

## Frequency Gearing Clock for CPU, PCIe Gen1, Gen2, & FBD

## ICS9FG1201H

### Description

The **ICS9FG1201H** follows the Intel DB1200G Rev 1.0 Differential Buffer Specification. This buffer provides 12 output clocks for CPU Host Bus, PCI-Express, or Fully Buffered DIMM applications. The outputs are configured with two groups. Both groups (DIF 9:0) and (DIF 11:10) can be equal to or have a gear ratio to the input clock. A differential CPU clock from a CK410B or CK410B+ main clock generator, such as the ICS932S421, drives the ICS9FG1201. The **ICS9FG1201H** can provide outputs up to 400MHz

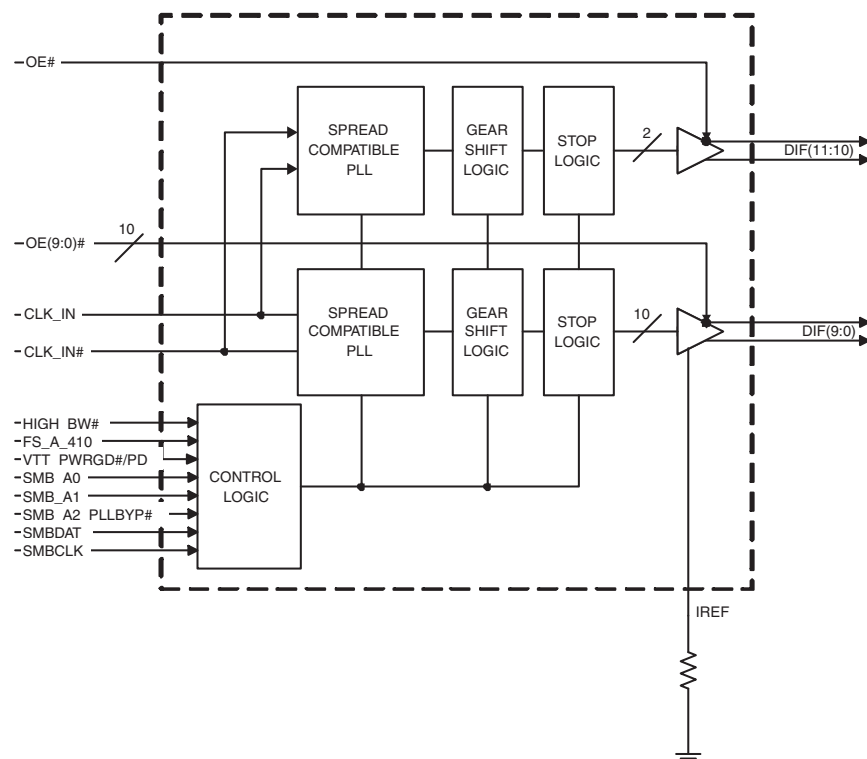
### Key Specifications

- DIF output cycle-to-cycle jitter < 50ps
- DIF output-to-output skew < 50ps within a group
- DIF output-to-output skew < 100ps across all outputs
- 56-pin SSOP/TSSOP package
- RoHS compliant packaging

### Features/Benefits

- Drives 2 channels of 4 FBDIMMs (total of 8 FBDIMMs)
- Power up default is all outputs in 1:1 mode
- DIF\_(9:0) can be "gear-shifted" from the input CPU Host Clock
- DIF\_(11:10) can be "gear-shifted" from the input CPU Host Clock
- Spread spectrum compatible
- Supports output clock frequencies up to 400 MHz
- 8 Selectable SMBus addresses
- SMBus address determines PLL or Bypass mode

### Functional Block Diagram



## Pin Configuration

|          |    |    |                |
|----------|----|----|----------------|
| HIGH_BW# | 1  | 56 | VDDA           |
| CLK_IN   | 2  | 55 | GNDA           |
| CLK_IN#  | 3  | 54 | IREF           |
| SMB_A0   | 4  | 53 | OE10_11#       |
| OE0#     | 5  | 52 | DIF_11         |
| DIF_0    | 6  | 51 | DIF_11#        |
| DIF_0#   | 7  | 50 | VDD            |
| OE1#     | 8  | 49 | GND            |
| DIF_1    | 9  | 48 | DIF_10         |
| DIF_1#   | 10 | 47 | DIF_10#        |
| VDD      | 11 | 46 | FS_A_410       |
| GND      | 12 | 45 | VTT_PWRGD#/PD  |
| DIF_2    | 13 | 44 | OE9#           |
| DIF_2#   | 14 | 43 | DIF_9          |
| OE2#     | 15 | 42 | DIF_9#         |
| DIF_3    | 16 | 41 | OE8#           |
| DIF_3#   | 17 | 40 | DIF_8          |
| OE3#     | 18 | 39 | DIF_8#         |
| DIF_4    | 19 | 38 | VDD            |
| DIF_4#   | 20 | 37 | GND            |
| OE4#     | 21 | 36 | DIF_7          |
| VDD      | 22 | 35 | DIF_7#         |
| GND      | 23 | 34 | OE7#           |
| DIF_5    | 24 | 33 | DIF_6          |
| DIF_5#   | 25 | 32 | DIF_6#         |
| OE5#     | 26 | 31 | OE6#           |
| SMB_A1   | 27 | 30 | SMB_A2_PLLBYP# |
| SMBDAT   | 28 | 29 | SMBCLK         |

**ICS9FG1201H**

**56-pin SSOP & TSSOP**

## Functionality Table

| FS_A_410 <sup>1</sup> | CLK_IN (CPU FSB)<br>MHz | DIF_(9:0) Output<br>MHz | DIF_(11:10) Output<br>MHz |
|-----------------------|-------------------------|-------------------------|---------------------------|
| 1                     | 100.00                  | 100.00                  | 100.00                    |
| 1                     | 133.33                  | 133.33                  | 133.33                    |
| 1                     | 166.66                  | 166.66                  | 166.66                    |
| 1                     | RESERVED                |                         |                           |
| 0                     | 200.00                  | 200.00                  | 200.00                    |
| 0                     | 266.66                  | 266.66                  | 266.66                    |
| 0                     | 333.33                  | 333.33                  | 333.33                    |
| 0                     | 400.00                  | 400.00                  | 400.00                    |

1. FS\_A\_410 is a low-threshold input. Please see the  $V_{IL\_FS}$  and  $V_{IH\_FS}$  specifications in the Input/Supply/Common Output Parameters Table for correct values.

## Power Groups

| Pin Number  |             | Description      |
|-------------|-------------|------------------|
| VDD         | GND         |                  |
| 56          | 55          | Main PLL, Analog |
| 11,22,38,50 | 12,23,37,49 | DIF clocks       |

## Pin Description

| Pin # | Pin Name | Type | Pin Description                                                                        |
|-------|----------|------|----------------------------------------------------------------------------------------|
| 1     | HIGH_BW# | IN   | 3.3V input for selecting PLL Band Width<br>0 = High, 1 = Low                           |
| 2     | CLK_IN   | IN   | Input for reference clock.                                                             |
| 3     | CLK_IN#  | IN   | "Complementary" reference clock input.                                                 |
| 4     | SMB_A0   | IN   | SMBus address bit 0 (LSB)                                                              |
| 5     | OE0#     | IN   | Active low input for enabling DIF pair 0.<br>1 = tri-state outputs, 0 = enable outputs |
| 6     | DIF_0    | OUT  | 0.7V differential true clock output                                                    |
| 7     | DIF_0#   | OUT  | 0.7V differential complement clock output                                              |
| 8     | OE1#     | IN   | Active low input for enabling DIF pair 1.<br>1 = tri-state outputs, 0 = enable outputs |
| 9     | DIF_1    | OUT  | 0.7V differential true clock output                                                    |
| 10    | DIF_1#   | OUT  | 0.7V differential complement clock output                                              |
| 11    | VDD      | PWR  | Power supply, nominal 3.3V                                                             |
| 12    | GND      | PWR  | Ground pin.                                                                            |
| 13    | DIF_2    | OUT  | 0.7V differential true clock output                                                    |
| 14    | DIF_2#   | OUT  | 0.7V differential complement clock output                                              |
| 15    | OE2#     | IN   | Active low input for enabling DIF pair 2.<br>1 = tri-state outputs, 0 = enable outputs |
| 16    | DIF_3    | OUT  | 0.7V differential true clock output                                                    |
| 17    | DIF_3#   | OUT  | 0.7V differential complement clock output                                              |
| 18    | OE3#     | IN   | Active low input for enabling DIF pair 3.<br>1 = tri-state outputs, 0 = enable outputs |
| 19    | DIF_4    | OUT  | 0.7V differential true clock output                                                    |
| 20    | DIF_4#   | OUT  | 0.7V differential complement clock output                                              |
| 21    | OE4#     | IN   | Active low input for enabling DIF pair 4<br>1 = tri-state outputs, 0 = enable outputs  |
| 22    | VDD      | PWR  | Power supply, nominal 3.3V                                                             |
| 23    | GND      | PWR  | Ground pin.                                                                            |
| 24    | DIF_5    | OUT  | 0.7V differential true clock output                                                    |
| 25    | DIF_5#   | OUT  | 0.7V differential complement clock output                                              |
| 26    | OE5#     | IN   | Active low input for enabling DIF pair 5.<br>1 = tri-state outputs, 0 = enable outputs |
| 27    | SMB_A1   | IN   | SMBus address bit 1                                                                    |
| 28    | SMBDAT   | I/O  | Data pin of SMBUS circuitry, 5V tolerant                                               |

