



# **WAN PLL**

# **IDT82V3285**

**Version 1**  
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## FEATURES

### HIGHLIGHTS

- The first single PLL chip:
  - Features 0.5 mHz to 560 Hz bandwidth
  - Exceeds GR-253-CORE (OC-12) and ITU-T G.813 (STM-16/Option I) jitter generation requirements
  - Provides node clocks for Cellular and WLL base-station (GSM and 3G networks)
  - Provides clocks for DSL access concentrators (DSLAM), especially for Japan TCM-ISDN network timing based ADSL equipments

### MAIN FEATURES

- Provides an integrated single-chip solution for Synchronous Equipment Timing Source, including Stratum 2, 3E, 3, SMC, 4E and 4 clocks
- Employs DPLL and APLL to feature excellent jitter performance and minimize the number of the external components
- Integrates T0 DPLL and T4 DPLL; T4 DPLL locks independently or locks to T0 DPLL
- Supports Forced or Automatic operating mode switch controlled by an internal state machine; the primary operating modes are Free-Run, Locked and Holdover
- Supports programmable DPLL bandwidth (0.5 mHz to 560 Hz in 19 steps) and damping factor (1.2 to 20 in 5 steps)
- Supports  $1.1 \times 10^{-5}$  ppm absolute holdover accuracy and  $4.4 \times 10^{-8}$  ppm instantaneous holdover accuracy
- Supports PBO to minimize phase transients on T0 DPLL output to be no more than 0.61 ns
- Supports phase absorption when phase-time changes on T0 selected input clock are greater than a programmable limit over an interval of less than 0.1 seconds
- Supports programmable input-to-output phase offset adjustment
- Limits the phase and frequency offset of the outputs
- Supports manual and automatic selected input clock switch
- Supports automatic hitless selected input clock switch on clock failure
- Supports three types of input clock sources: recovered clock from STM-N or OC-n, PDH network synchronization timing and external synchronization reference timing
- Provides a 2 kHz, 4 kHz or 8 kHz frame sync input signal, and a 2 kHz and an 8 kHz frame sync output signals
- Provides 5 input clocks whose frequency cover from 2 kHz to 622.08 MHz
- Provides 5 output clocks whose frequency cover from 1 Hz to 622.08 MHz
- Provides output clocks for BITS, GPS, 3G, GSM, etc.
- Supports PECL/LVDS and CMOS input/output technologies
- Supports master clock calibration
- Supports Master/Slave application (two chips used together) to enable system protection against single chip failure
- Meets Telcordia GR-1244-CORE, GR-253-CORE, GR-1377-CORE, ITU-T G.812, ITU-T G.813 and ITU-T G.783 criteria

### OTHER FEATURES

- Multiple microprocessor interface modes: EPROM, Multiplexed, Intel, Motorola and Serial
- IEEE 1149.1 JTAG Boundary Scan
- Single 3.3 V operation with 5 V tolerant CMOS I/Os
- 100-pin TQFP package, Green package options available

### APPLICATIONS

- BITS / SSU
- SMC / SEC (SONET / SDH)
- DWDM cross-connect and transmission equipments
- Central Office Timing Source and Distribution
- Core and access IP switches / routers
- Gigabit and Terabit IP switches / routers
- IP and ATM core switches and access equipments
- Cellular and WLL base-station node clocks
- Broadband and multi-service access equipments
- Any other telecom equipments that need synchronous equipment system timing

## DESCRIPTION

The IDT82V3285 is an integrated, single-chip solution for the Synchronous Equipment Timing Source for Stratum 2, 3E, 3, SMC, 4E and 4 clocks in SONET / SDH equipments, DWDM and Wireless base station, such as GSM, 3G, DSL concentrator, Router and Access Network applications.

The device supports three types of input clock sources: recovered clock from STM-N or OC-n, PDH network synchronization timing and external synchronization reference timing.

Based on ITU-T G.783 and Telcordia GR-253-CORE, the device consists of T0 and T4 paths. The T0 path is a high quality and highly configurable path to provide system clock for node timing synchronization within a SONET / SDH network. The T4 path is simpler and less configurable for equipment synchronization. The T4 path locks independently from the T0 path or locks to the T0 path.

An input clock is automatically or manually selected for T0 and T4 each for DPLL locking. Both the T0 and T4 paths support three primary operating modes: Free-Run, Locked and Holdover. In Free-Run mode, the DPLL refers to the master clock. In Locked mode, the DPLL locks to the selected input clock. In Holdover mode, the DPLL resorts to the fre-

quency data acquired in Locked mode. Whatever the operating mode is, the DPLL gives a stable performance without being affected by operating conditions or silicon process variations.

If the DPLL outputs are processed by T0/T4 APLL, the outputs of the device will be in a better jitter/wander performance.

The device provides programmable DPLL bandwidths: 0.5 mHz to 560 Hz in 19 steps and damping factors: 1.2 to 20 in 5 steps. Different settings cover all SONET / SDH clock synchronization requirements.

A high stable input is required for the master clock in different applications. The master clock is used as a reference clock for all the internal circuits in the device. It can be calibrated within  $\pm 741$  ppm.

All the read/write registers are accessed through a microprocessor interface. The device supports five microprocessor interface modes: EPROM, Multiplexed, Intel, Motorola and Serial.

In general, the device can be used in Master/Slave application. In this application, two devices should be used together to enable system protection against single chip failure. See [Chapter 4 Typical Application](#) for details.

# FUNCTIONAL BLOCK DIAGRAM

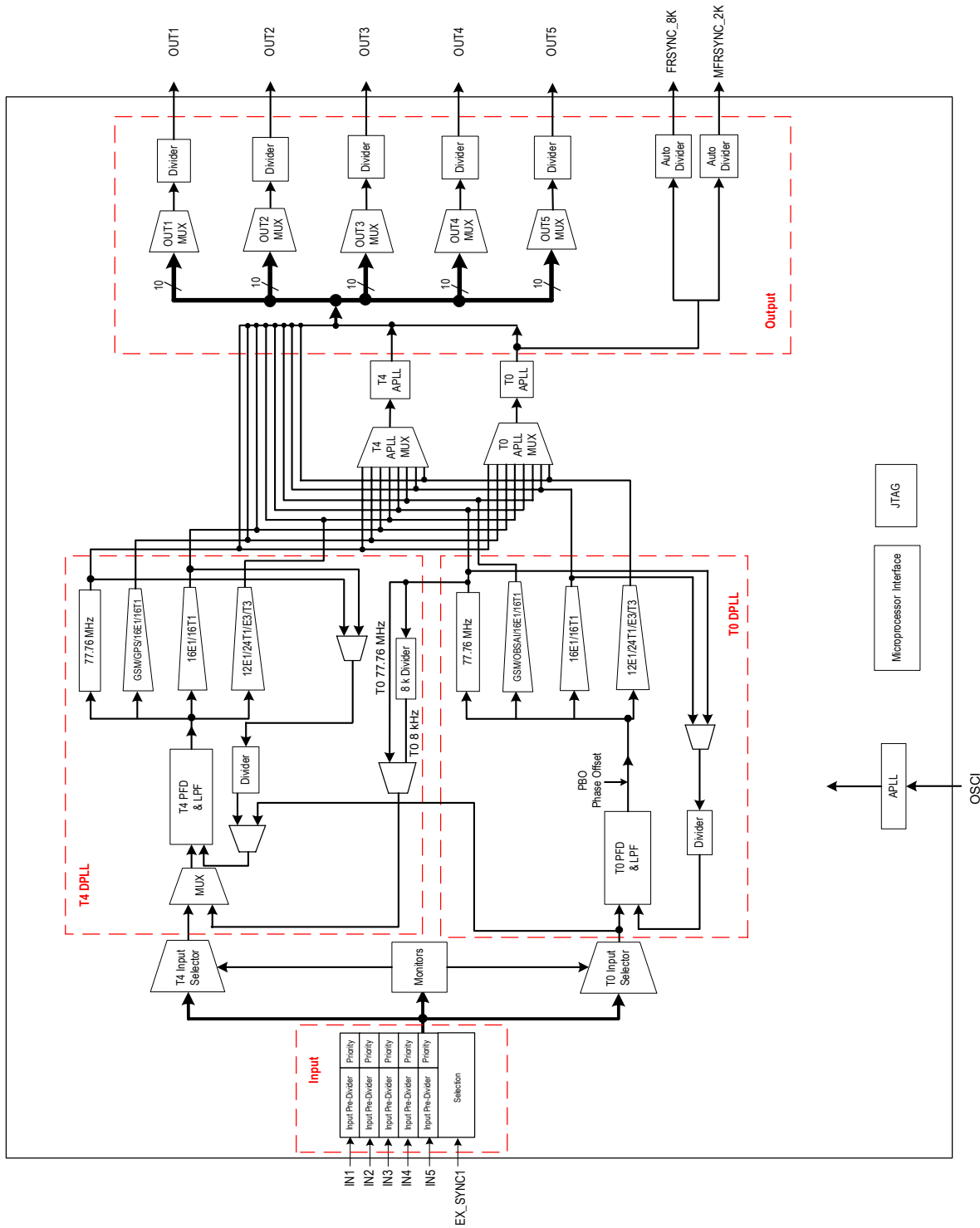


Figure 1. Functional Block Diagram

# 1 PIN ASSIGNMENT

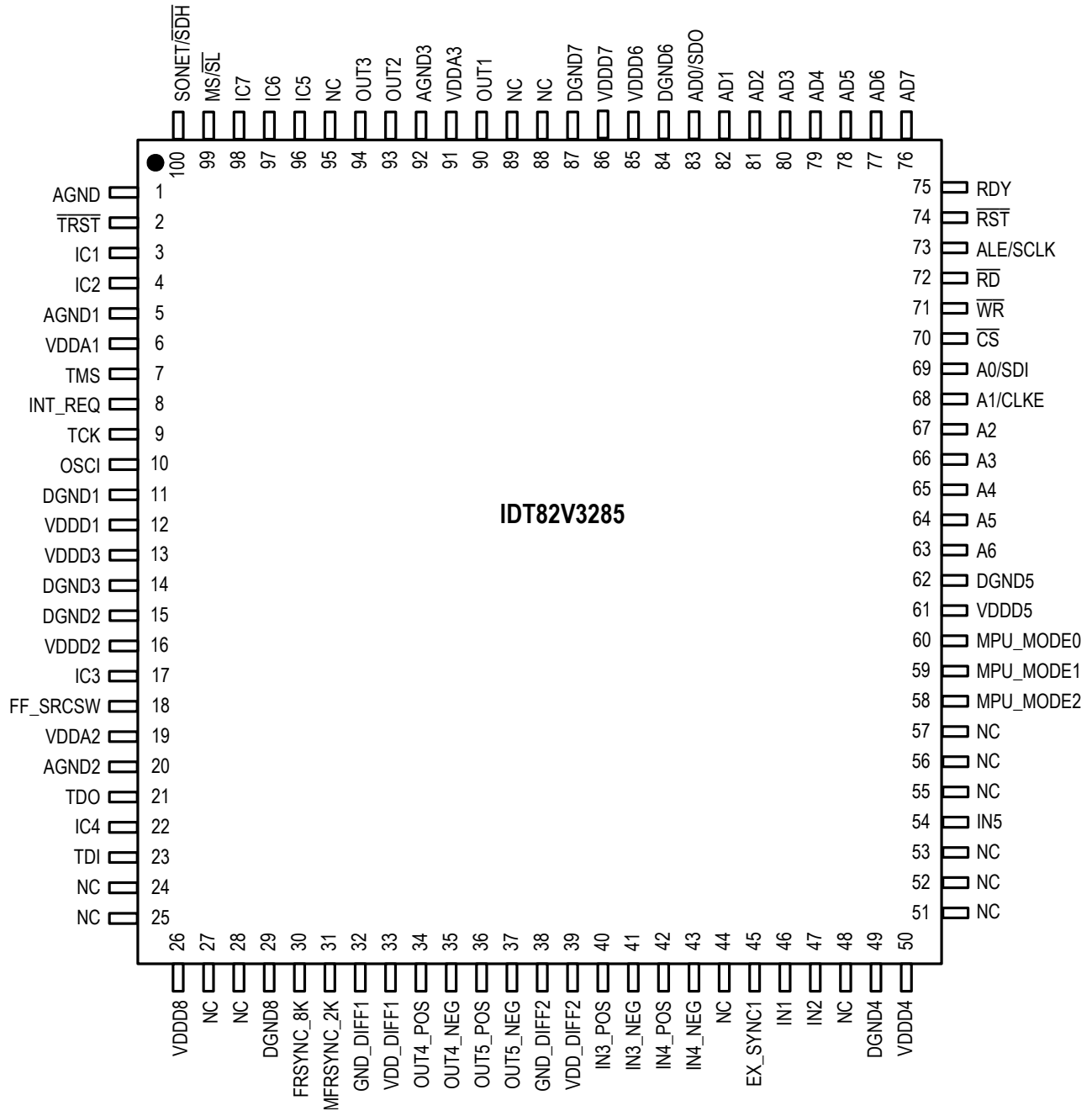


Figure 2. Pin Assignment (Top View)

## 2 PIN DESCRIPTION

Table 1: Pin Description

| Name                                      | Pin No.  | I/O            | Type      | Description <sup>1</sup>  |
|---|----------|----------------|-----------|---|
| <b>Global Control Signal</b>              |          |                |           |   |
| OSCI                                      | 10       | I              | CMOS      | <b>OSCI: Crystal Oscillator Master Clock</b><br>A nominal 12.8000 MHz clock provided by a crystal oscillator is input on this pin. It is the master clock for the device.   |
| FF_SRCSW                                  | 18       | I<br>pull-down | CMOS      | <b>FF_SRCSW: External Fast Selection Enable</b><br>During reset, this pin determines the default value of the EXT_SW bit (b4, 0BH) <sup>2</sup> . The EXT_SW bit determines whether the External Fast Selection is enabled.<br>High: The default value of the EXT_SW bit (b4, 0BH) is '1' (External Fast selection is enabled);<br>Low: The default value of the EXT_SW bit (b4, 0BH) is '0' (External Fast selection is disabled).<br>After reset, this pin selects an input clock pair for the T0 DPLL if the External Fast selection is enabled:<br>High: Pair IN1 / IN3 is selected.<br>Low: Pair IN2/ IN4 is selected.<br>After reset, the input on this pin takes no effect if the External Fast selection is disabled. |
| MS/ $\overline{\text{SL}}$                | 99       | I<br>pull-up   | CMOS      | <b>MS/<math>\overline{\text{SL}}</math>: Master / Slave Selection</b><br>This pin, together with the MS_SL_CTRL bit (b0, 13H), controls whether the device is configured as the Master or as the Slave. Refer to <a href="#">Chapter 3.14 Master / Slave Configuration</a> for details.<br>The signal level on this pin is reflected by the MASTER_SLAVE bit (b1, 09H).   |
| SONET/ $\overline{\text{SDH}}$            | 100      | I<br>pull-down | CMOS      | <b>SONET/<math>\overline{\text{SDH}}</math>: SONET / SDH Frequency Selection</b><br>During reset, this pin determines the default value of the IN_SONET_SDH bit (b2, 09H):<br>High: The default value of the IN_SONET_SDH bit is '1' (SONET);<br>Low: The default value of the IN_SONET_SDH bit is '0' (SDH).<br>After reset, the value on this pin takes no effect.  |
| $\overline{\text{RST}}$                   | 74       | I<br>pull-up   | CMOS      | <b><math>\overline{\text{RST}}</math>: Reset</b><br>A low pulse of at least 50 $\mu\text{s}$ on this pin resets the device. After this pin is high, the device will still be held in reset state for 500 ms (typical).  |
| <b>Frame Synchronization Input Signal</b> |          |                |           |   |
| EX_SYNC1                                  | 45       | I<br>pull-down | CMOS      | <b>EX_SYNC1: External Sync Input 1</b><br>A 2 kHz, 4 kHz or 8 kHz signal is input on this pin.  |
| <b>Input Clock</b>                        |          |                |           |   |
| IN1                                       | 46       | I<br>pull-down | CMOS      | <b>IN1: Input Clock 1</b><br>A 2 kHz, 4 kHz, N x 8 kHz <sup>3</sup> , 1.544 MHz (SONET) / 2.048 MHz (SDH), 6.48 MHz, 19.44 MHz, 25.92 MHz, 38.88 MHz, 51.84 MHz, 77.76 MHz or 155.52 MHz clock is input on this pin.  |
| IN2                                       | 47       | I<br>pull-down | CMOS      | <b>IN2: Input Clock 2</b><br>A 2 kHz, 4 kHz, N x 8 kHz <sup>3</sup> , 1.544 MHz (SONET) / 2.048 MHz (SDH), 6.48 MHz, 19.44 MHz, 25.92 MHz, 38.88 MHz, 51.84 MHz, 77.76 MHz or 155.52 MHz clock is input on this pin.  |
| IN3_POS<br>IN3_NEG                        | 40<br>41 | I              | PECL/LVDS | <b>IN3_POS / IN3_NEG: Positive / Negative Input Clock 3</b><br>A 2 kHz, 4 kHz, N x 8 kHz <sup>3</sup> , 1.544 MHz (SONET) / 2.048 MHz (SDH), 6.48 MHz, 19.44 MHz, 25.92 MHz, 38.88 MHz, 51.84 MHz, 77.76 MHz, 155.52 MHz, 311.04 MHz or 622.08 MHz clock is differentially input on this pair of pins. Whether the clock signal is PECL or LVDS is automatically detected.  |
| IN4_POS<br>IN4_NEG                        | 42<br>43 | I              | PECL/LVDS | <b>IN4_POS / IN4_NEG: Positive / Negative Input Clock 4</b><br>A 2 kHz, 4 kHz, N x 8 kHz <sup>3</sup> , 1.544 MHz (SONET) / 2.048 MHz (SDH), 6.48 MHz, 19.44 MHz, 25.92 MHz, 38.88 MHz, 51.84 MHz, 77.76 MHz, 155.52 MHz, 311.04 MHz or 622.08 MHz clock is differentially input on this pair of pins. Whether the clock signal is PECL or LVDS is automatically detected.  |

Table 1: Pin Description (Continued)

| Name                                       | Pin No.  | I/O            | Type      | Description <sup>1</sup>  |
|--|----------|----------------|-----------|---|
| IN5  | 54       | I<br>pull-down | CMOS      | <b>IN5: Input Clock 5</b><br>A 2 kHz, 4 kHz, N x 8 kHz <sup>3</sup> , 1.544 MHz (SONET) / 2.048 MHz (SDH), 6.48 MHz, 19.44 MHz, 25.92 MHz, 38.88 MHz, 51.84 MHz, 77.76 MHz or 155.52 MHz clock is input on this pin.<br>In Slave operation, the frequency of the T0 selected input clock IN5 is recommended to be 6.48 MHz.   |
| <b>Output Frame Synchronization Signal</b> |          |                |           |   |
| FRSYNC_8K                                  | 30       | O              | CMOS      | <b>FRSYNC_8K: 8 kHz Frame Sync Output</b><br>An 8 kHz signal is output on this pin.   |
| MFRSYNC_2K                                 | 31       | O              | CMOS      | <b>MFRSYNC_2K: 2 kHz Multiframe Sync Output</b><br>A 2 kHz signal is output on this pin.  |
| <b>Output Clock</b>                        |          |                |           |   |
| OUT1                                       | 90       | O              | CMOS      | <b>OUT1: Output Clock 1</b><br>A 1 Hz, 400 Hz, 2 kHz, 8 kHz, 64 kHz, N x E1 <sup>4</sup> , N x T1 <sup>5</sup> , N x 13.0 MHz <sup>6</sup> , N x 3.84 MHz <sup>7</sup> , 5 MHz, 10 MHz, 20 MHz, E3, T3, 6.48 MHz, 19.44 MHz, 25.92 MHz, 38.88 MHz, 51.84 MHz, 77.76 MHz or 155.52 MHz clock is output on this pin.  |
| OUT2                                       | 93       | O              | CMOS      | <b>OUT2: Output Clock 2</b><br>A 1 Hz, 400 Hz, 2 kHz, 8 kHz, 64 kHz, N x E1 <sup>4</sup> , N x T1 <sup>5</sup> , N x 13.0 MHz <sup>6</sup> , N x 3.84 MHz <sup>7</sup> , 5 MHz, 10 MHz, 20 MHz, E3, T3, 6.48 MHz, 19.44 MHz, 25.92 MHz, 38.88 MHz, 51.84 MHz, 77.76 MHz or 155.52 MHz clock is output on this pin.  |
| OUT3                                       | 94       | O              | CMOS      | <b>OUT3: Output Clock 3</b><br>A 1 Hz, 400 Hz, 2 kHz, 8 kHz, 64 kHz, N x E1 <sup>4</sup> , N x T1 <sup>5</sup> , N x 13.0 MHz <sup>6</sup> , N x 3.84 MHz <sup>7</sup> , 5 MHz, 10 MHz, 20 MHz, E3, T3, 6.48 MHz, 19.44 MHz, 25.92 MHz, 38.88 MHz, 51.84 MHz, 77.76 MHz or 155.52 MHz clock is output on this pin.  |
| OUT4_POS<br>OUT4_NEG                       | 34<br>35 | O              | PECL/LVDS | <b>OUT4_POS / OUT4_NEG: Positive / Negative Output Clock 4</b><br>A 1 Hz, 400 Hz, 2 kHz, 8 kHz, 64 kHz, N x E1 <sup>4</sup> , N x T1 <sup>5</sup> , N x 13.0 MHz <sup>6</sup> , N x 3.84 MHz <sup>7</sup> , 5 MHz, 10 MHz, 20 MHz, E3, T3, 6.48 MHz, 19.44 MHz, 25.92 MHz, 38.88 MHz, 51.84 MHz, 77.76 MHz, 155.52 MHz, 311.04 MHz or 622.08 MHz clock is differentially output on this pair of pins. |
| OUT5_POS<br>OUT5_NEG                       | 36<br>37 | O              | PECL/LVDS | <b>OUT5_POS / OUT5_NEG: Positive / Negative Output Clock 5</b><br>A 1 Hz, 400 Hz, 2 kHz, 8 kHz, 64 kHz, N x E1 <sup>4</sup> , N x T1 <sup>5</sup> , N x 13.0 MHz <sup>6</sup> , N x 3.84 MHz <sup>7</sup> , 5 MHz, 10 MHz, 20 MHz, E3, T3, 6.48 MHz, 19.44 MHz, 25.92 MHz, 38.88 MHz, 51.84 MHz, 77.76 MHz, 155.52 MHz, 311.04 MHz or 622.08 MHz clock is differentially output on this pair of pins. |
| <b>Microprocessor Interface</b>            |          |                |           |   |
| $\overline{\text{CS}}$                     | 70       | I<br>pull-up   | CMOS      | <b><math>\overline{\text{CS}}</math>: Chip Selection</b><br>A transition from high to low must occur on this pin for each read or write operation and this pin should remain low until the operation is over.   |
| INT_REQ                                    | 8        | O              | CMOS      | <b>INT_REQ: Interrupt Request</b><br>This pin is used as an interrupt request. The output characteristics are determined by the HZ_EN bit (b1, 0CH) and the INT_POL bit (b0, 0CH).  |

Table 1: Pin Description (Continued)

| Name            | Pin No. | I/O              | Type | Description <sup>1</sup>  |
|-----------------|---------|------------------|------|---|
| MPU_MODE0       | 60      | I<br>pull-down   | CMOS | <p><b>MPU_MODE[2:0]: Microprocessor Interface Mode Selection</b><br/>The device supports five microprocessor interface modes: EPROM, Multiplexed, Intel, Motorola and Serial.<br/>During reset, these pins determine the default value of the MPU_SEL_CNFG[2:0] bits (b2~0, 7FH) as follows:<br/>001 (EPROM mode);<br/>010 (Multiplexed mode);<br/>011 (Intel mode);<br/>100 (Motorola mode);<br/>101 (Serial mode);<br/>110 - 111 (Reserved).<br/>After reset, these pins are general purpose inputs. The microprocessor interface mode is selected by the MPU_SEL_CNFG[2:0] bits (b2~0, 7FH).<br/>The value of these pins is always reflected by the MPU_PIN_STS[2:0] bits (b2~0, 02H).</p> |
| MPU_MODE1       | 59      |                  |      |   |
| MPU_MODE2       | 58      |                  |      |   |
| A0 / SDI        | 69      | I<br>pull-down   | CMOS | <p><b>A[6:0]: Address Bus</b><br/>In EPROM, Intel and Motorola modes, these pins are the address bus of the microprocessor interface.</p> <p><b>SDI: Serial Data Input</b><br/>In Serial mode, this pin is used as the serial data input. Address and data on this pin are serially clocked into the device on the rising edge of SCLK.</p> <p><b>CLKE: SCLK Active Edge Selection</b><br/>In Serial mode, this pin selects the active edge of SCLK to update the SDO:<br/>High - The falling edge;<br/>Low - The rising edge.</p> <p>In Multiplexed mode, A0/SDI, A1/CLKE and A[6:2] pins should be connected to ground.<br/>In Serial mode, A[6:2] pins should be connected to ground.</p>  |
| A1 / CLKE       | 68      |                  |      |   |
| A2              | 67      |                  |      |   |
| A3              | 66      |                  |      |   |
| A4              | 65      |                  |      |   |
| A5              | 64      |                  |      |   |
| A6              | 63      |                  |      |   |
| AD0 / SDO       | 83      | I/O<br>pull-down | CMOS | <p><b>AD[7:0]: Address / Data Bus</b><br/>In EPROM, Intel and Motorola modes, these pins are the bi-directional data bus of the microprocessor interface.<br/>In Multiplexed mode, these pins are the bi-directional address/data bus of the microprocessor interface.</p> <p><b>SDO: Serial Data Output</b><br/>In Serial mode, this pin is used as the serial data output. Data on this pin is serially clocked out of the device on the active edge of SCLK.</p> <p>In Serial mode, AD[7:1] pins should be connected to ground.</p>  |
| AD1             | 82      |                  |      |   |
| AD2             | 81      |                  |      |   |
| AD3             | 80      |                  |      |   |
| AD4             | 79      |                  |      |   |
| AD5             | 78      |                  |      |   |
| AD6             | 77      |                  |      |   |
| AD7             | 76      |                  |      |   |
| $\overline{WR}$ | 71      | I<br>pull-up     | CMOS | <p><b><math>\overline{WR}</math>: Write Operation</b><br/>In Multiplexed and Intel modes, this pin is asserted low to initiate a write operation.<br/>In Motorola mode, this pin is asserted low to initiate a write operation or asserted high to initiate a read operation.<br/>In EPROM and Serial modes, this pin should be connected to ground.</p>  |
| $\overline{RD}$ | 72      | I<br>pull-up     | CMOS | <p><b><math>\overline{RD}</math>: Read Operation</b><br/>In Multiplexed and Intel modes, this pin is asserted low to initiate a read operation.<br/>In EPROM, Motorola and Serial modes, this pin should be connected to ground.</p>  |

Table 1: Pin Description (Continued)

| Name                          | Pin No. | I/O            | Type | Description <sup>1</sup>  |
|-------------------------------|---------|----------------|------|---|
| ALE / SCLK                    | 73      | I<br>pull-down | CMOS | <p><b>ALE: Address Latch Enable</b><br/>In Multiplexed mode, the address on AD[7:0] pins is sampled into the device on the falling edge of ALE.</p> <p><b>SCLK: Shift Clock</b><br/>In Serial mode, a shift clock is input on this pin. Data on SDI is sampled by the device on the rising edge of SCLK. Data on SDO is updated on the active edge of SCLK. The active edge is determined by the CLKE.</p> <p>In EPROM, Intel and Motorola modes, this pin should be connected to ground.</p>               |
| RDY                           | 75      | O              | CMOS | <p><b>RDY: Ready/Data Acknowledge</b><br/>In Multiplexed and Intel modes, a high level on this pin indicates that a read/write cycle is completed. A low level on this pin indicates that wait state must be inserted.<br/>In Motorola mode, a low level on this pin indicates that valid information on the data bus is ready for a read operation or acknowledges the acceptance of the written data during a write operation.<br/>In EPROM and Serial modes, this pin should be connected to ground.</p> |
| <b>JTAG (per IEEE 1149.1)</b> |         |                |      |   |
| $\overline{\text{TRST}}$      | 2       | I<br>pull-down | CMOS | <p><b><math>\overline{\text{TRST}}</math>: JTAG Test Reset (Active Low)</b><br/>A low signal on this pin resets the JTAG test port.<br/>This pin should be connected to ground when JTAG is not used.</p>   |
| TMS                           | 7       | I<br>pull-up   | CMOS | <p><b>TMS: JTAG Test Mode Select</b><br/>The signal on this pin controls the JTAG test performance and is sampled on the rising edge of TCK.</p>  |
| TCK                           | 9       | I<br>pull-down | CMOS | <p><b>TCK: JTAG Test Clock</b><br/>The clock for the JTAG test is input on this pin. TDI and TMS are sampled on the rising edge of TCK and TDO is updated on the falling edge of TCK.<br/>If TCK is idle at a low level, all stored-state devices contained in the test logic will indefinitely retain their state.</p>   |
| TDI                           | 23      | I<br>pull-up   | CMOS | <p><b>TDI: JTAG Test Data Input</b><br/>The test data is input on this pin. It is clocked into the device on the rising edge of TCK.</p>  |
| TDO                           | 21      | O              | CMOS | <p><b>TDO: JTAG Test Data Output</b><br/>The test data is output on this pin. It is clocked out of the device on the falling edge of TCK. TDO pin outputs a high impedance signal except during the process of data scanning.<br/>This pin can indicate the interrupt of T0 selected input clock fail, as determined by the LOS_FLAG_ON_TDO bit (b6, 0BH). Refer to <a href="#">Chapter 3.8.1 Input Clock Validity</a> for details.</p>   |
| <b>Power &amp; Ground</b>     |         |                |      |   |
| VDDD1                         | 12      | Power          | -    | <p><b>VDDn: 3.3 V Digital Power Supply</b><br/>VDDn connections should be connected using the recommended decoupling scheme shown in <a href="#">Figure 14</a>.</p>   |
| VDDD2                         | 16      |                |      |   |
| VDDD3                         | 13      |                |      |   |
| VDDD4                         | 50      |                |      |   |
| VDDD5                         | 61      |                |      |   |
| VDDD6                         | 85      |                |      |   |
| VDDD7                         | 86      |                |      |   |



Table 1: Pin Description (Continued)

| Name          | Pin No.  | I/O    | Type | Description <sup>1</sup>  |
|---------------|--|--------|------|---|
| VDDA1         | 6  | Power  | -    | <b>VDDAn: 3.3 V Analog Power Supply</b><br>VDDAn connections should be connected using the recommended decoupling scheme shown in <a href="#">Figure 14</a> . |
| VDDA2         | 19   |        |      |   |
| VDDA3         | 91   |        |      |   |
| VDDD8         | 26   | Power  | -    | <b>VDDD8: 3.3 V Digital Power Supply</b>  |
| VDD_DIFF1     | 33   | Power  | -    | <b>VDD_DIFF1: 3.3 V Power Supply for OUT4</b>   |
| VDD_DIFF2     | 39   | Power  | -    | <b>VDD_DIFF2: 3.3 V Power Supply for OUT5</b>   |
| DGND1         | 11   | Ground | -    | <b>DGNDn: Digital Ground</b>  |
| DGND2         | 15   |        |      |   |
| DGND3         | 14   |        |      |   |
| DGND4         | 49   |        |      |   |
| DGND5         | 62   |        |      |   |
| DGND6         | 84   |        |      |   |
| DGND7         | 87   |        |      |   |
| AGND1         | 5  | Ground | -    | <b>AGNDn: Analog Ground</b>   |
| AGND2         | 20   |        |      |   |
| AGND3         | 92   |        |      |   |
| GND_DIFF1     | 32   | Ground | -    | <b>GND_DIFF: Ground for OUT4</b>  |
| GND_DIFF2     | 38   | Ground | -    | <b>GND_DIFF: Ground for OUT5</b>  |
| DGND8         | 29   | Ground | -    | <b>DGND8: Digital Ground</b>  |
| AGND          | 1  | Ground | -    | <b>AGND: Analog Ground</b>  |
| <b>Others</b> |  |        |      |   |
| IC1           | 3  | -      | -    | <b>IC: Internally Connected</b><br>Internal Use. These pins should be left open for normal operation.   |
| IC2           | 4  |        |      |   |
| IC3           | 17   |        |      |   |
| IC4           | 22   |        |      |   |
| IC5           | 96   |        |      |   |
| IC6           | 97   |        |      |   |
| IC7           | 98   |        |      |   |
| NC            | 24, 25, 27, 28, 44, 48,<br>51, 52, 53, 55, 56, 57,<br>88, 89, 95 | -      | -    | <b>NC: Not Connected</b>  |

**Note:**

- All the unused input pins should be connected to ground; the output of all the unused output pins are don't-care.
- The contents in the brackets indicate the position of the register bit/bits.
- N x 8 kHz:  $1 \leq N \leq 19440$ .
- N x E1: N = 1, 2, 3, 4, 6, 8, 12, 16, 24, 32, 48, 64.
- N x T1: N = 1, 2, 3, 4, 6, 8, 12, 16, 24, 32, 48, 64, 96.
- N x 13.0 MHz: N = 1, 2, 4.
- N x 3.84 MHz: N = 1, 2, 4, 8, 16, 10, 20, 40.

### 3 FUNCTIONAL DESCRIPTION

#### 3.1 RESET

The reset operation resets all registers and state machines to their default value or status.

After power on, the device must be reset for normal operation.

For a complete reset, the  $\overline{\text{RST}}$  pin must be asserted low for at least 50  $\mu\text{s}$ . After the  $\overline{\text{RST}}$  pin is pulled high, the device will still be in reset state for 500 ms (typical). If the  $\overline{\text{RST}}$  pin is held low continuously, the device remains in reset state.

#### 3.2 MASTER CLOCK

A nominal 12.8000 MHz clock, provided by a crystal oscillator, is input on the OSC1 pin. This clock is provided for the device as a master clock. The master clock is used as a reference clock for all the internal circuits. A better active edge of the master clock is selected by the OSC\_EDGE bit to improve jitter and wander performance.

In fact, an offset from the nominal frequency may input on the OSC1 pin. This offset can be compensated by setting the NOMINAL\_FREQ\_VALUE[23:0] bits. The calibration range is within  $\pm 741$  ppm.

The performance of the master clock should meet GR-1244-CORE, GR-253-CORE, ITU-T G.812 and G.813 criteria.

**Table 2: Related Bit / Register in Chapter 3.2**

| Bit                      | Register  | Address (Hex) |
|--------------------------|---|---------------|
| NOMINAL_FREQ_VALUE[23:0] | NOMINAL_FREQ[23:16]_CNFG, NOMINAL_FREQ[15:8]_CNFG, NOMINAL_FREQ[7:0]_CNFG | 06, 05, 04    |
| OSC_EDGE                 | DIFFERENTIAL_IN_OUT_OSCI_CNFG   | 0A            |

### 3.3 INPUT CLOCKS & FRAME SYNC SIGNAL

Altogether 5 clocks and 1 frame sync signal are input to the device.

#### 3.3.1 INPUT CLOCKS

The device provides 5 input clock ports.

According to the input port technology, the input ports support the following technologies:

- PECL/LVDS
- CMOS

According to the input clock source, the following clock sources are supported:

- T1: Recovered clock from STM-N or OC-n
- T2: PDH network synchronization timing
- T3: External synchronization reference timing

IN1, IN2 and IN5 support CMOS input signal only and the clock sources can be from T1, T2 or T3.

IN3 and IN4 support PECL/LVDS input signal only and automatically detect whether the signal is PECL or LVDS. The clock sources can be from T1, T2 or T3.

For SDH and SONET networks, the default frequency is different. SONET / SDH frequency selection is controlled by the IN\_SONET\_SDH bit. During reset, the default value of the IN\_SONET\_SDH bit is determined by the SONET/SDH pin: high for SONET and low for SDH. After reset, the input signal on the SONET/SDH pin takes no effect.

#### 3.3.2 FRAME SYNC INPUT SIGNALS

A 2 kHz, 4 kHz or 8 kHz frame sync signal is input on the EX\_SYNC1 pin. It is a CMOS input. The input frequency should match the setting in the SYNC\_FREQ[1:0] bits.

The frame sync input signal is used for frame sync output signal synchronization. Refer to [Chapter 3.13.2 Frame SYNC Output Signals](#) for details.

**Table 3: Related Bit / Register in Chapter 3.3**

| Bit            | Register        | Address (Hex) |
|----------------|-----------------|---------------|
| IN_SONET_SDH   | INPUT_MODE_CNFG | 09            |
| SYNC_FREQ[1:0] |                 |               |

### 3.4 INPUT CLOCK PRE-DIVIDER

Each input clock is assigned an internal Pre-Divider. The Pre-Divider is used to divide the clock frequency down to the DPLL required frequency, which is no more than 38.88 MHz.

For IN1 ~ IN5, the DPLL required frequency is set by the corresponding IN\_FREQ[3:0] bits.

If the input clock is of 2 kHz, 4 kHz or 8 kHz, the Pre-Divider is bypassed automatically and the corresponding IN\_FREQ[3:0] bits should be set to match the input frequency; the input clock can be inverted, as determined by the IN\_2K\_4K\_8K\_INV bit.

Each Pre-Divider consists of a HF (High Frequency) Divider (only available for IN3 and IN4), a DivN Divider and a Lock 8k Divider, as shown in Figure 3.

The HF Divider, which is only available for IN3 and IN4, should be used when the input clock is higher than (>) 155.52 MHz. The input clock can be divided by 4, 5 or can bypass the HF Divider, as determined by the IN3\_DIV[1:0]/IN4\_DIV[1:0] bits correspondingly.

Either the DivN Divider or the Lock 8k Divider can be used or both can be bypassed, as determined by the DIRECT\_DIV bit and the LOCK\_8K bit.

When the DivN Divider is used for INn (1 ≤ n ≤ 5), the division factor setting should observe the following order:

1. Select an input clock by the PRE\_DIV\_CH\_VALUE[3:0] bits;
2. Write the lower eight bits of the division factor to the PRE\_DIVN\_VALUE[7:0] bits;
3. Write the higher eight bits of the division factor to the PRE\_DIVN\_VALUE[14:8] bits.

Once the division factor is set for the input clock selected by the PRE\_DIV\_CH\_VALUE[3:0] bits, it is valid until a different division factor is set for the same input clock. The division factor is calculated as follows:

$$\text{Division Factor} = (\text{the frequency of the clock input to the DivN Divider} \div \text{the frequency of the DPLL required clock set by the IN_FREQ[3:0] bits}) - 1$$

The DivN Divider can only divide the input clock whose frequency is lower than (<) 155.52 MHz.

When the Lock 8k Divider is used, the input clock is divided down to 8 kHz automatically.

The Pre-Divider configuration and the division factor setting depend on the input clock on one of the IN1 ~ IN5 pins and the DPLL required clock. Here is an example:

The input clock on the IN4 pin is 622.08 MHz; the DPLL required clock is 6.48 MHz by programming the IN\_FREQ[3:0] bits of register IN4 to '0010'. Do the following step by step to divide the input clock:

1. Use the HF Divider to divide the clock down to 155.52 MHz:  
622.08 ÷ 155.52 = 4, so set the IN4\_DIV[1:0] bits to '01';
2. Use the DivN Divider to divide the clock down to 6.48 MHz:  
Set the PRE\_DIV\_CH\_VALUE[3:0] bits to '0110';  
Set the DIRECT\_DIV bit in Register IN4\_CNFG to '1' and the LOCK\_8K bit in Register IN4\_CNFG to '0';  
155.52 ÷ 6.48 = 24; 24 - 1 = 23, so set the PRE\_DIVN\_VALUE[14:0] bits to '10111'.

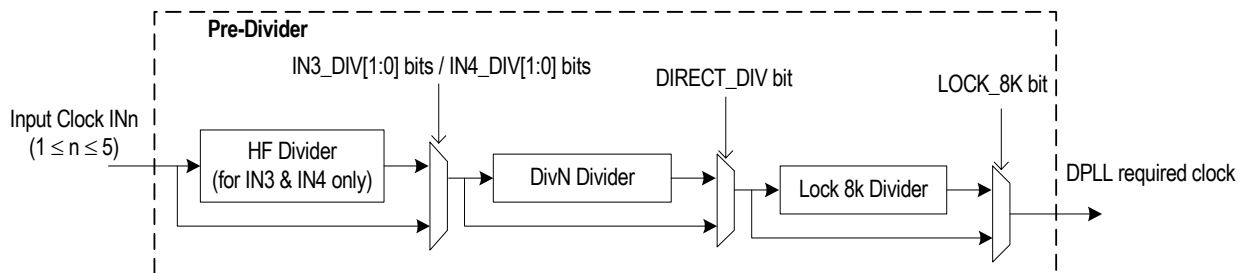


Figure 3. Pre-Divider for An Input Clock

Table 4: Related Bit / Register in Chapter 3.4

| Bit                   | Register                                | Address (Hex)        |
|-----------------------|---|----------------------|
| IN3_DIV[1:0]          | IN3_IN4_HF_DIV_CNFG                     | 18                   |
| IN4_DIV[1:0]          |   |                      |
| IN_FREQ[3:0]          | IN1_CNFG ~ IN5_CNFG                     | 16 ~ 17, 19 ~ 1A, 1F |
| IN_2K_4K_8K_INV       | FR_MFR_SYNC_CNFG                        | 74                   |
| DIRECT_DIV            | IN1_CNFG ~ IN5_CNFG                     | 16 ~ 17, 19 ~ 1A, 1F |
| LOCK_8K               |   |                      |
| PRE_DIV_CH_VALUE[3:0] | PRE_DIV_CH_CNFG                         | 23                   |
| PRE_DIVN_VALUE[14:0]  | PRE_DIVN[14:8]_CNFG, PRE_DIVN[7:0]_CNFG | 25, 24               |

### 3.5 INPUT CLOCK QUALITY MONITORING

The qualities of all the input clocks are always monitored in the following aspects:

- Activity
- Frequency

Activity and frequency monitoring are conducted on all the input clocks.

The qualified clocks are available for T0/T4 DPLL selection. The T0 and T4 selected input clocks have to be monitored further. Refer to [Chapter 3.7 Selected Input Clock Monitoring](#) for details.

#### 3.5.1 ACTIVITY MONITORING

Activity is monitored by using an internal leaky bucket accumulator, as shown in [Figure 4](#).

Each input clock is assigned an internal leaky bucket accumulator. The input clock is monitored for each period of 128 ms and the internal leaky bucket accumulator increases by 1 when an event is detected; it decreases by 1 if no event is detected within the period set by the decay rate. The event is that an input clock drifts outside ( $>$ )  $\pm 500$  ppm with respect to the master clock within a 128 ms period.

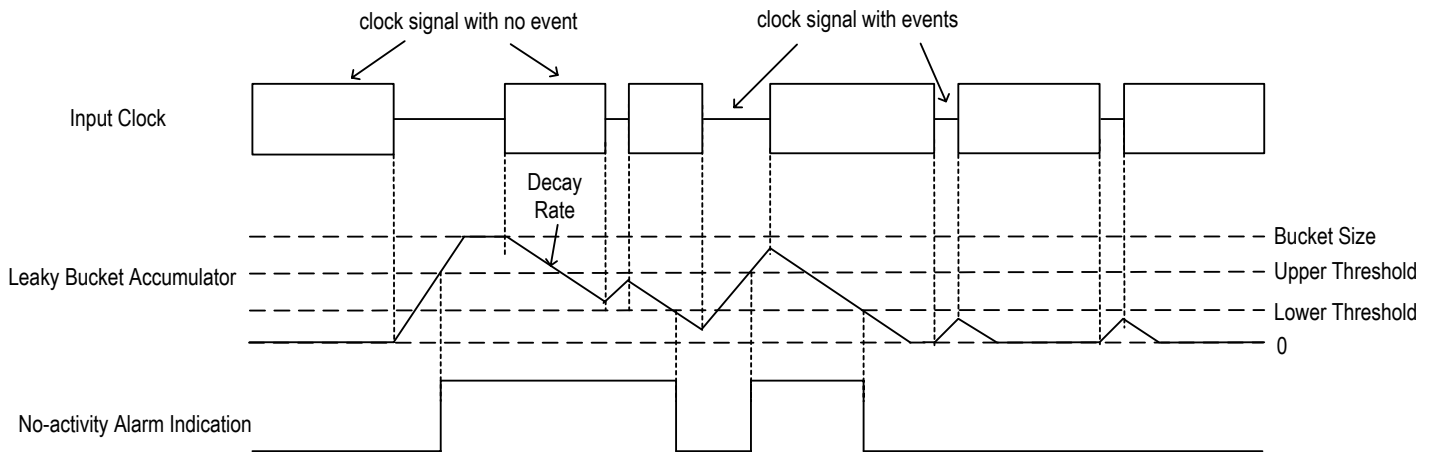
There are four configurations (0 - 3) for a leaky bucket accumulator. The leaky bucket configuration for an input clock is selected by the corresponding BUCKET\_SEL[1:0] bits. Each leaky bucket configuration consists of four elements: upper threshold, lower threshold, bucket size and decay rate.

The bucket size is the capability of the accumulator. If the number of the accumulated events reaches the bucket size, the accumulator will stop increasing even if further events are detected. The upper threshold is a point above which a no-activity alarm is raised. The lower threshold is a point below which the no-activity alarm is cleared. The decay rate is a certain period during which the accumulator decreases by 1 if no event is detected.

The leaky bucket configuration is programmed by one of four groups of register bits: the BUCKET\_SIZE\_n\_DATA[7:0] bits, the UPPER\_THRESHOLD\_n\_DATA[7:0] bits, the LOWER\_THRESHOLD\_n\_DATA[7:0] bits and the DECAY\_RATE\_n\_DATA[1:0] bits respectively; 'n' is 3.

The no-activity alarm status of the input clock is indicated by the INn\_NO\_ACTIVITY\_ALARM bit ( $1 \leq n \leq 5$ ).

The input clock with a no-activity alarm is disqualified for clock selection for T0/T4 DPLL.



**Figure 4. Input Clock Activity Monitoring**

### 3.5.2 FREQUENCY MONITORING

Frequency is monitored by comparing the input clock with a reference clock. The reference clock can be derived from the master clock or the output of T0 DPLL, as determined by the `FREQ_MON_CLK` bit.

A frequency hard alarm threshold is set for frequency monitoring. If the `FREQ_MON_HARD_EN` bit is '1', a frequency hard alarm is raised when the frequency of the input clock with respect to the reference clock is above the threshold; the alarm is cleared when the frequency is below the threshold.

The frequency hard alarm threshold can be calculated as follows:

$$\text{Frequency Hard Alarm Threshold (ppm)} = (\text{ALL\_FREQ\_HARD\_THRESHOLD}[3:0] + 1) \times \text{FREQ\_MON\_FACTOR}[3:0]$$

If the `FREQ_MON_HARD_EN` bit is '1', the frequency hard alarm status of the input clock is indicated by the `INn_FREQ_HARD_ALARM` bit ( $1 \leq n \leq 5$ ). When the `FREQ_MON_HARD_EN` bit is '0', no frequency hard alarm is raised even if the input clock is above the frequency hard alarm threshold.

The input clock with a frequency hard alarm is disqualified for clock selection for T0/T4 DPLL.

In addition, if the input clock is 2 kHz, 4 kHz or 8 kHz, its clock edges with respect to the reference clock are monitored. If any edge drifts outside  $\pm 5\%$ , the input clock is disqualified for clock selection for T0/T4 DPLL. The input clock is qualified if any edge drifts inside  $\pm 5\%$ . This function is supported only when the `IN_NOISE_WINDOW` bit is '1'.

The frequency of each input clock with respect to the reference clock can be read by doing the following step by step:

1. Select an input clock by setting the `IN_FREQ_READ_CH[3:0]` bits;
2. Read the value in the `IN_FREQ_VALUE[7:0]` bits and calculate as follows:

$$\text{Input Clock Frequency (ppm)} = \text{IN\_FREQ\_VALUE}[7:0] \times \text{FREQ\_MON\_FACTOR}[3:0]$$

Note that the value set by the `FREQ_MON_FACTOR[3:0]` bits depends on the application.

**Table 5: Related Bit / Register in Chapter 3.5**

| Bit  | Register                                       | Address (Hex)        |
|--|--|----------------------|
| <code>BUCKET_SIZE_n_DATA[7:0]</code> ( $n = 3$ )         | <code>BUCKET_SIZE_3_CNFG</code>                | 3F                   |
| <code>UPPER_THRESHOLD_n_DATA[7:0]</code> ( $n = 3$ )     | <code>UPPER_THRESHOLD_3_CNFG</code>            | 3D                   |
| <code>LOWER_THRESHOLD_n_DATA[7:0]</code> ( $n = 3$ )     | <code>LOWER_THRESHOLD_3_CNFG</code>            | 3E                   |
| <code>DECAY_RATE_n_DATA[1:0]</code> ( $n = 3$ )          | <code>DECAY_RATE_3_CNFG</code>                 | 40                   |
| <code>BUCKET_SEL[1:0]</code>                             | <code>IN1_CNFG ~ IN5_CNFG</code>               | 16 ~ 17, 19 ~ 1A, 1F |
| <code>INn_NO_ACTIVITY_ALARM</code> ( $1 \leq n \leq 5$ ) | <code>IN1_IN2_STS, IN3_IN4_STS, IN5_STS</code> | 44~ 45, 48           |
| <code>INn_FREQ_HARD_ALARM</code> ( $1 \leq n \leq 5$ )   |  |                      |
| <code>FREQ_MON_CLK</code>                                | <code>MON_SW_PBO_CNFG</code>                   | 0B                   |
| <code>FREQ_MON_HARD_EN</code>                            |  |                      |
| <code>ALL_FREQ_HARD_THRESHOLD[3:0]</code>                | <code>ALL_FREQ_MON_THRESHOLD_CNFG</code>       | 2F                   |
| <code>FREQ_MON_FACTOR[3:0]</code>                        | <code>FREQ_MON_FACTOR_CNFG</code>              | 2E                   |
| <code>IN_NOISE_WINDOW</code>                             | <code>PHASE_MON_PBO_CNFG</code>                | 78                   |
| <code>IN_FREQ_READ_CH[3:0]</code>                        | <code>IN_FREQ_READ_CH_CNFG</code>              | 41                   |
| <code>IN_FREQ_VALUE[7:0]</code>                          | <code>IN_FREQ_READ_STS</code>                  | 42                   |

### 3.6 T0 / T4 DPLL INPUT CLOCK SELECTION

An input clock is selected for T0 DPLL and for T4 DPLL respectively.

For T0 path, the EXT\_SW bit and the T0\_INPUT\_SEL[3:0] bits determine the input clock selection, as shown in [Table 6](#):

**Table 6: Input Clock Selection for T0 Path**

| Control Bits |                   | Input Clock Selection   |
|--------------|-------------------|-------------------------|
| EXT_SW       | T0_INPUT_SEL[3:0] |                         |
| 1            | don't-care        | External Fast selection |
| 0            | other than 0000   | Forced selection        |
|              | 0000              | Automatic selection     |

For T4 path, the T4 DPLL may lock to a T0 DPLL output or lock independently from T0 path, as determined by the T4\_LOCK\_T0 bit. When the T4 DPLL locks to the T0 DPLL output, the T4 selected input clock is a 77.76 MHz or 8 kHz signal from the T0 DPLL 77.76 MHz path (refer to [Chapter 3.11.5.1 T0 Path](#)), as determined by the T0\_FOR\_T4 bit. When the T4 path locks independently from the T0 path, the T4 DPLL input clock selection is determined by the T4\_INPUT\_SEL[3:0] bits. Refer to [Table 7](#):

**Table 7: Input Clock Selection for T4 Path**

| Control Bits - T4_INPUT_SEL[3:0] | Input Clock Selection |
|----------------------------------|-----------------------|
| other than 0000                  | Forced selection      |
| 0000                             | Automatic selection   |

External Fast selection is done between IN1/IN3 and IN2/IN4 pairs.

Forced selection is done by setting the related registers.

**Table 8: External Fast Selection**

| Control Pin & Bits     |                       |                       | Selected Input Clock |
|------------------------|-----------------------|-----------------------|----------------------|
| FF_SRCSW (after reset) | IN1_SEL_PRIORITY[3:0] | IN2_SEL_PRIORITY[3:0] |                      |
| high                   | 0000                  | don't-care            | IN3                  |
|                        | other than 0000       |                       | IN1                  |
| low                    | don't-care            | 0000                  | IN4                  |
|                        |                       | other than 0000       | IN2                  |

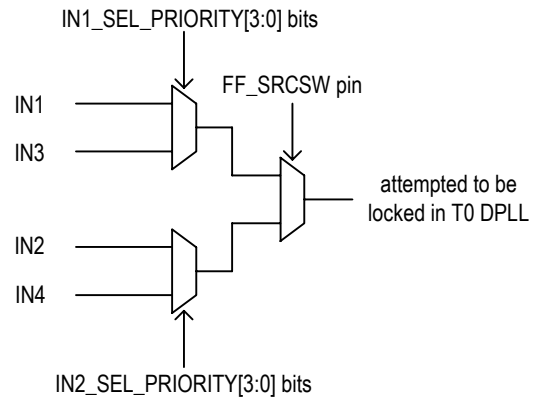
Automatic selection is done based on the results of input clocks quality monitoring and the related registers configuration.

The selected input clock is attempted to be locked in T0/T4 DPLL.

#### 3.6.1 EXTERNAL FAST SELECTION (T0 ONLY)

The External Fast selection is supported by T0 path only. In External Fast selection, only IN1/IN3 and IN2/IN4 pairs are available for selection. Refer to [Figure 5](#). The results of input clocks quality monitoring (refer to [Chapter 3.5 Input Clock Quality Monitoring](#)) do not affect input clock selection.

