



# Binary Counter

**ELECTRICALLY TESTED PER:**  
**MPG 1654 (-30°C to +85°C)**

The 1654 is a 4-bit counter capable of divide-by-two, divide-by-four, divide-by-eight, or divide-by-16 functions. Clock inputs trigger on the positive going edge of the clock pulse.

Set and Reset inputs 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. True outputs are available at all levels.

- Power Dissipation = 750 mW typ
- $f_{Tog}$  = 325 MHz typ

ABSOLUTE MAXIMUM RATINGS:	Symbol	Min	Max	Unit
Power Supply Voltage ( $V_{CC} = 0$ )	$V_{CC}$	-8.0	0	Vdc
Base Input Voltage ( $V_{CC} = 0$ )	$V_{IN}$	0	$V_{EE}$	Vdc
Output Source Current Continuous	$I_O$		< 40	mAdc
Storage Temperature Range	$T_{stg}$	-55	+125	°C
Operating Temperature Range	$T_A$	-30	+85	°C

### PIN ASSIGNMENTS

FUNCTION	DIL	BURN-IN (CONDITION C)
$V_{CC1}$	1	GND
Clock 2	2	OPEN
$S_0$	3	GND
$\overline{Q_0}$	4	51 $\Omega$ to $V_{TT}$
$Q_0$	5	51 $\Omega$ to $V_{TT}$
$Q_1$	6	51 $\Omega$ to $V_{TT}$
$S_1$	7	GND
$V_{EE}$	8	$V_{EE}$
$S_2$	9	GND
Reset	10	OPEN
$Q_2$	11	51 $\Omega$ to $V_{TT}$
$Q_3$	12	51 $\Omega$ to $V_{TT}$
$\overline{Q_3}$	13	51 $\Omega$ to $V_{TT}$
$S_3$	14	GND
Clock 1	15	OPEN
$V_{CC2}$	16	GND

**BURN - IN CONDITIONS:**  
 $V_{TT} = -1.8$  V MAX/  $-2.2$  V MIN  
 $V_{EE} = -5.7$  V MAX/  $-4.7$  V MIN

**Military 1654**

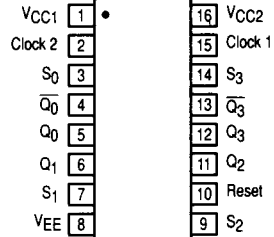


**AVAILABLE AS**

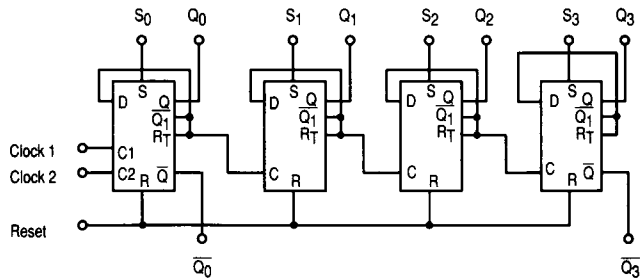
- 1) JAN: N/A
  - 2) SMD: N/A
  - 3) 883: N/A
  - 4) 1654/BXA \*
- X = CASE OUTLINE AS FOLLOWS:

**PACKAGE: CERDIP: E**

\* 883 Processing (Non-Compliant)



