3.3V, 3.2Gbps DIFFERENTIAL 4:1 LVDS MULTIPLEXER with INTERNAL INPUT TERMINATION

Precision Edge® SY89545L

FEATURES

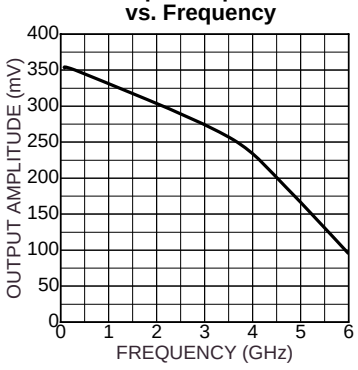
- Selects among four differential inputs
- Guaranteed AC performance over temp and voltage:
  - DC-to > 3.2Gbps data rate throughput
  - < 600ps In-to-Out t_{pd}
  - < 150ps t_r/t_f
- Ultra-low jitter design:
  - < 1ps$_{RMS}$ random jitter
  - < 10ps$_{PP}$ deterministic jitter
  - < 10ps$_{PP}$ total jitter (clock)
  - < 0.7ps$_{RMS}$ crosstalk-induced jitter
- Unique input isolation design minimizes crosstalk
- Internal input termination
- Unique input termination and V_T pin accepts DC-coupled and AC-coupled inputs (LVDS, LVPECL, CML)
- 350mV LVDS output swing
- CMOS/TTL compatible MUX select
- Power supply 3.3V +10%
- –40°C to +85°C temperature range
- Available in 32-pin (5mm x 5mm) MLF® package

APPLICATIONS

- SONET/SDH channel select applications
- Fiber Channel multi-channel select applications
- Gigabit Ethernet multi-channel select

TYPICAL PERFORMANCE

Output Amplitude vs. Frequency



Precision Edge®

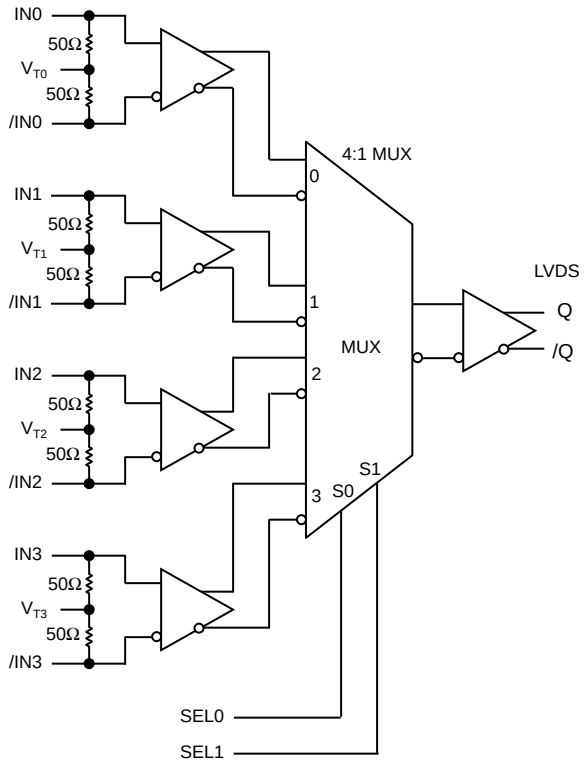
DESCRIPTION

The SY89545L is a fast, low jitter 4:1 differential MUX with an LVDS (350mV) compatible output with guaranteed data rate throughput of 3.2Gbps over temperature and voltage.

The SY89545L differential inputs include a unique, 3-pin internal termination that allows access to the termination network through a V_T pin. This feature allows the device to easily interface to different logic standards, both AC- and DC-coupled without external resistor-bias and termination networks. The result is a clean, stub-free, low jitter interface solution.

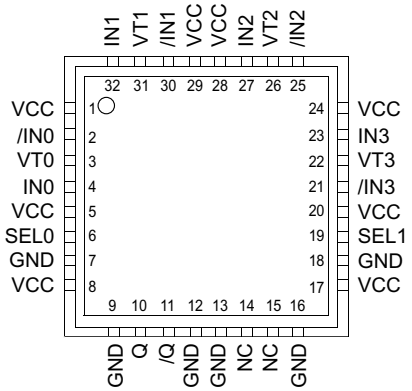
The SY89545L operates from a single 3.3V supply, and is guaranteed over the full industrial temperature range (–40°C to +85°C). For applications that require a 2.5V supply, consider the SY89544U. For applications that require two differential outputs, consider the SY89546U or SY89545L.The SY89545L is part of a Micrel's Precision Edge® product family. All support documentation can be found on Micrel's web site at www.micrel.com.

