WARNING

AS WITH ALL ELECTRICAL DEVICES, THERE IS A SHOCK HAZARD ASSOCIATED WITH THIS DEVICE. ALL INSTRUCTIONS SHOULD BE FOLLOWED PERTAINING TO THE USE OF SUITABLE INTERLOCKS ON ALL POWER SUPPLIES TO BE USED TO POWER THIS PRODUCT.
Precautions to assure the proper operation of your MAK Source

• Water **MUST** be flowing thru the MAK while sputtering. Please see O&M manual for flow requirements.

![CAUTION]

If MAK has been operated without water --- **DO NOT** turn the water on --- allow the MAK to cool down before turning water on.

• Target paste [supplied with MAK] **MUST** be used. This provides a thermal layer between the target and cathode [Copper block]. It is required to protect against uneven or irregular surfaces of the target and / or cathode.

![CAUTION]

**Failure to use target paste can damage the MAK. A VERY SMALL AMOUNT MUST BE APPLIED -- A GLOVED FINGER USED TO SPREAD EVENLY OVER THE CATHODE BLOCK.** The block should be clearly visible --- thru a thin gray film.

**NOTE:** A substitute paste such as thin [0.005”] Indium foil can also be used.

• A keeper **MUST** be used for all targets --- including magnetic. The keeper is used for centering the target and maintaining a continuous magnetic path.

• Ceramic or Oxide targets --- **MUST** --- be bonded to a copper backing plate that contains a keeper.

• **MAK Sputter Sources should be CLEANED** on a routine basis. This is easily accomplished during target change.
  1. With target removed, clean entire cathode assembly --- removing any foreign material present. Cleaning of both inside and outside of the block is suggested.
  2. Clean the anode shield.
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TARGET DIMENSIONS  1.3"  2.0"  3.0"  4.0"  6.0"
SPARE PARTS       1.3"  2.0"  3.0"  4.0"  6.0"
TUTORIALS         {Benefits}  {Simplicity}  {TargetMounting}
INTRODUCING US, a Division of MeiVac, Inc.
US has been an innovative manufacturer of sputtering since 1977. Exclusive licenses were obtained from Stanford University and Lawrence Livermore Laboratory to build and distribute their patented magnetron sputtering sources on a worldwide basis.

MeiVac, Inc. QUALITY ASSURANCE
All MeiVac products are manufactured under the most stringent conditions. This includes proper selection & inspection of original materials, assembly in clean environments, and complete testing for leaks & functionality. These quality products are packaged in durable containers for shipment throughout the world.

INTRODUCING MAK SPUTTER SOURCES
The MAK sputter sources were designed, developed & tested under controlled laboratory conditions at a major United States government laboratory. This low cost planar magnetron sputtering source is compact, easy to install and requires no target bonding. All of the MAK sputter sources (1.3, 2, 3, 4, and 6 inch) provide shielded electrical paths which allow RF as well as DC power to the cathode with minimum line losses and low reflection of RF power.

The MAK sputter source has a unique feature of allowing low operational pressures (0.5 millitorr) as well as high operational pressures (600 millitorr) without losing the focused plasma to the target. The MAK sputter source is available in non-UHV and UHV designs.
Observations of the phenomenon we now call sputtering, go back over one hundred years to early experiments which introduced electricity into a reduced pressure atmosphere. L. Holland describes these beginnings in his book *Vacuum Deposition of Thin Films*.

“When an electrical discharge is passed between electrodes at a low gas pressure, the cathode electrode is slowly disintegrated under the bombardment of the ionized gas molecules. This phenomenon is termed cathodic sputtering. The disintegrated material leaves the electrode surface either as free atoms or in chemical combination with the residual gas molecules. Some of the liberated atoms are condensed on surfaces surrounding the cathode while the remainder are returned to the cathode by collision with gas molecules.”

The ensuing process might be compared to a fine sand blasting in which the momentum of the bombarding particles is more important than their charge. The inert gas argon was chosen, to act as the sputtering medium, because it is a heavy rare gas and is plentiful. It also has a low ionization potential. The inert nature of argon inhibits compounds from being formed at the target surface.

Once sputtered, the target atoms travel until they reach a nearby surface most notably, the substrate. The deposited layer forms or grows on the substrate structure, influenced by such things as material, temperature and gas structure.

When the ions strike the target, their primary electrical charge is neutralized (gain back the lost electron) and they return to the process as atoms. Thus, direct current sources generally prevail as the electrical energy source.

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**Planar Magnetron Sputtering**

*CROSS SECTION OF A PLANAR MAGNETRON*

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*Issued September 11, 2008*
In order to increase sputtering rate, magnetic coils were sometimes placed around the chamber to pinch the plasma during the deposition. The pressure was reduced to 20 microns ($2 \times 10^{-2}$ torr) and the rates increased. The electrodes were close together and the R.F. voltage was high. These conditions caused damage to semiconductor devices due to the high electron and secondary ion bombardment, which took place.

When it was realized how important the role of a magnetic field was in concentrating the plasma and the effects that it had on rate, sputtering became more attractive as a commercial process. Several magnetic configurations were used such as the post cathode, magnetically enhanced hollow cathodes and magnetrons. In order to make a magnetron work, it is necessary to cause the $E \times B$ drift currents to close on themselves. This realization led to the magnetron cathode designs that are in use today.

**MAK BENEFITS**

**BENEFITS OF THE MAK**

**SIMPLICITY IN SPUTTERING**

**Magnetics**

Balanced / Unbalanced

- Magnet array is INTERCHANGEABLE from balanced or unbalanced. Disassembly of source NOT REQUIRED!

- No Magnetic Housing

- Provides higher magnetic density at target surface

- Sputters at lower voltage for comparable power levels

- Standard MAK sputters magnetic material
RF SPUTTERING
If the target is an insulator, the neutralization process results in a positive charge on the target surface. This charge may grow to the point that the bombarding ions (±) are repelled and the sputtering process will stop. In order to make the process continue the polarity of the target must be reversed to attract enough electrons from the discharge to eliminate the surface charge. In order to attract the electrons and not repel the ions, the frequency must be high enough to reverse before the direction of the ions are affected. The usual industrial frequency assigned by the FCC for such is in the MHz range. Since this is a “radio” frequency, the process is called radio frequency sputtering, or RF sputtering. Most of the early sputtering was done using direct current sources. This meant high voltage, with current draw being limited by the gas pressure. Typical voltages were 3-5 kV with a current from 50-250 ma at pressures of 50-250 microns. R.F. power was introduced because it makes it possible to sputter insulators.

BENEFITS OF THE MAK
SIMPLICITY IN SPUTTERING

Physical Parameters

VACUUM SEAL
One Vacuum Seal
- Elastomer (HV) or Metal (UHV) field interchangeable
- No water to Vacuum Seal

Small Profile
- Mounts on CF, ISO or installs thru a Quick Disconnect
- As example, standard 3” MAK fits thru opening of 6” CF

Anode
- Height adjustable to target thickness - Selectively positioning anode to same plane as target --- obviously minimizing material build-up

No Mechanical Target Clamp
- Target surface is not in contact with dissimilar clamping material --- minimizing stress during sputtering and cool down

WATER LINES
- Teflon water lines with quick disconnects

HN CONNECTOR
- Standard HN power connector permits RF/DC operation

Issued September 11, 2008
OPERATION OF THE MAK VACUUM SYSTEMS

To successfully operate the MAK Series, a leak-tight vacuum system must be available. This system should be pumped with a high vacuum pump of the turbo, or a cryo type. It may be necessary to have a throttle valve, or orifice in the system to control pump throughput while the sputtering gas is introduced. If a cryopump is used, the throttle valve may not be required, however, it is desirable if sputtering gas pressures of more than five microns are to be used.

