

Fault Symptoms

no heat in ltr when the switch is closed.
 Switch plate 1, switch 1/2, switch plate 2,
 switch 3 is on at the beginning.
 switch plate 4, switch 1, measure the resistance
 between supply AIN/G and ltr AIN/G.

circuit fault

ltrs neutral wire is not properly connected
 ✓ visual inspection.

circuit fault

open neutral
 ✓ visual inspection
 ✓ voltage test
 ✓ Isolation
 ✓ continuity test

Resistance Test

IR Tests
 Sectional Test
 half split Test

① Benefit of split Testing

It can reduce the substantially ^{number of} ~~be most~~ tests, necessary to locate a fault when the number of components or blocks in series is large.

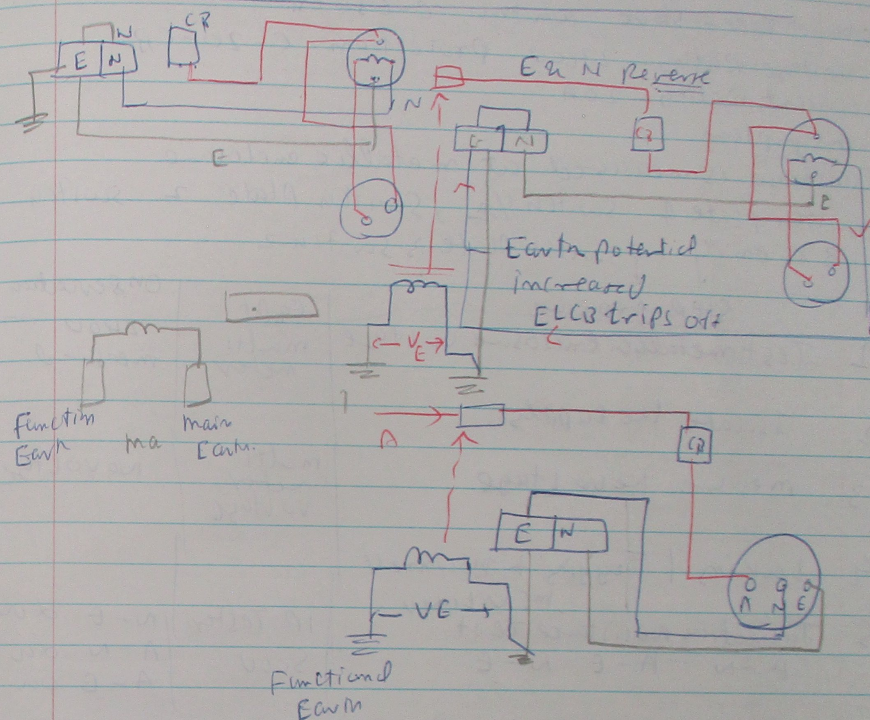
② Electrical eqpt fault, only ^{located} ~~be~~ by visual inspection

Blocked vents	over heating
Blowing failure	broken component
Burnt insulation	wire

③ Safety procedure

1/ Isolate electrical supply, locking, Tagging.
 2/ Test the electricity at all exposed terminals before touch and working.

7.2.1 Fault Find Electrical circuits 2. Equipment



Note When Neutral and Earth are wrongly connected, the earth potential will increase because the current flows in to earth.

The potential between main earth and function earth electrodes will increase causing ELCB to trip off the supply.

Hazards

240V exposed conductor	D/H	Test terminal/endor
Untagged, un locked switch	D/H	Properly perform Locking Tagging
Insulation resistance failure	D/H	perform IR Test
Reverse polarity	D/H	perform polarity Test.

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Electrical Fundamentals

C-63-CB

C-20-CB

completo
proteito

CL ~~240~~ 6403

for led to

Fault Systems

100m leakage 1/2
Earth leakage 1/2

switches, can at the beginning

4th, measure

CEA CgAT

Chetani

well

Elts did not
off although
is grand dan

12 Teds

High seas
1525001

500V
multimeter

relative
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location

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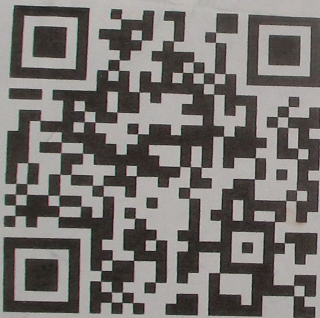
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connection
1. cable - 2 1/2 inch
double ended
4x3 1/2

Reporting

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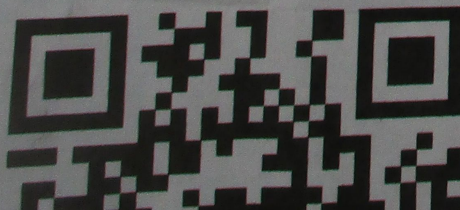
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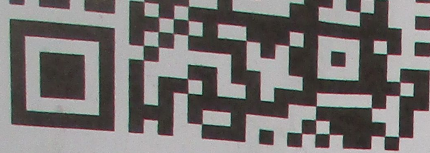


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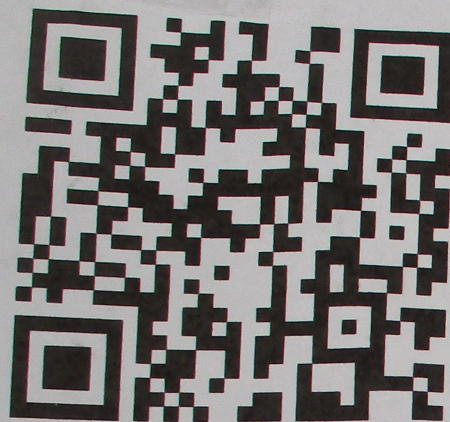