The T0 input clock selection is determined by the FF\_SRCSW pin after reset (this pin determines the default value of the EXT\_SW bit during reset, refer to [Chapter 2 Pin Description](#)), the IN1\_SEL\_PRIORITY[3:0] bits and the IN2\_SEL\_PRIORITY[3:0] bits, as shown in [Figure 5](#) and [Table 8](#):



**Figure 5. External Fast Selection**

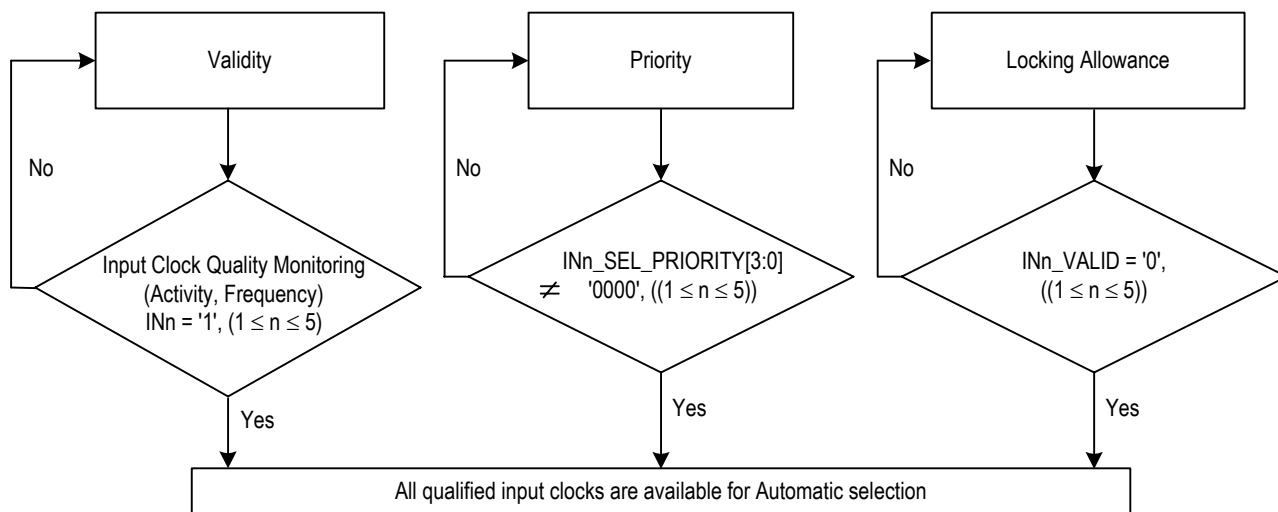
**3.6.2 FORCED SELECTION**

In Forced selection, the selected input clock is set by the T0\_INPUT\_SEL[3:0] / T4\_INPUT\_SEL[3:0] bits. The results of input clocks quality monitoring (refer to [Chapter 3.5 Input Clock Quality Monitoring](#)) do not affect the input clock selection.

**3.6.3 AUTOMATIC SELECTION**

In Automatic selection, the input clock selection is determined by its validity, priority and locking allowance configuration. The validity

depends on the results of input clock quality monitoring (refer to [Chapter 3.5 Input Clock Quality Monitoring](#)). Locking allowance is configured by the corresponding INn\_VALID bit ( $1 \leq n \leq 5$ ). Refer to [Figure 6](#). In all the qualified input clocks, the one with the highest priority is selected. The priority is set by the corresponding INn\_SEL\_PRIORITY[3:0] bits ( $1 \leq n \leq 5$ ). If more than one qualified input clock INn is available and has the same priority, the input clock with the smallest 'n' is selected.



**Figure 6. Qualified Input Clocks for Automatic Selection**

**Table 9: Related Bit / Register in Chapter 3.6**

| Bit   | Register  | Address (Hex) |
|---|---|---------------|
| EXT_SW                                      | MON_SW_PBO_CNFG   | 0B            |
| T0_INPUT_SEL[3:0]                           | T0_INPUT_SEL_CNFG   | 50            |
| T4_LOCK_T0                                  | T4_INPUT_SEL_CNFG   | 51            |
| T0_FOR_T4                                   |   |               |
| T4_INPUT_SEL[3:0]                           |   |               |
| INn_SEL_PRIORITY[3:0] ( $1 \leq n \leq 5$ ) | IN1_IN2_SEL_PRIORITY_CNFG<br>IN3_IN4_SEL_PRIORITY_CNFG<br>IN5_SEL_PRIORITY_CNFG | 27 ~ 28, 2B   |
| INn_VALID ( $1 \leq n \leq 5$ )             | REMOTE_INPUT_VALID1_CNFG,<br>REMOTE_INPUT_VALID2_CNFG                           | 4C, 4D        |
| INn ( $1 \leq n \leq 5$ )                   | INPUT_VALID1_STS, INPUT_VALID2_STS  | 4A, 4B        |
| T4_T0_SEL                                   | T4_T0_REG_SEL_CNFG  | 07            |

**Note:** \* The setting in the 26 ~ 2C registers is either for T0 path or for T4 path, as determined by the T4\_T0\_SEL bit.



### 3.7 SELECTED INPUT CLOCK MONITORING

The quality of the selected input clock is always monitored (refer to [Chapter 3.5 Input Clock Quality Monitoring](#)) and the DPLL locking status is always monitored.

#### 3.7.1 T0 / T4 DPLL LOCKING DETECTION

The following events are always monitored:

- Fast Loss;
- Coarse Phase Loss;
- Fine Phase Loss;
- Hard Limit Exceeding.

##### 3.7.1.1 Fast Loss

A fast loss is triggered when the selected input clock misses 2 consecutive clock cycles. It is cleared once an active clock edge is detected.

For T0 path, the occurrence of the fast loss will result in T0 DPLL being unlocked if the FAST\_LOS\_SW bit is '1'. For T4 path, the occurrence of the fast loss will result in T4 DPLL being unlocked regardless of the FAST\_LOS\_SW bit.

##### 3.7.1.2 Coarse Phase Loss

The T0/T4 DPLL compares the selected input clock with the feedback signal. If the phase-compared result exceeds the coarse phase limit, a coarse phase loss is triggered. It is cleared once the phase-compared result is within the coarse phase limit.

When the selected input clock is of 2 kHz, 4 kHz or 8 kHz, the coarse phase limit depends on the MULTI\_PH\_8K\_4K\_2K\_EN bit, the WIDE\_EN bit and the PH\_LOS\_COARSE\_LIMT[3:0] bits. Refer to [Table 10](#). When the selected input clock is of other frequencies than 2 kHz, 4 kHz and 8 kHz, the coarse phase limit depends on the WIDE\_EN bit and the PH\_LOS\_COARSE\_LIMT[3:0] bits. Refer to [Table 11](#).

**Table 10: Coarse Phase Limit Programming (the selected input clock of 2 kHz, 4 kHz or 8 kHz)**

| MULTI_PH_8K_4K_2K_EN | WIDE_EN    | Coarse Phase Limit                      |
|----------------------|------------|---|
| 0                    | don't-care | ±1 UI                                   |
| 1                    | 0          | ±1 UI                                   |
|                      | 1          | set by the PH_LOS_COARSE_LIMT[3:0] bits |

**Table 11: Coarse Phase Limit Programming (the selected input clock of other than 2 kHz, 4 kHz and 8 kHz)**

| WIDE_EN | Coarse Phase Limit                      |
|---------|---|
| 0       | ±1 UI                                   |
| 1       | set by the PH_LOS_COARSE_LIMT[3:0] bits |

The occurrence of the coarse phase loss will result in T0/T4 DPLL being unlocked if the COARSE\_PH\_LOS\_LIMT\_EN bit is '1'.

##### 3.7.1.3 Fine Phase Loss

The T0/T4 DPLL compares the selected input clock with the feedback signal. If the phase-compared result exceeds the fine phase limit programmed by the PH\_LOS\_FINE\_LIMT[2:0] bits, a fine phase loss is triggered. It is cleared once the phase-compared result is within the fine phase limit.

The occurrence of the fine phase loss will result in T0/T4 DPLL being unlocked if the FINE\_PH\_LOS\_LIMT\_EN bit is '1'.

##### 3.7.1.4 Hard Limit Exceeding

Two limits are available for this monitoring. They are DPLL soft limit and DPLL hard limit. When the frequency of the DPLL output with respect to the master clock exceeds the DPLL soft / hard limit, a DPLL soft / hard alarm will be raised; the alarm is cleared once the frequency is within the corresponding limit. The occurrence of the DPLL soft alarm does not affect the T0/T4 DPLL locking status. The DPLL soft alarm is indicated by the corresponding T0\_DPLL\_SOFT\_FREQ\_ALARM / T4\_DPLL\_SOFT\_FREQ\_ALARM bit. The occurrence of the DPLL hard alarm will result in T0/T4 DPLL being unlocked if the FREQ\_LIMT\_PH\_LOS bit is '1'.

The DPLL soft limit is set by the DPLL\_FREQ\_SOFT\_LIMT[6:0] bits and can be calculated as follows:

$$DPLL \text{ Soft Limit (ppm)} = DPLL\_FREQ\_SOFT\_LIMT[6:0] \times 0.724$$

The DPLL hard limit is set by the DPLL\_FREQ\_HARD\_LIMT[15:0] bits and can be calculated as follows:

$$DPLL \text{ Hard Limit (ppm)} = DPLL\_FREQ\_HARD\_LIMT[15:0] \times 0.0014$$

#### 3.7.2 LOCKING STATUS

The DPLL locking status depends on the locking monitoring results. The DPLL is in locked state if none of the following events is triggered during 2 seconds; otherwise, the DPLL is unlocked.

- Fast Loss (the FAST\_LOS\_SW bit is '1');
- Coarse Phase Loss (the COARSE\_PH\_LOS\_LIMT\_EN bit is '1');
- Fine Phase Loss (the FINE\_PH\_LOS\_LIMT\_EN bit is '1');
- DPLL Hard Alarm (the FREQ\_LIMT\_PH\_LOS bit is '1').

If the FAST\_LOS\_SW bit, the COARSE\_PH\_LOS\_LIMT\_EN bit, the FINE\_PH\_LOS\_LIMT\_EN bit or the FREQ\_LIMT\_PH\_LOS bit is '0', the DPLL locking status will not be affected even if the corresponding event is triggered. If all these bits are '0', the DPLL will be in locked state in 2 seconds.

The DPLL locking status is indicated by the T0\_DPLL\_LOCK / T4\_DPLL\_LOCK bit.

The T4\_STS<sup>1</sup> bit will be set when the locking status of the T4 DPLL changes (from 'locked' to 'unlocked' or from 'unlocked' to 'locked'). If the T4\_STS<sup>2</sup> bit is '1', an interrupt will be generated.

### 3.7.3 PHASE LOCK ALARM (T0 ONLY)

A phase lock alarm will be raised when the selected input clock can not be locked in T0 DPLL within a certain period. This period can be calculated as follows:

$$\text{Period (sec.)} = \text{TIME\_OUT\_VALUE}[5:0] \times \text{MULTI\_FACTOR}[1:0]$$

The phase lock alarm is indicated by the corresponding IN<sub>n</sub>\_PH\_LOCK\_ALARM bit (1 ≤ n ≤ 5).

The phase lock alarm can be cleared by the following two ways, as selected by the PH\_ALARM\_TIMEOUT bit:

- Be cleared when a '1' is written to the corresponding IN<sub>n</sub>\_PH\_LOCK\_ALARM bit;
- Be cleared after the period (=  $\text{TIME\_OUT\_VALUE}[5:0] \times \text{MULTI\_FACTOR}[1:0]$  in seconds) which starts from when the alarm is raised.

The selected input clock with a phase lock alarm is disqualified for T0 DPLL locking.

Note that no phase lock alarm is raised if the T4 selected input clock can not be locked.

**Table 12: Related Bit / Register in Chapter 3.7**

| Bit  | Register   | Address (Hex) |
|--|--|---------------|
| FAST_LOS_SW                                | PHASE_LOSS_FINE_LIMIT_CNFG   | 5B *          |
| PH_LOS_FINE_LIMIT[2:0]                     |  |               |
| FINE_PH_LOS_LIMIT_EN                       |  |               |
| MULTI_PH_8K_4K_2K_EN                       | PHASE_LOSS_COARSE_LIMIT_CNFG                                       | 5A *          |
| WIDE_EN                                    |  |               |
| PH_LOS_COARSE_LIMIT[3:0]                   |  |               |
| COARSE_PH_LOS_LIMIT_EN                     | OPERATING_STS  | 52            |
| T0_DPLL_SOFT_FREQ_ALARM                    |  |               |
| T4_DPLL_SOFT_FREQ_ALARM                    |  |               |
| T0_DPLL_LOCK                               |  |               |
| T4_DPLL_LOCK                               | DPLL_FREQ_SOFT_LIMIT_CNFG  | 65            |
| DPLL_FREQ_SOFT_LIMIT[6:0]                  |  |               |
| FREQ_LIMIT_PH_LOS                          | DPLL_FREQ_HARD_LIMIT[15:8]_CNFG,<br>DPLL_FREQ_HARD_LIMIT[7:0]_CNFG | 67, 66        |
| DPLL_FREQ_HARD_LIMIT[15:0]                 |  |               |
| T4_STS <sup>1</sup>                        | INTERRUPTS3_STS  | 0F            |
| T4_STS <sup>2</sup>                        | INTERRUPTS3_ENABLE_CNFG  | 12            |
| TIME_OUT_VALUE[5:0]                        | PHASE_ALARM_TIME_OUT_CNFG  | 08            |
| MULTI_FACTOR[1:0]                          |  |               |
| IN <sub>n</sub> _PH_LOCK_ALARM (1 ≤ n ≤ 5) | IN1_IN2_STS, IN3_IN4_STS, IN5_STS                                  | 44 ~ 45, 48   |
| PH_ALARM_TIMEOUT                           | INPUT_MODE_CNFG  | 09            |
| T4_T0_SEL                                  | T4_T0_REG_SEL_CNFG   | 07            |

**Note:** \* The setting in the 5A and 5B registers is either for T0 path or for T4 path, as determined by the T4\_T0\_SEL bit.

### 3.8 SELECTED INPUT CLOCK SWITCH

If the input clock is selected by External Fast selection or by Forced selection, it can be switched by setting the related registers (refer to [Chapter 3.6.1 External Fast Selection \(T0 only\)](#) & [Chapter 3.6.2 Forced Selection](#)) any time. In this case, whether the input clock is qualified for DPLL locking does not affect the clock switch. If the T4 selected input clock is a T0 DPLL output, it can only be switched by setting the T0\_FOR\_T4 bit.

When the input clock is selected by Automatic selection, the input clock switch depends on its validity, priority and locking allowance configuration. If the current selected input clock is disqualified, a new qualified input clock may be switched to.

#### 3.8.1 INPUT CLOCK VALIDITY

For all the input clocks, the validity depends on the results of input clock quality monitoring (refer to [Chapter 3.5 Input Clock Quality Monitoring](#)). When all of the following conditions are satisfied, the input clock is valid; otherwise, it is invalid.

- No no-activity alarm (the INn\_NO\_ACTIVITY\_ALARM bit is '0');
- No frequency hard alarm (the INn\_FREQ\_HARD\_ALARM bit is '0');
- If the IN\_NOISE\_WINDOW bit is '1', all the edges of the input clock of 2 kHz, 4 kHz or 8 kHz drift inside ±5%; if the IN\_NOISE\_WINDOW bit is '0', this condition is ignored.

The validity qualification of the T0 selected input clock is different from that of the T4 selected input clock. The validity qualification of the T4 selected input clock is the same as the above. The T0 selected input clock is valid when all of the above and the following conditions are satisfied; otherwise, it is invalid.

- No phase lock alarm, i.e., the INn\_PH\_LOCK\_ALARM bit is '0';
- If the ULTR\_FAST\_SW bit is '1', the T0 selected input clock misses less than (<) 2 consecutive clock cycles; if the ULTR\_FAST\_SW bit is '0', this condition is ignored.

The validities of all the input clocks are indicated by the INn<sup>1</sup> bit (1 ≤ n ≤ 5). When the input clock validity changes (from 'valid' to 'invalid' or from 'invalid' to 'valid'), the INn<sup>2</sup> bit will be set. If the INn<sup>3</sup> bit is '1', an interrupt will be generated.

When the T0 selected input clock has failed, i.e., the validity of the T0 selected input clock changes from 'valid' to 'invalid', the T0\_MAIN\_REF\_FAILED<sup>1</sup> bit will be set. If the T0\_MAIN\_REF\_FAILED<sup>2</sup> bit is '1', an interrupt will be generated. This interrupt can also be indicated by hardware - the TDO pin, as determined by the LOS\_FLAG\_TO\_TDO bit. When the TDO pin is used to indicate this interrupt, it will be set high when this interrupt is generated and will remain high until this interrupt is cleared.

#### 3.8.2 SELECTED INPUT CLOCK SWITCH

When the device is configured as Automatic input clock selection, T0 input clock switch is different from T4 input clock switch.

For T0 path, Revertive and Non-Revertive switches are supported, as selected by the REVERTIVE\_MODE bit.

For T4 path, only Revertive switch is supported.

The difference between Revertive and Non-Revertive switches is that whether the selected input clock is switched when another qualified input clock with a higher priority than the current selected input clock is available for selection. In Non-Revertive switch, input clock switch is minimized.

Conditions of the qualified input clocks available for T0 selection are different from that for T4 selection, as shown in [Table 13](#):

**Table 13: Conditions of Qualified Input Clocks Available for T0 & T4 Selection**

| Conditions of Qualified Input Clocks Available for T0 & T4 Selection |   |
|--|---|
| <b>T0</b>  | <ul style="list-style-type: none"> <li>• Valid, i.e., the INn<sup>1</sup> bit is '1';</li> <li>• Priority enabled, i.e., the corresponding INn_SEL_PRIORITY[3:0] bits are not '0000';</li> <li>• Locking to the input clock is allowed, i.e., the corresponding INn_VALID bit is '0'.</li> </ul>  |
| <b>T4</b>  | <ul style="list-style-type: none"> <li>• Valid (all the validity conditions listed in <a href="#">Chapter 3.8.1 Input Clock Validity</a> are satisfied);</li> <li>• Priority enabled, i.e., the corresponding INn_SEL_PRIORITY[3:0] bits are not '0000';</li> <li>• Locking to the input clock is allowed, i.e., the corresponding INn_VALID bit is '0'.</li> </ul> |

The input clock is disqualified if any of the above conditions is not satisfied.

In summary, the selected input clock can be switched by:

- External Fast selection (supported by T0 path only);
- Forced selection;
- Revertive switch;
- Non-Revertive switch (supported by T0 path only);
- T4 DPLL locked to T0 DPLL output (supported by T4 path only).

#### 3.8.2.1 Revertive Switch

In Revertive switch, the selected input clock is switched when another qualified input clock with a higher priority than the current selected input clock is available.

The selected input clock is switched if any of the following is satisfied:

- the selected input clock is disqualified;
- another qualified input clock with a higher priority than the selected input clock is available.

A qualified input clock with the highest priority is selected by revertive switch. If more than one qualified input clock INn is available and has the same priority, the input clock with the smallest 'n' is selected.

### 3.8.2.2 Non-Revertive Switch (T0 only)

In Non-Revertive switch, the T0 selected input clock is not switched when another qualified input clock with a higher priority than the current selected input clock is available. In this case, the selected input clock is switched and a qualified input clock with the highest priority is selected only when the T0 selected input clock is disqualified. If more than one qualified input clock is available and has the same priority, the input clock with the smallest 'n' is selected.

### 3.8.3 SELECTED / QUALIFIED INPUT CLOCKS INDICATION

The selected input clock is indicated by the CURRENTLY\_SELECTED\_INPUT[3:0] bits. Note if the T4 selected input clock is a T0 DPLL output, it can not be indicated by these bits.

The qualified input clocks with the three highest priorities are indicated by HIGHEST\_PRIORITY\_VALIDATED[3:0] bits, the SECOND\_PRIORITY\_VALIDATED[3:0] bits and the THIRD\_PRIORITY\_VALIDATED[3:0] bits respectively. If more than one input clock INn has the same priority, the input clock with the smallest 'n' is indicated by the HIGHEST\_PRIORITY\_VALIDATED[3:0] bits.

When the device is configured in Automatic selection and Revertive switch is enabled, the input clock indicated by the CURRENTLY\_SELECTED\_INPUT[3:0] bits is the same as the one indicated by the HIGHEST\_PRIORITY\_VALIDATED[3:0] bits; otherwise, they are not the same.

When all the input clocks for T4 path become unqualified, the INPUT\_TO\_T4<sup>1</sup> bit will be set. If the INPUT\_TO\_T4<sup>2</sup> bit is '1', an interrupt will be generated.

Table 14: Related Bit / Register in Chapter 3.8

| Bit                               | Register  | Address (Hex) |
|-----------------------------------|---|---------------|
| T0_FOR_T4                         | T4_INPUT_SEL_CNFG   | 51            |
| INn <sup>1</sup> (1 ≤ n ≤ 5)      | INPUT_VALID1_STS, INPUT_VALID2_STS  | 4A, 4B        |
| INn <sup>2</sup> (1 ≤ n ≤ 5)      | INTERRUPTS1_STS, INTERRUPTS2_STS  | 0D, 0E        |
| INn <sup>3</sup> (1 ≤ n ≤ 5)      | INTERRUPTS1_ENABLE_CNFG, INTERRUPTS2_ENABLE_CNFG                            | 10, 11        |
| INn_NO_ACTIVITY_ALARM (1 ≤ n ≤ 5) | IN1_IN2_STS, IN3_IN4_STS, IN5_STS   | 44 ~ 45, 48   |
| INn_FREQ_HARD_ALARM (1 ≤ n ≤ 5)   |   |               |
| INn_PH_LOCK_ALARM (1 ≤ n ≤ 5)     |   |               |
| IN_NOISE_WINDOW                   | PHASE_MON_PBO_CNFG  | 78            |
| ULTR_FAST_SW                      | MON_SW_PBO_CNFG   | 0B            |
| LOS_FLAG_TO_TDO                   |   |               |
| T0_MAIN_REF_FAILED <sup>1</sup>   | INTERRUPTS2_STS   | 0E            |
| T0_MAIN_REF_FAILED <sup>2</sup>   | INTERRUPTS2_ENABLE_CNFG   | 11            |
| INPUT_TO_T4 <sup>1</sup>          | INTERRUPTS3_STS   | 0F            |
| INPUT_TO_T4 <sup>2</sup>          | INTERRUPTS3_ENABLE_CNFG   | 12            |
| REVERTIVE_MODE                    | INPUT_MODE_CNFG   | 09            |
| INn_SEL_PRIORITY[3:0] (1 ≤ n ≤ 5) | IN1_IN2_SEL_PRIORITY_CNFG, IN3_IN4_SEL_PRIORITY_CNFG, IN5_SEL_PRIORITY_CNFG | 27 ~ 28, 2B   |
| INn_VALID (1 ≤ n ≤ 5)             | REMOTE_INPUT_VALID1_CNFG, REMOTE_INPUT_VALID2_CNFG                          | 4C, 4D        |
| CURRENTLY_SELECTED_INPUT[3:0]     | PRIORITY_TABLE1_STS   | 4E *          |
| HIGHEST_PRIORITY_VALIDATED[3:0]   |   |               |
| SECOND_PRIORITY_VALIDATED[3:0]    |   |               |
| THIRD_PRIORITY_VALIDATED[3:0]     | PRIORITY_TABLE2_STS   | 4F *          |
| T4_T0_SEL                         | T4_T0_REG_SEL_CNFG  | 07            |

Note: \* The setting in the 26 ~ 2C, 4E and 4F registers is either for T0 path or for T4 path, as determined by the T4\_T0\_SEL bit.

### 3.9 SELECTED INPUT CLOCK STATUS VS. DPLL OPERATING MODE

The operating modes supported by T0 DPLL are more complex than the ones supported by T4 DPLL for T0 path is the main one. T0 DPLL supports three primary operating modes: Free-Run, Locked and Hold-over, and three secondary, temporary operating modes: Pre-Locked, Pre-Locked2 and Lost-Phase. T4 DPLL supports three operating modes: Free-Run, Locked and Holdover. The operating modes of T0 DPLL and T4 DPLL can be switched automatically or by force, as controlled by the T0\_OPERATING\_MODE[2:0] / T4\_OPERATING\_MODE[2:0] bits respectively.

When the operating mode is switched by force, the operating mode switch is under external control and the status of the selected input clock takes no effect to the operating mode selection. The forced operating mode switch is applicable for special cases, such as testing.

When the operating mode is switched automatically, the internal state machines for T0 and for T4 automatically determine the operating mode respectively.

#### 3.9.1 T0 SELECTED INPUT CLOCK VS. DPLL OPERATING MODE

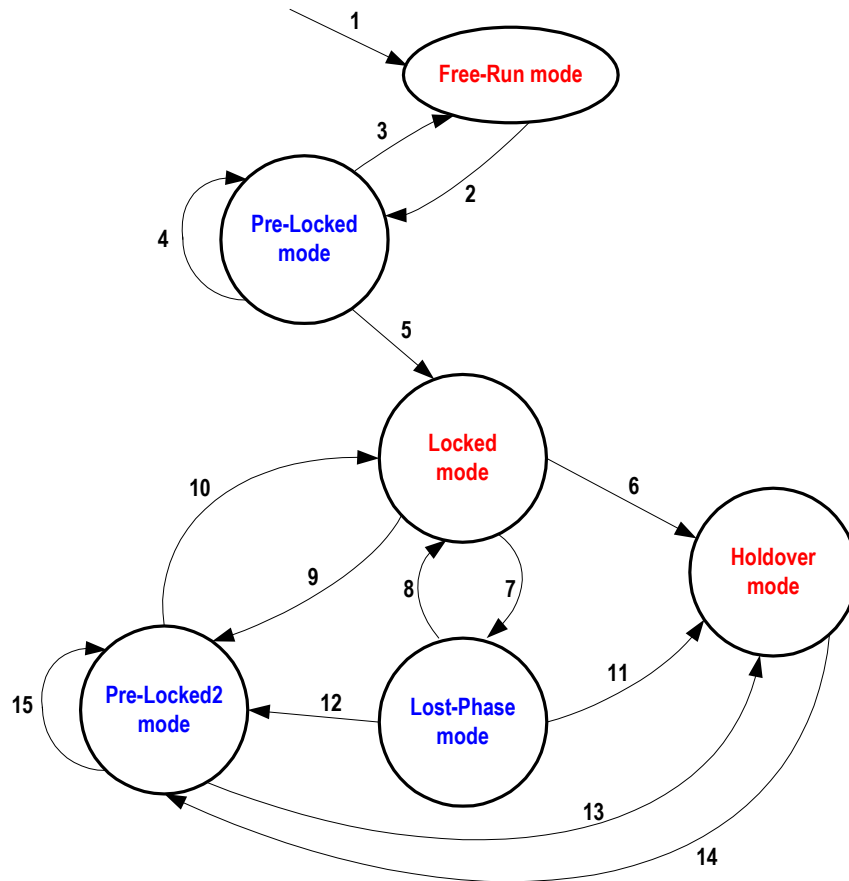
The T0 DPLL operating mode is controlled by the T0\_OPERATING\_MODE[2:0] bits, as shown in [Table 15](#):

**Table 15: T0 DPLL Operating Mode Control**

| T0_OPERATING_MODE[2:0] | T0 DPLL Operating Mode |
|------------------------|------------------------|
| 000                    | Automatic              |
| 001                    | Forced - Free-Run      |
| 010                    | Forced - Holdover      |
| 100                    | Forced - Locked        |
| 101                    | Forced - Pre-Locked2   |
| 110                    | Forced - Pre-Locked    |
| 111                    | Forced - Lost-Phase    |

When the operating mode is switched automatically, the operation of the internal state machine is shown in [Figure 7](#).

Whether the operating mode is under external control or is switched automatically, the current operating mode is always indicated by the T0\_DPLL\_OPERATING\_MODE[2:0] bits. When the operating mode switches, the T0\_OPERATING\_MODE<sup>1</sup> bit will be set. If the T0\_OPERATING\_MODE<sup>2</sup> bit is '1', an interrupt will be generated.



**Figure 7. T0 Selected Input Clock vs. DPLL Automatic Operating Mode**

Notes to Figure 7:

1. Reset.
2. An input clock is selected.
3. The T0 selected input clock is disqualified **AND** No qualified input clock is available.
4. The T0 selected input clock is switched to another one.
5. The T0 selected input clock is locked (the T0\_DPLL\_LOCK bit is '1').
6. The T0 selected input clock is disqualified **AND** No qualified input clock is available.
7. The T0 selected input clock is unlocked (the T0\_DPLL\_LOCK bit is '0').
8. The T0 selected input clock is locked again (the T0\_DPLL\_LOCK bit is '1').
9. The T0 selected input clock is switched to another one.
10. The T0 selected input clock is locked (the T0\_DPLL\_LOCK bit is '1').
11. The T0 selected input clock is disqualified **AND** No qualified input clock is available.
12. The T0 selected input clock is switched to another one.
13. The T0 selected input clock is disqualified **AND** No qualified input clock is available.
14. An input clock is selected.
15. The T0 selected input clock is switched to another one.

The causes of Item 4, 9, 12, 15 - 'the T0 selected input clock is switched to another one' - are: (The T0 selected input clock is disqualified **AND** Another input clock is switched to) **OR** (In Revertive switch, a qualified input clock with a higher priority is switched to) **OR** (The T0 selected input clock is switched to another one by External Fast selection or Forced selection).

Refer to Table 13 for details about the input clock qualification for T0 path.

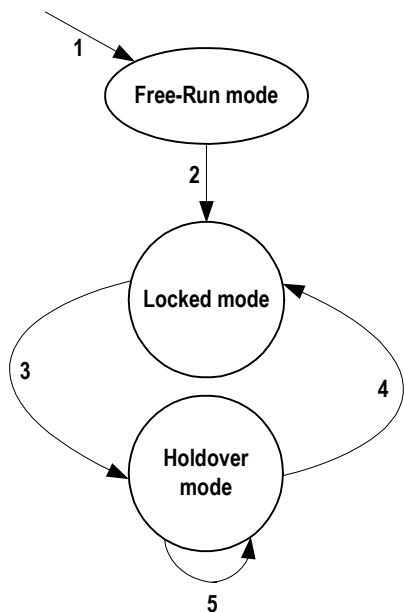
**3.9.2 T4 SELECTED INPUT CLOCK VS. DPLL OPERATING MODE**

The T4 DPLL operating mode is controlled by the T4\_OPERATING\_MODE[2:0] bits, as shown in Table 16:

**Table 16: T4 DPLL Operating Mode Control**

| T4_OPERATING_MODE[2:0] | T4 DPLL Operating Mode |
|------------------------|------------------------|
| 000                    | Automatic              |
| 001                    | Forced - Free-Run      |
| 010                    | Forced - Holdover      |
| 100                    | Forced - Locked        |

When the operating mode is switched automatically, the operation of the internal state machine is shown in Figure 8:



**Figure 8. T4 Selected Input Clock vs. DPLL Automatic Operating Mode**

Notes to Figure 8:

1. Reset.
2. An input clock is selected.
3. (The T4 selected input clock is disqualified) **OR** (A qualified input clock with a higher priority is switched to) **OR** (The T4 selected input clock is switched to another one by Forced selection) **OR** (When T4 DPLL locks to the T0 DPLL output, the T4 selected input clock is switched by setting the T0\_FOR\_T4 bit).
4. An input clock is selected.
5. No input clock is selected.

Refer to Table 13 for details about the input clock qualification for T4 path.

**Table 17: Related Bit / Register in Chapter 3.9**

| Bit                            | Register                | Address (Hex) |
|--------------------------------|-------------------------|---------------|
| T0_OPERATING_MODE[2:0]         | T0_OPERATING_MODE_CNFG  | 53            |
| T4_OPERATING_MODE[2:0]         | T4_OPERATING_MODE_CNFG  | 54            |
| T0_DPLL_OPERATING_MODE[2:0]    | OPERATING_STS           | 52            |
| T0_DPLL_LOCK                   |                         |               |
| T0_OPERATING_MODE <sup>1</sup> | INTERRUPTS2_STS         | 0E            |
| T0_OPERATING_MODE <sup>2</sup> | INTERRUPTS2_ENABLE_CNFG | 11            |
| T0_FOR_T4                      | T4_INPUT_SEL_CNFG       | 51            |

### 3.10 T0 / T4 DPLL OPERATING MODE

The T0/T4 DPLL gives a stable performance in different applications without being affected by operating conditions or silicon process variations. It integrates a PFD (Phase & Frequency Detector), a LPF (Low Pass Filter) and a DCO (Digital Controlled Oscillator), which form a closed loop. If no input clock is selected, the loop is not closed, and the PFD and LPF do not function.

The PFD detects the phase error, including the fast loss, coarse phase loss and fine phase loss (refer to [Chapter 3.7.1.1 Fast Loss](#) to [Chapter 3.7.1.3 Fine Phase Loss](#)). The averaged phase error of the T0/T4 DPLL feedback with respect to the selected input clock is indicated by the CURRENT\_PH\_DATA[15:0] bits. It can be calculated as follows:

$$\text{Averaged Phase Error (ns)} = \text{CURRENT\_PH\_DATA}[15:0] \times 0.61$$

The LPF filters jitters. Its 3 dB bandwidth and damping factor are programmable. A range of bandwidths and damping factors can be set to meet different application requirements. Generally, the lower the damping factor is, the longer the locking time is and the more the gain is.

The DCO controls the DPLL output. The frequency of the DPLL output is always multiplied on the basis of the master clock. The phase and frequency offset of the DPLL output may be locked to those of the selected input clock. The current frequency offset with respect to the master clock is indicated by the CURRENT\_DPLL\_FREQ[23:0] bits, and can be calculated as follows:

$$\text{Current Frequency Offset (ppm)} = \text{CURRENT\_DPLL\_FREQ}[23:0] \times 0.000011$$

#### 3.10.1 T0 DPLL OPERATING MODE

The T0 DPLL loop is closed except in Free-Run mode and Holdover mode.

For a closed loop, different bandwidths and damping factors can be used depending on DPLL locking stages: starting, acquisition and locked.

In the first two seconds when the T0 DPLL attempts to lock to the selected input clock, the starting bandwidth and damping factor are used. They are set by the T0\_DPLL\_START\_BW[4:0] bits and the T0\_DPLL\_START\_DAMPING[2:0] bits respectively.

During the acquisition, the acquisition bandwidth and damping factor are used. They are set by the T0\_DPLL\_ACQ\_BW[4:0] bits and the T0\_DPLL\_ACQ\_DAMPING[2:0] bits respectively.

When the T0 selected input clock is locked, the locked bandwidth and damping factor are used. They are set by the T0\_DPLL\_LOCKED\_BW[4:0] bits and the T0\_DPLL\_LOCKED\_DAMPING[2:0] bits respectively.

The corresponding bandwidth and damping factor are used when the T0 DPLL operates in different DPLL locking stages: starting, acquisition and locked, as controlled by the device automatically.

Only the locked bandwidth and damping factor can be used regardless of the T0 DPLL locking stage, as controlled by the AUTO\_BW\_SEL bit.

#### 3.10.1.1 Free-Run Mode

In Free-Run mode, the T0 DPLL output refers to the master clock and is not affected by any input clock. The accuracy of the T0 DPLL output is equal to that of the master clock.

#### 3.10.1.2 Pre-Locked Mode

In Pre-Locked mode, the T0 DPLL output attempts to track the selected input clock.

The Pre-Locked mode is a secondary, temporary mode.

#### 3.10.1.3 Locked Mode

In Locked mode, the T0 selected input clock is locked. The phase and frequency offset of the T0 DPLL output track those of the T0 selected input clock.

In this mode, if the T0 selected input clock is in fast loss status and the FAST\_LOS\_SW bit is '1', the T0 DPLL is unlocked (refer to [Chapter 3.7.1.1 Fast Loss](#)) and will enter Lost-Phase mode when the operating mode is switched automatically; if the T0 selected input clock is in fast loss status and the FAST\_LOS\_SW bit is '0', the T0 DPLL locking status is not affected and the T0 DPLL will enter Temp-Holdover mode automatically.

##### 3.10.1.3.1 Temp-Holdover Mode

The T0 DPLL will automatically enter Temp-Holdover mode with a selected input clock switch or no qualified input clock available when the operating mode switch is under external control.

In Temp-Holdover mode, the T0 DPLL has temporarily lost the selected input clock. The T0 DPLL operation in Temp-Holdover mode and that in Holdover mode are alike (refer to [Chapter 3.10.1.5 Holdover Mode](#)) except the frequency offset acquiring methods. See [Chapter 3.10.1.5 Holdover Mode](#) for details about the methods. The method is selected by the TEMP\_HOLDOVER\_MODE[1:0] bits, as shown in [Table 18](#):

**Table 18: Frequency Offset Control in Temp-Holdover Mode**

| TEMP_HOLDOVER_MODE[1:0] | Frequency Offset Acquiring Method      |
|-------------------------|--|
| 00                      | the same as that used in Holdover mode |
| 01                      | Automatic Instantaneous                |
| 10                      | Automatic Fast Averaged                |
| 11                      | Automatic Slow Averaged                |

The device automatically controls the T0 DPLL to exit from Temp-Holdover mode.

#### 3.10.1.4 Lost-Phase Mode

In Lost-Phase mode, the T0 DPLL output attempts to track the selected input clock.

The Lost-Phase mode is a secondary, temporary mode.

#### 3.10.1.5 Holdover Mode

In Holdover mode, the T0 DPLL resorts to the stored frequency data acquired in Locked mode to control its output. The T0 DPLL output is not



phase locked to any input clock. The frequency offset acquiring method is selected by the MAN\_HOLD OVER bit, the AUTO\_AVG bit and the FAST\_AVG bit, as shown in [Table 19](#):

**Table 19: Frequency Offset Control in Holdover Mode**

| MAN_HOLD OVER | AUTO_AVG   | FAST_AVG   | Frequency Offset Acquiring Method |
|---------------|------------|------------|-----------------------------------|
| 0             | 0          | don't-care | Automatic Instantaneous           |
|               | 1          | 0          | Automatic Slow Averaged           |
|               |            | 1          | Automatic Fast Averaged           |
| 1             | don't-care |            | Manual                            |

#### 3.10.1.5.1 Automatic Instantaneous

By this method, the T0 DPLL freezes at the operating frequency when it enters Holdover mode. The accuracy is  $4.4 \times 10^{-8}$  ppm.

#### 3.10.1.5.2 Automatic Slow Averaged

By this method, an internal IIR (Infinite Impulse Response) filter is employed to get the frequency offset. The IIR filter gives a 3 dB attenuation point corresponding to a period of 110 minutes. The accuracy is  $1.1 \times 10^{-5}$  ppm.

#### 3.10.1.5.3 Automatic Fast Averaged

By this method, an internal IIR (Infinite Impulse Response) filter is employed to get the frequency offset. The IIR filter gives a 3 dB attenuation point corresponding to a period of 8 minutes. The accuracy is  $1.1 \times 10^{-5}$  ppm.

#### 3.10.1.5.4 Manual

By this method, the frequency offset is set by the T0\_HOLD OVER\_FREQ[23:0] bits. The accuracy is  $1.1 \times 10^{-5}$  ppm.

The frequency offset of the T0 DPLL output is indicated by the CURRENT\_DPLL\_FREQ[23:0] bits.

The device provides a reference for the value to be written to the T0\_HOLD OVER\_FREQ[23:0] bits. The value to be written can refer to the value read from the CURRENT\_DPLL\_FREQ[23:0] bits or the T0\_HOLD OVER\_FREQ[23:0] bits (refer to [Chapter 3.10.1.5.5 Holdover Frequency Offset Read](#)); or then be processed by external software filtering.

#### 3.10.1.5.5 Holdover Frequency Offset Read

The offset value, which is acquired by Automatic Slow Averaged, Automatic Fast Averaged and is set by related register bits, can be read from the T0\_HOLD OVER\_FREQ[23:0] bits by setting the READ\_AVG bit and the FAST\_AVG bit, as shown in [Table 20](#).

**Table 20: Holdover Frequency Offset Read**

| READ_AVG | FAST_AVG   | Offset Value Read from T0_HOLD OVER_FREQ[23:0]  |
|----------|------------|---|
| 0        | don't-care | The value is equal to the one written to.   |
| 1        | 0          | The value is acquired by Automatic Slow Averaged method, not equal to the one written to. |
|          | 1          | The value is acquired by Automatic Fast Averaged method, not equal to the one written to. |

The frequency offset in ppm is calculated as follows:

$$\text{Holdover Frequency Offset (ppm)} = T0\_HOLD OVER\_FREQ[23:0] \times 0.000011$$

#### 3.10.1.6 Pre-Locked2 Mode

In Pre-Locked2 mode, the T0 DPLL output attempts to track the selected input clock.

The Pre-Locked2 mode is a secondary, temporary mode.

### 3.10.2 T4 DPLL OPERATING MODE

The T4 path is simpler compared with the T0 path.

#### 3.10.2.1 Free-Run Mode

In Free-Run mode, the T4 DPLL output refers to the master clock and is affected by any input clock. The accuracy of the T4 DPLL output is equal to that of the master clock.

#### 3.10.2.2 Locked Mode

In Locked mode, the T4 selected input clock may be locked in the T4 DPLL.

When the T4 selected input clock is locked, the phase and frequency offset of the T4 DPLL output track those of the T4 selected input clock; when unlocked, the phase and frequency offset of the T4 DPLL output attempt to track those of the selected input clock.

The T4 DPLL loop is closed in Locked mode. Its bandwidth and damping factor are set by the T4\_DPLL\_LOCKED\_BW[1:0] bits and the T4\_DPLL\_LOCKED\_DAMPING[2:0] bits respectively.

#### 3.10.2.3 Holdover Mode

In Holdover mode, the T4 DPLL resorts to the stored frequency data acquired in Locked mode to control its output. The T4 DPLL output is not

phase locked to any input clock. The T4 DPLL freezes at the operating frequency when it enters Holdover mode. The accuracy is  $4.4 \times 10^{-8}$  ppm.

**Table 21: Related Bit / Register in Chapter 3.10**

| Bit                         | Register  | Address (Hex)    |
|-----------------------------|---|------------------|
| CURRENT_PH_DATA[15:0]       | CURRENT_DPLL_PHASE[15:8]_STS, CURRENT_DPLL_PHASE[7:0]_STS                             | 69 *, 68 *       |
| CURRENT_DPLL_FREQ[23:0]     | CURRENT_DPLL_FREQ[23:16]_STS, CURRENT_DPLL_FREQ[15:8]_STS, CURRENT_DPLL_FREQ[7:0]_STS | 64 *, 63 *, 62 * |
| T0_DPLL_START_BW[4:0]       | T0_DPLL_START_BW_DAMPING_CNFG   | 56               |
| T0_DPLL_START_DAMPING[2:0]  |   |                  |
| T0_DPLL_ACQ_BW[4:0]         | T0_DPLL_ACQ_BW_DAMPING_CNFG   | 57               |
| T0_DPLL_ACQ_DAMPING[2:0]    |   |                  |
| T0_DPLL_LOCKED_BW[4:0]      | T0_DPLL_LOCKED_BW_DAMPING_CNFG  | 58               |
| T0_DPLL_LOCKED_DAMPING[2:0] |   |                  |
| AUTO_BW_SEL                 | T0_BW_OVERSHOOT_CNFG  | 59               |
| FAST_LOS_SW                 | PHASE_LOSS_FINE_LIMIT_CNFG  | 5B *             |
| TEMP_HOLDOVER_MODE[1:0]     | T0_HOLDOVER_MODE_CNFG   | 5C               |
| MAN_HOLDOVER                |   |                  |
| AUTO_AVG                    |   |                  |
| FAST_AVG                    |   |                  |
| READ_AVG                    |   |                  |
| T0_HOLDOVER_FREQ[23:0]      | T0_HOLDOVER_FREQ[23:16]_CNFG, T0_HOLDOVER_FREQ[15:8]_CNFG, T0_HOLDOVER_FREQ[7:0]_CNFG | 5F, 5E, 5D       |
| T4_DPLL_LOCKED_BW[1:0]      | T4_DPLL_LOCKED_BW_DAMPING_CNFG  | 61               |
| T4_DPLL_LOCKED_DAMPING[2:0] |   |                  |
| T4_T0_SEL                   | T4_T0_REG_SEL_CNFG  | 07               |

**Note:** \* The setting in the 5B, 62 ~ 64, 68 and 69 registers is either for T0 path or for T4 path, as determined by the T4\_T0\_SEL bit.

### 3.11 T0 / T4 DPLL OUTPUT

The DPLL output is locked to the selected input clock. According to the phase-compared result of the feedback and the selected input clock, and the DPLL output frequency offset, the PFD output is limited and the DPLL output is frequency offset limited.

#### 3.11.1 PFD OUTPUT LIMIT

The PFD output is limited to be within  $\pm 1$  UI or within the coarse phase limit (refer to [Chapter 3.7.1.2 Coarse Phase Loss](#)), as determined by the MULTI\_PH\_APP bit.

#### 3.11.2 FREQUENCY OFFSET LIMIT

The DPLL output is limited to be within the DPLL hard limit (refer to [Chapter 3.7.1.4 Hard Limit Exceeding](#)).

For T0 DPLL, the integral path value can be frozen when the DPLL hard limit is reached. This function, enabled by the T0\_LIMT bit, will minimize the subsequent overshoot when T0 DPLL is pulling in.

#### 3.11.3 PBO (T0 ONLY)

The PBO function is only supported by the T0 path.

When a PBO event is triggered, the phase offset of the selected input clock with respect to the T0 DPLL output is measured. The device then automatically accounts for the measured phase offset and compensates an appropriate phase offset into the DPLL output so that the phase transients on the T0 DPLL output are minimized.

A PBO event is triggered if any one of the following conditions occurs:

- T0 selected input clock switches (the PBO\_EN bit is '1');
- T0 DPLL exits from Holdover mode or Free-Run mode (the PBO\_EN bit is '1');
- Phase-time changes on the T0 selected input clock are greater than a programmable limit over an interval of less than 0.1 seconds (the PH\_MON\_PBO\_EN bit is '1').

For the first two conditions, the phase transients on the T0 DPLL output are minimized to be no more than 0.61 ns with PBO. The PBO can also be frozen at the current phase offset by setting the PBO\_FREZ bit. When the PBO is frozen, the device will ignore any further PBO events triggered by the above two conditions, and maintain the current phase offset. When the PBO is disabled, there may be a phase shift on the T0 DPLL output and the T0 DPLL output tracks back to 0 degree phase offset with respect to the T0 selected input clock.

The last condition is specially for stratum 2 and 3E clocks. The PBO requirement specified in the Telcordia GR-1244-CORE is: 'Input phase-time changes of 3.5  $\mu$ s or greater over an interval of less than 0.1 seconds or less shall be built-out by stratum 2 and 3E clocks to reduce the resulting clock phase-time change to less than 50 ns. Phase-time changes of 1.0  $\mu$ s or less over an interval of 0.1 seconds shall not be built-out.' Based on this requirement, phase-time changes of more than

1.0  $\mu$ s but less than 3.5  $\mu$ s that occur over an interval of less than 0.1 seconds may or may not be built-out.

An integrated Phase Transient Monitor can be enabled by the PH\_MON\_EN bit to monitor the phase-time changes on the T0 selected input clock. When the phase-time changes are greater than a limit over an interval of less than 0.1 seconds, a PBO event is triggered and the phase transients on the DPLL output are absorbed. The limit is programmed by the PH\_TR\_MON\_LIMT[3:0] bits, and can be calculated as follows:

$$\text{Limit (ns)} = (\text{PH\_TR\_MON\_LIMT}[3:0] + 7) \times 156$$

The phase offset induced by PBO will never result in a coarse or fine phase loss.

#### 3.11.4 PHASE OFFSET SELECTION (T0 ONLY)

The phase offset of the T0 selected input clock with respect to the T0 DPLL output can be adjusted. If the device is configured as the Master, the PH\_OFFSET\_EN bit determines whether the input-to-output phase offset is enabled; if the device is configured as the Slave, the input-to-output phase offset is always enabled. If enabled, the input-to-output phase offset can be adjusted by setting the PH\_OFFSET[9:0] bits.

The input-to-output phase offset can be calculated as follows:

$$\text{Phase Offset (ns)} = \text{PH\_OFFSET}[9:0] \times 0.61$$

#### 3.11.5 FOUR PATHS OF T0 / T4 DPLL OUTPUTS

The T0 DPLL output and the T4 DPLL output are phase aligned with the T0 selected input clock and the T4 selected input clock respectively every 125  $\mu$ s period. Each DPLL has four output paths.

##### 3.11.5.1 T0 Path

The four paths for T0 DPLL output are as follows:

- 77.76 MHz path - outputs a 77.76 MHz clock;
- 16E1/16T1 path - outputs a 16E1 or 16T1 clock, as selected by the IN\_SONET\_SDH bit;
- GSM/OBSAI/16E1/16T1 path - outputs a GSM, OBSAI, 16E1 or 16T1 clock, as selected by the T0\_GSM\_OBSAI\_16E1\_16T1\_SEL[1:0] bits;
- 12E1/24T1/E3/T3 path - outputs a 12E1, 24T1, E3 or T3 clock, as selected by the T0\_12E1\_24T1\_E3\_T3\_SEL[1:0] bits.

T0 selected input clock is compared with a T0 DPLL output for DPLL locking. The output can only be derived from the 77.76 MHz path or the 16E1/16T1 path. The output path is automatically selected and the output is automatically divided to get the same frequency as the T0 selected input clock.

The T0 DPLL 77.76 MHz output or an 8 kHz signal derived from it can be provided for the T4 DPLL input clock selection (refer to [Chapter 3.6 T0 / T4 DPLL Input Clock Selection](#)).

T0 DPLL outputs are provided for T0/T4 APLL or device output process.

### 3.11.5.2 T4 Path

The four paths for T4 DPLL output are as follows:

- 77.76 MHz path - outputs a 77.76 MHz clock;
- 16E1/16T1 path - outputs a 16E1 or 16T1 clock, as selected by the IN\_SONET\_SDH bit;
- GSM/GPS/16E1/16T1 path - outputs a GSM, GPS, 16E1 or 16T1 clock, as selected by the T4\_GSM\_GPS\_16E1\_16T1\_SEL[1:0] bits;
- 12E1/24T1/E3/T3 path - outputs a 12E1, 24T1, E3 or T3 clock, as selected by the T4\_12E1\_24T1\_E3\_T3\_SEL[1:0] bits.

T4 selected input clock is compared with a T4 DPLL output for DPLL locking. The output can be derived from the 77.76 MHz path or the

16E1/16T1 path. In this case, the output path is automatically selected and the output is automatically divided to get the same frequency as the T4 selected input clock.

In addition, T4 selected input clock is compared with the T0 selected input clock to get the phase difference between T0 and T4 selected input clocks, as determined by the T4\_TEST\_T0\_PH bit.

T4 DPLL outputs are provided for T0/T4 APLL or device output process.

**Table 22: Related Bit / Register in Chapter 3.11**

| Bit                             | Register                                       | Address (Hex) |
|---------------------------------|--|---------------|
| MULTI_PH_APP                    | PHASE_LOSS_COARSE_LIMIT_CNFG                   | 5A *          |
| T0_LIMIT                        | T0_BW_OVERSHOOT_CNFG                           | 59            |
| PBO_EN                          | MON_SW_PBO_CNFG                                | 0B            |
| PBO_FREZ                        |  |               |
| PH_MON_PBO_EN                   | PHASE_MON_PBO_CNFG                             | 78            |
| PH_MON_EN                       |  |               |
| PH_TR_MON_LIMIT[3:0]            |  |               |
| PH_OFFSET_EN                    | PHASE_OFFSET[9:8]_CNFG                         | 7B            |
| PH_OFFSET[9:0]                  | PHASE_OFFSET[9:8]_CNFG, PHASE_OFFSET[7:0]_CNFG | 7B, 7A        |
| IN_SONET_SDH                    | INPUT_MODE_CNFG                                | 09            |
| T0_GSM_OBSAI_16E1_16T1_SEL[1:0] | T0_DPLL_APLL_PATH_CNFG                         | 55            |
| T0_12E1_24T1_E3_T3_SEL[1:0]     |  |               |
| T4_GSM_GPS_16E1_16T1_SEL[1:0]   | T4_DPLL_APLL_PATH_CNFG                         | 60            |
| T4_12E1_24T1_E3_T3_SEL[1:0]     |  |               |
| T4_TEST_T0_PH                   | T4_INPUT_SEL_CNFG                              | 51            |
| T4_T0_SEL                       | T4_T0_REG_SEL_CNFG                             | 07            |

**Note:** \* The setting in the 5A register is either for T0 path or for T4 path, as determined by the T4\_T0\_SEL bit.

### 3.12 T0 / T4 APLL

A T0 APLL and a T4 APLL are provided for a better jitter and wander performance of the device output clocks.

The bandwidths of the T0/T4 APLL are set by the T0\_APLL\_BW[1:0] / T4\_APLL\_BW[1:0] bits respectively. The lower the bandwidth is, the better the jitter and wander performance of the T0/T4 APLL output are.

The input of the T0/T4 APLL can be derived from one of the T0 and T4 DPLL outputs, as selected by the T0\_APLL\_PATH[3:0] / T4\_APLL\_PATH[3:0] bits respectively.

Both the APLL and DPLL outputs are provided for selection for the device output.

**Table 23: Related Bit / Register in Chapter 3.12**

| Bit               | Register               | Address (Hex) |
|-------------------|------------------------|---------------|
| T0_APLL_BW[1:0]   | T0_T4_APLL_BW_CNFG     | 6A            |
| T4_APLL_BW[1:0]   |                        |               |
| T0_APLL_PATH[3:0] | T0_DPLL_APLL_PATH_CNFG | 55            |
| T4_APLL_PATH[3:0] | T4_DPLL_APLL_PATH_CNFG | 60            |

### 3.13 OUTPUT CLOCKS & FRAME SYNC SIGNALS

The device supports 5 output clocks and 2 frame sync output signals altogether.

**Table 24: Outputs on OUT1 ~ OUT5 if Derived from T0/T4 DPLL Outputs**

| OUTn_DIVIDER[3:0]<br>(Output Divider) <sup>1</sup> | outputs on OUT1 ~ OUT5 if derived from T0/T4 DPLL outputs <sup>2</sup> |      |      |      |      |    |    |                 |                      |                 |
|--|--|------|------|------|------|----|----|-----------------|----------------------|-----------------|
|  | 77.76 MHz  | 12E1 | 16E1 | 24T1 | 16T1 | E3 | T3 | GSM<br>(26 MHz) | OBSAI<br>(30.72 MHz) | GPS<br>(40 MHz) |
| 0000   | Output is disabled (output low).                                       |      |      |      |      |    |    |                 |                      |                 |
| 0001   |  |      |      |      |      |    |    |                 |                      |                 |
| 0010   |  | 12E1 | 16E1 | 24T1 | 16T1 | E3 | T3 |                 |                      |                 |
| 0011   |  | 6E1  | 8E1  | 12T1 | 8T1  |    |    | 13 MHz          | 15.36 MHz            | 20              |
| 0100   |  | 3E1  | 4E1  | 6T1  | 4T1  |    |    |                 |                      | 10              |
| 0101   |  | 2E1  |      | 4T1  |      |    |    |                 |                      |                 |
| 0110   |  |      | 2E1  | 3T1  | 2T1  |    |    |                 |                      | 5               |
| 0111   |  | E1   |      | 2T1  |      |    |    |                 |                      |                 |
| 1000   |  |      | E1   |      | T1   |    |    |                 |                      |                 |
| 1001   |  |      |      | T1   |      |    |    |                 |                      |                 |
| 1010   | 64 kHz   |      |      |      |      |    |    |                 |                      |                 |
| 1011   | 8 kHz  |      |      |      |      |    |    |                 |                      |                 |
| 1100   | 2 kHz  |      |      |      |      |    |    |                 |                      |                 |
| 1101   | 400 Hz   |      |      |      |      |    |    |                 |                      |                 |
| 1110   | 1Hz  |      |      |      |      |    |    |                 |                      |                 |
| 1111   | Output is disabled (output high).                                      |      |      |      |      |    |    |                 |                      |                 |

**Note:**  
 1.  $1 \leq n \leq 5$ . Each output is assigned a frequency divider.  
 2. E1 = 2.048 MHz, T1 = 1.544 MHz, E3 = 34.368 MHz, T3 = 44.736 MHz. The blank cell means the configuration is reserved.

