

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

General Description

The SLG46824 provides a small, low power component for commonly used mixed-signal functions. The user creates the circuit design by programming the multiple time Non-Volatile Memory (NVM) to configure the interconnect logic, the IOs, and the macrocells of the SLG46824. Dual power supply allows to flexibly interface two independent voltage domains. This highly versatile device allows a wide variety of mixed-signal functions to be designed within a very small, low power single integrated circuit.

Key Features

- Two Low Power General Purpose Rail-to-Rail Analog Comparators (ACMPxL)
- One Voltage Reference
 - One Vref Output
- Eleven Combination Function Macrocells
 - Three Selectable DFF/LATCH or 2-bit LUTs
 - One Selectable Programmable Pattern Generator or 2-bit LUT
 - Six Selectable DFF/LATCH or 3-bit LUTs
 - One Selectable Pipe Delay or Ripple Counter or 3-bit LUT
- Eight Multi-Function Macrocells
 - Seven Selectable DFF/LATCH or 3-bit LUTs + 8-bit Delay/Counters
 - One Selectable DFF/LATCH or 4-bit LUT + 16-bit Delay/Counter
- Serial Communications
 - I²C Protocol Interface
- Programmable Delay with Edge Detector Output
- Deglitch Filter or Edge Detector
- Three Oscillators
 - 2.048 kHz Oscillator
 - 2.048 MHz Oscillator
 - 25 MHz Oscillator
- Power-On Reset
- In System Programmability
- Multiple Time Programmable Memory
- Wide Range Power Supply
 - 2.5 V (±8 %) to 5 V (±10 %) V_{DD}
 - 1.8 V (±5 %) to 5 V (±10 %) V_{DD2} (V_{DD2} ≤ V_{DD})
- Operating Temperature Range: -40 °C to 85 °C
- RoHS Compliant/Halogen-Free
- Two Packages Available
 - 20-pin STQFN: 2 mm x 3 mm x 0.55 mm, 0.4 mm pitch
 - 20-pin TSSOP: 6.5 mm x 6.4 mm x 1.2 mm, 0.65 mm pitch

Applications

- Personal Computers and Servers
- PC Peripherals
- Consumer Electronics
- Data Communications Equipment
- Handheld and Portable Electronics
- Smartphones and Fitness Bands
- Notebook and Tablet PCs

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1 Block Diagram

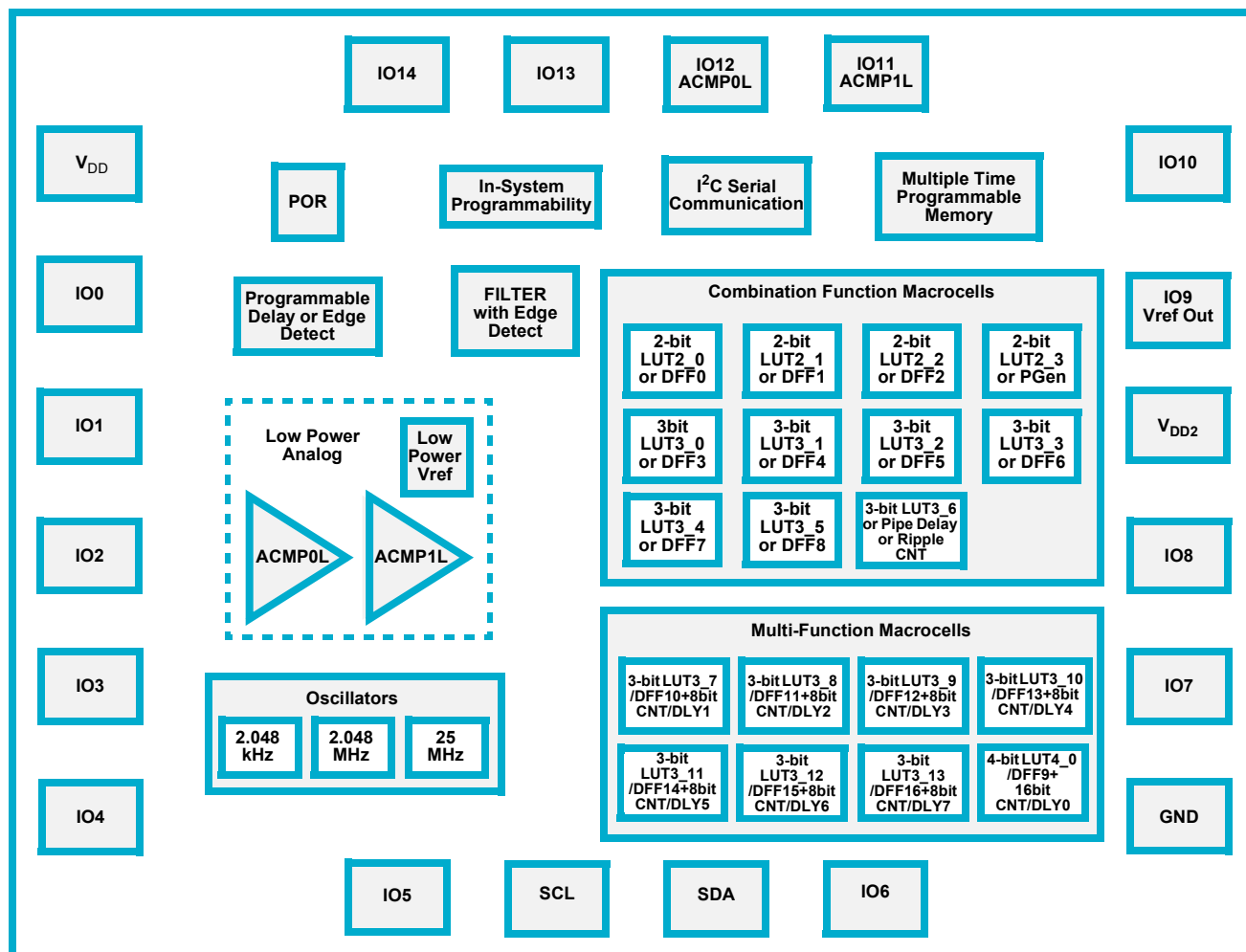
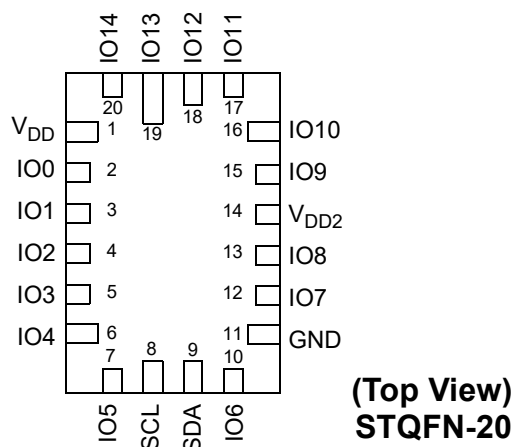


Figure 1: Block Diagram

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

2 Pinout

2.1 PIN CONFIGURATION - STQFN- 20L



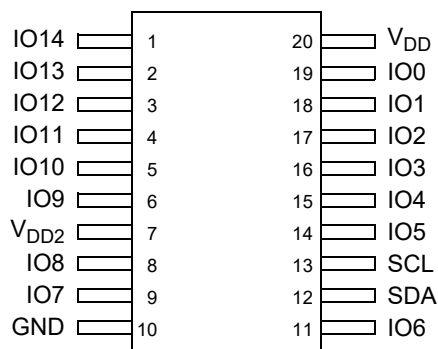
Pin #	Signal Name	Pin Functions
1	V _{DD}	Power Supply
2	IO0	GPIO
3	IO1	GPIO or Vref IN
4	IO2	GPIO, SLA_0
5	IO3	GPIO, SLA_1
6	IO4	GPIO, SLA_2
7	IO5	GPIO, SLA_3
8	SCL	I ² C_SCL
9	SDA	I ² C_SDA
10	IO6	GPO
11	GND	Ground
12	IO7	GPO
13	IO8	GPIO
14	V _{DD2}	Power Supply
15	IO9	GPIO or Vref_OUT1
16	IO10	GPIO
17	IO11	GPIO or ACMP1L_IN
18	IO12	GPIO or ACMP0L_IN
19	IO13	GPIO
20	IO14	GPIO

Legend:

ACMPx+: ACMPx Positive Input
ACMPx-: ACMPx Negative Input
SCL: I²C Clock Input
SDA: I²C Data Input/Output
Vrefx: Voltage Reference Output
SLA: Slave Address

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2.2 PIN CONFIGURATION - TSSOP-20L



**TSSOP-20
(Top View)**

Pin #	Signal Name	Pin Functions
1	IO14	GPIO
2	IO13	GPIO
3	IO12	GPIO or ACMP0L_IN
4	IO11	GPIO or ACMP1L_IN
5	IO10	GPIO
6	IO9	GPIO or Vref_OUT1
7	VDD2	Power Supply
8	IO8	GPIO
9	IO7	GPO
10	GND	Ground
11	IO6	GPO
12	SDA	I ² C_SDA
13	SCL	I ² C_SCL
14	IO5	GPIO, SLA_3
15	IO4	GPIO, SLA_2
16	IO3	GPIO, SLA_1
17	IO2	GPIO, SLA_0]
18	IO1	GPIO or Vref IN
19	IO0	GPIO
20	VDD	Power Supply

Legend:

ACMPx+: ACMPx Positive Input
ACMPx-: ACMPx Negative Input
SCL: I²C Clock Input
SDA: I²C Data Input/Output
Vrefx: Voltage Reference Output
SLA: Slave Address

Table 1: Functional Pin Description

Pin No.		Pin Name	Signal Name	Function	Input Options	Output Options
STQFN 20L	TSSOP 20L					
1	20	VDD	VDD	Power Supply	--	--
			ACMP0L+	Analog Comparator 0 Positive Input	Analog	--
			ACMP1L+	Analog Comparator 1 Positive Input	Analog	--
2	19	IO0	IO0	General Purpose IO	Digital Input without Schmitt Trigger	Push-Pull (1x) (2x)
					Digital Input with Schmitt Trigger	Open Drain NMOS (1x) (2x)
					Low Voltage Digital Input	--
			I ² C_EXPAND_0	--	--	--
			EXT_OSC0_IN	External Clock Connection	--	--

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Table 1: Functional Pin Description(Continued)

Pin No.		Pin Name	Signal Name	Function	Input Options	Output Options
STQFN 20L	TSSOP 20L					
3	18	IO1	IO1	General Purpose IO with OE (Note 1)	Digital Input without Schmitt Trigger	Push-Pull (1x) (2x)
					Digital Input with Schmitt Trigger	Open Drain NMOS (1x) (2x)
					Low Voltage Digital Input	--
4	17	IO2	EXT_Vref	Analog Comparator Negative Input	Analog	--
			IO2	General Purpose IO	Digital Input without Schmitt Trigger	Push-Pull (1x) (2x)
			EXT_SLA_0		Digital Input with Schmitt Trigger	Open Drain NMOS (1x) (2x)
5	16	IO3	IO3	General Purpose IO	Low Voltage Digital Input	--
			EXT_SLA_1		Digital Input without Schmitt Trigger	Push-Pull (1x) (2x)
					Digital Input with Schmitt Trigger	Open Drain NMOS (1x) (2x)
6	15	IO4	IO4	General Purpose IO with OE (Note 1)	Low Voltage Digital Input	--
			EXT_SLA_2		Digital Input without Schmitt Trigger	Push-Pull (1x) (2x)
					Digital Input with Schmitt Trigger	Open Drain NMOS (1x) (2x)
7	14	IO5	IO5	General Purpose IO with OE (Note 1)	Low Voltage Digital Input	--
			EXT_SLA_3		Digital Input without Schmitt Trigger	Push-Pull (1x) (2x)
					Digital Input with Schmitt Trigger	Open Drain NMOS (1x) (2x)
			I ² C_EXPAND_1	--	--	--
8	13	SCL	SCL	I ² C Serial Clock	Digital Input without Schmitt Trigger	--
					Low Voltage Digital Input	--
9	12	SDA	SDA	I ² C Serial Data	Digital Input without Schmitt Trigger	--
					Low Voltage Digital Input	--
10	11	IO6	IO6	General Purpose Output	--	Push-Pull (1x) (2x)
					--	Open Drain NMOS (1x) (2x)
					--	--
			I ² C_EXPAND_2	--	--	--
11	10	GND	GND	Ground	--	--
12	9	IO7	IO7	General Purpose Output	--	Push-Pull (1x) (2x)
					--	Open Drain NMOS (1x) (2x)
					--	--

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Table 1: Functional Pin Description(Continued)

Pin No.		Pin Name	Signal Name	Function	Input Options	Output Options
STQFN 20L	TSSOP 20L					
13	8	IO8	IO8	General Purpose IO with OE (Note 1)	Digital Input without Schmitt Trigger	Push-Pull (1x) (2x)
					Digital Input with Schmitt Trigger	Open Drain NMOS (1x) (2x)
					Low Voltage Digital Input	--
			EXT_OSC2_IN	--	--	--
14	7	V _{DD2}	V _{DD2}	Power Supply	--	--
15	6	IO9	IO9	General Purpose IO with OE (Note 1)	Digital Input without Schmitt Trigger	Push-Pull (1x) (2x)
					Digital Input with Schmitt Trigger	Open Drain NMOS (1x) (2x)
					Low Voltage Digital Input	--
			Vref_OUT	Voltage Reference 1 Output	--	Analog
			I ² C_EXPAND_3	--	--	--
16	5	IO10	IO10	General Purpose IO with OE (Note 1)	Digital Input without Schmitt Trigger	Push-Pull (1x) (2x)
					Digital Input with Schmitt Trigger	Open Drain NMOS (1x) (2x)
					Low Voltage Digital Input	--
			EXT_OSC1_IN	--	--	--
17	4	IO11	IO11	General Purpose IO with OE (Note 1)	Digital Input without Schmitt Trigger	Push-Pull (1x) (2x)
					Digital Input with Schmitt Trigger	Open Drain NMOS (1x) (2x)
					Low Voltage Digital Input	--
			Slave Address 0	--	--	--
			ACMP1L+	Analog Comparator 3 Positive Input	Analog	--
18	3	IO12	IO12	General Purpose IO with OE (Note 1)	Digital Input without Schmitt Trigger	Push-Pull (1x) (2x)
					Digital Input with Schmitt Trigger	Open Drain NMOS (1x) (2x)
					Low Voltage Digital Input	--
			Slave Address 1	--	--	--
			ACMP0L+	Analog Comparator 2 Positive Input	Analog	--
19	2	IO13	IO13	General Purpose IO with OE (Note 1)	Digital Input without Schmitt Trigger	Push-Pull (1x) (2x)
					Digital Input with Schmitt Trigger	Open Drain NMOS (1x) (2x)
					Low Voltage Digital Input	--
			Slave Address 2	--	--	--

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Table 1: Functional Pin Description(Continued)

Pin No.		Pin Name	Signal Name	Function	Input Options	Output Options
STQFN 20L	TSSOP 20L					
20	1	IO14	IO14	General Purpose IO with OE (Note 1)	Digital Input without Schmitt Trigger	Push-Pull (1x) (2x)
	1				Digital Input with Schmitt Trigger	Open Drain NMOS (1x) (2x)
					Slave Address 3	--

Note 1 General Purpose IO's with OE can be used to implement bidirectional signals under user control via Connection Matrix to OE signal in IO structure.

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

3 Characteristics

3.1 ABSOLUTE MAXIMUM RATINGS

Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, so functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification are not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

Table 2: Absolute Maximum Ratings

Parameter		Min	Max	Unit
Supply Voltage on V_{DD} relative to GND		-0.3	7	V
DC Input Voltage		GND - 0.5 V	$V_{DD} + 0.5$ V	V
Maximum Average or DC Current Through V_{DD} Pin		--	90	mA
Maximum Average or DC Current Through V_{DD2} Pin		--	90	mA
Maximum Average or DC Current Through GND Pin (Per chip side, (Note 1))		--	100	mA
Maximum Average or DC Current (Through pin)	Push-Pull 1x	--	15.3	mA
	Push-Pull 2x	--	22.1	
	OD 1x	--	15.5	
	OD 2x	--	23	
Current at Input Pin		-1.0	1.0	mA
Input leakage (Absolute Value)		--	1000	nA
Storage Temperature Range		-65	150	°C
Junction Temperature		--	150	°C
Moisture Sensitivity Level		1		

Note 1 The GreenPAK's GND rail is divided in two sides. IOs 0 to 6, SCL, SDA are connected to one side and IOs 7 to 14 are connected to another side.

3.2 ELECTROSTATIC DISCHARGE RATINGS

Table 3: Electrostatic Discharge Ratings

Parameter	Min	Max	Unit
ESD Protection (Human Body Model)	2000	--	V
ESD Protection (Charged Device Model)	1300	--	V

3.3 RECOMMENDED OPERATING CONDITIONS

Table 4: Recommended Operating Conditions

Parameter	Condition	Min	Max	Unit
Supply Voltage (V_{DD})		2.3	5.5	V
	During NVM Write and Erase commands	2.5	5.5	V
Supply Voltage 2 (V_{DD2})	$V_{DD2} \leq V_{DD}$	1.71	5.5	V
Operating Temperature		-40	85	°C
Maximal Voltage Applied to any PIN in High Impedance State		--	$V_{DD} + 0.3$	V
Capacitor Value at V_{DD}		0.1	--	μF
Analog Input Common Mode Range	Allowable Input Voltage at Analog Pins	0	V_{DD}	V

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3.4 ELECTRICAL CHARACTERISTICS

Table 5: EC at T = -40 °C to +85 °C, V_{DD} = 2.3 V to 5.5 V Unless Otherwise Noted

Parameter	Description	Condition	Min	Typ	Max	Unit
V _{IH}	HIGH-Level Input Voltage	Logic Input (Note 2)	0.7x V _{DD} (Note 1)	--	V _{DD} +0.3 (Note 1)	V
		Logic Input with Schmitt Trigger	0.8x V _{DD} (Note 1)	--	V _{DD} +0.3 (Note 1)	V
		Low-Level Logic Input (Note 2)	1.25	--	V _{DD} +0.3 (Note 1)	V
V _{IL}	LOW-Level Input Voltage	Logic Input (Note 2)	GND-0.3	--	0.3x V _{DD} (Note 1)	V
		Logic Input with Schmitt Trigger	GND-0.3	--	0.2x V _{DD} (Note 1)	V
		Low-Level Logic Input (Note 2)	GND-0.3	--	0.5	V
V _{HYS}	Schmitt Trigger Hysteresis Voltage	V _{DD2} = 1.8 V ± 5 %	0.1	0.4	0.7	V
		V _{DD} = 2.5 V ± 8 % (Note 1)	0.29	0.41	0.56	V
		V _{DD} = 3.3 V ± 10 % (Note 1)	0.33	0.45	0.57	V
		V _{DD} = 5 V ± 10 % (Note 1)	0.42	0.57	0.74	V
V _O	Maximal Voltage Applied to any PIN in High Impedance State		--	--	V _{DD} +0.3 (Note 1)	V
V _{OH}	HIGH-Level Output Voltage	Push-Pull, 1x Drive, I _{OH} = 1 mA, V _{DD} = V _{DD2} = 2.3 V (Note 1)	2.178	--	--	V
		Push-Pull, 1x Drive, I _{OH} = 1 mA, V _{DD} = V _{DD2} = 2.5 V (Note 1)	2.389	--	--	V
		Push-Pull, 1x Drive, I _{OH} = 1 mA, V _{DD} = V _{DD2} = 2.7 V (Note 1)	2.598	--	--	V
		Push-Pull, 1x Drive, I _{OH} = 3 mA, V _{DD} = V _{DD2} = 3.0 V (Note 1)	2.712	--	--	V
		Push-Pull, 1x Drive, I _{OH} = 3 mA, V _{DD} = V _{DD2} = 3.3 V (Note 1)	3.039	--	--	V
		Push-Pull, 1x Drive, I _{OH} = 3 mA, V _{DD} = V _{DD2} = 3.6 V (Note 1)	3.36	--	--	V
		Push-Pull, 1x Drive, I _{OH} = 5 mA, V _{DD} = V _{DD2} = 4.5 V (Note 1)	4.157	--	--	V
		Push-Pull, 1x Drive, I _{OH} = 5 mA, V _{DD} = V _{DD2} = 5.0 V (Note 1)	4.678	--	--	V
		Push-Pull, 1x Drive, I _{OH} = 5 mA, V _{DD} = V _{DD2} = 5.5 V (Note 1)	5.201	--	--	V
		Push-Pull, 2x Drive, I _{OH} = 1 mA, V _{DD} = V _{DD2} = 2.3 V (Note 1)	2.239	--	--	V
		Push-Pull, 2x Drive, I _{OH} = 1 mA, V _{DD} = V _{DD2} = 2.5 V (Note 1)	2.443	--	--	V
		Push-Pull, 2x Drive, I _{OH} = 1 mA, V _{DD} = V _{DD2} = 2.7 V (Note 1)	2.648	--	--	V
		Push-Pull, 2x Drive, I _{OH} = 3 mA, V _{DD} = V _{DD2} = 3.0 V (Note 1)	2.854	--	--	V

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Table 5: EC at T = -40 °C to +85 °C, V_{DD} = 2.3 V to 5.5 V Unless Otherwise Noted(Continued)

Parameter	Description	Condition	Min	Typ	Max	Unit
V _{OH}	HIGH-Level Output Voltage	Push-Pull, 2x Drive, I _{OH} = 3 mA, V _{DD} = V _{DD2} = 3.3 V (Note 1)	3.165	--	--	V
		Push-Pull, 2x Drive, I _{OH} = 3 mA, V _{DD} = V _{DD2} = 3.6 V (Note 1)	3.474	--	--	V
		Push-Pull, 2x Drive, I _{OH} = 5 mA, V _{DD} = V _{DD2} = 4.5 V (Note 1)	4.314	--	--	V
		Push-Pull, 2x Drive, I _{OH} = 5 mA, V _{DD} = V _{DD2} = 5.0 V (Note 1)	4.821	--	--	V
		Push-Pull, 2x Drive, I _{OH} = 5 mA, V _{DD} = V _{DD2} = 5.5 V (Note 1)	5.329	--	--	V
V _{OL}	LOW-Level Output Voltage	Push-Pull, 1x Drive, I _{OL} = 1 mA, V _{DD} = V _{DD2} = 2.3 V (Note 1)	--	--	0.085	V
		Push-Pull, 1x Drive, I _{OL} = 1 mA, V _{DD} = V _{DD2} = 2.5 V (Note 1)	--	--	0.079	V
		Push-Pull, 1x Drive, I _{OL} = 1 mA, V _{DD} = V _{DD2} = 2.7 V (Note 1)	--	--	0.074	V
		Push-Pull, 1x Drive, I _{OL} = 3 mA, V _{DD} = V _{DD2} = 3.0 V (Note 1)	--	--	0.210	V
		Push-Pull, 1x Drive, I _{OL} = 3 mA, V _{DD} = V _{DD2} = 3.3 V (Note 1)	--	--	0.195	V
		Push-Pull, 1x Drive, I _{OL} = 3 mA, V _{DD} = V _{DD2} = 3.6 V (Note 1)	--	--	0.183	V
		Push-Pull, 1x Drive, I _{OL} = 5 mA, V _{DD} = V _{DD2} = 4.5 V (Note 1)	--	--	0.271	V
		Push-Pull, 1x Drive, I _{OL} = 5 mA, V _{DD} = V _{DD2} = 5.0 V (Note 1)	--	--	0.256	V
		Push-Pull, 1x Drive, I _{OL} = 5 mA, V _{DD} = V _{DD2} = 5.5 V (Note 1)	--	--	0.246	V
		Push-Pull, 2x Drive, I _{OL} = 1 mA, V _{DD} = V _{DD2} = 2.3 V (Note 1)	--	--	0.046	V
		Push-Pull, 2x Drive, I _{OL} = 1 mA, V _{DD} = V _{DD2} = 2.5 V (Note 1)	--	--	0.043	V
		Push-Pull, 2x Drive, I _{OL} = 1 mA, V _{DD} = V _{DD2} = 2.7 V (Note 1)	--	--	0.040	V
		Push-Pull, 2x Drive, I _{OL} = 3 mA, V _{DD} = V _{DD2} = 3.0 V (Note 1)	--	--	0.114	V
		Push-Pull, 2x Drive, I _{OL} = 3 mA, V _{DD} = V _{DD2} = 3.3 V (Note 1)	--	--	0.107	V
		Push-Pull, 2x Drive, I _{OL} = 3 mA, V _{DD} = V _{DD2} = 3.6 V (Note 1)	--	--	0.102	V
		Push-Pull, 2x Drive, I _{OL} = 5 mA, V _{DD} = V _{DD2} = 4.5 V (Note 1)	--	--	0.152	V
		Push-Pull, 2x Drive, I _{OL} = 5 mA, V _{DD} = V _{DD2} = 5.0 V (Note 1)	--	--	0.145	V
		Push-Pull, 2x Drive, I _{OL} = 5 mA, V _{DD} = V _{DD2} = 5.5 V (Note 1)	--	--	0.140	V
		NMOS OD, 1x Drive, I _{OL} = 1 mA, V _{DD} = V _{DD2} = 2.3 V (Note 1)	--	--	0.038	V
		NMOS OD, 1x Drive, I _{OL} = 1 mA, V _{DD} = V _{DD2} = 2.5 V (Note 1)	--	--	0.035	V

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Table 5: EC at T = -40 °C to +85 °C, V_{DD} = 2.3 V to 5.5 V Unless Otherwise Noted(Continued)

Parameter	Description	Condition	Min	Typ	Max	Unit
V _{OL}	LOW-Level Output Voltage	NMOS OD, 1x Drive, I _{OL} = 1 mA, V _{DD} = V _{DD2} = 2.7 V (Note 1)	--	--	0.033	V
		NMOS OD, 1x Drive, I _{OL} = 3 mA, V _{DD} = V _{DD2} = 3.0 V (Note 1)	--	--	0.094	V
		NMOS OD, 1x Drive, I _{OL} = 3 mA, V _{DD} = V _{DD2} = 3.3 V (Note 1)	--	--	0.088	V
		NMOS OD, 1x Drive, I _{OL} = 3 mA, V _{DD} = V _{DD2} = 3.6 V (Note 1)	--	--	0.084	V
		NMOS OD, 1x Drive, I _{OL} = 5 mA, V _{DD} = V _{DD2} = 4.5 V (Note 1)	--	--	0.127	V
		NMOS OD, 1x Drive, I _{OL} = 5 mA, V _{DD} = V _{DD2} = 5.0 V (Note 1)	--	--	0.121	V
		NMOS OD, 1x Drive, I _{OL} = 5 mA, V _{DD} = V _{DD2} = 5.5 V (Note 1)	--	--	0.117	V
		NMOS OD, 2x Drive, I _{OL} = 1 mA, V _{DD} = V _{DD2} = 2.3 V (Note 1)	--	--	0.032	V
		NMOS OD, 2x Drive, I _{OL} = 1 mA, V _{DD} = V _{DD2} = 2.5 V (Note 1)	--	--	0.03	V
		NMOS OD, 2x Drive, I _{OL} = 1 mA, V _{DD} = V _{DD2} = 2.7 V (Note 1)	--	--	0.029	V
		NMOS OD, 2x Drive, I _{OL} = 3 mA, V _{DD} = V _{DD2} = 3.0 V (Note 1)	--	--	0.064	V
		NMOS OD, 2x Drive, I _{OL} = 3 mA, V _{DD} = V _{DD2} = 3.3 V (Note 1)	--	--	0.062	V
		NMOS OD, 2x Drive, I _{OL} = 3 mA, V _{DD} = V _{DD2} = 3.6 V (Note 1)	--	--	0.059	V
		NMOS OD, 2x Drive, I _{OL} = 5 mA, V _{DD} = V _{DD2} = 4.5 V (Note 1)	--	--	0.085	V
		NMOS OD, 2x Drive, I _{OL} = 5 mA, V _{DD} = V _{DD2} = 5.0 V (Note 1)	--	--	0.081	V
		NMOS OD, 2x Drive, I _{OL} = 5 mA, V _{DD} = V _{DD2} = 5.5 V (Note 1)	--	--	0.08	V
I _{OH}	HIGH-Level Output Current	Push-Pull, 1x Drive, V _{OH} = V _{DD} - 0.2 = V _{DD2} - 0.2 V _{DD} = V _{DD2} = 2.3 V (Note 1)	1.60	--	--	mA
		Push-Pull, 1x Drive, V _{OH} = V _{DD} - 0.2 = V _{DD2} - 0.2 V _{DD} = V _{DD2} = 2.5 V (Note 1)	1.76	--	--	mA
		Push-Pull, 1x Drive, V _{OH} = V _{DD} - 0.2 = V _{DD2} - 0.2 V _{DD} = V _{DD2} = 2.7 V (Note 1)	1.92	--	--	mA
		Push-Pull, 1x Drive, V _{OH} = 2.4 V, V _{DD} = V _{DD2} = 3.0 V (Note 1)	5.64	--	--	mA

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Table 5: EC at T = -40 °C to +85 °C, V_{DD} = 2.3 V to 5.5 V Unless Otherwise Noted(Continued)

Parameter	Description	Condition	Min	Typ	Max	Unit
I _{OH}	HIGH-Level Output Current	Push-Pull, 1x Drive, V _{OH} = 2.4 V, V _{DD} = V _{DD2} = 3.3 V (Note 1)	8.56	--	--	mA
		Push-Pull, 1x Drive, V _{OH} = 2.4 V, V _{DD} = V _{DD2} = 3.6 V (Note 1)	11.51	--	--	mA
		Push-Pull, 1x Drive, V _{OH} = 2.4 V, V _{DD} = V _{DD2} = 4.5 V (Note 1)	20.46	--	--	mA
		Push-Pull, 1x Drive, V _{OH} = 2.4 V, V _{DD} = V _{DD2} = 5.0 V (Note 1)	25.12	--	--	mA
		Push-Pull, 1x Drive, V _{OH} = 2.4 V, V _{DD} = V _{DD2} = 5.5 V (Note 1)	29.34	--	--	mA
		Push-Pull, 2x Drive, V _{OH} = V _{DD} - 0.2 = V _{DD2} - 0.2 V _{DD} = V _{DD2} = 2.3 V (Note 1)	3.10	--	--	mA
		Push-Pull, 2x Drive, V _{OH} = V _{DD} - 0.2 = V _{DD2} - 0.2 V _{DD} = V _{DD2} = 2.5 V (Note 1)	3.40	--	--	mA
		Push-Pull, 2x Drive, V _{OH} = V _{DD} - 0.2 = V _{DD2} - 0.2 V _{DD} = V _{DD2} = 2.7 V (Note 1)	3.69	--	--	mA
		Push-Pull, 2x Drive, V _{OH} = 2.4 V, V _{DD} = V _{DD2} = 3.0 V (Note 1)	10.89	--	--	mA
		Push-Pull, 2x Drive, V _{OH} = 2.4 V, V _{DD} = V _{DD2} = 3.3 V (Note 1)	16.54	--	--	mA
		Push-Pull, 2x Drive, V _{OH} = 2.4 V, V _{DD} = V _{DD2} = 3.6 V (Note 1)	22.28	--	--	mA
		Push-Pull, 2x Drive, V _{OH} = 2.4 V, V _{DD} = V _{DD2} = 4.5 V (Note 1)	39.61	--	--	mA
		Push-Pull, 2x Drive, V _{OH} = 2.4 V, V _{DD} = V _{DD2} = 5.0 V (Note 1)	48.49	--	--	mA
		Push-Pull, 2x Drive, V _{OH} = 2.4 V, V _{DD} = V _{DD2} = 5.5 V (Note 1)	56.39	--	--	mA
I _{OL}	LOW-Level Output Current	Push-Pull, 1x Drive, V _{OL} = 0.15 V, V _{DD} = V _{DD2} = 2.3 V (Note 1)	1.73	--	--	mA
		Push-Pull, 1x Drive, V _{OL} = 0.15 V, V _{DD} = V _{DD2} = 2.5 V (Note 1)	1.87	--	--	mA
		Push-Pull, 1x Drive, V _{OL} = 0.15 V, V _{DD} = V _{DD2} = 2.7 V (Note 1)	2.00	--	--	mA
		Push-Pull, 1x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 3.0 V (Note 1)	5.45	--	--	mA
		Push-Pull, 1x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 3.3 V (Note 1)	5.90	--	--	mA
		Push-Pull, 1x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 3.6 V (Note 1)	6.29	--	--	mA
		Push-Pull, 1x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 4.5 V (Note 1)	7.25	--	--	mA
		Push-Pull, 1x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 5.0 V (Note 1)	7.67	--	--	mA
		Push-Pull, 1x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 5.5 V (Note 1)	8.01	--	--	mA

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Table 5: EC at T = -40 °C to +85 °C, V_{DD} = 2.3 V to 5.5 V Unless Otherwise Noted(Continued)

Parameter	Description	Condition	Min	Typ	Max	Unit
I _{OL}	LOW-Level Output Current	Push-Pull, 2x Drive, V _{OL} = 0.15 V, V _{DD} = V _{DD2} = 2.3 V (Note 1)	3.20	--	--	mA
		Push-Pull, 2x Drive, V _{OL} = 0.15 V, V _{DD} = V _{DD2} = 2.5 V (Note 1)	3.44	--	--	mA
		Push-Pull, 2x Drive, V _{OL} = 0.15 V, V _{DD} = V _{DD2} = 2.7 V (Note 1)	3.65	--	--	mA
		Push-Pull, 2x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 3.0 (Note 1)	10.01	--	--	mA
		Push-Pull, 2x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 3.3 (Note 1)	10.73	--	--	mA
		Push-Pull, 2x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 3.6 (Note 1)	11.36	--	--	mA
		Push-Pull, 2x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 4.5 (Note 1)	12.85	--	--	mA
		Push-Pull, 2x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 5.0 (Note 1)	13.52	--	--	mA
		Push-Pull, 2x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 5.5 (Note 1)	14.05	--	--	mA
		NMOS OD, 1x Drive, V _{OL} = 0.15 V, V _{DD} = V _{DD2} = 2.3 V (Note 1)	3.91	--	--	mA
		NMOS OD, 1x Drive, V _{OL} = 0.15 V, V _{DD} = V _{DD2} = 2.5 V (Note 1)	4.19	--	--	mA
		NMOS OD, 1x Drive, V _{OL} = 0.15 V, V _{DD} = V _{DD2} = 2.7 V (Note 1)	4.44	--	--	mA
		NMOS OD, 1x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 3.0 V (Note 1)	12.18	--	--	mA
		NMOS OD, 1x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 3.3 V (Note 1)	13.02	--	--	mA
		NMOS OD, 1x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 3.6 V (Note 1)	13.75	--	--	mA
		NMOS OD, 1x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 4.5 V (Note 1)	15.47	--	--	mA
		NMOS OD, 1x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 5.0 V (Note 1)	16.19	--	--	mA
		NMOS OD, 1x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 5.5 V (Note 1)	16.80	--	--	mA
		NMOS OD, 2x Drive, V _{OL} = 0.15 V, V _{DD} = V _{DD2} = 2.3 V (Note 1)	6.28	--	--	mA
		NMOS OD, 2x Drive, V _{OL} = 0.15 V, V _{DD} = V _{DD2} = 2.5 V (Note 1)	6.68	--	--	mA
		NMOS OD, 2x Drive, V _{OL} = 0.15 V, V _{DD} = V _{DD2} = 2.7 V (Note 1)	7.02	--	--	mA
		NMOS OD, 2x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 3.0 V (Note 1)	20.14	--	--	mA
		NMOS OD, 2x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 3.3 V (Note 1)	21.23	--	--	mA
		NMOS OD, 2x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 3.6 V (Note 1)	22.12	--	--	mA
		NMOS OD, 2x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 4.5 V (Note 1)	24.84	--	--	mA

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Table 5: EC at T = -40 °C to +85 °C, V_{DD} = 2.3 V to 5.5 V Unless Otherwise Noted(Continued)

Parameter	Description	Condition	Min	Typ	Max	Unit
I _{OL}	LOW-Level Output Current	NMOS OD, 2x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 5.0 V (Note 1)	26.08	--	--	mA
		NMOS OD, 2x Drive, V _{OL} = 0.4 V, V _{DD} = V _{DD2} = 5.5 V (Note 1)	26.72	--	--	mA
T _{SU}	Startup Time	From V _{DD} rising past PON _{THR}	--	1.66	2.59	ms
T _{WR}	NVM Page Write Time	V _{DD} = 2.5 V to 5.5 V	--	--	20	ms
T _{ER}	NVM Page Erase Time	V _{DD} = 2.5 V to 5.5 V	--	--	20	ms
PON _{THR}	Power-On Threshold	V _{DD} Level Required to Start Up the Chip	1.60	1.85	2.07	V
POFF _{THR}	Power-Off Threshold	V _{DD} Level Required to Switch Off the Chip	0.97	1.23	1.46	V
R _{PULL}	Pull-up or Pull-down Resistance	1 M for Pull-up: V _{IN} = GND; for Pull-down: V _{IN} = V _{DD} (Note 1)	0.72	1.12	1.4	MΩ
		100 k for Pull-up: V _{IN} = GND; for Pull-down: V _{IN} = V _{DD} (Note 1)	72	110	134.4	kΩ
		10 k For Pull-up: V _{IN} = GND; for Pull-down: V _{IN} = V _{DD} (Note 1)	6.32	10	13.5	kΩ
C _{IN}	Input Capacitance			4		pF

Note 1 The GreenPAK's power rails are divided in two sides. IOs 0 to 6, SCL, SDA are powered from V_{DD} (one side) and IOs 7 to 14 are powered from V_{DD2} (another side).

Note 2 No hysteresis.

Table 6: EC of the I²C Pins at T = -40 °C to +85 °C, V_{DD} = 2.3 V to 5.5 V Unless Otherwise Noted

Parameter	Description	Condition	Fast-Mode		Fast-Mode Plus		Unit
			Min	Max	Min	Max	
V _{IL}	LOW-level Input Voltage		-0.5	0.3xV _{DD}	-0.5	0.3xV _{DD}	V
V _{IH}	HIGH-level Input Voltage		0.7xV _{DD}	5.5	0.7xV _{DD}	5.5	V
V _{HYS}	Hysteresis of Schmitt Trigger Inputs		0.05xV _{DD}	--	0.05xV _{DD}	--	V
V _{OL1}	LOW-Level Output Voltage 1	(Open-Drain) at 3mA sink current V _{DD} > 2 V	0	0.4	0	0.4	V
V _{OL2}	LOW-Level Output Voltage 2	(Open-Drain) at 2 mA sink current V _{DD} ≤ 2 V	0	0.2xV _{DD}	0	0.2xV _{DD}	V
I _{OL}	LOW-Level Output Current (Note 1)	V _{OL} = 0.4 V, V _{DD} = 2.3 V	3	--	16.75	--	mA
		V _{OL} = 0.4 V, V _{DD} = 3.0 V	3	--	20	--	mA
		V _{OL} = 0.4 V, V _{DD} = 4.5 V	3	--	20	--	mA
		V _{OL} = 0.6 V	6	--	--	--	mA
t _{of}	Output Fall Time from V _{IHmin} to V _{ILmax} (Note 1)		14x (V _{DD} /5.5V)	250	10x (V _{DD} /5.5V)	120	ns

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Table 6: EC of the I²C Pins at T = -40 °C to +85 °C, V_{DD} = 2.3 V to 5.5 V Unless Otherwise Noted(Continued)

Parameter	Description	Condition	Fast-Mode		Fast-Mode Plus		Unit
			Min	Max	Min	Max	
t _{SP}	Pulse Width of Spikes that must be suppressed by the Input Filter		0	50	0	50	ns
I _i	Input Current each IO Pin	0.1V _{DD} < V _I < 0.9V _{DDmax}	-10	+10	-10	+10	μA
C _i	Capacitance for each IO Pin		--	10	--	10	pF

Note 1 Does not meet standard I²C specifications: t_{of} = 20x(V_{DD}/5.5 V) (min); For Fast-mode Plus I_{OL} = 20 mA (min) at V_{OL} = 0.4 V.
Note 2 For Fast-mode Plus SDA pin must be configured as NMOS 2x Open-Drain, see registers [834:833] in section 17.

Table 7: I²C Pins Timing Characteristics at T = -40 °C to +85 °C, V_{DD} = 2.3 V to 5.5 V Unless Otherwise Noted

Parameter	Description	Condition	Fast-Mode		Fast-Mode Plus		Unit
			Min	Max	Min	Max	
F _{SCL}	Clock Frequency, SCL		--	400	--	1000	kHz
t _{LOW}	Clock Pulse Width Low		1300	--	500	--	ns
t _{HIGH}	Clock Pulse Width High		600	--	260	--	ns
t _i	Input Filter Spike Suppression (SCL, SDA) (Note 2)	V _{DD} = 2.5 V ± 8 %	--	95	--	168	ns
		V _{DD} = 3.3 V ± 10 %	--	95	--	157	
		V _{DD} = 5.0 V ± 10 %	--	111	--	156	
t _{AA}	Clock Low to Data Out Valid		--	900	--	450	ns
t _{BUF}	Bus Free Time between Stop and Start		1300	--	500	--	ns
t _{HD_STA}	Start Hold Time		600	--	260	--	ns
t _{SU_STA}	Start Set-up Time		600	--	260	--	ns
t _{HD_DAT}	Data Hold Time		0	--	0	--	ns
t _{SU_DAT}	Data Set-up Time		100	--	50	--	ns
t _R	Inputs Rise Time		--	300	--	120	ns
t _F	Inputs Fall Time		--	300	--	120	ns
t _{SU_STO}	Stop Set-up Time		600	--	260	--	ns
t _{DH}	Data Out Hold Time		50	--	50	--	ns

Note 1 Timing diagram can be found in the [Figure 81](#).
Note 2 Does not meet standard I²C specifications: 50 ns.

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Table 8: Typical Current Estimated for Each Macrocell at T = -40 °C to +85 °C

Parameter	Description	Note	V _{DD} = 2.5 V	V _{DD} = 3.3V	V _{DD} = 5.0V	Unit
		Chip Quiescent	0.39	0.43	0.53	μA
		Vref OUT (Source none, Buffer On)	6.53	6.61	7.02	μA
		Vref OUT (Source none, Buffer Off)	1.40	1.44	1.54	μA
		Vref (ACMPxL, 0.32 mV, Buffer On)	6.93	7.01	7.43	μA
I	Current	ACMP0L, 1L, hysteresis disabled, gain = 1, +IN - IO11, 12 Pull-up 1M, Vref = 32 mV	2.54	2.59	2.74	μA
		ACMP0L, 1L, hysteresis disabled, gain = 1, +IN - IO11, 12 Pull-down 1M, Vref = 32 mV	1.92	1.96	2.09	μA
		ACMP0L, hysteresis disabled, gain = 1, +IN - IO12 Pull-up 1M, Vref = 32 mV	1.98	2.02	2.15	μA
		ACMP0L, hysteresis disabled, gain = 0.25, +IN - IO12 Pull-up 1M, Vref = 32 mV	2.53	2.82	3.60	μA
		ACMP0L, hysteresis disabled, gain = 1 or gain = 0.25, +IN - IO12 Pull-down 1M, Vref = 32 mV	1.66	1.70	1.82	μA
		OSC2 25 MHz, pre-divider = 1	48.79	60.45	87.16	μA
		OSC2 25 MHz, pre-divider = 4	33.19	39.57	54.85	μA
		OSC2 25 MHz, pre-divider = 8	30.30	35.70	48.87	μA
		OSC1 2.048 MHz, pre-divider = 1	23.37	25.98	32.00	μA
		OSC1 2.048 MHz, pre-divider = 4	19.13	20.11	22.32	μA
		OSC1 2.048 MHz, pre-divider = 8	18.40	19.10	20.64	μA
		OSC0 2.048 kHz, Force	0.65	0.70	0.83	μA

3.5 TIMING CHARACTERISTICS

Table 9: Typical Delay Estimated for Each Macrocell at T = 25 °C

Parameter	Description	Note	V _{DD} = 2.5 V		V _{DD} = 3.3 V		V _{DD} = 5 V		Unit
			Rising	Falling	Rising	Falling	Rising	Falling	
tpd	Delay	Multi-Function DFF Q	23	21	16	15	11	11	ns
tpd	Delay	Multi-Function DFF nQ	23	21	17	15	12	11	ns
tpd	Delay	Multi-Function DFF nRESET Q	--	29	--	21	--	15	ns
tpd	Delay	Multi-Function DFF nRESET nQ	31	--	22	--	16	--	ns
tpd	Delay	Multi-Function DFF nSET Q	31	--	22	--	16	--	ns
tpd	Delay	Multi-Function DFF nSET nQ	--	29	--	21	--	15	ns
tpd	Delay	DFF Q	17	17	12	12	8	8	ns
tpd	Delay	DFF nQ	18	16	13	11	9	8	ns
tpd	Delay	DFF nRESET Q	--	21	--	15	--	11	ns
tpd	Delay	DFF nRESET nQ	23	--	16	--	11	--	ns
tpd	Delay	DFF nSET Q	22	--	16	--	11	--	ns

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Table 9: Typical Delay Estimated for Each Macrocell at T = 25 °C(Continued)

Parameter	Description	Note	V _{DD} = 2.5 V		V _{DD} = 3.3 V		V _{DD} = 5 V		Unit
			Rising	Falling	Rising	Falling	Rising	Falling	
tpd	Delay	DFF nSET nQ	--	22	--	15	--	11	ns
tpd	Delay	DFF3 First Q	18	17	12	12	9	9	ns
tpd	Delay	DFF3 First nQ	19	17	13	12	9	8	ns
tpd	Delay	DFF3 First nRESET Q	--	22	--	16	--	11	ns
tpd	Delay	DFF3 First nRESET nQ	23	--	17	--	12	--	ns
tpd	Delay	DFF3 First nSET Q	23	--	16	--	12	--	ns
tpd	Delay	DFF3 First nSET nQ	--	22	--	16	--	11	ns
tpd	Delay	DFF3 Second Q	21	20	15	15	10	10	ns
tpd	Delay	DFF3 Second nQ	22	20	15	14	11	10	ns
tpd	Delay	DFF3 Second nRESET Q	--	22	--	16	--	11	ns
tpd	Delay	DFF3 Second nRESET nQ	23	--	16	--	12	--	ns
tpd	Delay	DFF3 Second nSET Q	23	--	16	--	11	--	ns
tpd	Delay	DFF3 Second nSET nQ	--	22	--	16	--	11	ns
tpd	Delay	Multi-Function LATCH Q	22	24	15	18	11	13	ns
tpd	Delay	Multi-Function LATCH nQ	27	20	19	14	14	10	ns
tpd	Delay	Multi-Function LATCH nRESET Q	27	30	19	22	14	16	ns
tpd	Delay	Multi-Function LATCH nRESET nQ	32	26	23	18	16	13	ns
tpd	Delay	Multi-Function LATCH nSET Q	30	23	21	17	15	12	ns
tpd	Delay	Multi-Function LATCH nSET nQ	25	28	18	20	13	15	ns
tpd	Delay	LATCH Q	16	19	11	13	8	9	ns
tpd	Delay	LATCH nQ	20	15	14	11	10	8	ns
tpd	Delay	LATCH nRESET Q	20	22	14	16	10	11	ns
tpd	Delay	LATCH nRESET nQ	24	20	17	14	12	10	ns
tpd	Delay	LATCH nSET Q	21	17	15	12	11	8	ns
tpd	Delay	LATCH nSET nQ	18	20	13	15	9	10	ns
tpd	Delay	LATCH3 First Q	17	19	12	14	8	10	ns
tpd	Delay	LATCH3 First nQ	21	16	15	11	10	8	ns
tpd	Delay	LATCH3 First nRESET Q	21	23	15	17	11	12	ns
tpd	Delay	LATCH3 First nRESET nQ	24	21	17	15	12	10	ns
tpd	Delay	LATCH3 First nSET Q	22	18	15	13	11	9	ns
tpd	Delay	LATCH3 First nSET nQ	19	21	14	15	10	11	ns
tpd	Delay	LATCH3 Second Q	18	18	13	13	9	9	ns
tpd	Delay	LATCH3 Second nQ	19	17	14	12	9	9	ns
tpd	Delay	LATCH3 Second nRESET Q	--	23	--	16	--	12	ns
tpd	Delay	LATCH3 Second nRESET nQ	24	--	17	--	12	--	ns
tpd	Delay	LATCH3 Second nSET Q	22	--	15	--	11	--	ns
tpd	Delay	LATCH3 Second nSET nQ	--	21	--	15	--	11	ns
tpd	Delay	Multi-Function 3-bit LUT	22	24	16	18	11	13	ns

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Table 9: Typical Delay Estimated for Each Macrocell at T = 25 °C(Continued)

Parameter	Description	Note	V _{DD} = 2.5 V		V _{DD} = 3.3 V		V _{DD} = 5 V		Unit
			Rising	Falling	Rising	Falling	Rising	Falling	
tpd	Delay	Multi-Function 3-bit LUT, CNT Delay	50	52	36	38	25	27	ns
tpd	Delay	Multi-Function 4-bit LUT	22	25	16	18	11	13	ns
tpd	Delay	Multi-Function 4-bit LUT, CNT Delay	52	50	37	36	25	26	ns
tpd	Delay	2-bit LUT	17	16	12	12	8	8	ns
tpd	Delay	3-bit LUT	17	17	12	12	8	9	ns
tpd	Delay	Digital input to Low Voltage to PP 1x	35	222	24	150	16	96	ns
tpd	Delay	Digital input to with Schmitt Trigger to PP 1x	26	30	19	22	13	16	ns
tpd	Delay	Digital input to PP 1x	27	31	19	22	13	16	ns
tpd	Delay	Digital input to PP 2x	24	29	18	21	12	15	ns
tpd	Delay	Digital input to NMOS 1x	--	27	--	20	--	14	ns
tpd	Delay	Digital input to NMOS 2x	--	26	--	19	--	14	ns
tpd	Delay	Digital input to 1x3-State (Z to 0)	--	24	--	17	--	12	ns
tpd	Delay	Digital input to 2x3-State (Z to 0)	--	23	--	17	--	12	ns
tpd	Delay	Digital input to 1x3-State (Z to 1)	27	--	19	--	14	--	ns
tpd	Delay	Digital input to 2x3-State (Z to 1)	26	--	19	--	13	--	ns
tpd	Delay	Digital input to 1xOE (Z to 0)	--	24	--	17	--	12	ns
tpd	Delay	Digital input to 1xOE (Z to 1)	27	--	19	--	14	--	ns
tpd	Delay	Ripple CNT CLK UP Q0	18	15	13	11	9	8	ns
tpd	Delay	Ripple CNT CLK UP Q0	23	22	17	16	12	12	ns
tpd	Delay	Ripple CNT CLK UP Q1	28	21	20	16	14	12	ns
tpd	Delay	Ripple CNT CLK DOWN Q0	18	15	13	11	9	8	ns
tpd	Delay	Ripple CNT CLK DOWN Q0	27	21	19	15	14	11	ns
tpd	Delay	Ripple CNT CLK DOWN Q1	26	27	19	20	13	14	ns
tpd	Delay	Ripple CNT nSET UP Q0	26	35	19	25	14	18	ns
tpd	Delay	Ripple CNT nSET UP Q0	25	39	18	28	13	20	ns
tpd	Delay	Ripple CNT nSET UP Q1	24	44	17	32	12	23	ns
tpd	Delay	Ripple CNT nSET DOWN Q0	26	34	19	25	14	18	ns
tpd	Delay	Ripple CNT nSET DOWN Q0	25	41	18	30	13	22	ns
tpd	Delay	Ripple CNT nSET DOWN Q1	24	40	17	29	12	21	ns
tpd	Delay	Edge detect	21	20	15	14	11	10	ns
tw	Width	Edge detect	205	206	153	153	113	113	ns
tpd	Delay	Edge detect Delayed	227	229	168	169	123	124	ns
tpd	Delay	Filter nQ	141	154	99	106	67	67	ns
tpd	Delay	Filter Q	158	137	108	97	68	65	ns
tpd	Delay	PGen CLK	16	15	11	11	8	8	ns
tpd	Delay	PGen nRESET (Z to 0)	--	20	--	14	--	10	ns

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Table 9: Typical Delay Estimated for Each Macrocell at T = 25 °C(Continued)

Parameter	Description	Note	V _{DD} = 2.5 V		V _{DD} = 3.3 V		V _{DD} = 5 V		Unit
			Rising	Falling	Rising	Falling	Rising	Falling	
tpd	Delay	PGen nRESET (Z to 1)	18	--	12	--	8	--	ns
tpd	Delay	Pipe Delay nRESET Out	30	26	22	19	16	14	ns
tpd	Delay	Pipe Delay Out	22	19	16	13	11	10	ns

Table 10: Programmable Delay Expected Delays and Widths (Typical) at T = 25 °C

Parameter	Description	Note	V _{DD} = 2.5 V	V _{DD} = 3.3 V	V _{DD} = 5.0 V	Unit
tw	Pulse Width, 1 cell	mode: (any) edge detect, edge detect output	205	153	113	ns
tw	Pulse Width, 2 cell	mode: (any) edge detect, edge detect output	407	303	223	ns
tw	Pulse Width, 3 cell	mode: (any) edge detect, edge detect output	610	453	334	ns
tw	Pulse Width, 4 cell	mode: (any) edge detect, edge detect output	812	603	444	ns
time1	Delay, 1 cell	mode: (any) edge detect, edge detect output	20	14	10	ns
time1	Delay, 2 cell	mode: (any) edge detect, edge detect output	20	14	10	ns
time1	Delay, 3 cell	mode: (any) edge detect, edge detect output	20	14	10	ns
time1	Delay, 4 cell	mode: (any) edge detect, edge detect output	20	14	10	ns
time2	Delay, 1 cell	mode: both edge delay, edge detect output	226	168	123	ns
time2	Delay, 2 cell	mode: both edge delay, edge detect output	429	318	234	ns
time2	Delay, 3 cell	mode: both edge delay, edge detect output	632	468	344	ns
time2	Delay, 4 cell	mode: both edge delay, edge detect output	834	618	455	ns

Table 11: Typical Filter Rejection Pulse Width at T = 25 °C

Parameter	V _{DD} = 2.5 V	V _{DD} = 3.3 V	V _{DD} = 5.0 V	Unit
Filtered Pulse Width	< 123	< 84	< 52	ns

Table 12: Typical Counter/Delay Offset Measurements at T = 25 °C

Parameter	OSC Freq	OSC Power	V _{DD} = 2.5 V	V _{DD} = 3.3 V	V _{DD} = 5.0 V	Unit
Power-ON time	25 MHz	auto	0.13	0.13	0.13	μs
Power-ON time	2.048 MHz	auto	0.3	0.4	0.4	μs
Power-ON time	2.048 kHz	auto	660	570	480	μs
frequency settling time	25 MHz	auto	4	4	8	μs
frequency settling time	2.048 MHz	auto	0.3	0.4	0.4	μs
frequency settling time	2.048 kHz	auto	660	570	480	μs
variable (CLK period)	25 MHz	forced	0-40	0-40	0-40	ns
variable (CLK period)	2.048 MHz	forced	0-0.5	0-0.5	0-0.5	μs
variable (CLK period)	2.048 kHz	forced	0-488	0-488	0-488	μs
tpd (non-delayed edge)	25 MHz/ 2.048 kHz	either	35	14	10	ns

3.6 OSC CHARACTERISTICS

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

3.6.1 OSC Specifications

Table 13: Oscillators Frequency Limits, $V_{DD} = 2.3 \text{ V to } 5.5 \text{ V}$

OSC	Temperature Range					
	+25 °C			-40 °C to +85 °C		
	Minimum Value, kHz	Maximum Value, kHz	Error, %	Minimum Value, kHz	Maximum Value, kHz	Error, %
2.048 kHz RC OSC0	2.025	2.071	+1.13	1.900	2.093	+2.19
			-1.03			-6.16
2.048 MHz RC OSC1	2020.83	2073.33	+1.19	1991.05	2083.90	+1.75
			-1.24			-2.00
25 MHz RC OSC2	24585.51	25354.98	+1.42	23562.69	25606.32	+2.43
			-1.49			-4.28

3.6.2 OSC Power-On Delay

Table 14: Oscillators Power-On Delay at $T = 25 \text{ °C}$, OSC Power Mode: "Auto Power-On"

Power Supply Range (V_{DD}), V	Oscillator2 25 MHz		Oscillator2 25 MHz Start with delay		Oscillator1 2.048 MHz		Oscillator0 2.048 kHz	
	Typical Value, ns	Maximum Value, ns	Typical Value, ns	Maximum Value, ns	Typical Value, ns	Maximum Value, ns	Typical Value, μs	Maximum Value, μs
2.30	43.41	48.00	142.46	153.00	530.99	549.00	746.66	1011.73
2.50	38.55	42.00	140.90	150.00	508.76	521.00	704.97	939.85
2.70	34.89	38.00	140.22	149.00	491.43	512.00	671.91	884.63
3.00	30.82	34.00	139.81	149.00	473.49	497.00	633.51	819.23
3.30	27.79	30.00	139.66	148.00	460.75	481.00	604.09	768.79
3.60	25.53	27.00	139.70	149.00	450.80	472.00	580.73	730.10
4.00	23.21	26.00	139.84	149.00	439.61	462.00	556.22	690.04
4.20	22.32	25.00	140.03	148.00	435.00	456.00	545.94	673.29
4.50	21.12	25.00	140.16	150.00	428.88	449.00	532.09	649.85
5.00	19.61	20.00	140.34	149.00	419.91	439.00	510.48	616.17
5.50	18.57	19.00	140.51	149.00	412.39	432.00	485.59	579.80

3.7 ACMP SPECIFICATIONS

Table 15: ACMP Specifications at $T = -40 \text{ °C to } +85 \text{ °C}$, $V_{DD} = 2.3 \text{ V to } 5.5 \text{ V}$ Unless Otherwise Noted

Parameter	Description	Note	Condition	Min	Typ	Max	Unit
V_{ACMP}	ACMP0L, ACMP1L Input Voltage Range	Positive Input		0	--	V_{DD}	V
		Negative Input		0	--	V_{DD}	V
V_{offset}	ACMP0L, ACMP1L Input Offset Voltage	$V_{hys} = 0 \text{ mV}$, Gain = 1, $V_{ref} = 32 \text{ mV to } 2016 \text{ mV}$	$T = 25 \text{ °C}$	-6.4	--	6.7	mV
				-7.3	--	7.2	mV
t_{start}	ACMP0L, ACMP1L Start Time	ACMP Power-On delay	$T = 25 \text{ °C}$	--	139.3	233.3	μs
				--	144.6	326.6	μs

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Table 15: ACMP Specifications at T = -40 °C to +85 °C, V_{DD} = 2.3 V to 5.5 V Unless Otherwise Noted(Continued)

Parameter	Description	Note	Condition	Min	Typ	Max	Unit
V _{HYS}	ACMP0L, ACMP1L Built-in Hysteresis	V _{HYS} = 32 mV	T = 25 °C	27.23	--	43.27	mV
		V _{HYS} = 64 mV	T = 25 °C	59.43	--	75.81	mV
		V _{HYS} = 192 mV	T = 25 °C	187.14	--	206.30	mV
		V _{HYS} = 32 mV		25.29	--	44.19	mV
		V _{HYS} = 64 mV		56.49	--	77.18	mV
		V _{HYS} = 192 mV		186.73	--	206.30	mV
R _{sin}	Input Resistance	Gain = 1x		--	100.0	--	MΩ
		Gain = 0.25x, 0.33x, 0.5x		--	2.0	--	MΩ
PROP	Propagation Delay, Response Time for ACMP0L, ACMP1L	Gain = 1, V _{ref} = 32 mV to 2016 mV, Overdrive = 10 mV	Low to High	--	42.93	114.55	μs
			High to Low	--	38.99	83.66	μs
		Gain = 1, V _{ref} = 32 mV to 2016 mV, Overdrive = 100 mV	Low to High	--	21.13	51.24	μs
			High to Low	--	20.34	51.08	μs
G	Gain error (including threshold and internal V _{ref} error)	G = 1		--	1	--	
		G = 0.5		0.496	--	0.504	
		G = 0.33		0.330	--	0.338	
		G = 0.25		0.246	--	0.255	
V _{ref}	V _{ref} Output error, V _{ref} = 32 mV to 2016 mV, Buffer Enabled		T = 25 °C, Loading = 1 mA	-6.04	--	5.59	mV
			Loading = 1 mA	-6.11	--	5.72	mV
	V _{ref} Output Capacitance Loading		Load Resistance = 1 MΩ	--	--	15	pF
			Load Resistance = 560 kΩ	--	--	27	pF
			Load Resistance = 100 kΩ	--	--	64	pF
			Load Resistance = 10 kΩ	--	--	120	pF
			Load Resistance = 2 kΩ	--	--	180	pF
			Load Resistance = 1 kΩ, V _{ref} = 32 mV to 1024 mV	--	--	210	pF

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

4 User Programmability

The SLG46824 is a user programmable device with Multiple-Time-Programmable (MTP) memory elements that are able to configure the connection matrix and macrocells. A programming development kit allows the user the ability to create initial devices. Once the design is finalized, the programming code (.gpx file) is forwarded to Dialog Semiconductor to integrate into a production process.