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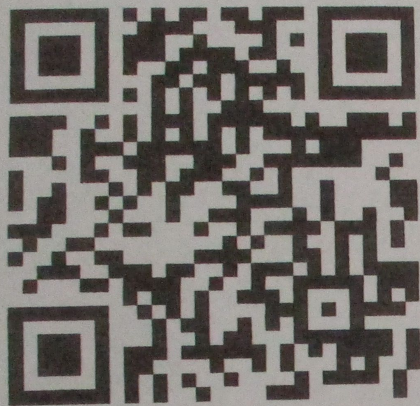
men
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Electrical fault

connected load = 2
1. 110A double outlet
403 A

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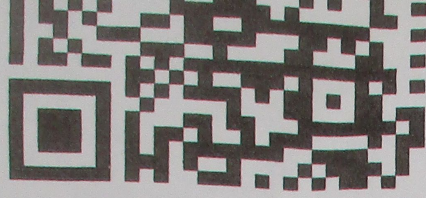


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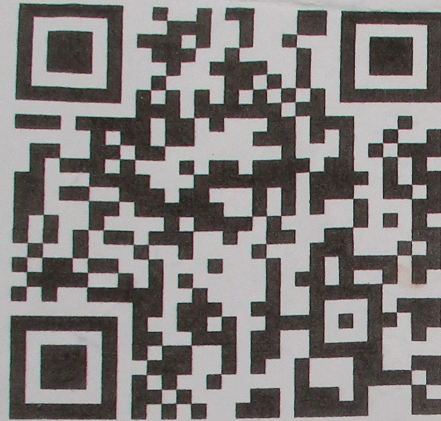


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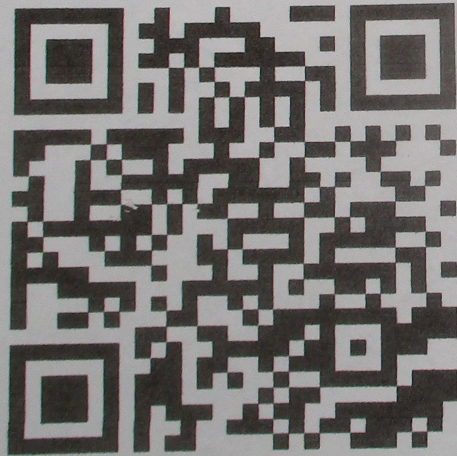




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Electrical Fault finding Scenario 1

Circuit Type - Stove, control C-63-CB

Voltage Rating - 240V Protection C-20-CB

Current Rating - 20A

1. Fault Symptoms

Voltage is measured at metallic enclosure

Switch plate 1 Switch 1/2, Switch plate 2 Switch 3 is on
Switch plate 3 Switch 2

NO	STEP PROCEDURE	EQUIPMENT	OBSERVATION
1	Test metallic enclosure voltage	CBT multi meter	240V measured
2	Isolate the supply		
3	measure the voltage	multi meter voltage	No voltage
4	Locking / Tagging + Disconnect MGN LINE		
5	Insulation resistance test A-N - A-E N-E	IR Tester 500V	N-E ok A-N ok A-E ok

Identified faults	Location	Recommendation / Repair
A-E fault	Supply cable at Stove terminal	Remove the grounding fault Insulate Test again insulation resistance Switch on, Test the voltage at metallic enclosure

Electrical Fault finding Scenario 2

Circuit Type - power, connected load - 2 Lights

control - C-63-CB 4x10A double outlet
Protection EL 2403 RCB current Rating 63A

Fault Symptoms

Earth leakage circuit breaker failed to operate, switch plate 1, switch 1/2 Switch plate 2 Switch 3 is on at the beginning
Switch plate 4, Switch 4, measure the resistance of main earth wire to earth point

NO	STEPS	TEST EQUIPMENT	OBSERVATION
1	RTA-AS in Scenario 1		
2	Inspect ELCB	visual	ELCB did not trip off although there is ground fault
3	Isolate the supply		
4	Remove MGN LINE		
5	Tag on, locked		
6	measure the resistance between main earth wire to earth point	IR Tester 500V multimeter	High resistance (52.5 ohms) measured loose connection at earth terminal is found
7	Inspect the earth point	ohm	

Identified faults	Location	Recommended Action / Repair
Loose connection of earthed Terminal	At earth terminal	properly tighten up the earth connection point measure earth resistance again

Electrical Fault Finding Scenario 3

Circuit Type - Lighting
 Connected Load - 2 Lights
 Control - Switch
 Voltage Rating - 240V
 Protection - C16 CB
 Current Rating - 16A

Fault Symptoms

When the switch is on, no light comes out from the bulb

Switch Plate 1, Switch 1/2, Switch Plate 2, Switch 3 is on at the beginning, Switch Plate 3, Switch 4 measure the resistance between Active to Light 2 Active.

NO	Step / Procedure	Test Equipment	Observation / Test Result
1	Switch on	Visual	no light comes out
2	Isolate the supply		
3	Tag on, Lock on		
4	Test the resistance between Active of G3 Terminal to Switch wire	Ohmmeter	continuity between Loop at Light point to switch is on
5	measure the resistance between switch to neutral terminal	Ohmmeter	OL is indicated. There is open circuit between switch to light
6	measure light bulb resistance	Ohmmeter	30 (light bulb resistance)
7	check the connection at bulb	Visual	The connection

Identified fault

Loose connection of switch wire at loop holder - open active

At holder properly put the wire, since light is on

Fault Finding Scenario 4

Circuit Type - HWS
 Connected Load - 2 Lights
 Control - Switch
 Voltage Rating - 240V
 Protection - C20 CB
 Current Rating - 20A

Fault Symptoms

When the switch is on, no heat comes out from the HWS
 Switch Plate 1, Switch 1/2, Switch Plate 2, Switch 3 is on at the beginning

Switch Plate 4, Switch 1, measure resistance between Supply NINE and HWS NINE

NO	Steps / Procedure	Test Equipment	Observation / Test Result
1	Switch on	Visual	no Heat from HWS
2	Isolate the supply		
3	Tag on, Lock on		
4	measure the resistance between Supply Active - HWS active	Ohmmeter	OL
5	Supply Neutral to HWS Neutral	Ohmmeter	OL
6	Supply Earth to HWS Earth	Ohmmeter	OL

Identified fault	Location	Recommended Action / Repair
Open Neutral	Loose Neutral wire at HWS Terminal	Properly fix Neutral wire at HWS

ELECTRICAL FAULT FINDING SCENARIO 5

Circuit Type - Power connected load - 4x10A double outlet
 control - Switch voltage rating - 240V
 protection - C20 CB current rating - 20A

Fault Symptoms -

Power 1 and Power 2 circuits switch on/off at either power 1 or 2 affects both.

