

Re: Series-Parallel DC RC circuit

Source: <http://sci.tech-archive.net/Archive/sci.electronics.basics/2009-03/msg00141.html>

- *From:* Jon Kirwan <jonk@xxxxxxxxxxxxxxxxxxxxxx>
 - *Date:* Mon, 09 Mar 2009 01:25:58 GMT
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On Sun, 08 Mar 2009 17:56:32 -0700, Dan Coby <adcoby@xxxxxxxxxxxxxx> wrote:

Jon Kirwan wrote:

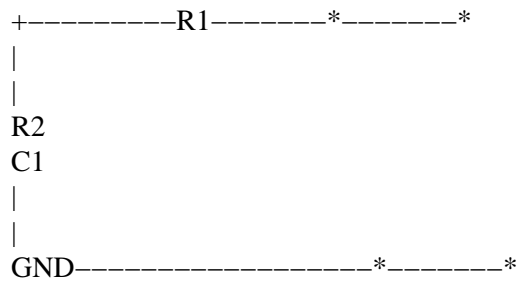
On Sun, 08 Mar 2009 17:15:41 -0700, Dan Coby <adcoby@xxxxxxxxxxxxxx> wrote:

Jon Kirwan wrote:

On Sun, 08 Mar 2009 14:25:54 -0700, John Larkin <jjlarkin@xx> wrote:

On Sun, 8 Mar 2009 14:08:03 -0700, "bg" <bg@xxxxxxxxxxxxxx> wrote:

kayvee wrote in message ...



Hi,
I'm

Re: Series-Parallel DC RC circuit

am
interested
in
finding
the
voltage
across
the
capacitor
in
this
DC
circuit
in
time.
Initially,
when
the
capacitor
is
uncharged,
I
know
that
the
voltage
across
it
is
0,
and
as
time
goes
on
the
charge
will
build
and
the
voltage
across
it
will
as
well.
But,
how
do
I

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calculate
the
voltage
across
it
as
a
function
of
time?

Thanks.

When you
charge a
capacitor
from a DC
source,
through a
resistor, the
voltage
across the
capacitor
rises. The
rise of the
capacitor
voltage with
time plots
according to
the equation

$$V_c = E (1 - e^{-t/RC})$$

V_c =
voltage
across the
cap
 E = applied
DC voltage
 e = epsilon
= base of
natural
logarithms
= 2.71828
 t = elapsed
time
 R =
resistance in
ohms

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$c =$
capacitance
in farads

If you make
your
applied
voltage
equal to 1,
then the
capacitor
voltage V_c
is equal to a
fraction or
percentage
of the
applied
voltage for
any given
time that
has elapsed.
This is
called a
universal
time
constant
chart. What
makes it
universal, is
that the
shape of the
curve never
changes,
only the
values for
time and
percent
change.
RC is called
a time
constant.
RC is
actually
equal to
time in this
instance.
So you can
mark the X
axis in units
of time or
RC units.

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The y axis
is
marked in
percent or
as a decimal
part of E
applied

Now if you
plot this
equation –
 $V_c = 1 - e^{(-t/RC)}$
you get a
universal
time
constant
chart of the
capacitor
voltage
expressed
as a
percentage
or decimal
part of the
applied
voltage for
the elapsed
time
in RC units.

Examples

If you
allowed the
capacitor to
charge for
1RC unit
then the
capacitor
voltage will
rise to 63%
of the
applied
voltage.
2 RC units
= 86%
3 RC units
= 95%
etc

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Your circuit has a shunt resistor and a series resistor. The capacitor charges through the series resistor, and it is the value of the series resistor that you should use for the RC units.

No. The Thevenin equivalent resistor value sets the time constant, and that's the equivalent value of the two resistors in parallel.

If $V=1$, $R_1=R_2=1K$ and $C=1\mu F$, C will charge to 0.5 volts with a time constant of 500 microseconds.

Well, he didn't specify what R was, as I read it (I may have missed something, of course.)

I agree that the thevenin resistance is the correct value to use for the time constant. However my reading of bg posting agrees with JL. Bg says:

"Your circuit has a shunt resistor and a series resistor. The capacitor charges through the series resistor, and it is the value of the series resistor that you should use for the RC units."

To me, this says that only the series resistance is used for the time constant calculation.

But that is incorrect to say.

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Jon

As I said: "I agree that the thevenin resistance is the correct value to use for the time constant."

I also agree that bj's statement is wrong.

I disagreed with your statement that bg had not specified what resistance he meant to use for the time constant calculation. In his post which I quoted and later posts, he argues that only the series resistance should be used for the time constant calculation. I do not agree with him (and I do not think that you do either).

Ah! I couldn't tell from your last sentence. Thanks.

Jon

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