DS08MB200 Dual 800 Mbps 2:1/1:2 LVDS Mux/Buffer

Check for Samples: DS08MB200

FEATURES

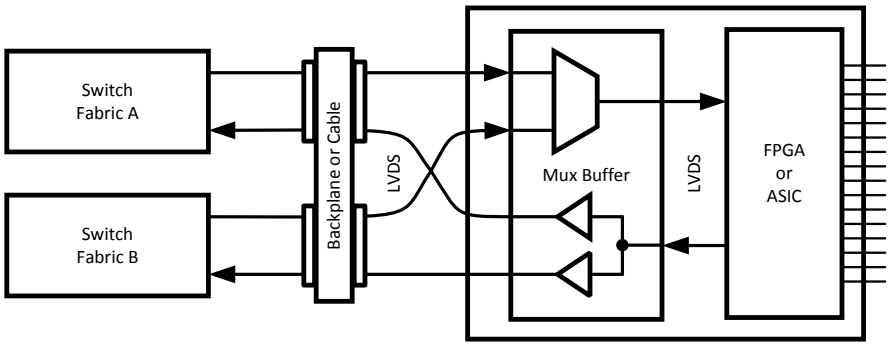
- **Up to 800 Mbps Data Rate per Channel**
- **LVDS/BLVDS/CML/LVPECL Compatible Inputs, LVDS Compatible Outputs**
- **Low Output Skew and Jitter**
- **On-Chip 100Ω Input Termination**
- **15 kV ESD Protection on LVDS Inputs/Outputs**
- **Hot Plug Protection**
- **Single 3.3V Supply**
- **Industrial -40 to +85°C Temperature Range**
- **48-pin WQFN Package**

DESCRIPTION

The DS08MB200 is a dual-port 1 to 2 repeater/buffer and 2 to 1 multiplexer. High-speed data paths and flow-through pinout minimize internal device jitter and simplify board layout. The differential inputs and outputs interface to LVDS or Bus LVDS signals such as those on TI's 10-, 16-, and 18- bit Bus LVDS SerDes, or to CML or LVPECL signals.

The 3.3V supply, CMOS process, and robust I/O ensure high performance at low power over the entire industrial -40 to +85°C temperature range.

