DS36950 Quad Differential Bus Transceiver

Check for Samples: DS36950

FEATURES

- **Pinout for IPI Interface**
- **Compact 20-pin PLCC Package**
- **Meets EIA-485 Standard for Multipoint Bus Transmission**
- **Greater than 60 mA Source/Sink**
- **Thermal Shutdown Protection**

DESCRIPTION

The DS36950 is a low power, space-saving quad EIA-485 differential bus transceiver especially suited for high speed, parallel, multipoint, computer I/O bus applications. A compact 20-pin surface mount PLCC package provides high transceiver integration and a very small PC board footprint.

Timing uncertainty across an interface using multiple devices, a typical problem in a parallel interface, is specified—minimum and maximum propagation delay times are guaranteed.

Six devices can implement a complete IPI master or slave interface. Three transceivers in a package are pinned out for connection to a parallel databus. The fourth transceiver, with the flexibility provided by its individual enables, can serve as a control bus transceiver.

Pinout and Logic Diagram

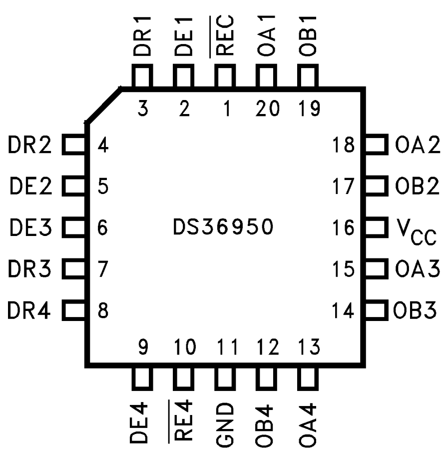


Figure 1. Top View (Package Number FN0020A)

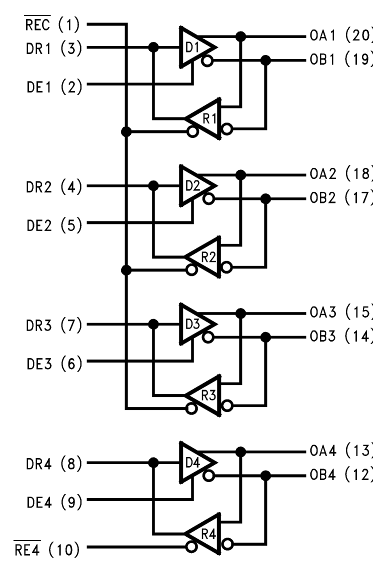


Figure 2. Block Diagram

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	7V
Control Input Voltage	V_{CC} + 0.5V
Driver Input Voltage	V_{CC} + 0.5V
Driver Output Voltage/Receiver	
Input Voltage	−10V to +15V
Receiver Output Voltage	5.5V
Continuous Power Dissipation @ 25°C FN0020A Package	1.73W
Derate FN0020A Package 13.9 mW/°C above 25°C	
Storage Temp. Range	−65°C to +150°C
Lead Temp. (Soldering 4 Sec.)	260°C

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

Recommended Operating Conditions [1]

Supply Voltage, V_{CC}	4.75V to 5.25V
Bus Voltage	−7V to +12V
Operating Free Air Temperature (T_A)	0°C to +70°C

(1) All typicals are given for V_{CC} = 5.0V and T_A = 25°C.

Electrical Characteristics [1]

Over Supply Voltage and Operating Temperature ranges, unless otherwise specified

Parameter		Test Conditions	Min	Typ	Max	Units
Driver Characteristics						
V_{ODL}	Differential Driver Output	I_L = 60 mA	1.5	1.9		V
	Voltage (Full Load)	V_{CM} = 0V				
V_{OD}	Differential Driver Output	R_L = 100Ω (EIA-422)	2.0	3.5		V
	Voltage (Termination Load)	R_L = 54Ω (EIA-485)	1.5	3.2		V
$\Delta\|V_{OD}\|$	Change in Magnitude of Driver	R_L = 54Ω or 100Ω				
	Differential Output Voltage for	[2](Figure 3)			0.2	V
	Complementary Output States	(EIA-485)				
V_{OC}	Driver Common Mode Output	R_L = 54Ω			3.0	V
	Voltage [3]	(Figure 3) (EIA-485)				
$\Delta\|V_{OC}\|$	Change in Magnitude of Common	[2] (Figure 3)			0.2	V
	Mode Output Voltage	(EIA-485)				
V_{OH}	Output Voltage HIGH	I_{OH} = −55 mA	2.7	3.2		V
V_{OL}	Output Voltage LOW	I_{OL} = 55 mA		1.4	1.7	V
V_{IH}	Input Voltage HIGH		2.0			V
V_{IL}	Input Voltage LOW				0.8	V
V_{CL}	Input Clamp Voltage	I = −18 mA			−1.5	V
I_{IH}	Input High Current	V_I = 2.4V [4]			20	μA
I_{IL}	Input Low Current	V_I = 0.4V [4]			−20	μA

(1) Current into device pins is define as positive. Current out of device pins is defined as negative. All voltages are referenced to ground unless otherwise specified.
(2) $\Delta|V_{OD}|$ and $\Delta|V_{OC}|$ are changes in magnitude of V_{OD} and V_{OC}, respectively, that occur when the input changes state.
(3) In EIA Standards EIA-422 and EIA-485, V_{OC}, which is the average of the two output voltages with respect to ground, is called output offset voltage, V_{OS}.
(4) I_{IH} and I_{IL} includes driver input current and receiver TRI-STATE leakage current.

