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**Software Interface to the PCIe Timing Board**

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# Overview

The PCIe timing interface board is a PCI Express board that interfaces the computer software through a memory mapped interface. As part of the PCI bus enumeration the operating system assign the board a unique memory region in the physical address space. This document describes the register assignment within this region.

The board uses an 8 kb address region divided into 2 blocks of 4 kb. The first block is used for the control registers, whereas the second block is used to read the status of the LIGO timing interface.

|  |  |  |
| --- | --- | --- |
| **Address** | **Description** | **Size** |
| 0x0000 | Control and monitor registers for on-board features, backplane and expansion modules | 4096 |
| 0x1000 | Timing Diagnostics Information | 4096 |

1. Memory map of PCIe timing interface.

The PCIe timing board has the following features:

* Part of the Advanced LIGO optical timing distribution system which is based on distributed synchronized 226 Hz crystal oscillators driven by a master GPS clock.
* Interfaces the IO interface backplane and provides clocking signals for converters.
* Supports an optional master clock expansion module with GPS capabilities
* Supports an optional fanout expansion module with 12 fiber downlinks.

# Applicable Documents

The applicable documents can be located through the following dcc pages:

* [E2000328](https://dcc.ligo.org/LIGO-E2000328): PCIe Timing Interface (DCC top node)
* [E2000337](https://dcc.ligo.org/LIGO-E2000337): PCIe Timing Interface Software Release
* [D2000329](https://dcc.ligo.org/LIGO-D2000329): PCIe Timing Interface Board
* [D2000297](https://dcc.ligo.org/LIGO-D2000297): IO Interface Backplane (LVDS)
* [D2000301](https://dcc.ligo.org/LIGO-D2000301): Master Clock Expansion Option (GPS)
* [D2000302](https://dcc.ligo.org/LIGO-D2000302): Fanout Expansion Option
* [E0900036](https://dcc.ligo.org/LIGO-E0900036): Diagnostics Information for the Advanced LIGO Optical Timing Distribution

# Control Registers

Registers are organized in double words (32 bit). It is envisioned that they are read and written as double words through the PCI Express bus. Reading from unassigned memory addresses within the assign memory region results in zeros. Similarly, writing to an empty address or a read-only address is ignored but treated as successful.

## Current Time

There are two registers to read the current time. The first register needs to be read first. It contains the fractional seconds of the GPS time and it will latch the second register which contains the GPS seconds.

|  |  |  |  |
| --- | --- | --- | --- |
| **Address** | **Description** | **RW** | **Size** |
| 0x0000 | Fractional seconds in units of 2-32 sReading this register will latch the GPS seconds. Writing has no effect.  | R | 4 |
| 0x0004 | GPS secondsReads the GPS seconds associated with the last reading of the fractional seconds register. Writing has no effect. | R | 4 |
| 0x0008…0x000C | Reserved |  | 8 |

1. Registers to read the current time.

## Converter Backplane Interface

The PCIe timing board interfaces a 10-slot backplane which supports interface cards for the digital converters LIGO is using. Each slot has its own dedicated clock line that can be configured individually. For each clock line the frequency and phase shift can be specified. One can also ask that the clock starts at the next 1 second boundary.

There are 3 options for providing clock signals to the 10 slots:

1. Old type TTL ADC/DAC clock (1 per slot)
2. Fast LVDS clock (1 per slot)
3. Fast LVDS clock and sync lines (shared on neighboring odd/even slots)

Additionally, there a few bits of binary IO that can be controlled for each slot. This is typically used to add the analog DuoTone signal to slot 10, and to route another DuoTone signal from slot 9 to 10. However, these bits are available on all slots, and can be used for other purposes.

