

**Model 6800HP
Galvanometer Optical Scanner**

INSTRUCTION MANUAL

**CAMBRIDGE TECHNOLOGY, INC.
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U.S.A.**

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Revision 1, November 21, 1996

1.0. Introduction and Warnings

This manual was written to help the customer use the Model 6800HP scanner successfully. There are several warnings and precautions written throughout this manual. Read this manual carefully. It is possible to damage the scanner by exposing it to rough handling or contaminants.

As the demand for speed and accuracy of today's optical systems increases, so does the need for high performance, high accuracy scanners. This scanner was designed for just those applications that require ultra-high speed and accuracy.

Note: Throughout this manual the terms mechanical angle and optical angle will be used. For all applications the mechanical angle refers to the angular change of the scanner shaft. For most optical systems the optical angle is the angular change of the beam. For these optical systems, the:

$$\text{optical angle} = 2 \times \text{mechanical angle}$$

WARNING!!!! Upon system shutdown or malfunction, the scanner has the ability to point the beam anywhere within $\sim 120^\circ$ optical. It is up to the end user to limit the exit window of the laser beam in order to provide laser safety.

*****CAUTION!!!** Ensure that the scanner and/or the XY mount has adequate heatsinking to allow scanner operation. Never operate the scanner without a heatsink!! The scanner will suffer irreparable damage if allowed to overheat!! For more information, refer to section 3.2. The Cambridge Technology XY mount is a sufficient heatsink only if bolted to a customer supplied adequate heatsink to conduct away the heat.

Note: These scanners are high performance devices that require some special handling. Never let them impact a hard surface especially on the front shaft. Do not pull or push with anything other than light finger pressure on the front shaft or damage to the front bearing can occur. Do not expose the scanner to extremes of temperature outside the operating limits shown in the specifications section 2.0. Do not let any foreign material, e.g. dust, dirt, solvent, water, oil, etc. come in contact with the front bearing. It is located right at the front end of the scanner. Foreign material inside the bearing will reduce bearing life.

2.0. Specifications

Note: All angles are in mechanical degree unless stated otherwise.

| Scanner MODEL NO. | 6800HP | Tolerance | Units/Notes |
|---|--------------|-----------|--------------------|
| <u>Mechanical Specifications</u> | | | |
| Rated Excursion, Rotor | 40 | Max | degrees p-p |
| Optical Aperture, Two-Axis, std. | 3 | Max | millimeters |
| Rotor Inertia | 0.015 | +/-10% | gm-cm ² |
| Recommended Load | 0.000 - 0.15 | - | gm-cm ² |
| Torque Constant | 2.5E+04 | +/-10% | dyne-cm/amp |
| Coil Resistance | 4.5 | +/-10% | ohms |
| Coil Inductance | 120 | +/-10% | μhenries |
| Back EMF Voltage | 43.6 | +/-10% | μv/degrees/s |
| Thermal Conductivity, Coil-to-Case | 4 | Max | °C/watt |
| Maximum Coil Temperature | 110 | Max | °C |
| Maximum RMS Current | 1.60 | Max | amps |
| Maximum Peak Current | 6 | Max | amps |
| Maximum RMS Power | 15 | Max | watts |
| Fuse rating | 2 | - | amps, fast-blo |
| Settling time | 300 | Typ | μsec.* |
| Scanner Weight | 45 | Typ | grams |
| <u>Position Detector, PD</u> | | | |
| Linearity | 98 | Min | % over 30° |
| Scale Drift | 0.05 | Max | %FSR/°C |
| Zero Drift | 0.01 | Max | °/°C |
| Long Term Drift | 0.25 | Max | %/year |
| Repeatability, Short Term | 20 | Max | μrad. |
| Output Signal, Diff. Mode | { 2.4 | +/-5% | μA/° diff.@ |
| Output Signal, Common Mode | { 58 | Nom | μA@AGC=10V+/-20% |
| PD Power Requirements | { 10 | +/-20% | volts, DC |
| | { 26 | Nom | milliamps |

Mounting requirements: The scanner mount must dissipate 1.5 watt/°C. for a mount temperature of 40°C. In an XY mount, it must dissipate 3.0 watt/°C for a mount temperature of 40°C. See section 3.2 for more information.

* Setup for settling time: 0.002 gm-cm² load moving through a 5° step and settling to within 99% of final position.