## Pin Description (continued)

| Pin # | Pin Name       | Type | Pin Description                                                                                                                                                                                                                                               |
|-------|----------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 29    | SMBCLK         | IN   | Clock pin of SMBUS circuitry, 5V tolerant                                                                                                                                                                                                                     |
| 30    | SMB_A2_PLLBYP# | IN   | SMBus address bit 2. When Low, the part operates as a fanout buffer with the PLL bypassed. When High, the part operates as a zero-delay buffer (ZDB) with the PLL operating.<br>0 = fanout mode (PLL bypassed), 1 = ZDB mode (PLL used)                       |
| 31    | OE6#           | IN   | Active low input for enabling DIF pair 6.<br>1 = tri-state outputs, 0 = enable outputs                                                                                                                                                                        |
| 32    | DIF_6#         | OUT  | 0.7V differential complement clock output                                                                                                                                                                                                                     |
| 33    | DIF_6          | OUT  | 0.7V differential true clock output                                                                                                                                                                                                                           |
| 34    | OE7#           | IN   | Active low input for enabling DIF pair 7.<br>1 = tri-state outputs, 0 = enable outputs                                                                                                                                                                        |
| 35    | DIF_7#         | OUT  | 0.7V differential complement clock output                                                                                                                                                                                                                     |
| 36    | DIF_7          | OUT  | 0.7V differential true clock output                                                                                                                                                                                                                           |
| 37    | GND            | PWR  | Ground pin.                                                                                                                                                                                                                                                   |
| 38    | VDD            | PWR  | Power supply, nominal 3.3V                                                                                                                                                                                                                                    |
| 39    | DIF_8#         | OUT  | 0.7V differential complement clock output                                                                                                                                                                                                                     |
| 40    | DIF_8          | OUT  | 0.7V differential true clock output                                                                                                                                                                                                                           |
| 41    | OE8#           | IN   | Active low input for enabling DIF pair 8.<br>1 = tri-state outputs, 0 = enable outputs                                                                                                                                                                        |
| 42    | DIF_9#         | OUT  | 0.7V differential complement clock output                                                                                                                                                                                                                     |
| 43    | DIF_9          | OUT  | 0.7V differential true clock output                                                                                                                                                                                                                           |
| 44    | OE9#           | IN   | Active low input for enabling DIF pair 9.<br>1 = tri-state outputs, 0 = enable outputs                                                                                                                                                                        |
| 45    | VTT_PWRGD#/PD  | IN   | Vtt_PwrGd# is an active low input used to determine when latched inputs are ready to be sampled. PD is an asynchronous active high input pin used to put the device into a low power state. The internal clocks, PLLs and the crystal oscillator are stopped. |
| 46    | FS_A_410       | IN   | 3.3V tolerant low threshold input for CPU frequency selection. This pin requires CK410 FSA. Refer to input electrical characteristics for Vil_FS and Vih_FS threshold values.                                                                                 |
| 47    | DIF_10#        | OUT  | 0.7V differential complement clock output                                                                                                                                                                                                                     |
| 48    | DIF_10         | OUT  | 0.7V differential true clock output                                                                                                                                                                                                                           |
| 49    | GND            | PWR  | Ground pin.                                                                                                                                                                                                                                                   |
| 50    | VDD            | PWR  | Power supply, nominal 3.3V                                                                                                                                                                                                                                    |
| 51    | DIF_11#        | OUT  | 0.7V differential complement clock output                                                                                                                                                                                                                     |
| 52    | DIF_11         | OUT  | 0.7V differential true clock output                                                                                                                                                                                                                           |
| 53    | OE10_11#       | IN   | Active low input for enabling output pairs 10 and 11.<br>1 = tri-state outputs, 0 = enable outputs                                                                                                                                                            |
| 54    | IREF           | OUT  | This pin establishes the reference current for the differential current-mode output pairs. This pin requires a fixed precision resistor tied to ground in order to establish the appropriate current. 475 ohms is the standard value.                         |
| 55    | GNDA           | PWR  | Ground pin for the PLL core.                                                                                                                                                                                                                                  |
| 56    | VDDA           | PWR  | 3.3V power for the PLL core.                                                                                                                                                                                                                                  |

## ICS9FG1201 Programmable Gear Ratios

| FS_A_410 | SMBus Byte 0 |          |          |          | Input (m) | Output (n) | Gear Ratio (n/m) | Input (CPU FSB) and Output Frequencies (MHz) |              |              |              |              |
|----------|--------------|----------|----------|----------|-----------|------------|------------------|----------------------------------------------|--------------|--------------|--------------|--------------|
|          | Bit 3        | Bit 2    | Bit 1    | Bit 0    |           |            |                  | 200.0                                        | 266.7        | 320.0        | 333.3        | 400.0        |
| 0        | 0            | 0        | 0        | 0        | 3         | 1          | 0.333            | 66.7                                         | 88.9         | 106.7        | 111.1        | 133.3        |
| 0        | 0            | 0        | 0        | 1        | 5         | 2          | 0.400            | 80.0                                         | 106.7        | 128.0        | 133.3        | 160.0        |
| 0        | 0            | 0        | 1        | 0        | 12        | 5          | 0.417            | 83.3                                         | 111.1        | 133.3        | 138.9        | 166.7        |
| 0        | 0            | 0        | 1        | 1        | 2         | 1          | 0.500            | 100.0                                        | 133.3        | 160.0        | 166.7        | 200.0        |
| 0        | 0            | 1        | 0        | 0        | 5         | 3          | 0.600            | 120.0                                        | 160.0        | 192.0        | 200.0        | 240.0        |
| 0        | 0            | 1        | 0        | 1        | 8         | 5          | 0.625            | 125.0                                        | 166.7        | 200.0        | 208.3        | 250.0        |
| 0        | 0            | 1        | 1        | 0        | 3         | 2          | 0.667            | 133.3                                        | 177.8        | 213.3        | 222.2        | 266.7        |
| 0        | 0            | 1        | 1        | 1        | 4         | 3          | 0.750            | 150.0                                        | 200.0        | 240.0        | 250.0        | 300.0        |
| 0        | 1            | 0        | 0        | 0        | 6         | 5          | 0.833            | 166.7                                        | 222.2        | 266.7        | 277.8        | 333.3        |
| <b>0</b> | <b>1</b>     | <b>0</b> | <b>0</b> | <b>1</b> | <b>1</b>  | <b>1</b>   | <b>1.000</b>     | <b>200.0</b>                                 | <b>266.7</b> | <b>320.0</b> | <b>333.3</b> | <b>400.0</b> |
| 0        | 1            | 0        | 1        | 0        | 5         | 6          | 1.200            | 240.0                                        | 320.0        | 384.0        | 400.0        | NA           |
| 0        | 1            | 0        | 1        | 1        | 4         | 5          | 1.250            | 250.0                                        | 333.3        | 400.0        | NA           | NA           |
| 0        | 1            | 1        | 0        | 0        | 3         | 4          | 1.333            | 266.7                                        | 355.6        | NA           | NA           | NA           |
| 0        | 1            | 1        | 0        | 1        | 2         | 3          | 1.500            | 300.0                                        | 400.0        | NA           | NA           | NA           |
| 0        | 1            | 1        | 1        | 0        | 3         | 5          | 1.667            | 333.3                                        | NA           | NA           | NA           | NA           |
| 0        | 1            | 1        | 1        | 1        | 1         | 2          | 2.000            | 400.0                                        | NA           | NA           | NA           | NA           |
|          |              |          |          |          |           |            |                  | CLK IN (CPU FSB) Frequency (MHz)             |              |              |              |              |
|          |              |          |          |          |           |            |                  | 100                                          | 133.33       | 160          | 166.67       |              |
| 1        | 0            | 0        | 0        | 0        | 3         | 1          | 0.333            |                                              |              |              |              |              |
| 1        | 0            | 0        | 0        | 1        | 5         | 2          | 0.400            | NA                                           | 53.3         | 64.0         | 66.7         |              |
| 1        | 0            | 0        | 1        | 0        | 12        | 5          | 0.417            | NA                                           | 55.6         | 66.7         | 69.4         |              |
| 1        | 0            | 0        | 1        | 1        | 2         | 1          | 0.500            | 50.0                                         | 66.7         | 80.0         | 83.3         |              |
| 1        | 0            | 1        | 0        | 0        | 5         | 3          | 0.600            | 60.0                                         | 80.0         | 96.0         | 100.0        |              |
| 1        | 0            | 1        | 0        | 1        | 8         | 5          | 0.625            | 62.5                                         | 83.3         | 100.0        | 104.2        |              |
| 1        | 0            | 1        | 1        | 0        | 3         | 2          | 0.667            | 66.7                                         | 88.9         | 106.7        | 111.1        |              |
| 1        | 0            | 1        | 1        | 1        | 5         | 4          | 0.800            | 80.0                                         | 106.7        | 128.0        | 133.3        |              |
| 1        | 1            | 0        | 0        | 0        | 6         | 5          | 0.833            | NA                                           | 111.1        | 133.3        | 138.9        |              |
| <b>1</b> | <b>1</b>     | <b>0</b> | <b>0</b> | <b>1</b> | <b>1</b>  | <b>1</b>   | <b>1.000</b>     | <b>100.0</b>                                 | <b>133.3</b> | <b>160.0</b> | <b>166.7</b> |              |
| 1        | 1            | 0        | 1        | 0        | 5         | 6          | 1.200            | 120.0                                        | 160.0        | 192.0        | 200.0        |              |
| 1        | 1            | 0        | 1        | 1        | 4         | 5          | 1.250            | 125.0                                        | 166.7        | 200.0        | 208.3        |              |
| 1        | 1            | 1        | 0        | 0        | 3         | 4          | 1.333            | 133.3                                        | 177.8        | 213.3        | 222.2        |              |
| 1        | 1            | 1        | 0        | 1        | 2         | 3          | 1.500            | 150.0                                        | 200.0        |              |              |              |
| 1        | 1            | 1        | 1        | 0        | 3         | 5          | 1.667            | 166.7                                        | 222.2        | 266.7        | 277.8        |              |
| 1        | 1            | 1        | 1        | 1        | 1         | 2          | 2.000            | 200.0                                        | 266.7        | 320.0        | 333.3        |              |

Note: Lines in **BOLD** are Power-up defaults for FS\_A\_410 = 0 and 1 respectively.

