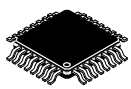
3.3 V/5 V ECL 6-Bit Differential Register with Master Reset

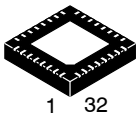
MC10EP451, MC100EP451

ON Semiconductor®

www.onsemi.com



LQFP−32
FA SUFFIX
CASE 561AB



QFN32
MN SUFFIX
CASE 488AM

Description

The MC10/100EP451 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 a 75 kΩ pulldown resistor internally. 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 < V_{EE} + 1.2 V, the clamp will override and force the output to a default state. When in the default state, and since the flip−flop is edge triggered, the output reaches a determined, but not predicted, valid state.

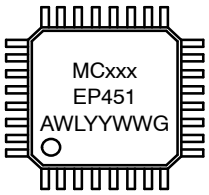
The positive transition of CLK (pin 4) will latch the registers. Master Reset (MR) HIGH will asynchronously reset all registers forcing Q outputs to go LOW.

The 100 Series contains temperature compensation.

Features

- 450 ps Typical Propagation Delay
- Maximum Frequency > 3.0 GHz Typical
- Asynchronous Master Reset
- 20 ps Skew Within Device, 35 ps Skew Device−To−Device
- 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 Devices are Pb−Free and are RoHS Compliant

MARKING DIAGRAMS*



xxx	= 10 or 100
A	= Assembly Location
WL	= Wafer Lot
YY	= Year
WW	= Work Week
G or ▪	= Pb−Free Package

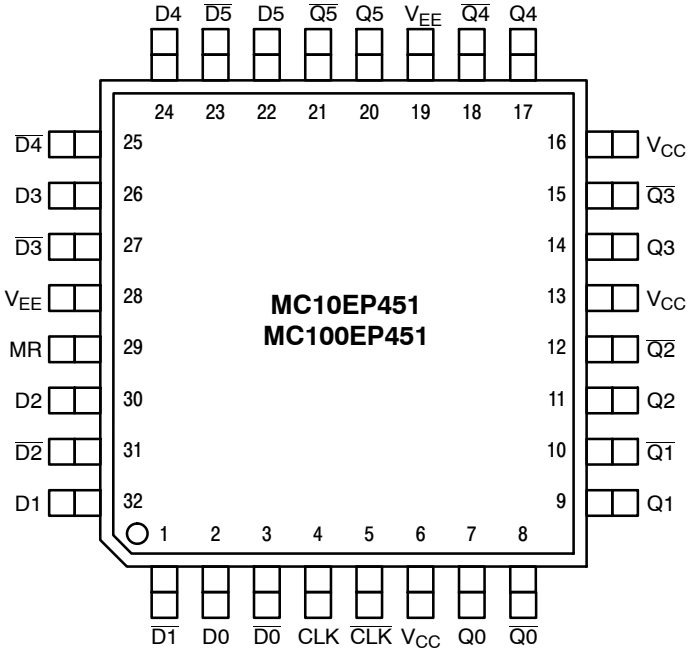
(Note: Microdot may be in either location)

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

ORDERING INFORMATION

Device	Package	Shipping†
MC10EP451FAG	LQFP−32 (Pb−Free)	250 Units / Tube
MC100EP451FAG	LQFP−32 (Pb−Free)	250 Units / Tube
MC100EP451FAR2G	LQFP−32 (Pb−Free)	2000 / Tape & Reel
MC100EP451MNG	QFN−32 (Pb−Free)	72 Units / Tube
MC100EP451MNR4G	QFN−32 (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.



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

Figure 1. LQFP−32 Pinout (Top View)

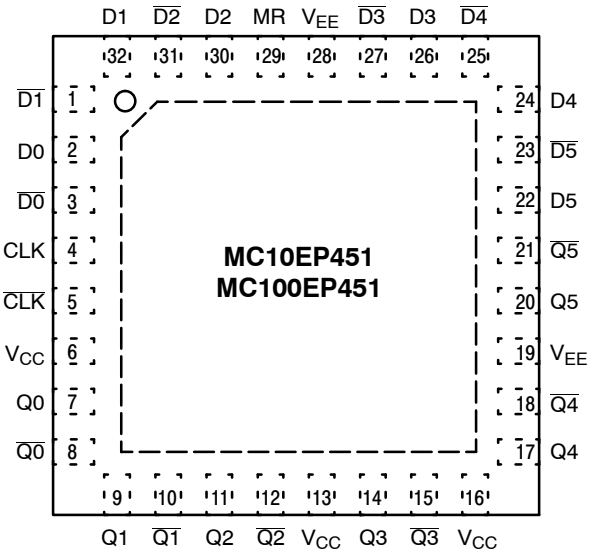


Figure 2. QFN−32 Pinout (Top View)

