8P34S1204-1

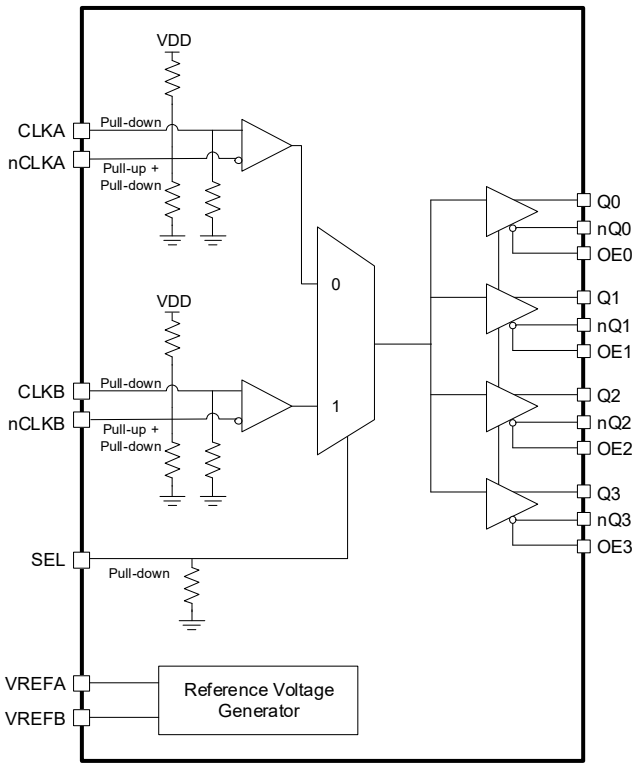
2:4 LVDS 1.8V / 2.5V Fanout Buffer for 1PPS and High-Speed Clocks with Individual OE Control

The 8P34S1204-1 is a high-performance differential LVDS fanout buffer. The device is designed for the fanout of 1PPS signals or high-frequency, very low additive phase-noise clock and data signals.

The 8P34S1204-1 supports fail-safe operation and is characterized to operate from a 1.8V or 2.5V power supply. Guaranteed output-to-output and part-to-part skew characteristics make the device ideal for clock distribution applications that demand well-defined performance and repeatability. Two selectable differential inputs and four low skew outputs are available. The integrated bias voltage reference enables easy interfacing of single-ended signals to the device inputs. The device is optimized for low power consumption and low noise additive phase.

The 8P34S1204-1 has a individual OE control pin for each output, which provides excellent control over the output enable functions.

Block Diagram



Features

- Four low skew, low additive jitter LVDS output pairs
- Individual OE control pin for each output
- Two selectable, differential clock input pairs
- Differential CLK, nCLK pairs can accept LVDS and CML differential input levels
- Maximum input clock frequency of 2GHz
- LVCMOS/LVTTL interface levels for the control input select pin
- Output skew of 10ps (typical)
- Propagation delay of 475ps (maximum)
- Low propagation delay variation across temperature for 1PPS applications
- Low additive phase jitter, RMS; f_{REF} = 156.25MHz, V_{PP} = 1V, 12kHz–20MHz: 50fs (typical)
- Device current consumption (I_{DD}): 100mA (typical)
- Full 1.8V or 2.5V supply voltage
- Lead-free (RoHS 6), 28-QFN packaging
- -40°C to +85°C ambient operating temperature
- Supports case temperature up to +105°C

Applications

- 4G and 5G RU and DU system
- Ethernet switches / routers
- Medical imaging
- Professional audio and video
- Data center and server

