

# MC10138

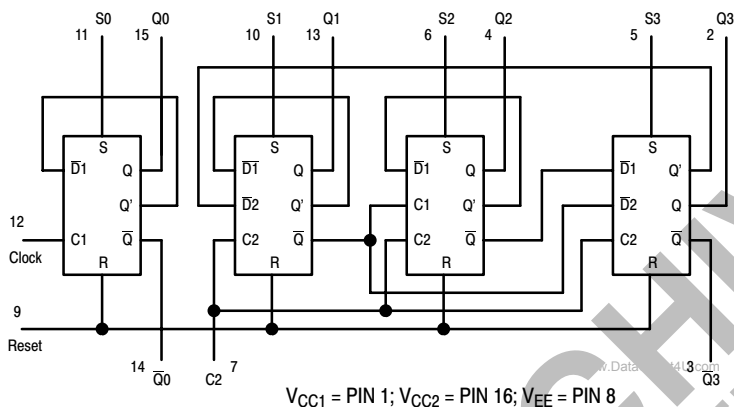
## Bi-Quinary Counter

The MC10138 is a four bit counter capable of divide by two, five, or ten functions. It is composed of four set–reset master–slave flip–flops. Clock inputs trigger on the positive going edge of the clock pulse.

Set or reset input override the clock, allowing asynchronous “set” or “clear.” Individual set and common reset inputs are provided, as well as complementary outputs for the first and fourth bits.

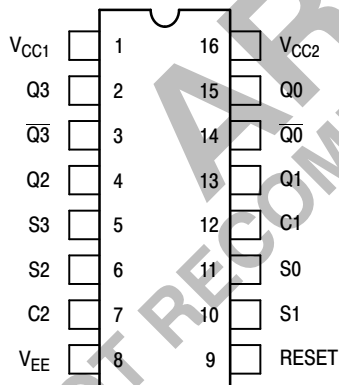
- $P_D = 370 \text{ mW typ/pkg (No Load)}$
- $f_{\text{tog}} = 150 \text{ MHz typ}$
- $t_r, t_f = 2.5 \text{ ns typ (20\%–80\%)}$

### LOGIC DIAGRAM



$V_{CC1} = \text{PIN } 1; V_{CC2} = \text{PIN } 16; V_{EE} = \text{PIN } 8$

### DIP PIN ASSIGNMENT



Pin assignment is for Dual-in-Line Package.

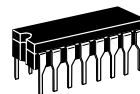
For PLCC pin assignment, see the Pin Conversion Tables on page 18 of the ON Semiconductor MECL Data Book (DL122/D).



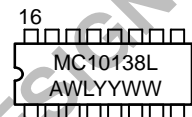
ON Semiconductor

<http://onsemi.com>

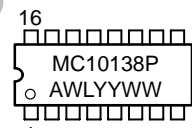
### MARKING DIAGRAMS



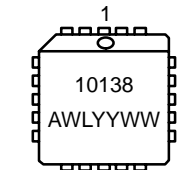
CDIP-16  
L SUFFIX  
CASE 620



PDIP-16  
P SUFFIX  
CASE 648



PLCC-20  
FN SUFFIX  
CASE 775



A = Assembly Location  
WL = Wafer Lot  
YY = Year  
WW = Work Week

### ORDERING INFORMATION

Device	Package	Shipping
MC10138L	CDIP-16	25 Units / Rail
MC10138P	PDIP-16	25 Units / Rail
MC10138FN	PLCC-20	46 Units / Rail

# MC10138

## COUNTER TRUTH TABLES

### BI-QUINARY

(Clock connected to C2  
and  $\overline{Q3}$  connected to C1)

