CONVERTING AMPERES TO kVA

The load on an electrical installation, or the load of an item of equipment, may be expressed either in amperes or in kVA (kilovoltamperes).

The NICEIC technical helpline is sometimes asked how to convert amperes to kVA, or vice-versa.

The main reason for wishing to make such a conversion is likely to be that, whilst Regulation 311-01-01 of BS 7671 requires the assessed maximum demand of an installation to be expressed in amperes, electricity distributors usually require to be advised of the maximum demand in kVA when dealing with applications for new supplies.

Alternatively, in the case of a house or flat, a distributor may request the maximum demand of the installation in kW (kilowatts), rather than kVA. This is dealt with at the end of this article.

Single-Phase Loads

Converting amperes to kVA

For a single-phase load expressed in amperes, the load in kVA may be calculated using equation (1):

$$\text{kVA} = \frac{\text{nominal voltage (volts) x current (amperes)}}{1{,}000} \quad (1)$$

eg. supposing the designer of a single-phase 230 V electrical installation has assessed the maximum demand to be 65 A, the load is then equal to 15 kVA (given by 230 V x 65 A ÷ 1,000).

Converting kVA to amperes

For a single-phase load expressed in kVA, the load in amperes may be calculated using equation (2):

$$\text{Current (amperes)} = \frac{\text{kVA x 1,000}}{\text{nominal voltage (volts)}} \quad (2)$$

eg. supposing an item equipment of rated voltage 230 V has a nameplate rating of 10 kVA, the rated current of the equipment is then equal to 43.5 A (given by 10 kVA x 1,000 ÷ 230 V).

Balanced Three-Phase Loads

Converting amperes to kVA

For a balanced three-phase load expressed in amperes, the load in kVA may be calculated using either equation (3), which uses the nominal phase (to neutral) voltage (U_0), or equation (4), which uses the nominal line (phase-to-phase) voltage (U):

$$\text{kVA} = \frac{\text{3 x nominal phase voltage } (U_0)\text{(volts) x line current (amperes)}}{1{,}000} \quad (3)$$

$$\text{kVA} = \frac{\sqrt{3}\text{ x nominal line voltage } (U)\text{(volts) x line current (amperes)}}{1{,}000} \quad (4)$$

Where:

$\sqrt{3}$ is the square root of 3, which is equal to 1.732

As an example of the use of equation (3), suppose that a three-phase installation having nominal phase voltage (U_0) of 230 V has a balanced three-phase maximum demand current of 120 A, as shown in Figure 1. The maximum demand in kVA is then equal to 82.8 kVA (given by 3 x 230 V x 120 A ÷ 1,000).

A balanced three-phase load where the phase-to-neutral voltage U_0 and the load current are known (kVA calculated using equation (3))

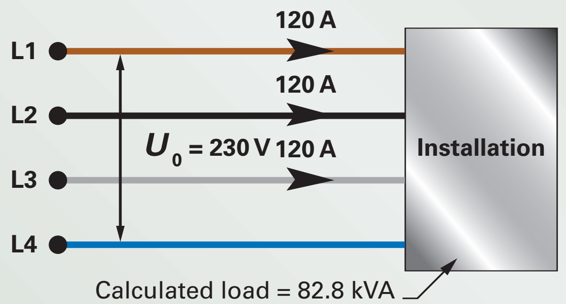

Fig. 1.

A balanced three-phase load where the phase-to-phase voltage U and the load kVA are known (line current calculated using equation (6))

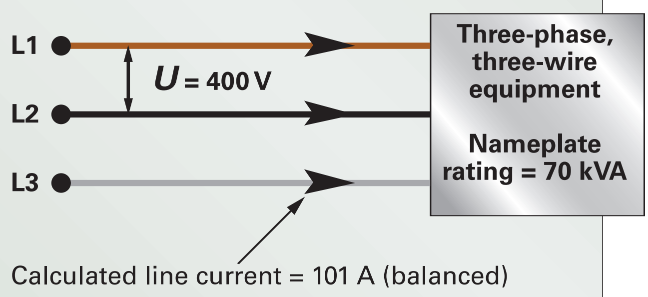

Fig. 2.

Converting kVA to amperes

For a balanced three-phase load expressed in kVA, the load in amperes may be calculated using either equation (5), which uses the nominal phase (to neutral) voltage (U_0), or equation (6), which uses the nominal line (phase-to-phase) voltage (U):

$$\text{Current (amperes)} = \frac{\text{kVA x 1,000}}{\text{3 x nominal voltage to earth } (U_0)\text{(volts)}} \quad (5)$$

$$\text{Current (amperes)} = \frac{\text{kVA x 1,000}}{\sqrt{3}\text{ x nominal line voltage } (U)\text{(volts)}} \quad (6)$$

As an example of the use of equation (6), suppose that an item of balanced three-phase, three-wire equipment having a rated line voltage (U) of 400 V has a nameplate rating of 70 kVA, as shown in Figure 2. The line current is then equal to 101 A, given by [(70 kVA x 1,000) ÷ (1.732 x 400 V)].

Expressing loads in kW

Electricity distributors sometimes request values of load (maximum demand) for domestic installations to be expressed in kW, rather than kVA. This is reasonable, as the load in a typical dwelling will not be significantly inductive or capacitive and will therefore have a power factor close to unity.

For a load having unity power factor, the load in kW has the same numerical value as the load in kVA, and may be calculated by means of equation (1), for a single-phase load.