The vacuum system should be equipped with suitable gauging to measure and monitor pressures in the 0.5-600 micron range during sputtering, and the $1 \times 10^{-5}$ to $1 \times 10^{-9}$ torr range during pre-sputter pump down. The system must also be equipped with a fine metering valve and separate in-series shut-off valve used for the introduction of the sputtering gas.

A suitable fixture for mounting and holding the substrate(s) during film deposition should be provided, in conjunction with a means of shuttering the source (target) from the substrate during pre-cleaning of the target.

Since the MAK Series will not operate properly if the shutter is positioned too close to the target, it is suggested that the total distance from target to shutter be at least 1”.

**TURBO PUMPED SYSTEM**
To obtain ideal uniformity, the distance from source to substrate should be adjustable.

Note: The rate will decrease by the square of the distance from source to substrate, however uniformity will be enhanced as this distance is increased.

The chamber may be made of glass or metal. If the chamber is metal, a viewing port should be provided for observation during sputtering.
INSTALLATION OF SOURCES

STANDARD MOUNTING
To mount the source a **QUICK COUPLE** feedthrough adapter is required. A 0.75" adapter is used for the 1.3", 2", and 3", and 4" sources. The 6" MAK requires a 1.25" quick coupler adapter.

A. PREPARING THE SOURCE FOR MOUNTING VIA A QUICK COUPLER

1. Loosen the screws on the End Adapter holding the electrical connector on the end of the tube.
2. Pull straight out on the electrical connector mounting assembly. The whole assembly will come off, leaving the water tubes free and the electrical connector assembly unplugged from the power feed rod.
3. Remove the tube clamp from the tube. This clamp is designed to keep the source in position when the system is under vacuum.
4. From the inside of the vacuum system, insert the water tubes into the feedthrough hole, and then insert the tube. Position the tube to the approximate desired source to substrate distance.
5. Slide on the “O” ring, compression ring and coupler nut. Hand tighten the nut.
6. Slide on the clamp tube, position and tighten.
7. Slide the End Adapter on the tube, making sure that the slip pin in the connector body is inserted in the socket of the power feed rod. Push on as far as it will go and tighten the screws.

8. The system may now be pumped down.

9. Hook up the water lines. Connect the house supply and drain lines to the source tubes. See technical specifications for minimum flow requirements.

10. Connect the power cable.

B. DIRECT FLANGE MOUNTING VIA CF, ISO, ANSI, JIS and other flanges

1. MAK Source has been attached to the mounting flange. To adjust source to substrate distance --- either the substrate must be moved or a feedthrough nipple must be placed between the mounting flange and the vacuum system.

2. Attach the MAK mounting flange to the system.

3. Refer to step (7) above.
POWER HOOK-UP
All MAK sputter sources may be operated in either the DC or RF mode. All models are supplied with an HN (Amphenol UG-496/U) for convenient electrical connection to your choice of power source. The following US Sputtering Power Supplies come complete with output cables having the HN mating connector.

P/N SU-500 DC  500 Watt DC Power Supply
P/N SU-1500 DC  1500 Watt DC Power Supply
P/N SU-5000 DC  5000 Watt DC Power Supply
P/N: SU-R301   300 Watt RF Generator and Automatic Tuning Network
P/N: SU-R601   600 Watt RF Generator and Automatic Tuning Network
P/N: SU-R1001  1000 Watt RF Generator and Automatic Tuning Network

DC Connection
The power supply is provided with twelve feet of RG 8/U high voltage cable. Connect the PL 259 connector to the power supply and the HN connector to the sputter source.

RF Connection
The RF Generator / Automatic Tuning Network is provided with all necessary cables for hook-up.
- 12’ co-axial cable for connection of the power supply to tuning network
- 3’ co-axial cable for connection of tuning network to sputter source (HN Connector)
- 24’ interface cable between network controller and tuning network
- Four-foot control cable between control panel and RF supply

Issued September 11, 2008
**RF Generator**

**Auto Tuning Network**

**D Connector to D Connector**

**50 Pin Connectors with metal covers**

**Power Connection**

**12’ RG-8U Cable with N Type Connections**

**Input Power Connection**

**3’ or 5’ RG 393/U Cable with HN Connector**

**OUTPUT TO SPUTTERING**

**CAUTIONS IN RF HOOK-UP**

Cable length between should be a derivative of the 13.56 MHz. Wave length. Approximately 48, 24, or 12 feet and be 50 ohm RF shielded cable.

Cable length between the tuning network and sputter source should be minimized (3’ or 5’ is recommended for use with US generators).

*Do not use external grounds at electrical connections; see power supply manual for additional details.*
TARGET PARAMETERS

Purity
Target material for the MAK sputtering source is not confined to a minimum or maximum purity level. This parameter is dependent upon film requirements.

Surface
The mounting (bottom side) surface of the target should be smooth and flat to allow good contact to source. The top and bottom of the target should be parallel for best deposition uniformity.

Target Dimensions
See the Target Specifications at www.us-incorp.com.

[1.3" MAK]  [2.0" MAK]  [3.0" MAK]  [4.0" MAK]  [6.0" MAK]

Target Suppliers – For a list of qualified target suppliers, see Appendix B.

Simplicity in Sputtering

INTRODUCING

The MAK
Planar Magnetron Sputtering Source

Target Installation on the MAK

TARGET KEEPER

The MAK sputtering sources have the unique feature of attaching the target using magnetic force. This is accomplished by attaching a magnetically permeable "keeper" (see appendix) to the bottom of the target. This keeper coupling with the magnetic field of the MAK source provides sufficient force to clamp and center the target, eliminating the need for complex mechanical clamps.
Machinable Materials
The target keeper can be attached to machinable materials by drilling and tapping the target to 90% of its thickness and attaching the keeper using a vented flat head screw.

TARGET MOUNTING OF THE MAK
MACHINABLE MATERIALS

By attaching a magnetic keeper to the target, the MAK source uses the magnetics of the gun to hold the target in place.

If you have old targets, NO PROBLEM! Drill and tap your existing targets as shown and attach the metallic keeper.

Then, snap the target into place. It’s that simple!
Non-Machinable Materials
Ceramic and oxide materials, a copper backing plate containing a magnetic keeper should be used. The target must be bonded to this backing plate and this bond must be able to withstand a temperature of 220°C.

TARGET MOUNTING OF THE MAK NON-MACHINABLE MATERIALS

Backing Plates
Ceramics, oxides, and any other non-machinable targets are commonly bonded to a copper backing plate for all sputtering sources.

MAK Backing Plates
The MAK sputter source uses the same backing plate, but with a magnetic keeper attached. The keeper holds the target in place without a mechanical clamp.

Bonded Target - Example
This is an example of a SiO₂ target bonded to a copper backing plate with a magnetic keeper attached.
Copper Backing Plate Specifications (See Appendix A)

MAK 1.3” Copper Backing Plate  Part Number: MAK-130-BP
MAK 2” Copper Backing Plate  Part Number: MAK-200-BP
MAK 3” Copper Backing Plate  Part Number: MAK-300-BP
MAK 4” Copper Backing Plate  Part Number: MAK-400-BP
MAK 6” Copper Backing Plate  Part Number: MAK-600-BP

Caution
Failure to use thermal contact paste or a thin metal foil as an interface layer between the target and the copper cooling block can cause over heating and may damage the MAK source and/or target.

