

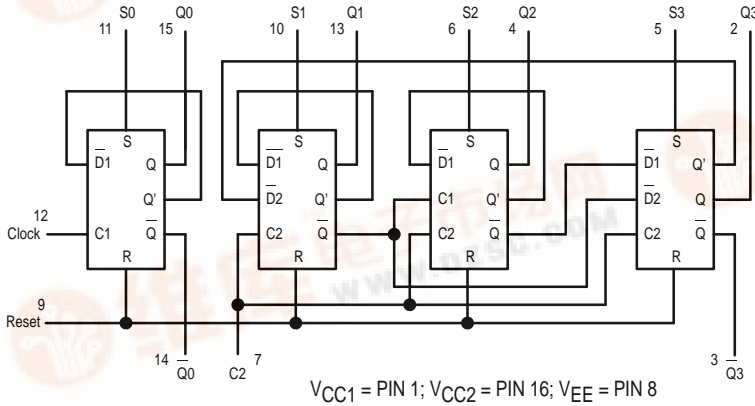
Bi-Quinary Counter

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



COUNTER TRUTH TABLES

BI-QUINARY

(Clock connected to C2 and 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

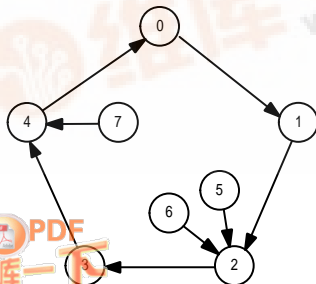
BCD

(Clock connected to C1 and Q0 connected to C2)

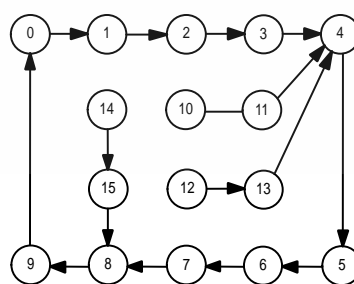
COUNT	Q0	Q1	Q2	Q3
0	L	L	L	L
1	H	L	L	L
2	L	H	L	L
3	H	H	L	L
4	L	L	H	L
5	H	L	H	L
6	L	H	H	L
7	H	H	H	L
8	L	L	L	H
9	H	L	L	H

COUNTER STATE DIAGRAM — POSITIVE LOGIC

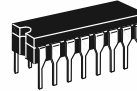
CLOCK CONNECTED TO C2



Q0 CONNECTED TO C2



MC10138



L SUFFIX
 CERAMIC PACKAGE
 CASE 620-10

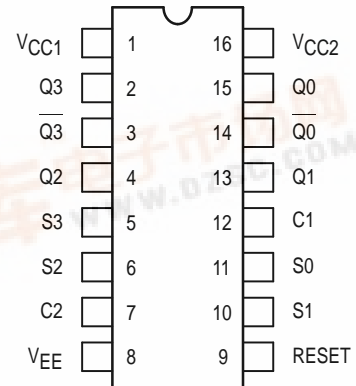


P SUFFIX
 PLASTIC PACKAGE
 CASE 648-08



FN SUFFIX
 PLCC
 CASE 775-02

DIP PIN ASSIGNMENT




Pin assignment is for Dual-in-Line Package. For PLCC pin assignment, see the Pin Conversion Tables on page 6–11 of the Motorola MECL Data Book (DL122/D).

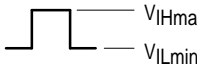
MC10138

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	μ Adc	
		5,6,10,11		390			245		245		
7			460			290		290			
9			650			410					
	I_{inL}	All	0.5		0.5			0.3		μ Adc	
Output Voltage	Logic 1	V_{OH}	3,14 (3.) 2,4,13,15 (2.)	-1.060 -1.060	-0.890 -0.890	-0.960 -0.960		-0.810 -0.810	-0.890 -0.890	-0.700 -0.700	Vdc
Output Voltage	Logic 0	V_{OL}	3,14 (2.) 2,4,13,15 (3.)	-1.890 -1.890	-1.675 -1.675	-1.850 -1.850		-1.650 -1.650	-1.825 -1.825	-1.615 -1.615	Vdc
Threshold Voltage	Logic 1	V_{OHA}	2,4,13,15 (2.) 3,14 (3.) 13,15 (2.)	-1.080 -1.080 -1.080		-0.980 -0.980 -0.980			-0.910 -0.910 -0.910		Vdc
Threshold Voltage	Logic 0	V_{OLA}	2,4,13,15 (3.) 3,14 (2.) 13,15 (3.)		-1.655 -1.655 -1.655			-1.630 -1.630 -1.630		-1.595 -1.595 -1.595	Vdc
Switching Times (50 Ω Load)										ns	
Propagation Clock Delays Delay	t_{12+15+} t_{12+14+} t_{7+13+} t_{7+4+} t_{7+2+} t_{7+3+} t_{12+15-} t_{12+14-} t_{7+13-} t_{7+4-} t_{7+2-} t_{7+3-}	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
			t_{11+14-}	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		
	t_{9+15-}	15	1.4	5.2	1.5		5.0	1.5	5.5		
Rise Time (20 to 80%)	t_{14+} t_{15+}	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-} t_{15-}	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.