Switch Plate 1 Switch 1/2 Switch Plate 2 Switch 3 is on only
 at the beginning of Switch Plate 4 Switch 6 - on switch plate 2
 Switch 3 off measure the resistance between

P1 - P2
 A - A
 N - N
 E - E

NO	Step Procedure	Test eqpt	observation Test Result
1	Switch on the switch at P1 Test the outlet in P2	voltmeter	voltage is present
2	Switch on the switch at P2 Test voltage at outlet in P1	voltmeter	voltage is present
3	Intermix occurs		
4	Isolate the supply / remove main / Remove main / Remove Earth connection at main earth.		
5	measure the resistance between P1 & P2 P1 - P2 A - A N - N E - E	IR Tester	normal Abnormal normal

Identified fault	Location	Recommended Action Repair
mixed neutral at P1 & P2	at connector	Isolate the neutrals of P1 & P2 Test again - then put back the connections.

ELECTRICAL FAULT FINDING SCENARIO 6

Circuit Type - Lighting connected load 2 lights
 controls - Switch voltage rating - 240V
 protection - C16 CB current rating - 16A

Fault Symptom - switch is broken

NO	Step / Procedure	Test equipment	observation Test Result
1	Check the switch	visual	Broken
2	Isolate the supply		
3	Tag on / Lock on		
4	Take out the broken switch	Hand Tool	
5	Replace with good switch	Hand Tool	
6	DO the continuity Test	ohm meter	continuity is present
7	Switch on	visual	Light comes out

Identified faults	Location	Recommended Action / Repair
Broken Switch due to mechanical impact	on the wall	replace the switch

ELECTRICAL FAULT FINDING SCENARIO 7

Circuit Type - Power connected load - 4x10A double outlet
 control - Switch voltage rating - 240V
 protection - C20 CB current rating - 20A

Fault Symptoms - when switch on, fault happens.
 circuit Breaker tripped off { Switch Plate 1 Switch 1/2
 Switch Plate 2 Switch 3 is on at the beginning.
 Switch Plate 2 Switch 2 is on, measure the resistance
 between A & N of Power 1.

NO	STEP / Procedure	Test equipment	Observations / Test Results
1	Switch on power 1	visual	Short happens C-B Trips off
2	Isolate the supply		
3	Tag on / Lock on		
4	measure the resistance between Active and Neutral wires terminal of Power 1	ohmmeter	Zero resistance was measured Active - Neutral fault

Identified fault	Location	Recommended Action / Repair
Active to Neutral fault at Power 1	Broken insulation between supply cable A & N of Power 1 supply	- Replace the cable as necessary

ELECTRICAL FAULT FINDING SCENARIO 8

Circuit Type - power connected Load - 4 x 10A double socket outlet
 control - switch
 protection - ELCB, CBCCB
 voltage rating - 240V
 current Rating - 20A

Fault symptoms - Reverse polarity between Neutral and Earth (Switch Plate 1 switch 1/2 Switch Plate 2 Switch 3) is on at the beginning, Switch Plate 4 Switch 3 measure the resistance between

- ① Neutral wire of outlet and supply Neutral
- ② Earth wire of outlet and supply Earth
- ③ Neutral wire of outlet and supply Earth.

NO	Steps / Procedure	Test eqpt	Observation / Test Results
1	ELCB Trips off		
2	Isolate the supply		
3	Tag on / Lock on		
4	measure the resistance between neutral wire of supply and neutral outlet	ohmmeter	∞ or no Neutral continuity
5	measure the resistance between earth wire of supply / Earth bar and Earth terminal of outlet	ohmmeter	∞ or no earth continuity
6	measure the resistance between earth bar and neutral terminal of outlet	ohmmeter	∞ or wrong neutral to Earth

Identified fault	Location	Recommended Action / Repair
wrong neutral and earth	wrong connection of Neutral & Earth of outlet	properly reconnect the neutral and earth wires

① Short circuit, practical example

A short circuit is a low resistance connection between two conductors supplying electrical power to any circuit. This results in excessive current flow in the power source through the short and even causes the power source to be destroyed.

Example Insulation broken down between active and neutral wires and active and neutral conductors are touching.

2 Open circuit | Practical example

A circuit in which the continuity is broken due to which the electrical current can not flow is known as an open circuit.

Example

Broken switch contacts.

3 Various types of incorrect connections faults

- Reverse polarity of Active and Neutral
- Reverse polarity of Neutral to Earth
- Reverse polarity of Active and Earth
- Intermix between two active wires of two different circuits
- Intermix between two neutral wires of two different circuits.

4 Two possible causes of insulation failure

- High current causing melting down of insulation
- High temperature causing melting down of insulation

5 4 Typical examples of component failure

- Broken down of switch switch
- Broken down of appliances, electrical parts.
- Broken down of supply wires
- Broken down of appliances (mechanical parts)

6 4 Typical examples of mechanical faults

- motor bearing damage
- circuit breaker spring failure causing mal function
- motor shaft bent causing crushing to stator winding

- Loose screw causing improper contacts of electrical connection

7 How a mechanical fault can cause circuit protection to trip

① In a water pump driven by motor, the impeller of pump crashes with its body causing mechanical over load on motor shaft.
Motor suffers over load and circuit breaker is tripped off by over current relay.