Simplicity in Sputtering
MAK with target installed

1. Spread a small amount of thermal contact paste on the top of the copper chill block. The paste should be spread evenly and so thin you can see through it.
   a) If the thermal contact paste is not used a thermally and electrically conductive foil e.g. indium ~0.005” thick with a donut shape slightly smaller than the cathode/chill block must be placed between the block and the target.
   b) Place the target at the center of the source assuring that the magnetic keeper has been properly positioned in the recessed center magnet cavity. Twist slightly to evenly distribute the thermal contact paste.
   c) Replace Anode

NOTE: A target keeper is not required with magnetic materials; however, the user should take care to insure even spacing between the O.D. of the target and the I.D. of the ground shield.

Thermal Contact Paste
Part Number TP-832
RATE VS. POWER

When gathering rate data, it is also desirable to take rates at different power levels. These values can be plotted to produce a graph similar to the one shown.

**Please Note:** For approximating DC rates, multiply by 1.75.

RELATIVE SPUTTERING RATES OF 50 MATERIALS

The following list of materials and their relative sputtering rates are normalized to copper as 1.00. Copper is a convenient and readily available material to use as a reference. Once the rate of copper is known, then the other 49 may be approximated.

**Please Note:** These rates may vary from those of other periodicals, due to the conditions under which the rates were taken.

**Element (or compound) Cu = Rate of 1.00**

<table>
<thead>
<tr>
<th>Element</th>
<th>Relative Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ag</td>
<td>2.06</td>
</tr>
<tr>
<td>Al</td>
<td>0.73</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>0.15</td>
</tr>
<tr>
<td>Au</td>
<td>1.76</td>
</tr>
<tr>
<td>Be</td>
<td>0.22</td>
</tr>
<tr>
<td>Bi</td>
<td>10.00</td>
</tr>
<tr>
<td>C</td>
<td>0.05</td>
</tr>
<tr>
<td>CdS (1010)</td>
<td>2.39</td>
</tr>
<tr>
<td>CdTe</td>
<td>0.64</td>
</tr>
<tr>
<td>Co</td>
<td>0.58</td>
</tr>
<tr>
<td>Cr</td>
<td>0.60</td>
</tr>
<tr>
<td>Cu</td>
<td>1.00</td>
</tr>
<tr>
<td>Dy</td>
<td>1.18</td>
</tr>
<tr>
<td>Er</td>
<td>1.00</td>
</tr>
<tr>
<td>Fe</td>
<td>0.56</td>
</tr>
<tr>
<td>GaS₅a (110)</td>
<td>1.70</td>
</tr>
<tr>
<td>Hf</td>
<td>1.00</td>
</tr>
<tr>
<td>He</td>
<td>0.53</td>
</tr>
<tr>
<td>Mg</td>
<td>1.00</td>
</tr>
<tr>
<td>MgF</td>
<td>0.03</td>
</tr>
<tr>
<td>Mn</td>
<td>0.99</td>
</tr>
<tr>
<td>Mo</td>
<td>0.53</td>
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<tr>
<td>Nb</td>
<td>0.44</td>
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<tr>
<td>Ni</td>
<td>0.65</td>
</tr>
<tr>
<td>Os</td>
<td>0.5</td>
</tr>
<tr>
<td>Pb</td>
<td>3.52</td>
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<tr>
<td>Pd</td>
<td>1.31</td>
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<tr>
<td>Pt</td>
<td>0.9</td>
</tr>
<tr>
<td>Re</td>
<td>0.53</td>
</tr>
<tr>
<td>Si</td>
<td>0.23</td>
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<tr>
<td>SiO</td>
<td>0.03</td>
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<tr>
<td>SiO₂</td>
<td>0.45</td>
</tr>
<tr>
<td>SiC</td>
<td>0.26</td>
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<tr>
<td>Sm</td>
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<tr>
<td>Sn</td>
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<tr>
<td>Ta</td>
<td>0.43</td>
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<tr>
<td>Th</td>
<td>0.84</td>
</tr>
<tr>
<td>Ti</td>
<td>0.38</td>
</tr>
<tr>
<td>U</td>
<td>0.73</td>
</tr>
<tr>
<td>V</td>
<td>0.38</td>
</tr>
<tr>
<td>W</td>
<td>0.39</td>
</tr>
<tr>
<td>Y</td>
<td>0.95</td>
</tr>
<tr>
<td>Zr</td>
<td>0.65</td>
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</tbody>
</table>
RELATIVE RATES OF SPUTTERING SOURCES VS DISTANCE

Rate data, for sputtering with small sources, is usually taken by making step samples and then measuring them with either profilometer or interferometer. A quartz crystal micro-balance type rate monitor may also be used. If a rate monitor is used, the geometry and the density of the deposit must be taken into account. Because of the uncertainties of rate monitor data, the most prudent course is to correlate the values taken with the rate monitor with those taken by step sample method.

If the distance from the substrate to the target is changed and the power remains constant, the change in deposition rate is a function of the ratio of the distances squared. For example, if the rate at a 3” target to substrate distance is 15 Å/sec., the power is constant and the distance changes from 3” to 4”, the rate drops to 8.4 Å/sec.

\[ \text{Ratio for a change from 3” to 4” = } \frac{3^2}{4^2} = \frac{9}{16} = 0.563 \]

\[ \text{Ratio times Rate at 3” = 0.563 x 15 Å/sec = 8.4 Å/sec} \]

Many factors affect deposition rate, but this is a reasonable approximation of the effect of distance.
Claims & Returns

Shipping and Handling Claims
Purchaser should inspect the product carefully as soon as it is received and test it in accordance with any instructions that may be provided. If damage is noted, or the product fails to operate properly as the result of shipping or handling damage, a claim should be filed with the common carrier and a copy forwarded to MeiVac or its distributor. MeiVac or its distributor will not recognize any claim for equipment damaged as a result of shipping or handling damage if the claim is submitted more than thirty days after MeiVac's or its distributor's shipment of the product. Failing to report any damage within this period shall be considered an acknowledgement by Purchaser that the product was received undamaged.

Warranty Claims
For a warranty claim to be valid, it must:
- be made within the applicable warranty period,
- include the product serial number and a full description of the circumstances giving rise to the claim, and
- have been assigned an RMA number (see Authorized Returns) by MeiVac or its distributors.

Purchaser's exclusive remedy and MeiVac's sole responsibility under the Warranty set forth herein is the repair or replacement of the defective product, at MeiVac's option. Purchaser shall reimburse MeiVac for the repair of any returned product determined by MeiVac not to be defective or to have been damaged by misuse, abuse or unauthorized repair. All warranty work will be performed at an authorized MeiVac service center.

Purchaser is responsible for obtaining authorization (see Authorized Returns) to return any defective units, prepaying the freight costs, and ensuring that the units are returned to the location identified by MeiVac on the RMA. Provided the work required on the unit is covered under the Warranty, MeiVac will replace the affected unit or repair it at no charge to Purchaser. On completion of said repair or replacement, the unit will be returned (freight prepaid) to the Purchaser. Whoever ships the unit (either Purchaser or MeiVac) will be responsible for properly packaging and adequately insuring it.

Authorized Returns
Before returning any product for any reason, Purchaser shall call MeiVac or its distributor and discuss the reason for return. Be prepared to give the serial number of the unit. This consultation call shall be at no charge to the Purchaser and will allow MeiVac or its distributor to determine if the unit must actually be returned for a problem to be corrected. If it is determined that the unit needs to be returned a Return Material Authorization (RMA) number will be issued. This RMA number must be referenced on all paperwork associated with the return, and be prominently displayed on the outside of any packaging that the unit is being returned in.