Table 1. PIN DESCRIPTION

PIN	FUNCTION
D [0:5]*, $\overline{D}$ [0:5]*	ECL Differential Data Inputs
MR*	ECL Master Reset Input
CLK*, $\overline{CLK}$*	ECL Differential Clock Inputs
Q [0:5], $\overline{Q}$ [0:5]	ECL Differential Data Outputs
V_{CC}	Positive Supply
V_{EE}	Negative Supply
EP for QFN−32, only	The Exposed Pad (EP) on the QFN−32 package bottom is thermally connected to the die for improved heat transfer out of package. The exposed pad must be attached to a heat−sinking conduit. The pad is electrically connected to V_{EE}.

* Pins will default LOW when left open.

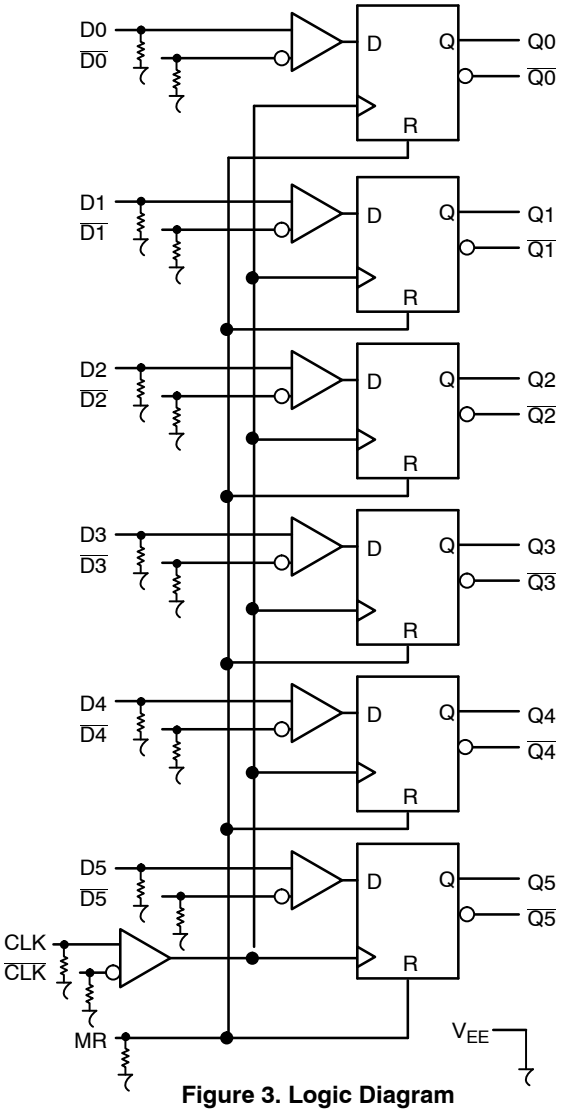


Figure 3. Logic Diagram

Table 2. 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 > 200 V > 2 kV
Moisture Sensitivity, Indefinite Time Out of Drypack (Note 1)	Pb−Free Pkg
LQFP−32 QFN−32	Level 2 Level 1
Flammability Rating Oxygen Index: 28 to 34	 UL 94 V−0 @ 0.125 in
Transistor Count	919 Devices
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test	

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

Table 3. 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
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	LQFP−32 LQFP−32	80 55	°C/W °C/W
θ_{JC}	Thermal Resistance (Junction−to−Case)	Standard Board	LQFP−32	12 to 17	°C/W
θ_{JA}	Thermal Resistance (Junction−to−Ambient)	0 lfpm 500 lfpm	QFN−32 QFN−32	31 27	°C/W °C/W
θ_{JC}	Thermal Resistance (Junction−to−Case)	2S2P	QFN−32	12	°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 4. 10EP DC CHARACTERISTICS, PECL V_{CC} = 3.3 V, V_{EE} = 0 V (Note 2)

