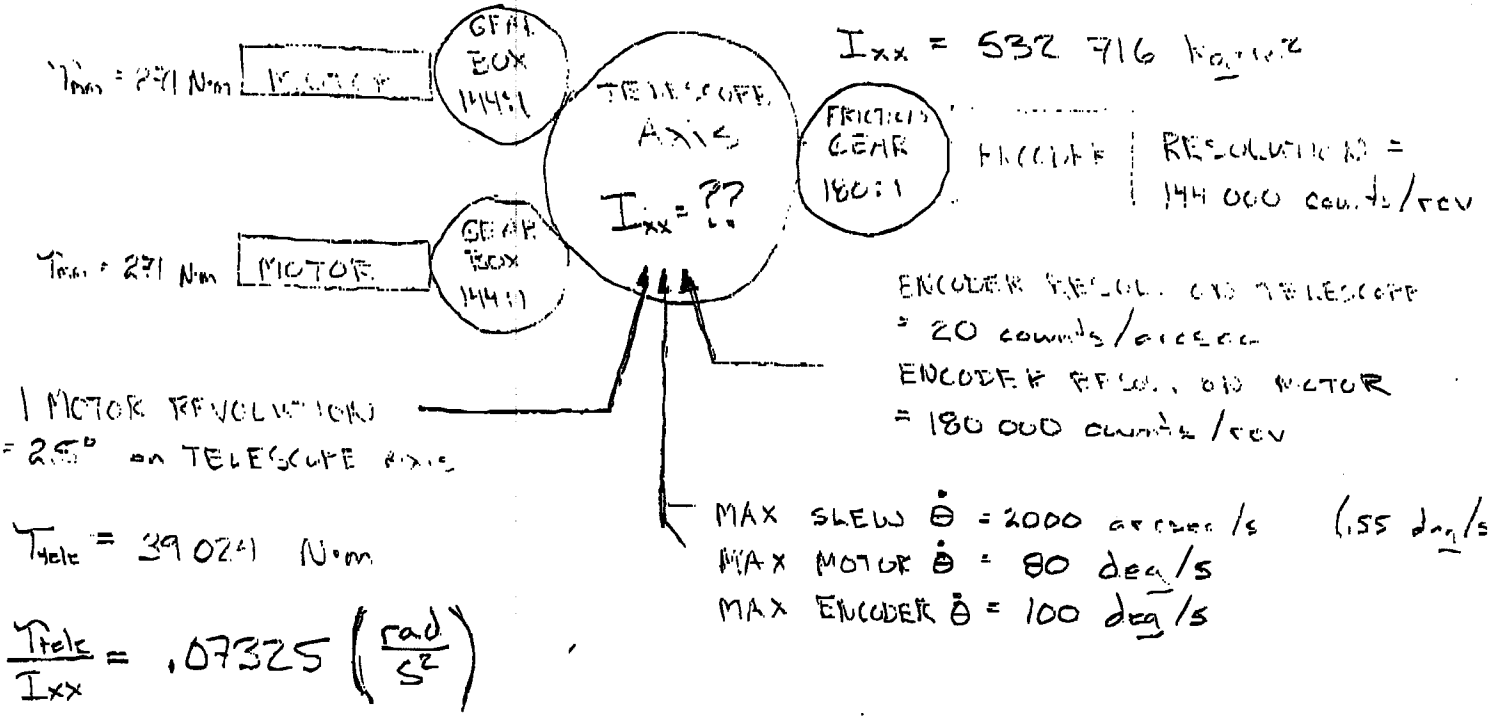
