SY75572L

267 MHz 1:2 3.3V HCSL/LVDS Fanout Buffer

Features

- Two Differential Pairs of LVDS or HCSL Outputs
- Two Pairs of Differential Inputs Accept LVDS or HCSL Logic Levels
- 267 MHz Maximum Frequency
- Ultra-Low Phase Jitter:
  - 137 fs_{RMS}, 200 MHz (12 kHz - 20 MHz)
  - 153 fs_{RMS}, 156.25 MHz (12 kHz - 20 MHz)
  - 212 fs_{RMS}, 100 MHz (12 kHz - 20 MHz)
- <2 ps Total Jitter (peak-to-peak), 200 MHz (BER = 10^{-12})
- 50 ps Output-to-Output Skew
- 3.3V ±5% Power Supply Operation
- –40°C to +85°C Operating Temperature
- Available in 16-pin (3 mm × 3 mm) QFN Lead-Free Package

Applications

- Blade Servers
- Desktop Servers
- Workstations
- Storage Area Networks
- IP Routers and Switches
- Telecom and Datacom
- High Performance Computing

General Description

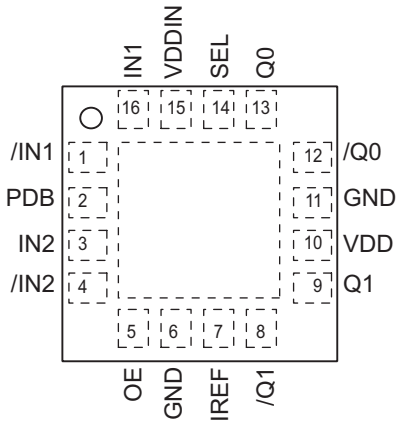
The SY75572L is a high-speed, fully differential 1:2 clock fanout buffer with a 2:1 input MUX optimized to provide two identical output copies with 137 fs phase jitter and a maximum of 50 ps output-to-output skew. Designed to be used with PCI Express applications, the SY75572L accepts and outputs HCSL or LVDS logic levels.

The SY75572L operates from a 3.3V ±5% power supply and is guaranteed over the full industrial temperature range (–40°C to +85°C). It is available in a 16-pin QFN lead-free package.

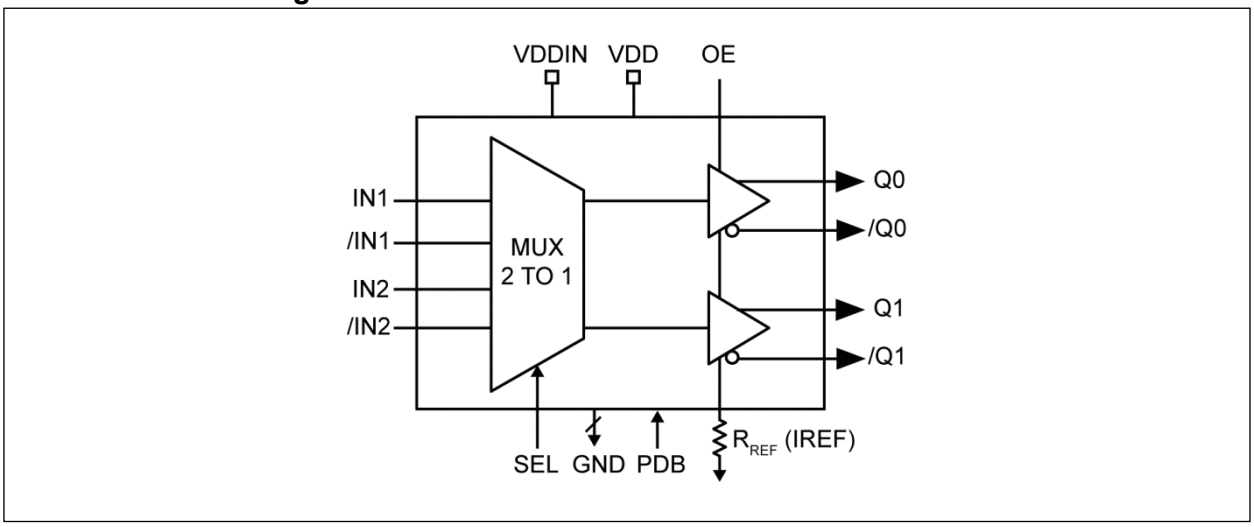
The SY75572L is part of Microchip's high-speed, ultra-low jitter, PrecisionEdge™ product line. The SY75572L supports PCIe Gen1-Gen4 requirements.