### LOGIC DIAGRAM



TRUTH TABLE

Inputs							Outputs			
R	S <sub>0</sub>	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	C <sub>1</sub>	C <sub>2</sub>	Q <sub>0</sub>	Q <sub>1</sub>	Q <sub>2</sub>	Q <sub>3</sub>
1	0	0	0	0	φ	φ	0	0	0	0
0	1	1	1	1	φ	φ	1	1	1	1
0	0	0	0	0	1	φ	No Count			
0	0	0	0	0	φ	1	No Count			
0	0	0	0	0	**	**	0	0	0	0
0	0	0	0	0	**	**	1	0	0	0
0	0	0	0	0	**	**	0	1	0	0
0	0	0	0	0	**	**	1	1	0	0
0	0	0	0	0	**	**	0	0	1	0
0	0	0	0	0	**	**	1	0	1	0
0	0	0	0	0	**	**	0	1	1	0
0	0	0	0	0	**	**	1	1	1	0
0	0	0	0	0	**	**	0	0	0	1
0	0	0	0	0	**	**	1	0	0	1
0	0	0	0	0	**	**	0	1	0	1
0	0	0	0	0	**	**	1	1	0	1
0	0	0	0	0	**	**	0	0	1	1
0	0	0	0	0	**	**	1	0	1	1
0	0	0	0	0	**	**	0	1	1	1
0	0	0	0	0	**	**	1	1	1	1

φ = Don't Care

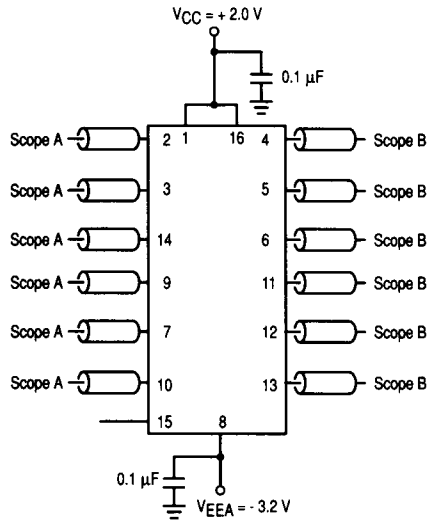
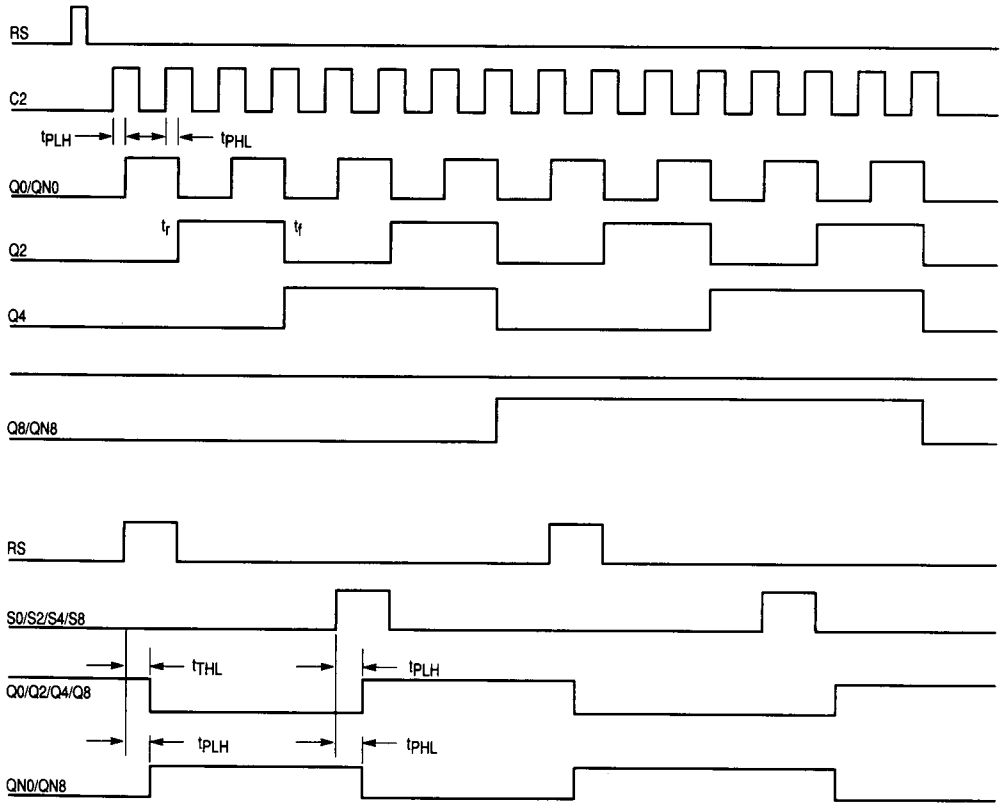
\*\* = V<sub>IH</sub> Clock transition from V<sub>IL</sub> to V<sub>IH</sub>V<sub>IL</sub> may be applied to C<sub>1</sub> or C<sub>2</sub> or both for same effect

