GSI LUMONICS

WaferMark®
SigmaDSC NT

Service Manual

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Customer Support Contact Addresses

GSI Lumonics North American Regional Customer Center
60 Fordham Road
Wilmington, MA 01887
U.S.A.
Tel: (248) 449 1578
Toll-free: 1–800 262 0160
Fax: (978) 988 9622

GSI Lumonics Worldwide Service Headquarters
60 Fordham Road
Wilmington, MA 01887
U.S.A.
Tel: +1–978 661 4300
Fax: +1–978 988 8798

GSI Lumonics North American Regional Customer Center
60 Fordham Road
Wilmington, MA 01887
U.S.A.
Tel: (248) 449 1578
Toll-free: 1–800 262 0160
Fax: (978) 988 9622

GSI Lumonics European Regional Customer Centre
Einsteinstrasse 2
D-85716 Unterschleissheim
Germany
Tel: +49 89–31707 111
Fax: +49 89–31707 350
Toll-free: 0800–58666427

GSI Lumonics International Sales and Service – Western Europe
29 rue Jean Rostand
Parc Orsay Université
F-91893
ORSAY CEDEX
France
Tel: +33 1 69 35 44 35
Fax: +33 1 69 35 44 00

GSI Lumonics International Sales and Service – Southern Europe
Via Umbria, 10
I-20090 Segrate (MI)
Italy
Tel: +39 02 26 99 28 33
Fax: +39 02 26 99 28 22

GSI Lumonics International Sales and Service – Northern Europe
Cosford Lane, Swift Valley
Rugby
Warwickshire CV21 1QN
England
Tel: +44 1788–532 612
Fax: +44 1788–553 564

GSI Lumonics Asia Pacific Regional Customer Center
11th Floor, BOC Credit Card Center
68 Connaught Road West
Sheung Wan
Hong Kong
Tel: +852–2549–8660
Fax: +852–2549–5896

GSI Lumonics International Sales and Service – Singapore
10 Toh Guan Road, #05-01B
TT International Tradepark
Singapore 608838
Tel: +65–774–6788
Fax: +65–774–2488

GSI Lumonics International Sales and Service – Taiwan
51, Lane 2, Kuang Fu Road
Sec 2
Hsinchu 300
Taiwan R.O.C.
Tel: +886–3–575–0670
Fax: +886–3–575–0470

GSI Lumonics International Sales and Service – Japan
Technoport Kamata, 16-1
Minami-Kamata 2-Chome,
Ohta-ku, Tokyo 144-0035,
Japan
Tel: +81 3 5714 0520
Fax: +81 3 5714 0552

GSI Lumonics International Sales and Service – Korea
SeokCheon Building 401
1551-5 Seo Cho 3-Dong
SeoCho-Ku
Seoul
Korea 137 073
Tel: +82 2 584 5595
Fax: +82 2 584 5598

This Product is Manufactured By:

GSI Lumonics
60 Fordham Road
Wilmington, MA 01887
U.S.A.
Tel: (978) 661 4300
Fax: (978) 988 8798

About GSI Lumonics

GSI Lumonics brings laser-based automated advanced manufacturing systems, instrumentation, and components to leading industrial companies worldwide. The Company supplies products and service to the semiconductor, electronics, medical, automotive, aerospace, and consumer packaging markets. GSI Lumonics shares are listed on the NASDAQ (GSLI) and the Toronto Stock Exchange (LSI).

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Preface

Intended Readers

The *WaferMark® SigmaDSC NT Service Manual* is a stand-alone document that provides information for the installation, maintenance, adjustments and hardware operation of the laser marking system by customer and GSI Lumonics service technicians. It is intended to be read and used as a reference by personnel who are GSI Lumonics trained and certified to service and maintain the WaferMark® SigmaDSC NT system.

Related Documents and Publications

The documentation package includes the following related publications:

- *WaferMark® SigmaDSC NT Operator Manual (P/N 273.508.00)*
- *WaferMark® GEM/SECS Interface User's Guide (P/N 273.499.00)*

One set of these manuals is shipped with each system. In addition, the WaferMark® SigmaDSC NT Site Preparation Guide should be on site at least one month prior to the system ship date to aid in preparing the site for system installation.

How to Use This Manual

This manual is organized into chapters and supplemental appendices. Refer to the Table of Contents for a specific listing of the sections, subsections, figures and tables comprising this document. For the printed version, there is an index for locating information on individual topics.

Conventions Used in This Manual

The following typographical conventions are used in this manual.

General text

- Chapter and section titles, figure and table captions are shown in large bold font.
- Important text and notes, and tips are shown in italics.
- Names of signals, lines, connectors, etc. are shown initially capitalized or upper case and in sans-serif font.

  For example: Vcc, Gnd, Pin 1, CCTV In, USER INTERLOCK.
- Mouse buttons are referenced to a right-hand mouse: MB1 (left button), MB2 (middle button), and MB3 (right button).

  Selection of an item using the left button is defined as left-click.

  Selection of an item using the right button is defined as right-click.

Machine control buttons and switches

- Computer keyboard buttons are shown in initially capitalized Courier bold font.

  For example: **Return**, **F2**, **Ctrl + F1**.
- Control panel buttons, switch positions, and indicators are shown in upper case sans-serif font.

  For example: SHUTTER CLOSE, START, COOLER

Menu, window, dialog box, scrolling list, and field names

- Single menu items, window names, scrolling list items, or field names are shown as initially capitalized sans-serif bold font.

  For example: **Edit**, **Save As**, **File Name**.
- Menu items in a sequence are shown separated by “>”.

  For example: **File > Save As**

File Names, Variable Names, and Replacement Text Names

- File names are shown in lower case sans-serif bold font.

  For example: **photograph.jpg**, **newjob.mrk**

- Variable names, such as predefined keywords used in programming, are shown, as they appear, in sans-serif font.

  For example: X-offset, Imax, Absolute.
- Replacement text, used to indicate part of a programming command where the example will be replaced by an actual value, is shown by lower case sans-serif bold font, within angle brackets.

  For example: To open the file enter <drive letter><path><filename>.

Computer code entry and display

- Keyboard entry and screen response is shown, as it appears, in Courier bold font.

  For example: **TRIM_TOOL,VDVM1**
- Software listings are shown, as they appear, in Courier font.

  For example:

```
1...  Get number of update buffers.
2...  Get size of update buffers.
3...  Perform a remote update.
4...  Get a remote update buffer.
Q...  Return to main menu.
```

Cross-references and Links

- On paper, cross references and links are indicated by the number of the item referenced.

  For example:

  This is described in the System Performance section (2.4).
- On screen, cross references and links are indicated by underscored text or by the inline symbol

What to do if Something Goes Wrong

GSI Lumonics is committed to providing timely and effective customer support to its customers worldwide. You may telephone or FAX the nearest office (see Customer Support Contact Addresses at the front of this manual) or if unsure, contact the factory in Wilmington, Massachusetts and your inquiry will be directed to the proper office.

The Customer Support Center Internet E-mail address is:

support@gsilumonics.com

GSI Lumonics will respond to E-mail messages within 24 hours of receipt.

ISO 9001 Certification

GSI Lumonics's Advanced Manufacturing Systems Group at 60 Fordham Road in Wilmington, Massachusetts, USA has established and applies a quality system for the design and manufacture of laser systems for the Semiconductor Industry. It has received the ISO 9001 version 2000 certification, registration number 74 300 7674A.

1 Safety

Please read this chapter before carrying out installation, operation or maintenance of this laser equipment.

All users of the WaferMark® SigmaDSC NT laser marking system, including system operators, customer personnel trained by GSI Lumonics to perform system maintenance tasks, and GSI Lumonics field service personnel must be familiar with the Safety information in this section before installing, operating, or maintaining this system.

This product is a Class 1 (I) laser system. However, several hazards may be present when servicing the equipment. Exercise extreme caution at all times. These potential hazards include:

- Laser hazards (Section 1.3) - In normal operations, the WaferMark® SigmaDSC NT system is a Class I system. The system laser access panels have built-in interlock protection. However, any service which directly or indirectly exposes the laser beam can render the system a Class 4 (IV) hazard for radiation exposure. Figure 1-1 shows an actual Laser Hazard label copied from the outside panel of the system.

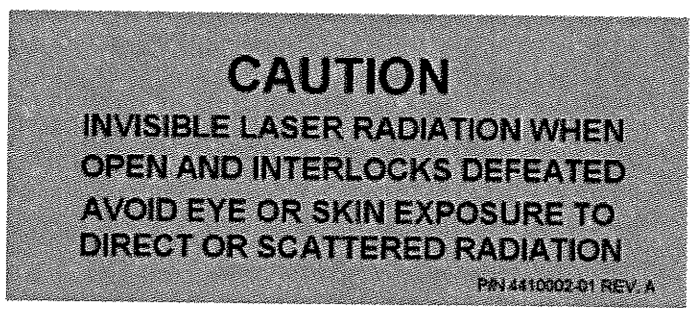


Figure 1-1 – Caution Laser Hazard Label

⚠ WARNING
Laser Hazard

Perform all maintenance/service actions within the safety guidelines discussed in this section and follow the Control Measures listed in ANSI Z136.1-1993, American National Standard for the Safe Use of Lasers. Wear laser safety glasses or goggles with a minimum optical density (OD) 6.0 for 1053 nm and 8.0 for 532 nm when the laser is energized during maintenance/service. This provides adequate protection for most applications.

NEVER EXPOSE YOURSELF TO A DIRECT LASER BEAM.

⚠ WARNING
Potential Laser Radiation Exposure

The GSI Lumonics WaferMark® SigmaDSC NT laser marking system has an Nd:YLF laser. During normal operation, the system functions as a Class I laser product pursuant to the United States Code for Federal Regulations, Title 21, Sub-chapter J, Part 1040; and to EN 60825–1: 1994

USE OF CONTROLS OR ADJUSTMENTS, OR THE PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN, MAY RESULT IN HAZARDOUS LASER RADIATION EXPOSURE.

- Electrical hazards (Section 1.4) - The WaferMark® SigmaDSC NT system power supply output can reach a High Voltage level and is potentially lethal. The system cabinet access panels have built-in interlock protection. Observe all electrical precautions. Figure 1-2 displays an actual Electrical Hazard label copied from the side of the system.

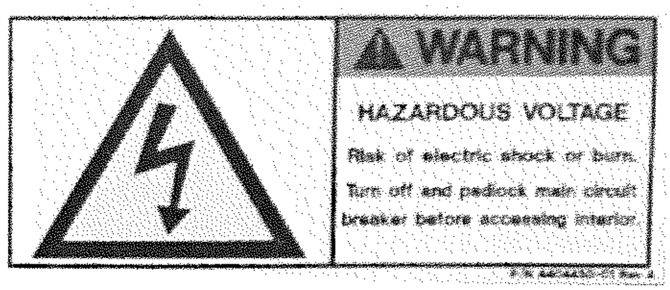


Figure 1-2 – Warning Electrical Hazard Label

> ⚠ **DANGER**
> **Electrocution Hazard**
>
> To avoid potentially lethal electrical hazards, observe all electrical precautions during system maintenance/service.

- Mechanical hazards (Section 1.6 - The movements of the WaferMark® SigmaDSC NT robot pose the risk of mechanical pinch and jam hazards. Hazard tape marks a clearance zone. The operator (and other personnel) should avoid reaching inside of this area when the system is operating.
- Environmental hazards (Section 1.7) - During the marking of bare silicon wafers, the WaferMark® SigmaDSC NT system poses no environmental hazards. However, introducing doping chemicals, such as Gallium Arsenide (GaAs), is highly toxic and requires the proper venting of toxic gases. If toxic chemicals are introduced into the processing, ensure that the system's built-in vent system is connected to an exhaust vent system that complies with governmental and corporate regulations for hazardous fume removal.

Modification of the equipment or changes in application may make any of these hazards applicable in the new situation. GSI Lumonics recommends that you read this complete safety chapter in order to become familiar with all aspects of laser safety.

Safety of this equipment is reinforced by the use of safety labels which are fixed to the equipment in a visible manner. The type of safety labels used and their location is detailed later in this chapter.

The use of controls, replacement parts, adjustments, or procedures other than those specified within this manual may result in exposure to any of these hazards.

The degree of seriousness of the hazard is indicated by the use of the following signal words. Each is presented with an example:

DANGER

Indicates an imminent hazard which, if not avoided, is extremely likely to result in death or serious injury.

NOTE: Use of this signal word is limited to the most extreme situations.

Example:

> **⚠ DANGER**
> **Potential for Electrocution**
> Disconnect from the wall unit or disengage safety switch prior to servicing unit.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

Example:

> **⚠ WARNING**
> **Laser Hazard**
> Use laser safety goggles at all times when servicing the laser.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It is also used to alert the user against unsafe working practices and potential damage to the equipment.

Example:

⚠ CAUTION
RISK OF INJURY OR DAMAGE TO EQUIPMENT

Always keep the keys in a secure place when not in use to prevent unauthorized operation of the equipment.

⚠ CAUTION

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

1.1 Location and Description of Warning Labels

The safety and CDRH labels used on the WaferMark® SigmaDSC NT System are shown in Table 1-1. Each label is identified in Table 1-1 by an ***identification letter***. The locations of each label on the system are shown in Figure 1-3 through Figure 1-9 by the corresponding label identification letter.

Table 1-1 – WaferMark® SigmaDSC NT System Safety and CDRH Labels

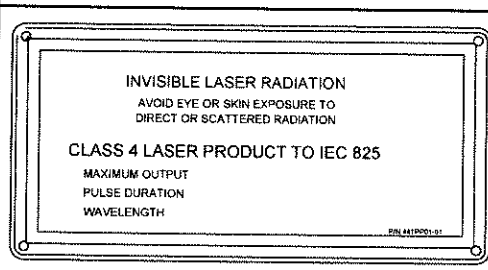
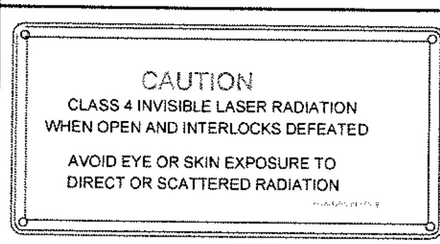
Identification Letter	Label	Locations Used
A		See Figure 1-7.
B		See Figure 1-3, Figure 1-6 and Figure 1-7 .

Table 1-1 – WaferMark® SigmaDSC NT System Safety and CDRH Labels

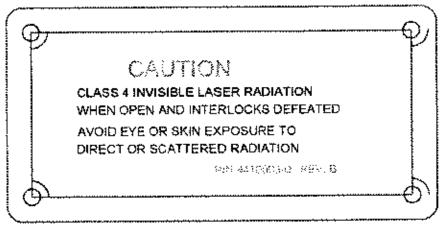
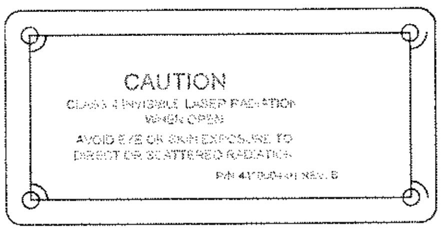
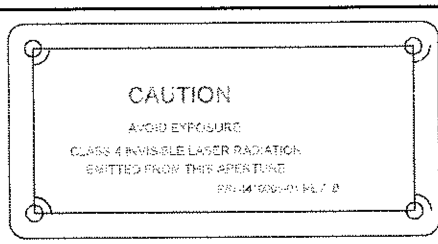
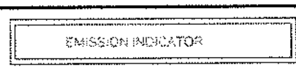
Identification Letter	Label	Locations Used
C		See Figure 1-4 and Figure 1-6.
D		See Figure 1-7 .
E		See Figure 1-7.
F		See Figure 1-6.
G		See Figure 1-3.

Table 1-1 – WaferMark® SigmaDSC NT System Safety and CDRH Labels

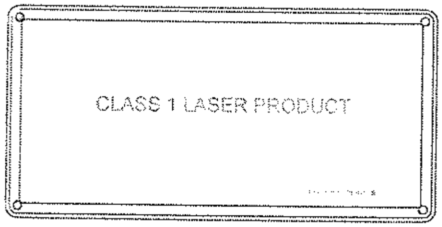
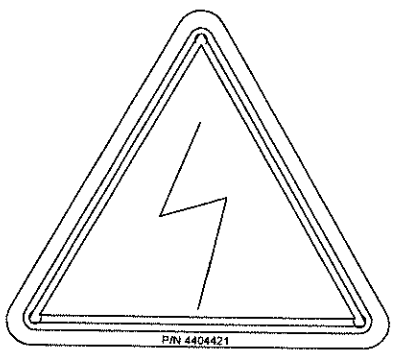
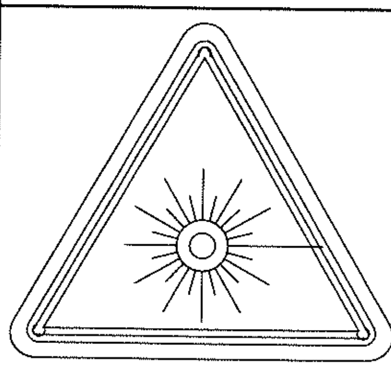
Identification Letter	Label	Locations Used
H		See Figure 1-6 .
J		See Figure 1-3, Figure 1-6 and Figure 1-8.
K		See Figure 1-3, Figure 1-6 and Figure 1-8.
L, M		See Figure 1-3 , Figure 1-4 and Figure 1-7.

Table 1-1 – WaferMark® SigmaDSC NT System Safety and CDRH Labels

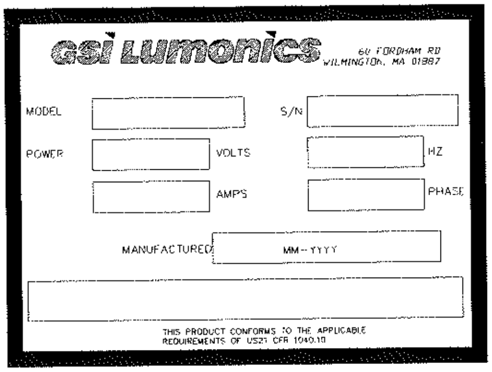
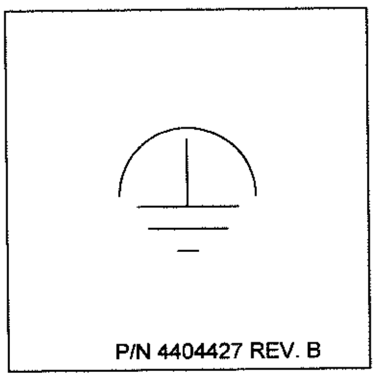
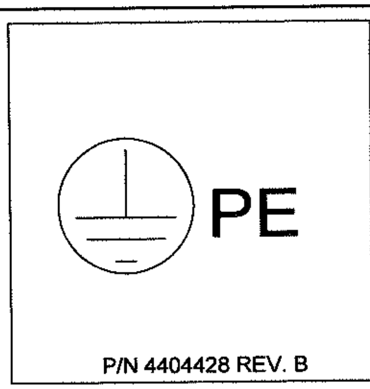
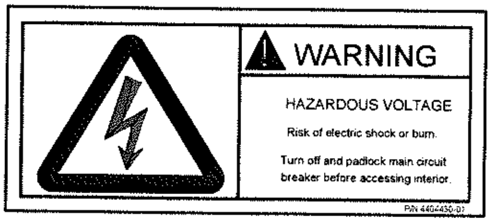
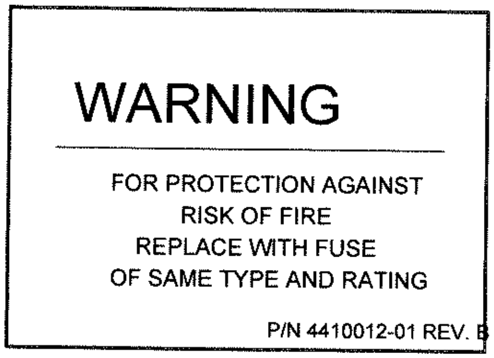
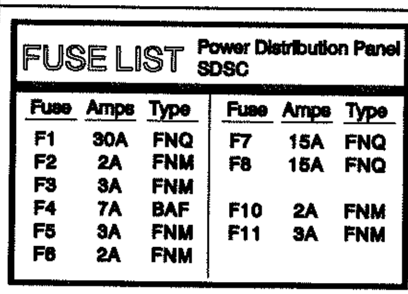
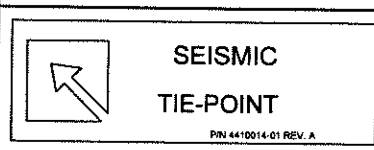
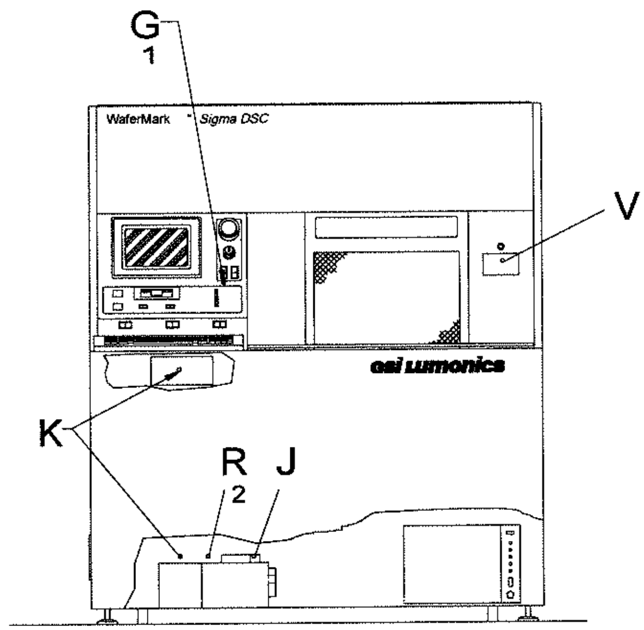
Identification Letter	Label	Locations Used
N		See Figure 1-6 .
P		See Figure 1-8.
PE		See Figure 1-8.
Q	P/N 4404429-01 CAUTION Invisible laser radiation when open and interlock defeated. AVOID EYE OR SKIN EXPOSURE TO	Apply Q labels to interlock defeat flags (3 places).Used in conjuction with Label B.

Table 1-1 – WaferMark® SigmaDSC NT System Safety and CDRH Labels

Identification Letter	Label	Locations Used
R		See Figure 1-3, Figure 1-4 and Figure 1-5.
S		See Figure 1-6 and Figure 1-8.
T		See Figure 1-8.
U		See Figure 1-9.
V		See Figure 1-3.

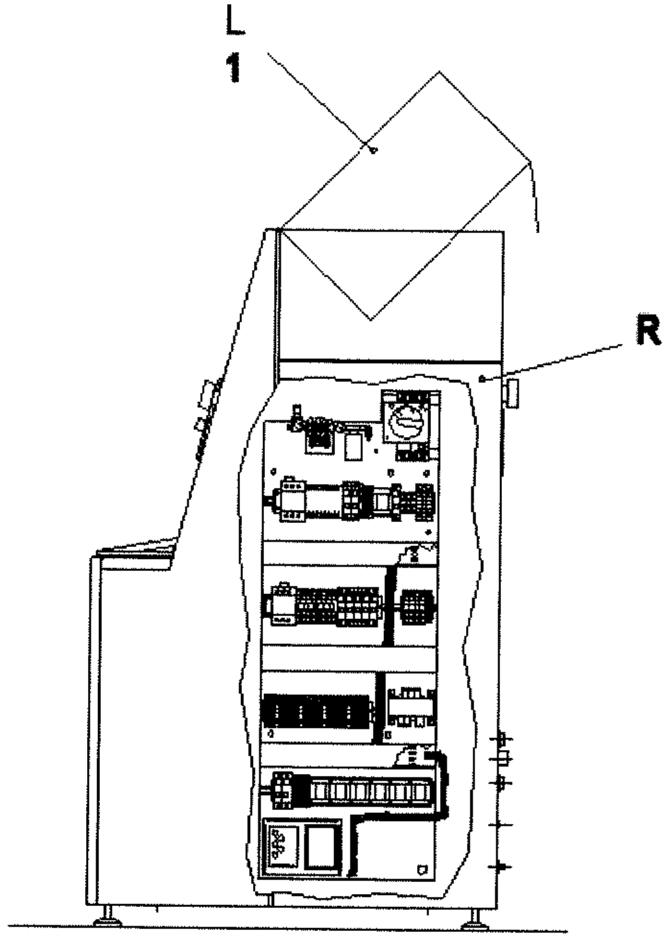
Refer to GSI Lumonics Drawing No. 2950169-01 for the safety and CDRH labels and GSI Lumonics Drawing No. 2950188 for label locations on the system.



1 Label G
Place directly under POWER ON indicator

2 Label R
Center on top of ventilation grill

Figure 1-3 – Safety and CDRH 1, Front View of System



1 Label L
Centered inside top cover

Figure 1-4 – Safety and CDRH Label Locations, Right Side View of System

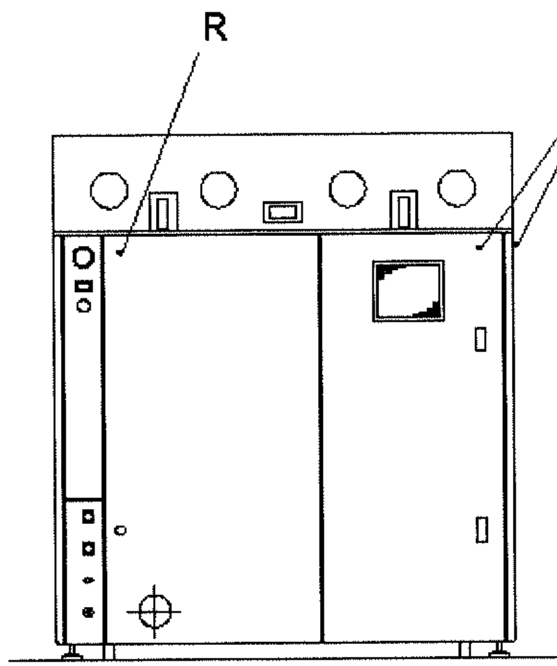
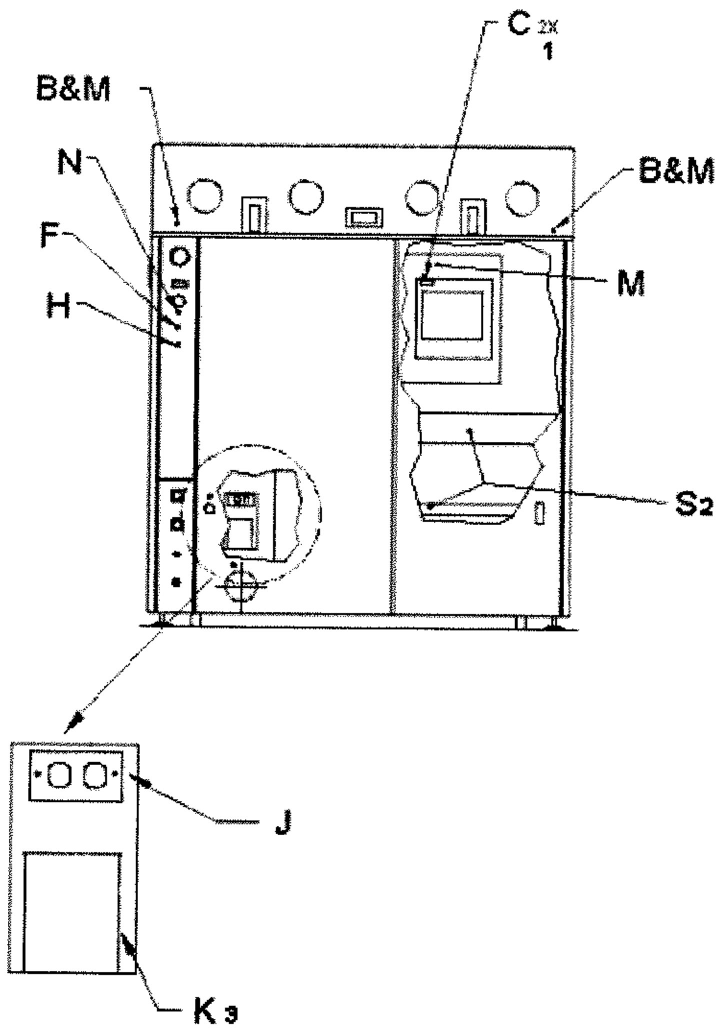


Figure 1-5 – Safety and CDRH Label Locations, Rear Access Panel

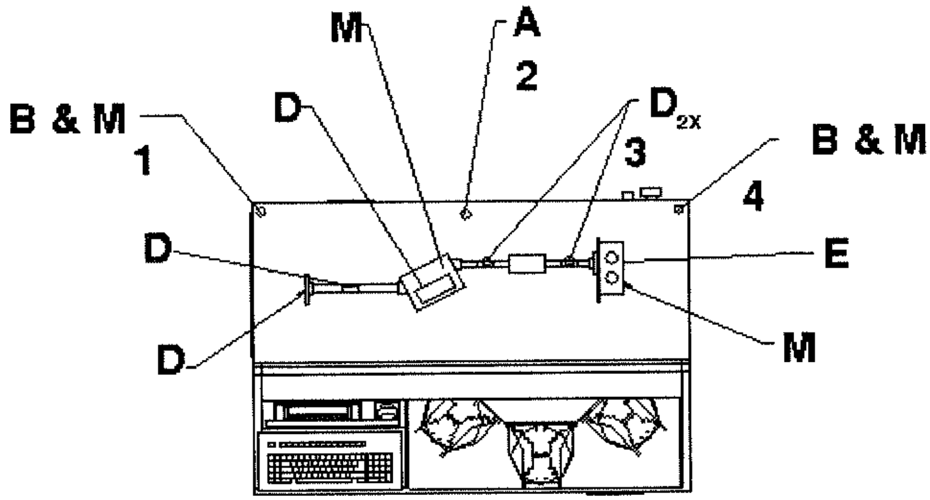


1 Label C (2 places)
Top outside of door and at top of door opening

2 Label S
Front panel of Laser Controller. (Fuse panel marking engine)

3 Label K
Place on side

Figure 1-6 – Safety and CDRH Label Locations, Rear of System



1 Label B
Corner of laser baseplate

2 Label A
Center of laser baseplate

3 Label D
2 places

4 Label B
Corner of laser baseplate

Figure 1-7 – Safety and CDRH Label Locations, Top View with Top Cover Removed

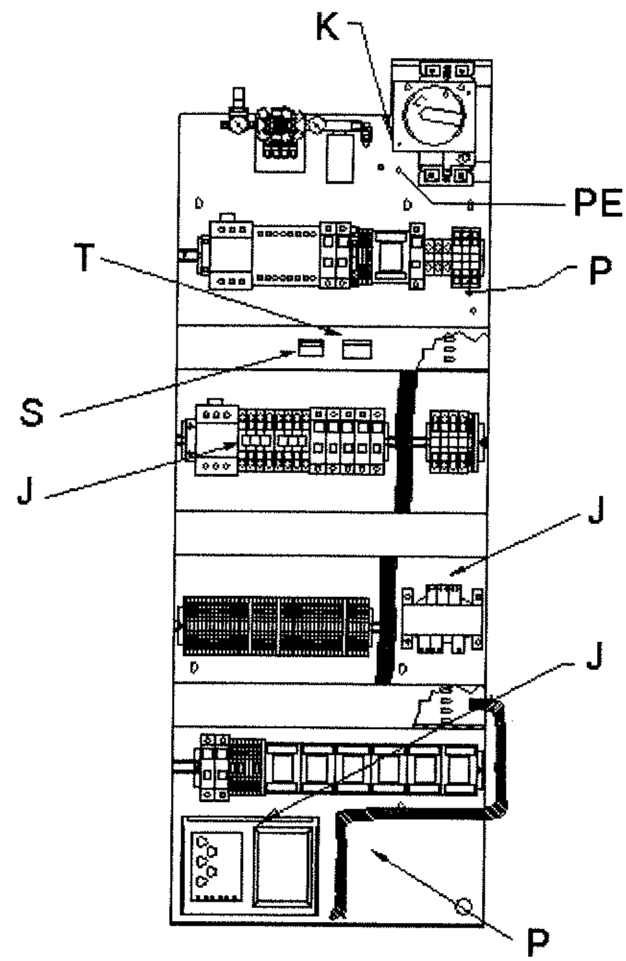
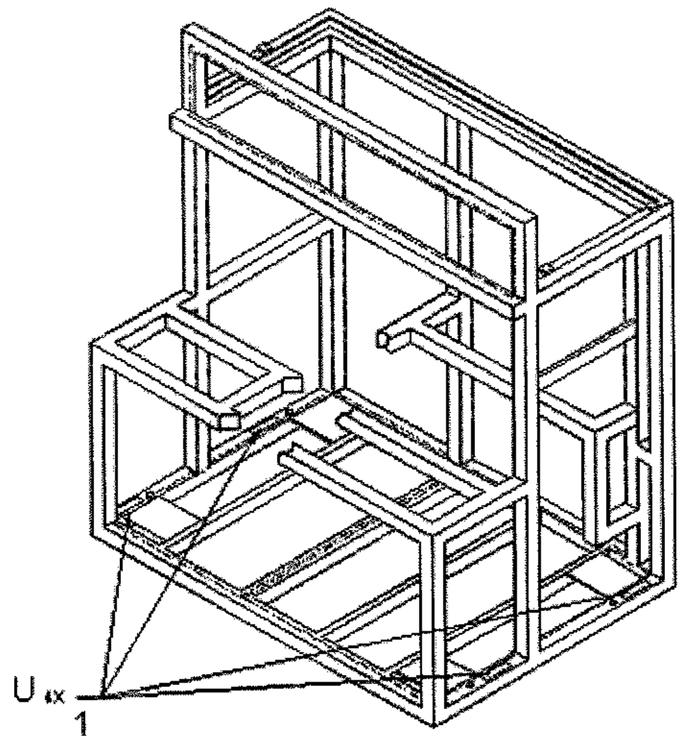


Figure 1-8 – Safety and CDRH Label Locations, Power Distribution Panel



1	Label U 4 places

Figure 1-9 – Safety and CDRH Label Locations, Seismic Tie-Down

1.2 Laser Classification

The WaferMark® SigmaDSC NT System uses the following lasers:

Table 1-2 – Wavelength Emitted by the WaferMark® SigmaDSC NT Laser

Laser type	Wavelength	Visible or Invisible
Nd:YLF	1.047 – 1.053µm	Invisible

These lasers are classified as follows:

Table 1-3 – WaferMark® SigmaDSC NT Laser Classification

Laser Class - IEC (CDRH)	Description	Hazard Potential
1 (I)	The WaferMark® SigmaDSC NTSystem in its normal operating mode is a Class 1 (I) laser and is inherently safe. Under normal operating conditions, it does not produce a hazard.	None
4 (IV)	During servicing, the WaferMark® SigmaDSC NT System is a Class 4 (IV) lasers. Both direct beams and diffuse reflections are hazardous and may cause severe damage to eyes and skin.	High

GSI Lumonics certifies the basic WaferMark® SigmaDSC NT product, when installed in the standard configuration, as a Class I laser product containing a Class IV laser system. If an integrator modifies the WaferMark® SigmaDSC NT laser system for use in the United States, a report must be submitted to CDRH for approval. United States verification of compliance can be obtained from:

Office of Compliance Center for Devices and Radiological Health
2098 Gaither Road
Rockville, MD 20850
Tel. (301) 594-4654; FAX (301) 594-4672

1.3 Laser Hazards

A laser beam is an intense, collimated beam of monochromatic light. This beam can damage human tissue. Take precautions to ensure that personnel working in the direct vicinity of the laser output cannot come into direct contact with the beam.

1.3.1 Eye Damage

The laser output for the WaferMark® SigmaDSC NT may be visible (or invisible depending on the wavelength). See Table 1-2.

⚠ WARNING
Optical Hazard

When the WaferMark® SigmaDSC NT System is being serviced, always use the appropriate certified laser safety goggles. In the servicing state, the beams are potentially damaging to eyesight and may result in permanent eye damage if laser radiation is allowed to enter the eye, either directly or by reflection.

1.3.2 Eye Protection and Safety Enclosures

⚠ WARNING
Optical Hazard

Laser safety glasses are designed to protect the wearer from reflected or scattered radiation. For a laser wavelength of 1053 nm, use goggles with a minimum Optical Density of 6.0. ***Never*** look directly into a laser beam, even when wearing safety glasses.

When servicing the WaferMark® SigmaDSC NT system, unless suitable laser-proof barriers are set up, all personnel working within 619 meters (2,789 feet) of the equipment must wear certified laser safety eyewear that is appropriate for the laser wavelength. The barrier should be at least 7-8 feet (2-2.4 meters) high, with no openings through which the beam could pass. The barrier can be any material with a minimum optical density of 6 rated for 1053 nm wavelength of light.

NOTE: Normal eye glasses and contact lenses ***do not*** *offer adequate protection against laser hazards. Personnel without eye protection must be excluded from the laser area.*

Laser safety glasses must conform to EN207 and 208:1994 - "Personal eye-protection - Filters and eye-protectors against laser radiation" or the guidelines in ANSI Z.136.1:1993. The regulations in force will depend on the location of the laser installation. In general, EN standards will apply in Europe and ANSI standards in North America.

> **⚠ WARNING**
> **Optical Hazard**
> Discard and replace damaged laser safety glasses. If the appearance or optical quality of glasses changes during use, verify the cause immediately.

1.3.3 Skin Damage

If a laser beam from a low-power laser, such as those used for marking, touches the skin, it can cause a burn. Normally, this is not severe if the affected part is quickly removed from the beam. However, prolonged exposure can cause severe skin damage. Take every precaution to ensure that no part of the body enters the beam path, especially during installation, servicing, and maintenance.

> **⚠ WARNING**
> **Optical Hazard**
> To avoid exposure to the direct beam, never defeat any interlock on the beam path guarding.

1.3.4 Emission Warning Indicators

To ensure the highest level of safety, the equipment is considered to be capable of producing laser output as soon as the power supply of the laser source is activated electrically. To indicate this, a blue "Laser On" emission warning indicator on the Operator Panel illuminates.

1.4 Electrical Hazards

Laser power supplies and machine controllers contain electrical supplies which are potentially dangerous and hence precautions must be taken to prevent the risk of electrocution.

1.4.1 General Precautions

- Access panels must only be removed by personnel trained and certified by GSI Lumonics.

- Ensure that only trained personnel, familiar with electrical hazards, have access to the area.
- Read the operating and maintenance instructions for the equipment before beginning any service procedures.
- Follow accepted working procedures and codes of practice as well as the electrical safety code for the site where the equipment is installed.
- Keep the area around the equipment dry. Never operate the equipment if there is a water leak in the cooling system.
- Never wear rings, bracelets, or other jewelry when working around electrical circuits.
- Never work on electrical equipment alone. Always have a colleague close by.
- Always wait for five minutes after isolating the equipment to ensure that stored energy has dissipated.
- Isolate the main power input at the circuit breaker.
- Never operate the equipment if any main power cable is frayed or damaged.
- Never operate the equipment in production with access panels removed.

1.4.2 Component Replacement

- Before replacing fuses, exchanging printed circuit boards, or disconnecting wiring:
  - Isolate the system at the main circuit breaker, lock it in the OFF position and attach a notice indicating that maintenance work is in progress.
  - Remove the key from the main switch on the control panel.
- Never assume the polarity of cabling or replacement components. Refer to electrical schematics or contact GSI Lumonics for confirmation.

1.4.3 Additional Considerations for High Voltages

Before working on the power supply:

- Ensure that only trained personnel, familiar with electrical hazards, have access to the area.
- Remove the key from the main switch on the control panel.
- Isolate the main power input at the circuit breaker, lock it in the OFF position and attach a notice, indicating that maintenance work is in progress.
- Read the operating, maintenance, and troubleshooting procedures to become familiar with the location of high voltage components.
- Do not override safety interlocks unless a key-operated override facility or special overridable interlock switch is fitted to the equipment.
- Use only GSI Lumonics-approved replacement parts.

1.5 Interlocks and Emergency Stop (E-Stop)

This section explains the interlocks, the key switch, emergency stops and lockout-tagout.

1.5.1 Interlocks

This equipment has internal safety interlocks which protect against:

- Exposure to laser radiation
- Exposure to electrical hazards
- Exposure to mechanical hazards,
- Damage to the equipment due to abnormal operating conditions or fault conditions.

In addition, the SigmaDSC NT provides one or two independent external interlock connection points via a Remote Interlock Connector (RIC) (see 4.9.12). The interlock(s) can be connected to:

- the access door(s) of the SigmaDSC NT equipment room to create a Class 1 safety environment (optional)

  NOTE: Opening a room access door breaks the interlock circuit and automatically closes the shutter to prevent further *transmission of the laser beam from the laser assembly to the marking surface.*

- an interface with external equipment.

Two types of interlocks are provided:

- Interlocks that operate on the main power supply or safety shutter and cause the equipment to shut down to normal start-up level. This type of interlock does not automatically reset.
- Interlocks that operate on the laser process shutter causing it to close and prevent emission of a laser beam. This type of interlock will automatically reset.

1.5.2 Keyswitches

Keyswitches are fitted to the main control panel. Start-up and operation of the equipment is not possible until a key is inserted into the switch and is turned to the ON position. The key cannot be removed from the switch until it is returned to the OFF position. In certain cases, the keyswitch has several positions giving access to different levels of operation and maintenance.

> ⚠ **CAUTION**
> **RISK OF INJURY OR DAMAGE TO EQUIPMENT**
>
> Always keep the keys in a secure place when not in use to prevent unauthorised operation of the equipment.

1.5.3 Emergency Stop (E-Stop)

When the equipment is used alone, an Emergency Stop (E-Stop) button is fitted to the main control panel and to any remote control panels which may be connected to the equipment. E-Stop buttons are coloured red with a yellow bezel. Pressing the E-Stop will shut down the equipment to a level where no hazards exist. The equipment will not restart when the E-Stop button is reset. The normal start-up procedure must be followed in order to return to operational status.

1.6 Mechanical Hazards

Part handling equipment, robots, and machinery can move at high speeds and in an unexpected manner. Take the following precautions to prevent dangerous situations.

1.6.1 General

- Do not wear loose fitting clothing, tie, or jewelry which could become entangled in moving parts.
- Do not try to remove piece parts from a moving handling system.

> ⚠ **WARNING**
> **PINCH POINT HAZARD**
>
> ROBOT MAY MOVE UNEXPECTEDLY. RISK OF BODILY INJURY, DO NOT CROSS HAZARD ZONE WHEN WARNING LIGHT IS ON.

1.6.2 Robots and CNC (Computer Numerical Control) Equipment

- Do not enter or place any part of the body in a robot cell or work enclosure when the equipment is in operation. Place the equipment in the Emergency Stop (E-Stop) mode and ensure that all motion has stopped before accessing the cell or enclosure.
- If a teach pendant is provided, ensure that only the person carrying the teach pendant enters the cell or enclosure.
- Check the correct operation of the Emergency Stop (E-Stop) button on a teach pendant before entering a cell or enclosure.
- Place the equipment in the Emergency Stop (E-Stop) mode whenever the equipment is not in use.
- Position all controllers and teach pendants outside the movement envelope of the equipment in normal operating mode.
- Test any new or modified program at low speed for at least one full cycle.
- Ensure that all safety features, such as light curtains, door interlocks, pressure mats, and safety barriers, are in good condition and are working correctly by testing them every week, or more often if they are subjected to heavy usage.

- If a work cycle is interrupted, extra care must be taken when resetting the equipment and homing axes. Axes may move in an unpredictable manner. If there is any doubt that an unsafe path may be followed by any axis, a manual reset and homing procedure must be carried out by trained personnel.

1.6.3 Special Precautions During Installation

- Ensure that only trained and qualified personnel are permitted within the work envelope of the equipment.
- Identify the work envelope of the equipment with floor markings, signs, and barriers.
- Eliminate areas where parts of the body may become trapped between moving and fixed parts of the equipment (pinch points).
- Provide sufficient room to permit safe teaching and maintenance procedures.

1.7 Environmental Hazards

1.7.1 Fire Hazard

Combustible material placed in the beam path can catch fire. High power laser beams are capable of igniting most metallic and non-metallic materials.

If there is any doubt about the reactivity of a material, carry out a processing test on a small piece and have an assistant present to:

- Switch off the laser equipment.
- Stand by with a suitable fire extinguisher.

Particular care is needed when using oxygen as a process assist gas since it can accelerate combustion rates, especially when processing reactive metals such as magnesium or titanium, and most plastics.

⚠ WARNING
Risk of Accelerated Combustion in the Presence of Oxygen

Take extreme care when using oxygen as a process assist gas. Normal combustion rates will be accelerated and materials that are non-combustible in air may burn in its presence. If a fire occurs, shut off the source of oxygen and the laser beam first and then fight it, using appropriate fire extinguishing equipment.

In all cases, oxygen feed lines must be equipped with a flashback arrester to prevent fire from reaching the compressed gas source.

1.7.2 Lithium Battery Hazard

Lithium batteries are fitted as a backup power source within software-based control units.

⚠ CAUTION
Danger of Explosion if the Battery is Incorrectly Replaced

Replace only with the same or an equivalent type recommended by the manufacturer. Dispose of batteries at an appropriate recycling facility or according to local codes.

1.7.3 Lead-Acid Battery Hazard

Sealed lead-acid batteries are installed as a storage power source within Uninterruptible Power Supplies (UPS).

⚠ CAUTION
Environmental Hazard

Replace only with the same or an equivalent type recommended by the manufacturer. Dispose of batteries at an appropriate recycling facility or according to local codes.

Lead-acid batteries are recyclable and may be returned to the battery manufacturer or their authorized service center in certain regions.

⚠ WARNING
Risk of Injury

Do not dispose of batteries in a fire as they may explode.

Do not open or mutilate batteries. They contain an electrolyte which is toxic and harmful to the skin and eyes.

1.7.4 Methanol

Methanol is used as a degreasing solvent and is recommended for cleaning optics.

⚠ WARNING
Flammable - Poison - Irritant

Methanol is a colorless liquid. It is a flammable poison that burns with a blue, non-luminous flame. Its main toxic effect is exerted upon the nervous system, particularly the optic nerves and possibly the retina, which can progress to permanent blindness. The vapor is harmful and may be fatal or cause blindness if swallowed. Potential health effects may include irritation to eyes; irritation, dryness and cracking of the skin; and may also cause nausea, vomiting, dizziness, blindness or death.

Since methanol is highly flammable, the following precautions should be observed:

- Keep the container tightly closed.
- Keep it away from sources of ignition.
- Avoid breathing the vapor and eye contact.
- Do not smoke in the vicinity of the solvent or its vapor.

If spilled, observe the following precautions:

- Do not touch the spilled material.
- Stop the leak or source of spill if you can do this without risk.
- Ventilate the area of the spill or leak.
- Using appropriate protective gloves (Nitrile rubber or Viton is recommended) and wearing splash-proof goggles, take up

the spilled liquid with sand or other absorbent material and place it in sealed containers for disposal.

First aid procedures for inhalation, eye contact, skin contact, and ingestion require immediate medical assistance.

1.7.5 Isopropyl Alcohol (Propanol)

Isopropyl alcohol is used as an additive to cooling systems and as a water displacing solvent for cleaning optics.

> ⚠ **WARNING**
>
> **Flammable - Irritant**
>
> Isopropyl alcohol is a colorless, flammable liquid. Effects of ingestion or inhalation are nausea, intoxication, depression of the central nervous system, headache, decreased blood rate, and coma. High vapor concentrations may cause eye injury and skin irritation.

Isopropyl alcohol is a health risk and explosive hazard. Vapor can travel distances to an ignition source and flash back. Observe the following precautions at all times:

- Keep the container tightly closed.
- Keep it away from sources of ignition.
- Avoid breathing the vapor and eye contact.
- Do not smoke in the vicinity of the solvent or its vapor.

If spilled, observe the following precautions:

- Evacuate the area of all unnecessary personnel.
- If the workplace exposure limit is exceeded, wear protective equipment.
- Wear safety glasses with side-shields at all times.
- Eliminate any ignition sources until the area is free from explosion or fire hazard.
- Do not smoke in the vicinity.
- Electrically ground all equipment when handling the product.

- Stop the leak or source of spill if you can do this without risk.
- Ventilate the area of the spill or leak.
- Using appropriate protective gloves (Nitrile rubber or Viton is recommended) and wearing splash-proof goggles, take up the spilled liquid with sand or other absorbent material and place it in sealed containers for disposal.

First-aid procedures for inhalation call for removal of the person to fresh air and artificial respiration if breathing has stopped. In case of eye contact, flush thoroughly with water for at least 15 minutes. In case of skin contact, wash thoroughly with soap and water. In case of ingestion, give water and induce vomiting. Call medical assistance immediately for all cases of overexposure.

1.7.6 Ethylene Glycol

Ethylene glycol is used as a coolant additive to prevent freezing. It is normally mixed with water as a 20 percent solution.

⚠ WARNING

Mild Irritant

Ethylene glycol is a colorless, viscous liquid. It is hygroscopic, odorless and relatively non-volatile. Avoid eye and skin contact.

The following precautions should be observed at all times:

- Keep the container tightly closed.
- Avoid breathing vapor or eye contact.
- Do not smoke in the vicinity.
- Wear protective clothing and safety glasses when handling.

If spilled, observe the following safety precautions:

- Wear protective clothing and safety glasses at all times.
- Do not smoke in the vicinity.
- Stop the leak or source of spill if you can do this without risk.
- Using appropriate protective gloves (Nitrile rubber or Viton is recommended) and wearing splash-proof goggles, take up

the spilled liquid with sand or other absorbent material and place it in sealed containers for disposal.

First aid procedures for eye contact require the eye to be flushed thoroughly with water for at least 15 minutes. For skin contact, wash thoroughly with soap and water. For ingestion, give water but do ***not*** induce vomiting. Call for medical assistance.

1.7.7 Optishield II Corrosion Inhibitor

> ⚠ **WARNING**
> **Irritant**
>
> Optishield II corrosion inhibitor is moderately toxic. Do not breathe mist or vapor. Wash hands thoroughly after handling product. Protect eyes with safety goggles or glasses with side shields.

The following precautions should be observed at all times:

- Keep the container tightly closed.
- Keep the container away from sources of ignition.
- Avoid breathing the vapor and contact with eyes.
- Do not smoke in the vicinity of the product or its vapor.

For spills, observe the following precautions:

- Evacuate the area of all unnecessary personnel.
- If the workplace exposure limit is exceeded, wear protective equipment.
- Wear safety glasses with side-shields at all times.
- Eliminate any ignition sources until the area is free from explosion or fire hazard.
- Do not smoke in the vicinity.
- Electrically ground all equipment when handling the product.
- Stop the leak or source of spill if you can do this without risk.
- Ventilate the area of the spill or leak.

- Using appropriate protective gloves (Nitrile rubber or Viton is recommended) and wearing splash-proof goggles, take up the spilled liquid with sand or other absorbent material and place it in sealed containers for disposal.

First aid procedures for inhalation call for removal to fresh air and artificial respiration if breathing has stopped. For eye contact, flush thoroughly with water for at least 15 minutes. For skin contact, wash thoroughly with soap and water. For ingestion, give water and induce vomiting. For all cases of overexposure, call for medical assistance immediately.

1.7.8 Process By-Product Hazard

When a laser beam reacts with any material, it produces vapor or fumes which are often toxic. These fumes must be effectively evacuated from the work area by means of a fume extraction system, designed to filter out the vapor and particulate material which is generated.

> ⚠ **CAUTION**
>
> **Short and Long-Term Health Risk**
>
> Safe evacuation of process by-products must comply with local health and safety regulations and is the responsibility of the customer.

1.7.9 Ozone Hazard

The ultra-violet beam generated by excimer lasers operating on argon fluoride (193 nm wavelength) produces ozone by interaction with air in the beam path. Ozone can act as a respiratory and eye irritant. All beam paths must be flushed with dry nitrogen (or other inert gas) to prevent ozone formation. The laser equipment should be operated in a well-ventilated area.

1.7.10 Compressed Gas Hazard

Users who are unfamiliar with handling compressed gases should note that local statutory requirements must be fulfilled concerning the storage, use and transportation of compressed gases. Your local gas supplier should be able to provide more information about the safe use of compressed gases.

Observe the following precautions:

- Never move a gas cylinder without first turning it off, removing the regulator, and fitting the safety cap.
- Always store gas cylinders vertically.
- Never leave a gas cylinder unattended without first securing it to a wall or a specially designed gas cylinder support.

1.7.11 Oxygen Hazard

Oxygen promotes rapid combustion and explosion.

Observe the following precautions:

- Never use grease on threads or any components that come in contact with oxygen, since an explosion may occur.
- Ensure that a flash-back arrester is fitted in the gas line to prevent fire from travelling back along the line to the compressed gas source.

> ⚠ **WARNING**
> **Risk of Accelerated Combustion in the Presence of Oxygen**
>
> Take extreme care when using oxygen as a process assist gas. Normal combustion rates will be accelerated and materials that are non-combustible in air may burn in its presence. If a fire occurs, shut off the source of oxygen and the laser beam first and then fight it, using appropriate fire extinguishing equipment.

1.7.12 Corrosive Gas Hazard

Corrosive halogens (chlorine, fluorine), as used with excimer lasers, are extremely toxic and must be handled with great care. Even though the halogen is diluted with a large percentage of helium or neon, precautions should be taken as for a full strength gas.

Observe the following precautions:

- Store bottles in a specially designed gas enclosure with an integral extraction system.
- Ensure that the gas scrubber fitted in the gas exhaust line is in good condition and effective. The active elements should be changed after 50 fills.
- Connect the gas exhaust to the extraction system by means of a large diameter flexible duct. Ensure that the duct cannot become constricted or blocked.
- Cap gas lines and connection points which are not in use to prevent the risk of a gas leak.

1.7.13 Cryogenic Liquid Hazard

Cryogenic liquids include the following liquefied gasses:

- Nitrogen
- Hydrogen
- Helium
- Argon
- Oxygen.

Improper handling of these liquids may cause:

- Explosions due to high-pressure gas build-up
- Fire caused by flammable gases
- Frostbite and other tissue damage due to contact with intense low temperatures
- Asphyxiation due to condensation of oxygen when liquid nitrogen is used in a confined, non-ventilated area
- Poisoning caused by toxic gases
- Asphyxiation due to oxygen displacement.

1.8 Special Safety Considerations Which Apply When Servicing This Equipment

Only GSI Lumonics field service technicians and engineers or GSI Lumonics trained technicians and engineers who are certified to service the SigmaDSC NT should ever make adjustments and or calibrate the equipment of the WaferMark® SigmaDSC NT product. Protective glasses must be worn by anyone that may be exposed to laser radiation as specified herein.

1.9 Product Compliance

GSI Lumonics certifies the basic WaferMark® SigmaDSC NT product, when installed in the standard configuration, as a Class I laser product containing a Class IV laser system. If an integrator modifies the WaferMark® SigmaDSC NT laser system for use in the United States, a report must be submitted to CDRH for approval. United States verification of compliance can be obtained from:

Office of Compliance Center for Devices and Radiological Health
2098 Gaither Road
Rockville, MD 20850
Tel. (301) 594-4654; FAX (301) 594-4672

1.10 Training of Personnel

GSI Lumonics provides training for operators, service, and maintenance personnel. Personnel who have been trained in service and maintenance shall be limited to performing only procedures and tasks taught during the training course. All other tasks must only be performed by GSI Lumonics-certified service personnel.

GSI Lumonics can also provide additional or advanced training. Retraining is recommended periodically, and especially, if equipment is upgraded.

1.11 Conditions of Use

This laser equipment should only be used under the following circumstances:

- By properly trained personnel
- On approved materials
- Using approved processing procedures
- Using approved maintenance and servicing procedures

- Under approved conditions
- With due authorization.

1.11.1 Approved Process Materials

Approved process materials are those which present no hazard to personnel and do not cause damage to the equipment. Material toxicity, flammability, process by-products, etc. must be taken into account prior to laser processing. For information about material safety, contact the material supplier.

1.11.2 Approved Processing Procedures

Approved processing procedures are those which are not hazardous to personnel or to the equipment. Choice of procedures must take into account toxicity and flammability of the material, process by-products, and the arrangements for fume containment and extraction.

1.11.3 Approved Maintenance and Servicing Procedures

During maintenance or service of this equipment, it may be necessary to establish a temporary Class 4 (IV) Laser Controlled Area (LCA) and to take other control measures to prevent accidental eye and skin exposure to laser radiation. This is necessary for any of the following reasons:

- The laser source covers have been removed and the shutter interlock is defeated.
- The beam delivery security has been breached and the shutter or power supply interlocks have been defeated.
- The safety enclosure door is open or interlocked covers have been removed and the shutter interlocks have been defeated.
- Non-interlocked covers have been removed.

The site Laser Safety Officer is responsible for establishing the boundaries of the LCA and imposes controls which include but are not limited to:

- Area controls

- Access restriction
- Enforced wearing of personal eye protection
- Utilization of temporary barriers, shrouds, beam stops, etc.

A notice should be posted outside the LCA when the equipment is operating in Class 4 mode.

Barriers, shrouds, beam stops, etc. used to construct the LCA should be specifically selected to withstand direct and diffusely scattered laser beams.

1.11.4 Approved Conditions Satisfying Local, National, and International Safety Regulations

Approved processes must satisfy the requirements of applicable local, national, and international safety standards and statutory requirements relating to electrical, laser radiation, and health hazards. In addition, they must satisfy the requirements of the Laser Safety Officer and the local safety regulations.

1.11.5 Due Authorization

Authorization must be obtained from the following personnel to confirm that the proposed production, maintenance, or servicing procedure satisfies the necessary safety conditions:

1. A competent, authorized person having a professional qualification in an appropriate technical discipline.
2. The supervisor responsible for the working area.
3. The site Laser Safety Officer or an authorized GSI Lumonics employee.

2 General Description

The WaferMark® SigmaDSC NT laser wafer marking system, with cleanroom quality, provides the most highly-advanced marking system for quickly and permanently identifying wafers throughout the semiconductor fabrication process. The system is housed in a Class I-compatible stainless steel cabinet. A standalone configuration is standard and a wall-mount is optional (p/n =65500304).

There are two styles of system – the standard WaferMark® SigmaDSC NT and the WaferMark® SigmaDSC NT 300.

NOTE: For simplicity, unless otherwise stated references in this manual to the WaferMark® SigmaDSC NT also apply to the SigmaDSC300.

The Operator Workstation on the front of the WaferMark® SigmaDSC NT provides controls and a monitor, keyboard and fault indicator display panel. There are five security log-on levels: Operator, Supervisor, Engineer and two customer-selectable (unspecified) levels.

The computer software controls the marking process, which uses an innovative diode-pumped laser design.

A wafer handler robot arm transfers the individual wafers to and from the cassette to an aligner in the Marking Chamber. Efficient robot handling provides fast wafer product throughput.

Unless otherwise noted, the following features are standard on WaferMark® SigmaDSC NT systems:

- Acousto-optic, Q-switched, TEM_{00}, Nd: YLF diode-pumped, water-cooled laser
- Closed-loop power stabilization circuitry for consistent laser power output
- A wafer handling system utilizing a precision robotic handler
- Marking with multiple dot matrix fonts on 200 mm (and/or optional 300 mm) wafers
- Interactive operator workstation with monitor, trackball, and keyboard for marking control and display of system status and fault conditions

Figure 2-1 – WaferMark® SigmaDSC NT System — Front View

2.1 Equipment Specifications

2.1.1 Utilities

Electrical:

Standard Connections:

208 VAC, single phase, 50/60 Hz, 23 FLA

220 VAC, single phase, 50/60 Hz, 22 FLA

240 VAC, single phase, 50/60 Hz, 20 FLA

Optional Connections:

380 VAC, single phase, 50/60 Hz, 13 FLA

416 VAC, single phase, 50/60 Hz, 12 FLA

System Circuit Breaker Rating:

18000 AIC @ 240 VAC

14000 AIC @ 480 VAC

Vacuum:

63.5-76.2 cm (25-30 inches) Hg at 2 SCFM

653-762 torr at 56.6 l/minute

$\frac{1}{4}$-inch diameter press-lock connection

Exhaust:

20 – 60 CFM (566 l/min – 1699 l/min) flow rate (maximum) through 1.25 inch (32mm) diameter port

NOTE: Actual rate is process-dependent.

2.1.2 System Weight

System:

637 kg (1405 lb)

System Load Distribution:

Right-Front Foot: 178 kg / 393 lb

Left-Front Foot: 210 kg / 464 lb

Right-Rear Foot: 159 kg / 351 lb

Left-Rear Foot: 89 kg / 197 lb

Center of Gravity:

See Figure 2-2 and Drawing No. 2850114 (Center of Gravity Location).

2.1.3 System Dimensions

Physical Dimensions:

1,675 mm H x 1,461 mm W x 976 mm D (66 in x 57.5 in x 38.5 in)

2.1.4 Operation and Storage Environment

Operating Environment:

Ambient Temperature 12.8 - 29.5°C (55.0 - 85.0°F)

Humidity (relative): Non-condensing

Should reside in a relatively clean environment.

Storage Environment:

Ambient Temperature 4 - 40°C (39.2 - 104.0°F)

Humidity (relative): Non-condensing

2.1.5 System Marking Performance

Marking Performance

Fonts

Bar Code 412; IDM (or ID Matrix); SEMI OCR 5x9; Single Dot Matrix 9x17; Double Density Dot Matrix 10x18. Also available as options are Engrave OCR-A and Triple Density Dot Matrix 15x23. Other custom fonts are available upon request. Contact GSI Lumonics for additional information.

Position

Multiple mark group at any orientation on the wafer front surface within a 25 mm band around the wafer circumference.

Marking Process

Hardmark

Engrave OCR-A is also available

Dot Diameter

60 – 90 µm

Dot Roundness

Major to minor axis ratio less than 1:1

Dot Depth

Dot depth varies, depending on customer needs. The general mark depth is 68 µm / 10 pulses

Throughput

1. For single pulse, 5 x 9 dot matrix, 12 characters (marking per *SEMI specification M12–0998*): 240 wafers/hour
2. For single pulse, 10 x 18 dot matrix, 12 characters (marking per *SEMI specification M12–0998*): 170 wafers/hour

NOTE: These throughput values are based on single pulse marking. For the marking described above, the throughput is much less. Also, see the Throughput under "Wafer Transport", below.

Workstation

The workstation consists of:

- physical workstation (components)
- control system
- application software
- diagnostics, and
- optional GEM/SECS interface software.

Workstation Components

The workstation consists of a flat panel monitor, trackball (pointing device) and a keyboard. An optional barcode wedge device is available. These provide the physical user interface to the system.

Control System

The control unit is an IBM-compatible PC with a minimum Pentium III 850 MHz processor with a 3.5-inch floppy drive, a Read/Write CD-ROM drive, and a hard disk drive (minimum 40 GB) to store all system parameters.

Software

The WaferMark application software runs on a Windows® NT-based operating system, using operator-prompted pull-down menus.

Diagnostics

Complete system diagnostic indicators are displayed on the front panel, along with an emergency OFF (EMO button) and the system keyswitch.

Communications

Optional SECS II / GEM interface.

Wafer Handling Specifications

Wafer Size Range

For SigmaDSC: 100, 125, 150 and 200 mm (4-, 5-, 6-, and 8-inch).

For SigmaDSC300: 200 and 300 mm (8-inch and 12-inch).

Alignment

Optical alignment over the entire wafer size range with no hardware change over for both flatted and notched wafers.

Repeatability

±125μm (±.005 inches) in both X- and Y-axes relative to the primary fiducial.

Wafer Transport

Pick-and-place robot arm with dual vacuum wand (end effectors). An optional flipper single end effector is available.

Throughput

For SigmaDSC: Up to 240 wafers per hour (marking per *SEMI specification M12–0998*) single pulse).

For SigmaDSC300: Up to 150 wafers per hour.

Sense and Receive Modules

Three load/unload cassette stations, capable of performing no-work-over-work handling. A two-cassette 300 mm option is available.

LASER AND OPTICS

Laser Type

Acousto-optic, Q-switched, TEM_{00}, Nd: YLF diode-pumped laser

- Maximum Output: 4 W
- Pulse Duration: CW/50 ns
- Wavelength: 1053 nm (standard)

Optics

Flat-field focusing lens

2.1.6 Precautions for Transport

The system is fitted into several custom pallet-base, wood crates for shipment by the factory shipping department.

2.2 Environmental Impact Considerations

2.2.1 Seismic Protection

The frame has the following seismic anchorage points that may be used to secure the system in facilities located in areas that are susceptible to seismic activity. It is the responsibility of the user to ensure that the vibration isolation, leveling, seismic reinforcement and distribution are adequate.

2.2.2 Energy Consumption

Component	KVA
System	1.7 KVA (normal operation)

2.2.3 Mass Balance

Component	Center of Mass
System	See Drawing No. 2850114 (Center of Gravity Location)

2.2.4 Sound Pressure Level

Component	Audible noise at one meter from unit surface
System	70dB max

2.2.5 Effluents, Wastes, and Emissions

Component	Thermal Dissipation
System	Contact the factory

2.3 Power Supply

The system requires grounded service to maintain safe, clean and stable power. A variety of power selections is available, as specified in Section 2.1.1.

2.4 Laser Head and Optics

Laser Type:

Acousto-optic, Q-switched, TEM_{00} Nd:YLF diode-pumped laser; the standard laser has a wavelength of 1.053 μm.

Optics:

Flat-field focusing lens shape the beam to produce a uniform circular spot.

2.5 Beam Delivery

The laser beam is directed through a series of focusing lenses, precision turning mirrors and galvos to reflect the beam to the wafer target positioned on the aligner.

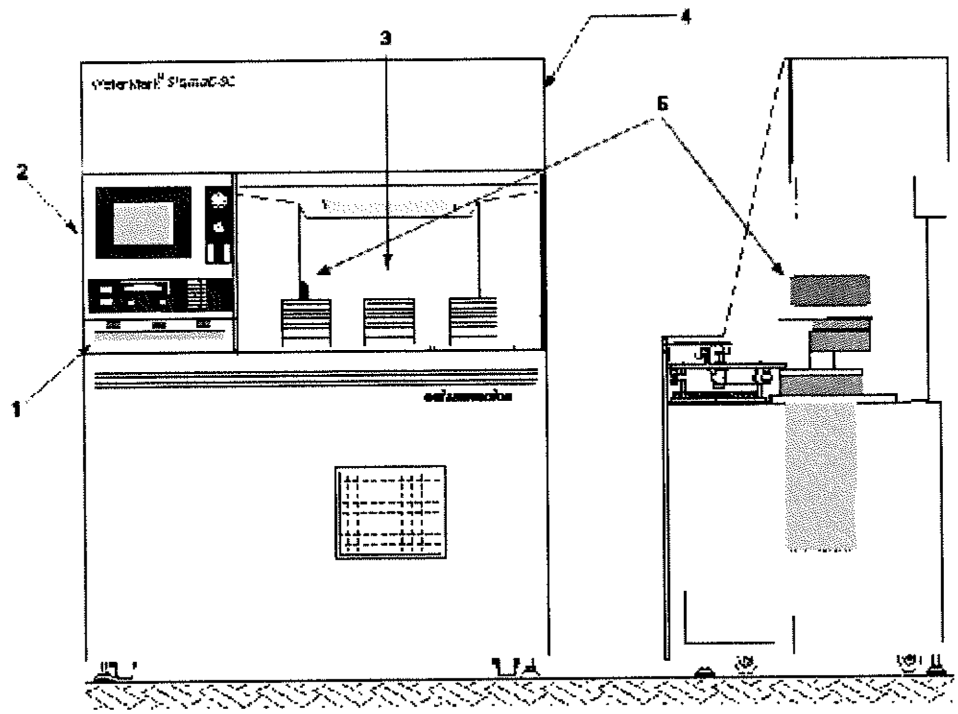
2.6 Handler/Control Cabinet Description

The Handler/Control stainless steel cabinet (Figure 2-1 and Figure 2-2) contains all components and modules required to perform wafer marking. These components, including the:

- laser and optics system
- wafer handling system
- operator workstation
- system computer
- dedicated electronic controllers.

Other self-contained units include a chiller and control electronics.

The laser used in this system, an ultra-stable GSI Lumonics Sigma–200 diode-pumped Nd:YLF laser, generates and delivers the laser beam to the enclosed marking chamber. The system uses high performance galvanometer beam positioners to steer the beam across the wafer surface under control of the system computer.



1	Keyboard and Trackball
2	Operator Workstation
3	Wafer Handling Area
4	Nd:YLF Laser and Optic System Enclosure (Laser Assembly Area)
5	Center of Gravity

Figure 2-2 – System — Front and Side Views

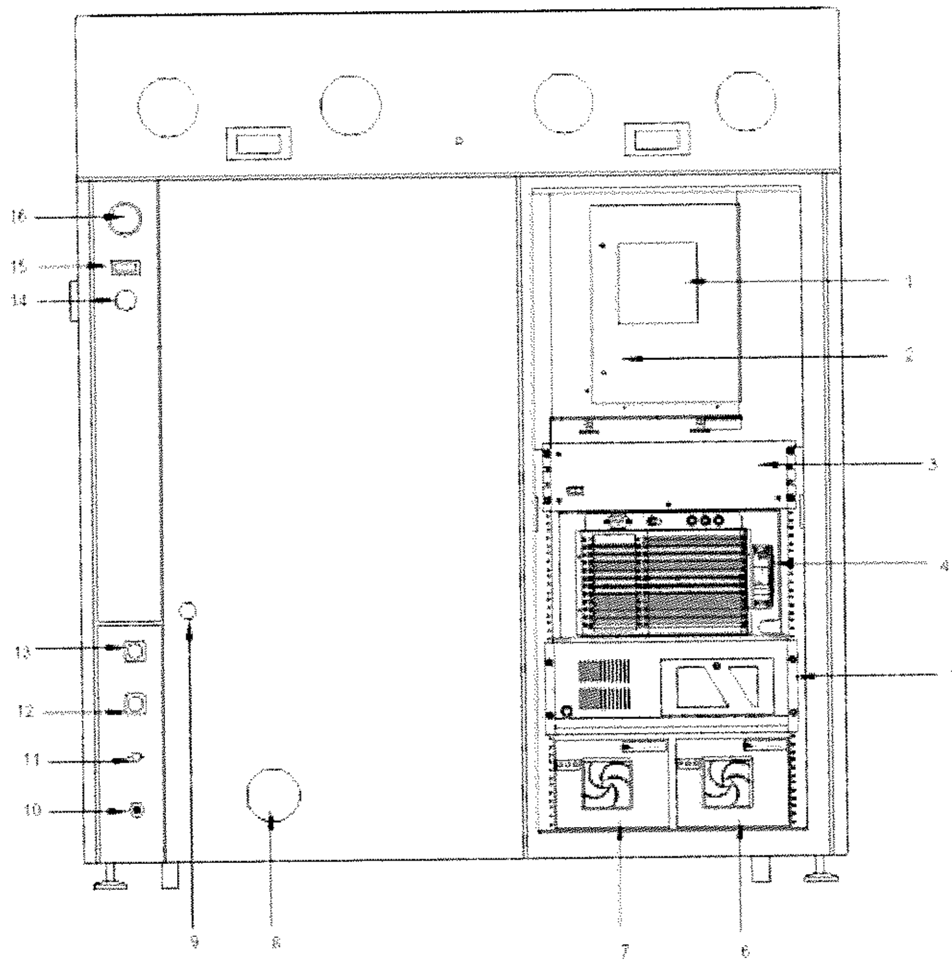
2.7 Wafer Handling System

The Wafer Handling System automatically loads and aligns wafers to be marked, and unloads wafers after marking has occurred. The main components of the Wafer Handling System are the cassette presenters, robot, and wafer aligner. Robotic movement and wafer alignment are controlled by the Robot and Aligner Controllers, respectively. Depending on the system configuration, the aligner is capable of positioning wafers sizes between 100 mm and 300 mm for marking anywhere on the wafer front surface within a 25 mm band of the circumference.

Standard WaferMark® SigmaDSC NT System

The standard WaferMark® SigmaDSC NT system contains three fixed position load/unload cassette presenters that are accessed by a radial arm robot with dual end effectors. The robot delivers wafers to the optical aligner. This non-contact aligner scans the wafer perimeter using a CCD array. The aligner locates the fiducial, flat or notch, then centers and positions the wafer under the mark point to within ± 125 µm accuracy.

The standard WaferMark® SigmaDSC NT wafer handling system can process 240 wafers per hour, in accordance with SEMI M12-0998 specification for alphanumeric marking on the front surface of silicon wafers.



1	Marking Chamber
2	Aligner (behind Chamber door)
3	Laser Controller
4	Marking Engine
5	System Computer
6	Aligner Controller
7	Robot Controller
8	Water Chiller (behind 10 cm (4.0-inch) O.D. connector air exhaust)
9	Mark Point Exhaust Port
10	Vacuum Inlet
11	SECS Host Connection
12	Signal Tower Connection
13	Remote User Interface
14	Power Cable
15	Circuit Breaker
16	E-Stop button (rear)

Figure 2-3 – WaferMark® SigmaDSC NT Cabinet — Rear View

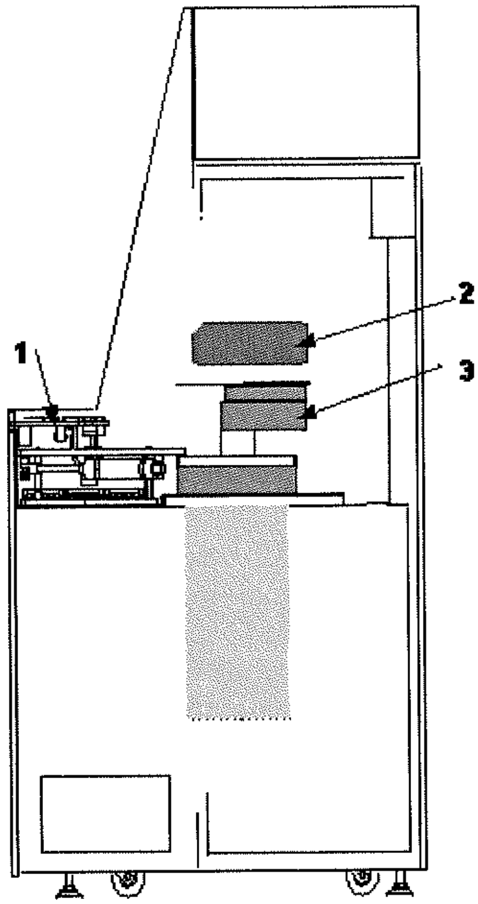
An optional system design allows for outboard presenters that can be rotated toward the front of the system to allow automatic wafer material transportation systems to access the cassettes, in accordance with SEMI specification E15 for inter-equipment material transport interface.

Other WaferMark® SigmaDSC NT options include:

- Modifications to accommodate customer-supplied Standard Mechanical Interface (SMIF) loading equipment.
- A wall-mount cover for through-the-wall installation of the system, with access from the service chase for maintenance activity.

WaferMark® DSC300 NT System

The WaferMark® DSC300 NT system handler has two fixed-position load/unload cassette presenters, a robot with dual end effectors, and a marking chamber containing an integrated (Vision) aligner and aligner controller, capable of handling 200 mm and 300 mm wafers (optional). The DSC300 NT's wafer handling system can process 150 wafers per hour, in accordance with SEMI M12-0998 specification for alphanumeric marking on the front surface of silicon wafers.



1 Cassette Presenters
2 Marking Chamber Safety Door
3 Robot

Figure 2-4 – Wafer Handling System — Inside-Sectional View

2.7.1 Cassette Presenter

Each presenter accepts a standard H-bar cassette containing up to 25 silicon wafers (100 mm, 125 mm, 150 mm, and 200 mm for WaferMark® SigmaDSC NT or 200 mm and 300 mm for WaferMark® DSC300 NT). Wafers to be marked are selected from the cassette(s) and returned after marking.

As a cassette is loaded or unloaded, sensors on each loading platform generate status signals indicating which platform(s):

- have mounted cassettes
- are in-process (i.e., are being addressed by the robot)
- are ready for loading.

The computer causes the appropriate LOAD/UNLOAD indicators at the Operator Workstation to light or flash to indicate each platform's status.

2.7.2 Robot

The robot selects and transports individual wafers from a platform-mounted cassette to the aligner located in the marking chamber. After marking, the robot retrieves the marked wafer and returns it to the specified cassette.

During operation, two end-effectors mounted on top of the robot arm handle two wafers simultaneously; one wafer is held ready to be inserted into the marking chamber as soon as the wafer in the chamber has been marked and removed. A vacuum seal between the wafer and end-effector surface allow wafers to be picked up, retained, and released during the handling process.

2.7.3 Aligner

The aligner is a self-contained unit located inside the marking chamber. It receives and positions each wafer for marking in the desired area. The robot places each wafer on an aligner rotary chuck prior to marking. The chuck then rotates the vacuum-held wafer while a CCD sensor determines the wafer positional eccentricity and offset and locates its reference mark.

2.7.4 Vacuum System

A vacuum system in the System distributes externally-supplied vacuum to the cassette presenter, robot, and marking chamber components of the Wafer Handling System. These components use the vacuum to rotate the cassettes on the (optional) movable presenter system, secure the wafer to the end effector, operate the safety door, and hold the wafer during aligning.

A vacuum gauge and preset vacuum sensor on the Power Distribution Panel monitor the system vacuum level. The sensor generates a vacuum fault signal which causes the VACUUM indicator on the Operator Workstation to light when system vacuum falls below the preset level.

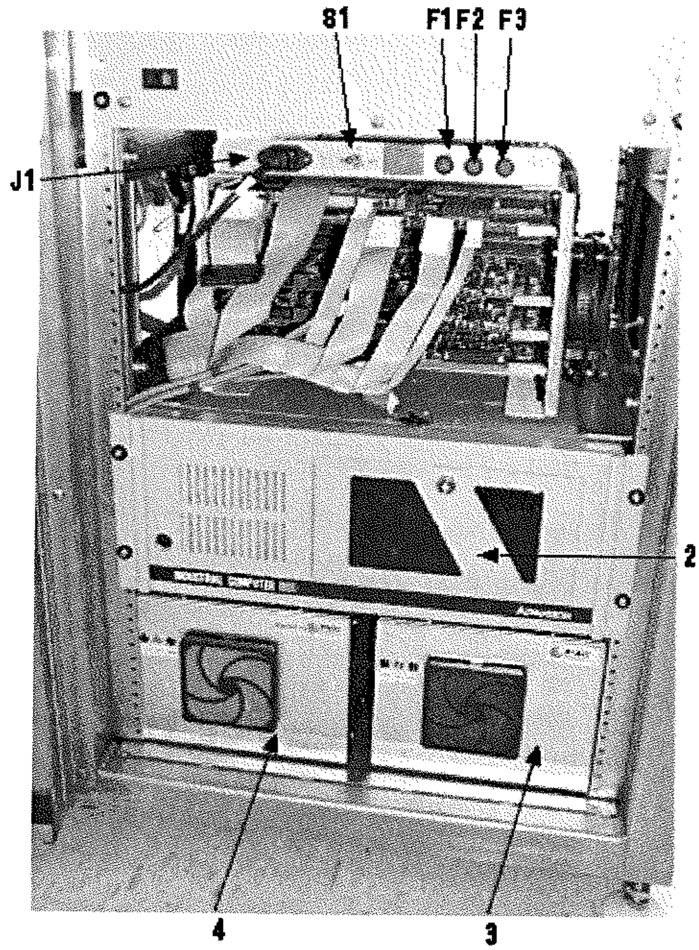
2.8 Electronics Bay Components

The Electronics Bay components are located on the rear left-hand side of the system (as viewed from the system front). Entry to the bay is made through two access panels on the System. The Electronics Bay houses the:

- Laser Controller
- System Computer
- Marking Computer (Engine)
- Aligner Controller, and
- Chiller Unit.

2.8.1 Laser Controller

The Laser Controller is microprocessor-based. It provides power supplies, control electronics and power distribution for the laser marking system. The controller interprets the system computer commands and controls the laser energy while monitoring all data-logging features, interlocks, warnings, and temperature data. See laser controller in Section 3.10. See Figure 2-5.



J1 AC Input Receptacle
S1 On/Off Toggle Switch
F1 4A Fuse- +24 Volt Power Supply
F2 4A Fuse- 24 Volt Power Supply
F3 4A Fuse- ±5 Volt Power Supply
1 Marking Engine
2 System Computer
3 Aligner Controller
4 Robot Controller

Figure 2-5 – Marking Engine and Aligner and Robot Controllers

2.8.2 System Computer

The System Computer provides user interface screens and general system control functions. The computer operates a

Windows® NT-based system that runs WaferMark® SigmaDSC NT application software. The industrial System Computer, located in the electronics bay underneath the Marking Engine (see Figure 2-5), is configured with:

- processor
- RAM
- Read-Write (RW) CD-ROM drive
- hard disk
- 1.44 Mb floppy disk
- digital I/O card, and
- serial expansion card.

See Section 3.3.1 for details.

2.8.3 Marking Engine

The Marking Engine controls the wafer marking process. The Marking Engine (see Section 3.3.2 for details) includes:

- System Marking Computer — A dedicated MAT486 microprocessor controls all components used in the laser marking process (see Figure 2-5). A multibus on the backplane of the rack provides the electronic interface for the marking engine boards.
- X- and Y-Galvanometer Drivers — Convert processor-generated motion data to signals used to drive galvos that steer the laser beam across the wafer surface.
- CW 50 — Generates timing signals to the RF Driver that controls laser firing.

2.8.4 Aligner Controller

The Aligner Controller controls the Marking Chamber aligner that positions wafers before marking. The Aligner Controller provides the vacuum sensing, turntable motor drive and CCD array to scan the wafer perimeter and offset position detection for balancing a wafer. This enables the non-contact aligner to use the CCD array to locate the fiducial, flat or notch, then centers and positions the wafer.

The aligner controller is a square end of a rectangular box mounted below the marking engine. It has a cooling fan and three indicator lamps: Power (green), Run (amber), and Error (red).

2.8.5 Robot Controller

The Robot Controller directs all robotic movement, controls the application of end-effector vacuum, and interfaces with the system computer through its RS-232 communications port.

2.8.6 Chiller Assembly

The chiller assembly is discussed in detail in Section 3.7.

To ensure that the laser diode bars and the Nd:YLF rod are adequately cooled at this repetition rate, a closed-cycle chiller circulates coolant through the pumping chamber. The excess heat is removed from the chiller by a water-to-air heat exchanger. The controller uses a heater and temperature sensor to maintain the coolant temperature within the optimal operating temperature range.

The laser modules are interconnected by coolant tubing connected to the chiller unit in the Electronics Bay (see Section 2.8.6) and by an umbilical assembly made up of electrical cabling.

The closed-loop chiller is mounted on the base of the Electronics Bay. The chiller has two functions:

- To maintain the laser diodes at a constant temperature of 34°C ± 0.5°C (93.2°F ± 0.9°F).
- To remove excess heat from the current modulator, the Q-Switch and the Nd:YLF crystal.

The coolant circulates through the system as follows:

- Chiller pump
- Chiller particle filter
- Laser assembly pumping chamber
- Laser assembly Q-Switch and laser rod

- Laser assembly current modulator
- Chiller flow sensor
- Chiller heat exchanger, and
- Chiller reservoir.

A pressure relief valve is located on the pump to protect the system from excess pressure. The chiller is also equipped with a drip tray.

Spill Prevention Feature The WaferMark® SigmaDSC NT system contains the following two spill prevention features:

- Coolant reservoir low level sensor — A sensor mounted in the reservoir detects the loss of coolant below an acceptable limit. The sensor will activate if a leakage occurs in the cooling system, causing the coolant level to drop.
- Secondary containment — Drip pans are located under the Laser assembly and in the area beneath the base of the chiller unit, for secondary containment resulting from a major spill or leak. The cooling hoses between the laser and the chiller are also enclosed in ducts so that a break in a hose will cause the coolant to flow back to the base of the chiller and thence through an opening into the drip pan below. Access to the drain plug in the drip pan can be gained by removing the cover plate near the base of the chiller. The capacity of the drip pan under the Laser assembly is 5.8 liters; the capacity for the drip pan in the base is 10.0 liters.

A spill of 400 ml (0.1 U.S. gallons) or small leak from the cooling system will eventually cause the low level sensor to activate as the fluid drains away. This will generate a low coolant level signal and thus cause an automatic shutdown. The shutdown stops any further processing, turns off the laser and chiller and produces an error message that is displayed on the operator screen.

NOTE: A larger leak will be sensed immediately by a flow sensor. The flow sensor will also turn off the laser and chiller and set an alarm condition on the Operator Panel.

2.9 Marking Chamber

An entry door at the left rear of the Control Cabinet provides access to the aligner inside the interior of the Marking Chamber. The door is fitted with a special glass viewing port so that marking can be observed in safety. If this door is inadvertently opened during the marking process, a door interlock is broken. This halts the marking process and prevent any further transmission of the laser beam to the wafer surface. The laser beam enters the Marking Chamber from the Laser Assembly, located directly above the chamber.

2.9.1 Debris Removal Port

Particles or toxic fumes may result from the marking process. The mark-point exhaust system (see 2.17) port is located adjacent to the wafer marking area.

2.10 Laser Assembly Area

The Laser assembly contains an integrated laser and optic assembly. It is enclosed in an interlocked compartment at the top of the system above the Wafer Handling Area (see Figure 2-2). The laser source is a patented GSI Lumonics Sigma–200 diode-pumped, solid-state, Nd:YLF laser. The closed-loop power control design of this infrared light source provides an ultra-stable energy output capable of producing quality laser marks.

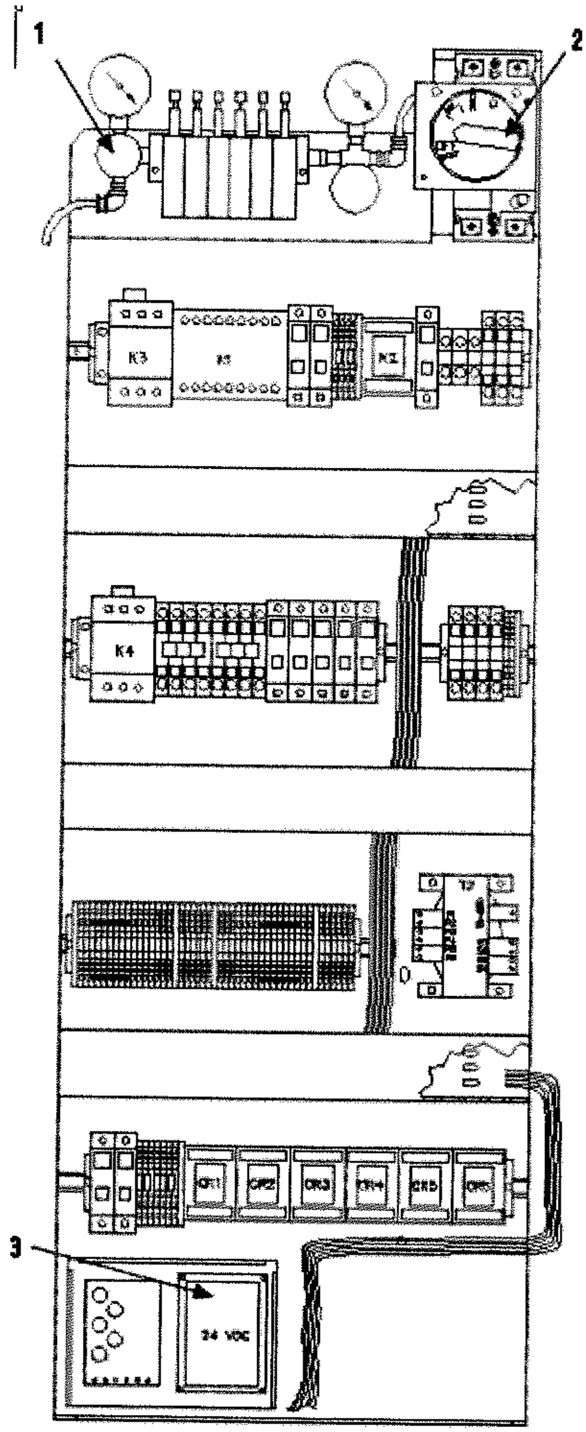
2.11 Power Distribution Bay

The Power Distribution Bay contains the Power Distribution Panel (PDP). The PDP is the central source for power distribution throughout the system. The Power Distribution Bay is located on the right-hand side of the system (viewed from the front of the system) and can be accessed by removing the panel on the right-hand side of the cabinet. The PDP (see Figure 2-6) is accessed by removing the panel on the right-hand side of the cabinet.

2.11.1 Power Distribution Panel

Figure 2-7 shows the main circuit breaker (located on the right side of the system). The PDP contains the following major components:

- AC Input Terminal Strip – The strip distributes AC power to the electronics bay.
- EMI Power Filter – The filter provides filtered power to the aligner controller, system marking computer, and the Laser Controller.
- 24 VDC Power Supply – Supplies power to control relays, interlock circuits, and control circuitry on the system interface board.
- Signal Tower Light Relays/Connectors
- Vacuum gauge and vacuum sensor – The gauge displays the externally supplied vacuum pressure. The vacuum sensor signals when the vacuum level is below acceptable limits
- Vacuum solenoids – The adjustable vacuum solenoids drive the presenter and safety door pneumatic cylinders.

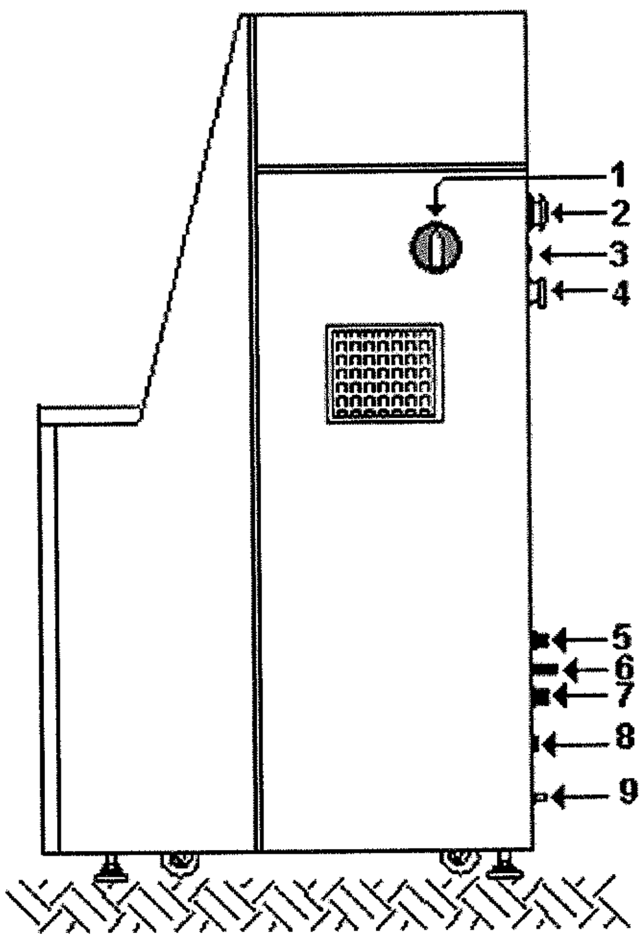


1 Vacuum Distribution

2 Main circuit breaker switch CB1

3 24 Volt Power Supply

Figure 2-6 – Power Distribution Panel

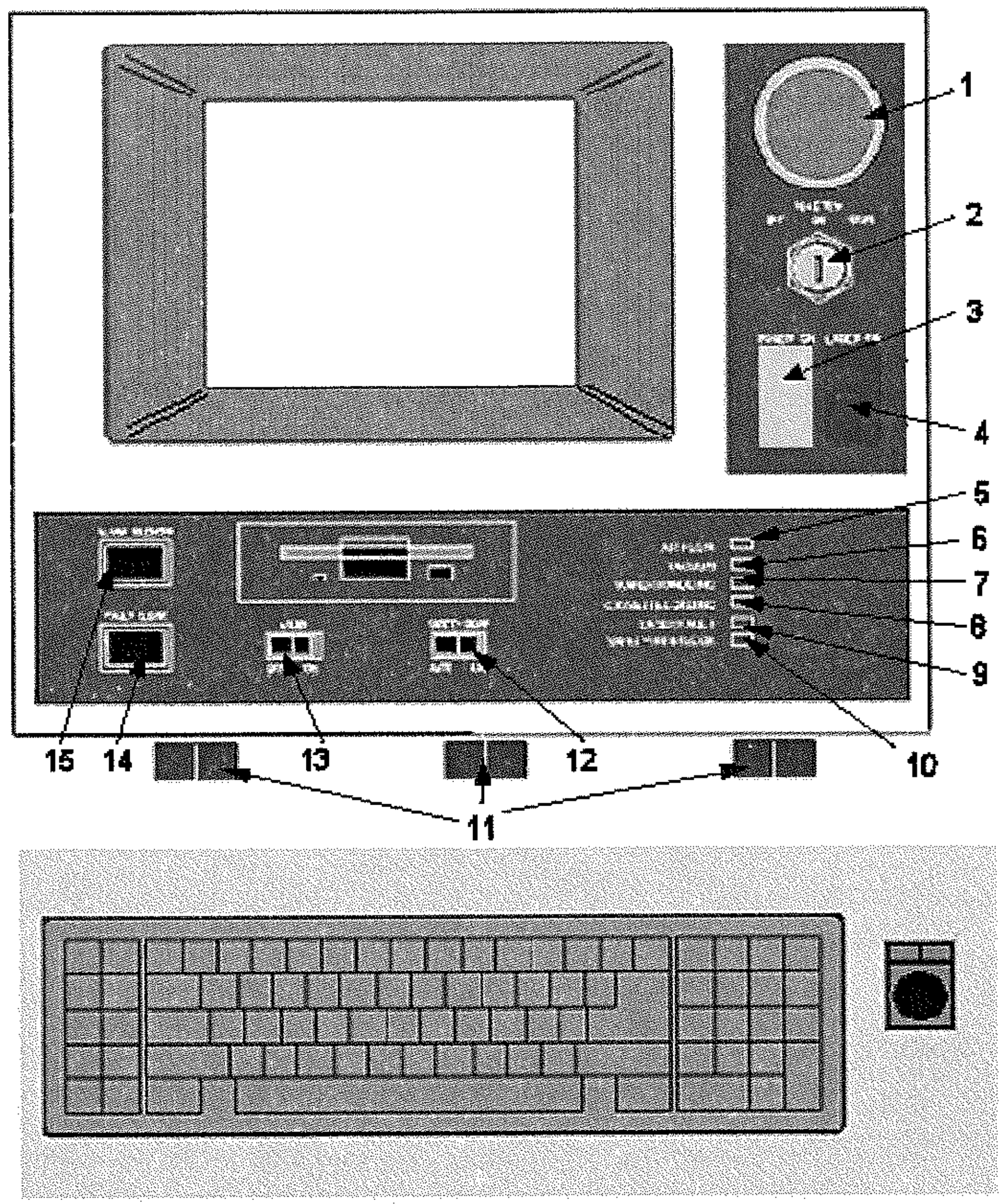


1 Main Circuit Breaker
2 E-Stop Pushbutton
3 User Hour Meter
4 Main Power Cable Input
5 Mark Point Exhaust Port (option)
6 Remote User Interface
7 Signal Tower Connection
8 SECS Host Connection
9 Vacuum Inlet Connection

Figure 2-7 – Main Circuit Breaker

2.12 Machine Control

The system performs its various sequential required tasks under the direction and control of the WaferMark® SigmaDSC NT software. At the physical user interface, the operator controls the marking process using **Main** and **Edit** menu selections.



1 E-Stop button
2 Master three-position key switch
3 Power ON indicator (green)
4 Laser ON indicator (blue)
5 Air Flow Indicator
6 Vacuum Indicator
7 Wafer Handling Indicator
8 Cassette Loading Indicator
9 Laser Fault Indicator

10	Safety Interlock Indicator
11	Load and Unload Switch/Indicator
12	Safety Door Switch
13	Laser ON/OFF switch
14	Fault Clear Switch/Indicator
15	Alarm Silencer Switch/Indicator

Figure 2-8 – WaferMark® SigmaDSC NT Operator Workstation — Controls and Indicators

Workstation

The workstation consists of:

- physical workstation (components)
- control system
- application software
- diagnostics, and
- optional GEM/SECS interface software.

Workstation Components

The workstation consists of a flat panel monitor, trackball (pointing device) and a keyboard. An optional barcode wedge device is available. These provide the physical user interface to the system.

Control System

The control unit is an IBM-compatible PC with a minimum Pentium III 850 MHz processor with a 3.5-inch floppy drive, a Read/Write CD-ROM drive, and a hard disk drive (minimum 40 GB) to store all system parameters.

Software

The WaferMark application software runs on a Windows® NT-based operating system, using operator-prompted pull-down menus.

Diagnostics

Complete system diagnostic indicators are displayed on the front panel, along with an emergency OFF (EMO button) and the system keyswitch.

Communications

Optional SECS II / GEM interface.

2.13 Signal Tower Operation

Using a predefined lighting sequence, the signal tower, located directly above the workstation, indicates the system status. The signal tower uses either three or four colors (red, amber, green and blue), as selected by mode through the Grayhill board (see Section 3.4.2). Some color variations are customer-specified. A typical signal tower is shown in Figure 2-9.

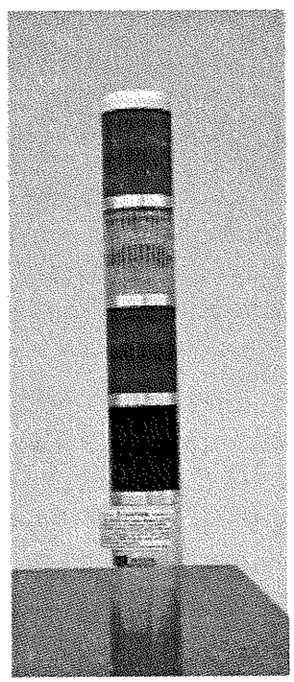
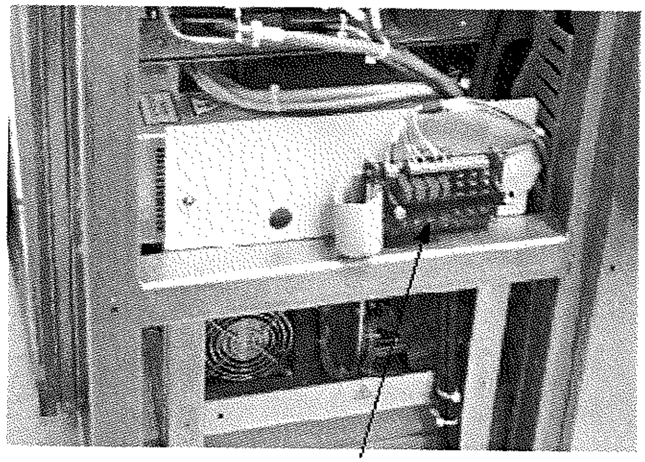


Figure 2-9 – Four-Color Signal Tower

The Grayhill board (see Figure 2-10) connects to the computer via the parallel I/O port in the computer.



1 Grayhill board

Figure 2-10 – Grayhill Board Location

2.14 System Features and Options

The WaferMark® SigmaDSC NT features and options follow.

2.14.1 System Features Included

- Status Indicator Tower 3-light
- Wafer Handling: Bottom Gripping

2.14.2 System Options Available

- 300 mm Fipper Kit (flipper, single-end effector and GenMark GP-7 robot)
- SECS II/GEM Interface
- High Speed Messaging System (HSMS). Consult with the Factory.
- Anti-Static Package
- Membrane keyboard (stainless or painted)
- Status Indicator Tower 4-light
- Bar Code Wedge Reader

- WaferTrace® Mark Verification System and Dot-by-Dot System
- Empty slot detection
- Bulkhead-mount cover panels
- Dual Spot Optics
- Moveable Presenter
- Leak Detector
- Vacuum Gauge (front mount)
- Seismic Tie-Down Package
- EMO Guard
- UPS (computer electronics only)

2.15 Sigma–200 Laser Assembly

The integrated laser and optic assembly are enclosed within an interlocked compartment at the top of the cabinet. The laser source is a patented GSI Lumonics Sigma–200 diode-pumped, solid-state, Nd:YLF laser. The closed-loop power control design of this infrared light source provides an ultra-stable energy output capable of producing quality laser marks in cleanroom environments.

The laser system consists of three separate modules, the:

- Laser Assembly
- Controller, and
- Chiller.

These three modules are interconnected by coolant tubing and by an umbilical assembly made up of electrical cabling.

The heart of the laser assembly is the pumping chamber, in which two key components are closely coupled—the laser diode bars and the Nd:YLF rod. When the Laser Controller transmits a trigger pulse, the current modulator excites the laser diode bars using a current pulse. The current modulator is capable of supplying current pulses of up to 100 amps peak current for time durations of up to 200 μs. Typically, it supplies a current pulse for 100 µs (called a pumping pulse), and the laser diode bars emit radiation at 800 nm for a similar time period.

The radiation emitted by the laser diode bars is collected and collimated into the Nd:YLF rod. The rod has several strong absorption bands in the 800 nm region, and the temperature of the bars is carefully adjusted to ensure that the diode radiation is efficiently absorbed in the Nd:YLF rod. Once the Nd ions have absorbed the 800 nm radiation, they are excited to the upper laser level and produce gain in the 1 µm region. In a conventional laser cavity, this gain would result in laser output at 1 µm for nearly the full 100 µs duration of the pumping pulse. This mode of operation is generally called ***fixed-Q***.

However, the Sigma–200 laser cavity consists of the pumping chamber and an acousto-optic Q-Switch, in addition to two optic mirrors: one highly reflective back mirror and a partially-transmitting output mirror. The Q-Switch is used to prevent 1 µm radiation from building up in the laser cavity during the 100 µs pumping pulse. At the end of the pumping pulse, the Q-Switch is switched from a non-transmitting state to a transmitting state. The 1 µm radiation builds up very quickly and a laser pulse of 1 to 2 mJ of energy and a duration of approximately 100 ns is emitted. This mode of operation is generally called ***Q-switched***.

The Sigma–200 accepts trigger pulses at any repetition rate up to 4000 pps. After each trigger pulse, there is a delay before the emission of the Q-switched pulse. To ensure that the laser diode bars and the Nd:YLF rod are adequately cooled at this repetition rate, a closed-cycle chiller circulates coolant through the pumping chamber. The excess heat is removed from the chiller by a water-to-air heat exchanger. The controller uses a heater and temperature sensor to maintain the coolant temperature within the optimal operating temperature range.

All of the control electronics, power supplies and power distribution system are mounted in the Laser Controller module, except for the current modulator, which is mounted on the Laser assembly. The microprocessor-based Controller handles all of the timing and calibration issues, the decision-making, the interlocks and warnings, the temperature control and laser energy control, and all the data-logging features.

2.16 Chiller Assembly

The closed-loop chiller is mounted on the base of the System. It can be accessed by removing the left panel at the rear of the cabinet. The chiller has two functions:

- To maintain the laser diodes at a constant temperature of 34°C ±0.5°C (93.2°F ±0.9°F).
- To remove excess heat from the current modulator, the laser diode module, the Q-Switch, and the Nd:YLF crystal.

The coolant circulates along the following pathway through the system:

- Chiller pump
- Chiller particle filter
- Laser assembly pumping chamber
- Laser assembly Q-Switch and laser rod
- Laser assembly current modulator
- Chiller flow sensor
- Chiller heat exchanger
- Chiller reservoir
- Chiller pump

A pressure relief valve is located on the pump to protect the system from excess pressure. The chiller is also equipped with a drip tray.

2.17 Mark-Point Exhaust System

A mark-point exhaust system provides an exhaust vent for carrying off any residue created during marking, as the need requires.

⚠ WARNING
Potential Inhalation Hazard

Normally, when marking polished silicone wafers, there is no debris generated; therefore, this option should not be required. However, when marking coated wafer material, various by-products are generated in the marking process. In these cases, it is the customer responsibility to be aware of which by-products are generated and to take the necessary precautions to filter them.

The mark-point exhaust system runs from the marking box to the outlet at the rear of the System. It uses a 1-inch (inside diameter) steel tube. For external connection to the mark-point exhaust system, GSI Lumonics recommends the use of the same material. See Section 2.1.1 for the exhaust requirements.

The mark-point exhaust external extraction system requires a flow rate of 20 CFM, and vacuum at greater than 2 in of H_2O.

2.18 Vacuum System

The externally supplied vacuum is connected to the rear panel of the cabinet. The vacuum line is then routed to the distribution panel for distribution and monitoring.

3 Functional Description

This section describes the major components and their roll in the WaferMark® SigmaDSC NT Marking system.

3.1 Introduction

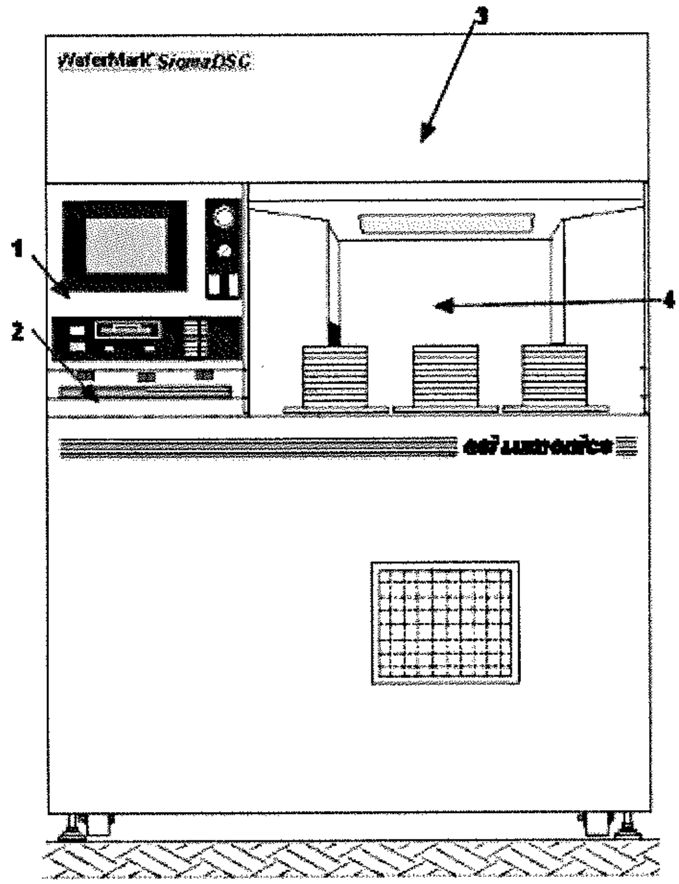
This section describes the operating controls and indicators of the WaferMark® SigmaDSC NT and the functions of the system hardware. For wafer marking instructions and operating procedures, refer to the *WaferMark® SigmaDSC NT Operator's Reference Manual (P/N 273.508.00).*

3.2 Major Components

The major components and subassemblies of the WaferMark® SigmaDSC NT system are the:

- system control computer
- marking engine
- laser controller
- aligner controller
- robot controller and associated electronic controllers
- operator Windows NT™ workstation
- chiller unit
- integrated laser, and
- optical system.

The system can also be optionally interfaced with a customer-supplied mainframe computer using an RJ-45 or serial port and dedicated connector at the rear of the Control cabinet.



1 Operator Workstation
2 Keyboard and Trackball
3 Nd:YLF Laser and Optic System Enclosure
4 Wafer Handling Area

Figure 3-1 – WaferMark® SigmaDSC NT Wafer Marking System

3.3 Electronics Systems

The WaferMark® SigmaDSC NT electronic systems directly control all system functions and marking operations. These include the system computer, interfaces, and dedicated controllers that direct wafer handling and control laser operation.

3.3.1 System Computer

The system computer is housed in the Electronics Bay. The WINDOWS-NT™-based system computer provides the operator interface, control marking operations, and monitor system operational status.

The system computer has two RS-232 serial communication ports (COM0 and COM1) and an 8-port serial expansion card. An octopus cable plugs into the serial expansion card. The serial ports have the following distribution:

Cable Ends	Cable Designation	Destination
COM 0	—	Unused
COM 1	—	Unused
Expansion Card		
COM 2	1	Laser Controller
COM 3	2	Aligner Com
COM 4	3	Mat 1-Com 2
COM 5	4	Robot J3
COM 6	5	SECS/GEM
COM 7	—	Unused
COM 8	—	Unused
COM 9	—	Unused

If a host computer is connected to the system, the master communicates with the host through the SECS/GEM interface.

The system computer also contains a 96–port digital I/O handler card. This card connects to the system interface board (see Section 3.3.3). The system interface board provides logic level input/output lines that interface with various discreet functions throughout the system.

3.3.2 Marking Engine

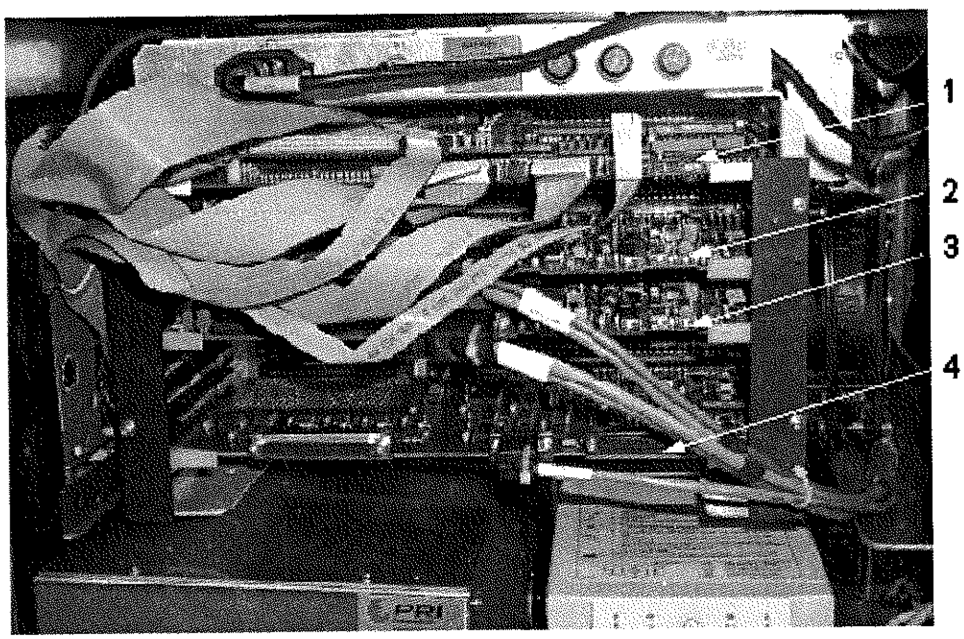
The Marking Engine is an electronics card cage located below the laser controller in the electronics rack. The Marking Engine is the processor and is dedicated to marking operations. It directs beam steering electronics and supplies the laser trigger pulse.

The Marking Engine and system computer communicate with each other via an RS-232 serial port. Additional specialized circuit boards provide laser-fire control and beam steering signals. The following PC boards occupy the indicated slots in the Marking Engine.

NOTE: Slots are numbered from the top down.

Figure 3-2 shows the Marking Engine rack with the boards in place.

Slot Number	Function Board	Part Number
2	MAT 486 board	2015048
6	SGRP Galvo Drive PCBA	60560094-01
8	SGRP Galvo Drive PCBA	60560094-01
11	CW50 PCB	6050066



1 Slot 2
2 Slot 6
3 Slot 8
4 Slot 11

Figure 3-2 – Marking Engine Board Placement

Multibus - The multibus is a parallel address and data bus that interconnects major computer components and interfaces the processor with other system components through the handler I/O. The bi-directional multibus is time-shared by the processor and carries device addresses and data. A processor wishing to issue a command or to send/receive data places the unique address of the applicable board onto the bus. The addressed device responds to its address and prepares to receive or furnish data. Data is then written to or read from the bus in subsequent processor states.

CW 50 Processor - The CW50 Processor resides in slot 11 of the Marking Engine Cage. The CW50 Processor generates the timing signals to the RF Driver that controls laser firing.

X–Y Galvo Drive Assemblies

Two galvo drive PC boards are located in slots 6 and 8 of the marking engine. The two galvo boards (X and Y) convert digital motion data generated by the marking engine to analog voltages in closed-loop servos to drive galvos. The galvos use a closed-loop feedback positioning system to steer the laser beam across the wafer surface. Digital data pertaining to character height and width is converted to analog drive signals that continuously position the scanners. Position feedback information from the galvos provides a reference and completes the loop.

3.3.3 System Interface Board

The system interface board is the major interface between the system computer, operator workstation, and wafer handling system.

Logic level signals from the processors via the handler I/O are converted to the levels necessary to drive operator workstation status and fault indicators and to operate system solenoids that control various functions.

Hardware-detected fault signals from system sensors are routed directly to operator workstation indicators and converted to logic level states before transfer to the handler I/O.

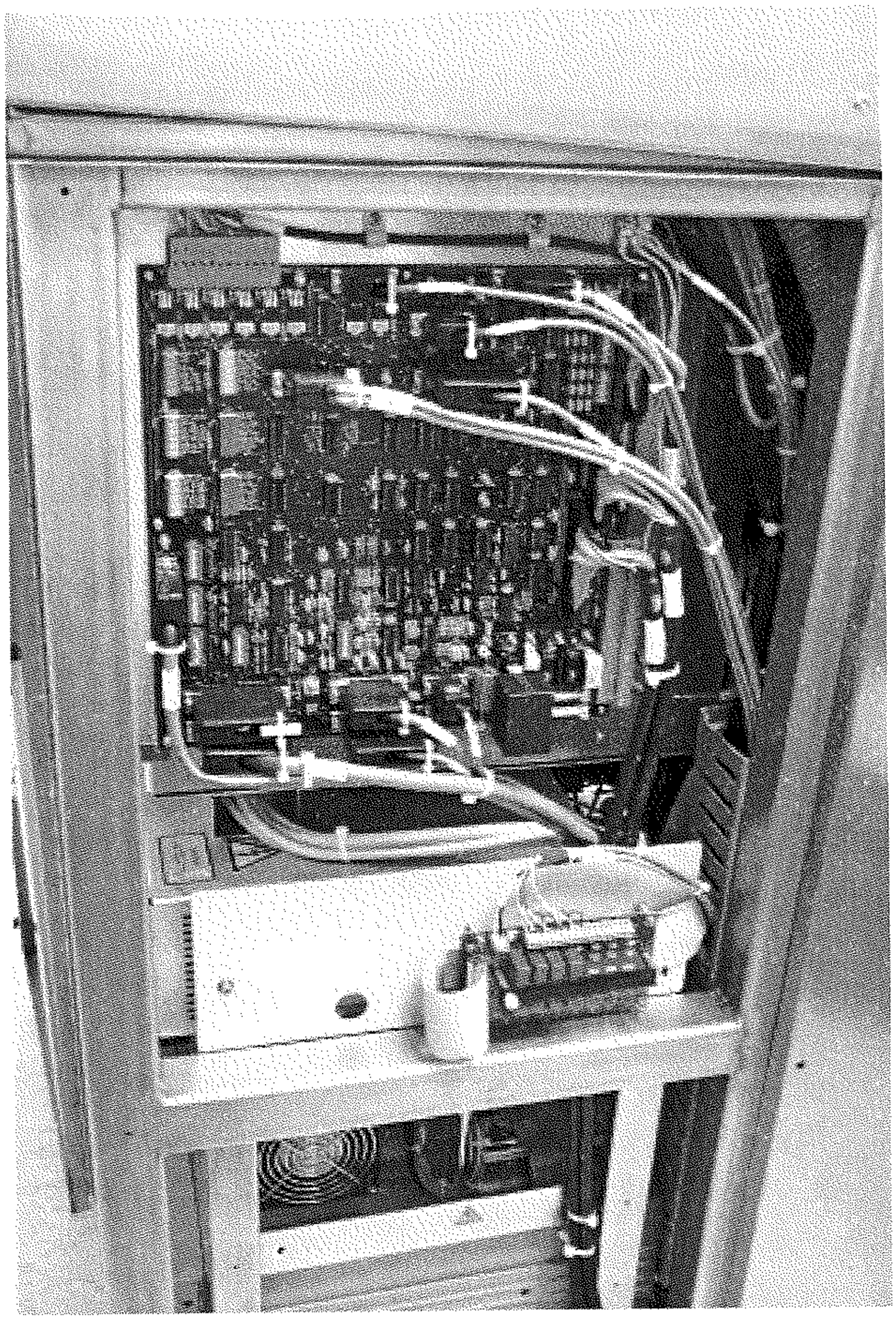


Figure 3-3 – System Interface Board

3.3.4 Aligner Controller

The Aligner Controller is dedicated to wafer handling. The Aligner Controller ensures wafers are correctly positioned in the marking chamber before marking. The Aligner Controller communicates with the system computer through an RS-232 port.

