CLASS V 2x2 LVDS CROSSPOINT SWITCH

Check for Samples: SN55LVCP22-SP

FEATURES

- **High Speed (>1000 Mbps) Upgrade for DS90CP22 2x2 LVDS Crosspoint Switch**
- **Low-Jitter Fully Differential Data Path**
- **50 ps (Typ), of Peak-to-Peak Jitter With PRBS = 2^{23}–1 Pattern**
- **Less Than 200 mW (Typ), 300 mW (Max) Total Power Dissipation**
- **Output (Channel-to-Channel) Skew Is 80 ps (Typ)**
- **Configurable as 2:1 Mux, 1:2 Demux, Repeater or 1:2 Signal Splitter**
- **Inputs Accept LVDS, LVPECL, and CML Signals**
- **Fast Switch Time of 1.7 ns (Typ)**
- **Fast Propagation Delay of 0.65 ns (Typ)**
- **Available in 16 pin CFP Package**
- **Inter-Operates With TIA/EIA-644-A LVDS Standard**
- **Military Temperature Range: –55°C to 125°C**

APPLICATIONS

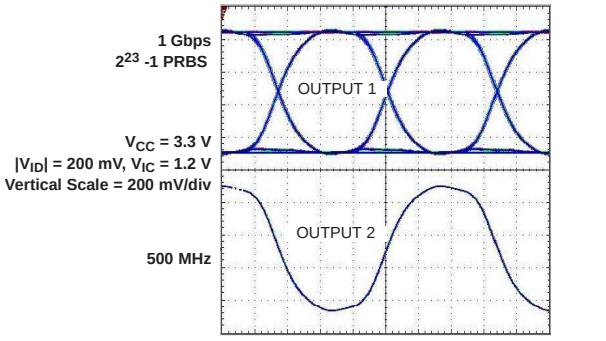
- **Base Stations**
- **Add/Drop Muxes**
- **Protection Switching for Serial Backplanes**
- **Network Switches/Routers**
- **Optical Networking Line Cards/Switches**
- **Clock Distribution**

DESCRIPTION

The SN55LVCP22 is a 2×2 crosspoint switch providing greater than 1000 Mbps operation for each path. The dual channels incorporate wide common-mode (0 V to 4 V) receivers, allowing for the receipt of LVDS, LVPECL, and CML signals. The dual outputs are LVDS drivers to provide low-power, low-EMI, high-speed operation. The SN55LVCP22 provides a single device supporting 2:2 buffering (repeating), 1:2 splitting, 2:1 multiplexing, 2×2 switching, and LVPECL/CML to LVDS level translation on each channel. The flexible operation of the SN55LVCP22 provides a single device to support the redundant serial bus transmission needs (working and protection switching cards) of fault-tolerant switch systems found in optical networking, wireless infrastructure, and data communications systems. TI offers additional gigabit repeater/ translator and crosspoint products in the SN65LVDS100 and SN65LVDS122.

The SN55LVCP22 uses a fully differential data path to ensure low-noise generation, fast switching times, low pulse width distortion, and low jitter. Output channel-to- channel skew is 80 ps (typ) to ensure accurate alignment of outputs in all applications. Both SOIC and TSSOP package options are available to allow easy upgrade for existing solutions, and board area savings where space is critical.

OUTPUTS OPERATING SIMULTANEOUSLY



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

Table 1. PACKAGE/ORDERING INFORMATION(1)

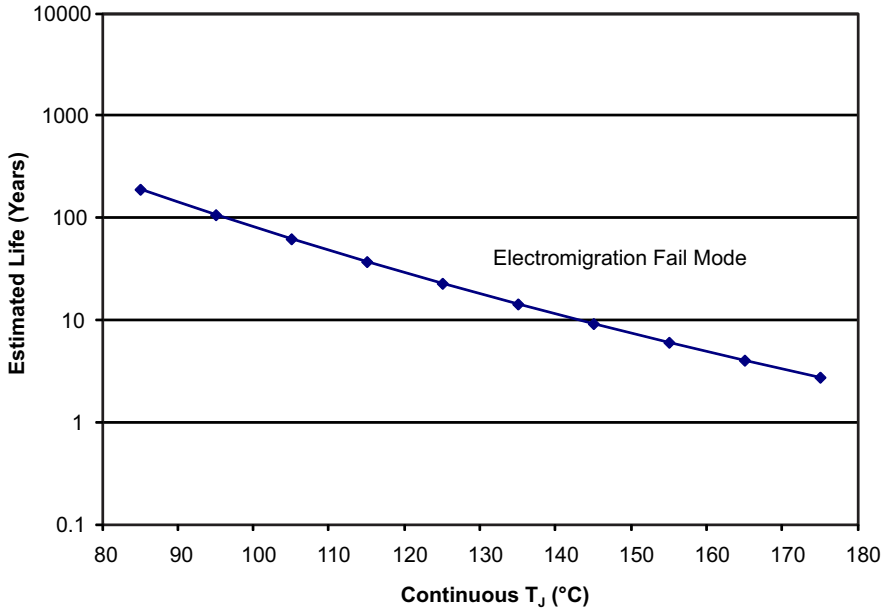
TEMPERATURE	PACKAGE(2)	ORDERABLE PART NUMBER	TOP-SIDE MARKING
–55°C to 125°C T_{case}	16 / W	5962-1124201VFA	5962-1124201VFA LVCP22W-SP
25°C		SN55LVCP22WMPR	SN55LVCP22W/EM(2) EVAL ONLY

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.

(2) These units are intended for engineering evaluation only. They are processed to a non-compliant flow (e.g. No Burn-In, etc.) and are tested to a temperature rating of 25°C only. These units are not suitable for qualification, production, radiation testing or flight use. Parts are not warranted for performance over the full MIL specified temperature range of -55°C to 125°C or operating life.

