



ULTRA PRECISION 8:1 MUX WITH INTERNAL TERMINATION AND 1:2 LVPECL FANOUT BUFFER

Precision Edge™
SY58038U

FEATURES

- Selects between 1 of 8 inputs, and provides 2 precision, low skew LVPECL output copies
- Ultra-low jitter design:
 - 72fs_{rms} phase jitter (typ)
- Guaranteed AC performance over temperature and voltage:
 - DC to 4.5Gbps throughput
 - <500ps propagation delay IN-to-Q ($V_{IN} > 100\text{mV}$)
 - <100ps t_r / t_f time
 - <15ps skew (output-to-output)
- Unique, patent-pending, channel-to-channel isolation design provides superior crosstalk performance
- Unique, patent-pending, input termination and VT pin accepts DC- and AC-coupled inputs (CML, PECL, LVDS)
- 800mV LVPECL output swing
- Power supply 2.5V $\pm 5\%$ or 3.3V $\pm 10\%$
- -40°C to $+85^\circ\text{C}$ temperature range
- Available in 44-pin (7mm * 7mm) QFN package



Precision Edge™

DESCRIPTION

The SY58038U is a low jitter, low skew, high-speed 8:1 multiplexer with a 1:2 differential fanout buffer optimized for precision telecom and enterprise server distribution applications. The SY58038U distributes clock frequencies from DC to 3.5GHz, and data rates to 4.5Gbps guaranteed over temperature and voltage.

The SY58038U differential input includes Micrel's unique, 3-pin input termination architecture that directly interfaces to any differential signal (AC- or DC-coupled) as small as 100mV without any level shifting or termination resistor networks in the signal path. The outputs are 800mV, 100K compatible LVPECL with extremely fast rise/fall times guaranteed to be less than 100ps.

The SY58038U features a patent-pending isolation design that significantly improves channel-to-channel crosstalk performance.

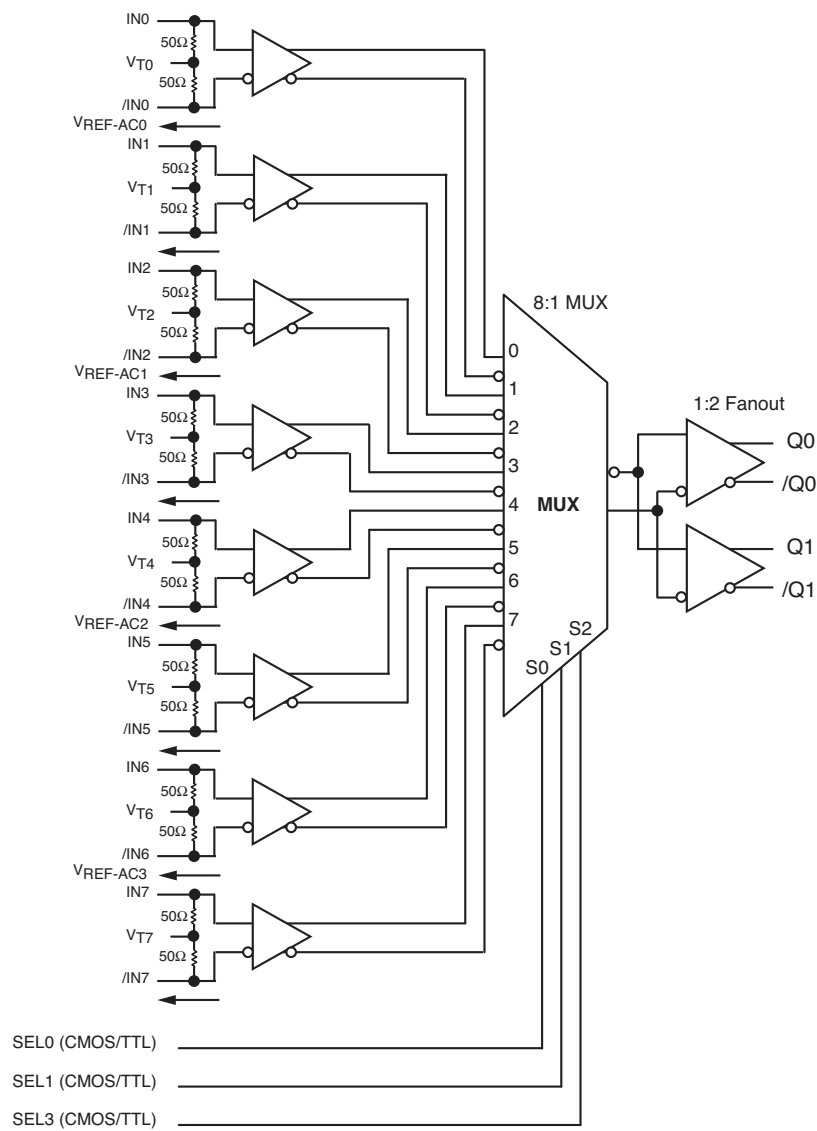
The SY58038U operates from a 2.5V $\pm 5\%$ or 3.3V $\pm 10\%$ supply and is guaranteed over the full industrial temperature range of -40°C to $+85^\circ\text{C}$. The SY58038U is part of Micrel's high-speed, Precision Edge™ product line.

