

## Trouble Shooting Nanomotion Motors using Capacitance Measurements



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## 1. General

Unlike conventional motors, the integrity of the internal connections of a Nanomotion motor cannot be determined with an ohmmeter. In fact, the motor element behaves actually as two capacitors, nominally 800pF each, where one capacitor is connected between the COM and UP terminals, and the other capacitor is connected between the COM and DOWN terminals. (see Figure 1 below.) Each capacitor represents the sum of the capacitances of the individual motor elements, as they are connected in parallel. The following procedure describes how to use capacitance measurement to verify the electrical integrity of a Nanomotion motor.

NOTE: This procedure does not replace functional motor testing. Even if a motor passes the capacitance test, it still may not produce the specified force / velocity performance due to mechanical or other issues.

## 2. Capacitance Measurement Procedure

- a. Required equipment: capacitance meter capable of measuring from 200pF to 10,000pF.
- b. Disconnect the motor from the amplifier.
- c. Using an insulated tool, momentarily short together pins 3, 4 and 5 (white, black and red wires, respectively) at the motor 9 pin connector to discharge any remaining high voltage.
- d. Measure the capacitance between pins 3 and 4 and record the result.
- e. Measure the capacitance between pins 4 and 5 and record the result.
- f. Compare your results to the values in Table 1 below.

### NOTES:

1. The tolerance on the capacitance of a motor element is  $\pm 15\%$ . The difference between the two measurements is more important than the actual value of each measurement. For example, if one side of one element is completely disconnected, there would be a difference of 800pF between the two measurements.
2. The measurement should be done as close to the motor as possible.
3. The capacitance of the cable needs to be taken into account as well. The standard (black) cable has capacitance of 64pF/ft, and the vacuum cable has capacitance of 13pF/ft. If it is a user supplied cable, the capacitance should be known.

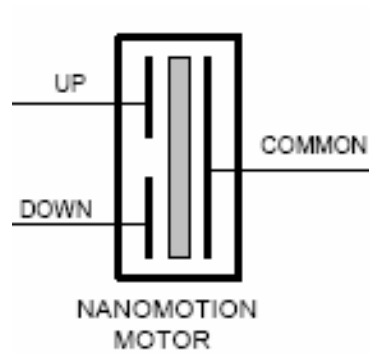


Figure 1 - Equivalent Circuit of a Nanomotion Motor

Motor	Number of Elements	Nominal Motor Capacitance, pF pin 3 to 4, pin 4 to 5
HR1	1	800
HR2	2	1600
HR4	4	3200
HR8	8	6400

Table 1- Nominal Capacitance Values