

# 3.3V / 5V ECL Differential Receiver/Driver With Reduced Output Swing

## Description

The MC100EP16F is a differential receiver/driver. The device is functionally equivalent to the EP16 device with higher performance capabilities. With reduced output swings, rise/fall transition times are significantly faster than on the EP16. The EP16F is ideally suited for interfacing with high frequency sources.

The  $V_{BB}$  pin, an internally generated voltage supply, is available to this device only. For single-ended input conditions, the unused differential input is connected to  $V_{BB}$  as a switching reference voltage.  $V_{BB}$  may also rebias AC coupled inputs. When used, decouple  $V_{BB}$  and  $V_{CC}$  via a 0.01  $\mu$ F capacitor and limit current sourcing or sinking to 0.5 mA. When not used,  $V_{BB}$  should be left open.

## Features

- 100 ps Typical Rise and Fall Time
- Max Frequency >4 GHz Typical
- The 100 Series Contains Temperature Compensation
- PECL Mode Operating Range:  $V_{CC} = 3.0$  V to 5.5 V with  $V_{EE} = 0$  V
- NECL Mode Operating Range:  $V_{CC} = 0$  V with  $V_{EE} = -3.0$  V to -5.5 V
- Open Input Default State
- Safety Clamp on Inputs
- Pb-Free Packages are Available



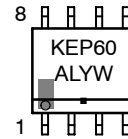
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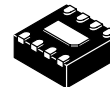
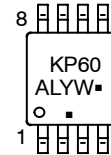
## MARKING DIAGRAMS\*



SOIC-8  
D SUFFIX  
CASE 751



TSSOP-8  
DT SUFFIX  
CASE 948R



DFN8  
MN SUFFIX  
CASE 506AA



- A = Assembly Location
- L = Wafer Lot
- Y = Year
- W = Work Week
- M = Date Code
- = Pb-Free Package

(Note: Microdot may be in either location)

\*For additional marking information, refer to Application Note AND8002/D.

## ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

# MC100EP16F

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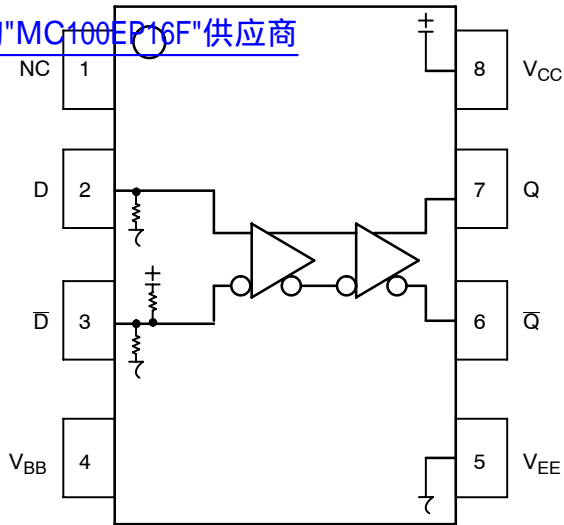


Figure 1. 8-Lead Pinout (Top View) and Logic Diagram

Table 1. PIN DESCRIPTION

PIN	FUNCTION
D*, D**	ECL Data Inputs
Q, Q̄	ECL Data Outputs
V <sub>BB</sub>	Reference Voltage Output
V <sub>CC</sub>	Positive Supply
V <sub>EE</sub>	Negative Supply
NC	No Connect
EP	Exposed pad must be connected to a sufficient thermal conduit. Electrically connect to the most negative supply or leave floating open.

\* Pins will default LOW when left open.

\*\* Pins will default to V<sub>CC</sub>/2 when left open.