Data sheets and support documentation can be found on Micrel's web site at www.micrel.com.

APPLICATIONS

- Data communication systems
- All SONET/SDH data/clock applications
- All Fibre Channel applications
- All Gigabit Ethernet applications

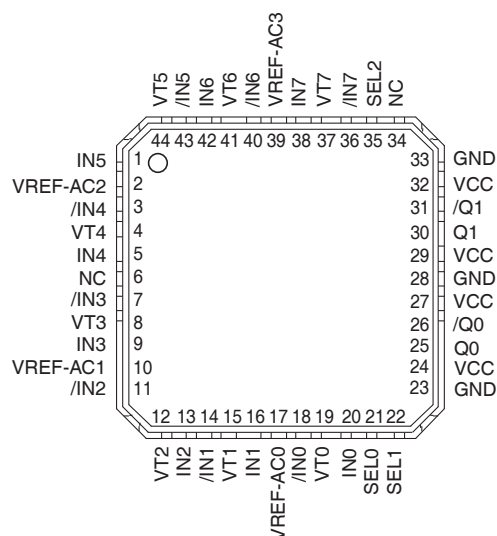
FUNCTIONAL BLOCK DIAGRAM



TRUTH TABLE

SEL2	SEL1	SEL0	Q	/Q
L	L	L	IN0	/IN0
L	L	H	IN1	/IN1
L	H	L	IN2	/IN2
L	H	H	IN3	/IN3
H	L	L	IN4	/IN4
H	L	H	IN5	/IN5
H	H	L	IN6	/IN6
H	H	H	IN7	/IN7

PACKAGE/ORDERING INFORMATION



44-Pin QFN (QFN-44)

Ordering Information⁽¹⁾

Part Number	Package Type	Operating Range	Package Marking
SY58038UMI	QFN-44 Pb-Free	Industrial	SY58038U
SY58038UMITR ⁽²⁾	QFN-44 Pb-Free	Industrial	SY58038U

Notes:

- Contact factory for die availability. Die are guaranteed at $T_A = 25^\circ\text{C}$, DC electricals only.
All devices are Pb-Free.
- Tape and Reel.

PIN DESCRIPTION

Pin Number	Pin Name	Pin Function
20, 18, 16, 14, 13, 11, 9, 7, 5, 3, 1, 43, 42, 40, 38, 36	IN0, /IN0, IN1, /IN1, IN2, /IN2, IN3, /IN3, IN4, /IN4, IN5, /IN5, IN6, /IN6, IN7, /IN7	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 VT pin through 50ohms. Note that these inputs will default to an indeterminate state if left open. Please refer to the "Input Interface Applications" section for more details.
19, 15, 12, 8, 4, 44, 41, 37	VT0, VT1 VT2, VT3, VT4, VT5, VT6, VT7	Input Termination Center-Tap: Each side of the differential input pair terminates to a VT pin. The VT pins provide a center-tap to a termination network for maximum interface flexibility. See "Input Interface Applications" section for more details. For a CML or LVDS inputs, the VT pin is left floating.
17, 10, 2 39	VREF-AC0, VREF-AC1, VREF-AC2, VREF-AC3	Reference Voltage: This output biases to $V_{CC}-1.2\text{V}$. It is used when AC coupling the inputs (IN, /IN). For AC-coupled applications, connect VREF_AC to the VT pin and bypass with a $0.01\mu\text{F}$ low ESR capacitor to V_{CC} . See "Input Interface Applications" section for more details.
21, 22, 35	SEL0, SEL1, SEL2	The single-ended TTL/CMOS-compatible inputs select the inputs to the multiplexer. Note that this input is internally connected to a 25kohms pull-up resistor and will default to a logic HIGH state if left open.
24, 27, 29, 32	VCC	Positive Power Supply. Bypass with $0.1\mu\text{F}/0.01\mu\text{F}$ low ESR capacitors as close to each VCC pin.
25, 26, 30, 31	Q0, /Q0, Q1, /Q1	Differential Outputs: These LVPECL output pairs are the outputs of the device. Unused output pairs may be left open. Each output is designed to drive 800mV into 50ohms terminated to $V_{CC}-2\text{V}$ (or $V_{CC}-1.2\text{V}$ if AC-coupled).
23, 28, 33	GND, Exposed Pad	Ground. GND and exposed pad must both be connected to the most negative potential of chip ground.