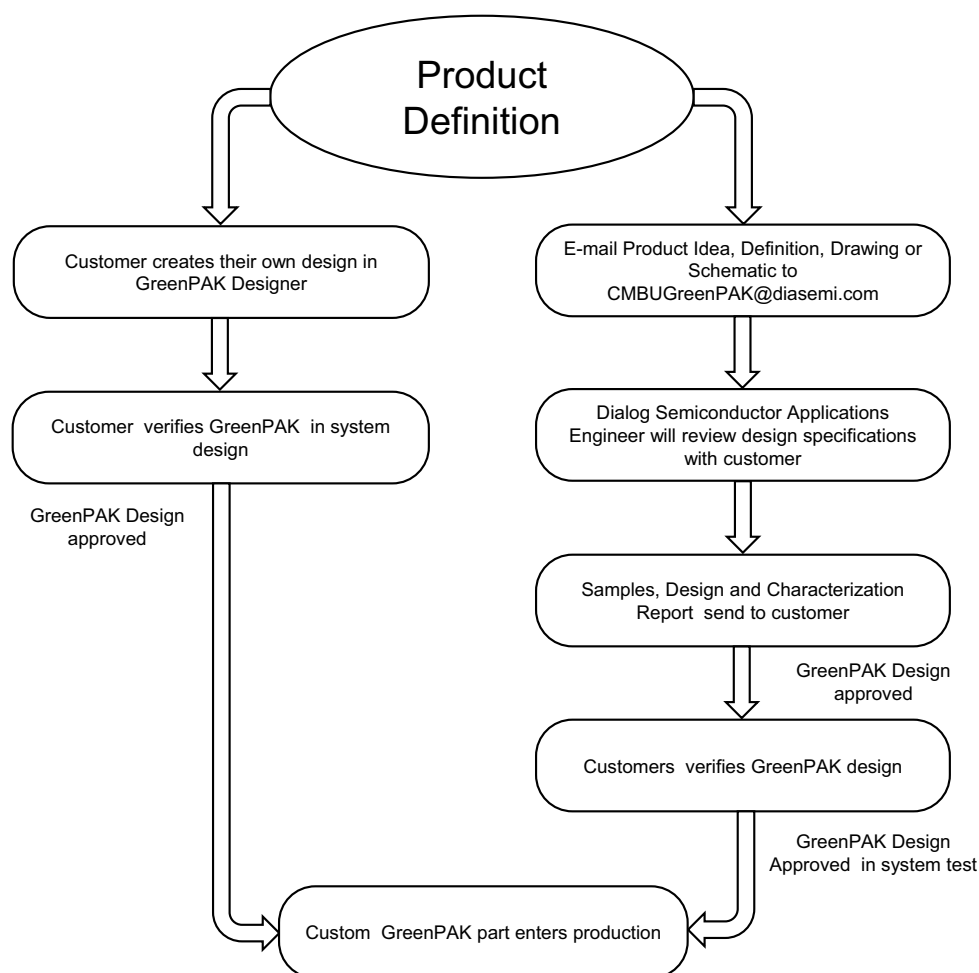


Figure 2: Steps to Create a Custom GreenPAK Device

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

5 IO Pins

5.1 IO PINS

The SLG46824 has a total of 13 GPIO, 2 GPO and 2 GPI 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).

IOs 0 to 6, SCL, SDA are powered from V_{DD} and IOs 7 to 14 are powered from V_{DD2} . All internal macrocells are powered from V_{DD} . Voltage on V_{DD2} Pin must be less or equal voltage on V_{DD} Pin.

In case V_{DD2} floating and any Pin powered from V_{DD2} is configured as input, ESD pin protection diodes must be considered when applying an input signal to the pin. This will cause a significant current leakage.

In case V_{DD2} floating and any Pin powered from V_{DD2} is configured as Output, the pin will behave as NMOS Open Drain.

It is not recommended to connect V_{DD2} to the GND.

5.2 GPIO PINS

IO0, IO1, IO2, IO3, IO4, IO5, IO8, IO9, IO10, IO11, IO12, IO13, IO14 serve as General Purpose IO Pins.

5.3 GPO PINS

IO6 and IO7 serve as General Purpose Output Pins.

5.4 GPI PINS

SCL and SDA serve as General Purpose Input Pins.

5.5 PULL-UP/DOWN RESISTORS

All IO Pins have the option of user-selectable resistors that can be connected to the pin structure. The selectable values on these resistors are 10 k Ω , 100 k Ω and 1 M Ω . The internal resistors can be configured as either Pull-up or Pull-downs.

5.6 FAST PULL-UP/DOWN DURING POWER UP

During power-up, IO Pull-up/down resistance will switch to 2.6 k Ω initially and then it will switch to normal setting value. This function is enabled by register [768].

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

5.7 I²C MODE IO STRUCTURE (V_{DD} OR V_{DD2})

5.7.1 I²C Mode Structure (for SCL and SDA)

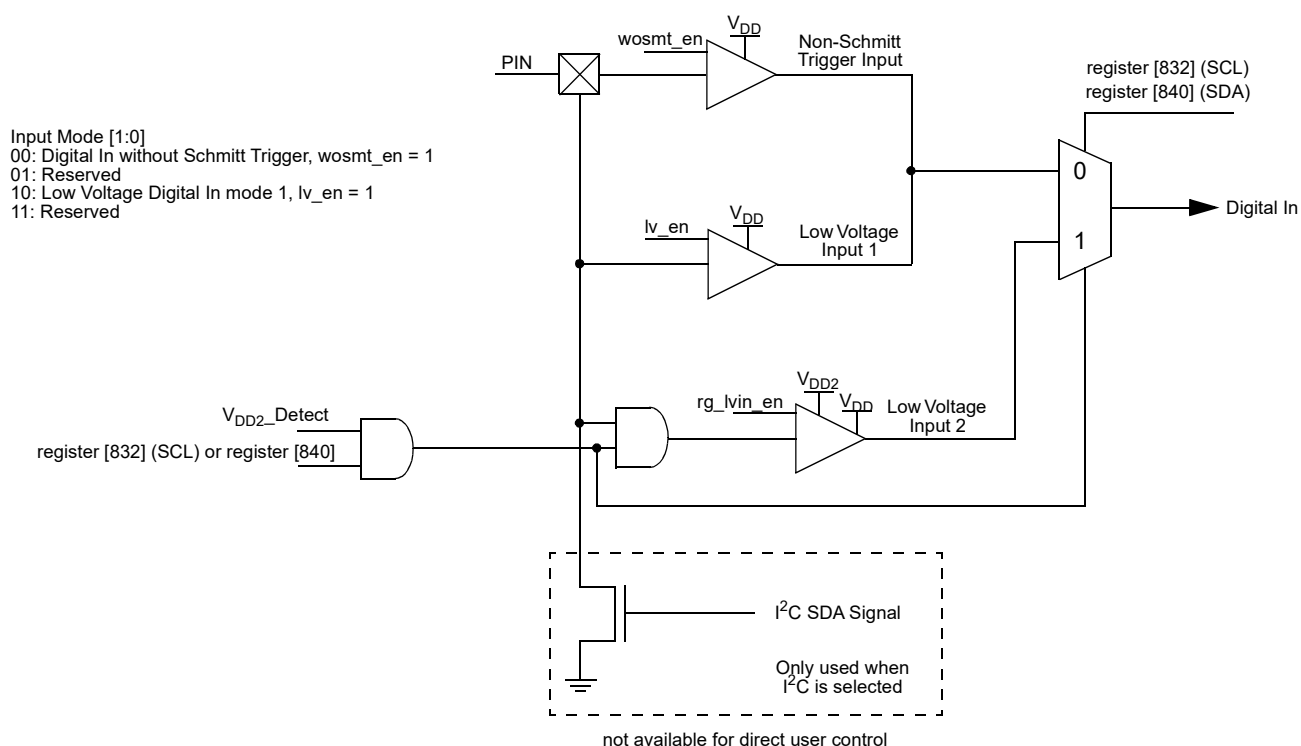


Figure 3: IO with I²C Mode IO Structure Diagram

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

5.8 MATRIX OE IO STRUCTURE (V_{DD} OR V_{DD2})

5.8.1 Matrix OE IO Structure (for IOs 1, 4, 5 with V_{DD}, and IOs 8, 9, 10, 11, 12, 13, 14 with V_{DD2})

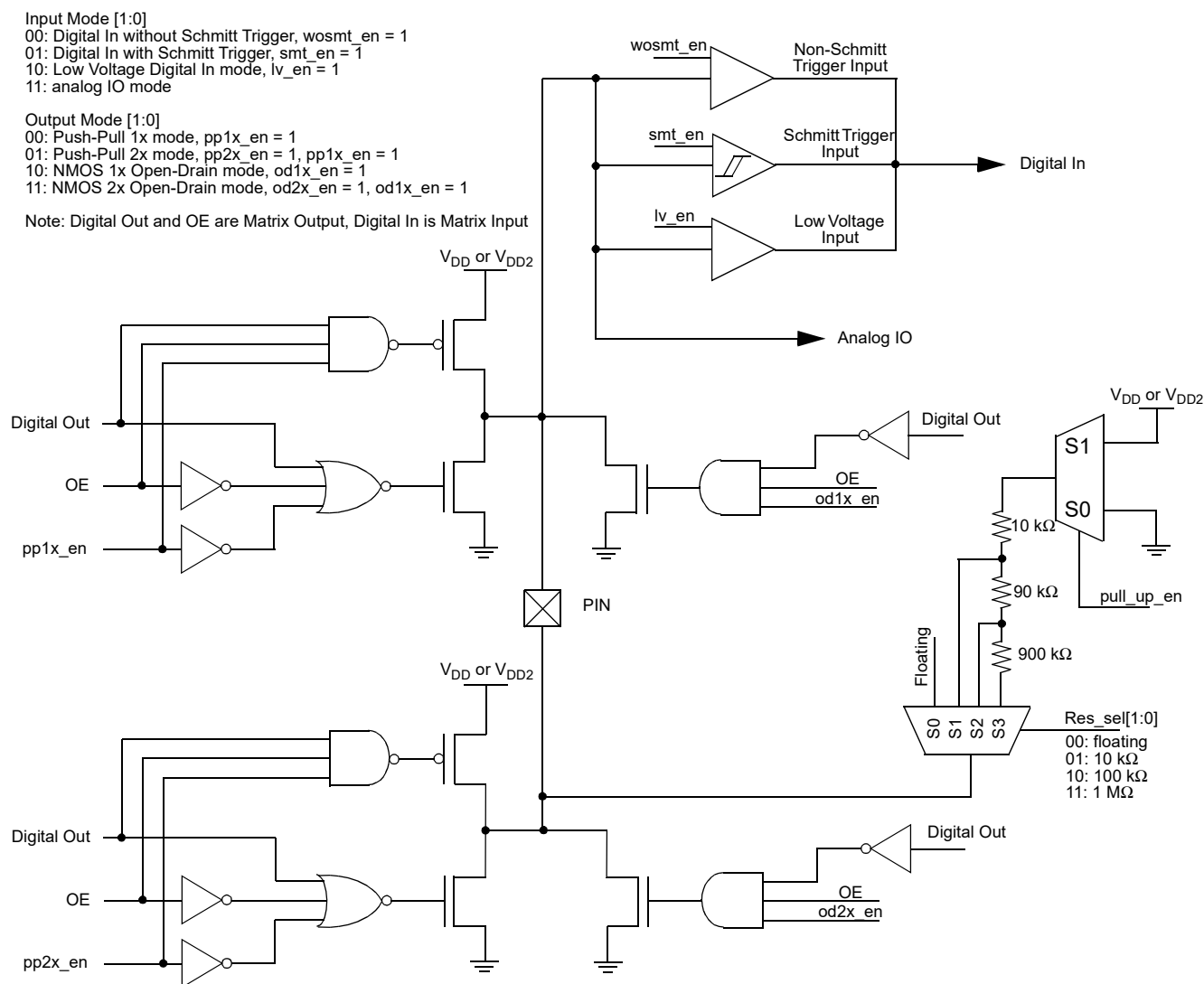


Figure 4: Matrix OE IO Structure Diagram

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

5.10 REGISTER OE IO STRUCTURE (VDD OR VDD2)

5.10.1 Register OE IO Structure (for IO 6 with V_{DD}, and IO 7 with V_{DD2})

Mode [2:0]
 000: Reserved
 001: Reserved
 010: Reserved
 011: Reserved
 100: Push-Pull mode, pp_en = 1, OE = 1
 101: NMOS Open-Drain mode, odn_en = 1, OE = 1
 110: PMOS Open-Drain mode, odp_en = 1, OE = 1
 111: analog IO and NMOS Open-Drain mode, odn_en = 1 and aio_en = 1

Note: OE cannot be selected by user and is controlled by register

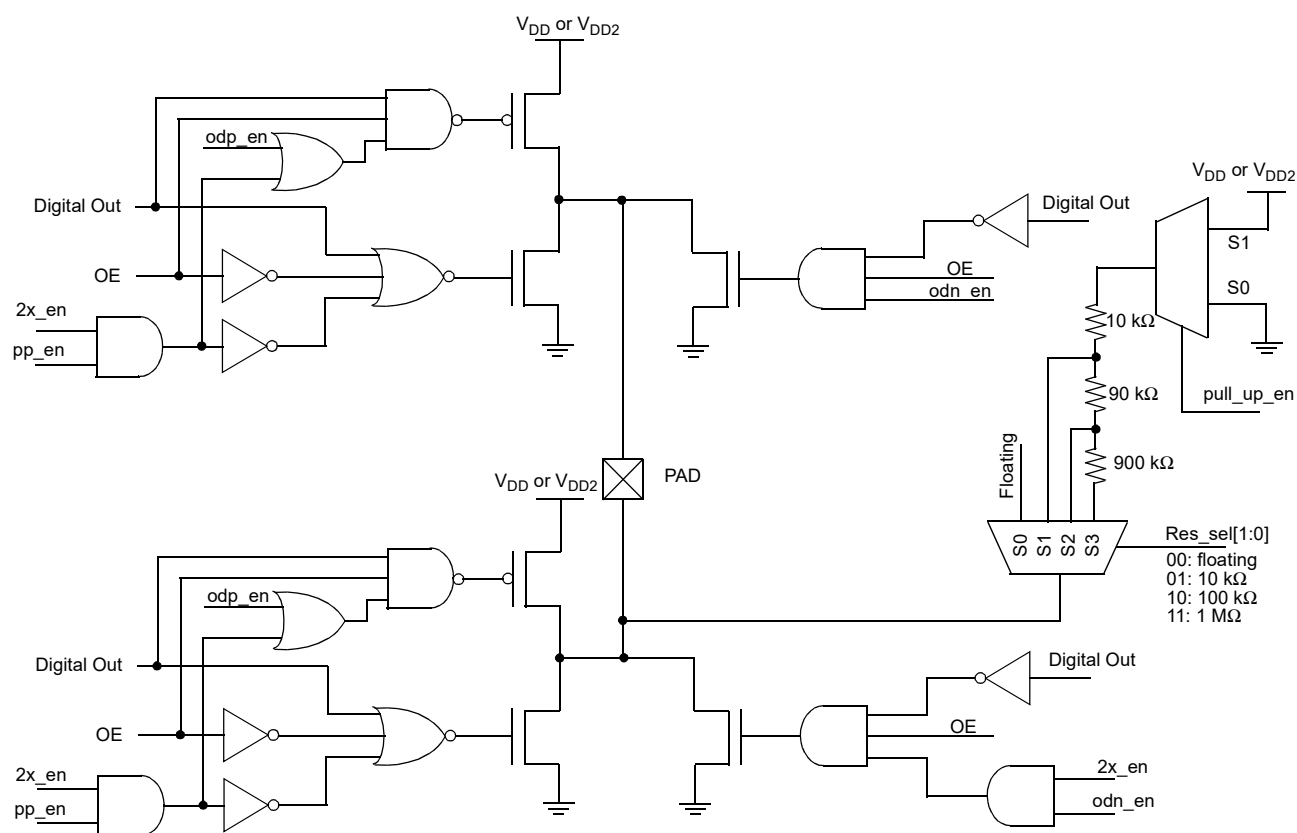


Figure 6: GPIO Register OE IO Structure Diagram

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

5.11 IO TYPICAL PERFORMANCE

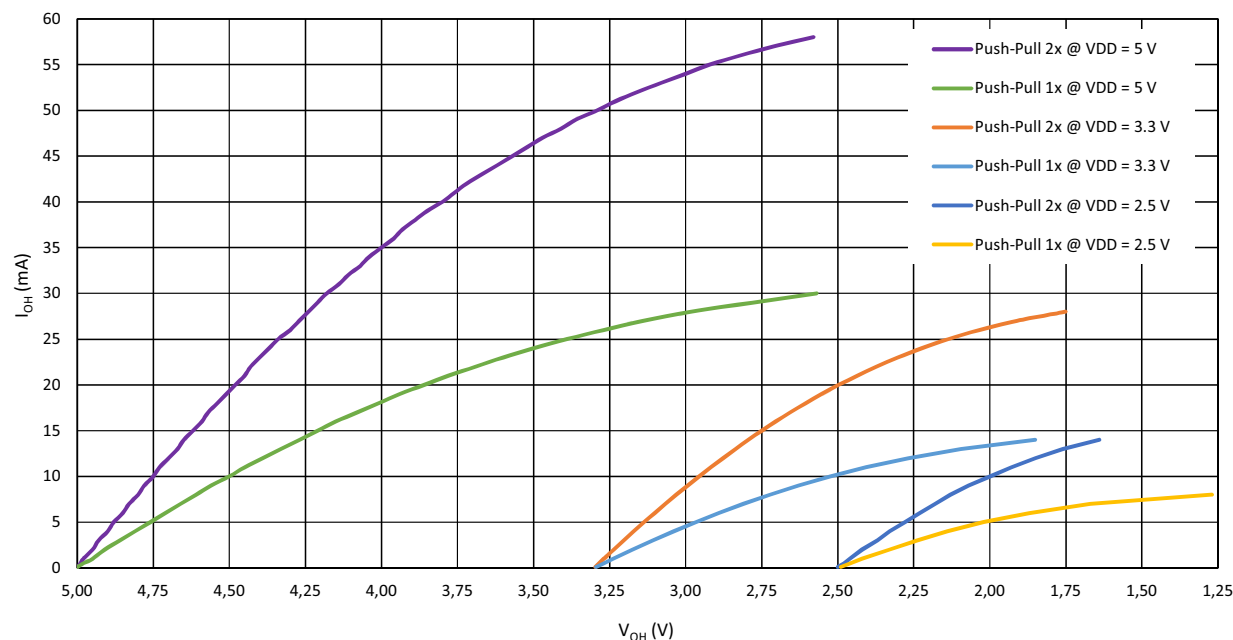


Figure 7: Typical High Level Output Current vs. High Level Output Voltage at $T = 25^\circ\text{C}$

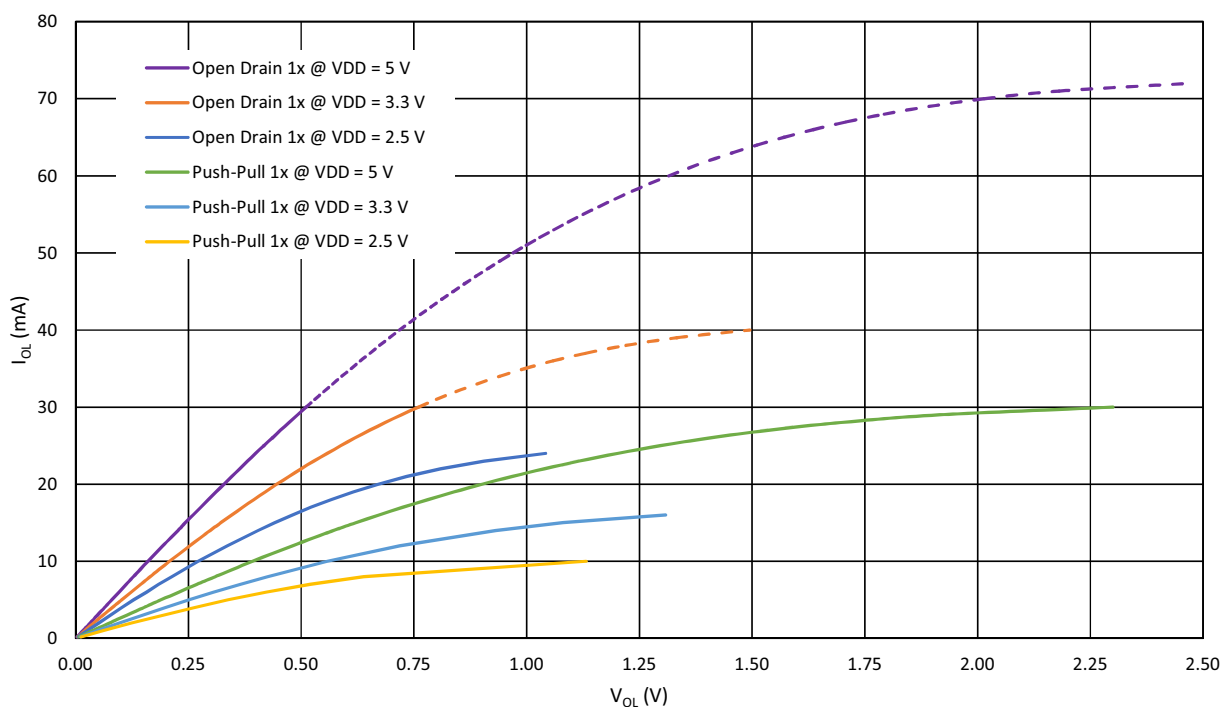


Figure 8: Typical Low Level Output Current vs. Low Level Output Voltage, 1x Drive at $T = 25^\circ\text{C}$, Full Range

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

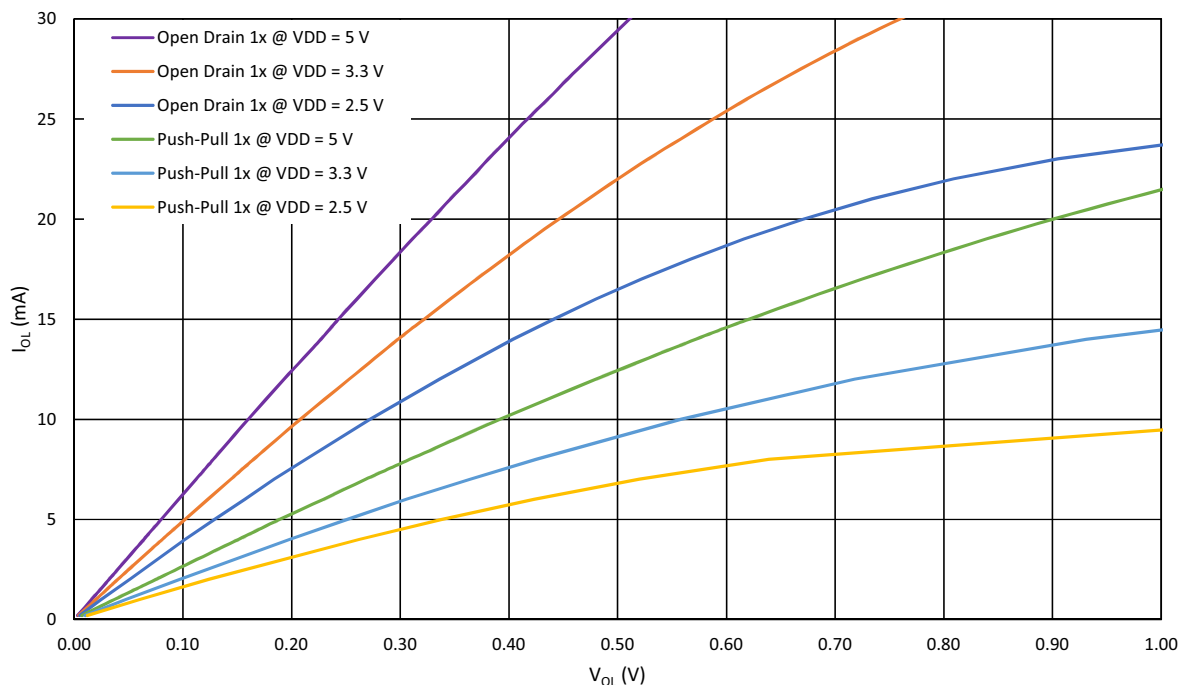


Figure 9: Typical Low Level Output Current vs. Low Level Output Voltage, 1x Drive at T = 25 °C

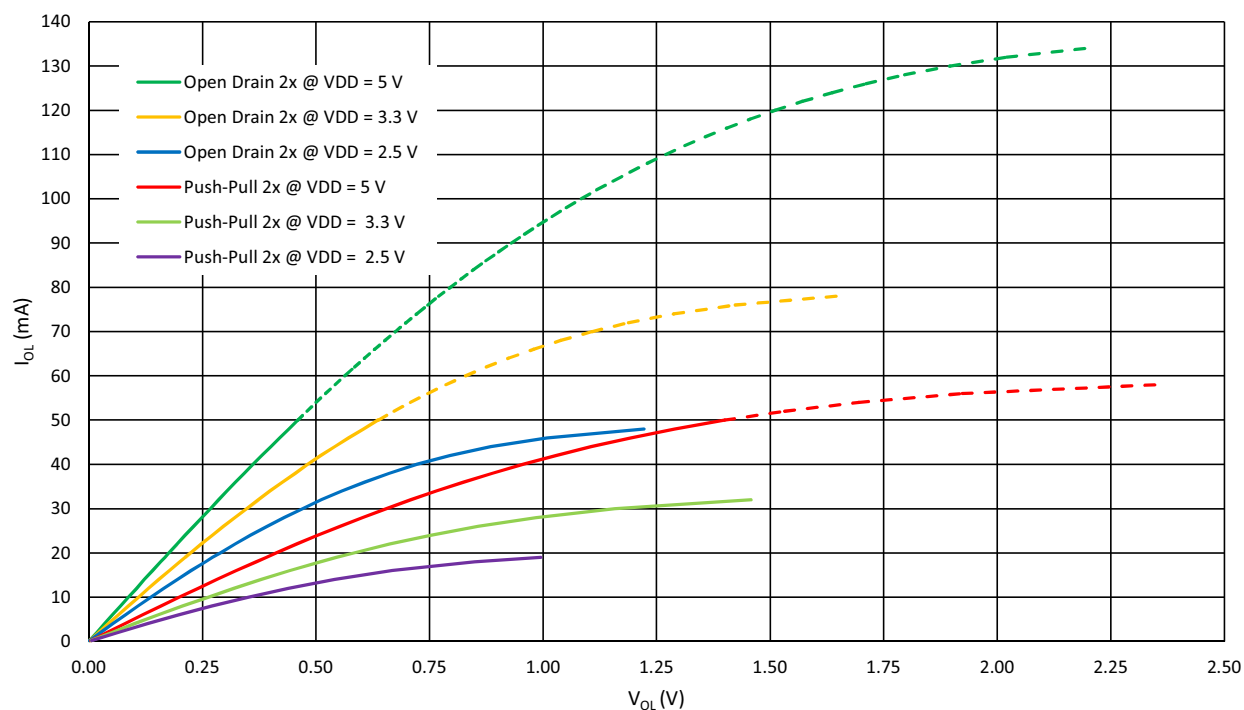


Figure 10: Typical Low Level Output Current vs. Low Level Output Voltage, 2x Drive at T = 25 °C, Full Range

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

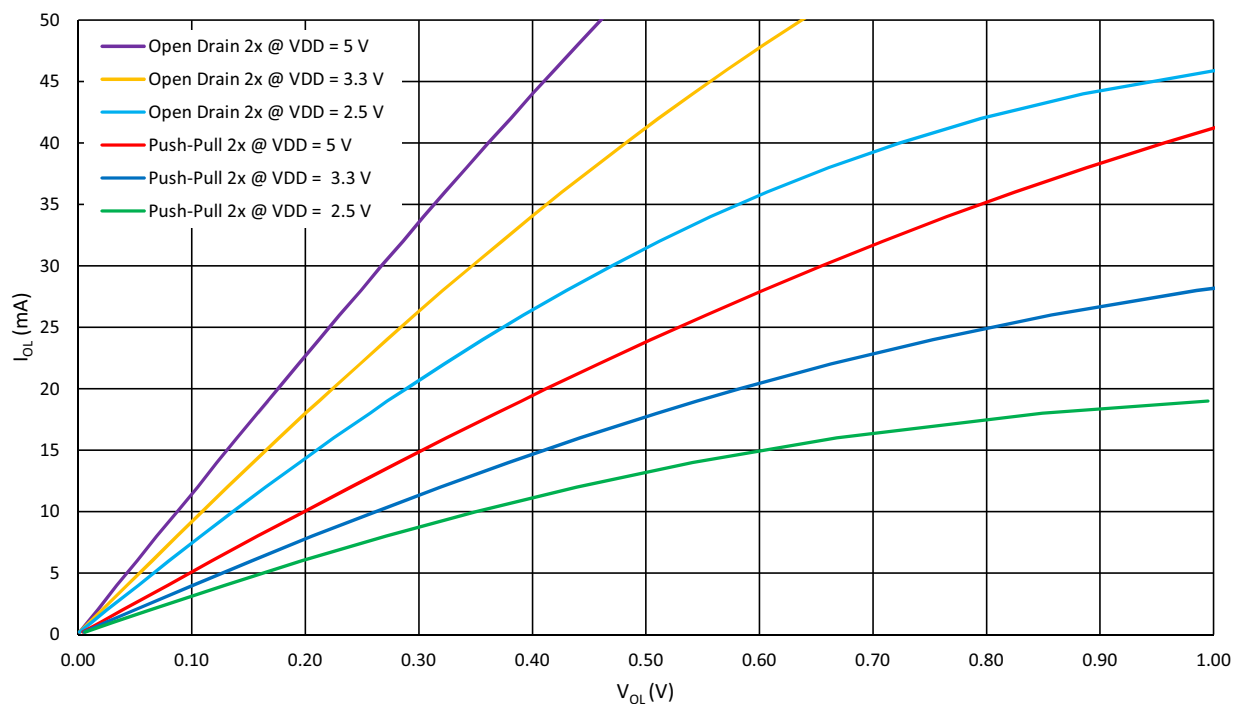


Figure 11: Typical Low Level Output Current vs. Low Level Output Voltage, 2x Drive at $T = 25$ °C

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

6 Connection Matrix

The Connection Matrix in the SLG46824 is used to create the internal routing for internal functional macrocells of the device once it is programmed. The registers are programmed from the multiple-time NVM cell during Test Mode Operation. The output of each functional macrocell within the SLG46824 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 2048 register bits within the SLG46824 are programmed a fully custom circuit will be created.

The Connection Matrix has 64 inputs and 96 outputs. Each of the 64 inputs to the Connection Matrix is hard-wired to the digital output of a particular source macrocell, including IOs, LUTs, analog comparators, other digital resources and V_{DD} and GND. The input to a digital macrocell uses a 6-bit register to select one of these 64 input lines.

For a complete list of the SLG46824’s register table, see Section 17.

Matrix Input Signal Functions	N						
GND	0						
IO0 Digital In	1						
IO1 Digital In	2						
IO2 Digital In	3						
⋮	⋮						
POR OUT	62						
V _{DD}	63						
Matrix Inputs	N	0	1	2	-----	95	
		Registers	registers [5:0]	registers [11:6]	registers [17:12]	-----	registers [575:570]
		Function	Matrix OUT: IN0 of LUT2_0 or Clock Input of DFF0	Matrix OUT: IN1 of LUT2_0 or Data Input of DFF0	Matrix Out: IN0 of LUT2_1 or Clock Input of PGen	-----	Matrix Output 95
Matrix Outputs							

Figure 12: Connection Matrix

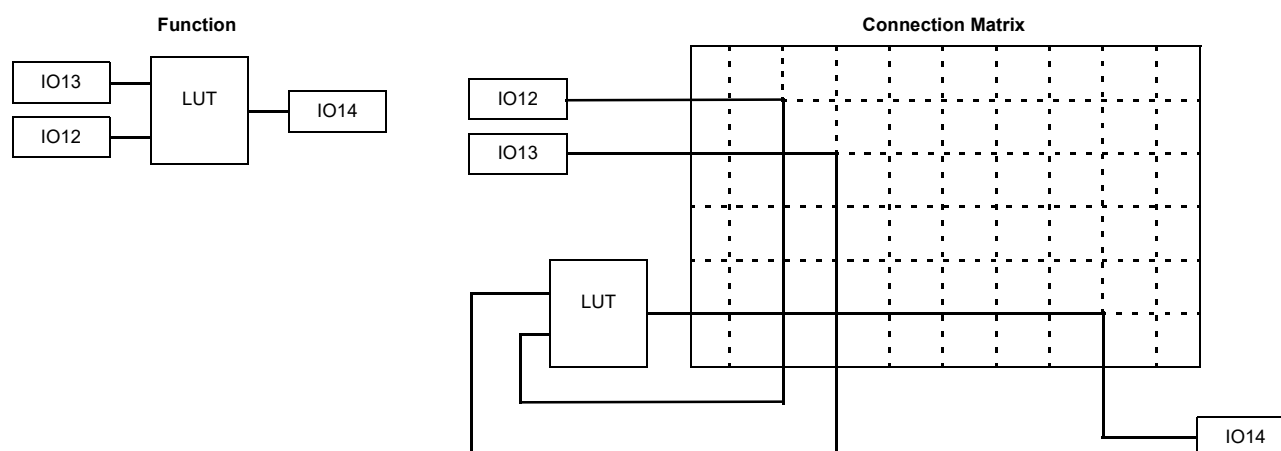


Figure 13: Connection Matrix Example

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

6.1 MATRIX INPUT TABLE

Table 16: Matrix Input Table

Matrix Input Number	Matrix Input Signal Function	Matrix Decode					
		5	4	3	2	1	0
0	GND	0	0	0	0	0	0
1	IO0 Digital Input	0	0	0	0	0	1
2	IO1 Digital Input	0	0	0	0	1	0
3	IO2 Digital Input	0	0	0	0	1	1
4	IO3 Digital Input	0	0	0	1	0	0
5	IO4 Digital Input	0	0	0	1	0	1
6	IO5 Digital Input	0	0	0	1	1	0
7	IO8 Digital Input	0	0	0	1	1	1
8	IO9 Digital Input	0	0	1	0	0	0
9	IO10 Digital Input	0	0	1	0	0	1
10	IO11 Digital Input	0	0	1	0	1	0
11	IO12 Digital Input	0	0	1	0	1	1
12	IO13 Digital Input	0	0	1	1	0	0
13	IO14 Digital Input	0	0	1	1	0	1
14	LUT2_0_DFF0_OUT	0	0	1	1	1	0
15	LUT2_1_DFF1_OUT	0	0	1	1	1	1
16	LUT2_2_DFF2_OUT	0	1	0	0	0	0
17	LUT2_3_PGEN_OUT	0	1	0	0	0	1
18	LUT3_0_DFF3_OUT	0	1	0	0	1	0
19	LUT3_1_DFF4_OUT	0	1	0	0	1	1
20	LUT3_2_DFF5_OUT	0	1	0	1	0	0
21	LUT3_3_DFF6_OUT	0	1	0	1	0	1
22	LUT3_4_DFF7_OUT	0	1	0	1	1	0
23	LUT3_5_DFF8_OUT	0	1	0	1	1	1
24	LUT3_6_PIPEDLY_RIPP_CNT_OUT0	0	1	1	0	0	0
25	PIPEDLY_RIPP_CNT_OUT1	0	1	1	0	0	1
26	RIPP_CNT_OUT2	0	1	1	0	1	0
27	EDET_FILTER_OUT	0	1	1	0	1	1
28	PROG_DLY_EDET_OUT	0	1	1	1	0	0
29	MULTFUNC_8BIT_1: DLY_CNT_OUT	0	1	1	1	0	1
30	CKRCOSC_MATRIX: OSC1 matrix input	0	1	1	1	1	0
31	CKLFOSC_MATRIX: OSC0 matrix input	0	1	1	1	1	1
32	CKRINGOSC_MATRIX: OSC2 matrix input	1	0	0	0	0	0
33	MULTFUNC_8BIT_2: DLY_CNT_OUT	1	0	0	0	0	1
34	MULTFUNC_8BIT_3: DLY_CNT_OUT	1	0	0	0	1	0
35	MULTFUNC_8BIT_4: DLY_CNT_OUT	1	0	0	0	1	1
36	MULTFUNC_8BIT_5: DLY_CNT_OUT	1	0	0	1	0	0
37	MULTFUNC_8BIT_6: DLY_CNT_OUT	1	0	0	1	0	1

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Table 16: Matrix Input Table(Continued)

Matrix Input Number	Matrix Input Signal Function	Matrix Decode					
		5	4	3	2	1	0
38	MULTFUNC_8BIT_7: DLY_CNT_OUT	1	0	0	1	1	0
39	MULTFUNC_16BIT_0: LUT_DFF_OUT	1	0	0	1	1	1
40	MULTFUNC_8BIT_1: LUT_DFF_OUT	1	0	1	0	0	0
41	MULTFUNC_8BIT_2: LUT_DFF_OUT	1	0	1	0	0	1
42	MULTFUNC_8BIT_3: LUT_DFF_OUT	1	0	1	0	1	0
43	MULTFUNC_8BIT_4: LUT_DFF_OUT	1	0	1	0	1	1
44	MULTFUNC_8BIT_5: LUT_DFF_OUT	1	0	1	1	0	0
45	MULTFUNC_8BIT_6: LUT_DFF_OUT	1	0	1	1	0	1
46	MULTFUNC_8BIT_7: LUT_DFF_OUT	1	0	1	1	1	0
47	MULTFUNC_16BIT_0: DLY_CNT_OUT	1	0	1	1	1	1
48	I ² C_virtual_7 Input: register [976]	1	1	0	0	0	0
49	I ² C_virtual_6 Input: register [977]	1	1	0	0	0	1
50	I ² C_virtual_5 Input: register [978]	1	1	0	0	1	0
51	I ² C_virtual_4 Input: register [979]	1	1	0	0	1	1
52	I ² C_virtual_3 Input: register [980]	1	1	0	1	0	0
53	I ² C_virtual_2 Input: register [981]	1	1	0	1	0	1
54	I ² C_virtual_1 Input: register [982]	1	1	0	1	1	0
55	I ² C_virtual_0 Input: register [983]	1	1	0	1	1	1
56	Reserved	1	1	1	0	0	0
57	Reserved	1	1	1	0	0	1
58	ACMP0L_OUT	1	1	1	0	1	0
59	ACMP1L_OUT	1	1	1	0	1	1
60	2nd CKRCOSC_MATRIX	1	1	1	1	0	0
61	2nd CKLFOSC_MATRIX	1	1	1	1	0	1
62	POR OUT	1	1	1	1	1	0
63	V _{DD}	1	1	1	1	1	1

6.2 MATRIX OUTPUT TABLE

Table 17: Matrix Output Table

Register Bit Address	Matrix Output Signal Function	Matrix Output Number
[5:0]	IN0 of LUT2_0 or Clock Input of DFF0	0
[11:6]	IN1 of LUT2_0 or Data Input of DFF0	1
[17:12]	IN0 of LUT2_3 or Clock Input of PGen	2
[23:18]	IN1 of LUT2_3 or nRST of PGen	3
[29:24]	IN0 of LUT2_1 or Clock Input of DFF1	4
[35:30]	IN1 of LUT2_1 or Data Input of DFF1	5
[41:36]	IN0 of LUT2_2 or Clock Input of DFF2	6
[47:42]	IN1 of LUT2_2 or Data Input of DFF2	7
[53:48]	IN0 of LUT3_0 or Clock Input of DFF3	8

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Table 17: Matrix Output Table(Continued)

Register Bit Address	Matrix Output Signal Function	Matrix Output Number
[59:54]	IN1 of LUT3_0 or Data Input of DFF3	9
[65:60]	IN2 of LUT3_0 or nRST(nSET) of DFF3	10
[71:66]	IN0 of LUT3_1 or Clock Input of DFF4	11
[77:72]	IN1 of LUT3_1 or Data Input of DFF4	12
[83:78]	IN2 of LUT3_1 or nRST(nSET) of DFF4	13
[89:84]	IN0 of LUT3_2 or Clock Input of DFF5	14
[95:90]	IN1 of LUT3_2 or Data Input of DFF5	15
[101:96]	IN2 of LUT3_2 or nRST(nSET) of DFF5	16
[107:102]	IN0 of LUT3_3 or Clock Input of DFF6	17
[113:108]	IN1 of LUT3_3 or Data Input of DFF6	18
[119:114]	IN2 of LUT3_3 or nRST(nSET) of DFF6	19
[125:120]	IN0 of LUT3_4 or Clock Input of DFF7	20
[131:126]	IN1 of LUT3_4 or Data Input of DFF7	21
[137:132]	IN2 of LUT3_4 or nRST(nSET) of DFF7	22
[143:138]	IN0 of LUT3_5 or Clock Input of DFF8	23
[149:144]	IN1 of LUT3_5 or Data Input of DFF8	24
[155:150]	IN2 of LUT3_5 or nRST(nSET) of DFF8	25
[161:156]	IN0 of LUT3_6 or Input of Pipe Delay or UP Signal of RIPP CNT	26
[167:162]	IN1 of LUT3_6 or nRST of Pipe Delay or STB of RIPP CNT	27
[173:168]	IN2 of LUT3_6 or Clock of Pipe Delay_RIPP_CNT	28
[179:174]	Reserved	29
[185:180]	MULTFUNC_16BIT_0: IN0 of LUT4_0 or Clock Input of DFF9; Delay0 Input (or Counter0 nRST/SET Input)	30
[191:186]	MULTFUNC_16BIT_0: IN1 of LUT4_0 or nRST of DFF9; Delay0 Input (or Counter0 nRST Input) or Delay/Counter0 External Clock Source	31
[197:192]	MULTFUNC_16BIT_0: IN2 of LUT4_0 or nSET of DFF9; Delay0 Input (or Counter0 nRST Input) or Delay/Counter0 External Clock Source or KEEP Input of FSM0	32
[203:198]	MULTFUNC_16BIT_0: IN3 of LUT4_0 or Data Input of DFF9; Delay0 Input (or Counter0 nRST Input) or UP Input of FSM0	33
[209:204]	MULTFUNC_8BIT_1: IN0 of LUT3_7 or Clock Input of DFF10; Delay1 Input (or Counter1 nRST Input)	34
[215:210]	MULTFUNC_8BIT_1: IN1 of LUT3_7 or nRST (nSET) of DFF10; Delay1 Input (or Counter1 nRST Input) or Delay/Counter1 External Clock Source	35
[221:216]	MULTFUNC_8BIT_1: IN2 of LUT3_7 or Data Input of DFF10; Delay1 Input (or Counter1 nRST Input)	36
[227:222]	MULTFUNC_8BIT_2: IN0 of LUT3_8 or Clock Input of DFF11; Delay2 Input (or Counter2 nRST Input);	37
[233:228]	MULTFUNC_8BIT_2: IN1 of LUT3_8 or nRST (nSET) of DFF11; Delay2 Input (or Counter2 nRST Input) or Delay/Counter2 External Clock Source	38
[239:234]	MULTFUNC_8BIT_2: IN2 of LUT3_8 or Data Input of DFF11; Delay2 Input (or Counter2 nRST Input)	39

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Table 17: Matrix Output Table(Continued)

Register Bit Address	Matrix Output Signal Function	Matrix Output Number
[245:240]	MULTFUNC_8BIT_3: IN0 of LUT3_9 or Clock Input of DFF12; Delay3 Input (or Counter3 nRST Input)	40
[251:246]	MULTFUNC_8BIT_3: IN1 of LUT3_9 or nRST (nSET) of DFF12; Delay3 Input (or Counter3 nRST Input) or Delay/Counter3 External Clock Source	41
[257:252]	MULTFUNC_8BIT_3: IN2 of LUT3_9 or Data Input of DFF12; Delay3 Input (or Counter3 nRST Input)	42
[263:258]	MULTFUNC_8BIT_4: IN0 of LUT3_10 or Clock Input of DFF13; Delay4 Input (or Counter4 nRST Input)	43
[269:264]	MULTFUNC_8BIT_4: IN1 of LUT3_10 or nRST (nSET) of DFF13; Delay4 Input (or Counter4 nRST Input) or Delay/Counter4 External Clock Source	44
[275:270]	MULTFUNC_8BIT_4: IN2 of LUT3_10 or Data Input of DFF13; Delay4 Input (or Counter4 nRST Input)	45
[281:276]	MULTFUNC_8BIT_5: IN0 of LUT3_11 or Clock Input of DFF14; Delay5 Input (or Counter5 nRST Input)	46
[287:282]	MULTFUNC_8BIT_5: IN1 of LUT3_11 or nRST (nSET) of DFF14; Delay5 Input (or Counter5 nRST Input) or Delay/Counter5 External Clock Source	47
[293:288]	MULTFUNC_8BIT_5: IN2 of LUT3_11 or Data Input of DFF14; Delay5 Input (or Counter5 nRST Input)	48
[299:294]	MULTFUNC_8BIT_6: IN0 of LUT3_12 or Clock Input of DFF15; Delay6 Input (or Counter6 nRST Input)	49
[305:300]	MULTFUNC_8BIT_6: IN1 of LUT3_12 or nRST (nSET) of DFF15; Delay6 Input (or Counter6 nRST Input) or Delay/Counter6 External Clock Source	50
[311:306]	MULTFUNC_8BIT_6: IN2 of LUT3_12 or Data Input of DFF15; Delay6 Input (or Counter6 nRST Input)	51
[317:312]	MULTFUNC_8BIT_7: IN0 of LUT3_13 or Clock Input of DFF16; Delay7 Input (or Counter7 nRST Input)	52
[323:318]	MULTFUNC_8BIT_7: IN1 of LUT3_13 or nRST (nSET) of DFF16; Delay7 Input (or Counter7 nRST Input) or Delay/Counter7 External Clock Source	53
[329:324]	MULTFUNC_8BIT_7: IN2 of LUT3_13 or Data Input of DFF16; Delay7 Input (or Counter7 nRST Input)	54
[335:330]	Filter/Edge detect input	55
[341:336]	Programmable delay/edge detect input	56
[347:342]	OSC2 ENABLE from matrix	57
[353:348]	OSC0 ENABLE from matrix	58
[359:354]	OSC1 ENABLE matrix	59
[365:360]	Vref PD from matrix	60
[371:366]	BG power-down from matrix	61
[377:372]	Reserved	62
[383:378]	Reserved	63
[389:384]	PWR UP of ACMP0L from matrix	64
[395:390]	PWR UP of ACMP1L from matrix	65
[401:396]	Reserved	66
[407:402]	IO0 Digital Output	67
[413:408]	IO1 Digital Output	68

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Table 17: Matrix Output Table(Continued)

Register Bit Address	Matrix Output Signal Function	Matrix Output Number
[419:414]	IO1 Digital Output OE	69
[425:420]	IO2 Digital Output	70
[431:426]	IO3 Digital Output	71
[437:432]	IO4 Digital Output	72
[443:438]	IO4 Digital Output OE	73
[449:444]	IO5 Digital Output	74
[455:450]	IO5 Digital Output OE	75
[461:456]	IO6 Digital Output	76
[467:462]	IO7 Digital Output	77
[473:468]	IO8 Digital Output	78
[479:474]	IO8 Digital Output OE	79
[485:480]	IO9 Digital Output	80
[491:486]	IO9 Digital Output OE	81
[497:492]	IO10 Digital Output	82
[503:498]	IO10 Digital Output OE	83
[509:504]	IO11 Digital Output	84
[515:510]	IO11 Digital Output OE	85
[521:516]	IO12 Digital Output	86
[527:522]	IO12 Digital Output OE	87
[533:528]	IO13 Digital Output	88
[539:534]	IO13 Digital Output OE	89
[545:540]	IO14 Digital Output	90
[551:546]	IO14 Digital Output OE	91
[557:552]	Reserved	92
[563:558]	Reserved	93
[569:564]	Matrix OUT 94	94
[575:570]	Matrix OUT 95	95

Note 1 For each Address, the two most significant bits are unused.

6.3 CONNECTION MATRIX VIRTUAL INPUTS

As mentioned previously, the Connection Matrix inputs come from the outputs of various digital macrocells on the device. Eight of the Connection Matrix inputs have the special characteristic that the state of these signal lines comes from a corresponding data bit written as a register value via I²C. This gives the user the ability to write data via the serial channel, and have this information translated into signals that can be driven into the Connection Matrix and from the Connection Matrix to the digital inputs of other macrocells on the device. The I²C address for reading and writing these register values is at 0x7A (0122).

An I²C write command to these register bits will set the signal values going into the Connection Matrix to the desired state. A read command to these register bits will read either the original data values coming from the NVM memory bits (that were loaded during the initial device startup), or the values from a previous write command (if that has happened). See [Table 18](#).

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Table 18: Connection Matrix Virtual Inputs

Matrix Input Number	Matrix Input Signal Function	Register Bit Addresses (d)
55	I ² C_virtual_0 Input	[983]
54	I ² C_virtual_1 Input	[982]
53	I ² C_virtual_2 Input	[981]
52	I ² C_virtual_3 Input	[980]
51	I ² C_virtual_4 Input	[979]
50	I ² C_virtual_5 Input	[978]
49	I ² C_virtual_6 Input	[977]
48	I ² C_virtual_7 Input	[976]

6.4 CONNECTION MATRIX VIRTUAL OUTPUTS

The digital outputs of the various macrocells are routed to the Connection Matrix to enable interconnections to the inputs of other macrocells in the device. At the same time, it is possible to read the state of each of the macrocell outputs as a register value via I²C. This option, called Connection Matrix Virtual Outputs, allows the user to remotely read the values of each macrocell output. The I²C addresses for reading these register values are 0x74 (0116) to 0x7B (0123). Write commands to these same register values will be ignored (with the exception of the Virtual Input register bits at 0x7A (0122)).

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

7 Combination Function Macrocells

The SLG46824 has 11 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.

- Three macrocells that can serve as either 2-bit LUT or as D Flip-Flop
- Six macrocells that can serve as either 3-bit LUTs or as D Flip-Flops with Set/Reset Input
- One macrocell that can serve as either 3-bit LUT or as Pipe Delay/Ripple Counter
- One macrocell that can serve as either 2-bit LUT or as Programmable Pattern Generator (PGen)

Inputs/Outputs for the 11 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).