THERMAL CHARACTERISTICS

PARAMETER			TEST CONDITIONS	VALUE	UNITS
θ_{JA}	Junction-to-ambient thermal resistance			82.5	°C/W
θ_{JC}	Junction-to-case thermal resistance			7.5	°C/W
P_D	Device power dissipation	Typical	V_{CC} = 3.3 V, T_A = 25°C, 1 Gbps	198	mW
		Maximum	V_{CC} = 3.6 V, T_A = 125°C, 1 Gbps	313	



A. See datasheet for absolute maximum and minimum recommended operating conditions.

B. Silicon operating life design goal is 10 years at 105°C junction temperature (does not include package interconnect life).

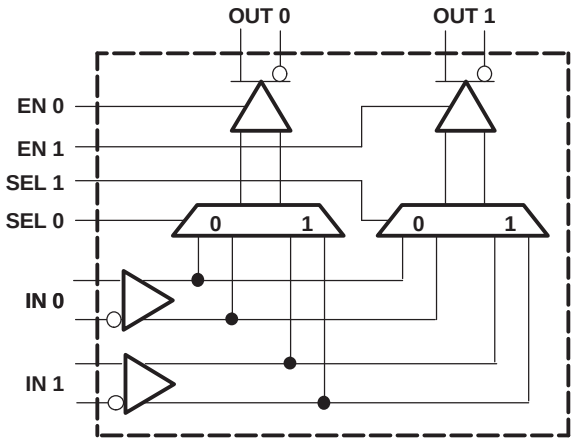
C. The predicted operating lifetime vs. junction temperature is based on reliability modeling using electromigration as the dominant failure mechanism affecting device wearout for the specific device process and design characteristics.

Figure 1. SN55LVCP22-SP Operating Life Derating Chart

Table 2. FUNCTION TABLE

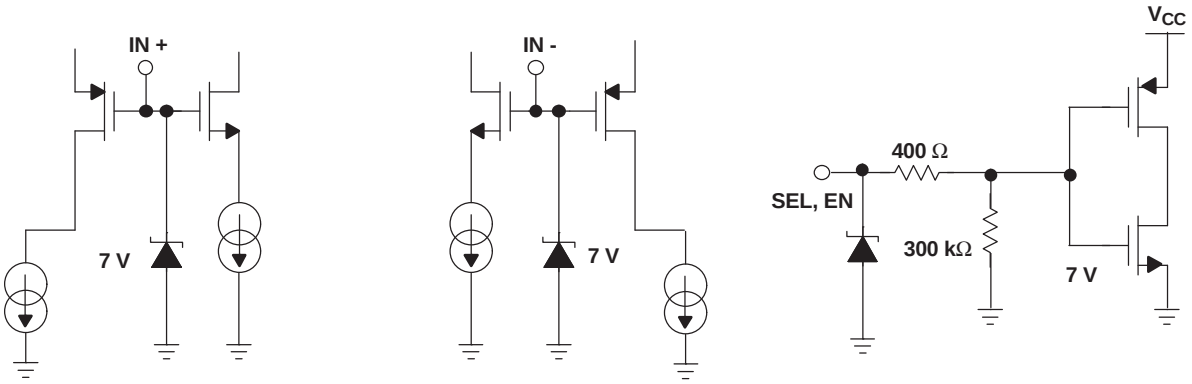
SEL0	SEL1	OUT0	OUT1	FUNCTION
0	0	IN0	IN0	1:2 Splitter
0	1	IN0	IN1	Repeater
1	0	IN1	IN0	Switch
1	1	IN1	IN1	1:2 Splitter

FUNCTIONAL BLOCK DIAGRAM

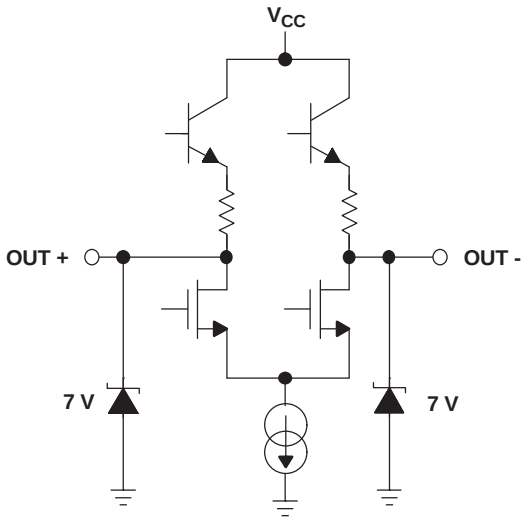


EQUIVALENT INPUT AND OUTPUT SCHEMATIC DIAGRAMS

INPUTS



OUTPUTS



ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range unless otherwise noted(1)

			UNITS
Supply voltage(2) range, V_{CC}			–0.5 V to 4 V
CMOS/TTL input voltage (ENO, EN1, SEL0, SEL1)			–0.5 V to 4 V
LVDS receiver input voltage (IN+, IN–)			–0.7 V to 4.3 V
LVDS driver output voltage (OUT+, OUT–)			–0.5 V to 4 V
LVDS output short circuit current			Continuous
Storage temperature range			–65°C to 125°C
Maximum Junction temperature			150°C
Electrostatic discharge	Human body model(3)	All pins	±5 kV
	Charged-device mode(4)	All pins	±500 V

(1) Stresses beyond those listed under *absolute maximum ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *recommended operating conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltage values, except differential I/O bus voltages, are with respect to network ground terminals.
(3) Tested in accordance with JEDEC Standard 22, Test Method A114-A.
(4) Tested in accordance with JEDEC Standard 22, Test Method C101.

RECOMMENDED OPERATING CONDITIONS

	MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}	3	3.3	3.6	V
Receiver input voltage	0		4	V
Operating Case Ttemperature range, T_C (1)	–55		125	°C
Magnitude of differential input voltage $\|V_{ID}\|$	0.1		3	V

(1) Maximum case temperature operation is allowed as long as the device maximum junction temperature is not exceeded.