Absolute Maximum Ratings⁽¹⁾

Power Supply Voltage (V_{CC})	–0.5V to +4.0V
Input Voltage (V_{IN})	–0.5V to V_{CC}
LVPECL Output Current (I_{OUT})	
Continuous	50mA
Surge	100mA
Termination Current ⁽³⁾	
Source or sink current on VT pin	±100mA
Lead Temperature (soldering, 10 sec.)	265°C
Storage Temperature Range (T_S)	–65°C to +150°C

Operating Ratings⁽²⁾

Power Supply Voltage (V_{CC})	+2.375V to +2.625V
	+3.0V to +3.6V
Ambient Temperature Range (T_A)	–40°C to +85°C
Package Thermal Resistance ⁽⁴⁾	
QFN (θ_{JA})	
Still-Air	24°C/W
QFN (ψ_{JB})	
Junction-to-board	12°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 Voltage	$V_{CC} = 2.5V$.	2.375	2.5	2.625	V
		$V_{CC} = 3.3V$.	3.0	3.3	3.6	V
I_{CC}	Power Supply Current	No load, max. V_{CC} .		120	170	mA
R_{IN}	Input Resistance (IN-to- V_T)		40	50	60	ohms
R_{DIFF_IN}	Differential Input Resistance (IN-to-/IN)		80	100	120	ohms
V_{IH}	Input HIGH Voltage (IN-to-/IN)	Note 6	$V_{CC}-1.6$		V_{CC}	V
V_{IL}	Input LOW Voltage (IN-to-/IN)		0		$V_{IH}-0.1$	V
V_{IN}	Input Voltage Swing (IN-to-/IN)	See Figure 1a.	0.1		1.7	V
V_{DIFF_IN}	Differential Input Voltage Swing (IN-to-/IN)	See Figure 1b.	0.2			V
V_{T_IN}	IN-to- V_T (IN-to-/IN)				1.28	V
V_{REF_AC}	Output Reference Voltage		$V_{CC}-1.3$	$V_{CC}-1.2$	$V_{CC}-1.1$	V

Notes:

1. Permanent device damage may occur if ratings in the “Absolute Maximum Ratings” section are exceeded. This is a stress rating only and functional operation is not implied for 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 number 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. V_{IH} (min), not lower than 1.2V.

LVPECL OUTPUT DC ELECTRICAL CHARACTERISTICS⁽⁷⁾

$V_{CC} = 2.5V \pm 5\%$ or $3.3V \pm 10\%$; $T_A = -40^\circ C$ to $+85^\circ C$; $R_L = 50\Omega$ to $V_{CC} - 2V$, unless otherwise stated.

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{OH}	Output HIGH Voltage Q, /Q		$V_{CC} - 1.145$		$V_{CC} - 0.895$	V
V_{OL}	Output LOW Voltage Q, /Q		$V_{CC} - 1.945$		$V_{CC} - 1.695$	V
V_{OUT}	Output Differential Swing Q, /Q	See Figure 1a.	550	800		mV
V_{DIFF_OUT}	Differential Output Voltage Swing Q, /Q	See Figure 1b.	1100	1600		mV

LVTTTL/CMOS DC ELECTRICAL CHARACTERISTICS⁽⁷⁾

$V_{CC} = 2.5V \pm 5\%$ or $3.3V \pm 10\%$; $T_A = -40^\circ C$ to $+85^\circ C$, 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		-125		30	μA
I_{IL}	Input LOW Current		-300			μA

Note:

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

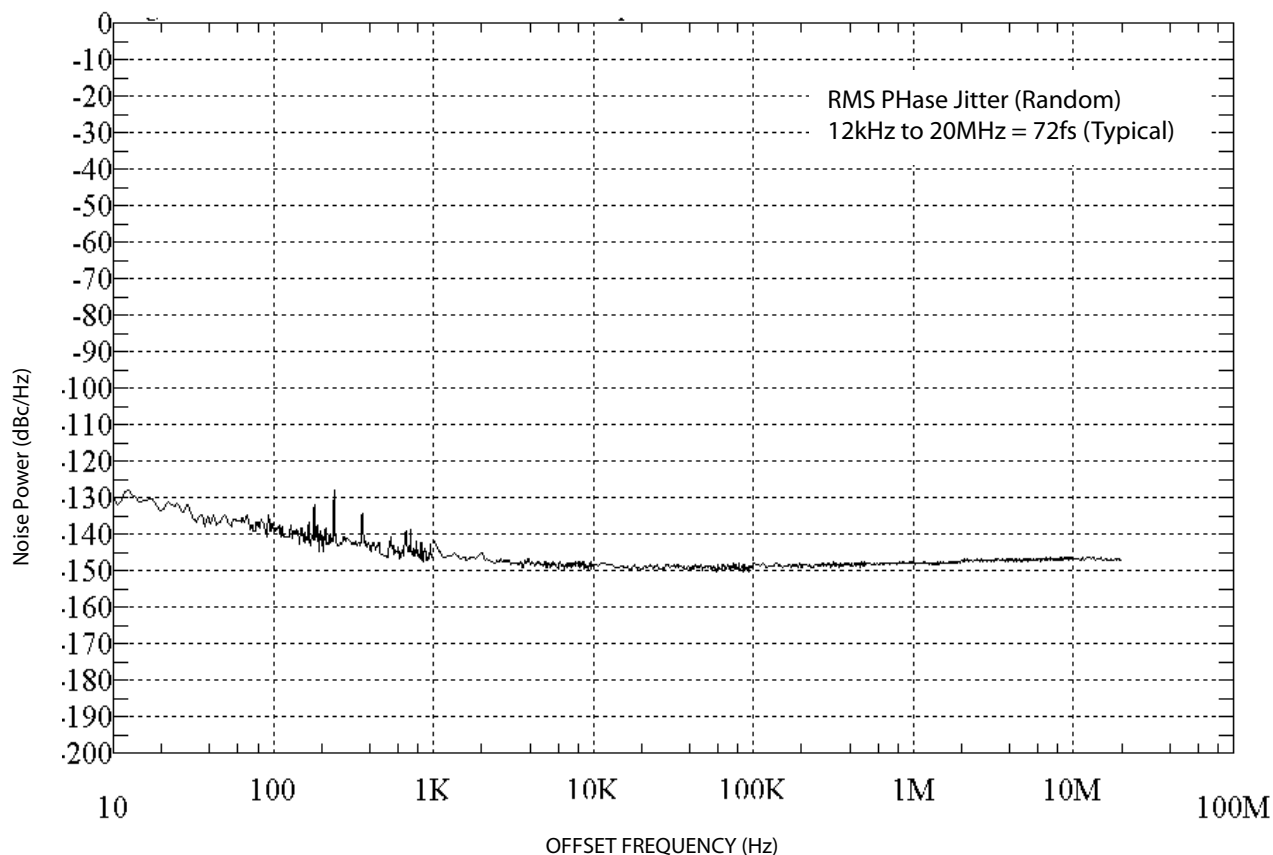
AC ELECTRICAL CHARACTERISTICS⁽⁸⁾

$V_{CC} = 2.5V \pm 5\%$ or $3.3V \pm 10\%$; $T_A = -40^\circ C$ to $+85^\circ C$, $R_L = 50\Omega$ to $V_{CC} - 2V$, unless otherwise stated.

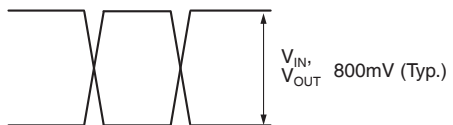
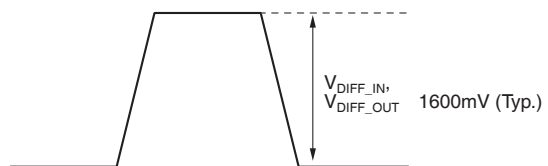
Symbol	Parameter	Condition	Min	Typ	Max	Units
f_{MAX}	Maximum Operating Frequency	NRZ data	4.5			Gbps
		$V_{OUT} > 400mV$ Clock	3.5	5		GHz
t_{pd}	Differential Propagation Delay (IN-to-Q)	$V_{IN} > 100mV$	280	390	500	ps
	(SEL-to-Q)		150		600	ps
$\Delta t_{pd} \text{ Tempco}$	Differential Propagation Delay Temperature Coefficient			220		fs/ $^\circ C$
t_{SKEW}	Output-to-Output Skew	Note 9			15	ps
	Part-to-Part Skew	Note 10			150	ps
t_{JITTER}	RMS Phase Jitter	Output = 622MHz Integration Range: 12kHz - 20MHz		72		fs _{rms}
t_r, t_f	Output Rise/Fall Time	At full output swing, 20% to 80%.	35	65	100	ps