#### 3.13.1 OUTPUT CLOCKS

The device provides 5 output clocks.

According to the output port technology, the output ports support the following technologies:

- PECL/LVDS;
- CMOS.

OUT1 ~ OUT3 output CMOS signals.

OUT4 and OUT5 output PECL or LVDS signals, as selected by the OUT4\_PECL\_LVDS bit and the OUT5\_PECL\_LVDS bit respectively.

The outputs on OUT1 ~ OUT5 are variable, depending on the signals derived from the T0/T4 DPLL and T0/T4 APLL outputs, and the corresponding OUTn\_PATH\_SEL[3:0] bits ( $1 \leq n \leq 5$ ). The derived signal can be from the T0/T4 DPLL and T0/T4 APLL outputs, as selected by the corresponding OUTn\_PATH\_SEL[3:0] bits ( $1 \leq n \leq 5$ ). If the signal is derived from one of the T0/T4 DPLL outputs, please refer to [Table 24](#) for the output frequency. If the signal is derived from the T0/T4 APLL output, please refer to [Table 25](#) for the output frequency.

The outputs on OUT1 to OUT5 can be inverted, as determined by the corresponding OUTn\_INV bit ( $1 \leq n \leq 5$ ).

All the output clocks derived from T0/T4 selected input clock are aligned with the T0/T4 selected input clock respectively every 125  $\mu$ s period.

Table 25: Outputs on OUT1 ~ OUT5 if Derived from T0/T4 APLL

| OUTn_DIVIDER[3:0]<br>(Output Divider) <sup>1</sup> | outputs on OUT1 ~ OUT5 if derived from T0/T4 APLL output <sup>2</sup> |          |          |          |          |    |    |                     |                           |                        |
|--|---|----------|----------|----------|----------|----|----|---------------------|---------------------------|------------------------|
|  | 77.76 MHz X 4   | 12E1 X 4 | 16E1 X 4 | 24T1 X 4 | 16T1 X 4 | E3 | T3 | GSM<br>(26 MHz X 2) | OBSAI<br>(30.72 MHz X 10) | GPS<br>(40 MHz)        |
| 0000   | Output is disabled (output low).                                      |          |          |          |          |    |    |                     |                           |                        |
| 0001   | 622.08 MHz <sup>3</sup>   |          |          |          |          |    |    |                     |                           |                        |
| 0010   | 311.04 MHz <sup>3</sup>   | 48E1     | 64E1     | 96T1     | 64T1     | E3 | T3 | 52 MHz              |                           |                        |
| 0011   | 155.52 MHz  | 24E1     | 32E1     | 48T1     | 32T1     |    |    | 26 MHz              | 153.6 MHz                 | 20 MHz                 |
| 0100   | 77.76 MHz   | 12E1     | 16E1     | 24T1     | 16T1     |    |    | 13 MHz              | 76.8 MHz                  | 10 MHz                 |
| 0101   | 51.84 MHz   | 8E1      |          | 16T1     |          |    |    |                     |                           |                        |
| 0110   | 38.88 MHz   | 6E1      | 8E1      | 12T1     | 8T1      |    |    |                     | 38.4 MHz                  | 5 MHz                  |
| 0111   | 25.92 MHz   | 4E1      |          | 8T1      |          |    |    |                     |                           |                        |
| 1000   | 19.44 MHz   | 3E1      | 4E1      | 6T1      | 4T1      |    |    |                     |                           |                        |
| 1001   |   | 2E1      |          | 4T1      |          |    |    |                     |                           | 61.44 MHz <sup>4</sup> |
| 1010   |   |          | 2E1      | 3T1      | 2T1      |    |    |                     |                           | 30.72 MHz <sup>4</sup> |
| 1011   | 6.48 MHz  | E1       |          | 2T1      |          |    |    |                     |                           | 15.36 MHz <sup>4</sup> |
| 1100   |   |          | E1       |          | T1       |    |    |                     |                           | 7.68 MHz <sup>4</sup>  |
| 1101   |   |          |          | T1       |          |    |    |                     |                           | 3.84 MHz <sup>4</sup>  |
| 1110   |   |          |          |          |          |    |    |                     |                           |                        |
| 1111   | Output is disabled (output high).                                     |          |          |          |          |    |    |                     |                           |                        |

- Note:**
- $1 \leq n \leq 5$ . Each output is assigned a frequency divider.
  - In the APLL, the selected T0/T4 DPLL output may be multiplied. E1 = 2.048 MHz, T1 = 1.544 MHz, E3 = 34.368 MHz, T3 = 44.736 MHz. The blank cell means the configuration is reserved.
  - The 622.08 MHz and 311.04 MHz differential signals are only output on OUT4 and OUT5.
  - The 61.44 MHz, 30.72 MHz, 15.36 MHz, 7.68 MHz and 3.84 MHz outputs are only derived from T0 APLL.

### 3.13.2 FRAME SYNC OUTPUT SIGNALS

An 8 kHz and a 2 kHz frame sync signals are output on the FRSYNC\_8K and MFRSYNC\_2K pins if enabled by the 8K\_EN and 2K\_EN bits respectively. They are CMOS outputs.

The two frame sync signals are derived from the T0 APLL output and are aligned with the output clock. They can be synchronized to the frame sync input signal.

If the frame sync input signal with respect to the T0 selected input clock is above a limit set by the SYNC\_MON\_LIMT[2:0] bits, an external sync alarm will be raised and EX\_SYNC1 is disabled to synchronize the frame sync output signals. The external sync alarm is cleared once EX\_SYNC1 with respect to the T0 selected input clock is within the limit. If it is within the limit, whether EX\_SYNC1 is enabled to synchronize the frame sync output signal is determined by the AUTO\_EXT\_SYNC\_EN bit and the EXT\_SYNC\_EN bit. Refer to Table 26 for details.

When the frame sync input signal is enabled to synchronize the frame sync output signal, it should be adjusted to align itself with the T0

selected input clock. Nominally, the falling edge of EX\_SYNC1 is aligned with the rising edge of the T0 selected input clock. EX\_SYNC1 may be 0.5 UI early/late or 1 UI late due to the circuit and board wiring delays. Setting the sampling of EX\_SYNC1 by the SYNC\_PH1[1:0] bits will compensate this early/late. Refer to Figure 9 to Figure 12.

The EX\_SYNC\_ALARM\_MON bit indicates whether EX\_SYNC1 is in external sync alarm status. The external sync alarm is indicated by the EX\_SYNC\_ALARM<sup>1</sup> bit. If the EX\_SYNC\_ALARM<sup>2</sup> bit is '1', the occurrence of the external sync alarm will trigger an interrupt.

The 8 kHz and the 2 kHz frame sync output signals can be inverted by setting the 8K\_INV and 2K\_INV bits respectively. The frame sync outputs can be 50:50 duty cycle or pulsed, as determined by the 8K\_PUL and 2K\_PUL bits respectively. When they are pulsed, the pulse width is defined by the period of OUT1; and they are pulsed on the position of the falling or rising edge of the standard 50:50 duty cycle, as selected by the 2K\_8K\_PUL\_POSITION bit.

Table 26: Synchronization Control

| AUTO_EXT_SYNC_EN | EXT_SYNC_EN | Synchronization   |
|------------------|-------------|---|
| don't-care       | 0           | Disabled  |
| 0                | 1           | Enabled   |
| 1                | 1           | Enabled if the T0 selected input clock is IN5; otherwise, disabled. |

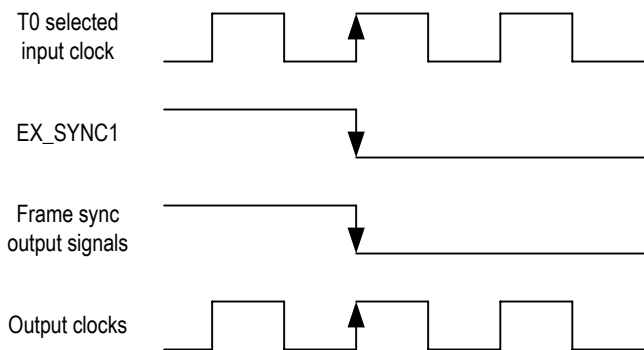


Figure 9. On Target Frame Sync Input Signal Timing

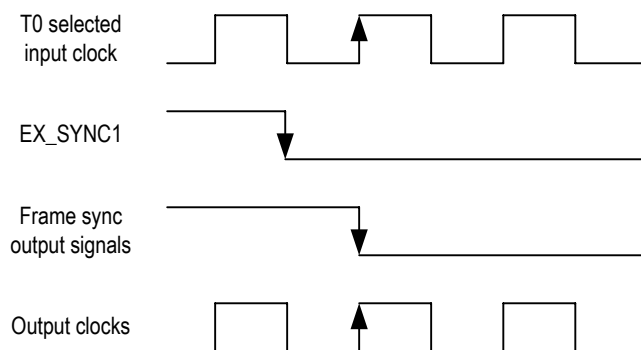


Figure 10. 0.5 UI Early Frame Sync Input Signal Timing

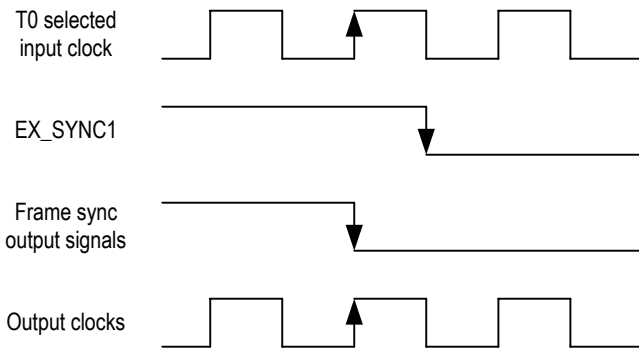


Figure 11. 0.5 UI Late Frame Sync Input Signal Timing

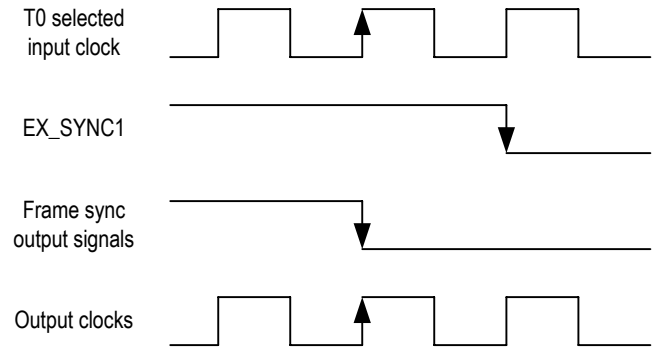


Figure 12. 1 UI Late Frame Sync Input Signal Timing

Table 27: Related Bit / Register in Chapter 3.13

| Bit                            | Register                        | Address (Hex) |
|--------------------------------|---------------------------------|---------------|
| OUT4_PECL_LVDS                 | DIFFERENTIAL_IN_OUT_OSCI_CNFG   | 0A            |
| OUT5_PECL_LVDS                 |                                 |               |
| OUTn_PATH_SEL[3:0] (1 ≤ n ≤ 5) | OUT1_FREQ_CNFG ~ OUT5_FREQ_CNFG | 6D ~ 71       |
| OUTn_DIVIDER[3:0] (1 ≤ n ≤ 5)  |                                 |               |
| IN_SONET_SDH                   | INPUT_MODE_CNFG                 | 09            |
| AUTO_EXT_SYNC_EN               |                                 |               |
| EXT_SYNC_EN                    |                                 |               |
| 8K_EN                          | FR_MFR_SYNC_CNFG                | 74            |
| 2K_EN                          |                                 |               |
| 8K_INV                         |                                 |               |
| 2K_INV                         |                                 |               |
| 8K_PUL                         |                                 |               |
| 2K_PUL                         |                                 |               |
| 2K_8K_PUL_POSITION             |                                 |               |
| SYNC_MON_LIMT[2:0]             | SYNC_MONITOR_CNFG               | 7C            |
| SYNC_PH1[1:0]                  | SYNC_PHASE_CNFG                 | 7D            |
| EX_SYNC_ALARM_MON              | OPERATING_STS                   | 52            |
| EX_SYNC_ALARM <sup>1</sup>     | INTERRUPTS3_STS                 | 0F            |
| EX_SYNC_ALARM <sup>2</sup>     | INTERRUPTS3_ENABLE_CNFG         | 12            |



### 3.14 MASTER / SLAVE CONFIGURATION

Master / Slave configuration is only supported by the T0 path of the device.

Two devices should be used together in order to:

- Enable system protection against single chip failure;
- Guarantee no service interrupt during system maintenance, such as software or hardware upgrade.

Of the two devices, one is configured as the Master and the other is configured as the Slave. The configuration is made by the MS/SL pin and the MS\_SL\_CTRL bit (b0, 13H), as shown in Table 28:

**Table 28: Device Master / Slave Control**

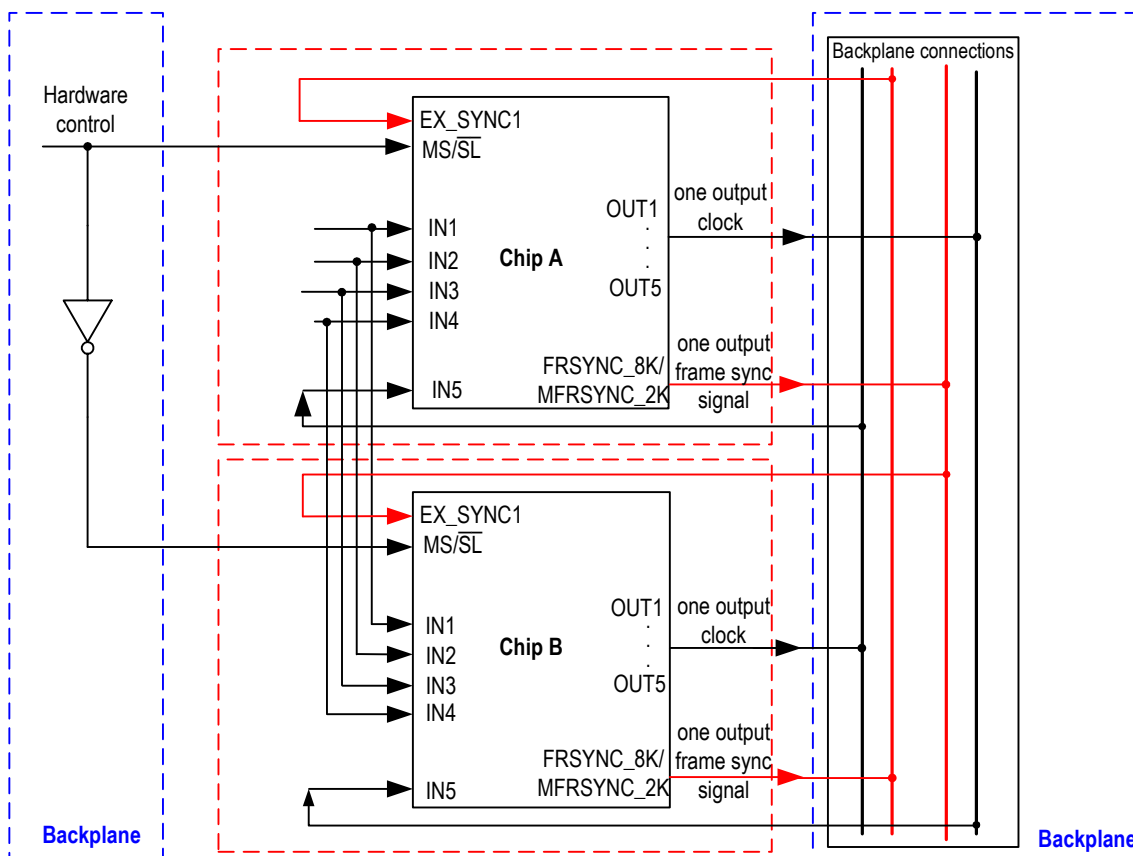
| Master / Slave Control |                | Result |
|------------------------|----------------|--------|
| MS/SL pin              | MS_SL_CTRL Bit |        |
| High                   | 0              | Master |
|                        | 1              | Slave  |
| Low                    | 0              | Slave  |
|                        | 1              | Master |

In this application, all the output clocks derived from the T0 selected input clock and the frame sync output signals from the two devices are at the same frequency offset and phase. Refer to Chapter 3.13.2 Frame SYNC Output Signals for details.

The difference between the Master and the Slave is: in the Master, the IN5 should not be selected by the T0 DPLL; in the Slave, the following functions are automatically forced:

- The T0 selected input clock is IN5;
- T0 PBO is disabled;
- T0 DPLL operates at the acquisition bandwidth and damping factor;
- EX\_SYNC1 is used for synchronization;
- T0 DPLL operates in Locked mode.

In the Slave, the corresponding registers of the above forced functions can still be configured, but their configuration does not take any effect. The frequency of the T0 selected input clock IN5 is recommended to be 6.48 MHz.



**Figure 13. Physical Connection Between Two Devices**

### 3.15 INTERRUPT SUMMARY

The interrupt sources of the device are as follows:

- T4 DPLL locking status change
- Input clocks for T0 path validity change
- T0 selected input clock fail
- No qualified input clock for T4 path is available
- T0 DPLL operating mode switch
- External sync alarm

All of the above interrupt events are indicated by the corresponding interrupt status bit. If the corresponding interrupt enable bit is set, any of the interrupts can be reported by the INT\_REQ pin. The output characteristics on the INT\_REQ pin are determined by the HZ\_EN bit and the INT\_POL bit.

Interrupt events are cleared by writing a '1' to the corresponding interrupt status bit. The INT\_REQ pin will be inactive only when all the pending enabled interrupts are cleared.

In addition, the interrupt of T0 selected input clock fail can be reported by the TDO pin, as determined by the LOS\_FLAG\_TO\_TDO bit.

**Table 29: Related Bit / Register in Chapter 3.15**

| Bit             | Register        | Address (Hex) |
|-----------------|-----------------|---------------|
| HZ_EN           | INTERRUPT_CNFG  | 0C            |
| INT_POL         |                 |               |
| LOS_FLAG_TO_TDO | MON_SW_PBO_CNFG | 0B            |

### 3.16 T0 AND T4 SUMMARY

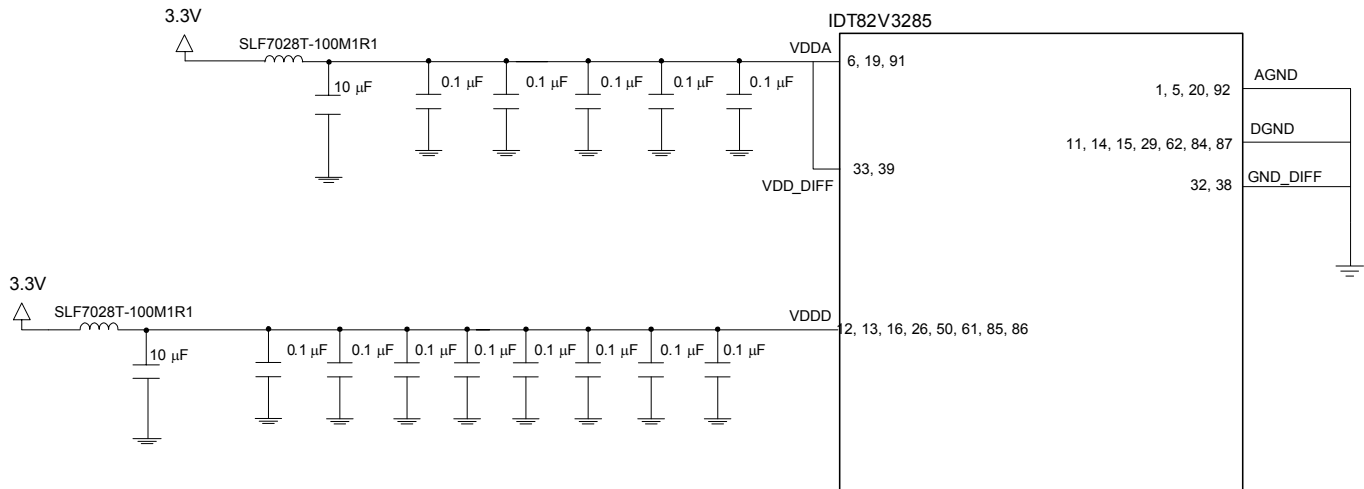
The main features supported by the T0 path are as follows:

- Phase lock alarm;
- Forced or Automatic input clock selection/switch;
- 3 primary and 3 secondary, temporary DPLL operating modes, switched automatically or under external control;
- Automatic switch between starting, acquisition and locked bandwidths/damping factors;
- Programmable DPLL bandwidths from 0.5 mHz to 560 Hz in 19 steps;
- Programmable damping factors: 1.2, 2.5, 5, 10 and 20;
- Fast loss, coarse phase loss, fine phase loss and hard limit exceeding monitoring;
- Output phase and frequency offset limited;
- Automatic Instantaneous, Automatic Slow Averaged, Automatic Fast Averaged or Manual holdover frequency offset acquiring;
- PBO to minimize output phase transients;
- Programmable output phase offset;
- Low jitter multiple clock outputs with programmable polarity;
- Low jitter 2 kHz and 8 kHz frame sync signal outputs with programmable pulse width and polarity;
- Master / Slave application to enable system protection against single device failure.

The main features supported by the T4 path are as follows:

- Forced or Automatic input clock selection/switch;
- Locking to T0 DPLL output;
- 3 DPLL operating modes, switched automatically or under external control;
- Programmable DPLL bandwidth: 18 Hz, 35 Hz, 70 Hz and 560 Hz;
- Programmable damping factor: 1.2, 2.5, 5, 10 and 20;
- Fast loss, coarse phase loss, fine phase loss and hard limit exceeding monitoring;
- Output phase and frequency offset limited;
- Automatic Instantaneous holdover frequency offset;
- Low jitter multiple clock outputs with programmable polarity.

### 3.17 POWER SUPPLY FILTERING TECHNIQUES



**Figure 14. IDT82V3285 Power Decoupling Scheme**

To achieve optimum jitter performance, power supply filtering is required to minimize supply noise modulation of the output clocks. The common sources of power supply noise are switch power supplies and the high switching noise from the outputs to the internal PLL. The IDT82V3285 provides separate VDDA power pins for the internal analog PLL, VDD\_DIFF for the differential output driver circuit and VDDD pins for the core logic as well as I/O driver circuits.

To minimize switching power supply noise generated by the switching regulator, the power supply output should be filtering with sufficient bulk capacity to minimize ripple and 0.1 µF (0402 case size, ceramic) caps to filter out the switching transients.

For the IDT82V3285, the decoupling for VDDA, VDD\_DIFF and VDDD are handled individually. VDDD, VDD\_DIFF and VDDA should be individually connected to the power supply plane through vias, and bypass capacitors should be used for each pin. Figure 14 illustrated how bypass capacitor and ferrite bead should be connected to power pins.

The analog power supply VDDA and VDD\_DIFF should have low impedance. This can be achieved by using one 10 µF (1210 case size, ceramic) and at least four 0.1 µF (0402 case size, ceramic) capacitors in parallel. The 0.1 µF (0402 case size, ceramic) capacitors must be placed right next to the VDDA and VDD\_DIFF pins as close as possible. Note that the 10 µF capacitor must be of 1210 case size, and it must be ceramic for lowest ESR (Effective Series Resistance) possible. The 0.1 µF should be of case size 0402, this offers the lowest ESL (Effective Series Inductance) to achieve low impedance towards the high speed range.

For VDDD, at least ten 0.1 µF (0402 case size, ceramic) and one 10 µF (1210 case size, ceramic) capacitors are recommended. The 0.1 µF capacitors should be placed as close to the VDDD pins as possible.

Please refer to evaluation board schematic for details.

## 4 TYPICAL APPLICATION

The device supports Master / Slave application, as shown in Figure 15:

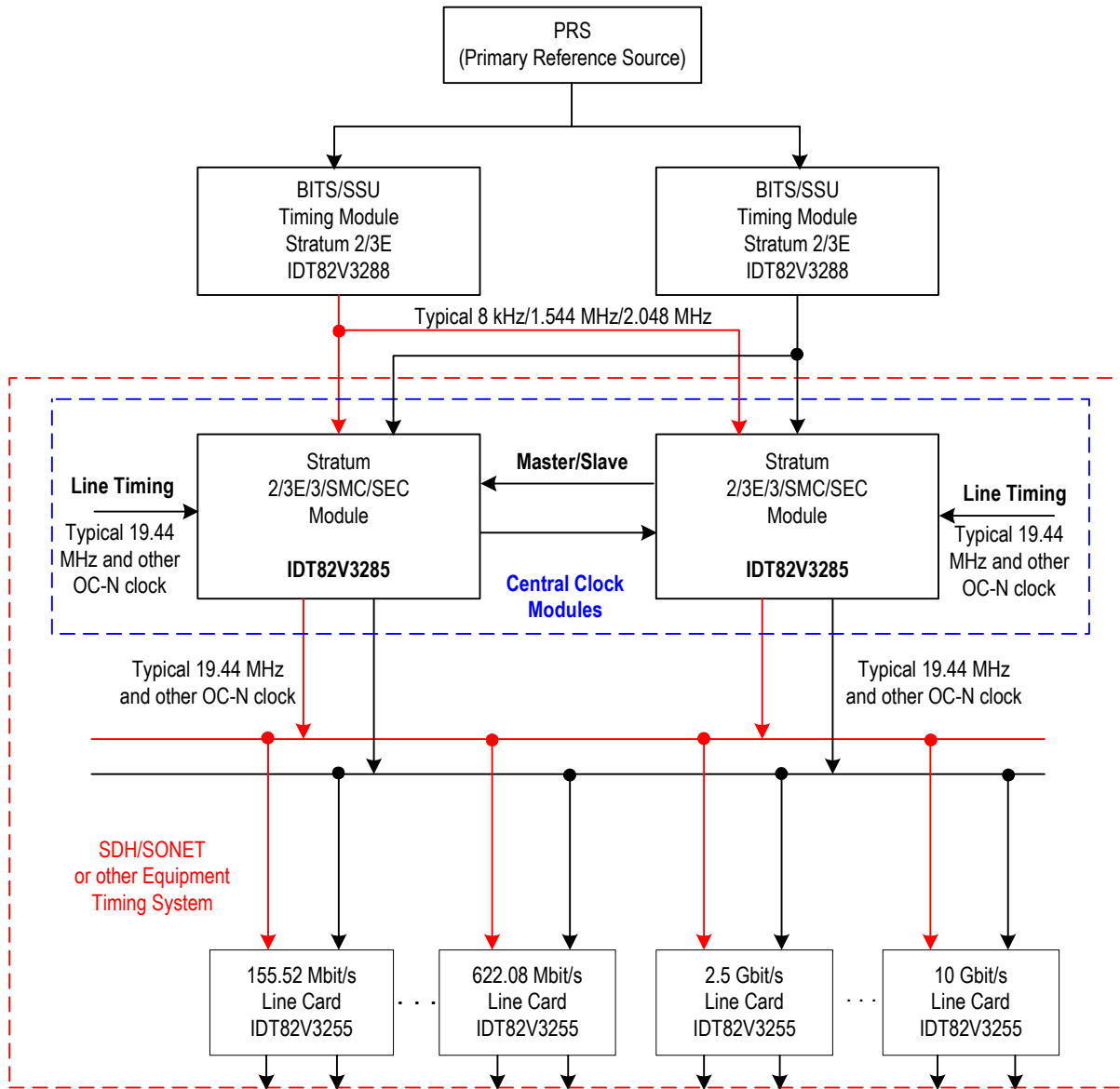


Figure 15. Typical Application

### 4.1 MASTER / SLAVE APPLICATION

Master / Slave application is only supported by the T0 path of the device.

In Master / Slave application, two devices should be used together. Of the two devices, one is configured as the Master and the other is configured as the Slave. Refer to Chapter 3.14 Master / Slave Configuration for details.

## 5 MICROPROCESSOR INTERFACE

The microprocessor interface provides access to read and write the registers in the device. The microprocessor interface supports the following five modes:

- EPROM mode;
- Multiplexed mode;
- Intel mode;
- Motorola mode;
- Serial mode.

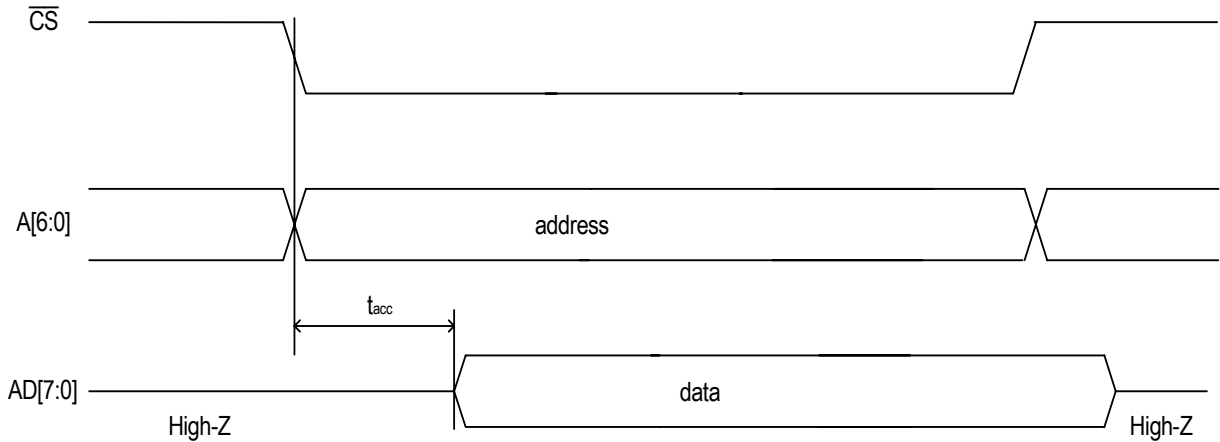
The microprocessor interface mode is selected by the MPU\_SEL\_CNFG[2:0] bits (b2~0, 7FH). The interface pins in different interface modes are listed in [Table 30](#):

**Table 30: Microprocessor Interface**

| MPU_SEL_CNFG[2:0] bits | Microprocessor Interface Mode | Interface Pins   |
|------------------------|-------------------------------|--|
| 001                    | ERPOM                         | $\overline{CS}$ , A[6:0], AD[7:0]  |
| 010                    | Multiplexed                   | $\overline{CS}$ , ALE, $\overline{WR}$ , $\overline{RD}$ , AD[7:0], RDY    |
| 011                    | Intel                         | $\overline{CS}$ , $\overline{WR}$ , $\overline{RD}$ , A[6:0], AD[7:0], RDY |
| 100                    | Motorola                      | $\overline{CS}$ , $\overline{WR}$ , A[6:0], AD[7:0], RDY                   |
| 101                    | Serial                        | $\overline{CS}$ , SCLK, SDI, SDO, CLKE                                     |

### 5.1 EPROM MODE

In this mode, the device is used with an EPROM. The configuration data will be automatically read from the EPROM after the device is powered on.



**Figure 16. EPROM Access Timing Diagram**

**Table 31: Access Timing Characteristics in EPROM Mode**

| Symbol    | Parameter                                | Min | Typ | Max | Unit |
|-----------|--|-----|-----|-----|------|
| $t_{acc}$ | $\overline{CS}$ to valid data delay time |     |     | 920 | ns   |

5.2 MULTIPLEXED MODE

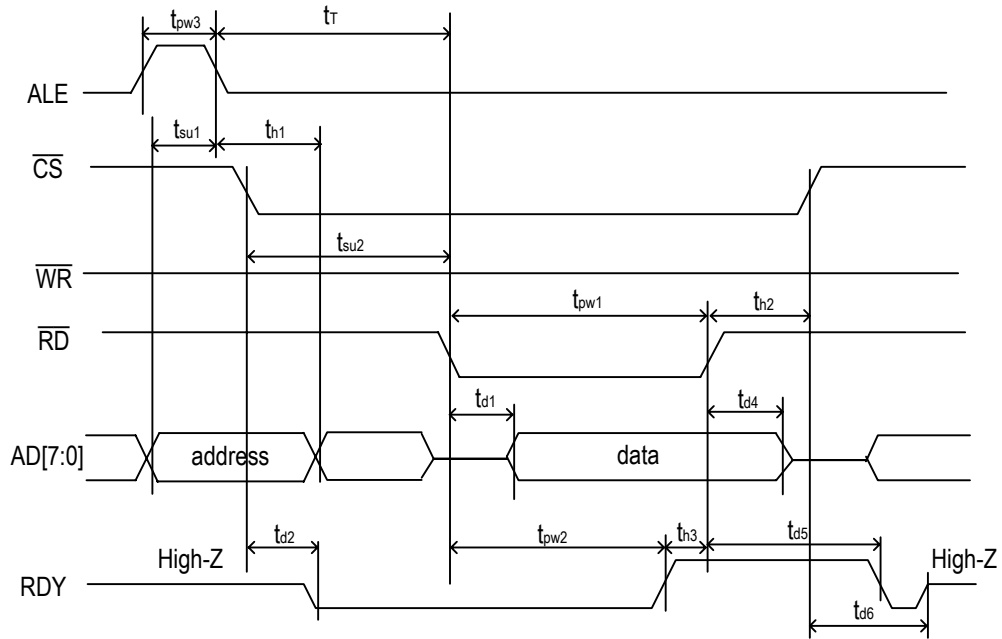


Figure 17. Multiplexed Read Timing Diagram

Table 32: Read Timing Characteristics in Multiplexed Mode

| Symbol    | Parameter   | Min         | Typ   | Max       | Unit |
|-----------|---|-------------|-------|-----------|------|
| T         | One cycle time of the master clock  |             | 12.86 |           | ns   |
| $t_{in}$  | Delay of input pad  |             | 5     |           | ns   |
| $t_{out}$ | Delay of output pad   |             | 5     |           | ns   |
| $t_{su1}$ | Valid address to ALE falling edge setup time  | 2           |       |           | ns   |
| $t_{su2}$ | Valid CS to Valid RD setup time   | 0           |       |           | ns   |
| $t_{d1}$  | Valid RD to valid data delay time   |             |       | 3.5T + 10 | ns   |
| $t_{d2}$  | Valid CS to valid RDY delay time  |             | 13    |           | ns   |
| $t_{d4}$  | RD rising edge to AD[7:0] high impedance delay time   |             | 10    |           | ns   |
| $t_{d5}$  | RD rising edge to RDY low delay time  |             | 13    |           | ns   |
| $t_{d6}$  | CS rising edge to RDY release delay time  |             | 13    |           | ns   |
| $t_{pw1}$ | Valid RD pulse width low  | 4.5T + 10 * |       |           | ns   |
| $t_{pw2}$ | Valid RDY pulse width low   | 4.5T + 10   |       |           | ns   |
| $t_{pw3}$ | Valid ALE pulse width high  | 2           |       |           | ns   |
| $t_{h1}$  | Valid address after ALE falling edge hold time  | 3           |       |           | ns   |
| $t_{h2}$  | Valid CS after RD rising edge hold time   | 0           |       |           | ns   |
| $t_{h3}$  | Valid RD after RDY rising edge hold time  | 0           |       |           | ns   |
| $t_T$     | Time between ALE falling edge and RD falling edge   | 0           |       |           | ns   |
| $t_{T1}$  | Time between consecutive Read-Read or Read-Write accesses (RD rising edge to ALE rising edge) | >T          |       |           | ns   |

Note:

\* Timing with RDY. If RDY is not used,  $t_{pw1}$  is 3.5T + 10.

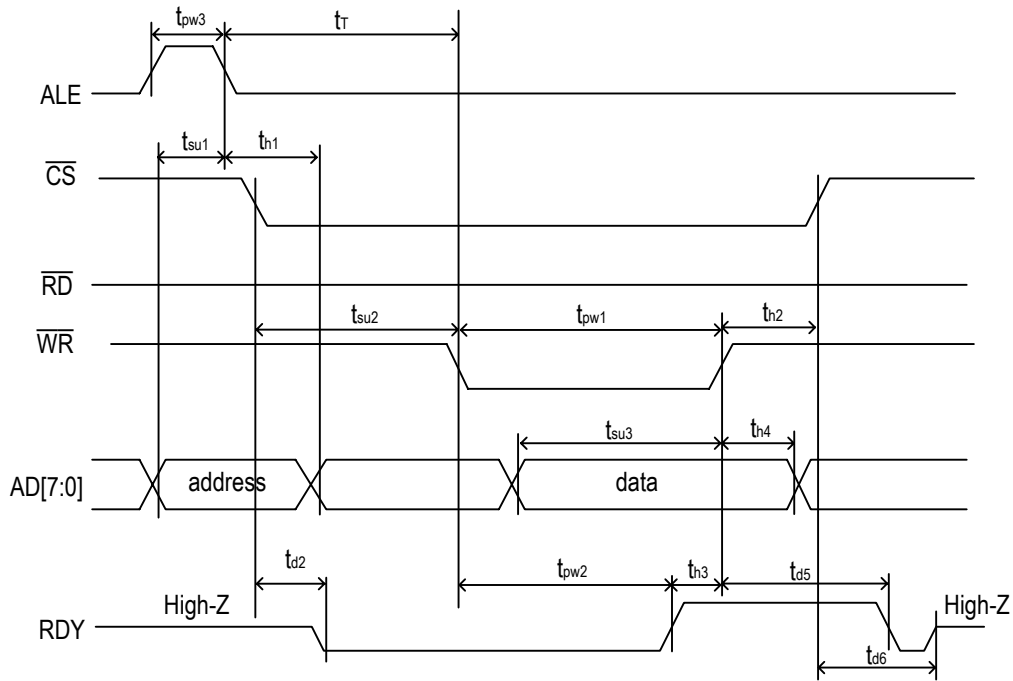


Figure 18. Multiplexed Write Timing Diagram

Table 33: Write Timing Characteristics in Multiplexed Mode

| Symbol    | Parameter   | Min         | Typ   | Max | Unit |
|-----------|---|-------------|-------|-----|------|
| T         | One cycle time of the master clock  |             | 12.86 |     | ns   |
| $t_{in}$  | Delay of input pad  |             | 5     |     | ns   |
| $t_{out}$ | Delay of output pad   |             | 5     |     | ns   |
| $t_{su1}$ | Valid address to ALE falling edge setup time  | 2           |       |     | ns   |
| $t_{su2}$ | Valid CS to valid WR setup time   | 0           |       |     | ns   |
| $t_{su3}$ | Valid data to WR rising edge setup time   | 3           |       |     | ns   |
| $t_{d2}$  | Valid CS to valid RDY delay time  |             | 13    |     | ns   |
| $t_{d5}$  | WR rising edge to RDY low delay time  |             | 13    |     | ns   |
| $t_{d6}$  | CS rising edge to RDY release delay time  |             | 13    |     | ns   |
| $t_{pw1}$ | Valid WR pulse width low  | $1.5T + 10$ |       |     | ns   |
| $t_{pw2}$ | Valid RDY pulse width low   | $1.5T + 10$ |       |     | ns   |
| $t_{pw3}$ | Valid ALE pulse width high  | 2           |       |     | ns   |
| $t_{h1}$  | Valid address after ALE falling edge hold time  | 3           |       |     | ns   |
| $t_{h2}$  | Valid CS after WR rising edge hold time   | 0           |       |     | ns   |
| $t_{h3}$  | Valid WR after RDY rising edge hold time  | 0           |       |     | ns   |
| $t_{h4}$  | Valid data after WR rising edge hold time   | 9           |       |     | ns   |
| $t_T$     | Time between ALE falling edge and WR falling edge   | 0           |       |     | ns   |
| $t_{T1}$  | Time between consecutive Write-Read or Write-Write accesses (WR rising edge to ALE rising edge) | $>7T$       |       |     | ns   |



5.3 INTEL MODE

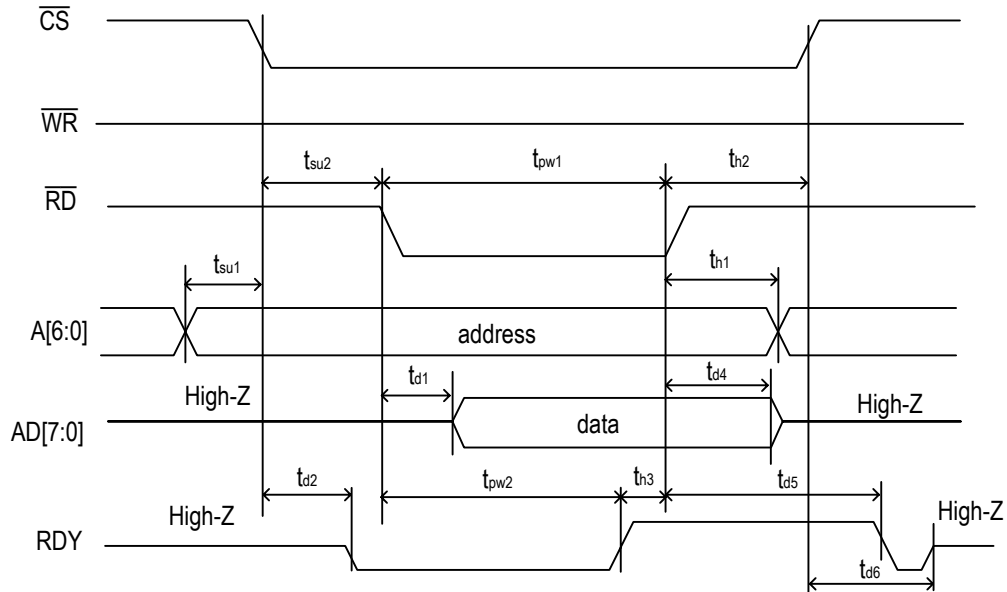


Figure 19. Intel Read Timing Diagram

Table 34: Read Timing Characteristics in Intel Mode

| Symbol    | Parameter  | Min         | Typ   | Max       | Unit |
|-----------|--|-------------|-------|-----------|------|
| T         | One cycle time of the master clock   |             | 12.86 |           | ns   |
| $t_{in}$  | Delay of input pad   |             | 5     |           | ns   |
| $t_{out}$ | Delay of output pad  |             | 5     |           | ns   |
| $t_{su1}$ | Valid address to valid $\overline{CS}$ setup time  | 0           |       |           | ns   |
| $t_{su2}$ | Valid $\overline{CS}$ to valid $\overline{RD}$ setup time  | 0           |       |           | ns   |
| $t_{d1}$  | Valid $\overline{RD}$ to valid data delay time   |             |       | 3.5T + 10 | ns   |
| $t_{d2}$  | Valid $\overline{CS}$ to valid RDY delay time  |             | 13    |           | ns   |
| $t_{d4}$  | $\overline{RD}$ rising edge to AD[7:0] high impedance delay time   |             | 10    |           | ns   |
| $t_{d5}$  | $\overline{RD}$ rising edge to RDY low delay time  |             | 13    |           | ns   |
| $t_{d6}$  | $\overline{CS}$ rising edge to RDY release delay time  |             | 13    |           | ns   |
| $t_{pw1}$ | Valid $\overline{RD}$ pulse width low  | 4.5T + 10 * |       |           | ns   |
| $t_{pw2}$ | Valid RDY pulse width low  | 4.5T + 10   |       |           | ns   |
| $t_{h1}$  | Valid address after $\overline{RD}$ rising edge hold time  | 0           |       |           | ns   |
| $t_{h2}$  | Valid $\overline{CS}$ after $\overline{RD}$ rising edge hold time  | 0           |       |           | ns   |
| $t_{h3}$  | Valid $\overline{RD}$ after RDY rising edge hold time  | 0           |       |           | ns   |
| $t_{T1}$  | Time between consecutive Read-Read or Read-Write accesses ( $\overline{RD}$ rising edge to $\overline{RD}$ falling edge, or $\overline{RD}$ rising edge to $\overline{WR}$ falling edge) | >T          |       |           | ns   |

Note:

\* Timing with RDY. If RDY is not used,  $t_{pw1}$  is 3.5T + 10.

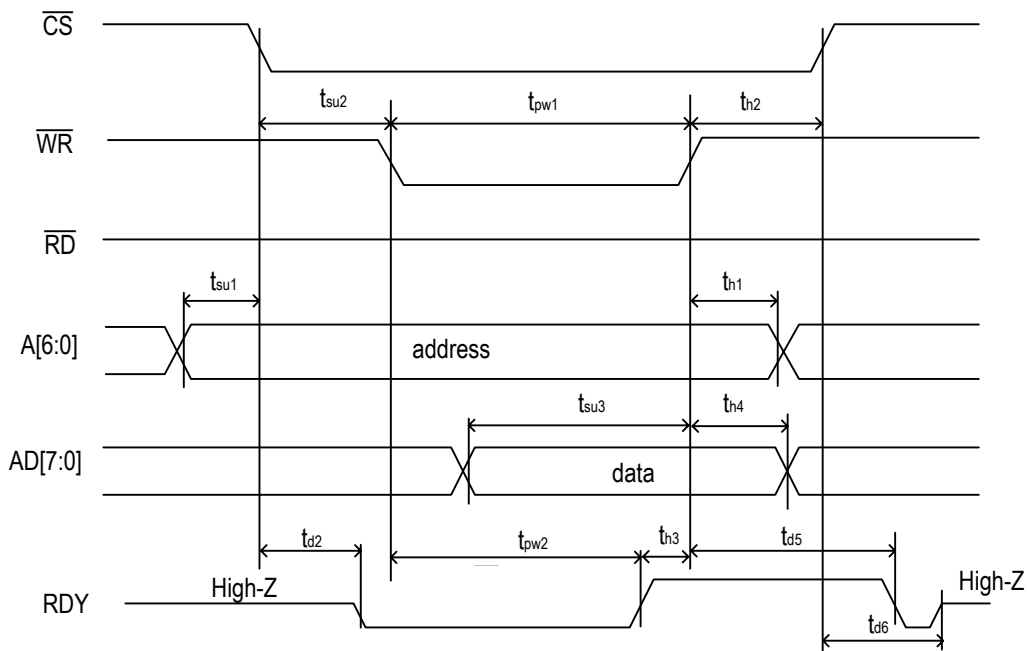


Figure 20. Intel Write Timing Diagram

Table 35: Write Timing Characteristics in Intel Mode

| Symbol    | Parameter  | Min         | Typ   | Max | Unit |
|-----------|--|-------------|-------|-----|------|
| T         | One cycle time of the master clock   |             | 12.86 |     | ns   |
| $t_{in}$  | Delay of input pad   |             | 5     |     | ns   |
| $t_{out}$ | Delay of output pad  |             | 5     |     | ns   |
| $t_{su1}$ | Valid address to valid $\overline{CS}$ setup time  | 0           |       |     | ns   |
| $t_{su2}$ | Valid $\overline{CS}$ to valid $\overline{WR}$ setup time  | 0           |       |     | ns   |
| $t_{su3}$ | Valid data before $\overline{WR}$ rising edge setup time   | 3           |       |     | ns   |
| $t_{d2}$  | Valid $\overline{CS}$ to valid RDY delay time  |             | 13    |     | ns   |
| $t_{d5}$  | $\overline{WR}$ rising edge to RDY low delay time  |             | 13    |     | ns   |
| $t_{d6}$  | $\overline{CS}$ rising edge to RDY release delay time  |             | 13    |     | ns   |
| $t_{pw1}$ | Valid $\overline{WR}$ pulse width low  | $1.5T + 10$ |       |     | ns   |
| $t_{pw2}$ | Valid RDY pulse width low  | $1.5T + 10$ |       |     | ns   |
| $t_{h1}$  | Valid address after $\overline{WR}$ rising edge hold time  | 0           |       |     | ns   |
| $t_{h2}$  | Valid $\overline{CS}$ after $\overline{WR}$ rising edge hold time  | 0           |       |     | ns   |
| $t_{h3}$  | Valid $\overline{WR}$ after RDY rising edge hold time  | 0           |       |     | ns   |
| $t_{h4}$  | Valid data after $\overline{WR}$ rising edge hold time   | 9           |       |     | ns   |
| $t_{T1}$  | Time between consecutive Write-Read or Write-Write accesses ( $\overline{WR}$ rising edge to $\overline{WR}$ falling edge, or $\overline{WR}$ rising edge to $\overline{RD}$ falling edge) | $>7T$       |       |     | ns   |

5.4 MOTOROLA MODE

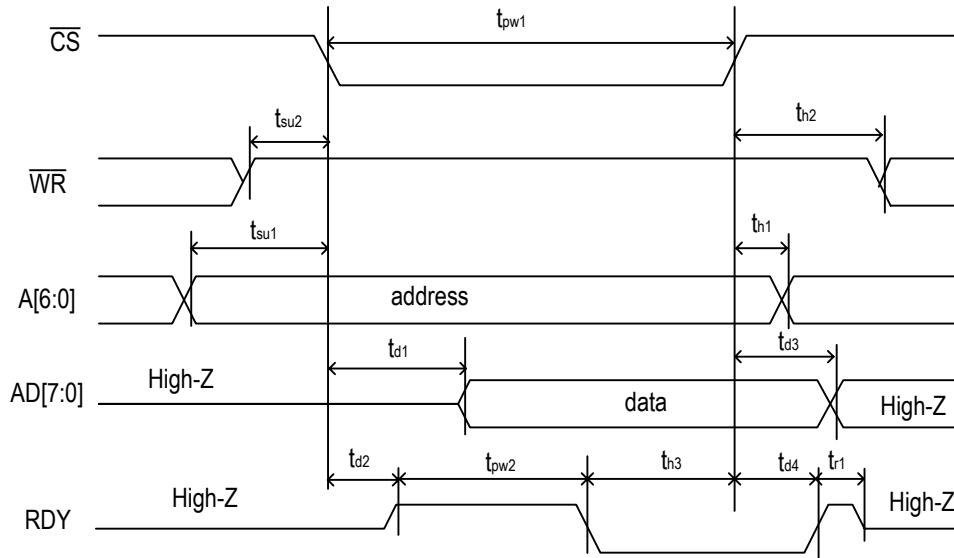


Figure 21. Motorola Read Timing Diagram

Table 36: Read Timing Characteristics in Motorola Mode

| Symbol    | Parameter  | Min           | Typ   | Max         | Unit |
|-----------|--|---------------|-------|-------------|------|
| T         | One cycle time of the master clock   |               | 12.86 |             |      |
| $t_{in}$  | Delay of input pad   |               | 5     |             | ns   |
| $t_{out}$ | Delay of output pad  |               | 5     |             | ns   |
| $t_{su1}$ | Valid address to valid $\overline{CS}$ setup time  | 0             |       |             | ns   |
| $t_{su2}$ | Valid $\overline{WR}$ to valid $\overline{CS}$ setup time  | 0             |       |             | ns   |
| $t_{d1}$  | Valid $\overline{CS}$ to valid data delay time   |               |       | $3.5T + 10$ | ns   |
| $t_{d2}$  | Valid $\overline{CS}$ to valid $RDY$ delay time  |               | 13    |             | ns   |
| $t_{d3}$  | $\overline{CS}$ rising edge to $AD[7:0]$ high impedance delay time   |               | 10    |             | ns   |
| $t_{d4}$  | $\overline{CS}$ rising edge to $RDY$ release delay time  |               | 13    |             | ns   |
| $t_{pw1}$ | Valid $\overline{CS}$ pulse width low  | $4.5T + 10^*$ |       |             | ns   |
| $t_{pw2}$ | Valid $RDY$ pulse width high   | $4.5T + 10$   |       |             | ns   |
| $t_{h1}$  | Valid address after $\overline{CS}$ rising edge hold time  | 0             |       |             | ns   |
| $t_{h2}$  | Valid $\overline{WR}$ after $\overline{CS}$ rising edge hold time  | 0             |       |             | ns   |
| $t_{h3}$  | Valid $\overline{CS}$ after $RDY$ falling edge hold time   | 0             |       |             | ns   |
| $t_{r1}$  | $RDY$ release time   |               | 3     |             | ns   |
| $t_{T1}$  | Time between consecutive Read-Read or Read-Write accesses ( $\overline{CS}$ rising edge to $\overline{CS}$ falling edge) | $> T$         |       |             | ns   |

Note:

\* Timing with  $RDY$ . If  $RDY$  is not used,  $t_{pw1}$  is  $3.5T + 10$ .

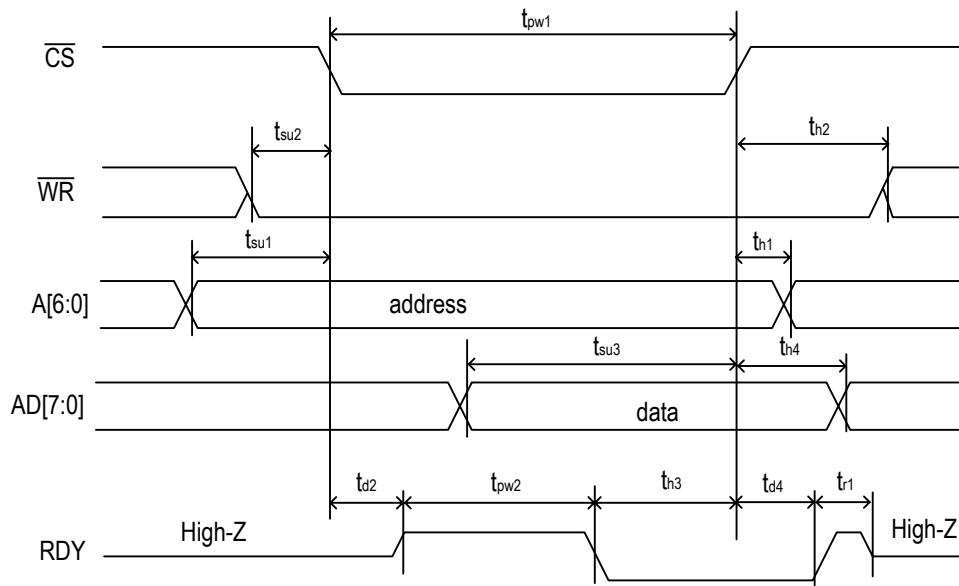


Figure 22. Motorola Write Timing Diagram

Table 37: Write Timing Characteristics in Motorola Mode

| Symbol    | Parameter  | Min         | Typ   | Max | Unit |
|-----------|--|-------------|-------|-----|------|
| T         | One cycle time of the master clock   |             | 12.86 |     | ns   |
| $t_{in}$  | Delay of input pad   |             | 5     |     | ns   |
| $t_{out}$ | Delay of output pad  |             | 5     |     | ns   |
| $t_{su1}$ | Valid address to valid $\overline{CS}$ setup time  | 0           |       |     | ns   |
| $t_{su2}$ | Valid $\overline{WR}$ to valid $\overline{CS}$ setup time  | 0           |       |     | ns   |
| $t_{su3}$ | Valid data before $\overline{CS}$ rising edge setup time   | 3           |       |     | ns   |
| $t_{d2}$  | Valid $\overline{CS}$ to valid $RDY$ delay time  |             | 13    |     | ns   |
| $t_{d4}$  | $\overline{CS}$ rising edge to $RDY$ release delay time  |             | 13    |     | ns   |
| $t_{pw1}$ | Valid $\overline{CS}$ pulse width low  | $1.5T + 10$ |       |     | ns   |
| $t_{pw2}$ | Valid $RDY$ pulse width high   | $1.5T + 10$ |       |     | ns   |
| $t_{h1}$  | Valid address after valid $\overline{CS}$ rising edge hold time  | 0           |       |     | ns   |
| $t_{h2}$  | Valid $\overline{WR}$ after valid $\overline{CS}$ rising edge hold time  | 0           |       |     | ns   |
| $t_{h3}$  | Valid $\overline{CS}$ after $RDY$ falling edge hold time   | 0           |       |     | ns   |
| $t_{h4}$  | Valid data after valid $\overline{CS}$ rising edge hold time   | 9           |       |     | ns   |
| $t_{r1}$  | $RDY$ release time   |             | 3     |     | ns   |
| $t_{T1}$  | Time between consecutive Write-Write or Write-Read accesses ( $\overline{CS}$ rising edge to $\overline{CS}$ falling edge) | $> 7T$      |       |     | ns   |

### 5.5 SERIAL MODE

In a read operation, the active edge of SCLK is selected by CLKE. When CLKE is asserted low, data on SDO will be clocked out on the rising edge of SCLK.

