DS25BR204 3.125 Gbps 1:4 LVDS Repeater with Transmit Pre-Emphasis and Receive Equalization

Check for Samples: DS25BR204

FEATURES

- **DC - 3.125 Gbps Low Jitter, Low Skew, Low Power Operation**
- **Pin Selectable Transmit Pre-Emphasis and Receive Equalization Eliminate Data Dependant Jitter**
- **Wide Input Common Mode Range Allows DC-coupled Interface to LVDS, CML and LVPECL Drivers**
- **Redundant Inputs**
- **Integrated 100Ω Input and Output Terminations**
- **8 kV ESD on LVDS I/O Pins Protects Adjoining Components**
- **Small 6 mm x 6 mm WQFN-40 Space Saving Package**

APPLICATIONS

- **Clock and Data Distribution**
- **Clock and Data Buffering and Muxing**
- **OC-48 / STM-16**
- **SD/HD/3GHD SDI Routers**

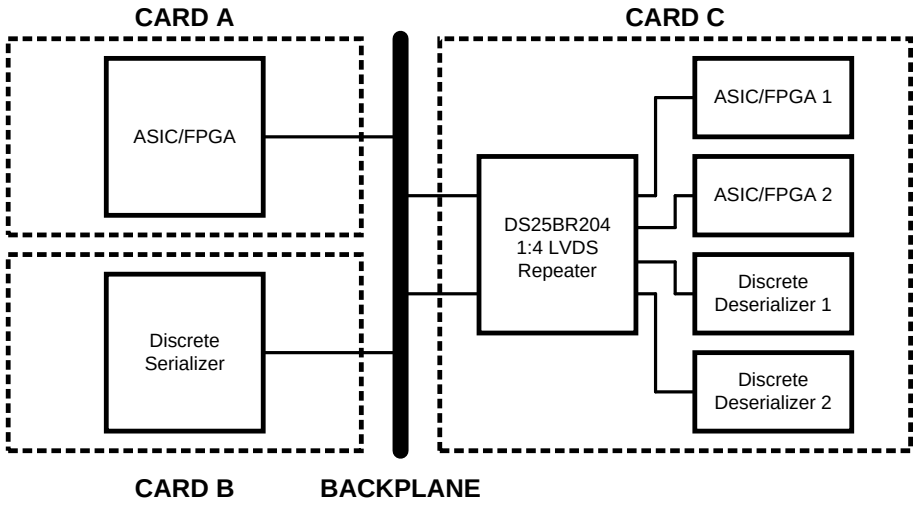
DESCRIPTION

The DS25BR204 is a 3.125 Gbps 1:4 LVDS repeater optimized for high-speed signal routing and switching over lossy FR-4 printed circuit board backplanes and balanced cables. Fully differential signal paths ensure exceptional signal integrity and noise immunity.

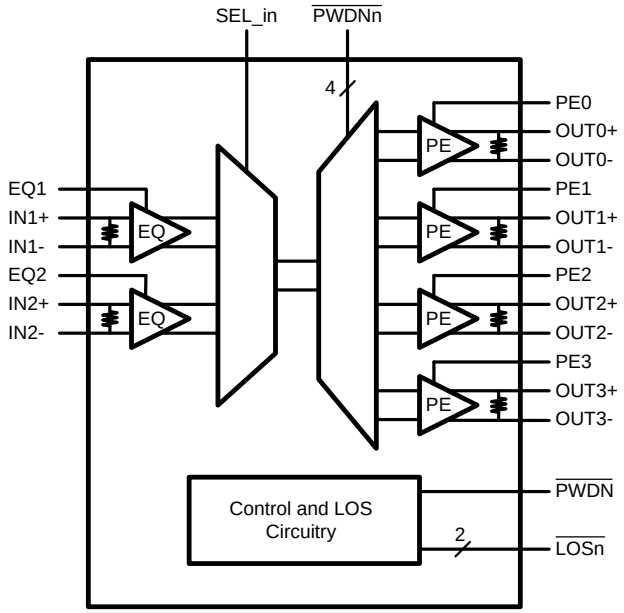
The device has two different LVDS input channels and a select line determines which input is active. Both inputs have programmable equalization providing maximum signal strength. A loss-of-signal (LOS) circuit monitors both input channels and a unique LOS pin reports when no signal is detected at that input.

Wide input common mode range allows the switch to accept signals with LVDS, CML and LVPECL levels; the output levels are LVDS. A very small package footprint requires a minimal space on the board while the flow-through pinout allows easy board layout. Each differential input and output is internally terminated with a 100Ω resistor to lower device return losses, reduce component count and further minimize board space.