Table 2. ATTRIBUTES

Characteristics		Value	
Internal Input Pulldown Resistor		75 kΩ	
Internal Input Pullup Resistor		37.5 kΩ	
ESD Protection	Human Body Model	> 4 kV	
	Machine Model	> 200 V	
	Charged Device Model	> 2 kV	
Moisture Sensitivity, Indefinite Time Out of Drypack (Note 1)		Pb Pkg	Pb-Free Pkg
	SOIC-8	Level 1	Level 1
	TSSOP-8	Level 1	Level 3
	DFN8	Level 1	Level 1
Flammability Rating	Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in	
Transistor Count		139	
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test			

1. For additional information, see Application Note AND8003/D.

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Table 8. MAXIMUM RATINGS  
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Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
V <sub>CC</sub>	PECL Mode Power Supply	V <sub>EE</sub> = 0 V		6	V
V <sub>EE</sub>	NECL Mode Power Supply	V <sub>CC</sub> = 0 V		-6	V
V <sub>I</sub>	PECL Mode Input Voltage	V <sub>EE</sub> = 0 V	V <sub>I</sub> ≤ V <sub>CC</sub>	6	V
	NECL Mode Input Voltage	V <sub>CC</sub> = 0 V	V <sub>I</sub> ≥ V <sub>EE</sub>	-6	V
I <sub>out</sub>	Output Current	Continuous Surge		50	mA
				100	mA
I <sub>BB</sub>	V <sub>BB</sub> Sink/Source			± 0.5	mA
T <sub>A</sub>	Operating Temperature Range			-40 to +85	°C
T <sub>stg</sub>	Storage Temperature Range			-65 to +150	°C
θ <sub>JA</sub>	Thermal Resistance (Junction-to-Ambient)	0 lfpm	8 SOIC	190	°C/W
		500 lfpm	8 SOIC	130	°C/W
θ <sub>JC</sub>	Thermal Resistance (Junction-to-Case)	Standard Board	8 SOIC	41 to 44 ± 5%	°C/W
θ <sub>JA</sub>	Thermal Resistance (Junction-to-Ambient)	0 lfpm 500 lfpm	8 TSSOP	185	°C/W
			8 TSSOP	140	°C/W
θ <sub>JC</sub>	Thermal Resistance (Junction-to-Case)	Standard Board	8 TSSOP	41 to 44 ± 5%	°C/W
θ <sub>JA</sub>	Thermal Resistance (Junction-to-Ambient)	0 lfpm 500 lfpm	DFN8	129	°C/W
			DFN8	84	°C/W
T <sub>sol</sub>	Wave Solder	Pb	<2 to 3 sec @ 248°C	265	°C
		Pb-Free	<2 to 3 sec @ 260°C	265	

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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Table 4. DC CHARACTERISTICS, PECL  $V_{CC} = 3.3\text{ V}$ ,  $V_{EE} = 0\text{ V}$  (Note 2)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{EE}$	Power Supply Current	23	28	40	25	33	45	26	33	45	mA
$V_{OH}$	Output HIGH Voltage (Note 3)	2155	2280	2405	2155	2280	2405	2155	2280	2405	mV
$V_{OL}$	Output LOW Voltage (Note 3)	1525	1690	1775	1525	1690	1775	1525	1690	1775	mV
$V_{IH}$	Input HIGH Voltage (Single-Ended)	2075		2420	2075		2420	2075		2420	mV
$V_{IL}$	Input LOW Voltage (Single-Ended) (Note 4)	1355		1675	1355		1675	1355		1675	mV
$V_{BB}$	Output Voltage Reference	1775	1875	1975	1775	1875	1975	1775	1875	1975	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 5)	2.0		3.3	2.0		3.3	2.0		3.3	V
$I_{IH}$	Input HIGH Current			150			150			150	$\mu\text{A}$
$I_{IL}$	Input LOW Current	D D	0.5 -150		0.5 -150			0.5 -150			$\mu\text{A}$

NOTE: 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 500 lfm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

- Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary +0.3 V to -2.2 V.
- All loading with 50  $\Omega$  to  $V_{CC} - 2.0\text{ V}$ .
- Not recommended for Single-Ended operation when using an EP16F to drive another EP16F.  $V_{OL}$  has reduced output swing and may not meet the  $V_{IL}$  specification over temperature.
- $V_{IHCMR}$  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.