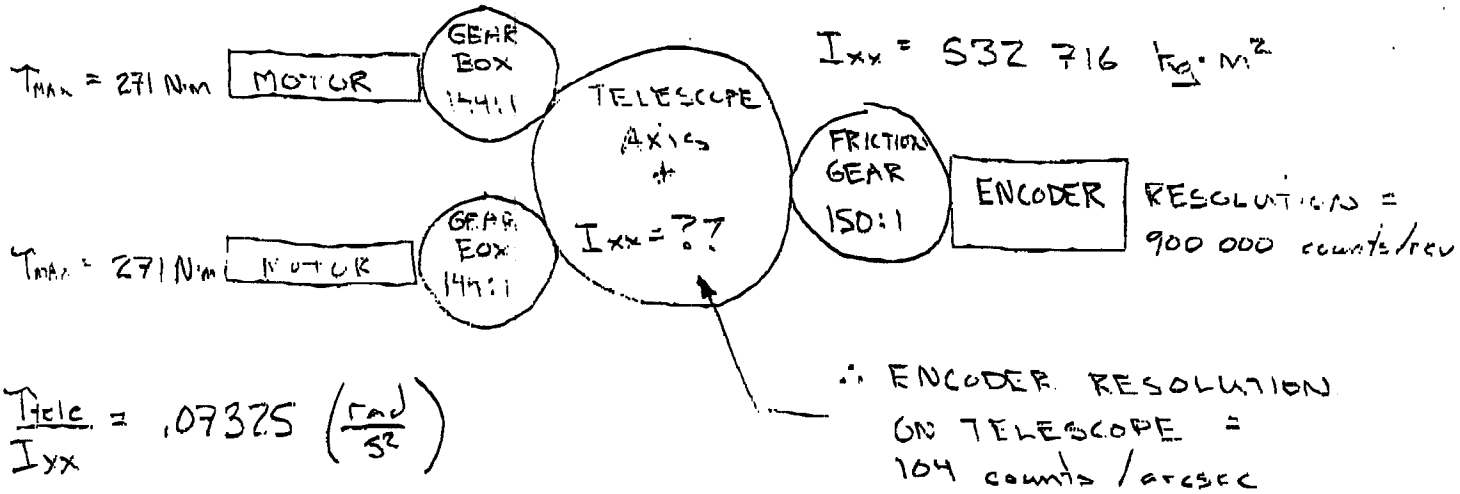
CURRENT CONFIGURATION