Package Type

SY75572L
16-Pin QFN



Functional Block Diagram



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Supply Voltage, V_{CC}, V_{DDIN} 5.5V
Input Voltage, V_{IN} ..... –0.5V to V_{DDIN} +0.5V
ESD Protection (Input) ..... 2 kV

Operating Ratings ††

Supply Voltage, V_{DD}, V_{DDIN} ..... 3.135V to 3.465V

† Notice: Permanent device damage may occur if absolute maximum ratings are exceeded. This is a stress rating only and functional operation is not implied at conditions other than those detailed in the operational sections of this data sheet. Exposure to absolute maximum ratings conditions for extended periods may affect device reliability.

†† Notice: The data sheet limits are not guaranteed if the device is operated beyond the operating ratings.

DC ELECTRICAL CHARACTERISTICS

Electrical Characteristics: V_{DD} = V_{DDIN} = 3.135V to 3.465V, T_A = –40°C to +85°C, unless otherwise stated. R_{REF} = 475Ω. (Note 1)

Parameters	Symbol	Min.	Typ.	Max.	Units	Conditions
Power Supply Voltage Range	V_{DD}, V_{DDIN}	3.135	3.3	3.465	V	—
Input Capacitance	C_{IN}	—	—	6	pF	—
Output Capacitance	C_{OUT}	—	—	5	pF	—
Pin Inductance	L_{PIN}	—	—	4	nH	—
Output Resistance	R_{OUT}	3	—	—	kΩ	—
Pull up Resistance	$R_{PULL-UP}$	—	110	—	kΩ	SEL, PDB, OE
Input High Voltage	V_{IH}	2	—	V_{DDIN} + 0.3	V	SEL, PDB, OE
Input Low Voltage	V_{IL}	–0.3	—	0.8	V	SEL, PDB, OE
Input High Voltage	V_{IH}	350	—	850	mV	HCSL, IN, /IN
Input Low Voltage	V_{IL}	–150	0	—	mV	HCSL, IN, /IN
Differential Input Voltage Range	V_{IN}	200	350	550	mV	LVDS, IN, /IN
Input Common Mode Voltage	$V_{INPUT\ OFFSET}$	1.125	1.25	1.375	V	LVDS, IN, /IN
Output High Voltage	V_{OH}	660	750	850	mV	HCSL
Output Low Voltage	V_{OL}	–150	0	27	mV	HCSL
Crossing Point Voltage Note 2, Note 3	V_{CROSS}	250	350	550	mV	Absolute
Variation of Crossing Point Voltage Note 2, Note 3, Note 4	$V_{CROSS\_VARIATION}$	—	—	140	mV	Variation over all edges
Power Supply Current For V_{DD} + V_{DDIN}	I_{DD}	—	42	60	mA	50Ω, 2 pF
		—	—	0.4		No load, PDB = Low
		—	—	20		OE = Logic Low
Input Leakage Current Note 5	I_{IL}	–5	—	5	µA	0 < V_{IN} < V_{DDIN}

Note 1: The circuit is designed to meet the DC specifications shown in the table above after thermal equilibrium has been established.

2: Test setup is R_L = 50Ω with 2 pF, R_{REF} = 475Ω ±1%.

3: Measurement taken from Q and /Q.

4: Measured at the crossing point where instantaneous voltages of Q and /Q are equal.

5: Inputs with pull-up/pull-down resistances are not included.

AC ELECTRICAL CHARACTERISTICS

Electrical Characteristics: V_{DD} = V_{DDIN} = 3.135V to 3.465V, T_A = –40°C to +85°C, unless otherwise stated. (Note 1)						
Parameters	**Symbol**	**Min.**	**Typ.**	**Max.**	**Units**	**Conditions**
Maximum Frequency	f_{MAX}	—	—	267	MHz	HCSL
		—	—	100		LVDS
Propagation Delay	t_{PD}	—	2	3	ns	Note 2
Output-to-Output skew	t_{SKEW}	—	—	50	ps	Note 3, Note 4
Output Rise/Fall Times 0.175V to 0.525V / 0.525V to 0.175V	t_r, t_f	150	350	700	ps	At full output swing. 50Ω, 2 pF
Rise/Fall Time Variation	t_{r/f_VAR}	—	—	125	ps	At full output swing. 50Ω, 2 pF
Phase Jitter	t_{JITTER}	—	137	—	fs_{RMS}	At 200 MHz
		—	153	—	fs_{RMS}	At 156.25 MHz
		—	212	—	fs_{RMS}	At 100 MHz
Total Jitter	t_{TJ_JITTER}	—	2	—	ps	BER = 10^{-12}, T_{DJ} = 0, at 200 MHz
Output Enable Time	t_{OE_ENABLE}	—	2	—	µs	All outputs
Output Disable Time	$t_{OE\_DISABLE}$	—	10	—	ns	All outputs
Duty Cycle	t_{DCY}	45	50	55	%	—