Units that are returned without MeiVac's or its distributor's authorization will be held by MeiVac or its distributor until such time as Purchaser can identify the reason for the return, after which, action deemed appropriate by MeiVac or its distributor (including return of the unit to Purchaser freight collect) shall be taken.

Terms governing all products sold by US, a Division of MeiVac are the MeiVac Terms and Conditions of Sale. These can be found on the MeiVac web site (www.meivac.com), the US web site (www.us-incorp.com) or obtained from your local representative.
### Appendix A

**MAK TECHNICAL SPECIFICATIONS**

<table>
<thead>
<tr>
<th>MAK SIZE:</th>
<th>MAK 1.3&quot; (33mm)</th>
<th>MAK 2&quot; (50.8mm)</th>
<th>MAK 3&quot; (76.2mm)</th>
<th>MAK 4&quot; (101.6mm)</th>
<th>MAK 6&quot; (152.4mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TARGET</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target Thickness</td>
<td>mm</td>
<td>1.00-5.70</td>
<td>1.00-9.50</td>
<td>1.00-15.90</td>
<td>1.00-19.05</td>
</tr>
<tr>
<td></td>
<td>inch</td>
<td>0.040-0.225</td>
<td>0.040-0.375</td>
<td>0.040-0.625</td>
<td>0.040-0.750</td>
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<td>Magnet Target- (1)</td>
<td>mm</td>
<td>1.00-2.54</td>
<td>1.00-4.70</td>
<td>1.00-6.35</td>
<td>1.00-9.50</td>
</tr>
<tr>
<td>Thickness min-max</td>
<td>inch</td>
<td>0.040-0.100</td>
<td>0.040-0.187</td>
<td>0.404-0.250</td>
<td>0.404-0.375</td>
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<tr>
<td>Target Volume</td>
<td>ccm</td>
<td>4.90</td>
<td>19.25</td>
<td>72.47</td>
<td>154.00</td>
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<tr>
<td></td>
<td>cu inch</td>
<td>0.30</td>
<td>1.17</td>
<td>4.42</td>
<td>9.40</td>
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<tr>
<td>Target Surface Area</td>
<td>cm sq</td>
<td>8.56</td>
<td>20.27</td>
<td>45.60</td>
<td>81.10</td>
</tr>
<tr>
<td></td>
<td>sq in</td>
<td>1.33</td>
<td>3.14</td>
<td>7.07</td>
<td>12.56</td>
</tr>
<tr>
<td><strong>ELECTRICAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max Power Dc</td>
<td>watts</td>
<td>350.00</td>
<td>1000.00</td>
<td>2000.00</td>
<td>3000.00</td>
</tr>
<tr>
<td>Max Power RF</td>
<td>watts</td>
<td>200.00</td>
<td>400.00</td>
<td>750.00</td>
<td>1200.00</td>
</tr>
<tr>
<td>Max Power DC (Per)</td>
<td>cm sq</td>
<td>40.88</td>
<td>49.30</td>
<td>43.86</td>
<td>37.00</td>
</tr>
<tr>
<td></td>
<td>in sq</td>
<td>263.00</td>
<td>318.00</td>
<td>283.00</td>
<td>240.00</td>
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<tr>
<td>Max Power RF (Per)</td>
<td>cm sq</td>
<td>24.00</td>
<td>20.00</td>
<td>17.00</td>
<td>15.00</td>
</tr>
<tr>
<td></td>
<td>in sq</td>
<td>150.00</td>
<td>130.00</td>
<td>106.00</td>
<td>96.00</td>
</tr>
<tr>
<td>Max Current</td>
<td>amps</td>
<td>1.00</td>
<td>3.00</td>
<td>5.00</td>
<td>7.00</td>
</tr>
<tr>
<td>VOLTAGE Min-Max</td>
<td>200-1000</td>
<td>200-1000</td>
<td>200-1000</td>
<td>200-1000</td>
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# Appendix A

## MAK TECHNICAL SPECIFICATIONS

### COOLING

<table>
<thead>
<tr>
<th></th>
<th>MAK 1.3&quot; (33mm)</th>
<th>MAK 2&quot; (50.8mm)</th>
<th>MAK 3&quot; (76.2mm)</th>
<th>MAK 4&quot; (101.6mm)</th>
<th>MAK 6&quot; (152.4mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Flow at 30psi min. at lowest power level</td>
<td>l/min gal/min</td>
<td>3.48 0.90</td>
<td>3.48 0.90</td>
<td>3.48 0.90</td>
<td>3.48 0.90</td>
</tr>
<tr>
<td>Nominal Water Flow at 60psi for max. power</td>
<td>l/min gal/min</td>
<td>6.20 1.60</td>
<td>6.20 1.60</td>
<td>6.20 1.60</td>
<td>6.20 1.60</td>
</tr>
<tr>
<td>Water Pressure Range</td>
<td>Bar psi</td>
<td>2.1-5.6 30-80</td>
<td>2.1-5.6 30-80</td>
<td>2.1-5.6 30-80</td>
<td>2.1-5.6 30-80</td>
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<tr>
<td>Water Lines Size</td>
<td></td>
<td>1/4&quot; OD 3/16&quot; ID</td>
<td>1/4&quot; OD 3/16&quot; ID</td>
<td>1/4&quot; OD 3/16&quot; ID</td>
<td>1/4&quot; OD 3/16&quot; ID</td>
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### MECHANICAL

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<tr>
<td>Max OD</td>
<td>mm inch</td>
<td>59.70 2.350</td>
<td>59.70 2.350</td>
<td>85.80 3.378</td>
<td>104.80 4.125</td>
<td>170.80 6.725</td>
<td></td>
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<tr>
<td>Shaft Diameter</td>
<td>mm inch</td>
<td>19.05 0.75</td>
<td>19.05 0.75</td>
<td>19.05 0.75</td>
<td>19.05 0.75</td>
<td>19.05 0.75</td>
<td>31.75 1.25</td>
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<tr>
<td>Anode Adjustable To Target Thickness</td>
<td></td>
<td>NO YES YES YES YES</td>
<td></td>
<td></td>
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<tr>
<td>Weight</td>
<td>lbs. kgms.</td>
<td>1.75 3.85</td>
<td>2.0 4.4</td>
<td>4.0 8.8</td>
<td>5.5 12.1</td>
<td>13.0 28.6</td>
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### PERFORMANCE

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<tbody>
<tr>
<td>Rate For Cu @ 5 mtorr Ar. Target To Substrate = Diameter Of MAK²</td>
<td>Angstrom / Sec</td>
<td>35@200W</td>
<td>100@500W</td>
<td><a href="mailto:165@1.5KW">165@1.5KW</a></td>
<td><a href="mailto:160@2.5KW">160@2.5KW</a></td>
<td>145@5KW</td>
<td></td>
</tr>
<tr>
<td>UNIFORMITY</td>
<td>± %</td>
<td>5%</td>
<td>6%</td>
<td>8%</td>
<td>8%</td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td>Substrate Dia. = Source Dia. Target to Substrate = Dia. of Source²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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(1) Maximum magnetic target thickness is material dependent.
(2) Means 2” MAK @ 2” target to substrate 4” MAK @ 4”
APPENDIX B

TARGET SUPPLIERS

ACI Alloys, Inc.
1985 Las Plumas Avenue
San Jose, CA 95133
Larry Albert
PH: (408) 259-7337
FX: (408) 729-0277
www.acialloys.com

Cerac, Inc.
Box 1178
Milwaukee, WI 53201
Rick Vehlow
PH: (414) 289-9800
FX: (414) 289-9805
www.cerac.com

