<br>1: nSET from matrix output |
|                                 | reg <245> DFF2 initial polarity select                  | 0: Low<br>1: High                                        |
|                                 | reg <249:246> Unused if DFF/Latch selected              | Unused                                                   |

| Register Bit Address                               | Signal Function                                                | Register Bit Definition                                                                                                                                                                                                                                                           |
|----------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3-bit LUT1 or DFF3/Latch</b>                    |                                                                |                                                                                                                                                                                                                                                                                   |
| reg <257:250>                                      | reg <250> DFF3 or Latch select                                 | 0: DFF function<br>1: Latch function                                                                                                                                                                                                                                              |
|                                                    | reg <251> DFF3 output select                                   | 0: Q output<br>1: nQ output                                                                                                                                                                                                                                                       |
|                                                    | reg <252> DFF3 nRST/nSET select                                | 0: nRST from matrix output<br>1: nSET from matrix output                                                                                                                                                                                                                          |
|                                                    | reg <253> DFF3 initial polarity select                         | 0: Low<br>1: High                                                                                                                                                                                                                                                                 |
|                                                    | reg <257:254> Unused if DFF/Latch selected                     | Unused                                                                                                                                                                                                                                                                            |
| <b>3-bit LUT2 data</b>                             |                                                                |                                                                                                                                                                                                                                                                                   |
| reg <265:258>                                      | 3-bit LUT2 data                                                | 3-bit LUT2 data                                                                                                                                                                                                                                                                   |
| <b>3-bit LUT3 data</b>                             |                                                                |                                                                                                                                                                                                                                                                                   |
| reg <273:266>                                      | 3-bit LUT3 data                                                | 3-bit LUT3 data                                                                                                                                                                                                                                                                   |
| <b>3-bit LUT4 or pipe number select</b>            |                                                                |                                                                                                                                                                                                                                                                                   |
| reg <281:274>                                      | reg <276:274>: OUT0 select                                     | data (pipe number)                                                                                                                                                                                                                                                                |
|                                                    | reg <279:277>: OUT1 select                                     | data (pipe number)                                                                                                                                                                                                                                                                |
|                                                    | reg <281:280>: Unused if Pipe Delay selected                   | Unused                                                                                                                                                                                                                                                                            |
| <b>3-bit LUT0/DFF Select</b>                       |                                                                |                                                                                                                                                                                                                                                                                   |
| reg <282>                                          | 3-bit LUT0 or DFF2 select                                      | 0: 3-bit LUT0<br>1: DFF2                                                                                                                                                                                                                                                          |
| reg <283>                                          | 3-bit LUT1 or DFF3 select                                      | 0: 3-bit LUT1<br>1: DFF3                                                                                                                                                                                                                                                          |
| reg <284>                                          | 3-bit LUT4 or Pipe Delay output select                         | 0: 3-bit LUT4<br>1: Pipe Delay                                                                                                                                                                                                                                                    |
| <b>4-bit LUT0 or Counter/Delay2 mode selection</b> |                                                                |                                                                                                                                                                                                                                                                                   |
| reg <300:285>                                      | reg <285> Counter/Delay2 mode selection                        | 0: Delay Mode<br>1: Counter Mode                                                                                                                                                                                                                                                  |
|                                                    | reg <288:286> 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 <296:289> Counter/Delay2 Control Data                      | 1-255: (delay time = (counter data + 2 + variable)/freq), where 0 < variable < 1                                                                                                                                                                                                  |
|                                                    | reg <298:297> Delay2 Mode Select or asynchronous counter reset | 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: 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 <300:299> Unused is Counter/Delay2 selected                | Unused                                                                                                                                                                                                                                                                            |
| reg <301>                                          | 4-bit LUT0 or Counter2 select 0: 4-bit LUT0, 1: Counter2       | 0: 4-bit LUT0<br>1: Counter2                                                                                                                                                                                                                                                      |

