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## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China





## SY10/100EP451L

### 3.3V ECL 6-Bit Differential Register with Master Reset

#### General Description

The SY10/100EP451L is a 6-bit fully differential register with common clock and single-ended Master Reset (MR). It is ideal for very high frequency applications where a registered data path is necessary.

All inputs have an internal 75k $\Omega$  pull-down resistor. Differential inputs have an override clamp. Unused differential register inputs can be left open and will default LOW. When the differential inputs are forced to a value smaller than  $V_{EE} + 1.2V$ , the clamp will override and force the output to a default state.

The positive transition of CLK (pin 4) will latch the registers. Master Reset (MR) HIGH will asynchronously reset all registers forcing Q outputs to go LOW.

Datasheets and support documentation can be found on Micrel's web site at: [www.micrel.com](http://www.micrel.com).

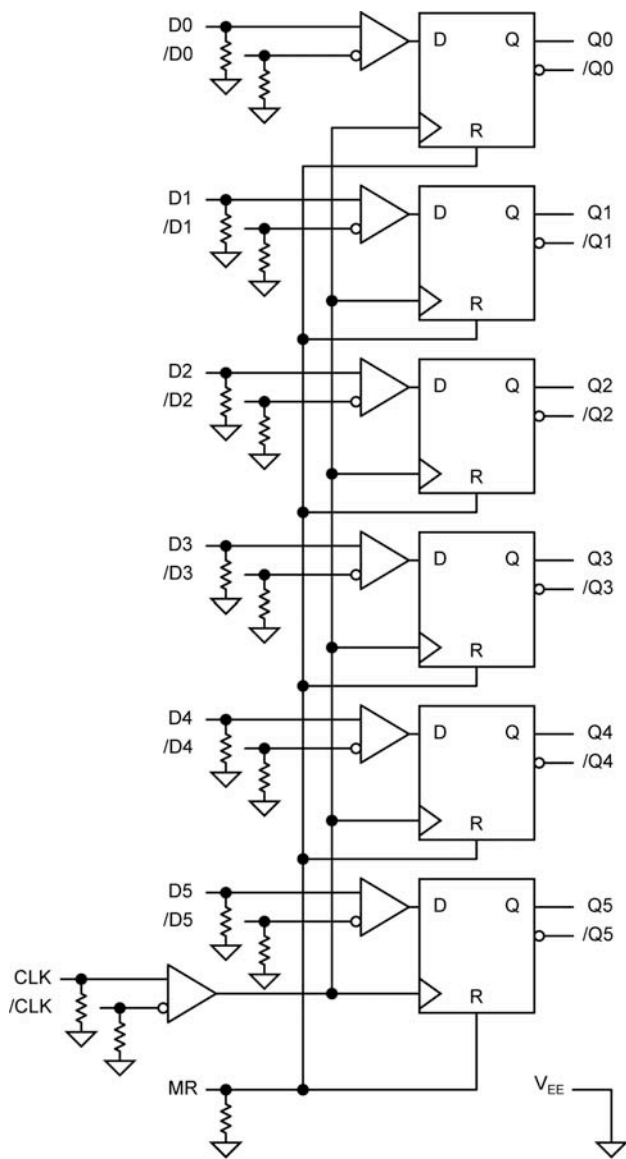
#### Features

- 450ps typical propagation delay
- Maximum frequency > 3.0GHz typical
- Asynchronous Master Reset
- 20ps skew within device, 35ps skew device-to-device
- PECL mode operating range:
  - $V_{CC} = 3.0V$  to  $3.6V$  with  $V_{EE} = 0V$
- NECL mode operating range:
  - $V_{CC} = 0V$  with  $V_{EE} = -3.0V$  to  $-3.6V$
- Open input default state
- Safety clamp on inputs
- Available in 32-pin TQFP