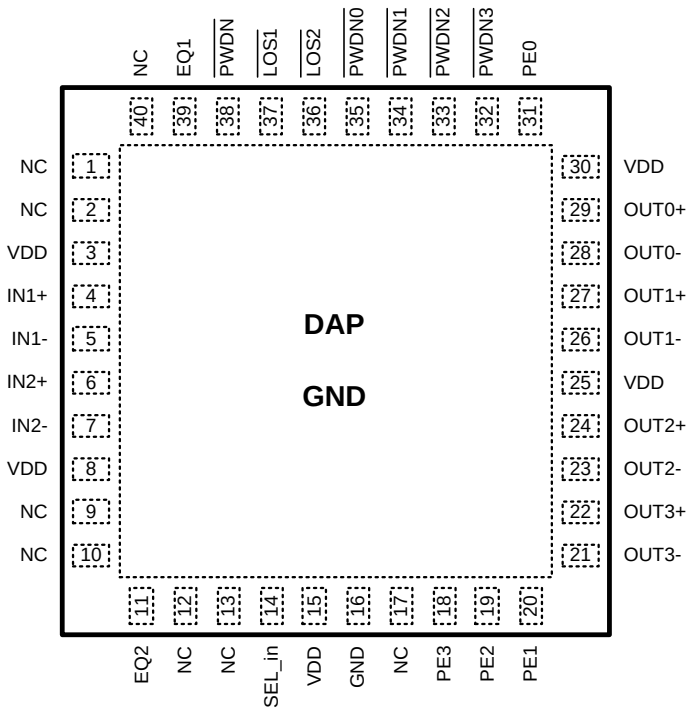
Typical Application



Block Diagram



Connection Diagram



DS25BR204 Pin Diagram

PIN DESCRIPTIONS

Pin Name	Pin Number	I/O, Type	Pin Description
IN1+, IN1-, IN2+, IN2-,	4, 5, 6, 7,	I, LVDS	Inverting and non-inverting high speed LVDS input pins.
OUT0+, OUT0-, OUT1+, OUT1-, OUT2+, OUT2-, OUT3+, OUT3-	29, 28, 27, 26, 24, 23, 22, 21	O, LVDS	Inverting and non-inverting high speed LVDS output pins.
EQ1, EQ2,	39,11	I, LVCMOS	Receive equalization level select pins.
PE0, PE1, PE2, PE3	31, 20, 19, 18	I, LVCMOS	Transmit pre-emphasis level select pins.
SEL_in	14	I, LVCMOS	Input select pin.
$\overline{\text{LOS2}}$ $\overline{\text{LOS1}}$	36, 37	O, LVCMOS	Loss of Signal output pin, LOSn, reports when an open input fault condition is detected at the input, INn. These are open drain outputs. External pull up resistors are required.
$\overline{\text{PWDN0}}$, $\overline{\text{PWDN1}}$, $\overline{\text{PWDN2}}$, $\overline{\text{PWDN3}}$	35, 34, 33, 32	I, LVCMOS	Channel output power down pins. When the $\overline{\text{PWDNn}}$ is set to L, the channel output, OUTn, is in the power down mode.
NC	1, 2, 9, 10, 12, 13, 17, 40	NC	NO CONNECT pins. May be left floating.
$\overline{\text{PWDN}}$	38	I, LVCMOS	Device power down pin. When the $\overline{\text{PWDN}}$ is set to L, the device is in the power down mode.
VDD	3, 8, 15,25, 30	Power	Power supply pins.
GND	16, DAP	Power	Ground pin and a pad (DAP - die attach pad).

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings[1][2]

Supply Voltage	−0.3V to +4V
LVCMOS Input Voltage	−0.3V to (V_{CC} + 0.3V)
LVCMOS Output Voltage	−0.3V to (V_{CC} + 0.3V)
LVDS Input Voltage	−0.3V to +4V
Differential Input Voltage |VID|	1V
LVDS Output Voltage	−0.3V to (V_{CC} + 0.3V)
LVDS Differential Output Voltage	0.0V to +1V
LVDS Output Short Circuit Current Duration	5 ms
Junction Temperature	+150°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature Range Soldering (4 sec.)	+260°C
Maximum Package Power Dissipation at 25°C	
RTA0040A Package	4.65W
Derate RTA0040A Package	37.2 mW/°C above +25°C
Package Thermal Resistance	
θ_{JA}	+26.9°C/W
θ_{JC}	+3.8°C/W
ESD Susceptibility	
HBM [3]	≥8 kV
MM [4]	≥250V
CDM [5]	≥1250V

(1) "Absolute Maximum Ratings" indicate limits beyond which damage to the device may occur, including inoperability and degradation of device reliability and/or performance. Functional operation of the device and/or non-degradation at the Absolute Maximum Ratings or other conditions beyond those indicated in the Recommended Operating Conditions is not implied. The Recommended Operating Conditions indicate conditions at which the device is functional and the device should not be operated beyond such conditions.
(2) If Military/Aerospace specified devices are required, please contact the TI Sales Office/Distributors for availability and specifications.
(3) Human Body Model, applicable std. JESD22-A114C
(4) Machine Model, applicable std. JESD22-A115-A
(5) Field Induced Charge Device Model, applicable std. JESD22-C101-C

Recommended Operating Conditions

	Min	Typ	Max	Units
Supply Voltage (V_{CC})	3.0	3.3	3.6	V
Receiver Differential Input Voltage (V_{ID})	0		1	V
Operating Free Air Temperature (T_A)	−40	+25	+85	°C

Electrical Characteristics[1]

Over recommended operating supply and temperature ranges unless otherwise specified. [2] [3]

Symbol	Parameter	Conditions	Min	Typ	Max	Units
LVCMOS DC SPECIFICATIONS						
V_{IH}	High Level Input Voltage		2.0		V_{DD}	V
V_{IL}	Low Level Input Voltage		GND		0.8	V
I_{IH}	High Level Input Current	V_{IN} = 3.6V V_{CC} = 3.6V		0	±10	µA

(1) The Electrical Characteristics tables list guaranteed specifications under the listed Recommended Operating Conditions except as otherwise modified or specified by the Electrical Characteristics Conditions and/or Notes. Typical specifications are estimations only and are not guaranteed.
(2) Current into device pins is defined as positive. Current out of device pins is defined as negative. All voltages are referenced to ground except V_{OD} and ΔV_{OD}.
(3) Typical values represent most likely parametric norms for V_{CC} = +3.3V and T_A = +25°C, and at the Recommended Operation Conditions at the time of product characterization and are not guaranteed.

Electrical Characteristics[1] (continued)

Over recommended operating supply and temperature ranges unless otherwise specified. [2] [3]

Symbol	Parameter	Conditions	Min	Typ	Max	Units
I_{IL}	Low Level Input Current	V_{IN} = GND V_{CC} = 3.6V		0	±10	µA
V_{CL}	Input Clamp Voltage	I_{CL} = −18 mA, V_{CC} = 0V		−0.9	−1.5	V
V_{OL}	Low Level Output Voltage	I_{OL}= 4 mA			0.4	V
LVDS INPUT DC SPECIFICATIONS						
V_{ID}	Input Differential Voltage		0		1	V
V_{TH}	Differential Input High Threshold	V_{CM} = +0.05V or V_{CC}-0.05V		0	+100	mV
V_{TL}	Differential Input Low Threshold		−100	0		mV
V_{CMR}	Common Mode Voltage Range	V_{ID} = 100 mV	0.05		V_{CC} - 0.05	V
I_{IN}	Input Current	V_{IN} = 3.6V or 0V V_{CC} = 3.6V or 0V		±1	±10	µA
C_{IN}	Input Capacitance	Any LVDS Input Pin to GND		1.7		pF
R_{IN}	Input Termination Resistor	Between IN+ and IN-		100		Ω
LVDS OUTPUT DC SPECIFICATIONS						
V_{OD}	Differential Output Voltage	R_L = 100Ω	250	350	450	mV
ΔV_{OD}	Change in Magnitude of V_{OD} for Complimentary Output States		-35		35	mV
V_{OS}	Offset Voltage	R_L = 100Ω	1.05	1.2	1.375	V
ΔV_{OS}	Change in Magnitude of V_{OS} for Complimentary Output States		-35		35	mV
I_{OS}	Output Short Circuit Current [4]	OUT to GND		-35	-55	mA
		OUT to V_{CC}		7	55	mA
C_{OUT}	Output Capacitance	Any LVDS Output Pin to GND		1.2		pF
R_{OUT}	Output Termination Resistor	Between OUT+ and OUT-		100		Ω
SUPPLY CURRENT						
I_{CC}	Supply Current	PE = OFF, EQ = OFF, $\overline{PWDN}$ = H		150	185	mA
I_{CCZ}	Power Down Supply Current	$\overline{PWDN}$ = L		47	65	mA

(4) Output short circuit current (I_{OS}) is specified as magnitude only, minus sign indicates direction only.