Contents

1. Pin Information

1.1 Pin Assignments

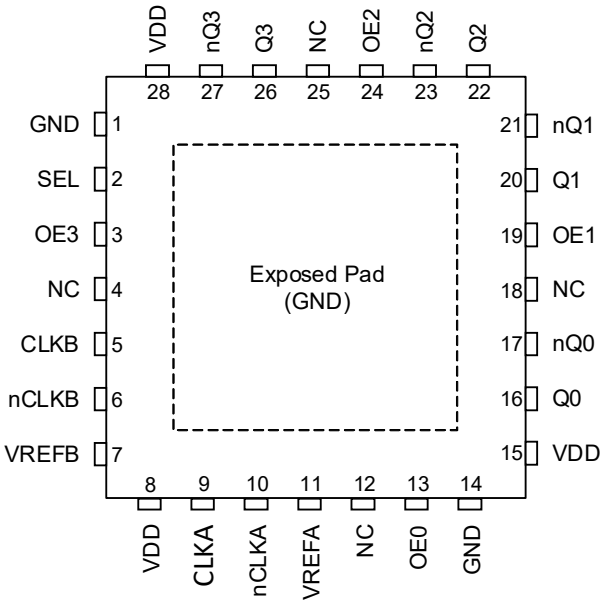


Figure 1. Pin Assignments – Top View

1.2 Pin Descriptions

Table 1. Pin Descriptions

Pin Number	Pin Name	Type	Description
1	GND	Power	Ground pin.
2	SEL	Input, Pull-down	Reference selects control pin. LVCMOS/LVTTL interface levels.
3	OE3	Input, Pull-up	Control output enable function for Q3. LVCMOS/TTL input levels.
4	NC	-	Not connected
5	CLKB	Input	Non-inverting differential clock/data input B.
6	nCLKB	Input	Inverting differential clock/data input B. VDD/2 default when left floating.
7	VREFB	Power	Bias voltage reference. Provides an input bias voltage for the CLKB, nCLKB.
8	VDD	Power	Power supply pin.
9	CLKA	Input	Non-inverting differential clock/data input A.
10	nCLKA	Input	Inverting differential clock/data input A. VDD/2 default when left floating.
11	VREFA	Power	Bias voltage reference. Provides an input bias voltage for the CLKA, nCLKA.
12	NC	-	Not connected.
13	OE0	Input, Pull-up	Control output enable function for Q3. LVCMOS/TTL input levels.
14	GND	Power	Ground pin.
15	VDD	Power	Power supply pin.
16	Q0	Output	Differential output pair Q0. LVDS interface levels.
17	nQ0	Output	Differential output pair Q0. LVDS interface levels.
18	NC	-	Not connected.

Table 1. Pin Descriptions (Cont.)

Pin Number	Pin Name	Type	Description
19	OE1	Input, Pull-up	Control output enable function for Q1. LVCMOS/TTL input levels.
20	Q1	Output	Differential output pair Q1. LVDS interface levels.
21	nQ1	Output	Differential output pair Q1. LVDS interface levels.
22	Q2	Output	Differential output pair Q2. LVDS interface levels.
23	nQ2	Output	Differential output pair Q2. LVDS interface levels.
24	OE2	Input, Pull-up	Control output enable function for Q2. LVCMOS/TTL input levels.
25	NC	-	Not connected.
26	Q3	Output	Differential output pair Q3. LVDS interface levels.
27	nQ3	Output	Differential output pair Q3. LVDS interface levels.
28	VDD	Output	Power supply pin.
-	ePAD	Power	Epad connect to GND.

1.3 SEL Input Functions

Table 2. SEL Input Functions

SEL Input [1]	Operation
0	CLKA, nCLKA is the selected differential clock input.
1	CLKB, nCLKB is the selected differential clock input.

1. SEL is an asynchronous control.

1.4 OE Input Functions

Table 3. OE Input Functions

OE Input	Input Level Value	Operation
OE0	0	Q0, nQ0 was in power-down state (disable).
	1	Q0, nQ0 was in output enable mode.
OE1	0	Q1, nQ1 was in power-down state (disable).
	1	Q1, nQ1 was in output enable mode.
OE2	0	Q2, nQ2 was in power-down state (disable).
	1	Q2, nQ2 was in output enable mode.
OE3	0	Q3, nQ3 was in power-down state (disable).
	1	Q3, nQ3 was in output enable mode.

2. Specifications

2.1 Absolute Maximum Ratings

Caution: Do not operate at or near the maximum ratings listed for extended periods of time. Exposure to such conditions can adversely impact product reliability and result in failures not covered by warranty.

Figure 2. Absolute Maximum Ratings

Parameter	Minimum	Maximum	Unit
Supply Voltage, V_{DD}	-	4.6	V
Input, V_I	-0.5	4.6	V
Input, I_I	-	20m	A
Outputs, I_O Continuous Current Surge Current	 - -	 10 15	mA
Input Sink/Source, I_{REF}	-	±2	mA
Maximum Junction Temperature, $T_{J,MAX}$	-	125	°C
Storage Temperature, T_{STG}	-65	150	°C
ESD - Human Body Model	-	2000	V
ESD - Charged Device Model	-	1500	V

2.2 Recommended Operating Conditions

Table 4. Recommended Operating Conditions [1][2]

Symbol	Parameter	Condition	Minimum	Typical	Maximum	Unit
T_J	Maximum Junction Temperature	-	-	-	125	°C
T_A	Ambient Operating Temperature	-	-40	-	85	°C
V_{DDx}	Supply Voltage with Respect to Ground	Any V_{DD} pin, 1.8V supply	1.71	1.8	1.89	V
		Any V_{DD} pin, 2.5V supply, 2.1V, 2.5V, 2.7V	2.1	2.5	2.7	V

1. All electrical characteristics are specified over Recommended Operating Conditions unless noted otherwise.
2. All conditions in this table must be met to guarantee device functionality and performance.