Typical Application



Block Diagram

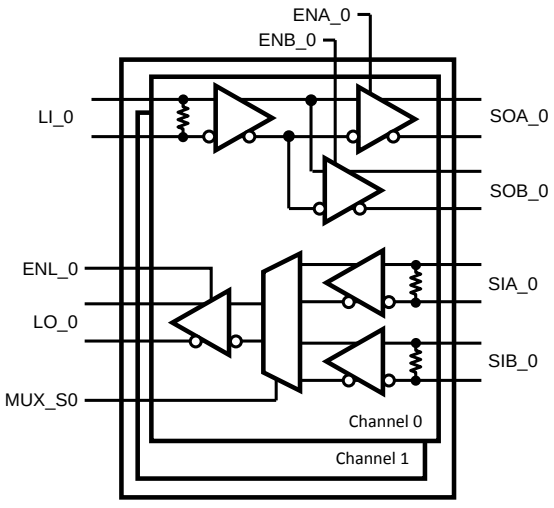


Figure 1. DS08MB200 Block Diagram

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PIN DESCRIPTIONS

Pin Name	WQFN Pin Number	I/O, Type	Description
SWITCH SIDE DIFFERENTIAL INPUTS			
SIA_0+ SIA_0−	30 29	I, LVDS	Switch A-side Channel 0 inverting and non-inverting differential inputs. LVDS, Bus LVDS, CML, or LVPECL compatible.
SIA_1+ SIA_1−	19 20	I, LVDS	Switch A-side Channel 1 inverting and non-inverting differential inputs. LVDS, Bus LVDS, CML, or LVPECL compatible.
SIB_0+ SIB_0−	28 27	I, LVDS	Switch B-side Channel 0 inverting and non-inverting differential inputs. LVDS, Bus LVDS, CML, or LVPECL compatible.
SIB_1+ SIB_1−	21 22	I, LVDS	Switch B-side Channel 1 inverting and non-inverting differential inputs. LVDS, Bus LVDS, CML, or LVPECL compatible.
LINE SIDE DIFFERENTIAL INPUTS			
LI_0+ LI_0−	40 39	I, LVDS	Line-side Channel 0 inverting and non-inverting differential inputs. LVDS, Bus LVDS, CML, or LVPECL compatible.
LI_1+ LI_1−	9 10	I, LVDS	Line-side Channel 1 inverting and non-inverting differential inputs. LVDS, Bus LVDS, CML, or LVPECL compatible.
SWITCH SIDE DIFFERENTIAL OUTPUTS			
SOA_0+ SOA_0−	34 33	O, LVDS	Switch A-side Channel 0 inverting and non-inverting differential outputs. LVDS compatible(1)(2).
SOA_1+ SOA_1−	15 16	O, LVDS	Switch A-side Channel 1 inverting and non-inverting differential outputs. LVDS compatible(1)(2).
SOB_0+ SOB_0−	32 31	O, LVDS	Switch B-side Channel 0 inverting and non-inverting differential outputs. LVDS compatible(1)(2).
SOB_1+ SOB_1−	17 18	O, LVDS	Switch B-side Channel 1 inverting and non-inverting differential outputs. LVDS compatible(1)(2).
LINE SIDE DIFFERENTIAL OUTPUTS			
LO_0+ LO_0−	42 41	O, LVDS	Line-side Channel 0 inverting and non-inverting differential outputs. LVDS compatible(1)(2).
LO_1+ LO_1−	7 8	O, LVDS	Line-side Channel 1 inverting and non-inverting differential outputs. LVDS compatible(1)(2).
DIGITAL CONTROL INTERFACE			
MUX_S0 MUX_S1	38 11	I, LVTTL	Mux Select Control Inputs (per channel) to select which Switch-side input, A or B, is passed through to the Line-side.
ENA_0 ENA_1 ENB_0 ENB_1	36 13 35 14	I, LVTTL	Output Enable Control for Switch A-side and B-side outputs. Each output driver on the A-side and B-side has a separate enable pin.
ENL_0 ENL_1	45 4	I, LVTTL	Output Enable Control for The Line-side outputs. Each output driver on the Line-side has a separate enable pin.
POWER			
V_{DD}	6, 12, 37, 43, 48	I, Power	V_{DD} = 3.3V ±0.3V.
GND	2, 3, 46, 47(3)	I, Power	Ground reference for LVDS and CMOS circuitry. For the WQFN package, the DAP is used as the primary GND connection to the device. The DAP is the exposed metal contact at the bottom of the WQFN-48 package. It should be connected to the ground plane with at least 4 vias for optimal AC and thermal performance.
N/C	1, 5, 23, 24, 25, 26, 44		No Connect

(1) For interfacing LVDS outputs to CML or LVPECL compatible inputs, refer to the APPLICATIONS section of this datasheet.
(2) The LVDS outputs do not support a multidrop (BLVDS) environment. The LVDS output characteristics of the DS08MB200 device have been optimized for point-to-point backplane and cable applications.
(3) Note that the DAP on the backside of the WQFN package is the primary GND connection for the device when using the WQFN package.