Table 5. DC CHARACTERISTICS, PECL  $V_{CC} = 5.0\text{ V}$ ,  $V_{EE} = 0\text{ V}$  (Note 6)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{EE}$	Power Supply Current	23	28	40	25	35	45	26	33	45	mA
$V_{OH}$	Output HIGH Voltage (Note 7)	3855	3980	4105	3855	3980	4105	3855	3980	4105	mV
$V_{OL}$	Output LOW Voltage (Note 7)	3225	3390	3475	3225	3390	3475	3225	3390	3475	mV
$V_{IH}$	Input HIGH Voltage (Single-Ended)	3775		4120	3775		4120	3775		4120	mV
$V_{IL}$	Input LOW Voltage (Single-Ended) (Note 8)	3055		3375	3055		3375	3055		3375	mV
$V_{BB}$	Output Voltage Reference	3475	3575	3675	3475	3575	3675	3475	3575	3675	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 9)	2.0		5.0	2.0		5.0	2.0		5.0	V
$I_{IH}$	Input HIGH Current			150			150			150	$\mu\text{A}$
$I_{IL}$	Input LOW Current	D D	0.5 -150		0.5 -150			0.5 -150			$\mu\text{A}$

NOTE: 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 500 lfm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

- Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary +2.0 V to -0.5 V.
- All loading with 50  $\Omega$  to  $V_{CC} - 2.0\text{ V}$ .
- Not recommended for Single-Ended operation when using an EP16F to drive another EP16F.  $V_{OL}$  has reduced output swing and may not meet the  $V_{IL}$  specification over temperature.
- $V_{IHCMR}$  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.

# MC100EP16F

Table 6. DC CHARACTERISTICS, NECL  $V_{CC} = 0\text{ V}$ ;  $V_{EE} = -5.5\text{ V}$  to  $-3.0\text{ V}$  (Note 10)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{EE}$	Power Supply Current	23	28	40	25	34	45	26	33	45	mA
$V_{OH}$	Output HIGH Voltage (Note 11)	-1145	-1020	-895	-1145	-1020	-895	-1145	-1020	-895	mV
$V_{OL}$	Output LOW Voltage (Note 11)	-1775	-1610	-1525	-1775	-1610	-1525	-1775	-1610	-1525	mV
$V_{IH}$	Input HIGH Voltage (Single-Ended)	-1225		-880	-1225		-880	-1225		-880	mV
$V_{IL}$	Input LOW Voltage (Single-Ended) (Note 12)	-1810		-1625	-1810		-1625	-1810		-1625	mV
$V_{BB}$	Output Voltage Reference	-1525	-1425	-1325	-1525	-1425	-1325	-1525	-1425	-1325	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 13)	$V_{EE}+2.0$		0.0	$V_{EE}+2.0$		0.0	$V_{EE}+2.0$		0.0	V
$I_{IH}$	Input HIGH Current			150			150			150	$\mu\text{A}$
$I_{IL}$	Input LOW Current	D D	0.5 -150		0.5 -150			0.5 -150			$\mu\text{A}$

NOTE: 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 500 lpm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

10. Input and output parameters vary 1:1 with  $V_{CC}$ .

11. All loading with  $50\ \Omega$  to  $V_{CC} - 2.0\text{ V}$ .

12. Not recommended for Single-Ended operation when using an EP16F to drive another EP16F.  $V_{OL}$  has reduced output swing and may not meet the  $V_{IL}$  specification over temperature.

13.  $V_{IHCMR}$  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.

Table 7. AC CHARACTERISTICS  $V_{CC} = 0\text{ V}$ ;  $V_{EE} = -3.0\text{ V}$  to  $-5.5\text{ V}$  or  $V_{CC} = 3.0\text{ V}$  to  $5.5\text{ V}$ ;  $V_{EE} = 0\text{ V}$  (Note 14)

Symbol	Characteristic	-40°C			25°C			85°C			Unit	
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max		
$f_{max}$	Maximum Toggle Frequency (See Figure 2. $F_{max}/\text{JITTER}$ )		> 4			> 4			> 4		GHz	
$t_{PLH}$ , $t_{PHL}$	Propagation Delay to Output Differential	170	210	250	180	220	260	200	250	300	ps	
$t_{SKEW}$	Duty Cycle Skew		5.0	20		5.0	20		5.0	20	ps	
$t_{JITTER}$	Cycle-to-Cycle Jitter (RMS) (See Figure 2. $F_{max}/\text{JITTER}$ )		0.2	< 1		0.2	< 1		0.2	< 1	ps	
$V_{PP}$	Input Voltage Swing (Differential Configuration)	150	800	1200	150	800	1200	150	800	1200	mV	
$t_r$ , $t_f$	Output Rise/Fall Times (20% - 80%)	Q	70	85	110	80	100	120	90	110	130	ps

NOTE: 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 500 lpm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

14. Measured using a 750 mV source, 50% duty cycle clock source. All loading with  $50\ \Omega$  to  $V_{CC}-2.0\text{ V}$ .

