

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

## Description

The MC100LVEL29 is a dual master-slave flip flop. The device features fully differential Data and Clock inputs as well as outputs. The MC100LVEL29 is pin and functionally equivalent to the MC100EL29. 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  $\bar{D}$  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  $\mu$ F capacitor and limit current sourcing or sinking to 0.5 mA. When not used,  $V_{BB}$  should be left open.

## Features

- 1100 MHz Flip-Flop Toggle Frequency
- ESD Protection: >2 kV Human Body Model
- 580 ps Typical Propagation Delays
- The 100 Series Contains Temperature Compensation
- PECL Mode Operating Range:  $V_{CC} = 3.0$  V to 3.8 V with  $V_{EE} = 0$  V
- NECL Mode Operating Range:  $V_{CC} = 0$  V with  $V_{EE} = -3.0$  V to  $-3.8$  V
- Internal Input Pulldown Resistors
- Meets or Exceeds JEDEC Spec EIA/JESD78 IC Latchup Test
- Moisture Sensitivity Level 1
- For Additional Information, see Application Note AND8003/D
- Flammability Rating: UL 94 V-0 @ 0.125 in, Oxygen Index: 28 to 34
- Transistor Count = 313 devices
- Pb-Free Packages are Available\*

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



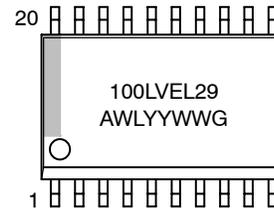
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SO-20 WB  
DW SUFFIX  
CASE 751D

## MARKING DIAGRAM\*



- A = Assembly Location
- WL = Wafer Lot
- YY = Year
- WW = Work Week
- G = Pb-Free Package

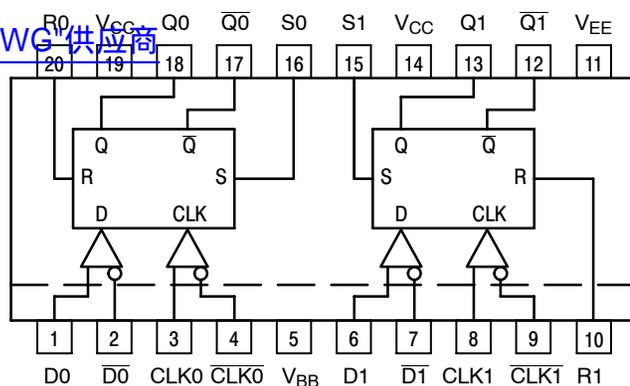
\*For additional marking information, refer to Application Note AND8002/D.

## ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

# MC100LVEL29

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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. Logic Diagram and Pinout: 20-Lead SOIC (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

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. MAXIMUM RATINGS

Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
$V_{CC}$	PECL Mode Power Supply	$V_{EE} = 0\text{ V}$		8 to 0	V
$V_{EE}$	NECL Mode Power Supply	$V_{CC} = 0\text{ V}$		-8 to 0	V
$V_I$	PECL Mode Input Voltage NECL Mode Input Voltage	$V_{EE} = 0\text{ V}$ $V_{CC} = 0\text{ V}$	$V_I \leq V_{CC}$ $V_I \geq V_{EE}$	6 to 0 -6 to 0	V
$I_{out}$	Output Current	Continuous Surge		50 100	mA mA
$I_{BB}$	$V_{BB}$ Sink/Source			$\pm 0.5$	mA
$T_A$	Operating Temperature Range			-40 to +85	$^{\circ}\text{C}$
$T_{stg}$	Storage Temperature Range			-65 to +150	$^{\circ}\text{C}$
$\theta_{JA}$	Thermal Resistance (Junction to Ambient)	0 lfpm 500 lfpm	20 SOIC 20 SOIC	90 60	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
$\theta_{JC}$	Thermal Resistance (Junction to Case)	Standard Board	20 SOIC	30 to 35	$^{\circ}\text{C}/\text{W}$
$T_{sol}$	Wave Solder	Pb Pb-Free	<2 to 3 sec @ 248 $^{\circ}\text{C}$ <2 to 3 sec @ 260 $^{\circ}\text{C}$	265 265	$^{\circ}\text{C}$

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.