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Connection Diagrams

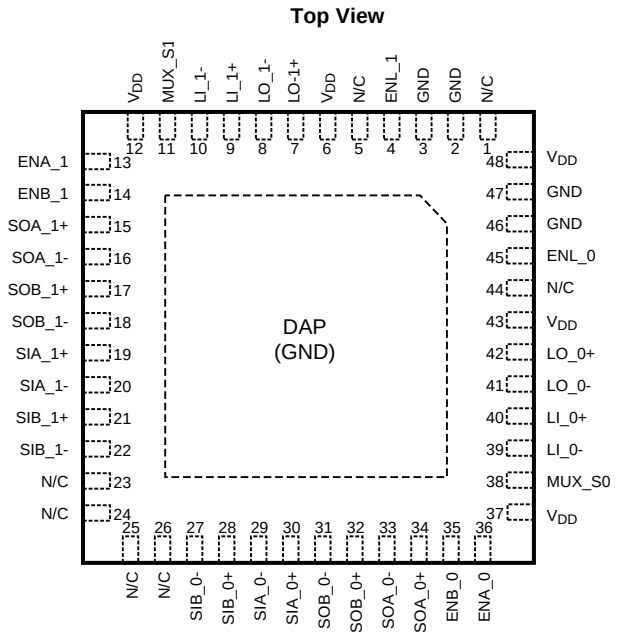


Figure 2. WQFN Package
See Package Number RHS0048A
DAP = GND

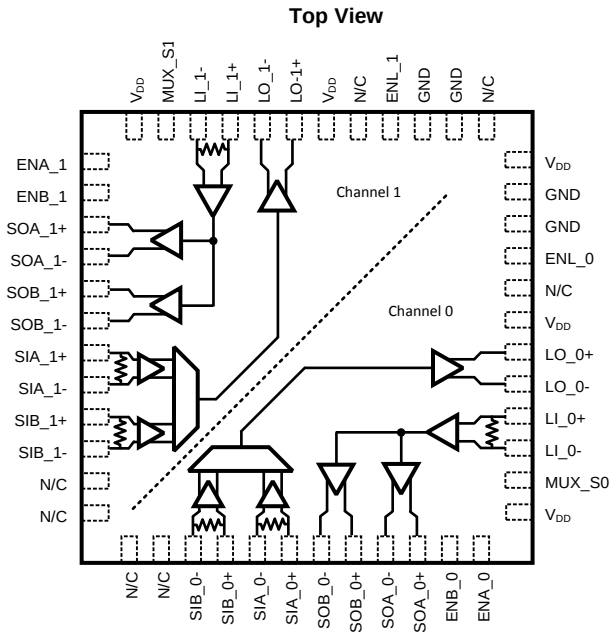


Figure 3. Directional Signal Paths
(Refer to pin names for signal polarity)

TRI-STATE and Powerdown Modes

The DS08MB200 has output enable control on each of the six onboard LVDS output drivers. This control allows each output individually to be placed in a low power TRI-STATE mode while the device remains active, and is useful to reduce power consumption on unused channels. In TRI-STATE mode, some outputs may remain active while some are in TRI-STATE.

When all six of the output enables (all drivers on both channels) are deasserted (LOW), then the device enters a Powerdown mode that consumes only 0.5mA (typical) of supply current. In this mode, the entire device is essentially powered off, including all receiver inputs, output drivers and internal bandgap reference generators. When returning to active mode from Powerdown mode, there is a delay until valid data is presented at the outputs because of the ramp to power up the internal bandgap reference generators.

Any single output enable that remains active will hold the device in active mode even if the other five outputs are in TRI-STATE.

When in Powerdown mode, any output enable that becomes active will wake up the device back into active mode, even if the other five outputs are in TRI-STATE.

Input Failsafe Biasing

External pull up and pull down resistors may be used to provide enough of an offset to enable an input failsafe under open-circuit conditions. This configuration ties the positive LVDS input pin to VDD thru a pull up resistor and the negative LVDS input pin is tied to GND by a pull down resistor. The pull up and pull down resistors should be in the 5kΩ to 15kΩ range to minimize loading and waveform distortion to the driver. Please refer to application note SNLA051B AN-1194, “Failsafe Biasing of LVDS Interfaces” for more information.

Output Characteristics

The output characteristics of the DS08MB200 have been optimized for point-to-point backplane and cable applications, and are not intended for multipoint or multidrop signaling.

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MULTIPLEXER TRUTH TABLE(1)(2)

Data Inputs		Control Inputs		Output
SIA_0	SIB_0	MUX_S0	ENL_0	LO_0
X	valid	0	1	SIB_0
valid	X	1	1	SIA_0
X	X	X	0 (3)	Z

(1) Same functionality for channel 1
(2) X = Don't Care
Z = High Impedance (TRI-STATE)
(3) When all enable inputs from both channels are Low, the device enters a powerdown mode. Refer to the TRI-STATE and Powerdown Modes section.

REPEATER/BUFFER TRUTH TABLE(1)(2)

Data Input	Control Inputs		Outputs	
LI_0	ENA_0	ENB_0	SOA_0	SOB_0
X	0	0	Z (3)	Z (3)
valid	0	1	Z	LI_0
valid	1	0	LI_0	Z
valid	1	1	LI_0	LI_0

(1) Same functionality for channel 1
(2) X = Don't Care
Z = High Impedance (TRI-STATE)
(3) When all enable inputs from both channels are Low, the device enters a powerdown mode. Refer to the TRI-STATE and Powerdown Modes section.



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)

Supply Voltage (V_{DD})		−0.3V to +4.0V
CMOS Input Voltage		-0.3V to (V_{DD}+0.3V)
LVDS Receiver Input Voltage(2)		-0.3V to (V_{DD}+0.3V)
LVDS Driver Output Voltage		-0.3V to (V_{DD}+0.3V)
LVDS Output Short Circuit Current		+40 mA
Junction Temperature		+150°C
Storage Temperature		−65°C to +150°C
Lead Temperature (Solder, 4sec)		260°C
Max Pkg Power Capacity @ 25°C		5.2W
Thermal Resistance (θ_{JA})		24°C/W
Package Derating above +25°C		41.7mW/°C
ESD Last Passing Voltage	HBM, 1.5kΩ, 100pF	8kV
	LVDS pins to GND only	15kV
	EIAJ, 0Ω, 200pF	250V
	CDM	1000V

(1) Absolute maximum ratings are those values beyond which damage to the device may occur. Texas Instruments does not recommend operation of products outside of recommended operation conditions.
(2) V_{ID} max < 2.4V

RECOMMENDED OPERATING CONDITIONS

Supply Voltage (V_{CC})		3.0V to 3.6V
Input Voltage (V_I)(1)		0V to V_{CC}
Output Voltage (V_O)		0V to V_{CC}
Operating Temperature (T_A)	Industrial	−40°C to +85°C

(1) V_{ID} max < 2.4V

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ELECTRICAL CHARACTERISTICS

Over recommended operating supply and temperature ranges unless other specified.