Note 1: The circuit is designed to meet the DC specifications shown in the table above after thermal equilibrium as been established.

2: Measured from the differential input crossing point to the differential output crossing point.

3: Output-to-output skew is the difference in time between outputs, receiving data from the same input, for the same temperature, voltage, and transition.

4: This parameter is defined in accordance with JEDEC Standard 65.

TEMPERATURE SPECIFICATIONS

Parameters	Symbol	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Operating Temperature Range	T_A	–40	—	+85	°C	—
Lead Temperature	—	—	—	+260	°C	Soldering, 20 sec.
Storage Temperature Range	T_S	–65	—	+150	°C	—
Package Thermal Resistance (Note 1)						
16-Pin QFN	θ_{JA}	—	59	—	°C/W	Still-Air
	ψ_{JB}	—	38	—	°C/W	Junction-to-board

Note 1: Package thermal resistance assumes exposed pad is soldered (or equivalent) to the device's most negative potential on the PCB. ψ_{JB} and θ_{JA} values are determined for a 4-layer board in still-air number, unless otherwise stated. The circuit is designed to meet the DC specifications shown in the above table after thermal equilibrium has been established.

2.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 2-1.

TABLE 2-1: PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	/IN1	HCSL/LVDS inverted input 1.
2	PDB	PDB = 0 powers down the chip and tri-states outputs. The pin is attached to an internal pull-up resistor.
3	IN2	HCSL/LVDS input 2.
4	/IN2	HCSL/LVDS inverted input 2.
5	OE	Tri-state outputs. High = enable outputs. Low = disable outputs. Internal pull-up resistor, outputs are enabled by default.
6	GND	Ground.
7	IREF	External resistor R_{REF} between pin IREF and GND controls reference current.
8	/Q1	Inverted Output 1.
9	Q1	Non-inverted Output 1.
10	VDD	3.3V power supply.
11	GND	Ground.
12	/Q0	Inverted Output 0.
13	Q0	Non-inverted Output 0.
14	SEL	SEL = 0 propagates IN2, /IN2 to outputs. SEL = 1 propagates IN1, /IN1 to outputs. Internal pull-up resistors, IN1, /IN1 is selected by default.
15	VDDIN	3.3V power supply.
16	IN1	HCSL/LVDS input 1.

3.0 JITTER ANALYSIS

Jitter is defined as the deviation of a signal from its ideal position. Phase noise is the presence of signal energy at frequencies other than the carrier. Random jitter has a Gaussian distribution and is specified as an RMS unit, which is one standard deviation of the distribution. Since Gaussian distribution is unbounded in an infinite sample, no communication system can be completely error free. Instead, communication links are rated with a maximum bit error rate (BER), which is typically around 10^{-12} for high-speed communication equipment. Achieving a desired BER requires accounting for a number of standard deviations of random noise by using the appropriate value for N (see Table 3-1) in the formula in Equation 3-1.

EQUATION 3-1:

$$T_J = N \times R_J + D_J$$

Where:

T_J = Total jitter
R_J = Random jitter
D_J = Deterministic jitter

If routing clock signals, the deterministic jitter is usually negligible and the T_J is dominated by the random jitter. Calculating T_J from R_J using Equation 3-1 gives the values in Table 3-1.