AC Electrical Characteristics

Over recommended operating supply and temperature ranges unless otherwise specified. (1) (2)

Symbol	Parameter	Conditions		Min	Typ	Max	Units
LVDS OUTPUT AC SPECIFICATIONS							
t_{PLHD}	Differential Propagation Delay Low to High (3)	R_L = 100Ω			460	600	ps
t_{PHLD}	Differential Propagation Delay High to Low (3)				420	600	ps
t_{SKD1}	Pulse Skew $\|t_{PLHD} - t_{PHLD}\|$ (2) (4)				40	100	ps
t_{SKD2}	Channel to Channel Skew (5) (3)				55	110	ps
t_{SKD3}	Part to Part Skew (3) (6)				50	190	ps
t_{LHT}	Rise Time (3)	R_L = 100Ω			80	160	ps
t_{HLT}	Fall Time (3)				80	160	ps
t_{ON}	Any $\overline{PWDN}$ to Output Active Time				8	20	µs
t_{OFF}	Any $\overline{PWDN}$ to Output Inactive Time				5	12	ns
t_{SEL}	Select Time				5	12	ns
JITTER PERFORMANCE WITH EQ = Off, PE = Off (3) (Figure 5)							
t_{RJ1}	Random Jitter (RMS Value) No Test Channels (7)	V_{ID} = 350 mV V_{CM} = 1.2V Clock (RZ)	2.5 Gbps		0.5	1	ps
t_{RJ2}			3.125 Gbps		0.5	1	ps
t_{DJ1}	Deterministic Jitter (Peak to Peak) No Test Channels (8)	V_{ID} = 350 mV V_{CM} = 1.2V K28.5 (NRZ)	2.5 Gbps		11	19	ps
t_{DJ2}			3.125 Gbps		13	24	ps
t_{TJ1}	Total Jitter (Peak to Peak) No Test Channels (9)	V_{ID} = 350 mV V_{CM} = 1.2V PRBS-23 (NRZ)	2.5 Gbps		0.05	0.10	UI_{P-P}
t_{TJ2}			3.125 Gbps		0.07	0.13	UI_{P-P}
JITTER PERFORMANCE WITH EQ = Off, PE = On (3) (Figure 6, Figure 9)							
t_{RJ1B}	Random Jitter (RMS Value) Test Channel B (7)	V_{ID} = 350 mV V_{CM} = 1.2V Clock (RZ)	2.5 Gbps		0.5	1	ps
t_{RJ2B}			3.125 Gbps		0.5	1	ps
t_{DJ1B}	Deterministic Jitter (Peak to Peak) Test Channel B (8)	V_{ID} = 350 mV V_{CM} = 1.2V K28.5 (NRZ)	2.5 Gbps		10	23	ps
t_{DJ2B}			3.125 Gbps		4	20	ps
t_{TJ1B}	Total Jitter (Peak to Peak) Test Channel B (9)	V_{ID} = 350 mV V_{CM} = 1.2V PRBS-23 (NRZ)	2.5 Gbps		0.06	0.10	UI_{P-P}
t_{TJ2B}			3.125 Gbps		0.05	0.13	UI_{P-P}
JITTER PERFORMANCE WITH EQ = On, PE = Off (3) (Figure 7, Figure 9)							
t_{RJ1D}	Random Jitter (RMS Value) Test Channel D (7)	V_{ID} = 350 mV V_{CM} = 1.2V Clock (RZ)	2.5 Gbps		0.5	1	ps
t_{RJ2D}			3.125 Gbps		0.5	1	ps

(1) The Electrical Characteristics tables list guaranteed specifications under the listed Recommended Operating Conditions except as otherwise modified or specified by the Electrical Characteristics Conditions and/or Notes. Typical specifications are estimations only and are not guaranteed.
(2) Typical values represent most likely parametric norms for V_{CC} = +3.3V and T_A = +25°C, and at the Recommended Operation Conditions at the time of product characterization and are not guaranteed.
(3) Specification is guaranteed by characterization and is not tested in production.
(4) t_{SKD1}, $|t_{PLHD} - t_{PHLD}|$, Pulse Skew, is the magnitude difference in differential propagation delay time between the positive going edge and the negative going edge of the same channel.
(5) t_{SKD2}, Channel to Channel Skew, is the difference in propagation delay (t_{PLHD} or t_{PHLD}) among all output channels in Broadcast mode (any one input to all outputs).
(6) t_{SKD3}, Part to Part Skew, is defined as the difference between the minimum and maximum differential propagation delays. This specification applies to devices at the same V_{CC} and within 5°C of each other within the operating temperature range.
(7) Measured on a clock edge with a histogram and an accumulation of 1500 histogram hits. Input stimulus jitter is subtracted geometrically.
(8) Tested with a combination of the 1100000101 (K28.5+ character) and 0011111010 (K28.5- character) patterns. Input stimulus jitter is subtracted algebraically.
(9) Measured on an eye diagram with a histogram and an accumulation of 3500 histogram hits. Input stimulus jitter is subtracted.

AC Electrical Characteristics (continued)

Over recommended operating supply and temperature ranges unless otherwise specified. (1) (2)

Symbol	Parameter	Conditions		Min	Typ	Max	Units
t_{DJ1D}	Deterministic Jitter (Peak to Peak) Test Channel D (8)	V_{ID} = 350 mV V_{CM} = 1.2V K28.5 (NRZ)	2.5 Gbps		17	30	ps
t_{DJ2D}			3.125 Gbps		15	28	ps
t_{TJ1D}	Total Jitter (Peak to Peak) Test Channel D (9)	V_{ID} = 350 mV V_{CM} = 1.2V PRBS-23 (NRZ)	2.5 Gbps		0.07	0.13	UI_{P-P}
t_{TJ2D}			3.125 Gbps		0.08	0.15	UI_{P-P}
JITTER PERFORMANCE WITH EQ = On, PE = On (3) (Figure 8, Figure 9)							
t_{RJ1BD}	Random Jitter (RMS Value) Input Test Channel D Output Test Channel B (7)	V_{ID} = 350 mV V_{CM} = 1.2V Clock (RZ)	2.5 Gbps		0.5	1	ps
t_{RJ2BD}			3.125 Gbps		0.5	1	ps
t_{DJ1BD}	Deterministic Jitter (Peak to Peak) Input Test Channel D Output Test Channel B (8)	V_{ID} = 350 mV V_{CM} = 1.2V K28.5 (NRZ)	2.5 Gbps		10	20	ps
t_{DJ2BD}			3.125 Gbps		8	21	ps
t_{TJ1BD}	Total Jitter (Peak to Peak) Input Test Channel D Output Test Channel B (9)	V_{ID} = 350 mV V_{CM} = 1.2V PRBS-23 (NRZ)	2.5 Gbps		0.07	0.12	UI_{P-P}
t_{TJ2BD}			3.125 Gbps		0.08	0.15	UI_{P-P}