Praxair
16130 Wood Red Road #7
Woodinville, WA 98072
Ron Ekdahl
PH: (425) 487-1769
FX: (425) 487-1859
www.praxair.com

Process Materials, Inc.
5625 Brisa Street, Suite A
Livermore, CA 94550
Steve Verley
PH: (925) 245.9626
FX: (925) 245.9629
www.processmaterials.com

SCI Engineered Materials
2839 Charter St.
Columbus, OH 43228
PH: (800) 346-6567
FX: (800) 292-8654
www.sciengineeredmaterials.com

Sputtering Target Manufacturing Co.
1005 Corbin Court
Westerville, OH 43081
J. R. Gaines
PH: (614) 446-2202
FX: (740) 965-5701
www.sputtertarget.com

Tico Titanium
52900 Grand river
New Hudson, MI 48165
Mr. J. P. Cruzen
PH: (800) 521-4392
FX: (248) 446-1995
www.ticotitanium.com

Vacuum Engineering & Materials Co.
131-B Albright Way
Los Gatos, CA 95032
Gina Craig
Jack Kavanaugh
PH: (408) 871-9900
TOLL FREE: (877) 986-8900
FX: (408) 871-2900
www.vacengmat.com

Williams Advanced Materials
42 Mt. Ebo Road South
Brewster, NY 10509
PH: (845) 279-0900
FX: (845) 279-0922
www.williams-adv.com

SCI Engineered Materials
2839 Charter St.
Columbus, OH 43228
PH: (800) 346-6567
FX: (800) 292-8654
www.sciengineeredmaterials.com
**NOTE**

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<th>MIN</th>
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<tr>
<td>A NORMAGNETIC</td>
<td>0.040&quot;</td>
<td>0.225&quot;</td>
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<td>B MAGNETIC**</td>
<td>0.040&quot;</td>
<td>0.100&quot;</td>
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**THICKNESS OF A MAGNETIC TARGET DEPENDS ON THE PERMEABILITY OF THE MATERIAL**
1.3" MINIMAK TARGET MOUNTING OPTIONS

TARGET ATTACHED TO TARGET KEEPER WITH SCREW

TARGET

TARGET KEEPER

2-56 (M2) VENTED FLAT HEAD SCREW

TAPPING INFORMATION FOR TARGETS:
0.008" OR LESS TAP THRU
0.100" OR GREATER TAP 90%

NOTE: SEE DWG# L130-02 TARGET KEEPER FOR SPECIFICATIONS

TARGET BONDED TO BACKING PLATE WITH ATTACHED KEEPER

TARGET

BACKING PLATE

TARGET KEEPER

2-56 (M2) VENTED FLAT HEAD SCREW
TRIM SCREW - FLUSH WITH BACKING PLATE

BOND TARGET TO BACKING PLATE CONCENTRIC TO ±0.005
BOND MUST WITHSTAND 220° C MAXIMUM TEMPERATURE

NOTE: SEE DWG# L130-BP BACKING PLATE SPECIFICATIONS

US INCORPORATED

1.3" MINIMAK TARGET MOUNTING OPTIONS

SIZE: TOLERANCES, UNLESS NOTED
A

DRAWING NUMBER: L130-01M

REV: E

THE INFORMATION ON THIS DRAWING IS PROPRIETARY AND MAY NOT BE USED, COPIED, OR REPRODUCED WITHOUT WRITTEN PERMISSION

SCALE: FULL
DUN BY: N/A
DATE: 1-06-09
SHEET: 1 OF 1
1.3" MINIMAK TARGET KEEPER OPTIONS

USE IF ATTACHING TARGET KEEPER TO BACKING PLATE* OR DIRECTLY TO TARGET**

\[ \Phi 0.155 \text{ C'SINK 82°} \]
\[ \Phi 0.500 \]
FOR 2-56 (M2) VENTED FLAT HEAD SCREW
SCREW HEAD MUST FIT FLUSH WITH BOTTOM
\[ \Theta 0.002 \]

**NOTE:** SEE DWG# L130-01M FOR TARGET MOUNTING OPTIONS
2-56 (M2) TAP THRU
(Ø0.002

Ø1.30 -A-

L130-02 TARGET KEEPER
(SEE DWG# L130-02 FOR TARGET KEEPER SPECIFICATIONS)

ATTACH TARGET KEEPER TO BACKING PLATE CONCENTRIC TO ±0.005
USE 2-56 (M2) VENTED FLAT HEAD SCREW
SCREW HEAD MUST BE FLUSH WITH TARGET KEEPER SURFACE

NOTE: CONCENTRICITY IS IMPORTANT IN MAINTAINING MAGNETIC PATH
TO TARGET AND CENTERING TARGET ON CATHODE

US INCORPORATED

TITLE: 1.3” MINIMAK
BACKING PLATE WITH SCREW

MATERIAL: OFHC COPPER
FINISH: ALL SURFACES 32/ -NO BURRS
CNC FILE: N/A
ACAD FILE: L130-BP

THE INFORMATION ON THIS DRAWING IS PROPRIETARY
AND MAY NOT BE USED, COMMUNICATED, OR REPRODUCED WITHOUT WRITTEN PERMISSION

REV DATE
A 11-10-00 NOホール REVIEW
A N/A PRODUCTION RELEASE
DECEPITION OF CHANCE

SIZE TOLERANCES, UNLESS NOTED
A ± 32/ DRIVING NUMBER
REV
A L130-BP B

SCALE: FULL DRA W BY: REV
DATE: 11-10-00 SHEET: 1 OF 1
FOLLOWING DIMENSIONS FOR ALL MATERIALS, NON-MACHINEABLE AND MACHINEABLE

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<th>*NOTE</th>
<th>MIN</th>
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<tr>
<td>A NONMAGNETIC</td>
<td>0.040</td>
<td>0.312</td>
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<tr>
<td>B MAGNETIC**</td>
<td>0.040</td>
<td>0.187</td>
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** THICKNESS OF A MAGNETIC TARGET DEPENDS ON THE PERMEABILITY OF THE MATERIAL
2" MAK TARGET MOUNTING OPTIONS

TARGET ATTACHED TO TARGET KEEPER WITH SCREW

TARGET ATTACHED TO TARGET KEEPER WITH SCREW

TARGET  

TAPPING INFORMATION FOR TARGETS
0.000" OR LESS TAP THRU
0.100" OR GREATER TAP 90%

TARGET KEEPER

2-56 (M2) VENTED FLAT HEAD SCREW

NOTE: SEE DWG# L200-02 TARGET KEEPER FOR SPECIFICATIONS

TARGET BONDED TO BACKING PLATE WITH ATTACHED KEEPER

TARGET BONDED TO BACKING PLATE WITH ATTACHED KEEPER

TARGET  

BACKING PLATE

TARGET KEEPER

2-56 (M2) VENTED FLAT HEAD SCREW

TRIM SCREW - FLUSH WITH BACKING PLATE

BOND TARGET TO BACKING PLATE CONCENTRIC TO ±0.005
BOND MUST WITHSTAND 220° C MAXIMUM TEMPERATURE

NOTE: SEE DWG# L200-BP BACKING PLATE SPECIFICATIONS
2" MAK TARGET KEEPER OPTIONS

USE IF ATTACHING TARGET KEEPER TO BACKING PLATE OR DIRECTLY TO TARGET**

Ø.094 THRU
C'SINK 82° X Ø.185
FOR 2-56 (M2) VENTED
FLAT HEAD SCREW
SCREW HEAD MUST
FIT FLUSH WITH BOTTOM
Ø.002 A

.062

**NOTE: SEE DWG# L200-01M FOR TARGET MOUNTING OPTIONS

US INCORPORATED

TITLE: 2" MAK TARGET KEEPER

REV  DATE  DESCRIPTION OF CHANGE
A  L200-02  2-18-00

MATERIAL: 1010 - 1018 CRS
FINISH: ALL SURFACES ¬— NO BURRS
CNC FILE: N/A
ACAD FILE: L200-02

THE INFORMATION ON THIS DRAWING IS PROPRIETARY
AND MAY NOT BE USED, COMMUNICATED, OR REPRODUCED WITHOUT WRITTEN PERMISSION.
2" MAK
BACKING PLATE WITH SCREW

