

# MC100EP16VT

## 3.3V / 5V ECL Differential Receiver/Driver with Variable Output Swing and Internal Input Termination

### Description

The MC100EP16VT is a differential receiver functionally equivalent to the 100EP16 with input pins controlling the amplitude of the outputs (pin 1) and providing an internal termination network (pin 4).

The  $V_{CTRL}$  input pin controls the output amplitude of the EP16VT and is referenced to  $V_{CC}$ . (See Figure 4.) The operational range of the  $V_{CTRL}$  input is from  $\leq V_{BB}$  (a supply at  $V_{CC}-1.42$  V, maximum output amplitude) to  $V_{CC}$  (minimum output amplitude).  $V_{BB}$  is an externally supplied voltage equal to  $V_{CC}-1.42$  V (See Figures 2 and Figure 3). A variable resistor between  $V_{CC}$  and  $V_{BB}$ , with the wiper driving  $V_{CTRL}$ , can control the output amplitude. Typical application circuits and a  $V_{CTRL}$  Voltage vs. Output Amplitude graph are described in this data sheet. When left open, the  $V_{CTRL}$  pin will be internally pulled down to  $V_{EE}$  and operate as a standard EP16, with 100% output amplitude.

The  $V_{TT}$  input pin offers an internal termination network for a 50  $\Omega$  line impedance environment, shown in Figure 1. For further reference, see Application Note AND8020, Termination of ECL Logic Devices. Input considerations are required for D and  $\bar{D}$  under no signal conditions to prevent instability.

Special considerations are required for differential inputs under No Signal conditions to prevent instability.

### Features

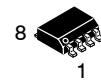
- 220 ps Propagation Delay
- Maximum Frequency > 4 GHz Typical (See Graph)
- The 100 Series Contains Temperature Compensation
- PECL Mode Operating Range:  $V_{CC} = 3.0$  V to 5.5 V with  $V_{EE} = 0$  V
- NECL Mode Operating Range:  $V_{CC} = 0$  V with  $V_{EE} = -3.0$  V to  $-5.5$  V
- Open Input Default State
- 50  $\Omega$  Internal Termination Resistor
- Pb-Free Packages are Available



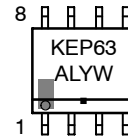
ON Semiconductor®

<http://onsemi.com>

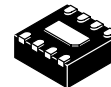
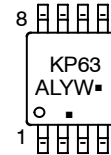
### MARKING DIAGRAMS\*



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 9 of this data sheet.

# MC100EP16VT

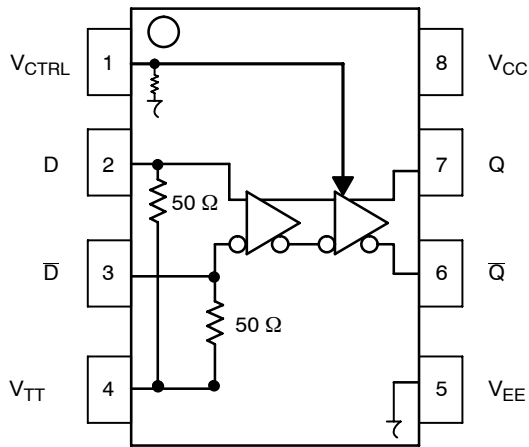


Figure 1. 8-Lead Pinout (Top View) and Logic Diagram

Table 1. PIN DESCRIPTION

PIN	FUNCTION
D, $\bar{D}$	ECL Data Inputs
Q, $\bar{Q}$	ECL Data Outputs
V <sub>CTRL</sub> *	Output Swing Control
V <sub>TT</sub>	Termination Supply
V <sub>CC</sub>	Positive Supply
V <sub>EE</sub>	Negative Supply
EP	Exposed pad must be connected to a sufficient thermal conduit. Electrically connect to the most negative supply or leave floating open.

\* Pin will default LOW when left open.

