

## DS91D176/DS91C176 100 MHz Single Channel M-LVDS Transceivers

Check for Samples: [DS91C176](#), [DS91D176](#)

### FEATURES

- DC to 100+ MHz / 200+ Mbps Low Power, Low EMI Operation
- Optimal for ATCA, uTCA Clock Distribution Networks
- Meets or Exceeds TIA/EIA-899 M-LVDS Standard
- Wide Input Common Mode Voltage for Increased Noise Immunity
- DS91D176 has Type 1 Receiver Input
- DS91C176 has Type 2 Receiver with Fail-safe
- Industrial Temperature Range
- Space Saving SOIC-8 Package

### DESCRIPTION

The DS91C176 and DS91D176 are 100 MHz single channel M-LVDS (Multipoint Low Voltage Differential Signaling) transceivers designed for applications that utilize multipoint networks (e.g. clock distribution in ATCA and uTCA based systems). M-LVDS is a new bus interface standard (TIA/EIA-899) optimized for multidrop networks. Controlled edge rates, tight input receiver thresholds and increased drive strength are some of the key enhancements that make M-LVDS devices an ideal choice for distributing signals via multipoint networks.

The DS91C176/DS91D176 are half-duplex transceivers that accept LVTTTL/LVCMOS signals at the driver inputs and convert them to differential M-LVDS signals. The receiver inputs accept low voltage differential signals (LVDS, B-LVDS, M-LVDS, LV-PECL and CML) and convert them to 3V LVCMOS signals. The DS91D176 has a M-LVDS type 1 receiver input with no offset. The DS91C176 has an M-LVDS type 2 receiver which enable failsafe functionality.

### Typical Application in an ATCA Clock Distribution Network

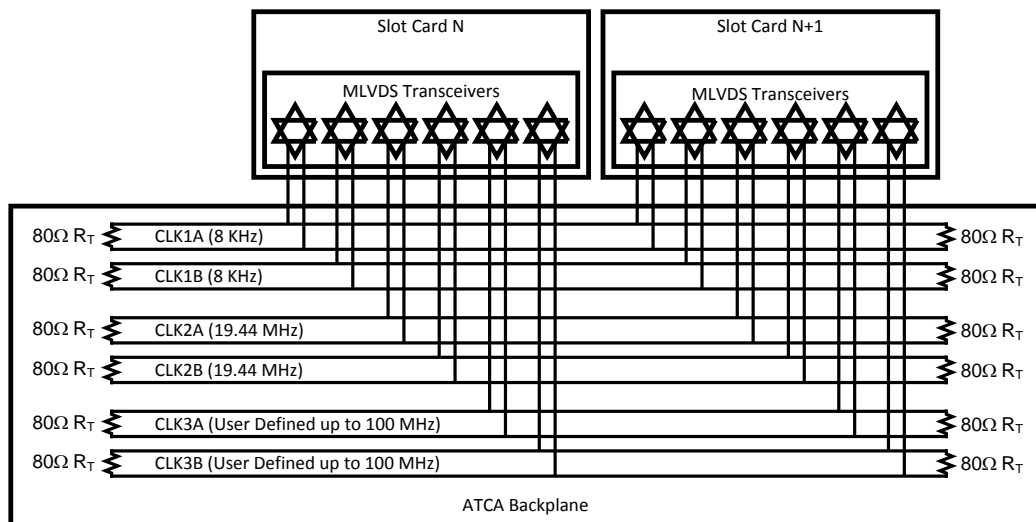


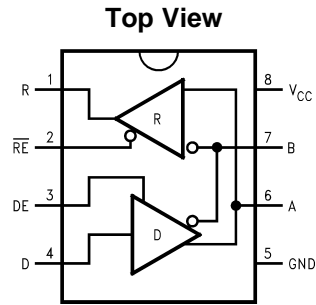
Figure 1. System Diagram



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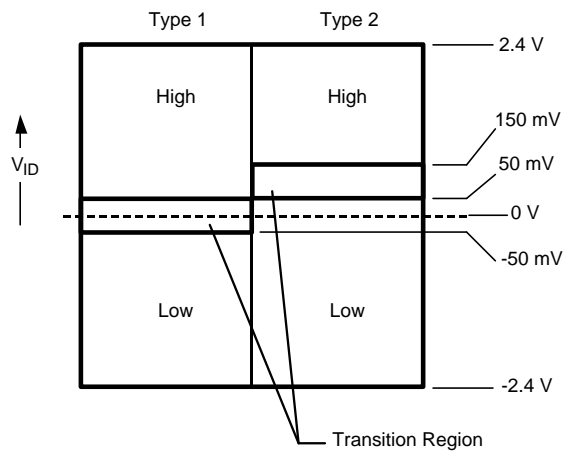
**Connection and Logic Diagram**



**Figure 2. SOIC Package**  
See Package Number D0008A

**M-LVDS Receiver Types**

The EIA/TIA-899 M-LVDS standard specifies two different types of receiver input stages. A type 1 receiver has a conventional threshold that is centered at the midpoint of the input amplitude,  $V_{ID}/2$ . A type 2 receiver has a built in offset that is 100mV greater than  $V_{ID}/2$ . The type 2 receiver offset acts as a failsafe circuit where open or short circuits at the input will always result in the output stage being driven to a low logic state.