Symbol	Parameter	Conditions	Min	Typ[1]	Max	Units
LVTTL DC SPECIFICATIONS (MUX_Sn, ENA_n, ENB_n, ENL_n)						
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	$V_{IN} = V_{DD} = V_{DDMAX}$	−10		+10	µA
I_{IL}	Low Level Input Current	$V_{IN} = V_{SS}$, $V_{DD} = V_{DDMAX}$	−10		+10	µA
C_{IN1}	Input Capacitance	Any Digital Input Pin to V_{SS}		3.5		pF
C_{OUT1}	Output Capacitance	Any Digital Output Pin to V_{SS}		5.5		pF
V_{CL}	Input Clamp Voltage	I_{CL} = −18 mA	−1.5	−0.8		V
LVDS INPUT DC SPECIFICATIONS (SIA±, SIB±, LI±)						
V_{TH}	Differential Input High Threshold[2]	V_{CM} = 0.8V or 1.2V or 3.55V, V_{DD} = 3.6V		0	100	mV
V_{TL}	Differential Input Low Threshold[2]	V_{CM} = 0.8V or 1.2V or 3.55V, V_{DD} = 3.6V	−100	0		mV
V_{ID}	Differential Input Voltage	V_{CM} = 0.8V to 3.55V, V_{DD} = 3.6V	100		2400	mV
V_{CMR}	Common Mode Voltage Range	V_{ID} = 150 mV, V_{DD} = 3.6V	0.05		3.55	V
C_{IN2}	Input Capacitance	IN+ or IN− to V_{SS}		3.5		pF
I_{IN}	Input Current	V_{IN} = 3.6V, $V_{DD} = V_{DDMAX}$	−15		+15	µA
		V_{IN} = 0V, $V_{DD} = V_{DDMAX}$	−15		+15	µA
LVDS OUTPUT DC SPECIFICATIONS (SOA_n±, SOB_n±, LO_n±)						
V_{OD}	Differential Output Voltage[2]	R_L is the internal 100Ω between OUT+ and OUT−	250	360	500	mV
ΔV_{OD}	Change in V_{OD} between Complementary States		-35		35	mV
V_{OS}	Offset Voltage[3]		1.05	1.22	1.475	V
ΔV_{OS}	Change in V_{OS} between Complementary States		-35		35	mV
I_{OS}	Output Short Circuit Current	OUT+ or OUT− Short to GND		−21	-40	mA
C_{OUT2}	Output Capacitance	OUT+ or OUT− to GND when TRI-STATE		5.5		pF
SUPPLY CURRENT (Static)						
I_{CC}	Supply Current	All inputs and outputs enabled and active, terminated with differential load of 100Ω between OUT+ and OUT-.		225	275	mA
I_{CCZ}	Supply Current - Powerdown Mode	ENA_0 = ENB_0 = ENL_0= ENA_1 = ENB_1 = ENL_1 = L		0.6	4.0	mA
SWITCHING CHARACTERISTICS—LVDS OUTPUTS						
t_{LHT}	Differential Low to High Transition Time	Use an alternating 1 and 0 pattern at 200 Mb/s, measure between 20% and 80% of V_{OD}.[4]		170	250	ps
t_{HLT}	Differential High to Low Transition Time			170	250	ps
t_{PLHD}	Differential Low to High Propagation Delay	Use an alternating 1 and 0 pattern at 200 Mb/s, measure at 50% V_{OD} between input to output.		1.0	2.5	ns
t_{PHLD}	Differential High to Low Propagation Delay			1.0	2.5	ns
t_{SKD1}	Pulse Skew	$\lvert t_{PLHD} - t_{PHLD} \rvert$[4]		25	75	ps
t_{SKCC}	Output Channel to Channel Skew	Difference in propagation delay (t_{PLHD} or t_{PHLD}) among all output channels.[4]		50	115	ps

(1) Typical parameters are measured at V_{DD} = 3.3V, T_A = 25°C. They are for reference purposes, and are not production-tested.
(2) Differential output voltage V_{OD} is defined as ABS(OUT+–OUT−). Differential input voltage V_{ID} is defined as ABS(IN+–IN−).
(3) Output offset voltage V_{OS} is defined as the average of the LVDS single-ended output voltages at logic high and logic low states.
(4) Not production tested. Ensured by statistical analysis on a sample basis at the time of characterization.

