Description

The 9QXL2001C is an enhanced-performance 9QXL2001B with ultra-low-additive phase jitter for PCIe Gen5, Gen6 and UPI applications. The 9QXL2001C also reduces propagation delay by approximately 50% with respect to the 9QXL2001B.

PCIe Clocking Architectures

- Common Clocked (CC)
- Independent Reference (IR) – SRNS, SRIS

Typical Applications

- Servers, Storage, Networking, Accelerators

Key Specifications

- Output-to-output skew: < 50ps
- PCIe Gen5 additive phase jitter: 6fs RMS
- PCIe Gen6 additive phase jitter: 4fs RMS
- DB2000Q additive phase jitter: 10fs RMS
- 12kHz–20MHz additive jitter: 23fs RMS at 156.25MHz
- Propagation delay: 1.4ns typical

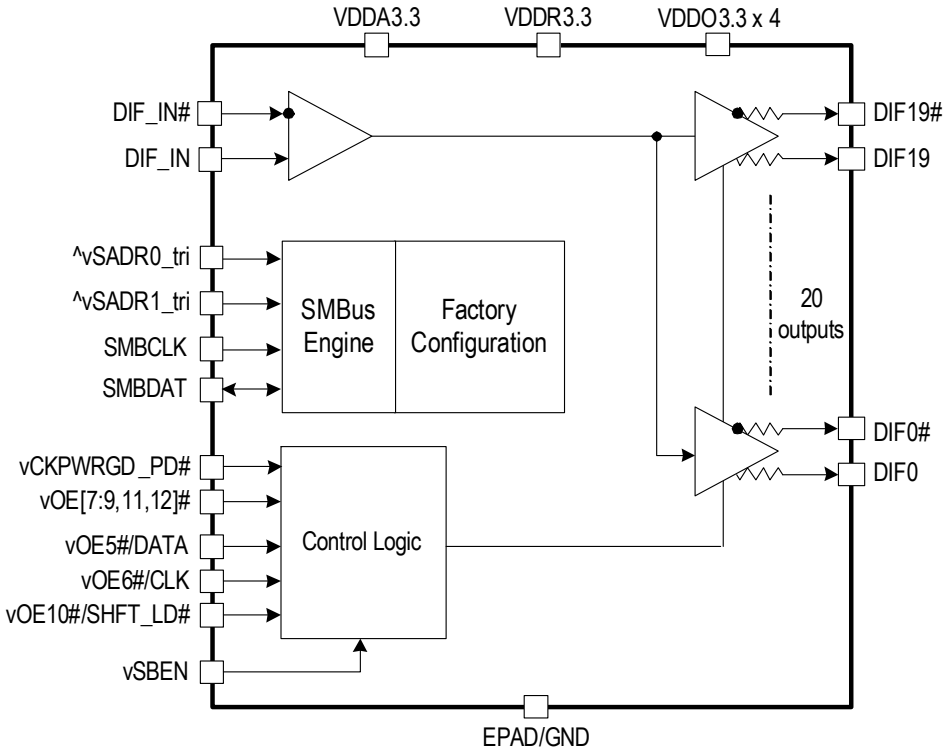
Features

- 8 OE# pins provide hardware control of 8 outputs
- SMBus allows software control of each output
- 25MHz Side-Band Interface allows real-time control of all 20 outputs
- Outputs remain Low/Low when powered up with floating input clock
- Power Down Tolerant (PDT) inputs
- 85Ω Low-Power HCSL (LP-HCSL) outputs:
  - Eliminate 80 resistors, saving 130mm^2 of area
  - Power consumption reduced by 50%
- 9 selectable SMBus addresses
- Spread spectrum compatible
- 6 × 6 mm dual-row 80-GQFN
- -40° to +105°C, 3.3V ±10% operation

Output Features

20 Low-Power HCSL (LP-HCSL) 85Ω output pairs

Block Diagram



Contents

Pin Assignments

Table 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.

Figure 1. Pin Assignments for 6 × 6 mm 80-GQFN Package – Top View

	1	2	3	4	5	6	7	8	9	10	11	12	
A	DIF17	DIF16#	DIF16	DIF15#	DIF15	DIF14#	DIF14	DIF13#	DIF13	DIF12#	DIF12	DIF11#	A
B	DIF17#	VDDO3.3	NC	^v SADR0_tri	NC	VDDA3.3	NC	^v SADR1_tri	NC	vOE12#	VDDO3.3	DIF11	B
C	DIF18	NC									vOE11#	DIF10#	C
D	DIF18#	NC									NC	DIF10	D
E	DIF19	vSBEN									vOE10#/SHFT_LD#	vOE9#	E
F	DIF19#	NC									NC	DIF9#	F
G	DIF_IN	NC									NC	DIF9	G
H	DIF_IN#	VDDR3.3									vOE8#	DIF8#	H
J	DIF0	NC									NC	DIF8	J
K	DIF0#	NC									vOE7#	DIF7#	K
L	DIF1	VDDO3.3	NC	SMBDAT	SMBCLK	NC	NC	vOE5#/DATA	NC	vOE6#/CLK	VDDO3.3	DIF7	L
M	DIF1#	DIF2	DIF2#	DIF3	DIF3#	vCKPWRGD_PD#	DIF4	DIF4#	DIF5	DIF5#	DIF6	DIF6#	M
	1	2	3	4	5	6	7	8	9	10	11	12	

9QXL2001
6 x 6 mm, x 0.5mm pitch
80-GQFN Package
Top View
EPAD is GND

Note: Pins with ^ prefix have internal pull-up resistor.
Pins with v prefix have internal pull-down resistor.
Pins with ^v prefix have internal pull-up/pull-down resistor network biasing input to VDD/2.

Pin Descriptions

Table 2. Pin Descriptions

Number		Name	Type	Description
A	1	DIF17	O, DIF	Differential true clock output.
A	2	DIF16#	O, DIF	Differential complementary clock output.
A	3	DIF16	O, DIF	Differential true clock output.
A	4	DIF15#	O, DIF	Differential complementary clock output.
A	5	DIF15	O, DIF	Differential true clock output.
A	6	DIF14#	O, DIF	Differential complementary clock output.
A	7	DIF14	O, DIF	Differential true clock output.
A	8	DIF13#	O, DIF	Differential complementary clock output.
A	9	DIF13	O, DIF	Differential true clock output.
A	10	DIF12#	O, DIF	Differential complementary clock output.
A	11	DIF12	O, DIF	Differential true clock output.
A	12	DIF11#	O, DIF	Differential complementary clock output.
B	1	DIF17#	O, DIF	Differential complementary clock output.
B	2	VDDO3.3	PWR	Power supply for outputs. Nominally 3.3V.
B	3	NC	NC	No connection.
B	4	^vSADR0_tri	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. It has internal pull-up/down resistors to bias to $V_{DD}/2$. See the SMBus Address Selection table.
B	5	NC	NC	No connection.
B	6	VDDA3.3	PWR	3.3V power for the PLL core.
B	7	NC	NC	No connection.
B	8	^vSADR1_tri	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. It has internal pull-up/down resistors to bias to VDD/2. See the SMBus Address Selection table.
B	9	NC	NC	No connection.
B	10	vOE12#	I, SE, PD, PDT	Active low input for enabling output 12. This pin has an internal pull-down. 1 = disable output, 0 = enable output.
B	11	VDDO3.3	PWR	Power supply for outputs. Nominally 3.3V.
B	12	DIF11	O, DIF	Differential true clock output.
C	1	DIF18	O, DIF	Differential true clock output.
C	2	NC	NC	No connection.
C	11	vOE11#	I, SE, PD, PDT	Active low input for enabling output 11. This pin has an internal pull-down. 1 = disable output, 0 = enable output.
C	12	DIF10#	O, DIF	Differential complementary clock output.
D	1	DIF18#	O, DIF	Differential complementary clock output.
D	2	NC	NC	No connection.