When CLKE is asserted high, data on SDO will be clocked out on the falling edge of SCLK.

In a write operation, data on SDI will be clocked in on the rising edge of SCLK.

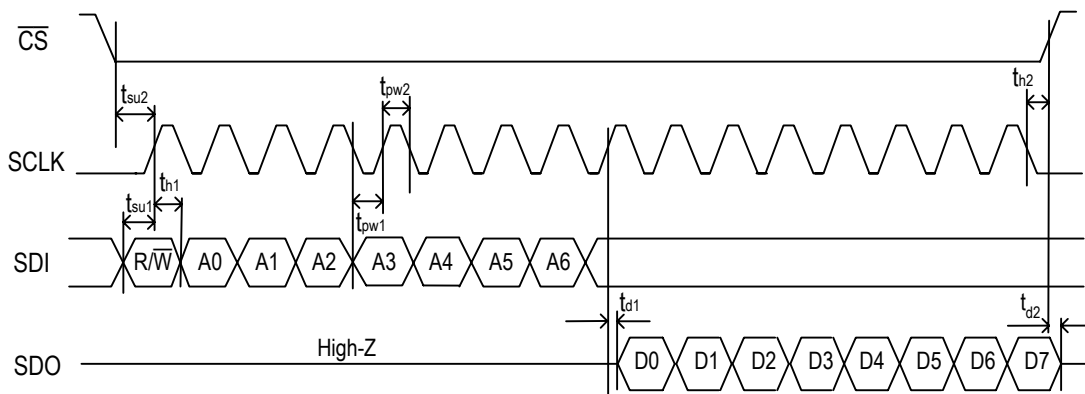


Figure 23. Serial Read Timing Diagram (CLKE Asserted Low)

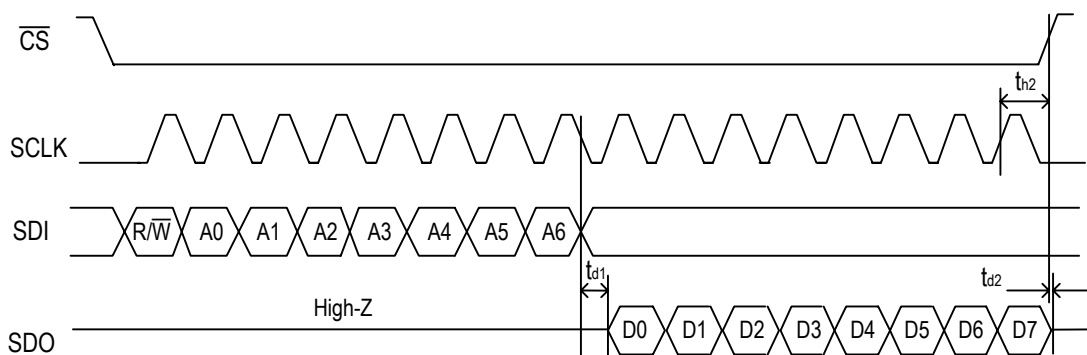


Figure 24. Serial Read Timing Diagram (CLKE Asserted High)

Table 38: Read Timing Characteristics in Serial Mode

| Symbol           | Parameter   | Min      | Typ   | Max | Unit |
|------------------|---|----------|-------|-----|------|
| T                | One cycle time of the master clock  |          | 12.86 |     | ns   |
| t <sub>in</sub>  | Delay of input pad  |          | 5     |     | ns   |
| t <sub>out</sub> | Delay of output pad   |          | 5     |     | ns   |
| t <sub>su1</sub> | Valid SDI to valid SCLK setup time  | 4        |       |     | ns   |
| t <sub>su2</sub> | Valid CS to valid SCLK setup time   | 14       |       |     | ns   |
| t <sub>d1</sub>  | Valid SCLK to valid data delay time   |          | 10    |     | ns   |
| t <sub>d2</sub>  | CS rising edge to SDO high impedance delay time   |          | 10    |     | ns   |
| t <sub>pw1</sub> | SCLK pulse width low  | 3.5T + 5 |       |     | ns   |
| t <sub>pw2</sub> | SCLK pulse width high   | 3.5T + 5 |       |     | ns   |
| t <sub>h1</sub>  | Valid SDI after valid SCLK hold time  | 6        |       |     | ns   |
| t <sub>h2</sub>  | Valid CS after valid SCLK hold time (CLKE = 0/1)  | 5        |       |     | ns   |
| t <sub>T1</sub>  | Time between consecutive Read-Read or Read-Write accesses (CS rising edge to CS falling edge) | 10       |       |     | ns   |

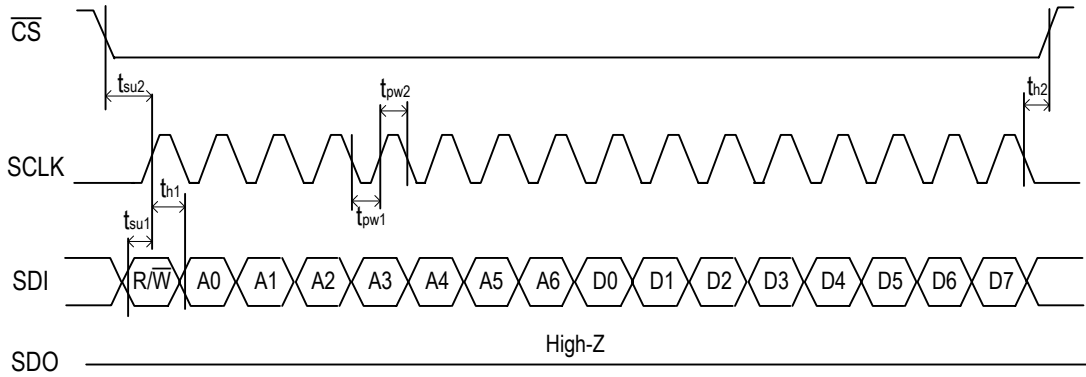


Figure 25. Serial Write Timing Diagram

Table 39: Write Timing Characteristics in Serial Mode

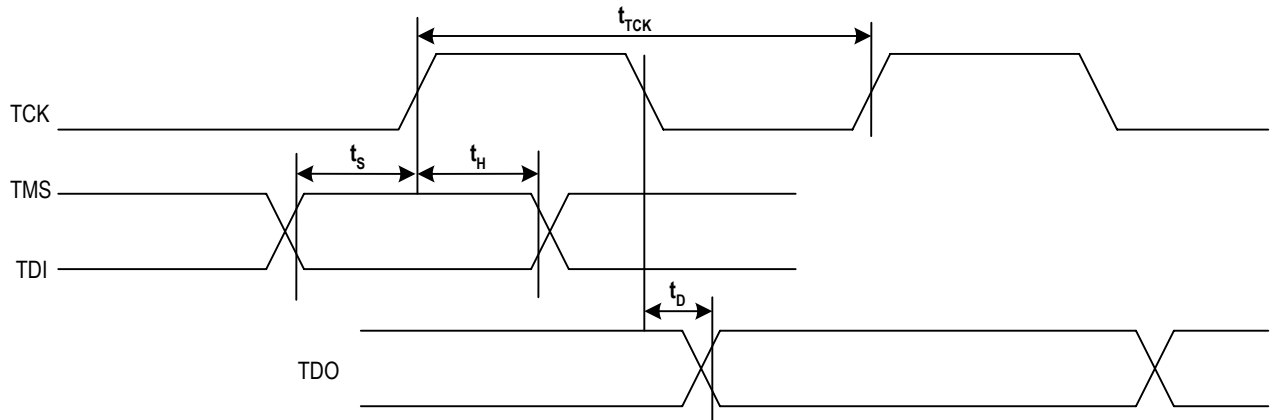
| Symbol    | Parameter   | Min  | Typ   | Max | Unit |
|-----------|---|------|-------|-----|------|
| T         | One cycle time of the master clock  |      | 12.86 |     | ns   |
| $t_{in}$  | Delay of input pad  |      | 5     |     | ns   |
| $t_{out}$ | Delay of output pad   |      | 5     |     | ns   |
| $t_{su1}$ | Valid SDI to valid SCLK setup time  | 4    |       |     | ns   |
| $t_{su2}$ | Valid $\overline{CS}$ to valid SCLK setup time  | 14   |       |     | ns   |
| $t_{pw1}$ | SCLK pulse width low  | 3.5T |       |     | ns   |
| $t_{pw2}$ | SCLK pulse width high   | 3.5T |       |     | ns   |
| $t_{h1}$  | Valid SDI after valid SCLK hold time  | 6    |       |     | ns   |
| $t_{h2}$  | Valid $\overline{CS}$ after valid SCLK hold time  | 5    |       |     | ns   |
| $t_{T1}$  | Time between consecutive Write-Write or Write-Read accesses (CS rising edge to CS falling edge) | 10   |       |     | ns   |

## 6 JTAG

This device is compliant with the IEEE 1149.1 Boundary Scan standard except the following:

- The output boundary scan cells do not capture data from the core and the device does not support EXTEST instruction;
- The  $\overline{\text{TRST}}$  pin is set low by default and JTAG is disabled in order to be consistent with other manufacturers.

The JTAG interface timing diagram is shown in [Figure 26](#).



**Figure 26. JTAG Interface Timing Diagram**

**Table 40: JTAG Timing Characteristics**

| Symbol           | Parameter                   | Min | Typ | Max | Unit |
|------------------|-----------------------------|-----|-----|-----|------|
| $t_{\text{TCK}}$ | TCK period                  | 100 |     |     | ns   |
| $t_{\text{s}}$   | TMS / TDI to TCK setup time | 25  |     |     | ns   |
| $t_{\text{H}}$   | TCK to TMS / TDI Hold Time  | 25  |     |     | ns   |
| $t_{\text{D}}$   | TCK to TDO delay time       |     |     | 50  | ns   |

## 7 PROGRAMMING INFORMATION

After reset, all the registers are set to their default values. The registers are read or written via the microprocessor interface.

Before any write operation, the value in register PROTECTION\_CNFG is recommended to be confirmed to make sure whether the write operation is enabled. The device provides 3 register protection modes:

- Protected mode: no other registers can be written except register PROTECTION\_CNFG itself;
- Fully Unprotected mode: all the writable registers can be written;
- Single Unprotected mode: one more register can be written besides register PROTECTION\_CNFG. After write operation (not including writing a '1' to clear a bit to '0'), the device automatically switches to Protected mode.

Writing '0' to the registers will take no effect if the registers are cleared by writing '1'.

T0 and T4 paths share some registers, whose addresses are 27H, 28H, 2BH, 4EH, 4FH, 5AH, 5BH, 62H ~ 64H, 68H and 69H. The names of shared registers are marked with a \*. Before register read/write operation, register T4\_T0\_REG\_SEL\_CNFG is recommended to be confirmed to make sure whether the register operation is available for T0 or T4 path.

The access of the Multi-word Registers is different from that of the Single-word Registers. Take the registers (04H, 05H and 06H) for an example, the write operation for the Multi-word Registers follows a fixed sequence. The register (04H) is configured first and the register (06H) is configured last. The three registers are configured continuously and should not be interrupted by any operation. The crystal calibration configuration will take effect after all the three registers are configured. During read operation, the register (04H) is read first and the register (06H) is read last. The crystal calibration reading should be continuous and not be interrupted by any operation.

Certain bit locations within the device register map are designated as Reserved. To ensure proper and predictable operation, bits designated as Reserved should not be written by the users. In addition, their value should be masked out from any testing or error detection methods that are implemented.

### 7.1 REGISTER MAP

Table 41 is the map of all the registers, sorted in an ascending order of their addresses.

Table 41: Register List and Map

| Address (Hex)                   | Register Name   | Bit 7                     | Bit 6           | Bit 5                    | Bit 4               | Bit 3 | Bit 2            | Bit 1              | Bit 0              | Reference Page |      |
|---------------------------------|---|---------------------------|-----------------|--------------------------|---------------------|-------|------------------|--------------------|--------------------|----------------|------|
| <b>Global Control Registers</b> |   |                           |                 |                          |                     |       |                  |                    |                    |                |      |
| 00                              | ID[7:0] - Device ID 1   | ID[7:0]                   |                 |                          |                     |       |                  |                    |                    | P 61           |      |
| 01                              | ID[15:8] - Device ID 2  | ID[15:8]                  |                 |                          |                     |       |                  |                    |                    | P 62           |      |
| 02                              | MPU_PIN_STS - MPU_MODE[2:0] Pins Status   | -                         | -               | -                        | -                   | -     | MPU_PIN_STS[2:0] |                    |                    | P 62           |      |
| 04                              | NOMINAL_FREQ[7:0]_CNFG - Crystal Oscillator Frequency Offset Calibration Configuration 1      | NOMINAL_FREQ_VALUE[7:0]   |                 |                          |                     |       |                  |                    |                    | P 62           |      |
| 05                              | NOMINAL_FREQ[15:8]_CNFG - Crystal Oscillator Frequency Offset Calibration Configuration 2     | NOMINAL_FREQ_VALUE[15:8]  |                 |                          |                     |       |                  |                    |                    | P 62           |      |
| 06                              | NOMINAL_FREQ[23:16]_CNFG - Crystal Oscillator Frequency Offset Calibration Configuration 3    | NOMINAL_FREQ_VALUE[23:16] |                 |                          |                     |       |                  |                    |                    | P 63           |      |
| 07                              | T4_T0_REG_SEL_CNFG - T0 / T4 Registers Selection Configuration                                | -                         | -               | -                        | T4_T0_SEL           | -     | -                | -                  | -                  | P 63           |      |
| 08                              | PHASE_ALARM_TIME_OUT_CNFG - Phase Lock Alarm Time-Out Configuration                           | MULTI_FACTOR[1:0]         |                 |                          | TIME_OUT_VALUE[5:0] |       |                  |                    |                    |                | P 64 |
| 09                              | INPUT_MODE_CNFG - Input Mode Configuration  | AUTO_EX<br>T_SYNC_<br>EN  | EXT_SYN<br>C_EN | PH_ALAR<br>M_TIMEO<br>UT | SYNC_FREQ[1:0]      |       | IN_SONET<br>_SDH | MASTER_<br>SLAVE   | REVERTIV<br>E_MODE | P 65           |      |
| 0A                              | DIFFERENTIAL_IN_OUT_OSCI_CNFG - Differential Input / Output Port & Master Clock Configuration | -                         | -               | -                        | -                   | -     | OSC_EDG<br>E     | OUT5_PE<br>CL_LVDS | OUT4_PE<br>CL_LVDS | P 66           |      |



Table 41: Register List and Map (Continued)

| Address (Hex)   | Register Name  | Bit 7                 | Bit 6                | Bit 5           | Bit 4                 | Bit 3                 | Bit 2             | Bit 1        | Bit 0            | Reference Page |      |      |
|---|--|-----------------------|----------------------|-----------------|-----------------------|-----------------------|-------------------|--------------|------------------|----------------|------|------|
| 0B  | MON_SW_PBO_CNFG - Frequency Monitor, Input Clock Selection & PBO Control     | FREQ_MON_CLK          | LOS_FLAG_TO_TDO      | ULTR_FAST_SW    | EXT_SW                | PBO_FREQ_Z            | PBO_EN            | -            | FREQ_MON_HARD_EN | P 67           |      |      |
| 13  | MS_SL_CTRL_CNFG - Master Slave Control                                       | -                     | -                    | -               | -                     | -                     | -                 | -            | MS_SL_CTRL       | P 68           |      |      |
| 7E  | PROTECTION_CNFG - Register Protection Mode Configuration                     | PROTECTION_DATA[7:0]  |                      |                 |                       |                       |                   |              |                  |                | P 68 |      |
| 7F  | MPU_SEL_CNFG - Microprocessor Interface Mode Configuration                   | -                     | -                    | -               | -                     | -                     | MPU_SEL_CNFG[2:0] |              |                  | P 69           |      |      |
| <b>Interrupt Registers</b>  |  |                       |                      |                 |                       |                       |                   |              |                  |                |      |      |
| 0C  | INTERRUPT_CNFG - Interrupt Configuration                                     | -                     | -                    | -               | -                     | -                     | -                 | HZ_EN        | INT_POL          | P 70           |      |      |
| 0D  | INTERRUPTS1_STS - Interrupt Status 1   | -                     | -                    | IN[4:1]         |                       |                       | -                 | -            |                  | P 70           |      |      |
| 0E  | INTERRUPTS2_STS - Interrupt Status 2   | T0_OPERATING_MODE     | T0_MAIN_REF_FAILED   | -               | -                     | -                     | IN5               | -            | -                | P 71           |      |      |
| 0F  | INTERRUPTS3_STS - Interrupt Status 3   | EX_SYNC_ALARM         | T4_STS               | -               | INPUT_TO_T4           | -                     | -                 | -            | -                | P 72           |      |      |
| 10  | INTERRUPTS1_ENABLE_CNFG - Interrupt Control 1                                | -                     | -                    | IN[4:1]         |                       |                       | -                 | -            |                  | P 72           |      |      |
| 11  | INTERRUPTS2_ENABLE_CNFG - Interrupt Control 2                                | T0_OPERATING_MODE     | T0_MAIN_REF_FAILED   | -               | -                     | -                     | IN5               | -            | -                | P 73           |      |      |
| 12  | INTERRUPTS3_ENABLE_CNFG - Interrupt Control 3                                | EX_SYNC_ALARM         | T4_STS               | -               | INPUT_TO_T4           | -                     | -                 | -            | -                | P 73           |      |      |
| <b>Input Clock Frequency &amp; Priority Configuration Registers</b> |  |                       |                      |                 |                       |                       |                   |              |                  |                |      |      |
| 16  | IN1_CNFG - Input Clock 1 Configuration                                       | DIRECT_DIV            | LOCK_8K              | BUCKET_SEL[1:0] |                       | IN_FREQ[3:0]          |                   |              |                  | P 74           |      |      |
| 17  | IN2_CNFG - Input Clock 2 Configuration                                       | DIRECT_DIV            | LOCK_8K              | BUCKET_SEL[1:0] |                       | IN_FREQ[3:0]          |                   |              |                  | P 75           |      |      |
| 18  | IN3_IN4_HF_DIV_CNFG - Input Clock 3 & 4 High Frequency Divider Configuration | IN4_DIV[1:0]          |                      | -               | -                     | -                     | -                 | IN3_DIV[1:0] |                  | P 76           |      |      |
| 19  | IN3_CNFG - Input Clock 3 Configuration                                       | DIRECT_DIV            | LOCK_8K              | BUCKET_SEL[1:0] |                       | IN_FREQ[3:0]          |                   |              |                  | P 77           |      |      |
| 1A  | IN4_CNFG - Input Clock 4 Configuration                                       | DIRECT_DIV            | LOCK_8K              | BUCKET_SEL[1:0] |                       | IN_FREQ[3:0]          |                   |              |                  | P 78           |      |      |
| 1F  | IN5_CNFG - Input Clock 5 Configuration                                       | DIRECT_DIV            | LOCK_8K              | BUCKET_SEL[1:0] |                       | IN_FREQ[3:0]          |                   |              |                  | P 79           |      |      |
| 23  | PRE_DIV_CH_CNFG - DivN Divider Channel Selection                             | -                     | -                    | -               | -                     | PRE_DIV_CH_VALUE[3:0] |                   |              |                  | P 80           |      |      |
| 24  | PRE_DIVN[7:0]_CNFG - DivN Divider Division Factor Configuration 1            | PRE_DIVN_VALUE[7:0]   |                      |                 |                       |                       |                   |              |                  |                | P 80 |      |
| 25  | PRE_DIVN[14:8]_CNFG - DivN Divider Division Factor Configuration 2           | -                     | PRE_DIVN_VALUE[14:8] |                 |                       |                       |                   |              |                  |                |      | P 81 |
| 27  | IN1_IN2_SEL_PRIORITY_CNFG - Input Clock 1 & 2 Priority Configuration *       | IN2_SEL_PRIORITY[3:0] |                      |                 | IN1_SEL_PRIORITY[3:0] |                       |                   |              |                  | P 82           |      |      |

Table 41: Register List and Map (Continued)

| Address (Hex)  | Register Name  | Bit 7                       | Bit 6 | Bit 5 | Bit 4                 | Bit 3                        | Bit 2 | Bit 1                   | Bit 0 | Reference Page |
|--|--|-----------------------------|-------|-------|-----------------------|------------------------------|-------|-------------------------|-------|----------------|
| 28   | IN3_IN4_SEL_PRIORITY_CNFG - Input Clock 3 & 4 Priority Configuration *                       | IN4_SEL_PRIORITY[3:0]       |       |       | IN3_SEL_PRIORITY[3:0] |                              |       |                         |       | P 83           |
| 2B   | IN5_SEL_PRIORITY_CNFG - Input Clock 5 Priority Configuration *                               | -                           | -     | -     | -                     | IN5_SEL_PRIORITY[3:0]        |       |                         | P 84  |                |
| <b>Input Clock Quality Monitoring Configuration &amp; Status Registers</b> |  |                             |       |       |                       |                              |       |                         |       |                |
| 2E   | FREQ_MON_FACTOR_CNFG - Factor of Frequency Monitor Configuration                             | -                           | -     | -     | -                     | FREQ_MON_FACTOR[3:0]         |       |                         | P 85  |                |
| 2F   | ALL_FREQ_MON_THRESHOLD_CNFG - Frequency Monitor Threshold for All Input Clocks Configuration | -                           | -     | -     | -                     | ALL_FREQ_HARD_THRESHOLD[3:0] |       |                         | P 85  |                |
| 31   | UPPER_THRESHOLD_0_CNFG - Upper Threshold for Leaky Bucket Configuration 0                    | UPPER_THRESHOLD_0_DATA[7:0] |       |       |                       |                              |       |                         |       | P 86           |
| 32   | LOWER_THRESHOLD_0_CNFG - Lower Threshold for Leaky Bucket Configuration 0                    | LOWER_THRESHOLD_0_DATA[7:0] |       |       |                       |                              |       |                         |       | P 86           |
| 33   | BUCKET_SIZE_0_CNFG - Bucket Size for Leaky Bucket Configuration 0                            | BUCKET_SIZE_0_DATA[7:0]     |       |       |                       |                              |       |                         |       | P 86           |
| 34   | DECAY_RATE_0_CNFG - Decay Rate for Leaky Bucket Configuration 0                              | -                           | -     | -     | -                     | -                            | -     | DECAY_RATE_0_DATA [1:0] | P 87  |                |
| 35   | UPPER_THRESHOLD_1_CNFG - Upper Threshold for Leaky Bucket Configuration 1                    | UPPER_THRESHOLD_1_DATA[7:0] |       |       |                       |                              |       |                         |       | P 87           |
| 36   | LOWER_THRESHOLD_1_CNFG - Lower Threshold for Leaky Bucket Configuration 1                    | LOWER_THRESHOLD_1_DATA[7:0] |       |       |                       |                              |       |                         |       | P 87           |
| 37   | BUCKET_SIZE_1_CNFG - Bucket Size for Leaky Bucket Configuration 1                            | BUCKET_SIZE_1_DATA[7:0]     |       |       |                       |                              |       |                         |       | P 88           |
| 38   | DECAY_RATE_1_CNFG - Decay Rate for Leaky Bucket Configuration 1                              | -                           | -     | -     | -                     | -                            | -     | DECAY_RATE_1_DATA [1:0] | P 88  |                |
| 39   | UPPER_THRESHOLD_2_CNFG - Upper Threshold for Leaky Bucket Configuration 2                    | UPPER_THRESHOLD_2_DATA[7:0] |       |       |                       |                              |       |                         |       | P 88           |
| 3A   | LOWER_THRESHOLD_2_CNFG - Lower Threshold for Leaky Bucket Configuration 2                    | LOWER_THRESHOLD_2_DATA[7:0] |       |       |                       |                              |       |                         |       | P 89           |
| 3B   | BUCKET_SIZE_2_CNFG - Bucket Size for Leaky Bucket Configuration 2                            | BUCKET_SIZE_2_DATA[7:0]     |       |       |                       |                              |       |                         |       | P 89           |
| 3C   | DECAY_RATE_2_CNFG - Decay Rate for Leaky Bucket Configuration 2                              | -                           | -     | -     | -                     | -                            | -     | DECAY_RATE_2_DATA [1:0] | P 89  |                |
| 3D   | UPPER_THRESHOLD_3_CNFG - Upper Threshold for Leaky Bucket Configuration 3                    | UPPER_THRESHOLD_3_DATA[7:0] |       |       |                       |                              |       |                         |       | P 90           |
| 3E   | LOWER_THRESHOLD_3_CNFG - Lower Threshold for Leaky Bucket Configuration 3                    | LOWER_THRESHOLD_3_DATA[7:0] |       |       |                       |                              |       |                         |       | P 90           |
| 3F   | BUCKET_SIZE_3_CNFG - Bucket Size for Leaky Bucket Configuration 3                            | BUCKET_SIZE_3_DATA[7:0]     |       |       |                       |                              |       |                         |       | P 90           |
| 40   | DECAY_RATE_3_CNFG - Decay Rate for Leaky Bucket Configuration 3                              | -                           | -     | -     | -                     | -                            | -     | DECAY_RATE_3_DATA [1:0] | P 91  |                |

Table 41: Register List and Map (Continued)

| Address (Hex)  | Register Name  | Bit 7                                 | Bit 6               | Bit 5                   | Bit 4                   | Bit 3                                  | Bit 2                       | Bit 1                       | Bit 0             | Reference Page |
|--|--|---------------------------------------|---------------------|-------------------------|-------------------------|--|-----------------------------|-----------------------------|-------------------|----------------|
| 41   | IN_FREQ_READ_CH_CNFG - Input Clock Frequency Read Channel Selection                        | -                                     | -                   | -                       | -                       | IN_FREQ_READ_CH[3:0]                   |                             |                             |                   | P 91           |
| 42   | IN_FREQ_READ_STS - Input Clock Frequency Read Value  | IN_FREQ_VALUE[7:0]                    |                     |                         |                         |  |                             |                             |                   | P 92           |
| 44   | IN1_IN2_STS - Input Clock 1 & 2 Status   | -                                     | IN2_FREQ_HARD_ALARM | IN2_NO_ACTIVITY_ALARM   | IN2_PH_LOCK_ALARM       | -                                      | IN1_FREQ_HARD_ALARM         | IN1_NO_ACTIVITY_ALARM       | IN1_PH_LOCK_ALARM | P 93           |
| 45   | IN3_IN4_STS - Input Clock 3 & 4 Status   | -                                     | IN4_FREQ_HARD_ALARM | IN4_NO_ACTIVITY_ALARM   | IN4_PH_LOCK_ALARM       | -                                      | IN3_FREQ_HARD_ALARM         | IN3_NO_ACTIVITY_ALARM       | IN3_PH_LOCK_ALARM | P 94           |
| 48   | IN5_STS - Input Clock 5 Status   | -                                     | -                   | -                       | -                       | -                                      | IN5_FREQ_HARD_ALARM         | IN5_NO_ACTIVITY_ALARM       | IN5_PH_LOCK_ALARM | P 95           |
| <b>T0 / T4 DPLL Input Clock Selection Registers</b>    |  |                                       |                     |                         |                         |  |                             |                             |                   |                |
| 4A   | INPUT_VALID1_STS - Input Clocks Validity 1   | -                                     | -                   | IN[4:1]                 |                         |  |                             | -                           | -                 | P 96           |
| 4B   | INPUT_VALID2_STS - Input Clocks Validity 2   | -                                     | -                   | -                       | -                       | -                                      | IN5                         | -                           | -                 | P 96           |
| 4C   | REMOTE_INPUT_VALID1_CNFG - Input Clocks Validity Configuration 1                           | -D                                    | -                   | IN4_VALID               | IN3_VALID               | IN2_VALID                              | IN1_VALID                   | -                           | -                 | P 96           |
| 4D   | REMOTE_INPUT_VALID2_CNFG - Input Clocks Validity Configuration 2                           | -                                     | -                   | -                       | -                       | -                                      | IN5_VALID                   | -                           | -                 | P 97           |
| 4E   | PRIORITY_TABLE1_STS - Priority Status 1 *  | HIGHEST_PRIORITY_VALIDATED[3:0]       |                     |                         |                         | CURRENTLY_SELECTED_INPUT[3:0]          |                             |                             |                   | P 97           |
| 4F   | PRIORITY_TABLE2_STS - Priority Status 2 *  | THIRD_HIGHEST_PRIORITY_VALIDATED[3:0] |                     |                         |                         | SECOND_HIGHEST_PRIORITY_VALIDATED[3:0] |                             |                             |                   | P 98           |
| 50   | T0_INPUT_SEL_CNFG - T0 Selected Input Clock Configuration                                  | -                                     | -                   | -                       | -                       | T0_INPUT_SEL[3:0]                      |                             |                             |                   | P 99           |
| 51   | T4_INPUT_SEL_CNFG - T4 Selected Input Clock Configuration                                  | -                                     | T4_LOCK_T0          | T0_FOR_T4               | T4_TEST_T0_PH           | T4_INPUT_SEL[3:0]                      |                             |                             |                   | P 100          |
| <b>T0 / T4 DPLL State Machine Control Registers</b>    |  |                                       |                     |                         |                         |  |                             |                             |                   |                |
| 52   | OPERATING_STS - DPLL Operating Status  | EX_SYNC_ALARM_MON                     | T4_DPLL_LOCK        | T0_DPLL_SOFT_FREQ_ALARM | T4_DPLL_SOFT_FREQ_ALARM | T0_DPLL_LOCK                           | T0_DPLL_OPERATING_MODE[2:0] |                             |                   | P 101          |
| 53   | T0_OPERATING_MODE_CNFG - T0 DPLL Operating Mode Configuration                              | -                                     | -                   | -                       | -                       | -                                      | T0_OPERATING_MODE[2:0]      |                             |                   | P 102          |
| 54   | T4_OPERATING_MODE_CNFG - T4 DPLL Operating Mode Configuration                              | -                                     | -                   | -                       | -                       | -                                      | T4_OPERATING_MODE[2:0]      |                             |                   | P 102          |
| <b>T0 / T4 DPLL &amp; APLL Configuration Registers</b> |  |                                       |                     |                         |                         |  |                             |                             |                   |                |
| 55   | T0_DPLL_APLL_PATH_CNFG - T0 DPLL & APLL Path Configuration                                 | T0_APLL_PATH[3:0]                     |                     |                         |                         | T0_GSM_OBSAI_16E1_16T1_SEL[1:0]        |                             | T0_12E1_24T1_E3_T3_SEL[1:0] |                   | P 103          |
| 56   | T0_DPLL_START_BW_DAMPING_CNFG - T0 DPLL Start Bandwidth & Damping Factor Configuration     | T0_DPLL_START_DAMPING[2:0]            |                     |                         | T0_DPLL_START_BW[4:0]   |  |                             |                             |                   | P 104          |
| 57   | T0_DPLL_ACQ_BW_DAMPING_CNFG - T0 DPLL Acquisition Bandwidth & Damping Factor Configuration | T0_DPLL_ACQ_DAMPING[2:0]              |                     |                         | T0_DPLL_ACQ_BW[4:0]     |  |                             |                             |                   | P 105          |

Table 41: Register List and Map (Continued)

| Address (Hex)                         | Register Name  | Bit 7                       | Bit 6                     | Bit 5           | Bit 4                  | Bit 3                         | Bit 2                  | Bit 1                       | Bit 0 | Reference Page |       |
|---------------------------------------|--|-----------------------------|---------------------------|-----------------|------------------------|-------------------------------|------------------------|-----------------------------|-------|----------------|-------|
| 58                                    | T0_DPLL_LOCKED_BW_DAMPING_CNFG - T0 DPLL Locked Bandwidth & Damping Factor Configuration | T0_DPLL_LOCKED_DAMPING[2:0] |                           |                 | T0_DPLL_LOCKED_BW[4:0] |                               |                        |                             |       | P 106          |       |
| 59                                    | T0_BW_OVERSHOOT_CNFG - T0 DPLL Bandwidth Overshoot Configuration                         | AUTO_BW_SEL                 | -                         | -               | -                      | T0_LIMIT                      | -                      | -                           | -     | P 107          |       |
| 5A                                    | PHASE_LOSS_COARSE_LIMIT_CNFG - Phase Loss Coarse Detector Limit Configuration *          | COARSE_PH_LOS_LIMT_EN       | WIDE_EN                   | MULTI_PH_APP    | MULTI_PH_8K_4K_2K_EN   | PH_LOS_COARSE_LIMIT[3:0]      |                        |                             | P 108 |                |       |
| 5B                                    | PHASE_LOSS_FINE_LIMIT_CNFG - Phase Loss Fine Detector Limit Configuration *              | FINE_PH_LOS_LIMT_EN         | FAST_LOS_SW               | -               | -                      | -                             | PH_LOS_FINE_LIMIT[2:0] |                             |       | P 109          |       |
| 5C                                    | T0_HOLDOVER_MODE_CNFG - T0 DPLL Holdover Mode Configuration                              | MAN_HOLDOVER                | AUTO_AVG                  | FAST_AVG        | READ_AVG               | TEMP_HOLDOVER_MODE[1:0]       |                        | -                           | -     | P 110          |       |
| 5D                                    | T0_HOLDOVER_FREQ[7:0]_CNFG - T0 DPLL Holdover Frequency Configuration 1                  | T0_HOLDOVER_FREQ[7:0]       |                           |                 |                        |                               |                        |                             |       | P 110          |       |
| 5E                                    | T0_HOLDOVER_FREQ[15:8]_CNFG - T0 DPLL Holdover Frequency Configuration 2                 | T0_HOLDOVER_FREQ[15:8]      |                           |                 |                        |                               |                        |                             |       | P 111          |       |
| 5F                                    | T0_HOLDOVER_FREQ[23:16]_CNFG - T0 DPLL Holdover Frequency Configuration 3                | T0_HOLDOVER_FREQ[23:16]     |                           |                 |                        |                               |                        |                             |       | P 111          |       |
| 60                                    | T4_DPLL_APLL_PATH_CNFG - T4 DPLL & APLL Path Configuration                               | T4_APLL_PATH[3:0]           |                           |                 |                        | T4_GSM_GPS_16E1_16T1_SEL[1:0] |                        | T4_12E1_24T1_E3_T3_SEL[1:0] |       | P 112          |       |
| 61                                    | T4_DPLL_LOCKED_BW_DAMPING_CNFG - T4 DPLL Locked Bandwidth & Damping Factor Configuration | T4_DPLL_LOCKED_DAMPING[2:0] |                           |                 | -                      | -                             | -                      | T4_DPLL_LOCKED_BW[1:0]      |       | P 113          |       |
| 62                                    | CURRENT_DPLL_FREQ[7:0]_STS - DPLL Current Frequency Status 1 *                           | CURRENT_DPLL_FREQ[7:0]      |                           |                 |                        |                               |                        |                             |       | P 113          |       |
| 63                                    | CURRENT_DPLL_FREQ[15:8]_STS - DPLL Current Frequency Status 2 *                          | CURRENT_DPLL_FREQ[15:8]     |                           |                 |                        |                               |                        |                             |       | P 113          |       |
| 64                                    | CURRENT_DPLL_FREQ[23:16]_STS - DPLL Current Frequency Status 3 *                         | CURRENT_DPLL_FREQ[23:16]    |                           |                 |                        |                               |                        |                             |       | P 114          |       |
| 65                                    | DPLL_FREQ_SOFT_LIMIT_CNFG - DPLL Soft Limit Configuration                                | FREQ_LIMT_PH_LOS            | DPLL_FREQ_SOFT_LIMIT[6:0] |                 |                        |                               |                        |                             |       |                | P 114 |
| 66                                    | DPLL_FREQ_HARD_LIMIT[7:0]_CNFG - DPLL Hard Limit Configuration 1                         | DPLL_FREQ_HARD_LIMIT[7:0]   |                           |                 |                        |                               |                        |                             |       | P 114          |       |
| 67                                    | DPLL_FREQ_HARD_LIMIT[15:8]_CNFG - DPLL Hard Limit Configuration 2                        | DPLL_FREQ_HARD_LIMIT[15:8]  |                           |                 |                        |                               |                        |                             |       | P 115          |       |
| 68                                    | CURRENT_DPLL_PHASE[7:0]_STS - DPLL Current Phase Status 1 *                              | CURRENT_PH_DATA[7:0]        |                           |                 |                        |                               |                        |                             |       | P 115          |       |
| 69                                    | CURRENT_DPLL_PHASE[15:8]_STS - DPLL Current Phase Status 2 *                             | CURRENT_PH_DATA[15:8]       |                           |                 |                        |                               |                        |                             |       | P 115          |       |
| 6A                                    | T0_T4_APLL_BW_CNFG - T0 / T4 APLL Bandwidth Configuration                                | -                           | -                         | T0_APLL_BW[1:0] | -                      | -                             | T4_APLL_BW[1:0]        |                             | P 116 |                |       |
| <b>Output Configuration Registers</b> |  |                             |                           |                 |                        |                               |                        |                             |       |                |       |
| 6D                                    | OUT1_FREQ_CNFG - Output Clock 1 Frequency Configuration                                  | OUT1_PATH_SEL[3:0]          |                           |                 |                        | OUT1_DIVIDER[3:0]             |                        |                             |       | P 117          |       |

Table 41: Register List and Map (Continued)

| Address (Hex)                                   | Register Name  | Bit 7              | Bit 6              | Bit 5     | Bit 4                      | Bit 3               | Bit 2    | Bit 1          | Bit 0    | Reference Page |
|---|--|--------------------|--------------------|-----------|----------------------------|---------------------|----------|----------------|----------|----------------|
| 6E  | OUT2_FREQ_CNFG - Output Clock 2 Frequency Configuration              | OUT2_PATH_SEL[3:0] |                    |           | OUT2_DIVIDER[3:0]          |                     |          |                |          | P 118          |
| 6F  | OUT3_FREQ_CNFG - Output Clock 3 Frequency Configuration              | OUT3_PATH_SEL[3:0] |                    |           | OUT3_DIVIDER[3:0]          |                     |          |                |          | P 119          |
| 70  | OUT4_FREQ_CNFG - Output Clock 4 Frequency Configuration              | OUT4_PATH_SEL[3:0] |                    |           | OUT4_DIVIDER[3:0]          |                     |          |                |          | P 120          |
| 71  | OUT5_FREQ_CNFG - Output Clock 5 Frequency Configuration              | OUT5_PATH_SEL[3:0] |                    |           | OUT5_DIVIDER[3:0]          |                     |          |                |          | P 121          |
| 72  | OUTPUT_INV2 - Output Clock 4 & 5 Invert Configuration                | -                  |                    |           |                            |                     |          | OUT5_INV       | OUT4_INV | P 121          |
| 73  | OUTPUT_INV1 - Output Clock 1 ~ 3 Invert Configuration                | -                  |                    |           | OUT3_INV                   | OUT2_INV            | OUT1_INV | -              |          | P 122          |
| 74  | FR_MFR_SYNC_CNFG - Frame Sync & Multiframe Sync Output Configuration | IN_2K_4K_8K_INV    | 8K_EN              | 2K_EN     | 2K_8K_PU<br>L_POSITI<br>ON | 8K_INV              | 8K_PUL   | 2K_INV         | 2K_PUL   | P 123          |
| <b>PBO &amp; Phase Offset Control Registers</b> |  |                    |                    |           |                            |                     |          |                |          |                |
| 78  | PHASE_MON_PBO_CNFG - Phase Transient Monitor & PBO Configuration     | IN_NOISE_WINDOW    | -                  | PH_MON_EN | PH_MON_PBO_EN              | PH_TR_MON_LIMT[3:0] |          |                |          | P 124          |
| 7A  | PHASE_OFFSET[7:0]_CNFG - Phase Offset Configuration 1                | PH_OFFSET[7:0]     |                    |           |                            |                     |          |                |          | P 124          |
| 7B  | PHASE_OFFSET[9:8]_CNFG - Phase Offset Configuration 2                | PH_OFFSET_EN       | -                  | -         | -                          | -                   | -        | PH_OFFSET[9:8] |          | P 125          |
| <b>Synchronization Configuration Registers</b>  |  |                    |                    |           |                            |                     |          |                |          |                |
| 7C  | SYNC_MONITOR_CNFG - Sync Monitor Configuration                       | -                  | SYNC_MON_LIMT[2:0] |           |                            | -                   | -        | -              | -        | P 126          |
| 7D  | SYNC_PHASE_CNFG - Sync Phase Configuration                           | -                  | -                  | -         | -                          | -                   | -        | SYNC_PH1[1:0]  |          | P 126          |

## 7.2 REGISTER DESCRIPTION

### 7.2.1 GLOBAL CONTROL REGISTERS

#### ID[7:0] - Device ID 1

| Address: 00H            |         |  |  |     |  |     |  |     |  |     |  |
|-------------------------|---------|--|--|-----|--|-----|--|-----|--|-----|--|
| Type: Read              |         |  |  |     |  |     |  |     |  |     |  |
| Default Value: 10001000 |         |  |  |     |  |     |  |     |  |     |  |
| 7                       |         | 6  |  | 5   |  | 4   |  | 3   |  | 2   |  |
| 1                       |         | 0  |  | 1   |  | 0   |  | 1   |  | 0   |  |
| ID7                     |         | ID6  |  | ID5 |  | ID4 |  | ID3 |  | ID2 |  |
| ID1                     |         | ID0  |  |     |  |     |  |     |  |     |  |
| Bit                     | Name    | Description  |  |     |  |     |  |     |  |     |  |
| 7 - 0                   | ID[7:0] | Refer to the description of the ID[15:8] bits (b7~0, 01H). |  |     |  |     |  |     |  |     |  |

**ID[15:8] - Device ID 2**

Address: 01H  
 Type: Read  
 Default Value: 00010001

|      |      |      |      |      |      |     |     |
|------|------|------|------|------|------|-----|-----|
| 7    | 6    | 5    | 4    | 3    | 2    | 1   | 0   |
| ID15 | ID14 | ID13 | ID12 | ID11 | ID10 | ID9 | ID8 |

| Bit   | Name     | Description  |
|-------|----------|--|
| 7 - 0 | ID[15:8] | The value in the ID[15:0] bits are pre-set, representing the identification number for the IDT82V3285. |

**MPU\_PIN\_STS - MPU\_MODE[2:0] Pins Status**

Address: 02H  
 Type: Read  
 Default Value: XXXXXXXX

|   |   |   |   |   |              |              |              |
|---|---|---|---|---|--------------|--------------|--------------|
| 7 | 6 | 5 | 4 | 3 | 2            | 1            | 0            |
| - | - | - | - | - | MPU_PIN_STS2 | MPU_PIN_STS1 | MPU_PIN_STS0 |

| Bit   | Name             | Description  |
|-------|------------------|--|
| 7 - 3 | -                | Reserved.  |
| 2 - 0 | MPU_PIN_STS[2:0] | These bits indicate the value of the MPU_MODE[2:0] pins. The default value of these bits is determined by the MPU_MODE[2:0] pins during reset. |

**NOMINAL\_FREQ[7:0]\_CNFG - Crystal Oscillator Frequency Offset Calibration Configuration 1**

Address: 04H  
 Type: Read / Write  
 Default Value: 00000000

|                     |                     |                     |                     |                     |                     |                     |                     |
|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| 7                   | 6                   | 5                   | 4                   | 3                   | 2                   | 1                   | 0                   |
| NOMINAL_FREQ_VALUE7 | NOMINAL_FREQ_VALUE6 | NOMINAL_FREQ_VALUE5 | NOMINAL_FREQ_VALUE4 | NOMINAL_FREQ_VALUE3 | NOMINAL_FREQ_VALUE2 | NOMINAL_FREQ_VALUE1 | NOMINAL_FREQ_VALUE0 |

| Bit   | Name                    | Description   |
|-------|-------------------------|---|
| 7 - 0 | NOMINAL_FREQ_VALUE[7:0] | Refer to the description of the NOMINAL_FREQ_VALUE[23:16] bits (b7~0, 06H). |

**NOMINAL\_FREQ[15:8]\_CNFG - Crystal Oscillator Frequency Offset Calibration Configuration 2**

Address: 05H  
 Type: Read / Write  
 Default Value: 00000000

|                      |                      |                      |                      |                      |                      |                     |                     |
|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|---------------------|
| 7                    | 6                    | 5                    | 4                    | 3                    | 2                    | 1                   | 0                   |
| NOMINAL_FREQ_VALUE15 | NOMINAL_FREQ_VALUE14 | NOMINAL_FREQ_VALUE13 | NOMINAL_FREQ_VALUE12 | NOMINAL_FREQ_VALUE11 | NOMINAL_FREQ_VALUE10 | NOMINAL_FREQ_VALUE9 | NOMINAL_FREQ_VALUE8 |

| Bit   | Name                     | Description   |
|-------|--------------------------|---|
| 7 - 0 | NOMINAL_FREQ_VALUE[15:8] | Refer to the description of the NOMINAL_FREQ_VALUE[23:16] bits (b7~0, 06H). |

**NOMINAL\_FREQ[23:16]\_CNFG - Crystal Oscillator Frequency Offset Calibration Configuration 3**

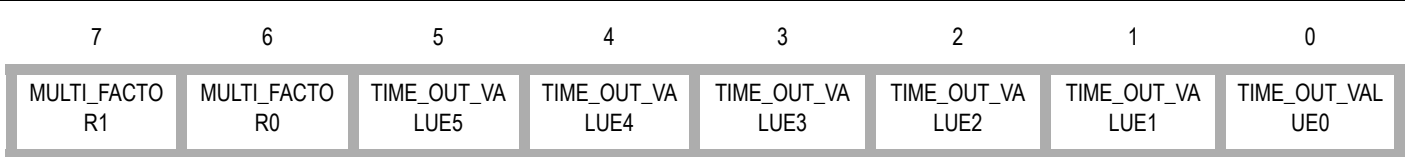
| Address: 06H            |                           |   |                      |                      |                      |                      |                      |
|-------------------------|---------------------------|---|----------------------|----------------------|----------------------|----------------------|----------------------|
| Type: Read / Write      |                           |   |                      |                      |                      |                      |                      |
| Default Value: 00000000 |                           |   |                      |                      |                      |                      |                      |
| 7                       | 6                         | 5   | 4                    | 3                    | 2                    | 1                    | 0                    |
| NOMINAL_FREQ_VALUE23    | NOMINAL_FREQ_VALUE22      | NOMINAL_FREQ_VALUE21  | NOMINAL_FREQ_VALUE20 | NOMINAL_FREQ_VALUE19 | NOMINAL_FREQ_VALUE18 | NOMINAL_FREQ_VALUE17 | NOMINAL_FREQ_VALUE16 |
| Bit                     | Name                      | Description   |                      |                      |                      |                      |                      |
| 7 - 0                   | NOMINAL_FREQ_VALUE[23:16] | <p>The NOMINAL_FREQ_VALUE[23:0] bits represent a 2's complement signed integer. If the value is multiplied by 0.0000884, the calibration value for the master clock in ppm will be gotten.</p> <p>For example, the frequency offset on OSC1 is +3 ppm. Though -3 ppm should be compensated, the calibration value is calculated as +3 ppm:</p> <p><math>3 \div 0.0000884 = 33937</math> (Dec.) = 8490 (Hex);</p> <p>So '008490' should be written into these bits.</p> <p>The calibration range is within <math>\pm 741</math> ppm.</p> |                      |                      |                      |                      |                      |

**T4\_T0\_REG\_SEL\_CNFG - T0 / T4 Registers Selection Configuration**

| Address: 07H            |           |   |           |   |   |   |   |
|-------------------------|-----------|---|-----------|---|---|---|---|
| Type: Read / Write      |           |   |           |   |   |   |   |
| Default Value: XXX0XXXX |           |   |           |   |   |   |   |
| 7                       | 6         | 5   | 4         | 3 | 2 | 1 | 0 |
| -                       | -         | -   | T4_T0_SEL | - | - | - | - |
| Bit                     | Name      | Description   |           |   |   |   |   |
| 7 - 5                   | -         | Reserved.   |           |   |   |   |   |
| 4                       | T4_T0_SEL | <p>A part of the registers are shared by T0 and T4 paths. These registers are addressed 27H, 28H, 2BH, 4EH, 4FH, 5AH, 5BH, 62H ~ 64H, 68H and 69H. This bit determines whether the register configuration is available for T0 or T4 path.</p> <p>0: T0 path (default).</p> <p>1: T4 path.</p> |           |   |   |   |   |
| 3 - 0                   | -         | Reserved.   |           |   |   |   |   |

**PHASE\_ALARM\_TIME\_OUT\_CNFG - Phase Lock Alarm Time-Out Configuration**

Address: 08H  
 Type: Read / Write  
 Default Value: 00110010



| Bit   | Name                | Description  |
|-------|---------------------|--|
| 7 - 6 | MULTI_FACTOR[1:0]   | These bits determine a factor which has a relationship with a period in seconds. A phase lock alarm will be raised if the T0 selected input clock is not locked in T0 DPLL within this period. If the PH_ALARM_TIMEOUT bit (b5, 09H) is '1', the phase lock alarm will be cleared after this period (starting from when the alarm is raised). Refer to the description of the TIME_OUT_VALUE[5:0] bits (b5~0, 08H).<br>00: 2 (default)<br>01: 4<br>10: 8<br>11: 16 |
| 5 - 0 | TIME_OUT_VALUE[5:0] | These bits represent an unsigned integer. If the value in these bits is multiplied by the value in the MULTI_FACTOR[1:0] bits (b7~6, 08H), a period in seconds will be gotten.<br>A phase lock alarm will be raised if the T0 selected input clock is not locked in T0 DPLL within this period. If the PH_ALARM_TIMEOUT bit (b5, 09H) is '1', the phase lock alarm will be cleared after this period (starting from when the alarm is raised).                     |



**INPUT\_MODE\_CNFG - Input Mode Configuration**

| Address: 09H            |                  |  |            |            |              |              |                |                  |             |                 |            |   |                    |   |   |         |   |   |   |
|-------------------------|------------------|--|------------|------------|--------------|--------------|----------------|------------------|-------------|-----------------|------------|---|--------------------|---|---|---------|---|---|---|
| Type: Read / Write      |                  |  |            |            |              |              |                |                  |             |                 |            |   |                    |   |   |         |   |   |   |
| Default Value: 10100XX0 |                  |  |            |            |              |              |                |                  |             |                 |            |   |                    |   |   |         |   |   |   |
| 7                       | 6                | 5  | 4          | 3          | 2            | 1            | 0              |                  |             |                 |            |   |                    |   |   |         |   |   |   |
| AUTO_EXT_SYNC_EN        | EXT_SYNC_EN      | PH_ALARM_TIMEOUT   | SYNC_FREQ1 | SYNC_FREQ0 | IN_SONET_SDH | MASTER_SLAVE | REVERTIVE_MODE |                  |             |                 |            |   |                    |   |   |         |   |   |   |
| Bit                     | Name             | Description  |            |            |              |              |                |                  |             |                 |            |   |                    |   |   |         |   |   |   |
| 7                       | AUTO_EXT_SYNC_EN | Refer to the description of the EXT_SYNC_EN bit (b6, 09H).   |            |            |              |              |                |                  |             |                 |            |   |                    |   |   |         |   |   |   |
| 6                       | EXT_SYNC_EN      | <p>This bit, together with the AUTO_EXT_SYNC_EN bit (b7, 09H), determines whether EX_SYNC1 is enabled to synchronize the frame sync output signals.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 20%;">AUTO_EXT_SYNC_EN</th> <th style="width: 20%;">EXT_SYNC_EN</th> <th style="width: 60%;">Synchronization</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">don't-care</td> <td style="text-align: center;">0</td> <td style="text-align: center;">Disabled (default)</td> </tr> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">Enabled</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">Enabled if the T0 selected input clock is IN5; otherwise, disabled.</td> </tr> </tbody> </table> |            |            |              |              |                | AUTO_EXT_SYNC_EN | EXT_SYNC_EN | Synchronization | don't-care | 0 | Disabled (default) | 0 | 1 | Enabled | 1 | 1 | Enabled if the T0 selected input clock is IN5; otherwise, disabled. |
| AUTO_EXT_SYNC_EN        | EXT_SYNC_EN      | Synchronization  |            |            |              |              |                |                  |             |                 |            |   |                    |   |   |         |   |   |   |
| don't-care              | 0                | Disabled (default)   |            |            |              |              |                |                  |             |                 |            |   |                    |   |   |         |   |   |   |
| 0                       | 1                | Enabled  |            |            |              |              |                |                  |             |                 |            |   |                    |   |   |         |   |   |   |
| 1                       | 1                | Enabled if the T0 selected input clock is IN5; otherwise, disabled.  |            |            |              |              |                |                  |             |                 |            |   |                    |   |   |         |   |   |   |
| 5                       | PH_ALARM_TIMEOUT | <p>This bit determines how to clear the phase lock alarm.</p> <p>0: The phase lock alarm will be cleared when a '1' is written to the corresponding INn_PH_LOCK_ALARM bit (b4/0, 44H &amp; 45H &amp; 48H).</p> <p>1: The phase lock alarm will be cleared after a period (= <i>TIME_OUT_VALUE</i>[5:0] (b5~0, 08H) X <i>MULTI_FACTOR</i>[1:0] (b7~6, 08H) in seconds) which starts from when the alarm is raised. (default)</p>  |            |            |              |              |                |                  |             |                 |            |   |                    |   |   |         |   |   |   |
| 4 - 3                   | SYNC_FREQ[1:0]   | <p>These bits set the frequency of the frame sync signal input on the EX_SYNC1 pin.</p> <p>00: 8 kHz (default)</p> <p>01: 8 kHz.</p> <p>10: 4 kHz.</p> <p>11: 2 kHz.</p>   |            |            |              |              |                |                  |             |                 |            |   |                    |   |   |         |   |   |   |
| 2                       | IN_SONET_SDH     | <p>This bit selects the SDH or SONET network type.</p> <p>0: SDH. The DPLL required clock is 2.048 MHz when the IN_FREQ[3:0] bits (b3~0, 16H &amp; 17H &amp; 19H) are '0001'; the T0/T4 DPLL output from the 16E1/16T1 path is 16E1.</p> <p>1: SONET. The DPLL required clock is 1.544 MHz when the IN_FREQ[3:0] bits (b3~0, 16H &amp; 17H &amp; 19H) are '0001'; the T0/T4 DPLL output from the 16E1/16T1 path is 16T1.</p> <p>The default value of this bit is determined by the SONET/SDH pin during reset.</p>   |            |            |              |              |                |                  |             |                 |            |   |                    |   |   |         |   |   |   |
| 1                       | MASTER_SLAVE     | <p>This bit is read only. It indicates the value of the MS/SL pin.</p> <p>Its default value is determined by the MS/SL pin during reset.</p>   |            |            |              |              |                |                  |             |                 |            |   |                    |   |   |         |   |   |   |
| 0                       | REVERTIVE_MODE   | <p>This bit selects Revertive or Non-Revertive switch for T0 path.</p> <p>0: Non-Revertive switch. (default)</p> <p>1: Revertive switch.</p>   |            |            |              |              |                |                  |             |                 |            |   |                    |   |   |         |   |   |   |