FUNCTIONAL BLOCK DIAGRAM



Precision Edge is a registered trademark of Micrel, Inc.
*Micro*LeadFrame and MLF are registered trademarks of Amkor Technology, Inc.

PACKAGE/ORDERING INFORMATION



32-Pin MLF®

Ordering Information[1]

Part Number	Package Type	Operating Range	Package Marking	Lead Finish
SY89545LMI	MLF-32	Industrial	SY89545L	Sn-Pb
SY89545LMITR[2]	MLF-32	Industrial	SY89545L	Sn-Pb
SY89545LMG[3]	MLF-32	Industrial	SY89545L with Pb-Free bar-line indicator	Pb-Free NiPdAu
SY89545LMGTR[2, 3]	MLF-32	Industrial	SY89545L with Pb-Free bar-line indicator	Pb-Free NiPdAu

Notes:

1. Contact factory for die availability. Dice are guaranteed at T_A = 25°C, DC electricals only.
2. Tape and Reel.
3. Recommended for new designs.

PIN DESCRIPTION

Pin Number	Pin Name	Pin Function
4, 2, 32, 30, 27, 25, 23, 21	IN0, /IN0, IN1, /IN1, IN2, /IN2, IN3, /IN3	Differential Inputs: These input pairs are the differential signal inputs to the device. Inputs accept AC- or DC-coupled signals as small as 100mV. Each pin of a pair internally terminates to a V_T pin through 50Ω. Note that these inputs will default to an indeterminate state if left open. Unused differential input pairs can be terminated by connecting one input to V_{CC} and the complementary input to GND through a 1kΩ resistor. The V_T pin is to be left open in this configuration. Please refer to the “Input Interface Applications” section for more details.
3, 31, 26, 22	VT0, VT1, VT2, VT3	Input Termination Center-Tap: Each side of the differential input pair, terminates to a V_T pin. The V_{T0}, V_{T1}, V_{T2}, V_{T3} pins provide a center-tap to a termination network for maximum interface flexibility. See “Input Interface Applications” section for more details.
6, 19	SEL0, SEL1	These single-ended TTL/CMOS compatible inputs select the inputs to the multiplexers. Note that these inputs are internally connected to a 25kΩ pull-up resistor and will default to a logic HIGH state if left open.
1, 5, 8, 17, 20, 24, 28, 29	VCC	Positive Power Supply: Bypass with 0.1µF||0.01µF low ESR capacitors. The 0.01µF capacitor should be as close to V_{CC} pin as possible.
10, 11	Q, /Q	Differential Outputs: This LVDS output pair is the output of the device. It is a logic function of the IN0, IN1, IN0, IN1 and SEL0 inputs. Please refer to the “Truth Table’” for details.
7, 9, 12, 13, 16, 18	GND, Exposed pad	Ground: Ground pin and exposed pad must be connected to the same ground plane.
14, 15	NC	No connect. (Unused pins).

Absolute Maximum Ratings(1)

Supply Voltage (V_{CC}) ..... – 0.5V to + 4.0V
Input Voltage (V_{IN}) ..... –0.5V to V_{CC}
Termination Current(3)
  Source or sink current on V_T ..... ±100mA
Input Current
  Source or sink current on IN, /IN ..... ±50mA
Lead Temperature (soldering, 20 sec.) ..... +260°C
Storage Temperature (TS) ..... –65°C to +150°C

Operating Ratings(2)

Supply Voltage (V_{CC}) ..... 3.0V to 3.6V
Ambient Temperature (T_A) ..... –40°C to +85°C
Package Thermal Resistance(4)
MLF® (θ_{JA})
  Still-Air ..... 35°C/W
  500lfpm ..... 28°C/W
MLF® (Ψ_{JB})
  Junction-to-Board ..... 20°C/W

DC ELECTRICAL CHARACTERISTICS(5)

T_A = –40°C to +85°C; Unless otherwise stated.

