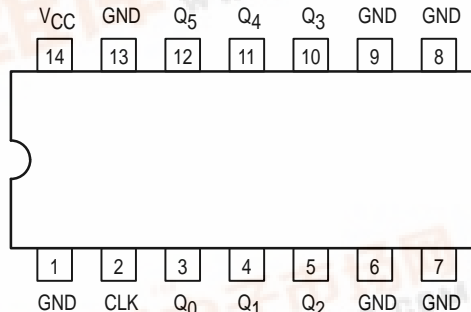


# Low Skew CMOS Clock Driver

The MC88913 is a high-speed, low power, hex divide-by-two D-type flip-flop with two inverting and four non-inverting outputs that have closely matched propagation delays. With a TTL compatible buffered clock input that is common to all flip-flops, the MC88913 is ideal for use in high-frequency systems as a clock driver, providing multiple outputs that are synchronous.

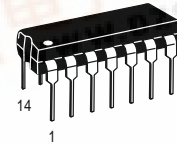
- Minimum Clock Input  $f_{MAX}$  of 110MHz
- TTL Compatible Positive Edge-Triggered Clock
- Matched Outputs for Synchronous Applications
- Outputs Source/Sink 24mA
- Part-to-Part Skew of Less Than 4.0ns
- Guaranteed Rise and Fall Times for a Given Capacitive Load

Pinout: 14-Lead Plastic (Top View)

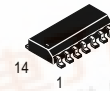


## MC88913

### LOW SKEW CMOS CLOCK DRIVER



**N SUFFIX**  
 PLASTIC PACKAGE  
 CASE 646-06



**D SUFFIX**  
 PLASTIC PACKAGE  
 CASE 751A-03

#### MAXIMUM RATINGS\*

Symbol	Parameter	Value	Units
$V_{CC}$	DC Supply Voltage (Referenced to GND)	-0.5 to +7.0	V
$V_{in}$	DC Input Voltage (Referenced to GND)	-0.5 to $V_{CC} + 0.5$	V
$V_{out}$	DC Output Voltage (Referenced to GND)	-0.5 to $V_{CC} + 0.5$	V
$I_{in}$	DC Input Current, per Pin	$\pm 20$	mA
$I_{out}$	DC Output Sink/Source Current, per Pin	$\pm 50$	mA
$I_{CC}$	DC $V_{CC}$ or GND Current per Output Pin	$\pm 50$	mA
$P_D$	Power Dissipation in Still Air	Plastic Package** 750 SOIC Package** 500	mW
$T_{stg}$	Storage Temperature	-65 to +150	$^{\circ}C$
$T_L$	Lead Temperature, 1mm from Case for 10s (Plastic or SOIC Package)	260	$^{\circ}C$

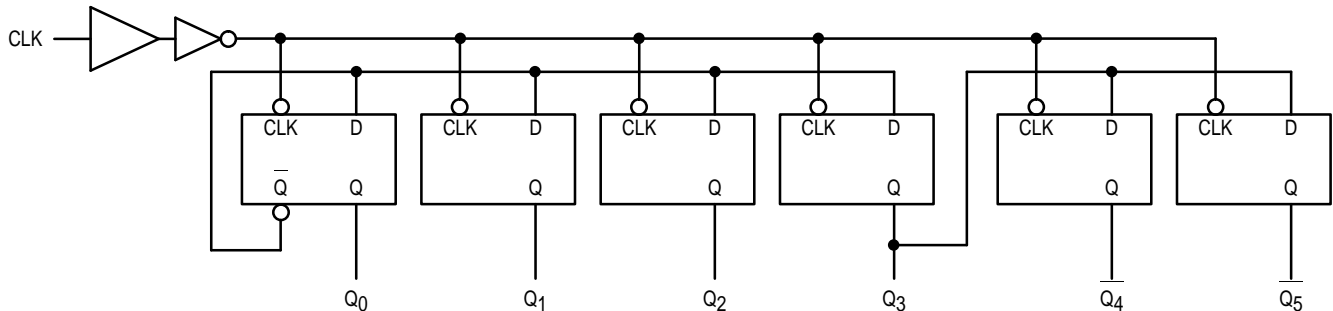
\* Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the Recommended Operating Conditions.