② motor mechanical brake jammed. Motor suffers over load and over current relay trips off the motor supply.

8 Locations of faults in fluorescent lighting

- ① starter failure
- ② choke coil failure
- ③ capacitor failure

9 3 Types of faults in socket outlet circuit

- wrong connection of terminal wires
- Loose screw causing no contact
- Small socket outlet current carrying capacity causing over load and heating up

10 3 safety procedures in electrical fault finding

- Isolate the supply, Locking & Tagging, Test before touching

6 Items of test equipments for fault finding

- | | | |
|-----------|----------------|-----------------|
| ohmmeter | circuit Tester | CRO |
| IR Tester | clamp meter | Frequency meter |

44440012 Select Wiring Systems and Select cables for low voltage electrical installations

1.3 Electrical Protection Arrangements

10.1 Low voltage installation requirements

1 Consumer main

Consumer mains are conductors between the connection point and the main service equipment enclosure and form part of an electrical installation.

Consumer mains may be overhead, underground or within an underground structure.

2 Point of attachment and point of supply

The point at which the mechanical loads of overhead conductors at an overhead service or overhead consumer mains are terminated on a customer's building or structure.

3 1.12.3.1

Minimum insulation resistance

The insulation resistance between conductors and between conductors and earth/neutral services shall not be less than 500M Ω when tested using a 500V dc insulation resistance tester.

4 1.12.3.4

1.7.

4.16

- 5 The customer must supply and install a contactor if electricity is to be supplied with the provisions of a tariff for a CT metered portion of an installation only during certain hours.

- 6 Level 2 service provider can install or alter the electricity connections in NSW

- 7 1.17.3 The loading of an installation or a separately metered part of an installation which is supplied by more than one phase must be arranged so that the maximum demand in active service conductors is not more than 25A above the current in any other active service conductor.

8 2.4.1.1

Underground service cable of less than 240mm² must be installed in conduit throughout their entire length.

Cables must be installed in UPVC conduit for CAT A system.

(b) The UG conduit must be maintained a minimum 300mm depth throughout the entire length.

(c) Orange marker tape shall be positioned at approx 500mm of the depth of cover above the underground conduit for its entire length.

- 9 3.9 The maximum span for an overhead service up to 100A is 30m. For a service greater than 100A the maximum span is 30m.

- 10 3.7.1 The minimum height of the POA fixing is 3m.

- 11 8.6.13 The size of consumer main shall allow no more than 15% voltage rise NS/MS 3000 Table C7
AS 3000 7.5.11.2 | 3.12.2.2 copper 6mm² Aluminium 16mm²

- 12 4.2 The access to any enclosure or for service equipment is never restricted or made unsafe. The location must always be kept clear.

13 4.6 no lower than 0.6m or no more than 2m above the ground, floor or platform

4.10

14 The links must be

(a) be the all insulated type

(b) be fitted with a cover suitable for sealing

(c) have a separate tunnel terminal for each conductor which is clamped or by not less than two screws

(d) have a rated rating not less than the rated carrying capacity of the associated incoming conductor

(e) not higher than 2m, not lower than 0.6m above the ground, floor or platform

(f) be identified to indicate that they are either a service neutral link or meter neutral link. Labelling must be legible and durable in accordance with AS/NZS 3000.

(g) ^{at} near or panel

15 4.12.1 In installations where whole rated metering is used, a control device must be provided on the load side of the meter and load control equipment at the switchboard enclosure to enable each individual tariff to be isolated and sealed.

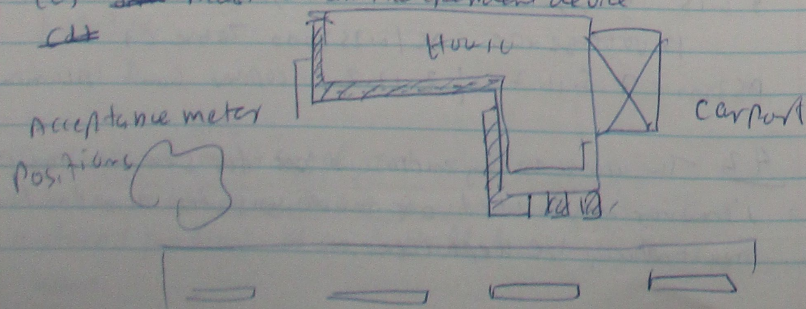
The means of isolation

(a) The switch toggle must be sealable in the open position in an acceptable manner.

