National Semiconductor

November 9, 2009

DS91M125

125 MHz 1:4 M-LVDS Repeater with LVDS Input

General Description

The DS91M125 is a 1:4 M-LVDS repeater designed for driving and distributing clock or data signals to up to four multipoint networks.

M-LVDS (Multipoint LVDS) is a new family of bus interface devices based on LVDS technology specifically designed for multipoint and multidrop cable and backplane applications. It differs from standard LVDS in providing increased drive current to handle double terminations that are required in multipoint applications. Controlled transition times minimize reflections that are common in multipoint configurations due to unterminated stubs.

A single DS91M125 channel is a 1:4 repeater that accepts M-LVDS/LVDS/CML/LVPECL signals and converts them to M-LVDS signal levels. Each output has an associated independent driver enable pin. The DS91M125 input conforms to the LVDS standard.

The DS91M125 has a flow-through pinout for easy PCB layout. It provides a new alternative for high speed multipoint interface applications. It is packaged in a space saving SOIC-16 package.

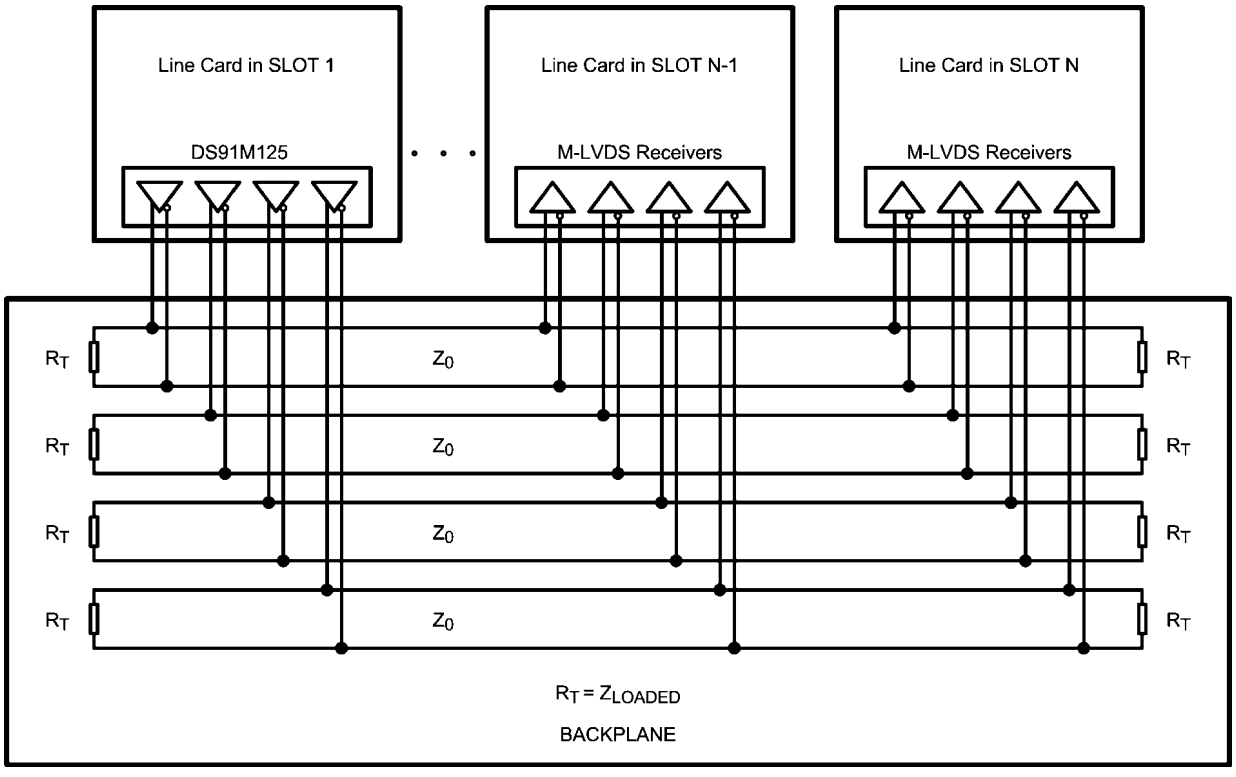
Features

- DC - 125 MHz / 250 Mbps low jitter, low skew, low power operation
- Independent Driver Enable pins
- Outputs Conform to TIA/EIA-899 M-LVDS Standard
- Controlled transition times minimize reflections
- Inputs Conform to TIA/EIA-644-A LVDS Standard
- 8 kV ESD on M-LVDS output pins protects adjoining components
- Flow-through pinout simplifies PCB layout
- Industrial operating temperature range (–40°C to +85°C)
- Available in a space saving SOIC-16 package