Electrical Characteristics [1] (continued)

Over Supply Voltage and Operating Temperature ranges, unless otherwise specified

Parameter		Test Conditions		Min	Typ	Max	Units
I_{OSC}	Driver Short-Circuit Output Current [5]	V_O = −7V	(EIA-485)		−130	−250	mA
		V_O = 0V	(EIA-422)		−90	−150	mA
		V_O = +12V	(EIA-485)		130	250	mA
Receiver Characteristics							
I_{OSR}	Short Circuit Output Current	V_O = 0V [5]		−15	−28	−75	mA
I_{OZ}	TRI-STATE Output Current	V_O = 0.4V to 2.4V				20	μA
V_{OH}	Output Voltage High	V_{ID} = 0.20V, I_{OH} = −0.4 mA		2.4	3.0		V
V_{OL}	Output Voltage Low	V_{ID} = −0.20V, I_{OL} = 4 mA			0.35	0.5	V
V_{TH}	Differential Input High Threshold Voltage	V_O = V_{OH}, I_O = −0.4 mA (EIA-422/485)			0.03	0.20	V
V_{TL}	Differential Input Low Threshold Voltage [6]	V_O = V_{OL}, I_O = 4.0 mA		−0.20	−0.03		V
		(EIA-422/485)					
V_{HST}	Hysteresis [7]	V_{CM} = 0V		35	60		mV
Driver and Receiver Characteristics							
V_{IH}	Enable Input Voltage High			2.0			V
V_{IL}	Enable Input Voltage Low					0.8	V
V_{CL}	Enable Input Clamp Voltage	I = −18 mA				−1.5	V
I_{IN}	Line Input Current [8]	Other Input = 0V	V_I = +12V		0.5	1	mA
			V_I = −7V		−0.45	−0.8	mA
I_{IH}	Enable Input Current High	V_{OH} = 2.4V	$\overline{RE4}$ or DE			20	μA
			$\overline{REC}$			60	μA
I_{IL}	Enable Input Current Low	V_{OL} = 0.4V	$\overline{RE4}$ or DE			−20	μA
			$\overline{REC}$			−60	μA
I_{CC}	Supply Current [9]	No Load, Outputs Enabled			75	90	mA
I_{CCZ}	Supply Current [9]	No Load, Outputs Disabled			50	70	mA

(5) Short one output at a time.
(6) Threshold parameter limits specified as an algebraic value rather than by magnitude.
(7) Hysteresis defined as $V_{HST} = V_{TH} - V_{TL}$.
(8) I_{IN} includes the receiver input current and driver TRI-STATE leakage current.
(9) Total package supply current.

Switching Characteristics

Over Supply Voltage and Operating Temperature ranges, unless otherwise specified

Symbol	Test Conditions		Min	Typ	Max	Units
Driver Single-Ended Characteristics						
t_{PZH}	R_L = 110Ω (Figure 6)			35	40	ns
t_{PZL}	R_L = 110Ω (Figure 7)			25	40	ns
t_{PHZ}	R_L = 110Ω (Figure 6)			15	25	ns
t_{PLZ}	R_L = 110Ω (Figure 7)			35	40	ns
Driver Differential Characteristics						
t_R, t_F	Rise & Fall Time	R_L = 54Ω		13	16	ns
t_{PLHD}	Differential Propagation	C_L = 50 pF	9	15	19	ns
t_{PHLD}	Delays [1]	C_D = 15 pF	9	15	19	ns
t_{SKD}	$\lvert t_{PLHD} - t_{PHLD} \rvert$ Differential Skew	(Figure 5)		3	6	ns

(1) Differential propagation delays are calculated from single-ended propagation delays measured from driver input to the 20% and 80% levels on the driver outputs (See Figure 5).

Switching Characteristics (continued)

Over Supply Voltage and Operating Temperature ranges, unless otherwise specified

Symbol	Test Conditions		Min	Typ	Max	Units
Receiver Characteristics						
t_{PLHD}	Differential Propagation Delays		9	14	19	ns
t_{PHLD}	C_L = 15 pF, V_{CM} = 1.5V (Figure 8)		9	14	19	ns
t_{SKD}	$\|t_{PLHD} - t_{PHLD}\|$ Differential Receiver Skew			1	3	ns
t_{ZH}	Output Enable Time to High Level	C_L = 15 pF Figure 9		15	22	ns
t_{ZL}	Output Enable Time to Low Level			20	30	ns
t_{HZ}	Output Disable Time from High Level			10	17	ns
t_{LZ}	Output Disable Time from Low Level			17	25	ns

