MAGNETIC BEARINGS FOR A HIGH-PERFORMANCE OPTICAL DISK BUFFER

VOLUME II

SatCon Technology Corporation
12 Emily Street
Cambridge, MA 02139

Contract No. NAS5-30309

May 1990
Final Report for Period May 1988 - April 1990

Prepared for

Goddard Space Flight Center
Greenbelt, Maryland 20771
Operating Instructions
A. Front Panel Layout

Leftmost on the front panel are five pairs of test points which give the user access to the position signals from the five magnetic-bearing control loops. From left to right, the signals and their scale factors are:

- x-axis displacement: 77 microns/volt
- z-axis displacement: 90 microns/volt
- x-axis rotation: 3.6 milliradians/volt
- y-axis rotation: 1.4 milliradians/volt
- z-axis rotation: 0.22 milliradians/volt

The leftmost switch on the front panel opens and closes the five magnetic-bearing control loops simultaneously using a start-up/shut-down procedure which takes approximately 5 seconds to complete.

The next switch on the front panel controls the DC power to the magnetic-bearing controller circuitry; the green LED to the right of the switch illuminates when the DC power is on.

Rightmost on the front panel is the switch which controls the AC power to the chassis, and the AC power-on light and line fuse.

B. Turn-On Procedure
The normal procedure for turning on the system is as follows:
1. Turn on the AC power to the chassis.
2. Turn on the DC power to the controller.
3. Place the "Control Loops" switch in the CLOSED position. Wait 5 seconds for start-up procedure.

C. Shut-Down Procedure
The normal procedure for shutting off the system is as follows:
1. Place the "Control Loops" switch in the OPEN position. Wait 5 seconds.
2. Turn off the DC power to the controller.
3. Turn off the AC power to the chassis.

D. Latch-Up Protection
Should the orientation of the translator become such that the control loops cannot return it to its nominal position, the protection circuitry will automatically cycle the system through both the shut-down and start-up procedures in an attempt to recover control. This process takes approximately 10 seconds to complete.
<table>
<thead>
<tr>
<th>DWG NO.</th>
<th>DWG NAME</th>
<th>DATE</th>
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<tbody>
<tr>
<td>1009-300</td>
<td>Frame Assy</td>
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<td>1009-301</td>
<td>Transport Assy</td>
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<td>1009-302</td>
<td>Layout-Force Sensor Assy</td>
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<td>Mount, Carriage-Force Sensor Fixture</td>
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<td>1009-304</td>
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<td>Layout/Holding Fixture</td>
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<td>1009-306</td>
<td>Mounting Bar, Rear</td>
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<td>1009-307</td>
<td>Mounting Bar, Front</td>
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<td>Support Gusset</td>
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<td>Adapter, Milling Machine</td>
<td>20 Nov 89</td>
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<td>1009-311</td>
<td>Rev A Spacer, Transport-1</td>
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<td>1009-101</td>
<td>Pole</td>
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<td>1009-102</td>
<td>Base Plate</td>
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<td>Pole Piece, X-Axis</td>
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<td>Gusset Bracket</td>
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<td>Gusset Spacer</td>
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<td>Plate, Adapter, Inner</td>
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<td>Mount, Force Sensor-Right</td>
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<td>Block, Frame/Sensor Interface</td>
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<td>Base Plate, Force Sensor Test Fixture</td>
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<td>Optical Head Mock-up</td>
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<td>1009-243</td>
<td>Chassis Interwiring Diagram</td>
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NOTES:
1. FINISH WHERE MACHINED 6/3
2. REMOVE BURRS AND BREAK SHARP EDGES .015 MAX
3. STRESS RELIEVE PRIOR TO FINAL GRINDING
4. FINAL GRIND AFTER HARDCOAT

DRILL AND TAP FOR A NO. 10-32UNF X 1.5# HELICAL INSERT 2 PL

.280 DIA THRU CBORE .406 DIA X .250 DP 6 PL

TOLERANCES

MOUNTING BAR, INNER HOLDING FIXTURE

Material: ALUMINUM | Finish: BUCK

Permit: 1/32 X .005

G010-Thru HARDCOAT ANODIZE 1009-506
NOTES:
1. FINISH WHERE MACHINED
2. REMOVE BURRS AND BREAK SHARP EDGES .015
3. DASH 1 MACHINE AS SHOWN, DASH 2 MIRROR IMAGE
4. STRESS RELIEVE PRIOR TO FINAL GRINDING
5. FINAL GRIND AFTER HARDCOAT