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{CC}	Power Supply		3.0	3.3	3.6	V
I_{CC}	Power Supply Current	No Load, Max. V_{CC}(6)		44	60	mA
R_{DIFF_IN}	Differential Input Resistance (IN-to-/IN)		80	100	120	Ω
R_{IN}	Input Resistance (IN-to-V_T, /IN-to-V_T)		40	50	60	Ω
V_{IH}	Input High Voltage (IN, /IN)		1.2		V_{CC}	V
V_{IL}	Input Low Voltage (IN, /IN)		0		V_{IH}–0.1	V
V_{IN}	Input Voltage Swing (IN, /IN)	**Notes 7**	0.1		V_{CC}	V
V_{DIFF_IN}	Differential Input Voltage Swing | IN - /IN |	**Notes 7**	0.2			V
IN-to-V_T	Voltage from Input to V_T				1.8	V

Notes:

1. 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.
2. The data sheet limits are not guaranteed if the device is operated beyond the operating ratings.
3. Due to the limited drive capability use for input of the same package only.
4. Package thermal resistance assumes exposed pad is soldered (or equivalent) to the device’s most negative potential on the PCB. Ψ_{JB} uses 4-layer θ_{JA} in still air unless otherwise stated.
5. The circuit is designed to meet the DC specifications shown in the above table after thermal equilibrium has been established.
6. Includes current through internal 50Ω pull-ups.
7. See “Operating Characteristics” section for V_{IN} and V_{DIFF_IN} definition.

LVDS OUTPUTS DC ELECTRICAL CHARACTERISTICS[9]

V_{CC} = 3.3V ±10%; T_A = –40°C to +85°C; R_L = 100Ω across Q and /Q, unless otherwise stated.

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{OH}	Output HIGH Voltage (Q, /Q)	See Figure 5a			1.475	V
V_{OL}	Output LOW Voltage (Q, /Q)	See Figure 5a	0.925			V
V_{OUT}	Output Voltage Swing (Q, /Q)	See Figures 1a, 5a	250	350		mV
$V_{DIFF-OUT}$	Differential Output Voltage Swing | Q - /Q |	See Figure 1b	500	700		mV
V_{OCM}	Output Common Mode Voltage (Q, /Q)	See Figure 5b	1.125		1.275	V
ΔV_{OCM}	Change in Common Mode Voltage (Q, /Q)	See Figure 5b	–50		+50	mV

LVTTL/CMOS DC ELECTRICAL CHARACTERISTICS[9]

V_{CC} = 3.3V ±10%; T_A = –40°C to +85°C; unless otherwise stated.

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{IH}	Input HIGH Voltage		2.0		V_{CC}	V
V_{IL}	Input LOW Voltage				0.8	V
I_{IH}	Input HIGH Current				40	µA
I_{IL}	Input LOW Current				–300	µA

Note:

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

AC ELECTRICAL CHARACTERISTICS[10]

V_{CC} = 3.3V ±10%; T_A = –40°C to +85°C; R_L = 100Ω across Q and /Q, unless otherwise stated.

Symbol	Parameter	Condition	Min	Typ	Max	Units
f_{MAX}	Maximum Operating Frequency	NRZ Data	3.2			Gbps
		$V_{OUT} \geq$ 200mV Clock		3		GHz
t_{pd}	Differential Propagation Delay	IN-to-Q	400	500	600	ps
		SEL-to-Q	230	500	750	ps
t_{SKEW}	Input-to-Input Skew	**Note 11**			25	ps
	Part-to-Part Skew	**Note 12**			200	ps
t_{JITTER}	Data Random Jitter (RJ)	**Note 13**			1	ps_{RMS}
	Deterministic Jitter (DJ)	**Note 14**			10	ps_{PP}
	Clock Total Jitter (TJ)	**Note 15**			10	ps_{PP}
	Cycle-to-Cycle Jitter	**Note 16**			1	ps_{RMS}
	Crosstalk-Induced Jitter Adjacent Channel	**Note 17**			0.7	ps_{RMS}
t_R, t_F	Output Rise / Fall Time (20% to 80%)	At full output swing	40	80	150	ps

Notes:

10. Measured with 100mV input swing. See “Timing Diagrams” section for definition of parameters. High frequency AC-parameters are guaranteed by design and characterization.
11. Input-to-input skew is the difference in propagation delay between any two inputs to the output under identical conditions.
12. Part-to-part skew is defined for two parts with identical power supply voltages at the same temperature and with no skew of the edges at the respective inputs.
13. RJ is measured with a K28.7 comma detect character pattern, measured at 1.25Gbps and 3.2Gbps.
14. DJ is measured at 1.25Gbps and 3.2Gbps, with both K28.5 and 2^{23}–1 PRBS pattern.
15. Total jitter definition: with an ideal clock input of frequency ≤f_{MAX}, no more than one output edge in 10^{12} output edges will deviate by more than the specified peak-to-peak jitter value.
16. Cycle-to-cycle jitter definition: the variation of periods between adjacent cycles, Tn-Tn-1 where T is the time between rising edges of the output signal.
17. Crosstalk is measured at the output while applying two similar frequencies to adjacent inputs that are asynchronous with respect to each other at the inputs.

SINGLE-ENDED AND DIFFERENTIAL SWINGS

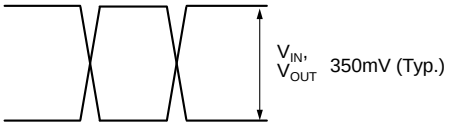


Figure 1a. Single-Ended Voltage Swing

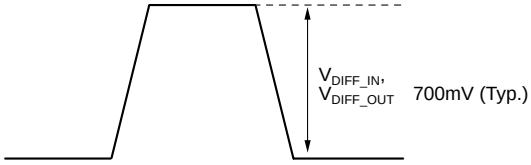


Figure 1b. Differential Voltage Swing

TIMING DIAGRAM

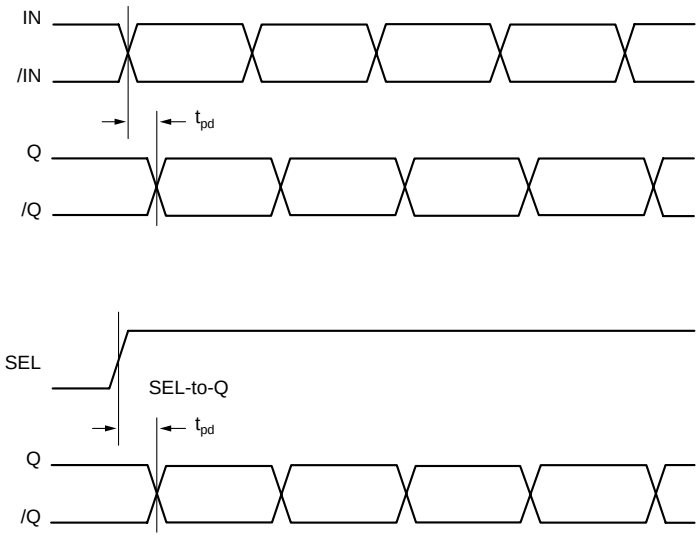


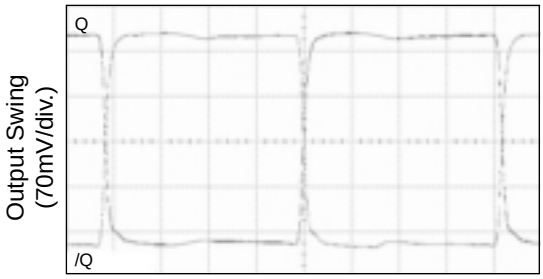
Figure 2. Timing Diagram

TRUTH TABLE

IN0	IN1	IN2	IN3	SEL0	SEL1	Q	/Q
0	X	X	X	0	0	0	1
1	X	X	X	0	0	1	0
X	0	X	X	1	0	0	1
X	1	X	X	1	0	1	0
X	X	0	X	0	1	0	1
X	X	1	X	0	1	1	0
X	X	X	0	1	1	0	1
X	X	X	1	1	1	1	0