3.3.5 Laser Controller

The Laser Controller is located at the top of the electronics rack on the right side of the system (viewed from the rear). The Laser Controller has an On/Off power switch indicator on the front panel. When powered up, the Laser On blue LED illuminates. The Laser Controller:

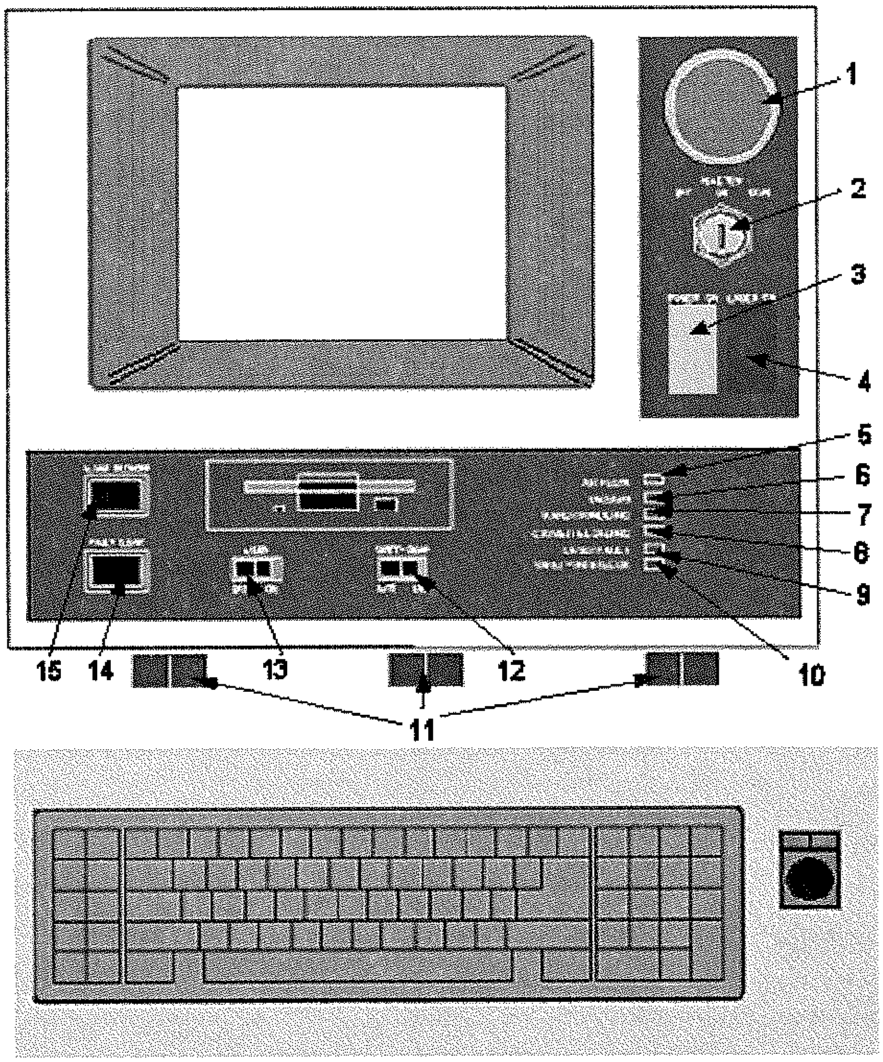
- Controls the width and amplitude of the current from the current modulator to the laser diode module.
- Monitors and stabilizes the output pulse energy.
- Controls triggering modes.
- Regulates the temperature of the coolant by controlling the chiller pump, heater, and fans.
- Monitors and reacts to faults and interlocks, including control of the beam shutter.
- Contains external interlock and safety interlock circuitry.
- Interprets and replies to software commands.
- Logs data about critical laser parameters.

The Laser Controller contains:

- A printed circuit board (the Control PCB assembly) containing a single microprocessor and digital and analog input/output (I/O) circuitry.
- A power supply for the Laser Controller.
- A power supply for the laser diode bars.

The Controller connects to the Laser assembly and Chiller via a wire harness called the umbilical. This umbilical is connected to the rear panel of the Controller. The Controller also communicates through an RS-232 port with the system computer.

3.4 Operator Workstation



1 E-STOP pushbutton switch
When pressed, power is immediately removed from all system components.

NOTE: This switch is intended for emergency use only – not for powering the system down under NORMAL conditions. Unnecessary use of this pushbutton can corrupt system data and job files.

2 MASTER OFF/ON/START three-position key switch

1. In the OFF position, no power is available to any of the system components.

NOTE: The key can only be removed when the switch is in the OFF *position.*

2. In the ON position, the power control relays check the status of the E-STOP circuitry and the positions of the (non-energized) contacts on the main contactors, and the (power control) relays are then primed accordingly.
3. When momentarily turned to the START position, power is applied to all system components. (Remember that power to the laser will only be applied if the LASER switch was left in the ON position.) If the power control relays were ***NOT*** latched in the correct state when the keyswitch was in the ON position (due to a fault with the E-STOP circuitry or a welded contact on either of the main contactors), then power will not be applied to any of the system components.
4. When the keyswitch is released to the ON position, the power control circuits are latched and power is maintained to the system components.

   NOTE: Any time that the system is going to be powered down, first shut down the Windows NT program using the **Start** *bar.*

3 POWER ON indicator (green)
Lights when MASTER keyswitch has been set to START and the main contactors have energized, indicating that power is being applied to all system components.

NOTE: Power to the laser controlled by the LASER ON *switch.*

4 LASER ON indicator (blue)
Lights when the LASER switch is set to ON to indicate that the laser power supply could be powered on and that a hazard exists from the possibility that the laser may be lasing.

5 AIR FLOW indicator (inoperable for WaferMark® DSC)
The SigmaDSC NT does not contain an air filtration system; therefore, the light is inoperable.

6 VACUUM indicator
Lights to indicate that insufficient system vacuum has been detected by vacuum sensor. When lit, system marking will be suspended until the fault has been corrected.

7 WAFER HANDLING indicator
Lights to indicate that a wafer handling fault has occurred. When lit, system marking will be suspended until the fault has been corrected.

8 CASSETTE LOADING indicator
Lights to indicate a cassette loading fault. When lit, system marking will be suspended until the fault has been corrected.

9 LASER FAULT indicator
Lights to indicate a laser fault. This can be either coolant flow interlock, coolant temperature fault, coolant level interlock, shutter failed to open, warm-up timeout, current pulse width at max., or external interlock. When lit, system marking will be suspended until the fault has been corrected.

10 SAFETY INTERLOCK indicator
Lights to indicate that open interlocks have been detected in the laser head and/or marking chamber. When lit, system marking will be suspended until the fault has been corrected.

11 LOAD/UNLOAD switch/indicator
Three combination switch/indicators prompt the operator for cassette loading and show job progress and status.

Table 3-4 illustrates all combinations of the LOAD/UNLOAD *switch indicators and the required operator response or marking job status.*

12 SAFETY DOOR switch
Opens marking chamber safety door when set to MAN (Manual). In the AUTO (Automatic) position, safety door operation is software controlled.

NOTE: The MAN *position should only be used by trained maintenance personnel.*

13 LASER ON/OFFswitch
When set to ON, starts the Chiller and provides an enabling signal to the laser diode power supply (in the Laser Controller.) When set to OFF, the laser diode power supply is disabled and the Chiller is stopped.

14 FAULT CLEAR switch/indicator
Lights to indicate a detected fault; when pressed, generates a software reset which causes original fault condition to be re-examined. Indicator goes out if fault has been successfully corrected.

Table 3-3 illustrates system status for all combinations of the ALARM SILENCER *and* FAULT CLEAR *pushbutton switches.*

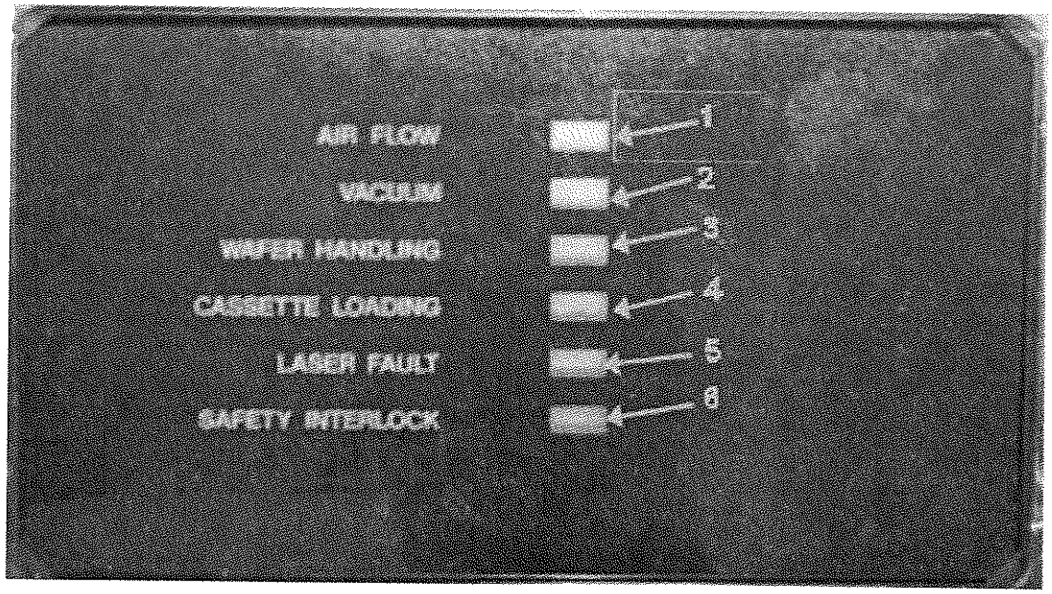
15 ALARM SILENCER switch/indicator
Silences audible alarm which sounds and accompanies the appropriate fault indicator when a detected fault occurs.

Table 3-3 illustrates system status for all combinations of the ALARM SILENCER *and* FAULT CLEAR *pushbutton switches.*

Figure 3-4 – WaferMark® SigmaDSC NT Operator Workstation — Controls and Indicators

3.4.1 Fault Display Panel

The Fault Display panel, located on the front of the system below the workstation, displays system status and fault conditions detected by software or by other system hardware sensors. A fault suspends or terminates marking operations. Operator intervention is required in order to recover or restart the operation after the fault has been corrected. Figure 3-5 represents the Fault Display Panel and Table 3-1 describes the system status indicators used by the Fault Display Panel.



1 Air Flow
2 Vacuum
3 Wafer Handling
4 Cassette Loading
5 Laser Fault
6 Safety Interlock

Figure 3-5 – Fault Display Panel

Table 3-1 – Fault Display Panel Indicator Functions

Indicator	When lit, indicates the following ... and system marking is suspended until the fault is corrected
AIR FLOW (inoperable for WaferMark® DSC)	Insufficient laminar air flow in or adjacent to the marking chamber.
VACUUM	Insufficient system vacuum has been detected by vacuum sensor.
WAFER HANDLING	A wafer handling fault has occurred.
CASSETTE LOADING	A cassette loading fault.
LASER FAULT	A laser fault. This can be due to: coolant flow interlock; coolant temperature fault; coolant level interlock; shutter failed to open; warm-up time-out; current pulse width at maximum; or, external interlock.
SAFETY INTERLOCK	Open interlocks have been detected in the laser head and/or marking chamber.

3.4.2 Signal Tower Operational Modes

SIGNAL_TOWER and Audible Indicator

To ensure the highest level of safety, the equipment is considered to be capable of producing laser output as soon as the power supply of the laser source is activated electrically. Depending on the configuration option, the signal tower illuminates, flashes, and/or sounds the audible indicator.

The keyword statement SIGNAL_TOWER (entered in the **Maintenance Startup** file) defines the operational mode for the signal tower lights controlled by the Grayhill board. The keyword can be set to either =0, =1, or =2. If the keyword is omitted from the file, the system defaults to Mode 0.

- Mode 0 is the mode described in Section 3.4.3. From the top, the colors in the four-color signal tower are red, amber, green, and blue.

  NOTE: This manual refers to the color "amber", but the amber light is sometimes called orange or yellow.
- Mode 1 is the mode described in Section 3.4.4. If using a four-color signal tower, this mode uses only the top three lights; the blue light is connected, but not used.
- Mode 2 is the mode described in Section 3.4.5. If using a four-color signal tower, this mode uses only the top three lights; the blue light is connected, but not used.

NOTE: The function associated with the "amber" and "green" lights differs by mode.

Refer to the appropriate Section (3.4.3, 3.4.4, or 3.4.5) for a full description of the signal tower operating mode used on your system.

3.4.3 Mode 0 Operation

When operating in Mode 0, the function names of the signal tower colors are:

COLOR	FUNCTION NAME
Red	Fault
Amber	Run Light
Green	SECS Light
Blue	Operator Call Light

RED (FAULT Light)

Indicates whether the system is ready for normal operation or reporting a fault or error condition. Specifically:

- Flashes any time an error is generated (either from a recoverable error or an unrecoverable fault.)
- Off when the fault or error condition has been corrected and the CLEAR pushbutton has been pressed.

AMBER (RUN Light)

Indicates whether the system is RUNNING or WAITING. Specifically:

- Flashes when the system is IDLE or not processing a job.
- Flashes while waiting for a LOAD or UNLOAD operation. (Blue light also flashes.)
- On when the LOAD or UNLOAD request has been satisfied.
- On while the system is processing a job.

GREEN (SECS Light)

Indicates the state of the SECS interface. Specifically:

- Flashes when SECS is operating in SEMI-AUTO mode and `SECS_PAT_MODE=0` (see note below.)
- On when SECS is operating in the FULL-AUTO mode.
- Off when SECS is in the SEMI-AUTO mode and `SECS_PAT_MODE=1` (see note below).
- Off if the SECS mode is disconnected.

BLUE (OPERATOR CALL Light)

Indicates that an operator action is pending. Specifically:

- Flashes while waiting for a LOAD or UNLOAD operation. (Amber light also flashes.)
- On when a SECS S10 Terminal Request has been received or if a HOST Terminal Request arrives while the operator is editing.
- Off when the LOAD or UNLOAD request has been satisfied.
- Off when the SECS S10 Terminal Request has been completed.

The following table summarizes the operation of each of the four colors in the signal tower:

COLOR	ON	FLASHING	OFF
Red	—	Error	—
Amber	Processing	Waiting	—
Green (`SECS_PAT_MODE=0`)	Full-Auto	Semi-Auto	Manual
Green (`SECS_PAT_MODE=1`)	Full-Auto	—	Semi-Auto (see Note)
Blue	Operator Call	(Un)Load Request	(Un)Load Satisfied

NOTE: The status of the GREEN signal tower light is dependent on the keyword statement `SECS_PAT_MODE` *in the* **FACTORY.SET** *file. If the keyword is set to =0 or the statement is not present, the light will flash when operating in the Semi-Auto mode; this is the default condition. If the keyword is set to =1, the light will be off in this mode. (This optional keyword allows the customer to choose how the SEMI-AUTO mode is displayed by the light.)*

The following table shows the specific operation of each light in the four-color signal tower:

STATUS	FAULT RED	RUN AMBER	SECS GREEN	OPERATOR BLUE
Error Message	Flashing	—	—	—

STATUS	FAULT RED	RUN AMBER	SECS GREEN	OPERATOR BLUE
Fault Cleared & CLEAR P/B Pressed	—	—	—	—
Idle or Waiting	—	Flashing	—	—
Processing	—	On	—	—
Load or Unload Request	—	Flashing	—	Flashing
Load or Unload Satisfied	—	Flashing →On	—	Flashing →Off
SECS S10 Terminal Request	—	—	—	On
Terminal Request Completed	—	—	—	—
SECS Full-Auto	—	—	On	—
SECS Semi-Auto (***SECS_PAT_MODE=0.*** See Note above)	—	—	Flashing	—
SECS Semi-Auto (***SECS_PAT_MODE=1.*** See Note above)	—	—	OFF	—

The status conditions in the above table are defined as follows:

Status	Definition
Full-Auto	Operation is the same as the current WaferMark® SigmaDSC NT standard with barcode reader messages active.
Semi-Auto	Limited input command from Host. (S1F1 & S2F21 mode change only). Barcode Readers are not active.
Processing	Running a Job. Not idle.
Waiting	Waiting for load buttons to be pressed to start processing; or, waiting for cassettes to be unloaded during or after a job has finished.
Unload Request	Waiting for cassettes to be loaded or unloaded; or, the HOST has sent a Terminal message to the operator.
Operator Call	Waiting for cassettes to be unloaded. Unload lights flashing.
Load Request	Waiting for load buttons to be pressed. Load lights flashing.
Error	An error has occurred requiring operator intervention. All recoverable errors and fault light conditions are reported in an error message.

NOTE: The colored lenses mounted on the standard four-color signal tower are in the order: red (top), amber, *green, and blue (bottom). For convenience, this is the order that the colors are shown in the tables above. However, if required, the individual lenses on the signal tower (or the wiring to the lenses) can be altered to display the system status in a different color sequence to suit specific customer requirements.*

3.4.4 Mode 1 Operation

In mode 1 operation only, the top three lights are used when using a four-color signal tower. The blue light remains connected, but is not used.

This table indicates the function names of the three colors used in the signal tower when operating in Mode 1:

COLOR	FUNCTIONAL NAME
Red	Fault Light
Amber	Operator Light
Green	Run Light

Each light indicates the following operating conditions:

RED (FAULT Light)

Indicates whether the system is ready for normal operation or is reporting a fault or error condition. Depending on the condition, an audible alarm may also be sounded. Specifically:

- Flashing/audible any time an error message is generated (either from a recoverable error or an irrecoverable fault). Indicates failure or abort. Immediate assistance is required.
- On after operator suppresses audible alarm acknowledging condition. Equipment is not capable. An alarm has been acknowledged, but not corrected.
- Off when the fault or error condition has been corrected and the CLEAR pushbutton has been pressed.

- Although not specific to Mode 1 operation in general, the following faults occur only when the system is running:

  INTERLOCK

  POWER_LEVELS_OK

AMBER (OPERATOR Light)

Indicates that an operator action is pending. Depending on the condition, an audible alarm may also be sounded. Specifically:

- Flashing/audible while waiting for a LOAD or UNLOAD operation (Green light also flashes) when a SECS S10 Terminal Request has been received or if a HOST Terminal Request arrives while the operator is editing. Generally, indicates an alarm is unacknowledged and requires an operator.
- On after the operator suppresses an audible alarm, acknowledging the condition. The alarm is acknowledged, but the LOAD or UNLOAD operation EQUIPMENT Still NEEDS ASSISTANCE.
- Off when the SECS S10 Terminal Request has been completed or when the LOAD or UNLOAD request has been satisfied.

GREEN (RUN Light)

Indicates whether the system is RUNNING or WAITING. Specifically:

- On after the operator suppresses an audible alarm acknowledging the condition. The alarm is acknowledged, but the equipment still needs assistance.
- Flashes while waiting for a LOAD or UNLOAD operation. (Amber light also flashes.)
- On while the system is processing a job or when the LOAD or UNLOAD request has been satisfied

Note that multiple lights may be active simultaneously, depending on the equipment state.

The transition from Flashing to On for the red light and the amber light is activated by the operator silencing the alarm button; this acts as a general acknowledgment of the fault or alarm condition.

The following table summarizes the operation of each light in the signal tower when operating in Mode 1:

COLOR	STATUS ON	STATUS FLASHING	STATUS OFF
Red	—	Error	—
Amber	Operator Call	(Un)Load Request	(Un)Load Satisfied
Green	Processing	Waiting	—

The status conditions in the above table are defined as follows:

Status	Definition
Processing	Running a Job. Not idle.
Waiting	Waiting for load buttons to be pressed to start processing; or, waiting for cassettes to be unloaded during or after a job has finished.
Error	An unrecoverable error has occurred requiring operator intervention. All recoverable errors and fault light conditions are reported in an error message.
Operator Call	Waiting for cassettes to be loaded or unloaded or the HOST has sent a Terminal message to the operator. System may be in an error state.
Load Request	Waiting for load buttons to be pressed. Load lights flashing.
Unload Request	Waiting for cassettes to be unloaded. Unload lights flashing.

The following table shows the specific operation of each light when operating in Mode 1:

STATUS	FAULT RED	OPERATOR AMBER	RUN GREEN
Error Message	Flashing	—	—
Acknowledged Error	On	—	—
Fault Cleared & CLEAR P/B Pressed	Off	—	—
Load or Unload Request	—	Flashing	Flashing
Load or Unload Acknowledge	—	On	Flashing
Load or Unload Satisfied	—	Off	On
Idle or Waiting	—	—	Flashing
Processing	—	—	On
Terminal Request	—	Flashing	—
Terminal Acknowledge	—	On	—
Terminal Request Completed	—	Off	—

3.4.5 Mode 2 Operation

The following table indicates the function names of the three colors used in the signal tower when operating in Mode 2:

COLOR	FUNCTIONAL NAME
Red	Fault Light
Amber	Operator Light
Green	Run Light

Each light indicates the following operating conditions:

RED (FAULT Light)

Indicates whether the system is ready for normal operation or is reporting a fault or error condition. Depending on the condition an audible alarm may also be sounded. Specifically:

- The red light flashing and an audible alarm any time an error message is generated indicates a failure or abort either from a recoverable error or an irrecoverable fault. Immediate assistance is required.
- The red light steady and an audible alarm occurs when Host sends an S2F41 Alarm Light command with the parameter set to ON. This is the only way a steady state ON condition can occur. The command will not take effect if the light is already flashing; i.e., a fault is active. If a fault occurs while the light is steady ON due to a Host command, the Host control will be ignored.
- The red light and an audible alarm will be OFF when the fault or error condition has been corrected and the **CLEAR** pushbutton has been pressed. Even though that no error condition exists, the Host can send an S2F41 Alarm Light command and turn the error light ON or OFF.
- Although not specific to Mode 2 operation in general, the following faults occur only when the system is running:

  INTERLOCK

  POWER_LEVELS_OK

AMBER (OPERATOR Light)

Indicates an operator action is pending. Specifically:

- Flashing while waiting for a LOAD operation, when a Host Terminal Request has been received, or if a HOST Terminal Request arrives while the operator is editing.
- On when the laser enclosure cover interlock is open or a **Maintenance** menu action is being performed.
- Off when a LOAD request is issued or the SECS S10 Terminal Request or the Maintenance operation has been completed.

GREEN (RUN Light)

Indicates the system is RUNNING or WAITING. Specifically:

- Flashing when an UNLOAD is pending a job may have completed or may still be in progress (for multiple cassette jobs).
- On while the system is processing wafers; no UNLOAD pending.
- Off when the system is IDLE and no UNLOAD is pending.
- Off when a LOAD request the SECS S10 Terminal Request or the Maintenance operation has been completed.
- Flashing when an UNLOAD is pending a job may have completed or may still be in progress (for multiple cassette jobs).
- On while the system is processing wafers; no UNLOAD pending.
- Off when the system is IDLE and no UNLOAD is pending.

NOTE: Depending on the equipment state, multiple lights can be active simultaneously.

The following table summarizes the operation of each light status in the signal tower when operating in Mode 2:

Color	ON	FLASHING	OFF
RED	Host Control	Error	Host Control No Error
AMBER	Maintenance	Load Request	Load Satisfied Not Maintenance
GREEN	Processing	Unload Request	Idle Unload Satisfied

The status conditions in the above table are defined as follows:

Status	Definition
Processing	Running a Job. Not idle
Error	An error requiring operator intervention. All errors and fault conditions are reported in an error message.
Load Request	Waiting for load buttons to be pressed. Load lights flashing.
Unload Request	Waiting for cassettes to be unloaded. Unload lights flashing.

The following table shows the specific operation for function and color for each light when operating in Mode 2:

STATUS	FAULT— RED	OPERATOR– AMBER	RUN —GREEN
Idle	—	—	—
Processing	—	—	On
Unload Request	—	—	Flashing
Load Request	—	Flashing	—
Fault condition	Flashing	—	—
Fault Cleared & CLEAR P/B Pressed	Flashing → Off	—	—
Host Command (S2F41 On) and no Faults	On	—	—
Host Command (S2F41 Off) and no Faults	On→ Off	—	—
Maintenance Terminal Request	—	On	—

Signal Tower Light Control by Host

The S2F41 Host Command allows the Host to control the FAULT light when no faults are present. If a fault is present the command response from the equipment will be NOT NOW. The signal tower command has been generalized to work with more than just the FAULT light by introducing the Light Position parameter. At this time, however, only position 1 the FAULT light position will be accepted; any other position will generate an error response with a bad parameter value indicator. For further information, please refer to the *WaferMark® GEM/SECS Interface User's Guide (P/N 273.499.00).*

3.4.6 Status & Control Panel

The status and control panel switches and indicators control the laser operation, and display system status and fault conditions. Each of the status and control panel fault indicators light to announce a fault condition detected by software or by other system hardware sensors. Detected faults suspend or terminate marking operations, which requires operator intervention in order to recover or restart the operation after the fault has been corrected. All switches and indicators are illustrated in Figure 3-4, and their functions are described in Table 3-2.

Keyswitch panel controls the application of power to the entire WaferMark® SigmaDSC NT system except the laser. Rotating the three-position switch past the ON position to START, applies power is all system components. The key returns to the ON position (straight up) and remains. The key is only removable in the OFF position. See Figure 3-4 and Item 2 in Table 3-2.

Table 3-2 – Operator Workstation Service Panel Controls and Indicators

Number	Switch or Indicator	Function
1	EMERGENCY POWER OFF pushbutton switch	Pressing the ESTOP removes power from all system components. Emergency use only! *NOTE: The E-STOP switch is for emergency use only– and not for powering the system down under NORMAL conditions. Unnecessary use of this pushbutton may result in corruption of system data and job files.*

Table 3-2 – Operator Workstation Service Panel Controls and Indicators

2	MASTER three–position key switch (OFF / ON / START)	1. In the OFF position no power is available to any of the system components. *NOTE: The key can only be removed when the switch is in the OFF position.* 2. In the ON position the power control relays check the status of the E-STOP circuitry and the positions of the (non-energized) contacts on the main contactors and the (power control) relays are then primed accordingly. 3. When momentarily turned to the START position power is applied to all system components. (Remember that power to the laser will only be applied if the LASER ON switch was left in the ON position.) If the power control relays were NOT latched in the correct state when the keyswitch was in the ON position (due to a fault with the E-STOP circuitry or a welded contact on either of the main contactors), power will not be applied to any of the system components. 4. When the keyswitch is released to the ON position, the power control circuits are latched and power is maintained to the system components. NOTE: Any time that the system is going to be powered down first shut down the WindowsNT program from the start bar.
3	POWER ON indicator (green)	Lights when MASTER keyswitch has been set to START and the main contactors have energized, indicating that power is being applied to all system components. (Note that power to the laser is dependent on the position of the LASER ON switch.)

Table 3-2 – Operator Workstation Service Panel Controls and Indicators

4	LASER ON indicator (blue)	Lights when the LASER switch is set to ON to indicate that the laser power supply could be powered on and that a hazard exists from the possibility that the laser may be lasing.
5	LASER ON/OFF switch	When set to ON, this starts the Chiller and provides an enabling signal to the laser diode power supply (in the Laser Controller.) When set to OFF, the laser diode power supply is disabled and the Chiller is stopped.
5	ALARM SILENCER pushbutton switch/indicator	Silences audible alarm that sounds and accompanies the appropriate fault indicator when a detected fault occurs.
6	FAULT CLEAR pushbutton switch/indicator	Lights to indicate a detected fault; when pressed, generates a software reset that causes original fault condition to be re-examined. Indicator goes out if fault has been successfully corrected.
7	AIR FLOW indicator (inoperable for WaferMark® DSC)	Lights to indicate insufficient laminar air flow in or adjacent to the marking chamber. When lit, system marking will be suspended until the fault has been corrected.
8	VACUUM indicator	Lights to indicate that insufficient system vacuum has been detected by vacuum sensor. When lit, system marking will be suspended until the fault has been corrected.
9	WAFER HANDLING indicator	Lights to indicate that a wafer handling fault has occurred. When lit, system marking will be suspended until the fault has been corrected.
10	cassette LOADING indicator	Lights to indicate a cassette loading fault. When lit, system marking will be suspended until the fault has been corrected.

Table 3-2 – Operator Workstation Service Panel Controls and Indicators

11	LASER FAULT indicator	Lights to indicate a laser fault. This can be due to: coolant flow interlock; coolant temperature fault; coolant level interlock; shutter failed to open; warm-up time-out; current pulse width at maximum; or external interlock. When lit, system marking will be suspended until the fault has been corrected.
12	SAFETY INTERLOCK indicator	Lights to indicate that open interlocks have been detected in the laser head and/or marking chamber. When lit, system marking will be suspended until the fault has been corrected.
13	ALARM SILENCER Switch/Indicator	Silences audible alarm which sounds and accompanies the appropriate fault indicator when a detected fault occurs. Table 3-3 illustrates system status for all combinations of the ALARM SILENCER and FAULT CLEAR pushbutton switches.
14	FAULT CLEAR Switch/Indicator	Illuminates to indicate a detected fault; when pressed, generates a software reset that causes original fault condition to be re-examined. Indicator goes out if fault has been successfully corrected. Table 3-3 illustrates system status for all combinations of the ALARM SILENCER and FAULT CLEAR pushbutton switches.
15	LOAD/UNLOAD Switch/Indicator	Three combination switch/indicators prompt the operator for cassette loading and show job progress and status. Table 3-4 illustrates all combinations of the LOAD/UNLOAD switch indicators and the required operator response or marking job status.

Table 3-3 – ALARM SILENCER and FAULT CLEAR Status

Alarm Silencer	Fault Clear	Status
Flashing	Flashing	Fault condition system marking halted alarm sounding.
ON	Flashing	ALARM SILENCER has been pressed to silence alarm fault condition continues.
ON	ON	ALARM SILENCER and FAULT CLEAR have been pressed fault condition continues.
OFF	OFF	Normal condition.

Table 3-4 – LOAD / UNLOAD Pushbutton Indicator Status

UNLOAD	LOAD	REQUIRED ACTION OR STATUS
OFF	Flashing	Load cassette prompt; indicated action is for operator to load appropriate platform and press LOAD
OFF	ON	LOAD has been pressed and the appropriate presenter platform is moving to the process position
ON	ON	Marking in progress
ON	OFF	Marking complete, appropriate presenter platform is moving to the load/unload position
Flashing	OFF	Operator remove cassette prompt
Flashing	Flashing	Cassette loading fault; This condition should be accompanied by CASSETTE LOADING indicator

3.5 Wafer Handling System

The wafer handling system automatically loads and aligns wafers to be marked, and unloads wafers after marking has occurred. The main system components are the cassette presenters, the robot system and the wafer aligner. The Robot and Aligner Controllers control robotic movement and wafer alignment, respectively.

3.5.1 Cassette Presenter

The standard WaferMark® SigmaDSC NT cassette presenter consists of three loading platforms (1, 2 and 3). Each platform accepts a standard H-bar cassette containing up to 25 silicon wafers (100, 125, 150, and 200 mm). Wafers to be marked are selected from the cassettes and returned after marking.

To specify a cassette size (see Figure 3-6):

1. Select **Robot** from the **Maintenance** menu.
2. Press the **Init** button in the **Robot Control** subsection.
3. Select a cassette size from the **Cassette Size** drop-down menu.

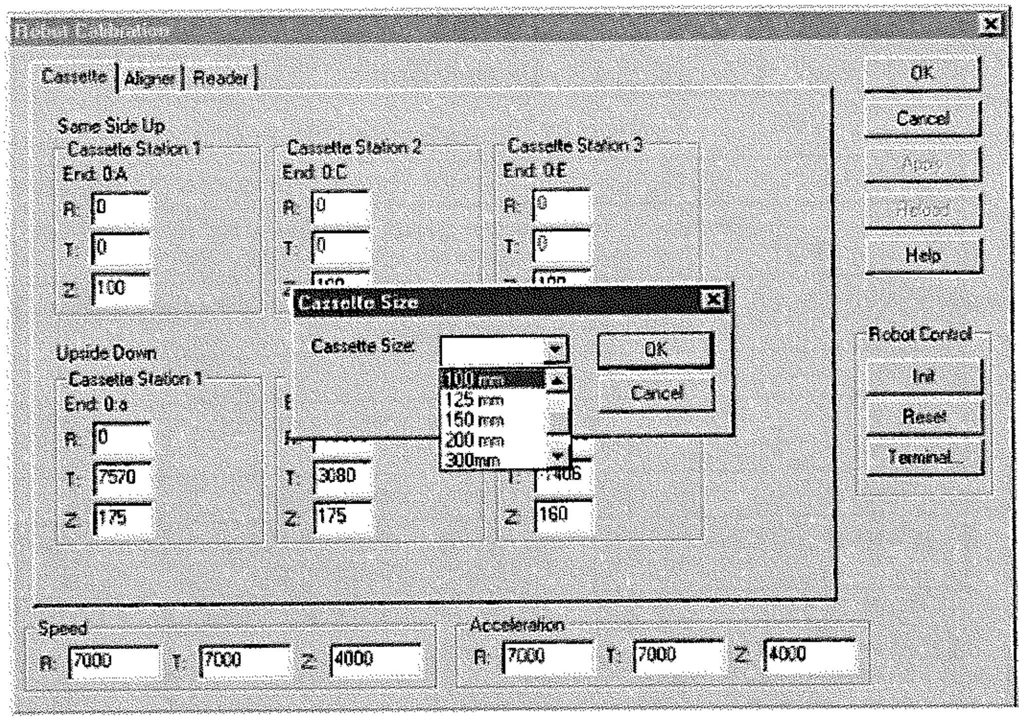


Figure 3-6 – Cassette Size Selection

In the standard configuration (see Figure 3-7), the three loading platforms are stationary. In the optional configuration (see Figure 3-9), the center platform (2) is stationary and the outer platforms (1 and 3) rotate 45 degrees so that they radially align with the robot for wafer loading and unloading. Pneumatic air cylinders, located under platforms #1 and #3, rotate the platforms when actuated by vacuum solenoid valves that are controlled by the system computer.

When a cassette is loaded or unloaded, platform-mounted sensors generate status signals indicating those platform(s) with mounted cassettes,those in process (being addressed by the robot), and those ready for loading. The computer uses these signals to generate load/unload operator prompts that light or flash the appropriate LOAD/UNLOAD indicators at the operator workstation.

In the specific SigmaDSC configuration (shown in Figure 3-10), the cassette presenter consists of two loading platforms that accepts cassettes containing up to either 13 or 25 200 or 300 mm silicon wafers. The load/unload operation of the cassettes, and the action of the robot when withdrawing wafers from the cassettes is similar to that described for the standard configuration above.

3.5.2 Robot

The robot selects and transports individual wafers from a platform-mounted cassette to the aligner located in the marking chamber. After marking, the robot retrieves the marked wafer and returns it to the specified cassette. Major components of the robot are the eccentric rotating and extending arm, and dual end-effector mounted on top of the arm. The dual-ended end-effector can handle two wafers at one time, with an option to flip a wafer. This increases throughput by minimizing wafer handling time during marking.

A wafer can be held ready to be inserted into the marking chamber as soon as the wafer in the chamber has been marked and removed. Vacuum channels on the tip of each end-effector create a vacuum seal between the wafer and end-effector surface that allow wafers to be picked up, retained, and released during the handling process. The Robot Controller activates a vacuum switch in the robot to provide vacuum to the end-effector.

At job start up, a typical marking sequence is as follows:

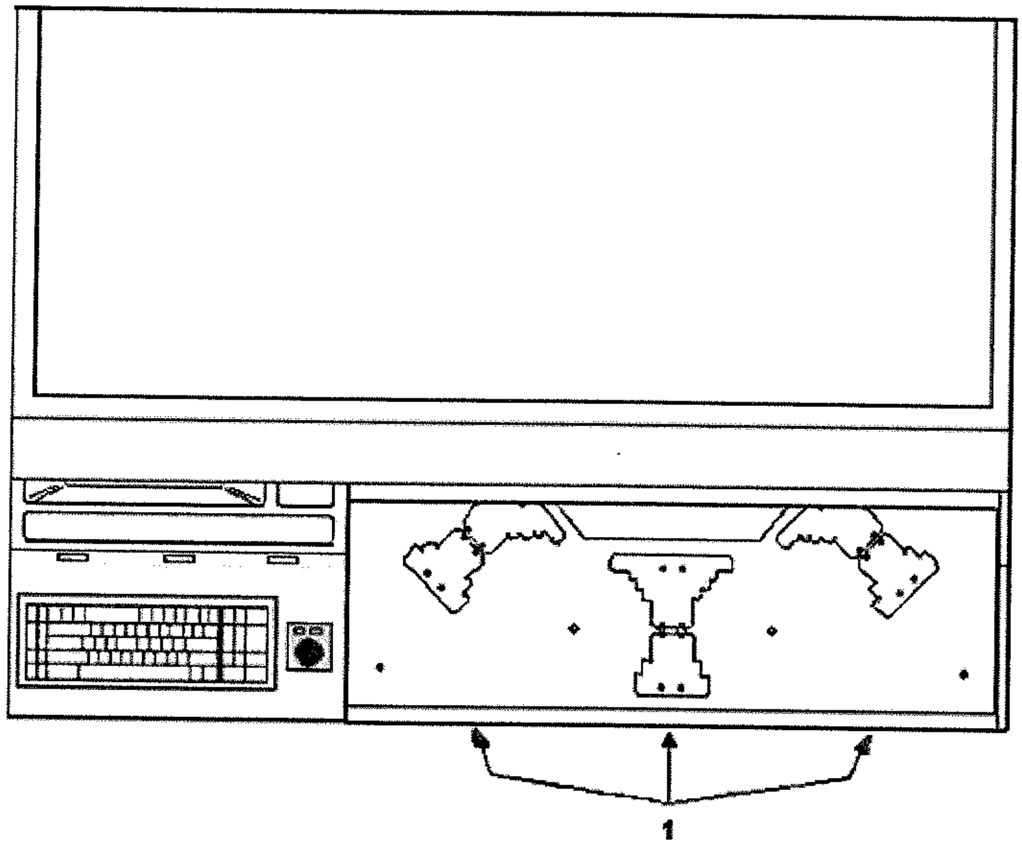
1. The robot removes the first wafer from the cassette, rotates the end effector 180° and removes a second wafer. After rotating again, the robot is elevated and passes the first wafer through the safety door and onto the aligner.

   NOTE: Some robots have an option to flip the wafer.
2. The robot holds the second wafer and remains stationary during the alignment and marking of the first wafer.

3. After marking, the robot retrieves the first wafer from the cassette, rotates 180° and loads the second wafer onto the aligner.
4. As the second wafer is aligned and marked, the robot returns the first wafer to its original position in the cassette or to an empty cassette; the specific action is a function of an operator-selected operation.
5. The robot then removes a third wafer from the cassette, rotates and retrieves the second wafer from the aligner, then rotates again and loads the third wafer onto the aligner.
6. The robot returns the second wafer to the cassette, removes the next wafer from the cassette and repeats the process until all wafers specified in the job have been marked.

NOTE: See the WaferMark® SigmaDSC NT Operator's Reference Manual, (P/N 273.508.00), for setup instructions.

If the job count is 25 wafers or less, the next job in the queue begins (see the *WaferMark® SigmaDSC NT Operator's Reference Manual* for further information on job programming and queue setup). For jobs of more than 25 wafers, the handling system continues with the next loaded cassette.



1 Opened Fixed Cassette Presenter Platforms

Figure 3-7 – Fixed Cassette Presenters (Plan View)

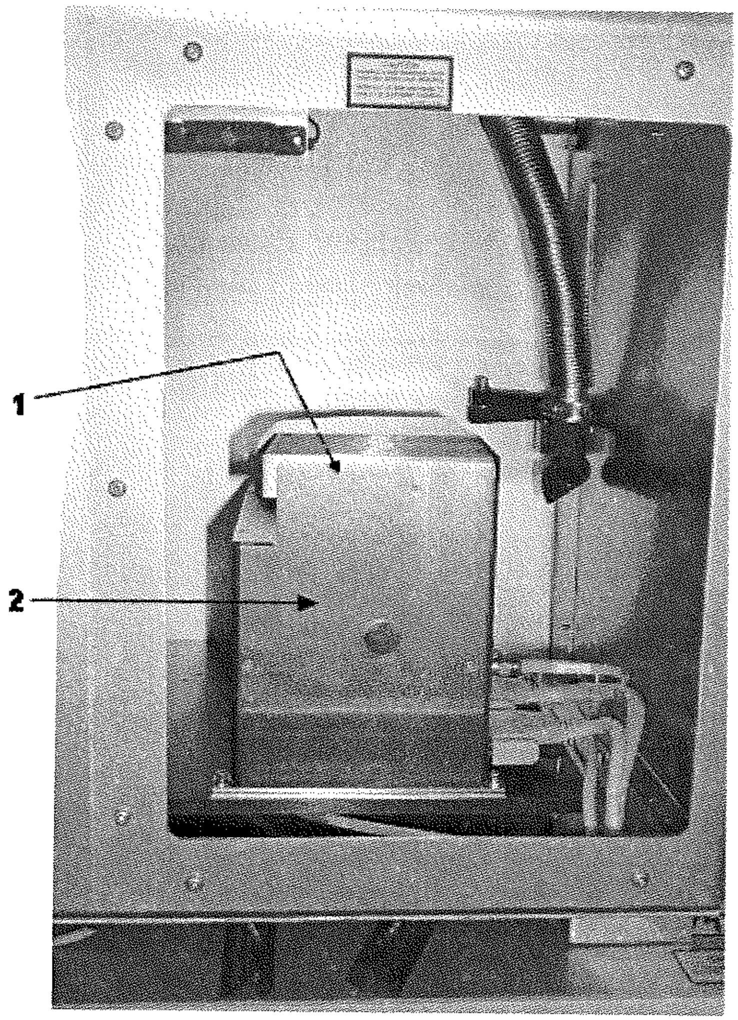
The Robot Controller directs all robotic movement, controls the application of the end-effector vacuum, and interfaces with the system computer through its RS-232 communications port.

3.5.3 Aligner

The aligner is a self-contained unit located inside the marking chamber (see Figure 3-8). It receives and positions each wafer for marking in the desired area. Main aligner components are a rotary chuck/horizontal displacement mechanism, a Charged Coupled Device (CCD) sensor, and a wafer lift mechanism. The CCD is an array of photosensors that generate an electrical charge proportional to the amount of light striking them.

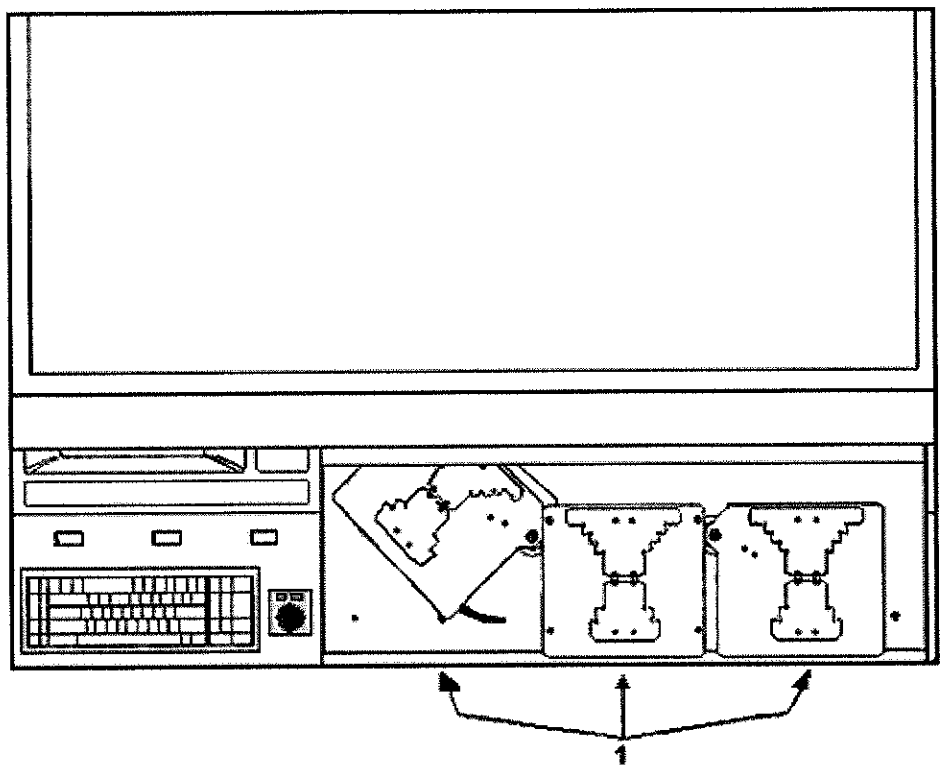
The aligner functions as follows:

1. The aligner controller controls the aligner through COM port 3.
2. The robot places each wafer on the aligner rotary chuck prior to marking.
3. The chuck rotates the vacuum-held wafer while the CCD sensor determines the wafer's positional eccentricity and offset, then locates its reference mark.
4. The wafer is raised from the chuck by the lifting mechanism and the chuck is repositioned, according to the misalignment detected by the CCD sensor.
5. The centered wafer is lowered onto the chuck and rotated, then checked again before marking.



1 Rotary Chuck (not visible from this viewpoint)
2 Aligner

Figure 3-8 – Marking Chamber and Aligner



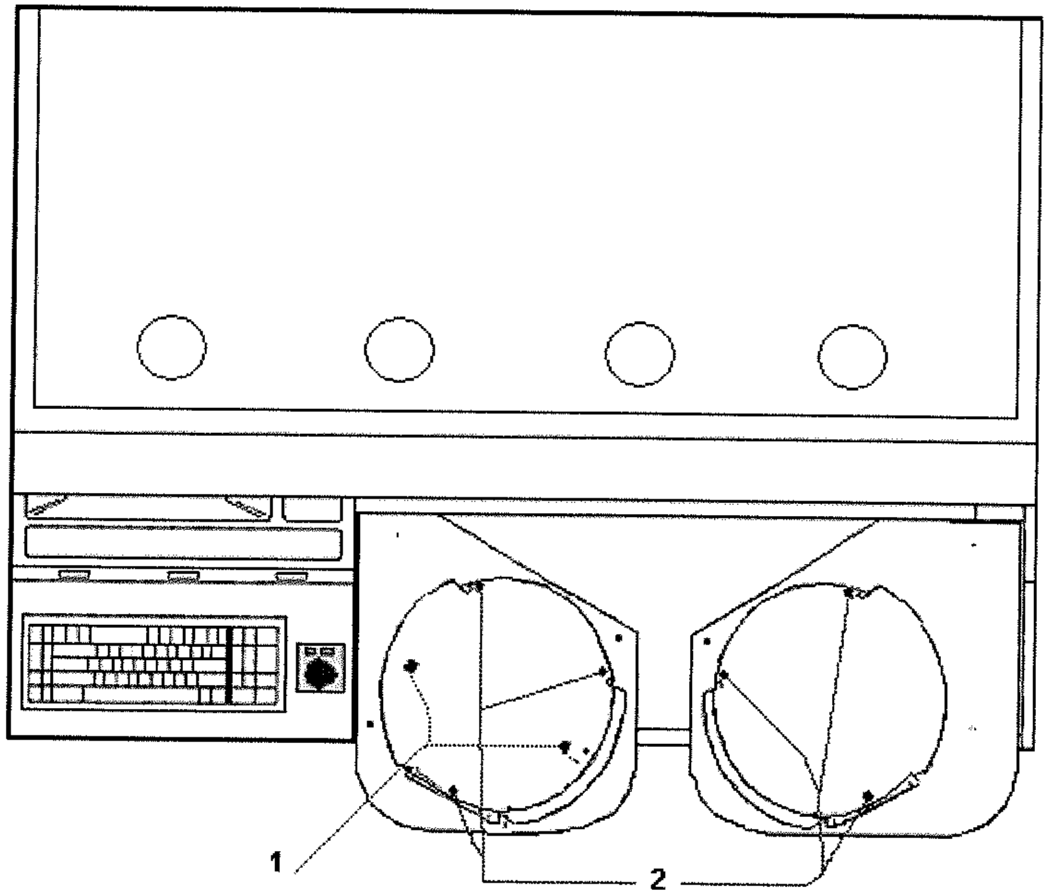
1 Cassette Presenter Platforms (Platform #1 in Process Position)

Figure 3-9 – Optional Movable Cassettes Presenters (Plan View)

3.5.4 Vacuum System

A facility vacuum system distributes vacuum to the robot, and marking chamber components of the wafer handling system. These components use the vacuum to facilitate presenter platform rotation, robot wafer manipulation, safety door operation and wafer holding during aligning. A minimum vacuum level of 25 inches Hg is required.

A preset vacuum sensor monitors the vacuum level. When the system vacuum falls below the preset level, the sensor generates a vacuum fault signal to the system computer and the operator workstation status panel (see Figure 2-6). Vacuum switches and solenoid valves distribute the vacuum. Switches in the Robot and Aligner modules control vacuum within these devices.



1 Cassette-In-Place Switches
2 Cassette Locater Pins

Figure 3-10 – WaferMark® SigmaDSC NT 300 Cassette Presenters (Plan View)

3.6 Laser and Optic System

Under the control of the embedded marking engine, the integrated laser and optic system generates, modulates and directs the laser beam during wafer marking. Various optic elements in the optic system expand, focus and steer the beam. The Laser Controller regulates lasing beam intensity using a closed-loop power stabilization and control circuit. The components of the integrated system are the laser rail, beam expander, beam steering mirrors, X and Y galvo scanners and a flat-field lens.

3.6.1 Laser Rail

The integrated laser rail (see Figure 3-11 and Figure 3-12) and optic assembly is enclosed in a Class I compartment at the top of the cabinet. This hood cover is unlatched and raised to gain access. Raising the hood breaks the safety interlock switches to immediately inhibit laser operation. During maintenance, the interlocks can be defeated using the GSI Lumonics-supplied interlock defeat flags.

> **⚠ WARNING**
> **Potential Laser Hazards**
>
> Defeating the interlocks places the laser in a Class IV operating condition. Be sure to adhere to all precautions prescribed in Sections 1.3 and 1.11.3.

3.6.2 Laser Assembly

The Laser assembly contains the:

- Energy Monitor
- Front and Rear Optics
- Current Modulator
- Pumping Chamber
- Acousto-optic Q-Switch, and
- Beam Shutter.

Energy Monitor

The Energy Monitor is a photodiode that measures the laser pulse energy transmitted from the rear optic. The module also contains a sensor that monitors the temperature of the Laser assembly.

Front and Rear Optics

The front optic is 90% reflective. The beam shutter can block the laser beam exiting the front optic.

The rear optic is 99% reflective. A small amount of light is transmitted through the optic and is used by the energy monitor to measure the laser output.

Each optic can be independently adjusted horizontally and vertically. When optimized, the optics are locked in position using set screws.

Current Modulator

The current modulator is capable of supplying current pulses of up to 100 amps peak current for time durations of up to 200 μs. Typically, it supplies a current pulse for 100 μs (called a pumping pulse) and the laser diode bars emits radiation at 800 nm for a similar time period.

The Current Modulator:

- Modulates the pulse width of the current to the laser diode module to control the pulse energy output.
- Modulates the amplitude of the current to the laser diode module, for temperature and wavelength stability.
- Acts as a fast power-off switch to protect the laser diode module from flow, temperature, or interlock failures.

Pumping Chamber

The heart of the Laser assembly is the pumping chamber, in which two key components are closely coupled — the laser diode bars and the Nd:YLF rod. When the Laser Controller transmits a trigger pulse, the current modulator excites the laser diode bars using a current pulse.

The module is cooled by the closed-loop Chiller and the coolant flows through the laser diode mount and around the Nd:YLF rod.

The radiation emitted by the laser diode bars is collected and collimated into the Nd:YLF rod. The rod has several strong absorption bands in the 800 nm region and the temperature of the bars is carefully adjusted to ensure that the diode radiation is efficiently absorbed in the Nd:YLF rod. Once the Nd ions have absorbed the 800 nm radiation, they are excited to the upper laser level and produce gain in the 1 μm region. In a conventional laser cavity, this gain results in laser output at 1 μm for nearly the full 100 μs duration of the pumping pulse. This mode of operation is generally called ***fixed-Q***.

Q-Switch

The acousto-optic Q-Switch prevents 1 μm radiation from building up in the laser cavity during the 100 μs pumping pulse. At the end of the pumping pulse, the Q-Switch is switched from a non-transmitting state to a transmitting state. The 1 μm radiation builds up very quickly and a laser pulse of 1 to 2 mJ of energy and a duration of approximately 100 μs is emitted. This mode of operation is generally called ***Q-switched***.

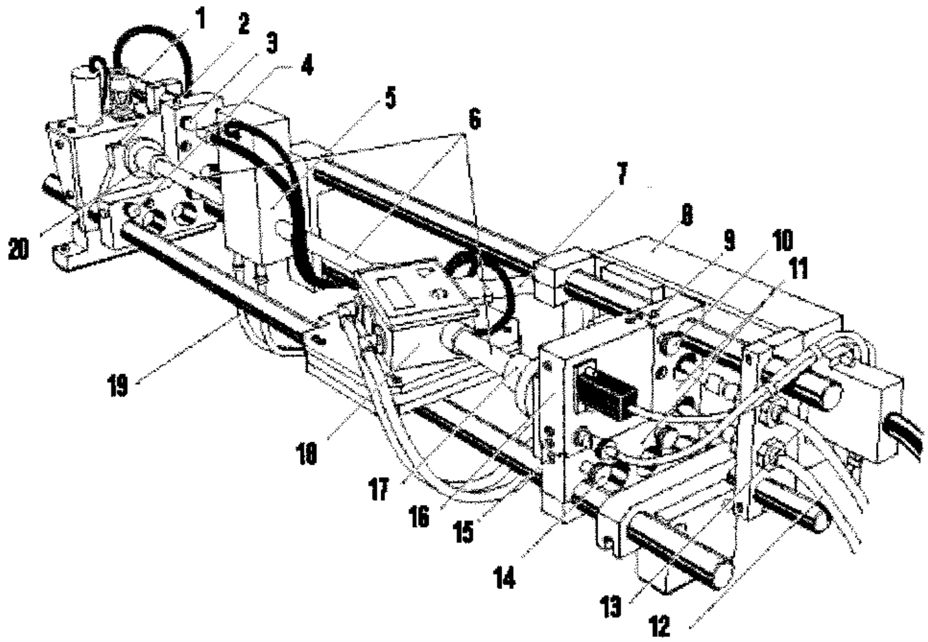
The Sigma–200 accepts trigger pulses at any repetition rate up to 4000 pps. After each trigger pulse, there is a delay before the emission of the Q-switched pulse.

Beam Shutter

The Beam Shutter is a diffuser, mounted on a rotating cam that is controlled by a 24 VDC solenoid. The shutter is mounted on the rail at the front of the laser. The shutter allows the laser beam to pass when the solenoid is energized and blocks the laser beam when the solenoid is de-energized. The shutter also allows the beam to be safely dumped into a beam block during calibration procedures.

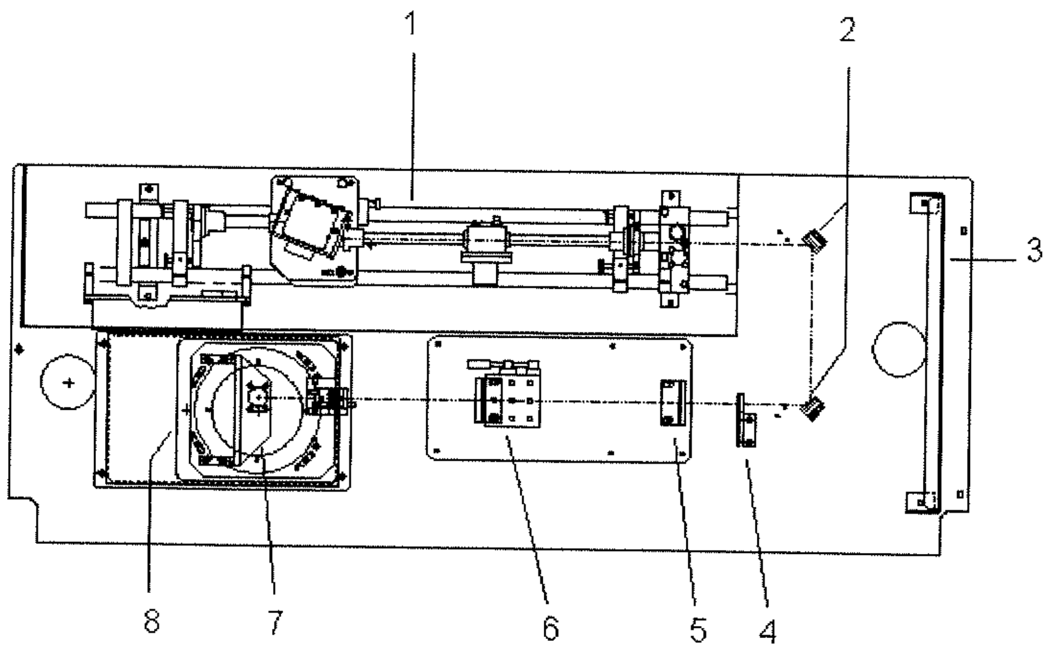
> **⚠ WARNING**
> **Potential Laser Hazard**
>
> The red LED (located on top of the beam shutter) illuminates to indicate a fully open shutter while the shutter cam depresses switch SW1 (in the safety interlock circuit). This LED is NOT an emission indicator. It does not indicate when the shutter is partially open.

The shutter safety interlock circuit functions so that if the shutter fails to close when the solenoid is de-energized, the laser diode power supply relay is de-energized and power is removed from the laser diode; that is, the laser cannot fire. The Laser Controller also issues a Shutter Failed-Open Interlock error to the operator workstation.



1	Beam Shutter
2	Locking screws for vertical and horizontal optics adjusts
3	Vertical Adjust
4	Horizontal Adjust
5	Q-Switch
6	Beam Tubes (Three Places)
7	Stripline
8	Current Modulator
9	Locking screws for vertical and horizontal optics adjusts
10	Vertical Adjust
11	Lockdown Screws
12	Coolant Inlet
13	Coolant Return
14	Horizontal Adjust
15	Locking screws for vertical and horizontal optics adjusts
16	Energy Detector
17	Rear Optic and Mount
18	Pumping Chamber contains laser diode module and flow cell
19	Tubing
20	Front Optic and Holder

Figure 3-11 – Laser Assembly



1	Sigma–200 Laser
2	Turning Mirrors 1 and 2
3	Beam Stop
4	Slow Shutter Assembly
5	First Focus Lens
6	Second Focus Lens on Micrometer Slide
7	Flat–field Lens
8	X, Y Galvo Scanners

Figure 3-12 – Laser and Optic System Layout

3.6.3 Beam Path

The laser beam is delivered to the mark-point through a simple optics path. Two fixed turning mirrors direct the beam through a flexible beam expander to the galvanometer mirrors. A flat-field focus optic provides consistent beam focus.

As the laser beam exits from the laser rail, it is turned 180° (in the horizontal direction) by turning mirrors 1 and 2. The beam then passes through two focusing lenses that expand and collimate the beam onto turning mirrors 3 and 4. The beam then passes to the X- and Y-galvo mirrors. The beam then passes through the flat-field lens to the work surface. Any rotational motion of either the X- or Y-galvos will deflect the laser beam to produce the required mark on the wafer.

3.6.4 X and Y Galvos

Actual movement of the lasing beam over the wafer surface is accomplished by two electromechanical galvanometers (galvos) that control the beam position. The X and Y galvos move the laser beam horizontally and vertically during marking under control of positioning signals from the X and Y galvanometer drive boards. Scanner temperature is also controlled and monitored by thermistors located in each scanner.

3.6.5 Flat-field Lens

The flat-field lens is the last element in the optic chain before the lasing beam enters the marking chamber. The lens expands the area in which the beam can be focused to a 7 x 7 inch field.

3.7 Chiller Assembly

To ensure that the laser diode bars and the Nd:YLF rod are adequately cooled at this repetition rate, a closed-cycle chiller circulates coolant through the pumping chamber. The excess heat is removed from the chiller by a water-to-air heat exchanger. The controller uses a heater and temperature sensor to maintain the coolant temperature within the optimal operating temperature range.

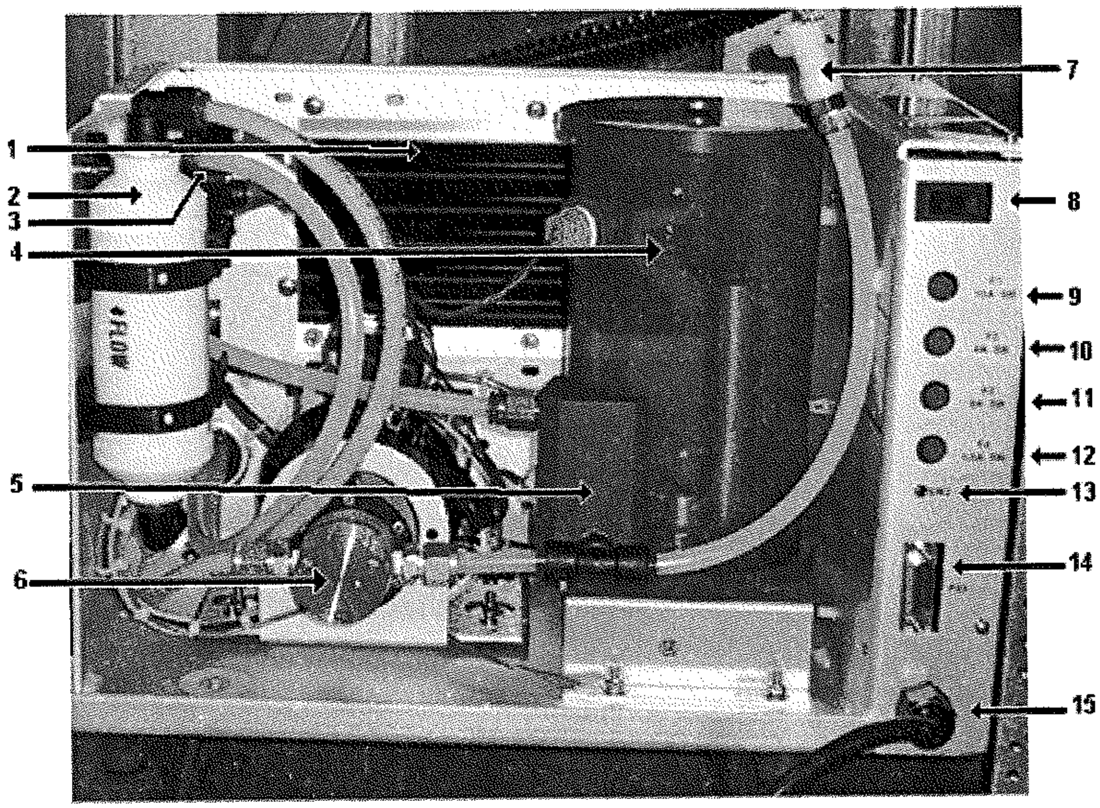
The laser modules are interconnected by coolant tubing connected to the chiller unit in the Electronics Bay (see Section 2.8.6) and by an umbilical assembly made up of electrical cabling.

The closed-loop chiller is mounted on the base of the Electronics Bay. The chiller has two functions:

- To maintain the laser diodes at a constant temperature of 34°C ± 0.5°C (93.2°F ± 0.9°F).
- To remove excess heat from the current modulator, the Q-Switch and the Nd:YLF crystal.

The coolant circulates through the system as follows:

- Chiller pump
- Chiller particle filter
- Laser assembly pumping chamber
- Laser assembly Q-Switch and laser rod
- Laser assembly current modulator
- Chiller flow sensor
- Chiller heat exchanger, and
- Chiller reservoir.



1	Air to Water Heat Exchanger
2	Particle Filter
3	Flow Sensor
4	Reservoir
5	Flow Switch
6	Chiller Pump
7	Filler
8	Power Switch
9	Main Fuse F1 10A FNQ10
10	Pump Fuse F2 4A SB MDA4
11	Resevoir Heater Fuse F3 8A SB
12	Heat Exchanger Fan Fuse 1.5A SB
13	SW2 Switch
14	P33 Interface Connector
15	Power Cable

Figure 3-13 – Chiller Assembly

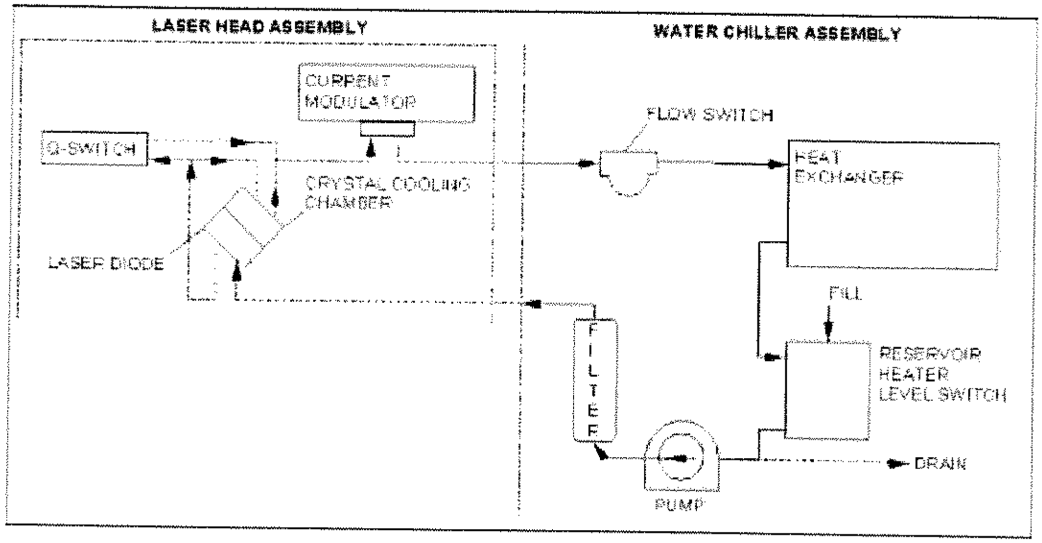


Figure 3-14 – Coolant Flow Diagram

Reservoir

The Reservoir stores 4.0 liters (1.0 U.S. gallon) of coolant that is circulated through the Laser assembly. The coolant consists of a mix of 95% steam-distilled water with 5% isopropyl alcohol. A coolant mixture of steam-distilled water with up to 10% isopropyl alcohol is acceptable.

The reservoir contains a level sensor—a temperature sensor, and a heater.

The level sensor detects the level of coolant in the reservoir and sends the information to the Laser Controller. If the level is below the level sensor, a relay on the Chiller power distribution board switches off the heater, and the Controller sends a Coolant Level Interlock error message to the software. Eventually, a Coolant Temperature Fault will occur and the Controller will stop the laser.

The Chiller maintains the coolant at a constant temperature of 34°C. The information from the temperature sensor in the reservoir is sent to the Laser Controller, which adjusts the duty cycle of the heater as necessary in order to maintain the coolant at the correct temperature.

Flow Sensor

The Flow Sensor is a rotating paddlewheel sensor that activates a Coolant Flow Interlock error message if the coolant flow drops below a level that is adequate to protect the laser diode module.

Pump

The Pump circulates the coolant through the closed cycle and is usually turned on and off by the Laser Controller. Pressing the primer switch on the front of the Chiller can also turn it on. The pump is isolated from the base of the Chiller to avoid transmitting vibrations to the laser diode module and flow cell in the Laser assembly's pumping chamber.

The pump has a pumping capacity of up to 2.0 liters/min at 50 psi.

Filter

The Filter is a 5-micron particle filter used in the water cycle to remove particles from the coolant. It should be replaced annually.

Air-to-Water Heat Exchanger

The Air-to-Water Heat Exchanger unit is located at the back of the Chiller and consists of a radiator and two fans. As the coolant passes through the radiator, the fan blows air over the radiator to remove excess heat from the coolant.

The Laser Controller turns the fans off and on. The fans are kept off while the laser is warming up in order to keep the warm-up time as short as possible. Once the laser is warmed up, the fans switch on as required.

Power Distribution

The Power Distribution-power requirement for the Chiller is 115 VAC ±10%, 50/60 Hz, nominal 7 A current, fused at 10 A. The power switch (SW1) is located at the top right corner. This switch should always be left in the ON position. The Controller will turn the power to the Chiller on and off as required. While the power switch is turned on, the pump can be turned on to circulate the coolant through the system by pressing the primer switch on the front of the Chiller. The Controller connector for the Chiller is located just above the power cord.

The power distribution board for the Chiller is located on the right side, under the cover. The board contains four fuses and five control relays. Each control relay has a light-emitting diode (LED) on it. When the LED is lit, the relay is energized, thus switching power to the load connected to it. Table 3-5, Table 3-6, and Table 3-7 summarize the functions of the fuses, relays and LEDs.

Table 3-5 – Fuses for the Chiller

Fuse	Type	Load and/or device
F1	10 A, S.B.	Main fuse.
F2	4 A, S.B.	Pump.
F3	8 A, S.B.	Reservoir heater.
F4	1.5 A, S.B.	Heat exchanger fans.

Table 3-6 – Control Relays for the Chiller

Relay	Load and/or device
CR1	Pump.
CR2	Heat exchanger fan #1.
CR3	Coolant level interlock; shuts off reservoir heater.
CR4	Duty cycle control for reservoir heater (mounted off the PCB).
CR5	Heat exchanger fan #2.

Table 3-7 – D Indicator Lamp Status

LED	Meaning, if lit
D2	Pump relay is on (CR1 on).
D4	Heat exchanger fan #1 is on (CR2 on).
D6	Coolant level is high enough, and reservoir heater relay is on (CR3 and CR4 on).
D8	Coolant level is high enough (CR3 on).
D10	Heat exchanger fan #2 is on (CR5 on) D10.
D11	Flashes at a rate proportional to coolant flow to indicate flaw rate.

The primer switch (SW2) is located just below the fuses on the front of the Chiller and is used for filling the Chiller with coolant. While depressed, this switch momentarily powers on the pump. Power to both the Chiller and Laser Controller must be on, but the Laser On switch can be off.

3.8 Power Distribution Panel

Power is distributed throughout the system from the Power Distribution Panel (PDP) (see Figure 2-6), mounted on the right-hand side of the System. Wiring of the power distribution circuits is provided in GSI Lumonics drawing number 2750161 at the back of this manual. The location of parts mounted on the PDP is shown in GSI Lumonics drawing number 6650090 at the back of this manual.

The PDP contains the following components:

AC terminal block

The AC terminal block distributes AC power to the electronics bay and other components.

EMI filter

The EMI filter filters the input AC power to the system.

24 VDC Power Supply

The 24 VDC Power supply for the system interface board and signal tower.

Vacuum sensor

The Vacuum sensor signals when the vacuum level is below acceptable limits.

Vacuum solenoids

The adjustable vacuum solenoids drive the safety door pneumatic cylinders.

The following voltages are distributed from the PDP to other components of the system:

- 115 VAC (supplied to the +24 VDC Power Supply, Marking Engine, Monitor, Laser Controller, Robot, Aligner, and Laser Diode Module).
- +24 VDC (supplied from the +24 VDC Power Supply, for component control).

3.8.1 Overview of the Power Control Circuit

The main power cable for the equipment is connected to the system circuit breaker (CB1) that is located near the top, right-hand side of the Power Distribution Panel (see Figure 2-6). When the circuit breaker is turned on, input power at 208, 220, 240, 380, or 416 VAC is routed through an RFI filter to a step-down transformer. This transforms the voltage to a nominal 115 VAC for system use. The voltage is connected via fuse F1 to the de-energized contacts of main contactor K3 and to the primary of the 24 VAC transformer T2. (For power distribution circuit details, refer to the GSI Lumonics schematic drawing No. ***2750366*** at the back of this manual.)

At this point, the distribution of power to the system is controlled by the three-position MASTER keyswitch located on the front of the Operator Panel. Section 3.8.2 describes how this keyswitch controls the system Power On sequence.

3.8.2 Power On Sequence

NOTE: The following description should be used in conjunction with the simplified power distribution logic diagram shown in Figure 3-15. The Safety Relay K1, shown in the logic diagram, actually consists of internal relays that are designated by a lower-case k [k1, k2, k3]. All other relays are designated by upper case K.

With the main circuit breaker set to ON and the MASTER keyswitch in the OFF position, the main and redundant power contactors (K3 and K4) are both in the de-energized condition. Because the contacts of K3 are open, 115 VAC power is prevented from being distributed to the remainder of the system.

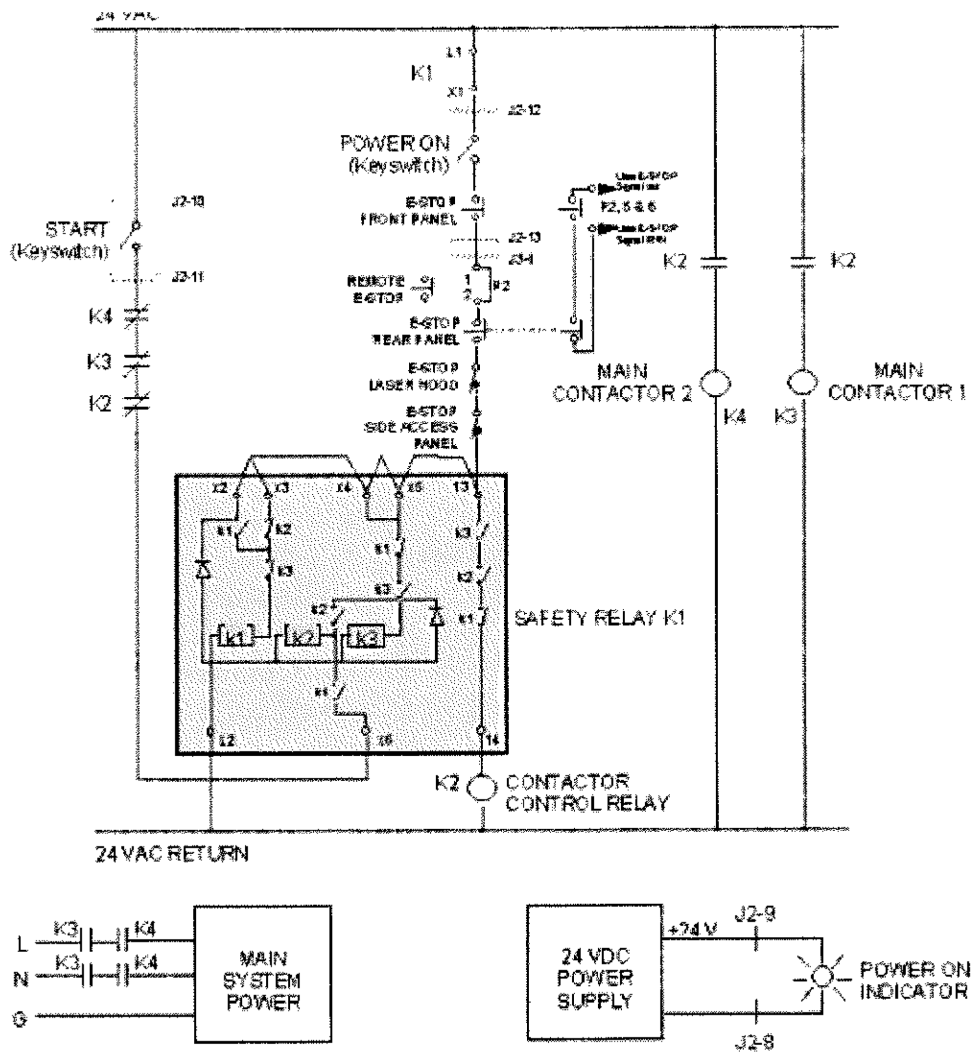


Figure 3-15 – Simplified Power Distribution Logic Diagram

3.8.3 System Startup

At all times that the main circuit breaker is in the ON position, 115 VAC is applied to the primary of transformer T2, which supplies a continuous 24 VAC output to the following components:

- The (open) POWER ON contact of the MASTER keyswitch (via terminals L1 and X1 of the de-energized Safety Relay K1).
- The open START contact of the keyswitch (via TB2).

- The open contacts of the Contactor Control Relay K2.

The power on sequence is initiated when the Power On keyswitch is turned to the ON position. This closes the ON contact of the switch and provides a path for 24 VAC to terminals 13, x2, x3, x4, and x5 of Safety Relay K1, via the closed contacts of the following E-STOP pushbuttons and safety switches:

- Front Panel E-STOP pushbutton.
- Remote E-STOP pushbutton (or shorting link if not fitted).
- Rear Panel E-STOP pushbutton.
- Laser Enclosure E-STOP safety switch.
- Power Distribution Panel E-STOP safety switch.

If any of the E-STOP pushbuttons or safety switches are not in their normal positions (i.e., with contacts closed), the 24 VAC will not be available at connector 13 on the Safety Relay; this prevents the system from continuing with the power on sequence.

The 24 VAC applied to connector x3 of Safety Relay K1 energizes relay k1 though the de-energized contacts of relays k2 and k3 and the holding contact of k1 latches the relay in the energized condition. The power control circuits are now in a primed condition.

When the MASTER keyswitch is turned to the START position, this closes the START contact of the switch and provides a path for 24 VAC to relay k2 (in the Safety Relay) through the closed contacts of K2, K3, and K4, connector x6, and the closed contact of k1. Relay k2 now energizes, which, in turn, energizes relay k3. When k3 energizes, the holding path for relay k1 is opened, causing the relay to de-energize. With k1 de-energized, a holding path is now provided for relay k3, via connectors x4, x5 (of the Safety Relay).

At this stage, the Safety Relay (K1) is conditioned with k1 de-energized and k2 and k3 energized. This means that 24 VAC from the closed contact of the keyswitch ON contact is now available to the coil of Contactor Control Relay K2, through the E-STOP logic circuit and connectors 13 and 14 on the Safety Relay.

The Contactor Control Relay K2 now energizes and routes 24 VAC from terminal TB2 to the coils of the Main Contactors 1 and 2 (K3 and K4). Both contactors are energized simultaneously so that 115 VAC main system power is output from contactor K4 to terminals TB4 and TB5. From here, main power is further distributed to the +24 VDC Power Supply, Marking Engine, Monitor, Laser Controller, Robot, Aligner, and Laser Diode Module.

With 115 VAC available, the +24 VDC Power Supply powers on. Outputs from these power supplies are used to turn on the fluorescent light, start the elapsed time meter, and light the Power On and Laser Emission indicators.

NOTE: No fluorescent light is provided with the SigmaDSC.

When the spring-loaded Power On keyswitch is released to the ON position, the ON contact of the switch closes, which arms the E-STOP (emergency power off) circuits. Because the main and redundant contactors (K3 and K4) are self-latching, 115 VAC main power is maintained throughout the system.

3.8.4 Operation of the E-STOP Interlock Circuit

The simplified power distribution logic diagram for the E-STOP circuitry is shown in Figure 3-15.

⚠ CAUTION

Risk of Damage to System Computer and the Wafer

ONLY use the E-STOP pushbutton to shut down the system in an EMERGENCY. Pressing the E-STOP will immediately remove all power from the system. This causes the vacuum to cease, which could result in damage to the wafer currently on the robot arm. It also causes the PC to shut down, which may result in the loss of job information or damage to software files. As a result, the Windows NT-based computer could have problems restarting. To ensure the ability to resume normal production following any emergency shutdown, BACK UP YOUR PC PROCESSING FILES AS FREQUENTLY AS YOUR FACILITY MANAGEMENT DEEMS NECESSARY. You might also need to reteach the robot following an emergency shutdown.

The E-STOP circuit consists of three E-STOP pushbuttons and two access panel interlock safety switches. E-STOP pushbuttons are mounted at the following locations:

- Operator panel
- Top left of the rear panel of the System
- Customer remote position (if fitted). If not fitted, a shorting link must be used between pins 1 and 2 on the External User Connector plug (P2) which is located at the bottom left corner at the rear of the cabinet.

NOTE: The remote pushbutton must be a normally closed, maintained mechanical switch.

E-STOP Access Panel Safety Switches:

- Laser Enclosure.
- Power Distribution Panel (one at right side door on PDP; one on Systemrear right door).

The E-STOP pushbutton has two primary functions: to provide an emergency stop signal to the user that can be used to halt other equipment on a production line and to immediately remove power to the system. If main power is removed in an emergency, this ensures that the Laser Power Supply will also power down, thus stopping any further laser emission.

With reference to the logic diagram shown in Figure 3-15, the E-STOP circuit operates so that if any E-STOP pushbutton is activated, the open circuit removes the 24 VAC supply line from the coil of the Contactor Control Relay K2. This immediately causes K2 to de-energize, which, in turn, de-energizes the Main Contactor relays K2 and K3. As a result, the control circuit is now returned to the initial power state (previously described above).

Before the system can be powered on again, the E-STOP circuit must first be rearmed by pulling the activated E-STOP pushbutton to its full out position, which returns the device to its normal (nonactivated) position. The system can now be powered on again by turning the MASTER keyswitch on the Operator Panel to the START position, then releasing the keyswitch so that it returns to ON.

One E-STOP access panel safety switch is mounted in the laser enclosure; one is mounted on the Power Distribution Panel access door on the right side of the system, and one is located on the right side rear access door of the System. Each switch has three operating positions. If the operating plunger is either pushed fully in or pulled fully out, the switch contacts are closed; in the mid-position, the switch contacts are open. In the power control circuit, if either switch moves to the mid-position, this removes the 24 VAC supply line from the Contactor Control Relay K2, causing an E-STOP power down sequence. This sequence is identical to that described for the E-STOP pushbutton, above.

These safety switches prevent exposure to possible laser emission if the cover of the laser enclosure is raised or to an electrical hazard if the right side access door or right rear access door is opened. If the cover or doors are opened, the contacts on the appropriate safety switch opens, causing the system to power down immediately.

NOTE: For maintenance, the safety switches can be overridden: Pull the operating plunger to its full out position; this allows the system to be powered on with the enclosure cover in the raised position or with the right side access door or right rear access door opened, as needed.

⚠ WARNING
Potential Laser or Electrical Hazards

When the safety switches are overridden, be sure to follow all safety procedures to avoid anyone in the area being exposed to the laser beam or to the electrical hazards.

3.9 Marking Chamber

The Marking Chamber provides an enclosed, controlled area for wafer marking. The chamber contains the aligner.

A debris removal vent is provided in the Marking Chamber as part of the optional mark-point exhaust system.

NOTE: GSI Lumonics provides the mark-point exhaust system as part of the WaferMark® SigmaDSC NT System (see Section 2.17.)

The customer must install the mark-point exhaust system and connect a facility vacuum filtration system to the mark-point exhaust to remove any vapors or silicon particulates from the Marking Chamber.

During marking, the chamber becomes negatively pressurized. Any vapors or silicon particulates are routed by the exhaust system to the rear of the System.

The system computer monitors the interlock sensors during marking to ensure safe operation. Operations are suspended if a door is opened, and will remain inhibited until the door is closed.

3.9.1 Marking Chamber Access Door

The Marking Chamber access door is accessed from the rear of the System. It provides access to the Marking Chamber for maintenance. A special glass viewing port permits marking to be watched safely and an interlock halts marking if the door is opened.

3.10 Laser Controller

Pulsed beam lasers, such as the Nd:YLF used in the WaferMark® SigmaDSC NT System, are susceptible to power drift and power supply-generated noise. These factors contribute to power instability and can adversely affect mark quality, as well as the amount of debris generated in the process. The WaferMark® SigmaDSC NT System design allows power to be controlled by the dedicated Laser Controller.

The Laser Controller:

- Controls the width and amplitude of the current from the current modulator to the laser diode module.
- Monitors and stabilizes the output pulse energy.
- Controls triggering mode.
- Regulates the temperature of the coolant by controlling the Chiller pump, heater and fans.
- Monitors and reacts to faults and interlocks, including control of the beam shutter.
- Contains external interlock and safety interlock circuitry.
- Interprets and replies to commands from the system software via the RS-232 connection.
- Logs data about critical laser parameters.

The Laser Controller contains:

- A printed circuit board (the Control PCB assembly) containing a single microprocessor and digital and analog input/output (I/O) circuitry.
- A power supply for the Controller.
- A power supply for the laser diode bars.

The Controller connects to the Laser assembly and Chiller via a wire harness called the umbilical. The umbilical connects to the rear panel of the Controller.

The Controller requires 115 VAC ±10% at 50/60 Hz, nominal current 5 A, fused at 6 A. The Controller power supply provides +5 VDC and +24 VDC to the Control PCB (printed circuit board) assembly.

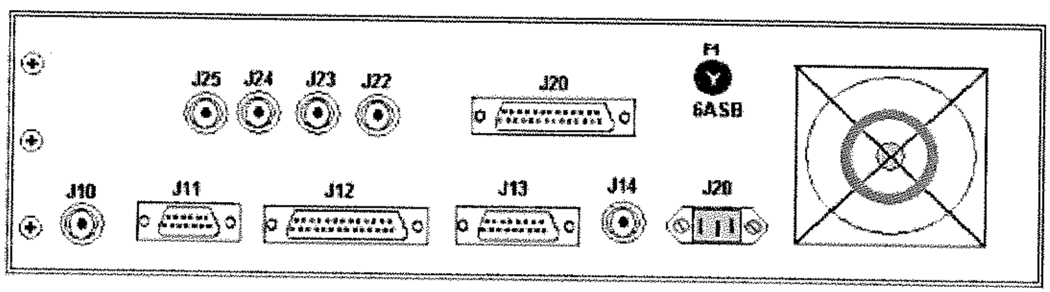
The laser diode power supply provides power to the current modulator, which controls the width and amplitude of the electrical current pulse to the laser diode module. A laser diode power supply relay is used in the safety interlock circuit. The relay connects AC power to the laser diode power supply when the relay is energized. When de-energized, the relay connects a dump resistor to the current modulator storage capacitors and the laser cannot emit a laser pulse.

The rear panel contains the following items:

- Connectors
- Monitoring points
- Fuse
- Fan.

3.10.1 Connectors

Seven connectors are located on the rear panel of the Laser Controller. Figure 3-16 shows the connector locations and Table 3-8 lists the connector type and function.



J10	Pulse Energy Input Connector
J11	RS232 Communications Connector
J12	Laser Control I/O Connector
J13	User Interface Connector
J14	Q-Switch Trigger Output Connector
J20	AC Power Input Connector
J21	Current Modulator Connector
J22	Sync Monitor Output Connector
J23	Current Monitor Output Connector
J24	Energy Monitor Output Connector
J25	DAC Output Connector

Figure 3-16 – Laser Controller (Rear Panel Identification)

Table 3-8 – Rear Panel Connectors

Reference Designator	Connector Type	Function
J10	BNC	Pulse Energy Input Connector
J11	DB9	RS232 Communications Connector
J12	DB37	Laser Control I/O Connector
J13	DB25	PDP Interface Connector
J14	BNC	Q-Switch Trigger Output
J20	IEC	AC Power Connector
J21	DB8	Current Modulator Connector

Pulse Energy Input (J10)

The pulse energy input (J10) is a BNC connector that receives a signal from the detector in the energy monitor located behind the rear optic in the Laser assembly. This signal represents the laser's pulse energy.

RS232 Communications Connector (J11)

J11 is an RS232 communications connector used for serial communications. This connector provides an interface to the Laser Controller from the System Computer to transmit ASCII commands and responses. In addition, software on the PCB can be upgraded and the laser performance data that has been collected can be accessed.

The setup parameters for the PC are:

- 9600 baud
- 8 data
- 1 stop bit
- N parity
- N handshaking

The pin-out for this DB9 connector is shown in Table 3-9. Pins 1, 4, 6 and 9 are not used.

Table 3-9 – RS-232 Communications Connector Pin-Out

Pin	Signal	Function
2	TXD (Transmit Data)	Output from the laser.
3	RXD (Receive Data)	Input to laser.
5	GND	Ground
7	CTS (Clear To Send) NOT IMPLEMENTED	Input to the laser must be active (low) to allow the laser to receive data, false (high) level on this line inhibits transmission.
8	RTS (Request To Send) NOT IMPLEMENTED	Output from laser must be active (low) to allow the laser to transmit data, false (high) level on this line inhibits transmission.

Laser Control Input/Output Connector (J12)

Connector J12 is a laser control input/output (I/O) connector that branches out to the Chiller and Laser assembly. It controls internal laser functions and receives status information from the Laser assembly and Chiller, such as controlling the beam shutter, monitoring the temperature of the coolant in the Chiller and adjusting the heater as required, and providing power to the energy monitor and the Q-switch in the Laser assembly.

Table 3-10 lists the pin-out for this DB37 connector.

Table 3-10 – Laser Control I/O Connector Pin-out (J12)

Pin	Signal	Function
1	Shutter control	Output; switched 24 VDC signal to beam shutter solenoid; controlled by safety interlock circuit
2	Switched 24 VDC	Output; switched 24 VDC power to current monitor, Q-switch and Laser On output (J13, pin 22). Controlled by microprocessor. On (24V present) when microprocessor switches on laser diode power supply.
4	Shutter fully closed switch (High = closed)	Input; high level 24 VDC signal indicates beam shutter is fully closed (shutter switches SW2 and SW3 closed)
5	Shutter fully opened switch (High = open)	Input; -24 VDC signal indicates beam shutter is fully open (shutter switch SW1 closed)
6	Spare 24V input	Input; not defined
7	Spare 24V input	Input; not defined
8	Coolant level interlock	Input; 24 VDC signal indicates coolant level is adequate (Chiller switch S2 closed)

Table 3-10 – Laser Control I/O Connector Pin-out (J12)

Pin	Signal	Function
9	Coolant flow interlock	Input; 24 VDC square wave output from chiller flow sensor represents flow rate. Freq. >90 Hz means flow is adequate.
10	Not Used	Not Used.
11	Coolant pump relay	Output; 24 V digital output energizes coolant pump.
12	Coolant heater relay	Output; 24 V digital output energizes coolant heater.
13	Spare 24 V output	Output; not defined.
14	Chiller ambient temperature sensor signal	Input; 2-wire RTD, signal connection
15	Coolant temperature sensor signal	Input; 2-wire NTC thermistor, signal connection.
16	Coolant temperature sensor execution	Input; 2-wire NTC thermistor, excitation connection.
17	Head temperature sensor signal	Input; 2-wire RTD, signal connection. Sensor located in energy monitor PCB.
18	+12 VDC *NOTE:* ***Not available*** *in SigmaDSC*	Power for energy monitor PCB assembly
19	–12 VDC *NOTE:* ***Not available*** *in SigmaDSC*	Power for energy monitor PCB assembly
20	+24 VDC	24 VDC for beam shutter interlock switches
21	+24 VDC	No Connection
22	+24 VDC	No Connection
23	+24 VDC	No Connection
24	+24 VDC	24 VDC for Chiller control and interlocks; signals for relays and LEDs
25	24 V Return	24 VDC return for beam shutter
26	24 V Return	24 VDC return for Q-switch
27	24 V Return	No Connection
28	24 V Return	24 VDC return for Chiller
30	Heat exchanger tan #1 relay	Output; 24 V digital output energizes heat exchanger fan #1 relay
31	Heat exchanger tan #2 relay	Output; 24 V digital output energizes heat exchanger fan #2 relay

Table 3-10 – Laser Control I/O Connector Pin-out (J12)

Pin	Signal	Function
32	Spare 24 V output	Not defined
34	Analog Ground	Ground for 2–wire RTD for Chiller ambient temperature (see pin 14)
35	Analog Ground	Ground for 2–wire RTD head temperature sensor, located in energy monitor PCB (see pin 17)
36	Analog Ground	Ground for energy monitor photodiode
37	Shield	Cable Shield

PDP Interface Connector (J13)

J13 is an interface connector to the Laser Controller from the Power Distribution Panel in the Power Distribution Bay that allows the laser to be connected to safety interlocks and external indicators using hardware input/output handshaking (all signals are digital I/O bits). Interface signals include shutter control, external interlock, mark enable, external trigger input, laser on input, laser ready indicator, and fault indicator. The pin-out for this DB25 connector is shown in Table 3-11.

NOTE: Pin 9 is not used.

Table 3-11 – PDP Interface Connector Pin-out (J13)

Pin	Signal	Function
1	Laser on input.	Digital input; 5 V=laser off, 0 V=laser on; internal pull up to 5 V (4.7 kohm).
2	Spare 5 V input.	Not defined.
3	External trigger input.	Digital input, internal pull-up to 5 V (4.7 kohm), falling edge trigger.
4	Signal Ground.	Ground for inputs.
5	Laser ready indicator OC	Open collector output indicates condition when transistor on (conducting). Use with pin 17 (pull-up resistor) to drive opto-coupler up to 24 VDC, 30 mA
6	Fault indicator OC	Open collector output Indicates condition when transistor on (conducting). Use with pin 18 (pull-up resistor) to drive opto-coupler up to 24 VDC, 30 mA
7	Spare OC	Not defined
8	Spare OC	Not defined

Table 3-11 – PDP Interface Connector Pin-out (J13)

Pin	Signal	Function
10	External shutter control #1	Applying 24 V to both inputs allows this control to open beam shutter.
11	External shutter control #2	Shutter will close if 24 VDC is removed (part of safety interlock circuit).
12	External interlock+ (source)	Install switch in series with these pins. Closing switch removes an external interlock condition.
13	External interlock- (return)	Opening switch causes an interlock. (Part of safety interlock circuit)
14	Mark enable input	Digital input. 0 V=mark enable, internal pull-up to 5 V (4.7 kohm)
15	Spare 5 V input	Not defined
16	Spare 5 V input	Not defined
17	Laser ready indicator (5 V pull-up)	4.7 kohm resistor pull-up to 5 VUse in conjunction with pin 6
18	Fault indicator (5 V pull-up)	4.7 kohm resistor pull-up to 5 VUse in conjunction with pin 6
19	Spare (5 V pull-up)	Not defined
20	Spare (5 V pull-up)	Not defined
21	+5 VDC	+5 VDC, limited by 100 ohm, 0.5 W series resistance
22	Laser on indicator	Output; 24 VDC switched. 24 VDC available when laser diode power supply enabled by the microprocessor
23	24 V return	Used to power external shutter control (250 mA max.)
24	+24 VDC	Used to power external shutter control (250 mA max.)
25	Shield	

Q-switch Trigger Output (J14)

Connector J14 is the Q-switch trigger output. A 5V signal level turns on the Q-switch in the Laser assembly (that is, the Q-switch is in the transmitting state). The Q-switch is also in the transmitting state when it is not powered.

Power Connector (J20)

Connector J20 is an IEC power connector. The power cord supplied with the laser plugs in here to supply power to the Laser Controller.

Current Modulator Connector (J21)

Connector J21 is the current modulator connector. Via this connector, the umbilical carries power and control signals from the Laser Controller to the current modulator and monitoring signals from the current modulator to the Laser Controller.

The pin-out for this DB8 connector is shown in Table 3-12.

Table 3-12 – Current Modulator Connector Pin-out (J21)

Pin	Signal	Function
1	Current pulse trigger output	0-5V output to current modulator. When this signal is high (5V), the current modulator produces a current with amplitude set by pin 2. Low (0V) output, no current.
2	Current amplitude control output	0-5V output to current modulator sets current modulator's output current level. 5 V=100 A.
3	Current monitor input	0-5 V input from current modulator signal represents diode current. 5 V=100 A.
4	+24 VDC	24 V to power internal circuitry
5	24 V return	Ground connection
6	No connection	No connection
7	Ground connection	Ground connection
8	Shield	Cable Shield

3.10.2 PDP Interface Connector Signal Lines

The interface connector (J13) on the rear panel of the Laser Controller is used to send signals to and receive signals from the System Computer via the interface cable assembly shown in GSI Lumonics dwg. ***6022226***.

In order for the laser to operate, the following signals are required on the interface connector:

- Laser On input.
- Mark Enable input.
- External Trigger input.
- External Shutter Control inputs #1 and #2.
- External Interlock input.

The following signals are output on the interface connector to the system software where they are used to display the status of the laser on the indicators of the Operator Panel:

- Laser Ready Indicator output.
- Laser On Indicator output.
- Fault Indicator output.

Laser On Input

The Laser On input true signal (0V) initiates the warm-up of the laser. With the Laser Controller and Chiller power switches on, the laser is switched on and off using this input.

Mark Enable Input

The Mark Enable input true signal (0V) is used to enable the triggering the laser; it also initiates self-calibration when the signal changes from 5V to 0V.

External Trigger Input

The External Trigger input true signal (0V) triggers the laser on the falling edge of this signal. There is an internal 4.7 K pull-up resistor to 5V.

External Shutter Control Inputs

The External Shutter Control inputs #1 and #2 are connected to the marking chamber trap door switch so that the beam shutter can be opened and closed according to the position of the door. When both inputs are energized (that is, connected to 24 VDC), the beam shutter can be opened and closed by either the Laser Controller or by the External Interlock input. When the inputs are de-energized (that is, no connection), the beam shutter is always closed.

This Laser Controller can open and close the beam shutter on the Laser assembly without disturbing the operation of the laser or issuing software faults. If, however, the beam shutter is told to close and shutter switches SW2 and SW3 do not detect that the shutter is fully closed, then a Shutter

Failed-Open Interlock is issued to the system software, and the laser stops operating.

NOTE: The shutter can also be controlled by issuing a command via the RS232 communications connector, using command WV.

External Interlock Input

The External Interlock input connects the switch for the laser enclosure cover to the safety interlock circuit. When the switch is closed:

- There is no interlock condition.
- The External Shutter Control input and the Laser Controller can control the beam shutter and the laser diode power supply relay.
- The laser can emit a beam.

When the switch opens:

- The beam shutter is closed.
- The laser diode module's power source is disconnected.
- An External Interlock fault is issued.
- The laser cannot emit a beam.

Laser Ready Indicator Output

The Laser Ready Indicator output is an open collector output. The signal is true when the output transistor is conducting to ground. This output indicates that the Chiller is warmed up, and the laser is warmed up and ready for operation. The output is not true during power-off, warm-up or when the laser is self-calibrating.

> ⚠ **CAUTION**
>
> **Laser On Indicator Output**
>
> The laser fires during warm-up and self-calibration when this output is not true.

Laser On Indicator Output

The Laser On Indicator output is a switched 24 VDC output. This output indicates that the laser diode power supply could be powered on and a hazard exists (that is, the laser could fire) when the signal level is 24 VDC. This output is used as an emission indicator on the Operator Panel.

Fault Indicator Output

The Fault Indicator output is an open collector output. The signal is true when the output transistor is conducting to ground, indicating that an interlock or fault condition exists.

3.10.3 Rear Panel Monitoring Points

Four monitoring points are located on the rear panel of the Laser Controller, as indicated in Table 3-13.

Table 3-13 – Rear Panel Monitoring Points

Designator	Connector Type	Name
J22	BNC	Sync monitor output
J23	BNC	Current monitor output
J24	BNC	Energy monitor output
J25	BNC	Digital-to-analog (DAC) output

Sync Monitor Output (J22)

Connector J22 is a sync monitor output that is a replica of the Q-switch trigger. When the Q-switch is in the transmitting state, the signal level goes high. A typical output is shown in Figure 3-17. The lower trace shows the sync monitor output at approximately 3 μs before laser output. The upper trace shows the signal on the energy monitor output (J24).

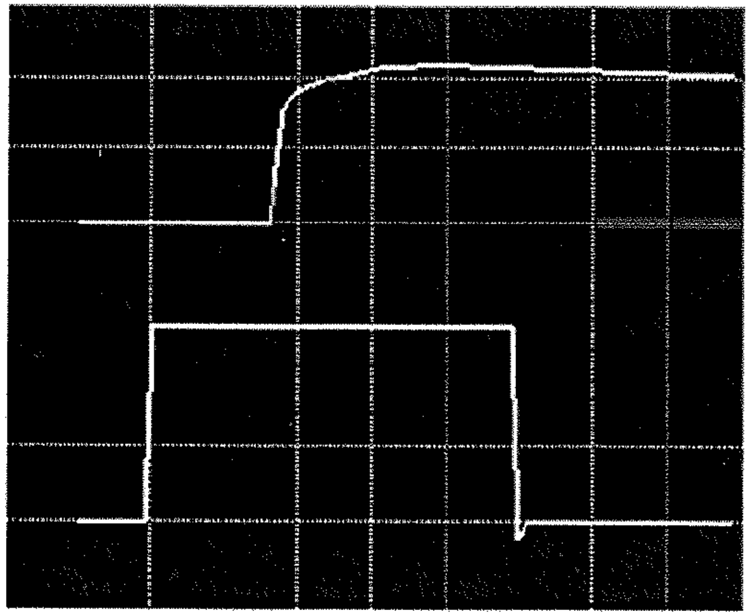


Figure 3-17 – Sync Monitor Output

Current Monitor Output (J23)

Connector J23 is a current monitor output. It produces a 0 to 5V signal that represents the current to the laser diode module. A typical (61 A, 200 μs) profile of the principle pulse is shown in Figure 3-18. See also Figure 3-21.

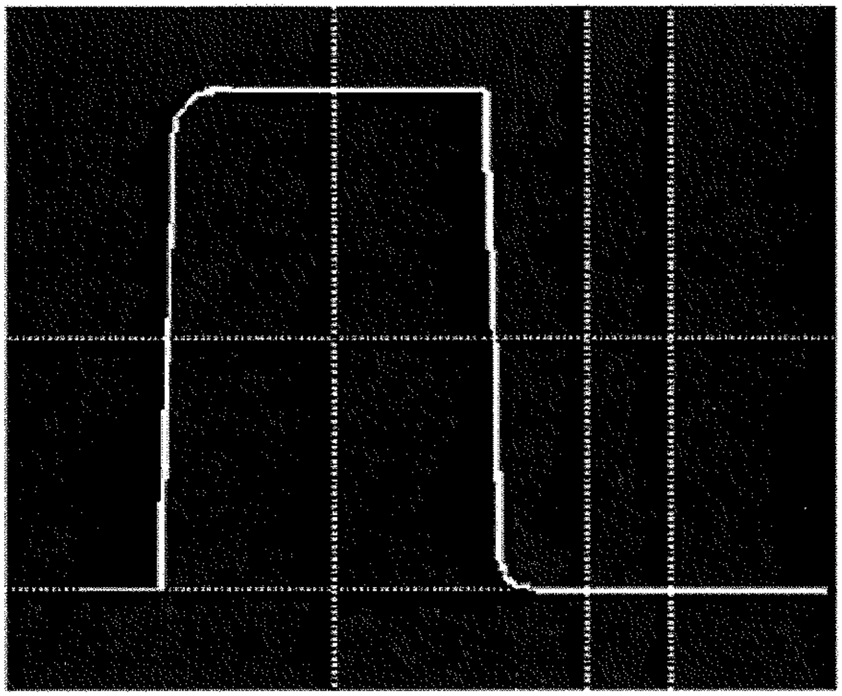


Figure 3-18 – Current Monitor Output

Energy Monitor Output (J24)

Connector J24 is an energy monitor output that indicates the laser pulse energy. Figure 3-19 shows a typical pulse shape for a fixed-Q energy pulse (when the Q-switch is in a transmitting state during the pumping pulse). Note the jagged leading edge of the pulse, indicating relaxation oscillations of the optical pulse. Also note the lengthened pulse rise time of about 150 μs (50 μs per division time base). Figure 3-20 shows a typical pulse shape for a Q-switched energy pulse (when the Q-switch is in a transmitting state after the pumping pulse). Note the sharp rise time (10 μs per division time base).

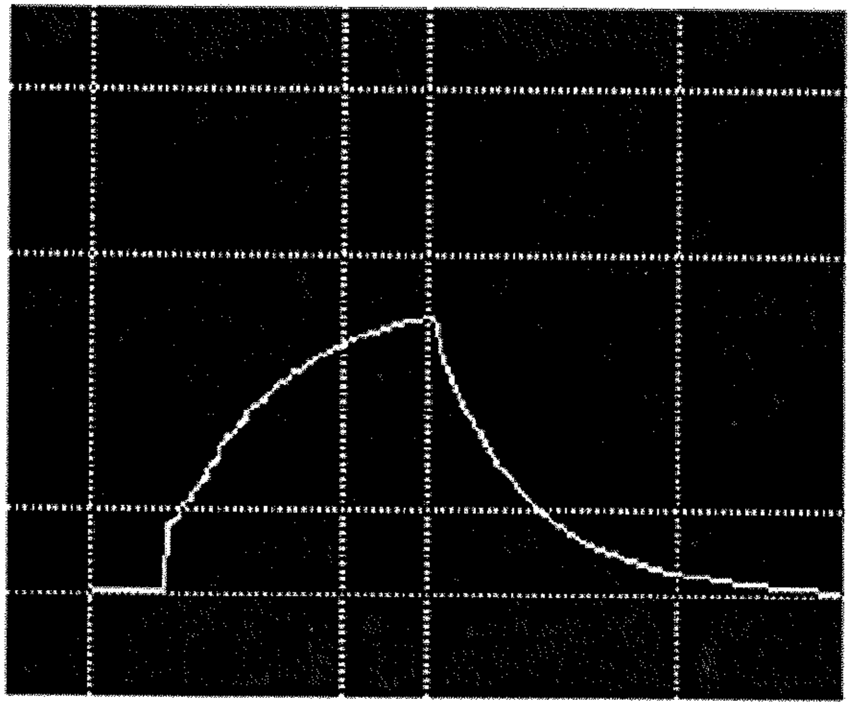


Figure 3-19 – Energy Monitor Output—Fixed-Q

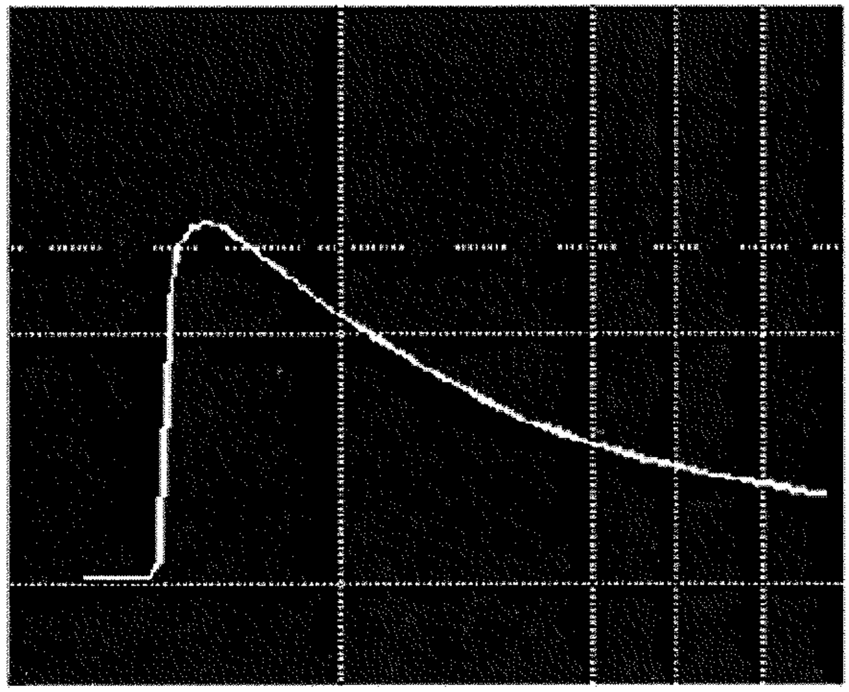


Figure 3-20 – Energy Monitor Output—Q-Switched

Figure 3-21 shows the typical relation between the energy monitor output (upper trace) and the current monitor output (lower trace) for a typical Q-switched energy pulse. In the current monitor output trace, notice the tall principle pumping pulse and the short bias current pulse.

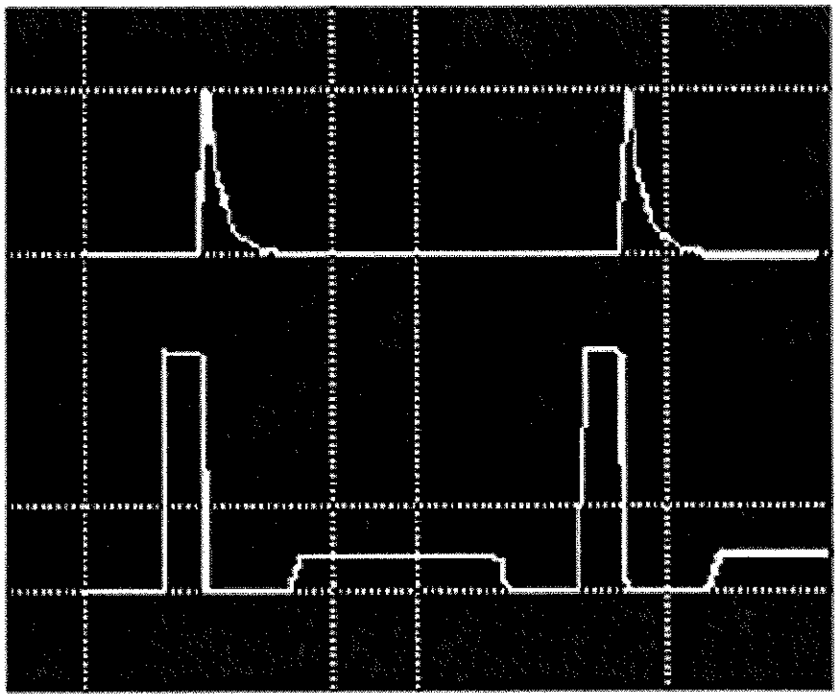


Figure 3-21 – Energy Monitor and Current Monitor Output

DAC Output (J25)

Connector J25 is a digital-to-analog converter (DAC) output that shows digitized energy pulses. The digitized pulses have been amplified and an offset has been subtracted to give a real-time indication of pulse-to-pulse energy stability. The output is not calibrated.

Figure 3-22 shows the typical relationship between the energy monitor output (upper trace) and the DAC output (lower trace) for a typical Q-switched energy pulse.

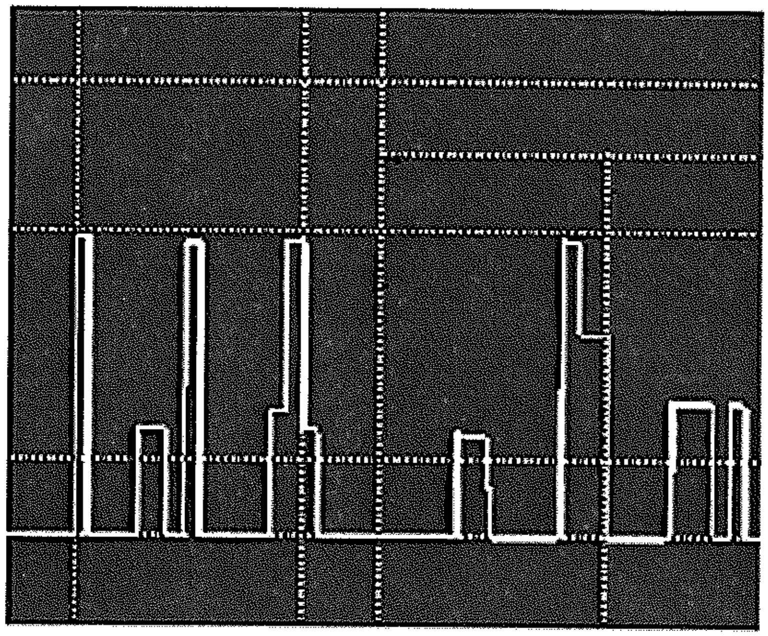


Figure 3-22 – Energy Monitor and DAC Outputs

3.10.4 Fuse

The main power fuse (F1) for the Laser Controller is located at the top right corner of the rear panel, beside the fan. It is rated at 6 A, slow-blow.

3.10.5 Fan

The Laser Controller cooling fan exhausts out the rear of the cabinet whenever the power switch is on and power is supplied to the unit. The air intake is on the right side of the unit, and should not be obstructed.

3.10.6 Power Switch

The power switch for the Laser Controller is located on the front of the unit. It should be left on at all times. The microprocessor on the Control PCB controls power to all other parts of the laser.

3.11 Laser Controller Software

The software resides in a flash memory on the Control PCB. A single microprocessor performs the following functions:

- Controls the calibration and timing of laser pulses.
- Monitors safety interlocks
- Issues information and warnings as required.
- Responds to user commands.
- Controls the temperature of the Laser assembly
- Records information about the performance of the laser (data logging).

4 System Installation

This section provides information for installing and testing the WaferMark® SigmaDSC NT system.

4.1 Introduction

The WaferMark® SigmaDSC NT System System can be installed as an island or optionally as a bulkhead-mounted unit, with access to the rear and side.

> ⚠ **WARNING**
> **HIGH VOLTAGE CAN CAUSE SEVERE INJURY OR DEATH.**
> ***Use extreme care during installation and functional testing to avoid possible exposure to high voltages that exist when the system is powered on.***

4.1.1 Installation Sequence

System installation is performed in the following sequence:

1. Unload the system units from the shipping pallet.
2. Unpack system units and inspect for shipping damage.
3. Clean system before moving to clean room environment.
4. Move the system to the installation area.
5. Connect power and exhaust services.
6. Pre-power on check.
7. Power on the system.
8. Fill the cooling system with steam-distilled water.
9. Prime the cooling system.
10. Connect any end user interface connections.
11. Perform system start-up and initialization.
12. Test end user connections and perform system functional check.