DRILL AND TAP FOR A NO 1/4-20 X 1.50 # LG HELICAL INSA 3 PL

TOLERANCES

SUPPORT GUSSET

MATERIAL ALLOY/ FINISH BLACK
GUSSET ANODIZE 100A-1000-1
NOTES:
1. FINISH WHERE MACHINED \(\checkmark\) EXCEPT AS NOTED
2. REMOVE BURRS AND BREAK SHARP EDGES .015 EXCEPT AS NOTED
SATCON TECHNOLOGY

STANDARD TOLERANCES

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BASE PLATE

ALUM ALLOY 6061-T6

DRAWING NUMBER
1009-102
NOTES:
1. FINISH ALL OVER
2. REMOVE BURRS AND BREAK SHARP EDGES .010 MAX
3. HEAT TREAT PRIOR TO FINAL FABRICATION PLR 1009-106

TOLERANCES

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POLE PIECE, X AXIS

FINISH: NONE
MATL: HY-MU 80
A Gusset Bracket

TOLERANCES

X/2

MATL: ALUM. ALLOYS FIN. BLACK ANODIZE 009-104

DRAWN BY KMD

SCALE: 2 IN. = 1 FT

DATE: 06/10/89

APPROVED BY

201 DIA THRU 2 PLACES

.480

.212

.275

.275

.562

.70

1.235

.300

.80

.40

6.0
.300

.80

.430

.215

.265

.275

.10 DIA THRU 2 PLACES

TOLERANCES

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GUSSET SPACER

MATL: ALUM ALLOY  FIN: BLACK ANODIZE

DRAWING NUMBER 1009-105
Annealing Instructions for HyMu-80

1) Heat to 2100°F in dry hydrogen atmosphere (dew point below -40 °F)

2) Hold at 2100°F for 3 hours

3) Furnace cool to 700°F at 350-600°F/hour

4) Air cool to room temperature, rate not critical

NOTE: Oil, grease, lacquer, and all other contaminants must be removed before annealing. Individual parts should be separated by inert insulating powder such as magnesium or aluminum oxide during hydrogen anneal to prevent fusion to holding tray or each other.
Drawing #1009-107

Annealing Instructions for Silicon Iron-C

1) Heat to 1600°F in wet hydrogen atmosphere, rate not critical
2) Hold at 1600°F for 3 hours
3) Furnace cool to 1000°F at 150°F/hour
4) Furnace cool to room temperature, rate not critical

NOTE: Oil, grease, lacquer, and all other contaminants must be removed before annealing. Individual parts should be separated by inert insulating powder such as magnesium or aluminum oxide during hydrogen anneal to prevent fusion to holding tray or each other.
1009-208 SHAFT ASSEMBLY

1) Fabricate piece parts 1009-201, 1009-202, 1009-203 per drawings.

2) Assemble parts on flat reference table, tighten bolts.

3) Drill and ream through pilot holes for press fit with .0625 dowel pin (.090 deep in 1009-203).

4) Match grind 5.600 shaft dimensions per 1009-208 and mark parts for correct re-assembly.
NOTES:
1. UNLESS OTHERWISE SPECIFIED TOLERANCE SHALL BE ±0.005
2. MATERIAL: SmCo22MGOe FROM PERMAG 96531A

DIRECTION OF MAGNETIZATION

BEARING, MAGNET
**NOTES:**

1. Finish all over
2. Remove burrs and break sharp edges .010 max
3. Dash 1, machine as shown. Dash 2, relief to be machined on opposite side
4. Heat treat per 1009-106 prior to final fabrication
5. See DWG 1009-207 for final dimensions after assembly
6. All holes to be located from indicated surface of relief, dash 1 and dash 2

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**TOLERANCES**

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**FINISH:** None  
**MATERIAL:** HY-MU 80 

**DRAWING NUMBER:** 1009-2000 A

**DRAWN BY:** KMA

**APPROVED BY:** Tim Haxby 1/1 MAY 89
NOTES:
1. FINISH ALL OVER \( \checkmark \)
2. REMOVE BURRS AND BREAK SHARP EDGES .015 MAX
3. HEAT TREAT PRIOR TO FINAL MACHINING PER DWG 1009-107
NOTES:
1. FINISH ALL OVER 32
2. REMOVE BURRS AND BREAK SHARP EDGES .015 MAX
3. HEAT TREAT PRIOR TO FINAL MACHINING
PER DWG 1009-107

