Charging Capacitor for 0 to 5 Time Constant's, in "Time Constant Increments"

Enter your circuit values in the orange cells

See the circuit drawing listed below

The Green cells will auto-compute

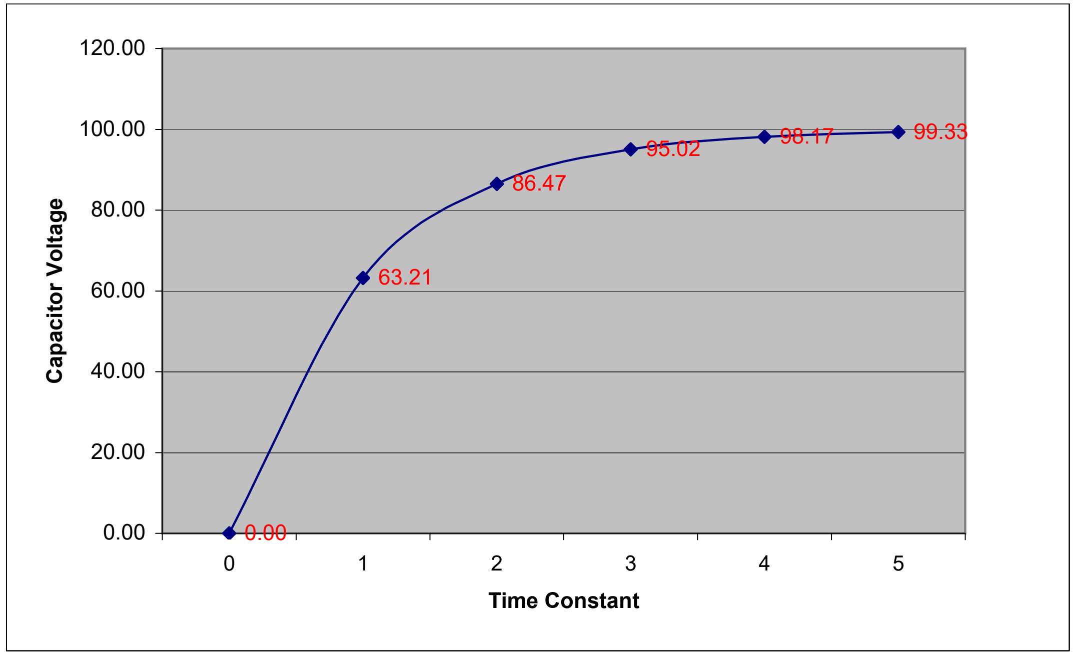
E_s is your Source (charging) Voltage

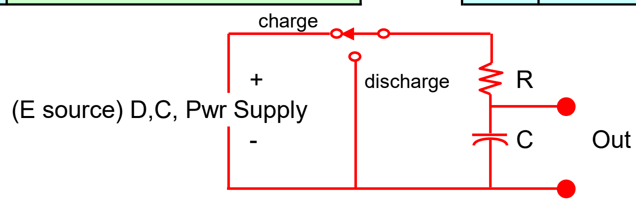
R=	1	Ohms	E_s=	100.0	Volts
C=	1	Farads	E_i=	0.0	Volts

E_i is any existing capacitor voltage (see Note)

RC= 1.00 Seconds (Note: RC is the value of one TC)

	E_c Capacitor Voltage		RC Time Constants		t Seconds
$E_{C@TC}$=	0.00	@ →	TC	0	0
$E_{C@TC}$=	63.21	@ →	TC	1	1
$E_{C@TC}$=	86.47	@ →	TC	2	2
$E_{C@TC}$=	95.02	@ →	TC	3	3
$E_{C@TC}$=	98.17	@ →	TC	4	4
$E_{C@TC}$=	99.33	@ →	TC	5	5





e= 2.718282
t= Time in Seconds
E_s= Source Voltage
E_i= Capacitor Initial Voltage
E_c= Capacitor Voltage when time "t" is reached

$$Ec = (1-e^{-t/rc})(Es-Ei)+Ei$$

Capacitor Charging Formula

Each TC Capacitor Voltage computation uses the above formula. Also, the beauty of this formula is that any time value can be used, not just TC time values.

Note: Normally your **Ei** value will be assumed to be Zero. You can set **Ei** to be non-zero but it should be less than the **Es** voltage for the capacitor to be charging. You can do this, but think carefully about this new circuit dynamic. Also, be careful if you use negative voltage levels and the results that are presented.

Capacitor_TC_Calc_Version_2.1r by L.Ernst WA2GKH (Apr. 2, 2020)

Some Fundamental Notes:

The time that it takes a capacitor to charge is determined by two major factors. In viewing the circuit as shown above these two factors are (1.) the value of "R" the resistance in Ohms of the resistor that the charge current is flowing through -and- (2.) the value of "C" capacitance in Farads of the capacitor.

The time is simply measured in "Seconds". The formula T=RC is very simple, and equals the time in seconds for a capacitor to charge up to 63.21% of the total source voltage (if starting at zero) -or- to discharge and lose 63.21% of its charged voltage value when discharging toward a zero voltage base.

This charge or discharge amount of a 63.21% change in voltage is referred to as "One Time Constant" or just a "TC". So again one TC in seconds is equal to R x C. Nominally is takes 5TCs to charge or discharge a capacitor by an amount of 99.33%. This amount of time in seconds is 5xRxC.

If you study the above plot and table values you will see that the amount of voltage change from TC to TC is equal to 63.21% of the remaining total difference (delta V) after each TC, in going from TC to next TC. Also be advised that mathematically, full charge or full discharge is never reached.

