

# RC190xx

## PCIe Gen5/6 Fanout Buffer Family with LOS

The RC190xx (RC19024, RC19020, RC19020A072, RC19016, RC19013, RC19008, RC19004, and RC19002) ultra-high performance fanout buffers support PCIe Gen5 and Gen6. They provide a Loss-Of-Signal (LOS) output for system monitoring and redundancy. The devices also incorporate Power Down Tolerant (PDT) and Flexible Startup Sequencing (FSS) features, easing system design. They can drive both source-terminated and double-terminated loads, operating up to 400MHz.

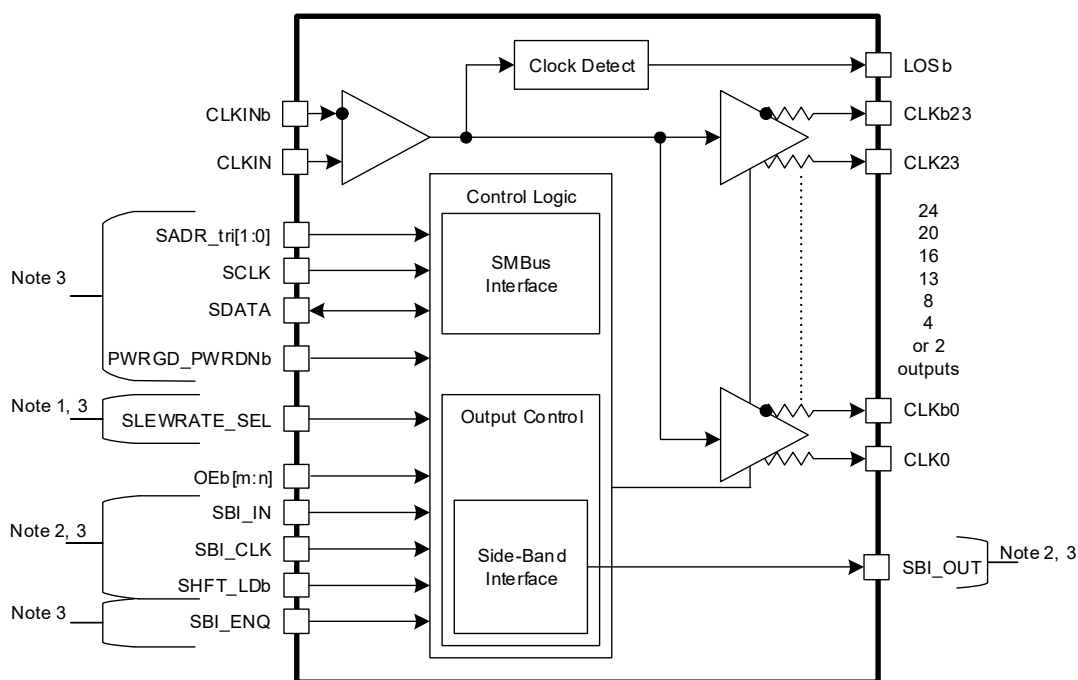
The family offers 2, 4, 8, 13, 16, 20, and 24 Low-Power (LP) HCSL output pairs in 3 × 3 mm to 10 × 10 mm packages. The RC190xx devices offer higher output counts in smaller packages compared to earlier buffer families. The buffers support both Common Clock (CC) and Independent Reference (IR) PCIe clock architectures.

## Applications

- Cloud/High-performance computing
- nVME storage
- Networking
- Accelerators

## Features

- PCIe Gen5 additive phase jitter: 6fs RMS
- PCIe Gen6 additive phase jitter: 4fs RMS
- DB2000Q additive phase jitter: 10fs RMS
- 12kHz to 20MHz additive phase jitter: 30fs RMS at 156.25MHz
- Power Down Tolerant (PDT) inputs
- Flexible Startup Sequencing (FSS)
- Automatic Clock Parking (ACP) upon loss of CLKIN
- Spread-spectrum tolerant
- CLKIN accepts HCSL or LVDS signal levels
- -40 to +105°C, 3.3V ±10% operation
- All devices except RC19002:
  - Selectable output slew rate via pin/SMBus
  - 4-wire Side-Band Interface supports high-speed serial output enable and device daisy-chaining
  - 9 SMBus addresses plus write protection
  - 85Ω or 100Ω (A100 suffix) output impedance
  - Pin-selectable slew rate
- RC19002: Pin-selectable output impedance



1. RC19016/13/08/04 only. Other devices use SMBus.
2. Some devices mux SBI with OEB pins. See specific pin outs. Devices with SBI have dedicated SBI\_ENQ pin.
3. Does not apply to the RC19002. On RC19002, the SLEWRATE\_SEL pin is ZOUT\_SEL.

Figure 1. RC190xx Block Diagram

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# 1. Pin Information

## 1.1 Signal Types

| Term | Description  |
|------|--|
| I    | Input  |
| O    | Input  |
| OD   | Open Drain Output  |
| I/O  | Bi-Directional   |
| PD   | Pull-down  |
| PU   | Pull-up  |
| Z    | Tristate   |
| D    | Driven   |
| X    | Don't care   |
| SE   | Single ended   |
| DIF  | Differential   |
| PWR  | 3.3 V power  |
| GND  | Ground   |
| PDT  | Power Down Tolerant: These signals must tolerate being driven when the device is powered down. |

Note that some pins have both internal pull-up and pull-down resistors which bias the pins to VDD/2. Other pins are multi-mode and have an internal pull-up or internal pull-down depending on the mode.

## 1.2 RC19024 Pin Information

### 1.2.1 RC19024 Pin Assignments

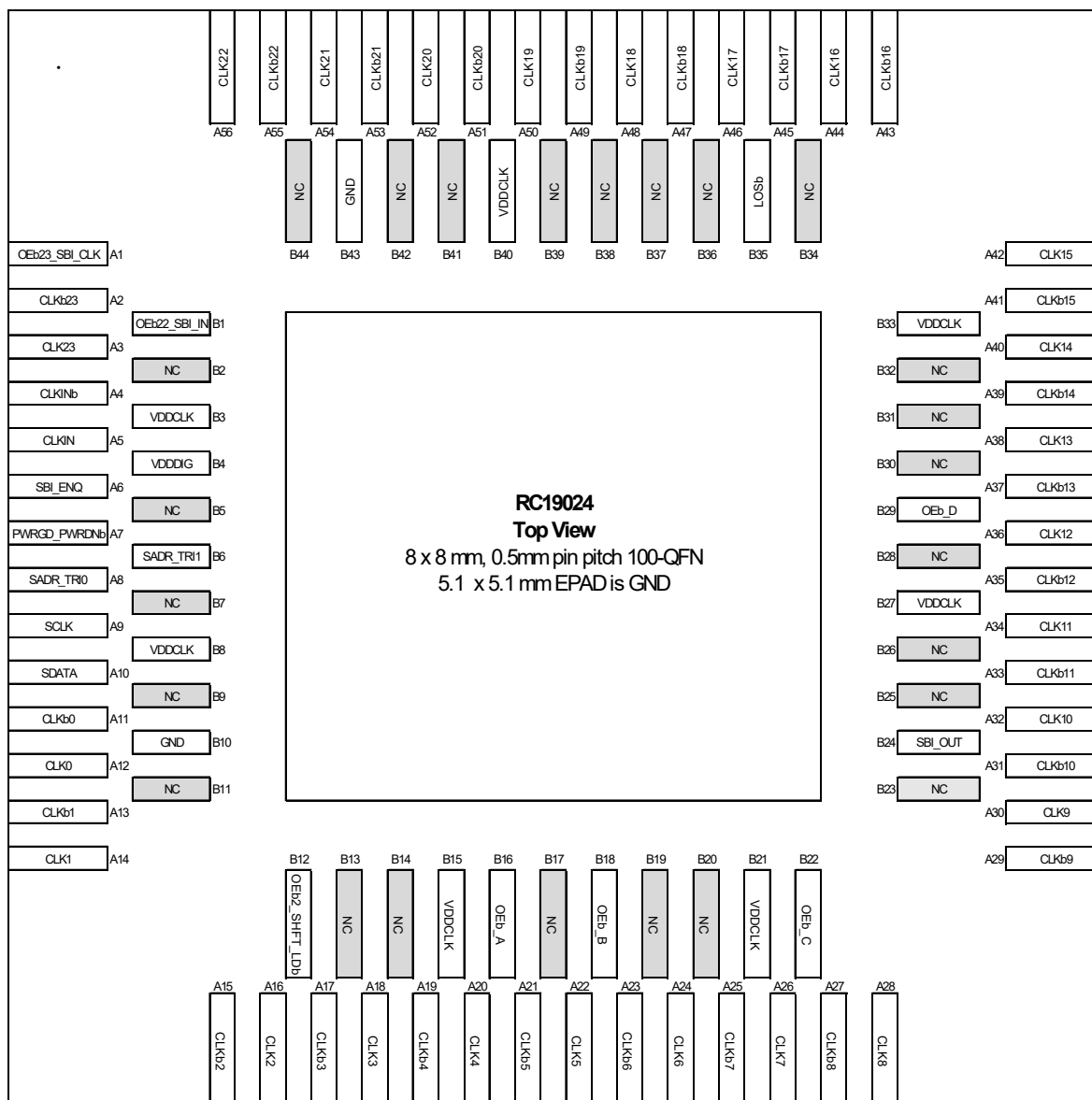


Figure 2. RC19024 100-VFQFPN – Top View

## 1.2.2 RC19024 Pin Descriptions

Table 1. RC19024 Pin Descriptions

| Pin Number | Pin Name      | Pin Type       | Description   |
|------------|---------------|----------------|---|
| A1         | OEB23_SBI_CLK | I, SE, PD, PDT | Active low input for enabling output 23 or the clock pin for the SBI shift register. The function of this pin is controlled by the SBEN or SBI_ENQ pin. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br>OE mode:<br>0 = enable output, 1 = disable output.<br>Side-Band mode:<br>Clocks data into the SBI on the rising edge.  |
| A2         | CLK23B        | O, DIF         | Complementary clock output.   |
| A3         | CLK23         | O, DIF         | True clock output.  |
| A4         | CLKINb        | I, DIF, PDT    | Complementary clock input.  |
| A5         | CLKIN         | I, DIF, PDT    | True clock input.   |
| A6         | SBI_ENQ       | I, SE, PD, PDT | Input that selects function of pins that are multiplexed between OE and SBI functionality. SMBus output enable bits and non-multiplexed OE pins remain functional when SBI is enabled. This pin must be strapped to its desired state. It cannot dynamically change.<br>0 = SBI is disabled. Multiplexed pins function as output enables.<br>1 = SBI is enabled. Multiplexed pins function as SBI control pins. |
| A7         | PWRGD_PWRDNb  | I, SE, PU, PDT | Input notifies device to sample Latched inputs and start up on first high assertion. Low enters Power Down Mode, subsequent high assertions exit Power Down Mode.   |
| A8         | SADR_tri0     | I, SE, PD, PU  | SMBus address bit. This is a tri-level input that works in conjunction with other SADR pins, if present, to decode SMBus Addresses. See the <a href="#">SMBus Address Decode</a> table and the tri-level input thresholds in the electrical tables.   |
| A9         | SCLK          | I, SE, PDT     | Clock pin of SMBus interface.   |
| A10        | SDAT          | I/O, OD, PDT   | Data pin for SMBus interface.   |
| A11        | CLK0b         | O, DIF         | Complementary clock output.   |
| A12        | CLK0          | O, DIF         | True clock output.  |
| A13        | CLK1b         | O, DIF         | Complementary clock output.   |
| A14        | CLK1          | O, DIF         | True clock output.  |
| A15        | CLK2b         | O, DIF         | Complementary clock output.   |
| A16        | CLK2          | O, DIF         | True clock output.  |
| A17        | CLK3b         | O, DIF         | Complementary clock output.   |
| A18        | CLK3          | O, DIF         | True clock output.  |
| A19        | CLK4b         | O, DIF         | Complementary clock output.   |
| A20        | CLK4          | O, DIF         | True clock output.  |
| A21        | CLK5b         | O, DIF         | Complementary clock output.   |
| A22        | CLK5          | O, DIF         | True clock output.  |
| A23        | CLK6b         | O, DIF         | Complementary clock output.   |
| A24        | CLK6          | O, DIF         | True clock output.  |
| A25        | CLK7b         | O, DIF         | Complementary clock output.   |

Table 1. RC19024 Pin Descriptions (Cont.)

| Pin Number | Pin Name     | Pin Type          | Description   |
|------------|--------------|-------------------|---|
| A26        | CLK7         | O, DIF            | True clock output.  |
| A27        | CLK8b        | O, DIF            | Complementary clock output.   |
| A28        | CLK8         | O, DIF            | True clock output.  |
| A29        | CLK9b        | O, DIF            | Complementary clock output.   |
| A30        | CLK9         | O, DIF            | True clock output.  |
| A31        | CLK10b       | O, DIF            | Complementary clock output.   |
| A32        | CLK10        | O, DIF            | True clock output.  |
| A33        | CLK11b       | O, DIF            | Complementary clock output.   |
| A34        | CLK11        | O, DIF            | True clock output.  |
| A35        | CLK12b       | O, DIF            | Complementary clock output.   |
| A36        | CLK12        | O, DIF            | True clock output.  |
| A37        | CLK13b       | O, DIF            | Complementary clock output.   |
| A38        | CLK13        | O, DIF            | True clock output.  |
| A39        | CLK14b       | O, DIF            | Complementary clock output.   |
| A40        | CLK14        | O, DIF            | True clock output.  |
| A41        | CLK15b       | O, DIF            | Complementary clock output.   |
| A42        | CLK15        | O, DIF            | True clock output.  |
| A43        | CLK16b       | O, DIF            | Complementary clock output.   |
| A44        | CLK16        | O, DIF            | True clock output.  |
| A45        | CLK17b       | O, DIF            | Complementary clock output.   |
| A46        | CLK17        | O, DIF            | True clock output.  |
| A47        | CLK18b       | O, DIF            | Complementary clock output.   |
| A48        | CLK18        | O, DIF            | True clock output.  |
| A49        | CLK19b       | O, DIF            | Complementary clock output.   |
| A50        | CLK19        | O, DIF            | True clock output.  |
| A51        | CLK20b       | O, DIF            | Complementary clock output.   |
| A52        | CLK20        | O, DIF            | True clock output.  |
| A53        | CLK21b       | O, DIF            | Complementary clock output.   |
| A54        | CLK21        | O, DIF            | True clock output.  |
| A55        | CLK22b       | O, DIF            | Complementary clock output.   |
| A56        | CLK22        | O, DIF            | True clock output.  |
| B1         | OEb22_SBI_IN | I, SE, PD,<br>PDT | Active low input for enabling output 22 or the data pin for the Side-Band Interface. The function is this pin is controlled by the SBEN or SBI_ENQ pin. Refer to the <a href="#">Side-Band Interface (SBI)</a> section for details.<br>OE mode:<br>0 = enable output, 1 = disable output.<br>Side-Band mode:<br>SBI shift register data input pin |
| B2         | NC           | NC                | No connect.   |

Table 1. RC19024 Pin Descriptions (Cont.)

| Pin Number | Pin Name      | Pin Type       | Description  |
|------------|---------------|----------------|--|
| B3         | VDDCLK        | PWR            | Clock Power supply.  |
| B4         | VDDDIG        | PWR            | Digital Power supply.  |
| B5         | NC            | NC             | No connect   |
| B6         | SADR_tri1     | I, SE, PD, PU  | SMBus address bit. This is a tri-level input that works in conjunction with other SADR pins, if present, to decode SMBus Addresses. See the <a href="#">SMBus Address Decode</a> table and the tri-level input thresholds in the electrical tables.  |
| B7         | NC            | NC             | No connect.  |
| B8         | VDDCLK        | PWR            | Clock Power supply.  |
| B9         | NC            | NC             | No connect   |
| B10        | GND           | GND            | Connect to ground.   |
| B11        | NC            | NC             | No connect.  |
| B12        | OEb2_SHFT_LDb | I, SE, PD, PDT | Active low input for enabling output 2 or SHFT_LDb pin for the Side-Band Interface. The function of this pin is controlled by the SBEN or SBI_ENQ pin. Refer to the <a href="#">Side-Band Interface (SBI)</a> section for details<br>OE mode:<br>0 = Enable output, 1 = Disable output.<br>Side-Band mode:<br>0 = Disable SBI shift register, 1 = Enable SBI shift register.<br>A falling edge transfers SBI shift register contents to SBI output control register. |
| B13        | NC            | NC             | No connect.  |
| B14        | NC            | NC             | No connect.  |
| B15        | VDDCLK        | PWR            | Clock Power supply.  |
| B16        | OEb_A         | I, SE, PD, PDT | Active low input for enabling output group A. See the OEb_ASSIGNMENT[2:0] registers for details.<br>0 = enable output, 1 = disable output.   |
| B17        | NC            | NC             | No connect.  |
| B18        | OEb_B         | I, SE, PD, PDT | Active low input for enabling output group B. See the OEb_ASSIGNMENT registers for details.<br>0 = enable output, 1 = disable output.  |
| B19        | NC            | NC             | No connect.  |
| B20        | NC            | NC             | No connect.  |
| B21        | VDDCLK        | PWR            | Clock Power supply.  |
| B22        | OEb_C         | I, SE, PD, PDT | Active low input for enabling output group C. See the OEb_ASSIGNMENT registers for details.<br>0 = enable output, 1 = disable output.  |
| B23        | NC            | NC             | No connect.  |
| B24        | SBI_OUT       | O, SE          | Side-Band Interface data output.   |
| B25        | NC            | NC             | No connect.  |
| B26        | NC            | NC             | No connect.  |
| B27        | VDDCLK        | PWR            | Clock Power supply.  |
| B28        | NC            | NC             | No connect.  |



Table 1. RC19024 Pin Descriptions (Cont.)

| Pin Number | Pin Name | Pin Type       | Description  |
|------------|----------|----------------|--|
| B29        | OEB_D    | I, SE, PD, PDT | Active low input for enabling output group D. See the OEB_ASSIGNMENT registers for details.<br>0 = enable output, 1 = disable output.  |
| B30        | NC       | NC             | No connect.  |
| B31        | NC       | NC             | No connect.  |
| B32        | NC       | NC             | No connect.  |
| B33        | VDDCLK   | PWR            | Clock Power supply.  |
| B34        | NC       | NC             | No connect.  |
| B35        | LOSb     | O, OD, PDT     | Output indicating Loss of Input Signal. This pin is an open drain output and requires an external pull up resistor for proper functionality. A low output on this pin indicates a loss of signal on the input clock. |
| B36        | NC       | NC             | No connect.  |
| B37        | NC       | NC             | No connect.  |
| B38        | NC       | NC             | No connect.  |
| B39        | NC       | NC             | No connect.  |
| B40        | VDDCLK   | PWR            | Clock Power supply.  |
| B41        | NC       | NC             | No connect.  |
| B42        | NC       | NC             | No connect.  |
| B43        | GND      | GND            | Connect to ground.   |
| B44        | NC       | NC             | No connect.  |
| N/A        | EPAD     | GND            | Connect Epad to ground.  |

## 1.3 RC19020 Pin Information

### 1.3.1 RC19020 Pin Assignments

|   | 1      | 2       | 3   | 4         | 5     | 6                | 7     | 8               | 9     | 10               | 11                 | 12     |   |
|---|--------|---------|---|-----------|-------|------------------|-------|-----------------|-------|------------------|--------------------|--------|---|
| A | CLK17  | CLKb16  | CLK16   | CLKb15    | CLK15 | CLKb14           | CLK14 | CLKb13          | CLK13 | CLKb12           | CLK12              | CLKb11 | A |
| B | CLKb17 | VDDCLK  | NC  | SADR_tri0 | NC    | VDDCLK           | NC    | SADR_tri1       | NC    | OEb12            | VDDCLK             | CLK11  | B |
| C | CLK18  | SBI_OUT | <div style="text-align: center;"> <b>RC19020A</b><br/>           6 x 6 mm, x 0.5mm pitch<br/>           80-GQFN Package<br/>           Top View<br/>           connect EPAD to GND         </div> |           |       |                  |       |                 |       |                  | OEb11              | CLKb10 | C |
| D | CLKb18 | NC      |   |           |       |                  |       |                 |       |                  | NC                 | CLK10  | D |
| E | CLK19  | SBI_ENQ |   |           |       |                  |       |                 |       |                  | OEb10_S<br>HFT_LDb | OEb9   | E |
| F | CLKb19 | NC      |   |           |       |                  |       |                 |       |                  | NC                 | CLKb9  | F |
| G | CLKIN  | NC      |   |           |       |                  |       |                 |       |                  | LOSb               | CLK9   | G |
| H | CLKINb | VDDR    |   |           |       |                  |       |                 |       |                  | OEb8               | CLKb8  | H |
| J | CLK0   | NC      |   |           |       |                  |       |                 |       |                  | NC                 | CLK8   | J |
| K | CLKb0  | NC      |   |           |       |                  |       |                 |       |                  | OEb7               | CLKb7  | K |
| L | CLK1   | VDDCLK  | NC  | SDATA     | SCLK  | NC               | NC    | OEb5_SBI<br>_IN | NC    | OEb6_SBI<br>_CLK | VDDCLK             | CLK7   | L |
| M | CLKb1  | CLK2    | CLKb2   | CLK3      | CLKb3 | PWRGD_P<br>WRDNb | CLK4  | CLKb4           | CLK5  | CLKb5            | CLK6               | CLKb6  | M |
|   | 1      | 2       | 3   | 4         | 5     | 6                | 7     | 8               | 9     | 10               | 11                 | 12     |   |

Figure 3. RC19020 80-GQFN – Top View

The RC19020 is pin-compatible to the 9QXL2001B (DB2000QL) with SBI\_OUT and LOSb pins added to 9QXL2001B NC pins (C2 and G11).

### 1.3.2 RC19020 Pin Descriptions

Table 2. RC19020 Pin Descriptions

| Pin Number | Pin Name | Type   | Description                 |
|------------|----------|--------|-----------------------------|
| A1         | CLK17    | O, DIF | True clock output.          |
| A2         | CLKb16   | O, DIF | Complementary clock output. |
| A3         | CLK16    | O, DIF | True clock output.          |
| A4         | CLKb15   | O, DIF | Complementary clock output. |
| A5         | CLK15    | O, DIF | True clock output.          |

Table 2. RC19020 Pin Descriptions (Cont.)

| Pin Number | Pin Name  | Type           | Description   |
|------------|-----------|----------------|---|
| A6         | CLKb14    | O, DIF         | Complementary clock output.   |
| A7         | CLK14     | O, DIF         | True clock output.  |
| A8         | CLKb13    | O, DIF         | Complementary clock output.   |
| A9         | CLK13     | O, DIF         | True clock output.  |
| A10        | CLKb12    | O, DIF         | Complementary clock output.   |
| A11        | CLK12     | O, DIF         | True clock output.  |
| A12        | CLKb11    | O, DIF         | Complementary clock output.   |
| B1         | CLKb17    | O, DIF         | Complementary clock output.   |
| B2         | VDDCLK    | PWR            | Power supply for clock outputs.   |
| B3         | NC        | NC             | No connect.   |
| B4         | SADR_tri0 | I, SE, PD, PU  | SMBus address bit. This is a tri-level input that works in conjunction with other SADR pins, if present, to decode SMBus Addresses. See the <a href="#">SMBus Address Decode</a> table and the tri-level input thresholds in the electrical tables.   |
| B5         | NC        | NC             | No connect.   |
| B6         | VDDCLK    | PWR            | Power supply for clock outputs.   |
| B7         | NC        | NC             | No connect.   |
| B8         | SADR_tri1 | I, SE, PD, PU  | SMBus address bit. This is a tri-level input that works in conjunction with other SADR pins, if present, to decode SMBus Addresses. See the <a href="#">SMBus Address Decode</a> table and the tri-level input thresholds in the electrical tables.   |
| B9         | NC        | NC             | No connect.   |
| B10        | OEb12     | I, SE, PD, PDT | Active low input for enabling output 12.<br>0 = enable output, 1 = disable output.  |
| B11        | VDDCLK    | PWR            | Power supply for clock outputs.   |
| B12        | CLK11     | O, DIF         | True clock output.  |
| C1         | CLK18     | O, DIF         | True clock output.  |
| C2         | SBI_OUT   | O, SE          | Side-Band Interface data output.  |
| C11        | OEb11     | I, SE, PD, PDT | Active low input for enabling output 11.<br>0 = enable output, 1 = disable output.  |
| C12        | CLKb10    | O, DIF         | Complementary clock output.   |
| D1         | CLKb18    | O, DIF         | Complementary clock output.   |
| D2         | NC        | NC             | No connect.   |
| D11        | NC        | NC             | No connect.   |
| D12        | CLK10     | O, DIF         | True clock output.  |
| E1         | CLK19     | O, DIF         | True clock output.  |
| E2         | SBI_ENQ   | I, SE, PD, PDT | Input that selects function of pins that are multiplexed between OE and SBI functionality. SMBus output enable bits and non-multiplexed OE pins remain functional when SBI is enabled. This pin must be strapped to its desired state. It cannot dynamically change.<br>0 = SBI is disabled. Multiplexed pins function as output enables.<br>1 = SBI is enabled. Multiplexed pins function as SBI control pins. |

Table 2. RC19020 Pin Descriptions (Cont.)

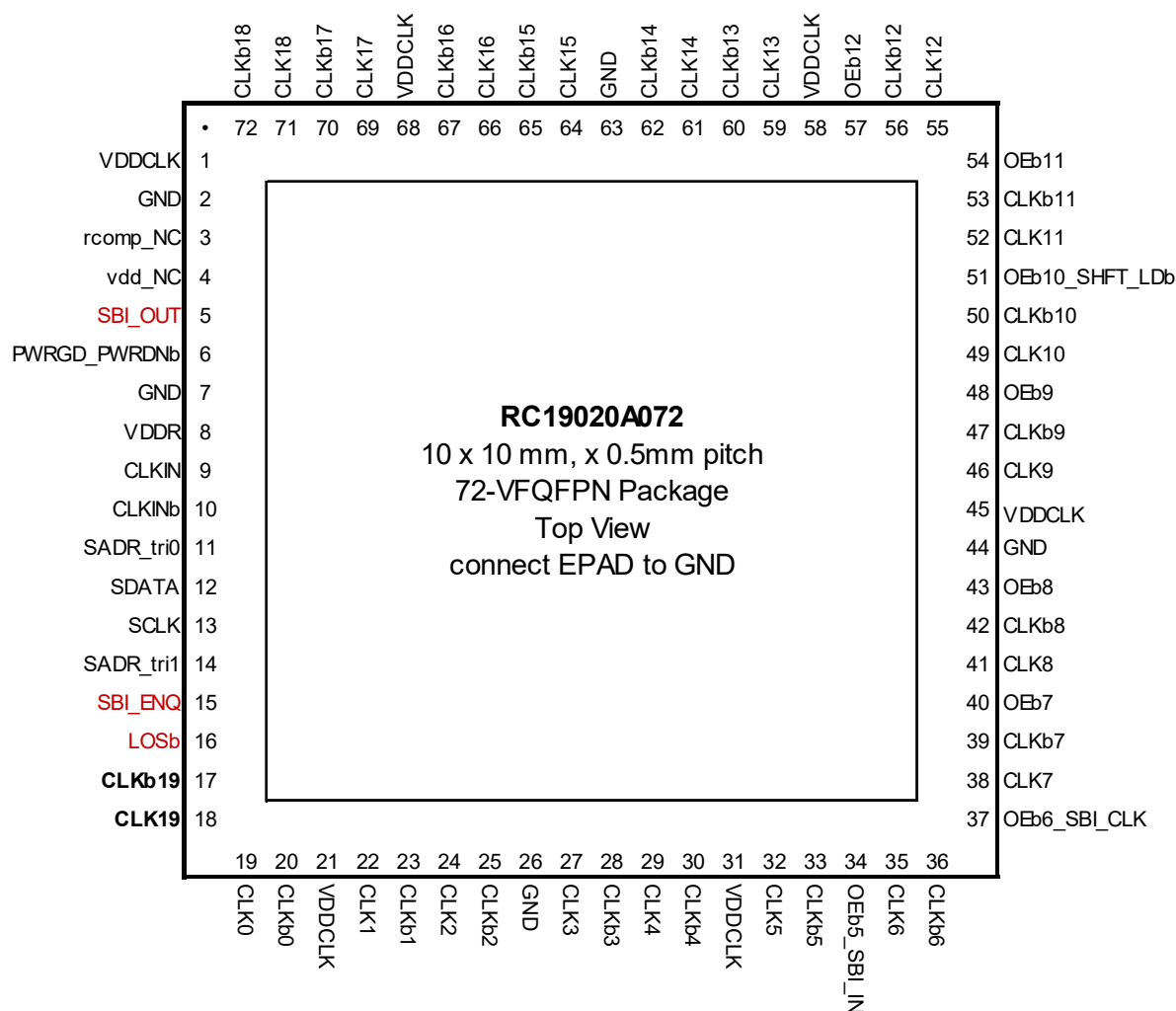
| Pin Number | Pin Name       | Type             | Description  |
|------------|----------------|------------------|--|
| E11        | OEB10_SHFT_LDb | I, SE, PD, PDT   | Active low input for enabling output 10 or SHFT_LDb pin for the Side-Band Interface. The function of this pin is controlled by the SBEN or SBI_ENQ pin. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br>OE mode:<br>0 = Enable output, 1 = Disable output.<br>Side-Band mode:<br>0 = Disable SBI shift register, 1 = Enable SBI shift register.<br>A falling edge transfers SBI shift register contents to SBI output control register. |
| E12        | OEB9           | I, SE, PD, PDT   | Active low input for enabling output 9.<br>0 = enable output, 1 = disable output.  |
| F1         | CLKb19         | O, DIF           | Complementary clock output.  |
| F2         | NC             | NC               | No connect.  |
| F11        | NC             | NC               | No connect.  |
| F12        | CLKb9          | O, DIF           | Complementary clock output.  |
| G1         | CLKIN          | I, DIF, PDT      | True clock input.  |
| G2         | NC             | NC               | No connect.  |
| G11        | LOSb           | O, OD, PDT       | Output indicating Loss of Input Signal. This pin is an open drain output and requires an external pull up resistor for proper functionality. A low output on this pin indicates a loss of signal on the input clock.   |
| G12        | CLK9           | O, DIF           | True clock output.   |
| H1         | CLKINb         | I, DIF, PDT      | Complementary clock input.   |
| H2         | VDDR           | PWR              | Power supply for clock input (receiver).   |
| H11        | OEB8           | I, SE, PD, PDT   | Active low input for enabling output 8.<br>0 = enable output, 1 = disable output.  |
| H12        | CLKb8          | O, DIF           | Complementary clock output.  |
| J1         | CLK0           | O, DIF           | True clock output.   |
| J2         | NC             | NC               | No connect.  |
| J11        | NC             | NC               | No connect.  |
| J12        | CLK8           | O, DIF           | True clock output.   |
| K1         | CLKb0          | O, DIF           | Complementary clock output.  |
| K2         | NC             | NC               | No connect.  |
| K11        | OEB7           | I, SE, PD, PDT   | Active low input for enabling output 7.<br>0 = enable output, 1 = disable output.  |
| K12        | CLKb7          | O, DIF           | Complementary clock output.  |
| L1         | CLK1           | O, DIF           | True clock output.   |
| L2         | VDDCLK         | PWR              | Power supply for clock outputs.  |
| L3         | NC             | NC               | No connect.  |
| L4         | SDATA          | I/O, SE, OD, PDT | Data pin for SMBus interface.  |

Table 2. RC19020 Pin Descriptions (Cont.)

| Pin Number | Pin Name     | Type           | Description  |
|------------|--------------|----------------|--|
| L5         | SCLK         | I, SE, PDT     | Clock pin of SMBus interface.  |
| L6         | NC           | NC             | No connect.  |
| L7         | NC           | NC             | No connect.  |
| L8         | OEb5_SBI_IN  | I, SE, PD, PDT | Active low input for enabling output 5 or the data pin for the Side-Band Interface. The function of this pin is controlled by the SBEN or SBI_ENQ pin. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br>OE mode:<br>0 = Enable output, 1 = Disable output.<br>Side-Band mode:<br>SBI shift register data input pin                   |
| L9         | NC           | NC             | No connect   |
| L10        | OEb6_SBI_CLK | I, SE, PD, PDT | Active low input for enabling output 6 or the clock pin for the SBI shift register. The function of this pin is controlled by the SBI_ENQ pin. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br>OE mode:<br>0 = Enable output, 1 = Disable output.<br>Side-Band mode:<br>Clocks data into the SBI shift register on the rising edge. |
| L11        | VDDCLK       | PWR            | Power supply for clock outputs.  |
| L12        | CLK7         | O, DIF         | True clock output.   |
| M1         | CLKb1        | O, DIF         | Complementary clock output.  |
| M2         | CLK2         | O, DIF         | True clock output.   |
| M3         | CLKb2        | O, DIF         | Complementary clock output.  |
| M4         | CLK3         | O, DIF         | True clock output.   |
| M5         | CLKb3        | O, DIF         | Complementary clock output.  |
| M6         | PWRGD_PWRDNb | I, SE, PU, PDT | Input notifies device to sample latched inputs and start up on first high assertion. Low enters Power Down Mode, subsequent high assertions exit Power Down Mode.  |
| M7         | CLK4         | O, DIF         | True clock output.   |
| M8         | CLKb4        | O, DIF         | Complementary clock output.  |
| M9         | CLK5         | O, DIF         | True clock output.   |
| M10        | CLKb5        | O, DIF         | Complementary clock output.  |
| M11        | CLK6         | O, DIF         | True clock output.   |
| M12        | CLKb6        | O, DIF         | Complementary clock output.  |
| N/A        | EPAD         | GND            | Connect Epad to ground.  |

## 1.4 RC19020A072 Pin Information

### 1.4.1 RC19020A072 Pin Assignments



Note: Polarity of CLK19 is reversed from CLK[18:0] per DB2000Q Specification Rev1.2

**Figure 4. RC19020A072 72-VFQFPN – Top View**

The RC19020A072 is pin-compatible to the 9QXL2000B (DB2000Q) with the SBI\_OUT, SBI\_ENQ and LOSb pins placed on 9QXL2000 NC pins (5, 15 and 16).

### 1.4.2 RC19020A072 Pin Descriptions

**Table 3. RC19020A072 Pin Descriptions**

| Pin Number | Pin Name | Type  | Description  |
|------------|----------|-------|--|
| 1          | VDDCLK   | PWR   | Power supply for clock outputs.  |
| 2          | GND      | GND   | Ground pin.  |
| 3          | rcomp_NC | N/A   | The DB2000Q specification calls this pin RCOMP. This pin is a true No connect on the Renesas 9QXL2000 device, since it is not needed. Any existing connections on the board may remain to support non-IDT DB2000Q devices. |
| 4          | vdd_NC   | NC    | The DB2000Q specification calls this pin VDD. This pin is a true No connect on the IDT 9QXL2000 device, since it is not needed. Any existing connections on the board may remain to support non-IDT DB2000Q devices.       |
| 5          | SBI_OUT  | O, SE | Side-Band Interface data output.   |

Table 3. RC19020A072 Pin Descriptions (Cont.)

| Pin Number | Pin Name     | Type             | Description   |
|------------|--------------|------------------|---|
| 6          | PWRGD_PWRDNb | I, SE, PU, PDT   | Input notifies device to sample latched inputs and start up on first high assertion. Low enters Power Down Mode, subsequent high assertions exit Power Down Mode.   |
| 7          | GND          | GND              | Ground pin.   |
| 8          | VDDR         | PWR              | Power supply for clock input (receiver).  |
| 9          | CLKIN        | I, DIF, PDT      | True clock input.   |
| 10         | CLKINb       | I, DIF, PDT      | Complementary clock input.  |
| 11         | SADR_tri0    | I, SE, PD, PU    | SMBus address bit. This is a tri-level input that works in conjunction with other SADR pins, if present, to decode SMBus Addresses. See the <a href="#">SMBus Address Decode</a> table and refer to the tri-level input thresholds in the electrical tables.  |
| 12         | SDATA        | I/O, SE, OD, PDT | Data pin for SMBus interface.   |
| 13         | SCLK         | I, SE, PDT       | Clock pin of SMBus interface.   |
| 14         | SADR_tri1    | I, SE, PD, PU    | SMBus address bit. This is a tri-level input that works in conjunction with other SADR pins, if present, to decode SMBus Addresses. See the <a href="#">SMBus Address Decode</a> table and refer to the tri-level input thresholds in the electrical tables.  |
| 15         | SBI_ENQ      | I, SE, PD, PDT   | Input that selects function of pins that are multiplexed between OE and SBI functionality. SMBus output enable bits and non-multiplexed OE pins remain functional when SBI is enabled. This pin must be strapped to its desired state. It cannot dynamically change.<br>0 = SBI is disabled. Multiplexed pins function as output enables.<br>1 = SBI is enabled. Multiplexed pins function as SBI control pins. |
| 16         | LOSb         | O, OD, PDT       | Output indicating Loss of Input Signal. This pin is an open drain output and requires an external pull up resistor for proper functionality. A low output on this pin indicates a loss of signal on the input clock.  |
| 17         | CLKb19       | O, DIF           | Complementary clock output.   |
| 18         | CLK19        | O, DIF           | True clock output.  |
| 19         | CLK0         | O, DIF           | True clock output.  |
| 20         | CLKb0        | O, DIF           | Complementary clock output.   |
| 21         | VDDCLK       | PWR              | Power supply for clock outputs.   |
| 22         | CLK1         | O, DIF           | True clock output.  |
| 23         | CLKb1        | O, DIF           | Complementary clock output.   |
| 24         | CLK2         | O, DIF           | True clock output.  |
| 25         | CLKb2        | O, DIF           | Complementary clock output.   |
| 26         | GND          | GND              | Ground pin.   |
| 27         | CLK3         | O, DIF           | True clock output.  |
| 28         | CLKb3        | O, DIF           | Complementary clock output.   |
| 29         | CLK4         | O, DIF           | True clock output.  |
| 30         | CLKb4        | O, DIF           | Complementary clock output.   |
| 31         | VDDCLK       | PWR              | Power supply for clock outputs.   |

Table 3. RC19020A072 Pin Descriptions (Cont.)

| Pin Number | Pin Name       | Type                            | Description  |
|------------|----------------|---------------------------------|--|
| 32         | CLK5           | O, DIF                          | True clock output.   |
| 33         | CLKb5          | O, DIF                          | Complementary clock output.  |
| 34         | OEb5_SBI_IN    | I, SE,<br>PDT,<br>None or<br>PD | Active low input for enabling output 5 or the data pin for the Side-Band Interface. The function of this pin is controlled by the SBEN or SBI_ENQ pin. Refer to the <a href="#">Side-Band Interface (SBI)</a> section for details.<br>OE mode:<br>0 = enable output, 1 = disable output.<br>Side-Band mode with internal pull down:<br>SBI shift register data input pin   |
| 35         | CLK6           | O, DIF                          | True clock output.   |
| 36         | CLKb6          | O, DIF                          | Complementary clock output.  |
| 37         | OEb6_SBI_CLK   | I, SE,<br>PDT,<br>None or<br>PD | Active low input for enabling output 6 or the clock pin for the SBI shift register. The function of this pin is controlled by the SBEN or SBI_ENQ pin. Refer to the <a href="#">Side-Band Interface (SBI)</a> section for details.<br>OE mode:<br>0 = enable output, 1 = disable output.<br>Side-Band mode with internal pull down:<br>Clocks data into the SBI shift register on the rising edge.   |
| 38         | CLK7           | O, DIF                          | True clock output.   |
| 39         | CLKb7          | O, DIF                          | Complementary clock output.  |
| 40         | OEb7           | I, SE,<br>PDT                   | Active low input for enabling output 7.<br>0 = enable output, 1 = disable output.  |
| 41         | CLK8           | O, DIF                          | True clock output.   |
| 42         | CLKb8          | O, DIF                          | Complementary clock output.  |
| 43         | OEb8           | I, SE,<br>PDT                   | Active low input for enabling output 8.<br>0 = enable output, 1 = disable output.  |
| 44         | GND            | GND                             | Ground pin.  |
| 45         | VDDCLK         | PWR                             | Power supply for clock outputs.  |
| 46         | CLK9           | O, DIF                          | True clock output.   |
| 47         | CLKb9          | O, DIF                          | Complementary clock output.  |
| 48         | OEb9           | I, SE,<br>PDT                   | Active low input for enabling output 9.<br>0 = enable output, 1 = disable output.  |
| 49         | CLK10          | O, DIF                          | True clock output.   |
| 50         | CLKb10         | O, DIF                          | Complementary clock output.  |
| 51         | OEb10_SHFT_LDb | I, SE,<br>PDT,<br>None or<br>PD | Active low input for enabling output 10 or SHFT_LDb pin for the Side-Band Interface. The function of this pin is controlled by the SBEN or SBI_ENQ pin. Refer to the <a href="#">Side-Band Interface (SBI)</a> section for details.<br>OE mode:<br>0 = enable output, 1 = disable output.<br>Side-Band Mode with internal pull-down:<br>0 = Disable SBI shift register, 1 = Enable SBI shift register.<br>A falling edge transfers SBI shift register contents to SBI output control register. |
| 52         | CLK11          | O, DIF                          | True clock output.   |



Table 3. RC19020A072 Pin Descriptions (Cont.)

| Pin Number | Pin Name | Type       | Description  |
|------------|----------|------------|--|
| 53         | CLKb11   | O, DIF     | Complementary clock output.  |
| 54         | OEb11    | I, SE, PDT | Active low input for enabling output 11.<br>0 = enable output, 1 = disable output. |
| 55         | CLK12    | O, DIF     | True clock output.   |
| 56         | CLKb12   | O, DIF     | Complementary clock output.  |
| 57         | OEb12    | I, SE, PDT | Active low input for enabling output 12.<br>0 = enable output, 1 = disable output. |
| 58         | VDDCLK   | PWR        | Power supply for clock outputs.  |
| 59         | CLK13    | O, DIF     | True clock output.   |
| 60         | CLKb13   | O, DIF     | Complementary clock output.  |
| 61         | CLK14    | O, DIF     | True clock output.   |
| 62         | CLKb14   | O, DIF     | Complementary clock output.  |
| 63         | GND      | GND        | Ground pin.  |
| 64         | CLK15    | O, DIF     | True clock output.   |
| 65         | CLKb15   | O, DIF     | Complementary clock output.  |
| 66         | CLK16    | O, DIF     | True clock output.   |
| 67         | CLKb16   | O, DIF     | Complementary clock output.  |
| 68         | VDDCLK   | PWR        | Power supply for clock outputs.  |
| 69         | CLK17    | O, DIF     | True clock output.   |
| 70         | CLKb17   | O, DIF     | Complementary clock output.  |
| 71         | CLK18    | O, DIF     | True clock output.   |
| 72         | CLKb18   | O, DIF     | Complementary clock output.  |
| 73         | EPAD     | GND        | Connect EPAD to Ground.  |

