3.3 V/5 V ECL Dual Differential Data and Clock D Flip-Flop With Set and Reset

MC10EP29, MC100EP29

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Description

The MC10/100EP29 is a dual master−slave flip−flop. The device features fully differential Data and Clock inputs as well as outputs. The MC10/100EP29 is functionally equivalent to the MC10/100EL29. Data enters the master latch when the clock is LOW and transfers to the slave upon a positive transition on the clock input.

The differential inputs have special circuitry which ensures device stability under open input conditions. When both differential inputs are left open the D input will pull down to V_{EE} and the $\overline{D}$ input will bias around $V_{CC}/2$. The outputs will go to a defined state, however the state will be random based on how the flip flop powers up.

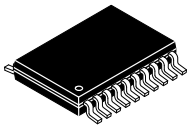
Both flip flops feature asynchronous, overriding Set and Reset inputs. Note that the Set and Reset inputs cannot both be HIGH simultaneously.

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 μF capacitor and limit current sourcing or sinking to 0.5 mA. When not used, V_{BB} should be left open.

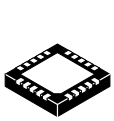
The 100 Series contains temperature compensation.

Features

- Maximum Frequency > 3 GHz Typical
- 500 ps Typical Propagation Delays
- 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
- These are Pb−Free Devices



TSSOP−20
DT SUFFIX
CASE 948E



QFN−20
MN SUFFIX
CASE 485E



MARKING DIAGRAM*

XXXX	= MC10 or 100
A	= Assembly Location
L	= Wafer Lot
Y	= Year
W	= Work Week
▪	= Pb−Free Package

(Note: Microdot may be in either location)

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

ORDERING INFORMATION

Device	Package	Shipping†
MC10EP29DTG	TSSOP−20 (Pb−Free)	75 Units / Tube
MC100EP29DTG	TSSOP−20 (Pb−Free)	75 Units / Tube
MC100EP29DTR2G	TSSOP−20 (Pb−Free)	2500 / Tape & Reel
MC100EP29MNG	QFN−20 (Pb−Free)	92 Units / Tube

†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.

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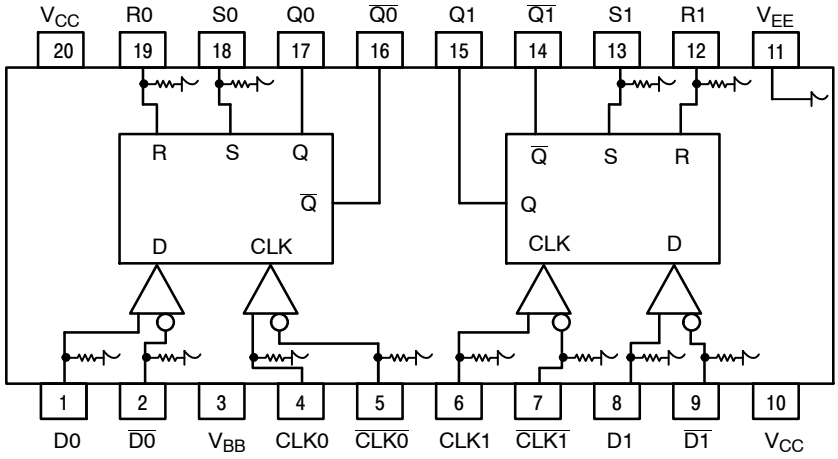
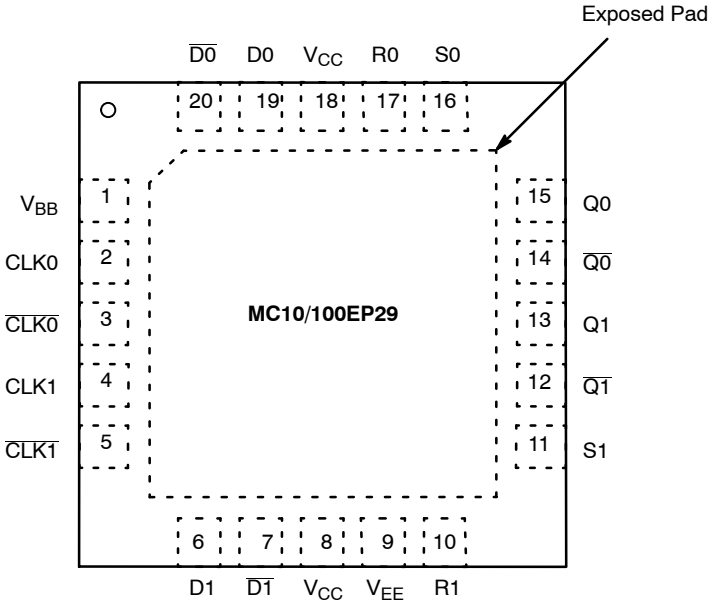


Warning: All V_{CC} and V_{EE} pins must be externally connected to Power Supply to guarantee proper operation.