Table 2. ATTRIBUTES

Characteristics	Value	Value
Internal Input Pulldown Resistor	75 k $\Omega$	
Internal Input Pullup Resistor	N/A	
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
	TSSOP-8	Level 1
	DFN8	Level 1
Flammability Rating	Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in
Transistor Count	140 Devices	
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test		

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

# MC100EP16VT

**Table 3. MAXIMUM RATINGS**

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 NECL Mode Input Voltage	V <sub>EE</sub> = 0 V V <sub>CC</sub> = 0 V	V <sub>I</sub> ≤ V <sub>CC</sub> V <sub>I</sub> ≥ V <sub>EE</sub>	6 -6	V V
I <sub>out</sub>	Output Current	Continuous Surge		50 100	mA 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 500 lfpm	8 SOIC 8 SOIC	190 130	°C/W °C/W
θ <sub>JC</sub>	Thermal Resistance (Junction-to-Case)	Standard Board	8 SOIC	41 to 44	°C/W
θ <sub>JA</sub>	Thermal Resistance (Junction-to-Ambient)	0 lfpm 500 lfpm	8 TSSOP 8 TSSOP	185 140	°C/W °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 DFN8	129 84	°C/W °C/W
T <sub>sol</sub>	Wave Solder	Pb Pb-Free	<2 to 3 sec @ 248°C <2 to 3 sec @ 260°C	265 265	°C

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.

**Table 4. DC CHARACTERISTICS, PECL V<sub>CC</sub> = 3.3 V, V<sub>EE</sub> = 0 V (Note 2)**

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
I <sub>EE</sub>	Power Supply Current	30	36	42	31	38	44	32	40	48	mA
V <sub>OH</sub>	Output HIGH Voltage (Max Swing) (Note 3) V <sub>CC</sub> ≥ V <sub>CTRL</sub> ≥ V <sub>EE</sub>	2155		2405	2155		2405	2155		2405	mV
V <sub>OL</sub>	Output LOW Voltage (Max Swing) (Note 3) V <sub>CTRL</sub> ≤ V <sub>BB</sub>	1355	1490	1605	1355	1520	1605	1355	1520	1605	mV
	V <sub>CC</sub> ≥ V <sub>CTRL</sub> > V <sub>BB</sub>		See Fig.2			See Fig.2			See Fig.2		
	V <sub>CTRL</sub> = V <sub>CC</sub> (Min Swing)	2105	2230	2355	2095	2220	2345	2065	2190	2315	
V <sub>IH</sub>	D, $\bar{D}$ Input HIGH Voltage (Single-Ended)	2075		2420	2075		2420	2075		2420	mV
V <sub>IL</sub>	D, $\bar{D}$ Input LOW Voltage (Single-Ended)	1355		1675	1355		1675	1355		1675	mV
V <sub>CTRL</sub>	Input Voltage (V <sub>CTRL</sub> )	V <sub>EE</sub>		V <sub>CC</sub>	V <sub>EE</sub>		V <sub>CC</sub>	V <sub>EE</sub>		V <sub>CC</sub>	mV
V <sub>IHCMR</sub>	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 4)	2.0		2.9	2.0		2.9	2.0		2.9	V
I <sub>IH</sub>	Input HIGH Current (V <sub>TT</sub> Open)			150			150			150	μA
I <sub>IL</sub>	Input LOW Current (V <sub>TT</sub> Open)	-150			-150			-150			μA

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 lfpm. 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<sub>CC</sub>. V<sub>EE</sub> can vary +0.3 V to -2.2 V.
- All loading with 50 Ω to V<sub>CC</sub> - 2.0 V. V<sub>OH</sub> does not change with V<sub>CTRL</sub>. V<sub>OL</sub> changes with V<sub>CTRL</sub>. V<sub>CTRL</sub> is referenced to V<sub>CC</sub>.
- V<sub>IHCMR</sub> min varies 1:1 with V<sub>EE</sub>, V<sub>IHCMR</sub> max varies 1:1 with V<sub>CC</sub>. The V<sub>IHCMR</sub> range is referenced to the most positive side of the differential input signal.