Parameter Measurement Information

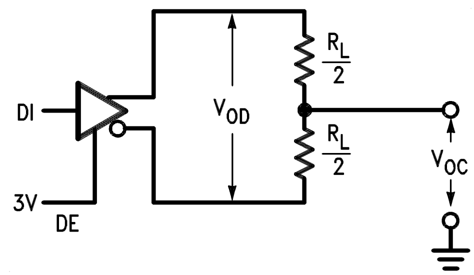


Figure 3. Driver V_{OD} and V_{OC}

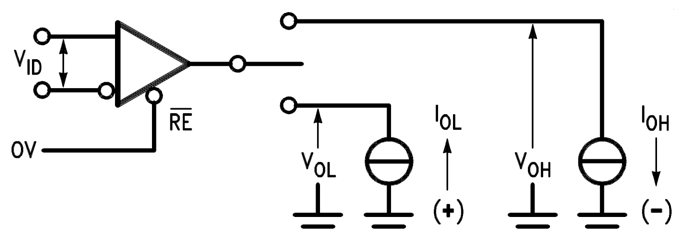
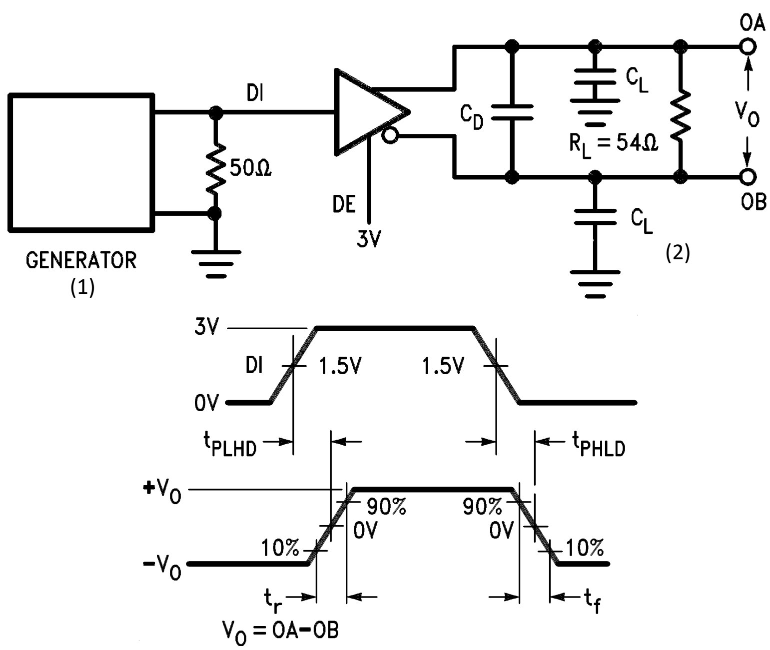


Figure 4. Receiver V_{OH} and V_{OL}

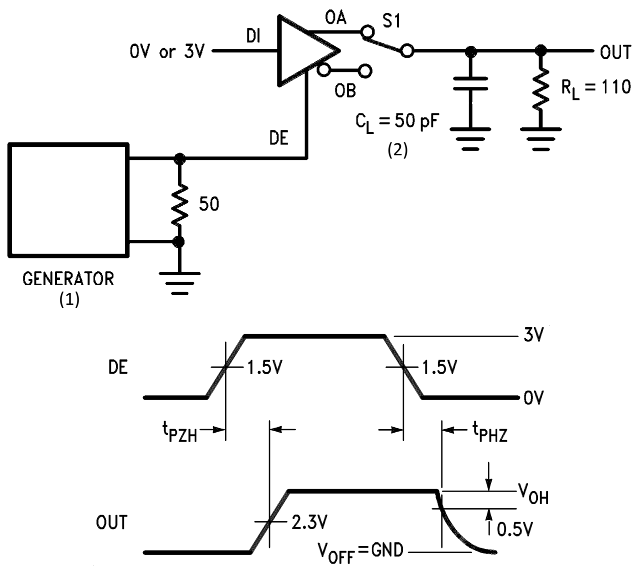


(1) The input pulse is supplied by a generator having the following characteristics: f = 1.0 MHz, 50% Duty Cycle, t_f and t_r < 6.0 ns, Z_O = 50Ω

(2) C_L includes probe and stray capacitance.

Figure 5. Driver Differential Propagation Delay and Transition Timing

Parameter Measurement Information (continued)

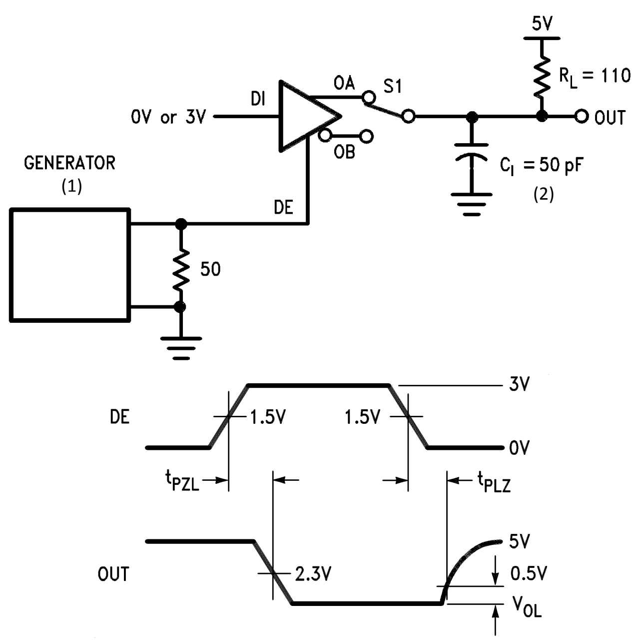


S1 to OA for DI = 3V
S1 to OB for DI = 0V

(1) The input pulse is supplied by a generator having the following characteristics: f = 1.0 MHz, 50% Duty Cycle, t_f and t_r < 6.0 ns, Z_O = 50Ω

(2) C_L includes probe and stray capacitance.