TABLE 3-1: STANDARD DEVIATIONS OF RANDOM NOISE

BER	N	R_J at 200 MHz	T_J at 200 MHz
10^{-10}	12.723	$137fs_{RMS}$	1.743 ps
10^{-11}	13.412	$137fs_{RMS}$	1.837 ps
10^{-12}	14.069	$137fs_{RMS}$	1.927 ps
10^{-13}	14.698	$137fs_{RMS}$	2.013 ps

4.0 PHASE NOISE PLOTS

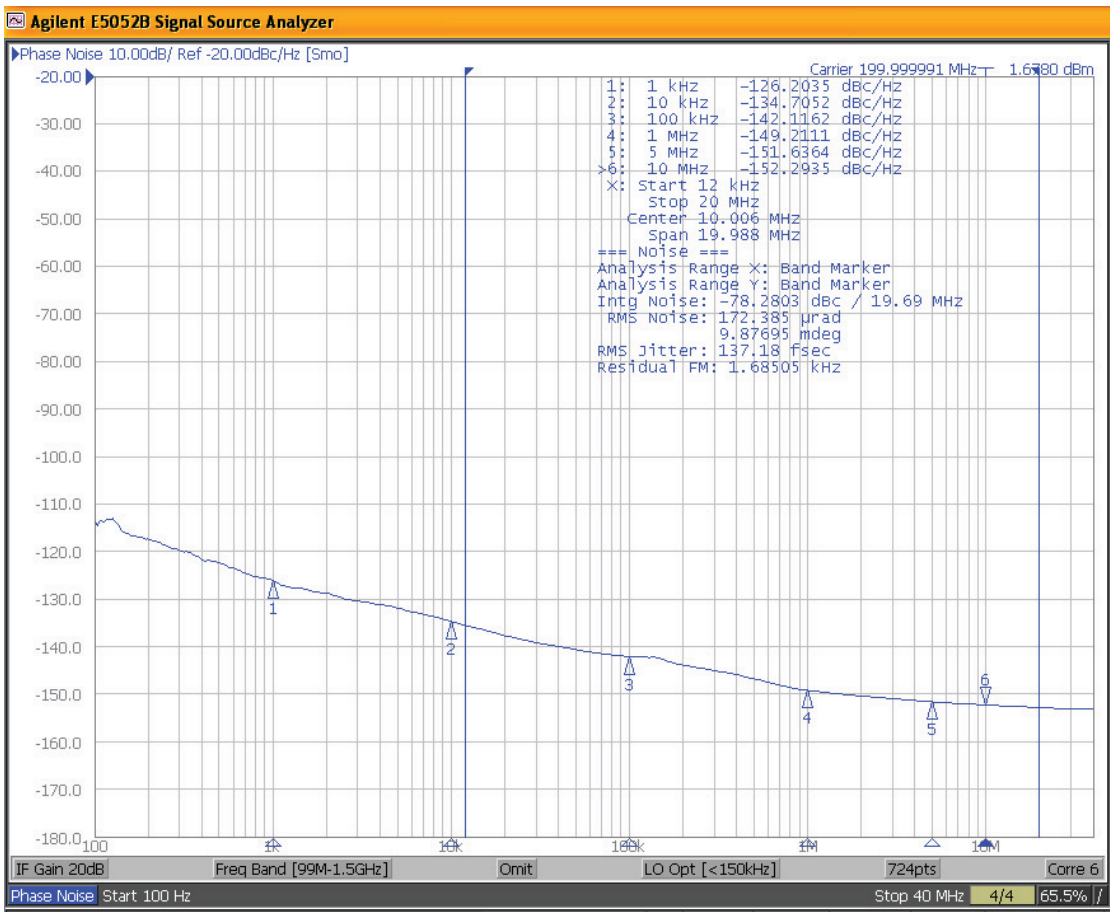


FIGURE 4-1: *Phase Jitter = 137 fsRMS, 200 MHz Carrier Frequency; Integration Range: 12 kHz - 20 MHz.*