3.0 Description of Operation

3.1 Overview

The 6800HP is a moving-magnet actuator, that is the rotor or working part of the scanner is a magnet. A moving magnet motor has no saturation torque limit and very little electrical inductance. Thus extremely high torque can be generated very quickly. This is essential for systems that need short step response times.

There are two practical factors that limit the amount of torque that can be generated by a moving magnet scanner. The peak torque is limited by the mechanical failure limit of the rotor assembly due to stator current in excess of the peak current specification. The rms torque is limited by the maximum power (I^2R losses in the stator coil) the scanner can conduct away. When the maximum rms current has been reached (with adequate heatsinking) the stator has reached its maximum temperature, and thus the motor has reached maximum rms torque level. Extremely high performance can be achieved in part because both the peak torque limit and maximum power that the stator coil can dissipate are very high.

The angular position of the shaft is detected by an optical sensor located on a small circuit card, the position detector board, on the back of the scanner. The output signal of this sensor is a differential current signal that is fed back to the drive electronics, closing the servo loop, and allowing very fast and accurate mirror positioning. A typical position demodulator circuit is included with this manual. Cambridge Technology strongly recommends using this circuit to all customers that do not buy the CTI driver electronics.

Also mounted on scanners with optical position detector boards is a small resistor-style fuse. The purpose of this fuse is to keep the motor from being damaged from excessive current. The fuse rating is listed in the "specifications section", 2.0., above. The fuse is a "Pico" fuse and is a standard part in most electronic parts catalogs. Do not replace it with any other type or value of fuse. Do not short across it unless there is another "Pico" fuse elsewhere in the drive current path. It is possible to put the fuse on a driver board if necessary.

Note: The fuse should never blow during normal operation of the scanner. It may blow if the system becomes unstable during tuning, or if a servo malfunction occurs. If your system keeps blowing its fuse, do not keep replacing it. Call Cambridge Technology for assistance.

A flying lead version of the 6800HP is now being released. This is called the 6800HPL. It does not have a 10-pin connector or a fuse on the position detector board. This allows for very compact XY head design.

The 6800HP and 6800HPL Outline Drawings are included in Appendix 5.1. at the end of this manual.

3.2. Mounting Scheme

Special attention should be given to the mechanical integration of the scanner into the optical system. The customer must provide an adequate path for conducting away the heat generated by the scanner body. The maximum temperature that the scanner body should be allowed to attain is 50°C. This is below the temperature at which a person feels pain, thus the scanner should **never** get too hot to touch! The XY mount should ideally have very low thermal resistance to the ambient temperature. Refer to the specifications section for the minimum heat sinking requirement.

Note: The amount of heatsinking necessary is affected by the ambient temperature of the optical enclosure. At an ambient temperature of 50°C the scanner mount's thermal resistance would have to be zero to run the scanner at its maximum rating.

For the 6800HP scanner, the only valid mounting surface is the long cylindrical section of the body. See the outline drawing at the end of this manual. The scanner must be mounted by this surface to adequately transfer the heat out. A cylindrical, compression-style mount made of aluminum is preferred. The mount should attempt to contact as much of the mounting surface as possible to minimize the thermal resistance. The mount should then be bolted to another thermally conductive plate to finally conduct the heat away to ambient. **Never attempt to mount the scanner by its position detector any other surface than just described or serious overheating will occur!!**

Caution!!! Never run the scanner without a heatsink attached. The scanner body will heat very quickly and irreparable damage will occur, thus voiding the warranty.

3.3. Mirrors

The standard 6800HP comes standard with a fused silica mirror coated with a broad-band hard dielectric. The mirror is designed to have very good flatness and very low blooming. This mirror has a reflectance well above 99% for most of the laser lines from 480 - 650nm. This mirror has been used in applications exceeding 25 watts over its 3mm input aperture. For more information on maximum power density, contact Cambridge Technology directly.