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ELECTRICAL CHARACTERISTICS (continued)

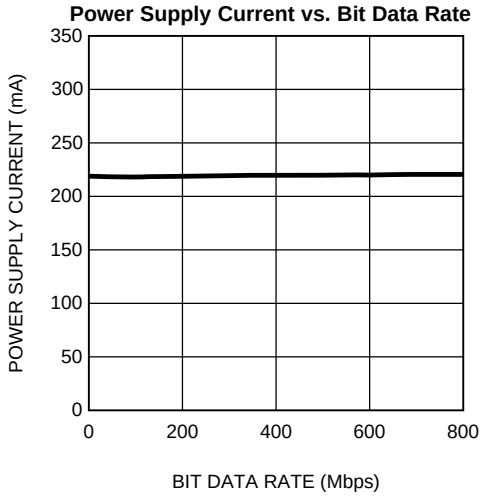
Over recommended operating supply and temperature ranges unless other specified.

Symbol	Parameter	Conditions	Min	Typ(1)	Max	Units
t_{JIT}	Jitter(5)	RJ - Alternating 1 and 0 at 400 MHz(6)		1.3	1.5	psrms
		DJ - K28.5 Pattern, 800 Mbps(7)		15	34	psp-p
		TJ - PRBS 2^7-1 Pattern, 800 Mbps(8)		16	34	psp-p
t_{ON}	LVDS Output Enable Time	Time from ENA_n, ENB_n, or ENL_n to OUT± change from TRI-STATE to active.		0.5	1.5	µs
t_{ON2}	LVDS Output Enable time from powerdown mode	Time from ENA_n, ENB_n, or ENL_n to OUT± change from Powerdown to active		10	20	µs
t_{OFF}	LVDS Output Disable Time	Time from ENA_n, ENB_n, or ENL_n to OUT± change from active to TRI-STATE or powerdown.			12	ns

(5) Jitter is not production tested, but ensured through characterization on a sample basis.
(6) Random Jitter, or RJ, is measured RMS with a histogram including 1500 histogram window hits. The input voltage = V_{ID} = 500mV, 50% duty cycle at 400 MHz, t_r = t_f = 50ps (20% to 80%).
(7) Deterministic Jitter, or D_J, is measured to a histogram mean with a sample size of 350 hits. Stimulus and fixture jitter has been subtracted. The input voltage = V_{ID} = 500mV, K28.5 pattern at 800 Mbps, t_r = t_f = 50ps (20% to 80%). The K28.5 pattern is repeating bit streams of (0011111010 1100000101).
(8) Total Jitter, or T_J, is measured peak to peak with a histogram including 3500 window hits. Stimulus and fixture jitter has been subtracted. The input voltage = V_{ID} = 500mV, 2^{7-1} PRBS pattern at 800 Mbps, t_r = t_f = 50ps (20% to 80%).

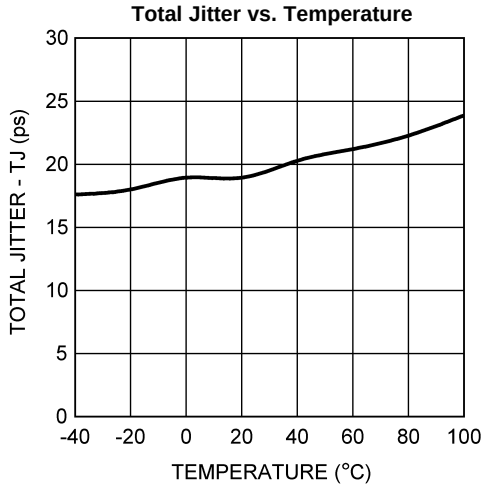
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TYPICAL PERFORMANCE CHARACTERISTICS



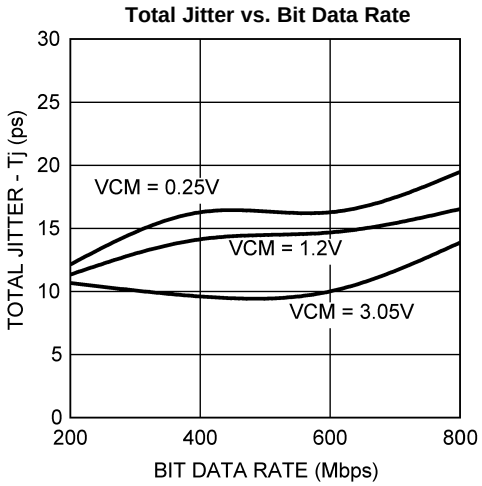
Dynamic power supply current was measured with all channels active and toggling at the bit data rate. Data pattern has no effect on the power consumption. V_{DD} = 3.3V, T_A = +25°C, V_{ID} = 0.5V, V_{CM} = 1.2V.