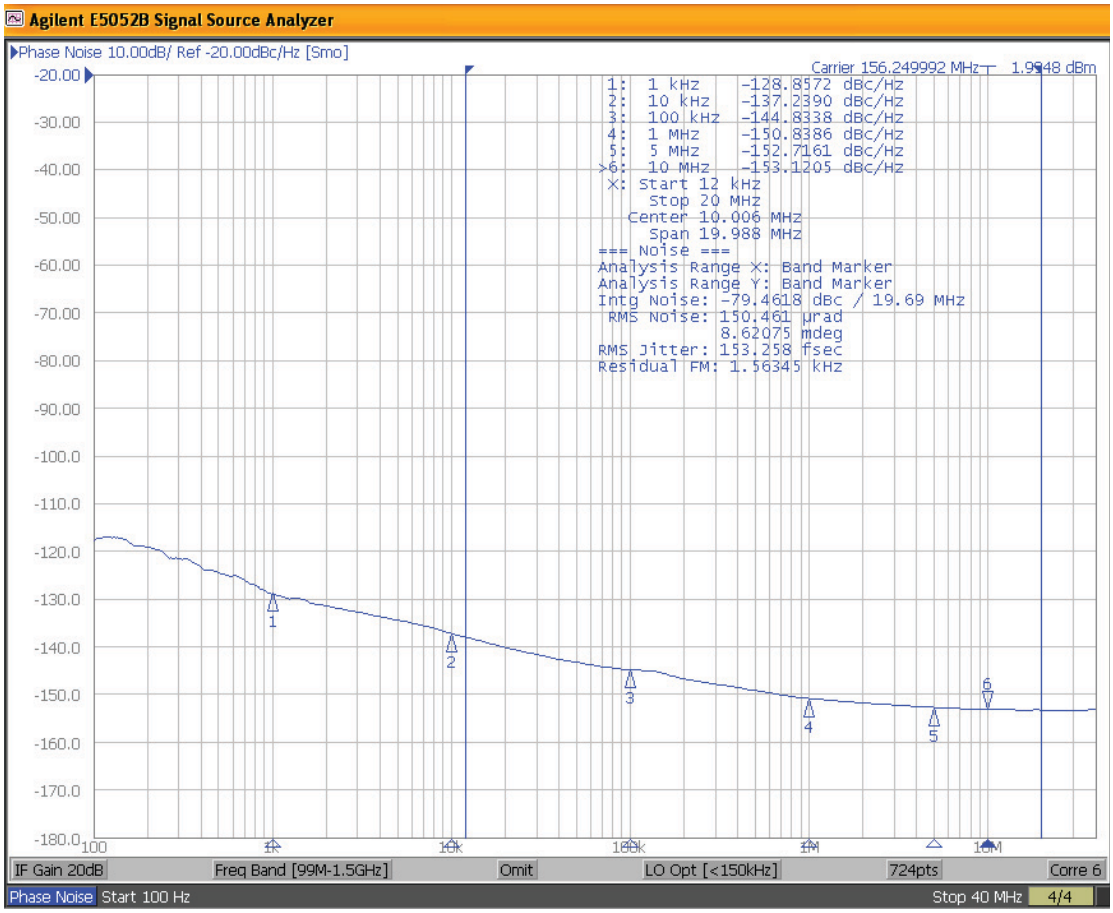


FIGURE 4-2: *Phase Jitter = 153 fsRMS, 156.25 MHz Carrier Frequency; Integration Range: 12 kHz - 20 MHz.*