## 1.5 RC19016 Pin Information

### 1.5.1 RC19016 Pin Assignments

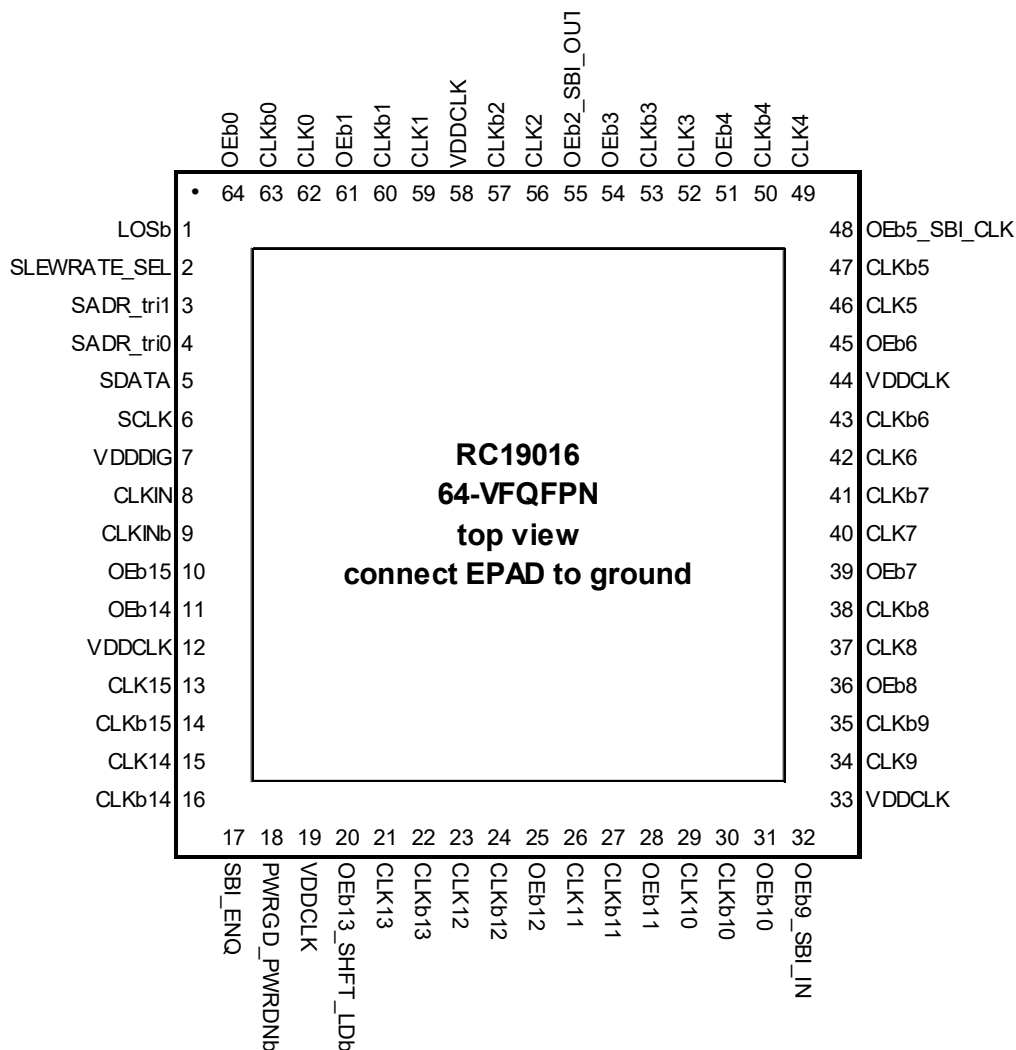


Figure 5. RC19016 64-VFQFPN – Top View

### 1.5.2 RC19016 Pin Descriptions

Table 4. RC19016 Pin Descriptions

| Pin Number | Pin Name     | Type           | Description   |
|------------|--------------|----------------|---|
| 1          | LOSb         | O, OD, PDT     | Output indicating Loss of Input Signal. This pin is an open-drain output and requires an external pull-up resistor for proper functionality. A low output on this pin indicates a loss of signal on the input clock.                                |
| 2          | SLEWRATE_SEL | I, SE, PU, PDT | Input to select default slew rate of the outputs.<br>0 = Slow Slew Rate, 1 = Fast Slew Rate.  |
| 3          | SADR_tri1    | I, SE, PD, PU  | SMBus address bit. This is a tri-level input that works in conjunction with other SADR pins, if present, to decode SMBus Addresses. See the <a href="#">SMBus Address Decode</a> table and the tri-level input thresholds in the electrical tables. |
| 4          | SADR_tri0    | I, SE, PD, PU  | SMBus address bit. This is a tri-level input that works in conjunction with other SADR pins, if present, to decode SMBus Addresses. See the <a href="#">SMBus Address Decode</a> table and the tri-level input thresholds in the electrical tables. |

Table 4. RC19016 Pin Descriptions (Cont.)

| Pin Number | Pin Name       | Type                 | Description  |
|------------|----------------|----------------------|--|
| 5          | SDATA          | I/O, SE, OD          | Data pin for SMBus interface.  |
| 6          | SCLK           | I, SE                | Clock pin of SMBus interface.  |
| 7          | VDDDIG         | PWR                  | Digital power.   |
| 8          | CLKIN          | I, DIF               | True clock input.  |
| 9          | CLKINb         | I, DIF               | Complementary clock input.   |
| 10         | OEB15          | I, SE, PU, PDT       | Active low input for enabling output 15.<br>0 = Enable output, 1 = Disable output.   |
| 11         | OEB14          | I, SE, PU, PDT       | Active low input for enabling output 14.<br>0 = Enable output, 1 = Disable output.   |
| 12         | VDDCLK         | PWR                  | Clock power supply.  |
| 13         | CLK15          | O, DIF               | True clock output.   |
| 14         | CLKb15         | O, DIF               | Complementary clock output.  |
| 15         | CLK14          | O, DIF               | True clock output.   |
| 16         | CLKb14         | O, DIF               | Complementary clock output.  |
| 17         | SBI_ENQ        | I, SE, PD, PDT       | Input that selects function of pins that are multiplexed between OE and SBI functionality. SMBus output enable bits and non-multiplexed OE pins remain functional when SBI is enabled. This pin must be strapped to its desired state. It cannot dynamically change.<br>0 = SBI is disabled. Multiplexed pins function as output enables.<br>1 = SBI is enabled. Multiplexed pins function as SBI control pins.  |
| 18         | PWRGD_PWRDNb   | I, SE, PU, PDT       | Input notifies device to sample latched inputs and start up on first high assertion. Low enters Power Down Mode, subsequent high assertions exit Power Down Mode.  |
| 19         | VDDCLK         | PWR                  | Clock power supply.  |
| 20         | OEB13_SHFT_LDb | I, SE, PDT, PU or PD | Active low input for enabling output 13 or SHFT_LDb pin for the Side-Band Interface. The function of this pin is controlled by the SBI_ENQ pin. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br>OE mode with internal pull-up:<br>0 = Enable output, 1 = Disable output.<br>Side-Band mode with internal pull-down:<br>0 = Disable SBI shift register, 1 = Enable SBI shift register.<br>A falling edge transfers SBI shift register contents to SBI output control register. |
| 21         | CLK13          | O, DIF               | True clock output.   |
| 22         | CLKb13         | O, DIF               | Complementary clock output.  |
| 23         | CLK12          | O, DIF               | True clock output.   |
| 24         | CLKb12         | O, DIF               | Complementary clock output.  |
| 25         | OEB12          | I, SE, PU, PDT       | Active low input for enabling output 12.<br>0 = Enable output, 1 = Disable output.   |
| 26         | CLK11          | O, DIF               | True clock output.   |
| 27         | CLKb11         | O, DIF               | Complementary clock output.  |
| 28         | OEB11          | I, SE, PU, PDT       | Active low input for enabling output 11.<br>0 = Enable output, 1 = Disable output.   |

Table 4. RC19016 Pin Descriptions (Cont.)

| Pin Number | Pin Name     | Type                 | Description   |
|------------|--------------|----------------------|---|
| 29         | CLK10        | O, DIF               | True clock output.  |
| 30         | CLKb10       | O, DIF               | Complementary clock output.   |
| 31         | OEb10        | I, SE, PU, PDT       | Active low input for enabling output 10.<br>0 = Enable output, 1 = Disable output.  |
| 32         | OEb9_SBI_IN  | I, SE, PDT, PU or PD | Active low input for enabling output 9 or the data pin for the Side-Band Interface. The function of this pin is controlled by the SBI_ENQ pin. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br>OE mode with internal pull-up:<br>0 = Enable output, 1 = Disable output.<br>Side-Band mode with internal pull-down:<br>SBI shift register data input pin            |
| 33         | VDDCLK       | PWR                  | Clock Power supply.   |
| 34         | CLK9         | O, DIF               | True clock output.  |
| 35         | CLKb9        | O, DIF               | Complementary clock output.   |
| 36         | OEb8         | I, SE, PU, PDT       | Active low input for enabling output 8.<br>0 = Enable output, 1 = Disable output.   |
| 37         | CLK8         | O, DIF               | True clock output.  |
| 38         | CLKb8        | O, DIF               | Complementary clock output.   |
| 39         | OEb7         | I, SE, PU, PDT       | Active low input for enabling output 7.<br>0 = Enable output, 1 = Disable output.   |
| 40         | CLK7         | O, DIF               | True clock output.  |
| 41         | CLKb7        | O, DIF               | Complementary clock output.   |
| 42         | CLK6         | O, DIF               | True clock output.  |
| 43         | CLKb6        | O, DIF               | Complementary clock output.   |
| 44         | VDDCLK       | PWR                  | Clock Power supply.   |
| 45         | OEb6         | I, SE, PU, PDT       | Active low input for enabling output 6.<br>0 = Enable output, 1 = Disable output.   |
| 46         | CLK5         | O, DIF               | True clock output.  |
| 47         | CLKb5        | O, DIF               | Complementary clock output.   |
| 48         | OEb5_SBI_CLK | I, SE, PDT, PU or PD | Active low input for enabling output 5 or the clock pin for the SBI shift register. The function of this pin is controlled by the SBI_ENQ pin. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br>OE mode with internal pull-up:<br>0 = Enable output, 1 = Disable output.<br>Side-Band mode with internal pull-down:<br>Clocks data into the SBI on the rising edge. |
| 49         | CLK4         | O, DIF               | True clock output.  |
| 50         | CLKb4        | O, DIF               | Complementary clock output.   |
| 51         | OEb4         | I, SE, PU, PDT       | Active low input for enabling output 4<br>0 = Enable output, 1 = Disable output.  |
| 52         | CLK3         | O, DIF               | True clock output.  |
| 53         | CLKb3        | O, DIF               | Complementary clock output.   |

Table 4. RC19016 Pin Descriptions (Cont.)

| Pin Number | Pin Name     | Type              | Description   |
|------------|--------------|-------------------|---|
| 54         | OEb3         | I, SE, PU,<br>PDT | Active low input for enabling output 3.<br>0 = Enable output, 1 = Disable output.   |
| 55         | OEb2_SBI_OUT | SE, I/O           | Active low input for enabling output 2 or the SBI shift register data output. The function of this pin is controlled by the SBI_ENQ. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br><b>Note:</b> This pin is NOT PDT.<br>OE mode:<br>0 = Enable output, 1 = Disable output.<br>Side-Band mode:<br>SBI shift register data output. |
| 56         | CLK2         | O, DIF            | True clock output.  |
| 57         | CLKb2        | O, DIF            | Complementary clock output.   |
| 58         | VDDCLK       | PWR               | Clock Power supply.   |
| 59         | CLK1         | O, DIF            | True clock output.  |
| 60         | CLKb1        | O, DIF            | Complementary clock output.   |
| 61         | OEb1         | I, SE, PU,<br>PDT | Active low input for enabling output 1.<br>0 = Enable output, 1 = Disable output.   |
| 62         | CLK0         | O, DIF            | True clock output.  |
| 63         | CLKb0        | O, DIF            | Complementary clock output.   |
| 64         | OEb0         | I, SE, PU,<br>PDT | Active low input for enabling output 0.<br>0 = Enable output, 1 = Disable output.   |
| 65         | EPAD         | GND               | Ground pin.   |

## 1.6 RC19013 Pin Information

### 1.6.1 RC19013 Pin Assignments

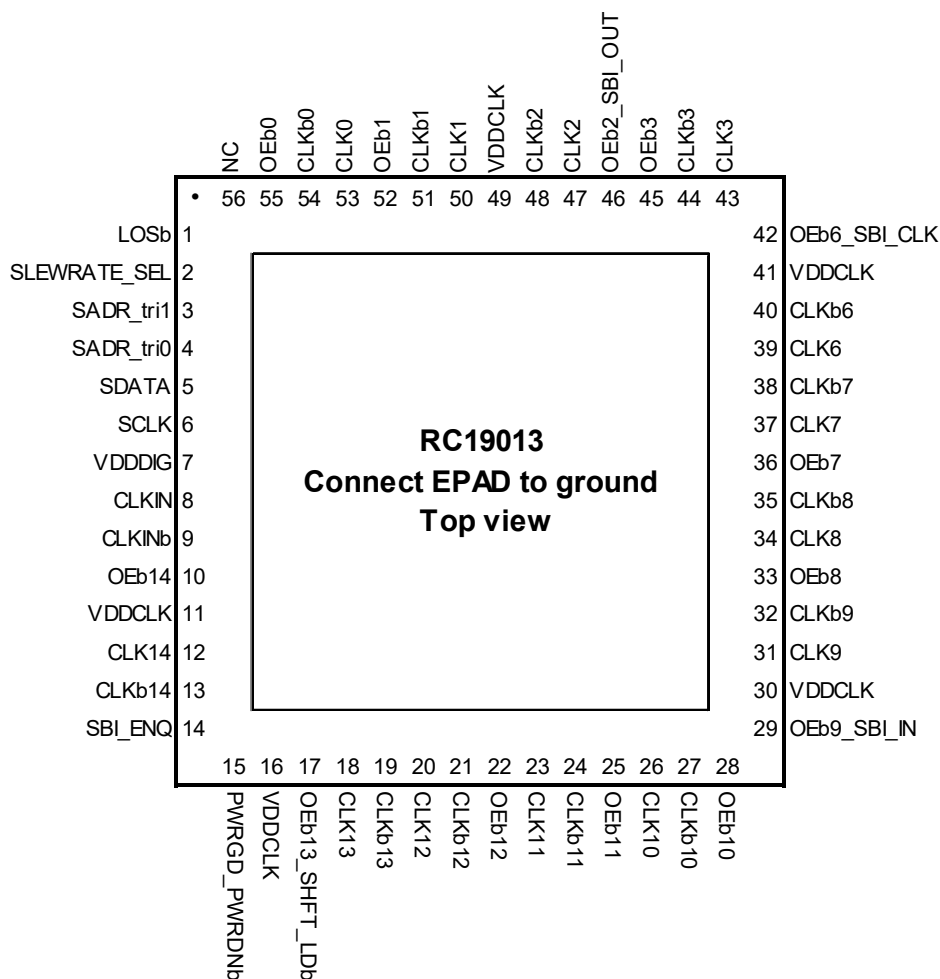


Figure 6. RC19013 56-VFQFP – Top View

### 1.6.2 RC19013 Pin Descriptions

Table 5. RC19013 Pin Descriptions

| Pin Number | Pin Name     | Type           | Description   |
|------------|--------------|----------------|---|
| 1          | LOSb         | O, OD, PDT     | Output indicating Loss of Input Signal. This pin is an open-drain output and requires an external pull-up resistor for proper functionality. A low output on this pin indicates a loss of signal on the input clock.                                |
| 2          | SLEWRATE_SEL | I, SE, PU, PDT | Input to select default slew rate of the outputs.<br>0 = Slow Slew Rate, 1 = Fast Slew Rate.  |
| 3          | SADR_tri1    | I, SE, PD, PU  | SMBus address bit. This is a tri-level input that works in conjunction with other SADR pins, if present, to decode SMBus Addresses. See the <a href="#">SMBus Address Decode</a> table and the tri-level input thresholds in the electrical tables. |
| 4          | SADR_tri0    | I, SE, PD, PU  | SMBus address bit. This is a tri-level input that works in conjunction with other SADR pins, if present, to decode SMBus Addresses. See the <a href="#">SMBus Address Decode</a> table and the tri-level input thresholds in the electrical tables. |
| 5          | SDATA        | I/O, SE, OD    | Data pin for SMBus interface.   |
| 6          | SCLK         | I, SE          | Clock pin of SMBus interface.   |

Table 5. RC19013 Pin Descriptions (Cont.)

| Pin Number | Pin Name       | Type                 | Description  |
|------------|----------------|----------------------|--|
| 7          | VDDDIG         | PWR                  | Digital power.   |
| 8          | CLKIN          | I, DIF               | True clock input.  |
| 9          | CLKINb         | I, DIF               | Complementary clock input.   |
| 10         | OEB14          | I, SE, PU, PDT       | Active low input for enabling output 14.<br>0 = Enable output, 1 = Disable output.   |
| 11         | VDDCLK         | PWR                  | Clock power supply.  |
| 12         | CLK14          | O, DIF               | True clock output.   |
| 13         | CLKb14         | O, DIF               | Complementary clock output.  |
| 14         | SBI_ENQ        | I, SE, PD, PDT       | Input that selects function of pins that are multiplexed between OE and SBI functionality. SMBus output enable bits and non-multiplexed OE pins remain functional when SBI is enabled. This pin must be strapped to its desired state. It cannot dynamically change.<br>0 = SBI is disabled. Multiplexed pins function as output enables.<br>1 = SBI is enabled. Multiplexed pins function as SBI control pins.  |
| 15         | PWRGD_PWRDNb   | I, SE, PU, PDT       | Input notifies device to sample latched inputs and start up on first high assertion. Low enters Power Down Mode, subsequent high assertions exit Power Down Mode.  |
| 16         | VDDCLK         | PWR                  | Clock Power supply.  |
| 17         | OEB13_SHFT_LDb | I, SE, PDT, PU or PD | Active low input for enabling output 13 or SHFT_LDb pin for the Side-Band Interface. The function of this pin is controlled by the SBI_ENQ pin. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br>OE mode with internal pull-up:<br>0 = Enable output, 1 = Disable output.<br>Side-Band mode with internal pull-down:<br>0 = Disable SBI shift register, 1 = Enable SBI shift register.<br>A falling edge transfers SBI shift register contents to SBI output control register. |
| 18         | CLK13          | O, DIF               | True clock output.   |
| 19         | CLKb13         | O, DIF               | Complementary clock output.  |
| 20         | CLK12          | O, DIF               | True clock output.   |
| 21         | CLKb12         | O, DIF               | Complementary clock output.  |
| 22         | OEB12          | I, SE, PU, PDT       | Active low input for enabling output 12.<br>0 = Enable output, 1 = Disable output.   |
| 23         | CLK11          | O, DIF               | True clock output.   |
| 24         | CLKb11         | O, DIF               | Complementary clock output.  |
| 25         | OEB11          | I, SE, PU, PDT       | Active low input for enabling output 11.<br>0 = Enable output, 1 = Disable output.   |
| 26         | CLK10          | O, DIF               | True clock output.   |
| 27         | CLKb10         | O, DIF               | Complementary clock output.  |
| 28         | OEB10          | I, SE, PU, PDT       | Active low input for enabling output 10.<br>0 = Enable output, 1 = Disable output.   |

Table 5. RC19013 Pin Descriptions (Cont.)

| Pin Number | Pin Name     | Type                 | Description  |
|------------|--------------|----------------------|--|
| 29         | OEB9_SBI_IN  | I, SE, PDT, PU or PD | Active low input for enabling output 9 or the data pin for the Side-Band Interface. The function of this pin is controlled by the SBI_ENQ pin. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br>OE mode with internal pull-up:<br>0 = Enable output, 1 = Disable output.<br>Side-Band mode with internal pull-down:<br>SBI shift register data input pin                           |
| 30         | VDDCLK       | PWR                  | Clock power supply.  |
| 31         | CLK9         | O, DIF               | True clock output.   |
| 32         | CLKb9        | O, DIF               | Complementary clock output.  |
| 33         | OEB8         | I, SE, PU, PDT       | Active low input for enabling output 8.<br>0 = Enable output, 1 = Disable output.  |
| 34         | CLK8         | O, DIF               | True clock output.   |
| 35         | CLKb8        | O, DIF               | Complementary clock output.  |
| 36         | OEB7         | I, SE, PU, PDT       | Active low input for enabling output 7.<br>0 = Enable output, 1 = Disable output.  |
| 37         | CLK7         | O, DIF               | True clock output.   |
| 38         | CLKb7        | O, DIF               | Complementary clock output.  |
| 39         | CLK6         | O, DIF               | True clock output.   |
| 40         | CLKb6        | O, DIF               | Complementary clock output.  |
| 41         | VDDCLK       | PWR                  | Clock power supply.  |
| 42         | OEB6_SBI_CLK | I, SE, PDT, PU or PD | Active low input for enabling output 6 or the clock pin for the SBI shift register. The function of this pin is controlled by the SBI_ENQ pin. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br>OE mode with internal pull-up:<br>0 = Enable output, 1 = Disable output.<br>Side-Band mode with internal pull-down:<br>Clocks data into the SBI shift register on the rising edge. |
| 43         | CLK3         | O, DIF               | True clock output.   |
| 44         | CLKb3        | O, DIF               | Complementary clock output.  |
| 45         | OEB3         | I, SE, PU, PDT       | Active low input for enabling output 3.<br>0 = Enable output, 1 = Disable output.  |
| 46         | OEB2_SBI_OUT | I/O, SE              | Active low input for enabling output 2 or the SBI shift register data output. The function of this pin is controlled by the SBI_ENQ pin. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br><b>Note:</b> This pin is NOT PDT.<br>OE mode:<br>0 = Enable output, 1 = Disable output.<br>Side-Band mode:<br>SBI shift register data output.  |
| 47         | CLK2         | O, DIF               | True clock output.   |
| 48         | CLKb2        | O, DIF               | Complementary clock output.  |
| 49         | VDDCLK       | PWR                  | Clock power supply.  |
| 50         | CLK1         | O, DIF               | True clock output.   |



Table 5. RC19013 Pin Descriptions (Cont.)

| Pin Number | Pin Name | Type           | Description   |
|------------|----------|----------------|---|
| 51         | CLKb1    | O, DIF         | Complementary clock output.   |
| 52         | OEb1     | I, SE, PU, PDT | Active low input for enabling output 1.<br>0 = Enable output, 1 = Disable output. |
| 53         | CLK0     | O, DIF         | True clock output.  |
| 54         | CLKb0    | O, DIF         | Complementary clock output.   |
| 55         | OEb0     | I, SE, PU, PDT | Active low input for enabling output 0.<br>0 = Enable output, 1 = Disable output. |
| 56         | NC       | NC             | No connect.   |
| 57         | EPAD     | GND            | Connect Epad to ground.   |

## 1.7 RC19008 Pin Information

### 1.7.1 RC19008 Pin Assignments

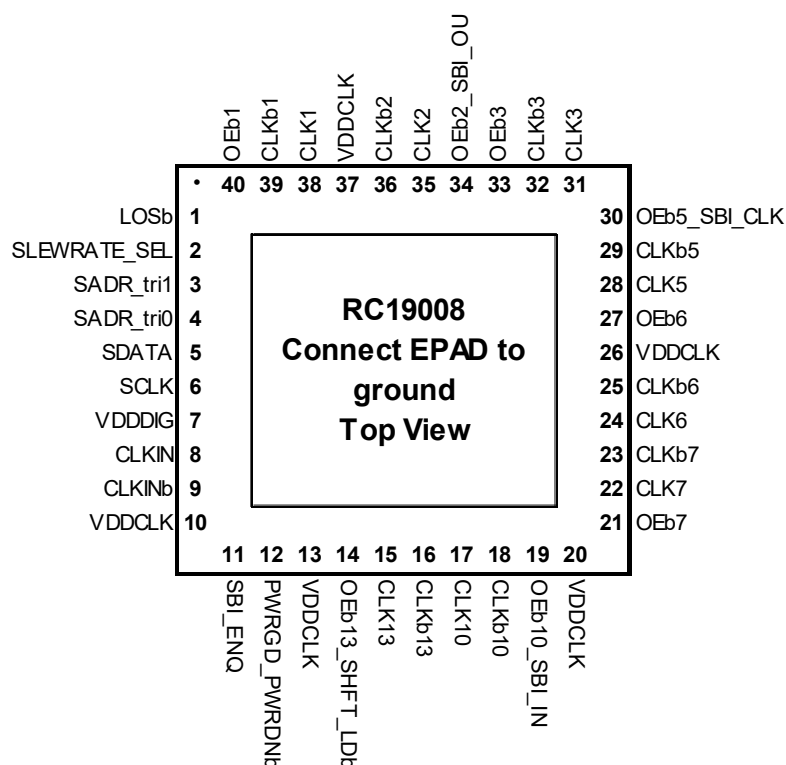


Figure 7. RC19008 40-VFQFPN – Top View

## 1.7.2 RC19008 Pin Descriptions

Table 6. RC19008 Pin Descriptions

| Pin Number | Pin Name       | Type                 | Description  |
|------------|----------------|----------------------|--|
| 1          | LOSb           | O, OD, PDT           | Output indicating Loss of Input Signal. This pin is an open-drain output and requires an external pull-up resistor for proper functionality. A low output on this pin indicates a loss of signal on the input clock.   |
| 2          | SLEWRATE_SEL   | I, SE, PU, PDT       | Input to select default slew rate of the outputs.<br>0 = Slow Slew Rate, 1 = Fast Slew Rate.   |
| 3          | SADR_tri1      | I, SE, PD, PU        | SMBus address bit. This is a tri-level input that works in conjunction with other SADR pins, if present, to decode SMBus Addresses. See the <a href="#">SMBus Address Decode</a> table and tri-level input thresholds in the electrical tables.  |
| 4          | SADR_tri0      | I, SE, PD, PU        | SMBus address bit. This is a tri-level input that works in conjunction with other SADR pins, if present, to decode SMBus Addresses. See the <a href="#">SMBus Address Decode</a> table and tri-level input thresholds in the electrical tables.  |
| 5          | SDATA          | I/O, SE, OD          | Data pin for SMBus interface.  |
| 6          | SCLK           | I, SE                | Clock pin of SMBus interface.  |
| 7          | VDDDIG         | PWR                  | Digital power.   |
| 8          | CLKIN          | I, DIF               | True clock input.  |
| 9          | CLKINb         | I, DIF               | Complementary clock input.   |
| 10         | VDDCLK         | PWR                  | Clock Power supply.  |
| 11         | SBI_ENQ        | I, SE, PD, PDT       | Input that selects function of pins that are multiplexed between OE and SBI functionality. SMBus output enable bits and non-multiplexed OE pins remain functional when SBI is enabled. This pin must be strapped to its desired state. It cannot dynamically change.<br>0 = SBI is disabled. Multiplexed pins function as output enables.<br>1 = SBI is enabled. Multiplexed pins function as SBI control pins.  |
| 12         | PWRGD_PWRDNb   | I, SE, PU, PDT       | Input notifies device to sample latched inputs and start up on first high assertion. Low enters Power Down Mode, subsequent high assertions exit Power Down Mode.  |
| 13         | VDDCLK         | PWR                  | Clock power supply.  |
| 14         | OEb13_SHFT_LDb | I, SE, PDT, PU or PD | Active low input for enabling output 13 or SHFT_LDb pin for the Side-Band Interface. The function of this pin is controlled by the SBI_ENQ pin. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br>OE mode with internal pull-up:<br>0 = Enable output, 1 = Disable output.<br>Side-Band mode with internal pull-down:<br>0 = Disable SBI shift register, 1 = Enable SBI shift register.<br>A falling edge transfers SBI shift register contents to SBI output control register. |
| 15         | CLK13          | O, DIF               | True clock output.   |
| 16         | CLKb13         | O, DIF               | Complementary clock output.  |
| 17         | CLK10          | O, DIF               | True clock output.   |
| 18         | CLKb10         | O, DIF               | Complementary clock output.  |

Table 6. RC19008 Pin Descriptions (Cont.)

| Pin Number | Pin Name     | Type                 | Description   |
|------------|--------------|----------------------|---|
| 19         | OEB10_SBI_IN | I, SE, PDT, PU or PD | Active low input for enabling output 10 or the data pin for the Side-Band Interface. The function of this pin is controlled by the SBI_ENQ pin. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br>OE mode with internal pull-up:<br>0 = Enable output, 1 = Disable output.<br>Side-Band mode with internal pull-down:<br>SBI shift-register data input.              |
| 20         | VDDCLK       | PWR                  | Clock power supply.   |
| 21         | OEB7         | I, SE, PU, PDT       | Active low input for enabling output 7.<br>0 = Enable output, 1 = Disable output.   |
| 22         | CLK7         | O, DIF               | True clock output.  |
| 23         | CLKb7        | O, DIF               | Complementary clock output.   |
| 24         | CLK6         | O, DIF               | True clock output.  |
| 25         | CLKb6        | O, DIF               | Complementary clock output.   |
| 26         | VDDCLK       | PWR                  | Clock Power supply.   |
| 27         | OEB6         | I, SE, PU, PDT       | Active low input for enabling output 6.<br>0 = Enable output, 1 = Disable output.   |
| 28         | CLK5         | O, DIF               | True clock output.  |
| 29         | CLKb5        | O, DIF               | Complementary clock output.   |
| 30         | OEB5_SBI_CLK | I, SE, PDT, PU or PD | Active low input for enabling output 5 or the clock pin for the SBI shift register. The function of this pin is controlled by the SBI_ENQ pin. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br>OE mode with internal pull-up:<br>0 = Enable output, 1 = Disable output.<br>Side-Band mode with internal pull-down:<br>Clocks data into the SBI on the rising edge. |
| 31         | CLK3         | O, DIF               | True clock output.  |
| 32         | CLKb3        | O, DIF               | Complementary clock output.   |
| 33         | OEB3         | I, SE, PU, PDT       | Active low input for enabling output 3.<br>0 = Enable output, 1 = Disable output.   |
| 34         | OEB2_SBI_OUT | I/O, SE              | Active low input for enabling output 2 or the SBI shift register data output. The function of this pin is controlled by the SBI_ENQ pin. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br><b>Note:</b> This pin is NOT PDT.<br>OE mode:<br>0 = Enable output, 1 = Disable output.<br>Side-Band mode:<br>SBI shift register data output.                             |
| 35         | CLK2         | O, DIF               | True clock output.  |
| 36         | CLKb2        | O, DIF               | Complementary clock output.   |
| 37         | VDDCLK       | PWR                  | Clock power supply.   |
| 38         | CLK1         | O, DIF               | True clock output.  |
| 39         | CLKb1        | O, DIF               | Complementary clock output.   |

Table 6. RC19008 Pin Descriptions (Cont.)

| Pin Number | Pin Name | Type           | Description   |
|------------|----------|----------------|---|
| 40         | OEB1     | I, SE, PU, PDT | Active low input for enabling output 1.<br>0 = Enable output, 1 = Disable output. |
| 41         | EPAD     | GND            | Connect Epad to ground.   |

## 1.8 RC19004 Pin Information

### 1.8.1 RC19004 Pin Assignments

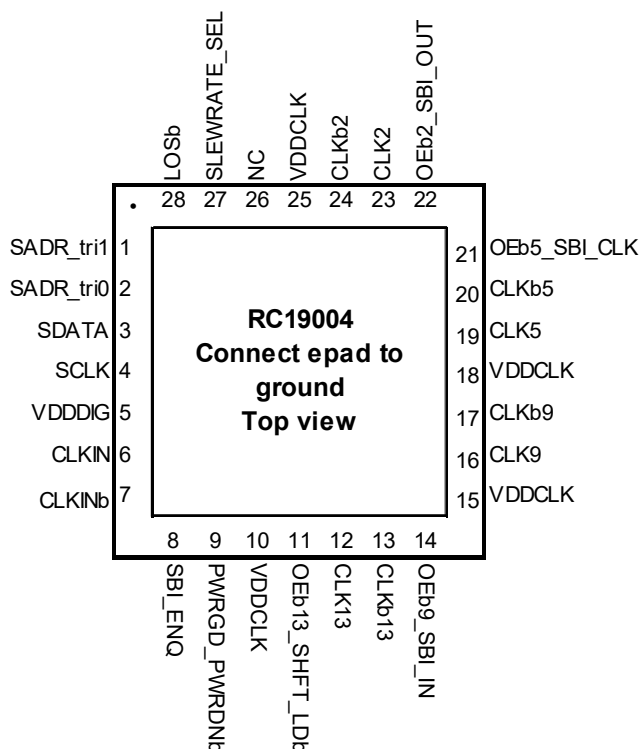


Figure 8. RC19004 28-VFQFPN – Top View

### 1.8.2 RC19004 Pin Descriptions

Table 7. RC19004 Pin Descriptions

| Pin Number | Pin Name  | Type          | Description   |
|------------|-----------|---------------|---|
| 1          | SADR_tri1 | I, SE, PD, PU | SMBus address bit. This is a tri-level input that works in conjunction with other SADR pins, if present, to decode SMBus Addresses. See the <a href="#">SMBus Address Decode</a> table and the tri-level input thresholds in the electrical tables. |
| 2          | SADR_tri0 | I, SE, PD, PU | SMBus address bit. This is a tri-level input that works in conjunction with other SADR pins, if present, to decode SMBus Addresses. See the <a href="#">SMBus Address Decode</a> table and the tri-level input thresholds in the electrical tables. |
| 3          | SDATA     | I/O, SE, OD   | Data pin for SMBus interface.   |
| 4          | SCLK      | I, SE         | Clock pin of SMBus interface.   |
| 5          | VDDDIG    | PWR           | Digital power.  |
| 6          | CLKIN     | I, DIF        | True clock input.   |
| 7          | CLKINb    | I, DIF        | Complementary clock input.  |

Table 7. RC19004 Pin Descriptions (Cont.)

| Pin Number | Pin Name       | Type                 | Description  |
|------------|----------------|----------------------|--|
| 8          | SBI_ENQ        | I, SE, PD, PDT       | Input that selects function of pins that are multiplexed between OE and SBI functionality. SMBus output enable bits and non-multiplexed OE pins remain functional when SBI is enabled. This pin must be strapped to its desired state. It cannot dynamically change.<br>0 = SBI is disabled. Multiplexed pins function as output enables.<br>1 = SBI is enabled. Multiplexed pins function as SBI control pins.  |
| 9          | PWRGD_PWRDNb   | I, SE, PU, PDT       | Input notifies device to sample latched inputs and start up on first high assertion. Low enters Power Down Mode, subsequent high assertions exit Power Down Mode.  |
| 10         | VDDCLK         | PWR                  | Clock power supply.  |
| 11         | OEb13_SHFT_LDb | I, SE, PU or PD      | Active low input for enabling output 13 or SHFT_LDb pin for the Side-Band Interface. The function of this pin is controlled by the SBI_ENQ pin. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br>OE mode with internal pull-down:<br>0 = Enable output, 1 = Disable output.<br>Side-Band mode with internal pull-up:<br>0 = Disable SBI shift register, 1 = Enable SBI shift register.<br>A falling edge transfers SBI shift register contents to SBI output control register. |
| 12         | CLK13          | O, DIF               | True clock output.   |
| 13         | CLKb13         | O, DIF               | Complementary clock output.  |
| 14         | OEb9_SBI_IN    | I, SE, PDT, PU or PD | Active low input for enabling output 9 or the data pin for the Side-Band Interface. The function of this pin is controlled by the SBI_ENQ pin. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br>OE mode with internal pull-down:<br>0 = Enable output, 1 = Disable output.<br>Side-Band mode with internal pull-up:<br>SBI shift register data input pin   |
| 15         | VDDCLK         | PWR                  | Clock power supply.  |
| 16         | CLK9           | O, DIF               | True clock output.   |
| 17         | CLKb9          | O, DIF               | Complementary clock output.  |
| 18         | VDDCLK         | PWR                  | Clock power supply.  |
| 19         | CLK5           | O, DIF               | True clock output.   |
| 20         | CLKb5          | O, DIF               | Complementary clock output.  |
| 21         | OEb5_SBI_CLK   | I, SE, PDT, PU or PD | Active low input for enabling output 5 or the clock pin for the SBI shift register. The function of this pin is controlled by the SBI_ENQ pin. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br>OE mode with internal pull-down:<br>0 = Enable output, 1 = Disable output.<br>Side-Band mode with internal pull-up:<br>Clocks data into the SBI on the rising edge.  |
| 22         | OEb2_SBI_OUT   | I/O, SE              | Active low input for enabling output 2 or the SBI shift register data output. The function of this pin is controlled by the SBI_ENQ pin. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br><b>Note:</b> This pin is NOT PDT.<br>OE mode:<br>0 = Enable output, 1 = Disable output.<br>Side-Band mode:<br>SBI shift register data output.  |

Table 7. RC19004 Pin Descriptions (Cont.)

| Pin Number | Pin Name     | Type           | Description  |
|------------|--------------|----------------|--|
| 23         | CLK2         | O, DIF         | True clock output.   |
| 24         | CLKb2        | O, DIF         | Complementary clock output.  |
| 25         | VDDCLK       | PWR            | Clock power supply.  |
| 26         | NC           | NC             | No connect.  |
| 27         | SLEWRATE_SEL | I, SE, PU, PDT | Input to select default slew rate of the outputs.<br>0 = Slow Slew Rate, 1 = Fast Slew Rate.   |
| 28         | LOSb         | O, OD, PDT     | Output indicating Loss of Input Signal. This pin is an open drain output and requires an external pull up resistor for proper functionality. A low output on this pin indicates a loss of signal on the input clock. |
| 29         | EPAD         | GND            | Connect to ground.   |

## 1.9 RC19002 Pin Information

### 1.9.1 RC19002 Pin Assignments

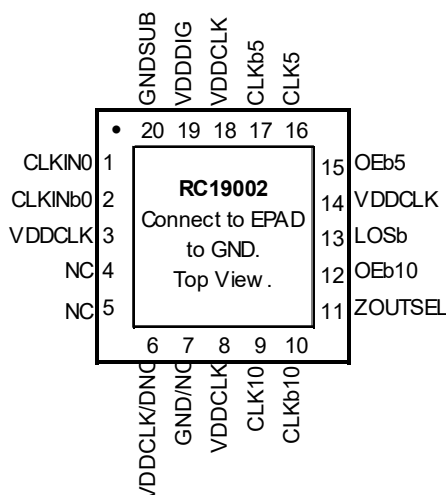


Figure 9. RC19002 20-VFQFPN – Top View

### 1.9.2 RC19002 Pin Descriptions

Table 8. RC19002 Pin Descriptions

| Pin Number | Pin Name   | Type        | Description                     |
|------------|------------|-------------|---------------------------------|
| 1          | CLKIN0     | I, DIF, PDT | True clock input.               |
| 2          | CLKINb0    | I, DIF, PDT | Complementary clock input.      |
| 3          | VDDCLK     | PWR         | Clock power supply.             |
| 4          | NC         | NC          | No connect                      |
| 5          | NC         | NC          | No connect                      |
| 6          | VDDCLK/DNC | PWR/DNC     | Clock power supply or floating. |
| 7          | GND        | GND/NC      | Ground pin or no connect.       |
| 8          | VDDCLK     | PWR         | Clock power supply.             |

Table 8. RC19002 Pin Descriptions (Cont.)

| Pin Number | Pin Name | Type           | Description  |
|------------|----------|----------------|--|
| 9          | CLK10    | O, DIF         | True clock output.   |
| 10         | CLKb10   | O, DIF         | Complementary clock output.  |
| 11         | ZOUTSEL  | I, SE, PD      | Input to select differential output impedance.<br>0 = 85ohm, 1 = 100ohm  |
| 12         | OEb10    | I, SE, PU, PDT | Active low input for enabling output 10.<br>1 = disable output, 0 = enable output.   |
| 13         | LOSb     | O, OD, PDT     | Output indicating Loss of Input Signal. This pin is an open drain output and requires an external pull up resistor for proper functionality. A low output on this pin indicates a loss of signal on the input clock. |
| 14         | VDDCLK   | PWR            | Clock power supply.  |
| 15         | OEb5     | I, SE, PU, PDT | Active low input for enabling output 5.<br>1 = disable output, 0 = enable output.  |
| 16         | CLK5     | O, DIF         | True clock output.   |
| 17         | CLKb5    | O, DIF         | Complementary clock output.  |
| 18         | VDDCLK   | PWR            | Clock power supply.  |
| 19         | VDDDIG   | PWR            | Digital power.   |
| 20         | GNDSUB   | GND            | Ground pin for substrate.  |
| 21         | EPAD     | GND            | Connect to ground.   |

## 2. Specifications

### 2.1 Absolute Maximum Ratings

| Symbol    | Parameter                             | Condition                           | Minimum | Maximum         | Unit |
|-----------|---------------------------------------|-------------------------------------|---------|-----------------|------|
| $V_{DDx}$ | Supply Voltage with respect to Ground | Any VDD pin                         | -0.5    | 3.9             | V    |
| $V_{IN}$  | Input Voltage                         | [1]                                 | -0.5    | 3.9             | V    |
| $V_{IN}$  | Input Voltage                         | [2]                                 | -0.5    | $V_{DDx} + 0.3$ | V    |
| $I_{IN}$  | Input Current                         | All SE inputs and CLKIN [2]         | -       | $\pm 50$        | mA   |
| $I_{OUT}$ | Output Current – Continuous           | CLK                                 | -       | 30              | mA   |
|           |                                       | SDATA, SBI_OUT                      | -       | 25              | mA   |
|           | Output Current – Surge                | CLK                                 | -       | 60              | mA   |
|           |                                       | SDATA, SBI_OUT                      | -       | 50              | mA   |
| $T_J$     | Maximum Junction Temperature          | -                                   | -       | 150             | °C   |
| $T_S$     | Storage Temperature                   | Storage Temperature                 | -65     | 150             | °C   |
| ESD       | Human Body Model                      | JESD22-A114 (JS-001) Classification | -       | 2000            | V    |
|           | Charged Device Model                  | JESD22-C101 Classification          | -       | 500             | V    |

1. Pins designated Power Down Tolerant (PDT) in the pin description tables.
2. Pins not designated Power Down Tolerant (PDT) in the pin description tables.