#### Applications

- High Speed Logic
- Wireless Communication Systems
- Data Communication Systems

# Logic Diagram



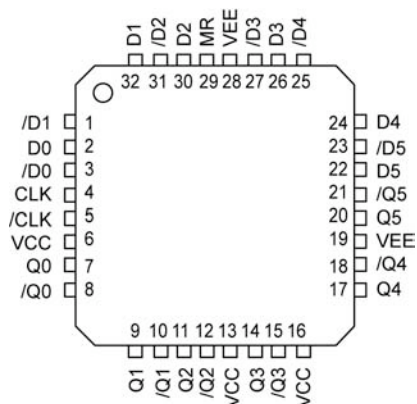
## Ordering Information<sup>(1)</sup>

Part Number	Package Type	Operating Range	Package Marking	Lead Finish
SY10EP451LTG	T32-1	Industrial	SY10EP451LTG with Pb-Free bar-line indicator	Pb-Free NiPdAu
SY10EP451LTGTR <sup>(2)</sup>	T32-1	Industrial	SY10EP451LTG with Pb-Free bar-line indicator	Pb-Free NiPdAu
SY100EP451LTG	T32-1	Industrial	SY100EP451LTG with Pb-Free bar-line indicator	Pb-Free NiPdAu
SY100EP451LTGTR <sup>(2)</sup>	T32-1	Industrial	SY100EP451LTG with Pb-Free bar-line indicator	Pb-Free NiPdAu

**Notes:**

1. Contact factory for die availability. Dice are guaranteed at T<sub>A</sub> = 25°C, DC Electricals only.
2. Tape and Reel.

## Pin Configuration



**32-Pin TQFP (T32-1)**



## Pin Description

Pin Number	Pin Name	Pin Function
2, 3 32, 1 30, 31 26, 27 24, 25 22, 23	D0, /D0 D1, /D1 D2, /D2 D3, /D3 D4, /D4 D5, /D5	ECL Differential Data Inputs: These input pairs are the different data signal inputs to the device. Each input pin is connected to a 75k $\Omega$ pull-down resistor. Due to an internal clamping circuit, D will default LOW and /D will default HIGH if left open.
29	MR	ECL Master Reset Input pin. If input pin is left open, it will default to LOW.
4, 5	CLK, /CLK	ECL Differential Clock Input: This input pair is the clock signal input to the device. Each input pin is connected to a 75k $\Omega$ pull-down resistor. Due to an internal clamping circuit, CLK will default LOW and /CLK will default HIGH if left open.
7, 8 9, 10 11, 12 14, 15 17, 18 20, 21	Q0, /Q0 Q1, /Q1 Q2, /Q2 Q3, /Q3 Q4, /Q4 Q5, /Q5	ECL Differential Data Outputs: Q defaults to LOW and /Q defaults to HIGH if D inputs are left open. See "LVPECL Output Interface Applications" section for recommendations on terminations.
6, 13, 16	VCC	Positive Supply: Bypass with 0.1 $\mu$ F  0.01 $\mu$ F low ESR capacitors as close to the V <sub>CC</sub> pins as possible.
19, 28	VEE	Negative Power Supply: V <sub>EE</sub> must be tied to most negative supply.

### Absolute Maximum Ratings<sup>(1)</sup>

Supply Voltage	
PECL Mode ( $V_{CC}$ )	+4V
NECL Mode ( $V_{EE}$ )	-4V
Input Voltage ( $V_{IN}$ )	
PECL Mode	$V_{CC}$
NECL Mode	$V_{EE}$
Output Current ( $I_{OUT}$ )	
Continuous	50mA
Surge	100mA
Lead Temperature (soldering, 20sec.)	260°C
Storage Temperature ( $T_s$ )	-65°C to +150°C

### Operating Ratings<sup>(2)</sup>

Supply Voltage ( $V_{CC}$ )	
PECL Mode ( $V_{EE} = 0V$ )	+3.0V to +3.6V
Supply Voltage ( $V_{EE}$ )	
NECL Mode ( $V_{CC} = 0V$ )	-3.0V to -3.6V
Ambient Temperature ( $T_A$ )	-40°C to +85°C
Junction Thermal Resistance <sup>(3)</sup>	
TQFP	
Junction-to-Ambient ( $\theta_{JA}$ )	
0lfpm	80°C/W
500lfpm	66°C/W
Junction-to-Case ( $\theta_{JC}$ )	20°C/W