7.1 2-BIT LUT OR D FLIP-FLOP MACROCELLS

There are three macrocells that can serve as either 2-bit LUT or as D Flip-Flop. When used to implement LUT functions, the 2-bit LUT takes 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.

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: when CLK is Low, then $Q = D$; otherwise Q remains its previous value (input D has no effect on the output, when CLK is High)

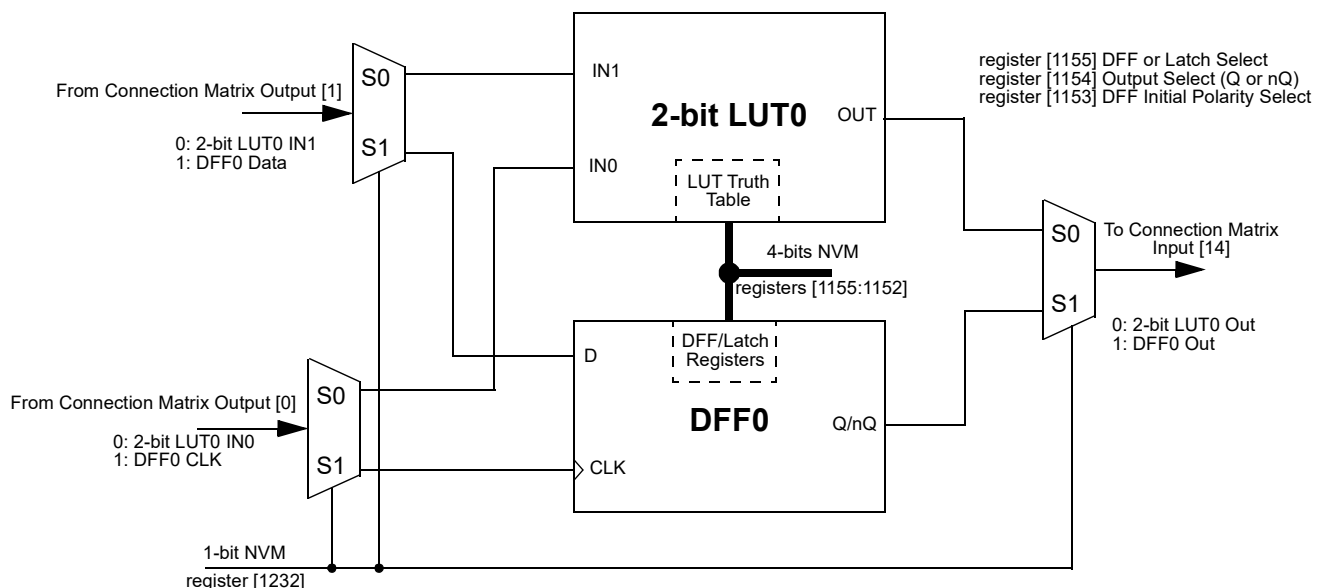


Figure 14: 2-bit LUT0 or DFF0

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

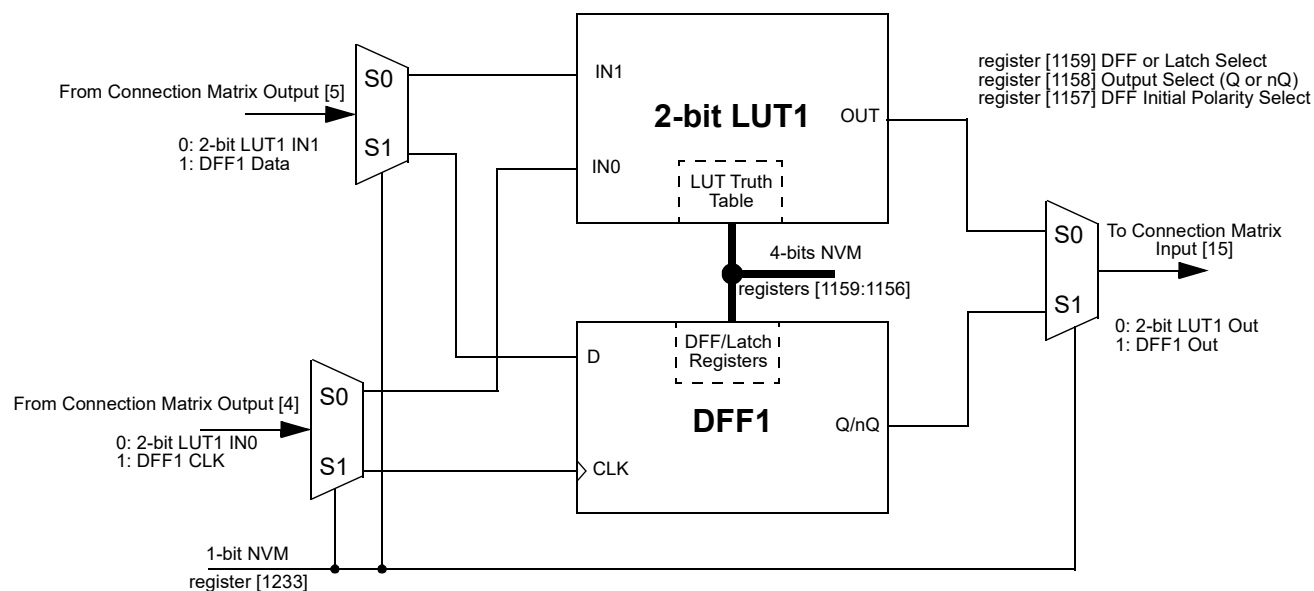


Figure 15: 2-bit LUT1 or DFF1

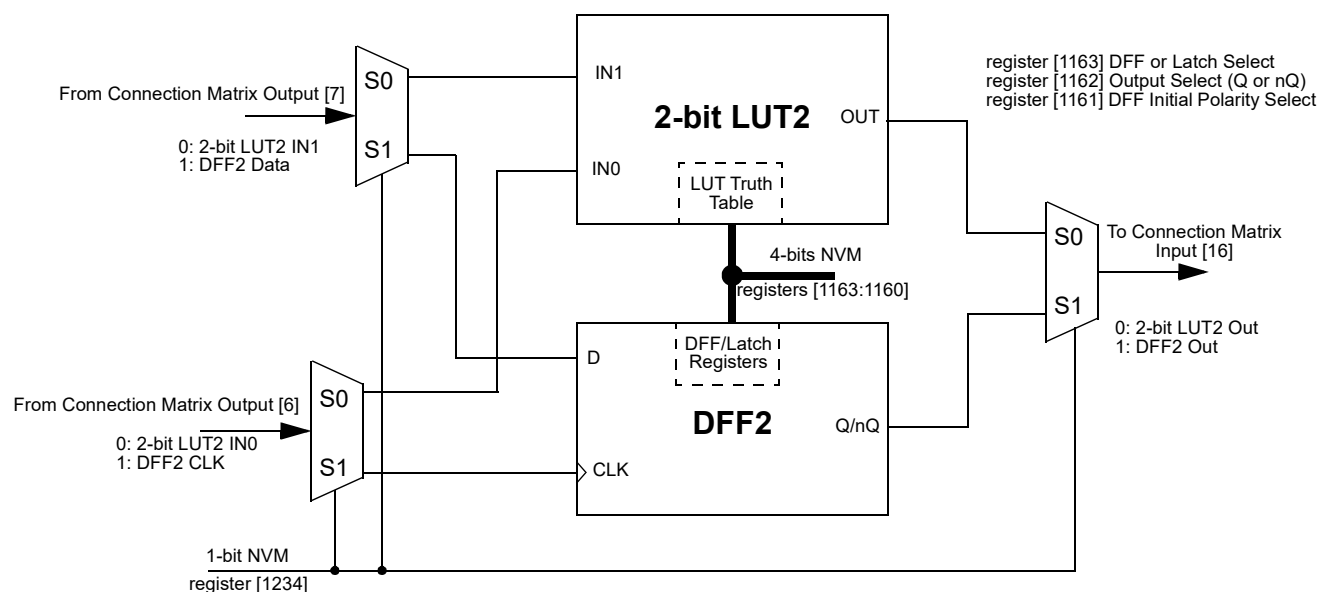


Figure 16: 2-bit LUT2 or DFF2

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

7.1.1 2-Bit LUT or D Flip-Flop Macrocell Used as 2-Bit LUT

Table 19: 2-bit LUT0 Truth Table

IN1	IN0	OUT	
0	0	register [1152]	LSB
0	1	register [1153]	
1	0	register [1154]	
1	1	register [1155]	MSB

Table 20: 2-bit LUT1 Truth Table

IN1	IN0	OUT	
0	0	register [1156]	LSB
0	1	register [1157]	
1	0	register [1158]	
1	1	register [1159]	MSB

Table 21: 2-bit LUT2 Truth Table

IN1	IN0	OUT	
0	0	register [1160]	LSB
0	1	register [1161]	
1	0	register [1162]	
1	1	register [1163]	MSB

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

2-Bit LUT0 is defined by registers [1155:1152]

2-Bit LUT1 is defined by registers [1159:1156]

2-Bit LUT2 is defined by registers [1163:1160]

The [Table 22](#) shows the register bits for the standard digital logic devices (AND, NAND, OR, NOR, XOR, XNOR) that can be created within each of the 2-bit LUT logic cells.

Table 22: 2-bit LUT Standard Digital Functions

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

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

7.1.2 Initial Polarity Operations

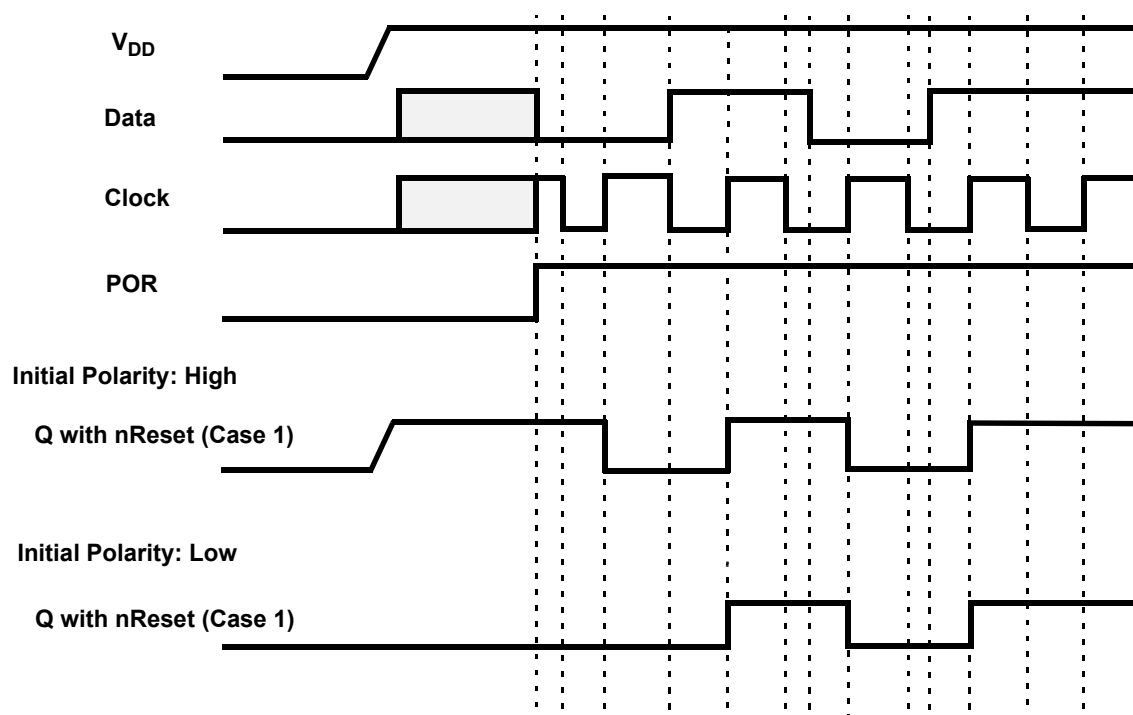


Figure 17: DFF Polarity Operations

7.2 2-BIT LUT OR PROGRAMMABLE PATTERN GENERATOR

The SLG46824 has one combination function macrocell that can serve as a logic or timing function. This macrocell can serve as a Look Up Table (LUT), or Programmable Pattern Generator (PGen).

When used to implement LUT functions, the 2-bit LUT takes in two input signals from the connection matrix and produces a single output, which goes back into the connection matrix. When used as a LUT to implement combinatorial logic functions, the outputs of the LUT can be configured to any user defined function, including the following standard digital logic devices (AND, NAND, OR, NOR, XOR, XNOR). The user can also define the combinatorial relationship between inputs and outputs to be any selectable function.

When operating as a Programmable Pattern Generator, the output of the macrocell with clock out a sequence of two to sixteen bits that are user selectable in their bit values, and user selectable in the number of bits (up to sixteen) that are output before the pattern repeats.

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

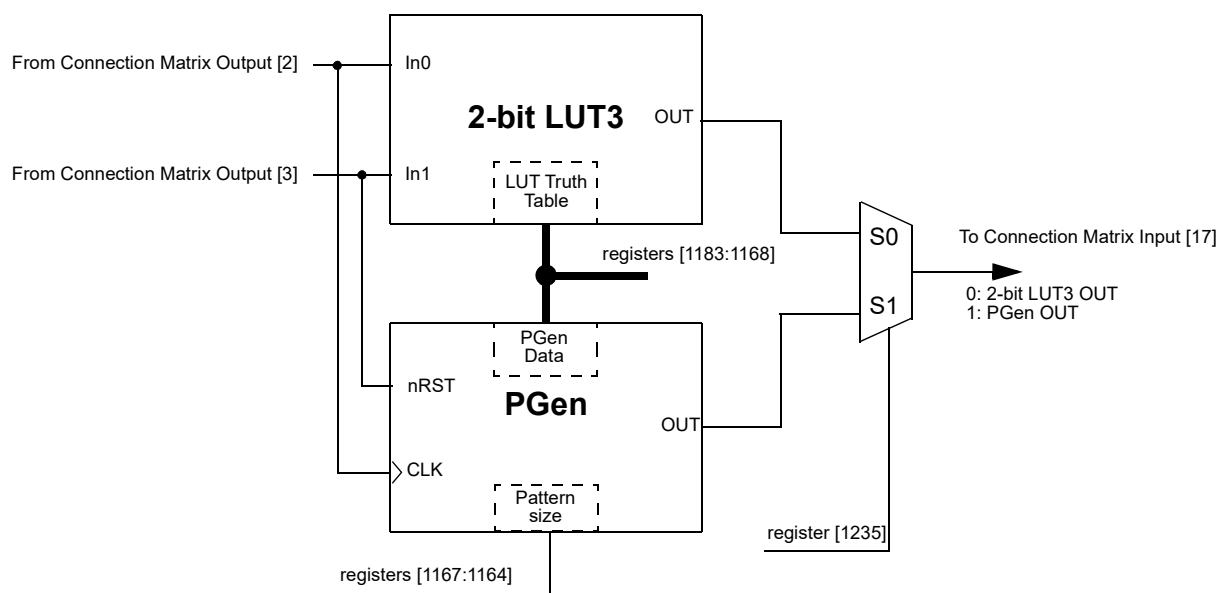


Figure 18: 2-bit LUT3 or PGen

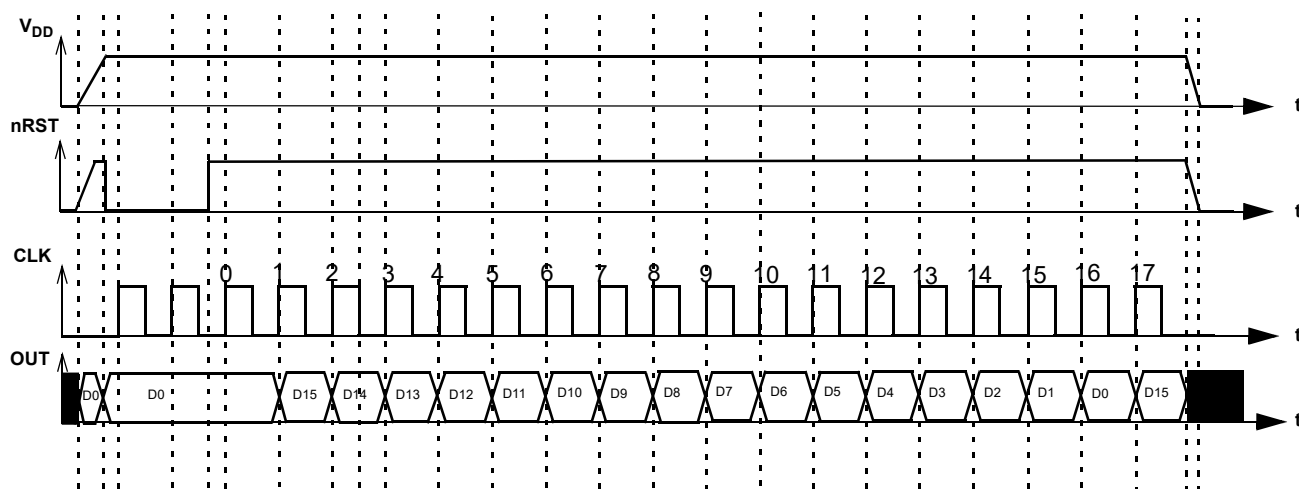


Figure 19: PGen Timing Diagram

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

7.2.1 2-Bit LUT or PGen Macrocell Used as 2-Bit LUT

Table 23: 2-bit LUT1 Truth Table

IN1	IN0	OUT	
0	0	register [1164]	LSB
0	1	register [1165]	
1	0	register [1166]	
1	1	register [1167]	MSB

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

2-Bit LUT3 is defined by registers [1167:1164]

The [Table 24](#) shows the register bits for the standard digital logic devices (AND, NAND, OR, NOR, XOR, XNOR) that can be created within each of the 2-bit LUT logic cells.

Table 24: 2-bit LUT Standard Digital Functions

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

7.3 3-BIT LUT OR D FLIP-FLOP WITH SET/RESET MACROCELLS

There are six macrocells that can serve as either 3-bit LUTs or as D Flip-Flops with Set/Reset inputs. 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.

DFF3 operation is described below:

- If register [1237] = 0, and the CLK is rising edge triggered, then Q = D, otherwise Q will not change
- If register [1237] = 1, then data from D is written into the DFF by the rising edge on CLK and output to Q by the falling edge on CLK.

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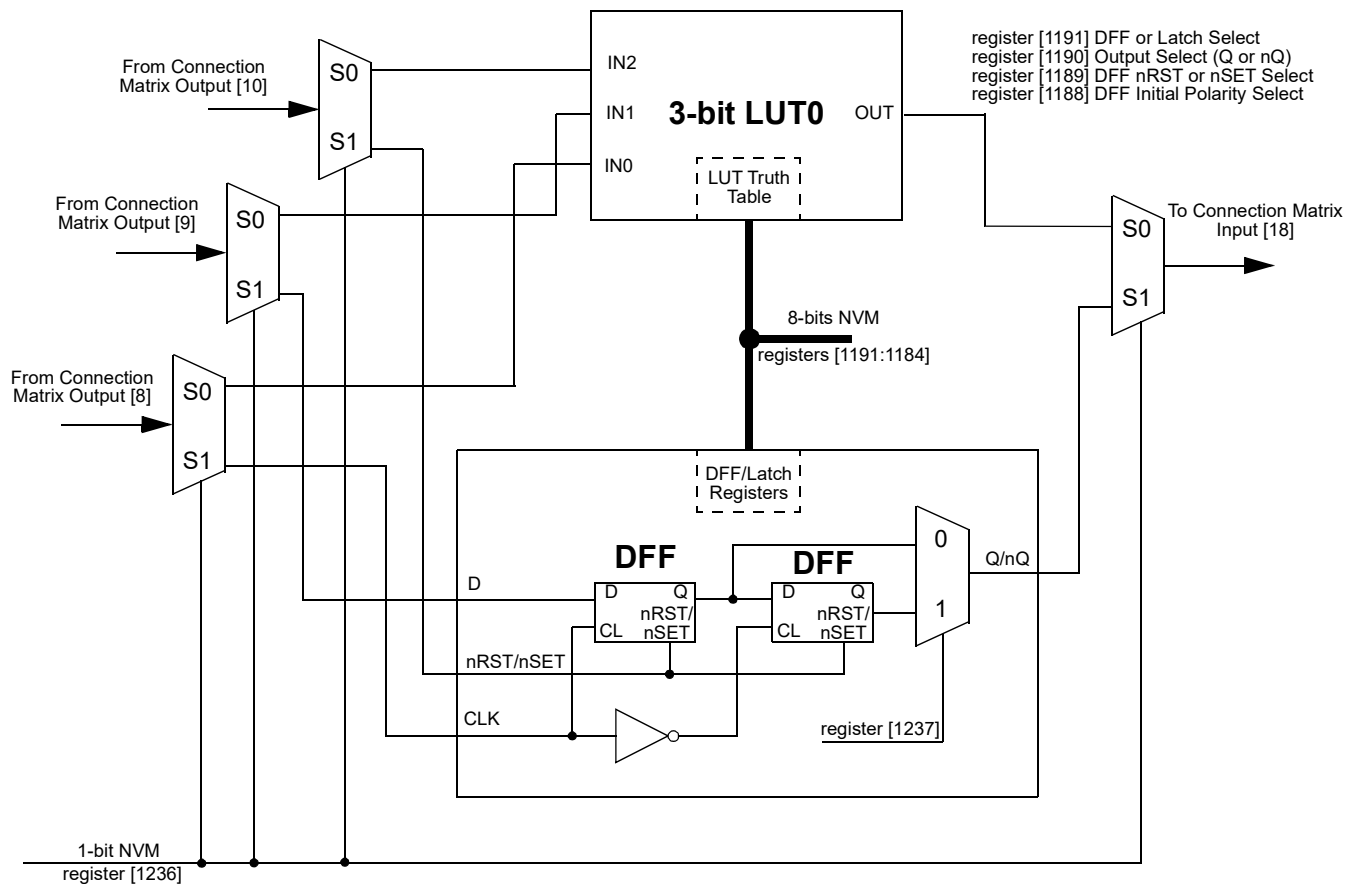


Figure 20: 3-bit LUT0 or DFF3

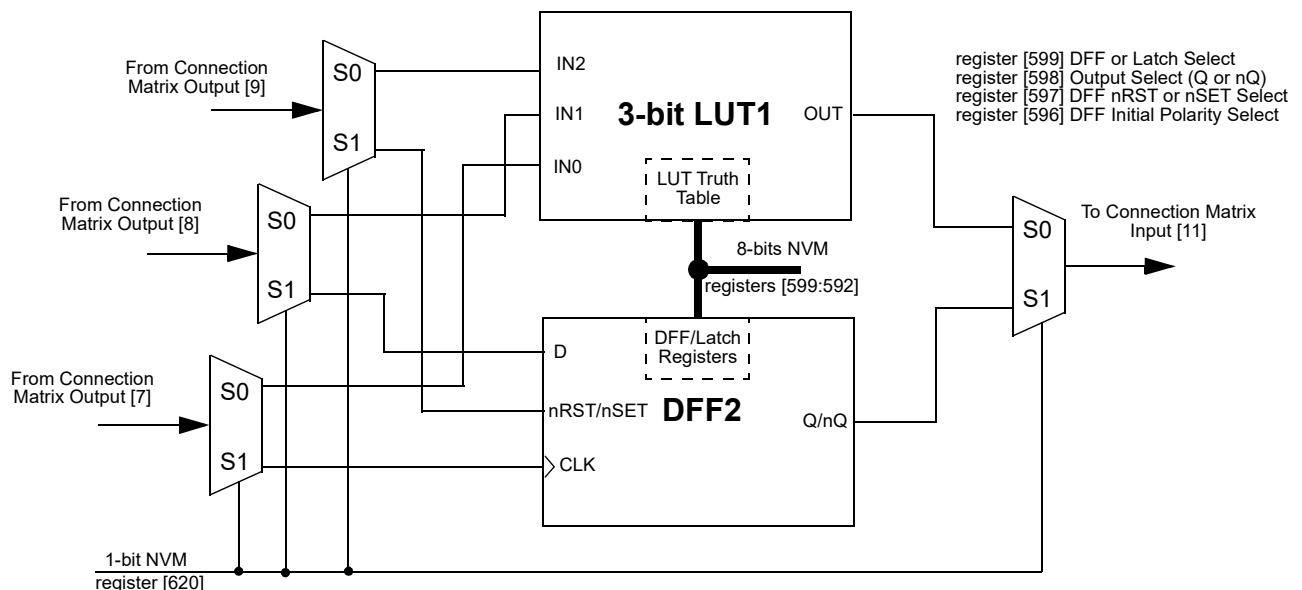


Figure 21: 3-bit LUT1 or DFF2

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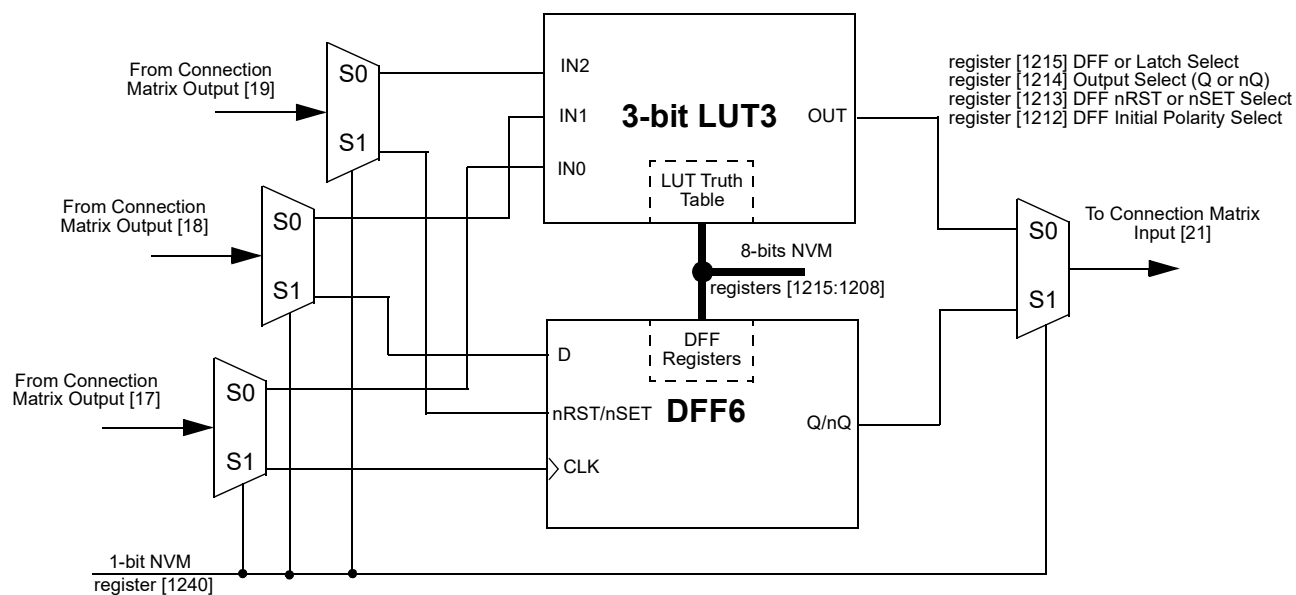


Figure 24: 3-bit LUT3 or DFF6

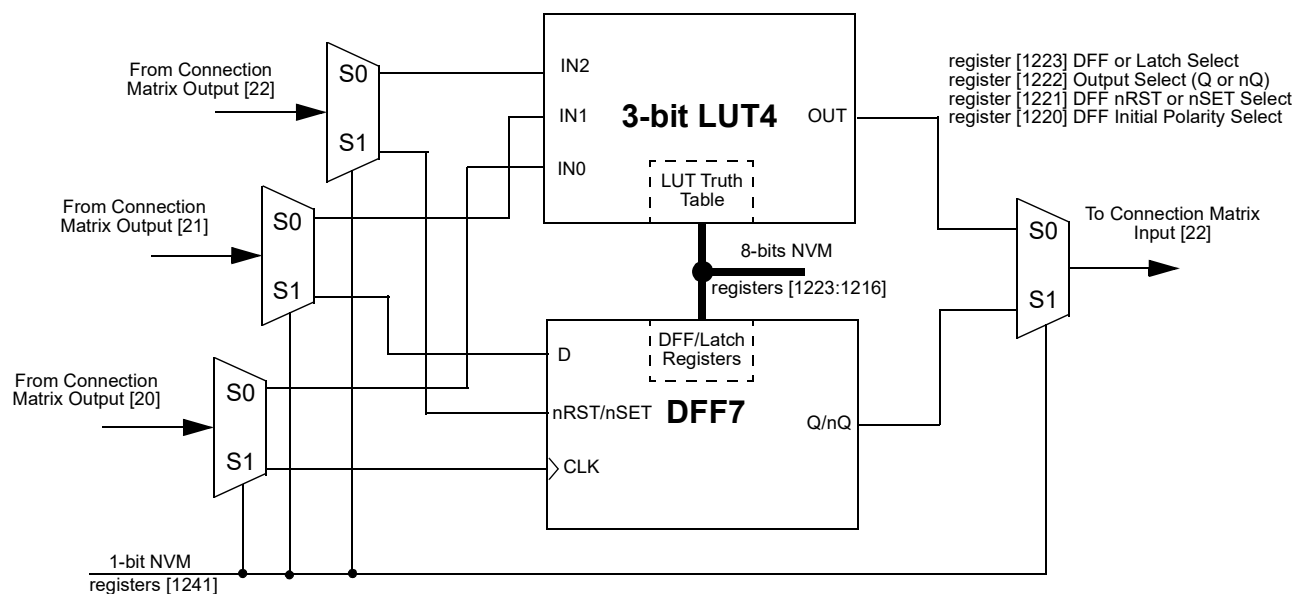


Figure 25: 3-bit LUT4 or DFF7

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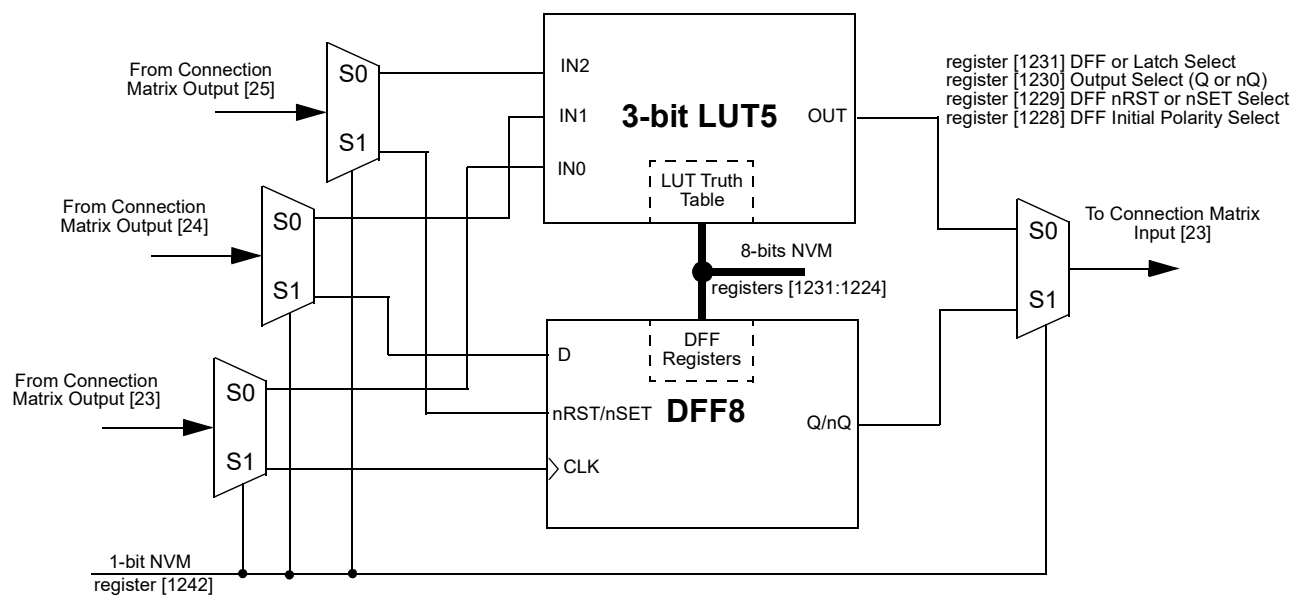


Figure 26: 3-bit LUT5 or DFF8

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7.3.1 3-Bit LUT or D Flip-Flop Macrocells Used as 3-Bit LUTs

Table 25: 3-bit LUT0 Truth Table

IN2	IN1	IN0	OUT	
0	0	0	register [1184]	LSB
0	0	1	register [1185]	
0	1	0	register [1186]	
0	1	1	register [1187]	
1	0	0	register [1188]	
1	0	1	register [1189]	
1	1	0	register [1190]	
1	1	1	register [1191]	MSB

Table 26: 3-bit LUT1 Truth Table

IN2	IN1	IN0	OUT	
0	0	0	register [1192]	LSB
0	0	1	register [1193]	
0	1	0	register [1194]	
0	1	1	register [1195]	
1	0	0	register [1196]	
1	0	1	register [1197]	
1	1	0	register [1198]	
1	1	1	register [1199]	MSB

Table 27: 3-bit LUT2 Truth Table

IN2	IN1	IN0	OUT	
0	0	0	register [1200]	LSB
0	0	1	register [1201]	
0	1	0	register [1202]	
0	1	1	register [1203]	
1	0	0	register [1204]	
1	0	1	register [1205]	
1	1	0	register [1206]	
1	1	1	register [1207]	MSB

Table 28: 3-bit LUT3 Truth Table

IN2	IN1	IN0	OUT	
0	0	0	register [1208]	LSB
0	0	1	register [1209]	
0	1	0	register [1210]	
0	1	1	register [1211]	
1	0	0	register [1212]	
1	0	1	register [1213]	
1	1	0	register [1214]	
1	1	1	register [1215]	MSB

Table 29: 3-bit LUT4 Truth Table

IN2	IN1	IN0	OUT	
0	0	0	register [1216]	LSB
0	0	1	register [1217]	
0	1	0	register [1218]	
0	1	1	register [1219]	
1	0	0	register [1220]	
1	0	1	register [1221]	
1	1	0	register [1222]	
1	1	1	register [1223]	MSB

Table 30: 3-bit LUT5 Truth Table

IN2	IN1	IN0	OUT	
0	0	0	register [1224]	LSB
0	0	1	register [1225]	
0	1	0	register [1226]	
0	1	1	register [1227]	
1	0	0	register [1228]	
1	0	1	register [1229]	
1	1	0	register [1230]	
1	1	1	register [1231]	MSB

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

3-Bit LUT0 is defined by registers [1191:1184]

3-Bit LUT1 is defined by registers [1199:1192]

3-Bit LUT2 is defined by registers [1207:1200]

3-Bit LUT3 is defined by registers [1215:1208]

3-Bit LUT4 is defined by registers [1223:1216]

3-Bit LUT5 is defined by registers [1231:1224]

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

The [Table 31](#) shows the register bits for the standard digital logic devices (AND, NAND, OR, NOR, XOR, XNOR) that can be created within each of the four 3-bit LUT logic cells.

Table 31: 3-bit LUT Standard Digital Functions

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

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

7.3.2 Initial Polarity Operations

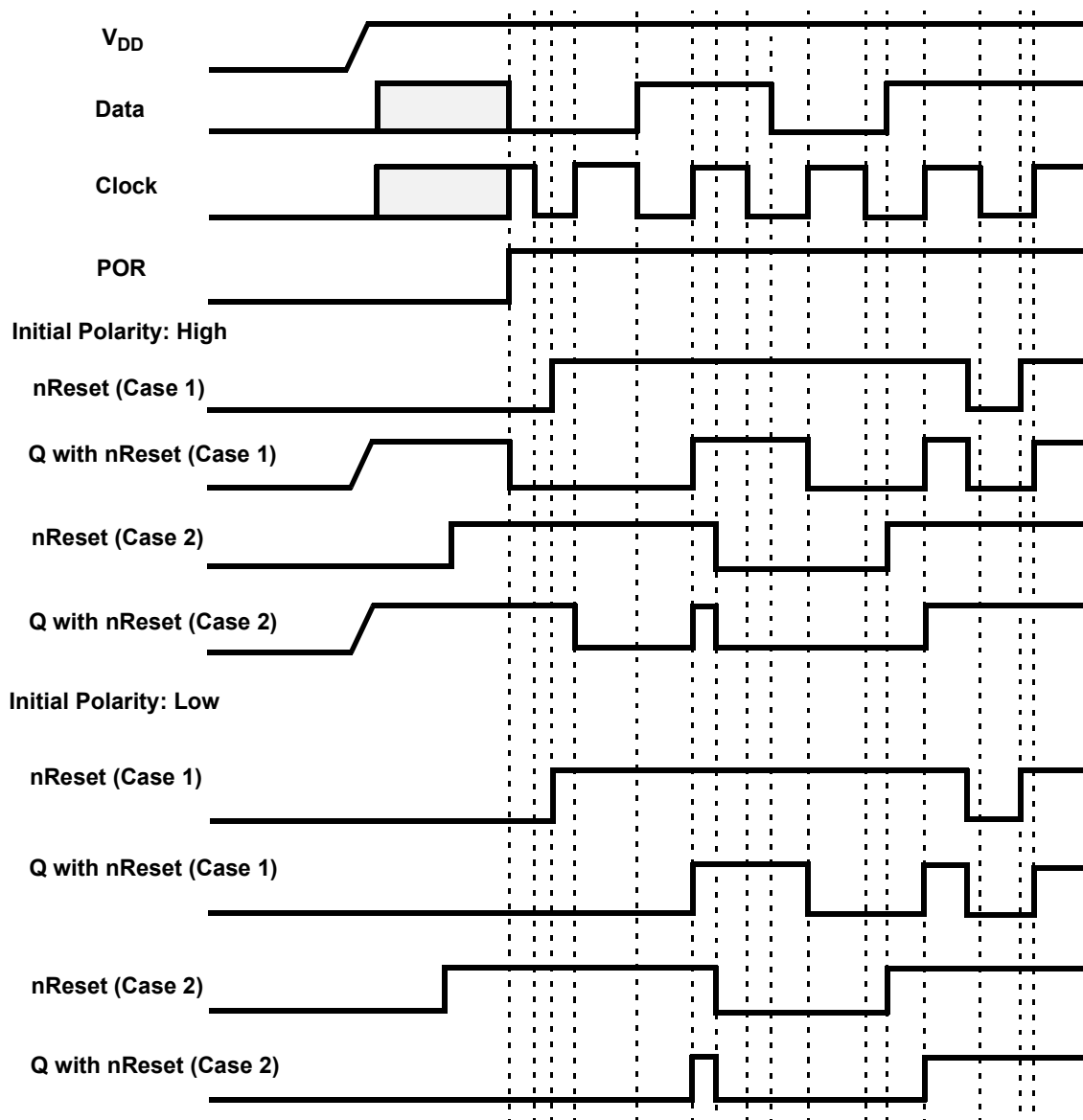


Figure 27: DFF Polarity Operations with nReset

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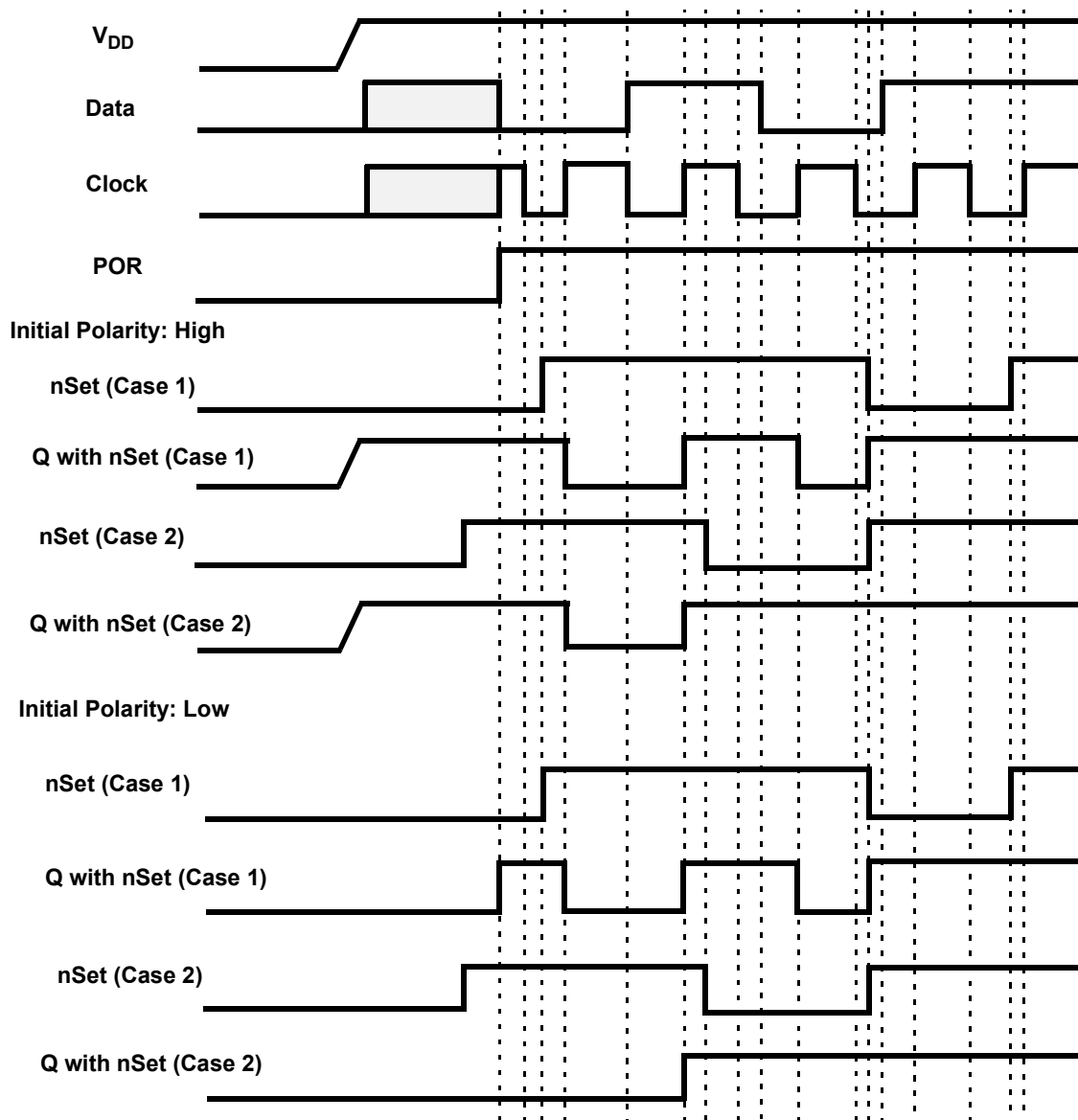


Figure 28: DFF Polarity Operations with nSet

7.4 3-BIT LUT OR PIPE DELAY/RIPPLE COUNTER MACROCELL

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

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 a pipe delay, there are three input signals from the matrix, Input (IN), Clock (CLK) and Reset (nRST). The pipe delay cell is built from 16 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 input (IN). Both of the two outputs (OUT0 and OUT1) provide user selectable options for 1 to 16 stages of delay. There are delay output points for each set of the OUT0 and OUT1 outputs to a 4-input mux that is controlled by registers [1251:1248] for OUT0 and registers [1255:1252] for OUT1. The 4-input mux is used to control the selection of the amount of delay.

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

The overall time of the delay is based on the clock used in the SLG46824 design. Each DFF cell has a time delay of the inverse of the clock time (either external clock or the internal Oscillator within the SLG46824). The sum of the number of DFF cells used will be the total time delay of the Pipe Delay logic cell. OUT1 Output can be inverted (as selected by register [1256]).

In the Ripple Counter mode, there are 3 options for setting, which use 7 bits. There are 3 bits to set **nSET value (SV)** in range from 0 to 7. It is a value, which will be set into the Ripple Counter outputs when nSET input goes LOW. **End value (EV)** will use 3 bits for setting outputs code, which will be last code in the cycle. After reaching the EV, the Ripple Counter goes to the first code by the rising edge on CLK input. The **Functionality mode** option uses 1 bit. This setting defines how exactly Ripple Counter will operate.

The user can select one of the functionality modes by register: RANGE or FULL. If the RANGE option is selected, the count starts from SV. If UP input is LOW the count goes down: $SV \rightarrow EV \rightarrow EV-1$ to $SV+1 \rightarrow SV$ etc (if SV is smaller than EV) or $SV \rightarrow SV-1$ to $EV+1 \rightarrow EV \rightarrow SV$ (if SV is bigger than EV). If UP input is HIGH, count starts from SV up to EV etc.

In the FULL range configuration the Ripple Counter functions as follows. If UP input is LOW, the count starts from SV and goes down to 0. Then current counter value jumps to EV and goes down to 0 etc.

If UP input is HIGH, count goes up starting from SV. Then current counter value jumps to 0 and counts up to EV etc. see Ripple counter functionality example in [Figure 30](#).

Every step is executed by the rising edge on CLK input.

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

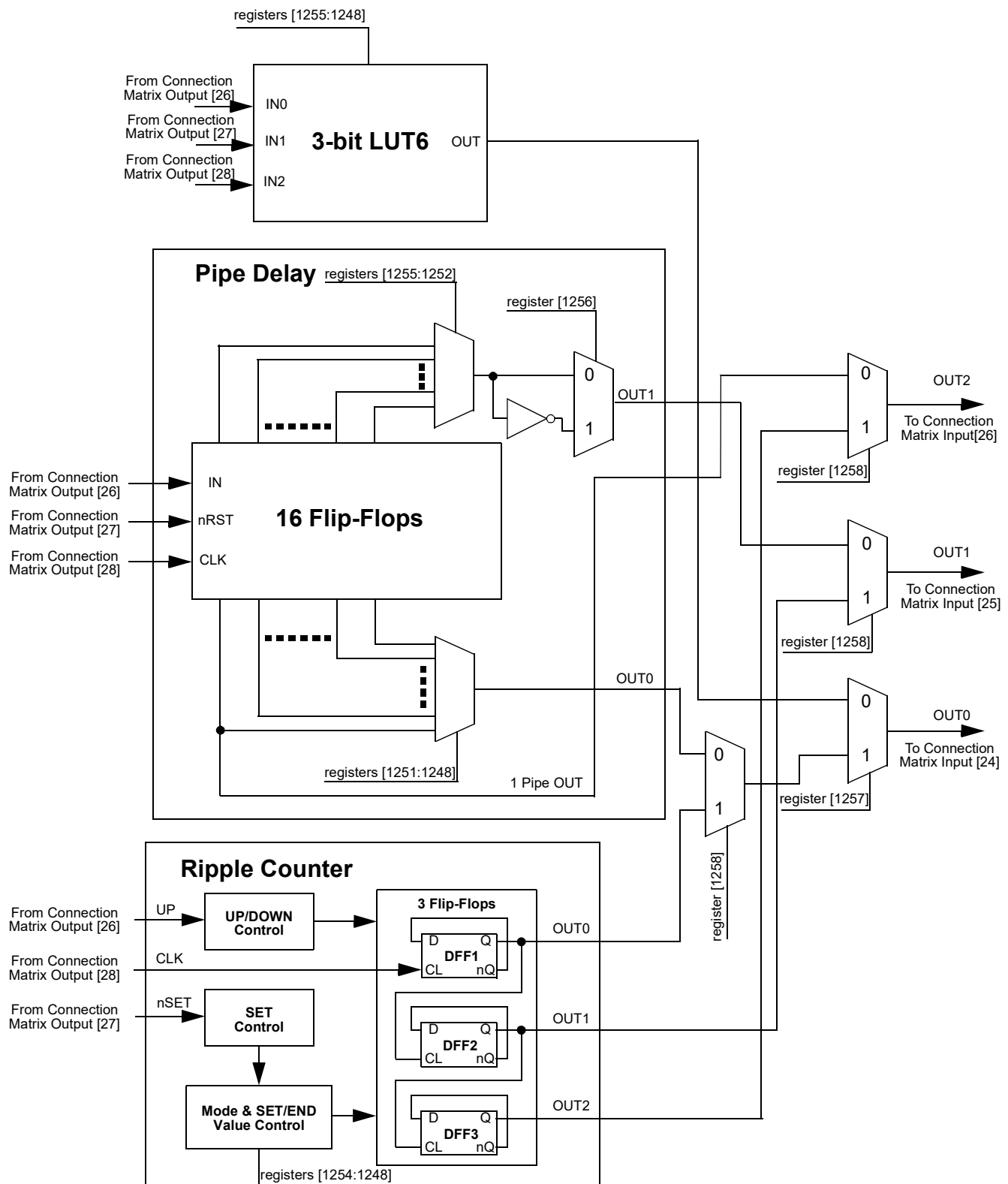


Figure 29: 3-bit LUT6/Pipe Delay/Ripple Counter

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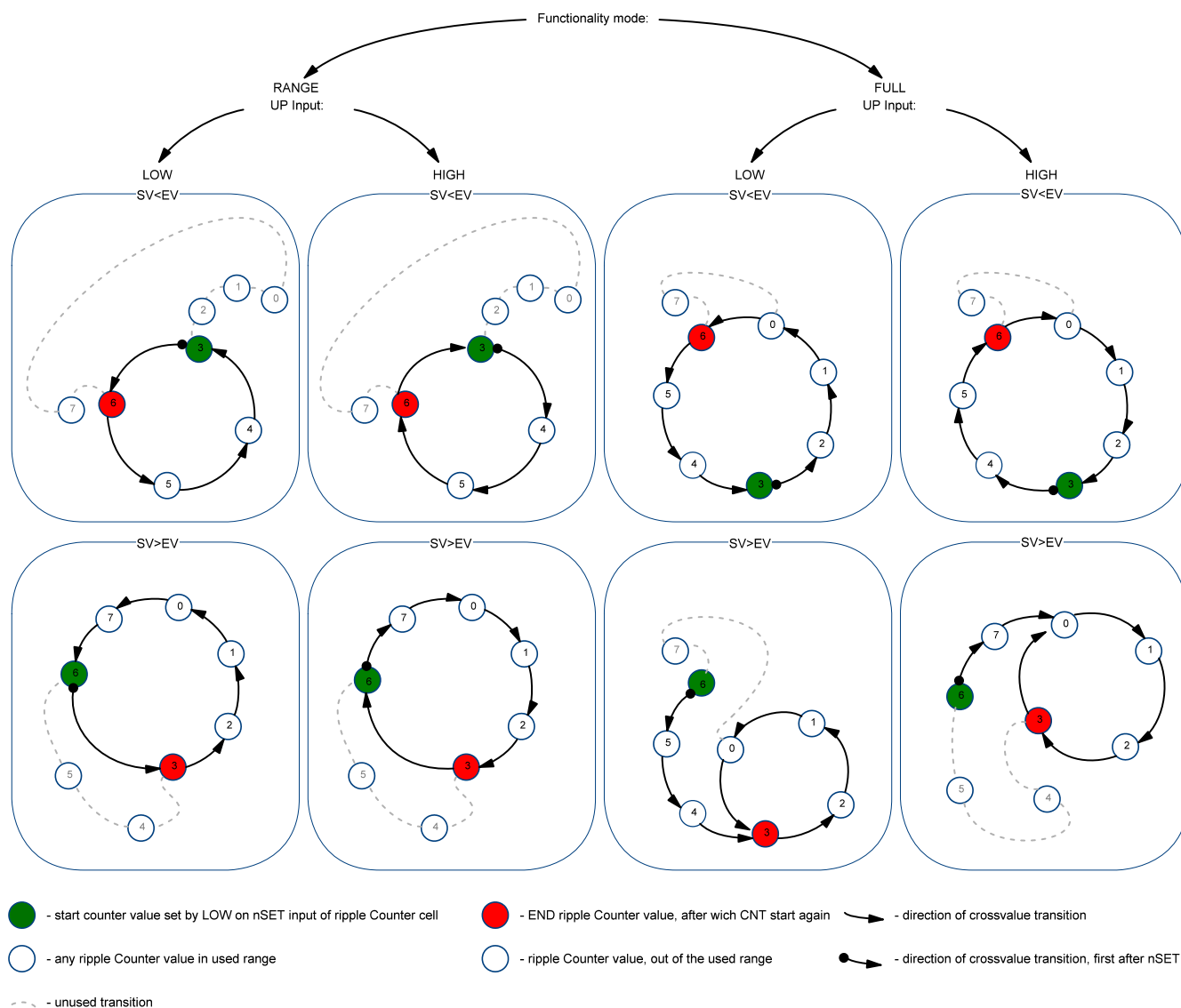


Figure 30: Example: Ripple Counter Functionality

7.4.1 3-Bit LUT or Pipe Delay Macrocells Used as 3-Bit LUT

Table 32: 3-bit LUT6 Truth Table

IN2	IN1	IN0	OUT
0	0	0	register [1248]
0	0	1	register [1249]
0	1	0	register [1250]
0	1	1	register [1251]
1	0	0	register [1252]
1	0	1	register [1253]
1	1	0	register [1254]
1	1	1	register [1255]

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

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

3-Bit LUT6 is defined by registers [1255:1248]

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

8 Multi-Function Macrocells

The SLG46824 has 8 Multi-Function macrocells that can serve more than one logic or timing function. In each case, they can serve as a LUT, DFF with flexible settings, or as CNT/DLY with multiple modes such as One Shot, Frequency Detect, Edge Detect etc. Also, the macrocell is capable to combine those functions: LUT/DFF connected to CNT/DLY or CNT/DLY connected to LUT/DFF, see Figure 31.

See the list below for the functions that can be implemented in these macrocells:

- Seven macrocells that can serve as 3-bit LUTs/D Flip-Flops and as 8-Bit Counter/Delays
- One macrocell that can serve as a 4-bit LUT/D Flip-Flop and as 16-Bit Counter/Delay/FSM

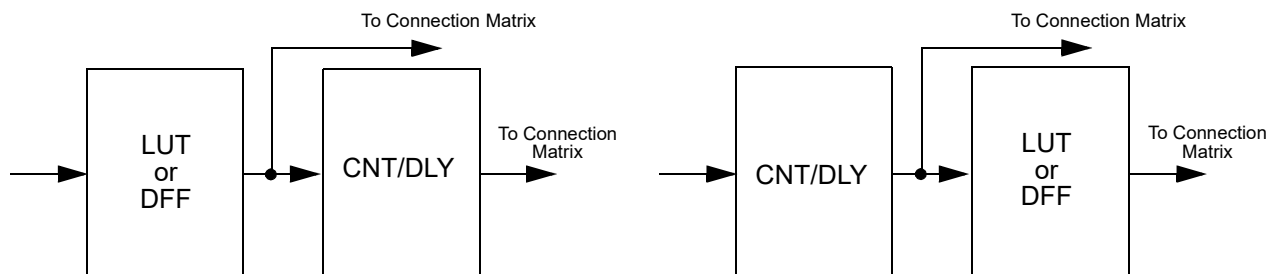


Figure 31: Possible Connections Inside Multi-Function Macrocell

Inputs/Outputs for the 8 Multi-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).

8.1 3-BIT LUT OR 8-BIT COUNTER/DELAY MACROCELLS

There are seven macrocells that can serve as 3-bit LUTs/D Flip-Flops and as 8-Bit Counter/Delays.

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 or can be connected to CNT/DLY's input.

When used to implement D Flip-Flop function, the three input signals from the connection matrix go to the data (D), clock (CLK), and Set/Reset (nRST/nSET) inputs of the Flip-Flop, with the output going back to the connection matrix or to the CNT/DLY's input.

When used to implement Counter/Delays, each macrocell has a dedicated matrix input connection. 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. These macrocells can also operate in a One-Shot mode, which will generate an output pulse of user-defined width. They can also operate in a Frequency Detection or Edge Detection mode.