Table 2. Pin Descriptions (Cont.)

Number		Name	Type	Description
D	11	NC	NC	No connection.
D	12	DIF10	O, DIF	Differential true clock output.
E	1	DIF19	O, DIF	Differential true clock output.
E	2	vSBEN	I, SE, PD, PDT	Input that enables the Side-Band Interface for controlling output enables. This pin disables the output enable pins when asserted. It has an internal pull-down resistor. 0 = OE pins and SMBus enable bits control outputs, Side-band interface disabled. 1 = Side-Band Interface controls output enables, OE pins and SMBus enable bits are disabled.
E	11	vOE10#/SHFT_LD#	I, SE, PD, PDT	Active low input for enabling output 10 or SHFT_LD# pin for the Side-Band Interface. Refer to the Side-Band Interface section for details. This pin has an internal pull-down. **OE mode**: 1 = disable output, 0 = enable output. **Side-Band Mode**: 1 = enable Side-Band Interface shift register, 0 = disable Side-Band Interface shift register. A falling edge transfers Side-Band shift register contents to output register.
E	12	vOE9#	I, SE, PD, PDT	Active low input for enabling output 9. This pin has an internal pull-down. 1 = disable output, 0 = enable output.
F	1	DIF19#	O, DIF	Differential complementary clock output.
F	2	NC	NC	No connection.
F	11	NC	NC	No connection.
F	12	DIF9#	O, DIF	Differential complementary clock output.
G	1	DIF_IN	I, DIF, PDT	HCSL true input.
G	2	NC	NC	No connection.
G	11	NC	O, OD, PDT	No connection.
G	12	DIF9	O, DIF	Differential true clock output.
H	1	DIF_IN#	I, DIF, PDT	HCSL complementary input.
H	2	VDDR3.3	PWR	Power supply for differential input clock (receiver). This V_{DD} should be treated as an analog power rail and filtered appropriately. Nominally 3.3V.
H	11	vOE8#	I, SE, PD, PDT	Active low input for enabling output 8. This pin has an internal pull-down. 1 = disable output, 0 = enable output.
H	12	DIF8#	O, DIF	Differential complementary clock output.
J	1	DIF0	O, DIF	Differential true clock output.
J	2	NC	NC	No connection.
J	11	NC	NC	No connection.
J	12	DIF8	O, DIF	Differential true clock output.
K	1	DIF0#	O, DIF	Differential complementary clock output.
K	2	NC	NC	No connection.
K	11	vOE7#	I, SE, PD, PDT	Active low input for enabling output 7. This pin has an internal pull-down. 1 = disable output, 0 = enable output.

Table 2. Pin Descriptions (Cont.)

Number		Name	Type	Description
K	12	DIF7#	O, DIF	Differential complementary clock output.
L	1	DIF1	O, DIF	Differential true clock output.
L	2	VDDO3.3	PWR	Power supply for outputs. Nominally 3.3V.
L	3	NC	NC	No connection.
L	4	SMBDAT	I/O, SE, OD, PDT	Data pin of SMBUS circuitry.
L	5	SMBCLK	I, SE, PDT	Clock pin of SMBUS circuitry.
L	6	NC	NC	No connection.
L	7	NC	NC	No connection.
L	8	vOE5#/DATA	I, SE, PD, PDT	Active low input for enabling output 5 or the data pin for the Side-Band Interface. Refer to the Side-Band Interface section for details. This pin has an internal pull-down. **OE mode**: 1 = disable output, 0 = enable output. **Side-Band mode**: Data pin.
L	9	NC	NC	No connection.
L	10	vOE6#/CLK	I, SE, PD, PDT	Active low input for enabling output 6 or the clock pin for the Side-Band Interface shift register. Refer to the Side-Band Interface section for details. This pin has an internal pull-down. **OE mode:** 1 = disable output, 0 = enable output. **Side-Band mode**: Clocks data into the Side-Band Interface shift register on the rising edge.
L	11	VDDO3.3	PWR	Power supply for outputs. Nominally 3.3V.
L	12	DIF7	O, DIF	Differential true clock output.
M	1	DIF1#	O, DIF	Differential complementary clock output.
M	2	DIF2	O, DIF	Differential true clock output.
M	3	DIF2#	O, DIF	Differential complementary clock output.
M	4	DIF3	O, DIF	Differential true clock output.
M	5	DIF3#	O, DIF	Differential complementary clock output.
M	6	vCKPWRGD_PD#	I, SE, PD, 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. This pin has internal pull-down resistor.
M	7	DIF4	O, DIF	Differential true clock output.
M	8	DIF4#	O, DIF	Differential complementary clock output.
M	9	DIF5	O, DIF	Differential true clock output.
M	10	DIF5#	O, DIF	Differential complementary clock output.
M	11	DIF6	O, DIF	Differential true clock output.
M	12	DIF6#	O, DIF	Differential complementary clock output.
—		EPAD	GND	Connect EPAD to ground.

Output Control

Table 3. Output Control (SBEN = 0)

		Traditional Interface		Side-Band Interface		Outputs
CKPWRGD_PD#	DIF_IN	OEx bit Byte[2:0]	OEx# Pin	MASKx Byte[10:8]	Qx	DIFx
0	X	X	X	X	X	Low/Low
1	Running	0	X	X	X	Low/Low
		1	0	X	X	Running
		1	1	X	X	Low/Low
1	Stopped	1	0	X	X	Stopped
		1	1	X	X	Low/Low

Table 4. Output Control (SBEN = 1)

		Traditional Interface		Side-Band Interface		Outputs
CKPWRGD_PD#	DIF_IN	OEx bit Byte[2:0]	OEx# Pin	MASKx Byte[10:8]	Qx	DIFx
0	X	X	X	X	X	Low/Low
1	Running	X	X	0	0	Low/Low
		X	X	0	1	Running
		X	X	1	X	Running
1	Stopped	X	X	0	0	Low/Low
		X	X	0	1	Stopped
		X	X	1	X	Stopped

Power Management

Table 5. Power Connections

Pin Number		Description
V_{DD}	GND	
B6, H2	EPAD	Analog
B2, B11, L2, L11	EPAD	Outputs

Output Enable Control on 9QXL2001C (DB2000QL)

Traditional Method

The 20-output 9QXL2001C has two methods for enabling and disabling outputs. The first is the traditional method of OE# pins and SMBus output enable bits. Outputs 5 through 12 have dedicated output enable pins and each of the 20 outputs have dedicated SMBus output enable bits in Bytes[0:2] of the SMBus register set.

Side-Band Interface

The second method is a simple 3-wire serial interface referred to as the Side-Band Interface (SBI). This interface consists of DATA, CLK and SHFT_LD# pins. When the SHFT_LD# pin is high, the rising edge of CLK can shift DATA into the shift register. After shifting data, the falling edge of SHFT_LD# clocks the shift register contents to the Output register.

Both the SBI and the traditional interface feed common output enable/disable synchronization logic ensuring glitch free enable and disable of outputs, regardless of the method used.