### PECL 10EP DC Electrical Characteristics<sup>(4)</sup>

$V_{CC} = 3.3V$ ;  $V_{EE} = 0V$ ;  $T_A = -40^\circ C$  to  $+85^\circ C$ , unless otherwise stated.<sup>(5)</sup>

Symbol	Parameter	-40°C			25°C			85°C			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{EE}$	Power Supply Current		80	105		80	105		80	105	mA
$V_{OH}$	Output HIGH Voltage <sup>(6)</sup>	2165	2290	2415	2230	2355	2480	2290	2415	2540	mV
$V_{OL}$	Output LOW Voltage <sup>(6)</sup>	1365	1490	1615	1430	1555	1680	1470	1615	1740	mV
$V_{IH}$	Input HIGH Voltage (Single-Ended)	2090		2415	2155		2480	2215		2540	mV
$V_{IL}$	Input LOW Voltage (Single-Ended)	1365		1690	1430		1755	1490		1815	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) <sup>(7)</sup>	2.0		3.3	2.0		3.3	2.0		3.3	V
$I_{IH}$	Input HIGH Current			150			150			150	μA
$I_{IL}$	Input LOW Current	0.5			0.5			0.5			μA

### NECL 10EP DC Electrical Characteristics<sup>(4)</sup>

$V_{CC} = 0V$ ;  $V_{EE} = -3.0V$  to  $-3.6V$ ;  $T_A = -40^\circ C$  to  $+85^\circ C$ , unless otherwise stated.

Symbol	Parameter	-40°C			25°C			85°C			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{EE}$	Power Supply Current		80	105		80	105		80	105	mA
$V_{OH}$	Output HIGH Voltage <sup>(6)</sup>	-1135	-1010	-885	-1070	-945	-820	-1010	-885	-760	mV
$V_{OL}$	Output LOW Voltage <sup>(6)</sup>	-1935	-1810	-1685	-1870	-1745	-1620	-1830	-1685	-1560	mV
$V_{IH}$	Input HIGH Voltage (Single-Ended)	-1210		-885	-1145		-820	-1085		-760	mV
$V_{IL}$	Input LOW Voltage (Single-Ended)	-1935		-1610	-1870		-1545	-1810		-1485	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) <sup>(7)</sup>	$V_{EE} + 2.0$		0.0	$V_{EE} + 2.0$		0.0	$V_{EE} + 2.0$		0.0	V
$I_{IH}$	Input HIGH Current			150			150			150	μA
$I_{IL}$	Input LOW Current	0.5			0.5			0.5			μA

**Notes:**

- Exceeding the absolute maximum rating may damage the device.
- The device is not guaranteed to function outside its operating rating.
- $\theta_{JA}$  and  $\theta_{JC}$  values are determined for a 4-layer board in still-air unless otherwise stated.
- The device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500lfpm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specifications limit values are applied individually under normal operating conditions and not valid simultaneously.
- Input and output parameters vary 1:1 with  $V_{CC}$ .
- All loading with 50Ω to  $V_{CC} - 2.0V$ .
- $V_{IHCMR}$  (min) varies 1:1 with  $V_{EE}$ ,  $V_{IHCMR}$  (max) varies 1:1 with  $V_{CC}$ . The  $V_{IHCMR}$  range is referenced to the most positive side of the differential input signal.