Counter/Delay macrocell has an initial value, which define its initial value after GPAK is powered up. It is possible to select initial Low or initial High, as well as initial value defined by a Delay In signal.

For example, in case initial LOW option is used, the rising edge delay will start operation.

For timing diagrams refer to Section 8.2.

Three of eight macrocells can have their active count value read/write via I²C (CNT0, CNT2 and CNT4). In this mode, it is possible to load count data immediately (plus two clock cycles) or after counter ends counting. See Section 15.5.3 for further details.

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

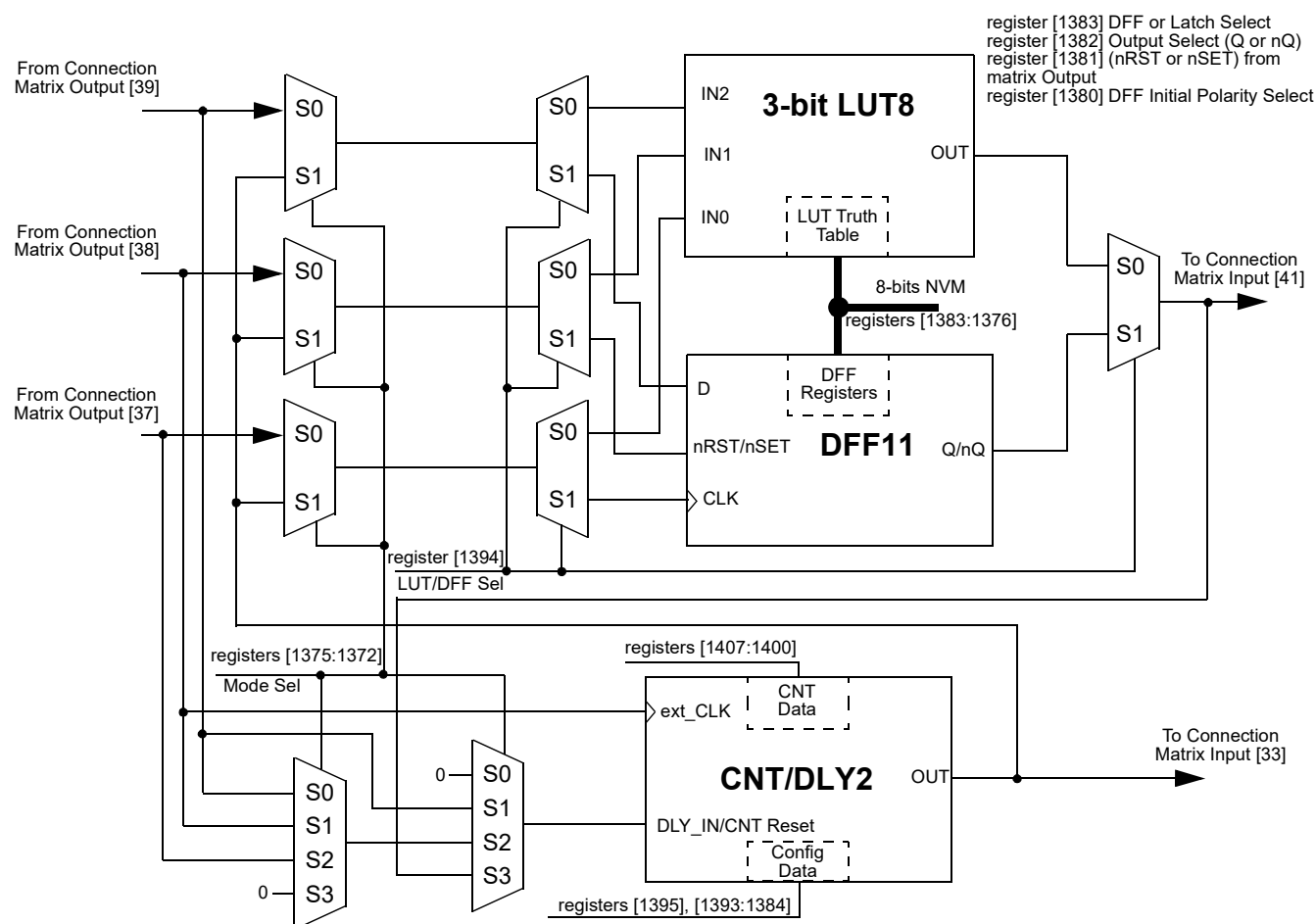


Figure 33: 8-bit Multi-Function Macrocells Block Diagram (3-bit LUT8/DFF11, CNT/DLY2)

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

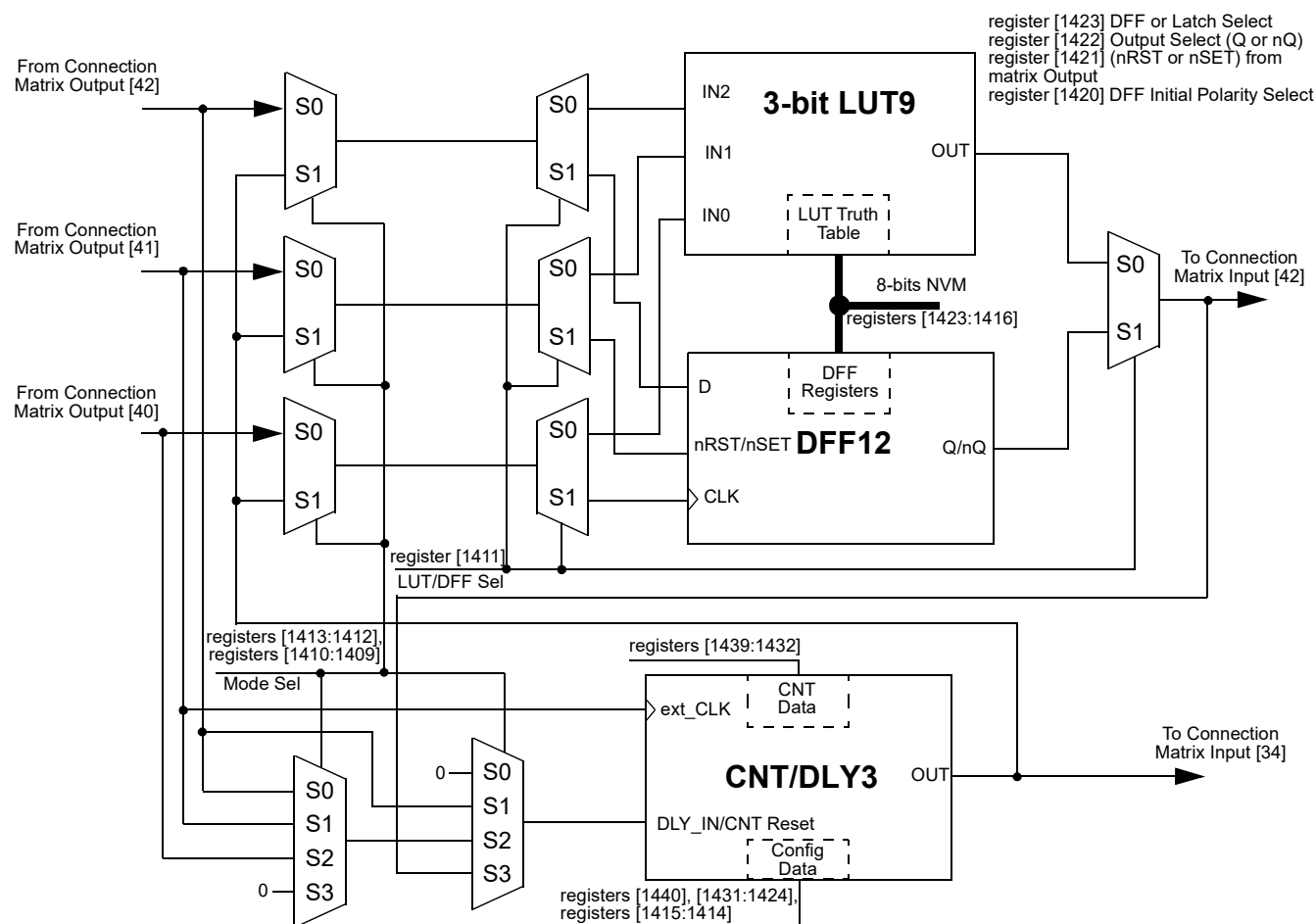
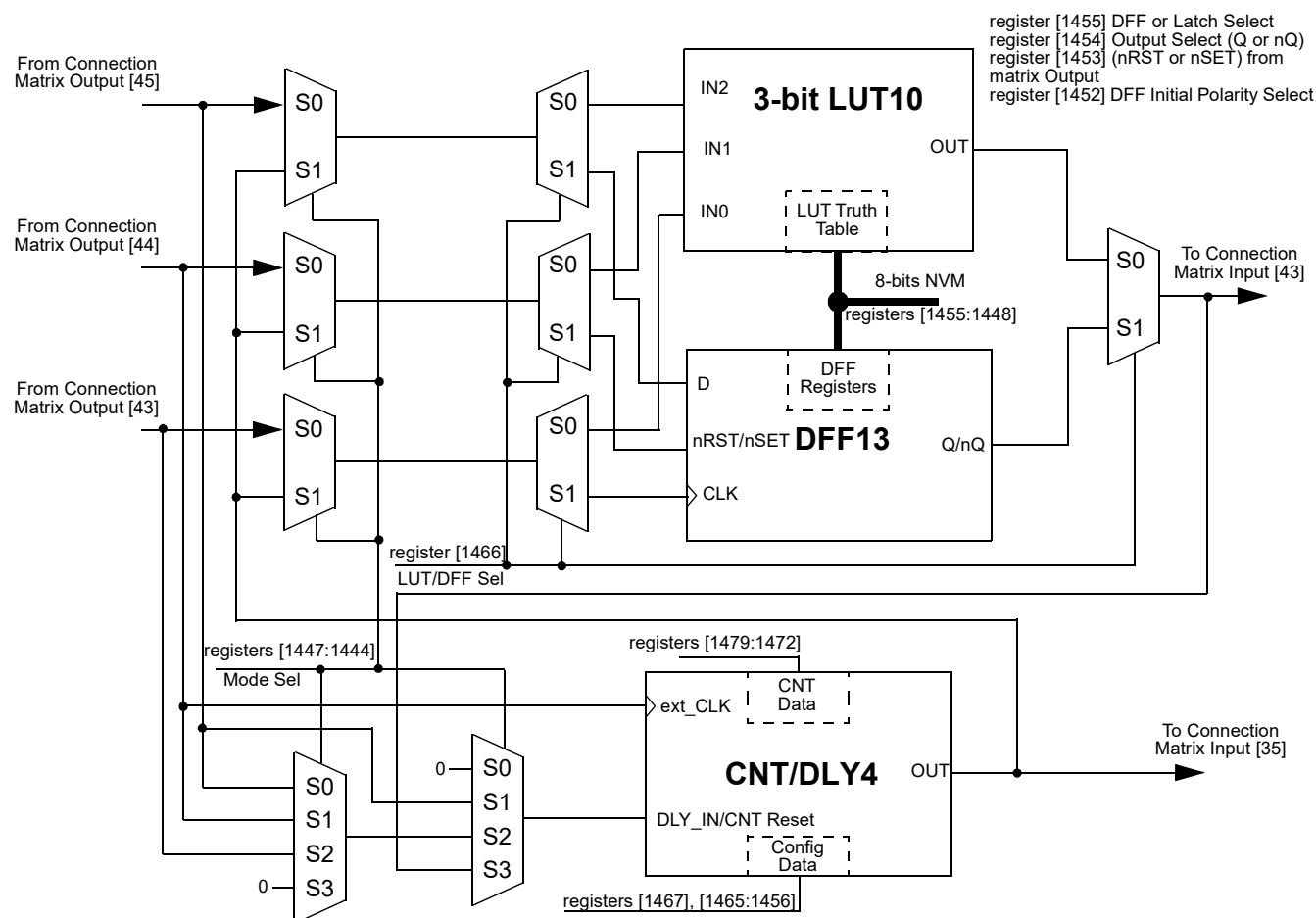


Figure 34: 8-bit Multi-Function Macrocells Block Diagram (3-bit LUT9/DFF12, CNT/DLY3)



GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

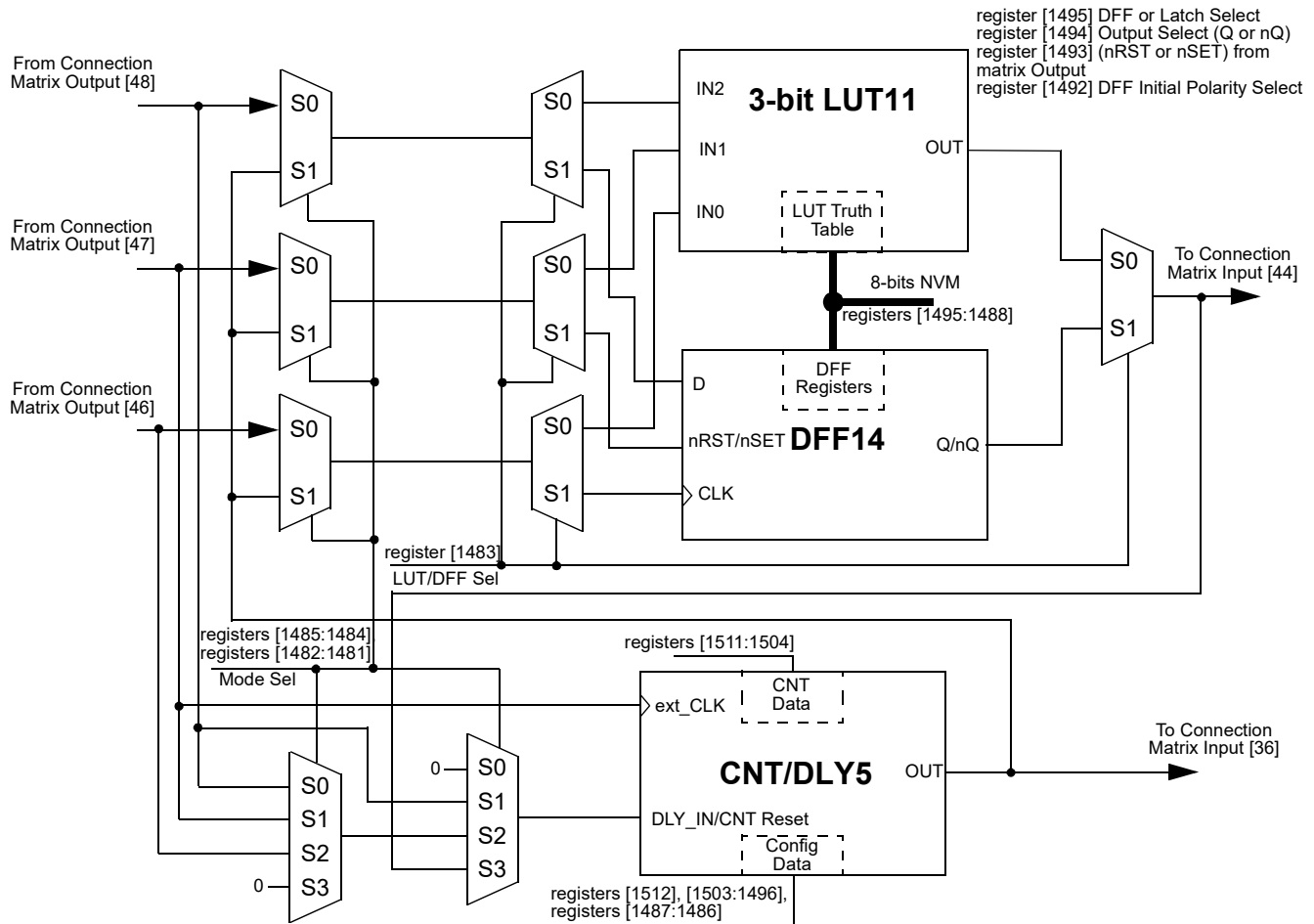


Figure 36: 8-bit Multi-Function Macrocells Block Diagram (3-bit LUT11/DFF14, CNT/DLY5)

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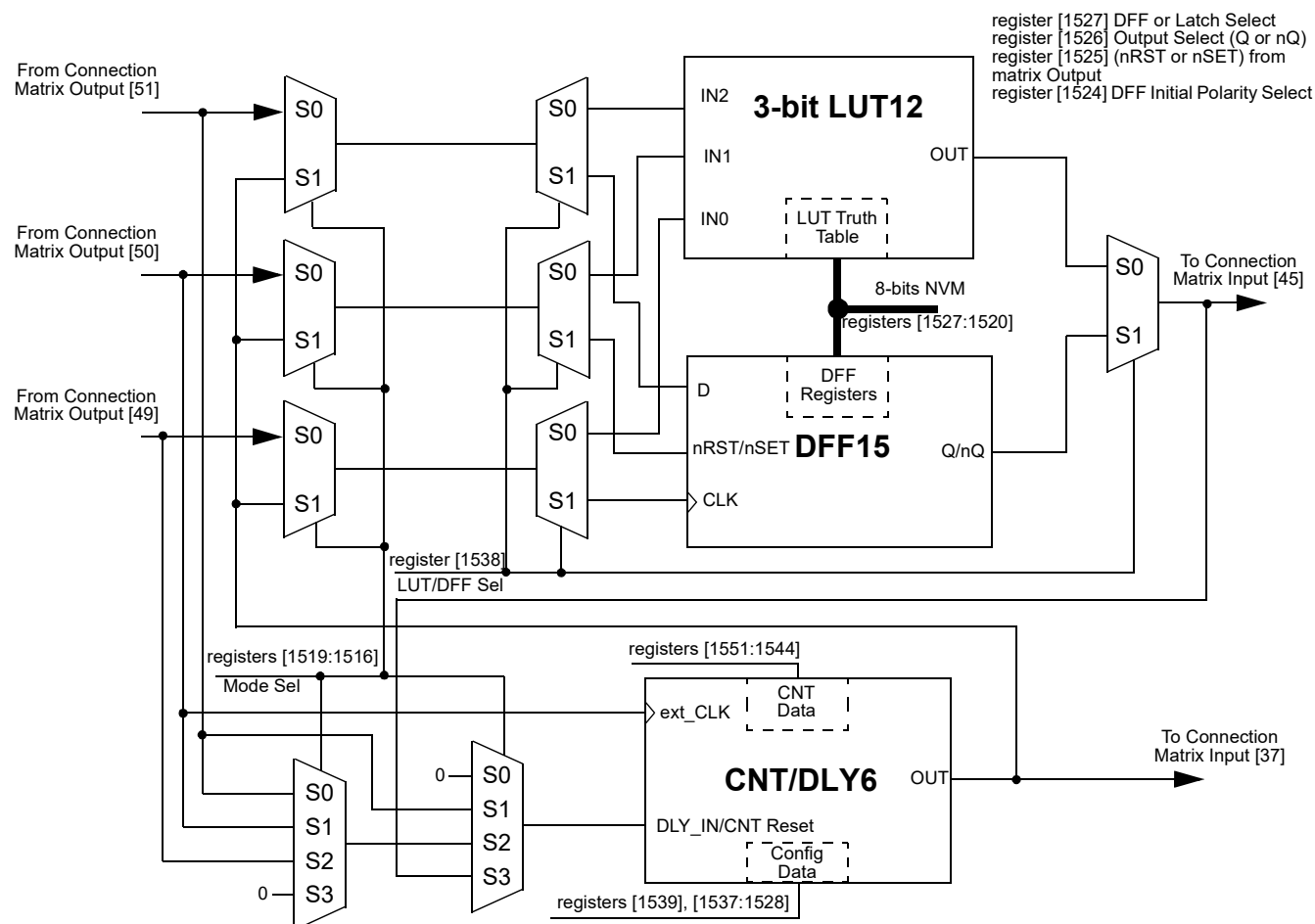
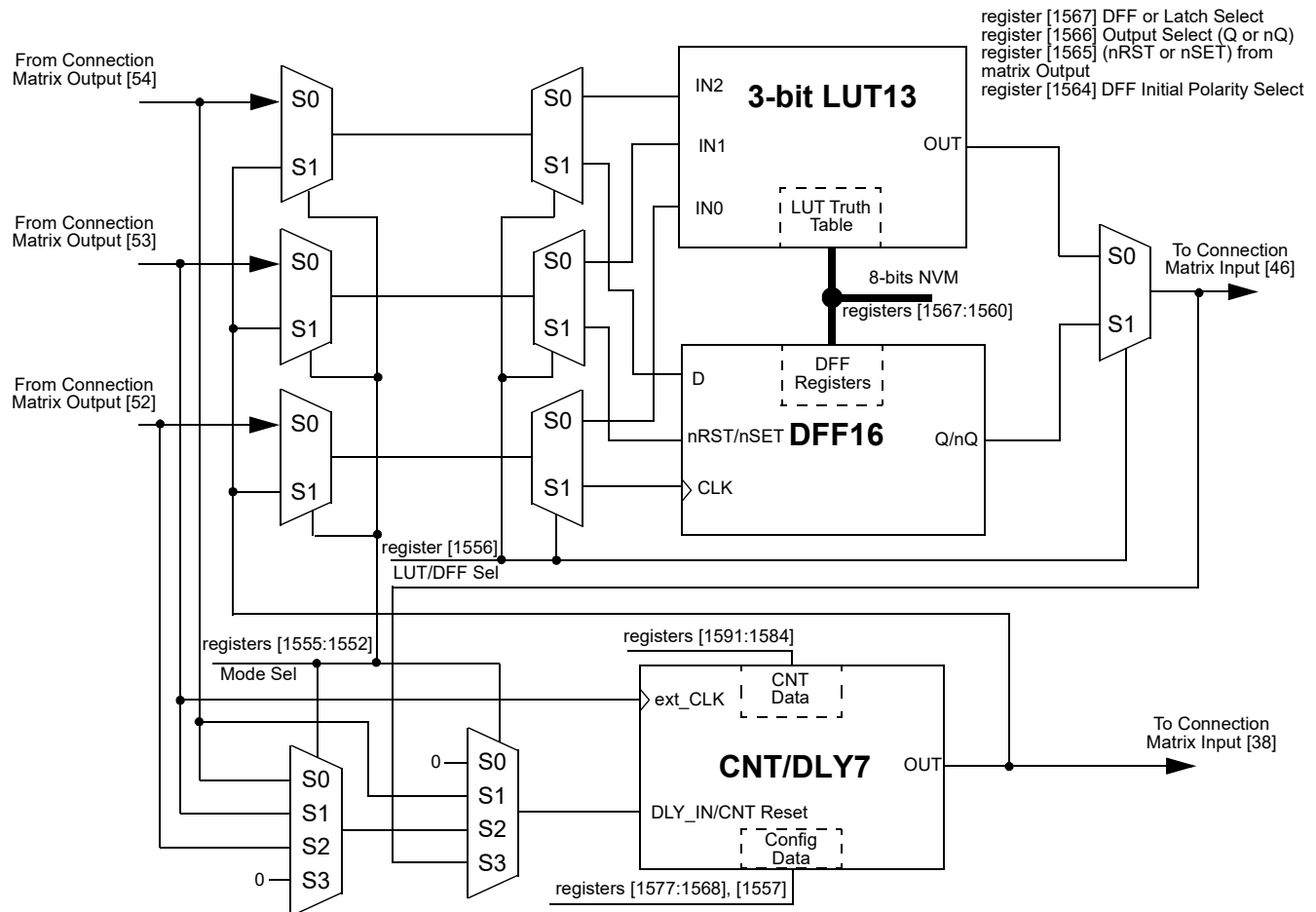


Figure 37: 8-bit Multi-Function Macrocells Block Diagram (3-bit LUT12/DFF15, CNT/DLY6)



GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

8.1.2 3-Bit LUT or CNT/DLYs Used as 3-Bit LUTs

Table 33: 3-bit LUT7 Truth Table

IN2	IN1	IN0	OUT	
0	0	0	register [1344]	LSB
0	0	1	register [1345]	
0	1	0	register [1346]	
0	1	1	register [1347]	
1	0	0	register [1348]	
1	0	1	register [1349]	
1	1	0	register [1350]	
1	1	1	register [1351]	MSB

Table 34: 3-bit LUT8 Truth Table

IN2	IN1	IN0	OUT	
0	0	0	register [1376]	LSB
0	0	1	register [1377]	
0	1	0	register [1378]	
0	1	1	register [1379]	
1	0	0	register [1380]	
1	0	1	register [1381]	
1	1	0	register [1382]	
1	1	1	register [1383]	MSB

Table 35: 3-bit LUT9 Truth Table

IN2	IN1	IN0	OUT	
0	0	0	register [1416]	LSB
0	0	1	register [1417]	
0	1	0	register [1418]	
0	1	1	register [1419]	
1	0	0	register [1420]	
1	0	1	register [1421]	
1	1	0	register [1422]	
1	1	1	register [1423]	MSB

Table 36: 3-bit LUT10 Truth Table

IN2	IN1	IN0	OUT	
0	0	0	register [1448]	LSB
0	0	1	register [1449]	
0	1	0	register [1450]	
0	1	1	register [1451]	
1	0	0	register [1452]	
1	0	1	register [1453]	
1	1	0	register [1454]	
1	1	1	register [1455]	MSB

Table 37: 3-bit LUT11 Truth Table

IN2	IN1	IN0	OUT	
0	0	0	register [1488]	LSB
0	0	1	register [1489]	
0	1	0	register [1490]	
0	1	1	register [1491]	
1	0	0	register [1492]	
1	0	1	register [1493]	
1	1	0	register [1494]	
1	1	1	register [1495]	MSB

Table 38: 3-bit LUT12 Truth Table

IN2	IN1	IN0	OUT	
0	0	0	register [1520]	LSB
0	0	1	register [1521]	
0	1	0	register [1522]	
0	1	1	register [1523]	
1	0	0	register [1524]	
1	0	1	register [1525]	
1	1	0	register [1526]	
1	1	1	register [1527]	MSB

Table 39: 3-bit LUT13 Truth Table

IN2	IN1	IN0	OUT	
0	0	0	register [1560]	LSB
0	0	1	register [1561]	
0	1	0	register [1562]	
0	1	1	register [1563]	
1	0	0	register [1564]	
1	0	1	register [1565]	
1	1	0	register [1566]	
1	1	1	register [1567]	MSB

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

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

3-Bit LUT7 is defined by registers [1351:1344]

3-Bit LUT8 is defined by registers [1383:1376]

3-Bit LUT9 is defined by registers [1423:1416]

3-Bit LUT10 is defined by registers [1455:1448]

3-Bit LUT11 is defined by registers [1495:1488]

3-Bit LUT12 is defined by registers [1527:1520]

3-Bit LUT13 is defined by registers [1567:1560]

8.2 CNT/DLY/FSM TIMING DIAGRAMS

8.2.1 Delay Mode (Edge Select: Both, Counter Data: 3) CNT/DLY0 to CNT/DLY7

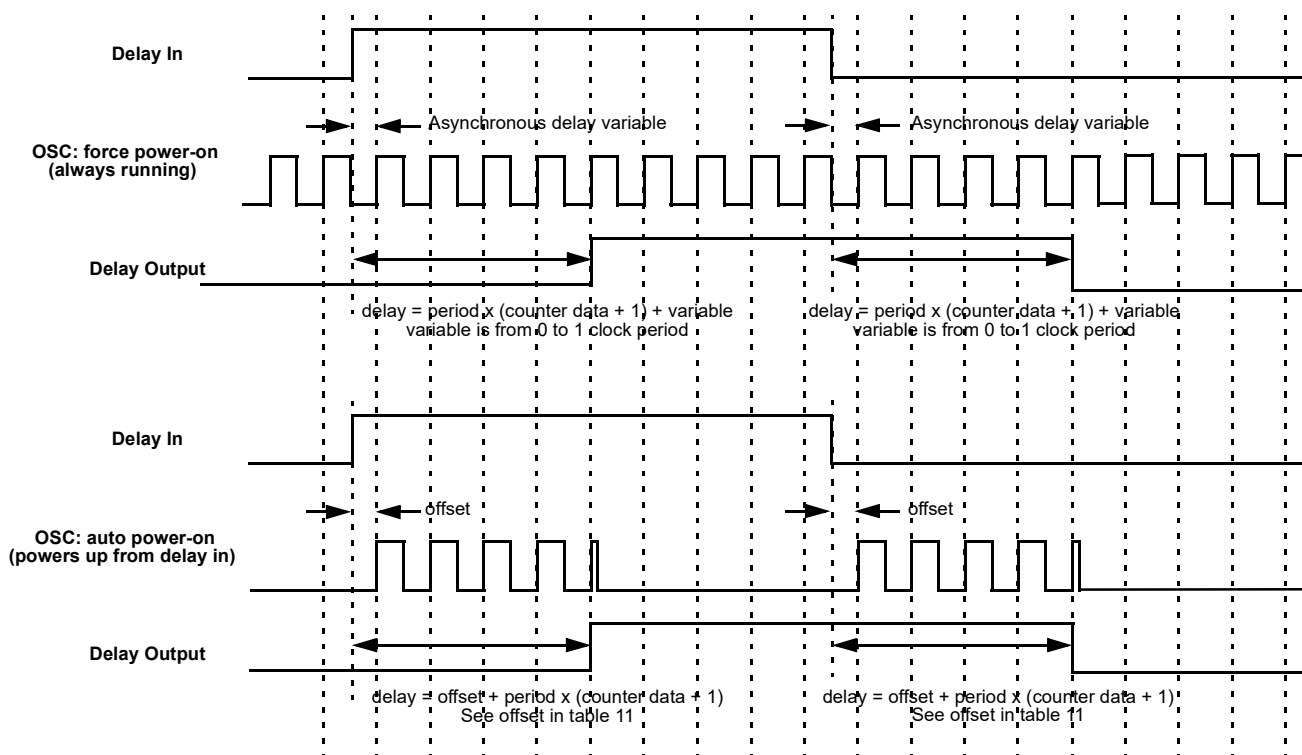


Figure 39: Delay Mode Timing Diagram

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

8.2.2 Count Mode (Count Data: 3), Counter Reset (Rising Edge Detect) CNT/DLY0 to CNT/DLY7

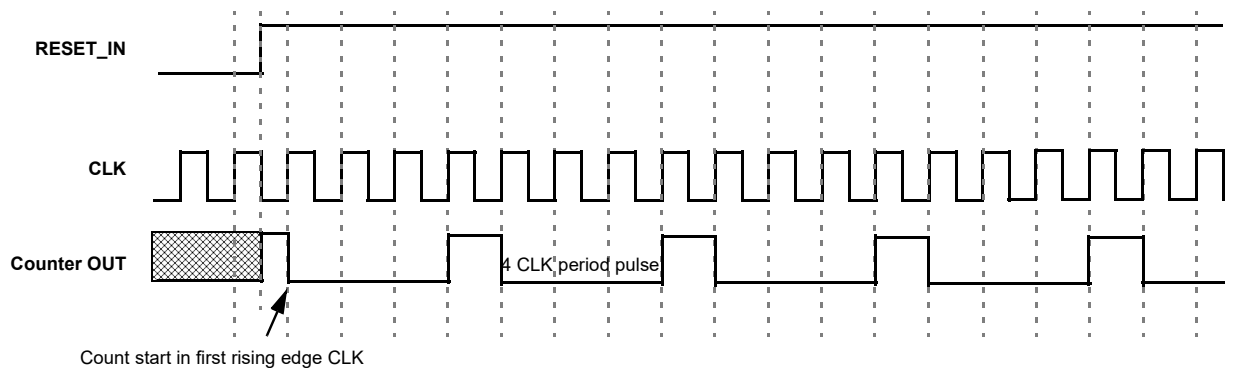


Figure 40: Counter Mode Timing Diagram without Two DFFs Synced Up

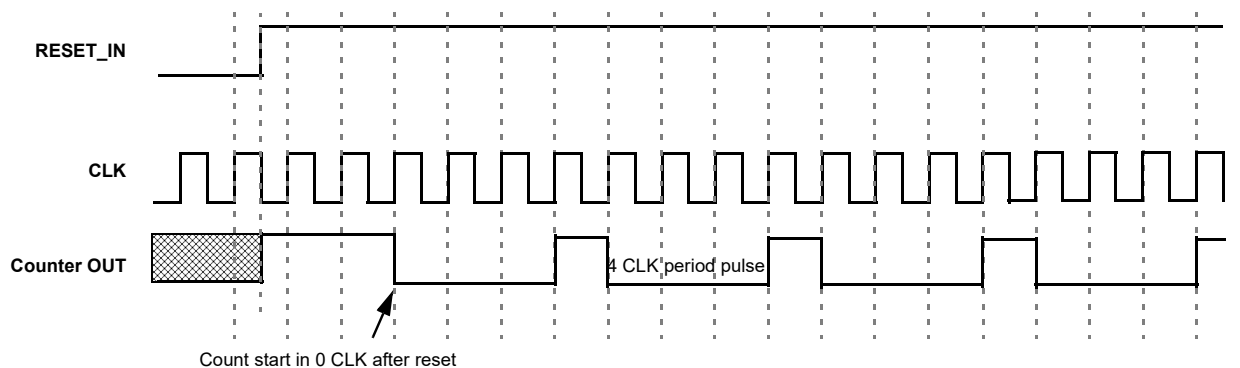


Figure 41: Counter Mode Timing Diagram with Two DFFs Synced Up

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

8.2.3 One-Shot Mode CNT/DLY0 to CNT/DLY7

This macrocell will generate a pulse whenever a selected edge is detected on its input. Register bits set the edge selection. The pulse width determines by counter data and clock selection properties.

The output pulse polarity (non-inverted or inverted) is selected by register bit. Any incoming edges will be ignored during the pulse width generation. The following diagram shows one-shot function for non-inverted output.

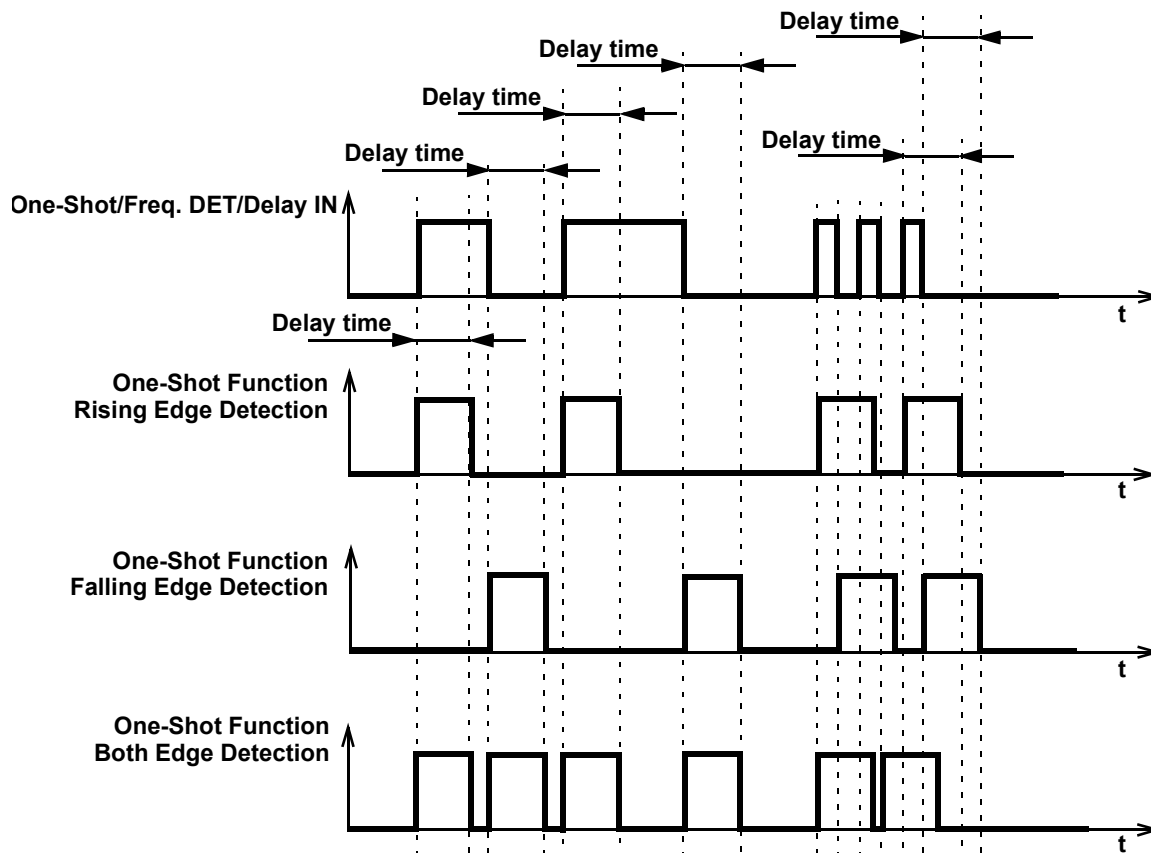


Figure 42: One-Shot Function Timing Diagram

This macrocell generates a high level pulse with a set width (defined by counter data) when detecting the respective edge. It does not restart while pulse is high.

8.2.4 Frequency Detection Mode CNT/DLY0 to CNT/DLY7

Rising Edge: The output goes high if the time between two successive edges is less than the delay. The output goes low if the second rising edge has not come after the last rising edge in specified time.

Falling Edge: The output goes high if the time between two falling edges is less than the set time. The output goes low if the second falling edge has not come after the last falling edge in specified time.

Both Edge: The output goes high if the time between the rising and falling edges is less than the set time, which is equivalent to the length of the pulse. The output goes low if after the last rising/falling edge and specified time, the second edge has not come.

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

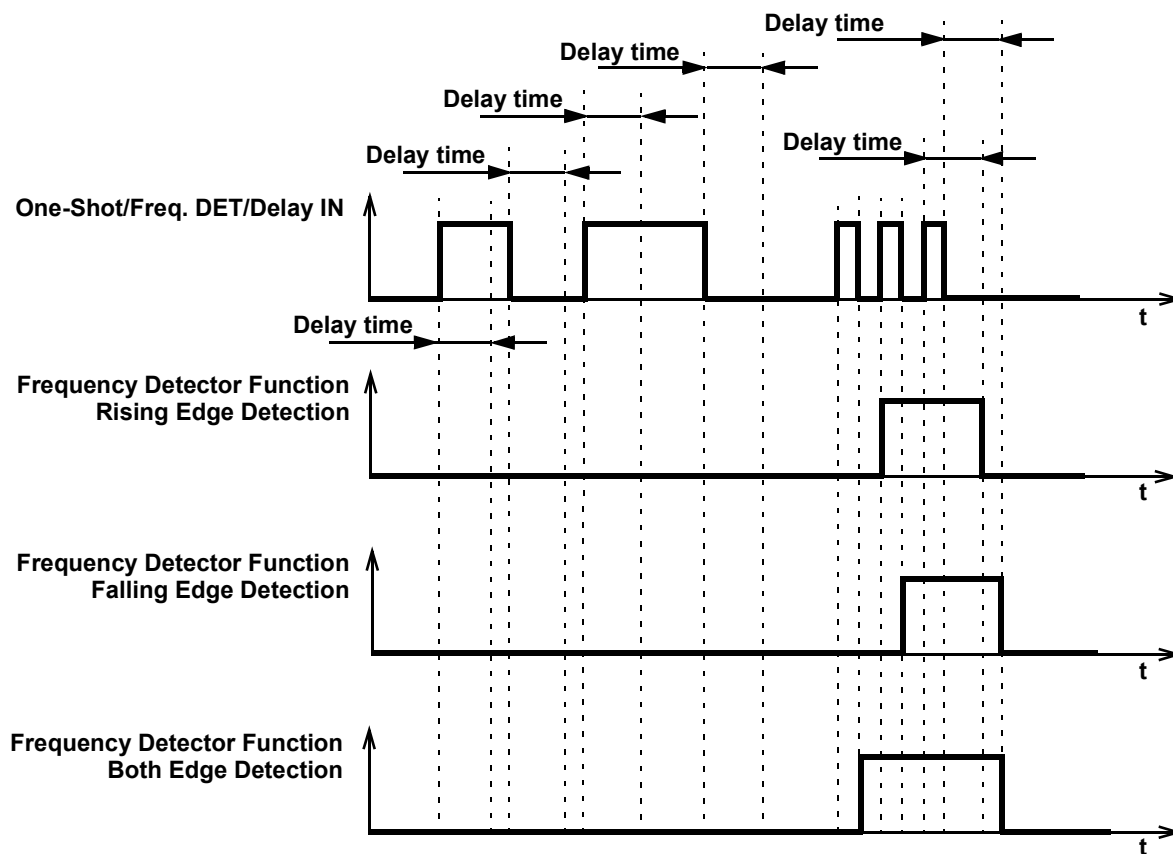


Figure 43: Frequency Detection Mode Timing Diagram

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

8.2.5 Edge Detection Mode CNT/DLY1 to CNT/DLY7

The macrocell generates high level short pulse when detecting the respective edge. See [Table 10](#).

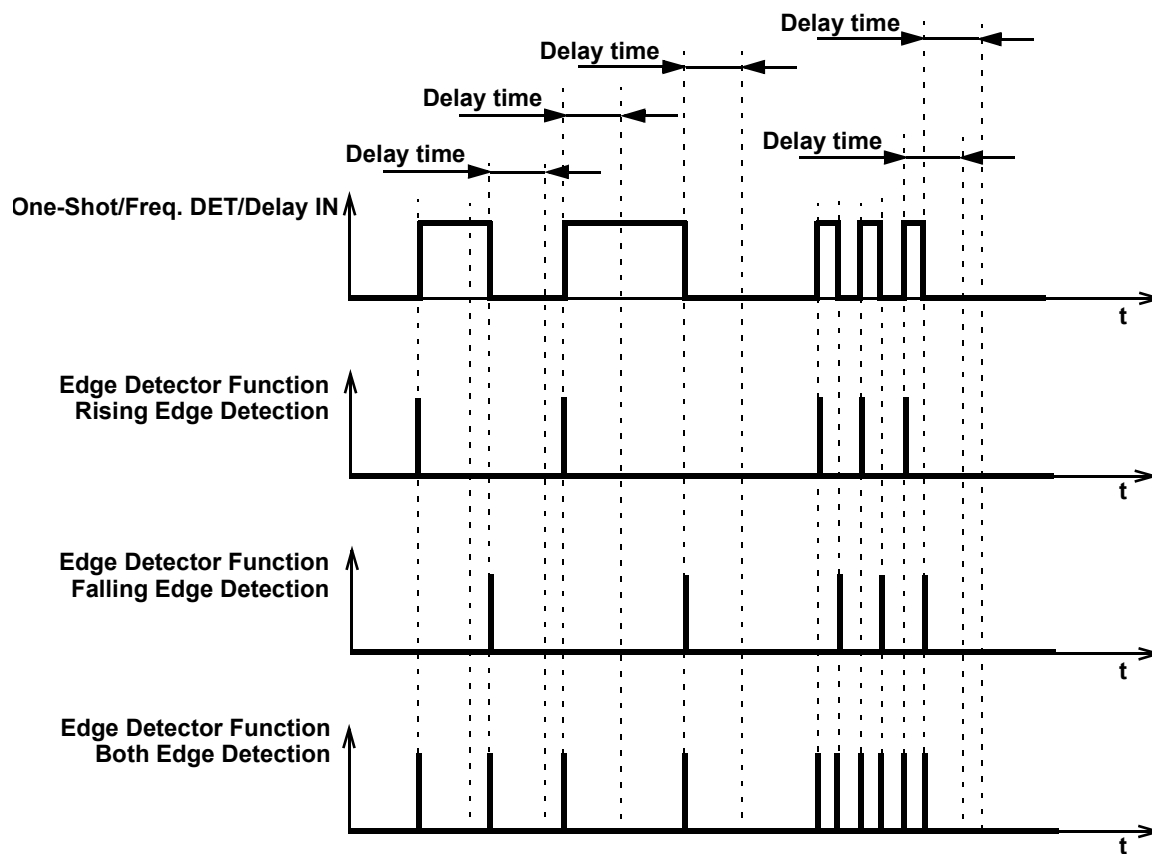


Figure 44: Edge Detection Mode Timing Diagram

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

8.2.6 Delay Mode CNT/DLY0 to CNT/DLY7

The macrocell shifts the respective edge to a set time and restarts by appropriate edge. It works as a filter if the input signal is shorter than the delay time.

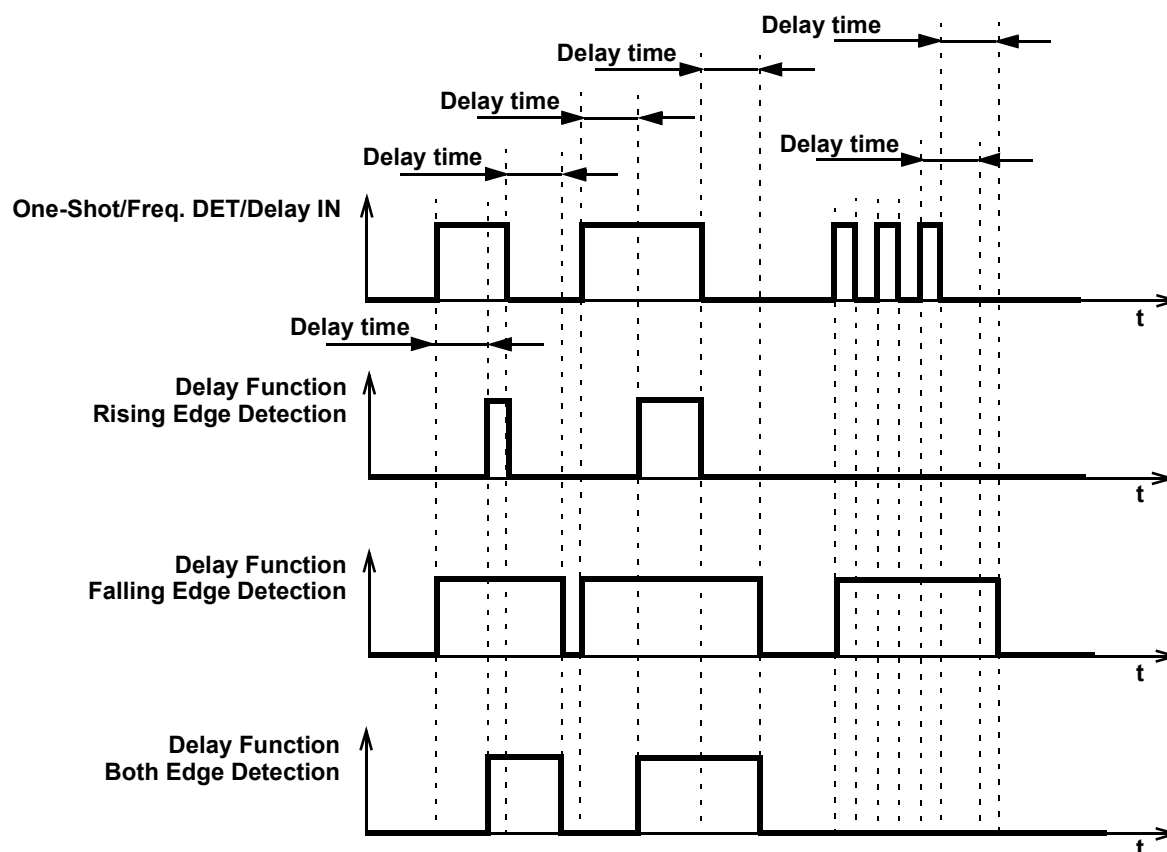


Figure 45: Delay Mode Timing Diagram

8.2.7 CNT/FSM Mode CNT/DLY0

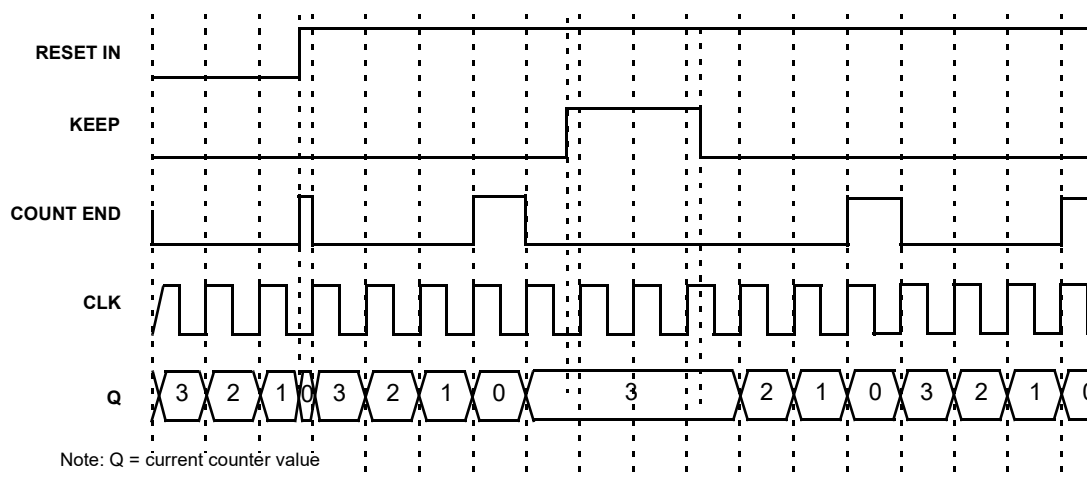


Figure 46: CNT/FSM Timing Diagram (Reset Rising Edge Mode, Oscillator is Forced On, UP = 0) for Counter Data = 3

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

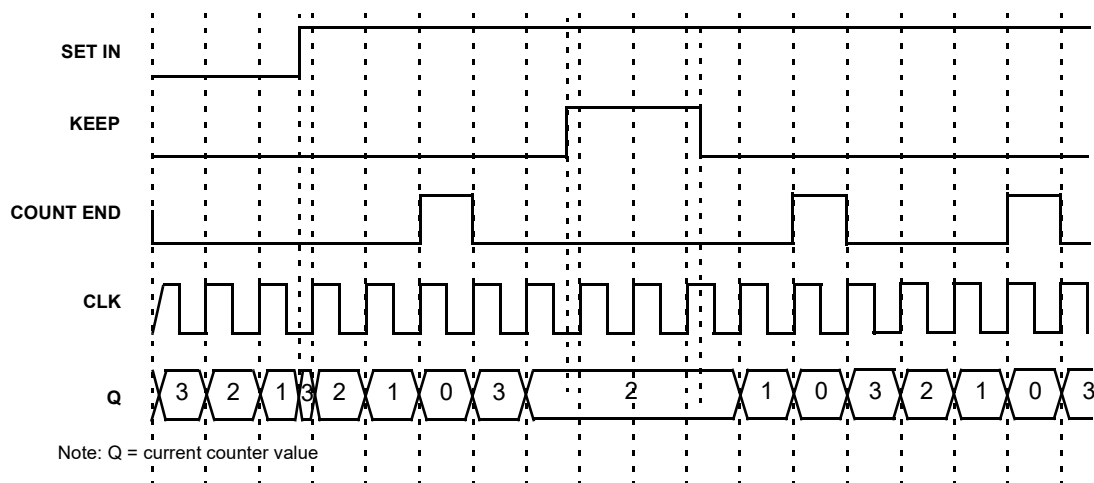


Figure 47: CNT/FSM Timing Diagram (Set Rising Edge Mode, Oscillator is Forced On, UP = 0) for Counter Data = 3

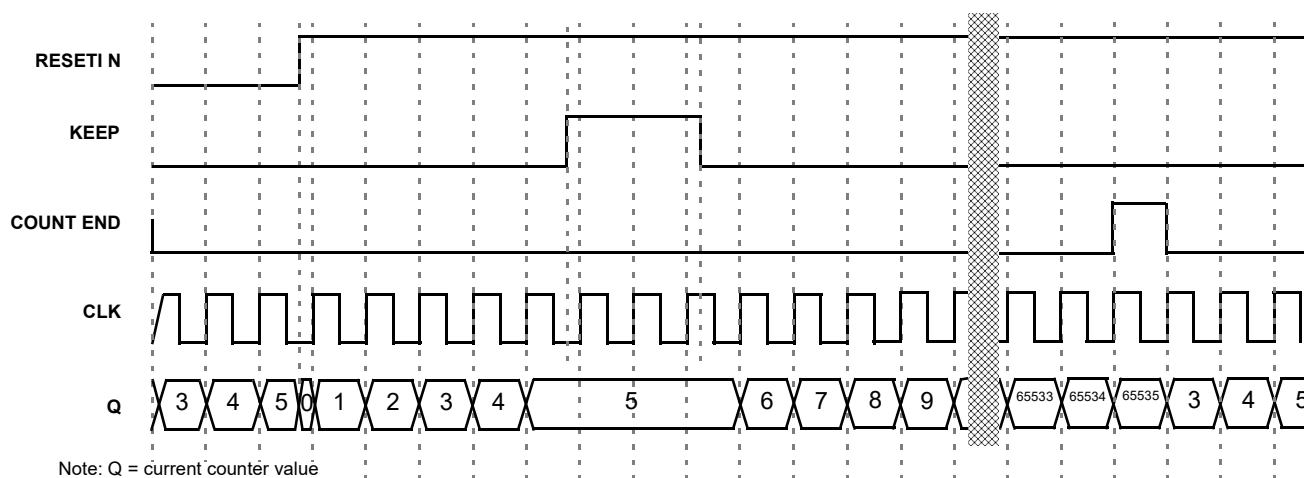


Figure 48: CNT/FSM Timing Diagram (Reset Rising Edge Mode, Oscillator is Forced On, UP = 1) for Counter Data = 3

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

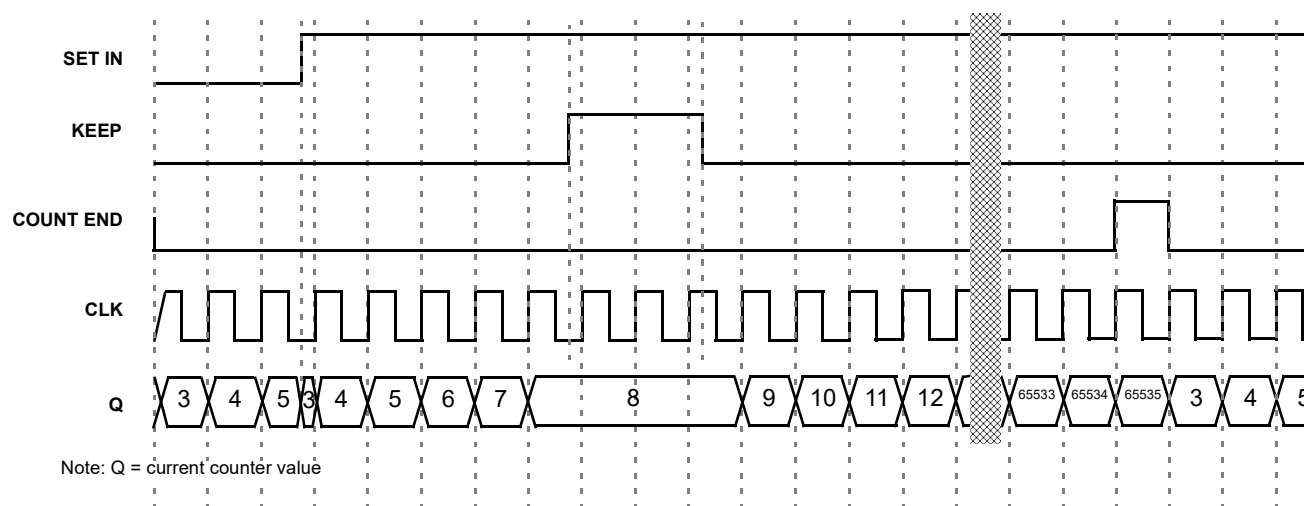


Figure 49: CNT/FSM Timing Diagram (Set Rising Edge Mode, Oscillator is Forced On, UP = 1) for Counter Data = 3

8.2.8 Difference in Counter Value for Counter, Delay, One-Shot and Frequency Detect Modes

There is a difference in counter value for Counter and Delay/One-Shot/Frequency Detect modes. The counter value is shifted for two rising edges of the clock signal in Delay/One-Shot/Frequency Detect modes compared to Counter mode. See [Figure 50](#).

