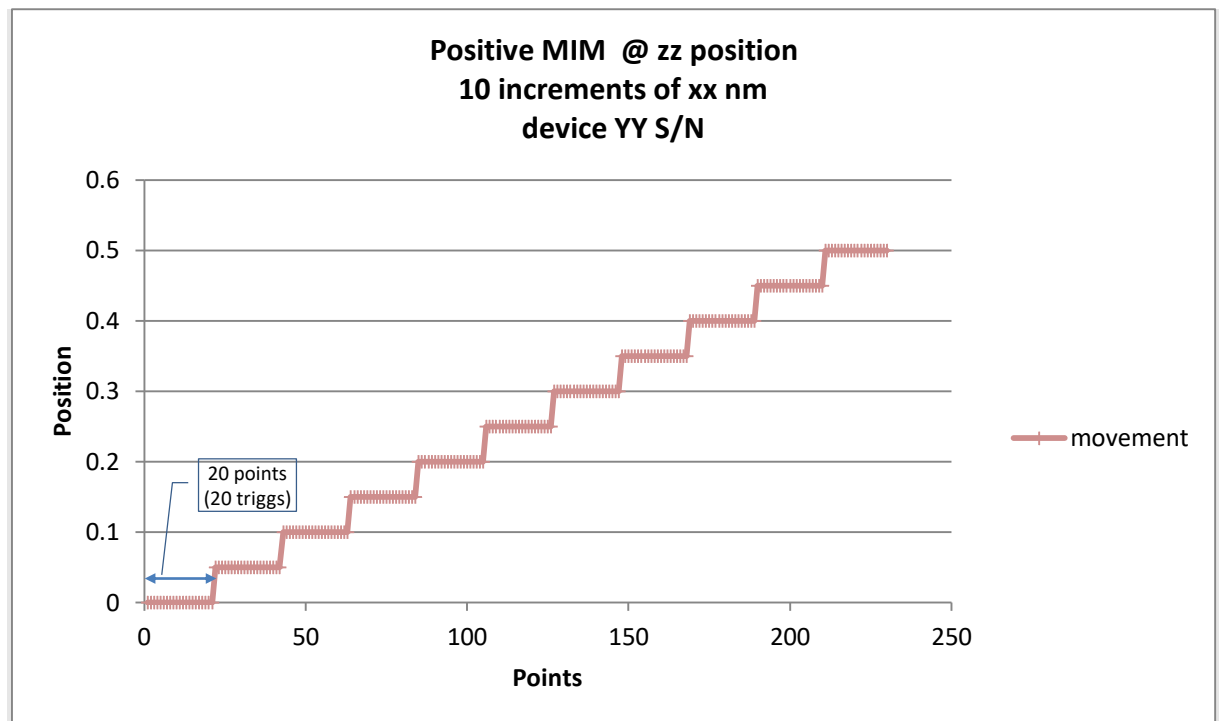
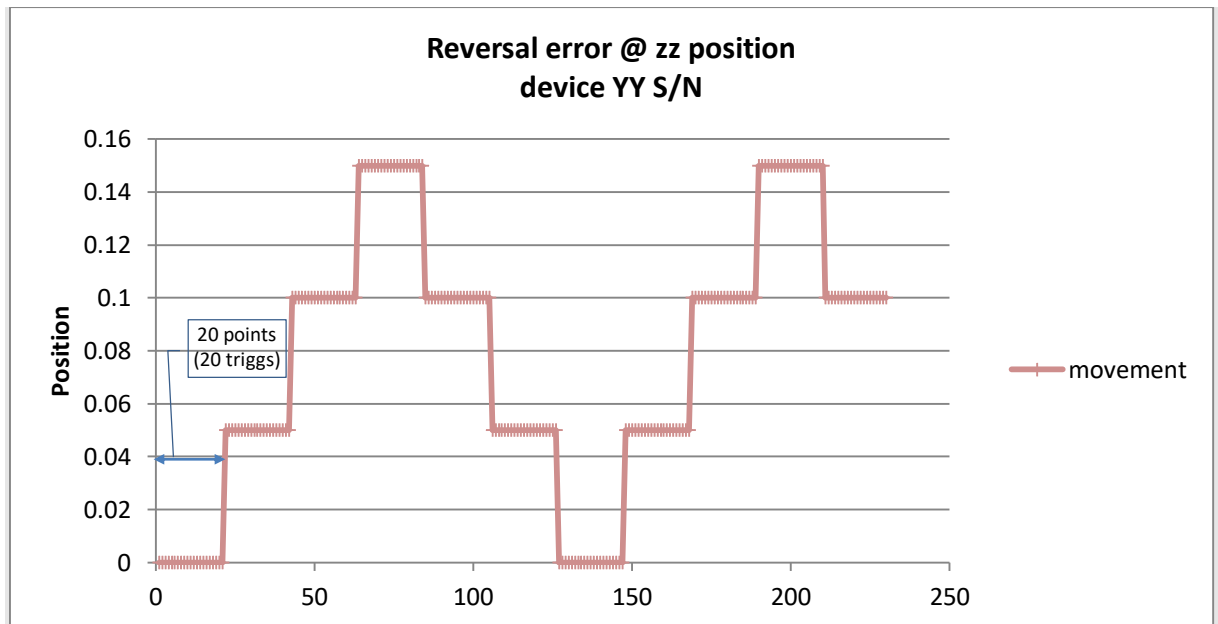
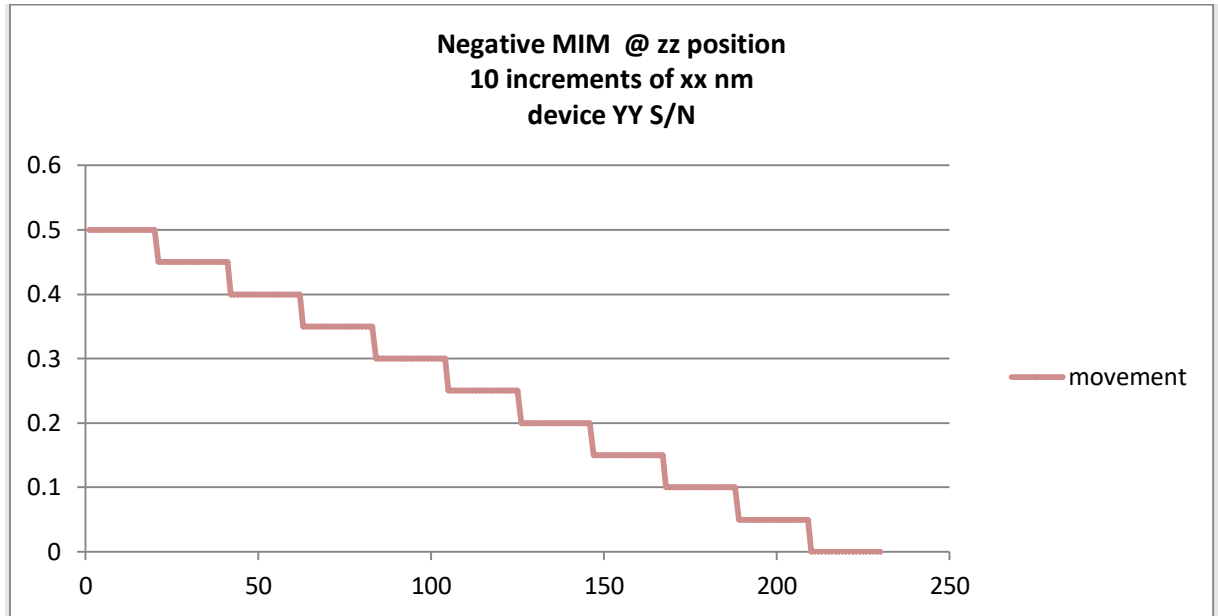