Notes:

8. High-frequency AC-parameters are guaranteed by design and characterization.
 9. Output-to-output skew is measured between two different outputs under identical input transitions.
 10. 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.

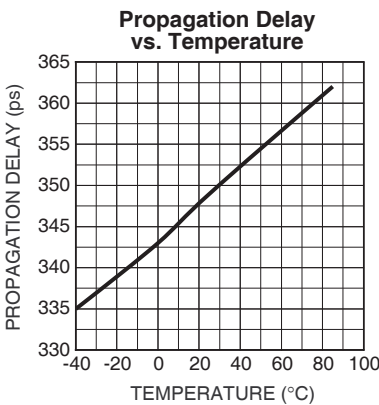
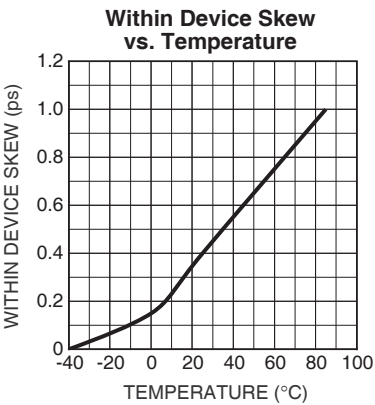
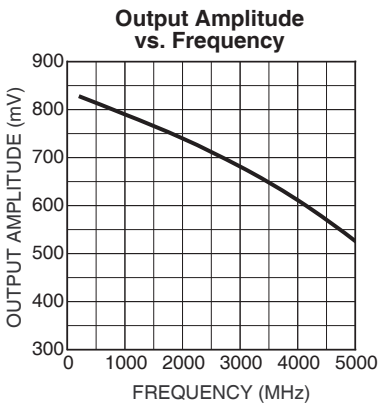
PHASE NOISE

Phase Noise Plot: 622MHz @ 3.3V

SINGLE-ENDED AND DIFFERENTIAL SWINGS**Figure 1a. Single-Ended Voltage Swing****Figure 1b. Differential Voltage Swing**

