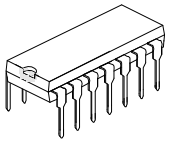
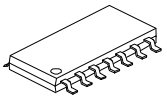
CD4541

CMOS IC

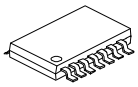
PROGRAMMABLE TIMER



DIP-14



SOP-14



TSSOP-14

■ DESCRIPTION

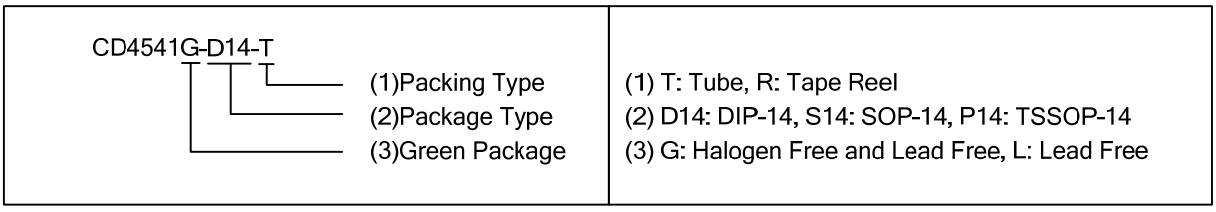
The **CD4541** programmable timer comprise a 16-stage binary counter, an integrated oscillator for use with an external capacitor and two resistors, output control logic, and a special power-on reset circuit. The counter divides the oscillator frequency by any of 4 digitally controlled division ratios.

■ FEATURES

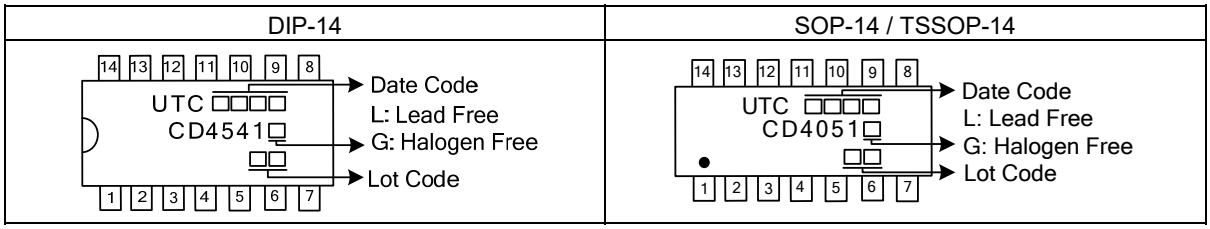
* Operates at 2^n frequency divider or as single transition timer
* Increments on positive edge clock transitions
* Wide supply voltage range: 3.0V ~ 15V
* Built-in low power RC oscillator
* Oscillator frequency range ~ DC to 100 kHz
* External clock applied to Pin 3 can be used instead of oscillator
* Available division ratios 2^8, 2^{10}, 2^{13}, or 2^{16}
* High noise immunity: 0.45 V_{DD} (typ)
* Master reset totally independent of automatic reset operation
* Automatic reset initializes all counters when power turns on
* Q/$\overline{Q}$ select provides output logic level flexibility
* High output drive min. one TTL load
* Maximum input leakage 1μA at 15V over full temperature range

■ ORDERING INFORMATION

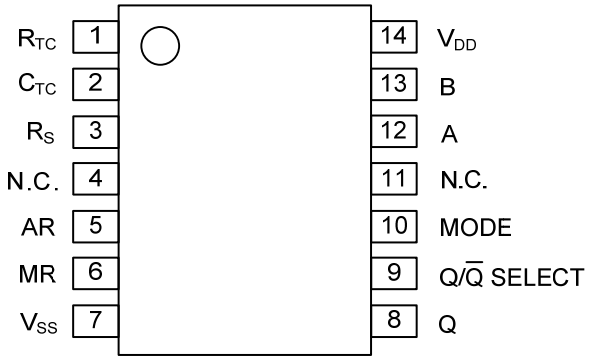
Ordering Number		Package	Packing
Lead Free	Halogen Free		
CD4541L-D14-T	CD4541G-D14-T	DIP-14	Tube
CD4541L-S14-R	CD4541G-S14-R	SOP-14	Tape Reel
CD4541L-P14-R	CD4541G-P14-R	TSSOP-14	Tape Reel