Figure 4.



Total Jitter measured at 0V differential while running a PRBS 2^{7-1} pattern with one channel active, all other channels are disabled. V_{DD} = 3.3V, V_{ID} = 0.5V, V_{CM} = 1.2V, 800 Mbps data rate. Stimulus and fixture jitter has been subtracted.

Figure 5.



Total Jitter measured at 0V differential while running a PRBS 2^{7-1} pattern with one channel active, all other channels are disabled. V_{DD} = 3.3V, T_A = +25°C, V_{ID} = 0.5V. Stimulus and fixture jitter has been subtracted.

Figure 6.

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APPLICATIONS

Interfacing LVPECL to LVDS

An LVPECL driver consists of a differential pair with coupled emitters connected to GND via a current source. This drives a pair of emitter-followers that require a 50 ohm to V_{CC}-2.0 load. A modern LVPECL driver will typically include the termination scheme within the device for the emitter follower. If the driver does not include the load, then an external scheme must be used. The 1.3 V supply is usually not readily available on a PCB, therefore, a load scheme without a unique power supply requirement may be used.

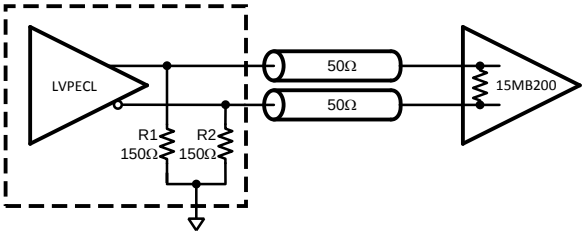


Figure 7. DC Coupled LVPECL to LVDS Interface

Figure 7 is a separated π termination scheme for a 3.3 V LVPECL driver. R1 and R2 provides proper DC load for the driver emitter followers, and may be included as part of the driver device. The DS08MB200 includes a 100 ohm input termination for the transmission line. The common mode voltage will be at the normal LVPECL levels – around 2 V. This scheme works well with LVDS receivers that have rail-to-rail common mode voltage, V_{CM}, range. Most Texas Instruments LVDS receivers have wide V_{CM} range. The exceptions are noted in devices' respective datasheets. Those LVDS devices that do have a wide V_{CM} range do not vary in performance significantly when receiving a signal with a common mode other than standard LVDS V_{CM} of 1.2 V.

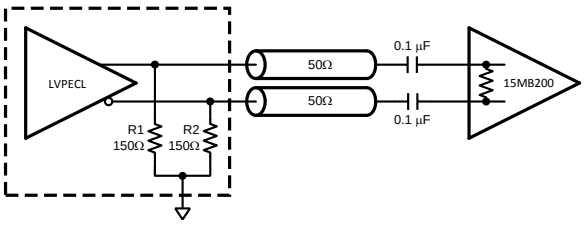


Figure 8. AC Coupled LVPECL to LVDS Interface

An AC coupled interface is preferred when transmitter and receiver ground references differ more than 1 V. This is a likely scenario when transmitter and receiver devices are on separate PCBs. Figure 8 illustrates an AC coupled interface between a LVPECL driver and LVDS receiver. R1 and R2, if not present in the driver device, provide DC load for the emitter followers and may range between 140-220 ohms for most LVPECL devices for this particular configuration. The DS08MB200 includes an internal 100 ohm resistor to terminate the transmission line for minimal reflections. The signal after ac coupling capacitors will swing around a level set by internal biasing resistors (i.e. fail-safe) which is either V_{DD}/2 or 0 V depending on the actual failsafe implementation. If internal biasing is not implemented, the signal common mode voltage will slowly wander to GND level.

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Interfacing LVDS to LVPECL

An LVDS driver consists of a current source (nominal 3.5mA) which drives a CMOS differential pair. It needs a differential resistive load in the range of 70 to 130 ohms to generate LVDS levels. In a system, the load should be selected to match transmission line characteristic differential impedance so that the line is properly terminated. The termination resistor should be placed as close to the receiver inputs as possible. When interfacing an LVDS driver with a non-LVDS receiver, one only needs to bias the LVDS signal so that it is within the common mode range of the receiver. This may be done by using separate biasing voltage which demands another power supply. Some receivers have required biasing voltage available on-chip (V_T, V_{TT} or V_{BB}).