		−40°C			25°C			85°C			
Symbol	Characteristic	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Unit
I_{EE}	Power Supply Current	80	95	125	80	95	125	80	95	125	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	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) (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

Table 5. 10EP DC CHARACTERISTICS, PECL V_{CC} = 5.0 V, V_{EE} = 0 V (Note 5)

		−40°C			25°C			85°C			
Symbol	Characteristic	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Unit
I_{EE}	Power Supply Current	80	95	125	80	95	125	80	95	125	mA
V_{OH}	Output HIGH Voltage (Note 3)	3865	3990	4115	3930	4055	4180	3990	4115	4240	mV
V_{OL}	Output LOW Voltage (Note 3)	3065	3190	3315	3130	3255	3380	3170	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_{IHCMR}	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 4)	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

Table 6. 10EP DC CHARACTERISTICS, NECL V_{CC} = 0 V, V_{EE} = −5.5 V to −3.0 V (Note 6)

		−40°C			25°C			85°C			
Symbol	Characteristic	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Unit
I_{EE}	Power Supply Current	80	95	125	80	95	125	80	95	125	mA
VOH	Output HIGH Voltage (Note 3)	−1135	−1010	−885	−1070	−945	−820	−1010	−885	−760	mV
V_{OL}	Output LOW Voltage (Note 3)	−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) (Note 4)	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.

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.
5. Input and output parameters vary 1:1 with V_{CC}. V_{EE} can vary +2.0 V to −0.5 V.
6. Input and output parameters vary 1:1 with V_{CC}.

Table 7. 100EP DC CHARACTERISTICS, PECL V_{CC} = 3.3 V, V_{EE} = 0 V (Note 7)

Symbol	Characteristic	−40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
I_{EE}	Power Supply Current	85	105	135	85	105	135	85	105	135	mA
V_{OH}	Output HIGH Voltage (Note 8)	2155	2280	2405	2155	2280	2405	2155	2280	2405	mV
V_{OL}	Output LOW Voltage (Note 8)	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_{IHCMR}	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 9)	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.

7. Input and output parameters vary 1:1 with V_{CC}. V_{EE} can vary +0.3 V to −2.2 V.
8. All loading with 50 Ω to V_{CC} − 2.0 V.
9. 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} = 5.0 V, V_{EE} = 0 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	85	105	135	85	105	135	85	105	135	mA
V_{OH}	Output HIGH Voltage (Note 11)	3855	3980	4105	3855	3980	4105	3855	3980	4105	mV
V_{OL}	Output LOW Voltage (Note 11)	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_{IHCMR}	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 12)	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.

10. Input and output parameters vary 1:1 with V_{CC}. V_{EE} can vary +2.0 V to −0.5 V.
11. All loading with 50 Ω to V_{CC} − 2.0 V.
12. 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, NECL V_{CC} = 0 V, V_{EE} = −5.5 V to −3.0 V (Note 13)

Symbol	Characteristic	−40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
I_{EE}	Power Supply Current	85	105	135	85	105	135	85	105	135	mA
V_{OH}	Output HIGH Voltage (Note 14)	−1145	−1020	−895	−1145	−1020	−895	−1145	−1020	−895	mV
V_{OL}	Output LOW Voltage (Note 14)	−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_{IHCMR}	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 15)	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.

13. Input and output parameters vary 1:1 with V_{CC}.
14. All loading with 50 Ω to V_{CC} − 2.0 V.
15. 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. 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 16)