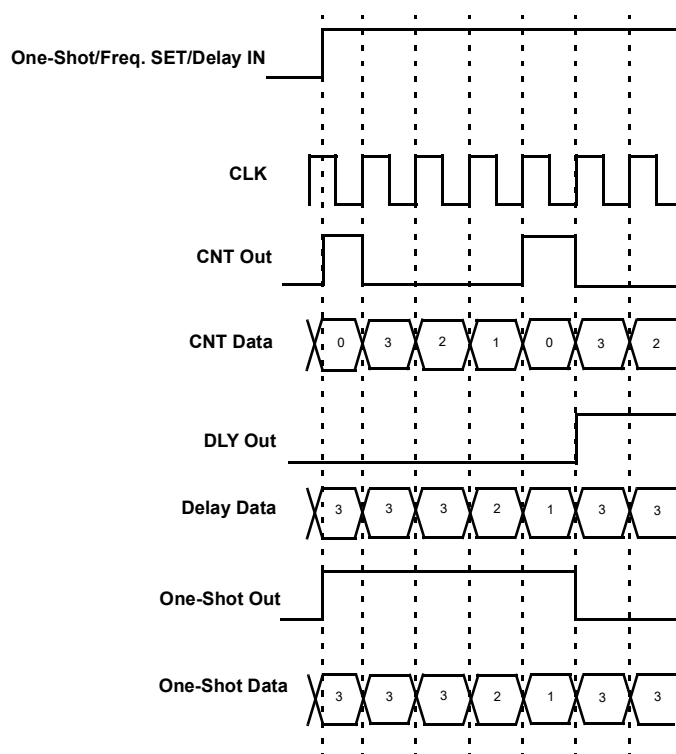


Figure 50: Counter Value, Counter Data = 3

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8.3 4-BIT LUT OR 16-BIT COUNTER/DELAY MACROCELL

There is one macrocell that can serve as either 4-bit LUT or as 16-bit Counter/Delay. When used to implement LUT function, 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 or can be connected to CNT/DLY's input or LUT/DFF's input. When used to implement 16-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.

This macrocell has an optional Finite State Machine (FSM) function. There are two additional matrix inputs for Up and Keep to support FSM functionality.

This macrocell can also operate in a one-shot mode, which will generate an output pulse of user-defined width.

This macrocell can also operate in a frequency detection.

This macrocell can have its active count value read via I²C. See Section 15.5.3 for further details.

8.3.1 4-Bit LUT or 16-Bit CNT/DLY Block Diagram

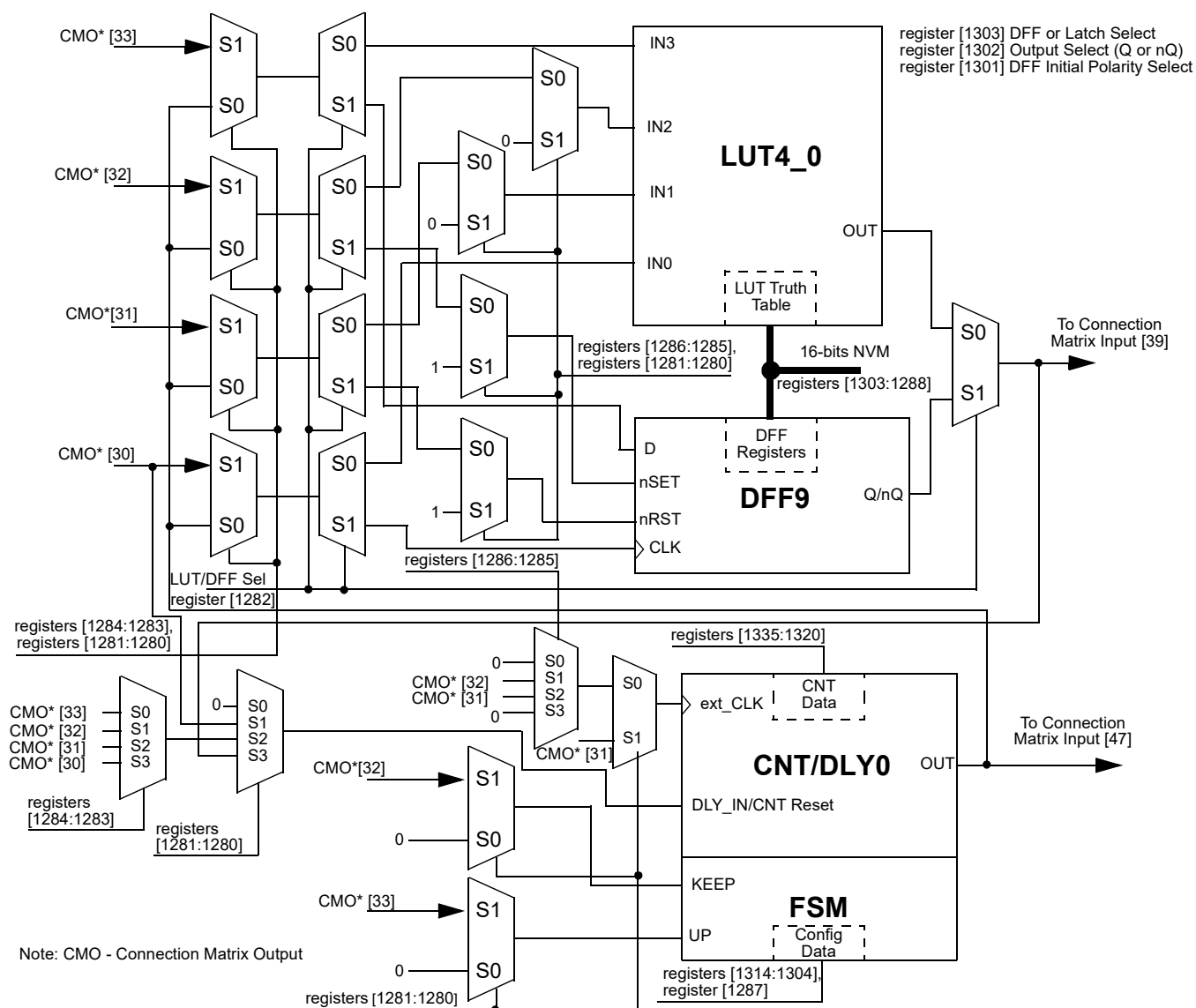


Figure 51: 4-bit LUT0 or CNT/DLY0

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8.3.2 4-Bit LUT or 16-Bit Counter/Delay Macrocells Used as 4-Bit LUTs

Table 40: 4-bit LUT0 Truth Table

IN3	IN2	IN1	IN0	OUT	
0	0	0	0	register [1288]	LSB
0	0	0	1	register [1289]	
0	0	1	0	register [1290]	
0	0	1	1	register [1291]	
0	1	0	0	register [1292]	
0	1	0	1	register [1293]	
0	1	1	0	register [1294]	
0	1	1	1	register [1295]	
1	0	0	0	register [1296]	
1	0	0	1	register [1297]	
1	0	1	0	register [1298]	
1	0	1	1	register [1299]	
1	1	0	0	register [1300]	
1	1	0	1	register [1301]	
1	1	1	0	register [1302]	
1	1	1	1	register [1303]	MSB

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

4-Bit LUT0 is defined by registers [1303:1288]

Table 41: 4-bit LUT Standard Digital Functions

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

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9 Analog Comparators

There are two General Purpose Rail-to-Rail Analog Comparator (ACMP) macrocells in the SLG46824. In order for the ACMP cells to be used in a GreenPAK design, the power up signals (ACMP0L PWR UP and ACMP1L PWR UP) 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.

ACMPs are optimized for low power operation.

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.

PWR UP = 1 → ACMP is powered up.

PWR UP = 0 → ACMP is powered down.

During power-up, the ACMP output will remain LOW, and then become valid 51.4 μ s (max) after power up signal goes high for ACMP0L and ACMP1L. Input bias current < 1 nA (typ). The Gain divider is unbuffered and consists of 1 M Ω resistors.

Each cell also has a hysteresis selection, to offer hysteresis of (0, 32, 64, 192) mV. The hysteresis option is available when using an internal Vref only.

ACMP0L IN+ options are IO11

ACMP1L IN+ options are IO12

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9.1 ACMP0L BLOCK DIAGRAM

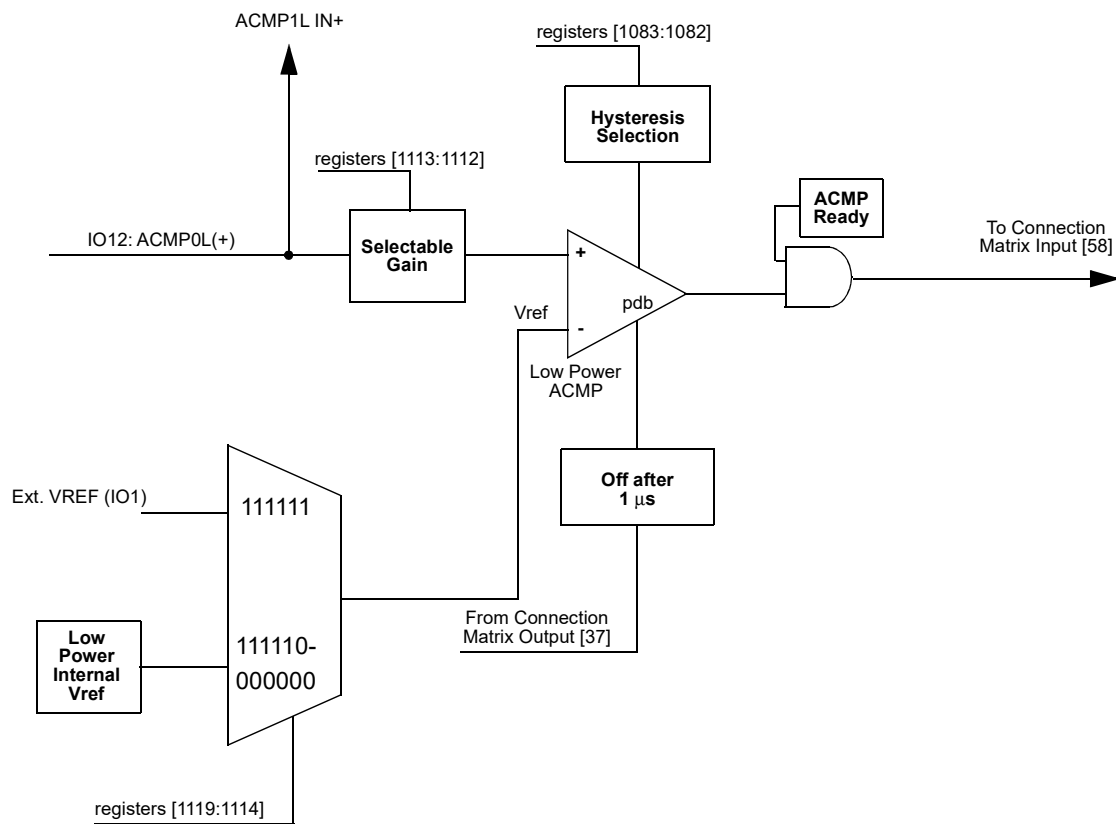


Figure 52: ACMP0L Block Diagram

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9.2 ACMP1L BLOCK DIAGRAM

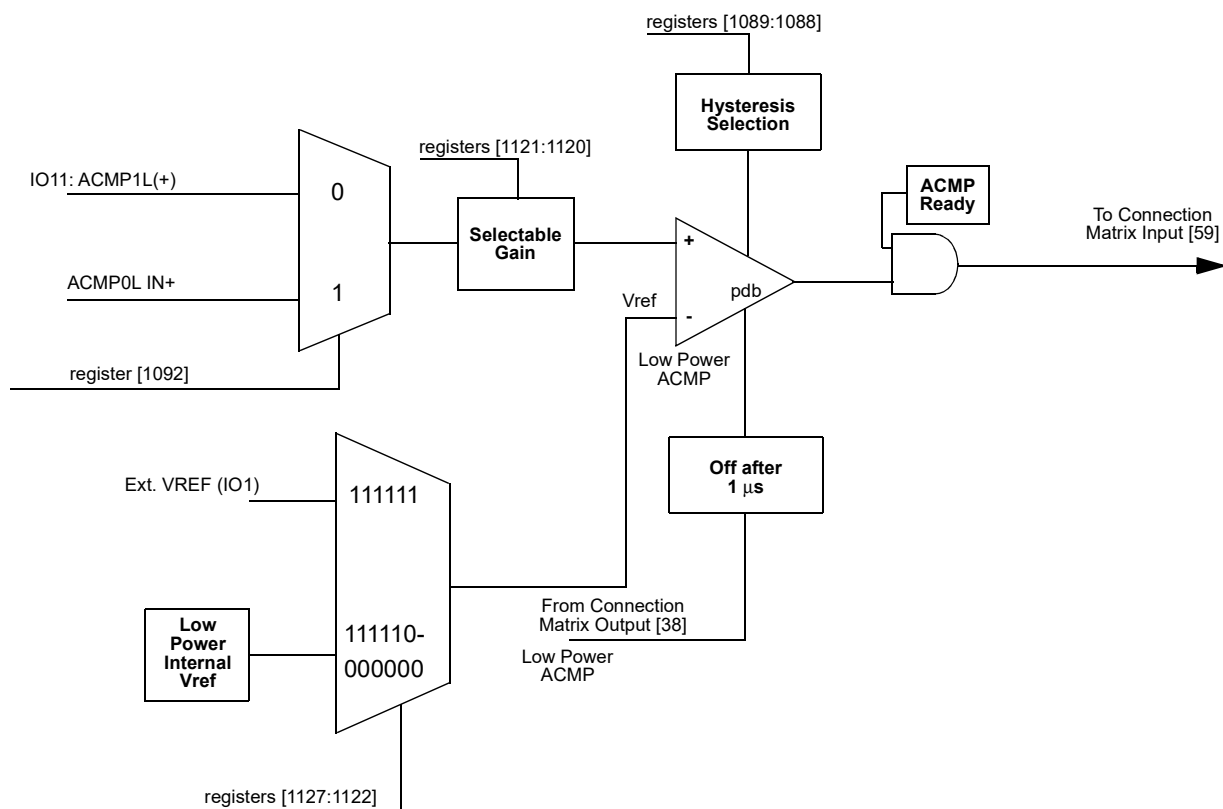


Figure 53: ACMP0L Block Diagram

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9.3 ACMP TYPICAL PERFORMANCE

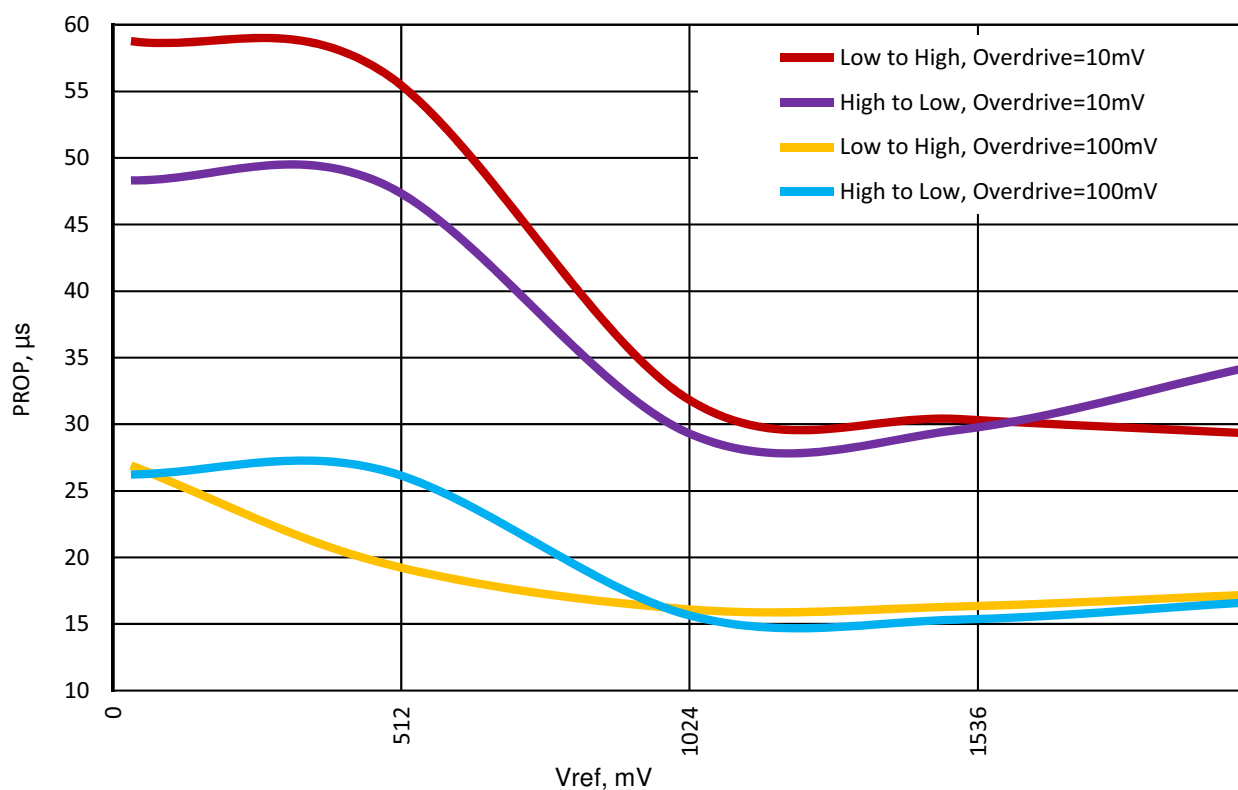


Figure 54: Typical Propagation Delay vs. V_{ref} for ACMPxL at $T = 25^\circ\text{C}$, Gain = 1, Buffer - Disabled, Hysteresis = 0

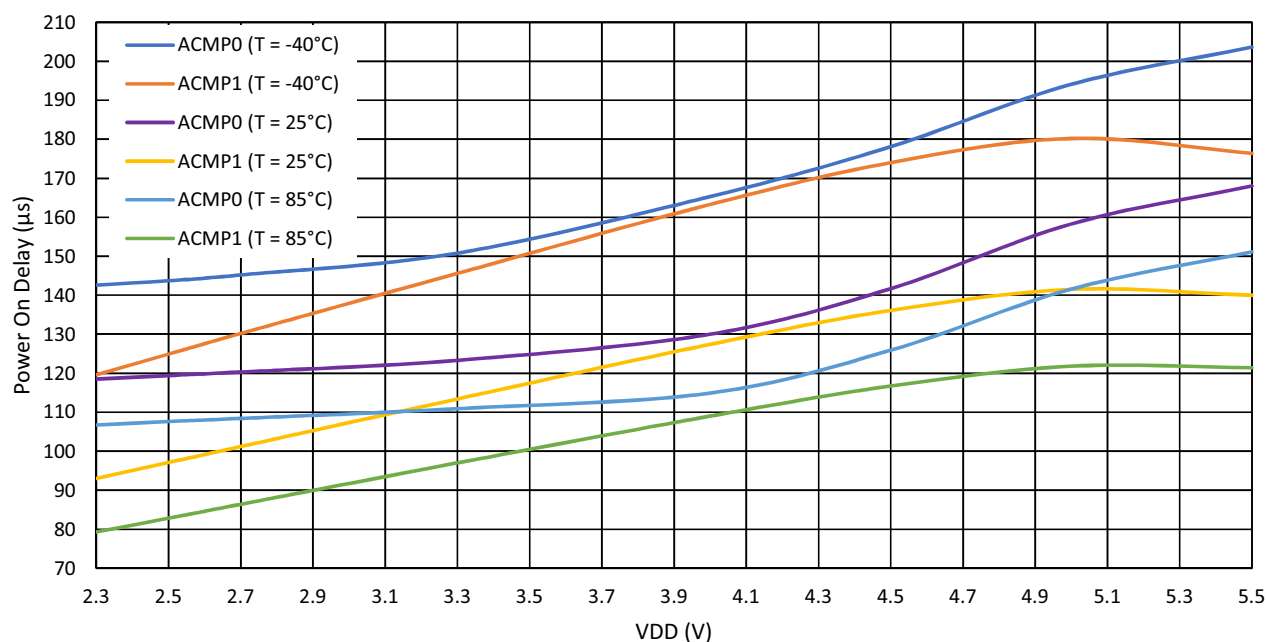


Figure 55: ACMPxL Power-On Delay vs. V_{DD}

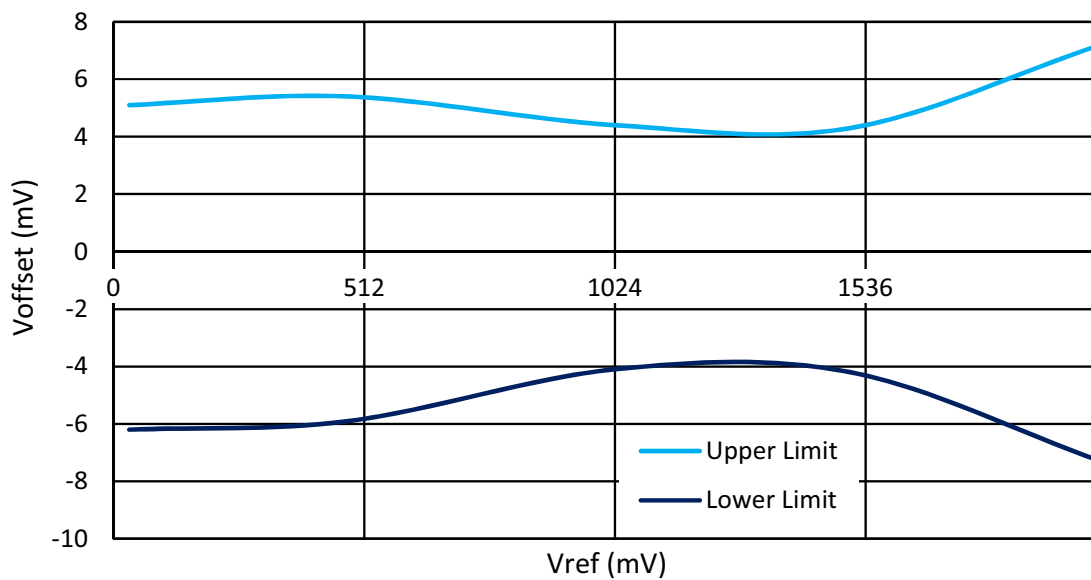
GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Figure 56: ACMPxL Input Offset Voltage vs. Vref at T = -40 °C to 85 °C

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10 Programmable Delay/Edge Detector

The SLG46824 has a programmable time delay logic cell available that can generate a delay that is selectable from one of four timings (time 2) 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 [Figure 58](#) for further information.

Note 1: The input signal must be longer than the delay, otherwise it will be filtered out.

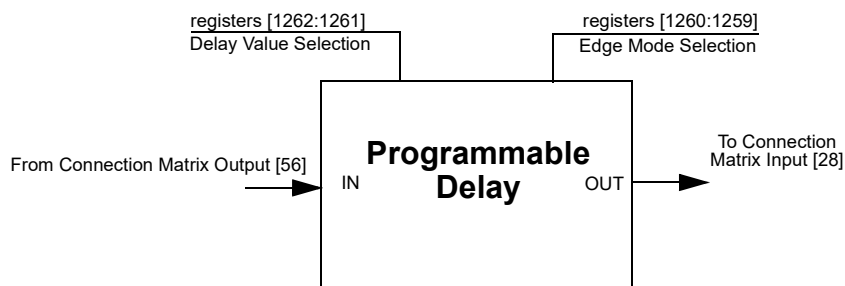


Figure 57: Programmable Delay

10.1 PROGRAMMABLE DELAY TIMING DIAGRAM - EDGE DETECTOR OUTPUT

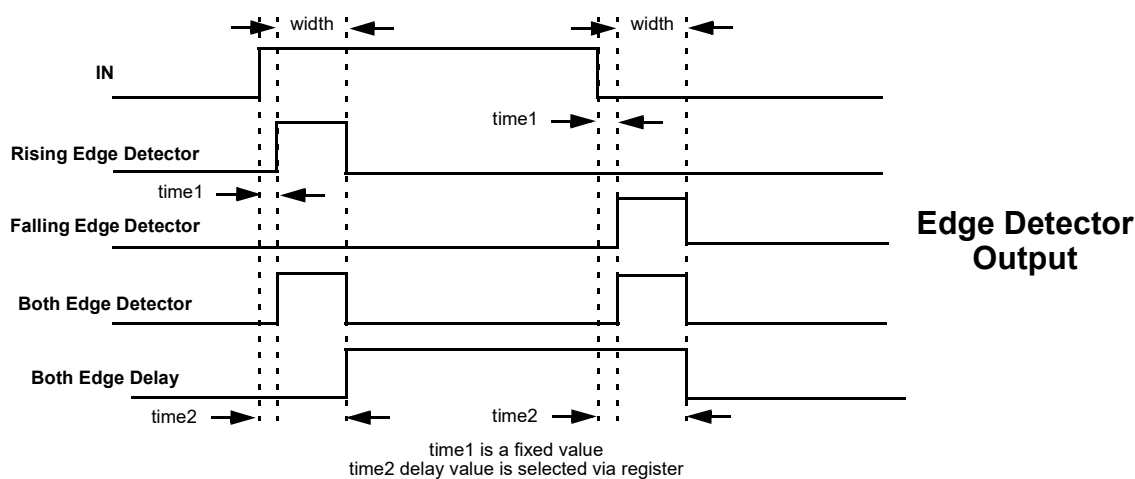


Figure 58: Edge Detector Output

Please refer to [Table 10](#).

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

11 Additional Logic Function. Deglitch Filter

The SLG46824 has one Deglitch Filter macrocell with inverter function that is connected directly to the Connection Matrix inputs and outputs. In addition, this macrocell can be configured as an Edge Detector, with the following settings:

- Rising Edge Detector
- Falling Edge Detector
- Both Edge Detector
- Both Edge Delay

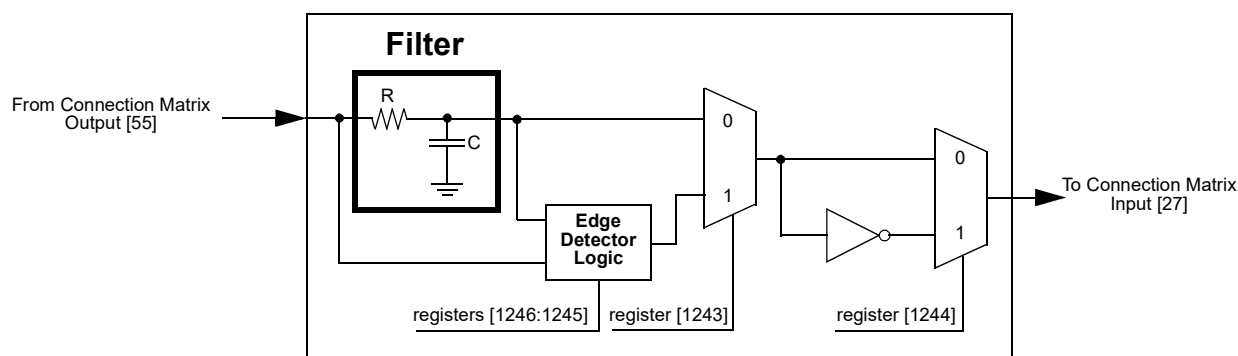


Figure 59: Deglitch Filter or Edge Detector

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

12 Voltage Reference

12.1 VOLTAGE REFERENCE OVERVIEW

The SLG46824 has a Voltage Reference (Vref) Macrocell to provide references to the two analog comparators. This macrocell can supply a user selection of fixed voltage reference. The macrocell also has the option to output reference voltage on IO9. See [Table 42](#) for the available selections for each analog comparator. Also see [Figure 60](#), which shows the reference output structure.

12.2 VREF SELECTION TABLE

Table 42: Vref Selection Table

SEL[5:0]	Vref	SEL[5:0]	Vref
0	0.032	32	1.056
1	0.064	33	1.088
2	0.096	34	1.12
3	0.128	35	1.152
4	0.16	36	1.184
5	0.192	37	1.216
6	0.224	38	1.248
7	0.256	39	1.28
8	0.288	40	1.312
9	0.32	41	1.344
10	0.352	42	1.376
11	0.384	43	1.408
12	0.416	44	1.44
13	0.448	45	1.472
14	0.48	46	1.504
15	0.512	47	1.536
16	0.544	48	1.568
17	0.576	49	1.6
18	0.608	50	1.632
19	0.64	51	1.664
20	0.672	52	1.696
21	0.704	53	1.728
22	0.736	54	1.76
23	0.768	55	1.792
24	0.8	56	1.824
25	0.832	57	1.856
26	0.864	58	1.888
27	0.896	59	1.92
28	0.928	60	1.952
29	0.96	61	1.984
30	0.992	62	2.016
31	1.024	63	External

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

12.3 VREF BLOCK DIAGRAM

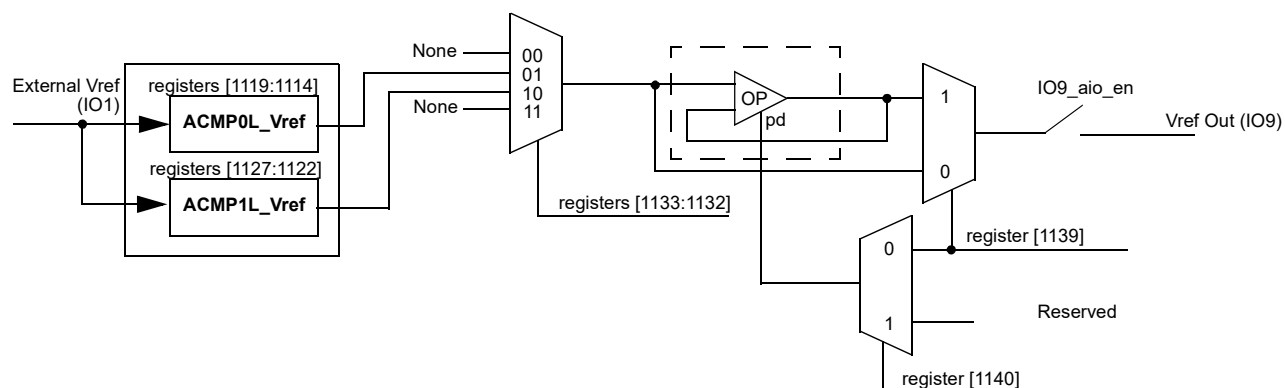


Figure 60: Voltage Reference Block Diagram

12.4 VREF LOAD REGULATION

Note 1 It is not recommended to use Vref connected to external pin without buffer

Note 2 Vref buffer performance is not guaranteed at $V_{DD} < 2.7$ V.

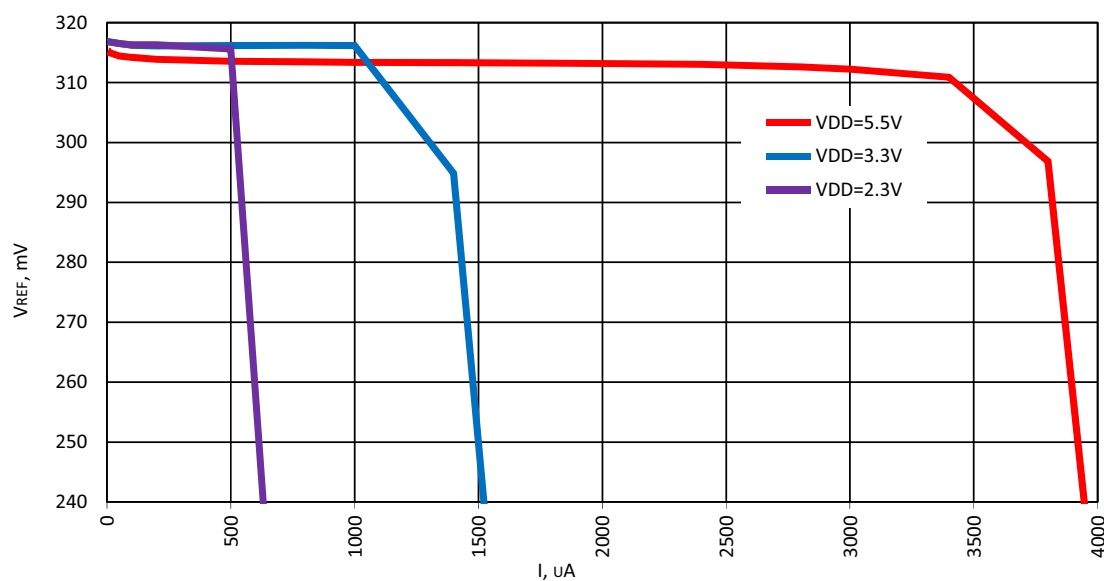


Figure 61: Typical Load Regulation, Vref = 320 mV, T = -40 °C to +85 °C, Buffer - Enable

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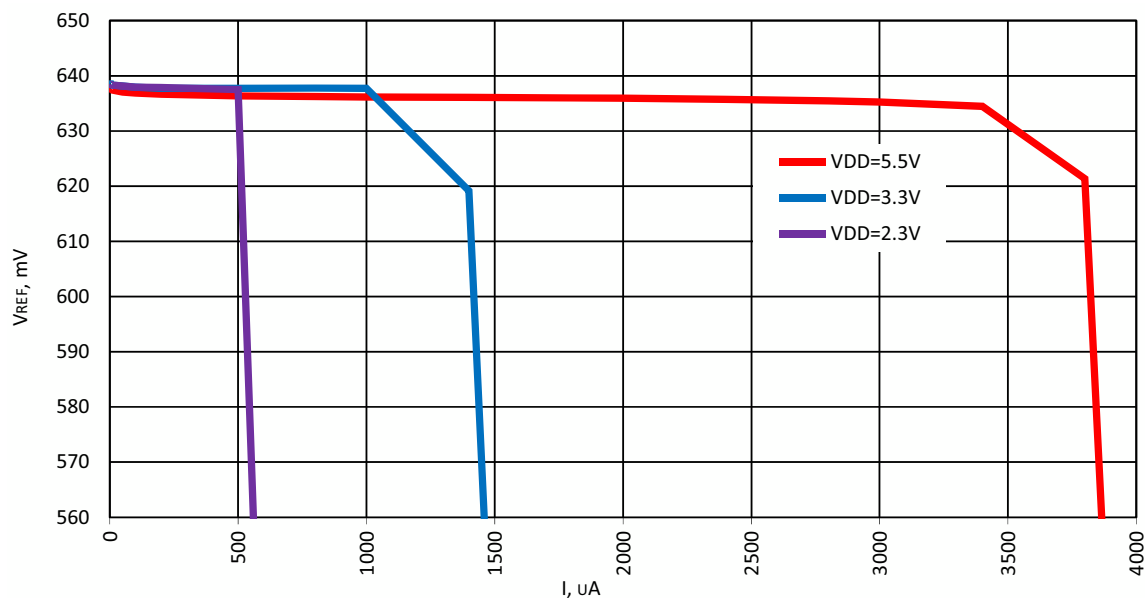


Figure 62: Typical Load Regulation, Vref = 640 mV, T = -40 °C to +85 °C, Buffer - Enable

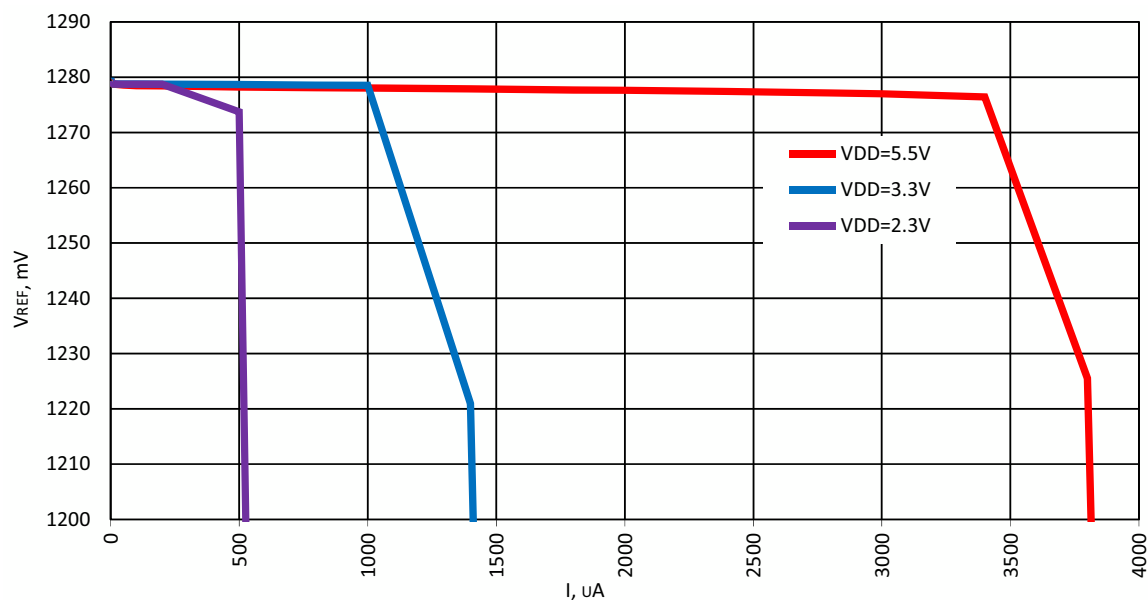


Figure 63: Typical Load Regulation, Vref = 1280 mV, T = -40 °C to +85 °C, Buffer - Enable

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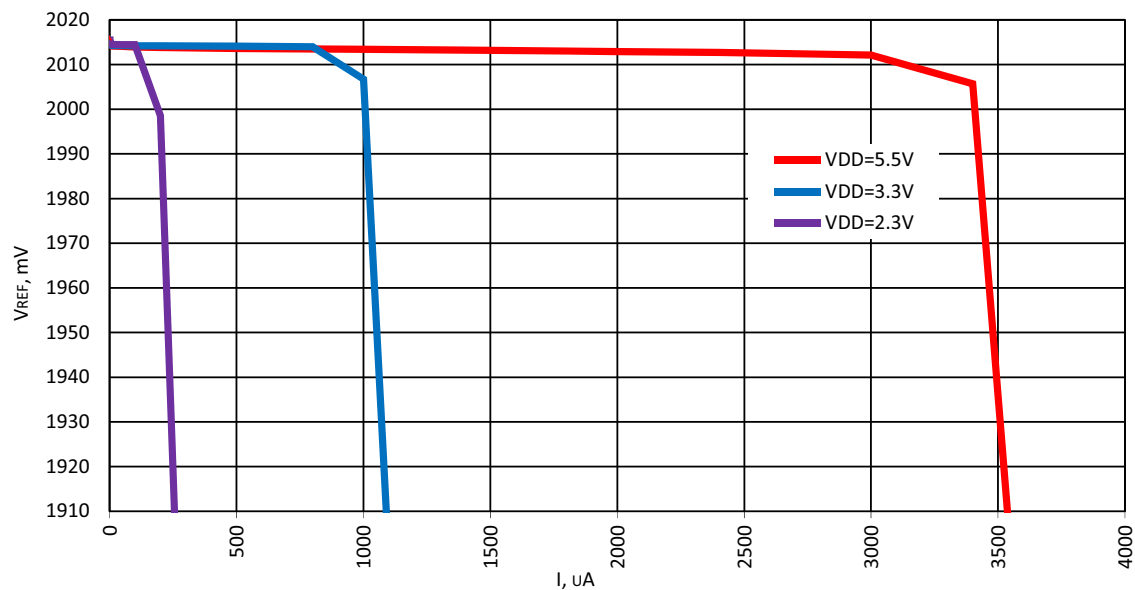


Figure 64: Typical Load Regulation, $V_{ref} = 2016$ mV, $T = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, Buffer - Enable

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

13 Clocking

13.1 OSCILLATOR GENERAL DESCRIPTION

The SLG46824 has three internal oscillators to support a variety of applications:

- Oscillator0 (2.048 kHz)
- Oscillator1 (2.048 MHz)
- Oscillator2 (25 MHz)

There are two divider stages for each oscillator that gives the user flexibility for introducing clock signals to connection matrix, as well as various other Macrocells. The pre-divider (first stage) for Oscillator allows the selection of /1, /2, /4 or /8 to divide down frequency from the fundamental. The second stage divider has an input of frequency from the pre-divider, and outputs one of eight different frequencies divided by /1, /2, /3, /4, /8, /12, /24 or /64 on Connection Matrix Input lines [27], [28] and [29]. Please see [Figure 68](#), for more details on the SLG46824 clock scheme.

Oscillator2 (25 MHz) has an additional function of 100 ns delayed startup, which can be enabled/disabled by register [1052]. This function is recommended to use when analog blocks are used along with the Oscillator.

The Matrix Power-down/Force On function allows switching off or force on the oscillator using an external pin. The Matrix Power-down/Force On (Connection Matrix Output [72], [73], [74]) signal has the highest priority. The OSC operates according to the [Table 43](#).

Table 43: Oscillator Operation Mode Configuration Settings

POR	External Clock Selection	Signal From Connection Matrix	Register: Power-Down or Force On by Matrix Input	Register: Auto Power-On or Force On	OSC Enable Signal from CNT/DLY Macrocells	OSC Operation Mode
0	X	X	X	X	X	OFF
1	1	X	X	X	X	Internal OSC is OFF, logic is ON
1	0	1	0	X	X	OFF
1	0	1	1	X	X	ON
1	0	0	X	1	X	ON
1	0	0	X	0	CNT/DLY requires OSC	ON
1	0	0	X	0	CNT/DLY does not require OSC	OFF

Note 1 The OSC will run only when any macrocell that uses OSC is powered on.

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

13.2 OSCILLATOR0 (2.048 KHZ)

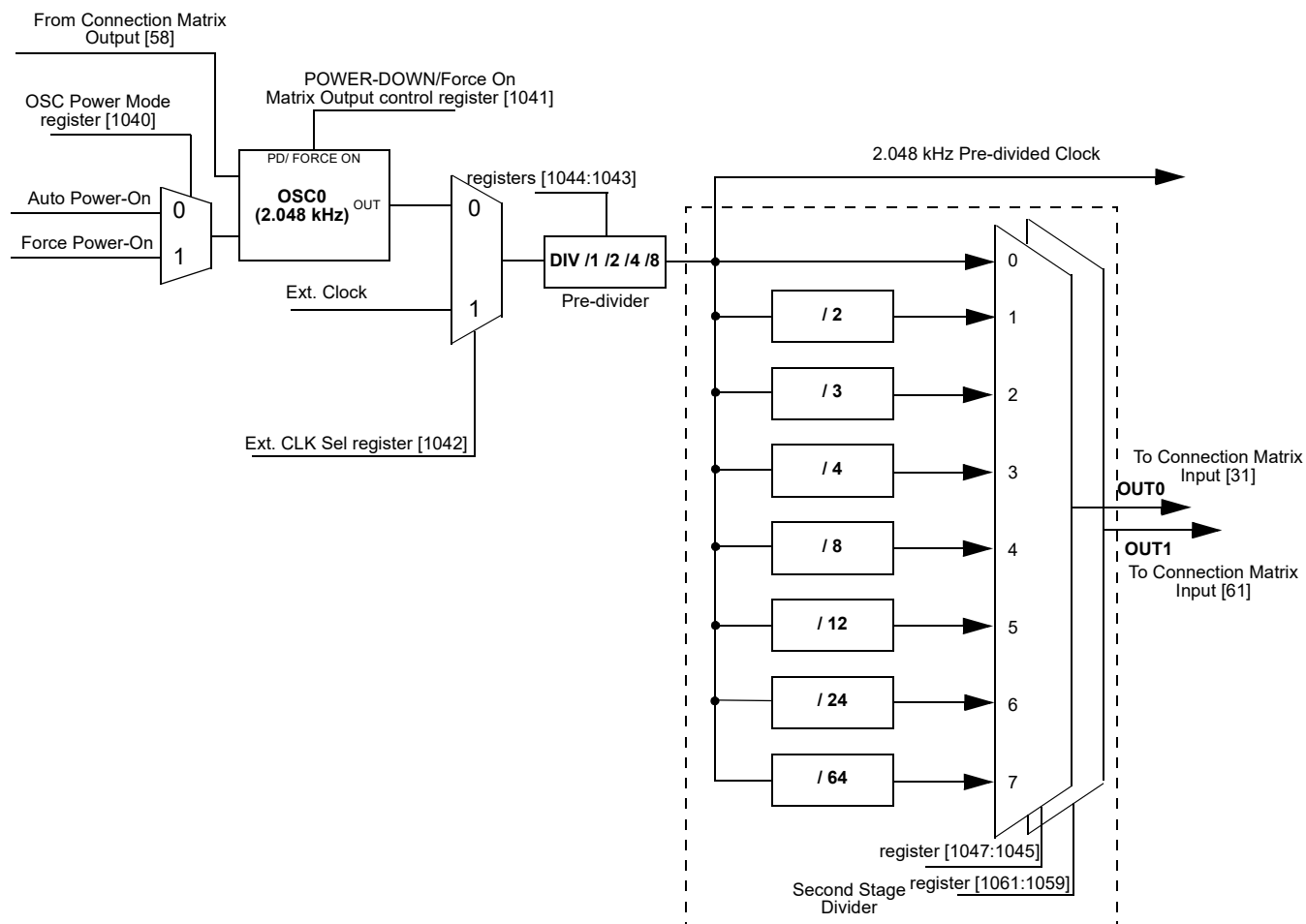


Figure 65: Oscillator0 Block Diagram

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13.3 OSCILLATOR1 (2.048 MHZ)

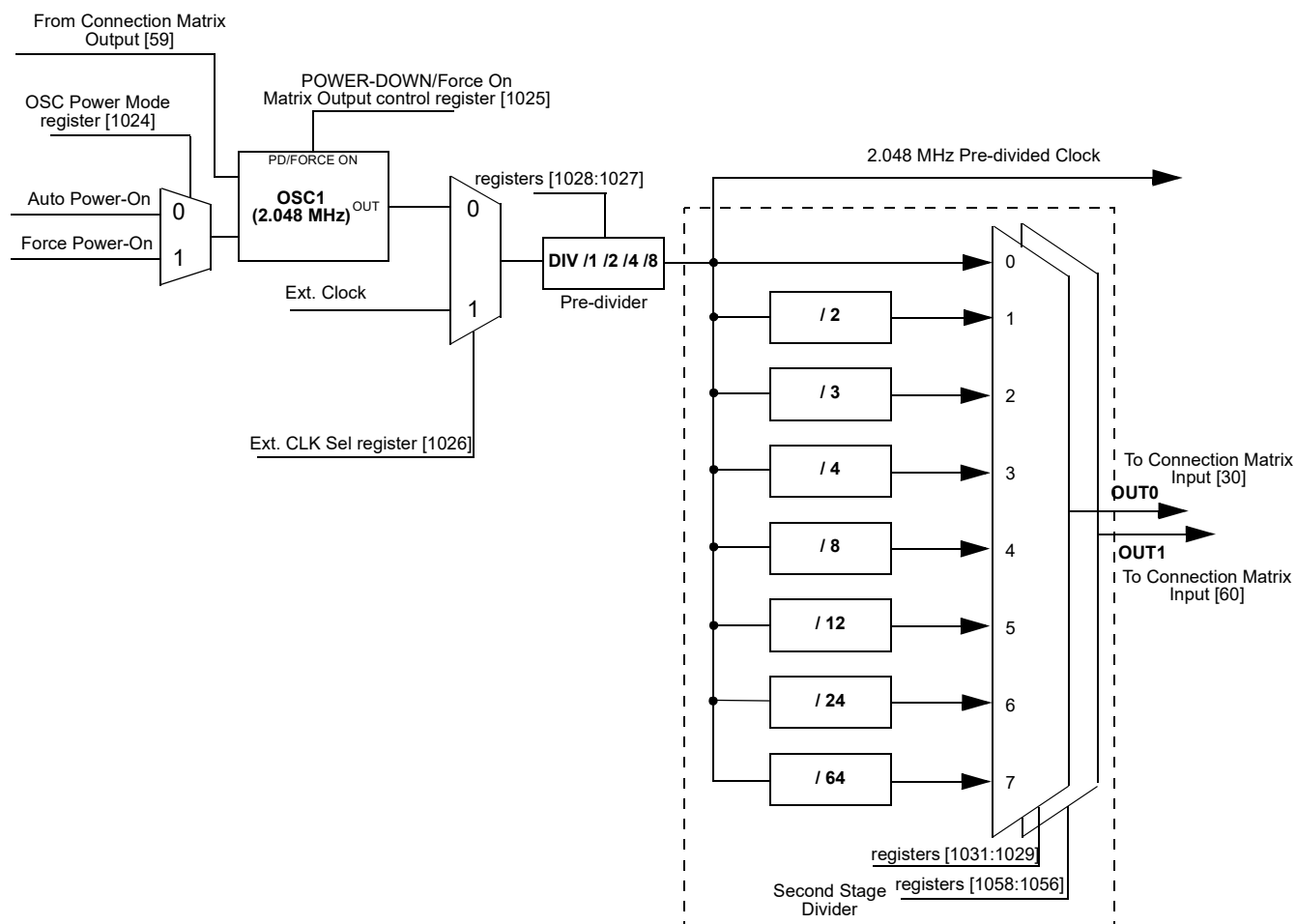


Figure 66: Oscillator1 Block Diagram

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13.4 OSCILLATOR2 (25 MHZ)

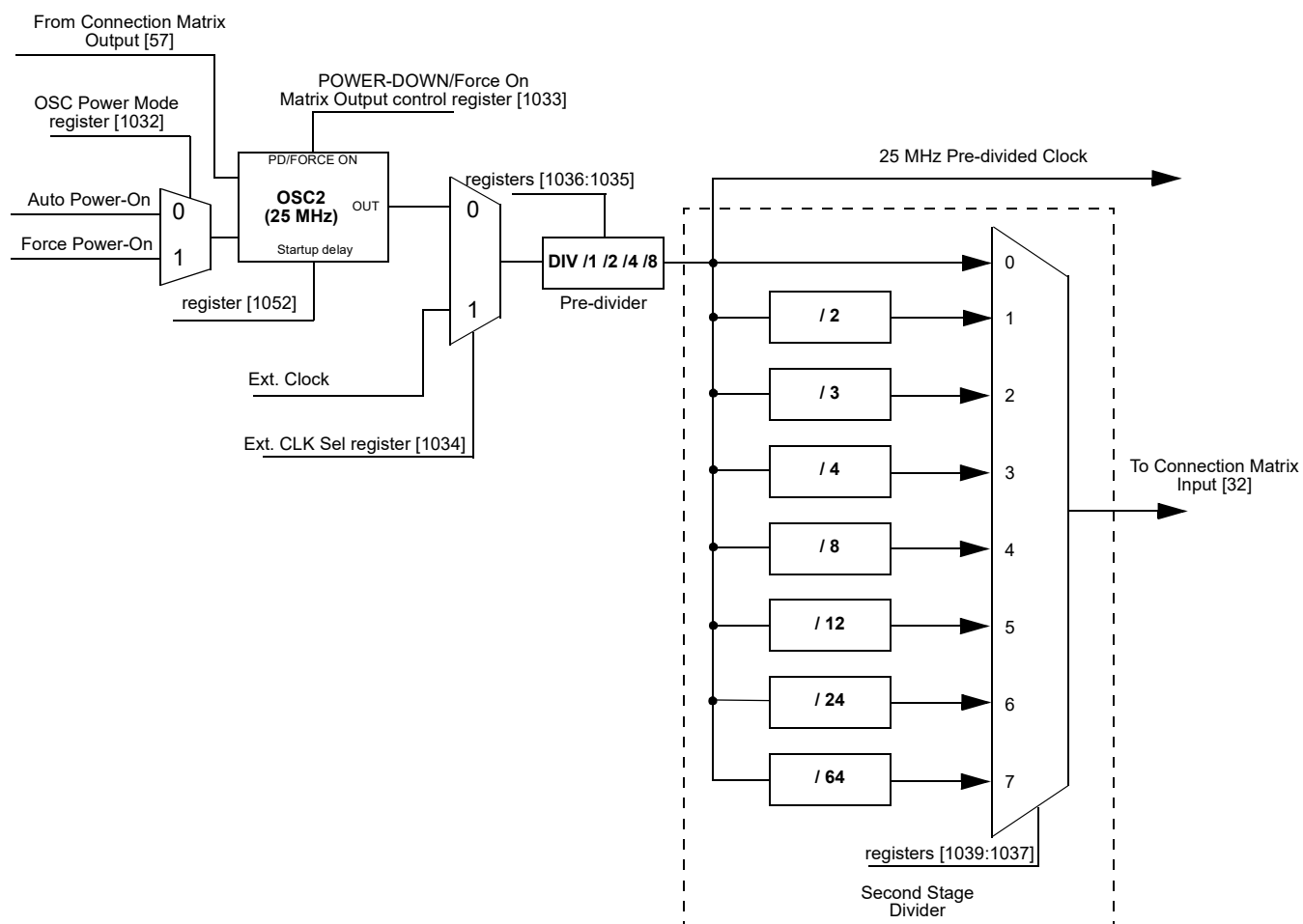


Figure 67: Oscillator2 Block Diagram

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13.5 CLOCK SCHEME

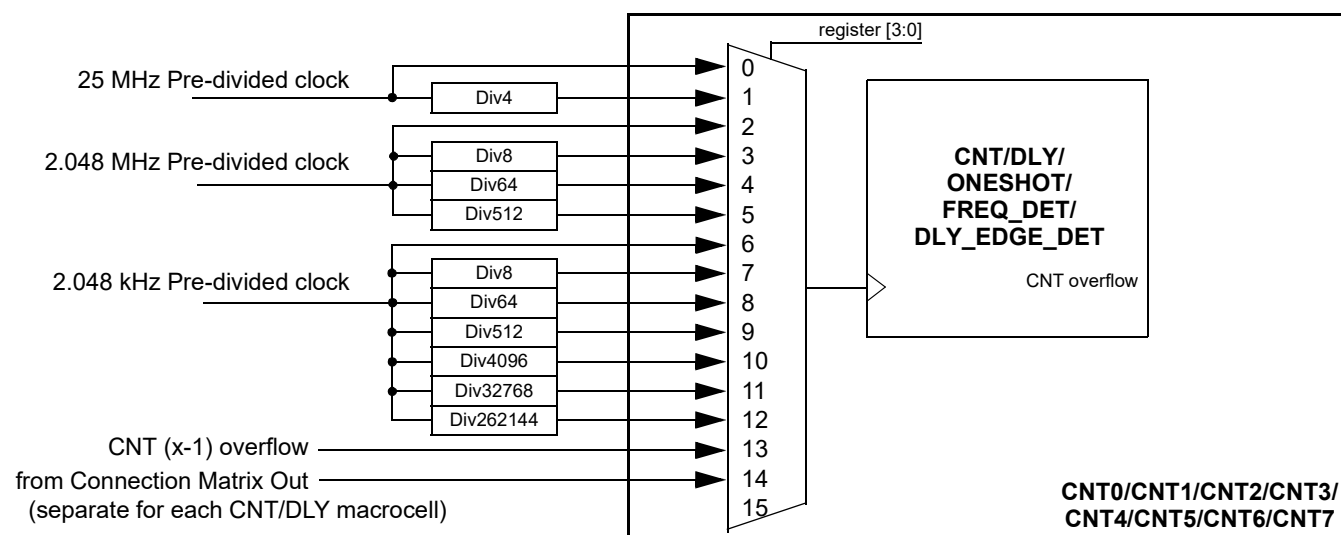


Figure 68: Clock Scheme

13.6 EXTERNAL CLOCKING

The SLG46824 supports several ways to use an external, higher accuracy clock as a reference source for internal operations.