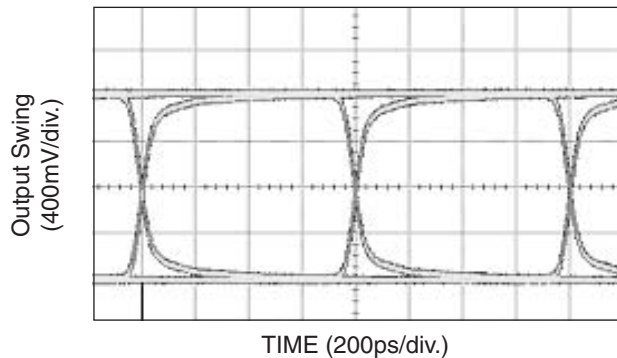
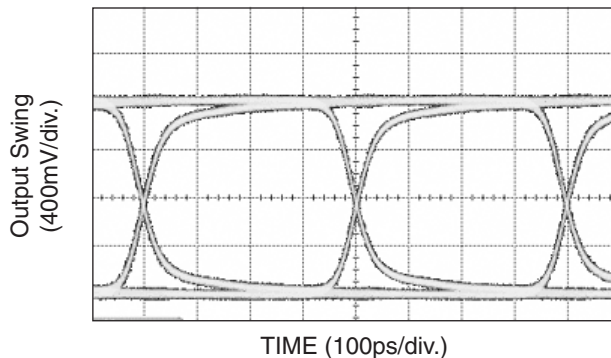
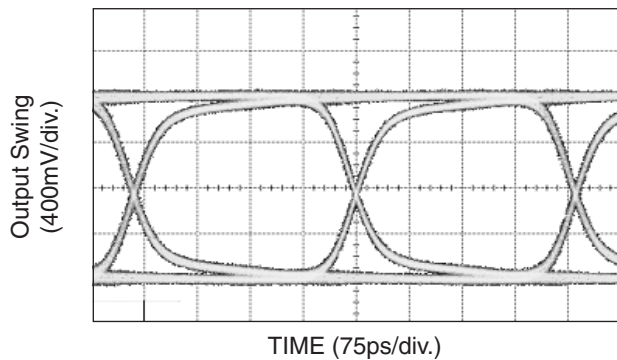
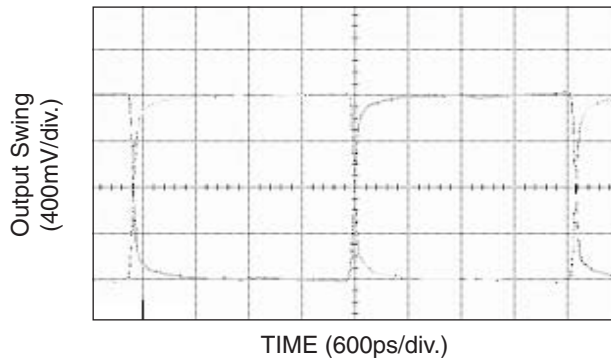
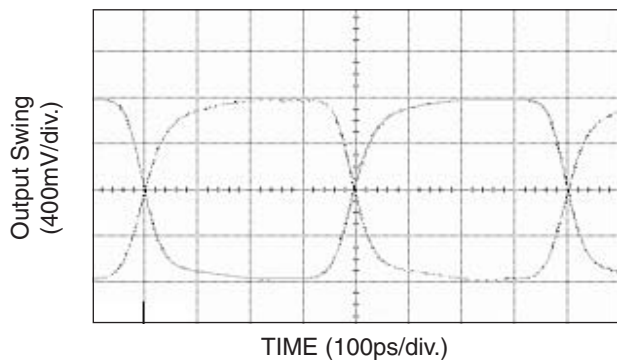
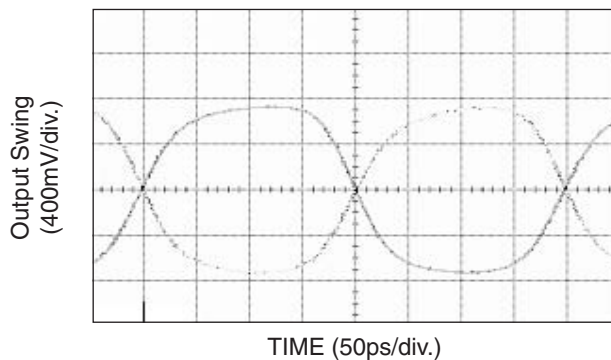
TYPICAL OPERATING CHARACTERISTICS

$V_{CC} = 3.3V$, $GND = 0$, $V_{IN} = 100mV$, $T_A = 25^{\circ}C$, unless otherwise stated.



FUNCTIONAL CHARACTERISTICS

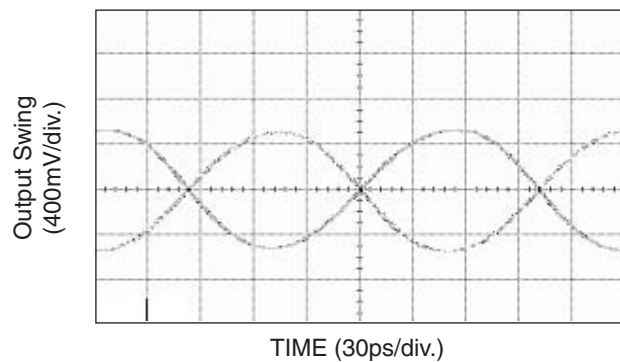
$V_{CC} = 3.3V$, $GND = 0$, $V_{IN} = 100mV$, $T_A = 25^\circ C$, unless otherwise stated.

1.25Gbps Output (Q – /Q)**2.5Gbps Output (Q – /Q)****3.2Gbps Output (Q – /Q)****200MHz Output (Q – /Q)****1.25GHz Output (Q – /Q)****2.5GHz Output (Q – /Q)**

FUNCTIONAL CHARACTERISTICS (CONTINUED)

$V_{CC} = 3.3V$, $GND = 0$, $V_{IN} = 100mV$, $T_A = 25^\circ C$, unless otherwise stated.