2.3 Thermal Specifications

Parameter	Package	Symbol	Conditions	Typical Value	Unit
Thermal Resistance	28-QFN, 5.0 × 5.0 mm	θ_{JA0}	Junction to ambient, still air	30	°C/W
		θ_{JA1}	Junction to ambient, 1 m/s air flow	27	°C/W
		θ_{JA2}	Junction to ambient, 2 m/s air flow	25	°C/W
		θ_{JB}	Junction to board	2.68	°C/W
		θ_{JC}	Junction to case	24.6	°C/W

2.4 DC Input Characteristics

Table 5. DC Input Characteristics

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Unit
C_{IN}	Input Capacitance	-	-	2	-	pF
$R_{PULLDOWN}$	Input Pull-down Resistor	-	-	51	-	k ohms
R_{PULLUP}	Input Pull-up Resistor	-	-	51	-	k ohms

2.5 Power Supply DC Characteristics

Table 6. Power Supply DC Characteristics – V_{DD} = 1.8V ± 5%, T_A = -40ºC to 85ºC

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Unit
V_{DD}	Core Supply Voltage	-	1.71	1.8	1.89	V
I_{DD}	Power Supply Current	-	-	100.0	125.0	mA

2.6 Power Supply DC Characteristics

Table 7. Power Supply DC Characteristics – V_{DD} = 2.1V to 2.7V, T_A = -40ºC to 85ºC

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Unit
V_{DD}	Core Supply Voltage	-	2.1	2.5	2.7	V
I_{DD}	Power Supply Current	-	-	105.0	130.0	mA

2.7 LVCMOS/LVTTL Input DC Characteristics

Table 8. LVCMOS/LVTTL Input DC Characteristics – V_{DD} = 1.8V ± 5%, 2.1V to 2.7V, T_A = -40ºC to 85ºC

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Unit
V_{IH}	Input High Voltage	V_{DD} = 1.89V, 2.7V	0.65 × V_{DD}	-	V_{DD}+ 0.3	V
V_{IL}	Input Low Voltage	V_{DD} = 1.89V, 2.7V	-0.3	-	0.35 × V_{DD}	V
I_{IH}	Input High Current, SEL, OE0, OE1, OE2, OE3	V_{DD} = V_{IN} = 1.89V, 2.7V	-	-	150	µA
I_{IL}	Input Low Current, SEL, OE0, OE1, OE2, OE3	V_{DD} = 1.89V, 2.7V, V_{IN} = 0V	-150	-	-	µA
I_{LEAK}	Input Leakage Current, SEL, OE0, OE1, OE2, OE3	V_{IN} = 2.7V, V_{DD} = 0V	-	-	250	µA

2.8 Differential Input Characteristics

Table 9. Differential Input Characteristics – V_{DD} = = 1.8V ± 5%, 2.1V to 2.7V, T_A = -40ºC to 85ºC

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Unit
I_{IH}	Input High Current CLKA, nCLKA; CLKB, nCLKB	V_{DD} = V_{IN} = 1.89V, 2.7V	-	-	150	µA

Table 9. Differential Input Characteristics – V_{DD} = = 1.8V ± 5%, 2.1V to 2.7V, T_A = -40ºC to 85ºC

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Unit
I_{IL}	Input Low Current CLKA, CLKB	V_{IN} = 0V, V_{DD} = 1.89V, 2.7V	-150	-	-	µA
	Input Low Current nCLKA, nCLKB	V_{IN} = 0V, V_{DD} = 1.89V, 2.7V	-150	-	-	µA
I_{LEAK}	Input Leakage Current	V_{IN} = 2.7V, V_{DD} = 0V	-	-	250	µA
V_{REF}	Reference Voltage for Input Bias	IREF = -100µA; V_{DD} = 1.8V, 2.5V	0.7 × V_{DD}	-	0.85 × V_{DD}	V

2.9 LVDS AC and DC Characteristics

Table 10. LVDS AC and DC Characteristics – V_{DD} = 1.8V ± 5%, 2.1V to 2.7V, T_A = -40ºC to 85ºC

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Unit
deltaV$_{OD}$	VOD Magnitude Change	-	-	-	50	mV
deltaV$_{OD}$	VOD Magnitude Change	-	-	-	50	mV

2.10 AC Characteristics

Table 11. AC Characteristics – V_{DD} = 1.8V ± 5% or 2.1V to 2.7V, T_A = -40ºC to 85ºC [1]

Symbol	Parameter	Test Conditions		Minimum	Typical	Maximum	Unit
F_{REF}	Input frequency	-		0	-	2	GHz
dV/dt	Input edge rate	-		1.5	-	-	V/ns
t_{PD}	Propagation delay	CLK[0:1], nCLK[0:1] to any Qx, nQx	V_{DD} = 1.8V ±5%	100	350	450	ps
			V_{DD} = 2.5V ±5%				
tsk(o)	Output skew	Qx, nQx	V_{DD} = 1.8V ±5%	-	10	40	ps
			V_{DD} = 2.5V ±5%				
tsk(i)	Input skew	-	-	-	-	20	ps
tsk(p)	Pulse skew	f_{REF} = 100MHz	V_{DD} = 1.8V ±5%	-	5	30	ps
			V_{DD} = 2.5V ±5%				
tsk(pp)	Part-to-part skew	f_{REF} = 100MHz	V_{DD} = 1.8V ±5%	-	-	215	ps
			V_{DD} = 2.5V ±5%				
t_{jit}	Buffer additive phase jitter, RMS	f_{REF} = 122.88MHz Square Wave, VPP = 1V, Integration Range: 12kHz to 20MHz		-	50	-	fs
		f_{REF} = 156.25MHz Square Wave, VPP = 1V, Integration Range: 12kHz to 20MHz		-	50	-	fs
		f_{REF} = 156.25MHz Square Wave, VPP = 0.5V, Integration Range: 12kHz to 20MHz		-	50	-	fs
PNF	Phase noise floor	Phase noise floor carrier frequency at 122.88MHz at 20MHz offset		-	-160	-	dBc/Hz

Table 11. AC Characteristics – V_{DD} = 1.8V ± 5% or 2.1V to 2.7V, T_A = -40ºC to 85ºC [1] (Cont.)

