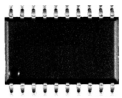
3.3V/5V PECL/ECL 3GHz DIFFERENTIAL 4:1 MULTIPLEXER

ECL Pro™
SY100EP57V

FEATURES

- **Fully differential 4:1 PECL/ECL multiplexer**
- **Guaranteed AC-parameters over temp/voltage:**
  - **> 3GHz Fmax (toggle)**
  - **< 220ps rise/fall Time**
  - **< 520ps propagation delay (D-to-Q)**
- **Flexible power supply: 3.0V to 5.5V**
- **Wide operating temp range: –40°C to +85°C**
- **V_{BB} reference for AC-coupled and single-ended applications**
- **100k PECL/ECL compatible logic**
- **Available in 20-pin TSSOP package**



ECL Pro™

DESCRIPTION

The SY100EP57V is a high-speed, low-skew, fully differential PECL/ECL 4:1 multiplexer in a 20-pin TSSOP package. This device is a pin-for-pin, plug-in replacement to the MC10/100EP57DT. The signal-path inputs (D0:D3) accept differential signals as low as 150mVpk-pk. All I/O pins are 100K EP PECL/ECL logic compatible.

AC–performance is guaranteed over the industrial –40°C to +85°C temperature range and 3.0V to 5.5V supply voltage range. This device will operate in PECL/LVPECL or ECL/LVECL mode. The SY100EP57 propagation delay is less than 520ps, and the Select-to-valid output delay is less than 575ps over temperature and voltage. For clock applications, the high-speed design combined with an extremely fast rise/fall time of less than 220ps produces a toggle frequency as high as 3GHz (400mVpk-pk swing). Two V_{BB} output reference pins (approx equal to V_{CC}–1.4V) are available for AC–coupled or single-ended applications.

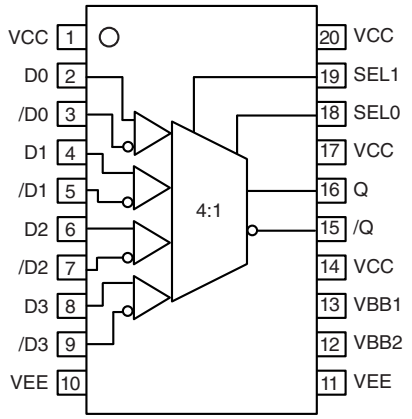
The SY100EP57V is part of Micrel's high-speed, Precision Edge timing and distribution family. For applications that require a different I/O combination, consult the Micrel website at www.micrel.com, and choose from a comprehensive product line of high-speed, low skew fanout buffers, translators, and clock dividers.

CROSS REFERENCE TABLE

Micrel Semiconductor	ON Semiconductor
SY100EP57VK4I	MC100EP57DT
SY100EP57VK4ITR	MC100EP57DTR2

ECL Pro is a trademark of Micrel, Inc.

PACKAGE/ORDERING INFORMATION



20-Pin TSSOP (K4-20-1)

Ordering Information[1]

Part Number	Package Type	Operating Range	Package Marking	Lead Finish
SY100EP57VK4I	K4-20-1	Industrial	XEP57V	Sn-Pb
SY100EP57VK4ITR[2]	K4-20-1	Industrial	XEP57V	Sn-Pb
SY100EP57VK4G[3]	K4-20-1	Industrial	XEP57V with Pb-Free bar-line indicator	Pb-Free NiPdAu
SY100EP57VK4GTR[2, 3]	K4-20-1	Industrial	XEP57V 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. Pb-Free package is recommended for new designs.