Figure 1. Test Circuit



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Figure 2. Test Circuit Waveforms

Temp.	25°C	85°C	-30°C
V <sub>ILL</sub>	0.31 V	0.337 V	0.285 V
V <sub>IHH</sub>	1.11 V	1.185 V	1.041 V
P <sub>IN</sub>	1.0 MHz	1.0 MHz	1.0 MHz
t <sub>r</sub> , t <sub>f</sub>	1.5 ns	1.5 ns	1.5 ns

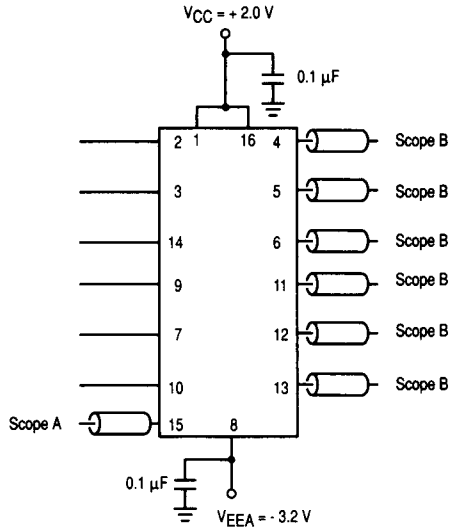


Figure 3. Toggle Test Circuit

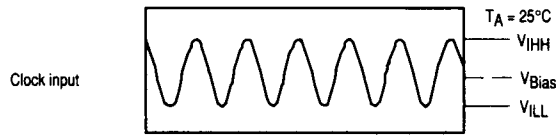


Figure 4. Toggle Waveform

Temp.	25°C	85°C	-30°C
V <sub>ILL</sub>	0.31 V	0.337 V	0.285 V
V <sub>IHH</sub>	1.11 V	1.185 V	1.041 V
P <sub>IN</sub>	300 MHz	260 MHz	260 MHz

# 1654 QUIESCENT LIMIT TABLE

Test Temperature	Test Voltage Values (Volts)					
	V <sub>IH</sub>	V <sub>IL</sub>	V <sub>IHA</sub>	V <sub>ILA</sub>	VEE	V <sub>EEA</sub>
T <sub>A</sub> = 25 °C	-0.81	-1.85	-1.095	-1.485	-5.2	-3.2
T <sub>A</sub> = 85 °C	-0.70	-1.83	-1.025	-1.440	-5.2	-3.2
T <sub>A</sub> = -30 °C	-0.875	-1.89	-1.180	-1.515	-5.2	-3.2

