

## Features

- Supports the requirements of ITU-T G.8262 for synchronous Ethernet Equipment slave Clocks (EEC option 1 and 2)
- Supports the requirements of Telcordia GR-1244 Stratum 3 and GR-253, ITU-T G.813, and G.781 SETS
- Supports ITU-T G.823, G.824 and G.8261 for 2048 kbit/s and 1544 kbit/s interfaces
- Meets the SONET/SDH jitter generation requirements up to OC-48/STM-16
- Synchronizes to telecom reference clocks (2 kHz, N\*8 kHz up to 77.76 MHz, 155.52 MHz) or to Ethernet reference clocks (25 MHz, 50 MHz, 62.5 MHz, 125 MHz)
- Supports composite clock inputs (64 kHz, 64 kHz + 8 kHz, 64kHz + 8 kHz + 400 Hz)
- Generates standard SONET/SDH clock rates (e.g., 19.44 MHz, 38.88 MHz, 77.76 MHz, 155.52 MHz, 622.08 MHz) or Ethernet clock rates (e.g., 25 MHz, 50 MHz, 125 MHz, 156.25 MHz, 312.5 MHz) for synchronizing Gigabit Ethernet PHYs
- Programmable output synthesizers (P0, P1) generate telecom clock frequencies from any multiple of 8 kHz up to 100 MHz
- Generates several styles of telecom frame pulses with selectable pulse width, polarity and frequency
- Provides two DPLLs which are independently configurable through a serial interface

## Ordering Information

ZL30143GGG	100 Pin CABGA	Trays
ZL30143GGG2	100 Pin CABGA*	Trays

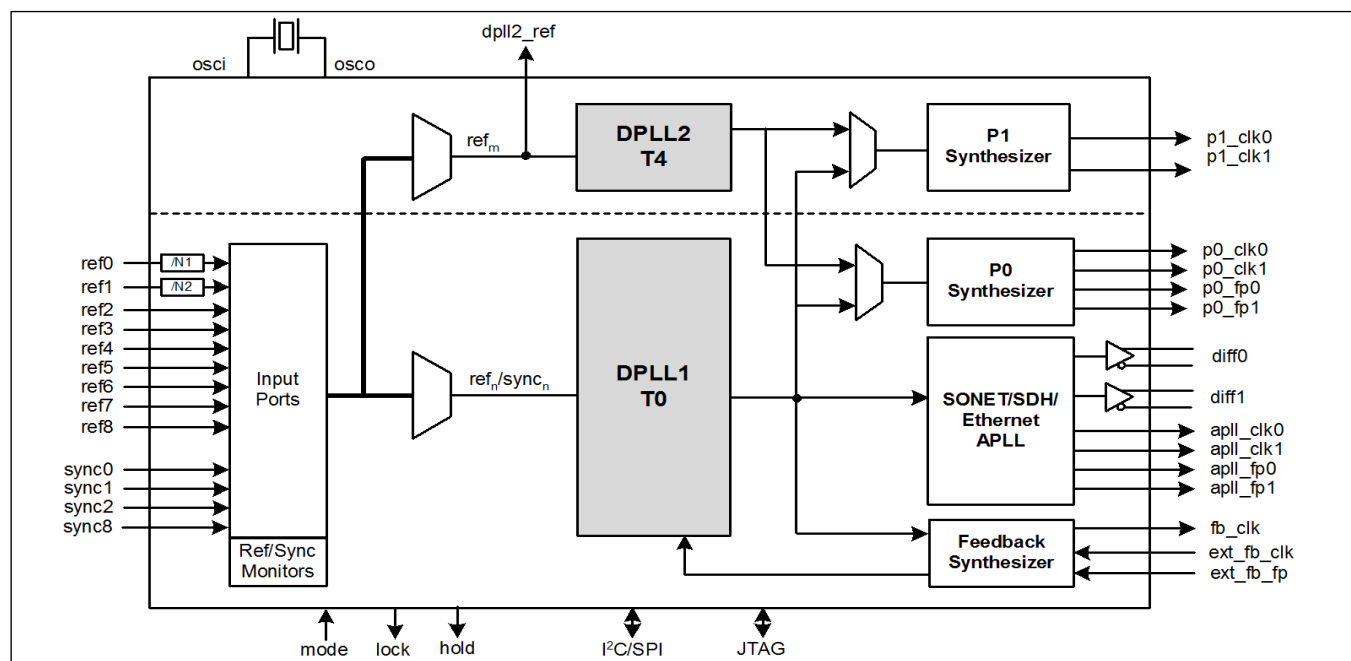
\*Pb Free Tin/Silver/Copper

**-40°C to +85°C**

- Internal state machine automatically controls mode of operation (free-run, locked, holdover)
- Flexible input reference monitoring automatically disqualifies references based on frequency and phase irregularities
- Provides automatic reference switching and holdover during loss of reference input
- Supports master/slave configuration and dynamic input to output delay compensation for AdvancedTCA™
- Configurable input to output delay and output to output phase alignment

## Applications

- ITU-T G.8262 System Timing Cards which support 1 GbE and 10 GbE interfaces
- Telcordia GR-253 Carrier Grade SONET/SDH Stratum 3 System Timing Cards
- System Timing Cards which supports ITU-T G.781 SETS (SDH Equipment Timing Source)



**Figure 1 - Functional Block Diagram**

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## Change Summary

The following table captures changes from September 2010 issue to March 2013 issue.

Page	Item	Change
Multiple	Zarlink logo and name reference	Updated to Microsemi® logo and name.

Below are the changes from the April 2010 issue to the September 2010 issue.

Page	Item	Change
21	Table 8	Added note for 1 Hz sync detection.
141	Register "1Hz_enable (08_0x71)"	Added register description.
118	Register "Page Pointer" (0x64)	Updated register description.

Below are the changes from the July 2009 issue to the April 2010 issue.

Page	Item	Change
134	Page_Address: 01_0x75 to Page_Address: 01_0x7C	Added Registers.
143	Page_Address: 0A_0x72	Replaced Table.
143	Page_Address: 0A_0x76 to Page_Address: 0A_0x7D	Added Registers.

Below are the changes from the February 2009 issue to the July 2009 issue.

Page	Item	Change
15	Table 1 -, "DPLL1 and DPLL2 Features"	Updated lock times and add ToP Client mode
17	Section 2.2.1.1, "ToP (Timing over Packet) Client Mode"	Added section for ToP Client Mode
29	2.13, "Reference Monitoring for Custom Configurations"	Added instructions for SCM and CFM limits when using low frequency customs frequencies
33	2.15, "Output Clocks and Frame Pulses"	Added reference to ZLAN-254.
36	Table 14 - P0 Frame Pulse Frequencies	Added 1 Hz option for p0_fpn outputs
81	Register Address: 0x1F	Added ToP Client Mode
101	Register address: 0x3E	Added 1 Hz option for po_fp0
101	Register address: 0x3F	Updated descriptions for 1 Hz option
103	Register address: 0x43	Added 1 Hz option for po_fp1

Page	Item	Change
103	Register address: 0x44	Updated descriptions for 1 Hz option
131	Register Addresses 01_0x69 to 01_0x70	Added DCO_Phase_0 to DCO_Phase_7 registers
133	Register Addresses: 01_0x71 to 01_0x74	Added Local_Time_0 to Local_Time_4 registers
142	Register Address: 0A_0x6C	Added DCO_Update register
143	Register Address: 0A_0x71	Added DCO_update_interval register
137	Register Address: 0A_0x72	Added ToP_1 Hz_Alignment register
146	Register Address: 0F_0x65	Corrected the bit descriptions
146	Register Address: 0F_0x67	Clarified bit descriptions.
148	Register Address: 0F_0x6E	Added ToP_isr register
148	Register Address: 0F_0x6F	Added ToP_isr_mask register
148	Register Address: 0F_0x7D	Added isr0_reg
149	Register Address: 0F_0x7E	Added Register
130, 131	Register Address: 01_0x65, Register Address: 01_0x67 and Register Address: 01_0x68	Corrected description

## Pin Description

Pin #	Name	I/O Type	Description
<b>Input Reference</b>			
C1 B2 A3 C3 B3 B4 C4 A4	ref0 ref1 ref2 ref3 ref4 ref5 ref6 ref7	I <sub>u</sub>	<b>Input References 7:0 (LVCMOS, Schmitt Trigger).</b> These input references are available to both DPLL1 and DPLL2 for synchronizing output clocks. All eight input references can lock to any multiple of 8 kHz up to 77.76 MHz including 25 MHz and 50 MHz. Input ref0 and ref1 have additional configurable pre-dividers allowing input frequencies of 62.5 MHz, 125 MHz, and 155.52 MHz. These pins are internally pulled up to V <sub>dd</sub> .
B1 A1 A2	sync0 sync1 sync2	I <sub>u</sub>	<b>Frame Pulse Synchronization References 2:0 (LVCMOS, Schmitt Trigger).</b> These are optional frame pulse synchronization inputs associated with input references 0, 1 and 2. These inputs accept frame pulses in a clock format (50% duty cycle) or a basic frame pulse format with minimum pulse width of 5 ns. These pins are internally pulled up to V <sub>dd</sub> .
C5	ref8/ext_fb_clk	I <sub>u</sub>	<b>Input Reference 8/External DPLL Feedback Clock (LVCMOS, Schmitt Trigger).</b> This pin acts as either an ext_fb_clk input or as the ref8 input. The desired function for the pin is selectable through the software interface with a programmable register bit. This pin is internally pulled up to V <sub>dd</sub> . Leave open when not in use.
B5	sync8/ext_fb_fp	I <sub>u</sub>	<b>Frame Pulse Synchronization Reference 8/External DPLL Feedback Frame Pulse (LVCMOS, Schmitt Trigger).</b> This pin acts as either an ext_fb_fp input or as the sync8 input. The desired function for the pin is selectable through the software interface with a programmable register bit. This pin is internally pulled up to V <sub>dd</sub> . Leave open when not in use.
<b>Output Clocks and Frame Pulses</b>			
A9 B10	diff0_p diff0_n	O	<b>Differential Output Clock 0 (LVPECL).</b> When in SONET/SDH mode, this output can be configured to provide any one of the available SONET/SDH clocks (6.48 MHz, 19.44 MHz, 38.88 MHz, 51.84 MHz, 77.76 MHz, 155.52 MHz, 311.04 MHz, 622.08 MHz). When in Ethernet mode, this output can be configured to provide any of the Ethernet clocks (25 MHz, 50 MHz, 62.5 MHz, 125 MHz, 156.25 MHz, 312.5 MHz). See “Output Clocks and Frame Pulses” on page 33 for more details on clock frequency settings.
A10 B9	diff1_p diff1_n	O	<b>Differential Output Clock 1 (LVPECL).</b> When in SONET/SDH mode, this output can be configured to provide any one of the available SONET/SDH clocks (6.48 MHz, 19.44 MHz, 38.88 MHz, 51.84 MHz, 77.76 MHz, 155.52 MHz, 311.04 MHz, 622.08 MHz). When in Ethernet mode, this output can be configured to provide any of the Ethernet clocks (25 MHz, 50 MHz, 62.5 MHz, 125 MHz, 156.25 MHz, 312.5 MHz). See “Output Clocks and Frame Pulses” on page 33 for more details on clock frequency settings.
D10	apll_clk0	O	<b>APLL Output Clock 0 (LVCMOS).</b> When in SONET/SDH mode, this output can be configured to provide any one of the available SONET/SDH clocks up to 77.76 MHz. When in Ethernet mode, this output can be configured to provide any of the Ethernet clocks up to 125 MHz. See “Output Clocks and Frame Pulses” on page 33 for more details on clock frequency settings. The default frequency for this output is 77.76 MHz.

Pin #	Name	I/O Type	Description
G10	apll_clk1	O	<b>APLL Output Clock 1 (LVCMOS).</b> When in SONET/SDH mode, this output can be configured to provide any one of the available SONET/SDH clocks up to 77.76 MHz. When in Ethernet mode, this output can be configured to provide any of the Ethernet clocks up to 125 MHz. See “Output Clocks and Frame Pulses” on page 33 for more details on clock frequency settings. The default frequency for this output is 19.44 MHz.
E10	apll_fp0	O	<b>APLL Output Frame Pulse 0 (LVCMOS).</b> This output can be configured to provide virtually any style of output frame pulse synchronized with an associated SONET/SDH family output clock. The default frequency for this frame pulse output is 8 kHz.
F10	apll_fp1	O	<b>APLL Output Frame Pulse 1 (LVCMOS).</b> This output can be configured to provide virtually any style of output frame pulse synchronized with an associated SONET/SDH family output clock. The default frequency for this frame pulse output is 2 kHz.
K9	p0_clk0	O	<b>Programmable Synthesizer 0 - Output Clock 0 (LVCMOS).</b> This output can be configured to provide any frequency with a multiple of 8 kHz up to 100 MHz in addition to 2 kHz. The default frequency for this output is 2.048 MHz.
K7	p0_clk1	O	<b>Programmable Synthesizer 0 - Output Clock 1 (LVCMOS).</b> This is a programmable clock output configurable as a multiple or division of the p0_clk0 frequency within the range of 2 kHz to 100 MHz. The default frequency for this output is 8.192 MHz.
K8	p0_fp0	O	<b>Programmable Synthesizer 0 - Output Frame Pulse 0 (LVCMOS).</b> This output can be configured to provide virtually any style of output frame pulse associated with the p0 clocks. The default frequency for this frame pulse output is 8 kHz.
J7	p0_fp1	O	<b>Programmable Synthesizer 0 - Output Frame Pulse 1 (LVCMOS).</b> This output can be configured to provide virtually any style of output frame pulse associated with the p0 clocks. The default frequency for this frame pulse output is 8 kHz.
J10	p1_clk0	O	<b>Programmable Synthesizer 1 - Output Clock 0 (LVCMOS).</b> This output can be configured to provide any frequency with a multiple of 8 kHz up to 100 MHz in addition to 2 kHz. The default frequency for this output is 1.544 MHz (DS1).
K10	p1_clk1	O	<b>Programmable Synthesizer 1 - Output Clock 1 (LVCMOS).</b> This is a programmable clock output configurable as a multiple or division of the p1_clk0 frequency within the range of 2 kHz to 100 MHz. The default frequency for this output is 3.088 MHz (2x DS1).
H10	fb_clk	O	<b>Feedback Clock (LVCMOS).</b> This output is a buffered copy of the feedback clock for DPLL1. The frequency of this output always equals the frequency of the selected reference.
E1	dpll2_ref	O	<b>DPLL2 Selected Output Reference (LVCMOS).</b> This is a buffered copy of the output of the reference selector for DPLL2. Switching between input reference clocks at this output is not hitless.
<b>Control</b>			
H5	rst_b	I	<b>Reset (LVCMOS, Schmitt Trigger).</b> A logic low at this input resets the device. To ensure proper operation, the device must be reset after power-up. Reset should be asserted for a minimum of 300 ns.



Pin #	Name	I/O Type	Description
J5	dpll1_hs_en	I <sub>U</sub>	<b>DPLL1 Hitless Switching Enable (LVCMOS, Schmitt Trigger).</b> A logic high at this input enables hitless reference switching. A logic low disables hitless reference switching and re-aligns DPLL1's output phase to the phase of the selected reference input. This feature can also be controlled through software registers. This pin is internally pulled up to Vdd.
C2 D2	dpll1_mod_sel0 dpll1_mod_sel1	I <sub>U</sub>	<b>DPLL1 Mode Select 1:0 (LVCMOS, Schmitt Trigger).</b> During reset, the levels on these pins determine the default mode of operation for DPLL1 (Automatic, Normal, Holdover or Freerun). After reset, the mode of operation can be controlled directly with these pins, or by accessing the dpll1_modesel register (0x1F) through the serial interface. This pin is internally pulled up to Vdd.
D1	slave_en	I <sub>U</sub>	<b>Master/Slave control (LVCMOS, Schmitt Trigger).</b> This pin selects the mode of operation for the device. If set high, slave mode is selected. If set low, master mode is selected. This feature can also be controlled through software registers. This pin is internally pulled up to Vdd.
K1	diff0_en	I <sub>U</sub>	<b>Differential Output 0 Enable (LVCMOS, Schmitt Trigger).</b> When set high, the differential LVPECL output 0 driver is enabled. When set low, the differential driver is tristated reducing power consumption. This pin is internally pulled up to Vdd.
D3	diff1_en	I <sub>U</sub>	<b>Differential Output 1 Enable (LVCMOS, Schmitt Trigger).</b> When set high, the differential LVPECL output 1 driver is enabled. When set low, the differential driver is tristated reducing power consumption. This pin is internally pulled up to Vdd.
<b>Status</b>			
H1	dpll1_lock	O	<b>Lock Indicator (LVCMOS).</b> This is the lock indicator pin for DPLL1. This output goes high when DPLL1's output is frequency and phase locked to the input reference.
J1	dpll1_holdover	O	<b>Holdover Indicator (LVCMOS).</b> This pin goes high when DPLL1 enters the holdover mode.
<b>Serial Interface</b>			
E2	sck_scl	I/B	<b>Clock for Serial Interface (LVCMOS).</b> Serial interface clock. When i2c_en = 0, this pin acts as the sck pin for the serial interface. When i2c_en = 1, this pin acts as the scl pin (bidirectional) for the I <sup>2</sup> C interface.
F1	si_sda	I/B	<b>Serial Interface Input (LVCMOS).</b> Serial interface data pin. When i2c_en = 0, this pin acts as the si pin for the serial interface. When i2c_en = 1, this pin acts as the sda pin (bidirectional) for the I <sup>2</sup> C interface.
G1	so	O	<b>Serial Interface Output (LVCMOS).</b> Serial interface data output. When i2c_en = 0, this pin acts as the so pin for the serial interface. When i2c_en = 1, this pin is unused and should be left unconnected.
E3	cs_b_ase0	I <sub>U</sub>	<b>Chip Select/Address Select 0 for the Serial Interface (LVCMOS).</b> Serial interface chip select. When i2c_en = 0, this pin acts as the cs pin (active low) for the serial interface. When i2c_en = 1, this pin acts as the ase0 pin for the I <sup>2</sup> C interface.

Pin #	Name	I/O Type	Description
G2	int_b	O	<b>Interrupt Pin (LVCMOS).</b> Indicates a change of device status prompting the processor to read the enabled interrupt service registers (ISR). This pin is an open drain, active low and requires an external pulled up to VDD.
J2	i2c_en	I <sub>u</sub>	<b>I<sup>2</sup>C Interface Enable (LVCMOS).</b> If set high, the I <sup>2</sup> C interface is enabled, if set low, the SPI interface is enabled. Internally pull-up to Vdd.
<b>APLL Loop Filter</b>			
A6	apll_filter	A	<b>External Analog PLL Loop Filter terminal.</b>
B6	filter_ref0	A	<b>Analog PLL External Loop Filter Reference.</b>
C6	filter_ref1	A	<b>Analog PLL External Loop Filter Reference.</b>
<b>JTAG and Test</b>			
J4	tdo	O	<b>Test Serial Data Out (Output).</b> JTAG serial data is output on this pin on the falling edge of tck. This pin is held in high impedance state when JTAG scan is not enabled.
K2	tdi	I <sub>u</sub>	<b>Test Serial Data In (Input).</b> JTAG serial test instructions and data are shifted in on this pin. This pin is internally pulled up to Vdd. If this pin is not used then it should be left unconnected.
H4	trst_b	I <sub>u</sub>	<b>Test Reset (LVCMOS).</b> Asynchronously initializes the JTAG TAP controller by putting it in the Test-Logic-Reset state. This pin should be pulsed low on power-up to ensure that the device is in the normal functional state. This pin is internally pulled up to Vdd. If this pin is not used then it should be connected to GND.
K3	tck	I	<b>Test Clock (LVCMOS):</b> Provides the clock to the JTAG test logic. If this pin is not used then it should be pulled down to GND.
J3	tms	I <sub>u</sub>	<b>Test Mode Select (LVCMOS).</b> JTAG signal that controls the state transitions of the TAP controller. This pin is internally pulled up to V <sub>DD</sub> . If this pin is not used then it should be left unconnected.
<b>Master Clock</b>			
K4	osci	I	<b>Oscillator Master Clock Input (LVCMOS).</b> This input accepts a 20 MHz reference from a clock oscillator (TCXO, OCXO). The stability and accuracy of the clock at this input determines the free-run accuracy and the long term holdover stability of the output clocks.
K5	osco	O	<b>Oscillator Master Clock Output (LVCMOS).</b> This pin must be left unconnected when the osci pin is connected to a clock oscillator.
<b>Miscellaneous</b>			
J6	IC		<b>Internal Connection.</b> Connect to ground.
K6	IC		<b>Internal Connection.</b> Leave unconnected.
F2 F3 G3 H7	NC		<b>No Connection.</b> Leave unconnected.

Pin #	Name	I/O Type	Description
<b>Power and Ground</b>			
D9 E4 G8 G9 J8 J9 H6 H8	V <sub>DD</sub>	P P P P P P P P	<b>Positive Supply Voltage.</b> +3.3V <sub>DC</sub> nominal.
E8 F4	V <sub>CORE</sub>	P P	<b>Positive Supply Voltage.</b> +1.8V <sub>DC</sub> nominal.
A5 A8 C10	AV <sub>DD</sub>	P P P	<b>Positive Analog Supply Voltage.</b> +3.3V <sub>DC</sub> nominal.
B7 B8 H2	AV <sub>CORE</sub>	P P P	<b>Positive Analog Supply Voltage.</b> +1.8V <sub>DC</sub> nominal.
D4 D5 D6 D7 E5 E6 E7 F5 F6 F7 G4 G5 G6 G7 E9 F8 F9 H9	V <sub>SS</sub>	G G G G G G G G G G G G G G G G G G	<b>Ground.</b> 0 Volts.
A7 C7 C8 C9 D8 H3	AV <sub>SS</sub>	G G G G G G	<b>Analog Ground.</b> 0 Volts.

I - Input

I<sub>d</sub> - Input, Internally pulled downI<sub>u</sub> - Input, Internally pulled up

O - Output

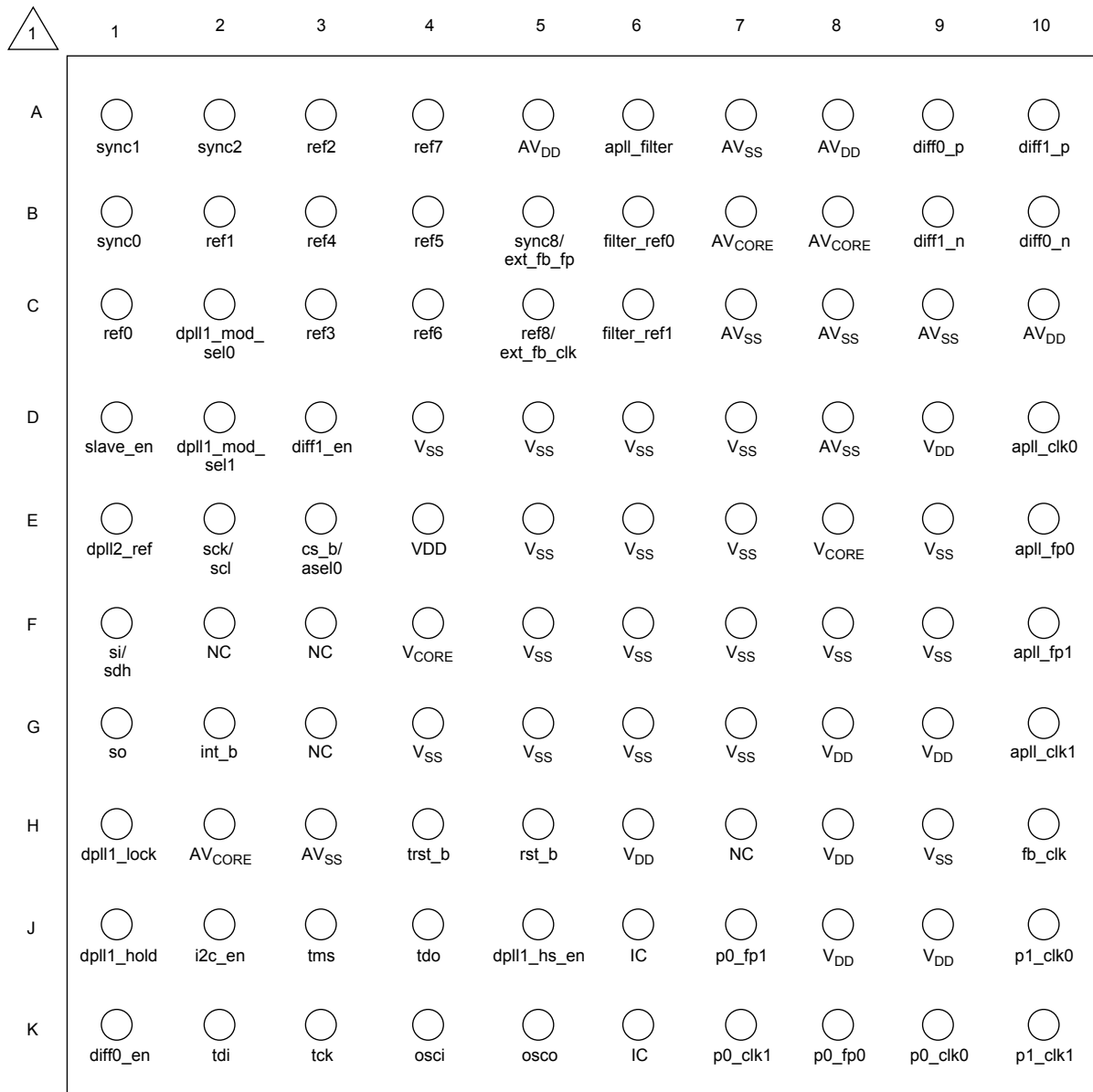
A - Analog

P - Power

G - Ground

## 1.0 Pin Diagram

### TOP VIEW



1 - A1 corner is identified with a dot.

## 2.0 Overview

The ZL30143 System Synchronizer and SETS device is a highly integrated device that provides all of the functionality that is required for a central timing card in carrier grade network equipment. The basic functions of a central timing card include:

- Input reference monitoring for both frequency accuracy and phase irregularities
- Automatic input reference selection
- Support of both external timing and line timing modes
- Hitless reference switching
- Wander and jitter filtering
- Master/slave crossover for minimizing phase alignment between redundant timing cards
- Independent derived output timing path for support of the SETS functionality

In a typical application, the main timing path uses DPPLL1 to synchronize to either an external BITS source or to a recovered line timed source. DPPLL1 monitors all references and automatically selects the best available reference based on configurable priority and revertive properties. DPPLL1 provides the wander filtering function and the P0 synthesizer generates a jitter filtered clock and frame pulse for the system timing bus which supplies all line cards with a common timing reference. The APPLL is used to generate a reference clock for an Ethernet PHY which can be used to synchronize remote equipment. A derived output timing path using DPPLL2 is available to support the SETS function. In this case DPPLL2 uses a filter above 10 Hz to prevent it from filtering wander.

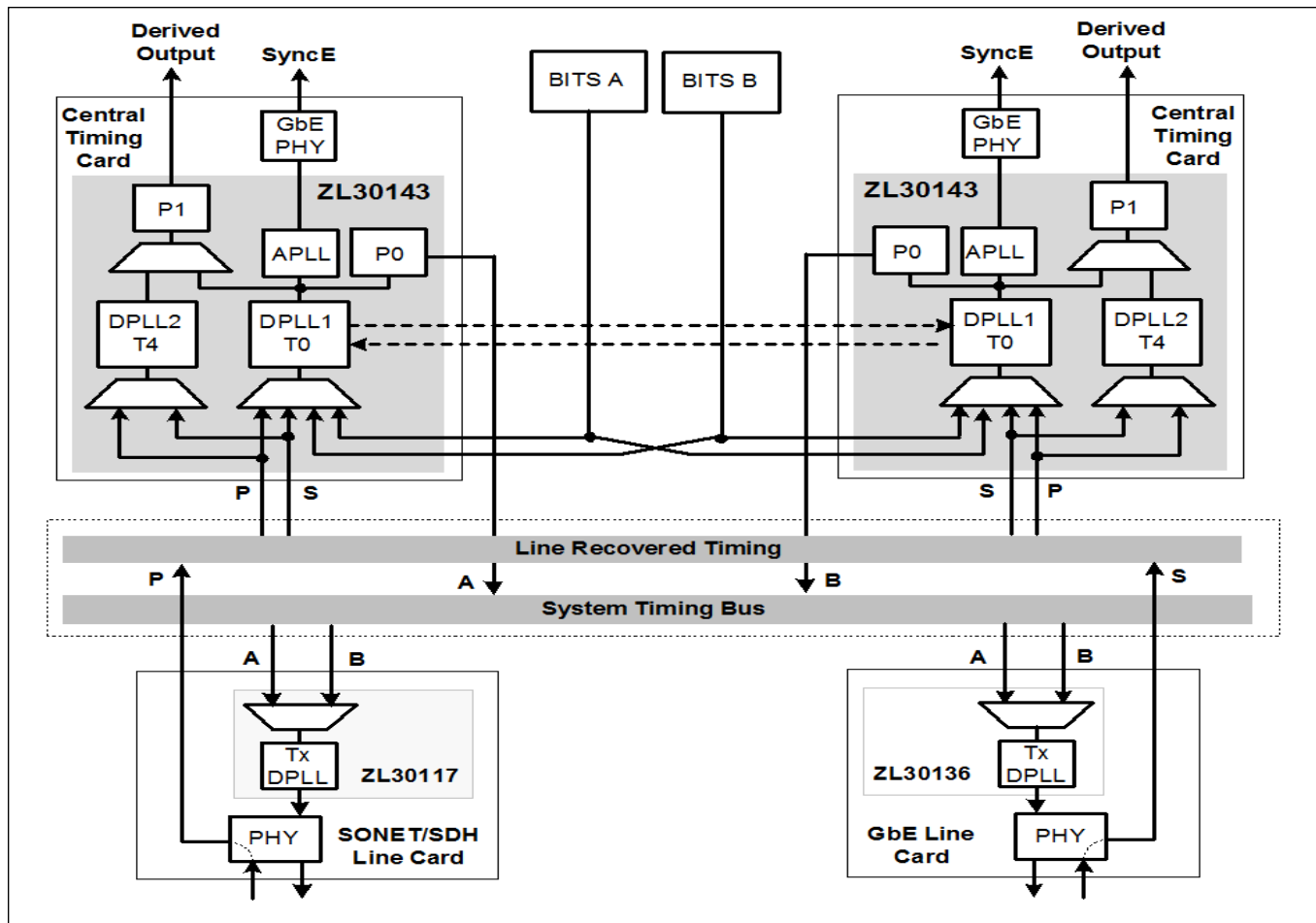


Figure 2 - Typical Application of the ZL30143

Alternatively, the ZL30143 could be used in systems that were not designed with central timing cards in mind. In this case, the ZL30143 provides all of the features required to meet both the timing card and the line card functions in one package. This application is shown in Figure 3. DPLL1 recovers the reference clock from the backplane and filters wander. The APLL and the P0 synthesizer filter jitter and generate transmit clocks for a SONET/SDH/10GbE PHY (up to OC-48/STM-16) and/or a PDH PHY (T1/E1, DS3/E3, etc). DPLL2 is used to recover the line timing reference, filter jitter, and translate its frequency to the rate required by the backplane.

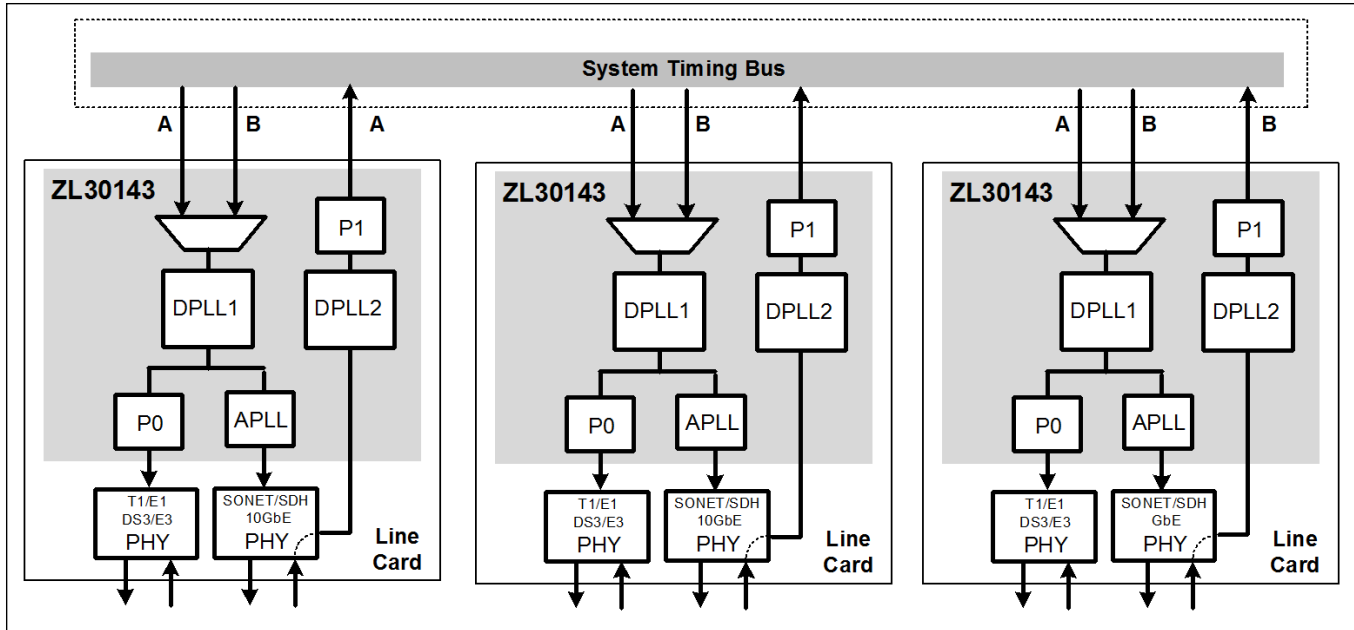


Figure 3 - The ZL30143 as a Timing Card and a Line Card Device

## 2.1 DPLL Features

The ZL30143 provides two independently controlled Digital Phase-Locked Loops (DPLL1, DPLL2) for clock and/or frame pulse synchronization. Table 1 shows a feature summary for both DPLLs.

Feature	DPLL1	DPLL2
Modes of Operation	Free-run, Normal (locked), Holdover, ToP (Timing over Packet) Client Mode	Free-run, Normal (locked), Holdover
Loop Bandwidth (BW)	User selectable: 0.1 Hz, 1.7 Hz, 3.5 Hz, fast lock (7 Hz), 14 Hz, 28 Hz <sup>1</sup> , or wideband <sup>2</sup> (890 Hz / 56 Hz / 14 Hz)	Fixed: 14 Hz
Lock Time	< 60 s for 0.1 Hz, 1.7 Hz, 3.5 Hz BW < 10 s for all other BW (PSL = 885 ns/s) < 1 s for all other BW (PSL = 7.5 $\mu$ s/s, 61 $\mu$ s/s, or unlimited)	< 1 s (fixed 14 Hz BW)
Phase Slope Limiting	User selectable: 885 ns/s, 7.5 $\mu$ s/s, 61 $\mu$ s/s, or unlimited	User selectable: 61 $\mu$ s/s, or unlimited
Pull-in Range	User selectable: 12 ppm, 52 ppm, 83 ppm, 130 ppm	Fixed: 130 ppm
Holdover Parameters	Selectable Update Times: 26 ms, 1 s, 10 s, 60 s, and Selectable Holdover Post Filter BW: 18 mHz, 0.6 Hz, 10 Hz.	Fixed Update Time: 26 ms No Holdover Post Filtering
Holdover Frequency Accuracy	Better than 1 ppb (Stratum 3E) initial frequency offset. Frequency drift depends on the 20 MHz external oscillator (OCXO or TCXO).	Better than 50 ppb (Stratum 3) initial frequency offset. Frequency drift depends on the 20 MHz external oscillator.
Reference Inputs	Ref0 to Ref8	Ref0 to Ref8
Sync Inputs	Sync0, Sync1, Sync2, Sync8	Sync inputs are not supported.
Input Reference Selection/Switching	Automatic (based on programmable priority and revertiveness), or manual	Automatic (based on programmable priority and revertiveness), or manual
Hitless Ref Switching	Can be enabled or disabled	Can be enabled or disabled
External Status Pin Indicators	Lock, Holdover	None

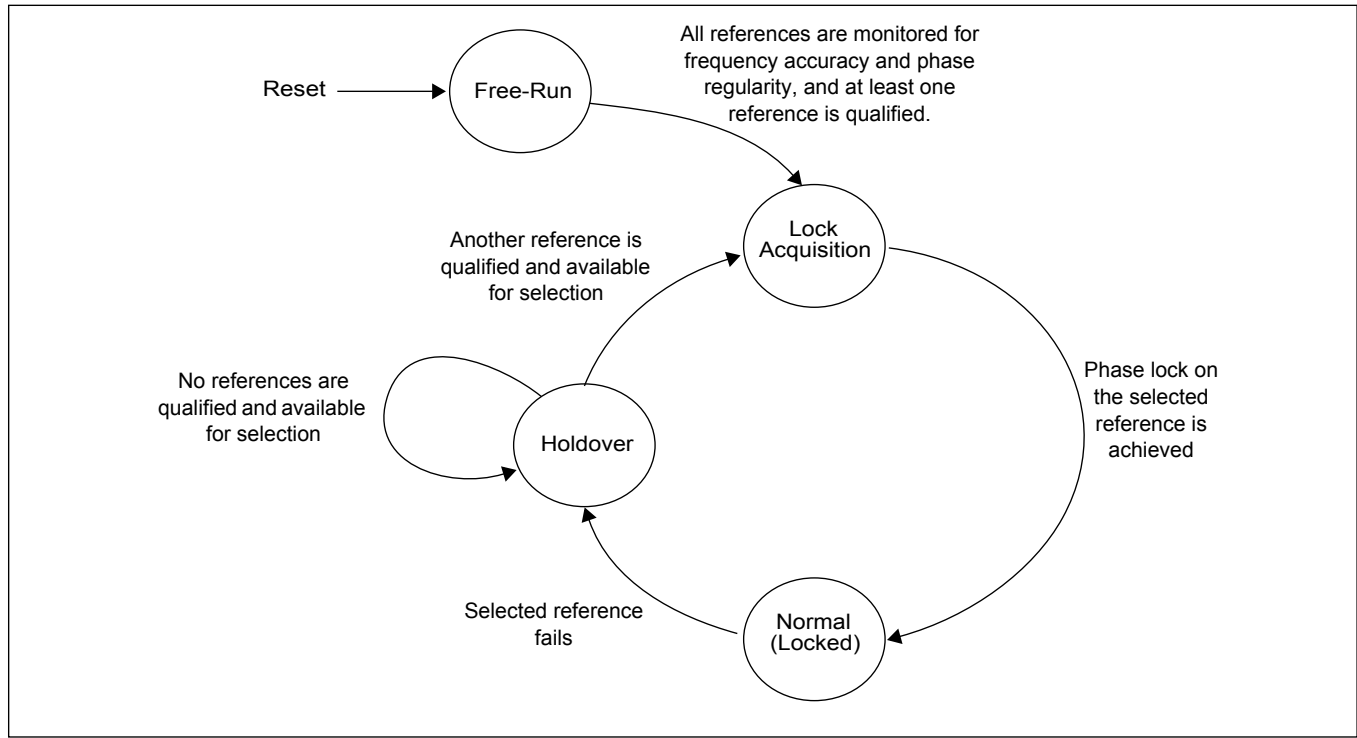
**Table 1 - DPLL1 and DPLL2 Features**

1. Limited to 14 Hz for 2 kHz references)

2. In the wideband mode, the loop bandwidth depends on the frequency of the reference input. For reference frequencies greater than 8 kHz, the loop bandwidth = 890 Hz. For reference frequencies equal to 8 kHz, the loop bandwidth = 56 Hz. The loop bandwidth is equal to 14 Hz for reference frequencies of 2 kHz.

## 2.2 DPLL Mode Control

Both DPLL1 and DPLL2 independently support three modes of operation - free-run, normal, and holdover. The mode of operation can be manually set or controlled by an automatic state machine as shown in Figure 4.



**Figure 4 - Automatic Mode State Machine**

### Free-run

The free-run mode occurs immediately after a reset cycle or when the DPLL has never been synchronized to a reference input. In this mode, the frequency accuracy of the output clocks is equal to the frequency accuracy of the external master oscillator.

### Lock Acquisition

The input references are continuously monitored for frequency accuracy and phase regularity. If at least one of the input references is qualified by the reference monitors, then the DPLL will begin lock acquisition on that input. Given a stable reference input, the ZL30143 will enter in the Normal (locked) mode.

### Normal (locked)

The usual mode of operation for the DPLL is the normal mode where the DPLL phase locks to a selected qualified reference input and generates output clocks and frame pulses with a frequency accuracy equal to the frequency accuracy of the reference input. While in the normal mode, the DPLL's clock and frame pulse outputs comply with the MTIE and TDEV wander generation specifications as described in Telcordia and ITU-T telecommunication standards.

### Holdover

When the DPLL operating in the normal mode loses its reference input, and no other qualified references are available, it will enter the holdover mode and continue to generate output clocks based on historical frequency data collected while the DPLL was synchronized. The transition between normal and holdover modes is controlled by the DPLL so that its initial frequency offset is better than 1 ppb which meets the requirement of Stratum 3E. The frequency drift after this transition period is dependant on the frequency drift of the external master oscillator.



### 2.2.1 DPLL1 Mode Of Operation

During reset, the level on the **dpll1\_mod\_sel1:0** pins determine the default start-up mode of operation for DPLL1. Table 2 shows the settings for these pins. When left unconnected, the default mode of operation will be set to automatic normal mode. The selected value is reflected in the *dpll1\_modesel* register (0x1F).

After reset, the mode of operation can be controlled by software using the *dpll1\_modesel* register (0x1F), or it can be controlled using the **dpll1\_mod\_sel1:0** pins by setting the *dpll1\_mode\_hsw* bit of the *use\_hw\_ctrl* register (0x01) to 1.

dpll1_mod_sel1:0		Function
1	0	
0	0	Set the default mode of operation to <b>Manual Normal Mode</b> . In this mode, automatic reference switching is disabled and the selected reference is determined by the <i>dpll1_refsel</i> register (0x20). If the selected reference fails, the device automatically enters the holdover mode.
0	1	Set the default state of operation to <b>Manual Holdover Mode</b> . In this mode, automatic reference switching is disabled and DPLL1 stays in the holdover mode.
1	0	Set the default state to <b>Manual Freerun Mode</b> . In this mode, automatic reference switching is disabled and DPLL1 stays in the free-run mode.
1	1	Set the default state to <b>Automatic Normal Mode</b> . In this mode, automatic reference switching is enabled so that DPLL1 automatically selects the highest priority qualified reference. If that reference fails, an automatic reference switchover to the next highest priority and qualified reference is initiated. If there are no suitable references for selection, DPLL1 will stay in free-run or enter the holdover state.

**Table 2 - DPLL1 Default Mode Selection**

#### 2.2.1.1 ToP (Timing over Packet) Client Mode

In software control mode the ZL30143 can also be set in Timing over Packet (ToP) Client Mode using the *dpll1\_modesel* register (0x1F).

ToP Client mode allows external software to control DCO frequency offset of DPLL1 using the 28 bit 2's complement value in the *DCO\_freq\_offset* registers (page 1, addresses 0x65 to 0x68). The offset is programmed in steps according to the following equation.

$$\text{LSB} = 2^{-40} * (80\text{MHz}/65,536\text{MHz}) * 10^9 \text{ppb}$$

In ToP client mode, the ZL30143 also samples the DCO Phase Word and Local System time to be read by the ToP clock recovery algorithm software.