DC TEST CIRCUITS

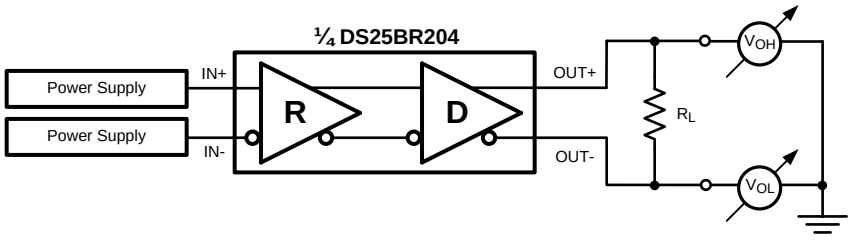


Figure 1. Differential Driver DC Test Circuit

AC Test Circuits and Timing Diagrams

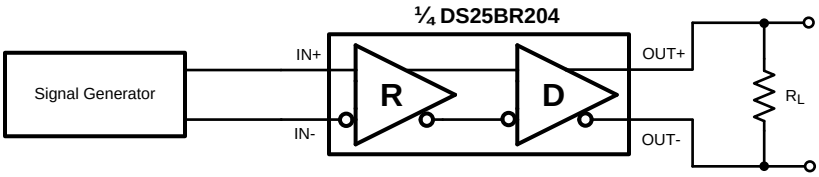


Figure 2. Differential Driver AC Test Circuit

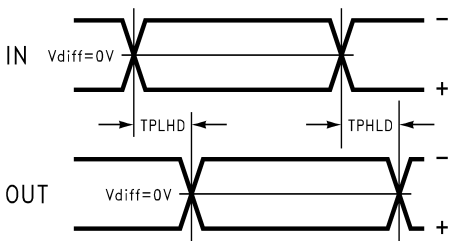


Figure 3. Propagation Delay Timing Diagram

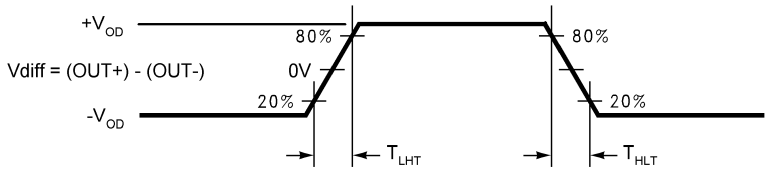


Figure 4. LVDS Output Transition Times

Pre-Emphasis and Equalization Test Circuits

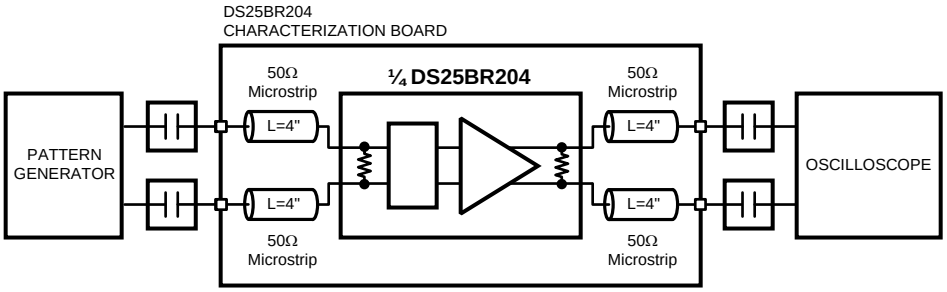


Figure 5. Jitter Performance Test Circuit

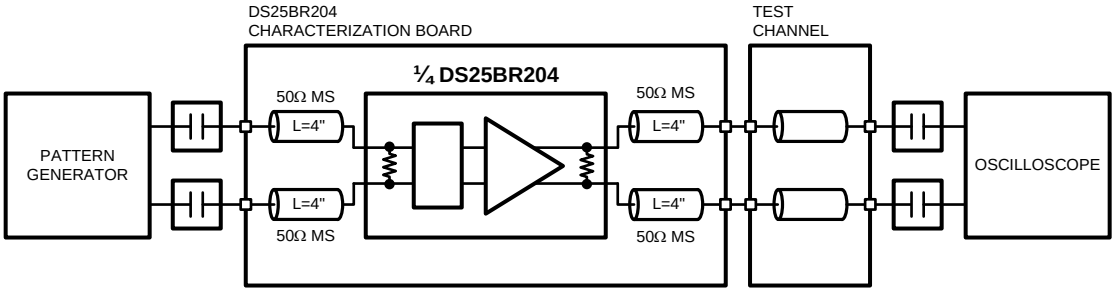


Figure 6. Pre-emphasis Performance Test Circuit

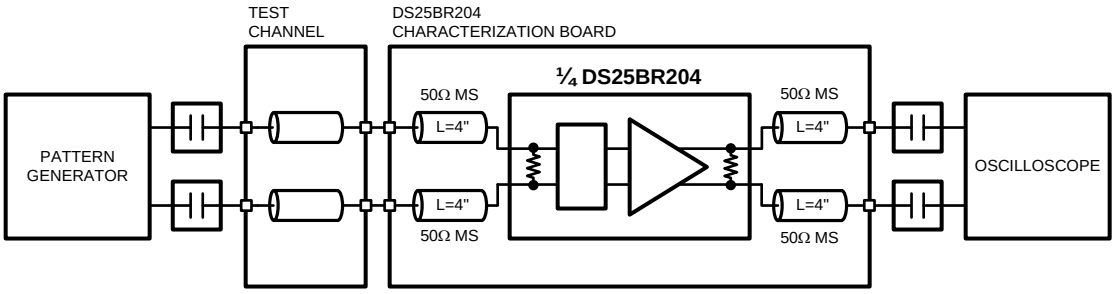


Figure 7. Equalization Performance Test Circuit

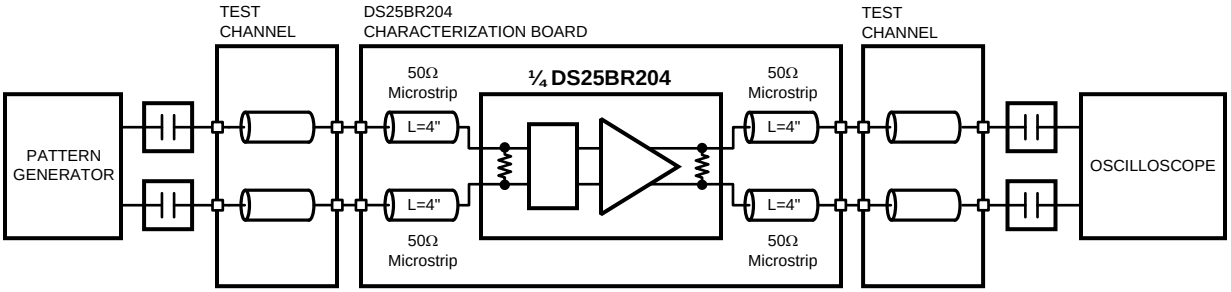


Figure 8. Pre-Emphasis and Equalization Performance Test Circuit

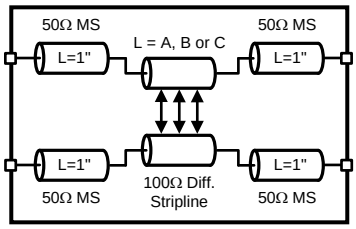


Figure 9. Test Channel Block Diagram

Test Channel Loss Characteristics

The test channel was fabricated with Polyclad PCL-FR-370-Laminate/PCL-FRP-370 Prepreg materials (Dielectric constant of 3.7 and Loss Tangent of 0.02). The edge coupled differential striplines have the following geometries: Trace Width (W) = 5 mils, Gap (S) = 5 mils, Height (B) = 16 mils.

Test Channel	Length (inches)	Insertion Loss (dB)					
		500 MHz	750 MHz	1000 MHz	1250 MHz	1500 MHz	1560 MHz
A	10	-1.2	-1.7	-2.0	-2.4	-2.7	-2.8
B	20	-2.6	-3.5	-4.1	-4.8	-5.5	-5.6
C	30	-4.3	-5.7	-7.0	-8.2	-9.4	-9.7
D	15	-1.6	-2.2	-2.7	-3.2	-3.7	-3.8
E	30	-3.4	-4.5	-5.6	-6.6	-7.7	-7.9
F	60	-7.8	-10.3	-12.4	-14.5	-16.6	-17.0

Functional Description

The DS25BR204 is a 3.125 Gbps 1:4 LVDS repeater optimized for high-speed signal routing and switching over lossy FR-4 printed circuit board backplanes and balanced cables.

The DS25BR204 SEL_in pin selects one out of two available LVDS inputs. The following is the input select truth tables.

Table 1. Input Select Truth Table

CONTROL Pin (SEL_in) State	Input Selected
0	IN1
1	IN2