### 2.2 Recommended Operation Conditions

| Symbol    | Parameter   | Condition  | Minimum | Typical | Maximum | Unit |
|-----------|---|--|---------|---------|---------|------|
| $T_J$     | Maximum Junction Temperature  | -  | -       | -       | 125     | °C   |
| $T_A$     | Ambient Operating Temperature   | -  | -40     | 25      | 105     | °C   |
| $V_{DDx}$ | Supply Voltage with respect to Ground   | Any VDD pin, 3.3V $\pm 10\%$ supply.   | 2.97    | 3.3     | 3.63    | V    |
| $t_{PU}$  | Power-up time for all VDDs to reach minimum specified voltage (power ramps must be monotonic) | Power-up time for all VDDs to reach minimum specified voltage (power ramps must be monotonic). | 0.05    | -       | 5       | ms   |



## 2.3 Thermal Specifications

| Package [1]                                   | Symbol         | Condition                           | Typical Value (°C/W) |
|---|----------------|-------------------------------------|----------------------|
| 8 × 8 mm 100-VFQFPN<br>(5.1 × 5.1 mm ePad)    | $\theta_{Jc}$  | Junction to Case                    | 8.6                  |
|   | $\theta_{Jb}$  | Junction to Board                   | 0.6                  |
|   | $\theta_{JA0}$ | Junction to Ambient, still air      | 21.4                 |
|   | $\theta_{JA1}$ | Junction to Ambient, 1 m/s air flow | 17.9                 |
|   | $\theta_{JA3}$ | Junction to Ambient, 3 m/s air flow | 15.8                 |
|   | $\theta_{JA5}$ | Junction to Ambient, 5 m/s air flow | 15.3                 |
| 6 × 6 mm 80-GQFN<br>(2.8 × 2.8 mm ePad)       | $\theta_{Jc}$  | Junction to Case                    | 44                   |
|   | $\theta_{Jb}$  | Junction to Board                   | 2                    |
|   | $\theta_{JA0}$ | Junction to Ambient, still air      | 33                   |
|   | $\theta_{JA1}$ | Junction to Ambient, 1 m/s air flow | 29                   |
|   | $\theta_{JA3}$ | Junction to Ambient, 3 m/s air flow | 28                   |
|   | $\theta_{JA5}$ | Junction to Ambient, 5 m/s air flow | 27                   |
| 10 × 10 mm 72-VFQFPN<br>(5.95 × 5.95 mm ePad) | $\theta_{Jc}$  | Junction to Case                    | 16.9                 |
|   | $\theta_{Jb}$  | Junction to Board                   | 2.7                  |
|   | $\theta_{JA0}$ | Junction to Ambient, still air      | 26.4                 |
|   | $\theta_{JA1}$ | Junction to Ambient, 1 m/s air flow | 22.7                 |
|   | $\theta_{JA3}$ | Junction to Ambient, 3 m/s air flow | 20.6                 |
|   | $\theta_{JA5}$ | Junction to Ambient, 5 m/s air flow | 19.8                 |
| 9 × 9 mm 64-VFQFPN<br>(5.2 × 5.2 mm ePad)     | $\theta_{Jc}$  | Junction to Case                    | 24.6                 |
|   | $\theta_{Jb}$  | Junction to Board                   | 2.7                  |
|   | $\theta_{JA0}$ | Junction to Ambient, still air      | 26.8                 |
|   | $\theta_{JA1}$ | Junction to Ambient, 1 m/s air flow | 22.9                 |
|   | $\theta_{JA3}$ | Junction to Ambient, 3 m/s air flow | 21.5                 |
|   | $\theta_{JA5}$ | Junction to Ambient, 5 m/s air flow | 20.7                 |
| 7 × 7 mm 56-VFQFPN<br>(5.3 × 5.3 mm ePad)     | $\theta_{Jc}$  | Junction to Case                    | 26.6                 |
|   | $\theta_{Jb}$  | Junction to Base                    | 3.4                  |
|   | $\theta_{JA0}$ | Junction to Ambient, still air      | 26.9                 |
|   | $\theta_{JA1}$ | Junction to Ambient, 1 m/s air flow | 23.4                 |
|   | $\theta_{JA3}$ | Junction to Ambient, 3 m/s air flow | 21.9                 |
|   | $\theta_{JA5}$ | Junction to Ambient, 5 m/s air flow | 21.0                 |
| 5 × 5 mm 40-VFQFPN<br>(3.3 × 3.3 mm ePad)     | $\theta_{Jc}$  | Junction to Case                    | 37.0                 |
|   | $\theta_{Jb}$  | Junction to Base                    | 4.8                  |
|   | $\theta_{JA0}$ | Junction to Ambient, still air      | 33.1                 |
|   | $\theta_{JA1}$ | Junction to Ambient, 1 m/s air flow | 29.6                 |
|   | $\theta_{JA3}$ | Junction to Ambient, 3 m/s air flow | 28.0                 |
|   | $\theta_{JA5}$ | Junction to Ambient, 5 m/s air flow | 27.1                 |

| Package <sup>[1]</sup>                      | Symbol         | Condition                           | Typical Value (°C/W) |
|---|----------------|-------------------------------------|----------------------|
| 4 × 4 mm 28-VFQFPN<br>(2.6 × 2.6 mm ePad)   | $\theta_{Jc}$  | Junction to Case                    | 45.3                 |
|   | $\theta_{Jb}$  | Junction to Board                   | 2.2                  |
|   | $\theta_{JA0}$ | Junction to Ambient, still air      | 36.3                 |
|   | $\theta_{JA1}$ | Junction to Ambient, 1 m/s air flow | 32.7                 |
|   | $\theta_{JA3}$ | Junction to Ambient, 3 m/s air flow | 31.0                 |
|   | $\theta_{JA5}$ | Junction to Ambient, 5 m/s air flow | 30.0                 |
| 3 × 3 mm 20-VFQFPN<br>(1.65 × 1.65 mm Epad) | $\theta_{Jc}$  | Junction to Case                    | 96.3                 |
|   | $\theta_{Jb}$  | Junction to Board                   | 20.4                 |
|   | $\theta_{JA0}$ | Junction to Ambient, still air      | 54.8                 |
|   | $\theta_{JA1}$ | Junction to Ambient, 1 m/s air flow | 51.1                 |
|   | $\theta_{JA3}$ | Junction to Ambient, 3 m/s air flow | 47.7                 |
|   | $\theta_{JA5}$ | Junction to Ambient, 5 m/s air flow | 46.2                 |

1. ePad soldered to board.

## 2.4 Electrical Specifications

### 2.4.1 Phase Jitter

Table 9. PCIe Refclk Phase Jitter - Normal Conditions<sup>[1][2][3][8]</sup>

| Symbol             | Parameter  | Condition                                | Typical | Maximum | Specification Limit   | Unit   |
|--------------------|--|--|---------|---------|-----------------------|--------|
| $t_{jphPCIeG1-CC}$ | Additive PCIe Phase Jitter<br>(Common Clocked Architecture)<br>SSC $\leq -0.5\%$   | PCIe Gen1 (2.5 GT/s)                     | 528     | 623     | 86,000 <sup>[6]</sup> | fs p-p |
| $t_{jphPCIeG2-CC}$ |  | PCIe Gen2 Hi Band (5.0 GT/s)             | 32      | 37      | 3,100 <sup>[6]</sup>  | fs RMS |
| $t_{jphPCIeG3-CC}$ |  | PCIe Gen2 Lo Band (5.0 GT/s)             | 9       | 11      | 3,000 <sup>[6]</sup>  |        |
| $t_{jphPCIeG4-CC}$ |  | PCIe Gen3 (8.0 GT/s)                     | 15      | 18      | 1,000 <sup>[6]</sup>  |        |
| $t_{jphPCIeG5-CC}$ |  | PCIe Gen4 (16.0 GT/s) <sup>[3] [4]</sup> | 15      | 18      | 500 <sup>[6]</sup>    |        |
| $t_{jphPCIeG6-CC}$ |  | PCIe Gen5 (32.0 GT/s) <sup>[3] [5]</sup> | 6       | 7       | 150 <sup>[6]</sup>    |        |
| $t_{jphPCIeG6-CC}$ |  | PCIe Gen6 (64.0 GT/s) <sup>[3] [5]</sup> | 3.5     | 4.1     | 100 <sup>[6]</sup>    |        |
| $t_{jphPCIeG2-IR}$ | Additive PCIe Phase Jitter<br>(IR Architectures - SRIS, SRNS)<br>SSC $\leq -0.3\%$ | PCIe Gen2 (5.0 GT/s)                     | 41      | 48      | [7]                   | fs RMS |
| $t_{jphPCIeG3-IR}$ |  | PCIe Gen3 (8.0 GT/s)                     | 11      | 13      |                       |        |
| $t_{jphPCIeG4-IR}$ |  | PCIe Gen4 (16.0 GT/s) <sup>[3] [4]</sup> | 11      | 13      |                       |        |
| $t_{jphPCIeG5-IR}$ |  | PCIe Gen5 (32.0 GT/s) <sup>[3] [5]</sup> | 10      | 11      |                       |        |
| $t_{jphPCIeG6-IR}$ |  | PCIe Gen6 (64.0 GT/s) <sup>[3] [5]</sup> | 12      | 14      |                       |        |

1. The Refclk jitter is measured after applying the filter functions found in the *PCI Express Base Specification 6.0, Revision 1.0*. For the exact measurement setup, see [Test Loads](#). The worst case results for each data rate are summarized in this table. Equipment noise is removed from all measurements.
2. Jitter measurements should be made with a capture of at least 100,000 clock cycles captured by a real-time oscilloscope (RTO) with a sample rate of 20GS/s or greater. Broadband oscilloscope noise must be minimized in the measurement. The measured PP jitter is used (no extrapolation) for RTO measurements. Alternately, jitter measurements can be used with a Phase Noise Analyzer (PNA) extending (flat) and integrating and folding the frequency content up to an offset from the carrier frequency of at least 200MHz (at 300MHz absolute frequency) below the Nyquist frequency. For PNA measurements for the 2.5GT/s data rate, the RMS jitter is converted to peak-to-peak jitter using a multiplication factor of 8.83.
3. SSC spurs from the fundamental and harmonics are removed up to a cutoff frequency of 2MHz taking care to minimize removal of any non-SSC content.
4. Note that 0.7ps RMS is to be used in channel simulations to account for additional noise in a real system.
5. Note that 0.25ps RMS is to be used in channel simulations to account for additional noise in a real system.
6. The rms sum of the source jitter and the additive jitter (arithmetic sum for PCIe Gen1) must be less than the jitter specification listed.
7. The *PCI Express Base Specification 6.0, Revision 1.0* provides the filters necessary to calculate SRIS jitter values; it does not provide specification limits, therefore, the reference to this footnote in the Limit column. SRIS values are informative only. A common practice is to split the common clock budget in half. For 16GT/s data rates and above, the user must choose whether to use the output jitter specification, or the input jitter specification, which includes an allocation for the jitter added by the channel. Using 32GT/s, the Refclk jitter budget is 150fs RMS. One half of the Refclk jitter budget is 106fs RMS. At the clock input, the system must deliver 250fs RMS. One half of this value is 177fs RMS. If the clock is placed next to the PCIe device in an SRIS system, the channel is very short and the user can choose to use this more relaxed value as the jitter limit.
8. Differential input swing  $\geq 1600\text{mV}$  and input slew rate  $\geq 3.5\text{V/ns}$

Table 10. PCIe Refclk Phase Jitter - Degraded Conditions<sup>[1][2][3][8]</sup>

| Symbol             | Parameter  | Condition                               | Typical | Maximum | Specification Limit   | Unit   |
|--------------------|--|---|---------|---------|-----------------------|--------|
| $t_{jphPCIeG1-CC}$ | Additive PCIe Phase Jitter<br>(Common Clocked Architecture)<br>SSC $\leq -0.5\%$   | PCIe Gen1 (2.5 GT/s)                    | 692     | 839     | 86,000 <sup>[6]</sup> | fs p-p |
| $t_{jphPCIeG2-CC}$ |  | PCIe Gen2 Hi Band (5.0 GT/s)            | 41      | 49      | 3,100 <sup>[6]</sup>  | fs RMS |
|                    |  | PCIe Gen2 Lo Band (5.0 GT/s)            | 11      | 14      | 3,000 <sup>[6]</sup>  |        |
| $t_{jphPCIeG3-CC}$ |  | PCIe Gen3 (8.0 GT/s)                    | 20      | 24      | 1,000 <sup>[6]</sup>  |        |
| $t_{jphPCIeG4-CC}$ |  | PCIe Gen4 (16.0 GT/s) <sup>[3][4]</sup> | 20      | 24      | 500 <sup>[6]</sup>    |        |
| $t_{jphPCIeG5-CC}$ |  | PCIe Gen5 (32.0 GT/s) <sup>[3][5]</sup> | 8       | 9.3     | 150 <sup>[6]</sup>    |        |
| $t_{jphPCIeG6-CC}$ |  | PCIe Gen6 (64.0 GT/s) <sup>[3][5]</sup> | 5       | 6       | 100 <sup>[6]</sup>    |        |
| $t_{jphPCIeG2-IR}$ | Additive PCIe Phase Jitter<br>(IR Architectures - SRIS, SRNS)<br>SSC $\leq -0.3\%$ | PCIe Gen2 (5.0 GT/s)                    | 52      | 63      | <sup>[7]</sup>        | fs RMS |
| $t_{jphPCIeG3-IR}$ |  | PCIe Gen3 (8.0 GT/s)                    | 14      | 17      |                       |        |
| $t_{jphPCIeG4-IR}$ |  | PCIe Gen4 (16.0 GT/s) <sup>[3][4]</sup> | 14      | 17      |                       |        |
| $t_{jphPCIeG5-IR}$ |  | PCIe Gen5 (32.0 GT/s) <sup>[3][5]</sup> | 12      | 15      |                       |        |
| $t_{jphPCIeG6-IR}$ |  | PCIe Gen6 (64.0 GT/s) <sup>[3][5]</sup> | 15      | 19      |                       |        |

1. The Refclk jitter is measured after applying the filter functions found in the *PCI Express Base Specification 6.0, Revision 1.0*. For the exact measurement setup, see [Test Loads](#). The worst case results for each data rate are summarized in this table. Equipment noise is removed from all measurements.
2. Jitter measurements should be made with a capture of at least 100,000 clock cycles captured by a real-time oscilloscope (RTO) with a sample rate of 20GS/s or greater. Broadband oscilloscope noise must be minimized in the measurement. The measured PP jitter is used (no extrapolation) for RTO measurements. Alternately, jitter measurements may be used with a Phase Noise Analyzer (PNA) extending (flat) and integrating and folding the frequency content up to an offset from the carrier frequency of at least 200MHz (at 300MHz absolute frequency) below the Nyquist frequency. For PNA measurements for the 2.5GT/s data rate, the RMS jitter is converted to peak-to-peak jitter using a multiplication factor of 8.83.
3. SSC spurs from the fundamental and harmonics are removed up to a cutoff frequency of 2MHz taking care to minimize removal of any non-SSC content.
4. Note that 0.7ps RMS is to be used in channel simulations to account for additional noise in a real system.
5. Note that 0.25ps RMS is to be used in channel simulations to account for additional noise in a real system.
6. The rms sum of the source jitter and the additive jitter (arithmetic sum for PCIe Gen1) must be less than the jitter specification listed.
7. The *PCI Express Base Specification 6.0, Revision 1.0* provides the filters necessary to calculate SRIS jitter values; it does not provide specification limits, therefore, the reference to this footnote in the Limit column. SRIS values are informative only. A common practice is to split the common clock budget in half. For 16GT/s data rates and above, the user must choose whether to use the output jitter specification, or the input jitter specification, which includes an allocation for the jitter added by the channel. Using 32GT/s, the Refclk jitter budget is 150fs RMS. One half of the Refclk jitter budget is 106fs RMS. At the clock input, the system must deliver 250fs RMS. One half of this value is 177fs RMS. If the clock is placed next to the PCIe device in an SRIS system, the channel is very short and the user may choose to use this more relaxed value as the jitter limit.
8. Differential input swing = 800mV and input slew rate = 1.5V/ns

Table 11. Non-PCIe Refclk Phase Jitter [1][2][3]

| Symbol           | Parameter  | Condition                                    | Typical | Maximum | Specification Limit | Unit   |
|------------------|--|--|---------|---------|---------------------|--------|
| $t_{jphDB2000Q}$ | Additive Phase Jitter - normal conditions <sup>[4]</sup>   | 100MHz, Intel-supplied filter <sup>[3]</sup> | 10      | 12      | 80 <sup>[5]</sup>   | fs RMS |
| $t_{jph12k-20M}$ |  | 156.25MHz (12kHz to 20MHz)                   | 30      | 36      | N/A                 |        |
| $t_{jphDB2000Q}$ | Additive Phase Jitter - degraded conditions <sup>[6]</sup> | 100MHz, Intel-supplied filter <sup>[3]</sup> | 13      | 16      | 80 <sup>[5]</sup>   |        |
| $t_{jph12k-20M}$ |  | 156.25MHz (12kHz to 20MHz)                   | 39      | 48      | N/A                 |        |

1. See [Test Loads](#) for test configuration.
2. SMA100B used as signal source.
3. The RC19xxx devices meet all legacy QPI/UPI specifications by meeting the PCIe and DB2000Q specifications listed in this document.
4. Differential input swing = 1,600mV and input slew rate = 3.5V/ns.
5. The rms sum of the source jitter and the additive jitter (arithmetic sum for PCIe Gen1) must be less than the jitter specification listed.
6. Differential input swing = 800mV and input slew rate = 1.5V/ns.

## 2.4.2 Output Frequencies, Startup Time, and LOS Timing

Table 12. Output Frequencies, Startup Time, and LOS Timing

| Symbol            | Parameter           | Condition   | Minimum | Typical | Maximum | Unit |
|-------------------|---------------------|---|---------|---------|---------|------|
| $f_{OP}$          | Operating Frequency | Automatic Clock Parking (ACP) Circuit disabled                                  | 1       | -       | 400     | MHz  |
|                   |                     | Automatic Clock Parking (ACP) Circuit enabled                                   | 25      | -       | 400     |      |
| $t_{STARTUP}$     | Start-up Time       | <sup>[1]</sup>  | -       | 1.2     | 3       | ms   |
| $t_{STARTUP}$     | Start-up Time       | <sup>[2]</sup>  | -       | 0.3     | 1       | ms   |
| $t_{LATOEB}$      | OEB latency         | OEB assertion/de-assertion CLK start/stop latency. Input clock must be running. | 4       | 5       | 10      | clks |
| $t_{LOSAssert}$   | LOS Assert Time     | Time from disappearance of input clock to LOS assert. <sup>[3][4]</sup>         | -       | 123     | 200     | ns   |
| $t_{LOSDeassert}$ | LOS De-assert Time  | Time from appearance of input clock to LOS de-assert. <sup>[3][5]</sup>         | -       | 6       | 9       | clks |

1. Measured from when all power supplies have reached > 90% of nominal voltage to the first stable clock edge on the output. PWRGD\_PWRDNb tied to VDD in this case.
2. VDD stable, measured from de-assertion of PWRGD\_PWRDNb.
3. The clock detect circuit does not qualify the accuracy of the input clock. The first input clock must appear to release the power on reset and enable the LOS circuit at power up.
4. PWRGD\_PWRDNb high. The Automatic Clock Parking (ACP) circuit - if enabled - will park the outputs in a low/low state within this time. See Byte4, bit 4 LOSb\_ACP\_ENABLE.
5. PWRGD\_PWRDNb high. The device will drive the outputs to a high/low state within this time and then begin clocking the outputs.

### 2.4.3 RC1902xA CLK AC/DC Output Characteristics

The tables in this section apply to the RC19024, RC19020 and RC19020A072.

**Table 13. RC1902xA 85-ohm CLK AC/DC Characteristics - Source-Terminated 100MHz PCIe [1]**

| Symbol             | Parameter   | Conditions   | Minimum | Typical | Maximum | Specification Limit [2] | Unit |
|--------------------|---|--|---------|---------|---------|-------------------------|------|
| $V_{MAX}$          | Absolute Max Voltage<br>Includes 300mV of Overshoot (Vovs) [3][4]   | Across all settings in this table at 100MHz.                 | -       | -       | 1092    | 1150                    | mV   |
| $V_{MIN}$          | Absolute Min Voltage<br>Includes -300mV of Undershoot (Vuds) [3][5] |  | -166    | -       | -       | -300                    |      |
| $V_{HIGH}$         | Voltage High [3]  | $V_{HIGH}$ set to 800mV.                                     | 678     | 819     | 994     | -                       |      |
| $V_{LOW}$          | Voltage Low [3]   |  | -88     | 29      | 146     | -                       |      |
| $V_{CROSS}$        | Crossing Voltage (abs) [3][6][7]                                    | $V_{HIGH}$ set to 800mV, scope averaging off.                | 278     | 403     | 543     | 250 to 550              |      |
| $\Delta V_{CROSS}$ | Crossing Voltage (var) [3][6][8]                                    |  | -       | 1       | 97      | 140                     |      |
| dv/dt              | Slew Rate [9][10]   | $V_{HIGH}$ set to 800mV, Fast slew rate, scope averaging on. | 2.0     | 2.8     | 4.0     | 2 to 5                  | V/ns |
|                    |   | $V_{HIGH}$ set to 800mV, Slow slew rate, scope averaging on. | 1.6     | 2.2     | 3.3     | 1.5 to 3.5              |      |
| $\Delta T_{R/F}$   | Rise/Fall Matching [3][11]  | $V_{HIGH}$ set to 800mV. Fast slew rate.                     | -       | 4       | 19      | 20                      | %    |
|                    |   | $V_{HIGH}$ set to 800mV. Slow slew rate.                     | -       | 6       | 24      | N/A                     |      |
| $V_{HIGH}$         | Voltage High [3]  | $V_{HIGH}$ set to 900mV.                                     | 719     | 903     | 1090    | -                       | mV   |
| $V_{LOW}$          | Voltage Low [3]   |  | -115    | 37      | 163     | -                       |      |
| $V_{CROSS}$        | Crossing Voltage (abs) [3][6][7]                                    | $V_{HIGH}$ set to 900mV, scope averaging off.                | 289     | 445     | 582     | 250 to 600              |      |
| $\Delta V_{CROSS}$ | Crossing Voltage (var) [3][6][8]                                    |  | -       | 1       | 105     | 140                     |      |
| dv/dt              | Slew Rate [9][10]   | $V_{HIGH}$ set to 900mV, Fast slew rate, scope averaging on. | 2.1     | 2.9     | 4.3     | 2 to 5                  | V/ns |
|                    |   | $V_{HIGH}$ set to 900mV, Slow slew rate, scope averaging on. | 1.7     | 2.3     | 3.5     | 1.5 to 3.5              |      |
| $\Delta T_{R/F}$   | Rise/Fall Matching [3][11]  | $V_{HIGH}$ set to 900mV. Fast slew rate.                     | -       | 5       | 18      | 20                      | %    |
|                    |   | $V_{HIGH}$ set to 900mV. Slow slew rate.                     | -       | 6       | 26      | N/A                     |      |
| $t_{DC}$           | Output Duty Cycle [9]   | $V_T = 0V$ differential. 50% duty cycle input.               | 49      | 49.9    | 51      | 45 to 55                | %    |

1. Standard high impedance load with  $C_L = 2pF$ . See [Test Loads](#).

2. The specification limits are taken from either the *PCIe Base Specification Revision 6.0* or from relevant x86 processor specifications, whichever is more stringent.

3. Measured from single-ended waveform.

4. Defined as the maximum instantaneous voltage including overshoot.

5. Defined as the minimum instantaneous voltage including undershoot.

6. Measured at crossing point where the instantaneous voltage value of the rising edge of REFCLK+ equals the falling edge of REFCLK-.
7. Refers to the total variation from the lowest crossing point to the highest, regardless of which edge is crossing. Refers to all crossing points for this measurement.
8. Defined as the total variation of all crossing voltages of Rising REFCLK+ and Falling REFCLK-. This is the maximum allowed variance in VCROSS for any particular system.
9. Measured from differential waveform.
10. Measured from -150 mV to +150 mV on the differential waveform (derived from REFCLK+ minus REFCLK-). The signal must be monotonic through the measurement region for rise and fall time. The 300 mV measurement window is centered on the differential zero crossing.
11. Matching applies to rising edge rate for REFCLK+ and falling edge rate for REFCLK-. It is measured using a  $\pm 75$  mV window centered on the median cross point where REFCLK+ rising meets REFCLK- falling. The median cross point is used to calculate the voltage thresholds the oscilloscope is to use for the edge rate calculations. The Rise Edge Rate of REFCLK+ should be compared to the Fall Edge Rate of REFCLK-; the maximum allowed difference should not exceed 20% of the slowest edge rate.

**Table 14. RC1902xA 85Ω CLK AC/DC Characteristics - Non-PCIe, Source-Terminated Loads <sup>[1]</sup>**

| Symbol              | Parameter  | Conditions   | Minimum | Typical | Maximum | Unit |
|---------------------|--|--|---------|---------|---------|------|
| V <sub>OH</sub>     | Output High Voltage <sup>[2]</sup>                               | V <sub>HIGH</sub> = 800mV, Fast Slew Rate, 25MHz, 156.25MHz, 312.5MHz. | 651     | 820     | 1003    | mV   |
| V <sub>OL</sub>     | Output Low Voltage <sup>[2]</sup>                                |  | -142    | 18      | 169     |      |
| V <sub>CROSS</sub>  | Crossing Voltage (abs) <sup>[3]</sup>                            |  | 234     | 400     | 577     |      |
| ΔV <sub>CROSS</sub> | Crossing Voltage (var) <sup>[3][4][5]</sup>                      |  | -       | 56      | 148     |      |
| t <sub>R</sub>      | Rise Time <sup>[2]</sup><br>V <sub>T</sub> = 20% to 80% of swing | V <sub>HIGH</sub> = 800mV, Fast Slew Rate, 25MHz, 156.25MHz, 312.5MHz. | 142     | 442     | 753     | ps   |
| t <sub>F</sub>      | Fall Time <sup>[2]</sup><br>V <sub>T</sub> = 20% to 80% of swing |  | 173     | 435     | 756     | ps   |
| V <sub>OH</sub>     | Output High Voltage <sup>[2]</sup>                               | V <sub>HIGH</sub> = 900mV, Fast Slew Rate, 25MHz, 156.25MHz, 312.5MHz. | 720     | 916     | 1130    | mV   |
| V <sub>OL</sub>     | Output Low Voltage <sup>[2]</sup>                                |  | -164    | 25      | 190     |      |
| V <sub>CROSS</sub>  | Crossing Voltage (abs) <sup>[3]</sup>                            |  | 266     | 440     | 636     |      |
| ΔV <sub>CROSS</sub> | Crossing Voltage (var) <sup>[3][4][5]</sup>                      |  | -       | 35      | 162     |      |
| t <sub>R</sub>      | Rise Time <sup>[2]</sup><br>V <sub>T</sub> = 20% to 80% of swing |  | 164     | 502     | 861     | ps   |
| t <sub>F</sub>      | Fall Time <sup>[2]</sup><br>V <sub>T</sub> = 20% to 80% of swing |  | 160     | 432     | 757     | ps   |
| t <sub>DC</sub>     | Output Duty Cycle <sup>[6]</sup>                                 | Across all settings in this table, V <sub>T</sub> = 0V.                | 47      | 49.7    | 52      | %    |

1. Standard high impedance load with C<sub>L</sub> = 2pF. See [Test Loads](#).
2. Measured from single-ended waveform.
3. Measured at crossing point where the instantaneous voltage value of the rising edge of CLK equals the falling edge of CLKb.
4. Refers to the total variation from the lowest crossing point to the highest, regardless of which edge is crossing. Refers to all crossing points for this measurement.
5. Defined as the total variation of all crossing voltages of Rising CLK and Falling CLKb. This is the maximum allowed variance in VCROSS for any particular system.
6. Measured from differential waveform.

Table 15. RC1902xA 85Ω CLK AC/DC Characteristics - Non-PCIe, Double-Terminated Loads [1]

| Symbol              | Parameter   | Conditions  | Minimum | Typical | Maximum | Unit |
|---------------------|---|---|---------|---------|---------|------|
| V <sub>OH</sub>     | Output High Voltage [2]                               | V <sub>HIGH</sub> = 800mV, Fast Slew Rate, 25MHz, 156.25MHz, 312.5MHz (amplitude is reduced by ~50% due to double termination).         | 372     | 430     | 473     | mV   |
| V <sub>OL</sub>     | Output Low Voltage [2]                                |   | -32     | 11      | 57      |      |
| V <sub>CROSS</sub>  | Crossing Voltage (abs) [3]                            |   | 156     | 205     | 243     |      |
| ΔV <sub>CROSS</sub> | Crossing Voltage (var) [3][4][5]                      |   | -       | 8       | 38      |      |
| t <sub>R</sub>      | Rise Time [2]<br>V <sub>T</sub> = 20% to 80% of swing |   | 211     | 400     | 561     | ps   |
| t <sub>F</sub>      | Fall Time [2]<br>V <sub>T</sub> = 20% to 80% of swing |   | 130     | 263     | 381     | ps   |
| V <sub>OH</sub>     | Output High Voltage [2]                               | V <sub>HIGH</sub> = 900mV, Fast Slew Rate, 25MHz, 100MHz, 156.25MHz, 312.5MHz (amplitude is reduced by ~50% due to double termination). | 389     | 479     | 549     | mV   |
| V <sub>OL</sub>     | Output Low Voltage [2]                                |   | -31     | 12      | 55      |      |
| V <sub>CROSS</sub>  | Crossing Voltage (abs) [3]                            |   | 173     | 222     | 265     |      |
| ΔV <sub>CROSS</sub> | Crossing Voltage (var) [3][4][5]                      |   | -       | 8       | 41      |      |
| t <sub>R</sub>      | Rise Time [2]<br>V <sub>T</sub> = 20% to 80% of swing |   | 220     | 477     | 635     | ps   |
| t <sub>F</sub>      | Fall Time [2]<br>V <sub>T</sub> = 20% to 80% of swing |   | 152     | 268     | 356     | ps   |
| t <sub>DC</sub>     | Output Duty Cycle [6]                                 | Across all settings in this table, V <sub>T</sub> = 0V.   | 49      | 49.8    | 51      | %    |

- Both Tx and Rx are terminated (double-terminated) with C<sub>L</sub> = 2pF. This reduces amplitude by 50%. See [Test Loads](#).
- Measured from single-ended waveform.
- Measured at crossing point where the instantaneous voltage value of the rising edge of CLK equals the falling edge of CLKb.
- Refers to the total variation from the lowest crossing point to the highest, regardless of which edge is crossing. Refers to all crossing points for this measurement.
- Defined as the total variation of all crossing voltages of Rising CLK and Falling CLKb. This is the maximum allowed variance in VCROSS for any particular system.
- Measured from differential waveform.



## 2.4.4 RC1901xA/RC1900xA CLK AC/DC Output Characteristics

The tables in the section apply to the RC19016/A100, RC19013/A100, RC19008/A100, RC19004/A100 and RC19002.

**Table 16. RC1901xA/RC1900xA 85Ω CLK AC/DC Characteristics - Source-Terminated 100MHz PCIe Applications [1]**

| Symbol             | Parameter   | Condition  | Minimum | Typical | Maximum | Specification Limit [2] | Unit |
|--------------------|---|--|---------|---------|---------|-------------------------|------|
| $V_{MAX}$          | Absolute Max Voltage<br>Includes 300mV of Overshoot (Vovs) [3][4]   | Across all settings in this table at 100MHz.                 | -       | 871     | 1040    | 1150                    | mV   |
| $V_{MIN}$          | Absolute Min Voltage<br>Includes -300mV of Undershoot (Vuds) [3][5] |  | -93     | 2       | 47      | -300                    |      |
| $V_{HIGH}$         | Voltage High [3]  | $V_{HIGH}$ set to 800mV.                                     | 713     | 795     | 993     | -                       | mV   |
| $V_{LOW}$          | Voltage Low [3]   |  | -43     | 31      | 108     | -                       |      |
| $V_{CROSS}$        | Crossing Voltage (abs) [3]<br>[6][7]                                | $V_{HIGH}$ set to 800mV, scope averaging off.                | 286     | 406     | 519     | 250 to 550              | mV   |
| $\Delta V_{CROSS}$ | Crossing Voltage (var) [3]<br>[6][8]                                |  | -       | 31      | 136     | 140                     |      |
| dv/dt              | Slew Rate [9][10]   | $V_{HIGH}$ set to 800mV, Fast slew rate, scope averaging on. | 2.1     | 3.2     | 4.6     | 2 to 5                  | V/ns |
|                    |   | $V_{HIGH}$ set to 800mV, Slow slew rate, scope averaging on. | 1.6     | 2.3     | 3.2     | 1.5 to 3.5              |      |
| $\Delta T_{R/F}$   | Rise/Fall Matching [3][11]  | $V_{HIGH}$ set to 800mV. Fast slew rate.                     | -       | 5%      | 15%     | 20                      | %    |
| $\Delta T_{R/F}$   | Rise/Fall Matching [3][11]  | $V_{HIGH}$ set to 800mV. Slow slew rate.                     | -       | 7%      | 15%     | 20                      | %    |
| $V_{HIGH}$         | Voltage High [3]  | $V_{HIGH}$ set to 900mV.                                     | 793     | 883     | 1032    | -                       | mV   |
| $V_{LOW}$          | Voltage Low [3]   |  | -56     | 32      | 112     | -                       |      |
| $V_{CROSS}$        | Crossing Voltage (abs) [3]<br>[6][7]                                | $V_{HIGH}$ set to 900mV, scope averaging off.                | 312     | 441     | 567     | 300 to 600              | mV   |
| $\Delta V_{CROSS}$ | Crossing Voltage (var) [3]<br>[6][8]                                |  | -       | 33      | 140     | 140                     |      |
| dv/dt              | Slew Rate [9][10]   | $V_{HIGH}$ set to 900mV, Fast slew rate, scope averaging on. | 2.1     | 3.4     | 4.9     | 2 to 5                  | V/ns |
|                    |   | $V_{HIGH}$ set to 900mV, Slow slew rate, scope averaging on. | 1.6     | 2.4     | 3.3     | 1.5 to 3.5              |      |
| $\Delta T_{R/F}$   | Rise/Fall Matching [3][11]  | $V_{HIGH}$ set to 900mV. Fast slew rate.                     | -       | 5%      | 18%     | 20                      | %    |
| $\Delta T_{R/F}$   | Rise/Fall Matching [3][11]  | $V_{HIGH}$ set to 900mV. Slow slew rate.                     | -       | 7%      | 17%     | 20                      | %    |
| $t_{DC}$           | Output Duty Cycle [9]   | $V_T = 0V$ differential.                                     | 48.9    | 49.8    | 50.7    | 45 to 55                | %    |

1. Standard high impedance load with  $C_L = 2pF$ . For more information, see [Test Loads](#).

2. The specification limits are taken from either the *PCIe Base Specification Revision 6.0* or from relevant x86 processor specifications, whichever is more stringent.

3. Measured from single-ended waveform.

4. Defined as the maximum instantaneous voltage including overshoot.

5. Defined as the minimum instantaneous voltage including undershoot.
6. Measured at crossing point where the instantaneous voltage value of the rising edge of REFCLK+ equals the falling edge of REFCLK-.
7. Refers to the total variation from the lowest crossing point to the highest, regardless of which edge is crossing. Refers to all crossing points for this measurement.
8. Defined as the total variation of all crossing voltages of Rising REFCLK+ and Falling REFCLK-. This is the maximum allowed variance in VCROSS for any particular system.
9. Measured from differential waveform.
10. Measured from -150mV to +150mV on the differential waveform (derived from REFCLK+ minus REFCLK-). The signal must be monotonic through the measurement region for rise and fall time. The 300mV measurement window is centered on the differential zero crossing.
11. Matching applies to rising edge rate for REFCLK+ and falling edge rate for REFCLK-. It is measured using a  $\pm 75\text{mV}$  window centered on the median cross point where REFCLK+ rising meets REFCLK- falling. The median cross point is used to calculate the voltage thresholds the oscilloscope is to use for the edge rate calculations. The Rise Edge Rate of REFCLK+ should be compared to the Fall Edge Rate of REFCLK-; the maximum allowed difference should not exceed 20% of the slowest edge rate.

**Table 17. RC1901xA\RC1900xA 100 $\Omega$  CLK AC/DC Characteristics - Source-Terminated 100MHz PCIe Apps [1]**

| Symbol                    | Parameter   | Condition   | Minimum | Typical | Maximum | Specification Limit [2] | Unit |
|---------------------------|---|---|---------|---------|---------|-------------------------|------|
| $V_{\text{MAX}}$          | Absolute Max Voltage<br>Includes 300mV of Overshoot (Vovs) [3][4]   | Across all settings in this table at 100MHz.                        | 844     | 930     | 1062    | 1150                    | mV   |
| $V_{\text{MIN}}$          | Absolute Min Voltage<br>Includes -300mV of Undershoot (Vuds) [3][5] |   | -139    | 7       | 65      | -300                    |      |
| $V_{\text{HIGH}}$         | Voltage High [3]  | $V_{\text{HIGH}}$ set to 800mV.                                     | 713     | 816     | 918     | -                       | mV   |
| $V_{\text{LOW}}$          | Voltage Low [3]   |   | -47     | 22      | 103     | -                       |      |
| $V_{\text{CROSS}}$        | Crossing Voltage (abs) [3]<br>[6][7]                                | $V_{\text{HIGH}}$ set to 800mV, scope averaging off.                | 296     | 420     | 498     | 250 to 550              |      |
| $\Delta V_{\text{CROSS}}$ | Crossing Voltage (var) [3]<br>[6][8]                                |   | -28     | 39      | 106     | 140                     |      |
| dv/dt                     | Slew Rate [9][10]   | $V_{\text{HIGH}}$ set to 800mV, Fast slew rate, scope averaging on. | 2.1     | 2.9     | 3.7     | 2 to 4                  | V/ns |
|                           |   | $V_{\text{HIGH}}$ set to 800mV, Slow slew rate, scope averaging on. | 1.6     | 2.4     | 3.2     | 1.5 to 3.5              |      |
| $\Delta T_{\text{R/F}}$   | Rise/Fall Matching [3][11]  | $V_{\text{HIGH}}$ set to 800mV. Fast slew rate.                     | -       | 3.6     | 18      | 20                      | %    |
| $\Delta T_{\text{R/F}}$   | Rise/Fall Matching [3][11]  | $V_{\text{HIGH}}$ set to 800mV. Slow slew rate.                     | -       | 3.5     | 15.5    | 20                      | %    |
| $V_{\text{HIGH}}$         | Voltage High [3]  | $V_{\text{HIGH}}$ set to 900mV.                                     | 802     | 907     | 1012    | -                       | mV   |
| $V_{\text{LOW}}$          | Voltage Low [3]   |   | -52     | 21      | 112     | -                       |      |
| $V_{\text{CROSS}}$        | Crossing Voltage (abs) [3]<br>[6][7]                                | $V_{\text{HIGH}}$ set to 900mV, scope averaging off.                | 326     | 454     | 535     | 300 to 600              |      |
| $\Delta V_{\text{CROSS}}$ | Crossing Voltage (var) [3]<br>[6][8]                                |   | -31     | 40      | 111     | 140                     |      |
| dv/dt                     | Slew Rate [9][10]   | $V_{\text{HIGH}}$ set to 900mV, Fast slew rate, scope averaging on. | 2.1     | 3.0     | 4.0     | 2 to 4                  | V/ns |
|                           |   | $V_{\text{HIGH}}$ set to 900mV, Slow slew rate, scope averaging on. | 1.7     | 2.6     | 3.4     | 1.5 to 3.5              |      |
| $\Delta T_{\text{R/F}}$   | Rise/Fall Matching [3][11]  | $V_{\text{HIGH}}$ set to 900mV. Fast slew rate.                     | -       | 4.8     | 19.7    | 20                      | %    |

Table 17. RC1901xA\RC1900xA 100Ω CLK AC/DC Characteristics - Source-Terminated 100MHz PCIe Apps <sup>[1]</sup> (Cont.)

| Symbol           | Parameter                             | Condition                                | Minimum | Typical | Maximum | Specification Limit <sup>[2]</sup> | Unit |
|------------------|---------------------------------------|--|---------|---------|---------|------------------------------------|------|
| $\Delta T_{R/F}$ | Rise/Fall Matching <sup>[3][11]</sup> | $V_{HIGH}$ set to 900mV. Slow slew rate. | -       | 4.9     | 19.4    | 20                                 | %    |
| $t_{DC}$         | Output Duty Cycle <sup>[9]</sup>      | $V_T = 0V$ differential.                 | 49.6    | 49.9    | 50.2    | 45 to 55                           | %    |

1. Standard high impedance load with  $C_L = 2pF$ . For more information, see [Test Loads](#).
2. The specification limits are taken from either the *PCIe Base Specification Revision 6.0* or from relevant x86 processor specifications, whichever is more stringent.
3. Measured from single-ended waveform.
4. Defined as the maximum instantaneous voltage including overshoot.
5. Defined as the minimum instantaneous voltage including undershoot.
6. Measured at crossing point where the instantaneous voltage value of the rising edge of REFCLK+ equals the falling edge of REFCLK-.
7. Refers to the total variation from the lowest crossing point to the highest, regardless of which edge is crossing. Refers to all crossing points for this measurement.
8. Defined as the total variation of all crossing voltages of Rising REFCLK+ and Falling REFCLK-. This is the maximum allowed variance in VCROSS for any particular system.
9. Measured from differential waveform.
10. Measured from -150mV to +150mV on the differential waveform (derived from REFCLK+ minus REFCLK-). The signal must be monotonic through the measurement region for rise and fall time. The 300mV measurement window is centered on the differential zero crossing.
11. Matching applies to rising edge rate for REFCLK+ and falling edge rate for REFCLK-. It is measured using a  $\pm 75mV$  window centered on the median cross point where REFCLK+ rising meets REFCLK- falling. The median cross point is used to calculate the voltage thresholds the oscilloscope is to use for the edge rate calculations. The Rise Edge Rate of REFCLK+ should be compared to the Fall Edge Rate of REFCLK-; the maximum allowed difference should not exceed 20% of the slowest edge rate.

Table 18. RC1901xA/RC1900xA 85Ω CLK AC/DC Characteristics - Non-PCIe Apps, Source-Terminated Loads [1]

| Symbol              | Parameter   | Condition   | Minimum | Typical | Maximum | Unit |
|---------------------|---|---|---------|---------|---------|------|
| V <sub>OH</sub>     | Output High Voltage [2]                               | V <sub>HIGH</sub> = 800mV, Fast Slew Rate,<br>156.25MHz, 312.5MHz.<br>(Slow slew rate is not recommended for<br>frequencies > 100MHz) | 695     | 811     | 950     | mV   |
| V <sub>OL</sub>     | Output Low Voltage [2]                                |   | -71     | 30      | 115     |      |
| V <sub>CROSS</sub>  | Crossing Voltage (abs) [3]                            |   | 283     | 431     | 582     |      |
| ΔV <sub>CROSS</sub> | Crossing Voltage (var) [3][4][5]                      |   | 0       | 35      | 168     |      |
| t <sub>R</sub>      | Rise Time [2]<br>V <sub>T</sub> = 20% to 80% of swing |   | 93      | 334     | 543     | ps   |
| t <sub>F</sub>      | Fall Time [2]<br>V <sub>T</sub> = 20% to 80% of swing |   | 103     | 293     | 539     | ps   |
| V <sub>OH</sub>     | Output High Voltage [2]                               | V <sub>HIGH</sub> = 900mV, Fast Slew Rate,<br>156.25MHz, 312.5MHz.<br>(Slow slew rate is not recommended for<br>frequencies > 100MHz) | 744     | 901     | 1084    | mV   |
| V <sub>OL</sub>     | Output Low Voltage [2]                                |   | -87     | 27      | 133     |      |
| V <sub>CROSS</sub>  | Crossing Voltage (abs) [3]                            |   | 234     | 446     | 656     |      |
| ΔV <sub>CROSS</sub> | Crossing Voltage (var) [3][4][5]                      |   | 0       | 35      | 168     |      |
| t <sub>R</sub>      | Rise Time [2]<br>V <sub>T</sub> = 20% to 80% of swing |   | 65      | 386     | 683     | ps   |
| t <sub>F</sub>      | Fall Time [2]<br>V <sub>T</sub> = 20% to 80% of swing |   | 82      | 302     | 565     | ps   |
| t <sub>DC</sub>     | Output Duty Cycle [6]                                 | Across all settings in this table, V <sub>T</sub> = 0V.   | 47.6    | 49.9    | 51.9    | %    |

1. Standard high impedance load with C<sub>L</sub> = 2pF. For more information, see [Test Loads](#).
2. Measured from single-ended waveform.
3. Measured at crossing point where the instantaneous voltage value of the rising edge of CLK equals the falling edge of CLKb.
4. Refers to the total variation from the lowest crossing point to the highest, regardless of which edge is crossing. Refers to all crossing points for this measurement.
5. Defined as the total variation of all crossing voltages of Rising CLK and Falling CLKb. This is the maximum allowed variance in V<sub>CROSS</sub> for any particular system.
6. Measured from differential waveform.

Table 19. RC1901xA/RC1900xA 85Ω CLK AC/DC Characteristics - Non-PCIe Apps, Double-Terminated Loads [1]

| Symbol              | Parameter   | Condition  | Minimum | Typical | Maximum | Unit |
|---------------------|---|--|---------|---------|---------|------|
| V <sub>OH</sub>     | Output High Voltage [2]                               | V <sub>HIGH</sub> = 800mV, Fast Slew Rate, 156.25MHz, 312.5MHz - amplitude is reduced by ~50% due to double termination. (Slow slew rate is not recommended for frequencies >100MHz) | 372     | 431     | 475     | mV   |
| V <sub>OL</sub>     | Output Low Voltage [2]                                |  | -32     | 12      | 57      |      |
| V <sub>CROSS</sub>  | Crossing Voltage (abs) [3]                            |  | 156     | 205     | 245     |      |
| ΔV <sub>CROSS</sub> | Crossing Voltage (var) [3][4][5]                      |  | -19     | 10      | 45      |      |
| t <sub>R</sub>      | Rise Time [2]<br>V <sub>T</sub> = 20% to 80% of swing |  | 185     | 396     | 615     | ps   |
| t <sub>F</sub>      | Fall Time [2]<br>V <sub>T</sub> = 20% to 80% of swing |  | 130     | 253     | 381     | ps   |
| V <sub>OH</sub>     | Output High Voltage [2]                               | V <sub>HIGH</sub> = 900mV, Fast Slew Rate, 156.25MHz, 312.5MHz - amplitude is reduced by ~50% due to double termination. (Slow slew rate is not recommended for frequencies >100MHz) | 389     | 479     | 549     | mV   |
| V <sub>OL</sub>     | Output Low Voltage [2]                                |  | -31     | 12      | 55      |      |
| V <sub>CROSS</sub>  | Crossing Voltage (abs) [3]                            |  | 173     | 223     | 265     |      |
| ΔV <sub>CROSS</sub> | Crossing Voltage (var) [3][4][5]                      |  | -20     | 10      | 45      |      |
| t <sub>R</sub>      | Rise Time [2]<br>V <sub>T</sub> = 20% to 80% of swing |  | 220     | 456     | 670     | ps   |
| t <sub>F</sub>      | Fall Time [2]<br>V <sub>T</sub> = 20% to 80% of swing |  | 152     | 256     | 356     | ps   |
| t <sub>DC</sub>     | Output Duty Cycle [6]                                 | Across all settings in this table, V <sub>T</sub> = 0V.  | 48.6    | 49.8    | 50.7    | %    |

- Both Tx and Rx are terminated (double-terminated) with C<sub>L</sub> = 2pF. This reduces amplitude by 50%. For more information, see [Test Loads](#).
- Measured from single-ended waveform.
- Measured at crossing point where the instantaneous voltage value of the rising edge of CLK equals the falling edge of CLKb.
- Refers to the total variation from the lowest crossing point to the highest, regardless of which edge is crossing. Refers to all crossing points for this measurement.
- Defined as the total variation of all crossing voltages of Rising CLK and Falling CLKb. This is the maximum allowed variance in V<sub>CROSS</sub> for any particular system.
- Measured from differential waveform.