The 6800HP design does not allow for the use of a mirror mount. The mirror is glued directly into a slot cut into the output shaft. This minimizes the extra inertia required to hold the mirror in a removable mount. Mirror alignment is ensured by close tolerancing of the slot's position, and by a mirror alignment fixture. This fixture slips over the front of the motor and holds the mirror in position during gluing. The Mirror Alignment Kit, 6800MRK is not included standard with a 6800HP, but is offered as an option. It includes two mirror alignment fixtures (one for the X mirror and one for the Y), two X and Y mirrors, a large supply of appropriate epoxy, and a written procedure on the gluing operation. **Note: Use the glue sparingly! Do not get the glue into the front bearing!!**

3.4. XY Mounts

There are two standard XY mount designs built for the 6800HP. They are specifically designed for maximum heat dissipation into the mounting surface the XY mount is bolted to.

The standard XY mount is designed to accept a 3mm clear aperture and scan that through an angle of +/-30° optical in each axis. The XY mount comes in to variations: Right- and Left-Handed. This is to accept beams from either the right or the left and project the beam straight ahead. Their part numbers are 6108003R and 6108003L respectively.

Note: CTI XY mounts are designed with the X-scanner tipped back to minimize the inertia of the Y-mirror. The beam still exits the XY mount parallel to the bottom mounting surface. See the two XY Mount Interface Dwg. in appendix 7.1.

4.0. Limited Warranty

The 6800HP scanner is warranted to be free of defects in materials and workmanship for one year from the date of shipment. Cambridge Technology, Inc. will repair or replace, at our option, any part of the system which upon our examination is found to be defective while under warranty. Obligations under this warranty are limited to repair or replacement of the equipment. Cambridge Technology shall not be liable for any other damages of any kind, including consequential damages, personal injury, or the like. Opening the scanner assembly itself will void this warranty. Damage to the system through misuse will void this warranty. Cambridge Technology pursues a policy of continual product development and improvement. We reserve the right to change published specifications without prior notice.

5.0 Appendix

5.1. Schematics and Mechanical Drawings

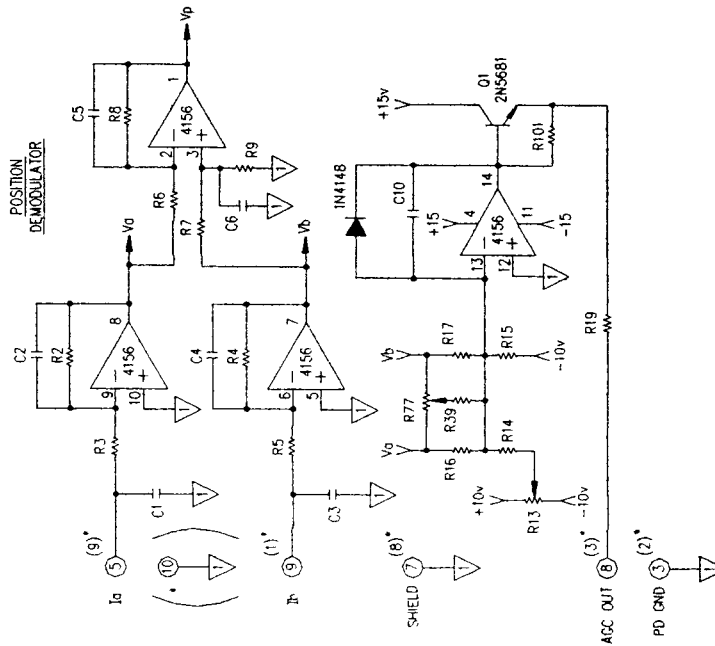
The following drawings are included in this section

- | | |
|---|--------|
| 1. Series 6000 Position Demodulator Components | D01747 |
| 2. 6800HP Outline Drawing | D02598 |
| 3. 6800HP Preferred Mounting Block | D02469 |
| 4. 6800HP Right Handed 3mm XY Mount Interface Dwg | D02134 |
| 5. 6800HP Left Handed 3mm XY Mount Interface Dwg | D02989 |
| 6. 6800HPL Outline Drawing | D03085 |

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| REVISION | | DATE |
|----------|-----|---|
| ECO | REV | DESCRIPTION |
| | C | CHG TO CERAMIC BUTTERFLY, TO REF REV B SEE OBS FILE |
| | D | 6900 COMPS ADDED |
| | E | DMG WAS 'C' SIZE, 6800HP ADDED |
| | F | CHART UPDATED TO REFLECT CURRENT PRODUCTS |
| | G | 6200/6210 COMPS ADDED, R39&R77 ADDED |
| | H | SEE ECO |
| | J | R15 ON 6450 WAS 6.04K |