INPUT ELECTRICAL CHARACTERISTICS

over recommended operating conditions unless otherwise noted

PARAMETER		TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
CMOS/TTL DC SPECIFICATIONS (EN0, EN1, SEL0, SEL1)						
V_{IH}	High-level input voltage		2		V_{CC}	V
V_{IL}	Low-level input voltage		GND		0.8	V
I_{IH}	High-level input current	V_{IN} = 3.6 V or 2.0 V, V_{CC} = 3.6 V	-25	±3	25	µA
I_{IL}	Low-level input current	V_{IN} = 0.0 V or 0.8 V, V_{CC} = 3.6 V	-15	±1	15	µA
V_{CL}	Input clamp voltage	I_{CL} = –18 mA		-0.8	-1.5	V
LVDS OUTPUT SPECIFICATIONS (OUT0, OUT1)						
$\|V_{OD}\|$	Differential output voltage	R_L = 75 Ω, See Figure 3	255	365	475	mV
		R_L = 75 Ω, V_{CC} = 3.3 V, T_A = 25°C, See Figure 3	285	365	440	
$\Delta\|V_{OD}\|$	Change in differential output voltage magnitude between logic states	V_{ID} = ±100 mV, See Figure 3	–25		25	mV
V_{OS}	Steady-state offset voltage	See Figure 4	1	1.2	1.45	V
ΔV_{OS}	Change in steady-state offset voltage between logic states	See Figure 4	–25		25	mV
$V_{OC(PP)}$	Peak-to-peak common-mode output voltage	See Figure 4		50		mV
I_{OZ}	High-impedance output current	V_{OUT} = GND or V_{CC}	-15		15	µA
I_{OFF}	Power-off leakage current	V_{CC} = 0 V, 1.5 V; V_{OUT} = 3.6 V or GND	-15		15	µA
I_{OS}	Output short-circuit current	V_{OUT+} or V_{OUT-}= 0 V			-8	mA
I_{OSB}	Both outputs short-circuit current	V_{OUT+} and V_{OUT-}= 0 V	–8		8	mA
C_O	Differential output capacitance	V_I = 0.4 sin(4E6πt) + 0.5 V		3		pF
LVDS RECEIVER DC SPECIFICATIONS (IN0, IN1)						
V_{TH}	Positive-going differential input voltage threshold	See Figure 2 and Table 3			100	mV
V_{TL}	Negative-going differential input voltage threshold	See Figure 2 and Table 3	–100			mV
$V_{ID(HYS)}$	Differential input voltage hysteresis			25	150	mV
V_{CMR}	Common-mode voltage range	V_{ID} = 100 mV, V_{CC} = 3.0 V to 3.6 V	0.05		3.95	V
I_{IN}	Input current	V_{IN} = 4 V, V_{CC} = 3.6 V or 0.0	-18	±1	18	µA
		V_{IN} = 0 V, V_{CC} = 3.6V or 0.0	-18	±1	18	
C_{IN}	Differential input capacitance	V_I = 0.4 sin (4E6πt) + 0.5 V		3		pF
SUPPLY CURRENT						
I_{CCQ}	Quiescent supply current	R_L = 75 Ω, EN0=EN1=High		60	87	mA
I_{CCD}	Total supply current	R_L = 75 Ω, C_L = 5 pF, 500 MHz (1000 Mbps), EN0=EN1=High		63	87	mA
I_{CCZ}	3-state supply current	EN0 = EN1 = Low		25	35	mA

(1) All typical values are at 25°C and with a 3.3-V supply.

SWITCHING CHARACTERISTICS

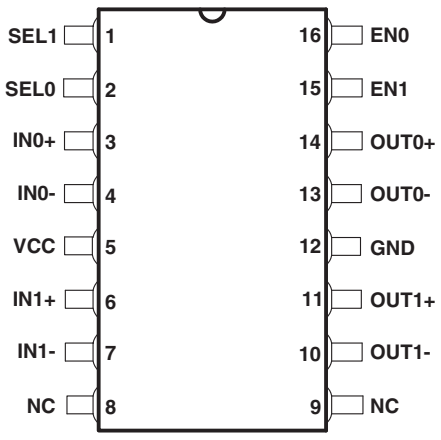
over recommended operating conditions unless otherwise noted

parameter		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{SET}	Input to SEL setup time	See Figure 7	2.2	0.8		ns
t_{HOLD}	Input to SEL hold time	See Figure 7	2.2	1.0		ns
t_{SWITCH}	SEL to switched output	See Figure 7		1.7	2.6	ns
t_{PHZ}	Disable time, high-level-to-high-impedance	See Figure 6		2	8	ns
t_{PLZ}	Disable time, low-level-to-high-impedance	See Figure 6		2	8	ns
t_{PZH}	Enable time, high-impedance -to-high-level output	See Figure 6		2	8	ns
t_{PZL}	Enable time, high-impedance-to-low-level output	See Figure 6		2	8	ns
t_{LHT}	Differential output signal rise time (20%-80%)(1)	C_L = 5 pF, See Figure 5		280	620	ps
t_{HLT}	Differential output signal fall time (20%-80%)(1)	C_L = 5 pF, See Figure 5		280	620	ps
t_{JIT}	Added peak-to-peak jitter	V_{ID} = 200 mV, 50% duty cycle, V_{CM} = 1.2 V, 500 MHz, C_L = 5 pF		20		ps
		V_{ID} = 200 mV, PRBS = 2^{23}-1 data pattern, V_{CM} = 1.2 V at 1000 Mbps, C_L = 5 pF		50		ps
t_{Jrms}	Added random jitter (rms)	V_{ID} = 200 mV, 50% duty cycle, V_{CM} = 1.2 V at 500 MHz, C_L = 5 pF		1.1		ps_{RMS}
t_{PLHD}	Propagation delay time, low-to-high-level output(1)		200	650	2350	ps
t_{PHLD}	Propagation delay time, high-to-low-level output(1)		200	650	2350	ps
t_{skew}(2)	Pulse skew ($\lvert t_{PLHD} - t_{PHLD} \rvert$)(3)	C_L = 5 pF, See Figure 5		45	160	ps
t_{CCS}	Output channel-to-channel skew, splitter mode	C_L = 5 pF, See Figure 5		80		ps
f_{MAX}(2)	Maximum operating frequency(4)		1			GHz

(1) Input: V_{IC} = 1.2 V, V_{ID} = 200 mV, 50% duty cycle, 1 MHz, t_r/t_f = 500 ps
(2) Pulse Skew and fMAX parameters are guaranteed by characterization, but not production tested.
(3) t_{skew} is the magnitude of the time difference between the t_{PLHD} and t_{PHLD} of any output of a single device.
(4) Signal generator conditions: 50% duty cycle, t_r or t_f ≤ 100 ps (10% to 90%), transmitter output criteria: duty cycle = 45% to 55% V_{OD} ≥ 300 mV.