| Register Bit Address   | Signal Function                                                                            | Register Bit Definition                                                                                                                                                                                                                                                                 |
|------------------------|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| reg <302>              | Force RC oscillator on                                                                     | 0: Auto Power on<br>1: Force Power on                                                                                                                                                                                                                                                   |
| reg <303>              | RC Oscillator frequency control                                                            | 0: 25k<br>1: 2M                                                                                                                                                                                                                                                                         |
| reg <305:304>          | Osc clock pre-divider                                                                      | 00: div1<br>01: div2<br>10: div4<br>11: div8                                                                                                                                                                                                                                            |
| reg <308:306>          | Internal Oscillator frequency divider control 0 for Matrix Input                           | 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 <311:309>          | Internal Oscillator frequency divider control 1 for Matrix Input                           | 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 <312>              | External Clock Source Select                                                               | 0: Internal Oscillator<br>1: External Clock from PIN11                                                                                                                                                                                                                                  |
| reg <313>              | Reserved<br>Reserved                                                                       | Reserved                                                                                                                                                                                                                                                                                |
| <b>Counter/Delay 0</b> |                                                                                            |                                                                                                                                                                                                                                                                                         |
| reg <327:314>          | reg <314> Counter/Delay0 mode selection                                                    | 0: Delay Mode<br>1: Counter Mode                                                                                                                                                                                                                                                        |
|                        | reg <317:315> 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 <325:318> Counter0 Control Data/Delay0 Time Control                                    | 1-255: (delay time = (counter data + 2 + variable)/freq), where 0 < variable < 1                                                                                                                                                                                                        |
|                        | reg <327:326> Delay0 Mode Select or asynchronous counter reset                             | 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 |

| Register Bit Address   | Signal Function                                                                            | Register Bit Definition                                                                                                                                                                                                                                                                 |
|------------------------|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Counter/Delay 1</b> |                                                                                            |                                                                                                                                                                                                                                                                                         |
| reg <341:328>          | reg <328> Counter/Delay1 mode selection                                                    | 0: Delay Mode<br>1: Counter Mode                                                                                                                                                                                                                                                        |
|                        | reg <331:329> Counter/Delay1 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: Counter0 Overflow                                                                                                                                    |
|                        | reg <339:332> Counter1 Control Data/Delay1 Time Control                                    | 1-255: (delay time = (counter data + 2 + variable)/freq), where 0 < variable < 1                                                                                                                                                                                                        |
|                        | reg <341:340> Delay1 Mode Select or asynchronous counter reset                             | 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 |
| <b>Counter/Delay 3</b> |                                                                                            |                                                                                                                                                                                                                                                                                         |
| reg <355:342>          | reg <342> Counter/Delay3 mode selection                                                    | 0: Delay Mode<br>1: Counter Mode                                                                                                                                                                                                                                                        |
|                        | reg <345:343> Counter/Delay3 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: Counter2 Overflow                                                                                                                                    |
|                        | reg <353:346> Counter3 Control Data/Delay4 Time Control                                    | 1-255: (delay time = (counter data + 2 + variable)/freq), where 0 < variable < 1                                                                                                                                                                                                        |
|                        | reg <355:354> Delay3 Mode Select                                                           | 00: Delay on both falling and rising edges<br>01: Delay on falling edge only<br>10: Delay on rising edge only<br>11: No Delay on either falling or rising edges                                                                                                                         |



| Register Bit Address | Signal Function                                                 | Register Bit Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------|-----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ACMP0</b>         |                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| reg <366:356>        | reg <360:356> 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(PIN1) |
|                      | reg <362:361> ACMP0 hysteresis Enable                           | 00: Disabled (0 mV)<br>01: Enabled (25 mV)<br>10: Enabled (50 mV)<br>11: Enabled (200 mV)                                                                                                                                                                                                                                                                                                                                                                                        |
|                      | reg <364:363> ACMP0 positive Input divider                      | 00: 1.0x<br>01: 0.5x<br>10: 0.33x<br>11: 0.25x                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                      | reg <365> ACMP0 low bandwidth (typ: Max.1 MHz) enable           | 0: off<br>1: on                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                      | reg <366> ACMP0 positive input source select PIN14 and $V_{DD}$ | 0: PIN14<br>1: $V_{DD}$                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