# MC100EP16VT

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

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{EE}$	Power Supply Current	30	36	42	31	38	44	32	40	48	mA
$V_{OH}$	Output HIGH Voltage (Note 6) $V_{CC} > V_{CTRL} > V_{EE}$	3855	3980	4105	3855	3980	4105	3855	3980	4105	mV
$V_{OL}$	Output LOW Voltage (Max Swing) (Note 6) $V_{CTRL} \leq V_{BB}$	3055	3190	3305	3055	3220	3305	3055	3220	3305	mV
	$V_{CC} \geq V_{CTRL} > V_{BB}$		See Fig.2			See Fig.2		See Fig.2			
	$V_{CTRL} = V_{CC}$ (Min Swing)	3805	3930	4055	3795	3920	4045	3765	3890	4015	
$V_{IH}$	D, $\bar{D}$ Input HIGH Voltage (Single-Ended)	3775		4120	3775		4120	3775		4120	mV
$V_{IL}$	D, $\bar{D}$ Input LOW Voltage (Single-Ended)	3055		3375	3055		3375	3055		3375	mV
$V_{CTRL}$	Input Voltage ( $V_{CTRL}$ )	$V_{EE}$		$V_{CC}$	$V_{EE}$		$V_{CC}$	$V_{EE}$		$V_{CC}$	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 7)	2.0		4.6	2.0		4.6	2.0		4.6	V
$I_{IH}$	Input HIGH Current ( $V_{TT}$ Open)			150			150			150	$\mu\text{A}$
$I_{IL}$	Input LOW Current ( $V_{TT}$ Open)	-150			-150			-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  $V_{CC} - 2.0\text{ V}$ .  $V_{OH}$  does not change with  $V_{CTRL}$ .  $V_{OL}$  changes with  $V_{CTRL}$ .  $V_{CTRL}$  is referenced to  $V_{CC}$ .
- $V_{IHCMR}$  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.

# MC100EP16VT

**Table 6. DC CHARACTERISTICS, NECL**  $V_{CC} = 0\text{ V}$ ;  $V_{EE} = -5.5\text{ V}$  to  $-3.0\text{ V}$  (Note 8)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{EE}$	Power Supply Current	30	36	42	31	38	44	32	40	48	mA
$V_{OH}$	Output HIGH Voltage (Note 9) $V_{CC} > V_{CTRL} > V_{EE}$	-1145	-1020	-895	-1145	-1020	-895	-1145	-1020	-895	mV
$V_{OL}$	Output LOW Voltage (Max Swing) (Note 9) $V_{CTRL} \leq V_{BB}$	-1945	-1810	-1695	-1945	-1780	-1695	-1945	-1780	-1695	mV
	$V_{CC} \geq V_{CTRL} > V_{BB}$		See Fig.2			See Fig.2			See Fig.2		
	$V_{CTRL} = V_{CC}$ (Min Swing)	-1195	-1070	-945	-1205	-1080	-955	-1235	-1110	-985	
$V_{IH}$	D, $\bar{D}$ Input HIGH Voltage (Single-Ended)	-1225		-880	-1225		-880	-1225		-880	mV
$V_{IL}$	D, $\bar{D}$ Input LOW Voltage (Single-Ended)	-1945		-1625	-1945		-1625	-1945		-1625	mV
$V_{CTRL}$	Input Voltage ( $V_{CTRL}$ )	$V_{EE}$		$V_{CC}$	$V_{EE}$		$V_{CC}$	$V_{EE}$		$V_{CC}$	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 10)	$V_{EE}+2.0$		-0.4	$V_{EE}+2.0$		-0.4	$V_{EE}+2.0$		-0.4	V
$I_{IH}$	Input HIGH Current ( $V_{TT}$ Open)			150			150			150	$\mu\text{A}$
$I_{IL}$	Input LOW Current ( $V_{TT}$ Open)	-150			-150			-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.

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

9. All loading with  $50\ \Omega$  to  $V_{CC} - 2.0\text{ V}$ .  $V_{OH}$  does not change with  $V_{CTRL}$ .  $V_{OL}$  changes with  $V_{CTRL}$ .  $V_{CTRL}$  is referenced to  $V_{CC}$ .

10.  $V_{IHCMR}$  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 11)

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 8. $F_{max}/\text{JITTER}$ )		> 4			> 4			> 4		GHz
$t_{PLH}$ , $t_{PHL}$	Propagation Delay to Output Differential Max Swing Min Swing	250 200	300 250	350 300	250 200	300 250	350 300	250 200	300 250	350 300	ps
$t_{SKEW}$	Duty Cycle Skew (Note 12)		5.0	20		5.0	20		5.0	20	ps
$t_{JITTER}$	Cycle-to-Cycle Jitter (See Figure 8. $F_{max}/\text{JITTER}$ )		0.2	< 1		0.2	< 1		0.2	< 1	ps
$V_{PP}$	Input Voltage Swing (Differential Configuration) (Note 13)	150	800	1200	150	800	1200	150	800	1200	mV
$t_r$ , $t_f$	Output Rise/Fall Times (20% – 80%) Max Swing Q Min Swing	70 30	120 80	170 130	80 20	130 70	180 120	100 20	150 70	200 120	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.