The DS25BR204 has a pre-emphasis control pin for each output for switching the transmit pre-emphasis to ON and OFF setting and an equalization control pin for each input for switching the receive equalization to ON and OFF setting. The following are the transmit pre-emphasis and receive equalization truth tables.

Table 2. Transmit Pre-Emphasis Truth Table(1)

OUTPUT OUTn, n = {0, 1, 2, 3}	
CONTROL Pin (PEn) State	**Pre-emphasis Level**
0	OFF
1	ON

(1) Transmit Pre-emphasis Level Selection for an Output OUTn

Table 3. Receive Equalization Truth Table(1)

INPUT INn, n = {1, 2}	
CONTROL Pin (EQn) State	**Equalization Level**
0	OFF
1	ON

(1) Receive Equalization Level Selection for an Input INn

Input Interfacing

The DS25BR204 accepts differential signals and allows simple AC or DC coupling. With a wide common mode range, the DS25BR204 can be DC-coupled with all common differential drivers (i.e. LVPECL, LVDS, CML). The following three figures illustrate typical DC-coupled interface to common differential drivers. Note that the DS25BR204 inputs are internally terminated with a 100Ω resistor.

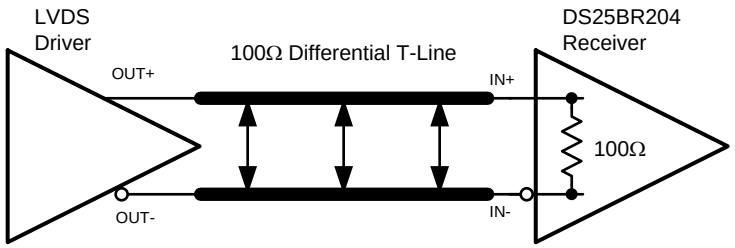


Figure 10. Typical LVDS Driver DC-Coupled Interface to an DS25BR204 Input

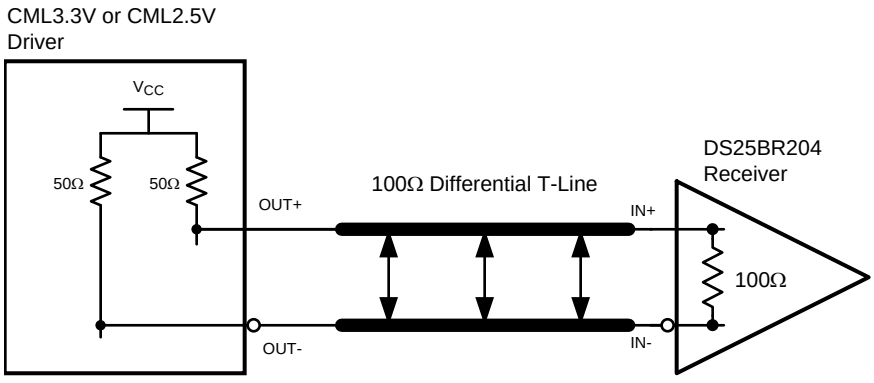


Figure 11. Typical CML Driver DC-Coupled Interface to an DS25BR204 Input

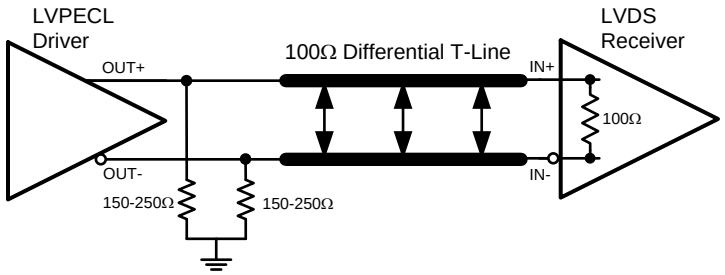


Figure 12. Typical LVPECL Driver DC-Coupled Interface to an DS25BR204 Input

Output Interfacing

The DS25BR204 outputs signals are compliant to the LVDS standard. Its outputs can be DC-coupled to most common differential receivers. The following figure illustrates typical DC-coupled interface to common differential receivers and assumes that the receivers have high impedance inputs. While most differential receivers have a common mode input range that can accommodate LVDS compliant signals, it is recommended to check the respective receiver's data sheet prior to implementing the suggested interface implementation.