Both interfaces are not active at the same time, and the SBEN pin selects which interface is active. Tying the SBEN high enables the SBI. Tying the SBEN pin low enables the traditional OE# pin/SMBus output enable interface. When the SBI is enabled, OE[7:9, 11,12]# are disabled and DATA, CLK and SHFT_LD# are enabled on OE5#, OE6# and OE10# respectively. Additionally, SMBus registers for masking off the disable function of the shift register (0 value of a bit) become active. When set to a one, the mask register forces its respective output to 'enabled'. This prevents accidentally disabling critical outputs when using the SBI.

An SMBus read back bit in Byte 4 indicates which output enable control interface is enabled.

When the SBI is enabled, and power has been applied, the SBI is active, even if the CKPWRGD_PD# pin indicates the part is in power down. This allows loading the shift register and transferring the contents to the output register before the assertion of CKPWRGD. Note that the mask registers are part of the normal SMBus interface and cannot be accessed when the CKPWRGD_PD# is low. Figure 1 provides a functional description of the SBI.

The SBI and the traditional SMBus output enable registers both default to the 'output enabled' state at power-up. The mask registers default to zero at power-up, allowing the shift register bits to disable their respective output. See Figure 2.

Figure 2. Side-Band Interface Control Logic – Functional Description

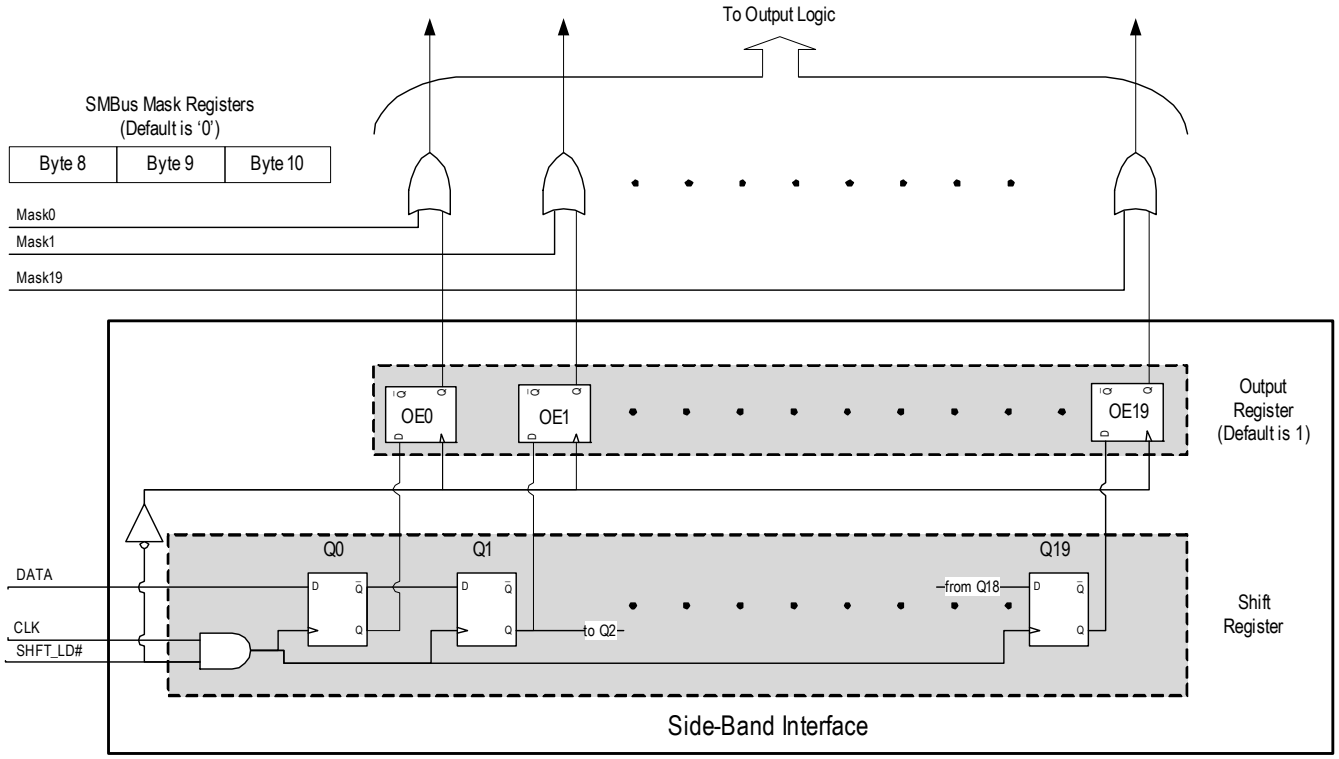
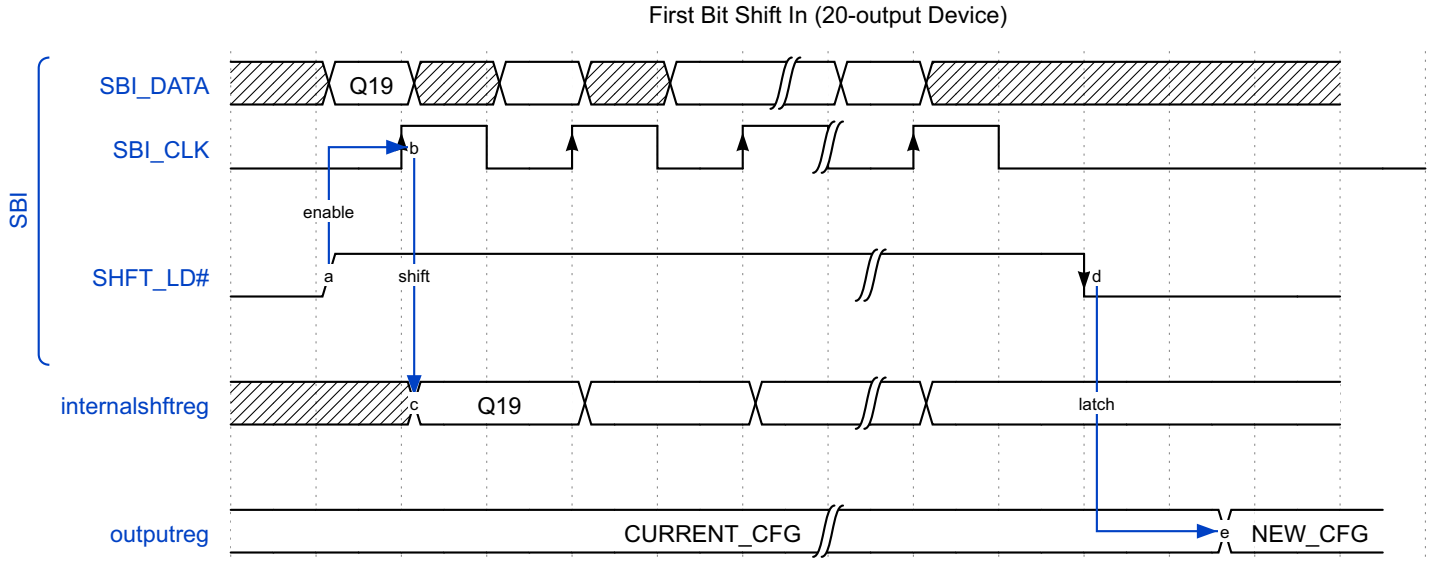


Figure 3 shows the basic timing of the side-band interface. The SHFT_LD# pin goes high to enable the CLK input. Next, the rising edge of CLK clocks enable DATA into the shift register. After the 20th clock, stop the clock low and drive the SHFT_LD# pin low. The falling edge of SHFT_LD# clocks the shift register contents to the output register, enabling or disabling the outputs. Always shift 20 bits of data into the shift register to control the outputs.