Shaded areas are shown for reference only and are not necessarily valid operating points

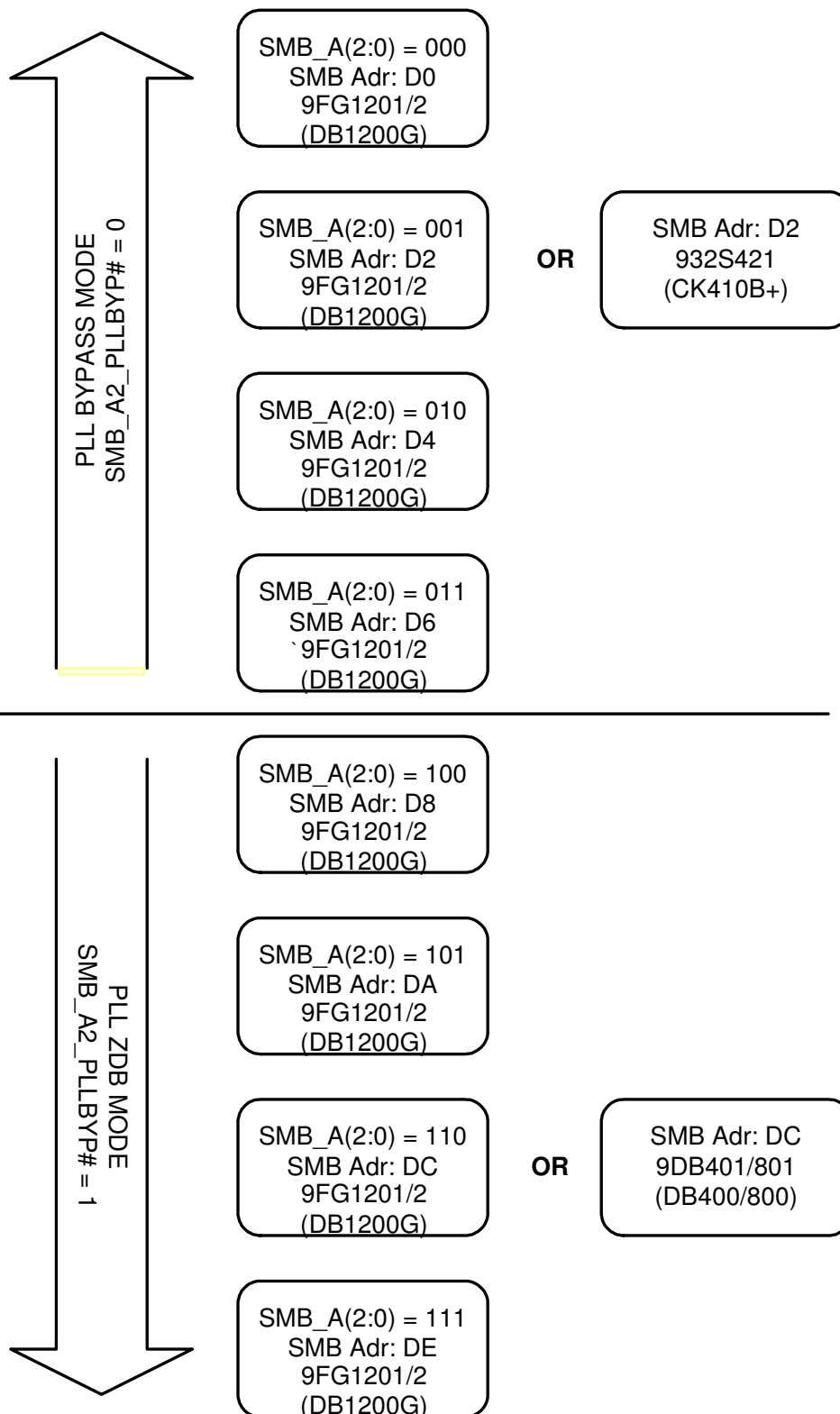
### ICS 9FG1201H 1:1 PLL Programming

| Byte 8,<br>bit 2<br>FSC | Byte 8,<br>bit 1<br>FSB | Byte 8,<br>bit 0<br>FS_A_410 | CLK_IN<br>(CPU FSB)<br>MHz | 1:1 DIF<br>Outputs<br>MHz | Notes |
|-------------------------|-------------------------|------------------------------|----------------------------|---------------------------|-------|
| 1                       | 0                       | 1                            | 100.00                     | 100.00                    | 3     |
| 0                       | 0                       | 1                            | 133.33                     | 133.33                    | 3     |
| 0                       | 1                       | 1                            | <b>166.67</b>              | <b>166.67</b>             | 1     |
| 0                       | 1                       | 0                            | 200.00                     | 200.00                    | 3     |
| 0                       | 0                       | 0                            | 266.67                     | 266.67                    | 3     |
| 1                       | 0                       | 0                            | 333.33                     | 333.33                    | 3     |
| 1                       | 1                       | 0                            | <b>400.00</b>              | <b>400.00</b>             | 2     |
| 1                       | 1                       | 1                            | Reserved                   |                           |       |

**Notes:FS\_A\_410 = 1**

1. Powerup Default for FS\_A\_410 = 1
2. Powerup Default for FS\_A\_410 = 0
3. Setting the exact FSB frequency after Power up is required for best phase noise performance.

**9FG1201/2 SMBus Address Mapping  
when using CK410B+ and DB400/800**



## General SMBus serial interface information for the ICS9FG1201H

### How to Write:

- Controller (host) sends a start bit.
- Controller (host) sends the write address D0<sub>(h)</sub>
- ICS clock will **acknowledge**
- Controller (host) sends the beginning byte location = N
- ICS clock will **acknowledge**
- Controller (host) sends the data byte count = X
- ICS clock will **acknowledge**
- Controller (host) starts sending **Byte N through Byte N + X - 1**
- ICS clock will **acknowledge** each byte **one at a time**
- Controller (host) sends a Stop bit

### How to Read:

- Controller (host) will send start bit.
- Controller (host) sends the write address D0<sub>(h)</sub>
- ICS clock will **acknowledge**
- Controller (host) sends the beginning byte location = N
- ICS clock will **acknowledge**
- Controller (host) will send a separate start bit.
- Controller (host) sends the read address D1<sub>(h)</sub>
- ICS clock will **acknowledge**
- ICS clock will send the data byte count = X
- ICS clock sends **Byte N + X - 1**
- ICS clock sends **Byte 0 through byte X (if X<sub>(h)</sub> was written to byte 8).**
- Controller (host) will need to acknowledge each byte
- Controller (host) will send a not acknowledge bit
- Controller (host) will send a stop bit

| Index Block Write Operation       |           |                      |     |
|-----------------------------------|-----------|----------------------|-----|
| Controller (Host)                 |           | ICS (Slave/Receiver) |     |
| T                                 | starT bit |                      |     |
| Slave Address D0 <sub>(h)</sub> * |           |                      |     |
| WR                                | WRite     |                      |     |
|                                   |           | ACK                  |     |
| Beginning Byte = N                |           |                      |     |
|                                   |           | ACK                  |     |
| Data Byte Count = X               |           |                      |     |
|                                   |           | ACK                  |     |
| Beginning Byte N                  |           | X Byte               |     |
|                                   |           |                      | ACK |
| ◊                                 |           |                      |     |
| ◊                                 |           |                      | ◊   |
| ◊                                 |           |                      | ◊   |
|                                   |           |                      | ◊   |
| Byte N + X - 1                    |           |                      |     |
|                                   |           | ACK                  |     |
| P                                 | stoP bit  |                      |     |

| Index Block Read Operation        |                 |                      |
|-----------------------------------|-----------------|----------------------|
| Controller (Host)                 |                 | ICS (Slave/Receiver) |
| T                                 | starT bit       |                      |
| Slave Address D0 <sub>(h)</sub> * |                 |                      |
| WR                                | WRite           |                      |
|                                   |                 | ACK                  |
| Beginning Byte = N                |                 |                      |
|                                   |                 | ACK                  |
| RT                                | Repeat starT    |                      |
| Slave Address D1 <sub>(h)</sub> * |                 |                      |
| RD                                | ReaD            |                      |
|                                   |                 | ACK                  |
|                                   |                 | Data Byte Count = X  |
| ACK                               |                 |                      |
| ACK                               |                 | Beginning Byte N     |
|                                   | X Byte          | ○                    |
| ○                                 |                 | ○                    |
| ○                                 |                 | ○                    |
|                                   |                 |                      |
|                                   |                 | Byte N + X - 1       |
| N                                 | Not acknowledge |                      |
| P                                 | stoP bit        |                      |

\* Note: See SMBus Address Mapping (page 7), for programming SMBus Read/Write Address



**SMBusTable: Gear Ratio Select Register**

| Byte 0 | Pin #      | Name                          | Control Function | Type | 0                                                | 1   | PWD   |
|--------|------------|-------------------------------|------------------|------|--------------------------------------------------|-----|-------|
| Bit 7  | DIF(9:0)   | Group of 10 gear ratio enable |                  | RW   | Gear Ratio                                       | 1:1 | 1     |
| Bit 6  | DIF(11:10) | Group of 2 gear ratio enable  |                  | RW   | Gear Ratio                                       | 1:1 | 1     |
| Bit 5  | -          | Reserved                      |                  | RW   |                                                  |     | 1     |
| Bit 4  | -          | Gear Ratio FS4 (FS_A 410)     |                  | RW   | See 9FG1201<br>Programmable Gear<br>Ratios Table |     | Latch |
| Bit 3  | -          | Gear Ratio FS3                |                  | RW   |                                                  |     | 1     |
| Bit 2  | -          | Gear Ratio FS2                |                  | RW   |                                                  |     | 0     |
| Bit 1  | -          | Gear Ratio FS1                |                  | RW   |                                                  |     | 1     |
| Bit 0  | -          | Gear Ratio FS0                |                  | RW   |                                                  |     | 1     |

**SMBusTable: Output Control Register**

| Byte 1 | Pin #  | Name  | Control Function | Type | 0    | 1      | PWD |
|--------|--------|-------|------------------|------|------|--------|-----|
| Bit 7  | 35, 36 | DIF_7 | Output Control   | RW   | Hi-Z | Enable | 1   |
| Bit 6  | 32, 33 | DIF_6 | Output Control   | RW   | Hi-Z | Enable | 1   |
| Bit 5  | 24, 25 | DIF_5 | Output Control   | RW   | Hi-Z | Enable | 1   |
| Bit 4  | 19,20  | DIF_4 | Output Control   | RW   | Hi-Z | Enable | 1   |
| Bit 3  | 16,17  | DIF_3 | Output Control   | RW   | Hi-Z | Enable | 1   |
| Bit 2  | 13,14  | DIF_2 | Output Control   | RW   | Hi-Z | Enable | 1   |
| Bit 1  | 9,10   | DIF_1 | Output Control   | RW   | Hi-Z | Enable | 1   |
| Bit 0  | 6,7    | DIF_0 | Output Control   | RW   | Hi-Z | Enable | 1   |

**SMBusTable: Output and PLL BW Control Register**

| Byte 2 | Pin #    | Name                    | Control Function | Type | 0       | 1      | PWD |
|--------|----------|-------------------------|------------------|------|---------|--------|-----|
| Bit 7  |          | Reserved                |                  |      |         |        | 1   |
| Bit 6  | see note | PLL_BW# adjust          |                  | RW   | High BW | Low BW | 1   |
| Bit 5  | see note | BYPASS# test mode / PLL |                  | RW   | Bypass  | PLL    | 1   |
| Bit 4  |          | Reserved                |                  |      |         |        | 1   |
| Bit 3  | 51,52    | DIF_11                  | Output Control   | RW   | Hi-Z    | Enable | 1   |
| Bit 2  | 47,48    | DIF_10                  | Output Control   | RW   | Hi-Z    | Enable | 1   |
| Bit 1  | 42,43    | DIF_9                   | Output Control   | RW   | Hi-Z    | Enable | 1   |
| Bit 0  | 39,40    | DIF_8                   | Output Control   | RW   | Hi-Z    | Enable | 1   |