| Register Bit Address | Signal Function                                             | Register Bit Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ACMP1</b>         |                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| reg <378:367>        | reg <371:367> 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(PIN1) |
|                      | reg <373:372> ACMP1 hysteresis Enable                       | 00: Disabled (0 mV)<br>01: Enabled (25 mV)<br>10: Enabled (50 mV)<br>11: Enabled (200 mV)                                                                                                                                                                                                                                                                                                                                                                                        |
|                      | reg <375:374> ACMP1 positive Input divider                  | 00: 1.0x<br>01: 0.5x<br>10: 0.33x<br>11: 0.25x                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                      | reg <376> ACMP1 100uA current source option                 | 0: disable<br>1: enable                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                      | reg <377> ACMP1 low bandwidth (typ: Max.1 MHz) enable       | 0: off<br>1: on                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                      | reg <378> ACMP1 positive input source select PIN2 and PIN14 | 0: PIN2<br>1: PIN14                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>PIN 1</b>         |                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| reg <396:390>        | reg <392:390> PIN1 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: Analog Input / Output & Open drain                                                                                                                                                                                                               |
|                      | reg <394:393> PIN1 pull up/down resistor value selection    | 00: floating<br>01: 10K<br>10: 100K<br>11: 1M                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                      | reg <395> PIN1 pull up/down resistor select                 | 0: pull down resistor enable<br>1: pull up resistor enable                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                      | reg <396> PIN1 driver strength selection                    | 0: 1X<br>1: 2X                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

| Register Bit Address | Signal Function                                           | Register Bit Definition                                                                                                                                                                                                     |
|----------------------|-----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PIN2</b>          |                                                           |                                                                                                                                                                                                                             |
| reg <403:397>        | reg <398:397> PIN2 mode control (sig_PIN2_oe =0)          | 00: Digital Input without Schmitt trigger<br>01: Digital Input with Schmitt trigger<br>11: Low Voltage Digital Input<br>10: Analog Input / Output                                                                           |
|                      | reg <400:399> PIN2 mode control (sig_PIN2_oe =1)          | 00: Push Pull 1X<br>01: Push Pull 2X<br>10: Open Drain NMOS 1X<br>11: Open Drain NMOS 2X                                                                                                                                    |
|                      | reg <402:401> PIN2 pull up/down resistor value selection  | 00: floating<br>01: 10K<br>10: 100K<br>11: 1M                                                                                                                                                                               |
|                      | reg <403> PIN2 pull up/down resistor select               | 0: pull down resistor enable<br>1: pull up resistor enable                                                                                                                                                                  |
| <b>PIN10</b>         |                                                           |                                                                                                                                                                                                                             |
| reg <424:418>        | reg <419:418> PIN10 mode control (sig_PIN10_oe =0)        | 00: Digital Input without Schmitt trigger<br>01: Digital Input with Schmitt trigger<br>11: Low Voltage Digital Input<br>10: Analog Input / Output                                                                           |
|                      | reg <421:420> 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 <423:422> PIN10 pull up/down resistor value selection | 00: floating<br>01: 10K<br>10: 100K<br>11: 1M                                                                                                                                                                               |
|                      | reg <424> PIN10 pull up/down resistor select              | 0: pull down resistor enable<br>1: pull up resistor enable                                                                                                                                                                  |
| <b>PIN11</b>         |                                                           |                                                                                                                                                                                                                             |
| reg <431:425>        | reg <427:425> 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: Reserved |
|                      | reg <429:428> PIN11 pull up/down resistor value selection | 00: floating<br>01: 10K<br>10: 100K<br>11: 1M                                                                                                                                                                               |
|                      | reg <430> PIN11 pull up/down resistor select              | 0: pull down resistor enable<br>1: pull up resistor enable                                                                                                                                                                  |
|                      | reg <431> PIN11 driver strength selection                 | 0: 1X<br>1: 2X                                                                                                                                                                                                              |

