NORTON'S THEOREM

any two-terminal linear ac network can be replaced with an equivalent circuit consisting of a current source (Phasor) and an impedance in parallel, as shown in Fig. 18.59.

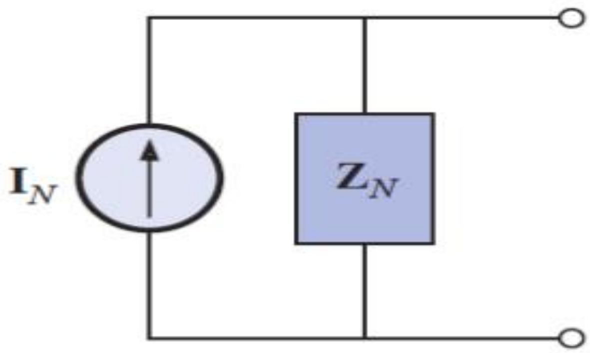


FIG. 18.59
The Norton equivalent circuit for ac networks.

Since the reactances of a circuit are frequency dependent, the Norton's circuit found

for a particular network is applicable only at one frequency

1. Remove that portion of the network across which the Norton equivalent

circuit is to be found.

2. Mark (o , ●, and so on) the terminals of the remaining two-terminal network.

3. Calculate ZN by first setting all voltage and current sources to zero (short

circuit and open circuit, respectively) and then finding the resulting impedance between the two marked terminals.

4. Calculate IN by first replacing the voltage and current sources and then finding the short-circuit current between the marked terminals.

5. Draw the Norton equivalent circuit with the portion of the circuit previously removed replaced between the terminals of the Norton equivalent circuit.

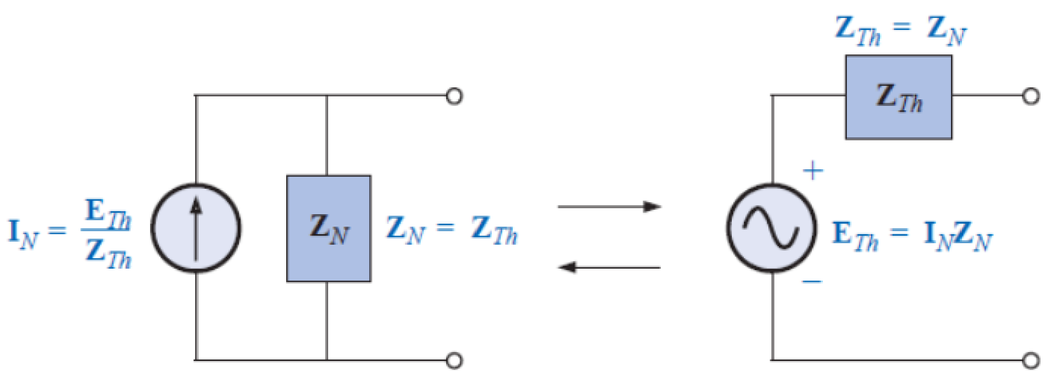
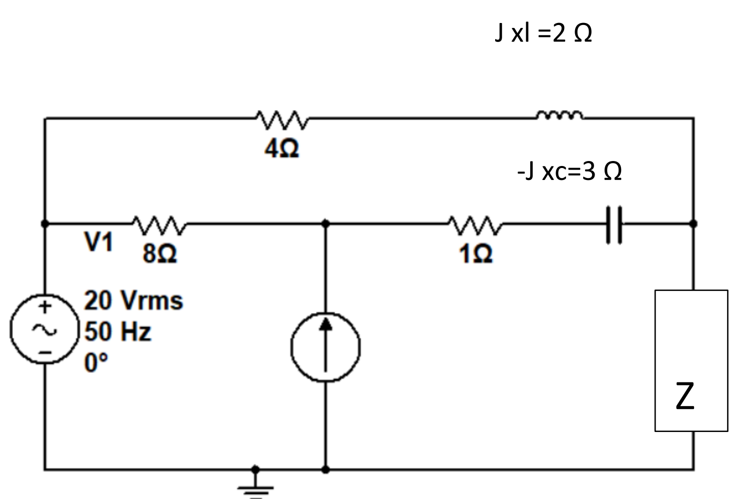


FIG. 18.60
Conversion between the Thévenin and Norton equivalent circuits.