PIN DESCRIPTION

Pin	Pin Number	Function
D0: D3 /D0: /D3	2, 4, 6, 8 3, 5, 7, 9	Input Channels 0-3 PECL/ECL differential signal inputs. Multiplexing of these 4 differential inputs is controlled by SEL0, SEL1. The signal inputs include internal 75kΩ pull-down resistors. Default condition is LOW when left floating. The input signal should be terminated externally. See "*Termination*" section
VEE	10, 11	Negative Power Supply: For PECL/LVPECL applications, connect to Ground. Both V_{EE} pins must be connected together, externally on the PCB, for proper operation.
VBB1, VBB2	13, 12	Reference output voltage. This reference is typically used to bias the unused inverting input for single-ended input applications, or as the termination point for AC–coupled differential input applications. V_{BB} reference value is approximately V_{CC} –1.4V, and tracks V_{CC} 1:1. Maximum sink/source capability for each V_{BB} reference pin is 0.50mA. For single ended PECL inputs, connect to the unused input through a 50Ω resistor. Decouple the V_{BB} pin with a 0.01μF capacitor. For PECL/LVPECL inputs, the decoupling capacitor is connected to V_{CC}, since PECL signals are referenced to V_{CC}. Leave floating if not used.
/Q, Q	15, 16	100KEP PECL/ECL compatible differential output. PECL/ECL termination is with a 50Ω resistor to V_{CC} –2V. Unused single-ended outputs must have a balanced load. For AC–coupled applications, the output stage emitter follower must have a DC current path to ground. See "*Termination*" section.
SEL0, SEL1	18, 19	100KEP PECL/ECL compatible 4:1 MUX select control. See "*MUX Select Truth Table.*" Each pin includes an internal 75kΩ pull-down resistor. Default condition when left floating is LOW.
VCC	1, 14, 17, 20	Positive Power Supply. All V_{CC} pins must be connected to the same power supply externally. Bypass with 0.1μF//0.01μF low ESR capacitors.

MUX SELECT TRUTH TABLE

SEL1	SEL0	DATA OUT
L	L	D0, /D0
L	H	D1, /D1
H	L	D2, /D2
H	H	D3, /D3

ABSOLUTE MAXIMUM RATINGS[1]

Symbol	Rating		Value	Unit
$V_{CC} - V_{EE}$	Power Supply Voltage		6.0	V
V_{IN}	Input Voltage (V_{CC} = 0V, V_{IN} not more negative than V_{EE}) Input Voltage (V_{EE} = 0V, V_{IN} not more positive than V_{CC})		–6.0 to 0 +6.0 to 0	V V
I_{OUT}	Output Current	–Continuous –Surge	50 100	mA
I_{BB}	V_{BB} Sink/Source Current[2]		±0.5	mA
T_{LEAD}	Lead Temperature (soldering, 20sec.)		+260	°C
T_A	Operating Temperature Range		–40 to +85	°C
T_{store}	Storage Temperature Range		–65 to +150	°C
θ_{JA}	Package Thermal Resistance (Junction-to-Ambient)	–Still-Air (single-layer PCB) –Still-Air (multi-layer PCB) –500lfpm (multi-layer PCB)	115 75 65	°C/W
θ_{JC}	Package Thermal Resistance (Junction-to-Case)		21	°C/W

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 ratlng conditions for extended periods may affect device reliability.
2. Due to the limited drive capability, the V_{BB} reference should only be used for inputs from the same package device (i.e., do not sue for other devices).

DC ELECTRICAL CHARACTERISTICS[1]

Symbol	Parameter	T_A = –40°C			T_A = +25°C			T_A = +85°C			Unit	Condition
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
V_{CC}	Power Supply Voltage										V	
	(PECL)	4.5	5.0	5.5	4.5	5.0	5.5	4.5	5.0	5.5		
	(LVPECL)	3.0	—	3.8	3.0	—	3.8	3.0	—	3.8		
	(ECL)	–5.5	–5.0	–4.5	–5.5	–5.0	–4.5	–5.5	–5.0	–4.5		
	(LVECL)	–3.8	–3.3	–3.0	–3.8	–3.3	–3.0	–3.8	–3.3	–3.0		
I_{EE}	Supply Current	—	35	50	—	35	50	—	35	50	mA	No Load
I_{IH}	Input HIGH Current	—	—	75	—	—	75	—	—	80	μA	$V_{IN} = V_{IH}$
I_{IL}	Input LOW Current											
	All Inputs	0.5	—	—	0.5	—	—	0.5	—	—	μA	$V_{IN} = V_{IL}$
C_{IN}	Input Capacitance (TSSOP)	—	—	—	—	1.0	—	—	—	—	pF	

Note:

1. 100KEP circuits are designed to meet the DC specifications shown in the above table after thermal equilibrium has been established. The circuit is in a test socket or mounted on a printed circuit board and traverse airflow greater than 500lfpm is maintained.