Dis-charging Capacitor for 0 to 5 Time Constant's, in "Time Constant Increments"

Enter your circuit values in the orange cells

See the circuit drawing listed below

The Green cells will auto-compute

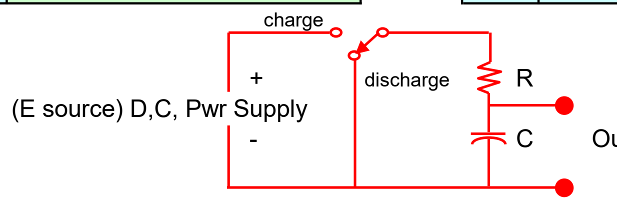
E_s is your Source Voltage (see Note)

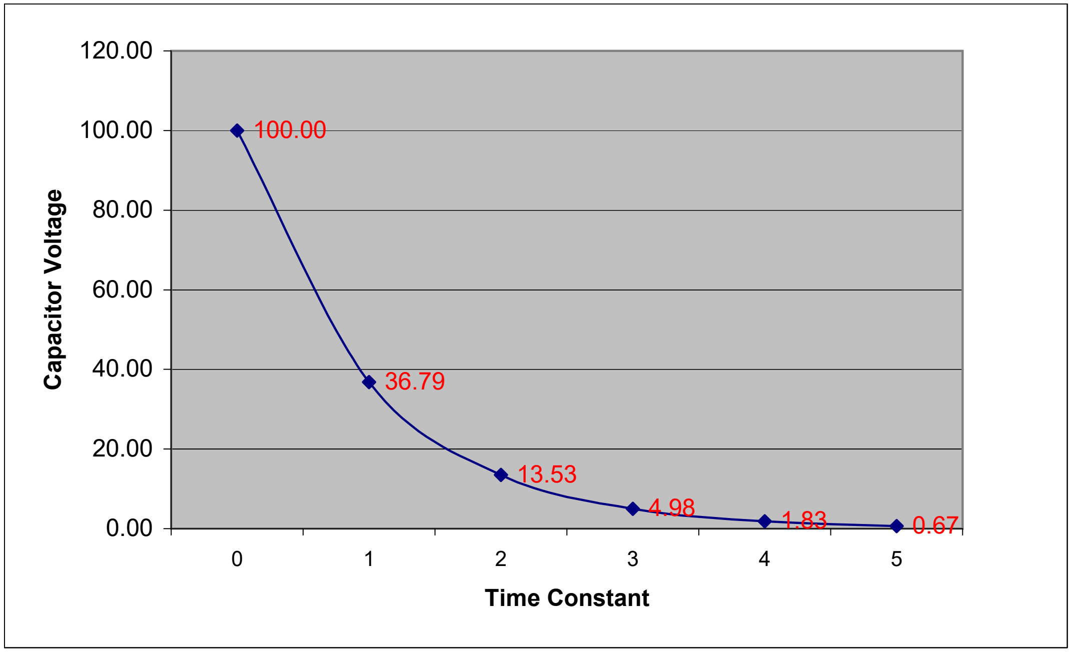
R=	1	Ohms	**E_s=**	0.0	Volts
C=	1	Farads	**E_i=**	100.0	Volts

E_i is the existing stored capacitor voltage

RC= **1.00** Seconds (Note: RC is the value of one TC)

	E_c Capacitor Voltage		RC Time Constants		t Seconds
$E_{C@TC}$=	**100.00**	@ →	TC	0	**0**
$E_{C@TC}$=	**36.79**	@ →	TC	1	**1**
$E_{C@TC}$=	**13.53**	@ →	TC	2	**2**
$E_{C@TC}$=	**4.98**	@ →	TC	3	**3**
$E_{C@TC}$=	**1.83**	@ →	TC	4	**4**
$E_{C@TC}$=	**0.67**	@ →	TC	5	**5**





e= 2.718282
t= Time in Seconds
E_s= Source Voltage
E_i= Capacitor Initial Voltage
E_c= Capacitor Voltage when time "t" is reached

$$Ec = (e^{-t/rc})(Ei-Es)+Es$$

Capacitor Dis-Charging Formula

Each TC Capacitor Voltage computation uses the above formula. Also, the beauty of this formula is that any time value can be used, not just TC time values.

Note: Normally your **E_s** value will be Zero. That is because there is no Power Supply in the above discharge circuit path as shown. You can make **E_s** to be non-zero but it should be less than the **E_i** voltage for the capacitor to be in discharge. If you do, your Non-Zero **E_s** will be a new **E_s** that you have virtually placed within the discharge circuit path. You can do this, but think carefully about the results and the new circuit dynamic you have now included.

Capacitor_TC_Calc_Version_2.1r by L.Ernst WA2GKH (Apr. 2, 2020)

Some Fundamental Notes:

The time it takes a capacitor to dis-charge is determined by two major factors. In viewing the circuit as shown above these two factors are (1.) the value of "R" the resistance in Ohms of the resistor that the discharge current is flowing through -and- (2.) the value of "C" capacitance in Farads of the capacitor.

The time is simply measured in "Seconds". The formula T=RC is very simple, and equals the time in seconds for a capacitor to dis-charge and lose 63.21% of its charged voltage value when discharging toward a zero voltage base or charge up to 63.21% of the total source voltage (if starting at zero).

This discharge or charge amount of a 63.21% change in voltage is referred to as "One Time Constant" or just a "TC". So again one TC in seconds is equal to R x C. Nominally is takes 5TCs to discharge or charge a capacitor by an amount of 99.33%. This amount of time in seconds is 5xRxC.

If you study the above plot and table values you will see that the amount of voltage change from TC to TC is equal to 63.21% of the remaining total difference (delta V) after each TC, in going from TC to next TC. Also be advised that mathematically, full charge or full discharge is never reached.