Symbol	Characteristic		−40°C			25°C			85°C			Unit
			Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
V_{OUTpp}	Output Voltage Amplitude @ 3 GHz (Figure 4) (Note 17)		540	670		520	650		450	580		mV
t_{PLH}, t_{PHL}	Propagation Delay to Output Differential	CLK to Q, $\overline{Q}$ MR to Q, $\overline{Q}$	330 430	430 530	530 630	350 450	450 550	550 650	390 490	490 590	590 690	ps
t_{RR}	Reset Recovery	MR to CLK	240	145		250	150		260	160		ps
t_S t_H	Setup Time Hold Time	D to CLK CLK to D	80 80	40 40		80 80	40 40		80 80	40 40		ps
t_{PW}	Minimum Pulse Rate	MR	400			400			400			ps
t_{SKEW}	Within−Device Skew (Note 18) Device−To−Device Skew (Note 19)			20 35	40 100		20 35	40 100		20 35	40 100	
t_{JITTER}	CLOCK Random Jitter (RMS) @ ≤3.0 GHz (Figure 4)			0.2	1		0.2	1		0.2	1	ps
t_r t_f	Output Rise/Fall Times (20% − 80%)	Q, $\overline{Q}$	100 100	150 150	250 250	110 110	160 160	260 260	130 130	180 180	280 280	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.

16. Measured using a 750 mV source, 50% duty cycle clock source. All loading with 50 Ω to V_{CC} − 2.0 V.
17. V_{OL} and V_{OH} specifications not guaranteed for F_{max} testing.
18. Skew is measured between outputs under identical transitions and conditions on any one device.
19. Device−To−Device skew for identical transitions at identical V_{CC} levels.

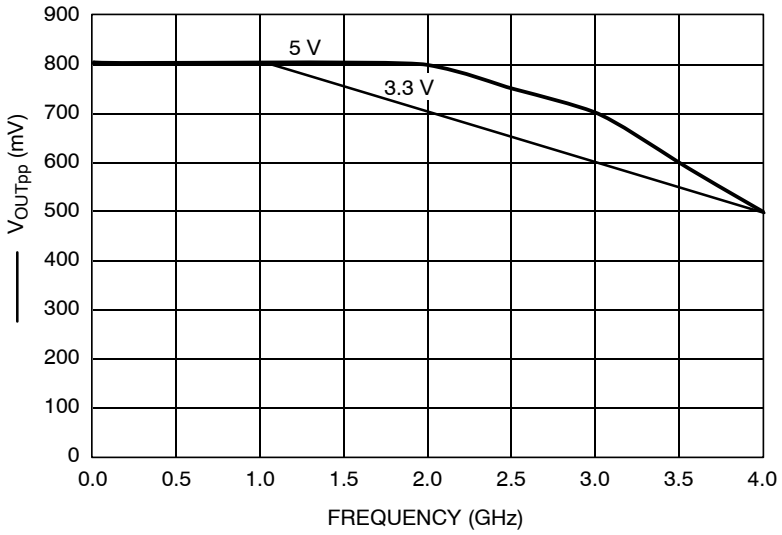


Figure 4. F_{max} Typical

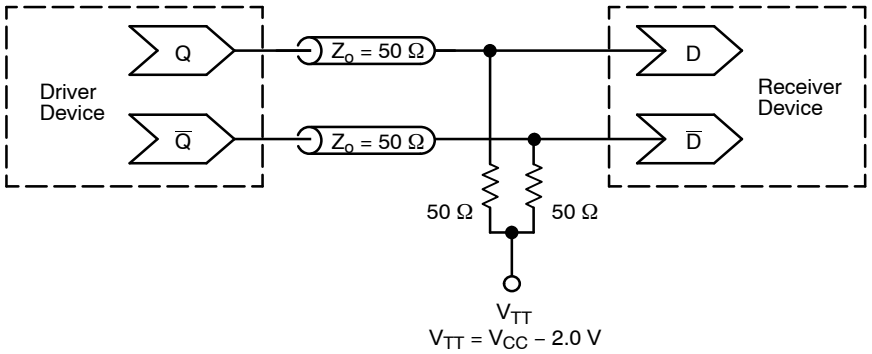


Figure 5. Typical Termination for Output Driver and Device Evaluation (See Application Note AND8020/D – Termination of ECL Logic Devices.)