2-56 (M2) TAP THRU

\[ \phi 2.000 \pm 0.010 \ -A- \]

\[ 0.002 \pm A \]

L200-02 TARGET KEEPER
(SEE DWG# L200-02 FOR TARGET KEEPER SPECIFICATIONS)

\[ 0.080 \pm 0.005 \]

ATTACH TARGET KEEPER TO BACKING PLATE CONCENTRIC TO \( \pm 0.005 \)
USE 2-56 (M2) VENTED FLAT HEAD SCREW
SCREW HEAD MUST BE FLUSH WITH TARGET KEEPER SURFACE

NOTE: CONCENTRICITY IS IMPORTANT IN MAINTAINING MAGNETIC PATH
TO TARGET AND CENTERING TARGET ON CATHODE
**NOTE**  

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<tr>
<td>A</td>
<td>0.040&quot;</td>
<td>0.625&quot;</td>
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<tr>
<td>B</td>
<td>0.040&quot;</td>
<td>0.250&quot;</td>
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**THICKNESS OF A MAGNETIC TARGET DEPENDS ON THE PERMEABILITY OF THE MATERIAL**

---

**US INCORPORATED**

**3" MAK TARGET**

**REV**

G 7-1-1999
F 11-1-96
E 10-8-95
D 6-11-94
C 8-11-93
B 8-11-92
A N/A

**MATERIAL:** SEE NOTES
**FINISH:** SEE NOTES
**CNC FILE:** N/A
**ACAD FILE:** L300-01

THE INFORMATION ON THIS DRAWING IS PROPRIETARY AND MAY NOT BE USED, COMMUNICATED, OR REPRODUCED WITHOUT WRITTEN PERMISSION.
3" MIGHTY MAK TARGET MOUNTING OPTIONS

TARGET ATTACHED TO TARGET KEEPER WITH SCREW

TARGET COUNTERSINK TARGET AND KEEPER SD SCREW HEAD FITS FLUSH (STD TAP PROC)

TARGET KEEPER TAPPING INFORMATION FOR TARGETS
0.000" OR LESS TAP THRU
0.100" OR GREATER TAP 90%

NOTE: SEE DWG# L300-02 TARGET KEEPER FOR SPECIFICATIONS

TARGET BONDED TO BACKING PLATE WITH ATTACHED KEEPER

TARGET BACKING PLATE

TARGET KEEPER 6-32 (M3) VENTED FLAT HEAD SCREW

TRIM SCREW - FLUSH WITH BACKING PLATE

BOND TARGET TO BACKING PLATE CONCENTRIC TO ±0.005
BOND MUST WITHSTAND 220° C MAXIMUM TEMPERATURE

NOTE: SEE DWG# L300-BP BACKING PLATE SPECIFICATIONS
3" MIGHTY MAK TARGET KEEPER OPTIONS

USE IF ATTACHING TARGET KEEPER TO BACKING PLATE* OR DIRECTLY TO TARGET**

Ø0.260 C'SINK 82°
FOR 6-32 (M3) VENTED
FLAT HEAD SCREW
SCREW HEAD MUST
FIT FLUSH WITH BOTTOM

Ø1.230

** NOTE: SEE DWG# L300-01M FOR TARGET MOUNTING OPTIONS
3" MIGHTY MAK BACKING PLATE WITH SCREW

6-32 (M3) TAP THRU
Ø3.00

L300-02 TARGET KEEPER
(SEE DWG# L300-02 FOR TARGET KEEPER SPECIFICATIONS)

ATTACH TARGET KEEPER TO BACKING PLATE CONCENTRIC TO ±0.005
USE 6-32 (M3) VENTED FLAT HEAD SCREW
SCREW HEAD MUST BE FLUSH WITH TARGET KEEPER SURFACE

NOTE: CONCENTRICITY IS IMPORTANT IN MAINTAINING MAGNETIC PATH TO TARGET AND CENTERING TARGET ON CATHODE

US INCORPORATED

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<tr>
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THE INFORMATION ON THIS DRAWING IS PROPRIETARY AND MAY NOT BE USED, COMMUNICATED, OR REPRODUCED WITHOUT WRITTEN PERMISSION.
FOLLOWING DIMENSIONS FOR ALL MATERIALS, NON-MACHINEABLE AND MACHINEABLE

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<th>NOTE</th>
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<tr>
<td>A NONMAGNETIC</td>
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**THICKNESS OF A MAGNETIC TARGET DEPENDS ON THE PERMEABILITY OF THE MATERIAL**

US INCORPORATED

4" MAK TARGET
4" MAK TARGET MOUNTING OPTIONS

TARGET ATTACHED TO TARGET KEEPER WITH SCREW

TARGET

COUNTERSINK TARGET AND KEEPER SD
SCREW HEAD FITS FLUSH
(STD TAP PROC)

A
TAPPING INFORMATION FOR TARGETS
0.080" OR LESS TAP THRU
0.100" OR GREATER TAP 90%

8-32 (M4) VENTED FLAT HEAD SCREW

NOTE: SEE DWG# L400-07A TARGET KEEPER FOR SPECIFICATIONS

TARGET BONDED TO BACKING PLATE WITH ATTACHED KEEPER

TARGET

BACKING PLATE

TARGET KEEPER

8-32 (M4) VENTED FLAT HEAD SCREW
TRIM SCREW - FLUSH WITH BACKING PLATE

BOND TARGET TO BACKING PLATE CONCENTRIC TO ±0.005
BOND MUST WITHSTAND 220° C MAXIMUM TEMPERATURE

NOTE: SEE DWG# L400-BP BACKING PLATE SPECIFICATIONS

US INCORPORATED

TITLE: 4" MAK TARGET MOUNTING OPTIONS

MATERIAL:
FINISH:
CNC FILE: N/A
ACAD FILE: L400-01M

THE INFORMATION ON THIS DRAWING IS PROPRIETARY
AND MAY NOT BE USED, COMMUNICATED, OR REPRODUCED WITHOUT WRITTEN PERMISSION

SCALE: FULL  SUN BY: JJ  DATE: 1-30-08  SHEET: 1 OF 1
4" MAK TARGET KEEPER OPTIONS
USE IF ATTACHING TARGET KEEPER TO BACKING PLATE* OR DIRECTLY TO TARGET**

Ø0.375 C’SINK 82°
FOR 8-32 (M4) VENTED
FLAT HEAD SCREW
SCREW HEAD MUST
FIT FLUSH WITH BOTTOM

Ø1.23 -A-

0.25 \( \pm 0.005 \)

** NOTE: SEE DWG# L400-01M FOR TARGET MOUNTING OPTIONS

US INCORPORATED

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<th>DESCRIPTION OF CHANGE</th>
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| MATERIAL: | 440C STAINLESS STEEL |
| FINISH:    | NO BURRS - 32 FINISH  |
| CNC FILE:  | N/A                  |
| ACAD FILE: | L400-02A             |