# MC100EP16F

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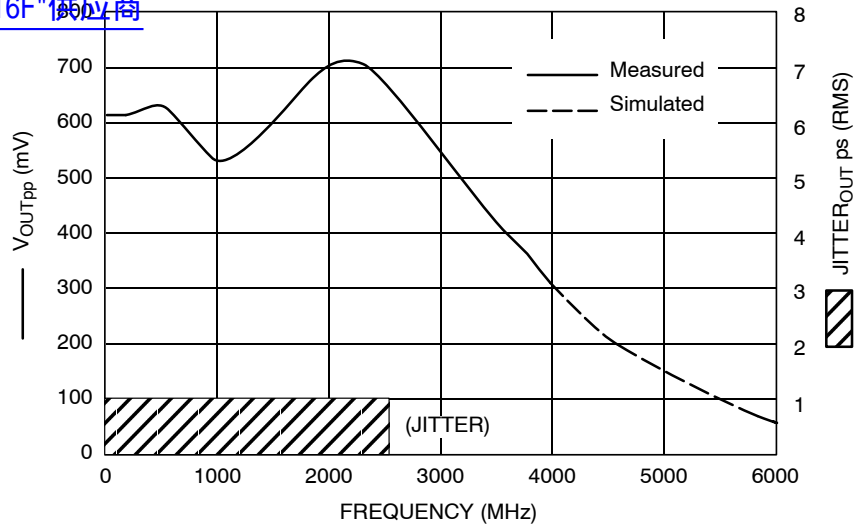


Figure 2.  $F_{max}/JITTER$

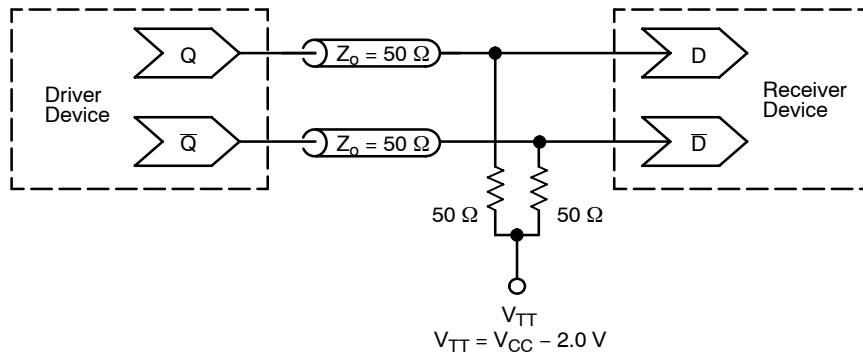


Figure 3. Typical Termination for Output Driver and Device Evaluation  
(See Application Note AND8020/D – Termination of ECL Logic Devices.)

# MC100EP16F

## ORDERING INFORMATION

Device	Package	Shipping†
MC100EP16FD	SOIC-8	98 Units / Rail
MC100EP16FDG	SOIC-8 (Pb-Free)	98 Units / Rail
MC100EP16FDR2	SOIC-8	2500 / Tape & Reel
MC100EP16FDR2G	SOIC-8 (Pb-Free)	2500 / Tape & Reel
MC100EP16FDT	TSSOP-8	100 Units / Rail
MC100EP16FDTG	TSSOP-8 (Pb-Free)	100 Units / Rail
MC100EP16FDTR2	TSSOP-8	2500 / Tape & Reel
MC100EP16FDTR2G	TSSOP-8 (Pb-Free)	2500 / Tape & Reel
MC100EP16FMNR4	DFN8	1000 / Tape & Reel
MC100EP16FMNR4G	DFN8 (Pb-Free)	1000 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