■ MARKING



■ PIN CONFIGURATION



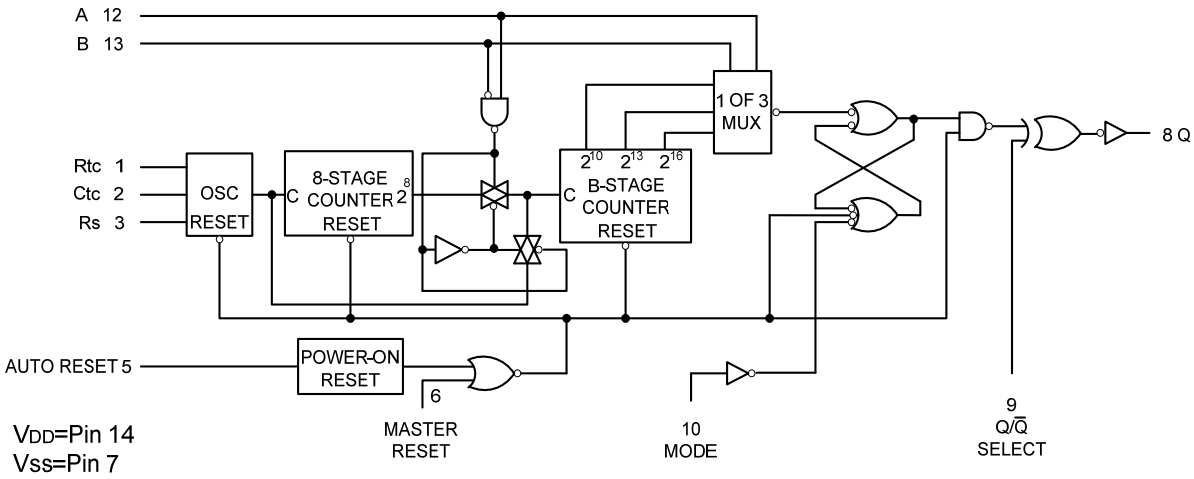
■ TRUTH TABLE

PIN	STATE	
	0	1
5	Auto Reset Operating	Auto Reset Disabled
6	Timer Operational	Master Reset On
9	Output Initially Low after Reset	Output Initially High after Reset
10	Single Cycle Mode	Recycle Mode

■ DIVISION RATIO TABLE

A	B	Number of Counter Stages n	Count 2^n
0	0	13	8192
0	1	10	1024
1	0	8	256
1	1	16	65536

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING

PARAMETER		SYMBOL	RATINGS	UNIT
Supply Voltage		V_{DD}	-0.5 ~ +18	V
Input Voltage		V_{IN}	-0.5 ~ V_{DD}+0.5	V
Power Dissipation	DIP-14	P_D	700	mW
	SOP-14 TSSOP-14		500	
Junction Temperature		T_J	125	°C
Storage Temperature		T_{STG}	-40 ~ +150	°C

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V_{DD}	3 ~ 15	V
Input Voltage	V_{IN}	0 ~ V_{DD}	V
Operating Temperature	T_A	-40 ~ +125	°C

■ DC ELECTRICAL CHARACTERISTICS (Unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Quiescent Device Current	I_{DD}	V_{DD}= 5V, V_{IN}=V_{DD} or V_{SS}		0.005	20	μA
		V_{DD}=10V, V_{IN}=V_{DD} or V_{SS}		0.010	40	
		V_{DD}=15V, V_{IN}=V_{DD} or V_{SS}		0.015	80	
Low Level Output Voltage	V_{OL}	V_{DD}=5V		0	0.05	V
		V_{DD}=10V, I I_O I<1μA		0	0.05	
		V_{DD}=15V		0	0.05	
High Level Output Voltage	V_{OH}	V_{DD}=5V	4.95	5		V
		V_{DD}=10V, I I_O I<1μA	9.95	10		
		V_{DD}=15V	14.95	15		
Low Level Input Voltage	V_{IL}	V_{DD}=5V, V_O=0.5V or 4.5V		2	1.5	V
		V_{DD}=10V, V_O=1.0V or 9.0V		4	3.0	
		V_{DD}=15V, V_O=1.5V or 13.5V		6	4.0	
High Level Input Voltage	V_{IH}	V_{DD}=5V, V_O=0.5V or 4.5V	3.5	3		V
		V_{DD}=10V, V_O=1.0V or 9.0V	7.0	6		
		V_{DD}=15V, V_O=1.5V or 13.5V	11.0	9		
Low Level Output Current (Note)	I_{OL}	V_{DD}=5V, V_O=0.4V	1.96	3.6		mA
		V_{DD}=10V, V_O=0.5V	2.66	9.0		
		V_{DD}=15V, V_O=1.5V	10.4	34.0		
High Level Output Current (Note)	I_{OH}	V_{DD}=5V, V_O=2.5V	4.27	130		mA
		V_{DD}=10V, V_O=9.5V	2.25	8.0		
		V_{DD}=15V, V_O=13.5V	8.8	30.0		
Input Current	I_{IN}	V_{DD}=15V, V_{IN}=0V		-10^{-5}	-0.3	μA
		V_{DD}=15V, V_{IN}=15V		10^{-5}	0.3	