(100KEP) LVPECL DC ELECTRICAL CHARACTERISTICS[1]

V_{CC} = 3.3V ±10%, V_{EE} = 0V

Symbol	Parameter	T_A = –40°C			T_A = +25°C			T_A = +85°C			Unit	Condition
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
V_{IL}	Input LOW Voltage (Single-Ended)	1355	—	1675	1355	—	1675	1355	—	1675	mV	
V_{IH}	Input HIGH Voltage (Single-Ended)	2075	—	2420	2075	—	2420	2075	—	2420	mV	
V_{OL}	Outuput LOW Voltage	1355	1480	1605	1355	1480	1605	1355	1480	1605	mV	50Ω to V_{CC}–2V
V_{OH}	Output HIGH Voltage	2155	2280	2405	2155	2280	2405	2155	2280	2405	mV	50Ω to V_{CC}–2V
V_{BB}	Output Reference Voltage	1775	1875	1975	1775	1875	1975	1775	1875	1975	mV	
V_{IHCMR}	Input HIGH Voltage[2] Common Mode Range	2.0	—	V_{CC}	2.0	—	V_{CC}	2.0	—	V_{CC}	V	

Notes:

1. 100KEP circuits are designed to meet the DC specifications shown in the above table after thermal equilibrium has been established. The circuit is in a test socket or mounted on a printed circuit board and traverse airflow greater than 500lfpm is maintained. Input and output parameters are at V_{CC} = 3.3V. They vary 1:1 with V_{CC}.
2. The V_{IHCMR} range is referenced to the most positive side of the differential input signal.

(100KEP) PECL DC ELECTRICAL CHARACTERISTICS[1]

V_{CC} = 5.0V ±10%, V_{EE} = 0V

Symbol	Parameter	T_A = –40°C			T_A = +25°C			T_A = +85°C			Unit	Condition
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
V_{IL}	Input LOW Voltage (Single-Ended)	3055	—	3375	3055	—	3375	3055	—	3375	mV	
V_{IH}	Input HIGH Voltage (Single-Ended)	3775	—	4120	3775	—	4120	3775	—	4120	mV	
V_{OL}	Outuput LOW Voltage	3055	3180	3305	3055	3180	3305	3055	3180	3305	mV	50Ω to V_{CC}–2V
V_{OH}	Output HIGH Voltage	3855	3980	4105	3855	3980	4105	3855	3980	4105	mV	50Ω to V_{CC}–2V
V_{BB}	Output Reference Voltage	3475	3575	3675	3475	3575	3675	3475	3575	3675	mV	
V_{IHCMR}	Input HIGH Voltage[2] Common Mode Range	2.0	—	V_{CC}	2.0	—	V_{CC}	2.0	—	V_{CC}	V	

Notes:

1. 100KEP circuits are designed to meet the DC specifications shown in the above table after thermal equilibrium has been established. The circuit is in a test socket or mounted on a printed circuit board and traverse airflow greater than 500lfpm is maintained. Input and output parameters are at V_{CC} = 3.3V. They vary 1:1 with V_{CC}.
2. The V_{IHCMR} range is referenced to the most positive side of the differential input signal.

(100KEP) ECL/LVECL DC ELECTRICAL CHARACTERISTICS[1]

V_{CC} = 0V, V_{EE} = –5.5V to –3.0V

Symbol	Parameter	T_A = –40°C			T_A = +25°C			T_A = +85°C			Unit	Condition
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
V_{IL}	Input LOW Voltage	–1945	—	–1625	–1945	—	–1625	–1945	—	–1625	mV	
V_{IH}	Input HIGH Voltage	–1225	—	–880	–1225	—	–880	–1225	—	–880	mV	
V_{OL}	Outuput LOW Voltage	–1945	–1820	–1695	–1945	–1820	–1695	–1945	–1820	–1695	mV	50Ω to V_{CC}–2V
V_{OH}	Output HIGH Voltage	–1145	–1020	–895	–1145	–1020	–895	–1145	–1020	–895	mV	50Ω to V_{CC}–2V
V_{BB}	Output Reference Voltage	–1525	–1425	–1325	–1525	–1425	–1325	–1525	–1425	–1325	mV	
V_{IHCMR}	Input HIGH Voltage[2] Common Mode Range	V_{EE} +2.0		0.0	V_{EE} +2.0		0.0	V_{EE} +2.0		0.0	V	

Notes:

1. 100KEP circuits are designed to meet the DC specifications shown in the above table after thermal equilibrium has been established. The circuit is in a test socket or mounted on a printed circuit board and traverse airflow greater than 500lfpm is maintained. Input and output parameters are at V_{CC} = 3.3V. They vary 1:1 with V_{CC}.
2. The V_{IHCMR} range is referenced to the most positive side of the differential input signal.