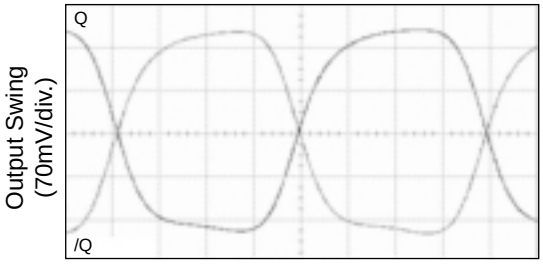
FUNCTIONAL CHARACTERISTICS

200MHz Output



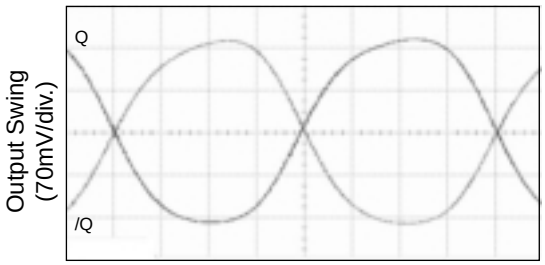
TIME (600ps/div.)

1.6GHz Output



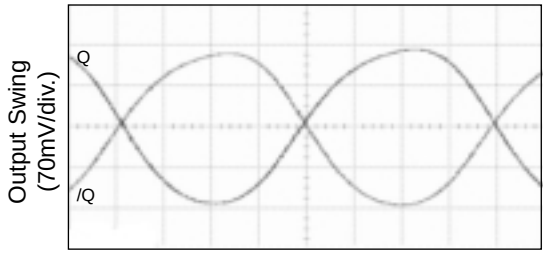
TIME (80ps/div.)

2.5GHz Output



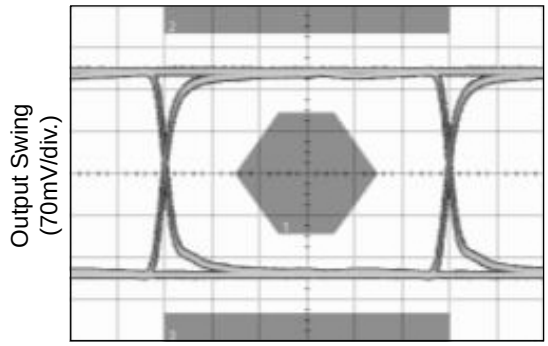
TIME (50ps/div.)

3.2GHz Output



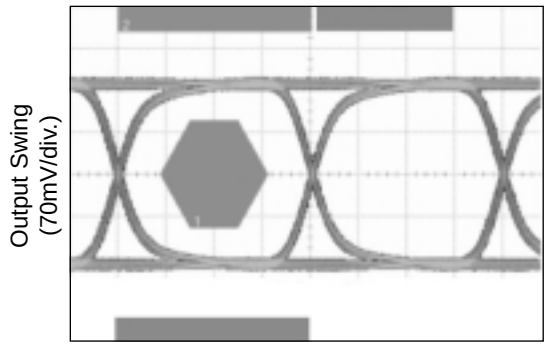
TIME (40ps/div.)

622Mbps Eye Mask (2^{23}–1 PRBS)



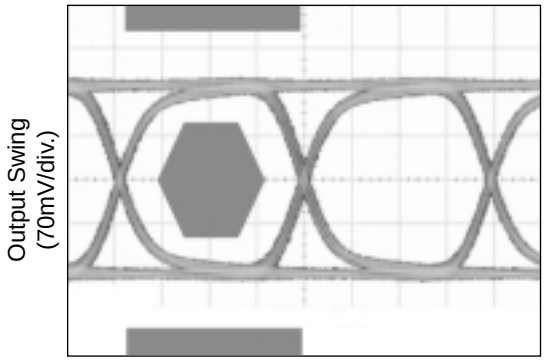
TIME (270ps/div.)

2.5Gbps Output Eye (2^{23}–1 PRBS)



TIME (100ps/div.)

3.2Gbps Eye Mask (2^{23}–1 PRBS)



TIME (80ps/div.)