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

12. 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.

13.  $V_{PP}(\text{min})$  is minimum input swing for which AC parameters are guaranteed.

# MC100EP16VT

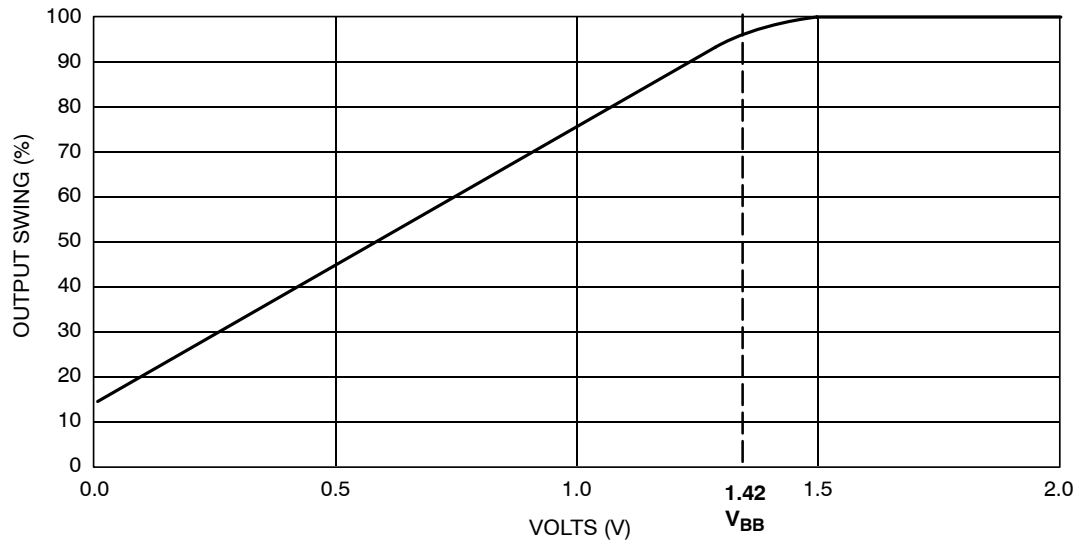


Figure 2.  $V_{CC} - V_{CTRL}$  (pin #1)