AC ELECTRICAL CHARACTERISTICS

V_{CC} = 0V; V_{EE} = –3.0V to –5.5V or V_{CC} = 3.0V to 5.5V, V_{EE} = 0V

Symbol	Parameter	T_A = –40°C			T_A = +25°C			T_A = +85°C			Unit	Condition
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
f_{MAX}	Max. Toggle Frequency[1]	3	—	—	3	—	—	3	—	—	GHz	
t_{PLH} t_{PHL}	Propagation Delay (Differential) D to Q, /Q SEL to Q, /Q	 250 300	 310 370	 450 500	 250 300	 315 380	 475 520	 250 300	 320 390	 520 575	 ps ps	
t_{SKEW}	Part-to-Part Skew[2]	—	—	200	—	—	200	—	—	200	ps	
t_{JITTER}	Cycle-to-Cycle Jitter (rms)	—	0.2	< 1	—	0.2	< 1	—	0.2	< 1	ps_{RMS}	
	Random Jitter	—	—	—	—	<1	—	—	—	—	ps_{RMS}	**Note 3**
	Deterministic Jitter @1.25Gbps @2.5Gbps	 — —	 — —	 — —	 — —	 <25 <50	 — —	 — —	 — —	 — —	ps_{PP}	**Note 4**
V_{DIFF}	Input Voltage (Differential)	150	800	1200	150	800	1200	150	800	1200	mV	
t_r, t_f	Output Rise/Fall Time Q, /Q (20% to 80%)	—	120	170	—	140	200	—	150	220	ps	

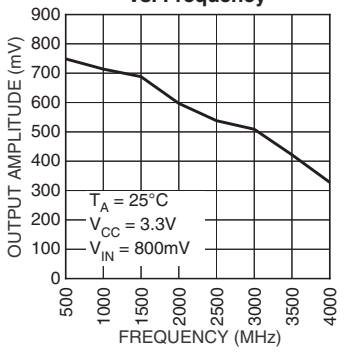
Notes:

1. Measured with 750mV input signal, 50% duty cycle. Output swing ≥ 400mV. All loading with a 50Ω to V_{CC} –2.0V.
2. Skew is measured between outputs under identical transitions. Duty cycle skew is defined only for differential operation when the delays are measured from the cross point of the inputs to the cross point of the outputs.
3. RJ is measured with a K28.7 comma detect character pattern, measured at 1.25Gbps and 2.5Gbps.
4. DJ is measured at 1.25Gbps and 2.5Gbps, with both K28.5 and 2^{23}–1 PRBS pattern.

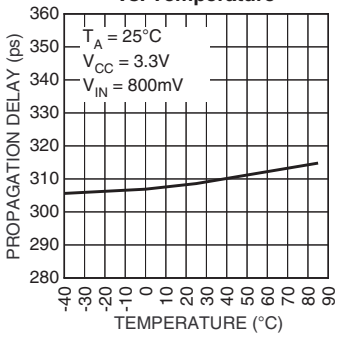
TYPICAL OPERATING CHARACTERISTICS

V_{CC} = 3.3V, V_{EE} = GND, T_A = 25°C, unless otherwise stated.