Figure 6. Driver Enable and Disable Timing (t_{PZH}, t_{PHZ})



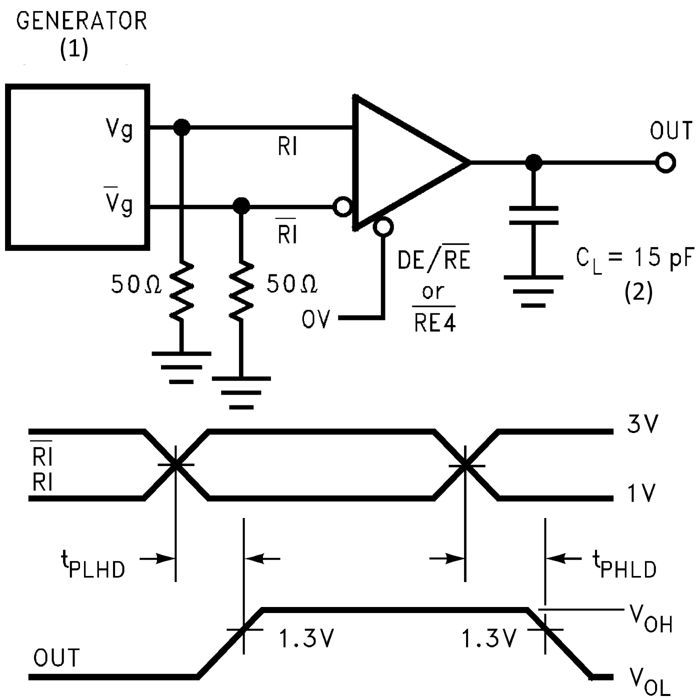
S1 to OA for DI = 0V
S1 to OB for DI = 3V

(1) The input pulse is supplied by a generator having the following characteristics: f = 1.0 MHz, 50% Duty Cycle, t_f and t_r < 6.0 ns, Z_O = 50Ω

(2) C_L includes probe and stray capacitance.

Figure 7. Driver Enable and Disable Timing (t_{PZL}, t_{PLZ})

Parameter Measurement Information (continued)

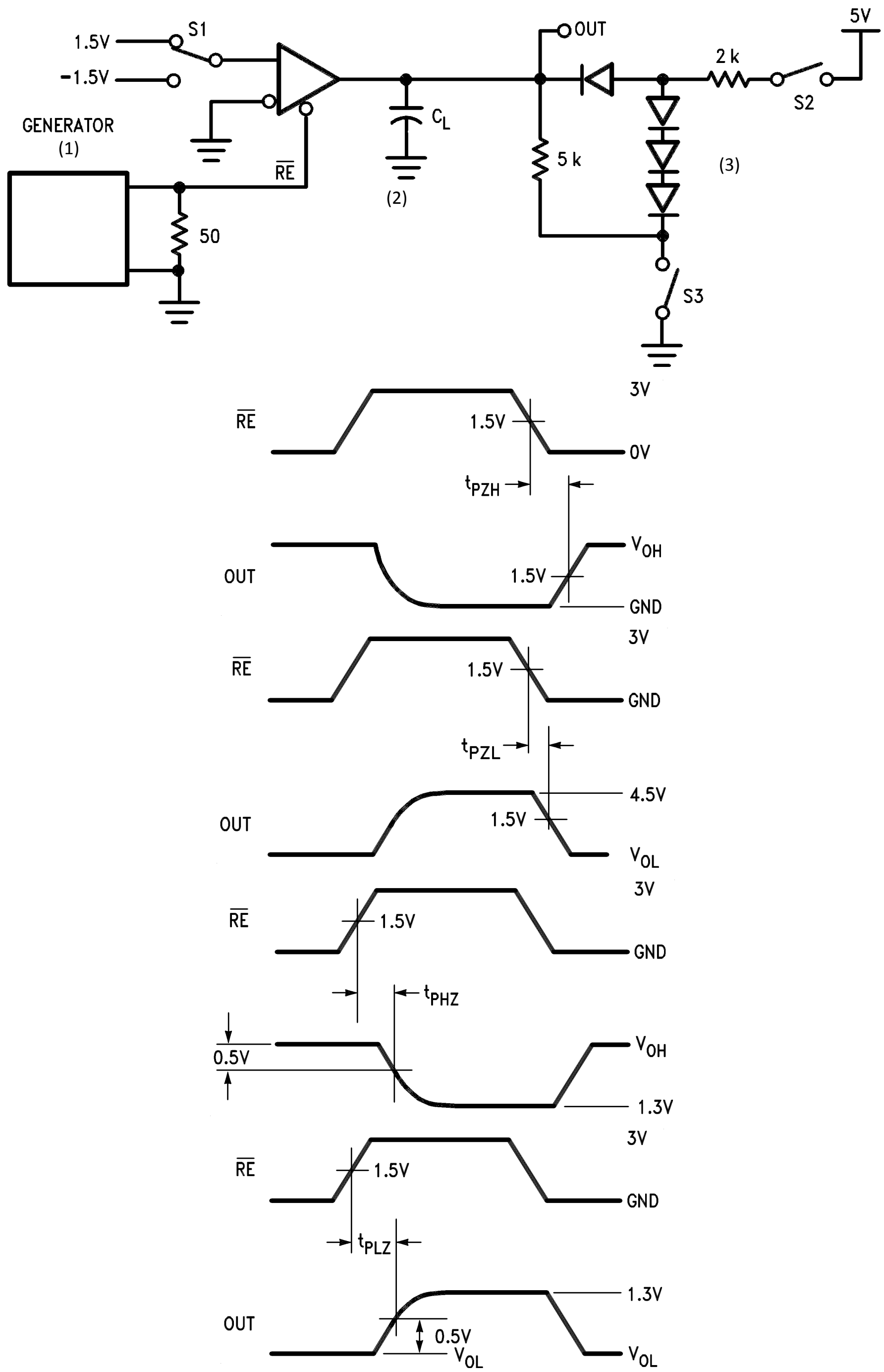


(1) The input pulse is supplied by a generator having the following characteristics: f = 1.0 MHz, 50% Duty Cycle, t_f and t_r < 6.0 ns, Z_O = 50Ω

(2) C_L includes probe and stray capacitance.