NOTE 4



NOTE 5

| REF DESIG | 6800/6800H/6810/6850 | 6800HP/6810P/6850P | 6350/6860/6870 | 6450/6880 | 6500 | 6300 | 6400 | 6200/6210/6220/6230 |
|-----------|----------------------|---------------------|----------------|-----------|-----------|-----------|---------------------|---------------------|
| C1 | 22pF | 39pF | 470pF | 470pF | 470pF | 150pF | 470pF | — |
| C2 | — | — | 330pF | 560pF | 470pF | .0022uF | .0015uF | 69pF |
| C3 | — | — | 470pF | 470pF | 470pF | 150pF | 470pF | — |
| C4 | 22pF | 39pF | 330pF | 560pF | .0015uF | .0022uF | .0015uF | 69pF |
| C5 | 220pF | 220pF | .0012uF | .001uF | .0015uF | .0015uF | .0015uF | 220pF |
| C6 | 220pF | .001uF | .0012uF | .001uF | .0015uF | .0015uF | .0015uF | 220pF |
| C7 | .001uF | .001uF | .001uF | .001uF | .001uF | .001uF | .001uF | .001uF |
| C8 | 100K, 5% | 50K, 5% | 16.9K, 1% | 9.09K, 1% | 5K, 1% | 4.99K, 1% | 6.04K, 1% | 30K, 1% |
| C9 | 1K, 5% | 1K, 5% | 453Ω, 1% | 453Ω, 1% | 453Ω, 1% | 453Ω, 1% | 453Ω, 1% | 30Ω, 1% |
| C10 | 1K, 5% | 1K, 5% | 453Ω, 1% | 453Ω, 1% | 453Ω, 1% | 453Ω, 1% | 453Ω, 1% | 30Ω, 1% |
| R1 | 2K, 5% | 2K, 5% | 2K, 1% | 2K, 1% | 2K, 1% | 2K, 1% | 2K, 1% | 6.81K, 1% |
| R2 | 2K, 5% | 2K, 5% | 2K, 1% | 2K, 1% | 2K, 1% | 2K, 1% | 2K, 1% | 6.81K, 1% |
| R3 | 6.2K, 5% | 6.2K, 5% | 4.53K, 1% | 5.11K, 1% | 4.53K, 1% | 6.04K, 1% | 6.04K, 1% | 10K, 1% |
| R4 | 6.2K, 5% | 6.2K, 5% | 4.53K, 1% | 5.11K, 1% | 4.53K, 1% | 6.04K, 1% | 6.04K, 1% | 10K, 1% |
| R5 | 20K, 201 | 20K, 201 | 20K, 201 | 20K, 201 | 20K, 201 | 20K, 201 | 20K, 201 | 20K, 201 |
| R6 | 51K, 5% | 51K, 5% | 49.9K, 1% | 49.9K, 1% | 49.9K, 1% | 49.9K, 1% | 49.9K, 1% | 10K, 1% |
| R7 | 15K, 5% | 15K, 5% | 5.49K, 1% | 5.49K, 1% | 6.04K, 1% | 6.04K, 1% | 6.04K, 1% | 10K, 1% |
| R8 | 10K, 5% | 10K, 5% | 10K, 1% | 10K, 1% | 10K, 1% | 10K, 1% | 10K, 1% | 10K, 1% |
| R9 | 300Ω, 5% 1/2W, C.C. | 300Ω, 5% 1/2W, C.C. | 10Ω, 5% | 10Ω, 5% | 10Ω, 5% | 10Ω, 5% | 250Ω, 5% 1/2W, C.C. | — |
| R10 | 150Ω, 5% | 150Ω, 5% | 150Ω, 5% | 150Ω, 5% | 150Ω, 5% | 150Ω, 5% | 150Ω, 5% | — |
| R11 | 10K, 251 | 10K, 251 | 10K, 251 | 10K, 251 | 10K, 251 | 10K, 251 | 10K, 251 | — |
| R12 | 24K, 5% | 24K, 5% | 200K, 5% | 200K, 5% | 200K, 1% | 200K, 1% | 200K, 1% | — |
| R13 | — | — | — | — | — | — | — | — |
| R14 | — | — | — | — | — | — | — | — |
| R15 | — | — | — | — | — | — | — | — |
| R16 | — | — | — | — | — | — | — | — |
| R17 | — | — | — | — | — | — | — | — |
| R18 | — | — | — | — | — | — | — | — |
| R19 | — | — | — | — | — | — | — | — |