**Figure 3. M-LVDS Receiver Input Thresholds**



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** <sup>(1)(2)</sup>

Supply Voltage, $V_{CC}$	-0.3V to +4V
Control Input Voltages	-0.3V to ( $V_{CC} + 0.3V$ )
Driver Input Voltage	-0.3V to ( $V_{CC} + 0.3V$ )
Driver Output Voltages	-1.8V to +4.1V
Receiver Input Voltages	-1.8V to +4.1V
Receiver Output Voltage	-0.3V to ( $V_{CC} + 0.3V$ )
Maximum Package Power Dissipation at +25°C	
SOIC Package	833 mW
Derate SOIC Package	6.67 mW/°C above +25°C
Thermal Resistance (4-Layer, 2 oz. Cu, JEDEC)	
$\theta_{JA}$	150°C/W
$\theta_{JC}$	63°C/W
Maximum Junction Temperature	150°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 4 seconds)	260°C
ESD Ratings: (HBM 1.5k $\Omega$ , 100pF)	
	≥ 8 kV
(EIAJ 0 $\Omega$ , 200pF)	
	≥ 250 V
(CDM 0 $\Omega$ , 0pF)	
	≥ 1000 V

- (1) "Absolute Maximum Ratings" are those beyond which the safety of the device cannot be verified. They are not meant to imply that the device should be operated at these limits. The tables of "Electrical Characteristics" provide conditions for actual device operation.
- (2) If Military/Aerospace specified devices are required, please contact the TI Sales Office/Distributors for availability and specifications.

**Recommended Operating Conditions**

	Min	Typ	Max	Units
Supply Voltage, $V_{CC}$	3.0	3.3	3.6	V
Voltage at Any Bus Terminal (Separate or Common-Mode)	-1.4		+3.8	V
Differential Input Voltage $V_{ID}$			2.4	V
LVTTL Input Voltage High $V_{IH}$	2.0		$V_{CC}$	V
LVTTL Input Voltage Low $V_{IL}$	0		0.8	V
Operating Free Air Temperature $T_A$	-40	+25	+85	°C

**Electrical Characteristics**

 Over recommended operating supply and temperature ranges unless otherwise specified. <sup>(1) (2) (3) (4)</sup>

Parameter		Test Conditions	Min	Typ	Max	Units
<b>M-LVDS Driver</b>						
$ V_{AB} $	Differential output voltage magnitude	$R_L = 50\Omega$ , $C_L = 5pF$ See <a href="#">Figure 4</a> and <a href="#">Figure 6</a>	480		650	mV
$\Delta V_{AB}$	Change in differential output voltage magnitude between logic states		-50	0	+50	mV
$V_{OS(SS)}$	Steady-state common-mode output voltage	$R_L = 50\Omega$ , $C_L = 5pF$ See <a href="#">Figure 4</a> and <a href="#">Figure 5</a> ( $V_{OS(PP)}$ @ 500KHz clock)	0.3	1.8	2.1	V
$ \Delta V_{OS(SS)} $	Change in steady-state common-mode output voltage between logic states		0		+50	mV
$V_{OS(PP)}$	Peak-to-peak common-mode output voltage			135		mV
$V_{A(OC)}$	Maximum steady-state open-circuit output voltage	See <a href="#">Figure 7</a>	0		2.4	V
$V_{B(OC)}$	Maximum steady-state open-circuit output voltage		0		2.4	V

- (1) All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to device ground unless otherwise specified.
- (2) All typicals are given for  $V_{CC} = 3.3V$  and  $T_A = 25^\circ C$ .
- (3) The algebraic convention, in which the least positive (most negative) limit is designated as minimum, is used in this datasheet.
- (4)  $C_L$  includes fixture capacitance and  $C_D$  includes probe capacitance.