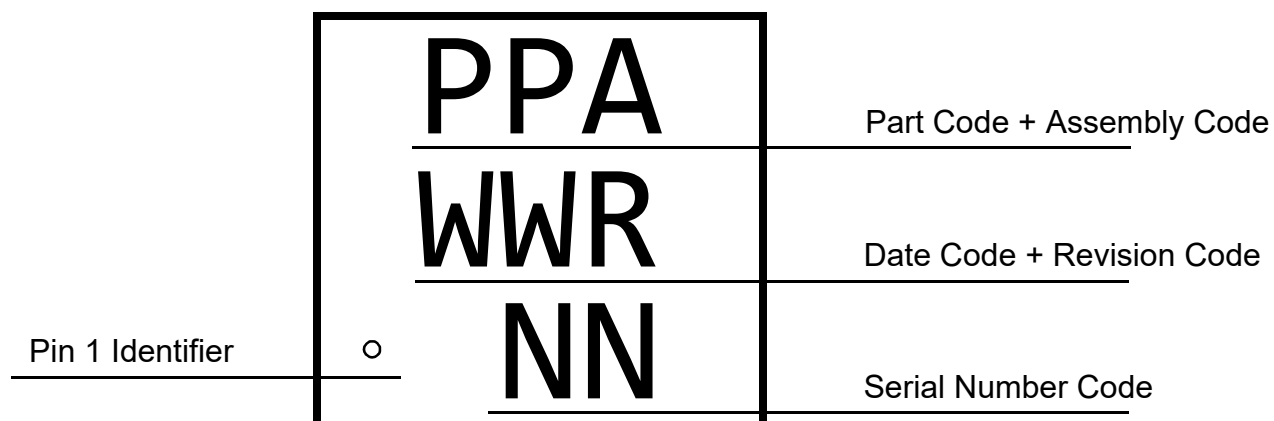
| Register Bit Address | Signal Function                                           | Register Bit Definition                                                                                                                                                                                                                                            |
|----------------------|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PIN 13</b>        |                                                           |                                                                                                                                                                                                                                                                    |
| reg <382:379>        | reg <380:379> PIN13 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 <382:381> PIN13 pull down resistor value selection    | 00: floating<br>01: 10K<br>10: 100K<br>11: 1M                                                                                                                                                                                                                      |
| <b>PIN 14</b>        |                                                           |                                                                                                                                                                                                                                                                    |
| reg <389:383>        | reg <385:383> PIN14 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: Analog Input / Output & Open drain |
|                      | reg <387:386> PIN14 pull up/down resistor value selection | 00: floating<br>01: 10K<br>10: 100K<br>11: 1M                                                                                                                                                                                                                      |
|                      | reg <388> PIN14 pull up/down resistor select              | 0: pull down resistor enable<br>1: pull up resistor enable                                                                                                                                                                                                         |
|                      | reg <389> PIN14 driver strength selection                 | 0: 1X<br>1: 2X                                                                                                                                                                                                                                                     |
| <b>PIN15</b>         |                                                           |                                                                                                                                                                                                                                                                    |
| reg <410:404>        | reg <406:404> PIN15 mode control                          | 000: Digital Input without Schmitt trigger<br>001: Reserved<br>010: Reserved<br>011: Reserved<br>100: Push Pull<br>101: Reserved<br>110: Reserved<br>111: Reserved                                                                                                 |
|                      | reg <408:407> PIN15 pull up/down resistor value selection | 00: Reserved<br>01: Reserved<br>10: Reserved<br>11: Reserved                                                                                                                                                                                                       |
|                      | reg <409> PIN15 pull up/down resistor select              | 0: Reserved<br>1: Reserved                                                                                                                                                                                                                                         |
|                      | reg <410> PIN15 driver strength selection                 | 0: Reserved<br>1: 2X                                                                                                                                                                                                                                               |