### Resource Reference of Application Notes

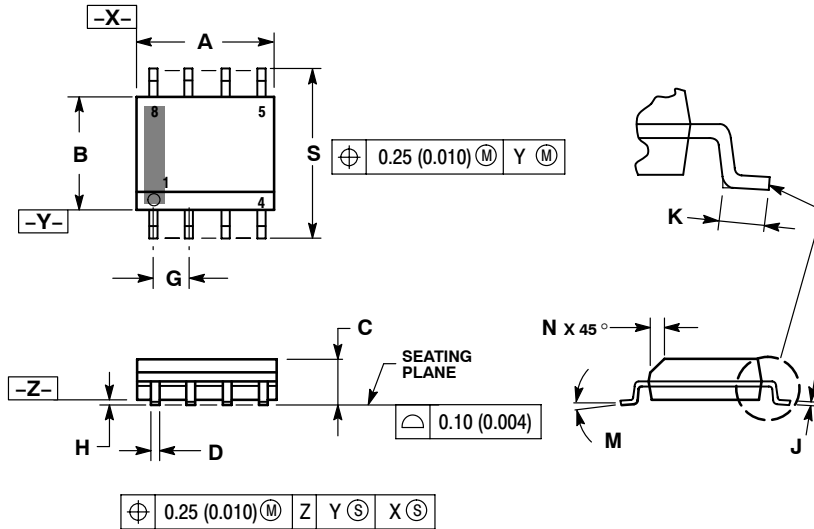
- AN1405/D** - ECL Clock Distribution Techniques
- AN1406/D** - Designing with PECL (ECL at +5.0 V)
- AN1503/D** - ECLinPS™ I/O SPICE Modeling Kit
- AN1504/D** - Metastability and the ECLinPS Family
- AN1568/D** - Interfacing Between LVDS and ECL
- AN1672/D** - The ECL Translator Guide
- AND8001/D** - Odd Number Counters Design
- AND8002/D** - Marking and Date Codes
- AND8020/D** - Termination of ECL Logic Devices
- AND8066/D** - Interfacing with ECLinPS
- AND8090/D** - AC Characteristics of ECL Devices

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## PACKAGE DIMENSIONS

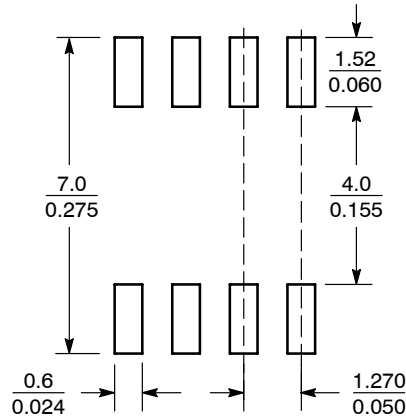
SOIC-8 NB  
CASE 751-07  
ISSUE AH



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
  4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
  5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
  6. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0°	8°	0°	8°
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

### SOLDERING FOOTPRINT\*



SCALE 6:1 ( $\frac{\text{mm}}{\text{inches}}$ )