⚠ CAUTION
Potential Damage to Equipment

Only GSI Lumonics service personnel or a service technician trained and certified by GSI Lumonics to do so should install the system. If necessary after initial installation to relocate your system, to avoid damage to equipment, contact your nearest GSI Lumonics Regional Customer Center (Customer Support Contact Addresses) for assistance in preparing and repositioning the system.

The customer personnel may perform the procedures given in Sections 4.9.1 through 4.9.6 of the installation sequence without the assistance of a GSI Lumonics trained and certified service technician. All installation procedures, beginning with Section 4.9.7 through Section 4.9.12, ***MUST*** only be performed by, or in the presence of a service technician trained and certified by GSI Lumonics to perform these procedures; otherwise, any warranties may be voided.

4.2 Installation Requirements

The environmental, power, and service requirements for the installation and operation of the WaferMark® SigmaDSC NT System are specified in this section.

⚠ WARNING
Potential Laser Hazard

When servicing the laser area of the system, if the laser is powered on, there is potential exposure to Class 4 Laser radiation. This radiation can cause severe eye damage and/or burns to skin. Avoid eye or skin exposure to the laser beam. All persons within the Nominal Ocular Hazard Distance (850 meters; 2,789 feet) must wear appropriate protective eyewear during laser servicing unless otherwise protected by a laser-proof barrier.

All system users must be aware of safety precautions detailed in Chapter 1 of this manual (Safety).

For further information, contact your nearest GSI Lumonics Regional Customer Center (Customer Support Contact Addresses).

4.2.1 System Outline Dimensions

The WaferMark® SigmaDSC NT System outline dimensions for installation and for access clearance are shown in Figure 4-1 through Figure 4-4.

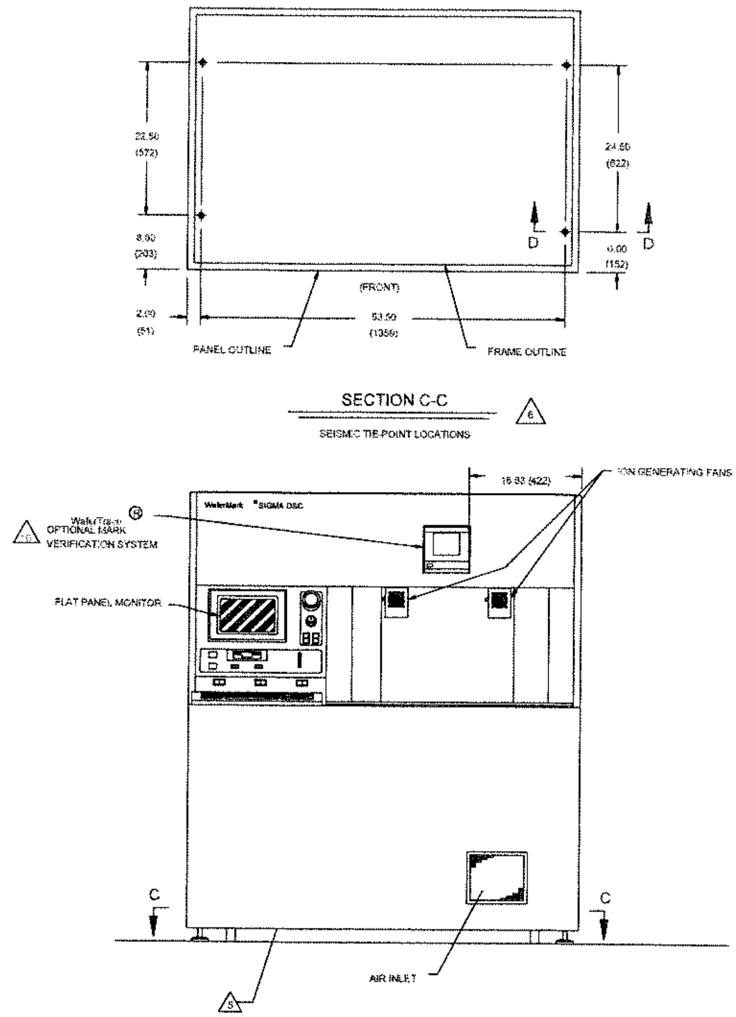


Figure 4-1 – Handler/Control Marker Installation Footprint Dimensions — Front View

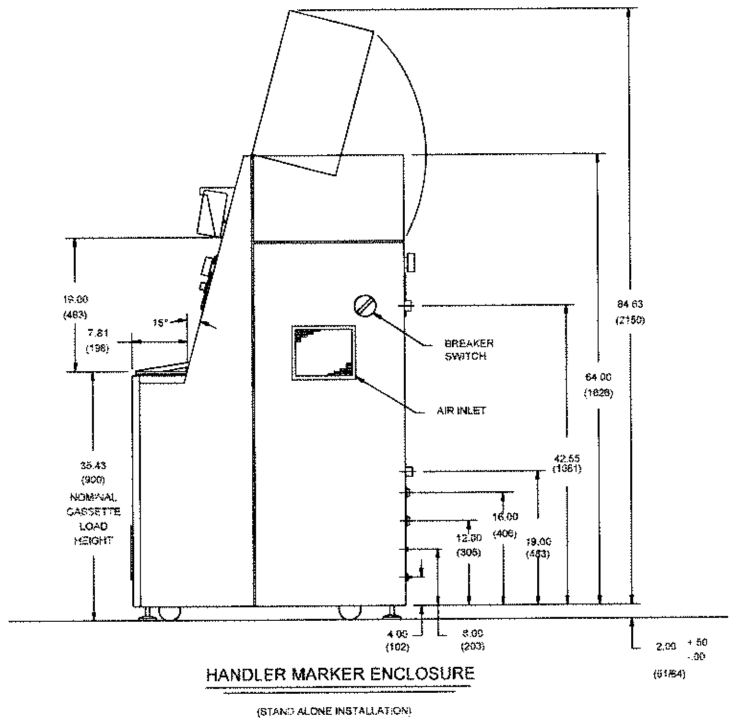


Figure 4-2 – Handler/Control Marker Installation Footprint Dimensions — Side View

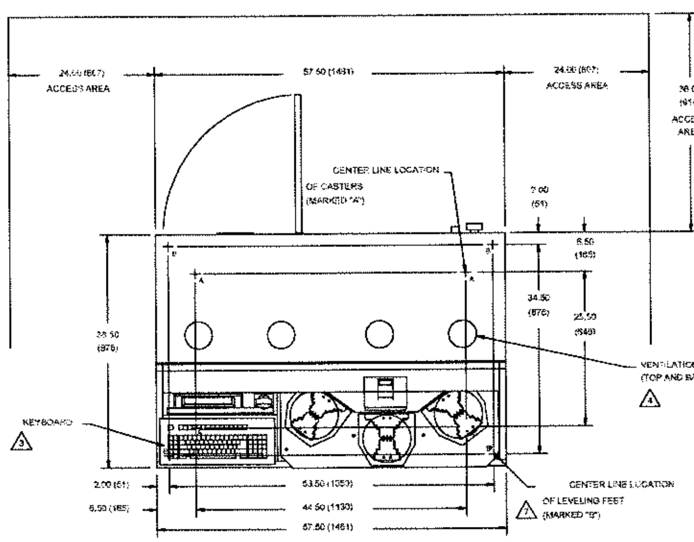


Figure 4-3 – Handler/Control Marker Top View Dimensions Including Access Area

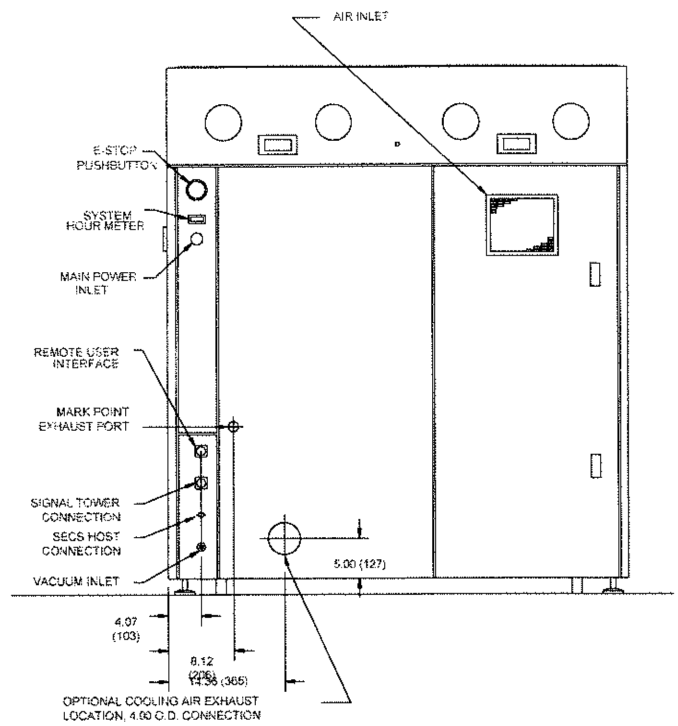


Figure 4-4 – Rear of System – Outline Dimensions

4.2.2 Service Clearance

For ease of maintenance, provide a service clearance of 610 mm (24 inches) to each side (see Figure 4-3) and 914 mm (36 inches) above and behind the WaferMark® SigmaDSC NT System.

4.2.3 Environment Requirements

Operation, Shipping and Storage Ambient Temperature and Humidity (relative): See Section 2.1.4.

4.2.4 System Weight

The WaferMark® SigmaDSC NT System weighs 646 kg (1425 lb). Ensure that the installation site can adequately support the system.

4.2.5 Power Requirements

The power requirements of the WaferMark® SigmaDSC NT System are specified as follows:

Electrical

See Section 2.1.1 for WaferMark® SigmaDSC NT System electrical requirements.

The customer-supplied power cable is installed during system installation at the customer site.

Service

3-wire connection (line, neutral, and earth)

Customer Service

45 Amp rating for 208 / 220 / 240 VAC electrical service

Circuit Breaker

30 Amp rating for 380 / 416 VAC electrical service

4.2.6 Service Requirements

The WaferMark® SigmaDSC NT cooling system, vacuum and exhaust requirements are:

Coolant Capacity

4.0 liters (1.0 U.S. gallon) (as a mix of 5 – 10% Isopropyl Alcohol with 95 – 90% steam-distilled water).

NOTE: Sodium-free steam-distilled water can usually be purchased locally. Recommended stocking: 8 liters (2 gallons), for reserve use.

Vacuum

For vacuum requirements, refer to Section 2.1.1.

Exhaust

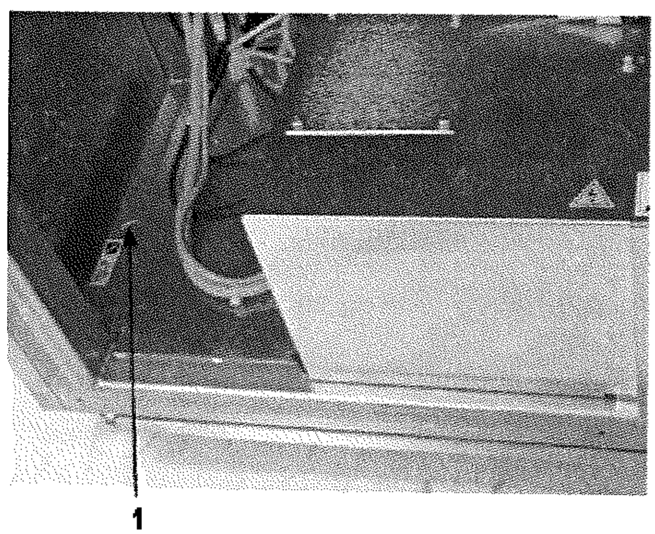
For exhaust requirements, refer to Section 2.1.1.

4.3 Seismic Tie-Downs

For WaferMark® SigmaDSC NT System installation at a location having possible seismic activity, optional tie-down fixtures are provided for anchoring the system frame to the work area floor.

The seismic tie-down angle brackets are installed after system installation by attaching and securing each bracket onto a tie-down location on the system frame using two mounting screws and then securing the two mounting screws through the bracket foot into pre-drilled holes in the work area floor.

The seismic tie-down points are near each corner of the frame on the WaferMark® SigmaDSC NT System. A sample tie-down point is shown in Figure 4-5.



1 Tiedown Point

Figure 4-5 – Sample Tie-Down Point

4.4 System Configuration

WaferMark® SigmaDSC NT System components are shipped in a wooden pallet-crate. The main power cable needed to connect the system to the facility power service is not included.

Additional items such as documentation, specific tools and parts needed for installation are included in an Accessories Box which is included in the system shipment. Spares and tool kits, if ordered, may be included in the Accessories box, but are listed separately on the accompanying shipping list.

4.5 Service Tools and Test Equipment

The following tools and test equipment may be required for the installation and functional testing of the WaferMark® SigmaDSC NT System:

Test Equipment:

Digital Voltage Meter (DVM)

Tools:

Flat Head Screwdriver

Phillips Head Screwdriver

Hex key Set, Inches

Hex key Set, Metric

Adjustable Wrench, SAE, Medium

Adjustable Wrench, SAE, Large

Socket Wrench Set, SAE, Standard

Bubble Level

Pry Bar/Large Screwdriver

Interlock Defeat Flags (3), GSI Lumonics Part No. 6160001 (provided in system accessories box)

In addition to the above items, other tools or test equipment may be required for adjustment, calibration or failure analysis. Where required, these tools are specified.

Additional Equipment:

A Step Platform or similar small portable platform is recommended as an aid to raising the cover of the laser enclosure to a full open position, and for performing maintenance and service of the laser or alignment of the optics.

4.6 End-User Responsibility

The end-user is responsible for providing input power cabling and exhaust to the system in accordance with the specifications provided in this document. The end-user will ensure that the operating space and environment meet the required parameters, and that equipment is positioned with sufficient clearance to permit maintenance access as recommended by the guidelines

Specifications and details of user connections for remote powering and laser interlock control are specified later in this chapter. Where the end-user provides installed wiring for any remote devices, the remote wiring connection to the system and the functional testing of these devices will be performed by the engineer during system installation.

4.7 Supporting Documentation

The following documents contain operational procedures or detailed technical information about specific WaferMark® SigmaDSC NT system components.

SUBJECT	DOCUMENT
System Operation	WaferMark® SigmaDSC NT Operator Reference Manual, (P/N 273.508.00)
System Computer	Pentium processor PC with multibus architecture
Operating System	Windows NT® Version 4.0, Reference Manual Microsoft.
Configuration	MANUAL MAT486 TECHNICAL P/N 6192007
Input/Output	PC CARD, 8 PORT, PCI BUS, SERIAL ADAPTER P/N2016160
Wafer Handling System	
Aligner	Wafer Pre-Aligner Operations Manual (provided by applicable manufacturer of Aligner)
Robot	The Operation and Service Documentation Manual provided with the robot installed

4.8 Shipping Configuration

System components are shipped on a single pallet, blocked, banded, wrapped in plastic, and crated for shipment outside the United States. The main power cable needed to connect the system to the facility power service is not included.

Additional items such as documentation, certain tools, and parts needed for installation are included in an Accessories box that is included in the system shipment. Spares and tool kits, if ordered, may be included in the Accessories box but are listed separately on the accompanying shipping list.

4.9 Installation Procedure

System installation is performed in the following sequence:

1. Unload the system units from the shipping pallet.
2. Unpack system units and inspect for shipping damage.
3. Clean system before moving to cleanroom environment.
4. Move the system to the installation area.
5. Connect power and exhaust services.
6. Pre-power on check.
7. Power on the system.
8. Fill the cooling system with a mix of 5 – 10% Isopropyl Alcohol with 95 – 90% steam-distilled water.
9. Prime the cooling system.
10. Connect any end user interface connections.
11. Perform system start-up and initialization.
12. Test end user connections and perform system functional check.

Normally, GSI Lumonics Field Service personnel perform system installation. End-users who need to relocate the system at a future date should contact the nearest GSI Lumonics Regional Customer Center (at the address shown at the beginning of this manual) for further assistance in preparing the system for repositioning.

The customer-supplied power cable will be installed during system installation at the customer site.

The customer personnel can perform the procedures given in Sections 4.9.1 through 4.9.6 of the installation sequence without the assistance of a GSI Lumonics service technician. All procedures following (and including) Section 3.10 MUST only be performed by, or in the presence of the service technician. Installation of the system beyond that outlined in Section 4.9.6 without the presence of a service technician may void any warranties.

4.9.1 Unload the System

Using a forklift truck, move the shipping pallet from the temporary storage area to the unpacking and cleaning area. Allow sufficient space for unpacking and preparation.

> ⚠ **CAUTION**
>
> **IMPROPER HANDLING CAN CAUSE SERIOUS BODILY INJURY AND/OR DAMAGE TO THE EQUIPMENT**
>
> ***The total weight of the WaferMark® SigmaDSC NT system is approximately 637 kg (1405 lb). To avoid injury to personnel and/or damage to the equipment, use extreme caution when positioning the unit in place.***

4.9.2 Unpack the System

Remove the System from its shipping crate, as follows:

1. Remove the lag bolts that are located along the bottom edge of the crate.
2. Use a pry tool to remove door clips.
3. Pull off the crate door.

> ⚠ **WARNING**
>
> **Danger of Lifting Injury**
>
> The shipping crate has large panels. Use two people to handle any panels.

4. Slide the crate away from the base.
5. Remove the tape from the plastic skirt around the base perimeter boards. Pull down the skirt.
6. Remove the bolts from the front base board; remove the board.

7. Remove the mounting brackets.
8. Carefully move a forklift underneath the system.
9. Move the system away from the base or slide the base away from under the system.
10. Lower the system to the floor and remove the forklift.
11. Rolling it on its castors, move the system to the preinstallation area.

4.9.3 Unpack and Inspect the System

Perform the following steps to remove packing material and shipping brackets from the System:

1. Remove external plastic wrapping material from the shipping pallet.
2. Unpack the System as follows:
   a. Cut and remove shipping bands.
   b. Remove all plastic covering.
   c. Visually inspect the System for shipping damage. If damage is present, immediately contact both the shipper and GSI Lumonics.

4.9.4 Unpack the Accessories Box

Unpack the Accessories Box and check the contents against the shipping list. Additional spare parts ordered on the Sales Order will be included in the Accessories box and will also be listed separately on the shipping list.

4.9.5 Wipe Down the System

1. Using a forklift, carefully lift the System from the shipping pallet and move the unit to the area set aside for cleaning.
2. Wipe clean the exterior of the WaferMark® SigmaDSC NT System units.

IMPORTANT

It is the responsibility of the end-user to ensure that the equipment is properly prepared before installation in the cleanroom environment. Typically, this process includes progressive wipe-downs of the exterior panels of the equipment using standard facility procedures. GSI Lumonics makes no recommendation as to the type, quantity, use, or control of any solvent(s) used in wiping down the exterior of the WaferMark® SigmaDSC NT system. In this respect, it is assumed that the facility will employ standard industry practices that comply with the necessary administrative controls and regulations.

4.9.6 Position Units at Installation Area

⚠ CAUTION

IMPROPER HANDLING CAN CAUSE SERIOUS BODILY INJURY AND/OR DAMAGE TO THE EQUIPMENT

The total weight of the WaferMark® SigmaDSC NT system is approximately 646 kg (1425 lb). To avoid injury to personnel and/or damage to the equipment, use extreme caution when positioning the unit.

Position the units as follows:

1. Using a forklift, carefully move the System from the cleaning area to the installation area.
2. Place the unit in the desired operating position.
3. Place a bubble level on the robot table. Using a wrench, adjust the leveling feet of the unit until the bubble indicates that the unit is perfectly level.

NOTE: Individual components such as the laser, presenter platforms, robot and marking chamber are factory-leveled and do not require individual leveling.

4.9.7 Connect Power and Service Utilities

⚠ WARNING

HIGH VOLTAGE CAN CAUSE SEVERE INJURY OR DEATH

The power cable between the WaferMark® SigmaDSC NT system and the wall-mounted, main disconnect circuit breaker will be connected by the facility maintenance engineer. Verify that this circuit breaker is turned off and locked out before proceeding. This prevents the possibility of the power being accidentally switched on. Ensure that a warning notice similar to that shown in Figure 4-6 is attached to the circuit breaker to indicate that work is in progress.

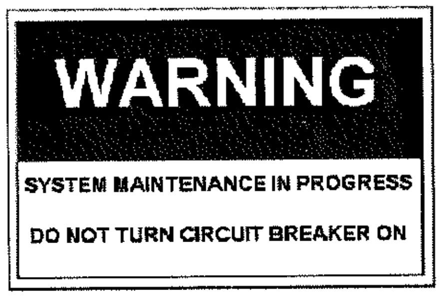


Figure 4-6 – Sample Circuit Breaker Lockout Sign

Connect power and service utilities as follows:

1. Ensure that the system circuit breaker on the right-hand side of the cabinet, and the MASTER keyswitch on the Operator Panel are both set to OFF.

⚠ CAUTION

IMPORTANT PROCEDURAL NOTICE

A facility maintenance engineer must perform steps 2 through 5.

2. Thread the (customer-supplied) single phase, main power cable through the strain relief AC fitting on the rear of the cabinet and route the cable upwards to the system circuit breaker. Leave an adequate service loop for connection.

3. Connect the single phase wires to the system circuit breaker and connect the ground wire to the ground stud located inside the cabinet on the rear face, next to the cable entry point.
4. Tighten the AC strain relief fitting on the rear panel of the cabinet until the internal rubber gland tightens to the point where the cable cannot be pulled from the cabinet.
5. Connect the opposite-end of the main power cable to the wall-mounted, main disconnect circuit breaker. Connect the ground wire to the local grounding terminal.

> **⚠ CAUTION**
> **Important Procedural Notice**
>
> The designated installation engineer must perform the remaining steps, beginning at step 6.

6. Note the input voltage that is indicated on the Manufacturing label at the cabinet's rear left corner.

1 Manufacturing label

Figure 4-7 – Manufacturing Label

7. Measure the voltage at the input to the wall-mounted main disconnect circuit breaker using a digital voltmeter. Verify that this voltage is the same as that indicated on the Manufacturing label affixed to the rear of the system cabinet and is within the operating tolerance given in

Section 2.1.1; if the voltage is correct, proceed to step 8. IF THE MEASURED VOLTAGE IS NOT WITHIN SPECIFICATION, CONTACT THE FACTORY.

> **⚠ CAUTION**
> **Important Procedural Notice**
>
> Before changing any tappings on the WaferMark® SigmaDSC NT main input transformer, contact your GSI Lumonics service representative for further advice. Do NOT continue with this installation until directed to do so by the factory.

8. Connect a vacuum source to the vacuum connector (0.25-inch female tubing connector) at the rear of the cabinet. Open the shut-off valve on the customer input line and verify that vacuum meter on the Power Distribution Panel is within the specifications given in Section 2.1.1.
9. If necessary, connect vacuum exhaust system to the mark-point exhaust outlet at the rear of the cabinet.

4.9.8 Pre-Power On Check

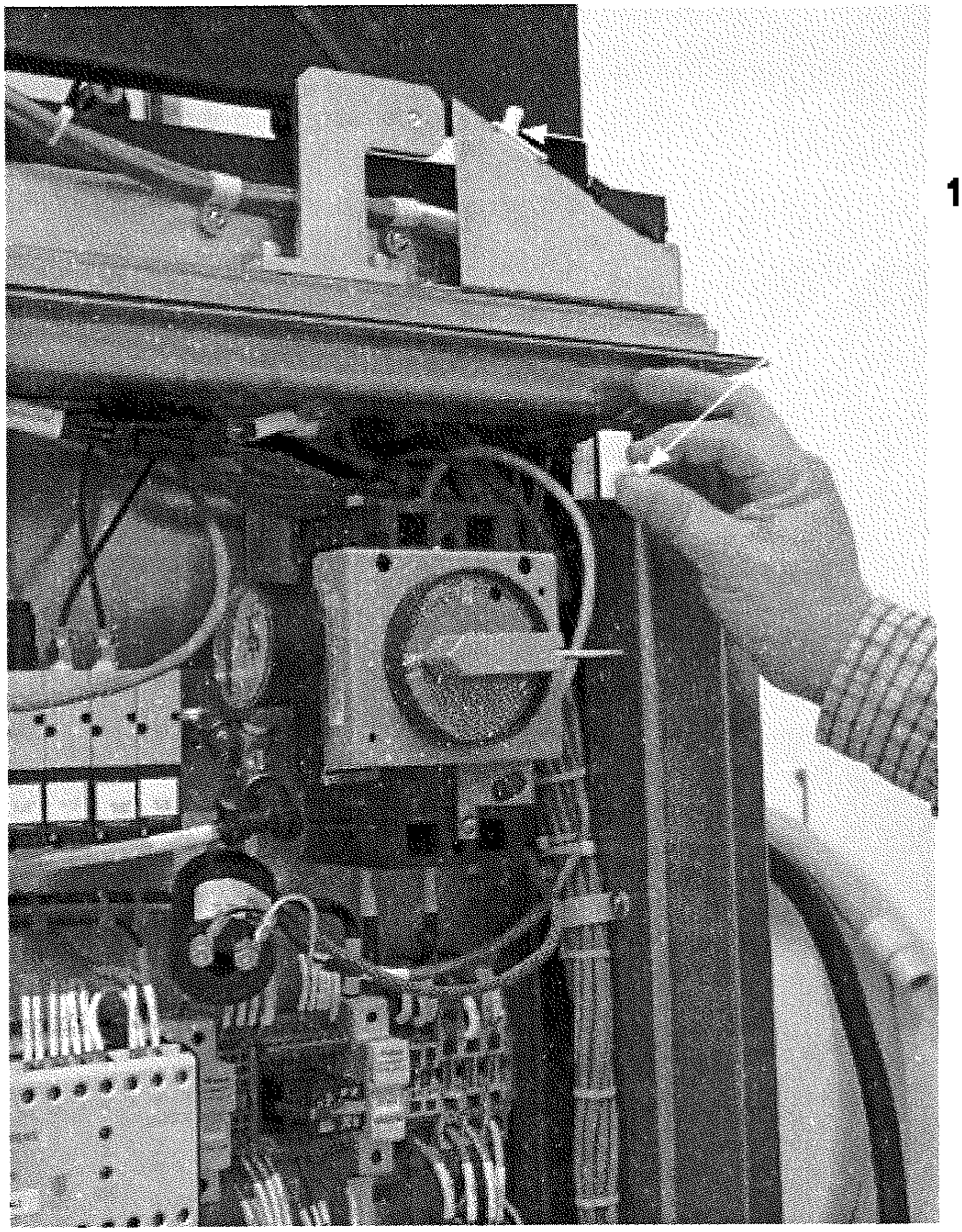
Perform the following check of the system before applying power to the system:

1. Open the right-hand access door; open the rear doors of the system and raise the cover of the laser enclosure. Inspect all cabling and verify that the cables are not unduly taut and that all cable connectors are secure.
2. Examine all fuses in the PDP to ensure that they are properly secure in their fuse holders. See GSI Lumonics drawing No. 6650133-1AD at the back of this manual for PDP parts identifications and locations.
3. Check that all cards in the system computer card rack are properly seated in their slots.
4. Check the Chiller Assembly and all hose connections throughout the cooling system for secure connections. Tighten any loose fittings.

4.9.9 Apply Power to the System

1. Verify that the MASTER keyswitch and LASER/ON/OFF switches on the Operator Panel are both set to OFF.
2. Unlock and turn on the wall-mounted main disconnect circuit breaker.

   NOTE: Power should now be available to the system circuit breaker on the right side of the WaferMark® SigmaDSC NT System.
3. Open the right-hand access door for the Power Distribution Panel.
4. Pull out the interlock switch to the Bypass position.
5. Unlatch and open the laser enclosure cover.
6. Pull out the interlock switch to the Bypass position (see Figure 4-8).



1 Interlock switches

Figure 4-8 – Interlock Switches

7. Insert two interlock defeat flags.

> **⚠ WARNING**
> **Potential Laser Hazards**
>
> Defeating the interlocks places the laser in a Class IV operating condition. Be sure to adhere to all precautions prescribed in Sections 1.3 and 1.11.3.

8. Set the system circuit breaker to ON.
9. Verify with a digital volt meter that 115 VAC single phase is available for distribution by measuring the voltage across input terminals L1 and L2 of main contactor K3 on the PDP (see Figure 2-6).
10. Turn the MASTER keyswitch on the Operator Panel to START, then release the key to the ON position. The system will now power on and the software will initialize.

4.9.10 Filling the Cooling System

The reservoir in the Chiller Assembly stores 4.0 liters (1.0 U.S. gallon) of coolant, as a mix of 5 – 10% Isopropyl Alcohol with 95 – 90% steam-distilled water.

> **⚠ WARNING**
> **FLAMMABLE—IRRITANT**
>
> Isopropyl alcohol is a colorless flammable liquid. Effects of ingestion or inhalation are nausea, intoxication, depression of the central nervous system, headache, decreased blood rate, and coma. High vapor concentrations may cause irritation of the eyes and respiratory system, and contact may cause eye injury and skin irritation. To avoid any of the harmful effects described here, observe the precautions given in Chapter 1, Section 1.7.5 (Isopropyl Alcohol (Propanol) Solvent Hazards) at all times
>
> To minimize the risk of fire from isopropyl alcohol, only the smallest quantity of fluid required for the immediate task should be brought to the area of the equipment.

To fill the primary cooling loop with the steam-distilled water and alcohol mix:

1. Open the right front lower panel of the cabinet.

2. Remove the sealing screw on the vent hole at the top of the reservoir to allow air to escape (see Figure 4-9).

1

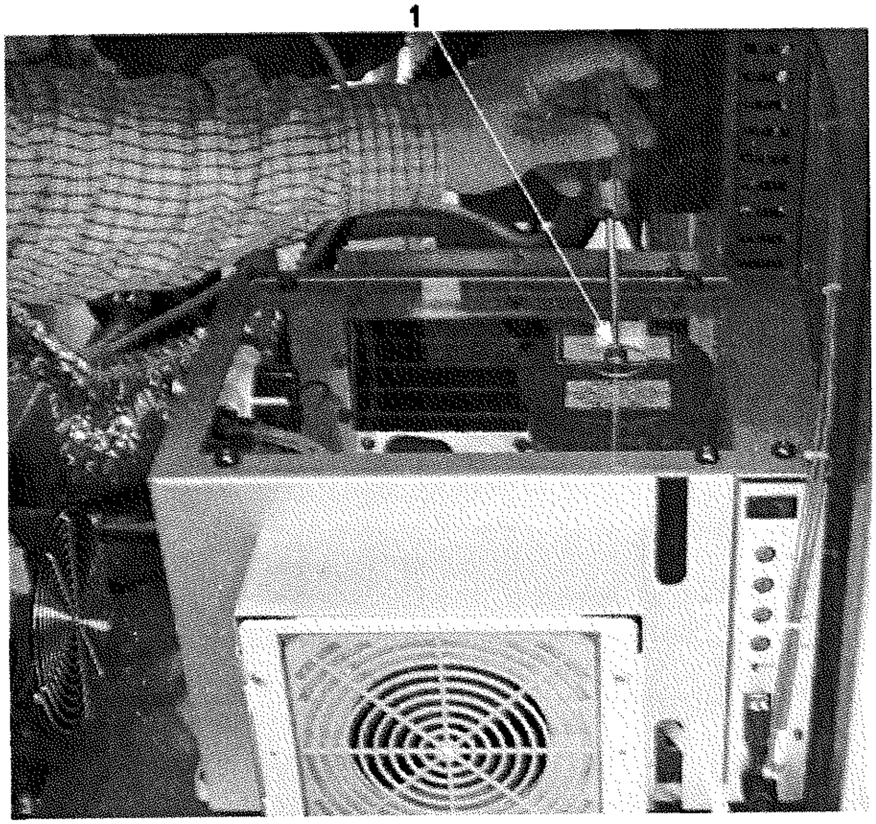


Figure 4-9 – Removing the Sealing Screw

1 Sealing screw

3. To siphon the cooling mix into the reservoir:

   a. Connect a one meter (approx. three-foot) long fill hose, such as a 1 cm (3/8–inch) TVA or Tephlon tubing, to the connection at the top of the Chiller reservoir.

   NOTE: Be sure the tubing has a male CPC shut-off fitting connected at one end.

   b. Using a large, clean syringe, fill the tubing with the coolant.

   c. Place the open end of the filled tubing in the coolant in the container (see Figure 4-10).

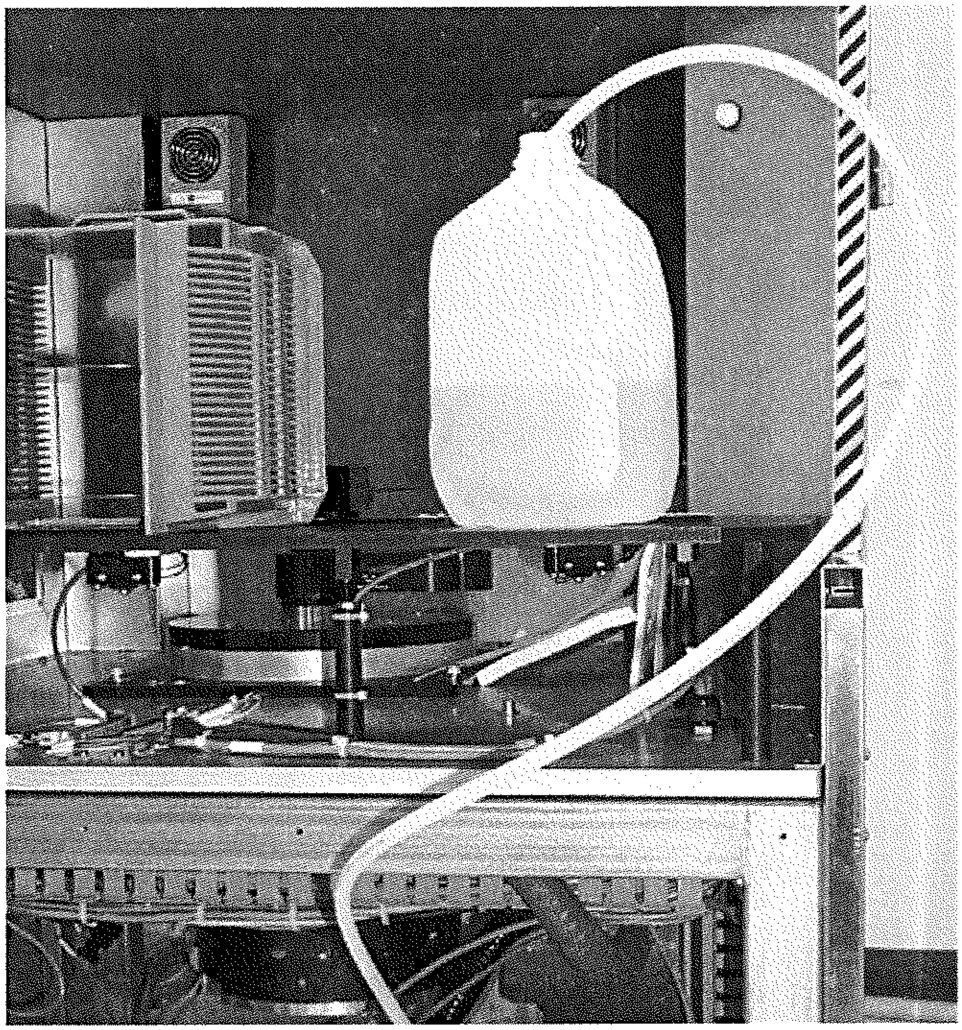


Figure 4-10 – Reservoir Fill Tube

d. Place the container of coolant mixture above the level of the reservoir to allow gravity feed to siphon the coolant into the cooling system.

CAUTION
Potential Equipment Damage
Be careful to not fill the reservoir beyond the water level.

e. Fill the reservoir until the coolant level is 1 cm (3/8–inch) below the top of the reservoir.

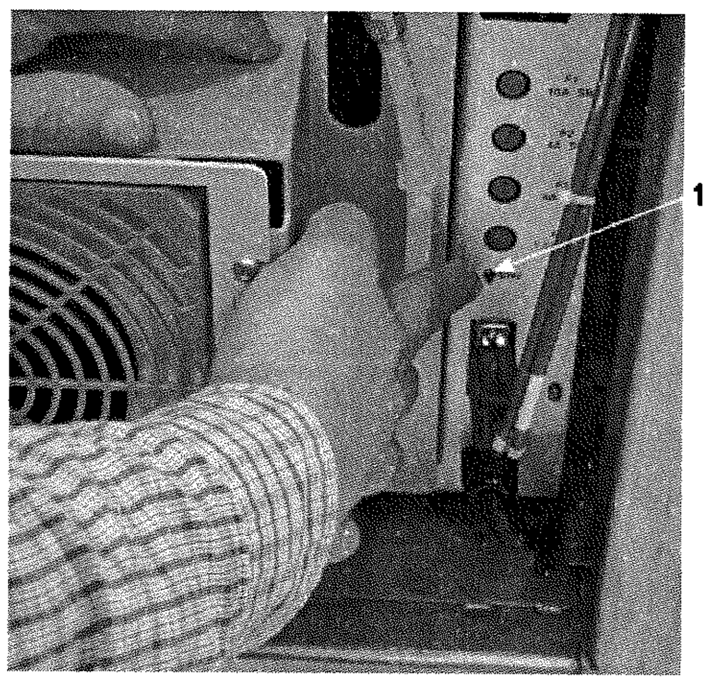
f. Disconnect the CPC fitting from the drain/fill fitting.

4.9.11 Priming the Cooling System

Prime the cooling system as follows:

1. Press and hold the primer pushbutton (SW2) on the front of the Chiller (see Figure 4-11). The Chiller pump will turn on and circulate coolant through the system.

   NOTE: If you see any leaks, stop and fix them.



1 Primer Switch SW2

Figure 4-11 – Chiller Primer Switch SW2

2. Continue holding SW2 until air bubbles are no longer visible in the tubing.

> ⚠ **CAUTION**
> **Potential Laser Energy Degradation**
> Air bubbles in the coolant degrade the laser's pulse-to-pulse energy stability. Tap the reservoir and filter after approximately one hour of running time to free up any bubbles that may form on the reservoir or filter walls.

3. As air is displaced from the coolant tubing and Laser assembly, the level of coolant in the reservoir will drop. Refill the reservoir until there is less than a 1 cm (approximately 3/8-inch) air gap at the top of the reservoir.
4. Remove the CPC fitting from the drain/fill fitting.
5. Replace the sealing screw at the top of the Chiller reservoir to avoid evaporation loss.
6. Turn the LASER switch on the Operator Panel to ON. The Chiller pump should start automatically.
7. Check all hoses and connections in the system for leaks.
   a. If you see any leaks:
      i. Turn off the laser power switch.
      ii. Perform steps 8 through 10 of this procedure.
   b. Repair the leaks.

      NOTE: If the laser leaks, try pushing the hose ends further into their fittings. If the laser still leaks, trim hose ends and push into fittings.
   c. After repairing any leaks, turn the MASTER keyswitch to ON and repeat this procedure from step 1 in order to re-prime the Chiller and top up the reservoir.
8. Terminate the WaferMark User Interface program by selecting the **File** menu, then the **Exit** command.

   NOTE: Only an Engineer can initiate this operation.
9. Turn the LASER switch to OFF.
10. Turn the MASTER keyswitch to OFF.

11. Set the system circuit breaker on the right-hand side of the System to OFF.
12. Replace all removed access panels.
13. Secure the locking screws on all doors and panels.
14. Remove the interlock defeat flags that were inserted in step 7 of Section 4.9.9.
15. Close and lock the laser enclosure cover.

4.9.12 Hook-Up End User Wiring

The optional user connections on the WaferMark® SigmaDSC NT system, described below, are:

- Remote Interlock Connection (RIC)
- Remote E-Stop
- User E-Stop.

The E-Stop/Interlock cable harness drawing No. 6022228 is shown in the Addendum of this manual.

The service technician should connect the customer wiring for each feature to the appropriate pins on the connector (P2), as shown in the drawing. (Also, refer to drawing No. 27500110 for a cable interconnect diagram of the system.)

After connecting the appropriate wiring, each feature should be tested for functionality immediately after completing the steps given in Section 4.10.2 to power down the system.

Remote Interlock Connection (RIC)

A low voltage remote interlock can be installed on any WaferMark equipment room access door. When connected to the system, this creates a Class 1 safety environment. Opening the equipment room access door breaks the interlock circuit, automatically closing the intercavity shutter to prevent further transmission of the laser beam from the Laser assembly to the marking surface.

An RIC can also be connected to equipment external to the WaferMark® SigmaDSC NT system so that an event with that equipment can break the interlock circuit, if necessary.

Remote E-Stop

A remote Emergency Stop (E-Stop) switch can be connected to the system that enables the customer to provide an emergency stop signal from a remote location to the WaferMark® SigmaDSC NT equipment. The remote E-Stop switch must be a ***normally-closed*** maintained mechanical switch. When pressed, the system is immediately powered down. Once the remote switch has been activated, power cannot be restored to the system until this switch has been returned to its original position; the keyswitch at the Operator Panel must also be momentarily placed to the START position to reset the E-Stop circuit.

User E-Stop

The user E-Stop connection is wired in series with the contacts of the E-Stop pushbuttons on the Operator Panel (see item 1 in Figure 2-8 and the rear panel of the system Figure 2-3). This wiring allows the user to connect to power control circuits in external equipment so that the equipment will halt or power down if either of the E-Stop pushbuttons is pressed on the WaferMark® SigmaDSC NT system.

The system should now be reinitialized to prepare for a basic functional test of system hardware and software features. Perform the normal start-up sequence given in Section 4.10.1.

4.10 System Power On and Off Procedures

The following procedures contain instructions for powering on the system in preparation for laser marking and powering off the system when marking is complete. Also included are instructions on how to shut down the system during an emergency.

For additional information and instructions for loading and marking jobs after powering on, please refer to the *WaferMark® SigmaDSC NT Operator Manual (P/N 273.508.00)*, provided with the system.

4.10.1 System Power On Procedure

To initialize the WaferMark® SigmaDSC NT system from a shutdown condition:

Procedure:

1. Verify that the MASTER key switch and LASER switch on the Operator Panel are both set to OFF.
2. If the system circuit breaker on the right-hand side of the system is OFF, turn it to ON and turn on any other required utilities.
3. Turn the MASTER key switch on the Operator Panel to ON, then momentarily turn to the START position. Verify that the green POWER ON indicator on the operator panel is lit.
4. Turn the LASER switch to ON. The Chiller pump starts and begins circulating the coolant to the laser.
5. Verify that the system computer is turned on.
6. Once the Windows NT Operating is booted, you must log in with administrative access.

   NOTE: It takes a few minutes for the equipment to initialize. When the software is initialized, the system start-up sequence is complete.
7. Perform marking operations using test wafers.

   *NOTE: When powering down the system, first shut down the Windows® NT program from the Windows **Start** menu.*

4.10.2 System Power Down Procedure

Power down the system using the following steps in order:

1. Terminate the WaferMark® User Interface program by selecting the **File** menu, then the **Exit** command.

   NOTE: Only an Engineer can initiate this operation.
2. Shut down the Windows NT operating system from the **Start** button.

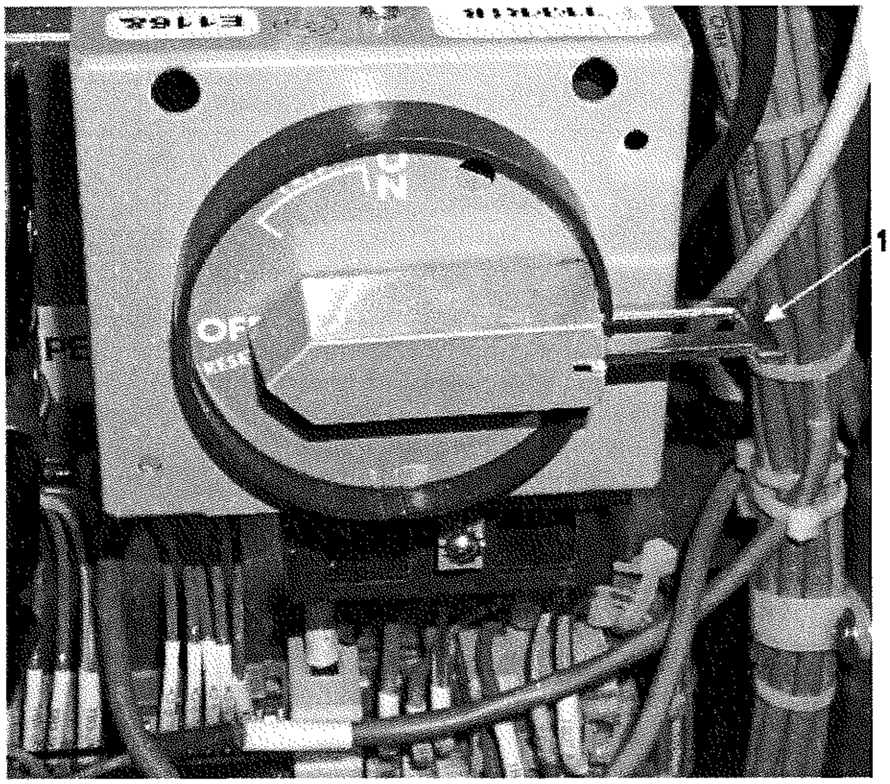
   NOTE: Whenever powering down the system, first power down the Windows NT operating system from the **Start** *button. Do NOT turn off the Windows NT computer power until* *the computer's monitor screen shows that the Windows NT shutdown is complete. Also, shut down any PC attached to the system before powering down.*

CAUTION

Risk of Damage to System Computer and the Wafer

ONLY use the E-STOP push-button to shut down the system in an EMERGENCY. Pressing the E-STOP will immediately remove all power from the system. This causes the vacuum to cease, which could result in damage to the wafer currently on the robot arm. It also causes the PC to shut down, which may result in the loss of job information or damage to software files. As a result, the Windows NT-based computer could have problems restarting. To ensure the ability to resume normal production following any emergency shutdown, BACKUP YOUR PC PROCESSING FILES AS FREQUENTLY AS YOUR FACILITY MANAGEMENT DEEMS NECESSARY. Additionally, it may be necessary to reteach the robot following an emergency shutdown.

3. On the Operator Panel, turn the LASER switch to OFF.
4. Turn the MASTER key switch to OFF. Verify that the green POWER ON indicator goes out; then, remove the key.
5. Set the system circuit breaker on the right-hand side of the System to OFF and insert a padlock to prevent the supply from being accidentally switched on (see Figure 4-12).



1 Pull out tab and insert padlock here

Figure 4-12 – Breaker Padlock Tab

6. Attach a notice to the breaker warning other personnel that maintenance is in progress (see sample notice in Figure 5-1.)

> ⚠ **CAUTION**
> **ONLY use the E-Stop pushbutton to shut down the system IN AN EMERGENCY.**
>
> Pressing the E-Stop will immediately remove all power from the system and may result in the loss of job information or damage to software files.

5 System Preventive Maintenance

This chapter contains information and guidelines for periodic system preventive maintenance.

5.1 Introduction

The WaferMark® SigmaDSC NT system requires only minimal maintenance for continuous trouble-free operation. No routine operator maintenance is required. Preventive maintenance involves periodic actions that are specified in the Preventive Maintenance Schedule (Table 5-1). Only a trained and qualified technician should perform the procedures listed here at the specified intervals, in order to prevent conditions that could lead to costly downtime. Periods of non-operation require special procedures that are also described in this chapter.

For replacement parts and order information, refer to Chapter 7.

5.2 Inspection and Preventive Maintenance Schedule

The following schedule of inspections and preventive maintenance actions is provided as a guide for these activities. The frequency of inspections and required preventive maintenance procedures will vary based upon the level of daily operation, and the installation environment. Continuous daily operation will accelerate the need for maintenance, while infrequent daily operation will lengthen the duration between maintenance actions. Bulkhead and island installations can also affect maintenance schedules.

Table 5-1 – Preventive Maintenance Schedule

Action	Procedure	Service Interval		
		3 months	6 months	12 months
General System Inspection	Section 5.3.1	X	X	X
Vacuum System Check	Section 5.3.2	X	X	X
System Safety Features Test *	Section 5.3.3	X	X	X
Filter & Coolant Replacement **	Section 5.3.4			X
Laser and Optics Inspection	Section 5.3.5			X

* *NOTE: This procedure checks that the laser and electrical safety features of the system are functioning correctly. This test is*

MANDATORY and must be carried out at the prescribed intervals, or more frequently, if required.

***NOTE: Filter and Coolant replacement will also be necessary if periods of non-operation exceed five days (refer to Section 5.3.4) and when replacement of the laser diode module becomes necessary. (The laser replacement period should be greater than bi-annually.)*

5.3 Preventive Maintenance Procedure

General system inspections are basically preventive and should therefore be thorough and performed regularly. Early recognition of minor system irregularities can prevent many major failures and costly down time. Detailed records can provide inspection-to-inspection continuity.

In any inspection or service procedure, close attention should be paid to the following system conditions:

1. Temperature

   Electrical components such as integrated circuits, and discrete components enjoy a much longer life when running cool, as opposed to operating near the system's upper temperature limit.

2. Vibration

   Vibration and movement can over a period of time, loosen both electrical and electronic components resulting in either total or intermittent failures.

⚠ WARNING

HIGH VOLTAGE CAN CAUSE SEVERE INJURY OR DEATH

Before carrying out a system inspection or preventive maintenance, ensure that the system is isolated from the main input power service by turning the system circuit breaker to the OFF position, then inserting a padlock in the metal stop to prevent the supply from being accidentally switched on.

Attach a warning notice similar to that shown in Figure 5-1 to the circuit breaker indicating that work is in progress.

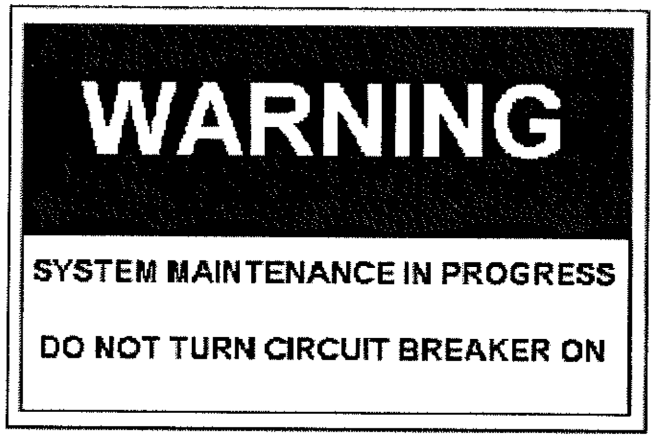


Figure 5-1 – Sample Circuit Breaker Lockout Sign

Remove power from the system by performing the following steps.

1. If the User Interface program is running, terminate the program by selecting **Exit** from the **Maintenance** menu.

   NOTE: Failure to shut down the program before powering off the system may cause data corruption or loss of job information.
2. Shut down the Windows NT operating system.

   NOTE: Any time that the system is going to be powered down, first power down the Windows NT operating system from the Start bar. DO NOT turn off the PC power until the PC screen shows that WinNT shutdown is complete.
3. Power down the system by turning the MASTER keyswitch on the Operator Panel to OFF. Remove the key.
4. On the Operator Panel, turn the LASER switch to OFF.
5. Set the system circuit breaker on the right-hand side of the System to OFF. Insert a padlock in the metal stop to prevent the supply from being accidentally switched on. Attach a warning notice similar to that shown in Figure Figure 5-1 to the circuit breaker indicating that work is in progress.

5.3.1 General System Inspection

General system inspection consists of the following tasks:

- Inspect and clean fans
- Inspect and clean PCBs
- Inspect electromechanical devices for wear

Perform an inspection and check of the following system components:

1. Fans

   Various modules within the System contain fans that provide cooling for internal components. All fans should be inspected to verify they are operating correctly and not binding in their housings. Check for excessive noise, vibration, or motor overheating. Although fans are normally self-lubricating, if the shaft does not spin freely, the fan should be replaced.

   Fans are located at the following locations:

   - Laser Controller (rear)
   - Aligner Controller (rear)
   - Robot Controller (front)
   - Chiller Heat Exchanger (one in front; two at rear)
   - System computer
   - PC filter

2. Printed Circuit Boards

   PCBs do not normally require maintenance other than keeping them clean, properly seated, and ensuring that any connectors are firmly attached.

3. Electromechanical Devices

   The robot, optional rotating presenter platforms, and safety door should be inspected for freedom of moving parts, wear, loose connections, and worn or damaged insulation, where applicable.

5.3.2 Vacuum System Check

Check that the vacuum input to the System is within specification, as follows:

1. Remove the padlock and set the system circuit breaker on the right-hand side of the system to ON.
2. Power on the system following the procedures in Section 4.10.1.

   NOTE: Power is required to activate the normally open switches on the Robot and Aligner.
3. Check and record the system vacuum at the vacuum gauge located near the support systems board. The recommended externally-supplied vacuum level is 635 to 762 mm (25 – 30 in.) Hg. Any significant variation in vacuum between inspections indicates a system vacuum leak, and a thorough inspection of all vacuum lines should be performed. Loss of vacuum can affect the operation of the robot, safety door, aligner and optional cassette presenters.

5.3.3 System Safety Features Test

It is important to periodically test the safety features of the system to ensure that the hardware devices and electrical circuits function correctly. Test the following features:

- System electrical safety switch interlocks
- E-Stop pushbuttons
- Aligner door interlock

To test the System Safety features:

1. Check the operation of the electrical interlock switches and circuits as follows:
   a. Shut down the Windows NT operating system from the **Start** button.

      NOTE: To avoid potential data loss whenever powering down the system, first power down the Windows NT operating system from the **Start** *button. Do NOT turn off* *the Windows NT computer power until the computer's monitor screen shows that the Windows NT shutdown is complete. Also, shut down any PC attached to the system before powering down.*

CAUTION

Risk of Damage to System Computer and the Wafer

ONLY use the E-STOP push-button to shut down the system in an EMERGENCY. Pressing the E-STOP will immediately remove all power from the system. This causes the vacuum to cease, which could result in damage to the wafer currently on the robot arm. It also causes the PC to shut down, which may result in the loss of job information or damage to software files. As a result, the Windows NT-based computer could have problems restarting.

To ensure the ability to resume normal production following any emergency shutdown, BACKUP YOUR PC PROCESSING FILES AS FREQUENTLY AS YOUR FACILITY MANAGEMENT DEEMS NECESSARY. Additionally, it may be necessary to reteach the robot following an emergency shutdown.

b. At the rear of the system, open the access door and set the System Computer Power Switch to Off.

CAUTION

COMPUTER MUST BE OFF!

Leave the System Computer off to avoid possible damage to its hard drive.

c. Set the LASER switch on the Operator Panel to OFF.

d. Power on the system (see steps 1 through 4 of Section 4.10.1).

e. Remove the six screws and carefully lift off the access panel on the right-hand side of the cabinet. Verify that when the panel is being removed, the system powers off.

f. Verify that the system DOES NOT power on when the MASTER keyswitch on the Operator Panel is turned to START.

g. Pull out the white interlock switch on the door frame to the BYPASS position (see Figure 4-8). Verify that the system DOES power on when the MASTER keyswitch on the Operator Panel is turned to START.

h. Power down the system by turning the keyswitch to OFF, then replace the access door using the screws removed in step e).

i. Power on the system.

j. Unlatch and raise the cover of the laser enclosure. Verify that when the cover is raised, the system powers off.

k. Verify that the system DOES NOT power on when the MASTER keyswitch on the Operator Panel is turned to START.

l. Pull out the cover's white interlock switch on the system frame to the BYPASS position. Verify that the system DOES power on when the MASTER keyswitch on the Operator Panel is turned to START.

m. Power down the system by turning the keyswitch to OFF, then close and latch the cover.

n. Power on the system and set the LASER switch to ON.

2. Check the operation of the laser enclosure safety interlocks, as follows:

   a. Follow the procedures in Section 4.10.2 to shut down the system.

   b. Unlatch and open the laser enclosure cover.

   c. Pull out the white interlock switch to the Bypass position.

   d. Install interlock defeat flags on both sides of the laser enclosure.

⚠ WARNING
Potential Laser Hazards

Defeating the interlocks places the laser in a Class IV operating condition. Be sure to adhere to all precautions prescribed in Sections 1.3 and 1.11.3.

e. Open the Marking Chamber access door, located on the left rear of the System.

f. Pull out the white interlock switch on the doorframe to the Bypass position.

g. Power on the system following the procedure in Section 4.10.1.

h. Load a test job and wafer. Set up the job parameters to produce a long mark on the test wafer. Save the job, and then start the mark.

i. While the laser is marking, pull out the interlock flag on the left-hand side of the enclosure. Verify that the laser stops lasing and the shutter closes. Reinstall the interlock flag.

j. Remove the wafer from the aligner.

k. Reset the software by selecting **Control + Reset**.

l. When the software has re-initialized and the laser is ready, reload the test job and start the mark.

m. While the laser is marking, pull out the interlock flag on the right-hand side of the enclosure. Verify that the laser stops lasing and the shutter closes.

n. Reinstall the interlock flag and repeat steps j, k, and l.

o. While the laser is marking, pull out the interlock flag on the Marking Chamber. Verify that the laser stops lasing and the shutter closes.

p. Close the Marking Chamber door and right side System door.

q. Reset the software by selecting **Control + Reset**, and then remove the wafer from the aligner.

r. Power down the system following the procedures in Section 4.10.2.

s. Remove the interlock defeat flags.

t. Close and latch the laser enclosure cover.

> ⚠ **WARNING**
> **Laser and Electrical Hazard Avoidance**
> IMMEDIATELY investigate any failure of the above tests of the electrical safety interlock or laser interlock circuits. When the problem has been corrected, this procedure must be repeated in its entirety (without error) before returning the system to normal operation.

5.3.4 Chiller Particle Filter and Coolant Replacement

The Chiller contains a particulate filter to remove any fine debris generated by the pump. Because the coolant circulates within a closed loop, the filter should last the life of the product. However, GSI Lumonics recommends that the filter and coolant be replaced annually using the following procedure.

NOTE: Before starting, read all procedural steps and notes.

The following solvent is used during maintenance of the equipment and can be injurious to health unless adequate precautions are taken:

ISOPROPYL ALCOHOL (Product Name: iso-Propyl Alcohol)

The reservoir in the system Chiller stores a 4.0 liter (1.0 U.S. gallon) mix of 5 – 10% Isopropyl Alcohol with 95 – 90% steam-distilled water.

Isopropyl Alcohol can be injurious to health unless adequate precautions are taken.

⚠ WARNING
FLAMMABLE—IRRITANT

Isopropyl Alcohol is a colorless flammable liquid. Effects of ingestion or inhalation are nausea, intoxication, depression of the central nervous system, headache, decreased blood rate, and coma. High vapor concentrations may cause irritation of the eyes and respiratory system, and contact may cause eye injury and skin irritation.

Isopropyl Alcohol is a dangerous and explosive hazard. Vapor can travel distances to an ignition source and flash back. The following precautions should be observed at all times:

To avoid any of the harmful effects described here, observe the precautions given in the following Sections.

- Keep container tightly closed.
- Keep away from sources of ignition.
- Avoid breathing the vapor and contact with eyes.
- Do not smoke in the vicinity of the solvent or vapor.

For spills, observe the following precautions:

- Evacuate the area of all unnecessary personnel.
- If the workplace exposure limit is exceeded, wear protective equipment. A NIOSH/MSHA approved air-supplied respirator and protective gloves (Butyl rubber, PVC or equivalent is recommended) should be worn to prevent skin contact.
- Safety glasses with side shields must be worn at all times.
- Eliminate any ignition sources until the area is free from explosion or fire hazard.
- Ventilate the area in which the spill or leak occurred.
- Do not smoke.
- Electrically ground all equipment when handling this product.
- Contain the leak and eliminate its source, if this can be done without risk.

- Take up the spilled liquid with absorbent material (EM SCIENCE Spill-X is recommended) and place it in sealed containers for disposal.

Waste Disposal Considerations:

Material that has been contaminated with Isopropyl Alcohol from spills or leakage is considered hazardous waste. It is the responsibility of the end user to ensure that the waste material is treated and/or disposed of at a site authorized to handle hazardous chemical waste. Disposal must be in accordance with 40 CFR 262. A permitted waste disposer should be contacted before discharging, treating or disposing of waste material to assure compliance with all current local, state and federal regulations.

First aid procedures for inhalation call for removal to fresh air, and artificial respiration if breathing has stopped. For eye contact, flush thoroughly with water for at least 15 minutes. For skin contact, wash thoroughly with soap and water. For ingestion, give water and induce vomiting. For all cases of overexposure, call for medical assistance immediately.

Further information on the hazards, handling and storage, first-aid procedures, and accidental release measures associated with the use of isopropyl alcohol can be obtained from the following source:

EM Science, 480 S. Democrat Road, Gibbstown, New Jersey 08027 Tel: 1-800-222-0342 (Ext. 7515 - Queue) or (856) 423-6300.

For 24-hour emergency assistance, call CHEMTREC at 1-800-424-9300 or (703) 527-3887 (international).

To replace the Chiller particle filter and coolant, proceed as follows:

1. Power off the system following the steps in Section 4.10.2, System Shutdown Procedure.
2. Remove the sealing screw on the vent hole at the top of the reservoir to allow air to escape (see Figure 5-2).

1

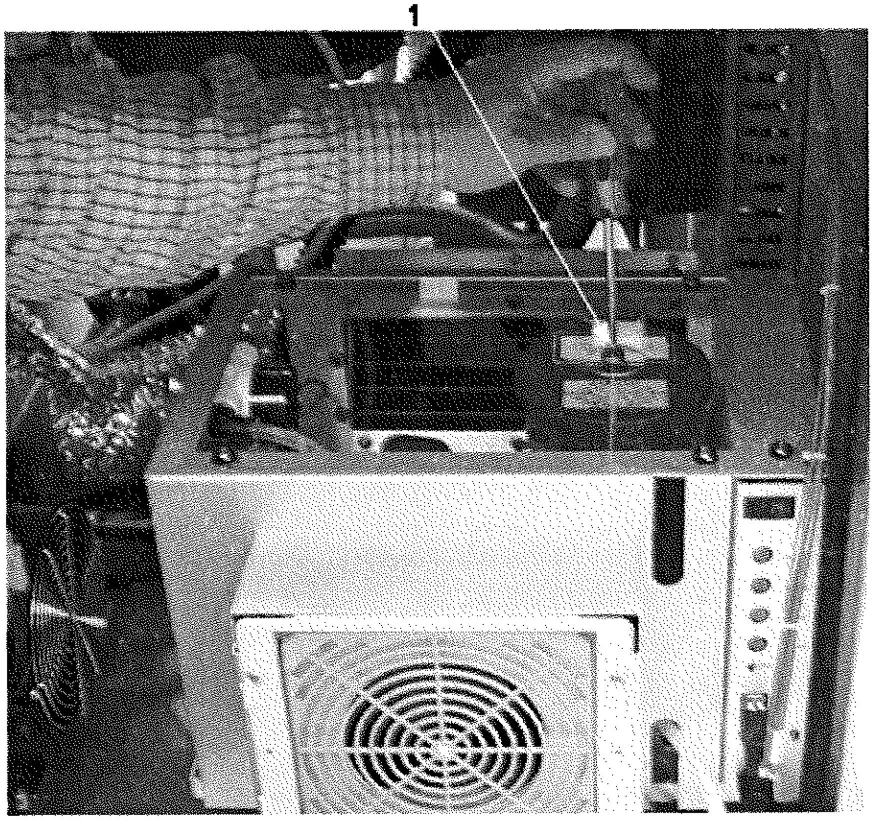
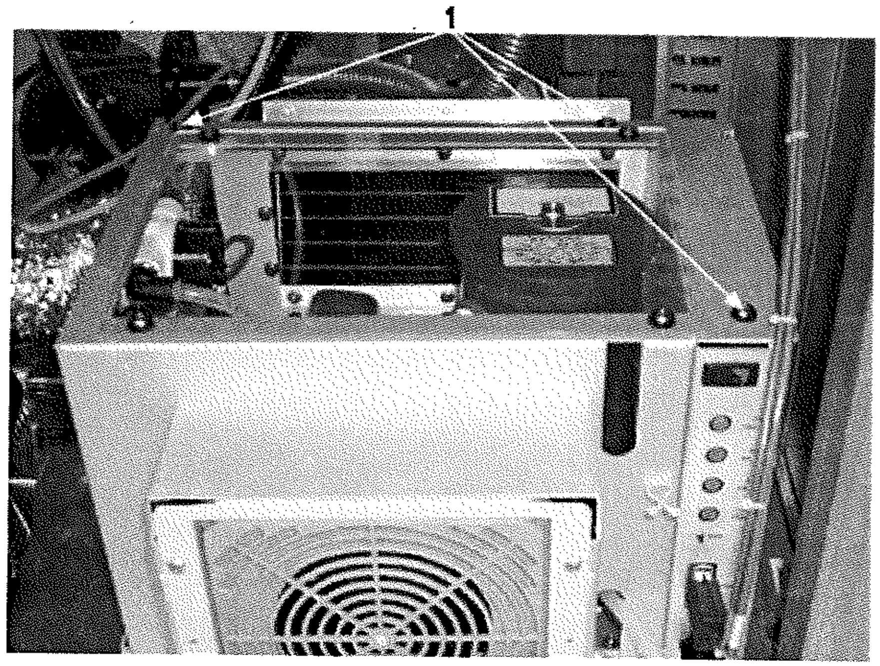


Figure 5-2 – Removing the Sealing Screw

1 Sealing screw

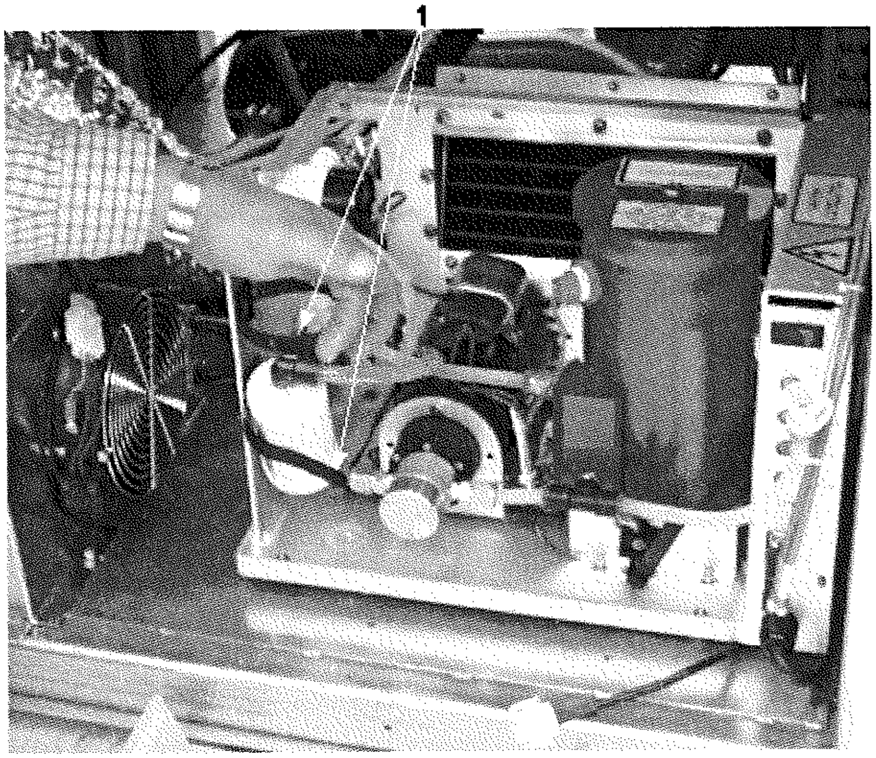
3. Drain the coolant by connecting tubing from the drain/fill fitting to the drain reservoir. Position the drain reservoir below the main reservoir.
4. Remove the chiller cover assembly by removing the three retaining screws (see Figure 5-3).



1 Cover assembly screws

Figure 5-3 – Cover Assembly Screws

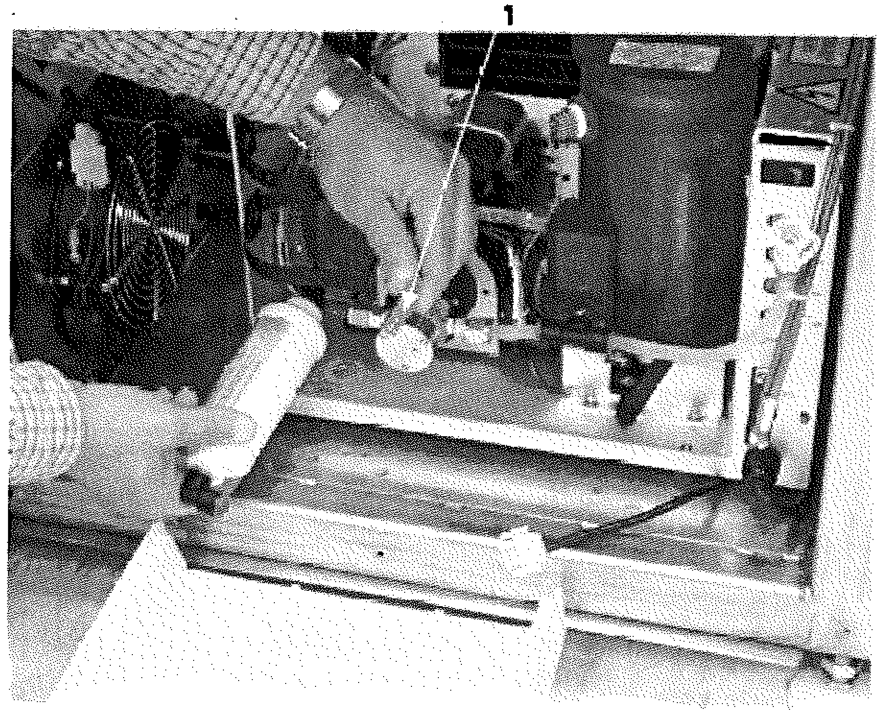
5. Disconnect the top filter retaining strap (see Figure 5-4).



1 Filter retaining straps

Figure 5-4 – Filter Retaining Straps

6. Disconnect the 1 cm (3/8–inch) tubing from the top of the filter outlet (see Figure 5-5).
7. Rotate the filter downward into the drain reservoir to remove any excess coolant from the filter (see Figure 5-5).



1 Disconnect tubing from filter top, then rotate filter

Figure 5-5 – Draining the Filter

8. Disconnect the tubing from the base of the filter. Discard the filter.
9. Connect the 1 cm (3/8–inch) tubing to the new particle filter (ensure that the arrow indicating the direction of flow is pointing up). Pull back on the tubing to check that a positive connection has been made.

> ⚠ **CAUTION**
>
> **Possible System Damage and Voiding of Warranties**
>
> Do not attempt to substitute filters in the cooling system. Use only filters recommended by GSI Lumonics. Use of any other filter will VOID ALL WARRANTIES.

10. Replace the chiller cover assembly.
11. Refill the reservoir with new coolant, as described in Section 4.9.10.

12. Prime the cooling system, as described in Section 4.9.11.
13. The system can now be returned to normal operation. (Setting the LASER switch to ON will restart the Chiller pump and turn on the laser.)

5.3.5 Laser and Optic Inspection and Cleaning

Laser and optic inspection should be performed annually using the following procedure and guidelines. Laser inspection consists of a general inspection of the Laser assembly for signs of dust and water leaks.

NOTE: Before starting, read all procedural steps and notes.

1. Raise the interlocked cover of the laser enclosure.

> **⚠ CAUTION**
> **WHEN PERFORMING MAINTENANCE ON THE LASER OR OPTIC ASSEMBLY, ALWAYS WEAR THE GROUNDED WRIST STRAP AND WORK ON A GROUNDED SURFACE.**
> FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN DAMAGE TO THE LASER DIODE MODULE AND MAY ALSO VOID ANY WARRANTIES.

Laser Inspection

2. Inspect the enclosure base plate and area of the laser for signs of dust. If any dust or other matter is present, it must be carefully removed to avoid possible contamination of the optics by airborne particles.

   NOTE: Because the system is operating in a cleanroom environment, there should be no dust present.
3. Inspect the coolant tubing to the laser rail for leaks. If necessary, remove any excess fluid and tighten the connections.

   NOTE: If any tubing is disconnected to correct a leak, the cooling system must be purged of air before the system can be operated. To purge the system, refer to Section 5.3.4, Chiller Filter and Coolant Replacement.

Optic Inspection

⚠ CAUTION
Possible Damage to Precision Optic
Cleaning of any precision optic may degrade its surface. Therefore optic cleaning should only be carried out when absolutely necessary.

Under normal operating conditions in a cleanroom environment, it is unlikely that the optics will require any cleaning. However, if an optic surface is accidentally touched with a finger while performing service or maintenance in the laser enclosure, then the affected optic must be cleaned to ensure satisfactory laser output and marking performance. Similarly, optic surfaces can be contaminated with water spots if a leak occurs in the laser water system, or while servicing the water hoses in the enclosure.

Following is a list of materials and supplies that may be required for optic cleaning. Read all instructions before cleaning the optics to determine the most suitable technique to use and the required materials and supplies.

Materials and Supplies:

- Polyethylene lab gloves or Latex finger cots
- Dust-free blower (filtered, dry, pressurized nitrogen gas recommended)
- Deionized water
- Mild, neutral soap (1% solution in deionized water. Non-perfumed, alkali or colored soap.)
- Lint-free tissues (lens tissue is suitable)
- Cotton swab (non-plastic stems)
- Methanol (only sufficient quantity required to moisten lens tissues).

The following solvent is used during cleaning of optical elements on the WaferMark® SigmaDSC NT System and can be injurious to health unless adequate precautions are taken:

METHANOL ALCOHOL

Methanol Alcohol is a degreasing solvent recommended for cleaning optics.

> **⚠ WARNING**
>
> **FLAMMABLE—POISON—IRRITANT**
>
> ***Methanol is a colorless liquid. It is a flammable poison that burns with a blue non-luminous flame. Its main toxic effect is exerted upon the nervous system, particularly the optic nerves and possibly the retina, which can progress to permanent blindness. The vapor is harmful and may be fatal or cause blindness if swallowed. Potential health effects may include irritation to eyes; irritation, dryness and cracking of the skin; and may also cause nausea, vomiting, dizziness, blindness or death.***
>
> ***To avoid any of the harmful effects described here, observe the precautions given in the following Sections.***

- Keep container tightly closed.
- Keep away from sources of ignition.
- Avoid breathing the vapor and contact with eyes.
- Do not smoke in the vicinity of the solvent or vapor.

For spills, observe the following precautions:

- Do not touch spilled material.
- Stop the leak if you can do it without risk.
- Ventilate the area in which the spill or leak occurred.
- Using appropriate protective gloves (NITRILE rubber or VITRON is recommended) and wearing splash-proof goggles, take up the spilled liquid with sand or other absorbent material and place it in sealed containers for disposal.

> **⚠ CAUTION**
>
> **Potential Health Hazards**
>
> First aid procedures for inhalation, eye contact, skin contact, and ingestion will require medical assistance immediately. For ingestion, call a physician immediately; only qualified medical personnel should administer an antidote.

Waste Disposal Considerations:

Material which has been contaminated with Methanol Alcohol from spills, leakage, supplies used for optic cleaning, etc. is considered hazardous waste if discarded. It is the responsibility of the end user to ensure that the waste material is treated and/or disposed of at a site authorized to handle hazardous chemical waste. Disposal must be in accordance with 40 CFR 262. A permitted waste disposer should be contacted before discharging, treating or disposing of waste material to assure compliance with all current Local, State and Federal regulations.

Further information on the hazards, handling and storage, first-aid procedures, and accidental release measures associated with the use of Methanol can be obtained from the following source:

http://www.hhmi.org/science/labsafe/lcss/lcss58.htm

For 24-hour emergency assistance, call CHEMTREC at (800) 424-9300 or (703) 527-3887 (international).

NOTE: No other solvents are recommended by GSI Lumonics for the purpose of cleaning the optics on the WaferMark® SigmaDSC NT System.

Cleaning Procedures

Dust:

Dust on optics can be very tightly bound by static electricity. Blowing removes some dirt; the remainder can be collected by the surface tension of a moistened tissue.

1. Visually inspect the laser optical element surfaces for dust or other particulate matter.

> ⚠ **CAUTION**
>
> **Do not touch any optical surfaces during inspection or cleaning.**
>
> Oil from fingerprints can damage optical elements over a period of time. Always wear latex finger cots when working near optical components.

2. Blow off any loose dust using clean, dry, pressurized gas.

3. If any dust remains, slightly moisten a lint-free tissue with methanol, then use the drop-drag method to gently drag the tissue across the optic surface.
4. Repeat until all dust has been removed.
5. If stubborn dust remains, twist the moistened tissue around a cotton swab and wipe the optic in one direction, in a gentle figure eight motion.

> ⚠ **CAUTION**
> **Potential Damage to Optic**
> Avoid wiping in a circular pattern.

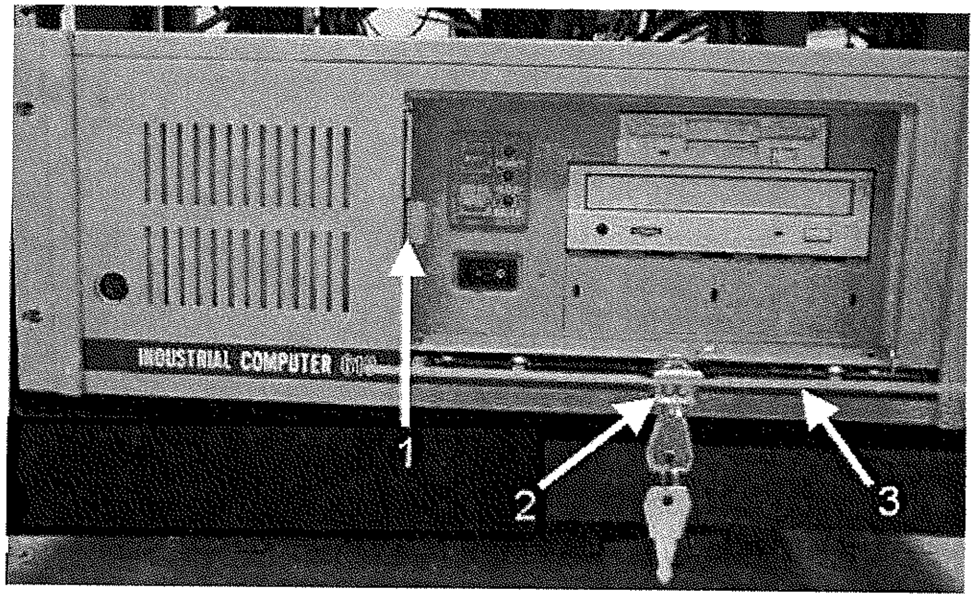
Fingerprints or Waterspots:

Because skin acids attack the optic coating, fingerprints should be cleaned from the optic immediately. The following procedure will require the removal of the optic for rinsing with deionized water.

1. Blow off any loose dust using clean, dry pressurized gas.
2. Moisten a lint-free tissue with the soap solution (see Materials and Supplies, above) and twist around a cotton swab. Wipe the optic in one direction, in a gentle figure eight motion. Avoid wiping in a circular pattern.
3. Rinse the optic in deionized water to remove any soap residue.
4. Remove the water from the optic using a lint-free tissue that has been slightly moistened with methanol. Use the drop-drag method to gently drag the tissue across the optic surface.
5. If necessary, repeat steps 2 through 4 until all traces of contamination have been removed.

5.3.6 Clean and/or Replace the Computer Air Filter

On a Quarterly basis (every three months), inspect and clean or, if necessary, replace the System Computer air filter. The air filter is located behind the left front panel of the System Computer. See Figure 5-6.



1 Tab on filter
2 Access door lock with keys
3 Access door opened

Figure 5-6 – Accessing the System Computer Air Filter

Use a vacuum with soft-bristled brush attachment to clean the filter, as follows:

1. Open the access door to the Electronics Bay on the left-hand side of the system.
2. If necessary, unlock the computer access door, then swing the door down to open it.
3. Pull gently on the tab on the left-hand side in the compartment.
4. Slide the filter out from the computer.
5. Inspect the filter for any damage. If the filter is damaged, replace it.
6. Use a vacuum with a soft-bristle brush attachment to clean the filter on both sides.
7. Slide the filter back into the compartment. Close the computer access door, then close the Electronics Bay access door.

5.4 Periods Of Non-Operation

During extended periods of non-operation, any particulate matter that may be suspended in the coolant water will settle. Such particulate matter in the laser rail can impair optical clarity and affect marking. If this period of non-operation exceeds five days, drain the coolant and replace the Chiller filter and coolant, as described in Section 5.3.4, Chiller Filter and Coolant Replacement.

5.5 Scheduled Maintenance Spares Items

The WaferMark® SigmaDSC NT System preventive maintenance schedule (see Section5.2) calls for the annual replacement of the Chiller filter. The Chiller filter may also need to be replaced (including the coolant) if leaking hoses are disconnected, or if the system is powered off for periods longer than five days (as explained in Section 5.4, Periods of Non-Operation).

To ensure that these items are available when replacement becomes due or necessary, sufficient quantities should be maintained on site. They can be ordered from GSI Lumonics using the following part number: 550000521 for the Chiller filter.

NOTE: The Laser Diode Module is guaranteed for two years of continuous operation. During this period, no scheduled maintenance of this module is necessary. When replacement becomes necessary, the installation, set-up and alignment must be performed by a GSI Lumonics trained and certified service technician.

5.5.1 Replacement Parts

For replacement parts, refer to Section 6.15 (Recommended Inventory And Spare Parts Kits).

5.5.2 Parts Ordering Information

For ordering information, refer to Section 6.16 (Parts Ordering Information).

6 Components Replacement and Adjustment Procedures

This chapter contains procedures for replacing the major components used in the WaferMark® SigmaDSC NT system or SigmaDSC NT 300 system.

6.1 Introduction

Before performing any component replacement on the equipment, perform the following:

1. Perform the system shutdown procedure specified in Section 4.10.2.
2. To avoid the possibility of the power being accidentally switched on, attach a warning notice, similar to that shown in Figure 5-1, to the circuit breaker to indicate that work is in progress and insert a padlock in the metal stop.

The WaferMark system does not require periodic adjustment. Adjustments should be made only when indicated in the troubleshooting procedures as a possible corrective action for a problem, or when advised in the Section following the replacement of a module, part, or component.

Before removing any component from the system, ensure the system is shut down and the system circuit breaker on the right side of the system is padlocked in the OFF position. Power should only be reapplied to the system after the module has been reconnected and is ready for adjustment or testing in the system.

6.2 System Fuses and Locations

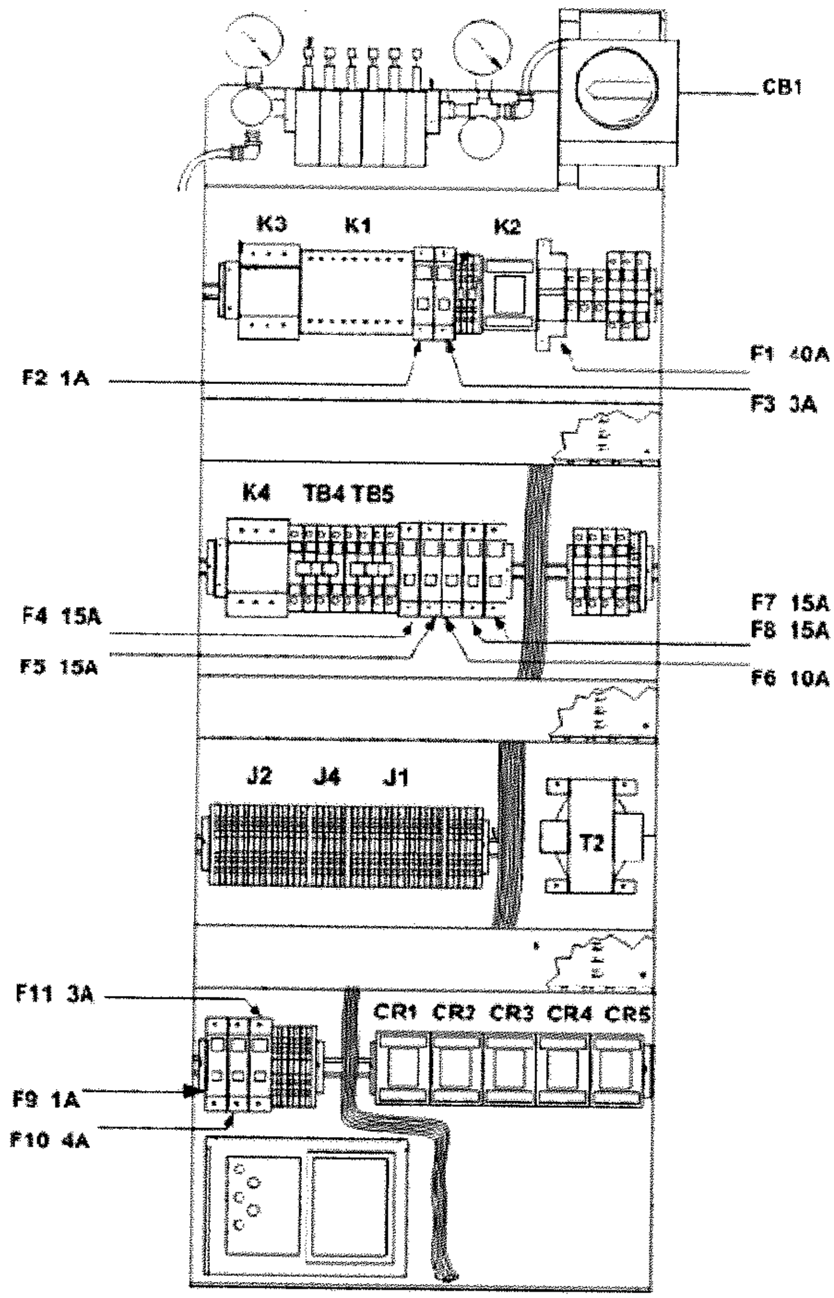
Table 6-1 provides a complete list of system fuses, including the circuits protected and fuse locations.

Table 6-1 – WaferMark® SigmaDSC NT Fuse Finder

Fuse	Circuit Protected	Rating	Part Number
SYSTEM INTERFACE PCB (See Drawing No. 60560124 in the Addendum for fuse locations)			
F1	+5V, distribution	2.5A, 250V S.B.	2230020
F2	+24V distribution	4A, MDA-4	2230006

Table 6-1 – WaferMark® SigmaDSC NT Fuse Finder

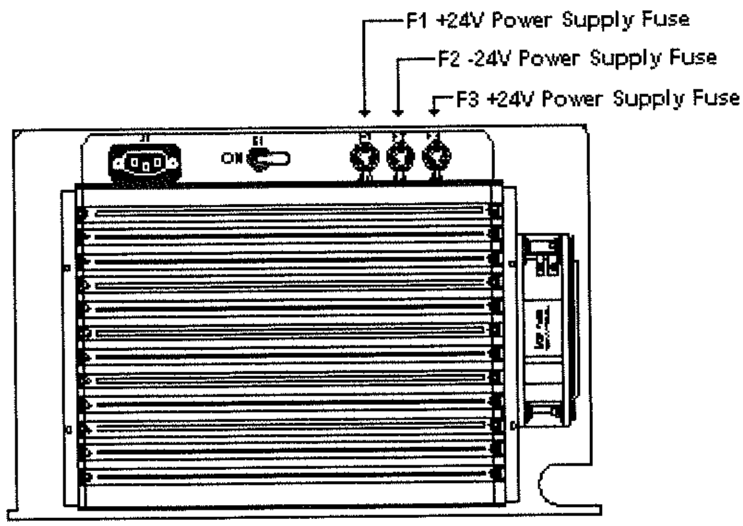
Fuse	Circuit Protected	Rating	Part Number
POWER DISTRIBUTION PANEL (Figure 6-1)			
F1	115 VAC line	40A, 500V GL	2230045
F2	T2 primary (115 VAC)	1A, FNM-1	2230022
F3	T2 secondary (24 VAC)	3A, FNM-3	2230021
F4	115 VAC receptacles (#1)	15A, 500V FNQ	2230039
F5	Cooling fans #1 and #2	15A, 500V FNQ	2230039
F7	115 VAC receptacles (#2)	15A, 500V FNQ	2230039
F8	Chiller 115 VAC input supply	15A, 500V FNQ	2230039
F9	— Spare	1A, FNM-4	2230022
F10	115 VAC input to 24 VDC P.S.	4A, FNM-4	2230007
F11	+24 VDC Signal Tower	3A, FNM-4	2230021
SYSTEM COMPUTER (Figure 6-2)			
F1	+24V Power Supply	4A, MDA-4	2230006
F2	-24V Power Supply	4A, MDA-4	2230006
F3	+5V Power Supply	4A, MDA-4	2230006
CHILLER (Figure 6-3)			
F1	Main fuse	10A, 500V FNQ-10	2230042
F2	Pump	4A, S.B. MDA-4	2230006
F3	Reservoir heater	8A, 250V S.B.	188C80301
F4	Heat exchanger fans	1.5A, 250V S.B.	188C15301
ROBOT/ALIGNER CONTROLLER (Internal)			
F1	Robot/Aligner Fuse	3A, 125V S.B.	188C30201
LASER CONTROLLER (Figure 6-4)			
F1	Main fuse	6A, 250V S.B.	188C60301
VIDEO MONITOR (Internal)			
F1	Main fuse	2A, 250V S.B.	2230026
DISK DRIVE UNIT			
F1	Main fuse	2A, 125V S.B.	188C20201



F1	40A Fuse, 500V GL, 115 VAC line
F2	1A Fuse, FNM-1T2, primary (115 VAC)
F3	3A Fuse, FNM-3T2, secondary (24 VAC)
F4	15A Fuse, 500V FNQ, 115 VAC receptacles (#1)
F5	15A Fuse, 500V FNQ, Cooling fans #1 and #2
F6	Not applicable for SigmaDSC NT

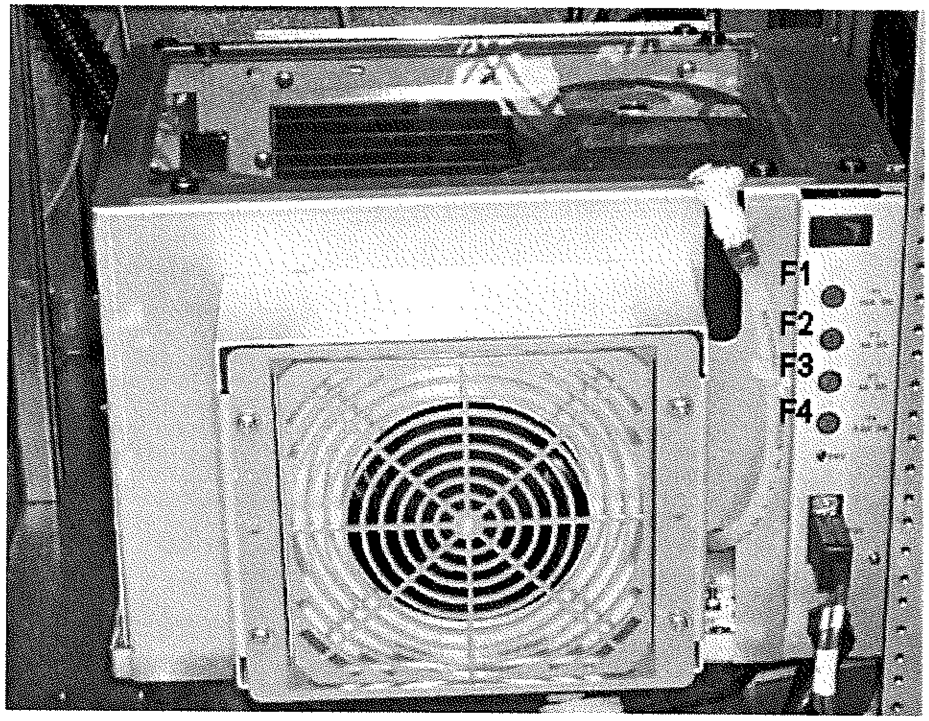
F7	15A Fuse, 500V FNQ, 115 VAC receptacles (#2)
F8	15A Fuse 500V FNQ, Chiller 115 VAC input supply
F9	Spare, 1A Fuse, FNM-4
F10	4A Fuse, FNM-4, 115 VAC input to 24 VDC Power Supply
F11	3A Fuse, FNM-4, +24VDC Signal Tower

Figure 6-1 – Fuse Locations—Power Distribution Panel



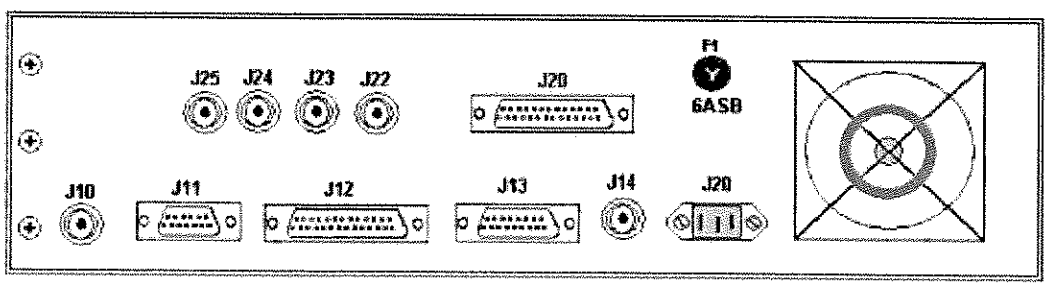
F1	4A Fuse, MDA-4, +24VDC Power Supply
F2	4A Fuse, MDA-4, –24VDC Power Supply
F3	4A Fuse, MDA-4, ±5 VDC Power Supply

Figure 6-2 – Fuse Locations—Marking Engine



F1 10A Fuse, 500V FNQ-10, Main fuse
F2 4A Fuse, S.B. MDA-4, Pump
F3 8A, Fuse, 250V S.B., Reservoir heater
F4 1.5A Fuse , 250V S.B., Heat exchanger fans

Figure 6-3 – Fuse Locations—Chiller Unit



F1 6A Fuse, 250V S.B., Main fuse

Figure 6-4 – Fuse Location—Laser Controller

6.3 Chiller System

6.3.1 Particle Filter and Coolant Replacement

GSI Lumonics recommends replacing the particle filter and coolant annually using the following procedure. To do so, follow the procedures in Section 5.3.4.

6.3.2 Chiller and Laser Controller Setup

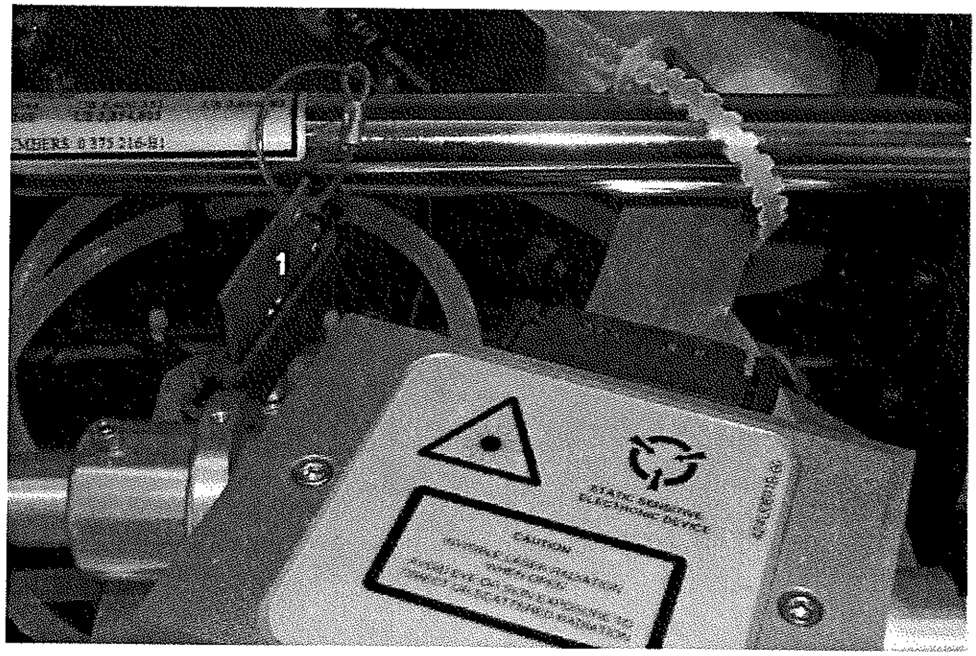
Required Tools and Supplies:

- Utility knife
- Large Phillips screwdriver
- 1 Gallon jug of steam-distilled water, as a mix of 5 – 10% Isopropyl Alcohol with 95 – 90% steam-distilled water.

1. Make sure that the laser controller is installed and the cables are secure. Check that all hose connections are tight. If a hose end is ragged, trim it with the utility knife.

> ⚠ **CAUTION**
> **Potential Static Discharge: Use Ground Strap from Laser**
> The diode is extremely electro-sensitive. To prevent static electricity discharge, be sure to first put on the ground strap that is attached to the laser.

2. Remove the shorting plug from the laser diodes and install the cable from the current modulator.



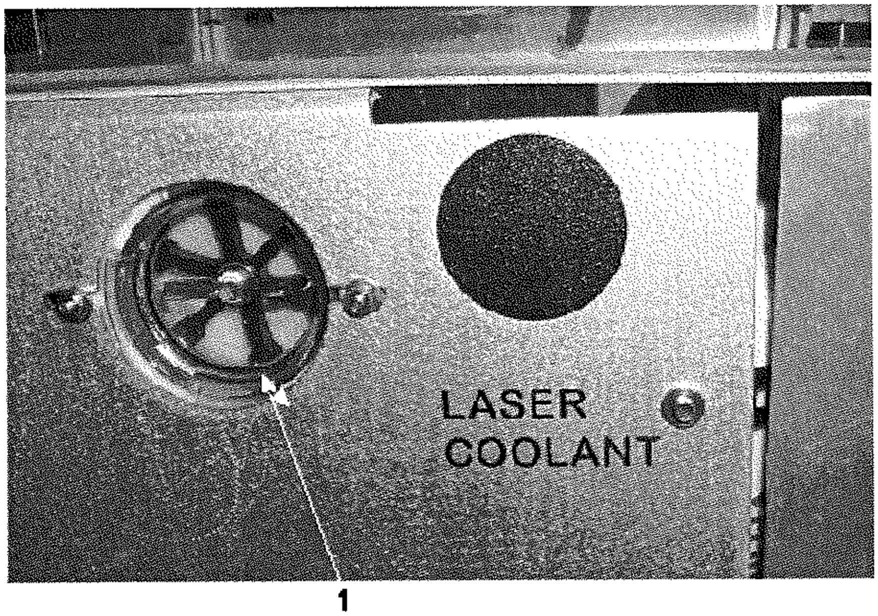
1 Shorting Plug

CAUTION

Potential Static Discharge: Use Ground Strap from Laser

The diode is extremely electro-sensitive. To prevent static electricity discharge, be sure to first put on the ground strap that is attached to the laser.

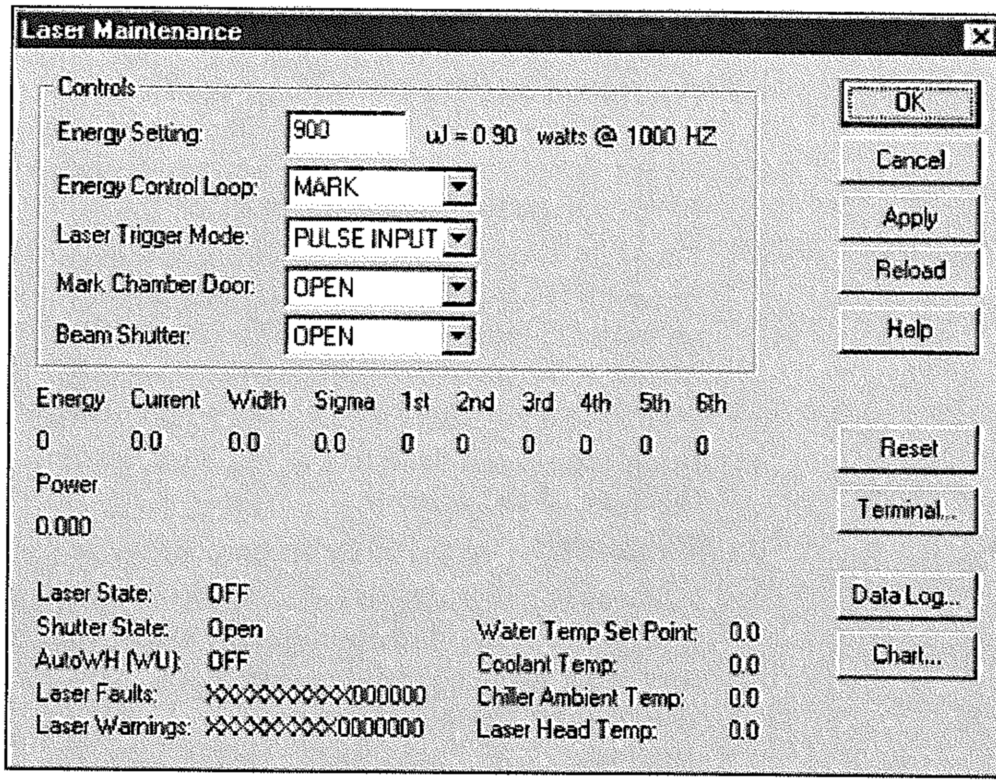
3. Fill the cooler, as described in Section 4.9.10.
4. Prime the cooling system, as described in Section 4.9.11.
5. Toggle the LASER switch on and off at the operator panel. Observe that the water flow in the chiller starts and stops by watching the flow meter spin:



1 Flow meter

6. Recheck the cooler and water lines for leaks.
7. Verify that the system computer is turned on.
8. Once the Windows® NT Operating is booted, you must log in with administrative access.

   NOTE: It takes a few minutes for the equipment to initialize. When the software is initialized, the system start-up sequence is complete.
9. Leave the Laser switch on for 5 minutes. Record the coolant operating temperature and deviation:
   a. In the **Maintenance** menu, select the **Laser Power** command to bring up the Laser Maintenance screen.



b. Let the coolant flow through the laser system for $\frac{1}{2}$ hour. Watch the 'Coolant Temp' reading fluctuate over several minutes.

6.4 Circuit Board Replacement

6.4.1 System Computer PCB Replacement

To replace the circuit board in the system computer, proceed as follows:

1. Terminate the WaferMark® User Interface program by selecting the **File** menu, then the **Exit** command.

   NOTE: Only an Engineer can initiate this operation. Failure to shut down the program before powering off the system may cause data corruption or loss of job information.

2. Shut down the Windows® NT operating system

NOTE: Any time that the system is going to be powered down, first power down the Windows® NT™ operating system from the Start bar. DO NOT turn off the PC power until the PC screen shows that Windows® NT shutdown is complete.

3. Power down the system by turning the keyswitch on the Operator Panel to OFF.
4. Turn the system circuit breaker on the right-hand side of the cabinet to the OFF position and insert a padlock to prevent the power from being accidentally switched on. Attach a notice to the breaker warning other personnel that maintenance is in progress (see sample notice in Figure 5-1.)
5. Open the access door to the maintenance bay at the rear of the cabinet.
6. Set switch S1 on the system computer card cage to OFF.
7. Remove any cable(s) attached to the front edge connector(s), then remove the defective circuit board from the card cage by applying pressure to the card extractors and pulling the board forward.
8. Slide the replacement board into the slot and apply pressure on the card extractors until the board is firmly latched and the P1 and P2 edge connectors on the bottom of the card are properly seated on the multibus.
9. Reconnect any cables removed in step 4, then set the S1 switch on the card cage to ON.
10. Close the rear access door.
11. Set the system circuit breaker to ON, then power up the system by turning the keyswitch on the control panel to ON.
12. Turn on the PC and log in.
13. Load a job and perform sample marking on a test wafer to verify that the replacement board is functioning properly.

6.5 Jumper/Switch Configuration for System Circuit Boards

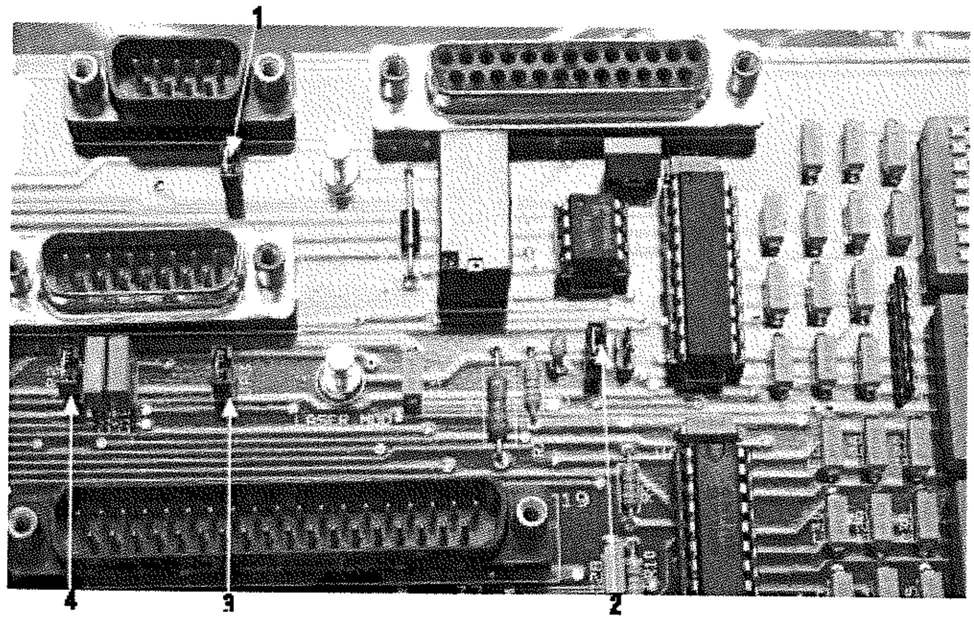
Following are the positions of installed jumpers and the switch settings for the indicated system circuit boards. Only installed jumpers are called out here and all other switches are set to the opposite state.

NOTE: Jumpers that are indicated by an asterisk (*) are either wire-wrapped or soldered directly on the board.

System Interface Board

Jumpers IN:

JP1, JP2, JP3, JP4



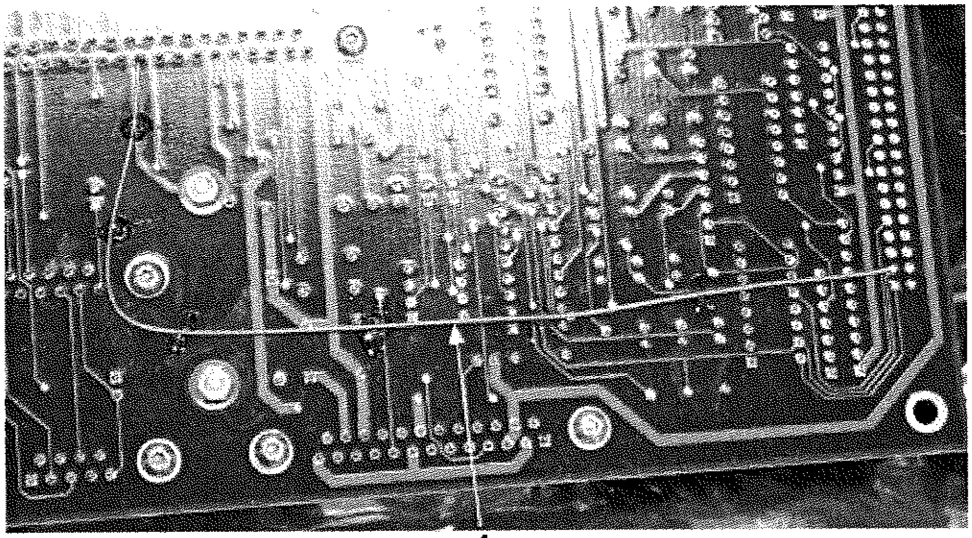
1	JP1
2	JP4
3	JP3
4	JP2

Figure 6-5 – System Interface Board Jumpers IN

Jumper:

P12 - 10 to P13 - 3 *

P1–27 to P2–18



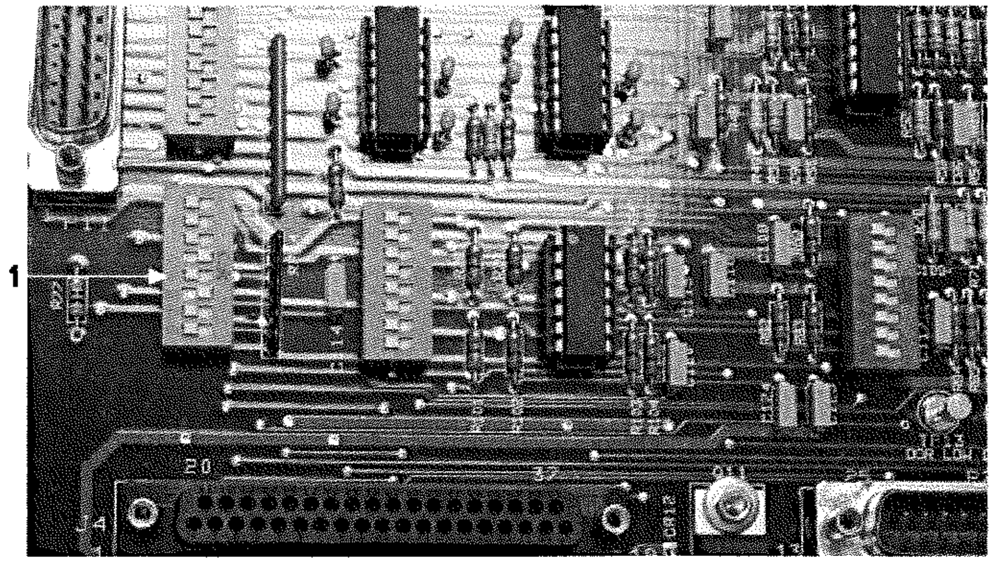
1 P12–10 to P13–3

Figure 6-6 – System Interface Board Jumper P12–10 to P13–3

DIP Switches:

SW6 - 4 and 6 are set to ON; all others are set to OFF.

NOTE: For optional movable presenters, ALL DIP switches are set to OFF.