The 64 bit DCO phase Word is available in the *DCO\_Phase* registers (page 1, address 0x69 to 0x70). The 32 bit Local System Time is available in the *Local Time* registers (page 1, address 0x71 to 0x74)

For more details contact your local Microsemi FAE.

### 2.2.2 DPLL2 Mode of Operation

The mode of operation for DPLL2 can only be controlled in software using the *dpll2\_modesel* register (0x2C). By default, its mode of operation is set to Free Run.

### 2.3 Loop Bandwidth

The loop bandwidth determines the amount of wander and jitter filtering that is provided by the DPLL. The loop bandwidth for DPLL1 is programmable using the *bandwidth* field of the *dpll1\_control\_register\_0* register (0x1D). The bandwidth should be set according to the application. Table 3 gives examples of typical applications and their bandwidth settings. DPLL2's loop bandwidth is not programmable and is fixed at 14 Hz.

bandwidth[3:1]	BW (Hz)	Application
000	0.1	GR-253 SONET Stratum 3, SMC, G.813 option 2, G.8262 EEC 2
001	1.7	GR-1244 Stratum 3, G.813 option 1
010	3.5	G.813 option 1, G.8262 EEC 1
101	14/56/890	Wide Band Mode. BW depends on input frequency.
110	7	Fast Lock
111		Reserved

**Table 3 - DPLL1 Loop Bandwidth**

### 2.4 Pull-in/hold-in Range

The **pull-in range** defines the maximum input frequency range that the DPLL can lock to. The pull-in range for DPLL1 is programmable using the *dpll1\_pull\_in\_range* register (0x29). The pull-in range should be set according to the application as shown in Table 4. The **hold-in range**, which defines the range of input frequencies that the PLL will continue to lock to, is equal to the pull-in range. The pull-in/hold-in range for DPLL2 is fixed at +/-130 ppm.

pull_in_range[1:0]	+/- ppm	Application
00	12	Stratum 3, G.813 option 1, G.8262 EEC 1 & 2
01	52	SONET Minimum Clock, G.813 option 2
10	130	ITU-T G.703, ETSI ETS 300 011
11	83	ANSI T1.403, Stratum 4

**Table 4 - DPLL1 Pull-in Range**

### 2.5 Phase Slope Limiting

DPLL1 offers a phase slope limit feature which can be used to limit the rate of output phase movement of the output clocks and frame pulses during an input transient. This feature is used for meeting the phase slope requirements of Telcordia and ITU-T standards. The level of phase slope limiting depends on the application. The *dpll1\_ph\_slopelim* field of the *dpll1\_ctrl\_0* register (0x1D) allows four levels of phase slope limiting as shown in Table 5. By default, the phase slope limit is unrestricted. DPLL2 also has a phase slope limiting feature which can be enabled using the *ph\_slopelim* bit of the *dpll2\_ctrl\_0* (0x2A) register. When enabled, a phase slope ANSI T1.403, Stratum 4 limit of 61  $\mu$ s/s is applied, otherwise it is unrestricted.

dpll1_ph_slopelim[1:0]	Phase Slope Limiting	Application
00	885 ns/s	GR-1244 Stratum 3 (objective)
01	7.5 $\mu$ s/s	G.813 option 1 and G.8262

**Table 5 - DPLL Phase Slope Limiting**

<b>dpll1_ph_slopelim[1:0]</b>	<b>Phase Slope Limiting</b>	<b>Application</b>
10	61 $\mu$ s/s	GR-1244 Stratum 3
11	Unrestricted (default)	
<b>dpll2_ph_slopelim</b>	<b>Phase Slope Limiting</b>	<b>Application</b>
0	61 $\mu$ s/s	GR-1244 Stratum 3
1	Unrestricted (default)	

**Table 5 - DPLL Phase Slope Limiting**

## 2.6 Hitless Reference Switching

With hitless reference switching enabled, the phase difference between the originally selected reference and the newly selected reference is absorbed by the DPLL preventing a possible non-compliant phase transient at its output. The *hs\_en* bit of the *dpll\_n\_ctrl\_0* registers (0x1D, 0x2A) allows this feature to be enabled or disabled. When disabled, the DPLL will align its output to the new reference at a rate of alignment which is dependant on the phase slope limit set in the *dpll\_ph\_slopelim* field of the *dpll\_ctrl\_0* register (0x1D).

## 2.7 Free-run Frequency Offset

When operating in Free Run mode, the accuracy of the output clocks is equal to that of the oscillator connected to the Master Clock Input (OSCI). The ZL30143 allows the user to offset this frequency by +/-149 ppm by using the 28 bit 2's complement value in the *DCO\_freq\_offset* registers (page 1, addresses 0x65, 0x66, 0x67, and 0x68). The offset is programmed in steps according to the following equation.

$$\text{LSB} = 2^{-40} * (80\text{MHz}/65,536\text{MHz}) * 10^9 \text{ppb}$$

The offset can be enabled or disabled independently for each of the two DPLLs. To enable the free run frequency offset for DPLL1 set the *freq\_offset\_en* bit of the *dpll1\_ctrl\_1* register (page 0, address 0x1E, bit 1). To enable the free run frequency offset for DPLL2 set the *freq\_offset\_en* bit of the *dpll2\_ctrl\_1* register (page 0, address 0x2B, bit 1).

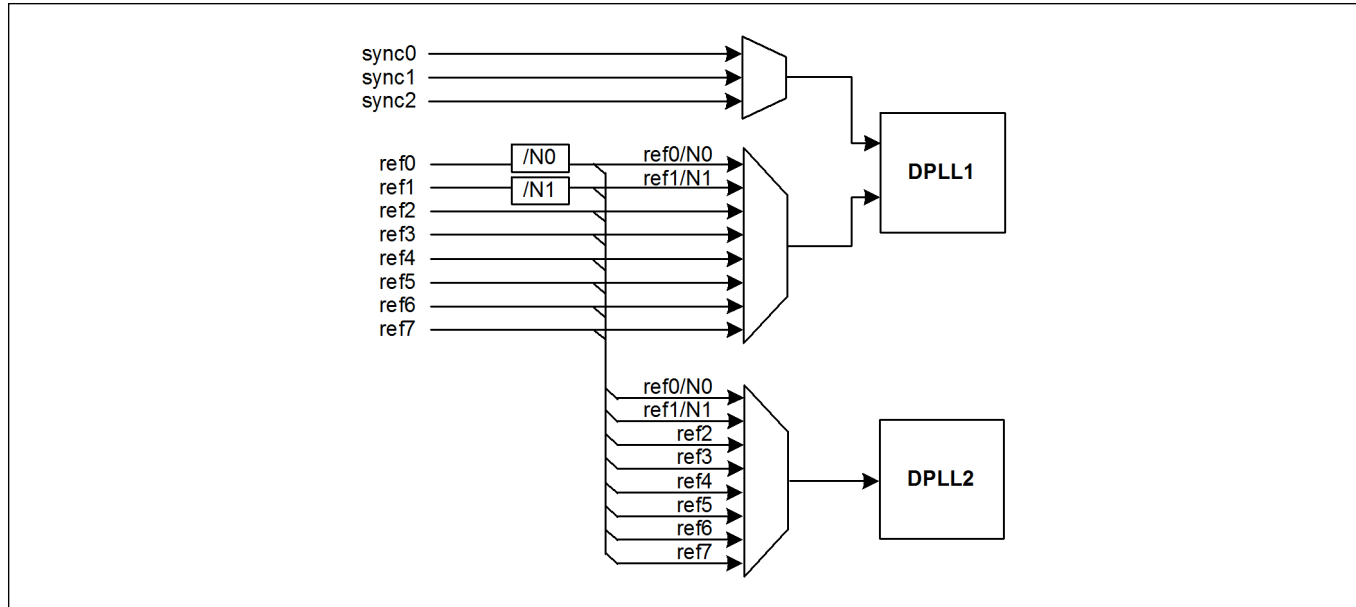
## 2.8 Holdover

The DPLLs continuously collect phase data while synchronized to a valid reference. These data samples are accumulated and averaged to determine a stable holdover frequency in the event that all of the valid references are lost. To prevent reference input jitter from corrupting the final holdover value, samples are taken on phase data filtered by the DPLL's loop bandwidth. DPLL1 offers an additional stage of filtering that can be enabled if the DPLL's loop bandwidth does not provide adequate filtering. This allows the DPLL to operate in a wide bandwidth mode and still provide an accurate holdover value. This is useful when the DPLL1 is used in a slave mode. The holdover filter bandwidth is programmable using the *hold\_filt\_bw* field of the *dpll1\_ctrl\_1* register (0x1E).

The holdover performance of the output clocks will depend on two factors. One is the initial offset of the DPLL, and the other is the frequency drift (or stability) of the external oscillator. The initial offset of the DPLL meets both Stratum 3/G.813 opt 1 and Stratum 3E/G.812 type 3 leaving the overall holdover performance dependant on the frequency drift of the external oscillator. An OCXO or TCXO is recommended for Stratum 3/G.813.

## 2.9 Reference and Sync Inputs

There are eight reference clock inputs (**ref0** to **ref7**) available to both DPLL1 and DPLL2. The selected reference input is used to synchronize the output clocks. Each of the DPLLs have independent reference selectors which can be controlled using a built-in state machine or set in a manual mode.



**Figure 5 - Reference and Sync Inputs**

Each of the **ref** inputs accept a single-ended LVCMOS clock with a frequency ranging from 2 kHz to 77.76 MHz. Built-in frequency detection circuitry automatically determines the frequency of the reference if its frequency is within the set of pre-defined frequencies as shown in Table 6. Once detected, the resulting frequency of the reference can be read from the *ref\_freq\_detected* registers (0x10 - 0x13). Two additional custom reference frequencies (Custom A and Custom B) are also programmable using the *custA\_mult* and *custB\_mult* registers (0x67, 0x68, 0x71, 0x72). These custom frequencies are programmable as 8 kHz \* N up to 77.76 MHz (where N = 1 to 9720), or 2 kHz (when N = 0). The *ref\_freq\_mode\_0* register (0x65) are used to configure each of the reference inputs as auto-detect, custom A, or custom B.

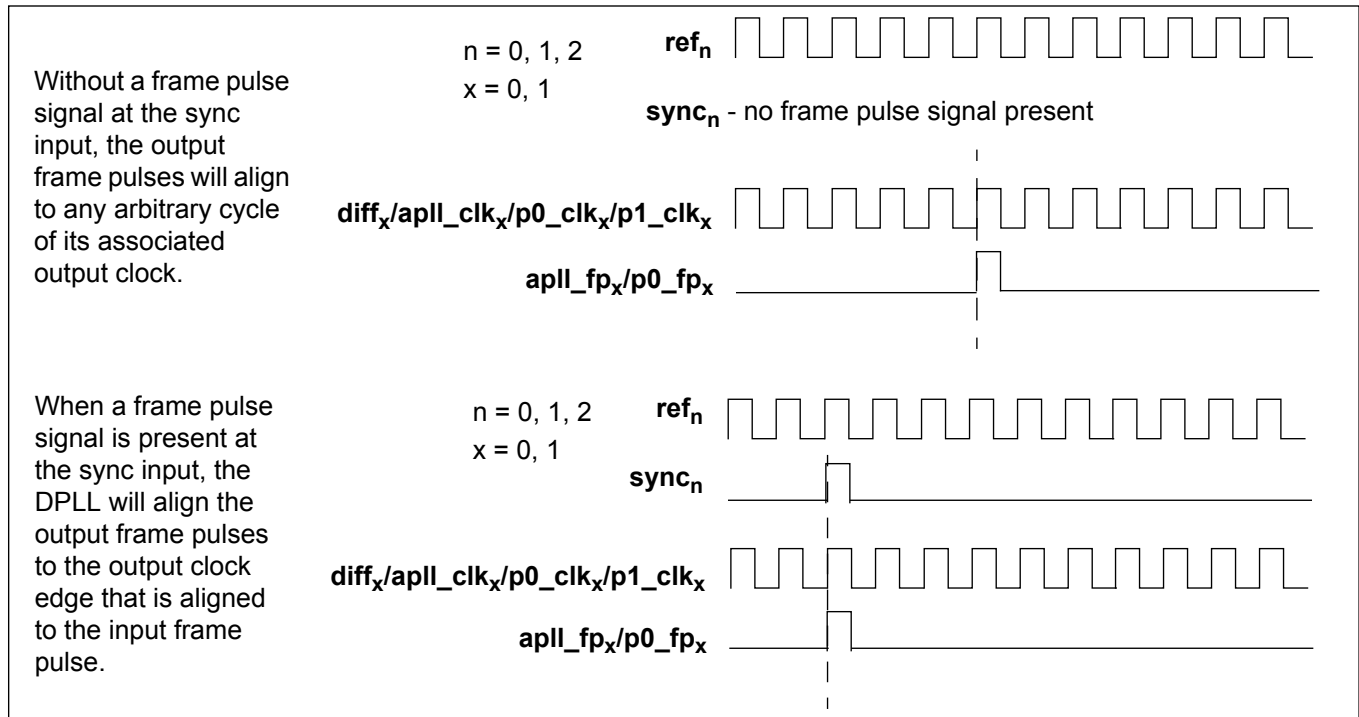
2 kHz	16.384 MHz
8 kHz	19.44 MHz
64 kHz	38.88 MHz
1.544 MHz	77.76 MHz
2.048 MHz	
6.48 MHz	
8.192 MHz	

**Table 6 - Set of Pre-Defined Auto-Detect Clock Frequencies**

The first two reference inputs (**ref0** and **ref1**) have programmable pre-dividers which allows them to lock to frequencies higher than 77.76 MHz or to non-standard frequencies. By default the pre-dividers divide by 1, but they can be programmed to divide by 1.5, 2, 2.5, 3, 4, 5, 6, 7, and 8 using the *ref0\_div* and *ref1\_div* bits of the *predivider\_control* register (0x7E). For example, an input frequency of 125 MHz can be divided down by 5 using the pre-dividers to create a 25 MHz input reference. The 25 MHz can then be programmed as a custom input frequency. Similarly, a 62.5 MHz input clock can be divided by 2.5 to create 25 MHz. **Note that division by non-integer values (e.g., 1.5, 2.5) is achieved by using both the rising and falling edges of the input reference.**

This may cause higher jitter levels at the output clocks when the reference input does not have a 50% duty cycle.

In addition to the reference inputs, DPLL1 has three optional frame pulse synchronization inputs (**sync0** to **sync2**) used to align the output frame pulses. The **sync<sub>n</sub>** input is selected with its corresponding **ref<sub>n</sub>** input, where  $n = 0, 1, 2$ . Note that the sync input cannot be used to synchronize the DPLL, it only determines the alignment of the frame pulse outputs. An example of output frame pulse alignment is shown in Figure 6.



**Figure 6 - Output Frame Pulse Alignment**

Each of the **sync** inputs accept a single-ended LVCMOS frame pulse. Since alignment is determined from the rising edge of the frame pulse, there is no duty cycle restriction on this input, but there is a minimum pulse width requirement of 5 ns. Frequency detection for the sync inputs is automatic for the supported frame pulse frequencies shown in Table 7.

1 Hz <sup>1</sup>
166.67 Hz (48x 125 $\mu$ s frames)
400 Hz
1 kHz
2 kHz
8 kHz
64 kHz

1. Bit 0 of 1Hz\_Enable Register (08\_0x71) must be set to 1 for 1Hz detection

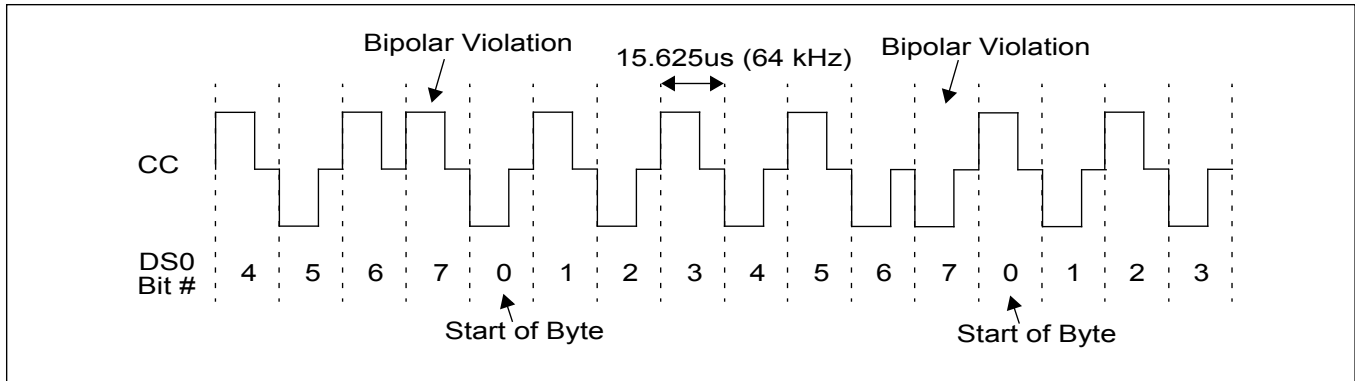
**Table 7 - Set of Pre-Defined Auto-Detect Sync Frequencies**

Each of the **sync** inputs can be enabled or disabled using the **sync\_en** bits of the **sync\_enable** register (08\_0x68). By default all sync inputs are enabled so that DPLL1 generates frame aligned frame pulse outputs when a frame pulse is available at the selected sync input. It is also possible to invert the sync inputs using the **sync\_inv** bits of the **sync\_enable** register (08\_0x68).

An additional 9<sup>th</sup> input clock and sync reference (**ref8** and **sync8**) is also available. Refer to the “9th Input Reference (Ref8/Sync8)” section on page 31 for more details.

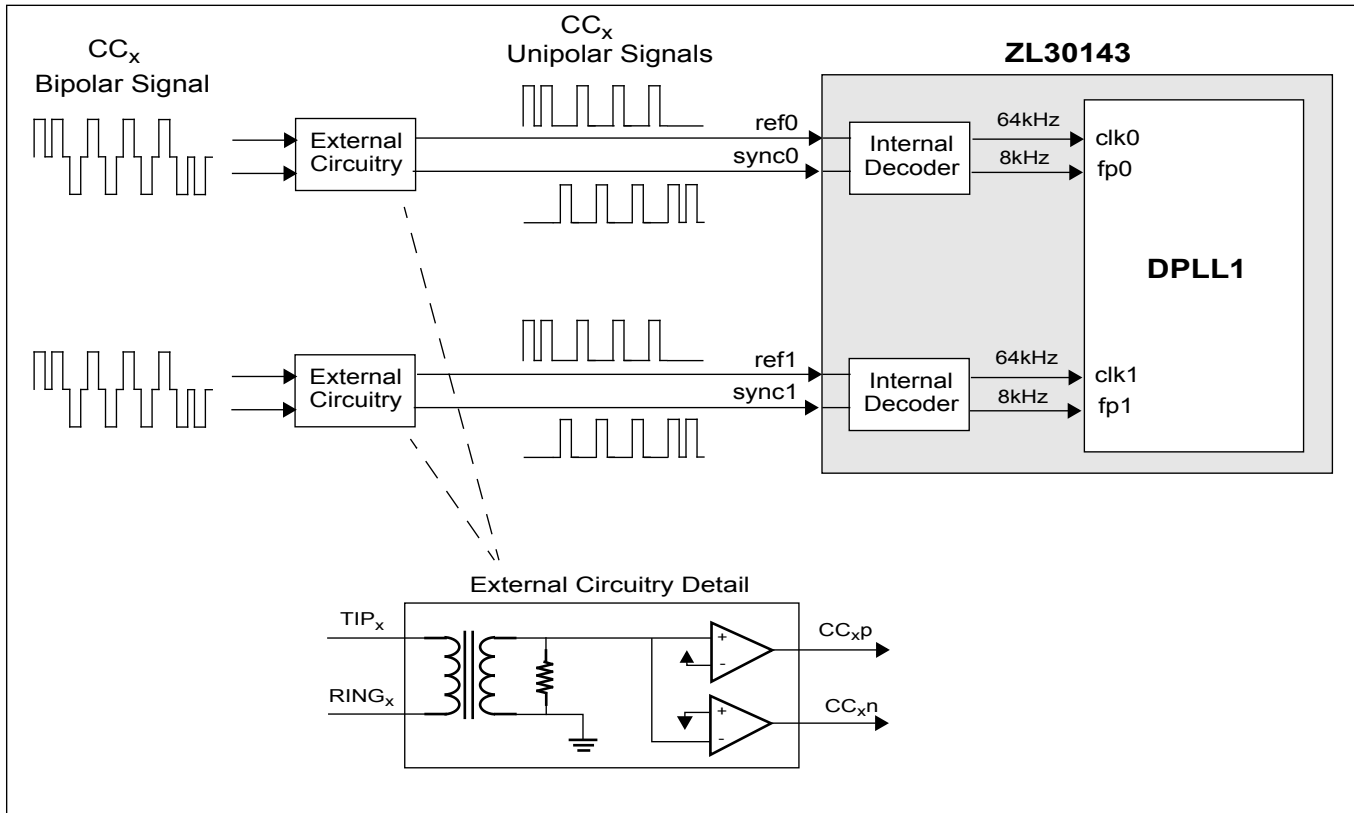
### 2.9.1 Receiving Composite Clocks

The composite clock (CC) is a timing signal that provides both phase (bit/byte alignment) and frequency synchronization for SONET/SDH network elements. The CC signal is a 64 kHz, 5/8 duty cycle, return-to-zero, bipolar signal with bipolar violation (BPV) every 8<sup>th</sup> bit. The format of the CC signal is shown in Figure 7. Bit synchronization is achieved on the trailing edge of the 64 kHz CC signal, byte synchronization is indicated on the occurrence of the 8 kHz BPV. Specifications for the CC signal are covered in Telcordia GR-378 and ITU-T G.703.



**Figure 7 - GR-378/G.703 Composite Clock Format**

The ZL30143 provides internal decoding logic necessary for extracting the 64 kHz reference clock and the 8 kHz frame pulse from the CC signal. It is capable of receiving two CC references using existing ref/sync input pins. One CC signal is received on the ref0/sync0 pins, and the other on the ref1/sync1 pins. Before interfacing the bipolar CC signal to the ref/sync pair, it must be separated into two unipolar signals using a simple external circuit as shown in Figure 8.

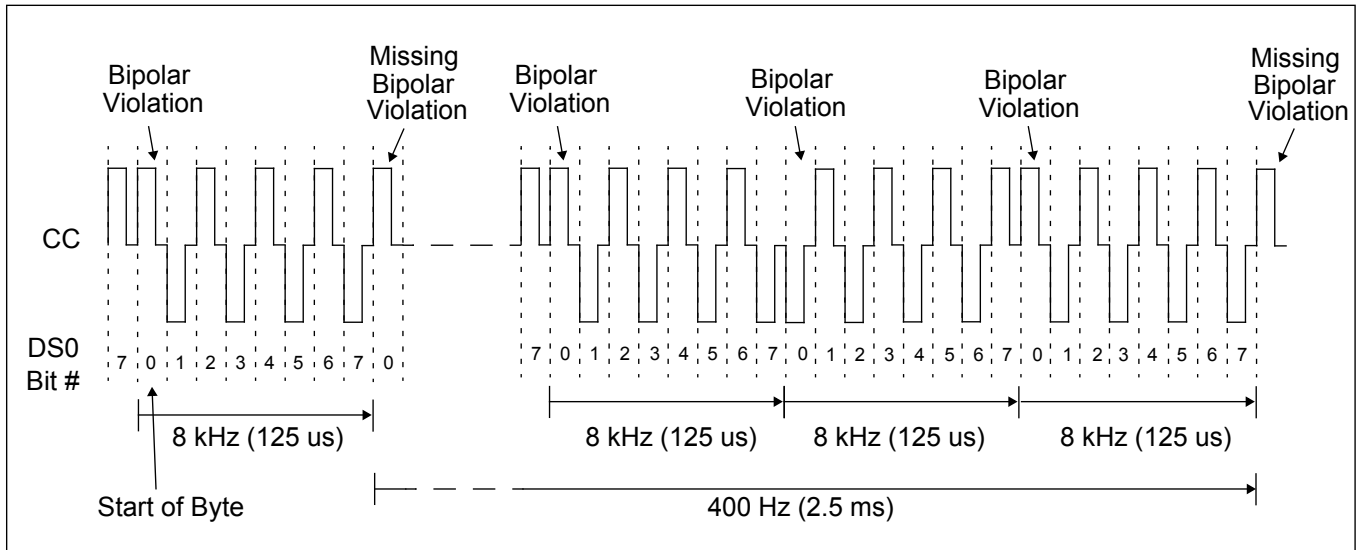


**Figure 8 - External Circuit for Converting a Bipolar CC Signal into Two Unipolar Signals**

By default a ref/sync pair accepts a normal clock and optional frame pulse signal. Enabling a ref/sync pair to accept a unipolar CC signal requires modification of the *cc\_ref0\_ctrl (0x7B)* and/or the *cc\_ref1\_ctrl (0x7C)* registers. The *ref0\_cc\_mode* and the *ref1\_cc\_mode* bits of these registers control when the composite clock mode is enabled.

When the composite clock mode is selected, the output clocks locked to DPLL1 will be synchronous with the 64 kHz clock rate of the selected CC signal. The frame pulse output can be made to align with the 8 kHz BPV by modifying the *ref0\_cc\_fp\_sel* and *ref1\_cc\_fp\_sel* register bits of the *cc\_ref0\_ctrl (0x7B)* and *cc\_ref1\_ctrl (0x7C)* registers. Set these control bits to "select 8 kHz" if frame pulse alignment to the 8 kHz BPV is desired, otherwise leave it as default where the frame pulse outputs have arbitrary alignment to the 8 kHz BPV.

Another form of the CC signal (mainly used in Japan) is shown in Figure 9. Its format is similar to the CC shown in Figure 7 with the exception that the byte alignment is marked during the occurrence of the 8 kHz BPV instead of the bit after the BPV. It also provides for optional multi-frame synchronization by violating the 8 kHz bipolar violation at a 400 Hz rate. The specification for this CC signal is covered in ITU-T G.703 Appendix II.



**Figure 9 - G.703 Japanese Composite Clock (Appendix II)**

The main difference between the CC signal in Figure 7 and in Figure 9 is in the definition of byte alignment with respect to the 8 kHz BPV. Start of byte alignment in the CC signal of figure 5 occurs after the 8 kHz BPV, whereas start of byte alignment in figure 7 occurs during the 8 kHz BPV. The frame pulse outputs can be made to align with either of these CC signal formats using the *ref0\_cc\_fp\_mode* and *ref1\_cc\_fp\_mode* bits in the *cc\_ref0\_ctrl* (0x7B) and *cc\_ref1\_ctrl* (0x7C) registers.

The CC signal shown in Figure 9 has an additional 400 Hz frame indicator. It is indicated by a missing BPV every 2.5 ms. The frame pulse outputs can be made to align to the missing BPV by modifying the *ref0\_cc\_fp\_sel* and *ref1\_cc\_fp\_sel* bits of the *cc\_ref0\_ctrl* (0x7B) and *cc\_ref1\_ctrl* (0x7C) registers.

Composite clocks are monitored for bipolar violation (BPV) errors. The *ref0\_bpv\_error* or *ref1\_bpv\_error* bits of the *cc\_isr* register (0F\_0x69) are asserted whenever two PBV occur within two consecutive eight bit periods. An interrupt can be triggered in the event of a BPV error. Mask bits for the BPV error are controlled in the *cc\_isr\_mask* register (0F\_0x6A). By default these errors are masked from triggering an interrupt.

## 2.10 Reference Input Selection

Both DPLL1 and DPLL2 can independently select any of the qualified input references for synchronization. Reference selection can be automatic or manual depending on the *dpll<sub>n</sub>modesel* registers (0x1F, 0x2C). For automatic reference selection, the mode selection register must be set to the "Automatic Normal Mode" setting. For manual reference selection, set the mode selection registers to the "Manual Normal Mode".

In the case of automatic reference selection, the selection criteria is based on reference qualification, input priority, and the revertive setting. Only references that are valid can be selected by the automatic state machine. If there are no valid references available, then the DPLL will automatically enter the holdover mode. Each of the references has an assignable priority using *dp11\_ref\_pri\_ctrl* registers (0x24 to 0x27), and the input priority for DPLL2 is defined in the *dp12\_ref\_pri\_ctrl* registers (0x30 to 0x34). Any of the references can be prevented from being selected by setting their priority to "1111".

The *revert\_en* bit of the *dppll\_n\_control\_register\_1* registers (0x1E, 0x2B) controls the revertive switching option for the DPLLs. With revertive switching enabled, the highest priority reference input with a valid reference is always selected. If a reference with a higher priority becomes valid, then a reference switchover to that reference will be initiated. With non-revertive switching, the active reference will always remain selected while it is valid. If this reference becomes invalid, a reference switchover to a valid reference with the highest priority will be initiated. Note that if two or more references have been assigned the same priority, then priority will be given to the lowest



reference number (e.g., if ref4 and ref7 have the same assigned priority, then ref4 will have higher priority over ref7).

The revertive feature can also be applied to individual references using the *dp11<sub>n</sub>\_reference\_revertive\_control* registers (0x23, 0x30).

When the *dp11\_modesel* register is set to the "Manual Normal Mode", the active reference is selected using the *dp11<sub>1</sub>\_refsel* or the *dp11<sub>2</sub>\_refsel* registers (0x20, 0x2D). If the defined reference is not valid, then the DPLL will automatically enter the holdover mode.

## 2.11 Reference Monitoring

All input references (**ref0** to **ref7**) are monitored for frequency accuracy and phase regularity. New references are qualified before they can be selected as a synchronization source and qualified references are continuously monitored to ensure that they are suitable for synchronization. The process of qualifying a reference depends on four levels of monitoring.

### Single Cycle Monitor (SCM)

The SCM block measures the period of each reference clock cycle to detect phase irregularities or a missing clock edge. In general, if the measured period deviates by more than 50% from the nominal period, then an SCM failure (*scm\_fail*) is declared.

### Coarse Frequency Monitor (CFM)

The CFM block monitors the reference frequency over a measurement period of 30  $\mu$ s so that it can quickly detect large changes in frequency. A CFM failure (*cfm\_fail*) is triggered when the frequency has changed by more than 3% or approximately 30000 ppm.

### Precise Frequency Monitor (PFM)

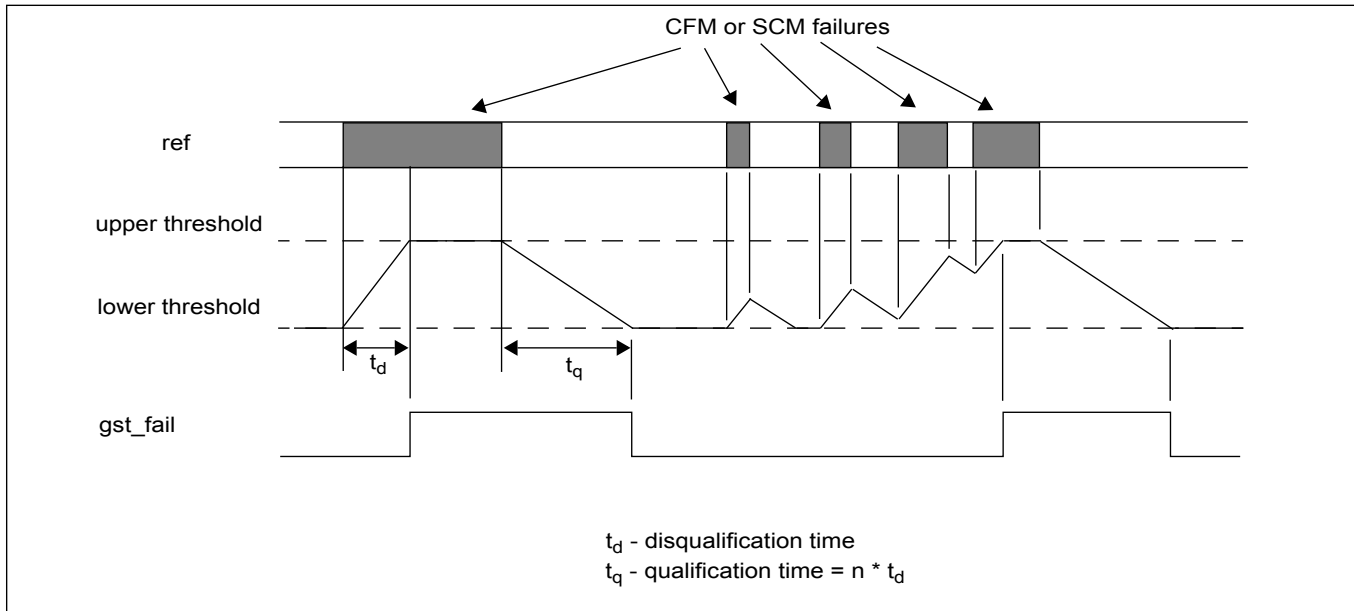
The PFM block measures the frequency accuracy of the reference over a 10 second interval. To ensure an accurate frequency measurement, the PFM measurement interval is re-initiated if phase or frequency irregularities are detected by the SCM or CFM. The PFM provides a level of hysteresis between the acceptance range and the rejection range to prevent a failure indication from toggling between valid and invalid for references that are on the edge of the acceptance range.

When determining the frequency accuracy of the reference input, the PFM uses the external oscillator's output frequency ( $f_{\text{ocsi}}$ ) as its point of reference.

### Guard Soak Timer (GST)

The GST block mimics the operation of an analog integrator by accumulating failure events from the CFM and the SCM blocks and applying a selectable rate of decay when no failures are detected.

As shown in Figure 10, a GST failure (*gst\_fail*) is triggered when the accumulated failures have reached the upper threshold during the disqualification observation window. When there are no CFM or SCM failures, the accumulator decrements until it reaches its lower threshold during the qualification window.



**Figure 10 - Behaviour of the Guard Soak Timer during CFM or SCM Failures**

#### Precise Frequency Monitor (PFM)

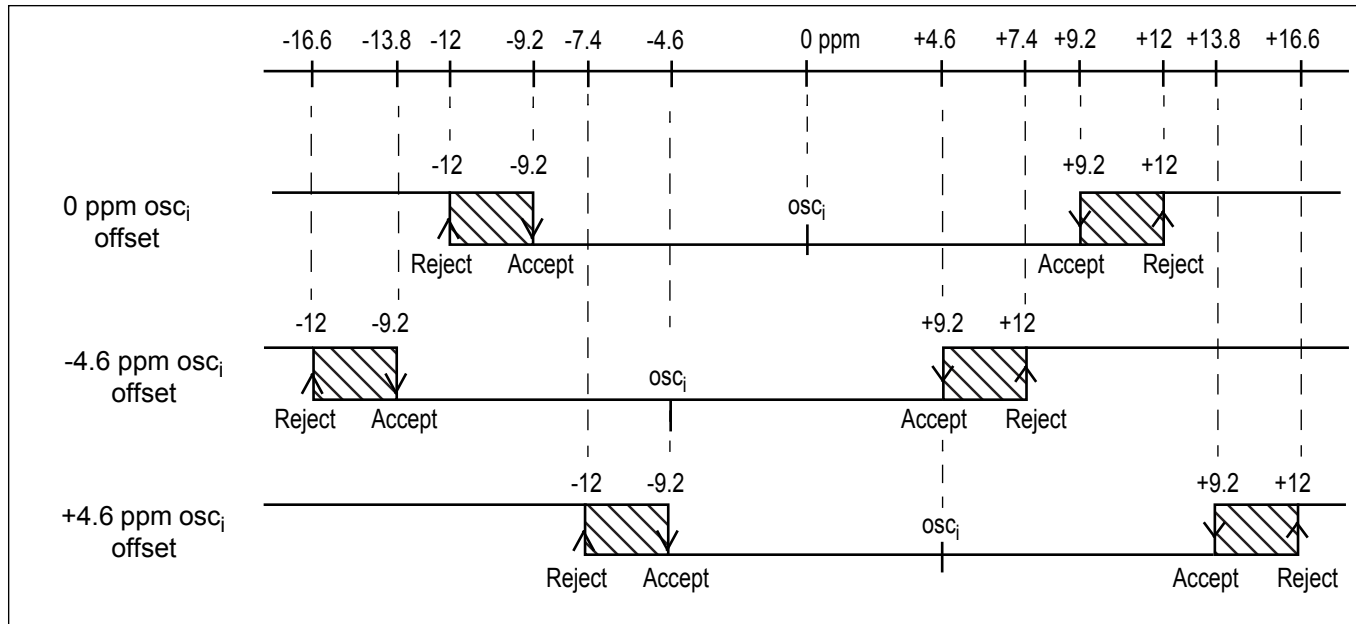
The PFM is used to keep track of the frequency of the reference clock. It measures its frequency over a 10 second period and indicates a failure when the measured frequency exceeds the out-of-range (OOR) limits configured in the `oor_ctrl[0:3]` registers (0x16 to 0x19). The OOR should be set according to the application as shown in Table 8.

oor_ctrl[0:3]	Acceptance Range	Rejection Range	Typical Application
000	+/- 9.2 ppm	+/- 12 ppm	Stratum 3, G.813 option 1, G.8262 EEC 1 & 2
100	+/- 13.8 ppm	+/- 18 ppm	
101	+/- 24.6 ppm	+/- 32 ppm	
110	+/- 36.6 ppm	+/- 47.5 ppm	
001	+/- 40 ppm	+/- 52 ppm	SONET Minimum Clock, G.813 option 2
111	+/- 52 ppm	+/- 67.5 ppm	
011	+/- 64 ppm	+/- 83 ppm	ANSI T1.403, Stratum 4
010	+/- 100 ppm	+/- 130 ppm	ITU-T G.703, ETSI ETS 300 011

**Table 8 - Frequency Out of Range Limits**

To ensure an accurate frequency measurement, the PFM measurement interval is re-initiated if phase or frequency irregularities are detected by the SCM or CFM. The PFM provides a level of hysteresis between the acceptance range and the rejection range to prevent a failure indication from toggling between valid and invalid for references that are on the edge of the acceptance range.

When determining the frequency accuracy of the reference input, the PFM uses the external oscillator's output frequency ( $f_{\text{osci}}$ ) as its point of reference. As a result, the actual acceptance and rejection frequencies can be offset with respect to the external oscillator's output frequency. This is accounted for in the acceptance and rejection requirements as described in Telcordia GR-1244 section 3.4.1. An example of the acceptance and rejection ranges for Stratum 3 application (acceptance in the range of  $\pm 9.2$  ppm, rejection at  $\pm 12$  ppm) given a  $\pm 4.6$  ppm free-run frequency accuracy of a Stratum 3 reference oscillator is shown in Figure 11.



**Figure 11 - Stratum 3/G.813 Option I Frequency Acceptance and Rejection Ranges**

SCM, CFM, PFM, and GST failures are indicated in the `ref_mon_fail` registers (0x05 to 0x08). As shown in Figure 12, the SCM, CFM, PFM, and GST indicators are logically ORed together to form a reference failure indicator. An interrupt is triggered when the failure indicator is triggered. The status of the failure indicators can be read in the `ref_fail_isr` interrupt service register (0x02). A change in the bit status of this register will cause the interrupt pin (`int_b`) to go low. It is possible to mask this interrupt with the `ref_fail_isr_mask` register (0x09) which is represented as "mask\_isr<sub>n</sub>".

It is possible to mask an individual reference monitor from triggering a reference failure by setting the `ref_mon_fail_mask_3:0` registers (0x0C - 0x0F). These are represented by mask\_scm<sub>n</sub>, mask\_cfm<sub>n</sub>, mask\_gst<sub>n</sub>, and mask\_pfm<sub>n</sub> in Figure 12. In addition, the CFM and SCM reference monitor indicators can be masked from indicating failures to the GST reference monitor using the `gst_mask1:0` registers (0x1A - 0x1B). These are represented as mask\_cfm\_gst<sub>n</sub> and mask\_scm\_gst<sub>n</sub>.

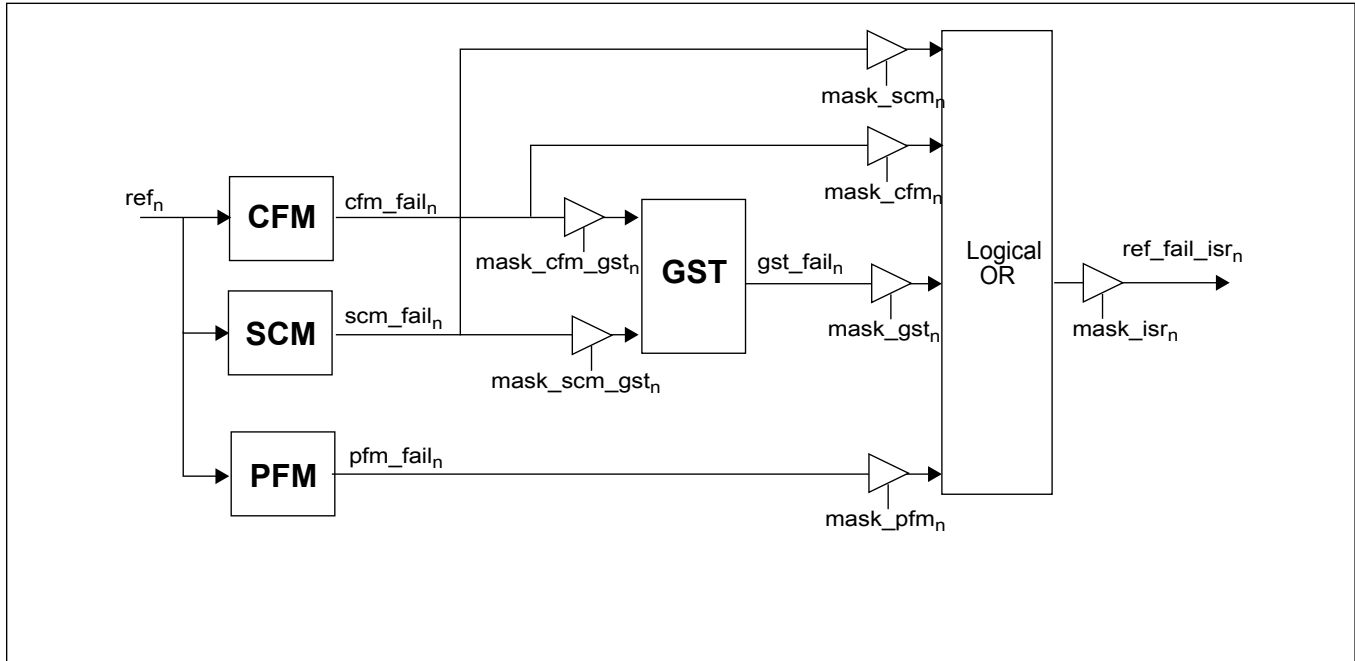


Figure 12 - Reference Monitoring Block Diagram

## 2.12 Sync Monitoring

Sync inputs (**sync0** to **sync2**) are continuously monitored by the Sync Ratio Monitor (SRM). The SRM ensures that the sync inputs are valid by verifying that there is a correct number of reference cycles within the sync period. The status of this monitor is reported in the *sync\_fail* bits of the *detected\_sync* registers (0x14, 0x15).