NO. 6(.138)-32 UNC-2B THD 2 PL

.120 DIA C'BORE .200 DIA .005
X .12S DP 2 PL

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TOLERANCES

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PLATE, ADAPTER, INNER

FINISH: NONE   MATL: HY-MU 80   DRAWING NUMBER 1009-202
NOTES:
1. FINISH ALL OVER 
2. REMOVE BURRS AND BREAK SHARP EDGES .015 MAX
3. SEE DWG 1009-300 FOR FINAL DIMENSIONS
4. HEAT TREAT PRIOR TO FINAL MACHINING PER DWG 1009-107
NOTES:

1. PARTS SHALL BE DISASSEMBLED TO WIND CONDUCTORS ONTO POLE PIECE. AFTER REASSEMBLY PARTS SHALL MEET SPECIFIED TOLERANCES

2. SEE ATTACHED SHEET FOR ASSEMBLY PROCEDURES

△ TO ACHIEVE .9700 DIM REMOVE EQUAL MATERIAL FROM BOTH SIDES

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MAGNETIC BEARING ASSEMBLY
PLATE, ADAPTER, OUTER 1009-201

PLATE, ADAPTER, INNER 1009-202

NO. 4-40 S/J HL CAF x .312 LG 4 FL

SHAFT 1009-203

DRILL AND REAM THRU PILOT HOLE FOR PRESS FIT WITH .0625 DOWEL PIN 4 FL

\[ \pm .0005 \]

5.600

\[ \pm .0003 \]

NOTE:

\[ \Delta \] DASH 1 AND DASH 2 TO BE MATCH GROUND
NOTES:
1. THIS PART TO BE MATCH GROUND WITH 1009-210, 1009-211, 1009-212 AND 1009-213
NOTES

1. THIS PART TO BE MATCH GROUND WITH
   1009-209, 1009-210, 1009-212 AND 1009-213

MATERIAL TO BE REMOVED FROM THIS SIDE

\[ .319 - 323 \text{ DIA C'\#ORE} \times .09 \text{ DP} \]

\[ .0085 \]

\[ 1.125 \]

\[ .250 \]

\[ .266 \]

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71 ROGERS STREET
CAMBRIDGE, MA 02142

SCALE: 1/1
APPROVED BY
DATE: 20 JUN 89
Tim Hauser 79-4-029

SUPPORT, INNER FRAME

TOLERANCES

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MATL: MAKE FROM RCA
PART NO. 8382783-1
DRAWING NUMBER 1009-211
NOTES:

1. THIS PART TO BE MATCH GROUND WITH
   1009-209, 1009-210, 1009-211 AND 1009-213
NOTES:

1. THIS PART TO BE MATCH GROUND WITH 1009-209, 1009-210, 1009-211 AND 1009-212
HOLE "B"

.125 DIA THRU
.22 DIA C'BORE
.13 DP
2 PLACES

NOTES:
1. HOLE "B" .125 DIA THRU
   C'BORE .312 DIA x .100 DP
   REAM .319 DIA
   FLOOR HOLE "B" MUST BE FLAT

2. HOLE "B" .125 DIA THRU
   C'BORE .219 DIA x .100 DP
   REAM .225 DIA
   FLOOR HOLE "B" MUST BE FLAT

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STANDARD TOLERANCES

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SENSOR MOUNT

ALUM ALLOY 6061-T6

DRAWING NUMBER 1009-215-X
NOTES:
1. FINISH ALL OVER EXCEPT AS NOTED
2. REMOVE BURRS AND BREAK SHARP EDGES .015

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NOTES:
1. FINISH ALL OVER √ EXCEPT AS NOTED
2. REMOVE BURRS AND BREAK SHARP EDGES .015

TOLERANCES

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MOUNT, FORCE SENSOR - RIGHT

MATL: ALUM ALLOY 6061-T651
FINISH: BLACK ANODIZE
DRAWING NUMBER 1009-217
NOTES:
1. FINISH ALL OVER √
2. REMOVE BURRS AND BREAK SHARP EDGES .015

TOLERANCES

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BLOCK, SENSOR/FRAME INTERFACE
MATL: 302 ST. ST. OR EQUIV.
FINISH: NONE
DRAWING NUMBER 1009-218
NOTES:
1. FINISH WHERE MACHINED
2. REMOVE BURRS AND BREAK SHARP EDGES .015

DRILL AND TAP FOR A NO. 10-32 UNF-2B HELICOIL INSR X 1.50 # LG 12 PL

7 5/8
3.600
1.380
1.32
3.000
1.80
7.888
2.250
13 3/4

TOLERANCES

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NOTES:
1. FINISH WHERE MACHINED
2. REMOVE BURRS AND BREAK SHARP EDGES .015 MAX