## Electrical Characteristics (continued)

Over recommended operating supply and temperature ranges unless otherwise specified. <sup>(1)</sup> <sup>(2)</sup> <sup>(3)</sup> <sup>(4)</sup>

Parameter		Test Conditions	Min	Typ	Max	Units	
V <sub>P(H)</sub>	Voltage overshoot, low-to-high level output	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, C <sub>D</sub> = 0.5pF			1.2V <sub>SS</sub>	V	
V <sub>P(L)</sub>	Voltage overshoot, high-to-low level output	See Figure 9 and Figure 10 <sup>(5)</sup>	-0.2V <sub>SS</sub>			V	
I <sub>IH</sub>	High-level input current (LVTTTL inputs)	V <sub>IH</sub> = 2.0V	-15		15	μA	
I <sub>IL</sub>	Low-level input current (LVTTTL inputs)	V <sub>IL</sub> = 0.8V	-15		15	μA	
V <sub>IKL</sub>	Input Clamp Voltage (LVTTTL inputs)	I <sub>IN</sub> = -18mA	-1.5			V	
I <sub>OS</sub>	Differential short-circuit output current	See Figure 8	-43		43	mA	
<b>M-LVDS Receiver</b>							
V <sub>IT+</sub>	Positive-going differential input voltage threshold	See FUNCTION TABLES	Type 1		20	50	mV
			Type 2		94	150	mV
V <sub>IT-</sub>	Negative-going differential input voltage threshold	See FUNCTION TABLES	Type 1	-50	20		mV
			Type 2	50	94		mV
V <sub>OH</sub>	High-level output voltage (LVTTTL output)	I <sub>OH</sub> = -8mA	2.4	2.7		V	
V <sub>OL</sub>	Low-level output voltage (LVTTTL output)	I <sub>OL</sub> = 8mA		0.28	0.4	V	
I <sub>OZ</sub>	TRI-STATE output current	V <sub>O</sub> = 0V or 3.6V	-10		10	μA	
I <sub>OSR</sub>	Short-circuit receiver output current (LVTTTL output)	V <sub>O</sub> = 0V		-48	-90	mA	
<b>M-LVDS Bus (Input and Output) Pins</b>							
I <sub>A</sub>	Transceiver input/output current	V <sub>A</sub> = 3.8V, V <sub>B</sub> = 1.2V			32	μA	
		V <sub>A</sub> = 0V or 2.4V, V <sub>B</sub> = 1.2V	-20		+20	μA	
		V <sub>A</sub> = -1.4V, V <sub>B</sub> = 1.2V	-32			μA	
I <sub>B</sub>	Transceiver input/output current	V <sub>B</sub> = 3.8V, V <sub>A</sub> = 1.2V			32	μA	
		V <sub>B</sub> = 0V or 2.4V, V <sub>A</sub> = 1.2V	-20		+20	μA	
		V <sub>B</sub> = -1.4V, V <sub>A</sub> = 1.2V	-32			μA	
I <sub>AB</sub>	Transceiver input/output differential current (I <sub>A</sub> - I <sub>B</sub> )	V <sub>A</sub> = V <sub>B</sub> , -1.4V ≤ V ≤ 3.8V	-4		+4	μA	
I <sub>A(OFF)</sub>	Transceiver input/output power-off current	V <sub>A</sub> = 3.8V, V <sub>B</sub> = 1.2V, DE = V <sub>CC</sub> 0V ≤ V <sub>CC</sub> ≤ 1.5V			32	μA	
		V <sub>A</sub> = 0V or 2.4V, V <sub>B</sub> = 1.2V, DE = V <sub>CC</sub> 0V ≤ V <sub>CC</sub> ≤ 1.5V	-20		+20	μA	
		V <sub>A</sub> = -1.4V, V <sub>B</sub> = 1.2V, DE = V <sub>CC</sub> 0V ≤ V <sub>CC</sub> ≤ 1.5V	-32			μA	
I <sub>B(OFF)</sub>	Transceiver input/output power-off current	V <sub>B</sub> = 3.8V, V <sub>A</sub> = 1.2V, DE = V <sub>CC</sub> 0V ≤ V <sub>CC</sub> ≤ 1.5V			32	μA	
		V <sub>B</sub> = 0V or 2.4V, V <sub>A</sub> = 1.2V, DE = V <sub>CC</sub> 0V ≤ V <sub>CC</sub> ≤ 1.5V	-20		+20	μA	
		V <sub>B</sub> = -1.4V, V <sub>A</sub> = 1.2V, DE = V <sub>CC</sub> 0V ≤ V <sub>CC</sub> ≤ 1.5V	-32			μA	
I <sub>AB(OFF)</sub>	Transceiver input/output power-off differential current (I <sub>A(OFF)</sub> - I <sub>B(OFF)</sub> )	V <sub>A</sub> = V <sub>B</sub> , -1.4V ≤ V ≤ 3.8V, DE = V <sub>CC</sub> 0V ≤ V <sub>CC</sub> ≤ 1.5V	-4		+4	μA	
C <sub>A</sub>	Transceiver input/output capacitance	V <sub>CC</sub> = OPEN		9		pF	
C <sub>B</sub>	Transceiver input/output capacitance			9		pF	
C <sub>AB</sub>	Transceiver input/output differential capacitance			5.7		pF	
C <sub>A/B</sub>	Transceiver input/output capacitance balance (C <sub>A</sub> /C <sub>B</sub> )			1.0			

(5) Not production tested. Specified by a statistical analysis on a sample basis at the time of characterization.