## DIFFERENTIAL\_IN\_OUT\_OSCI\_CNFG - Differential Input / Output Port &amp; Master Clock Configuration

| Address: 0AH            |                |   |   |   |          |                |                |
|-------------------------|----------------|---|---|---|----------|----------------|----------------|
| Type: Read / Write      |                |   |   |   |          |                |                |
| Default Value: XXXXX001 |                |   |   |   |          |                |                |
| 7                       | 6              | 5   | 4 | 3 | 2        | 1              | 0              |
| -                       | -              | -   | - | - | OSC_EDGE | OUT5_PECL_LVDS | OUT4_PECL_LVDS |
| Bit                     | Name           | Description   |   |   |          |                |                |
| 7 - 3                   | -              | Reserved.   |   |   |          |                |                |
| 2                       | OSC_EDGE       | This bit selects a better active edge of the master clock.<br>0: The rising edge. (default)<br>1: The falling edge. |   |   |          |                |                |
| 1                       | OUT5_PECL_LVDS | This bit selects a port technology for OUT5.<br>0: LVDS. (default)<br>1: PECL.                                      |   |   |          |                |                |
| 0                       | OUT4_PECL_LVDS | This bit selects a port technology for OUT4.<br>0: LVDS.<br>1: PECL. (default)                                      |   |   |          |                |                |

## MON\_SW\_PBO\_CNFG - Frequency Monitor, Input Clock Selection &amp; PBO Control

| Address: 0BH            |                  |  |        |          |        |   |                  |
|-------------------------|------------------|--|--------|----------|--------|---|------------------|
| Type: Read / Write      |                  |  |        |          |        |   |                  |
| Default Value: 100X01X1 |                  |  |        |          |        |   |                  |
| 7                       | 6                | 5  | 4      | 3        | 2      | 1 | 0                |
| FREQ_MON_CLK            | LOS_FLAG_TO_TDO  | ULTR_FAST_SW   | EXT_SW | PBO_FREZ | PBO_EN | - | FREQ_MON_HARD_EN |
| Bit                     | Name             | Description  |        |          |        |   |                  |
| 7                       | FREQ_MON_CLK     | The bit selects a reference clock for input clock frequency monitoring.<br>0: The output of T0 DPLL.<br>1: The master clock. (default)   |        |          |        |   |                  |
| 6                       | LOS_FLAG_TO_TDO  | The bit determines whether the interrupt of T0 selected input clock fail - is reported by the TDO pin.<br>0: Not reported. TDO pin is used as JTAG test data output which complies with IEEE 1149.1. (default)<br>1: Reported. TDO pin mimics the state of the T0_MAIN_REF_FAILED bit (b6, 0EH) and does not strictly comply with IEEE 1149.1.         |        |          |        |   |                  |
| 5                       | ULTR_FAST_SW     | This bit determines whether the T0 selected input clock is valid when missing 2 consecutive clock cycles or more.<br>0: Valid. (default)<br>1: Invalid.  |        |          |        |   |                  |
| 4                       | EXT_SW           | This bit determines the T0 input clock selection.<br>0: Forced selection or Automatic selection, as controlled by the T0_INPUT_SEL[3:0] bits (b3~0, 50H).<br>1: External Fast selection.<br>The default value of this bit is determined by the FF_SRCSW pin during reset.  |        |          |        |   |                  |
| 3                       | PBO_FREZ         | This bit is valid only when the PBO is enabled by the PBO_EN bit (b2, 0BH). It determines whether PBO is frozen at the current phase offset when a PBO event is triggered.<br>0: Not frozen. (default)<br>1: Frozen. Further PBO events are ignored and the current phase offset is maintained.  |        |          |        |   |                  |
| 2                       | PBO_EN           | This bit determines whether PBO is enabled when the T0 selected input clock switch or the T0 DPLL exiting from Holdover mode or Free-Run mode occurs.<br>0: Disabled.<br>1: Enabled. (default)   |        |          |        |   |                  |
| 1                       | -                | Reserved.  |        |          |        |   |                  |
| 0                       | FREQ_MON_HARD_EN | This bit determines whether the frequency hard alarm is enabled when the frequency of the input clock with respect to the reference clock is above the frequency hard alarm threshold. The reference clock can be the output of T0 DPLL or the master clock, as determined by the FREQ_MON_CLK bit (b7, 0BH).<br>0: Disabled.<br>1: Enabled. (default) |        |          |        |   |                  |

**MS\_SL\_CTRL\_CNFG - Master Slave Control**

Address: 13H  
 Type: Read / Write  
 Default Value: XXXXXXX0

|   |   |   |   |   |   |   |            |
|---|---|---|---|---|---|---|------------|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0          |
| - | - | - | - | - | - | - | MS_SL_CTRL |

| Bit                  | Name           | Description   |                      |  |        |           |                |      |   |        |   |       |     |   |       |   |        |
|----------------------|----------------|---|----------------------|--|--------|-----------|----------------|------|---|--------|---|-------|-----|---|-------|---|--------|
| 7 - 1                | -              | Reserved.   |                      |  |        |           |                |      |   |        |   |       |     |   |       |   |        |
| 0                    | MS_SL_CTRL     | This bit, together with the MS/SL pin, controls whether the device is configured as the Master or as the Slave. <table border="1" style="margin: 10px auto; border-collapse: collapse;"> <thead> <tr> <th colspan="2">Master/Slave Control</th> <th rowspan="2">Result</th> </tr> <tr> <th>MS/SL pin</th> <th>MS_SL_CTRL Bit</th> </tr> </thead> <tbody> <tr> <td rowspan="2">High</td> <td>0</td> <td>Master</td> </tr> <tr> <td>1</td> <td>Slave</td> </tr> <tr> <td rowspan="2">Low</td> <td>0</td> <td>Slave</td> </tr> <tr> <td>1</td> <td>Master</td> </tr> </tbody> </table> The default value of this bit is '0'. | Master/Slave Control |  | Result | MS/SL pin | MS_SL_CTRL Bit | High | 0 | Master | 1 | Slave | Low | 0 | Slave | 1 | Master |
| Master/Slave Control |                | Result  |                      |  |        |           |                |      |   |        |   |       |     |   |       |   |        |
| MS/SL pin            | MS_SL_CTRL Bit |   |                      |  |        |           |                |      |   |        |   |       |     |   |       |   |        |
| High                 | 0              | Master  |                      |  |        |           |                |      |   |        |   |       |     |   |       |   |        |
|                      | 1              | Slave   |                      |  |        |           |                |      |   |        |   |       |     |   |       |   |        |
| Low                  | 0              | Slave   |                      |  |        |           |                |      |   |        |   |       |     |   |       |   |        |
|                      | 1              | Master  |                      |  |        |           |                |      |   |        |   |       |     |   |       |   |        |

**PROTECTION\_CNFG - Register Protection Mode Configuration**

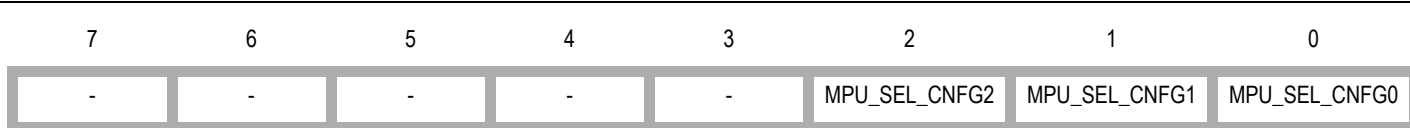
Address: 7EH  
 Type: Read / Write  
 Default Value: 10000101

|                  |                  |                  |                  |                  |                  |                  |                  |
|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| 7                | 6                | 5                | 4                | 3                | 2                | 1                | 0                |
| PROTECTION_DATA7 | PROTECTION_DATA6 | PROTECTION_DATA5 | PROTECTION_DATA4 | PROTECTION_DATA3 | PROTECTION_DATA2 | PROTECTION_DATA1 | PROTECTION_DATA0 |

| Bit   | Name                 | Description  |
|-------|----------------------|--|
| 7 - 0 | PROTECTION_DATA[7:0] | These bits select a register write protection mode.<br>00000000 - 10000100, 10000111 - 11111111: Protected mode. No other registers can be written except this register.<br>10000101: Fully Unprotected mode. All the writable registers can be written. (default)<br>10000110: Single Unprotected mode. One more register can be written besides this register. After write operation (not including writing a '1' to clear the bit to '0'), the device automatically switches to Protected mode. |

**MPU\_SEL\_CNFG - Microprocessor Interface Mode Configuration**

Address: 7FH  
 Type: Read / Write  
 Default Value: XXXXXXXX



| Bit   | Name              | Description   |
|-------|-------------------|---|
| 7 - 3 | -                 | Reserved.   |
| 2 - 0 | MPU_SEL_CNFG[2:0] | These bits select a microprocessor interface mode:<br>000: Reserved.<br>001: ERPOM mode.<br>010: Multiplexed mode.<br>011: Intel mode.<br>100: Motorola mode.<br>101: Serial mode.<br>110, 111: Reserved.<br>The default value of these bits are determined by the MPU_MODE[2:0] pins during reset. |

7.2.2 INTERRUPT REGISTERS

INTERRUPT\_CNFG - Interrupt Configuration

| Address: 0CH            |         |   |   |   |   |       |         |
|-------------------------|---------|---|---|---|---|-------|---------|
| Type: Read / Write      |         |   |   |   |   |       |         |
| Default Value: XXXXXX10 |         |   |   |   |   |       |         |
| 7                       | 6       | 5   | 4 | 3 | 2 | 1     | 0       |
| -                       | -       | -   | - | - | - | HZ_EN | INT_POL |
| Bit                     | Name    | Description   |   |   |   |       |         |
| 7 - 2                   | -       | Reserved.   |   |   |   |       |         |
| 1                       | HZ_EN   | This bit determines the output characteristics of the INT_REQ pin.<br>0: The output on the INT_REQ pin is high/low when the interrupt is active; the output is the opposite when the interrupt is inactive.<br>1: The output on the INT_REQ pin is high/low when the interrupt is active; the output is in high impedance state when the interrupt is inactive. (default) |   |   |   |       |         |
| 0                       | INT_POL | This bit determines the active level on the INT_REQ pin for an active interrupt indication.<br>0: Active low. (default)<br>1: Active high.  |   |   |   |       |         |

INTERRUPTS1\_STS - Interrupt Status 1

| Address: 0DH            |      |  |     |     |     |   |   |
|-------------------------|------|--|-----|-----|-----|---|---|
| Type: Read / Write      |      |  |     |     |     |   |   |
| Default Value: 11111111 |      |  |     |     |     |   |   |
| 7                       | 6    | 5  | 4   | 3   | 2   | 1 | 0 |
| -                       | -    | IN4  | IN3 | IN2 | IN1 | - | - |
| Bit                     | Name | Description  |     |     |     |   |   |
| 7 - 6                   | -    | Reserved.  |     |     |     |   |   |
| 5 - 2                   | INn  | This bit indicates the validity changes (from 'valid' to 'invalid' or from 'invalid' to 'valid') for the corresponding INn; i.e., whether there is a transition (from '0' to '1' or from '1' to '0') on the corresponding INn bit (b5~2, 4AH). Here n is any one of 4 to 1.<br>0: Has not changed.<br>1: Has changed. (default)<br>This bit is cleared by writing a '1'. |     |     |     |   |   |
| 1 - 0                   | -    | Reserved.  |     |     |     |   |   |

**INTERRUPTS2\_STS - Interrupt Status 2**

Address: 0EH  
 Type: Read / Write  
 Default Value: 00111111

|                   |                    |   |   |   |     |   |   |
|-------------------|--------------------|---|---|---|-----|---|---|
| 7                 | 6                  | 5 | 4 | 3 | 2   | 1 | 0 |
| T0_OPERATING_MODE | T0_MAIN_REF_FAILED | - | - | - | IN5 | - | - |

| Bit   | Name               | Description  |
|-------|--------------------|--|
| 7     | T0_OPERATING_MODE  | This bit indicates the operating mode switch for T0 DPLL; i.e., whether the value in the T0_DPLL_OPERATING_MODE[2:0] bits (b2~0, 52H) changes.<br>0: Has not switched. (default)<br>1: Has switched.<br>This bit is cleared by writing a '1'.  |
| 6     | T0_MAIN_REF_FAILED | This bit indicates whether the T0 selected input clock has failed. The T0 selected input clock fails when its validity changes from 'valid' to 'invalid'; i.e., when there is a transition from '1' to '0' on the corresponding INn bit (4AH, 4BH).<br>0: Has not failed. (default)<br>1: Has failed.<br>This bit is cleared by writing a '1'. |
| 5 - 3 | -                  | Reserved.  |
| 2     | IN5                | This bit indicates the validity changes (from 'valid' to 'invalid' or from 'invalid' to 'valid') for IN5 for T0 path, i.e., whether there is a transition (from '0' to '1' or from '1' to '0') on IN5 bit (b2, 4BH).<br>0: Has not changed.<br>1: Has changed. (default)<br>This bit is cleared by writing a '1'.                              |
| 1 - 0 | -                  | Reserved.  |

**INTERRUPTS3\_STS - Interrupt Status 3**

Address: 0FH  
 Type: Read / Write  
 Default Value: 11X10000

|               |        |   |             |   |   |   |   |
|---------------|--------|---|-------------|---|---|---|---|
| 7             | 6      | 5 | 4           | 3 | 2 | 1 | 0 |
| EX_SYNC_ALARM | T4_STS | - | INPUT_TO_T4 | - | - | - | - |

| Bit | Name          | Description  |
|-----|---------------|--|
| 7   | EX_SYNC_ALARM | This bit indicates whether an external sync alarm is raised; i.e., whether there is a transition from '0' to '1' on the EX_SYNC_ALARM_MON bit (b7, 52H).<br>0: Not raised.<br>1: Raised. (default)<br>This bit is cleared by writing a '1'.  |
| 6   | T4_STS        | This bit indicates the T4 DPLL locking status changes (from 'locked' to 'unlocked' or from 'unlocked' to 'locked'); i.e., whether there is a transition (from '0' to '1' or from '1' to '0') on the T4_DPLL_LOCK bit (b6, 52H).<br>0: Has not changed.<br>1: Has changed. (default)<br>This bit is cleared by writing a '1'. |
| 5   | -             | Reserved.  |
| 4   | INPUT_TO_T4   | This bit indicates whether all the input clocks for T4 path change to be unqualified; i.e., whether the HIGHEST_PRIORITY_VALIDATED[3:0] bits (b7~4, 4EH) are set to '0000' when these bits are available for T4 path.<br>0: Has not changed.<br>1: Has changed. (default)<br>This bit is cleared by writing a '1'.           |
| 3-0 | -             | Reserved.  |

**INTERRUPTS1\_ENABLE\_CNFG - Interrupt Control 1**

Address: 10H  
 Type: Read / Write  
 Default Value: 00000000

|   |   |     |     |     |     |   |   |
|---|---|-----|-----|-----|-----|---|---|
| 7 | 6 | 5   | 4   | 3   | 2   | 1 | 0 |
| - | - | IN4 | IN3 | IN2 | IN1 | - | - |

| Bit | Name | Description   |
|-----|------|---|
| 7-6 | -    | Reserved.   |
| 5-2 | INn  | This bit controls whether the interrupt is enabled to be reported on the INT_REQ pin when the input clock validity changes (from 'valid' to 'invalid' or from 'invalid' to 'valid'), i.e., when the corresponding INn bit (b5~2, 0DH) is '1'. Here n is any one of 4 to 1.<br>0: Disabled. (default)<br>1: Enabled. |
| 0-1 | -    | Reserved  |



## INTERRUPTS2\_ENABLE\_CNFG - Interrupt Control 2

| Address: 11H            |                    |  |   |   |     |   |   |
|-------------------------|--------------------|--|---|---|-----|---|---|
| Type: Read / Write      |                    |  |   |   |     |   |   |
| Default Value: 00000000 |                    |  |   |   |     |   |   |
| 7                       | 6                  | 5  | 4 | 3 | 2   | 1 | 0 |
| T0_OPERATING_MODE       | T0_MAIN_REF_FAILED | -  | - | - | IN5 | - | - |
| Bit                     | Name               | Description  |   |   |     |   |   |
| 7                       | T0_OPERATING_MODE  | This bit controls whether the interrupt is enabled to be reported on the INT_REQ pin when the T0 DPLL operating mode switches, i.e., when the T0_OPERATING_MODE bit (b7, 0EH) is '1'.<br>0: Disabled. (default)<br>1: Enabled.                                     |   |   |     |   |   |
| 6                       | T0_MAIN_REF_FAILED | This bit controls whether the interrupt is enabled to be reported on the INT_REQ pin when the T0 selected input clock has failed; i.e., when the T0_MAIN_REF_FAILED bit (b6, 0EH) is '1'.<br>0: Disabled. (default)<br>1: Enabled.                                 |   |   |     |   |   |
| 5 - 3                   | -                  | Reserved.  |   |   |     |   |   |
| 2                       | IN5                | This bit controls whether the interrupt is enabled to be reported on the INT_REQ pin when the input clock validity changes (from 'valid' to 'invalid' or from 'invalid' to 'valid'), i.e., when IN5 bit (b2, 0EH) is '1'.<br>0: Disabled. (default)<br>1: Enabled. |   |   |     |   |   |
| 1 - 0                   | -                  | Reserved.  |   |   |     |   |   |

## INTERRUPTS3\_ENABLE\_CNFG - Interrupt Control 3

| Address: 12H            |               |   |             |   |   |   |   |
|-------------------------|---------------|---|-------------|---|---|---|---|
| Type: Read / Write      |               |   |             |   |   |   |   |
| Default Value: 00X00000 |               |   |             |   |   |   |   |
| 7                       | 6             | 5   | 4           | 3 | 2 | 1 | 0 |
| EX_SYNC_ALARM           | T4_STS        | -   | INPUT_TO_T4 | - | - | - | - |
| Bit                     | Name          | Description   |             |   |   |   |   |
| 7                       | EX_SYNC_ALARM | This bit controls whether the interrupt is enabled to be reported on the INT_REQ pin when an external sync alarm has occurred, i.e., when the EX_SYNC_ALARM bit (b7, 0FH) is '1'.<br>0: Disabled. (default)<br>1: Enabled.  |             |   |   |   |   |
| 6                       | T4_STS        | This bit controls whether the interrupt is enabled to be reported on the INT_REQ pin when the T4 DPLL locking status changes (from 'locked' to 'unlocked' or from 'unlocked' to 'locked'), i.e., when the T4_STS bit (b6, 0FH) is '1'.<br>0: Disabled. (default)<br>1: Enabled. |             |   |   |   |   |
| 5                       | -             | Reserved.   |             |   |   |   |   |
| 4                       | INPUT_TO_T4   | This bit controls whether the interrupt is enabled to be reported on the INT_REQ pin when all the input clocks for T4 path become unqualified, i.e., when the INPUT_TO_T4 bit (b4, 0FH) is '1'.<br>0: Disabled. (default)<br>1: Enabled.  |             |   |   |   |   |
| 3 - 0                   | -             | Reserved.   |             |   |   |   |   |

7.2.3 INPUT CLOCK FREQUENCY & PRIORITY CONFIGURATION REGISTERS

IN1\_CNFG - Input Clock 1 Configuration

| Address: 16H            |                 |  |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
|-------------------------|-----------------|--|-------------|----------|----------|----------|----------|----------------|-------------|--------------|---|---|-------------------------|---|---|-----------------|---|---|--------------|---|---|----------|
| Type: Read / Write      |                 |  |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| Default Value: 00000000 |                 |  |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 7                       | 6               | 5  | 4           | 3        | 2        | 1        | 0        |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| DIRECT_DIV              | LOCK_8K         | BUCKET_SEL1  | BUCKET_SEL0 | IN_FREQ3 | IN_FREQ2 | IN_FREQ1 | IN_FREQ0 |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| Bit                     | Name            | Description  |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 7                       | DIRECT_DIV      | Refer to the description of the LOCK_8K bit (b6, 16H).   |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 6                       | LOCK_8K         | This bit, together with the DIRECT_DIV bit (b7, 16H), determines whether the DivN Divider or the Lock 8k Divider is used for IN1: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>DIRECT_DIV bit</th> <th>LOCK_8K bit</th> <th>Used Divider</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>Both bypassed (default)</td> </tr> <tr> <td>0</td> <td>1</td> <td>Lock 8k Divider</td> </tr> <tr> <td>1</td> <td>0</td> <td>DivN Divider</td> </tr> <tr> <td>1</td> <td>1</td> <td>Reserved</td> </tr> </tbody> </table> |             |          |          |          |          | DIRECT_DIV bit | LOCK_8K bit | Used Divider | 0 | 0 | Both bypassed (default) | 0 | 1 | Lock 8k Divider | 1 | 0 | DivN Divider | 1 | 1 | Reserved |
| DIRECT_DIV bit          | LOCK_8K bit     | Used Divider   |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 0                       | 0               | Both bypassed (default)  |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 0                       | 1               | Lock 8k Divider  |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 1                       | 0               | DivN Divider   |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 1                       | 1               | Reserved   |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 5 - 4                   | BUCKET_SEL[1:0] | These bits select one of the four groups of leaky bucket configuration registers for IN1:<br>00: Group 0; the addresses of the configuration registers are 31H ~ 34H. (default)<br>01: Group 1; the addresses of the configuration registers are 35H ~ 38H.<br>10: Group 2; the addresses of the configuration registers are 39H ~ 3CH.<br>11: Group 3; the addresses of the configuration registers are 3DH ~ 40H.  |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 3 - 0                   | IN_FREQ[3:0]    | These bits set the DPLL required frequency for IN1:<br>0000: 8 kHz. (default)<br>0001: 1.544 MHz (when the IN_SONET_SDH bit (b2, 09H) is '1') / 2.048 MHz (when the IN_SONET_SDH bit (b2, 09H) is '0').<br>0010: 6.48 MHz.<br>0011: 19.44 MHz.<br>0100: 25.92 MHz.<br>0101: 38.88 MHz.<br>0110 ~ 1000: Reserved.<br>1001: 2 kHz.<br>1010: 4 kHz.<br>1011 ~ 1111: Reserved.<br>For IN1, the required frequency should not be set higher than that of the input clock.   |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |

**IN2\_CNFG - Input Clock 2 Configuration**

Address: 17H  
 Type: Read / Write  
 Default Value: 00000000



| Bit            | Name            | Description  |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
|----------------|-----------------|--|----------------|-------------|--------------|---|---|-------------------------|---|---|-----------------|---|---|--------------|---|---|----------|
| 7              | DIRECT_DIV      | Refer to the description of the LOCK_8K bit (b6, 17H).   |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 6              | LOCK_8K         | This bit, together with the DIRECT_DIV bit (b7, 17H), determines whether the DivN Divider or the Lock 8k Divider is used for IN2: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>DIRECT_DIV bit</th> <th>LOCK_8K bit</th> <th>Used Divider</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>Both bypassed (default)</td> </tr> <tr> <td>0</td> <td>1</td> <td>Lock 8k Divider</td> </tr> <tr> <td>1</td> <td>0</td> <td>DivN Divider</td> </tr> <tr> <td>1</td> <td>1</td> <td>Reserved</td> </tr> </tbody> </table> | DIRECT_DIV bit | LOCK_8K bit | Used Divider | 0 | 0 | Both bypassed (default) | 0 | 1 | Lock 8k Divider | 1 | 0 | DivN Divider | 1 | 1 | Reserved |
| DIRECT_DIV bit | LOCK_8K bit     | Used Divider   |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 0              | 0               | Both bypassed (default)  |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 0              | 1               | Lock 8k Divider  |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 1              | 0               | DivN Divider   |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 1              | 1               | Reserved   |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 5 - 4          | BUCKET_SEL[1:0] | These bits select one of the four groups of leaky bucket configuration registers for IN2:<br>00: Group 0; the addresses of the configuration registers are 31H ~ 34H. (default)<br>01: Group 1; the addresses of the configuration registers are 35H ~ 38H.<br>10: Group 2; the addresses of the configuration registers are 39H ~ 3CH.<br>11: Group 3; the addresses of the configuration registers are 3DH ~ 40H.  |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 3 - 0          | IN_FREQ[3:0]    | These bits set the DPLL required frequency for IN2<br>0000: 8 kHz. (default)<br>0001: 1.544 MHz (when the IN_SONET_SDH bit (b2, 09H) is '1') / 2.048 MHz (when the IN_SONET_SDH bit (b2, 09H) is '0').<br>0010: 6.48 MHz.<br>0011: 19.44 MHz.<br>0100: 25.92 MHz.<br>0101: 38.88 MHz.<br>0110 ~ 1000: Reserved.<br>1001: 2 kHz.<br>1010: 4 kHz.<br>1011 ~ 1111: Reserved.<br>For the IN2, the required frequency should not be set higher than that of the input clock.  |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |

**IN3\_IN4\_HF\_DIV\_CNFG - Input Clock 3 & 4 High Frequency Divider Configuration**

| Address: 18H            |              |   |   |   |   |          |          |
|-------------------------|--------------|---|---|---|---|----------|----------|
| Type: Read / Write      |              |   |   |   |   |          |          |
| Default Value: 00XXXX00 |              |   |   |   |   |          |          |
| 7                       | 6            | 5   | 4 | 3 | 2 | 1        | 0        |
| IN4_DIV1                | IN4_DIV0     | -   | - | - | - | IN3_DIV1 | IN3_DIV0 |
| Bit                     | Name         | Description   |   |   |   |          |          |
| 7 - 6                   | IN4_DIV[1:0] | These bits determine whether the HF Divider is used and what the division factor is for IN4 frequency division:<br>00: Bypassed. (default)<br>01: Divided by 4.<br>10: Divided by 5.<br>11: Reserved. |   |   |   |          |          |
| 5 - 2                   | -            | Reserved.   |   |   |   |          |          |
| 1 - 0                   | IN3_DIV[1:0] | These bits determine whether the HF Divider is used and what the division factor is for IN3 frequency division:<br>00: Bypassed. (default)<br>01: Divided by 4.<br>10: Divided by 5.<br>11: Reserved. |   |   |   |          |          |

**IN3\_CNFG - Input Clock 3 Configuration**

| Address: 19H            |                 |  |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
|-------------------------|-----------------|--|-------------|----------|----------|----------|----------|----------------|-------------|--------------|---|---|-------------------------|---|---|-----------------|---|---|--------------|---|---|----------|
| Type: Read / Write      |                 |  |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| Default Value: 00000011 |                 |  |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 7                       | 6               | 5  | 4           | 3        | 2        | 1        | 0        |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| DIRECT_DIV              | LOCK_8K         | BUCKET_SEL1  | BUCKET_SEL0 | IN_FREQ3 | IN_FREQ2 | IN_FREQ1 | IN_FREQ0 |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| Bit                     | Name            | Description  |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 7                       | DIRECT_DIV      | Refer to the description of the LOCK_8K bit (b6, 19H).   |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 6                       | LOCK_8K         | This bit, together with the DIRECT_DIV bit (b7, 19H), determines whether the DivN Divider or the Lock 8k Divider is used for IN3: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>DIRECT_DIV bit</th> <th>LOCK_8K bit</th> <th>Used Divider</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">Both bypassed (default)</td> </tr> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">Lock 8k Divider</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">DivN Divider</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">Reserved</td> </tr> </tbody> </table> |             |          |          |          |          | DIRECT_DIV bit | LOCK_8K bit | Used Divider | 0 | 0 | Both bypassed (default) | 0 | 1 | Lock 8k Divider | 1 | 0 | DivN Divider | 1 | 1 | Reserved |
| DIRECT_DIV bit          | LOCK_8K bit     | Used Divider   |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 0                       | 0               | Both bypassed (default)  |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 0                       | 1               | Lock 8k Divider  |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 1                       | 0               | DivN Divider   |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 1                       | 1               | Reserved   |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 5 - 4                   | BUCKET_SEL[1:0] | These bits select one of the four groups of leaky bucket configuration registers for IN3:<br>00: Group 0; the addresses of the configuration registers are 31H ~ 34H. (default)<br>01: Group 1; the addresses of the configuration registers are 35H ~ 38H.<br>10: Group 2; the addresses of the configuration registers are 39H ~ 3CH.<br>11: Group 3; the addresses of the configuration registers are 3DH ~ 40H.  |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 3 - 0                   | IN_FREQ[3:0]    | These bits set the DPLL required frequency for IN3:<br>0000: 8 kHz.<br>0001: 1.544 MHz (when the IN_SONET_SDH bit (b2, 09H) is '1') / 2.048 MHz (when the IN_SONET_SDH bit (b2, 09H) is '0').<br>0010: 6.48 MHz.<br>0011: 19.44 MHz. (default)<br>0100: 25.92 MHz.<br>0101: 38.88 MHz.<br>0110 ~ 1000: Reserved.<br>1001: 2 kHz.<br>1010: 4 kHz.<br>1011 ~ 1111: Reserved.<br>The required frequency should not be set higher than that of the input clock.  |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |

**IN4\_CNFG - Input Clock 4 Configuration**

Address: 1AH  
 Type: Read / Write  
 Default Value: 00000011



| Bit            | Name            | Description   |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
|----------------|-----------------|---|----------------|-------------|--------------|---|---|-------------------------|---|---|-----------------|---|---|--------------|---|---|----------|
| 7              | DIRECT_DIV      | Refer to the description of the LOCK_8K bit (b6, 1AH).  |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 6              | LOCK_8K         | This bit, together with the DIRECT_DIV bit (b7, 1AH), determines whether the DivN Divider or the Lock 8k Divider is used for IN4: <table border="1" style="margin: 10px auto; border-collapse: collapse;"> <thead> <tr> <th>DIRECT_DIV bit</th> <th>LOCK_8K bit</th> <th>Used Divider</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>Both bypassed (default)</td> </tr> <tr> <td>0</td> <td>1</td> <td>Lock 8k Divider</td> </tr> <tr> <td>1</td> <td>0</td> <td>DivN Divider</td> </tr> <tr> <td>1</td> <td>1</td> <td>Reserved</td> </tr> </tbody> </table> | DIRECT_DIV bit | LOCK_8K bit | Used Divider | 0 | 0 | Both bypassed (default) | 0 | 1 | Lock 8k Divider | 1 | 0 | DivN Divider | 1 | 1 | Reserved |
| DIRECT_DIV bit | LOCK_8K bit     | Used Divider  |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 0              | 0               | Both bypassed (default)   |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 0              | 1               | Lock 8k Divider   |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 1              | 0               | DivN Divider  |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 1              | 1               | Reserved  |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 5 - 4          | BUCKET_SEL[1:0] | These bits select one of the four groups of leaky bucket configuration registers for IN4<br>00: Group 0; the addresses of the configuration registers are 31H ~ 34H. (default)<br>01: Group 1; the addresses of the configuration registers are 35H ~ 38H.<br>10: Group 2; the addresses of the configuration registers are 39H ~ 3CH.<br>11: Group 3; the addresses of the configuration registers are 3DH ~ 40H.  |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 3 - 0          | IN_FREQ[3:0]    | These bits set the DPLL required frequency for IN4:<br>0000: 8 kHz.<br>0001: 1.544 MHz (when the IN_SONET_SDH bit (b2, 09H) is '1') / 2.048 MHz (when the IN_SONET_SDH bit (b2, 09H) is '0').<br>0010: 6.48 MHz.<br>0011: 19.44 MHz. (default)<br>0100: 25.92 MHz.<br>0101: 38.88 MHz.<br>0110 ~ 1000: Reserved.<br>1001: 2 kHz.<br>1010: 4 kHz.<br>1011 ~ 1111: Reserved.<br>For IN4, the required frequency should not be set higher than that of the input clock.  |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |

**IN5\_CNFG - Input Clock 5 Configuration**

| Address: 1FH            |                 |   |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
|-------------------------|-----------------|---|-------------|----------|----------|----------|----------|----------------|-------------|--------------|---|---|-------------------------|---|---|-----------------|---|---|--------------|---|---|----------|
| Type: Read / Write      |                 |   |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| Default Value: 0000XXXX |                 |   |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 7                       | 6               | 5   | 4           | 3        | 2        | 1        | 0        |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| DIRECT_DIV              | LOCK_8K         | BUCKET_SEL1   | BUCKET_SEL0 | IN_FREQ3 | IN_FREQ2 | IN_FREQ1 | IN_FREQ0 |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| Bit                     | Name            | Description   |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 7                       | DIRECT_DIV      | Refer to the description of the LOCK_8K bit (b6, 1FH).  |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 6                       | LOCK_8K         | <p>This bit, together with the DIRECT_DIV bit (b7, 1FH), determines whether the DivN Divider or the Lock 8k Divider is used for IN5:</p> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>DIRECT_DIV bit</th> <th>LOCK_8K bit</th> <th>Used Divider</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">Both bypassed (default)</td> </tr> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">Lock 8k Divider</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">DivN Divider</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">Reserved</td> </tr> </tbody> </table> |             |          |          |          |          | DIRECT_DIV bit | LOCK_8K bit | Used Divider | 0 | 0 | Both bypassed (default) | 0 | 1 | Lock 8k Divider | 1 | 0 | DivN Divider | 1 | 1 | Reserved |
| DIRECT_DIV bit          | LOCK_8K bit     | Used Divider  |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 0                       | 0               | Both bypassed (default)   |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 0                       | 1               | Lock 8k Divider   |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 1                       | 0               | DivN Divider  |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 1                       | 1               | Reserved  |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 5 - 4                   | BUCKET_SEL[1:0] | <p>These bits select one of the four groups of leaky bucket configuration registers for IN5:</p> <p>00: Group 0; the addresses of the configuration registers are 31H ~ 34H. (default)</p> <p>01: Group 1; the addresses of the configuration registers are 35H ~ 38H.</p> <p>10: Group 2; the addresses of the configuration registers are 39H ~ 3CH.</p> <p>11: Group 3; the addresses of the configuration registers are 3DH ~ 40H.</p>  |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |
| 3 - 0                   | IN_FREQ[3:0]    | <p>These bits set the DPLL required frequency for IN5:</p> <p>0000: 8 kHz.</p> <p>0001: 1.544 MHz (when the IN_SONET_SDH bit (b2, 09H) is '1') / 2.048 MHz (when the IN_SONET_SDH bit (b2, 09H) is '0').</p> <p>0010: 6.48 MHz.</p> <p>0011: 19.44 MHz.</p> <p>0100: 25.92 MHz.</p> <p>0101: 38.88 MHz.</p> <p>0110 ~ 1000: Reserved.</p> <p>1001: 2 kHz.</p> <p>1010: 4 kHz.</p> <p>1011 ~ 1111: Reserved.</p> <p>For IN5, the required frequency should not be set higher than that of the input clock.</p> <p>The default value of these bits depends on the device application as follows:</p> <p>In Master / Slave application, when the device is configured as the Master, the default value is '0001'; when the device is configured as the Slave, the default value is '0010'.</p>   |             |          |          |          |          |                |             |              |   |   |                         |   |   |                 |   |   |              |   |   |          |

**PRE\_DIV\_CH\_CNFG - DivN Divider Channel Selection**

| Address: 23H            |                       |   |   |                   |                   |                   |                   |
|-------------------------|-----------------------|---|---|-------------------|-------------------|-------------------|-------------------|
| Type: Read / Write      |                       |   |   |                   |                   |                   |                   |
| Default Value: XXXX0000 |                       |   |   |                   |                   |                   |                   |
| 7                       | 6                     | 5   | 4 | 3                 | 2                 | 1                 | 0                 |
| -                       | -                     | -   | - | PRE_DIV_CH_VALUE3 | PRE_DIV_CH_VALUE2 | PRE_DIV_CH_VALUE1 | PRE_DIV_CH_VALUE0 |
| Bit                     | Name                  | Description   |   |                   |                   |                   |                   |
| 7 - 4                   | -                     | Reserved.   |   |                   |                   |                   |                   |
| 3 - 0                   | PRE_DIV_CH_VALUE[3:0] | This register is an indirect address register for Register 24H and 25H.<br>These bits select an input clock. The value set in the PRE_DIVN_VALUE[14:0] bits (25H, 24H) is available for the selected input clock.<br>0000: Reserved. (default)<br>0001, 0010: Reserved.<br>0011: IN1.<br>0100: IN2.<br>0101: IN3<br>0110: IN4<br>0111, 1000, 1001, 1010: Reserved<br>1011: IN5<br>1100, 1101, 1110, 1111: Reserved. |   |                   |                   |                   |                   |

**PRE\_DIVN[7:0]\_CNFG - DivN Divider Division Factor Configuration 1**

| Address: 24H            |                     |  |                     |                     |                     |                     |                     |
|-------------------------|---------------------|--|---------------------|---------------------|---------------------|---------------------|---------------------|
| Type: Read / Write      |                     |  |                     |                     |                     |                     |                     |
| Default Value: 00000000 |                     |  |                     |                     |                     |                     |                     |
| 7                       | 6                   | 5  | 4                   | 3                   | 2                   | 1                   | 0                   |
| PRE_DIVN_VA<br>LUE7     | PRE_DIVN_VA<br>LUE6 | PRE_DIVN_VA<br>LUE5  | PRE_DIVN_VA<br>LUE4 | PRE_DIVN_VA<br>LUE3 | PRE_DIVN_VA<br>LUE2 | PRE_DIVN_VA<br>LUE1 | PRE_DIVN_VA<br>LUE0 |
| Bit                     | Name                | Description  |                     |                     |                     |                     |                     |
| 7 - 0                   | PRE_DIVN_VALUE[7:0] | Refer to the description of the PRE_DIVN_VALUE[14:8] bits (b6~0, 25H). |                     |                     |                     |                     |                     |

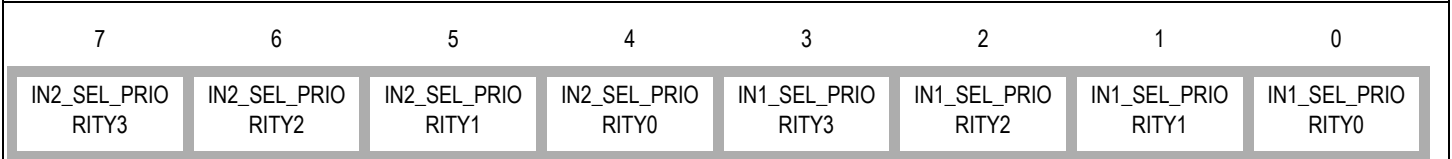


**PRE\_DIVN[14:8]\_CNFG - DivN Divider Division Factor Configuration 2**

| Address: 25H            |                      |  |                      |                      |                      |                     |                     |
|-------------------------|----------------------|--|----------------------|----------------------|----------------------|---------------------|---------------------|
| Type: Read / Write      |                      |  |                      |                      |                      |                     |                     |
| Default Value: X0000000 |                      |  |                      |                      |                      |                     |                     |
| 7                       | 6                    | 5  | 4                    | 3                    | 2                    | 1                   | 0                   |
| -                       | PRE_DIVN_VAL<br>UE14 | PRE_DIVN_VAL<br>UE13   | PRE_DIVN_VAL<br>UE12 | PRE_DIVN_VAL<br>UE11 | PRE_DIVN_VAL<br>UE10 | PRE_DIVN_VAL<br>UE9 | PRE_DIVN_VAL<br>UE8 |
| Bit                     | Name                 | Description  |                      |                      |                      |                     |                     |
| 7                       | -                    | Reserved.  |                      |                      |                      |                     |                     |
| 6 - 0                   | PRE_DIVN_VALUE[14:8] | <p>The division factor for an input clock is the value in the PRE_DIVN_VALUE[14:0] bits plus 1. The input clock is selected by the PRE_DIV_CH_VALUE[3:0] bits (b3~0, 23H).</p> <p>A value from '0' to '4BEF' (Hex) can be written into, corresponding to a division factor from 1 to 19440. The others are reserved. So the DivN Divider only supports an input clock whose frequency is lower than (&lt;) 155.52 MHz.</p> <p>The division factor setting should observe the following order:</p> <ol style="list-style-type: none"> <li>1. Write the lower eight bits of the division factor to the PRE_DIVN_VALUE[7:0] bits;</li> <li>2. Write the higher eight bits of the division factor to the PRE_DIVN_VALUE[14:8] bits.</li> </ol> |                      |                      |                      |                     |                     |

**IN1\_IN2\_SEL\_PRIORITY\_CNFG - Input Clock 1 & 2 Priority Configuration \***

Address: 27H  
 Type: Read / Write  
 Default Value: T0 - 01010100 / T4 - 00000000



| Bit   | Name                  | Description   |
|-------|-----------------------|---|
| 7 - 4 | INn_SEL_PRIORITY[3:0] | These bits set the priority of the corresponding INn. Here n is 2.<br>0000: Disable INn for automatic selection. (T4 default)<br>0001: Priority 1.<br>0010: Priority 2.<br>0011: Priority 3.<br>0100: Priority 4.<br>0101: Priority 5. (T0 default)<br>0110: Priority 6.<br>0111: Priority 7.<br>1000: Priority 8.<br>1001: Priority 9.<br>1010: Priority 10.<br>1011: Priority 11.<br>1100: Priority 12.<br>1101: Priority 13.<br>1110: Priority 14.<br>1111: Priority 15. |
| 3 - 0 | INn_SEL_PRIORITY[3:0] | These bits set the priority of the corresponding INn. Here n is 1.<br>0000: Disable INn for automatic selection. (T4 default)<br>0001: Priority 1.<br>0010: Priority 2.<br>0011: Priority 3.<br>0100: Priority 4. (T0 default)<br>0101: Priority 5.<br>0110: Priority 6.<br>0111: Priority 7.<br>1000: Priority 8.<br>1001: Priority 9.<br>1010: Priority 10.<br>1011: Priority 11.<br>1100: Priority 12.<br>1101: Priority 13.<br>1110: Priority 14.<br>1111: Priority 15. |

**IN3\_IN4\_SEL\_PRIORITY\_CNFG - Input Clock 3 & 4 Priority Configuration \***

| Address: 28H                    |                       |   |                   |                   |                   |                   |                   |
|---------------------------------|-----------------------|---|-------------------|-------------------|-------------------|-------------------|-------------------|
| Type: Read / Write              |                       |   |                   |                   |                   |                   |                   |
| Default Value: T0/T4 - 01110110 |                       |   |                   |                   |                   |                   |                   |
| 7                               | 6                     | 5   | 4                 | 3                 | 2                 | 1                 | 0                 |
| IN4_SEL_PRIORITY3               | IN4_SEL_PRIORITY2     | IN4_SEL_PRIORITY1   | IN4_SEL_PRIORITY0 | IN3_SEL_PRIORITY3 | IN3_SEL_PRIORITY2 | IN3_SEL_PRIORITY1 | IN3_SEL_PRIORITY0 |
| Bit                             | Name                  | Description   |                   |                   |                   |                   |                   |
| 7 - 4                           | INn_SEL_PRIORITY[3:0] | These bits set the priority of the corresponding INn. Here n is 4.<br>0000: Disable INn for automatic selection.<br>0001: Priority 1.<br>0010: Priority 2.<br>0011: Priority 3.<br>0100: Priority 4.<br>0101: Priority 5.<br>0110: Priority 6.<br>0111: Priority 7. (default)<br>1000: Priority 8.<br>1001: Priority 9.<br>1010: Priority 10.<br>1011: Priority 11.<br>1100: Priority 12.<br>1101: Priority 13.<br>1110: Priority 14.<br>1111: Priority 15. |                   |                   |                   |                   |                   |
| 3 - 0                           | INn_SEL_PRIORITY[3:0] | These bits set the priority of the corresponding INn. Here n is 3.<br>0000: Disable INn for automatic selection.<br>0001: Priority 1.<br>0010: Priority 2.<br>0011: Priority 3.<br>0100: Priority 4.<br>0101: Priority 5.<br>0110: Priority 6. (default)<br>0111: Priority 7.<br>1000: Priority 8.<br>1001: Priority 9.<br>1010: Priority 10.<br>1011: Priority 11.<br>1100: Priority 12.<br>1101: Priority 13.<br>1110: Priority 14.<br>1111: Priority 15. |                   |                   |                   |                   |                   |

**IN5\_SEL\_PRIORITY\_CNFG - Input Clock 5 Priority Configuration \***

| Address: 2BH  |                       |   |   |                   |                   |                   |                   |
|---|-----------------------|---|---|-------------------|-------------------|-------------------|-------------------|
| Type: Read / Write  |                       |   |   |                   |                   |                   |                   |
| Default Value: 11011100 (T0 Master)/11010001 (T0 Slave) 00000000 (T4) |                       |   |   |                   |                   |                   |                   |
| 7   | 6                     | 5   | 4 | 3                 | 2                 | 1                 | 0                 |
| -   | -                     | -   | - | IN5_SEL_PRIORITY3 | IN5_SEL_PRIORITY2 | IN5_SEL_PRIORITY1 | IN5_SEL_PRIORITY0 |
| Bit   | Name                  | Description   |   |                   |                   |                   |                   |
| 7 - 4   | -                     | Reserved  |   |                   |                   |                   |                   |
| 3 - 0   | INn_SEL_PRIORITY[3:0] | These bits set the priority of the corresponding INn. Here n is 5:<br>0000: Disable INn for automatic selection. (T4 default)<br>0001: Priority 1. (T0 Slave default)<br>0010: Priority 2.<br>0011: Priority 3.<br>0100: Priority 4.<br>0101: Priority 5.<br>0110: Priority 6.<br>0111: Priority 7.<br>1000: Priority 8.<br>1001: Priority 9.<br>1010: Priority 10.<br>1011: Priority 11.<br>1100: Priority 12. (T0 Master default)<br>1101: Priority 13.<br>1110: Priority 14.<br>1111: Priority 15. |   |                   |                   |                   |                   |

7.2.4 INPUT CLOCK QUALITY MONITORING CONFIGURATION & STATUS REGISTERS

FREQ\_MON\_FACTOR\_CNFG - Factor of Frequency Monitor Configuration

| Address: 2EH            |                      |   |   |                      |                      |                      |                      |
|-------------------------|----------------------|---|---|----------------------|----------------------|----------------------|----------------------|
| Type: Read / Write      |                      |   |   |                      |                      |                      |                      |
| Default Value: XXXX1011 |                      |   |   |                      |                      |                      |                      |
| 7                       | 6                    | 5   | 4 | 3                    | 2                    | 1                    | 0                    |
| -                       | -                    | -   | - | FREQ_MON_F<br>ACTOR3 | FREQ_MON_F<br>ACTOR2 | FREQ_MON_F<br>ACTOR1 | FREQ_MON_F<br>ACTOR0 |
| Bit                     | Name                 | Description   |   |                      |                      |                      |                      |
| 7 - 4                   | -                    | Reserved.   |   |                      |                      |                      |                      |
| 3 - 0                   | FREQ_MON_FACTOR[3:0] | <p>These bits determine a factor. The factor has a relationship with the frequency hard alarm threshold in ppm (refer to the description of the ALL_FREQ_HARD_THRESHOLD[3:0] bits (b3~0, 2FH)) and with the frequency of the input clock with respect to the master clock in ppm (refer to the description of the IN_FREQ_VALUE[7:0] bits (b7~0, 42H)). The factor represents the accuracy of the frequency monitor and should be set according to the requirements of different applications.</p> <p>0000: 0.0032.<br/>                     0001: 0.0064.<br/>                     0010: 0.0127.<br/>                     0011: 0.0257.<br/>                     0100: 0.0514.<br/>                     0101: 0.103.<br/>                     0110: 0.206.<br/>                     0111: 0.412.<br/>                     1000: 0.823.<br/>                     1001: 1.646.<br/>                     1010: 3.292.<br/>                     1011: 3.81. (default)<br/>                     1100 - 1111: 4.6.</p> |   |                      |                      |                      |                      |

ALL\_FREQ\_MON\_THRESHOLD\_CNFG - Frequency Monitor Threshold for All Input Clocks Configuration

| Address: 2FH            |                              |  |   |                              |                              |                              |                              |
|-------------------------|------------------------------|--|---|------------------------------|------------------------------|------------------------------|------------------------------|
| Type: Read / Write      |                              |  |   |                              |                              |                              |                              |
| Default Value: XXXX0011 |                              |  |   |                              |                              |                              |                              |
| 7                       | 6                            | 5  | 4 | 3                            | 2                            | 1                            | 0                            |
| -                       | -                            | -  | - | ALL_FREQ_HARD_<br>THRESHOLD3 | ALL_FREQ_HARD_<br>THRESHOLD2 | ALL_FREQ_HARD_<br>THRESHOLD1 | ALL_FREQ_HARD_<br>THRESHOLD0 |
| Bit                     | Name                         | Description  |   |                              |                              |                              |                              |
| 7 - 4                   | -                            | Reserved.  |   |                              |                              |                              |                              |
| 3 - 0                   | ALL_FREQ_HARD_THRESHOLD[3:0] | <p>These bits represent an unsigned integer. The frequency hard alarm threshold in ppm can be calculated as follows:</p> <p><b>Frequency Hard Alarm Threshold (ppm) = (ALL_FREQ_HARD_THRESHOLD[3:0] + 1) X FREQ_MON_FACTOR[3:0] (b3~0, 2EH)</b></p> <p>This threshold is symmetrical about zero.</p> |   |                              |                              |                              |                              |

**UPPER\_THRESHOLD\_0\_CNFG - Upper Threshold for Leaky Bucket Configuration 0**

| Address: 31H<br>Type: Read / Write<br>Default Value: 00000110 |                                 |  |                                 |                                 |                                 |                                 |                                 |
|---|---------------------------------|--|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| 7   | 6                               | 5  | 4                               | 3                               | 2                               | 1                               | 0                               |
| UPPER_THRE<br>SHOLD_0_DAT<br>A7                               | UPPER_THRE<br>SHOLD_0_DAT<br>A6 | UPPER_THRE<br>SHOLD_0_DAT<br>A5  | UPPER_THRE<br>SHOLD_0_DAT<br>A4 | UPPER_THRE<br>SHOLD_0_DAT<br>A3 | UPPER_THRE<br>SHOLD_0_DAT<br>A2 | UPPER_THRE<br>SHOLD_0_DAT<br>A1 | UPPER_THRE<br>SHOLD_0_DAT<br>A0 |
| Bit   | Name                            | Description  |                                 |                                 |                                 |                                 |                                 |
| 7 - 0   | UPPER_THRESHOLD_0_DATA[7:0]     | These bits set an upper threshold for the internal leaky bucket accumulator. When the number of the accumulated events is above this threshold, a no-activity alarm is raised. |                                 |                                 |                                 |                                 |                                 |

**LOWER\_THRESHOLD\_0\_CNFG - Lower Threshold for Leaky Bucket Configuration 0**

| Address: 32H<br>Type: Read / Write<br>Default Value: 00000100 |                                 |  |                                 |                                 |                                 |                                 |                                 |
|---|---------------------------------|--|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| 7   | 6                               | 5  | 4                               | 3                               | 2                               | 1                               | 0                               |
| LOWER_THRE<br>SHOLD_0_DAT<br>A7                               | LOWER_THRE<br>SHOLD_0_DAT<br>A6 | LOWER_THRE<br>SHOLD_0_DAT<br>A5  | LOWER_THRE<br>SHOLD_0_DAT<br>A4 | LOWER_THRE<br>SHOLD_0_DAT<br>A3 | LOWER_THRE<br>SHOLD_0_DAT<br>A2 | LOWER_THRE<br>SHOLD_0_DAT<br>A1 | LOWER_THRE<br>SHOLD_0_DAT<br>A0 |
| Bit   | Name                            | Description  |                                 |                                 |                                 |                                 |                                 |
| 7 - 0   | LOWER_THRESHOLD_0_DATA[7:0]     | These bits set a lower threshold for the internal leaky bucket accumulator. When the number of the accumulated events is below this threshold, the no-activity alarm is cleared. |                                 |                                 |                                 |                                 |                                 |

**BUCKET\_SIZE\_0\_CNFG - Bucket Size for Leaky Bucket Configuration 0**

| Address: 33H<br>Type: Read / Write<br>Default Value: 00001000 |                         |  |                         |                         |                         |                         |                         |
|---|-------------------------|--|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| 7   | 6                       | 5  | 4                       | 3                       | 2                       | 1                       | 0                       |
| BUCKET_SIZE<br>_0_DATA7                                       | BUCKET_SIZE<br>_0_DATA6 | BUCKET_SIZE<br>_0_DATA5  | BUCKET_SIZE<br>_0_DATA4 | BUCKET_SIZE<br>_0_DATA3 | BUCKET_SIZE<br>_0_DATA2 | BUCKET_SIZE<br>_0_DATA1 | BUCKET_SIZE<br>_0_DATA0 |
| Bit   | Name                    | Description  |                         |                         |                         |                         |                         |
| 7 - 0   | BUCKET_SIZE_0_DATA[7:0] | These bits set a bucket size for the internal leaky bucket accumulator. If the number of the accumulated events reach the bucket size, the accumulator will stop increasing even if further events are detected. |                         |                         |                         |                         |                         |

**DECAY\_RATE\_0\_CNFG - Decay Rate for Leaky Bucket Configuration 0**

| Address: 34H            |                        |   |   |   |   |                    |                    |
|-------------------------|------------------------|---|---|---|---|--------------------|--------------------|
| Type: Read / Write      |                        |   |   |   |   |                    |                    |
| Default Value: XXXXXX01 |                        |   |   |   |   |                    |                    |
| 7                       | 6                      | 5   | 4 | 3 | 2 | 1                  | 0                  |
| -                       | -                      | -   | - | - | - | DECAY_RATE_0_DATA1 | DECAY_RATE_0_DATA0 |
| Bit                     | Name                   | Description   |   |   |   |                    |                    |
| 7 - 2                   | -                      | Reserved.   |   |   |   |                    |                    |
| 1 - 0                   | DECAY_RATE_0_DATA[1:0] | These bits set a decay rate for the internal leaky bucket accumulator:<br>00: The accumulator decreases by 1 in every 128 ms with no event detected.<br>01: The accumulator decreases by 1 in every 256 ms with no event detected. (default)<br>10: The accumulator decreases by 1 in every 512 ms with no event detected.<br>11: The accumulator decreases by 1 in every 1024 ms with no event detected. |   |   |   |                    |                    |