1 SW6 – Switches 4 and 6 ON

Figure 6-7 – System Interface Board DIP Switch Settings

SGRP Galvo Boards

Jumpers IN:

JP1 - ADL CS (see Figure 6-10 for JP1 through JP9)

JP2 - +5V

JP3 - 2

JP5 - Notch IN (3.571K resistor for X-board; 3.241K resistor for Y-board)

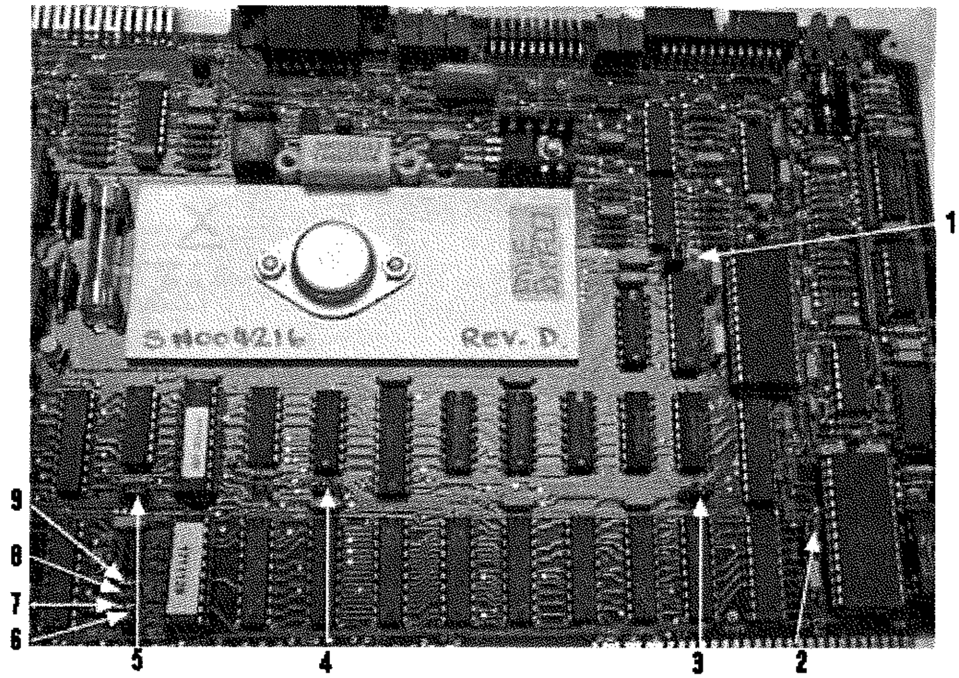
JP9 - CLK2

JP10 - I/O, JP17 - NO, JP18 - NO, JP19 - MAN (see Figure 6-8 for JP10 through JP25 (except JP24))

JP20 - OFF, JP21 - OFF, JP22 - OFF, JP23 - OFF

JP24 - VAR (see Figure 6-10)

JP25 - Both jumpers in vertical position: +POL

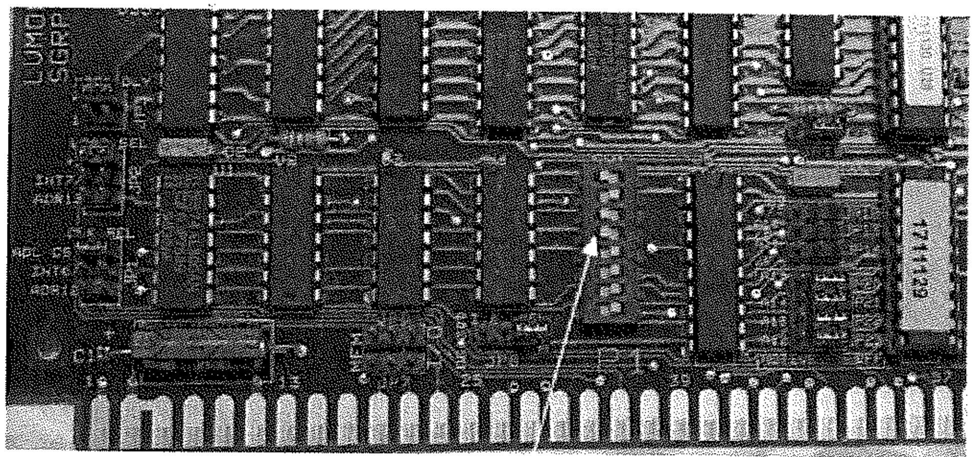


1	JP25
2	JP19
3	JP18
4	JP17
5	JP10
6	JP23
7	JP22
8	JP21
9	JP20

Figure 6-8 – Galvo Board Jumpers In (Partial)

DIP Switches:

X Axis Board - 1, 3, 4 OFF

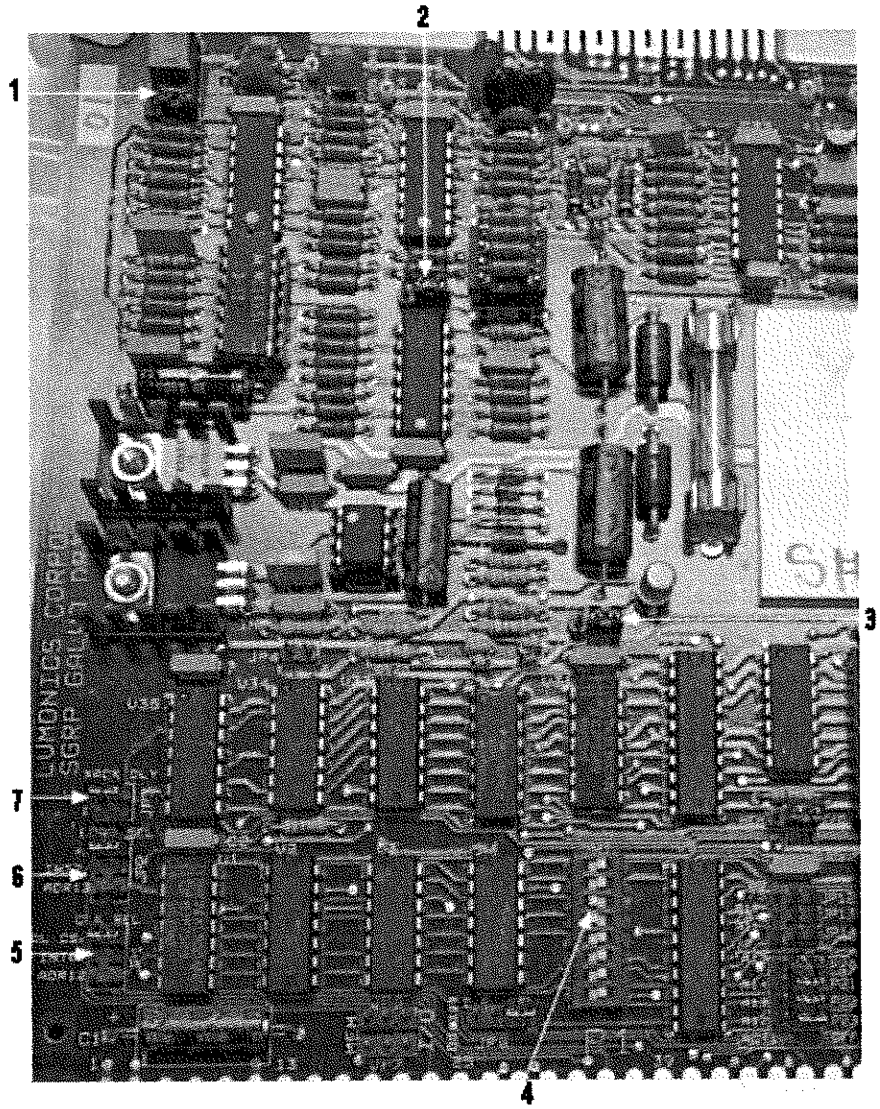


1

1 Switches 1, 3, 4 OFF

Figure 6-9 – X-Galvo Board DIP Switch Settings

Y Axis Board - 3, 4 OFF



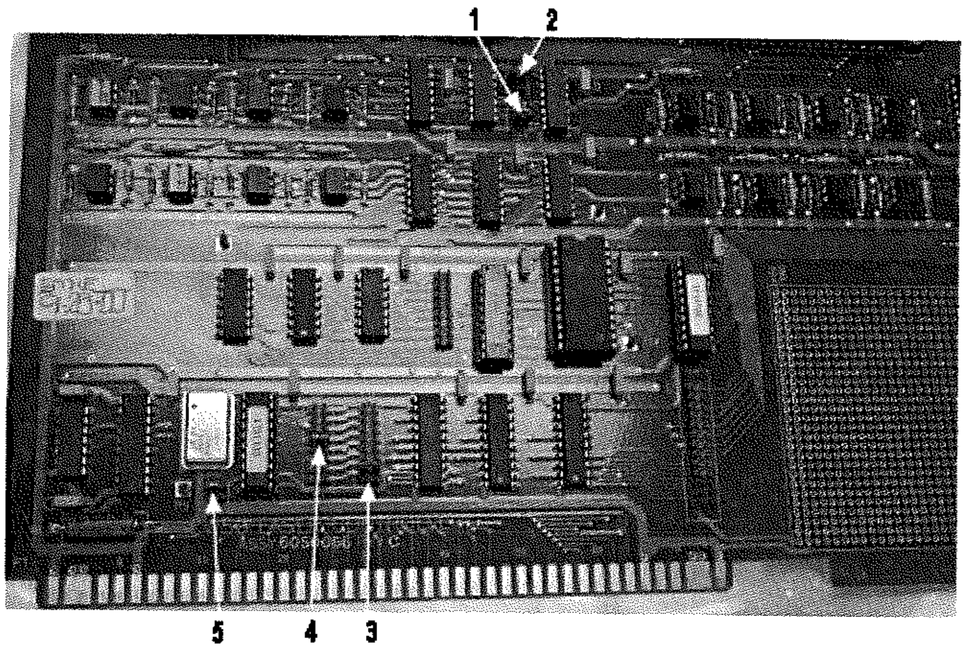
1	JP24
2	JP5
3	JP9
4	Switches 3, 4 OFF
5	JP1
6	JP2
7	JP3

Figure 6-10 – Jumpers and Y-Galvo Board DIP Switch Settings

CW 50 Board

Jumpers IN:

16-bit, S5, S10, S25, S28



1	S25
2	S28
3	S10
4	S5
5	16–bit

Figure 6-11 – CW 50 Board Jumpers IN

MAT486 Processor

MAT486 SYSIO Board

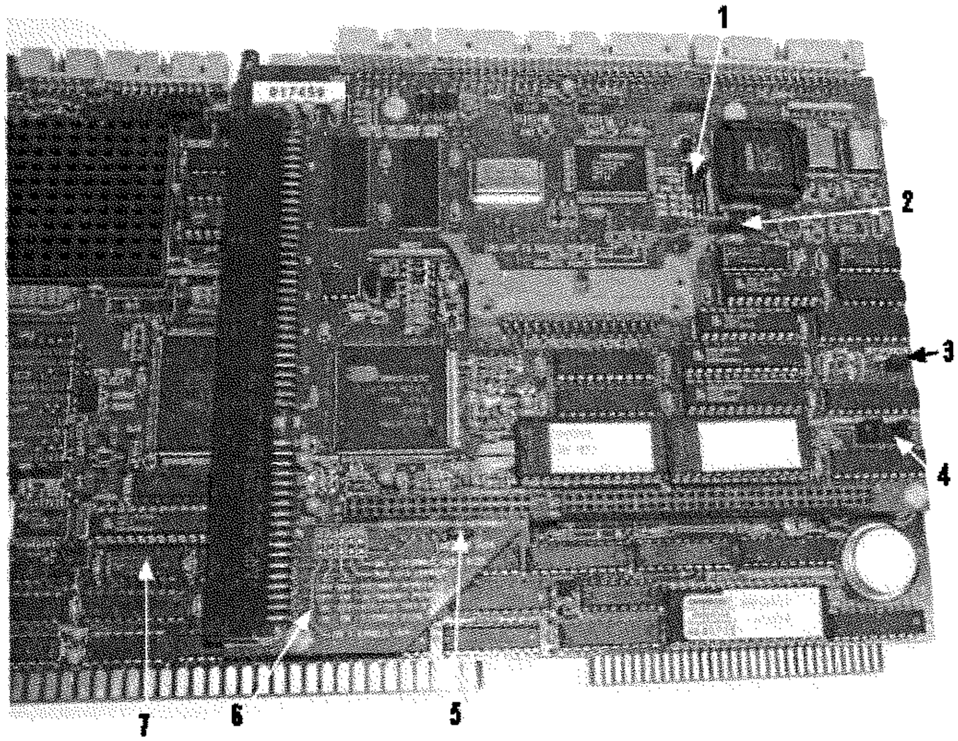
Some of the jumper areas are not marked on the MAT486 SYSIO Board. Refer to the MAT486 manual or drawing for the location of the jumper areas, or see Table 6-2 and Figure 6-12.

Table 6-2 – MAT486 SYSIO Board Jumper Settings

Location	Designation	Setting
1	SCSI CFG	TERM
2	Remote IDE	3 - 4 (counting from left; see instructions on board)

Table 6-2 – MAT486 SYSIO Board Jumper Settings

3	IDE	ON
4	CFG Jumpers	1 - 2 - 5 (counting from left); see CFG legend on board (callout 6 in Figure 6-12)
5	IDE/ATA INTR	IRQ14 (PRIMARY)



1 SCSI CFG
2 Remote IDE
3 IDE
4 CFG Jumpers
5 IDE/ATA INTR
6 CFG Legend
7 MAT 486 Board

Figure 6-12 – MAT486 SYSIO Board — Jumper Configuration

MAT486

To configure the marker engine MAT486 board, set the jumpers and switches to the positions shown in Figure 6-13.

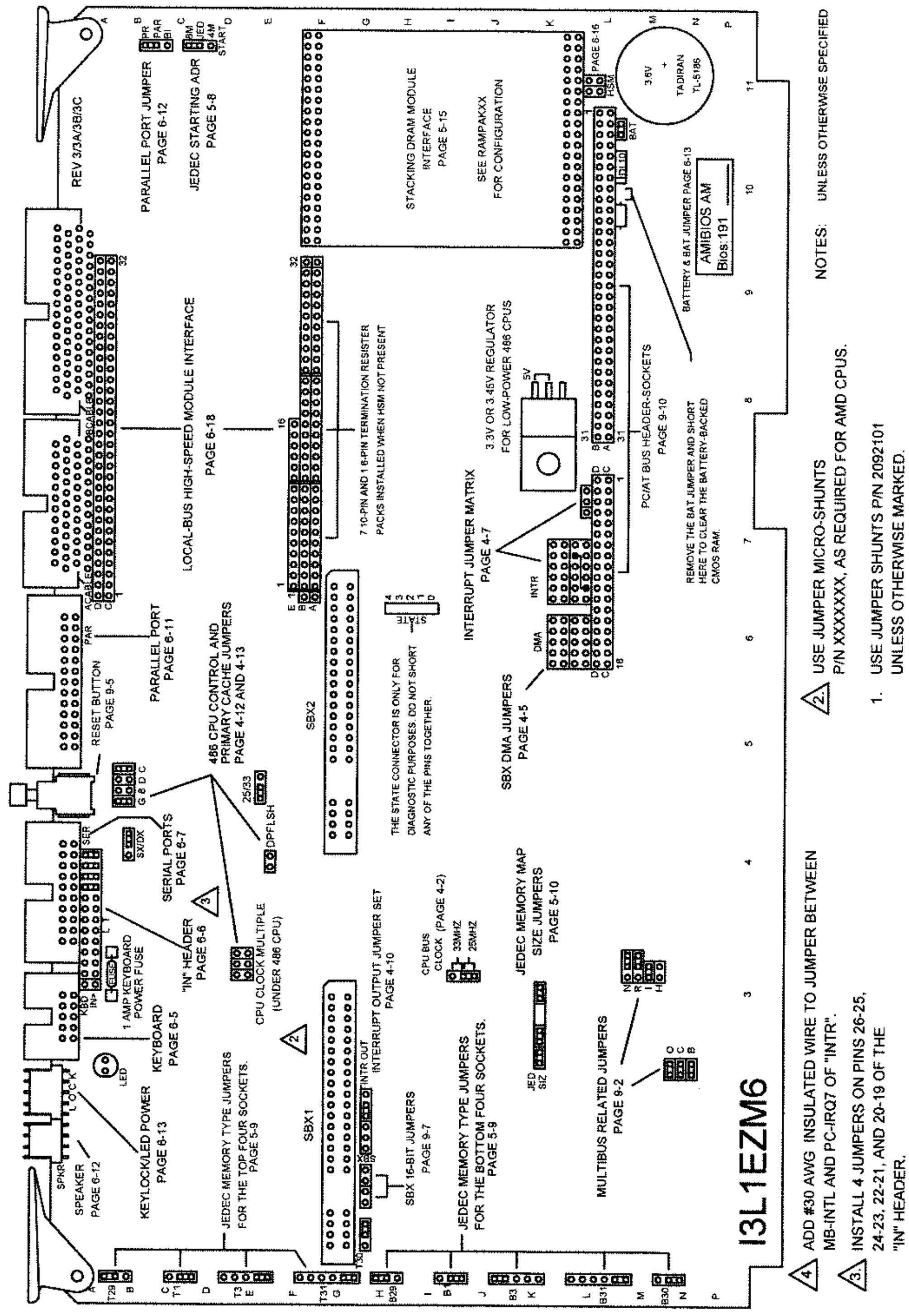


Figure 6-13 – Marking Engine MAT486 Board-Jumper and Switch Configuration

PCI DIO 96 Board

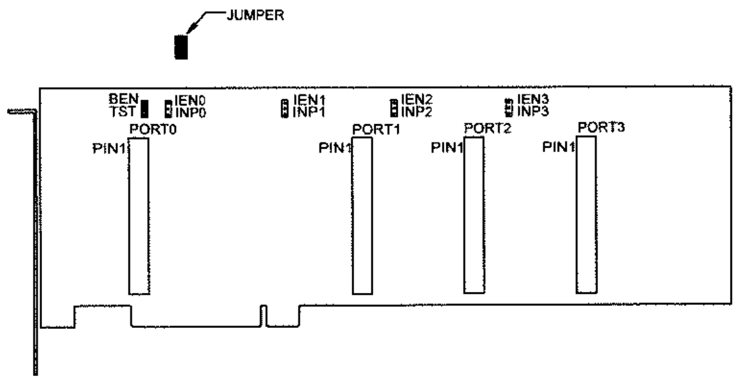


Figure 6-14 – PCI DIO 96 Board Jumpers

Jumpers

Figure 6-14 identifies the jumpers for the PCI DIO 96 Board.

6.6 Robot Service and Maintenance

All GSI Lumonics service technicians who have been contracted by the end user to perform maintenance or repair of the system are fully qualified to perform service, maintenance, program and teach the robot. Similarly, all end user personnel who have successfully completed a WaferMark® SigmaDSC NT training course at the GSI Lumonics factory in which the curriculum includes servicing and maintenance of the robot, are also qualified to perform these tasks.

End user personnel who have been trained on-site by a GSI Lumonics service technician or by any other end user personnel are NOT qualified to perform ANY maintenance or repair of the robot system unless this training is to the required standard, and has the approval of GSI Lumonics.

GSI Lumonics recommends that the Laser Safety Officer for the end user maintains a record of training and competency of personnel authorized to perform these tasks.

⚠ CAUTION
FAILURE TO OBSERVE THE SAFETY PRECAUTIONS GIVEN HERE CAN CAUSE BODILY INJURY OR DAMAGE TO THE EQUIPMENT

Before performing any service or maintenance of the robot system, read Section 6.6.1 (Robot System Safeguards) and Section 6.6.2 (Robot System Safety Checks). These Sections provide Important safety information and the avoidance of hazards when operating the robot. Observe all directives and precautions given here.

6.6.1 Robot System Safeguards

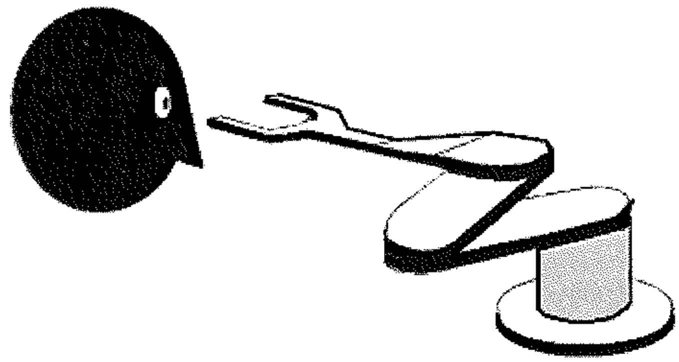
The maximum mechanical envelope of the robot used on the WaferMark® SigmaDSC NT system is defined by a band of yellow and black striping surrounding the entry to the robot enclosure at the front of the cabinet. The striping identifies a hazard area within which unexpected robot motion is possible when the system is powered on. A yellow warning light and hazard-warning label are positioned on the right-facing panel of the robot bay. When turned on, the light provides a visible warning to the user that robot motion is possible. The system software turns on the light anytime that a job is loaded to the marking queue and either **Mark All**, <F3> **Go/Resume**, <F5> or **Transfer** <F7> is selected from the Control Menu. The light is turned off when:

- The marking queue is empty
- **Stop/Pause** <F4>, or **Abort** <F8> is selected
- **Quit** <F6> is selected
- All wafers have been returned to their cassettes, and
- The system is Idle.

All users must use extreme caution when loading cassettes or when working within or near the area defined by the robot mechanical envelope. ***USERS MUST NEVER ATTEMPT TO LOAD CASSETTES ONTO THE PLATFORMS OR RETRIEVE WAFERS FROM THE ROBOT UNLESS THE SYSTEM IS IN A STOPPED OR PAUSED CONDITION AND THE YELLOW HAZARD WARNING LIGHT IS OFF.***

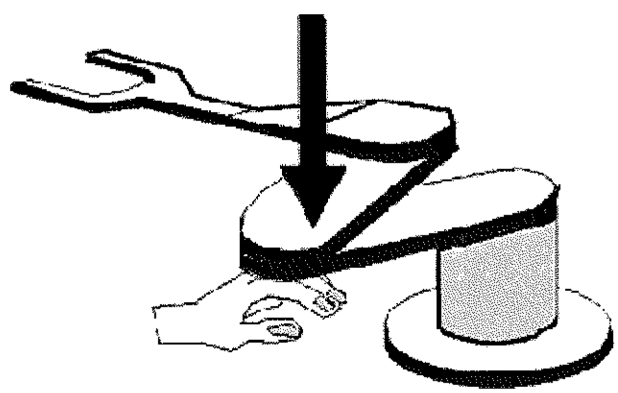
⚠ WARNING
PINCH POINT HAZARD

ROBOT ARM MAY MOVE SUDDENLY. END EFFECTOR CAN CAUSE SERIOUS EYE DAMAGE OR OTHER BODILY INJURY. Do not place hands or body within the striped hazard zone of the robot enclosure when yellow hazard warning light is on.



⚠ WARNING
PINCH POINT HAZARD

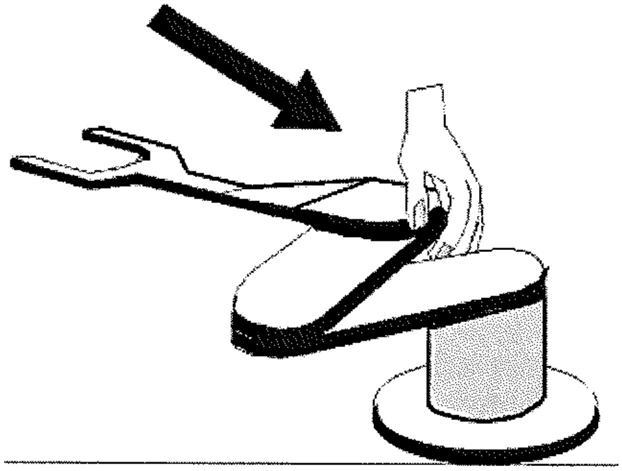
ROBOT ARM MAY MOVE SUDDENLY. LOWER LINK OF ROBOT ARM CAN CAUSE SERIOUS HAND OR BODILY INJURY. Do not place hands or body within the striped hazard zone of the robot enclosure when yellow hazard warning light is



on.

⚠ WARNING
PINCH POINT HAZARD

ROBOT ARM MAY MOVE SUDDENLY. PLACING HAND OR FINGERS WITHIN AREA OF ROBOT ARM TRAVEL CAN CAUSE SERIOUS INJURY. Do not place hands or body within the striped hazard zone of the robot enclosure when yellow hazard warning light is on.



⚠ WARNING
Possible Personnel Injury

Before performing any maintenance or repair on the robot with the system powered on, the service technician must ensure that a warning notice similar to that shown in Figure 6-15 is displayed on the Operator Panel.

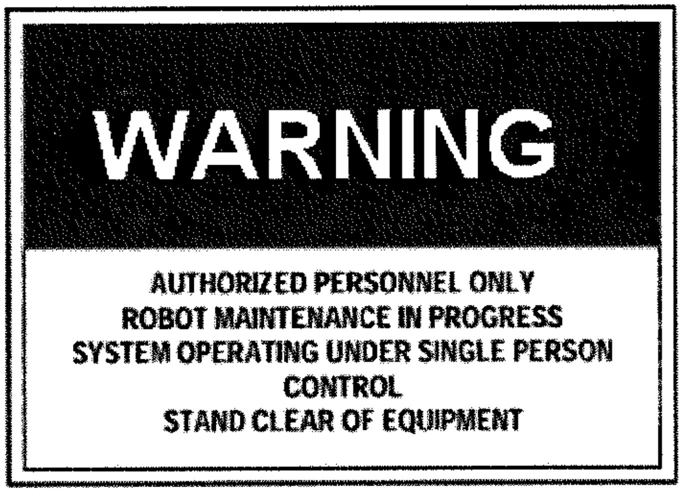


Figure 6-15 – Sample Warning Sign Used During Robot Maintenance

Only personnel who have been trained and certified at the GSI Lumonics factory are qualified to use the robot teach procedure. For additional reference, please refer to Section 6.6 (Robot Service and Maintenance).

Before starting the teach robot procedure, the teacher shall visually check the robot and the area within the robot mechanical envelope for hazardous conditions.

The teacher shall also conduct an emergency stop of the robot during robot motion. First, issue a robot motion command using an appropriate Terminal command from the Robot Calibration window. While the robot is in motion, press the E-Stop pushbutton on the Operator Panel.

While teaching the robot, only the service technician conducting the teach operation shall access the robot hazard area (which is defined as the maximum mechanical envelope). All teach operations ***MUST*** be performed in slow-speed control.

While operating in the teach mode, the teacher shall have sole control of robot motion. Before initiating any teach operation, the teacher shall verify that all other personnel are clear of the robot hazard zone which is defined by warning stripes at the boundary of the robot enclosure.

6.6.2 Robot Safety Checks

The following robot checks must be performed whenever there is a change in the system status that can affect the performance and operation of the robot. (Changes in system status can be, but are not limited to, any of the following: new system installation, relocation of existing system, maintenance and repair (change or alteration of robot parameters), or system software upgrades.)

For a New system Installation or a system Relocation only:

Before applying power to the system, the following must be verified:

- Mechanical mounting and stability of the robot.
- Electrical, signal, and vacuum connections.
- All personnel are clear of the robot hazard zone, indicated by warning stripes.

For New system installation, system relocation, robot maintenance or repair, and system software upgrades:

After applying power to the system, the following functions must be verified:

- Using Terminal commands, the robot moves in each axis as intended.
- Pressing the E-Stop pushbutton on the Operator Panel instantly stops all robot motion.
- Robot motion corresponds to the ***Transfer*** settings specified in a test job.
- The robot is capable of operating in the slow speed control mode.

6.7 Robot Removal Procedure

The following procedures provide instructions for removing and replacing the robot in a WaferMark® SigmaDSC NT system. On completion, the robot MUST be re-taught the cassette and aligner positions. ***However, teaching must only be carried out by personnel who have been trained and certified to***

perform robot and aligner teach procedures at the GSI Lumonics factory.

> **⚠ WARNING**
>
> **IMPROPER HANDLING DURING ROBOT REMOVAL MAY CAUSE SERIOUS INJURY TO HANDS OR FINGERS, AND MAY ALSO DAMAGE UNIT.**
>
> **THE ROBOT WEIGHS 44 lb (20 kg)**
>
> ***To avoid injury or damage to the unit, always remove the robot unit with the aid of a second person. Refer to the following procedures for complete lifting and removal instructions.***

Remove the robot from the robot enclosure using the following instructions. Refer to Figure 6-18 for additional reference information.

NOTE: The robot installed in the system may be manufactured by either Brooks-PRI (Equipe) or GenMark. The Equipe style has three threaded holes on top of the flange that can be used to attach $\frac{1}{4}$-20 lifting bolts. These can then be connected to a lifting device to aid in supporting the unit during the removal and replacement. However, this feature is not available on the GenMark robot; therefore the following is the recommended procedure for removing either style of robot.

1. With the system powered on, select the **Robot** command from the **Maintenance** Menu (see Figure 6-16).

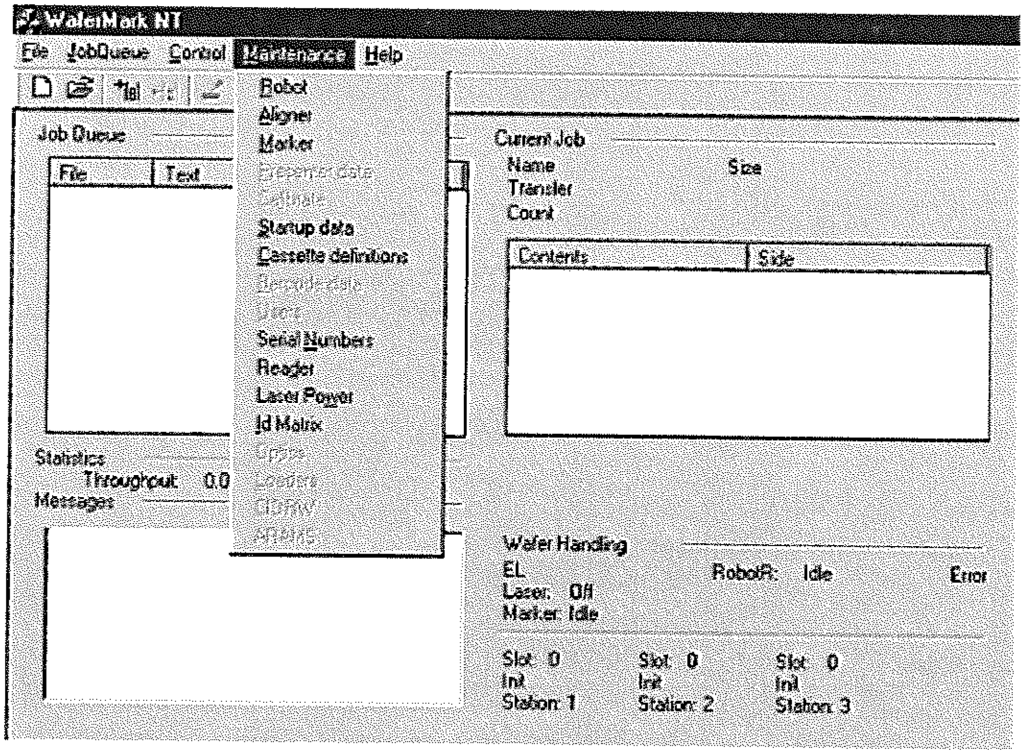


Figure 6-16 – Maintenance Menu

2. Select **Terminal** command from the **Robot Calibration** window (see Figure 6-17).

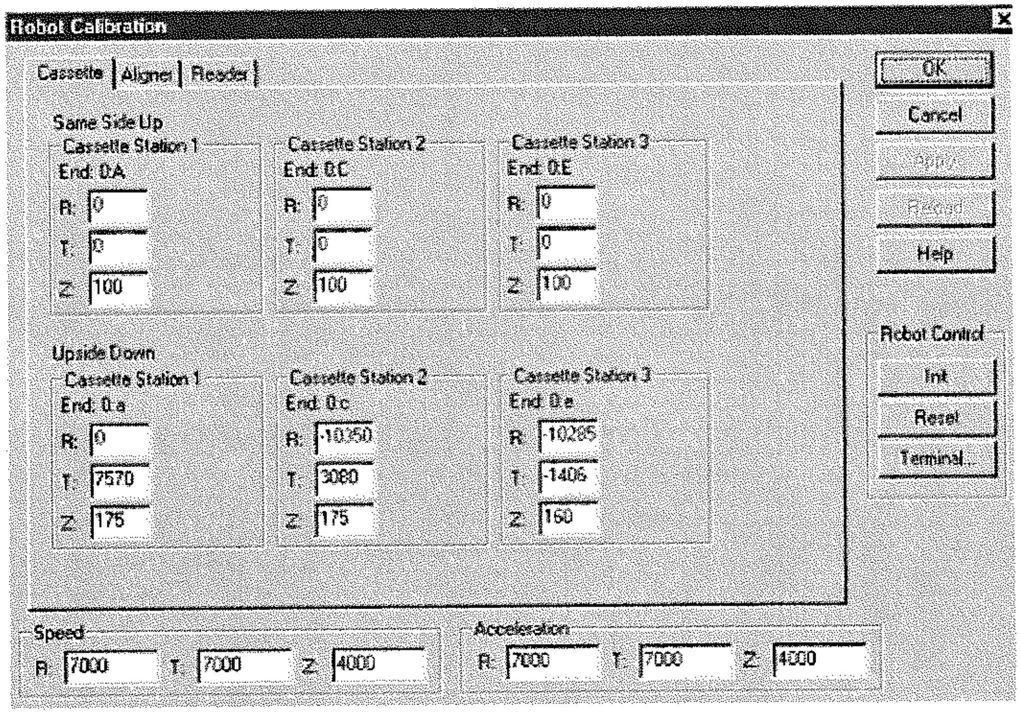
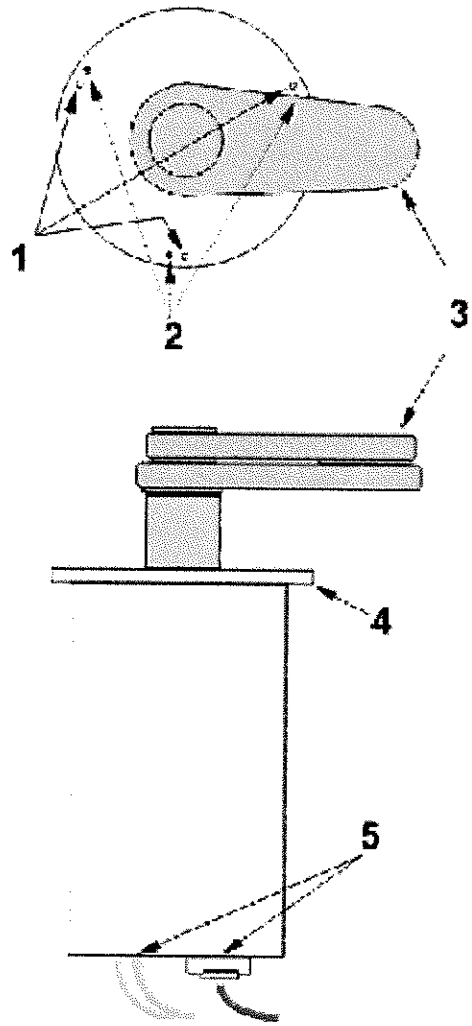


Figure 6-17 – Robot Calibration Window

3. On the keyboard, turn on the **Caps Lock** key.
4. Type: **HOM** and press **<Enter>**. The robot returns to its home position.
5. Exit to Windows® NT from the **User Interface.**
6. Prepare a stand to support the robot and mounting plate after it is removed from the System. Ensure the mounting plate will be positioned high enough to keep the robot base off the floor.
7. Power down the system following the procedures in Section 4.10.2.
8. Turn the system circuit breaker at the right-hand side of the cabinet to OFF. Insert a padlock to prevent the power from being accidentally switched on.
9. Attach a warning notice to the circuit breaker indicating that work is in progress



1	Robot Securing Screws
2	1/4–20 Lifting Bolt Locating Holes (Brooks-PRI (Equipe) Only)
3	Do Not Lift or Handle Robot Using Shaded Areas.
4	Lift And Position By Grasping This Flange.
5	Remove Vacuum Lines and Connector(s) Before Lifting.

Figure 6-18 – Robot Lifting Instructions

10. Remove the front access panel of the System.
11. Disconnect the cable connector(s) and both vacuum lines from the base of the robot (see Figure 6-18).
12. Set the cable(s) aside; these will be returned to the factory with the robot.

13. Disconnect the power and communication cables from the robot controller box and remove the controller from the marking enclosure.
14. Set the controller aside, along with the cables; the controller will be returned to the factory.
15. Carefully disconnect the green and red vacuum lines from the end effectors.
16. Remove the end effectors from the robot by removing the four securing screws. The end effectors will be used with the new robot.
17. Loosen the three $\frac{1}{4}$-inch hex-screws in the top flange that secure the robot to the cabinet baseplate. For Gencobot units, remove the screws. For Brooks-PRI (Equipe) units, do not remove the screws at this time; this will prevent the unit toppling if the standoffs are accidentally dislodged.
18. With one person supporting the base of the robot (from inside the cabinet) and the second person grasping the top flange, gently lift the robot and maneuver it through the opening in the baseplate.

> **⚠ CAUTION**
> **Possible Damage To Robot**
>
> To avoid damaging the robot, always lift the robot by the flange shown in Figure 6-18.

19. When clear of the baseplate, tilt the robot towards the front of the cabinet, if needed, until the unit is at an angle of approximately 45°, then lower the unit until it rests against the sides of the opening. Grasp and steady the unit with both hands to prevent it from toppling.
20. With one person positioned on each side of the robot, grasp the base with one hand and the flange with the other. Gently raise and lift the unit forward until it is clear of the presenter platform baseplate.
21. Remove the robot to a suitable worksurface.

22. Remove the two barbed vacuum fittings and exhaust flange from the base of the robot and set them aside; these items will be re-installed on the new robot.

6.8 Robot Replacement Procedure

> ⚠ **WARNING**
>
> **IMPROPER HANDLING DURING ROBOT REPLACEMENT MAY CAUSE SERIOUS INJURY TO HANDS OR FINGERS, AND MAY ALSO DAMAGE UNIT.**
>
> **THE WEIGHT OF THE ROBOT UNIT IS 44 lb (20 kg).**
>
> ***This unit is very heavy. To avoid injury or damage to the unit, always replace the robot with the aid of a second person. Refer to the following procedures for complete replacement instructions***

To replace the robot in the WaferMark® SigmaDSC NT system, carry out the following instructions:

1. Remove the new robot from its shipping container and inspect for any damage that may have occurred in transit
2. Install the two barbed vacuum fittings and exhaust flange removed from the old robot.
3. With the aid of a second person, grasp the top flange and carry the robot from the work surface to the front of the cabinet.
4. With one person positioned on each side of the robot, grasp the base with one hand and the flange with the other. Gently raise the unit and tilt forward to approximately 45°.
5. Lift the unit back into the robot enclosure (over the platform baseplate) and temporarily rest the unit against the sides of the baseplate opening. Grasp and steady the unit with both hands to prevent it toppling.
6. With one person supporting the base of the robot (from the opening at the front of the cabinet) and the second person grasping the top flange, gently maneuver the unit through the opening, then lower the robot into position on top of the support flange.

7. For Brooks-PRI (Equipe) units ONLY, raise the unit sufficiently to allow the standoffs to be inserted between the top flange and the support flange and insert the three securing screws through the top flange and the standoffs.
8. For both robot styles, swivel the unit until the overhanging robot arm is directly towards the front of the cabinet, and then tighten the screws into the baseplate flange.
9. Re-install both end effectors using the four securing screws. Install the green vacuum line onto the end effector closest to the front of the enclosure, and install the red vacuum line onto the end effector nearest the back of the enclosure.
10. Remove the new controller box from the shipping container and inspect for any damage that may have occurred in transit. Install the box into the marking enclosure and connect the power and communication cables.
11. Remove the cables from the shipping container and install them between the robot and controller; be careful not to bend any of the pins. Secure the cables using the appropriate cable ties.
12. Using a bubble level, check that the robot base plate and cassette presenter plates are level. If either is not level at this point, make adjustments to make them level.
13. With the robot level and the arm in the retracted position, place a wafer on one of the two end effectors. Put a small level on top of the wafer and use the adjusting screws to level the end effector. Extend the arm and recheck that it is level. Repeat the leveling process for the opposite end effector.
14. Replace and secure the front panel of the System.
15. Proceed with the robot leveling procedure given in Section 6.9.

6.9 Robot Leveling and End Effector Setup Procedure

EQUIPMENT REQUIRED

- High quality Bubble Level
- Adjustable Wrench
- Allen Wrenches

- Cassette of Wafers

LEVELING THE ROBOT

Before the handling system can be set up, the robot must be leveled as follows:

1. Place the bubble level on the top plate of the robot, mid-way between the center column and the screw at the front of the plate.
2. Adjust all four leveling feet on the bottom of the enclosure until the bubble on the level is accurately centered. Tighten the locking nuts on the leveling feet, then re-check that the bubble is still centered.

END EFFECTOR SETUP

1. Remove the padlock and turn the system circuit breaker on the right-hand side of the cabinet to ON.
2. Power up the system by turning the MASTER keyswitch to ON.
3. Inspect both end effectors for damage, including the tape on the bottom of the effectors. If the tape is damaged, the end effector will not hold vacuum, which will cause the wafers to be dropped.
4. Ensure that all screws are in the proper positions and that there is a vacuum mount on each end effector.
5. Back the set screws out to the point where they are not extending from the bottom of the effector.
6. Mount the end effector on the robot, being careful not to overtighten the mounting screws. (These should only be finger-tightened from the shaft of the Allen wrench being used.)
7. From the Main Menu, select the **Maintenance Menu** and select the **Robot** command.
8. Type `>SVFA` to turn off the robot's servo motor.
9. First, determine which vacuum line is designated '0' and which is '1'. Type `OUT 1,0` and press **Enter**. This will turn on vacuum for the line that will go to end effector '0'. Make

a note of the color of the line which has vacuum applied. (Normally, this line ['0'] will be either green or blue and the color of the line with no vacuum ['1'] will be red.)

10. Now determine which end effector is designated '0' and which '1'. Manually extend one of the end effectors towards the front of the system. Type RCP R. If the number displayed on the screen is a negative value, this is end effector '0'. If the number is positive, this is end effector '1'.
11. Type OUT 1,1 to turn off the vacuum.
12. Connect the vacuum line identified as '0' in step 9 to the end effector identified as '0' in step 10. Connect the other vacuum line to the opposite end effector.
13. Extend end effector '0' over the center presenter.
14. Type OUT 1,0 to turn on the vacuum.
15. Place a wafer on the end effector, then place the bubble level on the wafer, centered above the jaws of the end effector.
16. Tighten the set screws on the end effector until they are pressing against the robot arm.
17. Using the two mounting screws and three set screws, level the end effector. (These are not spring loaded, so, to make the adjustments, one or more screws may have to be loosened to tighten another.)
18. Type OUT 1,1 to turn off the vacuum and remove the wafer.
19. Rotate the robot until the end effector '1' is extended over the center presenter.
20. Type OUT 2,0 to turn on the vacuum for end effector '1'.
21. Repeat steps 15 through 17 for the second end effector.
22. Type OUT 2,1 to turn off the vacuum.
23. Type SVNA to the robot's servo motor on.
24. Type HOM to home the robot.
25. Press **Esc** to exit the Robot Calibration screen.
26. Proceed with the robot teach procedure (see Section 6.11).

6.10 Leveling the Wafer Marker System

Level the wafer marker system by leveling the:

- robot lower arm
- robot end effectors
- presenter plate
- aligner
- optic head.

1. To level the robot's lower arm (see Figure 6-19):
   a. Place a bubble level on the robot's lower arm.

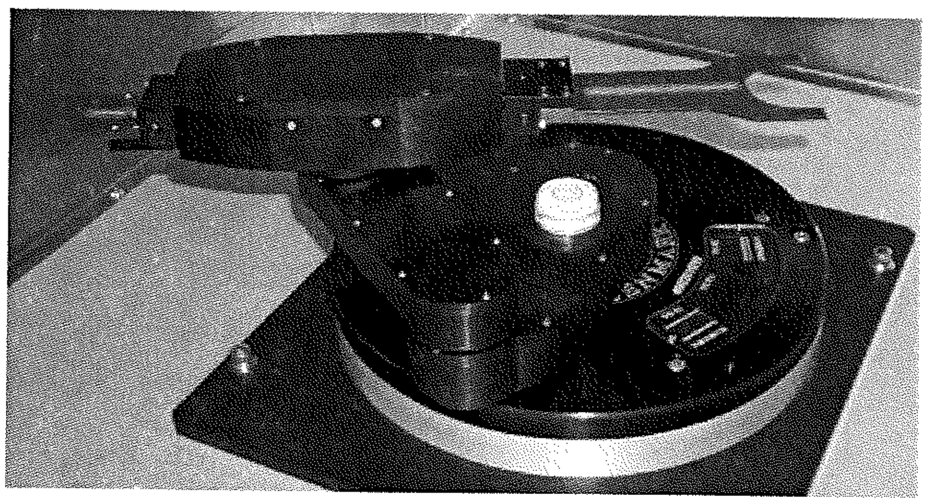


Figure 6-19 – Leveling the Genmark Robot Lower Arm

   b. View the bubble level to check the level setting. If an adjustment is needed, adjust the four feet on the WaferMark® SigmaDSC NT system cabinet until it is level.

2. To level the robot end effectors (see Figure 6-20):
   a. Place a wafer on top of one end effector.

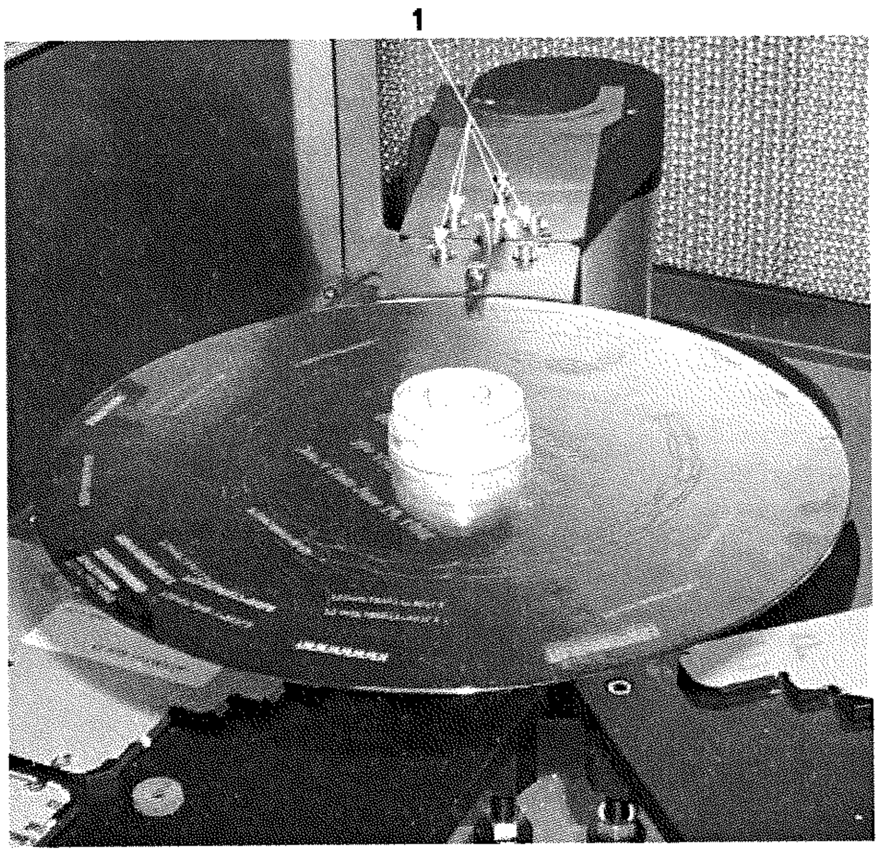


Figure 6-20 – Leveling the Equipe End Effector

1 Leveling set screws

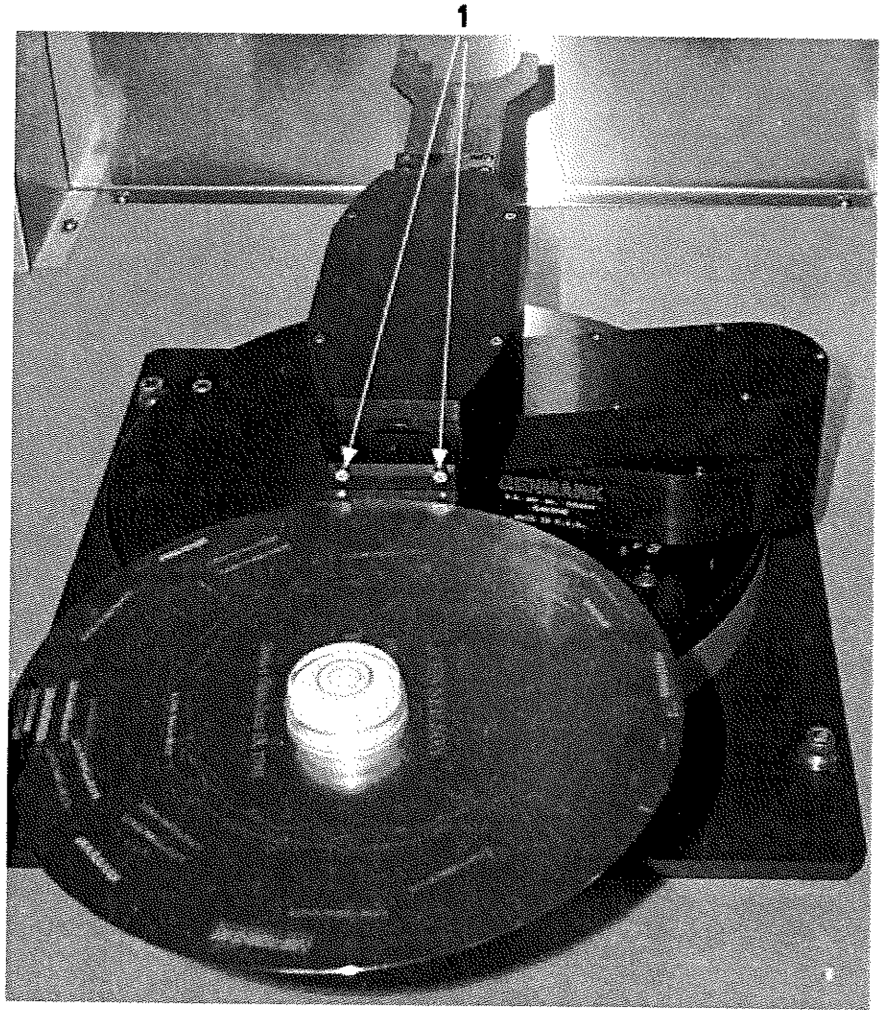


Figure 6-21 – Leveling the Genmark End Effector

1 Leveling set screws

b. Place a bubble level on the wafer and view it.

c. If an adjustment is needed, adjust the leveling set screws.

3. To level the presenter plate (see Figure 6-22):

   a. Place and view a bubble level on the presenter plate to the immediate side of a cassette locator.

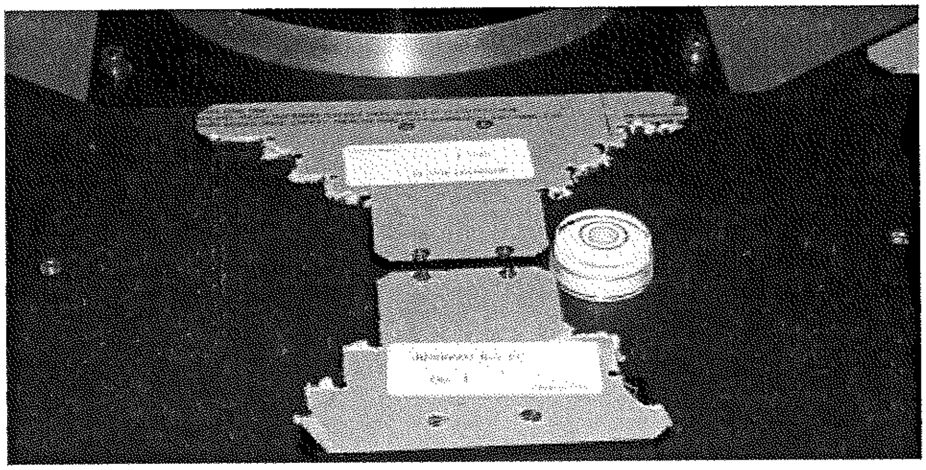


Figure 6-22 – Leveling the Presenter Plate

b. If an adjustment is needed:

   i. Loosen the sockethead screws using a 5/32 hex key (see Figure 6-23).

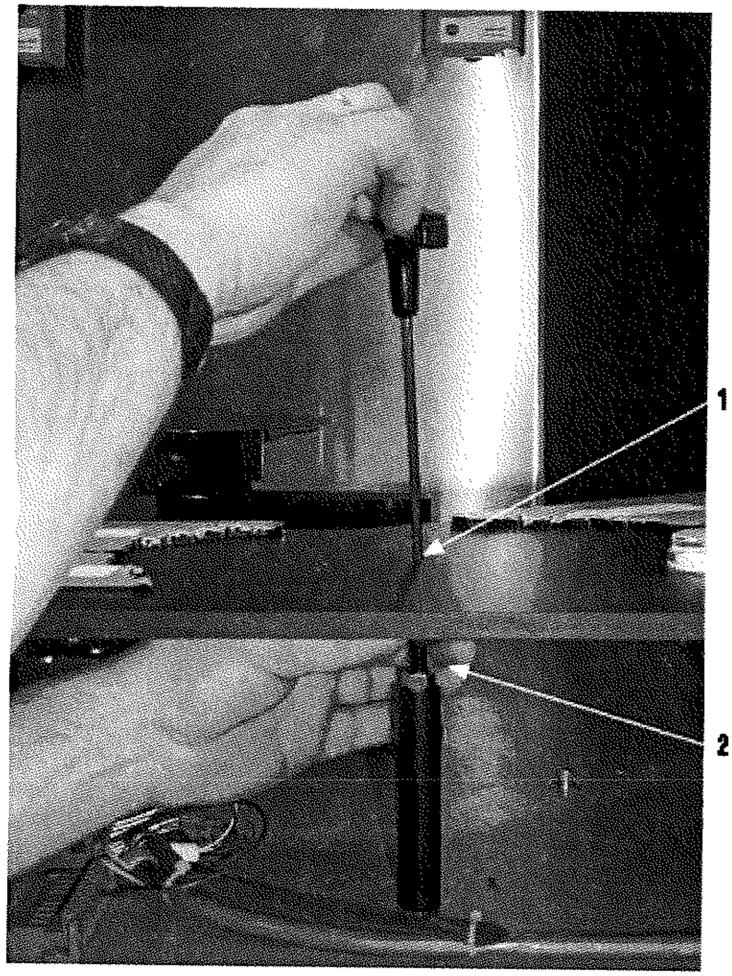


Figure 6-23 – Adjusting the Presenter Plate

1 Sockethead screw
2 Locking nut

ii. Under the presenter plate, loosen the locking nuts nearest the cassette locator.

iii. Loosen the sockethead screws and rotate the adjuster.

iv. Inspect the bubble level, fine-tuning the adjusters until the presenter plate is level next to the cassette locator.

c. Move the bubble level to the other side of the cassette locator and repeat step b.

d. For each remaining cassette locator on the presenter plate (see Figure 6-24), repeat the above process.

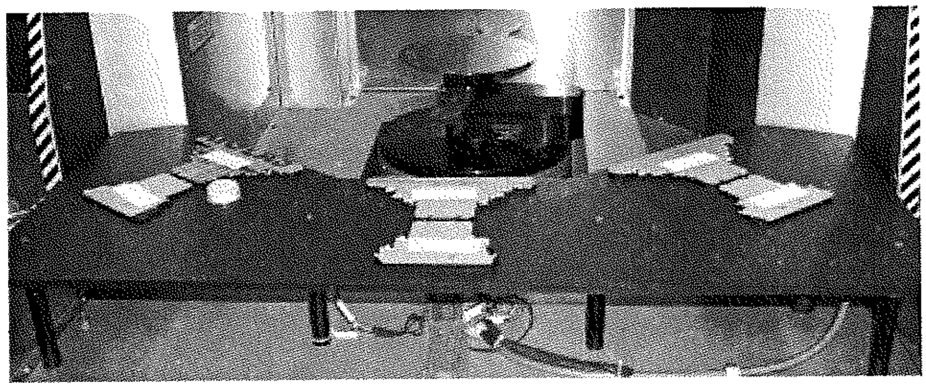


Figure 6-24 – Cassette Locators

4. To level the aligner (see Figure 6-25):

   a. Place a bubble level on the aligner.

   b. Place a mirror on top of the aligner so as to be able to see the bubble level.

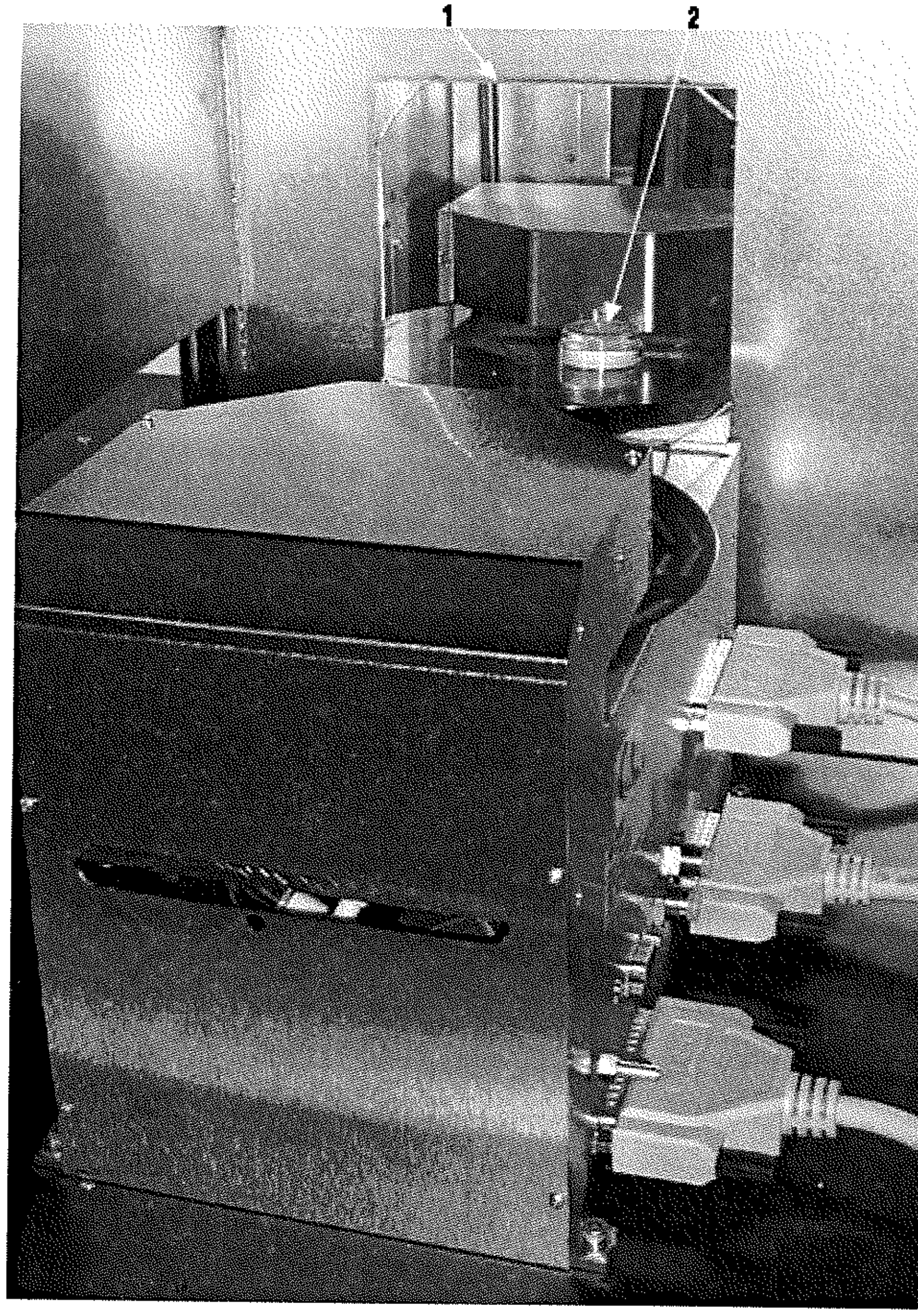


Figure 6-25 – Leveling the Aligner

1 Mirror
2 Bubble level on top of aligner (as seen in mirror)

c. View the bubble level through a mirror, as shown. If an adjustment is needed, adjust by hand the three leveling set screws underneath the aligner box (see Figure 6-26).

NOTE: Maintain a distance from the lens bottom of 13.225+/-.050 inches.

1

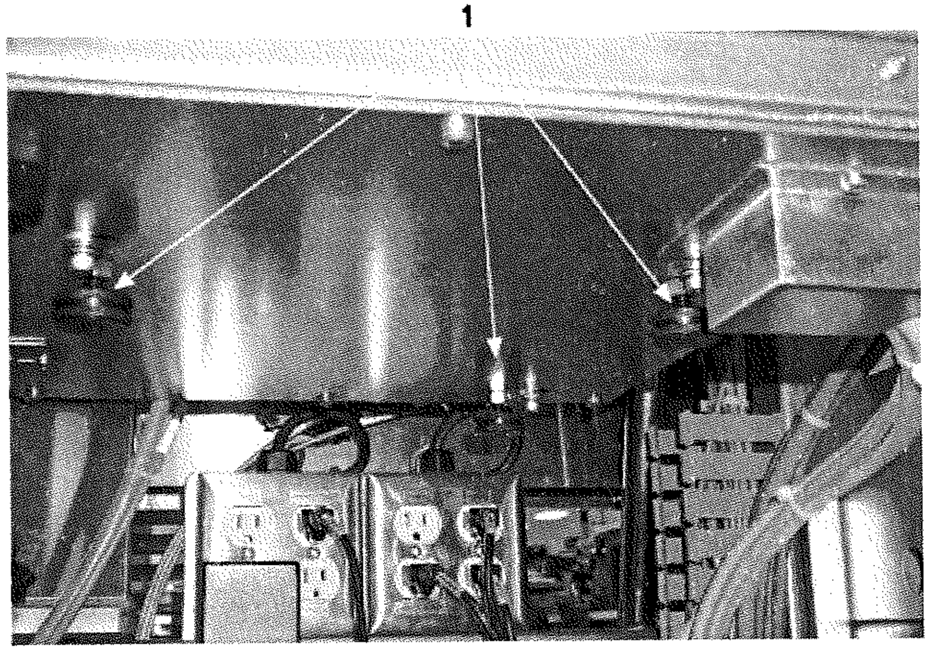


Figure 6-26 – Aligner Leveling Set Screws

1 Aligner leveling set screws

5. To level the optic head (see Figure 6-27):

   a. Place a bubble level on the optic head and observe it. If an adjustment is needed, adjust the four leveling set screws.

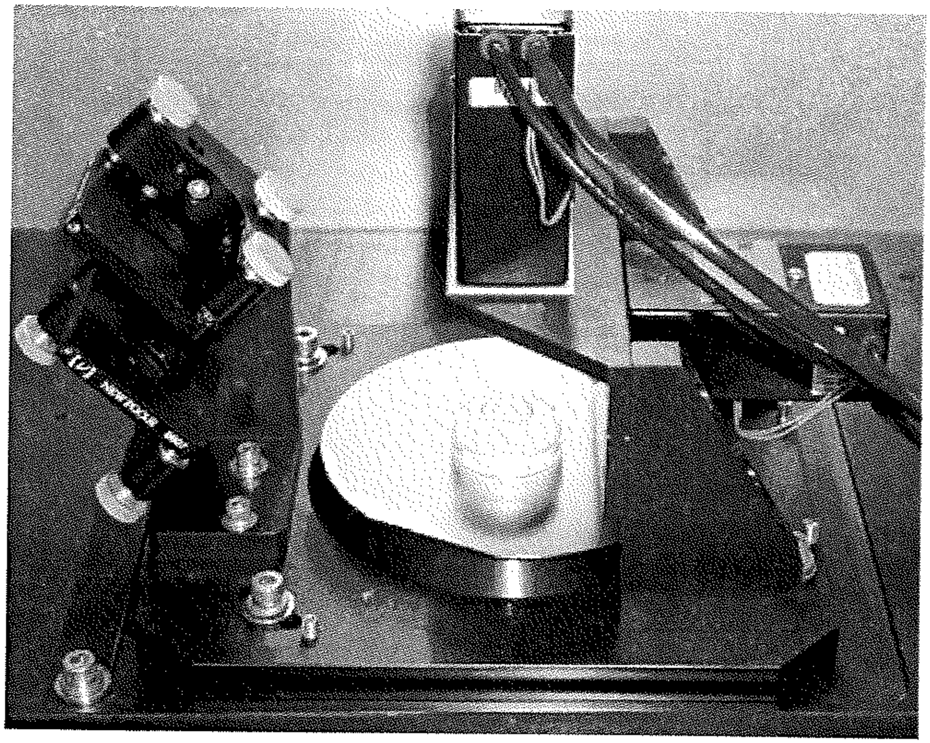


Figure 6-27 – Leveling the Optic Head

6.11 Teaching the Robot Handler

⚠ CAUTION
Potential Equipment Damage

The procedures in this section are only to be done by service technicians who have successfully completed training and been certified in robot teaching procedures at the GSI Lumonics factory.

⚠ CAUTION
FAILURE TO CARRY OUT THE ROBOT TEACH PROCEDURE RISKS DAMAGE!

FAILURE TO CARRY OUT THE ROBOT TEACH PROCEDURE BEFORE PERFORMING ANY WAFER TRANSFER OPERATIONS CAN CAUSE SERIOUS DAMAGE TO THE ROBOT ARMS, ROBOT ASSEMBLY, END EFFECTORS, WAFERS AND/OR THE CASSETTE.

6.11.1 Brooks-PRI (Equipe) Robot Teach Procedure

NOTE: This section is only for use with a Brooks-PRI (Equipe) Robot. When instructed to Type a value, press ***Enter*** *key after typing the value.*

1. Reference Table 6-3 for position names:

Table 6-3 – Brooks-PRI (Equipe) Robot Teach References

Arm	Arm Position	Leftmost Presenter Position	Center Presenter Position	Rightmost Presenter Position	Aligner
0	rightside up	A	C	E	Y
1	rightside up	B	D	F	Z

2. Teach the robot arms 0 and 1 the aligner positions:
   a. Teach arm 0 the aligner position:
      i. Verify that arm 0 is connected to the RED vacuum hose.
      ii. In the **Maintenance** menu, select **Robot**, then **Terminal**. Type:
         a. **>SVFA** to turn off the servo motors

b. `> OUT 1,0` to turn on the vacuum

c. `> OUT 1,1` to turn off the vacuum.

iii. Raise the robot by hand until the arm 0 is roughly 1/16-inch BELOW the top of the aligner chuck.

iv. Type `>SVN Z` to lock the robot at that height.

v. Center the arm 0 around the aligner chuck. Rotate the arm in one direction until the arm touches the chuck. Type `>RCP T` and write down the value. Rotate the arm in the opposite direction until the arm touches the chuck. Type `>RCP T` and write down the value. Average the values to get the T value.

NOTE: Make sure the arm does not physically hit the aligner sensors.

vi. Type `>RCP R` and record the R value. Type `RCP Z` and record the Z value. For definitions, see Table 6-4.

Table 6-4 – Radial Coordinate Definitions

Radial Coordinates	Definition
R	Radial distance from the center of rotation. As an example, Station A (Arm 0) will be assigned a positive R value and Station B (Arm 1) will be assigned a negative R value. • +R = the radial distance from the center point when the arm is extended. These values move Arm 0 out. • –R = the radial distance from the center point when the arm is retracted. These values move Arm 1 out.
T (theta (θ))	Angle that the arm is rotated from the home position. • +T is measured in the clockwise direction. • -T is measured in a counter-clockwise direction.
Z	Elevation that the entire arm mechanism is raised (+Z) or lowered (-Z).

vii. Program the position into the robot:

a. In the **Maintenance** menu, select **Robot**, then **Aligner.** Use the track ball to position the cursor and type the new R, T, and Z values for position Y.

b. Press **Apply** button to save the new values into the software. Press the **Robot Control** screen **Init** button to initialize the new values into the robot.

c. A **Cassette Size** screen appears. Select the wafer size in use from the drop-down menu, then press **OK**.

b. Teach arm 1 the aligner position:

   i. Verify that arm 1 is connected to the BLUE vacuum hose.

   ii. Repeat step 2.a for arm 1, substituting R, T, and Z values for position Z. Record the new R, T, and Z values for position Z.

c. Verify the aligner position:

   NOTE: Record the robot acceleration and speed for all R, T and Z values before changing any values.

   i. Reduce the R speed for safety. In the **Maintenance** menu, select **Robot**.

   ii. Change the radial speed to `200`.

   iii. Press the **Apply** button to save the new values into the software. Press the **Robot Control** screen **Init** button to initialize the new values into the robot.

   iv. Go to the **Terminal** screen. Type `>GET Y`. Arm 0 should extend into the aligner, then retract to home. Type `>GET Z`. Arm 1 should extend into the aligner, then retract to home.

3. Teach the robot arms the presenter stations:

   a. Align a wafer:

      i. Place a wafer on the aligner chuck. Make sure it is close to being centered on the aligner.

      ii. Select the **Aligner** tab in the **Robot Terminal** screen.

      iii. Type:

         a. `SWD *`, where * is the wafer diameter in mm

         b. `SAO 2700` to align the wafer notch to the back center of the cassette

         c. `>BAL` to begin the wafer alignment; then wait for `>0810` to return on the screen

         d. `>REL` to release the vacuum from the wafer.

   b. Train arm 0 for the presenter stations:

i. Get the wafer from the aligner. Select the **Robot** tab in the **Robot Terminal** screen. Type `>GET Y`.

ii. Type `>SVFA` to turn off the robot's servo motor.

iii. Teach the leftmost presenter station. This is station A:

  a. Place an empty cassette on station A.

  b. Carefully manually move the robot so the wafer is centered into the bottom slot of the cassette. Gently move the robot arm into the cassette. Be sure the wafer does not touch any part of the cassette.

  NOTE: If the wafer shifts on the robot arm, then the wafer must be re-aligned. Redo the procedure from step 3.a.

  c. Type `>RCP R`, then `>RCP T`, and finally `>RCP Z`. The screen replies to each with the requested value. Record these values.

  NOTE: For an 8–inch wafer, subtract 395 from the Z-value reported by the RCP command to determine the approximate Z-value to enter in the step below for programming the presenter position into the robot.

iv. Teach the center presenter station. This is station C:

  a. Repeat the same steps as for station A. Record the values.

  NOTE: If the wafer shifts on the robot arm, then the wafer must be re-aligned. Redo the procedure from step 3.a and reteach station C.

v. Teach the rightmost presenter station. This is station E:

  a. Repeat the same steps as for station A. Record the values.

  NOTE: If the wafer shifts on the robot arm, then the wafer must be re-aligned. Redo the procedure from step 3.a and reteach station E.

vi. Press **OK** to exit the **Robot Terminal** screen.

vii. Program the presenter positions into the robot:

  a. Select the **Cassette** tab in the **Robot Calibration** screen. Use the track ball to position the cursor and type the new R, T, and Z values for positions A, C, and E (or A and C for a two-cassette system).

b. Press the **Apply** button to save the new values into the software. Press the **Robot Control** screen **Init** button to initialize the new values into the robot.

c. Train arm 1 for the presenter stations:

i. Remove the wafer from the robot. Repeat step 3.a to align the wafer.

ii. Get the wafer from the aligner. Select the **Robot** tab in the **Robot Terminal** screen. Type **>GET Z**. Type **>SVFA** to turn off the robot's servo motor.

iii. Teach the leftmost presenter station. This is station B.

iv. Teach the center presenter station. This is station D.

v. Teach the rightmost presenter station. This is station F.

vi. Press **OK** to exit the **Robot Terminal** screen.

vii. Program the presenter positions into the robot:

a. Select the **Cassette** tab in the **Robot Calibration** screen. Use the track ball to position the cursor and type in the new R, T, and Z values for position B, D, and F (or B and D for a two-cassette system).

b. Press the **Apply** button to save the new values into the software. Press the **Robot Control** screen **Init** button to initialize the new values into the robot.

d. Test the presenter station:

NOTE: Check that the robot speed is still 200.

i. Test station A:

a. Place an empty cassette on station A. Place a wafer in the bottom slot of the cassette.

b. Select the **Terminal** tab in the **Robot Calibration** screen. Type **>GET A,1** to get the wafer. Observe the movement. Type **PUT Y** to place the wafer into the aligner.

c. Select the **Aligner** tab. Type **>BAL**.

d. Wait for the aligner to return a value, then type>REL.

e. Select the **Robot** tab in the **Robot Terminal Robot** screen. Type >GET Y.

f. Wait for the robot to return a value, then type >PUT A,1. Observe the robot's movement.

e. If the wafer is properly aligned, go to step h. Otherwise, continue with step f.

f. Fine tune the presenter station:

i. Select the **Cassette** tab in the **Robot Calibration** screen. Increment or decrement the R, T, and Z values of any presenter station where the wafer is not perfectly centered in the cassette slot.

ii. Press the **Apply** button to save the new values into the software. Press the **Robot Control** screen **Init** button to initialize the new values into the robot.

iii. Retest the presenter station that was fine tuned.

g. Repeat step 3.f until the presenter stations are tuned.

h. Test stations B, C, D, E, F using the same steps from 3.d. Use the following aligner stations for the appropriate presenter station.

Table 6-5 – Aligner – Presenter Station Relationships

Aligner	Y	Y	Y	Z	Z	Z
Presenter	A	C	E	B	D	F

4. Save the **.set** files to a floppy disk. Label the floppy disk.
5. Create a directory **C:\WaferMarkNT\robot** and copy robot disks into this directory.
6. Create a directory **C:\WaferMarkNT\aligner** and copy aligner disks into this directory.
7. Restore the original robot speed value, as recorded in step 2c.

6.11.2 GenMark Robot Teach Procedure

NOTE: This section is only for use with a GenMark Robot.

1. Reference Table 6-6 for position names:

Table 6-6 – GenMark Robot Teach References

Arm	Arm Position	Leftmost Presenter Position	Center Presenter Position	Rightmost Presenter Position	Aligner
0	rightside up	A	C	E	Y
0	upside down	a	c	e	W
1	rightside up	B	D	F	Z
1	upside down	b	d	f	X

2. Teach the robot with the arms in the UP position:
   a. Teach arm 0 the aligner position:
      i. Verify arm 0 by turning the vacuum on. In the **Maintenance** menu, select **Robot**, then **Terminal**. Type `>OUT 1,0` to turn the vacuum on. Type `>OUT 1,1` to turn the vacuum off.
      ii. Type `>RUP 0` to make sure the arm is in the UP position.
      iii. In the **Maintenance** menu, select **Robot**, then **Terminal**. Type `>SVFA` to turn off the robot's servo motor.
      iv. To move the robot in the Z-axis, type `MVR Z,xxx`, where xxx represents a distance based on one inch = 1000. Repeat this command until arm 0 is roughly 1/16-inch below the top of the aligner chuck.
      v. Center the arm 0 around the aligner chuck. Rotate the arm in one direction until the arm touches the chuck. Type `>RCP T` and write down the value. Rotate the arm in the opposite direction until the arm touches the chuck. Type `>RCP T` and write down the value. Average the values to get the T value.

         NOTE: Make sure the arm does not physically hit the aligner sensors.
      vi. Type `>RCP R` and record the R value. Type `RCP Z` and record the Z value. For definitions, see Table 6-4.
      vii. Program the aligner position into the robot:
         a. In the **Maintenance** menu, select **Robot**, then **Aligner**. Use the track ball to position the cursor and type the new R, T, and Z values for position Y.

b. Press **Apply** button to save the new values into the software. Press the **Robot Control** screen **Init** button to initialize the new values into the robot.

c. A **Cassette Size** screen appears. Select the wafer size in use from the drop-down menu, then press **OK**.

b. Teach arm 1 the aligner position:

i. Verify arm 1 by turning the vacuum on and feeling the vacuum at the end effector. In the **Maintenance** menu, select **Robot**, then **Terminal**. Type `>OUT 2,0` to turn the vacuum on. Type `>OUT 2,1` to turn the vacuum off.

ii. Type `>RUP 1` to make sure the arm is in the UP position.

iii. Repeat step 2.a for arm 1. Record the new R, T, and Z values for position Z.

c. Verify the aligner position:

NOTE: Record the robot acceleration and speed for all R, T and Z values before changing any values.

i. Reduce the R speed for safety: In the **Maintenance** menu, select **Robot**.

ii. Change the radial speed to `200`.

iii. Press the **Apply** button to save the new values into the software. Press the **Robot Control** screen **Init** button to initialize the new values into the robot.

iv. Go to the **Terminal** screen. Type `>GET Y`. Type `>ABM` (abort movement) and prepare to hit **Enter** if the robot seems like it will crash. Arm 0 should extend into the aligner, then retract to home.

> **⚠ CAUTION**
> **Potential Equipment Damage**
> It is essential to be prepared to abort the robot movement as directed above. Immediately hit the **Enter** key if a robot crash seems imminent.

If arm 0 does not extend into the aligner, repeat steps 2 a and b.

d. Align a wafer:

   i. Place a wafer on the aligner chuck. Make sure it is close to being centered on the aligner.

   ii. Select the **Aligner** tab in the **Robot Terminal** screen.

   iii. Type:

      a. `>SWD *`, where * is the wafer diameter in mm

      b. `SAO 2700` to align the wafer notch to the back center of the cassette

      c. `>BAL` to begin the wafer alignment; then wait for `>0810` to return on the screen

      d. `>REL` to release the vacuum from the wafer.

e. Train arm 0 for the presenter stations:

   i. Check that the robot speed is set to 200.

   ii. Get the wafer from the aligner. Select the **Robot** tab in the **Robot Terminal** screen. Type `>GET W`.

   iii. Type `>SVFA` to turn off the robot's servo motor.

   iv. Teach the leftmost presenter station. This is station A:

      a. Place an empty cassette on station A.

      b. To move the robot in the Z-axis, type `MVR Z,-xxx`, where xxx represents a distance based on one inch = 1000. Repeat this command until the wafer is centered into the bottom slot of the cassette.

      NOTE: If the wafer shifts on the robot arm, then the wafer must be re-aligned. Redo the procedure from step 2.

c. Type >RCP R, then >RCP T, and finally >RCP Z. The screen replies to each with the requested value. Record these values.

NOTE: For an 8–inch wafer, subtract 395 from the Z-value reported by the RCP command to determine the approximate Z-value to enter in the step below for programming the presenter position into the robot.

v. Teach the center presenter station. This is station C:

a. Repeat the same steps as for station A. Record the values.

NOTE: If the wafer shifts on the robot arm, then the wafer must be re-aligned. Redo the procedure from step2.d and reteach station C.

vi. Teach the rightmost presenter station. This is station E:

a. Repeat the same steps as for station A. Record the values.

NOTE: If the wafer shifts on the robot arm, then the wafer must be re-aligned. Redo the procedure from step 2.d and reteach station E.

vii. Press **OK** to exit the **Robot Terminal** screen.

viii. Program the presenter positions into the robot:

a. Select the **Cassette** tab in the **Robot Calibration** screen. Use the track ball to position the cursor and type in the new R, T, and Z values for position A, C, and E (or A and C for a two-cassette system).

b. Press the **Apply** button to save the new values into the software. Press the **Robot Control** screen **Init** button to initialize the new values into the robot.

f. Train arm 1 for the presenter stations:

i. Remove the wafer from the robot. Repeat step 2.a to align the wafer.

ii. Get the wafer from the aligner. Select the **Robot** tab in the **Robot Terminal** screen. Type >GET Z.

iii. Type >SVFA to turn off the robot's servo motor.

iv. Teach the leftmost presenter station. This is station B.

v. Teach the center presenter station. This is station D.

vi. Teach the rightmost presenter station.
This is station F.

vii. Press **OK** to exit the **Robot Terminal** screen.

viii. Program the presenter positions into the robot:

a. Select the **Cassette** tab in the **Robot Calibration** screen. Use the track ball to position the cursor and type in the new R, T, and Z values for position B, D, and F (or B and D for a two-cassette system).

b. Press the **Apply** button to save the new values into the software. Press the **Robot Control** screen **Init** button to initialize the new values into the robot.

g. Test the presenter station:

i. Check that the robot speed is set to 200.

ii. Test station A:

a. Place an empty cassette on station A. Place a wafer in the bottom slot of the cassette.

b. Select the **Terminal** tab in the **Robot Calibration** screen. Type `>GET A,1` to get the wafer. Observe the movement. Type `PUT W` to place the wafer into the aligner.

c. Select the **Aligner** tab. Type `>BAL`. Wait for the aligner to return a value, then type`>REL`.

d. Select the **Robot** tab in the **Robot Terminal Robot** screen. Type `>GET W`. Wait for the robot to return a value, then type `>PUT A,1`. Observe the robot's movement.

h. If the wafer is properly aligned, go to step j. Otherwise, continue with step i.

i. Fine tune the presenter stations:

i. In the **Maintenance** menu, select **Robot**. Increment or decrement the R, T, and Z values of any presenter station where the wafer is not perfectly centered in the cassette slot.

ii. Press the **Apply** button to save the new values into the software. Press the **Robot Control** screen **Init** button to initialize the new values into the robot.

iii. Retest the presenter stations that were fine tuned.

iv. Repeat step 2.i until the presenter stations are tuned.

j. Test stations B, C, D, E, F using the same steps from step 2.g. Use the following aligner stations for the appropriate presenter station.

Table 6-7 – Aligner – Presenter Station Relationships

Aligner	Y	Y	Y	Z	Z	Z
Presenter	A	C	E	B	D	F

3. Teach the robot with the arms in the DOWN position:

a. Teach arm 0 the aligner position:

i. Type `RDW 0` to make sure the arm is in the DOWN position.

ii. In the **Maintenance** menu, select **Robot**, then **Terminal.** Type `>SVFA` to turn off the robot's servo motor.

iii. Raise the robot by hand until the arm 0 is roughly 1/8" ABOVE the top of the aligner chuck.

iv. Center the arm 0 around the aligner chuck. Rotate the arm in one direction until the arm touches the chuck. Type `>RCP T` and write down the value. Rotate the arm in the opposite direction until the arm touches the chuck. Type `>RCP T` and write down the value. Average the values to get the T value.

NOTE: Make sure the arm does not physically hit the aligner sensors.

v. Type `RCP R` and record the R value. Type `>RCP Z` and record the Z value. For definitions, see Table 6-4.

vi. Program the aligner position into the robot:

a. In the **Maintenance** menu, select **Robot**, then **Aligner.** Use the track ball to position the cursor and type the new R, T, and Z values for position Y.

b. Press **Apply** button to save the new values into the software. Press the **Robot Control** screen **Init** button to initialize the new values into the robot.

c. A **Cassette Size** screen appears. Select the wafer size in use from the drop-down menu, then press **OK**.

b. Teach arm 1 the aligner position:

   i. Type `>RDW 1` to make sure the arm is in the DOWN position.

   ii. Repeat step 3.a for arm 1, substituting R, T, and Z values for position Z. Record the new R, T, and Z values for position Z.

c. Verify the aligner position:

   i. Reduce the R speed for safety. In the **Maintenance** menu, select **Robot.** Change the radial speed to `200`.

   ii. Press the **Apply** button to save the new values into the software. Press the **Robot Control** screen **Init** button to initialize the new values into the robot.

   iii. Go to the **Terminal** screen. Type `>GET Y`. Arm 0 should extend into the aligner, then retract to home. If it does not,repeat steps 2 a and b.

   iv. Type `>GET Z`. Arm 1 should extend into the aligner, then retract to home. If it does not, repeat steps 2 a and b.

d. Align a wafer:

   i. Place a wafer on the aligner chuck. Make sure it is close to being centered on the aligner.

   ii. Select the **Aligner** tab in the **Robot Terminal** screen.

   iii. Type:

      a. `>SWD *`, where * is the wafer diameter in mm

      b. `SAO 2700` to align the wafer notch to the back center of the cassette

      c. `>BAL` to begin the wafer alignment; then wait for `>0810` to return on the screen

      d. `>REL` to release the vacuum from the wafer.

e. Train arm 0 for the presenter stations:

   i. Get the wafer from the aligner. Select the **Robot** tab in the **Robot Terminal** screen. Type `>GET W`.

   ii. Type `>SVFA` to turn off the robot's servo motor.

   iii. Teach the leftmost presenter station. This is station A:

      a. Place an empty cassette on station A.

      b. Type MVR Z, -xxx and repeat until the wafer is centered into the bottom slot of the cassette.

      NOTE: If the wafer shifts on the robot arm, then the wafer must be re-aligned. Redo the procedure from step 3.d.

      c. Type `>RCP R`, then `>RCP T`, and finally `>RCP Z`. The screen replies to each with the requested value. Record these values.

      NOTE: For an 8–inch wafer, subtract 395 from the Z-value reported by the RCP command to determine the approximate Z-value to enter in the step below for programming the presenter position into the robot.

   iv. Teach the center presenter station. This is station C:

      a. Repeat the same steps as for station A. Record the values.

      NOTE: If the wafer shifts on the robot arm, then the wafer must be re-aligned. Redo the procedure from step 3.d and reteach station C.

   v. Teach the rightmost presenter station. This is station E:

      a. Repeat the same steps as for station A. Record the values.

      NOTE: If the wafer shifts on the robot arm, then the wafer must be re-aligned. Redo the procedure from step 3.a and reteach station E.

   vi. Press **OK** to exit the **Robot Terminal** screen.

   vii. Program the presenter positions into the robot:

      a. In the **Maintenance** menu, select **Robot**, then **Presenter**. Use the track ball to position the cursor and type the new R, T, and Z values for positions A, C, and E.

b. Press the **Apply** button to save the new values into the software. Press the **Robot Control**screen **Init** button to initialize the new values into the robot.

f. Train arm 1 for the presenter stations:

i. Remove the wafer from the robot. Repeat step 3.a to align the wafer.

ii. Get the wafer from the aligner. Select the **Robot** tab in the **Robot Terminal** screen. Type `>GET Z`.

iii. Type `>SVFA` to turn off the robot's servo motor.

iv. Teach the leftmost presenter station. This is station B:

v. Teach the center presenter station. This is station D:

vi. Teach the rightmost presenter station. This is station F:

vii. Program the presenter positions into the robot:

a. In the **Maintenance** menu, select **Robot**, then **Presenter**. Use the track ball to position the cursor and type the new R, T, and Z values for positions B, D, and F.

b. Press the **Apply** button to save the new values into the software. Press the **Robot Control**screen **Init** button to initialize the new values into the robot.

g. Test the presenter stations:

i. Test station A:

a. Place an empty cassette on station A. Place a wafer in the bottom slot of the cassette.

b. Check that the robot speed is set to 200.

c. Select the **Terminal** tab in the **Robot Calibration** screen. Type `>GET A,1` to get the wafer. Observe the movement. Type `PUT W` to place the wafer into the aligner.

d. Select the **Aligner** tab. Type `>BAL`. Wait for the aligner to return a value, then type`>REL`.

e. Select the **Robot** tab in the **Robot Terminal Robot** screen. Type `>GET W`. Wait for the robot to return a value, then type `>PUT A,1`. Observe the robot's movement.

h. Fine tune the presenter stations:

   i. In the **Maintenance** menu, select **Robot**. Increment or decrement the R, T, and Z values of any presenter station where the wafer is not perfectly centered in the cassette slot.

   ii. Press the **Apply** button to save the new values into the software. Press the **Robot Control** screen **Init** button to initialize the new values into the robot.

   iii. Retest the presenter stations that were fine tuned.

   i. Repeat step 3.h until the presenter stations are tuned.

i. Test stations B, C, D, E, F using the same steps from 3.h.. Use the following aligner stations for the appropriate presenter station.

Table 6-8 – Aligner – Presenter Station Relationships

Aligner	Y	Y	Y	Z	Z	Z
Presenter	A	C	E	B	D	F

4. Save the **.set** files to a floppy disk. Label the floppy disk.
5. Create a directory **C:\WaferMarkNT\robot** and copy robot disks into this directory.
6. Create a directory **C:\WaferMarkNT\aligner** and copy aligner disks into this directory.
7. Restore the original robot speed value, as recorded in step 2c.

6.12 5 kVA Transformer Removal Procedure

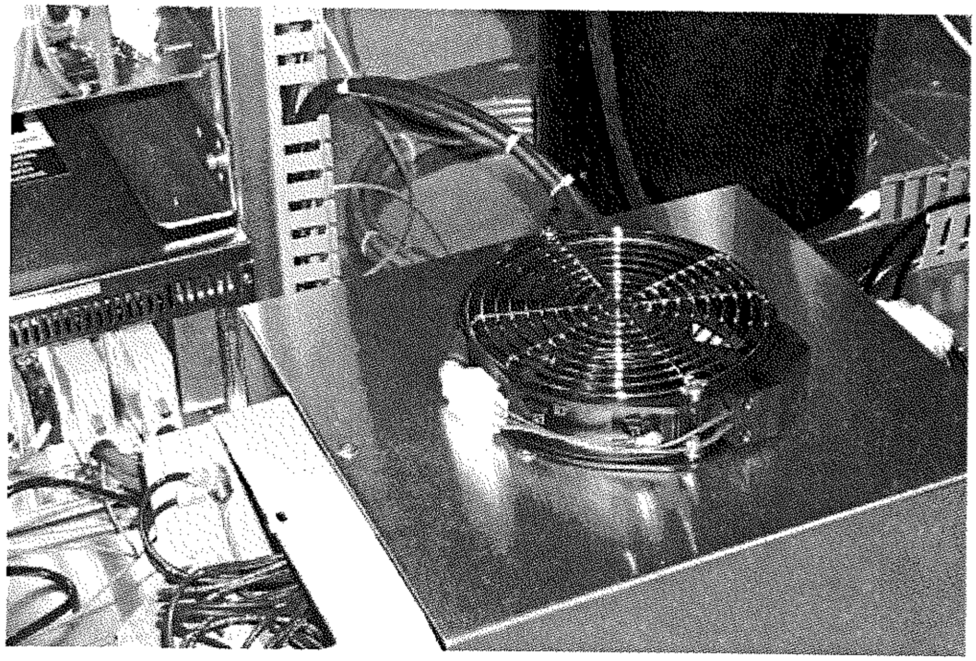
Only service technicians or end-user personnel who are trained and certified by GSI Lumonics should perform the following removal procedures.

> **⚠ WARNING**
> **IMPROPER HANDLING DURING UNIT REMOVAL CAN CAUSE SERIOUS INJURY TO HANDS OR FINGERS AND CAN ALSO DAMAGE UNIT. THE TRANSFORMER WEIGHS 85 lb (38.6 kg)**
>
> This unit is very heavy. To avoid injury, always remove the transformer with the aid of a second person. Refer to the following procedures for complete removal instructions.

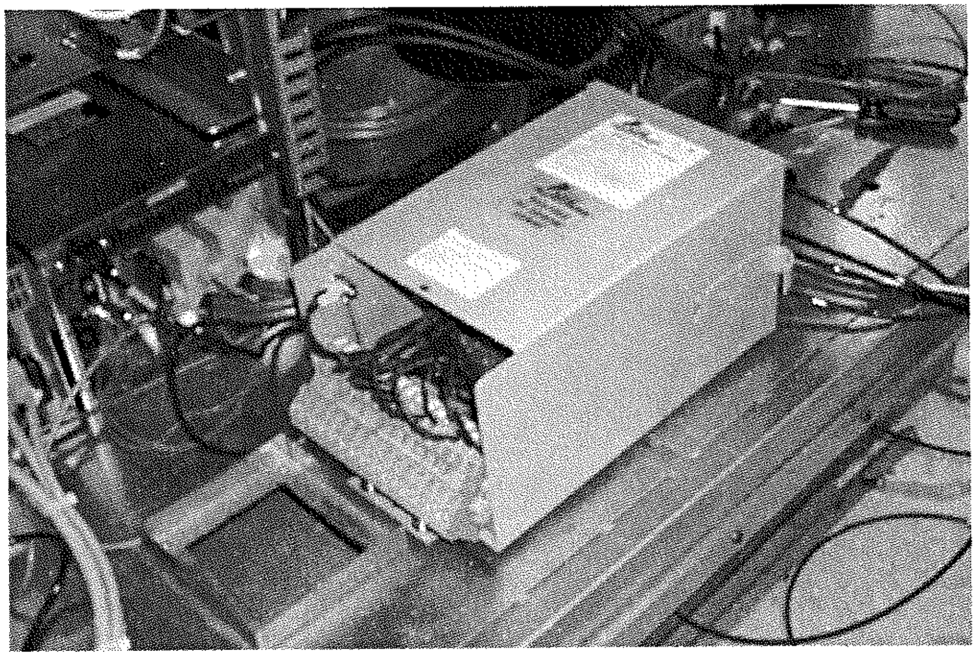
To remove the 5 kVA transformer:

1. Follow the procedure specified in Section 6.1 to power off the system.

   NOTE: Ensure that the system circuit breaker on the right-hand side of the System is padlocked in the OFF *position.*
2. Isolate the system from the facility power source by padlocking the wall-mounted circuit breaker in the OFF position. To avoid the possibility of the supply being accidentally switched on, attach a warning notice similar to that shown in Figure 5-1 to the circuit breaker to indicate that work is in progress.
3. Remove the front panel of the System.
4. Remove the six hex-head screws that secure the dual cover plate of the transformer to the base and remove the single screw connecting the two covers. Take off the left-hand cover.



5. Remove the two screws from each of the two fans, and then move the fans to the side (clear of the transformer unit).
6. On the terminal block, label the four black wires and the ground wire that pass through the strain relief gland on the right side of the transformer cover. Disconnect these wires from the terminal block and pull them back through the gland.
7. Remove the cover from the transformer.
8. Record the wiring connections at the terminal block and the transformer then disconnect the wires from the terminal block.



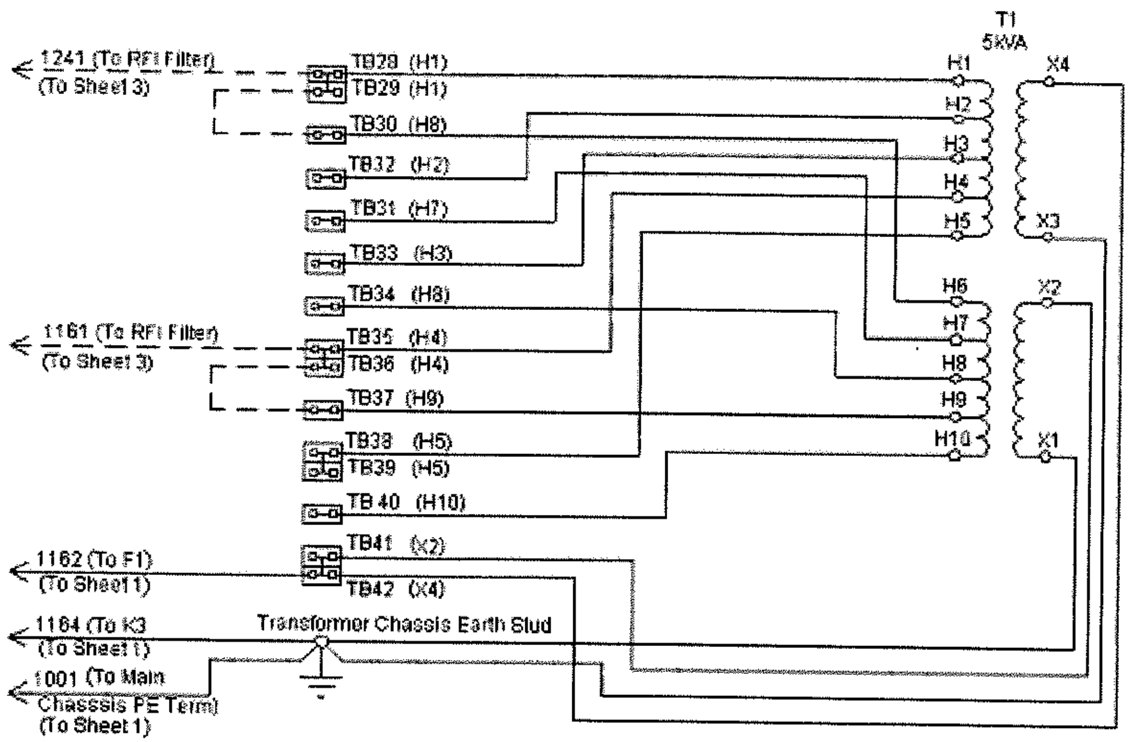
9. Remove the four screws securing the transformer to the base.
10. With the aid of a second person, carefully lift out the transformer and remove to a work surface.

6.13 5 kVA Transformer Replacement Procedure

> **⚠ WARNING**
> **IMPROPER HANDLING DURING UNIT REMOVAL CAN CAUSE SERIOUS INJURY TO HANDS OR FINGERS AND CAN ALSO DAMAGE UNIT. THE TRANSFORMER WEIGHS 85 lb (38.6 kg)**
>
> ***This unit is very heavy. To avoid injury, always remove the transformer with the aid of a second person. Refer to the following procedures for complete removal instructions.***

To install the new 5 kVA transformer:

1. With the aid of a second person, carefully lift the new 5 kVA transformer into place and lower it onto the base of the cabinet.
2. Secure the transformer to the base, using the four screws removed in step 9, of Section 6.12.
3. Connect the wires from the transformer to the terminal block connections noted in step 8 of Section 6.12. (If necessary, refer to Drawing No. 2750161, sheet 2 [Power Distribution Wiring Diagram] which shows the wiring connections for each voltage configuration.)



See Table 6-9 for wiring legend at the end of this procedure.

4. Re-route the four black wires and ground wire (removed in step 6 of Section 6.12) through the gland on the transformer cover, then reposition the cover over the transformer.

5. Reconnect the input wires and ground to the terminal block, according to the connections noted on the labels.
6. Replace the left-hand cover over the terminal block; then, secure both covers to the base using the six hex-headed screws removed in step 4 of Section 6.12. Install the single screw that connects the top of the two covers.
7. Replace the front panel on the cabinet.
8. Remove the padlock from the wall-mounted circuit breaker and turn the circuit breaker on.
9. Remove the access panel on the right-hand side of the cabinet.
10. Turn the system circuit breaker at the right-hand side of the cabinet to ON.
11. Using a digital voltmeter, measure the voltage across terminals L1 and L2 of the main contactor K3 (refer to Figure 6-1). Verify that the meter reads 115 ± 5 VAC.
12. Secure the access panel in place; then, return the system to normal operation.

Table 6-9 – Wiring Legend

Voltage	Connections
208 VAC	Connect TB29 to TB30
	Connect TB33 to TB34
	Connect wire 1241 from RFI filter to TB34
	Connect wire 1161 from RFI filter to TB28
220 VAC	Connect TB29 to TB30
	Connect TB36 to TB37
	Connect wire 1241 from RFI filter to TB37
	Connect wire 1161 from RFI filter to TB28
240 VAC	Connect TB29 to TB30
	Connect TB39 to TB40
	Connect wire 1241 from RFI filter to TB40
	Connect wire 1161 from RFI filter to TB28
380 VAC	Connect TB30 to TB33
	Connect wire 1241 from RFI filter to TB32
	Connect wire 1161 from RFI filter to TB28

Table 6-9 – Wiring Legend

Voltage	Connections
416 VAC	Connect TB33 to TB30
	Connect wire 1241 from RFI filter to TB34
	Connect wire 1161 from RFI filter to TB28

6.14 Galvonometer Alignment

To align the galvonometer:

1. Use a hex wrench to align both galvonometer mirrors so the beam is at the origin of the wafer. The side galvo adjusts the X-axis and the top galvo adjusts the Y-axis.
2. Make sure the galvos are parallel to the wafer flat:
   a. Mark an 8" wafer with a flat by drawing a black mark along the flat with a magic marker. Place it the marked wafer on the aligner and balance it.
   b. Mark a line of "LLLLLLLLLLLL..." along the flat.
   c. Remove the wafer and view it under a microscope. If the mark is not parallel to the flat within $\frac{1}{2}$ dot, then adjust the lens plate, as directed in step 2d. Otherwise, this procedure is complete.
   d. Loosen the screws that hold down the lens plate and rotate the plate slightly to correct for misalignment. Repeat step 2.

6.15 Recommended Inventory and Spare Parts Kits

Table 6-10 shows a Level II Spares Kit (p/n 6250148) for WaferMark® SigmaDSC NT systems, containing major items that will provide a comprehensive on-site maintenance capability.

⚠ CAUTION
Possible Equipment Damage

The installation and calibration of the items shown in the list must only be performed by GSI Lumonics trained and certified customer personnel or by GSI Lumonics field service technicians.

NOTE: Retain minimum levels of each item in inventory at all times to ensure maximum equipment up time.

Check with your GSI Lumonics representative to determine the:

- warranty on items purchased for inventory and spare parts
- estimated delivery time

NOTE: Overnight delivery is available for emergency orders in which the items are in stock at the GSI Lumonics factory.

Table 6-11 lists the tools and test equipment provided in the System Tool Kit for WaferMark® SigmaDSC NT systems. All items in this list are essential for system troubleshooting and maintenance.

NOTE: GSI Lumonics recommends that customers purchase both the System Tool Kit and Level II spares kit to ensure maximum uptime from the system.

Table 6-10 – WaferMark® SigmaDSC NT System Level II Spares Kit

P/N	Description	Quantity
2015048	PCB MAT486 CPU & SYSIO4 w/4MB	1
2302001	Vacuum Switch	1
4401030	Solenoid Valve, 3-way, 24VDC	1
4402435	Solenoid Valve, 4-way, 24VDC	1
6050066	Laser Controller CW50 PCB	1
60560094-01	PCBA, Galvo Driver RP	1
60560124–1	Assy PCB WMSDSC Interface Circuits	1
000-Z1913	G325DT	1

Table 6-11 – WaferMark® SigmaDSC NT System Tool Kit

P/N	Description	Quantity
2251012	Lamp Assembly, 22UV, (UV lamp)	1
2402513	Power Meter, Fieldmaster w/ 100W Head	1
2420013	Cable, BNC 2249-C-60	2
217.056.00	IR Viewer, with case, Model 7215	1
3003003	IR Block	1
3020000	YAG Laser Safety Goggles	1
3020003	IR Phosphor Card, 2" x 3"	1
27500395	SGRP Test cassette	1
67500395	TEST POD SGRP WMSC	
4501038	METRIC HEX WRENCH TOOL SET	1
5000000	Case, System Tool Kit	1

The System Tool Kit (p/n 6201106) contains test equipment and items necessary for troubleshooting and system maintenance. Check with your GSI Lumonics representative to determine the estimated delivery time.

System Tool Kit Notes

- An optional item, P/N 2402506, Fluke Meter, Model 77, can be ordered for the System Tool Kit.
- Laser Safety Glasses (P/N 3020000) ensure eye safety in the presence of laser radiation. Additional glasses can be ordered directly from GSI Lumonics using this part number. For use by personnel who wear normal eye glasses, Laser Safety Goggles can also be ordered from GSI Lumonics by requesting P/N 3020001.
- The IR Viewer (P/N 3003002) enables viewing of the IR beam on optic and marking surfaces.
- The IR Card (P/N 3020003) is a phosphorus card used for quick detection of laser emission.
- The UV Lamp (P/N 2251012) is used with the IR block to see the mode structure of the laser beam.
- The Fieldmaster Meter (P/N 2402512) measures output power from the laser head.

- The System Tool Case (P/N 5000000) is a molded reinforced aluminum tool case designed to hold all other items in the System Tool Kit.

The system is delivered with the following Fuse Kit that includes a full complement of fuses that are used in the WaferMark® SigmaDSC NT system.

Table 6-12 – WaferMark® SigmaDSC NT System Fuse Kit (P/N 6201016)

P/N	Description	Quantity
2230022	Fuse, 1A, FNM-1	2
188C15301	Fuse, 1.5A, 250V S.B.	2
2230026	Fuse, 2A, 250V S.B.	2
188C20201	Fuse, 2A, 125V S.B.	2
2230020	Fuse, 2.5A, 250V S.B.	2
188C30201	Fuse, 3A, 125V S.B.	2
2230021	Fuse, 3A, FNM-3	2
2230006	Fuse, 4A, MDA-4	2
2230007	Fuse, 4A, FNM-4	2
2230043	Fuse, 7A, 250V BAF BUSSMAN	2
188C80301	Fuse, 8A, 250V S.B.	2
2230042	Fuse, 10A, 500V FNQ-10	2
2230039	Fuse, 15A, 500V FNQ-15	2
2230045	Fuse, 40A, 500V GL ALTECH	2

6.16 Parts Ordering Information

A minimum order for parts is required. A purchase order number or C.O.D. shipment terms are required before an order can be accepted. To obtain replacement parts, telephone GSI Lumonics North America Regional Customer Center in North America: **1-800-262-0160** or contact your local GSI Lumonics Regional office at the address given in the Customer Support Contact Addresses at the beginning of this manual .

7 Troubleshooting and Fault Diagnosis

This chapter provides information to troubleshoot and fault isolate possible common operational problems.

7.1 Introduction

This chapter contains information and guidelines for general system fault diagnosis and troubleshooting of the WaferMark® SigmaDSC NT system.

> **⚠ CAUTION**
> **HIGH VOLTAGE**
>
> DANGEROUS HIGH VOLTAGE CAN CAUSE SEVERE INJURY OR DEATH.
>
> Use extreme care during installation and functional testing to avoid possible exposure to high voltages which exist when the system is powered on. Use extreme care during installation and functional testing to avoid possible exposure to high voltages which exist when the system is powered on.

> **⚠ CAUTION**
> **POTENTIAL CLASS 4 LASER RADIATION HAZARD**
>
> EXPOSURE TO CLASS 4 LASER RADIATION MAY CAUSE EYE DAMAGE AND/OR PHYSICAL BURNS.
>
> Use extreme care during installation and functional testing to avoid possible exposure to laser radiation when the system is powered on. Avoid eye or skin exposure. Always wear the appropriate protective eyewear when working within the Nominal Ocular Hazard Distance (850 meters; 2,789 feet). All system users must be aware of safety precautions detailed in Chapter 1 of this manual.

7.1.1 Component Replacement and Adjustment Responsibilities

The responsibility for replacement of parts and/or components and any required adjustments due to system failure falls into two categories:

1. By factory trained customer personnel.

2. By GSI Lumonics field service technicians.

Only customer personnel who have been trained and certified to do so by GSI Lumonics are qualified to perform any of the service procedures described in this manual. More complex procedures, not described herein, must be performed by GSI Lumonics service personnel or by customer personnel who are trained and certified in a Level II training course at the GSI Lumonics factory. Certain procedures, if not included in any customer training, should only be performed by GSI Lumonics service technicians only.

Before any part or component is replaced or adjusted by the user, contact your local GSI Lumonics Regional office at the address given in the Customer Support Contact Addresses at the beginning of this manual to discuss the failure incident and intended course of action.

⚠ WARNING

Risk of Personnel Injury or Equipment Damage

Under NO circumstances should any user who has not been trained in service procedures remove any service panels or attempt any repair, replacement, or adjustment of the equipment.

7.2 Fault Diagnosis

WaferMark® SigmaDSC NT systems employ a comprehensive set of sensors and fault detection software to monitor system operation. Detected faults are displayed by warning indicators located at the operator workstation and service panel. Certain fault conditions will cause a halt to any marking in progress until the problem has been corrected.

7.3 Troubleshooting

Table 7-1 is a troubleshooting guide to aid service personnel isolate a system malfunction to an assembly, subassembly, or part. Once a fault has been diagnosed and the cause identified, it is recommended that the replacement of a defective item is confined to assemblies, plug-in circuit boards, or plug-in components only. Any defective item must be replaced with an identical item or compatible item approved by GSI Lumonics.

This troubleshooting aid assumes that the system has been correctly installed, and that a basic functional check has been performed. The troubleshooting table cannot list all possible failures, but includes those most likely to be encountered.

Certain failures and problems which require component replacement may additionally necessitate adjustment or calibration procedures which cannot be performed because the spares and necessary test equipment and fixtures are not on hand. In these cases the user should contact the local GSI Lumonics Regional Customer Center or the GSI Lumonics factory in Wilmington, Massachusetts, U.S.A. for further assistance.

⚠ CAUTION

Always turn the MASTER keyswitch and system circuit breaker OFF when removing or replacing fuses, or when removing and replacing circuit boards and connectors.

Connecting or disconnecting connectors or install fuses with power on can create destructive voltage transients.

Table 7-1 – Troubleshooting

Symptom	Possible Cause	Suggested Action
AIR FLOW fault indicator on (insufficient air flow in or adjacent to the marking chamber) – (inoperable for WaferMark® DSC)	Defective blower motor	Replace motor
—	Defective air pressure switch	Check air pressure switch
CASSETTE LOADING fault indicator on (cassette absent or misloaded)	Cassette placement error (cassette bumped while job in process)	Check cassette position on presenter
—	Low or loss of vacuum	Check vacuum at gauge. Should read 20–30 lbs.
—	Presenter rotation failure	Check appropriate vacuum solenoid switch. Manually exercise presenter by pressing appropriate vacuum solenoid actuator button.
LASER FAULT Indicator on	—	—
SAFETY INTERLOCK fault indicator on (one or more broken interlocks)	Open laser enclosure cover and/or marking chamber safety door	Correct as necessary

Table 7-1 – Troubleshooting

Symptom	Possible Cause	Suggested Action
—	Defective interlock mechan-ism or circuit	Check interlock circuit
VACUUM fault indicator on (insufficient system vacuum)	Low or loss of vacuum input	Check vacuum gauge. Should read 20–30 lb.
—	Vacuum leak	Inspect system for leaks
—	Faulty vacuum sensor	Check sensor
—	Out of tolerance	Adjust vacuum input level
WAFER HANDLING fault indicator on (wafer handling fault)	Loss of vacuum	Check vacuum gauge. Should read 20-30 lb.
—	Safety door failure	Operate door manually by pressing safety door vacuum solenoid actuator button.
—	Wafer misaligned on aligner	Check and clear as necessary.
—	Robot obstruction	Clear and continue operation.
—	Defective robot or aligner	Contact GSI Lumonics Technical Support for further assistance.
—	Defective robot or aligner controller	Contact GSI Lumonics Technical Support for further assistance.
System will not power up. POWER ON indicator not lit.	Main system circuit breaker switch in the OFF position.	Check and correct as necessary.
—	Master keyswitch is in the OFF position.	Turn the keyswitch to the ON position.
—	Blown fuse	Check main supply fuses.
—	Local power failure on the Power Distribution Panel.	Check for +5 VDC, +12 VDC, –12 VDC, and -24 VDC. *NOTE: ±12 VDC are **Not Available** in SigmaDSC systems.*
—	E-STOP switch or External E-STOP switch is depressed.	Verify that the E-STOP switch is pulled fully out.
Poor quality marks	Low laser output power	Refer to the Laser Power Screen and check the laser energy setting.
—	Unstable laser	Refer to the Laser Power Screen and check the Sigma value.
—	Broken, dirty, or moved optical components	Inspect and repair/replace as necessary.

Table 7-1 – Troubleshooting

Symptom	Possible Cause	Suggested Action
—	Defective optical alignment	Perform optical alignment.
Missing marks (Laser beam not present at marking surface).	Interlock open. Laser intercavity shutter not opening.	Verify that all interlocks are closed.
—	Blown fuse in the laser power supply.	Remove fuses from the laser power supply and check with a DVM.
—	Dirty optical components	Inspect optical system
—	Optical component failure (burned, cracked or broken).	Inspect optical system
—	Moved optical components.	Check beam dump solenoid
—	Bad beam dump solenoid.	Check beam dump solenoid
—	Blown fuse in system computer.	Check fuses on the computer card rack. Verify ±24 VDC is available on the galvo driver boards.
—	Galvo driver board failure.	Check X and Y galvo driver boards.
—	Laser controller board failure.	Replace laser controller board.
—	Defective galvo scanner coils.	Replace appropriate galvo scanner.
Water leaks.	Loose connections.	Check cooling system hoses and connections. Correct as necessary.

Appendix A Laser Fault and Status Bits

This appendix describes laser faults and lists laser status bits.

A.1 Introduction

This appendix defines the fault and status bits which are reported in the two 16-bit binary strings displayed in the **Laser Warnings** and **Laser Faults** fields of the **Laser Maintenance** dialog display, which is shown in Figure A-1.

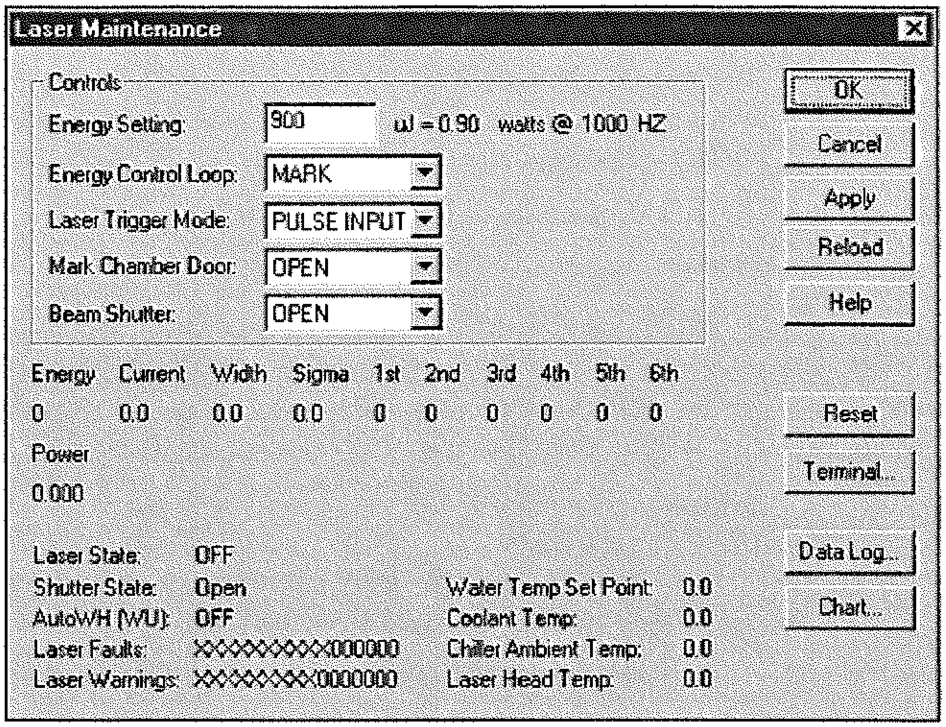


Figure A-1 – Laser Maintenance Dialog Display

A.2 Hardware Interlocks and Fault Bits

The Laser Controller software checks for hardware interlocks and fault conditions while the laser is in the warm-up and ready states. If any occur, the software will stop all trigger pulses to the diode laser module, turn off the power relay to disable the diodes, and turn off the heat exchanger fan and water pump relays in the chiller.

The condition of faults and interlocks are read when the software issues the Read Fault command (FF) or the command is issued from the terminal. The controller will return a 16-bit binary string for display on the screen, with each bit representing a fault. Bits 0 through 5 are currently used to represent faults. The bits are numbered from right to left, starting at 0. A " 0 " indicates no fault, and a " 1 " indicates a fault.

For example: FF 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1

bit 15 bit 0

. . . indicates two faults, represented by bits 0 and 3.

Fault and interlock bits are reset when the Laser On input is made true, or the CR command is received via the RS232 communications connector.

FF Bit-0 - Coolant Flow Interlock

Cause:

This fault is most often seen while filling the chiller's reservoir, and is caused by air trapped in the coolant tubing, reducing the effective flow rate. It could also mean that the pump fuse has blown or the chiller power switch is turned off.

Action:

1. Reset the interlock by entering CR or turning the Laser On input (J13) off and on.
2. Make sure the chiller power switch is on.
3. Check the fuse. Replace if necessary.
4. If this problem persists, connect an oscilloscope to test-points TP1 (signal) and TP2 (24V return) on the chiller power distribution board and measure the frequency of the 5 V signal. The frequency must be greater than 80 Hz. TP1 produces a 24 V signal with a frequency proportional to coolant flow. TP2 is a 24 V return.

FF Bit-1 - External Interlock

Cause:

An external interlock is open. One of the external interlock switches connected in series between pins 12 and 13 of the user interface connector on the rear panel of the controller (J13) is open.

Action:

Check all external interlocks.

FF Bit-2 - Shutter Failed-Open Interlock

Cause:

The beam shutter remains open although a command has been issued to close the shutter.

Action:

1. Remove the cover at the front of the beam shutter assembly.
2. Reset the interlock (enter CR), and cycle the interlock by entering the commands WV1 (open shutter) and WV2 (close shutter).
3. Once the shutter is functioning correctly, enter the command WV0 to give control of the shutter back to the laser software.
4. If the solenoid is unable to close the shutter, contact your nearest GSI Lumonics Regional Customer Center at the address shown at the beginning of this manual (How to Get Technical Support).

FF Bit-3 - Coolant Temperature Fault

Cause:

The reservoir temperature is outside of the range of stable operation. For a given set-point of WW, the reservoir temperature cannot vary by greater than +2/-5 °C.

Action:

Contact your nearest GSI Lumonics Regional Customer Center at the address shown at the beginning of this manual (How To Get Technical Support).

FF Bit-4 - Warm-up Timeout Fault

Cause:

The temperature of the chiller's reservoir did not reach its set-point within 12 minutes of entering warm-up.

Action:

1. Ensure that the reservoir level is full. If the reservoir level switch is opened, the heater will not turn on.

   Check the switch's state, if desired, by entering the command FS and checking the 16–bit reply. Bit 4 (fifth from the right) should be 0.
2. Check that the duty cycle of the reservoir heater is greater than 10%. Enter the command RG and the reply should be more than 10.
3. If the room in which the laser is operating is cool (<18°C), increase the air temperature locally for the chiller air intake.

FF Bit-5 - Pulse Width at Maximum

Cause:

The diode current pulse width is greater than 195 ms.

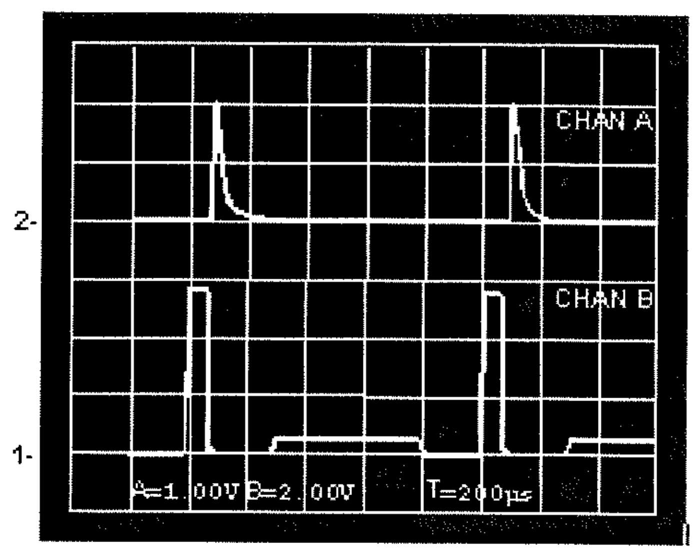
Action:

1. Turn the energy control loop off to evaluate the error (enter WE0).
2. Reset the laser (enter CR).
3. Set the laser to run internally at the following setting to ensure that the system is functioning correctly:

   - WP100 - sets current pulse to 100 ms.

- WR1000 - sets the internal trigger rate to 1000 Hz.
- WG1 - sets the laser to run on an internally controlled trigger.