Applications

- Multidrop / Multipoint clock and data distribution
- High-Speed, Low Power, Short-Reach alternative to TIA/EIA-485/422
- Clock distribution in AdvancedTCA (ATCA) and MicroTCA (µTCA, uTCA) backplanes

Typical Application



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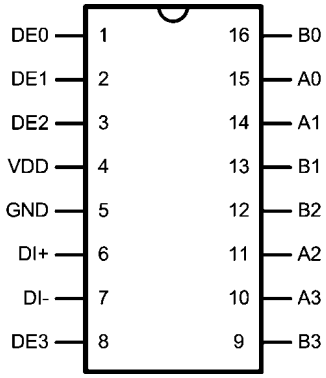
Ordering Information

Order Number	Function	Package Type
DS91M125TMA	1:4 Repeater	SOIC-16

Connection Diagram



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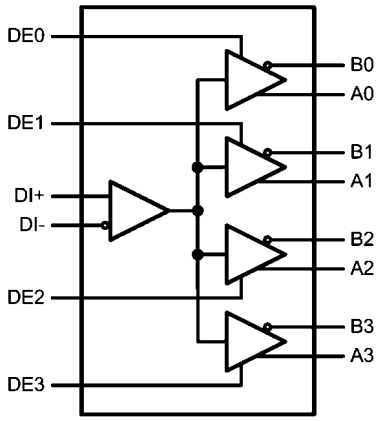
Logic Diagram



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Pin Descriptions

Number	Name	I/O, Type	Description
1, 2, 3, 8	DE	I, LVCMOS	Driver enable pins: When DE is low, the driver is disabled. When DE is high, the driver is enabled. There is a 300 kΩ pulldown resistor on each pin.
6	DI+	I, LVDS	Non-inverting receiver input pin.
7	DI-	I, LVDS	Inverting receiver input pin.
5	GND	Power	Ground pin.
10, 11, 14, 15	A	O, M-LVDS	Non-inverting driver output pin.
9, 12, 13, 16	B	O, M-LVDS	Inverting driver output pin.
4	V_{DD}	Power	Power supply pin, +3.3V ± 0.3V

Absolute Maximum Ratings (*Note 4*)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Supply Voltage	−0.3V to +4V
LVCMOS Input Voltages	−0.3V to (V_{DD} + 0.3V)
M-LVDS Output Voltages	−1.9V to +5.5V
LVDS Input Voltages	−0.3V to (V_{DD} + 0.3V)
Maximum Package Power Dissipation at +25°C	
SOIC Package	2.21W
Derate SOIC Package	19.2 mW/°C above +25°C
Thermal Resistance (4-Layer, 2 oz. Cu, JEDEC)	
θ_{JA}	52°C/W
θ_{JC}	19°C/W
Maximum Junction Temperature	140°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 4 seconds)	260°C
ESD Susceptibility	
HBM (*Note 1*)	≥ 8 kV
MM (*Note 2*)	≥ 250V
CDM (*Note 3*)	≥ 1250V

Note 1: Human Body Model, applicable std. JESD22-A114C

Note 2: Machine Model, applicable std. JESD22-A115-A

Note 3: Field Induced Charge Device Model, applicable std. JESD22-C101-C

Recommended Operating Conditions

	Min	Typ	Max	Units
Supply Voltage, V_{DD}	3.0	3.3	3.6	V
Voltage at M-LVDS Outputs	−1.4		+3.8	V
Voltage at LVDS Inputs	0		V_{DD}	V
LVCMOS Input Voltage High V_{IH}	2.0		V_{DD}	V
LVCMOS 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. (*Note 5*, *Note 6*, *Note 7*, *Note 10*)