Note: I_{OH} and I_{OL} are tested one output at a time.

■ AC ELECTRICAL CHARACTERISTICS (C_L=50pF (refer to test circuits) (Note 1)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output Rise Time	t_{TLH}	V_{DD}=5V		50	200	ns
		V_{DD}=10V		30	100	
		V_{DD}=15V		25	80	
Output Fall Time	t_{THL}	V_{DD}=5V		50	200	ns
		V_{DD}=10V		30	100	
		V_{DD}=15V		25	80	
Turn-Off, Turn-On Propagation Delay, Clock to Q (2^8 Output)	t_{PLH}, t_{PHL}	V_{DD}=5V		1.8	4.0	μs
		V_{DD}=10V		0.6	1.5	
		V_{DD}=15V		0.4	1.0	
Turn-On, Turn-Off Propagation Delay, Clock to Q (2^{16} Output)	t_{PHL}, t_{PLH}	V_{DD}=5V		3.2	8.0	μs
		V_{DD}=10V		1.5	3.0	
		V_{DD}=15V		1.0	2.0	
Clock Pulse Width	$t_{WH(CL)}$	V_{DD}=5V	400	200		ns
		V_{DD}=10V	200	100		
		V_{DD}=15V	150	70		
Clock Pulse Frequency	f_{CL}	V_{DD}=5V		2.5	1.0	MHz
		V_{DD}=10V		6.0	3.0	
		V_{DD}=15V		8.5	4.0	
MR Pulse Width	$t_{WH(R)}$	V_{DD}=5V	400	170		ns
		V_{DD}=10V	200	75		
		V_{DD}=15V	150	50		
Average Input Capacitance	C_I	Any Input		5.0	7.5	pF
Power Dissipation Capacitance	C_{PD}	(Note 2)		100		pF

Notes: 1. AC Parameters are guaranteed by DC correlated testing.
2. C_{PD} determines the no load AC power consumption of any CMOS device.

■ OPERATING CHARACTERISTICS

With Auto Reset pin set to a “0” the counter circuit is initialized by turning on power. Or with power already on, the counter circuit is reset when the Master Reset pin is set to a “1”. Both types of reset will result in synchronously resetting all counter stages independent of counter state.

The RC oscillator frequency is determined by the external RC network, i.e.:

$$f=\frac{1}{2.3\,R_{TC}C_{TC}} \text{ if } (1\text{ kHz}\leqq f\leqq 100\text{kHz})$$

and RS ~ 2 R_{TC} where RS≧10 kΩ

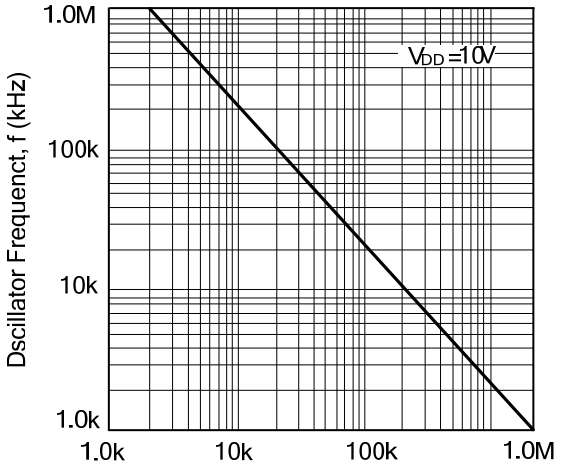
The time select inputs (A and B) provide a two-bit address to output any one of four counter stages (2^8, 2^{10}, 2^{13}, and 2^{16}). The 2^n counts as shown in the Division Ratio Table represent the Q output of the Nth stage of the counter. When A is “1”, 2^{16} is selected for both states of B.