5GHz Output (Q – /Q)



The circuit diagram shows a differential pair of NMOS transistors. The gates of both transistors are connected to an input signal labeled 'IN'. The sources of both transistors are connected to a common source node, which is connected to ground (GND) through a current source represented by a circle with a downward arrow. The drains of the two transistors are connected to a common drain node, which is connected to a supply voltage labeled 'V_{CC}' through two resistors. The output of the differential pair is taken from the drains, with one output labeled 'OUT' and the other labeled 'OUT' (implied). The input signal 'IN' is also connected to a voltage divider consisting of two 50Ω resistors, with the input voltage labeled 'V_T' and the input signal labeled 'IN'.

Figure 2a. Simplified Differential Input Stage

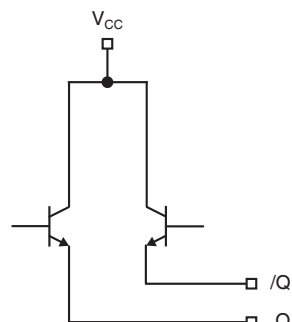


Figure 2b. Simplified LVPECL Output Stage

For $V_{CC} = 3.3V$, $R_{pd} = 50\Omega$.
 For $V_{CC} = 2.5V$, $R_{pd} = 19\Omega$.

Figure 3a. LVPECL Interface (DC-Coupled)

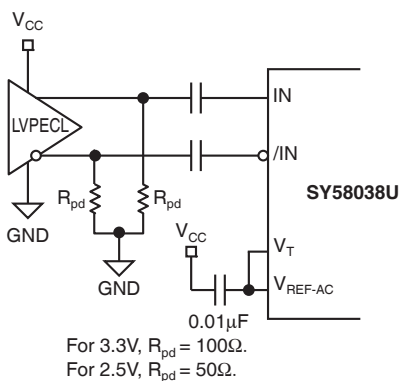
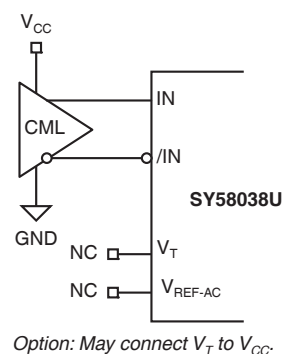
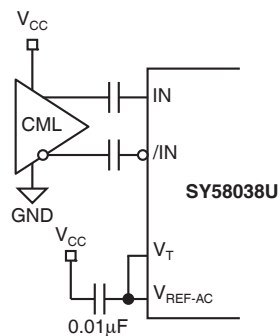


Figure 3b. LVPECL Interface (AC-Coupled)



**Figure 3c. CML
Interface (DC-Coupled)**



**Figure 3d. CML
Interface (AC-Coupled)**

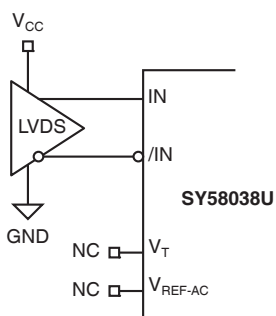


Figure 3e. LVDS Interface

OUTPUT INTERFACE APPLICATIONS

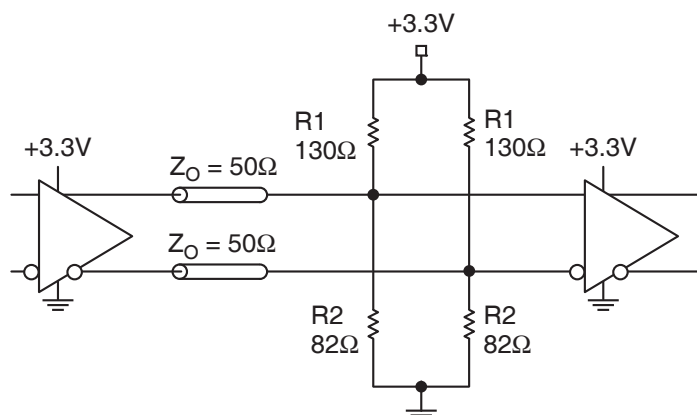


Figure 4a. Parallel Thevenin-Equivalent Termination

Note:

For +2.5V system, $R_1 = 250\Omega$, $R_2 = 62.5\Omega$.