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_{IH} = 3.6V	-15	±1	15	µA
I_{IL}	Low-Level Input Current	V_{IL} = 0V	-15	±1	15	µA
V_{CL}	Input Clamp Voltage	I_{IN} = -18 mA	-1.5			V
M-LVDS Driver DC Specifications						
$\|V_{AB}\|$	Differential output voltage magnitude	R_L = 50Ω, C_L = 5pF	480		650	mV
ΔV_{AB}	Change in differential output voltage magnitude between logic states	Figures 1, 3	−50	0	+50	mV
$V_{OS(SS)}$	Steady-state common-mode output voltage	R_L = 50Ω, C_L = 5pF	0.3	1.6	2.1	V
$\|\Delta V_{OS(SS)}\|$	Change in steady-state common-mode output voltage between logic states	Figures 1, 2	0		+50	mV
$V_{A(OC)}$	Maximum steady-state open-circuit output voltage	*Figure 4*	0		2.4	V
$V_{B(OC)}$	Maximum steady-state open-circuit output voltage		0		2.4	V
$V_{P(H)}$	Voltage overshoot, low-to-high level output	R_L = 50Ω, C_L = 5pF, C_D = 0.5pF Figures 6, 7 (*Note 8*)			$1.2V_{SS}$	V
$V_{P(L)}$	Voltage overshoot, high-to-low level output		$-0.2V_{SS}$			V
I_{OS}	Differential short-circuit output current	*Figure 5* (*Note 9*)	-43		43	mA
I_A	Driver output current	V_A = 3.8V, V_B = 1.2V			32	µA
		V_A = 0V or 2.4V, V_B = 1.2V	−20		+20	µA
		V_A = −1.4V, V_B = 1.2V	−32			µA
I_B	Driver output current	V_B = 3.8V, V_A = 1.2V			32	µA
		V_B = 0V or 2.4V, V_A = 1.2V	−20		+20	µA
		V_B = −1.4V, V_A = 1.2V	−32			µA
I_{AB}	Driver output differential current (I_A − I_B)	V_A = V_B, −1.4V ≤ V ≤ 3.8V	−4		+4	µA

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$I_{A(OFF)}$	Driver output power-off current	V_A = 3.8V, V_B = 1.2V, DE = 0V, 0V ≤ V_{DD} ≤ 1.5V			32	µA
		V_A = 0V or 2.4V, V_B = 1.2V, DE = 0V, 0V ≤ V_{DD} ≤ 1.5V	−20		+20	µA
		V_A = −1.4V, V_B = 1.2V, DE = 0V, 0V ≤ V_{DD} ≤ 1.5V	−32			µA
$I_{B(OFF)}$	Driver output power-off current	V_B = 3.8V, V_A = 1.2V, DE = 0V, 0V ≤ V_{DD} ≤ 1.5V			32	µA
		V_B = 0V or 2.4V, V_A = 1.2V, DE = 0V, 0V ≤ V_{DD} ≤ 1.5V	−20		+20	µA
		V_B = −1.4V, V_A = 1.2V, DE = 0V, 0V ≤ V_{DD} ≤ 1.5V	−32			µA
$I_{AB(OFF)}$	Driver output power-off differential current ($I_{A(OFF)}$ − $I_{B(OFF)}$)	V_A = V_B, −1.4V ≤ V ≤ 3.8V, DE = 0V, 0V ≤ V_{DD} ≤ 1.5V	−4		+4	µA
C_A	Driver output capacitance	V_{DD} = OPEN		7.8		pF
C_B	Driver output capacitance			7.8		pF
C_{AB}	Driver output differential capacitance			3		pF
$C_{A/B}$	Driver output capacitance balance (C_A/C_B)			1		
LVDS Receiver DC Specifications						
V_{IT+}	Positive-going differential input voltage threshold			-5	100	mV
V_{IT-}	Negative-going differential input voltage threshold		−100	-5		mV
V_{CMR}	Common mode voltage range	VID = 100 mV	0.05		V_{DD}-0.05	V
I_{IN}	Input current	VIN = 3.6V, V_{DD} = 3.6V		±1	±10	µA
		VIN = 0V, V_{DD} = 3.6V		±1	±10	µA
C_{IN}	Input capacitance	V_{DD} = OPEN		5		pF
POWER SUPPLY CURRENT						
I_{CCD}	Driver Supply Current	R_L = 50Ω, DE = V_{DD}		67	78	mA
I_{CCZ}	TRI-STATE Supply Current	DE = GND		21	26	mA

Note 4: "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.

