



DESIGN OF ELECTRICAL INSTALLATIONS

Assignment 2

COMMERCIAL INSTALLATION ALTERATION

This assignment covers the design considerations required to complete alterations to an active commercial premises.

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Section A

1.

The sales office is shown to have 6 light fittings. At 58W per fitting the total power consumption of the lights in the sales office alone is 348W. Assuming the lighting load to be purely resistive at a unity power factor, the Power(W)=Voltage(V) x Current(I), so $I = \frac{W}{V}$

The supply to the office is 230V, 50 Hz, so $I = \frac{348}{230} = 1.52A$.

There are 6 other fluorescent lights shown throughout the office, which would also total 1.52A, and 3 No 100W tungsten filament lamps.

The current for these would be $I = \frac{300}{230} = 1.31A$

The total current in the lighting load is 4.35A. The circuits in the office are protected by BS3036 protective devices, commonly known as rewirable fuses. For lighting circuits these fuses would be rated at 5A.

The change in light fittings in the sales office would add an additional 1.52A to the total lighting load, bringing the total to 5.87A.

This becomes a problem if all the office lighting is on a single circuit. It may be possible to upgrade the protective device to 15A, however, if the lighting circuit is wired in a 1.5sqmm twin and earth cable, then depending on the installation method the conductor size might not be sufficient to upgrade the circuit protection.

Table 4D5 from Requirements for Electrical Installations: BS 7671:2018: IET Wiring Regulations (2018) gives the maximum current carrying capacity for these type of cables at 13A if above a plasterboard ceiling and covered in more than 100mm of thermal insulation, or just 10A if in an insulated stud wall and not touching the inner wall surface.

If all lighting is currently installed onto a single circuit then an additional lighting circuit will be need to be installed.

2.

a. The partition wall has switched socket outlets on both sides, these will need to be removed and made safe before construction work can start. This will involve deenergising certain circuits within the building. If cables are to be re-used to reinstate the socket outlets on completion of the building works then temporary measures must be taken to ensure they are retained in a safe manor. This could be to keep the circuit de-energised and remove the fuse, however if the building is in use throughout the works another method would be required, such as terminating the cables into a suitable rated, suitably insulated junction box.

b. When working in small areas it is necessary to plan the work in advance. It would not be possible for the electrician to be removing the socket outlets while the builder is simultaneously using power tools to remove the partition wall. Likewise the electrician cannot wait for the builder to finish before removing the sockets. A safe method of completing the work is required before the work can actually begin, with different trades completing the work required before the next trade can commence.

c. This would be the responsibility of the Principle Contractor, according to HSE document L153, CDM Regulations (2015), *'In planning, managing, monitoring and*

coordinating the construction phase, a principal contractor must take account of the general principles of prevention (see Appendix 1). They must take account of these principles when:

(a) decisions are being taken to plan which items or stages of work can take place at the same time or in sequence; and

(b) estimating the time certain items or stages of work will take to complete.’ (P.36)

Where a principle contractor has not been appointed commercial clients assume the responsibilities of a principle contractor.

3.

When upgrading the lighting in the sales office there are several costing considerations. These include;

- Materials
 - Including materials to install a new circuit if necessary
- Consumables
- Access (ladders or other means of safely working at height)
- Access (to site)
 - Will the work need to be completed outside normal working hours
 - Will the work need to be completed in stages – increasing travelling costs
- Labour Costs
- Travelling Costs

With the removal and replacement of the socket outlets in the partition wall, the costing considerations include all of the above, plus thought to any materials needed to temporary make safe the circuit with the sockets removed, and the likely need for new pattress boxes or similar.

Section B

4.

Typically where electrical loading exceeds 100-125A/phase a traditional meter is not viable, and instead metering is done with the use of CT's (Current Transformers). CT's generally have a hollow core, and a secondary winding. The primary winding is the conductor of which current is measured, which passes through a hollow core, the secondary winding is wound around the core. The change in magnetic flux from the AC in the primary winding, or conductor, creates a current in the secondary winding. Typically CT's will have either a 1A or 5A maximum current from the secondary winding, small enough to be measured by a digital power meter. CT's can be used to measure currents of magnitudes of thousands of Amps.

Figure one below shows how CT's may be connected to a power meter for metering purposes.