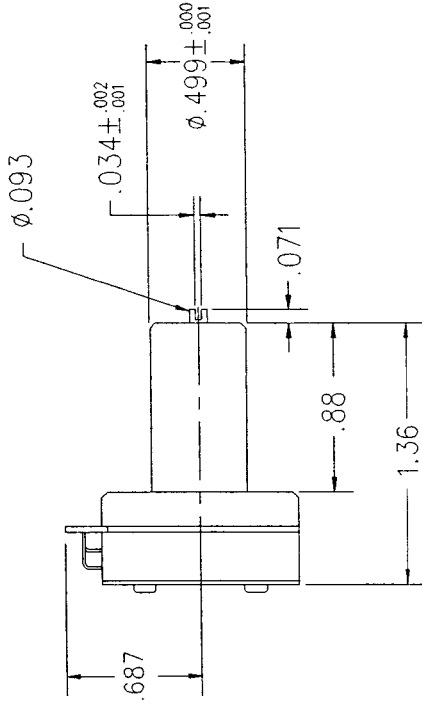
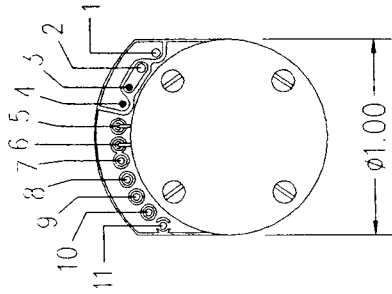
- NOTES:
1. * = 6800/6800H/6800HP/6810/6850 ONLY. PINS 10 AND 2 SHORTED IN MOTOR.
 2. ALL 5% RES. 1/4W OF UNLESS SPECIFIED.
 3. ALL 1% RES. 1/8W MF UNLESS SPECIFIED.
 4. SINGLE LED SYSTEMS.
 5. DUAL LED SYSTEMS.

| | | | | | |
|---------------------------------------|--|--------------|-----|----------------------------|--|
| UNLESS OTHERWISE SPECIFIED TOLERANCES | | DRN 02/25/83 | PTH | CAMBRIDGE TECHNOLOGY, INC. | |
| .XX = ±.010 | | DES | | 109 SMITH PLACE | |
| .XXX = ±.005 | | CHK | | CAMBRIDGE, MA. 02138 - USA | |
| () INDICATES mm | | ENG | | POSITION | |
| ANGLE ± 0°-30° 60° | | APPR | | DEMODULATOR COMPONENTS | |
| SURFACE ROUGHNESS | | PROJECTION | | 6000 SERIES PRODUCTS | |
| BREAK ALL SHARP EDGES | | REVISION | | D01747 | |
| MATERIAL | | | | SCALE: NONE | |
| FINISH | | | | SHEET 1 OF 1 | |
| USED ON | | | | | |

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REVISION

| ECO | REV | DESCRIPTION | APPR | DATE |
|-----|-----|-------------|------|------|
| | | | | |



| HOLE # | DESCRIPTION |
|--------|------------------------------------|
| 1 | +MOTOR |
| 2 | -MOTOR |
| 3 | -MOTOR (INTERNAL CONNECTION) |
| 4 | +MOTOR (INTERNAL CONNECTION) |
| 5 | LED1 ANODE (INTERNAL CONNECTION) |
| 6 | LED1 CATHODE (INTERNAL CONNECTION) |
| 7 | AGC OUT |
| 8 | DIODE COMMON |
| 9 | 1a |
| 10 | 1b |
| 11 | SHIELD |

(ALL DIMENSIONS ARE IN INCHES)

MASS = 45 GRAMS

| | | |
|--|------------|---|
| | DRN | |
| | DES | |
| | CHK | |
| | ENG | |
| | APPR | |
| | PROJECTION | |
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| | FINISH | |
| | USED ON | |