### Common Functions

The table below shows the common functions for the converter backplane interface. Depending on bit 0 a write to register 0x0018 will either reset the watchdog timer or initialize the SPI devices.

|  |  |  |  |
| --- | --- | --- | --- |
| **Address** | **Description** | **RW** | **Size** |
| 0x0010 | Backplane configurationBit 1: Reset watchdog timer every time the current time is readBit 0: Disable DuoTone output | RW | 4 |
| 0x0014 | Watchdog reset or SPI initializationBit 0: Init SPI bus when 1, Reset watchdog when 0 | W | 4 |
| 0x0018 | Backplane statusBits 31…10: ReservedBit 9: Backplane is presentBit 8: X5 inputBit 7: X3 inputBit 6: X1 inputBit 5: Temperature alarmBits 4…3: Backplane revisionBit 2: Watchdog monitorBit 1: Indicates that all clocks are runningBit 0: Indicates that all clocks are active | R | 4 |
| 0x001C | Reserved |  | 4 |

1. Common registers for the backplane interface.

The analog DuoTone signal is only routed to slots 9 and 10.

### Slot Functions

The table below lists the configuration and monitor registers for each slot of the back plane. There are 10 slots, with 2 10 configuration registers and 1 monitor register each. Slot 1 starts at address 0x0020, slot 2 at 0x0030 and so on. All registers are initialized to zero at the beginning and no clock signals are sent to the backplane.

|  |  |  |  |
| --- | --- | --- | --- |
| **Address** | **Description** | **RW** | **Size** |
| 0x0020 | Slot 1 (odd) configurationBits 31…23: ReservedBit 22: IgnoredBit 21: IgnoredBit 20: Bit 1 output highBit 19: Bit 1 is binary outputBit 18: Enable DAC DuoTone on second to last ADC channelBit 17: Enable Duotone on last ADC channelBit 16: Use LVDS clock linesBits 15…13: ReservedBit 12: Pull idle clock line highBit 11: Start clock at next transition from idle valueBit 10: Start clock at next second boundary after a 0.25 s countdownBit 9: Inverted clock signalBit 8: Enable clock signalBits 7…0: Log2 frequency 226 Hz is the highest allowed frequency | RW | 4 |
| 0x0024 | Slot 1 (odd) phase shiftBit 31…0: Phase shift in units of 2-32 s.  | RW | 4 |
| 0x0028 | Slot 1 (odd) statusBits 31…23: ReservedBit 22: UndefinedBit 22: UndefinedBit 20: Monitor of bit 1Bit 19: Monitor of DAC DuoTone select on last DAC channelBit 18: Monitor of DAC DuoTone select on second to last ADC channelBit 17: Monitor of DAC DuoTone select on last ADC channel Bit 16: UndefinedBits 15…2: ReservedBit 1: Indicates that clock is runningBit 0: Indicates that clock is active | R | 4 |
| 0x002C | Reserved |  | 4 |
|  |  |  |  |
| 0x0030 | Slot 2 (even) configurationBits 31…23: ReservedBit 22: Bit 2 output highBit 21: Bit 2 is binary output (shared on neighboring odd/even slots)Bit 20: Bit 1 output highBit 19: Bit 1 is binary outputBit 18: Select DAC DuoTone on second to last ADC channelBit 17: Select Duotone on last ADC channelBit 16: Use LVDS clock linesBits 15…13: ReservedBit 12: Pull idle clock line highBit 11: Start clock at next transition from idle valueBit 10: Start clock at next second boundary after a 0.25 s countdownBit 9: Inverted clock signalBit 8: Enable clock signalBits 7…0: Log2 frequency 226 Hz is the highest allowed frequency | RW |  |
| 0x0034 | Slot 2 (even) phase shiftBit 31…0: Phase shift in units of 2-32 s.  | RW | 4 |
|  | Slot 2 (even) statusBits 31…23: ReservedBit 22: Monitor of bit 2 (shared on neighboring odd slot)Bit 21: UndefinedBit 20: Monitor of bit 1Bit 19: Monitor of DAC DuoTone select on last DAC channelBit 18: Monitor of DAC DuoTone select on second to last ADC channelBit 17: Monitor of DAC DuoTone select on last ADC channelBit 16: UndefinedBits 15…2: ReservedBit 1: Indicates that clock is runningBit 0: Indicates that clock is active | R | 4 |
| 0x003C | Reserved |  | 4 |
| 0x0040…0x00BC | Configuration and status registers for slots 2 to 10. |  | 128 |