Figure 8. Receiver Differential Propagation Delay Timing

Parameter Measurement Information (continued)



S1 −1.5V
S2 CLOSED
S3 CLOSED

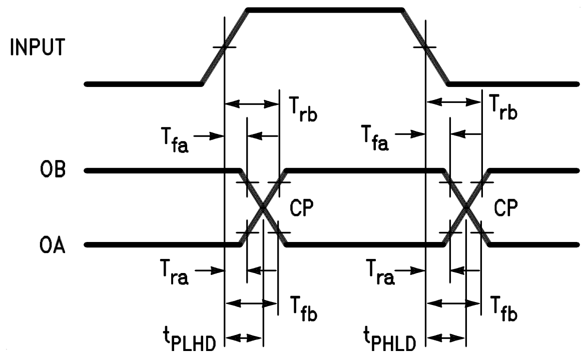
(1) The input pulse is supplied by a generator having the following characteristics: f = 1.0 MHz, 50% Duty Cycle, t_f and t_r < 6.0 ns, Z_O = 50Ω

(2) C_L includes probe and stray capacitance.

(3) Diodes are 1N916 or equivalent.

Figure 9. Receiver Enable and Disable Timing

Parameter Measurement Information (continued)



$$TCP = \frac{(Tfb \times Trb) - (Tra \times Tfa)}{Trb - Tra - Tfa + Tfb}$$

TCP = Crossing Point
Tra, Trb, Tfa, and Tfb are propagation delay measurements to the 20% and 80% levels.

Figure 10. Propagation Delay Timing for Calculation of Driver Differential Propagation Delays

Typical Performance Characteristics

Driver Differential Propagation Delay vs Temperature

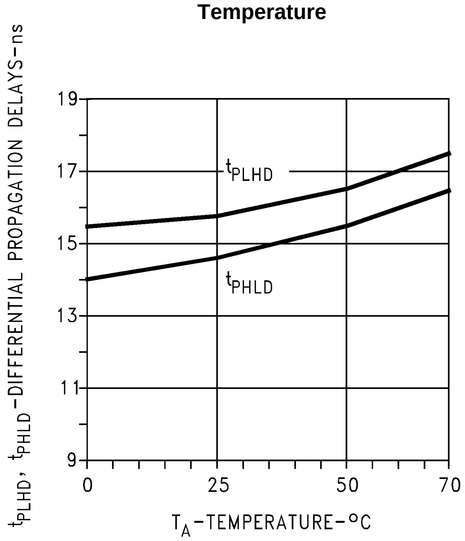


Figure 11.

Driver Differential Propagation Delay vs V_{CC}

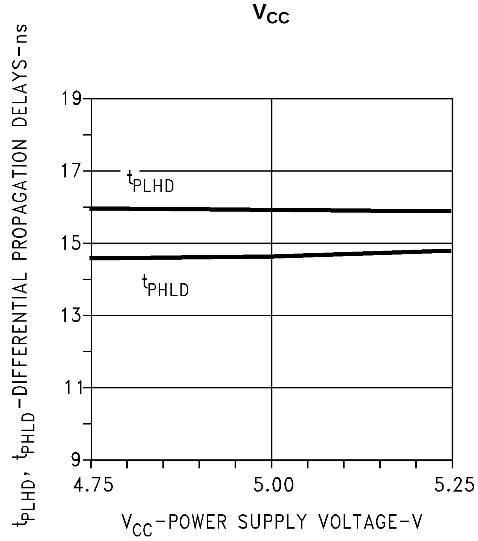


Figure 12.

Typical Performance Characteristics (continued)

Driver Transition Time vs Temperature

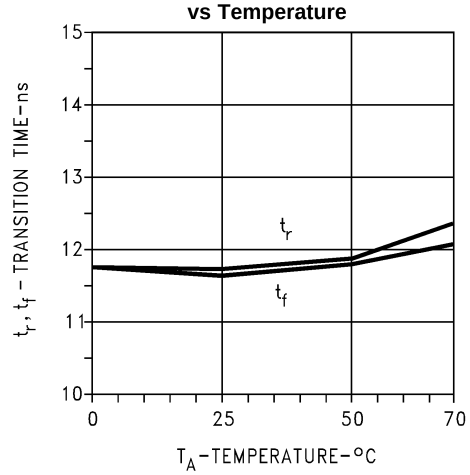


Figure 13.

Driver Transition Time vs V_{CC}

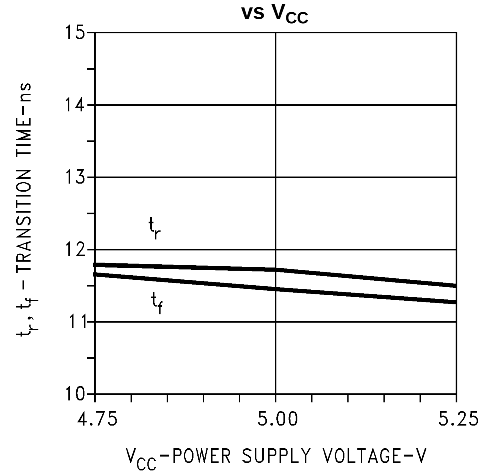


Figure 14.