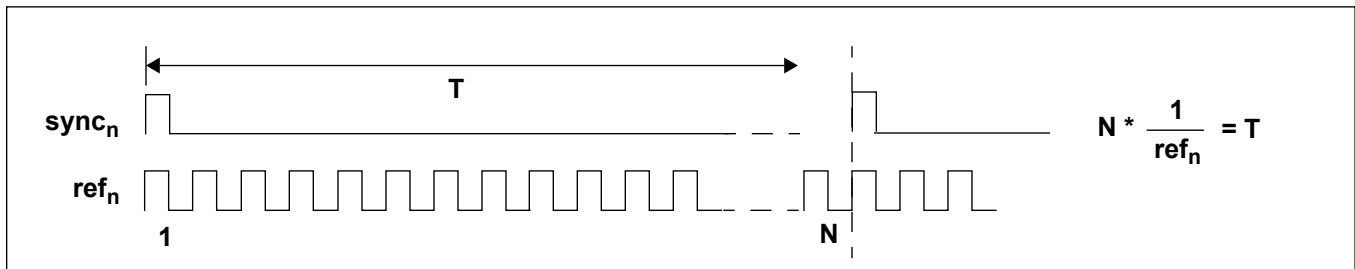
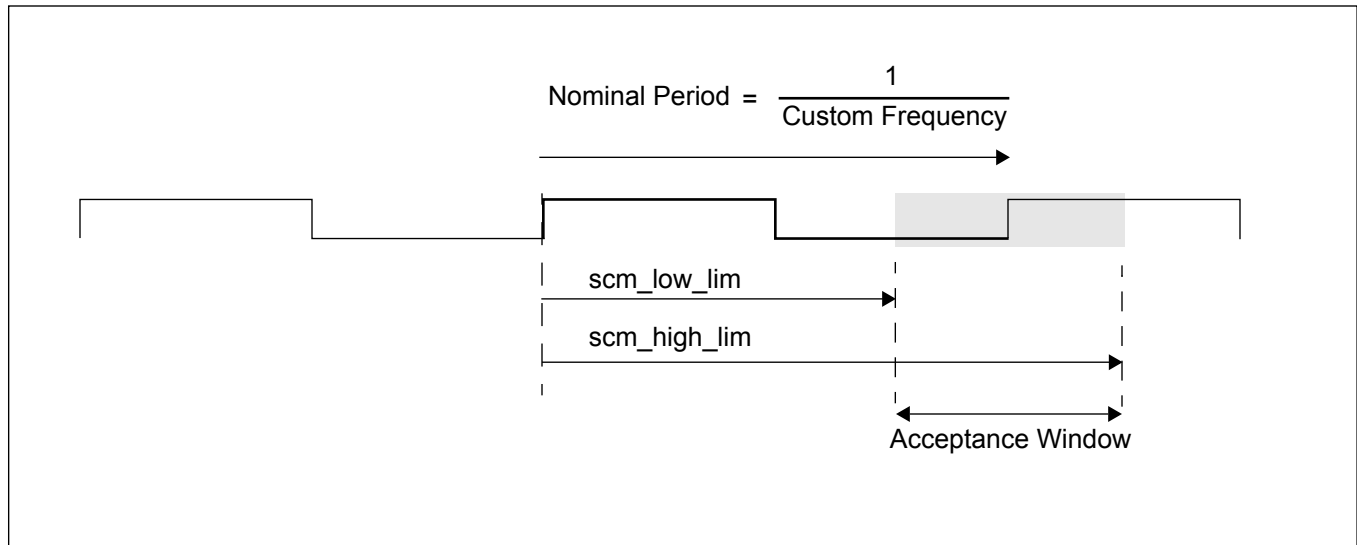


Figure 13 - Sync Monitoring

### 2.13 Reference Monitoring for Custom Configurations

As described in section 2.9, “Reference and Sync Inputs“, two additional custom reference input frequencies (Custom A, Custom B) are definable allowing a reference input to accept any multiple of 8 kHz up to 77.76 MHz.

Each of the custom configurations also have definable SCM and CFM limits. The SCM limits are programmable using the *custA\_scm\_low\_lim*, *custA\_scm\_high\_lim*, *custB\_scm\_low\_lim*, *custB\_scm\_high\_lim* registers (0x69, 0x6A, 0x73, 0x74). The SCM low and high limits determine the acceptance window for the clock period as shown in Figure 14. Any clock edge that does not fall into the acceptance window will trigger an SCM failure. High and low limits are programmed as multiples of a 300 MHz cycle (3.33 ns).



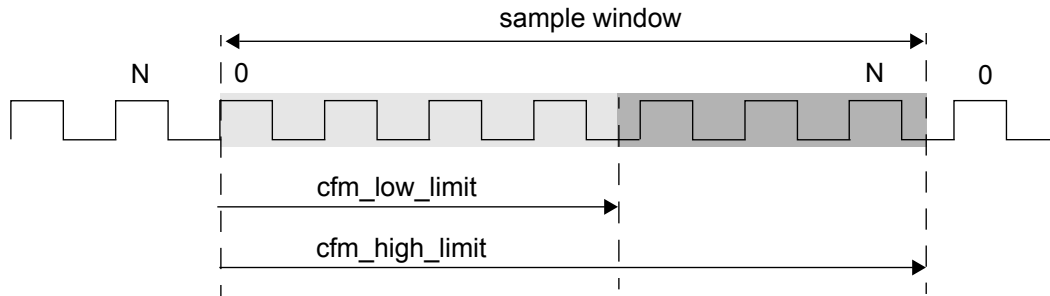
**Figure 14 - Defining SCM Limits for Custom Configurations**

Since the SCM is used to identify a missing clock edge, the acceptance window should be set to approximately +/- 50% of the nominal period. Using a smaller window may trigger unwanted SCM failures.

For example, if the Custom A frequency was defined as 25 MHz (using registers 0x67, 0x68), its nominal period is 40 ns. To fail the input reference when its period falls below 20 ns (-50% of the nominal period), the *custA\_scm\_low* register is programmed to 0x06 ( $6 \times 1/300\text{MHz} = 20\text{ ns}$ ). To fail the input reference if its period exceeds 60 ns (+50% of the nominal period), the *custA\_scm\_high* register is programmed with 0x12 ( $12 \times 1/300\text{MHz} = 60\text{ ns}$ ).

For low speed input references less than 1.8 MHz, the SCM counter does not provide enough range to reliably perform its function. Therefore for custom inputs of less than 1.8 MHz the device should set the *scm\_low\_lim* and *scm\_high\_lim* to 0 and the CFM should be used as the single cycle monitor.

The CFM quickly determines large changes in frequency by verifying that there are N amount of input reference clock cycles within a programmable sample window. The value of N is programmable in the *custA\_cfm\_cycle* and the *custB\_cfm\_cycle* registers (0x6F, 0x79). The size of the sample window is defined in terms of high and low limits and are programmed as multiples of 80 MHz cycles. These are defined using the *custA\_cfm\_low\_0*, *custA\_cfm\_low\_1*, *custA\_cfm\_high\_0*, *custA\_cfm\_high\_1*, *custB\_cfm\_low\_0*, *custB\_cfm\_low\_1*, *custB\_cfm\_high\_0*, *custB\_cfm\_high\_1* registers (0x6B-0x6E, 0x75-0x78). A divide-by-4 circuit can be enabled to increase the resolution of the sample window. This is recommended when the input reference frequency exceeds 19.44 MHz. The divide-by-4 is enabled using the *custA\_div* and *custB\_div* registers (0x70, 0x7A). Equations for calculating the high and low limits are shown in Figure 15.



$$\text{cfm\_low\_limit} = \frac{D}{\text{cust\_freq} + 3\%} \times N \times 80 \text{ MHz} \quad \text{cfm\_high\_limit} = \frac{D}{\text{cust\_freq} - 3\%} \times N \times 80 \text{ MHz}$$

where **N** and **D** are dependant on the setting of the custom frequency. Recommended values are shown in the following table:

Input Frequency Range	D (Divider)	N (Number of cycles)
38.88 MHz < freq ≤ 77.76 MHz	4	256
19.44 MHz < freq ≤ 38.88 MHz	4	128
8.192 MHz < freq ≤ 19.44 MHz	1	256
2.048 MHz < freq ≤ 8.192 MHz	1	128
1.8 Mhz < freq ≤ 2.048 MHz	1	32
2 kHz < freq ≤ 1.8 MHz (Recommended CFM limits = +/- 50%)	1	1

**Example:** Custom configuration A is set for 25 MHz (*custA\_mult13\_8* = 0x0C, *custA\_mult7\_0* = 0x35)  
(0C35<sub>hex</sub> = 3125<sub>dec</sub>, 3125 x 8 kHz = 25 MHz)

The values for D and N are determined using the table above with respect to a 25 MHz input reference.

D = 4 (*custA\_div* = 0x01)  
N = 128 (*custA\_cfm\_cycle* = 0x7F)

The CFM low and high values are calculated using the equations above:

$$\text{cfm\_low\_limit} = \frac{4}{25.75 \text{ MHz}} \times 128 \times 80 \text{ MHz} = 1591_{\text{dec}} = 0637_{\text{hex}} \quad (\text{custA\_cfm\_low15\_8} = 0x06) \\ (\text{custA\_cfm\_low7\_0} = 0x37)$$

$$\text{cfm\_high\_limit} = \frac{4}{24.25 \text{ MHz}} \times 128 \times 80 \text{ MHz} = 1689_{\text{dec}} = 0699_{\text{hex}} \quad (\text{custA\_cfm\_high15\_8} = 0x06) \\ (\text{custA\_cfm\_high7\_0} = 0x99)$$

**Figure 15 - Custom CFM Configuration for 25 MHz**

## 2.14 9<sup>th</sup> Input Reference (Ref8/Sync8)

The ZL30143 provides an additional reference clock and frame pulse input (**ref8** and **sync8**) for applications that require nine references. This ninth input reference uses the same pins as the external feedback pins (**ext\_fb\_clk**, **ext\_fb\_fp**). They can be configured as either a **ref8/sync8** pair or an **ext\_fb\_clk/ext\_fb\_fp** pair. By default they are configured as ref8/sync8, but they can be changed to ext\_fb\_clk/ext\_fb\_fp using the *fb\_ref8\_sync8\_ctrl* bit of the *fb\_control* register (0x62).

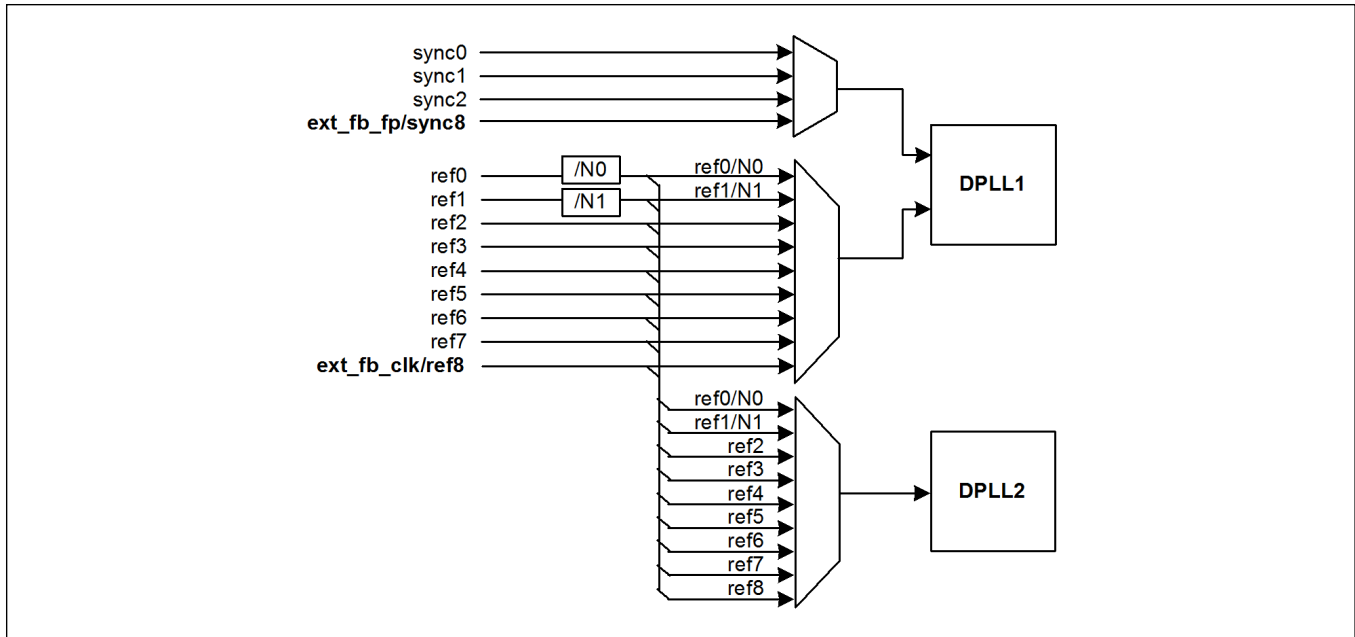


Figure 16 - Reference and Sync Inputs

All of the control, monitoring and status features for ref7:0 and sync2:0 are also available for **ref8** and **sync8**. Table 9 provides a list of the registers available for controlling and getting status from ref8 and sync8.

Function	Register		Bit Field
	Name	Address	
Select ref8/sync8 or ext_fb_clk/ext_fb_fp	<i>fb_control</i>	0x62	<i>fb_ref8_sync8_ctrl</i>
Ref8 automatic state machine reference selection priority for DPLL1	<i>dpll1_ref_pri_ctrl_4</i>	08_0x6E	ref8_priority
Ref8 automatic state machine reference selection priority for DPLL2	<i>dpll2_ref_pri_ctrl_4</i>	08_0x70	ref8_priority
Ref8 failure status indicator	<i>ref_fail_isr_1</i>	0F_0x65	<i>ref8_fail</i>
Ref8 auto frequency detect	<i>detected_ref_4</i>	08_0x69	ref8_frq_detected
Ref8 out-of-range	<i>oor_ctrl_4</i>	08_0x6A	ref8_oor_sel
Ref8 mask to inhibit CFM and SCM from affecting the GST monitor	<i>gst_mask_2</i>	08_0x6B	<i>ref8_gst_mask</i>
Ref8 frequency detect mode: Auto detect, CustomA, CustomB	<i>ref_freq_mode_2</i>	08_0x6C	<i>ref8_freq_mode</i>
Ref8_scm_failed	<i>ref_mon_fail_4</i>	0F_0x66	<i>ref8_scm_failed</i>
Ref8_cfm_failed	<i>ref_mon_fail_4</i>	0F_0x66	<i>ref8_cfm_failed</i>
Ref8_gst_failed	<i>ref_mon_fail_4</i>	0F_0x66	<i>ref8_gst_failed</i>
Ref8_pfm_failed	<i>ref_mon_fail_4</i>	0F_0x66	<i>ref8_pfm_failed</i>
Ref8 interrupt service register mask	<i>ref_fail_isr_mask_1</i>	0F_0x67	<i>ref8_fail_isr_mask</i>
Ref8 monitor fail mask	<i>ref_mon_fail_mask_4</i>	0F_0x68	<i>ref8_mon_fail_mask</i>
Sync8 failure status indicator	<i>ref_fail_isr_1</i>	0F_0x65	<i>sync_fail8</i>
Sync8 enable	<i>sync_enable</i>	08_0x68	<i>sync_en</i>
Sync8 invert	<i>sync_enable</i>	08_0x68	<i>sync_inv</i>
Sync8 interrupt service register mask	<i>ref_fail_isr_mask_1</i>	0F_0x67	<i>sync8_fail_isr_mask</i>

**Table 9 - Ref8 and Sync8 Control and Status Registers**



## 2.15 Output Clocks and Frame Pulses

The ZL30143 offers a wide variety of outputs including two low-jitter differential LVPECL clocks (**diff0**, **diff1**), two APLL LVCMOS (**apl\_clk0**, **apl\_clk1**) output clocks, and four programmable LVCMOS (**p0\_clk0**, **p0\_clk1**, **p1\_clk0**, **p1\_clk1**) output clocks. In addition to the clock outputs, two APLL LVCMOS frame pulse outputs (**apl\_fp0**, **apl\_fp1**) and two LVCMOS programmable frame pulses (**p0\_fp0**, **p0\_fp1**) are also available.

The feedback clock (**fb\_clk**) of DPLL1 is available as an output clock. Its output frequency is always equal to DPLL1's selected input frequency.

The output clocks and frame pulses derived from the SONET/SDH/Ethernet APLL are always synchronous with DPLL1, and the clocks and frame pulses generated from the programmable synthesizers can be synchronized to either DPLL1 or DPLL2. This allows the ZL30143 to have two independent timing paths. This is programmable by setting the *p0\_source* bit of the *p0\_enable* register (0x36), and the *p1\_source* bit of the *p1\_enable* register (0x48).

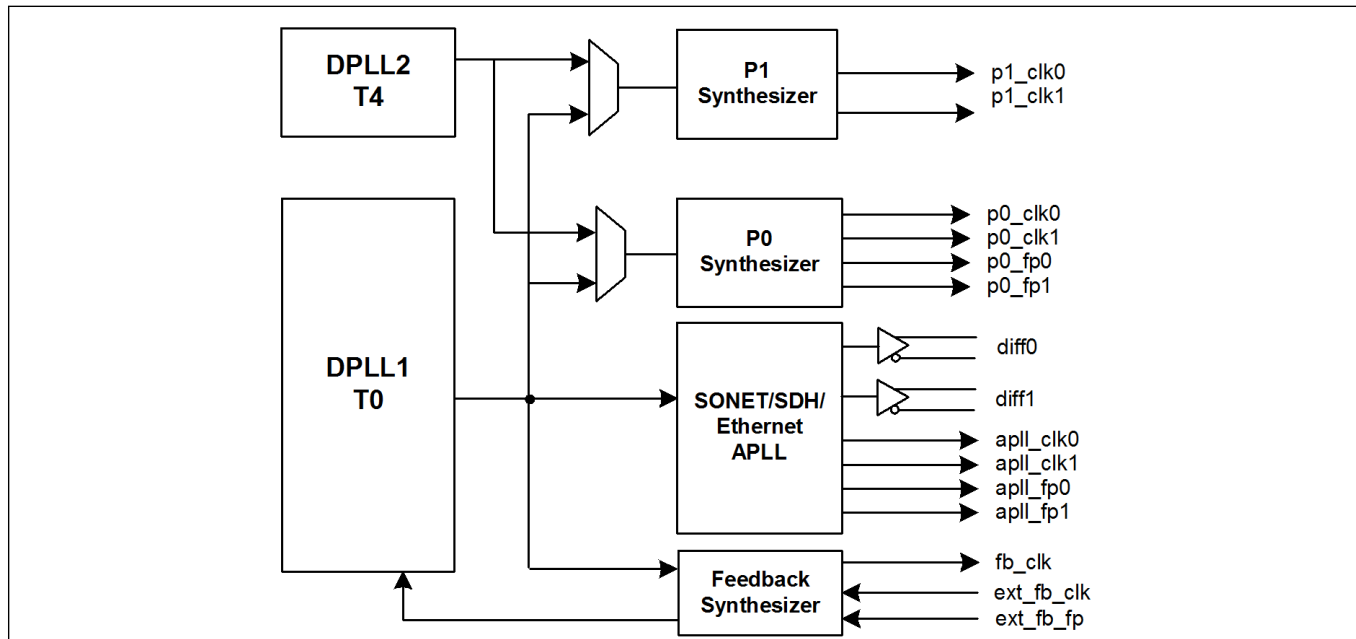


Figure 17 - Output Clock Configuration

The single ended APLL LVCMOS output clock (**apll\_clk0**, **apll\_clk1**) frequencies are programmable using the *apll\_clk0\_freq* and *apll\_clk1\_freq* fields of the *apll\_clk\_freq* register (0x52). The APLL can either generate SONET/SDH frequencies or Ethernet frequencies. This is programmable using the *eth\_en* and the *f\_sel* bits of the *apll\_run* register (0x51). By default SONET/SDH frequencies will be generated. Valid frequencies are listed in Table 10.

apll_clk <sub>n</sub> _freq bit settings	apll_clk <sub>n</sub> Output Frequency	
	SONET/SDH Mode	Ethernet Mode - Low Speed
	eth_en = 0 f_sel <sub>n</sub> = 0	eth_en = 1 f_sel <sub>n</sub> = 1
0001	Reserved	125 MHz
0010	77.76 MHz	62.5 MHz
0011	38.88 MHz	Reserved
0100	19.44 MHz	Reserved
0101	9.72 MHz	50 MHz
0110	Reserved	25 MHz
0111	Reserved	12.5 MHz
1010	51.84 MHz	Reserved
1011	25.92 MHz	Reserved
1100	12.96 MHz	Reserved
1101	6.48 MHz	Reserved

**Table 10 - APLL LVCMOS Output Clock Frequencies**

The differential output clocks (**diff0**, **diff1**) frequencies are programmable using the *diff0\_sel* and *diff1\_sel* bits of the *diff\_sel* register (0x61). When in SONET/SDH mode (eth\_en = 0, f\_sel = 0), any of the valid SONET/SDH clock frequencies shown in Table 11 can be selected. When in Ethernet mode (eth\_en = 1), the APLL can generate two groups of frequencies - low speed (f\_sel = 1) or high speed (f\_sel = 0). When low speed ethernet mode and high speed ethernet modes are enabled at the same time (i.e. (eth\_en = 1, fsel0 = 0 and fsel1 = 1) or (eth\_en = 1, fsel0 = 1 and fsel1 = 0)), please refer to Application Note ZLAN-254 for details on the appropriate device configuration settings.

diff <sub>n</sub> _sel Bit Settings	diff <sub>n</sub> p/n Output Frequency		
	SONET/SDH Mode	Ethernet Mode - Low Speed	Ethernet Mode - High Speed
	eth_en = 0 f_sel <sub>n</sub> = 0	eth_en = 1 f_sel <sub>n</sub> = 1	eth_en = 1 f_sel <sub>n</sub> = 0
000	19.44 MHz	Reserved	Reserved
001	38.88 MHz	125 MHz	Reserved
010	77.76 MHz	62.5 MHz	Reserved
011	155.52 MHz	Reserved	156.25 MHz
100	311.04 MHz	Reserved	312.5 MHz
101	622.08 MHz	50 MHz	Reserved
110	6.48 MHz	25 MHz	Reserved
111	51.84 MHz	12.5 MHz	Reserved

**Table 11 - APLL Differential Output Clock Frequencies**

The frequency of the **p0\_clk0** output is programmable from 2 kHz up to 100 MHz where,

$$f_{p0\_clk0} = N \times 8 \text{ kHz}$$

The value of N is a 16-bit word which is programmable using the *p0\_freq\_0* and *p0\_freq\_1* registers (0x38, 0x39). For an output frequency of 2 kHz, let N = 0.

The **p0\_clk1** output frequency is programmed as a multiple of the p0\_clk0 output frequency where

$$f_{p0\_clk1} = \frac{f_{p0\_clk0}}{2^M}$$

The value of M is defined in the *p0\_clk1\_div* register (0x3B). The minimum and maximum frequency limits of 2 kHz to 100 MHz are also applicable to p0\_clk1.

The frequency of the **p1\_clk\_0** and **p1\_clk1** output clocks are programmable in the same way as the p0\_clk\_0 and p0\_clk1 output clocks where N is defined using the *p1\_freq\_0* and *p1\_freq\_1* registers (0x4A, 0x4B), and M is defined in the *p1\_clk1\_div* register (0x4D).

The feedback clock (**fb\_clk**) is an output that is always equal in frequency to the selected reference input clock. When not in use, the **fb\_clk** output can be disabled to conserve power. The *fb\_clk\_en* bit of the *fb\_control* register (0x62) controls this function.

The frequency of the APLL frame pulses (**apll\_fp0**, **apll\_fp1**) is programmable using the *apll\_fp0\_freq* and the *apll\_fp1\_freq* registers (0x56, 0x5B). Valid frequencies are listed in Table 12.

<b>apll_fp<sub>n</sub>_freq bit settings</b>	<b>apll_fp<sub>n</sub> Frequency</b>
000	166.6667 Hz (48 x 125 μs frames)
001	400 Hz
010	1 kHz
011	2 kHz
100	4 kHz
101	8 kHz
110	32 kHz
111	64 kHz

**Table 12 - APLL Frame Pulse Frequencies**

The pulse width of the frame pulse is programmable using the *apll\_fp0\_type* bits of the *apll\_fp0\_type* register (0x57), and the *apll\_fp1\_type* bits of the *apll\_fp1\_type* register (0x5C). Valid pulse widths are shown in Table 13.

<b>apll_fp<sub>n</sub>_type bit settings</b>	<b>apll_fp<sub>n</sub> Pulse Width</b>
000	One period of a 19.44 MHz clock
001	One period of a 38.88 MHz clock
010	One period of a 77.76 MHz clock
011	One period of a 155.52 MHz clock
100	One period of a 6.48 MHz clock
101	One period of a 51.84 MHz clock
110	Reserved
111	Pulse width equal to one period of apll_clk <sub>n</sub>

**Table 13 - APLL Frame Pulse Widths**

The style (frame pulse or 50% duty cycle clock), alignment (rising or falling edge of its associated clock), and its polarity (positive or negative) is programmable using the *apll\_fp0\_type* register (0x57) and the *apll\_fp1\_type* register (0x5C).

The frequency of the frame pulses generated from the p0 synthesizer (**p0\_fp0**, **p0\_fp1**) is programmable using the *p0\_fp0\_freq* register and the *p0\_fp1\_freq* registers (0x3E, 0x43). Valid frequencies are listed in Table 14.

<b>p0_fp<sub>n</sub>_freq bit settings</b>	<b>p0_fp<sub>n</sub> Frequency</b>
0000	166.6667 Hz (48x 125 $\mu$ s frames)
0001	400 Hz
0010	1 kHz
0011	2 kHz
0100	4 kHz
0101	8 kHz
0110	32 kHz
0111	64 kHz
1000	1Hz

**Table 14 - P0 Frame Pulse Frequencies**

The pulse width of the frame pulse is programmable using the *p0\_fp0\_type* bits of the *p0\_fp0\_type* register (0x3F), and the *p0\_fp1\_type* bits of the *p0\_fp1\_type* register (0x44). Valid pulse widths are shown in Table 15.

<b>p0_fp<sub>n</sub>_type bit settings</b>	<b>p0_fp<sub>n</sub> Pulse Width</b>	<b>Comment</b>
000	One period of a 4.096 MHz clock	These are pre-defined pulse widths that are usable when p0_clk <sub>n</sub> is set to a frequency that is a multiple of the E1 rate (2.048 MHz). When p0_clk <sub>n</sub> is not an E1 multiple, the p0_fp <sub>n</sub> _type must be set to '111'
001	One period of a 8.192 MHz clock	
010	One period of a 16.384 MHz clock	
011	One period of a 32.768 MHz clock	
100	One period of a 65.536 MHz clock	
101	Reserved	
110	Reserved	
111	One period of p0_clk <sub>n</sub>	The frame pulse width is equal to one period of the p0_clk <sub>n</sub> . This setting must be used when the p0_clk <sub>n</sub> is not an E1 multiple.

**Table 15 - P0 Frame Pulse Widths**

The style (frame pulse or 50% duty cycle clock), alignment (rising or falling edge of its associated clock), and its polarity (positive or negative) is programmable using the *p0\_fp0\_type* register (0x3F) and the *p0\_fp1\_type* register (0x44).

### 2.15.1 Output Clock and Frame Pulse Squelching

A clock squelching feature is available which allows forcing an output clock to a specific logic level. The *apll\_clk0\_run* and the *apll\_clk1\_run* bits of the *apll\_run\_register* (0x51) control the single ended outputs. The programmable clock outputs can also be forced to a logic low level using the *p0\_clk0\_run* and *p0\_clk1\_run* bits of the *p0\_run* register (0x37), and the *p1\_clk0\_run* and *p1\_clk1\_run* bits of the *p1\_run* register (0x49).

The frame pulse outputs can be forced to a logic level using the *p0\_fp0\_run* and *p0\_fp1\_run* bits of the *p0\_run* registers (0x37), and the *apll\_fp0\_run* and *apll\_fp1\_run* bits of the *apll\_run* registers (0x51).

### 2.15.2 Disabling Output Clocks and Frame Pulses

Unused outputs can be set to a high impedance state to reduce power consumption. The differential outputs can be disabled using the *diff0\_en* and *diff1\_en* bits of the *diff\_ctrl* register (0x60). The single ended outputs can be disabled using the *apll\_clk0\_en* and *apll\_clk1\_en* bits of the *apll\_enable* register (0x50). The programmable clocks can be individually disabled using the *p0\_clk0\_en* and *p0\_clk1\_en* bits of the *p0\_enable* register (0x36), and the *p1\_clk0\_en* and *p1\_clk1\_en* bits of the *p1\_enable* register (0x48).

When not in use, the frame pulse outputs can be disabled using the *p0\_fp0\_en* and *p0\_fp1\_en* bits of the *p0\_enable* register (0x36), and the *apll\_fp0\_en* and *apll\_fp1\_en* bits of the *apll\_enable* register (0x50).

When not in use, the feedback clock output (**fb\_clk**) can be disabled using the *fb\_clk\_en* bit of the *fb\_control* register (0x62).

### 2.15.3 Disabling Output Synthesizers

In applications where none of the APLL clocks are used, the entire APLL can be disabled to conserve power using the `apl_en` bit of the `apl_enable` register (0x50). Both of the programmable synthesizers can also be disabled by using the `p0_en` bit of the `p0_enable` register (0x36), and the `p1_en` bit of the `p1_enable` register (0x48).

### 2.16 Configurable Input-to-Output and Output-to-Output Delays

The ZL30143 allows programmable static delay compensation for controlling input-to-output and output-to-output delays of its clocks and frame pulses. This is very useful for minimizing the delay between the master and slave output clocks in AdvancedTCA systems.

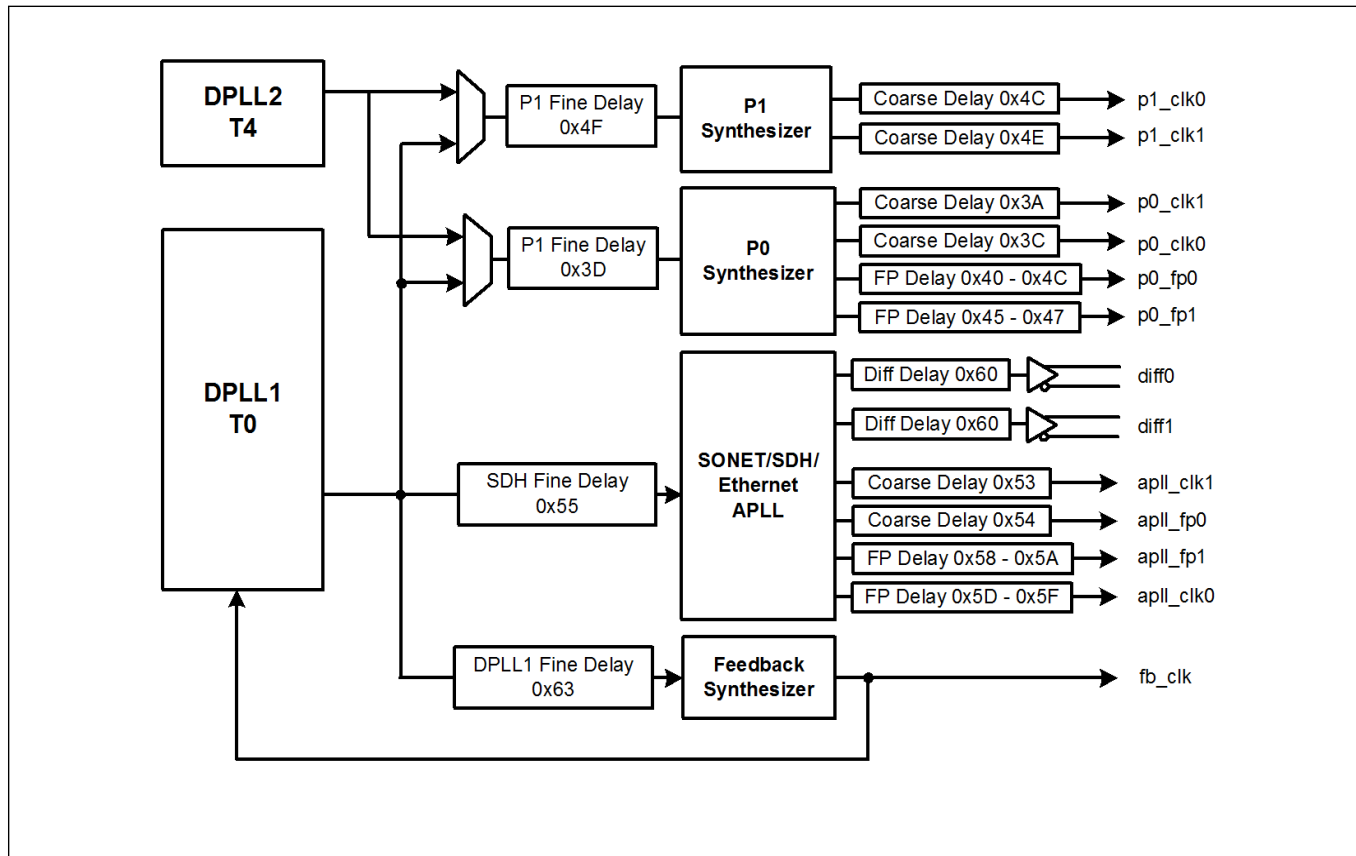


Figure 18 - Phase Delay Adjustments

All of the output synthesizers (APLL, P0, P1, Feedback) locked to DPLL1 can be configured to lead or lag the selected input reference clock. Register 0x63 allows delay adjustments in steps of 119.2 ps definable as an 8-bit two's complement value in the range of -128 to +127. Negative values delay the output clock, positive values advance the output clock. This gives a total delay adjustment in the range of -15.26 ns to +15.14 ns. Synthesizers that are locked to DPLL2 are unaffected by this delay adjustment.

In addition to the fine delay introduced in the DPLL1 path, the APLL, P0, and P1 synthesizers have the ability to add their own fine delay adjustments by programming registers 0x3D, 0x4F, and 0x55. These registers are also programmed as 8-bit two's complement values representing delays defined in steps of 119.2 ps with a range of -15.26 ns to +15.14 ns.

The single-ended output clocks of the APLL, P0, and P1 synthesizers can be independently offset by 90, 180 and 270 degrees using the coarse delay registers (0x3A, 0x3C, 0x4C, 0x4E, 0x53, 0x54).

The APLL differential outputs can be independently delayed by -1.6 ns, 0 ns, +1.6 ns, or +3.2 ns. This delay is programmable using the *diff0\_adjust* and *diff1\_adjust* bits of the *diff\_ctrl* register (0x60).

The output frame pulses (APLL, P0) can be independently offset with respect to each other using the frame pulse delay registers (0x40 - 0x42, 0x45 - 0x47, 0x58 - 0x5A, 0x5D - 0x5F).

- Frame pulses generated from the APLL (**apll\_fp0**, **apll\_fp1**) that are associated with APLL clocks (**apll\_clk0**, **apll\_clk1**) that are multiples of 6.48 MHz (6.48 MHz, 12.96 MHz, 25.92 MHz, 51.84 MHz) can be delayed in steps of 1/207.36 MHz (or approx. 4.82 ns per step). The delay value is programmed as a 16-bit value defined in registers 0x58/0x59 for *apll\_fp0* and 0x5D/0x5E for *apll\_fp1*. The maximum amount of delay is 125  $\mu$ s (= 25919 \* 1/207.36 MHz).
- Frame pulses generated from the APLL (**apll\_fp0**, **apll\_fp1**) that are associated with APLL clocks (**apll\_clk0**, **apll\_clk1**) that are multiples of 19.44 MHz (19.44 MHz, 38.88 MHz, 77.76 MHz, in addition to 9.72 MHz) can be delayed in steps of 1/311.04 MHz (or approx. 3.22 ns per step). The delay value is programmed as a 16-bit value defined in registers 0x58/0x59 for *apll\_fp0* and 0x5D/0x5E for *apll\_fp1*. The maximum amount of delay is 125  $\mu$ s (= 38879 \* 1/311.04 MHz).
- In addition to the delays mentioned above, frame pulses can be delayed in steps of 125  $\mu$ s (up to  $2^6 * 125 \mu$ s = 8 ms) using the 0x5A register for *apll\_fp0* and 0x5F for *apll\_fp1*.
- Frame pulses generated from the p0 synthesizer (**p0\_fp0**, **p0\_fp1**) that are associated with p0 clocks (**p0\_clk0**, **p0\_clk1**) that are multiples of 2.048 MHz (E1) can be delayed in steps of 1/262.144 MHz (or approx. 3.81 ns). The delay value is programmed as a 16-bit value defined in registers 0x40/0x41 for *p0\_fp0* and 0x45/0x46 for *p0\_fp1*. The maximum amount of delay is 125  $\mu$ s (= 32767 \* 1/262.14 MHz). In addition, the frame pulses can be delayed in steps of 125  $\mu$ s (up to  $2^6 * 125 \mu$ s = 8 ms) using the 0x42 register for *p0\_fp0* and 0x47 for *p0\_fp1*.

## 2.17 Master/Slave Configuration

In systems that provide redundant timing sources, it is desirable to minimize the output skew between the master and the slave's output clocks. This can be achieved by synchronizing the slave to one of the master's output clocks instead of synchronizing the slave to an external reference. If frame pulse alignment between the timing sources is required, then the crossover link should consist of a clk/fp pair.

One method of connecting two ZL30143 devices in a master/slave configuration is shown in Figure 19 where there is a dedicated crossover link between timing cards. Any of the master's unused outputs and the slave's unused inputs can be used as a crossover link.

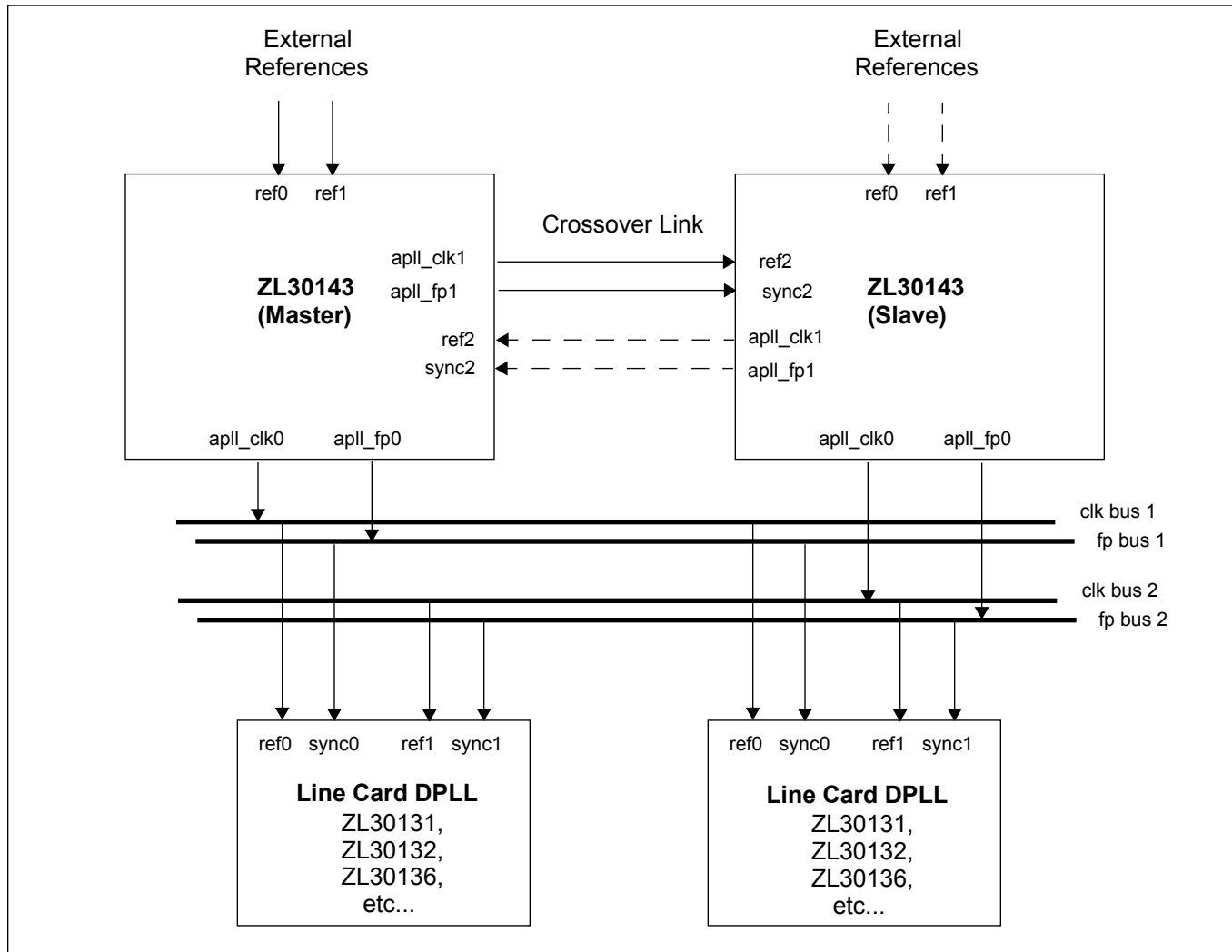


Figure 19 - Typical Master/Slave Configuration



## 2.18 External Feedback Inputs

In addition to the static delay compensation described in the “Configurable Input-to-Output and Output-to-Output Delays” section on page 38, the ZL30143 also provides the option of dynamic delay compensation to minimize path delay variation associated with external clock drivers and long PCB traces. This is accomplished by re-directing the internal DPLL1 feedback path to external pins and closing the loop externally as shown in Figure 20. The *ext\_fb\_clk\_en* bit of the *fb\_control* register (0x62) controls if the feedback path is internal or external. The *ref8/ext\_fb\_clk* and *ref8/extfb\_fp* pins must also be configured as *ext\_fb\_clk/pf* pins using the *fb\_ref8\_sync8\_ctrl* bit of the *fb\_control* register (0x62).

