MODS Filter Wheel Data Sheet

General Description
The MODS Filter Wheel places one of eight possible filters into the MODS science camera beam directly in front of the Field Flattener & CCD. The rectangular filters are mounted in cells with RTV. The filter cells are loaded into the filter wheel radially and are prevented from being inserted the wrong way by asymmetric guide rails. The filter cells are temporarily held in place with spring loaded ball detents and then locked in place with mounting cleats (requires 2.5mm hex wrench).

The mechanism is an 8 position indexed rotary device which can be driven to any position in any direction (CW or CCW). When the Filter Wheel reaches its selected destination the drive current is turned off and the Filter Wheel is held in place by a spring loaded detent roller. The position of the Filter Wheel is identified by means of a “Position Valid” bit which is TRUE when the wheel is in a detented position and “Binary Code” bits which indicates the filter wheel position with a binary number. The “Position Valid” bit and “Binary Code” bits are produced by inductive proximity sensors activated by slots in the drive gear.

Topology
Indexed Rotary
Rendering of Filter Wheel Asm.
Drive Motor
Motor Type: Size 23 Step motor, 200 full steps per revolution
Part #: Superior # KML062F07
Rated Current: 3.3 amps/phase parallel (RMS)
Rated Holding Torque: 250 in*oz
Rated Torque at operating Speed: ??

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 10usteps/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 = 60 Run Current = 3.0 amps RMS *1.4 = 4.2 amps peak (4.2/7 = 60%)
MHC = 0 Motor Hold Current is zero
ACLT=1 linear acceleration (default)
ACCL=DECL = 50 acceleration rate (rev/sec^2)
LDECL = 50 limit deceleration rate (rev/sec^2)
VM= ?? running speed (rev/sec)

Motor Controller I/O Connections
Vpull: not used
GND: 24 volt Gnd
I/O 21: 1’s LSB of Position Code bit
I/O 22: 2’s Position Code bit
I/O 23: 4’s MSB of Position Code bit
I/O 24: “Position Valid” bit
I/O 25: not used
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
Used for detecting “Position Valid” hole and “Code Position” slots.

***Sensor faces should be positioned 0.010” from gear face.

Connection for P&F E0 Sensors (3 wire)
Brown +24 volts
Blue  24 volt ground
Black  to input of controller

Output Devices
None

Drive Mechanics
The motor for the Filter Wheel was chosen for its ability to overcome the holding force of the detent and drive the filter wheel to its next position. The spring for the detent was chosen for its ability to overcome the cogging torque of the motor and back-drive the filter wheel into its docked position.

Pinion = ?? teeth
Gear = ?? teeth
Gear Ratio = (??) = ??
Fullsteps Between Filter Positions = (1/8 rev)* (??)* 200steps/rev = ?? Fullsteps

Performance
Maximum Travel Time  ?? seconds
Typical Travel Time for move of 2 positions  ?? seconds
Position Repeatability  ?? micron error
Position Hysteresis  ?? micron

Software Notes
Drive Mechanics
The motor for the Filter Wheel was chosen for its ability to overcome the holding force of the detent and drive the filter wheel to its next position. The spring for the detent was chosen for its ability to overcome the cogging torque of the motor and back-drive the filter wheel into its docked position.

Filter Wheel motion
Pinion = 18 teeth
Gear = 369 teeth
Gear Ratio = (369/18) = 20.5
(Full) Steps Between Filter Positions = 1/8 Rev (20.5)(200 Steps/Rev) = 512.5 Steps

Performance
For the following settings:
Speed = 1 rev/sec
Accel/Decel = 1 rev/sec/sec
Minimum Current = 1.5 Amps
Transfer Time = 4.1 seconds per position

Red vs. Blue Assembly Notes
The Blue and Red Filter Wheels differ only in configuration. The configurations are:
Blue Filter Wheel: Spacer is located between the Filter Wheel Base and the Gear
Red Filter Wheel: Spacer is located between bearing and clamp nut

Software Notes
The Blue and Red Filter Cells are loaded from opposite sides due to their location on MODS. This affects the numbering offset between the filter load positions and the active filter position

Blue Filter Wheel
Looking at the Filter Wheel from the motor side; the cells are loaded at the 3 o’clock position, the active position (in the camera beam) is at the 6 o’clock position, and the filter positions increase
in the CCW direction. Therefore when position “0” is in the active position, then the load position at 3 o’clock is filter position #2.

**Red Filter Wheel**
Looking at the Filter Wheel from the motor side; the cells are loaded at the 9 o’clock position, the active position (in the camera beam) is at the 6 o’clock position, and the filter positions increase in the CCW direction. Therefore when position “0” is in the active position, then the load position at 9 o’clock is filter position #6.

**Filter Wheel Viewed from Motor Side**