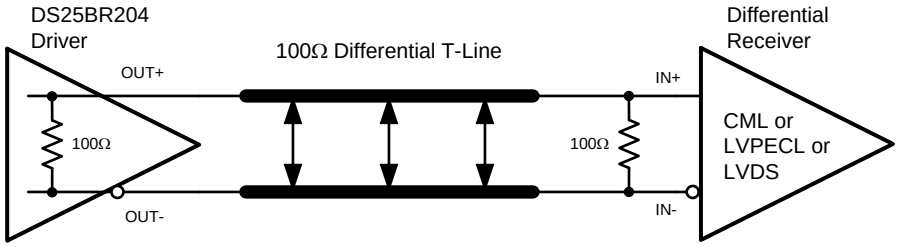


Figure 13. Typical DS25BR204 Output DC-Coupled Interface to an LVDS, CML or LVPECL Receiver

Typical Performance

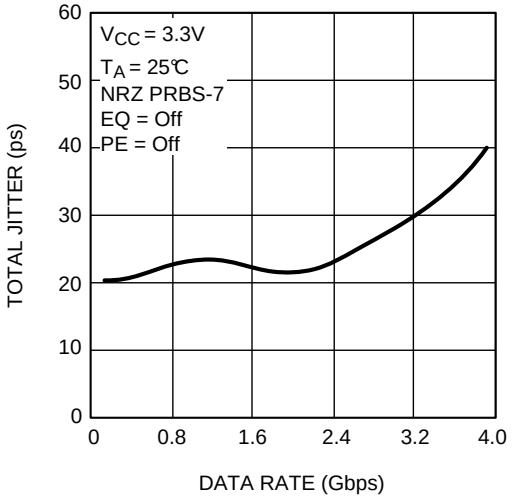


Figure 14. Total Jitter as a Function of Data Rate

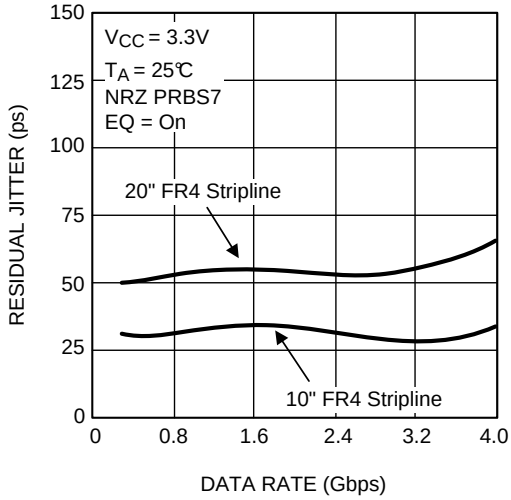


Figure 15. Residual Jitter as a Function of Data Rate, FR4 Stripline Length and EQ Level

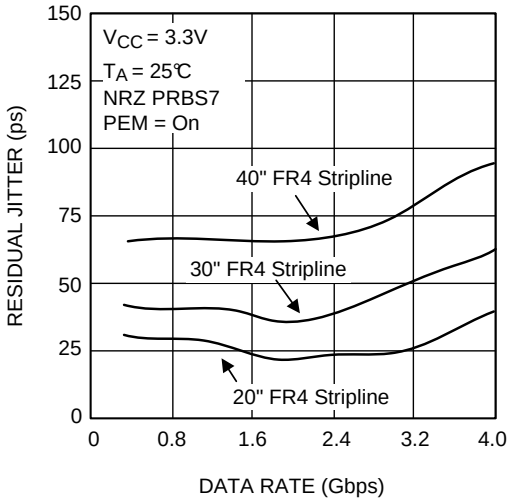


Figure 16. Residual Jitter as a Function of Data Rate, FR4 Stripline Length and PE Level

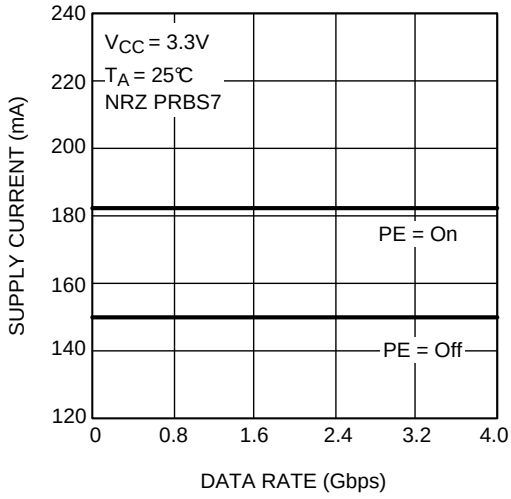


Figure 17. Supply Current as a Function of Data Rate and PE Level

REVISION HISTORY

Changes from Revision C (March 2013) to Revision D	Page
• Changed layout of National Data Sheet to TI format	12

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
DS25BR204TSQ/NOPB	ACTIVE	WQFN	RTA	40	250	RoHS & Green	SN	Level-3-260C-168 HR	-40 to 85	2BR204SQ	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

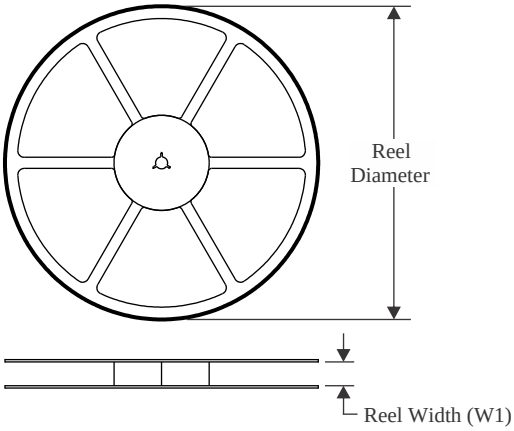
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

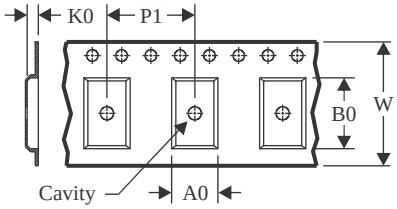
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