THE INFORMATION ON THIS DRAWING IS PROPRIETARY
AND MAY NOT BE USED, COMMUNICATED, OR REPRODUCED WITHOUT WRITTEN PERMISSION

SCALE: FULL
DRAWING NUMBER: L400-07A
REV: A
4" MAK BACKING PLATE WITH SCREW

8-32 (M4) TAP THRU

Ø4.00 A-

0.002

L400-07A TARGET KEEPER

(SEE DWG# L400-07A FOR TARGET KEEPER SPECIFICATIONS)

ATTACH TARGET KEEPER TO BACKING PLATE CONCENTRIC TO ±0.005

USE 8-32 (M4) VENTED FLAT HEAD SCREW

SCREW HEAD MUST BE FLUSH WITH TARGET KEEPER SURFACE

NOTE: CONCENTRICITY IS IMPORTANT IN MAINTAINING MAGNETIC PATH
TO TARGET AND CENTERING TARGET ON CATHODE

US INCORPORATED

TITLE
4" MAK BACKING PLATE

MATERIAL: OFHC COPPER
FINISH: NO BURRS - 32 FINISH
CNC FILE: N/A
ACAD FILE: L400-BP

THE INFORMATION ON THIS DRAWING IS PROPRIETARY
AND MAY NOT BE USED, COMMUNICATED, OR REPRODUCED WITHOUT WRITTEN PERMISSION

SCALE: FULL
DRAWN BY: FM
DATE: 8-14-00
SHEET: 1 OF 1
FOLLOWING DIMENSIONS FOR ALL MATERIALS, NON-MACHINEABLE AND MACHINEABLE

**NOTE**

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<th>MAX</th>
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<tbody>
<tr>
<td>A NONMAGNETIC</td>
<td>0.125&quot;</td>
<td>1.000&quot;</td>
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<tr>
<td>B MAGNETIC**</td>
<td>0.062&quot;</td>
<td>0.375&quot;</td>
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**THICKNESS OF A MAGNETIC TARGET DEPENDS ON THE PERMEABILITY OF THE MATERIAL**

US INC ORPORATED

6" MAK TARGET
### 6" MAK TARGET MOUNTING OPTIONS

**Target Attached to Target Keeper with Screw**

- Target
- Countersink target and keeper OD
- Screw head fits flush (STD tap proc)
- Target keeper
- Tapping information for targets:
  - 0.080" or less tap thru
  - 0.100" or greater tap 90%
- 8-32 (M4) vented flat head screw

**Note:** See DWG# L600-02 target keeper for specifications

### Target Bonded to Backing Plate with Attached Keeper

- Target
- Backing plate
- Target keeper
- 8-32 (M4) vented flat head screw
- Trim screw - flush with backing plate

**Bond target to backing plate concentric to ±0.005**
- Bond must withstand 220° C maximum temperature

**Note:** See DWG# L600-BP backing plate specifications

---

### US INCORPORATED

<table>
<thead>
<tr>
<th>TITLE: 6&quot; MAK TARGET MOUNTING OPTIONS</th>
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</table>

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**Table: Specifications**

| MATERIAL: SPECIFY |
| FINISH: ALL SURFACES 3% - NO BURRS |
| CNC FILE: N/A |
| ACAD FILE: L600-01M |

---

**Drawing Number:** L600-01M

---

**Instructions:**

- The information on this drawing is proprietary and may not be used, communicated, or reproduced without written permission.
6" MAK TARGET KEEPER OPTIONS
USE IF ATTACHING TARGET KEEPER TO BACKING PLATE* OR DIRECTLY TO TARGET**

\[ \Phi 2.125^{+0.005}_{-0.000} \]

\(0.188^{-0.005} \pm 0.005\)

\(\Phi 0.002\ A\)

**NOTE:** SEE DWG# L600-01M FOR TARGET MOUNTING OPTIONS

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**US INCORPORATED**

**TITLE:** 6" MAK TARGET KEEPER

**MATERIAL:** 1018 MILD STEEL

**FINISH:** NO BURRS - 32 FINISH

**CNC FILE:** L600-02

**ACAD FILE:** L600-02

**THE INFORMATION ON THIS DRAWING IS PROPRIETARY AND MAY NOT BE USED, COMMUNICATED, OR REPRODUCED WITHOUT WRITTEN PERMISSION**

**SCALE:** FULL

**DRAWING NUMBER:** L600-02

**REV:** H

**DATE:** 9-28-99

**SHEET:** 1 OF 1
6" MAK BACKING PLATE WITH SCREW

8-32 (M4) TAP THRU
Ø 0.002 A

Ø 6.000 ± 0.010

- A -

0.100 ± 0.005

L600-02 TARGET KEEPER

(SEE DWG# L600-02 FOR TARGET KEEPER SPECIFICATIONS)

ATTACH TARGET KEEPER TO BACKING PLATE CONCENTRIC TO ± 0.005

USE 8-32 (M4) VENTED FLAT HEAD SCREW

SCREW HEAD MUST BE FLUSH WITH TARGET KEEPER SURFACE

NOTE: CONCENTRICITY IS IMPORTANT IN MAINTAINING MAGNETIC PATH TO TARGET AND CENTERING TARGET ON CATHODE

US INCORPORATED

6" MAK BACKING PLATE WITH SCREW

 MATERIAL: OFHC COPPER
 FINISH: NO BURRS - 32 FINISH
 CNC FILE: N/A
 ACAD FILE: L600-BP

THE INFORMATION ON THIS DRAWING IS PROPRIETARY AND MAY NOT BE USED, COMMUNICATED, OR REPRODUCED WITHOUT WRITTEN PERMISSION

REV \ DATE \ DESCRIPTION OF CHANGE
A \ N/A \ PRODUCTION RELEASE

REV: B \ DATE: 3-05-99

DRAWING NUMBER: L600-BP

SCALE: FULL
DRAWN BY: N/A
DATE: 3-05-99
SHEET: 1 OF 1
<table>
<thead>
<tr>
<th>US Part Number</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>L130-04</td>
<td>Ceramic Ground Shield</td>
</tr>
<tr>
<td>L130-06</td>
<td>Ring Magnet</td>
</tr>
<tr>
<td>L130-09</td>
<td>Stainless Steel Ground Shield</td>
</tr>
<tr>
<td>L130A14</td>
<td>Block Assembly</td>
</tr>
<tr>
<td>J1200-06</td>
<td>Center Magnet</td>
</tr>
<tr>
<td>J1200-33</td>
<td>O-Ring</td>
</tr>
<tr>
<td>J1200-34M</td>
<td>Metal Seals</td>
</tr>
<tr>
<td>J1234-30</td>
<td>Water Lines (2) w/ ferrules</td>
</tr>
<tr>
<td>LL-130-01</td>
<td>Keeper w/ hole &amp; screw (pkg. 10)</td>
</tr>
<tr>
<td>MAK-130-BP</td>
<td>Copper Backing Plate w/ Keeper</td>
</tr>
<tr>
<td>TP-832</td>
<td>Thermal Contact Paste - 0.5 oz.</td>
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## 2.0" MAK