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

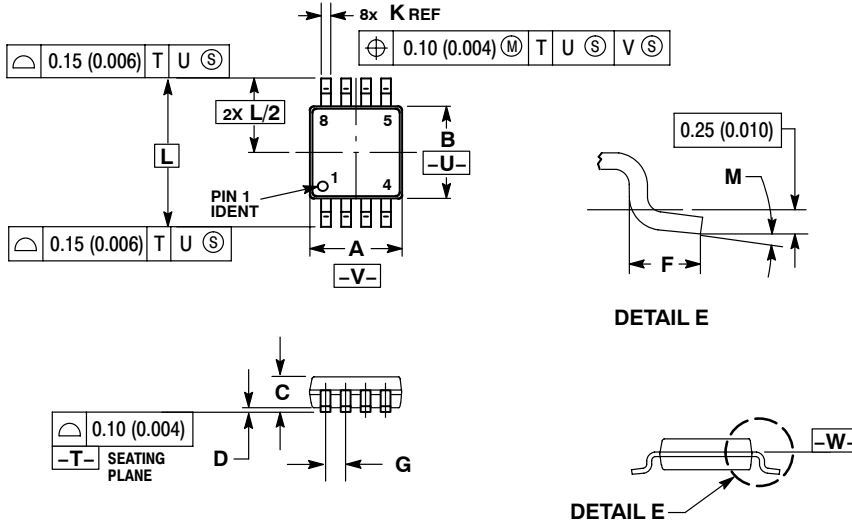


# MC100EP16F

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## PACKAGE DIMENSIONS

TSSOP-8  
DT SUFFIX  
PLASTIC TSSOP PACKAGE  
CASE 948R-02  
ISSUE A



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
6. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

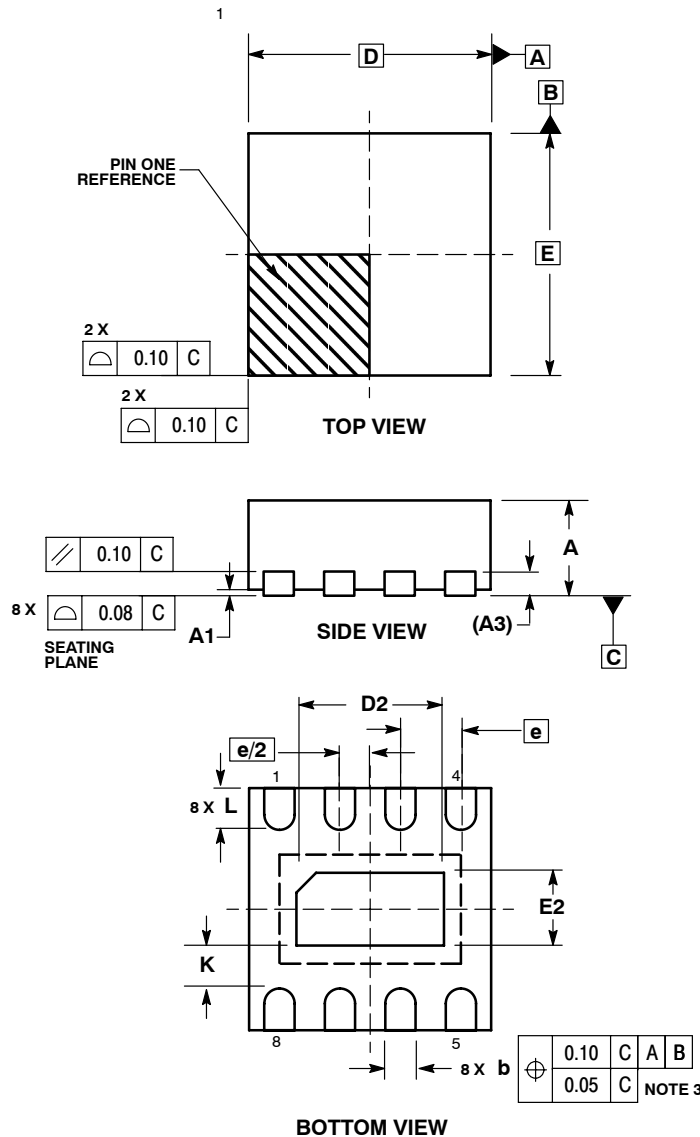
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.90	3.10	0.114	0.122
B	2.90	3.10	0.114	0.122
C	0.80	1.10	0.031	0.043
D	0.05	0.15	0.002	0.006
F	0.40	0.70	0.016	0.028
G	0.65 BSC		0.026 BSC	
K	0.25	0.40	0.010	0.016
L	4.90 BSC		0.193 BSC	
M	0°	6°	0°	6°

# MC100EP16F

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## PACKAGE DIMENSIONS

DFN8  
CASE 506AA-01  
ISSUE D



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994 .
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 MM FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

DIM	MILLIMETERS	
	MIN	MAX
A	0.80	1.00
A1	0.00	0.05
A3	0.20 REF	
b	0.20	0.30
D	2.00 BSC	
D2	1.10	1.30
E	2.00 BSC	
E2	0.70	0.90
e	0.50 BSC	
K	0.20	---
L	0.25	0.35

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