Symbol	Parameter	Test Conditions		Minimum	Typical	Maximum	Unit
t_R / t_F	Output rise/ fall time	V_{DD} = 1.8V ± 5%	10% to 90%	-	150	400	ps
			20% to 80%	-	90	160	
		V_{DD} = 2.1V, 2.5V, 2.7V	10% to 90%	-	200	420	ps
			20% to 80%	-	110	190	
$MUX_{isolation}$	Mux isolation	f_{REF} = 100MHz		-	80	-	dB
V_{CMR}	Common mode input voltage [2]	-		1.1	-	V_{DD} - ($V_{PP/2}$)	V
V_{OD}	Differential output voltage	R_{OUT} = 100Ω, f_{REF} < 2MHz		247	350	454	mV
		R_{OUT} = 100Ω, f_{REF} < 500MHz		305	385	454	mV
V_{OS}	Offset voltage, V_{DD} [3] = 1.8V ± 5%	-		0.61	0.77	0.91	V
	Offset voltage, V_{DD} [4] = 2.1V	-		0.80	1.01	1.20	V
	Offset voltage, V_{DD} [4] = 2.3V	-		1.00	1.21	1.42	V
	Off set voltage, V_{DD} [4] = 2.5V	-		1.30	1.45	1.62	V
	Offset voltage, V_{DD} [4] = 2.7V	-		1.40	1.61	1.82	V

1. Electrical parameters are guaranteed over the specified ambient operating temperature range, which is established when the device is mounted in a test socket with maintained transverse airflow greater than 500fpm. The device will meet specifications after thermal equilibrium has been reached under these conditions.
2. Common Mode Input Voltage is defined as the cross-point voltage.
3. Input V_{PP} = 400mV.

3. Additive Phase Jitter

The spectral purity in a band at a specific offset from the fundamental compared to the power of the fundamental is called the *dBc Phase Noise.* This value is normally expressed using a phase noise plot, and is most often the specified plot in many applications. Phase noise is defined as the ratio of the noise power present in a 1Hz band at a specified offset from the fundamental frequency to the power value of the fundamental. This ratio is expressed in decibels (dBm), or a ratio of the power in the 1Hz band to the power in the fundamental. When the required offset is specified, the phase noise is called a *dBc* value, which simply means dBm at a specified offset from the fundamental. By investigating jitter in the frequency domain, we get a better understanding of its effects on the desired application over the entire time record of the signal. It is mathematically possible to calculate an expected bit error rate given a phase noise plot.