COUNT	Q1	Q2	Q3	Q0
0	L	L	L	L
1	H	L	L	L
2	L	H	L	L
3	H	H	L	L
4	L	L	H	L
5	L	L	L	H
6	H	L	L	H
7	L	H	L	H
8	H	H	L	H
9	L	L	H	H

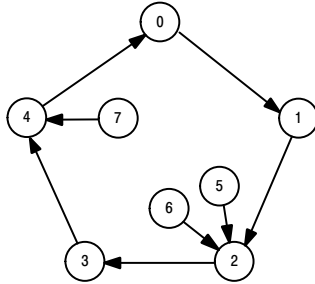
### BCD

(Clock connected to C1  
and  $\overline{Q0}$  connected to C2)

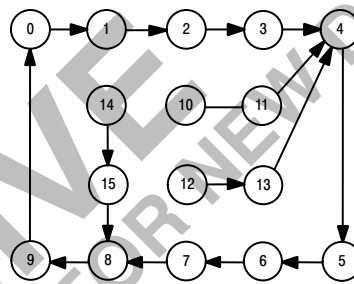
COUNT	Q0	Q1	Q2	Q3
0	L	L	L	L
1	H	L	L	L
2	L	H	L	L
3	H	H	L	L
4	L	L	H	L
5	H	L	H	L
6	L	H	H	L
7	H	H	H	L
8	L	L	L	H
9	H	L	L	H

## COUNTER STATE DIAGRAM — POSITIVE LOGIC

CLOCK CONNECTED TO C2



$\overline{Q0}$  CONNECTED TO C2



ARCHIVE FOR NEW DESIGN

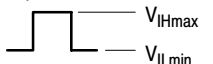
DEVICE NOT RECOMMENDED


# MC10138

## ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Pin Under Test	Test Limits						Unit			
			-30°C		+25°C		+85°C					
			Min	Max	Min	Typ	Max	Min		Max		
Power Supply Drain Current	$I_E$	8		97		70	88		97	mAdc		
Input Current	$I_{inH}$	12		350			220		220	$\mu$ Adc		
		5,6,10,11		390			245		245			
		7		460			290		290			
		9		650			410					
	$I_{inL}$	All	0.5		0.5			0.3		$\mu$ Adc		
Output Voltage Logic 1	$V_{OH}$	3,14 (3.)	-1.060	-0.890	-0.960		-0.810	-0.890	-0.700	Vdc		
		2,4,13,15 (2.)	-1.060	-0.890	-0.960		-0.810	-0.890	-0.700			
Output Voltage Logic 0	$V_{OL}$	3,14 (2.)	-1.890	-1.675	-1.850		-1.650	-1.825	-1.615	Vdc		
		2,4,13,15 (3.)	-1.890	-1.675	-1.850		-1.650	-1.825	-1.615			
Threshold Voltage Logic 1	$V_{OHA}$	2,4,13,15 (2.)	-1.080		-0.980			-0.910		Vdc		
		3,14 (3.)	-1.080		-0.980			-0.910				
		13,15 (2.)	-1.080		-0.980			-0.910				
Threshold Voltage Logic 0	$V_{OLA}$	2,4,13,15 (3.)		-1.655			-1.630		-1.595	Vdc		
		3,14 (2.)		-1.655			-1.630		-1.595			
		13,15 (3.)		-1.655			-1.630		-1.595			
Switching Times (50 $\Omega$ Load)										ns		
Propagation Clock Delays Delay	$t_{12+15+}$	15	1.4	5.0	1.5	3.5	4.8	1.5	5.3			
		14	1.4	5.0	1.5	3.5	4.8	1.5	5.3			
		13	1.4	5.2	1.5	3.5	5.0	1.5	5.5			
		4	1.4	5.2	1.5	3.5	5.0	1.5	5.5			
		2	1.4	5.2	1.5	3.5	5.0	1.5	5.5			
		3	1.4	5.2	1.5	3.5	5.0	1.5	5.5			
		15	1.4	5.0	1.5	3.5	4.8	1.5	5.3			
		14	1.4	5.0	1.5	3.5	4.8	1.5	5.3			
		13	1.4	5.2	1.5	3.5	5.0	1.5	5.5			
		4	1.4	5.2	1.5	3.5	5.0	1.5	5.5			
		2	1.4	5.2	1.5	3.5	5.0	1.5	5.5			
		3	1.4	5.2	1.5	3.5	5.0	1.5	5.5			
		Set Delay	$t_{11+15+}$	15	1.4	5.2	1.5		5.0		1.5	5.5
				14	1.4	5.2	1.5		5.0		1.5	5.5
Reset Delay	$t_{9+14+}$	14	1.4	5.2	1.5		5.0	1.5	5.5			
		15	1.4	5.2	1.5		5.0	1.5	5.5			
Rise Time (20 to 80%)	$t_{14+}$	14	1.1	4.7	1.1	2.5	4.5	1.1	5.0			
		15	1.1	4.7	1.1	2.5	4.5	1.1	5.0			
Fall Time (20 to 80%)	$t_{14-}$	14	1.1	4.7	1.1	2.5	4.5	1.1	5.0			
		15	1.1	4.7	1.1	2.5	4.5	1.1	5.0			
Counting Frequency	$f_{count}$	2	125		125	150		125		MHz		
		15	125		125	150		125				