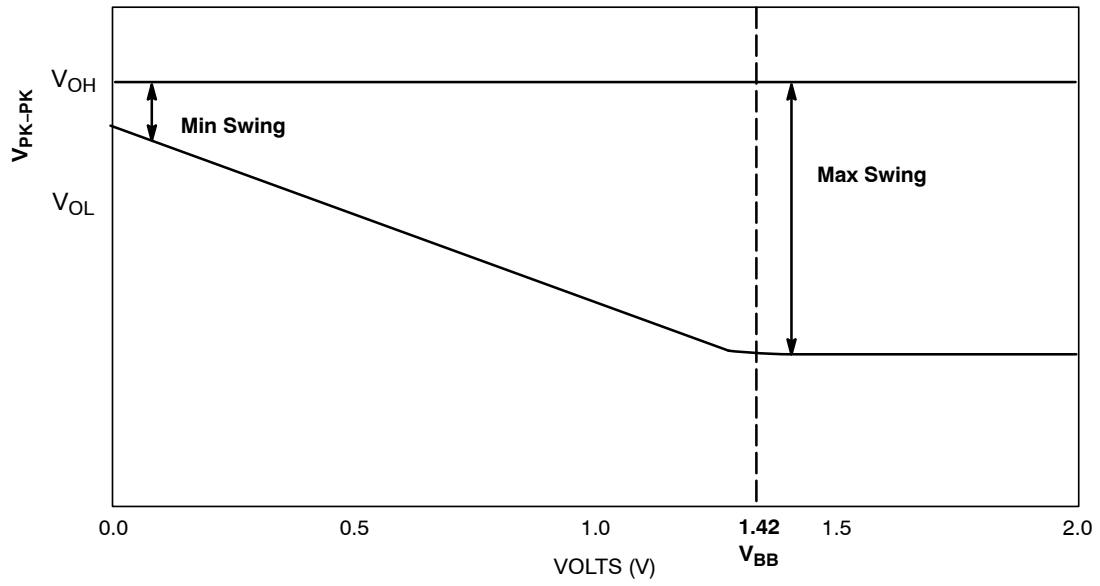


Figure 3.  $V_{CC} - V_{CTRL}$

# MC100EP16VT

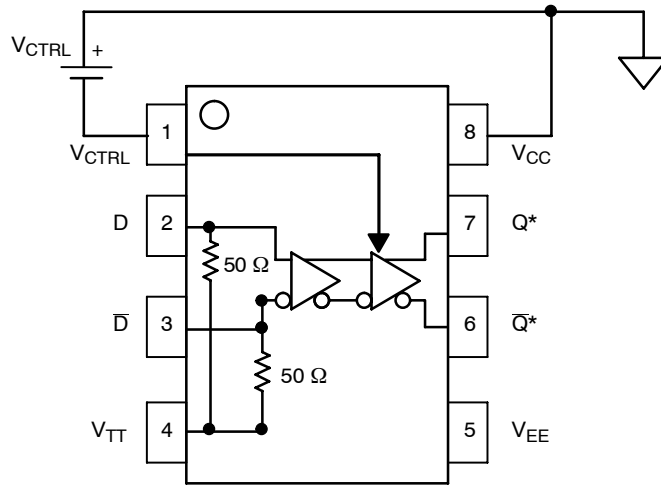


Figure 4. Voltage Source Implementation,  $V_{CTRL}$  Pin 1

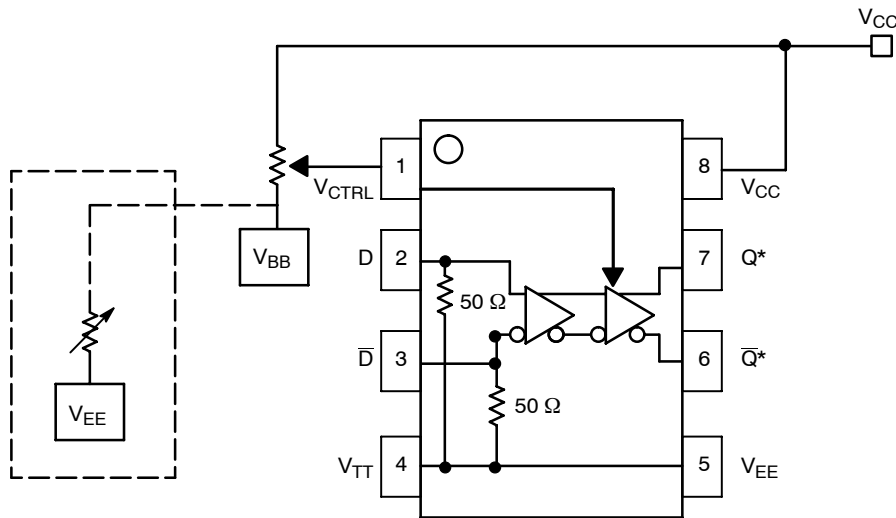


Figure 5. Alternative Implementations,  $V_{CTRL}$  Pin 1

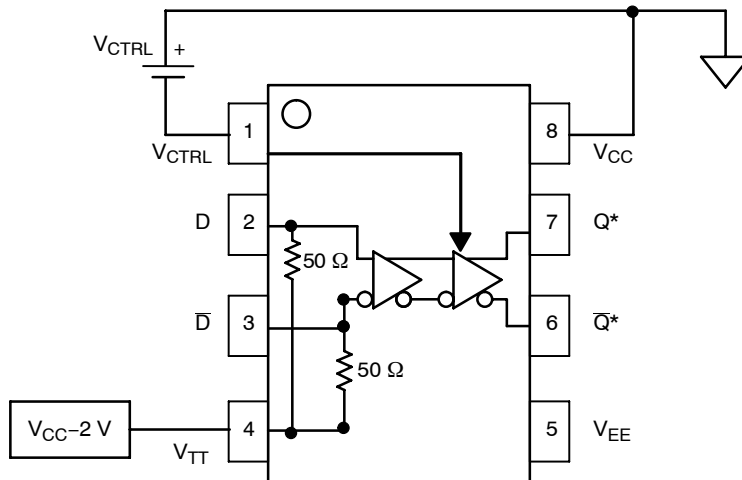


Figure 6. Standard Termination Method,  $V_{TT}$  Pin 4

# MC100EP16VT

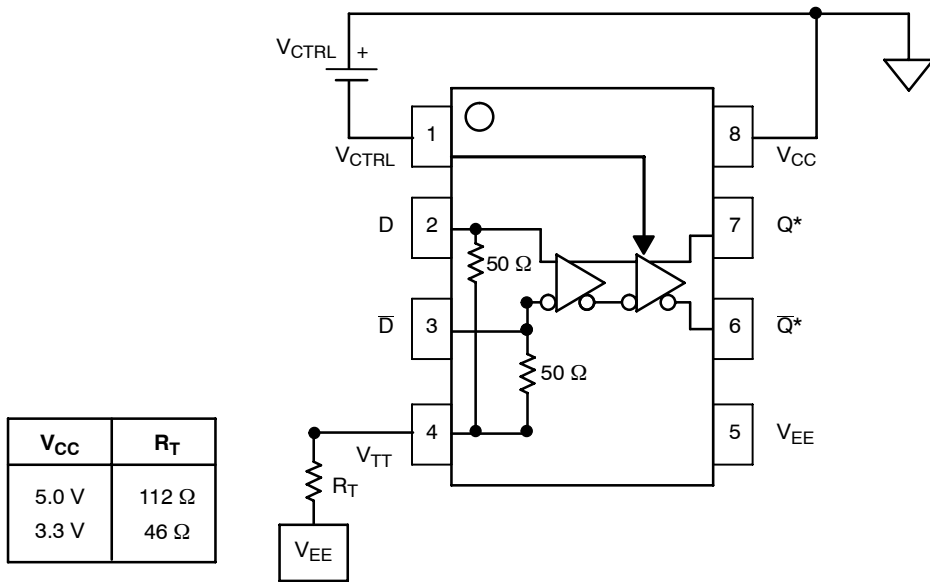