**Table 20. RC1901xA/RC1900xA 100Ω CLK AC/DC Characteristics - Non-PCIe Apps, Source-Terminated Loads [1]**

| Symbol              | Parameter                                 | Condition   | Minimum | Typical | Maximum | Unit |
|---------------------|---|---|---------|---------|---------|------|
| V <sub>OH</sub>     | Output High Voltage [2]                   | V <sub>HIGH</sub> = 800mV, Fast Slew Rate,<br>156.25MHz, 312.5MHz.<br>(Slow slew rate is not recommended for<br>frequencies > 100MHz) | 702     | 808     | 951     | mV   |
| V <sub>OL</sub>     | Output Low Voltage [2]                    |   | -73     | 34      | 118     |      |
| V <sub>CROSS</sub>  | Crossing Voltage (abs) [3]                |   | 256     | 376     | 539     |      |
| ΔV <sub>CROSS</sub> | Crossing Voltage (var) [3][4][5]          |   | 0       | 37      | 133     |      |
| t <sub>R</sub>      | Rise Time [2]<br>VT = 20% to 80% of swing |   | 217     | 376     | 541     | ps   |
| t <sub>F</sub>      | Fall Time [2]<br>VT = 20% to 80% of swing |   | 140     | 365     | 576     | ps   |
| V <sub>OH</sub>     | Output High Voltage [2]                   | V <sub>HIGH</sub> = 900mV, Fast Slew Rate,<br>156.25MHz, 312.5MHz.<br>(Slow slew rate is not recommended for<br>frequencies > 100MHz) | 756     | 890     | 1078    | mV   |
| V <sub>OL</sub>     | Output Low Voltage [2]                    |   | -85     | 31      | 147     |      |
| V <sub>CROSS</sub>  | Crossing Voltage (abs) [3]                |   | 269     | 405     | 635     |      |
| ΔV <sub>CROSS</sub> | Crossing Voltage (var) [3][4][5]          |   | 0       | 47      | 144     |      |
| t <sub>R</sub>      | Rise Time [2]<br>VT = 20% to 80% of swing |   | 222     | 412     | 610     | ps   |
| t <sub>F</sub>      | Fall Time [2]<br>VT = 20% to 80% of swing |   | 127     | 368     | 591     | ps   |
| t <sub>DC</sub>     | Output Duty Cycle [6]                     | Across all settings in this table, V <sub>T</sub> = 0V.   | 48.2    | 48.9    | 52.1    | %    |

1. Standard high impedance load with C<sub>L</sub> = 2pF. For more information, see [Test Loads](#).
2. Measured from single-ended waveform.
3. Measured at crossing point where the instantaneous voltage value of the rising edge of CLK equals the falling edge of CLKb.
4. Refers to the total variation from the lowest crossing point to the highest, regardless of which edge is crossing. Refers to all crossing points for this measurement.
5. Defined as the total variation of all crossing voltages of Rising CLK and Falling CLKb. This is the maximum allowed variance in V<sub>CROSS</sub> for any particular system.
6. Measured from differential waveform.

**Table 21. RC1901xA/RC1900xA 100Ω CLK AC/DC Characteristics–Non-PCIe Apps, Double-Terminated Loads [1]**

| Symbol              | Parameter                                 | Condition   | Minimum | Typical | Maximum | Unit |
|---------------------|---|---|---------|---------|---------|------|
| V <sub>OH</sub>     | Output High Voltage [2]                   | V <sub>HIGH</sub> = 800mV, Fast Slew Rate,<br>156.25MHz, 312.5MHz - amplitude is<br>reduced by ~50% due to double<br>termination. (Slow slew rate is not<br>recommended for frequencies > 100MHz) | 365     | 398     | 435     | mV   |
| V <sub>OL</sub>     | Output Low Voltage [2]                    |   | -31     | 10      | 43      |      |
| V <sub>CROSS</sub>  | Crossing Voltage (abs) [3]                |   | 152     | 186     | 233     |      |
| ΔV <sub>CROSS</sub> | Crossing Voltage (var) [3][4][5]          |   | -14     | 7       | 41      |      |
| t <sub>R</sub>      | Rise Time [2]<br>VT = 20% to 80% of swing |   | 226     | 409     | 634     | ps   |
| t <sub>F</sub>      | Fall Time [2]<br>VT = 20% to 80% of swing |   | 174     | 260     | 380     | ps   |

Table 21. RC1901xA/RC1900xA 100Ω CLK AC/DC Characteristics—Non-PCIe Apps, Double-Terminated Loads [1]

| Symbol              | Parameter                                 | Condition  | Minimum | Typical | Maximum | Unit |
|---------------------|---|--|---------|---------|---------|------|
| V <sub>OH</sub>     | Output High Voltage [2]                   | V <sub>HIGH</sub> = 900mV, Fast Slew Rate, 156.25MHz, 312.5MHz - amplitude is reduced by ~50% due to double termination. (Slow slew rate is not recommended for frequencies >100MHz) | 405     | 442     | 492     | mV   |
| V <sub>OL</sub>     | Output Low Voltage [2]                    |  | -33     | 12      | 45      |      |
| V <sub>CROSS</sub>  | Crossing Voltage (abs) [3]                |  | 167     | 201     | 261     |      |
| ΔV <sub>CROSS</sub> | Crossing Voltage (var) [3][4][5]          |  | -14     | 8       | 42      |      |
| t <sub>R</sub>      | Rise Time [2]<br>VT = 20% to 80% of swing |  | 203     | 467     | 695     | ps   |
| t <sub>F</sub>      | Fall Time [2]<br>VT = 20% to 80% of swing |  | 175     | 263     | 385     | ps   |
| t <sub>DC</sub>     | Output Duty Cycle [6]                     | Across all settings in this table, V <sub>T</sub> = 0V.  | 49      | 50      | 51      | %    |

- Both Tx and Rx are terminated (double-terminated) with C<sub>L</sub> = 2pF. This reduces amplitude by 50%. For more information, see [Test Loads](#).
- Measured from single-ended waveform.
- Measured at crossing point where the instantaneous voltage value of the rising edge of CLK equals the falling edge of CLKb.
- Refers to the total variation from the lowest crossing point to the highest, regardless of which edge is crossing. Refers to all crossing points for this measurement.
- Defined as the total variation of all crossing voltages of Rising CLK and Falling CLKb. This is the maximum allowed variance in V<sub>CROSS</sub> for any particular system.
- Measured from differential waveform.

## 2.4.5 Output-to-Output and Input-to-Output Skew

Table 22. RC1902xA Output-to-Output and Input-to-Output Skew [1]

| Symbol           | Parameter                                   | Condition  | Minimum | Typical | Maximum | Unit  |
|------------------|---|--|---------|---------|---------|-------|
| t <sub>SK</sub>  | Output-to-Output Skew [2]                   | Any two outputs, all outputs at fast slew rate.        | -       | 38      | 50      | ps    |
|                  |   | Any two outputs, all outputs at slow slew rate.        | -       | 40      | 60      | ps    |
| t <sub>PD</sub>  | Input-to-Output Delay Double-Terminated [3] | Clock in to any output, all outputs at fast slew rate. | 1.1     | 1.2     | 1.4     | ns    |
|                  |   | Clock in to any output, all outputs at slow slew rate. | 1.2     | 1.4     | 1.6     | ns    |
| t <sub>PD</sub>  | Input-to-Output Delay Source-Terminated [3] | Clock in to any output, all outputs at fast slew rate. | 1.2     | 1.4     | 1.6     | ns    |
|                  |   | Clock in to any output, all outputs at slow slew rate. | 1.4     | 1.5     | 1.8     | ns    |
| Δt <sub>PD</sub> | Input-to-Output Delay Variation [3]         | A single device, over temperature <i>and</i> voltage.  | -       | 1.4     | 2       | ps/°C |

- For more information, see [Test Loads](#).
- This parameter is defined in accordance with JEDEC Standard 65.
- Defined as the time between to output rising edge and the input rising edge that caused it.

Table 23. RC1901xA/RC1900xA Output-to-Output and Input-to-Output Skew [1]

| Symbol          | Parameter                                   | Condition  | Minimum | Typical | Maximum | Unit  |
|-----------------|---|--|---------|---------|---------|-------|
| $t_{SK}$        | Output-to-Output Skew [2]                   | Any two outputs, all outputs at fast slew rate.        | -       | 37      | 50      | ps    |
|                 |   | Any two outputs, all outputs at slow slew rate.        | -       | 39      | 60      | ps    |
| $t_{PD}$        | Input-to-Output Delay Double-Terminated [3] | Clock in to any output, all outputs at fast slew rate. | 1.1     | 1.4     | 1.6     | ns    |
|                 |   | Clock in to any output, all outputs at slow slew rate. | 1.2     | 1.5     | 1.8     | ns    |
| $t_{PD}$        | Input-to-Output Delay Source-Terminated [3] | Clock in to any output, all outputs at fast slew rate. | 1.2     | 1.4     | 1.7     | ns    |
|                 |   | Clock in to any output, all outputs at slow slew rate. | 1.3     | 1.5     | 1.8     | ns    |
| $\Delta t_{PD}$ | Input-to-Output Delay Variation [3]         | A single device, over temperature <i>and</i> voltage.  | -       | 1.5     | 1.8     | ps/°C |

1. For more information, see [Test Loads](#).
2. This parameter is defined in accordance with JEDEC Standard 65.
3. Defined as the time between to output rising edge and the input rising edge that caused it.

## 2.4.6 I/O Signals

Table 24. I/O Electrical Characteristics

| Symbol   | Parameter                                     | Condition  | Minimum | Typical | Maximum        | Unit    |
|----------|---|--|---------|---------|----------------|---------|
| $V_{IH}$ | Input High Voltage [1][2]                     | Single-ended inputs, unless otherwise listed.                                      | 2       | -       | $V_{DD} + 0.3$ | V       |
| $V_{IL}$ | Input Low Voltage [1][2]                      |  | -0.3    | -       | 0.8            | V       |
| $V_{IH}$ | Input High Voltage                            | SADR_tri[1:0].   | 2.4     | -       | $V_{DD} + 0.3$ | V       |
| $V_{IM}$ | Input Mid Voltage                             |  | 1.2     | -       | 1.8            | V       |
| $V_{IL}$ | Input Low Voltage                             |  | -0.3    | -       | 0.8            | V       |
| $V_{OH}$ | Output High Voltage [2]                       | SBI_OUT, IOH = -2mA  | 2.4     | 3.2     | $V_{DD} + 0.3$ | V       |
| $V_{OL}$ | Output Low Voltage [2]                        | SBI_OUT, IOL = 2mA   | -       | 0.1     | 0.4            | V       |
| $I_{IH}$ | Input Leakage Current High, $V_{IN} = V_{DD}$ | CLKIN (RC19020, RC19020A072)   | -3      | -       | +3             | $\mu A$ |
|          |   | CLKINb (RC19020, RC19020A072)  | 5       | -       | 15             |         |
|          |   | CLKIN (All other devices)  | 5       | -       | 15             |         |
|          |   | CLKINb (All other devices)   | -3      | -       | +3             |         |
|          |   | Single-ended inputs, unless otherwise listed (including PWRGD_PWRDNb for RC19020). | 25      | -       | 35             |         |
|          |   | PWRGD_PWRDNb (all devices except RC19020)  | -1      | -       | 5              |         |
|          |   | SADR_tri[1:0]  | 25      | -       | 35             |         |



Table 24. I/O Electrical Characteristics (Cont.)

| Symbol   | Parameter                                   | Condition   | Minimum | Typical | Maximum | Unit      |
|----------|---|---|---------|---------|---------|-----------|
| $I_{IL}$ | Input Leakage Current<br>Low, $V_{IN} = 0V$ | CLKIN (RC19020, RC19020A072)  | -12     | -       | -6      | $\mu A$   |
|          |   | CLKINb (RC19020, RC19020A072)   | -3      | -       | +3      |           |
|          |   | CLKIN (All other devices)   | -3      | -       | +3      |           |
|          |   | CLKINb (All other devices)  | -12     | -       | -6      |           |
|          |   | Single-ended inputs, unless otherwise listed<br>(including PWRGD_PWRDNb for RC19020). | -3      | -       | +3      |           |
|          |   | PWRGD_PWRDNb (all devices except RC19020).  | -35     | -       | -20     |           |
|          |   | SADR_tri[1:0]   | -35     | -       | -20     |           |
| $R_p$    | PD_CLKIN                                    | Value of internal pull-down resistor to ground<br>(CLKIN)                             | -       | 53      | -       | $k\Omega$ |
|          | PU_CLKINb                                   | Value of internal pull-up resistor to 0.5V (CLKINb).                                  | -       | 57      | -       |           |
|          | Pull-up/Pull-down<br>Resistor               | Single-ended inputs.  | -       | 125     | -       |           |
| $Z_o$    | Output Impedance                            | SBI_OUT pin.  | -       | 50      | -       | $\Omega$  |
|          |   | CLK outputs, RC190xxA (single-ended value).   | -       | 41      | -       | $\Omega$  |
|          |   | CLK outputs, RC190xxA100 (single-ended value).  | -       | 48      | -       | $\Omega$  |

1. For SCLK and SDATA, see the SMBus Electrical Characteristics table.

2. These values are compliant with JESD8C.01.

## 2.4.7 Power Supply Current

Table 25. Power Supply Current <sup>[1][2][3]</sup>

| Symbol      | Parameter                                  | Condition   | Minimum | Typical | Maximum | Unit |
|-------------|--|---|---------|---------|---------|------|
| $I_{DDCLK}$ | $V_{DDCLK}$ Operating Current –<br>RC19024 | 85 $\Omega$ impedance, fast slew rate, source-<br>terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                   | -       | 245     | 267     | mA   |
|             |  | 85 $\Omega$ impedance, fast slew rate, double-<br>terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                   | -       | 303     | 323     |      |
|             |  | 85 $\Omega$ impedance, fast slew rate, source-<br>terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1. | -       | 421     | 448     |      |
|             |  | 85 $\Omega$ impedance, fast slew rate, double-<br>terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1. | -       | 484     | 504     |      |

Table 25. Power Supply Current [1][2][3] (Cont.)

| Symbol      | Parameter                                   | Condition   | Minimum | Typical | Maximum | Unit |
|-------------|---|---|---------|---------|---------|------|
| $I_{DDCLK}$ | $V_{DDCLK}$ Operating Current – RC19020     | 85Ω impedance, fast slew rate, source-terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                   | -       | 217     | 233     | mA   |
|             |   | 85Ω impedance, fast slew rate, double-terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                   | -       | 262     | 279     |      |
|             |   | 85Ω impedance, fast slew rate, source-terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1. | -       | 362     | 381     |      |
|             |   | 85Ω impedance, fast slew rate, double-terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1. | -       | 420     | 439     |      |
| $I_{DDCLK}$ | $V_{DDCLK}$ Operating Current – RC19020A072 | 85Ω impedance, fast slew rate, source-terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                   | -       | 224     | 246     | mA   |
|             |   | 85Ω impedance, fast slew rate, double-terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                   | -       | 254     | 276     |      |
|             |   | 85Ω impedance, fast slew rate, source-terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1. | -       | 343     | 355     |      |
|             |   | 85Ω impedance, fast slew rate, double-terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1. | -       | 402     | 414     |      |
| $I_{DDCLK}$ | $V_{DDCLK}$ Operating Current – RC19016     | 85Ω impedance, fast slew rate, source-terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                   | -       | 154     | 175     | mA   |
|             |   | 85Ω impedance, fast slew rate, double-terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                   | -       | 210     | 231     |      |
|             |   | 85Ω impedance, fast slew rate, source-terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1. | -       | 270     | 291     |      |
|             |   | 85Ω impedance, fast slew rate, double-terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1. | -       | 336     | 357     |      |
| $I_{DDCLK}$ | $V_{DDCLK}$ Operating Current – RC19013     | 85Ω impedance, fast slew rate, source-terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                   | -       | 110     | 131     | mA   |
|             |   | 85Ω impedance, fast slew rate, double-terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                   | -       | 174     | 194     |      |
|             |   | 85Ω impedance, fast slew rate, source-terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1. | -       | 215     | 236     |      |
|             |   | 85Ω impedance, fast slew rate, double-terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1. | -       | 276     | 297     |      |

Table 25. Power Supply Current <sup>[1][2][3]</sup> (Cont.)

| Symbol             | Parameter  | Condition  | Minimum | Typical | Maximum | Unit |
|--------------------|--|--|---------|---------|---------|------|
| I <sub>DDCLK</sub> | V <sub>DDCLK</sub> Operating Current – RC19008     | 85Ω impedance, fast slew rate, source-terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                    | -       | 72      | 92      | mA   |
|                    |  | 85Ω impedance, fast slew rate, double-terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                    | -       | 116     | 137     |      |
|                    |  | 85Ω impedance, fast slew rate, source-terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1.  | -       | 126     | 146     |      |
|                    |  | 85Ω impedance, fast slew rate, double-terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1.  | -       | 183     | 203     |      |
| I <sub>DDCLK</sub> | V <sub>DDCLK</sub> Operating Current – RC19004     | 85Ω impedance, fast slew rate, source-terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                    | -       | 39      | 59      | mA   |
|                    |  | 85Ω impedance, fast slew rate, double-terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                    | -       | 60      | 80      |      |
|                    |  | 85Ω impedance, fast slew rate, source-terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1.  | -       | 79      | 100     |      |
|                    |  | 85Ω impedance, fast slew rate, double-terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1.  | -       | 102     | 122     |      |
| I <sub>DDCLK</sub> | V <sub>DDCLK</sub> Operating Current – RC19002     | 85Ω impedance, fast slew rate, source-terminated load at 100MHz.   | -       | 30      | 40      | mA   |
|                    |  | 85Ω impedance, fast slew rate, double-terminated load at 100MHz.   | -       | 39      | 49      |      |
|                    |  | 85Ω impedance, fast slew rate, source-terminated load at maximum output frequency.                       | -       | 55      | 62      |      |
|                    |  | 85Ω impedance, fast slew rate, double-terminated load at maximum output frequency.                       | -       | 66      | 73      |      |
| I <sub>DDCLK</sub> | V <sub>DDCLK</sub> Operating Current – RC19016A100 | 100Ω impedance, fast slew rate, source-terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                   | -       | 151     | 172     | mA   |
|                    |  | 100Ω impedance, fast slew rate, double-terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                   | -       | 187     | 208     |      |
|                    |  | 100Ω impedance, fast slew rate, source-terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1. | -       | 265     | 285     |      |
|                    |  | 100Ω impedance, fast slew rate, double-terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1. | -       | 303     | 323     |      |

Table 25. Power Supply Current <sup>[1][2][3]</sup> (Cont.)

| Symbol             | Parameter  | Condition  | Minimum | Typical | Maximum | Unit |
|--------------------|--|--|---------|---------|---------|------|
| I <sub>DDCLK</sub> | V <sub>DDCLK</sub> Operating Current – RC19013A100 | 100Ω impedance, fast slew rate, source-terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                   | -       | 97      | 117     | mA   |
|                    |  | 100Ω impedance, fast slew rate, double-terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                   | -       | 160     | 180     |      |
|                    |  | 100Ω impedance, fast slew rate, source-terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1. | -       | 194     | 214     |      |
|                    |  | 100Ω impedance, fast slew rate, double-terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1. | -       | 257     | 278     |      |
| I <sub>DDCLK</sub> | V <sub>DDCLK</sub> Operating Current – RC19008A100 | 100Ω impedance, fast slew rate, source-terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                   | -       | 70      | 90      | mA   |
|                    |  | 100Ω impedance, fast slew rate, double-terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                   | -       | 106     | 126     |      |
|                    |  | 100Ω impedance, fast slew rate, source-terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1. | -       | 121     | 142     |      |
|                    |  | 100Ω impedance, fast slew rate, double-terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1. | -       | 169     | 190     |      |
| I <sub>DDCLK</sub> | V <sub>DDCLK</sub> Operating Current – RC19004A100 | 100Ω impedance, fast slew rate, source-terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                   | -       | 38      | 59      | mA   |
|                    |  | 100Ω impedance, fast slew rate, double-terminated load at 100MHz.<br>PWRGD_PWRDNb = 1.                   | -       | 59      | 79      |      |
|                    |  | 100Ω impedance, fast slew rate, source-terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1. | -       | 74      | 94      |      |
|                    |  | 100Ω impedance, fast slew rate, double-terminated load at maximum output frequency.<br>PWRGD_PWRDNb = 1. | -       | 97      | 118     |      |
| I <sub>DDCLK</sub> | V <sub>DDCLK</sub> Operating Current – RC19002     | 100Ω impedance, fast slew rate, source-terminated load at 100MHz.  | -       | 35      | 44      | mA   |
|                    |  | 100Ω impedance, fast slew rate, double-terminated load at 100MHz.  | -       | 41      | 50      |      |
|                    |  | 100Ω impedance, fast slew rate, source-terminated load at maximum output frequency.                      | -       | 61      | 69      |      |
|                    |  | 100Ω impedance, fast slew rate, double-terminated load at maximum output frequency.                      | -       | 70      | 77      |      |
| I <sub>DDDIG</sub> | V <sub>DDDIG</sub> Operating Current               | PWRGD_PWRDNb = 1,<br>RC19024/RC19016/13A/08A/04A/02A.  | -       | 0.6     | 1.3     | mA   |
| I <sub>DDR</sub>   | V <sub>DDR</sub> Operating Current                 | PWRGD_PWRDNb = 1,<br>RC19020, RC19020A072  | -       | 0.6     | 1.3     | mA   |

Table 25. Power Supply Current <sup>[1][2][3]</sup> (Cont.)

| Symbol                | Parameter                             | Condition                                       | Minimum | Typical | Maximum | Unit |
|-----------------------|---------------------------------------|---|---------|---------|---------|------|
| I <sub>DDCLK_PD</sub> | V <sub>DDCLK</sub> Power-down Current | PWRGD_PWRDNb = 0, RC19016/13A/08A/04A.          | -       | 0.6     | 1.3     | mA   |
|                       |                                       | PWRGD_PWRDNb = 0, RC19024, RC19020, RC19020A072 | -       | 3.5     | 5.0     | mA   |
| I <sub>DDDIG_PD</sub> | V <sub>DDDIG</sub> Power-down Current | PWRGD_PWRDNb = 0, RC19024/RC19016/13A/08A/04A.  | -       | 3.1     | 5.0     | mA   |
| I <sub>DDR_PD</sub>   | V <sub>DDR</sub> Power-down Current   | PWRGD_PWRDNb = 0, RC19020, RC19020A072          | -       | 0.6     | 1.3     | mA   |

- For more information, see [Test Loads](#).
- Output voltage set to 800mV. Slew rate has negligible effect on current consumption, so only fast is listed.
- Total operating current is obtained by adding IDDCLK + IDDDIG, or IDDCLK + IDDR for a particular device and operating mode. Power down current is obtained by adding IDDCLK\_PD + IDDDIG\_PD, or IDDCLK\_PD + IDDR\_PD for a particular device.

## 2.4.8 CLKIN AC/DC Characteristics

Table 26. CLKIN AC/DC Characteristic

| Symbol             | Parameter               | Condition                               | Minimum <sup>[1]</sup> | Typical | Maximum | Unit |
|--------------------|-------------------------|---|------------------------|---------|---------|------|
| V <sub>CROSS</sub> | Input Crossover Voltage | -                                       | 100                    | -       | 1400    | mV   |
| V <sub>SWING</sub> | Input Swing             | Differential value.                     | 200                    | -       | -       | mV   |
| dv/dt              | Input Slew Rate         | Measured differentially. <sup>[2]</sup> | 0.6                    | -       | -       | V/ns |

- For values required for performance, see the [Phase Jitter](#) tables.
- Measured from -150mV to +150mV on the differential waveform (derived from REFCLK+ minus REFCLK-). The signal must be monotonic through the measurement region for rise and fall time. The 300mV measurement window is centered on the differential zero-crossing.

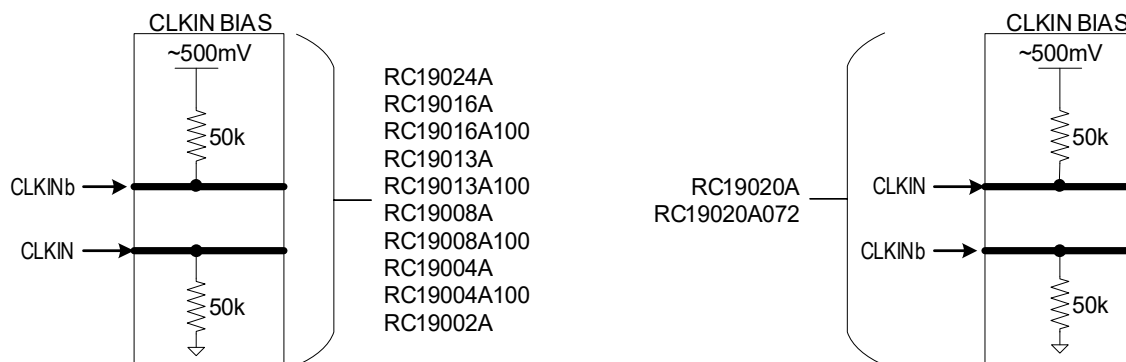


Figure 10. Clock Input Bias Network

## 2.4.9 SMBus Electrical Characteristics

This section applies to all devices except the RC19002 because the RC19002 does not have an SMBus interface.

Table 27. SMBus DC Electrical Characteristics [1]

| Symbol    | Parameter                                      | Condition             | Minimum  | Typical | Maximum | Unit          |
|-----------|--|-----------------------|----------|---------|---------|---------------|
| $V_{IH}$  | High-level Input Voltage for SMBCLK and SMBDAT | -                     | 0.8 VDD  | -       | -       | V             |
| $V_{IL}$  | Low-level Input Voltage for SMBCLK and SMBDAT  | -                     | -        | -       | 0.3 VDD |               |
| $V_{HYS}$ | Hysteresis of Schmitt Trigger Inputs           | -                     | 0.05 VDD | -       | -       |               |
| $V_{OL}$  | Low-level Output Voltage for SMBCLK and SMBDAT | $I_{OL} = 4\text{mA}$ | -        | 0.28    | 0.4     |               |
| $I_{IN}$  | Input Leakage Current per Pin                  | -                     | [2]      | -       | [2]     | $\mu\text{A}$ |
| $C_B$     | Capacitive Load for Each Bus Line              | -                     | -        | -       | 400     | pF            |

- $V_{OH}$  is governed by the  $V_{PUP}$ , the voltage rail to which the pull-up resistors are connected.
- For more information, see [I/O Electrical Characteristics](#).

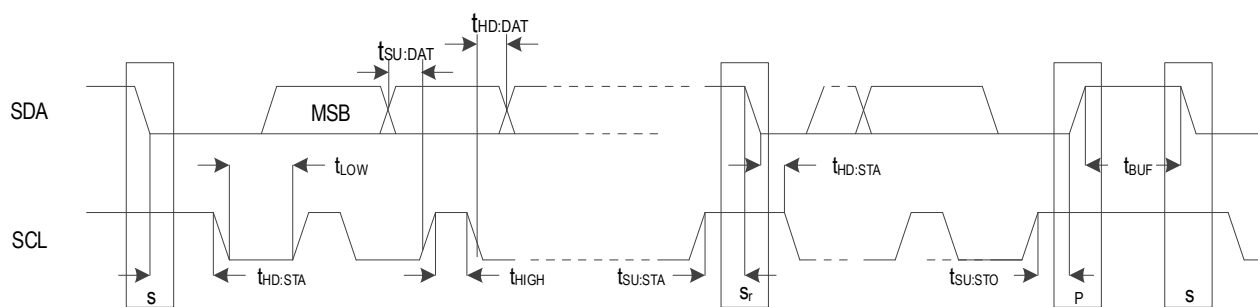


Figure 11. SMBus Slave Timing Diagram

Table 28. SMBus AC Electrical Characteristics

| Symbol         | Parameter                                      | Condition | 100kHz Class |         | 400kHz Class |         | Unit          |
|----------------|--|-----------|--------------|---------|--------------|---------|---------------|
|                |  |           | Minimum      | Maximum | Minimum      | Maximum |               |
| $f_{SMB}$      | SMBus Operating Frequency                      | [1]       | 10           | 100     | 10           | 400     | kHz           |
| $t_{BUF}$      | Bus free time between STOP and START Condition | -         | 4.7          | -       | 1.3          | -       | $\mu\text{s}$ |
| $t_{HD:STA}$   | Hold Time after (REPEATED) START Condition     | [2]       | 4            | -       | 0.6          | -       | $\mu\text{s}$ |
| $t_{SU:STA}$   | REPEATED START Condition Setup Time            | -         | 4.7          | -       | 0.6          | -       | $\mu\text{s}$ |
| $t_{SU:STO}$   | STOP Condition Setup Time                      | -         | 4            | -       | 0.6          | -       | $\mu\text{s}$ |
| $t_{HD:DAT}$   | Data Hold Time                                 | [3]       | 300          | -       | 300          | -       | ns            |
| $t_{SU:DAT}$   | Data Setup Time                                | -         | 250          | -       | 100          | -       | ns            |
| $t_{TIMEOUT}$  | Detect SCL_SCLK Low Timeout                    | [4]       | 25           | 35      | 25           | 35      | ms            |
| $t_{TIMEOUT}$  | Detect SDA_nCS Low Timeout                     | [5]       | 25           | 35      | 25           | 35      | ms            |
| $t_{LOW}$      | Clock Low Period                               | -         | 4.7          | -       | 1.3          | -       | $\mu\text{s}$ |
| $t_{HIGH}$     | Clock High Period                              | [6]       | 4            | 50      | 0.6          | 50      | $\mu\text{s}$ |
| $t_{LOW:SEXT}$ | Cumulative Clock Low Extend Time - Slave       | [7]       | N/A          |         | N/A          |         | ms            |
| $t_{LOW:MEXT}$ | Cumulative Clock Low Extend Time - Master      | [8]       | N/A          |         | N/A          |         | ms            |
| $t_F$          | Clock/Data Fall Time                           | [9]       | -            | 300     | -            | 300     | ns            |
| $t_R$          | Clock/Data Rise Time                           | [9]       | -            | 1000    | -            | 300     | ns            |
| $t_{SPIKE}$    | Noise Spike Suppression Time                   | [10]      | -            | -       | 0            | 50      | ns            |

- Power must be applied and PWRGD\_PWRDNb must be a 1 for the SMBus to be active.

2. A master should not drive the clock at a frequency below the minimum  $f_{SMB}$ . Further, the operating clock frequency should not be reduced below the minimum value of  $f_{SMB}$  due to periodic clock extending by slave devices as defined in Section 5.3.3 of System Management Bus (SMBus) Specification, Version 3.1, dated 19 Mar 2018. This limit does not apply to the bus idle condition, and this limit is independent from the  $t_{LOW:SEXT}$  and  $t_{LOW:MEXT}$  limits. For example, if the SMBCLK is high for  $t_{HIGH,MAX}$ , the clock must not be periodically stretched longer than  $1/f_{SMB,MIN} - t_{HIGH,MAX}$ . This requirement does not pertain to a device that extends the SMBCLK low for data processing of a received byte, data buffering and so forth for longer than 100  $\mu s$  in a non-periodic way.
3. A device must internally provide sufficient hold time for the SMBDAT signal (with respect to the  $V_{IH,MIN}$  of the SMBCLK signal) to bridge the undefined region of the falling edge of SMBCLK.
4. Slave devices may have caused other slave devices to hold SDA low. This is the maximum time that a device can hold SMBDAT low after the master raises SMBCLK after the last bit of a transaction. A slave device may detect how long SDA is held low and release SDA after the time out period.
5. Devices participating in a transfer can abort the transfer in progress and release the bus when any single clock low interval exceeds the value of  $t_{TIMEOUT,MIN}$ . After the master in a transaction detects this condition, it must generate a stop condition within or after the current data byte in the transfer process. Devices that have detected this condition must reset their communication and be able to receive a new START condition no later than  $t_{TIMEOUT,MAX}$ . Typical device examples include the host controller, and embedded controller, and most devices that can master the SMBus. Some simple devices do not contain a clock low drive circuit; this simple kind of device typically may reset its communications port after a start or a stop condition. A timeout condition can only be ensured if the device that is forcing the timeout holds the SMBCLK low for  $t_{TIMEOUT,MAX}$  or longer.
6. The device has the option of detecting a timeout if the SMBDATA pin is also low for this time.
7.  $t_{HIGH,MAX}$  provides a simple guaranteed method for masters to detect bus idle conditions. A master can assume that the bus is free if it detects that the clock and data signals have been high for greater than  $t_{HIGH,MAX}$ .
8.  $t_{LOW:MEXT}$  is the cumulative time a master device is allowed to extend its clock cycles within each byte of a message as defined from START-to-ACK, ACK-to-ACK, or ACK-to-STOP. It is possible that a slave device or another master will also extend the clock causing the combined clock low time to be greater than  $t_{LOW:MEXT}$  on a given byte. This parameter is measured with a full speed slave device as the sole target of the master.
9. The rise and fall time measurement limits are defined as follows:  
 Rise Time Limits: ( $V_{IL,MAX} - 0.15 V$ ) to ( $V_{IH,MIN} + 0.15 V$ )  
 Fall Time Limits: ( $V_{IH,MIN} + 0.15 V$ ) to ( $V_{IL,MAX} - 0.15 V$ )
10. Devices must provide a means to reject noise spikes of a duration up to the maximum specified value.

## 2.4.10 Side-Band Interface

This section applies to all device except the RC19002 because the RC19002 does not have a Side Band Interface.

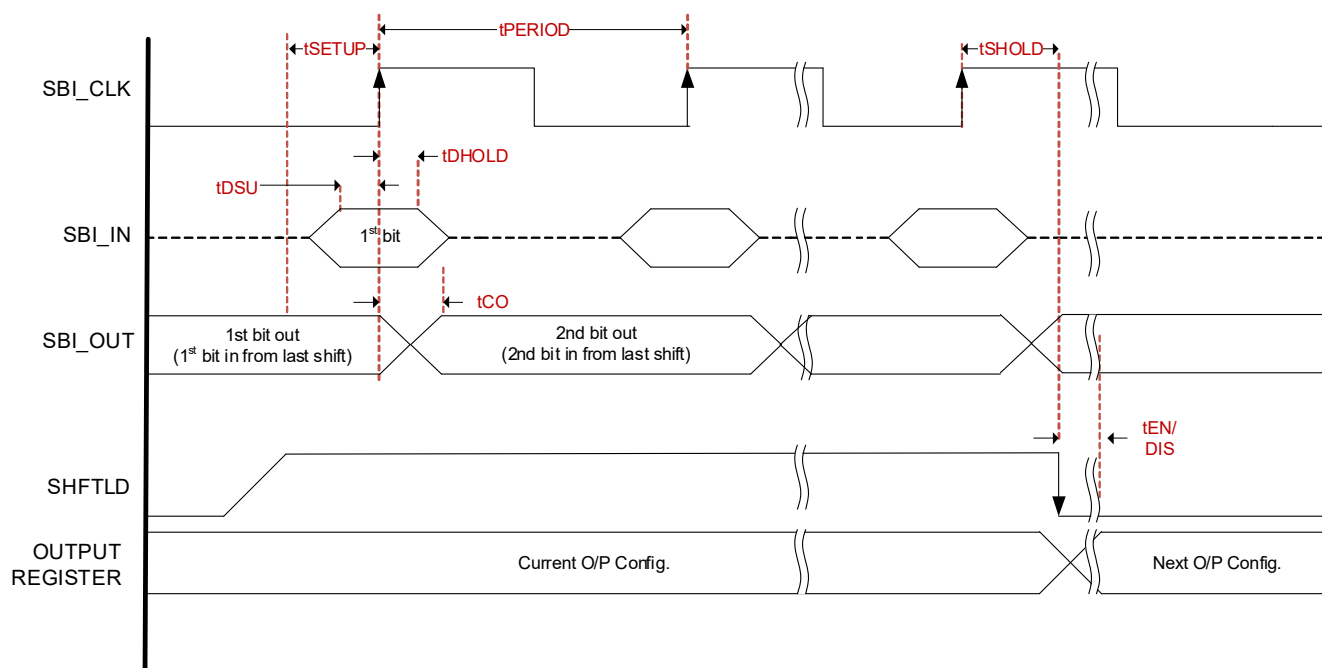


Figure 12. Side-Band Interface Timing

Figure 12 is the timing diagram and Table 29 provides the electrical characteristics for the Side-Band Interface. The SBI supports clock rates up to 25MHz.

Table 29. Electrical Characteristics – Side-Band Interface

| Symbol              | Parameter                | Condition   | Minimum | Typical | Maximum | Unit   |
|---------------------|--------------------------|---|---------|---------|---------|--------|
| $t_{\text{PERIOD}}$ | Clock Period             | Clock period.   | 40      | -       | -       | ns     |
| $t_{\text{SETUP}}$  | SHFT Setup Time to Clock | SHFT_LDB high to SBI_CLK rising edge.   | 10      | -       | -       | ns     |
| $t_{\text{DSU}}$    | SBI_IN Setup Time        | SBI_IN setup to SBI_CLK rising edge.  | 5       | -       | -       | ns     |
| $t_{\text{DHOLD}}$  | SBI_IN Hold Time         | SBI_IN hold after SBI_CLK rising edge.  | 2       | -       | -       | ns     |
| $t_{\text{CO}}$     | SBI_CLK to SBI_OUT       | SBI_CLK rising edge to SBI_OUT valid.   | 2       | -       | -       | ns     |
| $t_{\text{SHOLD}}$  | SHFT Hold Time           | SHFT_LDB hold (high) after SBI_CLK rising edge (SBI_CLK to SHFT_LDB falling edge).          | 10      | -       | -       | ns     |
| $t_{\text{EN/DIS}}$ | Enable/Disable Time      | Delay from SHFT_LDB falling edge to next output configuration taking effect. <sup>[1]</sup> | 4       | -       | 12      | clocks |
| $t_{\text{SLEW}}$   | Slew Rate                | SBI_CLK (between 20% and 80%). <sup>[2]</sup>   | 0.7     | -       | 6       | V/ns   |

1. Refers to the output clock.

2. Control input must be monotonic from 20% to 80% of input swing.

### 3. Test Loads

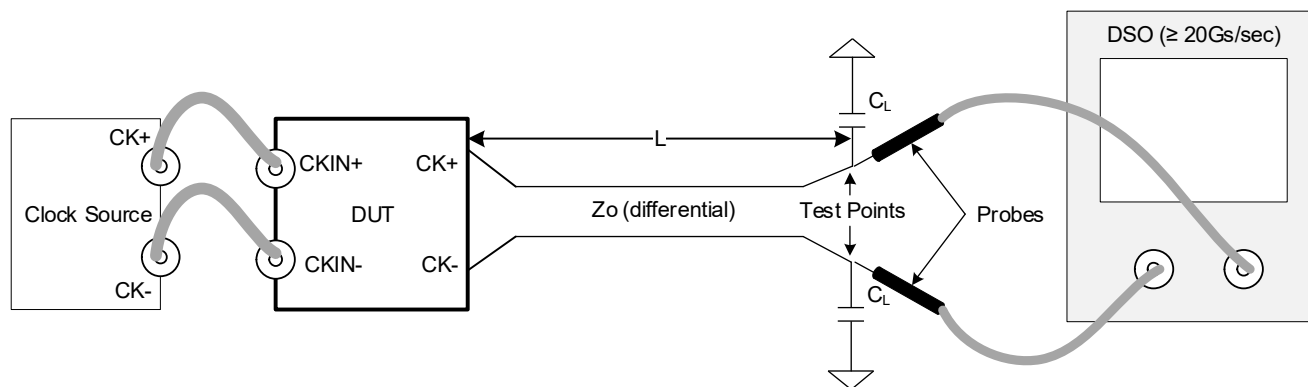


Figure 13. AC/DC Test Load for Differential Outputs (Standard PCIe Source-Terminated)

Table 30. Parameters for AC/DC Test Load (Standard PCIe Source-Terminated)

| Device      | Clock Source | Rs (ohms) | Zo (ohms) | L (cm) | CL (pF) |
|-------------|--------------|-----------|-----------|--------|---------|
| RC19xxxA    | SMA100B      | Internal  | 85        | 25.4   | 2       |
| RC19xxxA100 | SMA100B      | Internal  | 100       | 25.4   | 2       |



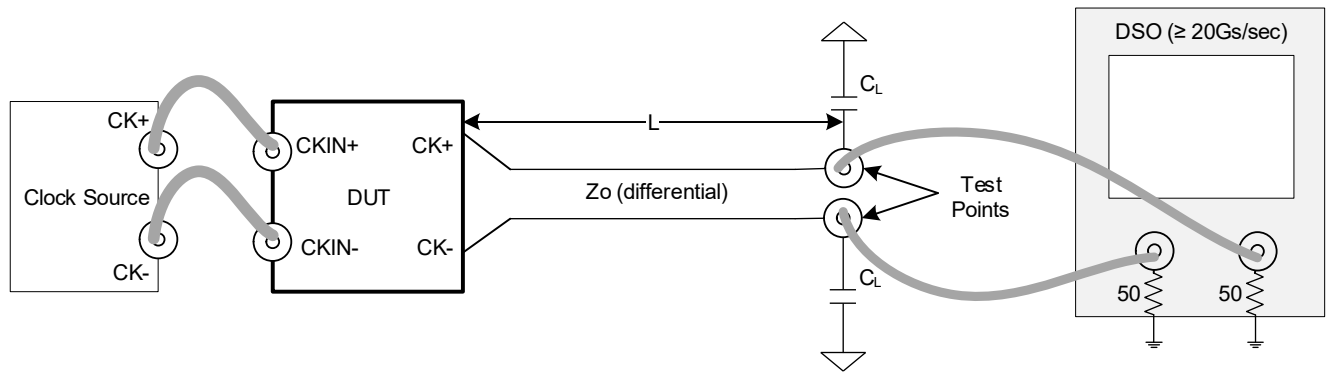


Figure 14. AC/DC Test Load for Differential Outputs (Double-Terminated)

Table 31. Parameters for AC/DC Test Load (Double-Terminated)

| Device      | Clock Source | Rs (ohms) | Zo (ohms) | L (cm) | C <sub>L</sub> (pF) |
|-------------|--------------|-----------|-----------|--------|---------------------|
| RC19xxxA    | SMA100B      | Internal  | 85        | 25.4   | 2                   |
| RC19xxxA100 | SMA100B      | Internal  | 100       | 25.4   | 2                   |

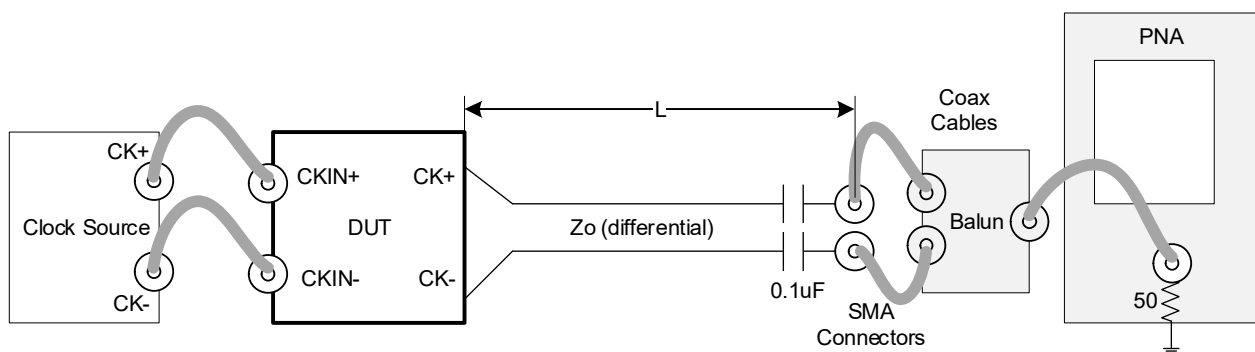


Figure 15. Test Load for PCIe Phase Jitter Measurements

Table 32. Parameters for PCIe Gen5 Jitter Measurement

| Device      | Clock Source | Rs (ohms) | Zo (ohms) | L (cm) [1] | C <sub>L</sub> (pF) |
|-------------|--------------|-----------|-----------|------------|---------------------|
| RC19xxxA    | SMA100B      | Internal  | 85        | 25.4       | 2                   |
| RC19xxxA100 | SMA100B      | Internal  | 100       | 25.4       | 2                   |

1. PCIe Gen6 specifies L = 0cm for 32 and 64 GT/s. L = 25.4cm is more conservative.

## 4. General SMBus Serial Interface Information

This section applies to all device except the RC19002 which does not have an SMBus interface.

