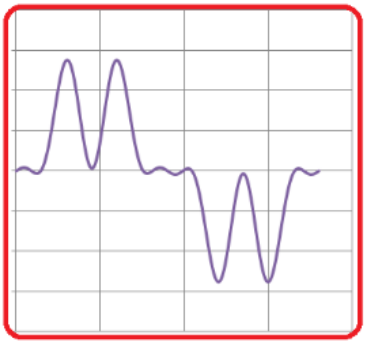
Techniques involving the electronic control of power to a load such as controlled rectification and variable frequency drives are widely used by industry. There can be, however, serious problems with these techniques because of the generation of harmonics and the consequential harmonic distortion. Harmonics, when fed back to the supply, can have adverse effects on other electrical equipment. It can increase the current in power lines resulting wasted power that causes higher temperatures in neutral conductors and distribution transformers. High order harmonics may cause excessive heating in the core of a.c. motors and can also interfere with communication systems. Increased temperatures can damage power systems and shorten the life of electronic equipment.

FIGURE 3 shows the oscilloscope trace of the supply current feeding a variable frequency drive (VFD).



The supply current was sampled 1024 times over a very short time interval. The data so obtained is given in column B of the accompanying *Excel* worksheet[1]. This worksheet has been set up to give a graph showing the spectral components of the data.

Question 3

i) Obtain the Fourier Transform for the data using the Fourier Analysis tool of *Excel*. The transformed data should commence in cell D2.

ii) Identify the principal frequencies in the current waveform.

iii) *Estimate* the total harmonic distortion [*THD*] present in the current waveform using the formula:

$$THD(I) = \frac{1}{I_1}\sqrt{\sum_{n=2}^{\max}(I_n)^2} \times 100\%$$

where I_1 is the r.m.s. value of the fundamental current, I_n the r.m.s value of the nth harmonic and n(max) is the number of the highest measurable or significant harmonic.

[Note the vertical axis of the spectrum graph is scaled in (current)^2.]

iv) Attempt to synthesise the shape of the original waveform from its principal harmonics [e.g. sketch the waveforms of the harmonics on the same time axis and add them together].