Note: Bit 6 is wired OR to the pin 1 input, any 0 selects High BW

Note: Bit 5 is wired OR to the pin 30 input, any 0 selects Fanout Bypass mode

**SMBusTable: Output Enable Readback Register**

| Byte 3 | Pin # | Name                  | Control Function | Type | 0        | 1 | PWD |
|--------|-------|-----------------------|------------------|------|----------|---|-----|
| Bit 7  | 34    | Readback - OE7# Input |                  | R    | Readback |   | X   |
| Bit 6  | 31    | Readback - OE6# Input |                  | R    | Readback |   | X   |
| Bit 5  | 26    | Readback - OE5# Input |                  | R    | Readback |   | X   |
| Bit 4  | 21    | Readback - OE4# Input |                  | R    | Readback |   | X   |
| Bit 3  | 18    | Readback - OE3# Input |                  | R    | Readback |   | X   |
| Bit 2  | 15    | Readback - OE2# Input |                  | R    | Readback |   | X   |
| Bit 1  | 8     | Readback - OE1# Input |                  | R    | Readback |   | X   |
| Bit 0  | 5     | Readback - OE0# Input |                  | R    | Readback |   | X   |

**SMBusTable: Output Enable Readback Register**

| Byte 4 | Pin # | Name                         | Control Function | Type | 0        | 1 | PWD |
|--------|-------|------------------------------|------------------|------|----------|---|-----|
| Bit 7  | 46    | Readback - FS_A 410          |                  | R    | Readback |   | X   |
| Bit 6  | 1     | Readback - HIGH BW# In       |                  | R    | Readback |   | X   |
| Bit 5  | 30    | Readback - SMB_A2_PLLBYP# In |                  | R    | Readback |   | X   |
| Bit 4  |       | Reserved                     |                  | R    | Readback |   | X   |
| Bit 3  |       | Reserved                     |                  | R    | Readback |   | X   |
| Bit 2  | 53    | Readback - OE10_11# Input    |                  | R    | Readback |   | X   |
| Bit 1  | 44    | Readback - OE9# Input        |                  | R    | Readback |   | X   |
| Bit 0  | 41    | Readback - OE8# Input        |                  | R    | Readback |   | X   |

**SMBusTable: Vendor & Revision ID Register**

| Byte 5 | Pin # | Name | Control Function | Type | 0 | 1 | PWD |
|--------|-------|------|------------------|------|---|---|-----|
| Bit 7  | -     | RID3 | REVISION ID      | R    | - | - | X   |
| Bit 6  | -     | RID2 |                  | R    | - | - | X   |
| Bit 5  | -     | RID1 |                  | R    | - | - | X   |
| Bit 4  | -     | RID0 |                  | R    | - | - | X   |
| Bit 3  | -     | VID3 | VENDOR ID        | R    | - | - | 0   |
| Bit 2  | -     | VID2 |                  | R    | - | - | 0   |
| Bit 1  | -     | VID1 |                  | R    | - | - | 0   |
| Bit 0  | -     | VID0 |                  | R    | - | - | 1   |

**SMBusTable: DEVICE ID**

| Byte 6 | Pin # | Name              | Control Function | Type | 0        | 1 | PWD |
|--------|-------|-------------------|------------------|------|----------|---|-----|
| Bit 7  | -     | Device ID 7 (MSB) |                  | RW   | Reserved |   | 1   |
| Bit 6  | -     | Device ID 6       |                  | RW   | Reserved |   | 1   |
| Bit 5  | -     | Device ID 5       |                  | RW   | Reserved |   | 0   |
| Bit 4  | -     | Device ID 4       |                  | RW   | Reserved |   | 0   |
| Bit 3  | -     | Device ID 3       |                  | RW   | Reserved |   | 0   |
| Bit 2  | -     | Device ID 2       |                  | RW   | Reserved |   | 0   |
| Bit 1  | -     | Device ID 1       |                  | RW   | Reserved |   | 0   |
| Bit 0  | -     | Device ID 0       |                  | RW   | Reserved |   | 1   |

**SMBusTable: Byte Count Register**

| Byte 7 | Pin # | Name | Control Function                                                      | Type | 0 | 1 | PWD |
|--------|-------|------|-----------------------------------------------------------------------|------|---|---|-----|
| Bit 7  | -     | BC7  | Writing to this register configures how many bytes will be read back. | RW   | - | - | 0   |
| Bit 6  | -     | BC6  |                                                                       | RW   | - | - | 0   |
| Bit 5  | -     | BC5  |                                                                       | RW   | - | - | 0   |
| Bit 4  | -     | BC4  |                                                                       | RW   | - | - | 0   |
| Bit 3  | -     | BC3  |                                                                       | RW   | - | - | 1   |
| Bit 2  | -     | BC2  |                                                                       | RW   | - | - | 0   |
| Bit 1  | -     | BC1  |                                                                       | RW   | - | - | 0   |
| Bit 0  | -     | BC0  |                                                                       | RW   | - | - | 1   |

**SMBusTable: 1:1 PLL Frequency Selection**

| Byte 8 | Pin # | Name               | Control Function | Type | 0                                         | 1 | PWD   |
|--------|-------|--------------------|------------------|------|-------------------------------------------|---|-------|
| Bit 7  |       |                    | RESERVED         |      |                                           |   | 0     |
| Bit 6  |       |                    | RESERVED         |      |                                           |   | 0     |
| Bit 5  |       |                    | RESERVED         |      |                                           |   | 0     |
| Bit 4  |       |                    | RESERVED         |      |                                           |   | 0     |
| Bit 3  |       |                    | RESERVED         |      |                                           |   | 0     |
| Bit 2  | -     | Frequency Select C |                  | RW   | See 9FG1201H 1:1 PLL<br>Programming Table |   | x     |
| Bit 1  | -     | Frequency Select B |                  | RW   |                                           |   | 1     |
| Bit 0  | -     | FS A 410           |                  | RW   |                                           |   | Latch |

**SMBusTable: Reserved Register**

| Byte 9 | Pin # | Name | Control Function | Type | 0 | 1 | PWD |
|--------|-------|------|------------------|------|---|---|-----|
| Bit 7  |       |      | RESERVED         |      |   |   | 0   |
| Bit 6  |       |      | RESERVED         |      |   |   | 0   |
| Bit 5  |       |      | RESERVED         |      |   |   | 0   |
| Bit 4  |       |      | RESERVED         |      |   |   | 0   |
| Bit 3  |       |      | RESERVED         |      |   |   | 0   |
| Bit 2  |       |      | RESERVED         |      |   |   | 0   |
| Bit 1  |       |      | RESERVED         |      |   |   | 0   |
| Bit 0  |       |      | RESERVED         |      |   |   | 0   |

**SMBus Table: M/N Programming Enable**

| Byte 10 | Pin # | Name   | Control Function                                  | Type | 0       | 1      | PWD |
|---------|-------|--------|---------------------------------------------------|------|---------|--------|-----|
| Bit 7   | -     | M/N_EN | Gear PLL and 1:1 PLL<br>M/N Programming<br>Enable | RW   | Disable | Enable | 0   |
| Bit 6   |       |        | RESERVED                                          |      |         |        | X   |
| Bit 5   |       |        | RESERVED                                          |      |         |        | X   |
| Bit 4   |       |        | RESERVED                                          |      |         |        | X   |
| Bit 3   |       |        | RESERVED                                          |      |         |        | X   |
| Bit 2   |       |        | RESERVED                                          |      |         |        | X   |
| Bit 1   |       |        | RESERVED                                          |      |         |        | X   |
| Bit 0   |       |        | RESERVED                                          |      |         |        | X   |

**SMBus Table: Gear PLL Frequency Control Register**

| Byte 11 | Pin # | Name            | Control Function              | Type | 0                                     | 1 | PWD |
|---------|-------|-----------------|-------------------------------|------|---------------------------------------|---|-----|
| Bit 7   |       |                 | RESERVED                      |      |                                       |   | X   |
| Bit 6   |       |                 | RESERVED                      |      |                                       |   | X   |
| Bit 5   | -     | Gear PLL M Div5 | M Divider Programming<br>bits | RW   | See 9FG1201H M/N<br>programming Table |   | X   |
| Bit 4   | -     | Gear PLL M Div4 |                               | RW   |                                       |   | X   |
| Bit 3   | -     | Gear PLL M Div3 |                               | RW   |                                       |   | X   |
| Bit 2   | -     | Gear PLL M Div2 |                               | RW   |                                       |   | X   |
| Bit 1   | -     | Gear PLL M Div1 |                               | RW   |                                       |   | X   |
| Bit 0   | -     | Gear PLL M Div0 |                               | RW   |                                       |   | X   |

**SMBus Table: Gear PLL Frequency Control Register**

| Byte 12 | Pin # | Name            | Control Function           | Type | 0                                  | 1 | PWD |
|---------|-------|-----------------|----------------------------|------|------------------------------------|---|-----|
| Bit 7   | -     | Gear PLL N Div7 | N Divider Programming bits | RW   | See 9FG1201H M/N programming Table |   | X   |
| Bit 6   | -     | Gear PLL N Div6 |                            | RW   |                                    |   | X   |
| Bit 5   | -     | Gear PLL N Div5 |                            | RW   |                                    |   | X   |
| Bit 4   | -     | Gear PLL N Div4 |                            | RW   |                                    |   | X   |
| Bit 3   | -     | Gear PLL N Div3 |                            | RW   |                                    |   | X   |
| Bit 2   | -     | Gear PLL N Div2 |                            | RW   |                                    |   | X   |
| Bit 1   | -     | Gear PLL N Div1 |                            | RW   |                                    |   | X   |
| Bit 0   | -     | Gear PLL N Div0 |                            | RW   |                                    |   | X   |