DRILL AND TAP FOR A NO G-32 UNC-2B x 1.0 Ø LG HELICAL INSR

DRILL AND REAM FOR PRESS FIT WITH .0625 DIA DOWEL PIN

.100 DIA C'BORE .500 DIA X 1.37 DEEP

TOLERANCES

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WINDING PLATE, X-AXIS

MATL: ALUM ALLOY 6061-T651

DRAWING NUMBER 1009-220
NOTES:
1. FINISH WHERE MACHINED
2. REMOVE BURRS AND BREAK SHARP EDGES .015 MAX

DRILL AND TAP FOR A -
NO. G-32UNC-ZB X
1.0 Ø LG HELICAL INSR

.500 DIA X
1.12 DP

WINDING PLATE, Z-AXIS

TOLERANCES

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MATL: ALUM ALLOY
G061-T651

DRAWN BY KMA

DRAWING NUMBER REV
1009-221 A
NOTES:
1. FINISH WHERE MACHINED
2. REMOVE BURRS AND BREAK
   SHARP EDGES .015 MAX

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<tr>
<td>±1/32</td>
<td>±.01 ±.005</td>
</tr>
</tbody>
</table>

MATL: ALUM ALLOY
G061-T651
FINISH: BLACK
ANODIZE
DRAWING NUMBER 1009-222
NOTES:
1. FINISH WHERE MACHINED
2. REMOVE BURRS AND BREAK SHARP EDGES .015

2.50

.700

.450

.250

.750

.375

.992

2.58

3.000

1.000

3.50

1.515

.780 DIA THRU
CBORE .406 DIA x
.60 DP
4 PL

DRILL AND TAP FOR A NO. 1/4-20 UNC x 1.5 Ø
HELICAL INSERT
2 PL

TOLERANCES

<table>
<thead>
<tr>
<th>X/X</th>
<th>XX</th>
<th>XXX</th>
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<tbody>
<tr>
<td>±1/2</td>
<td>±0.01</td>
<td>±0.005</td>
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BASE PLATE, HOLDING FIXTURE

MATL: ALUM ALLOY
FINISH: BLACK ANODIZE
DRAWING NUMBER 1009-223
NOTES:
1. FINISH WHERE MACHINED ✔
2. REMOVE BURRS AND BREAK SHARP EDGES .015

TOLERANCES
\( \pm \frac{1}{32} \)  \( \pm .01 \)  \( \pm .005 \)

CLAMP, HOLDING FIXTURE

MATERIAL: ALUM. ALLOY 6061-T651
FINISH: BLACK ANODIZE

DRAWN BY KMA

SCALE: 2/1
DATE: 1SAUG89
APPROVED BY: [Signature]
DRAWING NUMBER: 1009-224
NOTES:
1. FINISH WHERE MACHINED
2. REMOVE BURRS AND BREAK SHARP EDGES .015

<table>
<thead>
<tr>
<th>TOLERANCES</th>
<th>HOLDER, ROD - LVDT</th>
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<tbody>
<tr>
<td>x/x</td>
<td>.XX</td>
</tr>
<tr>
<td>±1/32</td>
<td>±.01</td>
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<tr>
<td>.XXX</td>
<td>±.005</td>
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</table>

MATL: ALUM ALLOY  FINISH: BLACK
G001-T651     ANODIZE  1009-Z25
NOTES:
1. FINISH WHERE MACHINED ✓
2. REMOVE BURRS AND BREAK SHARP EDGES .015

1.00
.500
.25
.31
.931
.18
2.00
.812 DIA

.186 DIA X .50 DP
NO. 8-32 UNC-2B THD
2 PL

.313 DIA X .75 DP
C BORE
2 PL

TOLERANCES

<table>
<thead>
<tr>
<th>±1/32</th>
<th>±0.01</th>
<th>±0.005</th>
</tr>
</thead>
<tbody>
<tr>
<td>x/x</td>
<td>XX</td>
<td>XXX</td>
</tr>
</tbody>
</table>

MATEL: ALUM ALLOY
FINISH: BLACK ANODIZE
DRAWING NUMBER
1009-226
NOTES:
1. UNLESS OTHERWISE SPECIFIED TOLERANCE ARE ± .005
2. MATERIAL~ AL ALY G061-T6

.086-52 UNC-2B X .25 DEEP 4 PLACES