Figure 1. 20−Lead Pinout (Top View) **and Logic Diagram**



NOTE: The Exposed Pad (EP) on package bottom must be attached to a heat−sinking conduit. The Exposed Pad may only be electrically connected to V_{EE}.

Figure 1. QFN−20 Pinout (Top View)

Table 1. PIN DESCRIPTION

Pin	Function
D0*, $\overline{D0}$*; D1*, $\overline{D1}$*	ECL Differential Data Inputs
R0*, R1*	ECL Reset Inputs
CLK0*, $\overline{CLK0}$*	ECL Differential Clock Inputs
CLK1*, $\overline{CLK1}$*	ECL Differential Clock Inputs
S0* S1*	ECL Set Inputs
Q0, $\overline{Q0}$; Q1, $\overline{Q1}$	ECL Differential Data Outputs
V_{BB}	Reference Voltage Output
V_{CC}	Positive Supply
V_{EE}	Negative Supply
EP	Exposed Pad

*Pins will default LOW when left open.

Table 2. TRUTH TABLE

R	S	D	CLK	Q	$\overline{Q}$
L	L	L	Z	L	H
L	L	H	Z	H	L
H	L	X	X	L	H
L	H	X	X	H	L
H	H	X	X	Undef	Undef

Z = LOW to HIGH Transition
X = Don't Care

Table 3. ATTRIBUTES

Characteristics	Value
Internal Input Pulldown Resistor	75 kΩ
Internal Input Pullup Resistor	N/A
ESD Protection Human Body Model Machine Model Charged Device Model	 > 2 kV > 100 V > 2 kV
Moisture Sensitivity, Indefinite Time Out of Drypack (Note 1)	Pb−Free Pkg
TSSOP−20 QFN−20	Level 3 Level 1
Flammability Rating Oxygen Index: 28 to 34	 UL 94 V−0 @ 0.125 in
Transistor Count	383 Devices
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test	

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

Table 4. MAXIMUM RATINGS

Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
V_{CC}	PECL Mode Power Supply	V_{EE} = 0 V		6	V
V_{EE}	NECL Mode Power Supply	V_{CC} = 0 V		−6	V
V_I	PECL Mode Input Voltage NECL Mode Input Voltage	V_{EE} = 0 V V_{CC} = 0 V	$V_I \le V_{CC}$ $V_I \ge V_{EE}$	6 −6	V V
I_{out}	Output Current	Continuous Surge		50 100	mA mA
I_{BB}	V_{BB} Sink/Source			±0.5	mA
T_A	Operating Temperature Range			−40 to +85	°C
T_{stg}	Storage Temperature Range			−65 to +150	°C
θ_{JA}	Thermal Resistance (Junction−to−Ambient)	0 lfpm 500 lfpm	20 TSSOP 20 TSSOP	140 100	°C/W °C/W
θ_{JC}	Thermal Resistance (Junction−to−Case)	Standard Board	20 TSSOP	23 to 41	°C/W
θ_{JA}	Thermal Resistance (Junction−to−Ambient)	0 lfpm 500 lfpm	QFN−20 QFN−20	47 33	°C/W °C/W
θ_{JC}	Thermal Resistance (Junction−to−Case)	Standard Board	QFN−20	18	°C/W
T_{sol}	Wave Solder (Pb−Free)			265	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

Table 5. 10EP DC CHARACTERISTICS, PECL V_{CC} = 3.3 V, V_{EE} = 0 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	35	46	55	37	48	57	40	49	60	mA
V_{OH}	Output HIGH Voltage (Note 3)	2165	2290	2415	2230	2355	2480	2290	2415	2540	mV
V_{OL}	Output LOW Voltage (Note 3)	1365	1490	1615	1430	1555	1680	1490	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	1460		1755	1490		1815	mV
V_{BB}	Output Voltage Reference	1790	1890	1990	1855	1955	2055	1915	2015	2115	mV
V_{IHCMR}	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 4)	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

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.