1. Registers to setup clock signals for the ADCs and DACs.

An 8-bit value, $N\leq 26$, is used to select the frequency with the equation $2^{N}$ Hz. The period is then $2^{-N}$ s. To get the clock signal applied one also must enable it. If the clock is disabled, the clock output is set to the idle value. If the clock must start at a 1 second boundary, one can choose to delay the enable to the next 1 second boundary after a fixed minimum delay of 0.25 sec has passed. The clock can also be enabled immediately, or on the next transition away from the idle value. The two options can be combined: wait for the 1PPS boundary and then wait again for the next transition away from idle. If the clock is enabled immediately, it may result in a very short half cycle at the beginning; it could be as short as $2^{-27}$ sec which may be too short for the converters of the data acquisition system.

An optional phase shift can be applied and is specified in units of 2-32 sec. The least significant bits below the clock’s resolution are ignored, as well as the most significant bits that would indicate a phase shift larger than a clock cycle. Additionally, there is a bit to invert the final output clock signal. This is equivalent to a 180º phase shift.

There are two status readbacks for the clock output: active and running. The difference is that running will wait for the first transition away from idle, when this option is selected, whereas active will go high immediately after the optional wait for the 1PPS.

Several binary IO channels are available too. The binary IO channels associated with the DuoTone were previously only available on slots 9 and 10 but were physically the same signals. In this implementation, separate binary IO channels are routed to each slot. If they are not used for DuoTone, they can be used for other purposes—together with two additional bits. Bit 1 and 2 have configurable direction. Bit 1 is a per slot channel, whereas bit 2 is shared among two neighboring odd/even slots.

## Interrupt Configuration

The board supports 4 message-based interrupts (MSI) over the PCI Express bus. These interrupts can be configured to be issued at regular intervals. The setup is the same as a converter clock with the rising edge of the configured clock signal being used to initiate the interrupt. PCI Express interrupts must be configured and enabled by the root complex during the initial setup process. The interrupt processing is done by the device driver, which is loaded by the operating system. Interrupt configuration registers for the first MSI are located at 0x00C0. The second, third and fourth MSI are at 0x00D0, 0x00E0 and 0x00F0, respectively.

|  |  |  |  |
| --- | --- | --- | --- |
| **Address** | **Description** | **RW** | **Size** |
| 0x00C0 | MSI 0 configurationBit 12: Pull idle clock line highBit 11: Start clock at next transition from idle valueBit 10: Start clock at next second boundary after a 0.25 s countdownBit 9: Inverted clock signalBit 8: Enable interrupt signalBits 7…0: Log2 frequency 226 Hz is the highest allowed frequency | RW | 4 |
| 0x00C4 | MSI 0 phase shiftBit 31…0: Phase shift in units of 2-32 s.  | RW | 4 |
| 0x00C8 | MSI 0 statusBit 1: Indicates that interrupts are issued at regular intervalsBit 0: Indicates that the interrupt is configured | R | 4 |
| 0x00CC | Reserved |  | 4 |
| 0x00D0…0x00FC | Configuration of interrupts MSI 1 through 3. |  | 24 |

1. Registers to configure interrupts over the PCI Express bus.

## GPS Expansion Module

It is possible to connect an expansion module to the DB25 and SMA connectors of the PCIe timing board. This expansion module implements an OCXO and a GPS receiver, an RS422 port, an additional SFP, both a 1 PPS input and output, as well as an external frequency input. If both GPS and OCXO are present, the PCIe interface board will default to be a timing root node (master clock). The OCXO is connected to the SMA on the PCI board and its frequency must be $2^{25}$ Hz. For a timing root node, it serves as the main clock source for the entire timing distribution system. The GPS receiver provides a time stamp that relates to UTC through a 1 PPS signal and a serial interface. If the expansion board is not equipped with a GPS or an OCXO, the PCI board acts as a normal downstream timing interface.