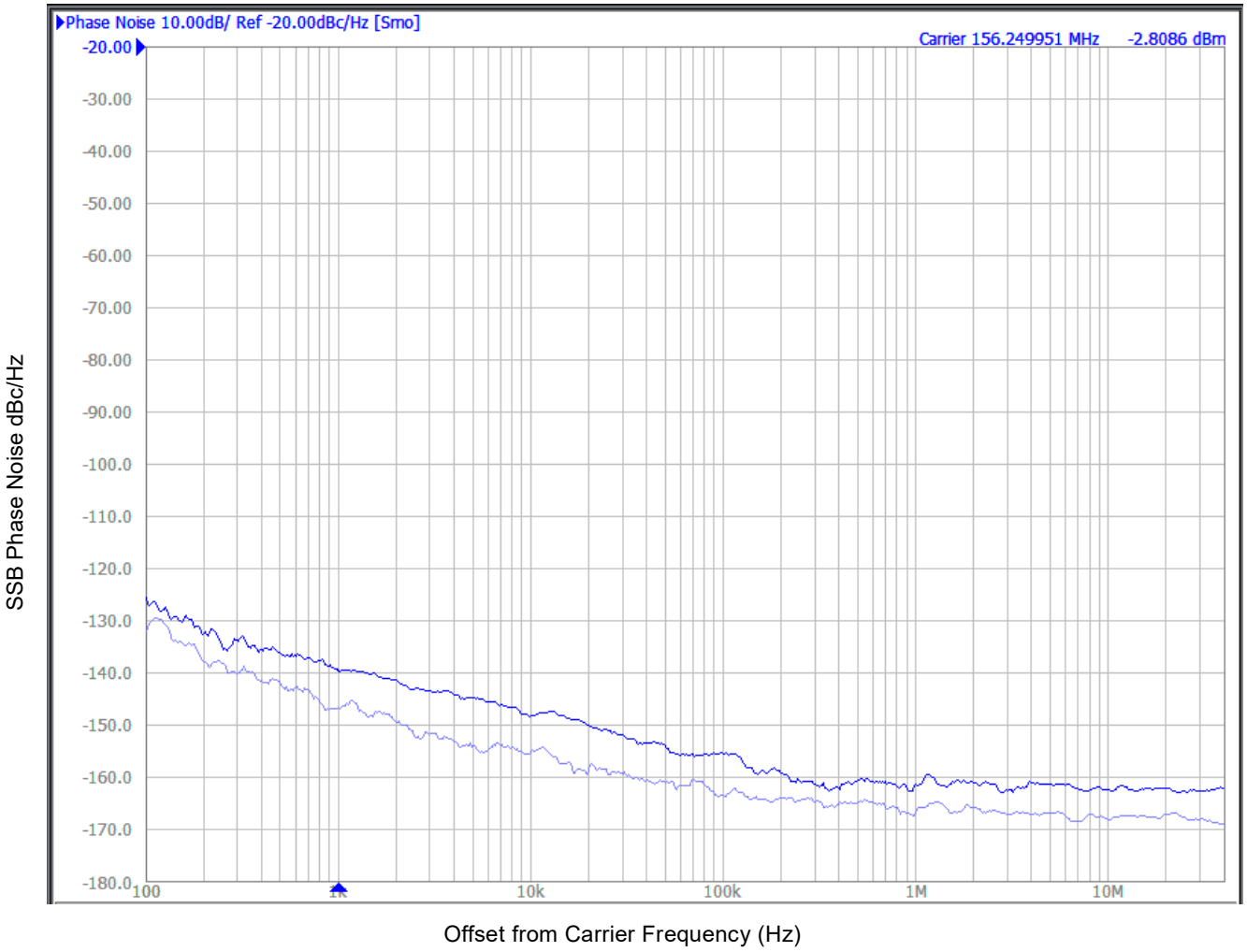


Figure 3. Additive Phase Jitter. Frequency: 156.25MHz, Integration Range: 12kHz to 20MHz = 45fs Typical

As with most timing specifications, phase noise measurements have issues relating to the limitations of the measurement equipment. The noise floor of the equipment can be higher or lower than the noise floor of the device. Additive phase noise is dependent on both the noise floor of the input source and measurement equipment.

Note: The phase noise plot was measured using a Wenzel 156.25MHz Oscillator as the input source.

4. Applications Information

4.1 Fail-Safe Operation

All clock inputs support fail-safe operation. That is, when the device is powered down, the clock inputs can be held at a DC voltage of up to 4.6V without damaging the device or the input pins.

4.2 Recommendations for Unused Input and Output Pins

4.2.1 Inputs

4.2.1.1 CLK/nCLK Inputs

For applications not requiring the use of the differential input, both CLK and nCLK can be left floating. Though not required, but for additional protection, a 1kΩ resistor can be tied from CLK to ground.

4.2.2 Outputs

4.2.2.1 LVDS Outputs

All unused LVDS output pairs can be either left floating or terminated with 100Ω across. If they are left floating there should be no trace attached.

4.2.2.2 VREFX

The unused VREFA and VREFB pins can be left floating. We recommend that there is no trace attached.

4.3 Wiring the Differential Input to Accept Single-Ended Levels

Figure 4 shows an example of how a differential input can be wired to accept single-ended levels. To satisfy the VCMR requirement, the reference voltage V1 is set to 1.2V which is generated by the bias resistors R1 and R2. The bypass capacitor (C1) is used to help filter noise on the DC bias. This bias circuit should be located as close to the input pin as possible. The ratio of R1 and R2 might need to be adjusted to position the V1 to meet the VCRM requirement. For example, if the input clock swing is 1.8V and V_{DD} = 1.8V, the R1 and R2 values should be adjusted to set V1 at 1.2V in this example.

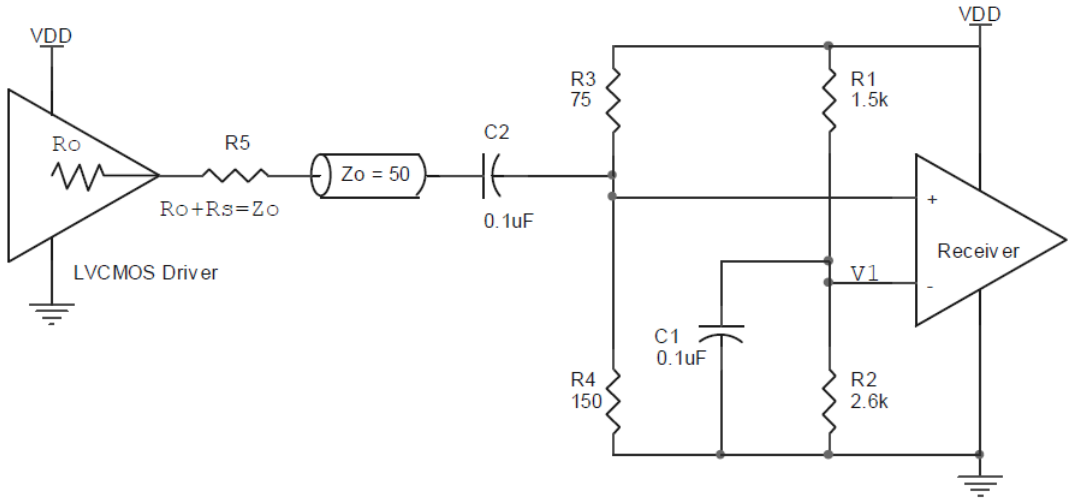


Figure 4. Example Schematic for Wiring a Differential Input to Accept Single-ended Levels