## Electrical Characteristics (continued)

 Over recommended operating supply and temperature ranges unless otherwise specified. <sup>(1)</sup> <sup>(2)</sup> <sup>(3)</sup> <sup>(4)</sup>

Parameter		Test Conditions	Min	Typ	Max	Units
<b>SUPPLY CURRENT (V<sub>CC</sub>)</b>						
I <sub>CCD</sub>	Driver Supply Current	R <sub>L</sub> = 50Ω, DE = V <sub>CC</sub> , $\overline{RE} = V_{CC}$		20	29.5	mA
I <sub>CCZ</sub>	TRI-STATE Supply Current	DE = GND, $\overline{RE} = V_{CC}$		6	9.0	mA
I <sub>CCR</sub>	Receiver Supply Current	DE = GND, $\overline{RE} = GND$		14	18.5	mA

## Switching Characteristics

 Over recommended operating supply and temperature ranges unless otherwise specified. <sup>(1)</sup> <sup>(2)</sup>

Parameter		Test Conditions	Min	Typ	Max	Units
<b>DRIVER AC SPECIFICATION</b>						
t <sub>PLH</sub>	Differential Propagation Delay Low to High	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5 pF, C <sub>D</sub> = 0.5 pF Figure 9 and Figure 10	1.3	3.4	5.0	ns
t <sub>PHL</sub>	Differential Propagation Delay High to Low		1.3	3.1	5.0	ns
t <sub>SKD1</sub> (t <sub>sk(p)</sub> )	Pulse Skew  t <sub>PLHD</sub> - t <sub>PHLD</sub>   <sup>(3)</sup> <sup>(4)</sup>			300	420	ps
t <sub>SKD3</sub>	Part-to-Part Skew <sup>(5)</sup> <sup>(5)</sup>				1.3	ns
t <sub>TLH</sub> (t <sub>r</sub> )	Rise Time <sup>(4)</sup>		1.0	1.8	3.0	ns
t <sub>THL</sub> (t <sub>f</sub> )	Fall Time <sup>(4)</sup>		1.0	1.8	3.0	ns
t <sub>PZH</sub>	Enable Time (Z to Active High)	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5 pF, C <sub>D</sub> = 0.5 pF See Figure 11 and Figure 12			8	ns
t <sub>PZL</sub>	Enable Time (Z to Active Low)				8	ns
t <sub>PLZ</sub>	Disable Time (Active Low to Z)				8	ns
t <sub>PHZ</sub>	Disable Time (Active High to Z)				8	ns
t <sub>JIT</sub>	Random Jitter, RJ <sup>(4)</sup>	100 MHz Clock Pattern <sup>(6)</sup>		2.5	5.5	psrms
f <sub>MAX</sub>	Maximum Data Rate		200			Mbps
<b>RECEIVER AC SPECIFICATION</b>						
t <sub>PLH</sub>	Propagation Delay Low to High	C <sub>L</sub> = 15 pF See Figure 13, Figure 14 and Figure 15	2.0	4.7	7.5	ns
t <sub>PHL</sub>	Propagation Delay High to Low		2.0	5.3	7.5	ns
t <sub>SKD1</sub> (t <sub>sk(p)</sub> )	Pulse Skew  t <sub>PLHD</sub> - t <sub>PHLD</sub>   <sup>(3)</sup> <sup>(4)</sup>			0.6	1.7	ns
t <sub>SKD3</sub>	Part-to-Part Skew <sup>(5)</sup> <sup>(4)</sup>				1.3	ns
t <sub>TLH</sub> (t <sub>r</sub> )	Rise Time <sup>(4)</sup>		0.5	1.2	2.5	ns
t <sub>THL</sub> (t <sub>f</sub> )	Fall Time <sup>(4)</sup>		0.5	1.2	2.5	ns
t <sub>PZH</sub>	Enable Time (Z to Active High)	R <sub>L</sub> = 500Ω, C <sub>L</sub> = 15 pF See Figure 16 and Figure 17			10	ns
t <sub>PZL</sub>	Enable Time (Z to Active Low)				10	ns
t <sub>PLZ</sub>	Disable Time (Active Low to Z)				10	ns
t <sub>PHZ</sub>	Disable Time (Active High to Z)				10	ns
f <sub>MAX</sub>	Maximum Data Rate		200			Mbps

(1) All typicals are given for V<sub>CC</sub> = 3.3V and T<sub>A</sub> = 25°C.

(2) C<sub>L</sub> includes fixture capacitance and C<sub>D</sub> includes probe capacitance.