T_{tele} = 39 024 N·m

$$\frac{T_{tele}}{I_{xx}} = .07325 \left(\frac{rad}{s^2}\right)$$

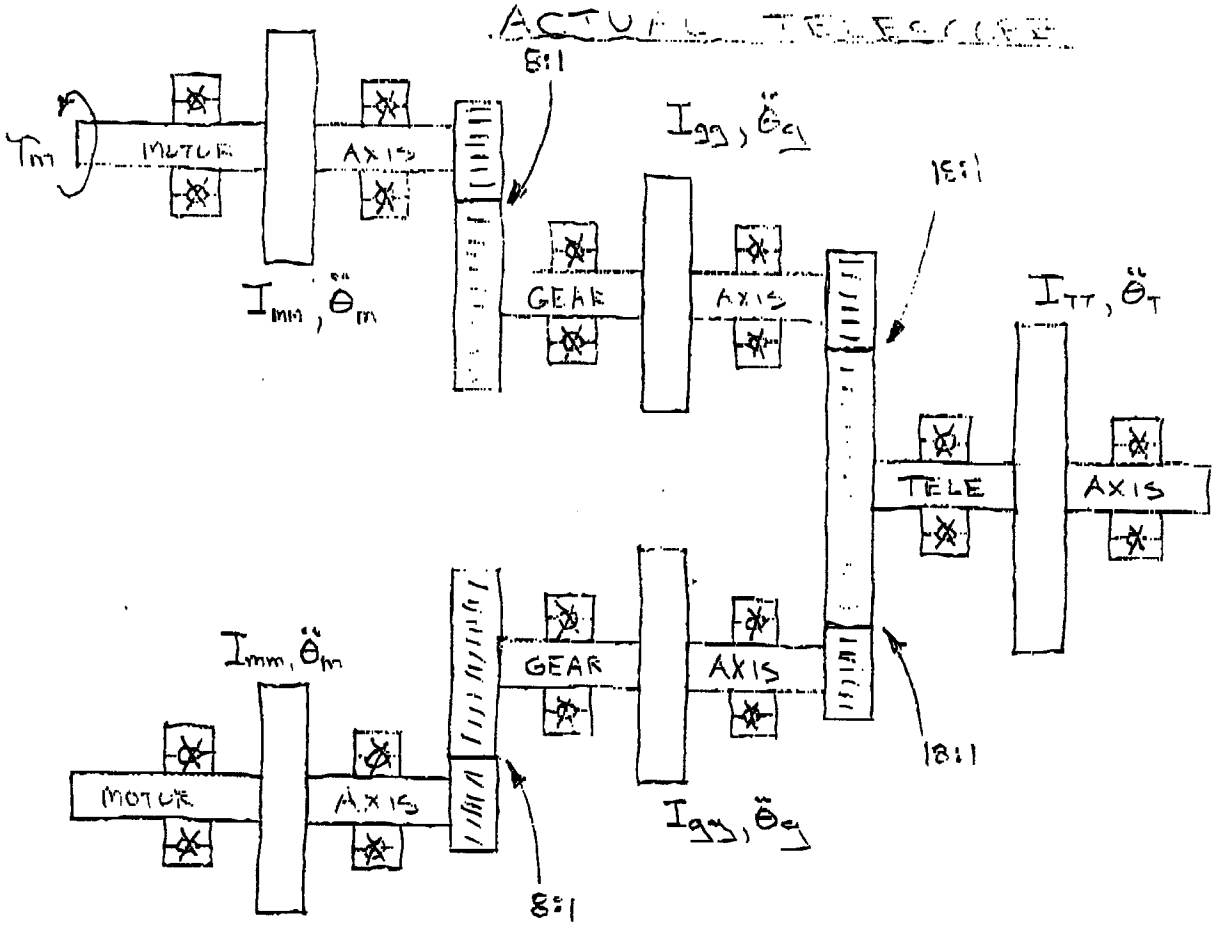
PROPOSED CONFIGURATION #1



$$\frac{T_{tele}}{I_{xx}} = .07325 \left(\frac{rad}{s^2}\right)$$

MAX SLEW $\dot{\theta}$ = 2000 arcsec/s
MAX MOTOR $\dot{\theta}$ = 80 deg/s
MAX ENCODER $\dot{\theta}$ = 83.3 deg/s

ACTUAL TELESCOPE ①



$$T_m = \left\{ 2 \times I_{mm} + 2 \times \left(\frac{1}{8}\right)^2 I_{gg} + \left(\frac{1}{8}\right)^2 \left(\frac{1}{18}\right)^2 I_{TT} \right\} \ddot{\theta}_m$$

* $T_m = 271$ N·m [max torque of telescope drive motors]
* $I_{mm} = 0.727$ kg·m² [from shop dwgs · shaft, coupling and motor rotor]
* $I_{gg} = 8.002$ kg·m² [from shop dwgs · 2 gears and shaft]
* $I_{TT} = 532.716$ kg·m² [from IPL estimates] Yoke + Tube

