SUBJECT: Application Notes for the Ripple Current Fault (F909) in the DSD-412 DC Elevator Drive

Ripple faults are symptomatic of poor drive tuning, intermittent SCR gating, or just a pulsating machine load. But in elevator drives bad SCR gating will usually cause F901s (ISTs) or worse. (An open SCR will cause a Ripple Fault also, but would be detected when the PCU Diagnostics (F#998) is done during intitial set-up of the DSD 412 at the site)

So, the drive tuning, hoistway tuning, or mechanical problems are suspect. Keep in mind that the Ripple Fault detection also responds to prolonged multiple low frequency excursions of the motor armature current. Here are some suggestions/guide on what to look for;

Poor Drive Tuning

1. System Inertia F#41 set too high can cause oscillations in motor armature current. This is usually felt by the passengers as vibration, but is also sensed by the DSD 412 PCU software as a high max-to-min ratio of armature current that repeats and lasts a significant length of time. Just like a missing SCR pulse. So it is kicked out as a Ripple Current Fault.

   Interestingly enough, if the load current is pulsating with large enough excursions and oscillations to be possibly caught by the DSD 412 ripple current detector, the current from the ac line must also be pulsating...And that may cause a pulsating reactance voltage drop effect at the isolation transformer secondary, and to the drive, that will look like the utility voltage keeps sagging and surging. The DSD 412 line sync signal noise filter will have the typical disturbance-plus-settling-time mathematical response, which means that the apparent sync point will move around. This may also cause a Sync Loss Fault (F903).

2. Mistuning of stabilizing functions like Tach Rate Gain (F# 107) or Stability (F# 42). These functions feed derivative disturbances to the current reference of the DSD 412. Too much gain here causes ***more*** ripple current rather than stability.

3. Running the DSD 412 up to where the CEMF bumps into the CEMF limit ceiling. The DSD 412 software will repetitively cut the current regulator to zero to avoid more CEMF. This repetitive action can trigger a Ripple Current fault. Ride quality will be poor due to the Armature Current cutting in and out. (Note: The CEMF ceiling is set at $V_{AC\ rated}$ X 1.15 V_{DC})

4. Mis-tuning the DSD 412 Drive with un-true Motor Armature Circuit Resistance or Motor Armature Current such that the calculated CEMF is incorrect, causing the DSD 412 to go into CEMF limit mode.

5. Trying to avoid Low Line Faults (F# 904) by telling the DSD 412 that $V_{AC\ rated}$ is lower than it really is. (Re-read # 4 on CEMF limiting)

Mechanical Problems

1. Poor Tach encoder mounting. An off-center Tach can cause Ripple Faults. Motor shaft and Tach must be on a concentric axis. This is related to oscillations in the speed regulating loop.

2. Repetitive/cyclic bumps or swings in the load. (Real bumps in the load caused by mechanical problems in the hoistway)

Loose Connections (inside and outside of the DSD 412)

1. Check 3 phase connections upstream of the DSD 412; circuit breaker, transformer, etc.
2. Failing motor brushes or loose connection in the armature loop.
3. Poor connections on the encoder feedback wires.
4. Loose connections on the DSD 412 armature interface connections to the line phases.
5. Loose gate wires (poor connections to the SCR's)
6. Defective DSD 412 A1 Control PCB, Armature Interface PCB, or Ribbon Cable J14.
7. Examine the motor armature for open coil connections.

Noise

1. Noise from contactor coils, relays. All coils should use noise suppressors.

Note: Ripple Fault (F#909) was originally intended to trip out the DSD 412 Drive in cases of SCR/Motor/Wiring problems to prevent damage to expensive motors by "single phasing" them during continuous running. This is a particulary difficult problem to detect with a thermal heating type overload (as caused by single phasing), as high ripple at the motor causes commutator sparking faster than rms heating.