4. Measure the following values:
   - RE - laser pulse energy.
   - RX - energy counts.
   - RC - diode current amplitude.
5. To check that the laser is Q-switching correctly, connect a BNC cable from an oscilloscope to monitoring points J23, the current monitor output, and J24, the energy monitor output, on the rear panel of the controller. The trace should look similar to Figure B-2, which shows the typical relation between the energy monitor output (upper trace) and the current monitor output (lower trace).
6. Contact your nearest GSI Lumonics Regional Customer Center (Customer Support Contact Addresses) to discuss corrective action.



1 Channel B - Energy monitor displays 2.00 Volts
2 Channel A - current monitor displays 1.00 Volts

Figure A-2 – Monitor Outputs

A.3 Status Condition Bits

The Laser Controller software monitors certain conditions that may be helpful for diagnostics but are not serious enough to be considered a fault. They indicate that corrective action or maintenance may be required. Laser operation is not interrupted.

These status conditions are read when the software issues the Read Status command (FS) or the command is issued from the terminal. The controller will return a 16-bit binary string with each bit representing a status condition. Bits 0 through 6 are currently used to represent status conditions, with the bits being numbered from right to left, starting at 0. A " 0 " indicates no condition, and a " 1 " indicates a condition.

For example: FS 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0

bit 15 bit 0 .

. . . indicates two conditions, represented by bits 1 and 2.

Each status bit is latched until the condition goes away and it is appropriate to clear it.

FS Bit-0 - Data Log Full

Cause:

The flash memory used to log data about the laser's performance is full. This condition is cleared when the flash memory on the controller PCB is erased.

Action:

Refer to the *WaferMark® SigmaDSC NT Operator Manual (P/N 273.490.00)* using the **Maintenance** menu **Laser Power** command and examine the datalog.

FS Bit-1 - Coolant Temperature Out

Cause

The temperature bandwidth of the chiller's reservoir is varying by more than ±0.5°C (0.9°F) after warm-up. This condition is cleared when the temperature returns to a value within specification.

Action

1. Monitor the inlet temperature to the chiller to ensure that large swings in the temperature are not present, caused by an air conditioner cycling, for example.
2. Enter the following commands and note the responses every minute for 10 minutes.

   RT___

   RG ___

   WW___

   RW___
3. Contact your nearest GSI Lumonics Regional Customer (Customer Support Contact Addresses) for further assistance.

FS Bit-2 - Mark Energy Out

Cause

An energy correction was required because the energy level varied by more than 3% during the marking process. This condition is cleared when the signal to mark (Mark Enable) at pin 14 of J13 on the rear panel on the controller is brought high.

Action

1. For applications that require tight energy control, check the workpiece to ensure that the process quality has not degraded.
2. Check the value of the pulse-to-pulse energy stability sigma (command RZ) to ensure that it is less then 0.5%.

3. Connect an oscilloscope to the energy monitor output (J24) on the rear panel of the controller.
4. Operate the laser in WG2 marking mode and view the pulse energy on the oscilloscope to integrate a pulse-train of 40 pulses. If there is any variation of the flatness of the pulse energy, recalibrate the current bias and first pulse compensation by performing the following steps:
   - WU1 - turn on auto WH
   - CC - starts auto-calibration of the bias

FS Bit-3 - Shutter Not Open

Cause

The beam shutter has failed to open during a shutter open command. This condition is cleared when the shutter is commanded to close.

Action

1. Verify that the beam shutter is connected and the Laser On input is true (J13).
2. Remove the cover at the front of the beam shutter assembly.
3. Reset the interlock (enter CR), and cycle the interlock by entering the commands WV1 (open the shutter) and WV2 (close the shutter).
4. Once the shutter is functioning correctly, enter the command WV0 to give control of the shutter back to the laser software.
5. If the solenoid is unable to open the shutter, contact your nearest GSI Lumonics Regional Customer Center (Customer Support Contact Addresses).

FS Bit 4 Coolant Level Interlock

Cause

The coolant level in the reservoir is low. This condition is cleared when the coolant level returns to normal.

Action

Refill the reservoir with coolant. If this condition occurs regularly, check the chiller monthly to make sure that the reservoir sealing screw at the top of the reservoir is sealing correctly, and that there are no other minor coolant leaks in the chiller system.

FS Bit-5 - T-Gap Expired

Cause

Since the signal to mark (Mark Enable) input went active (low), the Laser Controller has not received a trigger pulse for more than 60 minutes.

Action

This condition is cleared when the laser performs an energy check before the next signal to mark is received.

FS Bit-6 - Pulse Width > 185

Cause

The diode current pulse width has reached 185 ms, indicating that the Sigma laser requires a scheduled maintenance. If the current pulse duration reaches its maximum of 195 ms, the controller will shut down the laser and produce a Pulse Width at Maximum fault.

Action

1. Increase the diode current setting (command WC) to the maximum value recommended in the test report, and record the total number of laser pulses and read peak current (command RC).

2. Record the total number of laser pulses (commands TD and TQ).
3. If the number of laser pulses is more than $2.5X10^9$, the laser diode module has reached its expected end of life, and it should be replaced as soon as possible.
4. If the number of laser pulses is less than $2.5x10^9$, contact your nearest GSI Lumonics Regional Customer Center (Customer Support Contact Addresses) for further instructions.

Appendix B Assembly and Schematics Drawings

This section contains a listing of the WaferMark® SigmaDSC NT systems assembly and schematic drawings.

DRAWING TITLE	DRAWING NO.	REV
A: LASER SAFETY:		
IEC & CDRH LABEL IDENTIFICATION – ENGLISH SET (2 Sheets)	2950169-01	K
LABEL LOCATIONS, WaferMark Sigma DSC (3 Sheets)	2950188	E
WMSC CENTER OF GRAVITY LOCATION	2950114	A
B: FACILITIES:		
INSTALLATION, WaferMark SigmaDSC (2 Sheets)	2950185	F
INSTALLATION, WaferMark SigmaDSC with WIZARD READER	2950190	B
INSTALLATION, In–Sight Camera, WaferMark (2 Sheets)	6553106AD	A
C: ELECTRONICS DISTRIBUTION:		
WIRING DIAGRAM, POWER DISTRIBUTION WIRING DIAGRAM (4 Sheets)	2750161-1WD	A
WIRING DIAGRAM DISTRIBUTION PANEL	2750185	C
POWER SUPPLY, MARKING ENGINE WMSC	6650071	A
ELECTRICAL ASSEMBLY, PDP (2 Sheets)	6650133–1AD	J
D: SYSTEM CABINET		
ASSEMBLY, OPERATOR PANEL	6550110	D
ELECTRICAL ASSEMBLY, MARKING ENGINE (2 sheets)	66500334	I
SCHEMATIC DIAGRAM, MARKING ENGINE	27500383	D
WIRING DIAGRAM, PRESENTER	27500494	E
SCHEMATIC DIAGRAM, PRESENTER	2750162	A
SAC I MODULE ASSEMBLY 4I/4O HANDLER	6650142	B
E: SYSTEM INTERCONNECTIONS:		
WIRING DIAGRAM, INTERCONNECT DRAWING WINDOWS NT/WMSDSC	2750374	B
F: CABLE ASSEMBLIES:		
CABLE HARNESS ASSEMBLY	6022315	J
CABLE ASSEMBLY, E-STOP HARNESS	6022224	A
CABLE ASSEMBLY, INTERLOCK HARNESS	6022313	A
CABLE ASSEMBLY, LASER CONTROLLER	6022303	A

CABLE ASSEMBLY, SYSTEM CONTROL	6022304	B
CABLE ASSEMBLY, EXTERNAL E-STOP/INTERLOCK HARNESS	6022228	A
CABLE ASSEMBLY, FAULT DISPLAY PANEL	6022332	D
JUMPER CONNECTOR INTERFACE BOARD	6022209	A
CABLE ASSEMBLY, MARK CHAMBER INTERFACE	6022210	C
CABLE ASSEMBLY, HOST LINK	6022207	C
CABLE ASSEMBLY, LOAD/UNLOAD INDICATOR	6022230	C
CABLE ASSEMBLY, SIGNAL TOWER INTERFACE, 4 COLOR	6022175	B
CABLE SET, GALVO (Z1913)	60220963	F
CABLE ASSEMBLY, DISK DRIVE POWER	6022287	B
CABLE ASSEMBLY, 9 TO 25 PIN COMM	60220993	F
CABLE ASSEMBLY, PRE-ALIGNER COM	60221003	B
CABLE ASSEMBLY, PRESENTER PLATE INTERFACE	6022231	E
CABLE ASSEMBLY, CW50 INTERFACE	6022250	D
CABLE ASSEMBLY, HANDLER INTERFACE	6022543	A
CABLE ASSEMBLY, USER E-STOP	6022241	B
CABLE ASSEMBLY, EMO HARNESS	6022384	B
CABLE ASSEMBLY, EXTERNAL E-STOP/INTERLOCK HARNESS	6022385	A
CABLE ASSEMBLY, SOLENOID EXTENSION	6022237	E
CABLE ASSEMBLY, PRESENTER	6022280	D
CABLE ASSEMBLY, ROBOT WARN LIGHT	6022295	D
CABLE ASSEMBLY, 5V CABLE I.O. BOARD	6022284	D
CABLE ASSEMBLY, BAR CODE READER TO MARKING ENGINE	6022275	B
CABLE ASSEMBLY, DB9/10 PIN HEADER SERIAL PORT TO MARKING ENGINE	6022272	B
CABLE ASSEMBLY, SENSOR, SLOW SHUTTER OPEN	6022417	A
G: PCB ASSEMBLIES:		
ASSEMBLY, INTERFACE PCB	60560124-1	C
SCHEMATIC, INTERFACE PCB (8 Sheets)	2750195	A
SGRP GALVO BOARD, TOP LEVEL	60560094	B
H: OPTIONS PART 1:		
SCHEMATIC, SIGNAL TOWER, 4 COLOR	2750123	B
CABLE ASSEMBLY, SIGNAL TOWER, 4 COLOR	6022282	D

CABLE ASSEMBLY, SIGNAL TOWER 24V SUPPLY	6022283	D
SCHEMATIC, PRESENTER WMSCDPL300	2750233	X1
I: OPTIONS PART 2:		
ASSEMBLY, UPS FOR WaferMark SigmaClean	6550122	B
WIRING DIAGRAM, UPS, WaferMark SigmaClean	2750143	C
CABLE ASSEMBLY, UPS	6022270	A
CABLE ASSEMBLY, EXTENSION DUAL OPTIC REED SENSOR	6022374	A
CABLE ASSEMBLY, EXTENSION DUAL OPTIC SOLENOID	6022375	A
WIRING DIAGRAM, DUAL OPTIC	2750219	A
WIRING DIAGRAM, WMSCDPL DUAL SPOT SIZE	2750151	A

DRAWINGS SORTED IN DRAWING NUMBER ORDER

DRAWING NO.	TAB NO.	DRAWING TITLE (Sorted In Drawing Number Order)
27500383	D	SCHEMATIC DIAGRAM, MARKING ENGINE
27500494	D	WIRING DIAGRAM, PRESENTER
2750123	H	SCHEMATIC, SIGNAL TOWER, 4–COLOR
2750143	I	WIRING DIAGRAM, UPS, WMSC
2750151	I	WIRING DIAGRAM, WMS CDPL DUAL SPOT SIZE
2750161-1WD	C	WIRING DIAGRAM, POWER DISTRIBUTION WIRING DIAGRAM (4 Sheets)
2750162	D	SCHEMATIC DIAGRAM, PRESENTER
2750185	C	WIRING DIAGRAM DISTRIBUTION PANEL
2750195	G	SCHEMATIC, INTERFACE PCB (8 Sheets)
2750219	I	WIRING DIAGRAM, DUAL OPTIC
2750233	H	SCHEMATIC DIAGRAM, PRESENTER WMSCDPL300
2750374	E	WIRING DIAGRAM, INTERCONNECT DRAWING WINDOWS NT/WMSDSC
2950169–01	A	IEC & CDRH LABEL IDENTIFICATION – ENGLISH SET (2 Sheets)
2950185	B	INSTALLATION, WaferMark SigmaDSC (2 Sheets)
2950188	A	LABEL LOCATIONS, WaferMark Sigma DSC (3 Sheets)
2950190	B	INSTALLATION, WaferMark SigmaDSC with WIZARD READER
60220963	F	CABLE SET, GALVO (Z1913)
60220993	F	CABLE ASSEMBLY, 9 TO 25 PIN COMM
60221003	F	CABLE ASSEMBLY, PRE-ALIGNER COM

DRAWING NO.	TAB NO.	DRAWING TITLE (Sorted In Drawing Number Order)
6022175	F	CABLE ASSEMBLY, SIGNAL TOWER INTERFACE, 4–COLOR
6022207	F	CABLE ASSEMBLY, HOST LINK
6022209	F	JUMPER CONNECTOR INTERFACE BOARD
6022210	F	CABLE ASSEMBLY, MARK CHAMBER INTERFACE
6022224	F	CABLE ASSEMBLY, E-STOP HARNESS
6022230	F	CABLE ASSEMBLY, LOAD/UNLOAD INDICATOR
6022231	F	CABLE ASSEMBLY, PRESENTER PLATE INTERFACE
6022237	F	CABLE ASSEMBLY, SOLENOID EXTENSION
6022241	F	CABLE ASSEMBLY, USER E-STOP
6022250	F	CABLE ASSEMBLY, CW50 INTERFACE
6022270	I	CABLE ASSEMBLY, UPS
6022280	F	CABLE ASSEMBLY, PRESENTER
6022282	H	CABLE ASSEMBLY, SIGNAL TOWER, 4 COLOR
6022283	H	CABLE ASSEMBLY, SIGNAL TOWER 24V SUPPLY
6022284	F	CABLE ASSEMBLY, 5V CABLE I.O. BOARD
6022287	F	CABLE ASSEMBLY, DISK DRIVE POWER
6022295	F	CABLE ASSEMBLY, ROBOT WARN LIGHT
6022303	F	CABLE ASSEMBLY, LASER CONTROLLER
6022304	F	CABLE ASSEMBLY, SYSTEM CONTROL
6022313	F	CABLE ASSEMBLY, INTERLOCK HARNESS
6022319	C	SERIAL CABLE, POWER DIST E-STOP
6022320	C	CABLE ASSEMBLY, POWER DIST INTERLOCK
6022385	F	CABLE ASSEMBLY, EXTERNAL E-STOP
6022417	F	CABLE ASSEMBLY, SENSR SHSUTR OPEN
6022542	F	CABLE ASSEMBLY, SERIAL PC/PC 2'
6022543	F	CABLE ASSEMBLY, HANDLER INTERFACE
6022385	F	CABLE ASSEMBLY, EXTERNAL E-STOP
60560094	G	SGRP GALVO BOARD, TOP LEVEL
60560124-1	G	ASSEMBLY, INTERFACE PCB
6550110	D	ASSEMBLY, OPERATOR PANEL
6550122	I	ASSEMBLY, UPS FOR WaferMark SigmaClean

DRAWING NO.	TAB NO.	DRAWING TITLE (Sorted In Drawing Number Order)
6553106AD	B	INSTALLATION, In–Sight Camera, WaferMark (2 Sheets)
66500334	D	ELECTRICAL ASSEMBLY, MARKING ENGINE (Sheet 1)
66500334	D	ELECTRICAL ASSEMBLY, MARKING ENGINE (Sheet 2)
6650071	C	POWER SUPPLY, MARKING ENGINE WMSC
6650103	F	UMBILICAL ASSEMBLY, INTERNAL
6650133–1AD	C	ELECTRICAL ASSEMBLY, PDP (2 Sheets)
6650142	D	SAC I MODULE ASSEMBLY, 4I/4O HANDLER

Wire Table for 9700-5392-01 Jumpers

From	To
P1-1	P1-4
P1-2	P1-5

Wire Table for 9700-5396-XX

From	Color	To
P1-1	Blue	P2-1
P1-2	Orange	P2-2
P1-3	Black	P2-3
P1-4	Red	P2-4

Wire table for 9700-5398-xx

From	Color	To
P1-1	Red	P2-1
P1-2	Green	P2-2
P1-4	Black	P2-4
P1-2	Shield	P2-2

Wire table for 9700-5474-xx

From	Color	To
P1-1	Orange	P2-1

P1-2	Red	P2-2
P1-3	White	P2-3
P1-4	Blue	P2-4
P1-5	Black	P2-5
P1-6	Yellow	P2-6
P1-7	Brown	P2-7
P1-8	Green	P2-8
P1-9	Violet	P2-9
Ferrule	Shield	Ferrule

Wire table for 9700-5689-xx

From	Color	To
P1-2	Black	P2-2
P1-3	White	P2-3
P1-4	Red	P2-4

Wire Table for 9700-5795-XX

From	Color	To	Function
Tower	Amber	P1-1	+24 VDC
Tower	Gray	P1-2	Return
Tower	Brown	P1-3	Flash
Tower	Light Blue	P1-4	Buzzer
Tower	Red	P1-5	Red Light
Tower	Orange	P1-6	Amber Light
Tower	Green	P1-7	Green Light
Tower	Blue	P1-8	Blue Light

Wire table for 9700-5972-xx

From	Color	To
P1-8	Black	L1
P1-9	White	L2
Shield	Blue	Ring

Wire table for 9700-5792-xx

Cable	To	Wire
Blacks	To	Blacks
Whites	To	Whites
Shield	To	Blue

Wire table for 9700-5972-xx

From	Color	To
T21	Red	P2-3
T12	Black	P2-2
T11	White	P2-1
T22	Black	P2-4

Wire Table for 9700-6189-XX

From	Color	To	Function
P1-1	Red	P2-1	+24 VDC
P1-2	Green	P2-3	Ground
P1-3	Black	P2-2	Return
P1-4	Shield	P2-4	—

Wire Table for 9700-6279-01 Jumpers

From	To
P1-1	P1-2
P1-3	P1-4

Wire table for 9700-6460-xx

From	Color	To
P1–3	—	P2–14
P1–1	—	P2–13

Wire table for 9700-7188-xx

From	Color	To
P1-1	Black	C
P1-2	White	L2
Shield	Blue	RING

Wire table for 9700-7188-xx

From	Color	To
P1-1	BLK	P2-1
P1-2	WHT	P2-2
P1-3	RED	P2-3
P1-4	GRN	P2-4
P1-5	ORG	P2-5
P1-6	BLU	P2-6
P1-7	WHT/BLK	P2-7
P1-8	RED/BLK	P2-8
P1-9	GRN/BLK	P2-9
P1-10	ORN/BLK	P2-10
P1-11	BLU/BLK	P2-11
P1-12	BLK/WHT	P2-12
P1-13	RED/WHT	P2-13
P1-14	GRN/WHT	P2-14
P1-15	BLU/WHT	P2-15
P1-16	BLK/RED	P2-16
P1-17	WHT/RED	P2-17
P1-18 5	ORG/RED	P2-18
P1-19	BLU/RED	P2-19
P1-20	RED/GRN	P2-20
P1-21	ORG/GRN	P2-21
P1-22 P	BLK/WHT/RED	P2-22
1-23	WHT/BLK/RED	P2-23
P1-24	RED/BLK/WHT	P2-24
P1-2	GRN/BLK/WHT	P2-25

FUSES IN HANDLER/CONTROL ENCLOSURE section of System Cabinet

Jack#	Fuse#	Amps	Size	Volts	Type
Main	F18	8A	5AG	250V	SLO-BLO
INSW	F1	0.75A	3AG/AGC	250V	SLO-BLO
J6	F3	2A	3AG/AGC	250V	SLO-BLO
J7	F4	2.5A	3AG/AGC	250V	SLO-BLO
J8	F5	1A	3AG/AGC	250V	SLO-BLO
J10	F7	3A	3AG/AGC	250V	SLO-BLO
J11	F8	2A	3AG/AGC	250V	SLO-BLO
J12 J	F9	1.25A	3AG/AGC	250V	SLO-BLO
13	F10	6A	3AG/AGC	250V	SLO-BLO
J14	F11	3A	3AG/AGC	250V	FAST-BLO
J15	F12	0.1A	3AG/AGC	250V	SLO-BLO
J16	F13	3A	3AG/AGC	250V	FAST-BLO
J17	F14	0.1A	3AG/AGC	250V	FAST-BLO
J18	F15	0.1A	3AG/AGC	250V	FAST-BLO
J19	F16	0.1A	3AG/AGC	250V	FAST-BLO
J20	F17	0.1A	3AG/AGC	250V	FAST-BLO
If a Jack is not used, a 0.1 Amp, 3AG 250V Fast-acting fuse is placed in the fuse holder.					

Appendix C Units and Dimensions

The following tables show units and dimensions used in this manual.

C.1 SI Unit Multiples

Symbol	Prefix	Multiplier
M	mega	1 000 000 = 10^6
k	kilo	1 000 = 10^3
h	hecto	100 = 10^2
da	deca	10 = 10^1
d	deci	0.1 = 10^{-1}
c	centi	0.01 = 10^{-2}
m	milli	0.001 = 10^{-3}
µ	micro	0.000 001 = 10^{-6}
n	nano	0.000 000 001 = 10^{-9}
p	pico	0.000 000 000 001 = 10^{-12}

C.2 Standard Dimensional Abbreviations

Unit	Description
A	ampere
°C	degree Celsius
cd	candela
dB	decibel
eV	electron-volt
F	farad
°F	degree Fahrenheit
ft	foot
g	gramme (gram)
gal	gallon
H	henry
h	hour
Hz	hertz

Unit	Description
in	inch
J	joule
°K	degree Kelvin
l	litre (liter)
lb	pound
lbf	pound force
m	metre (meter)
min	minute
N	newton
Ω	ohm
Pa	pascal
pi	pica
psi	pounds per square inch
pt	point
rad	radian
S	siemens
s	second
t	tonne
V (VAC, VDC)	volt (volt alternating current, volt direct current)
VA	volt-ampere
W	watt

Appendix D Conversion Factors

SI metric units and Imperial units are used throughout this manual. The following approximate conversion factors may prove useful.

SI Metric Unit	Conversion Factor	Imperial Unit
	Length	
meter	39.370	inch
millimeter	0.039 370	inch
	Area	
square meter	1 550	square inch
square millimeter	1.55×10^{-3}	square inch
	Volume	
liter	0.219 969	gallon (UK)
liter	0.264 172	gallon (US)
	Mass	
kilogram	2.204 623	pounds
	Pressure	
113.25 kilopascal	1 atmosphere	14.695 916 pounds force per square inch
	Temperature	
0 degrees Celsius	Freezing point of water	32 degrees Fahrenheit
100 degrees Celsius	Boiling point of water	212 degrees Fahrenheit

Appendix E Glossary

This appendix is a collection of common abbreviations, acronyms and definitions used in the laser-related environmental and semiconductor industry.

Word	Definition
aligner	A tool used to locate the center and balance a wafer by spinning and re-aligning position. Also called a prealigner.
Bonded Wafer	A composite, di-electrically isolated substrate formed by fusing together (at high temperature) the oxidized surfaces of two individual silicon substrates.
cal	calibration
Cass	A cassette or pod is a case devise for holding, storing, transporting, handling, and protecting multiple silicon wafers before and after processing steps.
cleanroom	An enclosed area in which the temperature, humidity, and particulate matter size are precisely controlled within specified units. Clean room classification defines the maximum number of particles of 0.3 micron size or larger that may exist in one cubic foot of space anywhere in the designated area. ie.,Class 1 cleanroom only one particle of any kind may exist in one cubic foot of space. Newer cleanrooms are typically Class 1-10, and are needed for manufacturing ICs with feature size close to 1 micron.
CIDRW	Carrier ID(Identification) Reader Writer
<CR>	Carriage return, a control character used in print codes to command the head to go to the begining of the next line. ASCII Hex code: 13, Octal Code: 0D
dialog box	A box that provides an operator with interactive and integrated exchange (handshaking) with the operating system.
FACTORY.SET	FACTORY.SET file or Maintenance Startup file containing key words that assign system software program parameter values for system operation and options.
FIFO	First in first out defines a stack or list the jobs are processed in the order in which it is received.
gal	galvo
gem	GEM is a control mode that complies with SEMI E5–92
HSMS	High Speed Message Service
idm	Identification matrix definition of font file.
intlk	Interlock
ldg	Loading
KWFIO	TBD
<LF>	Line feed, a control character used in print codes to move the print head down to the line below the current line. ASCII Hex code: 12, Octal Code: 0C
list box	A button that opens a drop-down list of selectable options for display in the box.

Word	Definition
Location	Indicates the X and Y position parameters for the start of the mark. If Location is selected (highlighted), the Location Parameter window is added to the screen. Within this window are a number of parameters that can be adjusted to change the position or final appearance of the current line of text. These parameters are used during the actual marking process, in conjunction with the Parameter Set general variables that are listed in the Marker Parameter table.
LPC	Laser Power Controller (lamp-based system only)
LVS	Label Vision Systems
MSTRCOM	Master Communications
menu	A displayed list of options from which the operator chooses to perform an action.
NMI	Non-Maskable Interrupt
Recipe	The marking instruction for a job
SECS	Sequential event control system, a code protocol for controlling and reporting status, fault and actions and compatible with internet use.
SMIF	Standard Mechanical InterFace– Usually the interface for a device for loading and unloading the marking system.
SW	Software — computer programs that drive the hardware functions in a system.
Wafer	A thin slice, typically 10-30 mils thick, sawed from a cylindrical ingot (boule) of bulk semiconductor material (usually silicon), four to eight inches in diameter. Arrays of ICs or discrete devices are fabricated in the wafers during the manufacturing process.
Window	A portion of a display screen that contains a message or information for display.
WIP	Wafer in progress or work in progress sensors at presentation stations.

Index

S

T

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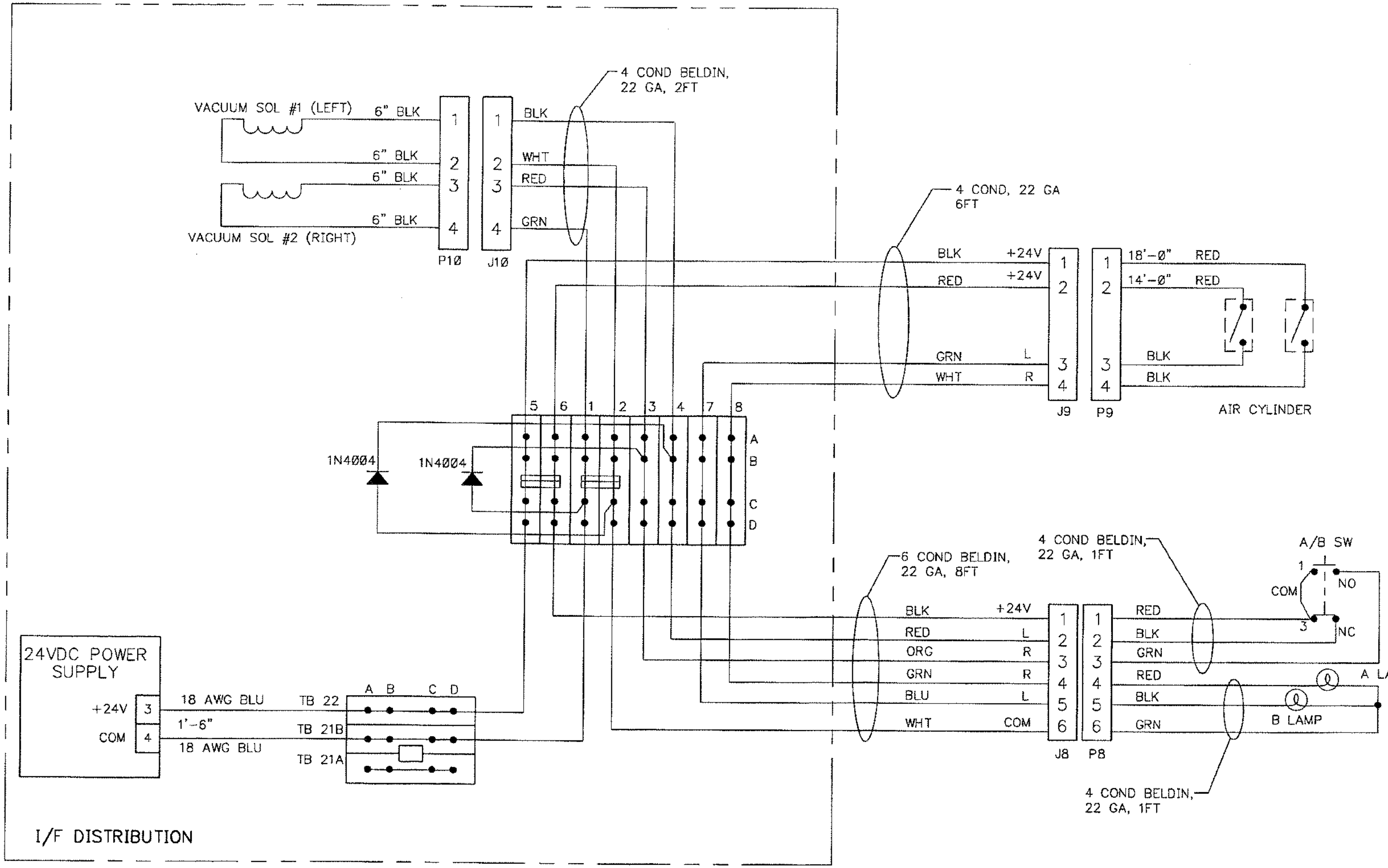
V

W

REVISIONS			
LVL	DESCRIPTION	DRWN/APVD	DATE
A	RELEASE TO PRODUCTION PER ECO 734	WM/TSL	4/25/96



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APPROVALS	DATE
DRAWN C. MARSH	04/12/96
CHECKED	
ENGR	

LUMONICS

WIRING DIAGRAM, WMSCDPL DUAL SPOT SIZE

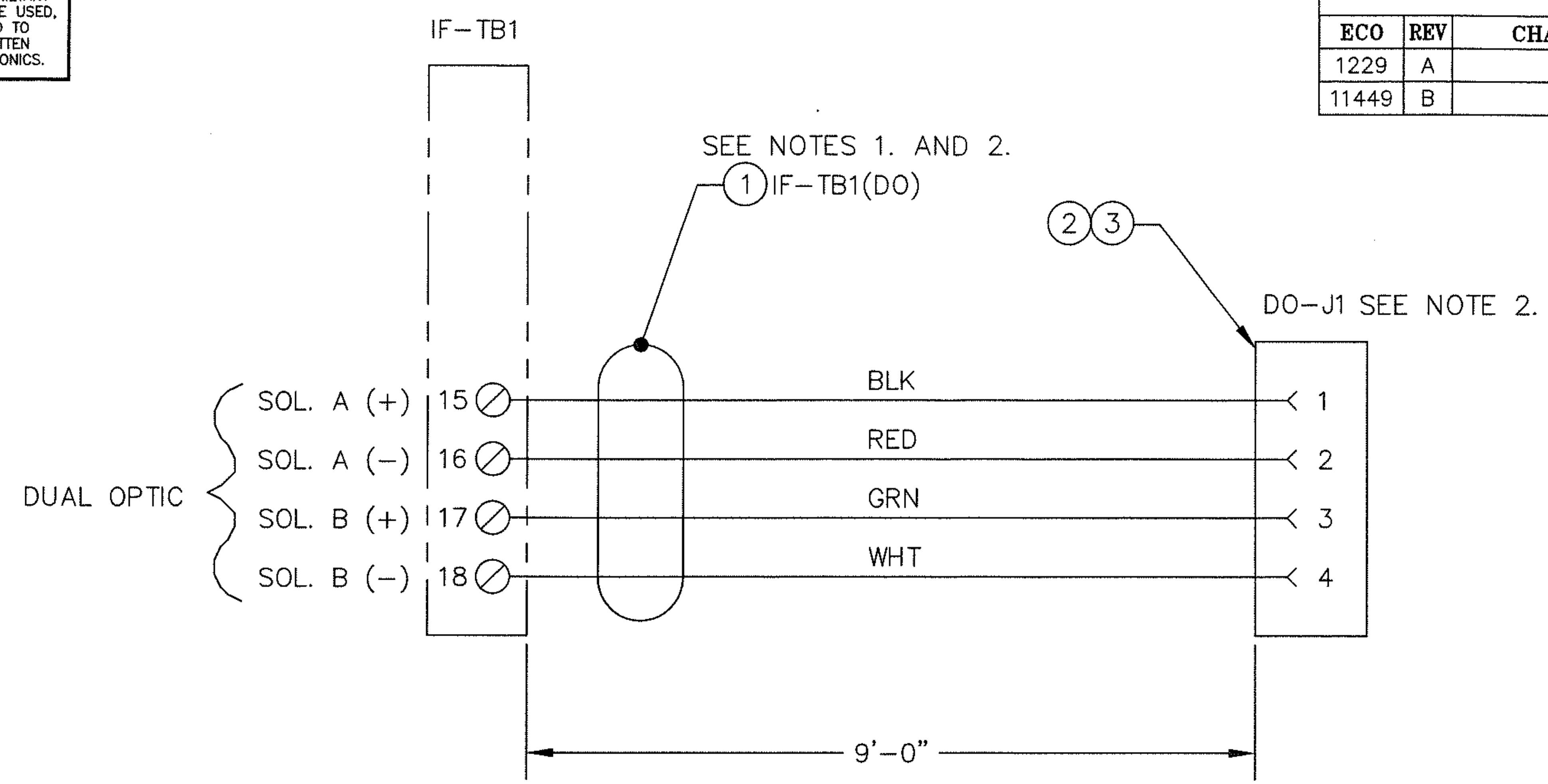
SCALE	SIZE	DRAWING NO.
NONE	B	2750151

DO NOT SCALE DRAWING — SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED

--- REVISIONS ---

ECO	REV	CHANGE DESCRIPTION	DATE	CHG BY	APPV'D
1229	A	INITIAL RELEASE	10/28/97	CS	CA
11449	B	REVISED LABEL DESC.	04/25/02	PVS	RP



NOTES:

1. STRIP BACK CABLE JACKET 4" AND COVER EXPOSED SLEEVE WITH HEAT SHRINK TUBING.
2. CABLE MARKER SHALL BE WHITE HEAT SHRINK TUBING USING BLACK, PERMANENT IDENTIFICATION WITH LEGEND SHOWN.
3. DRAWN FROM 702370015.

PACKAGE PER GSI LUMONICS CONTROL DOCUMENT #CD0013, METHOD # P21

AFTER FINISHING, ADD PIECE PART MARKING ON SURFACE INDICATED IN DRAWING PER GSI LUMONICS CNTRL DOC. #CD0002, METHOD # 1.

ALL DIMENSIONS ARE TO BE INTERPRETED PER LATEST ANSI Y14.5 SPECS.

ITEM	QTY	PART NUMBER	DESCRIPTION
3	4	2028003	CONN HDW 20GA FEMALE PIN
2	1	2023006	CONN BURNDY SMS4R-1
1	9'	2413115	CABLE 4 COND. 22GA, SHIELDED

MATERIAL: SEE PARTS LIST	DRAWN BY: CS	GSI LUMONICS 60 FORDHAM ROAD WILMINGTON, MA 01887
FINISH: NONE	DRAWN DATE: 10/28/97	DRAWING TITLE: CABLE ASSY, EXTENSION DUAL OPTIC SOLONOID,
UNLESS SPECIFIED 1. ALL DIMENSIONS APPLY AFTER FINISH 2. REMOVE ALL BURRS AND SHARP EDGES. (.010 MAX. R. OR CHAMFER) 3. MIN. BEND RADIUS, MIN. BEND RELIEF. 4. NO TOOL MARKS. 5. MACHINED FINISH 64 EXCEPT 32 FOR HORIZ. MILLING	CH.:	
	CFN:	DRAWING NUMBER: 6022375 — REV: B
UNLESS OTHERWISE SPECIFIED .X = ± .03 .XX = ± .01 .XXX = ± .005 X/X = ± 1/64 X° = ± 30' ALL DIMENSION IN INCHES	SIZE: B — SCALE: NONE	DO NOT SCALE DRAWING — SHEET 1 OF 1

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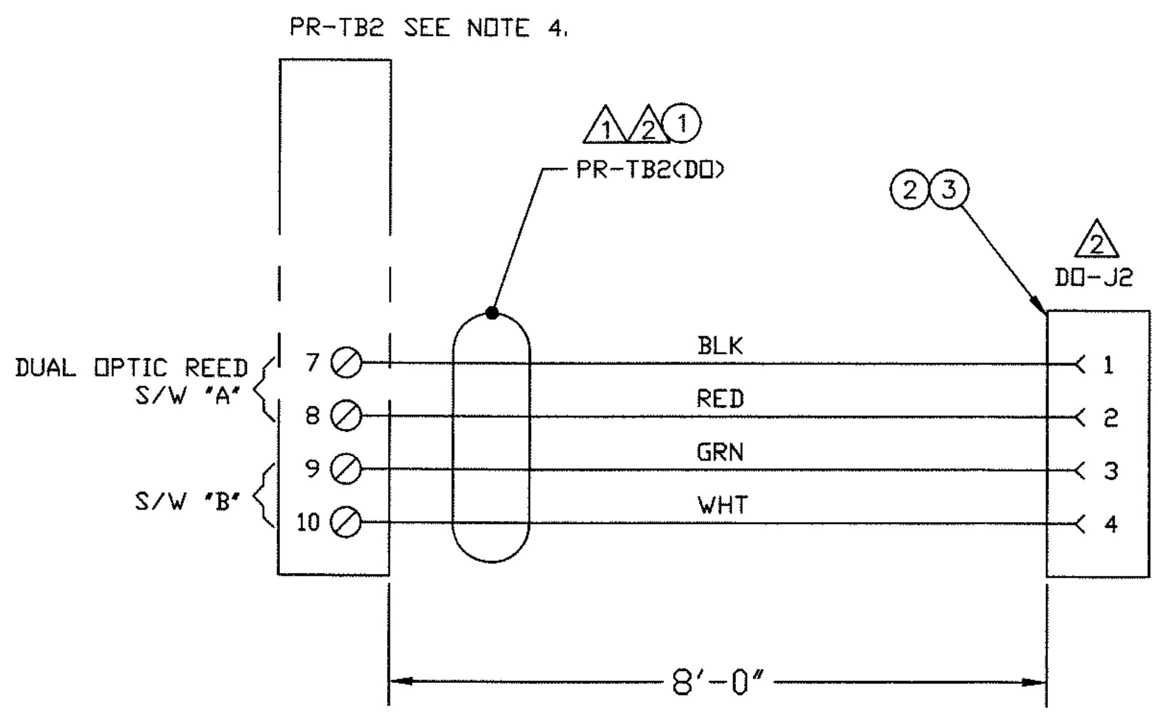
--- REVISIONS ---

ECO	REV	CHANGE DESCRIPTION	DATE	CHG BY	APPV'D
1229	A	INITIAL RELEASE	10/28/97	CS	CA
9372	B			DM	DAM
9254	C	ADDED NOTE 4.	03/01/00	DM	DAM
11736	D	MODIFIED NOTES. MORE WIRE LABEL	10/25/02	BYI	BYI



PACKAGE PER GSI LUMONICS CONTROL DOCUMENT #CD0013, METHOD # P21

AFTER FINISHING, ADD PIECE PART MARKING ON SURFACE INDICATED IN DRAWING PER GSI LUMONICS CNTRL DOC. #CD0002, METHOD # 1

ALL DIMENSIONS ARE TO BE INTERPRETED PER LATEST ANSI Y14.5 SPECS.

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL SPEC.
3	4	2028003	CONN HDW 20GA FEMALE PIN	
2	1	2023006	CONN BURNDY SMS4R-1	
1	8'	2413115	CABLE 4 COND, 22GA, SHIELDED	

4. REFERENCE: PR-TB2 PARTS ARE IN BOM 6750118
3. REFERENCE: DRAWN FROM 702370014.
2. CABLE MARKER SHALL BE WHITE HEAT SHRINK TUBING USING BLACK, PERMANENT IDENTIFICATION WITH LEGEND SHOWN. MARK INDIVUAL WIRES AS FOLLOWS:
   PR-TB2-7 , PR-TB2-8 , PR-TB2-9 , PR-TB2-10
1. STRIP BACK CABLE JACKET 4" AND COVER EXPOSED SLEEVE WITH HEAT SHRINK TUBING.

NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL: SEE BOM

FINISH: N/A

UNLESS SPECIFIED
1. ALL DIMENSIONS APPLY AFTER FINISH
2. REMOVE ALL BURRS AND SHARP EDGES. (.010 MAX. R. OR CHAMFER)
3. MIN. BEND RADIUS, MIN. BEND RELIEF.
4. NO TOOL MARKS.
5. MACHINED FINISH 64 EXCEPT 32 FOR HORIZ. MILLING

UNLESS OTHERWISE SPECIFIED
.X = ± .03 .XXX = ± .005 X° = ± 30'
.XX = ± .01 X/X = ± 1/64 ALL DIMENSION IN INCHES

DRAWN BY: DAM

DRAWN DATE: 03/01/00

CH.

CFN

GSI Lumonics 60 FORDHAM ROAD WILMINGTON, MA 01887

DRAWING TITLE: CABLE ASSY., EXTENSION DUAL OPTIC REED SENSOR

DRAWING NUMBER: 6022374

REV: D

SIZE

SCALE: 1=1

DO NOT SCALE DRAWING

SHEET: 1 OF 1

REVISIONS			
LVL	DESCRIPTION	DRWN/APVD	DATE
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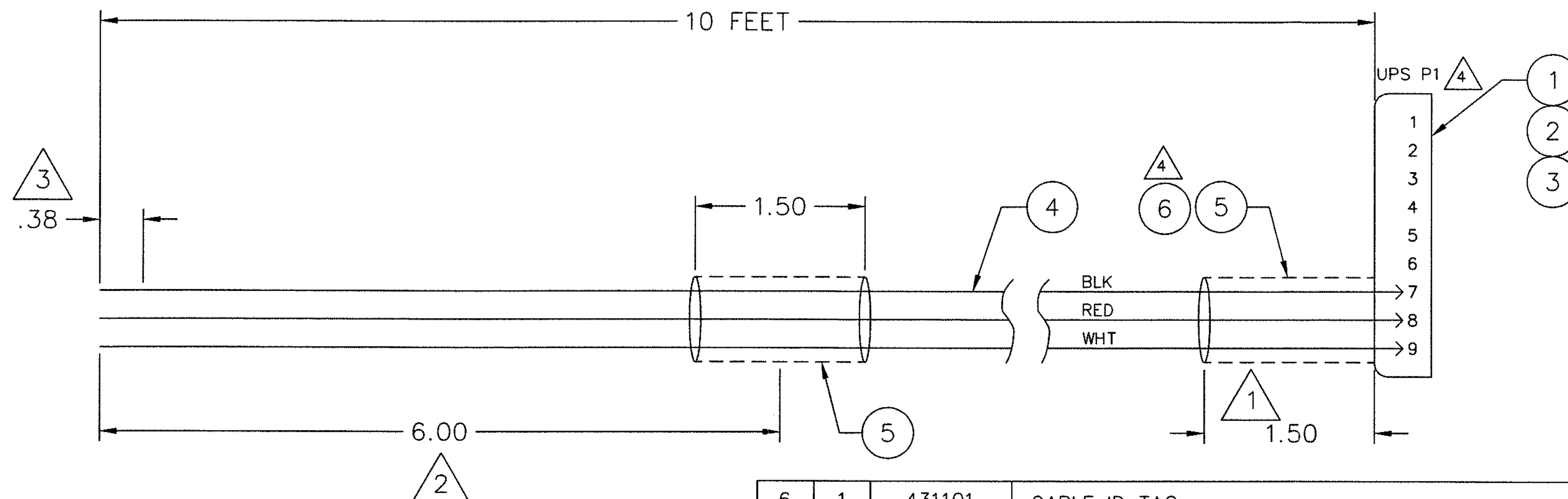
A	SEE ECO #707	JL/	4/4/96



ITEM	QTY	PART NO.	DESCRIPTION
6	1	431101	CABLE ID TAG
5	3"	4342009	SHRINK TUBING, BLACK, 3/16"
4	10'	2413115	CABLE, 4 COND, 22 AWG, SHIELDED
3	1	2029001	CONN HDW, 9 PIN BACKSHELL
2	1	2024001	CONN, DEC9P
1	1	2020002	CONN HDW, MALE MTG

4 LABEL CABLE END AS SHOWN

3 STRIP AND TIN 3 INDIVIDUAL WIRES BACK 3/8".

2 STRIP CABLE HOUSING BACK BY 6.00 INCHES AND INSTALL SHRINK TUBING.

1 INSTALL 1.50" OF SHRINK TUBING WHERE CABLE ENTERS CONNECTOR.

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
THREADS: CLASS 2A AND/OR 2B
MACHINING SURFACES: 64/
REMOVE ALL BURRS/SHARP EDGES

TOLERANCES ARE:
.XX± .01
.XXX± .005
ANGLE± 0.5°

MATERIAL:
TREATMENT:
FINISH:

APPROVALS	DATE
DRAWN PAT BAIR	12/19/95
CHECKED	
ENGR JIM TEMPLIN	12/19/95

LUMONICS

CABLE ASSY, UPS

SCALE	SIZE	DRAWING NO.
1/1	B	6022270

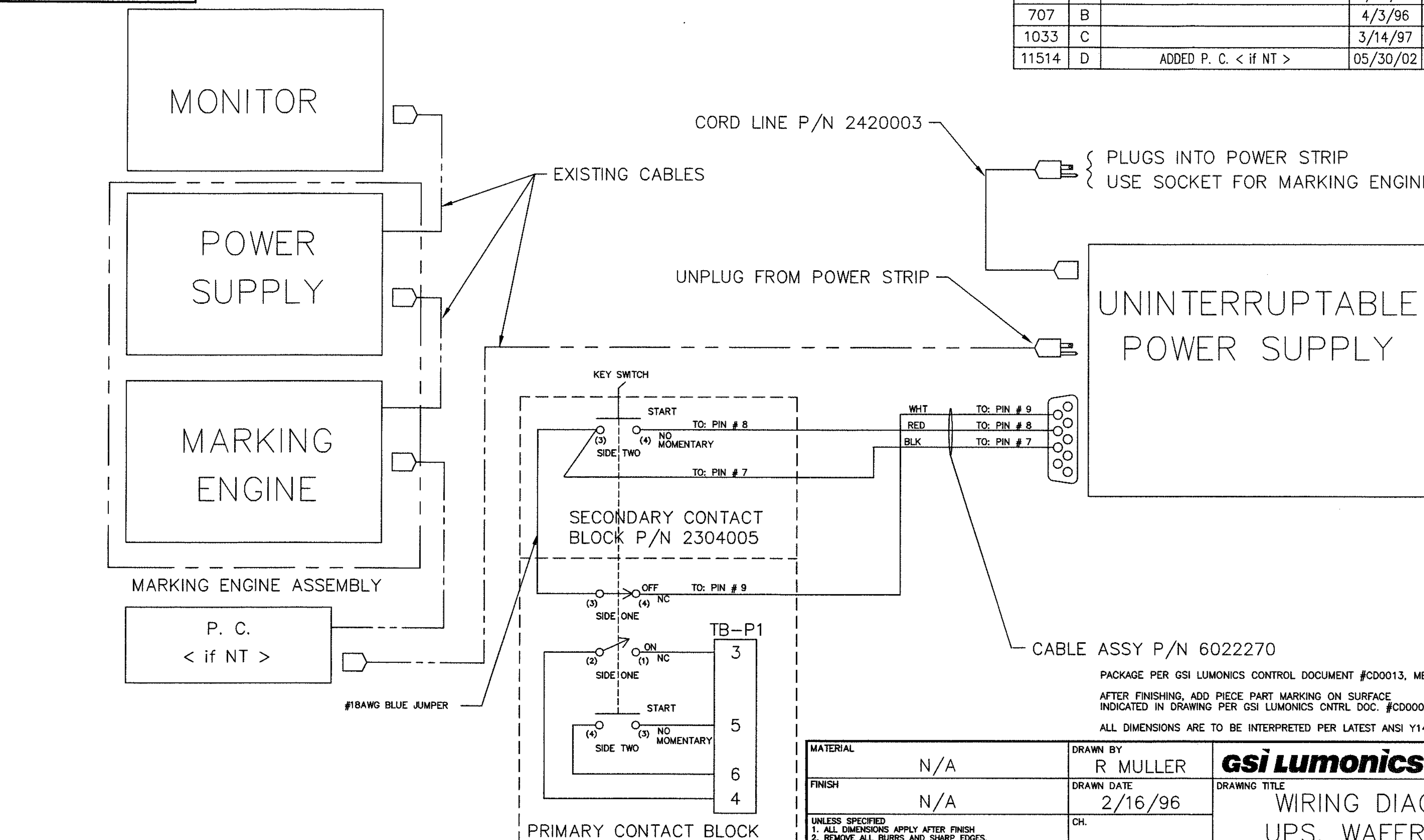
DO NOT SCALE DRAWING

SHEET 1 OF 1

THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND SHALL NOT BE USED, REPRODUCED, OR DISCLOSED TO THIRD PARTIES WITHOUT WRITTEN AUTHORIZATION FROM GSI LUMONICS.

--- REVISIONS ---

ECO	REV	CHANGE DESCRIPTION	DATE	CHG BY	APPV'D
645	A	FIRST RELEASE	2/23/96	RM	BL
707	B		4/3/96	JL	JHT
1033	C		3/14/97	MB	JL
11514	D	ADDED P. C. < if NT >	05/30/02	PVS	BI



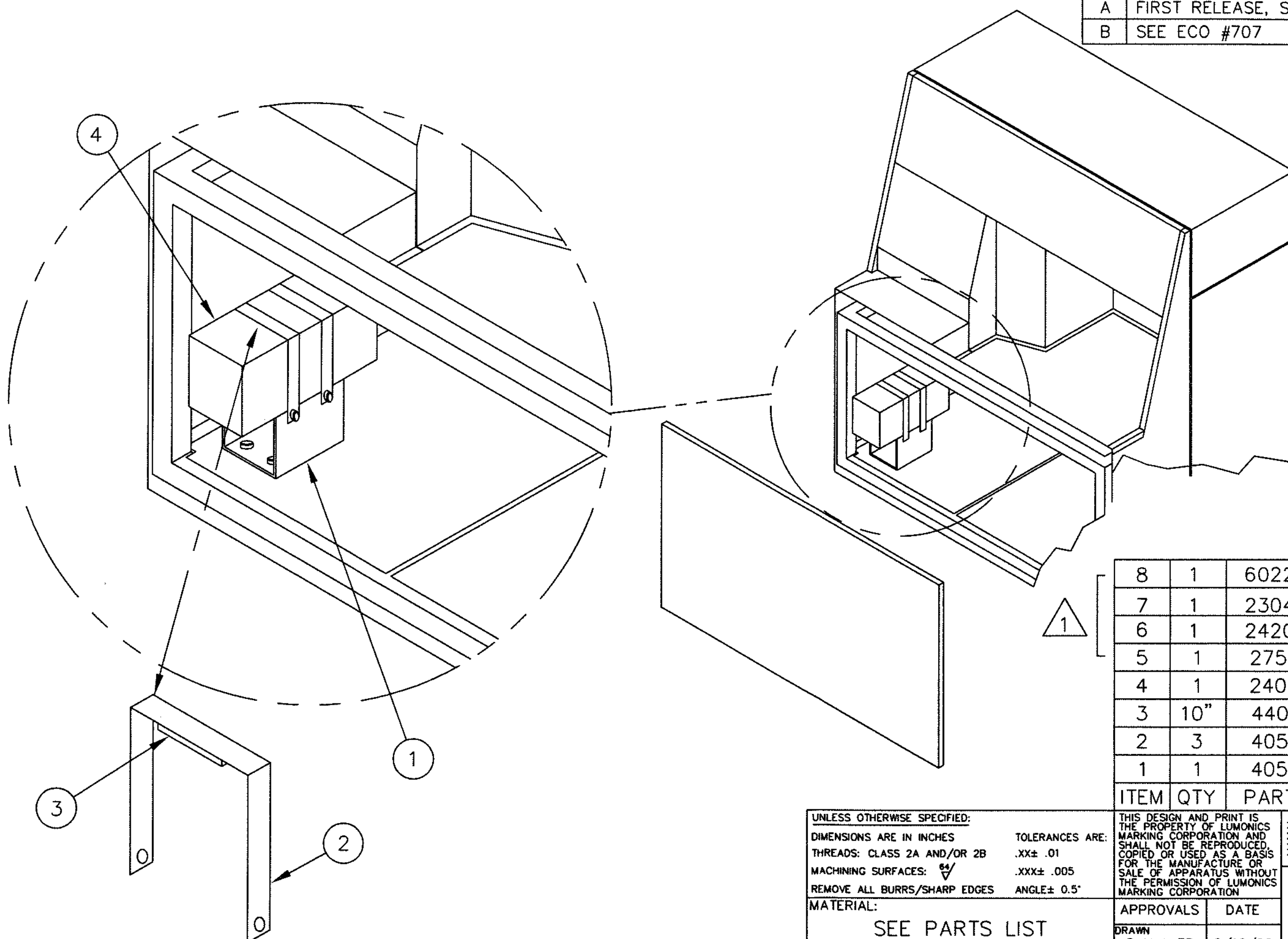
PACKAGE PER GSI LUMONICS CONTROL DOCUMENT #CD0013, METHOD # P21

AFTER FINISHING, ADD PIECE PART MARKING ON SURFACE INDICATED IN DRAWING PER GSI LUMONICS CNTRL DOC. #CD0002, METHOD # 1.

ALL DIMENSIONS ARE TO BE INTERPRETED PER LATEST ANSI Y14.5 SPECS.

NOTES: SWITCHES SHOWN IN KEY OFF POSITION

MATERIAL: N/A	DRAWN BY: R MULLER	GSI LUMONICS, 60 FORDHAM ROAD, WILMINGTON, MA 01887
FINISH: N/A	DRAWN DATE: 2/16/96	DRAWING TITLE: WIRING DIAGRAM UPS, WAFERMARK
UNLESS SPECIFIED 1. ALL DIMENSIONS APPLY AFTER FINISH 2. REMOVE ALL BURRS AND SHARP EDGES. (.010 MAX. R. OR CHAMFER) 3. MIN. BEND RADIUS, MIN. BEND RELIEF. 4. NO TOOL MARKS. 5. MACHINED FINISH 64 EXCEPT 32 FOR HORIZ. MILLING	CH.	
	CFN	DRAWING NUMBER: 2750143 — REV: D
UNLESS OTHERWISE SPECIFIED .X = ± .03 .XX = ± .01 .XXX = ± .005 X/X = ± 1/64 X° = ± 30' ALL DIMENSION IN INCHES	SIZE: B — SCALE: 1=1	DO NOT SCALE DRAWING — SHEET 1 OF 1



REVISIONS			
LVL	DESCRIPTION	DRWN/APVD	DATE
A	FIRST RELEASE, SEE ECO #645	RM/BL	2/23/96
B	SEE ECO #707	JL/	4/3/96

ITEM	QTY	PART NO.	DESCRIPTION
8	1	6022270	CABLE ASSY, UPS
7	1	2304005	CONTACT BLK A/B #800T-XA
6	1	2420003	CORD LINE
5	1	2750143	UPS WIRE DIAGRAM, WMSCDPL
4	1	2403124	POWER SUPPLY, SMART-UPS 700
3	10"	4407001	WEATHERSTRIP, 3/4" WIDE X 3/16" THK.
2	3	4051712	HOLD DOWN BRACKET
1	1	4051714	UPS BASE

△1 (items 6, 7, 8)

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
THREADS: CLASS 2A AND/OR 2B
MACHINING SURFACES: 64√
REMOVE ALL BURRS/SHARP EDGES

TOLERANCES ARE:
.XX± .01
.XXX± .005
ANGLE± 0.5°

MATERIAL: SEE PARTS LIST
TREATMENT:
FINISH:

APPROVALS	DATE
DRAWN R MULLER	2/16/96
CHECKED	
ENGR	

LUMONICS

ASSEMBLY, UPS FOR WMSCDPL

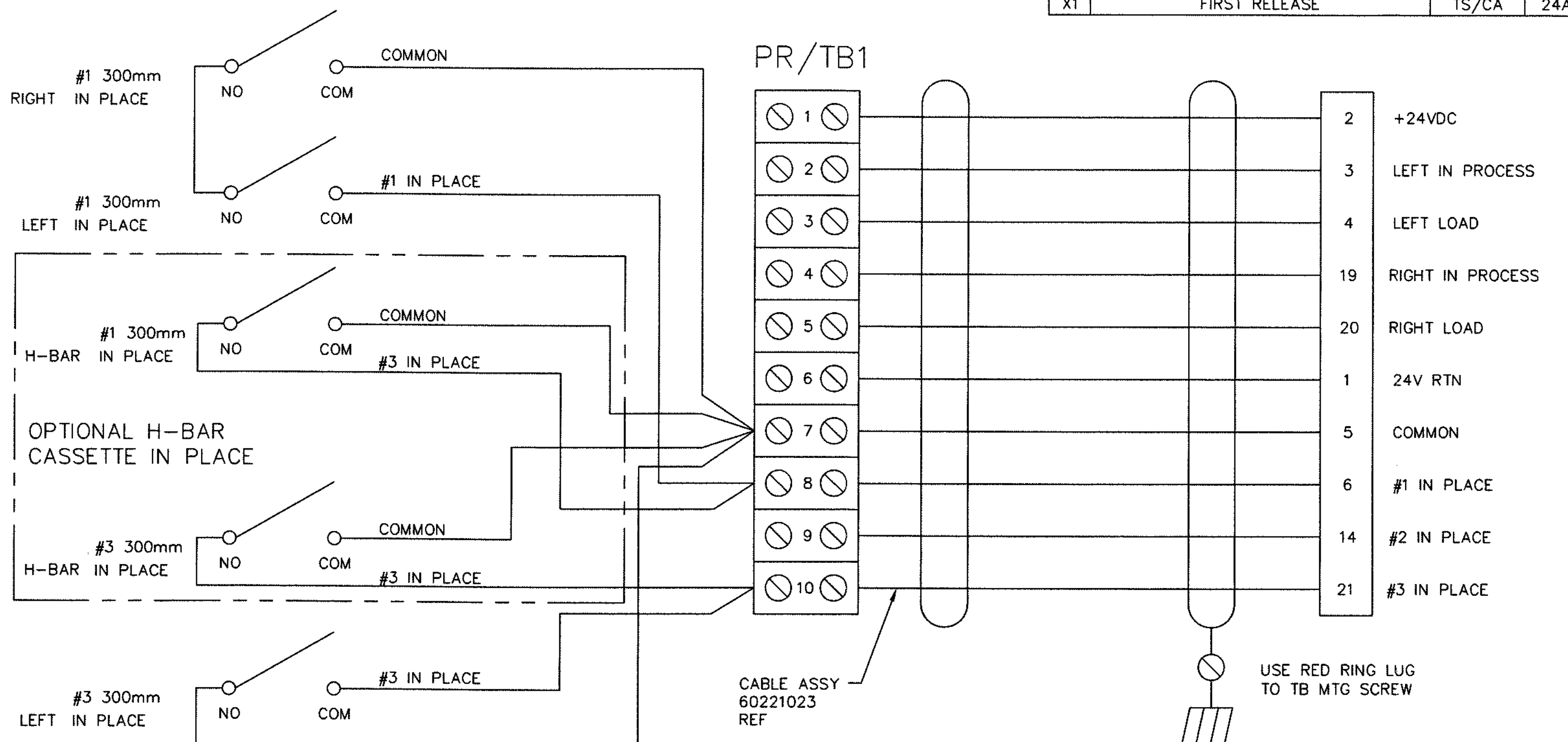
SCALE NONE | SIZE B | DRAWING NO. 6550122

DO NOT SCALE DRAWING | SHEET 1 OF 1

△1 THESE ITEMS NOT SHOWN.

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS			
LVL	DESCRIPTION	DRWN/APVD	DATE
X1	FIRST RELEASE	TS/CA	24APR98



UNLESS OTHERWISE SPECIFIED:	
DIMENSIONS ARE IN INCHES	TOLERANCES ARE:
THREADS: CLASS 2A AND/OR 2B	.XX± .01
MACHINING SURFACES: 64/	.XXX± .005
REMOVE ALL BURRS/SHARP EDGES	ANGLE± 0.5°
MATERIAL: —	
TREATMENT: —	
FINISH: —	

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ALL HARD (PAPER) COPIES OF THIS DOCUMENT ARE UNCONTROLLED. THE ELECTRONIC FILE IN THE NOVELL NETWORK IS CONTROLLED AND IS THE MASTER. YOU MUST CHECK VISIBILITY (MIS) TO ENSURE THE LATEST REVISION.

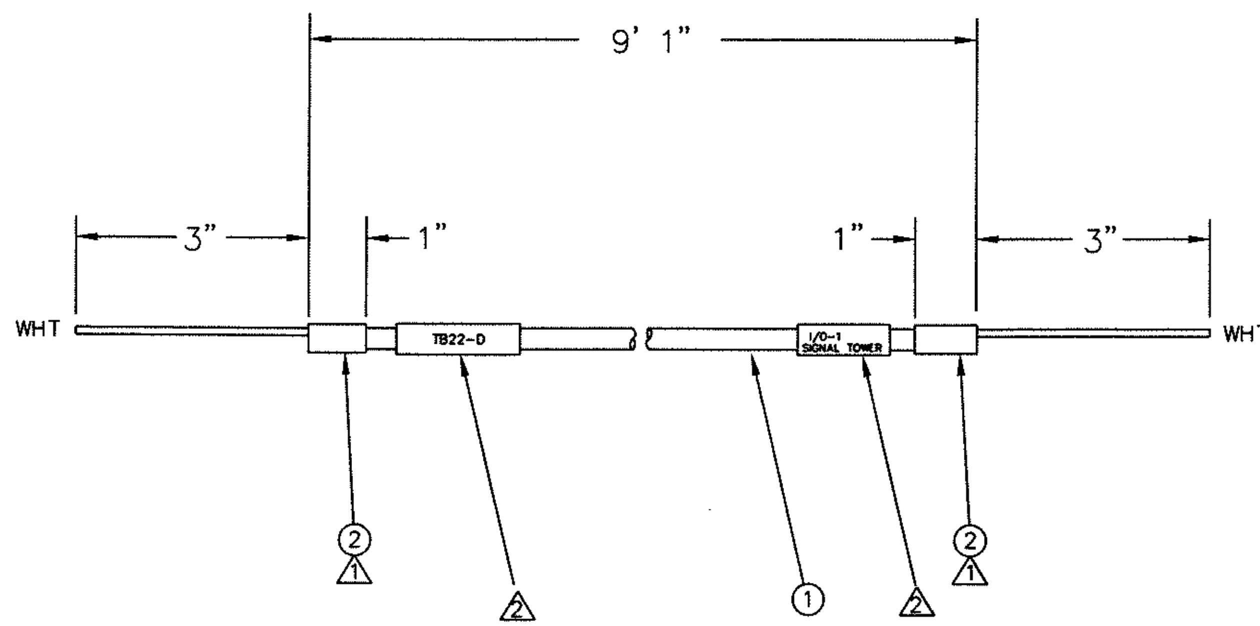
LUMONICS

TITLE
SCHEMATIC, PRESENTER
WMSCDPL300

SCALE	SIZE	DRAWING NO.
NONE	B	2750233
DO NOT SCALE DRAWING		SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS			
LVL	DESCRIPTION	DRWN/APPVD	DATE
A	RELEASE PER ECO #695	W.V./ JL	03/28/96
B	ECO #798	JL / JHT	6/21/96
C	ECO #852	JL / JHT	9/19/96
D	ECO #1031	BMc/BL	3/20/97



2 WIRE/CABLE MARKER SHALL BE WHITE HEAT SHRINK TUBING USING BLACK PERMENANT IDENTIFICATION WITH LEGEND SHOWN.

1 STRIP BACK WIRE 1/2" MORE THAN SHOWN AND COVER EXPOSED SLEEVING WITH ITEM 2 AS SHOWN.

ITEM No.	PART No.	QTY	DESCRIPTION
2	4342003	A/R	SHRINK SLEEVING 1/4"
1	2413119	10'	CABLE BELDON 2 COND. 18GA

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
THREADS: CLASS 2A AND/OR 2B
MACHINING SURFACES: 64
REMOVE ALL BURRS/SHARP EDGES

TOLERANCES ARE:
.XX± -
.XXX± -
ANGLE± -

MATERIAL: SEE PARTS LIST

TREATMENT: —

FINISH: N/A

APPROVALS	DATE
DRAWN W.Veca	11/16/95
CHECKED	
ENGR	

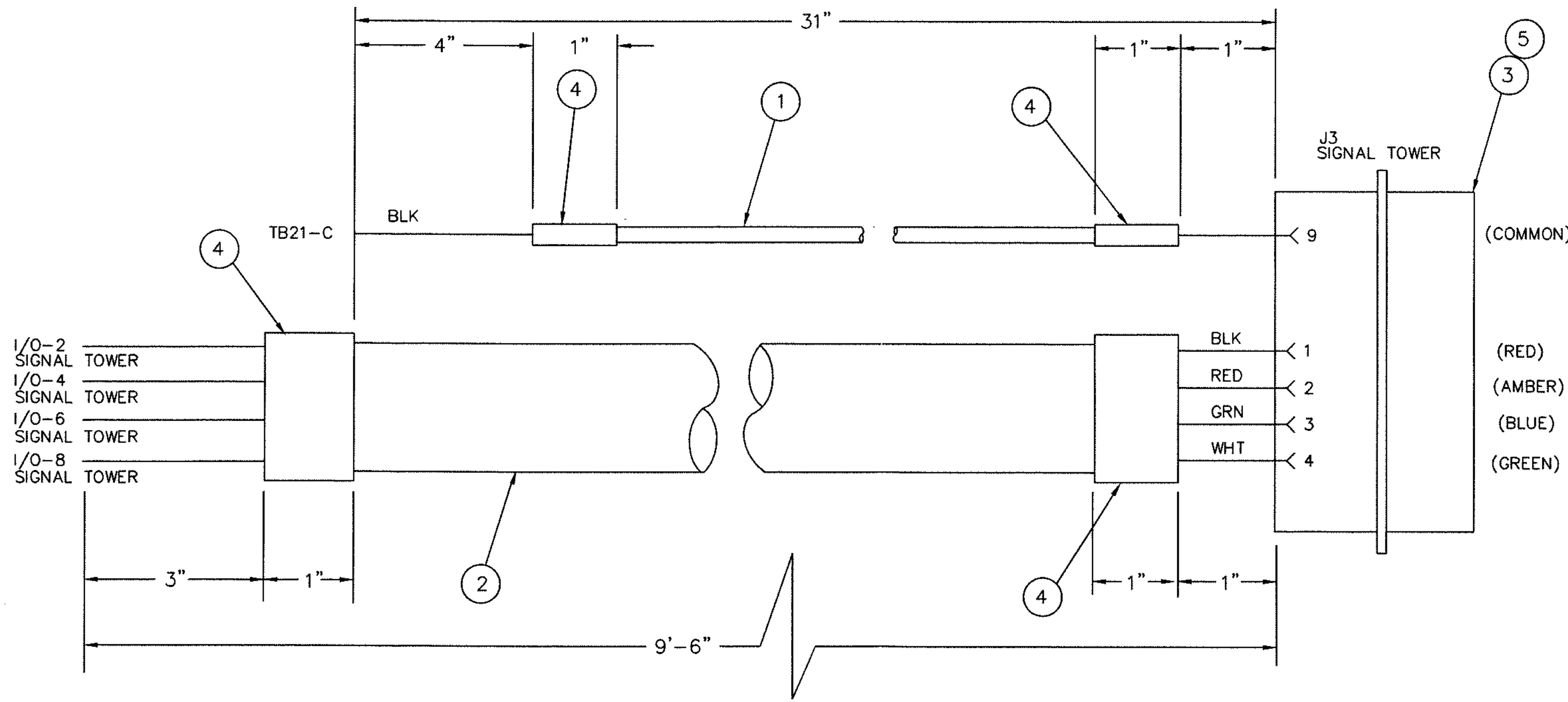
LUMONICS

SIGNAL TOWER 24V
SUPPLY CABLE

SCALE	SIZE	DRAWING NO.
NONE	B	6022283

DO NOT SCALE DRAWING | SHEET 1 OF 1

REVISIONS			
LVL	DESCRIPTION	DRWN/APPVD	DATE
A	RELEASE PER ECO #695	WV / JL	03/20/96
B	ECO #776	WV / JL	05/29/96
C	ECO #798	JL / JHT	06/21/96
D	ECO #852	JL /	08/19/96



2. LABEL CABLES WITH DESIGNATORS AS SHOWN.
1. STRIP BACK WIRE 1/2" MORE THAN SHOWN AND COVER EXPOSED SLEEVING WITH ITEM 4 AS SHOWN.

NOTES: UNLESS OTHERWISE SPECIFIED

ITEM No.	PART No.	QTY	DESCRIPTION
5	2023055	5	PINS SOCKET (FEMALE)
4	4342003	A/R	SHRINK SLEEVING 3/16"
3	2023053	5	CONNECTOR RECPT REVERSE (FEMALE)
2	2413115	10'	CABLE BELDON 4 COND. 22GA
1	2413119	3'	CABLE BELDON 2 COND. 18GA

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
THREADS: CLASS 2A AND/OR 2B
MACHINING SURFACES: 64
REMOVE ALL BURRS/SHARP EDGES

TOLERANCES ARE:
.XX±
.XXX±
ANGLE±

MATERIAL: SEE BOM
TREATMENT: N/A
FINISH: N/A

APPROVALS	DATE
DRAWN W.Veca	03/21/96
CHECKED	
ENGR	

LUMONICS

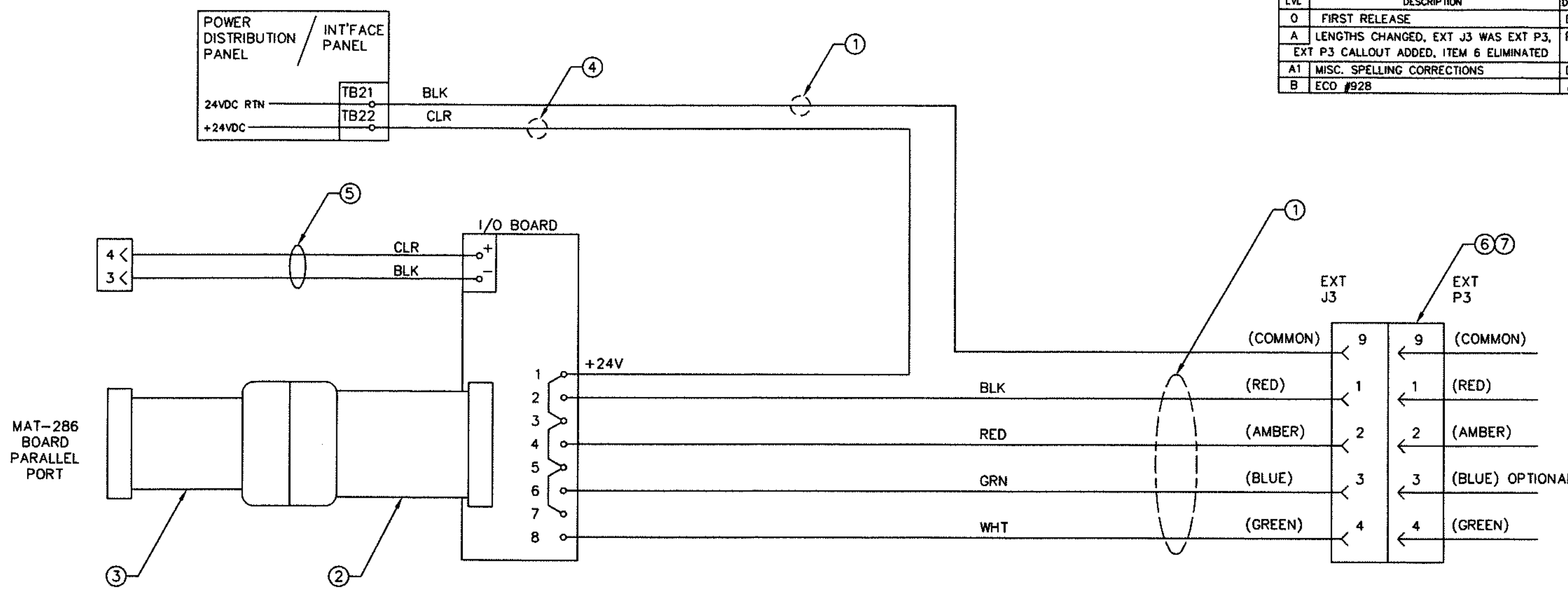
CABLE ASSY SIGNAL TOWER
4 COLOR

SCALE	SIZE	DRAWING NO.
NONE	B	6022282

DO NOT SCALE DRAWING | SHEET 1 OF 1

REVISIONS

LVL	DESCRIPTION	DRWN/APPVD	DATE
0	FIRST RELEASE	DD / AG	7/13/95
A	LENGTHS CHANGED, EXT J3 WAS EXT P3, EXT P3 CALLOUT ADDED, ITEM 6 ELIMINATED	PG / PG	9/11/95
A1	MISC. SPELLING CORRECTIONS	DD AG	11/13/95
B	ECO #928	JL /	12/02/96



ITEM	QTY	PART NUMBER	DESCRIPTION
7	5 REF	2023056	CONN HDW PIN
6	1 REF	2023054	CONN 9 PIN REVERSE PLUG
5	1 REF	6022284	CABLE 5V I. O. BOARD
4	1 REF	6022283	SIGNAL TOWER 24 SUPPLY CABLE
3	1 REF	3011338	PARALLEL CABLE MAT 286
2	1 REF	6022175	PATLIGHT INTERFACE 4 CLR
1	1 REF	6022282	CABLE ASSY SIGNAL TOWER 4 COLOR

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
THREADS: CLASS 2A AND/OR 2B
MACHINING SURFACES:
REMOVE ALL BURRS/SHARP EDGES

TOLERANCES ARE:
.XX± .01
.XXX± .005
ANGLE± 1/2°

LUMONICS

SCHEMATIC,
SIGNAL TOWER, WAFERMARK

MATERIAL: NONE
TREATMENT: NONE
FINISH: NONE

APPROVALS	DATE
DRAWN DAN DONGELMANS	6/7/95
CHECKED	
ENGR ASIF	7/13/95

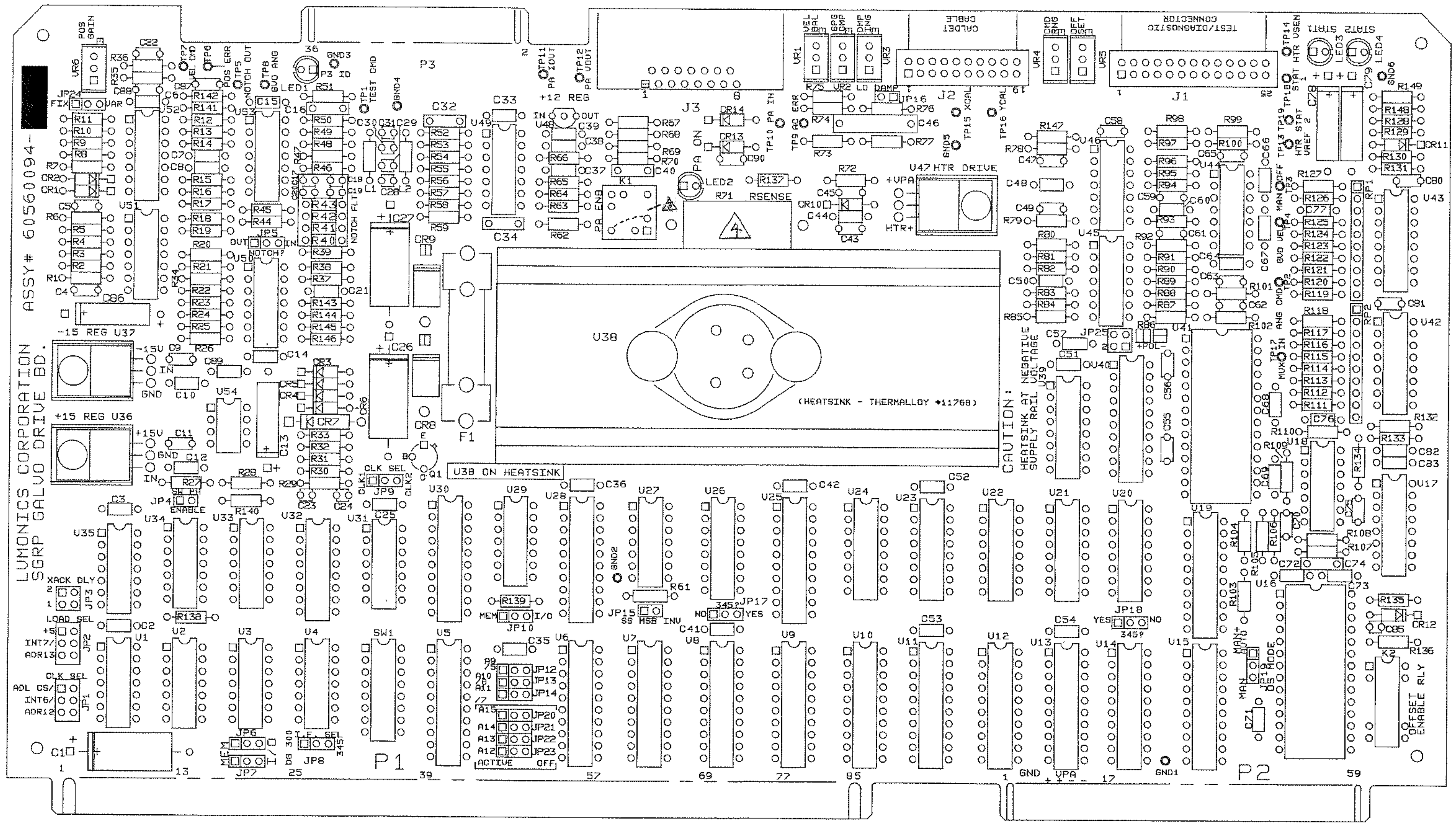
SCALE: NONE | SIZE: B | DRAWING NO. 2750123

DO NOT SCALE DRAWING | SHEET 1 OF 1

NOTES: UNLESS OTHERWISE NOTED

REVISIONS

ZONE	LTR	DESCRIPTION	DWN	CHK	DATE	APPROVED
	B					
	C	ECO #460			7-19-94	C.Marsh
	D	ECO # 817	B.Mc	TSL	9-3-96	B.Mc



4 RAISE R-71 ABOVE PCB BETWEEN 5 TO 8 m.m. -01 ONLY ECO# 817.

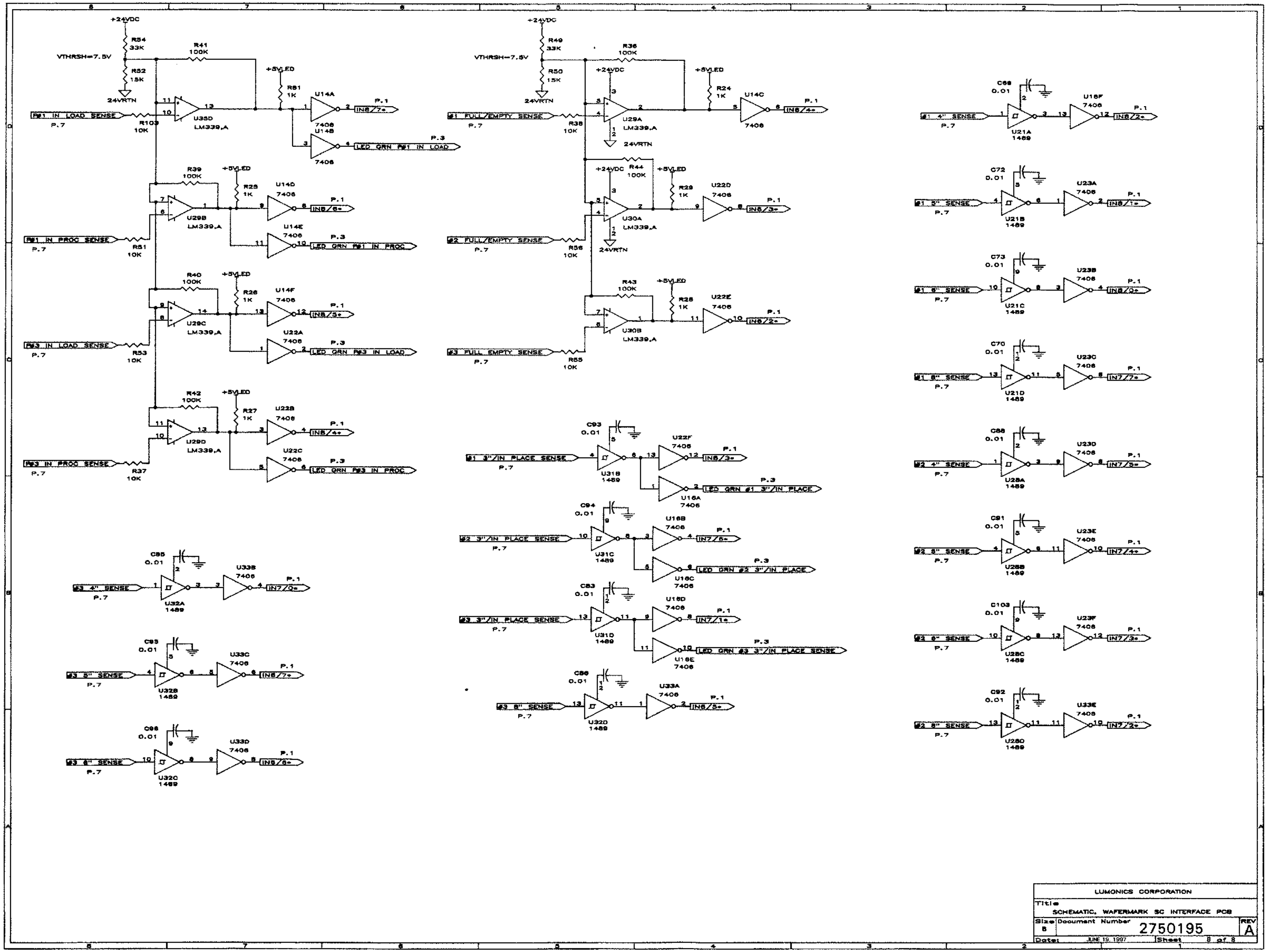
3 FOR "-13" ASSY, REMOVE K1 AND JUMPER K1-3 TO K1-8

2 FOR "-13" ASSY, REMOVE OR DO NOT INSTALL: R38 PER ECO # 393 12/21/93 BER 4 CM

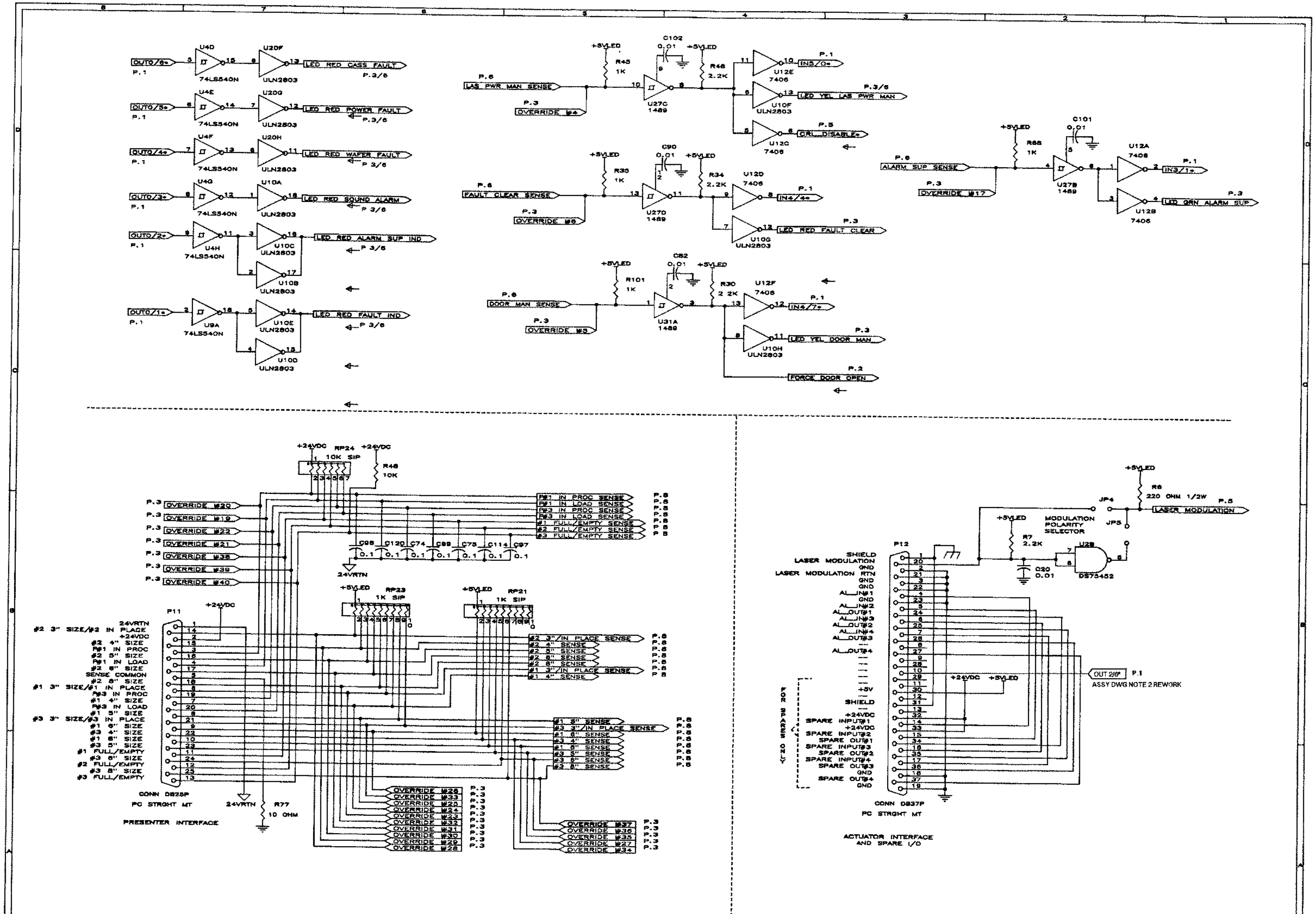
1 - THIS LAYOUT PERTAINS TO PWB 20160093 B OR C only (not A) RCP 5-5-92

NOTE: UNLESS OTHERWISE SPECIFIED

MATERIAL	UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES. DEBURR AND BREAK ALL SHARP EDGES AND CORNERS .010R OR CHAMFER DIM AND TOL PER ANSI Y14.5. TOLERANCES .XX ± .XXX ± .005 ANGULAR ± DO NOT SCALE DRAWING	SIGNATURE	DATE	LUMONICS ™
FINISH		DWN J. FAZIO	6-3-91	ASSEMBLY, SGRP GALVO DRIVE PCB
NEXT ASSY / USED ON		CHK R. PARKER	6-4-91	SIZE D
APPLICATION		ENG R. PARKER R	6-4-91 7-22-91	PROD CODE
		APVD		DWG NO 60560094-XX (PWB #20160093 B)
		APVD		SCALE / SHEET 1 OF 1



+24VDC
VTHRSH=7.5V
24VRTN
+5VLED
LM339,A
7406
1489
P.1
P.3
P.7
LUMONICS CORPORATION
Title
SCHEMATIC, WAFERMARK SC INTERFACE PCB
Size
B
Document Number
2750195
REV
A
Date: JUNE 19, 1997
Sheet 8 of 8

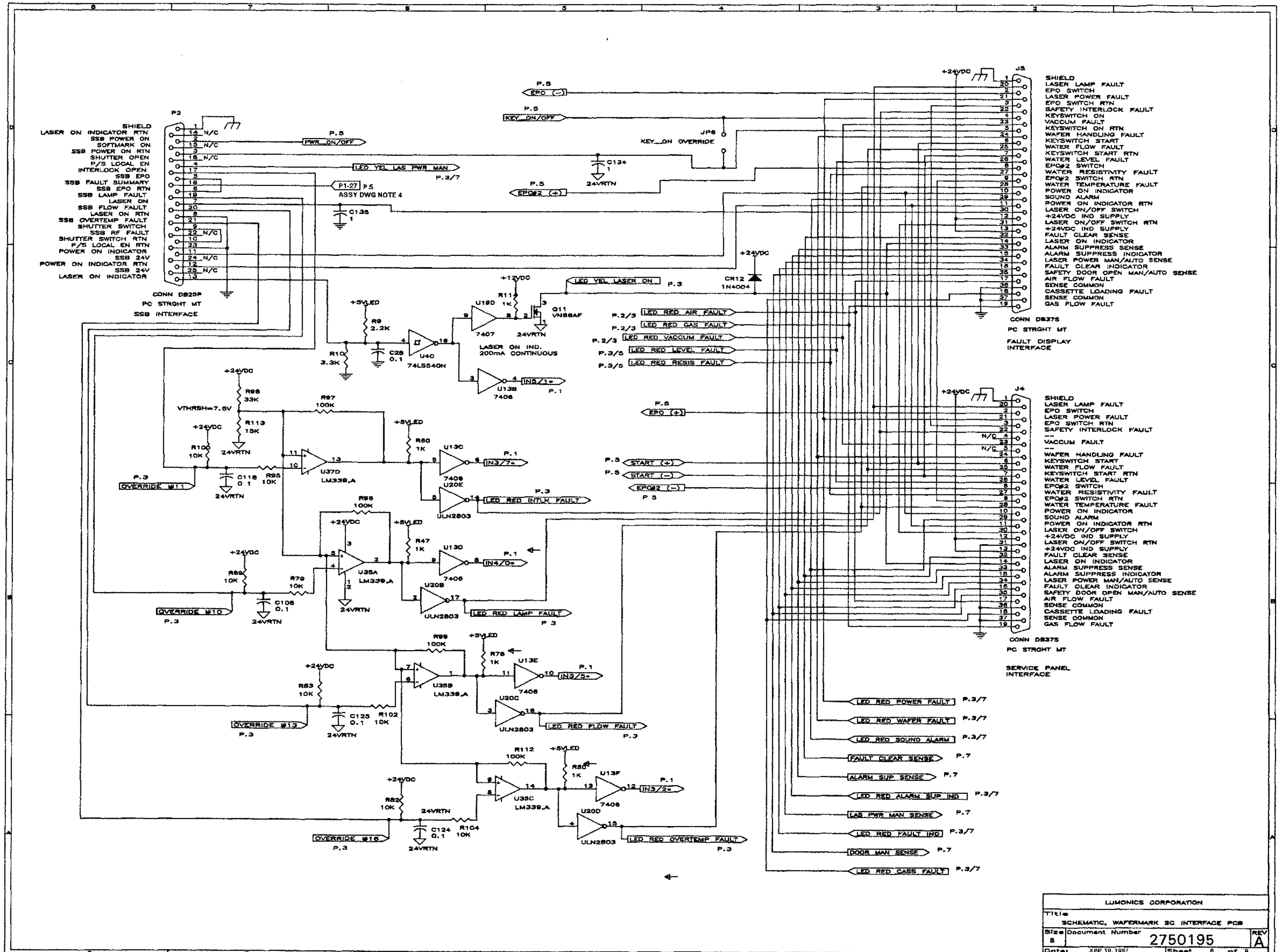


LUMONICS CORPORATION

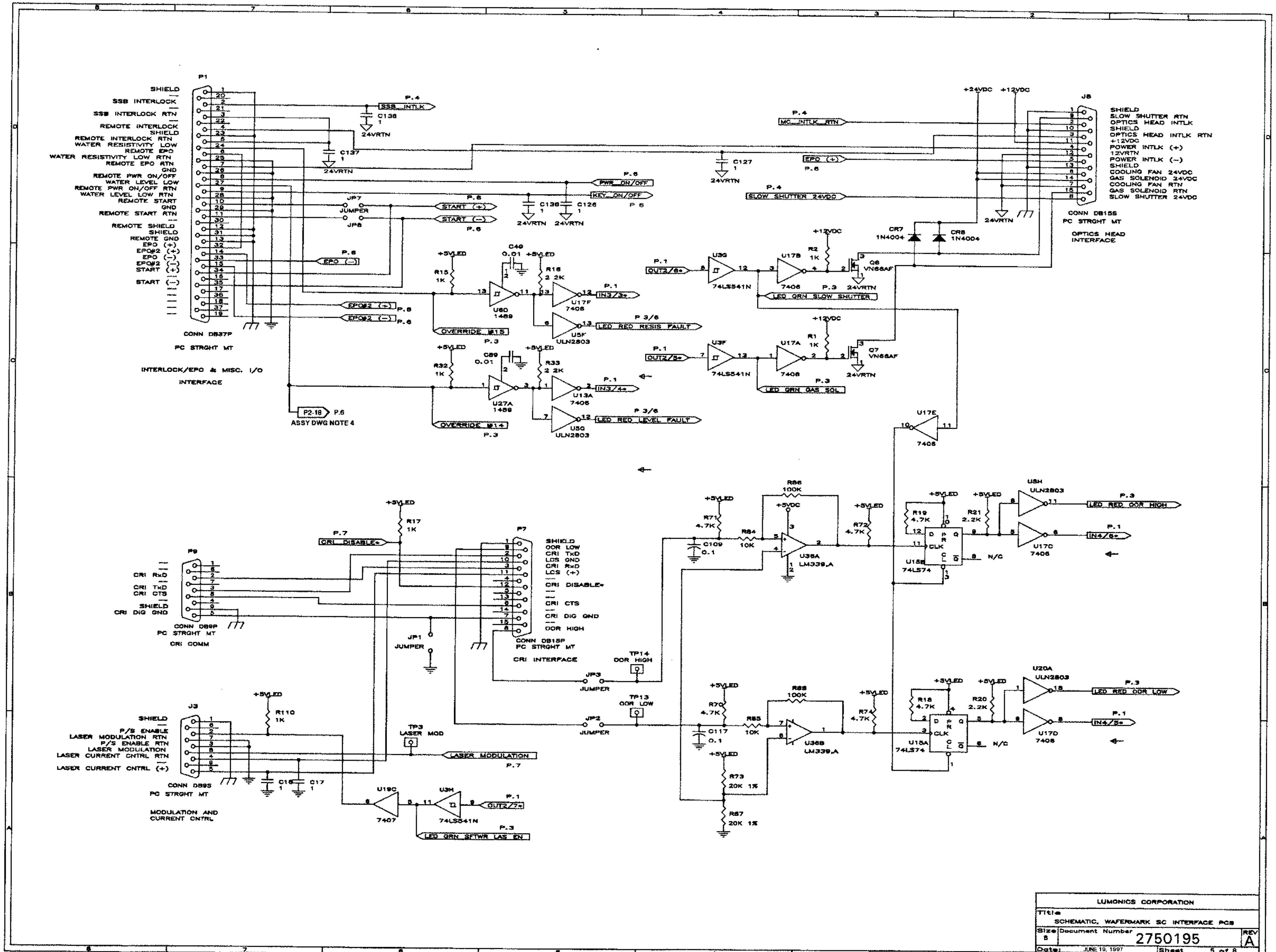
Title: SCHEMATIC, WAFERMARK SC INTERFACE PCB

Size	Document Number	REV
B	2750195	A

Date: JUNE 19, 1997 — Sheet 7 of 8



P2
SHIELD
LASER ON INDICATOR RTN
SSB POWER ON
SOFTMARK ON
SSB POWER ON RTN
SHUTTER OPEN
P/S LOCAL EN
INTERLOCK OPEN
SSB EPO
SSB FAULT SUMMARY
SSB EPO RTN
SSB LAMP FAULT
LASER ON
SSB FLOW FAULT
LASER ON RTN
SSB OVERTEMP FAULT
SHUTTER SWITCH
SSB RF FAULT
SHUTTER SWITCH RTN
P/S LOCAL EN RTN
POWER ON INDICATOR
SSB 24V
POWER ON INDICATOR RTN
SSB 24V
LASER ON INDICATOR
CONN DB25P
PC STRGHT MT
SSB INTERFACE
PWR_ON/OFF
LED YEL LAS PWR MAN
P1-27
ASSY DWG NOTE 4
EPO (-)
KEY_ON/OFF
JP6
KEY_ON OVERRIDE
EPO@2 (+)
LED YEL LASER ON
CR12
1N4004
Q11
VN88AF
LASER ON IND.
200mA CONTINUOUS
74LS540N
VTHRSH=7.5V
LM339,A
7406
7407
ULN2803
OVERRIDE #11
OVERRIDE #10
OVERRIDE #13
OVERRIDE #16
IN3/7+
IN4/0+
IN3/5+
IN3/2+
IN3/1+
LED RED INTLK FAULT
LED RED LAMP FAULT
LED RED FLOW FAULT
LED RED OVERTEMP FAULT
LED RED AIR FAULT
LED RED GAS FAULT
LED RED VACCUM FAULT
LED RED LEVEL FAULT
LED RED RESIS FAULT
EPO (+)
START (+)
START (-)
EPO@2 (-)
LED RED POWER FAULT
LED RED WAFER FAULT
LED RED SOUND ALARM
FAULT CLEAR SENSE
ALARM SUP SENSE
LED RED ALARM SUP IND
LAS PWR MAN SENSE
LED RED FAULT IND
DOOR MAN SENSE
LED RED CASS FAULT
J3
SHIELD
LASER LAMP FAULT
EPO SWITCH
LASER POWER FAULT
EPO SWITCH RTN
SAFETY INTERLOCK FAULT
KEYSWITCH ON
VACCUM FAULT
KEYSWITCH ON RTN
WAFER HANDLING FAULT
KEYSWITCH START
WATER FLOW FAULT
KEYSWITCH START RTN
WATER LEVEL FAULT
EPO@2 SWITCH
WATER RESISTIVITY FAULT
EPO@2 SWITCH RTN
WATER TEMPERATURE FAULT
POWER ON INDICATOR
SOUND ALARM
POWER ON INDICATOR RTN
LASER ON/OFF SWITCH
+24VDC IND SUPPLY
LASER ON/OFF SWITCH RTN
+24VDC IND SUPPLY
FAULT CLEAR SENSE
LASER ON INDICATOR
ALARM SUPPRESS SENSE
ALARM SUPPRESS INDICATOR
LASER POWER MAN/AUTO SENSE
FAULT CLEAR INDICATOR
SAFETY DOOR OPEN MAN/AUTO SENSE
AIR FLOW FAULT
SENSE COMMON
CASSETTE LOADING FAULT
SENSE COMMON
GAS FLOW FAULT
CONN DB37S
PC STRGHT MT
FAULT DISPLAY INTERFACE
J4
CONN DB37S
PC STRGHT MT
SERVICE PANEL INTERFACE
LUMONICS CORPORATION
Title
SCHEMATIC, WAFERMARK SC INTERFACE PCB
Size B
Document Number 2750195
REV A
Date: JUNE 19, 1997
Sheet 6 of 8

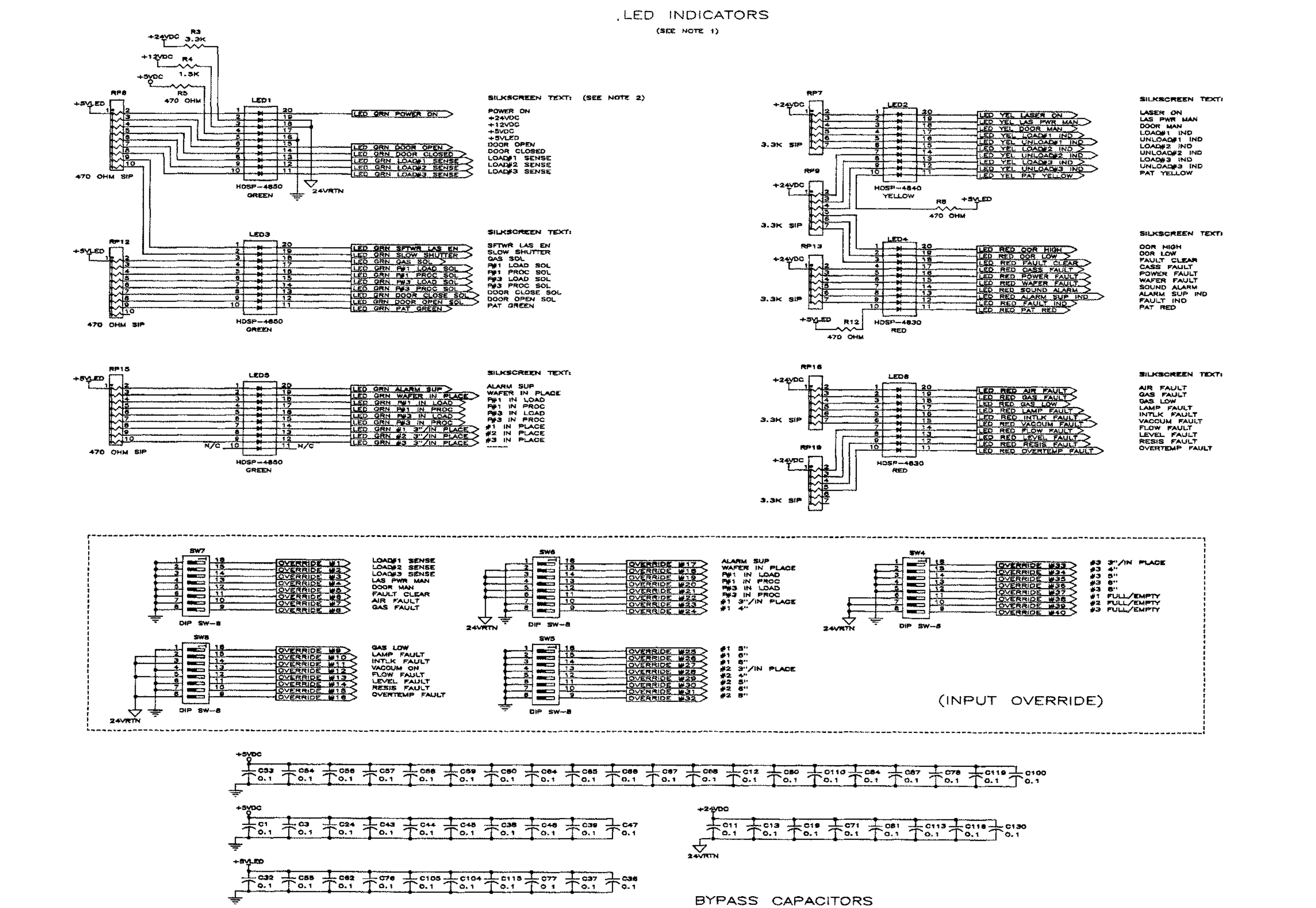


LUMONICS CORPORATION

Title
SCHEMATIC, WAFERMARK SC INTERFACE PCB

Size	Document Number	REV
B	2750195	A

Date: JUNE 19, 1997 Sheet 5 of 8

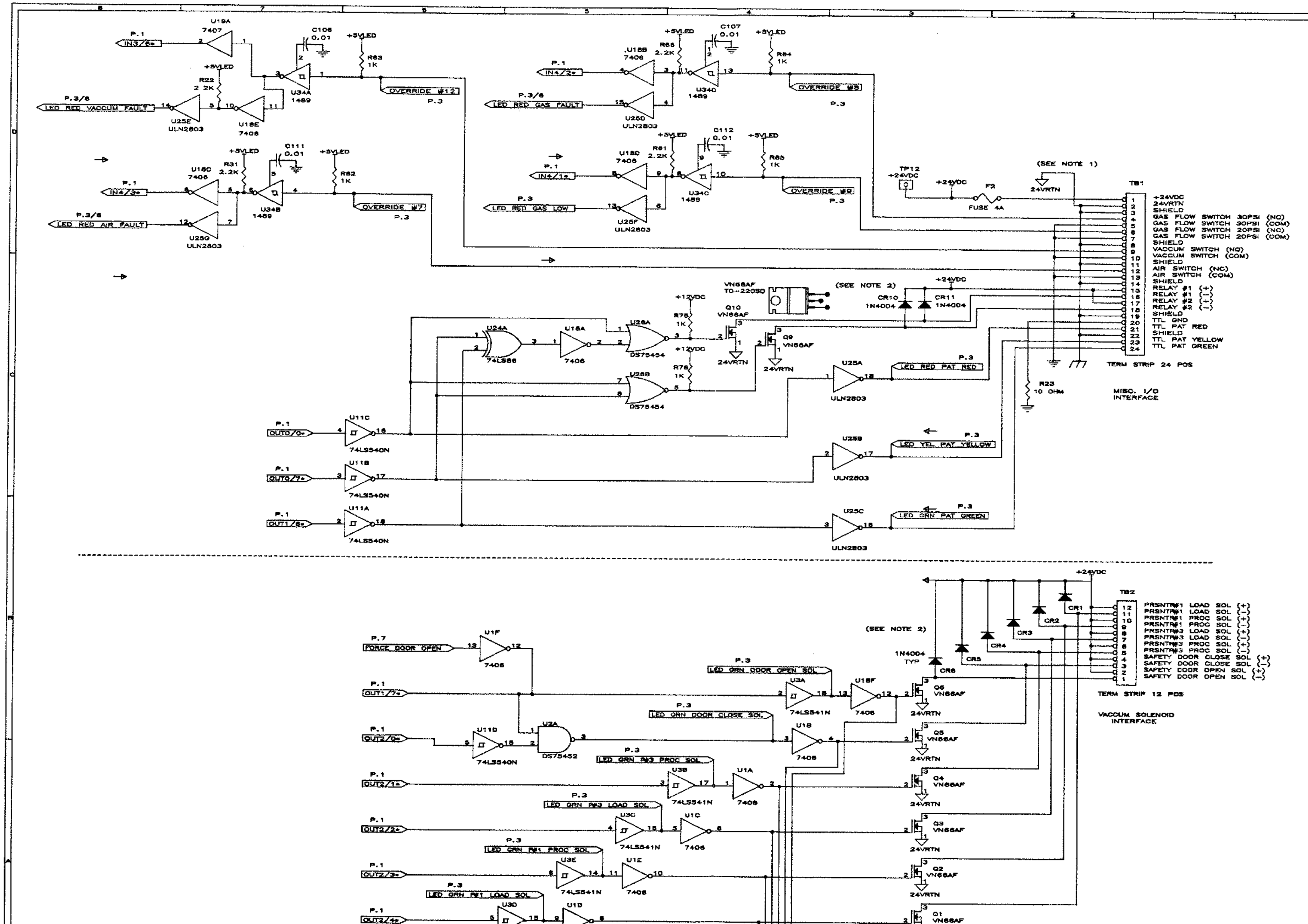


NOTES:

1. ALL LED BAR GRAPH INDICATORS TO BE LOCATED TOGETHER IN ONE AREA ON PCB.

2. SILKSCREEN STRING LENGTH 15 CHARACTERS EACH MAX. CHARACTER HEIGHT 0.062".

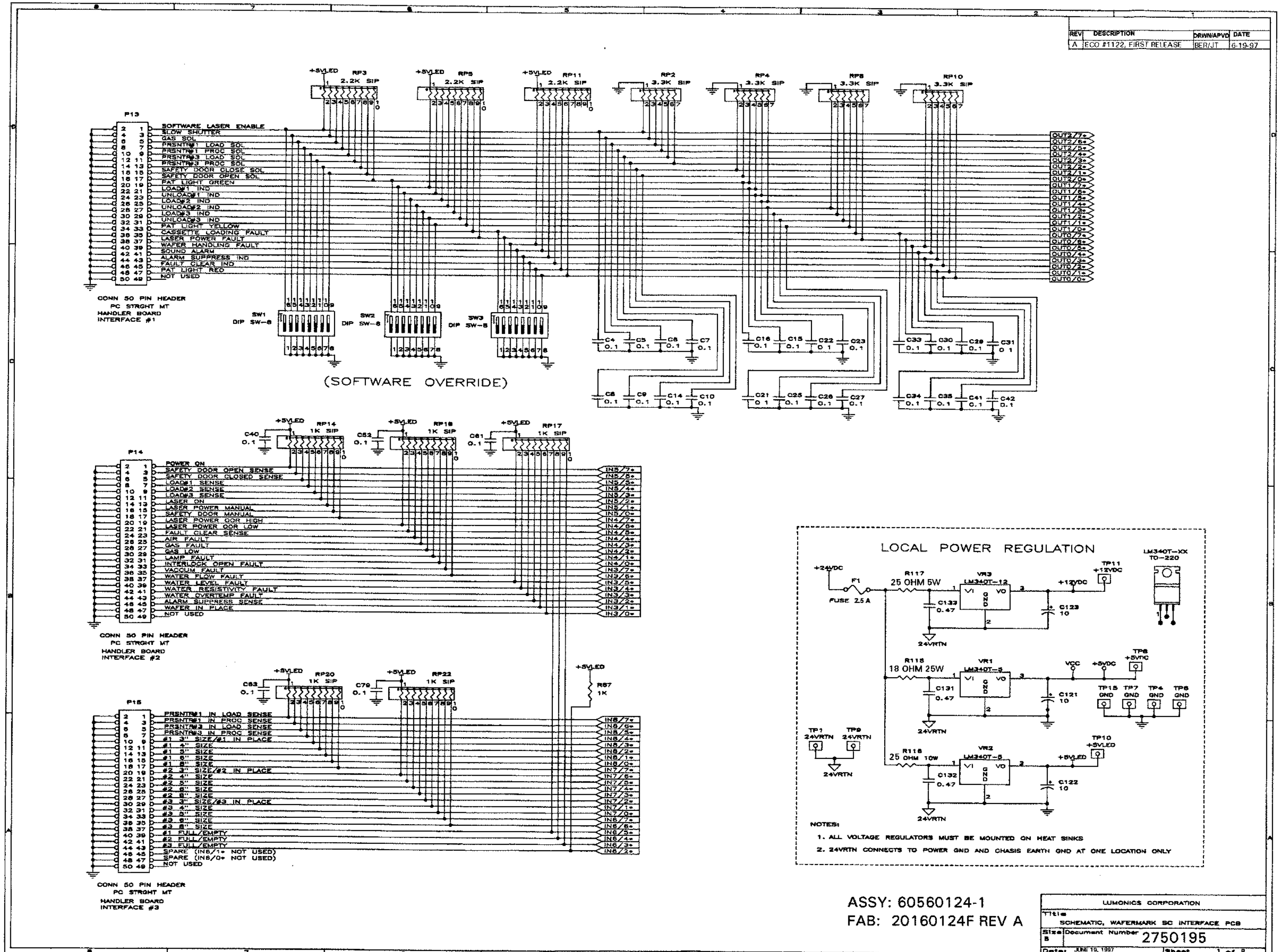
LUMONICS CORPORATION	
Title: SCHEMATIC, WAFERMARK SC INTERFACE PCB	
Size: B — Document Number: 2750195	REV: A
Date: JUNE 19, 1997	Sheet 3 of 8



NOTES:

1. 24VRTN CONNECTS TO CHASIS EARTH GND AND POWER GND AT ONE LOCATION ONLY
2. CLAMP DIODES MUST BE NEAR THE CONNECTOR

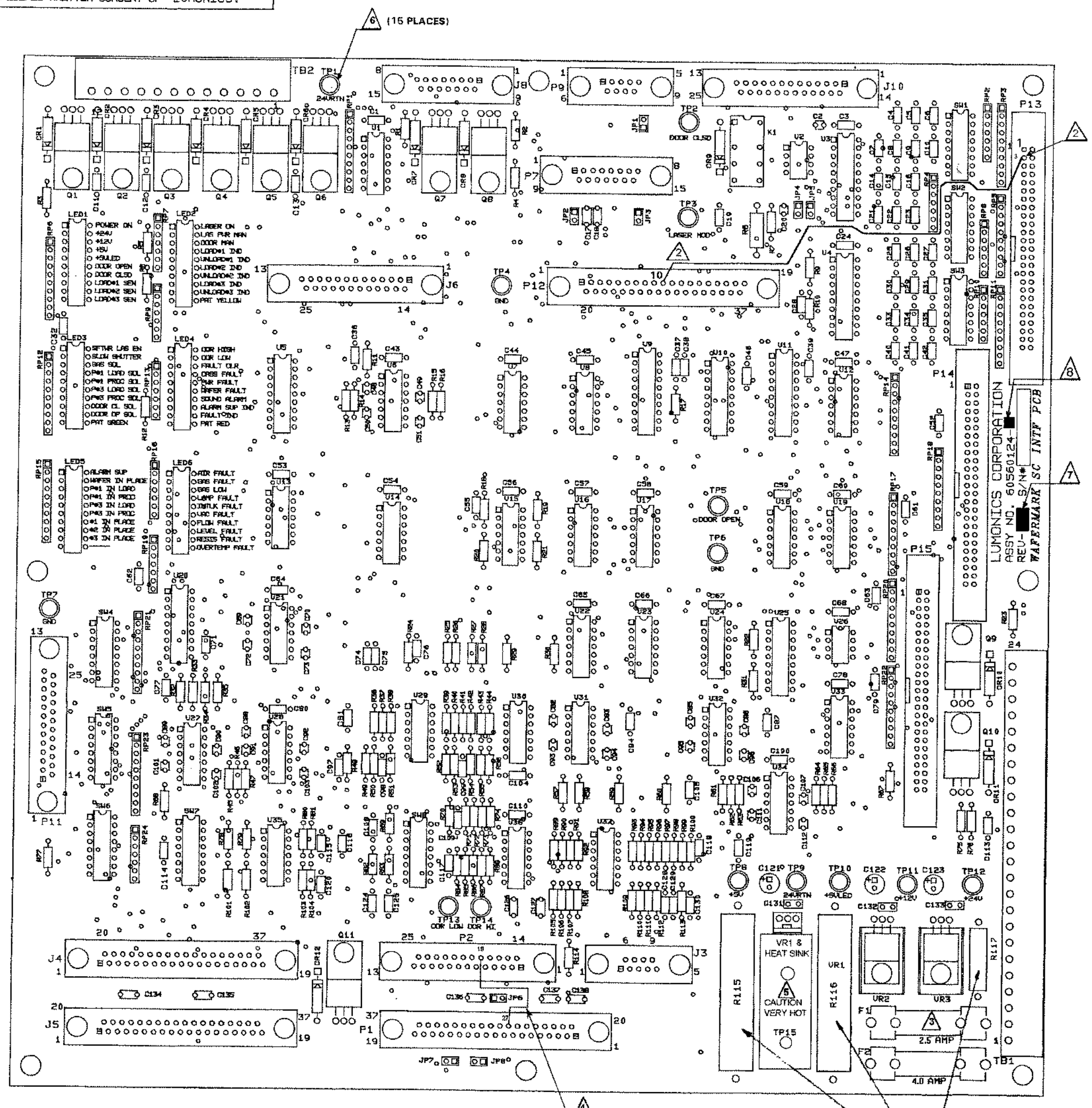
LUMONICS CORPORATION	
Title	SCHEMATIC, WAFERMARK SC INTERFACE PCB
Size B	Document Number 2750195 — REV A
Date: JUNE 19, 1997	Sheet 2 of 8



REV
DESCRIPTION
DRWN/APVD
DATE
A
ECO #1122, FIRST RELEASE
BER/JT
6-19-97
P13
SOFTWARE LASER ENABLE
SLOW SHUTTER
GAS SOL
PRSNTR#1 LOAD SOL
PRSNTR#1 PROC SOL
PRSNTR#3 LOAD SOL
PRSNTR#3 PROC SOL
SAFETY DOOR CLOSE SOL
SAFETY DOOR OPEN SOL
PAT LIGHT GREEN
LOAD#1 IND
UNLOAD#1 IND
LOAD#2 IND
UNLOAD#2 IND
LOAD#3 IND
UNLOAD#3 IND
PAT LIGHT YELLOW
CASSETTE LOADING FAULT
LASER POWER FAULT
WAFER HANDLING FAULT
SOUND ALARM
ALARM SUPPRESS IND
FAULT CLEAR IND
PAT LIGHT RED
NOT USED
CONN 50 PIN HEADER
PC STRGHT MT
HANDLER BOARD
INTERFACE #1
(SOFTWARE OVERRIDE)
P14
POWER ON
SAFETY DOOR OPEN SENSE
SAFETY DOOR CLOSED SENSE
LOAD#1 SENSE
LOAD#2 SENSE
LOAD#3 SENSE
LASER ON
LASER POWER MANUAL
SAFETY DOOR MANUAL
LASER POWER OOR HIGH
LASER POWER OOR LOW
FAULT CLEAR SENSE
AIR FAULT
GAS FAULT
GAS LOW
LAMP FAULT
INTERLOCK OPEN FAULT
VACUUM FAULT
WATER FLOW FAULT
WATER LEVEL FAULT
WATER RESISTIVITY FAULT
WATER OVERTEMP FAULT
ALARM SUPPRESS SENSE
WAFER IN PLACE
NOT USED
CONN 50 PIN HEADER
PC STRGHT MT
HANDLER BOARD
INTERFACE #2
P15
PRSNTR#1 IN LOAD SENSE
PRSNTR#1 IN PROC SENSE
PRSNTR#3 IN LOAD SENSE
PRSNTR#3 IN PROC SENSE
SPARE (IN6/1+ NOT USED)
SPARE (IN6/0+ NOT USED)
NOT USED
CONN 50 PIN HEADER
PC STRGHT MT
HANDLER BOARD
INTERFACE #3
LOCAL POWER REGULATION
LM340T-XX
TO-220
NOTES:
1. ALL VOLTAGE REGULATORS MUST BE MOUNTED ON HEAT SINKS
2. 24VRTN CONNECTS TO POWER GND AND CHASIS EARTH GND AT ONE LOCATION ONLY
ASSY: 60560124-1
FAB: 20160124F REV A
LUMONICS CORPORATION
Title
SCHEMATIC, WAFERMARK SC INTERFACE PCB
Size
B
Document Number
2750195
Date: JUNE 19, 1997
Sheet 1 of 8

REVISIONS						
ZONE	LTR	DESCRIPTION	DWN	CHK	DATE	APPROVED
	A	ECO #1122, INITIAL RELEASE	BER		6-19-97	J. TEMPLIN
	B	ECO #1122, CORRECT HOOK-UP ERROR IN NOTE 2 REWORK ILLUSTRATION	BER		9-6-97	J. TEMPLIN
	C	ECO #1210, EDIT NOTE 5, DELETE TP15, USE NEW VR1 HEATSINK USING TWO MOUNTING SCREWS TO SECURE TO PCB	BER	BER 9/97	9/19/97	J. TEMPLIN

22 SEP 97



8 MARK "1" IN DASH # BOX, USING BLACK INDELIBLE INK.

7 MARK CURRENT REVISION LEVEL IN REV BOX USING BLACK INDELIBLE INK.

6 INSTALL TP1-14 USING FOLLOWING HARDWARE ON SOLDER SIDE OF PCB:
NYLON FLAT WASHER, INTERNAL TOOTH LOCK WASHER AND SMALL PATTERN NUT.

