TQ 3.1 calculate the touch voltage for a single phase final subcircuit having $4mm^2$ active conductor having a percent impedance of 1.0Ω and $2.5mm^2$ earthing conductor having a percent impedance of 2.4Ω where the operating voltage of installation is 230V.

$$V_t = \frac{V_O \times Z_{PE}}{(Z_A + Z_{PE})} =$$

V_t = Touch voltage
V_O = operating voltage
Z_A : Impedance of active conductor

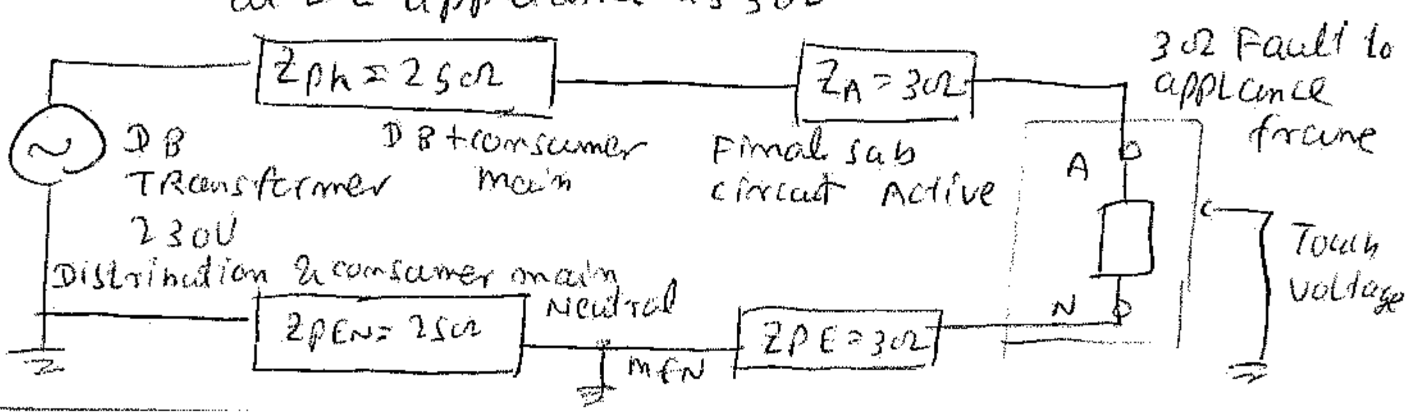
Z_{PE} = Protective earthing ~~Percent~~ impedance conductor (percent impedance

$Z_A - 1\Omega$, $Z_{PE} = 2.4\Omega$, $V_O = 230V$

$$\therefore V_t = \frac{230 \times 2.4}{(1+2.4)} = \frac{230 \times 2.4}{3.4} = \quad V$$

TQ 3.2 List 4 methods to protect against direct contact

TQ 3.11 For the loop shown below
(a) calculate the fault loop impedance
(b) The maximum fault current that will flow in the circuit
(c) The fault current if the fault resistance at the appliance is 3Ω



for TQ 3.12

Find cable resistence by referring the table on page 15.

Source = 0.028 Ω

$25 mm^2$ - 50m ⇒ 0.0330 Ω

$6 mm^2$ - 25m → 0.0755 Ω

$4 mm^2$ - 25m → 0.1130 Ω

$35 mm^2$ - 50m → 0.0257 Ω

Z fault Loop = 0.0330 + 0.0755 + 0.1130 + 0.0257 + 0.028

= 0.2472 Ω + 0.028

= 0.2752 Ω

$$I_{fault} = \frac{230V}{0.2752 Ω} = 835A$$

$$\text{fault resistance } 3Ω \rightarrow \frac{230}{3.2752} \approx 70.22 A$$

TQ 3.13 A final sub circuit supplies a load consisting of 10A socket outlet and is protected by a 20A type c circuit breaker. Determine the maximum fault loop impedance of the final subcircuit based on 230V, when supply is unavailable.

Table 8.1 page 10 20A - CB ⟶ Type(C) 1.53 Ω

TQ 3.14 A final sub circuit supplies a load consisting of 10A socket outlet and is protected by a 16A type c circuit breaker. The internal fault loop impedance measured at the furthermost socket

$$L_{max} = \frac{0.8\, U_o\, S_{ph}\, S_{pe}}{I_a\, \rho\, (S_{ph} + S_{pe})}$$

L_{max} = maximum ~~be~~ route length in metre

U_o = Nominal phase voltage (230V)

ρ = Resistivity Ω-mm^2/m → 22.5×10^{-3} (copper)
36×10^{-3} (Aluminium)

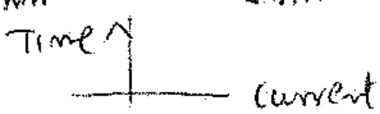
I_a = Trip current setting

S_{ph} = cross sectional Area of active conductor

S_{pe} - cross sectional area of protective earthing conductor.