The GPS expansion module implements an external frequency input. Normally, this input is just used as a frequency counter. However, it can also be used to lock the frequency of an external OCXO. This must be enabled explicitly, and the desired frequency must be set through the PCI. Since this OCXO will only be locked to the 1 PPS, its RF phase error can be relatively large.

|  |  |  |  |
| --- | --- | --- | --- |
| **Address** | **Description** | **RW** | **Size** |
| 0x0100 | GPS expansion configurationBits 31…8: ReservedBit 7: Use frequency input and DAC output to lock an external OCXO (only possible if not a root node) Bit 6: Output an IRIG-B (2nd channel) rather than an 1 PPSBit 5: Disable binary output (1 PPS normally)Bit 4: Disable RS422Bits 3…2: 1 PPS control (for a timing root node) b00: Use external 1 PPS, if present, GPS 1 PPS else b01: Always use the GPS 1 PPS b10 or b11: Always use the external 1 PPSBits 1…0: Timing root node control b00: If both GPS and OCXO are present, default to root b01: Prevent this to be the timing root node b10 or b11: Set this to be the timing root node | RW | 4 |
| 0x0104 | Preset frequencyBits 31…0: Preset frequency in Hz for an external OCXO | RW | 4 |
| 0x0108 | GPS expansion statusBits 31…5: ReservedBit 4: GPS is lockedBit 3: External OCXO is lockedBit 2: External frequency input is presentBit 1: External 1 PPS is usedBit 0: Root node flag | R | 4 |
| 0x010C | Frequency counterBits 31…0: External frequency in Hz | R | 4 |

1. Registers for the GPS expansion module.

The expansion module also has an external 1 PPS input which can be used to synchronize the master with an external frequency standard. A digital output is available which is normally configured as a 1 PPS output but can also output an IRIB-B signal instead.

An RS422 port writes the timing status information once a second and can be read by the slow controls system to provide diagnostics o the timing system. Since fanout modules collect the diagnostics information of their direct downstream partners, all diagnostics information is available by monitoring the fanout chassis.

The master clock expansion module also implements a fiber port. This fiber port can be used for either an uplink or a downlink. The logic is as follows: if the PCIe timing interface acts as a timing master, the fiber port is a fanout port. If this is a standard downstream timing interface, the fiber port is an uplink port. It can be used instead of the port mounted on the board. If both ports are connected, the on-board port has priority. However, the port on the expansion module can be forced to be a fanout port through software.

## Fanout Expansion Module

The fanout expansion module requires a PCIe daughter board to provide the additional signal lines. It provides up to 16 fiber downlink ports and makes the PCIe timing interface a fanout timing module. The daughter board implements 4 fiber ports, and it can be used stand-alone in systems that don’t need the full number of fanout ports.

One fiber port is implemented on the main timing interface board. Typically, this will be used for the uplink to a timing fanout. It is possible to add expansion boards which implement additional fiber ports. This can make the PCIe timing interface a master clock with fanout. There are 12 fiber ports located on the fanout expansion board. 4 fiber ports are located on the daughter board and one extra fiber port is located on the GPS expansion board. The GPS expansion board is connected through a DB25 to the main timing interface. The daughter board connects to the timing interface through the Samtec connectors and makes the PCIe board double width. The fanout expansion board connects to the daughter board through a SCSI-2 type high density cable.