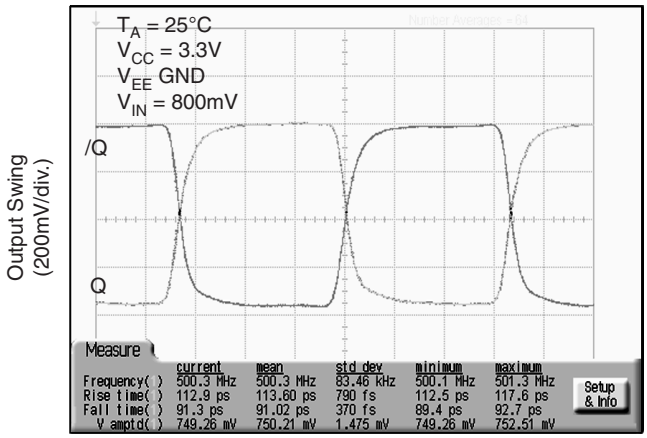
Output Amplitude vs. Frequency



Propagation Delay vs. Temperature

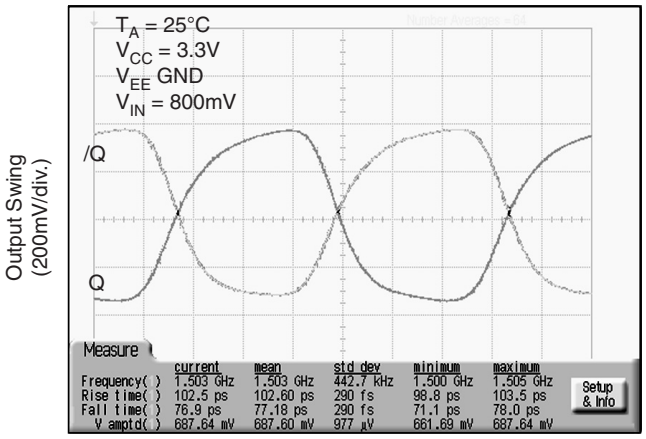


500MHz Output



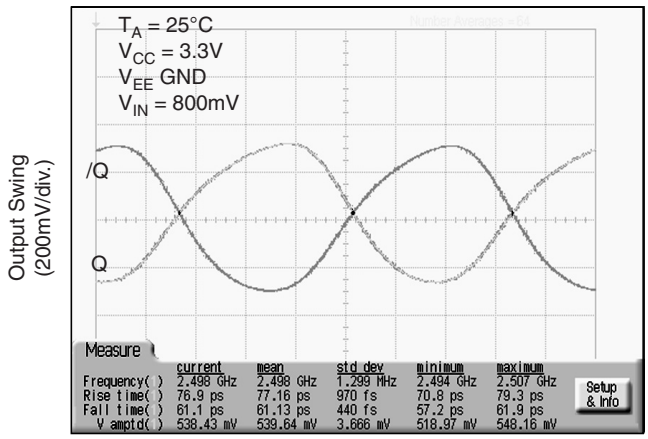
TIME (300ps/div.)

1.5GHz Output



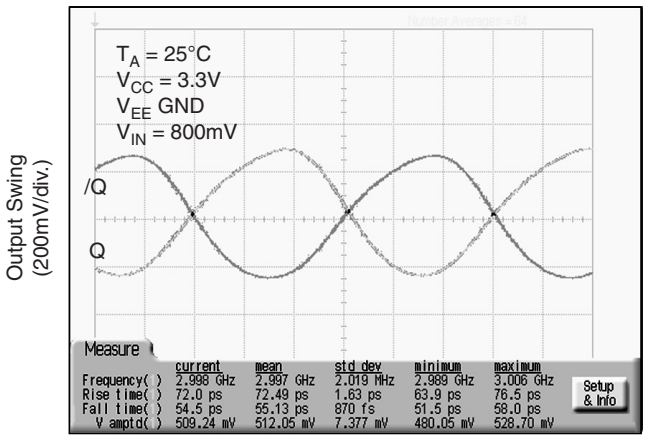
TIME (100ps/div.)

2.5GHz Output



TIME (60ps/div.)

3.0GHz Output



TIME (55ps/div.)

TERMINATION RECOMMENDATIONS

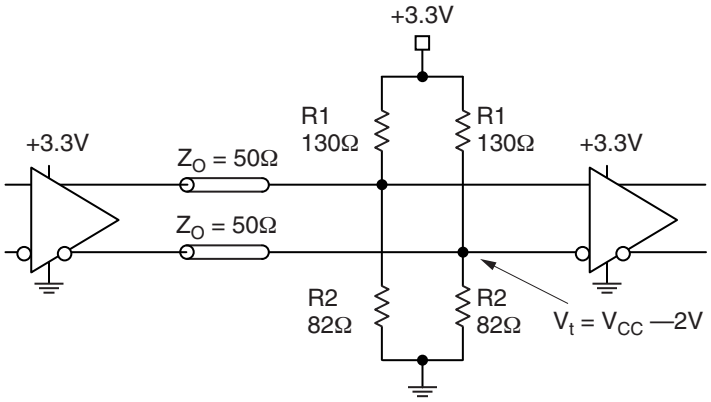


Figure 1. Parallel Termination–Thevenin Equivalent

Note:

1. For +5.0V systems: R1 = 82Ω, R2 = 130Ω.

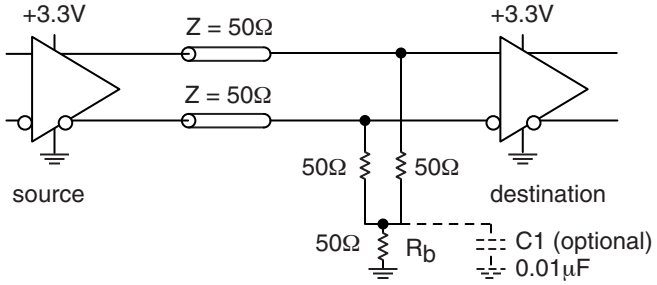


Figure 2. Three-Resistor "Y–Termination"

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_t. For +3.3V systems R_b = 46Ω to 50Ω. For +5V systems, R_b = 110Ω.

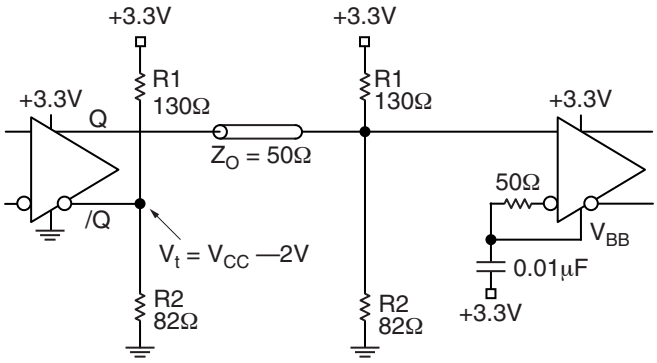
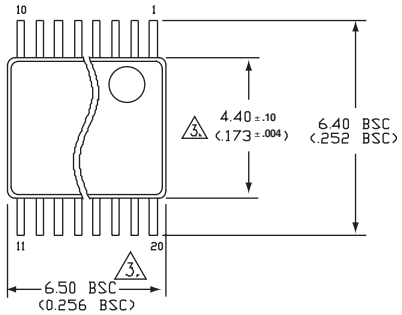


Figure 3. Terminating Unused I/O

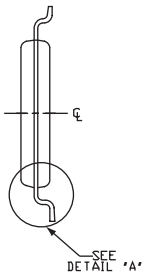
Notes:

1. Unused output (/Q) must be terminated to balance the output.
2. Micrel's differential I/O logic devices include a V_{BB} reference pin .
3. Connect unused input through 50Ω to V_{BB}. Bypass with a 0.01μF capacitor to V_{CC}, not GND.
4. For +2.5V systems: R1 = 250Ω, R2 = 62.5Ω.

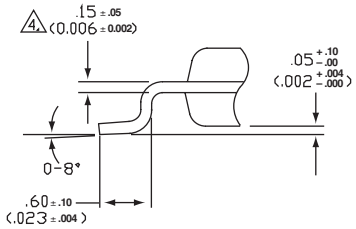
20-PIN TSSOP (K4-20-1)



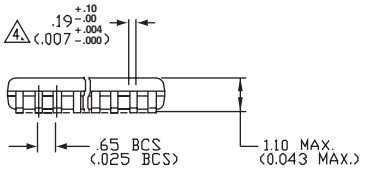
TOP VIEW



END VIEW



DETAIL 'A'
(VIEW ROTATED 90° C.W.)



SIDE VIEW

NOTES:
1. DIMENSIONS ARE IN MM[INCHES].
2. CONTROLLING DIMENSION: MM.
3. DIMENSION DOES NOT INCLUDE MOLD FLASH OF 0.254[0.010] MAX.
4. THIS DIMENSION INCLUDES LEAD FINISH.

Rev. 01

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