### 4.1 How to Write

- Controller (host) sends a start bit
- Controller (host) sends the write address
- Renesas clock will **acknowledge**
- Controller (host) sends the beginning byte Location = N
- Renesas clock will **acknowledge**
- Controller (host) sends the byte count = X
- Renesas clock will **acknowledge**
- Controller (host) starts sending Byte N through Byte N+X-1
- Renesas clock will **acknowledge** each byte one at a time
- Controller (host) sends a stop bit

| Index Block Write Operation |           |        |                          |
|-----------------------------|-----------|--------|--------------------------|
| Controller (Host)           |           |        | Renesas (Slave/Receiver) |
| T                           | starT bit |        |                          |
| Slave Address               |           |        |                          |
| WR                          | WRite     |        |                          |
|                             |           |        | ACK                      |
| Beginning Byte = N          |           |        |                          |
|                             |           |        | ACK                      |
| Data Byte Count = X         |           |        |                          |
|                             |           |        | ACK                      |
| Beginning Byte N            |           | X Byte |                          |
|                             |           |        | ACK                      |
| O                           |           |        |                          |
| O                           |           |        | O                        |
| O                           |           |        | O                        |
|                             |           |        | O                        |
| Byte N + X - 1              |           |        |                          |
|                             |           |        | ACK                      |
| P                           | stoP bit  |        |                          |

## 4.2 How to Read

- Controller (host) will send a start bit
- Controller (host) sends the write address
- Renesas clock will **acknowledge**
- Controller (host) sends the beginning byte Location = N
- Renesas clock will **acknowledge**
- Controller (host) will send a separate start bit
- Controller (host) sends the read address
- Renesas clock will **acknowledge**
- Renesas clock will send the data byte count = X
- Renesas clock sends Byte **N+X-1**
- Renesas clock sends **Byte L through Byte X (if X(H) was written to Byte 7)**
- 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 Read Operation |              |        |                   |
|----------------------------|--------------|--------|-------------------|
| Controller (Host)          |              |        | Renesas           |
| T                          | starT bit    |        |                   |
| Slave Address              |              |        |                   |
| WR                         | WRite        |        |                   |
|                            |              |        | ACK               |
| Beginning Byte = N         |              |        |                   |
|                            |              |        | ACK               |
| RT                         | Repeat starT |        |                   |
| Slave Address              |              |        |                   |
| RD                         | ReaD         |        |                   |
|                            |              |        | ACK               |
|                            |              |        |                   |
|                            |              |        | Data Byte Count=X |
| ACK                        |              |        |                   |
|                            |              | X Byte | Beginning Byte N  |
| ACK                        |              |        |                   |
|                            |              |        | O                 |
| O                          |              |        | O                 |
| O                          |              |        | O                 |
| O                          |              |        |                   |
|                            |              |        | Byte N + X - 1    |
| N                          | Not          |        |                   |
| P                          | stoP bit     |        |                   |

### 4.3 SMBus Bit Types

| Bit Description | Definition              |
|-----------------|-------------------------|
| RO              | Read-only               |
| RW              | Read-write              |
| RW1C            | Read/Write '1' to clear |
| RESERVED        | Undefined do not write  |

### 4.4 Write Lock Functionality

| WRITE_LOCK | WRITE_LOCK RW1C | SMBus Write Protect |
|------------|-----------------|---------------------|
| 0          | 0               | No                  |
| 0          | 1               | Yes                 |
| 1          | 0               | Yes                 |
| 1          | 1               | Yes                 |

### 4.5 SMBus Address Decode

| Address Selection |           | Binary Value |   |   |   |   |   |   |        | Hex Value |
|-------------------|-----------|--------------|---|---|---|---|---|---|--------|-----------|
| SADR_tri1         | SADR_tri0 | 7            | 6 | 5 | 4 | 3 | 2 | 1 | Rd/Wrt |           |
| 0                 | 0         | 1            | 1 | 0 | 1 | 1 | 0 | 0 | 0      | D8        |
|                   | M         | 1            | 1 | 0 | 1 | 1 | 0 | 1 | 0      | DA        |
|                   | 1         | 1            | 1 | 0 | 1 | 1 | 1 | 1 | 0      | DE        |
| M                 | 0         | 1            | 1 | 0 | 0 | 0 | 0 | 1 | 0      | C2        |
|                   | M         | 1            | 1 | 0 | 0 | 0 | 1 | 0 | 0      | C4        |
|                   | 1         | 1            | 1 | 0 | 0 | 0 | 1 | 1 | 0      | C6        |
| 1                 | 0         | 1            | 1 | 0 | 0 | 1 | 0 | 1 | 0      | CA        |
|                   | M         | 1            | 1 | 0 | 0 | 1 | 1 | 0 | 0      | CC        |
|                   | 1         | 1            | 1 | 0 | 0 | 1 | 1 | 1 | 0      | CE        |

## 4.6 RC19024 SMBus Registers

Table 33. RC19024 SMBus Registers

| Byte | Register         | Name     | Bit | Type | Default | Description             | Definition  |
|------|------------------|----------|-----|------|---------|-------------------------|---|
| 0    | OUTPUT_ENABLE_0  | CLK7_EN  | [7] | RW   | 1       | Output Enable for CLK7  | 0 = output is disabled (low/low)<br>1 = output is enabled |
|      |                  | CLK6_EN  | [6] | RW   | 1       | Output Enable for CLK6  |   |
|      |                  | CLK5_EN  | [5] | RW   | 1       | Output Enable for CLK5  |   |
|      |                  | CLK4_EN  | [4] | RW   | 1       | Output Enable for CLK4  |   |
|      |                  | CLK3_EN  | [3] | RW   | 1       | Output Enable for CLK3  |   |
|      |                  | CLK2_EN  | [2] | RW   | 1       | Output Enable for CLK2  |   |
|      |                  | CLK1_EN  | [1] | RW   | 1       | Output Enable for CLK1  |   |
|      |                  | CLK0_EN  | [0] | RW   | 1       | Output Enable for CLK0  |   |
| 1    | OUTPUT_ENABLE_1  | CLK15_EN | [7] | RW   | 1       | Output Enable for CLK15 | 0 = output is disabled (low/low)<br>1 = output is enabled |
|      |                  | CLK14_EN | [6] | RW   | 1       | Output Enable for CLK14 |   |
|      |                  | CLK13_EN | [5] | RW   | 1       | Output Enable for CLK13 |   |
|      |                  | CLK12_EN | [4] | RW   | 1       | Output Enable for CLK12 |   |
|      |                  | CLK11_EN | [3] | RW   | 1       | Output Enable for CLK11 |   |
|      |                  | CLK10_EN | [2] | RW   | 1       | Output Enable for CLK10 |   |
|      |                  | CLK9_EN  | [1] | RW   | 1       | Output Enable for CLK9  |   |
|      |                  | CLK8_EN  | [0] | RW   | 1       | Output Enable for CLK8  |   |
| 2    | OUTPUT_ENABLE_2  | CLK23_EN | [7] | RW   | 1       | Output Enable for CLK23 | 0 = output is disabled (low/low)<br>1 = output is enabled |
|      |                  | CLK22_EN | [6] | RW   | 1       | Output Enable for CLK22 |   |
|      |                  | CLK21_EN | [5] | RW   | 1       | Output Enable for CLK21 |   |
|      |                  | CLK20_EN | [4] | RW   | 1       | Output Enable for CLK20 |   |
|      |                  | CLK19_EN | [3] | RW   | 1       | Output Enable for CLK19 |   |
|      |                  | CLK18_EN | [2] | RW   | 1       | Output Enable for CLK18 |   |
|      |                  | CLK17_EN | [1] | RW   | 1       | Output Enable for CLK17 |   |
|      |                  | CLK16_EN | [0] | RW   | 1       | Output Enable for CLK16 |   |
| 3    | OEB_PIN_READBACK | RESERVED | [7] | RO   | 0       | RESERVED                | 0 = pin low<br>1 = pin high                               |
|      |                  | RB_OEb23 | [6] | RO   | 1'bX    | Status of OEb23         |   |
|      |                  | RB_OEb22 | [5] | RO   | 1'bX    | Status of OEb22         |   |
|      |                  | RB_OEb2  | [4] | RO   | 1'bX    | Status of OEb2          |   |
|      |                  | RB_OEb_D | [3] | RO   | 1'bX    | Status of OEb_D         |   |
|      |                  | RB_OEb_C | [2] | RO   | 1'bX    | Status of OEb_C         |   |
|      |                  | RB_OEb_B | [1] | RO   | 1'bX    | Status of OEb_B         |   |
|      |                  | RB_OEb_A | [0] | RO   | 1'bX    | Status of OEb_A         |   |

Table 33. RC19024 SMBus Registers (Cont.)

| Byte | Register             | Name       | Bit   | Type | Default | Description   | Definition  |
|------|----------------------|------------|-------|------|---------|---|---|
| 4    | SBEN_RDBK_ACP_CONFIG | RESERVED   | [7:5] | RW   | 1'b111  | -   | -   |
|      |                      | ACP_ENABLE | [4]   | RW   | 1       | Enable Automatic Clock Parking to low/low when LOS event is detected                  | 0 = disable ACP<br>1 = enable ACP                                   |
|      |                      | RESERVED   | [3:1] | RW   | 1'b110  | -   | -   |
|      |                      | RB_SBI_ENQ | [0]   | RO   | 1'bX    | Status of SBI_ENQ   | 0 = pin low<br>1 = pin high   |
| 5    | VENDOR_REVISION_ID   | RID        | [7:4] | RO   | 0x0     | REVISION ID, A rev is 0000  | -   |
|      |                      | VID        | [3:0] | RO   | 0x1     | VENDOR ID, ICS/IDT/Renesas  | -   |
| 6    | DEVICE_ID            | DEVICE_ID  | [7:0] | RO   | 0x18    | Device ID   | -   |
| 7    | BYTE_COUNT           | RESERVED   | [7:5] | RW   | 0x0     | RESERVED  | -   |
|      |                      | BC         | [4:0] | RW   | 0x7     | Writing to this register configures how many bytes will be read back in a block read. | -   |
| 8    | SBI_MASK_0           | MASK7      | [7]   | RW   | 0       | Masks off Side-band Disable for CLK7  | 0 = SBI may disable the output<br>1 = SBI cannot disable the output |
|      |                      | MASK6      | [6]   | RW   | 0       | Masks off Side-band Disable for CLK6  |   |
|      |                      | MASK5      | [5]   | RW   | 0       | Masks off Side-band Disable for CLK5  |   |
|      |                      | MASK4      | [4]   | RW   | 0       | Masks off Side-band Disable for CLK4  |   |
|      |                      | MASK3      | [3]   | RW   | 0       | Masks off Side-band Disable for CLK3  |   |
|      |                      | MASK2      | [2]   | RW   | 0       | Masks off Side-band Disable for CLK2  |   |
|      |                      | MASK1      | [1]   | RW   | 0       | Masks off Side-band Disable for CLK1  |   |
|      |                      | MASK0      | [0]   | RW   | 0       | Masks off Side-band Disable for CLK0  |   |

Table 33. RC19024 SMBus Registers (Cont.)

| Byte | Register   | Name   | Bit | Type | Default | Description                           | Definition  |
|------|------------|--------|-----|------|---------|---------------------------------------|---|
| 9    | SBI_MASK_1 | MASK15 | [7] | RW   | 0       | Masks off Side-band Disable for CLK15 | 0 = SBI may disable the output<br>1 = SBI cannot disable the output |
|      |            | MASK14 | [6] | RW   | 0       | Masks off Side-band Disable for CLK14 |   |
|      |            | MASK13 | [5] | RW   | 0       | Masks off Side-band Disable for CLK13 |   |
|      |            | MASK12 | [4] | RW   | 0       | Masks off Side-band Disable for CLK12 |   |
|      |            | MASK11 | [3] | RW   | 0       | Masks off Side-band Disable for CLK11 |   |
|      |            | MASK10 | [2] | RW   | 0       | Masks off Side-band Disable for CLK10 |   |
|      |            | MASK9  | [1] | RW   | 0       | Masks off Side-band Disable for CLK9  |   |
|      |            | MASK8  | [0] | RW   | 0       | Masks off Side-band Disable for CLK8  |   |
| 10   | SBI_MASK_2 | MASK23 | [7] | RW   | 0       | Masks off Side-band Disable for CLK23 | 0 = SBI may disable the output<br>1 = SBI cannot disable the output |
|      |            | MASK22 | [6] | RW   | 0       | Masks off Side-band Disable for CLK22 |   |
|      |            | MASK21 | [5] | RW   | 0       | Masks off Side-band Disable for CLK21 |   |
|      |            | MASK20 | [4] | RW   | 0       | Masks off Side-band Disable for CLK20 |   |
|      |            | MASK19 | [3] | RW   | 0       | Masks off Side-band Disable for CLK19 |   |
|      |            | MASK18 | [2] | RW   | 0       | Masks off Side-band Disable for CLK18 |   |
|      |            | MASK17 | [1] | RW   | 0       | Masks off Side-band Disable for CLK17 |   |
|      |            | MASK16 | [0] | RW   | 0       | Masks off Side-band Disable for CLK16 |   |

Table 33. RC19024 SMBus Registers (Cont.)

| Byte | Register                      | Name      | Bit | Type | Default | Description                             | Definition                  |
|------|-------------------------------|-----------|-----|------|---------|---|-----------------------------|
| 11   | SBI_READBACK_0 <sup>[1]</sup> | SBI_CLK7  | [7] | RO   | 1'bX    | Readback of Side-band Disable for CLK7  | 0 = bit low<br>1 = bit high |
|      |                               | SBI_CLK6  | [6] | RO   | 1'bX    | Readback of Side-band Disable for CLK6  |                             |
|      |                               | SBI_CLK5  | [5] | RO   | 1'bX    | Readback of Side-band Disable for CLK5  |                             |
|      |                               | SBI_CLK4  | [4] | RO   | 1'bX    | Readback of Side-band Disable for CLK4  |                             |
|      |                               | SBI_CLK3  | [3] | RO   | 1'bX    | Readback of Side-band Disable for CLK3  |                             |
|      |                               | SBI_CLK2  | [2] | RO   | 1'bX    | Readback of Side-band Disable for CLK2  |                             |
|      |                               | SBI_CLK1  | [1] | RO   | 1'bX    | Readback of Side-band Disable for CLK1  |                             |
|      |                               | SBI_CLK0  | [0] | RO   | 1'bX    | Readback of Side-band Disable for CLK0  |                             |
| 12   | SBI_READBACK_1 <sup>[1]</sup> | SBI_CLK15 | [7] | RO   | 1'bX    | Readback of Side-band Disable for CLK15 | 0 = bit low<br>1 = bit high |
|      |                               | SBI_CLK14 | [6] | RO   | 1'bX    | Readback of Side-band Disable for CLK14 |                             |
|      |                               | SBI_CLK13 | [5] | RO   | 1'bX    | Readback of Side-band Disable for CLK13 |                             |
|      |                               | SBI_CLK12 | [4] | RO   | 1'bX    | Readback of Side-band Disable for CLK12 |                             |
|      |                               | SBI_CLK11 | [3] | RO   | 1'bX    | Readback of Side-band Disable for CLK11 |                             |
|      |                               | SBI_CLK10 | [2] | RO   | 1'bX    | Readback of Side-band Disable for CLK10 |                             |
|      |                               | SBI_CLK9  | [1] | RO   | 1'bX    | Readback of Side-band Disable for CLK9  |                             |
|      |                               | SBI_CLK8  | [0] | RO   | 1'bX    | Readback of Side-band Disable for CLK8  |                             |



Table 33. RC19024 SMBus Registers (Cont.)

| Byte | Register           | Name         | Bit | Type | Default | Description                             | Definition  |
|------|--------------------|--------------|-----|------|---------|---|---|
| 13   | SBI_READBACK_2 [1] | SBI_CLK23    | [7] | RO   | 1'bX    | Readback of Side-band Disable for CLK23 | 0 = bit low<br>1 = bit high   |
|      |                    | SBI_CLK22    | [6] | RO   | 1'bX    | Readback of Side-band Disable for CLK22 |   |
|      |                    | SBI_CLK21    | [5] | RO   | 1'bX    | Readback of Side-band Disable for CLK21 |   |
|      |                    | SBI_CLK20    | [4] | RO   | 1'bX    | Readback of Side-band Disable for CLK20 |   |
|      |                    | SBI_CLK19    | [3] | RO   | 1'bX    | Readback of Side-band Disable for CLK19 |   |
|      |                    | SBI_CLK18    | [2] | RO   | 1'bX    | Readback of Side-band Disable for CLK18 |   |
|      |                    | SBI_CLK17    | [1] | RO   | 1'bX    | Readback of Side-band Disable for CLK17 |   |
|      |                    | SBI_CLK16    | [0] | RO   | 1'bX    | Readback of Side-band Disable for CLK16 |   |
| 14   | OEB_ASSIGNMENT_0   | CLK7_OEb_EN  | [7] | RW   | 0       | Output Enable by OEB_B                  | 0 = output stop by OEB is disabled<br>1 = output stop by OEB is enabled |
|      |                    | CLK6_OEb_EN  | [6] | RW   | 1       | Output Enable by OEB_B                  |   |
|      |                    | CLK5_OEb_EN  | [5] | RW   | 1       | Output Enable by OEB_A                  |   |
|      |                    | CLK4_OEb_EN  | [4] | RW   | 0       | Output Enable by OEB_A                  |   |
|      |                    | CLK3_OEb_EN  | [3] | RW   | 0       | Output Enable by OEB_A                  |   |
|      |                    | CLK2_OEb_EN  | [2] | RW   | 0       | Output Enable by OEB_A                  |   |
|      |                    | CLK1_OEb_EN  | [1] | RW   | 0       | Output Enable by OEB_A                  |   |
|      |                    | CLK0_OEb_EN  | [0] | RW   | 0       | Output Enable by OEB_A                  |   |
| 15   | OEB_ASSIGNMENT_1   | CLK15_OEb_EN | [7] | RW   | 0       | Output Enable by OEB_C                  | 0 = output stop by OEB is disabled<br>1 = output stop by OEB is enabled |
|      |                    | CLK14_OEb_EN | [6] | RW   | 0       | Output Enable by OEB_C                  |   |
|      |                    | CLK13_OEb_EN | [5] | RW   | 0       | Output Enable by OEB_C                  |   |
|      |                    | CLK12_OEb_EN | [4] | RW   | 0       | Output Enable by OEB_C                  |   |
|      |                    | CLK11_OEb_EN | [3] | RW   | 0       | Output Enable by OEB_B                  |   |
|      |                    | CLK10_OEb_EN | [2] | RW   | 0       | Output Enable by OEB_B                  |   |
|      |                    | CLK9_OEb_EN  | [1] | RW   | 0       | Output Enable by OEB_B                  |   |
|      |                    | CLK8_OEb_EN  | [0] | RW   | 0       | Output Enable by OEB_B                  |   |
| 16   | OEB_ASSIGNMENT_2   | CLK23_OEb_EN | [7] | RW   | 0       | Output Enable by OEB_D                  | 0 = output stop by OEB is disabled<br>1 = output stop by OEB is enabled |
|      |                    | CLK22_OEb_EN | [6] | RW   | 0       | Output Enable by OEB_D                  |   |
|      |                    | CLK21_OEb_EN | [5] | RW   | 0       | Output Enable by OEB_D                  |   |
|      |                    | CLK20_OEb_EN | [4] | RW   | 0       | Output Enable by OEB_D                  |   |
|      |                    | CLK19_OEb_EN | [3] | RW   | 0       | Output Enable by OEB_D                  |   |
|      |                    | CLK18_OEb_EN | [2] | RW   | 1       | Output Enable by OEB_D                  |   |
|      |                    | CLK17_OEb_EN | [1] | RW   | 1       | Output Enable by OEB_C                  |   |
|      |                    | CLK16_OEb_EN | [0] | RW   | 0       | Output Enable by OEB_C                  |   |

Table 33. RC19024 SMBus Registers (Cont.)

| Byte | Register           | Name             | Bit   | Type | Default | Description   | Definition  |
|------|--------------------|------------------|-------|------|---------|---|---|
| 17   | LPHCSL_AMP_CTRL    | AMP              | [7:4] | RW   | 0x7     | Global Differential output Control<br>0.6V~1V 25mV/step<br>Default = 0.8V | -   |
|      |                    | RESERVED         | [3:0] | RW   | 0x7     | RESERVED  | -   |
| 18   | PD_RESTORE_LOSb    | AC_IN            | [7]   | RW   | 0       | Enable receiver bias when CLKIN is AC coupled,                            | 0 = DC coupled input<br>1 = AC coupled input                              |
|      |                    | Rx_TERM          | [6]   | RW   | 0       | Enable termination resistors on CLKIN                                     | 0 = input termination R is disabled<br>1 = input termination R is enabled |
|      |                    | RESERVED         | [5:4] |      | 1'b11   | -   | -   |
|      |                    | PD_RESTOREb      | [3]   | RW   | 1       | Save Configuration in Power Down  | 0 = Config Cleared<br>1 = Config Saved                                    |
|      |                    | SDATA_TIMEOUT_EN | [2]   | RW   | 1       | Enable SMB SDATA time out monitoring                                      | 0 = disable SDATA time out<br>1 = enable SDATA time out                   |
|      |                    | RESERVED         | [1]   | RO   | 1'bX    | -   | -   |
|      |                    | LOSb_RB          | [0]   | RO   | 1'bX    | real time read back of loss detect block output                           | 0 = LOS event detected<br>1 = NO LOS event detected.                      |
| 19   | Reserved           | RESERVED         | [7:0] | RW   | 0x07    | RESERVED  | -   |
| 20   | OUTPUT_SLEW_RATE_0 | CLK7_SLEWRATE    | [7]   | RW   | 1       | CLK7 Slew Rate Control  | 0 = low slew rate<br>1 = high slew rate                                   |
|      |                    | CLK6_SLEWRATE    | [6]   | RW   | 1       | CLK6 Slew Rate Control  |   |
|      |                    | CLK5_SLEWRATE    | [5]   | RW   | 1       | CLK5 Slew Rate Control  |   |
|      |                    | CLK4_SLEWRATE    | [4]   | RW   | 1       | CLK4 Slew Rate Control  |   |
|      |                    | CLK3_SLEWRATE    | [3]   | RW   | 1       | CLK3 Slew Rate Control  |   |
|      |                    | CLK2_SLEWRATE    | [2]   | RW   | 1       | CLK2 Slew Rate Control  |   |
|      |                    | CLK1_SLEWRATE    | [1]   | RW   | 1       | CLK1 Slew Rate Control  |   |
|      |                    | CLK0_SLEWRATE    | [0]   | RW   | 1       | CLK0 Slew Rate Control  |   |

Table 33. RC19024 SMBus Registers (Cont.)

| Byte  | Register                   | Name            | Bit   | Type | Default       | Description   | Definition   |
|-------|----------------------------|-----------------|-------|------|---------------|---|--|
| 21    | OUTPUT_SLEW_RATE_1         | CLK15_SLEWRATE  | [7]   | RW   | 1             | CLK15 Slewrate Control  | 0 = low slew rate<br>1 = high slew rate  |
|       |                            | CLK14_SLEWRATE  | [6]   | RW   | 1             | CLK14 Slewrate Control  |  |
|       |                            | CLK13_SLEWRATE  | [5]   | RW   | 1             | CLK13 Slewrate Control  |  |
|       |                            | CLK12_SLEWRATE  | [4]   | RW   | 1             | CLK12 Slewrate Control  |  |
|       |                            | CLK11_SLEWRATE  | [3]   | RW   | 1             | CLK11 Slewrate Control  |  |
|       |                            | CLK10_SLEWRATE  | [2]   | RW   | 1             | CLK10 Slewrate Control  |  |
|       |                            | CLK9_SLEWRATE   | [1]   | RW   | 1             | CLK9 Slewrate Control   |  |
|       |                            | CLK8_SLEWRATE   | [0]   | RW   | 1             | CLK8 Slewrate Control   |  |
| 22    | OUTPUT_SLEW_RATE_2         | CLK23_SLEWRATE  | [7]   | RW   | 1             | CLK23 Slewrate Control  | 0 = low slew rate<br>1 = high slew rate  |
|       |                            | CLK22_SLEWRATE  | [6]   | RW   | 1             | CLK22 Slewrate Control  |  |
|       |                            | CLK21_SLEWRATE  | [5]   | RW   | 1             | CLK21 Slewrate Control  |  |
|       |                            | CLK20_SLEWRATE  | [4]   | RW   | 1             | CLK20 Slewrate Control  |  |
|       |                            | CLK19_SLEWRATE  | [3]   | RW   | 1             | CLK19 Slewrate Control  |  |
|       |                            | CLK18_SLEWRATE  | [2]   | RW   | 1             | CLK18 Slewrate Control  |  |
|       |                            | CLK17_SLEWRATE  | [1]   | RW   | 1             | CLK17 Slewrate Control  |  |
|       |                            | CLK16_SLEWRATE  | [0]   | RW   | 1             | CLK16 Slewrate Control  |  |
| 23–37 | Reserved                   | RESERVED        |       | RW   | 0xXX          | RESERVED  | -  |
| 38    | WRITE_LOCK_NCLEAR          | RESERVED        | [7:1] | RW   | 0x0           | RESERVED  | -  |
|       |                            | WRITE_LOCK      | [0]   | RW   | 0             | Non-clearable SMBus Write Lock bit. When written to one, the SMBus control registers cannot be written to. This bit can only be cleared by cycling power. | 0 = SMBus not locked for writing by this bit. See WRITE_LOCK_RW1C bit.<br>1 = SMBus locked for writing |
| 39    | WRITE_LOCK_CLEAR_LOS_EVENT | RESERVED        | [7:2] | RW1C | 1'b11100<br>0 | -   | -  |
|       |                            | LOS_EVT         | [1]   | RW1C | 0             | LOS Event Status<br>When high, indicates that a LOS event was detected. Can be cleared by writing a 1 to it.  | 0 = No LOS event detected<br>1 = LOS event detected.   |
|       |                            | WRITE_LOCK_RW1C | [0]   | RW1C | 0             | Clearable SMBus Write Lock bit.<br>When written to one, the SMBus control registers cannot be written to. This bit can be cleared by writing a 1 to it.   | 0 = SMBus not locked for writing by this bit. See WRITE_LOCK bit.<br>1 = SMBus locked for writing      |

1. Register only valid when the Side-Band Interface is enabled (SBI\_ENQ = 1).

## 4.7 RC19020 SMBus Registers

Table 34. RC19020 SMBus Registers

| Byte | Register             | Name       | Bit   | Type | Default | Description  | Definition  |
|------|----------------------|------------|-------|------|---------|--|---|
| 0    | OUTPUT_ENABLE_2      | RESERVED   | [7]   | RW   | 0       | RESERVED   | 0 = output is disabled (low/low)<br>1 = output is enabled |
|      |                      | CLK19_EN   | [6]   | RW   | 1       | Output Enable for CLK19  |   |
|      |                      | CLK18_EN   | [5]   | RW   | 1       | Output Enable for CLK18  |   |
|      |                      | CLK17_EN   | [4]   | RW   | 1       | Output Enable for CLK17  |   |
|      |                      | CLK16_EN   | [3]   | RW   | 1       | Output Enable for CLK16  |   |
|      |                      | RESERVED   | [2:0] | RW   | 1       | RESERVED   |   |
| 1    | OUTPUT_ENABLE_0      | CLK7_EN    | [7]   | RW   | 1       | Output Enable for CLK7   | 0 = output is disabled (low/low)<br>1 = output is enabled |
|      |                      | CLK6_EN    | [6]   | RW   | 1       | Output Enable for CLK6   |   |
|      |                      | CLK5_EN    | [5]   | RW   | 1       | Output Enable for CLK5   |   |
|      |                      | CLK4_EN    | [4]   | RW   | 1       | Output Enable for CLK4   |   |
|      |                      | CLK3_EN    | [3]   | RW   | 1       | Output Enable for CLK3   |   |
|      |                      | CLK2_EN    | [2]   | RW   | 1       | Output Enable for CLK2   |   |
|      |                      | CLK1_EN    | [1]   | RW   | 1       | Output Enable for CLK1   |   |
|      |                      | CLK0_EN    | [0]   | RW   | 1       | Output Enable for CLK0   |   |
| 2    | OUTPUT_ENABLE_1      | CLK15_EN   | [7]   | RW   | 1       | Output Enable for CLK15  | 0 = output is disabled (low/low)<br>1 = output is enabled |
|      |                      | CLK14_EN   | [6]   | RW   | 1       | Output Enable for CLK14  |   |
|      |                      | CLK13_EN   | [5]   | RW   | 1       | Output Enable for CLK13  |   |
|      |                      | CLK12_EN   | [4]   | RW   | 1       | Output Enable for CLK12  |   |
|      |                      | CLK11_EN   | [3]   | RW   | 1       | Output Enable for CLK11  |   |
|      |                      | CLK10_EN   | [2]   | RW   | 1       | Output Enable for CLK10  |   |
|      |                      | CLK9_EN    | [1]   | RW   | 1       | Output Enable for CLK9   |   |
|      |                      | CLK8_EN    | [0]   | RW   | 1       | Output Enable for CLK8   |   |
| 3    | OEB_PIN_READBACK     | RB_OEb_12  | [7]   | RO   | 1'bX    | Status of OEb12  | 0 = pin low<br>1 = pin high                               |
|      |                      | RB_OEb_11  | [6]   | RO   | 1'bX    | Status of OEb11  |   |
|      |                      | RB_OEb_10  | [5]   | RO   | 1'bX    | Status of OEb10  |   |
|      |                      | RB_OEb_9   | [4]   | RO   | 1'bX    | Status of OEb9   |   |
|      |                      | RB_OEb_8   | [3]   | RO   | 1'bX    | Status of OEb8   |   |
|      |                      | RB_OEb_7   | [2]   | RO   | 1'bX    | Status of OEb7   |   |
|      |                      | RB_OEb_6   | [1]   | RO   | 1'bX    | Status of OEb6   |   |
|      |                      | RB_OEb_5   | [0]   | RO   | 1'bX    | Status of OEb5   |   |
| 4    | SBEN_RDBK_ACP_CONFIG | RESERVED   | [7:5] | RW   | 1'b111  | RESERVED   | -   |
|      |                      | ACP_ENABLE | [4]   | RW   | 1       | Enable Automatic Clock Parking to low/low when LOS event is detected | 0 = disable ACP<br>1 = enable ACP                         |
|      |                      | RESERVED   | [3:1] | RW   | 1'b110  | RESERVED   | -   |
|      |                      | RB_SBI_ENQ | [0]   | RO   | 1'bX    | Status of SBI_ENQ  | 0 = pin low<br>1 = pin high                               |

Table 34. RC19020 SMBus Registers (Cont.)

| Byte | Register           | Name      | Bit   | Type | Default | Description   | Definition  |
|------|--------------------|-----------|-------|------|---------|---|---|
| 5    | VENDOR_REVISION_ID | RID       | [7:4] | RO   | 0x2     | REVISION ID, A rev is 0000  | -   |
|      |                    | VID       | [3:0] | RO   | 0x1     | VENDOR ID, ICS/IDT/Renesas  | -   |
| 6    | DEVICE_ID          | DEVICE_ID | [7:0] | RO   | 0xC9    | Device ID   | -   |
| 7    | BYTE_COUNT         | RESERVED  | [7:5] | RW   | 0x0     | RESERVED  | -   |
|      |                    | BC        | [4:0] | RW   | 0x7     | Writing to this register configures how many bytes will be read back in a block read. | -   |
| 8    | SBI_MASK_0         | MASK7     | [7]   | RW   | 0       | Masks off Side-band Disable for CLK7  | 0 = SBI may disable the output<br>1 = SBI cannot disable the output |
|      |                    | MASK6     | [6]   | RW   | 0       | Masks off Side-band Disable for CLK6  |   |
|      |                    | MASK5     | [5]   | RW   | 0       | Masks off Side-band Disable for CLK5  |   |
|      |                    | MASK4     | [4]   | RW   | 0       | Masks off Side-band Disable for CLK4  |   |
|      |                    | MASK3     | [3]   | RW   | 0       | Masks off Side-band Disable for CLK3  |   |
|      |                    | MASK2     | [2]   | RW   | 0       | Masks off Side-band Disable for CLK2  |   |
|      |                    | MASK1     | [1]   | RW   | 0       | Masks off Side-band Disable for CLK1  |   |
|      |                    | MASK0     | [0]   | RW   | 0       | Masks off Side-band Disable for CLK0  |   |
| 9    | SBI_MASK_1         | MASK15    | [7]   | RW   | 0       | Masks off Side-band Disable for CLK15   | 0 = SBI may disable the output<br>1 = SBI cannot disable the output |
|      |                    | MASK14    | [6]   | RW   | 0       | Masks off Side-band Disable for CLK14   |   |
|      |                    | MASK13    | [5]   | RW   | 0       | Masks off Side-band Disable for CLK13   |   |
|      |                    | MASK12    | [4]   | RW   | 0       | Masks off Side-band Disable for CLK12   |   |
|      |                    | MASK11    | [3]   | RW   | 0       | Masks off Side-band Disable for CLK11   |   |
|      |                    | MASK10    | [2]   | RW   | 0       | Masks off Side-band Disable for CLK10   |   |
|      |                    | MASK9     | [1]   | RW   | 0       | Masks off Side-band Disable for CLK9  |   |
|      |                    | MASK8     | [0]   | RW   | 0       | Masks off Side-band Disable for CLK8  |   |

Table 34. RC19020 SMBus Registers (Cont.)

| Byte    | Register           | Name           | Bit   | Type | Default | Description   | Definition  |
|---------|--------------------|----------------|-------|------|---------|---|---|
| 10      | SBI_MASK_2         | RESERVED       | [7:4] | RW   | 0       | RESERVED  | -   |
|         |                    | MASK19         | [3]   | RW   | 0       | Masks off Side-band Disable for CLK19                                     | 0 = SBI may disable the output<br>1 = SBI cannot disable the output |
|         |                    | MASK18         | [2]   | RW   | 0       | Masks off Side-band Disable for CLK18                                     |   |
|         |                    | MASK17         | [1]   | RW   | 0       | Masks off Side-band Disable for CLK17                                     |   |
|         |                    | MASK16         | [0]   | RW   | 0       | Masks off Side-band Disable for CLK16                                     |   |
| 11      | OUTPUT_SLEW_RATE_0 | CLK7_SLEWRATE  | [7]   | RW   | 1       | CLK7 Slewrate Control   | 0 = low slew rate<br>1 = high slew rate                             |
|         |                    | CLK6_SLEWRATE  | [6]   | RW   | 1       | CLK6 Slewrate Control   |   |
|         |                    | CLK5_SLEWRATE  | [5]   | RW   | 1       | CLK5 Slewrate Control   |   |
|         |                    | CLK4_SLEWRATE  | [4]   | RW   | 1       | CLK4 Slewrate Control   |   |
|         |                    | CLK3_SLEWRATE  | [3]   | RW   | 1       | CLK3 Slewrate Control   |   |
|         |                    | CLK2_SLEWRATE  | [2]   | RW   | 1       | CLK2 Slewrate Control   |   |
|         |                    | CLK1_SLEWRATE  | [1]   | RW   | 1       | CLK1 Slewrate Control   |   |
|         |                    | CLK0_SLEWRATE  | [0]   | RW   | 1       | CLK0 Slewrate Control   |   |
| 12      | OUTPUT_SLEW_RATE_1 | CLK15_SLEWRATE | [7]   | RW   | 1       | CLK15 Slewrate Control  | 0 = low slew rate<br>1 = high slew rate                             |
|         |                    | CLK14_SLEWRATE | [6]   | RW   | 1       | CLK14 Slewrate Control  |   |
|         |                    | CLK13_SLEWRATE | [5]   | RW   | 1       | CLK13 Slewrate Control  |   |
|         |                    | CLK12_SLEWRATE | [4]   | RW   | 1       | CLK12 Slewrate Control  |   |
|         |                    | CLK11_SLEWRATE | [3]   | RW   | 1       | CLK11 Slewrate Control  |   |
|         |                    | CLK10_SLEWRATE | [2]   | RW   | 1       | CLK10 Slewrate Control  |   |
|         |                    | CLK9_SLEWRATE  | [1]   | RW   | 1       | CLK9 Slewrate Control   |   |
|         |                    | CLK8_SLEWRATE  | [0]   | RW   | 1       | CLK8 Slewrate Control   |   |
| 13      | OUTPUT_SLEW_RATE_2 | RESERVED       | [7:4] | RW   | 0b111   | RESERVED  | 0 = low slew rate<br>1 = high slew rate                             |
|         |                    | CLK19_SLEWRATE | [3]   | RW   | 1       | CLK19 Slewrate Control  |   |
|         |                    | CLK18_SLEWRATE | [2]   | RW   | 1       | CLK18 Slewrate Control  |   |
|         |                    | CLK17_SLEWRATE | [1]   | RW   | 1       | CLK17 Slewrate Control  |   |
|         |                    | CLK16_SLEWRATE | [0]   | RW   | 1       | CLK16 Slewrate Control  |   |
| 14 - 19 | RESERVED           | -              | -     | -    | -       | RESERVED  | -   |
| 20      | LPHCSL_AMP_CTRL    | AMP            | [7:4] | RW   | 0x7     | Global Differential output Control<br>0.6V~1V 25mV/step<br>Default = 0.8V | -   |
|         |                    | RESERVED       | [3:0] | RW   | 0x7     | RESERVED  | -   |

Table 34. RC19020 SMBus Registers (Cont.)

| Byte  | Register                      | Name             | Bit   | Type | Default | Description                                     | Definition  |
|-------|-------------------------------|------------------|-------|------|---------|---|---|
| 21    | PD_RESTORE_LOSb               | AC_IN            | [7]   | RW   | 0       | Enable receiver bias when CLKIN is AC coupled,  | 0 = DC coupled input<br>1 = AC coupled input                              |
|       |                               | Rx_TERM          | [6]   | RW   | 0       | Enable termination resistors on CLKIN           | 0 = input termination R is disabled<br>1 = input termination R is enabled |
|       |                               | RESERVED         | [5:4] | -    | 1'b11   | -   | -   |
|       |                               | PD_RESTOREb      | [3]   | RW   | 1       | Save Configuration in Power Down                | 0 = Config Cleared<br>1 = Config Saved                                    |
|       |                               | SDATA_TIMEOUT_EN | [2]   | RW   | 1       | Enable SMB SDATA time out monitoring            | 0 = disable SDATA time out<br>1 = enable SDATA time out                   |
|       |                               | RESERVED         | [1]   | RO   | 1'bX    | -   | -   |
|       |                               | LOSb_RB          | [0]   | RO   | 1'bX    | real time read back of loss detect block output | 0 = LOS event detected<br>1 = NO LOS event detected.                      |
| 22–32 | RESERVED                      | RESERVED         | [7:0] | RW   | 0xXX    | RESERVED  | -   |
| 33    | SBI_READBACK_0 <sup>[1]</sup> | SBI_CLK7         | [7]   | RO   | 1'bX    | Readback of Side-band Disable for CLK7          | 0 = bit low<br>1 = bit high   |
|       |                               | SBI_CLK6         | [6]   | RO   | 1'bX    | Readback of Side-band Disable for CLK6          |   |
|       |                               | SBI_CLK5         | [5]   | RO   | 1'bX    | Readback of Side-band Disable for CLK5          |   |
|       |                               | SBI_CLK4         | [4]   | RO   | 1'bX    | Readback of Side-band Disable for CLK4          |   |
|       |                               | SBI_CLK3         | [3]   | RO   | 1'bX    | Readback of Side-band Disable for CLK3          |   |
|       |                               | SBI_CLK2         | [2]   | RO   | 1'bX    | Readback of Side-band Disable for CLK2          |   |
|       |                               | SBI_CLK1         | [1]   | RO   | 1'bX    | Readback of Side-band Disable for CLK1          |   |
|       |                               | SBI_CLK0         | [0]   | RO   | 1'bX    | Readback of Side-band Disable for CLK0          |   |

Table 34. RC19020 SMBus Registers (Cont.)

| Byte  | Register                      | Name            | Bit   | Type | Default       | Description   | Definition   |
|-------|-------------------------------|-----------------|-------|------|---------------|---|--|
| 34    | SBI_READBACK_1 <sup>[1]</sup> | SBI_CLK15       | [7]   | RO   | 1'bX          | Readback of Side-band Disable for CLK15   | 0 = bit low<br>1 = bit high  |
|       |                               | SBI_CLK14       | [6]   | RO   | 1'bX          | Readback of Side-band Disable for CLK14   |  |
|       |                               | SBI_CLK13       | [5]   | RO   | 1'bX          | Readback of Side-band Disable for CLK13   |  |
|       |                               | SBI_CLK12       | [4]   | RO   | 1'bX          | Readback of Side-band Disable for CLK12   |  |
|       |                               | SBI_CLK11       | [3]   | RO   | 1'bX          | Readback of Side-band Disable for CLK11   |  |
|       |                               | SBI_CLK10       | [2]   | RO   | 1'bX          | Readback of Side-band Disable for CLK10   |  |
|       |                               | SBI_CLK9        | [1]   | RO   | 1'bX          | Readback of Side-band Disable for CLK9  |  |
|       |                               | SBI_CLK8        | [0]   | RO   | 1'bX          | Readback of Side-band Disable for CLK8  |  |
| 35    | SBI_READBACK_2 <sup>[1]</sup> | RESERVED        | [7:4] | RO   | 1'bXXX        | RESERVED  | 0 = bit low<br>1 = bit high  |
|       |                               | SBI_CLK19       | [3]   | RO   | 1'bX          | Readback of Side-band Disable for CLK19   |  |
|       |                               | SBI_CLK18       | [2]   | RO   | 1'bX          | Readback of Side-band Disable for CLK18   |  |
|       |                               | SBI_CLK17       | [1]   | RO   | 1'bX          | Readback of Side-band Disable for CLK17   |  |
|       |                               | SBI_CLK16       | [0]   | RO   | 1'bX          | Readback of Side-band Disable for CLK16   |  |
| 36-37 | RESERVED                      | RESERVED        | [7:0] | RW   | 0xXX          | RESERVED  | RESERVED   |
| 38    | WRITE_LOCK_NCLEAR             | RESERVED        | [7:1] | RW   | 0x0           | RESERVED  | -  |
|       |                               | WRITE_LOCK      | [0]   | RW   | 0             | Non-clearable SMBus Write Lock bit. When written to one, the SMBus control registers cannot be written to. This bit can only be cleared by cycling power. | 0 = SMBus not locked for writing by this bit. See WRITE_LOCK_RW1C bit.<br>1 = SMBus locked for writing |
| 39    | WRITE_LOCK_CLEAR_LOS_EVENT    | RESERVED        | [7:2] | RW1C | 1'b11100<br>0 | -   | -  |
|       |                               | LOS_EVT         | [1]   | RW1C | 0             | LOS Event Status<br>When high, indicates that a LOS event was detected. Can be cleared by writing a 1 to it.  | 0 = No LOS event detected<br>1 = LOS event detected.   |
|       |                               | WRITE_LOCK_RW1C | [0]   | RW1C | 0             | Clearable SMBus Write Lock bit.<br>When written to one, the SMBus control registers cannot be written to. This bit can be cleared by writing a 1 to it.   | 0 = SMBus not locked for writing by this bit. See WRITE_LOCK bit.<br>1 = SMBus locked for writing      |

