MODS Grating Select Data Sheet

General Description
The MODS Grating Select mechanism is a 4 position limited angle rotary system. The Grating Select can be driven to any position in any direction (CW or CCW), however limit switches and a hard-stop prevent the Grating Select from over-rotating and damaging the cable harness. The maximum rotation of the grating select is approximately 300 degrees. When the Grating Select reaches its selected destination the drive current is turned off and it is held in place by a spring loaded detent roller. The position of the Grating Select is identified by means of a “Position Valid” bit which is TRUE when the Grating Select is in a detented position and “Binary Code” bits which indicates the position with a binary number. The “Position Valid” bit and “Binary Code” bits are produced by inductive proximity sensors activated by dowel pins.

Topology
Indexed Rotary

Rendering of Grating Select Asm.
**Drive Motor**

Motor Type: Size 34 Step motor, 200 full steps per revolution  
Part #: Superior # KML092F07  
Rated Current: 3.25 amps/phase parallel (RMS)  
Rated Holding Torque: 770 in*oz  
Rated Torque at Operating Speed: ?? in*oz

Motor Connection Diagram (for CW rotation viewed from motor front with positive command)

- A Red/White (Pin13)
- A Red (Pin12)
- B Black (Pin11)
- B Black/White (Pin10)

**Motor Controller Specifications**

Manufacturer & Model: IMS MicroLYNX 7 (#MX-CS100-701)  
Rated Current: 5amps RMS/phase, 7 amps peak/phase  
Rated Voltage: 24 to 75 VDC  
Daughterboards: None

**Motor Controller Settings**

- MSEL = 10  
  10 usteps/fullstep = 2000 microsteps/rev
- MUNIT = 2000  
  sets units to (2000 usteps/rev) gives velocity and accelerations in rev/sec
- MAC = 60  
  Acceleration Current = 60% = 4.2 amps peak
- MRC = 35  
  Run Current = 35% (3.25 amps RMS*1.4 = 4.55 amps peak (4.55/7 = 65% max )
- MHC = 0  
  Motor Hold Current is zero
- ACLT=1  
  linear acceleration (default)
- ACCL=0.5  
  acceleration rate (rev/sec^2)
- DECL=0.5  
  deceleration rate (rev/sec^2)
- LDECL = 125  
  limit deceleration rate (rev/sec^2)

Overtravel at Limit ~ Pi * Pinion Diameter * VM^2/(2*LDECL) = 0.95mm (diameter =30mm and VM = 1 rev/sec, LDECL=50 rev/sec^2 (minimum))

Maximum Permitted Overtravel ~ 1.5mm (Sensors do not get hit with overtravel as they are "side-looking. However Limit sensors must remain asserted after overtravel)

VM= 0.5  
running speed (rev/sec)

**Motor Controller I/O Connections**

- Vpull: not used
- GND: 24 volt Gnd
- I/O 21: CW Limit
- I/O 22: CCW Limit
- I/O 23: 1’s LSB of Position code bit
- I/O 24: 2’s MSB of Position code bit
- I/O 25: “Position Valid” sensor
- I/O 26: not used

**Input Sensors**

Model P&F # NBB1.5-8GM50-E0-V3  
8mm Inductive proximity sensor, Normally Open Sinking output (Type E0), 24 VDC supply
**Grating Select Gearing**
Pinion = 20 teeth
Gear = 536 teeth
Gear Ratio = (536/20) = 26.8
Motor Shaft Revs Between Positions = 1/4 Rev (26.8) = 6.700 Revs/index positions
(Full) Steps Between Positions = 1/4 Rev (26.8)(200 Steps/Rev) = 1340 Steps

**Performance**
Maximum Travel Time ~8 seconds
Position Repeatability +/- 8 micron error

The performance of the Grating Select was tested for continuous travel between positions vs. incremental travel between positions. It was determined that incremental travel with a short delay between moves (~1000 ms) provided the best performance. When using incremental travel the motor run current requirement was reduced and the allowable move velocity was greatly increased. This is due to the fact that when the Grating Select is incrementally stopped at each notch the ramping torque encountered as the detent roller travels across a detent notch is handled by the motor’s acceleration current instead of the motor’s run current (The Motor Acceleration Current Requirement is the same for Continuous & Incremental travel since the Grating Select is always starting motion with its detent roller engaged in a detent notch). Another benefit of incremental travel is that the detent roller is decelerated into each notch instead of just skipping across in a continuous motion, which provides for gentler Grating Select motion.
Software Notes

The Red and Blue Grating Selects have a Motor/Detent/Sensor Mounting Plate that points in opposing directions. The Active position is also opposite for the Red and Blue Channels. See the diagram at the beginning of this document for an illustration.

As shown in the illustration at the beginning of this document:
The Active Red Grating is in the 3 o’clock position (-135 Degrees away from Select Plate)
The Active Blue Grating is in the 9 o’clock position (+135 Degrees away from Select Plate)

The Code Bit Sensors are located on the Select Plate that is 135 Degrees from the respective active positions. It is important that the software recognizes that the code bit readout corresponds to a grating position that is offset by +/- 135 degrees (Depending on Red vs. Blue).