Note 5: 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.

Note 6: 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}.

Note 7: Typical values represent most likely parametric norms for V_{DD} = +3.3V and T_A = +25°C, and at the Recommended Operation Conditions at the time of product characterization and are not guaranteed.

Note 8: Specification is guaranteed by characterization and is not tested in production.

Note 9: Output short circuit current (I_{OS}) is specified as magnitude only, minus sign indicates direction only.

Note 10: C_L includes fixture capacitance and C_D includes probe capacitance.

Switching Characteristics

Over recommended operating supply and temperature ranges unless otherwise specified. (*Note 11*, *Note 12*, *Note 18*)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
DRIVER AC SPECIFICATION						
t_{PLH}	Differential Propagation Delay Low to High	R_L = 50Ω, C_L = 5 pF,	3.0	5.5	8.5	ns
t_{PHL}	Differential Propagation Delay High to Low	C_D = 0.5 pF	3.0	5.5	8.5	ns
t_{SKD1} ($t_{sk(p)}$)	Pulse Skew $\lvert t_{PLHD} - t_{PHLD} \rvert$ (*Note 14*, *Note 19*)	Figures 6, 7		65	350	ps
t_{SKD2}	Channel-to-Channel Skew (*Note 15*, *Note 19*)			65	400	ps
t_{SKD3}	Part-to-Part Skew (*Note 16*, *Note 19*)			2.2	2.5	ns
t_{SKD4}	Part-to-Part Skew (*Note 17*)				5.5	ns
t_{TLH} (t_r)	Rise Time (*Note 19*)		1.1	2.0	3.0	ns
t_{THL} (t_f)	Fall Time (*Note 19*)		1.1	2.0	3.0	ns
t_{PZH}	Enable Time (Z to Active High)	R_L = 50Ω, C_L = 5 pF,		6	11	ns
t_{PZL}	Enable Time (Z to Active Low)	C_D = 0.5 pF		6	11	ns
t_{PLZ}	Disable Time (Active Low to Z)	Figures 8, 9		6	11	ns
t_{PHZ}	Disable Time (Active High to Z)			6	11	ns
f_{MAX}	Maximum Operating Frequency (*Note 19*)		125			MHz

Note 11: 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.

Note 12: Typical values represent most likely parametric norms for V_{DD} = +3.3V and T_A = +25°C, and at the Recommended Operation Conditions at the time of product characterization and are not guaranteed.

Note 13: Specification is guaranteed by characterization and is not tested in production.

Note 14: t_{SKD1}, $\lvert t_{PLHD} - t_{PHLD} \rvert$, is the magnitude difference in differential propagation delay time between the positive going edge and the negative going edge of the same channel.

Note 15: t_{SKD2}, Channel-to-Channel Skew, is the difference in propagation delay (t_{PLHD} or t_{PHLD}) among all output channels.

Note 16: t_{SKD3}, 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_{DD} and within 5°C of each other within the operating temperature range.

Note 17: t_{SKD4}, Part-to-Part Skew, is the differential channel-to-channel skew of any event between devices. This specification applies to devices over recommended operating temperature and voltage ranges, and across process distribution. t_{SKD4} is defined as |Max – Min| differential propagation delay.

Note 18: C_L includes fixture capacitance and C_D includes probe capacitance.

Note 19: Specification is guaranteed by characterization and is not tested in production.