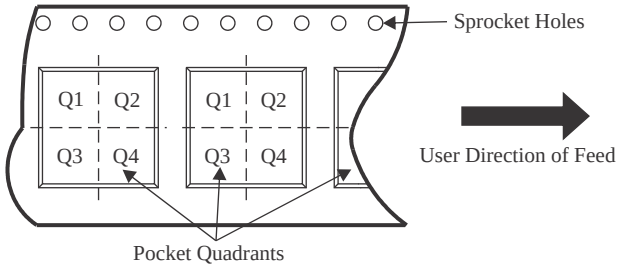


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

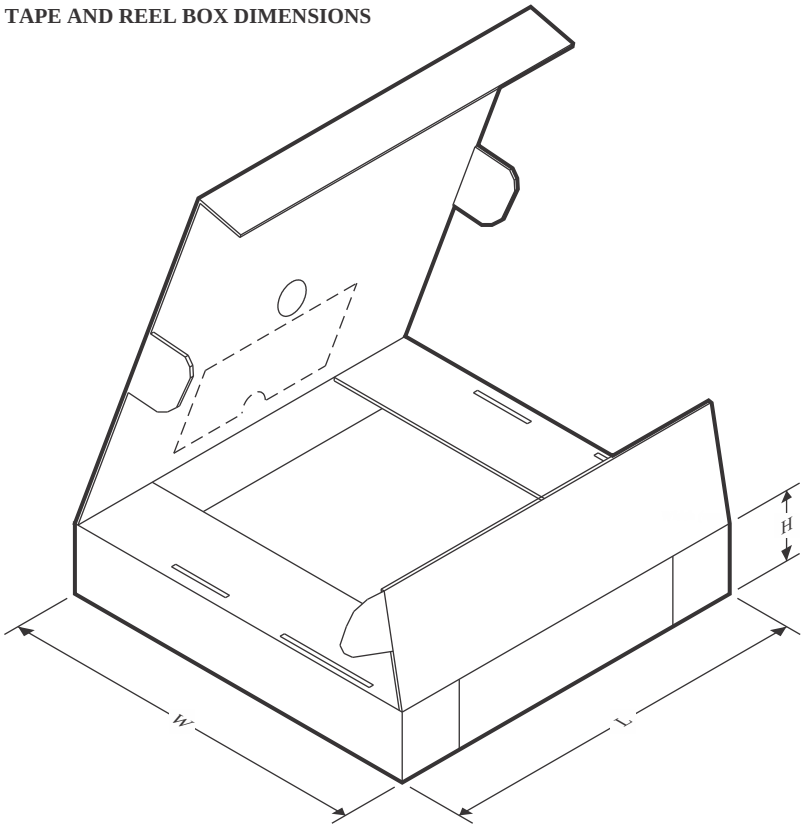
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
DS25BR204TSQ/NOPB	WQFN	RTA	40	250	178.0	16.4	6.3	6.3	1.5	12.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

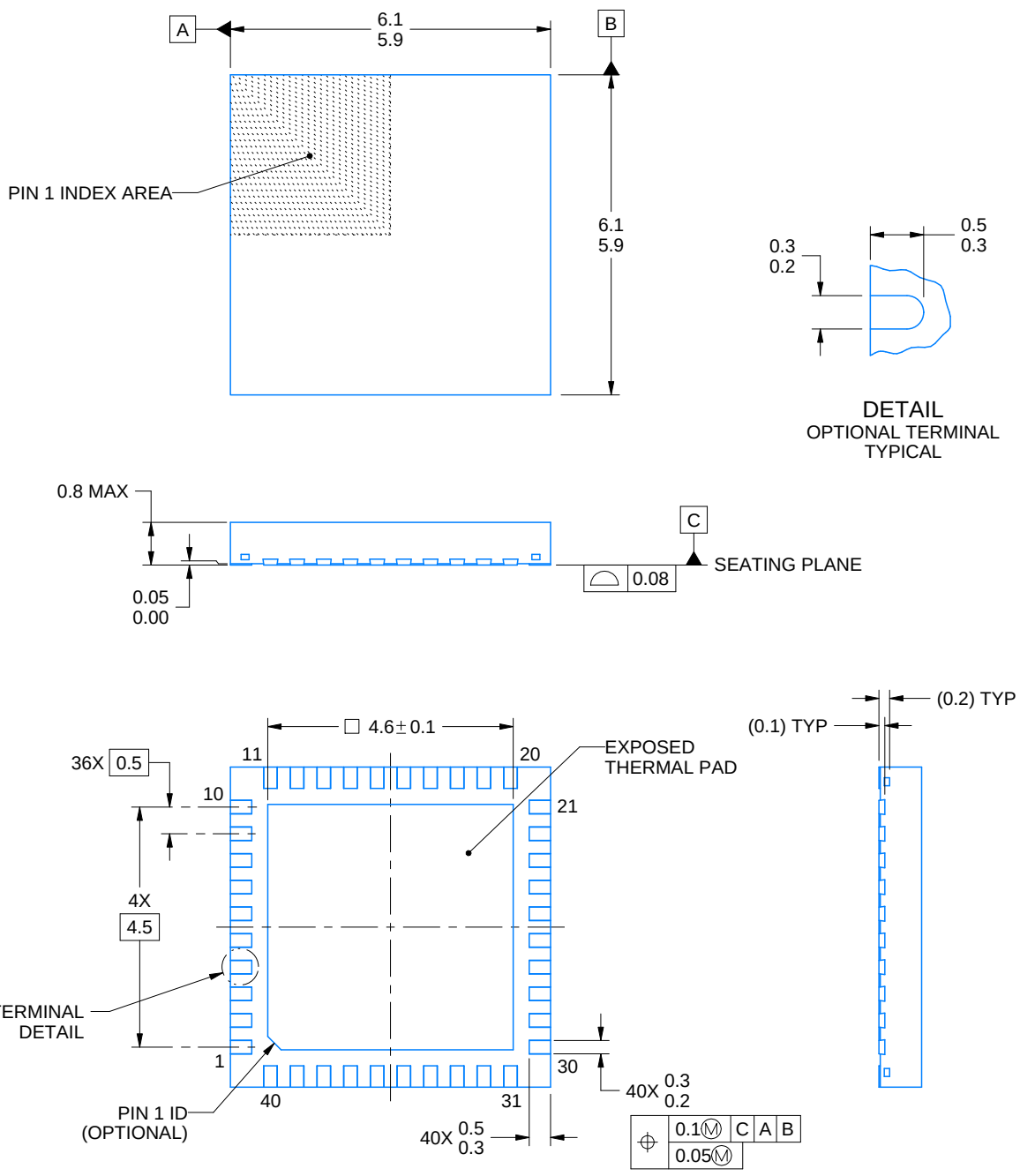
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DS25BR204TSQ/NOPB	WQFN	RTA	40	250	208.0	191.0	35.0