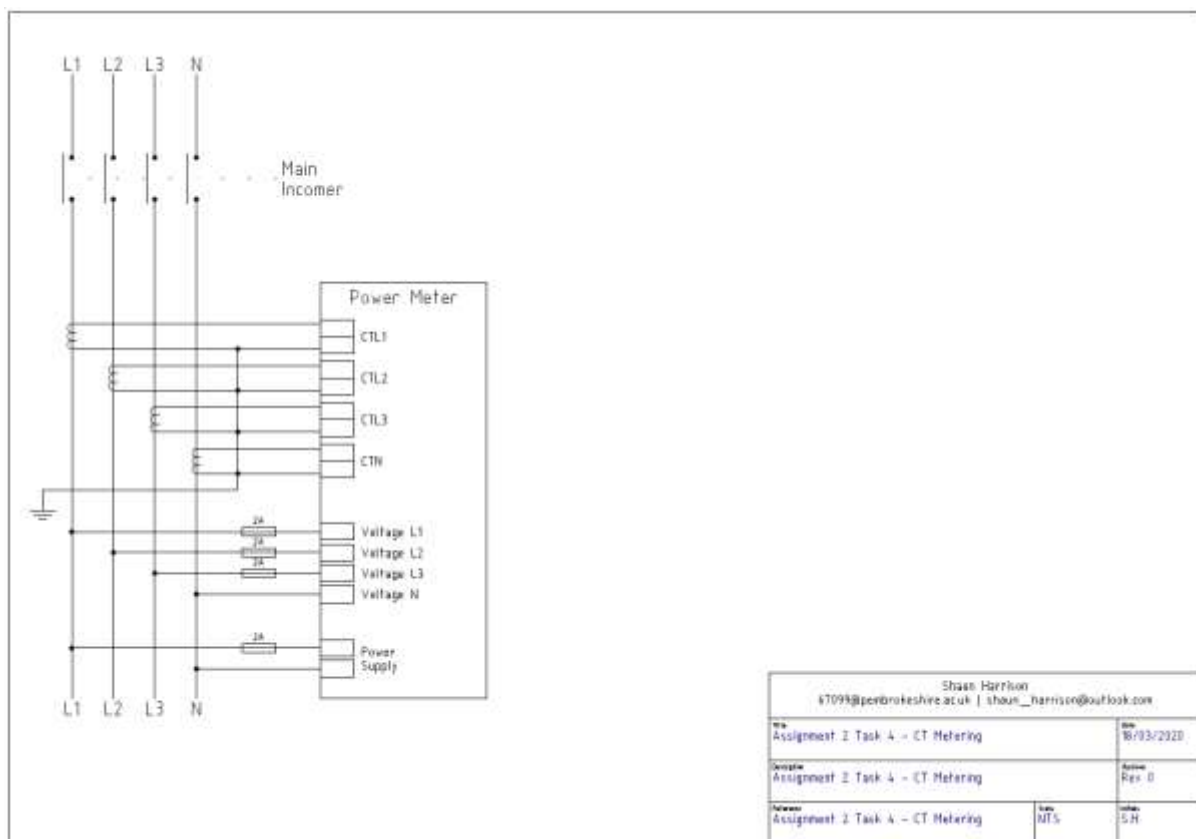


Figure 1 Diagram showing CT Metering

5.

a. Upon completion of the work, several tests need to be carried out and the results recorded, this include:

- Continuity of the CPC (Circuit protective conductor)
- Continuity of conductors in a ring final circuit
- Insulation resistance testing
- Earth fault loop impedance
- Polarity
- Correct operation of the RCD(s) if fitted

b. These tests must be completed by test equipment that meets standards set out in HSE GS38 guidelines.

c. The results of these test should be recorded on an electrical installation certificate.

d. The electrical installation certificate should be handed over to the client on project completion. If your appointment was from a main contractor the main contractor would be your client.

6.

The test instruments used for the testing described above include:

- A low resistance Ω meter, range 0-2000 Ω
- Continuity tester
- Polarity tester
- Insulation resistance tester, range 0-500M Ω
- Earth loop impedance tester, range 0-2000 Ω

7.

If the earth loop impedance test doesn't provide an acceptable value at the VDU, action can be taken to improve the result. The rewirable fuse could be replaced with an MCB. An RCD could be installed on the circuit.

Section C

8.

To control all lighting within the building by a single key switch, located by the front door, a contactor(s) can be added. To reduce the amount of current carrying conductors the contactor(s) should be installed near the consumer unit, with just control cables being run to the key switch position. This also reduces the current that needs to be switched, reducing the size and cost of the key switch. If there isn't sufficient length on the circuit conductors to re-terminate into the contactor(s), a junction box can be used to terminate and extend the conductors. Figure 2 shows the two lighting circuits for this installation both controlled by a single 2-pole contactor, switching only the line conductor, two 2-pole contactors could be used, or a 4-pole contactor. The control circuit is shown from a different fuse to the contactors.