2. Input and output parameters vary 1:1 with V_{CC}. V_{EE} can vary +0.3 V to −2.2 V.
3. All loading with 50 Ω to V_{CC} − 2.0 V.
4. 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 6. 10EP DC CHARACTERISTICS, PECL V_{CC} = 5.0 V, V_{EE} = 0 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	35	46	55	37	48	57	40	49	60	mA
V_{OH}	Output HIGH Voltage (Note 6)	3865	3990	4115	3930	4055	4180	3990	4115	4240	mV
V_{OL}	Output LOW Voltage (Note 6)	3065	3190	3315	3130	3255	3380	3190	3315	3440	mV
V_{IH}	Input HIGH Voltage (Single−Ended)	3790		4115	3855		4180	3915		4240	mV
V_{IL}	Input LOW Voltage (Single−Ended)	3065		3390	3130		3455	3190		3515	mV
V_{BB}	Output Voltage Reference	3490	3590	3690	3555	3655	3755	3615	3715	3815	mV
V_{IHCMR}	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 7)	2.0		5.0	2.0		5.0	2.0		5.0	V
I_{IH}	Input HIGH Current			150			150			150	μA
I_{IL}	Input LOW Current	0.5			0.5			0.5			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.

5. Input and output parameters vary 1:1 with V_{CC}. V_{EE} can vary +2.0 V to −0.5 V.
6. All loading with 50 Ω to V_{CC} − 2.0 V.
7. 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. 10EP DC CHARACTERISTICS, NECL V_{CC} = 0 V; V_{EE} = −5.5 V to −3.0 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	35	46	55	37	48	57	40	49	60	mA
VOH	Output HIGH Voltage (Note 9)	−1135	−1010	−885	−1070	−945	−820	−1010	−885	−760	mV
V_{OL}	Output LOW Voltage (Note 9)	−1935	−1810	−1685	−1870	−1745	−1620	−1810	−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_{BB}	Output Voltage Reference	−1510	−1410	−1310	−1445	−1345	−1245	−1385	−1285	−1185	mV
V_{IHCMR}	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 10)	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

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.

8. Input and output parameters vary 1:1 with V_{CC}.
9. All loading with 50 Ω to V_{CC} − 2.0 V.
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 8. 100EP DC CHARACTERISTICS, PECL V_{CC} = 3.3 V, V_{EE} = 0 V (Note 11)

Symbol	Characteristic	−40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
I_{EE}	Power Supply Current	35	46	55	37	48	57	40	49	60	mA
V_{OH}	Output HIGH Voltage (Note 12)	2155	2280	2405	2155	2280	2405	2155	2280	2405	mV
V_{OL}	Output LOW Voltage (Note 12)	1305	1480	1605	1305	1480	1605	1305	1480	1605	mV
V_{IH}	Input HIGH Voltage (Single−Ended)	2075		2420	2075		2420	2075		2420	mV
V_{IL}	Input LOW Voltage (Single−Ended)	1305		1675	1305		1675	1305		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 13)	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

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.

11. Input and output parameters vary 1:1 with V_{CC}. V_{EE} can vary +0.3 V to −2.2 V.
12. All loading with 50 Ω to V_{CC} − 2.0 V.
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 9. 100EP DC CHARACTERISTICS, PECL V_{CC} = 5.0 V, V_{EE} = 0 V (Note 14)

Symbol	Characteristic	−40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
I_{EE}	Power Supply Current	35	46	55	37	48	57	40	49	60	mA
V_{OH}	Output HIGH Voltage (Note 15)	3855	3980	4105	3855	3980	4105	3855	3980	4105	mV
V_{OL}	Output LOW Voltage (Note 15)	3005	3180	3305	3005	3180	3305	3005	3180	3305	mV
V_{IH}	Input HIGH Voltage (Single−Ended)	3775		4120	3775		4120	3775		4120	mV
V_{IL}	Input LOW Voltage (Single−Ended)	3005		3375	3005		3375	3005		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 16)	2.0		5.0	2.0		5.0	2.0		5.0	V
I_{IH}	Input HIGH Current			150			150			150	μA
I_{IL}	Input LOW Current	0.5			0.5			0.5			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.