# Typical ESRF procedure for test measurements

## 1. MIM measurement process

- Measurement with a measuring system which has an intrinsic resolution at least three times better than the MIM to be characterized.
- The measurement is done at the sample position.
- If a motion stage is part of kinematic chain: each motion is tested at three fixed different positions of the other movable parts of the chain.
- For each motion and in both senses, determination of the minimum reliable increment of position by continuous acquisition while the machine sequentially increments the position and stops the motion.
- With the same setup, performing of a test of inversion of the motion, in the same way but with inversion of the sense of the increments.





## 2. Accuracy and repeatability measurement process

In conformity with ISO 230-2 with the following parameters:

- The measurement is done at the sample position.
- Minimum 20 intervals (21 points) over the stroke
- Bi-directional repeatability & uni-directional repeatability

- No-warm up before the tests, minimum 5 cycles bi-directional measured, the 3 last ones could be selected for the contractual acceptance (minimum).
- Averaging time for one point (one position) max 100 ms.
- Loading during the tests in accordance with the specification
- The repeatability values must be given for the positive sense, the negative sense, and the bidirectional cycles. The repeatability is the maximum deviation observed on the measured points; the standard deviation is not a valid criterion due to the limited number of points.
- The accuracy is the maximum relative deviation observed between the position measured (average of every point measured at defined positions of the axis) and the reference length or angle defined by the metrology setup. A calibration report of the instrument must be included in the manufacturer's measurement report.

### 3. Axes of rotation measurement process

In conformity with ISO 230-7 with the following parameters:

- The measurement is done at the sample position.
- Minimum 180 intervals (increments of 2 degrees)
- Measurement in static angular positions
- Synchronous error motion (axial and radial) in positive and negative sense
- Asynchronous error motion for bi-directional cycles
- No-warm up before the tests, minimum 5 cycles bi-directional measured, the 3 last ones could be selected for the contractual acceptance (minimum).
- The asynchronous error (repeatability) is the maximum deviation observed on the measured points; the standard deviation is not a valid criterion due to the limited number of points.
- The axial error motion results can be shown with the thermal drift compensated, but the results without compensation must be shown as well
- Averaging time for one point (one position) max 100 ms
- Recommended instrumentation and test equipment:
  - A non-contact displacement (proximity) measuring system composed of a minimum of 3 calibrated sensors with adequate range, resolution, thermal stability, accuracy and bandwidth (such as capacitive sensor system and calibrated master balls) should be used. Other instruments capable of measuring the same quantities and having the same or greater accuracy may also be used.
  - The long-term accuracy of the measuring equipment and of the structure in which the displacement sensors are installed must be

verified. The measuring instruments must also be thermally stabilised prior to starting tests. To achieve this, the air-bearing and the measuring instrument must be placed in the test environment for long enough (preferably overnight) to have reached thermal equilibrium before testing. They shall be protected from air turbulences and external heat sources.