**PECL 100EP DC Electrical Characteristics<sup>(8)</sup>**

$V_{CC} = 3.3V$ ;  $V_{EE} = 0V$ ;  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$ , unless otherwise stated.<sup>(9)</sup>

Symbol	Parameter	-40°C			25°C			85°C			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{EE}$	Power Supply Current		85	120		85	120		85	120	mA
$V_{OH}$	Output HIGH Voltage <sup>(10)</sup>	2155	2280	2405	2155	2280	2405	2155	2280	2405	mV
$V_{OL}$	Output LOW Voltage <sup>(10)</sup>	1355	1480	1605	1355	1480	1605	1355	1480	1605	mV
$V_{IH}$	Input HIGH Voltage (Single-Ended)	2075		2420	2075		2420	2075		2420	mV
$V_{IL}$	Input LOW Voltage (Single-Ended)	1355		1675	1355		1675	1355		1675	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) <sup>(11)</sup>	2.0		3.3	2.0		3.3	2.0		3.3	V
$I_{IH}$	Input HIGH Current			150			150			150	$\mu A$
$I_{IL}$	Input LOW Current	0.5			0.5			0.5			$\mu A$

**NECL 100EP DC Electrical Characteristics<sup>(8)</sup>**

$V_{CC} = 0V$ ;  $V_{EE} = -3.0V$  to  $-3.6V$ ;  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$ , unless otherwise stated.

Symbol	Parameter	-40°C			25°C			85°C			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{EE}$	Power Supply Current		85	120		85	120		85	120	mA
$V_{OH}$	Output HIGH Voltage <sup>(10)</sup>	-1145	-1020	-895	-1145	-1020	-895	-1145	-1020	-895	mV
$V_{OL}$	Output LOW Voltage <sup>(10)</sup>	-1945	-1820	-1695	-1945	-1820	-1695	-1945	-1820	-1695	mV
$V_{IH}$	Input HIGH Voltage (Single-Ended)	-1225		-880	-1225		-880	-1225		-880	mV
$V_{IL}$	Input LOW Voltage (Single-Ended)	-1945		-1625	-1945		-1625	-1945		-1625	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) <sup>(11)</sup>	$V_{EE} + 2.0$		0.0	$V_{EE} + 2.0$		0.0	$V_{EE} + 2.0$		0.0	V
$I_{IH}$	Input HIGH Current			150			150			150	$\mu A$
$I_{IL}$	Input LOW Current	0.5			0.5			0.5			$\mu A$

**Notes:**

- The device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500lfpm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specifications limit values are applied individually under normal operating conditions and not valid simultaneously.
- Input and output parameters vary 1:1 with  $V_{CC}$ .
- All loading with  $50\Omega$  to  $V_{CC} - 2.0V$ .
- $V_{IHCMR}$  (min) varies 1:1 with  $V_{EE}$ ,  $V_{IHCMR}$  (max) varies 1:1 with  $V_{CC}$ . The  $V_{IHCMR}$  range is referenced to the most positive side of the differential input signal.

## AC Electrical Characteristics<sup>(12)</sup>

$V_{CC} = 0V$ ;  $V_{EE} = -3.0V$  to  $-3.6V$  or  $V_{CC} = 3.0V$  to  $3.6V$ ;  $V_{EE} = 0V$ ;  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$ ; for 10EP and 100EP, unless otherwise stated.<sup>(13)</sup>

Symbol	Parameter	-40°C			25°C			85°C			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$V_{OUTpp}$	Output Voltage Amplitude at 3GHz <sup>(14)</sup>	540	670		520	650		450	580		mV
$t_{PD}$	Propagation Delay to Output Differential	330 380	430 530	530 630	350 400	450 550	550 650	390 440	490 590	590 690	ps
$t_{RR}$	Reset Recovery	240	100		250	100		260	100		ps
$t_S$	Set-Up Time	80	0		80	0		80	0		ps
$t_H$	Hold Time	80	0		80	0		80	0		ps
$t_{PW}$	Minimum Pulse Rate	400			400			400			ps
$t_{SKEW}$	Within-Device Skew <sup>(15)</sup> Device-to-Device Skew <sup>(16)</sup>		10 35	40 100		10 35	40 100		10 35	40 100	ps
$t_{JITTER}$	Clock Random Jitter (RMS) at $\leq 3.0GHz$		0.2	1		0.2	1		0.2	1	ps
$t_r, t_f$	Output Rise/Fall Times (20% to 80%)	100	150	250	110	160	260	130	180	280	ps

**Notes:**

12. The device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500lfpm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specifications limit values are applied individually under normal operating conditions and not valid simultaneously.
13. Measured using a 750mV source, 50% duty cycle clock source, all loading with 50Ω to  $V_{CC}-2V$ .
14.  $V_{OL}$  and  $V_{OH}$  specifications not guaranteed for  $f_{MAX}$  testing
15. Skew is measured between outputs under identical transitions and conditions on any one device.
16. Device-to-device skew for identical transitions at identical  $V_{CC}$  levels.