**UPPER\_THRESHOLD\_1\_CNFG - Upper Threshold for Leaky Bucket Configuration 1**

| Address: 35H                    |                                 |  |                                 |                                 |                                 |                                 |                                 |
|---------------------------------|---------------------------------|--|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Type: Read / Write              |                                 |  |                                 |                                 |                                 |                                 |                                 |
| Default Value: 00000110         |                                 |  |                                 |                                 |                                 |                                 |                                 |
| 7                               | 6                               | 5  | 4                               | 3                               | 2                               | 1                               | 0                               |
| UPPER_THRE<br>SHOLD_1_DAT<br>A7 | UPPER_THRE<br>SHOLD_1_DAT<br>A6 | UPPER_THRE<br>SHOLD_1_DAT<br>A5  | UPPER_THRE<br>SHOLD_1_DAT<br>A4 | UPPER_THRE<br>SHOLD_1_DAT<br>A3 | UPPER_THRE<br>SHOLD_1_DAT<br>A2 | UPPER_THRE<br>SHOLD_1_DAT<br>A1 | UPPER_THRE<br>SHOLD_1_DAT<br>A0 |
| Bit                             | Name                            | Description  |                                 |                                 |                                 |                                 |                                 |
| 7 - 0                           | UPPER_THRESHOLD_1_DATA[7:0]     | These bits set an upper threshold for the internal leaky bucket accumulator. When the number of the accumulated events is above this threshold, a no-activity alarm is raised. |                                 |                                 |                                 |                                 |                                 |

**LOWER\_THRESHOLD\_1\_CNFG - Lower Threshold for Leaky Bucket Configuration 1**

| Address: 36H                    |                                 |  |                                 |                                 |                                 |                                 |                                 |
|---------------------------------|---------------------------------|--|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Type: Read / Write              |                                 |  |                                 |                                 |                                 |                                 |                                 |
| Default Value: 00000100         |                                 |  |                                 |                                 |                                 |                                 |                                 |
| 7                               | 6                               | 5  | 4                               | 3                               | 2                               | 1                               | 0                               |
| LOWER_THRE<br>SHOLD_1_DAT<br>A7 | LOWER_THRE<br>SHOLD_1_DAT<br>A6 | LOWER_THRE<br>SHOLD_1_DAT<br>A5  | LOWER_THRE<br>SHOLD_1_DAT<br>A4 | LOWER_THRE<br>SHOLD_1_DAT<br>A3 | LOWER_THRE<br>SHOLD_1_DAT<br>A2 | LOWER_THRE<br>SHOLD_1_DAT<br>A1 | LOWER_THRE<br>SHOLD_1_DAT<br>A0 |
| Bit                             | Name                            | Description  |                                 |                                 |                                 |                                 |                                 |
| 7 - 0                           | LOWER_THRESHOLD_1_DATA[7:0]     | These bits set a lower threshold for the internal leaky bucket accumulator. When the number of the accumulated events is below this threshold, the no-activity alarm is cleared. |                                 |                                 |                                 |                                 |                                 |

**BUCKET\_SIZE\_1\_CNFG - Bucket Size for Leaky Bucket Configuration 1**

Address: 37H

Type: Read / Write

Default Value: 00001000

| 7                       | 6                       | 5  | 4                       | 3                       | 2                       | 1                       | 0                       |
|-------------------------|-------------------------|--|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| BUCKET_SIZE<br>_1_DATA7 | BUCKET_SIZE<br>_1_DATA6 | BUCKET_SIZE<br>_1_DATA5  | BUCKET_SIZE<br>_1_DATA4 | BUCKET_SIZE<br>_1_DATA3 | BUCKET_SIZE<br>_1_DATA2 | BUCKET_SIZE<br>_1_DATA1 | BUCKET_SIZE<br>_1_DATA0 |
| Bit                     | Name                    | Description  |                         |                         |                         |                         |                         |
| 7 - 0                   | BUCKET_SIZE_1_DATA[7:0] | These bits set a bucket size for the internal leaky bucket accumulator. If the number of the accumulated events reach the bucket size, the accumulator will stop increasing even if further events are detected. |                         |                         |                         |                         |                         |

**DECAY\_RATE\_1\_CNFG - Decay Rate for Leaky Bucket Configuration 1**

Address: 38H

Type: Read / Write

Default Value: XXXXXX01

| 7     | 6                      | 5   | 4 | 3 | 2 | 1                      | 0                      |
|-------|------------------------|---|---|---|---|------------------------|------------------------|
| -     | -                      | -   | - | - | - | DECAY_RATE_<br>1_DATA1 | DECAY_RATE_<br>1_DATA0 |
| Bit   | Name                   | Description   |   |   |   |                        |                        |
| 7 - 2 | -                      | Reserved.   |   |   |   |                        |                        |
| 1 - 0 | DECAY_RATE_1_DATA[1:0] | These bits set a decay rate for the internal leaky bucket accumulator:<br>00: The accumulator decreases by 1 in every 128 ms with no event detected.<br>01: The accumulator decreases by 1 in every 256 ms with no event detected. (default)<br>10: The accumulator decreases by 1 in every 512 ms with no event detected.<br>11: The accumulator decreases by 1 in every 1024 ms with no event detected. |   |   |   |                        |                        |

**UPPER\_THRESHOLD\_2\_CNFG - Upper Threshold for Leaky Bucket Configuration 2**

Address: 39H

Type: Read / Write

Default Value: 00000110

| 7                               | 6                               | 5  | 4                               | 3                               | 2                               | 1                               | 0                               |
|---------------------------------|---------------------------------|--|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| UPPER_THRE<br>SHOLD_2_DAT<br>A7 | UPPER_THRE<br>SHOLD_2_DAT<br>A6 | UPPER_THRE<br>SHOLD_2_DAT<br>A5  | UPPER_THRE<br>SHOLD_2_DAT<br>A4 | UPPER_THRE<br>SHOLD_2_DAT<br>A3 | UPPER_THRE<br>SHOLD_2_DAT<br>A2 | UPPER_THRE<br>SHOLD_2_DAT<br>A1 | UPPER_THRE<br>SHOLD_2_DAT<br>A0 |
| Bit                             | Name                            | Description  |                                 |                                 |                                 |                                 |                                 |
| 7 - 0                           | UPPER_THRESHOLD_2_DATA[7:0]     | These bits set an upper threshold for the internal leaky bucket accumulator. When the number of the accumulated events is above this threshold, a no-activity alarm is raised. |                                 |                                 |                                 |                                 |                                 |



**LOWER\_THRESHOLD\_2\_CNFG - Lower Threshold for Leaky Bucket Configuration 2**

Address: 3AH  
 Type: Read / Write  
 Default Value: 00000100

|                                 |                                 |                                 |                                 |                                 |                                 |                                 |                                 |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| 7                               | 6                               | 5                               | 4                               | 3                               | 2                               | 1                               | 0                               |
| LOWER_THRE<br>SHOLD_2_DAT<br>A7 | LOWER_THRE<br>SHOLD_2_DAT<br>A6 | LOWER_THRE<br>SHOLD_2_DAT<br>A5 | LOWER_THRE<br>SHOLD_2_DAT<br>A4 | LOWER_THRE<br>SHOLD_2_DAT<br>A3 | LOWER_THRE<br>SHOLD_2_DAT<br>A2 | LOWER_THRE<br>SHOLD_2_DAT<br>A1 | LOWER_THRE<br>SHOLD_2_DAT<br>A0 |

| Bit   | Name                        | Description  |
|-------|-----------------------------|--|
| 7 - 0 | LOWER_THRESHOLD_2_DATA[7:0] | These bits set a lower threshold for the internal leaky bucket accumulator. When the number of the accumulated events is below this threshold, the no-activity alarm is cleared. |

**BUCKET\_SIZE\_2\_CNFG - Bucket Size for Leaky Bucket Configuration 2**

Address: 3BH  
 Type: Read / Write  
 Default Value: 00001000

|                         |                         |                         |                         |                         |                         |                         |                         |
|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| 7                       | 6                       | 5                       | 4                       | 3                       | 2                       | 1                       | 0                       |
| BUCKET_SIZE<br>_2_DATA7 | BUCKET_SIZE<br>_2_DATA6 | BUCKET_SIZE<br>_2_DATA5 | BUCKET_SIZE<br>_2_DATA4 | BUCKET_SIZE<br>_2_DATA3 | BUCKET_SIZE<br>_2_DATA2 | BUCKET_SIZE<br>_2_DATA1 | BUCKET_SIZE<br>_2_DATA0 |

| Bit   | Name                    | Description  |
|-------|-------------------------|--|
| 7 - 0 | BUCKET_SIZE_2_DATA[7:0] | These bits set a bucket size for the internal leaky bucket accumulator. If the number of the accumulated events reaches the bucket size, the accumulator will stop increasing even if further events are detected. |

**DECAY\_RATE\_2\_CNFG - Decay Rate for Leaky Bucket Configuration 2**

Address: 3CH  
 Type: Read / Write  
 Default Value: XXXXXX01

|   |   |   |   |   |   |                        |                        |
|---|---|---|---|---|---|------------------------|------------------------|
| 7 | 6 | 5 | 4 | 3 | 2 | 1                      | 0                      |
| - | - | - | - | - | - | DECAY_RATE_<br>2_DATA1 | DECAY_RATE_<br>2_DATA0 |

| Bit   | Name                   | Description   |
|-------|------------------------|---|
| 7 - 2 | -                      | Reserved.   |
| 1 - 0 | DECAY_RATE_2_DATA[1:0] | These bits set a decay rate for the internal leaky bucket accumulator:<br>00: The accumulator decreases by 1 in every 128 ms with no event detected.<br>01: The accumulator decreases by 1 in every 256 ms with no event detected. (default)<br>10: The accumulator decreases by 1 in every 512 ms with no event detected.<br>11: The accumulator decreases by 1 in every 1024 ms with no event detected. |

**UPPER\_THRESHOLD\_3\_CNFG - Upper Threshold for Leaky Bucket Configuration 3**

| Address: 3DH                    |                                 |  |                                 |                                 |                                 |                                 |                                 |
|---------------------------------|---------------------------------|--|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Type: Read / Write              |                                 |  |                                 |                                 |                                 |                                 |                                 |
| Default Value: 00000110         |                                 |  |                                 |                                 |                                 |                                 |                                 |
| 7                               | 6                               | 5  | 4                               | 3                               | 2                               | 1                               | 0                               |
| UPPER_THRE<br>SHOLD_3_DAT<br>A7 | UPPER_THRE<br>SHOLD_3_DAT<br>A6 | UPPER_THRE<br>SHOLD_3_DAT<br>A5  | UPPER_THRE<br>SHOLD_3_DAT<br>A4 | UPPER_THRE<br>SHOLD_3_DAT<br>A3 | UPPER_THRE<br>SHOLD_3_DAT<br>A2 | UPPER_THRE<br>SHOLD_3_DAT<br>A1 | UPPER_THRE<br>SHOLD_3_DAT<br>A0 |
| Bit                             | Name                            | Description  |                                 |                                 |                                 |                                 |                                 |
| 7 - 0                           | UPPER_THRESHOLD_3_DATA[7:0]     | These bits set an upper threshold for the internal leaky bucket accumulator. When the number of the accumulated events is above this threshold, a no-activity alarm is raised. |                                 |                                 |                                 |                                 |                                 |

**LOWER\_THRESHOLD\_3\_CNFG - Lower Threshold for Leaky Bucket Configuration 3**

| Address: 3EH                    |                                 |  |                                 |                                 |                                 |                                 |                                 |
|---------------------------------|---------------------------------|--|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Type: Read / Write              |                                 |  |                                 |                                 |                                 |                                 |                                 |
| Default Value: 00000100         |                                 |  |                                 |                                 |                                 |                                 |                                 |
| 7                               | 6                               | 5  | 4                               | 3                               | 2                               | 1                               | 0                               |
| LOWER_THRE<br>SHOLD_3_DAT<br>A7 | LOWER_THRE<br>SHOLD_3_DAT<br>A6 | LOWER_THRE<br>SHOLD_3_DAT<br>A5  | LOWER_THRE<br>SHOLD_3_DAT<br>A4 | LOWER_THRE<br>SHOLD_3_DAT<br>A3 | LOWER_THRE<br>SHOLD_3_DAT<br>A2 | LOWER_THRE<br>SHOLD_3_DAT<br>A1 | LOWER_THRE<br>SHOLD_3_DAT<br>A0 |
| Bit                             | Name                            | Description  |                                 |                                 |                                 |                                 |                                 |
| 7 - 0                           | LOWER_THRESHOLD_3_DATA[7:0]     | These bits set a lower threshold for the internal leaky bucket accumulator. When the number of the accumulated events is below this threshold, the no-activity alarm is cleared. |                                 |                                 |                                 |                                 |                                 |

**BUCKET\_SIZE\_3\_CNFG - Bucket Size for Leaky Bucket Configuration 3**

| Address: 3FH            |                         |  |                         |                         |                         |                         |                         |
|-------------------------|-------------------------|--|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| Type: Read / Write      |                         |  |                         |                         |                         |                         |                         |
| Default Value: 00001000 |                         |  |                         |                         |                         |                         |                         |
| 7                       | 6                       | 5  | 4                       | 3                       | 2                       | 1                       | 0                       |
| BUCKET_SIZE<br>_3_DATA7 | BUCKET_SIZE<br>_3_DATA6 | BUCKET_SIZE<br>_3_DATA5  | BUCKET_SIZE<br>_3_DATA4 | BUCKET_SIZE<br>_3_DATA3 | BUCKET_SIZE<br>_3_DATA2 | BUCKET_SIZE<br>_3_DATA1 | BUCKET_SIZE<br>_3_DATA0 |
| Bit                     | Name                    | Description  |                         |                         |                         |                         |                         |
| 7 - 0                   | BUCKET_SIZE_3_DATA[7:0] | These bits set a bucket size for the internal leaky bucket accumulator. If the number of the accumulated events reaches the bucket size, the accumulator will stop increasing even if further events are detected. |                         |                         |                         |                         |                         |

**DECAY\_RATE\_3\_CNFG - Decay Rate for Leaky Bucket Configuration 3**

Address: 40H  
 Type: Read / Write  
 Default Value: XXXXXX01

|   |   |   |   |   |   |                    |                    |
|---|---|---|---|---|---|--------------------|--------------------|
| 7 | 6 | 5 | 4 | 3 | 2 | 1                  | 0                  |
| - | - | - | - | - | - | DECAY_RATE_3_DATA1 | DECAY_RATE_3_DATA0 |

| Bit   | Name                   | Description   |
|-------|------------------------|---|
| 7 - 2 | -                      | Reserved.   |
| 1 - 0 | DECAY_RATE_3_DATA[1:0] | These bits set a decay rate for the internal leaky bucket accumulator:<br>00: The accumulator decreases by 1 in every 128 ms with no event detected.<br>01: The accumulator decreases by 1 in every 256 ms with no event detected. (default)<br>10: The accumulator decreases by 1 in every 512 ms with no event detected.<br>11: The accumulator decreases by 1 in every 1024 ms with no event detected. |

**IN\_FREQ\_READ\_CH\_CNFG - Input Clock Frequency Read Channel Selection**

Address: 41H  
 Type: Read / Write  
 Default Value: XXXX0000

|   |   |   |   |                  |                  |                  |                  |
|---|---|---|---|------------------|------------------|------------------|------------------|
| 7 | 6 | 5 | 4 | 3                | 2                | 1                | 0                |
| - | - | - | - | IN_FREQ_READ_CH3 | IN_FREQ_READ_CH2 | IN_FREQ_READ_CH1 | IN_FREQ_READ_CH0 |

| Bit   | Name                 | Description   |
|-------|----------------------|---|
| 7 - 4 | -                    | Reserved.   |
| 3 - 0 | IN_FREQ_READ_CH[3:0] | These bits select an input clock, the frequency of which with respect to the reference clock can be read.<br>0000: Reserved. (default)<br>0001, 0010: Reserved.<br>0011: IN1.<br>0100: IN2.<br>0101: IN3.<br>0110: IN4.<br>0111, 1000, 1001, 1010: Reserved.<br>1011: IN5.<br>1100, 1101, 1110, 1111: Reserved. |

**IN\_FREQ\_READ\_STS - Input Clock Frequency Read Value**

| Address: 42H            |                    |  |                    |                    |                    |                    |                    |
|-------------------------|--------------------|--|--------------------|--------------------|--------------------|--------------------|--------------------|
| Type: Read              |                    |  |                    |                    |                    |                    |                    |
| Default Value: 00000000 |                    |  |                    |                    |                    |                    |                    |
| 7                       | 6                  | 5  | 4                  | 3                  | 2                  | 1                  | 0                  |
| IN_FREQ_VAL<br>UE7      | IN_FREQ_VAL<br>UE6 | IN_FREQ_VAL<br>UE5   | IN_FREQ_VAL<br>UE4 | IN_FREQ_VAL<br>UE3 | IN_FREQ_VAL<br>UE2 | IN_FREQ_VAL<br>UE1 | IN_FREQ_VAL<br>UE0 |
| Bit                     | Name               | Description  |                    |                    |                    |                    |                    |
| 7 - 0                   | IN_FREQ_VALUE[7:0] | These bits represent a 2's complement signed integer. If the value is multiplied by the value in the<br>FREQ_MON_FACTOR[3:0] bits (b3~0, 2EH), the frequency of an input clock with respect to the reference clock in ppm will<br>be gotten. The input clock is selected by the IN_FREQ_READ_CH[3:0] bits (b3~0, 41H).<br>The value in these bits is updated every 16 seconds, starting when an input clock is selected. |                    |                    |                    |                    |                    |

**IN1\_IN2\_STS - Input Clock 1 & 2 Status**

Address: 44H  
 Type: Read  
 Default Value: X110X110

|   |                     |                       |                   |   |                     |                       |                   |
|---|---------------------|-----------------------|-------------------|---|---------------------|-----------------------|-------------------|
| 7 | 6                   | 5                     | 4                 | 3 | 2                   | 1                     | 0                 |
| - | IN2_FREQ_HARD_ALARM | IN2_NO_ACTIVITY_ALARM | IN2_PH_LOCK_ALARM | - | IN1_FREQ_HARD_ALARM | IN1_NO_ACTIVITY_ALARM | IN1_PH_LOCK_ALARM |

| Bit | Name                  | Description   |
|-----|-----------------------|---|
| 7   | -                     | Reserved.   |
| 6   | IN2_FREQ_HARD_ALARM   | This bit indicates whether IN2 is in frequency hard alarm status.<br>0: No frequency hard alarm.<br>1: In frequency hard alarm status. (default)  |
| 5   | IN2_NO_ACTIVITY_ALARM | This bit indicates whether IN2 is in no-activity alarm status.<br>0: No no-activity alarm.<br>1: In no-activity alarm status. (default)   |
| 4   | IN2_PH_LOCK_ALARM     | This bit indicates whether IN2 is in phase lock alarm status.<br>0: No phase lock alarm. (default)<br>1: In phase lock alarm status.<br>If the PH_ALARM_TIMEOUT bit (b5, 09H) is '0', this bit is cleared by writing '1' to this bit; if the PH_ALARM_TIMEOUT bit (b5, 09H) is '1', this bit is cleared after a period (= TIME_OUT_VALUE[5:0] (b5~0, 08H) X MULTI_FACTOR[1:0] (b7~6, 08H) in seconds) which starts from when the alarm is raised. |
| 3   | -                     | Reserved.   |
| 2   | IN1_FREQ_HARD_ALARM   | This bit indicates whether IN1 is in frequency hard alarm status.<br>0: No frequency hard alarm.<br>1: In frequency hard alarm status. (default)  |
| 1   | IN1_NO_ACTIVITY_ALARM | This bit indicates whether IN1 is in no-activity alarm status.<br>0: No no-activity alarm.<br>1: In no-activity alarm status. (default)   |
| 0   | IN1_PH_LOCK_ALARM     | This bit indicates whether IN1 is in phase lock alarm status.<br>0: No phase lock alarm. (default)<br>1: In phase lock alarm status.<br>If the PH_ALARM_TIMEOUT bit (b5, 09H) is '0', this bit is cleared by writing '1' to this bit; if the PH_ALARM_TIMEOUT bit (b5, 09H) is '1', this bit is cleared after a period (= TIME_OUT_VALUE[5:0] (b5~0, 08H) X MULTI_FACTOR[1:0] (b7~6, 08H) in seconds) which starts from when the alarm is raised. |

## IN3\_IN4\_STS - Input Clock 3 &amp; 4 Status

| Address: 45H            |                       |  |                   |   |                     |                       |                   |
|-------------------------|-----------------------|--|-------------------|---|---------------------|-----------------------|-------------------|
| Type: Read              |                       |  |                   |   |                     |                       |                   |
| Default Value: X110X110 |                       |  |                   |   |                     |                       |                   |
| 7                       | 6                     | 5  | 4                 | 3 | 2                   | 1                     | 0                 |
| -                       | IN4_FREQ_HARD_ALARM   | IN4_NO_ACTIVITY_ALARM  | IN4_PH_LOCK_ALARM | - | IN3_FREQ_HARD_ALARM | IN3_NO_ACTIVITY_ALARM | IN3_PH_LOCK_ALARM |
| Bit                     | Name                  | Description  |                   |   |                     |                       |                   |
| 7                       | -                     | Reserved.  |                   |   |                     |                       |                   |
| 6                       | IN4_FREQ_HARD_ALARM   | This bit indicates whether IN4 is in frequency hard alarm status.<br>0: No frequency hard alarm.<br>1: In frequency hard alarm status. (default)   |                   |   |                     |                       |                   |
| 5                       | IN4_NO_ACTIVITY_ALARM | This bit indicates whether IN4 is in no-activity alarm status.<br>0: No no-activity alarm.<br>1: In no-activity alarm status. (default)  |                   |   |                     |                       |                   |
| 4                       | IN4_PH_LOCK_ALARM     | This bit indicates whether IN4 is in phase lock alarm status.<br>0: No phase lock alarm. (default)<br>1: In phase lock alarm status.<br>If the PH_ALARM_TIMEOUT bit (b5, 09H) is '0', this bit is cleared by writing '1' to this bit; if the PH_ALARM_TIMEOUT bit (b5, 09H) is '1', this bit is cleared after a period (= $TIME\_OUT\_VALUE[5:0]$ (b5~0, 08H) X $MULTI\_FACTOR[1:0]$ (b7~6, 08H) in seconds) which starts from when the alarm is raised. |                   |   |                     |                       |                   |
| 3                       | -                     | Reserved.  |                   |   |                     |                       |                   |
| 2                       | IN3_FREQ_HARD_ALARM   | This bit indicates whether IN3 is in frequency hard alarm status.<br>0: No frequency hard alarm.<br>1: In frequency hard alarm status. (default)   |                   |   |                     |                       |                   |
| 1                       | IN3_NO_ACTIVITY_ALARM | This bit indicates whether IN3 is in no-activity alarm status.<br>0: No no-activity alarm.<br>1: In no-activity alarm status. (default)  |                   |   |                     |                       |                   |
| 0                       | IN3_PH_LOCK_ALARM     | This bit indicates whether IN3 is in phase lock alarm status.<br>0: No phase lock alarm. (default)<br>1: In phase lock alarm status.<br>If the PH_ALARM_TIMEOUT bit (b5, 09H) is '0', this bit is cleared by writing '1' to this bit; if the PH_ALARM_TIMEOUT bit (b5, 09H) is '1', this bit is cleared after a period (= $TIME\_OUT\_VALUE[5:0]$ (b5~0, 08H) X $MULTI\_FACTOR[1:0]$ (b7~6, 08H) in seconds) which starts from when the alarm is raised. |                   |   |                     |                       |                   |

**IN5\_STS - Input Clock 5 Status**

Address: 48H  
 Type: Read  
 Default Value: X110X110

|   |   |   |   |   |                         |                           |                       |
|---|---|---|---|---|-------------------------|---------------------------|-----------------------|
| 7 | 6 | 5 | 4 | 3 | 2                       | 1                         | 0                     |
| - | - | - | - | - | IN5_FREQ_HA<br>RD_ALARM | IN5_NO_ACTIV<br>ITY_ALARM | IN5_PH_LOCK<br>_ALARM |

| Bit   | Name                  | Description   |
|-------|-----------------------|---|
| 7 - 3 | -                     | Reserved.   |
| 2     | IN5_FREQ_HARD_ALARM   | This bit indicates whether IN5 is in frequency hard alarm status.<br>0: No frequency hard alarm.<br>1: In frequency hard alarm status. (default)  |
| 1     | IN5_NO_ACTIVITY_ALARM | This bit indicates whether IN5 is in no-activity alarm status.<br>0: No no-activity alarm.<br>1: In no-activity alarm status. (default)   |
| 0     | IN5_PH_LOCK_ALARM     | This bit indicates whether IN5 is in phase lock alarm status.<br>0: No phase lock alarm. (default)<br>1: In phase lock alarm status.<br>If the PH_ALARM_TIMEOUT bit (b5, 09H) is '0', this bit is cleared by writing '1' to this bit; if the PH_ALARM_TIMEOUT bit (b5, 09H) is '1', this bit is cleared after a period (= TIME_OUT_VALUE[5:0] (b5~0, 08H) X MULTI_FACTOR[1:0] (b7~6, 08H) in seconds) which starts from when the alarm is raised. |

7.2.5 T0 / T4 DPLL INPUT CLOCK SELECTION REGISTERS

**INPUT\_VALID1\_STS - Input Clocks Validity 1**

| Address: 4AH            |      |  |     |     |     |   |   |
|-------------------------|------|--|-----|-----|-----|---|---|
| Type: Read              |      |  |     |     |     |   |   |
| Default Value: 00000000 |      |  |     |     |     |   |   |
| 7                       | 6    | 5  | 4   | 3   | 2   | 1 | 0 |
| -                       | -    | IN4  | IN3 | IN2 | IN1 | - | - |
| Bit                     | Name | Description  |     |     |     |   |   |
| 7 - 6                   | -    | Reserved.  |     |     |     |   |   |
| 5 - 2                   | INn  | This bit indicates the validity of the corresponding INn. Here n is any of 4 to 1.<br>0: Invalid. (default)<br>1: Valid. |     |     |     |   |   |
| 1 - 0                   | -    | Reserved.  |     |     |     |   |   |

**INPUT\_VALID2\_STS - Input Clocks Validity 2**

| Address: 4BH            |      |   |   |   |     |   |   |
|-------------------------|------|---|---|---|-----|---|---|
| Type: Read              |      |   |   |   |     |   |   |
| Default Value: XX000000 |      |   |   |   |     |   |   |
| 7                       | 6    | 5   | 4 | 3 | 2   | 1 | 0 |
| -                       | -    | -   | - | - | IN5 | - | - |
| Bit                     | Name | Description   |   |   |     |   |   |
| 7 - 3                   | -    | Reserved.   |   |   |     |   |   |
| 2                       | IN5  | This bit indicates the validity of IN5.<br>0: Invalid. (default)<br>1: Valid. |   |   |     |   |   |
| 1 - 0                   | -    | Reserved.   |   |   |     |   |   |

**REMOTE\_INPUT\_VALID1\_CNFG - Input Clocks Validity Configuration 1**

| Address: 4CH            |           |  |           |           |           |   |   |
|-------------------------|-----------|--|-----------|-----------|-----------|---|---|
| Type: Read / Write      |           |  |           |           |           |   |   |
| Default Value: 11111111 |           |  |           |           |           |   |   |
| 7                       | 6         | 5  | 4         | 3         | 2         | 1 | 0 |
| -                       | -         | IN4_VALID  | IN3_VALID | IN2_VALID | IN1_VALID | - | - |
| Bit                     | Name      | Description  |           |           |           |   |   |
| 7 - 6                   | -         | Reserved.  |           |           |           |   |   |
| 5 - 2                   | INn_VALID | This bit controls whether the corresponding INn is allowed to be locked for automatic selection. Here n is any one of 4 to 1.<br>0: Enabled.<br>1: Disabled. (default) |           |           |           |   |   |
| 1 - 0                   | -         | Reserved.  |           |           |           |   |   |



**REMOTE\_INPUT\_VALID2\_CNFG - Input Clocks Validity Configuration 2**

Address: 4DH  
 Type: Read / Write  
 Default Value: XX111111

|   |   |   |   |   |           |   |   |
|---|---|---|---|---|-----------|---|---|
| 7 | 6 | 5 | 4 | 3 | 2         | 1 | 0 |
| - | - | - | - | - | IN5_VALID | - | - |

| Bit   | Name      | Description   |
|-------|-----------|---|
| 7 - 3 | -         | Reserved.   |
| 2     | IN5_VALID | This bit controls whether IN5 is allowed to be locked for automatic selection.<br>0: Enabled.<br>1: Disabled. (default) |
| 1 - 0 | -         | Reserved.   |

**PRIORITY\_TABLE1\_STS - Priority Status 1 \***

Address: 4EH  
 Type: Read  
 Default Value: 00000000

|                                     |                                     |                                     |                                     |                                  |                                  |                                  |                                  |
|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| 7                                   | 6                                   | 5                                   | 4                                   | 3                                | 2                                | 1                                | 0                                |
| HIGHEST_PRIORITY_VALIDATED3<br>TED3 | HIGHEST_PRIORITY_VALIDATED2<br>TED2 | HIGHEST_PRIORITY_VALIDATED1<br>TED1 | HIGHEST_PRIORITY_VALIDATED0<br>TED0 | CURRENTLY_SELECTED_INPUT3<br>UT3 | CURRENTLY_SELECTED_INPUT2<br>UT2 | CURRENTLY_SELECTED_INPUT1<br>UT1 | CURRENTLY_SELECTED_INPUT0<br>UT0 |

| Bit   | Name                            | Description  |
|-------|---------------------------------|--|
| 7 - 4 | HIGHEST_PRIORITY_VALIDATED[3:0] | These bits indicate a qualified input clock with the highest priority.<br>0000: No input clock is qualified. (default)<br>0001, 0010: Reserved.<br>0011: IN1.<br>0100: IN2.<br>0101: IN3.<br>0110: IN4.<br>0111, 1000, 1001, 1010: Reserved.<br>1011: IN5.<br>1100, 1101, 1110, 1111: Reserved.<br>Note that the input clock is indicated by these bits only when the corresponding INn (b5-2, 4CH) or INn (b2, 4DH) bit is '0'.   |
| 3 - 0 | CURRENTLY_SELECTED_INPUT[3:0]   | These bits indicate the T0/T4 selected input clock.<br>0000: No input clock is selected; or the T4 selected input clock is the T0 DPLL output. (default)<br>0001, 0010: Reserved.<br>0011: IN1 is selected.<br>0100: IN2 is selected.<br>0101: IN3 is selected.<br>0110: IN4 is selected.<br>0111, 1000, 1001, 1010: Reserved.<br>1011: IN5 is selected.<br>1100, 1101, 1110, 1111: Reserved.<br>Note that the input clock is indicated by these bits only when the corresponding INn (b5-2, 4CH) or INn (b2, 4DH) bit is '0'. |

**PRIORITY\_TABLE2\_STS - Priority Status 2 \***

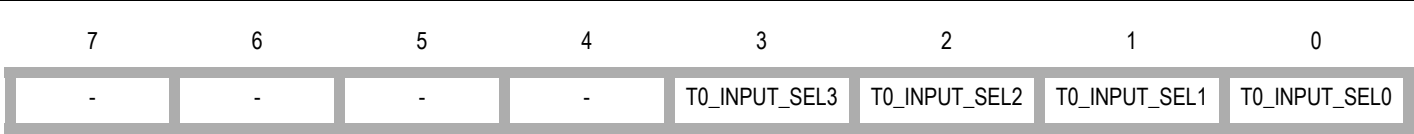
Address: 4FH  
 Type: Read  
 Default Value: 00000000

|                                   |                                   |                                   |                                   |                                    |                                    |                                    |                                    |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|
| 7                                 | 6                                 | 5                                 | 4                                 | 3                                  | 2                                  | 1                                  | 0                                  |
| THIRD_HIGHEST_PRIORITY_VALIDATED3 | THIRD_HIGHEST_PRIORITY_VALIDATED2 | THIRD_HIGHEST_PRIORITY_VALIDATED1 | THIRD_HIGHEST_PRIORITY_VALIDATED0 | SECOND_HIGHEST_PRIORITY_VALIDATED3 | SECOND_HIGHEST_PRIORITY_VALIDATED2 | SECOND_HIGHEST_PRIORITY_VALIDATED1 | SECOND_HIGHEST_PRIORITY_VALIDATED0 |

| Bit   | Name                                   | Description   |
|-------|--|---|
| 7 - 4 | THIRD_HIGHEST_PRIORITY_VALIDATED[3:0]  | These bits indicate a qualified input clock with the third highest priority.<br>0000: No input clock is qualified. (default)<br>0001, 0010: Reserved.<br>0011: IN1.<br>0100: IN2.<br>0101: IN3.<br>0110: IN4.<br>0111, 1000, 1001, 1010: Reserved.<br>1011: IN5.<br>1100, 1101, 1110, 1111: Reserved.<br>Note that the input clock is indicated by these bits only when the corresponding INn (b5-2, 4CH) or INn (b2, 4DH) bit is '0'.  |
| 3 - 0 | SECOND_HIGHEST_PRIORITY_VALIDATED[3:0] | These bits indicate a qualified input clock with the second highest priority.<br>0000: No input clock is qualified. (default)<br>0001, 0010: Reserved.<br>0011: IN1.<br>0100: IN2.<br>0101: IN3.<br>0110: IN4.<br>0111, 1000, 1001, 1010: Reserved.<br>1011: IN5.<br>1100, 1101, 1110, 1111: Reserved.<br>Note that the input clock is indicated by these bits only when the corresponding INn (b5-2, 4CH) or INn (b2, 4DH) bit is '0'. |

**T0\_INPUT\_SEL\_CNFG - T0 Selected Input Clock Configuration**

Address: 50H  
 Type: Read / Write  
 Default Value: XXXX0000



| Bit   | Name              | Description  |
|-------|-------------------|--|
| 7 - 4 | -                 | Reserved.  |
| 3 - 0 | T0_INPUT_SEL[3:0] | This bit determines T0 input clock selection. It is valid only when the EXT_SW bit (b4, 0BH) is '0'.<br>0000: Automatic selection. (default)<br>0001, 0010: Reserved.<br>0011: Forced selection - IN1 is selected.<br>0100: Forced selection - IN2 is selected.<br>0101: Forced selection - IN3 is selected.<br>0110: Forced selection - IN4 is selected.<br>0111, 1000, 1001, 1010: Reserved.<br>1011: Forced selection - IN5 is selected.<br>1100, 1101, 1110, 1111: Reserved. |

## T4\_INPUT\_SEL\_CNFG - T4 Selected Input Clock Configuration

Address: 51H

Type: Read / Write

Default Value: X0000000

| Bit   | Name              | Description  |
|-------|-------------------|--|
| 7     | -                 | Reserved.  |
| 6     | T4_LOCK_T0        | This bit determines whether the T4 DPLL locks to a T0 DPLL output or locks independently from the T0 DPLL.<br>0: Independently from the T0 path. (default)<br>1: Locks to a 77.76 MHz or 8 kHz signal from the T0 DPLL 77.76 MHz path.   |
| 5     | T0_FOR_T4         | This bit is valid only when the T4_LOCK_T0 bit (b6, 51H) is '1'. It determines whether a 77.76 MHz or 8 kHz signal from the T0 DPLL 77.76 MHz path is selected by the T4 DPLL.<br>0: 77.76 MHz. (default)<br>1: 8 kHz.   |
| 4     | T4_TEST_T0_PH     | This bit determines whether T4 selected input clock is compared with the feedback signal of the T4 DPLL for T4 DPLL locking or is compared with the T0 selected input clock to get the phase difference between T0 and T4 selected input clocks.<br>0: The T4 DPLL output. (default)<br>1: The T0 selected input clock.  |
| 3 - 0 | T4_INPUT_SEL[3:0] | These bits are valid only when the T4_LOCK_T0 bit (b6, 51H) is '0'. They determines the T4 DPLL input clock selection.<br>0000: Automatic selection. (default)<br>0001, 0010: Reserved.<br>0011: Forced selection - IN1 is selected.<br>0100: Forced selection - IN2 is selected.<br>0101: Forced selection - IN3 is selected.<br>0110: Forced selection - IN4 is selected.<br>0111, 1000, 1001, 1010: Reserved.<br>1011: Forced selection - IN5 is selected.<br>1100, 1101, 1110, 1111: Reserved. |

7.2.6 T0 / T4 DPLL STATE MACHINE CONTROL REGISTERS

OPERATING\_STS - DPLL Operating Status

| Address: 52H            |                             |   |                         |              |                         |                         |                         |
|-------------------------|-----------------------------|---|-------------------------|--------------|-------------------------|-------------------------|-------------------------|
| Type: Read              |                             |   |                         |              |                         |                         |                         |
| Default Value: 10000001 |                             |   |                         |              |                         |                         |                         |
| 7                       | 6                           | 5   | 4                       | 3            | 2                       | 1                       | 0                       |
| EX_SYNC_ALARM_MON       | T4_DPLL_LOCK                | T0_DPLL_SOFT_FREQ_ALARM   | T4_DPLL_SOFT_FREQ_ALARM | T0_DPLL_LOCK | T0_DPLL_OPERATING_MODE2 | T0_DPLL_OPERATING_MODE1 | T0_DPLL_OPERATING_MODE0 |
| Bit                     | Name                        | Description   |                         |              |                         |                         |                         |
| 7                       | EX_SYNC_ALARM_MON           | This bit indicates whether the frame sync input signal is in external sync alarm status.<br>0: No external sync alarm.<br>1: In external sync alarm status. (default)   |                         |              |                         |                         |                         |
| 6                       | T4_DPLL_LOCK                | This bit indicates the T4 DPLL locking status.<br>0: Unlocked. (default)<br>1: Locked.  |                         |              |                         |                         |                         |
| 5                       | T0_DPLL_SOFT_FREQ_ALARM     | This bit indicates whether the T0 DPLL is in soft alarm status.<br>0: No T0 DPLL soft alarm. (default)<br>1: In T0 DPLL soft alarm status.  |                         |              |                         |                         |                         |
| 4                       | T4_DPLL_SOFT_FREQ_ALARM     | This bit indicates whether the T4 DPLL is in soft alarm status.<br>0: No T4 DPLL soft alarm. (default)<br>1: In T4 DPLL soft alarm status.  |                         |              |                         |                         |                         |
| 3                       | T0_DPLL_LOCK                | This bit indicates the T0 DPLL locking status.<br>0: Unlocked. (default)<br>1: Locked.  |                         |              |                         |                         |                         |
| 2 - 0                   | T0_DPLL_OPERATING_MODE[2:0] | These bits indicate the current operating mode of T0 DPLL.<br>000: Reserved.<br>001: Free-Run. (default)<br>010: Holdover.<br>011: Reserved.<br>100: Locked.<br>101: Pre-Locked2.<br>110: Pre-Locked.<br>111: Lost-Phase. |                         |              |                         |                         |                         |

**T0\_OPERATING\_MODE\_CNFG - T0 DPLL Operating Mode Configuration**

| Address: 53H            |                        |  |   |   |                    |                    |                    |
|-------------------------|------------------------|--|---|---|--------------------|--------------------|--------------------|
| Type: Read / Write      |                        |  |   |   |                    |                    |                    |
| Default Value: XXXXX000 |                        |  |   |   |                    |                    |                    |
| 7                       | 6                      | 5  | 4 | 3 | 2                  | 1                  | 0                  |
| -                       | -                      | -  | - | - | T0_OPERATING_MODE2 | T0_OPERATING_MODE1 | T0_OPERATING_MODE0 |
| Bit                     | Name                   | Description  |   |   |                    |                    |                    |
| 7 - 3                   | -                      | Reserved.  |   |   |                    |                    |                    |
| 2 - 0                   | T0_OPERATING_MODE[2:0] | These bits control the T0 DPLL operating mode.<br>000: Automatic. (default)<br>001: Forced - Free-Run.<br>010: Forced - Holdover.<br>011: Reserved.<br>100: Forced - Locked.<br>101: Forced - Pre-Locked2.<br>110: Forced - Pre-Locked.<br>111: Forced - Lost-Phase. |   |   |                    |                    |                    |

**T4\_OPERATING\_MODE\_CNFG - T4 DPLL Operating Mode Configuration**

| Address: 54H            |                        |  |   |   |                    |                    |                    |
|-------------------------|------------------------|--|---|---|--------------------|--------------------|--------------------|
| Type: Read / Write      |                        |  |   |   |                    |                    |                    |
| Default Value: XXXXX000 |                        |  |   |   |                    |                    |                    |
| 7                       | 6                      | 5  | 4 | 3 | 2                  | 1                  | 0                  |
| -                       | -                      | -  | - | - | T4_OPERATING_MODE2 | T4_OPERATING_MODE1 | T4_OPERATING_MODE0 |
| Bit                     | Name                   | Description  |   |   |                    |                    |                    |
| 7 - 3                   | -                      | Reserved.  |   |   |                    |                    |                    |
| 2 - 0                   | T4_OPERATING_MODE[2:0] | These bits control the T4 DPLL operating mode.<br>000: Automatic. (default)<br>001: Forced - Free-Run.<br>010: Forced - Holdover.<br>011: Reserved.<br>100: Forced - Locked.<br>101, 110, 111: Reserved. |   |   |                    |                    |                    |

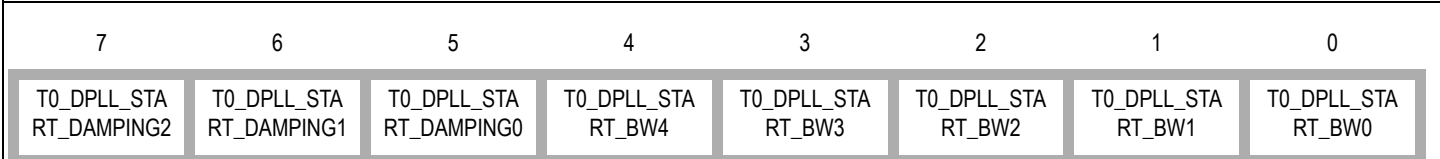
7.2.7 T0 / T4 DPLL & APLL CONFIGURATION REGISTERS

T0\_DPLL\_APLL\_PATH\_CNFG - T0 DPLL & APLL Path Configuration

| Address: 55H            |                                 |   |                   |                                 |                                 |                             |                             |
|-------------------------|---------------------------------|---|-------------------|---------------------------------|---------------------------------|-----------------------------|-----------------------------|
| Type: Read / Write      |                                 |   |                   |                                 |                                 |                             |                             |
| Default Value: 00000X0X |                                 |   |                   |                                 |                                 |                             |                             |
| 7                       | 6                               | 5   | 4                 | 3                               | 2                               | 1                           | 0                           |
| T0_APLL_PATH<br>3       | T0_APLL_PA<br>TH2               | T0_APLL_PA<br>TH1   | T0_APLL_PA<br>TH0 | T0_GSM_OBSAI_<br>16E1_16T1_SEL1 | T0_GSM_OBSAI_<br>16E1_16T1_SELO | T0_12E1_24T1_<br>E3_T3_SEL1 | T0_12E1_24T1_<br>E3_T3_SELO |
| Bit                     | Name                            | Description   |                   |                                 |                                 |                             |                             |
| 7 - 4                   | T0_APLL_PATH[3:0]               | These bits select an input to the T0 APLL.<br>0000: The output of T0 DPLL 77.76 MHz path. (default)<br>0001: The output of T0 DPLL 12E1/24T1/E3/T3 path.<br>0010: The output of T0 DPLL 16E1/16T1 path.<br>0011: The output of T0 DPLL GSM/OBSAI/16E1/16T1 path.<br>0100: The output of T4 DPLL 77.76 MHz path.<br>0101: The output of T4 DPLL 12E1/24T1/E3/T3 path.<br>0110: The output of T4 DPLL 16E1/16T1 path.<br>0111: The output of T4 DPLL GSM/GPS/16E1/16T1 path.<br>1XXX: Reserved. |                   |                                 |                                 |                             |                             |
| 3 - 2                   | T0_GSM_OBSAI_16E1_16T1_SEL[1:0] | These bits select an output clock from the T0 DPLL GSM/OBSAI/16E1/16T1 path.<br>00: 16E1.<br>01: 16T1.<br>10: GSM.<br>11: OBSAI.<br>The default value of the T0_GSM_OBSAI_16E1_16T1_SELO bit is determined by the SONET/SDH pin during reset.   |                   |                                 |                                 |                             |                             |
| 1 - 0                   | T0_12E1_24T1_E3_T3_SEL[1:0]     | These bits select an output clock from the T0 DPLL 12E1/24T1/E3/T3 path.<br>00: 12E1.<br>01: 24T1.<br>10: E3.<br>11: T3.<br>The default value of the T0_12E1_24T1_E3_T3_SELO bit is determined by the SONET/SDH pin during reset.   |                   |                                 |                                 |                             |                             |

**T0\_DPLL\_START\_BW\_DAMPING\_CNFG - T0 DPLL Start Bandwidth & Damping Factor Configuration**

Address: 56H  
 Type: Read / Write  
 Default Value: 01101111

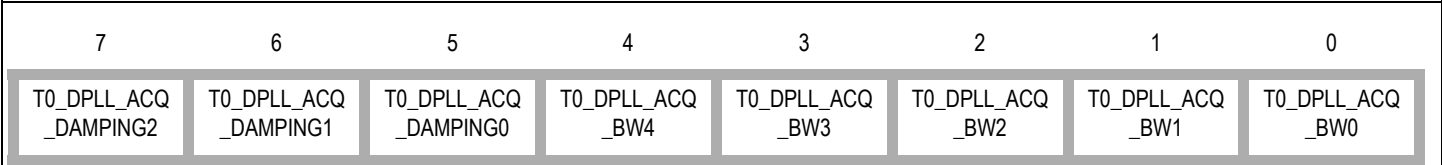


| Bit   | Name                       | Description  |
|-------|----------------------------|--|
| 7 - 5 | T0_DPLL_START_DAMPING[2:0] | These bits set the starting damping factor for T0 DPLL.<br>000: Reserved.<br>001: 1.2.<br>010: 2.5.<br>011: 5. (default)<br>100: 10.<br>101: 20.<br>110, 111: Reserved.  |
| 4 - 0 | T0_DPLL_START_BW[4:0]      | These bits set the starting bandwidth for T0 DPLL.<br>00000: 0.5 mHz.<br>00001: 1 mHz.<br>00010: 2 mHz.<br>00011: 4 mHz.<br>00100: 8 mHz.<br>00101: 15 mHz.<br>00110: 30 mHz.<br>00111: 60 mHz.<br>01000: 0.1 Hz.<br>01001: 0.3 Hz.<br>01010: 0.6 Hz.<br>01011: 1.2 Hz.<br>01100: 2.5 Hz.<br>01101: 4 Hz.<br>01110: 8 Hz.<br>01111: 18 Hz. (default)<br>10000: 35 Hz.<br>10001: 70 Hz.<br>10010: 560 Hz.<br>10011 ~ 11111: Reserved. |



**T0\_DPLL\_ACQ\_BW\_DAMPING\_CNFG - T0 DPLL Acquisition Bandwidth & Damping Factor Configuration**

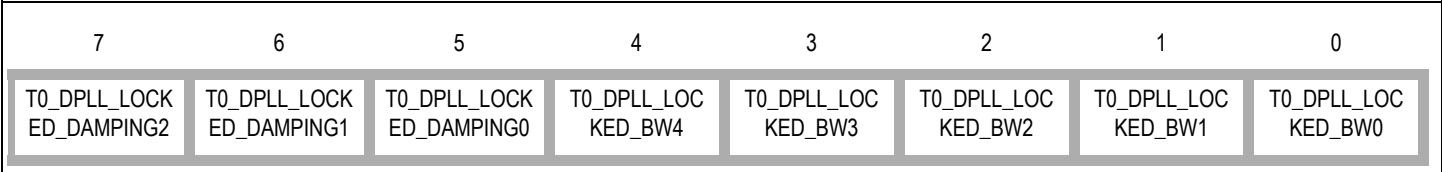
Address: 57H  
 Type: Read / Write  
 Default Value: 01101111



| Bit   | Name                     | Description   |
|-------|--------------------------|---|
| 7 - 5 | T0_DPLL_ACQ_DAMPING[2:0] | These bits set the acquisition damping factor for T0 DPLL.<br>000: Reserved.<br>001: 1.2.<br>010: 2.5.<br>011: 5. (default)<br>100: 10.<br>101: 20.<br>110, 111: Reserved.  |
| 4 - 0 | T0_DPLL_ACQ_BW[4:0]      | These bits set the acquisition bandwidth for T0 DPLL.<br>00000: 0.5 mHz.<br>00001: 1 mHz.<br>00010: 2 mHz.<br>00011: 4 mHz.<br>00100: 8 mHz.<br>00101: 15 mHz.<br>00110: 30 mHz.<br>00111: 60 mHz.<br>01000: 0.1 Hz.<br>01001: 0.3 Hz.<br>01010: 0.6 Hz.<br>01011: 1.2 Hz.<br>01100: 2.5 Hz.<br>01101: 4 Hz.<br>01110: 8 Hz.<br>01111: 18 Hz. (default)<br>10000: 35 Hz.<br>10001: 70 Hz.<br>10010: 560 Hz.<br>10011 ~ 11111: Reserved. |

**T0\_DPLL\_LOCKED\_BW\_DAMPING\_CNFG - T0 DPLL Locked Bandwidth & Damping Factor Configuration**

Address: 58H  
 Type: Read / Write  
 Default Value: 01101011



| Bit   | Name                        | Description  |
|-------|-----------------------------|--|
| 7 - 5 | T0_DPLL_LOCKED_DAMPING[2:0] | These bits set the locked damping factor for T0 DPLL.<br>000: Reserved.<br>001: 1.2.<br>010: 2.5.<br>011: 5. (default)<br>100: 10.<br>101: 20.<br>110, 111: Reserved.  |
| 4 - 0 | T0_DPLL_LOCKED_BW[4:0]      | These bits set the locked bandwidth for T0 DPLL.<br>00000: 0.5 mHz.<br>00001: 1 mHz.<br>00010: 2 mHz.<br>00011: 4 mHz.<br>00100: 8 mHz.<br>00101: 15 mHz.<br>00110: 30 mHz.<br>00111: 60 mHz.<br>01000: 0.1 Hz.<br>01001: 0.3 Hz.<br>01010: 0.6 Hz.<br>01011: 1.2 Hz. (default)<br>01100: 2.5 Hz.<br>01101: 4 Hz.<br>01110: 8 Hz.<br>01111: 18 Hz.<br>10000: 35 Hz.<br>10001: 70 Hz.<br>10010: 560 Hz.<br>10011 ~ 11111: Reserved. |

## T0\_BW\_OVERSHOOT\_CNFG - T0 DPLL Bandwidth Overshoot Configuration

| Address: 59H            |             |   |   |         |   |   |   |
|-------------------------|-------------|---|---|---------|---|---|---|
| Type: Read / Write      |             |   |   |         |   |   |   |
| Default Value: 1XXX1XXX |             |   |   |         |   |   |   |
| 7                       | 6           | 5   | 4 | 3       | 2 | 1 | 0 |
| AUTO_BW_SEL             | -           | -   | - | T0_LIMT | - | - | - |
| Bit                     | Name        | Description   |   |         |   |   |   |
| 7                       | AUTO_BW_SEL | This bit determines whether starting or acquisition bandwidth / damping factor is used for T0 DPLL.<br>0: The starting and acquisition bandwidths / damping factors are not used. Only the locked bandwidth / damping factor is used regardless of the T0 DPLL locking stage.<br>1: The starting, acquisition or locked bandwidth / damping factor is used automatically depending on different T0 DPLL locking stages. (default) |   |         |   |   |   |
| 6 - 4                   | -           | Reserved.   |   |         |   |   |   |
| 3                       | T0_LIMT     | This bit determines whether the integral path value is frozen when the T0 DPLL hard limit is reached.<br>0: Not frozen.<br>1: Frozen. It will minimize the subsequent overshoot when T0 DPLL is pulling in. (default)   |   |         |   |   |   |
| 2 - 0                   | -           | Reserved.   |   |         |   |   |   |

