DSD 412 ELEVATOR DRIVE SOFTWARE ENHANCEMENT

by Mark Kobiske

The DSD 412 is a standard for DC elevator drives and over the past two years Magnetek has developed the next generation of elevator drive software. This "Generation II" software was developed to make the drive even more flexible and to help meet the demands of the global market place. This version is reverse compatible with the original standard elevator software ("Generation I" or CS00274) that is currently used by a large number of OEMs across the globe.

This article will focus on what these new features are and how these features can help save time and money during the startup phase and later, if problems arise.

Features:

- Anti-rollback (ARB)
- Drive stand-by power reduction (DSPR)
- Elevator brake controls
- Encoderless (armature voltage feedback) maintenance mode
- Notch filter
- Advanced diagnostic/Self tune fault codes

Figure 1 – DSD 412 DC elevator drive

Anti-Rollback (ARB)

Elevator rollback occurs when an elevator motor drive is started and the brake is released, but the hoist motor has not yet developed enough torque to prevent gravity from moving the car. The car may move up or down depending on the overall balance of equipment and payload. Velocity regulators normally used for speed regulation will eventually detect unwanted movement and react to halt the car. But there will be a position error accumulated during that process that can represent many inches of unwanted car movement relative to the landing. This effect is most noticeable with low friction gearless elevators. It may be totally masked by the friction of an elevator driven through worm gears. Rollback by itself does not pose any hazards, but it does give an uneasy, out of control feeling to passengers. In many installations, brake release timing is adjusted so that the brake is released just as the car begins to accelerate toward the next landing to mask the rollback effect. This often results in jerky starts as the brake linings release. The correct countermeasure is to weigh the car just as the doors close to determine the degree of gravity unbalance, then pre-torque the motor so that when the brake is released all forces are balanced. This method is very effective, but does require expensive calibrated load-weighing equipment.

The purpose of the Magnetek anti-rollback feature is to help prevent rollback on elevators that do not use load weighing or do not use the motor pre-torque capability provided by the Magnetek drive. It uses a specially designed regulator when operating at zero speed to hold the elevator car at an average speed of zero and to regulate a constant position as the brake is released. When the velocity reference leaves zero speed to accelerate the car toward the next landing, the active velocity regulator is switched to Magnetek's Elevator Speed Regulator (E-Reg) to precisely track the velocity reference profile. Be aware that this anti-rollback feature works from encoder/tachometer signals, so there must and will be some movement in order for the feature to function, but the position error generated by elevator movement will recover.

Drive Stand-By Power Reduction (DSPR)

Elevators often sit idle for many hours during a 24-hour day. Even though the DSD 412 drive can be set up to reduce motor field current to a stand-by level, a significant amount of power is continually lost by having the three-phase main power transformer energized and cooling fans running. Now it is possible to set a timer so that when the elevator has not been used for a length of time, an external contactor can disconnect the main transformer and turn cooling fans off. When car controller logic recognizes that a new elevator call has been placed and asserts the Drive and Field Enable contact, the drive will re-enable the three-phase primary power, resynchronize to the power line and restart cooling fans. When three-phase power is off, motor field current will be zero amperes.

Elevator Brake Controls

Brake control logic has been programmed into the standard drive.

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Elevator Start with Brake Control:

1. The drive is started by activating first the ENABLE then RUN command lines. The contactor will pick (pull in), and when acknowledged, the drive will start the current and velocity regulator by priming it to provide pre-torque armature current (if enabled). The internal velocity reference will always start at zero.
2. Once START is confirmed, the Brake Lift and Brake Pick lines will both become active. This will apply full voltage to the brake coil and cause the brake to lift.
3. The Brake Pick output will deactivate at the end of Brake Pick time, and release the internal velocity reference clamp so that the drive can begin acceleration. The Brake Lift output will remain active. (Dropping of the external Brake Pick relay will reduce voltage to the elevator brake coil.)

Elevator Stop with Brake Control:

1. Automatic setting of the brake and drive shutdown sequence may begin at any speed.
2. The drive RUN command is released by customer's logic. This will set the internal reference speed to zero and start the Must Stop Timer. The velocity regulator will continue to control velocity and current, driving the speed to zero via the decel rate.
3. When the drive measures encoder speed as being zero the Brake Lift and Brake Pick outputs will de-energize. The drive velocity regulator will continue to hold zero speed while the brake drops, as set by a Brake Drop Timer.
4. When the Brake Drop Timer expires, motor armature current ramp-down will occur. This will gradually transfer torque from motor to brake to help prevent brake "thumping."
5. When Current ramp-down is complete, the drive will cease operating and open the contactor.
6. If Brake Auto Stop is ON, and a zero speed command is present, and the drive is stopped, the sequence of 2-5 above will be activated.

NOTE: The drive will turn OFF with the Drive Run and Enable commands still active. These signals must be cycled to recover and re-start from this auto-stop operation.

Encoderless (Armature Voltage Feedback) Maintenance Mode

This enhancement has been added to ease troubleshooting of encoder issues and/or maintenance. If the encoder is still in operation its feedback can be monitored to determine stability of this signal. The theory is quite simple, a DC motor with rated field current applied will produce rated armature voltage when spinning at rated speed. This will result in speed regulation in the range of 5%. When in this mode, operation over base speed will not be possible as the field weakening is inhibited. Due to the nature of this mode of operation the speed regulator gain will be defaulted at two radians to prevent unstable operation.

Notch Filter

Some hoistways may have rope resonances that cause occasional vibrations, roughness of ride or continuous oscillations at certain low frequencies. There may be critical hoistway locations or payload weight combinations that tend to be more sensitive than others. The effects are often felt rather than heard. The frequency sensitive notch filter, placed in the software path of the torque/armature current reference signal, can be effective to suppress the response of the DSD 412 drive to amplify those frequencies. Adjustments for this filter are via the period, or center frequency of the filter, and the depth of the notch, or its ability to attenuate. Use the filter as follows:

- Determine the approximate frequency of the oscillations or rope "ringing."
- Set a center frequency value slightly higher than that of the observed disturbance. The default value of 12 Hz will be sufficient in many cases.
- Increase the value of the notch depth to suppress the tendency to respond or amplify rope resonance.

CAUTION: Be aware that the ability of the drive to follow the speed commanded by the car controller is altered by these adjustments. If the frequency of the filter is set too low, or the notch depth is set too deep, there may be interference problems associated with operating the closed loop velocity regulator or position control loops within the Car Controller. Typical symptoms would include position overshoot of floor landings and potentially repetitive speed oscillations or speed "hunting." If these symptoms occur, back off on the Notch Depth setting and/or reduce the setting of Notch Period, this increases the notch center frequency to avoid interference.

Advanced Diagnostic/Self Tune Fault Codes

The Magnetek DSD 412 has always had the ability to verify drive operation and calculate key motor parameters required for proper motor operation. At times, these tests have come up with inconclusive results, this is due to the large diversity of motors and installations.

The software has been enhanced with 10 additional fault codes (F930-940) and four monitor functions (Fnct#688-691) to provide essential data required for the startup personnel to make the proper corrections if required.

Additional Information

For specifics on the set-up for each of these functions, please refer to the DSD 412 "Generation II" Technical Manual (CS00407). Also, Magnetek Elevator Products website (www.elevatordrives.com) contains detailed application tips, as well as other technical information about our elevator products.

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