PIN ASSIGNMENTS

W PACKAGE
(TOP VIEW)



NC - No internal connection

PARAMETER MEASUREMENT INFORMATION

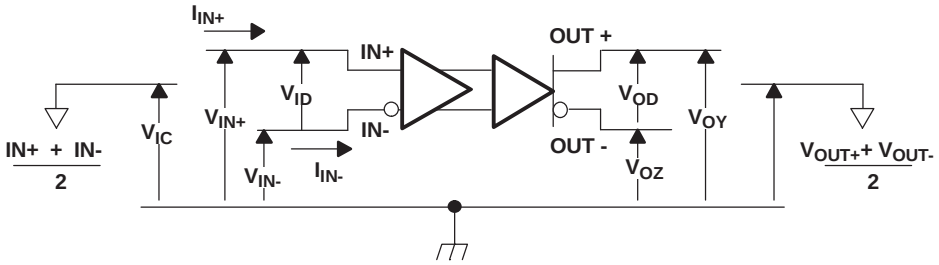


Figure 2. Voltage and Current Definitions

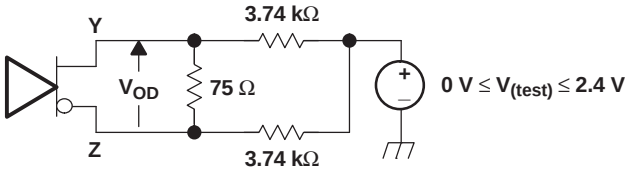
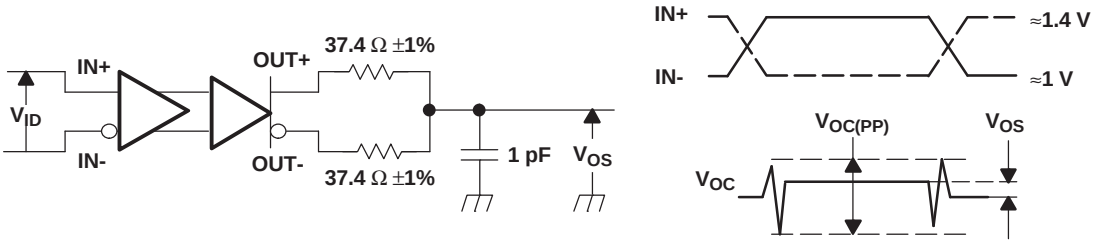


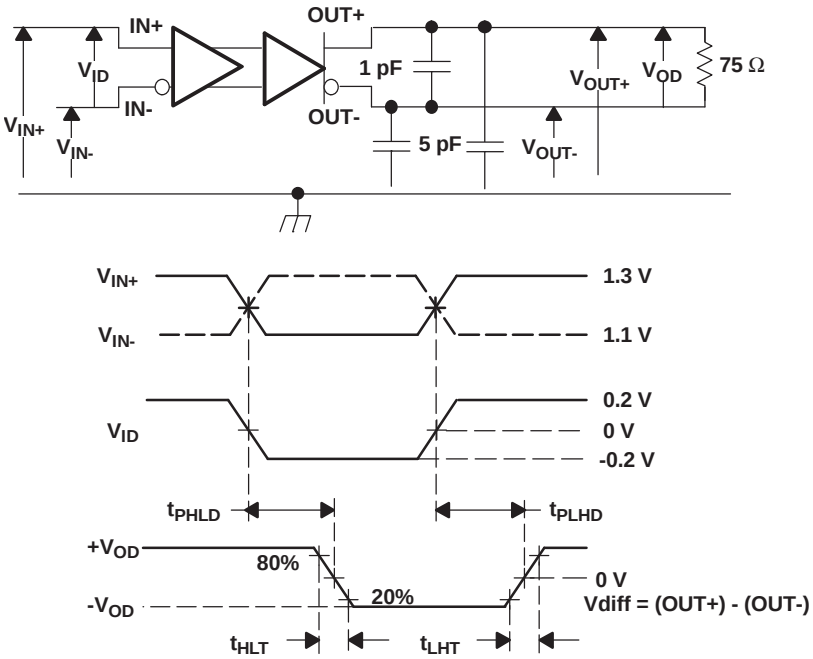
Figure 3. Differential Output Voltage (V_{OD}) Test Circuit



NOTE: All input pulses are supplied by a generator having the following characteristics: t_r or t_f ≤ 1 ns, pulse-repetition rate (PRR) = 0.5 Mpps, pulse width = 500 ±10 ns; R_L = 100 Ω; C_L includes instrumentation and fixture capacitance within 0,06 mm of the D.U.T.; the measurement of $V_{OC(PP)}$ is made on test equipment with a –3 dB bandwidth of at least 300 MHz.