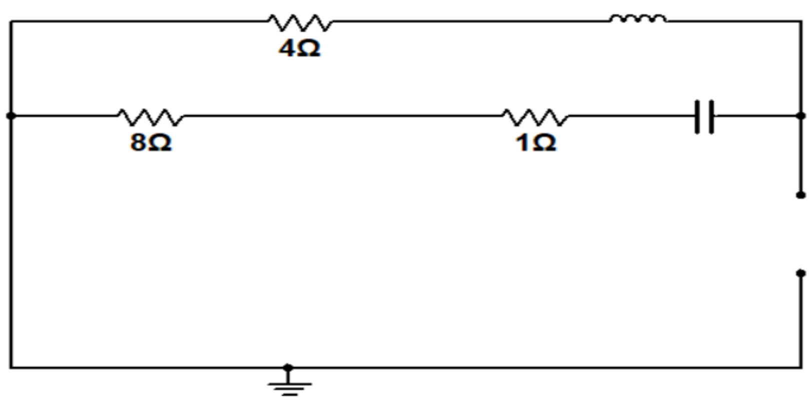
Example/ draw the thevinin and Norton circuit the following circuit across a – b terminal



Solution

To find Z th

1- Make I_S =O .C
2- Make v_S = S .C
3- Remove Z between a-b



Z1= R1+JXL Z1= 4+J 2

Z2= R2+R3- JXc Z2= 4 + 1 – j 3

Zth = Z1 // Z2

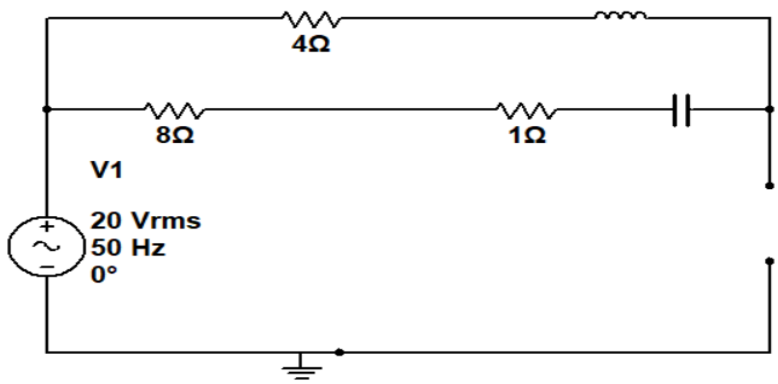
Zth = $\frac{4+j\ 2)*(5-j3)}{4+j\ 2+5-j\ 3}$ = 3. 18 +j 0.705

Step 2

Apply superposition theorem to find Vth

1- Make current source = o . c

Vth =20 <0

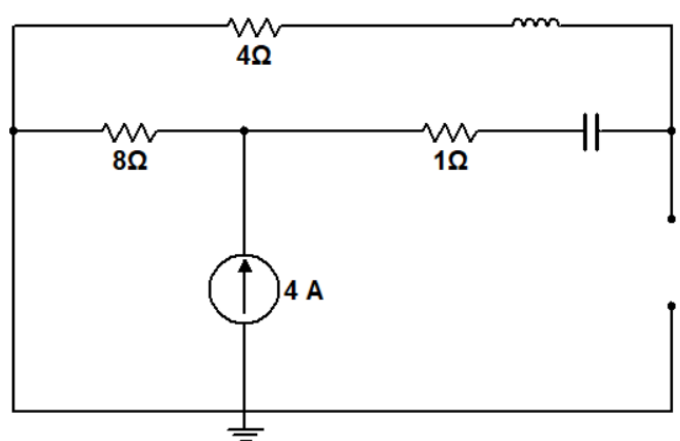


V"th = 20 <0

Because z1 and z2 parallel

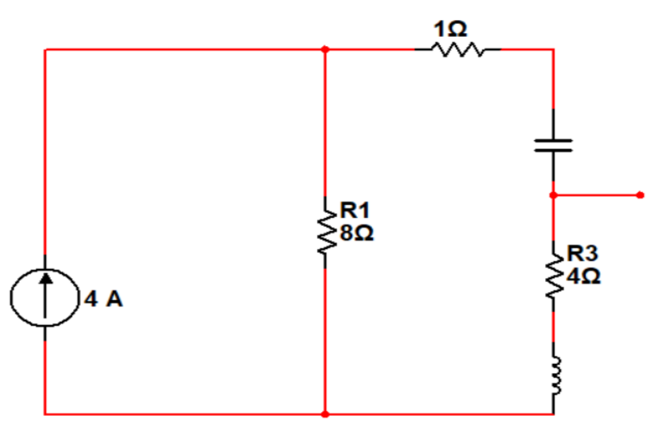
2- Make voltage source =s .c

4<-90



Apply voltage divider rule to find I1

Redraw the cct above



$I_T = \frac{Z1}{Z1+Z2} I_1$

$= \frac{8 * 4<-90}{8+5-J\,1}$ =2.45<-85.6

$$V''' = I * (4 + j2)$$

$= 2.45 < -85.6 * (\,4 + j2)$= 10 .95< -95

$vth = v'' + v'''$

Vth = 10.95 <-95 + 20 <20

IN= $\frac{vth}{zth}$ = 8. 38<-32