13.6.1 IO0 Source for Oscillator0 (2.048 kHz)

When register [1042] is set to 1, an external clocking signal on IO0 will be routed in place of the internal oscillator derived 2.048 kHz clock source. See [Figure 65](#). The high and low limits for frequency that can be selected are 0 MHz and 10 MHz.

13.6.2 IO10 Source for Oscillator1 (2.048 MHz)

When register [1026] is set to 1, an external clocking signal on IO10 will be routed in place of the internal oscillator derived 2.048 MHz clock source. See [Figure 66](#). The high and low limits for frequency that can be selected are 0 MHz and 10 MHz.

13.6.3 IO8 Source for Oscillator2 (25 MHz)

When register [1034] is set to 1, an external clocking signal on IO8 will be routed in place of the internal oscillator derived 25 MHz clock source. See [Figure 67](#). The external frequency range is 0 MHz to 20 MHz at $V_{DD} = 2.3$ V, 0 MHz to 30 MHz at $V_{DD} = 3.3$ V, 0 MHz to 50 MHz at $V_{DD} = 5.0$ V.

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

13.7 OSCILLATORS POWER-ON DELAY

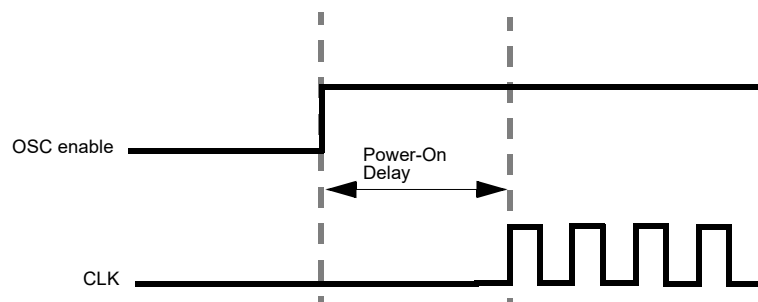


Figure 69: Oscillator Startup Diagram

Note 1 OSC power mode: “Auto Power-On”.

Note 2 “OSC enable” signal appears when any macrocell that uses OSC is powered on.

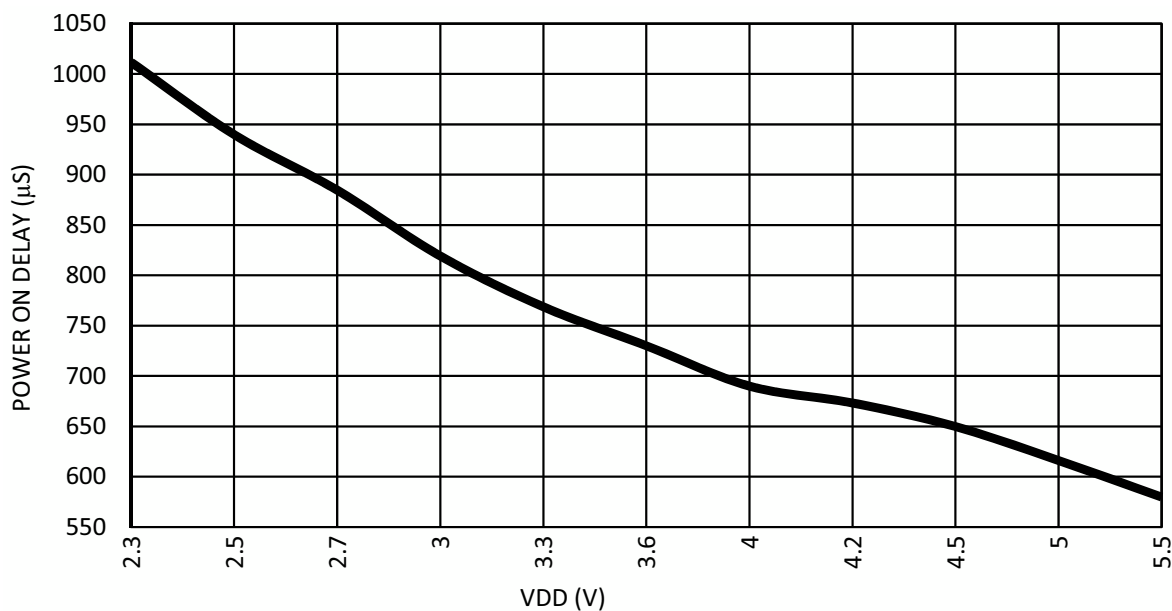


Figure 70: Oscillator0 Maximum Power-On Delay vs. V_{DD} at $T = 25\text{ }^{\circ}\text{C}$, $\text{OSC0} = 2.048\text{ kHz}$

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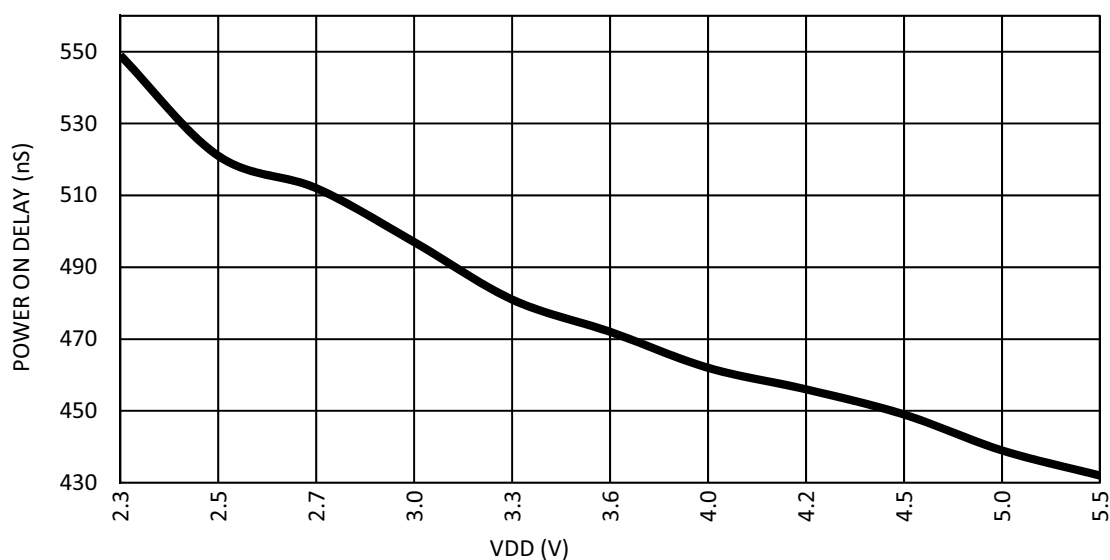


Figure 71: Oscillator1 Maximum Power-On Delay vs. V_{DD} at $T = 25\text{ }^{\circ}\text{C}$, $\text{OSC1} = 2.048\text{ MHz}$

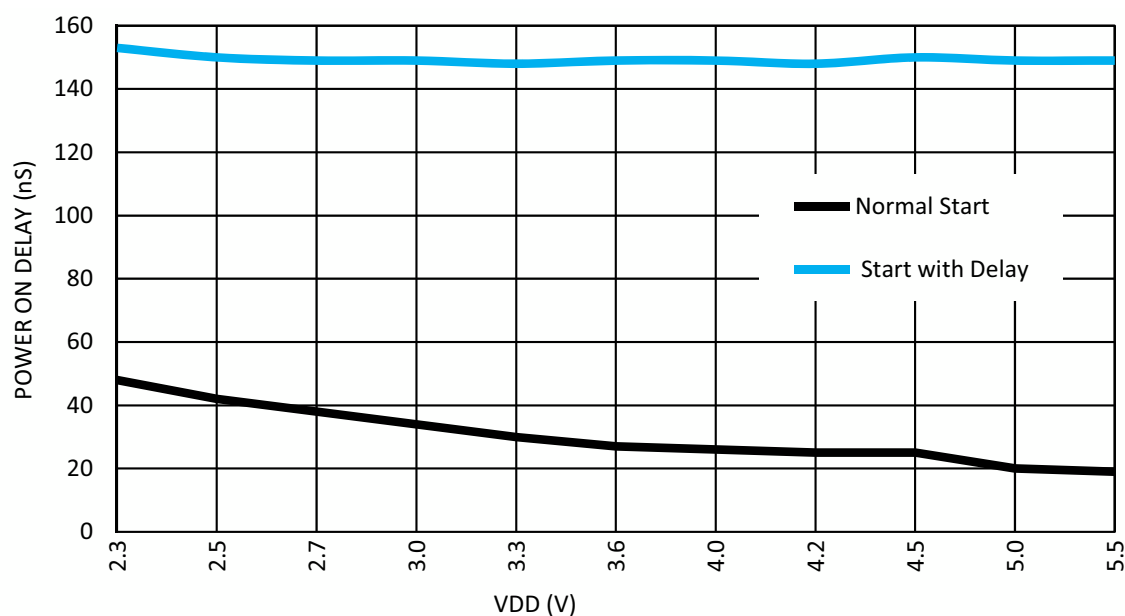


Figure 72: Oscillator2 Maximum Power-On Delay vs. V_{DD} at $T = 25\text{ }^{\circ}\text{C}$, $\text{OSC2} = 25\text{ MHz}$

Note: OSC power setting: Force Power-On; Clock to matrix input - enable; Bandgap: turn on by register - enable.

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13.8 OSCILLATORS ACCURACY

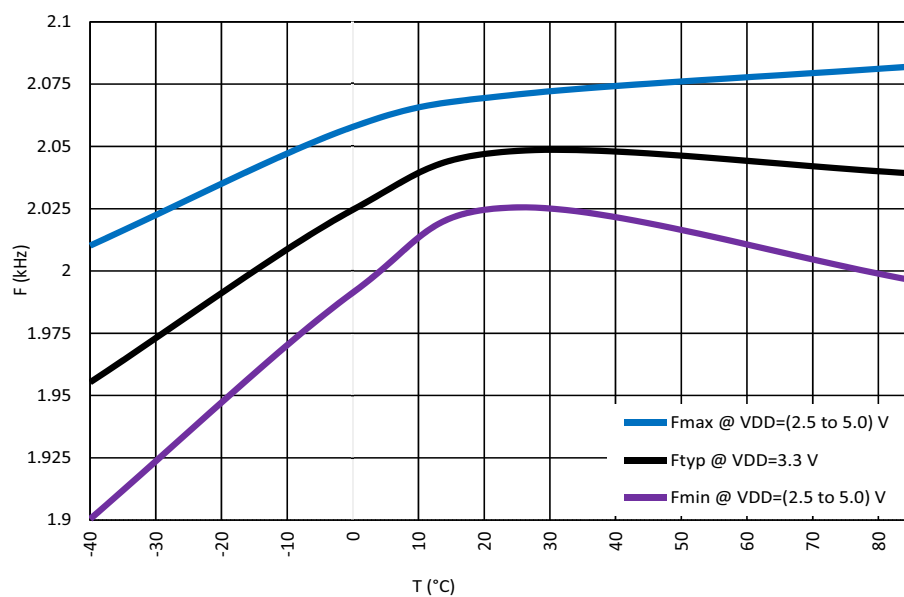


Figure 73: Oscillator0 Frequency vs. Temperature, OSC0 = 2.048 kHz

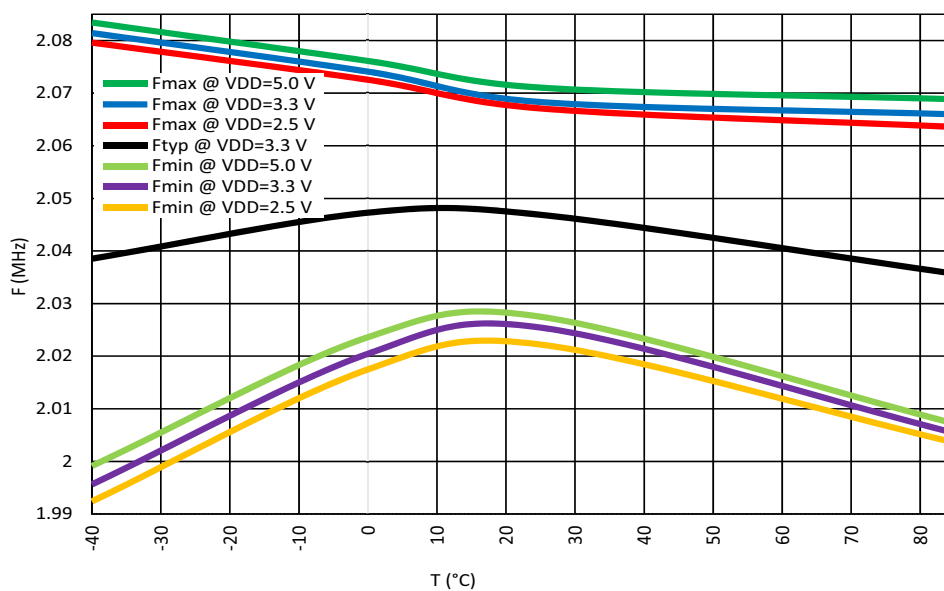


Figure 74: Oscillator1 Frequency vs. Temperature, OSC1 = 2.048 MHz

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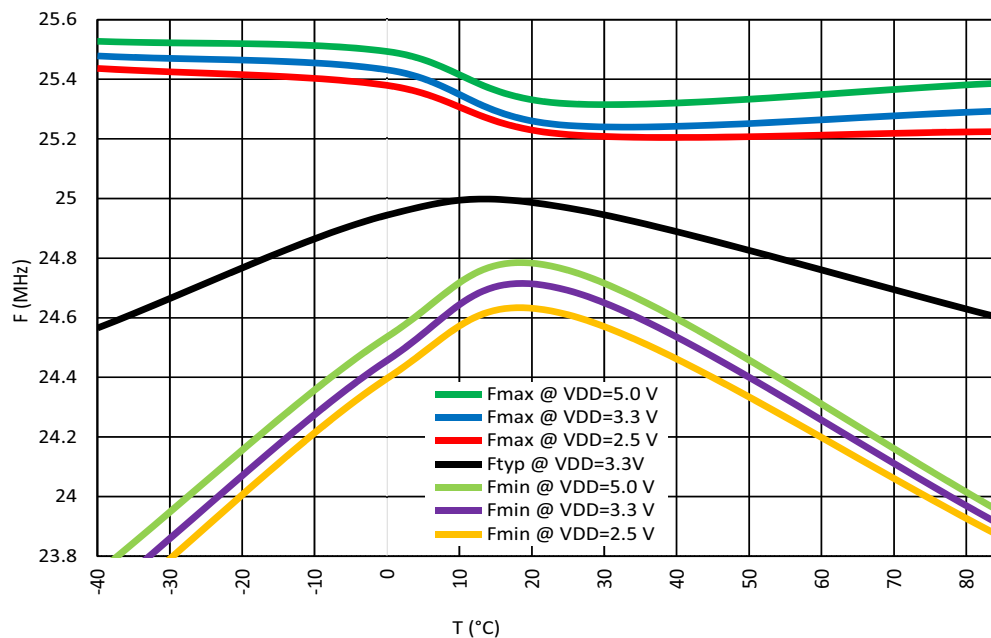


Figure 75: Oscillator2 Frequency vs. Temperature, OSC2 = 25 MHz

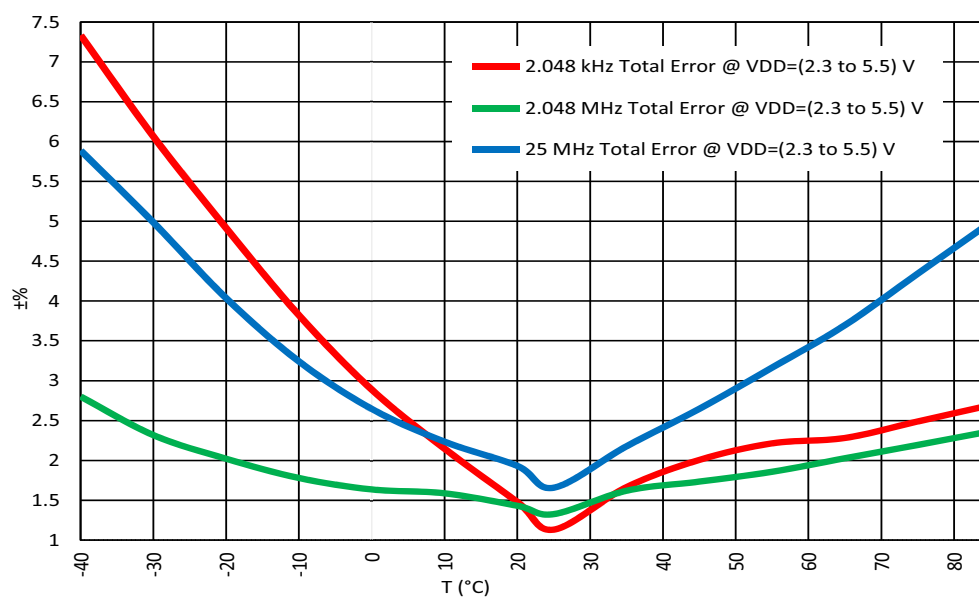


Figure 76: Oscillators Total Error vs. Temperature

Note: For more information see Section 3.6.

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Table 44: Oscillator Output Duty Cycle

Pre-divider	Second Stage Divider									
	OSC0 OSC1	OSC2	OSC0 OSC1 OSC2	OSC0 OSC1	OSC2	OSC0 OSC1 OSC2	OSC0 OSC1 OSC2	OSC0 OSC1 OSC2	OSC0 OSC1 OSC2	OSC0 OSC1 OSC2
	1		2	3		4	8	12	24	64
1	50	60	50	33.3	66	50	50	50	50	50
2	50	50	50	33.3	66	50	50	50	50	50
4	50	50	50	33.3	66	50	50	50	50	50
8	50	50	50	33.3	66	50	50	50	50	50

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14 Power-On Reset

The SLG46824 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 IOs.

14.1 GENERAL OPERATION

The SLG46824 is guaranteed to be powered down and non-operational when the V_{DD} voltage (voltage on PIN1 for STQFN package; voltage on PIN20 for TSSOP package) is less than Power-Off Threshold (see in [Table 3.4](#)), but not less than -0.6 V. Another essential condition for the chip to be powered down is that no voltage higher (Note) 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: There is a 0.6 V margin due to forward drop voltage of the ESD protection diodes.

To start the POR sequence in the SLG46824, the voltage applied on the V_{DD} should be higher than the Power-ON threshold (Note). The full operational V_{DD} range for the SLG46824 is 2.3 V to 5.5 V. 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 SLG46824 will have a typical Startup Time (see in [Table 3.4](#)) to go through all the steps in the sequence, and will be ready and completely operational after the POR sequence is complete.

Note: The Power-On threshold is defined in [Table 3.4](#).

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 Power-Off Threshold.

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 IO 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.

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

14.2 POR SEQUENCE

The POR system generates a sequence of signals that enable certain macrocells. The sequence is shown in [Figure 77](#).

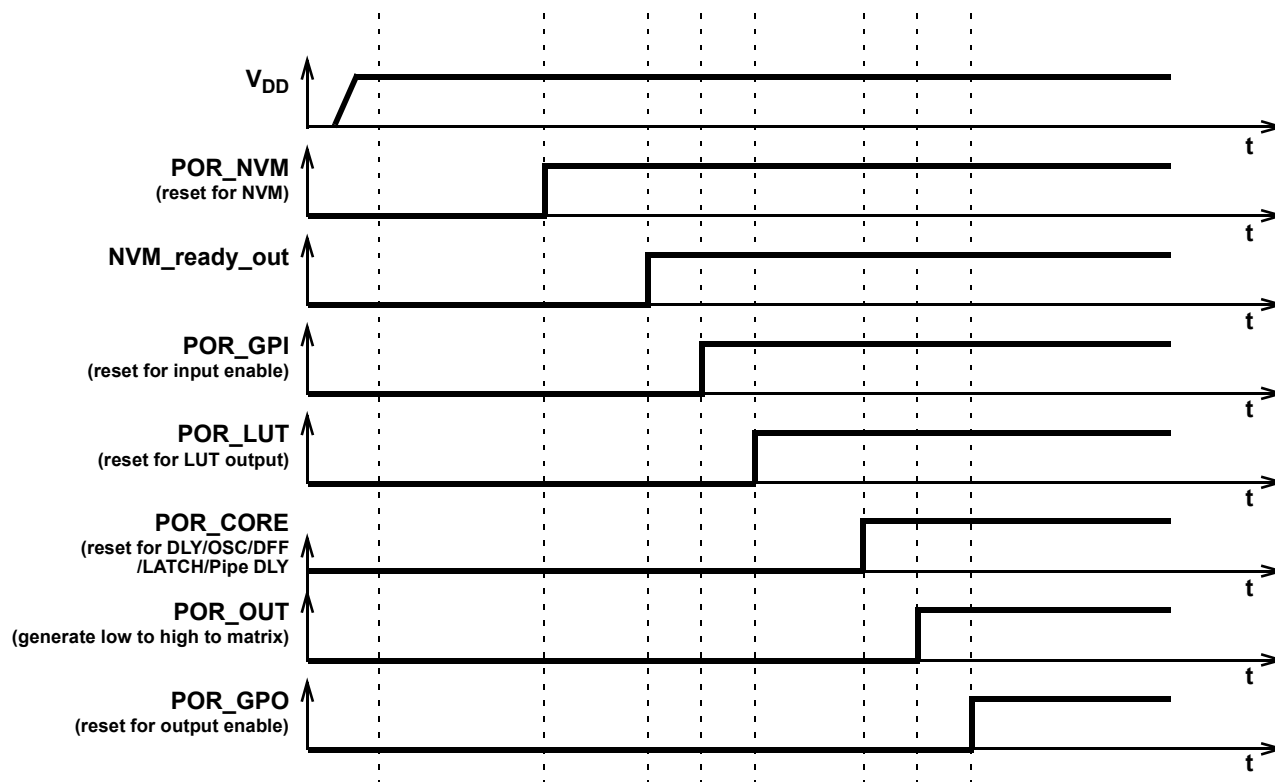


Figure 77: POR Sequence

As can be seen from [Figure 77](#) after the V_{DD} has started ramping up and crossed 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 a CMOS LATCH that serves 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, OSCs, DFFs, LATCHES and Pipe Delay are initialized. Only after all macrocells are initialized, internal POR signal (POR macrocell output) goes from LOW to HIGH (POR_OUT in [Figure 77](#)). The last portion of the device to be initialized is 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).

14.3 MACROCELLS OUTPUT STATES DURING POR SEQUENCE

To have a full picture of SLG46824 operation during powering and POR sequence, refer to [Figure 78](#) which describes the macrocell output states during the POR sequence.

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). On the next step, some of the macrocells start initialization: input pins output state becomes LOW; LUTs also output LOW. After that input pins are enabled. Next, only LUTs are configured. Then, all other macrocells are initialized. After

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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.

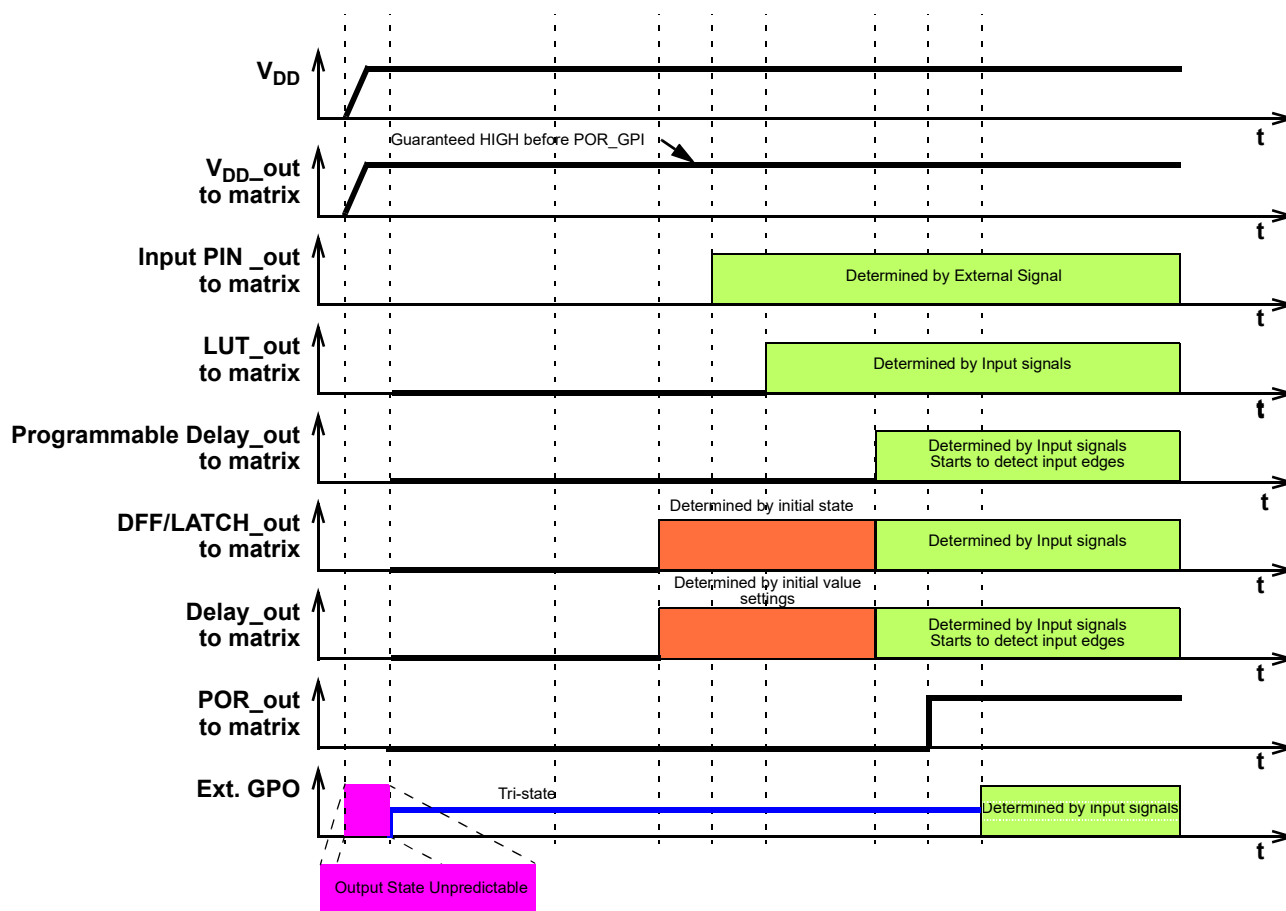


Figure 78: Internal Macrocell States during POR Sequence

14.3.1 Initialization

All internal macrocells by default have initial low level. Starting from indicated power-up time of 1.63 V to 2.04 V, macrocells in SLG46824 are powered on while forced to the reset state. All outputs are in Hi-Z and chip starts loading data from NVM. Then the reset signal is released for internal macrocells and they start to initialize according to the following sequence:

1. Input pins, Pull-up/down.
2. LUTs.
3. DFFs, Delays/Counters, Pipe Delay, OSCs, ACMPs.
4. POR output to matrix.
5. Output pin corresponds to the internal logic.

The Vref output pin driving signal can precede POR output signal going high by 3 μ s to 5 μ s. The POR signal going high indicates the mentioned power-up sequence is complete.

Note: The maximum voltage applied to any pin should not be higher than the V_{DD} level. There are ESD Diodes between pin $\rightarrow$ V_{DD} and pin $\rightarrow$ GND on each pin. Exceeding V_{DD} results in leakage current on the input pin, and V_{DD} will be pulled up, following the voltage on the input pin.

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14.3.2 Power-Down

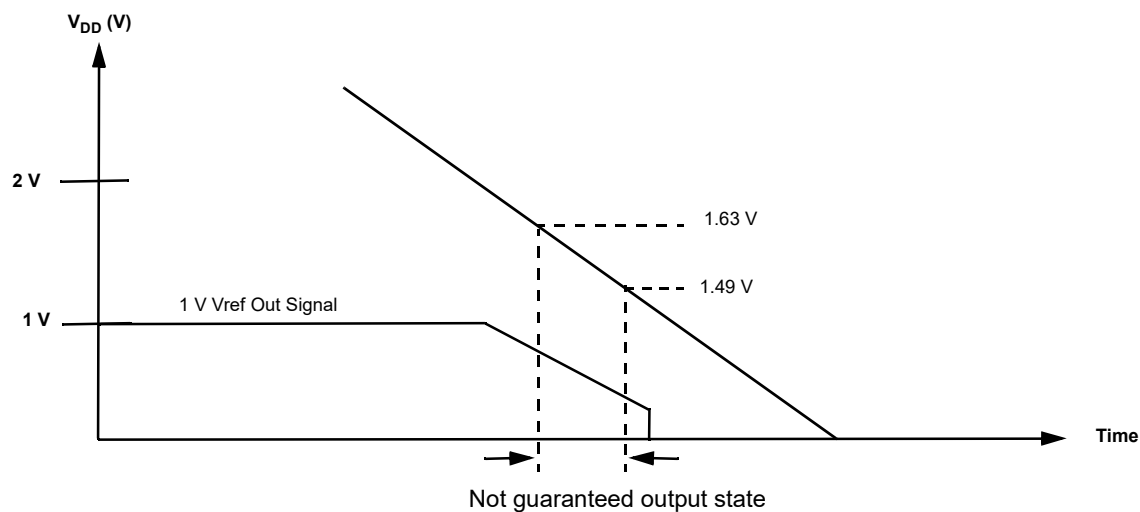


Figure 79: Power-Down

During powerdown, macrocells in SLG46824 are powered off after V_{DD} falling down below Power-Off Threshold. Please note that during a slow rampdown, outputs can possibly switch state.

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15 I²C Serial Communications Macrocell

15.1 I²C SERIAL COMMUNICATIONS MACROCELL OVERVIEW

In the standard use case for the GreenPAK devices, the configuration choices made by the user are stored as bit settings in the Non-Volatile Memory (NVM), and this information is transferred at startup time to volatile RAM registers that enable the configuration of the macrocells. Other RAM registers in the device are responsible for setting the connections in the Connection Matrix to route signals in the manner most appropriate for the user's application.

The I²C Serial Communications Macrocell in this device allows an I²C bus Master to read and write this information via a serial channel directly to the RAM registers, allowing the remote re-configuration of macrocells, and remote changes to signal chains within the device.

An I²C bus Master is also able read and write other register bits that are not associated with NVM memory. As an example, the input lines to the Connection Matrix can be read as digital register bits. These are the signal outputs of each of the macrocells in the device, giving an I²C bus Master the capability to remotely read the current value of any macrocell.

The user has the flexibility to control read access and write access via registers bits registers [1795:1792]. See Section 16 for more details on I²C read/write memory protection.

15.2 I²C SERIAL COMMUNICATIONS DEVICE ADDRESSING

Each command to the I²C Serial Communications macrocell begins with a Control Byte. The bits inside this Control Byte are shown in Figure 80. After the Start bit, the first four bits are a control code. Each bit in a control code can be sourced independently from the register or by value defined externally by IO5, IO4, IO3 and IO2. The LSB of the control code is defined by the value of IO2, while the MSB is defined by the value of IO5. The address source (either register bit or PIN) for each bit in the control code is defined by registers [1623:1620]. This gives the user flexibility on the chip level addressing of this device and other devices on the same I²C bus. The default control code is 0001. The Block Address is the next three bits (A10, A9, A8), which will define the most significant bits in the addressing of the data to be read or written by the command. The last bit in the Control Byte is the R/W bit, which selects whether a read command or write command is requested, with a "1" selecting for a Read command, and a "0" selecting for a Write command. This Control Byte will be followed by an Acknowledge bit (ACK), which is sent by this device to indicate successful communication of the Control Byte data.

In the I²C-bus specification and user manual, there are two groups of eight addresses (0000 xxx and 1111 xxx) that are reserved for the special functions, such as a system General Call address. If the user of this device chooses to set the Control Code to either "1111" or "0000" in a system with other slave device, please consult the I²C-bus specification and user manual to understand the addressing and implementation of these special functions, to insure reliable operation.

In the read and write command address structure, there are a total of 11 bits of addressing, each pointing to a unique byte of information, resulting in a total address space of 16K bytes. The valid addresses are shown in the memory map in Figure 80.

With the exception of the Current Address Read command, all commands will have the Control Byte followed by the Word Address.

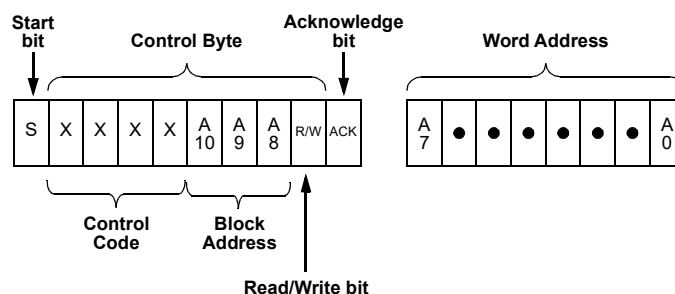


Figure 80: Basic Command Structure

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15.3 I²C SERIAL GENERAL TIMING

General timing characteristics for the I²C Serial Communications macrocell are shown in Figure 81. Timing specifications can be found in the Section 3.4.

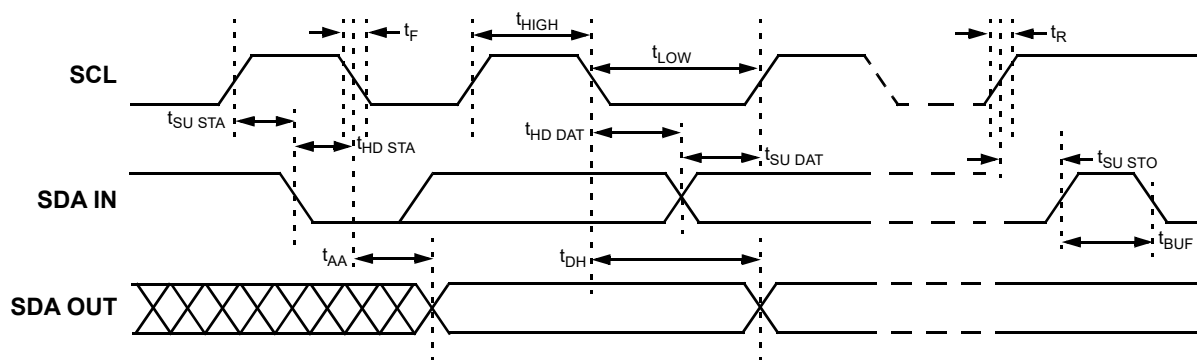


Figure 81: I²C General Timing Characteristics

15.4 I²C SERIAL COMMUNICATIONS COMMANDS

15.4.1 Byte Write Command

Following the Start condition from the Master, the Control Code [4 bits], the Block Address [3 bits] and the R/W bit (set to "0"), are placed onto the I²C bus by the Master. After the SLG46824 sends an Acknowledge bit (ACK), the next byte transmitted by the Master is the Word Address. The Block Address (A10, A9, A8), combined with the Word Address (A7 through A0), together set the internal address pointer in the SLG46824 where the data byte is to be written. After the SLG46824 sends another Acknowledge bit, the Master will transmit the data byte to be written into the addressed memory location. The SLG46824 again provides an Acknowledge bit and then the Master generates a Stop condition. The internal write cycle for the data will take place at the time that the SLG46824 generates the Acknowledge bit.

It is possible to latch all IOs during I²C write command to the register configuration data (block address A10A9A8 = 000), register [1602] = 1 - Enable. It means that IOs will remain their state until the write command is done.

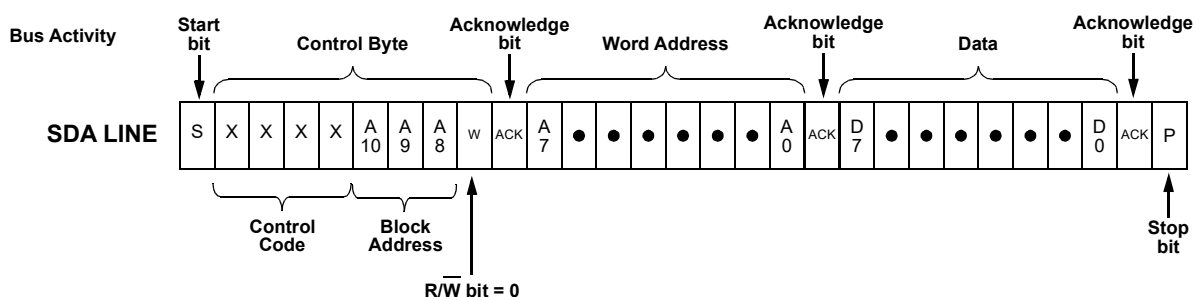


Figure 82: Byte Write Command, $R/\bar{W} = 0$

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15.4.2 Sequential Write Command

The write Control Byte, Word Address and the first data byte are transmitted to the SLG46824 in the same way as in a Byte Write command. However, instead of generating a Stop condition, the Bus Master continues to transmit data bytes to the SLG46824. Each subsequent data byte will increment the internal address counter, and will be written into the next higher byte in the command addressing. As in the case of the Byte Write command, the internal write cycle will take place at the time that the SLG46824 generates the Acknowledge bit.

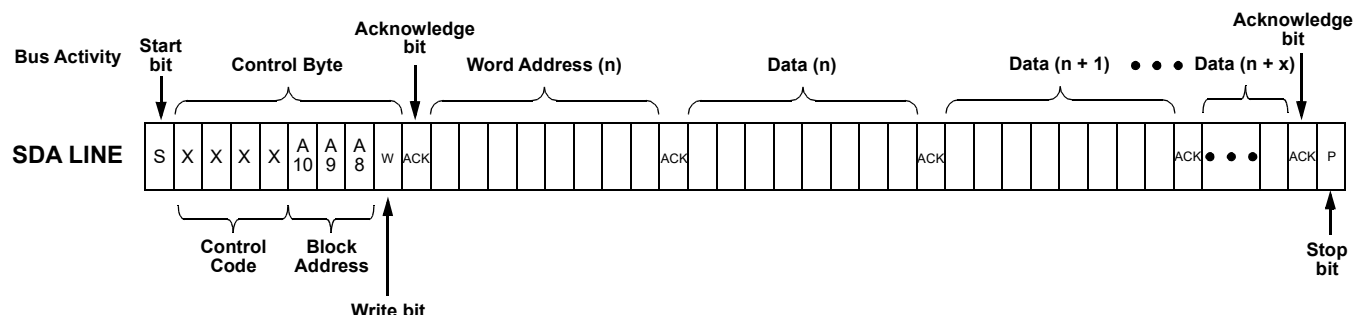


Figure 83: Sequential Write Command

15.4.3 Current Address Read Command

The Current Address Read Command reads from the current pointer address location. The address pointer is incremented at the first STOP bit following any write control byte. For example, if a Sequential Read command (which contains a write control byte) reads data up to address n , the address pointer would get incremented to $n + 1$ upon the STOP of that command. Subsequently, a Current Address Read that follows would start reading data at $n + 1$. The Current Address Read Command contains the Control Byte sent by the Master, with the R/W bit = "1". The SLG46824 will issue an Acknowledge bit, and then transmit eight data bits for the requested byte. The Master will not issue an Acknowledge bit, and follow immediately with a Stop condition.

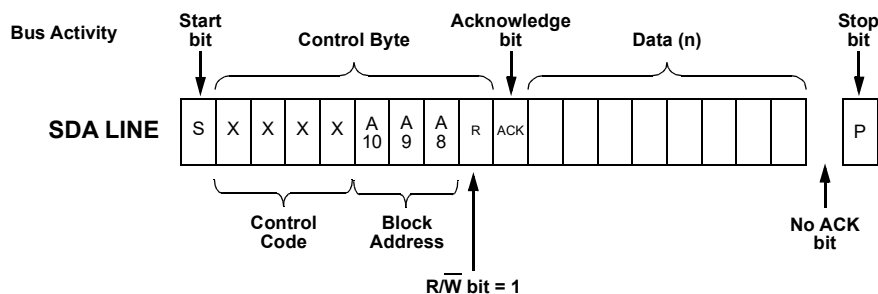


Figure 84: Current Address Read Command, $\overline{R/W} = 1$

15.4.4 Random Read Command

The Random Read command starts with a Control Byte (with R/W bit set to "0", indicating a write command) and Word Address to set the internal byte address, followed by a Start bit, and then the Control Byte for the read (exactly the same as the Byte Write command). The Start bit in the middle of the command will halt the decoding of a Write command, but will set the internal address

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counter in preparation for the second half of the command. After the Start bit, the Bus Master issues a second control byte with the R/W bit set to "1", after which the SLG46824 issues an Acknowledge bit, followed by the requested eight data bits.

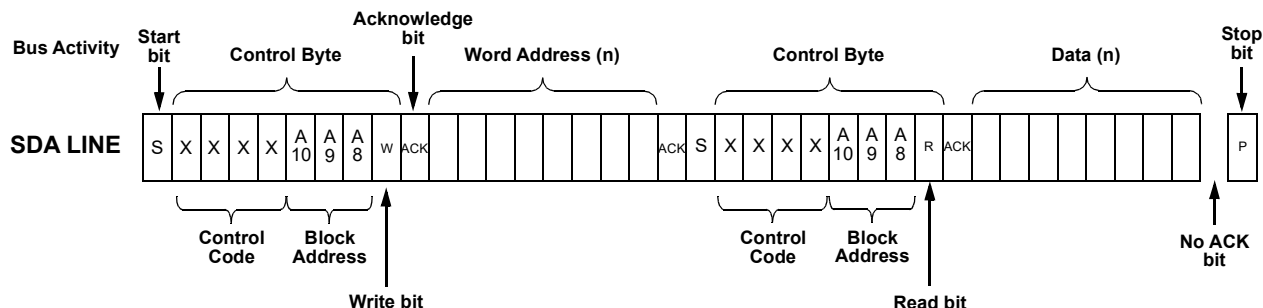


Figure 85: Random Read Command

15.4.5 Sequential Read Command

The Sequential Read command is initiated in the same way as a Random Read command, except that once the SLG46824 transmits the first data byte, the Bus Master issues an Acknowledge bit as opposed to a Stop condition in a random read. The Bus Master can continue reading sequential bytes of data, and will terminate the command with a Stop condition.

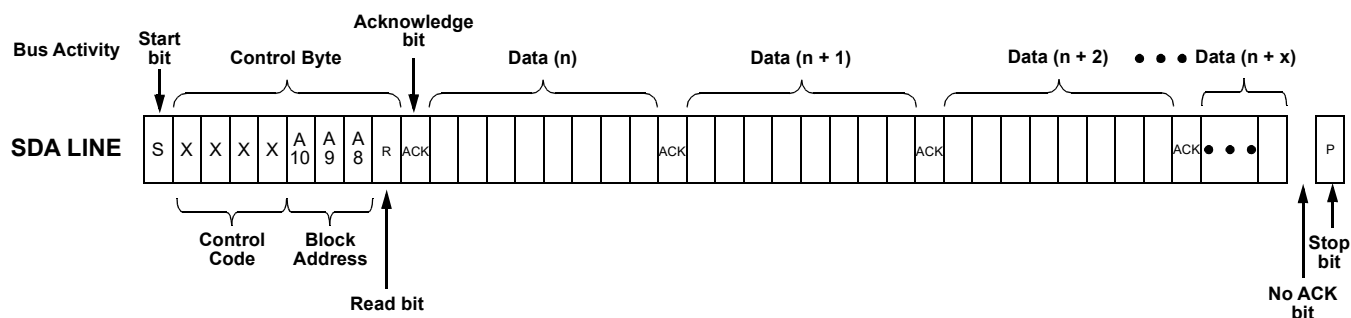


Figure 86: Sequential Read Command

15.5 CHIP CONFIGURATION DATA PROTECTION

The SLG46824 utilizes a scheme that allows a portion or the entire Register and NVM to be inhibited from being read or written/erased. There are two bytes that define the register and NVM access or change. The first byte RPR defines the 2k register read and write protection. The second byte NPR defines the 2k NVM data configuration read and write protection. If desired, the protection lock bit (PRL) can be set so that protection may no longer be modified, thereby making the current protection scheme permanent. The status of the RPR and NPR can be determined by following a Random Read sequence. Changing the state of the RPR and NPR is accomplished with a Byte Write sequence with the requirements outlined in this section.

The RPR register is located on H'E0 address, while NPR is located on H'E1 address.

The RPR format is shown in Table 45, and the RPR bit functions are included in Table 46.

Table 45: RPR Format

	b7	b6	b5	b4	b3	b2	b1	b0
RPR					RPRB3	RPRB2	RPRB1	RPRB0

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Table 46: RPR Bit Function Description

Bit	Name		Type	Description
3:2	RPRB3	2k Register Write Selection Bits	R/W*	00: 2k register data is unprotected for write; 01: 2k register data is partly protected for write; Please refer to the Table 49. 10: 2k register data is fully protected for write.
	RPRB2		R/W*	
1:0	RPRB1	2k Register Read Selection Bits	R/W*	00: 2k register data is unprotected for read; 01: 2k register data is partly protected for read; Please refer to the Table 49. 10: 2k register data is fully protected for read.
	RPRB0		R/W*	

* Becomes read only after PRL is high. The content is permanently locked for write and erase after PRL is high.

The NPR format is shown in [Table 47](#), and the NPR bit functions are included in [Table 48](#).

Table 47: NPR Format

	b7	b6	b5	b4	b3	b2	b1	b0
NPR							NPRB1	NPRB0

Table 48: NPR Bit Function Description

Bit	Name		Type	Description
1:0	NPRB1	2k NVM Configuration Selection Bits	R/W*	00: 2k NVM Configuration data is unprotected for read and write/erase; 01: 2k NVM Configuration data is fully protected for read; 10: 2k NVM Configuration data is fully protected for write/erase. 11: 2k NVM Configuration data is fully protected for read and write/erase.
	NPRB0		R/W*	

* Becomes read only after PRL is high. The content is permanently locked for write and erase after PRL is high.

The protection selection bits allow different levels of protection of the register and NVM Memory Array.

The Protect Lock Bit (PRL) is used to permanently lock (for write and erase) the current state of the RPR and NPR. A Logic 0 indicates that the protection byte can be modified, whereas a Logic 1 indicates the byte has been locked and can no longer be modified.

In this case it is impossible to erase the whole page E with protection bytes. The PRL is located at E4 address (register [1824]).

There are nine read/write protect modes for the design sequence from being corrupted or copied. See [Table 49](#) for details.

Table 49: Read/Write Register Protection Options

Configurations	Protection Modes Configuration									Test Mode	Register Address
	Unlock	Partly Lock Read	Partly Lock Write	Partly Lock Read/Write	Partly Lock Read & Lock Write	Lock Read & Partly Lock Write	Lock Read	Lock Write	Lock Read/Write		
RPR[1:0]	00	01	00	01	01	10	10	00	10		
RPR[3:2]	00	00	01	01	10	01	00	10	10		
I2C Byte Write Bit Masking (section 15.5.5)	R/W	R/W	R/W	R/W	R	W	W	R	-	-	C9
I2C Serial Reset Command (section 15.5.1)	R/W	R/W	R/W	R/W	R	W	W	R	-	-	C8b'1

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Table 49: Read/Write Register Protection Options(Continued)

Configurations	Protection Modes Configuration									Test Mode	Register Address
	Unlock	Partly Lock Read	Partly Lock Write	Partly Lock Read/Write	Partly Lock Read & Lock Write	Lock Read & Partly Lock Write	Lock Read	Lock Write	Lock Read/Write		
RPR[1:0]	00	01	00	01	01	10	10	00	10		
RPR[3:2]	00	00	01	01	10	01	00	10	10		
Outputs Latching During I ² C Write	R/W	R/W	R/W	R/W	R	W	W	R	-	-	C8b'2
Connection Matrix Virtual Inputs (section 6.3)	R/W	R/W	R/W	R/W	R	W	W	R	-	-	7A
Configuration Bits for All Macrocells (IOs, ACMPs, Combination Function Macrocells, etc.)	R/W	W	R	-	-	-	W	R	-	-	
Macrocells Inputs Configuration (Connection Matrix Outputs)	R/W	W	R	-	-	-	W	R	-	-	00~47
Protection Mode Selection	R/W	R/W	R	R	R	R	R/W	R	R	R	E4
Macrocells Output Values (Connection Matrix Inputs, section)	R	R	R	R	R	-	-	R	-	R	74~79;7B
Counter Current Value	R	R	R	R	R	-	-	R	-	R	7C~7F
Silicon Identification Service Bits	R	R	R	R	R	R	R	R	R	R	F9b'3~F9b'2
I ² C Control Code	R/W	R/W	R	R	R	R	R/W	R	R	R	CAb'3~CAb'0
Page Erase byte	W**	W**	W**	W**	W**	W**	W**	W**	W**	W**	E3

R/W	Allow Read and Write Data
W	Allow Write Data Only
W**	Pages that can be erased are defined by NVM write protection
R	Allow Read Data Only
-	The Data is protected for Read and Write

Note 1 R/W becomes read only if protection mode selection (lock bit) is set to 1.

Note 2 R/W Readable/writable depend on the "Trim mode enable" bit. If "Trim mode enable" bit value = 1, then trim bits are enable.

It is possible to read some data from macrocells, such as counter current value, connection matrix and connection matrix virtual inputs. The I²C write will not have any impact on data in case data comes from macrocell output, except Connection Matrix Virtual Inputs. The silicon identification service bits allows identifying silicon family, its revision, etc.

See Section 17 for detailed information on all registers.

15.5.1 I²C Serial Reset Command

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If I²C serial communication is established with the device, it is possible to reset the device to initial power up conditions, including configuration of all macrocells, and all connections provided by the Connection Matrix. This is implemented by setting register [1601] I²C reset bit to “1”, which causes the device to re-enable the Power-On Reset (POR) sequence, including the reload of all register data from NVM. During the POR sequence, the outputs of the device will be in tri-state. After the reset has taken place, the contents of register [1601] will be set to “0” automatically. Figure 87 illustrates the sequence of events for this reset function.

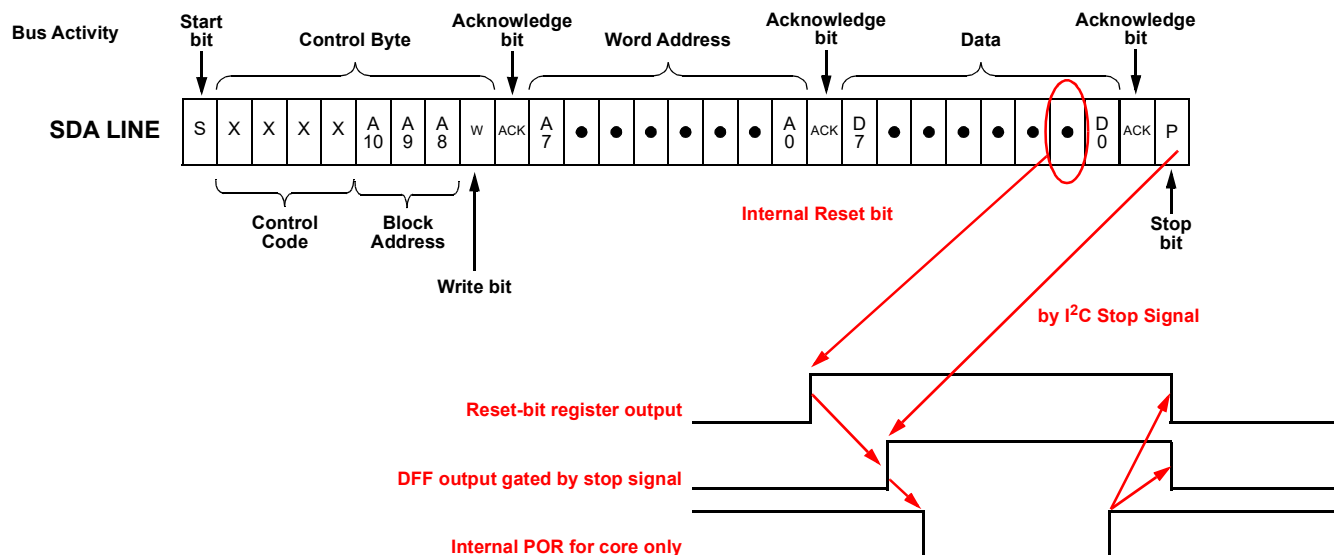


Figure 87: Reset Command Timing

15.5.2 I²C Additional Options

When Output latching during I²C write to the register configuration data (block address A10A9A8 = 000), register [1602] = 1 allows all PINs output value to be latched while register content is changing. It will protect the output change due to configuration process during I²C write in case multiple register bytes are changed. Inputs and internal macrocells retain their status during I²C write.

See Section 17 for detailed information on all registers.

15.5.3 Reading Counter Data via I²C

The current count value in three counters in the device can be read via I²C. The counters that have this additional functionality are 16-bit CNT0, and 8-bit counters CNT2 and CNT4.

15.5.4 I²C Expander

In addition to the eight Connection Matrix Virtual Inputs, the SLG46824 chip has four pins which can be used as an I²C Expander. These four pins are IO0, IO5, IO6, and IO9.

Each of these pins can be used as an I²C Expander output or used as a normal pin. Also each of these four expander outputs have initial state settings which are specified in registers [1599:1592].

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15.5.5 I²C Byte Write Bit Masking

The I²C macrocell inside SLG46824 supports masking of individual bits within a byte that is written to the RAM memory space. This function is supported across the entire RAM memory space. To implement this function, the user performs a Byte Write Command (see Section 15.4.1 for details) on the I²C Byte Write Mask Register (address 0C9H) with the desired bit mask pattern. This sets a bit mask pattern for the target memory location that will take effect on the next Byte Write Command to this register byte. Any bit in the mask that is set to “1” in the I²C Byte Write Mask Register will mask the effect of changing that particular bit in the target register, during the next Byte Write Command. The contents of the I²C Byte Write Mask Register are reset (set to 00h) after valid Byte Write Command. If the next command received by the device is not a Byte Write Command, the effect of the bit masking function will be aborted, and the I²C Byte Write Mask Register will be reset with no effect. Figure 88 shows an example of this function.