## Input Stage

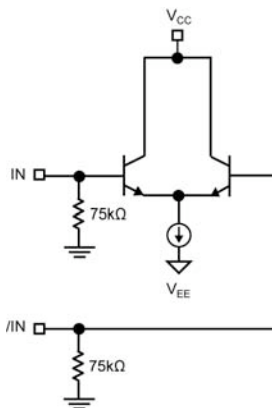
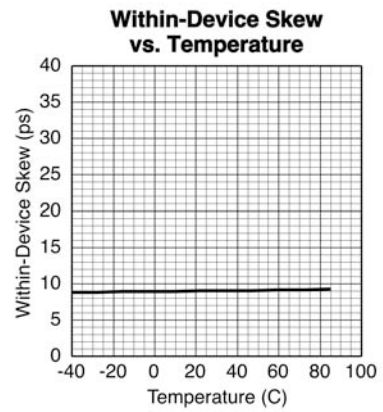
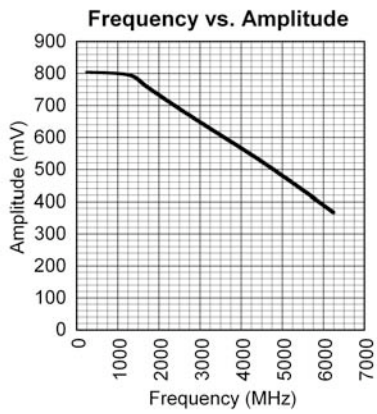


Figure 1. Simplified Differential Input Buffer



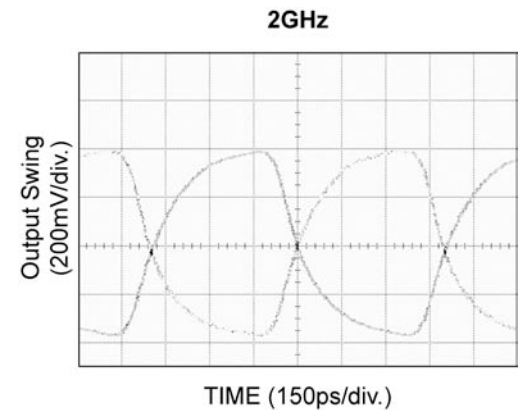
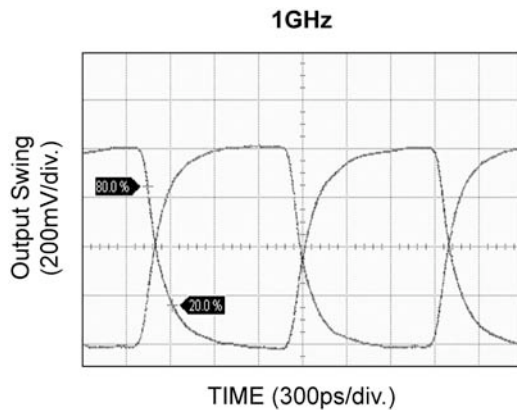
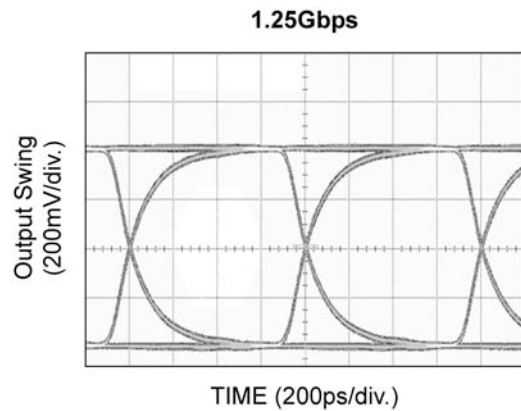
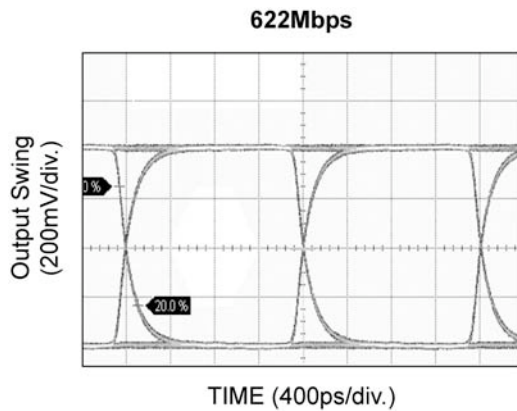
## Typical Characteristics