**PHASE\_LOSS\_COARSE\_LIMIT\_CNFG - Phase Loss Coarse Detector Limit Configuration \***

| Address: 5AH                      |                         |  |  |                     |                     |                     |                     |                      |                      |         |                    |                       |   |            |       |   |   |       |                                   |            |   |  |            |   |       |            |            |   |  |
|-----------------------------------|-------------------------|--|--|---------------------|---------------------|---------------------|---------------------|----------------------|----------------------|---------|--------------------|-----------------------|---|------------|-------|---|---|-------|-----------------------------------|------------|---|--|------------|---|-------|------------|------------|---|--|
| Type: Read / Write                |                         |  |  |                     |                     |                     |                     |                      |                      |         |                    |                       |   |            |       |   |   |       |                                   |            |   |  |            |   |       |            |            |   |  |
| Default Value: 10000101           |                         |  |  |                     |                     |                     |                     |                      |                      |         |                    |                       |   |            |       |   |   |       |                                   |            |   |  |            |   |       |            |            |   |  |
| 7                                 | 6                       | 5  | 4  | 3                   | 2                   | 1                   | 0                   |                      |                      |         |                    |                       |   |            |       |   |   |       |                                   |            |   |  |            |   |       |            |            |   |  |
| COARSE_PH_LOS_LIMT_EN             | WIDE_EN                 | MULTI_PH_APP   | MULTI_PH_8K_4K_2K_EN                                 | PH_LOS_COARSE_LIMT3 | PH_LOS_COARSE_LIMT2 | PH_LOS_COARSE_LIMT1 | PH_LOS_COARSE_LIMT0 |                      |                      |         |                    |                       |   |            |       |   |   |       |                                   |            |   |  |            |   |       |            |            |   |  |
| Bit                               | Name                    | Description  |  |                     |                     |                     |                     |                      |                      |         |                    |                       |   |            |       |   |   |       |                                   |            |   |  |            |   |       |            |            |   |  |
| 7                                 | COARSE_PH_LOS_LIMT_EN   | This bit controls whether the occurrence of the coarse phase loss will result in the T0/T4 DPLL being unlocked.<br>0: Disabled.<br>1: Enabled. (default)   |  |                     |                     |                     |                     |                      |                      |         |                    |                       |   |            |       |   |   |       |                                   |            |   |  |            |   |       |            |            |   |  |
| 6                                 | WIDE_EN                 | Refer to the description of the MULTI_PH_8K_4K_2K_EN bit (b4, 5AH).  |  |                     |                     |                     |                     |                      |                      |         |                    |                       |   |            |       |   |   |       |                                   |            |   |  |            |   |       |            |            |   |  |
| 5                                 | MULTI_PH_APP            | This bit determines whether the PFD output of T0/T4 DPLL is limited to ±1 UI or is limited to the coarse phase limit.<br>0: Limited to ±1 UI. (default)<br>1: Limited to the coarse phase limit. When the selected input clock is of 2 kHz, 4 kHz or 8 kHz, the coarse phase limit depends on the MULTI_PH_8K_4K_2K_EN bit, the WIDE_EN bit and the PH_LOS_COARSE_LIMT[3:0] bits; when the selected input clock is of other frequencies than 2 kHz, 4 kHz and 8 kHz, the coarse phase limit depends on the WIDE_EN bit and the PH_LOS_COARSE_LIMT[3:0] bits. Refer to the description of the MULTI_PH_8K_4K_2K_EN bit (b4, 5AH) for details.   |  |                     |                     |                     |                     |                      |                      |         |                    |                       |   |            |       |   |   |       |                                   |            |   |  |            |   |       |            |            |   |  |
| 4                                 | MULTI_PH_8K_4K_2K_EN    | <p>This bit, together with the WIDE_EN bit (b6, 5AH) and the PH_LOS_COARSE_LIMT[3:0] bits (b3~0, 5AH), determines the coarse phase limit when the selected input clock is of 2 kHz, 4 kHz or 8 kHz. When the selected input clock is of other frequencies than 2 kHz, 4 kHz and 8 kHz, the coarse phase limit depends on the WIDE_EN bit and the PH_LOS_COARSE_LIMT[3:0] bits.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Selected Input Clock</th> <th>MULTI_PH_8K_4K_2K_EN</th> <th>WIDE_EN</th> <th>Coarse Phase Limit</th> </tr> </thead> <tbody> <tr> <td rowspan="2" style="text-align: center;">2 kHz, 4 kHz or 8 kHz</td> <td style="text-align: center;">0</td> <td style="text-align: center;">don't-care</td> <td style="text-align: center;">±1 UI</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">±1 UI</td> </tr> <tr> <td rowspan="2" style="text-align: center;">other than 2 kHz, 4 kHz and 8 kHz</td> <td style="text-align: center;">don't-care</td> <td style="text-align: center;">1</td> <td style="text-align: center;">set by the PH_LOS_COARSE_LIMT[3:0] bits (b3~0, 5AH).</td> </tr> <tr> <td style="text-align: center;">don't-care</td> <td style="text-align: center;">0</td> <td style="text-align: center;">±1 UI</td> </tr> <tr> <td style="text-align: center;">don't-care</td> <td style="text-align: center;">don't-care</td> <td style="text-align: center;">1</td> <td style="text-align: center;">set by the PH_LOS_COARSE_LIMT[3:0] bits (b3~0, 5AH).</td> </tr> </tbody> </table> |  |                     |                     |                     |                     | Selected Input Clock | MULTI_PH_8K_4K_2K_EN | WIDE_EN | Coarse Phase Limit | 2 kHz, 4 kHz or 8 kHz | 0 | don't-care | ±1 UI | 1 | 0 | ±1 UI | other than 2 kHz, 4 kHz and 8 kHz | don't-care | 1 | set by the PH_LOS_COARSE_LIMT[3:0] bits (b3~0, 5AH). | don't-care | 0 | ±1 UI | don't-care | don't-care | 1 | set by the PH_LOS_COARSE_LIMT[3:0] bits (b3~0, 5AH). |
| Selected Input Clock              | MULTI_PH_8K_4K_2K_EN    | WIDE_EN  | Coarse Phase Limit                                   |                     |                     |                     |                     |                      |                      |         |                    |                       |   |            |       |   |   |       |                                   |            |   |  |            |   |       |            |            |   |  |
| 2 kHz, 4 kHz or 8 kHz             | 0                       | don't-care   | ±1 UI  |                     |                     |                     |                     |                      |                      |         |                    |                       |   |            |       |   |   |       |                                   |            |   |  |            |   |       |            |            |   |  |
|                                   | 1                       | 0  | ±1 UI  |                     |                     |                     |                     |                      |                      |         |                    |                       |   |            |       |   |   |       |                                   |            |   |  |            |   |       |            |            |   |  |
| other than 2 kHz, 4 kHz and 8 kHz | don't-care              | 1  | set by the PH_LOS_COARSE_LIMT[3:0] bits (b3~0, 5AH). |                     |                     |                     |                     |                      |                      |         |                    |                       |   |            |       |   |   |       |                                   |            |   |  |            |   |       |            |            |   |  |
|                                   | don't-care              | 0  | ±1 UI  |                     |                     |                     |                     |                      |                      |         |                    |                       |   |            |       |   |   |       |                                   |            |   |  |            |   |       |            |            |   |  |
| don't-care                        | don't-care              | 1  | set by the PH_LOS_COARSE_LIMT[3:0] bits (b3~0, 5AH). |                     |                     |                     |                     |                      |                      |         |                    |                       |   |            |       |   |   |       |                                   |            |   |  |            |   |       |            |            |   |  |
| 3 - 0                             | PH_LOS_COARSE_LIMT[3:0] | <p>These bit set the coarse phase limit. The limit is used only in some cases. Refer to the description of the MULTI_PH_8K_4K_2K_EN bit (b4, 5AH).</p> <p>0000: ±1 UI.<br/>                     0001: ±3 UI.<br/>                     0010: ±7 UI.<br/>                     0011: ±15 UI.<br/>                     0100: ±31 UI.<br/>                     0101: ±63 UI. (default)<br/>                     0110: ±127 UI.<br/>                     0111: ±255 UI.<br/>                     1000: ±511 UI.<br/>                     1001: ±1023 UI (T0); Reserved (T4).<br/>                     1010-1111: Reserved.</p>   |  |                     |                     |                     |                     |                      |                      |         |                    |                       |   |            |       |   |   |       |                                   |            |   |  |            |   |       |            |            |   |  |

**PHASE\_LOSS\_FINE\_LIMIT\_CNFG - Phase Loss Fine Detector Limit Configuration \***

| Address: 5BH            |                       |   |   |   |                   |                   |                   |
|-------------------------|-----------------------|---|---|---|-------------------|-------------------|-------------------|
| Type: Read / Write      |                       |   |   |   |                   |                   |                   |
| Default Value: 10XXX010 |                       |   |   |   |                   |                   |                   |
| 7                       | 6                     | 5   | 4 | 3 | 2                 | 1                 | 0                 |
| FINE_PH_LOS_LIMT_EN     | FAST_LOS_SW           | -   | - | - | PH_LOS_FINE_LIMT2 | PH_LOS_FINE_LIMT1 | PH_LOS_FINE_LIMT0 |
| Bit                     | Name                  | Description   |   |   |                   |                   |                   |
| 7                       | FINE_PH_LOS_LIMT_EN   | This bit controls whether the occurrence of the fine phase loss will result in the T0/T4 DPLL being unlocked.<br>0: Disabled.<br>1: Enabled. (default)  |   |   |                   |                   |                   |
| 6                       | FAST_LOS_SW           | The value in this bit can be switched only when it is available for T0 path; this bit is always '1' when it is available for T4 path.<br>This bit controls whether the occurrence of the fast loss will result in the T0/T4 DPLL being unlocked.<br>0: Does not result in the T0 DPLL being unlocked. T0 DPLL will enter Temp-Holdover mode automatically. (default)<br>1: Results in the T0/T4 DPLL being unlocked. For T0 path, T0 DPLL will enter Lost-Phase mode if the T0 DPLL operating mode is switched automatically. |   |   |                   |                   |                   |
| 5 - 3                   | -                     | Reserved.   |   |   |                   |                   |                   |
| 2 - 0                   | PH_LOS_FINE_LIMT[2:0] | These bits set a fine phase limit.<br>000: 0.<br>001: ± (45 ° ~ 90 °).<br>010: ± (90 ° ~ 180 °). (default)<br>011: ± (180 ° ~ 360 °).<br>100: ± (20 ns ~ 25 ns).<br>101: ± (60 ns ~ 65 ns).<br>110: ± (120 ns ~ 125 ns).<br>111: ± (950 ns ~ 955 ns).   |   |   |                   |                   |                   |

**T0\_HOLDOVER\_MODE\_CNFG - T0 DPLL Holdover Mode Configuration**

| Address: 5CH            |                         |   |            |                     |                                   |                         |   |
|-------------------------|-------------------------|---|------------|---------------------|-----------------------------------|-------------------------|---|
| Type: Read / Write      |                         |   |            |                     |                                   |                         |   |
| Default Value: 010001XX |                         |   |            |                     |                                   |                         |   |
| 7                       | 6                       | 5   | 4          | 3                   | 2                                 | 1                       | 0 |
| MAN_HOLDOVER            | AUTO_AVG                | FAST_AVG  | READ_AVG   | TEMP_HOLDOVER_MODE1 | TEMP_HOLDOVER_MODE0               | -                       | - |
| Bit                     | Name                    | Description   |            |                     |                                   |                         |   |
| 7                       | MAN_HOLDOVER            | Refer to the description of the FAST_AVG bit (b5, 5CH).   |            |                     |                                   |                         |   |
| 6                       | AUTO_AVG                | Refer to the description of the FAST_AVG bit (b5, 5CH).   |            |                     |                                   |                         |   |
| 5                       | FAST_AVG                | This bit, together with the AUTO_AVG bit (b6, 5CH) and the MAN_HOLDOVER bit (b7, 5CH), determines a frequency offset acquiring method in T0 DPLL Holdover Mode.   |            |                     |                                   |                         |   |
|                         |                         | MAN_HOLDOVER  | AUTO_AVG   | FAST_AVG            | Frequency Offset Acquiring Method |                         |   |
|                         |                         | 0   | 0          | don't-care          |                                   | Automatic Instantaneous |   |
|                         |                         |   | 1          | 0                   | Automatic Slow Averaged (default) |                         |   |
|                         |                         | 1   | don't-care |                     | 1                                 | Automatic Fast Averaged |   |
|                         |                         |   |            |                     |                                   | Manual                  |   |
| 4                       | READ_AVG                | This bit controls the holdover frequency offset reading, which is read from the T0_HOLDOVER_FREQ[23:0] bits (5FH ~ 5DH).<br>0: The value read from the T0_HOLDOVER_FREQ[23:0] bits (5FH ~ 5DH) is equal to the one written to them. (default)<br>1: The value read from the T0_HOLDOVER_FREQ[23:0] bits (5FH ~ 5DH) is not equal to the one written to them. The value is acquired by Automatic Slow Averaged method if the FAST_AVG bit (b5, 5CH) is '0'; or is acquired by Automatic Fast Averaged method if the FAST_AVG bit (b5, 5CH) is '1'. |            |                     |                                   |                         |   |
| 3 - 2                   | TEMP_HOLDOVER_MODE[1:0] | These bits determine the frequency offset acquiring method in T0 DPLL Temp-Holdover Mode.<br>00: The method is the same as that used in T0 DPLL Holdover mode.<br>01: Automatic Instantaneous. (default)<br>10: Automatic Fast Averaged.<br>11: Automatic Slow Averaged.  |            |                     |                                   |                         |   |
| 1 - 0                   | -                       | Reserved.   |            |                     |                                   |                         |   |

**T0\_HOLDOVER\_FREQ[7:0]\_CNFG - T0 DPLL Holdover Frequency Configuration 1**

| Address: 5DH            |                       |   |                   |                   |                   |                   |                   |
|-------------------------|-----------------------|---|-------------------|-------------------|-------------------|-------------------|-------------------|
| Type: Read / Write      |                       |   |                   |                   |                   |                   |                   |
| Default Value: 00000000 |                       |   |                   |                   |                   |                   |                   |
| 7                       | 6                     | 5   | 4                 | 3                 | 2                 | 1                 | 0                 |
| T0_HOLDOVER_FREQ7       | T0_HOLDOVER_FREQ6     | T0_HOLDOVER_FREQ5   | T0_HOLDOVER_FREQ4 | T0_HOLDOVER_FREQ3 | T0_HOLDOVER_FREQ2 | T0_HOLDOVER_FREQ1 | T0_HOLDOVER_FREQ0 |
| Bit                     | Name                  | Description   |                   |                   |                   |                   |                   |
| 7 - 0                   | T0_HOLDOVER_FREQ[7:0] | Refer to the description of the T0_HOLDOVER_FREQ[23:16] bits (b7~0, 5FH). |                   |                   |                   |                   |                   |

**T0\_HOLDOVER\_FREQ[15:8]\_CNFG - T0 DPLL Holdover Frequency Configuration 2**

| Address: 5EH            |                        |   |                    |                    |                    |                   |                   |
|-------------------------|------------------------|---|--------------------|--------------------|--------------------|-------------------|-------------------|
| Type: Read / Write      |                        |   |                    |                    |                    |                   |                   |
| Default Value: 00000000 |                        |   |                    |                    |                    |                   |                   |
| 7                       | 6                      | 5   | 4                  | 3                  | 2                  | 1                 | 0                 |
| T0_HOLDOVER_FREQ15      | T0_HOLDOVER_FREQ14     | T0_HOLDOVER_FREQ13  | T0_HOLDOVER_FREQ12 | T0_HOLDOVER_FREQ11 | T0_HOLDOVER_FREQ10 | T0_HOLDOVER_FREQ9 | T0_HOLDOVER_FREQ8 |
| Bit                     | Name                   | Description   |                    |                    |                    |                   |                   |
| 7 - 0                   | T0_HOLDOVER_FREQ[15:8] | Refer to the description of the T0_HOLDOVER_FREQ[23:16] bits (b7~0, 5FH). |                    |                    |                    |                   |                   |

**T0\_HOLDOVER\_FREQ[23:16]\_CNFG - T0 DPLL Holdover Frequency Configuration 3**

| Address: 5FH            |                         |  |                    |                    |                    |                    |                    |
|-------------------------|-------------------------|--|--------------------|--------------------|--------------------|--------------------|--------------------|
| Type: Read / Write      |                         |  |                    |                    |                    |                    |                    |
| Default Value: 00000000 |                         |  |                    |                    |                    |                    |                    |
| 7                       | 6                       | 5  | 4                  | 3                  | 2                  | 1                  | 0                  |
| T0_HOLDOVER_FREQ23      | T0_HOLDOVER_FREQ22      | T0_HOLDOVER_FREQ21   | T0_HOLDOVER_FREQ20 | T0_HOLDOVER_FREQ19 | T0_HOLDOVER_FREQ18 | T0_HOLDOVER_FREQ17 | T0_HOLDOVER_FREQ16 |
| Bit                     | Name                    | Description  |                    |                    |                    |                    |                    |
| 7 - 0                   | T0_HOLDOVER_FREQ[23:16] | The T0_HOLDOVER_FREQ[23:0] bits represent a 2's complement signed integer. In T0 DPLL Holdover mode, the value written to these bits multiplied by 0.000011 is the frequency offset set manually; the value read from these bits multiplied by 0.000011 is the frequency offset automatically slow or fast averaged or manually set, as determined by the READ_AVG bit (b4, 5CH) and the FAST_AVG bit (b5, 5CH). |                    |                    |                    |                    |                    |

## T4\_DPLL\_APLL\_PATH\_CNFG - T4 DPLL &amp; APLL Path Configuration

| Address: 60H            |                               |  |                   |                               |                               |                             |                             |
|-------------------------|-------------------------------|--|-------------------|-------------------------------|-------------------------------|-----------------------------|-----------------------------|
| Type: Read / Write      |                               |  |                   |                               |                               |                             |                             |
| Default Value: 01000X0X |                               |  |                   |                               |                               |                             |                             |
| 7                       | 6                             | 5  | 4                 | 3                             | 2                             | 1                           | 0                           |
| T4_APLL_PATH<br>3       | T4_APLL_PA<br>TH2             | T4_APLL_PA<br>TH1  | T4_APLL_PA<br>TH0 | T4_GSM_GPS_16<br>E1_16T1_SEL1 | T4_GSM_GPS_16<br>E1_16T1_SEL0 | T4_12E1_24T1_<br>E3_T3_SEL1 | T4_12E1_24T1_<br>E3_T3_SEL0 |
| Bit                     | Name                          | Description  |                   |                               |                               |                             |                             |
| 7 - 4                   | T4_APLL_PATH[3:0]             | <p>These bits select an input to the T4 APLL.</p> <p>0000: The output of T0 DPLL 77.76 MHz path.</p> <p>0001: The output of T0 DPLL 12E1/24T1/E3/T3 path.</p> <p>0010: The output of T0 DPLL 16E1/16T1 path.</p> <p>0011: The output of T0 DPLL GSM/OBSAI/16E1/16T1 path.</p> <p>0100: The output of T4 DPLL 77.76 MHz path. (default)</p> <p>0101: The output of T4 DPLL 12E1/24T1/E3/T3 path.</p> <p>0110: The output of T4 DPLL 16E1/16T1 path.</p> <p>0111: The output of T4 DPLL GSM/GPS/16E1/16T1 path.</p> <p>1XXX: Reserved.</p> |                   |                               |                               |                             |                             |
| 3 - 2                   | T4_GSM_GPS_16E1_16T1_SEL[1:0] | <p>These bits select an output clock from the T4 DPLL GSM/GPS/16E1/16T1 path.</p> <p>00: 16E1.</p> <p>01: 16T1.</p> <p>10: GSM.</p> <p>11: GPS.</p> <p>The default value of the T0_GSM_GPS_16E1_16T1_SEL0 bit is determined by the SONET/<math>\overline{\text{SDH}}</math> pin during reset.</p>  |                   |                               |                               |                             |                             |
| 1 - 0                   | T4_12E1_24T1_E3_T3_SEL[1:0]   | <p>These bits select an output clock from the T4 DPLL 12E1/24T1/E3/T3 path.</p> <p>00: 12E1.</p> <p>01: 24T1.</p> <p>10: E3.</p> <p>11: T3.</p> <p>The default value of the T4_12E1_24T1_E3_T3_SEL0 bit is determined by the SONET/<math>\overline{\text{SDH}}</math> pin during reset.</p>  |                   |                               |                               |                             |                             |



**T4\_DPLL\_LOCKED\_BW\_DAMPING\_CNFG - T4 DPLL Locked Bandwidth & Damping Factor Configuration**

Address: 61H  
 Type: Read / Write  
 Default Value: 011XXX00

|                         |                         |                         |   |   |   |                    |                    |
|-------------------------|-------------------------|-------------------------|---|---|---|--------------------|--------------------|
| 7                       | 6                       | 5                       | 4 | 3 | 2 | 1                  | 0                  |
| T4_DPLL_LOCKED_DAMPING2 | T4_DPLL_LOCKED_DAMPING1 | T4_DPLL_LOCKED_DAMPING0 | - | - | - | T4_DPLL_LOCKED_BW1 | T4_DPLL_LOCKED_BW0 |

| Bit   | Name                        | Description   |
|-------|-----------------------------|---|
| 7 - 5 | T4_DPLL_LOCKED_DAMPING[2:0] | These bits set the locked damping factor for T4 DPLL.<br>000: Reserved.<br>001: 1.2.<br>010: 2.5.<br>011: 5. (default)<br>100: 10.<br>101: 20.<br>110, 111: Reserved. |
| 4 - 2 | -                           | Reserved.   |
| 1 - 0 | T4_DPLL_LOCKED_BW[1:0]      | These bits set the locked bandwidth for T4 DPLL.<br>00: 18 Hz. (default)<br>01: 35 Hz.<br>10: 70 Hz.<br>11: 560 Hz.   |

**CURRENT\_DPLL\_FREQ[7:0]\_STS - DPLL Current Frequency Status 1 \***

Address: 62H  
 Type: Read  
 Default Value: 00000000

|                    |                    |                    |                    |                    |                    |                    |                    |
|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| 7                  | 6                  | 5                  | 4                  | 3                  | 2                  | 1                  | 0                  |
| CURRENT_DPLL_FREQ7 | CURRENT_DPLL_FREQ6 | CURRENT_DPLL_FREQ5 | CURRENT_DPLL_FREQ4 | CURRENT_DPLL_FREQ3 | CURRENT_DPLL_FREQ2 | CURRENT_DPLL_FREQ1 | CURRENT_DPLL_FREQ0 |

| Bit   | Name                   | Description  |
|-------|------------------------|--|
| 7 - 0 | CURRENT_DPLL_FREQ[7:0] | Refer to the description of the CURRENT_DPLL_FREQ[23:16] bits (b7~0, 64H). |

**CURRENT\_DPLL\_FREQ[15:8]\_STS - DPLL Current Frequency Status 2 \***

Address: 63H  
 Type: Read  
 Default Value: 00000000

|                     |                     |                     |                     |                     |                     |                    |                    |
|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|--------------------|--------------------|
| 7                   | 6                   | 5                   | 4                   | 3                   | 2                   | 1                  | 0                  |
| CURRENT_DPLL_FREQ15 | CURRENT_DPLL_FREQ14 | CURRENT_DPLL_FREQ13 | CURRENT_DPLL_FREQ12 | CURRENT_DPLL_FREQ11 | CURRENT_DPLL_FREQ10 | CURRENT_DPLL_FREQ9 | CURRENT_DPLL_FREQ8 |

| Bit   | Name                    | Description  |
|-------|-------------------------|--|
| 7 - 0 | CURRENT_DPLL_FREQ[15:8] | Refer to the description of the CURRENT_DPLL_FREQ[23:16] bits (b7~0, 64H). |

**CURRENT\_DPLL\_FREQ[23:16]\_STS - DPLL Current Frequency Status 3 \***

| Address: 64H<br>Type: Read<br>Default Value: 00000000 |                          |   |                     |                     |                     |                     |                     |
|---|--------------------------|---|---------------------|---------------------|---------------------|---------------------|---------------------|
| 7   | 6                        | 5   | 4                   | 3                   | 2                   | 1                   | 0                   |
| CURRENT_DPLL_FREQ23                                   | CURRENT_DPLL_FREQ22      | CURRENT_DPLL_FREQ21   | CURRENT_DPLL_FREQ20 | CURRENT_DPLL_FREQ19 | CURRENT_DPLL_FREQ18 | CURRENT_DPLL_FREQ17 | CURRENT_DPLL_FREQ16 |
| Bit   | Name                     | Description   |                     |                     |                     |                     |                     |
| 7 - 0   | CURRENT_DPLL_FREQ[23:16] | The CURRENT_DPLL_FREQ[23:0] bits represent a 2's complement signed integer. If the value in these bits is multiplied by 0.000011, the current frequency offset of the T0/T4 DPLL output in ppm with respect to the master clock will be gotten. |                     |                     |                     |                     |                     |

**DPLL\_FREQ\_SOFT\_LIMIT\_CNFG - DPLL Soft Limit Configuration**

| Address: 65H<br>Type: Read / Write<br>Default Value: 10001100 |                           |   |                       |                       |                       |                       |                       |
|---|---------------------------|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 7   | 6                         | 5   | 4                     | 3                     | 2                     | 1                     | 0                     |
| FREQ_LIMIT_PH_LOS   | DPLL_FREQ_SOFT_LIMIT6     | DPLL_FREQ_SOFT_LIMIT5   | DPLL_FREQ_SOFT_LIMIT4 | DPLL_FREQ_SOFT_LIMIT3 | DPLL_FREQ_SOFT_LIMIT2 | DPLL_FREQ_SOFT_LIMIT1 | DPLL_FREQ_SOFT_LIMIT0 |
| Bit   | Name                      | Description   |                       |                       |                       |                       |                       |
| 7   | FREQ_LIMIT_PH_LOS         | This bit determines whether the T0/T4 DPLL in hard alarm status will result in its being unlocked.<br>0: Disabled.<br>1: Enabled. (default)   |                       |                       |                       |                       |                       |
| 6 - 0   | DPLL_FREQ_SOFT_LIMIT[6:0] | These bits represent an unsigned integer. If the value is multiplied by 0.724, the DPLL soft limit for T0 and T4 paths in ppm will be gotten.<br>The DPLL soft limit is symmetrical about zero. |                       |                       |                       |                       |                       |

**DPLL\_FREQ\_HARD\_LIMIT[7:0]\_CNFG - DPLL Hard Limit Configuration 1**

| Address: 66H<br>Type: Read / Write<br>Default Value: 10101011 |                           |  |                       |                       |                       |                       |                       |
|---|---------------------------|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 7   | 6                         | 5  | 4                     | 3                     | 2                     | 1                     | 0                     |
| DPLL_FREQ_HARD_LIMIT7   | DPLL_FREQ_HARD_LIMIT6     | DPLL_FREQ_HARD_LIMIT5  | DPLL_FREQ_HARD_LIMIT4 | DPLL_FREQ_HARD_LIMIT3 | DPLL_FREQ_HARD_LIMIT2 | DPLL_FREQ_HARD_LIMIT1 | DPLL_FREQ_HARD_LIMIT0 |
| Bit   | Name                      | Description  |                       |                       |                       |                       |                       |
| 7 - 0   | DPLL_FREQ_HARD_LIMIT[7:0] | Refer to the description of the DPLL_FREQ_HARD_LIMIT[15:8] bits (b7~0, 67H). |                       |                       |                       |                       |                       |

**DPLL\_FREQ\_HARD\_LIMIT[15:8]\_CNFG - DPLL Hard Limit Configuration 2**

| Address: 67H<br>Type: Read / Write<br>Default Value: 00011001 |                            |  |                            |                            |                            |                           |                           |
|---|----------------------------|--|----------------------------|----------------------------|----------------------------|---------------------------|---------------------------|
| 7   | 6                          | 5  | 4                          | 3                          | 2                          | 1                         | 0                         |
| DPLL_FREQ_H<br>ARD_LIMIT15                                    | DPLL_FREQ_H<br>ARD_LIMIT14 | DPLL_FREQ_H<br>ARD_LIMIT13   | DPLL_FREQ_H<br>ARD_LIMIT12 | DPLL_FREQ_H<br>ARD_LIMIT11 | DPLL_FREQ_H<br>ARD_LIMIT10 | DPLL_FREQ_H<br>ARD_LIMIT9 | DPLL_FREQ_H<br>ARD_LIMIT8 |
| Bit   | Name                       | Description  |                            |                            |                            |                           |                           |
| 7 - 0   | DPLL_FREQ_HARD_LIMIT[15:8] | The DPLL_FREQ_HARD_LIMIT[15:0] bits represent an unsigned integer. If the value is multiplied by 0.0014, the DPLL hard limit for T0 and T4 paths in ppm will be gotten. The DPLL hard limit is symmetrical about zero. |                            |                            |                            |                           |                           |

**CURRENT\_DPLL\_PHASE[7:0]\_STS - DPLL Current Phase Status 1 \***

| Address: 68H<br>Type: Read<br>Default Value: 00000000 |                      |   |                      |                      |                      |                      |                      |
|---|----------------------|---|----------------------|----------------------|----------------------|----------------------|----------------------|
| 7   | 6                    | 5   | 4                    | 3                    | 2                    | 1                    | 0                    |
| CURRENT_PH<br>_DATA7                                  | CURRENT_PH<br>_DATA6 | CURRENT_PH<br>_DATA5  | CURRENT_PH<br>_DATA4 | CURRENT_PH<br>_DATA3 | CURRENT_PH<br>_DATA2 | CURRENT_PH<br>_DATA1 | CURRENT_PH<br>_DATA0 |
| Bit   | Name                 | Description   |                      |                      |                      |                      |                      |
| 7 - 0   | CURRENT_PH_DATA[7:0] | Refer to the description of the CURRENT_PH_DATA[15:8] bits (b7~0, 69H). |                      |                      |                      |                      |                      |

**CURRENT\_DPLL\_PHASE[15:8]\_STS - DPLL Current Phase Status 2 \***

| Address: 69H<br>Type: Read<br>Default Value: 00000000 |                       |  |                       |                       |                       |                      |                      |
|---|-----------------------|--|-----------------------|-----------------------|-----------------------|----------------------|----------------------|
| 7   | 6                     | 5  | 4                     | 3                     | 2                     | 1                    | 0                    |
| CURRENT_PH<br>_DATA15                                 | CURRENT_PH<br>_DATA14 | CURRENT_PH<br>_DATA13  | CURRENT_PH<br>_DATA12 | CURRENT_PH<br>_DATA11 | CURRENT_PH<br>_DATA10 | CURRENT_PH<br>_DATA9 | CURRENT_PH<br>_DATA8 |
| Bit   | Name                  | Description  |                       |                       |                       |                      |                      |
| 7 - 0   | CURRENT_PH_DATA[15:8] | The CURRENT_PH_DATA[15:0] bits represent a 2's complement signed integer. If the value is multiplied by 0.61, the averaged phase error of the T0/T4 DPLL feedback with respect to the selected input clock in ns will be gotten. |                       |                       |                       |                      |                      |

**T0\_T4\_APLL\_BW\_CNFG - T0 / T4 APLL Bandwidth Configuration**

| Address: 6AH            |                 |   |             |   |   |             |             |
|-------------------------|-----------------|---|-------------|---|---|-------------|-------------|
| Type: Read / Write      |                 |   |             |   |   |             |             |
| Default Value: XX01XX01 |                 |   |             |   |   |             |             |
| 7                       | 6               | 5   | 4           | 3 | 2 | 1           | 0           |
| -                       | -               | T0_APLL_BW1   | T0_APLL_BW0 | - | - | T4_APLL_BW1 | T4_APLL_BW0 |
| Bit                     | Name            | Description   |             |   |   |             |             |
| 7 - 6                   | -               | Reserved.   |             |   |   |             |             |
| 5 - 4                   | T0_APLL_BW[1:0] | These bits set the bandwidth for T0 APLL.<br>00: 100 kHz.<br>01: 500 kHz. (default)<br>10: 1 MHz.<br>11: 2 MHz. |             |   |   |             |             |
| 3 - 2                   | -               | Reserved.   |             |   |   |             |             |
| 1 - 0                   | T4_APLL_BW[1:0] | These bits set the bandwidth for T4 APLL.<br>00: 100 kHz.<br>01: 500 kHz. (default)<br>10: 1 MHz.<br>11: 2 MHz. |             |   |   |             |             |

7.2.8 OUTPUT CONFIGURATION REGISTERS

OUT1\_FREQ\_CNFG - Output Clock 1 Frequency Configuration

| Address: 6DH            |                    |   |                    |                   |                   |                   |                   |
|-------------------------|--------------------|---|--------------------|-------------------|-------------------|-------------------|-------------------|
| Type: Read / Write      |                    |   |                    |                   |                   |                   |                   |
| Default Value: 00001000 |                    |   |                    |                   |                   |                   |                   |
| 7                       | 6                  | 5   | 4                  | 3                 | 2                 | 1                 | 0                 |
| OUT1_PATH_S<br>EL3      | OUT1_PATH_S<br>EL2 | OUT1_PATH_S<br>EL1  | OUT1_PATH_S<br>EL0 | OUT1_DIVIDER<br>3 | OUT1_DIVIDER<br>2 | OUT1_DIVIDER<br>1 | OUT1_DIVIDER<br>0 |
| Bit                     | Name               | Description   |                    |                   |                   |                   |                   |
| 7 - 4                   | OUT1_PATH_SEL[3:0] | These bits select an input to OUT1.<br>0000 ~ 0011: The output of T0 APLL. (default: 0000)<br>0100: The output of T0 DPLL 77.76 MHz path.<br>0101: The output of T0 DPLL 12E1/24T1/E3/T3 path.<br>0110: The output of T0 DPLL 16E1/16T1 path.<br>0111: The output of T0 DPLL GSM/OBSAI/16E1/16T1 path.<br>1000 ~ 1011: The output of T4 APLL.<br>1100: The output of T4 DPLL 77.76 MHz path.<br>1101: The output of T4 DPLL 12E1/24T1/E3/T3 path.<br>1110: The output of T4 DPLL 16E1/16T1 path.<br>1111: The output of T4 DPLL GSM/GPS/16E1/16T1 path. |                    |                   |                   |                   |                   |
| 3 - 0                   | OUT1_DIVIDER[3:0]  | These bits select a division factor of the divider for OUT1.<br>The output frequency is determined by the division factor and the signal derived from T0/T4 DPLL or T0/T4 APLL output (selected by the OUT1_PATH_SEL[3:0] bits (b7~4, 6DH)). If the signal is derived from one of the T0/T4 DPLL outputs, please refer to <a href="#">Table 24</a> for the division factor selection. If the signal is derived from the T0/T4 APLL output, please refer to <a href="#">Table 25</a> for the division factor selection.                                  |                    |                   |                   |                   |                   |

**OUT2\_FREQ\_CNFG - Output Clock 2 Frequency Configuration**

| Address: 6EH            |                    |   |                    |                   |                   |                   |                   |
|-------------------------|--------------------|---|--------------------|-------------------|-------------------|-------------------|-------------------|
| Type: Read / Write      |                    |   |                    |                   |                   |                   |                   |
| Default Value: 00000110 |                    |   |                    |                   |                   |                   |                   |
| 7                       | 6                  | 5   | 4                  | 3                 | 2                 | 1                 | 0                 |
| OUT2_PATH_S<br>EL3      | OUT2_PATH_S<br>EL2 | OUT2_PATH_S<br>EL1  | OUT2_PATH_S<br>EL0 | OUT2_DIVIDER<br>3 | OUT2_DIVIDER<br>2 | OUT2_DIVIDER<br>1 | OUT2_DIVIDER<br>0 |
| Bit                     | Name               | Description   |                    |                   |                   |                   |                   |
| 7 - 4                   | OUT2_PATH_SEL[3:0] | These bits select an input to OUT2.<br>0000 ~ 0011: The output of T0 APLL. (default: 0000)<br>0100: The output of T0 DPLL 77.76 MHz path.<br>0101: The output of T0 DPLL 12E1/24T1/E3/T3 path.<br>0110: The output of T0 DPLL 16E1/16T1 path.<br>0111: The output of T0 DPLL GSM/OBSAI/16E1/16T1 path.<br>1000 ~ 1011: The output of T4 APLL.<br>1100: The output of T4 DPLL 77.76 MHz path.<br>1101: The output of T4 DPLL 12E1/24T1/E3/T3 path.<br>1110: The output of T4 DPLL 16E1/16T1 path.<br>1111: The output of T4 DPLL GSM/GPS/16E1/16T1 path. |                    |                   |                   |                   |                   |
| 3 - 0                   | OUT2_DIVIDER[3:0]  | These bits select a division factor of the divider for OUT2.<br>The output frequency is determined by the division factor and the signal derived from T0/T4 DPLL or T0/T4 APLL output (selected by the OUT2_PATH_SEL[3:0] bits (b7~4, 6EH)). If the signal is derived from one of the T0/T4 DPLL outputs, please refer to <a href="#">Table 24</a> for the division factor selection. If the signal is derived from the T0/T4 APLL output, please refer to <a href="#">Table 25</a> for the division factor selection.                                  |                    |                   |                   |                   |                   |

**OUT3\_FREQ\_CNFG - Output Clock 3 Frequency Configuration**

Address: 6FH  
 Type: Read / Write  
 Default Value: 00000100

|                    |                    |                    |                    |                   |                   |                   |                   |
|--------------------|--------------------|--------------------|--------------------|-------------------|-------------------|-------------------|-------------------|
| 7                  | 6                  | 5                  | 4                  | 3                 | 2                 | 1                 | 0                 |
| OUT3_PATH_S<br>EL3 | OUT3_PATH_S<br>EL2 | OUT3_PATH_S<br>EL1 | OUT3_PATH_S<br>EL0 | OUT3_DIVIDER<br>3 | OUT3_DIVIDER<br>2 | OUT3_DIVIDER<br>1 | OUT3_DIVIDER<br>0 |

| Bit   | Name               | Description   |
|-------|--------------------|---|
| 7 - 4 | OUT3_PATH_SEL[3:0] | These bits select an input to OUT3.<br>0000 ~ 0011: The output of T0 APLL. (default: 0000)<br>0100: The output of T0 DPLL 77.76 MHz path.<br>0101: The output of T0 DPLL 12E1/24T1/E3/T3 path.<br>0110: The output of T0 DPLL 16E1/16T1 path.<br>0111: The output of T0 DPLL GSM/OBSAI/16E1/16T1 path.<br>1000 ~ 1011: The output of T4 APLL.<br>1100: The output of T4 DPLL 77.76 MHz path.<br>1101: The output of T4 DPLL 12E1/24T1/E3/T3 path.<br>1110: The output of T4 DPLL 16E1/16T1 path.<br>1111: The output of T4 DPLL GSM/GPS/16E1/16T1 path. |
| 3 - 0 | OUT3_DIVIDER[3:0]  | These bits select a division factor of the divider for OUT3.<br>The output frequency is determined by the division factor and the signal derived from T0/T4 DPLL or T0/T4 APLL output (selected by the OUT3_PATH_SEL[3:0] bits (b7~4, 6FH)). If the signal is derived from one of the T0/T4 DPLL outputs, please refer to <a href="#">Table 24</a> for the division factor selection. If the signal is derived from the T0/T4 APLL output, please refer to <a href="#">Table 25</a> for the division factor selection.                                  |

**OUT4\_FREQ\_CNFG - Output Clock 4 Frequency Configuration**

| Address:70H             |                    |   |                    |                   |                   |                   |                   |
|-------------------------|--------------------|---|--------------------|-------------------|-------------------|-------------------|-------------------|
| Type: Read / Write      |                    |   |                    |                   |                   |                   |                   |
| Default Value: 00000110 |                    |   |                    |                   |                   |                   |                   |
| 7                       | 6                  | 5   | 4                  | 3                 | 2                 | 1                 | 0                 |
| OUT4_PATH_S<br>EL3      | OUT4_PATH_S<br>EL2 | OUT4_PATH_S<br>EL1  | OUT4_PATH_S<br>EL0 | OUT4_DIVIDER<br>3 | OUT4_DIVIDER<br>2 | OUT4_DIVIDER<br>1 | OUT4_DIVIDER<br>0 |
| Bit                     | Name               | Description   |                    |                   |                   |                   |                   |
| 7 - 4                   | OUT4_PATH_SEL[3:0] | These bits select an input to OUT4.<br>0000 ~ 0011: The output of T0 APLL. (default: 0000)<br>0100: The output of T0 DPLL 77.76 MHz path.<br>0101: The output of T0 DPLL 12E1/24T1/E3/T3 path.<br>0110: The output of T0 DPLL 16E1/16T1 path.<br>0111: The output of T0 DPLL GSM/OBSAI/16E1/16T1 path.<br>1000 ~ 1011: The output of T4 APLL.<br>1100: The output of T4 DPLL 77.76 MHz path.<br>1101: The output of T4 DPLL 12E1/24T1/E3/T3 path.<br>1110: The output of T4 DPLL 16E1/16T1 path.<br>1111: The output of T4 DPLL GSM/GPS/16E1/16T1 path. |                    |                   |                   |                   |                   |
| 3 - 0                   | OUT4_DIVIDER[3:0]  | These bits select a division factor of the divider for OUT4.<br>The output frequency is determined by the division factor and the signal derived from T0/T4 DPLL or T0/T4 APLL output (selected by the OUT4_PATH_SEL[3:0] bits (b7~4, 70H)). If the signal is derived from one of the T0/T4 DPLL outputs, please refer to <a href="#">Table 24</a> for the division factor selection. If the signal is derived from the T0/T4 APLL output, please refer to <a href="#">Table 25</a> for the division factor selection.                                  |                    |                   |                   |                   |                   |



**OUT5\_FREQ\_CNFG - Output Clock 5 Frequency Configuration**

Address:71H  
 Type: Read / Write  
 Default Value: 00001000

|                    |                    |                    |                    |                   |                   |                   |                   |
|--------------------|--------------------|--------------------|--------------------|-------------------|-------------------|-------------------|-------------------|
| 7                  | 6                  | 5                  | 4                  | 3                 | 2                 | 1                 | 0                 |
| OUT5_PATH_S<br>EL3 | OUT5_PATH_S<br>EL2 | OUT5_PATH_S<br>EL1 | OUT5_PATH_S<br>EL0 | OUT5_DIVIDER<br>3 | OUT5_DIVIDER<br>2 | OUT5_DIVIDER<br>1 | OUT5_DIVIDER<br>0 |

| Bit   | Name               | Description   |
|-------|--------------------|---|
| 7 - 4 | OUT5_PATH_SEL[3:0] | These bits select an input to OUT5.<br>0000 ~ 0011: The output of T0 APLL. (default: 0000)<br>0100: The output of T0 DPLL 77.76 MHz path.<br>0101: The output of T0 DPLL 12E1/24T1/E3/T3 path.<br>0110: The output of T0 DPLL 16E1/16T1 path.<br>0111: The output of T0 DPLL GSM/OBSAI/16E1/16T1 path.<br>1000 ~ 1011: The output of T4 APLL.<br>1100: The output of T4 DPLL 77.76 MHz path.<br>1101: The output of T4 DPLL 12E1/24T1/E3/T3 path.<br>1110: The output of T4 DPLL 16E1/16T1 path.<br>1111: The output of T4 DPLL GSM/GPS/16E1/16T1 path. |
| 3 - 0 | OUT5_DIVIDER[3:0]  | These bits select a division factor of the divider for OUT5.<br>The output frequency is determined by the division factor and the signal derived from T0/T4 DPLL or T0/T4 APLL output (selected by the OUT5_PATH_SEL[3:0] bits (b7~4, 71H)). If the signal is derived from one of the T0/T4 DPLL outputs, please refer to <a href="#">Table 24</a> for the division factor selection. If the signal is derived from the T0/T4 APLL output, please refer to <a href="#">Table 25</a> for the division factor selection.                                  |

**OUTPUT\_INV2 - Output Clock 4 & 5 Invert Configuration**

Address:72H  
 Type: Read / Write  
 Default Value: 01000000

|   |   |   |   |   |   |          |          |
|---|---|---|---|---|---|----------|----------|
| 7 | 6 | 5 | 4 | 3 | 2 | 1        | 0        |
| - | - | - | - | - | - | OUT5_INV | OUT4_INV |

| Bit   | Name     | Description   |
|-------|----------|---|
| 7 - 2 | -        | Reserved.   |
| 1     | OUT5_INV | This bit determines whether the output on OUT5 is inverted.<br>0: Not inverted. (default)<br>1: Inverted. |
| 0     | OUT4_INV | This bit determines whether the output on OUT4 is inverted.<br>0: Not inverted. (default)<br>1: Inverted. |

**OUTPUT\_INV1 - Output Clock 1 ~ 3 Invert Configuration**

| Address: 73H            |          |   |          |          |          |   |   |
|-------------------------|----------|---|----------|----------|----------|---|---|
| Type: Read / Write      |          |   |          |          |          |   |   |
| Default Value: 01000000 |          |   |          |          |          |   |   |
| 7                       | 6        | 5   | 4        | 3        | 2        | 1 | 0 |
| -                       | -        | -   | OUT3_INV | OUT2_INV | OUT1_INV | - | - |
| Bit                     | Name     | Description   |          |          |          |   |   |
| 7 - 5                   | -        | Reserved.   |          |          |          |   |   |
| 4                       | OUT3_INV | This bit determines whether the output on OUT3 is inverted.<br>0: Not inverted. (default)<br>1: Inverted. |          |          |          |   |   |
| 3                       | OUT2_INV | This bit determines whether the output on OUT2 is inverted.<br>0: Not inverted. (default)<br>1: Inverted. |          |          |          |   |   |
| 2                       | OUT1_INV | This bit determines whether the output on OUT1 is inverted.<br>0: Not inverted. (default)<br>1: Inverted. |          |          |          |   |   |
| 1 - 0                   | -        | Reserved.   |          |          |          |   |   |

## FR\_MFR\_SYNC\_CNFG - Frame Sync &amp; Multiframe Sync Output Configuration

| Address: 74H            |                    |  |                    |        |        |        |        |
|-------------------------|--------------------|--|--------------------|--------|--------|--------|--------|
| Type: Read / Write      |                    |  |                    |        |        |        |        |
| Default Value: 01100000 |                    |  |                    |        |        |        |        |
| 7                       | 6                  | 5  | 4                  | 3      | 2      | 1      | 0      |
| IN_2K_4K_8K_INV         | 8K_EN              | 2K_EN  | 2K_8K_PUL_POSITION | 8K_INV | 8K_PUL | 2K_INV | 2K_PUL |
| Bit                     | Name               | Description  |                    |        |        |        |        |
| 7                       | IN_2K_4K_8K_INV    | This bit determines whether the input clock is inverted before locked by the T0/T4 DPLL when the input clock is 2 kHz, 4 kHz or 8 kHz.<br>0: Not inverted. (default)<br>1: Inverted.   |                    |        |        |        |        |
| 6                       | 8K_EN              | This bit determines whether an 8 kHz signal is enabled to be output on FRSYNC_8K.<br>0: Disabled. FRSYNC_8K outputs low.<br>1: Enabled. (default)  |                    |        |        |        |        |
| 5                       | 2K_EN              | This bit determines whether a 2 kHz signal is enabled to be output on MFRSYNC_2K.<br>0: Disabled. MFRSYNC_2K outputs low.<br>1: Enabled. (default)   |                    |        |        |        |        |
| 4                       | 2K_8K_PUL_POSITION | This bit is valid only when FRSYNC_8K and/or MFRSYNC_2K output pulse; i.e., when one of the 8K_PUL bit (b2, 74H) and the 2K_PUL bit (b0, 74H) is '1' or when the 8K_PUL bit (b2, 74H) and the 2K_PUL bit (b0, 74H) are both '1'. It determines the pulse position referring to the standard 50:50 duty cycle.<br>0: Pulsed on the falling edge of the standard 50:50 duty cycle position. (default)<br>1: Pulsed on the rising edge of the standard 50:50 duty cycle position. |                    |        |        |        |        |
| 3                       | 8K_INV             | This bit determines whether the output on FRSYNC_8K is inverted.<br>0: Not inverted. (default)<br>1: Inverted.   |                    |        |        |        |        |
| 2                       | 8K_PUL             | This bit determines whether the output on FRSYNC_8K is 50:50 duty cycle or pulsed.<br>0: 50:50 duty cycle. (default)<br>1: Pulsed. The pulse width is defined by the period of the output on OUT1.   |                    |        |        |        |        |
| 1                       | 2K_INV             | This bit determines whether the output on MFRSYNC_2K is inverted.<br>0: Not inverted. (default)<br>1: Inverted.  |                    |        |        |        |        |
| 0                       | 2K_PUL             | This bit determines whether the output on MFRSYNC_2K is 50:50 duty cycle or pulsed.<br>0: 50:50 duty cycle. (default)<br>1: Pulsed. The pulse width is defined by the period of the output on OUT1.  |                    |        |        |        |        |

7.2.9 PBO & PHASE OFFSET CONTROL REGISTERS

PHASE\_MON\_PBO\_CNFG - Phase Transient Monitor & PBO Configuration

| Address:78H<br>Type: Read / Write<br>Default Value: 0X000110 |                     |   |                   |                     |                     |                     |                     |
|--|---------------------|---|-------------------|---------------------|---------------------|---------------------|---------------------|
| 7  | 6                   | 5   | 4                 | 3                   | 2                   | 1                   | 0                   |
| IN_NOISE_WIN<br>DOW  | -                   | PH_MON_EN   | PH_MON_PBO<br>_EN | PH_TR_MON_L<br>IMT3 | PH_TR_MON_L<br>IMT2 | PH_TR_MON_L<br>IMT1 | PH_TR_MON_L<br>IMT0 |
| Bit  | Name                | Description   |                   |                     |                     |                     |                     |
| 7  | IN_NOISE_WINDOW     | This bit determines whether the input clock whose edge respect to the reference clock is outside ±5% is enabled to be selected for T0/T4 DPLL.<br>0: Disabled. (default)<br>1: Enabled.   |                   |                     |                     |                     |                     |
| 6  | -                   | Reserved.   |                   |                     |                     |                     |                     |
| 5  | PH_MON_EN           | This bit is valid only when the PH_MON_PBO_EN bit (b4, 78H) is '1'. It determines whether the Phase Transient Monitor is enabled to monitor the phase-time changes on the T0 selected input clock.<br>0: Disabled. (default)<br>1: Enabled.   |                   |                     |                     |                     |                     |
| 4  | PH_MON_PBO_EN       | This bit determines whether a PBO event is triggered when the phase-time changes on the T0 selected input clock are greater than a programmable limit over an interval of less than 0.1 seconds with the PH_MON_EN bit being '1'. The limit is programmed by the PH_TR_MON_LIMT[3:0] bits (b3~0, 78H).<br>0: Disabled. (default)<br>1: Enabled. |                   |                     |                     |                     |                     |
| 3 - 0  | PH_TR_MON_LIMT[3:0] | These bits represent an unsigned integer. The Phase Transient Monitor limit in ns can be calculated as follows:<br><b>Limit (ns) = (PH_TR_MON_LIMT[3:0] + 7) X 156.</b>   |                   |                     |                     |                     |                     |

PHASE\_OFFSET[7:0]\_CNFG - Phase Offset Configuration 1

| Address:7AH<br>Type: Read / Write<br>Default Value: 00000000 |                |  |            |            |            |            |            |
|--|----------------|--|------------|------------|------------|------------|------------|
| 7  | 6              | 5  | 4          | 3          | 2          | 1          | 0          |
| PH_OFFSET7   | PH_OFFSET6     | PH_OFFSET5   | PH_OFFSET4 | PH_OFFSET3 | PH_OFFSET2 | PH_OFFSET1 | PH_OFFSET0 |
| Bit  | Name           | Description  |            |            |            |            |            |
| 7 - 0  | PH_OFFSET[7:0] | Refer to the description of the PH_OFFSET[9:8] bits (b1~0, 7BH). |            |            |            |            |            |

## PHASE\_OFFSET[9:8]\_CNFG - Phase Offset Configuration 2

| Address: 7BH            |                |  |   |   |   |            |            |
|-------------------------|----------------|--|---|---|---|------------|------------|
| Type: Read / Write      |                |  |   |   |   |            |            |
| Default Value: 0XXXXX00 |                |  |   |   |   |            |            |
| 7                       | 6              | 5  | 4 | 3 | 2 | 1          | 0          |
| PH_OFFSET_EN            | -              | -  | - | - | - | PH_OFFSET9 | PH_OFFSET8 |
| Bit                     | Name           | Description  |   |   |   |            |            |
| 7                       | PH_OFFSET_EN   | This bit determines whether the input-to-output phase offset is enabled.<br>If the device is configured as the Master, the input-to-output phase offset:<br>0: Disabled. (default)<br>1: Enabled.<br>If the device is configured as the Slave, the input-to-output phase offset is always enabled. |   |   |   |            |            |
| 6 - 2                   | -              | Reserved.  |   |   |   |            |            |
| 1 - 0                   | PH_OFFSET[9:8] | These bits represent a 2's complement signed integer. If the value is multiplied by 0.61, the input-to-output phase offset in ns to adjust will be gotten.   |   |   |   |            |            |

7.2.10 SYNCHRONIZATION CONFIGURATION REGISTERS

**SYNC\_MONITOR\_CNFG - Sync Monitor Configuration**

Address:7CH  
 Type: Read / Write  
 Default Value: X0101011

|   |                |                |                |   |   |   |   |
|---|----------------|----------------|----------------|---|---|---|---|
| 7 | 6              | 5              | 4              | 3 | 2 | 1 | 0 |
| - | SYNC_MON_LIMT2 | SYNC_MON_LIMT1 | SYNC_MON_LIMT0 | - | - | - | - |

| Bit   | Name               | Description   |
|-------|--------------------|---|
| 7     | -                  | Reserved.   |
| 6 - 4 | SYNC_MON_LIMT[2:0] | These bits set the limit for the external sync alarm.<br>000: ±1 UI.<br>001: ±2 UI.<br>010: ±3 UI. (default)<br>011: ±4 UI.<br>100: ±5 UI.<br>101: ±6 UI.<br>110: ±7 UI.<br>111: ±8 UI. |
| 3 - 0 | -                  | These bits must be set to '1011'.   |

**SYNC\_PHASE\_CNFG - Sync Phase Configuration**

Address:7DH  
 Type: Read / Write  
 Default Value: XXXXXX00

|   |   |   |   |   |   |           |           |
|---|---|---|---|---|---|-----------|-----------|
| 7 | 6 | 5 | 4 | 3 | 2 | 1         | 0         |
| - | - | - | - | - | - | SYNC_PH11 | SYNC_PH10 |

| Bit   | Name          | Description  |
|-------|---------------|--|
| 7 - 2 | -             | Reserved.  |
| 1 - 0 | SYNC_PH1[1:0] | These bits set the sampling of EX_SYNC1 when EX_SYNC1 is enabled to synchronize the frame sync output signal. Nominally, the falling edge of EX_SYNC1 is aligned with the rising edge of the T0 selected input clock.<br>00: On target. (default)<br>01: 0.5 UI early.<br>10: 1 UI late.<br>11: 0.5 UI late. |

## 8 THERMAL MANAGEMENT

The device operates over the industry temperature range -40°C ~ +85°C. To ensure the functionality and reliability of the device, the maximum junction temperature  $T_{jmax}$  should not exceed 125°C. In some applications, the device will consume more power and a thermal solution should be provided to ensure the junction temperature  $T_j$  does not exceed the  $T_{jmax}$ .

### 8.1 JUNCTION TEMPERATURE

Junction temperature  $T_j$  is the temperature of package typically at the geographical center of the chip where the device's electrical circuits are. It can be calculated as follows:

$$\text{Equation 1: } T_j = T_A + P \times \theta_{JA}$$

Where:

$\theta_{JA}$  = Junction-to-Ambient Thermal Resistance of the Package

$T_j$  = Junction Temperature

$T_A$  = Ambient Temperature

$P$  = Device Power Consumption

In order to calculate junction temperature, an appropriate  $\theta_{JA}$  must be used. The  $\theta_{JA}$  is shown in [Table 43](#).

Power consumption is the core power excluding the power dissipated in the loads. [Table 42](#) provides power consumption in special environments.

**Table 42: Power Consumption and Maximum Junction Temperature**

| Package     | Power Consumption (W) | Operating Voltage (V) | $T_A$ (°C) | Maximum Junction Temperature (°C) |
|-------------|-----------------------|-----------------------|------------|-----------------------------------|
| TQFP/PN100  | 1.9                   | 3.6                   | 85         | 125                               |
| TQFP/EQG100 | 1.9                   | 3.6                   | 85         | 125                               |

### 8.2 EXAMPLE OF JUNCTION TEMPERATURE CALCULATION

Assume:

$$T_A = 85^\circ\text{C}$$

$$\theta_{JA} = 18.9^\circ\text{C/W (TQFP/EQG100 Soldered \& when airflow rate is 0 m/s)}$$

$$P = 1.9\text{W}$$

**Table 43: Thermal Data**

| Package     | Pin Count | Thermal Pad   | $\theta_{JC}$ (°C/W) | $\theta_{JB}$ (°C/W) | $\theta_{JA}$ (°C/W) vs Air Flow in m/s |      |      |      |      |      |
|-------------|-----------|---------------|----------------------|----------------------|---|------|------|------|------|------|
|             |           |               |                      |                      | 0                                       | 1    | 2    | 3    | 4    | 5    |
| TQFP/PN100  | 100       | No            | 11.0                 | 34.2                 | 39.3                                    | 36.2 | 34.3 | 33.5 | 32.9 | 32.6 |
| TQFP/EQG100 | 100       | Yes/Exposed   | 16.1                 | 34.2                 | 35.8                                    | 31.1 | 29.5 | 28.6 | 27.9 | 27.4 |
| TQFP/EQG100 | 100       | Yes/Soldered* | 16.1                 | 1.3                  | 18.9                                    | 14.6 | 13.5 | 12.9 | 12.6 | 12.4 |

\*note: Simulated with 3 x 3 array of thermal vias.