$$\therefore \ddot{\theta}_m = \frac{271}{\{1.454 + .250 + 25.690\}}$$

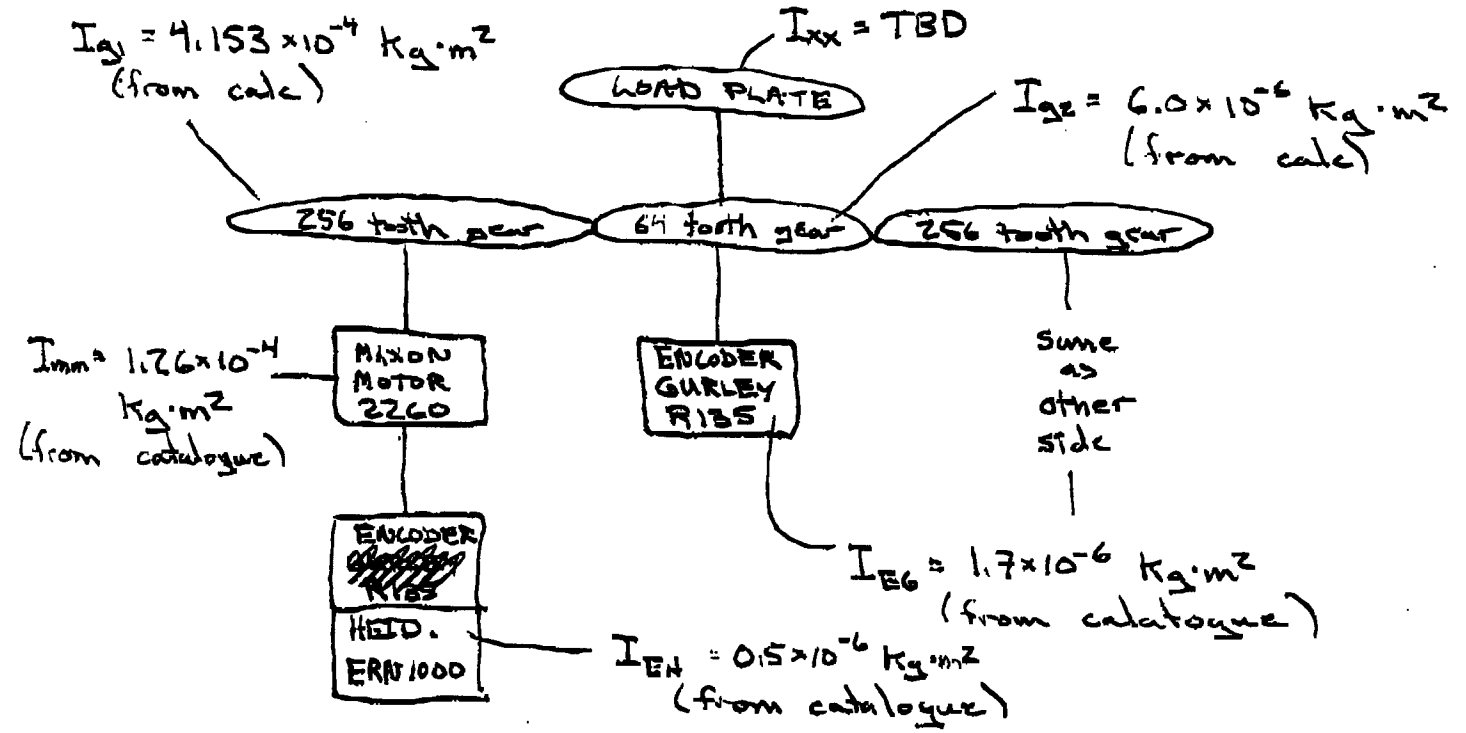
$$= 9.893 \text{ rad/s} \quad [\text{of motor axis}]$$

REVISED MODEL (Oct 27/03)

* now using Gurley R135 encoders for position
* still using Maxon 2260 motors
* now using Heidenhain ERN1000 encoders for velocity
* still using 256 tooth gear on motor axis
* now using 64 tooth gear on load axis

- Gurley R135 has 230 400 counts /rev (@ encoder)

∴ has 921 600 counts /rev (@ motor) ✓



$$\frac{.332}{9.893} = 2\left[1.26\times10^{-4} + 0.5\times10^{-6} + 4.153\times10^{-4}\right] + \left(\frac{256}{64}\right)^2\left[6.0\times10^{-6} + 1.7\times10^{-6} + I_{xx}\right]$$

$$I_{xx} = 2.035 \times 10^{-3} \text{ kg·m}^2$$

(3)

SOME Ixx Calcs for size of table

A disk : Aluminum ($\rho = 2700\ kg/m^3$)

dia = 150 mm (approx 6")
th = 6.35 mm (exact ¼")

$I_{xx} = 0.85 \times 10^{-3}\ kg \cdot m^2$
$m = 0.303\ kg$

A disk : Aluminum

dia = 175 mm (approx 7")
th = 6.35 mm (exact ¼")

$I_{xx} = 1.38 \times 10^{-3}\ kg \cdot m^2$
$m = 0.412\ kg$

---

* I recommend a 7" alum disk, ¼" thick with a bolt circle pattern @ ø6" (maybe 12 holes × ¼-20) that you can put SHCSs in to adjust mass.