# MC100LEVEL29

Table 4. LVNECL DC CHARACTERISTICS  $V_{CC} = 3.3\text{ V}$ ;  $V_{EE} = 0.0\text{ V}$  (Note 1)

Symbol	Characteristic	-40°C			25°C			85°C			Unit	
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max		
$I_{EE}$	Power Supply Current		35	50		35	50		35	50	mA	
$V_{OH}$	Output HIGH Voltage (Note 2)	2215	2295	2420	2275	2345	2420	2275	2345	2420	mV	
$V_{OL}$	Output LOW Voltage (Note 2)	1470	1605	1745	1490	1595	1680	1490	1595	1680	mV	
$V_{IH}$	Input HIGH Voltage (Single-Ended)	2135		2420	2135		2420	2135		2420	mV	
$V_{IL}$	Input LOW Voltage (Single-Ended)	1490		1825	1490		1825	1490		1825	mV	
$V_{BB}$	Output Voltage Reference	1.92		2.04	1.92		2.04	1.92		2.04	V	
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential) (Note 6)											
		$V_{pp} < 500\text{ mV}$	1.3		2.9	1.2		2.9	1.2		2.9	V
		$V_{pp} \geq 500\text{ mV}$	1.5		2.9	1.4		2.9	1.4		2.9	V
$I_{IH}$	Input HIGH Current			150			150			150	$\mu\text{A}$	
$I_{IL}$	Input LOW Current	$D_n$	0.5		0.5			0.5			$\mu\text{A}$	
		$\overline{D_n}$	-300		-300			-300			$\mu\text{A}$	

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.

1. Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary  $\pm 0.3\text{ V}$ .
2. Outputs are terminated through a  $50\ \Omega$  resistor to  $V_{CC} - 2.0\text{ V}$ .
3.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ , max varies 1:1 with  $V_{CC}$ . The  $V_{IHCMR}$  range is referenced to the most positive side of the differential input signal. Normal operation is obtained if the HIGH level falls within the specified range and the peak-to-peak voltage lies between  $V_{PPmin}$  and  $1\text{ V}$ .

Table 5. LVNECL DC CHARACTERISTICS  $V_{CC} = 0.0\text{ V}$ ;  $V_{EE} = -3.3\text{ V}$  (Note 4)

Symbol	Characteristic	-40°C			25°C			85°C			Unit	
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max		
$I_{EE}$	Power Supply Current		35	50		35	50		35	50	mA	
$V_{OH}$	Output HIGH Voltage (Note 5)	-1085	-1005	-880	-1025	-955	-880	-1025	-955	-880	mV	
$V_{OL}$	Output LOW Voltage (Note 5)	-1830	-1695	-1555	-1810	-1705	-1620	-1810	-1705	-1620	mV	
$V_{IH}$	Input HIGH Voltage (Single-Ended)	-1165		-880	-1165		-880	-1165		-880	mV	
$V_{IL}$	Input LOW Voltage (Single-Ended)	-1810		-1475	-1810		-1475	-1810		-1475	mV	
$V_{BB}$	Output Voltage Reference	-1.38		-1.26	-1.38		-1.26	-1.38		-1.26	V	
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential) (Note 6)											
		$V_{pp} < 500\text{ mV}$	-2.0		-0.4	-2.1		-0.4	-2.1		-0.4	V
		$V_{pp} \geq 500\text{ mV}$	-1.8		-0.4	-1.9		-0.4	-1.9		-0.4	V
$I_{IH}$	Input HIGH Current			150			150			150	$\mu\text{A}$	
$I_{IL}$	Input LOW Current	$D_n$	0.5		0.5			0.5			$\mu\text{A}$	
		$\overline{D_n}$	-300		-300			-300			$\mu\text{A}$	

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.

4. Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary  $\pm 0.3\text{ V}$ .
5. Outputs are terminated through a  $50\ \Omega$  resistor to  $V_{CC} - 2.0\text{ V}$ .
6.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ , max varies 1:1 with  $V_{CC}$ . The  $V_{IHCMR}$  range is referenced to the most positive side of the differential input signal. Normal operation is obtained if the HIGH level falls within the specified range and the peak-to-peak voltage lies between  $V_{PPmin}$  and  $1\text{ V}$ .