The junction temperature  $T_j$  can be calculated as follows:

$$T_j = T_A + P \times \theta_{JA} = 85^\circ\text{C} + 1.9\text{W} \times 18.9^\circ\text{C/W} = 120.9^\circ\text{C}$$

The junction temperature of 120.9°C is below the maximum junction temperature of 125°C so no extra heat enhancement is required.

In some operation environments, the calculated junction temperature might exceed the maximum junction temperature of 125°C and an external thermal solution such as a heatsink is required.

### 8.3 HEATSINK EVALUATION

A heatsink is expanding the surface area of the device to which it is attached.  $\theta_{JA}$  is now a combination of device case and heat-sink thermal resistance, as the heat flowing from the die junction to ambient goes through the package and the heatsink.  $\theta_{JA}$  can be calculated as follows:

$$\text{Equation 2: } \theta_{JA} = \theta_{JC} + \theta_{CH} + \theta_{HA}$$

Where:

$\theta_{JC}$  = Junction-to-Case Thermal Resistance

$\theta_{CH}$  = Case-to-Heatsink Thermal Resistance

$\theta_{HA}$  = Heatsink-to-Ambient Thermal Resistance

$\theta_{CH} + \theta_{HA}$  determines which heatsink and heatsink attachment can be selected to ensure the junction temperature does not exceed the maximum junction temperature. According to Equation 1 and 2,

$\theta_{CH} + \theta_{HA}$  can be calculated as follows:

$$\text{Equation 3: } \theta_{CH} + \theta_{HA} = (T_j - T_A) / P - \theta_{JC}$$

Assume:

$$T_j = 125^\circ\text{C (} T_{jmax} \text{)}$$

$$T_A = 85^\circ\text{C}$$

$$P = 1.9\text{ W}$$

$$\theta_{JC} = 16.1^\circ\text{C/W (TQFP/EQG100)}$$

$\theta_{CH} + \theta_{HA}$  can be calculated as follows:

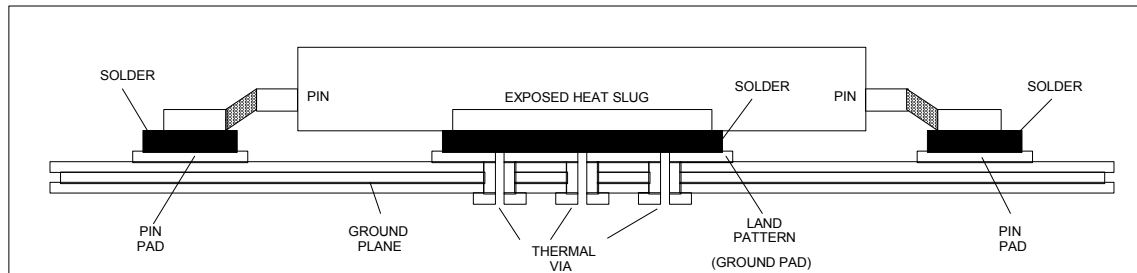
$$\theta_{CH} + \theta_{HA} = (125^\circ\text{C} - 85^\circ\text{C}) / 1.9\text{W} - 16.1^\circ\text{C/W} = 5.0^\circ\text{C/W}$$

That is, if a heatsink and heatsink attachment whose  $\theta_{CH} + \theta_{HA}$  is below or equal to 5.0°C/W is used in such operation environment, the junction temperature will not exceed the maximum junction temperature.

## 8.4 TQFP EPAD THERMAL RELEASE PATH

In order to maximize both the removal of heat from the package and the electrical performance, a land pattern must be incorporated on the Printed Circuit Board (PCB) within the footprint of the package corresponding to the exposed metal pad or exposed heat slug on the package, as shown in [Figure 27](#). The solderable area on the PCB, as defined

by the solder mask, should be at least the same size/shape as the exposed pad/slug area on the package to maximize the thermal/electrical performance. Sufficient clearance should be designed on the PCB between the outer edges of the land pattern and the inner edges of pad pattern for the leads to avoid any shorts.



**Figure 27. Assembly for Expose Pad thermal Release Path (Side View)**

While the land pattern on the PCB provides a means of heat transfer and electrical grounding from the package to the board through a solder joint, thermal vias are necessary to effectively conduct from the surface of the PCB to the ground plane(s). The land pattern must be connected to ground through these vias. The vias act as 'heat pipes'. The number of vias (i.e. 'heat pipes') are application specific and dependent upon the package power dissipation as well as electrical conductivity requirements. Thus, thermal and electrical analysis and/or testing are recommended to determine the minimum number needed. Maximum thermal and electrical performance is achieved when an array of vias is incorporated in the land pattern. It is recommended to use as many vias con-

nected to ground as possible. It is also recommended that the via diameter should be 12 to 13mils (0.30 to 0.33mm) with 1 oz copper via barrel plating. This is desirable to avoid any solder wicking inside the via during the soldering process which may result in voids in solder between the exposed pad/slug and the thermal land. Precautions should be taken to eliminate any solder voids between the exposed heat slug and the land pattern. Note: These recommendations are to be used as a guideline only. For further information, please refer to the Application Note on the Surface Mount Assembly of Amkor's Thermally/Electrically Enhance Leadframe Base Package, Amkor Technology.



## 9 ELECTRICAL SPECIFICATIONS

### 9.1 ABSOLUTE MAXIMUM RATING

Table 44: Absolute Maximum Rating

| Symbol     | Parameter                           | Min  | Max  | Unit |
|------------|-------------------------------------|------|------|------|
| $V_{DD}$   | Supply Voltage VDD                  | -0.5 | 3.6  | V    |
| $V_{IN}$   | Input Voltage (non-supply pins)     |      | 5.5  | V    |
| $V_{OUT}$  | Output Voltage (non-supply pins)    |      | 5.5  | V    |
| $T_A$      | Ambient Operating Temperature Range | -40  | +85  | °C   |
| $T_{STOR}$ | Storage Temperature                 | -50  | +150 | °C   |

### 9.2 RECOMMENDED OPERATION CONDITIONS

Table 45: Recommended Operation Conditions

| Symbol    | Parameter                     | Min | Typ | Max | Unit | Test Condition                        |
|-----------|-------------------------------|-----|-----|-----|------|---------------------------------------|
| $V_{DD}$  | Power Supply (DC voltage) VDD | 3.0 | 3.3 | 3.6 | V    |                                       |
| $T_A$     | Ambient Temperature Range     | -40 |     | +85 | °C   |                                       |
| $I_{DD}$  | Supply Current                |     | 455 | 528 | mA   | Exclude the loading current and power |
| $P_{TOT}$ | Total Power Dissipation       |     | 1.5 | 1.9 | W    |                                       |

## 9.3 I/O SPECIFICATIONS

### 9.3.1 CMOS INPUT / OUTPUT PORT

From Table 46 to Table 49,  $V_{DD}$  is 3.3 V.

**Table 46: CMOS Input Port Electrical Characteristics**

| Parameter | Description        | Min         | Typ | Max         | Unit    | Test Condition |
|-----------|--------------------|-------------|-----|-------------|---------|----------------|
| $V_{IH}$  | Input Voltage High | $0.7V_{DD}$ |     |             | V       |                |
| $V_{IL}$  | Input Voltage Low  |             |     | $0.2V_{DD}$ | V       |                |
| $I_{IN}$  | Input Current      |             |     | 10          | $\mu A$ |                |
| $V_{IN}$  | Input Voltage      | -0.5        |     | 5.5         | V       |                |

**Table 47: CMOS Input Port with Internal Pull-Up Resistor Electrical Characteristics**

| Parameter | Description        | Min         | Typ | Max         | Unit      | Test Condition |
|-----------|--------------------|-------------|-----|-------------|-----------|----------------|
| $V_{IH}$  | Input Voltage High | $0.7V_{DD}$ |     |             | V         |                |
| $V_{IL}$  | Input Voltage Low  |             |     | $0.2V_{DD}$ | V         |                |
| $P_U$     | Pull-Up Resistor   | 10          |     | 80          | $K\Omega$ |                |
| $I_{IN}$  | Input Current      |             |     | 250         | $\mu A$   |                |
| $V_{IN}$  | Input Voltage      | -0.5        |     | 5.5         | V         |                |

**Table 48: CMOS Input Port with Internal Pull-Down Resistor Electrical Characteristics**

| Parameter | Description        | Min         | Typ | Max         | Unit      | Test Condition   |
|-----------|--------------------|-------------|-----|-------------|-----------|--|
| $V_{IH}$  | Input Voltage High | $0.7V_{DD}$ |     |             | V         |  |
| $V_{IL}$  | Input Voltage Low  |             |     | $0.2V_{DD}$ | V         |  |
| $P_D$     | Pull-Down Resistor | 10          |     | 80          | $K\Omega$ | other CMOS input port with internal pull-down resistor |
|           |                    | 5           |     | 40          |           | TRST and TCK pin                                       |
|           |                    | 100         |     | 300         |           | A[6:0], AD[7:0] pins                                   |
| $I_{IN}$  | Input Current      |             |     | 350         | $\mu A$   | other CMOS input port with internal pull-down resistor |
|           |                    |             |     | 700         |           | TRST and TCK pin                                       |
|           |                    |             |     | 40          |           | A[6:0], AD[7:0] pins                                   |
| $V_{IN}$  | Input Voltage      | -0.5        |     | 5.5         | V         |  |

**Table 49: CMOS Output Port Electrical Characteristics**

| Application Pin | Parameter | Description         | Min | Typ | Max      | Unit | Test Condition          |
|-----------------|-----------|---------------------|-----|-----|----------|------|-------------------------|
| Output Clock    | $V_{OH}$  | Output Voltage High | 2.4 |     | $V_{DD}$ | V    | $I_{OH} = 8 \text{ mA}$ |
|                 | $V_{OL}$  | Output Voltage Low  | 0   |     | 0.4      | V    | $I_{OL} = 8 \text{ mA}$ |
|                 | $t_R$     | Rise time           |     | 3   | 4        | ns   | 15 pF                   |
|                 | $t_F$     | Fall time           |     | 3   | 4        | ns   | 15 pF                   |
| Other Output    | $V_{OH}$  | Output Voltage High | 2.5 |     | $V_{DD}$ | V    | $I_{OH} = 4 \text{ mA}$ |
|                 | $V_{OL}$  | Output Voltage Low  | 0   |     | 0.4      | V    | $I_{OL} = 4 \text{ mA}$ |
|                 | $t_R$     | Rise Time           |     |     | 10       | ns   | 50 pF                   |
|                 | $t_F$     | Fall Time           |     |     | 10       | ns   | 50 pF                   |

9.3.2 PECL / LVDS INPUT / OUTPUT PORT

9.3.2.1 PECL Input / Output Port

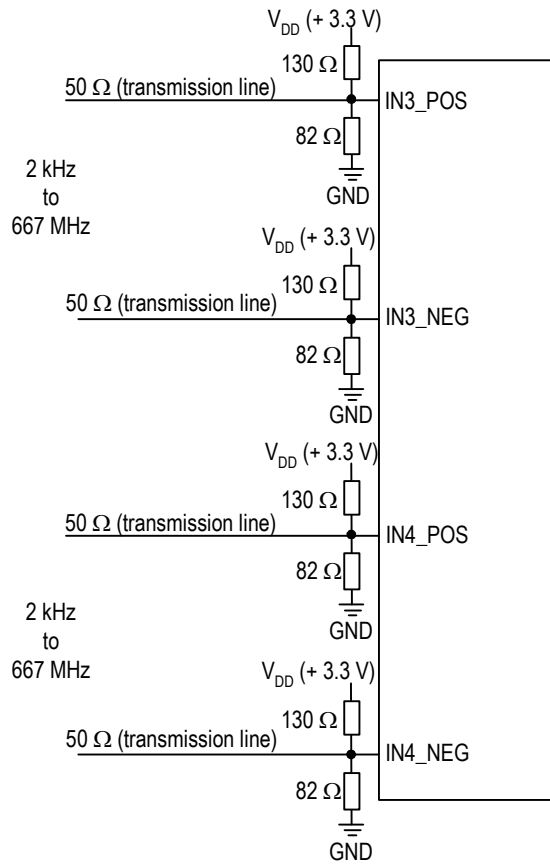


Figure 28. Recommended PECL Input Port Line Termination

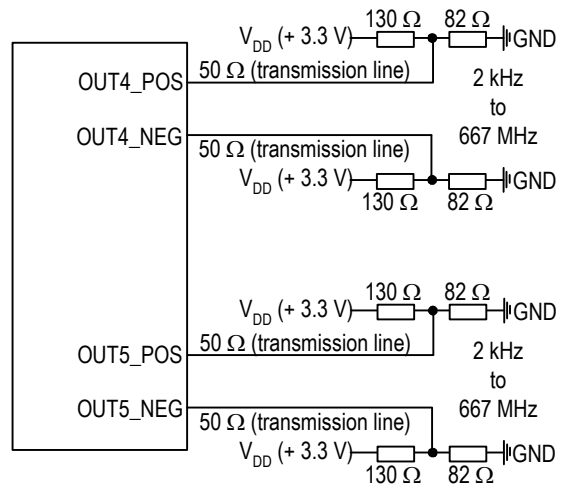


Figure 29. Recommended PECL Output Port Line Termination

Table 50: PECL Input / Output Port Electrical Characteristics

| Parameter   | Description   | Min             | Typ | Max             | Unit    | Test Condition |
|-------------|---|-----------------|-----|-----------------|---------|----------------|
| $V_{IL}$    | Input Low Voltage, Differential Inputs <sup>1</sup>             | $V_{DD} - 2.5$  |     | $V_{DD} - 0.5$  | V       |                |
| $V_{IH}$    | Input High Voltage, Differential Inputs <sup>1</sup>            | $V_{DD} - 2.4$  |     | $V_{DD} - 0.4$  | V       |                |
| $V_{ID}$    | Input Differential Voltage                                      | 0.1             |     | 1.4             | V       |                |
| $V_{IL\_S}$ | Input Low Voltage, Single-ended Input <sup>2</sup>              | $V_{DD} - 2.4$  |     | $V_{DD} - 1.5$  | V       |                |
| $V_{IH\_S}$ | Input High Voltage, Single-ended Input <sup>2</sup>             | $V_{DD} - 1.3$  |     | $V_{DD} - 0.5$  | V       |                |
| $I_{IH}$    | Input High Current, Input Differential Voltage $V_{ID} = 1.4$ V | -10             |     | 10              | $\mu$ A |                |
| $I_{IL}$    | Input Low Current, Input Differential Voltage $V_{ID} = 1.4$ V  | -10             |     | 10              | $\mu$ A |                |
| $V_{OL}$    | Output Voltage Low <sup>3</sup>                                 | $V_{DD} - 2.1$  |     | $V_{DD} - 1.62$ | V       |                |
| $V_{OH}$    | Output Voltage High <sup>3</sup>                                | $V_{DD} - 1.25$ |     | $V_{DD} - 0.88$ | V       |                |
| $V_{OD}$    | Output Differential Voltage <sup>3</sup>                        | 580             |     | 900             | mV      |                |
| $t_{RISE}$  | Output Rise time (20% to 80%)                                   | 200             |     | 300             | pS      |                |
| $t_{FALL}$  | Output Fall time (20% to 80%)                                   | 200             |     | 300             | pS      |                |
| $t_{SKEW}$  | Output Differential Skew  |                 |     | 50              | pS      |                |

**Note:**

1. Assuming a differential input voltage of at least 100 mV.
2. Unused differential input terminated to  $V_{DD} - 1.4$  V.
3. With 50  $\Omega$  load on each pin to  $V_{DD} - 2$  V, i.e. 82  $\Omega$  to GND and 130  $\Omega$  to  $V_{DD}$ .

9.3.2.2 LVDS Input / Output Port

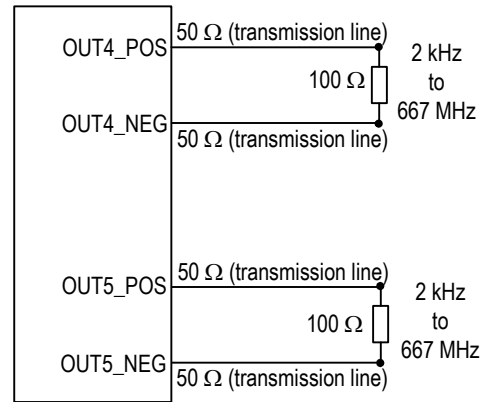
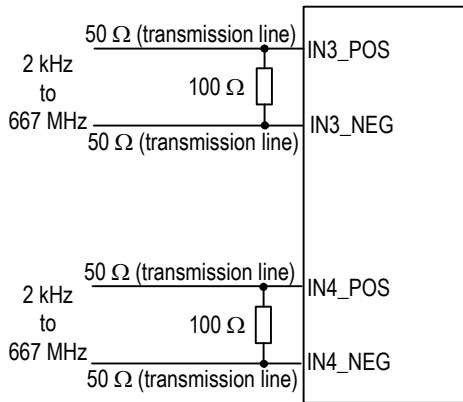


Figure 30. Recommended LVDS Input Port Line Termination

Figure 31. Recommended LVDS Output Port Line Termination

Table 51: LVDS Input / Output Port Electrical Characteristics

| Parameter        | Description                                    | Min  | Typ  | Max  | Unit     | Test Condition                  |
|------------------|--|------|------|------|----------|---------------------------------|
| $V_{CM}$         | Input Common-mode Voltage Range                | 0    | 1200 | 2400 | mV       |                                 |
| $V_{DIFF}$       | Input Peak Differential Voltage                | 100  |      | 900  | mV       |                                 |
| $V_{IDTH}$       | Input Differential Threshold                   | -100 |      | 100  | mV       |                                 |
| $R_{TERM}$       | External Differential Termination Impedance    | 95   | 100  | 105  | $\Omega$ |                                 |
| $V_{OH}$         | Output Voltage High                            | 1350 |      | 1475 | mV       | $R_{LOAD} = 100 \Omega \pm 1\%$ |
| $V_{OL}$         | Output Voltage Low                             | 925  |      | 1100 | mV       | $R_{LOAD} = 100 \Omega \pm 1\%$ |
| $V_{OD}$         | Differential Output Voltage                    | 250  |      | 400  | mV       | $R_{LOAD} = 100 \Omega \pm 1\%$ |
| $V_{OS}$         | Output Offset Voltage                          | 1125 |      | 1275 | mV       | $R_{LOAD} = 100 \Omega \pm 1\%$ |
| $R_O$            | Differential Output Impedance                  | 80   | 100  | 120  | $\Omega$ | $V_{CM} = 1.0 V$ or $1.4 V$     |
| $\Delta R_O$     | $R_O$ Mismatch between A and B                 |      |      | 20   | %        | $V_{CM} = 1.0 V$ or $1.4 V$     |
| $\Delta V_{OD}$  | Change in $V_{OD}$ between Logic 0 and Logic 1 |      |      | 25   | mV       | $R_{LOAD} = 100 \Omega \pm 1\%$ |
| $\Delta V_{OS}$  | Change in $V_{OS}$ between Logic 0 and Logic 1 |      |      | 25   | mV       | $R_{LOAD} = 100 \Omega \pm 1\%$ |
| $I_{SA}, I_{SB}$ | Output Current                                 |      |      | 24   | mA       | Driver shorted to GND           |
| $I_{SAB}$        | Output Current                                 |      |      | 12   | mA       | Driver shorted together         |
| $t_{RISE}$       | Output Rise time (20% to 80%)                  | 200  |      | 300  | pS       | $R_{LOAD} = 100 \Omega \pm 1\%$ |
| $t_{FALL}$       | Output Fall time (20% to 80%)                  | 200  |      | 300  | pS       | $R_{LOAD} = 100 \Omega \pm 1\%$ |
| $t_{SKEW}$       | Output Differential Skew                       |      |      | 50   | pS       | $R_{LOAD} = 100 \Omega \pm 1\%$ |

## 9.4 JITTER & WANDER PERFORMANCE

Table 52: Output Clock Jitter Generation

| Test Definition <sup>1</sup>  | Peak to Peak Typ | RMS Typ      | Note   | Test Filter      |
|---|------------------|--------------|--|------------------|
| N x 2.048MHz without APLL   | <2 ns            | <200 ps      |  | 20 Hz - 100 kHz  |
| N x 2.048MHz with T0/T4 APLL  | <1 ns            | <100 ps      | See <a href="#">Table 53: Output Clock Phase Noise</a> for details | 20 Hz - 100 kHz  |
| N x 1.544 MHz without APLL  | <2 ns            | <200 ps      |  | 10 Hz - 40 kHz   |
| N x 1.544 MHz with T0/T4 APLL   | <1 ns            | <100 ps      | See <a href="#">Table 53: Output Clock Phase Noise</a> for details | 10 Hz - 40 kHz   |
| 44.736 MHz without APLL   | <2 ns            | <200 ps      | See <a href="#">Table 53: Output Clock Phase Noise</a> for details | 100 Hz - 800 kHz |
| 44.736 MHz with T0/T4 APLL  | <1 ns            | <100 ps      |  | 100 Hz - 800 kHz |
| 34.368 MHz without APLL   | <2 ns            | <200 ps      | See <a href="#">Table 53: Output Clock Phase Noise</a> for details | 10 Hz - 400 kHz  |
| 34.368 MHz with T0/T4 APLL  | <1 ns            | <100 ps      |  | 10 Hz - 400 kHz  |
| OC-3<br>(Chip T0 DPLL + T0/T4 APLL) 6.48 MHz, 19.44 MHz, 25.92 MHz, 38.88 MHz, 51.84 MHz, 77.76 MHz, 155.52 MHz, 311.04 MHz, 622.08 MHz output  | 0.004 UI p-p     | 0.001 UI RMS | GR-253, G.813 Option 2<br>limit 0.1 UI p-p<br>(1 UI-6430 ps)       | 12 kHz - 1.3 MHz |
|   | 0.004 UI p-p     | 0.001 UI RMS | G.813 Option 1, G.812<br>limit 0.5 UI p-p<br>(1 UI-6430 ps)        | 500 Hz - 1.3 MHz |
|   | 0.001 UI p-p     | 0.001 UI RMS | G.813 Option 1<br>limit 0.1 UI p-p<br>(1 UI-6430 ps)               | 65 kHz - 1.3 MHz |
| OC-12<br>(Chip T0 DPLL + T0/T4 APLL) 6.48 MHz, 19.44 MHz, 25.92 MHz, 38.88 MHz, 51.84 MHz, 77.76 MHz, 155.52 MHz, 311.04 MHz, 622.08 MHz output + Intel GD16523 + Optical transceiver)  | 0.018 UI p-p     | 0.007 UI RMS | GR-253, G.813 Option 2<br>limit 0.1 UI p-p<br>(1 UI-1608 ps)       | 12 kHz - 5 MHz   |
|   | 0.028 UI p-p     | 0.009 UI RMS | G.813 Option 1, G.812<br>limit 0.5 UI p-p<br>(1 UI-1608 ps)        | 1 kHz - 5 MHz    |
|   | 0.002 UI p-p     | 0.001 UI RMS | G.813 Option 1, G.812<br>limit 0.1 UI p-p<br>(1 UI-160 8ps)        | 250 kHz - 5 MHz  |
| STM-16<br>(Chip T0 DPLL + T0/T4 APLL) 6.48 MHz, 19.44 MHz, 25.92 MHz, 38.88 MHz, 51.84 MHz, 77.76 MHz, 155.52 MHz, 311.04 MHz, 622.08 MHz output + Intel GD16523 + Optical transceiver) | 0.162 UI p-p     | 0.03 UI RMS  | G.813 Option 1, G.812<br>limit 0.5 UI p-p<br>(1 UI-402 ps)         | 5 kHz - 20 MHz   |
|   | 0.01 UI p-p      | 0.009 UI RMS | G.813 Option 1, G.812<br>limit 0.1 UI p-p<br>(1 UI-402 ps)         | 1 MHz - 20 MHz   |
| <b>Note:</b><br>1. CMAC E2747 TCXO is used.   |                  |              |  |                  |

Table 53: Output Clock Phase Noise

| Output Clock <sup>1</sup>         | @100Hz Offset<br>Typ | @1kHz Offset<br>Typ | @10kHz Offset<br>Typ | @100kHz Offset<br>Typ | @1MHz Offset<br>Typ | @5MHz Offset<br>Typ | Unit   |
|-----------------------------------|----------------------|---------------------|----------------------|-----------------------|---------------------|---------------------|--------|
| 622.08 MHz (T0 DPLL + T0/T4 APLL) | -70                  | -86                 | -95                  | -100                  | -107                | -128                | dBC/Hz |
| 155.52 MHz (T0 DPLL + T0/T4 APLL) | -82                  | -98                 | -107                 | -112                  | -119                | -140                | dBC/Hz |
| 38.88 MHz (T0 DPLL + T0/T4 APLL)  | -94                  | -110                | -118                 | -124                  | -131                | -143                | dBC/Hz |
| 16E1 (T0/T4 APLL)                 | -94                  | -110                | -118                 | -125                  | -131                | -142                | dBC/Hz |
| 16T1 (T0/T4 APLL)                 | -95                  | -112                | -120                 | -127                  | -132                | -143                | dBC/Hz |
| E3 (T0/T4 APLL)                   | -93                  | -109                | -116                 | -124                  | -131                | -138                | dBC/Hz |
| T3 (T0/T4 APLL)                   | -92                  | -108                | -116                 | -122                  | -126                | -141                | dBC/Hz |

**Note:**  
1. CMAC E2747 TCXO is used.

Table 54: Input Jitter Tolerance (155.52 MHz)

| Jitter Frequency | Jitter Tolerance Amplitude (UI p-p) |
|------------------|-------------------------------------|
| 12 $\mu$ Hz      | > 2800                              |
| 178 $\mu$ Hz     | > 2800                              |
| 1.6 mHz          | > 311                               |
| 15.6 mHz         | > 311                               |
| 0.125 Hz         | > 39                                |
| 19.3 Hz          | > 39                                |
| 500 Hz           | > 1.5                               |
| 6.5 kHz          | > 1.5                               |
| 65 kHz           | > 0.15                              |
| 1.3 MHz          | > 0.15                              |

Table 56: Input Jitter Tolerance (2.048 MHz)

| Jitter Frequency | Jitter Tolerance Amplitude (UI p-p) |
|------------------|-------------------------------------|
| 1 Hz             | 150                                 |
| 5 Hz             | 140                                 |
| 20 Hz            | 130                                 |
| 300 Hz           | 40                                  |
| 400 Hz           | 33                                  |
| 700 Hz           | 18                                  |
| 2400 Hz          | 5.5                                 |
| 10 kHz           | 1.3                                 |
| 50 kHz           | 0.4                                 |
| 100 kHz          | 0.4                                 |

Table 55: Input Jitter Tolerance (1.544 MHz)

| Jitter Frequency | Jitter Tolerance Amplitude (UI p-p) |
|------------------|-------------------------------------|
| 1 Hz             | 150                                 |
| 5 Hz             | 140                                 |
| 20 Hz            | 130                                 |
| 300 Hz           | 38                                  |
| 400 Hz           | 25                                  |
| 700 Hz           | 15                                  |
| 2400 Hz          | 5                                   |
| 10 kHz           | 1.2                                 |
| 40 kHz           | 0.5                                 |

Table 57: Input Jitter Tolerance (8 kHz)

| Jitter Frequency | Jitter Tolerance Amplitude (UI p-p) |
|------------------|-------------------------------------|
| 1 Hz             | 0.8                                 |
| 5 Hz             | 0.7                                 |
| 20 Hz            | 0.6                                 |
| 300 Hz           | 0.16                                |
| 400 Hz           | 0.14                                |
| 700 Hz           | 0.07                                |
| 2400 Hz          | 0.02                                |
| 3600 Hz          | 0.01                                |

Table 58: T0 DPLL Jitter Transfer &amp; Damping Factor

| 3 dB Bandwidth | Programmable Damping Factor |
|----------------|-----------------------------|
| 0.5 mHz        | 1.2, 2.5, 5, 10, 20         |
| 1 mHz          | 1.2, 2.5, 5, 10, 20         |
| 2 mHz          | 1.2, 2.5, 5, 10, 20         |
| 4 mHz          | 1.2, 2.5, 5, 10, 20         |
| 8 mHz          | 1.2, 2.5, 5, 10, 20         |
| 15 mHz         | 1.2, 2.5, 5, 10, 20         |
| 30 mHz         | 1.2, 2.5, 5, 10, 20         |
| 60 mHz         | 1.2, 2.5, 5, 10, 20         |
| 0.1 Hz         | 1.2, 2.5, 5, 10, 20         |
| 0.3 Hz         | 1.2, 2.5, 5, 10, 20         |
| 0.6 Hz         | 1.2, 2.5, 5, 10, 20         |
| 1.2 Hz         | 1.2, 2.5, 5, 10, 20         |
| 2.5 Hz         | 1.2, 2.5, 5, 10, 20         |
| 4 Hz           | 1.2, 2.5, 5, 10, 20         |
| 8 Hz           | 1.2, 2.5, 5, 10, 20         |
| 18 Hz          | 1.2, 2.5, 5, 10, 20         |
| 35 Hz          | 1.2, 2.5, 5, 10, 20         |
| 70 Hz          | 1.2, 2.5, 5, 10, 20         |
| 560 Hz         | 1.2, 2.5, 5, 10, 20         |

Table 59: T4 DPLL Jitter Transfer &amp; Damping Factor

| 3 dB Bandwidth | Programmable Damping Factor |
|----------------|-----------------------------|
| 18 Hz          | 1.2, 2.5, 5, 10, 20         |
| 35 Hz          | 1.2, 2.5, 5, 10, 20         |
| 70 Hz          | 1.2, 2.5, 5, 10, 20         |
| 560 Hz         | 1.2, 2.5, 5, 10, 20         |



9.5 OUTPUT WANDER GENERATION

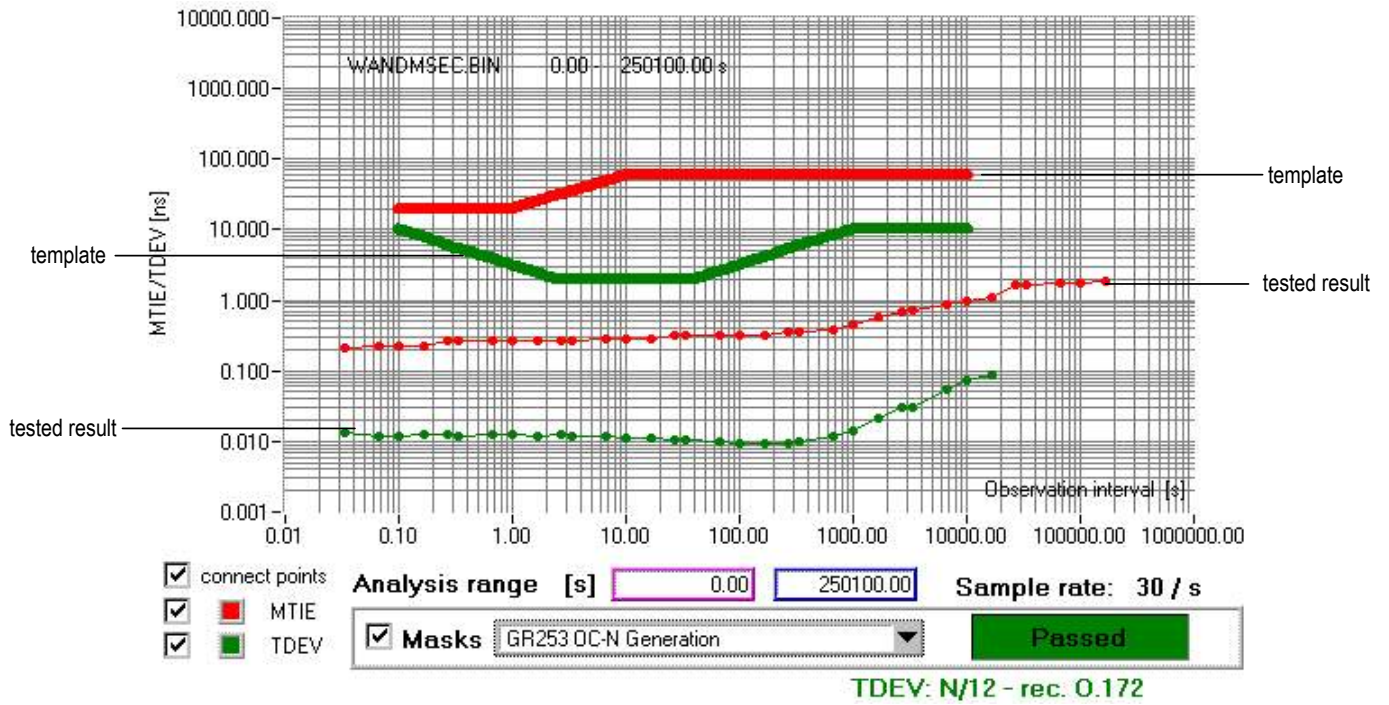
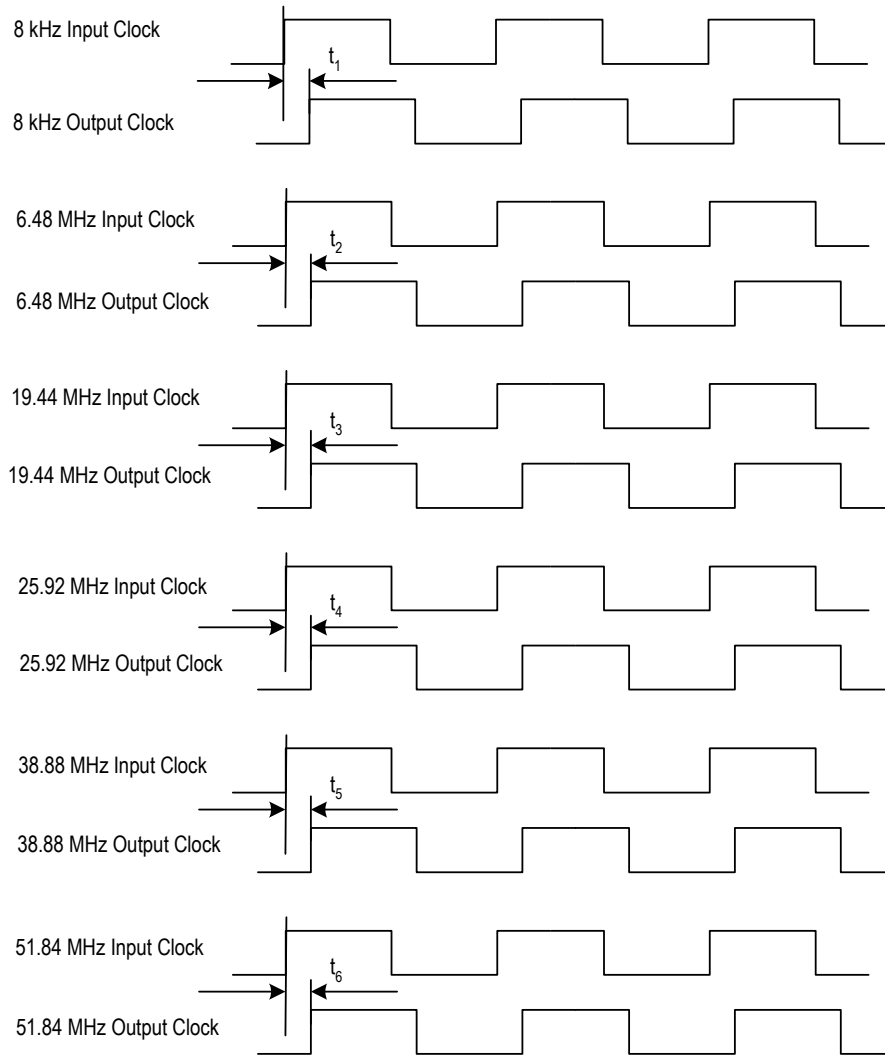


Figure 32. Output Wander Generation

### 9.6 INPUT / OUTPUT CLOCK TIMING

The inputs and outputs are aligned ideally. But due to the circuit delays, there is delay between the inputs and outputs.



**Figure 33. Input / Output Clock Timing**

**Table 60: Input/Output Clock Timing <sup>3</sup>**

| Symbol | Typical Delay <sup>1</sup> (ns) | Peak to Peak Delay Variation <sup>2</sup> (ns) |
|--------|---------------------------------|--|
| $t_1$  | 4                               | 1.6  |
| $t_2$  | 1                               | 1.6  |
| $t_3$  | 1                               | 1.6  |
| $t_4$  | 2                               | 1.6  |
| $t_5$  | 1.4                             | 1.6  |
| $t_6$  | 3                               | 1.6  |

**Note:**

- 1. Typical delay provided as reference only.
- 2. 'Peak to Peak Delay Variation' is the delay variation that is guaranteed not to be exceeded for IN5 in Master/Slave operation.
- 3. Tested when IN5 is selected.

9.7 OUTPUT CLOCK TIMING

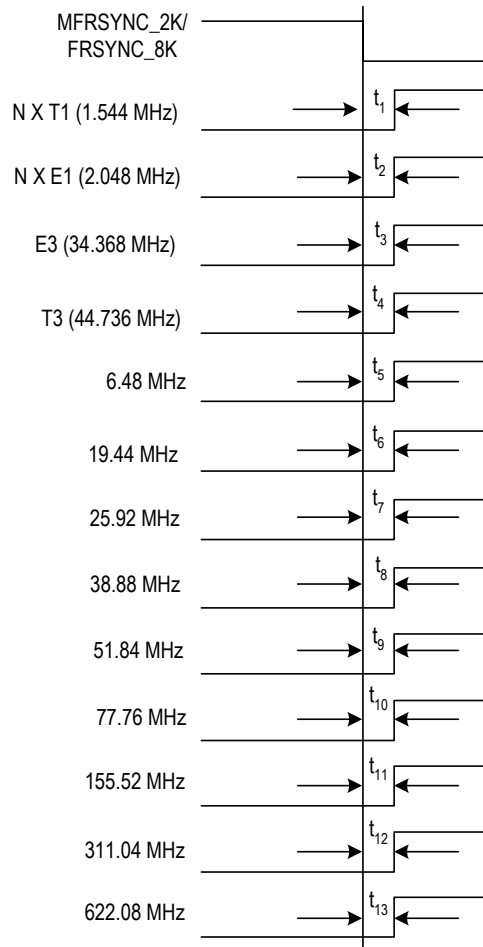


Figure 34. Output Clock Timing

Table 61: Output Clock Timing

| Symbol   | Typical Delay (ns) | Peak to Peak Delay Variation (ns) |
|----------|--------------------|-----------------------------------|
| $t_1$    | 0                  | 2                                 |
| $t_2$    | 0                  | 2                                 |
| $t_3$    | 0                  | 2                                 |
| $t_4$    | 0                  | 2                                 |
| $t_5$    | 0                  | 2                                 |
| $t_6$    | 0                  | 2                                 |
| $t_7$    | 0                  | 2                                 |
| $t_8$    | 0                  | 2                                 |
| $t_9$    | 0                  | 2                                 |
| $t_{10}$ | 0                  | 2                                 |
| $t_{11}$ | 0                  | 1.5                               |
| $t_{12}$ | 0                  | 1.5 (not recommended to use)      |
| $t_{13}$ | 0                  | 1.5 (not recommended to use)      |

---

|              |     |  |
|--------------|-----|--|
| <b>3G</b>    | --- | Third Generation   |
| <b>ADSL</b>  | --- | Asymmetric Digital Subscriber Line   |
| <b>APLL</b>  | --- | Analog Phase Locked Loop   |
| <b>ATM</b>   | --- | Asynchronous Transfer Mode   |
| <b>BITS</b>  | --- | Building Integrated Timing Supply  |
| <b>CMOS</b>  | --- | Complementary Metal-Oxide Semiconductor  |
| <b>DCO</b>   | --- | Digital Controlled Oscillator  |
| <b>DPLL</b>  | --- | Digital Phase Locked Loop  |
| <b>DSL</b>   | --- | Digital Subscriber Line  |
| <b>DSLAM</b> | --- | Digital Subscriber Line Access MUX   |
| <b>DWDM</b>  | --- | Dense Wavelength Division Multiplexing   |
| <b>EPROM</b> | --- | Erasable Programmable Read Only Memory   |
| <b>GPS</b>   | --- | Global Positioning System  |
| <b>GSM</b>   | --- | Global System for Mobile Communications  |
| <b>IIR</b>   | --- | Infinite Impulse Response  |
| <b>IP</b>    | --- | Internet Protocol  |
| <b>ISDN</b>  | --- | Integrated Services Digital Network  |
| <b>JTAG</b>  | --- | Joint Test Action Group  |
| <b>LPF</b>   | --- | Low Pass Filter  |
| <b>LVDS</b>  | --- | Low Voltage Differential Signal  |
| <b>MTIE</b>  | --- | Maximum Time Interval Error  |
| <b>MUX</b>   | --- | Multiplexer  |
| <b>OBSAI</b> | --- | Open Base Station Architecture Initiative  |
| <b>OC-n</b>  | --- | Optical Carried rate, n = 1, 3, 12, 48, 192, 768; 51 Mbit/s, 155 Mbit/s, 622 Mbit/s, 2.5 Gbit/s, 10 Gbit/s, 40 Gbit/s. |
| <b>PBO</b>   | --- | Phase Build-Out  |
| <b>PDH</b>   | --- | Plesiochronous Digital Hierarchy   |

|          |     |   |
|----------|-----|---|
| PECL     | --- | Positive Emitter Coupled Logic                                    |
| PFD      | --- | Phase & Frequency Detector  |
| PLL      | --- | Phase Locked Loop   |
| RMS      | --- | Root Mean Square  |
| PRS      | --- | Primary Reference Source  |
| SDH      | --- | Synchronous Digital Hierarchy                                     |
| SEC      | --- | SDH / SONET Equipment Clock                                       |
| SMC      | --- | SONET Minimum Clock   |
| SONET    | --- | Synchronous Optical Network                                       |
| SSU      | --- | Synchronization Supply Unit                                       |
| STM      | --- | Synchronous Transfer Mode   |
| TCM-ISDN | --- | Time Compression Multiplexing Integrated Services Digital Network |
| TDEV     | --- | Time Deviation  |
| UI       | --- | Unit Interval   |
| WLL      | --- | Wireless Local Loop   |



|  |        |   |        |
|--|--------|---|--------|
| <b>A</b>                                       |        | Frequency Hard Alarm .....              | 22, 27 |
| Averaged Phase Error .....                     | 32     | Frequency Hard Alarm Threshold .....    | 22     |
| <b>B</b>                                       |        | <b>H</b>                                |        |
| Bandwidths and Damping Factors .....           | 32     | Hard Limit .....                        | 25     |
| Acquisition Bandwidth and Damping Factor ..... | 32     | Holdover Frequency Offset .....         | 33     |
| Locked Bandwidth and Damping Factor .....      | 32     | <b>I</b>                                |        |
| Starting Bandwidth and Damping Factor .....    | 32     | IIR .....                               | 33     |
| <b>C</b>                                       |        | Input Clock Frequency .....             | 22     |
| Calibration .....                              | 18     | Input Clock Selection .....             | 23     |
| Coarse Phase Loss .....                        | 25     | Automatic selection .....               | 24, 27 |
| Crystal Oscillator .....                       | 18     | External Fast selection .....           | 23, 27 |
| Current Frequency Offset .....                 | 32     | Forced selection .....                  | 24, 27 |
| <b>D</b>                                       |        | Internal Leaky Bucket Accumulator ..... | 21     |
| DCO .....                                      | 32     | Bucket Size .....                       | 21     |
| Division Factor .....                          | 20     | Decay Rate .....                        | 21     |
| DPLL Hard Alarm .....                          | 25     | Lower Threshold .....                   | 21     |
| DPLL Hard Limit .....                          | 25     | Upper Threshold .....                   | 21     |
| DPLL Operating Mode .....                      | 32, 33 | <b>L</b>                                |        |
| Free-Run mode .....                            | 32, 33 | Limit .....                             | 35     |
| Holdover mode .....                            | 32, 33 | LPF .....                               | 32     |
| Automatic Fast Averaged .....                  | 33     | <b>M</b>                                |        |
| Automatic Instantaneous .....                  | 33     | Master / Slave Application .....        | 44     |
| Automatic Slow Averaged .....                  | 33     | Master / Slave Configuration .....      | 41     |
| Manual .....                                   | 33     | Master Clock .....                      | 18     |
| Locked mode .....                              | 32, 33 | Microprocessor Interface .....          | 45     |
| Temp-Holdover mode .....                       | 32     | microprocessor interface                |        |
| Lost-Phase mode .....                          | 32     | EPROM .....                             | 46     |
| Pre-Locked mode .....                          | 32     | Intel .....                             | 49     |
| Pre-Locked2 mode .....                         | 33     | Motorola .....                          | 51     |
| DPLL Soft Alarm .....                          | 25     | Multiplexed .....                       | 47     |
| DPLL Soft Limit .....                          | 25     | Serial .....                            | 53     |
| <b>E</b>                                       |        | <b>N</b>                                |        |
| External Sync Alarm .....                      | 39     | No-activity Alarm .....                 | 21, 27 |
| <b>F</b>                                       |        | <b>P</b>                                |        |
| Fast Loss .....                                | 25     | PBO .....                               | 35     |
| Fine Phase Loss .....                          | 25     |   |        |

|                        |        |                                   |        |
|------------------------|--------|-----------------------------------|--------|
| PFD .....              | 32     | <b>R</b>                          |        |
| Phase Lock Alarm ..... | 26, 27 | Reference Clock .....             | 22     |
| Phase Offset .....     | 35     | <b>S</b>                          |        |
| Phase-compared .....   | 25, 35 | Selected Input Clock Switch ..... | 27     |
| Phase-time .....       | 35     | Non-Revertive switch .....        | 28     |
| Pre-Divider .....      | 20     | Revertive switch .....            | 27     |
| DivN Divider .....     | 20     | State Machine .....               | 29, 31 |
| HF Divider .....       | 20     | <b>V</b>                          |        |
| Lock 8k Divider .....  | 20     | Validity .....                    | 27     |





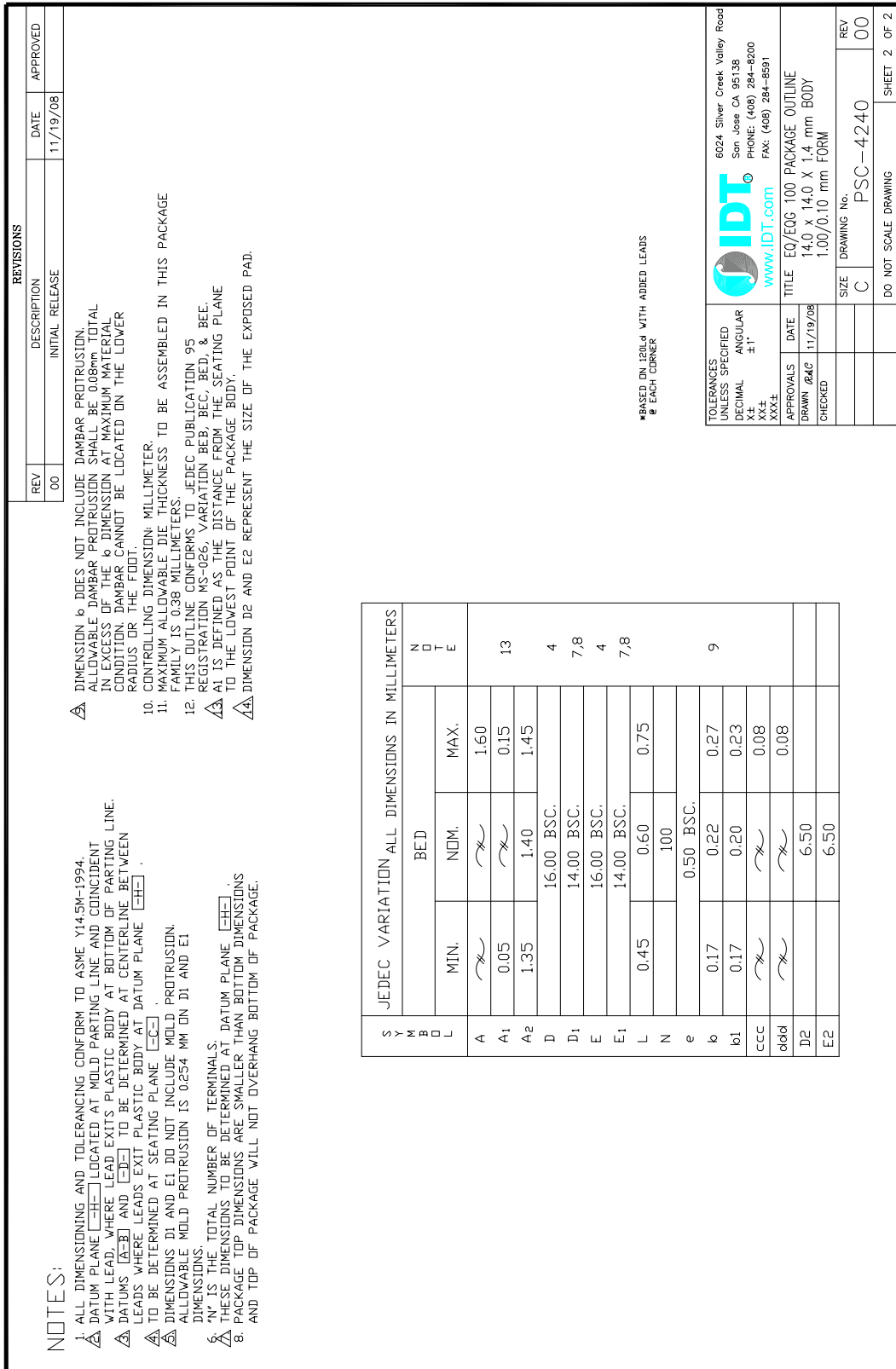


Figure 36. 100-Pin EQG Package Dimensions (b) (in Millimeters)

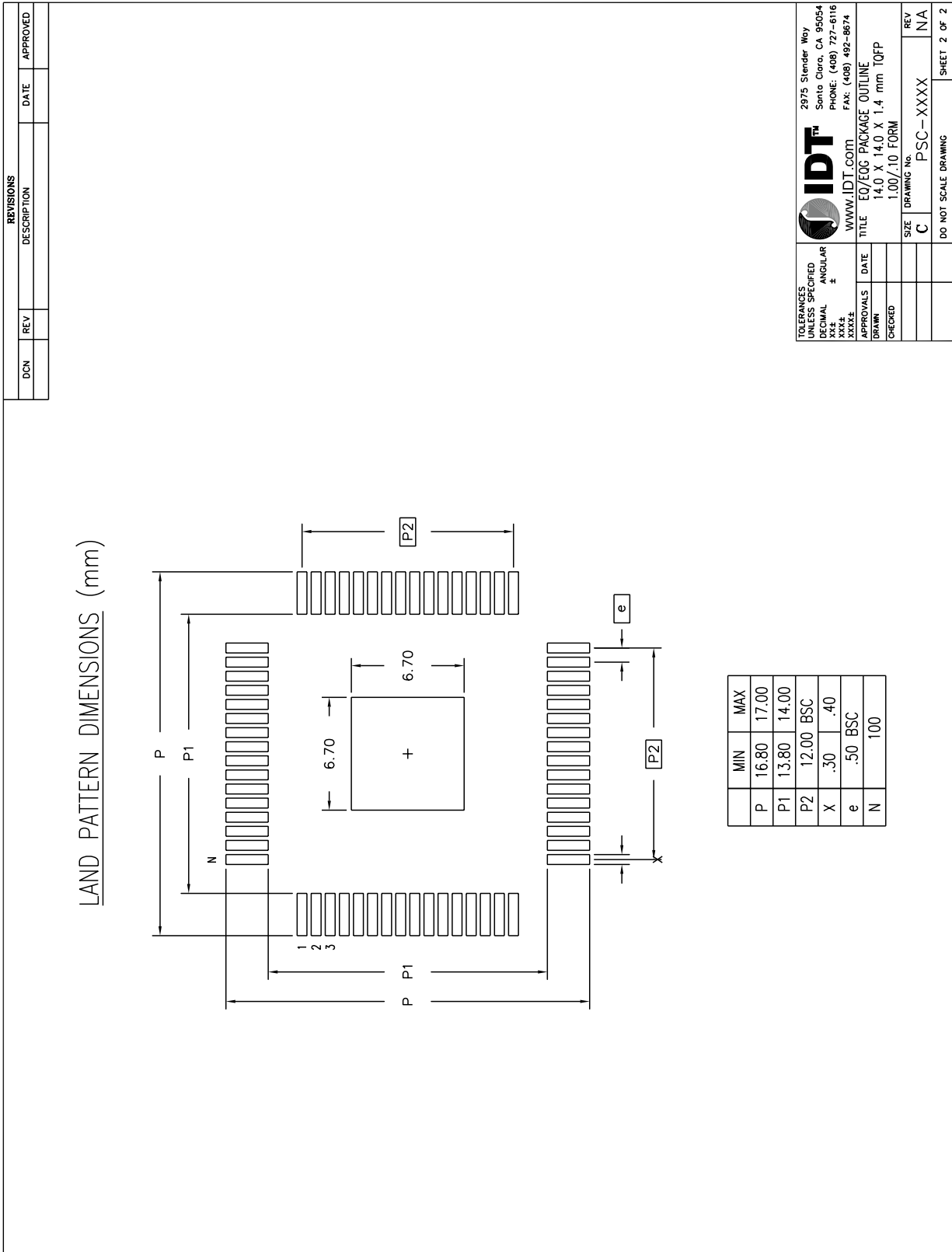
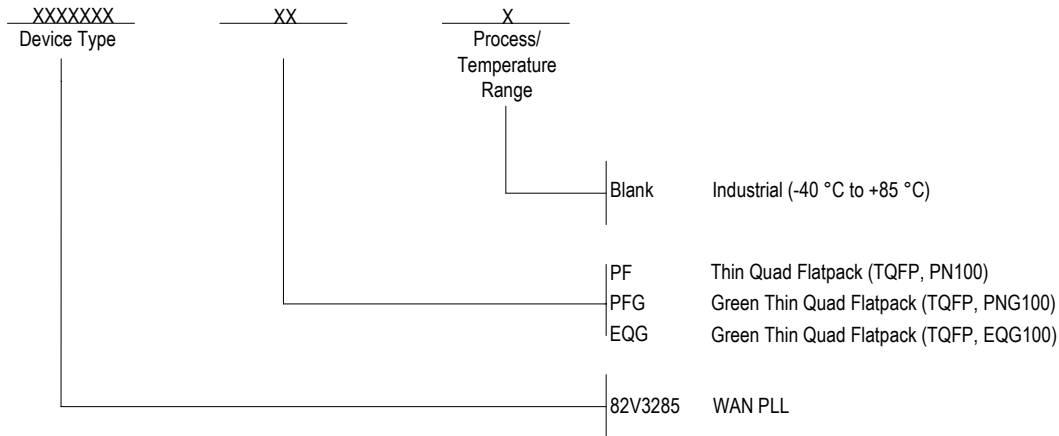


Figure 37. EQG100 Recommended Land Pattern with Exposed Pad (in Millimeters)

## ORDERING INFORMATION



## DATASHEET DOCUMENT HISTORY

12/09/2008 pgs. 127, 128, 129, 134, 144, 145, 146, 147



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