$V_{CC} = 3.3V$ ,  $GND = 0V$ ,  $V_{IN} = 800mV$ ,  $T_A = 25^\circ C$ ; for 10EP and 100EP, unless otherwise stated.



## Functional Characteristics

$V_{CC} = 3.3V$ ,  $GND = 0V$ ,  $V_{IN} = 800mV$ ,  $T_A = 25^\circ C$ ; for 10EP and 100EP, unless otherwise stated.



## LVPECL Output Interface Applications

LVPECL output has very low output impedance (open emitter), and small signal swing which results in low EMI. LVPECL is ideal for driving 50Ω and 100Ω controlled impedance transmission lines. There are several techniques in terminating the LVPECL output, as shown in Figures 2 through 4.

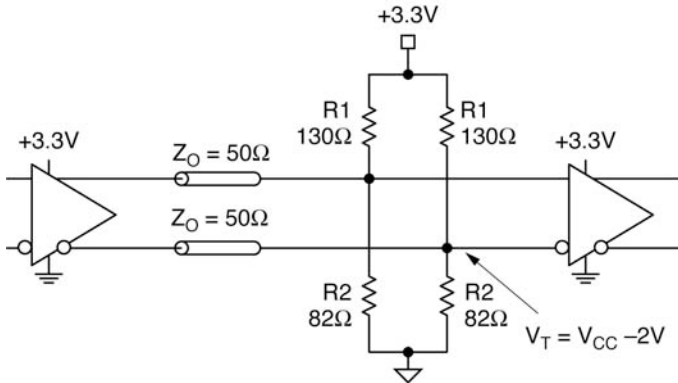


Figure 2. Parallel Termination-Thevenin Equivalent

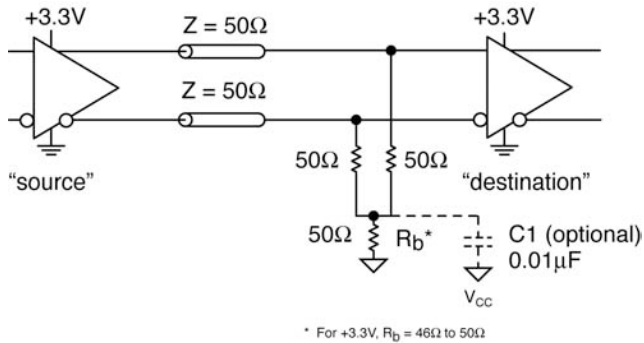


Figure 3. Three-Resistor "Y-Termination"

**Notes:**

1. Power-saving alternative to Thevenin termination.
2. Place termination resistors as close to destination inputs as possible.
3.  $R_b$  resistor sets the DC bias voltage, equal to  $V_{CC}-2V$ .
4.  $C1$  is an optional bypass capacitor intended to compensate for any  $t_r$ ,  $t_f$  mismatches.