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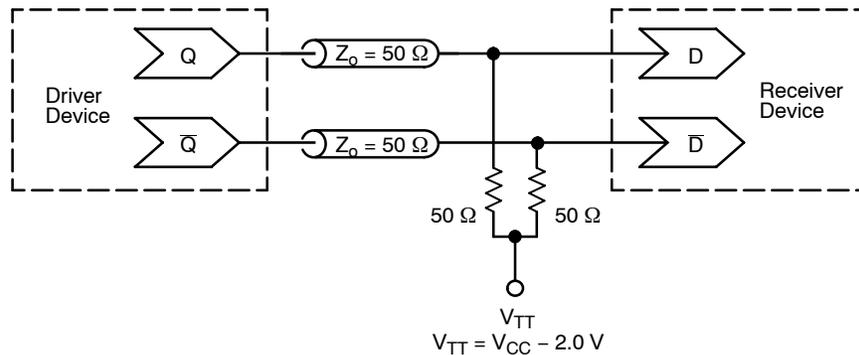
**Table 6. AC CHARACTERISTICS**  $V_{CC} = 3.3\text{ V}$ ;  $V_{EE} = 0.0\text{ V}$  or  $V_{CC} = 0.0\text{ V}$ ;  $V_{EE} = -3.3\text{ V}$  (Note 7)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$f_{\max}$	Maximum Toggle Frequency	1.1			1.1			1.1			GHz
$t_{PLH}$ $t_{PHL}$	Propagation Delay to Output CLK S, R	480 480		680 700	500 500	580 720	700 720	520 520		720 740	ps
$t_S$ $t_H$	Setup Time Hold Time	0 100			0 100			0 100			ps
$t_{RR}$	Set/Reset Recovery	100			100			100			ps
$t_{PW}$	Minimum Pulse Width CLK, Set, Reset	400			400			400			ps
$t_{JITTER}$	Cycle-to-Cycle Jitter		TBD			TBD			TBD		ps
$V_{PP}$	Input Swing (Note 8)	150		1000	150		1000	150		1000	mV
$t_r$ $t_f$	Output Rise/Fall Times Q (20% - 80%)	280		550	280		550	280		550	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 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.

7.  $V_{EE}$  can vary  $\pm 0.3\text{ V}$ .

8.  $V_{PP}(\min)$  is the minimum input swing for which AC parameters guaranteed.



**Figure 2. Typical Termination for Output Driver and Device Evaluation**  
(See Application Note AND8020/D – Termination of ECL Logic Devices.)

# MC100LVEL29

## ORDERING INFORMATION

Device	Package	Shipping†
MC100LVEL29DW	SO-20 WB	38 Units / Rail
MC100LVEL29DWG	SO-20 WB (Pb-Free)	38 Units / Rail
MC100LVEL29DWR2	SO-20 WB	1000 / Tape & Reel
MC100LVEL29DWR2G	SO-20 WB (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

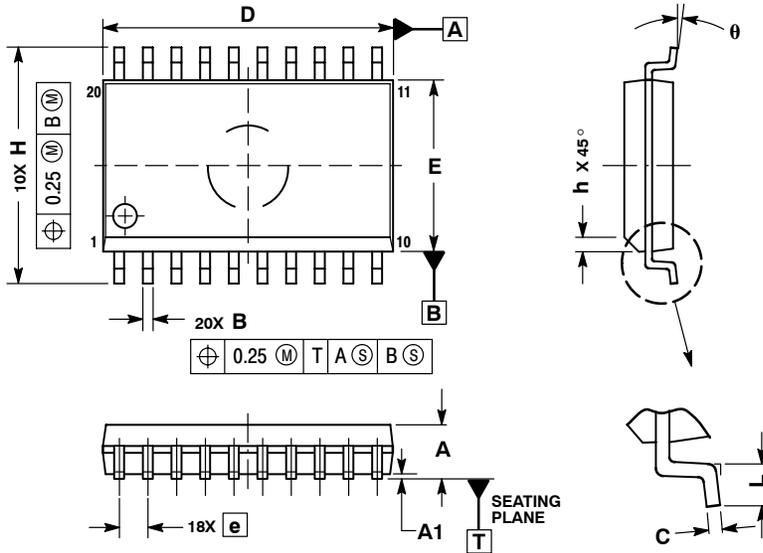
- AN1405/D** - ECL Clock Distribution Techniques
- AN1406/D** - Designing with PECL (ECL at +5.0 V)
- AN1503/D** - ECLinPS™ I/O SPiCE Modeling Kit
- AN1504/D** - Metastability and the ECLinPS Family
- AN1568/D** - Interfacing Between LVDS and ECL
- AN1672/D** - The ECL Translator Guide
- AND8001/D** - 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

SO-20 WB  
DW SUFFIX  
CASE 751D-05  
ISSUE G



**NOTES:**

1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF B DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS	
	MIN	MAX
A	2.35	2.65
A1	0.10	0.25
B	0.35	0.49
C	0.23	0.32
D	12.65	12.95
E	7.40	7.60
e	1.27 BSC	
H	10.05	10.55
h	0.25	0.75
L	0.50	0.90
θ	0°	7°

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