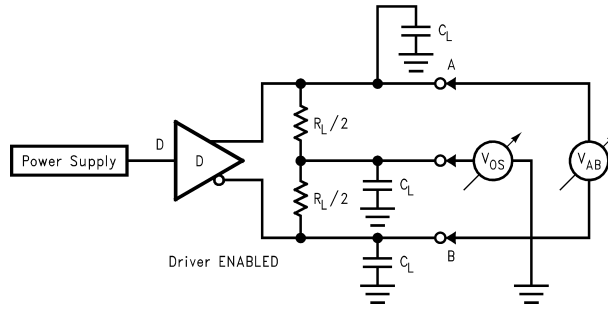
(3) t<sub>SKD1</sub>, |t<sub>PLHD</sub> - t<sub>PHLD</sub>|, is the magnitude difference in differential propagation delay time between the positive going edge and the negative going edge of the same channel.

(4) Not production tested. Specified by a statistical analysis on a sample basis at the time of characterization.

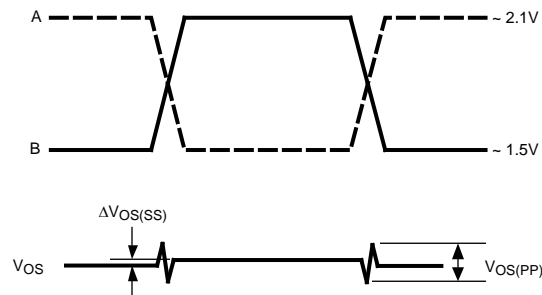
(5) t<sub>SKD3</sub>, Part-to-Part Skew, is defined as the difference between the minimum and maximum specified differential propagation delays. This specification applies to devices at the same V<sub>CC</sub> and within 5°C of each other within the operating temperature range.

(6) Stimulus and fixture Jitter has been subtracted.

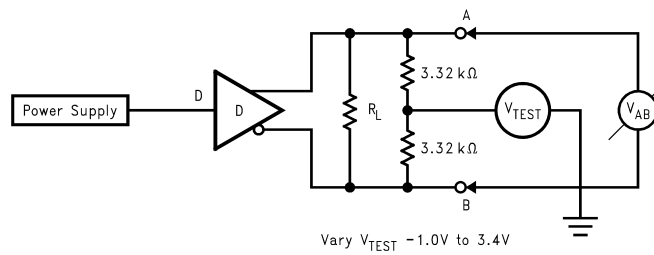
**Test Circuits and Waveforms**



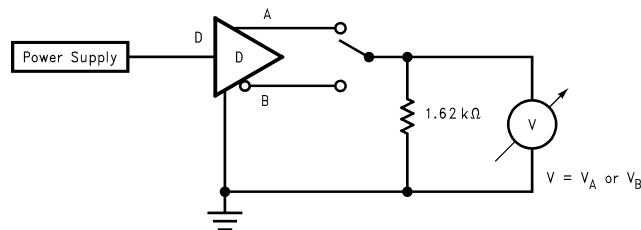
**Figure 4. Differential Driver Test Circuit**



