Application Note
CTAN #293

The Application Note is pertinent to the Commander SK Family

Fan and Pump Setup

Fans and Pumps (not reciprocating nor peristaltic pumps- only those that follow Variable Speed/Torque characteristics) are probably one of the most popular applications for the Commander SK Family. This application note will address the main parameters that should be addressed to take full advantage of the drives capabilities for these applications.

Parameter 01: Minimum Speed

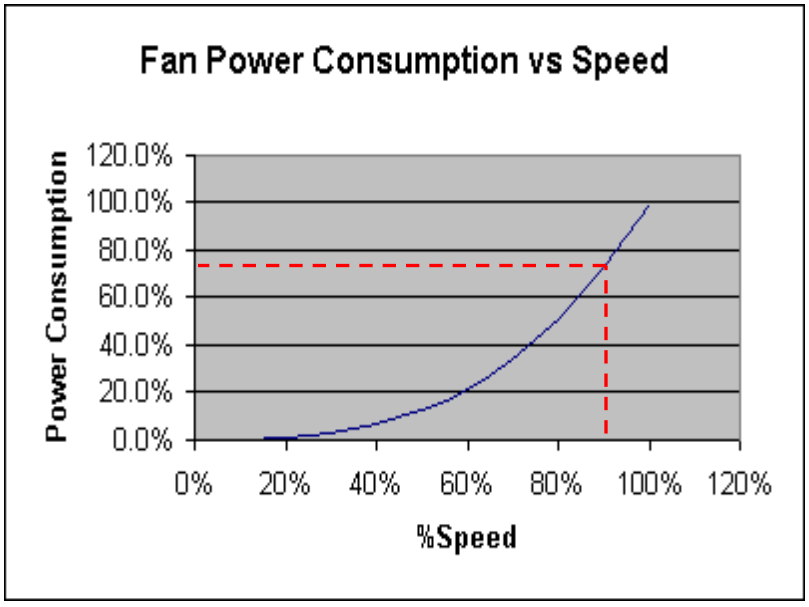
This parameter sets the minimum fan or pump speed. In many systems, the fan or pump must always be turning at some low speed.

Parameter 02: Maximum Speed

This parameter sets maximum fan or pump speed. This parameter is **ALWAYS** set to the base frequency of the motor (i.e. **50 or 60 Hz**). Fans and most pumps have a load characteristic where by the load increases as the square of the speed. Horsepower goes up as the cube of speed. If you double the speed, the load increases by a factor of 4 and the Horsepower by a factor of 9 ! This is where you could realize considerable energy savings. If you could live with just 90% fan or pump speed (a 10% reduction in speed or setting the drive to 54Hz for example), you could realize as much as 25% energy savings- (***even a 5% reduction in speed will yield about 15% energy savings***). Over a relatively short time, this energy savings will pay for the drive and start making you money !

Fans are very easy to spin @ lo speeds →

Speed	HP
0%	0.0%
10%	0.1%
20%	0.8%
30%	2.7%
40%	6.4%
50%	12.5%
60%	21.6%
70%	34.3%
80%	51.2%
90%	72.9%
100%	100.0%



Parameter 03/04: Acceleration / Deceleration Times

These times **should not** be set to anything less than the time the motor takes to coast from full speed to zero speed. The characteristic of the load is such that it appears to be a heavy frictional load at high speed and a high inertial load at low speed. If the deceleration time is set too quick, the drive will experience Over Voltage trips (OU). If quick stop times are required, a dynamic braking resistor will be required in order to absorb the inertial energy. In general, both acceleration and deceleration times should be set to the same time when controlled by an external process controller for symmetrical dynamic control reasons. Remember, the actual accel / decel time will typically be 60% of the entered value (i.e. accel/decel times are based on time to 100Hz vs. 60Hz).

For example: If we desire a 20 second Accel we would enter 20/0.6 or 33.3

Below is a convenient table based on a maximum frequency of 60Hz

Desired Accel/Decel Time (seconds)	Drive Setting
10	16.7
15	25.0
20	33.3
25	41.7
30	50.0
40	66.7
50	83.3
60	100.0
90	150.0
120	200.0

Parameter 07: Motor Rated Speed

This parameter should be set to zero. Its normal function is to compensate droop in motor speed due to load. The problem is that the compensation in the drive is a linear function while the external load for a fan or pump is non linear. Setting this parameter to zero disables the function.

Note: If the display is set up to display **rpm** or **machine speed** instead of the default of motor frequency (parameter #23 set to SP or Cd) parameter #40 must be set to the correct number of motor poles (i.e. 3600rpm = 2pole, 1800rpm = 4pole , 1200rpm = 6pole etc.).

Parameter 08: Motor Rated Voltage

This parameter should be set to:

480 for a 460vac motor or **240 for a 230vac motor**.

Parameter 09: Motor Power Factor

This parameter should be set to either the motor nameplate value (Note, **it is not** the S.F. – Service Factor value). Sometimes it is indicated as PF or P.F. or Cos Φ. If the motor nameplate does not have this information, the drive rotating autotune utility can compute it as long as the motor is uncoupled from the load during the tuning procedure. If no information is available, use the **default of 0.85**. Parameter 09 typically should never exceed 0.97 nor be less than 0.5.

Parameter 30: Ramp Mode

The default 2: Std.HV Standard Ramp should be alright for most situations.

If the drive was supplied with a dynamic braking resistor, this parameter should be set to 0 or Fast.

Parameter 32: Variable V/F select

When this parameter is selected, the motor V/Hz ratio will be reduced based on the actual load on the motor (parameter #4.02—Torque producing current). This function can be used to reduce the motor resistive losses at light loads.