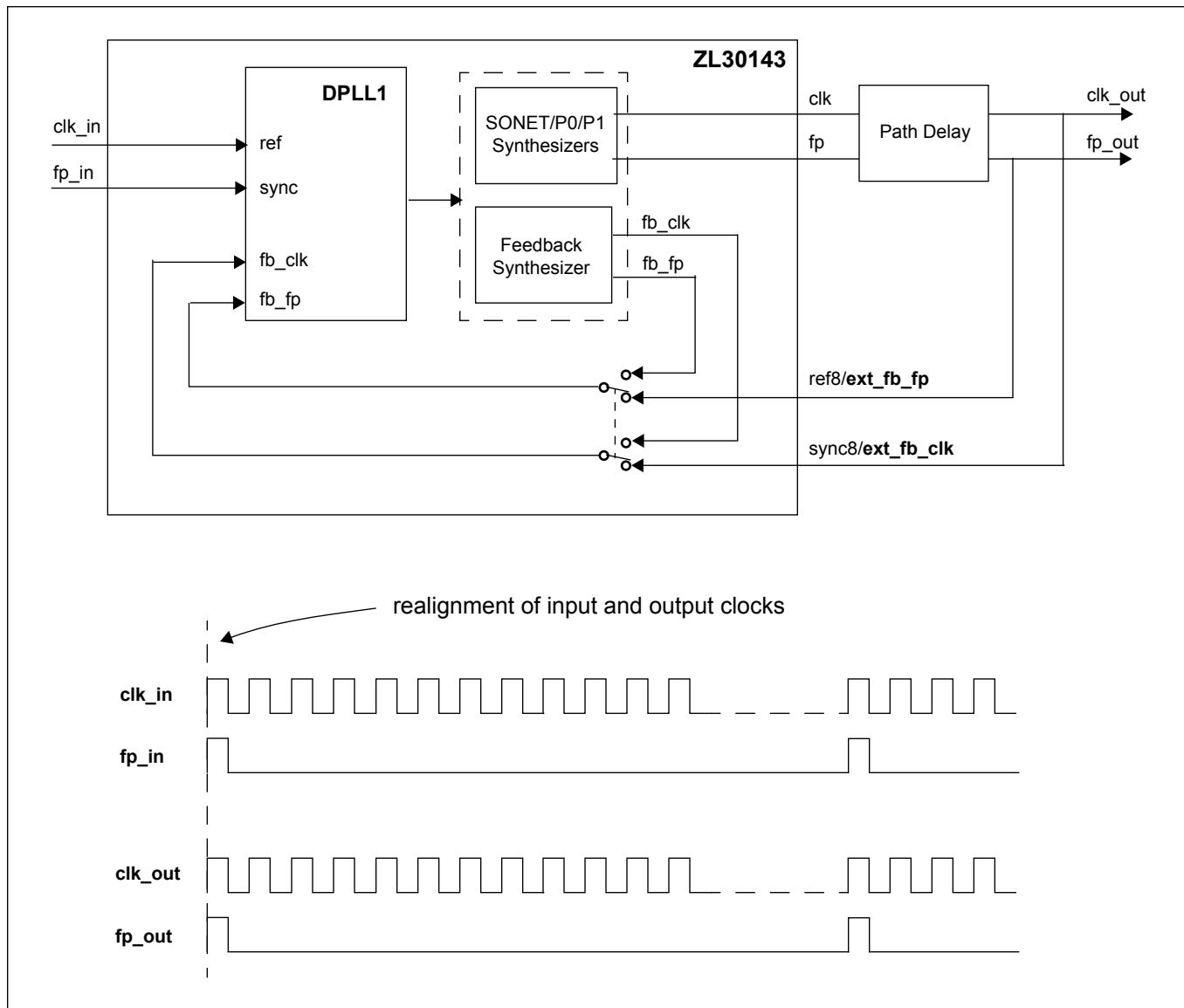


Figure 20 - External Feedback Configuration

## 2.19 Master Clock Interface

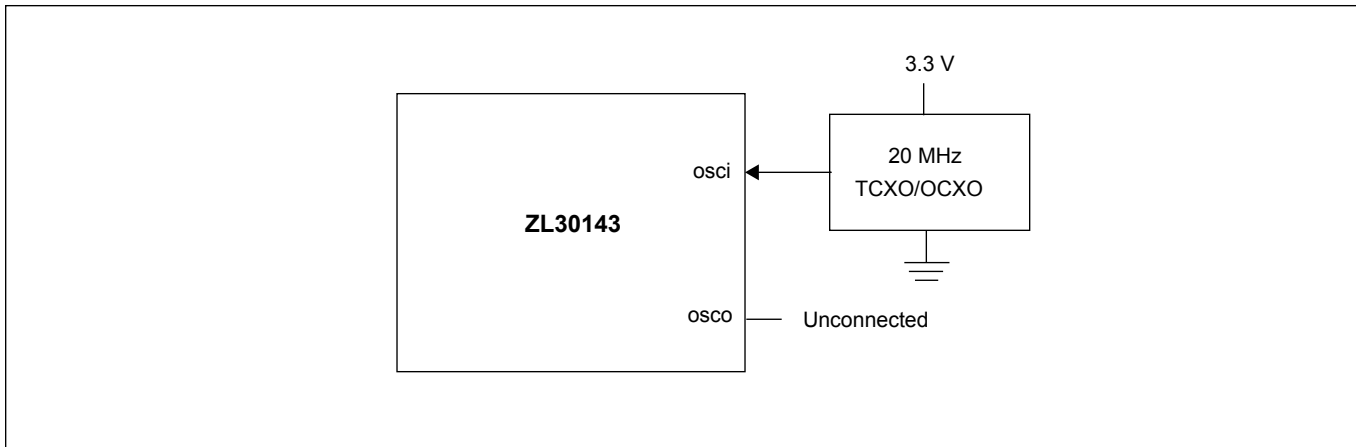
The master oscillator determines the DPLL's free-run frequency accuracy and holdover stability. The reference monitor circuitry also uses this frequency as its point of reference (0 ppm) when making frequency measurements. It is important to select a master oscillator with the appropriate frequency accuracy and stability for the given application. Table 16 lists typical applications. Refer to Application Note ZLAN-68 for a list of recommended clock oscillators.

Master Oscillator Frequency Accuracy (+/- ppm)	Application
4.6	SONET Stratum 3, G.813 option 1 SEC, G.8262 EEC 1 & 2
20	SONET Minimum Clock, G.813 option 2 SEC
32	ANSI T1.403, Stratum 4
50	ITU-T G.703, ETSI ETS 300 011

**Table 16 - Master Oscillator Frequency Accuracy**

### 2.19.1 Clock Oscillator

When using a clock oscillator as the master timing source, connect the oscillator's output clock to the **osci** pin as shown in Figure 21. The connection to **osci** should be direct and not AC coupled. The **osco** pin must be left unconnected.



**Figure 21 - Clock Oscillator Circuit**

## 2.20 Power Up/Down Sequence

The 3.3 V power rail should be powered before or simultaneously with the 1.8 V power rail to prevent the risk of latch-up. The power-down sequence is less critical, however it should be performed in the reverse order to reduce transient currents that consume power.

## 2.21 Power Supply Filtering

Jitter levels on the ZL30143 output clocks may increase if the device is exposed to excessive noise on its power pins. For optimal jitter performance, the ZL30143 device should be isolated from noise on power planes connected to its 3.3 V and 1.8 V supply pins. For recommended common layout practices, refer to Microsemi Application Note ZLAN-212.

## 2.22 Reset Circuit

To ensure proper operation, the device must be reset by holding the rst\_b pin low for at least 300 ns after power-up. Following reset, the device will operate under specified default settings.

The reset pin can be controlled with on-board system reset circuitry or by using a stand-alone power-up reset circuit as shown in Figure 22. This circuit provides approximately 60  $\mu$ s of reset low time. The rst\_b input has schmitt trigger properties to prevent level bouncing.

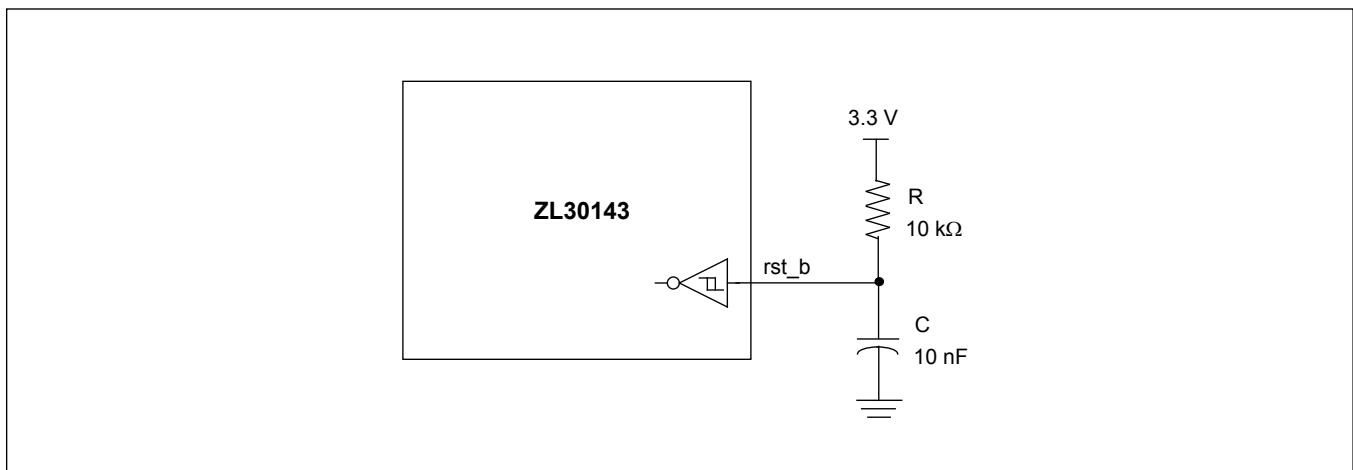
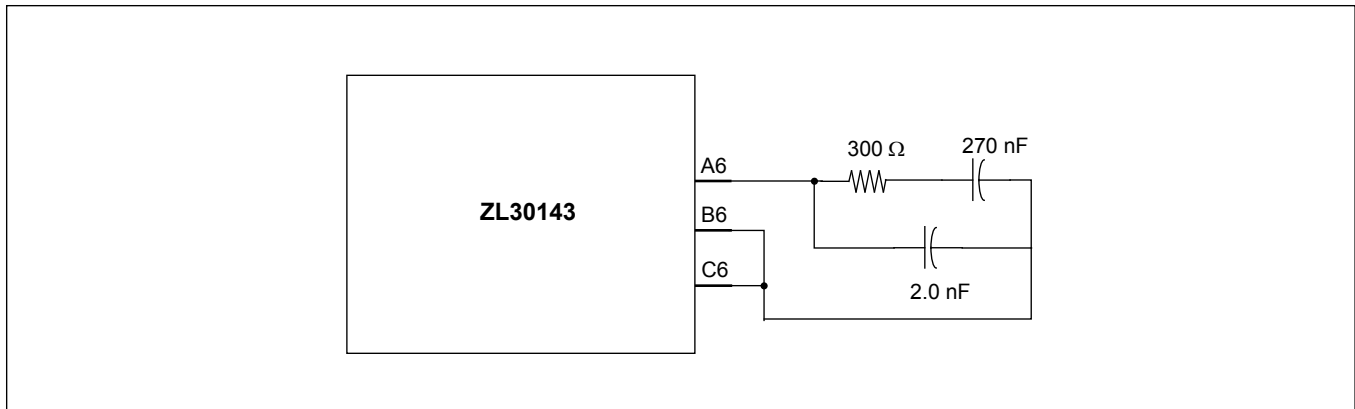


Figure 22 - Typical Power-Up Reset Circuit

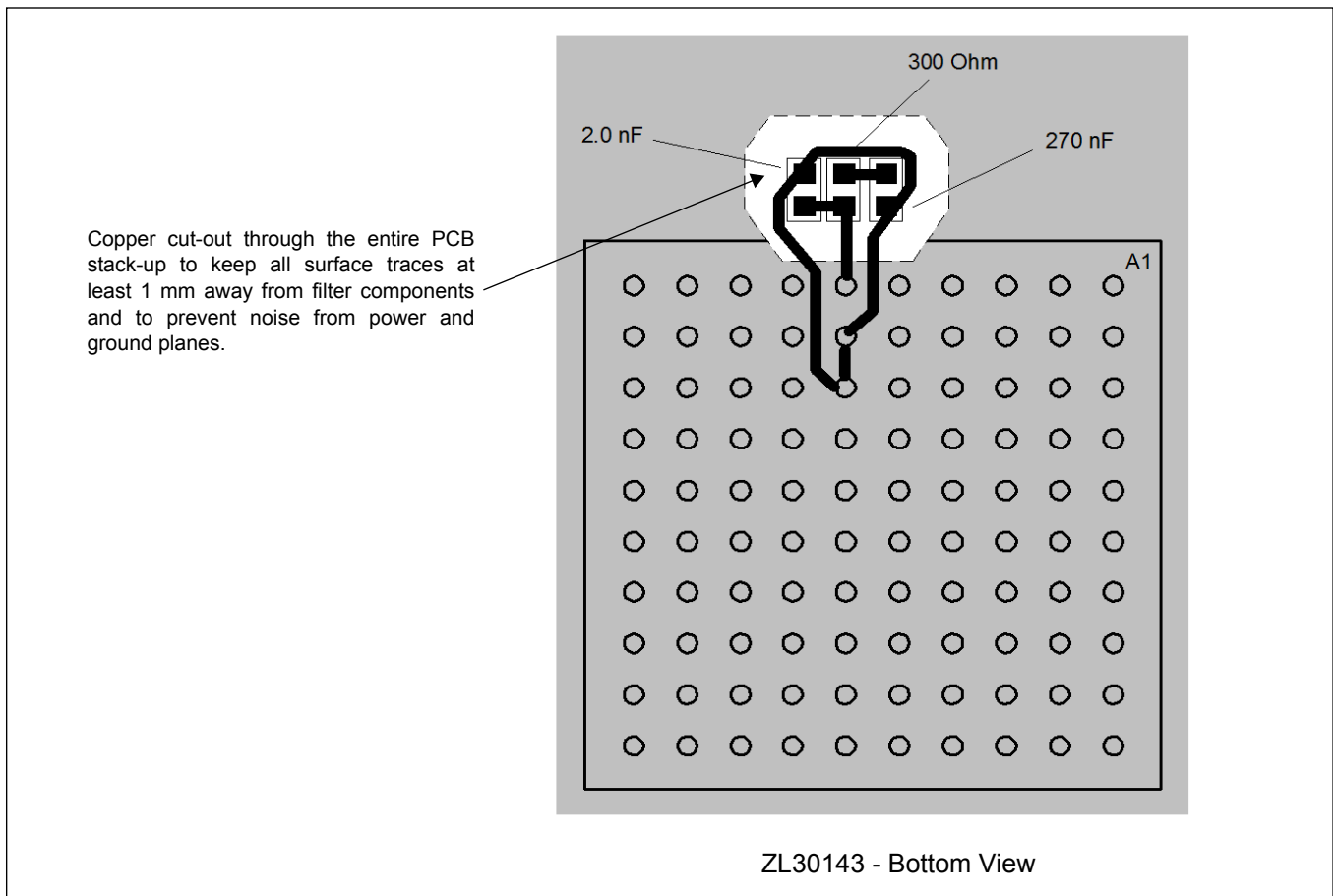
### 2.23 APLL Filter Components and Recommended Layout

The low jitter APLL in the ZL30143 uses external components to help optimize its loop bandwidth. For optimal jitter performance, the following component values are recommended:



**Figure 23 - APLL Filter Component Values**

The recommended PCB layout for the external filter components is shown in Figure 24.



**Figure 24 - Recommended APLL Filter Layout**

## 2.24 Serial Interface

A host processor controls and receives status from the ZL30143 using either a SPI or an I<sup>2</sup>C interface. The desired interface is selected using the **i2c\_en** pin. As shown in Figure 25, when **i2c\_en** is set high (or left unconnected) the serial interface is compatible with an I<sup>2</sup>C bus. Setting the pin low makes it compatible with an SPI bus.

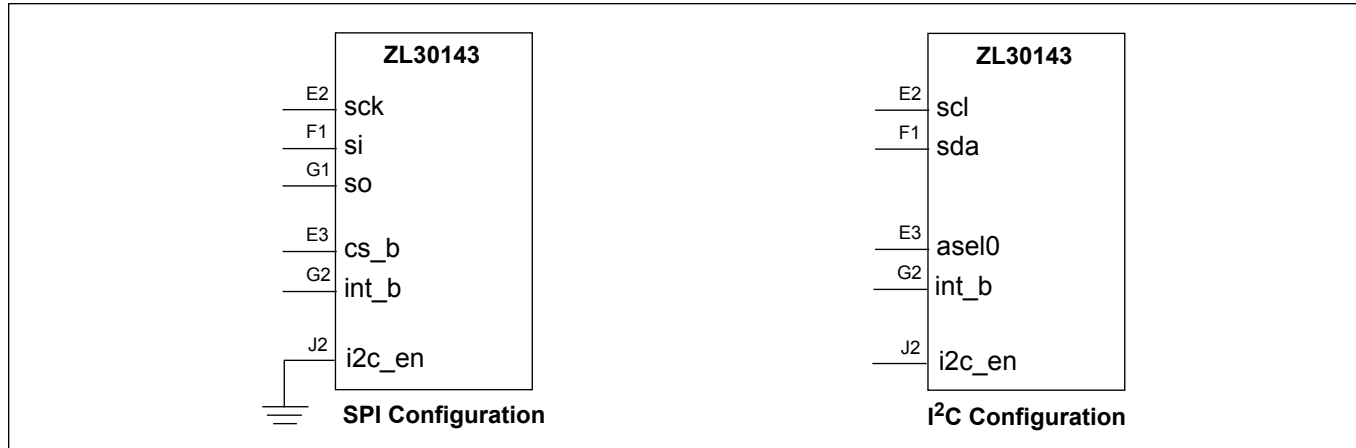


Figure 25 - Serial Interface Configuration

### 2.24.1 Serial Peripheral Interface

The serial peripheral interface (SPI) allows read/write access to the registers that are used to configure, read status, and allow manual control of the device.

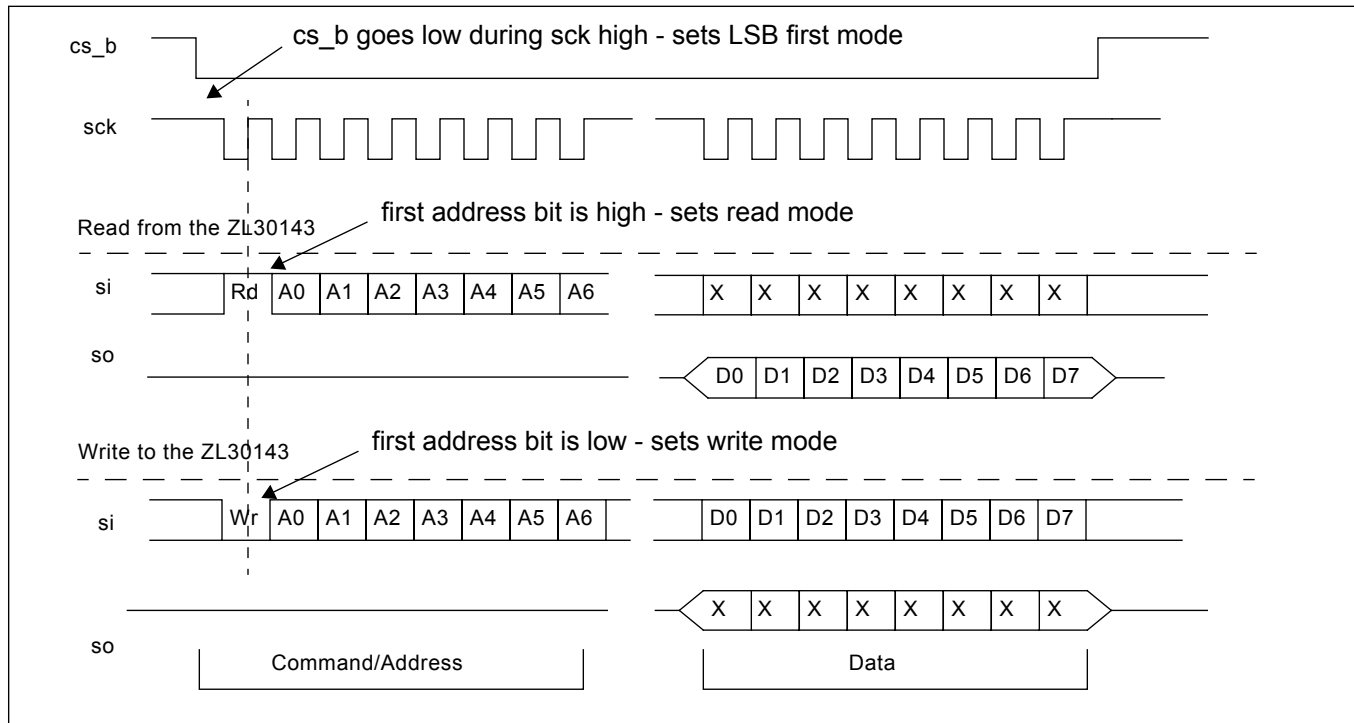
This interface supports two modes of access: Most Significant Bit (MSB) first transmission or Least Significant Bit (LSB) first transmission. The mode is automatically selected based on the state of **sck\_scl** pin when the **cs\_b\_asel0** pin is active. If the **sck\_scl** pin is low during **cs\_b\_asel0** activation, then MSB first timing is selected. If the **sck\_scl** pin is high during **cs\_b\_asel0** activation, then LSB first timing is assumed.

The SPI port expects 7-bit addressing and 8-bit data transmission, and is reset when the chip select pin **cs\_b\_asel0** is high. During SPI access, the **cs\_b\_asel0** pin must be held low until the operation is complete. The first bit transmitted during the address phase of a transfer indicates whether a read (1) or a write (0) is being performed. Burst read/write mode is also supported by leaving the chip select signal **cs\_b\_asel0** low after a read or a write. The address will be automatically incremented after each data byte is read or written.

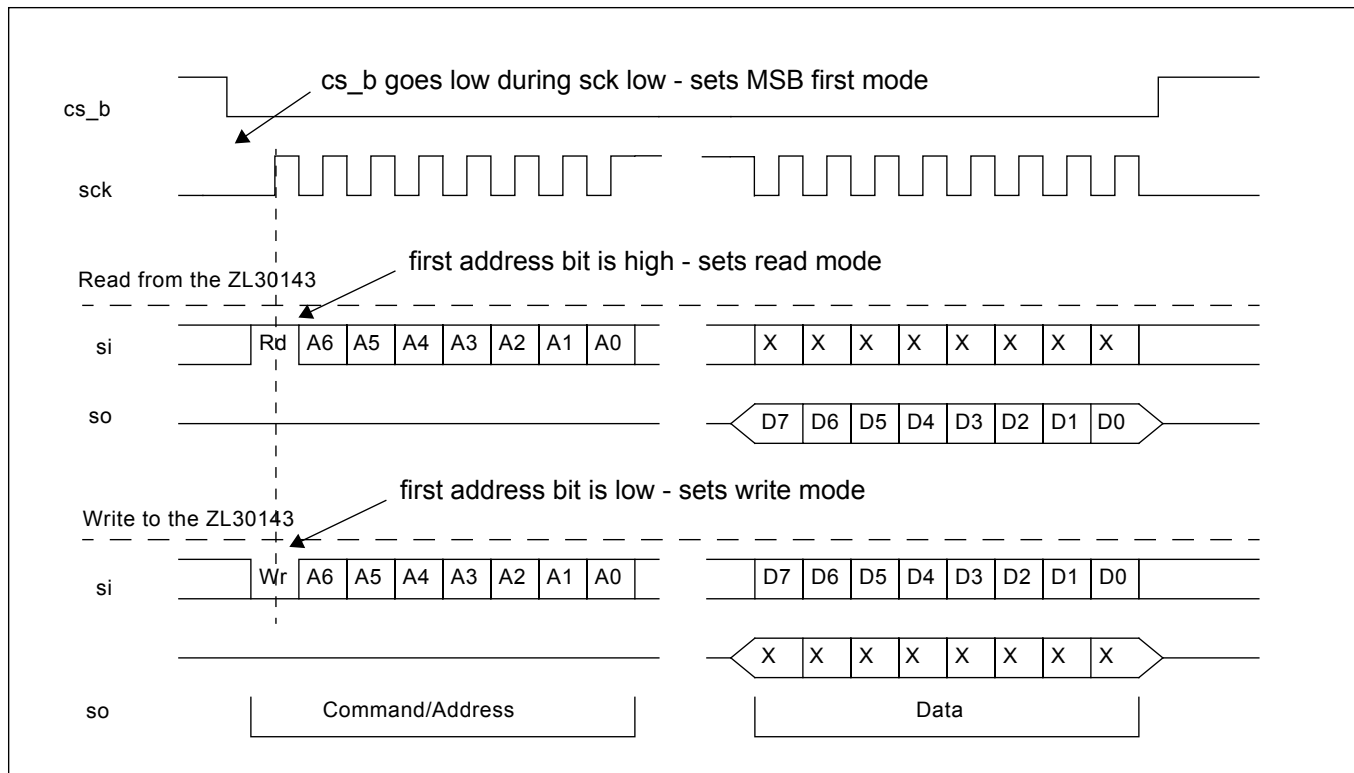
The SPI supports half-duplex processor mode which means that during a write cycle to the ZL30143, output data from the **so** pin must be ignored. Similarly, the input data on the **si\_sda** pin is ignored by the device during a read cycle from the ZL30143.

Functional waveforms for the LSB and MSB first mode, and burst mode are shown in Figure 26, Figure 27 and Figure 28. Timing characteristics are shown in Table 18, Figure 42 and Figure 43.

## 2.24.2 SPI Functional Waveforms



**Figure 26 - LSB First Mode - One Byte Transfer**



**Figure 27 - MSB First Mode - One Byte Transfer**

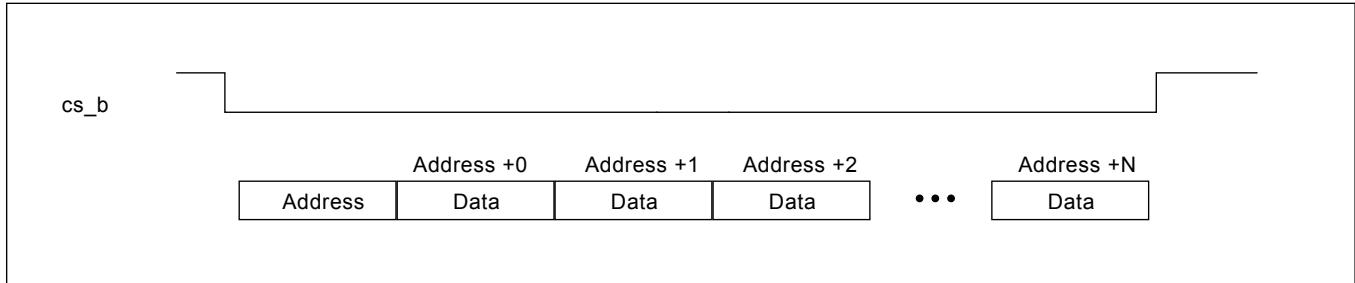
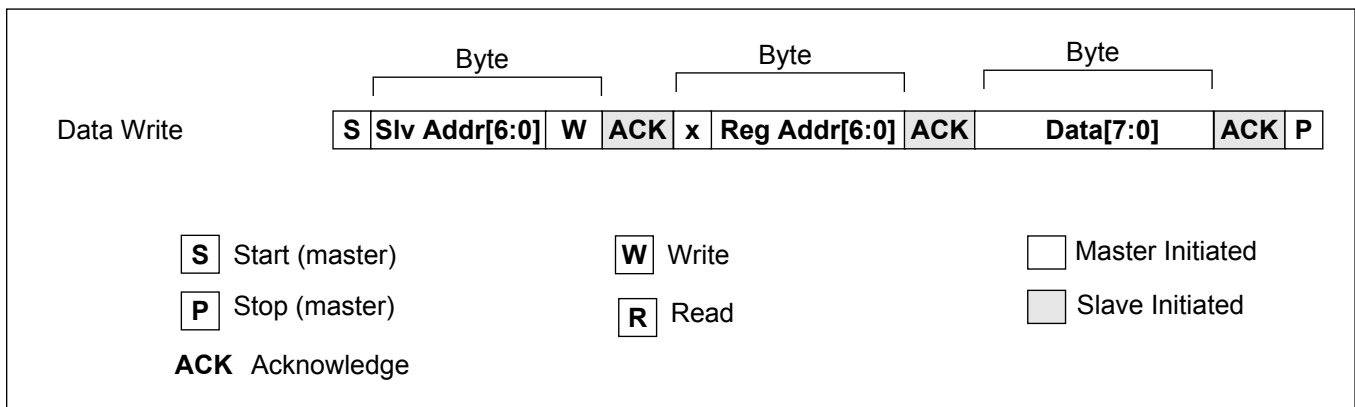


Figure 28 - Example of a Burst Mode Operation

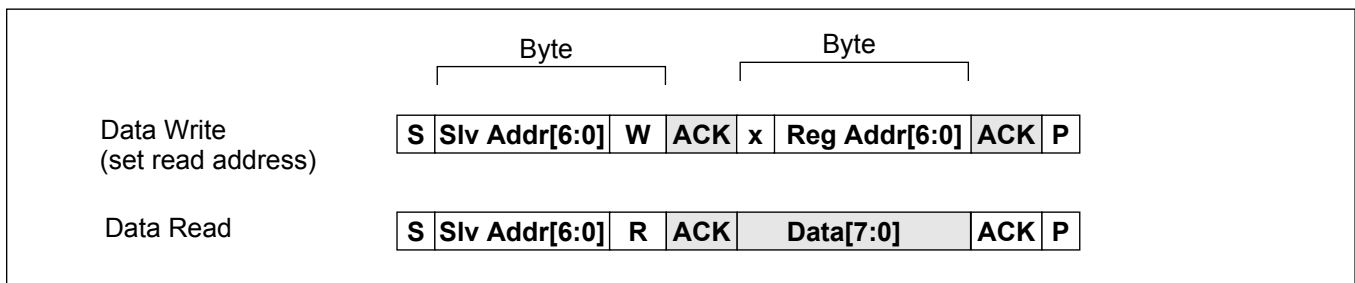
### 2.24.3 I<sup>2</sup>C Interface

The I<sup>2</sup>C controller supports version 2.1 (January 2000) of the Philips I<sup>2</sup>C bus specification. The port operates in slave mode with 7-bit addressing, and can operate in Standard (100 kbits/s) and Fast (400 kbits/s) mode. Burst mode is supported in both standard and fast modes.

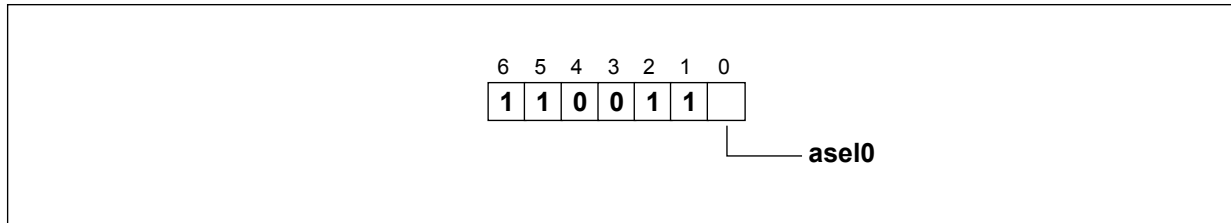
Data is transferred MSB first and occurs in 1 byte blocks. As shown in Figure 29, a **write** command consists of a 7-bit device (slave) address, a 7-bit register address (0x00 - 0x7F), and 8-bits of data.

Figure 29 - I<sup>2</sup>C Data Write Protocol

A **read** is performed in two stages. A data write is used to set the register address, then a data read is performed to retrieve the data from the set address. This is shown in Figure 30.

Figure 30 - I<sup>2</sup>C Data Write Protocol

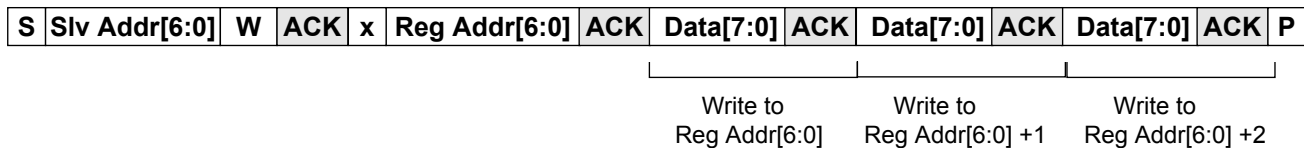
The **7-bit device (slave) address** of the ZL30143 contains a 6 bit fixed address plus a variable bit which is set with the **asel0** pin. This allows two ZL30143s to share the same I<sup>2</sup>C bus. The address configuration is shown in Figure 31.



**Figure 31 - ZL30143 I<sup>2</sup>C 7-bit slave address**

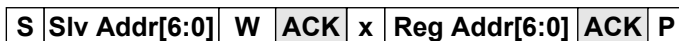
The ZL30143 also supports burst mode which allows multiple data write or read operations with a single specified address. This is shown in Figure 32 (write) and Figure 33 (read). The first data byte is written/read from the specified address, and subsequent data bytes are written/read using an automatically incremented address. The maximum auto incremented address of a burst operation is 0x7F. Any operations beyond this limit will be ignored. In other words, the auto incremented address does not wrap around to 0x00 after reaching 0x7F.

Data Write (Burst Mode)

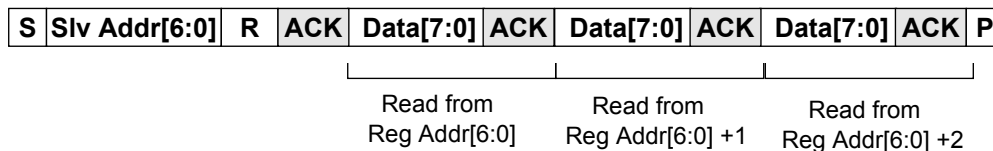


**Figure 32 - I<sup>2</sup>C Data Write Burst Mode**

Data Write (Set first read address)



Data Read (Burst Mode)



**Figure 33 - I<sup>2</sup>C Data Read Burst Mode**

The timing specification for the I<sup>2</sup>C interface is shown in Figure 44 and Table 19.



### 3.0 Software Configuration

The ZL30143 is mainly controlled by accessing software registers through the serial interface (SPI or I<sup>2</sup>C). The device can be configured to operate in a highly automated manner which minimizes its interaction with the system's processor, or it can operate in a manual mode where the system processor controls most of the operation of the device.

#### 3.1 Interrupts

The device has several status registers to indicate its current state of operation. The interrupt pin (**int\_b**) becomes active (low) when a critical change in status occurs. Examples of critical events that would trigger an interrupt are:

- Reference or sync input failures
- Changes in mode of operation (lock, holdover)
- Reference input switchovers

Most of the interrupt register bits behave like "sticky bits" which means that once they are triggered, they will stay triggered even if the condition that caused the interrupt is removed. When a register containing sticky bits is read, the sticky bits are automatically cleared.

#### 3.2 Extended Page Registers

The memory map is organized over 16 pages. Addressable locations as shown in Figure 34. Most of the general configuration and status registers are located in page 0, but some are located in the extended page area of the memory map. Extended page register addresses are identified with a two digit prefix in this document (e.g., **08\_0x6E**). Register addresses with no prefix (e.g. 0x6F) are located in page zero.

The page location is defined in the *page\_pointer* register (0x64). By default this register is set to 00 so that access to page zero registers can easily be made. To access extended pages of the memory map, the page pointer must be first set to the desired page location. For example, to access register 08\_0x6E, write 0x08 to register 0x64, then read or write to register 0x6E. It is recommended that the page pointer is set back to 0x00 once access to an extended page location is complete.

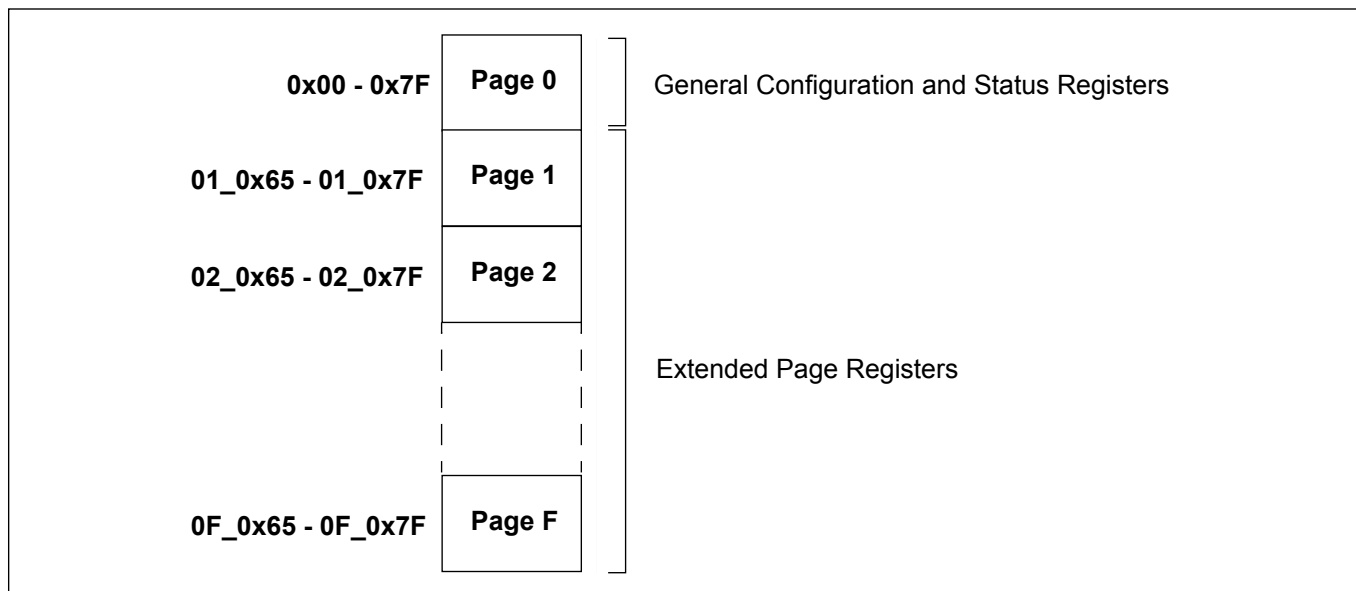


Figure 34 - Memory Map Organization

3.3 Multi-byte Register Values

The ZL30143 register map is based on 8-bit register access, so register values that require more than 8 bits must be spread out over multiple registers and accessed in 8-bit segments. When accessing multi-byte register values, it is important that the registers are accessed in the proper order. The 8-bit register containing the least significant byte (LSB) must be accessed first, and the register containing the most significant byte (MSB) must be accessed last. An example of a multi-byte register is shown in Figure 35. When reading a multi-byte value, the value across all of its registers remains stable until the MSB is read. When writing a multi-byte value, the value is latched when the MSB is written.

**Example:**  
The programmable frame pulse phase offset for p0\_fp0 is programmed using a 22-bit value which is spread over three 8-bit registers. The LSB is contained in address 0x40, the middle byte in 0x41, and the MSB in 0x42. When reading or writing this multi-byte value, the LSB must be accessed first, followed by the middle byte, and the MSB last.

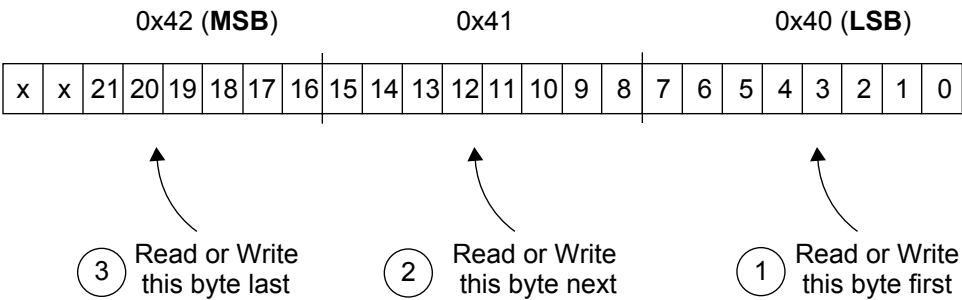


Figure 35 - Accessing Multi-byte Register Values

The following table provides a summary of the registers available for status updates and configuration of the device.