Table B1 page 460 / of AS/NZS 3000 : 2016

Active / Neutral conductor	Earth conductor	CB	C-curve	2.5% volt drop is
6mm^2	2.5mm2	40A	60m	31m



Type D

0.46Ω Table B.1

TQ 3.19, TQ 3.20 Do it yourself

$$\% Z = \frac{524.8}{15.15 \times 100} = 0.346\%$$

$$\% Z = \frac{I_{SL} \times Z_{ph}}{E_{ph}} \times 100$$

$$0.346 = \frac{15.15 \times Z_{ph}}{11 \times 10^3} \times 100$$

$$Z_{ph} = \frac{0.346 \times 11 \times 10^3}{15.15 \times 100} = 2.51\,\Omega$$

TQ 3.31, do it yourself

TQ 3.32 for the installation shown below determine the prospective fault current at each relevant point within the installation.

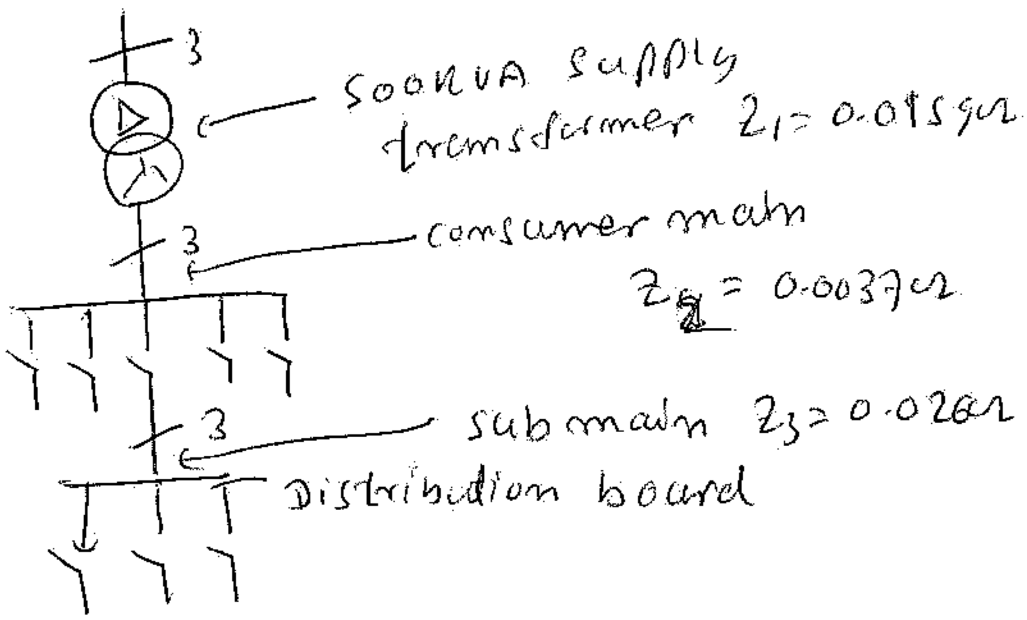


Fig 3.3.3

Z_1 $0.0159\Omega \rightarrow$ 3 KA

$Z_2 = 0.0037\Omega$ 5 KA

$Z_3 = 0.028\Omega =$ 5 KA

Short circuit protection?

2.2kw quick recovery heater

Table C_1 (AS 3000/2018 page

Load group (B) Quick recovery = Storage heater

full load current

(a) $\frac{2.2 \times 10^3}{240} = 9.16A$

(b) Resistance = $\frac{240\Omega}{9.16A} = 26\Omega$

cable selection - partially surrounded

AS 3008

(c) Table 3.2, 3 single core Row 4 Table 7/8 col 18/19

V75 - 10A → 1.5mm² cable size

I_B = maxi: demand current of conductor

I_N = nominal current of protective device

I_2 = current carrying capacity of conductor.

$I_B = 9.16A$, $I_N = 10A$ $\qquad I_B < I_N < I_Z$

$I_2 = 13A$

I_2 = effective operation of CB

$I_2 \leqslant 1.45 I_Z$ | CB = 10A

$1.45 \times 13 = 18.85A$ | ∴ comply with

(f) select appropriate cable size & breaker size

(g) yes