(b) may comprise the consumer main switch

(c) must be an independent device

cdt



10.2 Single Phase Single Tariff Switch board Arrangements

L1 - Lighting circuit 1 — 12x lighting point

L2 - Lighting circuit 2 — 12x lighting point

P1 - Socket circuit 1 — 6 x 10 A double socket outlet

P2 - Socket outlet circuit 2 — 6 x 10 A double socket outlet

P3 - Socket outlet circuit 3 — 1 x 15 A single socket outlet

R - Electric stove circuit — 1 x 6.3 kW fixed electric stove

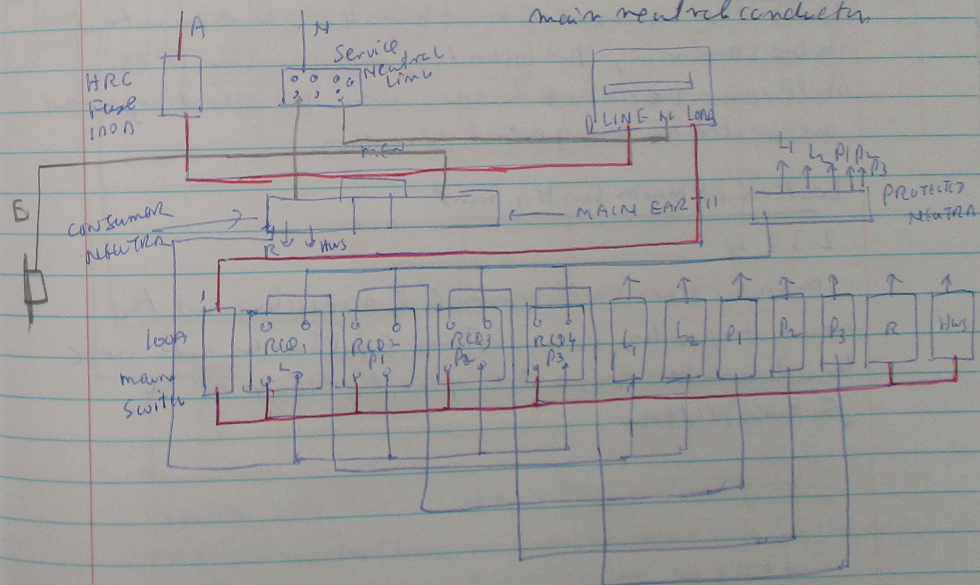
HWS - Hot water heater — 1 x 4 kW fixed instantaneous

Switch board up for purpose/function ~~that~~ hot water heater

1 x 100 A HRC fuse — Service protective device

1 x single tariff kWh meter — to meter the energy consumed by installation

1 x service neutral link — for connection of consumer main neutral conductor



RCD 1, 2, 3, 4 — for providing the current leakage to earth protection

circuit breaker L1, L2, P1, P2, P3 — for energizing and de-energizing appliances

circuit breaker (R) — for energizing and de-energizing the stove

Energy meter — to measure energy

- circuit breaker (ltus) - For energizing and de-energizing the hot water heater
 1 x consumer neutral line - To connect RCB, R and ltus neutrals.
 1 x Protected neutral line - To provide neutral connection to light and power outlets.
 1 x Protected neutral line - To provide neutral connection to light and power outlets.
 1 x main Earth line - To provide Earthing connection to main earth and appliances earth.

How many main switches - 1

orientation of circuit protection devices

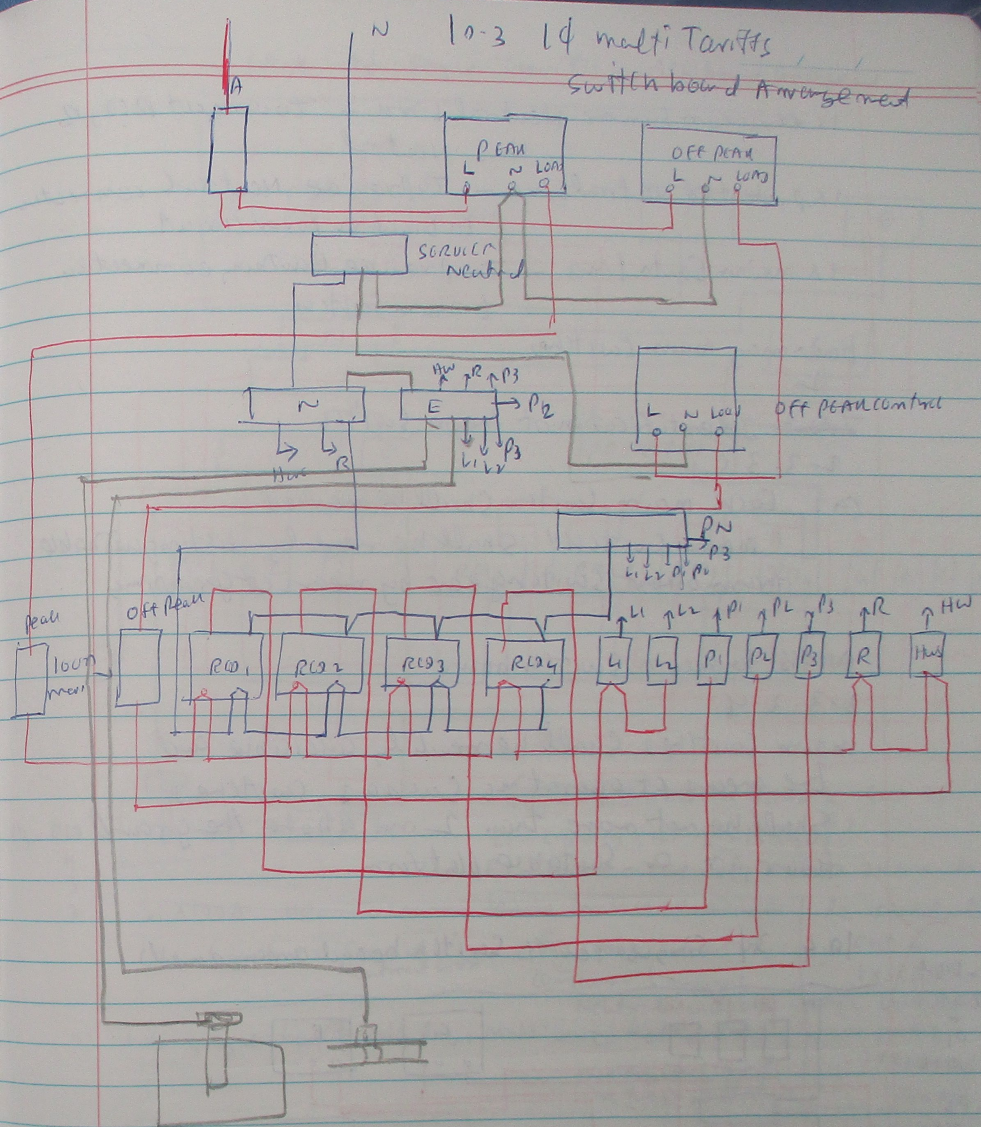
2.10.3.4

Where two or more circuit breakers are mounted in the same row, the operating mechanism of each shall cause the circuit to open when the operating means are oriented in one general direction.

Location of main switch board

2.3.3.4

main switches shall be readily accessible and the means of operating such switches shall be not more than two metres above the ground, floor or a suitable platform.