Figure 3. Side-Band Interface Functional Timing



The SBI interface supports clock rates up to 25MHz. Multiple devices may share CLK and DATA pins. Dedicating a SHFT_LD# pin to each devices allows its use as a chip-select pin. When the SHFT_LD# pin is low, the 9QXL2001 ignores any activity on the CLK and DATA pins.

Absolute Maximum Ratings

The absolute maximum ratings are stress ratings only. Stresses greater than those listed below can cause permanent damage to the device. Functional operation of the 9QXL2001C at absolute maximum ratings is not implied. Exposure to absolute maximum rating conditions may affect device reliability.

Table 6. Absolute Maximum Ratings

Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units	Notes
Supply Voltage	V_{DDx}		-	-	3.9	V	1,2
Input Low Voltage	V_{IL}		GND - 0.5	-	-	V	1
Input High Voltage	V_{IH}	Except for SMBus interface.	-	-	V_{DD} + 0.5	V	1,3
Input High Voltage	V_{IHSMB}	SMBus clock and data pins.	-	-	3.9	V	1
Storage Temperature	T_S		-65	-	150	°C	1
Junction Temperature	T_J	Maximum operating junction temperature.	-	-	125	°C	1
Human Body Model	ESD	JESD22-A114 (JS-001) Classification.	2000	-	-	V	1
Charged Device Model		JESD22-C101 Classification.	500	-	-	V	1

[1] Guaranteed by design and characterization, not 100% tested in production.

[2] Operation under these conditions is neither implied nor guaranteed.

[3] Not to exceed 3.9V.

Thermal Characteristics

Table 7. Thermal Characteristics

Parameter	Symbol	Conditions	Package	Typical Value	Units	Notes
Thermal Resistance	θ_{JC}	Junction to case.	NHG80	44	°C/W	1
	θ_{Jb}	Junction to base.		2	°C/W	1
	θ_{JA0}	Junction to air, still air.		33	°C/W	1
	θ_{JA1}	Junction to air, 1 m/s air flow.		29	°C/W	1
	θ_{JA3}	Junction to air, 3 m/s air flow.		28	°C/W	1
	θ_{JA5}	Junction to air, 5 m/s air flow.		27	°C/W	1

[1] EPAD soldered to board.

Electrical Characteristics

$T_A = T_{AMB}$. Supply voltages per normal operation conditions; see Test Loads for loading conditions.

Table 8. SMBus

Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units	Notes
SMBus Input Low Voltage	V_{ILSMB}		-	-	0.8	V	
SMBus Input High Voltage	V_{IHSMB}		2.1	-	V_{DDSMB}	V	
SMBus Output Low Voltage	V_{OLSMB}	At $I_{PULLUP.}$	-	-	0.4	V	
SMBus Sink Current	I_{PULLUP}	At $V_{OL.}$	4	-	-	mA	
Nominal Bus Voltage	V_{DDSMB}		2.7	-	3.6	V	1
SCLK/SDATA Rise Time	t_{RSMB}	(Max V_{IL} - 0.15V) to (Min V_{IH} + 0.15V).	-	-	1000	ns	1
SCLK/SDATA Fall Time	t_{FSMB}	(Min V_{IH} + 0.15V) to (Max V_{IL} - 0.15V).	-	-	300	ns	1
SMBus Operating Frequency	f_{SMB}	SMBus operating frequency.	-	-	400	kHz	5

[1] Guaranteed by design and characterization, not 100% tested in production.

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

[3] Time from deassertion until outputs are > 200mV.

[4] DIF_IN input.

[5] The device must be powered up with CKPWRGD_PD# = '1' for the SMBus to be active

Table 9. DIF_IN Clock Input Parameters

Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units	Notes
Input Crossover Voltage – DIF_IN	V_{CROSS}	Crossover voltage.	100	-	900	mV	1
Input Swing – DIF_IN	V_{SWING}	Differential value.	200	-	-	mV	1
Input Slew Rate – DIF_IN	dv/dt	Measured differentially.	0.7	-	-	V/ns	1,2
Input Leakage Current	I_{IN}	CLK_IN#, V_{IN} = 0.8V, CLK_IN, $V_{IN} = V_{DD.}$	-150	-	40	µA	
Input Duty Cycle	d_{tin}	Measurement from differential waveform.	45	-	55	%	1

[1] Guaranteed by design and characterization, not 100% tested in production.

[2] Slew rate measured through ±75mV window centered around differential zero.

Table 10. Input/Supply/Common Parameters

Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units	Notes
Supply Voltage	V_{DDx}	Supply voltage for core and analog.	2.97	3.3	3.63	V	
Ambient Operating Temperature	T_{AMB}	Industrial range.	-40	25	105	°C	
Input High Voltage	V_{IH}	Single-ended inputs, except SMBus, tri-level inputs.	2	-	V_{DD} + 0.3	V	
Input Low Voltage	V_{IL}	Single-ended inputs, except SMBus, tri-level inputs.	GND - 0.3	-	0.8	V	

Table 10. Input/Supply/Common Parameters (Cont.)

Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units	Notes
Input High Voltage	V_{IH}	Tri-level inputs.	2.2	-	V_{DD} + 0.3	V	
Input Mid Voltage	V_{IM}	Tri-level inputs.	1.2	$V_{DD}/2$	1.8	V	
Input Low Voltage	V_{IL}	Tri-level inputs.	GND - 0.3	-	0.8	V	
Input Current	I_{IN}	Single-ended inputs, V_{IN} = GND, V_{IN} = V_{DD}.	-5	-	5	µA	
	I_{INP}	Single-ended inputs. V_{IN} = 0 V; inputs with internal pull-up resistors. V_{IN} = V_{DD}; inputs with internal pull-down resistors.	-50	-	50	µA	
Input Frequency	F_{IN}	V_{DD} = 3.3V.	1	-	400	MHz	
Pin Inductance	L_{pin}			-	7	nH	1
Capacitance	C_{IN}	Logic inputs, except DIF_IN.	1.5	-	5	pF	1
	C_{INDIF_IN}	DIF_IN differential clock inputs.	1.5	-	2.7	pF	1,4
	C_{OUT}	Output pin capacitance.	-	-	6	pF	1
Clk Stabilization	T_{STAB}	From V_{DD} power-up and after input clock stabilization or de-assertion of PD# to 1st clock.	-	1.2	3	ms	1,2
OE# Latency	$t_{LATOE\#}$	DIF start after OE# assertion. DIF stop after OE# deassertion.	4	5	10	clocks	1,2,3
Tdrive_PD#	t_{DRVPD}	DIF output enable after PD# de-assertion.	-	0.3	1	ms	1,3
Tfall	t_F	Fall time of control inputs.	-	-	5	ns	2
Trise	t_R	Rise time of control inputs.	-	-	5	ns	2

[1] Guaranteed by design and characterization, not 100% tested in production.

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

[3] Time from deassertion until outputs are > 200mV.

[4] DIF_IN input.