**SMBusTable: Gear PLL Output Divider Register**

| Byte 13 | Pin # | Name      | Control Function    | Type | 0                             | 1 | PWD |
|---------|-------|-----------|---------------------|------|-------------------------------|---|-----|
| Bit 7   |       |           | RESERVED            |      |                               |   | 0   |
| Bit 6   |       |           | RESERVED            |      |                               |   | 0   |
| Bit 5   |       |           | RESERVED            |      |                               |   | 0   |
| Bit 4   |       |           | RESERVED            |      |                               |   | 0   |
| Bit 3   |       | GoutDiv 3 | Gear Output Divider | RW   | See Gear Output Divider Table |   | X   |
| Bit 2   |       | GoutDiv 2 |                     | RW   |                               |   | X   |
| Bit 1   |       | GoutDiv 1 |                     | RW   |                               |   | X   |
| Bit 0   |       | GoutDiv 1 |                     | RW   |                               |   | X   |

**SMBusTable: Reserved Register**

| Byte 14 | Pin # | Name | Control Function | Type | 0 | 1 | PWD |
|---------|-------|------|------------------|------|---|---|-----|
| Bit 7   |       |      | RESERVED         |      |   |   | 0   |
| Bit 6   |       |      | RESERVED         |      |   |   | 0   |
| Bit 5   |       |      | RESERVED         |      |   |   | 0   |
| Bit 4   |       |      | RESERVED         |      |   |   | 0   |
| Bit 3   |       |      | RESERVED         |      |   |   | 0   |
| Bit 2   |       |      | RESERVED         |      |   |   | 0   |
| Bit 1   |       |      | RESERVED         |      |   |   | 0   |
| Bit 0   |       |      | RESERVED         |      |   |   | 0   |

**SMBusTable: Reserved Register**

| Byte 15 | Pin # | Name | Control Function | Type | 0 | 1 | PWD |
|---------|-------|------|------------------|------|---|---|-----|
| Bit 7   |       |      | RESERVED         |      |   |   | 0   |
| Bit 6   |       |      | RESERVED         |      |   |   | 0   |
| Bit 5   |       |      | RESERVED         |      |   |   | 0   |
| Bit 4   |       |      | RESERVED         |      |   |   | 0   |
| Bit 3   |       |      | RESERVED         |      |   |   | 0   |
| Bit 2   |       |      | RESERVED         |      |   |   | 0   |
| Bit 1   |       |      | RESERVED         |      |   |   | 0   |
| Bit 0   |       |      | RESERVED         |      |   |   | 0   |

**SMBusTable: Reserved Register**

| Byte 16 | Pin # | Name | Control Function | Type | 0 | 1 | PWD |
|---------|-------|------|------------------|------|---|---|-----|
| Bit 7   |       |      | RESERVED         |      |   |   | 0   |
| Bit 6   |       |      | RESERVED         |      |   |   | 0   |
| Bit 5   |       |      | RESERVED         |      |   |   | 0   |
| Bit 4   |       |      | RESERVED         |      |   |   | 0   |
| Bit 3   |       |      | RESERVED         |      |   |   | 0   |
| Bit 2   |       |      | RESERVED         |      |   |   | 0   |
| Bit 1   |       |      | RESERVED         |      |   |   | 0   |
| Bit 0   |       |      | RESERVED         |      |   |   | 0   |

**SMBus Table: 1:1 PLL Frequency Control Register**

| Byte 17 | Pin # | Name           | Control Function           | Type | 0                                  | 1 | PWD |
|---------|-------|----------------|----------------------------|------|------------------------------------|---|-----|
| Bit 7   |       |                | RESERVED                   |      |                                    |   | 0   |
| Bit 6   |       |                | RESERVED                   |      |                                    |   | 0   |
| Bit 5   | -     | 1:1 PLL M Div5 | M Divider Programming bits | RW   | See 9FG1201H M/N programming Table |   | X   |
| Bit 4   | -     | 1:1 PLL M Div4 |                            | RW   |                                    |   | X   |
| Bit 3   | -     | 1:1 PLL M Div3 |                            | RW   |                                    |   | X   |
| Bit 2   | -     | 1:1 PLL M Div2 |                            | RW   |                                    |   | X   |
| Bit 1   | -     | 1:1 PLL M Div1 |                            | RW   |                                    |   | X   |
| Bit 0   | -     | 1:1 PLL M Div0 |                            | RW   |                                    |   | X   |

**SMBus Table: 1:1 PLL Frequency Control Register**

| Byte 18 | Pin # | Name           | Control Function           | Type | 0                                  | 1 | PWD |
|---------|-------|----------------|----------------------------|------|------------------------------------|---|-----|
| Bit 7   | -     | 1:1 PLL N Div7 | N Divider Programming bits | RW   | See 9FG1201H M/N programming Table |   | X   |
| Bit 6   | -     | 1:1 PLL N Div6 |                            | RW   |                                    |   | X   |
| Bit 5   | -     | 1:1 PLL N Div5 |                            | RW   |                                    |   | X   |
| Bit 4   | -     | 1:1 PLL N Div4 |                            | RW   |                                    |   | X   |
| Bit 3   | -     | 1:1 PLL N Div3 |                            | RW   |                                    |   | X   |
| Bit 2   | -     | 1:1 PLL N Div2 |                            | RW   |                                    |   | X   |
| Bit 1   | -     | 1:1 PLL N Div1 |                            | RW   |                                    |   | X   |
| Bit 0   | -     | 1:1 PLL N Div0 |                            | RW   |                                    |   | X   |

**SMBusTable: 1:1 PLL Output Divider Register**

| Byte 19 | Pin # | Name      | Control Function   | Type | 0                            | 1 | PWD |
|---------|-------|-----------|--------------------|------|------------------------------|---|-----|
| Bit 7   |       |           | RESERVED           |      |                              |   | 0   |
| Bit 6   |       |           | RESERVED           |      |                              |   | 0   |
| Bit 5   |       |           | RESERVED           |      |                              |   | 0   |
| Bit 4   |       |           | RESERVED           |      |                              |   | 0   |
| Bit 3   |       | 1outDiv 3 | 1:1 Output Divider | RW   | See 1:1 Output Divider Table |   | X   |
| Bit 2   |       | 1outDiv 2 |                    | RW   |                              |   | X   |
| Bit 1   |       | 1outDiv 1 |                    | RW   |                              |   | X   |
| Bit 0   |       | 1outDiv 1 |                    | RW   |                              |   | X   |

**SMBusTable: Reserved Register**

| Byte 20 | Pin # | Name | Control Function | Type | 0 | 1 | PWD |
|---------|-------|------|------------------|------|---|---|-----|
| Bit 7   |       |      | RESERVED         |      |   |   | 0   |
| Bit 6   |       |      | RESERVED         |      |   |   | 0   |
| Bit 5   |       |      | RESERVED         |      |   |   | 0   |
| Bit 4   |       |      | RESERVED         |      |   |   | 0   |
| Bit 3   |       |      | RESERVED         |      |   |   | 0   |
| Bit 2   |       |      | RESERVED         |      |   |   | 0   |
| Bit 1   |       |      | RESERVED         |      |   |   | 0   |
| Bit 0   |       |      | RESERVED         |      |   |   | 0   |

**SMBusTable: Test Byte Register**

| Byte 21 | Test | Test Function | Type | Test Result | PWD |
|---------|------|---------------|------|-------------|-----|
| Bit 7   |      | ICS ONLY TEST | RW   | Reserved    | 0   |
| Bit 6   |      | ICS ONLY TEST | RW   | Reserved    | 0   |
| Bit 5   |      | ICS ONLY TEST | RW   | Reserved    | 0   |
| Bit 4   |      | ICS ONLY TEST | RW   | Reserved    | 0   |
| Bit 3   |      | ICS ONLY TEST | RW   | Reserved    | 0   |
| Bit 2   |      | ICS ONLY TEST | RW   | Reserved    | 0   |
| Bit 1   |      | ICS ONLY TEST | RW   | Reserved    | 0   |
| Bit 0   |      | ICS ONLY TEST | RW   | Reserved    | 0   |

**Note: Do NOT write to Bit 21. Erratic device operation will result!**

## Absolute Max

| PARAMETER                 | SYMBOL               | CONDITIONS       | MIN       | TYP | MAX                    | UNITS | Notes |
|---------------------------|----------------------|------------------|-----------|-----|------------------------|-------|-------|
| 3.3V Core Supply Voltage  | VDD_A                |                  | GND - 0.5 |     | V <sub>DD</sub> + 0.5V | V     | 1     |
| 3.3V Logic Supply Voltage | VDD_In               |                  | GND - 0.5 |     | V <sub>DD</sub> + 0.5V | V     | 1     |
| Storage Temperature       | T <sub>s</sub>       |                  | -65       |     | 150                    | °C    | 1     |
| Ambient Operating Temp    | T <sub>ambient</sub> |                  | 0         |     | 70                     | °C    | 1     |
| Case Temperature          | T <sub>case</sub>    |                  |           |     | 115                    | °C    | 1     |
| Input ESD protection      | ESD prot             | Human Body Model | 2000      |     |                        | V     | 1     |