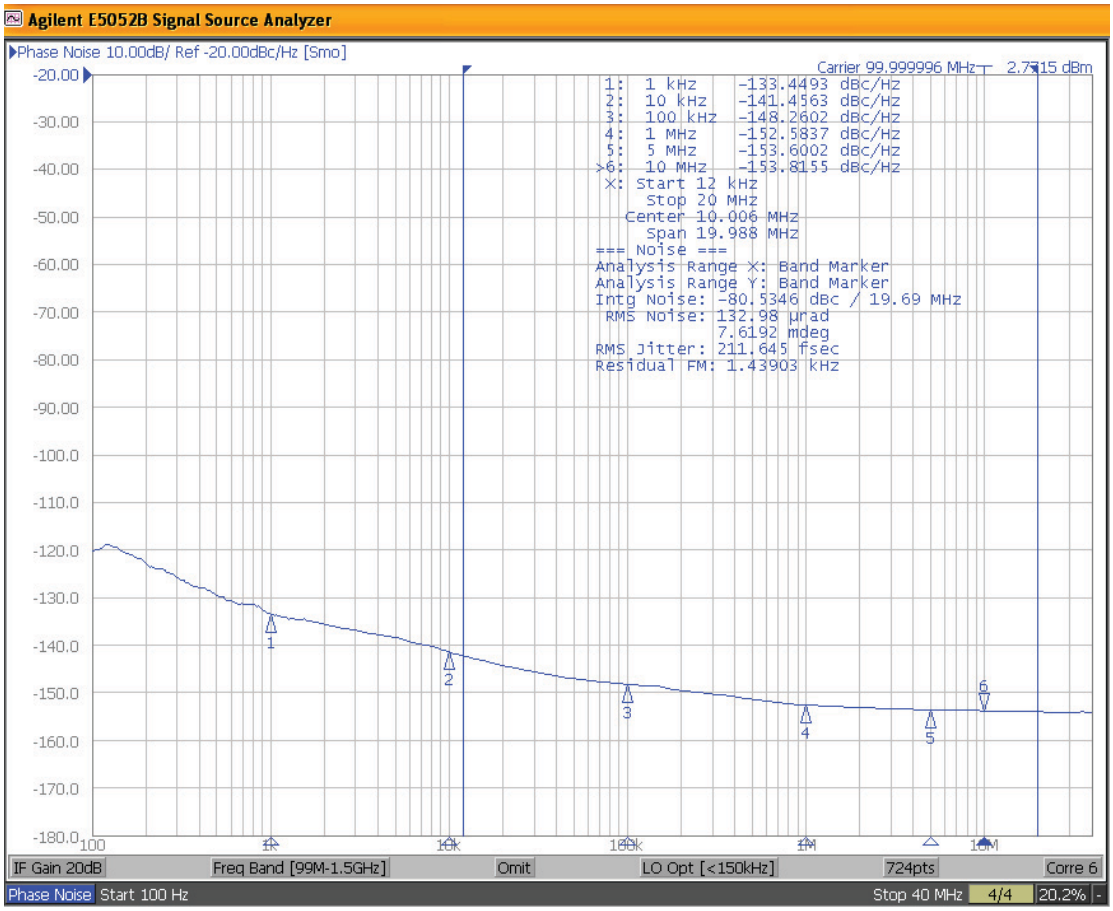
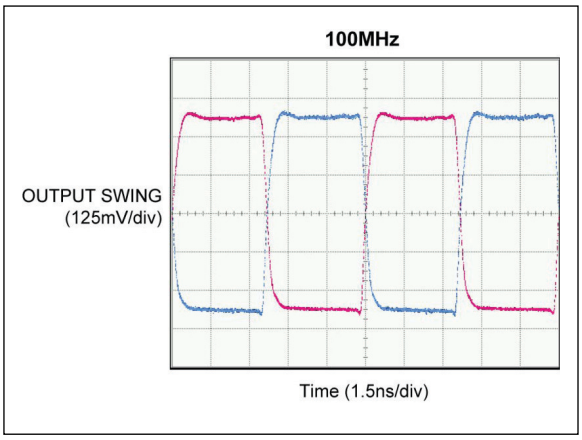


FIGURE 4-3: *Phase Jitter = 212 fs_{RMS}, 100 MHz Carrier Frequency; Integration Range: 12 kHz - 20 MHz.*