PACKAGE OUTLINE

RTA0040A

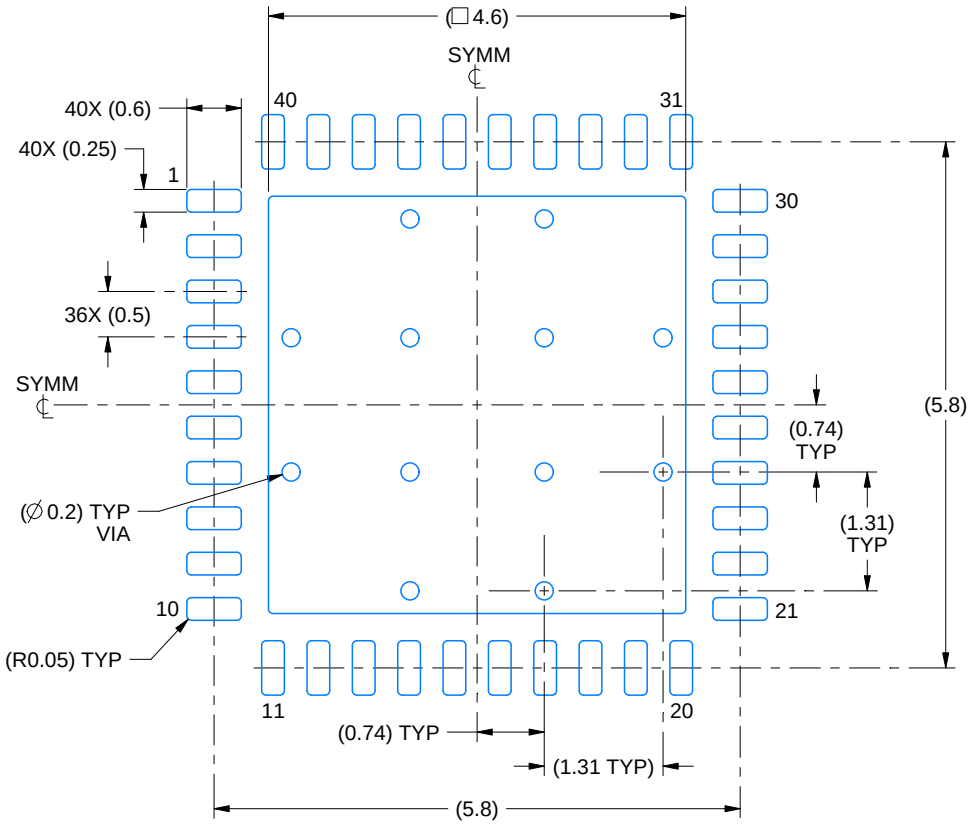
WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD

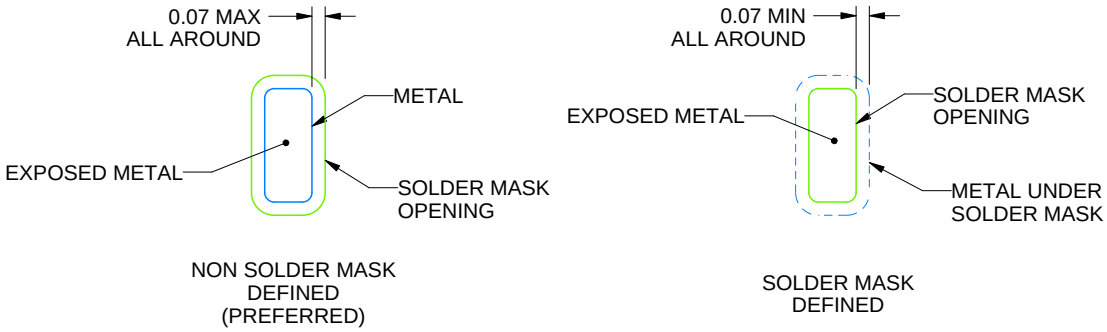


NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:12X



SOLDER MASK DETAILS

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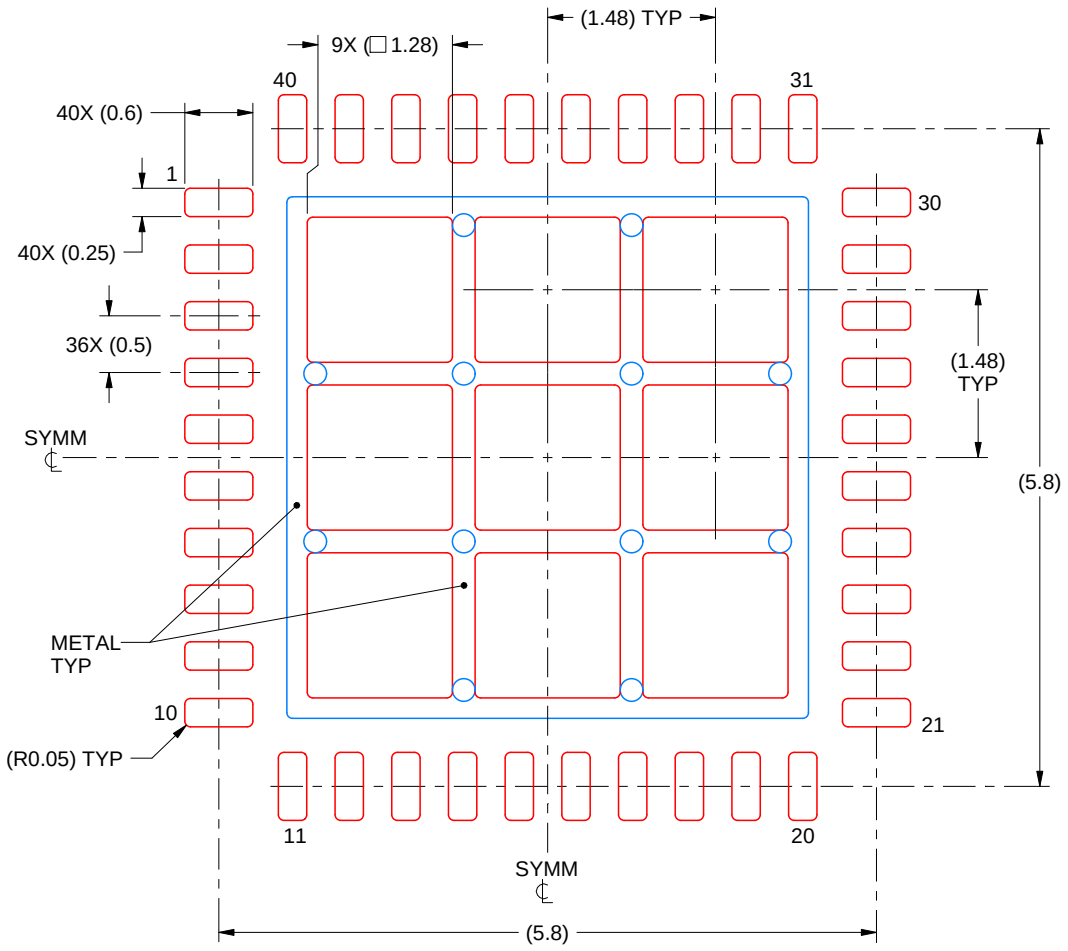
NOTES: (continued)

4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD
70% PRINTED SOLDER COVERAGE BY AREA
SCALE:15X

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NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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