INPUT AND OUTPUT STAGE INTERNAL TERMINATION

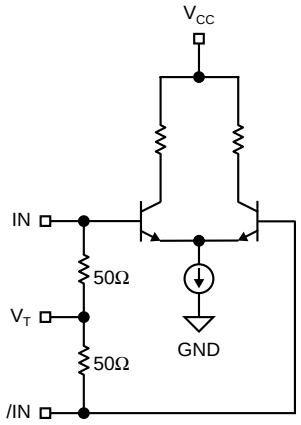


Figure 3. Simplified Differential Input Stage

INPUT INTERFACE APPLICATIONS

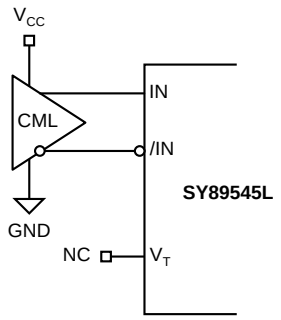


Figure 4a. CML Interface (DC-Coupled)

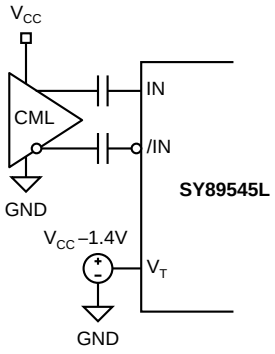


Figure 4b. CML Interface (AC-Coupled)

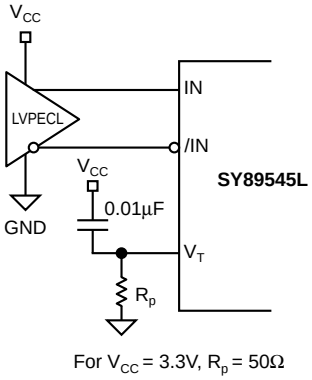


Figure 4c. LVPECL Interface (DC-Coupled)

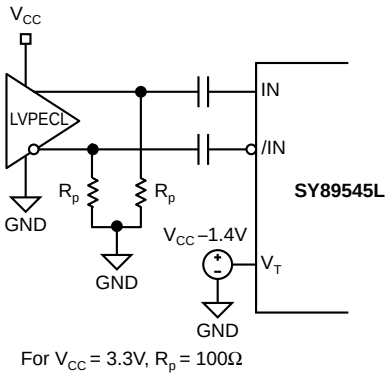


Figure 4d. LVPECL Interface (AC-Coupled)

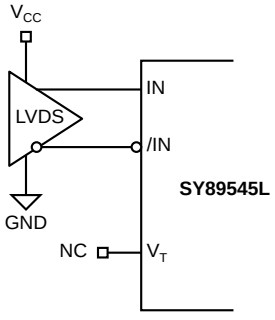


Figure 4e. LVDS Interface

OUTPUT INTERFACE APPLICATIONS

LVDS specifies a small swing of 350mV typical, on a nominal 1.25V common mode above ground. The common mode voltage has tight limits to permit large variations in ground between an LVDS driver and receiver. Also, change in common mode voltage, as a function of data input, is kept to a minimum, to keep EMI low.

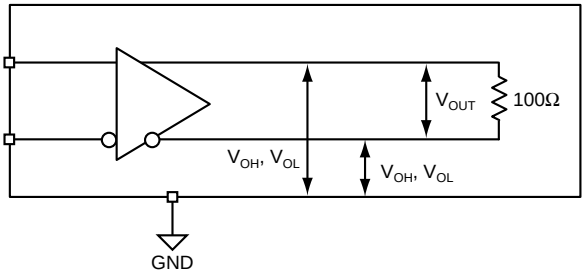


Figure 5a. LVDS Differential Measurement

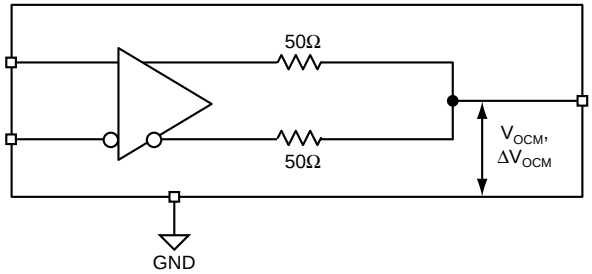
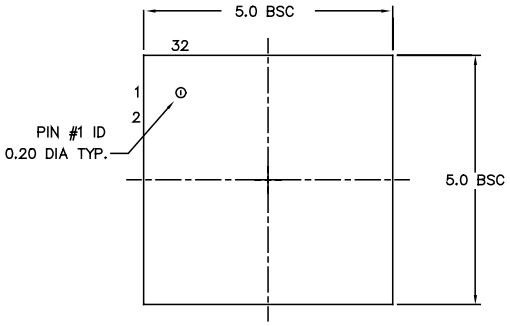