14. Input and output parameters vary 1:1 with V_{CC}. V_{EE} can vary +2.0 V to −0.5 V.
15. All loading with 50 Ω to V_{CC} − 2.0 V.
16. 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 10. 100EP DC CHARACTERISTICS, NECL V_{CC} = 0 V; V_{EE} = −5.5 V to −3.0 V (Note 17)

Symbol	Characteristic	−40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
I_{EE}	Power Supply Current	35	46	55	37	48	57	40	49	60	mA
V_{OH}	Output HIGH Voltage (Note 18)	−1145	−1020	−895	−1145	−1020	−895	−1145	−1020	−895	mV
V_{OL}	Output LOW Voltage (Note 18)	−1995	−1820	−1695	−1995	−1820	−1695	−1995	−1820	−1695	mV
V_{IH}	Input HIGH Voltage (Single−Ended)	−1225		−880	−1225		−880	−1225		−880	mV
V_{IL}	Input LOW Voltage (Single−Ended)	−1995		−1625	−1995		−1625	−1995		−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 19)	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

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.

17. Input and output parameters vary 1:1 with V_{CC}.
18. All loading with 50 Ω to V_{CC} − 2.0 V.
19. 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 11. AC CHARACTERISTICS V_{CC} = 0 V; V_{EE} = −3.0 V to −5.5 V or V_{CC} = 3.0 V to 5.5 V; V_{EE} = 0 V (Note 20)

		−40°C			25°C			85°C			
Symbol	**Characteristic**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Unit**
f_{max}	Maximum Frequency (See Figure 2 F_{max}/JITTER)		> 3.0			> 3.0			> 3.0		GHz
t_{PLH}, t_{PHL}	Propagation Delay to CLK Output Differential S R	300 275 300	380 380 400	450 475 500	350 300 325	420 400 420	500 500 525	400 350 375	470 450 470	550 550 575	ps
t_S t_H	Setup Time Hold Time	100 100	20 20		100 100	20 20		100 100	20 20		ps
t_{RR}/t_{RR2}	Set/Reset Recovery	150	80		150	80		150	80		ps
t_{PW}	Minimum Pulse Width Set, Reset	500	300		500	300		500	300		ps
t_{JITTER}	Cycle−to−Cycle Jitter (See Figure 2 F_{max}/JITTER)		0.2	< 1		0.2	< 1		0.2	< 1	ps
V_{PP}	Input Voltage Swing (Note 21)	150	800	1200	150	800	1200	150	800	1200	mV
t_r t_f	Output Rise/Fall Times Q, $\overline{Q}$ (20% − 80%)	100	180	250	150	210	300	175	230	325	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 lfpm.