Test Circuits and Waveforms

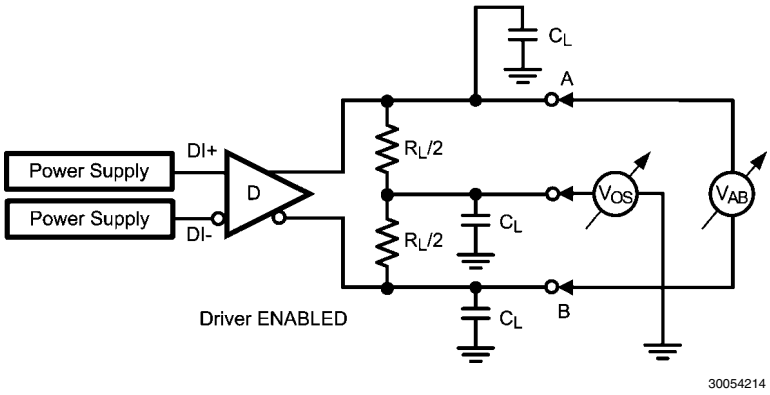


FIGURE 1. Differential Driver Test Circuit

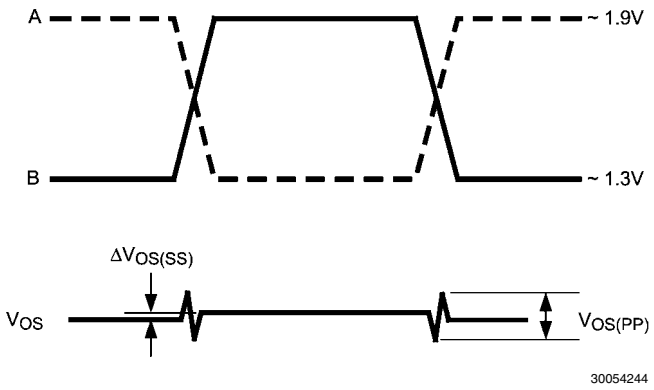


FIGURE 2. Differential Driver Waveforms

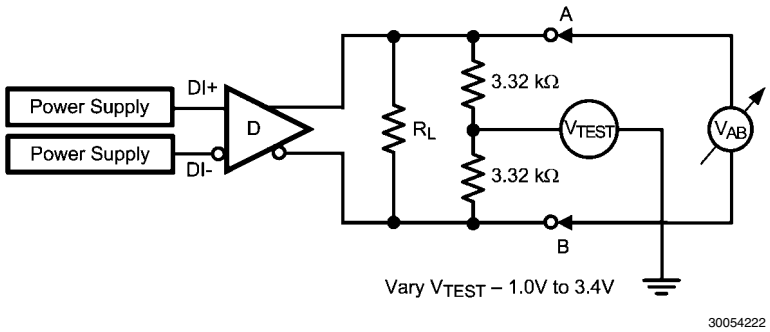


FIGURE 3. Differential Driver Full Load Test Circuit

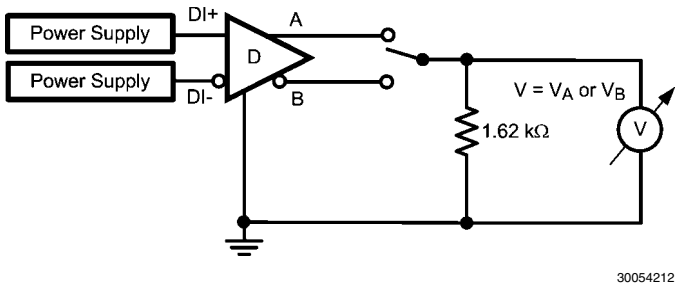


FIGURE 4. Differential Driver DC Open Test Circuit

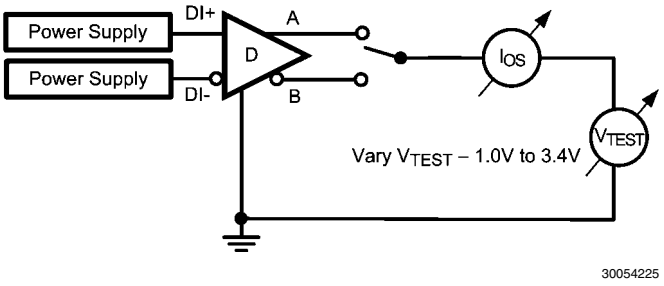


FIGURE 5. Differential Driver Short-Circuit Test Circuit