Table 11. Side-Band Interface

Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units	Notes
Clock Period	t_{PERIOD}	Clock period.	40	-	-	ns	
Setup Time to Clock	t_{SETUP}	SHFT setup to CLK rising edge.	10	-	-	ns	
Data Setup Time	t_{DSU}	DATA setup to CLK rising edge.	5	-	-	ns	
Data Hold Time	t_{DHOLD}	DATA hold after CLK rising edge.	2	-	-	ns	1
Delay Time	t_{DELAY}	Delay from CLK rising edge to LD# falling edge.	10	-	-	ns	1
Propagation Delay	t_{PD}	Delay from LD# falling edge to next output configuration taking effect.	4	-	10	clocks	3
Slew Rate	t_{SLEW}	CLK input (between 20% and 80%).	0.7	-	4	V/ns	2

[1] Guaranteed by design and characterization, not 100% tested in production.

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

[3] Refers to device differential input clock.

Table 12. LP-HCSL Outputs Driving High Impedance Receiver at 100MHz

Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Industry Limit	Units	Notes
Maximum Voltage	Vmax	Measurement on single ended signal using absolute value. (scope averaging off).	-	875	1010	1150	mV	7,8
Minimum Voltage	Vmin		-91	6	-	-300		1,5,7,8
Voltage High	Vhigh	Vhigh set to 800mV.	678	810	903	N/A	mV	7,8
Voltage Low	Vlow		-88	35	123	N/A		1,5,7,8
Slew Rate	dV/dt	Scope averaging on, fast setting.	2	2.6	3.4	2 to 5	V/ns	1,2,3,7
Rise/Fall Matching	ΔtR/tF	Single-ended measurement.	-	3.6	19	20	%	7
Crossing Voltage (abs)	Vcross_abs	Scope averaging off.	278	412	543	250 to 550	mV	1,6,7
Crossing Voltage (var)	Δ-Vcross	Scope averaging off.	-	10	57	140	mV	1,6,7

[1] Guaranteed by design and characterization, not 100% tested in production.

[2] Measured from differential waveform.

[3] Slew rate is measured through the Vswing voltage range centered around differential 0 V. This results in a ±150mV window around differential 0V.

[4] Matching applies to rising edge rate for Clock and falling edge rate for Clock#. It is measured using a ±75mV window centered on the average cross point where Clock rising meets Clock# falling. The median cross point is used to calculate the voltage thresholds the oscilloscope is to use for the edge rate calculations.

[5] Vcross is defined as voltage where Clock = Clock# measured on a component test board and only applies to the differential rising edge (i.e. Clock rising and Clock# falling).

[6] The total variation of all Vcross measurements in any particular system. Note that this is a subset of Vcross_min/max (Vcross absolute) allowed. The intent is to limit Vcross induced modulation by setting Δ-Vcross to be smaller than Vcross absolute.

[7] At default SMBus settings.

[8] Includes 300mV of overshoot for Vmax and 300mV of undershoot for Vmin.

Table 13. Current Consumption

Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units
Operating Supply Current	$I_{DDVDD + VDDA}$	Source termination, all outputs 100MHz, C_L = 2pF; Zo = 85Ω.	-	218	234	mA
	I_{DDR}		-	0.45	0.6	
Powerdown Current	I_{DD_PD}	All VDD's except VDDR, CKPWRGD_PD# = 0.	-	3.3	5	mA
	I_{DDR_PD}	VDDR, CKPWRGD_PD# = 0.	-	0.6	1	

Table 14. Skew and Differential Jitter Parameters

Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units	Notes
CLK_IN, DIF[x:0]	t_{PD}	Input-to-output skew.	1.2	1.4	1.6	ns	1,2,3,4,5,7
CLK_IN, DIF[x:0]	$t_{PDVARIATION}$	Input-to-output skew variation for a single device over temperature *and* voltage.	1.1	1.2	1.4	ps/°C	1,2,3,5,8
DIF[x:0]	t_{SKEW_ALL}	Output-to-output skew across all outputs.	-	37	50	ps	1,2,3,7
Duty Cycle Distortion	t_{DCD}	Measured differentially at 100MHz.	-0.5	-0.1	0.5	%	1,6,7

[1] Measured into fixed 2pF load cap. Input to output skew is measured at the first output edge following the corresponding input. Default SMBus settings unless otherwise noted.

[2] Measured from differential cross-point to differential cross-point.

[3] All input-to-output specs refer to the timing between an input edge and the specific output edge created by it.

[4] Measured with scope averaging on to find mean value.

[5] Guaranteed by design and characterization, not 100% tested in production.

[6] Duty cycle distortion is the difference in duty cycle between the output and the input clock.

[7] Measured from differential waveform.

[8] This is the amount of input-to-output delay variation with respect to temperature. This is equivalent to 250ps from -40°C to +85°C.

Table 15. PCIe Refclk Phase Jitter - Normal Conditions [9]

Parameter	Symbol	Conditions	Typical	Maximum	Specification Limits	Units	Notes
Additive PCIe Phase Jitter (Common Clock Architecture)	$t_{jphPCIeG1-CC}$	PCIe Gen1 (2.5GT/s)	528	623	86,000	fs pk-pk	1,2,7
	$t_{jphPCIeG2-CC}$	PCIe Gen2 Low Band (5GT/s)	9	11	3000	fs RMS	1,2,7
		PCIe Gen2 High Band (5GT/s)	31	37	3100		1,2,7
	$t_{jphPCIeG3-CC}$	PCIe Gen3 (8GT/s)	15	18	1000		1,2,7
	$t_{jphPCIeG4-CC}$	PCIe Gen4 (16GT/s)	15	18	500		1,2,3,4,7
	$t_{jphPCIeG5-CC}$	PCIe Gen5 (32GT/s)	6	7	150		1,2,3,5,7
	$t_{jphPCIeG6-CC}$	PCIe Gen6 (64GT/s)	4	5	100		1,2,3,6,
Additive PCIe Phase Jitter (IR Clock Architectures - SRIS, SRNS)	$t_{jphPCIeG2-IR}$	PCIe Gen2 (5GT/s)	41	48	[8]	fs RMS	8
	$t_{jphPCIeG3-IR}$	PCIe Gen3 (8GT/s)	11	13			8
	$t_{jphPCIeG4-IR}$	PCIe Gen4 (16GT/s)	11	13			4,8
	$t_{jphPCIeG5-IR}$	PCIe Gen5 (32GT/s)	9	11			5,8
	$t_{jphPCIeG6-IR}$	PCIe Gen6 (64GT/s)	12	14			6,8

[1] The Refclk jitter is measured after applying the filter functions found in the PCI Express Base Specification 6.0, Revision 0.9. For the exact measurement setup, see Test Loads in the data sheet. 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 700fs RMS is to be used in channel simulations to account for additional noise in a real system.

[5] Note that 250fs RMS is to be used in channel simulations to account for additional noise in a real system.

[6] Note that 150fs RMS is to be used in channel simulations to account for additional noise in a real system.

[7] The RMS sum of the source jitter and the additive jitter (arithmetic sum for PCIe Gen1) must be less than the jitter specification listed.

[8] The PCI Express Base Specification 6.0, Revision 0.9 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.

[9] Differential input swing = 1600mV and input slew rate = 3.5V/ns.

