

Multiple motors - single drive

Introduction

This document is to help with the installation and setup of a system with multiple motors that are run on a single drive at the same time. In this type of application, the drive can no longer protect individual motors so there are different system considerations as compared to a single drive/ single motor application.

System considerations

- Because the drive can't protect individual motors each motor has to have its own thermal protection device. This device cannot be self-resetting and should be something you can turn off to be able to disconnect the motor if needed. This is normally a manual motor protector. It is not recommended to use fuses on the motor unless the fuses are monitored and will remove all 3 phases if it blows one phase.
- When calculating the distance of the output run you have to add all of the cabling together. As an example, let's say we have a single run between the drive and the distribution box of 100'. From there we go to 5 different motors and each of those runs is 25'. The equivalent output run would be $25+25+25+25+25+100=225'$. We would need to protect the output for a 225' output run. In the minimum any multiple motor system should have an output reactor on it. On the above example we would want to put a DV/DT filter on this to be safe.
 - 0-150' recommended output reactor
 - 150-700' recommended DV/DT filter
 - Above 700' recommended sine filter (need to spec a sine filter capable of DC braking)
- As with any drive installation the output cable should be run with a high quality VFD cable. This is to improve performance and reduce risk of adverse results.
- For best results all motors should be the same make and model. These motors need to share the load as well as possible and any differences in the motors could cause an unbalanced load share.

Drive setup

The following parameters are what you set for this type of setup:

- Motor nameplate current: add all of the motor FLAs together and put this in the drive as nameplate current.
- Motor nameplate voltage: this is the voltage off of the rating plate of the motor. If you want to output more or less voltage to the motor, it is better to use voltage at field weakening point and not by changing the motor nameplate voltage. The drive uses the motor nameplate information for calculating a lot of things in the drive so if you skew this data you will make the drive calculate things like power, torque and temperature incorrectly. As an example, if you have a 230V motor but a 208V input to the drive do not put the motor nameplate at 208, it should be 230. If you want the voltage to increase up until the field weakening point we would change the voltage at field weakening point. In this case we would divide 208 by 230 which would give you 90%. You would put this in the drive for voltage at field weakening point.



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- Motor nameplate frequency: this should be taken directly off of the motor.
- Motor nameplate speed: this should be taken directly off of the motor.
- Power factor: this is taken directly off of the motor. If you can't find it on the motor rating plate leave it as the default setting. This could potentially change power and torque calculations but hopefully it is close.
- Current limit: should be set somewhere between 110-125%. I would start on the low end of this and increase it if we need more starting torque.
- Minimum frequency: this is application specific. This will set the minimum reference you can set to the drive.
- Maximum frequency: this is application specific. This is the maximum reference you can set to the drive.
- Acceleration time: this is application specific. Preferably you set this to a value that will allow the drive to accelerate the application without going into a current limit.
- Deceleration time: this is application specific. Preferably this is set to a value that will allow the drive to slow the application down without going into an overvoltage controller.
- Start mode: start mode should be set to ramp to start. On multiple motors you can't really use flying start because you can't find magnetizing current on multiple motors at the same time. If there is the possibility of flying motors, we will need to use DC braking at start.
- Stop mode: this will be application specific. Most of these applications will be fan banks which generally you will coast to stop. There are other applications where ramp to stop may be more preferable.
- DC brake current: this is the current that you would use during DC braking. If we have the potential of flying motors when we start, we want to bring them to a stop before starting. I would start with about 30% of the combined FLA of all motors for this value. You do not want to go too high with this value in case motors are removed from the circuit you don't want to put too much current to the remaining motors. If you go too low you may not be able to slow down the motors. The rough range would be between 30% to 75% of the combined FLA. If you go too high with this value you do not want to remove too many motors from the circuit without lowering this value.
- Start DC brake time: this is going to depend on the application. We will use this in combination with the DC brake current to bring the motors to a stop before we start them. A good starting point would be about 60 seconds.
- Voltage at field weakening point: this is the setting that you will use if you want the drive to output higher than motor nameplate voltage. If the input voltage is higher than the motor nameplate voltage you may want to use this voltage. You do this by increasing this number above 100%. As an example, let's say your input voltage is typically 490VAC. Your motor nameplate is 460V. With default settings the drive will output 460VAC at 60Hz. If we want to output the 490VAC at 60Hz instead of 460V we would take our input voltage and divide it by our motor nameplate voltage and put this in for this value. $490/460=106\%$

Setup of braking at start

If you have an application where it is possible for the motors to be moving when the drive starts you will need to use DC braking at start. You can't use flying start because the motors are not synced with each other so the drive will not be able to find what speed the motors are at because they are all at different speeds. The way to set this up is to do the following:

- The best way to watch the system is normally using the trendplotter on the HMAX or SVX series of drives or the powerexpert tool for DG1 series. This way you can look at multiple readings at once on your laptop. You can do this through the keypad but on the SVX and HMAX series you can record the readings which makes it easier to look at all the data.
- Set DC braking current to about 30% of FLA.*
- Set DC braking time at start to 60 sec.*
- If you are using ramp to stop change to coast to stop.
- Start the application with all of the motors attached. Ramp up to full speed if possible.

- Stop the application and then immediately restart it. Time how long it takes the motors to come to a stop.
- If the motors did not come to a complete stop before the drive tried to start the motors, you should either increase the braking current or increase the braking time. The caution with this is if you have to go high in braking current you have to be cautious about removing motors. Motors will take more than 100% current for a short period of time but as an example if you have 6 motors in the bank and you have braking set to 75% of the combined FLA you probably would not want to remove more than 3 of the motors from the circuit without changing this current. If you removed 3 of the motors from the circuit when you would start you would be putting 150% of FLA to the motors for the length of time you have the braking set for. This won't hurt for motor for the amount of time we should be using for braking but if you remove 1 more motor that percentage now goes to 225% of FLA. This is getting into an area that you shouldn't be running and if you go down to 1 motor you will now be at 450% of FLA. This will heat the motor and start to degrade the motor insulation along with the cabling insulation going to the individual motor.
- If the motors stopped well before the drive restarts the motors, you will probably want to decrease the braking time. I would recommend setting this about 5 to 10 seconds longer than it takes to stop the motors. This way if system characteristics change we have some leeway in the system.
- Retry this after adjusting these settings to make sure everything looks okay while starting and stopping the application.
- If you need ramp to stop change back to ramp to stop.

*If you are doing this on an HMAX drive you do not have DC braking at start. You will need to use pre-magnetizing current and pre-magnetizing time to get the same results.

Motor protection device

Each motor on the system has to be protected individually because the drive cannot tell the difference between motors and know where all of the current is going on the output.

This protection has to be something that will not auto-reset. We do not want the motor to be reconnected to a drive that is running. This will cause a lot of current to be drawn off of the drive and will trip the drive. Normally manual motor protectors (MMP) are used for this because you can also manually remove the motor from the circuit if you need to. Fuses should not be used to protect the motors unless there is something that will recognize a blown fuse and remove the other 2 phases to the motor.

When you set the protection devices you do not set them for the service factor of the motor. The service factor of the motor is for a clean sinusoidal output. The drive does not put out a clean sinusoidal output so there are harmonics involved. This makes the service factor of the motor 1.0 due to the extra heating. This is what you would set your protection devices for. You may want to give it a little extra to stop any false tripping, but you do not want to use the service factor rating of the motor.

Additional help

In the US or Canada: please contact the Technical Resource Center at 1-877-ETN-CARE or 1-877-326-2273 option 2, option 6.

All other supporting documentation is located on the Eaton web site at www.eaton.com/Drives

