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APPLICATION NOTE

Drive Applications Support Library

Application Note	AN-P2-024
Title	Energy Optimization Function
Related Products	P2 Series AC Drives
Level: 2	<ul style="list-style-type: none"> 1 - Fundamental - No previous experience necessary. 2 - Basic - Some basic drives knowledge recommended. 3 - Advanced - Some basic drives knowledge required. 4 - Expert - Good experience in topic of subject matter recommended.

Overview:

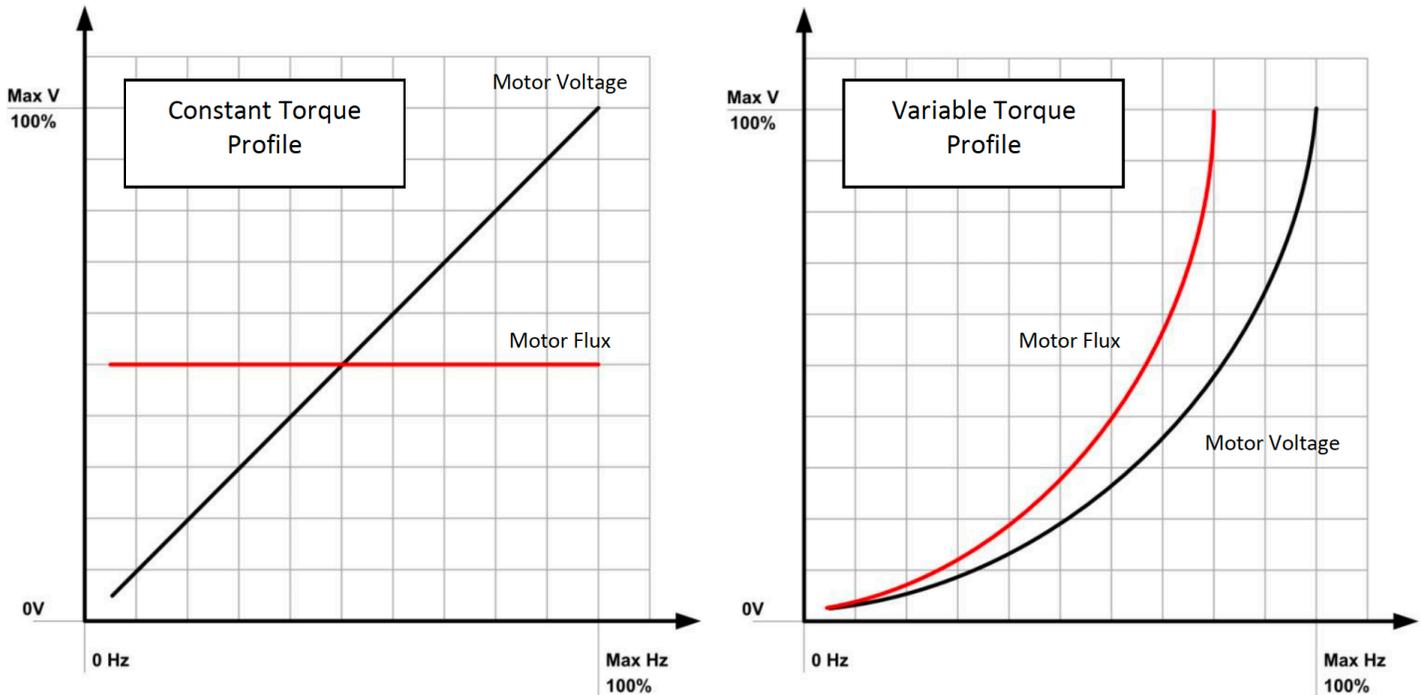
The P2 Series has a built in Energy Optimization function designed to maximize the energy savings achievable when the motor and drive is not operating at its rated load. The Energy Optimizer works with both constant and variable torque loads, whenever the output current level is less than the motor rated current set in P1-08.

This applications note examines the principles and advantages of the Energy Optimization function, and how it is enabled or disabled within the drive parameter set.

Energy optimization can be activated in both V/Hz and Sensorless Vector control modes.

Principles of the Energy Optimization function:

Most drives approximate the relationship between voltage and frequency using predefined voltage profiles programmed into the drive. These profiles are usually split into two categories called the constant and variable torque voltage profiles. Typically characteristics for these are shown below.