| Register Bit Address | Signal Function                                                            | Register Bit Definition                                                                                                                                                  |
|----------------------|----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PIN16</b>         |                                                                            |                                                                                                                                                                          |
| reg <417:411>        | reg <413:411> PIN16 mode control                                           | 000: Digital Input without Schmitt trigger<br>001: Reserved<br>010: Reserved<br>011: Reserved<br>100: Push Pull<br>101: Reserved<br>110: Reserved<br>111: Reserved       |
|                      | reg <415:414> PIN16 pull down resistor value selection                     | 00: Reserved<br>01: Reserved<br>10: Reserved<br>11: Reserved                                                                                                             |
|                      | reg <416> PIN16 pull up/down resistor select                               | 0: Reserved<br>1: Reserved                                                                                                                                               |
|                      | reg <417> PIN16 driver strength selection                                  | 0: Reserved<br>1: 2X                                                                                                                                                     |
| reg <432>            | Pipe Delay OUT1 polarity select bit                                        | 0: non-inverting<br>1: inverting                                                                                                                                         |
| reg <440:433>        | 8-bit pattern id                                                           | 8-bit pattern id                                                                                                                                                         |
| reg <441>            | filter0 output polarity select                                             | 0: non-inverting<br>1: inverting                                                                                                                                         |
| reg <443:442>        | Reserved Reserved                                                          |                                                                                                                                                                          |
| reg <444>            | GPIO quick charge enable                                                   | 0: Disable<br>1: Enable                                                                                                                                                  |
| reg <445>            | Force bandgap on                                                           | 0: Auto-mode<br>1: Enable                                                                                                                                                |
| reg <446>            | VREF Output Active Buffer Control                                          | 0: Disabled<br>1: Enabled                                                                                                                                                |
| reg <449:447>        | VREF Output Source Select                                                  | 000: ACMP0 reference voltage<br>001: ACMP1 reference voltage<br>100: $V_{DD}/2$<br>101: $V_{DD}/3$<br>110: $V_{DD}/4$<br>011: Reserved<br>010: Reserved<br>111: Reserved |
| reg <450>            | NVM data read disable                                                      | 0: Disable (read enable)<br>1: Enable (read disable)                                                                                                                     |
| reg <451>            | NVM power down (or NVM data programming disable)                           | 0: None (or programming enable)<br>1: Power Down (or programming disable)                                                                                                |
| reg <452>            | Power Divider Power                                                        | 0: Power down<br>1: Power On                                                                                                                                             |
| reg <453>            | POR Auto Power detect                                                      | 0: Enable<br>1: Disable                                                                                                                                                  |
| reg <454>            | 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 <455>            | $V_{DD}$ bypass enable                                                     | 0: Regulator auto on<br>1: Regulator off ( $V_{DD}$ bypass)                                                                                                              |
| reg <471:456>        | Reserved                                                                   | Reserved                                                                                                                                                                 |
| reg <479:472>        | Reserved                                                                   | Reserved                                                                                                                                                                 |

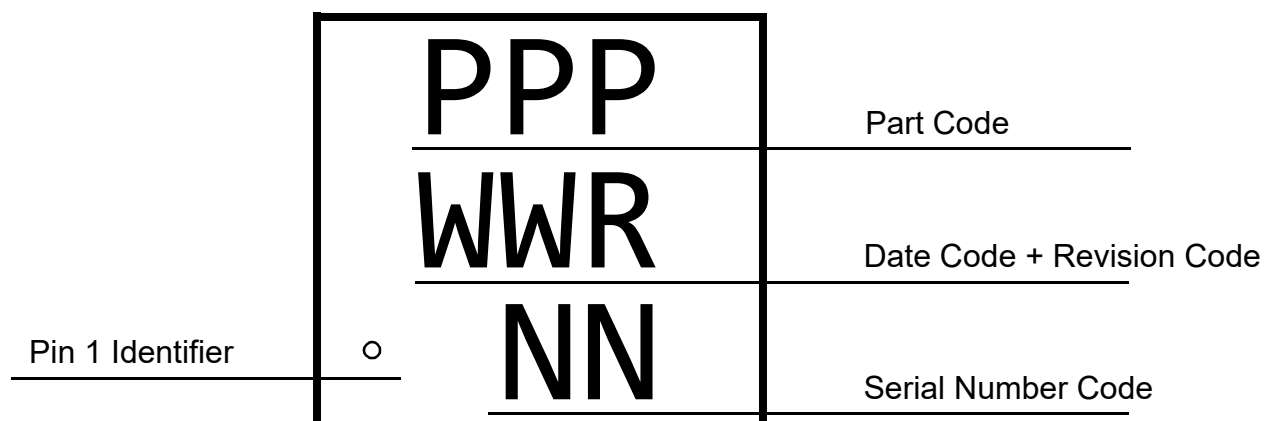
| Register Bit Address | Signal Function                                                                                          | Register Bit Definition                                                                                |
|----------------------|----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| reg <481:480>        | Reserved                                                                                                 | Reserved                                                                                               |
| reg <482>            | PIN13 edge detect mode                                                                                   | 0: rising edge<br>1: falling edge                                                                      |
| reg <483>            | Bypass the PIN13                                                                                         | 0: PIN13 edge active<br>1: PIN13 high active                                                           |
| reg <484>            | PIN13 reset enable                                                                                       | 0: Disable<br>1: Enable                                                                                |
| reg <485>            | programmable Delay or filter output select                                                               | 0: programmable Delay output<br>1: filter output                                                       |
| reg <487:486>        | 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 <489:488>        | Delay value select for programmable Delay & edge detector ( $V_{DD} = 3.3\text{ V}$ , typical condition) | 00: 125 ns<br>01: 250 ns<br>10: 375 ns<br>11: 500 ns                                                   |
| reg <490>            | Reserved                                                                                                 | Reserved                                                                                               |
| reg <495:491>        | Reserved                                                                                                 | Reserved                                                                                               |
| reg <501:496>        | Reserved                                                                                                 | Reserved                                                                                               |
| reg <502>            | Reserved                                                                                                 |                                                                                                        |
| reg <503>            | Reserved                                                                                                 | Reserved                                                                                               |
| reg <511:504>        | Reserved                                                                                                 | Reserved                                                                                               |