Table 16. PCIe Refclk Phase Jitter - Degraded Conditions [9]

Parameter	Symbol	Conditions	Typical	Maximum	Specification Limits	Units	Notes
Additive PCIe Phase Jitter (Common Clock Architecture)	$t_{jphPCIeG1-CC}$	PCIe Gen1 (2.5GT/s)	692	839	86,000	fs pk-pk	1,2,7
	$t_{jphPCIeG2-CC}$	PCIe Gen2 Low Band (5GT/s)	11	14	3000	fs RMS	1,2,7
		PCIe Gen2 High Band (5GT/s)	41	49	3100		1,2,7
	$t_{jphPCIeG3-CC}$	PCIe Gen3 (8GT/s)	20	24	1000		1,2,7
	$t_{jphPCIeG4-CC}$	PCIe Gen4 (16GT/s)	20	24	500		1,2,3,4,7
	$t_{jphPCIeG5-CC}$	PCIe Gen5 (32GT/s)	8	9	150		1,2,3,5,7
	$t_{jphPCIeG6-CC}$	PCIe Gen6 (64GT/s)	5	6	100		1,2,3,6,7
Additive PCIe Phase Jitter (IR Clock Architectures - SRIS, SRNS	$t_{jphPCIeG2-IR}$	PCIe Gen2 (5GT/s)	52	63	N/A	fs RMS	8
	$t_{jphPCIeG3-IR}$	PCIe Gen3 (8GT/s)	14	17			8
	$t_{jphPCIeG4-IR}$	PCIe Gen4 (16GT/s)	14	17			4,8
	$t_{jphPCIeG5-IR}$	PCIe Gen5 (32GT/s)	12	15			5,8
	$t_{jphPCIeG6-IR}$	PCIe Gen6 (64GT/s)	15	19			6,8

[1] The Refclk jitter is measured after applying the filter functions found in the PCI Express Base Specification 6.0, Revision 0.9. For the exact measurement setup, see Test Loads in the data sheet. 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 700fs RMS is to be used in channel simulations to account for additional noise in a real system.

[5] Note that 250fs RMS is to be used in channel simulations to account for additional noise in a real system.

[6] Note that 150fs RMS is to be used in channel simulations to account for additional noise in a real system.

[7] The RMS sum of the source jitter and the additive jitter (arithmetic sum for PCIe Gen1) must be less than the jitter specification listed.

[8] The PCI Express Base Specification 6.0, Revision 0.9 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.

[9] Differential input swing = 800mV and input slew rate = 1.5V/ns.

Table 17. Non-PCIe Refclk Phase Jitter

Parameter	Symbol	Conditions	Typical	Maximum	Specification Limit	Units	Notes
Additive Phase Jitter	$t_{jphDB2000Q}$	100MHz, Intel-supplied filter	10	12	80	fs RMS	1,2,3,4,5
	$t_{jphDB2000Q}$	100MHz, Intel-supplied filter	30	36	80		1,2,3,5,6
Additive Phase Jitter	$t_{jph12k-20M}$	156.25MHz (12kHz to 20MHz)	13	15	N/A		1,2,4
	$t_{jph12k-20M}$	156.25MHz (12kHz to 20MHz)	40	47	N/A		1,2,6

[1] See Test Loads for test configuration.

[2] SMA100B used as signal source.

[3] The 9QXL2001C meets all legacy QPI/UPI specifications by meeting the PCIe and DB2000Q specifications listed in this document.

[4] Differential input swing = 1600mV 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.

Test Loads

Figure 4. AC/DC Test Load for Differential Outputs (Standard PCIe Source-Termination)

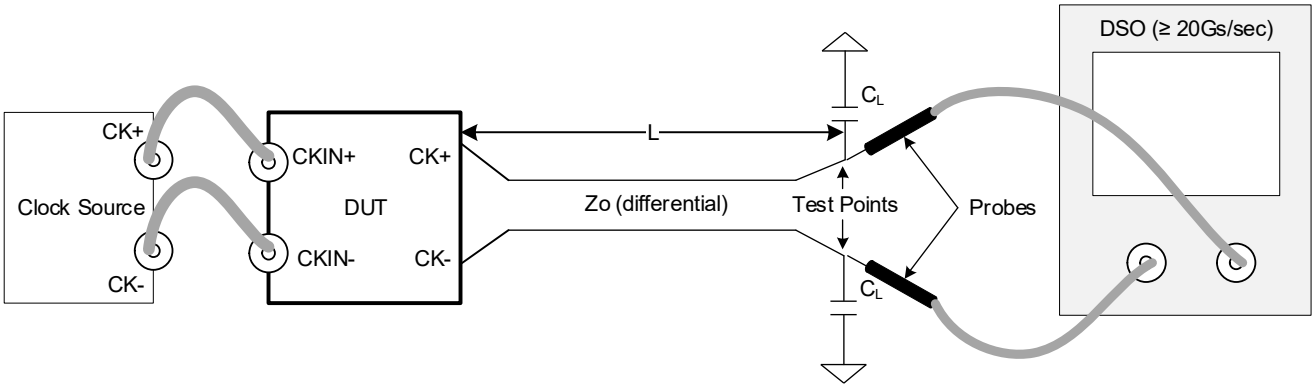


Figure 5. Test Load for Additive Phase Jitter Measurements

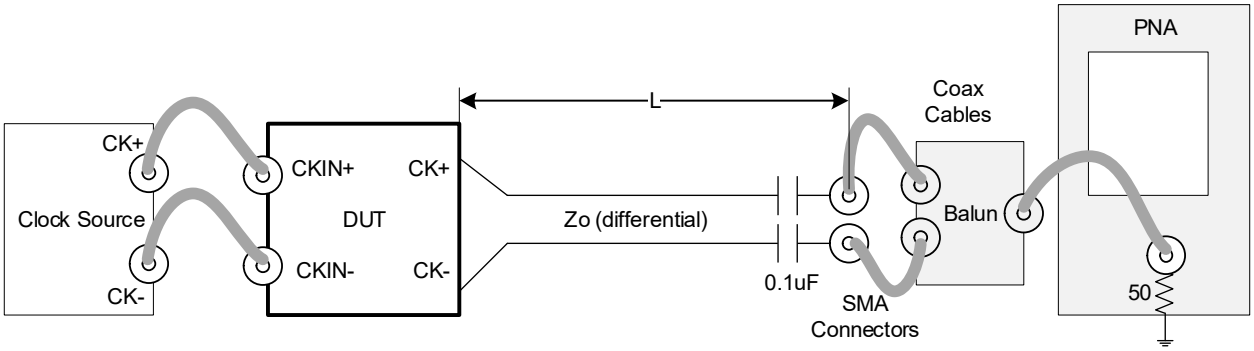


Table 18. Parameters for Test Loads

Clock Source	Rs (Ω)	Zo (Ω)	L (cm)	C_L (pF)
SMA100B	Internal	85	25.4	2

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

Alternate Terminations

The LP-HCSL output can easily drive other logic families. See "AN-891 Driving LVPECL, LVDS, and CML Logic with "Universal" Low-Power HCSL Outputs" for termination schemes for LVPECL, LVDS, CML and SSTL.