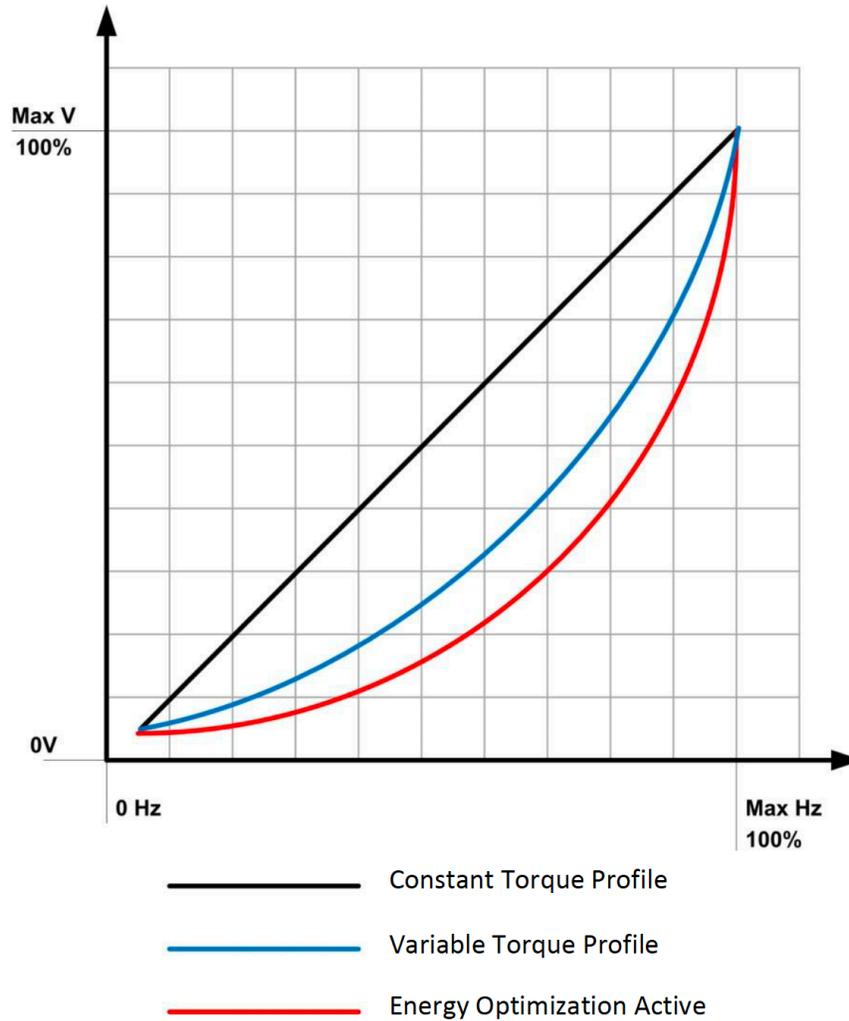


As its name implies, the constant torque voltage profile provides the best results in terms of energy saving when the load is constant and close to its nominal value. But under no load conditions the excess in magnetizing current would unnecessarily increase the losses in the stator making the motor less efficient.

In the same way, variable torque voltage profiles provide the best motor efficiency as long as the load matches the predefined variable torque profile. Any deviation from it would imply excessive losses in the stator circuit (when load is lower than the profile value) or in the rotor circuit (if load is higher than the estimated value).

The solution to this is to model the load more precisely than simply applying the constant torque or variable torque characteristic to each application the drive encounters. The simplest way to achieve this is to take the difficult process out of the hands of the commissioning engineer and to provide a function within the drive that automatically optimizes the voltage / frequency relationship to minimize the energy consumption of the motor. This is what the Energy Optimization function is designed to provide.

Operation of the drive with and without the Energy Optimization function is illustrated below. The graphs assumes operation of a variable torque load such as a fan or pump and illustrates the difference between running that type of load with a constant torque profile, a variable torque profile, and then with the Energy Optimization function turned on. The curves on the graph are approximations to show principle of operation.



It can be seen that energy savings exist in the area between the different profiles. The Energy Optimization function adjusts voltage to provide energy savings under all conditions. Even a constant torque drive with energy optimization function can operate the motor more efficiently than a variable torque drive without energy optimization.

Due to the drive continuously monitoring the load requirements the drive is able to provide additional torque immediately it is needed, so should the load change or the motor be required to accelerate or modify its output speed then it can provide current up to its maximum overload value. Once the motor reaches its steady state speed it immediately returns to optimizing the output to the load and the resultant energy savings therein.

Advantages of the Energy Optimization function:

The primary purpose of the Energy Optimization function is to save energy within the motor which ultimately saves operational energy costs within the application and for the customer / user. This is achieved by matching the required output from the drive with the load requirements and eliminating any over-sizing in the system and over magnetizing of the motor at reduced load.

In addition, by reducing the heat in stator and rotor circuits the thermal stresses on the motor can be reduced leading to improved motor reliability and life span.

The supply current to the drive might also be reduced and also that supplied to line reactors and other heat producing components within the control system, again leading to reduced energy losses and improved reliability.

As previously stated the Energy Optimization function reduces the load current during periods of low load operation and this has the additional positive effect of reducing the audible motor noise. Reduce motor noise can be an attractive feature when the motor is located close to human activity

As with all Invertek innovations this feature is easy to implement, using only a simple enable / disable parameter within the drive and allowing technicians and commissioning engineers of any skill level to implement the function within their application and fully benefit from the feature.

Parameters set up of the Energy Optimization function:

P2 Series drives provide a constant Torque output profile with or without Energy Optimization active.

The Energy Optimization function is enabled and disabled through a simple parameter change available in the basic parameter menu, without security level protection. This parameter is detailed below.

P1-06 Energy optimization:

P1-06 = 0: energy optimization function is disabled

P1-06 = 1: energy optimization function is enabled

Operation of the drive in Energy Optimization Mode:

When this function is enabled, the drive continuously monitors the motor load condition by checking the output current compared to the motor rated current. When the drive operates at constant speed and the motor load is less than full load, the drive will automatically reduce the output voltage applied to the motor, thereby reducing the energy consumption of the motor.

If the load on the motor increases, or the frequency setpoint changes, the output voltage will immediately increase in order to compensate for the load change.

The energy optimization function is fully dynamic, permitting energy saving to be achieved whilst maintaining the ability to deliver full rated motor torque whenever required.

The Energy Optimizer only operates when the drive frequency setpoint remains constant over a period of time. This can be especially useful, for example, in applications such as conveyers, which are required to operate with any load condition between full or empty belt.

Notes on the Use of Energy Optimization Mode:



Note: Care should be taken in using the energy optimizer function in applications where the frequency setpoint to the drive changes continuously, such as PI control applications. As the motor voltage is reduced, the slip of the motor may increase, resulting in a small drop in motor speed, which can make the PI control unstable.

Appendix:

Revision History

Version	Comments	Author	Date
1.0	Document Creation	JP / RL	02/21/12

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