**Figure 5. Differential Driver Waveforms**



**Figure 6. Differential Driver Full Load Test Circuit**



**Figure 7. Differential Driver DC Open Test Circuit**

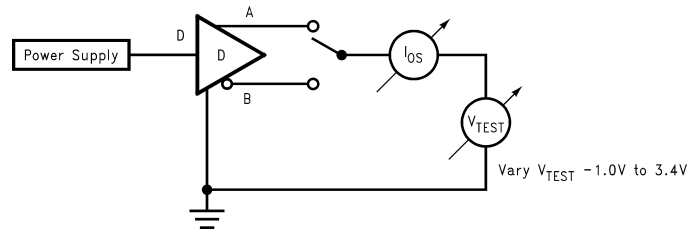


Figure 8. Differential Driver Short-Circuit Test Circuit

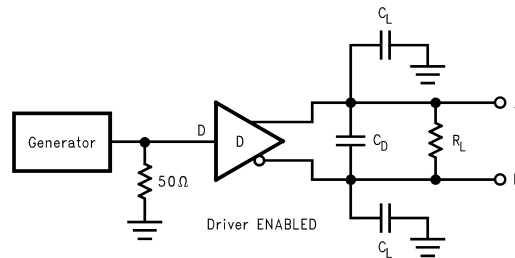


Figure 9. Driver Propagation Delay and Transition Time Test Circuit

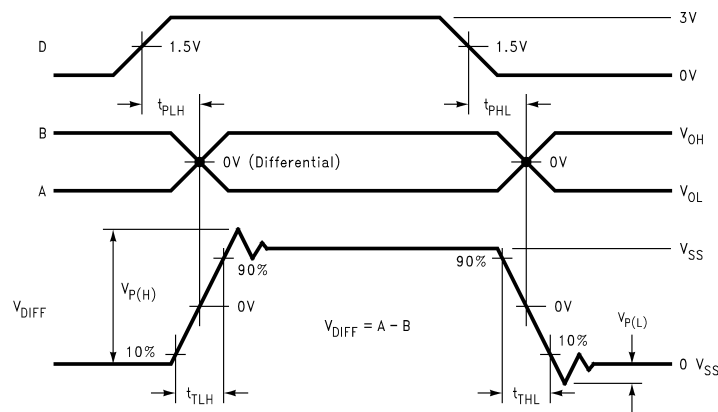


Figure 10. Driver Propagation Delays and Transition Time Waveforms

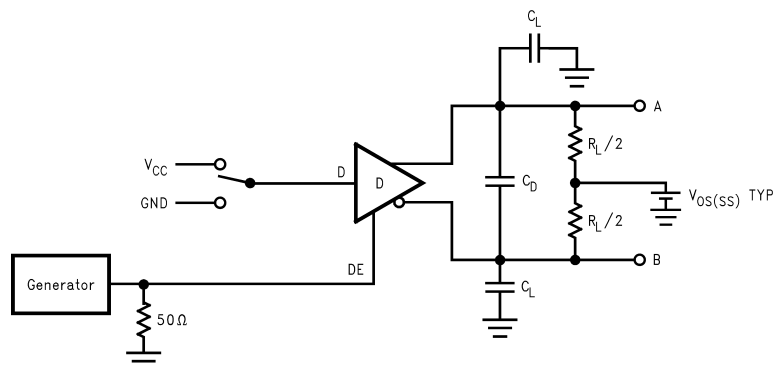


Figure 11. Driver TRI-STATE Delay Test Circuit

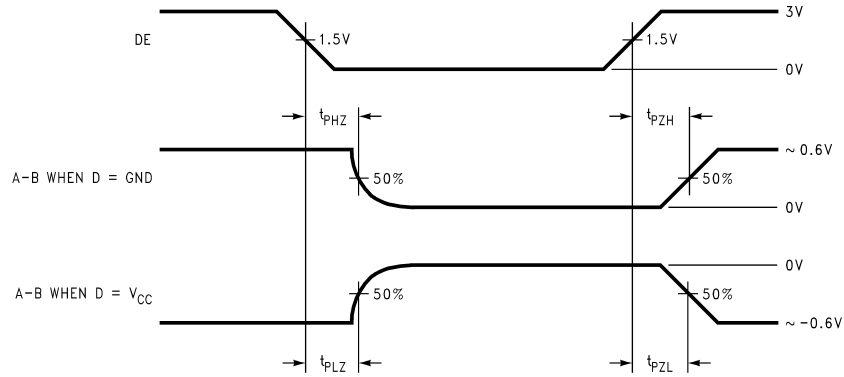


Figure 12. Driver TRI-STATE Delay Waveforms

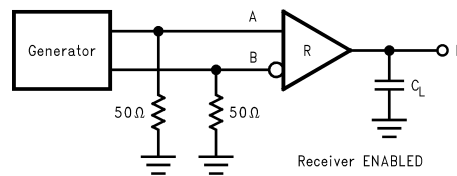


Figure 13. Receiver Propagation Delay and Transition Time Test Circuit

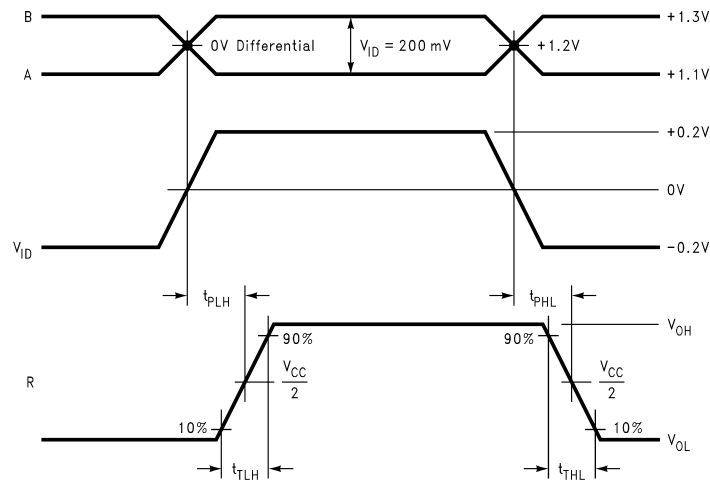


Figure 14. Type 1 Receiver Propagation Delay and Transition Time Waveforms



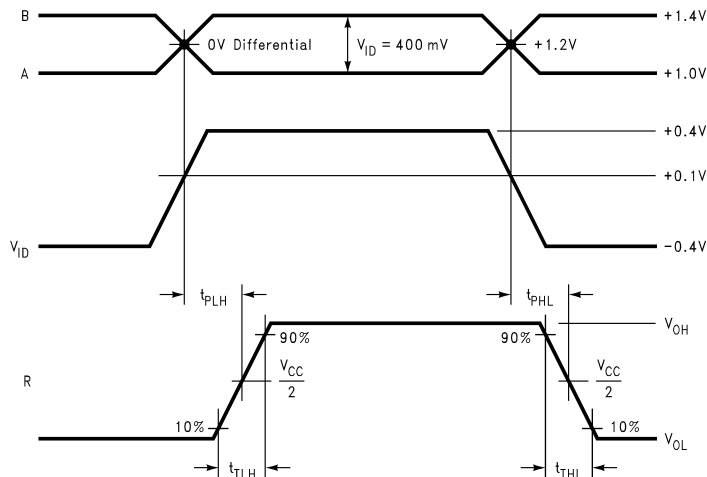


Figure 15. Type 2 Receiver Propagation Delay and Transition Time Waveforms

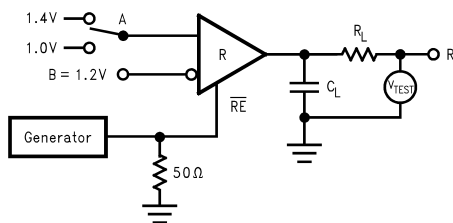


Figure 16. Receiver TRI-STATE Delay Test Circuit

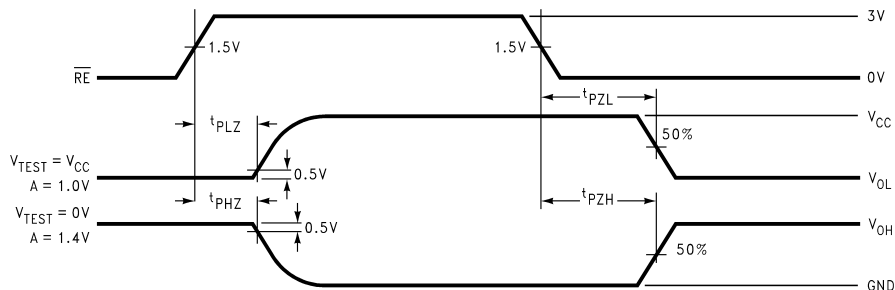


Figure 17. Receiver TRI-STATE Delay Waveforms