Page_Addr (Hex)	Register Name	Description	Type
<b>Miscellaneous Registers</b>			
0x00	id_reg	Chip and version identification	R
0x01	use_hw_ctrl	Allows some functions of the device to be controlled by hardware pins	R/W
<b>Interrupts</b>			
0x02	ref_fail_isr_0	Reference failure interrupt service register	R
0x03	dpll1_isr	DPLL1 interrupt service register	Sticky R
0x04	dpll2_isr	DPLL2 interrupt service register	Sticky R
0x05	ref_mon_fail_0	Ref0 and ref1 failure indications	Sticky R
0x06	ref_mon_fail_1	Ref2 and ref3 failure indications	Sticky R
0x07	ref_mon_fail_2	Ref4 and ref5 failure indications	Sticky R
0x08	ref_mon_fail_3	Ref6 and ref7 failure indications	Sticky R
0x09	ref_fail_isr_mask_0	Reference failure interrupt service register mask	R/W
0x0A	dpll1_isr_mask	DPLL1 interrupt service register mask	R/W
0x0B	dpll2_isr_mask	DPLL2 interrupt service register mask	R/W
0x0C	ref_mon_fail_mask_0	Control register to mask each failure indicator for ref0 and ref1	R/W
0x0D	ref_mon_fail_mask_1	Control register to mask each failure indicator for ref2 and ref3	R/W
0x0E	ref_mon_fail_mask_2	Control register to mask each failure indicator for ref4 and ref5	R/W
0x0F	ref_mon_fail_mask_3	Control register to mask each failure indicator for ref6 and ref7	R/W
<b>Reference Monitor Setup</b>			
0x10	detected_ref_0	Ref0 and ref1 auto-detected frequency value status register	R

**Table 17 - Register Map**

Page_Addr (Hex)	Register Name	Description	Type
0x11	detected_ref_1	Ref2 and ref3 auto-detected frequency value status register	R
0x12	detected_ref_2	Ref4 and ref5 auto-detected frequency value status register	R
0x13	detected_ref_3	Ref6 and ref7 auto-detected frequency value status register	R
0x14	detected_sync_0	Sync0 and sync1 auto-detected frequency value and sync failure status register	R
0x15	detected_sync_1	Sync2 auto-detected frequency value and sync failure status register	R
0x16	oor_ctrl_0	Control register for the ref0 and ref1 out of range limit	R/W
0x17	oor_ctrl_1	Control register for the ref2 and ref3 out of range limit	R/W
0x18	oor_ctrl_2	Control register for the ref4 and ref5 out of range limit	R/W
0x19	oor_ctrl_3	Control register for the ref6 and ref7 out of range limit	R/W
0x1A	gst_mask_0	Control register to mask the inputs to the guard soak timer for ref0 to ref3	R/W
0x1B	gst_mask_1	Control register to mask the inputs to the guard soak timer for ref4 to ref7	R/W
0x1C	gst_qualif_time	Control register for the guard_soak_timer qualification time and disqualification time for the references	R/W
<b>DPLL1 Control Registers</b>			
0x1D	dpll1_ctrl_0	Control register for the DPLL1 filter control; phase slope limit, bandwidth and hitless switching	R/W
0x1E	dpll1_ctrl_1	Holdover update time, filter_out_en, freq_offset_en, revert enable	R/W
0x1F	dpll1_modesel	Control register for the DPLL1 mode of operation	R/W
0x20	dpll1_refsel	DPLL2 reference selection or reference selection status	R/W
0x21	dpll1_ref_fail_mask	Control register to mask each failure indicator (SCM, CFM, PFM and GST) used for automatic reference switching and automatic holdover	R/W
0x22	dpll1_wait_to_restore	Control register to indicate the time to restore a previous failed reference	R/W
0x23	dpll1_ref_rev_ctrl	Control register for the ref0 and ref1 enable revertive signals	R/W
0x24	dpll1_ref_pri_ctrl_0	Control register for the ref0 and ref1 priority values	R/W
0x25	dpll1_ref_pri_ctrl_1	Control register for the ref2 and ref3 priority values	R/W

Table 17 - Register Map (continued)

Page_Addr (Hex)	Register Name	Description	Type
0x26	dpll1_ref_pri_ctrl_2	Control register for the ref4 and ref5 priority values	R/W
0x27	dpll1_ref_pri_ctrl_3	Control register for the ref6 and ref7 priority values	R/W
0x28	dpll1_lock_holdover_status	DPLL1 lock and holdover status register	R
0x29	dpll1_pullinrange	DPLL1 Pull-in range	R/W
<b>DPLL2 Control Registers</b>			
0x2A	dpll2_ctrl_0	Control register for the DPLL2 filter control; phase slope limit, bandwidth and hitless switching	R/W
0x2B	dpll2_ctrl_1	Holdover update time, filter_out_en, freq_offset_en, revert enable	R/W
0x2C	dpll2_modesel	Control register for the DPLL2 mode of operation	R/W
0x2D	dpll2_refsel	DPLL2 reference selection or reference selection status	R/W
0x2E	dpll2_ref_fail_mask	Control register to mask each failure indicator (SCM, CFM, PFM and GST) used for automatic reference switching and automatic holdover	R/W
0x2F	dpll2_wait_to_restore	Control register to indicate the time to restore a previous failed reference	R/W
0x30	dpll2_ref_rev_ctrl_0	Control register for the ref0 and ref1 enable revertive signals	R/W
0x31	dpll2_ref_pri_ctrl_0	Control register for the ref0 and ref1 priority values	R/W
0x32	dpll2_ref_pri_ctrl_1	Control register for the ref2 and ref3 priority values	R/W
0x33	dpll2_ref_pri_ctrl_2	Control register for the ref4 and ref5 priority values	R/W
0x34	dpll2_ref_pri_ctrl_3	Control register for the ref6 and ref7 priority values	R/W
0x35	dpll2_hold_lock_fail	DPLL2 lock and holdover status register	R
<b>Programmable Synthesizer Configuration Registers</b>			
0x36	p0_enable	Control register to enable the p0_clk0, p0_clk1, p0_fp0, p0_fp1 outputs of the programmable synthesizer	R/W
0x37	p0_run	Control register to enable/disable p0_clk0, p0_clk1, p0_fp0, p0_fp1	R/W
0x38	p0_freq_0	Configuration bits 7:0 used to set the frequency for p0_clk0	R/W
0x39	p0_freq_1	Configuration bits 13:8 used to set the frequency for p0_clk0	R/W
0x3A	p0_clk0_offset90	Control register for the p0_clk0 phase position coarse tuning	R/W

Table 17 - Register Map (continued)

Page_Addr (Hex)	Register Name	Description	Type
0x3B	p0_clk1_div	Control register for the p0_clk1 frequency selection	R/W
0x3C	p0_clk1_offset90	Control register for the p0_clk1 phase position coarse tuning	R/W
0x3D	p0_offset_fine	Control register for the output/output phase alignment fine tuning for the p0 path	R/W
0x3E	p0_fp0_freq	Control register to select the p0_fp0 frame pulse frequency	R/W
0x3F	p0_fp0_type	Control register to select p0_fp0 type	R/W
0x40	p0_fp0_offset_0	Bits [7:0] of the programmable frame pulse phase offset in multiples of 1/262.14 MHz	0x40
0x41	p0_fp0_offset_1	Bits [15:8] of the programmable frame pulse phase offset in multiples of 1/262.14 MHz	0x41
0x42	p0_fp0_offset_2	Bits [21:16] of the programmable frame pulse phase offset in multiples of 8 kHz cycles	0x42
0x43	p0_fp1_freq	Control register to select the p0_fp1 frame pulse frequency	R/W
0x44	p0_fp1_type	Control register to select p0_fp1 type	R/W
0x45	p0_fp1_offset_0	Bits [7:0] of the programmable frame pulse phase offset in multiples of 1/262.14 MHz	R/W
0x46	p0_fp1_offset_1	Bits [15:8] of the programmable frame pulse phase offset in multiples of 1/262.14 MHz	R/W
0x47	p0_fp1_offset_2	Bits [21:16] of the programmable frame pulse phase offset in multiples of 8 kHz cycles	R/W
0x48	p1_enable	Control register to enable the p1_clk0, p0_clk1 outputs of the programmable synthesizer	R/W
0x49	p1_run	Control register to enable/disable p1_clk0, p1_clk1	R/W
0x4A	p1_freq_0	Configuration bits 7:0 used to set the frequency for p1_clk0	R/W
0x4B	p1_freq_1	Configuration bits 13:8 used to set the frequency for p1_clk0	R/W
0x4C	p1_clk0_offset90	Control register for the p1_clk0 phase position coarse tuning	R/W
0x4D	p1_clk1_div	Control register for the p1_clk1 frequency selection	R/W
0x4E	p0_clk1_offset90	Control register for the p0_clk1 phase position coarse tuning	R/W
0x4F	p1_offset_fine	Control register for the output/output phase alignment fine tuning for the p1 path	R/W

Table 17 - Register Map (continued)

Page_Addr (Hex)	Register Name	Description	Type
<b>APLL Configuration Registers</b>			
0x50	apll_enable	Control register to enable apll_clk0, apll_clk1, apll_fp0, apll_fp1, and the APLL block	R/W
0x51	apll_run	Control register to generate apll_clk0, apll_clk1, apll_fp0, apll_fp1 and apll_fp. Also used for enabling ethernet output clocks.	R/W
0x52	apll_clk_freq	Control register for the apll_clk0 and apll_clk1 frequency selection	R/W
0x53	apll_clk0_offset90	Control register for the apll_clk0 phase position coarse tuning	R/W
0x54	apll_clk1_offset90	Control register for the apll_clk1 phase position coarse tuning	R/W
0x55	apll_offset_fine	Control register for the output/output phase alignment fine tuning for apll path	R/W
0x56	apll_fp0_freq	Control register to select the apll_fp0 frame pulse frequency	R/W
0x57	apll_fp0_type	Control register to select apll_fp0 type	R/W
0x58	apll_fp0_offset_0	Bits [7:0] of the programmable frame pulse phase offset in multiples of 1/311.04 MHz	R/W
0x59	apll_fp0_offset_1	Bits [15:8] of the programmable frame pulse phase offset in multiples of 1/311.04 MHz	R/W
0x5A	apll_fp0_offset_2	Bits [21:16] of the programmable frame pulse phase offset in multiples of 8 kHz cycles	R/W
0x5B	apll_fp1_freq	Control register to select the apll_fp1 frame pulse frequency	R/W
0x5C	apll_fp1_type	Control register to select apll_fp1 type	R/W
0x5D	apll_fp1_offset_0	Bits [7:0] of the programmable frame pulse phase offset in multiples of 1/311.04 MHz	R/W
0x5E	apll_fp1_offset_1	Bits [15:8] of the programmable frame pulse phase offset in multiples of 1/311.04 MHz	R/W
0x5F	apll_fp1_offset_2	Bits [21:16] of the programmable frame pulse phase offset in multiples of 8 kHz cycles	R/W
<b>Differential Output Configuration</b>			
0x60	diff_clk_ctrl	Control register to enable diff_clk0 and diff_clk1	R/W
0x61	diff_clk_sel	Control register to select the diff_clk0 and diff_clk1 frequency	R/W

Table 17 - Register Map (continued)

Page_Addr (Hex)	Register Name	Description	Type
<b>Feedback Synthesizer Configuration</b>			
0x62	fb_clk_en	Used to enable/disable the feedback clock, and select ref8/sync8 or ext_fb_clk/fp	R/W
0x63	fb_offset_fine	Control register for the input/output phase alignment fine tuning	R/W
<b>Page Pointer Control</b>			
0x64	page_pointer	Use to access extended page addresses	R/W
<b>Custom Input Frequency Configuration</b>			
0x65	ref_freq_mode_0	Control register to set whether to use auto detect, CustomA or CustomB for ref0, ref1, ref2, ref3	R/W
0x66	ref_freq_mode_1	Control register to set whether to use auto detect, CustomA or CustomB for ref4, ref5, ref6, ref7	R/W
0x67	custA_mult_0	Control register for the [7:0] bits of the custom configuration A. This is the N integer for the N*8kHz reference monitoring.	R/W
0x68	custA_mult_1	Control register for the [13:8] bits of the custom configuration A. This is the N integer for the N*8kHz reference monitoring.	R/W
0x69	custA_scm_low	Control register for the custom configuration A: single cycle SCM low limiter	R/W
0x6A	custA_scm_high	Control register for the custom configuration A: single cycle SCM high limiter	R/W
0x6B	custA_cfm_low_0	Control register for the custom configuration A: The [7:0] bits of the single cycle CFM low limit	R/W
0x6C	custA_cfm_low_1	Control register for the custom configuration A: The [15:0] bits of the single cycle CFM low limit	R/W
0x6D	custA_cfm_hi_0	Control register for the custom configuration A: The [7:0] bits of the single cycle CFM high limit	R/W
0x6E	custA_cfm_hi_1	Control register for the custom configuration A: The [15:0] bits of the single cycle CFM high limiter	R/W
0x6F	custA_cfm_cycle	Control register for the custom configuration A: CFM reference monitoring cycles - 1	R/W
0x70	custA_div	Control register for the custom configuration A: enable the use of ref_div4 for the CFM and PFM inputs	R/W
0x71	custB_mult_0	Control register for the [7:0] bits of the custom configuration B. This is the 8 k integer for the N*8kHz reference monitoring.	R/W

**Table 17 - Register Map (continued)**



Page_Addr (Hex)	Register Name	Description	Type
0x72	custB_mult_1	Control register for the [13:8] bits of the custom configuration B. This is the 8 k integer for the N*8kHz reference monitoring.	R/W
0x73	custB_scm_low	Control register for the custom configuration B: single cycle SCM low limiter	R/W
0x74	custB_scm_high	Control register for the custom configuration B: single cycle SCM high limiter	R/W
0x75	custB_cfm_low_0	Control register for the custom configuration B: The [7:0] bits of the single cycle CFM low limiter.	R/W
0x76	custB_cfm_low_1	Control register for the custom configuration B: The [15:0] bits of the single cycle CFM low limiter.	R/W
0x77	custB_cfm_hi_0	Control register for the custom configuration B: The [7:0] bits of the single cycle CFM high limiter.	R/W
0x78	custB_cfm_hi_1	Control register for the custom configuration B: The [15:0] bits of the single cycle CFM high limiter.	R/W
0x79	custB_cfm_cycle	Control register for the custom configuration B: CFM reference monitoring cycles - 1	R/W
0x7A	custB_div	Control register for the custom configuration B: enable the use of ref_div4 for the CFM and PFM inputs	R/W
Composite Clock (CC) Configuration and Status			
0x7B	ref0_cc_mode	Enables CC mode and selects CC format for ref0	R/W
0x7C	ref1_cc_mode	Enables CC mode and selects CC format for ref0	R/W
0x7D	cc_status	Frequency detect status for cc clock and frame pulse	R/W
Input Reference Pre-Divider Control			
0x7E	predivider_control	Controls pre-dividers for ref0 and ref1	R/W
0x7F	Reserved		
Extended Page Area			
DCO Frequency Control Registers			
01_0x65	DCO_freq_offset_0	Set programmable DCO frequency offset	R/W
01_0x66	fDCO_freq_offset_1	Set programmable DCO frequency offset	R/W
01_0x67	DCO_freq_offset_2	Set programmable DCO frequency offset	R/W
01_0x68	DCO_freq_offset_3	Set programmable DCO frequency offset	R/W
01_0x69	DCO_phase_0	Bits [7:0] of the 64 bit DCO Phase Word	R
01_0x6A	DCO_phase_1	Bits [15:8] of the 64 bit DCO Phase Word	R

Table 17 - Register Map (continued)

Page_Addr (Hex)	Register Name	Description	Type
01_0x6B	DCO_phase_2	Bits [23:16] of the 64 bit DCO Phase Word	R
01_0x6C	DCO_phase_3	Bits [31:24] of the 64 bit DCO Phase Word	R
01_0x6D	DCO_phase_4	Bits [39:32] of the 64 bit DCO Phase Word	R
01_0x6E	DCO_phase_5	Bits [47:40] of the 64 bit DCO Phase Word	R
01_0x6F	DCO_phase_6	Bits [55:48] of the 64 bit DCO Phase Word	R
01_0x70	DCO_phase_7	Bits [63:56] of the 64 bit DCO Phase Word	R
01_0x71	Local_Time_0	Bits [7:0] of the 32 bit Local System Time	R
01_0x72	Local_Time_1	Bits [15:8] of the 32 bit Local System Time	R
01_0x73	Local_Time_2	Bits [23:16] of the 32 bit Local System Time	R
01_0x74	Local_Time_3	Bits [31:24] of the 32 bit Local System Time	R
01_0x75	ToD_update_0	Bits[7:0] of the 64 bit ToD update register	R
01_0x76	ToD_update_1	Bits[15:8] of the 64 bit ToD update register	R
01_0x77	ToD_update_2	Bits[23:16] of the 64 bit ToD update register	R
01_0x78	ToD_update_3	Bits[31:24] of the 64 bit ToD update register	R
01_0x79	ToD_update_4	Bits[39:32] of the 64 bit ToD update register	R
01_0x7A	ToD_update_5	Bits[47:40] of the 64 bit ToD update register	R
01_0x7B	ToD_update_6	Bits[55:48] of the 64 bit ToD update register	R
01_0x7C	ToD_update_7	Bits[63:56] of the 64 bit ToD update register	R
Extended Page Area			
01_0x7D to 08_0x67	Reserved		
9th Reference Control and Status			
08_0x68	sync_enable	Allows enable/disable of sync0, 1, 2, 8	R/W
08_0x69	detected_ref_4	Status of ref8 detected frequency	R
08_0x6A	oor_ctrl_4	Set the OOR frequency for ref8	R/W
08_0x6B	gst_mask_2	Control register to mask the inputs to the guard soak timer for ref8	R/W
08_0x6C	ref_freq_mode_2	Control register to set whether to use auto detect, CustomA or CustomB for ref8	R/W
08_0x6D	dpll1_ref_rev_ctrl_1	Control register for ref8 revertive enable for dpll1	R/W
08_0x6E	dpll1_ref_pri_ctrl_4	Control register for ref8 priority	R/W

Table 17 - Register Map (continued)

Page_Addr (Hex)	Register Name	Description	Type
08_0x6F	dpll2_ref_rev_ctrl_1	Control register for ref8 revertive enable for dpll2	R/W
08_0x70	dpll2_ref_pri_ctrl_4	ref8 priority	R/W
08_0x71	1Hz_enable	Enables 1Hz sync detection	R/W
08_0x72	ref_inv	Allows inverting ref0, ref1, ref2, ref8 inputs	R/W
<b>Extended Page Area</b>			
08_0x73 to 0A_0x6B	Reserved		
<b>DCO update configuration Registers (ToP Client Mode)</b>			
0A_0x6C	DCO_update	Enables DCO updates	R/W
0A_0x6D to 0A_0x70	Reserved		
0A_0x71	DCO_Update_Interval	Configures DCO update Interval	R/W
0A_0x72	ToP_1Hz_Alignment	Enables 1 Hz alignment in ToP Client Mode	R/W
<b>Extended Page Area</b>			
0A_0x73 to 0A_0x75	Reserved		
0A_0x76	Time_of_Day_0	Bits[7:0] of the 64 bit Time of Day register	R/W
0A_0x77	Time_of_Day_1	Bits[15:8] of the 64 bit Time of Day register	R/W
0A_0x78	Time_of_Day_2	Bits[23:16] of the 64 bit Time of Day register	R/W
0A_0x79	Time_of_Day_3	Bits[31:24] of the 64 bit Time of Day register	R/W
0A_0x7A	Time_of_Day_4	Bits[39:32] of the 64 bit Time of Day register	R/W
0A_0x7B	Time_of_Day_5	Bits[47:40] of the 64 bit Time of Day register	R/W
0A_0x7C	Time_of_Day_6	Bits[55:48] of the 64 bit Time of Day register	R/W
0A_0x7D	Time_of_Day_7	Bits[63:56] of the 64 bit Time of Day register	R/W
0A_7E to 0D_0x7F	Reserved		
<b>9th Reference Interrupt Service Registers</b>			
0F_0x65	ref_fail_isr_1	Indicates ref8 failure	R

Table 17 - Register Map (continued)

Page_Addr (Hex)	Register Name	Description	Type
0F_0x66	ref_mon_fail_4	ref8 SCM, CFM, GST, PFM failure indicator	Sticky R
0F_0x67	ref_fail_isr_mask_1	ref8 fail mask	R/W
0F_0x68	ref_mon_fail_mask_4	ref8 SCM, CFM, GST, PFM failure mask	R/W
Composite Clock (CC) Interrupt Service Registers			
0F_0x69	cc_isr	Indicates ref0 and ref1 BPV errors	Sticky R
0F_0x6A	cc_isr_mask	Mask bits for ref0 and ref1 BPV errors	R/W
0F_0x6B to 0F_0x6D	Reserved		
Timing over Packet (ToP) Interrupt Service Registers			
0F_0x6E	ToP_isr	Indicates ToP interrupt	Sticky R
0F_0x6F	ToP_isr_mask	ToP interrupt mask	R/W
0F_0x6B to 0F_0x7C	Reserved		
Interrupt Service Registers			
0F_0x7D	isr0_reg	Indicates Interrupt Source	R/W
0F_0x7E	isr0_mask	Masks Interrupt sources	R/W

**Table 17 - Register Map (continued)**

#### 4.0 Detailed Register Map

Page_Address: <b>00_0x00</b> Register Name: <b>id_reg</b> Default Value: <b>See description</b> Type: <b>R/W</b>		
Bit Field	Function Name	Description
4:0	chip_id	Chip Identification = 11101
6:5	chip_revision	Chip revision number.
7	reset_ready	Reset ready indication. When this bit is set to 1 the reset cycle has completed. <b>Note that it is recommended not to read or write to any other registers until this bit is set to 1. It takes 5 ms after the reset for this bit to go high.</b>

Page_Address: <b>00_0x01</b> Register Name: <b>use_hw_ctrl</b> Default Value: <b>0x00</b> Type: <b>R/W</b>		
Bit Field	Function Name	Description
0	reserved	Leave as default
1	dp111_mode_hsw	This bit determines how the mode selection for DP111 is controlled. When set to 0, the mode selection is s/w controlled using the modesel bits of the dp111_modesel register (0x1F). When set to 1, the mode selection is h/w controlled using the dp111_mod_sel2:0 pins.
2	reserved	Leave as default
3	slave_en_hsw	This bit determines how the slave mode is selected. When set to 0, slave mode is s/w controlled. When set to 1, the slave mode is controlled using the slave_en pins.
7:2	reserved	Leave as default

Address: **0x02**  
 Register Name: **ref\_fail\_isr**  
 Default Value: **0xFF**  
 Type: **R**

Bit Field	Function Name	Description
0	ref0_fail	This bit is set to 1 when ref0 has a failure
1	ref1_fail	This bit is set to 1 when ref1 has a failure
2	ref2_fail	This bit is set to 1 when ref2 has a failure
3	ref3_fail	This bit is set to 1 when ref3 has a failure
4	ref4_fail	This bit is set to 1 when ref4 has a failure
5	ref5_fail	This bit is set to 1 when ref5 has a failure
6	ref6_fail	This bit is set to 1 when ref6 has a failure
7	ref7_fail	This bit is set to 1 when ref7 has a failure

Address: **0x03**  
 Register Name: **dpll1\_isr**  
 Default Value: **See Description**  
 Type: **R Sticky**

Bit Field	Function Name	Description
0	locked	This bit is set to high when DPLL1 achieves lock. The bit is cleared automatically when this register is read.
1	lost_lock	This bit is set to high when DPLL1 loses lock. The bit is cleared automatically when this register is read.
2	holdover	This bit is set to high when DPLL1 enters holdover. The bit is cleared automatically when this register is read.
3	ref_changed	This bit is set to high when DPLL1 makes a reference switch. The bit is cleared automatically when this register is read.
6:4	sync_fail[2:0]	This bit is set to high when a failure of the sync[i] is detected. The bit is cleared automatically when this register is read.
7	reserved	Leave as default

Address: **0x04**  
 Register Name: **dpll2\_isr**  
 Default Value: **See Description**  
 Type: **Sticky R**

Bit Field	Function Name	Description
0	locked	This bit is set to high when DPLL2 achieves lock. The bit is cleared automatically when this register is read.
1	lost_lock	This bit is set to high when DPLL2 loses lock. The bit is cleared automatically when this register is read.
2	holdover	This bit is set to high when DPLL2 enters holdover. The bit is cleared automatically when this register is read.
3	ref_changed	This bit is set to high when DPLL2 makes a reference switch. The bit is cleared automatically when this register is read.
7:4	reserved	Leave as default

Address: **0x05**  
 Register Name: **ref\_mon\_fail\_0**  
 Default Value: **See Description**  
 Type: **Sticky R**

Bit Field	Function Name	Description
0	ref0_scm_failed	SCM failure indication (1 indicates a failure)
1	ref0_cfm_failed	CFM failure indication (1 indicates a failure)
2	ref0_gst_failed	GST failure indication (1 indicates a failure)
3	ref0_pfm_failed	PFM failure indication (1 indicates a failure)
4	ref1_scm_failed	SCM failure indication (1 indicates a failure)
5	ref1_cfm_failed	CFM failure indication (1 indicates a failure)
6	ref1_gst_failed	GST failure indication (1 indicates a failure)
7	ref1_pfm_failed	PFM failure indication (1 indicates a failure)

Address: **0x06**  
 Register Name: **ref\_mon\_fail\_1**  
 Default Value: **See Description**  
 Type: **R Sticky**

Bit Field	Function Name	Description
0	ref2_scm_failed	SCM failure indication (1 indicates a failure)
1	ref2_cfm_failed	CFM failure indication (1 indicates a failure)
2	ref2_gst_failed	GST failure indication (1 indicates a failure)
3	ref2_pfm_failed	PFM failure indication (1 indicates a failure)
4	ref3_scm_failed	SCM failure indication (1 indicates a failure)
5	ref3_cfm_failed	CFM failure indication (1 indicates a failure)
6	ref3_gst_failed	GST failure indication (1 indicates a failure)
7	ref3_pfm_failed	PFM failure indication (1 indicates a failure)

Address: **0x07**  
 Register Name: **ref\_mon\_fail\_2**  
 Default Value: **See Description**  
 Type: **R Sticky**

Bit Field	Function Name	Description
0	ref4_scm_failed	SCM failure indication (1 indicates a failure)
1	ref4_cfm_failed	CFM failure indication (1 indicates a failure)
2	ref4_gst_failed	GST failure indication (1 indicates a failure)
3	ref4_pfm_failed	PFM failure indication (1 indicates a failure)
4	ref5_scm_failed	SCM failure indication (1 indicates a failure)
5	ref5_cfm_failed	CFM failure indication (1 indicates a failure)
6	ref5_gst_failed	GST failure indication (1 indicates a failure)
7	ref5_pfm_failed	PFM failure indication (1 indicates a failure)



Address: **0x08**  
 Register Name: **ref\_mon\_fail\_3**  
 Default Value: **See Description**  
 Type: **R Sticky**

Bit Field	Function Name	Description
0	ref6_scm_failed	SCM failure indication
1	ref6_cfm_failed	CFM failure indication
2	ref6_gst_failed	GST failure indication
3	ref6_pfm_failed	PFM failure indication
4	ref7_scm_failed	SCM failure indication
5	ref7_cfm_failed	CFM failure indication
6	ref7_gst_failed	GST failure indication
7	ref7_pfm_failed	PFM failure indication

Address: **0x09**  
 Register Name: **ref\_fail\_isr\_mask**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
7:0	ref_fail_isr_mask	Reference failure interrupt service register mask.Masking a bit to zero will disable interrupt generation. xxxxxxx0: masks ref0 failure xxxxxx0x: masks ref1 failure xxxxx0xx: masks ref2 failure xxxx0xxx: masks ref3 failure xxx0xxxx: masks ref4 failure xx0xxxxx: masks ref5 failure x0xxxxxx: masks ref6 failure 0xxxxxxx: masks ref7 failure

Address: **0x0A**  
 Register Name: **dpll1\_isr\_mask**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
6:0	dpll_isr_mask	DPLL1 interrupt service register mask. Enabling a mask bit to one will allow interrupt generation xxxxxxx0: masks locked condition xxxxxx0x: masks lost_lock condition xxxxx0xx: masks holdover condition xxxx0xxx: masks ref_changed condition x000xxxx: masks sync_fail[1:0] failure
7	Reserved	Leave as default

Address: **0x0B**  
 Register Name: **dpll2\_isr\_mask**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
3:0	dpll_isr_mask	DPLL2 interrupt service register mask. Enabling a mask bit to one will allow interrupt generation xxxxxxx0: masks locked condition xxxxxx0x: masks lost_lock condition xxxxx0xx: masks holdover condition xxxx0xxx: masks ref_changed condition
7:4	Reserved	Leave as default

Address: **0x0C**Register Name: **ref\_mon\_fail\_mask\_0**Default Value: **0xFF**Type: **R/W**

Bit Field	Function Name	Description
3:0	ref0_mon_fail_mask	Control register to mask each failure indicator for ref0 xxx0: mask ref SCM failure xx0x: mask ref CFM failure x0xx: mask ref GST failure 0xxx: mask ref PFM failure
7:4	ref1_mon_fail_mask	Control register to mask each failure indicator for ref1 xxx0: mask ref SCM failure xx0x: mask ref CFM failure x0xx: mask ref GST failure 0xxx: mask ref PFM failure

Address: **0x0D**Register Name: **ref\_mon\_fail\_mask\_1**Default Value: **0xFF**Type: **R/W**

Bit Field	Function Name	Description
3:0	ref2_mon_fail_mask	Control register to mask each failure indicator for ref2 xxx0: mask ref SCM failure xx0x: mask ref CFM failure x0xx: mask ref GST failure 0xxx: mask ref PFM failure
7:4	ref3_mon_fail_mask	Control register to mask each failure indicator for ref3 xxx0: mask ref SCM failure xx0x: mask ref CFM failure x0xx: mask ref GST failure 0xxx: mask ref PFM failure

Address: **0x0E**Register Name: **ref\_mon\_fail\_mask\_2**Default Value: **0xFF**Type: **R/W**

Bit Field	Function Name	Description
3:0	ref4_mon_fail_mask	Control register to mask each failure indicator for ref4 xxx0: mask ref SCM failure xx0x: mask ref CFM failure x0xx: mask ref GST failure 0xxx: mask ref PFM failure
7:4	ref5_mon_fail_mask	Control register to mask each failure indicator for ref5 xxx0: mask ref SCM failure xx0x: mask ref CFM failure x0xx: mask ref GST failure 0xxx: mask ref PFM failure

Address: **0x0F**Register Name: **ref\_mon\_fail\_mask\_3**Default Value: **0xFF**Type: **R/W**

Bit Field	Function Name	Description
3:0	ref6_mon_fail_mask	Control register to mask each failure indicator for ref6 xxx0: mask ref SCM failure xx0x: mask ref CFM failure x0xx: mask ref GST failure 0xxx: mask ref PFM failure
7:4	ref7_mon_fail_mask	Control register to mask each failure indicator for ref7 xxx0: mask ref SCM failure xx0x: mask ref CFM failure x0xx: mask ref GST failure 0xxx: mask ref PFM failure

Address: **0x10**Register Name: **detected\_ref\_0**Default Value: **See Description**Type: **R**

Bit Field	Function Name	Description
3:0	ref0_frq_detected	ref0 auto-detected frequency value 0000: -> 2 kHz 0001: -> 8 kHz 0010: -> 64 kHz 0011: -> 1.544 MHz 0100: -> 2.048 MHz 0101: -> 6.48 MHz 0110: -> 8.192 MHz 0111: -> 16.384 MHz 1000: -> 19.44 MHz 1001: -> 38.88 MHz 1010: -> 77.76 MHz 1111:-> Not yet detected
7:4	ref1_frq_detected	ref1 auto-detected frequency value 0000: -> 2 kHz 0001: -> 8 kHz 0010: -> 64 kHz 0011: -> 1.544 MHz 0100: -> 2.048 MHz 0101: -> 6.48 MHz 0110: -> 8.192 MHz 0111: -> 16.384 MHz 1000: -> 19.44 MHz 1001: -> 38.88 MHz 1010: -> 77.76 MHz 1111:-> Not yet detected

Address: **0x11**Register Name: **detected\_ref\_1**Default Value: **See Description**Type: **R**

Bit Field	Function Name	Description
3:0	ref2_frq_detected	ref2 auto-detected frequency value 0000: -> 2 kHz 0001: -> 8 kHz 0010: -> 64 kHz 0011: -> 1.544 MHz 0100: -> 2.048 MHz 0101: -> 6.48 MHz 0110: -> 8.192 MHz 0111: -> 16.384 MHz 1000: -> 19.44 MHz 1001: -> 38.88 MHz 1010: -> 77.76 MHz 1111:-> Not yet detected
7:4	ref3_frq_detected	ref3 auto-detected frequency value 0000: -> 2 kHz 0001: -> 8 kHz 0010: -> 64 kHz 0011: -> 1.544 MHz 0100: -> 2.048 MHz 0101: -> 6.48 MHz 0110: -> 8.192 MHz 0111: -> 16.384 MHz 1000: -> 19.44 MHz 1001: -> 38.88 MHz 1010: -> 77.76 MHz 1111:-> Not yet detected

Address: **0x12**Register Name: **detected\_ref\_2**Default Value: **See Description**Type: **R**

Bit Field	Function Name	Description
3:0	ref4_frq_detected	ref4 auto-detected frequency value 0000: -> 2 kHz 0001: -> 8 kHz 0010: -> 64 kHz 0011: -> 1.544 MHz 0100: -> 2.048 MHz 0101: -> 6.48 MHz 0110: -> 8.192 MHz 0111: -> 16.384 MHz 1000: -> 19.44 MHz 1001: -> 38.88 MHz 1010: -> 77.76 MHz 1111:-> Not yet detected
7:4	ref5_frq_detected	ref5 auto-detected frequency value 0000: -> 2 kHz 0001: -> 8 kHz 0010: -> 64 kHz 0011: -> 1.544 MHz 0100: -> 2.048 MHz 0101: -> 6.48 MHz 0110: -> 8.192 MHz 0111: -> 16.384 MHz 1000: -> 19.44 MHz 1001: -> 38.88 MHz 1010: -> 77.76 MHz 1111:-> Not yet detected

Address: **0x13**Register Name: **detected\_ref\_3**Default Value: **See Description**Type: **R**

Bit Field	Function Name	Description
3:0	ref6_frq_detected	ref6 auto-detected frequency value 0000: -> 2 kHz 0001: -> 8 kHz 0010: -> 64 kHz 0011: -> 1.544 MHz 0100: -> 2.048 MHz 0101: -> 6.48 MHz 0110: -> 8.192 MHz 0111: -> 16.384 MHz 1000: -> 19.44 MHz 1001: -> 38.88 MHz 1010: -> 77.76 MHz 1111:-> Not yet detected
7:4	ref7_frq_detected	ref7 auto-detected frequency value 0000: -> 2 kHz 0001: -> 8 kHz 0010: -> 64 kHz 0011: -> 1.544 MHz 0100: -> 2.048 MHz 0101: -> 6.48 MHz 0110: -> 8.192 MHz 0111: -> 16.384 MHz 1000: -> 19.44 MHz 1001: -> 38.88 MHz 1010: -> 77.76 MHz 1111:-> Not yet detected



Address: **0x14**Register Name: **detected\_sync\_0**Default Value: **See Description**Type: **R**

Bit Field	Function Name	Description
2:0	sync0_frq_detected	sync0 frequency value 100 -> 1 Hz 000 -> 166.67 Hz 001 -> 400 Hz 010 -> 1 kHz 011 -> 2 kHz 101 -> 8 kHz 111 -> 64 kHz Otherwise: not yet detected
3	sync0_fail	sync0 fail status. A value of 1 indicates a failure.
6:4	sync1_frq_detected	sync1 frequency value 100 -> 1 Hz 000 -> 166.67 Hz 001 -> 400 Hz 010 -> 1 kHz 011 -> 2 kHz 101 -> 8 kHz 111 -> 64 kHz Otherwise: not yet detected
7	sync1_fail	sync1 valid status. A value of 1 indicates a failure

Address: **0x15**Register Name: **detected\_sync\_1**Default Value: **See Description**Type: **R**

Bit Field	Function Name	Description
2:0	sync2_frq_detected	sync2 frequency value 100 -> 1 Hz 000 -> 166.67 Hz 001 -> 400 Hz 010 -> 1 kHz 011 -> 2 kHz 101 -> 8 kHz 111 -> 64 kHz Otherwise: not yet detected

Address: **0x15**Register Name: **detected\_sync\_1**Default Value: **See Description**Type: **R**

Bit Field	Function Name	Description
3	sync2_fail	sync2 fail status. A value of 1 indicates a failure.
6:4	sync8_frq_detect	sync8 frequency value 100 -> 1 Hz 000 - 166.67 Hz 001 - 400 Hz 010 - 1 kHz 011 - 2 kHz 100 - Not Used 101 - 8 kHz 111 - 64 kHz Otherwise: not yet detected
7	sync8_fail	sync8 failure status. (1 = failure)

Address: **0x16**Register Name: **oor\_ctrl\_0**Default Value: **0x33**Type: **R/W**

Bit Field	Function Name	Description
2:0	ref0_oor_sel	out of range limit selection 000: -> 9.2-12 (+/-ppm) 001: -> 40-52 (+/-ppm) 010 -> 100-130 (+/-ppm) 011: -> 64-83 (+/-ppm) 100: -> 13.8-18 (+/-ppm) 101: -> 24.6-32 (+/-ppm) 110: -> 36.6-47.5 (+/-ppm) 111: -> 52-67.5 (+/-ppm)
3	Reserved	Leave as default

Address: **0x16**  
 Register Name: **oor\_ctrl\_0**  
 Default Value: **0x33**  
 Type: **R/W**

Bit Field	Function Name	Description
6:4	ref1_oor_sel	out of range limit selection 000: -> 9.2-12 (+/-ppm) 001: -> 40-52 (+/-ppm) 010 -> 100-130 (+/-ppm) 011: -> 64-83 (+/-ppm) 100: -> 13.8-18 (+/-ppm) 101: -> 24.6-32 (+/-ppm) 110: -> 36.6-47.5 (+/-ppm) 111: -> 52-67.5 (+/-ppm)
7	Reserved	Leave as default

Address: **0x17**  
 Register Name: **oor\_ctrl\_1**  
 Default Value: **0x33**  
 Type: **R/W**

Bit Field	Function Name	Description
2:0	ref2_oor_sel	out of range limit selection 000: -> 9.2-12 (+/-ppm) 001: -> 40-52 (+/-ppm) 010 -> 100-130 (+/-ppm) 011: -> 64-83 (+/-ppm) 100: -> 13.8-18 (+/-ppm) 101: -> 24.6-32 (+/-ppm) 110: -> 36.6-47.5 (+/-ppm) 111: -> 52-67.5 (+/-ppm)
3	Reserved	Leave as default
6:4	ref3_oor_sel	out of range limit selection 000: -> 9.2-12 (+/-ppm) 001: -> 40-52 (+/-ppm) 010 -> 100-130 (+/-ppm) 011: -> 64-83 (+/-ppm) 100: -> 13.8-18 (+/-ppm) 101: -> 24.6-32 (+/-ppm) 110: -> 36.6-47.5 (+/-ppm) 111: -> 52-67.5 (+/-ppm)
7	Reserved	Leave as default

Address: **0x18**Register Name: **oor\_ctrl\_2**Default Value: **0x33**Type: **R/W**

Bit Field	Function Name	Description
2:0	ref4_oor_sel	out of range limit selection 000: -> 9.2-12 (+/-ppm) 001: -> 40-52 (+/-ppm) 010 -> 100-130 (+/-ppm) 011: -> 64-83 (+/-ppm) 100: -> 13.8-18 (+/-ppm) 101: -> 24.6-32 (+/-ppm) 110: -> 36.6-47.5 (+/-ppm) 111: -> 52-67.5 (+/-ppm)
3	Reserved	Leave as default
6:4	ref5_oor_sel	out of range limit selection 000: -> 9.2-12 (+/-ppm) 001: -> 40-52 (+/-ppm) 010 -> 100-130 (+/-ppm) 011: -> 64-83 (+/-ppm) 100: -> 13.8-18 (+/-ppm) 101: -> 24.6-32 (+/-ppm) 110: -> 36.6-47.5 (+/-ppm) 111: -> 52-67.5 (+/-ppm)
7	Reserved	Leave as default

Address: **0x19**Register Name: **oor\_ctrl\_3**Default Value: **0x33**Type: **R/W**

Bit Field	Function Name	Description
2:0	ref6_oor_sel	out of range limit selection 000: -> 9.2-12 (+/-ppm) 001: -> 40-52 (+/-ppm) 010 -> 100-130 (+/-ppm) 011: -> 64-83 (+/-ppm) 100: -> 13.8-18 (+/-ppm) 101: -> 24.6-32 (+/-ppm) 110: -> 36.6-47.5 (+/-ppm) 111: -> 52-67.5 (+/-ppm)

Address: **0x19**Register Name: **oor\_ctrl\_3**Default Value: **0x33**Type: **R/W**

Bit Field	Function Name	Description
3	Reserved	Leave as default
6:4	ref7_oor_sel	out of range limit selection 000: -> 9.2-12 (+/-ppm) 001: -> 40-52 (+/-ppm) 010 -> 100-130 (+/-ppm) 011: -> 64-83 (+/-ppm) 100: -> 13.8-18 (+/-ppm) 101: -> 24.6-32 (+/-ppm) 110: -> 36.6-47.5 (+/-ppm) 111: -> 52-67.5 (+/-ppm)
7	Reserved	Leave as default

Address: **0x1A**Register Name: **gst\_mask\_0**Default Value: **0xFF**Type: **R/W**

Bit Field	Function Name	Description
1:0	ref0_gst_mask	ref0 individual bits to inhibit CFM and SCM inputs to the guard soak timer. SCM is the LSB.
3:2	ref1_gst_mask	ref1 individual bits to inhibit CFM and SCM inputs to the guard soak timer. SCM is the LSB.
5:4	ref2_gst_mask	ref2 individual bits to inhibit CFM and SCM inputs to the guard soak timer. SCM is the LSB.
7:6	ref3_gst_mask	ref3 individual bits to inhibit CFM and SCM inputs to the guard soak timer. SCM is the LSB.

Address: **0x1B**Register Name: **gst\_mask\_1**Default Value: **0xFF**Type: **R/W**

Bit Field	Function Name	Description
1:0	ref4_gst_mask	ref4 individual bits to inhibit CFM and SCM inputs to the guard soak timer. SCM is the LSB.
3:2	ref5_gst_mask	ref5 individual bits to inhibit CFM and SCM inputs to the guard soak timer. SCM is the LSB.
5:4	ref6_gst_mask	ref6 individual bits to inhibit CFM and SCM inputs to the guard soak timer. SCM is the LSB.
7:6	ref6_gst_mask	ref7 individual bits to inhibit CFM and SCM inputs to the guard soak timer. SCM is the LSB.

Address: **0x1C**Register Name: **gst\_qualif\_time**Default Value: **0x1A**Type: **R/W**

Bit Field	Function Name	Description
3:0	time_to_disqualify	Guard_soak_timer control bits to disqualify the reference 0000: -> minimum delay possible 0001: -> 0.5 ms 0010: -> 1 ms 0011: -> 5 ms 0100: -> 10 ms 0101: -> 50 ms 0110: -> 100 ms 0111: -> 500 ms 1000: -> 1 s 1001: -> 2 s 1010: -> 2.5 s 1011: -> 4 s 1100: -> 8 s 1101: -> 16 s 1110: -> 32 s 1111: -> 64 s

Address: **0x1C**  
 Register Name: **gst\_qualif\_time**  
 Default Value: **0x1A**  
 Type: **R/W**

Bit Field	Function Name	Description
5:4	time_to_qualify	Timer control bits to qualify the reference. 00: -> 2 times the time to disqualify 01: -> 4 times the time to disqualify 10: -> 16 times the time to disqualify 11: -> 32 times the time to disqualify
7:6	Reserved	Leave as default

Address: **0x1D**  
 Register Name: **dpll1 control register 0**  
 Default Value: **See description**  
 Type: **R/W**

Bit Field	Function Name	Description
0	hs_en	Controls hitless reference switching. When set to 0, DPLL1 builds-out the phase difference between the current and the new reference to minimize the phase transient at the output. When set to 1, the output realigns itself with the new input phase.  The default value for this register bit is determined during power up and depends on the state of the dpll1_hs_en and the slave_en pins. The default value = 0 (hitless switching) when the dpll1_hs_en pin is held high and slave_en pin is held low, otherwise the default value = 1.
3:1	bandwidth	000: 0.1 Hz 001: 1.7 Hz 010: 3.5 Hz 011: 14 Hz 100: 28 Hz (limited to 14 Hz for 2 kHz references) 101: 890 Hz (limited to 14 Hz and 56 Hz for 2 kHz and 8 kHz references respectively) 110: fast lock (7 Hz) 111: Reserved  The default value for this register bit depends on the state of the slave_en pin. The default value = 110 (fast lock) when the slave_en pin is low and equal to 101 (890 Hz) when the slave_en pin is high.

Address: **0x1D**Register Name: **dp11 control register 0**Default Value: **See description**Type: **R/W**

Bit Field	Function Name	Description
5:4	dp11_ph_sloelim	available phase slope limits 00: 885 ns/s 01: 7.5 $\mu$ s/s 10: 61 $\mu$ s/s 11: (Default) unlimited
7:6	Reserved	Leave as default

Address: **0x1E**Register Name: **dp11\_ctrl\_1**Default Value: **See description**Type: **R/W**

Bit Field	Function Name	Description
0	revert_en	This signal enables revertive reference switching: 0: non-revertive (default) 1: revertive
1	freq_offset_en	Enables the Free-run frequency offset for DPLL1 (see Page 1, Address 0x65-0x68 to program offset value) 0: Free Run frequency offset disabled (default) 1: Free Run frequency offset enabled (only use in Free Run Mode)
3:2	reserved	Leave as default ([3:2] = 01)
5:4	hold_update	Holdover update time 00: 26 ms (default) 01: 1 s 10: 10 s 11: 60 s
7:6	hold_filt_bw	DPLL holdover post filtering bandwidth selection 00: bypass, no filtering 01: 18 mHz 10: 0.6 Hz 11: 10 Hz  The default value for this register bit depends on the state of the slave_en pin. The default value = 00 (no post filtering) when the slave_en pin is low and equal to 01 (18 mHz) when the slave_en pin is high.