## 19.0 Package Top Marking System Definition

### 19.1 Before February 1, 2021



### 19.2 After February 1, 2021



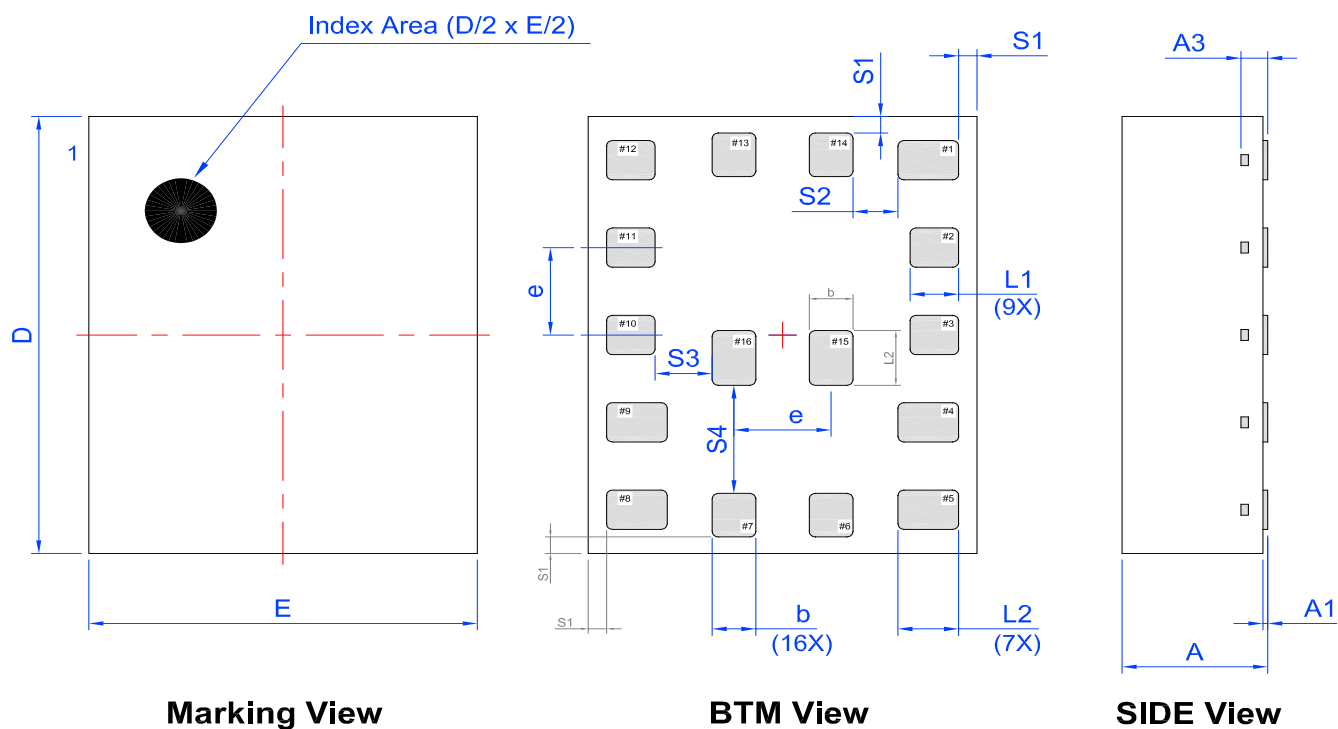
## 20.0 Package Drawing and Dimensions

16 Lead MSTQFN Package 1.6 x 2 mm

JEDEC MO-252

IC Net Weight: 0.059 g

### MSTQFN 16L 1.6x2mm 0.4P FC Green PKG



Unit: mm

| Symbol | Min.      | Nom.  | Max.  | Symbol | Min.      | Nom.  | Max.  |
|--------|-----------|-------|-------|--------|-----------|-------|-------|
| A      | 0.500     | 0.550 | 0.600 | D      | 1.950     | 2.000 | 2.050 |
| A1     | 0.00      | -     | 0.010 | E      | 1.550     | 1.600 | 1.650 |
| A3     | 0.11 REF  |       |       | L1     | 0.150     | 0.200 | 0.250 |
| b      | 0.130     | 0.180 | 0.230 | L2     | 0.200     | 0.250 | 0.300 |
| e      | 0.400 BSC |       |       | S3     | 0.235 REF |       |       |
| S1     | 0.075 REF |       |       | S4     | 0.495 REF |       |       |
| S2     | 0.185 REF |       |       |        |           |       |       |