Driver V_{OH} vs I_{OH} vs Temperature

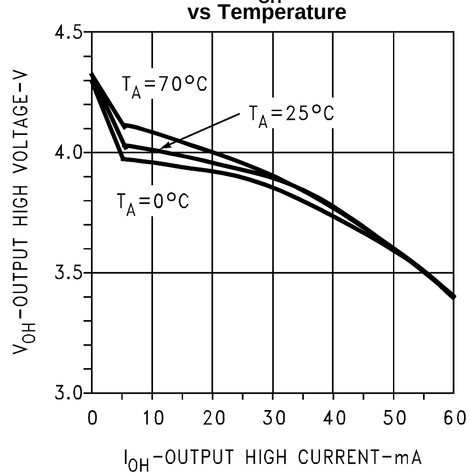


Figure 15.

Driver V_{OH} vs I_{OH} vs V_{CC}

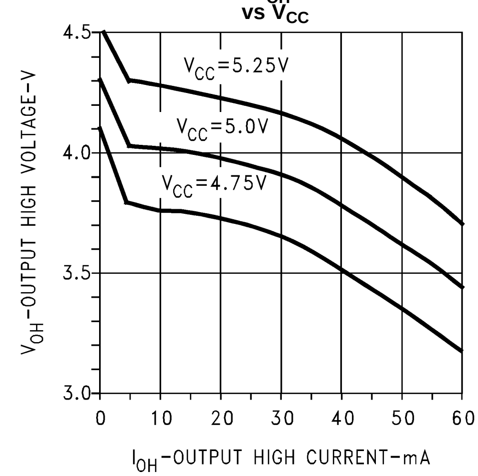


Figure 16.

Driver V_{OL} vs I_{OL} vs Temperature

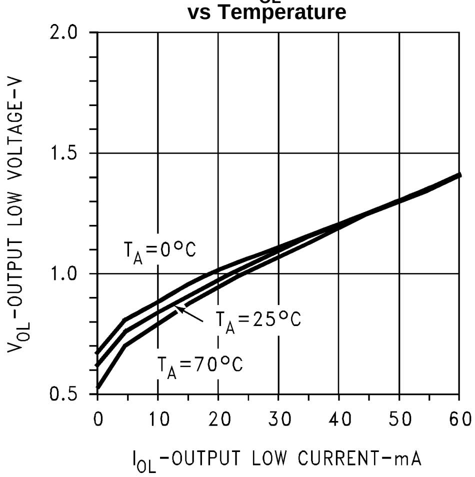


Figure 17.

Driver V_{OL} vs I_{OL} vs V_{CC}

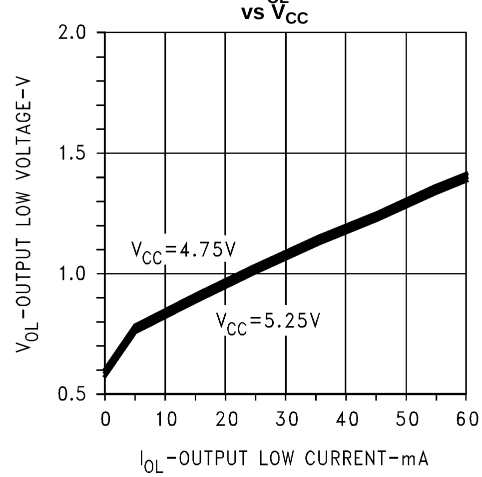


Figure 18.

Typical Performance Characteristics (continued)

Driver V_{OD} vs I_O vs Temperature

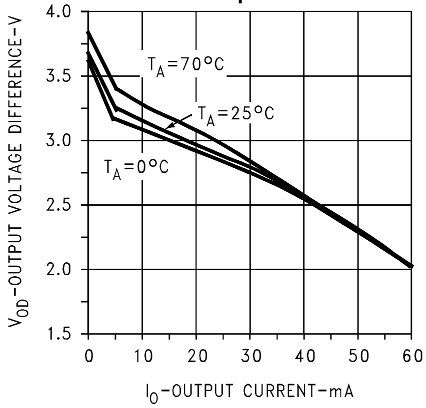


Figure 19.

Driver V_{OD} vs I_O vs V_{CC}

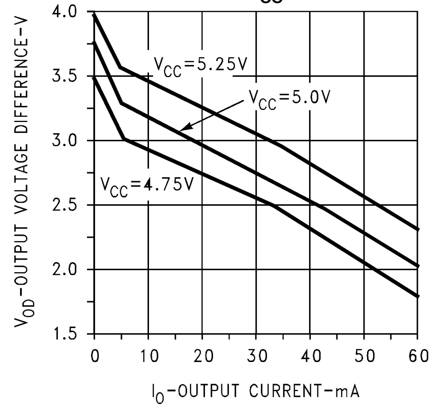


Figure 20.

Receiver Differential Propagation Delay vs Temperature

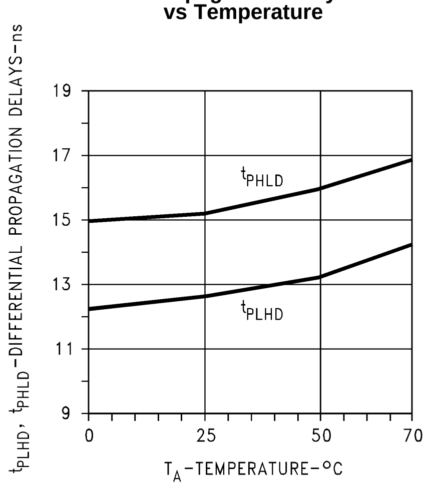


Figure 21.