Address: **0x1F**  
 Register Name: **dpll1\_modesel**  
 Default Value: **See description**  
 Type: **R/W**

Bit Field	Function Name	Description
2:0	modesel	<p>DPLL1 mode of operation</p> <p>000: <b>Manual Normal Mode.</b> In this mode, automatic reference switching is disabled and the selected reference is determined by the dpll1_refsel register (0x20). If the selected reference fails, the device enters holdover mode.</p> <p>001: <b>Manual Holdover Mode.</b> In this mode, automatic reference switching is disabled and DPLL1 stays in the holdover mode.</p> <p>010: <b>Manual Freerun Mode.</b> In this mode, automatic reference switching is disabled and DPLL1 stays in the free-run mode.</p> <p>011: <b>Automatic Normal Mode.</b> In this mode, automatic reference switching is enabled so that DPLL1 automatically selects the highest priority qualified reference. If that reference fails, an automatic reference switchover to the next highest priority qualified reference is initiated. If there are no suitable references for selection, DPLL1 will enter the holdover mode.</p> <p>100: <b>Timing over Packet (ToP) Client Mode.</b> In this mode, The DCO is controlled externally via software. This mode is only accessible through software and cannot be set as the default using the <b>dpll1_mode_sel</b> hardware pins on the device.</p> <p>The default value of this register depends on the setting of the <b>dpll1_mode_sel1:0</b> pins. See the “DPLL1 Mode Of Operation” section on page 17 for more details.</p>
7:3	reserved	Leave as default ([7:3] = 00000)

Address: **0x20**Register Name: **dpll1\_refsel**Default Value: **0x00**Type: **R in Automatic Normal Mode, R/W in Manual Normal Mode**

Bit Field	Function Name	Description
3:0	refsel	<p>In <b>Automatic Normal Mode</b> (see register 0x1F), this register indicates the currently selected reference. In <b>Manual Normal Mode</b> (see register 0x1F), this register is used to manually select the active reference.</p> <p>0000: ref 0  0001: ref 1  0010: ref 2  0011: ref 3  0100: ref 4  0101: ref 5  0110: ref 6  0111: ref 7  1000: ref 8  1001 to 1111: reserved</p>
7:4	reserved	Leave as default

Address: **0x21**Register Name: **dpll1\_ref\_fail\_mask**Default Values: **0x3C**Type: **R/W**

Bit Field	Function Name	Description
3:0	ref_sw_mask	<p>Mask for failure indicators (SCM, CFM, PFM and GST) used for automatic reference switching</p> <p>bit 0: SCM  bit 1: CFM  bit 2: GST  bit 3: PFM</p> <p>0: failure bit is masked (disabled)  1: failure bit is un-masked (enabled)</p>

Address: **0x21**  
 Register Name: **dpll1\_ref\_fail\_mask**  
 Default Values: **0x3C**  
 Type: **R/W**

Bit Field	Function Name	Description
7:4	ref_hold_mask	Mask for failure indicators (SCM, CFM, GST and PFM) used for automatic holdover. bit 4: SCM bit 5: CFM bit 6: GST bit 7: PFM  0: failure bit is masked (disabled) 1: failure bit is un-masked (enabled)

Address: **0x22**  
 Register Name: **dpll1\_wait\_to\_restore**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
3:0	wait_to_restore	Defines how long a previous failed reference must be fault free before it is considered as available for synchronization: 0000: 0 min (default) 0001: 1 min 0010: 2 min 0011: 3 min 0100: 4 min 0101: 5 min 0110: 6 min 0111: 7 min 1000: 8 min 1001: 9 min 1010: 10 min 1011: 11 min 1100: 12 min 1101: 13 min 1110: 14 min 1111: 15 min
7:4	Reserved	Leave as default

Address: **0x23**Register Name: **dpll1\_ref\_rev\_ctrl**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
7:0	ref_rev_ctrl	Revertive enable bits for ref0 to ref7. Bit 0 is used for ref0, bit 1 is used for ref1, etc  0: non-revertive 1: revertive

Address: **0x24**Register Name: **dpll1\_ref\_pri\_ctrl\_0**Default Value: **0x10**Type: **R/W**

Bit Field	Function Name	Description
3:0	ref0_priority	This selects the ref0 priority when in Automatic Normal Mode. 0000: ref0 has the highest priority 0001: ref0 has the 2nd highest priority 0010: ref0 has the 3rd highest priority 0011: ref0 has the 4th highest priority 0100: ref0 has the 5th highest priority 0101: ref0 has the 6th highest priority 0110: ref0 has the 7th highest priority 0111: ref0 has the 8th highest priority 1000: ref0 has the 9th highest priority 1001: ref0 has the 10th highest priority 1010: ref0 has the 11th highest priority 1011: ref0 has the 12th highest priority 1100: ref0 has the 13th highest priority 1101: ref0 has the 14th highest priority 1110: ref0 has the lowest priority 1111: ref0 is disabled

Address: **0x24**  
 Register Name: **dpll1\_ref\_pri\_ctrl\_0**  
 Default Value: **0x10**  
 Type: **R/W**

Bit Field	Function Name	Description
7:4	ref1_priority	<p>This selects the ref1 priority when in Automatic Normal Mode.</p> <p>0000: ref1 has the highest priority          0001: ref1 has the 2nd highest priority          0010: ref1 has the 3rd highest priority          0011: ref1 has the 4th highest priority          0100: ref1 has the 5th highest priority          0101: ref1 has the 6th highest priority          0110: ref1 has the 7th highest priority          0111: ref1 has the 8th highest priority          1000: ref1 has the 9th highest priority          1001: ref1 has the 10th highest priority          1010: ref1 has the 11th highest priority          1011: ref1 has the 12th highest priority          1100: ref1 has the 13th highest priority          1101: ref1 has the 14th highest priority          1110: ref1 has the lowest priority          1111: ref1 is disabled</p>

Address: **0x25**  
 Register Name: **dpll1\_ref\_pri\_ctrl\_1**  
 Default Value: **0x32**  
 Type: **R/W**

Bit Field	Function Name	Description
3:0	ref2_priority	<p>This selects the ref2 priority when in Automatic Normal Mode.</p> <p>0000: ref2 has the highest priority          0001: ref2 has the 2nd highest priority          0010: ref2 has the 3rd highest priority          0011: ref2 has the 4th highest priority          0100: ref2 has the 5th highest priority          0101: ref2 has the 6th highest priority          0110: ref2 has the 7th highest priority          0111: ref2 has the 8th highest priority          1000: ref2 has the 9th highest priority          1001: ref2 has the 10th highest priority          1010: ref2 has the 11th highest priority          1011: ref2 has the 12th highest priority          1100: ref2 has the 13th highest priority          1101: ref2 has the 14th highest priority          1110: ref2 has the lowest priority          1111: ref2 is disabled</p>

Address: **0x25**Register Name: **dpll1\_ref\_pri\_ctrl\_1**Default Value: **0x32**Type: **R/W**

Bit Field	Function Name	Description
7:4	ref3_priority	<p>This selects the ref3 priority when in Automatic Normal Mode.</p> <p>0000: ref3 has the highest priority  0001: ref3 has the 2nd highest priority  0010: ref3 has the 3rd highest priority  0011: ref3 has the 4th highest priority  0100: ref3 has the 5th highest priority  0101: ref3 has the 6th highest priority  0110: ref3 has the 7th highest priority  0111: ref3 has the 8th highest priority  1000: ref3 has the 9th highest priority  1001: ref3 has the 10th highest priority  1010: ref3 has the 11th highest priority  1011: ref3 has the 12th highest priority  1100: ref3 has the 13th highest priority  1101: ref3 has the 14th highest priority  1110: ref3 has the lowest priority  1111: ref3 is disabled</p>

Address: **0x26**Register Name: **dpll1\_ref\_pri\_ctrl\_2**Default Value: **0x54**Type: **R/W**

Bit Field	Function Name	Description
3:0	ref4_priority	<p>This selects the ref4 priority when in Automatic Normal Mode.</p> <p>0000: ref4 has the highest priority  0001: ref4 has the 2nd highest priority  0010: ref4 has the 3rd highest priority  0011: ref4 has the 4th highest priority  0100: ref4 has the 5th highest priority  0101: ref4 has the 6th highest priority  0110: ref4 has the 7th highest priority  0111: ref4 has the 8th highest priority  1000: ref4 has the 9th highest priority  1001: ref4 has the 10th highest priority  1010: ref4 has the 11th highest priority  1011: ref4 has the 12th highest priority  1100: ref4 has the 13th highest priority  1101: ref4 has the 14th highest priority  1110: ref4 has the lowest priority  1111: ref4 is disabled</p>

Address: **0x26**Register Name: **dpll1\_ref\_pri\_ctrl\_2**Default Value: **0x54**Type: **R/W**

Bit Field	Function Name	Description
7:4	ref5_priority	<p>This selects the ref5 priority when in Automatic Normal Mode.</p> <p>0000: ref5 has the highest priority</p> <p>0001: ref5 has the 2nd highest priority</p> <p>0010: ref5 has the 3rd highest priority</p> <p>0011: ref5 has the 4th highest priority</p> <p>0100: ref5 has the 5th highest priority</p> <p>0101: ref5 has the 6th highest priority</p> <p>0110: ref5 has the 7th highest priority</p> <p>0111: ref5 has the 8th highest priority</p> <p>1000: ref5 has the 9th highest priority</p> <p>1001: ref5 has the 10th highest priority</p> <p>1010: ref5 has the 11th highest priority</p> <p>1011: ref5 has the 12th highest priority</p> <p>1100: ref5 has the 13th highest priority</p> <p>1101: ref5 has the 14th highest priority</p> <p>1110: ref5 has the lowest priority</p> <p>1111: ref5 is disabled</p>

Address: **0x27**Register Name: **dpll1\_ref\_pri\_ctrl\_3**Default Value: **0x76**Type: **R/W**

Bit Field	Function Name	Description
3:0	ref6_priority	<p>This selects the ref6 priority when in Automatic Normal Mode.</p> <p>0000: ref6 has the highest priority</p> <p>0001: ref6 has the 2nd highest priority</p> <p>0010: ref6 has the 3rd highest priority</p> <p>0011: ref6 has the 4th highest priority</p> <p>0100: ref6 has the 5th highest priority</p> <p>0101: ref6 has the 6th highest priority</p> <p>0110: ref6 has the 7th highest priority</p> <p>0111: ref6 has the 8th highest priority</p> <p>1000: ref6 has the 9th highest priority</p> <p>1001: ref6 has the 10th highest priority</p> <p>1010: ref6 has the 11th highest priority</p> <p>1011: ref6 has the 12th highest priority</p> <p>1100: ref6 has the 13th highest priority</p> <p>1101: ref6 has the 14th highest priority</p> <p>1110: ref6 has the lowest priority</p> <p>1111: ref6 is disabled</p>

Address: **0x27**  
 Register Name: **dpll1\_ref\_pri\_ctrl\_3**  
 Default Value: **0x76**  
 Type: **R/W**

Bit Field	Function Name	Description
7:4	ref7_priority	<p>This selects the ref7 priority when in Automatic Normal Mode.</p> <p>0000: ref7 has the highest priority          0001: ref7 has the 2nd highest priority          0010: ref7 has the 3rd highest priority          0011: ref7 has the 4th highest priority          0100: ref7 has the 5th highest priority          0101: ref7 has the 6th highest priority          0110: ref7 has the 7th highest priority          0111: ref7 has the 8th highest priority          1000: ref7 has the 9th highest priority          1001: ref7 has the 10th highest priority          1010: ref7 has the 11th highest priority          1011: ref7 has the 12th highest priority          1100: ref7 has the 13th highest priority          1101: ref7 has the 14th highest priority          1110: ref7 has the lowest priority          1111: ref7 is disabled</p>

Address: **0x28**  
 Register Name: **dpll1\_hold\_lock\_fail**  
 Default Value: **See Description**  
 Type: **R**

Bit Field	Function Name	Description
0	holdover	This bit goes high whenever the PLL goes into holdover mode
1	lock	This bit goes high when the PLL is locked to the input reference
2	cur_ref_fail	This bit goes high when the currently selected reference (see refsel register) has a failure.
7:3	Reserved	Leave as default



Address: **0x29**Register Name: **dpll1\_pull\_in\_range**Default Value: **0x03**Type: **R/W**

Bit Field	Function Name	Description
1:0	pull_in_range	DPLL pull-in range 00: $\pm 12$ ppm 01: $\pm 52$ ppm 10: $\pm 130$ ppm 11: $\pm 83$ ppm (default)
7:2	Reserved	Leave as default

Address: **0x2A**Register Name: **dpll2\_control\_register\_0**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
0	$\overline{\text{hs\_en}}$	Controls hitless reference switching. When set to 0 (default), DPLL2 builds-out the phase difference between the current and the new reference to minimize the phase transient at the output. When set to 1, the output realigns itself with the new input phase.
3:1	Reserved	Leave as default
4	ph_slopelim	Available phase slope limits 0: 61 ms/s (default) 1: unlimited
6:5	Reserved	Leave as default
7	dpll_en	DPLL2 enable 0: DPLL2 disabled (default) 1: DPLL2 enable

Address: **0x2B**Register Name: **dpll2\_ctrl\_1**Default Value: **0x04**Type: **R/W**

Bit Field	Function Name	Description
0	revert_en	This signal enables revertive reference switching: 0: non-revertive (default) 1: revertive
1	freq_offset_en	Enables the Free-run frequency offset for DPLL2 (see Page 1, Address 0x65-0x68 to program offset value) 0: Free Run frequency offset disabled 1: Free Run frequency offset enabled
7:2	reserved	Leave as default

Address: **0x2C**Register Name: **dpll2\_modesel**Default Value: **0x02**Type: **R/W**

Bit Field	Function Name	Description
1:0	modesel	DPLL2 mode of operation 00: <b>Manual Normal Mode.</b> In this mode, automatic reference switching is disabled and the selected reference is determined by the dpll2_refsel register (0x2D). If the selected reference fails, the device enters holdover mode. 01: <b>Manual Holdover Mode.</b> In this mode, automatic reference switching is disabled and DPLL2 stays in the holdover mode. 10: <b>Manual Freerun Mode.</b> In this mode, automatic reference switching is disabled and DPLL2 stays in the free-run mode. 11: <b>Automatic Normal Mode.</b> In this mode, automatic reference switching is enabled so that DPLL2 automatically selects the highest priority qualified reference. If that reference fails, an automatic reference switchover to the next highest priority qualified reference is initiated. If there are no suitable references for selection, DPLL2 will enter the holdover mode.
7:2	Reserved	Leave as default

Address: **0x2D**Register Name: **dpll2\_refsel**Default Value: **0x00**Type: **R in Automatic Normal Mode, R/W in Manual Normal Mode**

Bit Field	Function Name	Description
3:0	refsel	<p>In <b>Automatic Normal Mode</b> (see register 0x1F), this register indicates the currently selected reference. In <b>Manual Normal Mode</b> (see register 0x1F), this register is used to manually select the active reference.</p> <p>0000: ref 0  0001: ref 1  0010: ref 2  0011: ref 3  0100: ref 4  0101: ref 5  0110: ref 6  0111: ref 7  1000: ref 8  1001 to 1111: reserved</p>
7:4	Reserved	Leave as default

Address: **0x2E**Register Name: **dpll2\_ref\_fail\_mask**Default Values: **0x3C**Type: **R/W**

Bit Field	Function Name	Description
3:0	ref_sw_mask	<p>Mask for failure indicators (SCM, CFM, PFM and GST) used for automatic reference switching</p> <p>bit 0: SCM  bit 1: CFM  bit 2: GST  bit 3: PFM</p> <p>0: failure bit is masked (disabled)  1: failure bit is un-masked (enabled)</p>

Address: **0x2E**Register Name: **dpll2\_ref\_fail\_mask**Default Values: **0x3C**Type: **R/W**

Bit Field	Function Name	Description
7:4	ref_hold_mask	Mask for failure indicators (SCM, CFM, GST and PFM) used for automatic holdover. bit 4: SCM bit 5: CFM bit 6: GST bit 7: PFM  0: failure bit is masked (disabled) 1: failure bit is un-masked (enabled)

Address: **0x2F**Register Name: **dpll2\_wait\_to\_restore**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
3:0	wait_to_restore	Defines how long a previous failed reference must be fault free before it is considered as available for synchronization: 0000: 0 min (default) 0001: 1 min 0010: 2 min 0011: 3 min 0100: 4 min 0101: 5 min 0110: 6 min 0111: 7 min 1000: 8 min 1001: 9 min 1010: 10 min 1011: 11 min 1100: 12 min 1101: 13 min 1110: 14 min 1111: 15 min
7:4	Reserved	Leave as default

Address: **0x30**Register Name: **dpll2\_ref\_rev\_ctrl**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
7:0	ref_rev_ctrl	Revertive enable bits for ref0 to ref7. Bit 0 is used for ref0, bit 1 is used for ref1, etc  0: non-revertive (default) 1: revertive

Address: **0x31**Register Name: **dpll2\_ref\_pri\_ctrl\_0**Default Value: **0x10**Type: **R/W**

Bit Field	Function Name	Description
3:0	ref0_priority	This selects the ref0 priority when in Automatic Normal Mode. 0000: ref0 has the highest priority 0001: ref0 has the 2nd highest priority 0010: ref0 has the 3rd highest priority 0011: ref0 has the 4th highest priority 0100: ref0 has the 5th highest priority 0101: ref0 has the 6th highest priority 0110: ref0 has the 7th highest priority 0111: ref0 has the 8th highest priority 1000: ref0 has the 9th highest priority 1001: ref0 has the 10th highest priority 1010: ref0 has the 11th highest priority 1011: ref0 has the 12th highest priority 1100: ref0 has the 13th highest priority 1101: ref0 has the 14th highest priority 1110: ref0 has the lowest priority 1111: ref0 is disabled

Address: **0x31**  
 Register Name: **dpll2\_ref\_pri\_ctrl\_0**  
 Default Value: **0x10**  
 Type: **R/W**

Bit Field	Function Name	Description
7:4	ref1_priority	<p>This selects the ref1 priority when in Automatic Normal Mode.</p> <p>0000: ref1 has the highest priority          0001: ref1 has the 2nd highest priority          0010: ref1 has the 3rd highest priority          0011: ref1 has the 4th highest priority          0100: ref1 has the 5th highest priority          0101: ref1 has the 6th highest priority          0110: ref1 has the 7th highest priority          0111: ref1 has the 8th highest priority          1000: ref1 has the 9th highest priority          1001: ref1 has the 10th highest priority          1010: ref1 has the 11th highest priority          1011: ref1 has the 12th highest priority          1100: ref1 has the 13th highest priority          1101: ref1 has the 14th highest priority          1110: ref1 has the lowest priority          1111: ref1 is disabled</p>

Address: **0x32**  
 Register Name: **dpll2\_ref\_pri\_ctrl\_1**  
 Default Value: **0x32**  
 Type: **R/W**

Bit Field	Function Name	Description
3:0	ref2_priority	<p>This selects the ref2 priority when in Automatic Normal Mode.</p> <p>0000: ref2 has the highest priority          0001: ref2 has the 2nd highest priority          0010: ref2 has the 3rd highest priority          0011: ref2 has the 4th highest priority          0100: ref2 has the 5th highest priority          0101: ref2 has the 6th highest priority          0110: ref2 has the 7th highest priority          0111: ref2 has the 8th highest priority          1000: ref2 has the 9th highest priority          1001: ref2 has the 10th highest priority          1010: ref2 has the 11th highest priority          1011: ref2 has the 12th highest priority          1100: ref2 has the 13th highest priority          1101: ref2 has the 14th highest priority          1110: ref2 has the lowest priority          1111: ref2 is disabled</p>

Address: **0x32**Register Name: **dpll2\_ref\_pri\_ctrl\_1**Default Value: **0x32**Type: **R/W**

Bit Field	Function Name	Description
7:4	ref3_priority	<p>This selects the ref3 priority when in Automatic Normal Mode.</p> <p>0000: ref3 has the highest priority  0001: ref3 has the 2nd highest priority  0010: ref3 has the 3rd highest priority  0011: ref3 has the 4th highest priority  0100: ref3 has the 5th highest priority  0101: ref3 has the 6th highest priority  0110: ref3 has the 7th highest priority  0111: ref3 has the 8th highest priority  1000: ref3 has the 9th highest priority  1001: ref3 has the 10th highest priority  1010: ref3 has the 11th highest priority  1011: ref3 has the 12th highest priority  1100: ref3 has the 13th highest priority  1101: ref3 has the 14th highest priority  1110: ref3 has the lowest priority  1111: ref3 is disabled</p>

Address: **0x33**Register Name: **dpll2\_ref\_pri\_ctrl\_2**Default Value: **0x54**Type: **R/W**

Bit Field	Function Name	Description
3:0	ref4_priority	<p>This selects the ref4 priority when in Automatic Normal Mode.</p> <p>0000: ref4 has the highest priority  0001: ref4 has the 2nd highest priority  0010: ref4 has the 3rd highest priority  0011: ref4 has the 4th highest priority  0100: ref4 has the 5th highest priority  0101: ref4 has the 6th highest priority  0110: ref4 has the 7th highest priority  0111: ref4 has the 8th highest priority  1000: ref4 has the 9th highest priority  1001: ref4 has the 10th highest priority  1010: ref4 has the 11th highest priority  1011: ref4 has the 12th highest priority  1100: ref4 has the 13th highest priority  1101: ref4 has the 14th highest priority  1110: ref4 has the lowest priority  1111: ref4 is disabled</p>

Address: **0x33**Register Name: **dpll2\_ref\_pri\_ctrl\_2**Default Value: **0x54**Type: **R/W**

Bit Field	Function Name	Description
7:4	ref5_priority	<p>This selects the ref5 priority when in Automatic Normal Mode.</p> <p>0000: ref5 has the highest priority  0001: ref5 has the 2nd highest priority  0010: ref5 has the 3rd highest priority  0011: ref5 has the 4th highest priority  0100: ref5 has the 5th highest priority  0101: ref5 has the 6th highest priority  0110: ref5 has the 7th highest priority  0111: ref5 has the 8th highest priority  1000: ref5 has the 9th highest priority  1001: ref5 has the 10th highest priority  1010: ref5 has the 11th highest priority  1011: ref5 has the 12th highest priority  1100: ref5 has the 13th highest priority  1101: ref5 has the 14th highest priority  1110: ref5 has the lowest priority  1111: ref5 is disabled</p>

Address: **0x34**Register Name: **dpll2\_ref\_pri\_ctrl\_3**Default Value: **0x76**Type: **R/W**

Bit Field	Function Name	Description
3:0	ref6_priority	<p>This selects the ref6 priority when in Automatic Normal Mode.</p> <p>0000: ref6 has the highest priority  0001: ref6 has the 2nd highest priority  0010: ref6 has the 3rd highest priority  0011: ref6 has the 4th highest priority  0100: ref6 has the 5th highest priority  0101: ref6 has the 6th highest priority  0110: ref6 has the 7th highest priority  0111: ref6 has the 8th highest priority  1000: ref6 has the 9th highest priority  1001: ref6 has the 10th highest priority  1010: ref6 has the 11th highest priority  1011: ref6 has the 12th highest priority  1100: ref6 has the 13th highest priority  1101: ref6 has the 14th highest priority  1110: ref6 has the lowest priority  1111: ref6 is disabled</p>



Address: **0x34**Register Name: **dpll2\_ref\_pri\_ctrl\_3**Default Value: **0x76**Type: **R/W**

Bit Field	Function Name	Description
7:4	ref7_priority	<p>This selects the ref7 priority when in Automatic Normal Mode.</p> <p>0000: ref7 has the highest priority</p> <p>0001: ref7 has the 2nd highest priority</p> <p>0010: ref7 has the 3rd highest priority</p> <p>0011: ref7 has the 4th highest priority</p> <p>0100: ref7 has the 5th highest priority</p> <p>0101: ref7 has the 6th highest priority</p> <p>0110: ref7 has the 7th highest priority</p> <p>0111: ref7 has the 8th highest priority</p> <p>1000: ref7 has the 9th highest priority</p> <p>1001: ref7 has the 10th highest priority</p> <p>1010: ref7 has the 11th highest priority</p> <p>1011: ref7 has the 12th highest priority</p> <p>1100: ref7 has the 13th highest priority</p> <p>1101: ref7 has the 14th highest priority</p> <p>1110: ref7 has the lowest priority</p> <p>1111: ref7 is disabled</p>

Address: **0x35**Register Name: **dpll2\_hold\_lock\_fail**Default Value: **0x04**Type: **R**

Bit Field	Function Name	Description
0	holdover	This bit goes high whenever the PLL goes into holdover mode
1	lock	This bit goes high when the PLL is locked to the input reference
2	cur_ref_fail	This bit goes high when the currently selected reference (see refsel register) has a failure.
7:3	Reserved	Leave as default

Address: **0x36**  
 Register Name: **p0\_enable**  
 Default Value: **0x8F**  
 Type: **R/W**

Bit Field	Function Name	Description
0	p0_clk0_en	1: enable p0_clk0 0: p0_clk0 is set to HiZ
1	p0_clk1_en	1: enable p0_clk1 0: p1_clk1 is set to HiZ
2	p0_fp0_en	1: enable p0_fp0 0: p0_fp0 is set to HiZ
3	p0_fp1_en	1: enable p0_fp1 0: p0_fp1 is set to HiZ
5:4	Reserved	Leave as default
6	p0_source	0: selects DPLL1 as its source 1: selects DPLL2 as its source
7	p_en	1: enable the P0 synthesizer 0: disable the P1 synthesizer

Address: **0x37**  
 Register Name: **p0\_run**  
 Default Value: **0x0F**  
 Type: **R/W**

Bit Field	Function Name	Description
0	p0_clk0_run	1: generate p0_clk0 0: p0_clk0 is set low
1	p0_clk1_run	1: generate p0_clk1 0: p0_clk1 is set low
2	p0_fp0_run	1: generate p0_fp0 0: p0_fp0 is set low
3	p0_fp1_run	1: generate p0_fp1 0: p0_fp1 is set low
7:4	Reserved	Leave as default

Address: **0x38**Register Name: **p0\_clk0\_freq\_0**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
7:0	p0_clk0_freq7_0	Sets the frequency of the p0_clk0 output programmed as N*8kHz. N is defined as a 14-bit value. This register defines bits 7:0.

Address: **0x39**Register Name: **p0\_clk0\_freq\_1**Default Value: **0x01**Type: **R/W**

Bit Field	Function Name	Description
5:0	p0_clk0_freq13_8	Sets the frequency of the p0_clk0 output programmed as N*8kHz. N is defined as a 14-bit value. This register defines bits 13:8.
7:6	Reserved	Leave as default

Address: **0x3A**Register Name: **p0\_clk0\_offset90**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
1:0	p0_clk0_offset90	p0_clk0 phase position coarse tuning 00: 00 degrees 01: 90 degrees 10: 180 degrees 11: 270 degrees
7:2	Reserved	Not used

Address: **0x3B**Register Name: **p0\_clk1\_div**Default Value: **0x3E**Type: **R/W**

Bit Field	Function Name	Description
5:0	p0_clk1_div	A two's complement value. Defines the p0_clk1 output frequency relative to the p0_clk0 output frequency: $p0\_clk1 = p0\_clk0 / (2^{p0\_clk1\_div})$ . p0_clk1_div must be set observing the minimum frequency limit of 2 kHz and the maximum frequency limit of 100 MHz.
7:6	Reserved	Not used

Address: **0x3C**Register Name: **p0\_clk1\_offset90**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
1:0	p0_clk1_offset90	p0_clk1 phase position coarse tuning 00: 00 degrees 01: 90 degrees 10: 180 degrees 11: 270 degrees
7:2	Reserved	Not used

Address: **0x3D**Register Name: **p0\_offset\_fine**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
7:0	p0_offset_fine	Phase alignment fine tuning for the P0 synthesizer. All p0 clocks and frame pulses are delayed by this delay value. Defined as an 8-bit two's complement value in 119.2 ps steps.

Address: **0x3E**Register Name: **p0\_fp0\_freq**Default Value: **0x05**Type: **R/W**

Bit Field	Function Name	Description
3:0	p0_fp0_freq	These signals select p0_fp0 frame pulse frequency 0000: 166.67 Hz 0001: 400 Hz 0010: 1 kHz 0011: 2 kHz 0100: 4 kHz 0101: 8 kHz 0110: 32 kHz 0111: 64 kHz 1000: 1 Hz
7:4	Reserved	Leave as default

Address: **0x3F**Register Name: **p0\_fp0\_type**Default Value: **0x83**Type: **R/W**

Bit Field	Function Name	Description
0	p0_fp0_style	0: Clock style (50% duty cycle, for 1 Hz, pulse width is equal to 4 msec) 1: frame pulse synchronizes to any of the available E1 family of output frequencies
1	p0_fp0_sync_edge	0: pulsed on rising edge of synchronization clock 1: pulsed on falling edge of synchronization clock (Not applicable for 1Hz)
3:2	Reserved	Leave as default

Address: **0x3F**Register Name: **p0\_fp0\_type**Default Value: **0x83**Type: **R/W**

6:4	p0_fp0_type	<p>Determines the pulse width of p0_fp0</p> <p>000 -&gt; pulse = one period of a 4.096 MHz clock</p> <p>001 -&gt; pulse = one period of a 8.192 MHz clock</p> <p>010 -&gt; pulse = one period of a 16.384 MHz clock</p> <p>011 -&gt; pulse = one period of a 32.768 MHz clock</p> <p>100 -&gt; pulse = one period of a 65.536 MHz clock</p> <p>101 -&gt; reserved</p> <p>110 -&gt; reserved</p> <p>111 -&gt; frame pulse width is one cycle of p0_clk0</p> <p><b>Note: the settings from 000 to 100 are pre-defined pulse widths when the p0_clk0 frequency is a multiple of the E1 rate (2.048 MHz). When p0_clk0 is not a multiple of E1, the 111 setting must be selected.</b></p>
7	p0_fp0_polarity	<p>0: positive polarity</p> <p>1: negative polarity</p>

Address: **0x40**Register Name: **p0\_fp0\_offset\_0**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
7:0	p0_fp0_fine_offset7_0	Bits [7:0] of the programmable frame pulse phase offset. When the p0_clk0 clock is an E1 multiple, the offset is defined in multiples of a 262.144 MHz period. This register is part of a 22-bit multi-byte register.

Address: **0x41**Register Name: **p0\_fp0\_offset\_1**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
7:0	p0_fp0_fine_offset15_8	Bits [15:8] of the programmable frame pulse phase offset. When the p0_clk0 clock is an E1 multiple, the offset is defined in multiples of a 262.144 MHz period. This register is part of a 22-bit multi-byte register.

Address: **0x42**  
 Register Name: **p0\_fp0\_offset\_2**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
5:0	p0_fp0_coarse_offset21_16	Bits [21:16] of the programmable frame pulse phase offset. This bit field programs the offset in multiples of 8 kHz cycles. This register is part of a 22-bit multi-byte register.
7:6	Reserved	Leave as default

Address: **0x43**  
 Register Name: **p0\_fp1\_freq\_2**  
 Default Value: **0x05**  
 Type: **R/W**

Bit Field	Function Name	Description
3:0	p0_fp1_freq	These signals select p0_fp1 frame pulse frequency 0000: 166.67 Hz 0001: 400 Hz 0010: 1 kHz 0011: 2 kHz 0100: 4 kHz 0101: 8 kHz 0110: 32 kHz 0111: 64 kHz 1000: 1 Hz
7:4	Reserved	Leave as default

Address: **0x44**  
 Register Name: **p0\_fp1\_type**  
 Default Value: **0x11**  
 Type: **R/W**

Bit Field	Function Name	Description
0	p0_fp1_style	0: Clock style (50% duty cycle, for 1 Hz, pulse width is equal to 4 msec) 1: frame pulse synchronizes to any of the available E1 family of output frequencies

Address: **0x44**Register Name: **p0\_fp1\_type**Default Value: **0x11**Type: **R/W**

1	p0_fp1_sync_edge	0: pulsed on rising edge of synchronization clock 1: pulsed on falling edge of synchronization clock (Not applicable for 1Hz)
3:2	Reserved	Leave as default
6:4	p0_fp1_type	Determines the pulse width of p0_fp0 000 -> pulse = one period of a 4.096 MHz clock 001 -> pulse = one period of a 8.192 MHz clock 010 -> pulse = one period of a 16.384 MHz clock 011 -> pulse = one period of a 32.768 MHz clock 100 -> pulse = one period of a 65.536 MHz clock 101 -> reserved 110 -> reserved 111 -> frame pulse width is one cycle of p0_clk0  <b>Note: the settings from 000 to 100 are pre-defined pulse widths when the p0_clk1 frequency is a multiple of the E1 rate (2.048 MHz). When p0_clk1 is not a multiple of E1, the 111 setting must be selected.</b>
7	p0_fp1_polarity	0: positive polarity 1: negative polarity

Address: **0x45**Register Name: **p0\_fp1\_offset\_0**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
7:0	p0_fp1_fine_offset7_0	Bits [7:0] of the programmable frame pulse phase offset. When the p0_clk1 clock is an E1 multiple, the offset is defined in multiples of a 262.144 MHz period. This register is part of a 22-bit multi-byte register.

Address: **0x46**Register Name: **p0\_fp1\_offset\_1**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
7:0	p0_fp1_fine_offset15_8	Bits [15:8] of the programmable frame pulse phase offset. When the p0_clk1 clock is an E1 multiple, the offset is defined in multiples of a 262.144 MHz period. This register is part of a 22-bit multi-byte register.



Address: **0x47**  
 Register Name: **p0\_fp1\_offset\_2**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
5:0	p0_fp1_coarse_offset21_16	Bits [21:16] of the programmable frame pulse phase offset. This bit field programs the offset in multiples of 8 kHz cycles. This register is part of a 22-bit multi-byte register.
7:6	Reserved	Leave as default

Address: **0x48**  
 Register Name: **p1\_enable**  
 Default Value: **0x8F**  
 Type: **R/W**

Bit Field	Function Name	Description
0	p1_clk0_en	1: enable p1_clk0 0: p1_clk0 is set to HiZ
1	p1_clk1_en	1: enable p1_clk1 0: p1_clk1 is set to HiZ
5:2	Reserved	Leave as default
6	p1_source	0: selects DPLL1 as its source 1: selects DPLL2 as its source
7	p1_en	1: enable the P1 synthesizer 0: disable the P1 synthesizer

Address: **0x49**  
 Register Name: **p0\_run**  
 Default Value: **0x0F**  
 Type: **R/W**

Bit Field	Function Name	Description
0	p1_clk0_run	1: generate p1_clk0 0: p1_clk0 is set low

Address: **0x49**Register Name: **p0\_run**Default Value: **0x0F**Type: **R/W**

Bit Field	Function Name	Description
1	p1_clk1_run	1: generate p1_clk1 0: p1_clk1 is set low
7:2	Reserved	Leave as default

Address: **0x4A**Register Name: **p1\_clk0\_freq\_0**Default Value: **0xC1**Type: **R/W**

Bit Field	Function Name	Description
7:0	p1_clk0_freq7_0	Sets the frequency of the p1_clk0 output programmed as N*8kHz. N is defined as a 14-bit value. This register defines bits 7:0.

Address: **0x4B**Register Name: **p1\_clk0\_freq\_1**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
5:0	p1_clk0_freq13_8	Sets the frequency of the p1_clk0 output programmed as N*8kHz. N is defined as a 14-bit value. This register defines bits 13:8.
7:6	Reserved	Leave as default

Address: **0x4C**  
 Register Name: **p1\_clk0\_offset90**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
1:0	p1_clk0_offset90	p1_clk0 phase position coarse tuning 00: 00 degrees 01: 90 degrees 10: 180 degrees 11: 270 degrees
7:2	Reserved	Not used

Address: **0x4D**  
 Register Name: **p1\_clk1\_div**  
 Default Value: **0x3F**  
 Type: **R/W**

Bit Field	Function Name	Description
5:0	p1_clk1_div	A two's complement value. Defines the p1_clk1 output frequency relative to the p0_clk0 output frequency: $p1\_clk1 = p1\_clk0 / (2^{p1\_clk1\_div})$ . p1_clk1_div must be set observing the minimum frequency limit of 2 kHz and the maximum frequency limit of 100 MHz.
7:6	Reserved	Not used

Address: **0x4E**  
 Register Name: **p1\_clk1\_offset90**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
1:0	p1_clk1_offset90	p1_clk1 phase position coarse tuning 00: 00 degrees 01: 90 degrees 10: 180 degrees 11: 270 degrees
7:2	Reserved	Not used

Address: **0x4F**Register Name: **p1\_offset\_fine**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
7:0	p1_offset_fine	Phase alignment fine tuning for the P1 synthesizer. All p1 clocks and frame pulses are delayed by this delay value. Defined as an 8-bit two's complement value in 119.2 ps steps.

Address: **0x50**Register Name: **apll\_enable**Default Value: **0x8F**Type: **R/W**

Bit Field	Function Name	Description
0	apll_clk0_en	1: enable apll_clk0 0: apll_clk0 is set to HiZ
1	apll_clk1_en	1: enable apll_clk1 0: apll_clk1 is set to HiZ
2	apll_fp0_en	1: enable apll_fp0 0: apll_fp0 is set to HiZ
3	apll_fp1_en	1: enable apll_fp1 0: apll_fp0 is set to HiZ
5:4	Reserved	Leave as default
6	apll_source	0: selects DPLL1 1: selects DPLL2
7	apll__en	1: enable the APLL 0: disable the APLL

Address: **0x51**Register Name: **apll\_run\_register**Default Value: **0x0F**Type: **R/W**

Bit Field	Function Name	Description
0	apll_clk0_run	1: generate apll_clk0 0: apll_clk0 is set low
1	apll_clk1_run	1: generate apll_clk1 0: apll_clk1 is set low
2	apll_fp0_run	1: generate apll_fp0 0: apll_fp0 is set low
3	apll_fp1_run	1: generate apll_fp1 0: apll_fp1 is set low
4	f_sel0	Along with eth_en bit select if the APLL generates SONET/SDH or Ethernet frequencies 0: SONET/SDH clocks 1: Ethernet clocks
5	f_sel1	Along with eth_en bit select if the APLL generates SONET/SDH or Ethernet frequencies 0: SONET/SDH clocks 1: Ethernet clocks
6	eth_en	Select if the APLL generates SONET/SDH or Ethernet frequencies 0: SONET/SDH clocks 1: Ethernet clocks
7	Reserved	Leave as default

Address: **0x52**Register Name: **apll\_clk\_freq**Default Value: **0x42**Type: **R/W**

Bit Field	Function Name	Description
3:0	apll_clk0_freq	Sets the frequency of the apll_clk0 clock output. Refer to Table 10, "APLL LVCMOS Output Clock Frequencies" on page 34 for list of available frequencies

Address: **0x52**  
 Register Name: **apll\_clk\_freq**  
 Default Value: **0x42**  
 Type: **R/W**

Bit Field	Function Name	Description
7:4	apll_clk1_freq	Sets the frequency of the apll_clk1 clock output. Refer to Table 10, "APLL LVCMOS Output Clock Frequencies" on page 34 for list of available frequencies

Address: **0x53**  
 Register Name: **apll\_clk0\_offset90**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
1:0	apll_clk0_offset90	apll_clk0 phase position coarse tuning 00: 00 degrees 01: 90 degrees 10: 180 degrees 11: 270 degrees
7:2	Reserved	Leave as default

Address: **0x54**  
 Register Name: **apll\_clk1\_offset90**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
1:0	apll_clk1_offset90	apll_clk1 phase position coarse tuning 00: 00 degrees 01: 90 degrees 10: 180 degrees 11: 270 degrees
7:2	Reserved	Leave as default

Address: **0x55**Register Name: **apll\_offset\_fine**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
7:0	apll_offset_fine	Phase alignment fine tuning for the APLL clock path. The delay is defined as an 8-bit two's complement value in 119.2 ps steps.

Address: **0x56**Register Name: **apll\_fp0\_freq**Default Value: **0x05**Type: **R/W**

Bit Field	Function Name	Description
2:0	apll_fp0_freq	This select the apll_fp0 frame pulse frequency 000: 166.67 Hz 001: 400 Hz 010: 1 kHz 011: 2 kHz 100: 4 kHz 101: 8 kHz 110: 32 kHz 111: 64 kHz
7:3	Reserved	Leave as default

Address: **0x57**Register Name: **apll\_fp0\_type**Default Value: **0x23**Type: **R/W**

Bit Field	Function Name	Description
0	apll_fp0_style	0: Clock style (50% duty cycle) 1: frame pulse synchronizes to any of the available E1 family of output frequencies
1	apll_fp0_sync_edge	0: pulsed on rising edge of synchronization clock 1: pulsed on falling edge of synchronization clock
3:2	Reserved	Leave as default

Address: **0x57**  
 Register Name: **apll\_fp0\_type**  
 Default Value: **0x23**  
 Type: **R/W**

Bit Field	Function Name	Description
6:4	apll_fp0_type	Determines the pulse width of apll_fp0 000 -> pulse = one period of a 19.44 MHz period 001 -> pulse = one period of a 38.88 MHz period 010 -> pulse = one period of a 77.76 MHz period 011 -> pulse = one period of a 155.52 MHz period 100 -> pulse = one period of a 6.48 MHz period 101 -> pulse = one period of a 51.84 MHz period 111 -> frame pulse width is one cycle of apll_clk0
7	apll_fp0_polarity	0: positive polarity 1: negative polarity

Address: **0x58**  
 Register Name: **apll\_fp0\_offset\_0**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
7:0	apll_fp0_fine_offset7_0	Bits [7:0] of the programmable frame pulse phase offset.  When apll_clk0 is a multiple of 6.48 MHz (6.48 MHz, 12.96 MHz, 25.92 MHz, 51.84 MHz), delay values are programmed in steps of 1/207.36 MHz.  When apll_clk0 is a multiple of 19.44 MHz (19.44 MHz, 38.88 MHz, 77.76 MHz, and 9.84 MHz), delay values are in steps of 1/311.04 MHz.  This register is part of a 22-bit multi-byte register.



Address: **0x59**Register Name: **apll\_fp0\_offset\_1**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
7:0	apll_fp0_fine_offset15_8	Bits [15:8] of the programmable frame pulse phase offset. See description in register 0x58. This register is part of a 22-bit multi-byte register.

Address: **0x5A**Register Name: **apll\_fp0\_offset\_2**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
5:0	apll_fp0_coarse_offset_21_16	Bits [21:16] of the programmable frame pulse phase offset. This bit field programs the offset in multiples of 8 kHz cycles. This register is part of a 22-bit multi-byte register.
7:6	Reserved	Leave as default

Address: **0x5B**Register Name: **apll\_fp1\_freq**Default Value: **0x03**Type: **R/W**

Bit Field	Function Name	Description
2:0	apll_fp1_freq	This select the apll_fp1 frame pulse frequency 000: 166.67 Hz 001: 400 Hz 010: 1 kHz 011: 2 kHz 100: 4 kHz 101: 8 kHz 110: 32 kHz 111: 64 kHz
7:3	Reserved	Leave as default

Address: **0x5C**Register Name: **apll\_fp1\_type**Default Value: **0x03**Type: **R/W**

Bit Field	Function Name	Description
0	apll_fp1_style	0: Clock style (50% duty cycle) 1: frame pulse synchronizes to any of the available E1 family of output frequencies
1	apll_fp1_sync_edge	0: pulsed on rising edge of synchronization clock 1: pulsed on falling edge of synchronization clock
3:2	Reserved	Leave as default
6:4	apll_fp1_type	Determines the pulse width of apll_fp1 000 -> pulse = one period of a 19.44 MHz period 001 -> pulse = one period of a 38.88 MHz period 010 -> pulse = one period of a 77.76 MHz period 011 -> pulse = one period of a 155.52 MHz period 100 -> pulse = one period of a 6.48 MHz period 101 -> pulse = one period of a 51.84 MHz period 111 -> frame pulse width is one cycle of apll_clk1
7	apll_fp1_polarity	0: positive polarity 1: negative polarity

Address: **0x5D**Register Name: **apll\_fp1\_offset\_0**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
7:0	apll_fp1_fine_offset7_0	Bits [7:0] of the programmable frame pulse phase offset.  When apll_clk1 is a multiple of 6.48 MHz (6.48 MHz, 12.96 MHz, 25.92 MHz, 51.84 MHz), delay values are programmed in steps of 1/207.36 MHz.  When apll_clk1 is a multiple of 19.44 MHz (19.44 MHz, 38.88 MHz, 77.76 MHz, and 6.84 MHz), delay values are in steps of 1/311.04 MHz.  This register is part of a 22-bit multi-byte register.

Address: **0x5E**Register Name: **apll\_fp1\_offset\_1**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
7:0	apll_fp1_fine_offset15_8	Bits [15:8] of the programmable frame pulse phase offset. See description in register 0x5D. This register is part of a 22-bit multi-byte register.