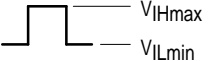
2. Set all four flip-flops by applying pulse  to pins 5, 6, 10, and 11 prior to applying test voltage indicated.

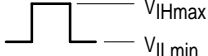
3. Reset all four flip-flops by applying pulse  to pin 9 prior to applying test voltage indicated.

ELECTRICAL CHARACTERISTICS (continued)

Characteristic	Symbol	Pin Under Test	TEST VOLTAGE VALUES (Volts)					(V _{CC}) Gnd			
			V _{IHmax}	V _{ILmin}	V _{IHAmin}	V _{ILAmax}	V _{EE}				
			@ Test Temperature								
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			
Characteristic	Symbol	Pin Under Test	TEST VOLTAGE APPLIED TO PINS LISTED BELOW					(V _{CC}) Gnd			
			V _{IHmax}	V _{ILmin}	V _{IHAmin}	V _{ILAmax}	V _{EE}				
Power Supply Drain Current	I _E	8	9				8	1, 16			
Input Current	I _{inH}	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 _{inL}	All		Note 1.			8	1, 16			
Output Voltage Logic 1	V _{OH}	3,14 (3.)	9				8	1, 16			
		2,4,13,15 (2.)	5,6,10,11				8	1, 16			
Output Voltage Logic 0	V _{OL}	3,14 (2.)	5,6,10,11				8	1, 16			
		2,4,13,15 (3.)	9				8	1, 16			
Threshold Voltage Logic 1	V _{OHA}	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 _{OLA}	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 ₁₂₊₁₅₊ t ₁₂₊₁₄₊ t ₇₊₁₃₊ t ₇₊₄₊ t ₇₊₂₊ t ₇₊₃₊ t ₁₂₊₁₅₋ t ₁₂₊₁₄₋ t ₇₊₁₃₋ t ₇₊₄₋ t ₇₊₂₋ t ₇₊₃₋	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 ₁₁₊₁₅₊ t ₁₁₊₁₄₋	15				11	15	8	1, 16
				14				11	14	8	1, 16
Reset Delay	t ₉₊₁₄₊ t ₉₊₁₅₋	14				9	14	8	1, 16		
		15				9	15	8	1, 16		
Rise Time (20 to 80%)	t ₁₄₊ t ₁₅₊	14				11	14	8	1, 16		
		15				11	15	8	1, 16		
Fall Time (20 to 80%)	t ₁₄₋ t ₁₅₋	14				9	14	8	1, 16		
		15				9	15	8	1, 16		
Counting Frequency	f _{count}	2				7	2	8	1, 16		
		15				12	15	8	1, 16		