|  |  |  |  |
| --- | --- | --- | --- |
| **Address** | **Description** | **RW** | **Size** |
| 0x0110 | Fanout expansion configurationBits 31…12: ReservedBits 11…7: Port number for identification (Use 31 for uplink) Bit 6: Enable port identificationBit 5: Reuse uplink SFP for fanout (requires bit 4..3 to be non-zero) Bit 4…3: Uplink SFP selection b00: Use SFP on main FPGA board b01: Use last SFP on the fanout expansion board for uplink b10: Use last SFP on the daughter board for uplink b11: Use SFP on the GPS expansion board for uplinkBit 2: Disable the SFP on the GPS expansion boardBit 1: Disable the 4 SFPs on the daughter boardBit 0: Disable the 12 SFPs on the fanout expansions board | RW | 4 |
| 0x0114 | IRIG-B configurationBits 31…20: Leap secondsBit 19: Delete rather than add a leap secondBit 18: Append a leap second (at end of next quarter)Bit 17: Daylight saving timeBit 16…11: Time zone (signed value in units of 0.5h)Bits 10…9: IRIG-B selection (2nd channel) b00: GPS based (no leap seconds) b01: UTC B10 or b11: Local timeBits 8…7: IRIG-B selection b00: GPS based (no leap seconds) b01: UTC B10 or b11: Local timeBit 6: Reuse IRIG-B input for an additional 1 PPS inputBit 5: Output a 2N clock rather than an IRIG-BBits 4…0: Log2 frequency, 225 Hz is the highest allowed frequency | RW | 4 |
| 0x0118 | Fanout expansion statusBits 31…17: ReservedBits 16…15: DIP switch position (SW12/SW11)Bits 14...10: Position of port reused as fanoutBits 9…5: Number of enabled fanout portsBits 4…0: Number of configured fanout ports | R | 4 |
| 0x011C | Time difference between the internal and the IRIG-B/1 PPS signal, 2’s complement in units of 2-32 s | R | 4 |
| 0x0120 | Time difference between the internal GPS and the IRIG-B signal,2’s complement in units of 1s | R | 4 |
| 0x0124to0x012C | Decoded bits of the received IRIG-B signal89 bits in little endian format, bits 89 to 95 are used for an error counterThis bits are reported on the next second after the IRIG-B signal has been decoded, so it is 2 seconds behind | R | 12 |

1. Registers for the fanout expansion module.

The fiber ports on the expansion boards can be enabled or disabled by setting the corresponding bits in the configuration register. Furthermore, the last port on an expansion board can be reassigned to be the uplink. This is useful in situations where the fiber port on the timing interface is not easily accessible. If the uplink has been reassigned, the port on the timing interface can optionally be reused as a fanout port.

Since the numbering of the fanout ports can be confusing, a port identification option is available to enable double blinking of the LED on a selected fanout or uplink port.

The fanout expansion module also implements two BNC connectors that are used for the input and output of an IRIG-B signal. The IRIG-B signals are TTL based square wave signals and not analog sine waves. Alternatively, the IRIG-B input can also be reassigned for an additional 1 PPS input, whereas the IRIG-B output can be used to output a square wave at a fixed frequency of 2*N* Hz.

## Advanced Timing Features

The fanout expansion module requires a PCIe daughter board to provide the additional signal lines. It provides up to 16 fiber downlink ports and makes the PCIe timing interface a fanout timing module.

|  |  |  |  |
| --- | --- | --- | --- |
| **Address** | **Description** | **RW** | **Size** |
| 0x0130 | Advanced timing configurationBits 31…0: Reserved | RW | 4 |
| 0x0134 | Writing the value 0xFEEDC0DE to this register will write the 1 kbyte located at 0x1C00 back to the EEPROM on the daughter board. | W | 4 |
| 0x0138 | Advanced timing statusBit 31…27: UnusedBit 26..24: Timing link version Bit 23: Analog output for XO locking enabledBit 22: RAM option enabled for timing diagnosticsBit 21: PCIE option enabledBit 20: IRIG option enabledBit 19: RS422 option enabledBit 18: PPS option enabledBit 17: OCXO option enabledBit 16: GPS option enabledBit 15: EEPROM on daughterboard has been readBits 14...3: Future expansion optionsBit 2: Fanout expansion is presentBit 1: GPS expansion is presentBit 0: Daughter board is present  | R | 4 |
| 0x013C | Unused |  | 4 |

1. Registers for advanced timing features.

## On Board Features

Several on board diagnostics features are available. They are mostly related to the power supply.