Address: **0x5F**Register Name: **apll\_fp1\_offset\_2**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
5:0	apll_fp1_coarse_offset21_16	Bits [21:16] of the programmable frame pulse phase offset. This bit field programs the offset in multiples of 8 kHz cycles. This register is part of a 22-bit multi-byte register.
7:6	Reserved	Leave as default

Address: **0x60**Register Name: **diff\_ctrl**Default Value: **0xA3**Type: **R/W**

Bit Field	Function Name	Description
0	diff0_en	1: enable diff0 0: diff0 is set to HiZ
1	diff1_en	1: enable diff1 0: diff1 is set to HiZ
3:2	Reserved	Leave as default
5:4	diff0_adjust	Adjusts alignment of differential output to the appl_clk0 output in steps of 1.6 ns. A lower value advances diff0, a higher value delays it with respect to the appl_clk0

Address: **0x60**  
 Register Name: **diff\_ctrl**  
 Default Value: **0xA3**  
 Type: **R/W**

Bit Field	Function Name	Description
7:6	diff1_adjust	Adjusts alignment of differential output to the appl_clk1 output in steps of 1.6 ns. A lower value advances diff1, a higher value delays it with respect to the appl_clk1

Address: **0x61**  
 Register Name: **diff\_sel**  
 Default Value: **0x53**  
 Type: **R/W**

Bit Field	Function Name	Description
2:0	diff0_sel	Selects the output frequency for diff0. Refer to Table 11, "APLL Differential Output Clock Frequencies" on page 34 for specific frequency settings.
3	Reserved	Leave as default
6:4	diff1_sel	Selects the output frequency for diff1. Refer to Table 11, "APLL Differential Output Clock Frequencies" on page 34 for specific frequency settings.
7	Reserved	Leave as default

Address: **0x62**Register Name: **fb\_control**Default Value: **0x80**Type: **R/W**

Bit Field	Function Name	Description
0	fb_clk_en	1: enable fb_clk 0: fb_clk is set to HiZ
3:1	Reserved	Leave as default
4	fb_ref8_sync8_ctrl	These bits control the functionality of ref8/ext_fb_clk and sync8/ext_fb_fp pins:  0: pins used as ref8/sync8 with internal feedback 1: pins used as ext_fb_clk/ext_fb_fp with external feedback
7:5	Reserved	Leave as default

Address: **0x63**Register Name: **fb\_offset\_fine**Default Value: **0xFF**Type: **R/W**

Bit Field	Function Name	Description
7:0	fb_offset_fine	Phase alignment fine tuning for both the APLL and Programmable Synthesizers in steps of 119.2 ps. Programmed as an 8-bit two's complement value.

Address: **0x64**Register Name: **page\_pointer**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
7:0	page_pointer	Use to access extended page addresses  00 - General registers 01 - Free run frequency offset 02 - Reserved 03 - Reserved 04 - Reserved 05 - Reserved 06 - Reserved 07 - Reserved 08 - Ref8, 1Hz sync enable 09 - Reserved 0A - Reserved 0B - Reserved 0C - Reserved 0D - Reserved 0E - Reserved 0F - Ref8, Composite CC

Address: **0x65**Register Name: **ref\_freq\_mode\_0**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
1:0	ref0_freq_mode	0: Auto_Frequency detect 1: CustomA configuration 2: CustomB configuration 3: Reserved
3:2	ref1_freq_mode	0: Auto_Frequency detect 1: CustomA configuration 2: CustomB configuration 3: Reserved
5:4	ref2_freq_mode	0: Auto_Frequency detect 1: CustomA configuration 2: CustomB configuration 3: Reserved

Address: **0x65**Register Name: **ref\_freq\_mode\_0**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
7:6	ref3_freq_mode	0: Auto_Frequency detect 1: CustomA configuration 2: CustomB configuration 3: Reserved

Address: **0x66**Register Name: **ref\_freq\_mode\_1**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
1:0	ref4_freq_mode	0: Auto_Frequency detect 1: CustomA configuration 2: CustomB configuration 3: Reserved
3:2	ref5_freq_mode	0: Auto_Frequency detect 1: CustomA configuration 2: CustomB configuration 3: Reserved
5:4	ref6_freq_mode	0: Auto_Frequency detect 1: CustomA configuration 2: CustomB configuration 3: Reserved
7:6	ref7_freq_mode	0: Auto_Frequency detect 1: CustomA configuration 2: CustomB configuration 3: Reserved

Address: **0x67**  
 Register Name: **custA\_mult\_0**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
7:0	custA_mult7_0	Bits 7:0 of a 14-bit value that defines the input reference Custom A frequency. This defined as a multiple of 8 kHz. See section 2.9, "Reference and Sync Inputs" for detail on this register settings.

Address: **0x68**  
 Register Name: **custA\_mult\_1**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
5:0	custA_mult13_8	Bits 13:8 of a 14-bit value that defines the input reference Custom A frequency. This defined as a multiple of 8 kHz. See section 2.9, "Reference and Sync Inputs" for detail on this register settings.
7:6	Reserved	Leave as default

Address: **0x69**  
 Register Name: **custA\_scm\_low**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
7:0	custA_scm_low_lim	Defines the SCM low limit for the Custom A frequency. See section 2.13, "Reference Monitoring for Custom Configurations" for more details.



Address: **0x6A**  
Register Name: **custA\_scm\_high**  
Default Value: **0x00**  
Type: **R/W**

Bit Field	Function Name	Description
7:0	custA_scm_high_lim	Defines the SCM high limit for the Custom A frequency. See section 2.13, "Reference Monitoring for Custom Configurations" for more details.

Address: **0x6B**  
Register Name: **custA\_cfm\_low\_0**  
Default Value: **0x00**  
Type: **R/W**

Bit Field	Function Name	Description
7:0	custA_cfm_low7_0	Bits 7:0 of a 16-bit value that defines the CFM low limit for the Custom A frequency. See section 2.13, "Reference Monitoring for Custom Configurations" for more details.

Address: **0x6C**  
Register Name: **custA\_cfm\_low\_1**  
Default Value: **0x00**  
Type: **R/W**

Bit Field	Function Name	Description
7:0	custA_cfm_low15_8	Bits 15:8 of a 16-bit value that defines the CFM low limit for the Custom A frequency. See section 2.13, "Reference Monitoring for Custom Configurations" for more details.

**Address: 0x6D****Register Name: custA\_cfm\_hi\_0****Default Value: 0x00****Type: R/W**

Bit Field	Function Name	Description
7:0	custA_cfm_hi7_0	Bits 7:0 of a 16-bit value that defines the CFM high limit for the Custom A frequency. See section 2.13, "Reference Monitoring for Custom Configurations" for more details.

**Address: 0x6E****Register Name: custA\_cfm\_hi\_1****Default Value: 0x00****Type: R/W**

Bit Field	Function Name	Description
7:0	custA_cfm_hi15_8	Bits 15:8 of a 16-bit value that defines the CFM high limit for the Custom A frequency. See section 2.13, "Reference Monitoring for Custom Configurations" for more details.

**Address: 0x6F****Register Name: custA\_cfm\_cycle****Default Value: 0x00****Type: R/W**

Bit Field	Function Name	Description
7:0	custA_cfm_cycle	Defines the number of cycles that are monitored in the given sample window for custom configuration A. Set as CFM reference monitoring cycles - 1. See section 2.13, "Reference Monitoring for Custom Configurations" for more details.

Address: **0x70**  
 Register Name: **custA\_div**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
0	custA_div	When enabled (set to 1) the CFM divides the reference input frequency by 4 to increase the measurement window. This is recommended when the reference frequency is greater than 19.44 MHz. See section 2.13, "Reference Monitoring for Custom Configurations" for more details.
7:1	Reserved	Leave as default

Address: **0x71**  
 Register Name: **custB\_mult\_0**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
7:0	custB_mult7_0	Bits 7:0 of a 14-bit value that defines the input reference Custom B frequency. This defined as a multiple of 8 kHz. See section 2.9, "Reference and Sync Inputs" for detail on this register settings.

Address: **0x72**  
 Register Name: **custB\_mult\_1**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
5:0	custB_mult13_8	Bits 13:8 of a 14-bit value that defines the input reference Custom B frequency. This defined as a multiple of 8 kHz. See section 2.9, "Reference and Sync Inputs" for detail on this register settings.
7:6	Reserved	Leave as default

Address: **0x73**  
Register Name: **custB\_scm\_low**  
Default Value: **0x00**  
Type: **R/W**

Bit Field	Function Name	Description
7:0	custB_scm_low_lim	Defines the SCM low limit for the Custom B frequency. See section 2.13, "Reference Monitoring for Custom Configurations" for more details.

Address: **0x74**  
Register Name: **custB\_scm\_high**  
Default Value: **0x00**  
Type: **R/W**

Bit Field	Function Name	Description
7:0	custB_scm_high_lim	Defines the SCM high limit for the Custom B frequency. See section 2.13, "Reference Monitoring for Custom Configurations" for more details.

Address: **0x75**  
Register Name: **custB\_cfm\_low\_0**  
Default Value: **0x00**  
Type: **R/W**

Bit Field	Function Name	Description
7:0	custB_cfm_low7_0	Bits 7:0 of a 16-bit value that defines the CFM low limit for the Custom B frequency. See section 2.13, "Reference Monitoring for Custom Configurations" for more details.

Address: **0x76**

Register Name: **custB\_cfm\_low\_1**

Default Value: **0x00**

Type: **R/W**

Bit Field	Function Name	Description
7:0	custB_cfm_low15_8	Bits 15:8 of a 16-bit value that defines the CFM low limit for the Custom B frequency. See section 2.13, "Reference Monitoring for Custom Configurations" for more details.

Address: **0x77**

Register Name: **custB\_cfm\_hi\_0**

Default Value: **0x00**

Type: **R/W**

Bit Field	Function Name	Description
7:0	custB_cfm_hi7_0	Bits 7:0 of a 16-bit value that defines the CFM high limit for the Custom B frequency. See section 2.13, "Reference Monitoring for Custom Configurations" for more details.

Address: **0x78**

Register Name: **custB\_cfm\_hi\_1**

Default Value: **0x00**

Type: **R/W**

Bit Field	Function Name	Description
7:0	custB_cfm_hi15_8	Bits 15:8 of a 16-bit value that defines the CFM high limit for the Custom B frequency. See section 2.13, "Reference Monitoring for Custom Configurations" for more details.

Address: **0x79**  
 Register Name: **custB\_cfm\_cycle**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
7:0	custB_cfm_cycle	Defines the number of cycles that are monitored in the given sample window for custom configuration B. Set as CFM reference monitoring cycles - 1. See section 2.13, "Reference Monitoring for Custom Configurations" for more details.

Address: **0x7A**  
 Register Name: **custB\_div**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
0	custB_div	When enabled (set to 1) the CFM divides the reference input frequency by 4 to increase the measurement window. This is recommended when the reference frequency is greater than 19.44 MHz. See section 2.13, "Reference Monitoring for Custom Configurations" for more details.
7:1	Reserved	Leave as default

Address: **0x7B**  
 Register Name: **cc\_ref0\_ctrl**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
1:0	ref0_cc_mode	Controls if ref0/sync0 become a composite clock input 00 = ref0 and sync0 operates as a reference and sync pulse pair 01 = ref0 and sync0 becomes a split phase unipolar input 10 = automatic detection 11 = reserved
2	ref0_cc_fp_mode	Selects one of two CC styles: GR-378 or G.703 Appendix II. 0: GR-378 style CC - the 8th bit of each octet generates a BPV 1: G.703 Appendix II style CC - the 1st bit of each octet generates a BPV

Address: **0x7B**  
 Register Name: **cc\_ref0\_ctrl**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
4:3	ref0_cc_fp_sel	Selects if the frame pulse output aligns with the 8 kHz BPV or the 400 Hz BPV violation.  00 = no selection 01 = select 8 KHz 10 = select 400 Hz 11 = reserved
7:5	Reserved	Leave as default

Address: **0x7C**  
 Register Name: **cc\_ref1\_ctrl**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
1:0	ref1_cc_mode	Controls if ref1/sync1 become a composite clock input 00 = ref1 and sync1 operates as a reference and sync pulse pair 01 = ref1 and sync1 becomes a split phase unipolar input 10 = automatic detection 11 = reserved
2	ref1_cc_fp_mode	Selects one of two CC styles: GR-378 or G.703 Appendix II. 0: GR-378 style CC - the 8th bit of each octet generates a BPV 1: G.703 Appendix II style CC - the 1st bit of each octet generates a BPV
4:3	ref1_cc_fp_sel	Selects if the frame pulse output aligns with the 8 kHz BPV or the 400 Hz BPV violation.  00 = no selection 01 = select 8 KHz 10 = select 400 Hz 11 = reserved
7:5	Reserved	Leave as default

Address: **0x7D**Register Name: **cc\_status**Default Value: **See description**Type: **R/W**

Bit Field	Function Name	Description
0	ref0_cc_detect	Composite clock detection for ref0: 0: no composite clock detected 1: composite clock detected
1	ref0_fp8k_detect	8 kHz frame sync detection for ref0: 0: not detected 1: detected
2	ref0_fp400_detect	400 Hz frame sync detection for ref0: 0: not detected 1: detected
3	ref1_cc_detect	Composite clock detection for ref1: 0: no composite clock detected 1: composite clock detected
4	ref1_fp8k_detect	8 kHz frame sync detection for ref1: 0: not detected 1: detected
5	ref1_fp400_detect	400 Hz frame sync detection for ref1: 0: not detected 1: detected
7:6	Reserved	Leave as default



Address: **0x7E**Register Name: **prescaler\_control**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
3:0	ref0_div	<p>Reference 0 frequency divide ratio</p> <p>0000: Divide by 1  0001: Divide by 2  0010: Divide by 3  0011: Divide by 4  0100: Divide by 5  0101: Divide by 6  0110: Divide by 7  0111: Divide by 8  1010: Divide by 1.5.  1100: Divide by 2.5.  1101 - 1111: reserved</p> <p>Note: Output jitter generation may be higher when using divide by 1.5 and 2.5 ratios</p>
7:4	ref1_div	<p>Reference 1 frequency divide ratio</p> <p>0000: Divide by 1  0001: Divide by 2  0010: Divide by 3  0011: Divide by 4  0100: Divide by 5  0101: Divide by 6  0110: Divide by 7  0111: Divide by 8  1010: Divide by 1.5.  1100: Divide by 2.5.  1101 - 1111: reserved</p> <p>Note: Output jitter generation may be higher when using divide by 1.5 and 2.5 ratios</p>

Address: **01\_0x65**  
 Register Name: **free\_run\_freq\_offset\_0**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
7:0	DCO_freq_offset_0	Bits[7:0] of the 28 bit DCO frequency offset value. Programmable in steps of $(2^{-40} * 80\text{MHz}/65.536\text{MHz} \times 10^9)\text{ppb}$ .

Address: **01\_0x66**  
 Register Name: **free\_run\_freq\_offset\_1**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
7:0	DCO_freq_offset_1	Bits[15:8] of the 28 bit DCO frequency offset value. Programmable in steps of $(2^{-40} * 80\text{MHz}/65.536\text{MHz} \times 10^9)\text{ppb}$ .

Address: **01\_0x67**  
 Register Name: **free\_run\_freq\_offset\_2**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
7:0	DCO_freq_offset_2	Bits[23:16] of the 28 bit DCO frequency offset value. Programmable in steps of $(2^{-40} * 80\text{MHz}/65.536\text{MHz} \times 10^9)\text{ppb}$ .

Address: **01\_0x68**Register Name: **free\_run\_freq\_offset\_3**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
3:0	DCO_freq_offset_3	Bits[27:24] of the 28 bit DCO frequency offset value. Programmable in steps of $(2^{-40} * 80\text{MHz}/65.536\text{MHz} \times 10^9)\text{ppb}$ .
7:4	Reserved	Leave as default

Address: **01\_0x69**Register Name: **DCO\_Phase\_0**Default Value: **0x00**Type: **R**

Bit Field	Function Name	Description
7:0	DCO_Phase_0	Bits[7:0] of the 64 bit DCO Phase Word.

Address: **01\_0x6A**Register Name: **DCO\_Phase\_1**Default Value: **0x00**Type: **R**

Bit Field	Function Name	Description
7:0	DCO_Phase_1	Bits[15:8] of the 64 bit DCO Phase Word.

Address: **01\_0x6B**  
 Register Name: **DCO\_Phase\_2**  
 Default Value: **0x00**  
 Type: **R**

Bit Field	Function Name	Description
7:0	DCO_Phase_2	Bits[23:16] of the 64 bit DCO Phase Word.

Address: **01\_0x6C**  
 Register Name: **DCO\_Phase\_3**  
 Default Value: **0x00**  
 Type: **R**

Bit Field	Function Name	Description
7:0	DCO_Phase_3	Bits[31:24] of the 64 bit DCO Phase Word.

Address: **01\_0x6D**  
 Register Name: **DCO\_Phase\_4**  
 Default Value: **0x00**  
 Type: **R**

Bit Field	Function Name	Description
7:0	DCO_Phase_4	Bits[39:32] of the 64 bit DCO Phase Word.

Address: **01\_0x6E**  
 Register Name: **DCO\_Phase\_5**  
 Default Value: **0x00**  
 Type: **R**

Bit Field	Function Name	Description
7:0	DCO_Phase_5	Bits[47:40] of the 64 bit DCO Phase Word.

Address: **01\_0x6F**  
 Register Name: **DCO\_Phase\_6**  
 Default Value: **0x00**  
 Type: **R**

Bit Field	Function Name	Description
7:0	DCO_Phase_6	Bits[55:48] of the 64 bit DCO Phase Word.

Address: **01\_0x70**  
 Register Name: **DCO\_Phase\_7**  
 Default Value: **0x00**  
 Type: **R**

Bit Field	Function Name	Description
7:0	DCO_Phase_7	Bits[63:56] of the 64 bit DCO Phase Word.

Address: **01\_0x71**  
 Register Name: **Local\_Time\_0**  
 Default Value: **0x00**  
 Type: **R**

Bit Field	Function Name	Description
7:0	Local_Time_0	Bits[7:0] of the 32 bit Local System Time.

Address: **01\_0x72**  
 Register Name: **Local\_Time\_1**  
 Default Value: **0x00**  
 Type: **R**

Bit Field	Function Name	Description
7:0	Local_Time_1	Bits[15:8] of the 32 bit Local System Time.

Address: **01\_0x73**Register Name: **Local\_Time\_2**Default Value: **0x00**Type: **R**

Bit Field	Function Name	Description
7:0	Local_Time_2	Bits[23:16] of the 32 bit Local System Time.

Address: **01\_0x74**Register Name: **Local\_Time\_3**Default Value: **0x00**Type: **R**

Bit Field	Function Name	Description
7:0	Local_Time_3	Bits[31:24] of the 32 bit Local System Time.

Page\_Address: **01\_0x75**Register Name: **ToD\_update\_0**Default Value: **0x00**Type: **R**

Bit Field	Function Name	Description
4:0	ToD_update_0	Bits[7:0] of the 64 bit ToD update register

Page\_Address: **01\_0x76**Register Name: **ToD\_update\_1**Default Value: **0x00**Type: **R**

Bit Field	Function Name	Description
4:0	ToD_update_1	Bits[15:8] of the 64 bit ToD update register

Page\_Address: **01\_0x77**  
Register Name: **ToD\_update\_2**  
Default Value: **0x00**  
Type: **R**

Bit Field	Function Name	Description
4:0	ToD_update_2	Bits[23:16] of the 64 bit ToD update register

Page\_Address: **01\_0x78**  
Register Name: **ToD\_update\_3**  
Default Value: **0x00**  
Type: **R**

Bit Field	Function Name	Description
4:0	ToD_update_3	Bits[31:24] of the 64 bit ToD update register

Page\_Address: **01\_0x79**  
Register Name: **ToD\_update\_4**  
Default Value: **0x00**  
Type: **R**

Bit Field	Function Name	Description
4:0	ToD_update_4	Bits[39:32] of the 64 bit ToD update register

Page\_Address: **01\_0x7A**  
Register Name: **ToD\_update\_5**  
Default Value: **0x00**  
Type: **R**

Bit Field	Function Name	Description
4:0	ToD_update_5	Bits[47:40] of the 64 bit ToD update register

Page\_Address: **01\_0x7B**  
Register Name: **ToD\_update\_6**  
Default Value: **0x00**  
Type: **R**

Bit Field	Function Name	Description
4:0	ToD_update_6	Bits[55:48] of the 64 bit ToD update register

Page\_Address: **01\_0x7C**  
Register Name: **ToD\_update\_7**  
Default Value: **0x00**  
Type: **R**

Bit Field	Function Name	Description
4:0	ToD_update_7	Bits[63:56] of the 64 bit ToD update register



Address: **08\_0x68**Register Name: **sync\_enable**Default Value: **0x0F**Type: **R/W**

Bit Field	Function Name	Description
3:0	sync_en	Control bits to enable frame pulse synchronization:  xxx1: enables sync0 xx1x: enables sync1 x1xx: enables sync2 1xxx: enables sync8  xxx0: disables sync0 xx0x: disables sync1 x0xx: disables sync2 0xxx: disables sync8
7:4	sync_inv	Control bits to enable frame pulse synchronization:  xxx1: inverts sync0 xx1x: inverts sync1 x1xx: inverts sync2 1xxx: inverts sync8  xxx0: non-inverted sync0 xx0x: non-inverted sync1 x0xx: non-inverted sync2 0xxx: non-inverted sync8

Address: **08\_0x69**  
 Register Name: **detected\_ref\_4**  
 Default Value: **0x0F**  
 Type: **R**

Bit Field	Function Name	Description
3:0	ref8_frq_detected	ref8 auto-detected frequency value  0000: 2 kHz 0001: 8 kHz 0010: 64 kHz 0011: 1.544 MHz 0100: 2.048 MHz 0101: 6.48 MHz 0110: 8.192 MHz 0111: 16.384 MHz 1000: 19.44 MHz 1001: 38.88 MHz 1010: 77.76 MHz 1111: Not yet detected
7:4	Reserved	Leave as default

Address: **08\_0x6A**  
 Register Name: **oor\_ctrl\_4**  
 Default Value: **0x03**  
 Type: **R/W**

Bit Field	Function Name	Description
2:0	ref8_oor_sel	out of range limit selection 000: -> 9.2-12 (+/-ppm) 001: -> 40-52 (+/-ppm) 010 -> 100-130 (+/-ppm) 011: -> 64-83 (+/-ppm) 100: -> 13.8-18 (+/-ppm) 101: -> 24.6-32 (+/-ppm) 110: -> 36.6-47.5 (+/-ppm) 111: -> 52-67.5 (+/-ppm)
7:3	Reserved	Leave as default

Address: **08\_0x6B**  
 Register Name: **gst\_mask\_2**  
 Default Value: **0x03**  
 Type: **R/W**

Bit Field	Function Name	Description
1:0	ref8_gst_mask	ref8 individual bits to inhibit CFM and SCM inputs to the guard soak timer. SCM is the LSB.
7:2	Reserved	Leave as default

Address: **08\_0x6C**  
 Register Name: **ref\_freq\_mode\_2**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
1:0	ref8_freq_mode	0: Auto_Frequency detect 1: CustomA configuration 2: CustomB configuration 3: Reserved sets (auto detect)
7:2	Reserved	Leave as default

Address: **08\_0x6D**  
 Register Name: **dp11\_ref\_rev\_ctrl\_1**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
0	ref8_rev_ctrl	Revertive enable bit for ref8  0: non-revertive 1: revertive
7:1	Reserved	Leave as default

Address: **08\_0x6E**Register Name: **dpll1\_ref\_pri\_ctrl\_4**Default Value: **0x08**Type: **R/W**

Bit Field	Function Name	Description
3:0	ref8_priority	This selects the ref8 priority when in Automatic Normal Mode. 0000: ref8 has the highest priority 0001: ref8 has the 2nd highest priority 0010: ref8 has the 3rd highest priority 0011: ref8 has the 4th highest priority 0100: ref8 has the 5th highest priority 0101: ref8 has the 6th highest priority 0110: ref8 has the 7th highest priority 0111: ref8 has the 8th highest priority 1000: ref8 has the 9th highest priority 1001: ref8 has the 10th highest priority 1010: ref8 has the 11th highest priority 1011: ref8 has the 12th highest priority 1100: ref8 has the 13th highest priority 1101: ref8 has the 14th highest priority 1110: ref8 has the lowest priority 1111: ref8 is disabled
7:4	Reserved	Leave as default

Address: **08\_0x6F**Register Name: **dpll2\_ref\_rev\_ctrl\_1**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
0	ref8_rev_ctrl	Revertive enable bit for ref8  0: non-revertive 1: revertive
7:1	Reserved	Leave as default

Address: **08\_0x70**Register Name: **dpll2\_ref\_pri\_ctrl\_4**Default Value: **0x08**Type: **R/W**

Bit Field	Function Name	Description
3:0	ref8_priority	This selects the ref8 priority when in Automatic Normal Mode. 0000: ref8 has the highest priority 0001: ref8 has the 2nd highest priority 0010: ref8 has the 3rd highest priority 0011: ref8 has the 4th highest priority 0100: ref8 has the 5th highest priority 0101: ref8 has the 6th highest priority 0110: ref8 has the 7th highest priority 0111: ref8 has the 8th highest priority 1000: ref8 has the 9th highest priority 1001: ref8 has the 10th highest priority 1010: ref8 has the 11th highest priority 1011: ref8 has the 12th highest priority 1100: ref8 has the 13th highest priority 1101: ref8 has the 14th highest priority 1110: ref8 has the lowest priority 1111: ref8 is disabled
7:4	Reserved	Leave as default

Address: **08\_0x71**Register Name: **1Hz\_enable**Default Value: **0x00**Type: **R/W**

Bit Field	Function Name	Description
0	1Hz_enable	1: enables 1Hz sync auto-detection and qualification 0: disables 1Hz sync auto-detection and qualification
7:1	Reserved	Leave as Default

Address: **08\_0x72**  
 Register Name: **ref\_inv**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
0	ref0_inv	1: inverts ref0 0: normal
1	ref1_inv	1: inverts ref1 0: normal
2	ref2_inv	1: inverts ref2 0: normal
3	ref8_inv	1: inverts ref8 0: normal
7:4	Reserved	Leave as default

Address: **0A\_0x6C**  
 Register Name: **DCO\_update**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
1:0	Reserved	Leave as Default.
3:2	DCO_Freq_update_en	00: Default mode, to be used in all modes except ToP Client Mode 01:Reserved 10:Reserved 11: ToP Client Mode (Enables the DCO updates and samples the DCO Phase Word and Local System Time and a ToP interrupt is generated at an interval specified in the DCO_update_interval register (0A_0x71),
7:4	Reserved	Leave as Default

Address: **0A\_0x71**  
 Register Name: **DCO\_update\_interval**  
 Default Value: **0x07**  
 Type: **R/W**

Bit Field	Function Name	Description
3:0	DCO_update_interval	Sets the interval between DCO frequency updates. Interval Time = $2^{(\text{DCO\_update\_interval} + 17)} \times 12.5\text{nsec}$
7:4	Reserved	Leave as Default

Page\_Address: **0A\_0x72**  
 Register Name: **ToP\_1Hz\_Alignment**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
1:0	Reserved	Reserved for ToP Client Mode
3:2	ToD_sync_ctrl	Used to latch the ToD into the ToD_update registers.
5:4	1Hz_sync_ctrl	Used to align internal 1 Hz to external 1 Hz sync pulse
7:6	Reserved	Reserved for ToP Client Mode

Page\_Address: **0A\_0x76**  
 Register Name: **Time\_of\_Day\_0**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
4:0	Time_of_Day_0	Bits[7:0] of the 64 bit Time of Day register

Page\_Address: **0A\_0x77**  
Register Name: **Time\_of\_Day\_1**  
Default Value: **0x00**  
Type: **R/W**

Bit Field	Function Name	Description
4:0	Time_of_Day_1	Bits[15:8] of the 64 bit Time of Day register

Page\_Address: **0A\_0x78**  
Register Name: **Time\_of\_Day\_2**  
Default Value: **0x00**  
Type: **R/W**

Bit Field	Function Name	Description
4:0	Time_of_Day_2	Bits[23:16] of the 64 bit Time of Day register

Page\_Address: **0A\_0x79**  
Register Name: **Time\_of\_Day\_3**  
Default Value: **0x00**  
Type: **R/W**

Bit Field	Function Name	Description
4:0	Time_of_Day_3	Bits[31:24] of the 64 bit Time of Day register

Page\_Address: **0A\_0x7A**  
Register Name: **Time\_of\_Day\_4**  
Default Value: **0x00**  
Type: **R/W**

Bit Field	Function Name	Description
4:0	Time_of_Day_4	Bits[39:32] of the 64 bit Time of Day register



Page\_Address: **0A\_0x7B**  
 Register Name: **Time\_of\_Day\_5**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
4:0	Time_of_Day_5	Bits[47:40] of the 64 bit Time of Day register

Page\_Address: **0A\_0x7C**  
 Register Name: **Time\_of\_Day\_6**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
4:0	Time_of_Day_6	Bits[55:48] of the 64 bit Time of Day register

Page\_Address: **0A\_0x7D**  
 Register Name: **Time\_of\_Day\_7**  
 Default Value: **0x00**  
 Type: **R/W**

Bit Field	Function Name	Description
4:0	Time_of_Day_7	Bits[63:56] of the 64 bit Time of Day register

Address: **0F\_0x65**  
 Register Name: **ref\_fail\_isr**  
 Default Value: **See description**  
 Type: **Sticky R**

Bit Field	Function Name	Description
0	ref8_fail	This bit is set to 1 when ref8 has a failure (default = 1)
3:1	Reserved	Leave as default

Address: **0F\_0x65**  
 Register Name: **ref\_fail\_isr**  
 Default Value: **See description**  
 Type: **Sticky R**

Bit Field	Function Name	Description
4	dpll1_sync8_fail	This bit is set to 1 when sync8 has a failure (default = 1).
7:5	Reserved	Leave as default

Address: **0F\_0x66**  
 Register Name: **ref\_fail\_isr\_4**  
 Default Value: **See description**  
 Type: **Sticky R**

Bit Field	Function Name	Description
0	ref8_scm_failed	SCM failure indication (1 indicates a failure)
1	ref8_cfm_failed	CFM failure indication (1 indicates a failure)
2	ref8_gst_failed	GST failure indication (1 indicates a failure)
3	ref8_pfm_failed	PFM failure indication (1 indicates a failure)
7:4	Reserved	Leave as default

Address: **0F\_0x67**  
 Register Name: **ref\_fail\_isr\_mask\_1**  
 Default Value: **0x11**  
 Type: **R/W**

Bit Field	Function Name	Description
0	ref8_fail_isr_mask	This bit masks ref8_fail of ref_fail_isr_1 register ('0' masks the interrupt)
3:1	Reserved	Leave as default
4	dpll1_sync_fail8_mask	This bit masks dpll1_sync_fail8 of ref_fail_isr_1 register ('0' masks the interrupt)
7:5	Reserved	Leave as default

Address: **0F\_0x68**  
 Register Name: **ref\_mon\_fail\_mask\_4**  
 Default Value: **0x0F**  
 Type: **R/W**

Bit Field	Function Name	Description
3:0	ref8_mon_fail_mask	Control register to mask each failure indicator for ref8 xxx0: mask ref SCM failure xx0x: mask ref CFM failure x0xx: mask ref GST failure 0xxx: mask ref PFM failure
7:4	Reserved	Leave as default

Address: **0F\_0x69**  
 Register Name: **cc\_isr**  
 Default Value: **0x00**  
 Type: **Sticky R**

Bit Field	Function Name	Description
0	ref0_bpv_error	ref0 BPV error. This bit is asserted in the absence of 2 bipolar violations within 2 consecutive eight bit periods.
1	ref1_bpv_error	ref1 BPV error. This bit is asserted in the absence of 2 bipolar violations within 2 consecutive eight bit periods.
7:2	Reserved	Leave as default

Address: **0F\_0x6A**  
 Register Name: **cc\_isr\_mask**  
 Default Value: **0x03**  
 Type: **R/W**

Bit Field	Function Name	Description
1:0	cc_isr_mask	Mask for cc_isr register. x0: mask ref0_bpv_error 0x: mask ref1_bpv_error
7:2	Reserved	Leave as default

Address: **0F\_0x6E**Register Name: **ToP\_isr**Default Value: **0x10**Type: **Sticky R**

Bit Field	Function Name	Description
0	Reserved	Reserved
1	ToP_isr	This bit is asserted when the DCO Phase Word and Local System Time have been sampled
7:2	Reserved	Reserved

Address: **0F\_0x6F**Register Name: **ToP\_isr\_mask**Default Value: **0x1F**Type: **R/W**

Bit Field	Function Name	Description
0	Reserved	Leave as Default
1	ToP_isr_mask	A 0 in this bit masks the ToP_isr
7:2	Reserved	Leave as Default

Address: **0F\_0x7D**Register Name: **isr0\_reg**Default Value: **0x48**Type: **R**

Bit Field	Function Name	Description
0	ref0_7_int	1: interrupt from ref_fail_isr_0 @0x02
1	dpll1_int	1: interrupt from dpll1_isr @0x03
2	dpll2_int	1: interrupt from dpll2_isr @0x04
3	ref_sync8_int	1: interrupt from ref_fail_isr_1@0F_0x65
4	cc_int	1: interrupt from cc_isr @0F_0x69

Address: **0F\_0x7D**  
 Register Name: **isr0\_reg**  
 Default Value: **0x48**  
 Type: **R**

Bit Field	Function Name	Description
5	Reserved	Reserved
6	ToP_int	1: interrupt from ToP_isr @0F_0x6E
7	Reserved	Reserved

Address: **0F\_0x7E**  
 Register Name: **isr0\_mask**  
 Default Value: **0x07**  
 Type: **R/W**

Bit Field	Function Name	Description
7:0	isr0_mask	Enabling a mask bit will allow interrupt generation. xxxxxx0: masks ref0_7_int xxxxxx0x: masks dpll1_int xxxxx0xx: masks dpll2_int xxxx0xxx: masks ref_sync8_int xxx0xxxx: masks cc_int x0xxxxxx: masks ToP_isr

## 5.0 AC and DC Electrical Characteristics

### DC Electrical Characteristics - Absolute Maximum Ratings\*

	Parameter	Symbol	Min.	Max.	Units
1	Supply voltage	$V_{DD}, AV_{DD}$	-0.5	4.6	V
2	Core supply voltage	$V_{CORE}, AV_{CORE}$	-0.5	2.5	V
3	Voltage on any digital pin	$V_{PIN}$	-0.5	6	V
4	Voltage on osci and osco pin	$V_{OSC}$	-0.3	$V_{DD} + 0.3$	V
5	Storage temperature	$T_{ST}$	-55	125	°C

\* Exceeding these values may cause permanent damage. Functional operation under these conditions is not implied.

\* Voltages are with respect to ground (GND) unless otherwise stated

### Recommended Operating Conditions\*

	Characteristics	Sym.	Min.	Typ.	Max.	Units
1	Supply voltage	$V_{DD}, AV_{DD}$	3.1	3.3	3.5	V
2	Core supply voltage	$V_{CORE}, AV_{CORE}$	1.7	1.8	1.9	V
3	Operating temperature	$T_A$	-40	25	85	°C

\* Voltages are with respect to ground (GND) unless otherwise stated

**DC Electrical Characteristics\***

	Characteristics	Sym.	Min.	Typ.	Max.	Units	Notes
1	1.8 V Core Supply Current	$I_{1.8\_CORE}$		138	188	mA	osci = 20 MHz, All outputs disabled.
2	I/O Supply Current (Differential Outputs)	$I_{DIFF}$		74	92	mA	All differential outputs operating at max frequency and biased with a 200 Ohm resistor to ground
3	I/O Supply Current (CMOS Outputs)	$I_{CMOS}$		100	143	mA	All CMOS outputs operating at max frequency and loaded with 20 pF
4	Total Power Dissipation	$P_{T\_D}$		823	1177	mW	All outputs operating at max frequency and loaded with 20 pF
5	CMOS high-level input voltage	$V_{IH}$	$0.7 \cdot V_{DD}$			V	Applies to osci pin
6	CMOS low-level input voltage	$V_{IL}$			$0.3 \cdot V_{DD}$	V	
7	Input leakage current	$I_{IL}$	-15		15	$\mu A$	$V_I = V_{DD}$ or 0 V
8	Input leakage current low for pull-up pads	$I_{IL\_PU}$	-121		-23	$\mu A$	$V_I = 0$ V
9	Input leakage current high for pull-down pads	$I_{IL\_PD}$	23		121	$\mu A$	$V_I = V_{DD}$
10	Schmitt trigger Low to High threshold point	$V_{t+}$	1.35		1.85	V	All CMOS inputs are schmitt level triggered
11	Schmitt trigger High to Low threshold point	$V_{t-}$	0.80		1.15	V	
12	CMOS high-level output voltage	$V_{OH}$	2.4			V	$I_{OH} = 8mA$ on clk & fp output. $I_{OH} = 4mA$ other outputs
13	CMOS low-level output voltage	$V_{OL}$			0.4	V	$I_{OL} = 8mA$ on clk & fp output. $I_{OL} = 4mA$ other outputs
14	LVPECL: High-level output voltage	$V_{OH\_LVPE\_CL}$	$V_{DD} - 1.08$	$V_{DD} - 0.96$	$V_{DD} - 0.88$	V	
15	LVPECL: Low-level output voltage	$V_{OL\_LVPE\_CL}$	$V_{DD} - 1.81$	$V_{DD} - 1.71$	$V_{DD} - 1.62$	V	
16	LVPECL: Differential output voltage	$V_{OD\_LVPE\_CL}$	0.6	0.8	0.93	V	

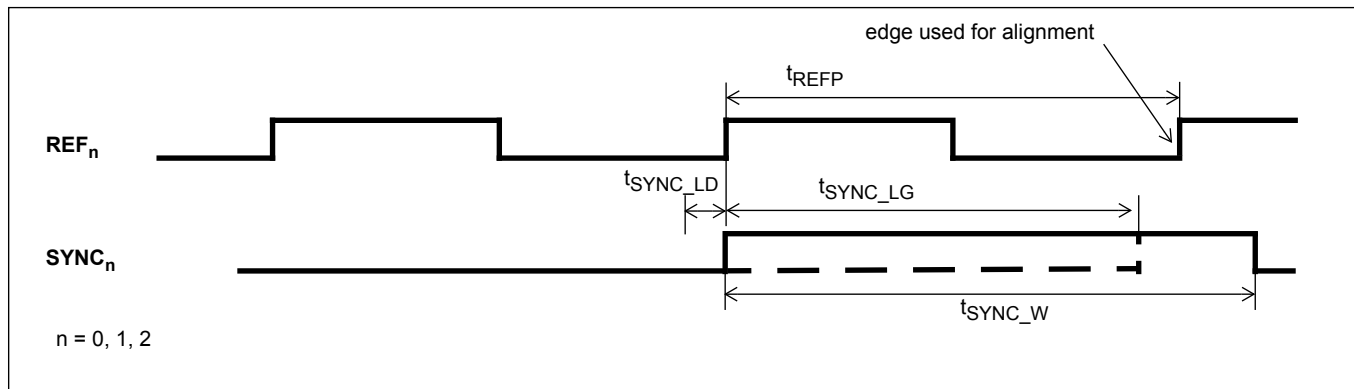
\* Supply voltage and operating temperature are as per Recommended Operating Conditions.

\* Voltages are with respect to ground (GND) unless otherwise stated.

**AC Electrical Characteristics\* - Input Timing For Sync References (See Figure 36).**

	Characteristics	Symbol	Min.	Max.	Units	Notes
1	sync0/1/2 lead time	$t_{\text{SYNC\_LD}}$		0	ns	
3	sync0/1/2 lag time	$t_{\text{SYNC\_LG}}$	0	$t_{\text{REFP}} - 4$	ns	$t_{\text{REFP}}$ = minimum period of ref0/1/2 clock
5	sync0/1/2 pulse width high or low	$t_{\text{SYNC\_W}}$	5		ns	

\* Supply voltage and operating temperature are as per Recommended Operating Conditions.



**Figure 36 - Sync Input Timing**

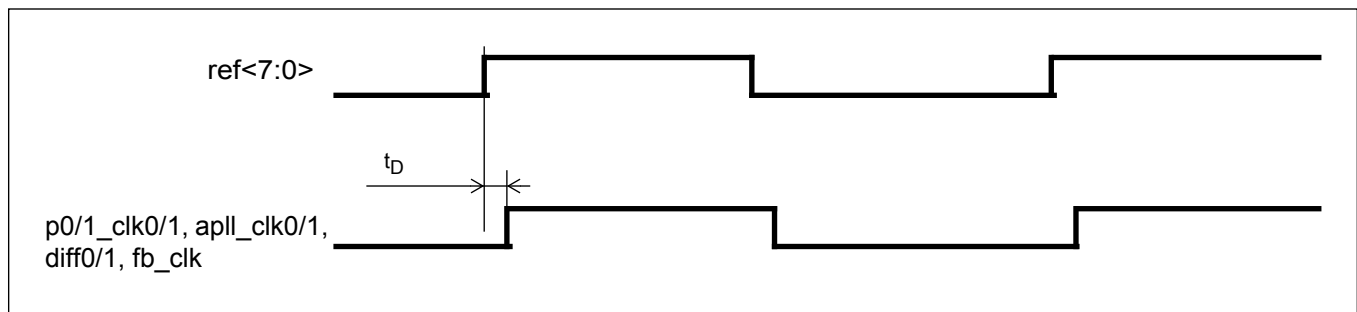


**AC Electrical Characteristics<sup>1</sup> - Input To Output Timing For Ref<7:0> References (See Figure 37).**

	Characteristics	Symbol	Min.	Max.	Units
1	LVC MOS Clock Outputs (p0_clk0/1) <sup>2</sup>	$t_D$	-1.5	+3.5	ns
2	LVC MOS Clock Output (p1_clk0/1) <sup>2</sup>	$t_D$	-2.0	+3.0	ns
3	LVC MOS Clock Outputs (apll_clk0/1) <sup>2</sup>	$t_D$	-1.5	+3.5	ns
4	LVC MOS Feedback Clock (fb_clk) <sup>2</sup>	$t_D$	+2.0	+7.0	ns
5	LVPECL Differential Clock Outputs (diff0/1) <sup>2</sup>	$t_D$	-0.5	+5.5	ns

<sup>1</sup> Input to output timing is measured over the specified operating voltage and temperature ranges using the same input and output spot frequencies of 2 kHz, 8 kHz, 1.544 MHz, 2.048 MHz, 6.48 MHz, 8.192 MHz, 16.384 MHz, 19.44 MHz, 38.88 MHz, and 77.76 MHz.

<sup>2</sup> Add 0.5 ns of delay when locked to ref0 or ref1 to account for the additional pre-dividers.



**Figure 37 - Input To Output Timing**

AC Electrical Characteristics - Output Clock Duty Cycle<sup>1</sup> (See Figure 38).

	Characteristics	Symbol	Min.	Max.	Units	Notes
1	LVCMOS Output Duty Cycle <sup>2</sup>	t <sub>SYM</sub>	45	55	%	2 kHz < f <sub>clk</sub> ≤ 125 MHz
			40	60	%	50 MHz
2	LVPECL Output Duty Cycle <sup>3</sup>	t <sub>SYM</sub>	45	55	%	2 kHz < f <sub>clk</sub> ≤ 125 MHz
			40	60	%	50 MHz

1. Duty cycle is measured over the specified operating voltage and temperature ranges at specified spot frequencies.
2. Measured on spot frequencies of 1.544 MHz, 2.048 MHz, 3.088 MHz, 4.096 MHz, 6.312 MHz, 8.192 MHz, 8.448 MHz, 16.384 MHz, 25 MHz, 32.768 MHz, 34.368 MHz, 44.736 MHz, 65.536 MHz, 125 MHz.
3. Measured on spot frequencies of 6.48 MHz, 19.44 MHz, 38.88 MHz, 51.84 MHz, 77.76 MHz, 155.52 MHz, 311.04 MHz, 622.08 MHz.