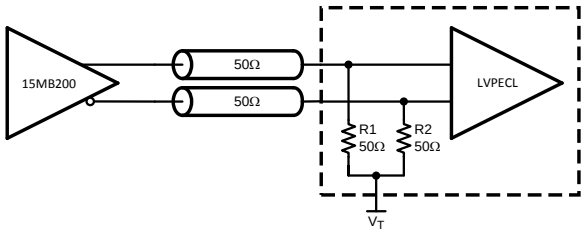


Figure 9. DC Coupled LVDS to LVPECL Interface

Figure 9 illustrates interface between an LVDS driver and a LVPECL with a V_T pin available. R1 and R2, if not present in the receiver, provide proper resistive load for the driver and termination for the transmission line, and V_T sets desired bias for the receiver.

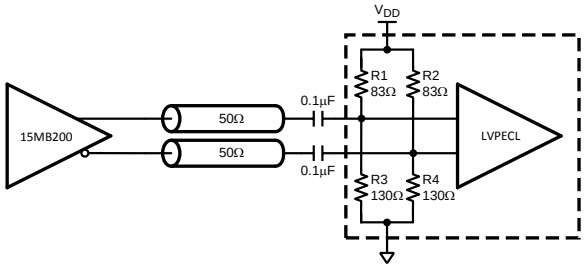


Figure 10. AC Coupled LVDS to LVPECL Interface

Figure 10 illustrates AC coupled interface between an LVDS driver and LVPECL receiver without a V_T pin available. The resistors R1, R2, R3, and R4, if not present in the receiver, provide a load for the driver, terminate the transmission line, and bias the signal for the receiver.

The bias networks shown above for LVPECL drivers and receivers may or may not be present within the driver device. The LVPECL driver and receiver specification must be reviewed closely to ensure compatibility between the driver and receiver terminations and common mode operating ranges.

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PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
DS08MB200TSQ/NOPB	ACTIVE	WQFN	RHS	48	250	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	-40 to 85	08MB200	Samples
DS08MB200TSQX/NOPB	ACTIVE	WQFN	RHS	48	2500	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	-40 to 85	08MB200	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) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

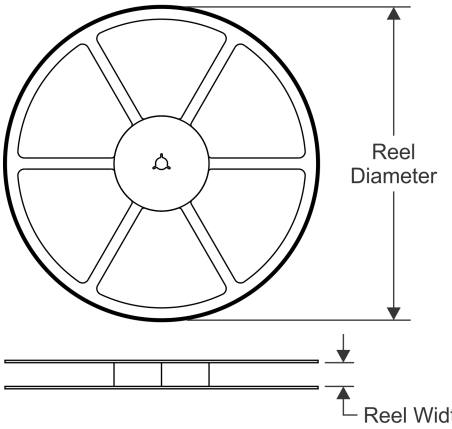
(4) Only one of markings shown within the brackets will appear on the physical device.

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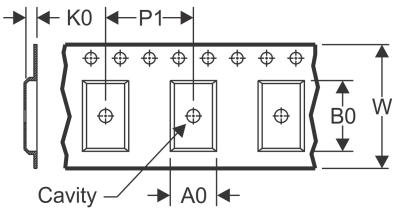
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TAPE AND REEL INFORMATION