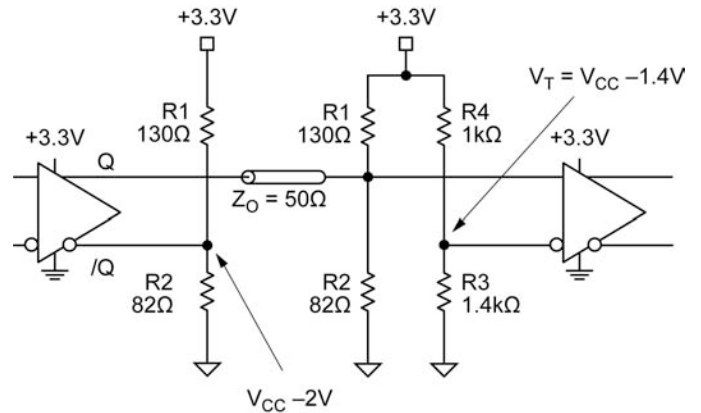
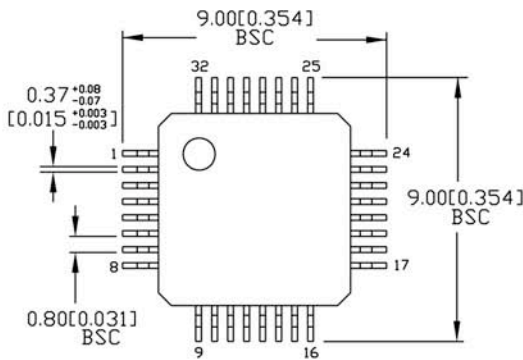


Figure 4. Terminating Unused I/O

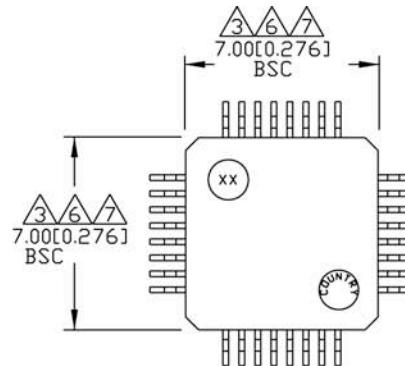
**Notes:**

1. Unused output ( $/Q$ ) must be terminated to balance the output.
2. Unused output pairs ( $Q$  and  $/Q$ ) may be left floating.

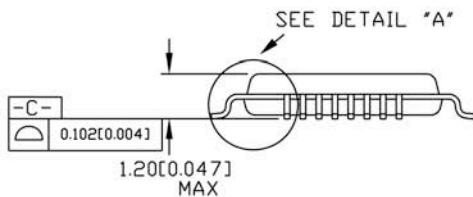
**Package Information**



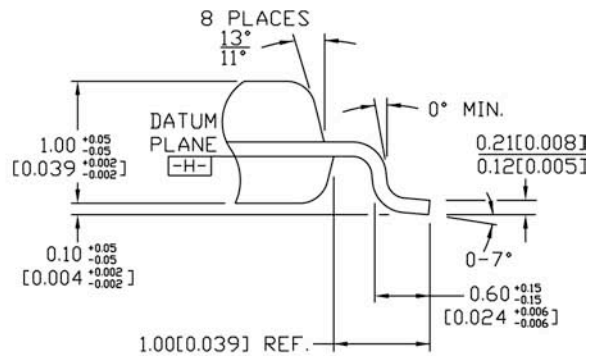
TOP VIEW



BOTTOM VIEW



SIDE VIEW



DETAIL "A"

**NOTES:**

1. DIMENSIONS ARE IN MM(INCHES).
2. CONTROLLING DIMENSION: MM.
3. DIMENSION DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS, EITHER OF WHICH SHALL NOT EXCEED 0.254 [0.010].
4. LEAD DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION.
5. MAXIMUM AND MINIMUM SPECIFICATIONS ARE INDICATED AS FOLLOWS: MAX/MIN.
6. THESE DIMENSIONS TO BE DETERMINED AT DATUM PLANE -H-
7. PACKAGE TOP DIMENSIONS ARE SMALLER THAN BOTTOM DIMENSIONS AND TOP OF PACKAGE WILL NOT OVERHANG BOTTOM OF PACKAGE.

**32-Pin TQFP (T32-1)**

**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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