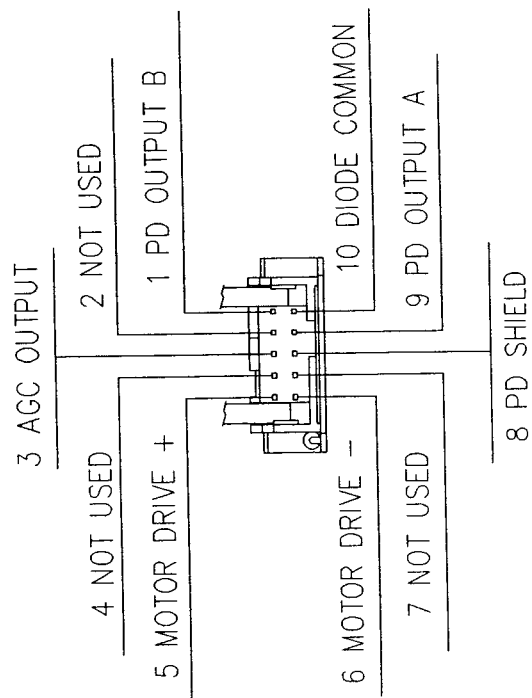
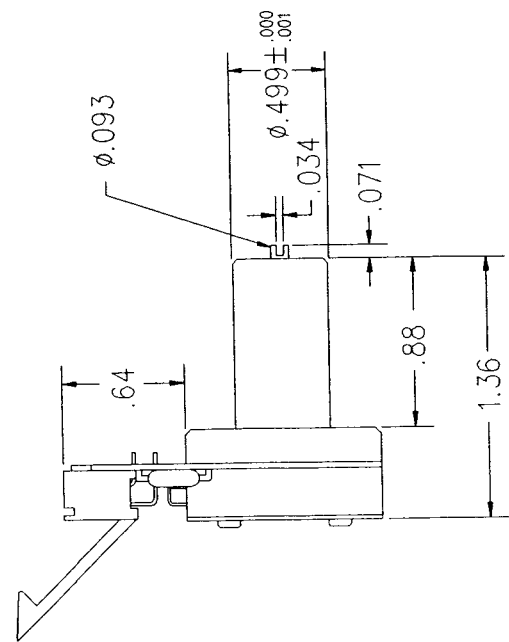
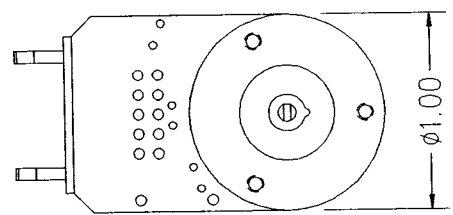
| | |
|--|--|
| | CAMBRIDGE TECHNOLOGY, INC. 23 ELM ST. WATERTOWN, MA. 02172 - USA |
| | 6800HPL OUTLINE DWG. |
| | D03085 |
| | SCALE NONE SHEET 1 OF 1 |

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REVISION

| ECO | REV | DESCRIPTION | APPR | DATE |
|-----|-----|-----------------------------|------|-------|
| 680 | B | END VIEW OF CONN. CORRECTED | PTH | 12/94 |

CONN. TOP VIEW



TOL. .xx = ±.010
.xxx = ±.005

(ALL DIMENSIONS ARE IN INCHES)