The values in the figure are for when both the single-ended swing and V_{DD} are at the same voltage. This configuration requires that the sum of the output impedance of the driver (Ro) and the series resistance (Rs) equals the transmission line impedance. In addition, matched termination at the input will attenuate the signal in half. This can be done in one of two ways. First, R3 and R4 in parallel should equal the transmission line impedance and the signal DC offset after AC coupling should be equal to V1 (in other words, 1.2V in this example). For most Zo = 50Ω applications, R3 = 75Ω and R4 can be 130Ω. By keeping the same R3/R4 ratio, the values of the resistors can be increased to reduce the loading for a slower or weaker LVCMOS driver. When using single-ended signaling, the noise rejection benefits of differential signaling are reduced. Even though the input can handle larger amplitude signaling, it is recommended that the amplitude be reduced.

For single-ended applications, the swing can be larger. Make sure the single-ended logic high and logic low signal operates within the specification limit. Though some of the recommended components might not be used, the pads should be placed in the layout. They can be used for debugging purposes. The datasheet specifications are characterized and confirmed by using a differential signal.

4.4 1.8V Differential Clock Input Interface

The CLK /nCLK accepts LVDS, LVPECL, and other differential signals. The differential input signal must meet both the V_{PP} and V_{CMR} input requirements. Figure 5 to Figure 7 show interface examples for the CLK /nCLK input driven by the most common driver types. The input interfaces suggested here are examples only. If the driver is from another vendor, use their termination recommendation. Please consult with the vendor of the driver component to confirm the driver termination requirements.