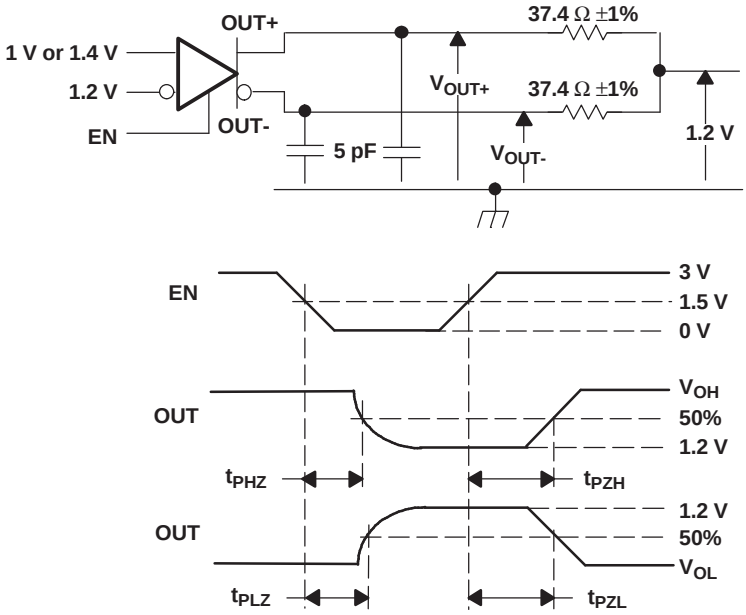
Figure 4. Test Circuit and Definitions for the Driver Common-Mode Output Voltage

PARAMETER MEASUREMENT INFORMATION (continued)



NOTE: All input pulses are supplied by a generator having the following characteristics: t_r or t_f ≤ .25 ns, pulse-repetition rate (PRR) = 0.5 Mpps, pulse width = 500 ± 10 ns. C_L includes instrumentation and fixture capacitance within 0,06 mm of the D.U.T.

Figure 5. Timing Test Circuit and Waveforms



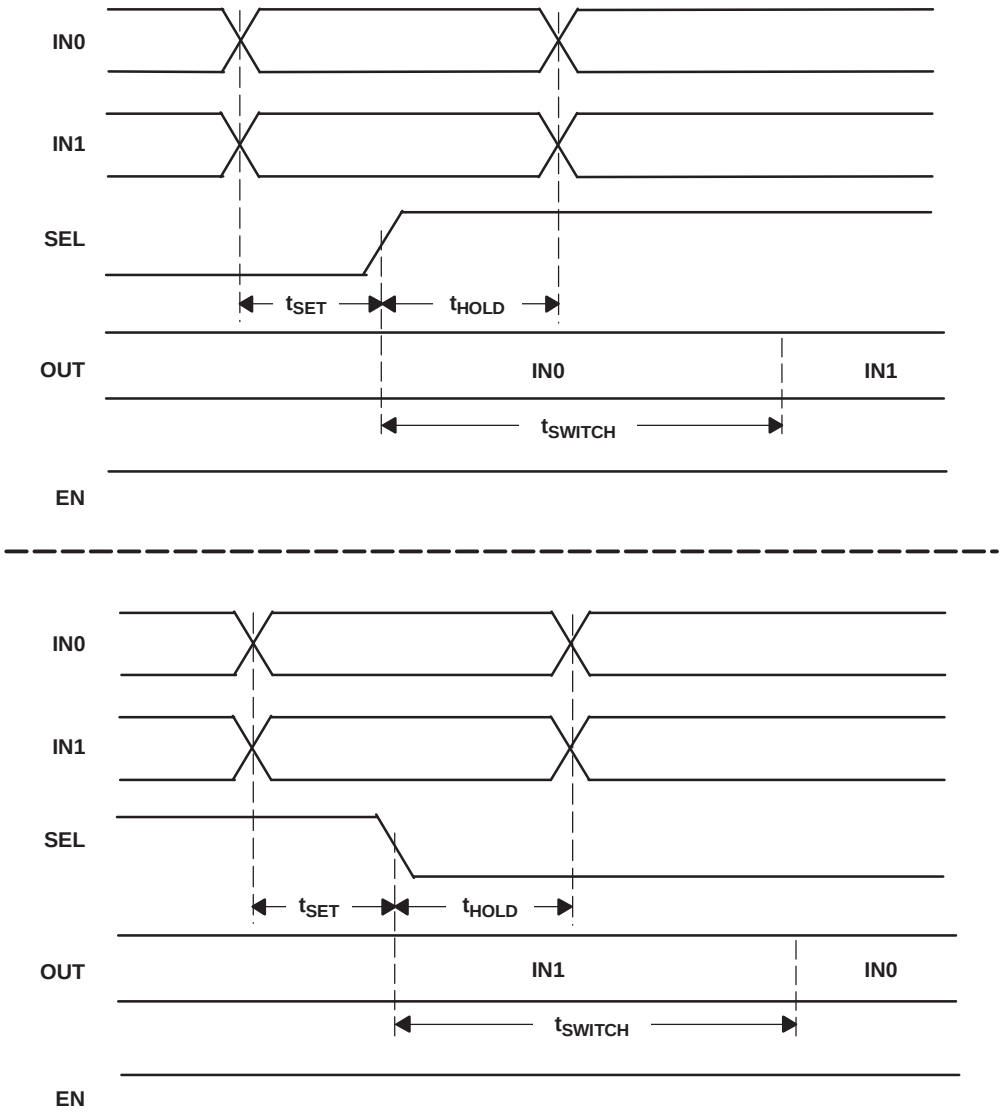
NOTE: All input pulses are supplied by a generator having the following characteristics: t_r or t_f ≤ 1 ns, pulse-repetition rate (PRR) = 0.5 Mpps, pulse width = 500 ± 10 ns. C_L includes instrumentation and fixture capacitance within 0,06 mm of the D.U.T.

Figure 6. Enable and Disable Time Circuit and Definitions

Table 3. Receiver Input Voltage Threshold Test

APPLIED VOLTAGES		RESULTING DIFFERENTIAL INPUT VOLTAGE	RESULTING COMMON-MODE INPUT VOLTAGE	OUTPUT(1)
V_{IA}	V_{IB}	V_{ID}	V_{IC}	
1.25 V	1.15 V	100 mV	1.2 V	H
1.15 V	1.25 V	–100 mV	1.2 V	L
4.0 V	3.9 V	100 mV	3.95 V	H
3.9 V	4. 0 V	–100 mV	3.95 V	L
0.1 V	0.0 V	100 mV	0.05 V	H
0.0 V	0.1 V	–100 mV	0.05 V	L
1.7 V	0.7 V	1000 mV	1.2 V	H
0.7 V	1.7 V	–1000 mV	1.2 V	L
4.0 V	3.0 V	1000 mV	3.5 V	H
3.0 V	4.0 V	–1000 mV	3.5 V	L
1.0 V	0.0 V	1000 mV	0.5 V	H
0.0 V	1.0 V	–1000 mV	0.5 V	L

(1) H = high level, L = low level



NOTE: t_{SET} and t_{HOLD} times specify that data must be in a stable state before and after mux control switches.