20. Measured using a 750 mV source, 50% duty cycle clock source. All loading with 50 Ω to V_{CC} − 2.0 V.

21. V_{PP}(min) is the minimum input swing for which AC parameters are guaranteed.

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

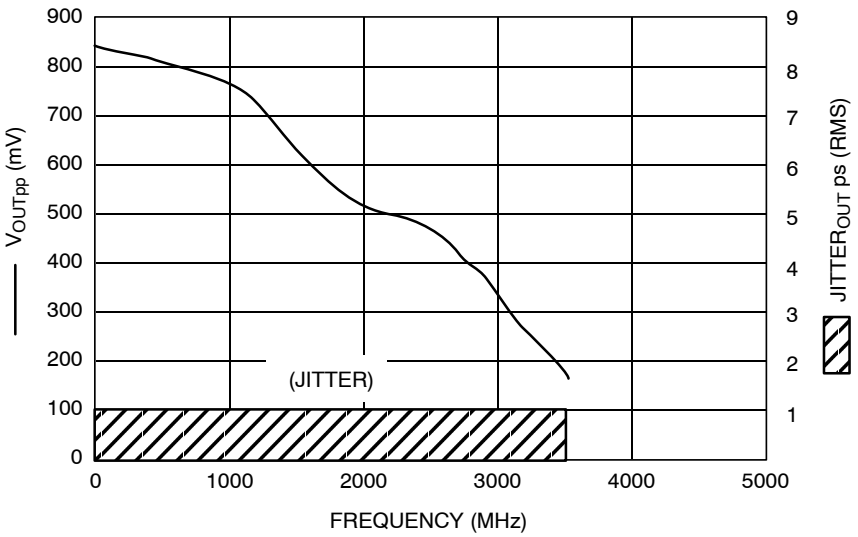


Figure 2. F_{max}/Jitter

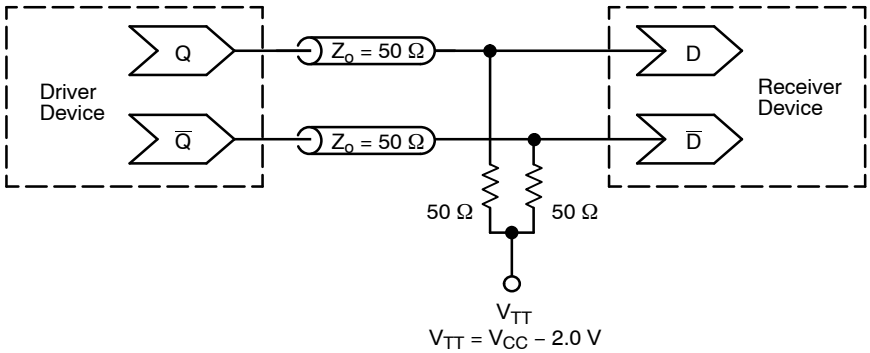


Figure 3. Typical Termination for Output Driver and Device Evaluation (See Application Note AND8020/D – Termination of ECL Logic Devices.)

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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MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

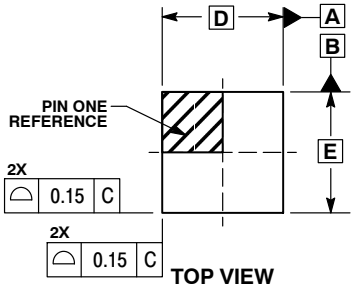
ON Semiconductor®

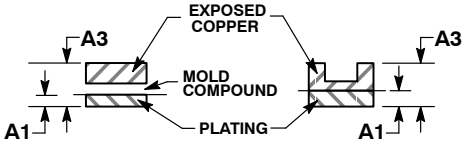
QFN20, 4x4, 0.5P
CASE 485E
ISSUE C

DATE 13 FEB 2018

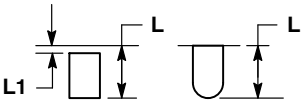


SCALE 2:1

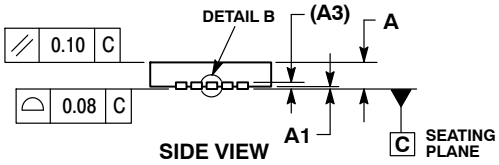




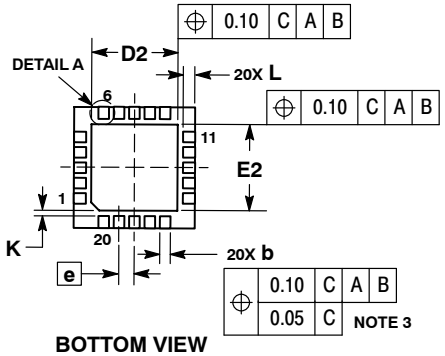
DETAIL B
ALTERNATE CONSTRUCTIONS



DETAIL A
OPTIONAL CONSTRUCTIONS

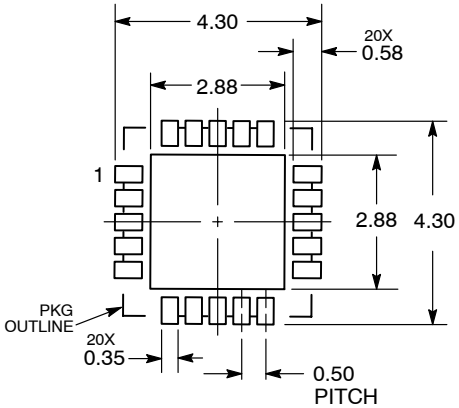


SIDE VIEW



BOTTOM VIEW

SOLDERING FOOTPRINT*



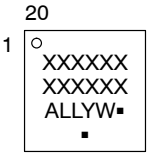
DIMENSIONS: MILLIMETERS

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/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 0.15 AND 0.30 MM FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

	MILLIMETERS	
DIM	MIN	MAX
A	0.80	1.00
A1	---	0.05
A3	0.20 REF	
b	0.20	0.30
D	4.00 BSC	
D2	2.60	2.90
E	4.00 BSC	
E2	2.60	2.90
e	0.50 BSC	
K	0.20 REF	
L	0.35	0.45
L1	0.00	0.15

GENERIC MARKING DIAGRAM*



XXXXXX= Specific Device Code
A = Assembly Location
LL = Wafer Lot
Y = Year
W = Work Week
▪ = Pb−Free Package

(Note: Microdot may be in either location)

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “ ▪”, may or may not be present. Some products may not follow the Generic Marking.