1. Individually test each input; apply  $V_{ILmin}$  to pin under test.

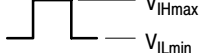
2. Set all four flip-flops by applying pulse  to pins 5, 6, 10, and 11 prior to applying test voltage indicated.

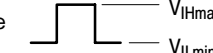
3. Reset all four flip-flops by applying pulse  to pin 9 prior to applying test voltage indicated.

ELECTRICAL CHARACTERISTICS (continued)

Characteristic	Symbol	Pin Under Test	TEST VOLTAGE VALUES (Volts)					(V <sub>CC</sub> ) Gnd			
			@ Test Temperature								
			V <sub>IHmax</sub>	V <sub>ILmin</sub>	V <sub>IHAmin</sub>	V <sub>ILAmax</sub>	V <sub>EE</sub>				
NOTE: Each MECL 10,000 series circuit has been designed to meet the dc specifications shown in the test table, after thermal equilibrium has been established. The circuit is in a test socket or mounted on a printed circuit board and transverse air flow greater than 500 linear fpm is maintained. Outputs are terminated through a 50-ohm resistor to -2.0 volts. Test procedures are shown for only one gate. The other gates are tested in the same manner.			-30°C	-0.890	-1.890	-1.205	-1.500	-5.2			
			+25°C	-0.810	-1.850	-1.105	-1.475	-5.2			
			+85°C	-0.700	-1.825	-1.035	-1.440	-5.2			
			TEST VOLTAGE APPLIED TO PINS LISTED BELOW								
			V <sub>IHmax</sub>	V <sub>ILmin</sub>	V <sub>IHAmin</sub>	V <sub>ILAmax</sub>	V <sub>EE</sub>				
Power Supply Drain Current	I <sub>E</sub>	8	9				8	1, 16			
Input Current	I <sub>inH</sub>	12	12				8	1, 16			
		5,6,10,11	5,6,10,11				8	1, 16			
		7	7				8	1, 16			
		9	9				8	1, 16			
	I <sub>inL</sub>	All		Note 1.			8	1, 16			
Output Voltage Logic 1	V <sub>OH</sub>	3,14 (3.)	9				8	1, 16			
		2,4,13,15 (2.)	5,6,10,11				8	1, 16			
Output Voltage Logic 0	V <sub>OL</sub>	3,14 (2.)	5,6,10,11				8	1, 16			
		2,4,13,15 (3.)	9				8	1, 16			
Threshold Voltage Logic 1	V <sub>OHA</sub>	2,4,13,15 (2.)			5,6,10,11		8	1, 16			
		3,14 (3.)			9		8	1, 16			
		13,15 (2.)			7,12		8	1, 16			
Threshold Voltage Logic 0	V <sub>OLA</sub>	2,4,13,15 (3.)				5,6,10,11	8	1, 16			
		3,14 (2.)				9	8	1, 16			
		13,15 (3.)				7,12	8	1, 16			
Switching Times (50Ω Load)					Pulse In	Pulse Out	-3.2 V	+2.0 V			
Propagation Delay Clock Delays	t <sub>12+15+</sub> t <sub>12+14+</sub> t <sub>7+13+</sub> t <sub>7+4+</sub> t <sub>7+2+</sub> t <sub>7+3+</sub> t <sub>12+15-</sub> t <sub>12+14-</sub> t <sub>7+13-</sub> t <sub>7+4-</sub> t <sub>7+2-</sub> t <sub>7+3-</sub>	15				12	15	8	1, 16		
		14				12	14	8	1, 16		
		13				7	13	8	1, 16		
		4				7	4	8	1, 16		
		2				7	2	8	1, 16		
		3				7	3	8	1, 16		
		15				12	15	8	1, 16		
		14				12	14	8	1, 16		
		13				7	13	8	1, 16		
		4				7	4	8	1, 16		
		2				7	2	8	1, 16		
		3				7	3	8	1, 16		
		Set Delay	t <sub>11+15+</sub> t <sub>11+14-</sub>	15				11	15	8	1, 16
				14				11	14	8	1, 16
Reset Delay	t <sub>9+14+</sub> t <sub>9+15-</sub>	14				9	14	8	1, 16		
		15				9	15	8	1, 16		
Rise Time (20 to 80%)	t <sub>14+</sub> t <sub>15+</sub>	14				11	14	8	1, 16		
		15				11	15	8	1, 16		
Fall Time (20 to 80%)	t <sub>14-</sub> t <sub>15-</sub>	14				9	14	8	1, 16		
		15				9	15	8	1, 16		
Counting Frequency	f <sub>count</sub>	2				7	2	8	1, 16		
		15				12	15	8	1, 16		