REEL DIMENSIONS

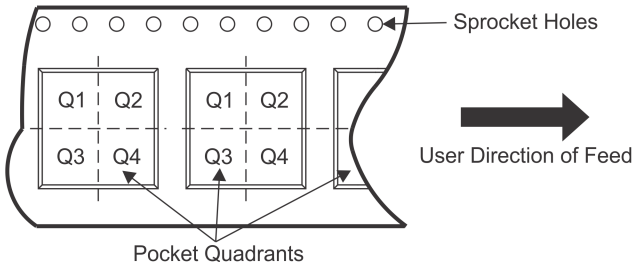


TAPE DIMENSIONS



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

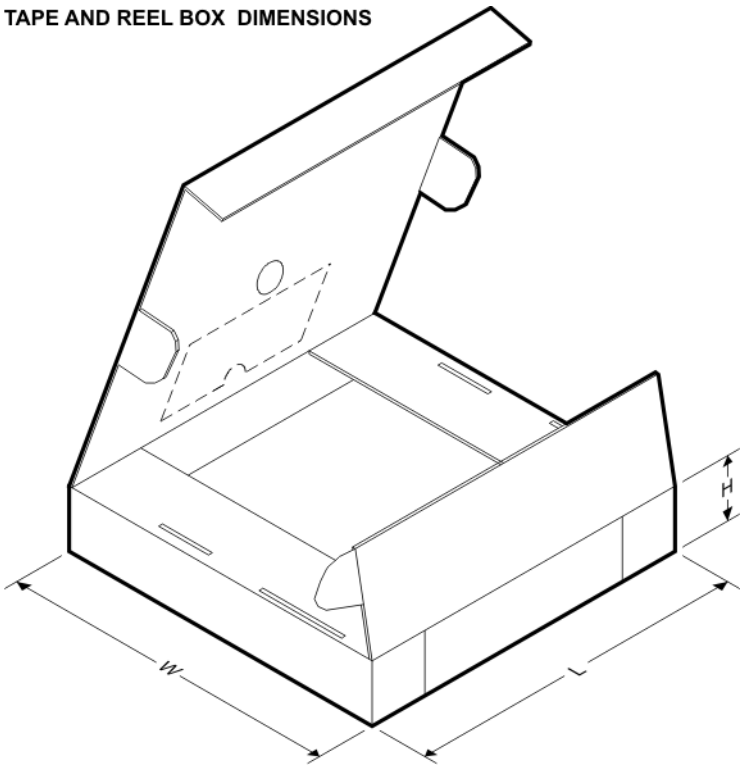
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
DS08MB200TSQ/NOPB	WQFN	RHS	48	250	178.0	16.4	7.3	7.3	1.3	12.0	16.0	Q1
DS08MB200TSQX/NOPB	WQFN	RHS	48	2500	330.0	16.4	7.3	7.3	1.3	12.0	16.0	Q1

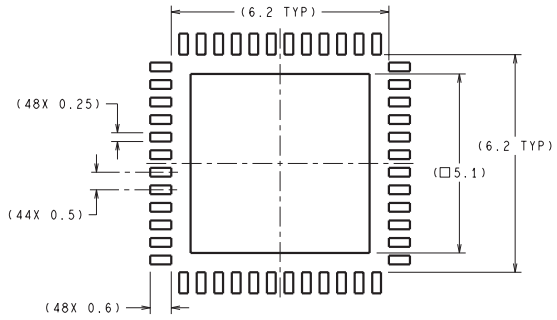
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

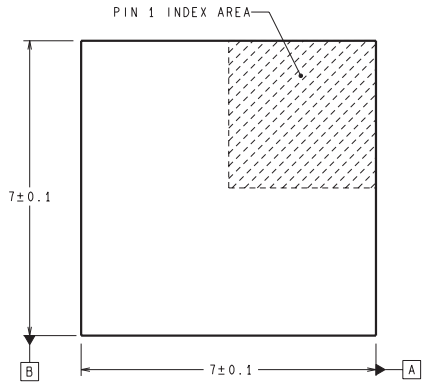
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DS08MB200TSQ/NOPB	WQFN	RHS	48	250	213.0	191.0	55.0
DS08MB200TSQX/NOPB	WQFN	RHS	48	2500	367.0	367.0	38.0

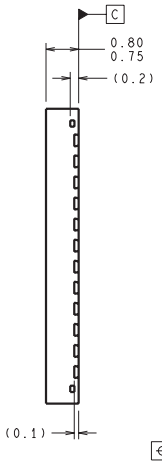
RHS0048A

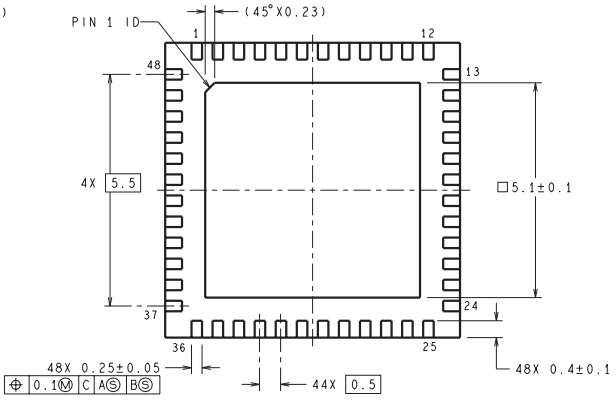


RECOMMENDED LAND PATTERN

DIMENSIONS ARE IN MILLIMETERS
DIMENSIONS IN ( ) FOR REFERENCE ONLY







SQA48A (Rev B)

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