SMBus Addressing

Table 19. SMBus Address Selection

SADR(1:0)_tri	SMBus Address (Read/Write bit = 0)
00	D8
0M	DA
01	DE
M0	C2
MM	C4
M1	C6
10	CA
1M	CC
11	CE

General SMBus Serial Interface Information

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 **acknowledg**e 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		

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 0 through Byte X (if $X_{(H)}$ was written to Byte 8)**
- Controller (host) will need to acknowledge each byte
- Controller (host) will send a not acknowledge bit
- Controller (host) will send a stop bit

Index Block Read Operation			
Controller (Host)			**Renesas (Slave/Receiver)**
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 acknowledge		
P	stoP bit		

SMBus Table: Output Enable Register (functional only when SBEN = 0)

Byte 0	Name	Control Function	Type	0	1	Default
Bit 7	Reserved					0
Bit 6	DIF_19_En	Output Enable	RW	Low/Low	Enable	1
Bit 5	DIF_18_En	Output Enable	RW	Low/Low	Enable	1
Bit 4	DIF_17_En	Output Enable	RW	Low/Low	Enable	1
Bit 3	DIF_16_En	Output Enable	RW	Low/Low	Enable	1
Bit 2	Reserved					0
Bit 1	Reserved					0
Bit 0	Reserved					0

SMBus Table: Output Enable Register (functional only when SBEN = 0)

Byte 1	Name	Control Function	Type	0	1	Default
Bit 7	DIF_7_En	Output Enable	RW	Disabled Low/Low	OE7# Controls	1
Bit 6	DIF_6_En	Output Enable	RW		OE6# Controls	1
Bit 5	DIF_5_En	Output Enable	RW		OE5# Controls	1
Bit 4	DIF_4_En	Output Enable	RW		Enabled	1
Bit 3	DIF_3_En	Output Enable	RW		Enabled	1
Bit 2	DIF_2_En	Output Enable	RW		Enabled	1
Bit 1	DIF_1_En	Output Enable	RW		Enabled	1
Bit 0	DIF_0_En	Output Enable	RW		Enabled	1

SMBus Table: Output Enable Register (functional only when SBEN = 0)

Byte 2	Name	Control Function	Type	0	1	Default
Bit 7	DIF_15_En	Output Enable	RW	Low/Low	Enabled	1
Bit 6	DIF_14_En	Output Enable	RW		Enabled	1
Bit 5	DIF_13_En	Output Enable	RW		Enabled	1
Bit 4	DIF_12_En	Output Enable	RW		OE12# Controls	1
Bit 3	DIF_11_En	Output Enable	RW		OE11# Controls	1
Bit 2	DIF_10_En	Output Enable	RW		OE10# Controls	1
Bit 1	DIF_9_En	Output Enable	RW		OE9# Controls	1
Bit 0	DIF_8_En	Output Enable	RW		OE8# Controls	1

SMBus Table: OE# Pin Readback Register

Byte 3	Name	Control Function	Type	0	1	Default
Bit 7	RB_OE12	Status of OE12#	R	Pin Low	Pin High	Real-time
Bit 6	RB_OE11	Status of OE11#	R			Real-time
Bit 5	RB_OE10	Status of OE10#	R			Real-time
Bit 4	RB_OE9	Status of OE9#	R			Real-time
Bit 3	RB_OE8	Status of OE8#	R			Real-time
Bit 2	RB_OE7	Status of OE7#	R			Real-time
Bit 1	RB_OE6	Status of OE6#	R			Real-time
Bit 0	RB_OE5	Status of OE5#	R			Real-time

SMBus Table: SBEN Readback Register

Byte 4	Name	Control Function	Type	0	1	Default
Bit 7	Reserved					0
Bit 6	Reserved					0
Bit 5	Reserved					0
Bit 4	Reserved					0
Bit 3	Reserved					0
Bit 2	Reserved					0
Bit 1	Reserved					0
Bit 0	RB_SBEN	Status of SBEN	R	Pin Low	Pin High	Real-time

SMBus Table: Vendor and Revision ID Register

Byte 5	Name	Control Function	Type	0	1	Default
Bit 7	RID3	REVISION ID	R	C rev is 0010		0
Bit 6	RID2		R			0
Bit 5	RID1		R			x
Bit 4	RID0		R			x
Bit 3	VID3	VENDOR ID	R	IDT/ICS		0
Bit 2	VID2		R			0
Bit 1	VID1		R			0
Bit 0	VID0		R			1

SMBus Table: Device ID

Byte 6	Name	Control Function	Type	0	1	Default
Bit 7	Device ID 7 (MSB)		R	C9		1
Bit 6	Device ID 6		R			1
Bit 5	Device ID 5		R			0
Bit 4	Device ID 4		R			0
Bit 3	Device ID 3		R			1
Bit 2	Device ID 2		R			0
Bit 1	Device ID 1		R			x
Bit 0	Device ID 0		R			1

SMBus Table: Byte Count Register

Byte 7	Name	Control Function	Type	0	1	Default
Bit 7	Reserved					0
Bit 6	Reserved					0
Bit 5	Reserved					0
Bit 4	BC4	Writing to this register configures how many bytes will be read back.	RW	Default value is 7.		0
Bit 3	BC3		RW			0
Bit 2	BC2		RW			1
Bit 1	BC1		RW			1
Bit 0	BC0		RW			1

SMBus Table: Side-Band Mask Register (functional only when SBEN = 1)

Byte8	Name	Control Function	Type	0	1	Default
Bit 7	Mask7	Masks off Side-band Disable	RW	Side-band shift register may disable the output	Forces output to always be enabled regardless of side-band shift register value	0
Bit 6	Mask6	Masks off Side-band Disable	RW			0
Bit 5	Mask5	Masks off Side-band Disable	RW			0
Bit 4	Mask4	Masks off Side-band Disable	RW			0
Bit 3	Mask3	Masks off Side-band Disable	RW			0
Bit 2	Mask2	Masks off Side-band Disable	RW			0
Bit 1	Mask1	Masks off Side-band Disable	RW			0
Bit 0	Mask0	Masks off Side-band Disable	RW			0

SMBus Table: Side-Band Mask Register (functional only when SBEN = 1)

Byte 9	Name	Control Function	Type	0	1	Default
Bit 7	Mask15	Masks off Side-band Disable	RW	Side-band shift register may disable the output	Forces output to always be enabled regardless of side-band shift register value	0
Bit 6	Mask14	Masks off Side-band Disable	RW			0
Bit 5	Mask13	Masks off Side-band Disable	RW			0
Bit 4	Mask12	Masks off Side-band Disable	RW			0
Bit 3	Mask11	Masks off Side-band Disable	RW			0
Bit 2	Mask10	Masks off Side-band Disable	RW			0
Bit 1	Mask9	Masks off Side-band Disable	RW			0
Bit 0	Mask8	Masks off Side-band Disable	RW			0

SMBus Table: Side-Band Mask Register (functional only when SBEN = 1)

Byte 10	Name	Control Function	Type	0	1	Default
Bit 7	Reserved					0
Bit 6	Reserved					0
Bit 5	Reserved					0
Bit 4	Reserved					0
Bit 3	Mask19	Masks off Side-band Disable	RW	Side-band shift register may disable the output	Forces output to always be enabled regardless of side-band shift register value	0
Bit 2	Mask18	Masks off Side-band Disable	RW			0
Bit 1	Mask17	Masks off Side-band Disable	RW			0
Bit 0	Mask16	Masks off Side-band Disable	RW			0

Bytes 11 through 19 are Reserved.