1. Individually test each input; apply V<sub>ILmin</sub> to pin under test.

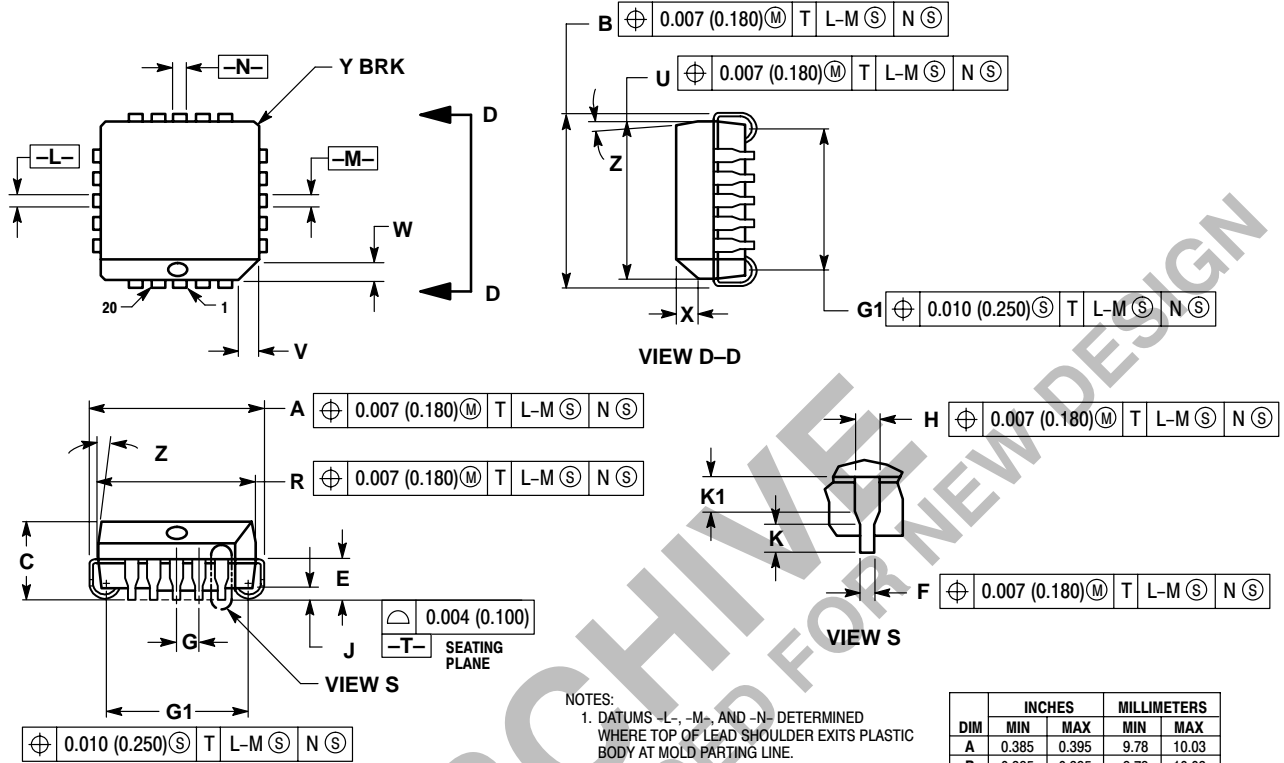
2. Set all four flip-flops by applying pulse  to pins 5, 6, 10, and 11 prior to applying test voltage indicated.