FUNCTION TABLES

Table 1. DS91D176/DS91C176 Transmitting<sup>(1)</sup>

Inputs			Outputs	
RE	DE	D	B	A
X	2.0V	2.0V	L	H
X	2.0V	0.8V	H	L
X	0.8V	X	Z	Z

(1) X — Don't care condition  
Z — High impedance state

**Table 2. DS91D176 Receiving<sup>(1)</sup>**

Inputs			Output
$\overline{RE}$	DE	A – B	R
0.8V	0.8V	$\geq +0.05V$	H
0.8V	0.8V	$\leq -0.05V$	L
0.8V	0.8V	0V	X
2.0V	0.8V	X	Z

- (1) X — Don't care condition  
Z — High impedance state

**Table 3. DS91C176 Receiving<sup>(1)</sup>**

Inputs			Output
$\overline{RE}$	DE	A – B	R
0.8V	0.8V	$\geq +0.15V$	H
0.8V	0.8V	$\leq +0.05V$	L
0.8V	0.8V	0V	L
2.0V	0.8V	X	Z

- (1) X — Don't care condition  
Z — High impedance state

**Table 4. DS91D176 Receiver Input Threshold Test Voltages<sup>(1)</sup>**

Applied Voltages		Resulting Differential Input Voltage	Resulting Common-Mode Input Voltage	Receiver Output
$V_{IA}$	$V_{IB}$	$V_{ID}$	$V_{IC}$	R
2.400V	0.000V	2.400V	1.200V	H
0.000V	2.400V	-2.400V	1.200V	L
3.800V	3.750V	0.050V	3.775V	H
3.750V	3.800V	-0.050V	3.775V	L
-1.400V	-1.350V	-0.050V	-1.375V	H
-1.350V	-1.400V	0.050V	-1.375V	L

- (1) H — High Level  
L — Low Level  
Output state assumes that the receiver is enabled ( $\overline{RE} = L$ )