1. Register only valid when the Side-Band Interface is enabled (SBI\_ENQ = 1).



## 4.8 RC19020A072 SMBus Registers

Table 35. RC19020A072 SMBus Registers

| Byte | Register             | Name                     | Bit   | Type | Default | Description  | Definition  |
|------|----------------------|--------------------------|-------|------|---------|--|---|
| 0    | OUTPUT_ENABLE_2      | RESERVED                 | [7]   | RW   | 0       | RESERVED   | 0 = output is disabled (low/low)<br>1 = output is enabled |
|      |                      | CLK19_EN                 | [6]   | RW   | 1       | Output Enable for CLK19  |   |
|      |                      | CLK18_EN                 | [5]   | RW   | 1       | Output Enable for CLK18  |   |
|      |                      | CLK17_EN                 | [4]   | RW   | 1       | Output Enable for CLK17  |   |
|      |                      | CLK16_EN                 | [3]   | RW   | 1       | Output Enable for CLK16  |   |
|      |                      | RESERVED                 | [2:0] | RW   | 0       | RESERVED   |   |
| 1    | OUTPUT_ENABLE_0      | CLK7_EN                  | [7]   | RW   | 1       | Output Enable for CLK7   | 0 = output is disabled (low/low)<br>1 = output is enabled |
|      |                      | CLK6_EN                  | [6]   | RW   | 1       | Output Enable for CLK6   |   |
|      |                      | CLK5_EN                  | [5]   | RW   | 1       | Output Enable for CLK5   |   |
|      |                      | CLK4_EN                  | [4]   | RW   | 1       | Output Enable for CLK4   |   |
|      |                      | CLK3_EN                  | [3]   | RW   | 1       | Output Enable for CLK3   |   |
|      |                      | CLK2_EN                  | [2]   | RW   | 1       | Output Enable for CLK2   |   |
|      |                      | CLK1_EN                  | [1]   | RW   | 1       | Output Enable for CLK1   |   |
|      |                      | CLK0_EN                  | [0]   | RW   | 1       | Output Enable for CLK0   |   |
| 2    | OUTPUT_ENABLE_1      | CLK15_EN                 | [7]   | RW   | 1       | Output Enable for CLK15  | 0 = output is disabled (low/low)<br>1 = output is enabled |
|      |                      | CLK14_EN                 | [6]   | RW   | 1       | Output Enable for CLK14  |   |
|      |                      | CLK13_EN                 | [5]   | RW   | 1       | Output Enable for CLK13  |   |
|      |                      | CLK12_EN                 | [4]   | RW   | 1       | Output Enable for CLK12  |   |
|      |                      | CLK11_EN                 | [3]   | RW   | 1       | Output Enable for CLK11  |   |
|      |                      | CLK10_EN                 | [2]   | RW   | 1       | Output Enable for CLK10  |   |
|      |                      | CLK9_EN                  | [1]   | RW   | 1       | Output Enable for CLK9   |   |
|      |                      | CLK8_EN                  | [0]   | RW   | 1       | Output Enable for CLK8   |   |
| 3    | OEB_PIN_READBACK     | RB_OEb_12                | [7]   | RO   | 1'bX    | Status of OEb12  | 0 = pin low<br>1 = pin high                               |
|      |                      | RB_OEb_11                | [6]   | RO   | 1'bX    | Status of OEb11  |   |
|      |                      | RB_OEb_10 <sup>[1]</sup> | [5]   | RO   | 1'bX    | Status of OEb10  |   |
|      |                      | RB_OEb_9                 | [4]   | RO   | 1'bX    | Status of OEb9   |   |
|      |                      | RB_OEb_8                 | [3]   | RO   | 1'bX    | Status of OEb8   |   |
|      |                      | RB_OEb_7                 | [2]   | RO   | 1'bX    | Status of OEb7   |   |
|      |                      | RB_OEb_6 <sup>[1]</sup>  | [1]   | RO   | 1'bX    | Status of OEb6   |   |
|      |                      | RB_OEb_5 <sup>[1]</sup>  | [0]   | RO   | 1'bX    | Status of OEb5   |   |
| 4    | SBEN_RDBK_ACP_CONFIG | RESERVED                 | [7:5] | RW   | 1'b111  | RESERVED   | -   |
|      |                      | ACP_ENABLE               | [4]   | RW   | 1       | Enable Automatic Clock Parking to low/low when LOS event is detected | 0 = disable ACP<br>1 = enable ACP                         |
|      |                      | RESERVED                 | [3:1] | RW   | 1'b110  | RESERVED   | -   |
|      |                      | RB_SBI_ENQ               | [0]   | RO   | 1'bX    | Status of SBI_ENQ  | 0 = pin low<br>1 = pin high                               |

Table 35. RC19020A072 SMBus Registers (Cont.)

| Byte | Register                         | Name           | Bit   | Type | Default | Description  | Definition   |
|------|----------------------------------|----------------|-------|------|---------|--|--|
| 5    | VENDOR_REVISION_ID               | RID            | [7:4] | RO   | 0x0     | REVISION ID, A rev is 0000   | -  |
|      |                                  | VID            | [3:0] | RO   | 0x1     | VENDOR ID, ICS/IDT/Renesas   | -  |
| 6    | DEVICE_ID                        | DEVICE_ID      | [7:0] | RO   | 0xC8    | Device ID  | -  |
| 7    | BYTE_COUNT                       | RESERVED       | [7:5] | RW   | 0x0     | RESERVED   | -  |
|      |                                  | BC             | [4:0] | RW   | 0x8     | Writing to this register configures how many bytes will be read back in a block read | -  |
| 8    | OEB_Configuration_A              | CFGA_OEb12     | [7]   | RW   | 1       | Controls CLK12   | 0 = OEB does not control output<br>1 = OEB controls output |
|      |                                  | CFGA_OEb11     | [6]   | RW   | 1       | Controls CLK11   |  |
|      |                                  | CFGA_OEb10     | [5]   | RW   | 1       | Controls CLK10 when SBI_ENQ = 0  |  |
|      |                                  | CFGA_OEb9      | [4]   | RW   | 1       | Controls CLK9  |  |
|      |                                  | CFGA_OEb8      | [3]   | RW   | 1       | Controls CLK8  |  |
|      |                                  | CFGA_OEb7      | [2]   | RW   | 1       | Controls CLK7  |  |
|      |                                  | CFGA_OEb6      | [1]   | RW   | 1       | Controls CLK6 when SBI_ENQ = 0   |  |
| 9    | OEB_Configuration_B              | CFGB_OEb12     | [7]   | RW   | 0       | Controls CLK13   | 0 = OEB does not control output<br>1 = OEB controls output |
|      |                                  | CFGB_OEb11     | [6]   | RW   | 0       | Controls CLK14   |  |
|      |                                  | CFGB_OEb10     | [5]   | RW   | 0       | Controls CLK15 when SBI_ENQ = 0  |  |
|      |                                  | CFGB_OEb9      | [4]   | RW   | 0       | Controls CLK0  |  |
|      |                                  | CFGB_OEb8      | [3]   | RW   | 0       | Controls CLK1  |  |
|      |                                  | CFGB_OEb7      | [2]   | RW   | 0       | Controls CLK2  |  |
|      |                                  | CFGB_OEb6      | [1]   | RW   | 0       | Controls CLK3 when SBI_ENQ = 0   |  |
| 10   | OEB_Configuration_C_AMP_Control_ | CFGC_OEb12     | [7]   | RW   | 0       | Controls CLK16   | 0 = OEB does not control output<br>1 = OEB controls output |
|      |                                  | CFGC_OEb11     | [6]   | RW   | 0       | Controls CLK17   |  |
|      |                                  | CFGC_OEb10     | [5]   | RW   | 0       | Controls CLK18 when SBI_EN = 0   |  |
|      |                                  | CFGC_OEb9      | [4]   | RW   | 0       | Controls CLK19   |  |
|      |                                  | AMPLITUDE_CTRL | [3:0] | RW   | 0x7     | Global Differential output Control<br>0.6V~1V 25mV/step<br>Default = 0.8V            | -  |

Table 35. RC19020A072 SMBus Registers (Cont.)

| Byte    | Register           | Name           | Bit   | Type | Default | Description            | Definition                              |
|---------|--------------------|----------------|-------|------|---------|------------------------|---|
| 11      | OUTPUT_SLEW_RATE_0 | CLK7_SLEWRATE  | [7]   | RW   | 1       | CLK7 Slewrate Control  | 0 = low slew rate<br>1 = high slew rate |
|         |                    | CLK6_SLEWRATE  | [6]   | RW   | 1       | CLK6 Slewrate Control  |   |
|         |                    | CLK5_SLEWRATE  | [5]   | RW   | 1       | CLK5 Slewrate Control  |   |
|         |                    | CLK4_SLEWRATE  | [4]   | RW   | 1       | CLK4 Slewrate Control  |   |
|         |                    | CLK3_SLEWRATE  | [3]   | RW   | 1       | CLK3 Slewrate Control  |   |
|         |                    | CLK2_SLEWRATE  | [2]   | RW   | 1       | CLK2 Slewrate Control  |   |
|         |                    | CLK1_SLEWRATE  | [1]   | RW   | 1       | CLK1 Slewrate Control  |   |
|         |                    | CLK0_SLEWRATE  | [0]   | RW   | 1       | CLK0 Slewrate Control  |   |
| 12      | OUTPUT_SLEW_RATE_1 | CLK15_SLEWRATE | [7]   | RW   | 1       | CLK15 Slewrate Control | 0 = low slew rate<br>1 = high slew rate |
|         |                    | CLK14_SLEWRATE | [6]   | RW   | 1       | CLK14 Slewrate Control |   |
|         |                    | CLK13_SLEWRATE | [5]   | RW   | 1       | CLK13 Slewrate Control |   |
|         |                    | CLK12_SLEWRATE | [4]   | RW   | 1       | CLK12 Slewrate Control |   |
|         |                    | CLK11_SLEWRATE | [3]   | RW   | 1       | CLK11 Slewrate Control |   |
|         |                    | CLK10_SLEWRATE | [2]   | RW   | 1       | CLK10 Slewrate Control |   |
|         |                    | CLK9_SLEWRATE  | [1]   | RW   | 1       | CLK9 Slewrate Control  |   |
|         |                    | CLK8_SLEWRATE  | [0]   | RW   | 1       | CLK8 Slewrate Control  |   |
| 13      | OUTPUT_SLEW_RATE_2 | RESERVED       | [7:4] | RW   | 0b111   | RESERVED               | 0 = low slew rate<br>1 = high slew rate |
|         |                    | CLK19_SLEWRATE | [3]   | RW   | 1       | CLK19 Slewrate Control |   |
|         |                    | CLK18_SLEWRATE | [2]   | RW   | 1       | CLK18 Slewrate Control |   |
|         |                    | CLK17_SLEWRATE | [1]   | RW   | 1       | CLK17 Slewrate Control |   |
|         |                    | CLK16_SLEWRATE | [0]   | RW   | 1       | CLK16 Slewrate Control |   |
| 14 - 20 | RESERVED           | -              | -     | -    | -       | RESERVED               | -                                       |

Table 35. RC19020A072 SMBus Registers (Cont.)

| Byte | Register                  | Name             | Bit | Type | Default | Description                                     | Definition  |
|------|---------------------------|------------------|-----|------|---------|---|---|
| 21   | PD_RESTORE_LOSb           | AC_IN            | [7] | RW   | 0       | Enable receiver bias when CLKIN is AC coupled,  | 0 = DC coupled input<br>1 = AC coupled input                              |
|      |                           | Rx_TERM          | [6] | RW   | 0       | Enable termination resistors on CLKIN           | 0 = input termination R is disabled<br>1 = input termination R is enabled |
|      |                           | RESERVED         | [5] | RW   | 1'b1    | RESERVED  | -   |
|      |                           | CLK Acquired     | [4] | RO   | 1'bX    | A clock was acquired                            | 1 = clock acquired  |
|      |                           | PD_RESTOREb      | [3] | RW   | 1       | Save Configuration in Power Down                | 0 = Config Cleared<br>1 = Config Saved                                    |
|      |                           | SDATA_TIMEOUT_EN | [2] | RW   | 1       | Enable SMB SDATA time out monitoring            | 0 = disable SDATA time out<br>1 = enable SDATA time out                   |
|      |                           | RESERVED         | [1] | RO   | 1'bX    | -   | -   |
| 22   | SBI_MASK_0 <sup>[2]</sup> | LOSb_RB          | [0] | RO   | 1'bX    | Real time read back of loss detect block output | 0 = LOS event detected<br>1 = NO LOS event detected.                      |
|      |                           | MASK7            | [7] | RW   | 0       | Masks off Side-band Disable for CLK7            | 0 = SBI may disable the output<br>1 = SBI cannot disable the output       |
|      |                           | MASK6            | [6] | RW   | 0       | Masks off Side-band Disable for CLK6            |   |
|      |                           | MASK5            | [5] | RW   | 0       | Masks off Side-band Disable for CLK5            |   |
|      |                           | MASK4            | [4] | RW   | 0       | Masks off Side-band Disable for CLK4            |   |
|      |                           | MASK3            | [3] | RW   | 0       | Masks off Side-band Disable for CLK3            |   |
|      |                           | MASK2            | [2] | RW   | 0       | Masks off Side-band Disable for CLK2            |   |
|      |                           | MASK1            | [1] | RW   | 0       | Masks off Side-band Disable for CLK1            |   |
|      |                           | MASK0            | [0] | RW   | 0       | Masks off Side-band Disable for CLK0            |   |

Table 35. RC19020A072 SMBus Registers (Cont.)

| Byte  | Register       | Name     | Bit   | Type | Default | Description                           | Definition  |
|-------|----------------|----------|-------|------|---------|---------------------------------------|---|
| 23    | SBI_MASK_1 [2] | MASK15   | [7]   | RW   | 0       | Masks off Side-band Disable for CLK15 | 0 = SBI may disable the output<br>1 = SBI cannot disable the output |
|       |                | MASK14   | [6]   | RW   | 0       | Masks off Side-band Disable for CLK14 |   |
|       |                | MASK13   | [5]   | RW   | 0       | Masks off Side-band Disable for CLK13 |   |
|       |                | MASK12   | [4]   | RW   | 0       | Masks off Side-band Disable for CLK12 |   |
|       |                | MASK11   | [3]   | RW   | 0       | Masks off Side-band Disable for CLK11 |   |
|       |                | MASK10   | [2]   | RW   | 0       | Masks off Side-band Disable for CLK10 |   |
|       |                | MASK9    | [1]   | RW   | 0       | Masks off Side-band Disable for CLK9  |   |
|       |                | MASK8    | [0]   | RW   | 0       | Masks off Side-band Disable for CLK8  |   |
| 24    | SBI_MASK_2 [2] | MASK23   | [7]   | RW   | 0       | Masks off Side-band Disable for CLK23 | 0 = SBI may disable the output<br>1 = SBI cannot disable the output |
|       |                | MASK22   | [6]   | RW   | 0       | Masks off Side-band Disable for CLK22 |   |
|       |                | MASK21   | [5]   | RW   | 0       | Masks off Side-band Disable for CLK21 |   |
|       |                | MASK20   | [4]   | RW   | 0       | Masks off Side-band Disable for CLK20 |   |
|       |                | MASK19   | [3]   | RW   | 0       | Masks off Side-band Disable for CLK19 |   |
|       |                | MASK18   | [2]   | RW   | 0       | Masks off Side-band Disable for CLK18 |   |
|       |                | MASK17   | [1]   | RW   | 0       | Masks off Side-band Disable for CLK17 |   |
|       |                | MASK16   | [0]   | RW   | 0       | Masks off Side-band Disable for CLK16 |   |
| 25–32 | RESERVED       | RESERVED | [7:0] | RW   | 0xXX    | RESERVED                              | -   |

Table 35. RC19020A072 SMBus Registers (Cont.)

| Byte  | Register           | Name      | Bit   | Type | Default | Description                             | Definition                  |
|-------|--------------------|-----------|-------|------|---------|---|-----------------------------|
| 33    | SBI_READBACK_0 [2] | SBI_CLK7  | [7]   | RO   | 1'bX    | Readback of Side-band Disable for CLK7  | 0 = bit low<br>1 = bit high |
|       |                    | SBI_CLK6  | [6]   | RO   | 1'bX    | Readback of Side-band Disable for CLK6  |                             |
|       |                    | SBI_CLK5  | [5]   | RO   | 1'bX    | Readback of Side-band Disable for CLK5  |                             |
|       |                    | SBI_CLK4  | [4]   | RO   | 1'bX    | Readback of Side-band Disable for CLK4  |                             |
|       |                    | SBI_CLK3  | [3]   | RO   | 1'bX    | Readback of Side-band Disable for CLK3  |                             |
|       |                    | SBI_CLK2  | [2]   | RO   | 1'bX    | Readback of Side-band Disable for CLK2  |                             |
|       |                    | SBI_CLK1  | [1]   | RO   | 1'bX    | Readback of Side-band Disable for CLK1  |                             |
|       |                    | SBI_CLK0  | [0]   | RO   | 1'bX    | Readback of Side-band Disable for CLK0  |                             |
| 34    | SBI_READBACK_1 [2] | SBI_CLK15 | [7]   | RO   | 1'bX    | Readback of Side-band Disable for CLK15 | 0 = bit low<br>1 = bit high |
|       |                    | SBI_CLK14 | [6]   | RO   | 1'bX    | Readback of Side-band Disable for CLK14 |                             |
|       |                    | SBI_CLK13 | [5]   | RO   | 1'bX    | Readback of Side-band Disable for CLK13 |                             |
|       |                    | SBI_CLK12 | [4]   | RO   | 1'bX    | Readback of Side-band Disable for CLK12 |                             |
|       |                    | SBI_CLK11 | [3]   | RO   | 1'bX    | Readback of Side-band Disable for CLK11 |                             |
|       |                    | SBI_CLK10 | [2]   | RO   | 1'bX    | Readback of Side-band Disable for CLK10 |                             |
|       |                    | SBI_CLK9  | [1]   | RO   | 1'bX    | Readback of Side-band Disable for CLK9  |                             |
|       |                    | SBI_CLK8  | [0]   | RO   | 1'bX    | Readback of Side-band Disable for CLK8  |                             |
| 35    | SBI_READBACK_2 [2] | RESERVED  | [7:4] | RO   | 1'bXXX  | RESERVED                                | 0 = bit low<br>1 = bit high |
|       |                    | SBI_CLK19 | [3]   | RO   | 1'bX    | Readback of Side-band Disable for CLK19 |                             |
|       |                    | SBI_CLK18 | [2]   | RO   | 1'bX    | Readback of Side-band Disable for CLK18 |                             |
|       |                    | SBI_CLK17 | [1]   | RO   | 1'bX    | Readback of Side-band Disable for CLK17 |                             |
|       |                    | SBI_CLK16 | [0]   | RO   | 1'bX    | Readback of Side-band Disable for CLK16 |                             |
| 36-37 | RESERVED           | RESERVED  | [7:0] | RW   | 0xXX    | RESERVED                                | RESERVED                    |

Table 35. RC19020A072 SMBus Registers (Cont.)

| Byte | Register                   | Name            | Bit   | Type | Default   | Description   | Definition   |
|------|----------------------------|-----------------|-------|------|-----------|---|--|
| 38   | WRITE_LOCK_NCLEAR          | RESERVED        | [7:1] | RW   | 0x0       | RESERVED  | -  |
|      |                            | WRITE_LOCK      | [0]   | RW   | 0         | Non-clearable SMBus Write Lock bit. Once written to '1', the SMBus control registers cannot be written to. This bit can only be cleared by cycling power. | 0 = SMBus not locked for writing by this bit. See WRITE_LOCK_RW1C bit.<br>1 = SMBus locked for writing |
| 39   | WRITE_LOCK_CLEAR_LOS_EVENT | RESERVED        | [7:2] | RW1C | 1'b111000 | -   | -  |
|      |                            | LOS_EVT         | [1]   | RW1C | 0         | LOS Event Status<br>When high, indicates that a LOS event was detected. Can be cleared by writing a 1 to it.  | 0 = No LOS event detected<br>1 = LOS event detected.   |
|      |                            | WRITE_LOCK_RW1C | [0]   | RW1C | 0         | Clearable SMBus Write Lock bit.<br>When written to one, other SMBus control registers cannot be written to. This bit can be cleared by writing a 1 to it. | 0 = SMBus not locked for writing by this bit. See WRITE_LOCK bit.<br>1 = SMBus locked for writing      |

1. Register is only valid when the Side-Band Interface is not enabled (SBI\_ENQ = 0).
2. Register only valid when the Side-Band Interface is enabled (SBI\_ENQ = 1).

## 4.9 RC19016/013/008/004 SMBus Registers

Table 36. RC19016/013/008/004 SMBus Registers

| Byte | Register        | Name    | Bit | Type | Default | Description                | Definition  |
|------|-----------------|---------|-----|------|---------|----------------------------|---|
| 0    | OUTPUT_ENABLE_0 | CLK7_EN | [7] | RW   | 1       | Output Enable Bit for CLK7 | 0 = output is disabled (low/low)<br>1 = output is enabled |
|      |                 | CLK6_EN | [6] | RW   | 1       | Output Enable Bit for CLK6 |   |
|      |                 | CLK5_EN | [5] | RW   | 1       | Output Enable Bit for CLK5 |   |
|      |                 | CLK4_EN | [4] | RW   | 1       | Output Enable Bit for CLK4 |   |
|      |                 | CLK3_EN | [3] | RW   | 1       | Output Enable Bit for CLK3 |   |
|      |                 | CLK2_EN | [2] | RW   | 1       | Output Enable Bit for CLK2 |   |
|      |                 | CLK1_EN | [1] | RW   | 1       | Output Enable Bit for CLK1 |   |
|      |                 | CLK0_EN | [0] | RW   | 1       | Output Enable Bit for CLK0 |   |

Table 36. RC19016/013/008/004 SMBus Registers (Cont.)

| Byte | Register             | Name            | Bit   | Type | Default | Description                                      | Definition  |
|------|----------------------|-----------------|-------|------|---------|--|---|
| 1    | OUTPUT_ENABLE_1      | CLK15_EN        | [7]   | RW   | 1       | Output Enable Bit for CLK15                      | 0 = output is disabled (low/low)<br>1 = output is enabled |
|      |                      | CLK14_EN        | [6]   | RW   | 1       | Output Enable Bit for CLK14                      |   |
|      |                      | CLK13_EN        | [5]   | RW   | 1       | Output Enable Bit for CLK13                      |   |
|      |                      | CLK12_EN        | [4]   | RW   | 1       | Output Enable Bit for CLK12                      |   |
|      |                      | CLK11_EN        | [3]   | RW   | 1       | Output Enable Bit for CLK11                      |   |
|      |                      | CLK10_EN        | [2]   | RW   | 1       | Output Enable Bit for CLK10                      |   |
|      |                      | CLK9_EN         | [1]   | RW   | 1       | Output Enable Bit for CLK9                       |   |
|      |                      | CLK8_EN         | [0]   | RW   | 1       | Output Enable Bit for CLK8                       |   |
| 2    | OEB_PIN_READBACK_0   | OE7b_Readback   | [7]   | RO   | pin     | Status of OE7b pin                               | 0 = OEB pin low<br>1 = OEB Pin high                       |
|      |                      | OE6b_Readback   | [6]   | RO   | pin     | Status of OE6b pin                               |   |
|      |                      | OE5b_Readback   | [5]   | RO   | pin     | Status of OE5b pin                               |   |
|      |                      | OE4b_Readback   | [4]   | RO   | pin     | Status of OE4b pin                               |   |
|      |                      | OE3b_Readback   | [3]   | RO   | pin     | Status of OE3b pin                               |   |
|      |                      | OE2b_Readback   | [2]   | RO   | pin     | Status of OE2b pin                               |   |
|      |                      | OE1b_Readback   | [1]   | RO   | pin     | Status of OE1b pin                               |   |
|      |                      | OE0b_Readback   | [0]   | RO   | pin     | Status of OE0b pin                               |   |
| 3    | OEB_PIN_READBACK_1   | OE15b_Readback  | [7]   | RO   | pin     | Status of OE15b pin                              | 0 = OEB pin low<br>1 = OEB Pin high                       |
|      |                      | OE14b_Readback  | [6]   | RO   | pin     | Status of OE14b pin                              |   |
|      |                      | OE13b_Readback  | [5]   | RO   | pin     | Status of OE13b pin                              |   |
|      |                      | OE12b_Readback  | [4]   | RO   | pin     | Status of OE12b pin                              |   |
|      |                      | OE11b_Readback  | [3]   | RO   | pin     | Status of OE11b pin                              |   |
|      |                      | OE10b_Readback  | [2]   | RO   | pin     | Status of OE10b pin                              |   |
|      |                      | OE9b_Readback   | [1]   | RO   | pin     | Status of OE9b pin                               |   |
|      |                      | OE8b_Readback   | [0]   | RO   | pin     | Status of OE8b pin                               |   |
| 4    | SBEN_RDBK_LOS_CONFIG | RESERVED        | [7:5] | -    | -       | -  | -   |
|      |                      | LOSb_ACP_ENABLE | [4]   | RW   | 1       | Enable input loss detect to park outputs low/low | 0 = disable,<br>1 = enable                                |
|      |                      | RESERVED        | [3:2] | -    | -       | -  | -   |
|      |                      | RESERVED        | [1]   | -    | -       | -  | -   |
|      |                      | RB_SBI_EN       | [0]   | RO   | pin     | Status of SBI_EN                                 | 0 = pin low<br>1 = pin high                               |
| 5    | VENDOR_REVISION_ID   | RID             | [7:4] | RO   | 0x0     | REVISION ID, A rev is 0000                       | -   |
|      |                      | VID             | [3:0] | RO   | 0x1     | VENDOR ID, ICS/IDT/Renesas                       | -   |



Table 36. RC19016/013/008/004 SMBus Registers (Cont.)

| Byte | Register  | Name      | Bit   | Type | Default | Description  | Definition  |
|------|---|-----------|-------|------|---------|--|---|
| 6    | DEVICE_ID   | DEVICE_ID | [7:0] | RO   | 0x18    | Device ID:<br>RC19016 = 0h10, RC19013 = 0h0D, RC19008 = 0h08, RC19004 = 0h04, RC19016A100 = 0h90, RC19013A100 = 0h8D, RC19008A100 = 0h88, RC19004A100 = 0h84 | -   |
| 7    | BYTE_COUNT  | RESERVED  | [7:5] | -    | -       | -  | -   |
|      |   | BC        | [4:0] | RW   | 0x7     | Writing to this register configures how many bytes will be read back in a block read.  | -   |
| 8    | SBI_MASK_0<br>(Register only functional and/or valid when SBEN = 1) | MASK7     | [7]   | RW   | 0       | Masks off Side-band Disable for CLK7   | 0 = SBI may disable the output<br>1 = SBI cannot disable the output |
|      |   | MASK6     | [6]   | RW   | 0       | Masks off Side-band Disable for CLK6   |   |
|      |   | MASK5     | [5]   | RW   | 0       | Masks off Side-band Disable for CLK5   |   |
|      |   | MASK4     | [4]   | RW   | 0       | Masks off Side-band Disable for CLK4   |   |
|      |   | MASK3     | [3]   | RW   | 0       | Masks off Side-band Disable for CLK3   |   |
|      |   | MASK2     | [2]   | RW   | 0       | Masks off Side-band Disable for CLK2   |   |
|      |   | MASK1     | [1]   | RW   | 0       | Masks off Side-band Disable for CLK1   |   |
|      |   | MASK0     | [0]   | RW   | 0       | Masks off Side-band Disable for CLK0   |   |
| 9    | SBI_MASK_1<br>(Register only functional and/or valid when SBEN = 1) | MASK15    | [7]   | RW   | 0       | Masks off Side-band Disable for CLK15  | 0 = SBI may disable the output<br>1 = SBI cannot disable the output |
|      |   | MASK14    | [6]   | RW   | 0       | Masks off Side-band Disable for CLK14  |   |
|      |   | MASK13    | [5]   | RW   | 0       | Masks off Side-band Disable for CLK13  |   |
|      |   | MASK12    | [4]   | RW   | 0       | Masks off Side-band Disable for CLK12  |   |
|      |   | MASK11    | [3]   | RW   | 0       | Masks off Side-band Disable for CLK11  |   |
|      |   | MASK10    | [2]   | RW   | 0       | Masks off Side-band Disable for CLK10  |   |
|      |   | MASK9     | [1]   | RW   | 0       | Masks off Side-band Disable for CLK9   |   |
|      |   | MASK8     | [0]   | RW   | 0       | Masks off Side-band Disable for CLK8   |   |
| 10   | RESERVED  | Reserved  | [7:0] | -    | -       | -  | -   |

Table 36. RC19016/013/008/004 SMBus Registers (Cont.)

| Byte      | Register  | Name                        | Bit   | Type | Default | Description                                | Definition                  |
|-----------|---|-----------------------------|-------|------|---------|--|-----------------------------|
| 11        | SBI_READBACK_0<br>(Register only functional<br>and/or valid when<br>SBEN = 1) | SBI_CLK7                    | [7]   | RO   | X       | Readback of Side-band<br>Disable for CLK7  | 0 = bit low<br>1 = bit high |
|           |   | SBI_CLK6                    | [6]   | RO   | X       | Readback of Side-band<br>Disable for CLK6  |                             |
|           |   | SBI_CLK5                    | [5]   | RO   | X       | Readback of Side-band<br>Disable for CLK5  |                             |
|           |   | SBI_CLK4                    | [4]   | RO   | X       | Readback of Side-band<br>Disable for CLK4  |                             |
|           |   | SBI_CLK3                    | [3]   | RO   | X       | Readback of Side-band<br>Disable for CLK3  |                             |
|           |   | SBI_CLK2                    | [2]   | RO   | X       | Readback of Side-band<br>Disable for CLK2  |                             |
|           |   | SBI_CLK1                    | [1]   | RO   | X       | Readback of Side-band<br>Disable for CLK1  |                             |
|           |   | SBI_CLK0                    | [0]   | RO   | X       | Readback of Side-band<br>Disable for CLK0  |                             |
| 12        | SBI_READBACK_1<br>(Register only functional<br>and/or valid when<br>SBEN = 1) | SBI_CLK15                   | [7]   | RO   | X       | Readback of Side-band<br>Disable for CLK15 | 0 = bit low<br>1 = bit high |
|           |   | SBI_CLK14                   | [6]   | RO   | X       | Readback of Side-band<br>Disable for CLK14 |                             |
|           |   | SBI_CLK13                   | [5]   | RO   | X       | Readback of Side-band<br>Disable for CLK13 |                             |
|           |   | SBI_CLK12                   | [4]   | RO   | X       | Readback of Side-band<br>Disable for CLK12 |                             |
|           |   | SBI_CLK11                   | [3]   | RO   | X       | Readback of Side-band<br>Disable for CLK11 |                             |
|           |   | SBI_CLK10                   | [2]   | RO   | X       | Readback of Side-band<br>Disable for CLK10 |                             |
|           |   | SBI_CLK9                    | [1]   | RO   | X       | Readback of Side-band<br>Disable for CLK9  |                             |
|           |   | SBI_CLK8                    | [0]   | RO   | X       | Readback of Side-band<br>Disable for CLK8  |                             |
| 13–<br>16 | RESERVED  | Reserved                    | [7:0] | -    | -       | -  | -                           |
| 17        | LPHCSL_AMP_CTRL   | Global Amplitude<br>Control | [7:4] | RW   | 0x7     | 0.6V~1V in 25mV steps.                     | Default = 0.8V              |
|           |   | Reserved                    | [3:0] | -    | -       | -  | -                           |

Table 36. RC19016/013/008/004 SMBus Registers (Cont.)

| Byte  | Register               | Name           | Bit   | Type | Default | Description   | Definition  |
|-------|------------------------|----------------|-------|------|---------|---|---|
| 18    | PD_RESTORE_LOSb_ENABLE | AC_IN          | [7]   | RW   | 0       | Enable receiver self bias when input clock is AC coupled, | 0 = DC coupled input<br>1 = AC coupled input                          |
|       |                        | Rx_TERM        | [6]   | RW   | 0       | Enable termination resistor on CLKIN/CLKINb               | 0 = input termination is disabled<br>1 = input termination is enabled |
|       |                        | Reserved       | [5:4] | -    | -       | -   | -   |
|       |                        | PD_RESTOREb    | [3]   | RW   | 1       | Save Configuration in Power Down                          | 0 = Config Cleared<br>1 = Config Saved                                |
|       |                        | Reserved       | [2:1] | -    | -       | -   | -   |
|       |                        | LOSb_Readback  | [0]   | RO   | X       | real time read back of loss detect block output           | 0 = LOS event detected<br>1 = NO LOS event detected.                  |
| 19    | RESERVED               | Reserved       | [7:0] | -    | -       | -   | -   |
| 20    | OUTPUT_SLEW_RATE_0     | CLK7_SLEWRATE  | [7]   | RW   | 1       | CLK7 Slew Rate Control                                    | 0 = low slew rate<br>1 = high slew rate                               |
|       |                        | CLK6_SLEWRATE  | [6]   | RW   | 1       | CLK6 Slew Rate Control                                    |   |
|       |                        | CLK5_SLEWRATE  | [5]   | RW   | 1       | CLK5 Slew Rate Control                                    |   |
|       |                        | CLK4_SLEWRATE  | [4]   | RW   | 1       | CLK4 Slew Rate Control                                    |   |
|       |                        | CLK3_SLEWRATE  | [3]   | RW   | 1       | CLK3 Slew Rate Control                                    |   |
|       |                        | CLK2_SLEWRATE  | [2]   | RW   | 1       | CLK2 Slew Rate Control                                    |   |
|       |                        | CLK1_SLEWRATE  | [1]   | RW   | 1       | CLK1 Slew Rate Control                                    |   |
|       |                        | CLK0_SLEWRATE  | [0]   | RW   | 1       | CLK0 Slew Rate Control                                    |   |
| 21    | OUTPUT_SLEW_RATE_1     | CLK15_SLEWRATE | [7]   | RW   | 1       | CLK15 Slewrate Control                                    | 0 = low slew rate<br>1 = high slew rate                               |
|       |                        | CLK14_SLEWRATE | [6]   | RW   | 1       | CLK14 Slewrate Control                                    |   |
|       |                        | CLK13_SLEWRATE | [5]   | RW   | 1       | CLK13 Slewrate Control                                    |   |
|       |                        | CLK12_SLEWRATE | [4]   | RW   | 1       | CLK12 Slewrate Control                                    |   |
|       |                        | CLK11_SLEWRATE | [3]   | RW   | 1       | CLK11 Slewrate Control                                    |   |
|       |                        | CLK10_SLEWRATE | [2]   | RW   | 1       | CLK10 Slewrate Control                                    |   |
|       |                        | CLK9_SLEWRATE  | [1]   | RW   | 1       | CLK9 Slewrate Control                                     |   |
|       |                        | CLK8_SLEWRATE  | [0]   | RW   | 1       | CLK8 Slewrate Control                                     |   |
| 22–37 | Reserved               | Reserved       | [7:0] | -    | -       | -   | -   |

Table 36. RC19016/013/008/004 SMBus Registers (Cont.)

| Byte | Register                   | Name            | Bit   | Type   | Default | Description   | Definition   |
|------|----------------------------|-----------------|-------|--------|---------|---|--|
| 38   | WRITE_LOCK_NOCLEAR         | Reserved        | [7:1] | RW     | 0       | reserved  | -  |
|      |                            | WRITE_LOCK      | [0]   | RW     | 0       | Non-clearable SMBus Write Lock bit. When written to one, the SMBus control registers cannot be written to. This bit can only be cleared by cycling power. | 0 = SMBus not locked for writing by this bit. See WRITE_LOCK_RW1C bit.<br>1 = SMBus locked for writing |
| 39   | WRITE_LOCK_CLEAR_LOS_EVENT | Reserved        | [7:2] | -      | -       | -   | -  |
|      |                            | LOS_EVT         | [1]   | R/W 1C | 0       | LOS Event Status<br>When high, indicates that a LOS event was detected. Can be cleared by writing a 1 to it.  | 0 = No LOS event detected<br>1 = LOS event detected.   |
|      |                            | WRITE_LOCK_RW1C | [0]   | R/W 1C | 0       | Clearable SMBus Write Lock bit.<br>When written to one, the SMBus control registers cannot be written to. This bit can be cleared by writing a 1 to it.   | 0 = SMBus not locked for writing by this bit. See WRITE_LOCK bit.<br>1 = SMBus locked for writing      |

## 5. Applications Information

### 5.1 Inputs, Outputs, and Output Enable Control

#### 5.1.1 Recommendations for Unused Inputs and Outputs

##### 5.1.1.1 Unused Differential CLKIN Inputs

The CLKIN/CLKINb inputs of the RC19xxx devices have internal bias networks that protect the devices from a floating input clock condition.

##### 5.1.1.2 Unused Single-ended Control Inputs

The single-ended control pins have internal pull-up and/or internal pull-down resistors and do not require external resistors. They can be left floating if the default pin state is the desired state. If external resistors are needed to change the pin state or are desired for design robustness, 10kohm is the recommended value.

##### 5.1.1.3 Unused Differential CLK Outputs

All unused CLK outputs can be left floating. Renesas recommends that no trace be attached to unused CLK outputs. While not required (but is highly recommended), the best design practice is to disable unused CLK outputs.

##### 5.1.1.4 Unused SMBus Clock and Data Pins

If the SMBus interface is not used, the clock and data pins must be pulled high with an external resistor. The two pins can share a resistor if there is no possibility of using the SMBus interface for debug purposes. If the interface may be used for debug, separate resistors should be used. 10kohm is the recommended value.

### 5.1.2 Differential CLKIN Configurations

The RC19xxx clock input buffer supports four configurations:

- Direct connection to HCSL-level inputs
- Direct connection to LVDS-level inputs with *external* termination resistor
- Internal self-bias circuit for applications that *externally* AC-couple the input clock

This feature is enabled by the **AC\_IN** bit.

- Internal pull-down resistors ( $R_p$ ) to terminate the clock input at the receiver.

This feature is enabled by the **Rx\_TERM** bit.

Devices with multiple input clocks have individual AC\_IN and Rx\_TERM configuration bits for each input. The internal input clock terminations prevent reflections and are useful for non-PCIe applications, where the frequency and transmission line length vary from the 100MHz PCIe standard.

Figure 16 through Figure 19 illustrate the above items.

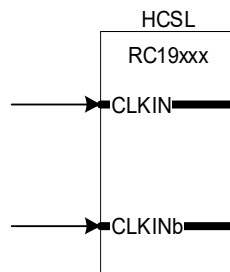


Figure 16. HCSL Input Levels (PCIe Standard)

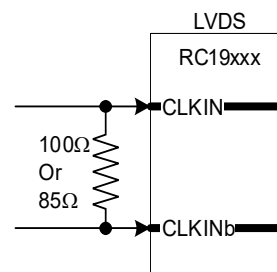


Figure 17. LVDS Input Levels

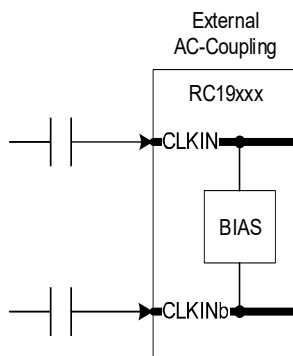


Figure 18. External AC-Coupling

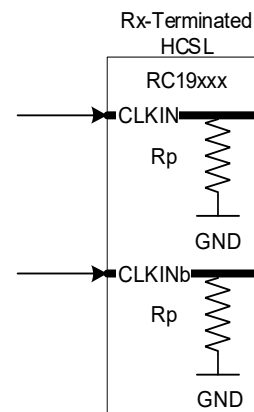


Figure 19. Receiver Termination

## 5.1.3 Differential CLK Output Configurations

### 5.1.3.1 Direct-Coupled HCSL Loads

The RC190 LP-HCSL CLK outputs have internal source terminations and directly drive industry-standard HCSL-level inputs with no external components. They support both 85ohm and 100ohm differential impedances. The CLK outputs can also drive receiver-terminated HCSL loads. The combination of source termination and receiver termination results in a double-terminated load. When double-terminated, the CLK output swing will be half of the source-terminated values.

### 5.1.3.2 AC-Coupled non-HCSL Loads

The RC190CLK output can directly drive AC-coupling capacitors without any termination components. The clock input side of the AC-coupling capacitor may require an input-dependent bias network (BN). For examples of terminating the RC19xxx CLK outputs to other logic families such as LVDS, LVPECL, or CML, see [AN-891](#).

[Figure 20](#) to [Figure 22](#) show the various CLK output configurations.

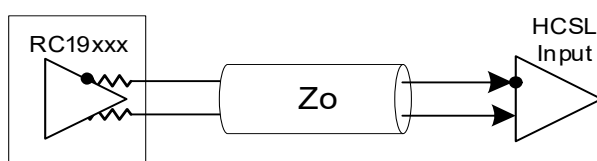


Figure 20. Direct-Coupled Source-Terminated HCSL

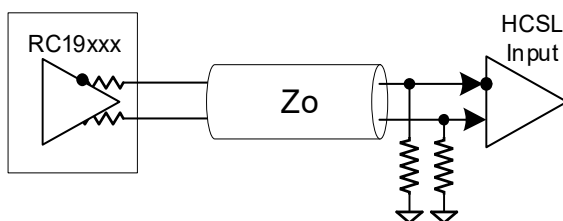


Figure 21. Direct-Coupled Double-Terminated HCSL

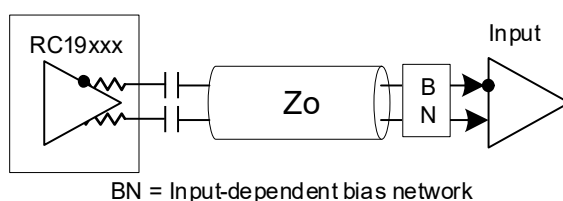


Figure 22. AC-Coupled

## 5.2 Power Down Tolerant Pins

Pins that are Power Down Tolerant (PDT) can be driven by voltages as high as the normal VDD of the chip, even though VDD is not present (the device is not powered). There will be no ill effects to the device and it will power up normally. This feature supports disaggregation, where the RC19xxx may be on one circuit board and devices that interface with it are on other boards. These boards may power up at different times, driving pins on the RC19xxx before it has received power. [Figure 23](#) provides an example of a PDT call-out in a data sheet.