1 x 100A HRC fuse - Service protective device

1 x Service neutral line - For reconnection of the consumer main neutral bar

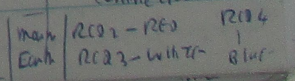
RCB 12 34 - To provide circuit leakage to earth protection

CB L1 L2 P1 P2 P3 P4 - Energize / deenergize

CB - R - Energize / deenergize Store

CB - ltus - ltus

Power energy meter - To measure power energy
 off peak - off peak



main switch

- 3

current carrying capacity of service neutral line

3.5.2

The current carrying capacity of the neutral conductor of multiphase circuit shall not be less than that determined in accordance with harmonic currents

3rd or higher order harmonic currents shall be added to maximum out of balance load to determine the current carrying capacity of neutral conductor.

five types of switchboard equipment to be labeled to indicate their function

1. 2.10.5.4

Termination of

(1) Bar (2) circuit breakers (3) Fuse (4) RCD (5) main switches. Shall be marked to identify the corresponding active & neutral connection for each circuit.

2. 10.5.5

Common neutral shall be legibly & permanently marked to identify the associated active conductors

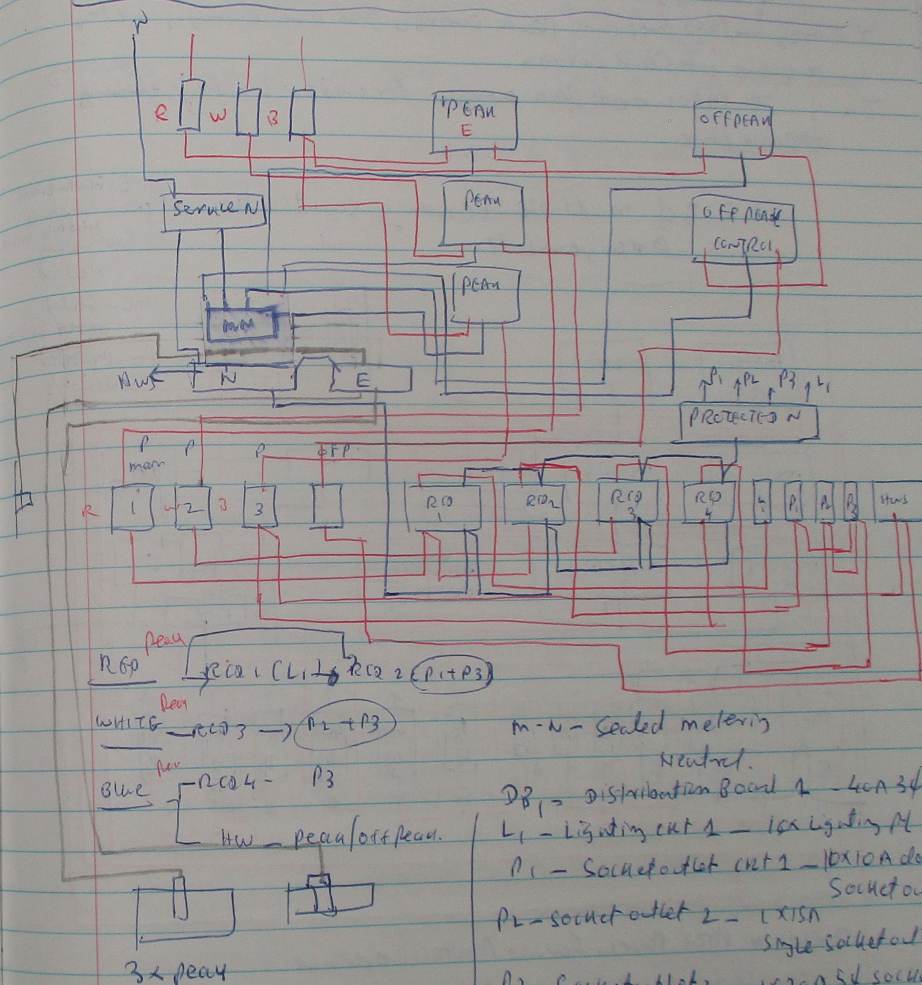
3. 10.5.6 Fuse, where the marking of fuse base does not indicate its rating & the associated fuse elements, the rating of fuse elements shall be marked

4. 10.5.2. Relation Imp of electrical equipment shall be marked

5. 10.5.3 Bars shall be identified whether they are active, neutral or earth

1x Protected Neutral Line - To provide N for L1

10.5 Three Phase Multiple Tariff Switchboard Arrangements



m-n - Sealed meters
Neutral.