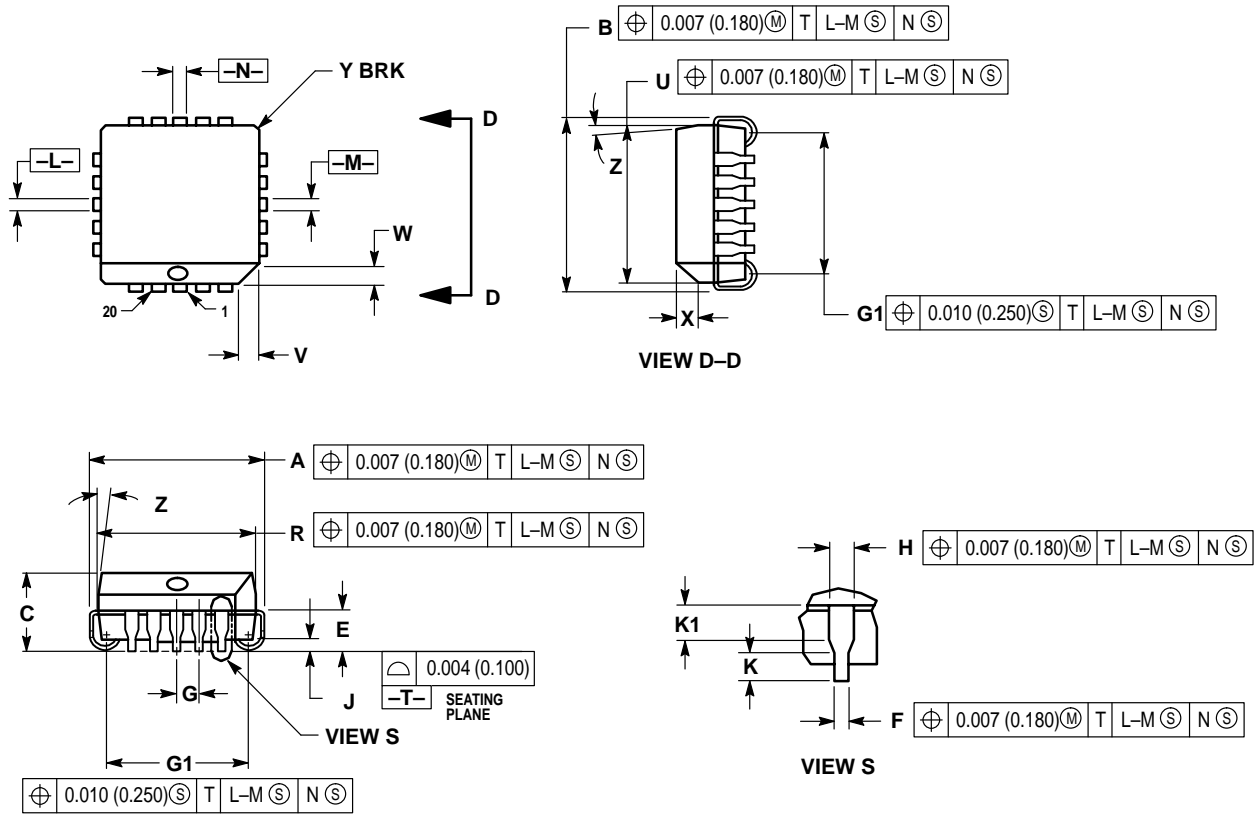
1. Individually test each input; apply V_{ILmin} to pin under test.

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

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

OUTLINE DIMENSIONS

FN SUFFIX
 PLASTIC PLCC PACKAGE
 CASE 775-02
 ISSUE C



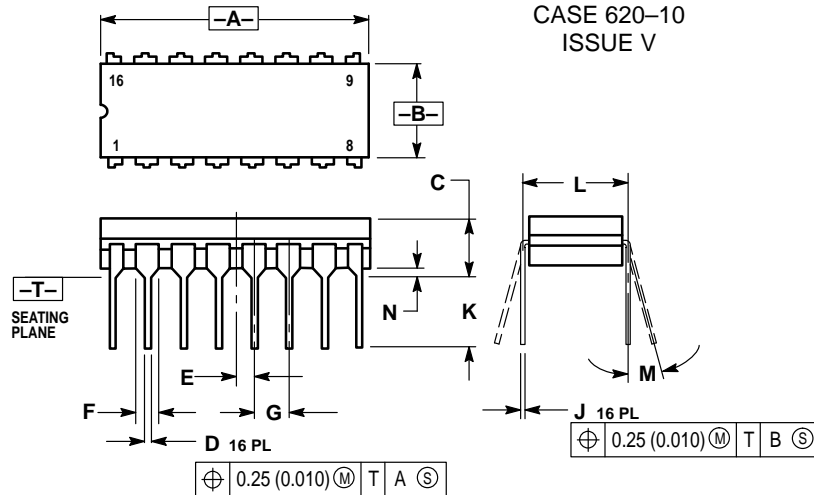
NOTES:

- 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	—

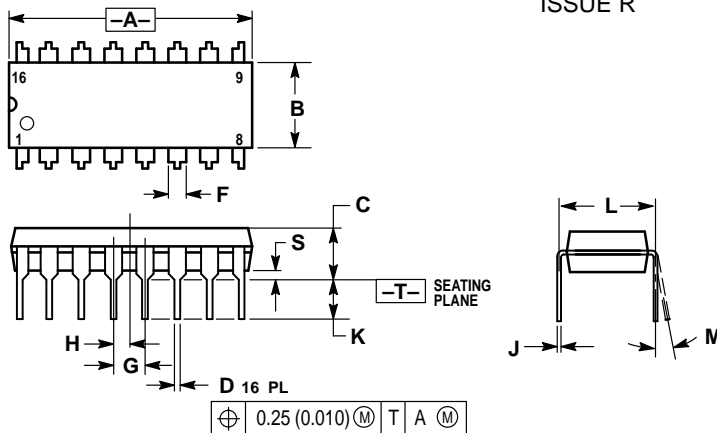
OUTLINE DIMENSIONS

L SUFFIX
CERAMIC DIP PACKAGE
CASE 620-10
ISSUE V



- 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.

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.

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