|  |  |  |  |
| --- | --- | --- | --- |
| **Address** | **Description** | **RW** | **Size** |
| 0x0180 | Board configuration:Bits 31…4: ReservedBits 3…0: Value describing the external synchronization frequency, 28+N Hz. Allowable values N = 1…15. Setting N to 0 will disable the output. | RW | 4 |
| 0x0184 | XADC configuration:Currently not used | RW | 4 |
| 0x0188 | Board and power supply status:Bits 31…9: ReservedBits 8: Switching regulator applied interruptBits 7…2: Interrupt flags od switching supply Temperature, low input voltage, power good for supplies 4 to 1Bit 1: Power good signal from PCIe suppliesBit 0: Power good signal from switching supply (ADP5050) | R | 4 |
| 0x018C | XADC status:Bits 31…6: ReservedBit 5: XADC enabledBit 4: VCCAUX alarm (>3% deviation)Bit 3: VCCINT alarm (>3% deviation)Bit 2: User temperature alarm (>75º)Bit 1: Over temperature alarm (>95º)Bit 0: Any alarm |  | 4 |
| 0x0190 | Temperature and internal power supply 1Bits 31…16: VCCINT (nominally 1.0V)Bits 15…0: Current internal chip temperature | R | 4 |
| 0x0194 | Internal power supply 2Bits 31…16: VCCBRAM (nominally 1.0V)Bits 15…0: VCCAUX (nominally 1.8V) | R | 4 |
| 0x0198 | External power supply 1Bits 31…16: Current of VCCINTBits 15…0: Current of VDD | R | 4 |
| 0x019C | External power supply 2Bits 31…16: Current of VCCBits 15…0: Current of VCCAUX | R | 4 |
| 0x01A0 | External power supply 3Bits 31…16: VDD (nominally 2.5V)Bits 15…0: VCC (nominally 3.3V) | R | 4 |
| 0x01A4 | External power supply 4Bits 31…16: AVTT (gigabit transceivers, nominally 1.2V)Bits 15…0: AVCC (gigabit transceivers, nominally 1.0V) | R | 4 |
| 0x01A8 | External power supply 5Bits 31…16: P10 (analog supply, nominally +10V)Bits 15…0: V12 (main supply voltage, nominally 12V) | R | 4 |
| 0x01AC | External power supply 6Bits 31…16: VREG (nominally 5.1V)Bits 15…0: P5 (analog voltage, nominally +5V) | R | 4 |
| 0x01B0 | External power supply 7Bits 31…16: N12 (analog supply, nominally ‒10V)Bits 15…0: VADC (XADC supply voltage, nominally 1.8V) | R | 4 |
| 0x01B4 | External power supply 4Bits 31…16: Current of V12Bits 15…0: V12 (main supply voltage, nominally ‒5V) | R | 4 |

1. Registers for board diagnostics.

The external power synchronization frequency is selected by the following equation: $2^{N+8}$ Hz, where *N* is a 4-bit number ranging from 0 to 15. This supports frequencies from ~512 Hz up to ~8 MHz. *N=0* turns it off.

# Timing Diagnostics Information

The available timing information is described in detail in [E0900036](https://dcc.ligo.org/LIGO-E0900036). The amount of available information depends whether we are configured as an end point in the timing distribution, or whether we are master or fanout module. The PCIe timing interface can support master and fanout functions through expansion modules. Every timing interface module sends some information back to the upstream fanout module through the uplink fiber port. Fanout modules collect this information and make it available through a RS422 port, which in turn is read by the slow controls system.

The same is true for the PCIe timing interface with the addition that this information is mapped into the timing diagnostics block and available through the PCIe interface. The PCIe interface implements version of the protocol which allocates an additional 128 bytes of data before the information form the downstream ports.