## Electrical Characteristics - Input/Supply/Common Output Parameters

T<sub>A</sub> = 0 - 70°C; Supply Voltage V<sub>DD</sub> = 3.3 V +/-5%

| PARAMETER                                  | SYMBOL               | CONDITIONS                                                        | MIN                   | TYP | MAX                   | UNITS | Notes |
|--------------------------------------------|----------------------|-------------------------------------------------------------------|-----------------------|-----|-----------------------|-------|-------|
| Input High Voltage                         | V <sub>IH</sub>      | 3.3 V +/-5%, Except CLK_IN                                        | 2                     |     | V <sub>DD</sub> + 0.3 | V     | 1     |
| Input Low Voltage                          | V <sub>IL</sub>      | 3.3 V +/-5%, Except CLK_IN                                        | V <sub>SS</sub> - 0.3 |     | 0.8                   | V     | 1     |
| Input High Current                         | I <sub>IH</sub>      | V <sub>IN</sub> = V <sub>DD</sub>                                 | -5                    |     | 5                     | uA    |       |
| Input Low Current                          | I <sub>IL1</sub>     | V <sub>IN</sub> = 0 V; Inputs with no pull-up resistors           | -5                    |     |                       | uA    |       |
| Low Threshold Input-High Voltage           | V <sub>IH_FS</sub>   | 3.3 V +/-5%, Applies to FS_A_410 pin                              | 0.7                   |     | V <sub>DD</sub> + 0.3 | V     | 1     |
| Low Threshold Input-Low Voltage            | V <sub>IL_FS</sub>   | 3.3 V +/-5%, Applies to FS_A_410 pin                              | V <sub>SS</sub> - 0.3 |     | 0.35                  | V     | 1     |
| Operating Current                          | I <sub>DD3.3OP</sub> | all outputs driven                                                |                       |     | 375                   | mA    | 1     |
| Powerdown Current                          | I <sub>DD3.3PD</sub> | all differential pairs tri-stated                                 |                       |     | 24                    | mA    | 1     |
| Input Frequency                            | F <sub>i</sub>       | V <sub>DD</sub> = 3.3 V                                           | 100                   |     | 400                   | MHz   | 3     |
| Pin Inductance                             | L <sub>pin</sub>     |                                                                   |                       |     | 7                     | nH    | 1     |
| Input Capacitance                          | C <sub>IN</sub>      | Logic Inputs                                                      |                       |     | 5                     | pF    | 1     |
|                                            | C <sub>OUT</sub>     | Output pin capacitance                                            |                       |     | 5                     | pF    | 1     |
| Clk Stabilization                          | T <sub>STAB</sub>    | From V <sub>DD</sub> Power-Up or de-assertion of PD# to 1st clock |                       |     | 1.8                   | ms    | 1     |
| Modulation Frequency                       |                      | Triangular Modulation                                             | 30                    |     | 33                    | kHz   | 1     |
| Tdrive_PD#                                 |                      | DIF output enable after PD# de-assertion                          |                       |     | 300                   | us    | 1     |
| Tfall_Pd#                                  |                      | PD# fall time of                                                  |                       |     | 5                     | ns    | 1     |
| Trise_Pd#                                  |                      | PD# rise time of                                                  |                       |     | 5                     | ns    | 2     |
| SMBus Voltage                              | V <sub>MAX</sub>     | Maximum input voltage                                             |                       |     | 5.5                   | V     | 1     |
| Low-level Output Voltage                   | V <sub>OL</sub>      | @ I <sub>PULLUP</sub>                                             |                       |     | 0.4                   | V     | 1     |
| Current sinking at V <sub>OL</sub> = 0.4 V | I <sub>PULLUP</sub>  |                                                                   | 4                     |     |                       | mA    | 1     |
| SCLK/SDATA Clock/Data Rise Time            | T <sub>RI2C</sub>    | (Max V <sub>IL</sub> - 0.15) to (Min V <sub>IH</sub> + 0.15)      |                       |     | 1000                  | ns    | 1     |
| SCLK/SDATA Clock/Data Fall Time            | T <sub>FI2C</sub>    | (Min V <sub>IH</sub> + 0.15) to (Max V <sub>IL</sub> - 0.15)      |                       |     | 300                   | ns    | 1     |

## Electrical Characteristics - DIF 0.7V Current Mode Differential Pair

$T_A = 0 - 70^\circ\text{C}$ ;  $V_{DD} = 3.3\text{ V} \pm 5\%$ ;  $C_L = 2\text{pF}$ ,  $R_S = 33.2\Omega$ ,  $R_P = 49.9\Omega$ ,  $I_{REF} = 475\Omega$

| PARAMETER                       | SYMBOL              | CONDITIONS                                                                       | MIN    | TYP | MAX     | UNITS    | NOTES |
|---------------------------------|---------------------|----------------------------------------------------------------------------------|--------|-----|---------|----------|-------|
| Current Source Output Impedance | $Z_{O1}$            | $V_O = V_x$                                                                      | 3000   |     |         | $\Omega$ | 1     |
| Voltage High                    | VHigh               | Statistical measurement on single ended signal using oscilloscope math function. | 660    |     | 850     | mV       | 1,3   |
| Voltage Low                     | VLow                |                                                                                  | -150   |     | 150     |          | 1,3   |
| Max Voltage                     | Vovs                | Measurement on single ended signal using absolute value.                         |        |     | 1150    | mV       | 1     |
| Min Voltage                     | Vuds                |                                                                                  | -300   |     |         |          | 1     |
| Crossing Voltage (abs)          | Vcross(abs)         |                                                                                  | 250    |     | 550     | mV       | 1     |
| Crossing Voltage (var)          | d-Vcross            | Variation of crossing over all edges                                             |        |     | 140     | mV       | 1     |
| Long Accuracy                   | ppm                 | see Tperiod min-max values                                                       | -300   |     | 300     | ppm      | 1,2   |
| Average period                  | Tperiod             | 400MHz nominal                                                                   | 2.4993 |     | 2.5008  | ns       | 2     |
|                                 |                     | 400MHz spread                                                                    | 2.4993 |     | 2.5133  | ns       | 2     |
|                                 |                     | 333.33MHz nominal                                                                | 2.9991 |     | 3.0009  | ns       | 2     |
|                                 |                     | 333.33MHz spread                                                                 | 2.9991 |     | 3.016   | ns       | 2     |
|                                 |                     | 266.66MHz nominal                                                                | 3.7489 |     | 3.7511  | ns       | 2     |
|                                 |                     | 266.66MHz spread                                                                 | 3.7489 |     | 3.77    | ns       | 2     |
|                                 |                     | 200MHz nominal                                                                   | 4.9985 |     | 5.0015  | ns       | 2     |
|                                 |                     | 200MHz spread                                                                    | 4.9985 |     | 5.0266  | ns       | 2     |
|                                 |                     | 166.66MHz nominal                                                                | 5.9982 |     | 6.0018  | ns       | 2     |
|                                 |                     | 166.66MHz spread                                                                 | 5.9982 |     | 6.0320  | ns       | 2     |
|                                 |                     | 133.33MHz nominal                                                                | 7.4978 |     | 7.5023  | ns       | 2     |
|                                 |                     | 133.33MHz spread                                                                 | 7.4978 |     | 7.5400  | ns       | 2     |
|                                 |                     | 100.00MHz nominal                                                                | 9.9970 |     | 10.0030 | ns       | 2     |
|                                 |                     | 100.00MHz spread                                                                 | 9.9970 |     | 10.0533 | ns       | 2     |
| Absolute min period             | T <sub>absmin</sub> | 400MHz nominal/spread                                                            | 2.4143 |     |         | ns       | 1,2   |
|                                 |                     | 333.33MHz nominal/spread                                                         | 2.9141 |     |         | ns       | 1,2   |
|                                 |                     | 266.66MHz nominal/spread                                                         | 3.6639 |     |         | ns       | 1,2   |
|                                 |                     | 200MHz nominal/spread                                                            | 4.8735 |     |         | ns       | 1,2   |
|                                 |                     | 166.66MHz nominal/spread                                                         | 5.8732 |     |         | ns       | 1,2   |
|                                 |                     | 133.33MHz nominal/spread                                                         | 7.3728 |     |         | ns       | 1,2   |
|                                 |                     | 100.00MHz nominal/spread                                                         | 9.8720 |     |         | ns       | 1,2   |
| Rise Time                       | $t_r$               | $V_{OL} = 0.175\text{V}$ , $V_{OH} = 0.525\text{V}$                              | 175    |     | 700     | ps       | 1     |
| Fall Time                       | $t_f$               | $V_{OH} = 0.525\text{V}$ $V_{OL} = 0.175\text{V}$                                | 175    |     | 700     | ps       | 1     |
| Rise Time Variation             | d- $t_r$            |                                                                                  |        |     | 125     | ps       | 1     |
| Fall Time Variation             | d- $t_f$            |                                                                                  |        |     | 125     | ps       | 1     |
| Duty Cycle                      | $d_{I3}$            | Measurement from differential waveform                                           | 45     |     | 55      | %        | 1     |
| Jitter, Cycle to cycle          | $t_{JCVC-CYC}$      | PLL mode, from differential waveform                                             |        |     | 50      | ps       | 1,4,5 |
|                                 | $t_{JBYP}$          | Bypass mode as additive jitter                                                   |        |     | 50      | ps       | 1,4   |

### Notes:

1. Guaranteed by design and characterization, not 100% tested in production.
2. All Long Term Accuracy and Clock Period specifications are guaranteed assuming that the input frequency meets CK410B accuracy requirements
3.  $I_{REF} = V_{DD}/(3 \times RR)$ . For  $RR = 475\Omega$  (1%),  $I_{REF} = 2.32\text{mA}$ .  $I_{OH} = 6 \times I_{REF}$  and  $V_{OH} = 0.7\text{V}$  @  $Z_O = 50\Omega$ .
4. Measured into fixed 2 pF load cap. Input to output skew is measured at the first output edge following the corresponding input.
5. Measured from differential cross-point to differential cross-point
6. All Bypass Mode Input-to-Output specs refer to the timing between an input edge and the specific output edge created by it.



## Electrical Characteristics - Skew and Differential Jitter Parameters

T<sub>A</sub> = 0 - 70°C; Supply Voltage V<sub>DD</sub> = 3.3 V +/-5%

| Group              | Parameter              | Description                                                                                            | Min  | Typ | Max   | Units | Notes             |
|--------------------|------------------------|--------------------------------------------------------------------------------------------------------|------|-----|-------|-------|-------------------|
| CLK_IN, DIF[x:0]   | t <sub>SPO_PLL</sub>   | Input-to-Output Skew in PLL mode (1:1 only), nominal value @ 25°C, 3.3V                                | -500 | 140 | 500   | ps    | 1,2,4,5,8,12      |
| CLK_IN, DIF[x:0]   | t <sub>PD_BYP</sub>    | Input-to-Output Skew in Bypass mode (1:1 only), nominal value @ 25°C, 3.3V                             | 2.5  | 3.1 | 4.5   | ns    | 1,2,3,5,12        |
| CLK_IN, DIF [x:0]  | Δt <sub>SPO_PLL</sub>  | Input-to-Output Skew Variation in PLL mode (over specified voltage / temperature operating ranges)     |      | 270 | [350] | ps    | 1,2,4,5,6,10,12   |
| CLK_IN, DIF [x:0]  | Δt <sub>PD_BYP</sub>   | Input-to-Output Skew Variation in Bypass mode (over specified voltage / temperature operating ranges)  |      | 470 | [500] | ps    | 1,2,3,4,5,6,10,12 |
| DIF[11:10]         | t <sub>SKEW_G2</sub>   | Output-to-Output Skew Group of 2 (Common to Bypass and PLL mode)                                       |      | 10  | 25    | ps    | 1,2,12            |
| DIF[9:0]           | t <sub>SKEW_G10</sub>  | Output-to-Output Skew Group of 10 (Common to Bypass and PLL mode)                                      |      | 40  | 50    | ps    | 1,2,12            |
| DIF[11:0]          | t <sub>SKEW_A12</sub>  | Output-to-Output Skew across all 12 outputs (Common to Bypass and PLL mode - all outputs at same gear) |      | 80  | 100   | ps    | 1,2,3,12          |
| DIF[11:0]          | t <sub>JPH</sub>       | Differential Phase Jitter (RMS Value)                                                                  |      | 5   | 10    | ps    | 1,4,7,12          |
| DIF[11:0]          | t <sub>SSTERROR</sub>  | Differential Spread Spectrum Tracking Error (peak to peak)                                             |      | 40  | 80    | ps    | 1,4,9,12          |
| PLL Jitter Peaking | j <sub>peak-hibw</sub> | (HIGH_BW# = 0)                                                                                         | 0    | 2   | 2.5   | dB    | 11,12             |
| PLL Jitter Peaking | j <sub>peak-lobw</sub> | (HIGH_BW# = 1)                                                                                         | 0    | 1.3 | 2     | dB    | 11,12             |
| PLL Bandwidth      | pll <sub>HIBW</sub>    | (HIGH_BW# = 0)                                                                                         | 2    | 3.6 | 4     | MHz   | 12,13             |
| PLL Bandwidth      | pll <sub>LOBW</sub>    | (HIGH_BW# = 1)                                                                                         | 0.7  | 1.2 | 1.4   | MHz   | 12,13             |