<table>
<thead>
<tr>
<th>US Part Number</th>
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<tbody>
<tr>
<td>L200-07</td>
<td>Ring Magnet</td>
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<tr>
<td>L200-10</td>
<td>Aluminum Ground Shield</td>
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<tr>
<td>L200A14</td>
<td>Block Assembly</td>
</tr>
<tr>
<td>J1200-06</td>
<td>Center Magnet</td>
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<tr>
<td>J1200-33</td>
<td>O-Ring</td>
</tr>
<tr>
<td>J1200-34M</td>
<td>Metal Seals</td>
</tr>
<tr>
<td>J1234-30</td>
<td>Water Lines (2) w/ ferrules</td>
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<tr>
<td>LL-200-01</td>
<td>Keeper w/ hole &amp; screw (pkg. 10)</td>
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<tr>
<td>MAK-200-BP</td>
<td>Copper Backing Plate w/ Keeper</td>
</tr>
<tr>
<td>TP-832</td>
<td>Thermal Contact Paste - 0.5 oz.</td>
</tr>
<tr>
<td>US Part Number</td>
<td>Description</td>
</tr>
<tr>
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<tr>
<td>L300-10</td>
<td>Aluminum Ground Shield (OLD STYLE MAK SOURCE ONLY)</td>
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<tr>
<td>L300-10NT</td>
<td>Aluminum Ground Shield</td>
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<tr>
<td>L300-13</td>
<td>Center Magnet</td>
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<td>L300-24</td>
<td>Ring Magnet</td>
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<td>L300A14</td>
<td>Block Assembly</td>
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<tr>
<td>J3400-33</td>
<td>O-Ring</td>
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<tr>
<td>J3400-34M</td>
<td>Metal Seals</td>
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<tr>
<td>J1234-30</td>
<td>Water Lines (2) w/ ferrules</td>
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<tr>
<td>LL-300-01</td>
<td>Keeper w/ hole &amp; screw (pkg. 10)</td>
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<td>MAK-300-BP</td>
<td>Copper Backing Plate w/ Keeper</td>
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<td>TP-832</td>
<td>Thermal Contact Paste - 0.5 oz.</td>
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### 4.0" MAK

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<th>US Part Number</th>
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<tr>
<td>L400-10</td>
<td>Aluminum Ground Shield</td>
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<tr>
<td>L400A20</td>
<td>Center Magnet Assembly</td>
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<tr>
<td>L400A14</td>
<td>Block Assembly</td>
</tr>
<tr>
<td>J4600-13</td>
<td>Center Magnet</td>
</tr>
<tr>
<td>J4600-32</td>
<td>Ring Magnet Segment (10 @ 31.25 each)</td>
</tr>
<tr>
<td>J3400-33</td>
<td>O-Ring</td>
</tr>
<tr>
<td>J3400-34M</td>
<td>Metal Seals</td>
</tr>
<tr>
<td>J1234-30</td>
<td>Water Lines (2) w/ ferrules</td>
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<tr>
<td>LL-400-01</td>
<td>Keeper w/ hole &amp; screw (pkg. 2)</td>
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<tr>
<td>MAK-400-BP</td>
<td>Copper Backing Plate w/ Keeper</td>
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<tr>
<td>TP-832</td>
<td>Thermal Contact Paste - 0.5 oz.</td>
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</tbody>
</table>
### 6.0" MAK

<table>
<thead>
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<th>US Part Number</th>
<th>Description</th>
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<tbody>
<tr>
<td>L600-10</td>
<td>Aluminum Ground Shield</td>
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<tr>
<td>L600-40</td>
<td>O-ring Magnet Plug</td>
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<tr>
<td>L600-41</td>
<td>O-Ring</td>
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<tr>
<td>L600A14</td>
<td>Block Assembly</td>
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<tr>
<td>L600A20</td>
<td>Center Magnet Assembly</td>
</tr>
<tr>
<td>J4600-13</td>
<td>Center Magnet</td>
</tr>
<tr>
<td>J4600-32</td>
<td>Ring Magnet Segments (16 @ 31.25 each)</td>
</tr>
<tr>
<td>L600-42</td>
<td>Water Lines (2) w/ ferrules</td>
</tr>
<tr>
<td>LL-600-01</td>
<td>Keeper w/ hole &amp; screw (pkg. 2)</td>
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<tr>
<td>MAK-600-BP</td>
<td>Copper Backing Plate w/ Keeper</td>
</tr>
<tr>
<td>TP-832</td>
<td>Thermal Contact Paste - 0.5 oz.</td>
</tr>
</tbody>
</table>
BENEFITS OF THE MAK
SIMPLICITY IN SPUTTERING

Water Isolated from:

- **MAGNETS** - NO magnet erosion
- **POWER** - (ALL electrical components)
  - no power changes due to water resistance
  - simplifies RF Tuning
- **NO** special treatment of water needed

Cathode (Copper)

- Only small volume above AlN has electrical potential applied,

  **THUS.....**
  - minimizing heated area - facilitating cooling
  - all components except small cathode area, are at ground or neutral potential

**Cooling Block (Copper)**

- Water channel 75% of volume,

  **THUS.....**

- High water flow - maximizing cooling efficiency of copper surface area

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**AIN - Alumina Nitride**

- Thermal Conductor
- Electrical Insulator
Magnetics

**Balanced / Unbalanced**
- Magnet array is INTERCHANGEABLE from balanced or unbalanced. Disassembly of source NOT REQUIRED!

**No Magnetic Housing**
- Provides higher magnetic density at target surface
  
  **THUS…..**
  - Sputters at lower voltage for comparable power levels
  - Standard MAK sputters magnetic material

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**BENEFITS OF THE MAK**

SIMPLICITY IN SPUTTERING 2 OF 3
One Vacuum Seal
- Elastomer (HV) or Metal (UHV) field interchangeable
- No water to Vacuum Seal

Small Profile
- Mounts on CF, ISO or installs thru a Quick Disconnect
- As example, standard 3” MAK fits thru opening of 6” CF (DN100)

Anode
- Height adjustable to target thickness - Selectively positioning anode to same plane of target--- minimizing material build-up

No Mechanical Target Clamp
- Target surface is not in contact with dissimilar clamping material--- minimizing stress during sputtering and cool down (especially for ceramics and oxides)

WATER LINES
- Teflon water lines with quick disconnects

HN CONNECTOR
- Standard HN power connector permits RF/DC operation
Simplicity in Sputtering

INTRODUCING

The MAK

Planar Magnetron Sputtering Source
Simplicity in Sputtering
Target Installation on the MAK
Simplicity in Sputtering

- Targets mounted by attraction of the center magnet
- No mechanical clamping of the target

THUS.....

- Ease of target change
- Adjustable anode

THUS.....

- Allows for target thickness variations
- Prevents material build up
- Standard and/or existing targets used
Simplicity in Sputtering

MAK without target installed

Target
Keeper
Cathode
Adjustable Anode
Simplicity in Sputtering

MAK with target installed

Target mounted with magnetic keeper

Anode retracted
Simplicity in Sputtering
The MAK with target and anode

- Slotted anode allows for variable target thickness
- Anode adjusted to accommodate thicker target

Target
Simplicity in Sputtering

MAK target installed w/o anode

0.100+ gap between target and magnets

Target

Magnet segments
Backings Plates

Ceramics, oxides, and any other non-machinable targets are commonly bonded to a copper backing plate for all sputtering sources.

MAK Backing Plates

The MAK sputter source uses the same backing plate, but with a magnetic keeper attached. The keeper holds the target in place without a mechanical clamp.
TARGET MOUNTING OF THE MAK NON-MACHINABLE MATERIALS

Bonded Target - Example

This is an example of a SiO$_2$ target bonded to a copper backing plate with a magnetic keeper attached.
By attaching a magnetic keeper to the target, the MAK source uses the magnetics of the gun to hold the target in place.

If you have old targets, NO PROBLEM! Drill and tap your existing targets as shown and attach the metallic keeper.

Then, snap the target into place. It’s that simple!