5 DO NOT INSTALL TP15. USE TP15 MOUNTING HOLE FOR HEAT SINK MOUNTING SCREW.
INSTALL VR1 USING SPECIAL VERTICAL MOUNT HEAT SINK. USE MOUNTING HARWARE TO SECURE HEATSINK THEN INSTALL VR1 ON HEAKSINK USING THERMAL COMPOUND AND SOLDER LEADS.

4 ADD #30 AWG INSULATED JUMPER FROM P2-18 TO P1-27 (BACKSIDE) AND SECURE WITH HOT GLUE DROPS.

3 SHOWS SILK SCREEN UPDATED FOR CORRECT FUSE VALUE. FOR OLD REVISON BOARD BLANKS APPLY CORRECTION LABEL TO COVER UP ORGINAL SILKSCREEN VALUE.

2 ADD #30 GA JUMPER WIRE FROM P13-3 TO P12-10 (BACKSIDE) AND SECURE WITH HOT GLUE DROPS.

1 RAISE RESISTORS ABOVE PCB BETWEEN 5 TO 8 mm

SCH: 2750195 REV A
FAB: 2016012F REV. A

NOTE: UNLESS OTHERWISE SPECIFIED

MATERIAL
FINISH
NEXT ASSY | USED ON
APPLICATION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES.
DEBURR AND BREAK ALL SHARP EDGES AND CORNERS .010R OR CHAMFER
DIM AND TOL PER ANSI Y14.5.
TOLERANCES
.XX ±
.XXX ± .005
ANGULAR ±
DO NOT SCALE DRAWING

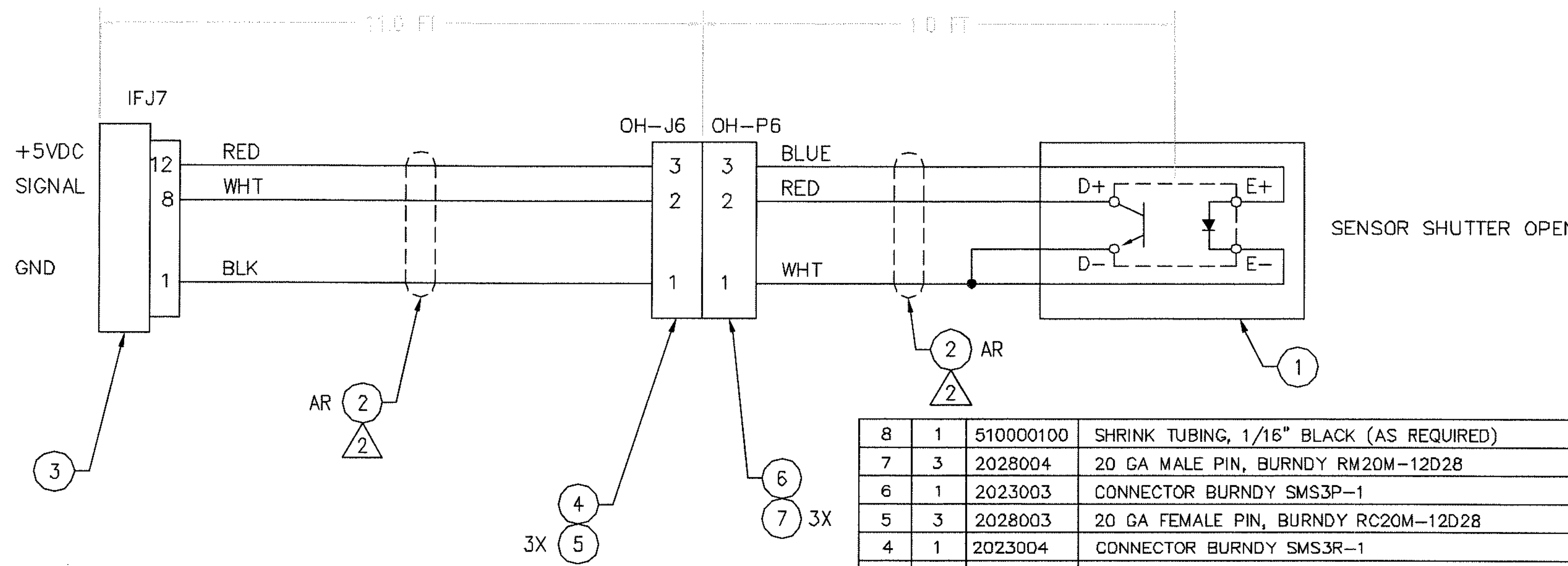
	SIGNATURE	DATE
DWN	J. FAZIO	4/29 91
CHK		
ENG	B E RYAN	6-19-97
APVD		
APVD	B E Ryan	9/20/97

LUMONICS ™

ASSY, PCB, WaferMark SIGMA DSC, INTERFACE CIRCUITS

SIZE: D | PROD CODE: | DWG NO: 60560124-1
SCALE | SHEET 1 OF 1

ECO	REV	CHANGE DESCRIPTION	DATE	CHG BY	APPV'D
	A	SEE ECO 1521	10/22/98	EM	CA
10482	B	ADDED PARTS LIST	2/16/01	KMC	LG



ITEM No.	QTY.	PART No.	DESCRIPTION
8	1	510000100	SHRINK TUBING, 1/16" BLACK (AS REQUIRED)
7	3	2028004	20 GA MALE PIN, BURNDY RM20M–12D28
6	1	2023003	CONNECTOR BURNDY SMS3P–1
5	3	2028003	20 GA FEMALE PIN, BURNDY RC20M–12D28
4	1	2023004	CONNECTOR BURNDY SMS3R–1
3	1	2024004	CONNECTOR, D SUB ITT CANNON DAC15S
2	1	2413115	CABLE, 4 CONDUCTOR 22 GA SHIELDED
1	1	13H21B1	IC H21B1

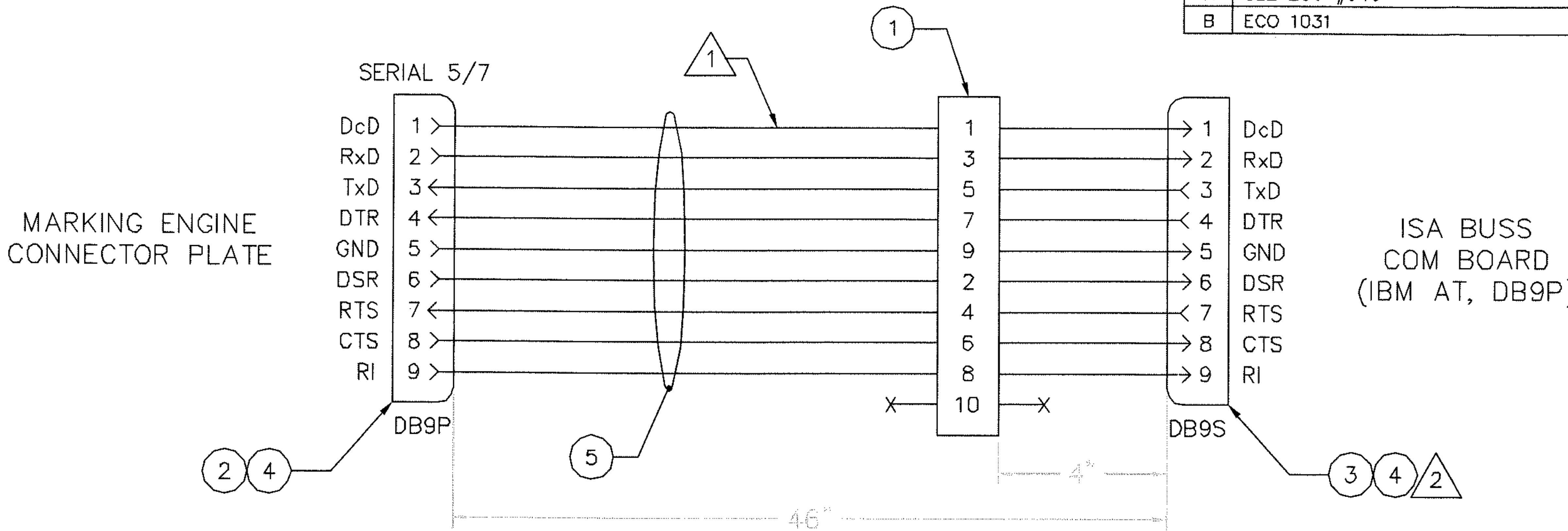
2 WIRE COLORS VARY WITH CABLE VENDOR/SUPPLIER.

1. CABLE AND WIRE MARKERS SHALL BE WHITE HEAT SHRINK TUBING USING BLACK PERMANENT IDENTIFICATION WITH LEGEND SHOWN.

NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL	DRAWN BY EM	gsi Lumonics	60 FORDHAM ROAD WILMINGTON, MA 01887
FINISH NONE	DRAWN DATE 10/22/98	DRAWING TITLE CABLE ASSY, SENSOR SLOW SHUTTER OPEN	
UNLESS SPECIFIED 1. ALL DIMENSIONS APPLY AFTER FINISH 2. REMOVE ALL BURRS AND SHARP EDGES. (.010 MAX. R. OR CHAMFER) 3. MIN. BEND RADIUS, MIN. BEND RELIEF. 4. NO TOOL MARKS. 5. MACHINED FINISH 64/EXCEPT 32/FOR HORIZ. MILLING	CH.		
	CFN	DRAWING NUMBER 6022417	REV B
UNLESS OTHERWISE SPECIFIED .X = ± .03 .XX = ± .01 .XXX = ± .005 X/X = ± 1/64 X° = ± 30' ALL DIMENSION IN INCHES	SIZE B	SCALE NONE	DO NOT SCALE DRAWING · SHEET 1 OF 1

REVISIONS			
LVL	DESCRIPTION	DRWN/APVD	DATE
0	FIRST RELEASE	PB / CL	2/7/96
A	SEE ECO #646		
B	ECO 1031	CS/CA	04/19/97



ITEM	QTY	PART NO.	DESCRIPTION
5	4 ft	2413006	CABLE, 15 COND, RIBBON, JACKETED
4	2	2024036	CABLE STABILIZER, 9 PIN-D, RIBBON
3	1	2024035	CONN, 9 PIN-D, RIBBON, RECEPTACLE
2	1	2024034	CONN, 9 PIN-D, RIBBON, PLUG
1	1	1B5021101	CONN, 10 PIN RIBBON, 2x5

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
THREADS: CLASS 2A AND/OR 2B
MACHINING SURFACES: 64
REMOVE ALL BURRS/SHARP EDGES

TOLERANCES ARE:
.XX±
.XXX±
ANGLE±

MATERIAL:

TREATMENT:

FINISH:

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APPROVALS	DATE
DRAWN PAT BAIR	2/5/96
CHECKED	
ENGR	

LUMONICS

CABLE ASSY,
DB9/10 PIN HDR SERIAL PORT to
MARKING ENGINE CONN. PLATE

SCALE NONE | SIZE B | DRAWING NO. 6022272

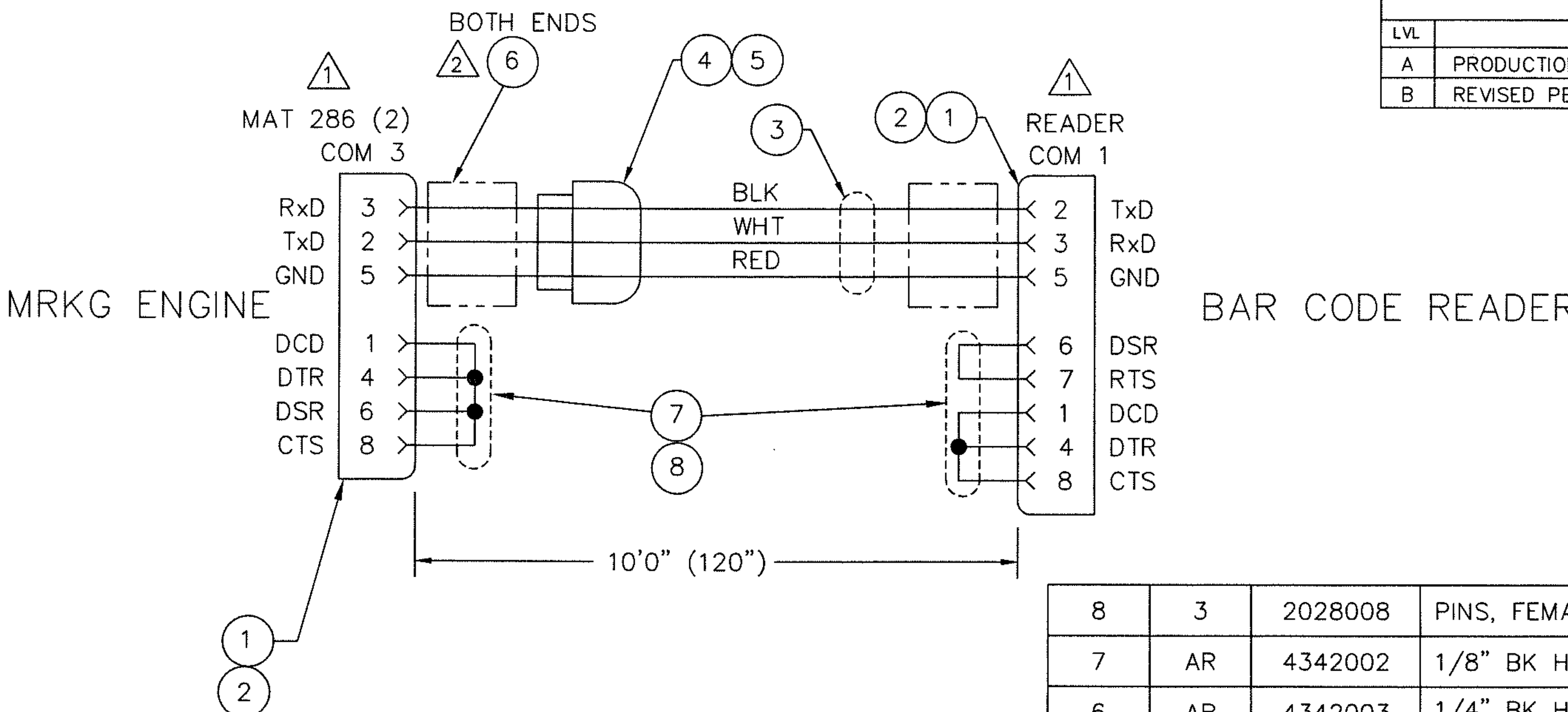
DO NOT SCALE DRAWING | SHEET 1 OF 1

2 WHEN ATTACHING TO OPTIONAL PIN HEADER ON PC BOARD, CUT CABLE TO REMOVE DB9S.

1 RIBBON CABLE PIN 1 STRIPE.

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS			
LVL	DESCRIPTION	DRWN/APPVD	DATE
A	PRODUCTION RELEASE, SEE ECO #646	RM / BL	2/22/86
B	REVISED PER ECO #727	WV /	04/16/96



ITEM NO	QTY REQD	PART NO.	DESCRIPTION
8	3	2028008	PINS, FEMALE
7	AR	4342002	1/8" BK HEAT SHRINK TUBE
6	AR	4342003	1/4" BK HEAT SHRINK TUBE
5	1	4281102	STRAIN RELIEF
4	1	4281101	NUT, PLASTIC
3	1	2413115	CABLE, 4 COND 22 AWG
2	2	2029001	BACKSHELL 9 PIN
1	2	2024002	CONN, DEC9S

2 INSTALL ITEM 6 APPROX. 1" LG AS SHOWN.

1 LABEL CONNECTORS AS SHOWN.

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
THREADS: CLASS 2A AND/OR 2B
MACHINING SURFACES: 64
REMOVE ALL BURRS/SHARP EDGES

TOLERANCES ARE:
.XX± .01
.XXX± .005
ANGLE± 1°

MATERIAL:

TREATMENT:

FINISH:

APPROVALS	DATE
DRAWN R MULLER	2/22/96
CHECKED	
ENGR	

LUMONICS

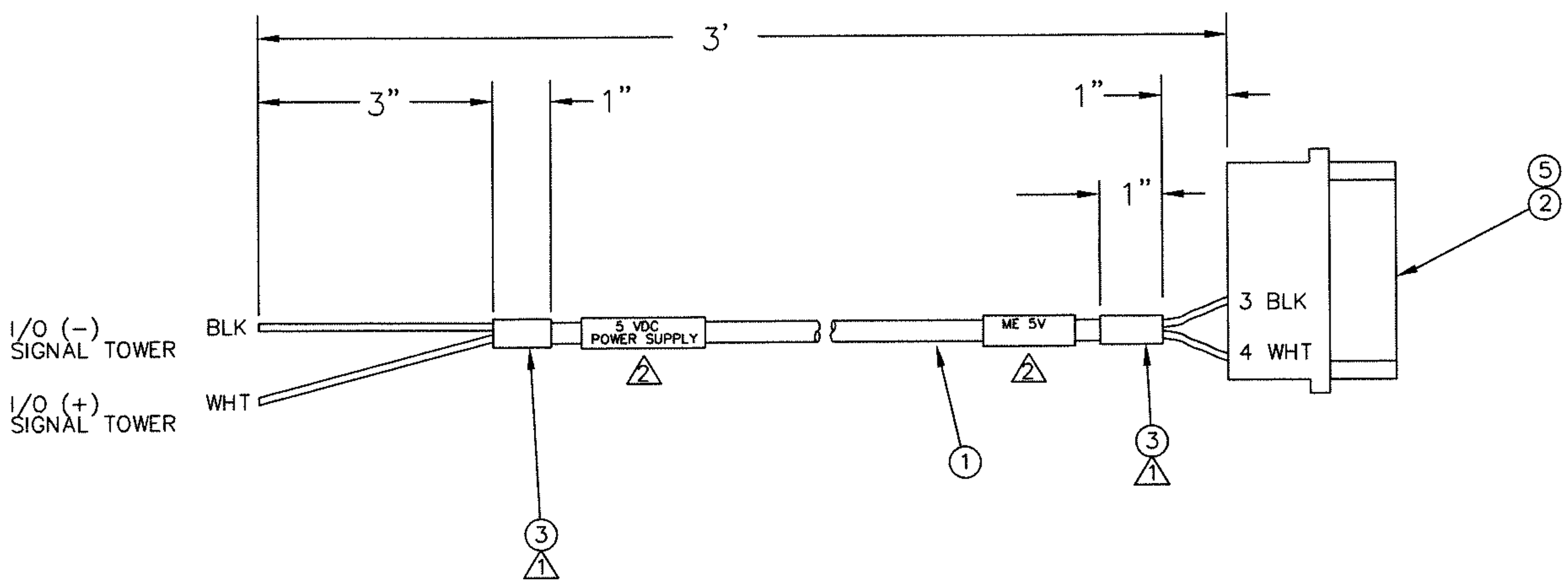
CABLE ASSY, BAR CODE READER TO MARKING ENGINE

SCALE	SIZE	DRAWING NO.
NONE	B	6022275

DO NOT SCALE DRAWING

SHEET 1 OF 1

REVISIONS			
LVL	DESCRIPTION	DRWN/APPVD	DATE
A	RELEASE PER ECO #683	W.V. / JL	03/21/96
B	ECO #798	JL /	6/21/96
C	REVISED PER ECO #1031	JG/BL	3/25/97
D	ECO 1071	CS/BL	04/21/97



ITEM No.	PART No.	QTY	DESCRIPTION
5	1B2P00001	2	PINS (MALE)
4			
3	4342003	A/R	SHRINK SLEEVING 1/4"
2	2023019	1	CONNECTOR (MALE)
1	2413119	3'	CABLE BELDON 2 COND. 18GA

3 LABEL WIRE ENDS WITH DESIGNATORS AS SHOWN

2 CABLE MARKER SHALL BE WHITE HEAT SHRINK TUBING USING BLACK PERMANENT IDENTIFICATION WITH LEGEND SHOWN.

1 STRIP BACK WIRE 1/2" MORE THAN SHOWN AND COVER EXPOSED SLEEVING WITH ITEM 3 AS SHOWN.

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
THREADS: CLASS 2A AND/OR 2B
MACHINING SURFACES: 64
REMOVE ALL BURRS/SHARP EDGES

TOLERANCES ARE:
.XX± –
.XXX± –
ANGLE± –

MATERIAL: SEE BOM

TREATMENT: ——

FINISH: N/A

APPROVALS	DATE
DRAWN W.Veca	11/16/95
CHECKED	
ENGR	

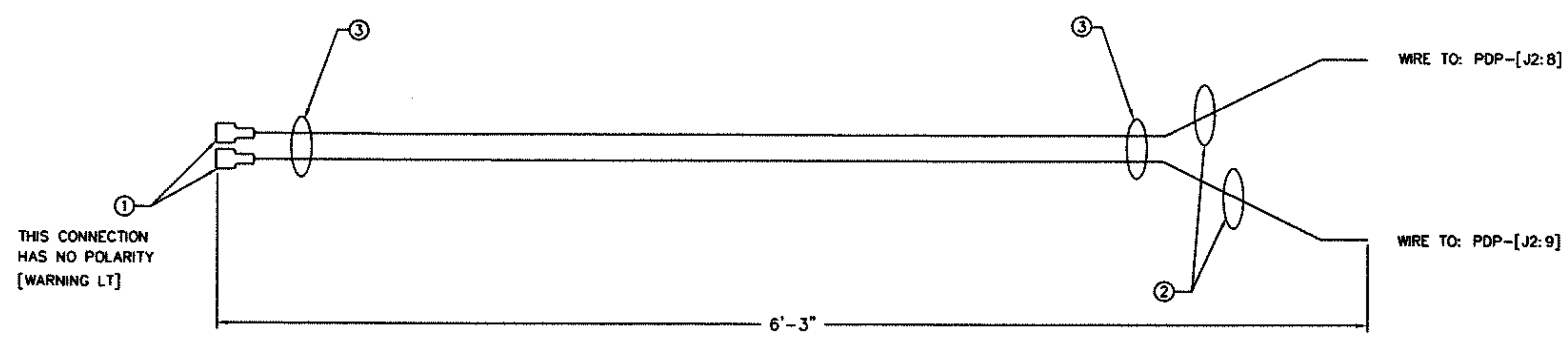
LUMONICS

5V CABLE I.O. BOARD

SCALE	SIZE	DRAWING NO.
NONE	B	6022284

DO NOT SCALE DRAWING | SHEET 1 OF 1

REVISIONS			
LVL	DESCRIPTION	DRWN/APPVD	DATE
A	ECO 818, FIRST RELEASE	BMc/ JL	09/23/96
B	ECO 927, CHANGE REF DESIG. 1F-TB1	BMc/JHT	12/02/96
C	ECO 951, CHANGE REF DESIG. PDP-J2:X	BMc/JHT	12/23/96
D	ECO 1158, CHANGE LENGTH, LABEL DESIG.	BMc/JHT	7/24/97



NOTES: UNLESS OTHERWISE SPECIFIED

1. 3 INCH PIGTAIL. TERMINATE WIRE ENDS IN SLIP-ON LUGS P/N 2090417. LABEL AS "WARN LT"
2. 4 INCH PIGTAIL, TERMINATING IN BARE WIRE ENDS, INSULATION STRIPPED BACK 1/4 INCH. LABEL WIRE ENDS SEPARATELY AS "PDP-J2:8" AND "PDP-J2:9". NO POLARITY.
3. DRESS TRIMMED ENDS OF CABLE SHEATH WITH HEAT-SHRINK TUBING.

ITEM	QTY	PART NUMBER	DESCRIPTION
2	2	2090417	LUG SLIP ON .250x22-18AWG
1	1	2413119	CABLE BELDEN 2 COND 18 GA

LUMONICS

CABLE ASSY
ROBOT WARN LT WMDPL

MATERIAL: SEE PARTS LIST

TREATMENT: NONE

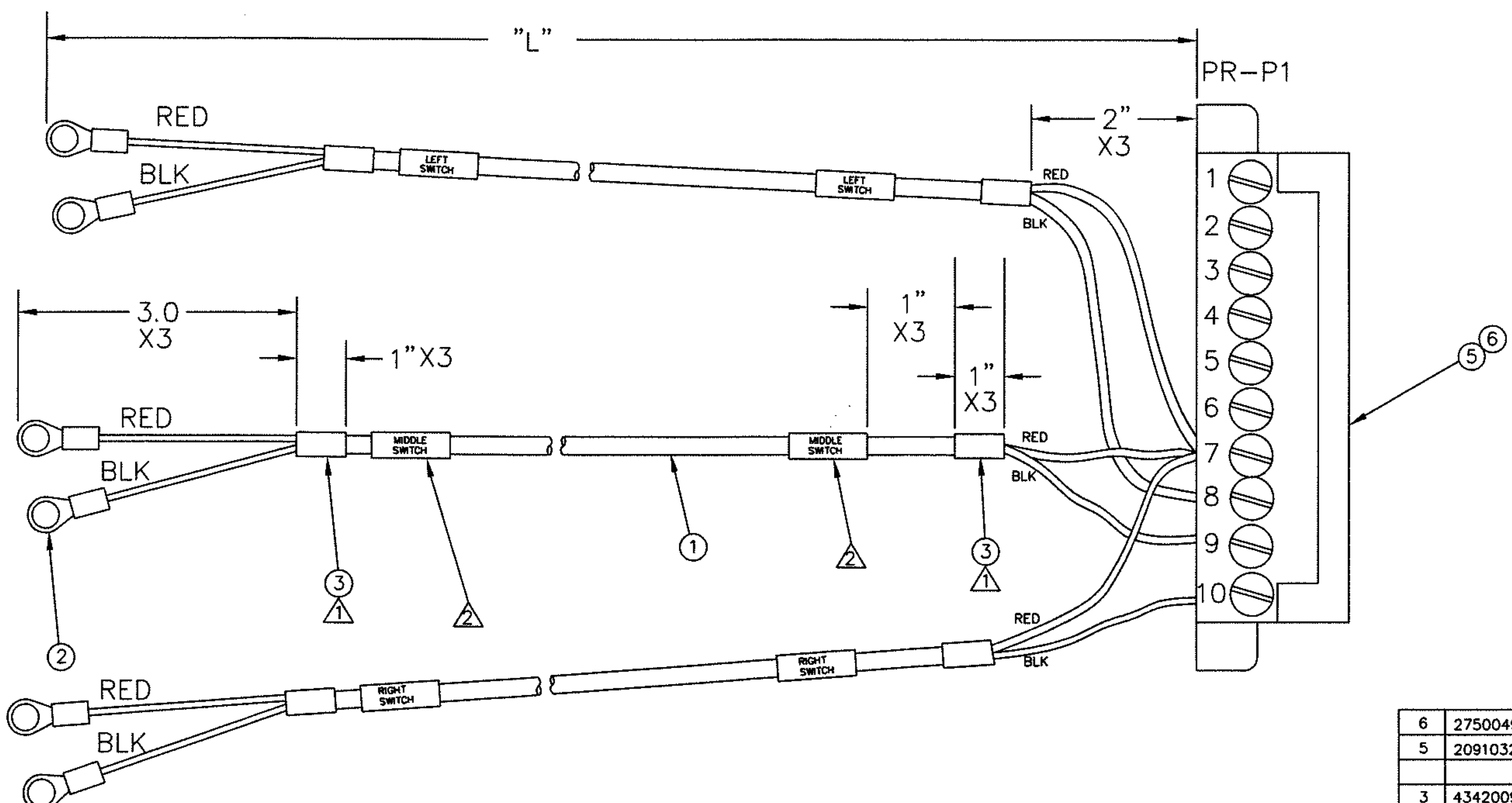
FINISH: NONE

APPROVALS — DATE: 9/23/96

SCALE	SIZE	DRAWING NO.
NONE	B	6022295

DO NOT SCALE DRAWING — SHEET 1 OF 1

REVISIONS			
LVL	DESCRIPTION	DRWN/APPVD	DATE
A	RELEASE PER ECO #683	W.V. / JL	03/21/96
B	ECO #787	JL / JL	6/6/96
C	ECO #810	JL / JHT	7/1/96
D	ECO 1031	CS/BL	03/24/97



ITEM No.	PART No.	QTY	DESCRIPTION
6	27500494	0 (REF)	WIRING DIAGRAM SUPERCLEAN PRESENTER
5	2091032	1	CONN 10 POLE PLUG
3	4342009	A/R	SHRINK SLEEVING 3/16"
2	2090202	6	LUG, RING #6
1	2413104	6 (64-1/2")	CABLE BELDON 2 COND. 22GA

3 REF WIRING DIAGRAM 27500494.

2 CABLE MARKER SHALL BE WHITE HEAT SHRINK TUBING USING BLACK PERMANENT IDENTIFICATION WITH LEGEND SHOWN

1 STRIP BACK WIRE 1/2" MORE THAN SHOWN AND COVER EXPOSED SLEEVING WITH ITEM 3 AS SHOWN.

NOTES: UNLESS OTHERWISE SPECIFIED

NOMENCLATURE	"L" (LENGTH)
RIGHT SWITCH 2	27 1/2"
MIDDLE SWITCH 2	15 1/2"
LEFT SWITCH 2	21 1/2"

TABULATION

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
THREADS: CLASS 2A AND/OR 2B
MACHINING SURFACES: 64/
REMOVE ALL BURRS/SHARP EDGES

TOLERANCES ARE:
.XX± -
.XXX± -
ANGLE± -

MATERIAL: SEE BOM

TREATMENT:

FINISH: N/A

APPROVALS	DATE
DRAWN W.Veca	11/16/95
CHECKED	
ENGR	

LUMONICS

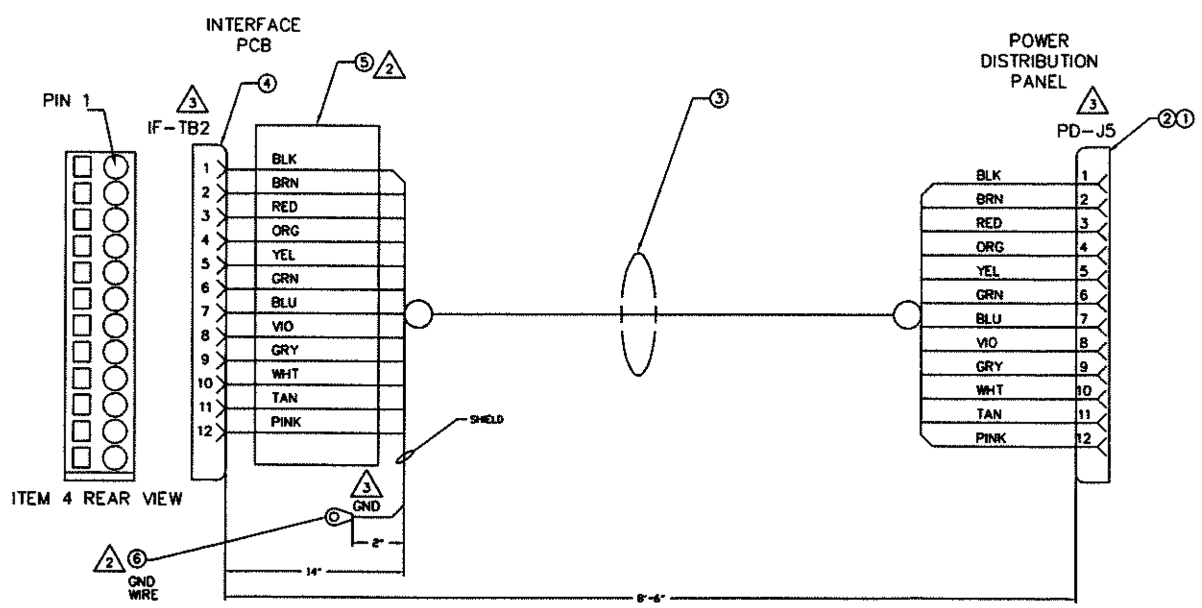
CABLE ASSY, PRESENTER

SCALE NONE | SIZE B | DRAWING NO. 6022280

DO NOT SCALE DRAWING | SHEET 1 OF 1

THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND SHALL NOT BE USED, REPRODUCED, OR DISCLOSED TO THIRD PARTIES WITHOUT WRITTEN AUTHORIZATION FROM GSI LUMONICS.

REVISIONS				
REV	ECO #	DESCRIPTION	DRWN/APPVD	DATE
0		FIRST RELEASE	AG / AG	7/26/95
A		ITEM 6 ADDED	PG/AG	8/25/95
A1		REMOVED ITEM 4 AND 5 AND NOTE 2. 2028003 WAS 2028001	DD/AG	8/28/95
A2		TAN WAS WHT/BLK, PINK WAS WHT/BRN ADDED TB2 AND J2 (REF. DESIGNATORS)	JL/BL	12/07/95
B		RELEASE PER ECO#652	WV /JL	03/06/96
C		ECO #810	WV /	07/01/96
D		REVISED PER ECO #1031	JG/BL	3/21/97
E		ECO 1272, ITEM 6 WAS QTY 13" & PN 2090403, ITEM 5 WAS QTY 2.	EE/BL	11/25/97
F	8923	ADDED VIEW OF ITEM 4	DAM	10/28/99



PACKAGE PER GSI LUMONICS CONTROL DOCUMENT #CD0013, METHOD # P21

AFTER FINISHING, ADD PIECE PART MARKING ON SURFACE INDICATED IN DRAWING PER GSI LUMONICS CNTRL DOC. #CD0002, METHOD # 1

ALL DIMENSIONS ARE TO BE INTERPRETED PER LATEST ANSI Y14.5 SPECS.

ITEM	QTY	PART NUMBER	DESCRIPTION
6	1	2090402	LUG RING RED #10 DC RNS-26-10
5	13"	4342003	SHRINK TUBING 1/4 BLACK
4	1	2023037	CONN FEMALE, 12 POS
3	9FT	2413113	CABLE, 12 COND. 22GA SHIELDED
2	12	2028003	CONN HDW 20 GA FEMALE PIN
1	1	2023011	CONN BURNDY SMS12R-1

3. WIRE/CABLE MARKER SHALL BE WHITE HEAT SHRINK TUBING USING BLACK PERMANENT IDENTIFICATION WITH LEGEND SHOWN.

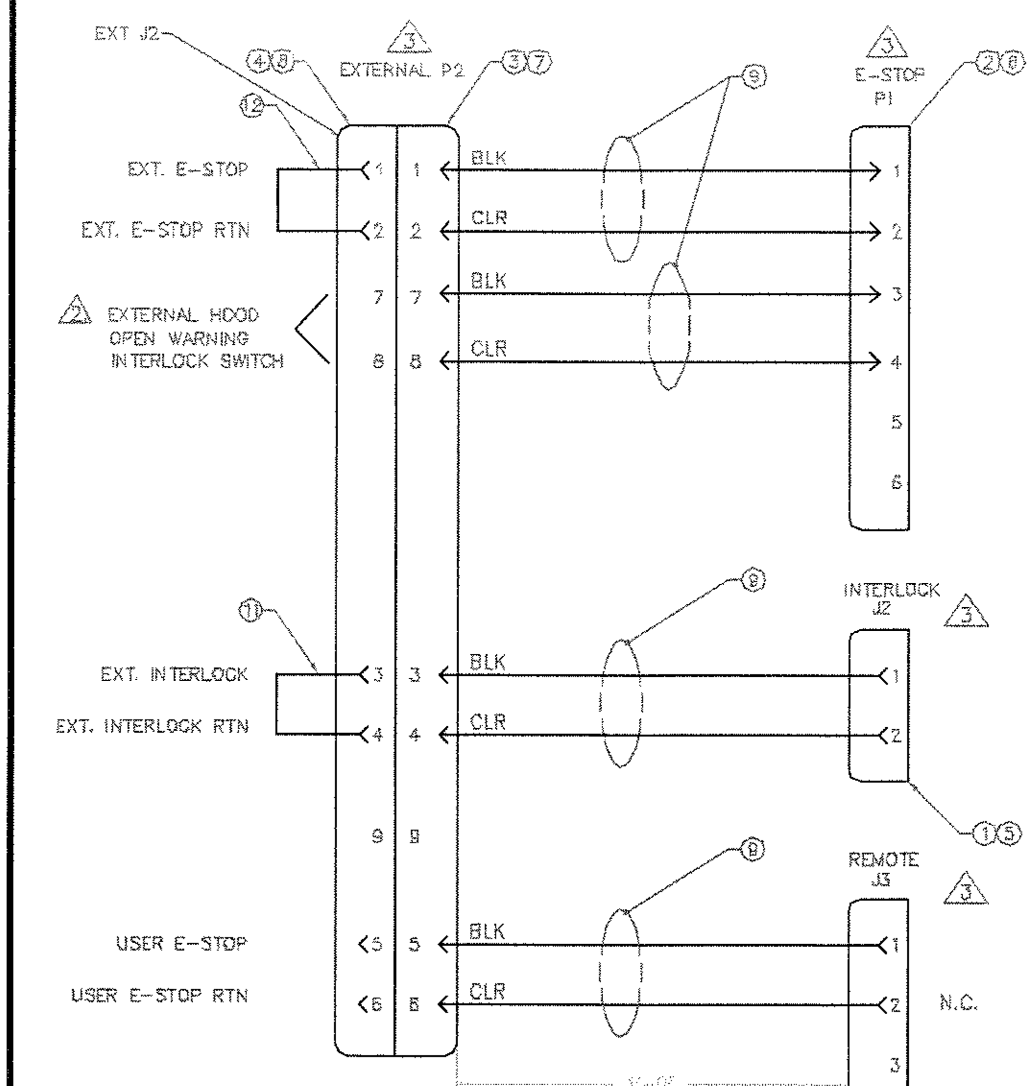
2. STRIP BACK 12 CONDUCTOR WIRE 14" THEN PULL OUT GROUND WIRE AND COVER REMAINING WIRE WITH 12" OF SHRINK TUBING

1. COLORS OF WIRE IN CABLE MAY DIFFER DEPENDING ON MANUFACTURER

NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL: SEE B.O.M.	DRAWN BY: DAM	GSI Lumonics, 60 FORDHAM ROAD WILMINGTON, MA 01887	
FINISH: NONE	DRAWN DATE: 10/29/99	DRAWING TITLE: CABLE ASSY. SOLENOID EXTENSION	
UNLESS SPECIFIED 1. ALL DIMENSIONS APPLY AFTER FINISH 2. REMOVE ALL BURRS AND SHARP EDGES. (.010 MAX. R. OR CHAMFER) 3. MIN. BEND RADIUS, MIN. BEND RELIEF. 4. NO TOOL MARKS. 5. MACHINED FINISH 64/ EXCEPT 32/ FOR HORIZ. MILLING	CH. / CFN	DRAWING NUMBER: 6022237	REV: F
UNLESS OTHERWISE SPECIFIED .X = ± .03 .XX = ± .01 .XXX = ± .005 X/X = ± 1/64 X° = ± 30' ALL DIMENSION IN INCHES	SIZE: B / SCALE: DO NOT	DO NOT SCALE DRAWING	SHEET 1 OF 1

--- REVISIONS ---					
ECO	REV	CHANGE DESCRIPTION	DATE	CHG BY	APPV'D
1275	A	INITIAL RELEASE	11/26/97	CJK	CA
9267	B	CHANGED PARTS LIST	2/23/00	DAM	



PACKAGE PER GSI LUMONICS CONTROL DOCUMENT #CD0014, METHOD # P21

AFTER FINISHING, ADD PIECE PART MARKING ON SURFACE INDICATED IN DRAWING PER GSI LUMONICS CNTRL DOC. #CD0002, METHOD # 1

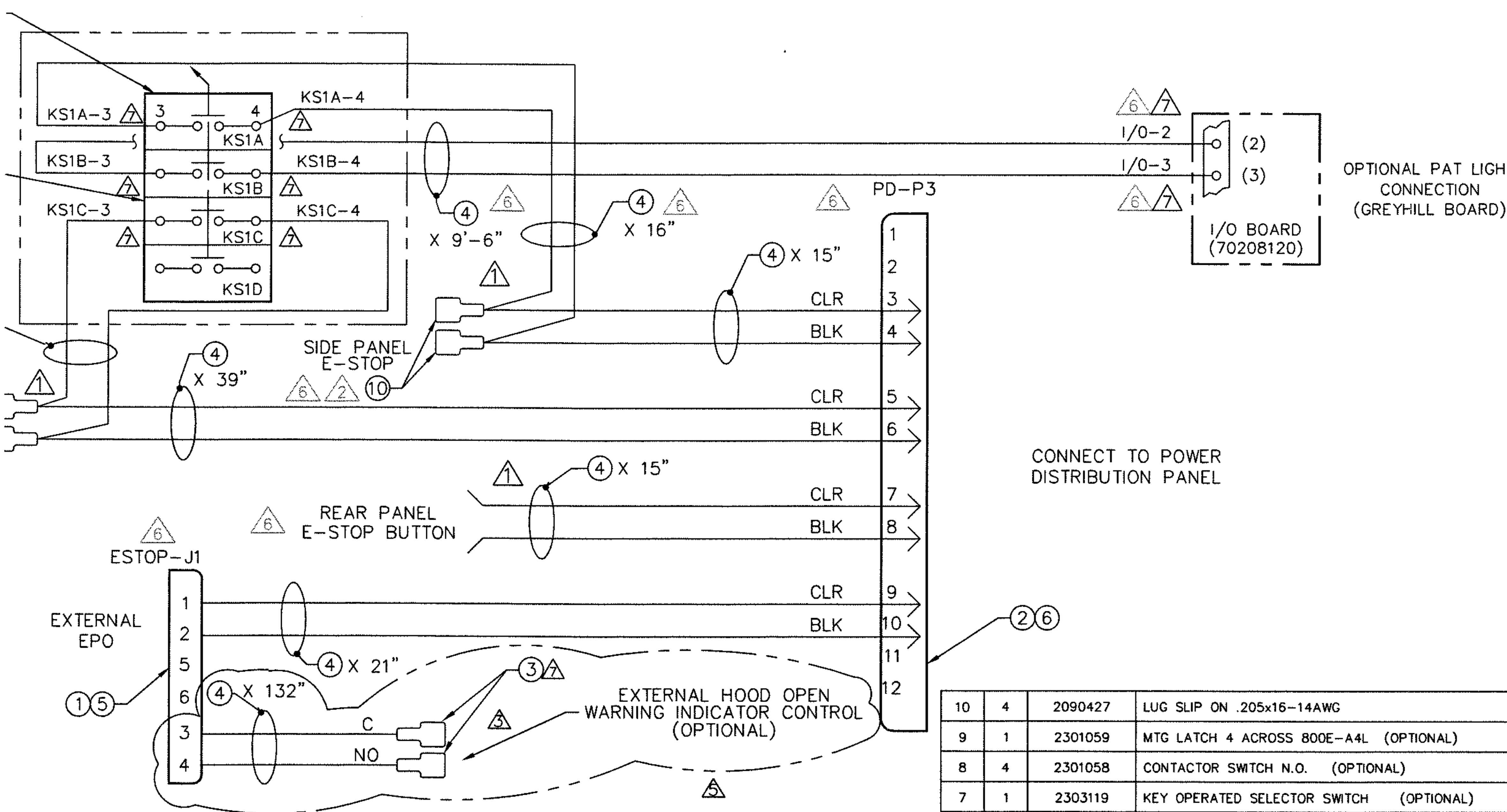
ALL DIMENSIONS ARE TO BE INTERPRETED PER LATEST ANSI Y14.5 SPECS.

ITEM	QTY	PART NUMBER	DESCRIPTION
12	3"	2411006	WIRE, 18 GA. RED MTW
11	3"	2411002	WIRE, 18 GA. 41 STD. BLUE
10	1	2023004	CONN BURNDY SMS3R-1
9	4'	2413104	CABLE 2 COND SHIELDED
8	4	2028043	PIN, CONNECTING FEMALE
7	8	2091027	PIN, MULTIMATE TYPE VI
6	4	2028004	CONN HDW 20 GA MALE PIN
5	4	2028003	CONN HDW 20 GA FEMALE PIN
4	1	2023028	CONN AMP ECONOSEAL 9 POSITION
3	1	2023027	CONN AMP ECONOSEAL 9 POSITION
2	1	2023007	CONN BURNDY SMS6P-1
1	1	2023001	CONN BURNDY SMS2R1

NOTES: UNLESS OTHERWISE SPECIFIED
1. DRAWN FROM 6022228 REV. 3 AND 701808003 REV. 3.
2. WARNING FOR SAFETY REQUIREMENTS MAX VOLTAGE 24V AC 60 HZ @ 1 AMP.
3. CABLE MARKER SHALL BE WHITE HEAT SHRINK TUBING USING BLACK PERMANENT IDENTIFICATION WITH LEGEND SHOWN.

MATERIAL: SEE PARTS LIST	DRAWN BY: DAM	gsi lumonics, 60 FORDHAM ROAD WILMINGTON, MA 01887	
FINISH: N/A	DRAWN DATE: 2/23/00	DRAWING TITLE: CABLE ASSY, EXTERNAL E-STOP/INTLK HARNESS	
UNLESS SPECIFIED 1. ALL DIMENSIONS APPLY AFTER FINISH 2. REMOVE ALL BURRS AND SHARP EDGES (.010 MAX R OR CHAMFER) 3. MIN. BEND RADIUS, MIN. BEND RELIEF. 4. NO TOOL MARKS. 5. MACHINED FINISH 64/EXCEPT 32/FOR HORZ. MILLING	CH:		
	CFN:	DRAWING NUMBER: 6022385	REV: B
UNLESS OTHERWISE SPECIFIED .X = ± .03 .XX = ± .01 .XXX = ± .005 X° = ± 30' X/X = ± 1/64 ALL DIMENSION IN INCHES	SIZE: B	SCALE: NONE	DO NOT SCALE DRAWING; SHEET 1 OF 1

REVISIONS			
LVL	DESCRIPTION	DRWN/APVD	DATE
A	ECO #1275	CJK/CA	12/10/97
B	ECO #1416 CHG LUGS ITEMS 3,10	JL/JHT	5/15/98



ITEM	QTY	PART NUMBER	DESCRIPTION
10	4	2090427	LUG SLIP ON .205x16-14AWG
9	1	2301059	MTG LATCH 4 ACROSS 800E-A4L (OPTIONAL)
8	4	2301058	CONTACTOR SWITCH N.O. (OPTIONAL)
7	1	2303119	KEY OPERATED SELECTOR SWITCH (OPTIONAL)
6	8	2028002	CONN HDW 16 GA MALE PIN
5	4	2028001	CONN HDW 16 GA FEMALE PIN
4	33'	2413119	CABLE, 2 COND. 18 GA
3	2	2090413	LUG SLIP ON
2	1	2023010	CONN BURNDY SMS12P-1
1	1	2023008	CONN BURNDY SMS6R-1

D/OPTION WIRES MUST REMAIN CAPPED OFF AND INSULATED.

MARKER SHALL BE WHITE HEAT SHRINK
NG BLACK PERMANENT IDENTIFICATION WITH LEGEND SHOWN.

XTERNAL HOOD OPEN WARNING INDICATOR CONTROL.

M 6022224 REV.A AND 702081022 REV.2.

RY SWITCH, TYPE: MOMENTARY.

RY SWITCH, TYPE: CHEAT-INTERLOCK.

INSULATION AND SHIELDING TO EXPOSE WIRES UNDERNEATH FOR 3".

SPECIFIED

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES — TOLERANCES ARE:
THREADS: CLASS 2A AND/OR 2B — .XX± .01
MACHINING SURFACES: 64/ — .XXX± .005
REMOVE ALL BURRS/SHARP EDGES — ANGLE± 0.5°

MATERIAL: SEE PARTS LIST

TREATMENT: N/A

FINISH: N/A

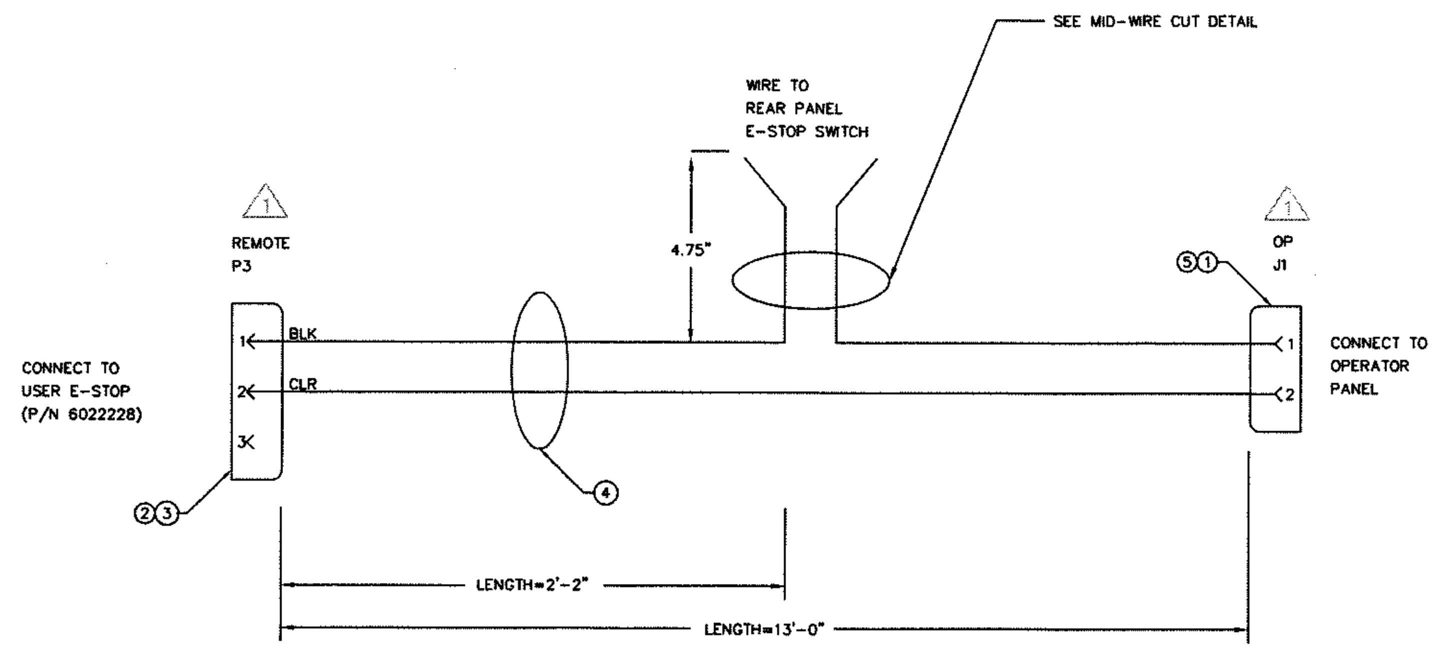
LUMONICS

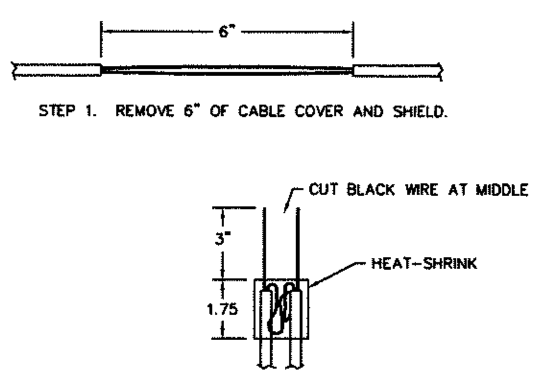
TITLE: CABLE ASSY
EMO HARNESS
WAFERMARK

SCALE: NONE | SIZE: C | DRAWING NO. 6022384

DO NOT SCALE DRAWING | SHEET 1 OF 1

REVISIONS			
LVL	DESCRIPTION	APPROVED	DATE
0	FIRST RELEASE	AG/AG	08/14/95
A	REVISED PER ECO#652	WV/	03/04/96
B	REVISED PER ECO #1031	JG/BL	3/26/97





STEP 1. REMOVE 6" OF CABLE COVER AND SHIELD.

STEP 2. PUSH TRIMMED COVER ENDS TOGETHER.
CUT BLACK WIRE IN THE MIDDLE.
LOOP REMAINING WIRE SO IT LAYS AGAINST THE CABLE COVER ON BOTH SIDES OF TRIMMED ENDS.
INSTALL HEAT-SHRINK ON BOTH SIDES OF EXPOSED RED WIRES.

MID-WIRE CUT DETAIL

SCALE: NONE

ITEM	QTY	PART NUMBER	DESCRIPTION
5	4	2028001	CONN HDW 16 GA FEMALE PIN
4	12.5	2413119	CABLE, BELDEN 2 COND, 18GA
3	1	2023003	CONN BURNDY SMS3P-1
2	2	2028002	CONN HDW 16GA MALE PIN
1	1	2023001	CONN BURNDY SMS2R-1

1. CABLE MARKER SHALL BE WHITE HEAT SHRINK TUBING USING BLACK PERMANENT IDENTIFICATION WITH LEGEND SHOWN.

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
THREADS: CLASS 2A AND/OR 2B
MACHINING SURFACES: 64/
REMOVE ALL BURRS/SHARP EDGES

TOLERANCES ARE:
.XX± .01
.XXX± .005
ANGLE± 0.5°

MATERIAL: SEE PARTS LIST
TREATMENT:
FINISH:

APPROVALS	DATE
DRAWN ASIF GOSLA	7/28/95
CHECKED	
ENGR	

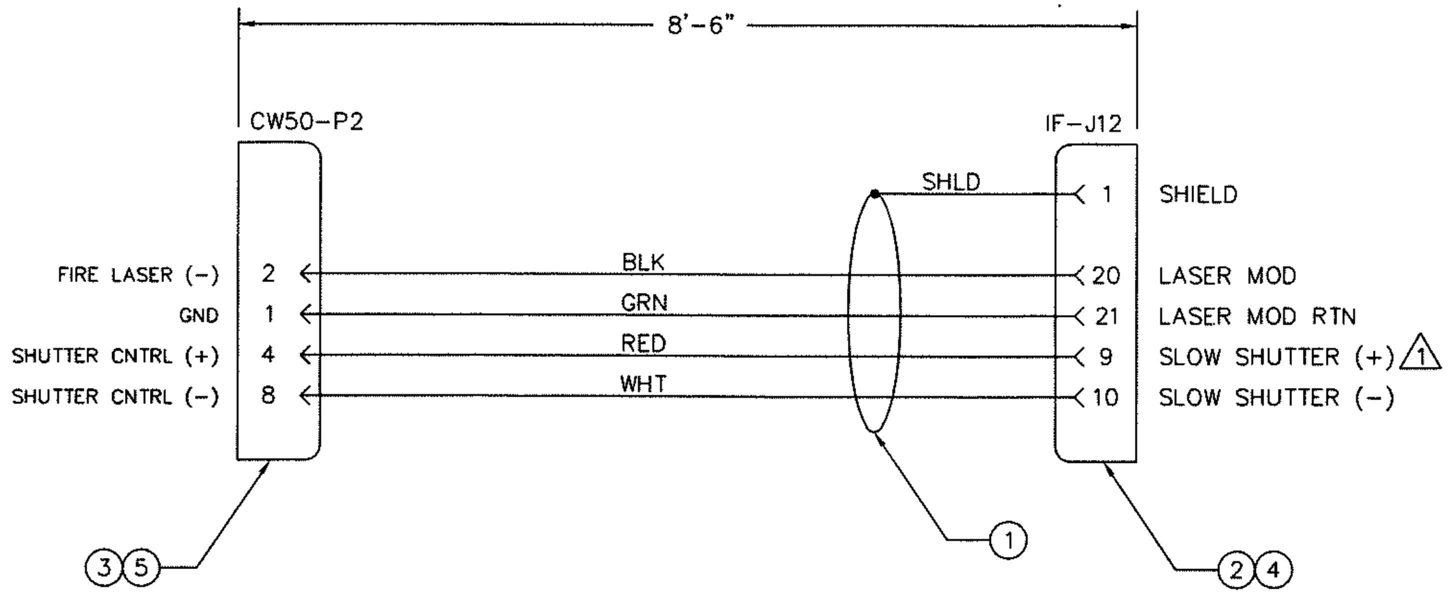
LUMONICS

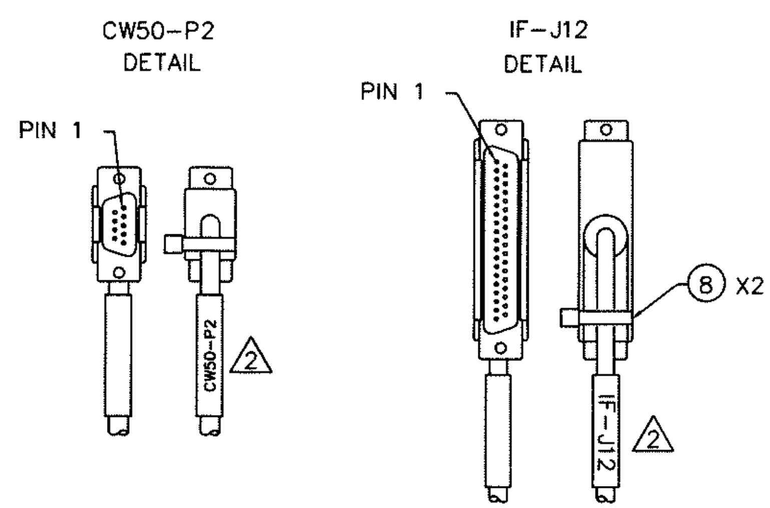
TITLE: CABLE ASSY, USER E-STOP DPL

SCALE: NONE | SIZE: B | DRAWING NO. 6022241

DO NOT SCALE DRAWING | SHEET 1 OF 1

REVISIONS			
LVL	DESCRIPTION	APPROVED	DATE
0	FIRST RELEASE	AG/AG	8/14/95
A	ECO 568	DD/PG	9/11/95
B	ECO 597	JL/B.L.	12/18/95
C	REVISED PER ECO #652	WV/	03/04/96
D	REVISED PER ECO #1031	JG/BL	03/21/97





ITEM NO	QTY REQD	PART NO.	DESCRIPTION
8	2	4301202	CABLE TIE STD
7			
6			
5	1	2024001	CONN DEC9P
4	1	2024008	CONN DCC37S
3	1	2029001	CONN HDW 9 PIN BACKSHELL
2	1	2029004	CONN HDW 37 PIN BACKSHELL
1	8.5'	2413115	CABLE, 4 COND, 22 GA. SHIELDED

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES — TOLERANCES ARE:
THREADS: CLASS 2A AND/OR 2B — .XX± .01
MACHINING SURFACES: 64 — .XXX± .005
REMOVE ALL BURRS/SHARP EDGES — ANGLE± 0.5°

MATERIAL: —
TREATMENT: —
FINISH: —

APPROVALS	DATE
DRAWN ASIF GOSLA	9AUG95
CHECKED	
ENGR	

LUMONICS

TITLE
CABLE ASSY,
CW50 INTERFACE DPL

SCALE NONE | SIZE B | DRAWING NO. 6022250

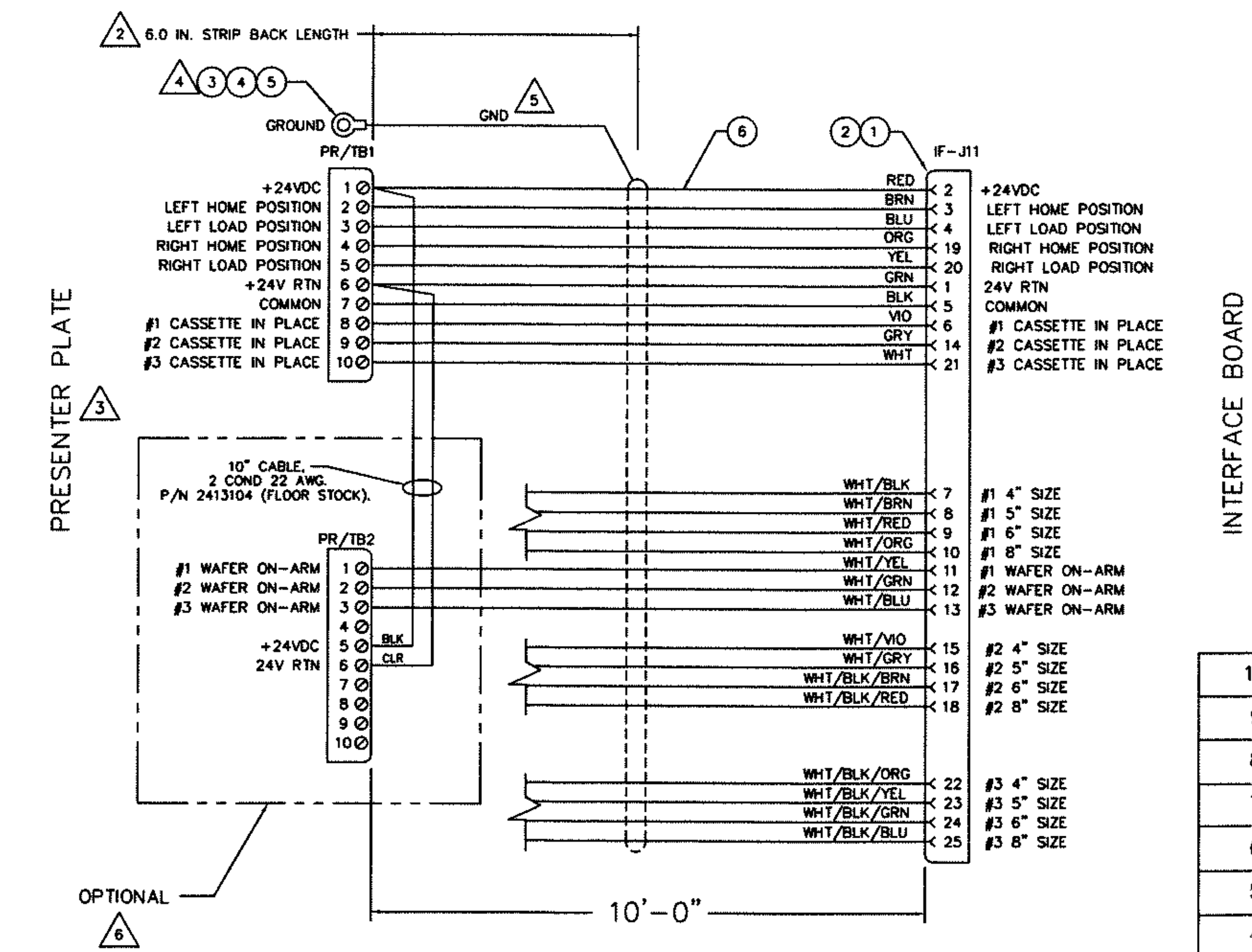
DO NOT SCALE DRAWING | SHEET 1 OF 1

2 CABLE MARKER SHALL BE WHITE HEAT SHRINK TUBING USING BLACK PERMANENT IDENTIFICATION WITH LEGEND SHOWN.

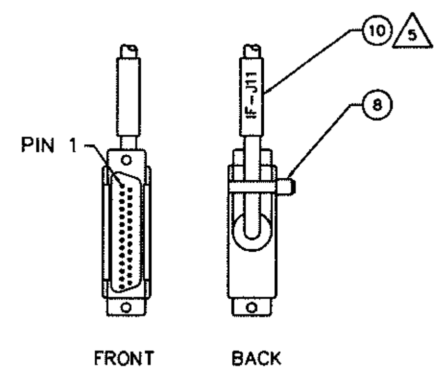
1 JUMPERED TO IF:P13-3 ON THE IF BOARD.

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS			
LVL	DESCRIPTION	DRWN/APVD	DATE
A	6.00 WAS 14.00, 11 FT WAS 8 FT	PG/AG	8/25/95
A1	10'-0" WAS 11 FT	DD/AG	9/29/95
B	ECO# 597.	JL/	12/18/95
C	REVISED PER ECO #1031	JG/BL	3/26/97
D	ECO# 1075.	CS/CA	04/23/97
E	ECO# 1254. IN NOTE 2: 6" WAS 14"; ITEM 7 AND 9 DELETED, ITEM 10 ADDED (CABLE I.D.LABEL 'IF-J11'); P/N4301202 WAS 4281102; NOTE 6 ADDED.	H.BEL/B.L	11/04-97



IF-J11
CONNECTOR DETAIL



ITEM NO	QTY REQD	PART NO.	DESCRIPTION	REFERENCE
10	1	N/A	CABLE I.D. LABEL: 'IF-J11'.	
9				
8	1	4301202	RELIEF, PLASTIC STRAIN	
7				
6	10'	2413111	CABLE, 25 COND 22 AWG	
5	1	2090402	LUG, RED #10	
4	1"	4342007	SHRINK TUBING, 1/16" BLUE	
3	14"	4342001	SHRINK TUBING, 1/16" CLEAR	
2	1	2029003	BACKSHELL 25 PIN	
1	1	2024006	CONN, DBC25S	IF-J11

6. USE WHEN OPTION LISTING WMSDSC NO. 6650147 APPLIES.
5. CABLE MARKER SHALL BE WHITE HEAT SHRINK TUBING USING BLACK PERMANENT IDENTIFICATION WITH LEGEND SHOWN.
4. INSTALL CLEAR SHRINK TUBING OVER EXPOSED GROUND WIRE. INSTALL BLUE SHRINK TUBING OVER CLEAR.
3. STRIP AND LABEL EACH WIRE ON PRESENTER ASSEMBLY SIDE.
2. STRIP BACK JACKET 6" TO EXPOSE INDIVIDUAL WIRES.
1. ATTACH REMAINING COMPONENTS TO CABLE WITH BAG.

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES — TOLERANCES ARE:
THREADS: CLASS 2A AND/OR 2B — .XX± .01
MACHINING SURFACES: 64/ — .XXX± .005
REMOVE ALL BURRS/SHARP EDGES — ANGLE± 0.5°

MATERIAL:

TREATMENT:

FINISH:

APPROVALS	DATE
DRAWN DAN DONGELMANS	6/22/95
CHECKED	
ENGR	

LUMONICS

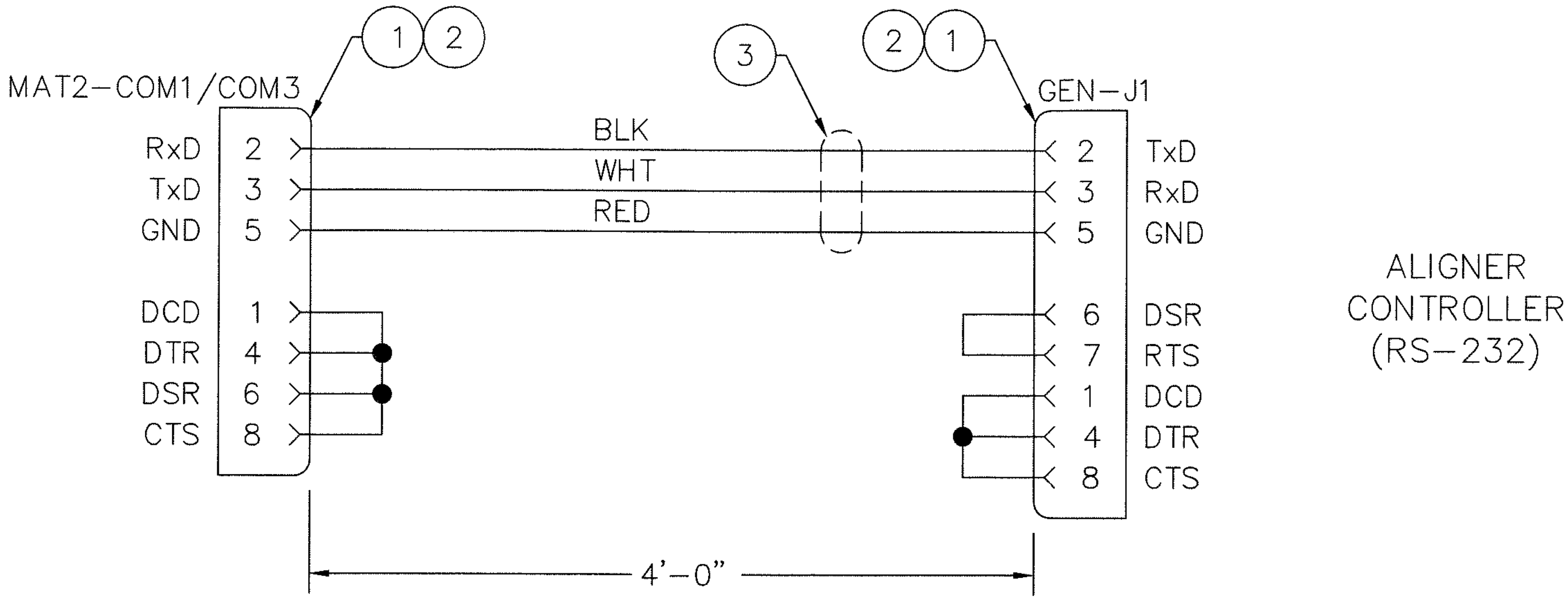
TITLE
CABLE ASSY,
PRESENTER PLATE-INTERFACE

SCALE	SIZE	DRAWING NO.
NONE	B	6022231

DO NOT SCALE DRAWING — SHEET 1 OF 1

--- REVISIONS ---

ECO	REV	CHANGE DESCRIPTION	DATE	CHG BY	APPV'D
	0	FIRST RELEASE	5MAR91	D GAUDY	
	A	4'-0" WAS 2 FT, PINS 2&3 SWAPPED ON GEN-J1			
11514	B	ADDED COM1 & COM3, DELETED MRKG ENGINE	05/30/02	PVS	BI



PACKAGE PER GSI LUMONICS CONTROL DOCUMENT #CD0013, METHOD # P21

AFTER FINISHING, ADD PIECE PART MARKING ON SURFACE INDICATED IN DRAWING PER GSI LUMONICS CNTRL DOC. #CD0002, METHOD # 1.

ALL DIMENSIONS ARE TO BE INTERPRETED PER LATEST ANSI Y14.5 SPECS.

ITEM NO	QTY REQD	PART NO.	DESCRIPTION	REFERENCE
3	1	2413115	CABLE, 4 COND 22 AWG	
2	2	2029001	BACKSHELL 9 PIN	
1	2	2024002	CONN, DEC9S	GEN-J1 & MAT2-COM2

MATERIAL: N/A

FINISH: N/A

UNLESS SPECIFIED
1. ALL DIMENSIONS APPLY AFTER FINISH
2. REMOVE ALL BURRS AND SHARP EDGES. (.010 MAX. R. OR CHAMFER)
3. MIN. BEND RADIUS, MIN. BEND RELIEF.
4. NO TOOL MARKS.
5. MACHINED FINISH 64 EXCEPT 32 FOR HORIZ. MILLING

UNLESS OTHERWISE SPECIFIED
.X = ± .03 .XXX = ± .005 X° = ± 30'
.XX = ± .01 X/X = ± 1/64 ALL DIMENSION IN INCHES

DRAWN BY: D GAUDY

DRAWN DATE: 5MAR91

CH.:

CFN:

GSI Lumonics 60 FORDHAM ROAD WILMINGTON, MA 01887

DRAWING TITLE: CABLE ASSY, PRE-ALIGNER COMM

DRAWING NUMBER: 60221003

REV: B

SIZE: B

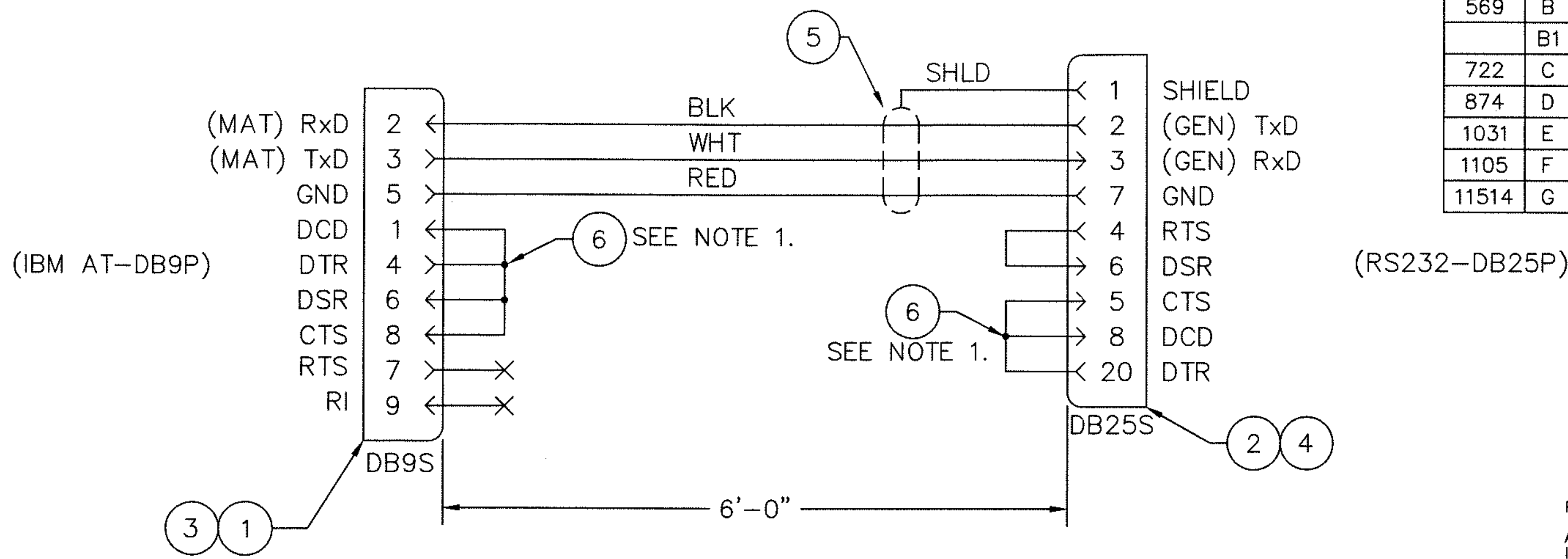
SCALE: NONE

DO NOT SCALE DRAWING

SHEET 1 OF 1

--- REVISIONS ---

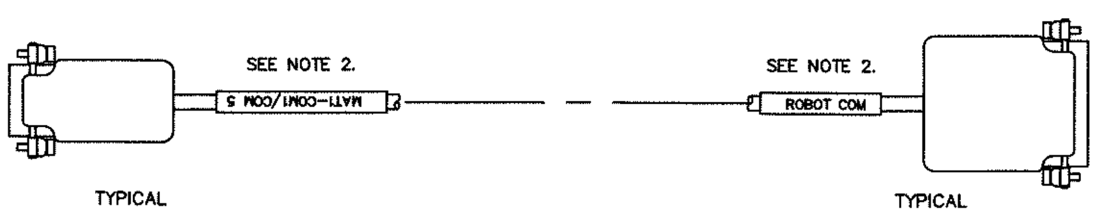
ECO	REV	CHANGE DESCRIPTION	DATE	CHG BY	APPV'D
	0	FIRST RELEASE			
345	A		3/9/93	BL	BL
569	B	4'-0" WAS 2'-6"	9/12/95	PG	PG
	B1	GEN-J1 WAS GEN-J2	----	----	----
722	C		7/9/96	CS	CL
874	D		9/12/96	JL	JHT
1031	E		3/21/97	JG	BL
1105	F		5/23/97	JL	JHT
11514	G	ADDED /COM 5, DELETED DASH# CHART	05/30/02	PVS	BI



PACKAGE PER GSI LUMONICS CONTROL DOCUMENT #CD0013, METHOD # P21

AFTER FINISHING, ADD PIECE PART MARKING ON SURFACE INDICATED IN DRAWING PER GSI LUMONICS CNTRL DOC. #CD0002, METHOD # 1 ,

ALL DIMENSIONS ARE TO BE INTERPRETED PER LATEST ANSI Y14.5 SPECS.



ITEM NO	QTY REQD	PART NO.	DESCRIPTION	REFERENCE
6	16	2028008	CONN HDW 18GA FEMALE PIN	
5	6	2413115	CABLE, 4 COND 22 AWG	
4	1	2029003	BACKSHELL 25 PIN	
3	1	2029001	BACKSHELL 9 PIN	
2	1	2024006	CONN, DBC25S	
1	1	2024002	CONN, DEC9S	

3. 60220993 CONSISTS OF 1 EA -01 & -02 CABLES LABELLED AS SHOWN IN TABLE ABOVE.

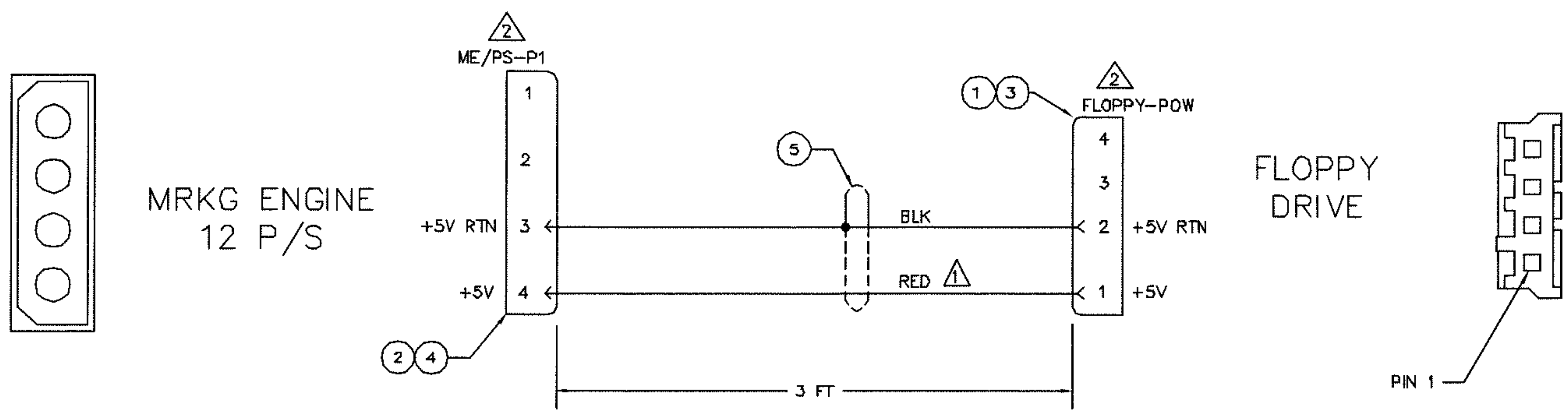
2. CABLE MARKER SHALL BE WHITE HEAT SHRINK TUBING USING BLACK PERMANENT IDENTIFICATION WITH LEGEND AND ORIENTATION SHOWN.

1. HEATSHRINK OVER PIN ENDS (18GA PINS).

NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL N/A	DRAWN BY D. GAUDY	GSI LUMONICS 60 FORDHAM ROAD WILMINGTON, MA 01887
FINISH N/A	DRAWN DATE 5 MAR 91	DRAWING TITLE CABLE ASSY, 9 TO 25 PIN COM
UNLESS SPECIFIED 1. ALL DIMENSIONS APPLY AFTER FINISH 2. REMOVE ALL BURRS AND SHARP EDGES. (.010 MAX. R. OR CHAMFER) 3. MIN. BEND RADIUS, MIN. BEND RELIEF. 4. NO TOOL MARKS. 5. MACHINED FINISH 64√ EXCEPT 32√ FOR HORIZ. MILLING	CH.	
	CFN	DRAWING NUMBER 60220993 — REV G
UNLESS OTHERWISE SPECIFIED .X = ± .03 .XX = ± .01 .XXX = ± .005 X/X = ± 1/64 X° = ± 30' ALL DIMENSION IN INCHES	SIZE B — SCALE NONE	DO NOT SCALE DRAWING — SHEET 1 OF 1

REVISIONS			
LVL	DESCRIPTION	APPROVED	DATE
A	RELEASE PER ECO #739	WV/	05/04/96
B	REVISED PER ECO #1031	JG/BL	3/21/97



ITEM NO	QTY REQD	PART NO.	DESCRIPTION	REFERENCE
5	1	2413104	CABLE, 2 COND 22 AWG	
4	4	1B2P00001	CONN PIN, TIN PL, #18-22	
3	1	2028024	RECEPTACLE, HOUSING	FLPY-POW
2	1	2023019	CONN, 4 PIN PLUG	M/E-PS
1	4	2028025	CONN CONTACT	

NOTES: UNLESS OTHERWISE SPECIFIED

2. CABLE MARKER SHALL BE WHITE HEAT SHRINK TUBING USING BLACK PERMANENT IDENTIFICATION WITH LEGEND SHOWN.

1. OTHER WIRE COLORS MAY VARY BY MANUFACTURER BUT RED MUST MATCH.

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
THREADS: CLASS 2A AND/OR 2B
MACHINING SURFACES:
REMOVE ALL BURRS/SHARP EDGES

TOLERANCES ARE:
.XX± .01
.XXX± .005
ANGLES± 1/2°

MATERIAL:

TREATMENT:

FINISH:

APPROVALS	DATE
DRAWN W. Vaca	05/04/96
CHECKED	
ENGR	

LUMONICS

CABLE ASSY,
DISK DRIVE POWER

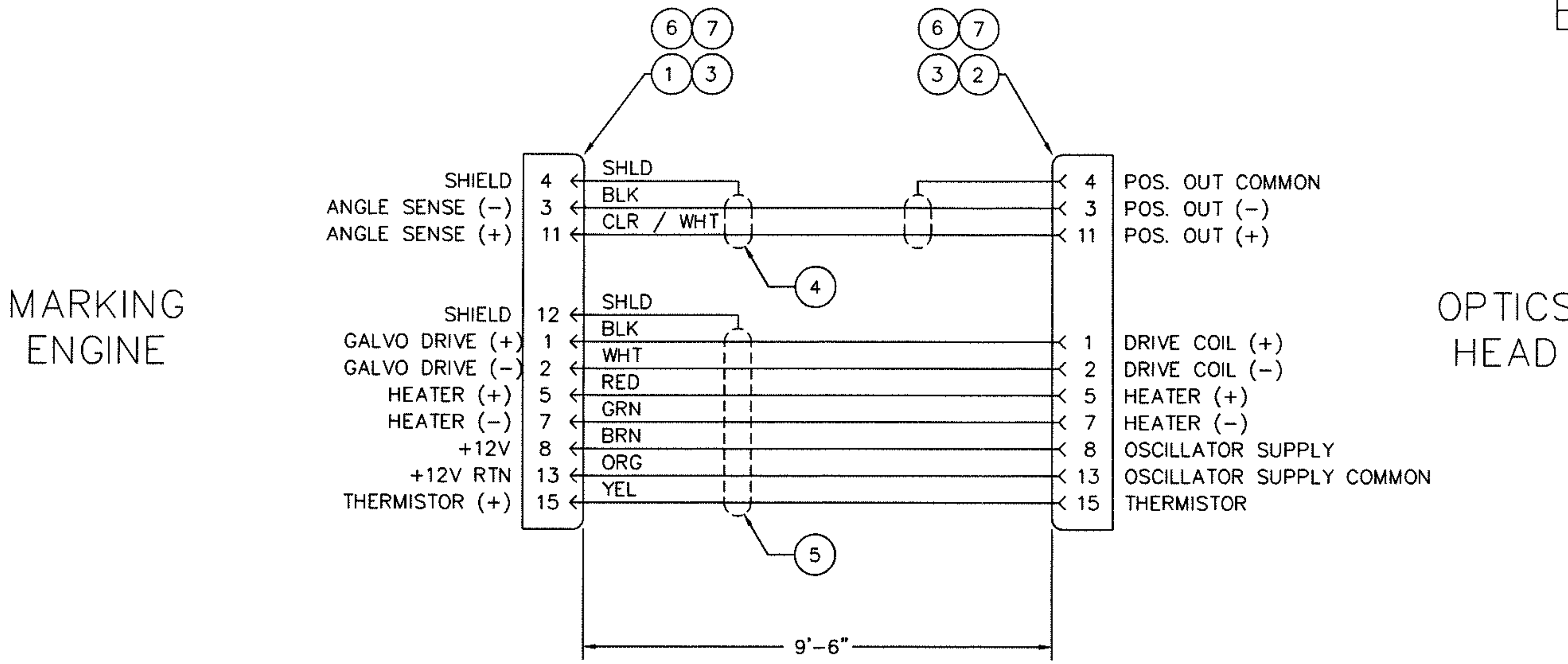
SCALE	SIZE	DRAWING NO.
NONE	B	6022287

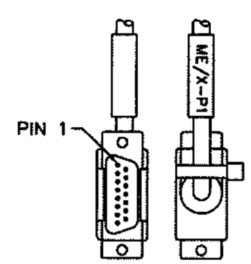
DO NOT SCALE DRAWING — SHEET 1 OF 1

DASH NO.	ITEM 1 REFERENCE	ITEM 2 REFERENCE
-01	ME/X-P1	OH/X-J1
-02	ME/Y-P2	OH/Y-J2

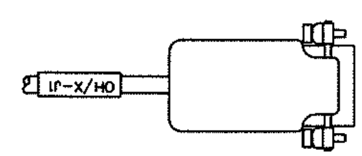
2

REVISIONS			
LVL	DESCRIPTION	APPROVED	DATE
0	FIRST RELEASE		
A	ECO 306: 7 FT WAS 8 FT	BL/BL	11/9/92
B	ECO 568	DD/PG	9/11/95
B1	OH/Y-J1 WAS OH/Y-1	DD/AG	11/13/95
C	CREATED CABLE SET -01,-02 ADDED ITEMS 6,7	JL/BL	12/7/95
D	REVISED PER ECO#652	WV/JL	03/11/96
E	ECO#929	JL/	12/02/96
F	REVISED PER ECO #1031	JG/BL	3/21/97





TYPICAL



TYPICAL

7				
6				
5	9.5'	2413109	CABLE, 8 COND 22 AWG	
4	9.5'	2413104	CABLE, 2 COND 22 AWG	
3	2	2029002	BACKSHELL 15 PIN	
2	1	2024004	CONN, DAC15S	SEE TABLE
1	1	2024003	CONN, DAC15P	SEE TABLE
ITEM NO	QTY REQD	PART NO.	DESCRIPTION	REFERENCE

2. CABLE MARKER SHALL BE WHITE HEAT SHRINK TUBING USING BLACK PERMANENT IDENTIFICATION WITH LEGEND SHOWN.

1. 60220963 CONSISTS OF 1 EA -01 & -02 CABLES LABELLED AS SHOWN IN TABLE ABOVE.

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
THREADS: CLASS 2A AND/OR 2B
MACHINING SURFACES:
REMOVE ALL BURRS/SHARP EDGES

TOLERANCES ARE:
.XX± .01
.XXX± .005
ANGLE± 1/2°

MATERIAL:
TREATMENT:
FINISH:

APPROVALS	DATE
DRAWN D. GAUDY	5MAR91
CHECKED	
ENGR	

LUMONICS

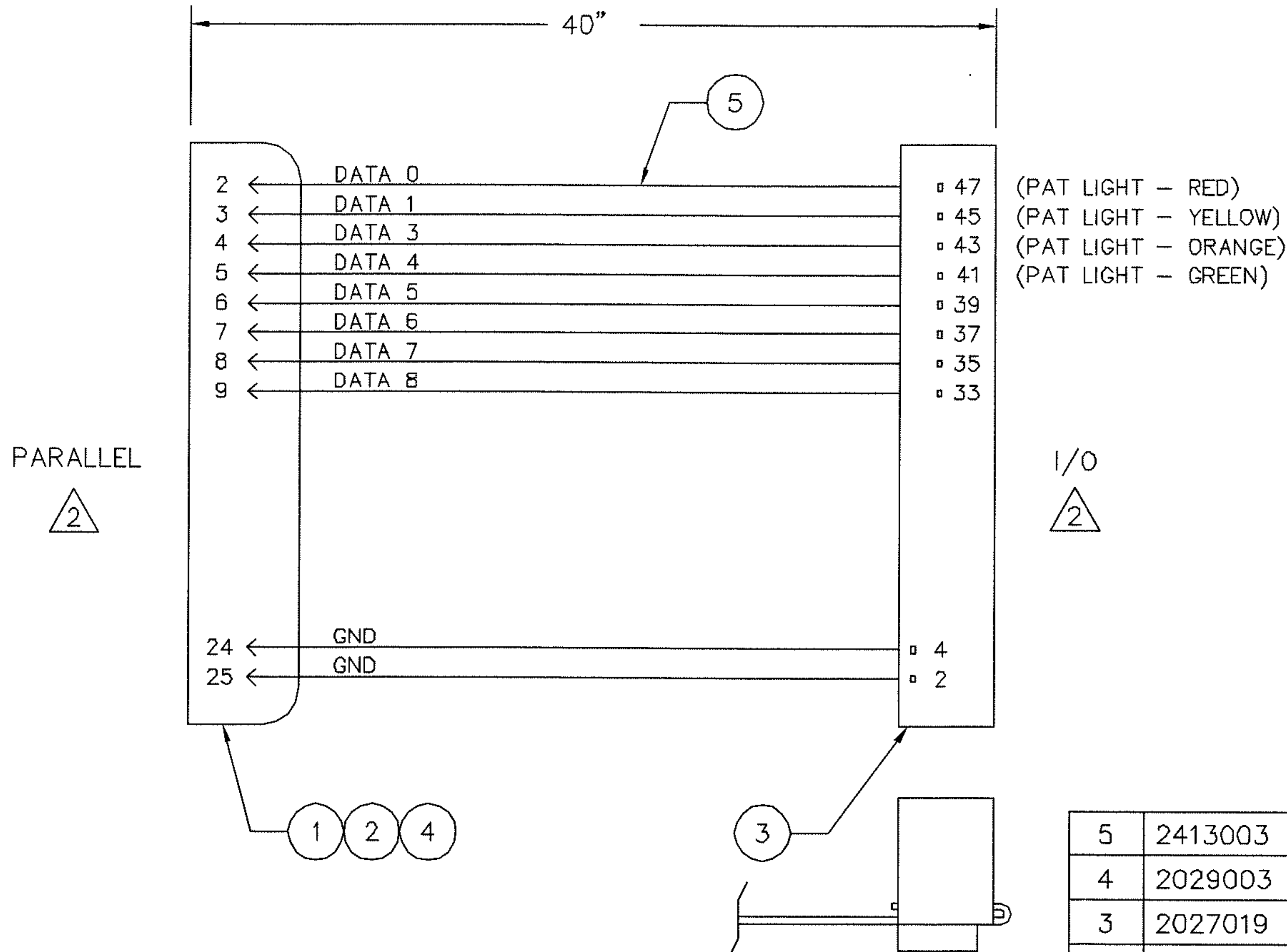
CABLE SET, GALVO (Z1913)

SCALE	SIZE	DRAWING NO.
NONE	B	60220963

DO NOT SCALE DRAWING

SHEET 1 OF 1

REVISIONS			
LVL	DESCRIPTION	DRWN/APPVD	DATE
0	FIRST RELEASE	BL / BL	5/24/94
A	ECO #1031	BMc/ BL	3/20/97
B	ECO #1235 SHORTEN LENGTH TO 40"	JL/JHT	10/13/97



ITEM NO.	PART NO.	QTY REQD	DESCRIPTION
5	2413003	6FT	50 COND RIBBON CABLE
4	2029003	1	25PIN BACKSHELL
3	2027019	1	CONN, 50PIN FLAT RIBBON SOCKET
2	2024005	1	CONN, DBC25P
1	2020002	1	MTG HDW

PARTS LIST

2 FLAT CABLE SHALL BE MARKED USING CABLE I.D. TAG (4301101) WITH LEGEND SHOWN.

1 SEPARATE INDIVIDUAL WIRES CONNECTED AT DB25 END. FOLD BACK UNUSED WIRES AND SECURE WITH HEAT SHRINK.

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
THREADS: CLASS 2A AND/OR 2B
MACHINING SURFACES: 64
REMOVE ALL BURRS/SHARP EDGES

TOLERANCES ARE:
.XX±
.XXX±
ANGLE±

MATERIAL: SEE PARTS LIST

TREATMENT:

FINISH:

APPROVALS	DATE
DRAWN B. LaChance	5/24/94
CHECKED	
ENGR	

LUMONICS

CABLE ASSEMBLY,
PAT LIGHT INTERFACE
4 COLOR

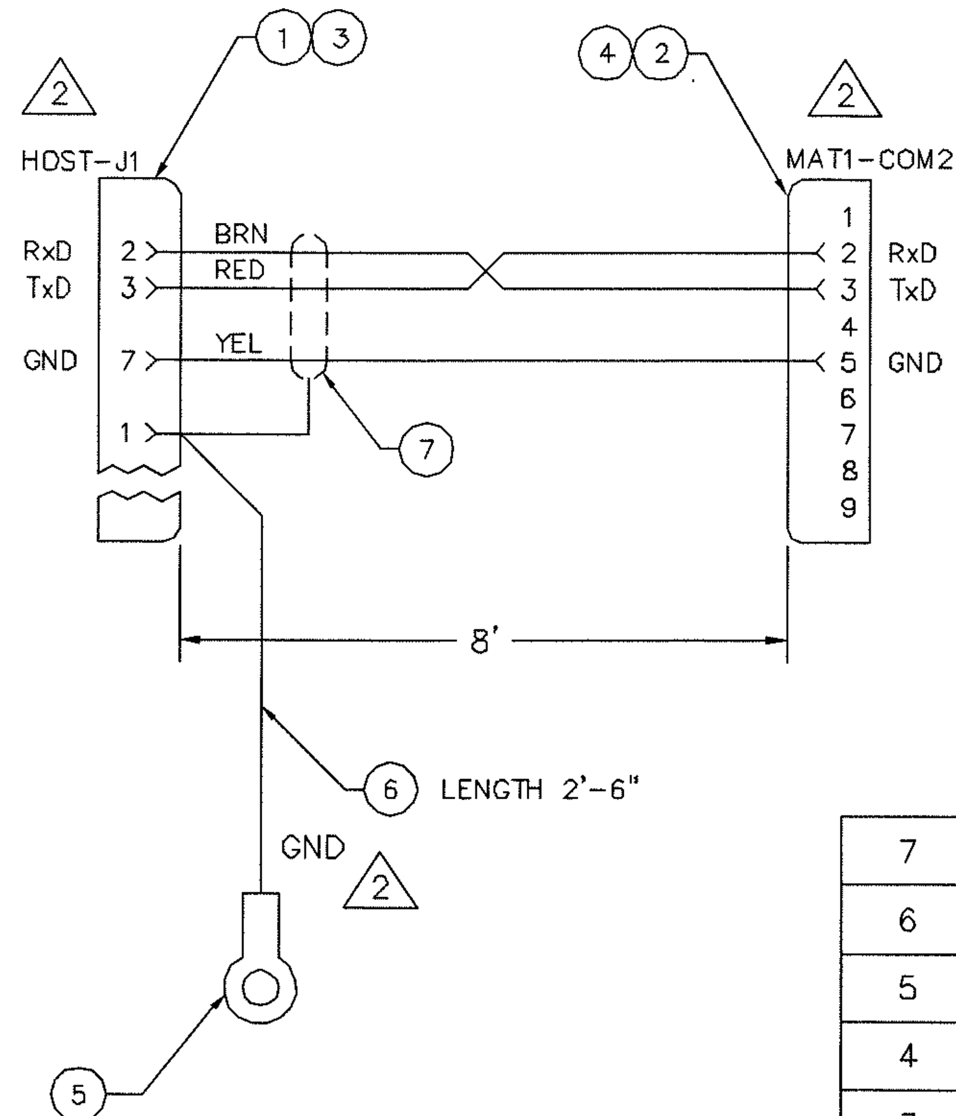
SCALE	SIZE	DRAWING NO.
NONE	B	6022175

DO NOT SCALE DRAWING

SHEET 1 OF 1

REVISIONS			
LVL	DESCRIPTION	DRWN/APVD	DATE
0	FIRST RELEASE	DD/AG	4/6/95
1	8' WAS 10', ADDED ITEMS 8 & 9 REMOVED PINS 4, 5, 6, 8, 9 2024006 WAS 2024001, ADDED 2029003 2413116 WAS 2413113	DD/AG	6/28/95
2	CHANGE LENGTHS	AG/AG	8/14/95
A	HOST-J1 WAS HOST-P1	PG/PG	9/11/95
A1	NOTE 1, ITEM 5 WAS ITEM 4		
B	REVISED PER ECO #1031	JG/BL	3/26/97
C	ECO#1358 REMOVE UNUSED PINS	NP/CA	3/2/98

EXTERNAL INTERCONNECT PANEL



MRKG ENGINE
MAT-286 #1
COM2

7	8'	2413116	CABLE, 6 COND 22 AWG SHLDED	
6	2.5'	2411004	WIRE, 18 GA GRN	
5	1	2090412	LUG RING 1/4" RED	
4	1	2029001	BACKSHELL, 9 PIN	
3	1	2029003	CONN, HDW 25 PIN BACKSHELL	
2	1	2024002	CONN, DEC9S	MAT1-COM2
1	1	2024006	CONN, DBC25S	HOST-J1
ITEM NO	QTY REQD	PART NO.	DESCRIPTION	REFERENCE

2. CABLE MARKER SHALL BE WHITE HEAT SHRINK TUBING USING BLACK PERMANENT IDENTIFICATION WITH LEGEND SHOWN.

1. CONNECT ITEM 5 TO CHASSIS GROUND AT FINAL ASSEMBLY.

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES — TOLERANCES ARE:
THREADS: CLASS 2A AND/OR 2B — .XX± .01
MACHINING SURFACES: 64/ — .XXX± .005
REMOVE ALL BURRS/SHARP EDGES — ANGLE± 0.5°

MATERIAL: NONE
TREATMENT: NONE
FINISH: NONE

APPROVALS	DATE
DRAWN DAN DONGELMANS	6/22/95
CHECKED	
ENGR ASIF GOSLA	6/22/95

LUMONICS

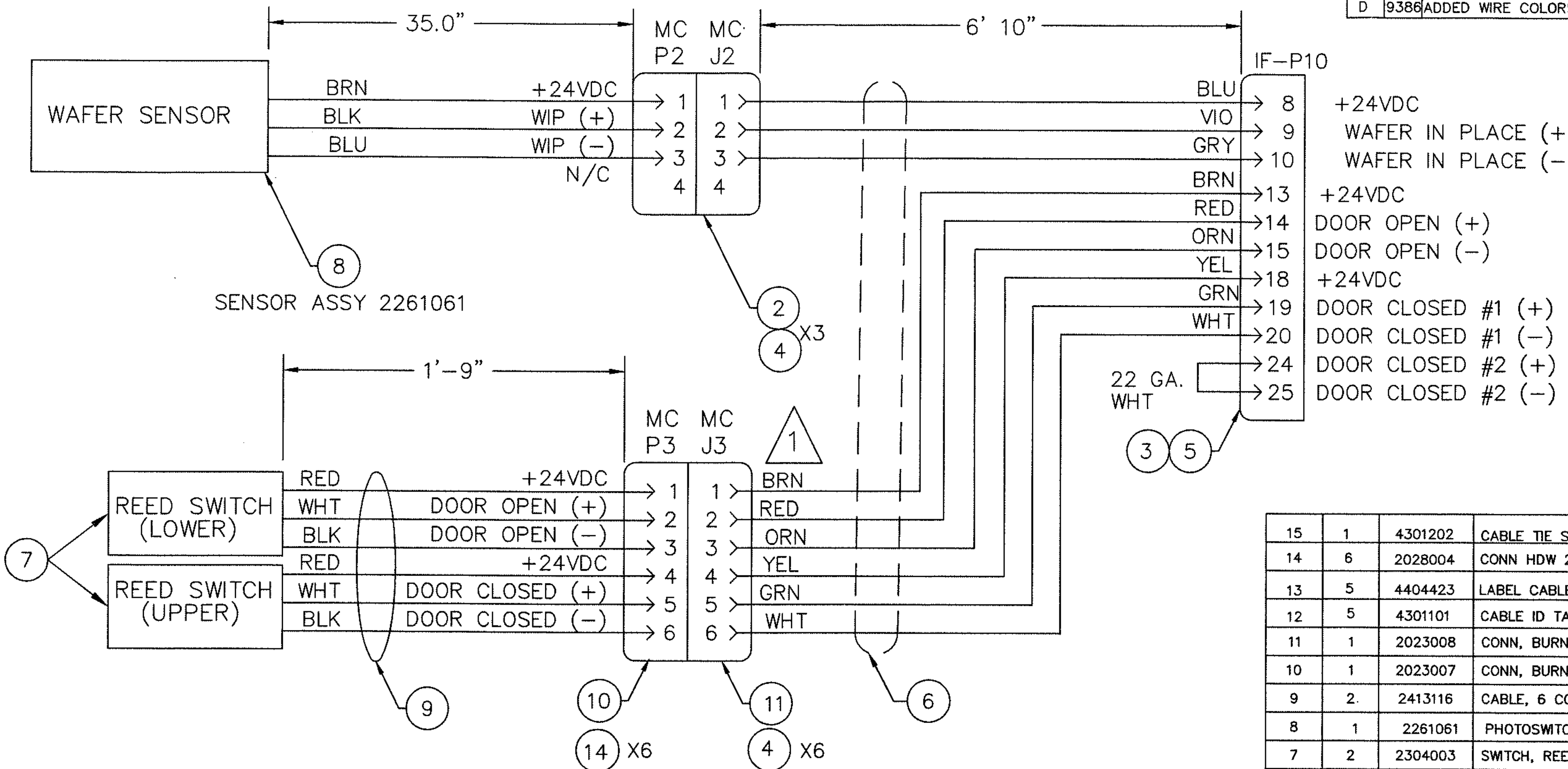
CABLE ASSY, HOST LINK, WAFERMARK SIGMACLEAN

SCALE NONE | SIZE B | DRAWING NO. 6022207

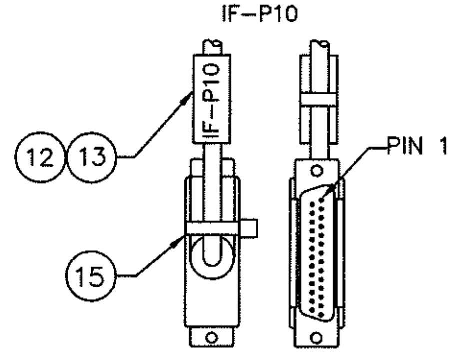
DO NOT SCALE DRAWING | SHEET 1 OF 1

REVISIONS

REV.	ECO	DESCRIPTION	DRWN/APVD	DATE
A	597	PROD RELEASE	JL/BL	12/18/95
B	652	REVISED PER ECO	WV/JL	03/04/96
C	1421	REMOVE SENSOR ASSY.	JL/JHT	6/2/98
D	9386	ADDED WIRE COLORS CHANGED BOM	DAM	3/20/00



CONNECTOR DETAIL
IF-P10



BACK FRONT

NOTES:

1. STRIP CABLE SHIELDING AND INSULATION BACK 3"
2. WRAP SENSORS AND SWITCHES IN PROTECTIVE COVERING PRIOR TO SHIPMENT.
3. CONNECTORS TO BE LABELED WITH ITEMS 13, 14 AND WITH ORIENTATION AS SHOWN IN DETAIL.