SMBus Table: Amplitude Configuration Register

Byte 20	Name	Control Function	Type	0	1	Default
Bit 7	AMP[3]	Global Differential output Control	RW	0.6V – 1V, 25mV/step Default=800mV		0
Bit 6	AMP[2]		RW			1
Bit 5	AMP[1]		RW			1
Bit 4	AMP[0]		RW			1
Bit 3	Reserved					0
Bit 2	Reserved					1
Bit 1	Reserved					1
Bit 0	Reserved					1

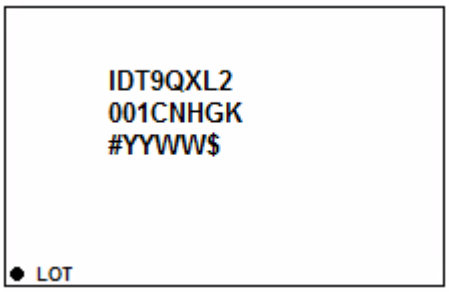
SMBus Table: PD_RESTORE

Byte 21	Name	Control Function	Type	0	1	Default
Bit 7	Reserved					0
Bit 6	Reserved					0
Bit 5	Reserved					0
Bit 4	Reserved					0
Bit 3	PD_RESTORE#	Save Configuration in Power Down	RW	Config Cleared	Config Saved	1
Bit 2	Reserved					0
Bit 1	Reserved					0
Bit 0	Reserved					0

Package Outline Drawings

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

Marking Diagram



- Lines 1 and 2: part number
  - "K" denotes temperature rating.
- Line 3:
  - "#" denotes the stepping number.
  - "YYWW" is the last digits of the year and work week that the part was assembled.
  - "$" denotes mark code.
- "LOT" denotes the lot sequence code.

Ordering Information

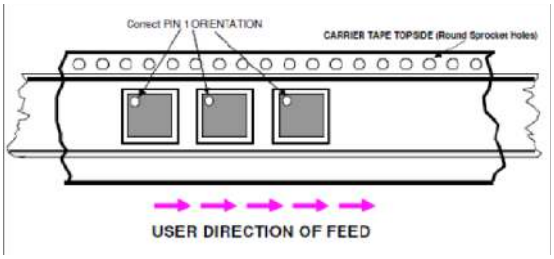
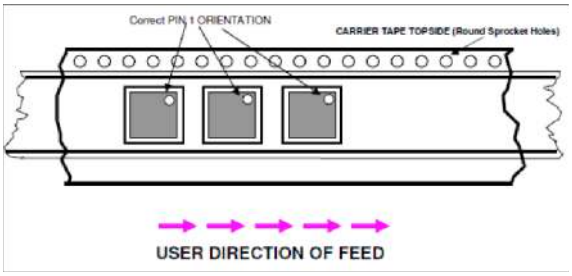
Orderable Part Number [1][2]	Package	Carrier Type	Temperature
9QXL2001CNHGK	6 × 6 mm, 0.5mm pitch 80-GQFN	Tray	-40° to +105°C
9QXL2001CNHGK8	6 × 6 mm, 0.5mm pitch 80-GQFN	Tape and Reel	-40° to +105°C
9QXL2001CNHGK/n [3]	6 × 6 mm, 0.5mm pitch 80-GQFN	Tray	-40° to +105°C
9QXL2001CNHGK8/n [3]	6 × 6 mm, 0.5mm pitch 80-GQFN	Tape and Reel	-40° to +105°C
9QXL2001CNHGK8/W	6 × 6 mm, 0.5mm pitch 80-GQFN	Tape and Reel, Pin 1 Orientation: EIA-481-D (see Table 20)	-40° to +105°C

[1] "C" is the device revision designator (will not correlate with the datasheet revision).

[2] "G" designates PB-free configuration, RoHS compliant.

[3] "n" is an alphanumeric character for specific customer requests or tracking.

Table 20. Pin 1 Orientation in Tape and Reel Packaging

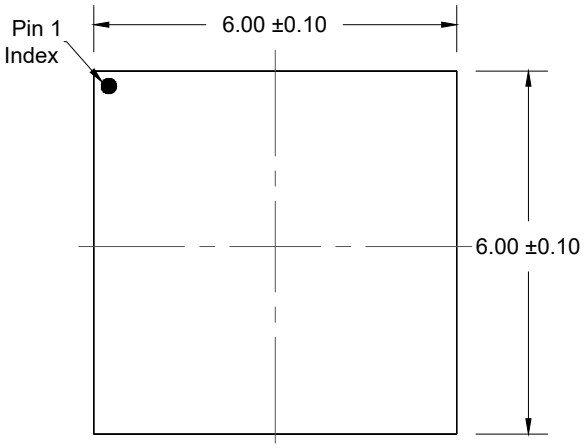
Part Number Suffix	Pin 1 Orientation	Illustration
8	Quadrant 1 (EIA-481-C)	
/W	Quadrant 2 (EIA-481-D)	

Revision History

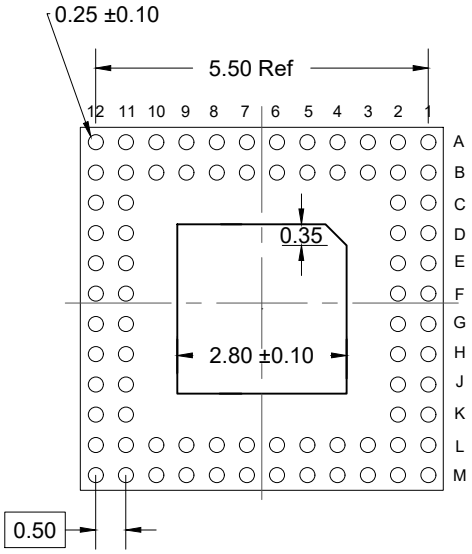
Revision Date	Description of Change
July 19, 2023	▪ Updated Clk Stabilization and Tdrive_PD# values in Table 10. ▪ Updated Maximum/Minimum Voltage and Slew Rate values in Table 12. ▪ Updated Operating Supply Current values in Table 13.
May 19, 2023	▪ Added 9QXL2001CNHGK8/W part number in Ordering Information. ▪ Added Table 20.
October 6, 2022	Added 9QXL2001CNHGK/n and 9QXL2001CNHGK8/n to Ordering Information.
April 8, 2022	Added Signal Types table and updated Pin Descriptions table with latest nomenclature.
November 9, 2021	Updated with characterization data; move to final.
October 4, 2021	Initial release.

Package Outline Drawing

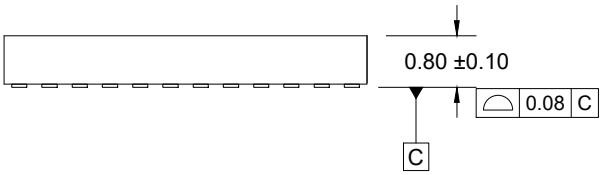
Package Code: NHG80P1
80-VFQFPN 6.00 x 6.00 x 0.80 mm Body 0.50mm Pitch
PSC-4496-01, Rev 01, Created: Jan 19, 2022



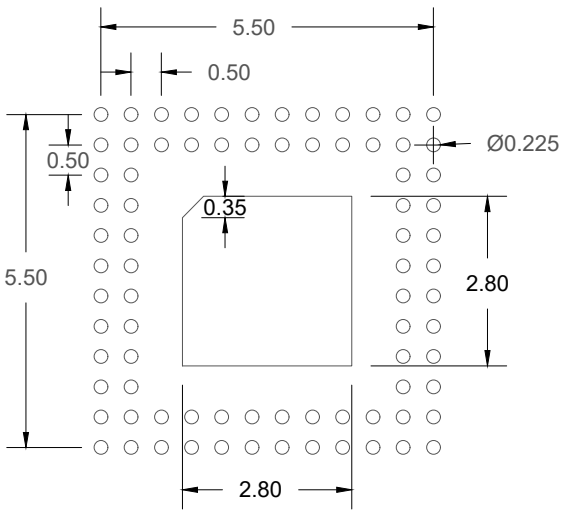
TOP VIEW



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 ±0.05 mm tolerance for all other dimensions
4. Numbers in ( ) are for reference only

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