\*\* Derating: Plastic Package: -10mW/ $^{\circ}C$  from 65 $^{\circ}C$  to 125 $^{\circ}C$   
 SOIC Package: -7.0mW/ $^{\circ}C$  from 65 $^{\circ}C$  to 125 $^{\circ}C$



# MC88913

## LOGIC DIAGRAM



NOTE: This diagram is provided only for understanding of logic operation and should **not** be used to estimate propagation delays

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
$V_{CC}$	DC Supply Voltage (Referenced to GND)	2.0	6.0	V
$V_{in}, V_{out}$	DC Input Voltage, Output Voltage (Referenced to GND)	0	$V_{CC}$	V
$T_A$	Operating Temperature	-40	+85	°C
$t_r, t_f$	Input Rise and Fall Time $V_{in}$ from 0.8 to 2.0V $V_{meas}$ from 0.8 to 2.0V	0	10	ns/V
		0	8.0	

## DC CHARACTERISTICS (unless otherwise specified)

Symbol	Parameter		Unit	Condition
$I_{CC}$	Maximum Quiescent Supply Current	80	$\mu A$	$V_{IN} = V_{CC}$ or GND $V_{CC} = 5.5V$ , $T_A = \text{Worst Case}$
$I_{CC}$	Maximum Quiescent Supply Current	8.0	$\mu A$	$V_{IN} = V_{CC}$ or GND $V_{CC} = 5.5V$ , $T_A = 25^\circ C$
$I_{CCT}$	Maximum Additional $I_{CC}$ /Input	1.5	mA	$V_{IN} = V_{CC} - 2.1V$ $V_{CC} = 5.5V$ , $T_A = \text{Worst Case}$

## AC OPERATING REQUIREMENTS

Symbol	Parameter	$V_{CC}$ (V)	$T_A = 25^\circ C$ $C_L = 50 pF$		$T_A = -40$ to $+85^\circ C$ $C_L = 50 pF$		Unit
			Min	Max	Min	Max	
$t_W$	CLK Pulse Width (HIGH to LOW)	5.0	3.0		3.0		ns

## CAPACITANCE

Symbol	Parameter	Typ	Unit	Condition
$C_{IN}$	Input Capacitance	4.5	pF	$V_{CC} = 5.0V$
$C_{PD}$	Power Dissipation Capacitance	30	pF	$V_{CC} = 5.0V$

## DC CHARACTERISTICS

Symbol	Parameter	V <sub>CC</sub>	T <sub>A</sub> = +25°C		T <sub>A</sub> = -40 to +85°C		Unit	Conditions
			Typ	Guaranteed Max				
V <sub>IH</sub>	Minimum High Level Input Voltage	4.5	1.5	2.0	2.0	V	V <sub>OUT</sub> = 0.1V or V <sub>CC</sub> - 0.1V	
		5.5	1.5	2.0	2.0			
V <sub>IL</sub>	Maximum Low Level Input Voltage	4.5	1.5	0.8	0.8	V	V <sub>OUT</sub> = 0.1V or V <sub>CC</sub> - 0.1V	
		5.5	1.5	0.8	0.8			
V <sub>OH</sub>	Minimum High Level	4.5	4.49	4.4	4.4	V	I <sub>OUT</sub> = -50μA	
		5.5	5.49	5.4	5.4			
		4.5		3.86	3.76	V	*V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OH</sub> = -24mA -24mA	
5.5		4.86	4.76					
V <sub>OL</sub>	Maximum Low Level Output Voltage	4.5	0.001	0.1	0.1	V	I <sub>OUT</sub> = 50μA	
		5.5	0.001	0.1	0.1			
		4.5		0.36	0.44	V	*V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OH</sub> = 24mA 24mA	
5.5		0.36	0.44					
I <sub>IN</sub>	Maximum Input	5.5		±0.1	±0.1	μA	V <sub>I</sub> = V <sub>CC</sub> , GND	
I <sub>CC</sub>	Maximum I <sub>CC</sub> /Input	5.5	0.6		1.5	mA	V <sub>I</sub> = V <sub>CC</sub> - 2.1V	
I <sub>OLD</sub>	Minimum Dynamic Output Current**	5.5			75	mA	V <sub>OLD</sub> = 1.65V	
I <sub>OHD</sub>		5.5			-75	mA	V <sub>OHD</sub> = 3.85V	

\* All outputs loaded; thresholds on inputs associated with output under test.

\*\* Maximum test duration 20ms, one output at a time.

AC CHARACTERISTICS (V<sub>CC</sub> = 5.0V ±10%)