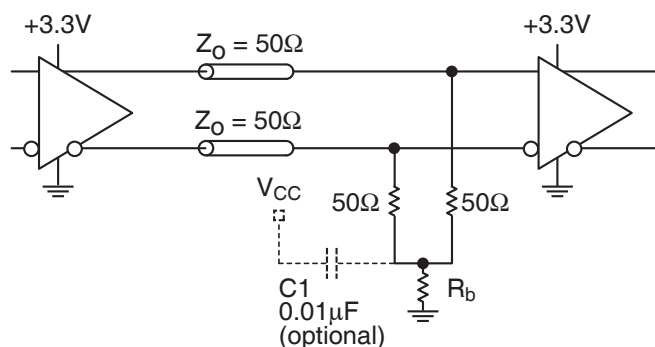


Figure 4b. Parallel Termination (3-Resistor)

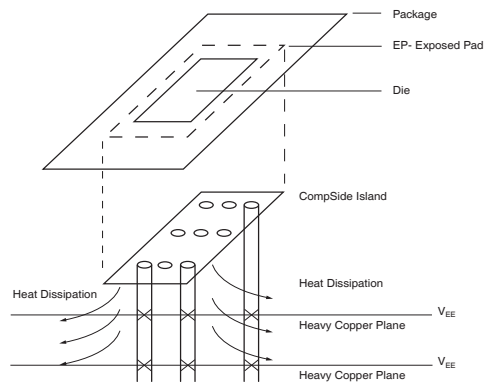
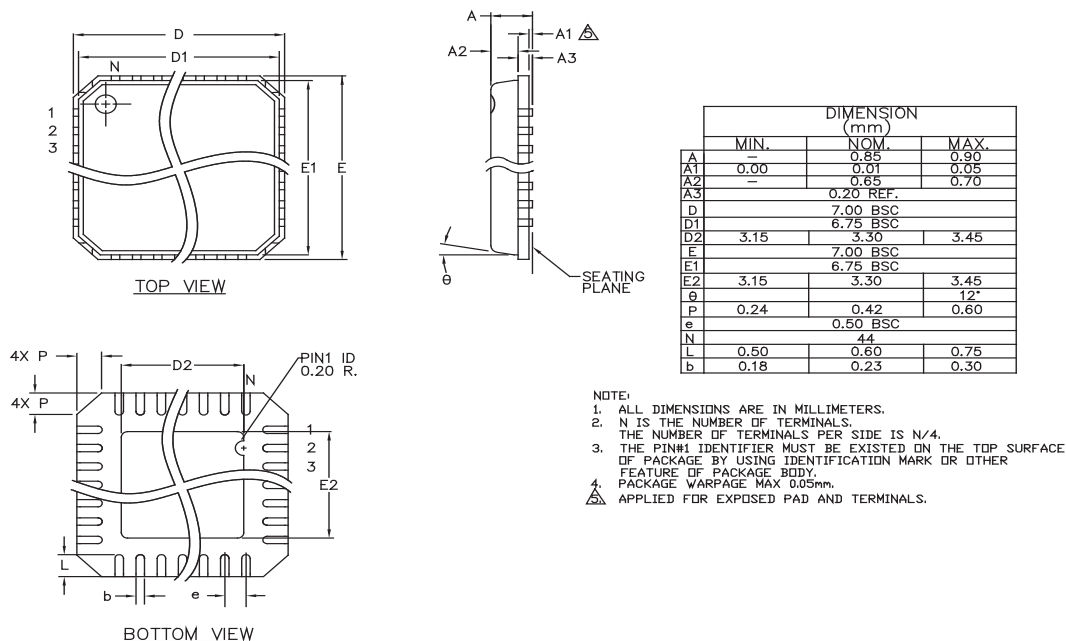
Note:

For +2.5V system, $R_b = 19\Omega$.

For +3.3V system, $R_b = 50\Omega$.

RELATED MICREL PRODUCTS AND SUPPORT DOCUMENTATION

Part Number	Function	Data Sheet Link
SY58037U	Ultra Precision 8:1 MUX with Internal Termination and 1:2 CML Fanout Buffer	http://www.micrel.com/product-info/products/sy58037u.shtml
SY58038U	Ultra Precision 8:1 MUX with Internal Termination and 1:2 LVPECL Fanout Buffer	http://www.micrel.com/product-info/products/sy58038u.shtml
SY58039U	Ultra Precision 8:1 MUX with Internal Termination and 1:2 400mV LVPECL Fanout Buffer	http://www.micrel.com/product-info/products/sy58039u.shtml
	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

44 LEAD QFM (QFN 44)

PCB Thermal Consideration for 44-Pin QFN 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>

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Наши контакты:

Телефон: +7 812 627 14 35

Электронная почта: sales@st-electron.ru

Адрес: 198099, Санкт-Петербург,
Промышленная ул, дом № 19, литера Н,
помещение 100-Н Офис 331