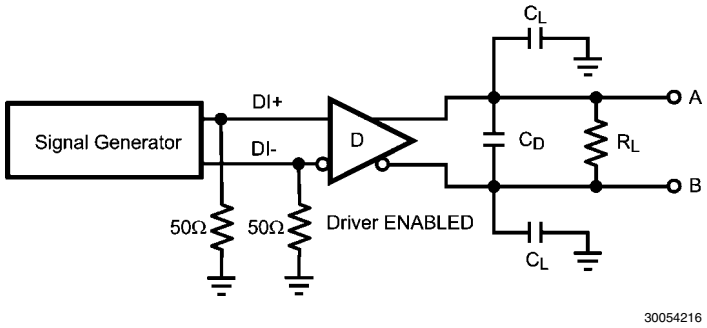


FIGURE 6. Driver Propagation Delay and Transition Time Test Circuit

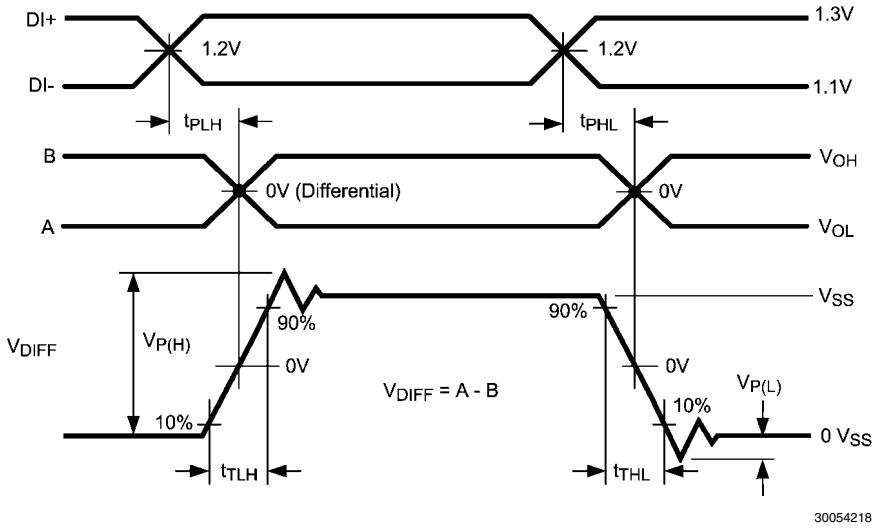


FIGURE 7. Driver Propagation Delays and Transition Time Waveforms

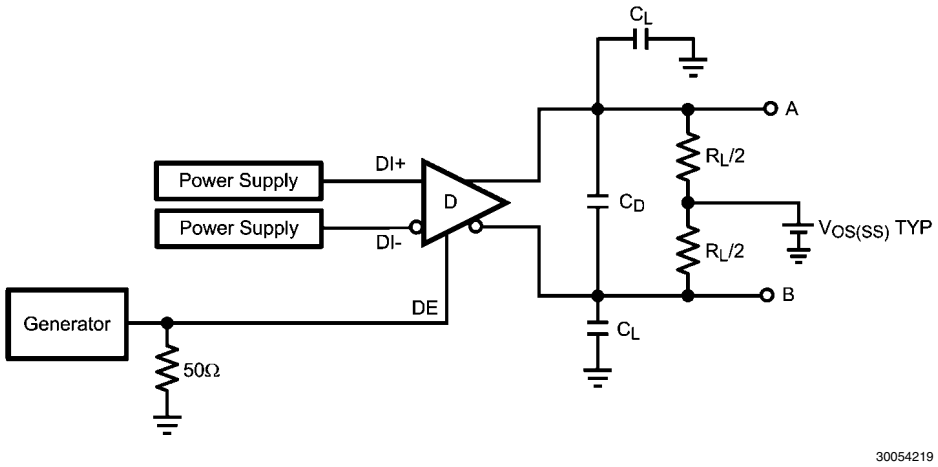


FIGURE 8. Driver TRI-STATE Delay Test Circuit

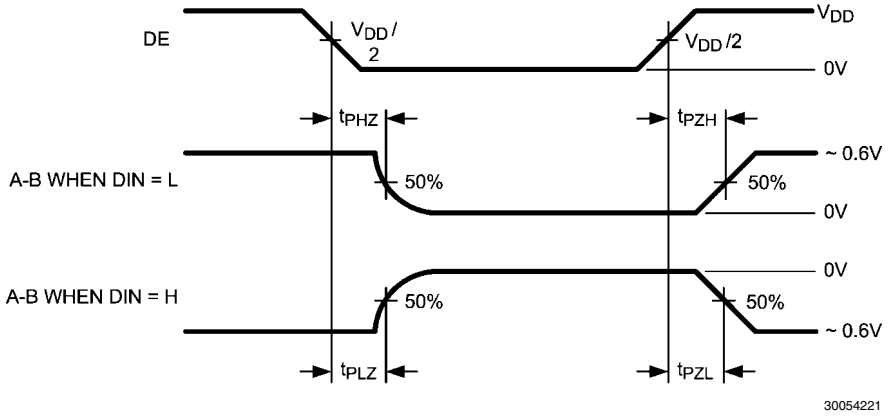
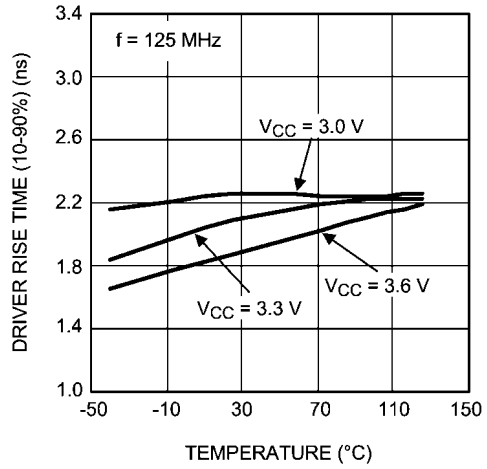


FIGURE 9. Driver TRI-STATE Delay Waveforms