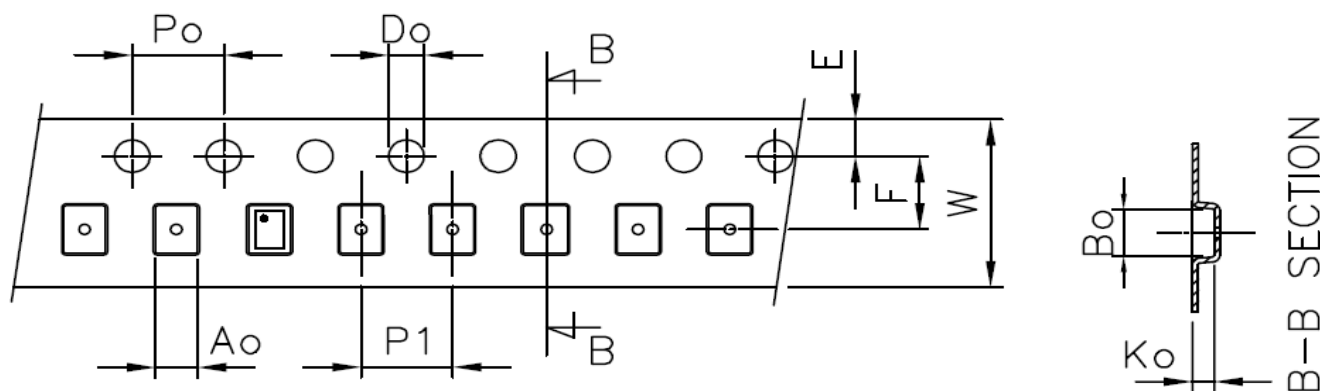


## 21.0 Tape and Reel Specifications

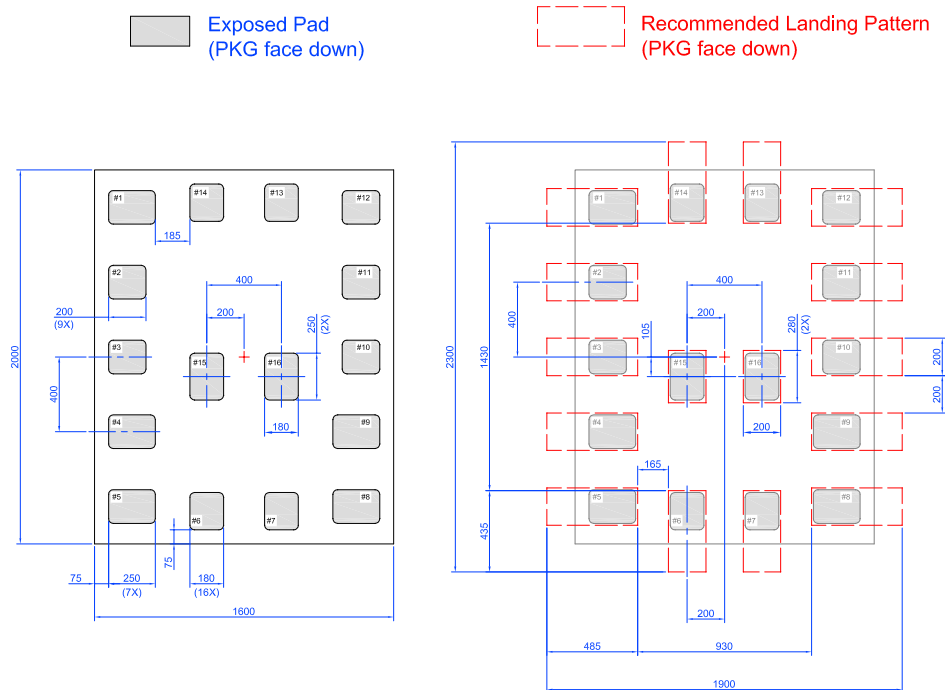
| Package Type                              | # of Pins | Nominal Package Size [mm] | Max Units |         | Reel & Hub Size [mm] | Leader (min) |             | Trailer (min) |             | Tape Width [mm] | Part Pitch [mm] |
|-------------------------------------------|-----------|---------------------------|-----------|---------|----------------------|--------------|-------------|---------------|-------------|-----------------|-----------------|
|                                           |           |                           | per Reel  | per Box |                      | Pockets      | Length [mm] | Pockets       | Length [mm] |                 |                 |
| MSTQFN 16L<br>1.6x2.0 mm FC<br>0.4P Green | 16        | 1.6x2x0.55                | 3000      | 3000    | 178/60               | 100          | 400         | 100           | 400         | 8               | 4               |