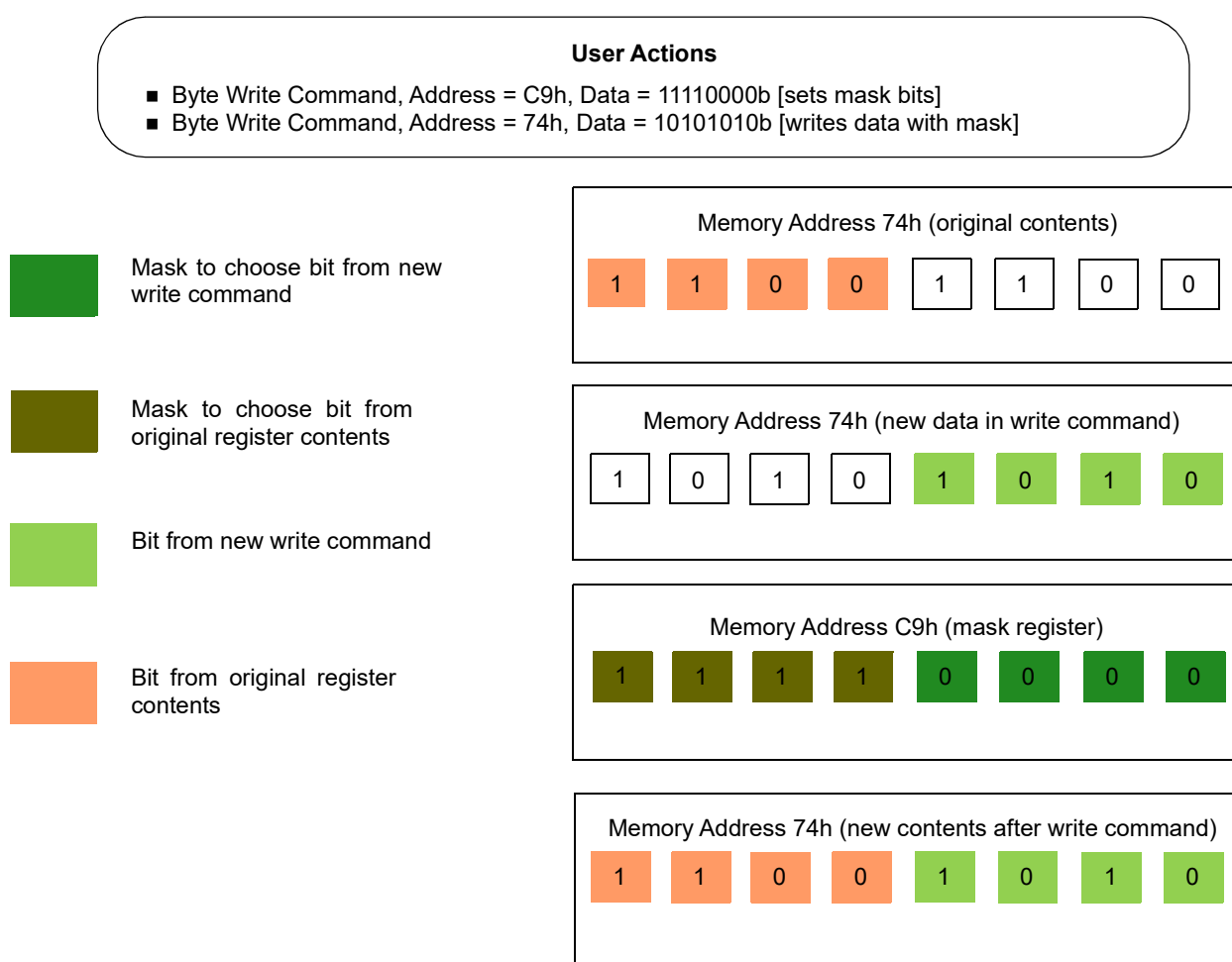


Figure 88: Example of I²C Byte Write Bit Masking

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16 Non-Volatile Memory

The SLG46824 provides 2,048 bits of Serial Electrically Erasable Memory internally organized as 16 pages of 16 bytes. The protection settings of the device can be made permanent if desired.

16.1 SERIAL NVM WRITE OPERATIONS

Write access to the NVM is possible by setting A3 A2 A1 A0 to “0000”, which allows serial write data for a single page only. Upon receipt of the proper Control Byte and Word Address bytes, the SLG46824 will send an ACK. The device will then be ready to receive page data, which is 16 sequential writes of 8-bit data words. The SLG46824 will respond with an ACK after each data word is received. The addressing device, such as a bus Master, must then terminate the write operation with a Stop condition after all page data is written. At that time the device will enter an internally self-timed write cycle, which will be completed within t_{WR} . While the data is being written into the NVM Memory Array, all inputs, outputs, internal logic and I²C access to the Register data will be operational/valid. Please refer to [Figure 89](#) for the SLG46824 Memory Map.

Note: The 16 programmed bytes should be in the same page. Any I²C command that does not meet specific requirements will be ignored and NVM will remain unprogrammed.

Data “1” cannot be re-programmed as data “0” without erasure. Each byte can only be programmed one time without erasure.

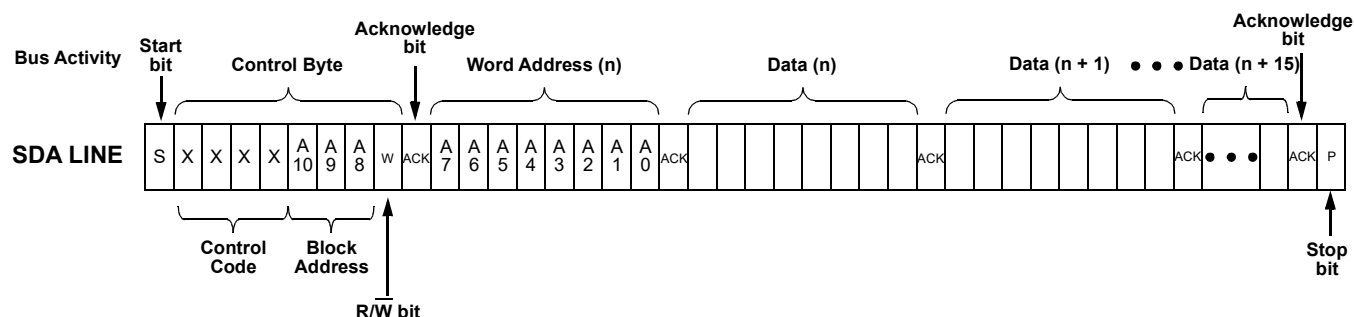


Figure 89: Page Write Command

A10 will be ignored during communication to SLG46824.

A9 = 1 will enable access to the NVM.

A9 = 1 and A8 = 0 corresponds to the 2K bits chip configuration NVM data.

A9 = 1 and A8 = 1A3, A2, A1, and A0 should be 0000 for the page write operation.

In a single page, if the data written to any byte is 00H, the contents of the matching byte in NVM memory will not be altered.

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16.2 SERIAL NVM READ OPERATIONS

There are three read operations:

- Current Address Read
- Random Address Read
- Sequential Read

Please refer to the Section 15 for more details.

16.3 SERIAL NVM ERASE OPERATIONS

The erase scheme allows a portion or the 2K bits NVM chip configuration to be erased by modifying the contents of the Erase Register (ERSR). Changing the state of the ERSR is accomplished with a Byte Write sequence with the requirements outlined in this section.

The ERSR register is located on I²C Block Address = 000b, I²C Word Address = E3H.

The ERSR format is shown in Table 50, and the ERSR bit functions are included in Table 51.

Table 50: Erase Register Bit format

	b7	b6	b5	b4	b3	b2	b1	b0
Page Erase Register	ERSE	--	--	ERSEB4	ERSEB3	ERSEB2	ERSEB1	ERSEB0

Table 51: Erase Register Bit Function Description

Bit	Name		Type	Description
7	ERSE	Erase Enable	W	Setting b7 bit to "1" will start an internal erase cycle on the page defined by ERSEB4-0
6	--	--	--	--
5	--	--	--	--
4	ERSEB4	Page Selection for Erase	W	Define the page address, which will be erased. ERSB4 = 0 corresponds to the Upper 2K NVM used for chip configuration; ERSB4 = 1 reserved
3	ERSEB3		W	
2	ERSEB2		W	
1	ERSEB1		W	
0	ERSEB0		W	

Upon receipt of the proper Device Address and Erase Register Address, the SLG46824 will send an ACK. The device will then be ready to receive Erase Register data. The SLG46824 will respond with an ACK after Erase Register data word is received. The addressing device, such as a bus Master, must then terminate the write operation with a Stop condition. At that time the device will enter an internally self-timed erase cycle, which will be completed within t_{ER} ms. While the data is being written into the Memory Array, all inputs, outputs, internal logic and I²C access to the Register data will be operational/valid.

After the erase has taken place, the contents of ERSE bits will be set to "0" automatically. The internal erase cycle will be triggered at the time the Stop Bit in the I²C command is received.

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17 Register Definitions

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
Matrix Output					
00	[5:0]	Matrix OUT0	IN0 of LUT2_0 or Clock Input of DFF0		
00	[11:6]	Matrix OUT1	IN1 of LUT2_0 or Data Input of DFF0		
01					
01	[17:12]	Matrix OUT2	IN0 of LUT2_3 or Clock Input of PGen		
02					
02	[23:18]	Matrix OUT3	IN1 of LUT2_3 or nRST of PGen		
03	[29:24]	Matrix OUT4	IN0 of LUT2_1 or Clock Input of DFF1		
03	[35:30]	Matrix OUT5	IN1 of LUT2_1 or Data Input of DFF1		
04					
04	[41:36]	Matrix OUT6	IN0 of LUT2_2 or Clock Input of DFF2		
05					
05	[47:42]	Matrix OUT7	IN1 of LUT2_2 or Data Input of DFF2		
06	[53:48]	Matrix OUT8	IN0 of LUT3_0 or Clock Input of DFF3		
06	[59:54]	Matrix OUT9	IN1 of LUT3_0 or Data Input of DFF3		
07					
07	[65:60]	Matrix OUT10	IN2 of LUT3_0 or nRST(nSET) of DFF3		
08	[71:66]	Matrix OUT11	IN0 of LUT3_1 or Clock Input of DFF4		
09	[77:72]	Matrix OUT12	IN1 of LUT3_1 or Data Input of DFF4		
09	[83:78]	Matrix OUT13	IN2 of LUT3_1 or nRST(nSET) of DFF4		
0A					
0A	[89:84]	Matrix OUT14	IN0 of LUT3_2 or Clock Input of DFF5		
0B					
0B	[95:90]	Matrix OUT15	IN1 of LUT3_2 or Data Input of DFF5		
0C	[101:96]	Matrix OUT16	IN2 of LUT3_2 or nRST(nSET) of DFF5		
0C	[107:102]	Matrix OUT17	IN0 of LUT3_3 or Clock Input of DFF6		
0D					
0D	[113:108]	Matrix OUT18	IN1 of LUT3_3 or Data Input of DFF6		
0E					
0E	[119:114]	Matrix OUT19	IN2 of LUT3_3 or nRST(nSET) of DFF6		
0F	[125:120]	Matrix OUT20	IN0 of LUT3_4 or Clock Input of DFF7		
0F	[131:126]	Matrix OUT21	IN1 of LUT3_4 or Data Input of DFF7		
10					
10	[137:132]	Matrix OUT22	IN2 of LUT3_4 or nRST(nSET) of DFF7		
11					
11	[143:138]	Matrix OUT23	IN0 of LUT3_5 or Clock Input of DFF8		
12	[149:144]	Matrix OUT24	IN1 of LUT3_5 or Data Input of DFF8		
12	[155:150]	Matrix OUT25	IN2 of LUT3_5 or nRST(nSET) of DFF8		
13					
13	[161:156]	Matrix OUT26	IN0 of LUT3_6 or Input of Pipe Delay or UP Signal of RIPP CNT		
14					

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
14	[167:162]	Matrix OUT27	IN1 of LUT3_6 or nRST of Pipe Delay or STB of RIPP CNT		
15	[173:168]	Matrix OUT28	IN2 of LUT3_6 or Clock of Pipe Delay_RIPP_CNT		
15	[179:174]	Matrix OUT29	Reserved		
16					
16	[185:180]	Matrix OUT30	MULTFUNC_16BIT_0: IN0 of LUT4_0 or Clock Input of DFF9; Delay0 Input (or Counter0 nRST/SET Input)		
17					
17	[191:186]	Matrix OUT31	MULTFUNC_16BIT_0: IN1 of LUT4_0 or nRST of DFF9; Delay0 Input (or Counter0 nRST Input) or Delay/Counter0 External Clock Source		
18	[197:192]	Matrix OUT32	MULTFUNC_16BIT_0: IN2 of LUT4_0 or nSET of DFF9; Delay0 Input (or Counter0 nRST Input) or Delay/Counter0 External Clock Source or KEEP Input of FSM0		
18	[203:198]	Matrix OUT33	MULTFUNC_16BIT_0: IN3 of LUT4_0 or Data Input of DFF9; Delay0 Input (or Counter0 nRST Input) or UP Input of FSM0		
19					
19	[209:204]	Matrix OUT34	MULTFUNC_8BIT_1: IN0 of LUT3_7 or Clock Input of DFF10; Delay1 Input (or Counter1 nRST Input)		
1A					
1A	[215:210]	Matrix OUT35	MULTFUNC_8BIT_1: IN1 of LUT3_7 or nRST (nSET) of DFF10; Delay1 Input (or Counter1 nRST Input) or Delay/Counter1 External Clock Source		
1B	[221:216]	Matrix OUT36	MULTFUNC_8BIT_1: IN2 of LUT3_7 or Data Input of DFF10; Delay1 Input (or Counter1 nRST Input)		
1B	[227:222]	Matrix OUT37	MULTFUNC_8BIT_2: IN0 of LUT3_8 or Clock Input of DFF11; Delay2 Input (or Counter2 nRST Input)		
1C					
1C	[233:228]	Matrix OUT38	MULTFUNC_8BIT_2: IN1 of LUT3_8 or nRST (nSET) of DFF11; Delay2 Input (or Counter2 nRST Input) or Delay/Counter2 External Clock Source		
1D					
1D	[239:234]	Matrix OUT39	MULTFUNC_8BIT_2: IN2 of LUT3_8 or Data Input of DFF11; Delay2 Input (or Counter2 nRST Input)		
1E	[245:240]	Matrix OUT40	MULTFUNC_8BIT_3: IN0 of LUT3_9 or Clock Input of DFF12; Delay3 Input (or Counter3 nRST Input)		
1E	[251:246]	Matrix OUT41	MULTFUNC_8BIT_3: IN1 of LUT3_9 or nRST (nSET) of DFF12; Delay3 Input (or Counter3 nRST Input) or Delay/Counter3 External Clock Source		
1F					
1F	[257:252]	Matrix OUT42	MULTFUNC_8BIT_3: IN2 of LUT3_9 or Data Input of DFF12; Delay3 Input (or Counter3 nRST Input)		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
1F	[263:258]	Matrix OUT43	MULTFUNC_8BIT_4: IN0 of LUT3_10 or Clock Input of DFF13; Delay4 Input (or Counter4 nRST Input)		
20					
21	[269:264]	Matrix OUT44	MULTFUNC_8BIT_4: IN1 of LUT3_10 or nRST (nSET) of DFF13; Delay4 Input (or Counter4 nRST Input) or Delay/Counter4 External Clock Source		
21	[275:270]	Matrix OUT45	MULTFUNC_8BIT_4: IN2 of LUT3_10 or Data Input of DFF13; Delay4 Input (or Counter4 nRST Input)		
22					
22	[281:276]	Matrix OUT46	MULTFUNC_8BIT_5: IN0 of LUT3_11 or Clock Input of DFF14; Delay5 Input (or Counter5 nRST Input)		
23					
23	[287:282]	Matrix OUT47	MULTFUNC_8BIT_5: IN1 of LUT3_11 or nRST (nSET) of DFF14; Delay5 Input (or Counter5 nRST Input) or Delay/Counter5 External Clock Source		
24	[293:288]	Matrix OUT48	MULTFUNC_8BIT_5: IN2 of LUT3_11 or Data Input of DFF14; Delay5 Input (or Counter5 nRST Input)		
24	[299:294]	Matrix OUT49	MULTFUNC_8BIT_6: IN0 of LUT3_12 or Clock Input of DFF15; Delay6 Input (or Counter6 nRST Input)		
25					
25	[305:300]	Matrix OUT50	MULTFUNC_8BIT_6: IN1 of LUT3_12 or nRST (nSET) of DFF15; Delay6 Input (or Counter6 nRST Input) or Delay/Counter6 External Clock Source		
26					
26	[311:306]	Matrix OUT51	MULTFUNC_8BIT_6: IN2 of LUT3_12 or Data Input of DFF15; Delay6 Input (or Counter6 nRST Input)		
27	[317:312]	Matrix OUT52	MULTFUNC_8BIT_7: IN0 of LUT3_13 or Clock Input of DFF16; Delay7 Input (or Counter7 nRST Input)		
27	[323:318]	Matrix OUT53	MULTFUNC_8BIT_7: IN1 of LUT3_13 or nRST (nSET) of DFF16; Delay7 Input (or Counter7 nRST Input) or Delay/Counter7 External Clock Source		
28					
28	[329:324]	Matrix OUT54	MULTFUNC_8BIT_7: IN2 of LUT3_13 or Data Input of DFF16; Delay7 Input (or Counter7 nRST Input)		
29					
29	[335:330]	Matrix OUT55	Filter/Edge detect input		
2A	[341:336]	Matrix OUT56	Programmable delay/edge detect input		
2A	[347:342]	Matrix OUT57	OSC2 ENABLE from matrix		
2B					
2B	[353:348]	Matrix OUT58	OSC0 ENABLE from matrix		
2C					
2C	[359:354]	Matrix OUT59	OSC1 ENABLE from matrix		
2D	[365:360]	Matrix OUT60	Vref PD from matrix		
2D	[371:366]	Matrix OUT61	BG power-down from matrix		
2E					

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
2E	[377:372]	Matrix OUT62	Reserved		
2F					
2F	[383:378]	Matrix OUT63	Reserved		
30	[389:384]	Matrix OUT64	PWR UP of ACMP0L from matrix		
30	[395:390]	Matrix OUT65	PWR UP of ACMP1L from matrix		
31					
31	[401:396]	Matrix OUT66	Reserved		
32					
32	[407:402]	Matrix OUT67	IO0 Digital Output		
33	[413:408]	Matrix OUT68	IO1 Digital Output		
33	[419:414]	Matrix OUT69	IO1 Digital Output OE		
34					
34	[425:420]	Matrix OUT70	IO2 Digital Output		
35					
35	[431:426]	Matrix OUT71	IO3 Digital Output		
36	[437:432]	Matrix OUT72	IO4 Digital Output		
36	[443:438]	Matrix OUT73	IO4 Digital Output OE		
37					
37	[449:444]	Matrix OUT74	IO5 Digital Output		
38					
38	[455:450]	Matrix OUT75	IO5 Digital Output OE		
39	[461:456]	Matrix OUT76	IO6 Digital Output		
39	[467:462]	Matrix OUT77	IO7 Digital Output		
3A					
3A	[473:468]	Matrix OUT78	IO8 Digital Output		
3B					
3B	[479:474]	Matrix OUT79	IO8 Digital Output OE		
3C	[485:480]	Matrix OUT80	IO9 Digital Output		
3C	[491:486]	Matrix OUT81	IO9 Digital Output OE		
3D					
3D	[497:492]	Matrix OUT82	IO10 Digital Output		
3E					
3E	[503:498]	Matrix OUT83	IO10 Digital Output OE		
3F	[509:504]	Matrix OUT84	IO11 Digital Output		
3F	[515:510]	Matrix OUT85	IO11 Digital Output OE		
40					
40	[521:516]	Matrix OUT86	IO12 Digital Output		
41					
41	[527:522]	Matrix OUT87	IO12 Digital Output OE		
42	[533:528]	Matrix OUT88	IO13 Digital Output		
42	[539:534]	Matrix OUT89	IO13 Digital Output OE		
43					

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
43	[545:540]	Matrix OUT90	IO14 Digital Output		
44					
44	[551:546]	Matrix OUT91	IO14 Digital Output OE		
45	[557:552]	Matrix OUT92	Reserved		
45	[563:558]	Matrix OUT93	Reserved		
46					
46	[569:564]	Matrix OUT94	Reserved		
47					
47	[575:570]	Matrix OUT95	Reserved		
48	[583:576]	Reserved			
49	[591:584]				
4A	[599:592]	Reserved			
4B	[607:600]				
4C	[615:608]	Reserved			
4D	[623:616]				
4E	[631:624]	Reserved			
4F	[639:632]				
50	[647:640]	Reserved			
51	[655:648]				
52	[663:656]	Reserved			
53	[671:664]				
54	[679:672]	Reserved			
55	[687:680]				
56	[695:688]	Reserved			
57	[703:696]				
58	[711:704]				
59	[719:712]	Reserved			
5A	[727:720]				
5B	[735:728]	Reserved			
5C	[743:736]				
5D	[751:744]	Reserved			
5E	[759:752]				
5F	[767:760]	Reserved			
IO Common					
60	[768]	IO fast Pull-up/down enable	0: disable 1: enable		
	[769]	I ² C mode selection	0: I ² C standard/fast mode 1: I ² C fast mode+		
	[775:770]	Reserved			
IO0					

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
61	[777:776]	IO0 input mode configuration	00: digital in without Schmitt Trigger 01: digital in with Schmitt Trigger 10: low voltage digital in mode 11: reserved		
	[779:778]	IO0 output mode configuration	00: Push-Pull 1x 01: Push-Pull 2x 10: 1x Open-Drain 11: 2x Open-Drain		
	[781:780]	IO0 Pull-up/down resistance selection	00: floating 01: 10K 10: 100K 11: 1M		
	[782]	IO0 Pull-up/down selection	0: Pull-down 1: Pull-up		
	[783]	IO0 output enable	0: disable 1: enable		
IO1					
62	[785:784]	IO1 input mode configuration	00: digital in without Schmitt Trigger 01: digital in with Schmitt Trigger 10: low voltage digital in mode 11: analog input		
	[787:786]	IO1 output mode configuration	00: Push-Pull 1x 01: Push-Pull 2x 10: 1x Open-Drain 11: 2x Open-Drain		
	[789:788]	IO1 Pull-up/down resistance selection	00: floating 01: 10K 10: 100K 11: 1M		
	[790]	IO1 Pull-up/down selection	0: Pull-down 1: Pull-up		
	[791]	Reserved			
Reserved					
63	[793:792]	Reserved			
	[795:794]	Reserved			
	[797:796]	Reserved			
	[798]	Reserved			
	[799]	Reserved			
IO2					

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
64	[801:800]	IO2 input mode configuration	00: digital in without Schmitt Trigger 01: digital in with Schmitt Trigger 10: low voltage digital in mode 11: reserved		
	[803:802]	IO2 output mode configuration	00: Push-Pull 1x 01: Push-Pull 2x 10: 1x Open-Drain 11: 2x Open-Drain		
	[805:804]	IO2 Pull-up/down resistance selection	00: floating 01: 10K 10: 100K 11: 1M		
	[806]	IO2 Pull-up/down selection	0: Pull-down 1: Pull-up		
	[807]	IO2 output enable	0: disable 1: enable		
IO3					
65	[809:808]	IO3 input mode configuration	00: digital in without Schmitt Trigger 01: digital in with Schmitt Trigger 10: low voltage digital in mode 11: reserved		
	[811:810]	IO3 output mode configuration	00: Push-Pull 1x 01: Push-Pull 2x 10: 1x Open-Drain 11: 2x Open-Drain		
	[813:812]	IO3 Pull-up/down resistance selection	00: floating 01: 10K 10: 100K 11: 1M		
65	[814]	IO3 Pull-up/down selection	0: Pull-down 1: Pull-up		
	[815]	IO3 output enable	0: disable 1: enable		
IO4					
66	[817:816]	IO4 input mode configuration	00: digital in without Schmitt Trigger 01: digital in with Schmitt Trigger 10: low voltage digital in mode 11: reserved		
	[819:818]	IO4 output mode configuration	00: Push-Pull 1x 01: Push-Pull 2x 10: 1x Open-Drain 11: 2x Open-Drain		
	[821:820]	IO4 Pull-up/down resistance selection	00: floating 01: 10K 10: 100K 11: 1M		
	[822]	IO4 Pull-up/down selection	0: Pull-down 1: Pull-up		
	[823]	Reserved			
IO5					

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
67	[825:824]	IO5 input mode configuration	00: digital in without Schmitt Trigger 01: digital in with Schmitt Trigger 10: low voltage digital in mode 11: reserved		
	[827:826]	IO5 output mode configuration	00: Push-Pull 1x 01: Push-Pull 2x 10: 1x Open-Drain 11: 2x Open-Drain		
	[829:828]	IO5 Pull-up/down resistance selection	00: floating 01: 10K 10: 100K 11: 1M		
	[830]	IO5 Pull-up/down selection	0: Pull-down 1: Pull-up		
	[831]	Reserved			
SCL					
68	[832]	Reserved			
	[834:833]	SCL input mode configuration	00: digital in without Schmitt Trigger 01: Reserved 10: low voltage digital in mode 11: Reserved		
	[836:835]	SCL Pull-up/down resistance selection	00: floating 01: Reserved 10: Reserved 11: Reserved		
	[837]	Reserved			
	[839:838]	Reserved			
SDA					
69	[840]	Reserved			
	[842:841]	SDA input mode configuration	00: digital in without Schmitt Trigger 01: Reserved 10: low voltage digital in mode 11: Reserved		
	[844:843]	SDA Pull-up/down resistance selection	00: floating 01: Reserved 10: Reserved 11: Reserved		
	[845]	Reserved			
	[847:846]	Reserved			
IO6					

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
6A	[849:848]	Reserved			
	[851:850]	IO6 output mode configuration	00: Push-Pull 1x 01: Push-Pull 2x 10: 1x Open-Drain 11: 2x Open-Drain		
	[853:852]	IO6 Pull-up/down resistance selection	00: floating 01: 10K 10: 100K 11: 1M		
	[854]	IO6 Pull-up/down selection	0: Pull-down 1: Pull-up		
	[855]	IO6 output enable	0: disable 1: enable		
IO7					
6B	[857:856]	Reserved			
	[859:858]	IO7 output mode configuration	00: Push-Pull 1x 01: Push-Pull 2x 10: 1x Open-Drain 11: 2x Open-Drain		
	[861:860]	IO7 Pull-up/down resistance selection	00: floating 01: 10K 10: 100K 11: 1M		
	[862]	IO7 Pull-up/down selection	0: Pull-down 1: Pull-up		
	[863]	IO7 output enable	0: disable 1: enable		
IO8					
6C	[865:864]	IO8 input mode configuration	00: digital in without Schmitt Trigger 01: digital in with Schmitt Trigger 10: low voltage digital in mode 11: reserved		
	[867:866]	IO8 output mode configuration	00: Push-Pull 1x 01: Push-Pull 2x 10: 1x Open-Drain 11: 2x Open-Drain		
	[869:868]	IO8 Pull-up/down resistance selection	00: floating 01: 10K 10: 100K 11: 1M		
	[870]	IO8 Pull-up/down selection	0: Pull-down 1: Pull-up		
	[871]	Reserved			
Reserved					
6D	[873:872]	Reserved			
	[875:874]	Reserved			
	[877:876]	Reserved			
	[878]	Reserved			
	[879]	Reserved			
IO9					

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
6E	[881:880]	IO9 input mode configuration	00: digital in without Schmitt Trigger 01: digital in with Schmitt Trigger 10: low voltage digital in mode 11: analog output		
	[883:882]	IO9 output mode configuration	00: Push-Pull 1x 01: Push-Pull 2x 10: 1x Open-Drain 11: 2x Open-Drain		
	[885:884]	IO9 Pull-up/down resistance selection	00: floating 01: 10K 10: 100K 11: 1M		
	[886]	IO9 Pull-up/down selection	0: Pull-down 1: Pull-up		
	[887]	Reserved			
IO10					
6F	[889:888]	IO10 input mode configuration	00: digital in without Schmitt Trigger 01: digital in with Schmitt Trigger 10: low voltage digital in mode 11: analog output		
	[891:890]	IO10 output mode configuration	00: Push-Pull 1x 01: Push-Pull 2x 10: 1x Open-Drain 11: 2x Open-Drain		
	[893:892]	IO10 Pull-up/down resistance selection	00: floating 01: 10K 10: 100K 11: 1M		
	[894]	IO10 Pull-up/down selection	0: Pull-down 1: Pull-up		
	[895]	Reserved			
IO11					
70	[897:896]	IO11 input mode configuration	00: digital in without Schmitt Trigger 01: digital in with Schmitt Trigger 10: low voltage digital in mode 11: analog input		
	[899:898]	IO11 output mode configuration	00: Push-Pull 1x 01: Push-Pull 2x 10: 1x Open-Drain 11: 2x Open-Drain		
	[901:900]	IO11 Pull-up/down resistance selection	00: floating 01: 10K 10: 100K 11: 1M		
	[902]	IO11 Pull-up/down selection	0: Pull-down 1: Pull-up		
	[903]	Reserved			
IO12					

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
71	[905:904]	IO12 input mode configuration	00: digital in without Schmitt Trigger 01: digital in with Schmitt Trigger 10: low voltage digital in mode 11: analog input		
	[907:906]	IO12 output mode configuration	00: Push-Pull 1x 01: Push-Pull 2x 10: 1x Open-Drain 11: 2x Open-Drain		
	[909:908]	IO12 Pull-up/down resistance selection	00: floating 01: 10K 10: 100K 11: 1M		
	[910]	IO12 Pull-up/down selection	0: Pull-down 1: Pull-up		
	[911]	Reserved			
IO13					
72	[913:912]	IO13 input mode configuration	00: digital in without Schmitt Trigger 01: digital in with Schmitt Trigger 10: low voltage digital in mode 11: analog IO		
	[915:914]	IO13 output mode configuration	00: Push-Pull 1x 01: Push-Pull 2x 10: 1x Open-Drain 11: 2x Open-Drain		
	[917:916]	IO13 Pull-up/down resistance selection	00: floating 01: 10K 10: 100K 11: 1M		
	[918]	IO13 Pull-up/down selection	0: Pull-down 1: Pull-up		
	[919]	Reserved			
IO14					
73	[921:920]	IO14 input mode configuration	00: digital in without Schmitt Trigger 01: digital in with Schmitt Trigger 10: low voltage digital in mode 11: analog input		
	[923:922]	IO14 output mode configuration	00: Push-Pull 1x 01: Push-Pull 2x 10: 1x Open-Drain 11: 2x Open-Drain		
	[925:924]	IO14 Pull-up/down resistance selection	00: floating 01: 10K 10: 100K 11: 1M		
	[926]	IO14 Pull-up/down selection	0: Pull-down 1: Pull-up		
	[927]	Reserved			
Matrix Input					

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
74	[928]	Matrix Input 0	Tie low		
	[929]	Matrix Input 1	IO0 Digital Input		
	[930]	Matrix Input 2	IO1 Digital Input		
	[931]	Matrix Input 3	IO2 Digital Input		
	[932]	Matrix Input 4	IO3 Digital Input		
	[933]	Matrix Input 5	IO4 Digital Input		
	[934]	Matrix Input 6	IO5 Digital Input		
	[935]	Matrix Input 7	IO8 Digital Input		
75	[936]	Matrix Input 8	IO9 Digital Input		
	[937]	Matrix Input 9	IO10 Digital Input		
	[938]	Matrix Input 10	IO11 Digital Input		
	[939]	Matrix Input 11	IO12 Digital Input		
	[940]	Matrix Input 12	IO13 Digital Input		
	[941]	Matrix Input 13	IO14 Digital Input		
	[942]	Matrix Input 14	LUT2_0_DFF0_OUT		
	[943]	Matrix Input 15	LUT2_1_DFF1_OUT		
76	[944]	Matrix Input 16	LUT2_2_DFF2_OUT		
	[945]	Matrix Input 17	LUT2_3_PGEN_OUT		
	[946]	Matrix Input 18	LUT3_0_DFF3_OUT		
	[947]	Matrix Input 19	LUT3_1_DFF4_OUT		
	[948]	Matrix Input 20	LUT3_2_DFF5_OUT		
	[949]	Matrix Input 21	LUT3_3_DFF6_OUT		
	[950]	Matrix Input 22	LUT3_4_DFF7_OUT		
	[951]	Matrix Input 23	LUT3_5_DFF8_OUT		
77	[952]	Matrix Input 24	LUT3_6_PIPEDLY_RIPP_CNT_OUT0		
	[953]	Matrix Input 25	PIPEDLY_RIPP_CNT_OUT1		
	[954]	Matrix Input 26	RIPP_CNT_OUT2		
	[955]	Matrix Input 27	EDET_FILTER_OUT		
	[956]	Matrix Input 28	PROG_DLY_EDET_OUT		
	[957]	Matrix Input 29	MULTFUNC_8BIT_1: DLY_CNT_OUT		
	[958]	Matrix Input 30	CKRCOSC_MATRIX: OSC1 matrix input		
	[959]	Matrix Input 31	CKLFOSC_MATRIX: OSC0 matrix input		
78	[960]	Matrix Input 32	CKRINGOSC_MATRIX: OSC2 matrix input		
	[961]	Matrix Input 33	MULTFUNC_8BIT_2: DLY_CNT_OUT		
	[962]	Matrix Input 34	MULTFUNC_8BIT_3: DLY_CNT_OUT		
	[963]	Matrix Input 35	MULTFUNC_8BIT_4: DLY_CNT_OUT		
	[964]	Matrix Input 36	MULTFUNC_8BIT_5: DLY_CNT_OUT		
	[965]	Matrix Input 37	MULTFUNC_8BIT_6: DLY_CNT_OUT		
	[966]	Matrix Input 38	MULTFUNC_8BIT_7: DLY_CNT_OUT		
	[967]	Matrix Input 39	MULTFUNC_16BIT_0: LUT_DFF_OUT		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
79	[968]	Matrix Input 40	MULTFUNC_8BIT_1: LUT_DFF_OUT		
	[969]	Matrix Input 41	MULTFUNC_8BIT_2: LUT_DFF_OUT		
	[970]	Matrix Input 42	MULTFUNC_8BIT_3: LUT_DFF_OUT		
	[971]	Matrix Input 43	MULTFUNC_8BIT_4: LUT_DFF_OUT		
	[972]	Matrix Input 44	MULTFUNC_8BIT_5: LUT_DFF_OUT		
	[973]	Matrix Input 45	MULTFUNC_8BIT_6: LUT_DFF_OUT		
	[974]	Matrix Input 46	MULTFUNC_8BIT_7: LUT_DFF_OUT		
	[975]	Matrix Input 47	MULTFUNC_16BIT_0: DLY_CNT_OUT		
7A	[976]	Matrix Input 48	Virtual Input [7]: register [976]		
	[977]	Matrix Input 49	Virtual Input [6]: register [977]		
	[978]	Matrix Input 50	Virtual Input [5]: register [978]		
	[979]	Matrix Input 51	Virtual Input [4]: register [979]		
	[980]	Matrix Input 52	Virtual Input [3]: register [980]		
	[981]	Matrix Input 53	Virtual Input [2]: register [981]		
	[982]	Matrix Input 54	Virtual Input [1]: register [982]		
	[983]	Matrix Input 55	Virtual Input [0]: register [983]		
7B	[984]	Matrix Input 56	Reserved		
	[985]	Matrix Input 57	Reserved		
	[986]	Matrix Input 58	ACMP0L OUT		
	[987]	Matrix Input 59	ACMP1L OUT		
	[988]	Matrix Input 60	2nd CKRCOSC_MATRIX		
	[989]	Matrix Input 61	2nd CKLFOSC_MATRIX		
	[990]	Matrix Input 62	POR CORE		
	[991]	Matrix Input 63	Tie high		
7C	[999:992]	CNT0(16-bit) Counted Value	Q[7:0]		
7D	[1007:1000]	CNT0(16-bit) Counted Value	Q[15:8]		
7E	[1015:1008]	CNT2(8-bit) Counted Value	Q[7:0]		
7F	[1023:1016]	CNT4(8-bit) Counted Value	Q[7:0]		
OSC/ACMP					

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
80	[1024]	OSC1 turn on by register	when matrix output enable/pd control signal = 0: 0: auto on by delay cells 1: always on		
	[1025]	matrix power-down or on select	0: matrix down 1: matrix on		
	[1026]	external clock source enable	0: internal OSC1 1: external clock from IO10		
	[1028:1027]	post divider ration control	00: div1 01: div2 10: div4 11: div8		
	[1031:1029]	matrix divider ratio control	000: /1 001: /2 010: /4 011: /3 100: /8 101: /12 110: /24 111: /64		
81	[1032]	OSC2 turn on by register	when matrix output enable/pd control signal = 0: 0: auto on by delay cells 1: always on		
	[1033]	matrix power-down or on select	0: matrix down 1: matrix on		
	[1034]	external clock source enable	0: internal OSC2 1: external clock from IO8		
	[1036:1035]	post divider ration control	00: div1 01: div2 10: div4 11: div8		
	[1039:1037]	matrix divider ratio control	000: /1 001: /2 010: /4 011: /3 100: /8 101: /12 110: /24 111: /64		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
82	[1040]	OSC0 turn on by register	when matrix output enable/pd control signal = 0: 0: auto on by delay cells 1: always on		
	[1041]	matrix power-down or on select	0: matrix down 1: matrix on		
	[1042]	external clock source enable	0: internal OSC0 1: external clock from IO0		
	[1044:1043]	post divider ration control	00: div1 01: div2 10: div4 11: div8		
	[1047:1045]	matrix divider ratio control	000: /1 001: /2 010: /4 011: /3 100: /8 101: /12 110: /24 111: /64		
83	[1048]	Reserved			
	[1049]	OSC0 matrix out enable	0: disable 1: enable		
	[1050]	OSC1 matrix out enable	0: disable 1: enable		
	[1051]	OSC2 matrix out enable	0: disable 1: enable		
	[1052]	OSC2 100 ns Startup Delay	0: enable 1: disable		
	[1053]	OSC0 2nd matrix out enable	0: disable 1: enable		
	[1054]	OSC1 2nd matrix out enable	0: disable 1: enable		
	[1055]	Reserved			
84	[1058:1056]	OSC1 2nd matrix input: matrix divider ratio control	000: /1 001: /2 010: /4 011: /3 100: /8 101: /12 110: /24 111: /64		
	[1061:1059]	OSC0 2nd matrix input: matrix divider ratio control	000: /1 001: /2 010: /4 011: /3 100: /8 101: /12 110: /24 111: /64		
	[1063:1062]	Reserved			

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
85	[1065:1064]	Reserved			
	[1066]	Reserved			
	[1067]	Reserved			
	[1068]	Reserved			
	[1069]	Reserved			
	[1070]	Reserved			
	[1071]	Reserved			
86	[1072]	Reserved			
	[1073]	Reserved			
	[1075:1074]	Reserved			
	[1076]	Reserved			
	[1077]	Reserved			
	[1078]	Reserved			
	[1079]	Reserved			
87	[1080]	Reserved			
	[1081]	Reserved			
	[1083:1082]	ACMP0L hysteresis	00: 0 mV 01: 32 mV 10: 64 mV 11: 196 mV		
	[1084]	Reserved			
	[1085]	Reserved			
	[1086]	Reserved			
	[1087]	Reserved			
88	[1089:1088]	ACMP1L hysteresis	00: 0 mV 01: 32 mV 10: 64 mV 11: 196 mV		
	[1090]	Reserved			
	[1091]	Reserved			
	[1092]	ACMP1L positive input come from ACMP0L's input mux output enable	0: disable 1: enable		
	[1093]	Reserved			
	[1094]	Reserved			
	[1095]	Reserved			
89	[1097:1096]	Reserved			
	[1103:1098]	Reserved			
8A	[1105:1104]	Reserved			
	[1111:1106]	Reserved			

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
8B	[1113:1112]	ACMP0L Gain divider	00: 1x 01: 0.5x 10: 0.33x 11: 0.25x		
	[1119:1114]	ACMP0L Vref	ACMP Vref select: 000000: 32 mV ~ 111110: 2.016V/step = 32 mV; 111111: External Vref		
8C	[1121:1120]	ACMP1L Gain divider	00: 1x 01: 0.5x 10: 0.33x 11: 0.25x		
	[1127:1122]	ACMP1L Vref	ACMP Vref select: 000000: 32 mV ~ 111110: 2.016V/step = 32 mV; 111111: External Vref		
8D	[1128]	Reserved	0: disable 1: enable		
	[1130:1129]	Reserved			
	[1131]	Vref output OP	0: disable 1: enable		
	[1133:1132]	Vref0 input selection	00: None 01: ACMP0L Vref 10: ACMP1L Vref 11: Reserved		
	[1134]	Reserved			
	[1135]	Reserved			
8E	[1136]	Reserved			
	[1137]	Reserved			
	[1138]	Reserved			
	[1139]	Vref OUT PD	0: Vref OUT disable 1: Vref OUT enable		
	[1140]	Reserved	0: enable/disable using Vref OUT PD register [1139] 1: Reserved		
	[1143:1141]	Reserved			
8F	[1145:1144]	Reserved			
	[1151:1146]	Reserved			
Digital Macrocell					

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
90	[1155:1152]	LUT2_0/DFF0 setting	[3]: LUT2_0[3]/DFF0 or LATCH Select 0: DFF function 1: LATCH function [2]: LUT2_0[2]/DFF0 Output Sel 0: Q output 1: QB output [1]: LUT2_0[1]/DFF0 Initial Polarity Select 0: Low 1: High [0]: LUT2_0[0]		
	[1159:1156]	LUT2_1/DFF1 setting	[3]: LUT2_1[3]/DFF1 or LATCH Select 0: DFF function 1: LATCH function [2]: LUT2_1[2]/DFF1 Output Select 0: Q output 1: QB output [1]: LUT2_1[1]/DFF1 Initial Polarity Select 0: Low 1: High [0]: LUT2_1[0]		
91	[1163:1160]	LUT2_2/DFF2 setting	[3]: LUT2_2[3]/DFF2 or LATCH Select 0: DFF function 1: LATCH function [2]: LUT2_2[2]/DFF2 Output Select 0: Q output 1: QB output [1]: LUT2_2[1]/DFF2 Initial Polarity Select 0: Low 1: High [0]: LUT2_2[0]		
	[1167:1164]	LUT2_3_VAL or PGen_data	LUT2_3[3:0] or PGen 4bit counter data[3:0]		
92	[1175:1168]	PGen data [7:0]	PGen data [7:0]		
93	[1183:1176]	PGen data [15:8]	PGen data [15:8]		
94	[1191:1184]	LUT3_0_DFF3 setting	[7]: LUT3_0[7]/DFF3 or LATCH Select 0: DFF function 1: LATCH function [6]: LUT3_0[6]/DFF3 Output Select 0: Q output 1: QB output [5]: LUT3_0[5]/DFF3 0: nRST from Matrix Output 1: nSET from Matrix Output [4]: LUT3_0[4]/DFF3 Initial Polarity Select 0: Low 1: High [3:0]: LUT3_0[3:0]		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
95	[1199:1192]	LUT3_1_DFF4 setting	[7]: LUT3_1[7]/DFF4 or LATCH Select 0: DFF function 1: LATCH function [6]: LUT3_1[6]/DFF4 Output Select 0: Q output 1: QB output [5]: LUT3_1[5]/DFF4 0: nRST from Matrix Output 1: nSET from Matrix Output [4]: LUT3_1[4]/DFF4 Initial Polarity Select 0: Low 1: High [3:0]: LUT3_1[3:0]		
96	[1207:1200]	LUT3_2_DFF5 setting	[7]: LUT3_2[7]/DFF5 or LATCH Select 0: DFF function 1: LATCH function [6]: LUT3_2[6]/DFF5 Output Select 0: Q output 1: QB output [5]: LUT3_2[5]/DFF5 0: nRST from Matrix Output 1: nSET from Matrix Output [4]: LUT3_2[4]/DFF5 Initial Polarity Select 0: Low 1: High [3:0]: LUT3_2[3:0]		
97	[1215:1208]	LUT3_3_DFF6 setting	[7]: LUT3_3[7]/DFF6 or LATCH Select 0: DFF function 1: LATCH function [6]: LUT3_3[6]/DFF6 Output Select 0: Q output 1: QB output [5]: LUT3_3[5]/DFF6 0: nRST from Matrix Output 1: nSET from Matrix Output [4]: LUT3_3[4]/DFF6 Initial Polarity Select 0: Low 1: High [3:0]: LUT3_3[3:0]		
98	[1223:1216]	LUT3_4_DFF7 setting	[7]: LUT3_4[7]/DFF7 or LATCH Select 0: DFF function 1: LATCH function [6]: LUT3_4[6]/DFF7 Output Select 0: Q output 1: QB output [5]: LUT3_4[5]/DFF7 0: nRST from Matrix Output 1: nSET from Matrix Output [4]: LUT3_4[4]/DFF7 Initial Polarity Select 0: Low 1: High [3:0]: LUT3_4[3:0]		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
99	[1231:1224]	LUT3_5_DFF8 setting	[7]: LUT3_5[7]/DFF8 or LATCH Select 0: DFF function 1: LATCH function [6]: LUT3_5[6]/DFF8 Output Select 0: Q output 1: QB output [5]: LUT3_5[5]/DFF8 0: RSTB from Matrix Output 1: SETB from Matrix Output [4]: LUT3_5[4]/DFF8 Initial Polarity Select 0: Low 1: High [3:0]: LUT3_5[3:0]		
9A	[1232]	LUT2_0 or DFF0 Select	0: LUT2_0 1: DFF0		
	[1233]	LUT2_1 or DFF1 Select	0: LUT2_1 1: DFF1		
	[1234]	LUT2_2 or DFF2 Select	0: LUT2_2 1: DFF2		
	[1235]	LUT2_3 or PGen Select	0: LUT2_3 1: PGen		
	[1236]	LUT3_0 or DFF3 Select	0: LUT3_0 1: DFF3		
	[1237]	DFF3_SECONDQ_Sel	0: Q of first DFF 1: Q of second DFF		
	[1238]	LUT3_1 or DFF4 Select	0: LUT3_1 1: DFF4		
	[1239]	LUT3_2 or DFF5 Select	0: LUT3_2 1: DFF5		
9B	[1240]	LUT3_3 or DFF6 Select	0: LUT3_3 1: DFF6		
	[1241]	LUT3_4 or DFF7 Select	0: LUT3_4 1: DFF7		
	[1242]	LUT3_5 or DFF8 Select	0: LUT3_5 1: DFF8		
	[1243]	Filter or Edge Detector selection	0: filter 1: edge det		
	[1244]	output Polarity Select	0: Filter/edge detect output 1: Filter/edge detect output inverted		
	[1246:1245]	Select the edge mode	00: Rising Edge Det 01: Falling Edge Det 10: Both Edge Det 11: Both Edge DLY		
	[1247]	Reserved			