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DESCRIPTION:	**QFN20, 4X4, 0.5P**	**PAGE 1 OF 1**

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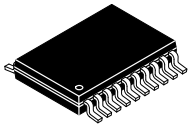
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

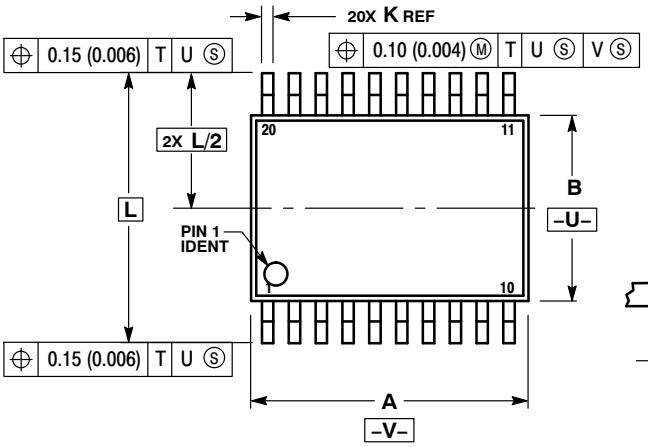
ON Semiconductor®

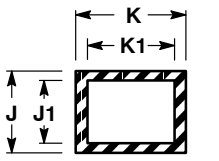
TSSOP−20 WB
CASE 948E
ISSUE D

DATE 17 FEB 2016

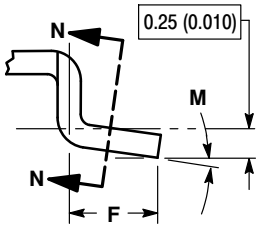


SCALE 2:1

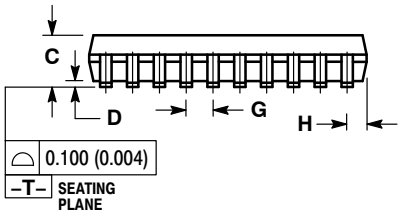


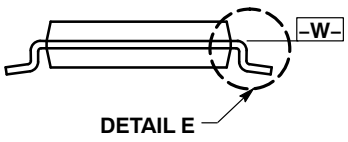


SECTION N−N



DETAIL E

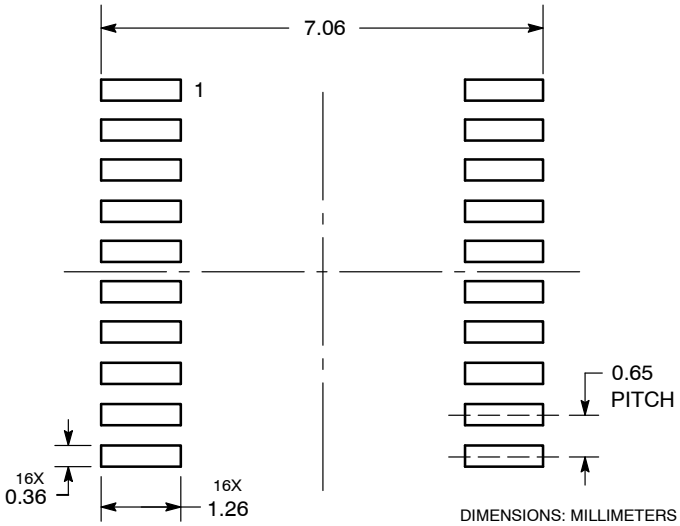




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE −W−.

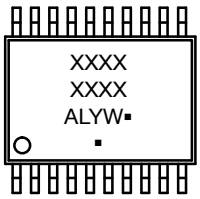
	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	6.40	6.60	0.252	0.260
B	4.30	4.50	0.169	0.177
C	---	1.20	---	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.27	0.37	0.011	0.015
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

SOLDERING FOOTPRINT



DIMENSIONS: MILLIMETERS

GENERIC MARKING DIAGRAM*



A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
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(Note: Microdot may be in either location)

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “ ▪”, may or may not be present.

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DESCRIPTION:	TSSOP−20 WB	PAGE 1 OF 1

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