### NOTES on Skew and Differential Jitter Parameters:

1. Measured into fixed 2 pF load cap. Input to output skew is measured at the first output edge following the corresponding input.
2. Measured from differential cross-point to differential cross-point
3. All Bypass Mode Input-to-Output specs refer to the timing between an input edge and the specific output edge created by it.
4. This parameter is deterministic for a given device
5. Measured with scope averaging on to find mean value.
6. Long-term variation from nominal of input-to-output skew over temperature and voltage for a single device.
7. This parameter is measured at the outputs of two separate 9FG1201H devices driven by a single CK410B+. The 9FG1201H must be set to high bandwidth. Differential phase jitter is the accumulation of the phase jitter not shared by the outputs (eg. not including the affects of spread spectrum). Target ranges of consideration are agents with BW of 1-22MHz and 11-33MHz.
8. t is the period of the input clock
9. Differential spread spectrum tracking error is the difference in spread spectrum tracking between two 9FG1201H devices. This parameter is measured at the outputs of two separate 9FG1201H devices driven by a single CK410B+ in Spread Spectrum mode. The 9FG1201H must set to high bandwidth. The spread spectrum characteristics are : maximum of 0.5%, 30 to 33KHz modulation frequency, linear profile.
10. This parameter is an absolute value. It is not a double-sided figure.
11. Measured as maximum pass band gain. At frequencies within the loop BW, highest point of magnification is called PLL jitter peaking.
12. Guaranteed by design and characterization, not 100% tested in production.
13. Measured at 3 db down or half power point.

### Electrical Characteristics - Phase Jitter

| PARAMETER     | SYMBOL              | CONDITIONS                                                                                                                                 | MIN | TYP.    | MAX | UNITS       | NOTES   |
|---------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----|---------|-----|-------------|---------|
| Jitter, Phase | $t_{jphPCle1}$      | PCIe Gen 1 REFCLK phase jitter<br>(including PLL BW 8 - 16 MHz,<br>$\zeta = 0.54$ ,<br>$T_d=10$ ns, $F_{trk}=1.5$ MHz )                    |     | 40/38   | 86  | ps          | 1,2,3,5 |
|               | $t_{jphPCle2Lo}$    | PCIe Gen 2 REFCLK phase jitter<br>(including PLL BW 8 - 16 MHz,<br>$\zeta = 0.54$ , $T_d=12$ ns)<br>Lo-band content<br>(10kHz to 1.5MHz)   |     | 1.3/1.2 | 3   | ps rms      | 1,2,5   |
|               | $t_{jphPCle2Hi}$    | PCIe Gen 2 REFCLK phase jitter<br>(including PLL BW 8 - 16 MHz,<br>$\zeta = 0.54$ , $T_d=12$ ns)<br>Hi-band content<br>(1.5MHz to Nyquist) |     | 3.0/2.4 | 3.1 | ps rms      | 1,2,5   |
|               | $t_{jphFBD1\_3.2G}$ | FBD REFCLK phase jitter<br>(including PLL BW 11 - 33 MHz,<br>$\zeta = 0.54$ , $T_d=12$ ns $F_{trl}=0.2$ MHz)                               |     | 2.8/2.3 | 3   | ps<br>(RMS) | 1,2,5   |
|               | $t_{jphFBD1\_4.8G}$ | FBD REFCLK phase jitter<br>(including PLL BW 11 - 33 MHz,<br>$\zeta = 0.54$ , $T_d=12$ ns $F_{trl}=0.2$ MHz)                               |     | 2.3/1.9 | 2.5 | ps<br>(RMS) | 1,2,5   |

#### Notes on Phase Jitter:

<sup>1</sup> See <http://www.pcisig.com> for complete specs. Guaranteed by design and characterization, not tested in production.

<sup>2</sup> Device driven by 932S421BGLF or equivalent

<sup>3</sup> Sample size of at least 100K cycles. This figures extrapolates to 108ps pk-pk @ 1M cycles for a BER of  $1^{-12}$

<sup>4</sup> Hi-Bandwidth Number/Low Bandwidth Number with Spread On. Spread Off gives lower numbers.

<sup>5</sup> Byte 8 must be properly set to meet these parameters.

| SRC Reference Clock                             |                    |      |        |
|-------------------------------------------------|--------------------|------|--------|
| Common Recommendations for Differential Routing | Dimension or Value | Unit | Figure |
| L1 length, route as non-coupled 50ohm trace     | 0.5 max            | inch | 1      |
| L2 length, route as non-coupled 50ohm trace     | 0.2 max            | inch | 1      |
| L3 length, route as non-coupled 50ohm trace     | 0.2 max            | inch | 1      |
| Rs                                              | 33                 | ohm  | 1      |
| Rt                                              | 49.9               | ohm  | 1      |

| Down Device Differential Routing                                 |                     |      |   |
|------------------------------------------------------------------|---------------------|------|---|
| L4 length, route as coupled microstrip 100ohm differential trace | 2 min to 16 max     | inch | 1 |
| L4 length, route as coupled stripline 100ohm differential trace  | 1.8 min to 14.4 max | inch | 1 |

| Differential Routing to PCI Express Connector                    |                       |      |   |
|------------------------------------------------------------------|-----------------------|------|---|
| L4 length, route as coupled microstrip 100ohm differential trace | 0.25 to 14 max        | inch | 2 |
| L4 length, route as coupled stripline 100ohm differential trace  | 0.225 min to 12.6 max | inch | 2 |

Figure 1: Down Device Routing

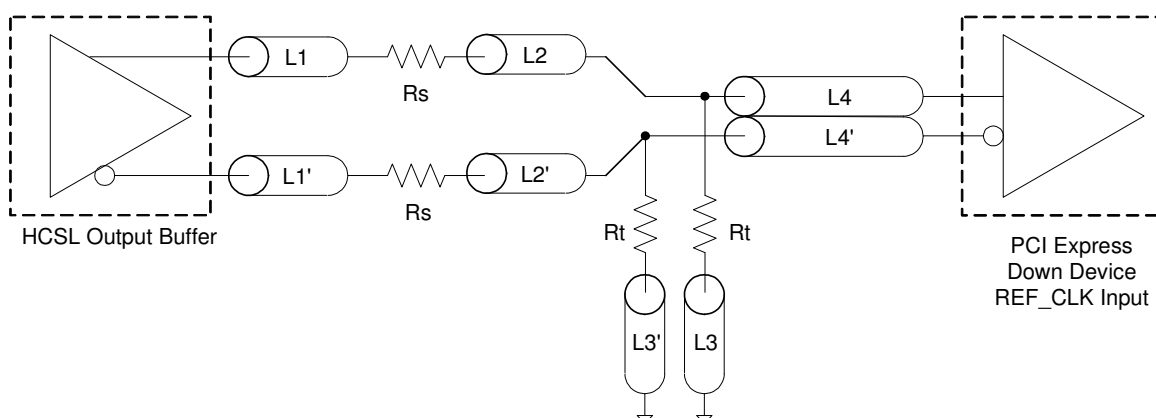
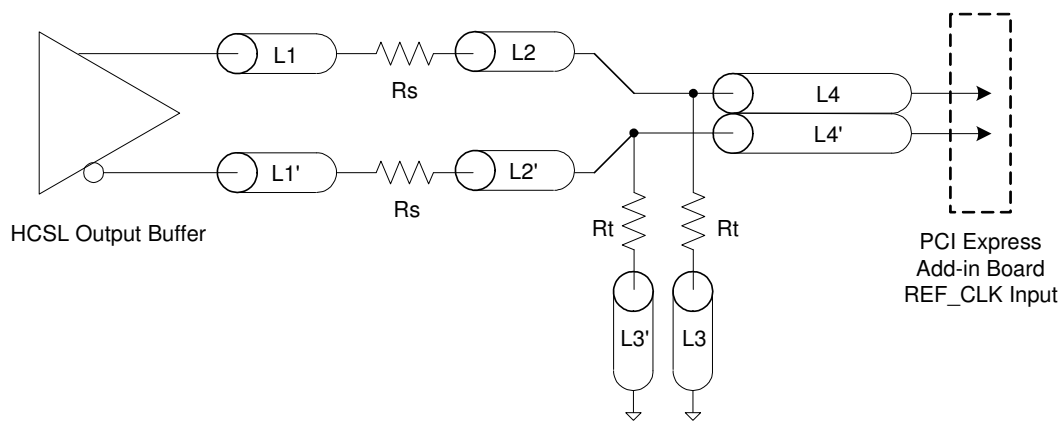