ITEM NO	QTY REQD	PART NO.	DESCRIPTION
15	1	4301202	CABLE TIE STD
14	6	2028004	CONN HDW 20 GA MALE PIN
13	5	4404423	LABEL CABLE ID TAG 2.5X.9
12	5	4301101	CABLE ID TAG
11	1	2023008	CONN, BURNDY SMS6R-1
10	1	2023007	CONN, BURNDY SMS6P-1
9	2.	2413116	CABLE, 6 COND
8	1	2261061	PHOTOSWITCH, 42KB, ALLEN BRADLEY
7	2	2304003	SWITCH, REED
6	5'	2413113	12 COND AWG 22 GA SHIELDED
5	1	2029003	BACKSHELL, 25 PIN
4	9	2028003	20 AWG FEMALE SOCKET
3	1	2024005	CONN, DBC25P
2	1	2023006	CONN, BURNDY SMS4R-1

MATERIAL: SEE B.O.M. FOR 6022210

FINISH: N/A

UNLESS SPECIFIED
1. ALL DIMENSIONS APPLY AFTER FINISH
2. REMOVE ALL BURRS AND SHARP EDGES. (.010 MAX. R. OR CHAMFER)
3. MIN. BEND RADIUS, MIN. BEND RELIEF.
4. NO TOOL MARKS.
5. MACHINED FINISH 64 EXCEPT 32 FOR HORIZ. MILLING

UNLESS OTHERWISE SPECIFIED
.X = ± .03 .XXX = ± .005 X° = ± 30'
.XX = ± .01 X/X = ± 1/64 ALL DIMENSION IN INCHES

DRAWN BY: DAM
DRAWN DATE: 03/20/00
CH.
CFN: DM00317
SIZE: B
SCALE: N/A

GSI LUMONICS 60 FORDHAM ROAD WILMINGTON, MA 01887

DRAWING TITLE: CABLE ASSY., MARK CHAMBER INTERFACE

DRAWING NUMBER: 6022210
REV: D
DO NOT SCALE DRAWING
SHEET 1 OF 1

REVISIONS

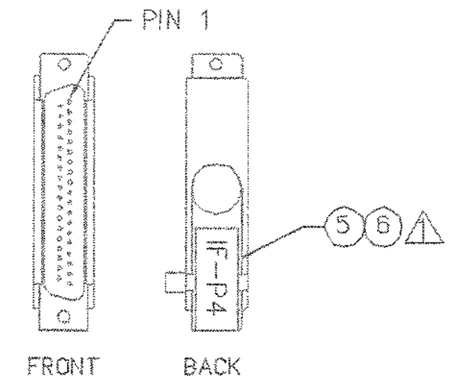
LVL.	DESCRIPTION	DRWN/APVD	DATE
A	PROD. REL. PER E.O.	JL/	12/6/95

IF-P4 (1)(2)(3)

1	SHIELD
2	EPO SWITCH
3	EPO SWITCH RTN
4	KEYSWITCH ON
5	KEYSWITCH ON RTN
6	KEYSWITCH START #1
7	KEYSWITCH START #1 RTN
8	EPO SWITCH #2
9	EPO SWITCH #2 RTN
10	POWER ON INDICATOR
11	POWER ON INDICATOR RTN
12	+24 VDC
13	+24V
14	LASER ON INDICATOR
15	ALARM SUPPRESS INDICATOR
16	FAULT CLEAR INDICATOR
17	AIR FLOW FAULT
18	CASSETTE LOADING FAULT
19	GAS FLOW FAULT
20	LASER LAMP FAULT
21	LASER POWER FAULT
22	SAFETY INTERLOCK FAULT
23	VACUUM FAULT
24	WAFER HANDLING FAULT
25	WATER FLOW FAULT
26	WATER LEVEL FAULT
27	WATER RESISTIVITY FAULT
28	WATER TEMPERATURE FAULT
29	SOUND ALARM
30	LASER ON/OFF SWITCH
31	LASER ON/OFF SWITCH RTN
32	FAULT CLEAR SENSE
33	ALARM CLEAR SENSE
34	LASER POWER MANUAL/AUTO
35	SAFETY DOOR MANUAL/AUTO
36	SENSE COMMON
37	SENSE COMMON

(4)

INTERFACE BOARD



ITEM NO	QTY REQD	PART NO.	DESCRIPTION
6	1	4404423	LABEL CABLE ID TAG 2.5X.9
5	1	4301101	CABLE ID TAG
4	6"	2412002	WIRE 22 GA 7 STRAND WHITE
3	4	2028004	CONN HDW 20 GA MALE PIN
2	1	2029004	BACKSHELL, 37 PIN
1	1	2024007	CONN, DCC37P

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
THREADS: CLASS 2A AND/OR 2B
MACHINING SURFACES:
REMOVE ALL BURRS/SHARP EDGES

TOLERANCES ARE:
.XX± .01
.XXX± .005
ANGLE± 0.5°

MATERIAL: NONE
TREATMENT: NONE
FINISH: NONE

APPROVALS	DATE
DRAWN DONGELMANS	8/22/95
CHECKED	
ENGR	

LUMONICS

JUMPER CONNECTOR
INTERFACE BOARD,
DPSSL

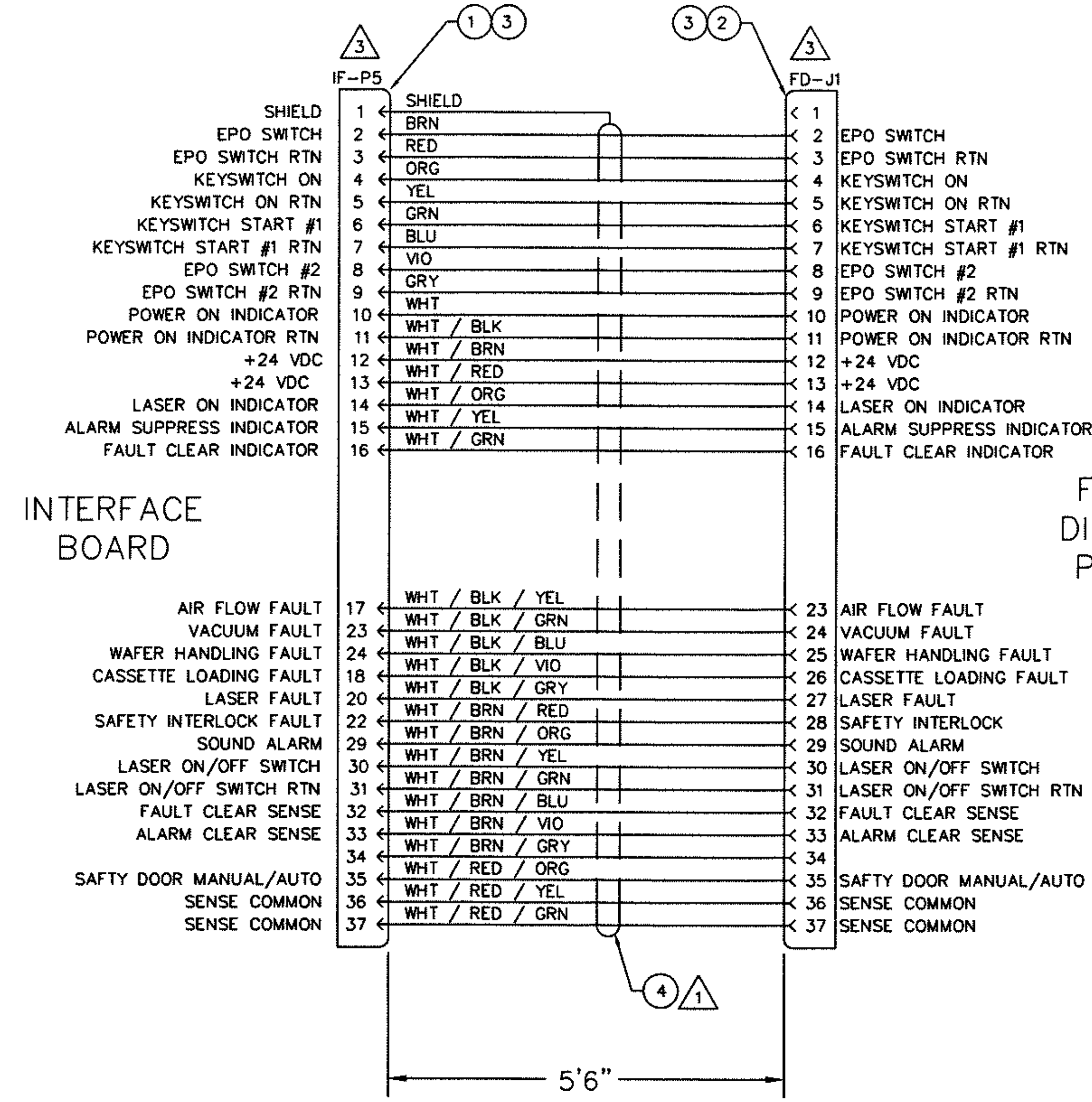
SCALE: NONE | SIZE: B | DRAWING NO. 6022209

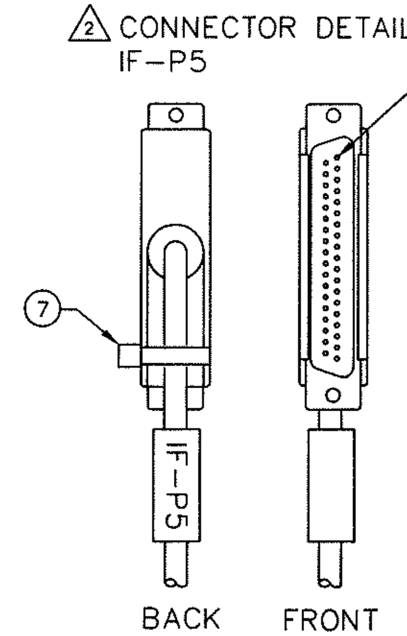
DO NOT SCALE DRAWING | SHEET 1 OF 1

1. LABEL ID TAG WITH TEXT ORIENTATION AS SHOWN.

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS			
LVL	DESCRIPTION	DRWN/APVD	DATE
A	PROD REL PER E.O. 597	JL/ B.L.	12/18/95
B	REVISED PER ECO#652	WV/	03/04/96
C	REVISED PER ECO #1031	JG/BL	3/21/97
D	ECO 1272, ITEM 4 WAS 2413112	EE/BL	11/24/97





ITEM NO	QTY REQD	PART NO.	DESCRIPTION	REF.
7	1	4301202	CABLE TIE STD	
6				
5				
4	5.5'	2413108	CABLE, 40 COND 22AWG	
3	2	2029004	CONN HDW 37 PIN BACKSHELL	IF-P5/FD-J1
2	1	2024008	CONN DCC37S	FD-J1
1	1	2024007	CONN DCC37P	IF-P5

3. CABLE MARKER SHALL BE WHITE HEAT SHRINK TUBING USING BLACK PERMANENT IDENTIFICATION WITH LEGEND SHOWN.

2. CONNECTORS TO BE LABELED WITH ORIENTATION AS SHOWN IN DETAIL.

1 COLORS OF WIRE MAY BE DIFFERENT ACCORDING TO TYPE OF CABLE. (PIN OUT MUST FOLLOW DRAWING)

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES — TOLERANCES ARE:
THREADS: CLASS 2A AND/OR 2B — .XX± .01
MACHINING SURFACES: 64 — .XXX± .005
REMOVE ALL BURRS/SHARP EDGES — ANGLE± 0.5°

MATERIAL: SEE PARTS LIST

TREATMENT: NONE

FINISH: NONE

APPROVALS	DATE
DRAWN DONGELMANS	6/22/95
CHECKED	
ENGR ASIF GOSLA	6/23/95

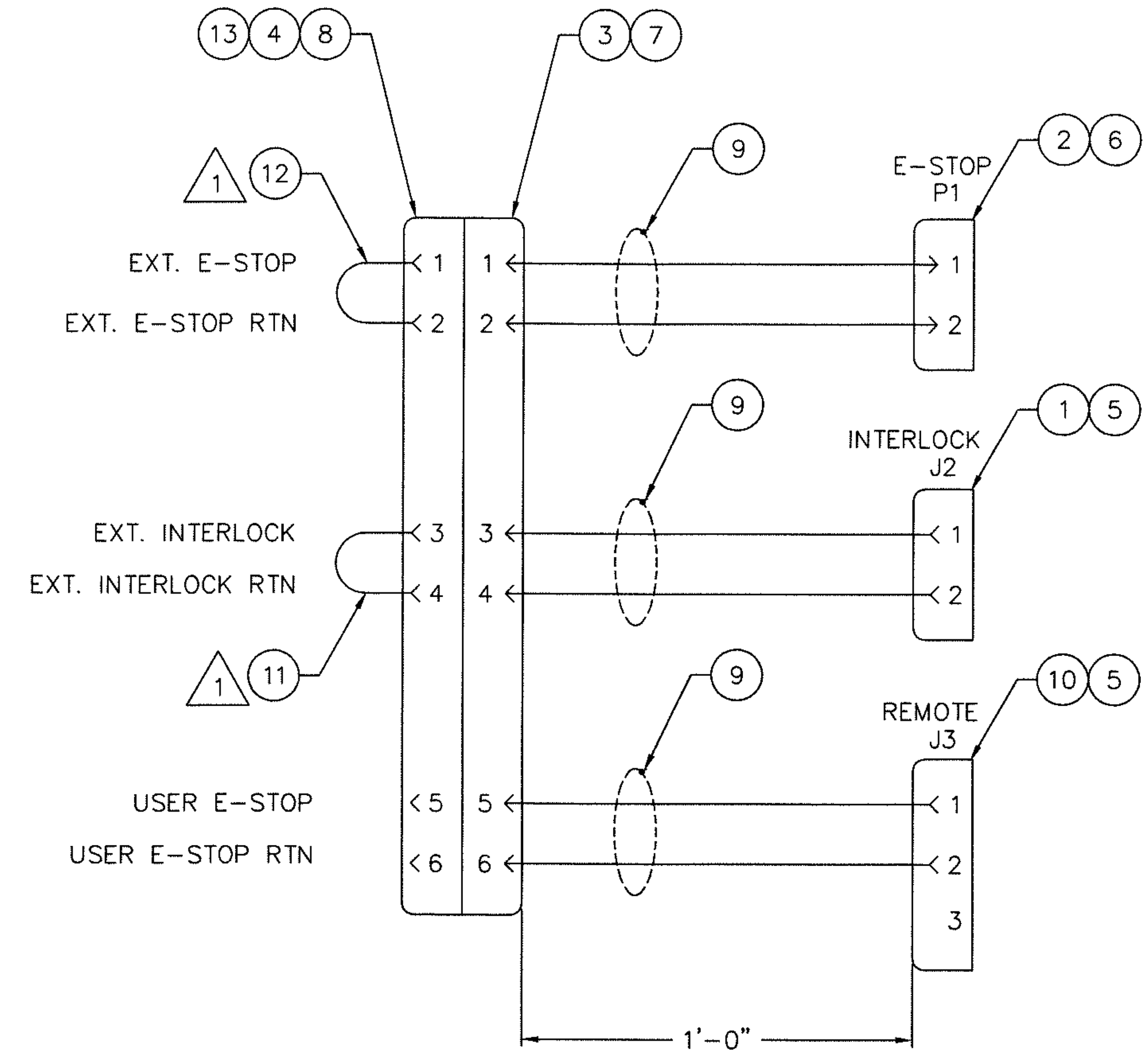
LUMONICS

CABLE ASSY, FAULT DISPLAY PANEL WMSC, DPSSL

SCALE	SIZE	DRAWING NO.
NONE	B	6022232

DO NOT SCALE DRAWING — SHEET 1 OF 1

REVISIONS			
LVL	DESCRIPTION	DRWN/APVD	DATE
0	FIRST RELEASE	DD / AG	6/23/95
1	ADD USER E-STOP CONNECTOR	AG/AG	8/14/95
2	ITEM 5, QTY.= 4 WAS 5, ADDED ITEMS 11 AND 12	DD/AG	9/11/95
3	2413119 WAS 2413104	DD/AG	09/25/97
A	ECO 1287, ITEM 12 WAS 2412106, ITEM 11 WAS 2412101. ADDED NOTE 1 & ITEM 13	EE/CA	12/08/97



ITEM	QTY	PART NUMBER	DESCRIPTION
13	1'	4342008	SHRINK TUBING 1" BLACK
12	1'	2411006	WIRE, 18 GA, 16 STR, RED
11	1'	2411002	WIRE, 18 GA, 16 STR, BLUE
10	1	2023004	CONN BURNDY SMS3R-1
9	3'	2413119	CABLE BELDEN 2 COND. 18GA
8	4	2091026	SOCKET, MULTIMATE TYPE VI
7	4	2091027	PIN, MULTIMATE TYPE VI
6	2	2028002	CONN HDW 16GA MALE PIN
5	4	2028001	CONN HDW 16GA FEMALE PIN
4	1	2023028	CONN AMP ECONOSEAL 9 POSITION
3	1	2023027	CONN AMP ECONOSEAL 9 POSITION
2	1	2023002	CONN BURNDY SMS2P-1
1	1	2023001	CONN BURNDY SMS2R1

1 JUMPER WIRES SHOULD EXTEND ABOUT 3 INCHES FROM CONNECTOR. AFTER JUMPERS ARE INSTALLED, THE TWO WIRES SHOULD BE TWISTED TOGETHER. COVER CONNECTOR AND WIRES WITH HEAT SHRINK.

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
THREADS: CLASS 2A AND/OR 2B
MACHINING SURFACES: 64
REMOVE ALL BURRS/SHARP EDGES

TOLERANCES ARE:
.XX± .01
.XXX± .005
ANGLE± 0.5°

MATERIAL: SEE PARTS LIST

TREATMENT: NONE

FINISH: NONE

LUMONICS

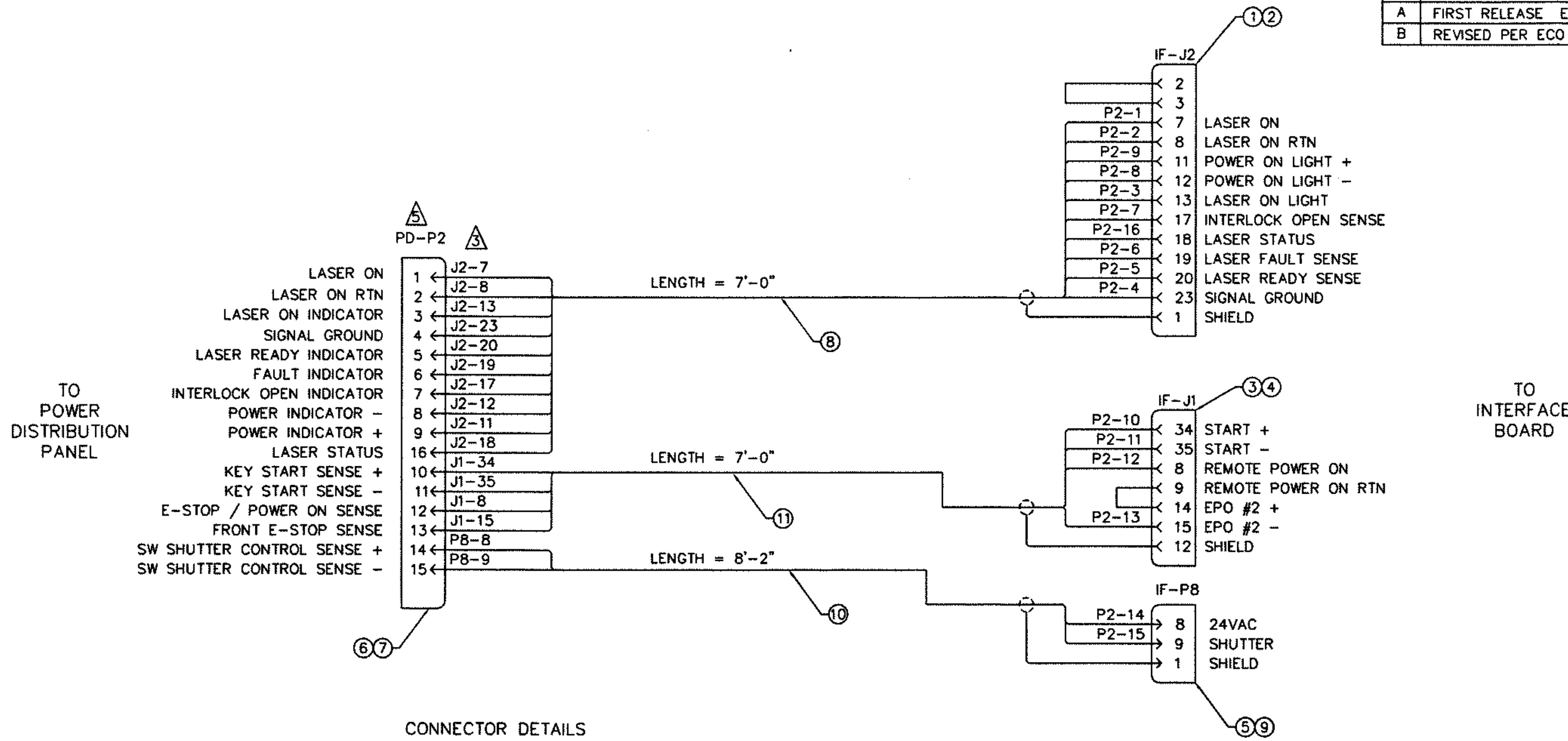
CABLE ASSY., EXTERNAL
E-STOP / INTERLOCK HARNESS
SIGMA CLEAN

SCALE	SIZE	DRAWING NO.
NONE	B	6022228

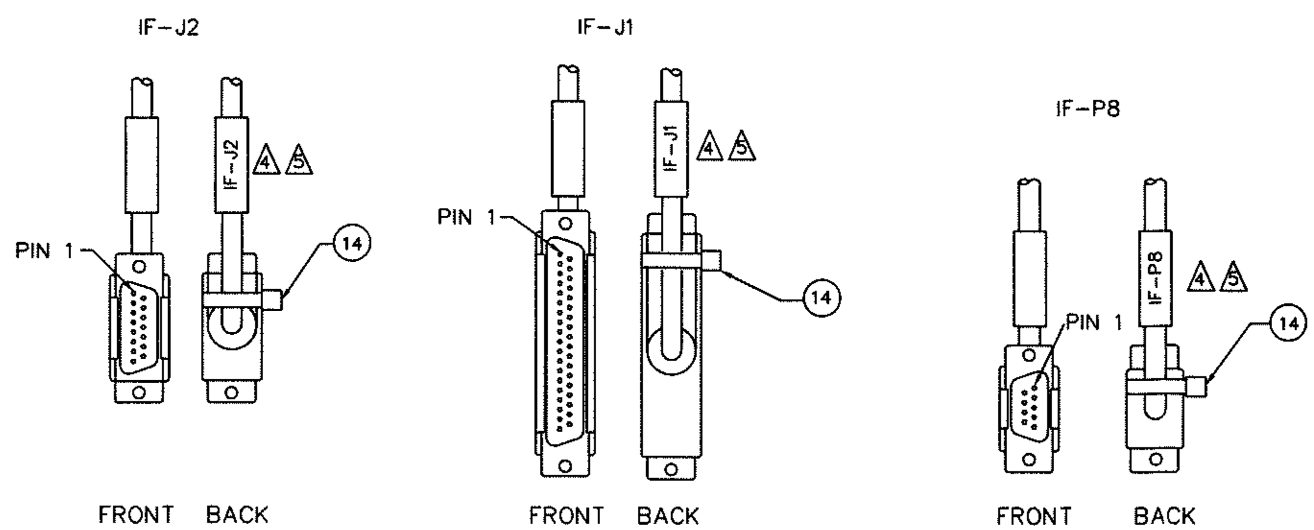
DO NOT SCALE DRAWING

SHEET 1 OF 1

REVISIONS			
LVL	DESCRIPTION	DRWN/APPVD	DATE
A	FIRST RELEASE ECO #959	CA / JT	02/05/95
B	REVISED PER ECO # 1031	JG/BL	3/21/97



CONNECTOR DETAILS



ITEM	QTY	PART NUMBER	DESCRIPTION
14	3	4301202	CABLE TIE STD
13			
12			
11	7'	2413115	CABLE 4 COND 22 GA SHIELDED
10	7'	2413104	CABLE 2 COND SHIELDED
9	1	2029002	CONN HDW 15PIN BACKSHELL
8	9'	2413113	CABLE, 12 COND SHIELDED
7	1	2023086	WAGO CODING KEY
6	1	2023083	CONN WAGO PLUG 16 PIN
5	1	2024003	CONN DAC15P
4	1	2024008	CONN DCC37S
3	1	2029004	CONN HDW 37 PIN BACKSHELL
2	1	2029003	CONN HDW 25 PIN BACKSHELL
1	1	2024006	CONN DBC25S

5. CABLE MARKER SHALL BE WHITE HEAT SHRINK TUBING, USING PERMANENT IDENTIFICATION WITH LEGEND SHOWN.
4. CABLE TO EXIT CONNECTOR AS SHOWN IN DETAIL.
3. CODING KEY SNAPS ON NEAR PIN 8 OF P2
2. PD = POWER DISTRIBUTION PANEL
1. IF = INTERFACE BOARD

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
THREADS: CLASS 2A AND/OR 2B
MACHINING SURFACES:
REMOVE ALL BURRS/SHARP EDGES
TOLERANCES ARE: .XX± .01 .XXX± .005 ANGLE± 1/2°

LUMONICS

MATERIAL: SEE PARTS LIST
TREATMENT: NONE
FINISH: NONE

APPROVALS	DATE
DRAWN DONGELMANS	6/22/95
CHECKED	
ENGR ASIF GOSLA	6/22/95

CABLE ASSY., SYSTEM CONTROL WAFERMARK SIGMA

SCALE NONE | SIZE B | DRAWING NO. 6022304

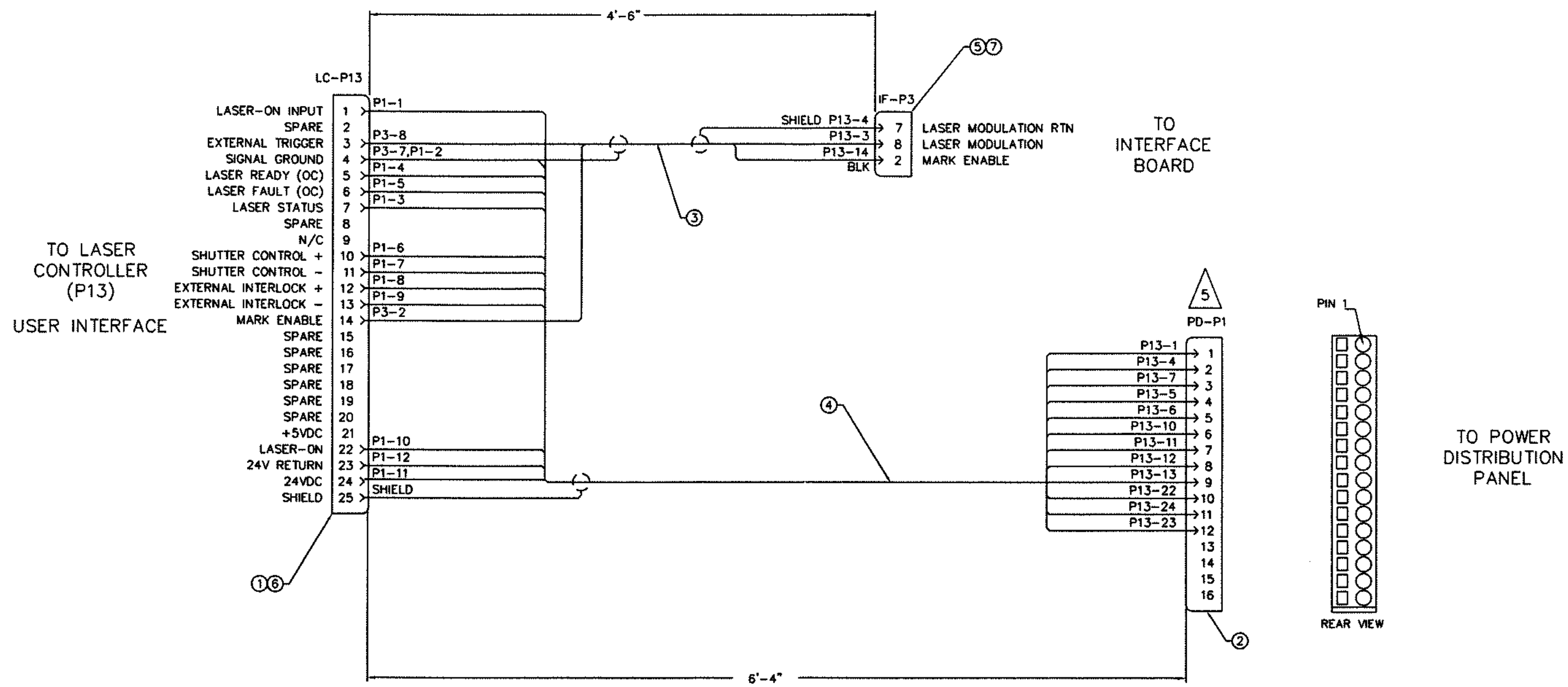
DO NOT SCALE DRAWING | SHEET 1 OF 1

THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND SHALL NOT BE USED, REPRODUCED, OR DISCLOSED TO THIRD PARTIES WITHOUT WRITTEN AUTHORIZATION FROM GSI LUMONICS.

5. CABLE MARKER SHALL BE WHITE HEAT SHRINK TUBING USING BLACK PERMANENT IDENTIFICATION WITH LEGEND SHOWN.
4. CABLE EXIT AND CABLE LABEL PER DETAILS SHOWN.
3. LC = LASER CONTROLLER
2. PD = POWER DISTRIBUTION PANEL
1. IF = INTERFACE BOARD

--- REVISIONS ---

ECO	REV	CHANGE DESCRIPTION	DATE	CHG BY	APPV'D
1031	A	INITIAL RELEASE	3/19/97	CS	BL
8923	B	ADDED A VIEW OF THE CONNECTOR END	10/29/99	DM	DAM

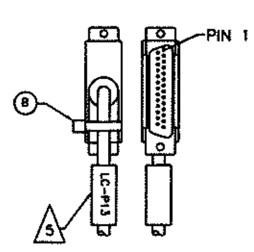


PACKAGE PER GSI LUMONICS CONTROL DOCUMENT #CD0013, METHOD # P21

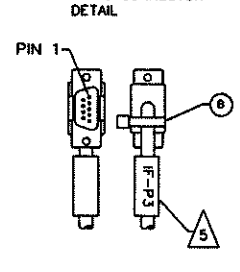
AFTER FINISHING, ADD PIECE PART MARKING ON SURFACE INDICATED IN DRAWING PER GSI LUMONICS CNTRL DOC. #CD0002, METHOD # 1

ALL DIMENSIONS ARE TO BE INTERPRETED PER LATEST ANSI Y14.5 SPECS.

LC-P13 CONNECTOR DETAIL



IF-P3 CONNECTOR DETAIL



ITEM	QTY	PART NUMBER	DESCRIPTION
8	2	4301202	CABLE TIE STD
7	1	2029001	CONN HDW 9 PIN BACKSHELL
6	1	2024005	CONN DBC25P
5	1	2024001	CONN DEC9P
4	8'	2413113	CABLE 12 COND 22 GA SHIELDED
3	3'	2413104	CABLE 2 COND SHIELDED
2	1	2023083	CONN WAGO PLUG 16 PIN
1	1	2029003	CONN HDW 25 PIN BACKSHELL

MATERIAL: SEE B.O.M.

FINISH: NONE

UNLESS SPECIFIED
1. ALL DIMENSIONS APPLY AFTER FINISH
2. REMOVE ALL BURRS AND SHARP EDGES. (.010 MAX. R. OR CHAMFER)
3. MIN. BEND RADIUS, MIN. BEND RELIEF.
4. NO TOOL MARKS.
5. MACHINED FINISH 64 EXCEPT 32 FOR HORIZ. MILLING

UNLESS OTHERWISE SPECIFIED
.X = ± .03 .XXX = ± .005 X° = ± 30'
.XX = ± .01 X/X = ± 1/64 ALL DIMENSION IN INCHES

DRAWN BY: DAM

DRAWN DATE: 10/99

CH.

CFN

GSI Lumonics 60 FORDHAM ROAD WILMINGTON, MA 01887

DRAWING TITLE: CABLE ASSEMBLY LASER CONTROLLER

DRAWING NUMBER: 6022303

REV: B

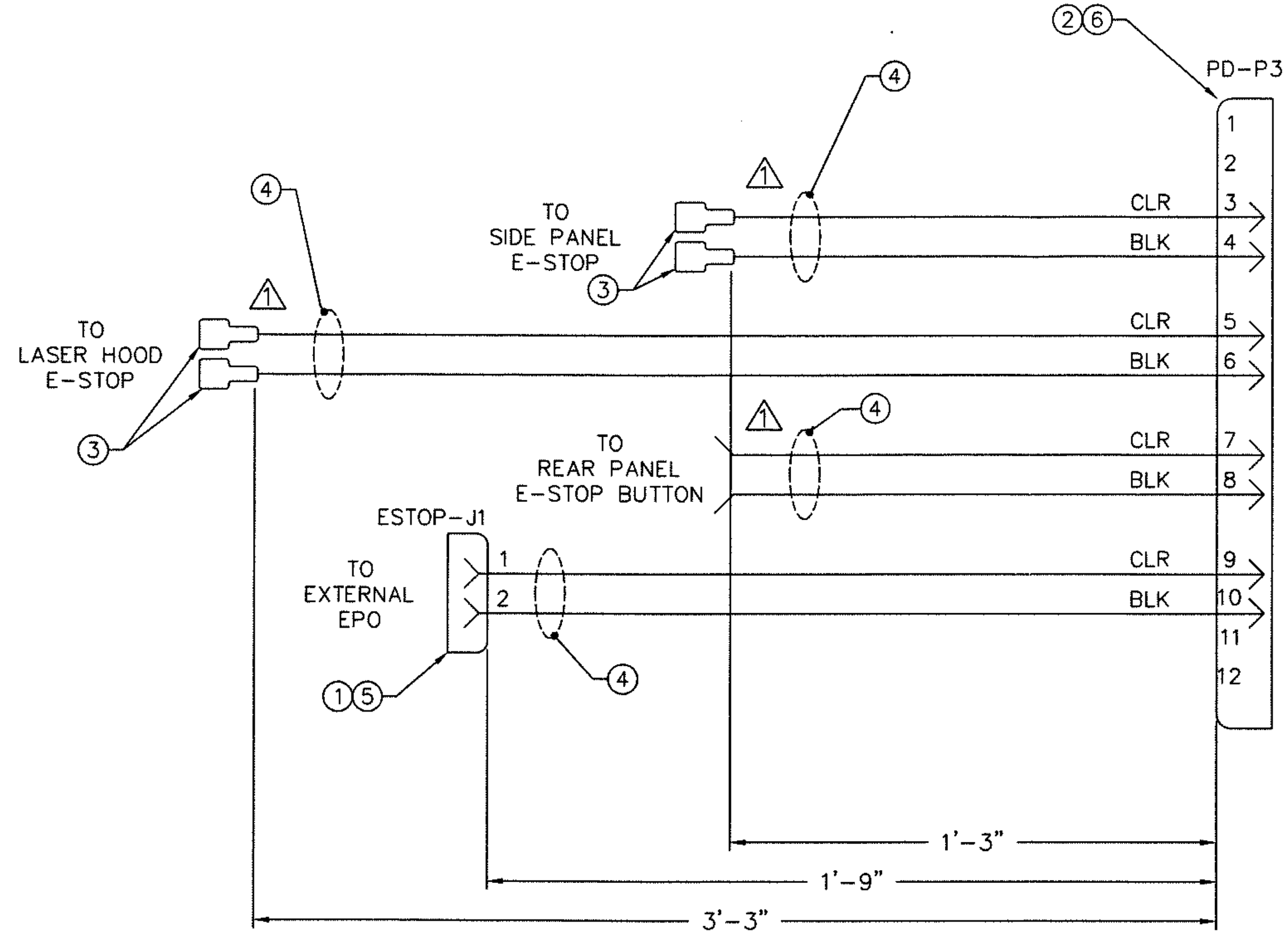
SIZE: B

SCALE: DO NOT

DO NOT SCALE DRAWING

SHEET 1 OF 1

REVISIONS			
LVL	DESCRIPTION	DRWN/APPVD	DATE
0	FIRST RELEASE	DD / AG	23JUN95
1	CHANGE LENGTHS	AG / AG	8/14/95
A	ADD NOTE ⚠1 CALLOUT TO REAR PNL E-STOP	/	



CONNECT TO POWER DISTRIBUTION PANEL

ITEM	QTY	PART NUMBER	DESCRIPTION
6	8	2028002	CONN HDW 16 GA MALE PIN
5	10	2028001	CONN HDW 16 GA FEMALE PIN
4	24.5'	2413119	CABLE, BELDEN 2 COND. 18 GA
3	4	2090413	LUG SLIP ON
2	1	2023010	CONN BURNDY SMS12P-1
1	1	2023001	CONN BURNDY SMSR1

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
THREADS: CLASS 2A AND/OR 2B
MACHINING SURFACES:
REMOVE ALL BURRS/SHARP EDGES
TOLERANCES ARE: .XX± .01 .XXX± .005 ANGLE± 1/2°

LUMONICS

MATERIAL: SEE PARTS LIST
TREATMENT: NONE
FINISH: NONE

APPROVALS	DATE
DRAWN DONGELMANS	6/22/95
CHECKED	
ENGR ASIF GOSLA	6/22/95

CABLE ASSY., EMO HARNESS, SIGMA CLEAN

SCALE NONE | SIZE C | DRAWING NO. 6022224

DO NOT SCALE DRAWING | SHEET 1 OF 1

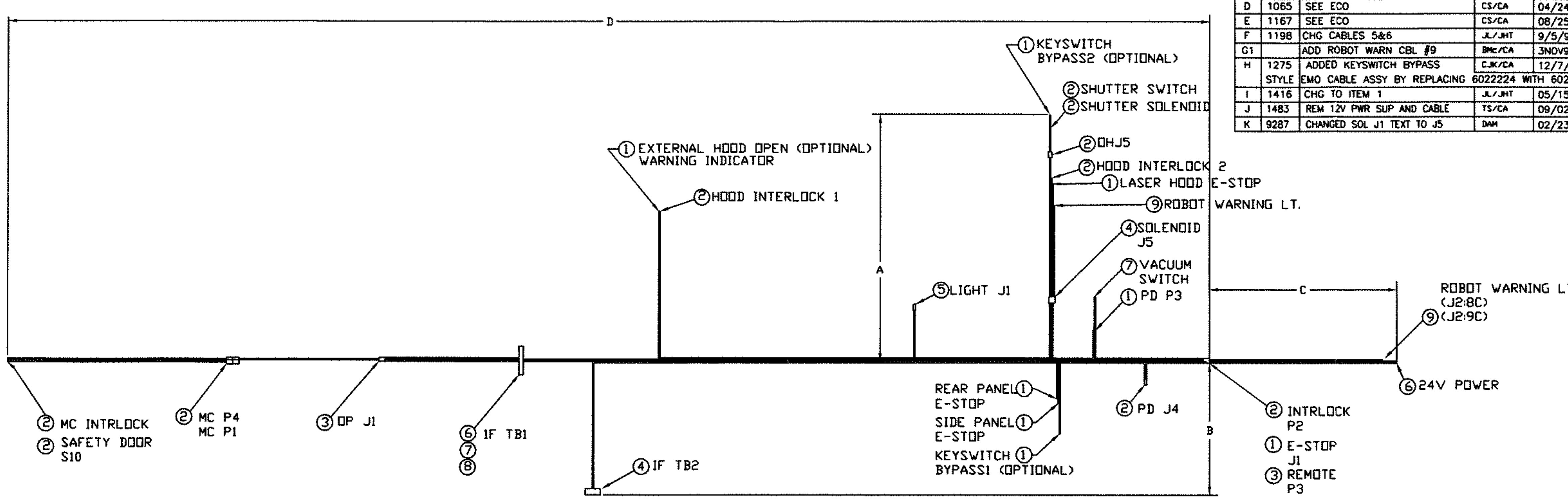
⚠1 STRIP BACK INSULATION AND SHIELDING TO EXPOSE WIRES UNDERNEATH FOR 3".

NOTES: UNLESS OTHERWISE SPECIFIED

THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND SHALL NOT BE USED, REPRODUCED, OR DISCLOSED TO THIRD PARTIES WITHOUT WRITTEN AUTHORIZATION FROM GSI LUMONICS.

REVISIONS

REV	ECO	DESCRIPTION	DRWN/APPVD	DATE
A	959	FIRST RELEASE	CA / JT	02/05/97
B	1034	SEE ECO	JL / JHT	03/19/97
C	1042	SEE ECO	JL / JHT	03/25/97
D	1065	SEE ECO	CS/CA	04/24/97
E	1167	SEE ECO	CS/CA	08/25/97
F	1198	CHG CABLES 5&6	JL/JHT	9/5/97
G1		ADD ROBOT WARN CBL #9	BMc/CA	3NOV97
H	1275	ADDED KEYSWITCH BYPASS	CJK/CA	12/7/97
	STYLE	EMO CABLE ASSY BY REPLACING 6022224 WITH 6022384		
I	1416	CHG TO ITEM 1	JL/JHT	05/15/98
J	1483	REM 12V PWR SUP AND CABLE	TS/CA	09/02/98
K	9287	CHANGED SOL J1 TEXT TO J5	DAM	02/23/00



ITEM #	P/N	REV	QTY	DESCRIPTION	A	B	C	D
9	6022295		1	CABLE ASSY ROBOT WARN LT	2'-1"	N/A	2'-0"	2'-2"
8	2091112		1	STRIP TERMINAL 24 POS FEM	N/A	N/A	N/A	N/A
7	6022262	B	REF	CABLE ASSY, VACUUM SWITCHIF TB1	0	0	N/A	9'-5.5"
7	6022262	I	1	CABLE ASSY, VACUUM SWITCH	N/A	10.5"	N/A	1'-7"
6	6022261	C	REF	24V POWER IF TB1	0	0	N/A	9'-5.5"
6	6022261	I	1	24V POWER	0	0	3'-5"	N/A
5				DELETED				
5				DELETED				
4	6022237	E	REF	CABLE ASSY SOLENOID EXT.IF TB2	N/A	1'-6.25"	N/A	8'-5.5"
4	6022237	I	1	CABLE ASSY SOLENOID EXT.J1	10.5"	N/A	N/A	2'-2"
3	6022241	B	REF	CABLE ASSY USER E-STOP OP J1	0	0	N/A	12'-8.5"
3	6022241	I	1	CABLE ASSY USER E-STOP REMOTE P3	0	0	0	0
2	6022313	E	REF	CABLE ASSY INTERLOCK HARNESSS10	0	0	N/A	16'-5.5"
2	6022313		REF	CABLE ASSY INTERLOCK HARNESSMCP4/1	0	0	N/A	13'-4.5"
2	6022313		REF	CABLE ASSY INTERLOCK HARNESSHOOD1	2'-.5"	N/A	N/A	7'-8.5"
2	6022313		REF	CABLE ASSY INTERLOCK HARNESSHOOD2	2'-6"	N/A	N/A	2'-2"
2	6022313		REF	CABLE ASSY INTERLOCK HARNESSPD J4	N/A	4"	N/A	10.5"
2	6022313		REF	CABLE ASSY INTERLOCK HARNESS SW/SOL	4'-3"	N/A	N/A	2'-2"
2	6022313		REF	CABLE ASSY INTERLOCK HARNESS DHJ5	3'-6"	N/A	N/A	2'-2"
2	6022313		1	CABLE ASSY INTERLOCK HARNESSINTLKP2	0	0	0	0
△2 1	6022384	B	REF	CABLE ASSY EMO HARNESSHOOD OPEN	2'-4"	N/A	N/A	7'-8.5"
△2 1	6022384		REF	CABLE ASSY EMO HARNESSKEY BYPASS2	5'-9"	N/A	N/A	2'-2"
△2 1	6022384		REF	CABLE ASSY EMO HARNESSKEY BYPASS1	N/A	1'-11"	N/A	2'-1"
1	6022384		REF	CABLE ASSY EMO HARNESSPD-P3	5"	N/A	N/A	1'-7"
1	6022384		REF	CABLE ASSY EMO HARNESSSIDE	N/A	7"	N/A	2'-1"
1	6022384		REF	CABLE ASSY EMO HARNESSREAR	N/A	6.25"	N/A	2'-1"
1	6022384		REF	CABLE ASSY EMO HARNESSLASER HOOD	2'-5"	N/A	N/A	2'-2"
1	6022384		1	CABLE ASSY EMO HARNESSE-STOP J1	0	0	0	0

△2 OPTIONAL KEY BYPASS ITEMS WHEN NOT USED MUST REMAIN INSULATED AND SEALED OFF.

1. TIE WRAP HARNESS MINIMUM AT EVERY BREAKOUT AND EVERY 6" IN LENGTH.

PACKAGE PER GSI LUMONICS CONTROL DOCUMENT #CD0013, METHOD #P21

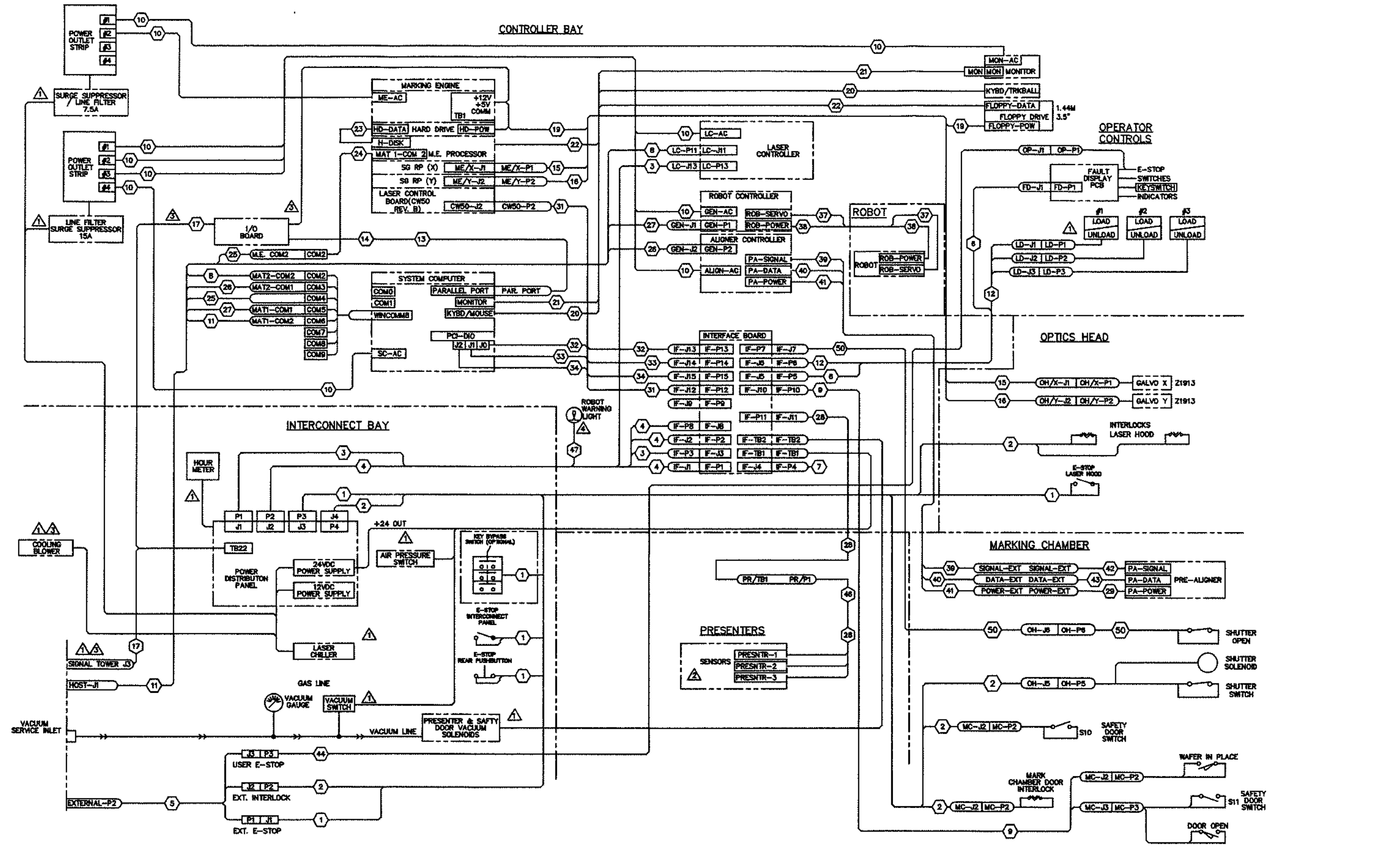
AFTER FINISHING, ADD PIECE PART MARKING ON SURFACE INDICATED IN DRAWING PER GSI LUMONICS CNTRL DOC. #CD0002, METHOD #1

ALL DIMENSIONS ARE TO BE INTERPRETED PER LATEST ANSI Y14.5 SPECS.

MATERIAL	DRAWN BY	gsi Lumonics 60 FORDHAM ROAD WILMINGTON, MA 01887		
N/A	DAM			
FINISH N/A	DRAWN DATE 02/23/00	DRAWING TITLE CABLE HARNESS ASSY WMSDSC		
UNLESS SPECIFIED 1. ALL DIMENSIONS APPLY AFTER FINISH 2. REMOVE ALL BURRS AND SHARP EDGES. (.010 MAX. R. OR CHAMFER) 3. MIN. BEND RADIUS, MIN. BEND RELIEF. 4. NO TOOL MARKS. 5. MACHINED FINISH 64 EXCEPT 32 FOR HORIZ. MILLING	CH.			
	CFN	DRAWING NUMBER 6022315		REV K
UNLESS OTHERWISE SPECIFIED .X = ± .03 .XXX = ± .005 X° = ± 30' .XX = ± .01 X/X = ± 1/64 ALL DIMENSION IN INCHES	SIZE B	SCALE NONE	DO NOT SCALE DRAWING	SHEET 1 OF 1

--- REVISIONS ---

ECO	REV	CHANGE DESCRIPTION	DATE	CHG BY	APPV'D
10777	A	INITIAL RELEASE	6/21/01	CA	CT
11312	B	REVISED COM PORTS	3/18/02	PVS	BI



ITEM NO	QTY REQD	PART NO.	DESCRIPTION
50	1	6022417	CABLE ASSY., SENSOR, SLOW SHUTTER OPEN
47	1	6022295	CABLE ASSY., ROBOT WARN LT. DPL
45	1	6022237	CABLE ASSY., SOLENOID EXTENSION
44	1	6022241	CABLE ASSY., USER E-STOP
43	1	3011339	CABLE, ALIGNER DATA EXT.
42	1	3011340	CABLE, ALIGNER SIGNAL EXT.
41	1	3011337	CABLE, ALIGNER POWER (10 COND)
40	1	3011336	CABLE, ALIGNER DATA (37 COND)
39	1	3011335	CABLE, ALIGNER SIGNAL (60 COND)
38	1	3011342	CABLE, ROBOT POWER
37	1	3011341	CABLE, ROBOT SERVO
36	0	XXXXXXX	XXXXXXXXXX
35	0	XXXXXXX	XXXXXXXXXX
34	1	60222543	CABLE ASSY, HANDLER INTERFACE
33	1	60222543	CABLE ASSY, HANDLER INTERFACE
32	1	60222543	CABLE ASSY, HANDLER INTERFACE
31	1	6022250	CABLE ASSY, CW50 INTERFACE
30	0	XXXXXXX	XXXXXXXXXX
29	1	3011338	CABLE, ALIGNER POWER EXT.
28	1	6022231	CABLE ASSY, PRESENTER INTERFACE
27	1	60220993	CABLE ASSY, ROBOT COMM
26	1	60221003	CABLE ASSY, ALIGNER COMM
25	1	6022542	CABLE, SERIAL DB9S TO DB9S
24	1	3011333	CABLE, DUAL SERIAL COMM
23	1	3011331	CABLE, SCSI HARD DISK
22	1	3011330	CABLE, FLOPPY DRIVE
21	1	4402061	CABLE, MONITOR
20	2	4402060	CABLE, PS2 EXTENSION
19	1	6022249	CABLE ASSY, DISK DRIVE POWER
18	0	XXXXXXX	XXXXXXXXXX
17	1	2413117	CABLE, 22GA, 4 COND
16	1	60220963	CABLE ASSY, GALVO (Z1913)
15	1	60220963	CABLE ASSY, GALVO (Z1913)
14	1	6022175	SIGNAL TOWER INTERFACE CABLE
13	1	3011338	PARALLEL CABLE
12	1	6022230	CABLE ASSY, LOAD / UNLOAD INDICATORS
11	1	6022207	CABLE ASSY, HOST/SECS LINK
10	6	2420003	CORD A/C POWER
9	1	6022210	CABLE ASSY, MARK CHAMBER INTERFACE
8	1	6022211	CABLE ASSY, LASER CONTROLLER
7	1	6022209	JUMPER CONNECTOR, INTERFACE BOARD
6	1	6022232	CABLE ASSY, FAULT DISPLAY PANEL
5	1	6022228	CABLE ASSY, EXTERNAL E-STOP/INTERLOCK HARNESS
4	1	6022227	CABLE ASSY, LASER SENSE/INDICATOR
3	1	6022226	CABLE ASSY, LASER CONTROLLER
2	1	6022225	CABLE ASSY, INTERLOCK HARNESS
1	1	6022224	CABLE ASSY, E-STOP

5. ECO 1422, FOR KIT, LOAD INHIBIT INTERFACE OPTION SEE DWG: 6650152
4. ECO 951, ROBOT MOTION AWARENESS LIGHT, ITEM 47
3. SEE SIGNAL TOWER SCHEMATIC NO. (2750123).
2. SEE PRESENTER SENSOR WIRING DIAGRAM NO. (27500494).
1. SEE DISTRIBUTION PANEL WIRING DIAGRAM NO. (2750122).

NOTES: UNLESS OTHERWISE SPECIFIED

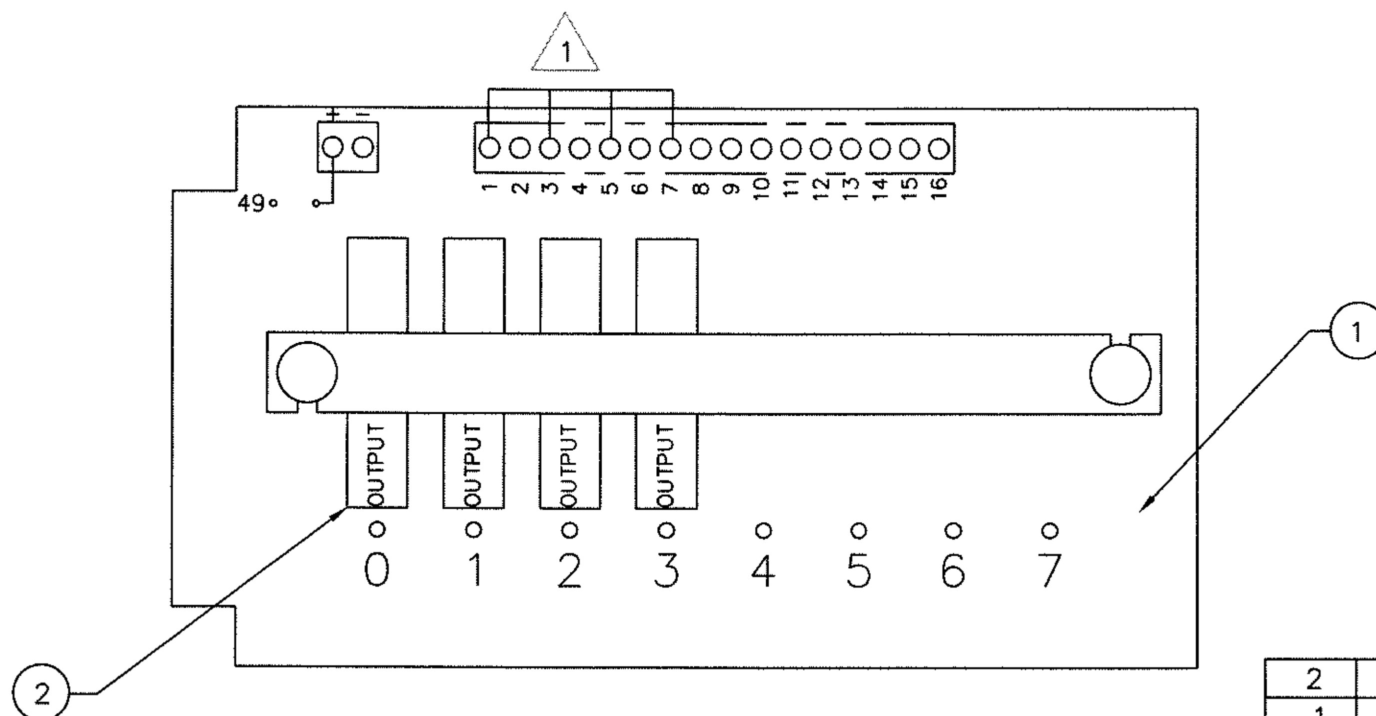
PACKAGE PER GSI LUMONICS CONTROL DOCUMENT #CD0013, METHOD # P21

AFTER FINISHING, ADD PIECE PART MARKING ON SURFACE INDICATED IN DRAWING PER GSI LUMONICS CNTRL DOC. #CD0002, METHOD # 1

ALL DIMENSIONS ARE TO BE INTERPRETED PER LATEST ANSI Y14.5 SPECS.

MATERIAL: N/A	DRAWN BY: CA	gsi Lumonics 60 FORDHAM ROAD WILMINGTON, MA 01887
FINISH: N/A	DRAWN DATE: 6/20/01	DRAWING TITLE: INTERCONNECT DRAWING WINDOWS NT/WMSDSC
UNLESS SPECIFIED 1. ALL DIMENSIONS APPLY AFTER FINISH 2. REMOVE ALL BURRS AND SHARP EDGES. (.010 MAX. R. OR CHAMFER) 3. MIN. BEND RADIUS, MIN. BEND RELIEF. 4. NO TOOL MARKS. 5. MACHINED FINISH 63/EXCEPT 32/FOR HORIZ. MILLING	CH.	
	CFN	DRAWING NUMBER: 2750374 — REV: B
UNLESS OTHERWISE SPECIFIED .X = ± .03 .XXX = ± .005 X° = ± 30' .XX = ± .01 X/X = ± 1/64 ALL DIMENSION IN INCHES	SIZE: D — SCALE: NONE	DO NOT SCALE DRAWING — SHEET 1 OF 1

REVISIONS			
LVL	DESCRIPTION	DRWN/APPVD	DATE
A	RELEASE PER ECO #1048	JL/JHT	3/27/97
B	ECO 1119 REPLACE 3001016 WITH 3004113	CA/JHT	11/06/97



ITEM	QTY	P/N	DESCRIPTION
2	4	3004113	OUTPUT MODULE CD PLN 70M-ODC5A
1	1	2015020	MOUNTING RACK 8 MODULE

DRAWN FROM 66500492

1 INSTALL 18GA BLUE WIRE JUMPERS FROM PINS 1 TO 3 TO 5 TO 7.

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES — TOLERANCES ARE:
THREADS: CLASS 2A AND/OR 2B — .XX± .01
MACHINING SURFACES: 64/ — .XXX± .005
REMOVE ALL BURRS/SHARP EDGES — ANGLE± 1/2°

LUMONICS

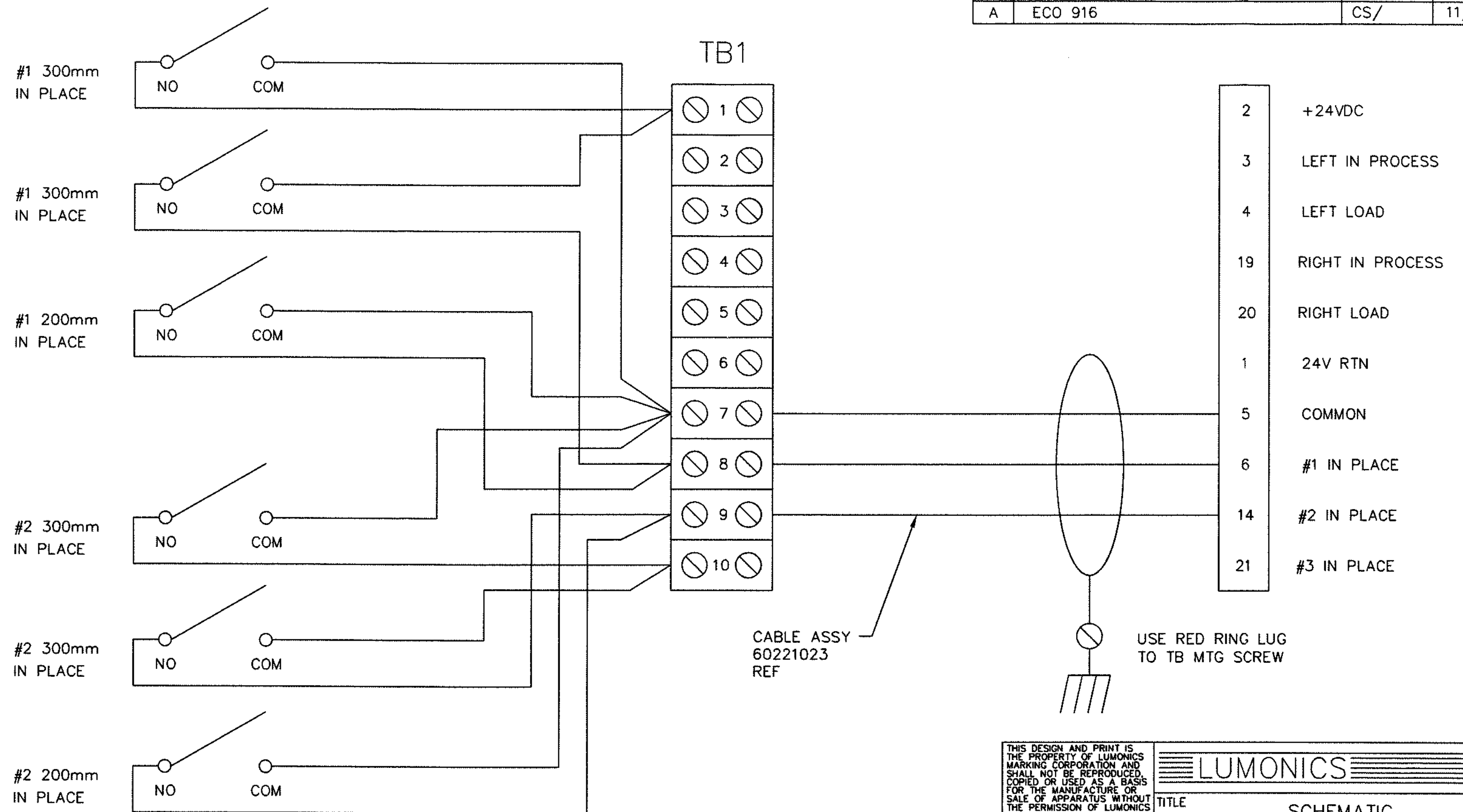
MATERIAL: N/A	APPROVALS	DATE
	DRAWN J. LIPPINCOTT	3/27/97
TREATMENT:	CHECKED	
FINISH: N/A	ENGR	

SAC 1 MODULE ASSEMBLY
41/40 HANDLER WAFERMARK

SCALE	SIZE	DRAWING NO.
FULL	B	6650142

DO NOT SCALE DRAWING — SHEET 1 OF 1

REVISIONS			
LVL	DESCRIPTION	DRWN/APVD	DATE
A	ECO 916	CS/	11/16/96



1. INSTALL CABLE 60221023, FOLD BACK & SHRINK WRAP.

NOTES: UNLESS OTHERWISE SPECIFIED

LUMONICS

APPROVALS	DATE
DRAWN PAT BAIR	5/17/95
CHECKED	
ENGR	

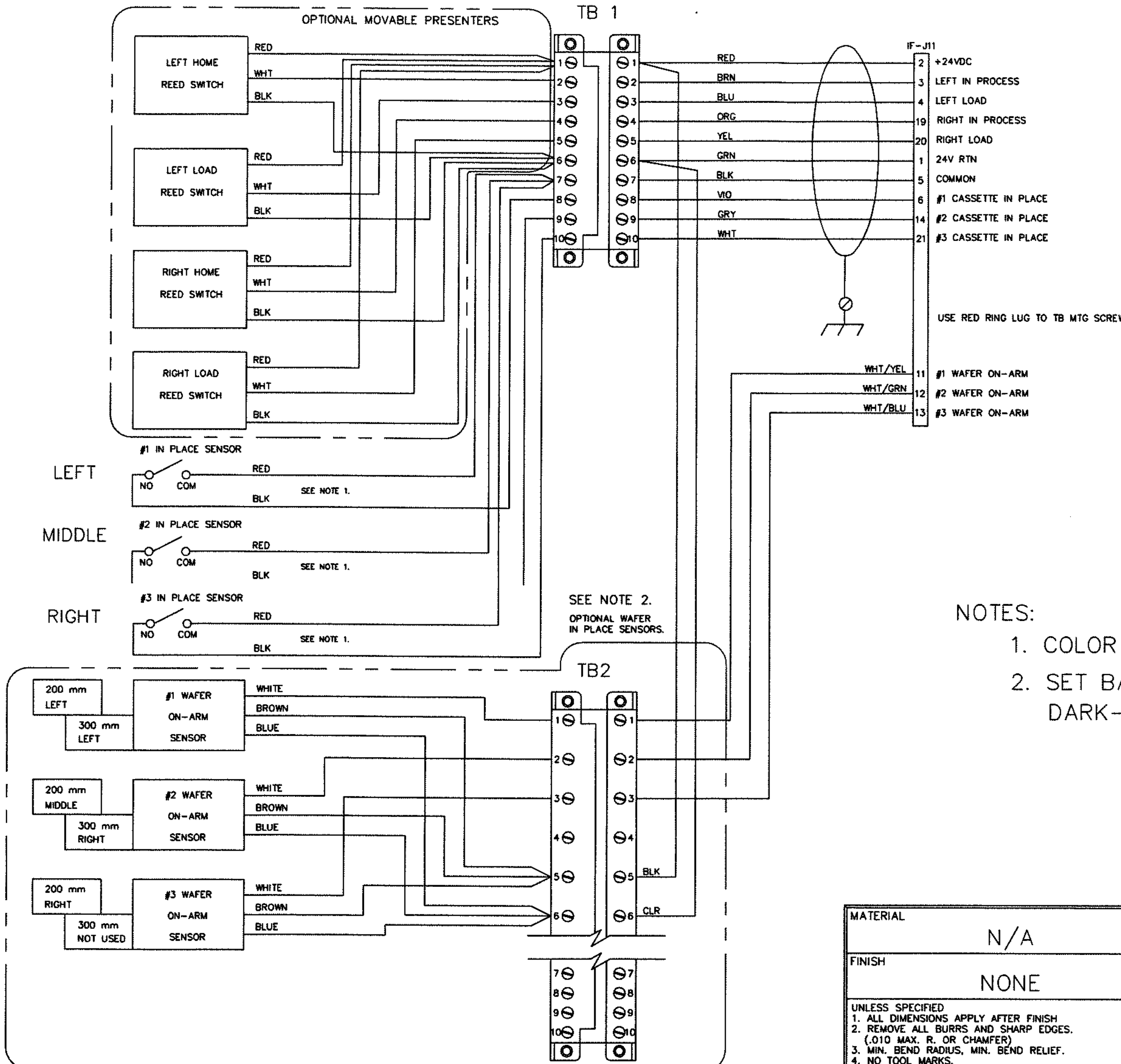
TITLE SCHEMATIC, PRESENTER WMDSC 300

SCALE NONE | SIZE B | DRAWING NO. 2750162

DO NOT SCALE DRAWING | SHEET 1 OF 1

--- REVISIONS ---

ECO	REV	CHANGE DESCRIPTION	DATE	CHG BY	APPV'D
10805	F	ADDED INFO FOR MOVABLE PRESENTER	05/30/01	PVS	RP



NOTES:

1. COLOR VARY WITH CABLE VENDOR/SUPPLIER.
2. SET BANNER SENSOR'S LIGHT/DARK OPERATE SWITCH TO DARK-OPERATE POSITION (FULLY COUNTER-CLOCKWISE).

PACKAGE PER GSI LUMONICS CONTROL DOCUMENT #CD0013, METHOD #P21

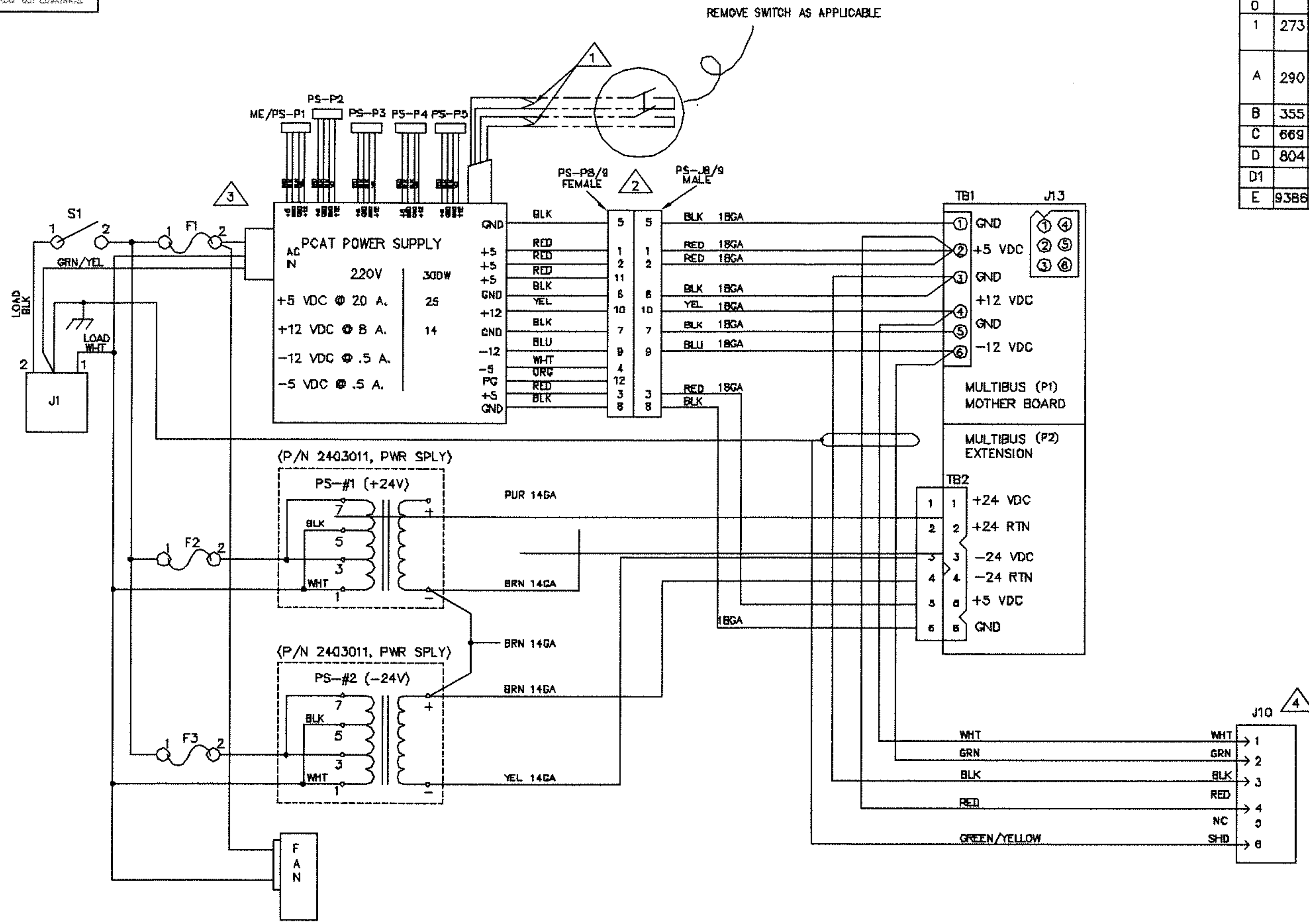
AFTER FINISHING, ADD PIECE PART MARKING ON SURFACE INDICATED IN DRAWING PER GSI LUMONICS CNTRL DOC. #CD0002, METHOD #1

ALL DIMENSIONS ARE TO BE INTERPRETED PER LATEST ANSI Y14.5 SPECS.

MATERIAL: N/A	DRAWN BY: MICYLEE	gsi Lumonics, 60 FORDHAM ROAD, WILMINGTON, MA 01887	
FINISH: NONE	DRAWN DATE: 06/22/91	DRAWING TITLE: WIRING DIAGRAM SUPERCLEAN PRESENTER	
UNLESS SPECIFIED 1. ALL DIMENSIONS APPLY AFTER FINISH 2. REMOVE ALL BURRS AND SHARP EDGES. (.010 MAX. R. OR CHAMFER) 3. MIN. BEND RADIUS, MIN. BEND RELIEF. 4. NO TOOL MARKS. 5. MACHINED FINISH 64 EXCEPT 32 FOR HORIZ. MILLING	CH. CFN	DRAWING NUMBER: 27500494	REV: F
UNLESS OTHERWISE SPECIFIED .X = ± .03 .XXX = ± .005 X° = ± 30' .XX = ± .01 X/X = ± 1/64 ALL DIMENSION IN INCHES	SIZE: B	SCALE: NONE DO NOT SCALE DRAWING	SHEET 1 OF 1

REVISIONS

REV	ECO	DESCRIPTION	APPROVED	DATE
0		FIRST RELEASE		
1	273	REVISED AND REDRAWN FOR NEW POWER SUPPLY	PG	8-13-92
A	290	CHANGED WIRE COLORS: WHT WAS BLU, BLU WAS WHT CHANGED NOTE 1.	JimTemplin	4 SEP 92
B	355	PER ECO	BL/BL	5/28/93
C	669	PER ECO	MF/JL/	3/13/96
D	804	CHANGED PER ECO	JL/	6/27/96
D1		FIXED WIRES FROM TB2	JL/JHT	
E	9386	DRAWING UPDATES	DAM	3/20/00



4. THIS CABLE INTERFACES WITH MARKING ENGINE CONNECTOR PLATE AND REQUIRES AN APPROXIMATE LENGTH OF 26" EXCLUSIVE OF SHIELD DRAIN WIRE. SEE DWG #6022277.

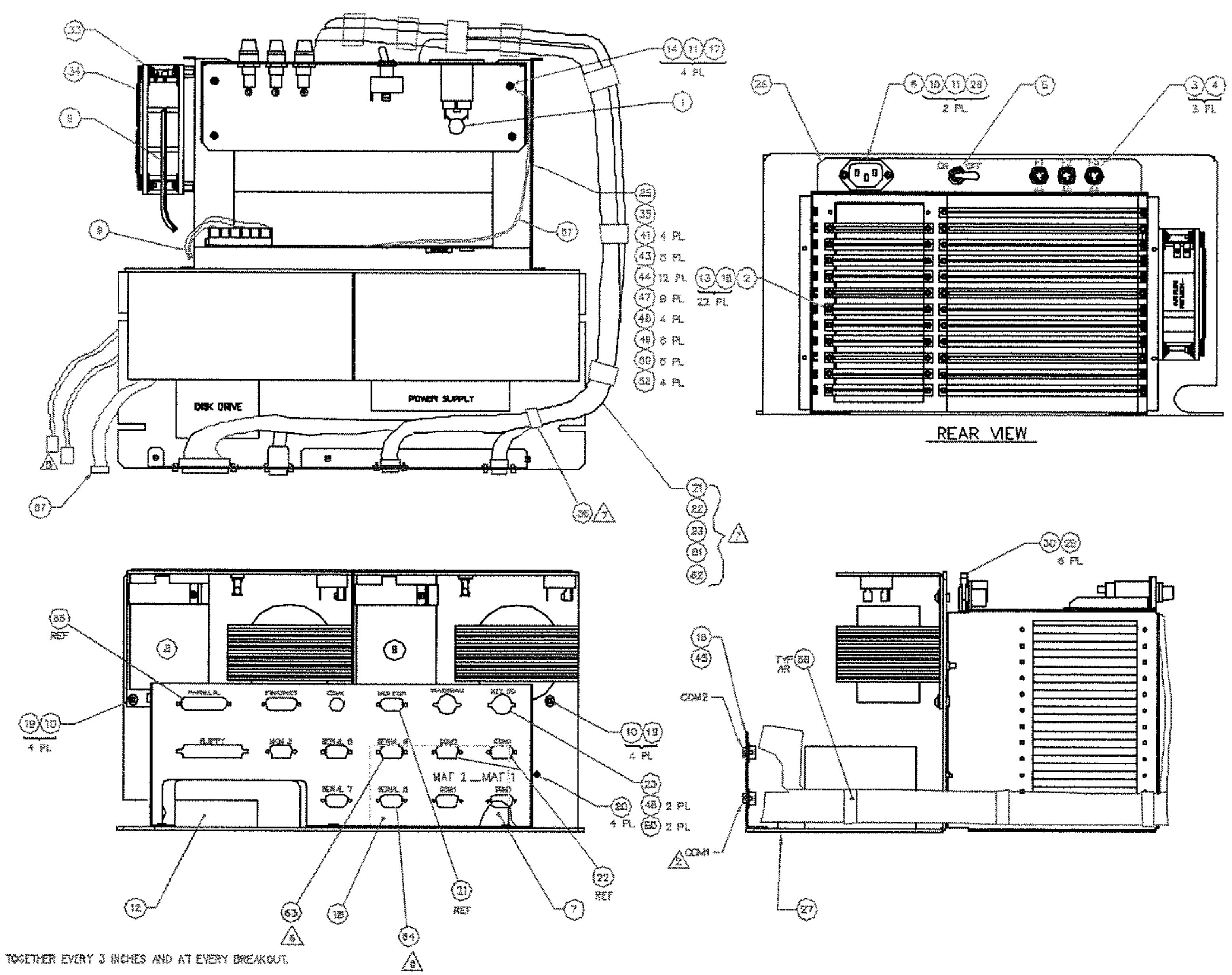
3. CUT OFF MALE PLUG TO LONGEST LENGTH NEEDED, STRIP BACK INSULATION, SOLDER AND HEATSHRINK TO INDICATED TERMINALS.

2. CUT OFF PC PLUG CONNECTIONS, ADD BURNDY PINS AND INSTALL IN CONNECTOR AS SHOWN.

1. CUT SWITCH CORD TO 4" FROM POWER SUPPLY. SPLICE ON/OFF SWITCH CONNECTIONS TO THE "ON" POSITION. HEAT SHRINK EACH CONNECTION SEPARATELY, THEN APPLY HEAT SHRINK TO COVER CONNECTIONS AND CORD. WIRE COLORS VARY DEPENDING ON MANUF. BROWN AND BLACK, BLUE AND WHITE GO TOGETHER.

NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL: N/A	DRAWN BY: DAM	gsi lumonics, 60 FORDHAM ROAD, WILMINGTON, MA 01887
FINISH: NONE	DRAWN DATE: 3/20/00	DRAWING TITLE: SCHEMATIC DIAGRAM MARKING ENGINE
UNLESS OTHERWISE SPECIFIED	SIZE: C	DRAWING NUMBER: 27500383, REV: E
	SCALE: N/A	DO NOT SCALE DRAWING; SHEET 1 OF 1



REVISIONS			
LTR	DESCRIPTION	APPROVED	DATE
0	FIRST RELEASE	SH	3 APR 91
A	PER ECO # 272	BL	9/11/92
B	PER ECO # 461	WV/JL	10/01/94
C	REVISED PER ECO #640	WV/JL	03/19/96
D	REVISED PER ECO #714	WV/JL	04/10/96
E	ECO #714	WV/JL	05/14/96
F	ECO #811	JL/JT	07/02/96
G	ECO #008	JO/CB	3/31/97
H	ECO #236 ADD PARALLEL CABLE	JL/MT	10/15/97
I	ECO #1496 CHG TO PS ASSY	JL/MT	4/15/98

7. ALL CABLES TO BE TIED TOGETHER EVERY 3 INCHES AND AT EVERY BREAKOUT.
6. OPTIONAL ASSEMBLY.
5. PART OF ITEM 7.
4. SEE SCHEMATIC DIAGRAM 27500383 FOR CONNECTOR LOCATION
3. NOT FLAGGED ON FACE OF DRAWING.
2. RED BAND ON RIBBON CABLE DENOTES COM 1 CONNECTOR.
1. WIRING PER SCHEMATIC DIAGRAM, DRAWING NO. 27500383.

NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL
TREATMENT
FINISH

APPROVALS	DATE
DRAWN	
CHECKED	
ENGR	

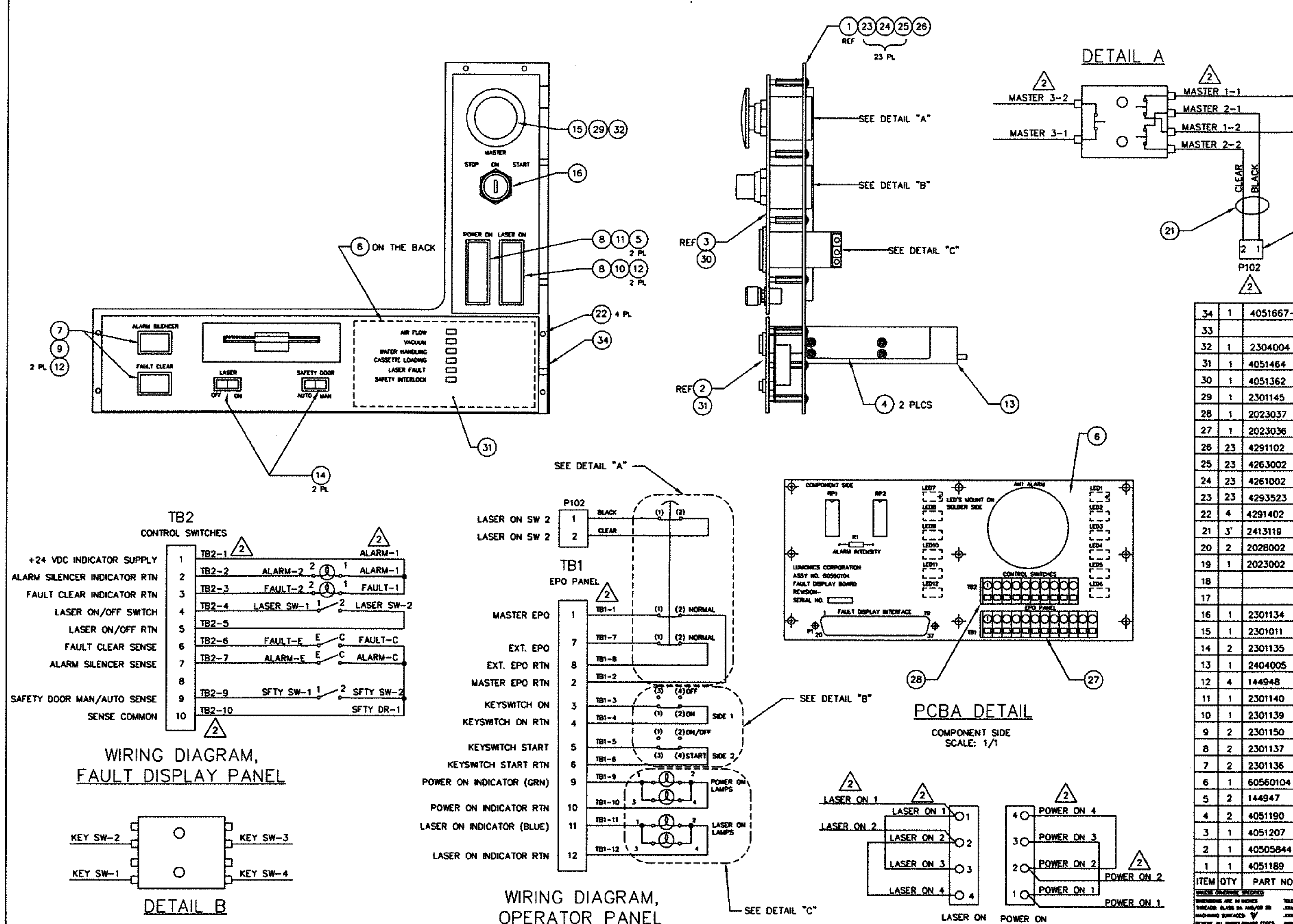
LUMONICS

ELECTRICAL ASSY, MARKING ENGINE

SCALE	SIZE	DRAWING NO.
1/2	B	66500334

DO NOT SCALE DRAWING — SHEET 1 OF 2

REVISIONS			
LTR	DESCRIPTION	APPROVED	DATE
A	RELEASE PER ECO #701	WV/JL	04/04/96
B	ECO 815	BMc/JHT	07/08/96
C	ECO 897	JL/JHT	10/17/96
D	ECO 1031	CS/BL	3/20/97



ITEM	QTY	PART NO.	DESCRIPTION
34	1	4051667-1	MONITOR PANEL BRACKET
33			NOT USED
32	1	2304004	CONTACT BLOCK
31	1	4051464	OVERLAY FAULT DISPLAY PANEL
30	1	4051362	OVERLAY OPERATOR PANEL
29	1	2301145	LEGEND, YELLOW RING
28	1	2023037	CONN, FEMALE 12 POS (TB2)
27	1	2023036	CONN, FEMALE 10 POS (TB1)
26	23	4291102	SCREW, BUT HD CAP, 6-32 x .50
25	23	4263002	WASHER, SPLIT LOCK #6
24	23	4261002	WASHER, FLAT #6
23	23	4293523	STANDOFF, HEX M/F, 6-32 x 1.12 LG
22	4	4291402	SCREW, BUT HD CAP, 10-32 X 1/2" LG
21	3'	2413119	CABLE, BELDEN 2 COND 18GA.
20	2	2028002	CONN HDW 16GA MALE PIN
19	1	2023002	CONN BURNDY SMS2P-1
18			NOT USED
17			NOT USED
16	1	2301134	KEYSWITCH, 3 POSITION
15	1	2301011	SWITCH, 800T
14	2	2301135	SWITCH, ROCKER S.P.D.T.
13	1	2404005	DISK DRIVE, 3.5 FLOPPY
12	4	144948	LED, BI-POLAR LAMP BLUE
11	1	2301140	LENS, TRANSLUCENT GREEN
10	1	2301139	LENS, TRANSLUCENT BLUE
9	2	2301150	LENS, TRANSLUCENT BLUE 02-901.6
8	2	2301137	INDICATOR, LIGHTED
7	2	2301136	SWITCH, PUSH-BUTTON, HEAVY DUTY LIGHTED
6	1	60560104	PCB ASSY, FAULT DISPLAY
5	2	144947	LED, BI-POLAR LAMP GREEN
4	2	4051190	BRACKET, FLOPPY DRIVE
3	1	4051207	PANEL, OPERATOR
2	1	40505844	PANEL, FAULT DISPLAY
1	1	4051189	PANEL, OPERATOR SUB-PANEL

LUMONICS

ASSY, OPERATOR PANEL DPL

APPROVALS	DATE	
C. MARSH	05/22/95	
C. MARSH	05/22/95	
SCALE: NONE	DRAWING NO. 6550110	
DO NOT SCALE DRAWING	SHEET 1 OF 1	

MATERIAL:

TREATMENT:

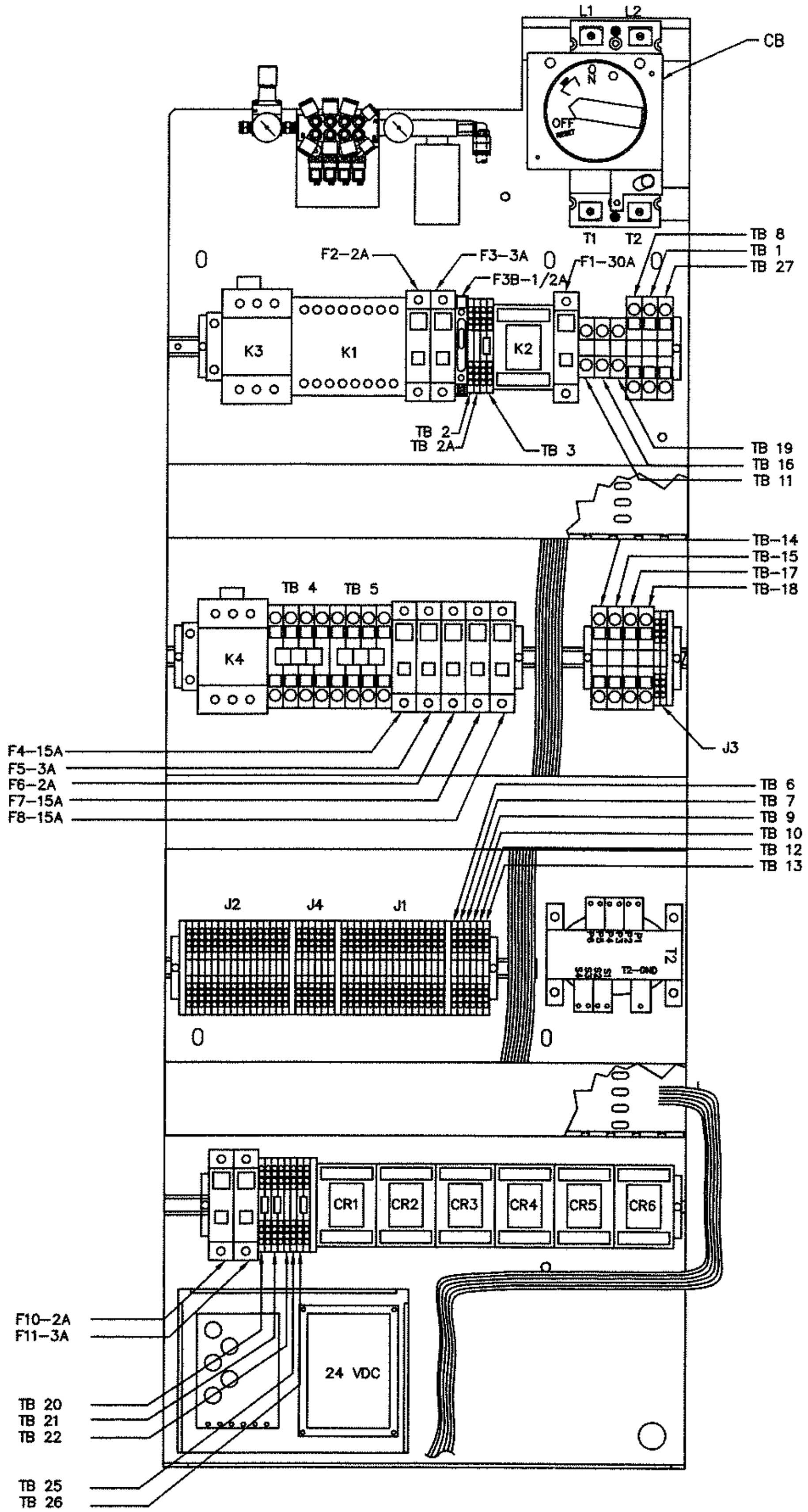
FINISH:

NOTES: UNLESS OTHERWISE SPECIFIED

1. WIRE TO BE 18 AWG BLUE UNLESS INDICATED.

2. WIRE/CABLE MARKER SHALL BE WHITE HEAT SHRINK TUBING USING BLACK PERMANENT IDENTIFICATION WITH LEGEND SHOWN.

--- REVISIONS ---
SEE SHEET 1 OF 2



QTY REQD	ITEM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION
1	56	6650186	ASSY C/B TDR HANDLE, WM	
1	55	6022320	CABLE ASSY, POWER DIST. INTERLOCK	
1	54	6022319	CABLE ASSY, POWER DIST. E-STOP	
4	53	4408201	WIRE WAY COVER 2"	
4	52	4408200	WIRE WAY 2 X 2	
1	51	471.050.00	FUSE 3Ag 1/2A 250V	
1	50	2230050	FUSE HOLDER INDICATING 250V	
30'	49	2412123	WIRE TRAY 14/3 EURO	
4	48	4293539	STANDOFF M/F 8-32 X .62 HEX	
1	47			
2	46	2023010	CONN BURNDY SMS12P-1	
2	45	1B5500101	SOCKET TERMINAL PIN	
1	44	1B5020801	PCB CONNECTOR	
1	43	4059416	BRACKET, VALVE ASSY	
1	42	6650358	ASSY, VALVE 4 WAY PDP	
2	41	4253060	HEX BUSHING 1/2"-3/8"NPT CRES	
1	40	4059338-1	PANEL INTERCONNECT MOUNT DSC-DPL	
1	39	4051578	RAIL KIT DIN MOUNTING DPL	
REF	38	2750185-1WD	WIRING DIAGRAM DISTRIBUTION PANEL WMSCDSC	
REF	37	2750161-1WD	POWER DISTRIBUTION WIRING DIAGRAM	
1	36	2403537	TRANSFORMER 24V 200VA MCI 4-50-1024	
1	35	2403017	POWER SUPPLY 24V	
	34			
1	33	2310034	RELAY 24VAC 4PDT 3A	
1	32	2310029	RELAY E-STOP UNIT 24VAC (EURO)	
6	31	2310020	RELAY DPDT 24DC #K10P-11015-24	
2	30	2303118	CONTRACTOR 45A GE SIDE AUX CONT	
	29			
REF	28	2303010	CIRCUIT BREAKER 45A 2 POLE TED E150	
1	27	2023005	CONN BURNDY SMS4P-1	
2	26	2240005-1	GAUGE VACUUM 1/8NPT REAR MOUNT	
1	25	2230047	FUSE 30A FNQ-30 500V	
1	24	2302001	SWITCH VACUUM	
3	23	2230039	FUSE 15 A 500 V FNQ-15	
3	22	2230032	FUSE 2 AMPS FNM-2	
3	21	2230021	FUSE 3 AMPS, FNM-3	
1	20	2102523	RELAY SOCKET 4PDT KH WAGO	
14	19	2102512	RELAY CARRIER FOOT WAGO	
7	18	2102511	RELAY CARRIER WAGO	
6	17	2102510	RELAY SOCKET, P & B K10 WAGO	
10	16	2101008	FUSE BLOCK DIN RAIL	
12	15	2092021	TERMINAL BLOCK 2 COND WAGO 6 GA	
3	14	2092020	TERMINAL BLOCK 2 COND GND WAGO	
3	13	2092018	TERMINAL BLOCK GND	
6	12	2092015	TERMINAL BLOCK JUMPER WAGO 8 AWG	
10	11	2092013	END STOP DIN35 RAIL 10MM	
7	8	2090422	LUG RING 6 AWG	
4	9	2092011	JUMPER HORIZONTAL WAGO	
58	8	2092010	TERMINAL BLOCK 4 CONDUCTOR GREY	
8	7	2090422	LUG RING 6 AWG 1/4 BOLT	
6	6	2090403	LUG RING BLUE NO. 10	
14	5	2028004	CONN HDWR 20 GA MALE PIN	
18	4	2028002	CONNECTOR HDWR 16 GA MALE PIN	
8	3	2028001	CONNECTOR HDWR 16 GA FEMALE SOCKET	
2	2	2023082	CONNECTOR WAGO, MTS TO TB 16	
2	1	1601023	VARISTOR 24 VAC GE	

PARTS LIST

QTY REQD	ITEM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

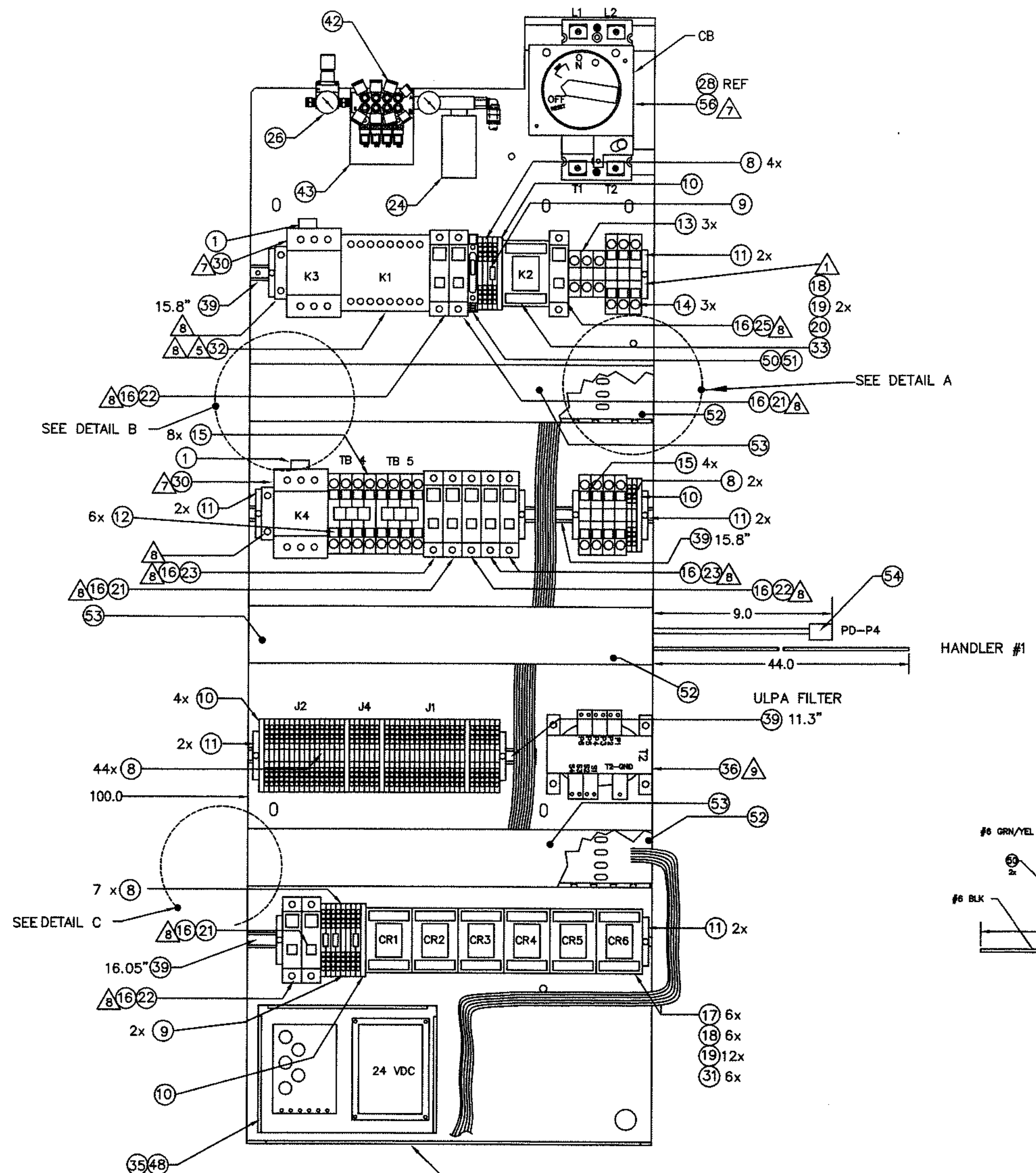
PARTS LIST

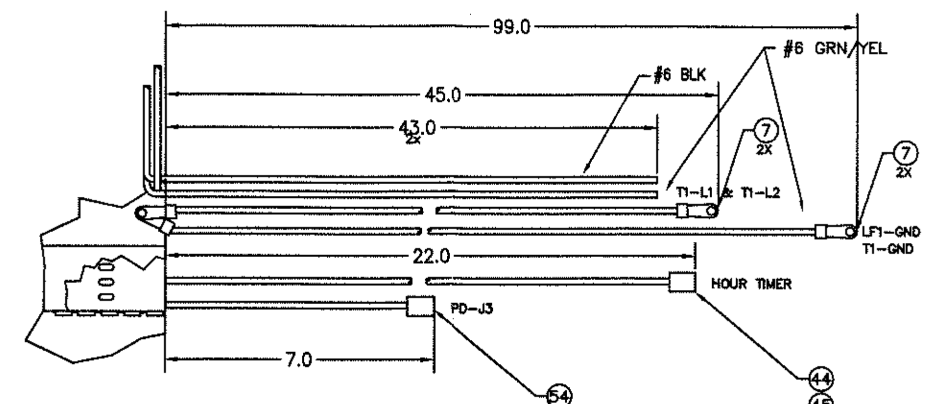
DRAWING NUMBER	REV
6650133-1AD	A

SIZE	SCALE		SHEET
C	NA	DO NOT SCALE DRAWING	2 OF 2

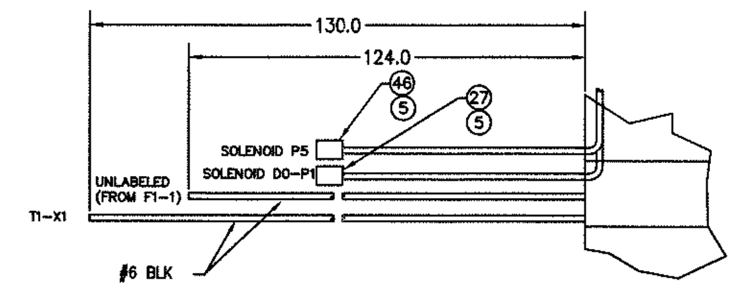
ECO	REV	CHANGE DESCRIPTION	DATE	CHG BY	APPV'D
11210	A	PRODUCTION RELEASE	1/17/02	MKS	BI

--- REVISIONS ---

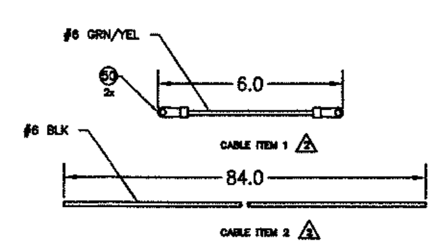


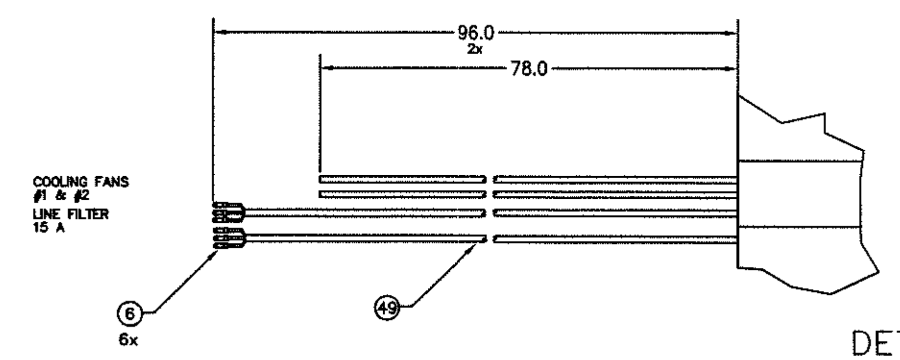


DETAIL A



DETAIL B





DETAIL C

NOTES: UNLESS OTHERWISE SPECIFIED

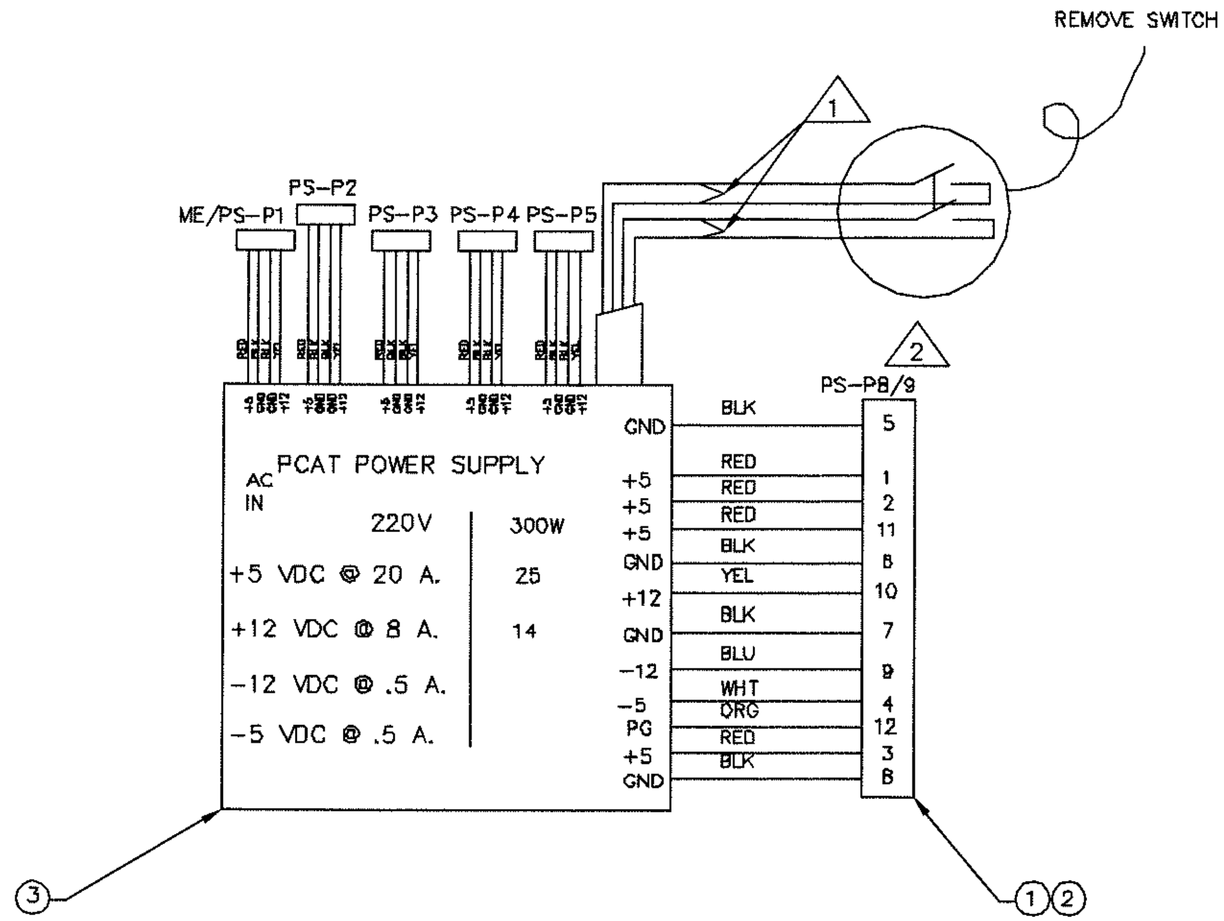
1. RIGHT JUSTIFY ALL COMPONENTS ON THIS RAIL.
2. ASSEMBLY INCLUDES 1 PC CABLE ITEM 1 AND 2 PCS CABLE ITEM 2.
3. LABEL CABLE ENDS AS SHOWN IN DETAILS.
4. LABEL COMPONENTS (OR NEAR COMPONENTS) AS SHOWN ON SHEET 2.
5. MOUNT K1 TO DIN RAIL WITH LOWER SET OF LATCHES.
6. WIRE ITEMS #53 & 54 PER DWGS # 6022319 AND 6022320.
7. TIGHTEN SCREWS TO 30 IN-LBS.
8. TIGHTEN SCREWS TO 15 IN-LBS.
9. TIGHTEN SCREWS TO 5 IN-LBS.
10. CONFIGURE PRESSURE GAUGE AND REGULATOR AS SHOWN, IF NEEDED.

QTY REQD	ITEM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

MATERIAL: SEE PARTS LIST	DRAWN BY: MKS	gsi Lumonics, 60 FORDHAM ROAD, WILMINGTON, MA 01887	
FINISH: NONE	DRAWN DATE: 1/17/02	DRAWING TITLE: ELECTRICAL ASSY, PDP WAFERMARK SIGMA DSC	
UNLESS SPECIFIED 1. ALL DIMENSIONS APPLY AFTER FINISH 2. REMOVE ALL BURRS AND SHARP EDGES. (.010 MAX. R. OR CHAMFER) 3. MIN. BEND RADIUS, MIN. BEND RELIEF. 4. NO TOOL MARKS. 5. MACHINED FINISH 64 EXCEPT 32 FOR HORIZ. MILLING	CH.		
	CFN	DRAWING NUMBER: 6650133-1AD	REV: A
UNLESS OTHERWISE SPECIFIED .X = ± .03 .XX = ± .01 .XXX = ± .005 X/X = ± 1/64 X° = ± 30' ALL DIMENSION IN INCHES	SIZE: C / SCALE: NA	DO NOT SCALE DRAWING	SHEET 1 OF 2

REVISIONS			
LVL	DESCRIPTION	DRWN/APVD	DATE
A	ECO #1398 PROD REL	JL/JHT	4/16/98



DRAWN FROM 27500383 REV D

NOTES: UNLESS OTHERWISE SPECIFIED

1. CUT SWITCH CORD TO 4" FROM POWER SUPPLY. SPLICE ON/OFF SWITCH CONNECTIONS TO THE "ON" POSITION. HEAT SHRINK EACH CONNECTION SEPARATELY, THEN APPLY HEAT SHRINK TO COVER CONNECTIONS AND CORD. WIRE COLORS VARY DEPENDING ON MANUF.

2. CUT OFF PC PLUG CONNECTIONS, ADD BURNDY PINS AND INSTALL IN CONNECTOR AS SHOWN.

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES — TOLERANCES ARE:
THREADS: CLASS 2A AND/OR 2B — .XX± .01
MACHINING SURFACES: — .XXX± .005
REMOVE ALL BURRS/SHARP EDGES — ANGLE± 0.5°

MATERIAL: SEE SEPARATE BOM

TREATMENT: N/A

FINISH: N/A

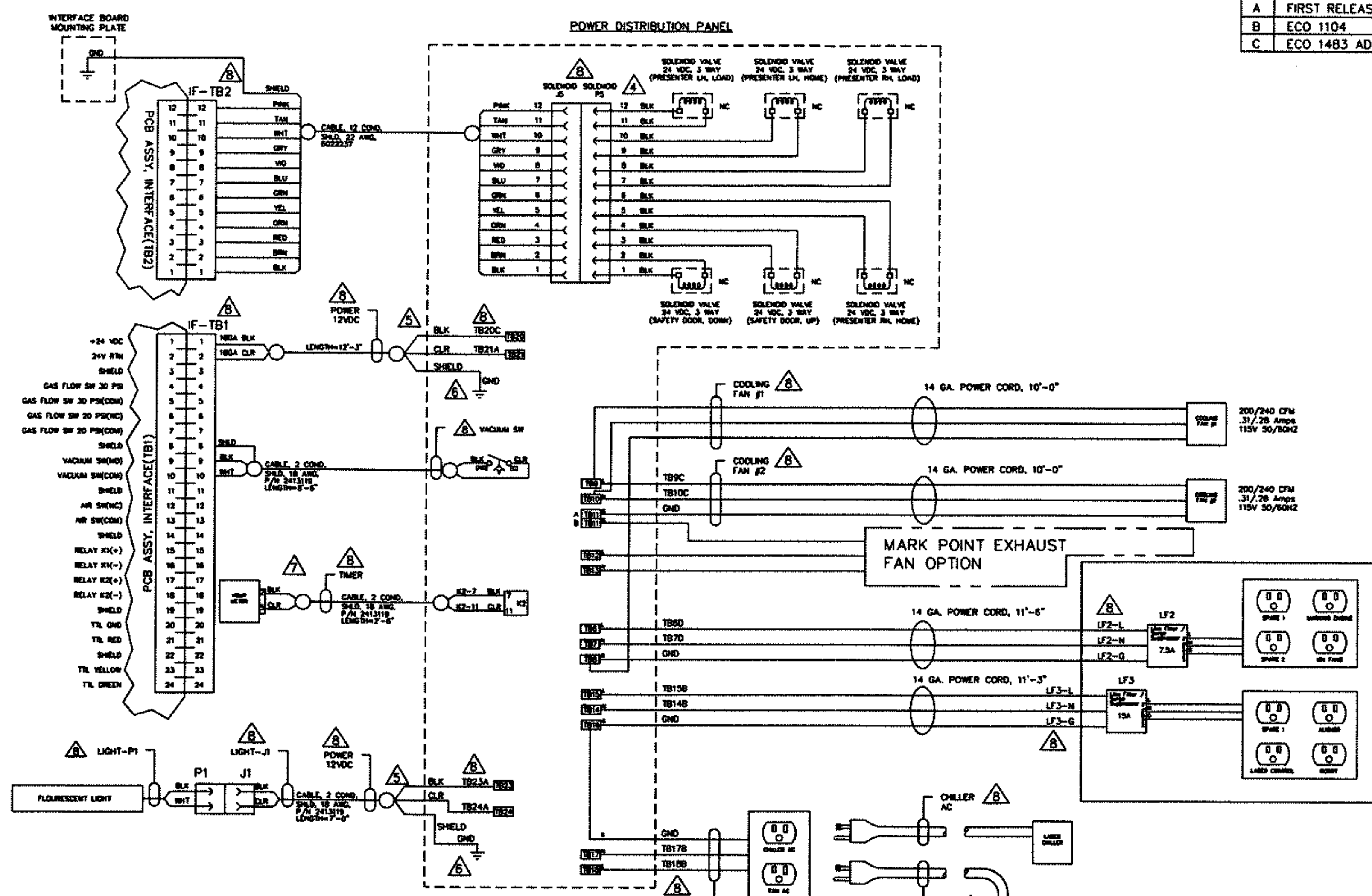
LUMONICS

TITLE: POWER SUPPLY M/E WMSC

SCALE: N/A | SIZE: B | DRAWING NO.: 6650071

DO NOT SCALE DRAWING | SHEET 1 OF 1

REVISIONS			
LVL	DESCRIPTION	DRWN/APVD	DATE
A	FIRST RELEASE PER ECO #1034	JL/JHT	3/25/97
B	ECO 1104	CS/CA	06/16/97
C	ECO 1483 ADD ION FANS PLUG	TS/CA	10/06/98



8. WIRE/CABLE MARKER SHALL BE WHITE HEAT SHRINK TUBING USING BLACK PERMANENT IDENTIFICATION WITH LEGEND SHOWN.
7. USE P/N 1B5S00101 TO ATTACH CABLE TO HOUR METER.
6. MAKE GROUND CONNECTION TO 12V SUPPLY CHASSIS.
5. STRIP BACK CABLE INSULATION 1" TO EXPOSE INDIVIDUAL WIRES.
4. CUT ALL SOLENOID LEADS TO 1' BEFORE ATTACHING TO CONNECTOR.
3. WIRE LENGTHS ARE TOTAL LENGTH OF MATERIAL (POINT TO POINT).
2. WHEN WIRES ARE CONNECTING COMPONENTS OFF POWER DIST. PANEL ATTACH APPROPRIATE LENGTH OF WIRE TO COMPONENTS PRESENT AND COMPLETE CONNECTION ONCE THE PANEL IS INSTALLED IN THE SYSTEM.
1. INSTALL HEAT SHRINK TUBING OVER CABLE ENDS WHERE JACKETING ENDS AND WIRES ARE EXPOSED BEFORE LUGS, CONNECTORS OR BACKSHELLS ARE INSTALLED.

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
THREADS: CLASS 2A AND/OR 2B
MACHINING SURFACES:
REMOVE ALL BURRS/SHARP EDGES

TOLERANCES ARE:
.XX± .01
.XXX± .005
ANGLE± 1/2°

LUMONICS

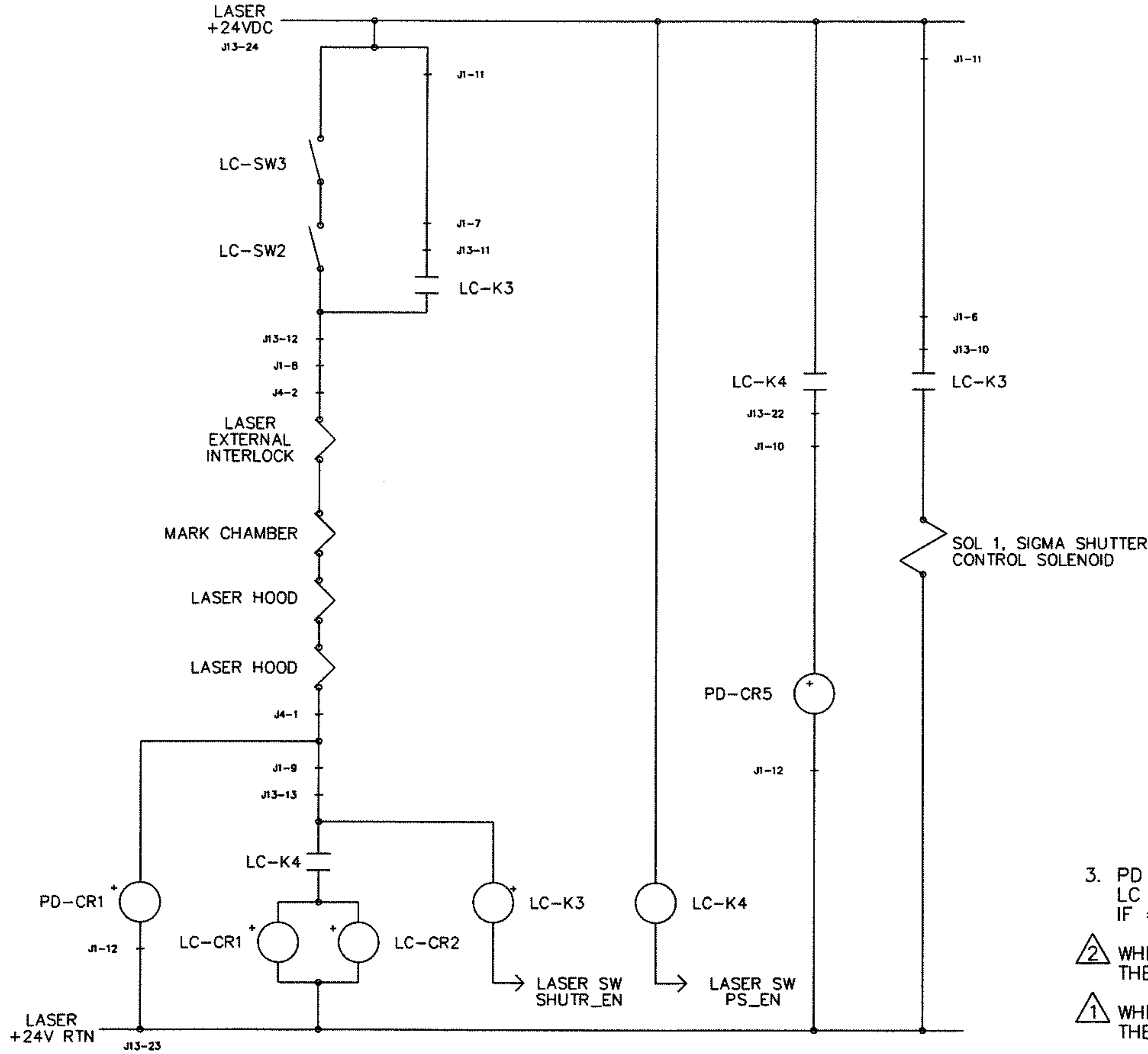
WIRING DIAGRAM
DISTRIBUTION PANEL

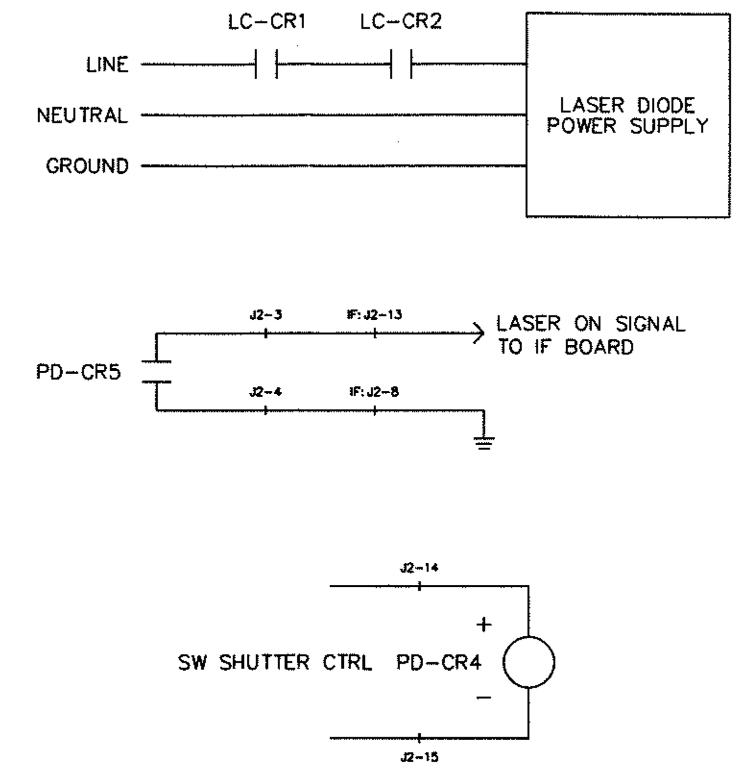
MATERIAL: NONE	APPROVALS	DATE	
	DRAWN DAN DONGELMANS	7/10/95	
TREATMENT:	CHECKED		SCALE NONE / SIZE C / DRAWING NO. 2750185
FINISH: NONE	ENGR ASF GOSLA	7/10/95	DO NOT SCALE DRAWING / SHEET 1 OF 1

THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND SHALL NOT BE USED, REPRODUCED, OR DISCLOSED TO THIRD PARTIES WITHOUT WRITTEN AUTHORIZATION FROM GSI LUMONICS.

--- REVISIONS ---

ECO	REV	CHANGE DESCRIPTION	DATE	CHG BY	APPV'D
11210	A	INITIAL RELEASE	12/20/01	PVS	BI





3. PD = POWER DISTRIBUTION PANEL
   LC = LASER CONTROL, SIGMA 100
   IF = INTERFACE BOARD

△2 WHEN TRAP DOOR OPENS AND LETS LIGHT THROUGH THIS SWITCH WILL INTERLOCK THE LASER IF THE SHUTTER ISN'T CLOSED.

△1 WHEN TRAP DOOR BEGINS TO OPEN, BUT STILL LIGHT TIGHT, THIS SWITCH CLOSES THE SHUTTER IN THE LASER.