DB1 - Distribution Board 1 - 40A 34/73

L1 - Lighting cut 1 - 10A Lighting M

P1 - Socket outlet cut 1 - 10A 10A down

P2 - socket outlet 2 - 10A 10A down

P3 - Socket outlet 3 - 10A 10A down

HWS - Hot Water Supply

1x Off Peak HWS

3x 100A 125C Fuse - Protection

1x Service Neutral Line - consumer main Neutral connection

1x sealed metering Neutral Line - for connection to meter Neutral

1x Peak Energy Meter - To measure peak energy

1x Off Peak energy meter - To measure off peak energy

3x main switch - To energize / de energize cut 1, 2, 3

1x off peak switch - To energize / de energize cut 1, 2, 3

1x RCD - To provide earth leakage protection

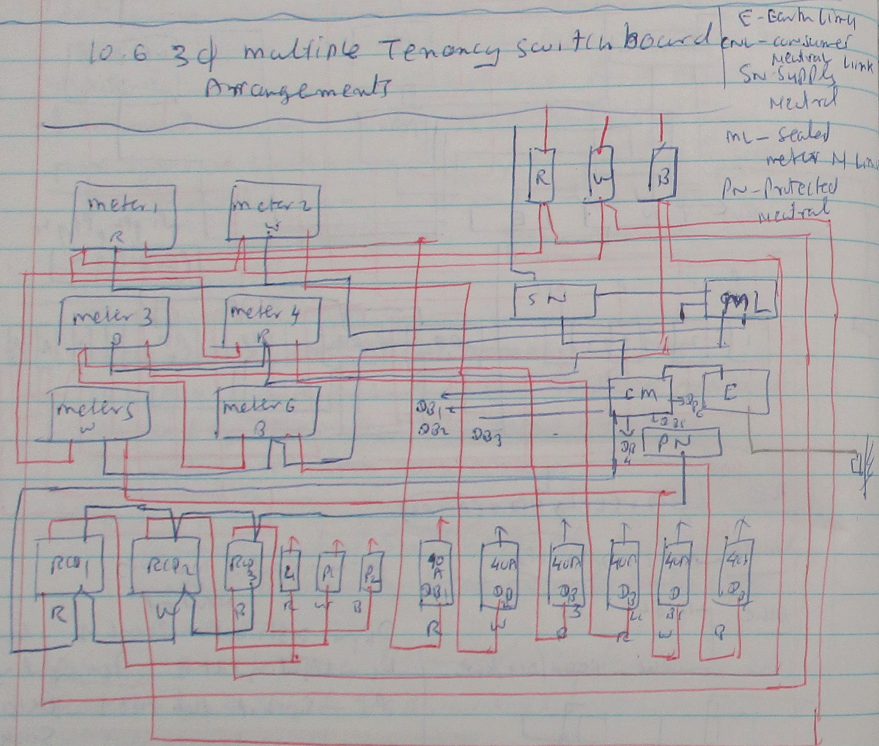
4 main switches

4 Energy meters

3 energy meters measure main energy and one energy meter measure off peak energy

Ten = means off peak energy for water heater during off peak time.

10.6 3d multiple Tenancy switch board Arrangements



3x100A MCB Fuses - Service Protection device

1x service neutral line - for reconnection to consumer main neutral conductor

CB DB1 → DB6 - Energize DB1 → DB6 / De energize meter 1 → 6 - To measure energy in DB1 to DB6

RCB1 - To protect earth leakage fault in L1

RCB2 - To protect earth leakage fault in L2

RCB3 - To protect earth leakage fault in L3

1x protected neutral line - To provide neutral connections L1, L2, L3

1x main earth line - To provide earthing connection

Ref	Circuit	Connected Load
L1	common area lighting	12 x lighting points
P1	common area power 1	9 x 10A single phase double socket outlets
P2	common area power 2	1 x 15A single phase socket outlet
DB1	Unit 1	40A 14 distribution board
DB2	2	
DB3	3	
DB4	4	
DB5	5	
DB6	6	

2-3-3-4 Total main switches (6)

Main switch board - multiple tenancy installation

2-3-3-4

Electrical installations with more than one occupier shall have readily available access to an isolation switch(es) for switches that isolate the occupier's portion of the electrical installation.

metering requirements

New Electrical Service Installation Rule 4.7.2 (C)

For installations with consumer's main maximum demand determined in accordance with AS/NZS 3000 exceeding the lesser of 100A per phase or the rated rating of a meter as determined by the metering provider (or otherwise metered with the use of current transformers) the current protection device must be on the line side of the current transformer.

10.7 main switch board Arrangements for CT metering

R/F — circuit connected load
 L.S.B — Lift services Switch board — 80A Lift services Switch board