Figure 2: PCI Express Connector Routing

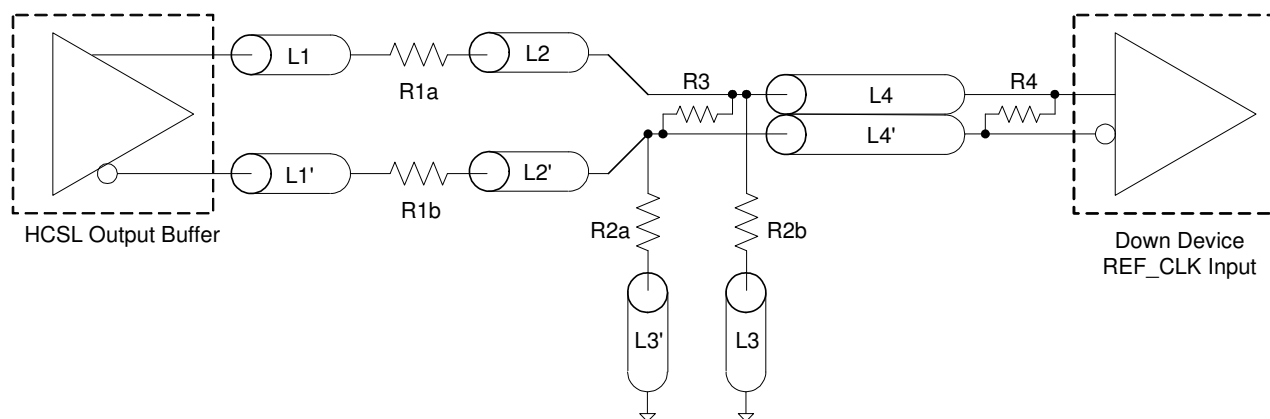


### Alternative Termination for LVDS and other Common Differential Signals (figure 3)

| Vdiff | Vp-p  | Vcm  | R1 | R2   | R3   | R4  | Note                           |
|-------|-------|------|----|------|------|-----|--------------------------------|
| 0.45v | 0.22v | 1.08 | 33 | 150  | 100  | 100 |                                |
| 0.58  | 0.28  | 0.6  | 33 | 78.7 | 137  | 100 |                                |
| 0.80  | 0.40  | 0.6  | 33 | 78.7 | none | 100 | ICS874003i-02 input compatible |
| 0.60  | 0.3   | 1.2  | 33 | 174  | 140  | 100 | Standard LVDS                  |

$$R1a = R1b = R1$$
$$R_{2a} = R_{2b} = R_2$$

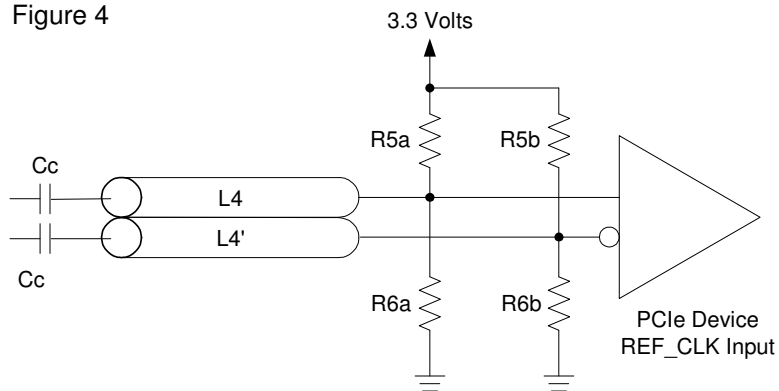
Figure 3



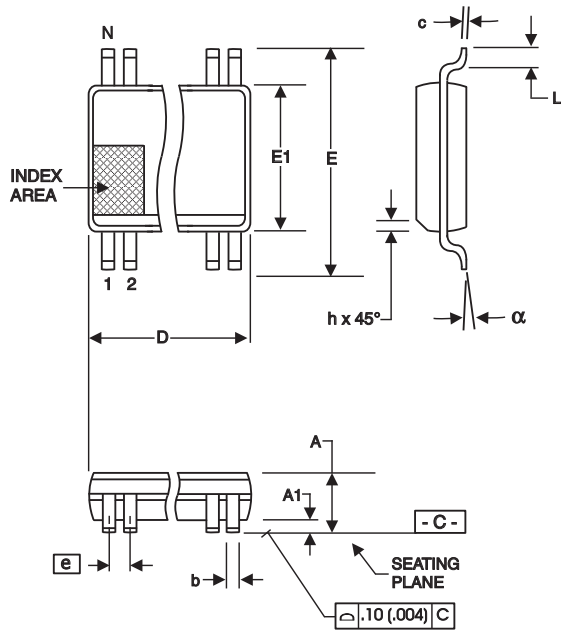
### Cable Connected AC Coupled Application (figure 4)

| Component | Value       | Note |
|-----------|-------------|------|
| R5a, R5b  | 8.2K 5%     |      |
| R6a, R6b  | 1K 5%       |      |
| Cc        | 0.1 $\mu$ F |      |
| Vcm       | 0.350 volts |      |

Figure 4



**ICS9FG1201H**  
Frequency Gearing Clock for CPU, PCIe Gen1, Gen2, & FBD



**56-Lead, 300 mil Body, 25 mil, SSOP**

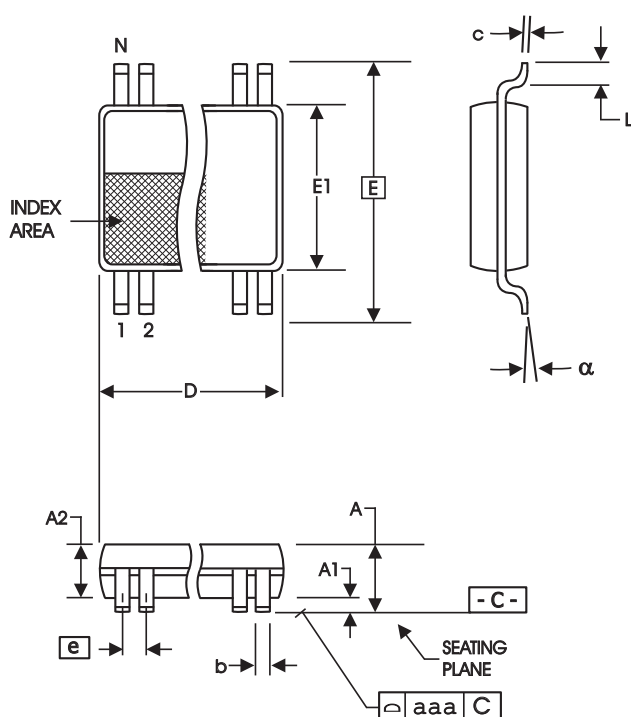
| SYMBOL | In Millimeters<br>COMMON DIMENSIONS |       | In Inches<br>COMMON DIMENSIONS |       |
|--------|-------------------------------------|-------|--------------------------------|-------|
|        | MIN                                 | MAX   | MIN                            | MAX   |
| A      | 2.41                                | 2.80  | .095                           | .110  |
| A1     | 0.20                                | 0.40  | .008                           | .016  |
| b      | 0.20                                | 0.34  | .008                           | .0135 |
| c      | 0.13                                | 0.25  | .005                           | .010  |
| D      | SEE VARIATIONS                      |       | SEE VARIATIONS                 |       |
| E      | 10.03                               | 10.68 | .395                           | .420  |
| E1     | 7.40                                | 7.60  | .291                           | .299  |
| e      | 0.635 BASIC                         |       | 0.025 BASIC                    |       |
| h      | 0.38                                | 0.64  | .015                           | .025  |
| L      | 0.50                                | 1.02  | .020                           | .040  |
| N      | SEE VARIATIONS                      |       | SEE VARIATIONS                 |       |
| α      | 0°                                  | 8°    | 0°                             | 8°    |

**VARIATIONS**

| N  | D mm. |       | D (inch) |      |
|----|-------|-------|----------|------|
|    | MIN   | MAX   | MIN      | MAX  |
| 56 | 18.31 | 18.55 | .720     | .730 |

Reference Doc.: JEDEC Publication 95, MO-118

10-0034



**56-Lead 6.10 mm. Body, 0.50 mm. Pitch TSSOP**  
(240 mil) (20 mil)

| SYMBOL   | In Millimeters    |      | In Inches         |      |
|----------|-------------------|------|-------------------|------|
|          | COMMON DIMENSIONS |      | COMMON DIMENSIONS |      |
|          | MIN               | MAX  | MIN               | MAX  |
| A        | --                | 1.20 | --                | .047 |
| A1       | 0.05              | 0.15 | .002              | .006 |
| A2       | 0.80              | 1.05 | .032              | .041 |
| b        | 0.17              | 0.27 | .007              | .011 |
| c        | 0.09              | 0.20 | .0035             | .008 |
| D        | SEE VARIATIONS    |      | SEE VARIATIONS    |      |
| E        | 8.10 BASIC        |      | 0.319 BASIC       |      |
| E1       | 6.00              | 6.20 | .236              | .244 |
| e        | 0.50 BASIC        |      | 0.020 BASIC       |      |
| L        | 0.45              | 0.75 | .018              | .030 |
| N        | SEE VARIATIONS    |      | SEE VARIATIONS    |      |
| $\alpha$ | 0°                | 8°   | 0°                | 8°   |
| aaa      | --                | 0.10 | --                | .004 |

**VARIATIONS**

| N  | D mm. |       | D (inch) |      |
|----|-------|-------|----------|------|
|    | MIN   | MAX   | MIN      | MAX  |
| 56 | 13.90 | 14.10 | .547     | .555 |

Reference Doc.: JEDEC Publication 95, MO-153

10-0039

## Ordering Information

| Part / Order Number | Shipping/Packaging | Package      | Temperature |
|---------------------|--------------------|--------------|-------------|
| 9FG1201HGLF         | Tubes              | 56-pin TSSOP | 0 to +70°C  |
| 9FG1201HGLFT        | Tape and Reel      | 56-pin TSSOP | 0 to +70°C  |
| 9FG1201HFLF         | Tubes              | 56-pin SSOP  | 0 to +70°C  |
| 9FG1201HFLFT        | Tape and Reel      | 56-pin SSOP  | 0 to +70°C  |

"LF" denotes Pb free packaging, RoHS compliant

"H" denotes revision designator (will not correlate with datasheet revision)

## Revision History

| Rev. | Issue Date | Description                                                                         | Page # |
|------|------------|-------------------------------------------------------------------------------------|--------|
| A    | 10/22/2007 | Release to Final.                                                                   | -      |
| B    | 1/29/2008  | Updated Key Specifications:<br>Changed units for DIF output-to-output skew to "ps". | 1      |
| C    | 2/12/2008  | Changed Cin value from 6 pf to 5 pf.                                                | 14     |
| D    | 9/24/2008  | Added 1:1 VCO Programming Table                                                     | 6      |
| E    | 1/21/2009  | Updated Skew and Phase Jitter tables.                                               | 17,18  |
| F    | 9/23/2009  | Updated Ordering Information table                                                  | 22     |
|      |            |                                                                                     |        |
|      |            |                                                                                     |        |

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