**MP’s Checklist for Stable Electrical Connections and Avoiding ESD Problems**

* Ferrite chokes installed as close as possible to controller (these damp out electrical spikes)
  + Power lines
    - Drive motors
    - Mechanism motors
    - Battery to PDM
  + Encoder lines
    - Drive motor encoders
    - Mechanism motor encoders
  + USB lines
    - PDM to controller USB to micro
    - Phone to PDM (critical to have one near the phone for this one. If there isn’t one built into the cable connecting to your phone, add one close to the phone!)
    - Sensor block to PDM
  + Servo lines
    - Mechanism servos
* Power lines twisted (this helps to minimize development of electro-magnetic field along wires)
  + Drive motors
  + Mechanism motors
* Power lines not running adjacent to signal lines. They should be as far apart as practical. If they run close to each other, power spikes can induce signal spikes.
* Wires not touching metal. Helps to minimize transmission of static discharge in the metal frame being transmitted into the wires.
  + Power lines
    - Drive motors
    - Mechanism motors
    - Battery to PDM
  + Encoder lines
    - Drive motor encoders
    - Mechanism motor encoders
  + USB lines
    - PDM to controller USB to micro
    - Phone to PDM
    - Sensor block to PDM
  + Servo lines
    - Mechanism servos
* Control modules & Phone isolated from contact with metal and Lexan that might develop a charge (such as a Lexan Ramp that has spinners rubbing against them). (prevents a conductive path for any static shock discharge going from the frame into the electronics)
  + PDM
  + Motor controllers
  + Servo controllers
  + Sensor block
  + Phone
* Control modules & Phone mounted with non conducting fasteners (zip ties or nylon fasteners) (prevents a conductive path for any static shock discharge going from the frame into the electronics)
  + PDM
  + Motor controllers
  + Servo controllers
  + Sensor block
  + Phone
* Connections fully supported (good practice to avoid loose connections vibrating loose)
  + PDM phone micro USB connection
  + PDM USB connections
  + Motor Controller micro USB
  + Servo Controller micro USB
  + Sensor micro USB
  + Phone right angle (a rubber band is a great method here)
* Servo extension line connectors securely connected (zip ties or clips (they sell clips made to hold these together - zip ties work well too))
  + Mechanism servo extensions (if used)
  + Motor encoder line extensions (if used)
* Motor power connections secured to motor with electrical tape (applied to older Tetrix motors not Andymark ones)
  + Spinner motor
* All frame isolated from metal contact with playing field (Electrical tape, wood, cloth tape, other non conducting coverings, etc.) (minimizes static discharge upon metal contact)

Each match

* Before each match, make sure phone connection is secured by rubber band
* Touch the bot to the field to short out any possible static
* Make sure all log files are cleared
* Spray bot with Static Guard before each match

References:

From NXT days but a good document

<http://ftc.flfirst.org/Docs/2014-2015/Addressing_NXT_Lockups.pdf>

Forum post

<http://ftcforum.usfirst.org/showthread.php?6623-Understanding-and-Managing-the-ESD-issue&s=4dab738844fe9822c1b8e65a74b68c2b&p=27459#post27459>