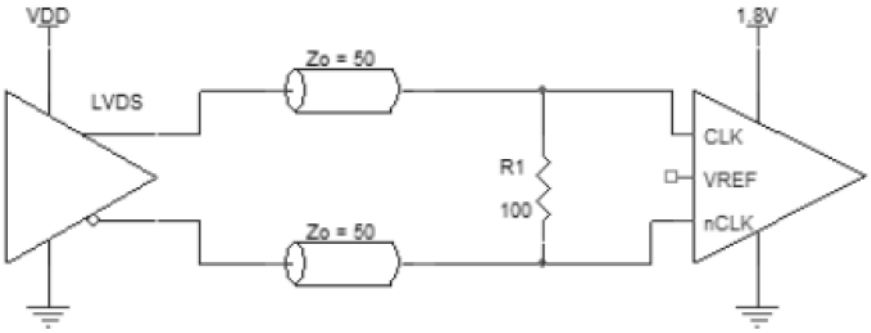


Figure 5. Differential Input Driven by an LVDS Driver – DC Coupling

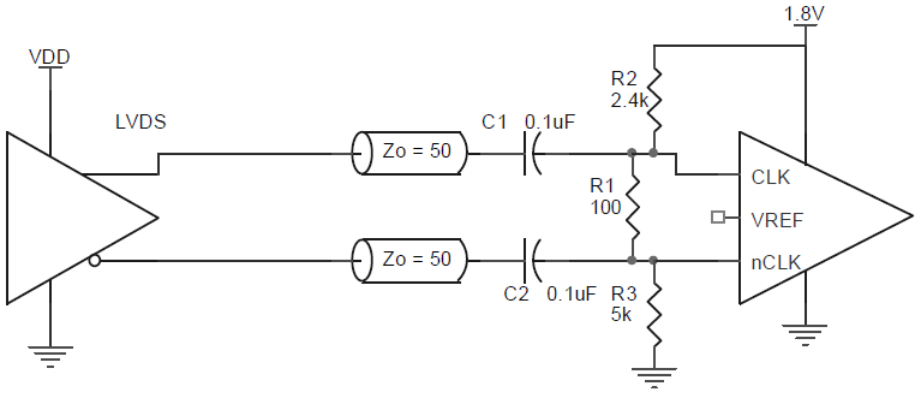


Figure 6. Differential Input Driven by an LVDS Driver – AC Coupling

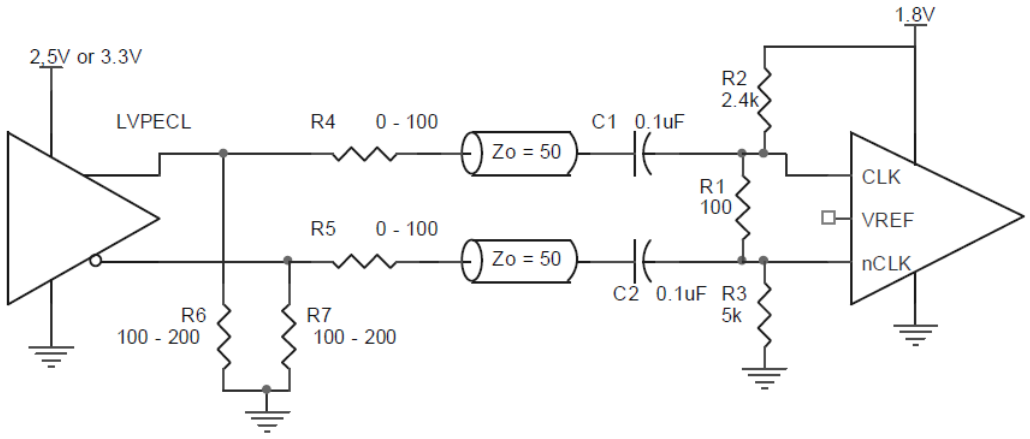


Figure 7. Differential Input Driven by an LVPECL Driver – AC Coupling

4.5 LVDS Driver Termination

For a general LVDS interface, the recommended value for the termination impedance (Z_T) is between 90Ω and 132Ω. The actual value should be selected to match the differential impedance (Z_0) of your transmission line. A typical point-to-point LVDS design uses a 100Ω parallel resistor at the receiver and a 100Ω differential transmission-line environment. In order to avoid any transmission-line reflection issues, the components should be surface-mounted and must be placed as close to the receiver as possible. Renesas offers a full line of LVDS compliant devices with two types of output structures: current source and voltage source.

The standard termination schematic as shown in Figure 8 can be used with either type of output structure. Figure 9, which can also be used with both output types, is an optional termination with center tap capacitance to help filter common mode noise. The capacitor value should be approximately 50pF. If using a non-standard termination, it is recommended to contact Renesas and confirm if the output structure is current source or voltage source type. In addition, since these outputs are LVDS compatible, the input receiver's amplitude and common-mode input range should be verified for compatibility with the output.

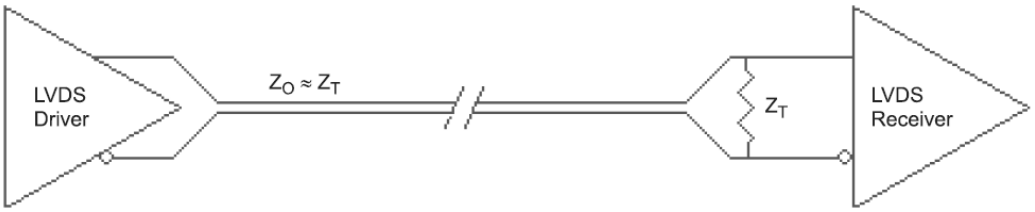


Figure 8. Standard LVDS Termination

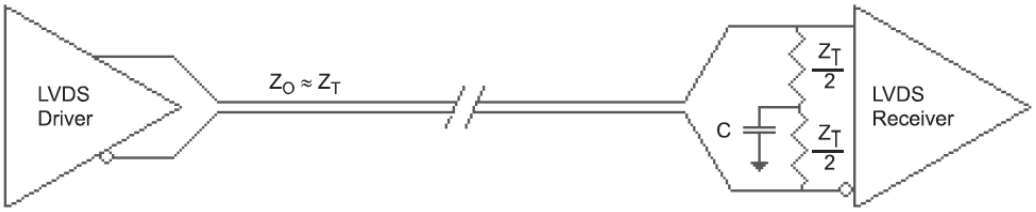
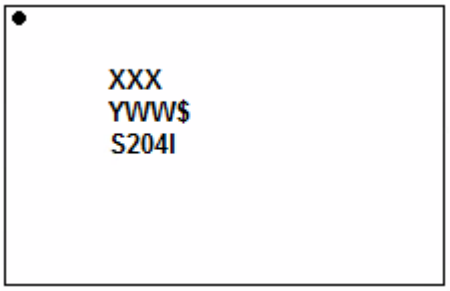


Figure 9. Optional LVDS Termination

5. Package Outline Drawings

The package outline drawings are located at the end of this document and are accessible from the Renesas website. The package information is the most current data available and is subject to change without revision of this document.

6. Marking Diagram

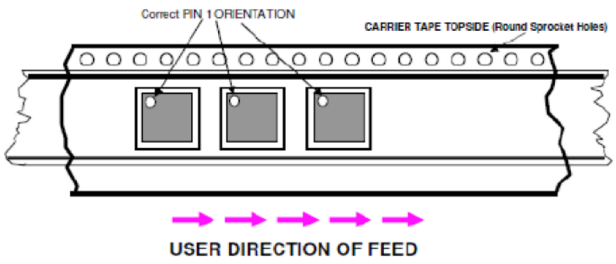
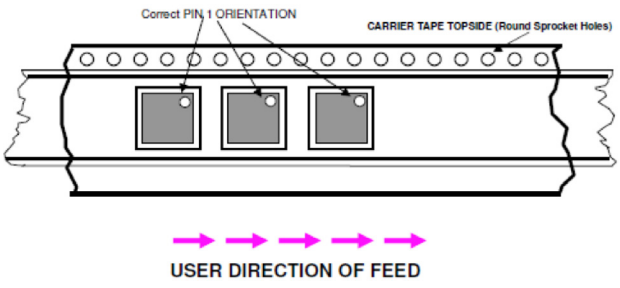


- Line 1 indicates the assembly lot number.
- Line 2:
  - “YWW” indicates the last digit of the year and work week the part was assembled.
  - “$” indicates the mark code.
- Line 3 indicates the part number.