5.0 FUNCTIONAL CHARACTERISTICS



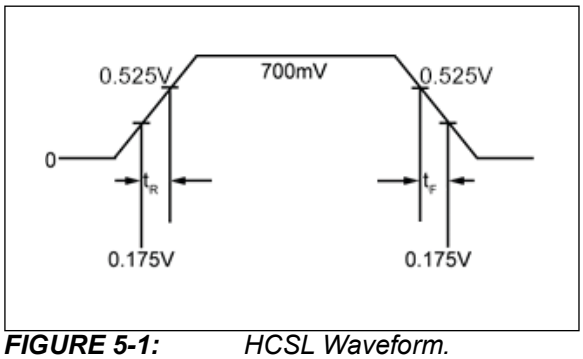


FIGURE 5-1: *HCSL Waveform.*

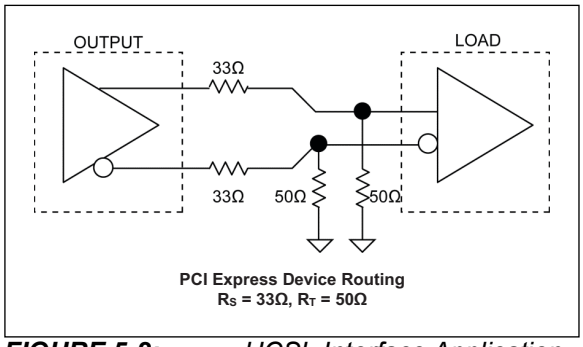


FIGURE 5-2: *HCSL Interface Application.*

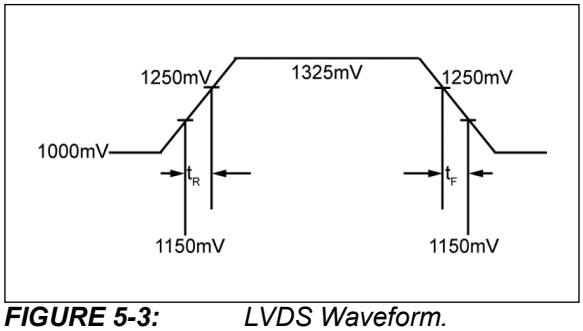


FIGURE 5-3: *LVDS Waveform.*

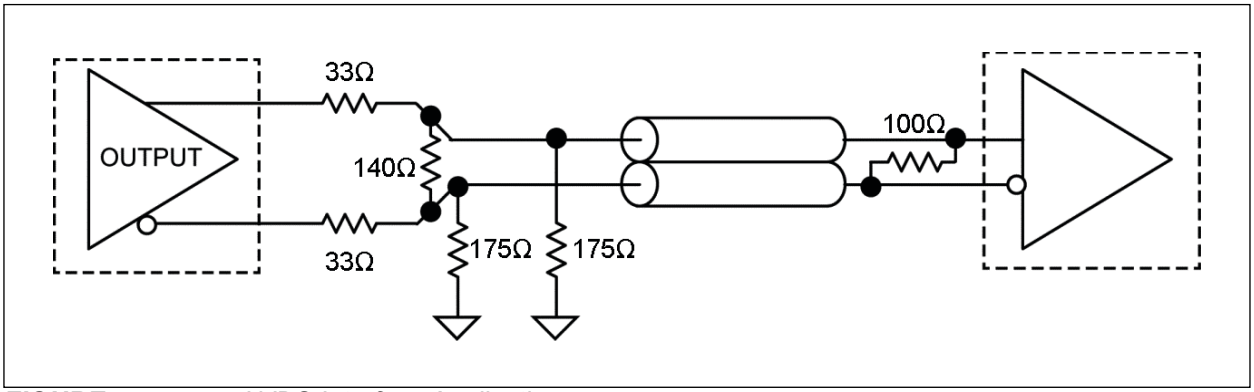


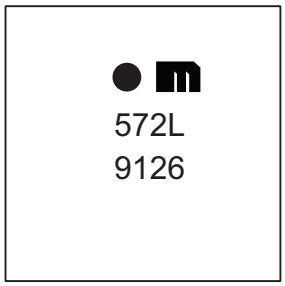
FIGURE 5-4: *LVDS Interface Application.*

6.0 PACKAGING INFORMATION

6.1 Package Marking Information

16-Lead QFN*

Example

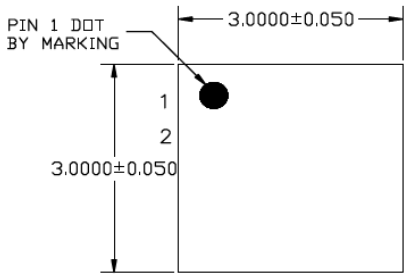


Legend:	XX...X	Product code or customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator (e3) can be found on the outer packaging for this package.
	●, ▲, ▼	Pin one index is identified by a dot, delta up, or delta down (triangle mark).
Note:		In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information. Package may or may not include the corporate logo.
		Underbar (_) and/or Overbar (¯) symbol may not be to scale.

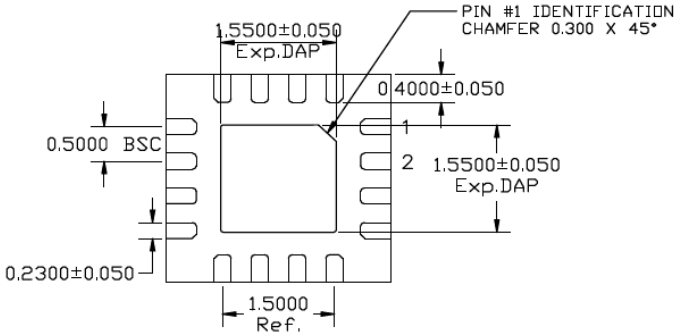
16-Lead QFN Package Outline and Recommended Land Pattern