However, when B is “0”, normal counting is interrupted and the 9th counter stage receives its clock directly from the oscillator (i.e., effectively outputting 2^8).

The Q/$\overline{Q}$ select output control pin provides for a choice of output level. When the counter is in a reset condition and Q/Q select pin is set to a “0” the Q output is a “0”. Correspondingly, when Q/$\overline{Q}$ select pin is set to a “1” the Q output is a “1”.

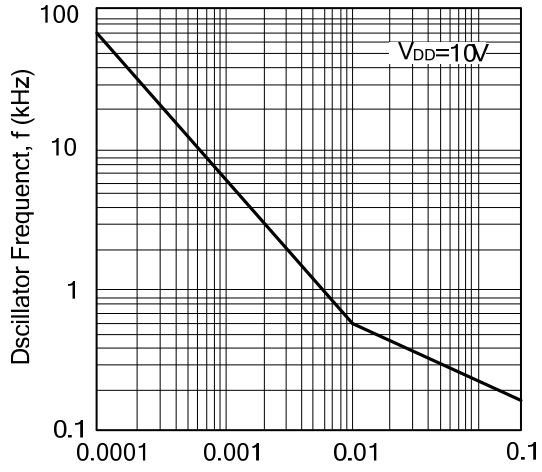
When the mode control pin is set to a “1”, the selected count is continually transmitted to the output. But, with mode pin “0” and after a reset condition the RS flip-flop resets (see Logic Diagram), counting commences and after 2^{n-1} counts the RS flip-flop sets which causes the output to change state. Hence, after another 2^{n-1} counts the output will not change. Thus, a Master Reset pulse must be applied or a change in the mode pin level is required to reset the single cycle operation.

RC Oscillator Frequency as a Function of R_{TC} and C



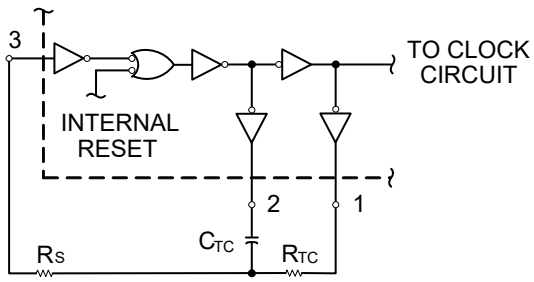
f as a function of R_{TC} and (C=100pF, Rs=2R_{TC})

RC Oscillator Frequency as a Function of R_{TC} and C



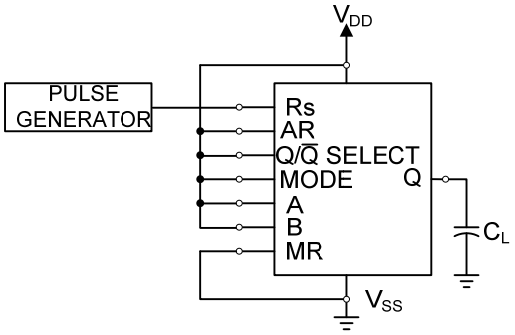
f as a function of C and (R_{TC}=56KΩ,Rs=120k)

Oscillator Circuit Using RC Configuration

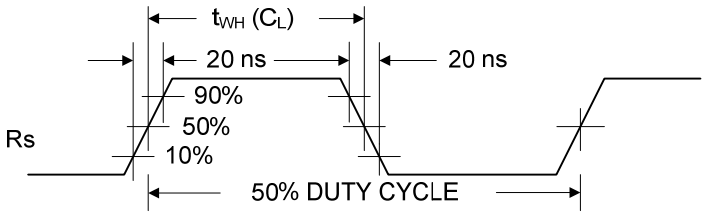


■ TEST CIRCUIT AND WAVEFORMS

Power Dissipation Test Circuit and Waveforms



(Rtc and Ctc outputs are left open)



Switching Time Test Circuit and Waveforms