## 5.3 Flexible Startup Sequencing

RC19024A Pin Descriptions

| Pin Number | Pin Name                   | Pin Type       | Description  |
|------------|----------------------------|----------------|--|
| A1         | OE <sub>b23</sub> _SBI_CLK | I, SE, PD, PDT | Active low input for enabling output 23 or the clock pin for the SBI shift register. The function of this pin is controlled by the SBEN or SBI_ENQ pin. For more information, see <a href="#">Side-Band Interface (SBI)</a> .<br>OE mode:<br>0 = enable output, 1 = disable output.<br>Side-Band mode:<br>Clocks data into the SBI on the rising edge. |
| A2         | CLK23B                     | O, DIF         | Complementary clock output.  |
| A3         | CLK23                      | O, DIF         | True clock output.   |
| A4         | CLKIN <sub>b</sub>         | I, DIF, PDT    | Complementary clock input.   |
| A5         | CLKIN                      | I, DIF, PDT    | True clock input.  |

Figure 23. Example: Power Down Tolerant Pin Descriptions

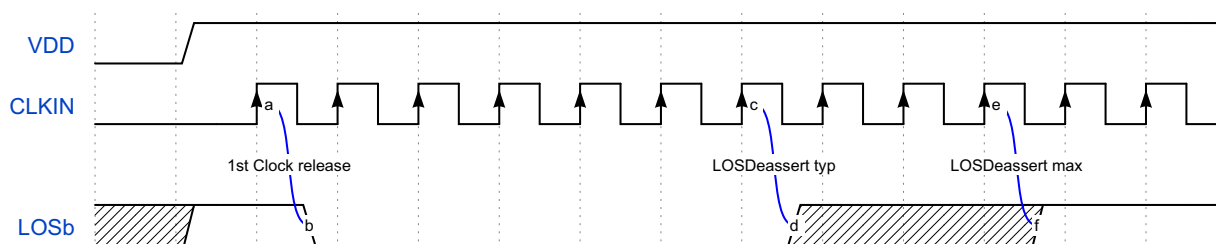
RC19xxx devices support Flexible Startup Sequencing (FSS). FSS allows application of CLKIN at different times in the device/system startup sequence. FSS is an additional feature that helps the system designer manage the impact of disaggregation. [Table 37](#) shows the supported sequences; that is, the RC19xxx devices can have CLKIN running before VDD is applied, and can have VDD applied and sit for extended periods with no input clock.

Table 37. Flexible Startup Sequences

| VDD         | PWRGD_PWRDN <sub>b</sub> | CLKIN/CLKIN <sub>b</sub> |
|-------------|--------------------------|--------------------------|
| Not present | X                        | Running                  |
|             |                          | Floating                 |
|             |                          | Low/Low                  |
| Present     | 0 or 1                   | Running                  |
|             |                          | Floating                 |
|             |                          | Low/Low                  |

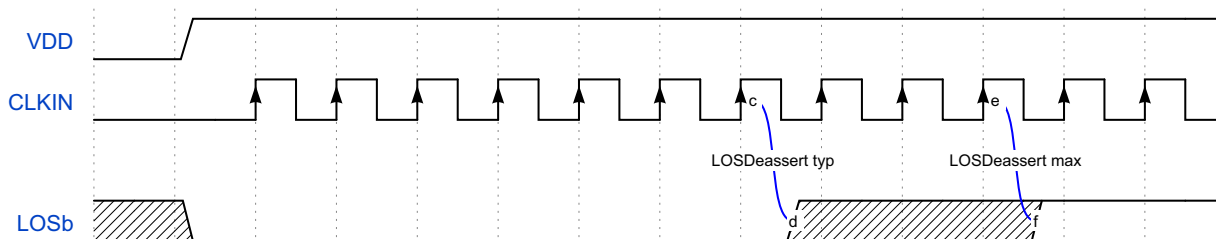
## 5.4 Loss of Signal and Automatic Clock Parking

The RC190 buffers and multiplexers have a Loss of Signal (LOS) circuit to detect the presence or absence of an input clock. The LOS circuit drives the open-drain LOS<sub>b</sub> pin (the “b” suffix indicates “bar”, or active-low) and sets the LOS\_EVT bit in the SMBus register space. There are two slightly different LOS<sub>b</sub> pin behaviors at power up. [Figure 24](#) shows the LOS<sub>b</sub> de-assertion timing for the 4, 8, 13, 16 and 24-output buffers. CLKIN is represented differentially in [Figure 24](#) and [Figure 25](#).

Figure 24. LOS<sub>b</sub> De-assert Timing, RC19004, RC19008, RC1901x, RC19024

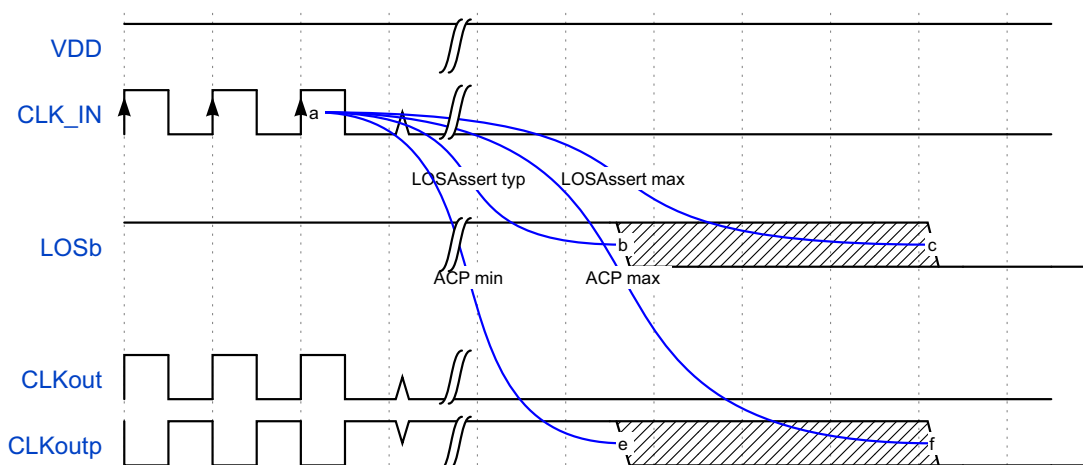
**Note:** The LOS circuit on the 4, 8, 13, 16, and 24 output buffers requires a CLKIN edge to release the LOSb pin after power up. So, the LOSb pin will be high until the first clock edge after power up.

Figure 25 shows the LOSb de-assertion timing for the 2-output and 20-output buffers that default to low at power up.



**Figure 25. LOSb De-assert Timing RC19002, RC19020 Devices**

The following diagram shows the LOSb assertion sequence when the CLKIN is lost. It also shows the Automatic Clock Parking (ACP) circuit bring the inputs to a Low/Low state after an LOS event. For exact timing, see [Electrical Specifications](#).



**Figure 26. LOSb Assert Timing**

## 5.5 Output Enable Control

The RC190 buffer/mux family provides three mechanisms to enable or disable clock outputs. All three mechanisms start and stop the output clocks in a synchronous, glitch-free manner. A clock output is enabled only when all three mechanisms indicate “enabled.” The following sections describe the three mechanisms.

### 5.5.1 SMBus Output Enable Bits

This section does not apply to the RC19002 because it does not have an SMBus.

The RC19xxx Clock buffer/multiplexer family has a traditional SMBus output enable bit for each output. The power-up default is 1, or enabled. Changing this bit to a 0 disables the output to a low/low state. The transitions between the enable and disable states are glitch-free in both directions.

**Note:** The glitch-free synchronization logic requires the CLKIN be running to enable or disable the outputs with this mechanism.

### 5.5.2 Output Enable (OEb) Pins

The OEb (Note: the “b” suffix indicates “bar”, or active-low) pins on the RC19xxx family provide flexible CLKREQb functionality for PCIe slots and/or banked OE control for ‘motherboard-down’ devices (depending on the device). If



the OEb pin is low the controlled output is enabled. If the OEb pin is high, the controlled output is disabled to a low/low state. All OEb pins enable and disable the controlled outputs in a glitch-free, synchronous manner.

*Note:* The glitch-free synchronization logic requires the CLKIN be running to enable or disable the outputs with this mechanism.

### 5.5.3 RC19024/020 Clock Buffer OEb Pins

The 24-output RC19024 has three dedicated OEb pins (OE2b, OE22b, and OE23b) that control CLK [2,22,23], respectively. It also has four bank OEb pins, OEb[A:D], that are mappable. Each pin can control up to six clock outputs, and defaults to controlling one output. The RC19024 output enable mapping is described in [Table 38](#).

**Table 38. RC19024 OEb Mapping**

| Pin Name      | SBI_ENQ Pin  | Default Pin Function | Optional Pin Function [1] |
|---------------|--------------|----------------------|---------------------------|
| OEb_A         | X            | CLK5 OEb             | CLK[4:0] OEb              |
| OEb_B         | X            | CLK6 OEb             | CLK[11:7] OEb             |
| OEb_C         | X            | CLK17 OEb            | CLK[18:12] OEb            |
| OEb_D         | X            | CLK18 OEb            | CLK[23:19]                |
| OEb2_SHFT_LDb | 0 (Disabled) | CLK2 OEb             | N/A                       |
|               | 1 (Enabled)  | SHFT_LDb             | N/A                       |
| OEb22_SBI_IN  | 0 (Disabled) | CLK22 OEb            | N/A                       |
|               | 1 (Enabled)  | SBI_IN               | N/A                       |
| OEb23_SBI_CLK | 0 (Disabled) | CLK23 OEb            | N/A                       |
|               | 1 (Enabled)  | SBI_CLK              | N/A                       |

1. See the OEb\_ASSIGNMENT registers in [Table 33](#).

The RC19020 and the RC19020A072 each have 8 OEb pins. Some of the pins are muxed with SBI functions.

The RC19020A072 OEb pins may be configured to control up to 2 outputs. Details are provided in [Table 39](#) and [Table 40](#).

**Table 39. RC19020 OEb Mapping**

| Pin Name       | SBI_ENQ Pin  | Pin Function |
|----------------|--------------|--------------|
| OEb12          | X            | CLK12 OEb    |
| OEb11          | X            | CLK11 OEb    |
| OEb10_SHFT_LDb | 0 (Disabled) | CLK10 OEb    |
|                | 1 (Enabled)  | SHFT_LDb     |
| OEb9           | X            | CLK9 OEb     |
| OEb8           | X            | CLK8 OEb     |
| OEb7           | X            | CLK7 OEb     |
| OEb6_SBI_CLK   | 0 (Disabled) | CLK6 OEb     |
|                | 1 (Enabled)  | SBI_CLK      |
| OEb5_SBI_IN    | 0 (Disabled) | CLK5 OEb     |
|                | 1 (Enabled)  | SBI_IN       |

Table 40. RC19020A072 OEb Mapping<sup>[1]</sup>

| Pin Name       | SBI_ENQ Pin  | Default Pin Function | Optional Pin Function |
|----------------|--------------|----------------------|-----------------------|
| OEb12          | X            | CLK12 OEb            | CLK13 OEb             |
| OEb11          | X            | CLK11 OEb            | CLK14 OEb             |
| OEb10_SHFT_LDb | 0 (Disabled) | CLK10 OEb            | CLK15 OEb             |
|                | 1 (Enabled)  | SHFT_LDb             | N/A                   |
| OEb9           | X            | CLK9 OEb             | CLK0 OEb              |
| OEb8           | X            | CLK8 OEb             | CLK1 OEb              |
| OEb7           | X            | CLK7 OEb             | CLK2 OEb              |
| OEb6_SBI_CLK   | 0 (Disabled) | CLK6 OEb             | CLK3 OEb              |
|                | 1 (Enabled)  | SBI_CLK              | N/A                   |
| OEb5_SBI_IN    | 0 (Disabled) | CLK5 OEb             | CLK4 OEb              |
|                | 1 (Enabled)  | SBI_IN               | N/A                   |

1. See the OEb\_ASSIGNMENT registers in [Table 35](#).

The smaller RC19016, RC19013, and RC19004 devices (16, 13, and 4 outputs respectively) provide a dedicated OEb pin for each output, and therefore do not have OEb\_ASSIGNMENT registers. Note that four OEb pins are used for the SBI interface when SBI\_ENQ = 1 (for more information, see [Table 41](#)).

The RC19002 has single function dedicated OEb pins. For more information, see [Figure 9](#).

Table 41. RC19016, RC19013, RC19008, RC19004 Buffer OEb Mapping

| Pin Name     | SBI_ENQ Pin  | RC19016 Pin Function | RC19013 Pin Function | RC19008 Pin Function | RC19004 Pin Function |
|--------------|--------------|----------------------|----------------------|----------------------|----------------------|
| OEb0         | X            | CLK0 OEb             | CLK0 OEb             | -                    | -                    |
| OEb1         | X            | CLK1 OEb             | CLK1 OEb             | CLK1 OEb             | -                    |
| OEb2_SBI_OUT | 0 (Disabled) | CLK2 OEb             | CLK2 OEb             | CLK2 OEb             | CLK2 OEb             |
|              | 1 (Enabled)  | SBI_OUT              | SBI_OUT              | SBI_OUT              | SBI_OUT              |
| OEb3         | X            | CLK3 OEb             | CLK3 OEb             | CLK3 OEb             | -                    |
| OEb4         | X            | CLK4 OEb             | -                    | -                    | -                    |
| OEb5_SBI_CLK | 0 (Disabled) | CLK5 OEb             | -                    | CLK5 OEb             | CLK5 OEb             |
|              | 1 (Enabled)  | SBI_CLK              | -                    | SBI_CLK              | SBI_CLK              |
| OEb6         | X            | CLK6 OEb             | -                    | CLK6 OEb             | -                    |
| OEb6_SBI_CLK | 0 (Disabled) | -                    | CLK6 OEb             | -                    | -                    |
|              | 1 (Enabled)  | -                    | SBI_CLK              | -                    | -                    |
| OEb7         | X            | CLK7 OEb             | CLK7 OEb             | CLK7 OEb             | -                    |
| OEb8         | X            | CLK8 OEb             | CLK8 OEb             | -                    | -                    |
| OEb9_SBI_IN  | 0 (Disabled) | CLK9 OEb             | CLK9 OEb             | -                    | CLK9 OEb             |
|              | 1 (Enabled)  | SBI_IN               | SBI_IN               | -                    | SBI_IN               |
| OEb10        | X            | CLK10 OEb            | CLK10 OEb            | -                    | -                    |

Table 41. RC19016, RC19013, RC19008, RC19004 Buffer OEB Mapping (Cont.)

| Pin Name       | SBI_ENQ Pin  | RC19016 Pin Function | RC19013 Pin Function | RC19008 Pin Function | RC19004 Pin Function |
|----------------|--------------|----------------------|----------------------|----------------------|----------------------|
| OEB10_SBI_IN   | 0 (Disabled) | -                    | -                    | CLK10 OEB            | -                    |
|                | 1 (Enabled)  | -                    | -                    | SBI_IN               | -                    |
| OEB11          | X            | CLK11 OEB            | CLK11 OEB            | -                    | -                    |
| OEB12          | X            | CLK12 OEB            | CLK12 OEB            | -                    | -                    |
| OEB13_SHFT_LDb | 0 (Disabled) | CLK13 OEB            | CLK13 OEB            | CLK13 OEB            | CLK13 OEB            |
|                | 1 (Enabled)  | SHFT_LDb             | SHFT_LDb             | SHFT_LDb             | SHFT_LDb             |
| OEB14          | X            | CLK14 OEB            | CLK14 OEB            | -                    | -                    |
| OEB15          | X            | CLK15 OEB            | -                    | -                    | -                    |

### 5.5.4 Side-Band Interface (SBI)

This section does not apply to the RC19002 because it does not have a side-band interface.

SMBus output enable bits and OEB pins are the traditional methods for enabling and disabling clocks. The 2-wire SMBus interface can enable or disable all clock outputs in a device. This pin efficiency is its advantage. The SMBus interface's main drawback is that it is a relatively slow physical interface, whose software is one of several routines running on an often overtaxed micro-controller. OEB pins are real-time and are ideally dedicated to an individual clock output. As buffers grow in output count, dedicated OEB pins become problematic for two reasons. First, the clock buffer pin count becomes much larger than it otherwise would be, resulting in a larger package. Second, unless the OEB pins are used for CLKREQ# functionality, the number of pins that need to be controlled outgrows the GPIO pins of an FPGA or micro-controller.

A third output enable/disable mechanism, the Side-Band Interface (SBI), addresses these issues. The SBI is a simple 3-wire (4-wire if the SBI\_OUT pin is used) interface that can control all outputs across multiple devices. The SBI is only slightly less pin efficient than the SMBus, and is much more pin efficient than a dedicated OEB pins per output. It is protocol-free, hardware-oriented and runs at speeds up to 25MHz, much faster than SMBus.

Another SBI advantage is that it is active after power is applied and before PWRGD is asserted. External logic can disable specific outputs before PWRGD is asserted, and can then dynamically adjust the output run state during device operation. The SBI can make the adjustments much more rapidly than SMBus.

The RC19xxxA 4-wire SBI interface consists of the SBI\_IN, SBI\_CLK, SHFT\_LDb, and SBI\_OUT pins. The RC19xxxA SBI is enabled by strapping the SBI\_ENQ pin to 1. When enabled, various OEB pins become the SBI interface. The exact pins that are multiplexed vary with device (for more information, see [Table 41](#)).

The SBI\_ENQ pin strap takes effect as soon as power is applied and is not dependent on the assertion of PWRGD\_PWRDNb to 1. Because of this, the SBI\_ENQ must be static and cannot change once power is applied. If SBI\_ENQ is 0 when power is applied, the SBI is disabled and has no impact on enabling or disabling outputs.

The SBI consists of a shift register, an SMBus readback register (of the shift register contents), and an SMBus MASK register. The SBI shifts a bit stream containing the enable/disable pattern into the shift register. A 1 enables an output and a 0 disables an output. All shift-register bits default to 1 at power up, indicating an enabled state. This means that the SBI can be used to disable outputs at power up because the default is enabled.

The SBI has its own SBI\_CLK and does not need a running CLKIN to shift in an enable/disable pattern. This provides utmost flexibility for setting output run state before the SMBus becomes active or before the CLKIN is applied. When the SBI indicates enabled, the standard SMBus output enable bits and OEB pins can control the outputs.

The SBI feeds common output enable/disable synchronization logic ensuring glitch-free enable and disable of outputs. Note: The glitch-free synchronization logic requires the CLKIN be running to enable or disable the outputs with this mechanism.

If the application does not use the SBI, the SBI\_ENQ pin can be tied to 0, and the entire SBI has no impact on enabling or disabling clock outputs.

The SBI Mask registers allow the user to block the disable function of the SBI via the SMBus. The SBI Mask registers default to 0 at power-up, allowing the SBI shift register bits to disable their respective output. After asserting the PWRGD\_PWRDNb pin high, the SMBus is active and the SBI mask registers can be configured via SMBus to mask off (block) the SBI disable function. In other words, setting an SBI Mask bit to 1 forces the SBI to always indicate “enable” for the respective output. This allows the user to prevent the SBI from accidentally turning off a critical output.

The RC190xx clock buffers provide the ability to read back the SBI shift register contents via the SMBus. The SMBus readback values update on each falling edge of SHFT\_LDb. Note: The SBI shift register can only be read using the SMBus; the SMBus *cannot* be used to load it.

Figure 27 shows the high-level functional description of SBI.

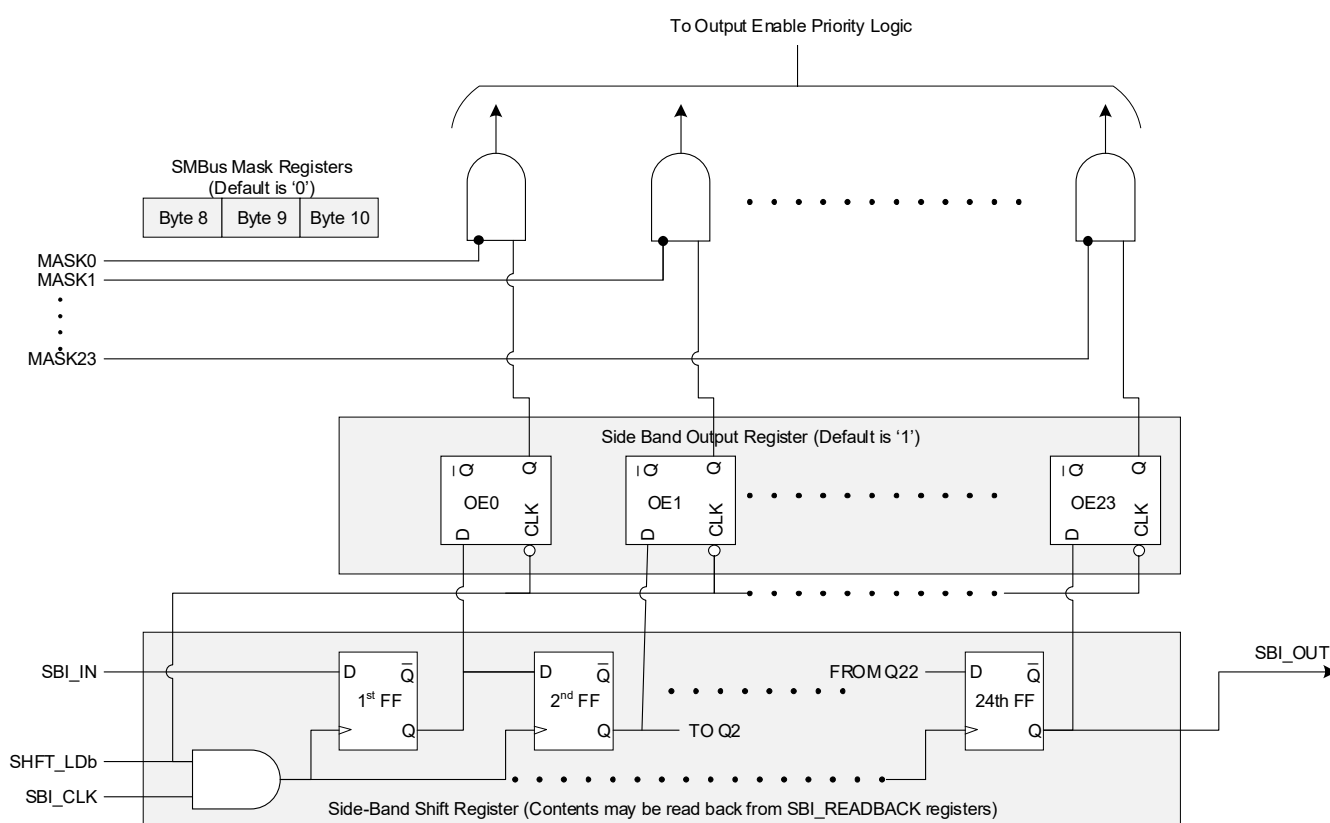


Figure 27. Side-band Interface High-Level Functional Diagram (RC19024 shown)

#### 5.5.4.1 Using the SBI

Using the RC19024 as an example, we see the SBI shift order follows the order of the SMBus enable bits. in Byte [2:0] as shown in Figure 28. The first bit shifted in would be the output enable/disable bit for the CLK23, which is in Byte 2 bit 7. The last bit shifted in would be the output enable/disable for CLK0, which is in Byte 0, bit 0.

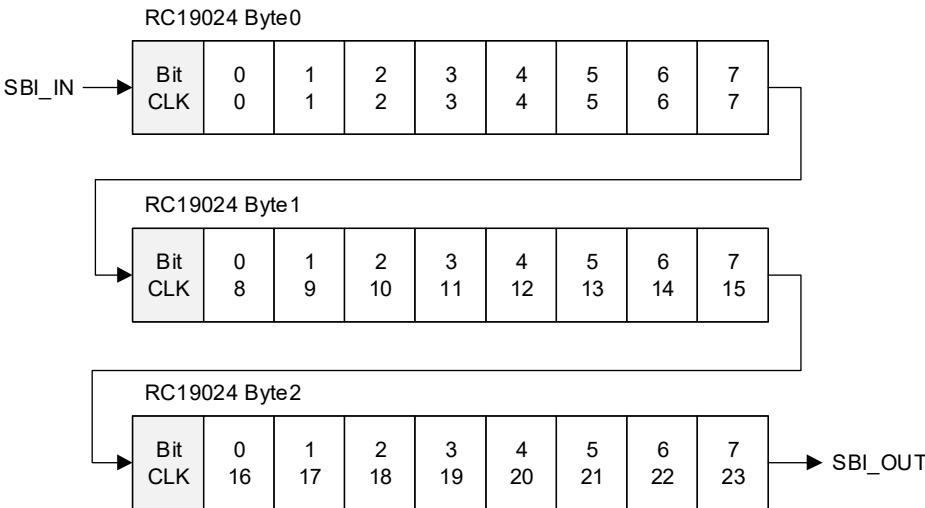


Figure 28. RC19024 Side-Band Shift Order

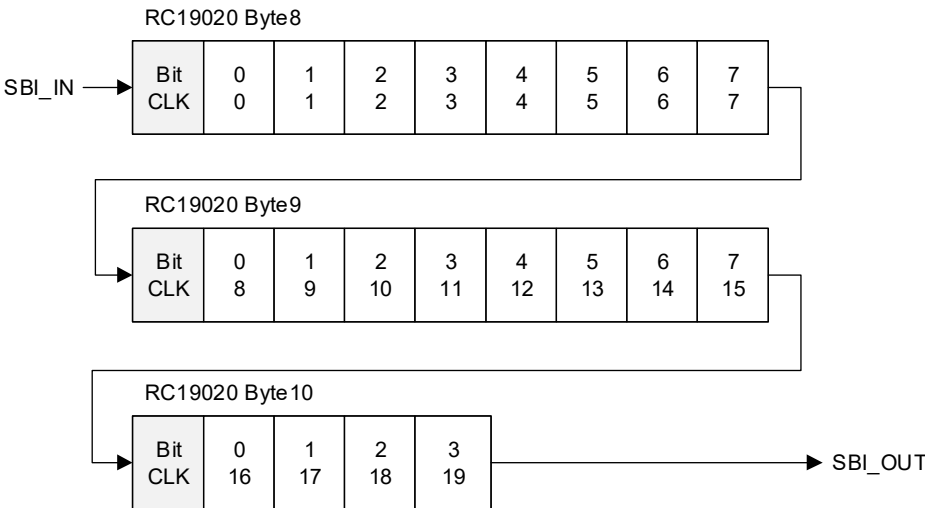


Figure 29. RC19020 Side-Band Shift Order

Figure 30 through Figure 33 show the Side-Band Shift Order for the RC19016, RC19013, RC19008, and RC19004 buffers. Notice that the Side-Band Shift Count is equal to the number of outputs in each device.

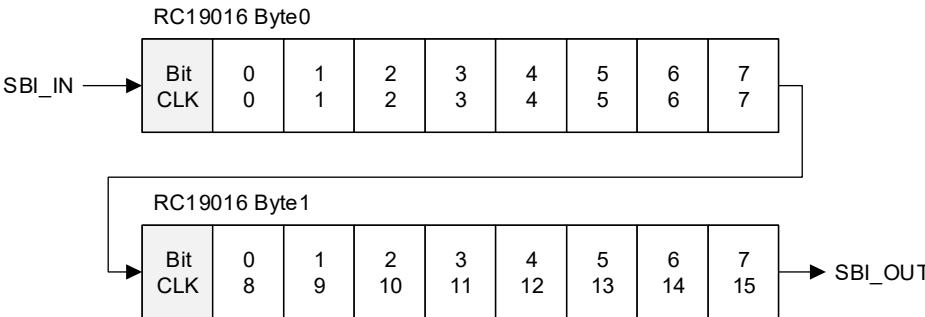


Figure 30. RC19016 Side-Band Shift Order

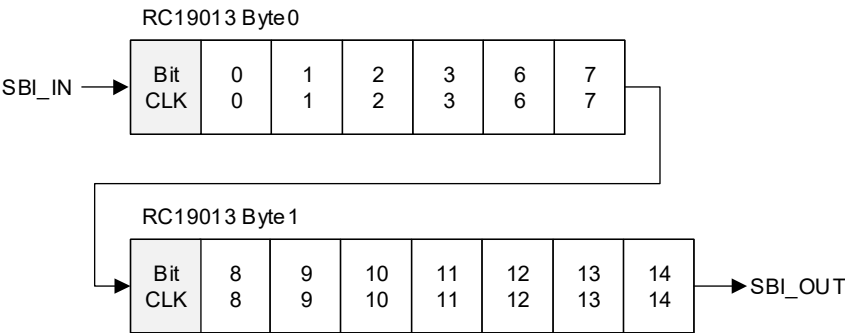


Figure 31. RC19013 Side-Band Shift Order

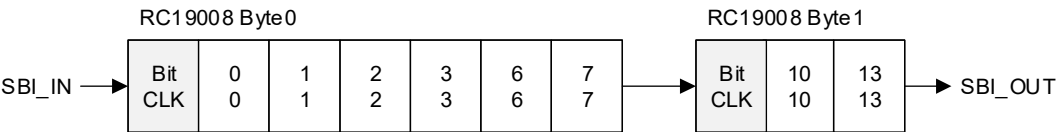


Figure 32. RC19008 Side-Band Shift Order

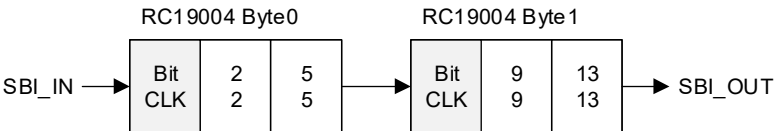


Figure 33. RC19004 Side-Band Shift Order

5.5.4.2 Side-Band Interface Timing

Figure 34 shows the basic timing of the side-band interface. The SHFT\_LDb pin goes high to enable the SBI\_CLK input. Next, the rising edge of SBI\_CLK clocks SBI\_IN data into the shift register. After the 24<sup>th</sup> clock (assuming the RC19024), stop the SBI\_CLK low and drive the SHFT\_LDB pin low. The falling edge of SHFT\_LDb latches the shift register contents to the output control register, disabling or enabling the outputs. Always shift the complete set of bits into the shift register to control the outputs. For the Side-Band Interface AC/DC Electrical Characteristics, see Table 29.

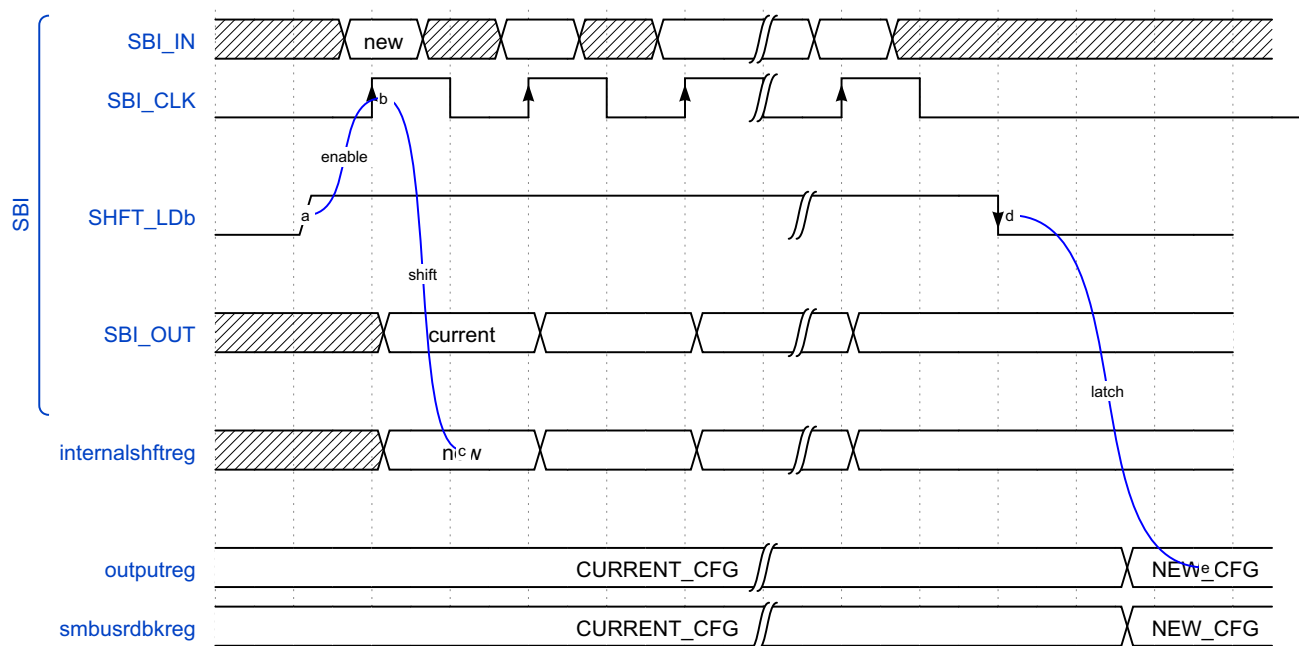


Figure 34. Side-Band Interface Functional Timing

#### 5.5.4.3 Side-Band Interface Connection Topologies

The RC190xxA buffer/mux devices support two SBI connection topologies: star and daisy chain. In a star topology, multiple devices can share the SBI\_CLK and SBI\_IN pins. In this topology, each RC190xx has a dedicated SHFT\_LDb pin. In a daisy-chain topology, the SBI\_OUT of one device connects to the SBI\_IN of a downstream device. When using the daisy-chain topology, the user must shift a complete set of bits for the combined devices. Two daisy-chained RC19024 devices require shifting of  $2 \times 24 = 48$  bits. An RC19016 followed by an RC19008 would require shifting  $8 + 16 = 24$  bits. When the SHFT\_LDb pin is low, the SBI interface ignores any activity on the SBI\_CLK and SBI\_IN pins.

Figure 35 shows a star topology connection for the RC190xxA SBI interface. The star topology allows independent configuration of each device. For the RC19024, this means shifting 24 bits at a time. A disadvantage is that a separate SHFT\_LDb pin is required for each device. The star topology allows additional devices to be controlled at the cost of an additional GPIO per device.

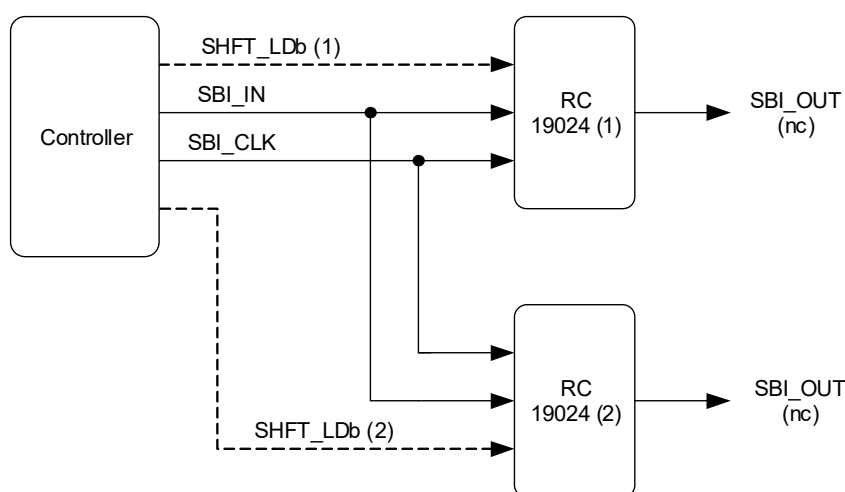


Figure 35. Side-Band Interface Star Topology

The daisy-chain topology allows configuration of any number of devices with only three signals from the SBI controller. It uses the SBI\_OUT pin of one device to drive the SBI\_IN pin of the next device in the daisy chain. Users must take care to shift the proper number of bits in this configuration. For the example shown in [Figure 36](#), the SBI bit stream consists of 48 bits.

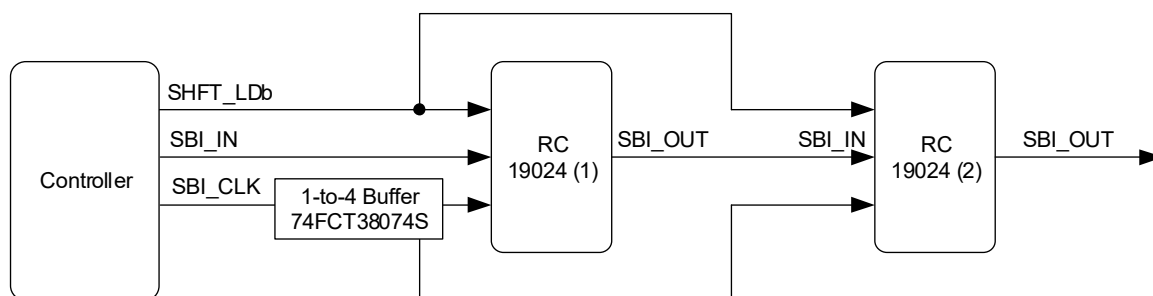


Figure 36. Side-Band Interface Daisy-Chain Topology

### 5.5.5 Output Enable/Disable Priority

The RC190 output enable/disable priority is an “AND” function of all enable methods. This means that the SMBus output enable bit AND the OEb pin (if present/assigned) AND the SBI must indicate that the output is enabled in order for the output to be enabled. A logical representation of the priority logic is shown in [Figure 37](#).

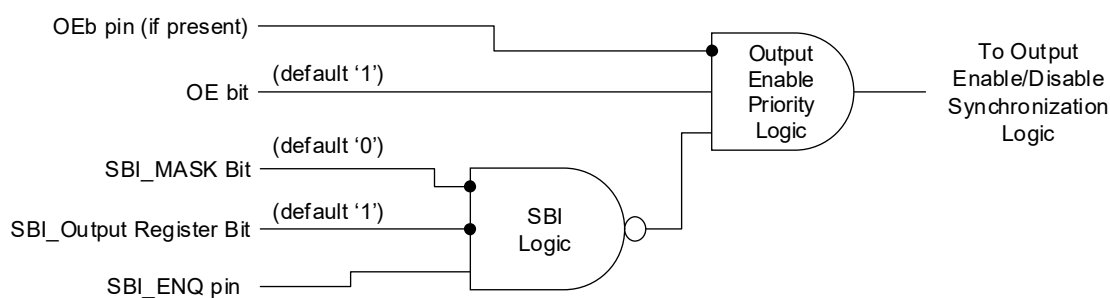


Figure 37. Output Enable/Disable Priority (Logical)

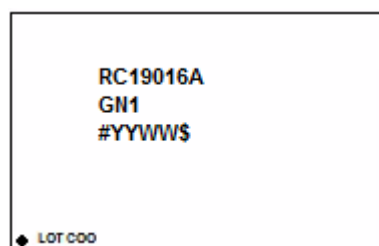
## 6. Package Outline Drawings

The package outline drawings are located at the end of this document and are accessible from the Renesas website (see the package links in [Ordering Information](#)). The package information is the most current data available and is subject to change without revision of this document.

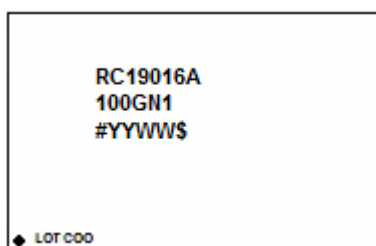


## 7. Marking Diagrams

### 7.1 RC1901xA/RC1900xA Marking Diagrams

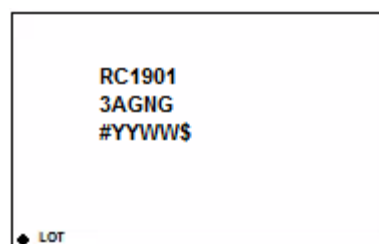


RC19016A 64-VFQFPN 85Ω

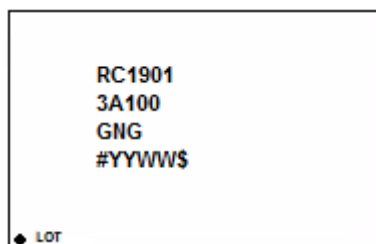


RC19016A 64-VFQFPN 100Ω

- Lines 1 and 2: part number.
- Line 3:
  - “#” indicates stepping number.
  - “YYWW” indicates the last two digits of the year and work week the part was assembled.
  - “\$” indicates the mark code.

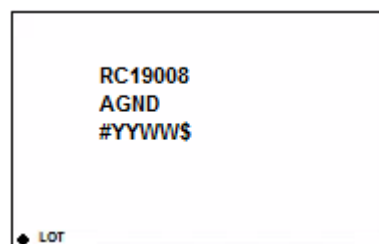


RC19013A 56-VFQFPN 85Ω

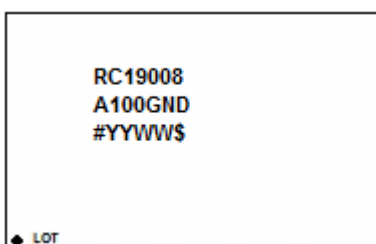


RC19013A 56-VFQFPN 100Ω

- Lines 1 and 2 (for 85Ω); 1, 2, and 3 (for 100Ω): part number.
- Line 3 (for 85Ω) or 4 (for 100Ω):
  - “#” indicates stepping number.
  - “YYWW” indicates the last two digits of the year and work week the part was assembled.
  - “\$” indicates the mark code.

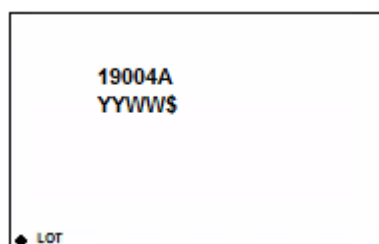


RC19008A 40-VFQFPN 85Ω

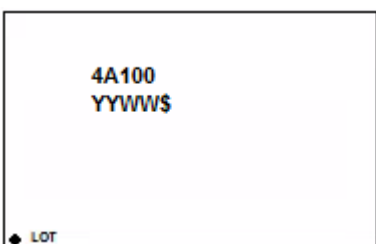


RC19008A 40-VFQFPN 100Ω

- Lines 1 and 2: part number.
- Line 3:
  - “#” indicates stepping number.
  - “YYWW” indicates the last two digits of the year and work week the part was assembled.
  - “\$” indicates the mark code.

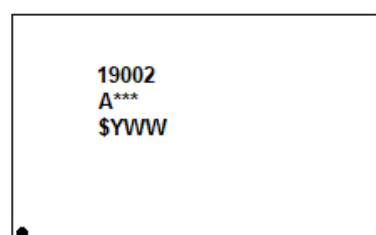


RC19004A 28-VFQFPN 85Ω



RC19004A 28-VFQFPN 100Ω

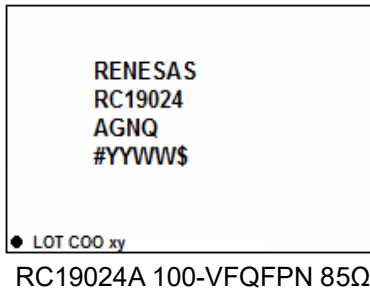
- Line 1: truncated part number.
- Line 2:
  - “YYWW” indicates the last two digits of the year and work week the part was assembled.
  - “\$” indicates the mark code.



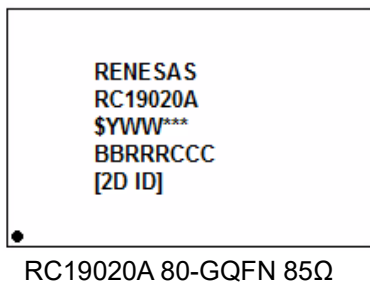
RC19002A 20-VFQFPN

- Line 1 is the part number
- Line 2 “A” is part of the part number and “\*\*\*” is the sequential code
- Line 3:
  - “\$” denotes the mark location code.
  - “YWW” denotes the assembly date: “Y” is the last digit of the year and “WW” are the last two digits of work week.

## 7.2 RC1902xA Marking Diagrams



- Lines 2 and 3: part number
- Line 4:
  - “#” denotes the stepping number.
  - “YYWW” denotes the last two digits of the year and the work week the part was assembled.
  - “\$” denotes the mark code.
- “LOT” denotes the lot number
- “COO” denotes country of origin.



- Lines 2 and 3: part number
- Line 4:
  - “#” denotes the stepping number.
  - “YYWW” denotes the last two digits of the year and the work week the part was assembled.
  - “\$” denotes the mark code.
- “LOT” denotes the lot number



- Lines 2 and 3: part number
- Line 4:
  - “#” denotes the stepping number.
  - “YYWW” denotes the last two digits of the year and the work week the part was assembled.
  - “\$” denotes the mark code.
- “LOT” denotes the lot number
- “COO” denotes country of origin.