Figure 7. Alternate "Y" Termination Method, V<sub>TT</sub> Pin 4

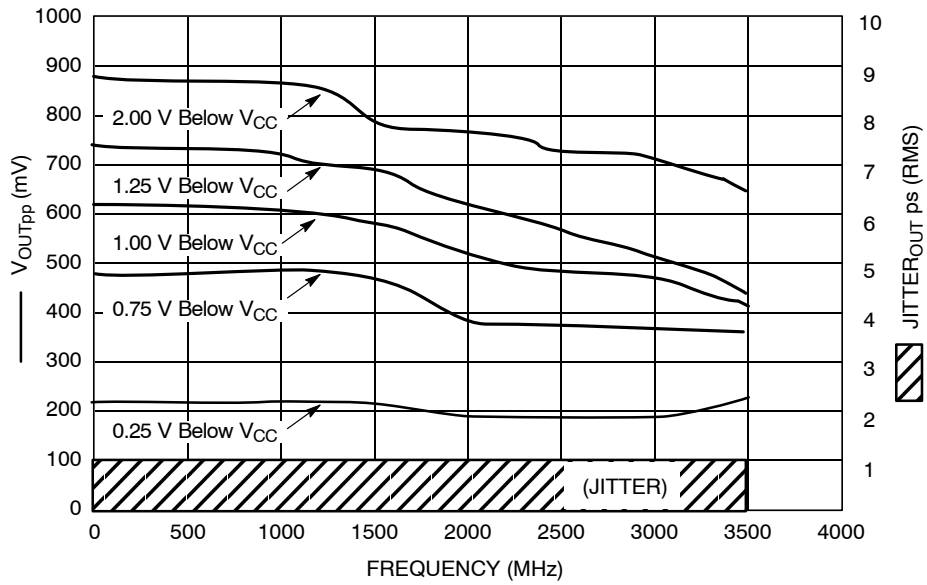


Figure 8. F<sub>max</sub>/Jitter

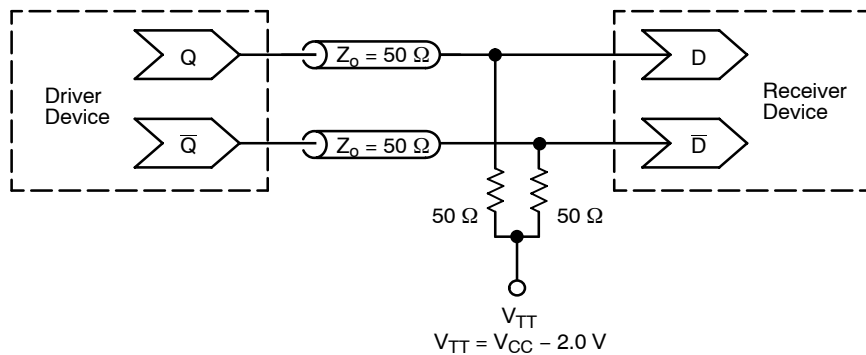


Figure 9. Typical Termination for Output Driver and Device Evaluation  
(See Application Note AND8020/D – Termination of ECL Logic Devices.)



# MC100EP16VT

## ORDERING INFORMATION

Device	Package	Shipping†
MC100EP16VTD	SOIC-8	98 Units / Rail
MC100EP16VTDG	SOIC-8 (Pb-Free)	98 Units / Rail