3. Reset all four flip-flops by applying pulse  to pin 9 prior to applying test voltage indicated.

# MC10138

## PACKAGE DIMENSIONS

PLCC-20  
FN SUFFIX  
PLASTIC PLCC PACKAGE  
CASE 775-02  
ISSUE C



### NOTES:

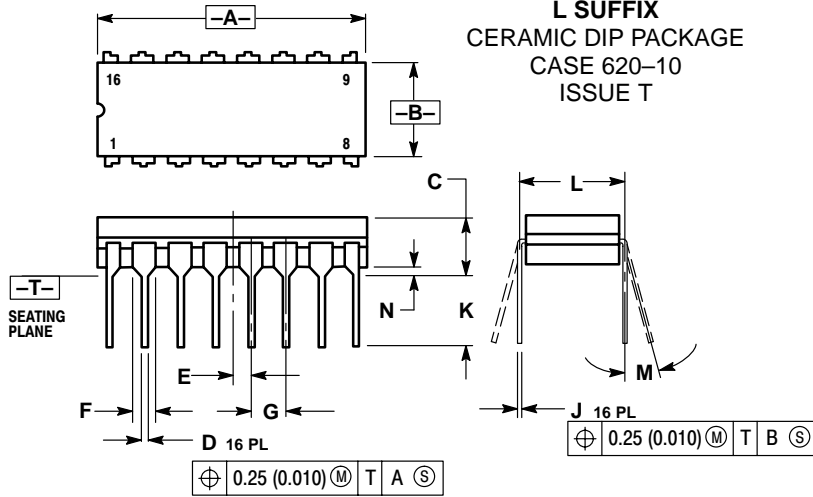
- DATUMS -L-, -M-, AND -N- DETERMINED WHERE TOP OF LEAD SHOULDER EXITS PLASTIC BODY AT MOLD PARTING LINE.
- DIMENSION G1, TRUE POSITION TO BE MEASURED AT DATUM -T-, SEATING PLANE.
- DIMENSIONS R AND U DO NOT INCLUDE MOLD FLASH. ALLOWABLE MOLD FLASH IS 0.010 (0.250) PER SIDE.
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: INCH.
- THE PACKAGE TOP MAY BE SMALLER THAN THE PACKAGE BOTTOM BY UP TO 0.012 (0.300). DIMENSIONS R AND U ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY EXCLUSIVE OF MOLD FLASH, TIE BAR BURRS, GATE BURRS AND INTERLEAD FLASH, BUT INCLUDING ANY MISMATCH BETWEEN THE TOP AND BOTTOM OF THE PLASTIC BODY.
- DIMENSION H DOES NOT INCLUDE DAMBAR PROTRUSION OR INTRUSION. THE DAMBAR PROTRUSION(S) SHALL NOT CAUSE THE H DIMENSION TO BE GREATER THAN 0.037 (0.940). THE DAMBAR INTRUSION(S) SHALL NOT CAUSE THE H DIMENSION TO BE SMALLER THAN 0.025 (0.635).