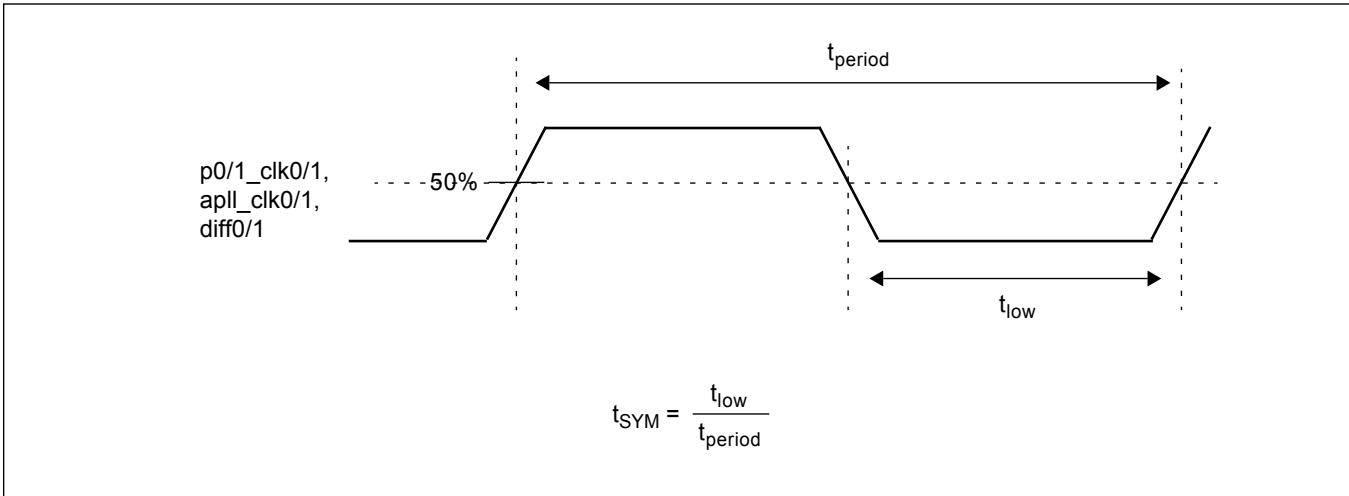
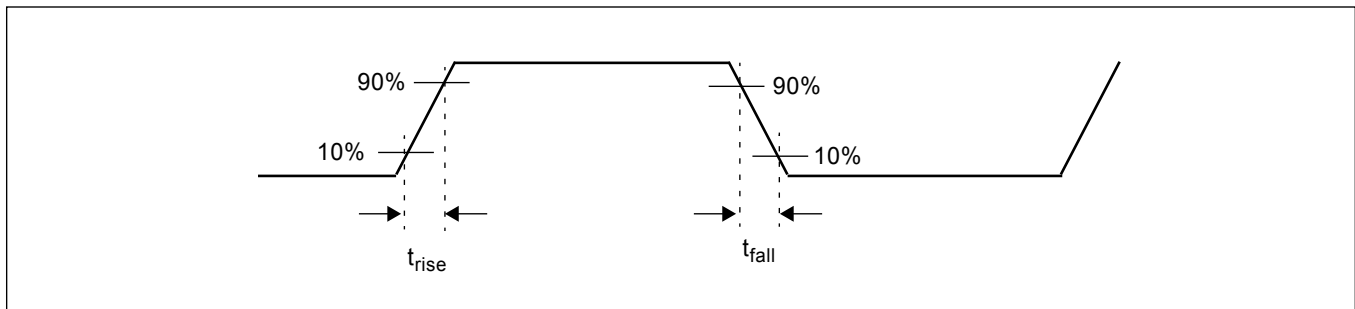


Figure 38 - Output Duty Cycle

**AC Electrical Characteristics\* - Output Clock and Frame Pulse Fall and Rise Times<sup>1</sup> (See Figure 39).**

	Characteristics	Symbol	Min.	Max.	Units	C <sub>LOAD</sub>
1	Output Rise Time	$t_{rise}$	2.3	4.5	ns	30 pF
2	Output Rise Time	$t_{rise}$	2.0	3.9	ns	25 pF
3	Output Rise Time	$t_{rise}$	1.6	3.2	ns	20 pF
4	Output Rise Time	$t_{rise}$	1.3	2.6	ns	15 pF
5	Output Rise Time	$t_{rise}$	1.0	1.9	ns	10 pF
6	Output Rise Time	$t_{rise}$	0.6	1.3	ns	5 pF
7	Output Fall Time	$t_{fall}$	2.1	5.2	ns	30 pF
8	Output Fall Time	$t_{fall}$	1.8	4.5	ns	25 pF
9	Output Fall Time	$t_{fall}$	1.5	3.7	ns	20 pF
10	Output Fall Time	$t_{fall}$	1.2	3.0	ns	15 pF
11	Output Fall Time	$t_{fall}$	0.9	2.3	ns	10 pF
12	Output Fall Time	$t_{fall}$	0.6	1.5	ns	5 pF

1. Output fall and rise times are specified over the operating voltage and temperature ranges at 10 MHz.

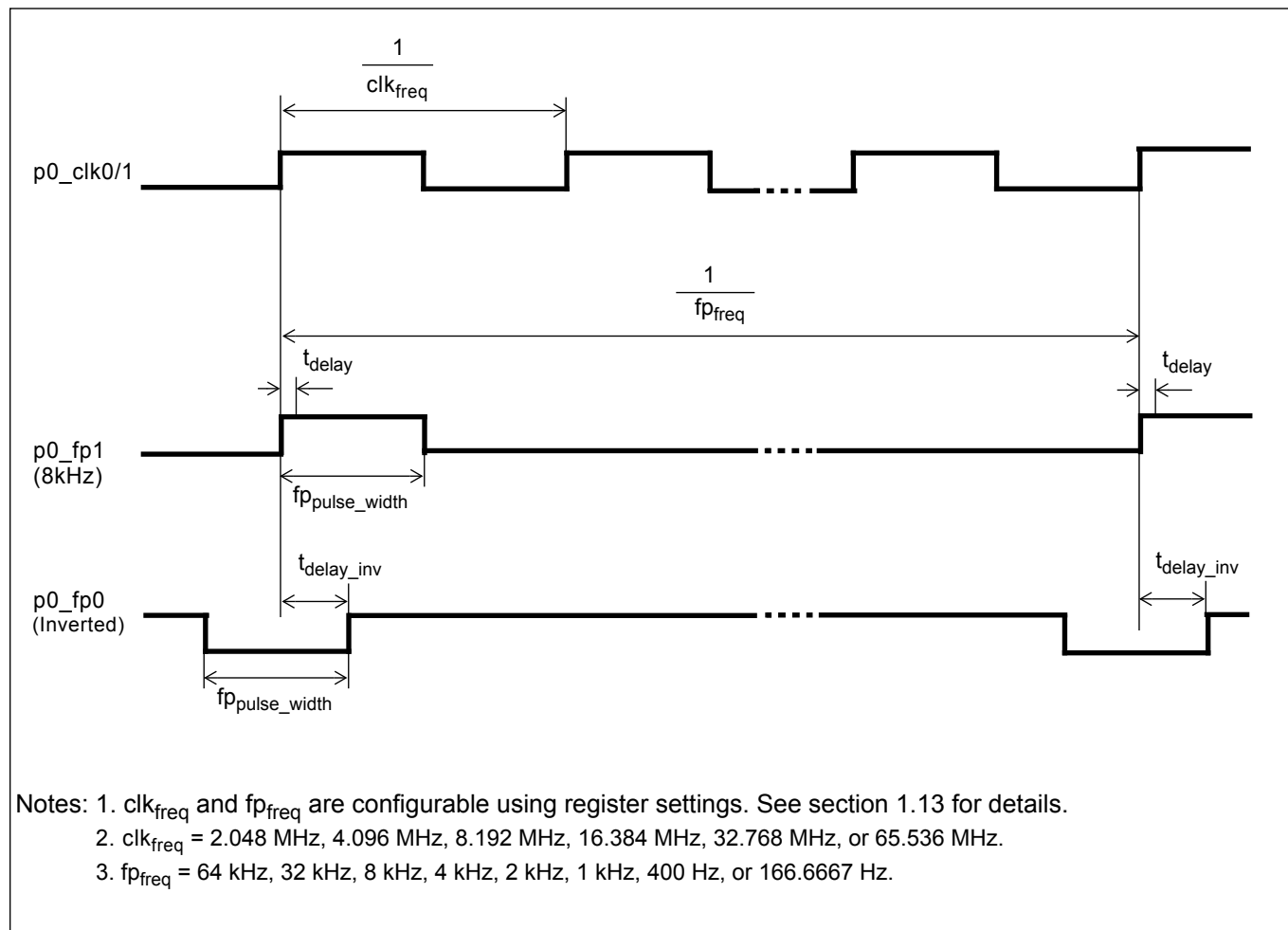


**Figure 39 - Output Clock Fall and Rise Times**

**AC Electrical Characteristics\* - E1 Output Frame Pulse Timing (See Figure 40).**

	Pulse Width Setting	$f_{p_{pulse\_width}}$		$t_{delay}$		$t_{delay\_inv}$		Units
		Min.	Max.	Min.	Max.	Min.	Max.	
1	One period of a 4.096 MHz clock	242	246	-2	2	120	124	ns
2	One period of a 8.192 MHz clock	120	124	-2	2	59	63	ns
3	One period of a 16.384 MHz clock	59	62	-2	2	29	33	ns
4	One period of a 32.768 MHz clock	29	32	-2	2	13	17	ns
5	One period of a 65.536 MHz clock	13.3	17.3	-2	2	5.6	9.6	ns

\* All measurements taken over the specified operating voltage and temperature range.

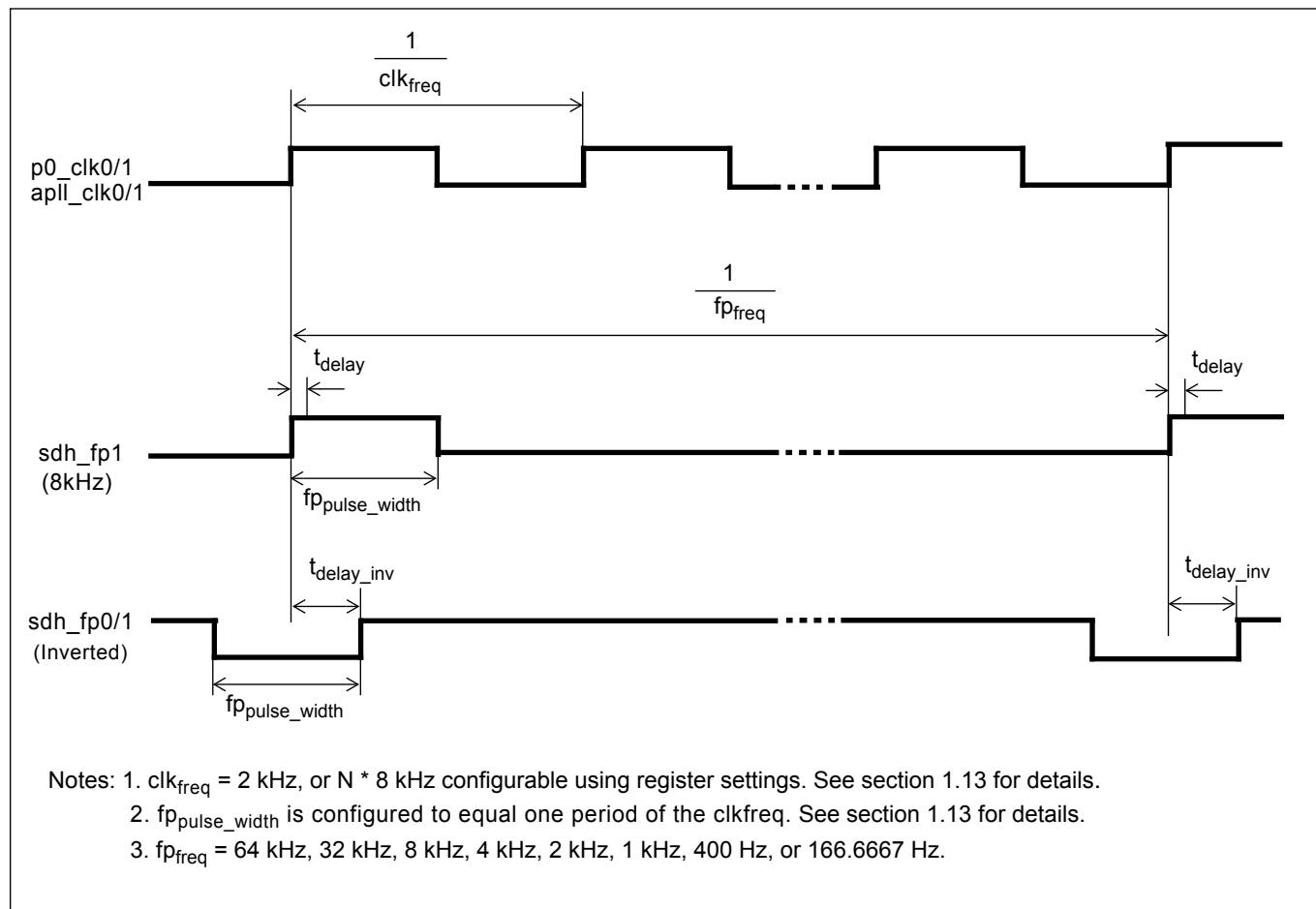


**Figure 40 - E1 Output Frame Pulse Timing**

**AC Electrical Characteristics\* - SONET Output Frame Pulse Timing (See Figure 41).**

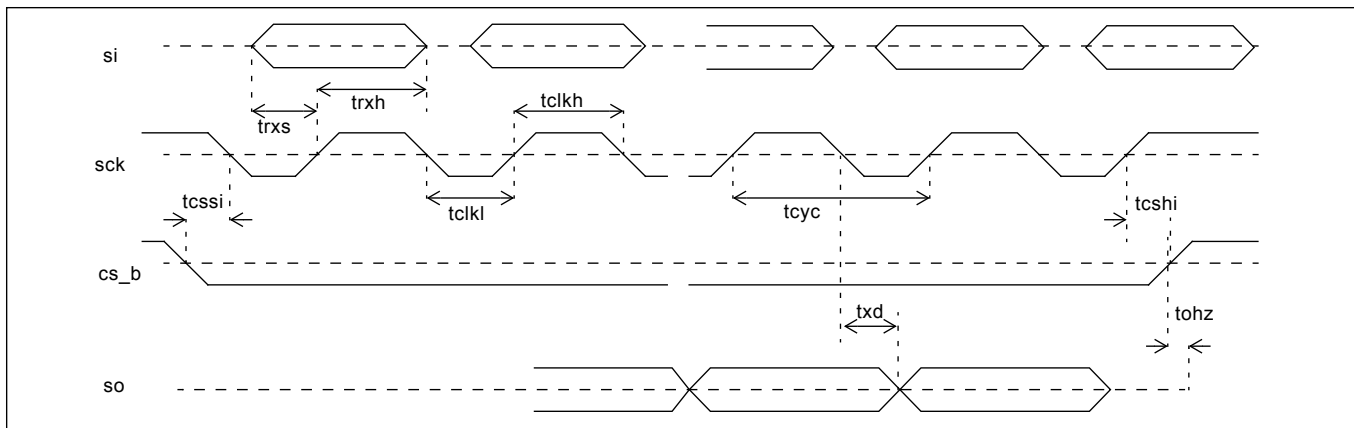
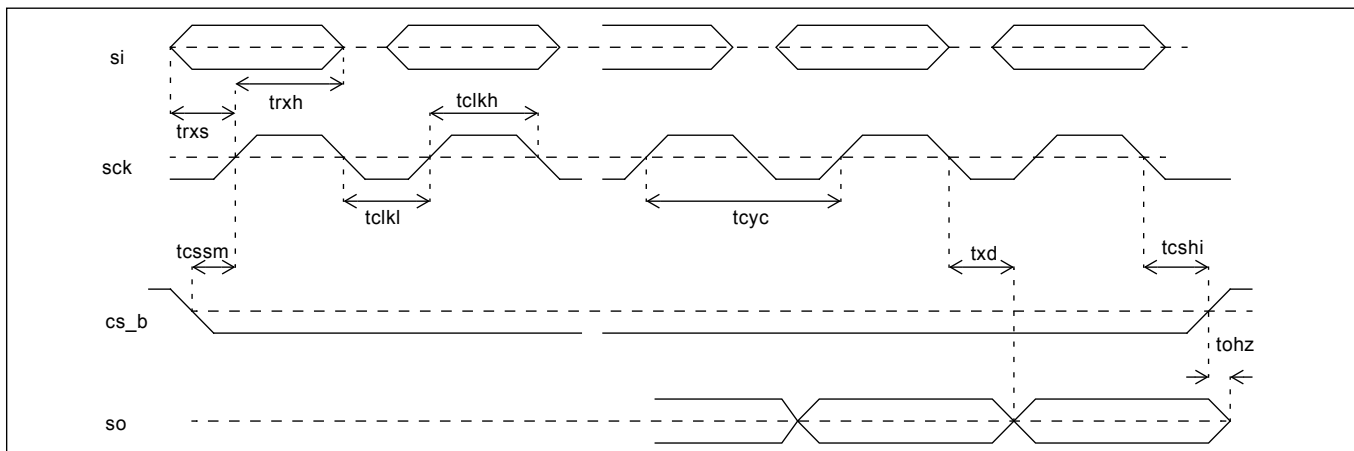
	Pulse Width Setting	$f_{p_{pulse\_width}}$		$t_{delay}$		$t_{delay\_inv}$		Units
		Min.	Max.	Min.	Max.	Min.	Max.	
1	One period of a 6.48 MHz clock	152	156	-2	2	-2	2	ns
2	One period of a 19.44 MHz clock	49	53	-2	2	-2	2	ns
3	One period of a 38.88 MHz clock	23.7	27.7	-2	2	-2	2	ns
4	One period of a 51.84 MHz clock	17.3	21.3	-2	2	-2	2	ns
5	One period of a 77.76 MHz clock	10.9	14.9	-2	2	-2	2	ns

\* All measurements taken over the specified operating voltage and temperature range.

**Figure 41 - SONET Output Frame Pulse Timing**

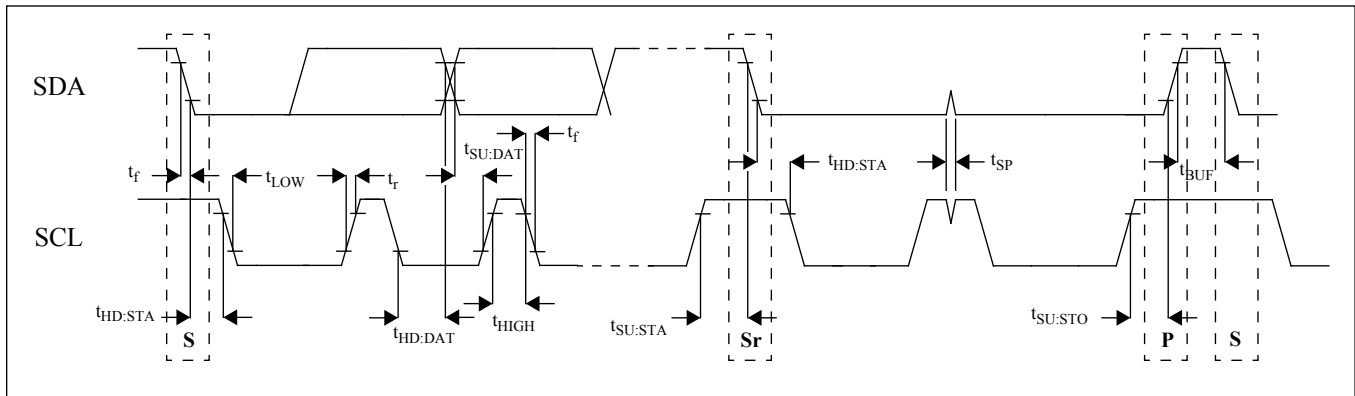
**AC Electrical Characteristics - Serial Peripheral Interface Timing**

Specification	Name	Min.	Max.	Units
sck period	tcyc	124		ns
sck pulse width low	tclk <sub>l</sub>	62		ns
sck pulse width high	tclk <sub>h</sub>	62		ns
si setup (write) from sck rising	trxs	10		ns
si hold (write) from sck rising	trxh	10		ns
so delay (read) from sck falling	txd		25	ns
cs_b setup from sck falling (LSB first)	tcssi	20		ns
cs_b setup from sck rising (MSB first)	tcssm	20		ns
cs_b hold from sck falling (MSB first)	tcshm	10		ns
cs_b hold from sck rising (LSB first)	tcshi	10		ns
cs_b to output high impedance	tohz		60	ns

**Table 18 - Serial Peripheral Interface Timing****Figure 42 - Serial Peripheral Interface Timing - LSB First Mode****Figure 43 - Serial Peripheral Interface Timing - MSB First Mode**

**AC Electrical Characteristics - I<sup>2</sup>C Timing**

Specification	Name	Min.	Typ.	Max.	Units	Note
SCL clock frequency	$f_{SCL}$	0		400	kHz	
Hold time START condition	$t_{HD:STA}$	0.6			us	
Low period SCL	$t_{LOW}$	1.3			us	
Hi period SCL	$t_{HIGH}$	0.6			us	
Setup time START condition	$t_{SU:STA}$	0.6			us	
Data hold time	$t_{HD:DAT}$	0		0.9	us	
Data setup time	$t_{SU:DAT}$	100			ns	
Rise time	$t_r$				ns	Determined by pull-up resistor
Fall time	$t_f$	20 + 0.1C <sub>b</sub>		250	ns	
Setup time STOP condition	$t_{SU:STO}$	0.6			us	
Bus free time between STOP/START	$t_{BUF}$	1.3			us	
Pulse width of spikes which must be suppressed by the input filter	$t_{SP}$	0		50	ns	
Max capacitance for each I/O pin				10	pF	

**Table 19 - I<sup>2</sup>C Serial Microport Timing****Figure 44 - I<sup>2</sup>C Serial Microport Timing**

**SONET Performance Characteristics - Output Jitter Generation On Differential LVPECL Output (diff0 and/or diff1). All other outputs disabled.**

Interface	Output Frequency	Jitter Measurement Filter	GR-253 Jitter Requirement		Jitter Generation		
					Typ <sup>1</sup>	Max <sup>2</sup>	Units
OC-3	19.44 MHz	12 kHz to 1.3 MHz	0.01 UI <sub>RMS</sub>	64.30	1.3	1.7	ps <sub>RMS</sub>
			0.1 UI <sub>P-P</sub>	643.00	14.7	19.1	ps <sub>P-P</sub>
	77.76 MHz	12 kHz to 1.3 MHz	0.01 UI <sub>RMS</sub>	64.30	0.7	0.9	ps <sub>RMS</sub>
			0.1 UI <sub>P-P</sub>	643.00	8.9	10.8	ps <sub>P-P</sub>
	155.52 MHz	12 kHz to 1.3 MHz	0.01 UI <sub>RMS</sub>	64.30	0.7	0.9	ps <sub>RMS</sub>
			0.1 UI <sub>P-P</sub>	643.00	9.1	11.2	ps <sub>P-P</sub>
OC-12	77.76 MHz	12 kHz to 5 MHz	0.01 UI <sub>RMS</sub>	16.08	0.8	1.0	ps <sub>RMS</sub>
			0.1 UI <sub>P-P</sub>	160.80	9.2	11.2	ps <sub>P-P</sub>
	155.52 MHz	12 kHz to 5 MHz	0.01 UI <sub>RMS</sub>	16.08	0.8	1.0	ps <sub>RMS</sub>
			0.1 UI <sub>P-P</sub>	160.80	9.2	11.4	ps <sub>P-P</sub>
	622.08 MHz	12 kHz to 5 MHz	0.01 UI <sub>RMS</sub>	4.020	0.7	0.9	ps <sub>RMS</sub>
			0.1 UI <sub>P-P</sub>	40.20	8.5	10.5	ps <sub>P-P</sub>
OC-48	155.52 MHz	12 kHz to 20 MHz	0.01 UI <sub>RMS</sub>	4.020	0.8	1.0	ps <sub>RMS</sub>
			0.1 UI <sub>P-P</sub>	40.20	9.5	11.7	ps <sub>P-P</sub>
	622.08 MHz	12 kHz to 20 MHz	0.01 UI <sub>RMS</sub>	4.020	0.7	0.9	ps <sub>RMS</sub>
			0.1 UI <sub>P-P</sub>	40.20	8.5	10.6	ps <sub>P-P</sub>

<sup>1</sup> Typical jitter specifications are measured when operating under nominal voltages of 1.8 V and 3.3 V and at an ambient temperature of 25°C.

<sup>2</sup> Maximum jitter specifications takes into account process variations and is measured over the entire operating temperature range and voltage range with differential outputs enabled and all other outputs disabled.



**SONET Performance Characteristics - Output Jitter Generation On Differential LVPECL Outputs (diff0 and/or diff1). All other outputs enabled.**

Interface	Output Frequency	Jitter Measurement Filter	GR-253 Jitter Requirement		Jitter Generation		
					Typ <sup>1</sup>	Max <sup>2</sup>	Units
OC-3	19.44 MHz	12 kHz to 1.3 MHz	0.01 UI <sub>RMS</sub>	64.30	2.0	2.6	ps <sub>RMS</sub>
			0.1 UI <sub>P-P</sub>	643.00	17.2	21.1	ps <sub>P-P</sub>
	77.76 MHz	12 kHz to 1.3 MHz	0.01 UI <sub>RMS</sub>	64.30	1.0	1.3	ps <sub>RMS</sub>
			0.1 UI <sub>P-P</sub>	643.00	10.3	12.6	ps <sub>P-P</sub>
	155.52 MHz	12 kHz to 1.3 MHz	0.01 UI <sub>RMS</sub>	64.30	1.0	1.1	ps <sub>RMS</sub>
			0.1 UI <sub>P-P</sub>	643.00	9.2	12.3	ps <sub>P-P</sub>
OC-12	77.76 MHz	12 kHz to 5 MHz	0.01 UI <sub>RMS</sub>	16.08	1.1	1.5	ps <sub>RMS</sub>
			0.1 UI <sub>P-P</sub>	160.80	10.8	13.3	ps <sub>P-P</sub>
	155.52 MHz	12 kHz to 5 MHz	0.01 UI <sub>RMS</sub>	16.08	1.1	1.5	ps <sub>RMS</sub>
			0.1 UI <sub>P-P</sub>	160.80	10.8	13.4	ps <sub>P-P</sub>
	622.08 MHz	12 kHz to 5 MHz	0.01 UI <sub>RMS</sub>	4.020	1.0	1.4	ps <sub>RMS</sub>
			0.1 UI <sub>P-P</sub>	40.20	9.2	12.7	ps <sub>P-P</sub>
OC-48	155.52 MHz	12 kHz to 20 MHz	0.01 UI <sub>RMS</sub>	4.020	1.2	1.6	ps <sub>RMS</sub>
			0.1 UI <sub>P-P</sub>	40.20	11.3	14.0	ps <sub>P-P</sub>
	622.08 MHz	12 kHz to 20 MHz	0.01 UI <sub>RMS</sub>	4.020	1.0	1.5	ps <sub>RMS</sub>
			0.1 UI <sub>P-P</sub>	40.20	10.2	12.9	ps <sub>P-P</sub>

<sup>1</sup> Typical jitter specifications are measured when operating under nominal voltages of 1.8 V and 3.3 V and at an ambient temperature of 25°C.

<sup>2</sup> Maximum jitter specifications takes into account process variations and is measured over the entire operating temperature range and voltage range with differential outputs enabled and all other outputs enabled.

**SDH Performance Characteristics - Output Jitter Generation On Differential LVPECL Outputs (diff0 and/or diff1). All other outputs enabled.**

Interface	Output Frequency	Jitter Measurement Filter	G.813 Jitter Requirement		Jitter Generation		
					Typ <sup>1</sup>	Max <sup>2</sup>	Units
Option 1							
STM-1	19.44 MHz	65 kHz to 1.3 MHz	0.1 UI <sub>P-P</sub>	643	15.4	22.2	ps <sub>P-P</sub>
		500 Hz to 1.3 MHz	0.5 UI <sub>P-P</sub>	3215	18.1	24.4	ps <sub>P-P</sub>
	77.76 MHz	65 kHz to 1.3 MHz	0.1 UI <sub>P-P</sub>	643	7.6	9.7	ps <sub>P-P</sub>
		500 Hz to 1.3 MHz	0.5 UI <sub>P-P</sub>	3215	11.4	14.0	ps <sub>P-P</sub>
	155.52 MHz	65 kHz to 1.3 MHz	0.1 UI <sub>P-P</sub>	643	7.6	9.6	ps <sub>P-P</sub>
		500 Hz to 1.3 MHz	0.5 UI <sub>P-P</sub>	3215	11.6	14.3	ps <sub>P-P</sub>
STM-4	77.76 MHz	250 kHz to 5 MHz	0.1 UI <sub>P-P</sub>	161	5.6	7.6	ps <sub>P-P</sub>
		1 kHz to 5 MHz	0.5 UI <sub>P-P</sub>	804	11.7	14.5	ps <sub>P-P</sub>
	155.52 MHz	250 kHz to 5 MHz	0.1 UI <sub>P-P</sub>	161	5.3	7.2	ps <sub>P-P</sub>
		1 kHz to 5 MHz	0.5 UI <sub>P-P</sub>	804	11.8	14.6	ps <sub>P-P</sub>
	622.08 MHz	250 kHz to 5 MHz	0.1 UI <sub>P-P</sub>	161	4.9	6.8	ps <sub>P-P</sub>
		1 kHz to 5 MHz	0.5 UI <sub>P-P</sub>	804	11.1	13.9	ps <sub>P-P</sub>
STM-16	155.52 MHz	1 MHz to 20 MHz	0.1 UI <sub>P-P</sub>	40.2	4.5	6.0	ps <sub>P-P</sub>
		5 kHz to 20 MHz	0.5 UI <sub>P-P</sub>	201	11.9	14.6	ps <sub>P-P</sub>
	622.08 MHz	1 MHz to 20 MHz	0.1 UI <sub>P-P</sub>	40.2	3.0	4.3	ps <sub>P-P</sub>
		5 kHz to 20 MHz	0.5 UI <sub>P-P</sub>	201	10.7	13.5	ps <sub>P-P</sub>
Option 2							
STM-1	77.76 MHz	12 kHz to 1.3 MHz	0.1 UI <sub>P-P</sub>	643	10.3	12.6	ps <sub>P-P</sub>
	155.52 MHz	12 kHz to 1.3 MHz	0.1 UI <sub>P-P</sub>	643	9.2	12.3	ps <sub>P-P</sub>
STM-4	77.76 MHz	12 kHz to 5 MHz	0.1 UI <sub>P-P</sub>	161	10.8	13.3	ps <sub>P-P</sub>
	155.52 MHz	12 kHz to 5 MHz	0.1 UI <sub>P-P</sub>	161	10.9	13.4	ps <sub>P-P</sub>
	622.08 MHz	12 kHz to 5 MHz	0.1 UI <sub>P-P</sub>	161	10.1	12.8	ps <sub>P-P</sub>
STM-16	155.52 MHz	12 kHz to 20 MHz	0.1 UI <sub>P-P</sub>	40.2	11.3	14.0	ps <sub>P-P</sub>
	622.08 MHz	12 kHz to 20 MHz	0.1 UI <sub>P-P</sub>	40.2	10.2	12.9	ps <sub>P-P</sub>

<sup>1</sup> Typical jitter specifications are measured when operating under nominal voltages of 1.8 V and 3.3 V and at an ambient temperature of 25°C.

<sup>2</sup> Maximum jitter specifications takes into account process variations and is measured over the entire operating temperature range and voltage range with differential outputs enabled and all other outputs enabled.

**Ethernet Performance Characteristics - Output Jitter Generation On Differential LVPECL Outputs (diff0, diff1). All other outputs disabled.**

Interface	Output Frequency	Jitter Measurement Filter	diff0 Jitter Generation			diff1 Jitter Generation		
			Typ <sup>1</sup>	Max <sup>2</sup>	Units	Typ <sup>1</sup>	Max <sup>2</sup>	Units
Ethernet Clock Rates	25 MHz	12 kHz to 10 MHz	2.8	3.9	ps <sub>RMS</sub>	1.2	1.6	ps <sub>RMS</sub>
			18.5	25.2	ps <sub>P-P</sub>	12.5	15.7	ps <sub>P-P</sub>
	125 MHz	12 kHz to 20 MHz	2.5	3.3	ps <sub>RMS</sub>	0.9	1.0	ps <sub>RMS</sub>
			15.2	19.3	ps <sub>P-P</sub>	9.8	11.9	ps <sub>P-P</sub>
	156.25 MHz	12 kHz to 20 MHz	0.8	1.0	ps <sub>RMS</sub>	0.8	1.0	ps <sub>RMS</sub>
			9.5	11.5	ps <sub>P-P</sub>	9.5	11.5	ps <sub>P-P</sub>

<sup>1</sup> Typical jitter specifications are measured when operating under nominal voltages of 1.8 V and 3.3 V and at an ambient temperature of 25°C.

<sup>2</sup> Maximum jitter specifications takes into account process variations and is measured over the entire operating temperature range and voltage range with differential outputs enabled and all other outputs disabled.

**Ethernet Performance Characteristics - Output Jitter Generation On Differential LVPECL Outputs (diff0, diff1). All other outputs enabled.**

Interface	Output Frequency	Jitter Measurement Filter	diff0 Jitter Generation			diff1 Jitter Generation		
			Typ <sup>1</sup>	Max <sup>2</sup>	Units	Typ <sup>1</sup>	Max <sup>2</sup>	Units
Ethernet Clock Rates	25 MHz	12 kHz to 10 MHz	2.9	3.8	ps <sub>RMS</sub>	1.4	1.7	ps <sub>RMS</sub>
			19.0	26.3	ps <sub>P-P</sub>	13.0	16.6	ps <sub>P-P</sub>
	125 MHz	12 kHz to 20 MHz	2.5	3.3	ps <sub>RMS</sub>	0.9	1.1	ps <sub>RMS</sub>
			15.4	19.3	ps <sub>P-P</sub>	10.0	12.1	ps <sub>P-P</sub>
	156.25 MHz	12 kHz to 20 MHz	0.9	1.1	ps <sub>RMS</sub>	0.9	1.1	ps <sub>RMS</sub>
			9.9	11.9	ps <sub>P-P</sub>	9.9	11.9	ps <sub>P-P</sub>

<sup>1</sup> Typical jitter specifications are measured when operating under nominal voltages of 1.8 V and 3.3 V and at an ambient temperature of 25°C.

<sup>2</sup> Maximum jitter specifications takes into account process variations and is measured over the entire operating temperature range and voltage range with differential outputs enabled and all other outputs enabled.

**Performance Characteristics - Measured Output Jitter On APLL CMOS Outputs (apll\_clk0, apll\_clk1). All other outputs enabled.**

Output Frequency	Jitter Measurement Filter	Jitter Generation		
		Typ <sup>1</sup>	Max <sup>2</sup>	Units
SONET/SDH 6.48 MHz, 19.44 MHz, 38.88 MHz, 51.84 MHz, 77.76 MHz	12 kHz to 5 MHz	1.7	2.4	ps <sub>RMS</sub>
		13.6	17.7	ps <sub>P-P</sub>
	unfiltered	3.0	4.1	ps <sub>RMS</sub>
		22.9	30.2	ps <sub>P-P</sub>
Ethernet 25 MHz	637 kHz to Nyquist	1.6	2.3	ps <sub>RMS</sub>
		10.9	16.2	ps <sub>P-P</sub>
	12 kHz to 10 MHz	1.9	2.7	ps <sub>RMS</sub>
		15.5	21.3	ps <sub>P-P</sub>
Ethernet 125 MHz	637 kHz to Nyquist	0.8	1.0	ps <sub>RMS</sub>
		5.6	9.3	ps <sub>P-P</sub>
	12 kHz to 20 MHz	1.0	1.4	ps <sub>RMS</sub>
		11.0	14.0	ps <sub>P-P</sub>

<sup>1</sup> Typical jitter specifications are measured when operating at nominal voltages of 1.8 V and 3.3 V and at an ambient temperature of 25°C.

<sup>2</sup> Maximum jitter specifications takes into account process variations and is measured over the entire operating temperature range and voltage range with all outputs enabled.

<sup>3</sup> Nyquist limits the upper limit of the measurement frequency band to half the generated output frequency (e.g. 125 MHz is measured from 637 kHz to 62.5 MHz).

**Performance Characteristics - Measured Output Jitter On Programmable CMOS Outputs (p0\_clk0, p0\_clk1, p1\_clk0, p1\_clk1).**

Output Frequency	Jitter Measurement Filter	Jitter Generation		
		Typ <sup>1</sup>	Max <sup>2</sup>	Units
8 kHz to 100 MHz	unfiltered	18.0	24.0	ps <sub>RMS</sub>

<sup>1</sup> Typical jitter specifications are measured when operating at nominal voltages of 1.8 V and 3.3 V and at an ambient temperature of 25°C.

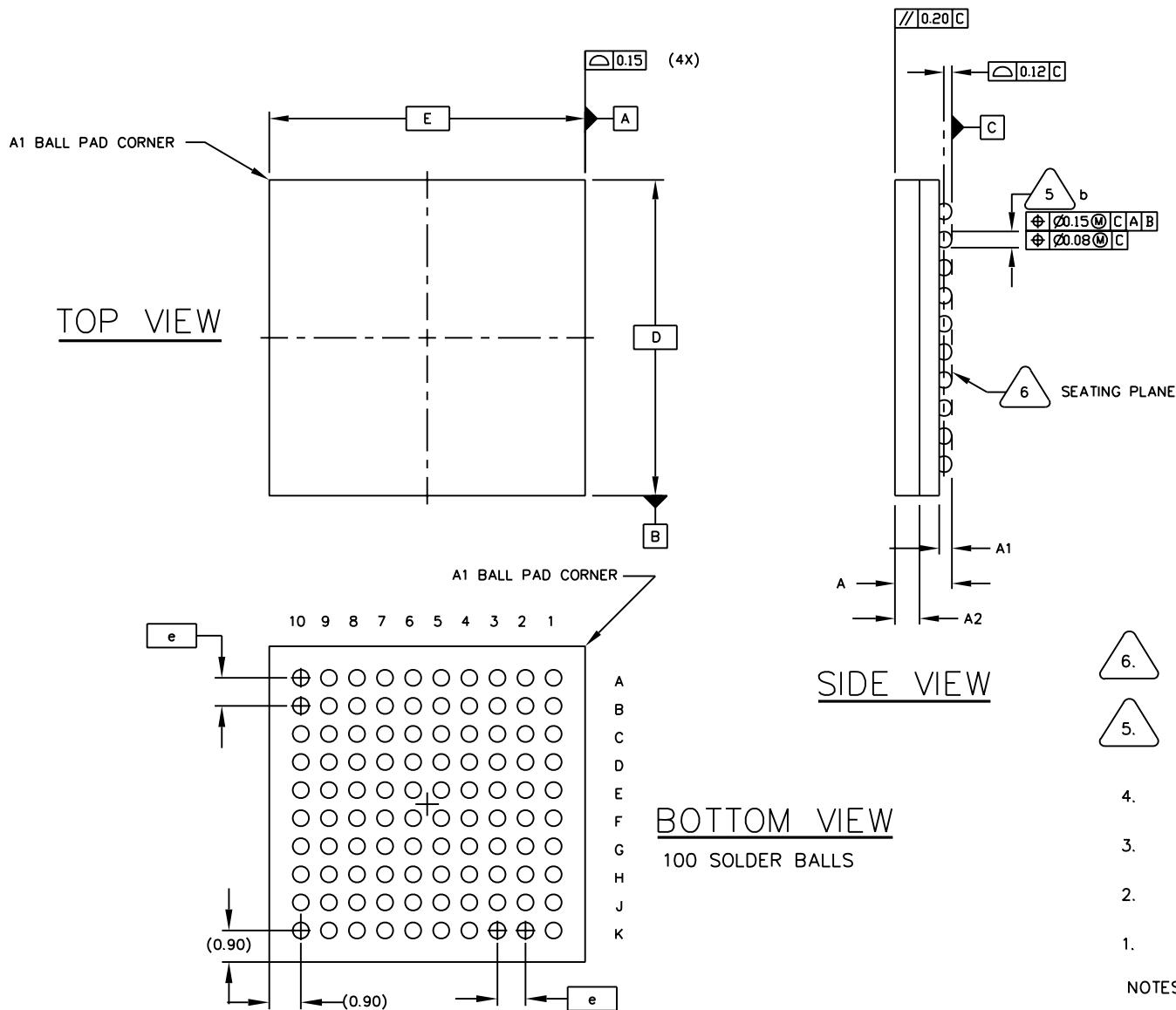
<sup>2</sup> Maximum jitter specifications takes into account process variations and is measured over the entire operating temperature range and voltage range with all outputs enabled.

<sup>3</sup> Note that locking DPLL2 to a reference input of 2 kHz or to any value of N\*8 kHz that results in an exact integer division of 80 MHz may cause output jitter as high as 13 ns pk-pk. This includes 2 kHz, 8 kHz, 16 kHz, 32 kHz, 40 kHz, 64 kHz, 80 kHz, 128 kHz, 160 kHz, 200 kHz, 320 kHz, 400 kHz, 640 kHz, 800 kHz, 1.000 MHz, 1.600 MHz, 2.000 MHz, 3.200 MHz, 4.000 MHz, 5.000 MHz, 8.000 MHz, 10.000 MHz, 16.000 MHz, 20.000 MHz, and 40.000 MHz.

## 6.0 Thermal Characteristics

Parameter	Symbol	Test Condition	Value	Unit
Junction to Ambient Thermal Resistance	$\theta_{ja}$	Still Air	35.7	°C/W
Junction to Case Thermal Resistance	$\theta_{jc}$	Still Air	14.2	°C/W

**Table 20 - Thermal Data**



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	1.52	1.62	1.72
A1	0.31	0.36	0.41
A2	0.65	0.70	0.75
b	0.46 Typ.		
D	8.85	9.00	9.15
E	8.85	9.00	9.15
e	0.8 Ref		
n	100		



PRIMARY DATUM C AND SEATING PLANE ARE DEFINED BY THE SPHERICAL CROWNS OF THE SOLDER BALLS.



DIMENSION b IS MEASURED AT THE MAXIMUM SOLDER BALL DIAMETER, PARALLEL TO PRIMARY DATUM C.

4. THE MAXIMUM ALLOWABLE NUMBER OF SOLDER BALLS IS 100.
3. Not to Scale.
2. THE BASIC SOLDER BALL GRID PITCH IS 0.8mm.
1. ALL DIMENSIONS AND TOLERANCES CONFORM TO ASME Y14.5M-1994.

NOTES: UNLESS OTHERWISE SPECIFIED

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ISSUE	1	2	3	
ACN	CDCA	CDCA	CDCA	
DATE	15April05	24Aug05	26Oct06	
APPRD.				



Previous package codes

N/A

Package Code GG

Package Outline for  
100ball 9x9mm, 0.8 mm  
Pitch, 4 layer, CABGA

111040

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**Microsemi Corporate Headquarters**  
One Enterprise, Aliso Viejo CA 92656 USA  
Within the USA: +1 (949) 380-6100  
Sales: +1 (949) 380-6136  
Fax: +1 (949) 215-4996

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