MC100EP16VTDR2	SOIC-8	2500 / Tape & Reel
MC100EP16VTDR2G	SOIC-8 (Pb-Free)	2500 / Tape & Reel
MC100EP16VTDT	TSSOP-8	100 Units / Rail
MC100EP16VTDTG	TSSOP-8 (Pb-Free)	100 Units / Rail
MC100EP16VTDR2	TSSOP-8	2500 / Tape & Reel
MC100EP16VTDR2G	TSSOP-8 (Pb-Free)	2500 / Tape & Reel
MC100EP16VTMNR4	DFN8	1000 / Tape & Reel
MC100EP16VTMNR4G	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.

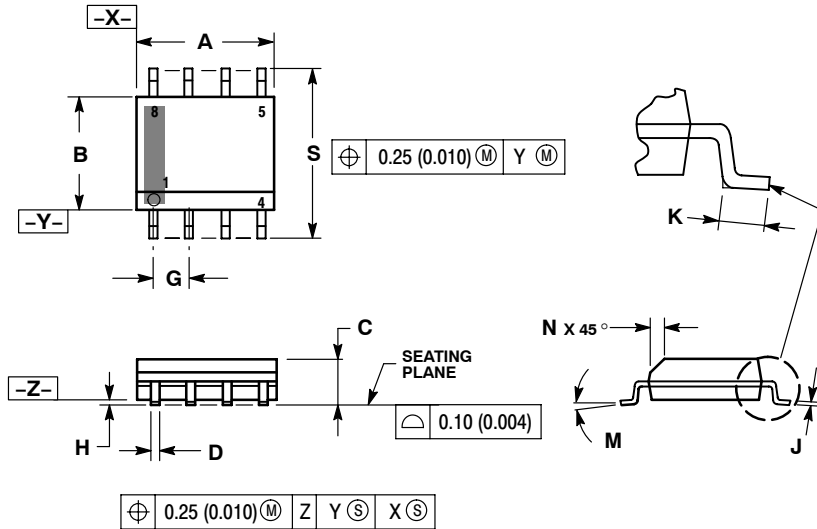
### Resource Reference of Application Notes