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
9C	[1255:1248]	LUT value or pipe delay out SEL or nSET/END value	[7:4]:LUT3_6[7:4]/REG_S1[3:0]pipe delay out1 SEL [3:0]:LUT3_6[3:0]/REG_S0[3:0]pipe delay out0 SEL at RIPP CNT mode: bit[1250:1248] is the nSET value bit[1253:1251] is the END value bit[1254] functional mode:0: full cycle; 1: ranged cycle bit[1255] not used		
9D	[1256]	Pipe Delay OUT1 Polarity Select	0: Non-inverted 1: Inverted		
	[1257]	LUT3_6 or Pipe Delay Select	0: LUT3_6 1: Pipe Delay or RIPP CNT		
	[1258]	PIPE_RIPP_CNT_S	0: Pipe delay mode selection 1: Ripple Counter mode selection		
	[1260:1259]	Select the Edge Mode of Programmable Delay & Edge Detector	00: Rising Edge Detector 01: Falling Edge Detector 10: Both Edge Detector 11: Both Edge Delay		
	[1262:1261]	Delay Value Select for Programmable Delay & Edge Detector	00: 125ns 01: 250ns 10: 375ns 11: 500ns		
	[1263]	Reserved			
9E	[1264]	Reserved			
	[1265]	Reserved			
	[1266]	Reserved			
	[1267]	Reserved			
9F	[1271:1267]	Reserved			
	[1276:1272]	Reserved			
	[1277]	Reserved			
	[1278]	Reserved			
	[1279]	Reserved			
Multifunction					
A0	[1286] [1285] [1282] [1284] [1283] [1281] [1280]	Single 4-bit LUT	0000000: Matrix A - In3; Matrix B - In2; Matrix C - In1; Matrix D - In0 (DLY_IN - LOW)		
		Single DFF w RST and SET	0010000: Matrix A - D; Matrix B - nSET; Matrix C - nRST; Matrix D - CLK (DLY_IN - LOW)		
		Single CNT/DLY	0000001: Matrix A - UP (CNT); Matrix B - KEEP (CNT); Matrix C - EXT_CLK (CNT); Matrix D - DLY_IN (CNT) (DLY_OUT connected to LUT/DFF)		
		CNT/DLY → LUT	0000010: Matrix A - DLY_IN; Matrix B - In2; Matrix C - In1; Matrix D - In0 (DLY_OUT connected to In3)		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
A0	[1286] [1285] [1282] [1284] [1283] [1281] [1280]	CNT/DLY → DFF	0000110: Matrix A - DLY_IN; Matrix B - nSET; Matrix C - nRST; Matrix D - CLK (DLY_OUT connected to D)		
		CNT/DLY → LUT	0100010: Matrix A - DLY_IN; Matrix B - EXT_CLK (CNT); Matrix C - In1; Matrix D - In0 (DLY_OUT connected to In3; In2 - LOW)		
		CNT/DLY → DFF	0100110: Matrix A - DLY_IN; Matrix B - EXT_CLK (CNT); Matrix C - nRST; Matrix D - CLK (DLY_OUT connected to D; nSET - HIGH)		
		CNT/DLY → LUT	1000010: Matrix A - DLY_IN; Matrix B - In2; Matrix C - EXT_CLK (CNT); Matrix D - In0 (DLY_OUT connected to In3; In1 - LOW)		
		CNT/DLY → DFF	1000110: Matrix A - DLY_IN; Matrix B - nSET; Matrix C - EXT_CLK (CNT); Matrix D - CLK (DLY_OUT connected to D; nRST - HIGH)		
		CNT/DLY → LUT	0001010: Matrix A - In3; Matrix B - DLY_IN; Matrix C - In1; Matrix D - In0 (DLY_OUT connected to In2)		
		CNT/DLY → DFF	0001110: Matrix A - D; Matrix B - DLY_IN; Matrix C - nRST; Matrix D - CLK (DLY_OUT connected to nSET)		
		CNT/DLY → LUT	1001010: Matrix A - In3; Matrix B - DLY_IN; Matrix C - EXT_CLK (CNT); Matrix D - In0 (DLY_OUT connected to In2; In1 - LOW)		
		CNT/DLY → DFF	1001110: Matrix A - D; Matrix B - DLY_IN; Matrix C - EXT_CLK (CNT); Matrix D - CLK (DLY_OUT connected to nSET; nRST - HIGH)		
		CNT/DLY → LUT	0010010: Matrix A - In3; Matrix B - In2; Matrix C - DLY_IN; Matrix D - In0 (DLY_OUT connected to In1)		
		CNT/DLY → DFF	0010110: Matrix A - D; Matrix B - nSET; Matrix C - DLY_IN; Matrix D - CLK (DLY_OUT connected to nRST)		
		CNT/DLY → LUT	0110010: Matrix A - In3; Matrix B - EXT_CLK (CNT); Matrix C - DLY_IN; Matrix D - In0 (DLY_OUT connected to In1; In2 - LOW)		
		CNT/DLY → DFF	0110110: Matrix A - D; Matrix B - EXT_CLK (CNT); Matrix C - DLY_IN; Matrix D - CLK (DLY_OUT connected to nRST; nSET - HIGH)		
		CNT/DLY → LUT	0011010: Matrix A - In3; Matrix B - In2; Matrix C - In1; Matrix D - DLY_IN (DLY_OUT connected to In0)		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
A0	[1286] [1285] [1282] [1284] [1283] [1281] [1280]	CNT/DLY → DFF	0011110: Matrix A - D; Matrix B - nSET; Matrix C - nRST; Matrix D - DLY_IN (DLY_OUT connected to CLK)		
		CNT/DLY → LUT	0111010: Matrix A - In3; Matrix B - EXT_CLK (CNT); Matrix C - In1; Matrix D - DLY_IN (DLY_OUT connected to In0; In2 - LOW)		
		CNT/DLY → DFF	0111110: Matrix A - D; Matrix B - EXT_CLK (CNT); Matrix C - nRST; Matrix D - DLY_IN (DLY_OUT connected to CLK; nSET - HIGH)		
		CNT/DLY → LUT	1011010: Matrix A - In3; Matrix B - In2; Matrix C - EXT_CLK (CNT); Matrix D - DLY_IN (DLY_OUT connected to In0; In1 - LOW)		
		CNT/DLY → DFF	1011110: Matrix A - D; Matrix B - nSET; Matrix C - EXT_CLK (CNT); Matrix D - DLY_IN (DLY_OUT connected to CLK; nRST - HIGH)		
		LUT → CNT/DLY	0000011: Matrix A - In3; Matrix B - In2; Matrix C - In1; Matrix D - In0 (LUT_OUT connected to DLY_IN)		
		DFF → CNT/DLY	0000111: Matrix A - D; Matrix B - nSET; Matrix C - nRST; Matrix D - CLK (DFF_OUT connected to DLY_IN)		
		LUT → CNT/DLY	0100011: Matrix A - In3; Matrix B - EXT_CLK (CNT); Matrix C - In1; Matrix D - In0 (LUT_OUT connected to DLY_IN; In2 - LOW)		
		DFF → CNT/DLY	0100111: Matrix A - D; Matrix B - EXT_CLK (CNT); Matrix C - nRST; Matrix D - CLK (DFF_OUT connected to DLY_IN; nSET - HIGH)		
		LUT → CNT/DLY	1000011: Matrix A - In3; Matrix B - In2; Matrix C - EXT_CLK (CNT); Matrix D - In0 (LUT_OUT connected to DLY_IN; In1 - LOW)		
		DFF → CNT/DLY	1000111: Matrix A - D; Matrix B - nSET; Matrix C - EXT_CLK (CNT); Matrix D - CLK (DFF_OUT connected to DLY_IN; nRST - HIGH)		
	[1287]	FSM0 SET/RST Selection	0: Reset to 0 1: Set to data		
A1	[1295:1288]	LUT4_0_DFF9 setting [7:0]	[7:0]: LUT4_0[7:0]		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
A2	[1303:1296]	LUT4_0_DFF9 setting [15:8]	[15]: LUT4_0[15]/DFF or LATCH Select 0: DFF function; 1: LATCH function [14]: LUT4_0[14]/DFF Output Select 0: Q output; 1: QB output [13]: LUT4_0[13]/DFF Initial Polarity Select 0: Low; 1: High [12:8]: LUT4_0[12:8]		
A3	[1305:1304]	DLY/CNT0 Mode Selection	00: DLY 01: one shot 10: frequency det 11: CNT		
	[1307:1306]	DLY/CNT0 edge Mode Selection	00: both edge 01: falling edge 10: rising edge 11: High Level Reset (only in CNT mode)		
	[1311:1308]	DLY/CNT0 Clock Source Select	Clock source SEL [3:0] 0000: 25M(OSC2); 0001: 25M/4; 0010: 2M(OSC1); 0011: 2M/8; 0100: 2M/64; 0101: 2M/512; 0110: 2K(OSC0); 0111: 2K/8; 1000: 2K/64; 1001: 2K/512; 1010: 2K/4096; 1011: 2K/32768; 1100: 2K/262144; 1101: CNT_END; 1110: External; 1111: Not used		
A4	[1312]	CNT0 output pol selection	0: Default Output 1: Inverted Output		
	[1314:1313]	CNT0 initial value selection	00: bypass the initial 01: initial 0 10: initial 1 11: initial 1		
	[1315]	Reserved			
	[1316]	Reserved			
	[1317]	Keep signal SYNC selection	0: bypass 1: after two DFF		
	[1318]	UP signal SYNC selection	0: bypass 1: after two DFF		
	[1319]	CNT0 DLY EDET FUNCTION Selection	0: normal 1: DLY function edge detection		
A5	[1327:1320]	REG_CNT0_Data[7:0]	Data[7:0]		
A6	[1335:1328]	REG_CNT0_Data[15:8]	Data[15:8]		
A7	[1336]	CNT0 CNT mode SYNC selection	0: bypass 1: after two DFF		
	[1339] [1341] [1340]	Single 3-bit LUT	00000: Matrix A - In2; Matrix B - In1; Matrix C - In0 (DLY_IN - LOW)		
	[1338] [1337]	Single DFF w RST and SET	10000: Matrix A - D; Matrix B - nSET/nRST; Matrix C - CLK (DLY_IN - LOW)		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
A7	[1339] [1341] [1340] [1338] [1337]	Single CNT/DLY	00001: Matrix A - DLY_IN (CNT); Matrix B - EXT_CLK (CNT); Matrix C - NC (DLY_OUT connected to LUT/DFF)		
		CNT/DLY → LUT	00010: Matrix A - DLY_IN; Matrix B - In1; Matrix C - In0 (DLY_OUT connected to In2)		
		CNT/DLY → DFF	00110: Matrix A - DLY_IN; Matrix B - nSET/nRST; Matrix C - CLK (DLY_OUT connected to D)		
		CNT/DLY → LUT	01010: Matrix A - In2; Matrix B - DLY_IN; Matrix C - In0 (DLY_OUT connected to In1)		
		CNT/DLY → DFF	01110: Matrix A - D; Matrix B - DLY_IN; Matrix C - CLK (DLY_OUT connected to nSET/nRST)		
		CNT/DLY → LUT	10010: Matrix A - In2; Matrix B - In1; Matrix C - DLY_IN (DLY_OUT connected to In0)		
		CNT/DLY → DFF	11010: Matrix A - D; Matrix B - nSET/nRST; Matrix C - DLY_IN (DLY_OUT connected to CLK)		
		LUT → CNT/DLY	00011: Matrix A - In2; Matrix B - In1; Matrix C - In0 (LUT_OUT connected to DLY_IN)		
		DFF → CNT/DLY	00111: Matrix A - D; Matrix B - nSET/nRST; Matrix C - CLK (DFF_OUT connected to DLY_IN)		
	[1343:1342]	CNT1 initial value selection	00: bypass the initial 01: initial 0 10: initial 1 11: initial 1		
A8	[1351:1344]	LUT3_7_DFF10 setting	[7]: LUT3_7[7]/DFF or LATCH Select 0: DFF function; 1: LATCH function [6]: LUT3_7[6]/DFF Output Select 0: Q output; 1: QB output [5]: LUT3_7[5]/DFF 0: nRST from Matrix Output; 1: nSET from Matrix Output [4]: LUT3_7[4]/DFF Initial Polarity Select 0: Low; 1: High [3:0]: LUT3_7[3:0]		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
A9	[1355:1352]	DLY/CNT1 Clock Source Select	Clock source SEL [3:0] 0000: 25M(OSC2); 0001: 25M/4; 0010: 2M(OSC1); 0011: 2M/8; 0100: 2M/64; 0101: 2M/512; 0110: 2K(OSC0); 0111: 2K/8; 1000: 2K/64; 1001: 2K/512; 1010: 2K/4096; 1011: 2K/32768; 1100: 2K/262144; 1101: CNT_END; 1110: External; 1111: Not used		
	[1359:1356]	CNT1 function and edge mode selection	0000: both edge Delay; 0001: falling edge delay; 0010: rising edge delay; 0011: both edge One Shot; 0100: falling edge One Shot; 0101: rising edge One Shot; 0110: both edge freq detect; 0111: falling edge freq detect; 1000: rising edge freq detect; 1001: both edge detect; 1010: falling edge detect; 1011: rising edge detect; 1100: both edge reset CNT; 1101: falling edge reset CNT; 1110: rising edge reset CNT; 1111: high level reset CNT		
AA	[1367:1360]	REG_CNT1_Data[7:0]	Data[7:0]		
AB	[1368]	CNT1 output pol selection	0: Default Output 1: Inverted Output		
	[1369]	Reserved			
	[1370]	CNT1 CNT mode SYNC selection	0: bypass 1: after two DFF		
	[1371]	CNT1 DLY EDET FUNCTION Selection	0: normal 1: DLY function edge detection		
	[1394], [1375:1372]	Single 3-bit LUT	00000: Matrix A - In2; Matrix B - In1; Matrix C - In0 (DLY_IN - LOW)		
		Single DFF w RST and SET	10000: Matrix A - D; Matrix B - nSET/nRST; Matrix C - CLK (DLY_IN - LOW)		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
AB	[1394], [1375:1372]	Single CNT/DLY	00001: Matrix A - DLY_IN (CNT); Matrix B - EXT_CLK (CNT); Matrix C - NC (DLY_OUT connected to LUT/DFF)		
		CNT/DLY → LUT	00010: Matrix A - DLY_IN; Matrix B - In1; Matrix C - In0 (DLY_OUT connected to In2)		
		CNT/DLY → DFF	10010: Matrix A - DLY_IN; Matrix B - nSET/nRST; Matrix C - CLK (DLY_OUT connected to D)		
		CNT/DLY → LUT	00110: Matrix A - In2; Matrix B - DLY_IN; Matrix C - In0 (DLY_OUT connected to In1)		
		CNT/DLY → DFF	10110: Matrix A - D; Matrix B - DLY_IN; Matrix C - CLK (DLY_OUT connected to nSET/nRST)		
		CNT/DLY → LUT	01010: Matrix A - In2; Matrix B - In1; Matrix C - DLY_IN (DLY_OUT connected to In0)		
		CNT/DLY → DFF	11010: Matrix A - D; Matrix B - nSET/nRST; Matrix C - DLY_IN (DLY_OUT connected to CLK)		
		LUT → CNT/DLY	00011: Matrix A - In2; Matrix B - In1; Matrix C - In0 (LUT_OUT connected to DLY_IN)		
		DFF → CNT/DLY	10011: Matrix A - D; Matrix B - nSET/nRST; Matrix C - CLK (DFF_OUT connected to DLY_IN)		
AC	[1383:1376]	LUT3_8_DFF_11 setting	[7]: LUT3_8[7]/DFF or LATCH Select 0: DFF function; 1: LATCH function [6]: LUT3_8[6]/DFF Output Select 0: Q output; 1: QB output [5]: LUT3_8[5]/DFF 0: nRST from Matrix Output; 1: nSET from Matrix Output [4]: LUT3_8[4]/DFF Initial Polarity Select 0: Low; 1: High [3:0]: LUT3_8[3:0]		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
AD	[1387:1384]	DLY/CNT2 Clock Source Select	Clock source SEL [3:0] 0000: 25M(OSC2); 0001: 25M/4; 0010: 2M(OSC1); 0011: 2M/8; 0100: 2M/64; 0101: 2M/512; 0110: 2K(OSC0); 0111: 2K/8; 1000: 2K/64; 1001: 2K/512; 1010: 2K/4096; 1011: 2K/32768; 1100: 2K/262144; 1101: CNT_END; 1110: External; 1111: Not used		
	[1391:1388]	CNT2 function and edge mode selection	0000: both edge Delay; 0001: falling edge delay; 0010: rising edge delay; 0011: both edge One Shot; 0100: falling edge One Shot; 0101: rising edge One Shot; 0110: both edge freq detect; 0111: falling edge freq detect; 1000: rising edge freq detect; 1001: both edge detect; 1010: falling edge detect; 1011: rising edge detect; 1100: both edge reset CNT; 1101: falling edge reset CNT; 1110: rising edge reset CNT; 1111: high level reset CNT		
AE	[1393:1392]	CNT2 initial value selection	00: bypass the initial 01: initial 0 10: initial 1 11: initial 1		
	[1395]	CNT2 output pol selection	0: Default Output 1: Inverted Output		
	[1396]	Reserved			
	[1397]	CNT2 CNT mode SYNC selection	0: bypass 1: after two DFF		
	[1398]	CNT2 DLY EDET FUNCTION Selection	0: normal 1: DLY function edge detection		
	[1399]	Reserved			
AF	[1407:1400]	REG_CNT2_Data[7:0]	Data[7:0]		
B0	[1408]	Reserved			
	[1411] [1413] [1412]	Single 3-bit LUT	00000: Matrix A - In2; Matrix B - In1; Matrix C - In0 (DLY_IN - LOW)		
	[1410] [1409]	Single DFF w RST and SET	00100: Matrix A - D; Matrix B - nSET/nRST; Matrix C - CLK (DLY_IN - LOW)		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
B0	[1411] [1413] [1412] [1410] [1409]	Single CNT/DLY	00001: Matrix A - DLY_IN (CNT); Matrix B - EXT_CLK (CNT); Matrix C - NC (DLY_OUT connected to LUT/DFF)		
		CNT/DLY → LUT	00010: Matrix A - DLY_IN; Matrix B - In1; Matrix C - In0 (DLY_OUT connected to In2)		
		CNT/DLY → DFF	00110: Matrix A - DLY_IN; Matrix B - nSET/nRST; Matrix C - CLK (DLY_OUT connected to D)		
		CNT/DLY → LUT	01010: Matrix A - In2; Matrix B - DLY_IN; Matrix C - In0 (DLY_OUT connected to In1)		
		CNT/DLY → DFF	01110: Matrix A - D; Matrix B - DLY_IN; Matrix C - CLK (DLY_OUT connected to nSET/nRST)		
		CNT/DLY → LUT	10010: Matrix A - In2; Matrix B - In1; Matrix C - DLY_IN (DLY_OUT connected to In0)		
		CNT/DLY → DFF	10110: Matrix A - D; Matrix B - nSET/nRST; Matrix C - DLY_IN (DLY_OUT connected to CLK)		
		LUT → CNT/DLY	00011: Matrix A - In2; Matrix B - In1; Matrix C - In0 (LUT_OUT connected to DLY_IN)		
		DFF → CNT/DLY	00111: Matrix A - D; Matrix B - nSET/nRST; Matrix C - CLK (DFF_OUT connected to DLY_IN)		
	[1415:1414]	CNT3 initial value selection	00: bypass the initial 01: initial 0 10: initial 1 11: initial 1		
B1	[1423:1416]	LUT3_9_DFF12 setting	[7]: LUT3_9[7]/DFF or LATCH Select 0: DFF function; 1: LATCH function [6]: LUT3_9[6]/DFF Output Select 0: Q output; 1: QB output [5]: LUT3_9[5]/DFF 0: nRST from Matrix Output; 1: nSET from Matrix Output [4]: LUT3_9[4]/DFF Initial Polarity Select 0: Low; 1: High [3:0]: LUT3_9[3:0]		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
B2	[1427:1424]	DLY/CNT3 Clock Source Select	Clock source SEL [3:0] 0000: 25M(OSC2); 0001: 25M/4; 0010: 2M(OSC1); 0011: 2M/8; 0100: 2M/64; 0101: 2M/512; 0110: 2K(OSC0); 0111: 2K/8; 1000: 2K/64; 1001: 2K/512; 1010: 2K/4096; 1011: 2K/32768; 1100: 2K/262144; 1101: CNT_END; 1110: External; 1111: Not used		
	[1431:1428]	CNT3 function and edge mode selection	0000: both edge Delay; 0001: falling edge delay; 0010: rising edge delay; 0011: both edge One Shot; 0100: falling edge One Shot; 0101: rising edge One Shot; 0110: both edge freq detect; 0111: falling edge freq detect; 1000: rising edge freq detect; 1001: both edge detect; 1010: falling edge detect; 1011: rising edge detect; 1100: both edge reset CNT; 1101: falling edge reset CNT; 1110: rising edge reset CNT; 1111: high level reset CNT		
B3	[1439:1432]	REG_CNT3_Data[7:0]	Data[7:0]		
B4	[1440]	CNT3 output pol selection	0: Default Output 1: Inverted Output		
	[1441]	Reserved			
	[1442]	CNT3 CNT mode SYNC selection	0: bypass 1: after two DFF		
	[1443]	CNT3 DLY EDET FUNCTION Selection	0: normal 1: DLY function edge detection		
	[1466], [1447:1444]	Single 3-bit LUT	00000: Matrix A - In2; Matrix B - In1; Matrix C - In0 (DLY_IN - LOW)		
		Single DFF w RST and SET	10000: Matrix A - D; Matrix B - nSET/nRST; Matrix C - CLK (DLY_IN - LOW)		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
B4	[1466], [1447:1444]	Single CNT/DLY	00001: Matrix A - DLY_IN (CNT); Matrix B - EXT_CLK (CNT); Matrix C - NC (DLY_OUT connected to LUT/DFF)		
		CNT/DLY → LUT	00010: Matrix A - DLY_IN; Matrix B - In1; Matrix C - In0 (DLY_OUT connected to In2)		
		CNT/DLY → DFF	10010: Matrix A - DLY_IN; Matrix B - nSET/nRST; Matrix C - CLK (DLY_OUT connected to D)		
		CNT/DLY → LUT	00110: Matrix A - In2; Matrix B - DLY_IN; Matrix C - In0 (DLY_OUT connected to In1)		
		CNT/DLY → DFF	10110: Matrix A - D; Matrix B - DLY_IN; Matrix C - CLK (DLY_OUT connected to nSET/nRST)		
		CNT/DLY → LUT	01010: Matrix A - In2; Matrix B - In1; Matrix C - DLY_IN (DLY_OUT connected to In0)		
		CNT/DLY → DFF	11010: Matrix A - D; Matrix B - nSET/nRST; Matrix C - DLY_IN (DLY_OUT connected to CLK)		
		LUT → CNT/DLY	00011: Matrix A - In2; Matrix B - In1; Matrix C - In0 (LUT_OUT connected to DLY_IN)		
		DFF → CNT/DLY	10011: Matrix A - D; Matrix B - nSET/nRST; Matrix C - CLK (DFF_OUT connected to DLY_IN)		
B5	[1455:1448]	LUT3_DFF setting	[7]: LUT3[7]/DFF or LATCH Select 0: DFF function; 1: LATCH function [6]: LUT3[6]/DFF Output Select 0: Q output; 1: QB output [5]: LUT3[5]/DFF 0: nRST from Matrix Output; 1: nSET from Matrix Output [4]: LUT3[4]/DFF Initial Polarity Select 0: Low; 1: High [3:0]: LUT3[3:0]		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
B6	[1459:1456]	DLY/CNT4 Clock Source Select	Clock source SEL [3:0] 0000: 25M(OSC2); 0001: 25M/4; 0010: 2M(OSC1); 0011: 2M/8; 0100: 2M/64; 0101: 2M/512; 0110: 2K(OSC0); 0111: 2K/8; 1000: 2K/64; 1001: 2K/512; 1010: 2K/4096; 1011: 2K/32768; 1100: 2K/262144; 1101: CNT_END; 1110: External; 1111: Not used		
	[1463:1460]	CNT4 function and edge mode selection	0000: both edge Delay; 0001: falling edge delay; 0010: rising edge delay; 0011: both edge One Shot; 0100: falling edge One Shot; 0101: rising edge One Shot; 0110: both edge freq detect; 0111: falling edge freq detect; 1000: rising edge freq detect; 1001: both edge detect; 1010: falling edge detect; 1011: rising edge detect; 1100: both edge reset CNT; 1101: falling edge reset CNT; 1110: rising edge reset CNT; 1111: high level reset CNT		
B7	[1465:1464]	CNT4 initial value selection	00: bypass the initial 01: initial 0 10: initial 1 11: initial 1		
	[1467]	CNT4 output pol selection	0: Default Output 1: Inverted Output		
	[1468]	Reserved			
	[1469]	CNT4 CNT mode SYNC selection	0: bypass 1: after two DFF		
	[1470]	CNT4 DLY EDET FUNCTION Selection	0: normal 1: DLY function edge detection		
	[1471]	Reserved			
B8	[1479:1472]	REG_CNT4_Data[7:0]	Data[7:0]		
B9	[1480]	Reserved			
	[1483] [1485] [1484]	Single 3-bit LUT	00000: Matrix A - In2; Matrix B - In1; Matrix C - In0 (DLY_IN - LOW)		
	[1482] [1481]	Single DFF w RST and SET	00100: Matrix A - D; Matrix B - nSET/nRST; Matrix C - CLK (DLY_IN - LOW)		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
B9	[1483] [1485] [1484] [1482] [1481]	Single CNT/DLY	00001: Matrix A - DLY_IN (CNT); Matrix B - EXT_CLK (CNT); Matrix C - NC (DLY_OUT connected to LUT/DFF)		
		CNT/DLY → LUT	00010: Matrix A - DLY_IN; Matrix B - In1; Matrix C - In0 (DLY_OUT connected to In2)		
		CNT/DLY → DFF	00110: Matrix A - DLY_IN; Matrix B - nSET/nRST; Matrix C - CLK (DLY_OUT connected to D)		
		CNT/DLY → LUT	01010: Matrix A - In2; Matrix B - DLY_IN; Matrix C - In0 (DLY_OUT connected to In1)		
		CNT/DLY → DFF	01110: Matrix A - D; Matrix B - DLY_IN; Matrix C - CLK (DLY_OUT connected to nSET/nRST)		
		CNT/DLY → LUT	10010: Matrix A - In2; Matrix B - In1; Matrix C - DLY_IN (DLY_OUT connected to In0)		
		CNT/DLY → DFF	10110: Matrix A - D; Matrix B - nSET/nRST; Matrix C - DLY_IN (DLY_OUT connected to CLK)		
		LUT → CNT/DLY	00011: Matrix A - In2; Matrix B - In1; Matrix C - In0 (LUT_OUT connected to DLY_IN)		
		DFF → CNT/DLY	00111: Matrix A - D; Matrix B - nSET/nRST; Matrix C - CLK (DFF_OUT connected to DLY_IN)		
	[1487:1486]	CNT5 initial value selection	00: bypass the initial 01: initial 0 10: initial 1 11: initial 1		
BA	[1495:1488]	LUT3_11_DFF14 setting	[7]: LUT3_11[7]/DFF or LATCH Select 0: DFF function; 1: LATCH function [6]: LUT3_11[6]/DFF Output Select 0: Q output; 1: QB output [5]: LUT3_11[5]/DFF 0: nRST from Matrix Output; 1: nSET from Matrix Output [4]: LUT3_11[4]/DFF Initial Polarity Select 0: Low; 1: High [3:0]: LUT3_11[3:0]		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
BB	[1499:1496]	DLY/CNT5 Clock Source Select	Clock source SEL [3:0] 0000: 25M(OSC2); 0001: 25M/4; 0010: 2M(OSC1); 0011: 2M/8; 0100: 2M/64; 0101: 2M/512; 0110: 2K(OSC0); 0111: 2K/8; 1000: 2K/64; 1001: 2K/512; 1010: 2K/4096; 1011: 2K/32768; 1100: 2K/262144; 1101: CNT_END; 1110: External; 1111: Not used		
	[1503:1500]	CNT5 function and edge mode selection	0000: both edge Delay; 0001: falling edge delay; 0010: rising edge delay; 0011: both edge One Shot; 0100: falling edge One Shot; 0101: rising edge One Shot; 0110: both edge freq detect; 0111: falling edge freq detect; 1000: rising edge freq detect; 1001: both edge detect; 1010: falling edge detect; 1011: rising edge detect; 1100: both edge reset CNT; 1101: falling edge reset CNT; 1110: rising edge reset CNT; 1111: high level reset CNT		
BC	[1511:1504]	REG_CNT5_Data[7:0]	Data[7:0]		
BD	[1512]	CNT5 output pol selection	0: Default Output 1: Inverted Output		
	[1513]	Reserved			
	[1514]	CNT5 CNT mode SYNC selection	0: bypass 1: after two DFF		
	[1515]	CNT5 DLY EDET FUNCTION Selection	0: normal 1: DLY function edge detection		
	[1538], [1519:1516]	Single 3-bit LUT	00000: Matrix A - In2; Matrix B - In1; Matrix C - In0 (DLY_IN - LOW)		
		Single DFF w RST and SET	10000: Matrix A - D; Matrix B - nSET/nRST; Matrix C - CLK (DLY_IN - LOW)		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
BD	[1538], [1519:1516]	Single CNT/DLY	00001: Matrix A - DLY_IN (CNT); Matrix B - EXT_CLK (CNT); Matrix C - NC (DLY_OUT connected to LUT/DFF)		
		CNT/DLY → LUT	00010: Matrix A - DLY_IN; Matrix B - In1; Matrix C - In0 (DLY_OUT connected to In2)		
		CNT/DLY → DFF	10010: Matrix A - DLY_IN; Matrix B - nSET/nRST; Matrix C - CLK (DLY_OUT connected to D)		
		CNT/DLY → LUT	00110: Matrix A - In2; Matrix B - DLY_IN; Matrix C - In0 (DLY_OUT connected to In1)		
		CNT/DLY → DFF	10110: Matrix A - D; Matrix B - DLY_IN; Matrix C - CLK (DLY_OUT connected to nSET/nRST)		
		CNT/DLY → LUT	01010: Matrix A - In2; Matrix B - In1; Matrix C - DLY_IN (DLY_OUT connected to In0)		
		CNT/DLY → DFF	11010: Matrix A - D; Matrix B - nSET/nRST; Matrix C - DLY_IN (DLY_OUT connected to CLK)		
		LUT → CNT/DLY	00011: Matrix A - In2; Matrix B - In1; Matrix C - In0 (LUT_OUT connected to DLY_IN)		
		DFF → CNT/DLY	10011: Matrix A - D; Matrix B - nSET/nRST; Matrix C - CLK (DFF_OUT connected to DLY_IN)		
BE	[1527:1520]	LUT3_12_DFF15 setting	[7]: LUT3_12[7]/DFF or LATCH Select 0: DFF function; 1: LATCH function [6]: LUT3_12[6]/DFF Output Select 0: Q output; 1: QB output [5]: LUT3_12[5]/DFF 0: nRST from Matrix Output; 1: nSET from Matrix Output [4]: LUT3_12[4]/DFF Initial Polarity Select 0: Low; 1: High [3:0]: LUT3_12[3:0]		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
BF	[1531:1528]	DLY/CNT6 Clock Source Select	Clock source SEL [3:0] 0000: 25M(OSC2); 0001: 25M/4; 0010: 2M(OSC1); 0011: 2M/8; 0100: 2M/64; 0101: 2M/512; 0110: 2K(OSC0); 0111: 2K/8; 1000: 2K/64; 1001: 2K/512; 1010: 2K/4096; 1011: 2K/32768; 1100: 2K/262144; 1101: CNT_END; 1110: External; 1111: Not used		
	[1535:1532]	CNT6 function and edge mode selection	0000: both edge Delay; 0001: falling edge delay; 0010: rising edge delay; 0011: both edge One Shot; 0100: falling edge One Shot; 0101: rising edge One Shot; 0110: both edge freq detect; 0111: falling edge freq detect; 1000: rising edge freq detect; 1001: both edge detect; 1010: falling edge detect; 1011: rising edge detect; 1100: both edge reset CNT; 1101: falling edge reset CNT; 1110: rising edge reset CNT; 1111: high level reset CNT		
C0	[1537:1536]	CNT6 initial value selection	00: bypass the initial 01: initial 0 10: initial 1 11: initial 1		
	[1539]	CNT6 output pol selection	0: Default Output 1: Inverted Output		
	[1540]	Reserved			
	[1541]	CNT6 CNT mode SYNC selection	0: bypass 1: after two DFF		
	[1542]	CNT6 DLY EDET FUNCTION Selection	0: normal 1: DLY function edge detection		
	[1543]	Reserved			
C1	[1551:1544]	REG_CNT6_Data[7:0]	Data[7:0]		
C2	[1556:1552]	Single 3-bit LUT	00000: Matrix A - In2; Matrix B - In1; Matrix C - In0 (DLY_IN - LOW)		
		Single DFF w RST and SET	10000: Matrix A - D; Matrix B - nSET/nRST; Matrix C - CLK (DLY_IN - LOW)		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
C2	[1556:1552]	Single CNT/DLY	00001: Matrix A - DLY_IN (CNT); Matrix B - EXT_CLK (CNT); Matrix C - NC (DLY_OUT connected to LUT/DFF)		
		CNT/DLY → LUT	00010: Matrix A - DLY_IN; Matrix B - In1; Matrix C - In0 (DLY_OUT connected to In2)		
		CNT/DLY → DFF	10010: Matrix A - DLY_IN; Matrix B - nSET/nRST; Matrix C - CLK (DLY_OUT connected to D)		
		CNT/DLY → LUT	00110: Matrix A - In2; Matrix B - DLY_IN; Matrix C - In0 (DLY_OUT connected to In1)		
		CNT/DLY → DFF	10110: Matrix A - D; Matrix B - DLY_IN; Matrix C - CLK (DLY_OUT connected to nSET/nRST)		
		CNT/DLY → LUT	01010: Matrix A - In2; Matrix B - In1; Matrix C - DLY_IN (DLY_OUT connected to In0)		
		CNT/DLY → DFF	11010: Matrix A - D; Matrix B - nSET/nRST; Matrix C - DLY_IN (DLY_OUT connected to CLK)		
		LUT → CNT/DLY	00011: Matrix A - In2; Matrix B - In1; Matrix C - In0 (LUT_OUT connected to DLY_IN)		
		DFF → CNT/DLY	10011: Matrix A - D; Matrix B - nSET/nRST; Matrix C - CLK (DFF_OUT connected to DLY_IN)		
	[1557]	CNT7 output pol selection	0: Default Output 1: Inverted Output		
	[1558]	Reserved			
	[1559]	CNT7 CNT mode SYNC selection	0: bypass 1: after two DFF		
C3	[1567:1560]	LUT3_13_DFF16 setting	[7]: LUT3_13[7]/DFF or LATCH Select 0: DFF function; 1: LATCH function [6]: LUT3_13[6]/DFF Output Select 0: Q output; 1: QB output [5]: LUT3_13[5]/DFF 0: nRST from Matrix Output; 1: nSET from Matrix Output [4]: LUT3_13[4]/DFF Initial Polarity Select 0: Low; 1: High [3:0]: LUT3_13[3:0]		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
C4	[1571:1568]	DLY/CNT7 Clock Source Select	Clock source SEL [3:0] 0000: 25M(OSC2); 0001: 25M/4; 0010: 2M(OSC1); 0011: 2M/8; 0100: 2M/64; 0101: 2M/512; 0110: 2K(OSC0); 0111: 2K/8; 1000: 2K/64; 1001: 2K/512; 1010: 2K/4096; 1011: 2K/32768; 1100: 2K/262144; 1101: CNT_END; 1110: External; 1111: Not used		
	[1575:1572]	CNT7 function and edge mode selection	0000: both edge Delay; 0001: falling edge delay; 0010: rising edge delay; 0011: both edge One Shot; 0100: falling edge One Shot; 0101: rising edge One Shot; 0110: both edge freq detect; 0111: falling edge freq detect; 1000: rising edge freq detect; 1001: both edge detect; 1010: falling edge detect; 1011: rising edge detect; 1100: both edge reset CNT; 1101: falling edge reset CNT; 1110: rising edge reset CNT; 1111: high level reset CNT		
C5	[1577:1576]	CNT7 initial value selection	00: bypass the initial 01: initial 0 10: initial 1 11: initial 1		
	[1578]	CNT7 DLY EDET FUNCTION Selection	0: normal 1: DLY function edge detection		
	[1583:1579]	Reserved			
C6	[1591:1584]	REG_CNT7_Data[7:0]	Data[7:0]		
C7	[1592]	IO0 I ² C output expander data			
	[1593]	IO0 I ² C output expander select	0: IO0 output come from matrix 1: IO0 output is register		
	[1594]	IO5 I ² C output expander data			
	[1595]	IO5 I ² C output expander select	0: IO5 output come from matrix 1: IO5 output is register		
	[1596]	IO6 I ² C output expander data			
	[1597]	IO6 I ² C output expander select	0: IO6 output come from matrix 1: IO6 output is register		
	[1598]	IO9 I ² C output expander data			
	[1599]	IO9 I ² C output expander select	0: IO9 output come from matrix 1: IO9 output is register		
C8	[1600]	Reserved			
	[1601]	I ² C reset bit with reloading NVM into Data register (soft reset)	0: Keep existing condition 1: Reset execution		
	[1602]	IO latching enable during I ² C write interface	1: disable 0: enable		
	[1607:1603]	Reserved			
C9	[1615:1608]	I ² C write mask bits	0: overwrite 1: mask		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
CA	[1619:1616]	I ² C slave address			
	[1620]	Slave address selection A4	0: from register 1: from IO5		
	[1621]	Slave address selection A5	0: from register 1: from IO4		
	[1622]	Slave address selection A6	0: from register 1: from IO3		
	[1623]	Slave address selection A7	0: from register 1: from IO2		
CB	[1631:1624]	8-bit Pattern ID Byte 0 (From NVM): ID[23:16]			
CC	[1639:1632]	Reserved			
Reserved					
CD	[1643:1640]	Reserved			
	[1647:1644]	Reserved			
CE	[1648]	Reserved			
	[1652:1649]	Reserved			
	[1653]	Reserved			
	[1654]	Reserved			
	[1655]	Reserved			
CF	[1657:1656]	Reserved			
	[1658]	Reserved			
	[1659]	Reserved			
	[1660]	Reserved			
	[1661]	Reserved			
	[1662]	Reserved			
	[1663]	Reserved			
D0	[1671:1664]	Reserved			
D1	[1679:1672]	Reserved			
D2	[1687:1680]	Reserved			
D3	[1695:1688]	Reserved			
D4	[1703:1696]	Reserved			
D5	[1711:1704]	Reserved			
D6	[1719:1712]	Reserved			
D7	[1727:1720]	Reserved			
D8	[1735:1728]	Reserved			
D9	[1743:1736]	Reserved			
DA	[1751:1744]	Reserved			
DB	[1759:1752]	Reserved			
DC	[1767:1760]	Reserved			
DD	[1775:1768]	Reserved			
DE	[1783:1776]	Reserved			
DF	[1791:1784]	Reserved			

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
E0 RPR	[1793:1792]	2k Register Read Selection Bits RPRB[1:0]	00: 2k register data is unprotected for read; 01: 2k register data is partly protected for read; 10: 2k register data is fully protected for read; 11: reserved		
	[1795:1794]	2k Register Write Selection Bits RPRB[3:2]	00: 2k register data is unprotected for write; 01: 2k register data is partly protected for write; 10: 2k register data is fully protected for write; 11: reserved		
	[1796]	Reserved			
	[1797]	Reserved			
	[1798]	Reserved			
	[1799]	Reserved			
E1 NPR	[1801:1800]	2k NVM Configuration Selection Bits NPRB[1:0]	00: 2k NVM Configuration data is unprotected for read and write/erase; 01: 2k NVM Configuration data is fully protected for read; 10: 2k NVM Configuration data is fully protected for write/erase; 11: 2k NVM Configuration data is fully protected for read and write/erase.		
	[1802]	Reserved			
	[1803]	Reserved			
	[1804]	Reserved			
	[1805]	Reserved			
	[1806]	Reserved			
	[1807]	Reserved			
E2 WPR	[1809:1808]	Reserved			
	[1810]	Write Protect Register Enable	0: No Software Write Protection enabled (default). 1: Write Protection is set by the state of the WPB[1:0] bits.		
	[1815:1811]	Reserved			
E3	[1820:1816]	Page Selection for Erase ERSEB[4:0]	Define the page address which will be erased. ERSEB[4] = 0 corresponds to the upper 2k NVM used for chip configuration;		
	[1821]	Reserved			
	[1822]	Reserved			
	[1823]	Erase Enable ERSE	0: erase disable 1: cause the NVM erase: full NVM (4k bits) erase for ERSCHIP = 1 (reg[1973]) if DIS_ERSCHIP = 0 (reg[1972]) or page erase for ERSCHIP = 0 (reg[1973]).		

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
E4	[1824]	Protection Lock Bit (PRL)	0: RPR/WPR/NPR setting can be changed 1: RPR/WPR/NPR setting cannot be changed		
	[1831:1825]	Reserved			
E5	[1839:1832]	Reserved			
E6	[1847:1840]	Reserved			
E7	[1855:1848]	Reserved			
E8	[1863:1856]	Reserved			
E9	[1871:1864]	Reserved			
EA	[1879:1872]	Reserved			
EB	[1887:1880]	Reserved			
EC	[1895:1888]	Reserved			
ED	[1903:1896]	Reserved			
EE	[1911:1904]	Reserved			
EF	[1919:1912]	Reserved			
F0	[1926:1920]	Reserved			
	[1927]	Reserved			
F1	[1932:1928]	Reserved			
	[1934:1933]				
	[1935]	Reserved			
F2	[1940:1936]	Reserved			
	[1943:1941]				
F3	[1949:1944]	Reserved			
	[1951:1950]				
F4	[1957:1952]	Reserved			
	[1959:1958]				
F5	[1965:1960]	Reserved			
	[1967:1966]				
F6	[1968]	Reserved			
	[1971:1969]	Reserved			
	[1972]	Reserved			
	[1973]	Reserved			
	[1974]	Reserved			
	[1975]	Reserved			
F7	[1983:1976]	Reserved			
F8	[1991:1984]	Reserved			
F9	[1992]	Reserved			
	[1993]	Reserved			
	[1995:1994]	Reserved			
	[1999:1996]	Reserved			

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Address		Signal Function	Register Bit Definition	I ² C Interface	
Byte	Register Bit			Read	Write
FA	[2000]	Reserved			
	[2001]	Reserved			
	[2002]	Reserved			
	[2006:2003]				
	[2007]	Reserved			
FB	[2015:2008]	Reserved			
FC	[2023:2016]	Reserved			
FD	[2031:2024]	Reserved			
FE	[2039:2032]	Reserved			
FF	[2047:2040]	Reserved			

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

18 Package Top Marking System Definition

18.1 STQFN 20L 2 MM X 3 MM 0.4P FCD PACKAGE

Part Code	XXXXXX	
Date Code	DD LLL	Lot #
Pin 1 Identifier	● CRR	COO + Revision

XXXXXX - Part ID Field identifies the specific device configuration

DD - Date Code Field: Coded date of manufacture

LLL - Lot Code: Designates Lot #

C - Assembly Site/COO: Specifies Assembly Site/Country of Origin

RR - Revision Code: Device Revision

18.2 TSSOP-20

	XXXXXXXXXXXX	Device Name
	\$RR###NNNN	\$: Subcon RR: Revision ###: Programming Code NNNN: Alphanumeric
	YYWW	Date Code
Pin 1 Identifier	○	

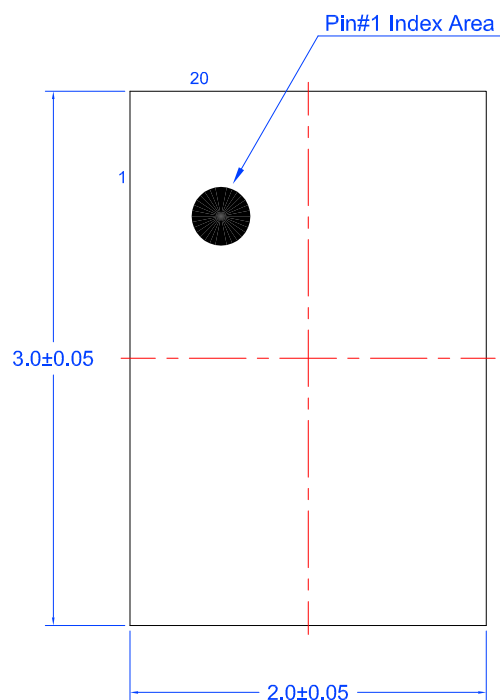
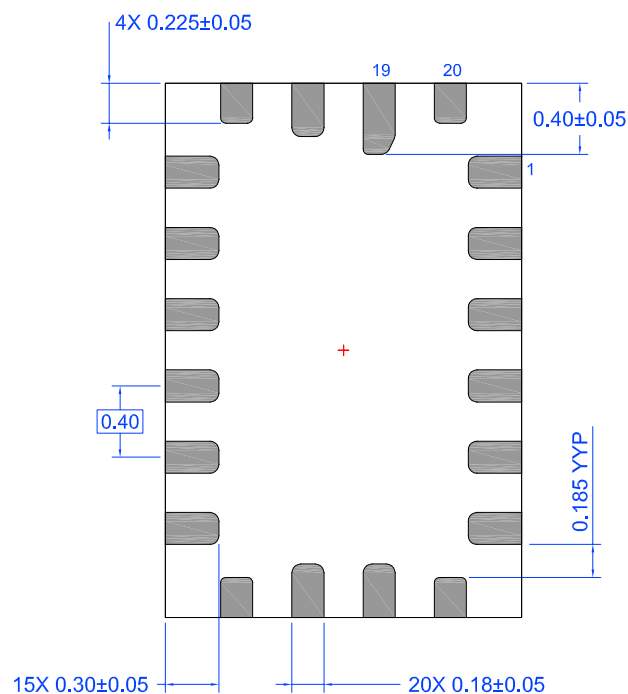
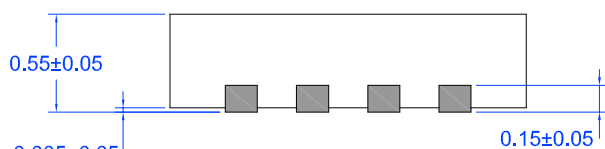
GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

19 Package Information

19.1 PACKAGE OUTLINES FOR STQFN 20L 2 MM X 3 MM 0.4P FCD

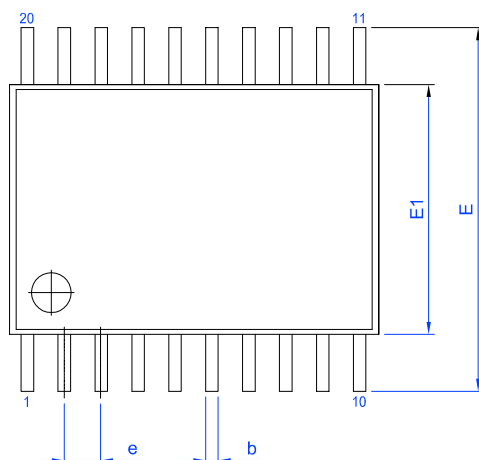
JEDEC MO-220, Variation WECE

IC Net Weight: TBD g

**Marking View****BTM View****Side view****Unit: mm**

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

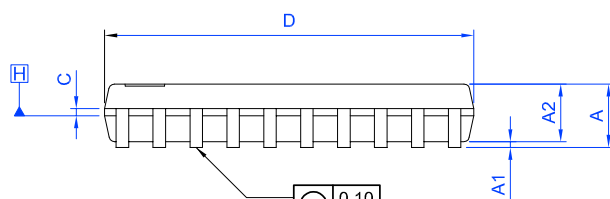
19.2 PACKAGE OUTLINES FOR TSSOP 20L 173 MIL GREEN



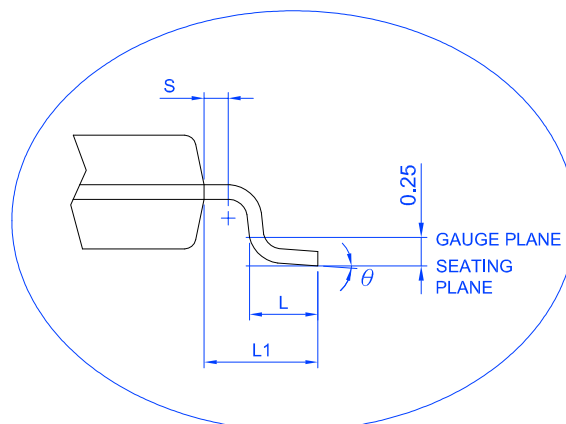
Marking View



Side View



Side view



NOTES:

- JEDEC OUTLINE :
STANDARD : MO-153 AC REV.F
THERMALLY ENHANCED : MO-153 ACT REV.F
- DIMENSION 'D' DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE.
- DIMENSION 'E1' DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 PER SIDE.
- DIMENSION 'b' DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 MM TOTAL IN EXCESS OF THE 'b' DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OF THE FOOT. MINIMUM SPACE BETWEEN PROTRUSION AND ADJACENT LEAD IS 0.07 MM.
- DIMENSIONS 'D' AND 'E1' TO BE DETERMINED AT DATUM PLANE H

Unit: mm

Symbol	Min	Nom.	Max	Symbol	Min	Nom.	Max
A	-	-	1.20	D	6.40	6.50	6.60
A1	0.05	-	0.15	E1	4.30	4.40	4.50
A2	0.80	0.90	1.05	E	6.40 BSC		
b	0.19	-	0.30	L	0.50	0.60	0.75
C	0.09	-	0.20	L1	1.00 REF		
e	0.65 BSC			S	0.20	-	-
				Θ	0°	-	8°

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

20 STQFN and TSSOP Handling

Be sure to handle STQFN and TSSOP packages only in a clean, ESD-safe environment. Tweezers or vacuum pick-up tools are suitable for handling. Do not handle STQFN and TSSOP packages with fingers as this can contaminate the package pins and interface with solder reflow.

21 Soldering Information

Please see IPC/JEDEC J-STD-020: latest revision for reflow profile based on package volume of 3.30 mm³ (nominal) for STQFN 20L Package and package volume of 25.74 mm³ (nominal) for TSSOP-20 Package. More information can be found at www.jedec.org.

22 Ordering Information

Part Number	Type
SLG46824V	20-pin STQFN
SLG46824VTR	20-pin STQFN - Tape and Reel (3k units)
SLG46824G	20-pin TSSOP
SLG46824GTR	20-pin TSSOP Tape and Reel (4k units)

22.1 TAPE AND REEL SPECIFICATIONS

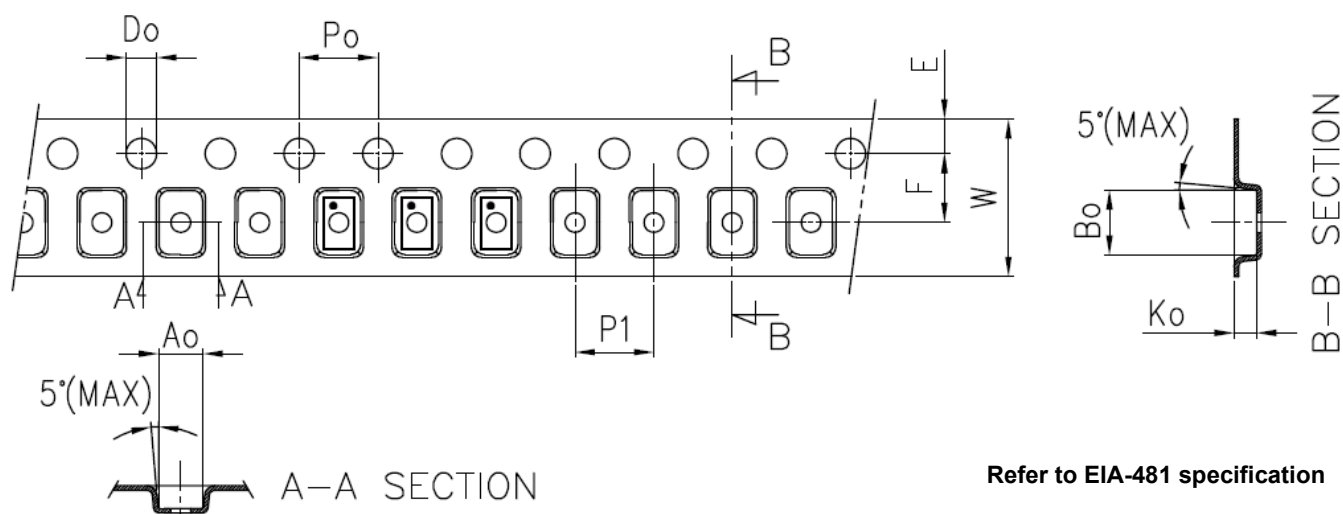
Package Type	# of Pins	Nominal Package Size (mm)	Max Units		Reel & Hub Size (mm)	Leader (min)		Trailer (min)		Tape Width (mm)	Part Pitch (mm)
			per Reel	per Box		Pockets	Length (mm)	Pockets	Length (mm)		
STQFN 20L 2 mm x 3 mm 0.4P FCD	20	2 x 3 x 0.55	3,000	3,000	178/60	100	400	100	400	8	4
TSSOP 20L 173 MIL Green Package	20	6.5 x 6.4	4,000	4,000	330/100	42	336	42	336	16	8

22.2 CARRIER TAPE DRAWING AND DIMENSIONS

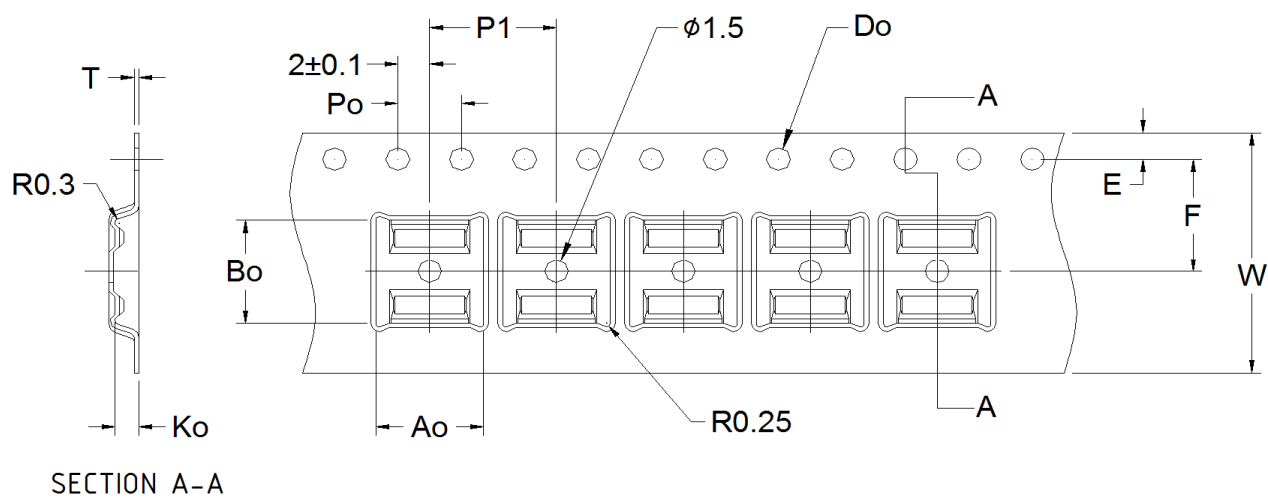
Package Type	Pocket BTM Length (mm)	Pocket BTM Width (mm)	Pocket Depth (mm)	Index Hole Pitch (mm)	Pocket Pitch (mm)	Index Hole Diameter (mm)	Index Hole to Tape Edge (mm)	Index Hole to Pocket Center (mm)	Tape Width (mm)
	A0	B0	K0	P0	P1	D0	E	F	W
STQFN 20L 2 mm x 3 mm 0.4P FCD	2.2	3.15	0.76	4	4	1.5	1.75	3.5	8
TSSOP 20L 173 MIL Green Package	6.8	6.9	1.6	4	8	1.5	1.75	7.5	16

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

22.3 STQFN-20L



22.4 TSSOP-20L



Note: Orientation in carrier: Pin1 is at upper left corner (Quadrant1).

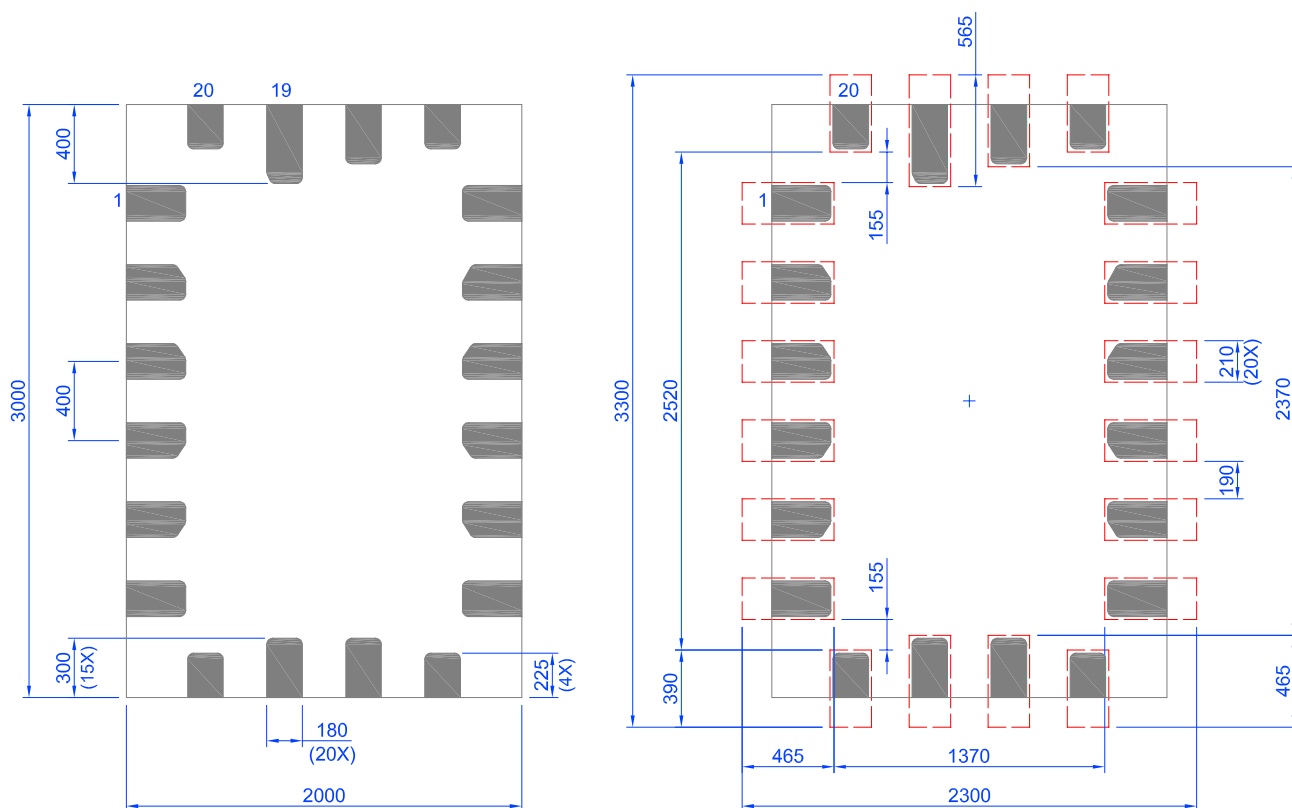
GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

23 Layout Guidelines

23.1 STQFN 20L 2 MM X 3 MM 0.4P FCD PACKAGE

 Exposed Pad
(PKG face down)

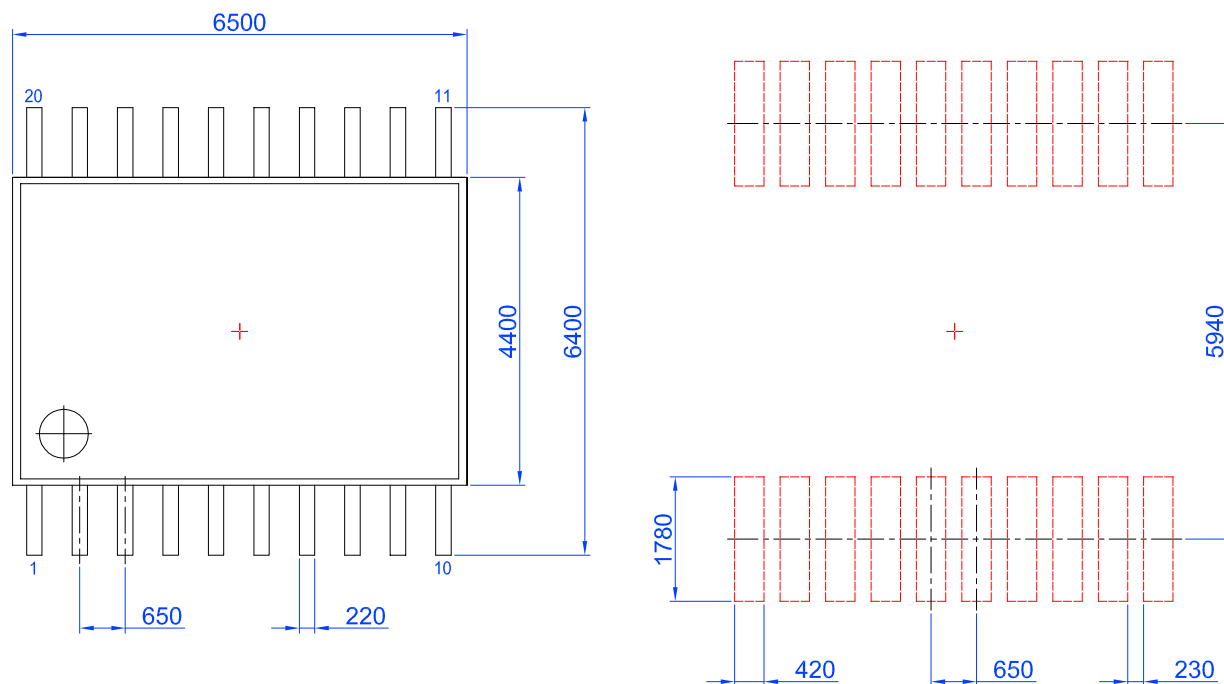
 Recommended Land Pattern
(PKG face down)



Unit: μm

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

23.2 TSSOP-20



Unit: μm

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Glossary

ACK	Acknowledge bit
ACMP	Analog Comparator
ACMPH	Analog Comparator High Speed
ACMPL	Analog Comparator Low Power
BG	Bandgap
CLK	Clock
CMO	Connection matrix output
CNT	Counter
DFF	D Flip-Flop
DLY	Delay
EC	Electrical Characteristics
ERSE	Erase Enable
ERSR	Erase Register
ESD	Electrostatic discharge
EV	End Value
FSM	Finite State Machine
GPI	General Purpose Input
GPIO	General Purpose Input/Output
GPO	General Purpose Output
IN	Input
IO	Input/Output
LPF	Low Pass Filter
LSB	Least Significant Bit
LUT	Look Up Table
LV	Low Voltage
MSB	Most Significant Bit
MTP	Multiple-Time-Programmable
MUX	Multiplexer
NPR	Non-Volatile Memory Read/Write/Erase Protection
nRST	Reset
NVM	Non-Volatile Memory
OD	Open-Drain
OE	Output Enable
OSC	Oscillator
OUT	Output
PD	Power-down
PGen	Pattern Generator
POR	Power-On Reset

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

PP	Push-Pull
PRL	Protect Lock Bit
PWR	Power
P DLY	Programmable Delay
RPR	Register Read/Write Protection
RPRB	Register Read/Write Protection Bit
RPRL	Register Protection Read/Write/Erase Lock
REG	Register
R/W	Read/Write
SCL	I ² C Clock Input
SDA	I ² C Data Input/Output
SLA	Slave Address
SMT	With Schmitt Trigger
SV	nSET Value
Vref	Voltage Reference
WOSMT	Without Schmitt Trigger
WPB	Write Protect Bit
WPR	Write Protection Register
WPRE	Write Protect Enable
WS	Wake and Sleep Controller

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Revision History

Revision	Date	Description
3.8	8-Apr-2019	Corrected 2-bit LUT3 or PGen figure Corrected Electrical Spec
3.7	22-Mar-2019	Added new subsection Electrostatic Discharge Ratings Fixed typos Removed information about SCL and SDA Pins' Schmitt Trigger Corrected Absolute Maximum Ratings Corrected Pinout figure
3.6	20-Feb-2019	Updated Absolute Maximum Ratings Added Maximum Average or DC Current (Through pin) parameter Corrected ACMPs Block Diagrams Added ACMPs' hysteresis information Added additional information about V _{DD2} to IO Pins section Corrected Absolute Maximum Ratings Updated Typical delay table Fixed typos
3.5	5-Nov-2018	Added graphs to IO pins, ACMP and Oscillator sections Fixed typos
3.4	14-Sep-2018	Updated Oscillator Startup Diagram Fixed typos Updated Example of I ² C Byte Write Bit Masking
3.3	8-Aug-2018	Fixed typos
3.2	7-Aug-2018	Fixed typos Updated Electrical Spec Updated figure I ² C Block Addressing
3.1	24-May-2018	Updated Electrical Spec Fixed typos Updated register definitions: [1602], [2015:2008] Updated Electrical spec notes and conditions Updated STQFN and TSSOP Handling section
3.0	2-May-2018	Final version

GreenPAK Programmable Mixed-Signal Matrix with In System Programmability

Status Definitions

Version	Datasheet Status	Product Status	Definition
1.[n]	Target	Development	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
2.[n]	Preliminary	Qualification	This datasheet contains the specifications and preliminary characterization data for products in pre-production. Specifications may be changed at any time without notice in order to improve the design.
3.[n]	Final	Production	This datasheet contains the final specifications for products in volume production. The specifications may be changed at any time in order to improve the design, manufacturing and supply. Major specification changes are communicated via Customer Product Notifications. Datasheet changes are communicated via www.dialog-semiconductor.com .
4.[n]	Obsolete	Archived	This datasheet contains the specifications for discontinued products. The information is provided for reference only.

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