EMERSON
Industrial Automation

Technical Note CTTN #130

Line Current and KVA requirements for a DC Drive

The Application Note is pertinent to the Quantum III / Mentor II Family

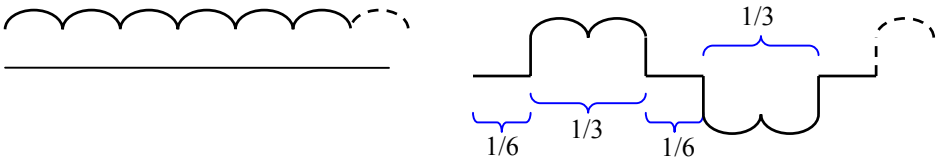
To calculate the required KVA for a supply transformer for a DC drive, first the line current to the drive must found:

$P_{mech} = P_{Hp} \bullet 746$ — *- mechanical power in watts.*

$P_{elect} = P_{mech}/(Eff_{drive} \bullet Eff_{motor})$ — *- required electrical power. (Where* Eff_{drive} and Eff_{motor} *are the motor and drive efficiencies, .99 and .94 for example)*

$I_{arm\_avg} = P_{elect}/V_{arm\_avg}$ — *- the armature's average current.*

The armature current and then the line current, which is made up of sections of the armature current, looks like:



The line current is equivalent to the armature current flowing for **2/3** of the time. This means that the RMS line current is **√(2/3) = .8165** of the value of the armature's RMS current. The ripple in the armature current makes the RMS slightly larger than the average level. **For a typical DC motor, the RMS line current will then be about .84 perunit of the average armature current**. Then:

$I_{line\_rms} = I_{arm\_avg} \bullet 0.84$ — *- the line current.*

$P_{VA} = I_{line\_rms} \bullet V_{line\_rms} \bullet \sqrt{3}$ — *- the VA of the source.*

All combined this becomes:

$$P_{VA} = (P_{Hp} \bullet V_{line\_rms} \bullet \sqrt{3} \bullet 746 \bullet 0.84) / (Eff_{drive} \bullet Eff_{motor} \bullet V_{arm\_avg})$$

Per Hp and for a 480Vac line, 89% efficiency and an armature voltage of 500V this becomes:

$$P_{VA} = (1 \bullet 480 \bullet \sqrt{3} \bullet 746 \bullet 0.84) / (0.89 \bullet 500) = 1171 \approx 1.2 \text{ KVA}$$

- the KVA per horsepower

Transformer sizing and K Factor rating:

From the above calculation, **a reasonable guideline for sizing a transformer is 1.2 KVA per horsepower of motor load**. Because the harmonic currents cause even more heating in the transformer laminations and windings than the RMS calculation of line current, I_{Line}, would indicate, **a transformer harmonic K factor rating of at least 9 is recommended**.

Questions ?? Ask the Author:

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