- 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

# MC100EP16VT

## PACKAGE DIMENSIONS

SOIC-8 NB  
CASE 751-07  
ISSUE AH

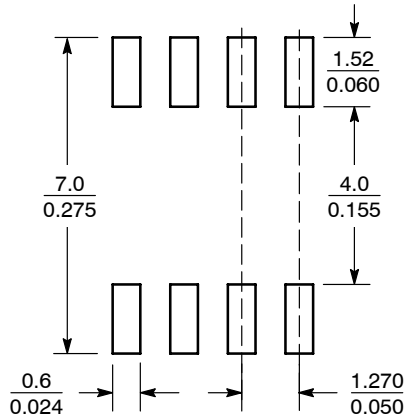


**NOTES:**

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\*



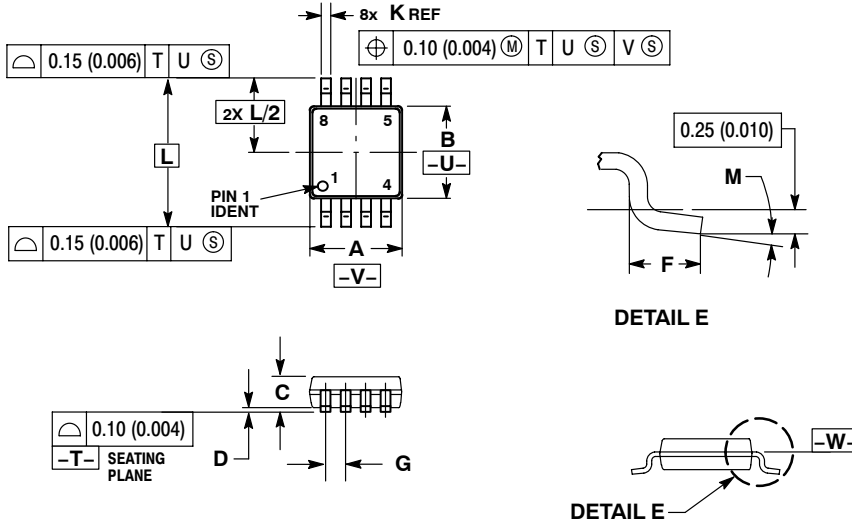
SCALE 6:1 ( $\frac{\text{mm}}{\text{inches}}$ )

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

# MC100EP16VT

## PACKAGE DIMENSIONS

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



### NOTES:

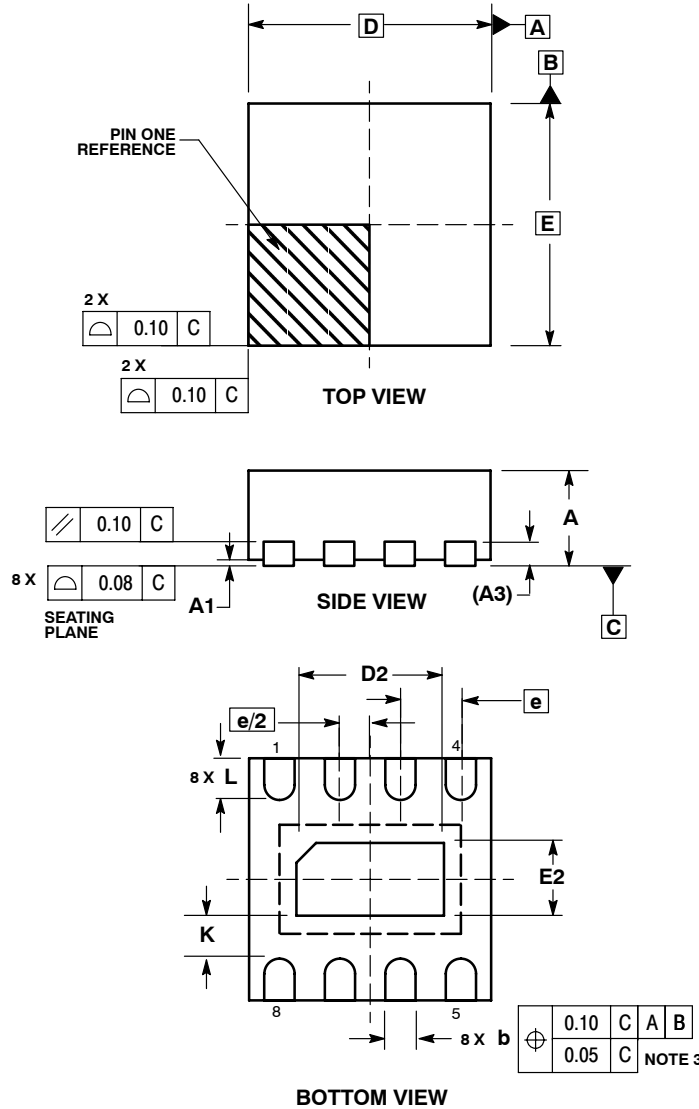
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD 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°

# MC100EP16VT

## 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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