Receiver Differential Propagation Delay vs V_{CC}

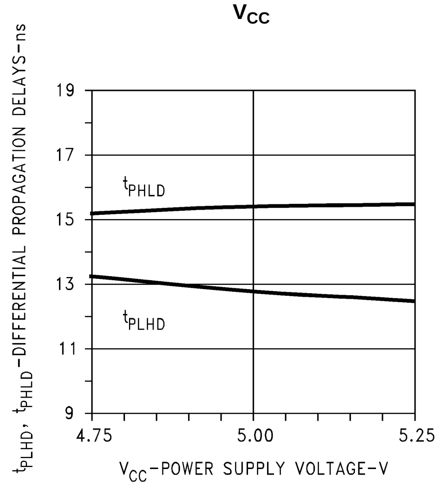


Figure 22.

Receiver V_{OH} vs I_{OH} vs Temperature

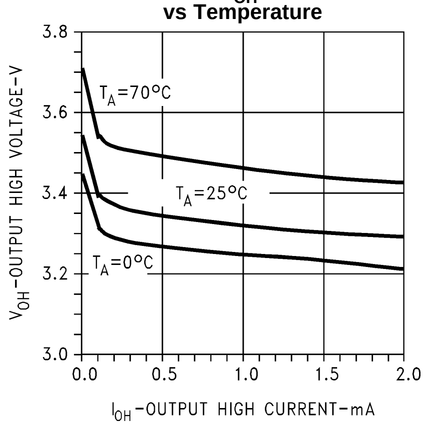


Figure 23.

Receiver V_{OH} vs I_{OH} vs V_{CC}

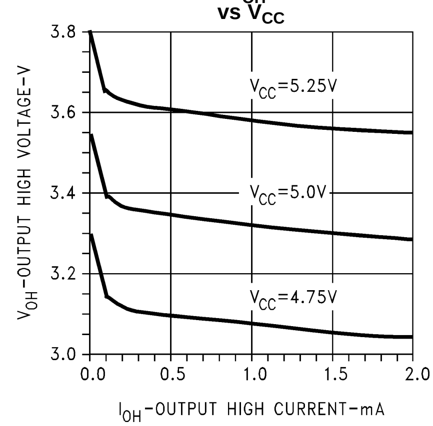


Figure 24.

Typical Performance Characteristics (continued)

Receiver V_{OL} vs I_{OL} vs Temperature

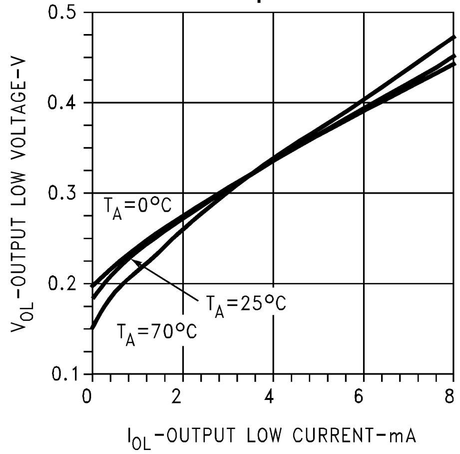


Figure 25.

Receiver V_{OL} vs I_{OL} vs V_{CC}

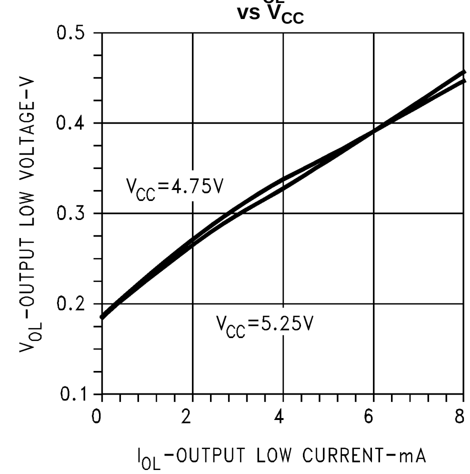


Figure 26.

Supply Current vs Temperature

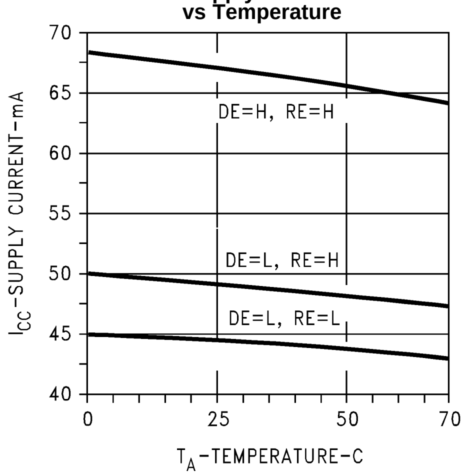


Figure 27.

Power Supply Current vs Power Supply Voltage

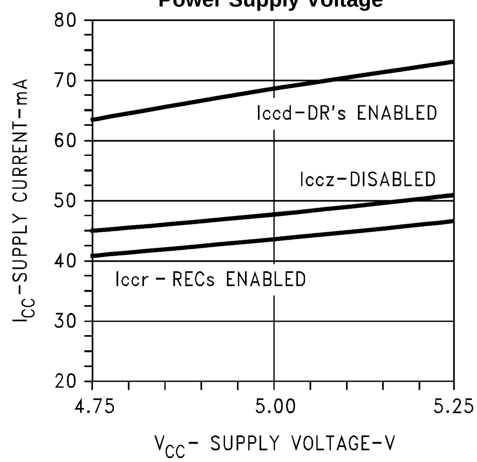


Figure 28.