Figure 5b. LVDS Common Mode Measurement

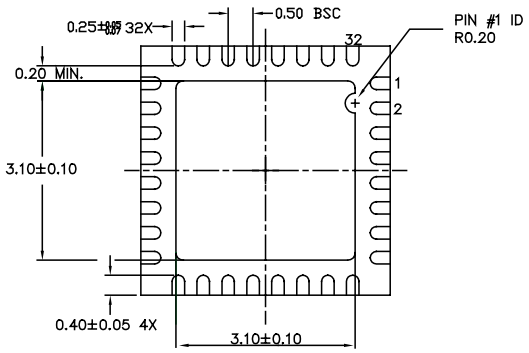
RELATED MICREL PRODUCTS AND SUPPORT DOCUMENTATION

Part Number	Function	Data Sheet Link
SY89542U	2.5V, 3.2Gbps Dual, Differential 2:1 LVDS Multiplexer with Internal Input Termination	http://www.micrel.com/_PDF/HBW/sy89542u.pdf
SY89543L	3.3V, 3.2Gbps Dual, Differential 2:1 LVDS Multiplexer with Internal Input Termination	http://www.micrel.com/_PDF/HBW/sy89543l.pdf
SY89544U	2.5V, 3.2Gbps 4:1 LVDS Multiplexer with Internal Input Termination	http://www.micrel.com/_PDF/HBW/sy89544u.pdf
SY89546U	2.5V, 3.2Gbps, Differential 4:1 LVDS Multiplexer with 1:2 Fanout and Internal Input Termination	http://www.micrel.com/_PDF/HBW/sy89546u.pdf
SY89547L	3.3V, 3.2Gbps, Differential 4:1 LVDS Multiplexer with 1:2 Fanout and Internal Input Termination	http://www.micrel.com/_PDF/HBW/SY89547L.pdf
	MLF® Application Note	www.amkor.com/products/notes_papers/MLF_AppNote_0902.pdf
HBW Solutions	New Products and Applications	www.micrel.com/product-info/products/solutions.shtml

32 LEAD *Micro*LeadFrame® (MLF-32)

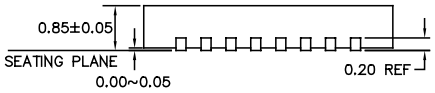


TOP VIEW

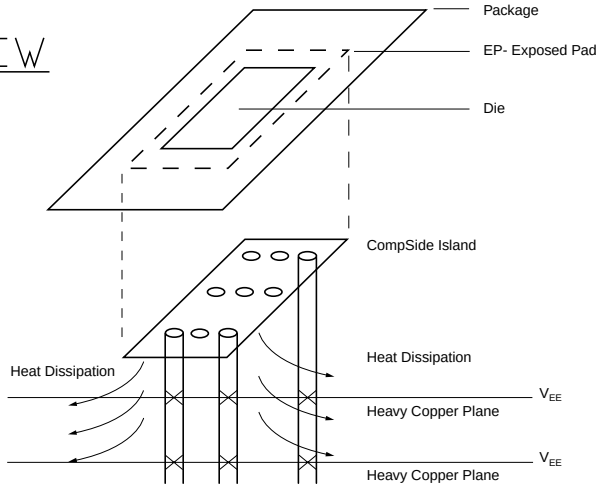


BOTTOM VIEW

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. MAX. PACKAGE WARPAGE IS 0.05 mm.
3. MAXIMUM ALLOWABE BURRS IS 0.076 mm IN ALL DIRECTIONS.
4. PIN #1 ID ON TOP WILL BE LASER/INK MARKED.



SIDE VIEW



PCB Thermal Consideration for 32-Pin MLF® Package
(Always solder, or equivalent, the exposed pad to the PCB)

Package Notes:

1. Package meets Level 2 qualification.
2. All parts are dry-packaged before shipment.
3. Exposed pads must be soldered to a ground for proper thermal management.

MICREL, INC. 2180 FORTUNE DRIVE SAN JOSE, CA 95131 USA

TEL + 1 (408) 944-0800 FAX + 1 (408) 474-1000 WEB http://www.micrel.com

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Microchip:

SY89545LMG SY89545LMG-TR