Figure 7. Input to Select for Both Rising and Falling Edge Setup and Hold Times

TYPICAL CHARACTERISTICS

DIFFERENTIAL OUTPUT VOLTAGE vs RESISTIVE LOAD

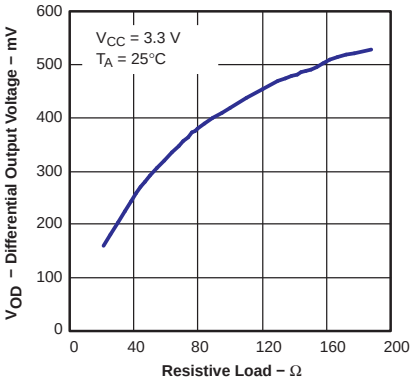


Figure 8.

SUPPLY CURRENT vs FREQUENCY

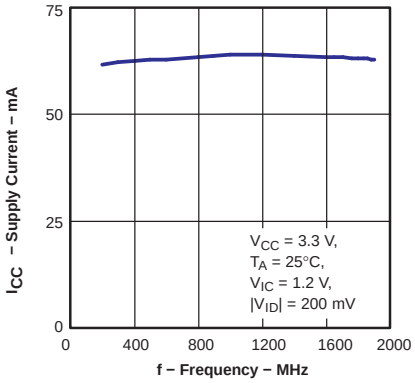


Figure 9.

PROPAGATION DELAY TIME vs FREE-AIR TEMPERATURE

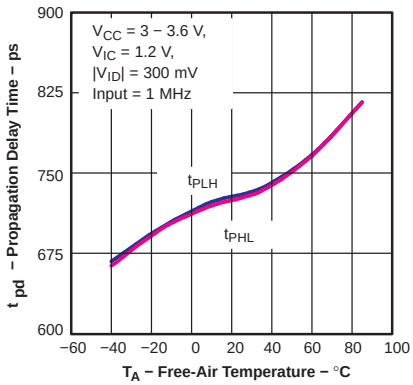


Figure 10.

PEAK-TO-PEAK JITTER vs FREQUENCY

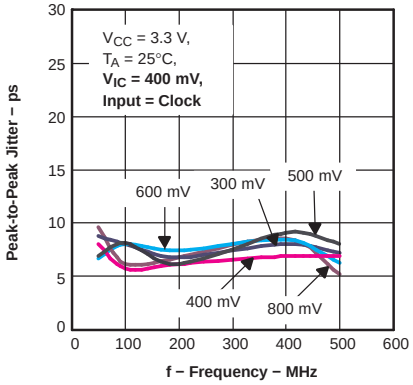


Figure 11.

PEAK-TO-PEAK JITTER vs DATA RATE

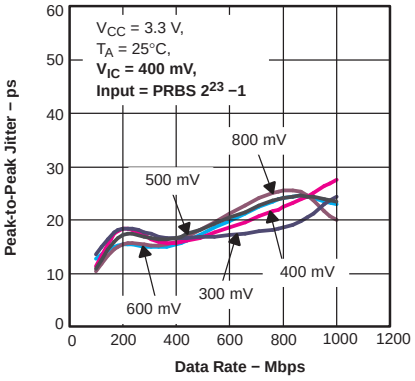


Figure 12.

PEAK-TO-PEAK JITTER vs FREQUENCY

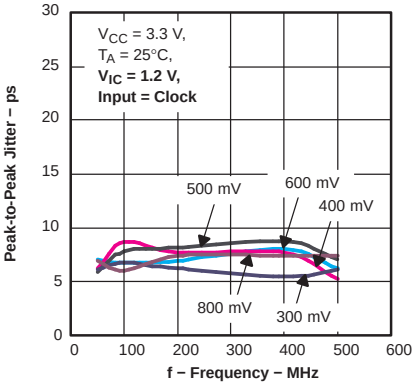


Figure 13.

PEAK-TO-PEAK JITTER vs DATA RATE

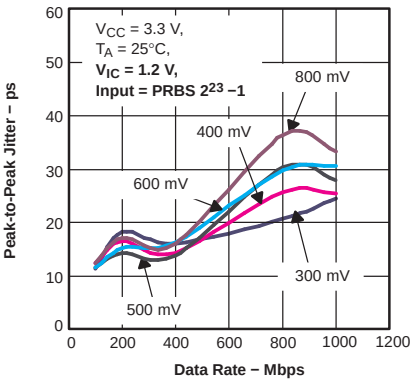


Figure 14.

PEAK-TO-PEAK JITTER vs FREQUENCY

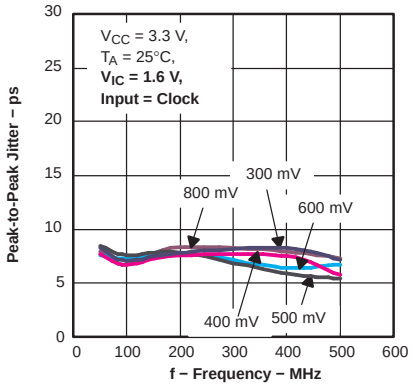


Figure 15.

PEAK-TO-PEAK JITTER vs DATA RATE

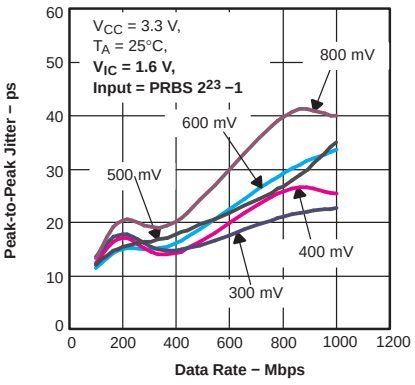


Figure 16.