## 8. Ordering Information

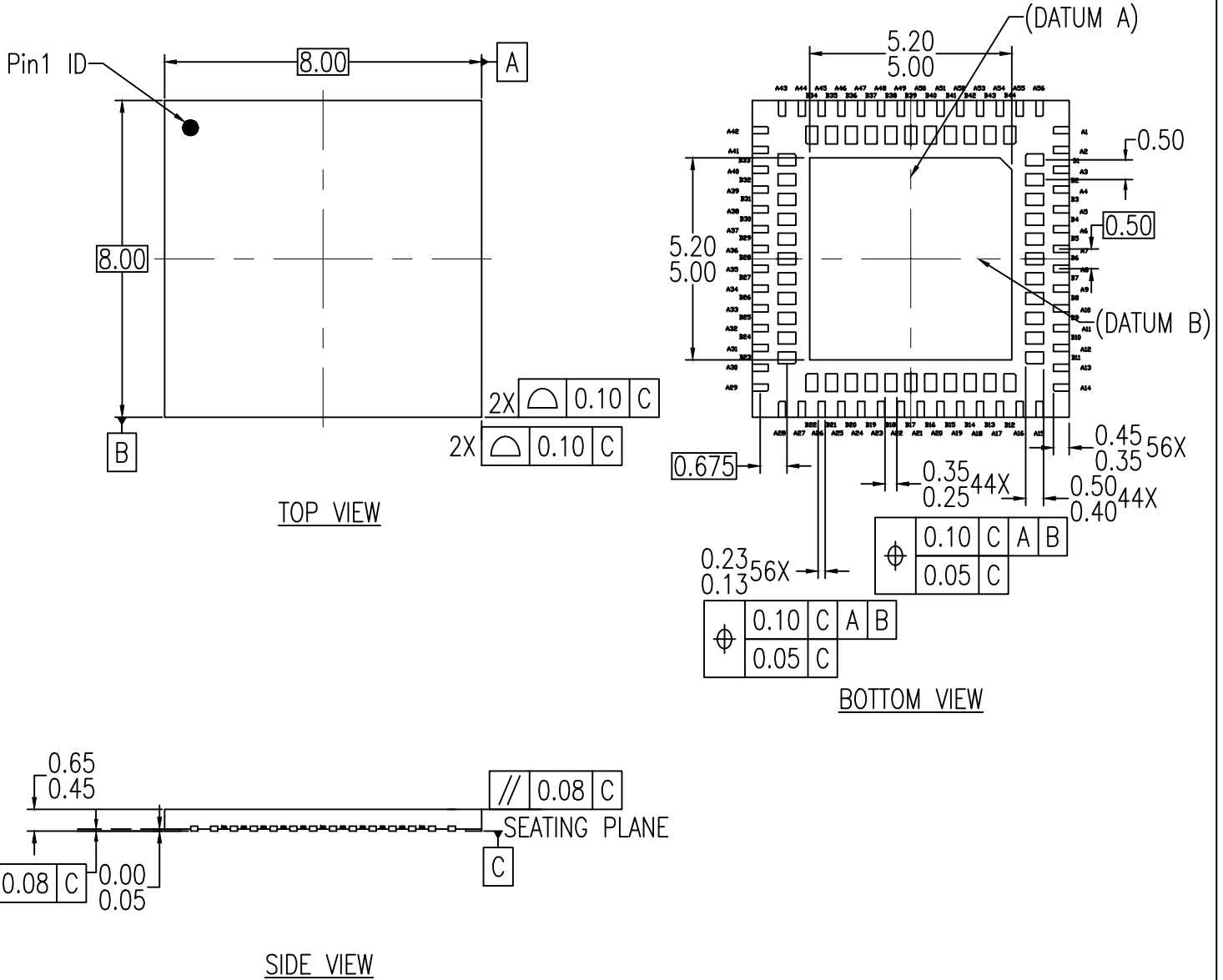
Table 42. Ordering Information

| Part Number        | Carrier Type              | Number of Outputs | Differential Output Impedance (Ω) | Package  | Temperature Range |
|--------------------|---------------------------|-------------------|-----------------------------------|--|-------------------|
| RC19024AGNQ#BB0    | Tray                      | 24                | 85                                | 8 × 8 mm, 0.5mm pitch, <a href="#">100-VFQFPN</a>  | -40 to +105°C     |
| RC19024AGNQ#KB0    | Tape and Reel (EIA-481-D) |                   |                                   |  |                   |
| RC19020AGN6#BD0    | Tray                      | 20                | 85                                | 6 × 6 mm, 0.5mm pitch, <a href="#">80-GQFN</a>     | -40 to +105°C     |
| RC19020AGN6#KD0    | Tape and Reel (EIA-481-D) |                   |                                   |  |                   |
| RC19020A072GN2#BB0 | Bulk                      | 20                | 85                                | 10 x 10 mm, 0.50mm pitch <a href="#">72-VFQFPN</a> | -40 to +105°C     |
| RC19020A072GN2#KB0 | Tape and Reel (EIA-481-D) |                   |                                   |  |                   |
| RC19016AGN1#BB0    | Tray                      | 16                | 85                                | 9 × 9 mm, 0.5mm pitch, <a href="#">64-VFQFPN</a>   | -40 to +105°C     |
| RC19016AGN1#KB0    | Tape and Reel (EIA-481-D) |                   | 100                               |  |                   |
| RC19016A100GN1#BB0 | Tray                      |                   |                                   |  |                   |
| RC19016A100GN1#KB0 | Tape and Reel (EIA-481-D) |                   |                                   |  |                   |
| RC19013AGNG#BB0    | Tray                      | 13                | 85                                | 7 × 7 mm, 0.4mm pitch, <a href="#">56-VFQFPN</a>   | -40 to +105°C     |
| RC19013AGNG#KB0    | Tape and Reel (EIA-481-D) |                   | 100                               |  |                   |
| RC19013A100GNG#BB0 | Tray                      |                   |                                   |  |                   |
| RC19013A100GNG#KB0 | Tape and Reel (EIA-481-D) |                   |                                   |  |                   |
| RC19008AGND#BB0    | Tray                      | 8                 | 85                                | 5 × 5 mm, 0.4mm pitch, <a href="#">40-VFQFPN</a>   | -40 to +105°C     |
| RC19008AGND#KB0    | Tape and Reel (EIA-481-D) |                   | 100                               |  |                   |
| RC19008A100GND#BB0 | Tray                      |                   |                                   |  |                   |
| RC19008A100GND#KB0 | Tape and Reel (EIA-481-D) |                   |                                   |  |                   |
| RC19004AGNL#BB0    | Tray                      | 4                 | 85                                | 4 × 4 mm, 0.4mm pitch, <a href="#">28-VFQFPN</a>   | -40 to +105°C     |
| RC19004AGNL#KB0    | Tape and Reel (EIA-481-D) |                   | 100                               |  |                   |
| RC19004A100GNL#BB0 | Tray                      |                   |                                   |  |                   |
| RC19004A100GNL#KB0 | Tape and Reel (EIA-481-D) |                   |                                   |  |                   |
| RC19002AGNT#BD0    | Tray                      | 2                 | Selectable                        | 3 × 3 mm, 0.4mm pitch <a href="#">20-VFQFPN</a>    | -40 to +105°C     |
| RC19002AGNT#KD0    | Tape and Reel (EIA-481-D) |                   |                                   |  |                   |

## 9. Revision History

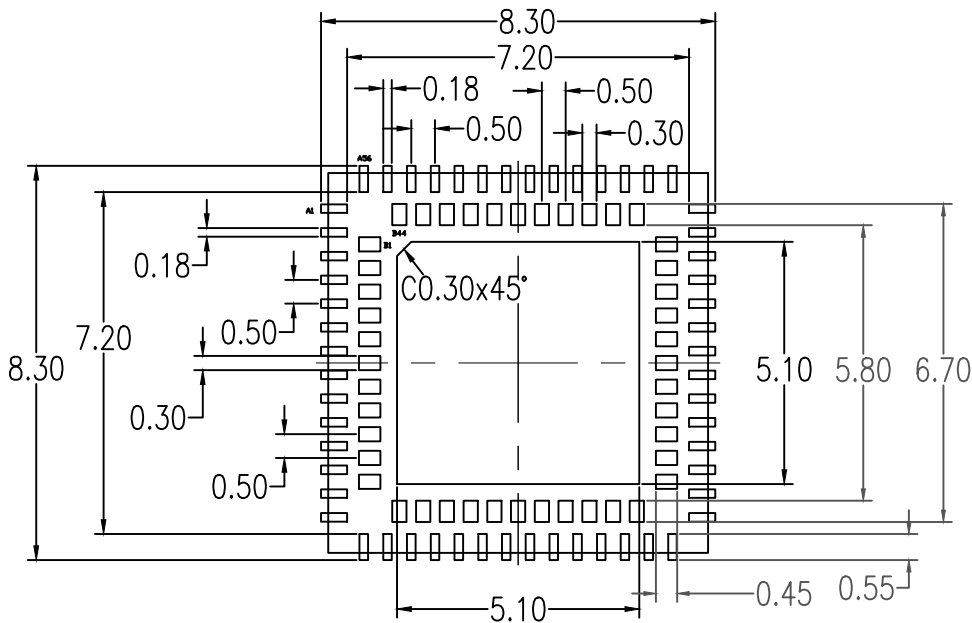
| Revision | Date         | Description  |
|----------|--------------|--|
| 1.15     | Jul 25, 2023 | <ul style="list-style-type: none"> <li>Updated descriptive text for <a href="#">Figure 25</a> in section 5.4.</li> <li>Updated part number to RC190xxA from RC19xxxA in section 5.5.4.3.</li> <li>Updated <a href="#">Figure 36</a>.</li> </ul>  |
| 1.14     | Jun 29, 2023 | <ul style="list-style-type: none"> <li>Updated <a href="#">RC19002 Pin Information</a> for pins 3, 6, 7, and 8.</li> <li>Updated various device specifications:               <ul style="list-style-type: none"> <li><math>V_{MAX}</math>, <math>V_{MIN}</math>, <math>V_{LOW}</math>, and <math>\Delta T_{R/F}</math> in <a href="#">Table 17</a></li> <li><math>V_{OL}</math> and <math>t_{DC}</math> in <a href="#">Table 18</a></li> <li><math>V_{OH}</math>, <math>V_{OL}</math>, <math>V_{CROSS}</math>, and <math>\Delta V_{CROSS}</math>, <math>t_F</math> in <a href="#">Table 19</a></li> <li><math>V_{OH}</math>, <math>V_{CROSS}</math>, <math>t_R</math>, and <math>t_{DC}</math> in <a href="#">Table 20</a></li> <li><math>V_{OL}</math>, <math>V_{CROSS}</math>, <math>\Delta V_{CROSS}</math>, <math>\Delta V_{CROSS}</math>, and <math>t_R</math> in <a href="#">Table 21</a></li> <li><math>V_{OH}</math>, <math>V_{OL}</math>, <math>V_{CROSS}</math>, <math>\Delta V_{CROSS}</math>, <math>t_R</math>, <math>t_F</math> in <a href="#">Table 22</a></li> <li>Added <math>V_{DDCLK}</math> Operating Current 100Ω impedance values for RC19002 in <a href="#">Table 25</a></li> </ul> </li> <li>Completed other minor changes</li> </ul> |
| 1.13     | Jun 2, 2023  | <ul style="list-style-type: none"> <li>Added missing slew rate control bytes 20 and 21 to <a href="#">Table 36</a></li> <li>Renamed various tables to list the parts they apply to instead of using “x” wildcard.</li> <li>Removed “A” suffix from generic part number references through out the document; left A100 and A072 suffixes.</li> </ul>  |
| 1.12     | May 10, 2023 | <ul style="list-style-type: none"> <li>Updated the Type information for OEb pins in Pin descriptions tables</li> <li>Updated the <a href="#">Applications Information</a></li> <li>Completed other minor changes</li> </ul>  |
| 1.11     | Mar 10, 2023 | <ul style="list-style-type: none"> <li>Added RC19002A to data sheet, moved back to Preliminary pending production release of the RC19002A.</li> </ul>  |
| 1.10     | Dec 1, 2022  | <ul style="list-style-type: none"> <li>Fixed the link for the 40-VFQFPN package in <a href="#">Table 42</a>.</li> </ul>  |
| 1.09     | Nov 17, 2022 | <ul style="list-style-type: none"> <li>Changed <math>t_{SLEW}</math> to 6 from 4 in <a href="#">Table 29</a>.</li> </ul>   |
| 1.08     | Nov 15, 2022 | <ul style="list-style-type: none"> <li>Updated the description of RC19024 pin A7 in <a href="#">Table 1</a></li> </ul>   |
| 1.07     | Apr 11, 2022 | <ul style="list-style-type: none"> <li>For all devices <i>except</i> RC19020A072:               <ul style="list-style-type: none"> <li>Updated Pin Type of all pins beginning with OEb to properly indicate internal pull-down (PD) resistors.</li> </ul> </li> <li>For all devices <i>except</i> RC19020A072 and RC19024A:               <ul style="list-style-type: none"> <li>Removed Power-Down Tolerant indicator from multiplexed OEb SBI_OUT pins, they are not PDT.</li> </ul> </li> <li>Minor reformatting of Pin Descriptions to reduce required space in Pin Description tables and to provide consistency across devices.</li> </ul>   |
| 1.06     | Apr 4, 2022  | <ul style="list-style-type: none"> <li>Updated <a href="#">Loss of Signal and Automatic Clock Parking</a> to change all CLK_IN to CLKIN for consistency.</li> <li>Inserted <a href="#">LOSb De-assert Timing RC19002, RC19020 Devices</a> figure to distinguish the LOSb start-up behavior of those devices from the other devices.</li> </ul>   |
| 1.05     | Mar 23, 2022 | Updated pins B10 and B43 from Do Not Connect (DNC) to GND on <a href="#">RC19024 Pin Assignments</a> to tie off floating pins used for test.   |
| 1.04     | Mar 15, 2022 | Updated the <i>PCI Express Base Specification 6.0</i> revision reference to 1.0 in footnotes 1 and 7 in <a href="#">Table 9</a> and <a href="#">Table 10</a> .   |
| 1.03     | Mar 3, 2022  | <ul style="list-style-type: none"> <li>Corrected pin 10 of RC19008A from NC to VDDCLK (see <a href="#">RC19008 Pin Assignments</a>).</li> </ul>  |
| 1.02     | Feb 24, 2022 | <ul style="list-style-type: none"> <li>Completed minor updates to titles of CLK AC/DC Characteristics Tables for clarity.</li> <li>Completed other minor changes</li> </ul>  |

| Revision | Date         | Description   |
|----------|--------------|---|
| 1.01     | Feb 01, 2022 | <ul style="list-style-type: none"><li>▪ Added RC19020A072 pin out and pin descriptions to data sheet.</li><li>▪ Updated <a href="#">Figure 10</a> for RC19020A and RC19020A072.</li><li>▪ Updated <a href="#">Figure 2</a> title to reference correct package type (VFQFPN) and updated “100-GQFN” references to “100-VFQFPN” throughout the document.</li><li>▪ Added RC19020A072 marking diagram to <a href="#">RC1902xA Marking Diagrams</a> and updated marking descriptions of RC19020A and RC19020A072.</li></ul> |
| 1.00     | Jan 18, 2022 | Initial release.  |



NOTES:

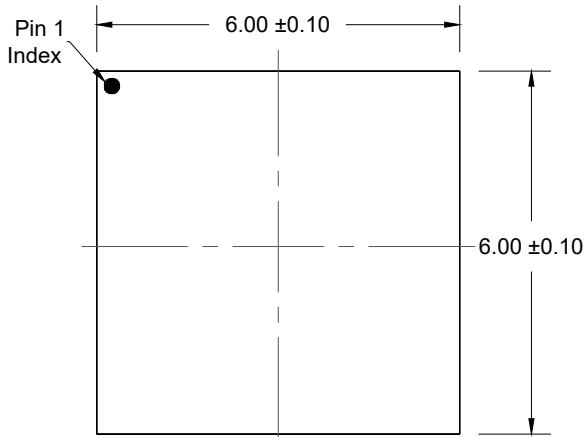
1. ALL DIMENSIONS AND TOLERANCES ARE PER ASME Y14.5M-1994.
2. ALL DIMENSIONS ARE IN MILLIMETERS.



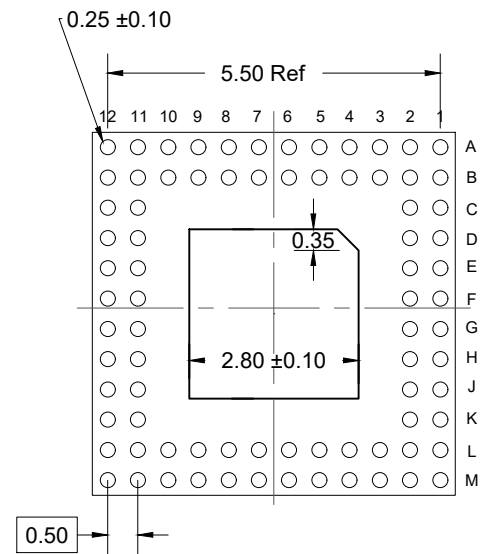
RECOMMENDED LAND PATTERN DIMENSION

- NOTES:
1. ALL DIMENSIONS ARE IN MM, ANGLES IN DEGREES.
  2. TOP DOWN VIEW, AS VIEW ON PCB.
  3. NSMD LAND PATTERN ASSUMED.
  4. LAND PATTERN RECOMMENDATION AS PR IPC-7351  
GENERIC REQUIREMENT FOR SURFACE MOUNT DESIGN AND LAND PATTERN.

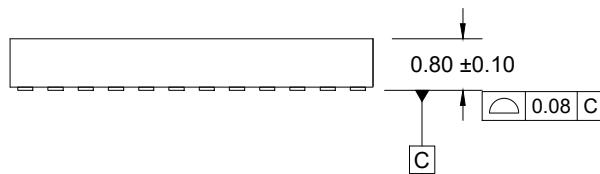
| Package Revision History |         |                 |
|--------------------------|---------|-----------------|
| Date Created             | Rev No. | Description     |
| August 12, 2019          | Rev 00  | Initial Release |



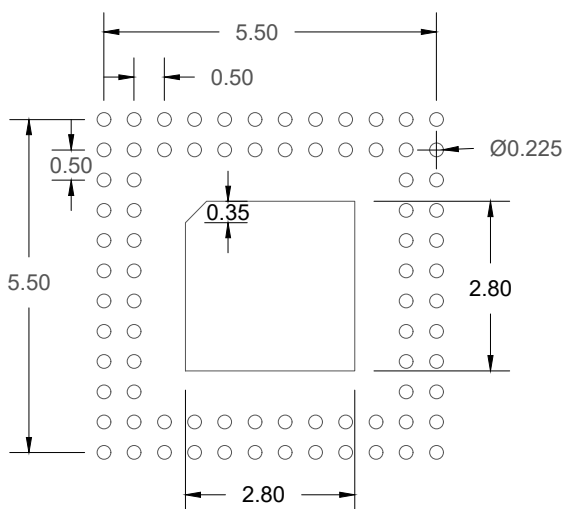
TOP VIEW



BOTTOM VIEW



SIDE VIEW



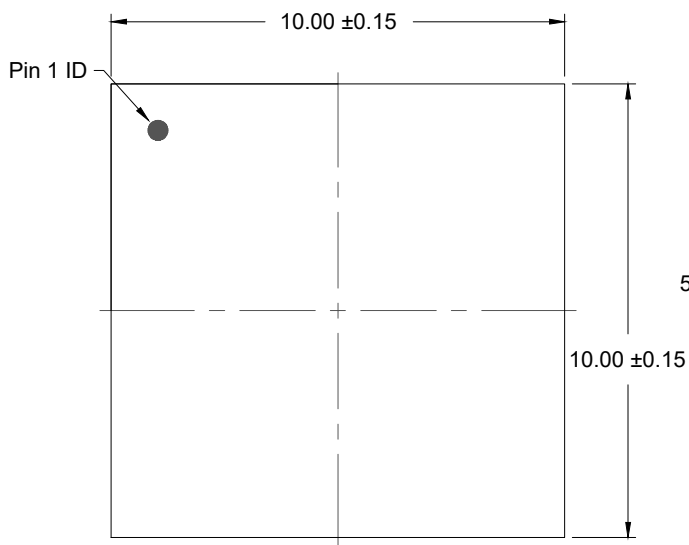
RECOMMENDED LAND PATTERN

(PCB Top View, NSMD Design)

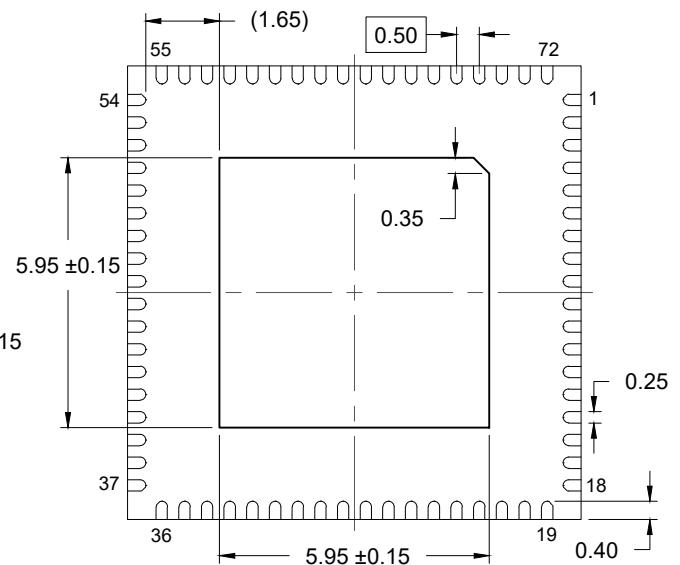
## NOTES:

1. JEDEC compatible
2. All dimensions are in mm and angles are in degrees
3. Use  $\pm 0.05$  mm tolerance for all other dimensions
4. Numbers in ( ) are for reference only

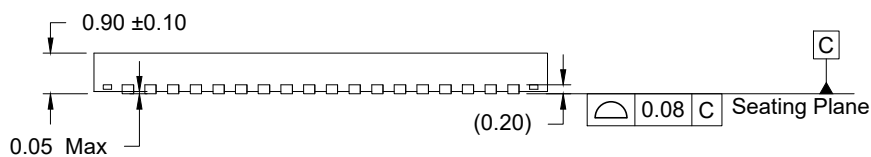




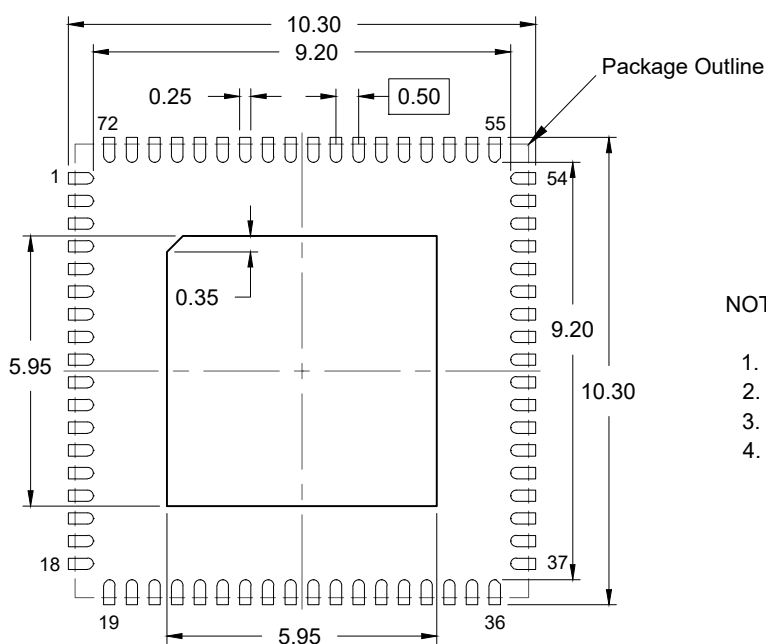
TOP VIEW



BOTTOM VIEW



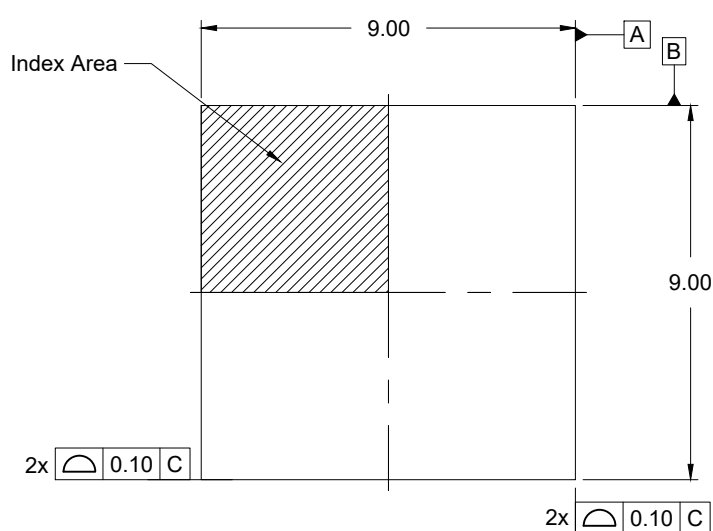
SIDE VIEW



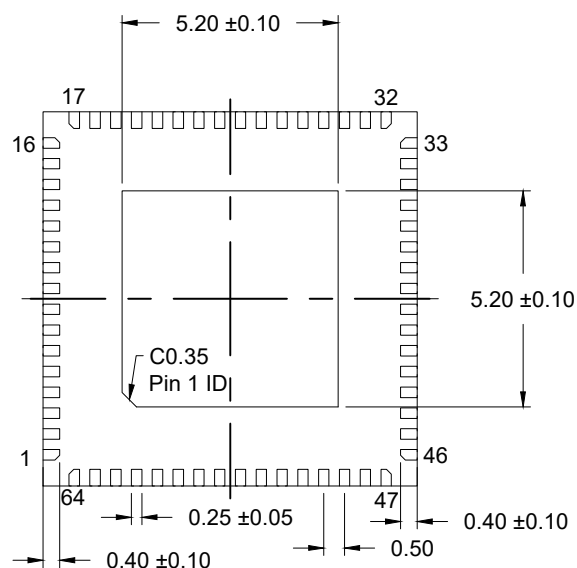
RECOMMENDED LAND PATTERN  
(PCB Top View, NSMD Design)

NOTES:

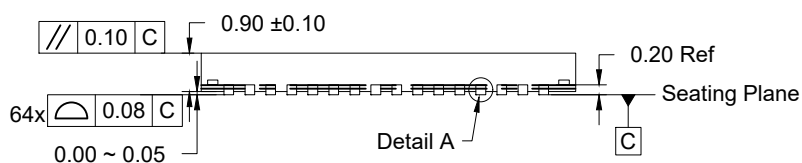
1. JEDEC compatible.
2. All dimensions are in mm and angles are in degrees.
3. Use  $\pm 0.05$  mm for the non-toleranced dimensions.
4. Numbers in ( ) are for references only.



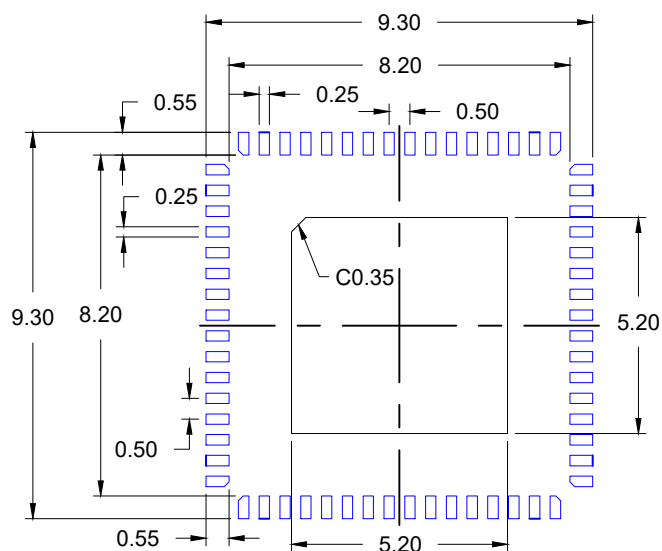
TOP VIEW



BOTTOM VIEW



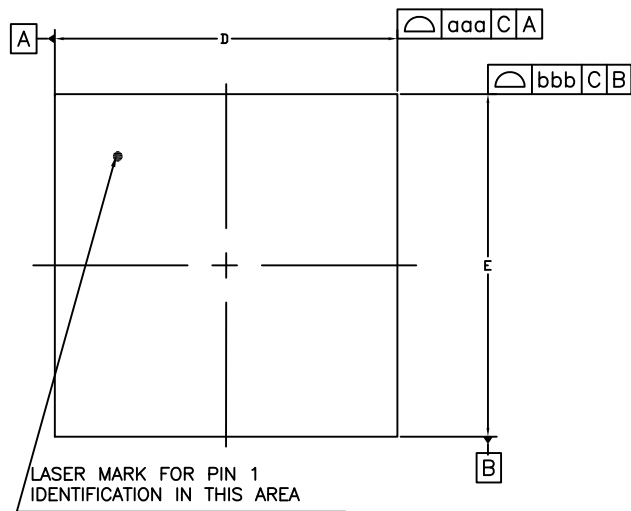
SIDE VIEW



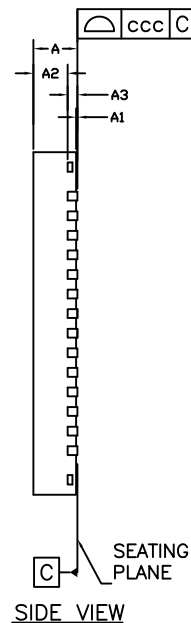
### RECOMMENDED LAND PATTERN

NOTES:

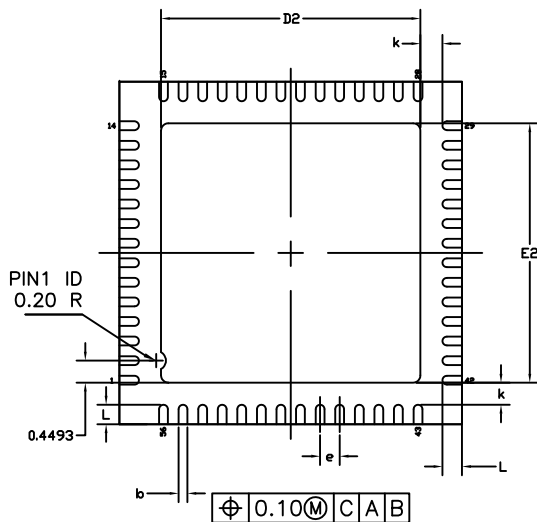
1. JEDEC compatible.
2. All dimensions are in mm and angles are in degrees.
3. Use  $\pm 0.05$  mm for the non-toleranced dimensions.
4. Numbers in ( ) are for references only.



TOP VIEW



SIDE VIEW



BOTTOM VIEW

NOTES :


- 1.ALL DIMENSIONS ARE IN MILLIMETERS.
- 2.DIE THICKNESS ALLOWABLE IS 0.305 mm MAXIMUM(.012 INCHES MAXIMUM)
- 3.DIMENSIONING & TOLERANCES CONFORM TO ASME Y14.5M. -1994.
- 4.THE PIN #1 IDENTIFIER MUST BE PLACED ON THE TOP SURFACE OF THE PACKAGE BY USING INDENTATION MARK OR OTHER FEATURE OF PACKAGE BODY.
- 5.EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
- 6.PACKAGE WARPAGE MAX 0.08 mm.
- 7.APPLIED FOR EXPOSED PAD AND TERMINALS. EXCLUDE EMBEDDING PART OF EXPOSED PAD FROM MEASURING.
- 8.APPLIED ONLY TO TERMINALS.

REVISIONS

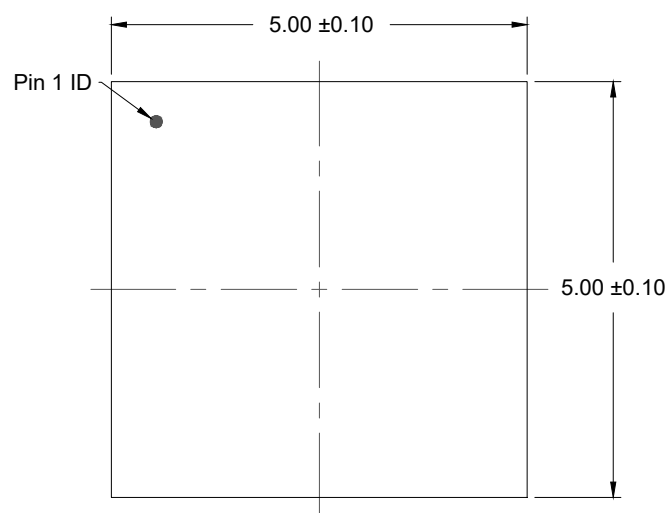
| REV | DESCRIPTION     | DATE    | APPROVED |
|-----|-----------------|---------|----------|
| 00  | INITIAL RELEASE | 5/18/16 | JH       |

DIMENSION

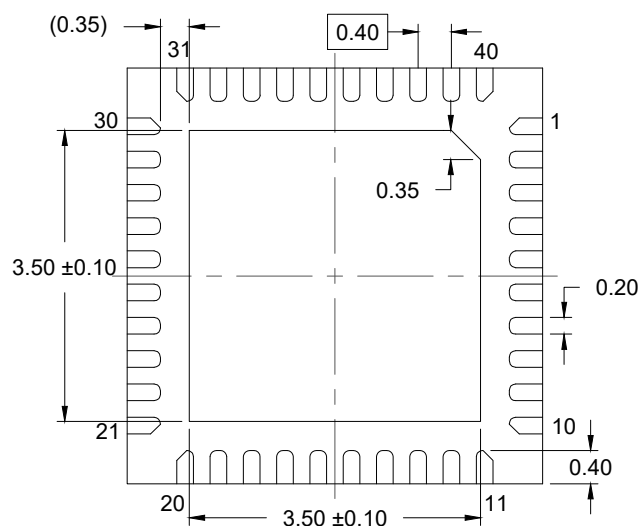
| SYMBOL | MIN.       | NOM. | MAX. |
|--------|------------|------|------|
| A      | 0.80       | 0.90 | 1.00 |
| A1     | 0.00       | 0.02 | 0.05 |
| A2     | ---        | 0.65 | 0.70 |
| A3     | 0.20 REF.  |      |      |
| b      | 0.15       | 0.20 | 0.25 |
| D      | 7.00 BSC   |      |      |
| E      | 7.00 BSC   |      |      |
| D2     | 5.20       | 5.30 | 5.40 |
| E2     | 5.20       | 5.30 | 5.40 |
| L      | 0.30       | 0.40 | 0.50 |
| k      | 0.450 REF. |      |      |
| e      | 0.40 BSC   |      |      |
| aaa    | 0.10       |      |      |
| bbb    | 0.10       |      |      |
| ccc    | 0.05       |      |      |

|                                |          |   |  |
|--------------------------------|----------|---|--|
| TOLERANCES<br>UNLESS SPECIFIED |          |  6024 Silver Creek Valley Road<br>San Jose, CA 95138<br>PHONE: (408) 284-8200<br>FAX: (408) 284-8591 |  |
| DECIMAL                        | ANGULAR  |   |  |
| XX±                            | ±        | www.IDT.com<br>ND/NDG56 PACKAGE OUTLINE<br>7.0 x 7.0 mm BODY, EPAD 5.30mm SQ<br>0.40 mm PITCH QFN   |  |
| XXX±                           |          |   |  |
| XXXX±                          |          | SIZE<br><b>C</b>  |  |
| APPROVALS                      | DATE     |   |  |
| DRAWN <i>MAC</i>               | 07/01/13 | DRAWING No.<br>PSC-4398-01  |  |
| CHECKED                        |          |   |  |
| DO NOT SCALE DRAWING           |          | SHEET 1 OF 2  |  |

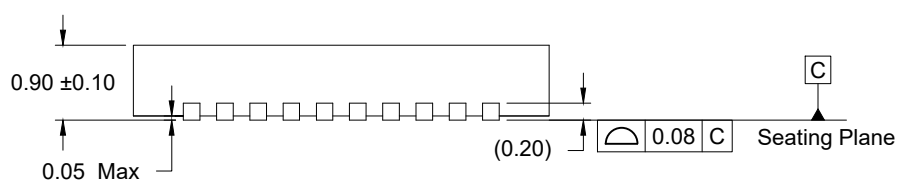




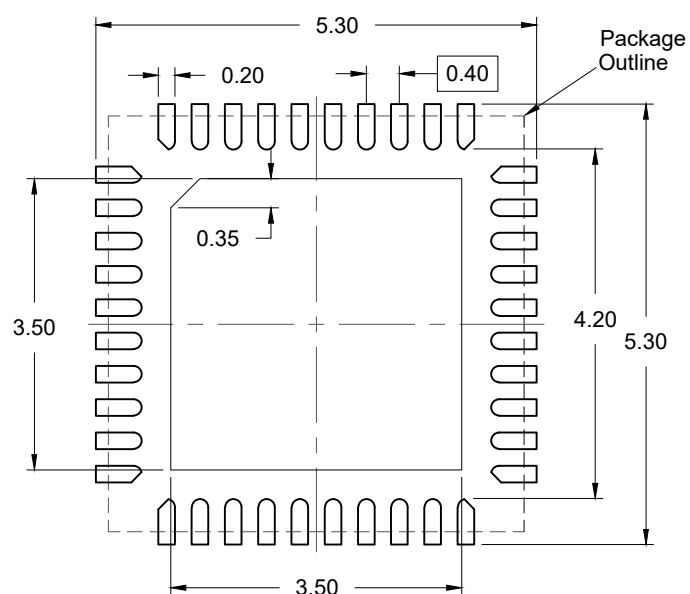
TOP VIEW



BOTTOM VIEW



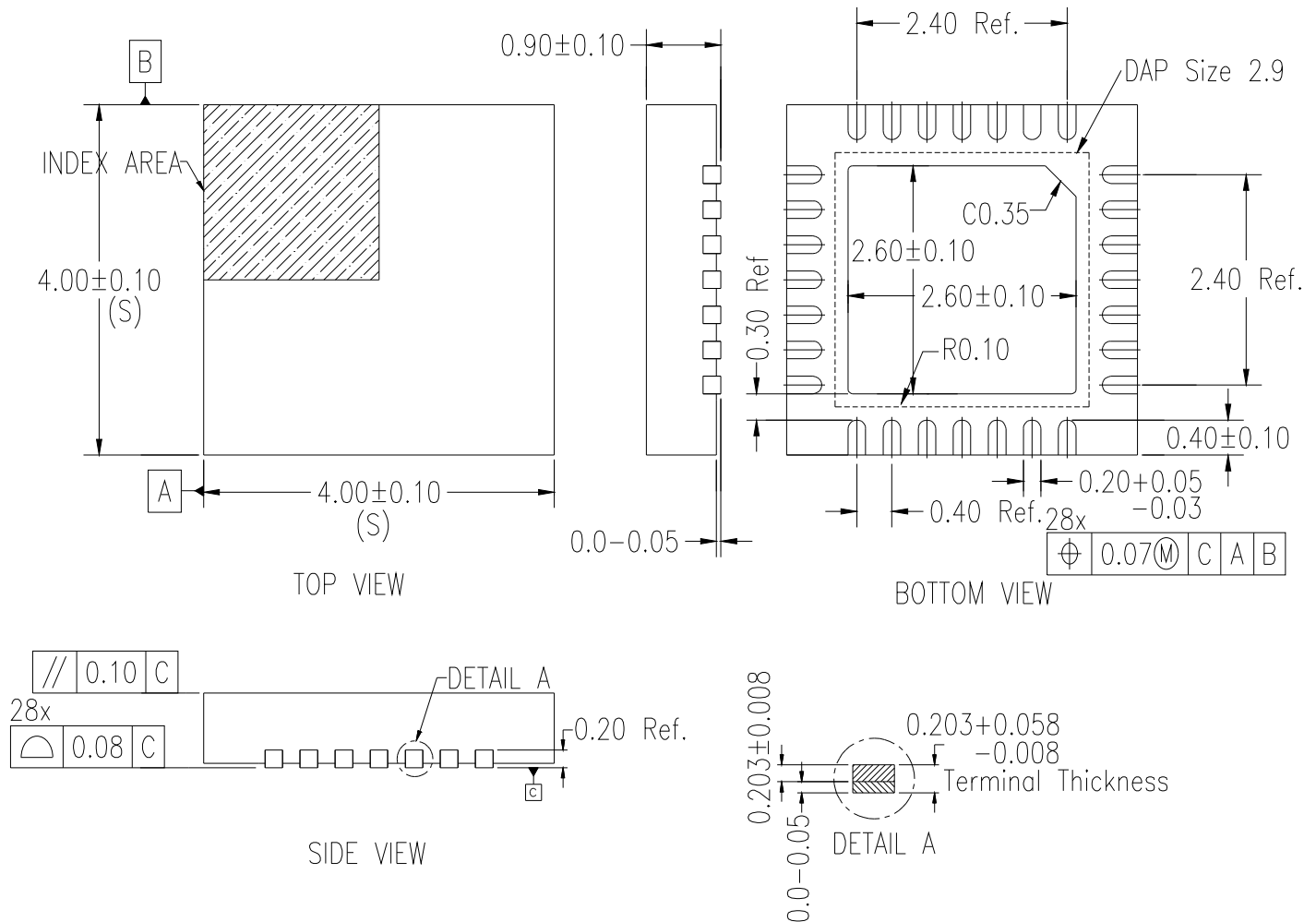
SIDE VIEW



RECOMMENDED LAND PATTERN  
(PCB Top View, NSMD Design)

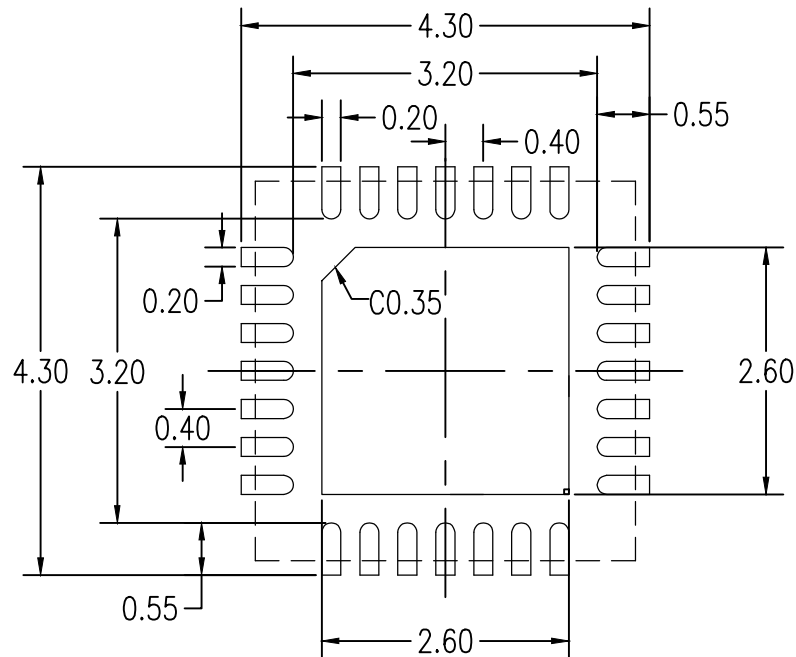
NOTES:

1. JEDEC compatible.
2. All dimensions are in mm and angles are in degrees.
3. Use  $\pm 0.05$  mm for the non-toleranced dimensions.
4. Numbers in ( ) are for references only.



## NOTES:

1. ALL DIMENSION ARE IN MM. ANGLES IN DEGREES.
2. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.  
COPLANARITY SHALL NOT EXCEED 0.08 MM.
3. WARPAGE SHALL NOT EXCEED 0.10 MM.
4. PACKAGE LENGTH/ PACKAGE WIDTH ARE CONSIDERED AS SPECIAL CHARACTERISTIC (S)
5. REFER JEDEC MO-220



## RECOMMENDED LAND PATTERN DIMENSION

NOTES:

1. ALL DIMENSION ARE IN MM. ANGLES IN DEGREES.
2. TOP DOWN VIEW. AS VIEWED ON PCB.
3. LAND PATTERN IN NSMD PATTERN ASSUMED.
4. LAND PATTERN RECOMMENDATION PER IPC-7351B GENERIC REQUIREMENT FOR SURFACE MOUNT DESIGN AND LAND PATTERN.

| Package Revision History |         |   |
|--------------------------|---------|---|
| Date Created             | Rev No. | Description                                   |
| April 5, 2021            | 00      | Initial Release                               |
| May 20, 2021             | 01      | Remove word "ball" from the description title |

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(Disclaimer Rev.1.0 Mar 2020)

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[www.renesas.com](http://www.renesas.com)

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