tion of very thin composite 20-cm-di-
diameter laminate face sheets with
good as-fabricated optical figure was
developed. The approach is a new
mandrel resin surface deposition
onto previously fabricated thin com-
posite laminates.

2. Matrix (regenerative) power topol-
yogy: Waveform correction can be
achieved across an entire face sheet
at 6 kHz, even for large actuator
counts. In practice, it was found to
be better to develop a quadrant
drive, that is, four quadrants of 169
actuators behind the face sheet. Each
quadrant has a single, small,
regenerative power supply driving
all 169 actuators at 8 kHz in effec-
tive parallel.

3. Q-switch drive architecture: The Q-
switch innovation is at the heart of
the matrix architecture, and allows
for a very fast current draw into a de-
sired actuator element in 120 counts
of a MHz clock without any actuator
coupling.

This work was done by Gareth J. Knowles,
Ross W. Bird, and Brian Shea of QorTek
and Peter Chen of the Catholic University of Amer-
ica for Goddard Space Flight Center. For fur-
ther information, contact the Goddard Innova-
tive Partnerships Office at (301)
286-5810. GSC-15666-1

T-Slide Linear Actuators

These long-stroke linear slide actuators can hold their position with power off.

Goddard Space Flight Center, Greenbelt, Maryland

T-slide linear actuators use
gear bearing differential
epicyclical transmissions (GB-
DETs) to directly drive a linear
rack, which, in turn, performs
the actuation. Conventional
systems use a rotary power
source in conjunction with a
nut and screw to provide lin-
ar motion. Non-back-drive
properties of GBDET’s make
the new actuator more direct
and simpler. Versions of this
approach will serve as a long-
stroke, ultra-precision, posi-
tion actuator for NASA sci-
ence instruments, and as a
rugged, linear actuator for
NASA deployment duties.

The T slide can operate effec-
tively in the presence of
side forces and torques. Ver-
sions of the actuator can per-
form ultra-precision posi-
tioning. A basic T-slide actuator is
a long-stroke, rack-and-pinion
linear actuator that, typically,
consists of a T slide, several
idlers, a transmission to drive
the slide (powered by an elec-
tric motor) and a housing that
holds the entire assembly. The
actuator is driven by gear ac-
tion on its top surface, and is guided and
constrained by gear-bearing idlers on its
other two parallel surfaces.

The geometry, implemented with
gear-bearing technology, is particularly
effective. An electronic motor operating
through a GBDET can directly drive the
T slide against large loads, as a rack and
pinion linear actuator, with no break
and no danger of back driving. The ac-
tuator drives the slide into position and
stops. The slide holes position with
power off and no brake, regard-
less of load. With the T-
slide configuration, this
GBDET has an entire T-gear
surface on which to operate.

The GB idlers coupling the
other two T slide parallel sur-
faces to their housing coun-
terpart surfaces provide con-
straints in five degrees-of-
freedom and rolling friction
in the direction of actuation.
Multiple GB idlers provide
roller bearing strength suffi-
cient to support efficient,
ralling friction movement,
even in the presence of large,
resisting forces.

T-slide actuators can be
controlled using the combi-
nation of an off-the-shelf,
electric servomotor, a motor
angle resolution sensor (typi-
cally an encoder or resolver),
and microprocessor-based in-
telligent software. In applica-
tions requiring precision posi-
tioning, it may be necessary
to add strain gauges to the T-
slide housing. Existing sen-
sory-interactive motion con-
trol art will work for T slides.
For open-loop positioning, a
stepping motor emulation technique
can be used.

This work was done by John Vranish of God-
dard Space Flight Center. Further informa-
tion is contained in a TSP (see page 1). GSC-
15023-1

Front, top, and back views of the T Slide and Idlers. The slide is driven by
gear action on its top surface and is guided by gear-bearing idlers on its
other two parallel surfaces.