**Table 5. DS91C176 Receiver Input Threshold Test Voltages<sup>(1)</sup>**

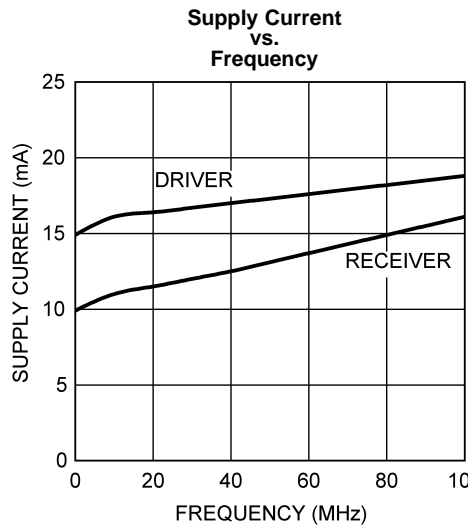
Applied Voltages		Resulting Differential Input Voltage	Resulting Common-Mode Input Voltage	Receiver Output
$V_{IA}$	$V_{IB}$	$V_{ID}$	$V_{IC}$	R
2.400V	0.000V	2.400V	1.200V	H
0.000V	2.400V	-2.400V	1.200V	L
3.800V	3.650V	0.150V	3.725V	H
3.800V	3.750V	0.050V	3.775V	L
-1.250V	-1.400V	0.150V	-1.325V	H
-1.350V	-1.400V	0.050V	-1.375V	L

- (1) H — High Level  
L — Low Level  
Output state assumes that the receiver is enabled ( $\overline{RE} = L$ )

**PIN DESCRIPTIONS**

Pin No.	Name	Description
1	R	Receiver output pin
2	$\overline{RE}$	Receiver enable pin: When $\overline{RE}$ is high, the receiver is disabled. When $\overline{RE}$ is low or open, the receiver is enabled.
3	DE	Driver enable pin: When DE is low, the driver is disabled. When DE is high, the driver is enabled.
4	D	Driver input pin
5	GND	Ground pin
6	A	Non-inverting driver output pin/Non-inverting receiver input pin
7	B	Inverting driver output pin/Inverting receiver input pin
8	$V_{CC}$	Power supply pin, +3.3V $\pm$ 0.3V

Typical Performance Characteristics – DS91D176/DS91C176



Supply Current measured using a clock pattern with driver terminated  $V_{CC} = 3.3V$ ,  $T_A = +25^\circ C$  to 50ohms .  $V_{CC} = 3.3V$ ,  $T_A = +25^\circ C$ .

Figure 18.

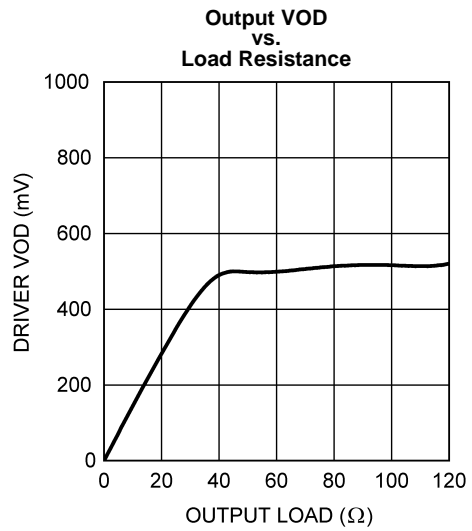


Figure 19.

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**REVISION HISTORY**

<b>Changes from Revision K (April 2013) to Revision L</b>	<b>Page</b>
<hr/> <ul style="list-style-type: none"><li>• Changed layout of National Data Sheet to TI format .....</li></ul>	<hr/> <a href="#">12</a>

**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
DS91C176TMA	ACTIVE	SOIC	D	8	95	TBD	Call TI	Call TI	-40 to 85	DS91C 176MA	<a href="#">Samples</a>
DS91C176TMA/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	DS91C 176MA	<a href="#">Samples</a>
DS91C176TMAX	ACTIVE	SOIC	D	8	2500	TBD	Call TI	Call TI	-40 to 85	DS91C 176MA	<a href="#">Samples</a>
DS91C176TMAX/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	DS91C 176MA	<a href="#">Samples</a>
DS91D176TMA/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	DS91D 176MA	<a href="#">Samples</a>
DS91D176TMAX	ACTIVE	SOIC	D	8	2500	TBD	Call TI	Call TI	-40 to 85	DS91D 176MA	<a href="#">Samples</a>
DS91D176TMAX/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	DS91D 176MA	<a href="#">Samples</a>

(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) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side 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 Top-Side Marking for that device.

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## TAPE AND REEL INFORMATION



### 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
DS91C176TMAX	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
DS91C176TMAX/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
DS91D176TMAX	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
DS91D176TMAX/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1



**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DS91C176TMAX	SOIC	D	8	2500	349.0	337.0	45.0
DS91C176TMAX/NOPB	SOIC	D	8	2500	349.0	337.0	45.0
DS91D176TMAX	SOIC	D	8	2500	349.0	337.0	45.0
DS91D176TMAX/NOPB	SOIC	D	8	2500	349.0	337.0	45.0

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.  
 D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.  
 E. Reference JEDEC MS-012 variation AA.

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