TYPICAL CHARACTERISTICS (continued)

PEAK-TO-PEAK JITTER vs FREQUENCY

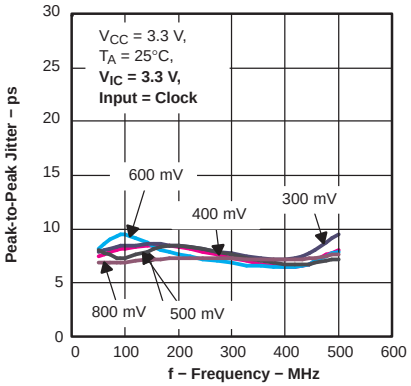


Figure 17.

PEAK-TO-PEAK JITTER vs DATA RATE

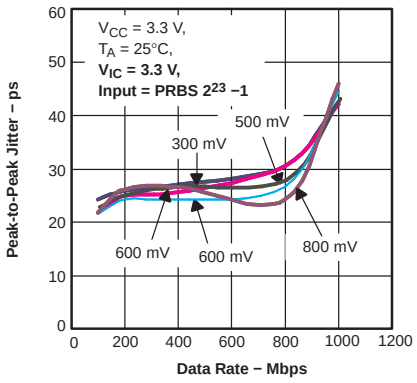


Figure 18.

DIFFERENTIAL OUTPUT VOLTAGE vs FREQUENCY

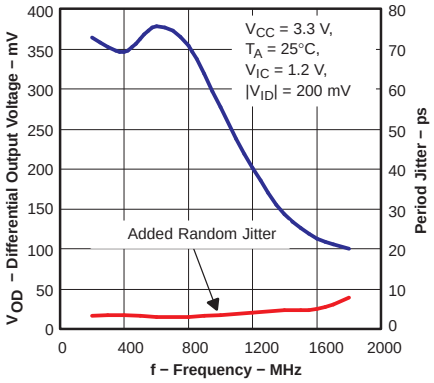


Figure 19.

PEAK-TO-PEAK JITTER vs DATA RATE

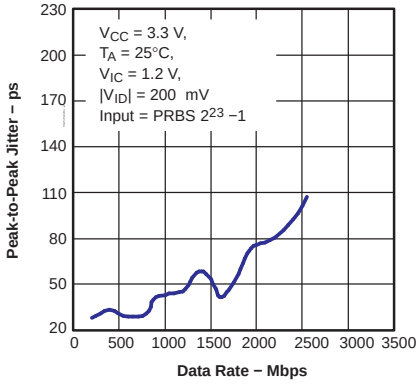


Figure 20.

APPLICATION INFORMATION

TYPICAL APPLICATION CIRCUITS (ECL, PECL, LVDS, etc.)

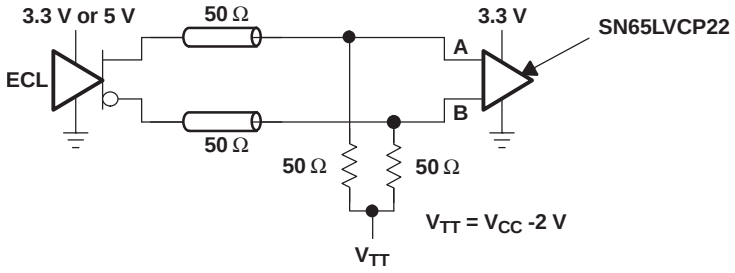


Figure 21. Low-Voltage Positive Emitter-Coupled Logic (LVPECL)

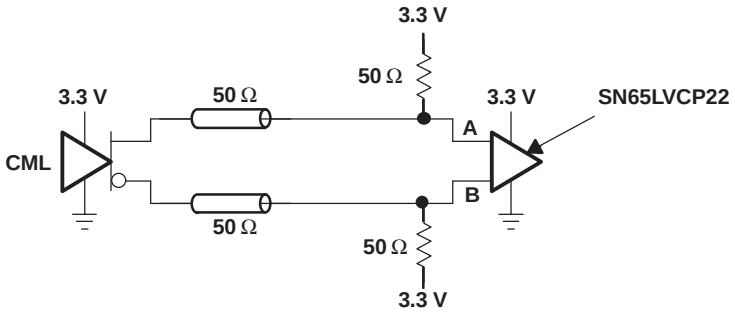


Figure 22. Current-Mode Logic (CML)

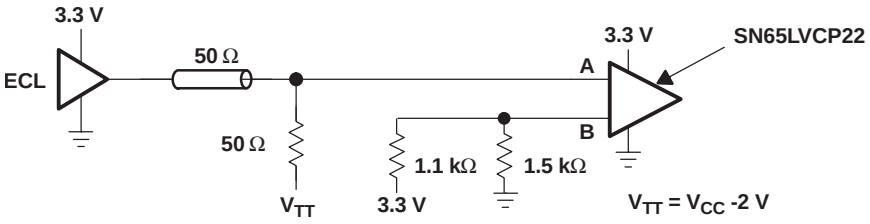


Figure 23. Single-Ended (LVPECL)

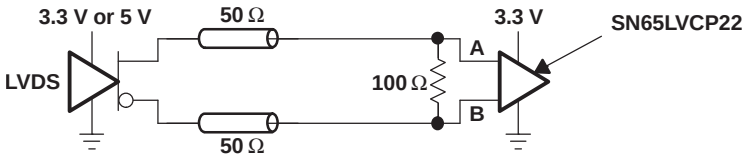


Figure 24. Low-Voltage Differential Signaling (LVDS)