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.385	0.395	9.78	10.03
B	0.385	0.395	9.78	10.03
C	0.165	0.180	4.20	4.57
E	0.090	0.110	2.29	2.79
F	0.013	0.019	0.33	0.48
G	0.050 BSC		1.27 BSC	
H	0.026	0.032	0.66	0.81
J	0.020	---	0.51	---
K	0.025	---	0.64	---
R	0.350	0.356	8.89	9.04
U	0.350	0.356	8.89	9.04
V	0.042	0.048	1.07	1.21
W	0.042	0.048	1.07	1.21
X	0.042	0.056	1.07	1.42
Y	---	0.020	---	0.50
Z	2°	10°	2°	10°
G1	0.310	0.330	7.88	8.38
K1	0.040	---	1.02	---

# MC10138

## PACKAGE DIMENSIONS

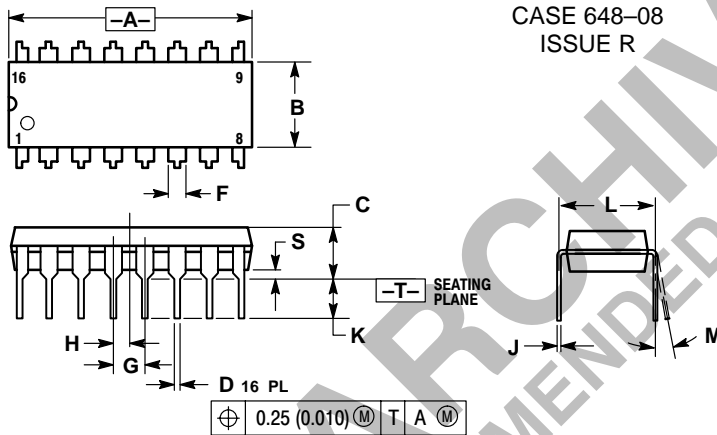
### CDIP-16 L SUFFIX CERAMIC DIP PACKAGE CASE 620-10 ISSUE T



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
  4. DIMENSION F MAY NARROW TO 0.76 (0.030) WHERE THE LEAD ENTERS THE CERAMIC BODY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.750	0.785	19.05	19.93
B	0.240	0.295	6.10	7.49
C	---	0.200	---	5.08
D	0.015	0.020	0.39	0.50
E	0.050 BSC		1.27 BSC	
F	0.055	0.065	1.40	1.65
G	0.100 BSC		2.54 BSC	
H	0.008	0.015	0.21	0.38
K	0.125	0.170	3.18	4.31
L	0.300 BSC		7.62 BSC	
M	0° 15°		0° 15°	
N	0.020	0.040	0.51	1.01

### PDIP-16 P SUFFIX PLASTIC DIP PACKAGE CASE 648-08 ISSUE R




- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
  4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
  5. ROUNDED CORNERS OPTIONAL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.740	0.770	18.80	19.55
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.021	0.39	0.53
F	0.040	0.70	1.02	1.77
G	0.100 BSC		2.54 BSC	
H	0.050 BSC		1.27 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.130	2.80	3.30
L	0.295	0.305	7.50	7.74
M	0° 10°		0° 10°	
S	0.020	0.040	0.51	1.01

**Notes**

**ARCHIVE**  
DEVICE NOT RECOMMENDED FOR NEW DESIGN

ARCHIVE  
RECOMMENDED FOR NEW DESIGN

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