## 22.0 Carrier Tape Drawing and Dimensions

| 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               |
| MSTQFN 16L 1.6x2.0 mm FC 0.4P Green | 1.9                   | 2.3                  | 0.76              | 4                     | 4                 | 1.5                      | 1.75                         | 3.5                              | 8               |



## 23.0 Recommended Landing Pattern



### Marking View

## 24.0 Recommended Reflow Soldering Profile

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

## 25.0 Revision History

| Date       | Version | Change                                                                                                                                                                                                                                                          |
|------------|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7/30/2026  | 1.12    | Removed table Gain Divider Accuracy<br>Added subsection 3-State Output 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<br>Updated ACMP1 Block Diagram |
| 8/14/2023  | 1.11    | Updated tables Electrical Characteristics<br>Fixed typos                                                                                                                                                                                                        |
| 3/10/2023  | 1.10    | Added notes to section Ordering Information                                                                                                                                                                                                                     |
| 3/4/2022   | 1.09    | Updated Pull Up/Down Resistance in Electrical Characteristics<br>Renesas rebranding<br>Updated tables CNT/DLY Register Settings<br>Corrected registers [296:289], [325:318], [339:332], [353:346] in Appendix A - SLG46127 Register Definition                  |
| 2/2/2021   | 1.08    | Updated section Package Top Marking System Definition<br>Added note for CNTs<br>Corrected registers [353:343], [339:329], [325:315], [296:286]                                                                                                                  |
| 10/29/2019 | 1.07    | Updated last page with disclaimer and contacts<br>Added pre front page                                                                                                                                                                                          |
| 7/2/2019   | 1.06    | Updated I <sub>DSS</sub> in Table 6<br>Fixed typos                                                                                                                                                                                                              |
| 12/20/2017 | 1.05    | Corrected subsection Driving the P-FET Switch                                                                                                                                                                                                                   |
| 12/11/2017 | 1.04    | Updated Dual, 2A P-FET Power Switches                                                                                                                                                                                                                           |
| 12/4/2017  | 1.03    | Fixed typos                                                                                                                                                                                                                                                     |
| 10/10/2017 | 1.02    | Updated Electrical Spec<br>Changed Programmable Delay/ Deglitch Filter Section Structure<br>Fixed typos                                                                                                                                                         |
| 9/28/2017  | 1.01    | Updated Power On Pins Settings<br>Fixed typos<br>Updated Power Switch Electrical Characteristics (each P-FET)<br>Updated Absolute Maximum Conditions<br>Updated Dual, 2A P-FET Power Switches                                                                   |
| 9/15/2017  | 1.00    | Production Release<br>Updated Power Switch Electrical Characteristics (each P-FET)                                                                                                                                                                              |

## IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES ("RENESAS") PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD-PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers who are designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only to develop an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third-party intellectual property. Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising from your use of these resources. Renesas' products are provided only subject to Renesas' Terms and Conditions of Sale or other applicable terms agreed to in writing. No use of any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

(Disclaimer Rev.1.01)

### Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,  
Koto-ku, Tokyo 135-0061, Japan  
[www.renesas.com](http://www.renesas.com)

### Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit [www.renesas.com/contact-us/](http://www.renesas.com/contact-us/).

### Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.