Typical Performance Characteristics



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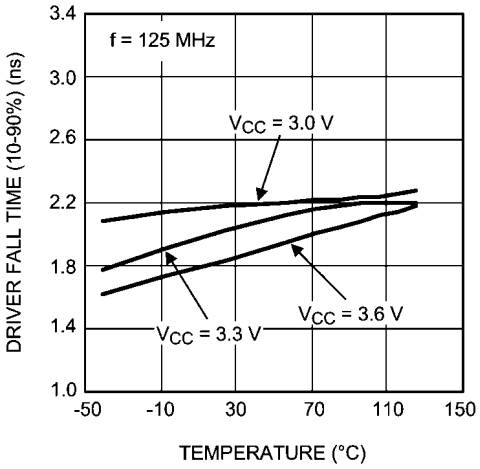
Driver Rise Time as a Function of Temperature



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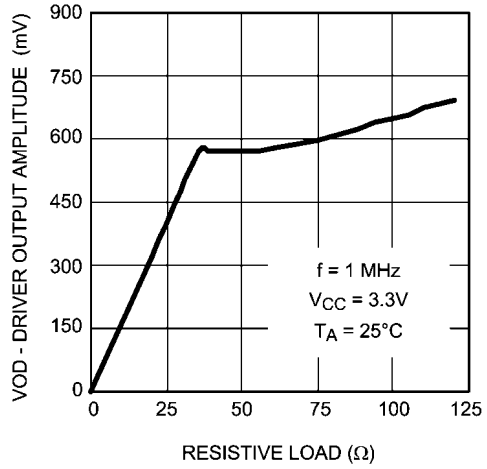
Driver Fall Time as a Function of Temperature



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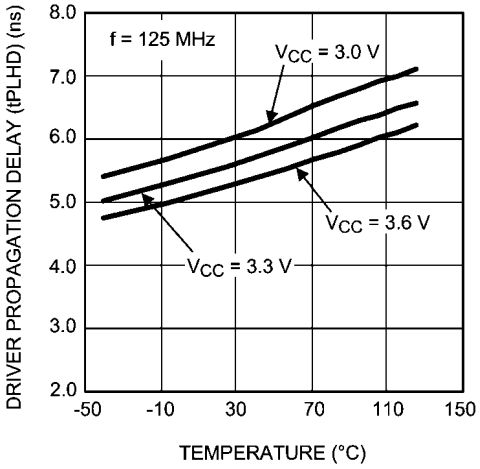
Driver Output Signal Amplitude as a Function of Resistive Load