The memory layout is as follows:

|  |  |  |
| --- | --- | --- |
| **Address** | **Description** | **Size** |
| 0x1000 | Status & Configuration Information  | 64 |
| 0x1040 | Records from up to 16 downlink records | 128 |
| 0x10C0 | GPS status | 32 |
| 0x10E0 | CRC error counters from fanout modules | 16 |
| 0x10F0 | Reserved | 16 |
| 0x1100(v2) | Additional information from the PCIe board (version 2 only) | 128 |
| 0x1100(v1)0x1180(v2) | Information sent back from the downlink nodes, each has32 bytes of status information96 bytes of node specific information | 2048 |
| 0x1900(v1)0x1980(v2) | CRC | 4 |
| 0x1904(v1)0x1984(v2) | Reserved | 764(v1)636(v2) |
| 0x1C00 | Data from EEPROM on daughter board (if present)  | 1024 |

1. Memory map of timing diagnostics information.

We explicitly list the first 16 double words and refer to [E0900036](https://dcc.ligo.org/LIGO-E0900036) for any additional information.

|  |  |  |
| --- | --- | --- |
| **Address** | **Description** | **Size** |
| 0x1000 | Board ID and revisionFirst 7 digits are the dcc number (D), last digit is the revision. Set to 0x2000329R with R the revision | 4 |
| 0x1004 | Board serial number. Currently used to indicate if this is a root or fanout node (0x0000) or a normal timing interface (0x0001) | 4 |
| 0x1008 | Software ID and revisionFirst 7 digits are the dcc number (E), last digit is the revision. Set to 0x2000337R with R the revision | 4 |
| 0x100C | Software revision numberThis is the subversion revision of the loaded FPGA program | 4 |
| 0x1010 | GPS time in seconds | 4 |
| 0x1014 | Module address. The first nibble (hex digit) is the nesting level and each following nibble represents a leaf in the timing distribution system with the master always set to 0x0. The first fanout port of the master gets assigned 0x1000000, the second port is 0x11000000, etc.  | 4 |
| 0x1018 | StatusBits 31…16: Control voltage applied to the VCXOBits 15…8: Status of the DIP switchesBits 7…6: Status of SW10 and SW9Bit 5: Loss of signal (LOS) at the uplink portBits 4…1: Number of consecutive seconds with missing 1PPSBit 0: Uplink is up and running normally | 4 |
| 0x101C | Configuration (master and fanout)Bits 31…16: UnusedBit 15: An OCXO is presentBit 14: External 1PPS presentBit 13: A GPS module is presentBit 12: GPS is lockedBit 11: OCXO is lockedBit 10: External 1PPS is used for timing referenceBit 9: GPS 1PPS is used for timing referenceBit 8: Uplink 1PPS is used for timing referenceBit 7: Uplink up and runningBit 6: Uplink loss of signalBits 5…2: Number of fanout ports (0 represents 16 ports)Bit 1: This is a fanout moduleBit 0: This is a master module | 4 |
| 0x1020 | OCXO ControlsBits 31…16: UnusedBits 15…0: OCXO control voltage | 4 |
| 0x1024 | OCXO Error Time difference between the internal 1PPS obtained from the OCXO clock signal, and the external 1PPS, 2’s complement in units of 2-32 s | 4 |
| 0x1028 | Uplink 1PPS delayTime difference between the uplink 1PPS input and the internal 1PPS | 4 |
| 0x102C | Ext 1PPS delayTime difference between the external 1PPS and the internal 1PPS. | 4 |
| 0x1030 | GPS 1PPS delayTime difference between the GPS 1PPS and the internal 1PPS. | 4 |
| 0x1034 | Fanout Up/LOSBits 31…16: Fanout ports are up (LSB is port 0)Bits 15…0: Loss of signal at fanout port | 4 |
| 0x1038 | Fanout Missing downlink 1PPS and delay errorBits 31…16: Missing 1PPS in downlink returnBits 15…0: Fiber delay is out of range | 4 |
| 0x103C | Error countBits 31…12: UnusedBit 11: GPS error (if master)Bit 10…8: GPS error count (if master)Bits: 7…0: CRC error count | 4 |

1. Memory map of the status information form the timing diagnostics.