7. Ordering Information

Part Number	Package Description	Carrier Type	Temperature Range
8P34S1204-1NBGI	28-QFN, 5.0 × 5.0 mm	Tray	-40 to +85°C
8P34S1204-1NBGI8		Tape & Reel, Pin 1 Orientation: EIA-481-C	
8P34S1204-1NBGI/W		Tape & Reel, Pin 1 Orientation: EIA-481-D/E	

Table 12. Pin 1 Orientation in Tape and Reel Packaging

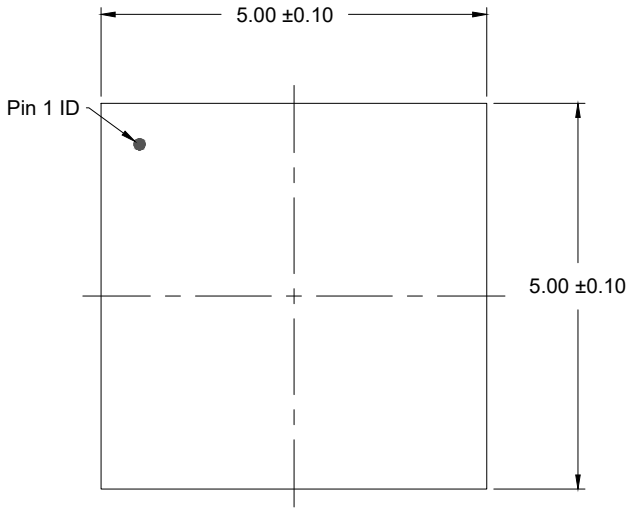
Part Number Suffix	Pin 1 Orientation	Illustration
8	Quadrant 1 (EIA-481-C)	
/W	Quadrant 2 (EIA-481-D/E)	

8. Revision History

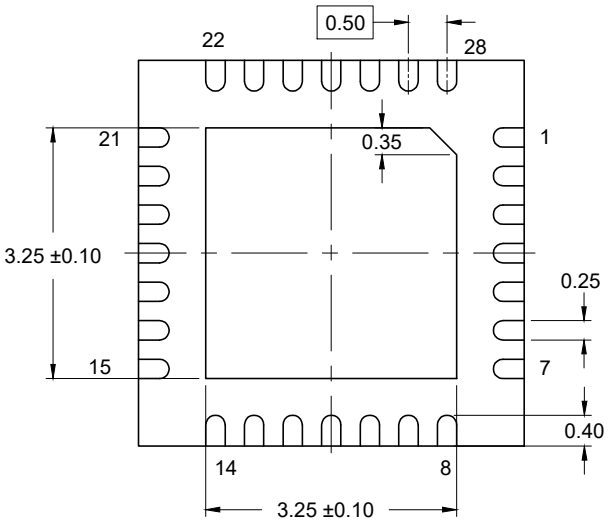
Revision	Date	Description
1.00	Jul 17, 2024	Initial release.

Package Outline Drawing

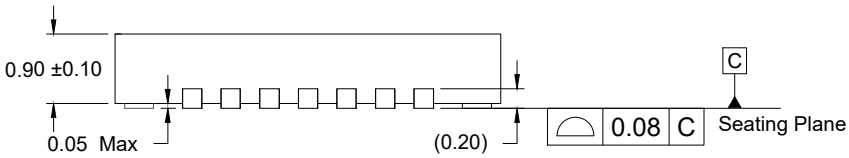
Package Code:QV0028AA
28-QFN 5.0 x 5.0 x 0.9 mm Body, 0.5mm Pitch
PSC-5008-01, Revision: 01, Date Created: Aug 10, 2023



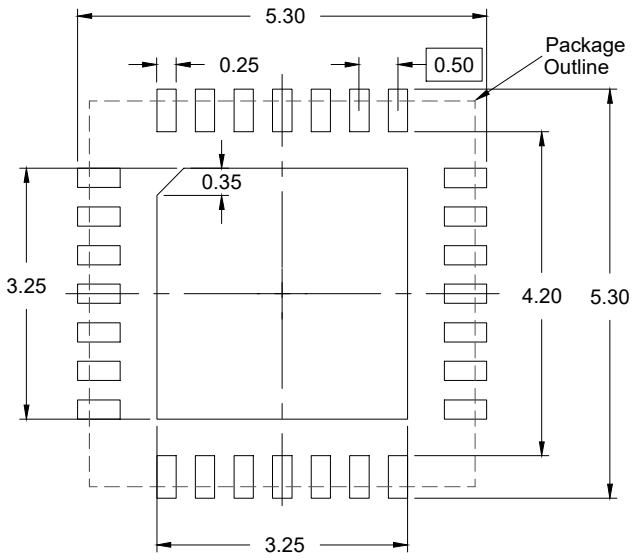
TOP VIEW



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 for the non-toleranced dimensions.
4. Numbers in ( ) are for references only.

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