TACH CALC

Currently : We use TG5714 (Inland)

12 Volts / (rad/s) ⇒ .008 V/(arcsec/sec) ⇐ *ON SKY!

⇒ .000058 1 V/(arcsec/sec) ⇐ *ON MOTOR

But our current noise floor is 1.22 mV

⇒ ∴ we currently have 21 arcsec/sec resolution on the motor

⇒ ∴ we currently have .145 arcsec/sec resolution on the telescope

---

⇒ TO GET 20 arcsec/sec resolution on motor

@ 100 Hz readout (.01 s)

we require (.01)(20) = .2 arcsec resolution on encode

= 5 counts / arcsec

= 6 480 000 counts / rev

ERN 1000 → 3600 lines/rev
IK 220 → 4096 interp
} ⇒ 15 782 400 counts / rev

⇒ TRY @ 150 Hz readout (5 × 30Hz) ⇒ $\left(\frac{1}{150}\right)$ sec/cycle

15 782 400 counts / rev = 12.178 counts / arcsec

= 0.0821 arcsec / count

∴ we get $\frac{.0821 \text{ arcsec}}{\left(\frac{1}{150}\right) \text{ sec}}$ ⇒ **12.31 arcsec/sec resolution (@motor)**

*** better than tach ***

TCS LAB MOTOR - BEARINGS

* It will be very important that we remove all axial/radial clearance.

* As bearing is mounted on shaft/in housing, an interferance fit or transition fit should be used.

* Using two "single row angular contact" bearings seated in a back to back arrangement will allow us to remove all clearance as we preload the bearing. SEE pg A-5
  A-20
  A-22

* I have selected SINGLE ROW ANGULAR CONTACT

  Bore - 10 mm ∅
  Housing - 30 mm ∅
  Width - 9 mm
  Contact Angle = 30°

  COST BETWEEN $50-200 pr

* Bearing tolerance class P4 (ABEC 7) SEE pg A52

* Bearing fits to be transition or interferance:

  ∴ on 10 mm shaft we require js5 ⇒ $^{+.003}_{-.003}$ mm
  or
  h5 ⇒ $^{+.000}_{-.006}$ mm

I found St. Steel ground shaft 10mm ∅ in the NORDEX catalogue with $^{+.000}_{-.005}$ tolerance and 25μm finish for approx. $8.00/ft.

LONG LEAD ITEMS

2 × Heidenhain ERN 1000		$280 ea
1 × Heidenhain IR 220		$1380 ea
2 × Maxon 2260 motor		$265 ea
2 × Maxon Servo Amp		$119 ea
FAQ 2 × 256 tooth gear		$50 ea
4 × Angular contact bearing		$100 ea
misc hardware (shaft coupling etc)		$100
1 × Gurley R135 encoder (230400)		$440
2 × Angular Contact bearing		$100
1 × 64 tooth gear		$25 ea
misc hardware (shaft, coupling, etc)		$100

4075

× 2 = 8150

Need Computer → OK

Need D/A board → 200^{00}

15K

∴ on 30 mm housing we req. JS6 $\Rightarrow \begin{matrix}+.0065\\-.0065\end{matrix}$

or H6 $\Rightarrow \begin{matrix}+.013\\-.000\end{matrix}$

I would prefer to go with the JS6 tolerance on the hole. ie. tolerance should read:

$30.0 \begin{matrix}+.0065\\-.0065\end{matrix}$ mm

SEE pg A80 - A85

* To remove all axial/radial clearance, preload should be applied using a nut, or cap & bolts capable of adjusting preload in the axial direction. SEE pg A106