F.I.P — Fire indicator panel — 32A Fire indicator Panel

D.B.1 — Distribution board 2 — 63A 14 DB

D.B.2 — 2 — 63A

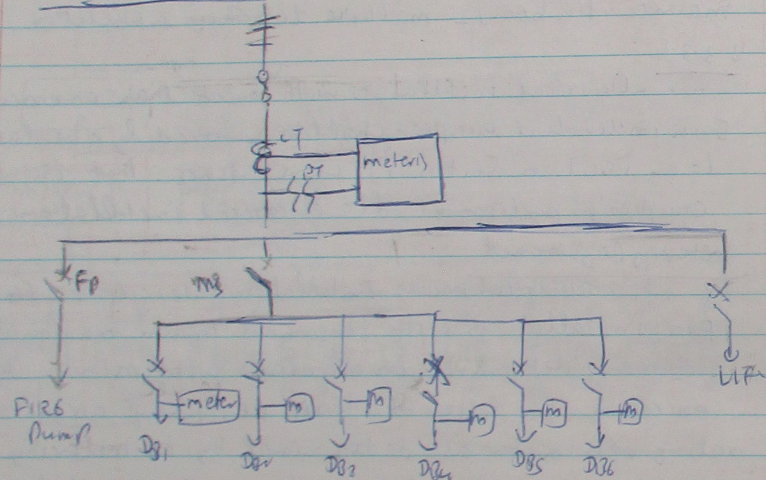
D.B.3 — 3 — 63A

D.B.4 — 4 — 80A

D.B.5 — 5 — 80A

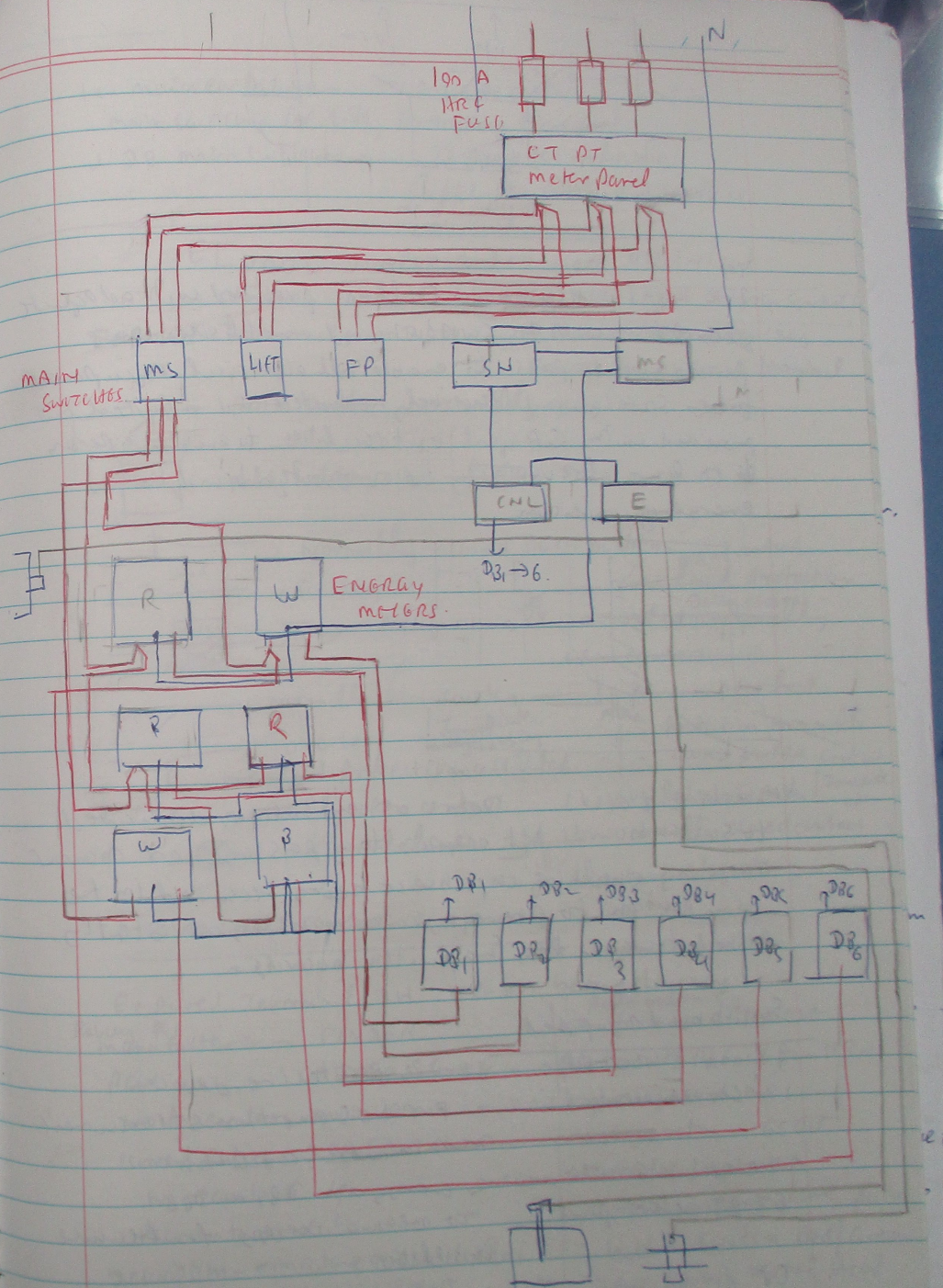
D.B.6 — 6 — 80A

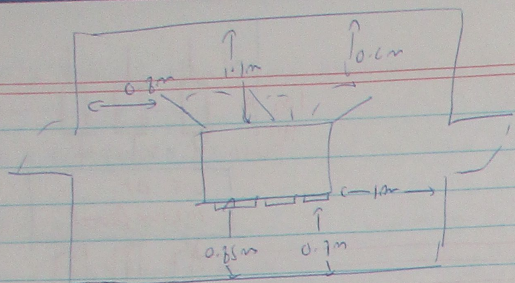
Single line diagram



How many switches — 9

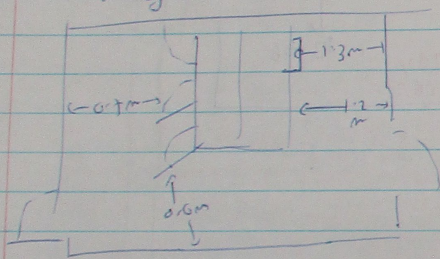
CT metering is required for more than 100A / phase
 per electrical service rule 4.22.6





Yes

2.10.2 (a) Switch board shall be provided with adequate space and around the switch board on all sides where persons are to pass to enable all electrical equipment to be safely and effectively operated and adjusted and provided with sufficient exit facilities to enable a person to leave vicinity of a switch board under emergency condition.



Yes - (a.2.2 (iv)) Doors of enclosure, dedicated to switch boards that open into a passage or narrow accessway shall be capable of being returned in the open position to prevent workers being inadvertently pushed towards the switch boards.

Switch board equipment

3 x 100mm HRG Fuse - service protective devices.

1 x service neutral line - for the connection of consumer's main neutral conductor.

meter 1 - 6 to measure energy in DB1 - D70

CT PT meter in panel - to measure energy for bench installation

CB for DB1 - 6 to energize/deenergize DB1 - 56.

- 1 x main earth line - to provide earthing conductor main switchgear for lift, Emergency fire pump
- 1 DB main switchgear - to provide reliable supply to emergency services.

EL0005 develop and connect electrical control circuits

1.1 Identify circuit diagrams symbols Exposed Terminals - D/14 - measure before touching Enclose the exposed terminal

Push button normally open

W/4 - relay holding coil Fuse

Normally closed push button.

Switch

Timer relay

overload protection relay closed normally open contact

normally open switch

overload protection activated normally open contact

signal lamp

overload protection normally closed switch contact Immediate open

1.3 select control equipment

Exposed Terminal D/14 measure before touching	
Relay K1	push button S1
Manufacturer - FINDER	Manufacturer - APCLE
Part no CAT NO SS-34	Part no 2 PLS XB2-HBN
Voltage rating 250V AC	Type relay - NO
Current Rating 5A (AC)	Voltage rating - 660V
No of contact 4	Current Rating - 10A
No contacts = 4	Description - momentary push button switch Red/Green
Description - miniature control Relay Plug in or solder connection	1 NO, 1 NC, metal lead 22mm