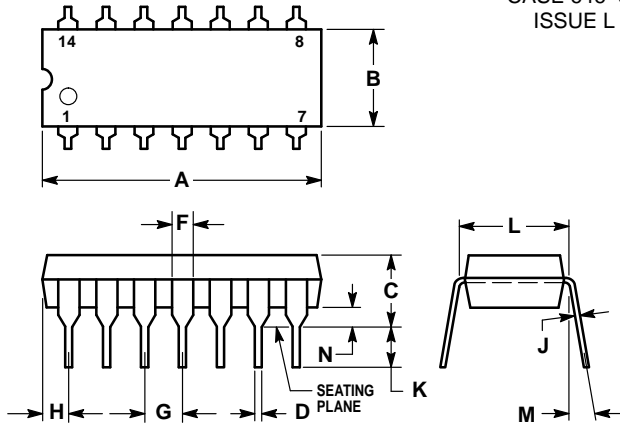
Symbol	Parameter	V <sub>CC</sub> (V)	T <sub>A</sub> = 25°C C <sub>L</sub> = 50 pF		T <sub>A</sub> = -40 to +85°C C <sub>L</sub> = 50 pF		Unit
			Min	Max	Min	Max	
f <sub>MAX</sub>	Maximum Clock Frequency (50% Duty Cycle)	5.0	110		110		MHz
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay CLK to Q <sub>N</sub> , Q <sub>N</sub>	5.0	4.0	10.5	4.0	11.5	ns
t <sub>PV</sub>	Propagation Delay Variation CLK to Q <sub>0</sub> , Q <sub>1</sub> , Q <sub>2</sub> (see Note 1)	5.0		4.0		5.0	ns
	Propagation Delay Variation CLK to All Outputs (see Note 1)	5.0		4.5		5.5	ns
t <sub>PS</sub>	Propagation Delay Skew (Q <sub>0</sub> , Q <sub>1</sub> , Q <sub>2</sub> )  t <sub>PHL</sub> Actual - t <sub>PLH</sub> Actual	5.0		1.0		1.0	ns
	Propagation Delay Skew (All Outputs)  t <sub>PHL</sub> Actual - t <sub>PLH</sub> Actual	5.0		1.5		1.5	ns
t <sub>OS</sub>	Output-to-Output Skew (Q <sub>0</sub> , Q <sub>1</sub> , Q <sub>2</sub> )  t <sub>p</sub> Q <sub>N</sub> - t <sub>p</sub> Q <sub>M</sub>   (see Note 2)	5.0		1.0		1.0	ns
	Output-to-Output Skew (All Outputs)  t <sub>p</sub> Q <sub>N</sub> - t <sub>p</sub> Q <sub>M</sub>   (see Note 2)	5.0		1.5		1.5	ns
t <sub>rise</sub> t <sub>fall</sub>	Rise/Fall Time for Q <sub>0</sub> , Q <sub>1</sub> , Q <sub>2</sub> (0.2 x V <sub>CC</sub> to 0.8 x V <sub>CC</sub> )	5.0		3.0		4.0	ns
	Rise/Fall Time for All Outputs (0.2 x V <sub>CC</sub> to 0.8 x V <sub>CC</sub> )	5.0		3.5		4.5	ns

1. For a given set of conditions (i.e., capacitive load, temperature and V<sub>CC</sub>) the variation from device to device is guaranteed to be less than or equal to the maximum.

2. Where t<sub>p</sub> Q<sub>N</sub> and t<sub>p</sub> Q<sub>M</sub> are the actual propagation delays (any combination of HIGH or LOW) for any two separate outputs from a given high transition of CLK.

OUTLINE DIMENSIONS

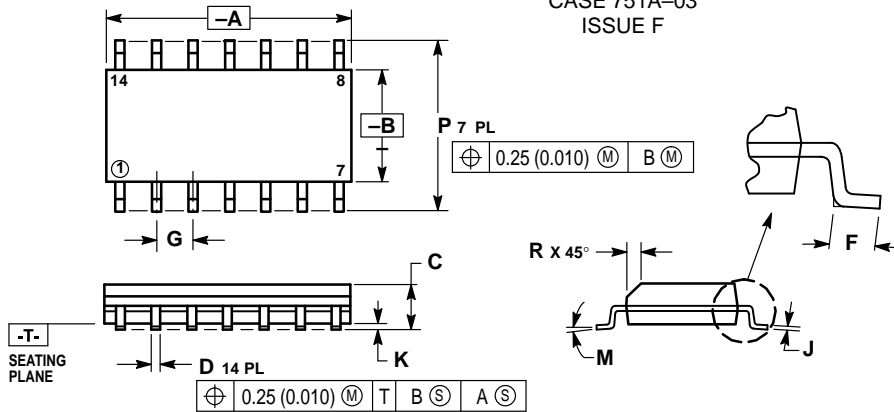
**N SUFFIX**  
**PLASTIC PACKAGE**  
**CASE 646-06**  
**ISSUE L**



- NOTES:
- LEADS WITHIN 0.13 (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
  - DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
  - DIMENSION B DOES NOT INCLUDE MOLD FLASH.
  - ROUNDED CORNERS OPTIONAL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.715	0.770	18.16	19.56
B	0.240	0.260	6.10	6.60
C	0.145	0.185	3.69	4.69
D	0.015	0.021	0.38	0.53
F	0.040	0.070	1.02	1.78
G	0.100 BSC		2.54 BSC	
H	0.052	0.095	1.32	2.41
J	0.008	0.015	0.20	0.38
K	0.115	0.135	2.92	3.43
L	0.300 BSC		7.62 BSC	
M	0°	10°	0°	10°
N	0.015	0.039	0.39	1.01

**D SUFFIX**  
**PLASTIC SOIC PACKAGE**  
**CASE 751A-03**  
**ISSUE F**



- NOTES:
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  - CONTROLLING DIMENSION: MILLIMETER.
  - DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
  - MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
  - DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	8.55	8.75	0.337	0.344
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.228	0.244
R	0.25	0.50	0.010	0.019

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