Symbol	Parameter	Limits						Units	TEST VOLTAGE APPLIED TO PINS BELOW						
		+ 25 °C		+ 85 °C		- 30 °C			Pinouts referenced are for DIL package, check Pin Assignments VCC = 0.0 V, Output Load = 50 Ω to - 2.0 V						
		Subgroup 1 Min	Subgroup 1 Max	Subgroup 2 Min	Subgroup 2 Max	Subgroup 3 Min	Subgroup 3 Max		V <sub>IH</sub>	V <sub>IL</sub>	V <sub>IHA</sub>	V <sub>ILA</sub>	VCC	VEE	P.U.T.
V <sub>OH</sub>	High Output Voltage	-0.96	-0.81	-0.89	-0.7	-1.045	-0.875	V	3, 7, 9, 10, 14			1, 16	8	4 - 6, 11 - 13	
V <sub>OL</sub>	Low Output Voltage	-1.85	-1.62	-1.83	-1.575	-1.89	-1.65	V	3, 10, 14			1, 16	8	4 - 6, 11 - 13	
V <sub>OHA</sub>	High Output Voltage	-0.98	-0.81	-0.91	-0.7	-1.065	-0.875	V		3, 7, 9, 10, 14		1, 16	8	4 - 6, 11 - 13	
V <sub>OLA</sub>	Low Output Voltage	-1.85	-1.60	-1.83	-1.555	-1.89	-1.63	V	3, 7, 9, 10, 14		3, 7, 9, 10, 14	1, 16	8	4 - 6, 11 - 13	
I <sub>EE</sub>	Power Supply Drain Current		-200					mA	2, 3, 7, 9, 10, 14, 15			1, 16	8	8	
I <sub>NH1</sub>	Input Current High		600					µA	2, 3, 7, 14, 15			1, 16	8	2, 3, 7, 14, 15	
I <sub>NH2</sub>	Input Current High		1.0					mA	10			1, 16	8	10	
I <sub>NL</sub>	Input Current Low		0.5					µA		2, 3, 7, 9, 10, 14, 15		1, 16	8	2, 3, 7, 9, 10, 14, 15	

# 1654 QUIESCENT LIMIT TABLE

Test Temperature	Test Voltage Values (Volts)							
	V <sub>IH</sub>	V <sub>IL</sub>	V <sub>IHA</sub>	V <sub>ILA</sub>	V <sub>EE</sub>	V <sub>EEA</sub>	V <sub>CC</sub>	V <sub>CCA</sub>
T <sub>A</sub> = 25 °C	-0.81	-1.85	-1.095	-1.485	-5.2	-3.2	+5.0	+5.0
T <sub>A</sub> = 85 °C	-0.70	-1.83	-1.025	-1.440	-5.2	-3.2	+5.0	+5.0
T <sub>A</sub> = -30 °C	-0.875	-1.89	-1.180	-1.515	-5.2	-3.2	+5.0	+5.0

Symbol	Parameter	Limits						Units	TEST VOLTAGE APPLIED TO PINS BELOW						
		+ 25 °C		+ 85 °C		- 30 °C			Pinouts referenced are for DIL package, check Pin Assignments Output Load = 50 Ω to GND						
		Subgroup 9	Subgroup 10	Subgroup 9	Subgroup 10	Subgroup 11	V <sub>ILL</sub>		V <sub>IN</sub>	V <sub>OUT</sub>	V <sub>CC</sub>	V <sub>EEA</sub>	C <sub>P1-3</sub>	P.U.T.	
t <sub>TLH</sub>	Rise Time (Pins 4 - 6, 11 - 13)		2.7		3.1		2.9	ns	2, 3, 7, 9, 14	2, 3, 10	4 - 6, 6 - 13	1, 16	8		4 - 6, 6 - 13
t <sub>THL</sub>	Fall Time (Pins 4 - 6, 11 - 13)		2.6		3.0		2.8	ns	2, 3, 7, 9, 14	2, 3, 10	4 - 6, 6 - 13	1, 16	8		4 - 6, 6 - 13
t <sub>pd</sub>	Propagation Delay Clock (I2+5+, I2+4+) Reset		3.3 4.9		3.7 4.9		2.9 5.1	ns	2, 3, 7, 9, 14 2, 3, 7, 9, 14	2, 3, 10 2, 3, 10	4 - 6, 6 - 13 4 - 6, 6 - 13	1, 16 1, 16	8 8		4 - 6, 6 - 13 4 - 6, 6 - 13
t <sub>tog</sub>	Toggle Frequency	260		260		260		MHZ			4 - 6, 6 - 13	1, 16	8	15	4 - 6, 6 - 13