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

AN1642/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

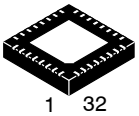
AND8090/D – AC Characteristics of ECL Devices

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

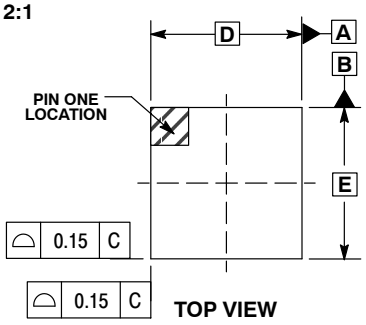
ON Semiconductor®

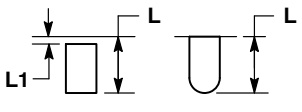
QFN32 5x5, 0.5P
CASE 488AM
ISSUE A

DATE 23 OCT 2013

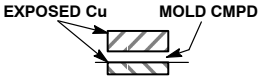


SCALE 2:1

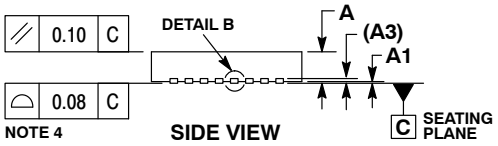


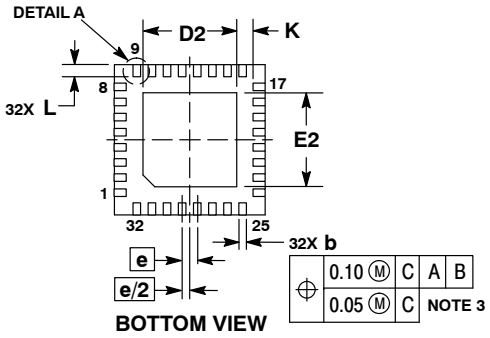


DETAIL A
ALTERNATE TERMINAL CONSTRUCTIONS



DETAIL B
ALTERNATE CONSTRUCTION

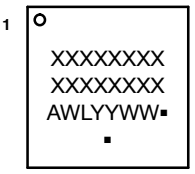




NOTES:
1. DIMENSIONS AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30MM FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

	MILLIMETERS	
DIM	MIN	MAX
A	0.80	1.00
A1	---	0.05
A3	0.20 REF	
b	0.18	0.30
D	5.00 BSC	
D2	2.95	3.25
E	5.00 BSC	
E2	2.95	3.25
e	0.50 BSC	
K	0.20	---
L	0.30	0.50
L1	---	0.15

GENERIC MARKING DIAGRAM*

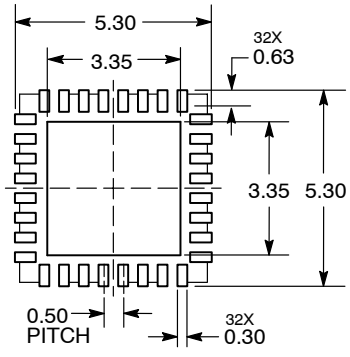


XXXXX = Specific Device Code
A = Assembly Location
WL = Wafer Lot
YY = Year
WW = Work Week
▪ = Pb−Free Package

(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.

RECOMMENDED SOLDERING FOOTPRINT*



DIMENSION: 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.