- **It should only be used on single motor applications where the drive is sized to the motor current rating.**
- **It should never be used on multiple motor applications**
- **It should not be used when the drive is being used as a soft start to full speed –** where the drive is not being used as a variable speed control

Parameter 41: Voltage Mode Selector

This parameter should be set to 2: Fixed boost mode.

Parameter 42: Low Frequency voltage boost

Since Fans and Pumps have very low starting torque requirement, therefore **this parameter should be set to 0.5 to 1%.**

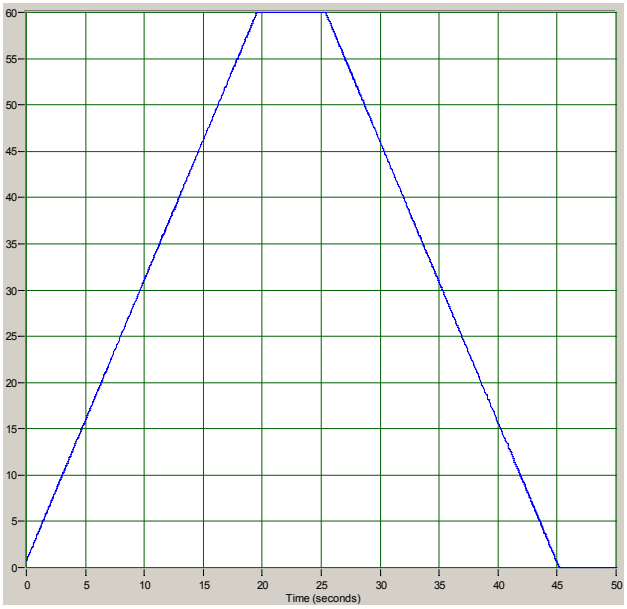
Generally

For 75-100HP this value should be about 0.3%
For 125-300HP this value should be about 0.1%

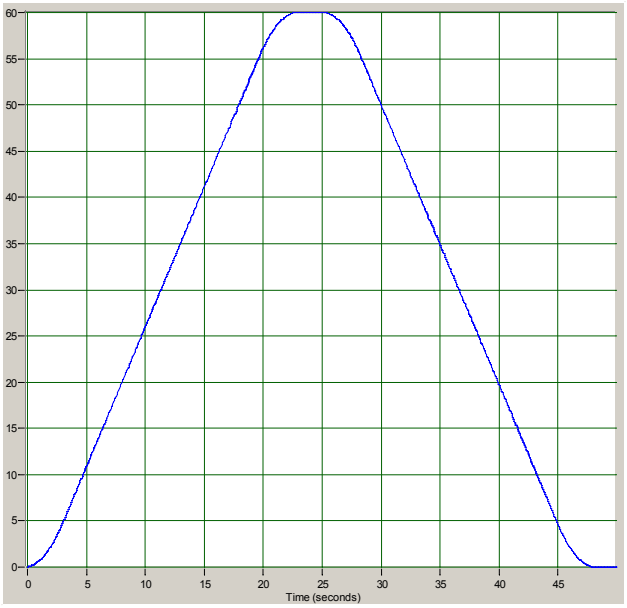
Taking Advantage of S-Curve Accel/Decel

For additional "*icing on the cake*", I would suggest invoking use of the built-in S-Ramp accel/decel contouring function. The drive default uses linear accel/deceleration for speed change transitions. This puts undue strain on belt, chains, gearboxes. In pumping systems it can stress valves generally put unnecessary strain on plumbing systems.

S-Ramp acceleration, besides creating a smooth rate of change, will allow you to save on maintenance of items mentioned above.



Linear (Default) Accel/Decel
Set for 20 seconds (Pr3/4=33)



Superior Smooth S-Ramp Accel/Decel
S turned On and Curvature set for 100

CTScope can help you visualize your results (and it's Free !)

If you are using **CTSoft** (PC Software for our drives) in order to enjoy these benefits you would set parameter #2.06= On and set in the amount of curvature into #2.07

If you are not using CTSoft you could:

Set Pr 71 = 2.06
Set Pr 72 = 2.07
(to get to these parameters you will need to set Pr10= L3)

Then

Set Pr 61 = On
Set Pr 62 = 60-100 (higher numbers offer more curvature)
If Pr 3/4 is around 100 you will need to set #2.07 or Pr62 to around 200-300

In general, the slower the Accel and Decel rates (parameter 03 and 04) the greater the value parameter 62 or #2.07 needs to be for adequate curvature.

Problems:

Tripping on OU (DC Bus Over Voltage)

If this occurs during the Deceleration phase from the target speed or just at the end of the Acceleration phase, invoking S-Ramp Acceleration with a good amount of curvature would most likely offer the cure. You may need to extend the Accel and Decel in extreme cases.

Applying S-Ramps as previous discussed should help significantly

If not, you may need to turn off Slip Compensation.

Set Pr 73 = 5.27

Then

Set Pr 63 = Off

Other things to try should the drive tend to trip on OU upon a Stop command or speed setpoint reduction:

- Increase Current Loop Prop Gain parameter #4.13 to around 40-50
- Reduce Current Loop Integral Gain parameter #4.14 to around 5-10
- Reduce the Ramp Voltage parameter #2.08 about 20-30 volts
- Try turning on parameter Pr32 On - Dynamic V/Hz if OU occurs around 15-40Hz

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When attempting to slow down the speed tends to rise or fails to fully stop
you may need to turn off Slip Compensation. To do this:

Set Pr 73 = 5.27

Then

Set Pr 63 = Off

Other things to try should the drive tend rise in speed upon a Stop command or speed setpoint reduction:

- Increase Current Loop Prop Gain parameter #4.13 to around 40-50
- Reduce Current Loop Integral Gain parameter #4.14 to around 5-10
- Reduce the Ramp Voltage parameter #2.08 about 20-30 volts

Questions: Ask the author ??

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