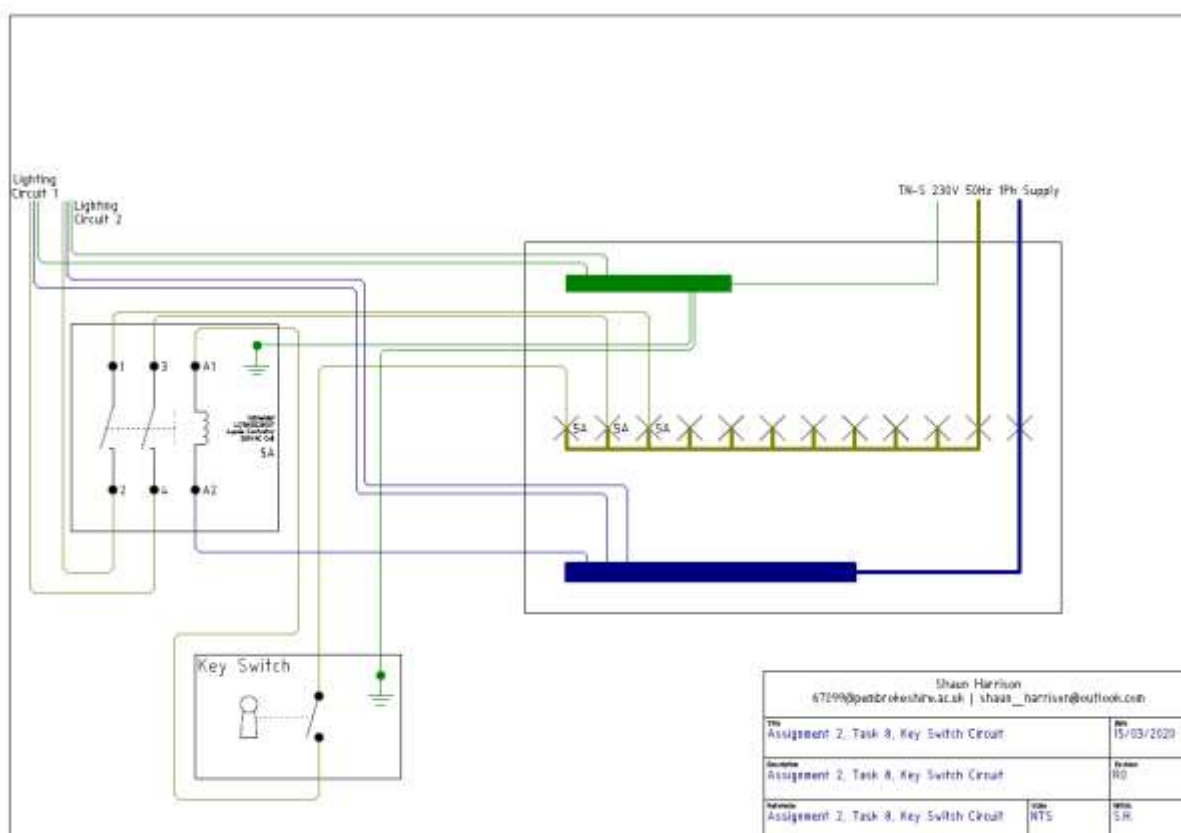


Figure 2 Contactor control for lighting circuits

The circuit is based on a Schneider 5A 2-pole AC1 miniature contactor. Different types of contactors are available, the two commonly available type are AC1 and AC3. AC3 contactors are for inductive loads with a lower power factor, often a lower operating temperature, and often varying load. These type of contactors may overheat if used for switching resistive circuits.

The terminals A1 and A2 are to energise a coil, energising the coil causes an electromagnetic affect that pulls in the contacts in the contactor, completing the circuit.

In this example the coil is energised when the key switch at the door is closed.

9.

There are numerous reasons one of the fluorescent lights within the office could stop working. The obvious would be the tube itself or the lamp starter. If either of these are diagnosed they should both be replaced. Other reasons could include a problem with wiring, including the protective device. This would be less likely where other lamps on the same circuit are still working, or particularly so if the other lamp in a twin lamp fitting is working. To rectify this the first item to check would be the protective device, and/or contactor controls. If a single light has failed and lights are installed on a radial circuit the connections to the lamp fitting would be the next item to check. If several lights are not working correctly tracing the wiring to look for faults might be necessary. Many fluorescent lights have an electrical ballast to limit current. This is another item to check, particularly if a new tube is damaged very quickly.

10.

To isolate the supply once the office is in use will have implications for the client, and possibly the contractor. A sales office might not be critical but if work was carried out in a live hospital any unplanned downtime or delays in reenergising could lead to fines or cancelling of contracts. Isolating either a single circuit or the supply to the building for the office here would result in lost production. This would be costly for the client during business hours, and conditions of the contract might include work being completed out of hours. There may be fines for not having all circuits reenergised before the start of business hours, or for power interruptions without an acceptable notice period.

References

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Appendices

Contactor Control Wiring Diagram

CT Metering AC Controller