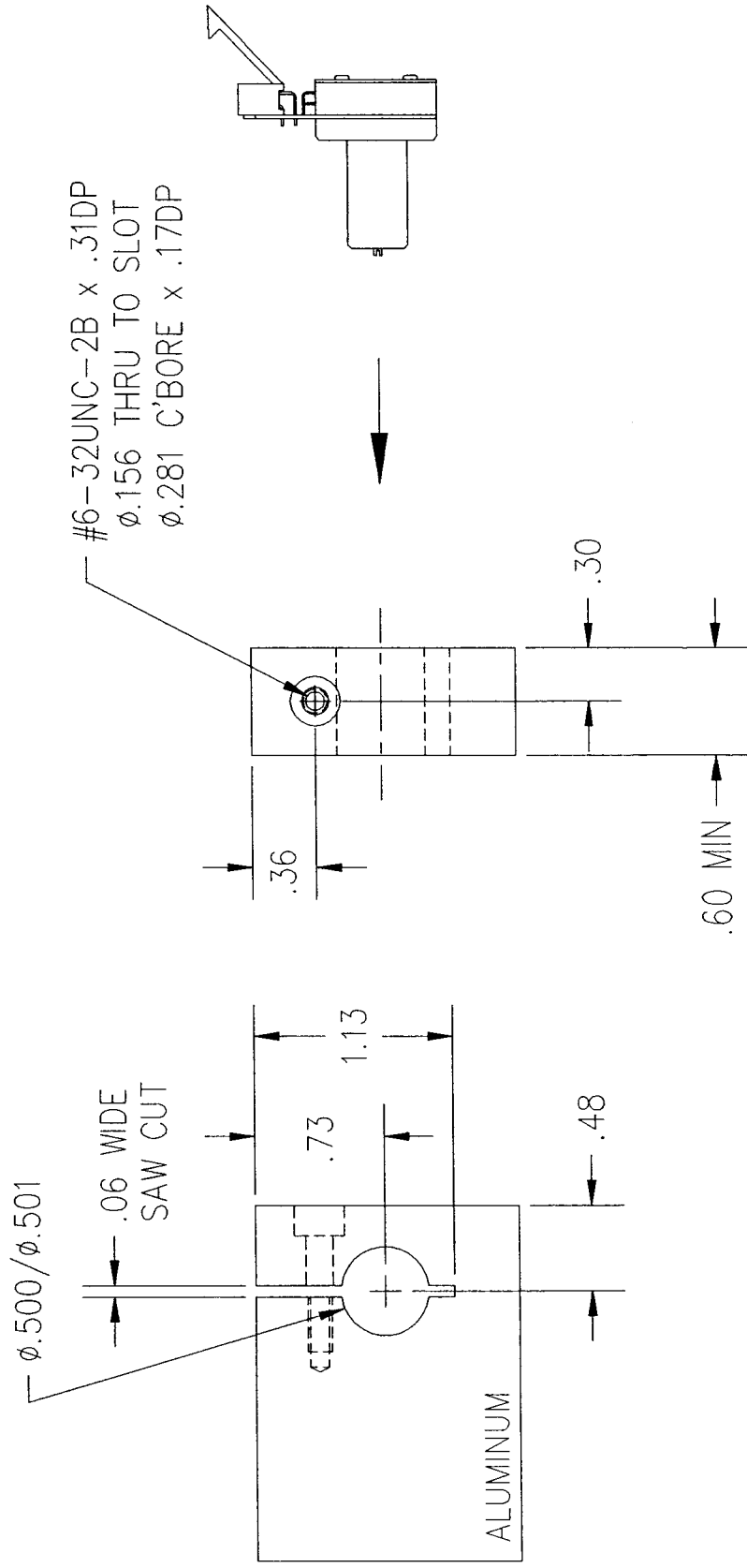
MASS = 45 GRAMS

| | | | | |
|----------------------------|--|------------|------|----------------------------|
| UNLESS OTHERWISE SPECIFIED | | DRN | | CAMBRIDGE TECHNOLOGY, INC. |
| TOLERANCES | | DES | | 23 ELM ST. |
| .XX = ±.010 | | CHK | | WATERTOWN, MA. 02172 - USA |
| .XXX = ±.005 | | ENG | | |
| () INDICATES mm | | APPR | | |
| ANGLES ± 0°-30' | | PROJECTION | | 6800HP |
| MATERIAL | | | | OUTLINE DWG. |
| FINISH | | REVISION | B | A0006-2598 |
| USED ON | | SCALE | NONE | SHEET 1 OF 1 |

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| ECO | REV | DESCRIPTION | APPR | DATE |
|-----|-----|---|------|------|
| 704 | B | .60 MIN WAS .60, .30 ADDED ϕ .156 WAS ϕ .16 | PTH | 2/95 |



| | | | |
|--|--|-----------------------------|-----|
| UNLESS OTHERWISE SPECIFIED TOLERANCES .XX±.010 .XXX±.005 () INDICATES mm ANGLES± 0°-30' | DRN | 7/6/94 | PTH |
| | DES | | |
| | CHK | | |
| | ENG | | |
| MATERIAL | CAMBRIDGE TECHNOLOGY, INC. 23 ELM ST. WATERTOWN, MA. 02172 - USA | | |
| FINISH | 6800/6800H/6800HP PREFERRED MOUNTING SCHEME | | |
| | PROJECTION | | |
| | REVISION | A0006-2469 | |
| | B | SCALE ; NONE SHEET 1 OF 1 | |