Driver I_{CC} vs Switching Frequency

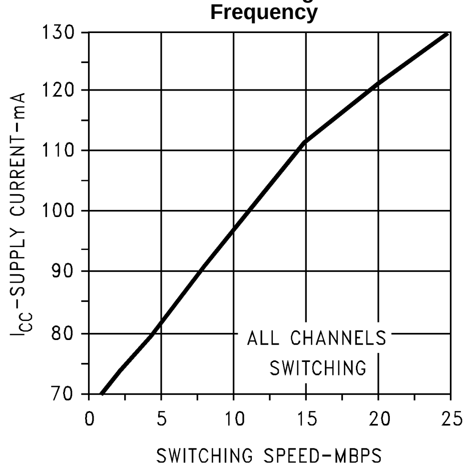


Figure 29.

REVISION HISTORY

Changes from Revision B (February 2013) to Revision C	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/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
DS36950VX	ACTIVE	PLCC	FN	20		TBD	Call TI	Call TI	0 to 70	DS36950V	Samples
DS36950VX/NOPB	ACTIVE	PLCC	FN	20	1000	Green (RoHS & no Sb/Br)	CU SN	Level-2A-250C-4 WEEK	0 to 70	DS36950V	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) 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.

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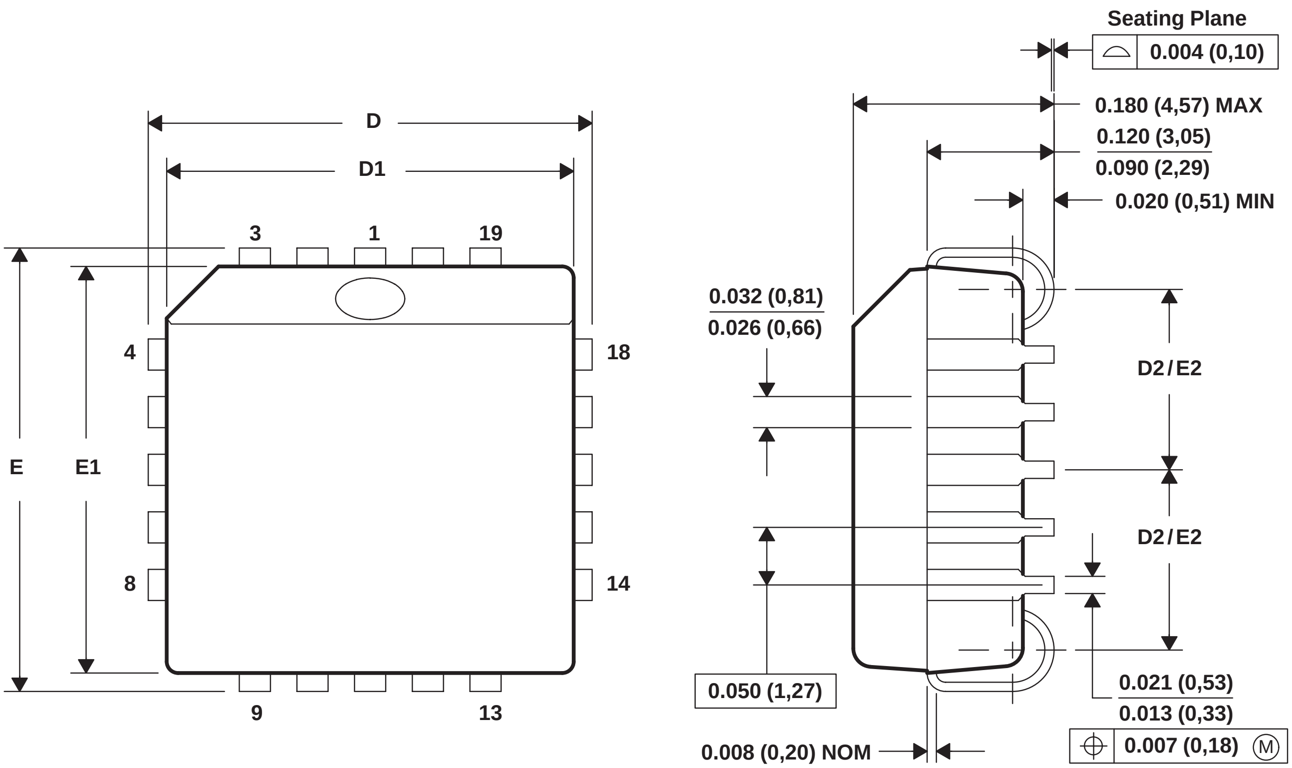
MPLC004A – OCTOBER 1994

FN (S-PQCC-J**) PLASTIC J-LEADED CHIP CARRIER

20 PIN SHOWN



NO. OF PINS **	D / E		D1 / E1		D2 / E2	
	MIN	MAX	MIN	MAX	MIN	MAX
20	0.385 (9,78)	0.395 (10,03)	0.350 (8,89)	0.356 (9,04)	0.141 (3,58)	0.169 (4,29)
28	0.485 (12,32)	0.495 (12,57)	0.450 (11,43)	0.456 (11,58)	0.191 (4,85)	0.219 (5,56)
44	0.685 (17,40)	0.695 (17,65)	0.650 (16,51)	0.656 (16,66)	0.291 (7,39)	0.319 (8,10)
52	0.785 (19,94)	0.795 (20,19)	0.750 (19,05)	0.756 (19,20)	0.341 (8,66)	0.369 (9,37)
68	0.985 (25,02)	0.995 (25,27)	0.950 (24,13)	0.958 (24,33)	0.441 (11,20)	0.469 (11,91)
84	1.185 (30,10)	1.195 (30,35)	1.150 (29,21)	1.158 (29,41)	0.541 (13,74)	0.569 (14,45)

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NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS-018

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