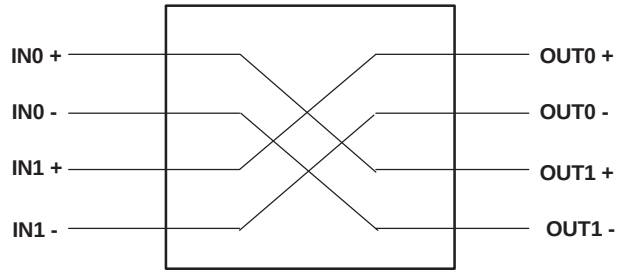


Figure 25. 2 x 2 Crosspoint

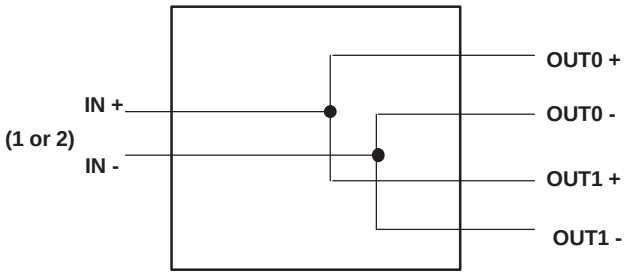


Figure 26. 1:2 Spitter

Figure 27. Dual Repeater

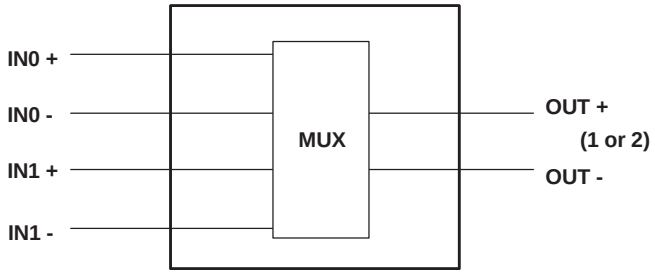


Figure 28. 2:1 MUX

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
5962-1124201VFA	ACTIVE	CFP	W	16	25	TBD	A42	N / A for Pkg Type	-55 to 125	5962-1124201VF A LVCP22W-SP	Samples
SN55LVCP22W/EM	PREVIEW	CFP	W	16		TBD	A42	N / A for Pkg Type	25degC	SN55LVCP22W/EM EVAL ONLY	

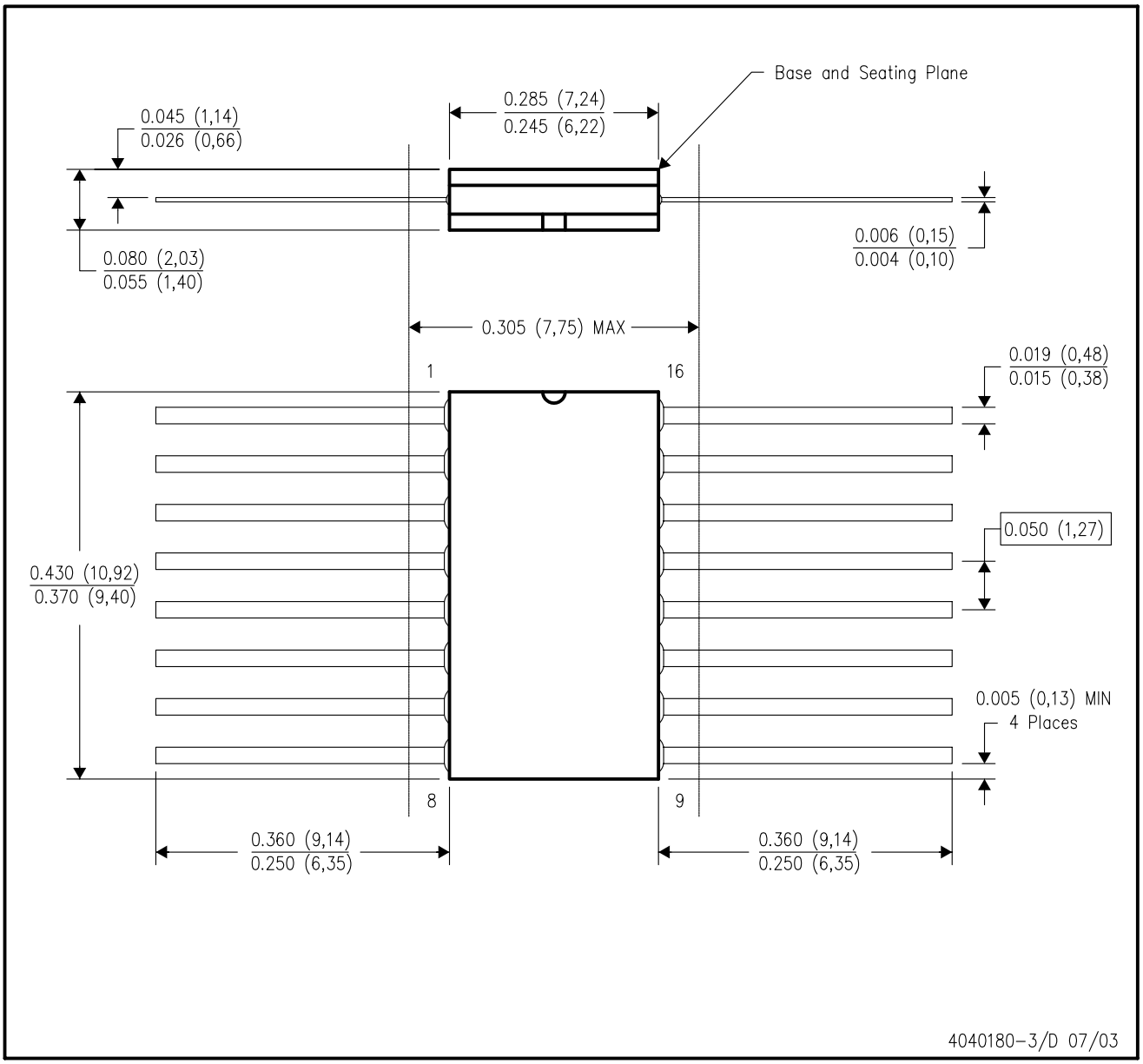
(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, 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.

W (R–GDFP–F16) CERAMIC DUAL FLATPACK



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification only.
E. Falls within MIL STD 1835 GDFP1–F16 and JEDEC MO–092AC

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