TITLE
16 LEAD QFN 3x3mm PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

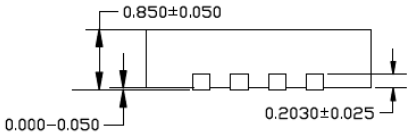
DRAWING #	QFN33-16LD-PL-1	UNIT	MM



TOP VIEW
NOTE: 1, 2, 3



BOTTOM VIEW
NOTE: 1, 2, 3



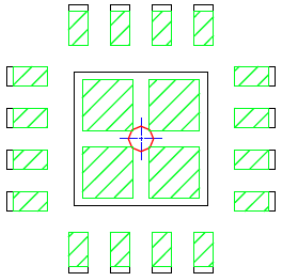
SIDE VIEW
NOTE: 1, 2, 3

NOTE:
1. MAX PACKAGE WARPAGE IS 0.05 MM
2. MAX ALLOWABLE BURR IS 0.076 MM IN ALL DIRECTIONS
3. PIN #1 IS ON TOP WILL BE LASER MARKED
4. RED CIRCLE IN LAND PATTERN INDICATE THERMAL VIA. SIZE SHOULD BE 0.30-0.35 MM IN DIAMETER AND SHOULD BE CONNECTED TO GND FOR MAX THERMAL PERFORMANCE
5. GREEN RECTANGLES (SHADED AREA) indicate SOLDER STENCIL OPENING ON EXPOSED PAD AREA. SIZE SHOULD BE 0.60x0.60 MM IN SIZE, 0.20 MM SPACING.

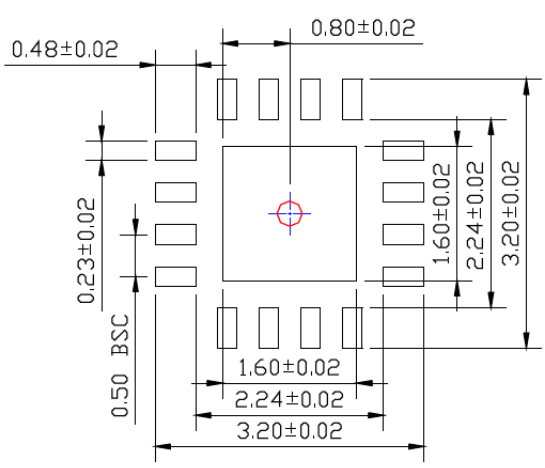
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging.

POD-Land Pattern drawing # QFN33-16LD-PL-1

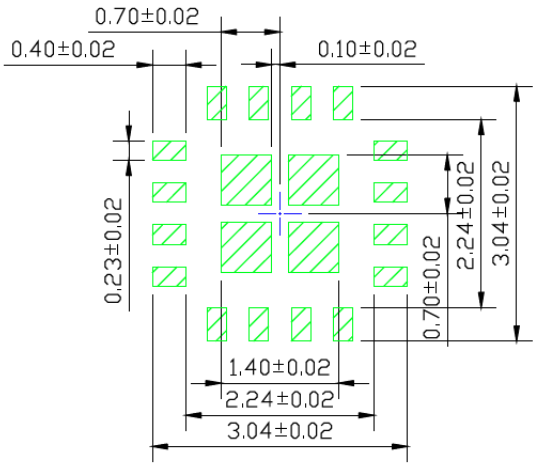
RECOMMENDED LAND PATTERN
NOTE: 4, 5



STACKED-UP



EXPOSED METAL TRACE



SOLDER STENCIL OPENING

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging.

APPENDIX A: REVISION HISTORY

Revision A (March 2022)

- Converted Micrel document SY75572L to Microchip data sheet template DS20006669A.
- Minor text changes throughout.

Revision B (May 2023)

- Updated HCSL Input High and Low Voltage information in the DC Electrical Characteristics table.

NOTES:

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

PART #.	X	X	X	XX
Device	Supply Voltage Range	Package	Junction Temperature Range	Special Processing

Device:	SY75572:	2.5V/3.3V, 2.5 GHz Differential Two-Channel Precision CML Delay Line	
Supply Voltage:	L	=	3.3V
Package:	M	=	16-Lead QFN
Temperature Range:	G	=	–40°C to +85°C (NiPdAu Lead Free)
Special Processing:	<blank>	=	100/Tube
	<T/R>	=	1,000/Reel

Examples:

a) SY75572LMG: SY75572, 3.3V Output Voltage, 16-Lead QFN, –40°C to +85°C Temperature Range, 100/Tube

b) SY75572LMG-TR: SY75572, 3.3V Output Voltage, 16-Lead QFN, –40°C to +85°C Temperature Range, 1,000/Reel

Note 1: Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.

NOTES:

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