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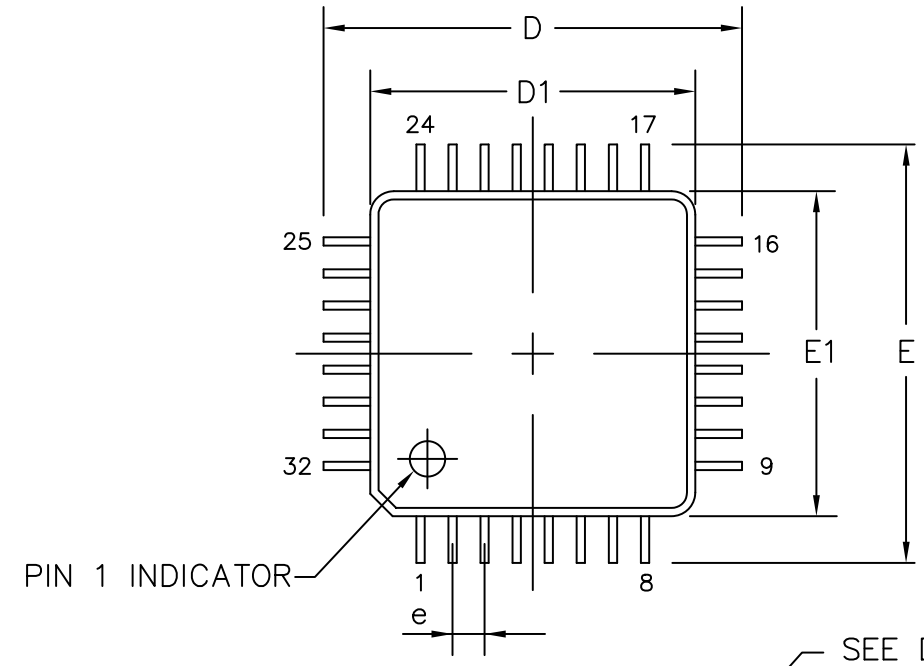
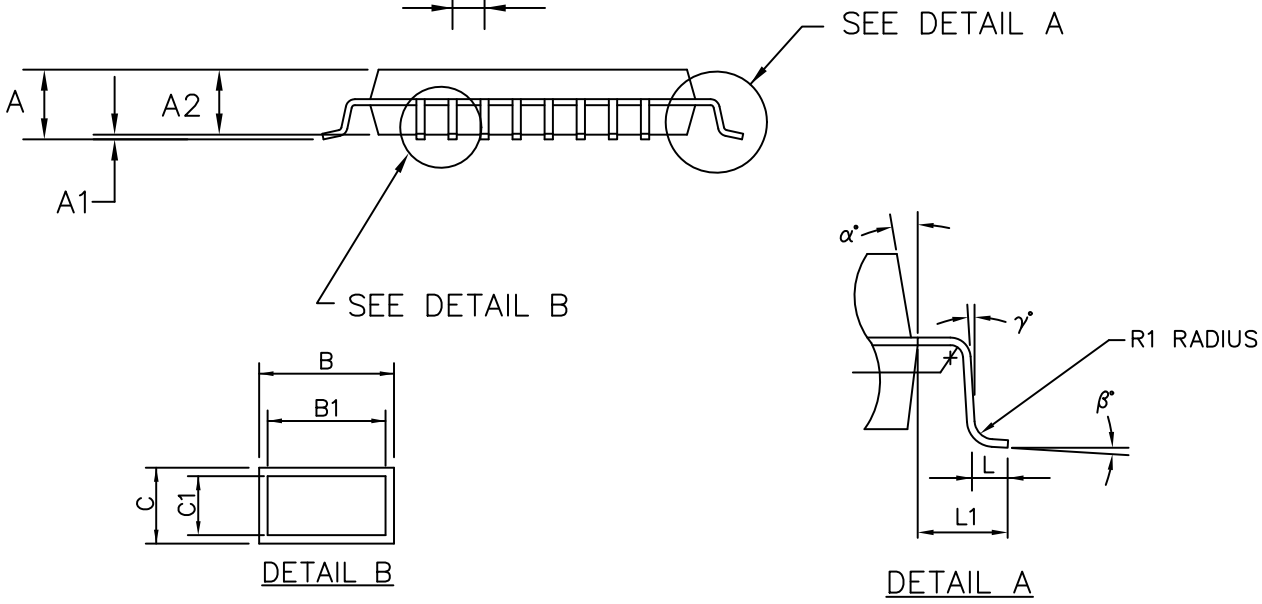
DESCRIPTION:	**QFN32 5x5 0.5P**	**PAGE 1 OF 1**

LQFP−32, 7x7
CASE 561AB−01
ISSUE O

DATE 19 JUN 2008



SYMBOL	MIN	NOM	MAX
A	–	–	1.60
A1	0.05	–	0.15
A2	1.35	1.40	1.45
B	0.30	0.37	0.45
B1	0.30	0.35	0.40
C	0.09	–	0.20
C1	0.09	–	0.16
D	9.00 BSC		
D1	7.00 BSC		
E	9.00 BSC		
E1	7.00 BSC		
e	0.80 BSC.		
L	0.45	0.60	0.75
L1	1.00		
R1	0.08	–	0.20
α°	11	–	13
β°	0	–	7
γ°	0	–	–



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DESCRIPTION:	**32 LEAD LQFP, 7X7**	**PAGE 1 OF 1**

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