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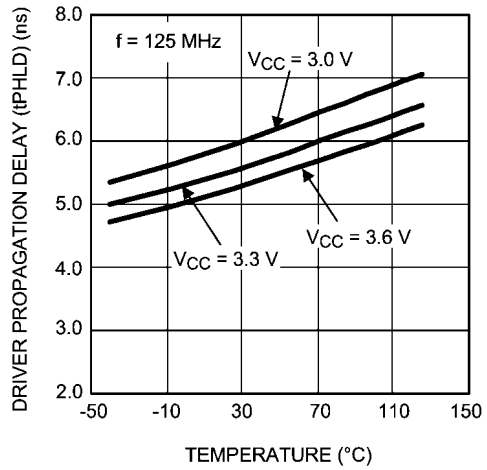
Driver Propagation Delay (tPLHD) as a Function of Temperature



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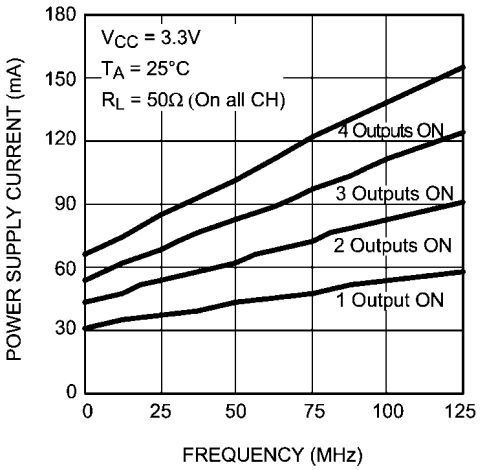
Driver Propagation Delay (tPHLD) as a Function of Temperature



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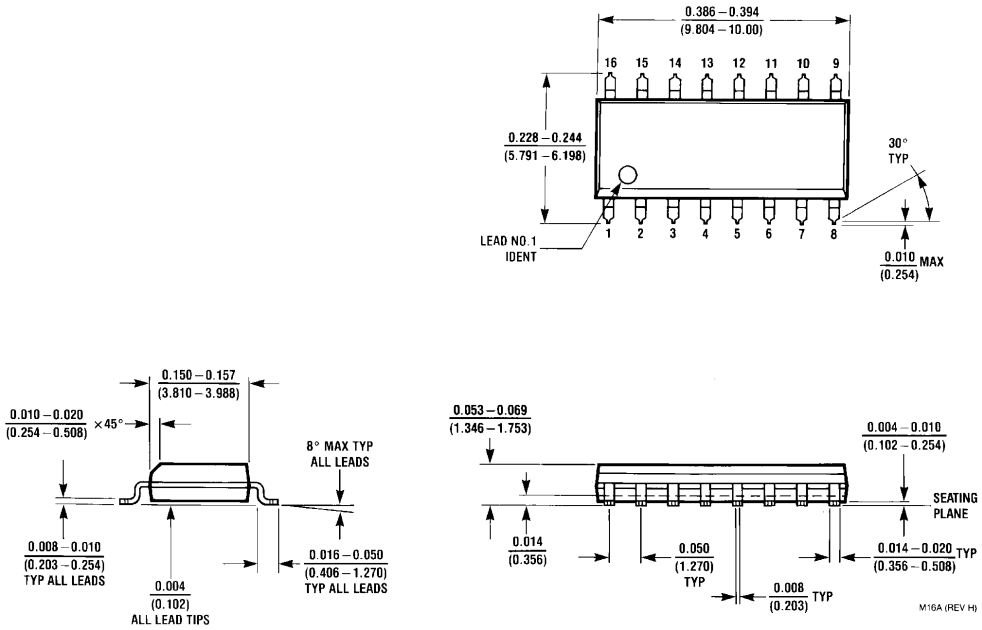
Driver Power Supply Current as a Function of Frequency

Physical Dimensions inches (millimeters) unless otherwise noted



16-Lead (0.150″ Wide) Molded Small Outline Package, JEDEC
Order Number DS91M125TMA
NS Package Number M16A

Notes

Notes

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Voltage Reference	www.national.com/vref	Design Made Easy	www.national.com/easy
PowerWise® Solutions	www.national.com/powerwise	Solutions	www.national.com/solutions
Serial Digital Interface (SDI)	www.national.com/sdi	Mil/Aero	www.national.com/milaero
Temperature Sensors	www.national.com/tempsensors	SolarMagic™	www.national.com/solarmagic
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