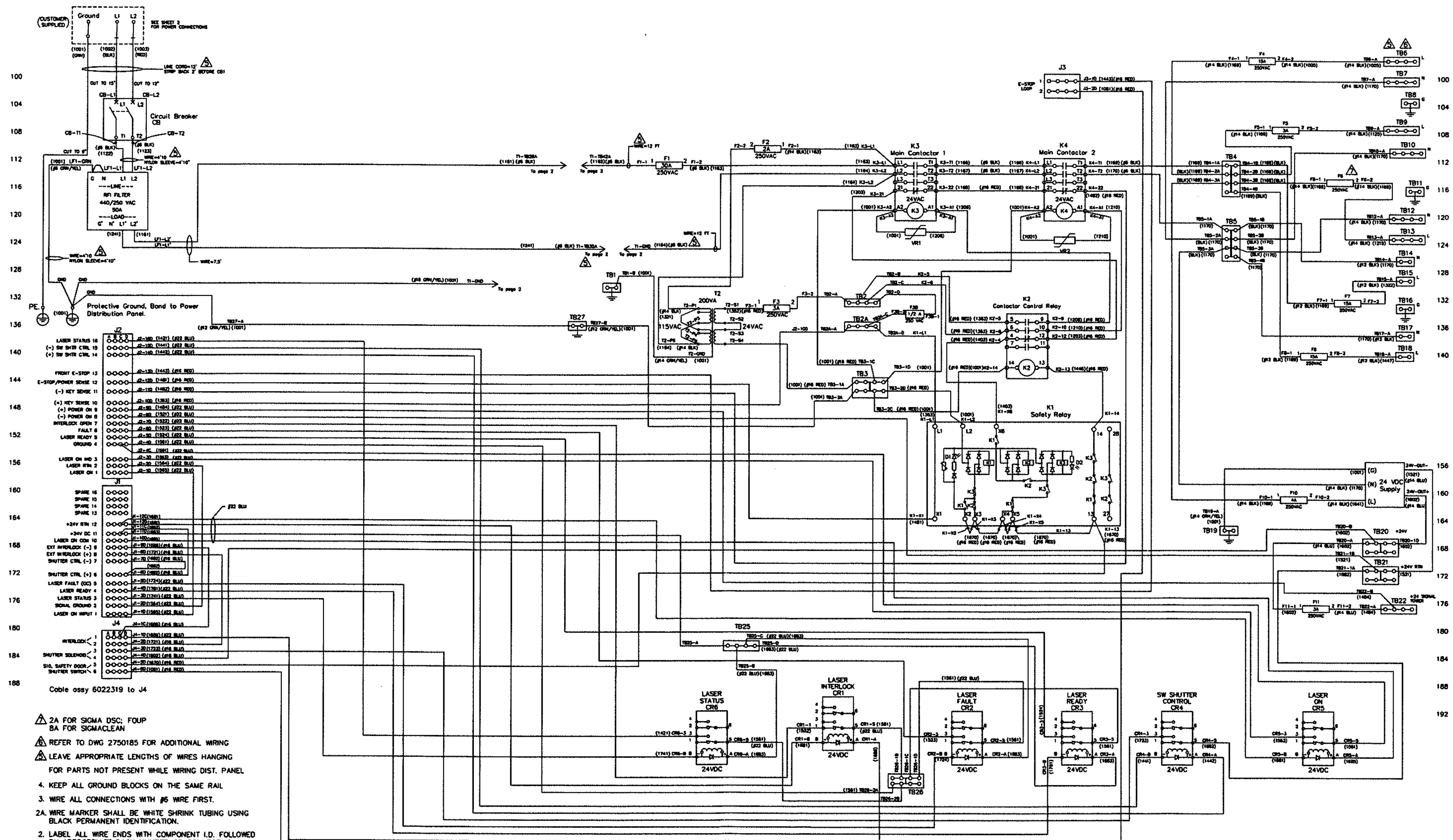
NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL: N/A	DRAWN BY: PVS	GSI Lumonics, 60 FORDHAM ROAD WILMINGTON, MA 01887	
FINISH: NONE	DRAWN DATE: 12/20/01	DRAWING TITLE: POWER DISTRIBUTION WIRING DIAGRAM WAFERMARK DSC DPL	
UNLESS SPECIFIED: 1. ALL DIMENSIONS APPLY AFTER FINISH 2. REMOVE ALL BURRS AND SHARP EDGES. (.010 MAX. R. OR CHAMFER) 3. MIN. BEND RADIUS, MIN. BEND RELIEF. 4. NO TOOL MARKS. 5. MACHINED FINISH 64/EXCEPT 32/FOR HORIZ. MILLING	CH.		
	CFN	DRAWING NUMBER: 2750161-1WD	REV: A
UNLESS OTHERWISE SPECIFIED .X = ± .03 .XX = ± .01 .XXX = ± .005 X/X = ± 1/64 X° = ± 30' ALL DIMENSION IN INCHES	SIZE: C	SCALE: NONE / DO NOT SCALE DRAWING	SHEET 4 OF 4

THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND SHALL NOT BE USED, REPRODUCED, OR DISCLOSED TO THIRD PARTIES WITHOUT WRITTEN AUTHORIZATION FROM GSI LUMONICS.

--- REVISIONS ---

ECO	REV	CHANGE DESCRIPTION	DATE	CHG BY	APPV'D
11210	A	INITIAL RELEASE	12/20/01	PVS	BI



7 2A FOR SIGMA DSC; FOUP
8A FOR SIGMACLEAN

6 REFER TO DWG 2750185 FOR ADDITIONAL WIRING

5 LEAVE APPROPRIATE LENGTHS OF WIRES HANGING
FOR PARTS NOT PRESENT WHILE WIRING DIST. PANEL

4. KEEP ALL GROUND BLOCKS ON THE SAME RAIL

3. WIRE ALL CONNECTIONS WITH #6 WIRE FIRST.

2A. WIRE MARKER SHALL BE WHITE SHRINK TUBING USING BLACK PERMANENT IDENTIFICATION.

2. LABEL ALL WIRE ENDS WITH COMPONENT I.D. FOLLOWED BY APPROPRIATE DASH NUMBER OR CONNECTING LOCATION, FOR EXAMPLE TB37-A FOR THE WIRE CONNECTED TO TB37 AT LOCATION "A".

1. ALL WIRE #12 UNLESS OTHERWISE SPECIFIED.

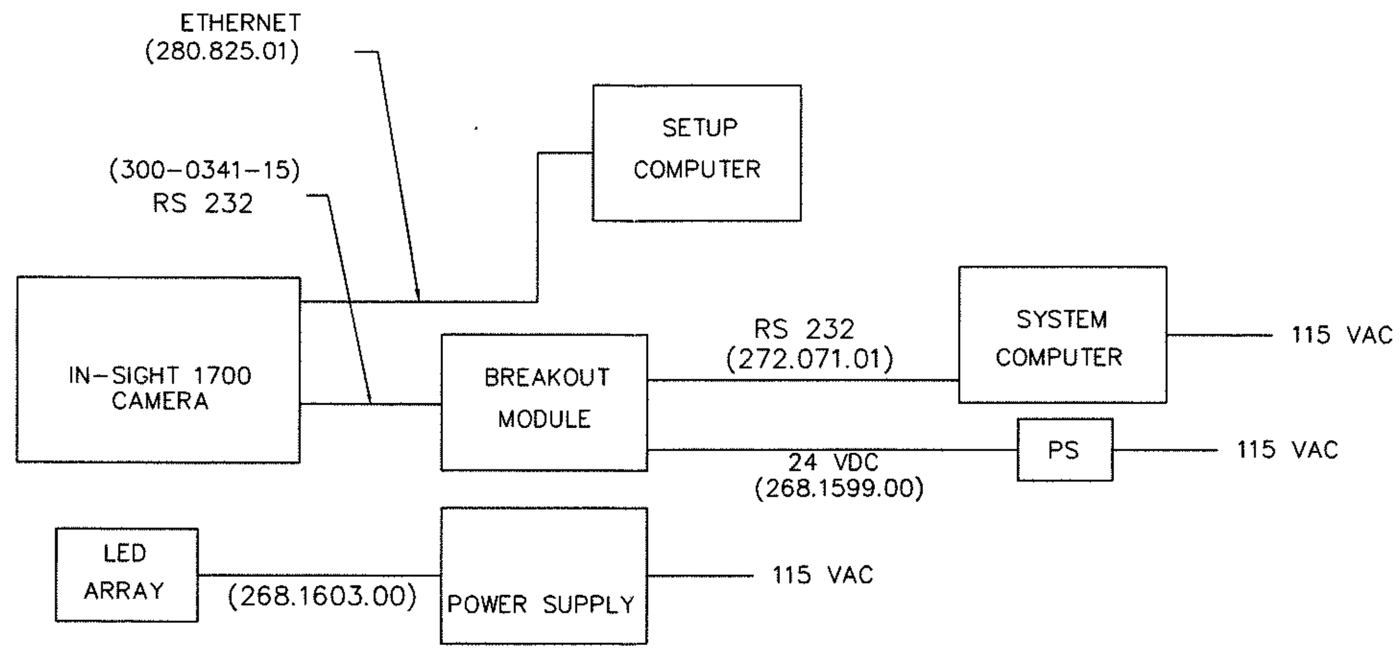
NOTES: UNLESS OTHERWISE SPECIFIED

PACKAGE PER GSI LUMONICS CONTROL DOCUMENT #CD0013, METHOD # P21

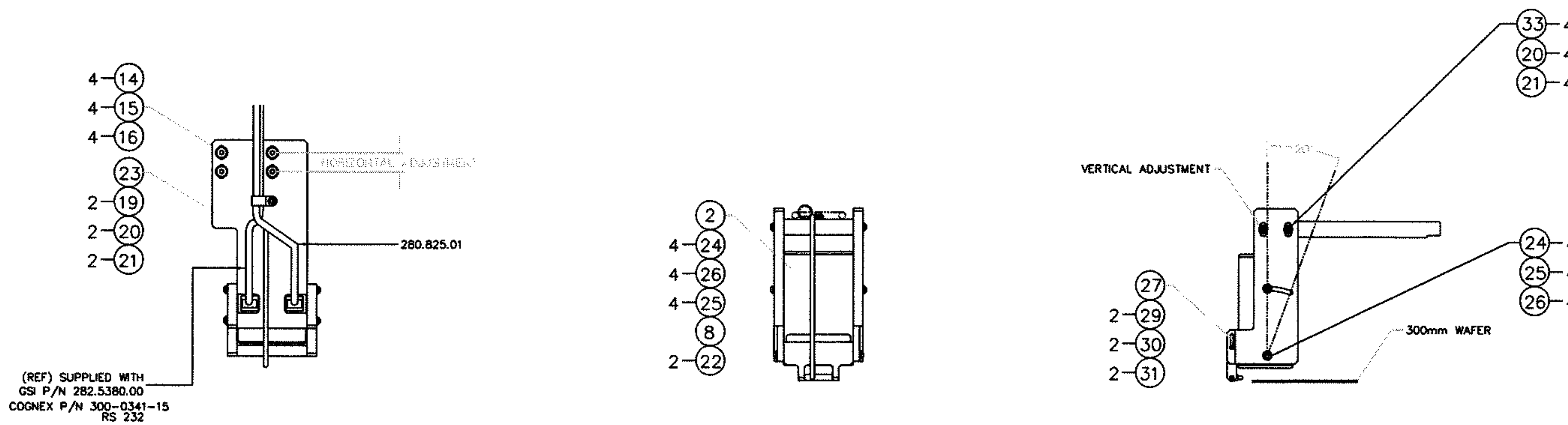
AFTER FINISHING, ADD PIECE PART MARKING ON SURFACE INDICATED IN DRAWING PER GSI LUMONICS CNTRL DOC. #CD0002, METHOD # 1

ALL DIMENSIONS ARE TO BE INTERPRETED PER LATEST ANSI Y14.5 SPECS.

MATERIAL: N/A	DRAWN BY: PVS	GSI LUMONICS, 60 FORDHAM ROAD, WILMINGTON, MA 01887
FINISH: NONE	DRAWN DATE: 12/20/01	DRAWING TITLE: POWER DISTRIBUTION WIRING DIAGRAM WAFERMARK DCS DPL
UNLESS SPECIFIED 1. ALL DIMENSIONS APPLY AFTER FINISH 2. REMOVE ALL BURRS AND SHARP EDGES. (.010 MAX. R. OR CHAMFER) 3. MIN. BEND RADIUS, MIN. BEND RELIEF. 4. NO TOOL MARKS. 5. MACHINED FINISH 64/EXCEPT 32/FOR HORZ. MILLING	CH. / CFN	DRAWING NUMBER: 2750161-1WD, REV: A
UNLESS OTHERWISE SPECIFIED .X = ± .03 .XX = ± .01 .XXX = ± .005 X/X = ± 1/64 X° = ± 30' ALL DIMENSION IN INCHES	SIZE: C, SCALE: NONE	DO NOT SCALE DRAWING, SHEET 1 OF 4



INTERCONNECT WIRING DIAGRAM



CAMERA, CABLES & MOUNTING BRACKETS.

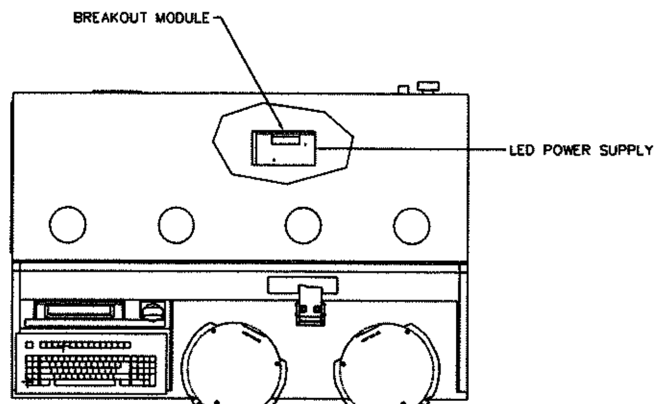
DRAWN BY PF	gsi Lumonics 60 FORDHAM ROAD WILMINGTON, MA 01887	
DRAWN DATE 4/3/02	DRAWING TITLE INSTALL., COGNEX CAMERA WAFERMARK	
CH.		
CFN	DRAWING NUMBER 6553106AD	REV A
SIZE C / SCALE N/A	DO NOT SCALE DRAWING	SHEET 2 OF 2

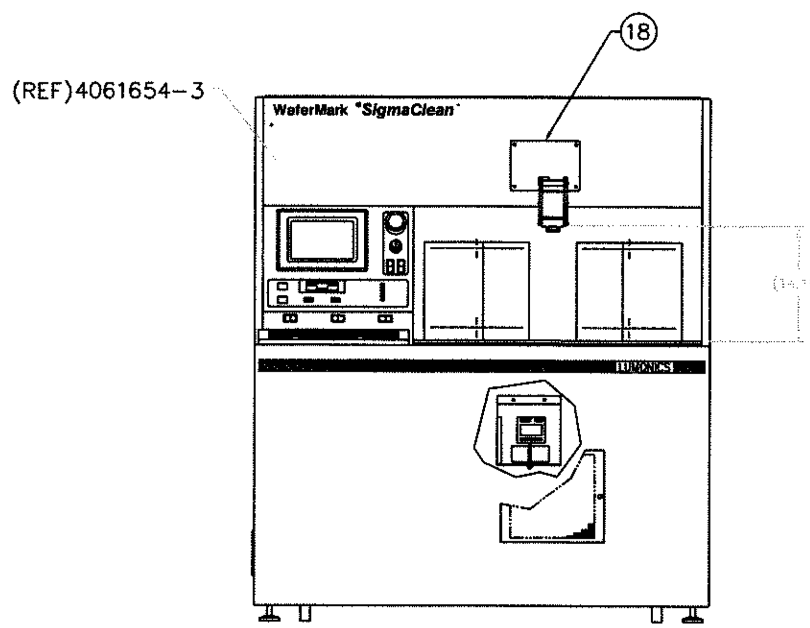
NOTES:

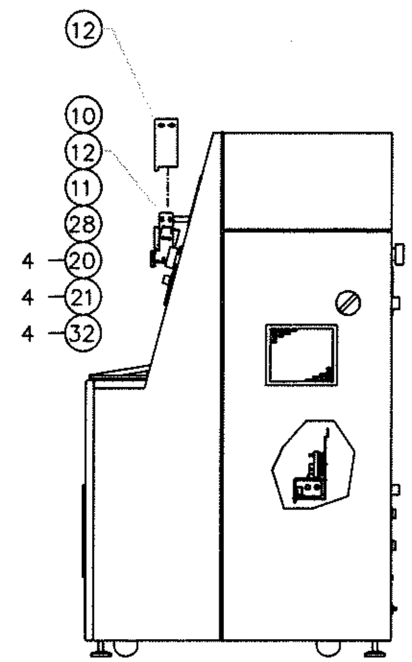
1. ETHERNET CABLE (300-0342-15) AND SERIAL CABLE (300-0341-15) SUPPLIED WITH COGNEX INSIGHT 1700 WAFER READER KIT, 282.5380.00

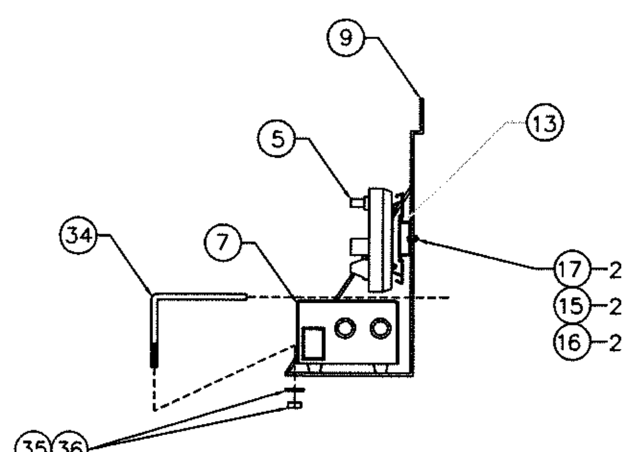
--- REVISIONS ---

ECO	REV	CHANGE DESCRIPTION	DATE	CHG BY	APPV'D
TBD	X1	PROTO RELEASE	7/23/01	CT	
TBD	X2	REVISED	8/09/01	CT	
11379	A	INITIAL RELEASE	3/29/02	PF	DB









BREAKOUT MODULE, POWER SUPPLY & MOUNTING BRACKET.

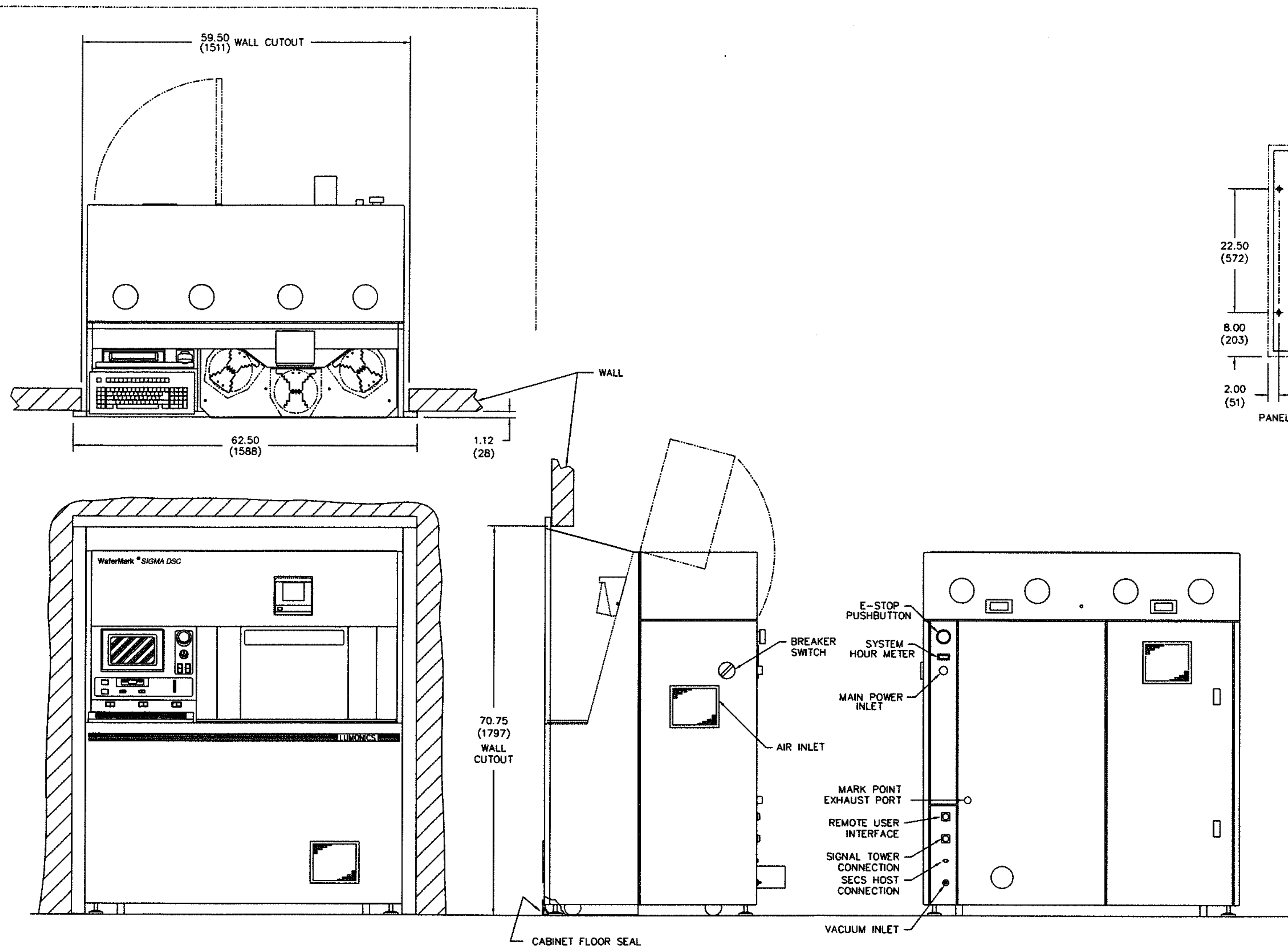
NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	ITEM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION
1	36	470.080.26	1/4" FLAT WASHER, S.S.	BREADMAN
1	35	470.241.07	1/4-20 NYLOCK NUT	BREADMAN
1	34	268.1671.00	HOLD DOWN BRACKET	
4	33	4291204	BHCS, 8-32 X 3/4	BREADMAN
4	32	268.1604.00	BUT HD 8-32 X 1	BREADMAN
2	31	470.080.08	FLAT WASHER, NO. 2	BREADMAN
2	30	470.023.01	SPRING LOCK WASHER NO. 2	BREADMAN
2	29	4292807	2-56 X 1/2 SKT HD	BREADMAN
1	28	4059425-02	WAFER READER MOUNT, LEFT SIDE	
1	27	4059424	LED MOUNT, SIDE	
4	26	4265118	SPRING LOCK WASHER M4	BREADMAN
4	25	4261028	M4 FLAT WASHER	BREADMAN
4	24	141-75033	BUTTON HD M4 X 20mm	BREADMAN
1	23	680000160	CABLE CLAMP, 3/8"	
2	22	268.518.00	SOCKET HD M2 X 10	BREADMAN
5	21	4261003	NO. 8 FLAT WASHER SAE	BREADMAN
5	20	4263003	NO. 8 SPLIT WASHER	BREADMAN
1	19	271.331.00	BUT HD 8-32 X .50	BREADMAN
1	18	4059422	COGNEX COVER SUPPORT ASSY	
6	17	4291402	BUT HD 10-32 X 1/2"	BREADMAN
6	16	4261004	NO. 10 FLAT WASHER SAE	BREADMAN
6	15	4263004	NO. 10 SPLIT WASHER	BREADMAN
4	14	4291404	BUT HD 10-32 X 1"	BREADMAN
1	13	4059420	BREAKOUT MODULE MTG BRKT, MOD	
1	12	4059421	COGNEX CAMERA COVER	
1	11	4059423	MOUNTING YOKE	
1	10	4059425-01	WAFER READER MOUNT, RIGHT	
1	9	4051954	BRACKET, CAMERA POWER SUPPLY	
1	8	268.1598.00	LED BAR LIGHT	CCS
1	7	268.1602.00	DIGITAL POWER SUPPLY	COGNEX
1	6	272.071.01	CABLE, DB9 EXTENSION	
1	5	268.1601.00	BREAKOUT MODULE KIT	COGNEX
1	4	268.1603.00	LED, CABLE POWER SUPPLY	CCS
1	3	268.1599.00	24V POWER SUPPLY CABLE ADAPTER	COGNEX
1	2	282.5380.00	IN-SIGHT 1700 WAFER READER	COGNEX
REF	1		WAFERMARK SIGMA CLEAN	

PARTS LIST

MATERIAL: N/A	DRAWN BY: C. TERADA	GSI LUMONICS, 60 FORDHAM ROAD WILMINGTON, MA 01887
FINISH: NONE	DRAWN DATE: 7/19/01	DRAWING TITLE: INSTALLATION , IN-SIGHT CAMERA WAFERMARK
UNLESS SPECIFIED 1. ALL DIMENSIONS APPLY AFTER FINISH 2. REMOVE ALL BURRS AND SHARP EDGES. (.010 MAX. R. OR CHAMFER) 3. MIN. BEND RADIUS, MIN. BEND RELIEF. 4. NO TOOL MARKS. 5. MACHINED FINISH 64/EXCEPT 32/FOR HORIZ. MILLING	CH.	
	CFN	DRAWING NUMBER: 6553106AD — REV: A
UNLESS OTHERWISE SPECIFIED .X = ± .03 .XX = ± .01 .XXX = ± .005 X/X = ± 1/64 X° = ± 30' ALL DIMENSION IN INCHES	SIZE: C — SCALE: N/A	DO NOT SCALE DRAWING — SHEET 1 OF 2

REVISIONS	
LVL	DESCRIPTION
B	SEE SHEET 1

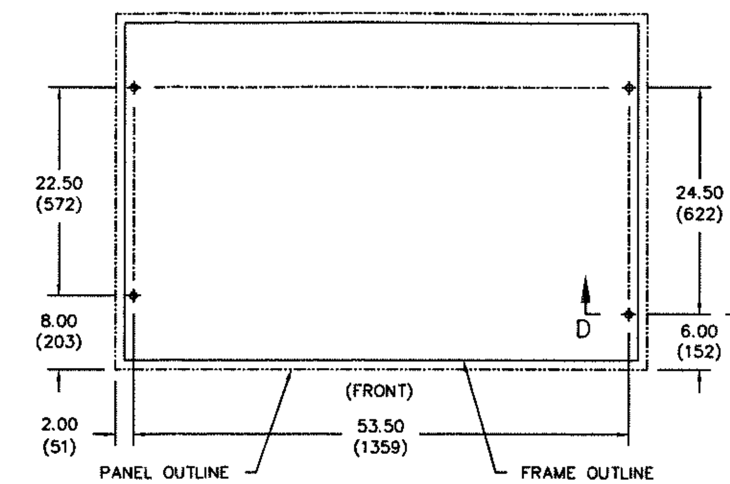


WALL MOUNT OPTION

(MARKING ENCLOSURE)

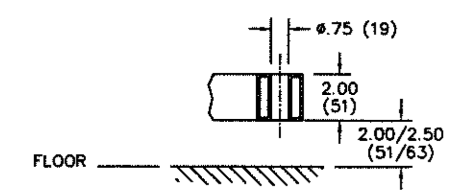
HANDLER MARKER ENCLOSURE BACK

(TYPICAL FOR STAND ALONE AND WALL MOUNT INSTALLATION)



SECTION C–C 6

SEISMIC TIE–POINT LOCATIONS



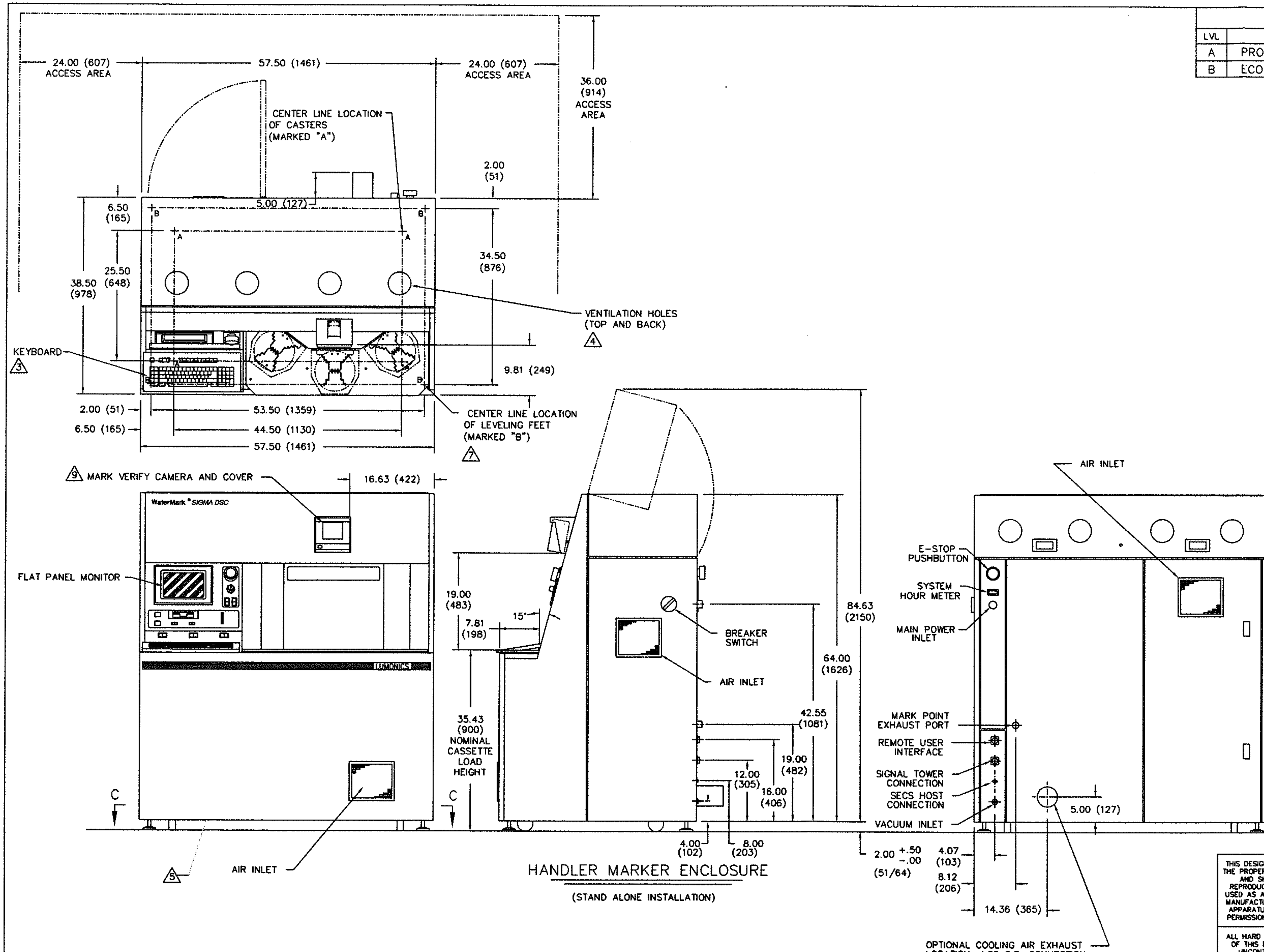
SECTION D–D

TIE–POINT DETAIL
4 PLACES
SCALE: NONE

NOTES: UNLESS OTHERWISE SPECIFIED

SCALE	SIZE	DRAWING NO.
1/20	B	2950190
DO NOT SCALE DRAWING		SHEET 2 OF 2

REVISIONS			
LVL	DESCRIPTION	DRWN/APVD	DATE
A	PRODUCTION RELEASE, ECO #1108.	CJK/BL	7/24/97
B	ECO 1162	CS/BL	16OCT97



9. VERIFY CAMERA LOCATION DIMENSIONS ARE APPROXIMATE.

8. DRAWING CREATED FROM 2950185.

7. WEIGHT/LOAD DISTRIBUTION:

RIGHT FRONT FOOT = 393 lb / 178 kg
LEFT FRONT FOOT = 464 lb / 210 kg
RIGHT REAR FOOT = 351 lb / 159 kg
LEFT REAR FOOT = 197 lb / 89 kg

6. SEISMIC TIE-POINT LOCATIONS SHOWN ON SHEET 2.

5. AIR EXHAUST FOR GRID FLOOR INSTALLATION. FOR OTHER CLEAN ROOM CONFIGURATIONS, OPTIONAL EXHAUST DUCT MAY BE REQUIRED. CONSULT FACTORY FOR DETAILS.

4. SEALED AS NECESSARY FOR USE IN HARSH ENVIRONMENTS.

3. MEMBRANE KEYBOARD OPTIONAL (NOT SHOWN).

2. DIMENSIONS ARE SHOWN IN INCHES AND (MILLIMETERS).

1. UTILITIES

ELECTRICAL:
STANDARD CONNECTIONS
208VAC, single phase, 50/60Hz, 23FLA
220VAC, single phase, 50/60Hz, 22FLA
240VAC, single phase, 50/60Hz, 20FLA
OPTIONAL CONNECTIONS
380VAC, single phase, 50/60Hz, 13FLA
416VAC, single phase, 50/60Hz, 12FLA

VACUUM:
25 – 30 inches Hg at 2 SCFM
(635 – 762 mm Hg @ 56.6 L/min)
1/4 inch diameter press-lock connection

MARK POINT EXHAUST:
20 CFM (560 L/min) flow rate maximum (optional)
1.25 inch (32mm) diameter port

DIMENSION/WEIGHT:
66 inches H X 57.5 inches W X 38.5 inches D
(1675mm H X 1461mm W X 978mm D)
1425 lbs (646 kg)

NOTES: UNLESS OTHERWISE SPECIFIED

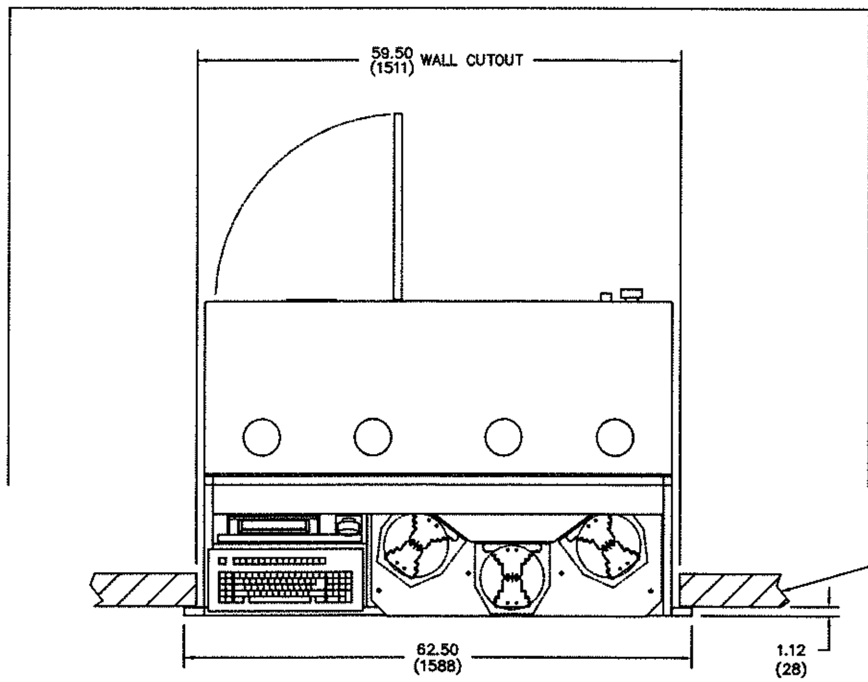
LUMONICS

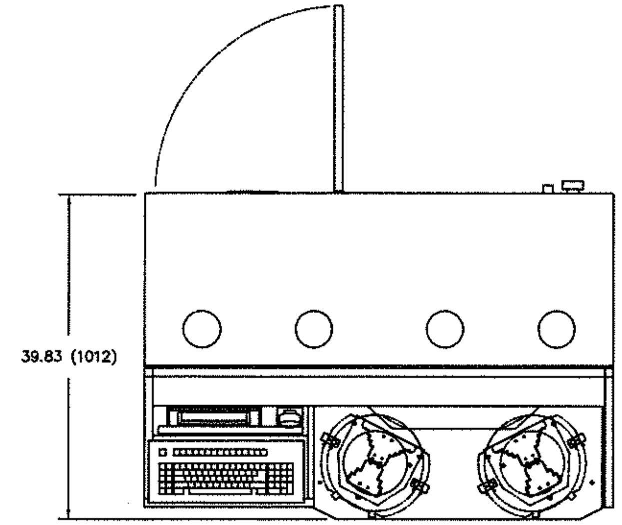
TITLE: INSTALL DRAWING
WIZARD READER I.D. SYSTEM
WAFERMARK SIGMA DSC

SCALE	SIZE	DRAWING NO.
1/20	B	2950190

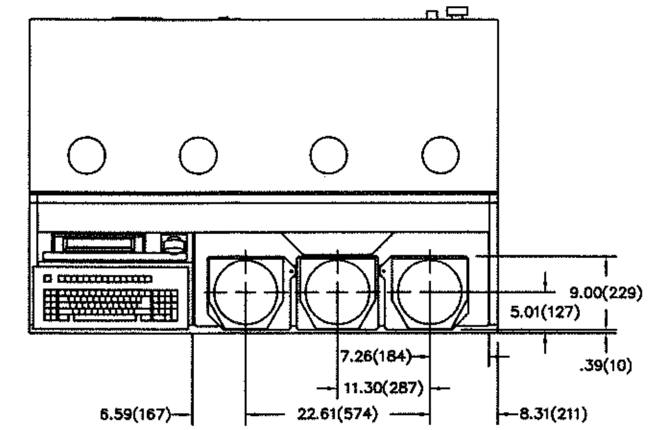
DO NOT SCALE DRAWING

ECO	REV	CHANGE DESCRIPTION	DATE	CHG BY	APPV'D
11608	F	SEE SHEET 1	07/23/02	PVS	BI



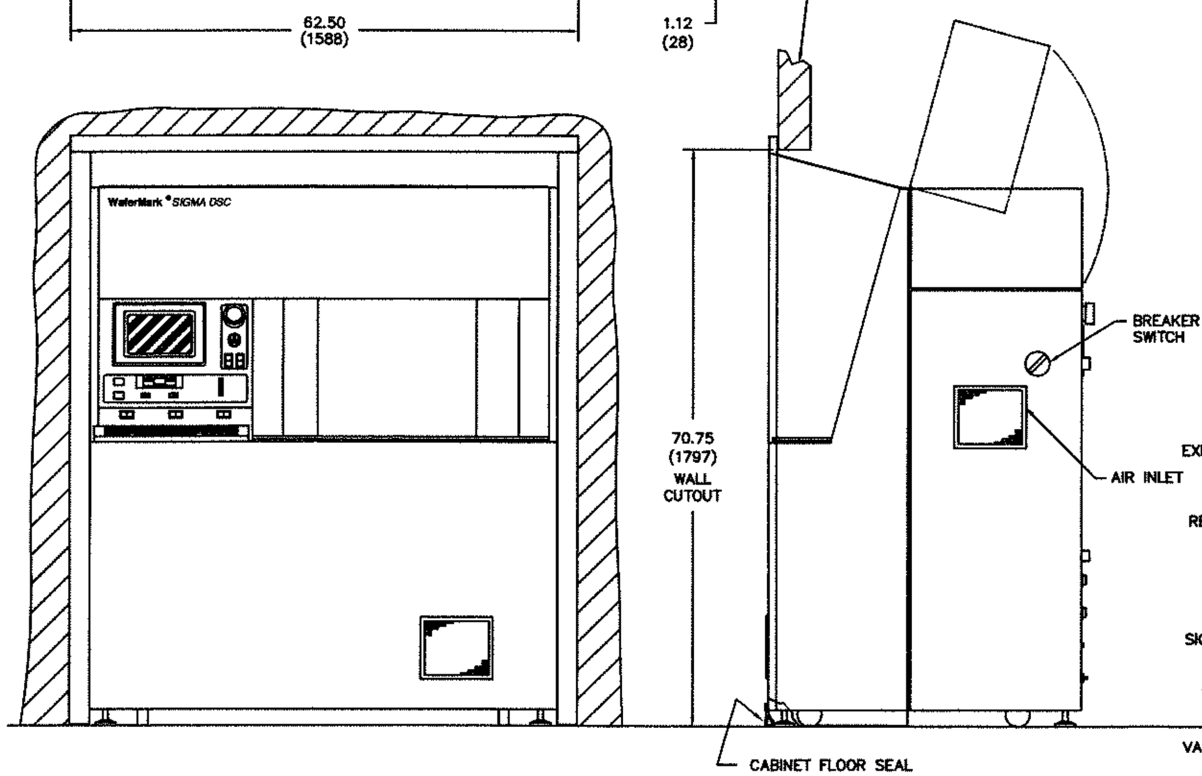


OPTIONAL 300 MM CONFIGURATION 8



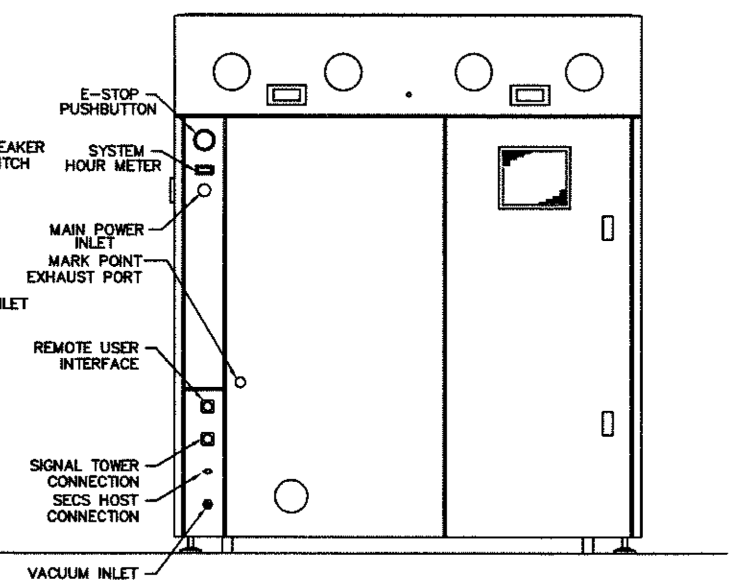
9 OPTIONAL AUTOMATED PRESENTER CONFIGURATION

(FOR ROBOTIC CASSETTE HANDLING)



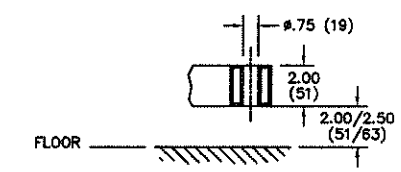
WALL MOUNT OPTION

(MARKING ENCLOSURE)



HANDLER MARKER ENCLOSURE BACK

(TYPICAL FOR STAND ALONE AND WALL MOUNT INSTALLATION)



SECTION D-D

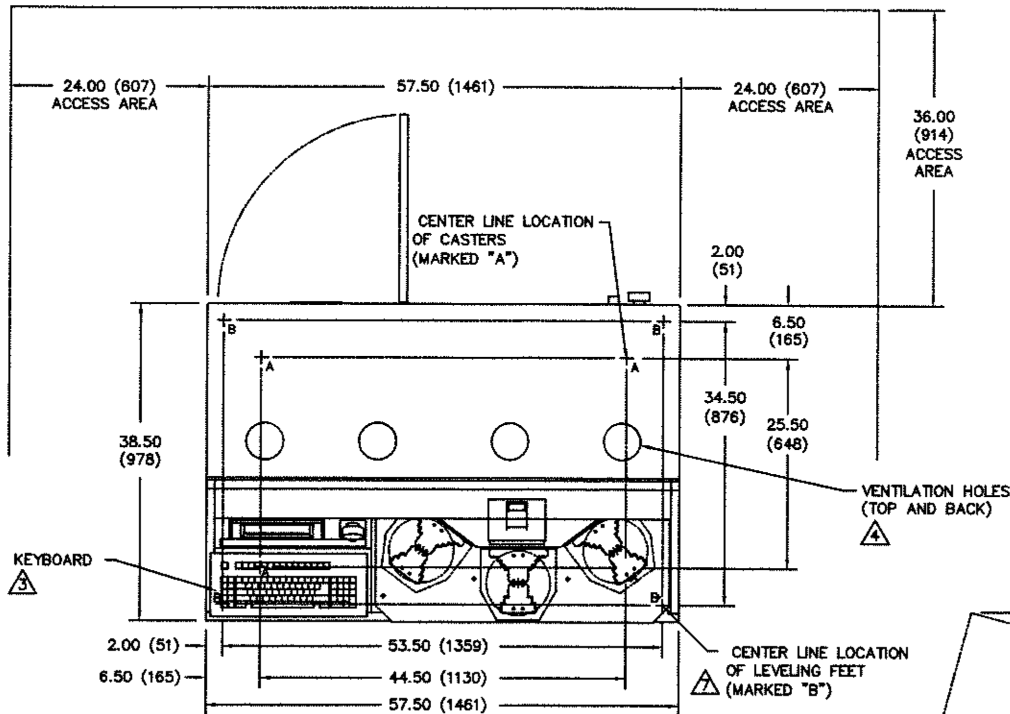
TIE-POINT DETAIL
4 PLACES
SCALE: NONE

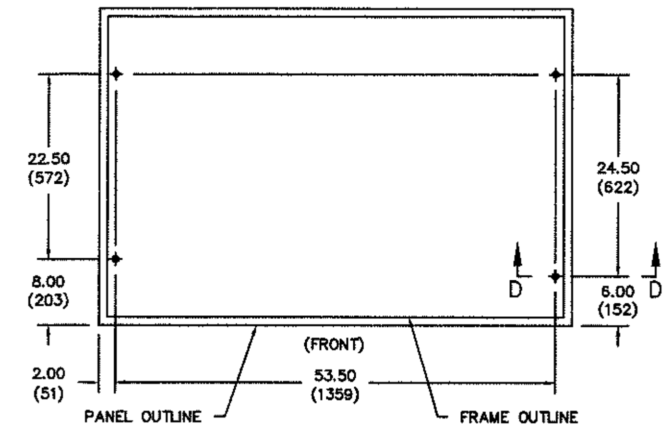
DRAWN BY SMS	gsi Lumonics 60 FORDHAM ROAD WILMINGTON, MA 01887	
DRAWN DATE 03 MAR97	DRAWING TITLE INSTALLATION, WAFERMARK SIGMA DSC	
CH.		
CFN	DRAWING NUMBER 2950185	REV F
SIZE C	SCALE NONE	DO NOT SCALE DRAWING — SHEET 2 OF 2

THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND SHALL NOT BE USED, REPRODUCED, OR DISCLOSED TO THIRD PARTIES WITHOUT WRITTEN AUTHORIZATION FROM GSI LUMONICS.

--- REVISIONS ---

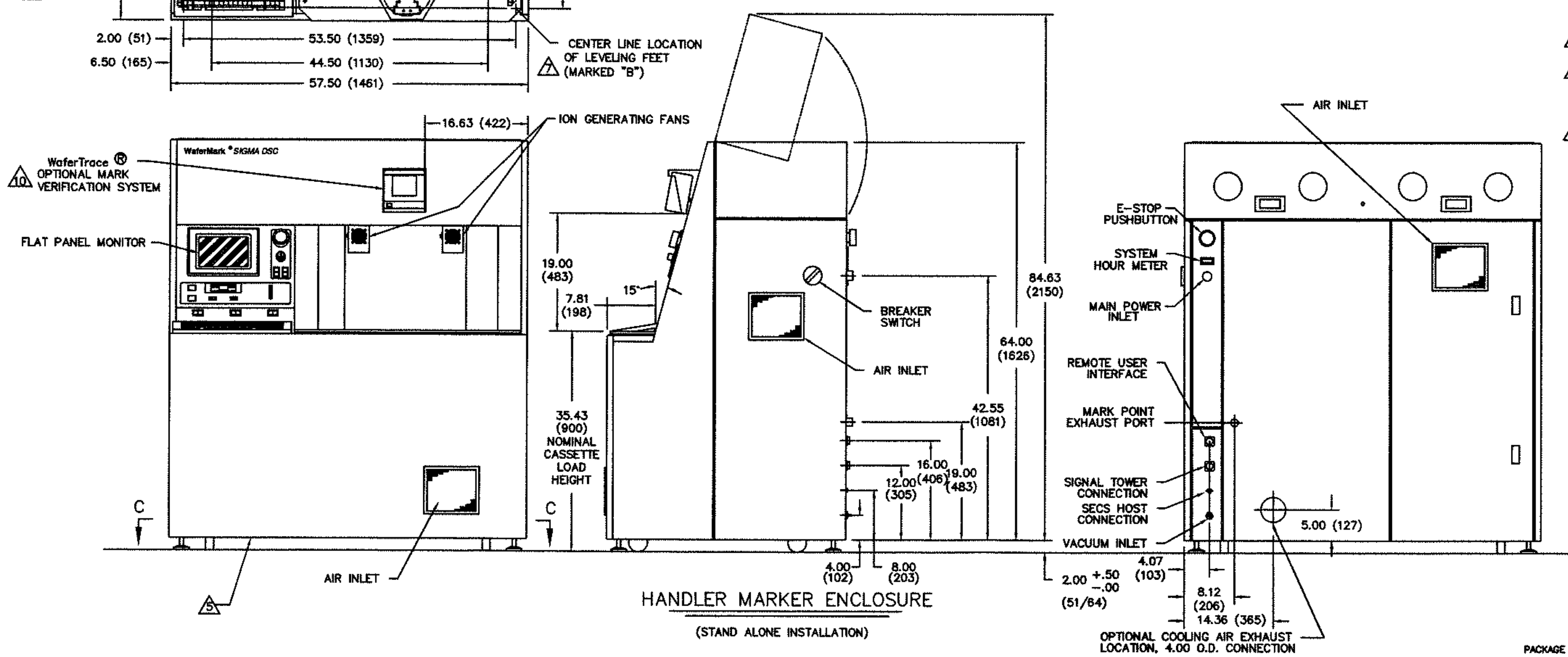
ECO	REV	CHANGE DESCRIPTION	DATE	CHG BY	APPV'D
1020	A	INITIAL RELEASE	05MAR97	SMS	BL
1180	B		11SEP97	SMS	BL
1470	C		31JULY98	TS	CA
1483	D	INITIAL RELEASE	16SEPT98	TS	CA
1580	E	REMOVED LUMONICS LOGO	18MAR99	CS	PG
11608	F	CORRECTED WEIGHT, NEW FORMAT	07/23/02	PVS	BI





SECTION C–C 6

SEISMIC TIE–POINT LOCATIONS



HANDLER MARKER ENCLOSURE

(STAND ALONE INSTALLATION)

10. LOCATION OF MARK VERIFICATION SYSTEM IS APPROXIMATE.
9. STANDARD FIXED PRESENTER SHOWN ON SHEET 1.
8. 300 mm UPGRADE KIT AVAILABLE IN 13 AND 25 WAFER COUNT CONFIGURATION.
7. WEIGHT/LOAD DISTRIBUTION:
   - RIGHT FRONT FOOT = 393 lb / 178 kg
   - LEFT FRONT FOOT = 464 lb / 210 kg
   - RIGHT REAR FOOT = 351 lb / 159 kg
   - LEFT REAR FOOT = 197 lb / 89 kg
6. SEISMIC TIE–POINT LOCATIONS SHOWN ON SHEET 2.
5. AIR EXHAUST FOR GRID FLOOR INSTALLATION. FOR OTHER CLEAN ROOM CONFIGURATIONS, OPTIONAL EXHAUST DUCT MAY BE REQUIRED. CONSULT FACTORY FOR DETAILS.
4. SEALED AS NECESSARY FOR USE IN HARSH ENVIRONMENTS.
3. MEMBRANE KEYBOARD OPTIONAL (NOT SHOWN).
2. DIMENSIONS ARE SHOWN IN INCHES AND (MILLIMETERS).
1. UTILITIES

ELECTRICAL:
STANDARD CONNECTIONS
208VAC, single phase, 50/60Hz, 23FLA
220VAC, single phase, 50/60Hz, 22FLA
240VAC, single phase, 50/60Hz, 20FLA
OPTIONAL CONNECTIONS
380VAC, single phase, 50/60Hz, 13FLA
416VAC, single phase, 50/60Hz, 12FLA

VACUUM:
25 – 30 inches Hg at 2 SCFM
(635 – 762 mm Hg @ 56.6 L/min)
1/4 inch diameter press–lock connection

MARK POINT EXHAUST:
20 CFM (560 L/min) flow rate maximum (optional)
1.25 inch (32mm) diameter port

DIMENSION/WEIGHT:
66 inches H X 57.5 inches W X 38.5 inches D
(1675mm H X 1461mm W X 978mm D)
1405 lbs (637 kg)

NOTES: UNLESS OTHERWISE SPECIFIED

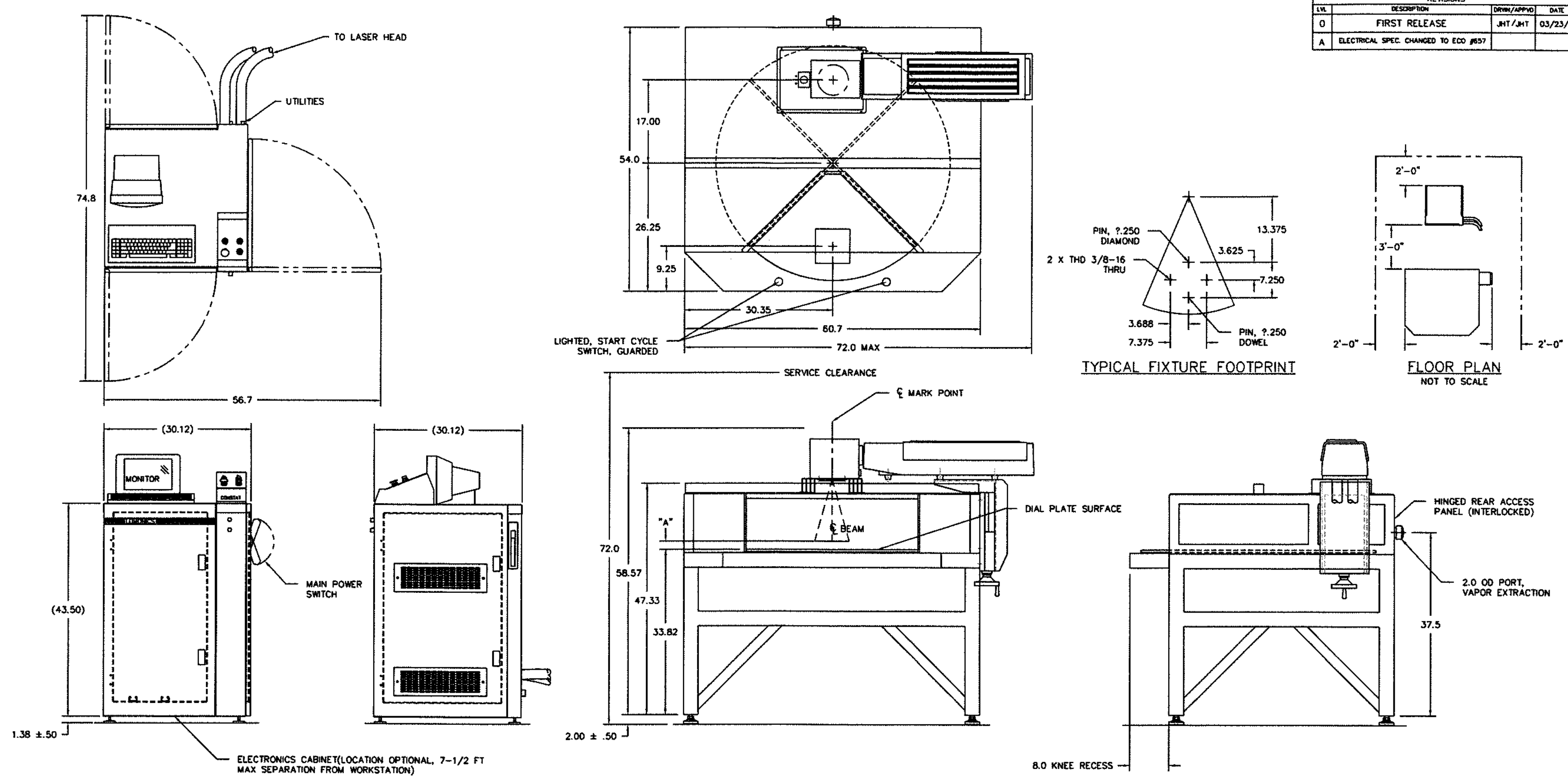
PACKAGE PER GSI LUMONICS CONTROL DOCUMENT #CD0013, METHOD # P21

AFTER FINISHING, ADD PIECE PART MARKING ON SURFACE INDICATED IN DRAWING PER GSI LUMONICS CNTRL DOC. #CD0002, METHOD # 1

ALL DIMENSIONS ARE TO BE INTERPRETED PER LATEST ANSI Y14.5 SPECS.

MATERIAL: NONE	DRAWN BY: SMS	GSI LUMONICS, 60 FORDHAM ROAD, WILMINGTON, MA 01887	
FINISH: NONE	DRAWN DATE: 03 MAR 97	DRAWING TITLE: INSTALLATION, WAFERMARK SIGMA DSC	
UNLESS SPECIFIED 1. ALL DIMENSIONS APPLY AFTER FINISH 2. REMOVE ALL BURRS AND SHARP EDGES. (.010 MAX. R. OR CHAMFER) 3. MIN. BEND RADIUS, MIN. BEND RELIEF. 4. NO TOOL MARKS. 5. MACHINED FINISH 64/EXCEPT 32/FOR HORIZ. MILLING	CH. / CFN	DRAWING NUMBER: 2950185	REV: F
UNLESS OTHERWISE SPECIFIED .X = ± .03 .XX = ± .01 .XXX = ± .005 X/X = ± 1/64 X° = ± 30' ALL DIMENSION IN INCHES	SIZE: C, SCALE: NONE	DO NOT SCALE DRAWING	SHEET 1 OF 2

REVISIONS			
LVL	DESCRIPTION	DRWN/APPVD	DATE
0	FIRST RELEASE	JHT/JHT	03/23/93
A	ELECTRICAL SPEC. CHANGED TO ECO #657		



7 X 7 FLAT FIELD	0.0	+7.8 −0.0
4 X 4 FLAT FIELD	2.5	+7.9 −0.0
2 X 2 FLAT FIELD	6.4	+4.0 −0.0
MARKING HEAD	"A"	
MARK POINT DISTANCE ⚠2		

3. ESTIMATED GROSS SHIPPING WEIGHT: 2000 LBS.

2 APPROXIMATE HEIGHT, DEPENDS ON APPLICATION PARAMETERS.

1. DESIGN SPECIFICATION:
   ELECTRICAL REQUIREMENTS:
   DOMESTIC:
   208 V, 30 FLA, (PROVIDE 40 A SERVICE),
   FIVE WIRE, THREE PHASE STAR (WYE),
   WITH EARTHED NEUTRAL & PROTECTIVE EARTH (GROUND)
   SEE LUMONICS DWG. NO. 2950116
   EURO NORM:
   400 V, 18 FLA, (PROVIDE 20 A SERVICE),
   FOUR WIRE, THREE PHASE DELTA
   WITH PROTECTIVE EARTH (GROUND)
   COOLING WATER REQUIREMENTS: SEE LUMONICS DWG. NO. 29500652
   (10 FT HOSES SUPPLIED W/
   .75 FEMALE HOSE FITTINGS)

NOTES: UNLESS OTHERWISE SPECIFIED

DRAWN FROM: 29500434, REV. B

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
THREADS: CLASS 2A AND/OR 2B
MACHINED SURFACES
REMOVE ALL BURRS/SHARP EDGES
TOLERANCES ARE: .XX± .02 .XXX± .005 ANGLE± 0.5°
MATERIAL:
TREATMENT:
FINISH:

APPROVALS	DATE
DRAWN	23 MAR 93
CHECKED	
ENGR	

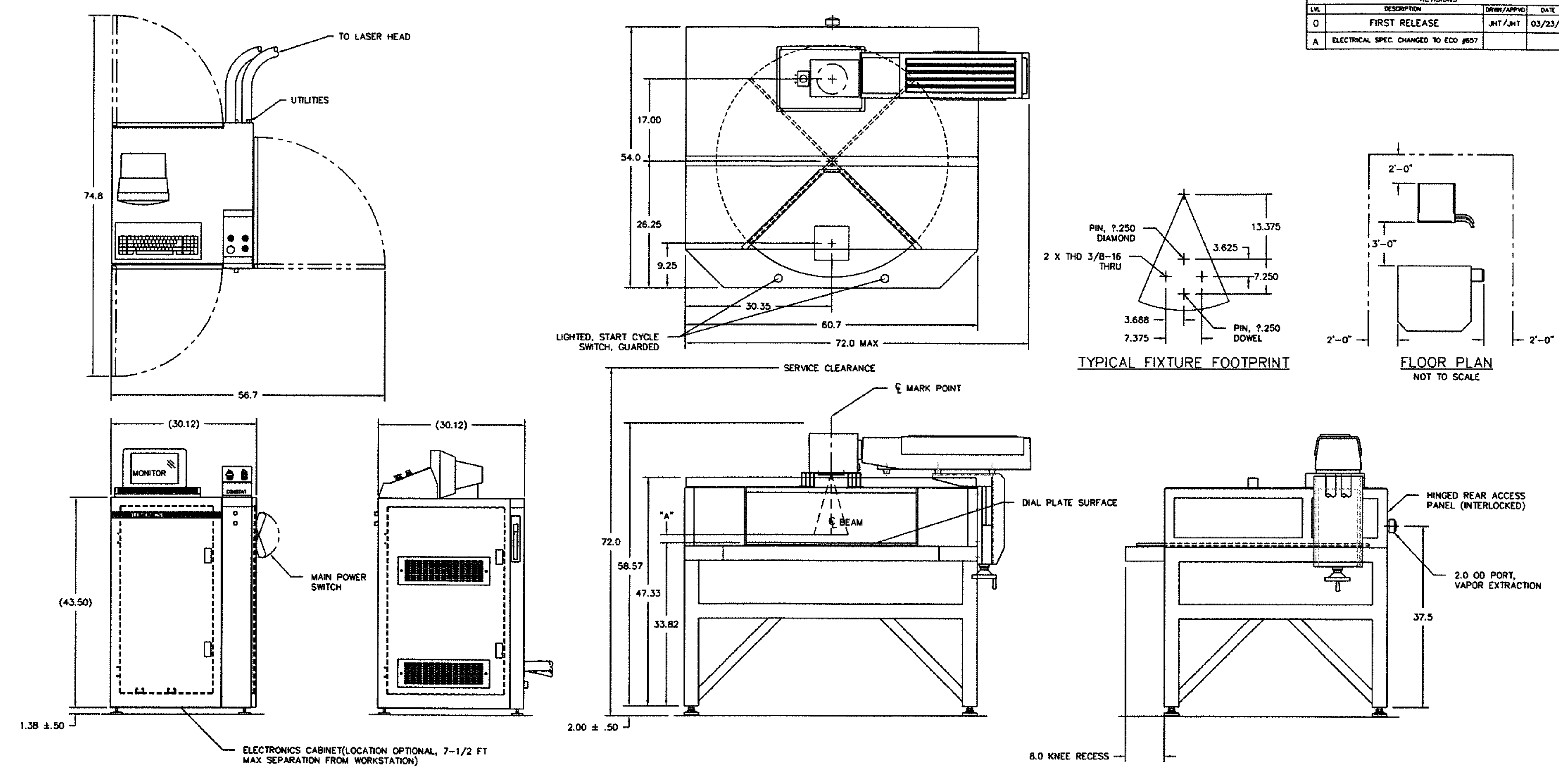
LUMONICS

INSTALLATION 48" ROTARY TABLE MANUAL Z LWSP & LWSPe

SCALE	SIZE	DRAWING NO.
F	B	2950114

DO NOT SCALE DRAWING — SHEET 1 OF 1

REVISIONS			
LVL	DESCRIPTION	DRWN/APPVD	DATE
0	FIRST RELEASE	JHT/JHT	03/23/93
A	ELECTRICAL SPEC. CHANGED TO ECO #657		



7 X 7 FLAT FIELD	0.0	+7.8 −0.0
4 X 4 FLAT FIELD	2.5	+7.9 −0.0
2 X 2 FLAT FIELD	6.4	+4.0 −0.0
MARKING HEAD	"A"	
MARK POINT DISTANCE (2)		

3. ESTIMATED GROSS SHIPPING WEIGHT: 2000 LBS.

(2) APPROXIMATE HEIGHT, DEPENDS ON APPLICATION PARAMETERS.

1. DESIGN SPECIFICATION:

ELECTRICAL REQUIREMENTS:

DOMESTIC:
208 V, 30 FLA, (PROVIDE 40 A SERVICE),
FIVE WIRE, THREE PHASE STAR (WYE),
WITH EARTHED NEUTRAL & PROTECTIVE EARTH (GROUND)
SEE LUMONICS DWG. NO. 2950116

EURO NORM:
400 V, 18 FLA, (PROVIDE 20 A SERVICE),
FOUR WIRE, THREE PHASE DELTA
WITH PROTECTIVE EARTH (GROUND)

COOLING WATER REQUIREMENTS: SEE LUMONICS DWG. NO. 29500652
(10 FT HOSES SUPPLIED W/
.75 FEMALE HOSE FITTINGS)

NOTES: UNLESS OTHERWISE SPECIFIED

DRAWN FROM: 29500434, REV. B

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
THREADS: CLASS 2A AND/OR 2B
MACHINED SURFACES
REMOVE ALL BURRS/SHARP EDGES
TOLERANCES ARE: .XX± .02 .XXX± .005 ANGLE± 0.5°
MATERIAL:
TREATMENT:
FINISH:

APPROVALS | DATE
23 MAR 93

LUMONICS

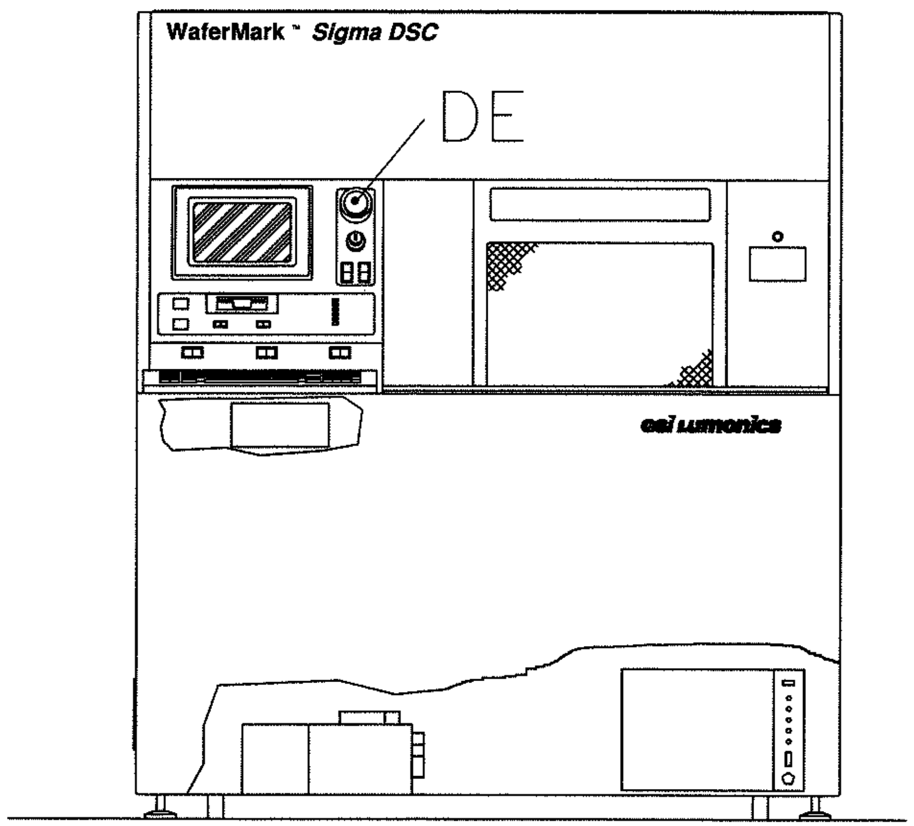
INSTALLATION 48" ROTARY TABLE MANUAL Z LWSP & LWSPe

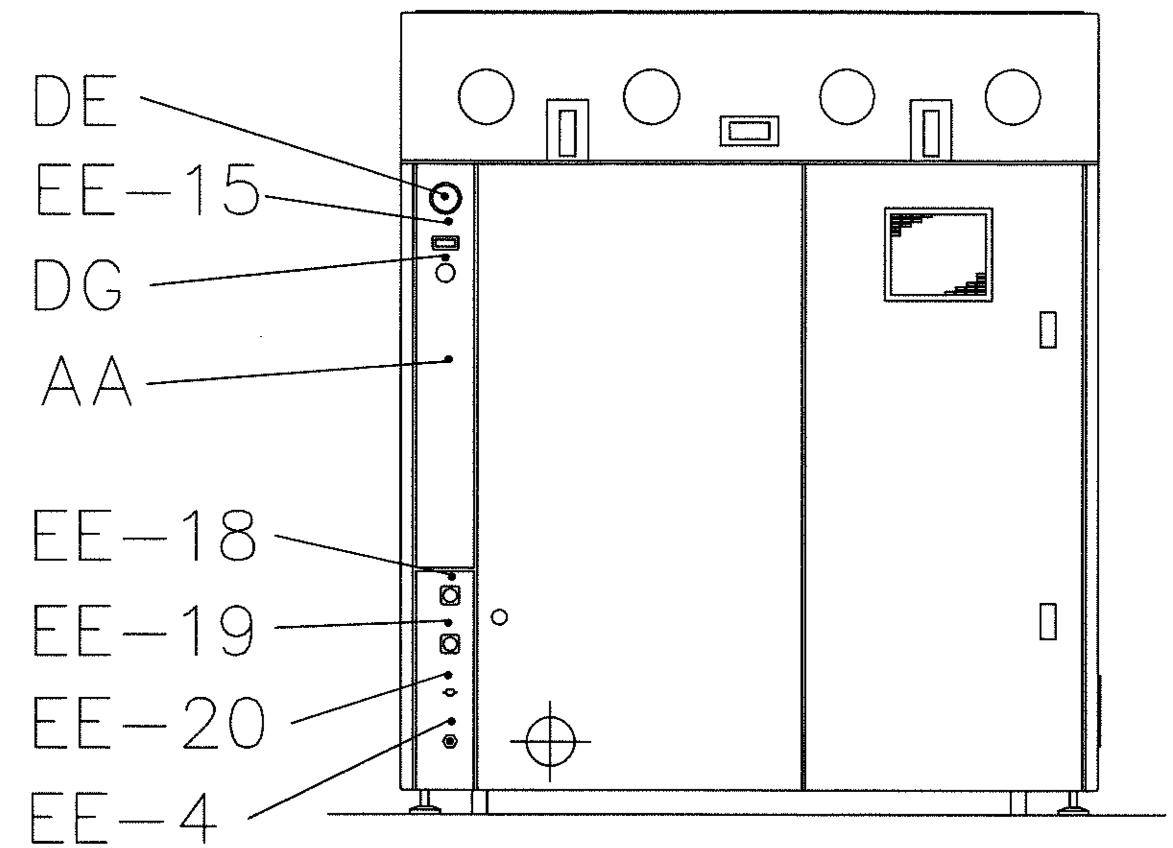
SCALE F | SIZE B | DRAWING NO. 2950114

DO NOT SCALE DRAWING | SHEET 1 OF 1

--- REVISIONS ---

ECO	REV	CHANGE DESCRIPTION	DATE	CHG BY	APPV'D
11222	E	UPDATE LABEL LOCATIONS	1/18/02	BI	

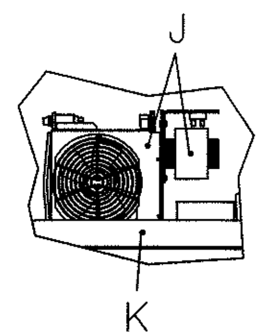




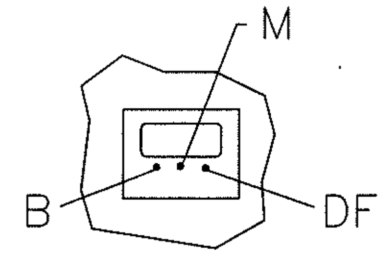
CE SYSTEMS GET THESE ADDITIONAL LABELS

MATERIAL	DRAWN BY DAM	GSI LUMONICS 60 FORDHAM ROAD WILMINGTON, MA 01887
FINISH N/A	DRAWN DATE 03/20/00	DRAWING TITLE LABEL LOCATION, WAFERMARK SIGMA DSC
UNLESS SPECIFIED 1. ALL DIMENSIONS APPLY AFTER FINISH 2. REMOVE ALL BURRS AND SHARP EDGES. (.010 MAX. R. OR CHAMFER) 3. MIN. BEND RADIUS, MIN. BEND RELIEF. 4. NO TOOL MARKS. 5. MACHINED FINISH √EXCEPT √FOR HORIZ. MILLING	CH.	
	CFN	DRAWING NUMBER 2950188 — REV E
UNLESS OTHERWISE SPECIFIED .X = ± .03 .XX = ± .01 .XXX = ± .005 X/X = ± 1/64 X° = ± 30' ALL DIMENSION IN INCHES	SIZE B — SCALE N/A	DO NOT SCALE DRAWING — SHEET 3 OF 3

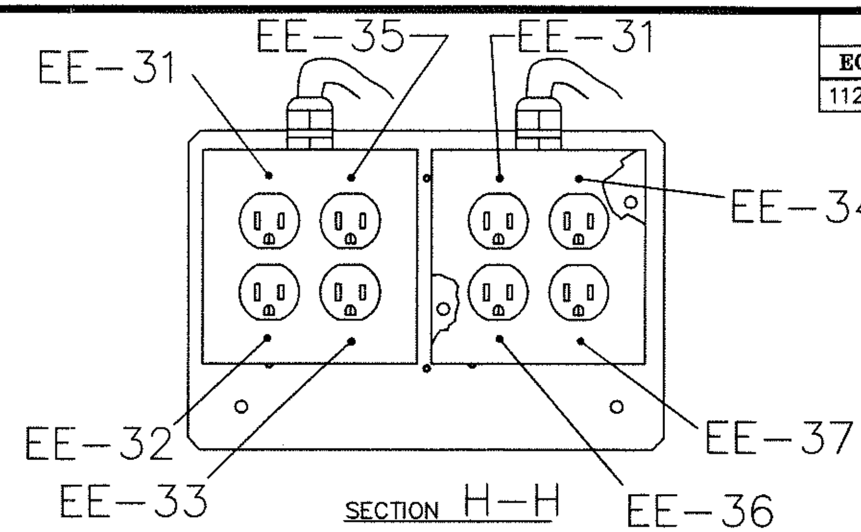
--- REVISIONS ---					
ECO	REV	CHANGE DESCRIPTION	DATE	CHG BY	APPV'D
11222	E	UPDATE LABEL LOCATIONS	1/18/02	BI	



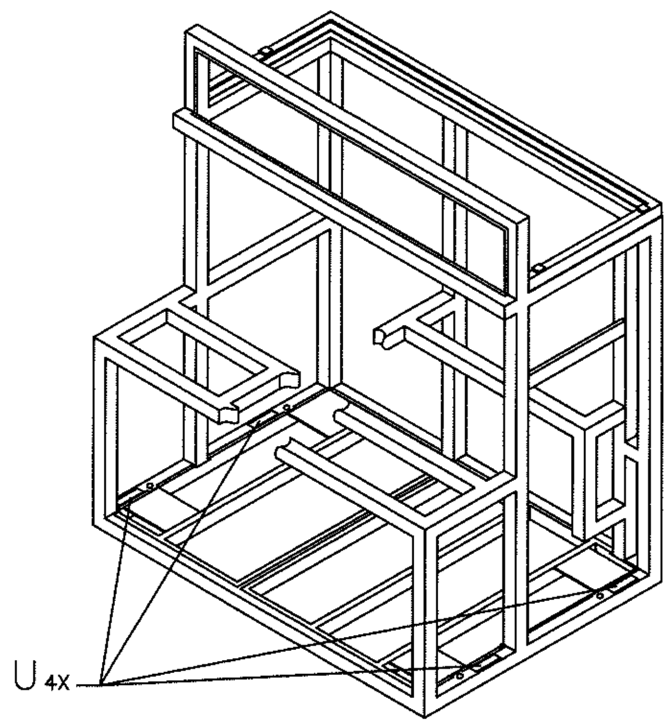
SECTION D–D

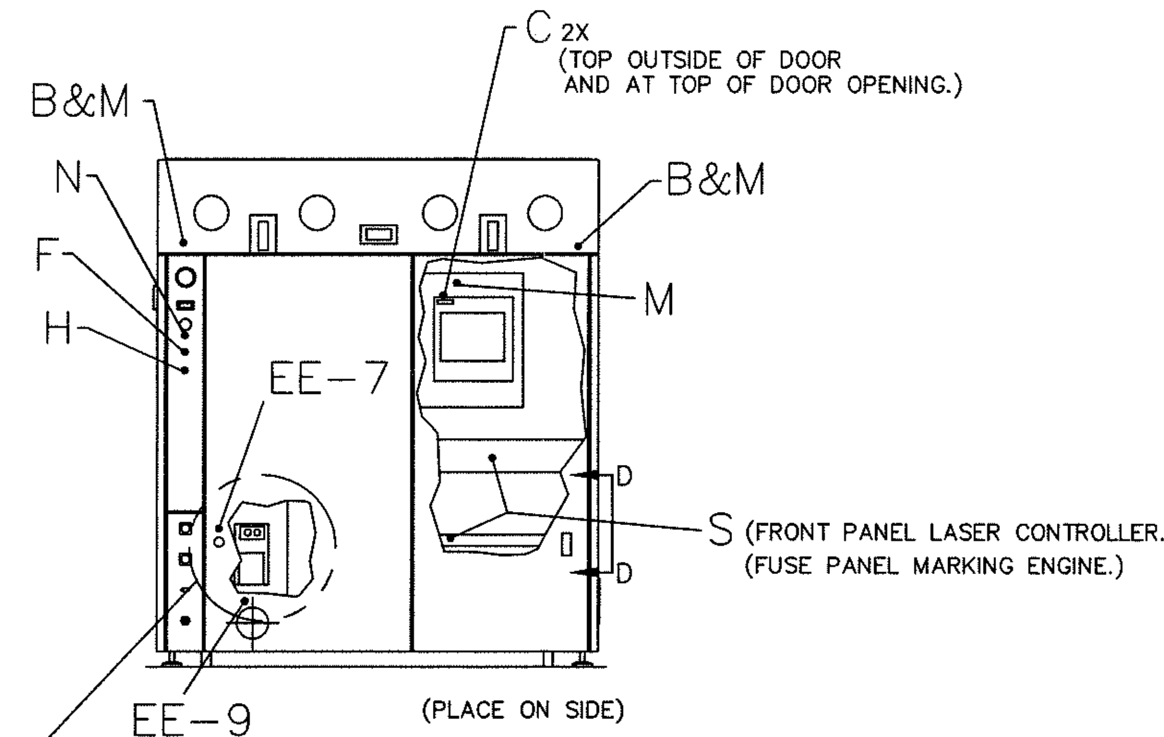


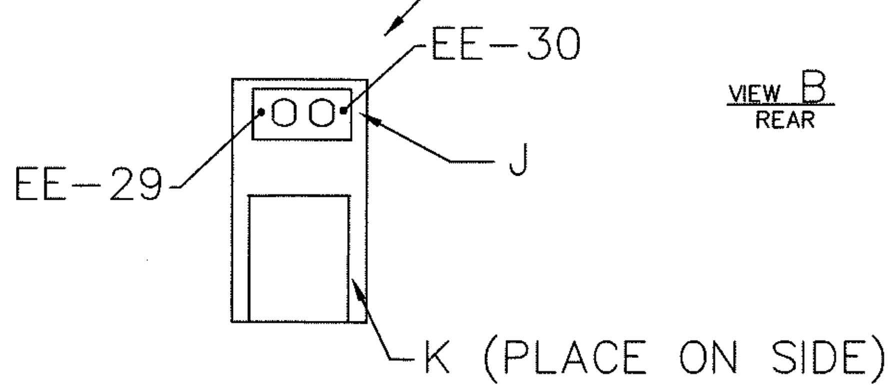
SECTION E–E



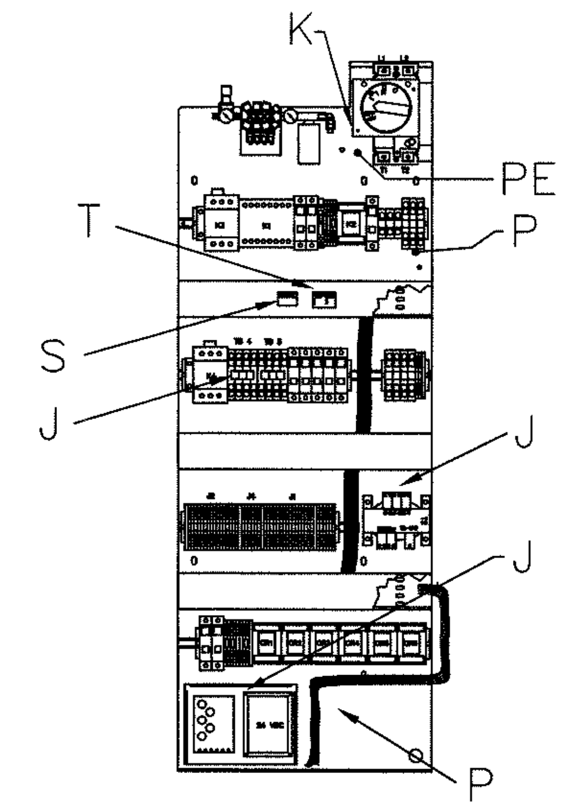
SECTION H–H







VIEW B
REAR

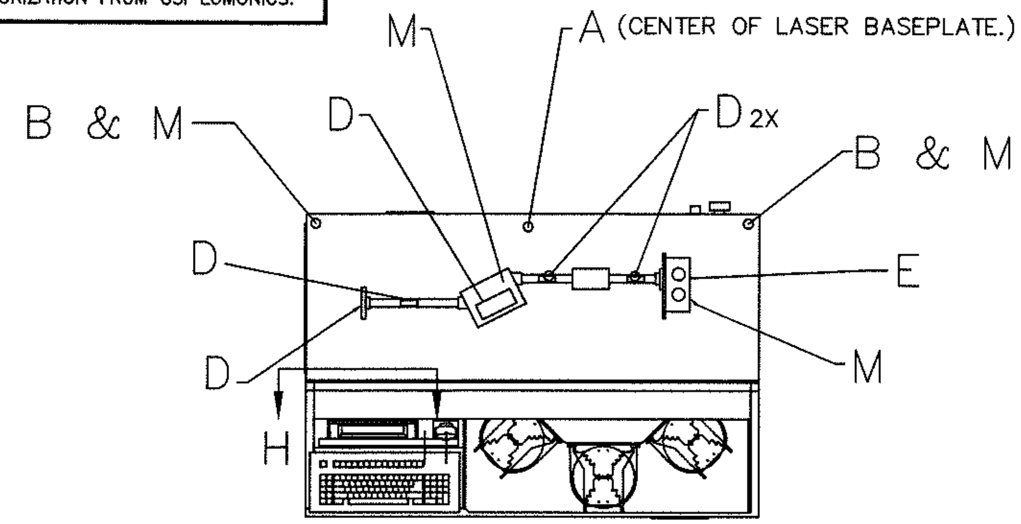


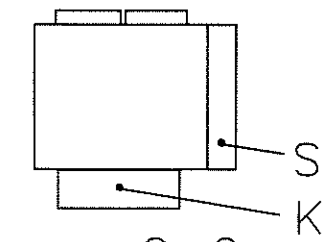
VIEW C
PANEL

MATERIAL	DRAWN BY DAM	GSI Lumonics 60 FORDHAM ROAD WILMINGTON, MA 01887
FINISH N/A	DRAWN DATE 03/20/00	DRAWING TITLE LABEL LOCATION, WAFERMARK SIGMA DSC
UNLESS SPECIFIED 1. ALL DIMENSIONS APPLY AFTER FINISH 2. REMOVE ALL BURRS AND SHARP EDGES. (.010 MAX. R. OR CHAMFER) 3. MIN. BEND RADIUS, MIN. BEND RELIEF. 4. NO TOOL MARKS. 5. MACHINED FINISH √ EXCEPT √ FOR HORIZ. MILLING	CH. / CFN	DRAWING NUMBER 2950188 — REV E
UNLESS OTHERWISE SPECIFIED .X = ± .03 .XX = ± .01 .XXX = ± .005 X/X = ± 1/64 X° = ± 30' ALL DIMENSION IN INCHES	SIZE B — SCALE N/A	DO NOT SCALE DRAWING — SHEET 2 OF 3

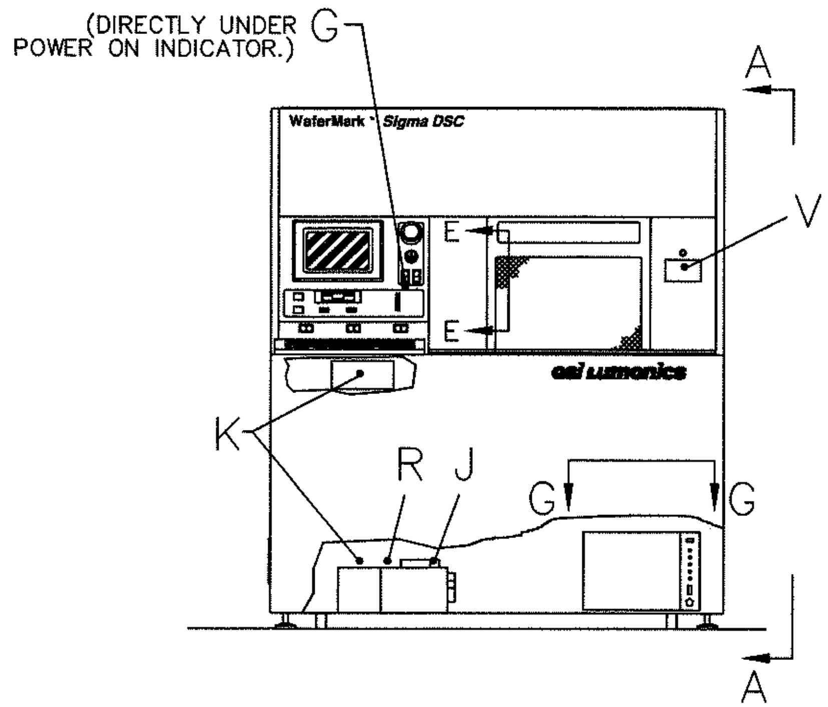
--- REVISIONS ---

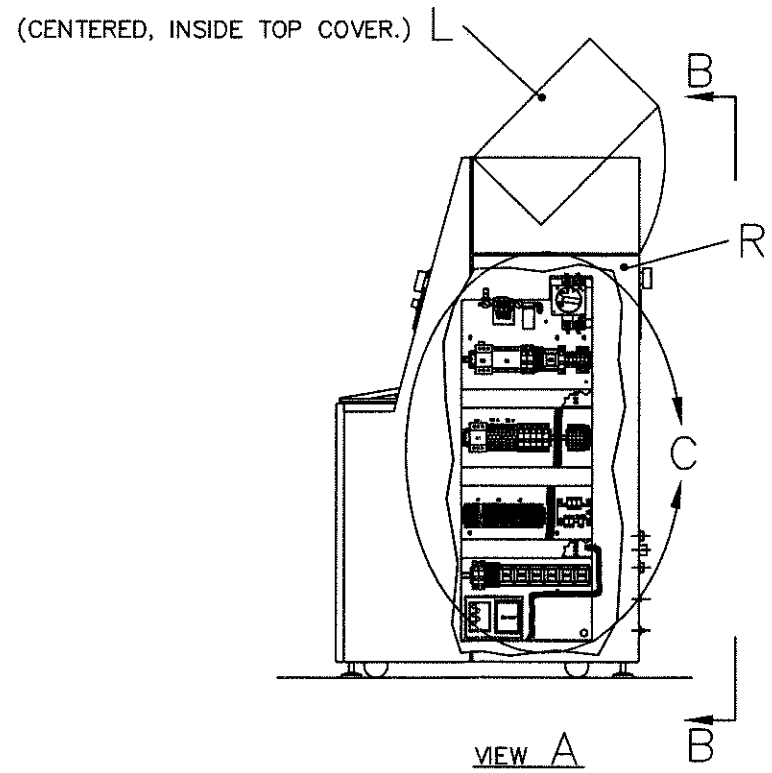
ECO	REV	CHANGE DESCRIPTION	DATE	CHG BY	APPV'D
1129	A	PRODUCTION RELEASE	6/20/97	CS	BL
1104	B		10/14/97	DD	BL
1277	C	CHANGE LABEL QUANTITIES	2/18/98	EE	BL
10997	D	ADD LABEL IDENTIFICATION DRAWING	8/8/01	JMK	
11222	E	UPDATE LABEL LOCATIONS	1/18/02	BI	



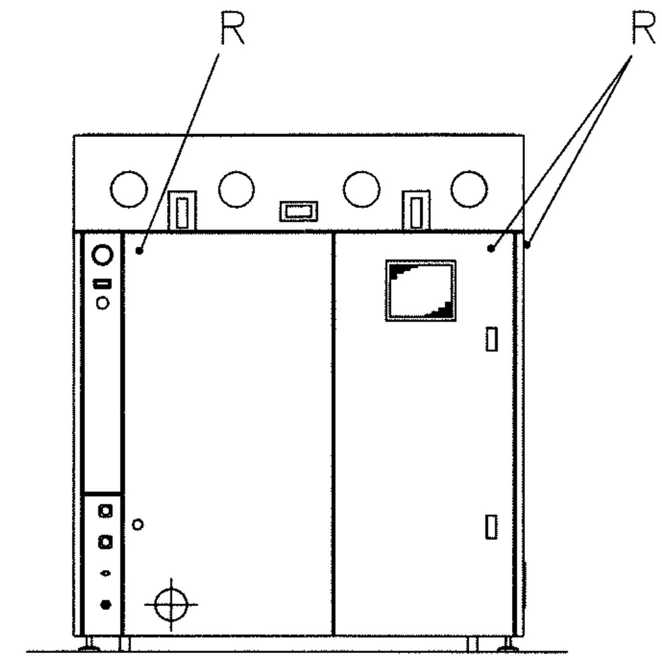


SECTION G—G
(TOP OF CHILLER)





VIEW A
RIGHT



FOR LABEL IDENTIFICATION SEE DWG # 2950169-01

IEC LABEL QUANTITIES

A=1	H=1	PE=1
B=5	J=7	Q=3
C=2	K=6	R=6
D=5	L=1	S=4
E=1	M=8	T=1
F=1	N=1	U=4
G=1	P=2	V=1
DF=1	EE=1	

4. APPLY Q LABELS TO INTERLOCK DEFEAT FLAGS (QTY 3).

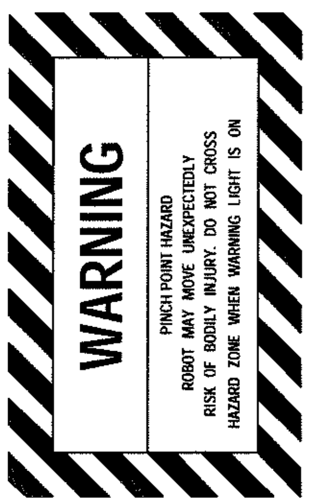
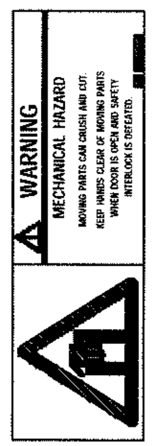
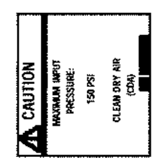
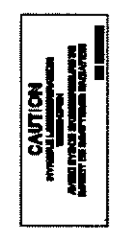
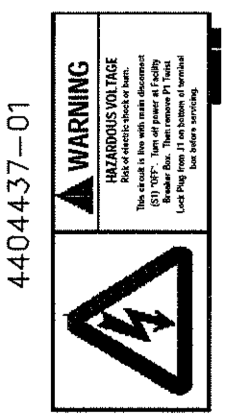
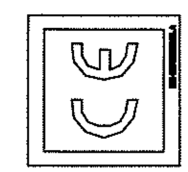
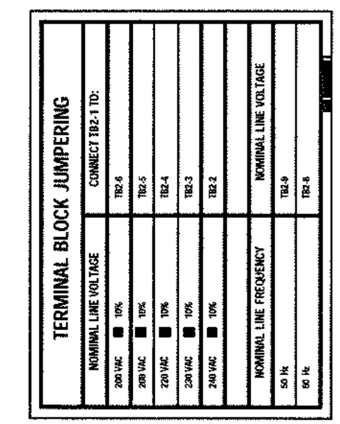
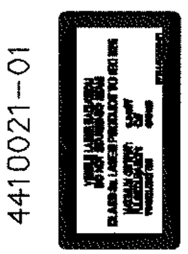
3. IF THERE IS INSUFFICIENT SURFACE AREA TO PLACE THE LABEL(S) SPACE WILL THEN BE MADE OR PROVIDED FOR THE LABEL.

2. THE LOCATIONS GIVEN ARE APPROXIMATE.LABELS CAN BE MOVED IN THE GENERAL AREA, FREE FROM ANY OBSTRUCTION OR TO PROVIDE A BETTER MOUNTING SURFACE.

1. ALL LABELS MUST BE PLACED IN PLAIN VIEW. FREE OF MAJOR OBSTRUCTIONS AT THE GIVEN LOCATIONS.

MATERIAL	DRAWN BY DAM	gsi lumonics 60 FORDHAM ROAD WILMINGTON, MA 01887
FINISH N/A	DRAWN DATE 03/20/00	DRAWING TITLE LABEL LOCATION, WAFERMARK SIGMA DSC
UNLESS SPECIFIED 1. ALL DIMENSIONS APPLY AFTER FINISH 2. REMOVE ALL BURRS AND SHARP EDGES. (.010 MAX. R. OR CHAMFER) 3. MIN. BEND RADIUS, MIN. BEND RELIEF. 4. NO TOOL MARKS. 5. MACHINED FINISH √EXCEPT √FOR HORIZ. MILLING	CH.	
	CFN	DRAWING NUMBER 2950188 — REV E
UNLESS OTHERWISE SPECIFIED .X = ± .03 .XX = ± .01 .XXX = ± .005 X/X = ± 1/64 X° = ± 30' ALL DIMENSION IN INCHES	SIZE B — SCALE N/A	DO NOT SCALE DRAWING — SHEET 1 OF 3

REVISIONS	
LVL	DESCRIPTION
J	SEE SHEET 1

LABEL	SYMBOL	
U	4410014-01	
V	4410013-01	
W	4404432-01	
X	4404431-01	
Y	4410703-01	
Z	4404437-01	
AA	4404436	
BB	4410020-01	
CC	4410021-01	

LABEL IDENTIFICATION—ENGLISH SET GENERAL LABELS

SCALE	SIZE	DRAWING NO.
NONE	B	2950169-01
DO NOT SCALE DRAWING		SHEET 2 OF 2

NOTES: UNLESS OTHERWISE SPECIFIED

LABEL IDENTIFICATION—ENGLISH SE

LABEL	CLASS 4 (INVISIBLE)
A TEXT=B BORDER=B BACKGROUND=Y	441PP01–01 INVISIBLE LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION CLASS 4 LASER PRODUCT TO IEC 825 MAXIMUM OUTPUT PULSE DURATION WAVELENGTH P/N 441PP01-01
B TEXT=B BORDER=B BACKGROUND=Y	4410002–01 CAUTION INVISIBLE LASER RADIATION WHEN OPEN AND INTERLOCKS DEFEATED AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION P/N 4410002-01
C TEXT=B BORDER=B BACKGROUND=Y	4410003–01 CAUTION
D TEXT=B BORDER=B BACKGROUND=Y	4410004–01 CAUTION
E TEXT=B BORDER=B BACKGROUND=Y	4410005–01 CAUTION
Q TEXT=B BORDER=B BACKGROUND=Y	4404429–01 CAUTION Invisible laser radiation when open and interlock defeated. AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION CAUTION Invisible laser radiation when open and interlock defeated. AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION

CLASS 2 (VISIBLE) (V)
4410006–01 VISIBLE LASER RADIATION DO NOT STARE INTO BEAM CLASS 2 LASER PRODUCT TO IEC 825
4410007–01 CAUTION
4410008–01 CAUTION

PART NUMBER LEGEND

PP	=	PRODUCT ID
01		WM SCDPL
02		WM DSC
03		LWSP
04		LWSP CO2
05		WMSDSC
06		TRAYMARK
07		LW2000
–XX	=	LANGUAGE ID
01		ENGLISH
02		FRENCH
03		ITALIAN
04		GERMAN
05		DUTCH
06		SWEDISH
07		DANISH
08		SPANISH

LASER SPECIFICATIONS (CLASS 4)

WMSCDPL	4W	CW/50ns	1053nm
WMDSC	400W	CW/10PS	1064nm
LWSP	400W	CW/10PS	1064nm
LWSP–CO2	100W	CW	10.6um
WMSDSC	8W	CW/50ns	1053nm
TRAYMARK	400W	CW/10PS	1064nm
LW2000	15W	CW/50ns	1053nm

LASER SPECIFICATIONS (CLASS 2)

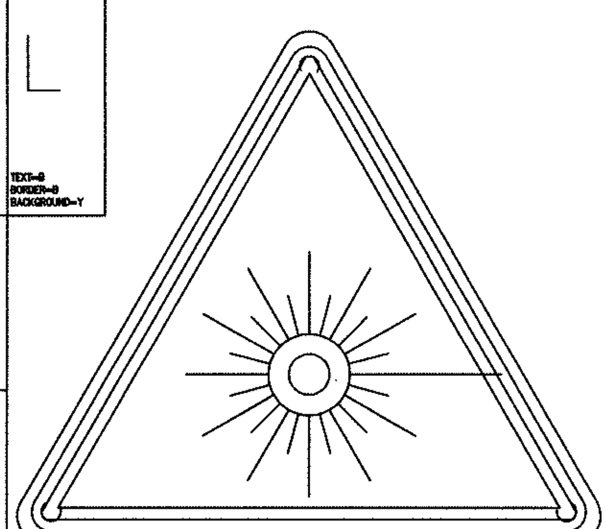
LWSP	1.0mW	CW	670nm

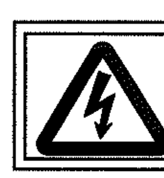
LASER SPECIFICATIONS (CLASS 3a)

LW2000	5.0mW	CW	670nm

GENERAL LABELS

LABEL	SYMBOL
F TEXT=B BORDER=B BACKGROUND=W	4410009–01 PRODUCT COMPLIES WITH IEC 825 (1990); EN60825 (1991) P/N 4410009-01
G TEXT=B BORDER=B BACKGROUND=W	4410010–01 EMISSION INDICATOR
H TEXT=B BORDER=B BACKGROUND=W	4410011–01 CLASS 1 LASER PRODUCT TO IEC 825 P/N 4410011-01
J TEXT=B BORDER=B BACKGROUND=Y	4404420 
K TEXT=B BORDER=B BACKGROUND=Y	4404421 

LABEL	SYMBOL
L TEXT=B BORDER=B BACKGROUND=Y	4404425 
M TEXT=B BORDER=B BACKGROUND=Y	4404426 
N TEXT=W BORDER=O,W BACKGROUND=B	4404402 LUMONICS CORPORATION OXNARD OPERATIONS 130 So. LOMBARD ST. OXNARD, CA 93030 MODEL SERIAL POWER VOLTS HZ AMP PHASE MANUFACTURER THIS PRODUCT CONFORMS TO THE APPLICABLE REQUIREMENTS OF 21 CFR SUBCHAPTER P/N 4404402

LABEL	SYMBOL
P TEXT=B BORDER=B BACKGROUND=W	4404427
PE TEXT=B BORDER=B BACKGROUND=W	4404428 PE
R TEXT=B BORDER=B BACKGROUND=W	4404430–01  WARNING HAZARDOUS VOLTAGE Risk of electric shock or burn. Turn off and padlock main circuit breaker before accessing interior.
S TEXT=B BORDER=B BACKGROUND=O,W	4410012–01 WARNING
T TEXT=B BORDER=B BACKGROUND=W	441PP02–01 FUSE LIST Power Distribution Panel Fuse Amps Type Fuse Amps Type

NOTES:

3. LABEL LOCATION DRAWINGS ARE 2950170 WMSCDPL/ 2950171 WMDSC/ 2950172, LWSP (STD)/ 2950175 LWSPEU/ AND 2950176 SPCO2 2950187 TRAYMARK/ 2950188 WMSDSC 2950196 LW2000
2. LABELS SHOWN FULL SCALE IN "D" SIZE DWG. INDIVIDUAL LABELS MAY BE RE-SCALED TO SUIT MFG REQUIREMENTS.
1. THE FOLLOWING ARE LETTER DESIGNATIONS.
   Y=YELLOW B=BLACK
   W=WHITE G=GRAY
   O=ORANGE

REVISIONS

LVL	DESCRIPTION	DRWN/APVD	DATE
P1	ECO #771	CS/CW	7/8/96
A	ECO 862	CS/CW	11/21/96
B	ECO 1053	CS/BS	04/02/97
C	ECO 1156	EE/PG	07/25/97
D	ECO 1104	CS/BL	10/14/97
E	ECO 1231	EE/PB	11/03/97
F	ECO 1359, ADDED "Z" LABEL	CS/BL	03/03/98
G	ECO 1379, ADDED "AA" LABEL	CS/JHT	03/20/98
H	ECO 1444, ADDED "BB" LABEL	CS/PG	06/19/98
I	ECO 1480, ADDED "CC" LABEL	CS/JHT	08/25/98
J	CORRECT NUMBERING ERRORS	NP/CA	07/07/99

LUMONICS

TITLE: LABEL IDENTIFICATION–ENGLISH SET

SCALE: NONE | SIZE: B | DRAWING NO. 2950169–01

DO NOT SCALE DRAWING | SHEET 1 OF 2

MINI-BEAM Installation and Alignment

Proper operation of these sensors requires that they be mounted securely and aligned properly. For best results, final-mount these sensors in an 18 mm hole by their threaded barrel or use one of the available mounting brackets, (see pages 6 - 7).

1) Begin with the sensor at the desired distance from the retro target and at the approximate position where it will be mounted. An object at the sensing position should pass through the "core" of the sensor's light beam.

2) Apply power to the sensor, and advance the sensor's 15-turn GAIN control to maximum (clockwise end of rotation). If the sensor is "seeing" the reflected light beam, the alignment LED should be "on". Move the sensor up-down-right-left to obtain the fastest receiver LED pulse rate. (alternatively, the retro target may be moved.) If a pulse is not observable (too fast to count), reduce the GAIN control (counterclockwise rotation) to obtain a countable pulse rate. (As an aid to alignment, it may be necessary to further reduce the strength of the light signal by tape-masking a portion of the retroreflective target area.)

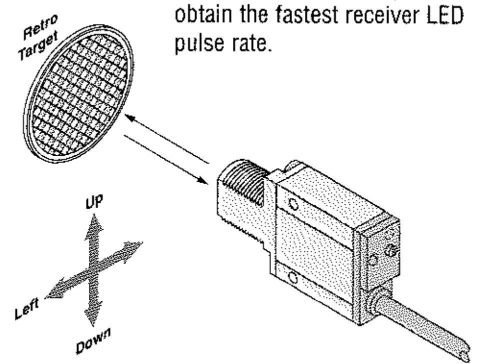
3) Repeat the alignment motions after each GAIN reduction. When you have found the sensor orientation that produces the fastest pulse rate, mount the sensor (or reflector) solidly in that position. Increase the receiver GAIN to maximum. Test the system by placing the object to be detected into the sensing position. The indicator should go "off". If an "LV" model sensor's indicator does not go "off" at this point, the sensor is reacting to light reflected from the object ("proxing").

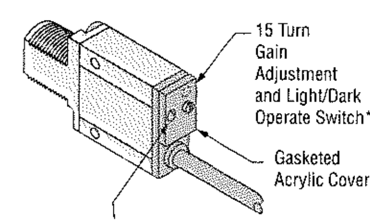
   If proxing occurs, reduce the GAIN setting until the alignment indicator goes "off", plus two additional full turns. Remove the object from the sensing position and check that the alignment indicator LED comes "on" and pulses at a rate of at least two flashes per second. Confirm that the LED goes "off" when the object is replaced.

   Proxing can be avoided by mounting the sensor so that it's light beam is not perpendicular to any flat reflective surface on the object to be detected (an angle of 10 to 15 degrees is usually sufficient). Also, at distances of a few feet or more, using more than one reflector may increase sensing contrast between object-present and object-absent.

Retroreflective Mode Alignment

Move sensor (or target) to obtain the fastest receiver LED pulse rate.

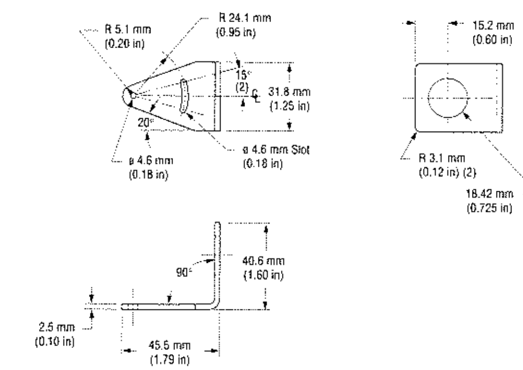
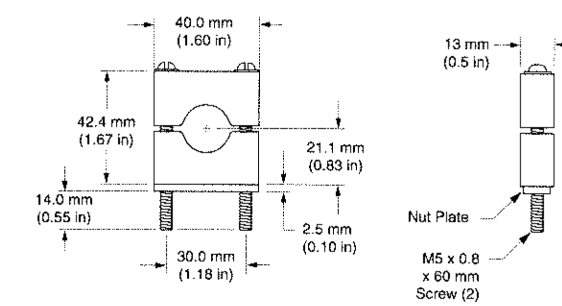
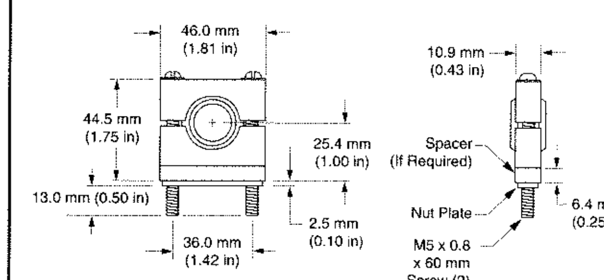




"AID" Indicator LED Lights when the sensor sees the reflection of its own modulated light and pulses at a rate proportional to the received light signal.

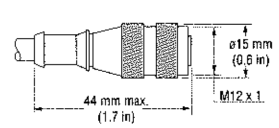
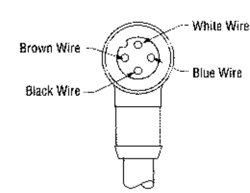
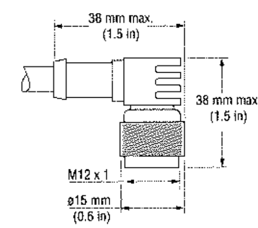
* **Note regarding Light/Dark operate switch:**
- Turn switch *fully* clockwise for light operate (sensor outputs conduct when sensing light is received)
- Turn switch *fully* counterclockwise for dark operate (sensor outputs conduct when sensing light is not received)

Mounting Brackets

Model	Description	Dimensions
SMB312PD	• Stainless steel 18 mm barrel-mounting bracket	
SMB18C	• 18 mm split clamp black thermoplastic polyester bracket • Stainless steel mounting hardware included	
SMB18S	• 18 mm swivel, black thermoplastic polyester bracket • Stainless steel mounting hardware included	

Euro-Style Quick-Disconnect Cables

Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 22 or 20 AWG high-flex stranded, PVC insulation, gold-plated contacts
Temperature: -40° to +90°C (-40° to +194°F)
Voltage Rating: 250V ac/300V dc

Style	Model	Length	Used with:	Dimensions	Pin-out
4-Pin Straight	**MQDC-406** **MQDC-415** **MQDC-430**	2 m (6.5') 5 m (15') 9 m (30')	• MINI-BEAM dc SM312 series		
4-Pin Right-angle	**MQDC-406RA** **MQDC-415RA** **MQDC-430RA**	2 m (6.5') 5 m (15') 9 m (30')			

the photoelectric specialist

⚠ **WARNING . . . Not To Be Used for Personnel Protection**

Never use this product as a sensing device for personnel protection. Doing so could lead to serious injury or death.

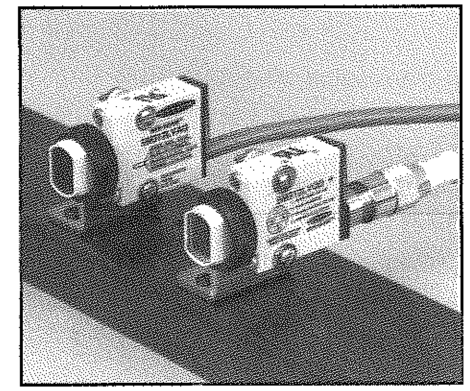
This product does NOT include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition. Consult your current Banner Safety Products catalog for safety products which meet OSHA, ANSI and IEC standards for personnel protection.

WARRANTY: Banner Engineering Corp. warrants its products to be free from defects for one year. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture found to be defective at the time it is returned to the factory during the warranty period. This warranty does not cover damage or liability for the improper application of Banner products. This warranty is in lieu of any other warranty either expressed or implied.

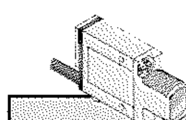
the photoelectric specialist

MINI-BEAM® SM312LV, SM312LVAG and SM312LP

Self-contained DC-operated Retroreflective Mode Sensors



- Compact, modulated, self-contained retroreflective sensors for 10-30V dc operation
- Choose standard visible model for highest excess gain and greatest range, or polarized models for detection of shiny objects
- Includes Banner's exclusive AID™ alignment system; US patent number 4356393
- Switch-selectable for light operate or dark operate
- Highly repeatable 1 millisecond response
- Both sourcing and sinking outputs (150 mA max. each); continuous overload and short-circuit protected
- Physically and electrically interchangeable with 18 mm barrel-type photoelectrics

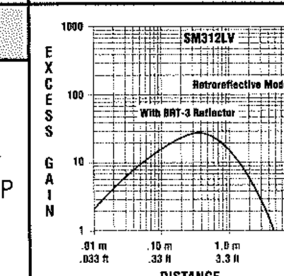
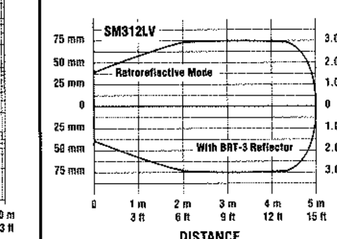
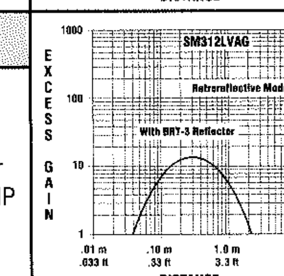
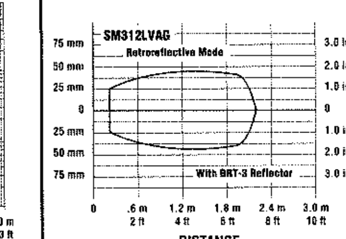
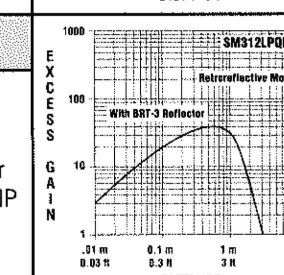
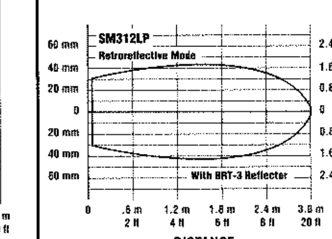


NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) used. See the Banner Photoelectric Sensors catalog for more information on available retroreflectors.

Visible red, 650 nm

Non-Polarized   Polarized

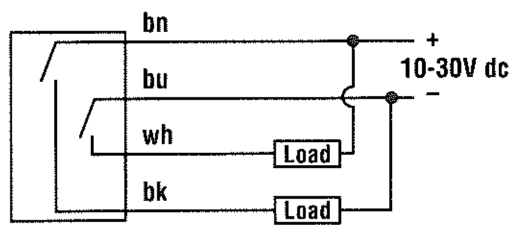
DC MINI-BEAM Retroreflective Mode Models

Models*	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Non-Polarized						
SM312LV **SM312LVQD**	5 m (15')	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
Polarized						
SM312LVAG **SM312LVAGQD**	50 mm to 2 m (2" to 7')	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
Extended Range Polarized						
SM312LP **SM312LPQD**	10 mm to 3 m (0.4" to 10')	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		

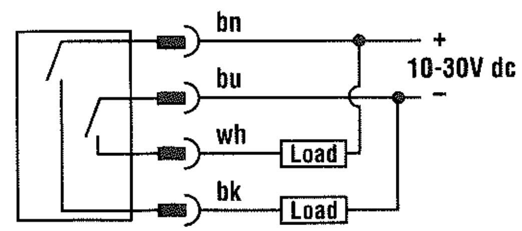
*See notes on page 3.

MINI-BEAM DC Hookup Diagrams

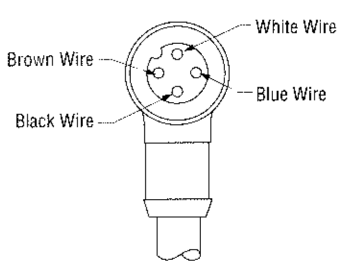
DC Sensors with Attached Cable



DC Sensors with Quick Disconnect (4-Pin Euro-Style)



4-Pin Euro-Style Pin-out (Cable Connector Shown)



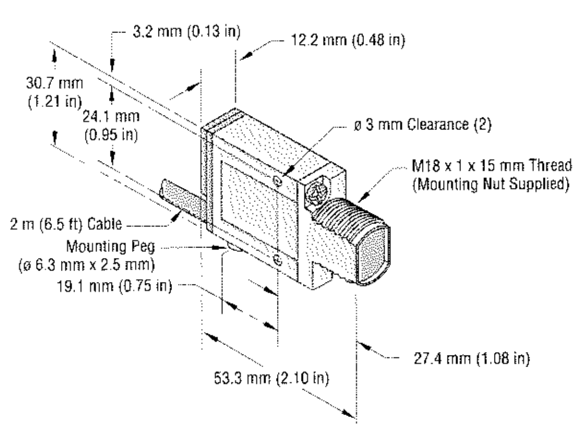
Quick Disconnect (QD) Option

DC MINI-BEAM sensors are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable, or with a 4-pin Euro-style QD cable fitting.

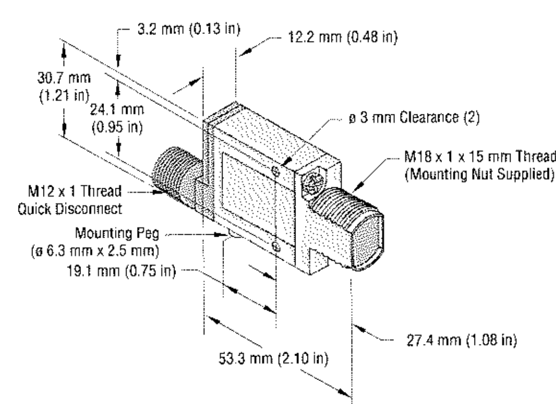
DC QD sensors are identified by the letters "QD" in their model number suffix. Mating cables for QD MINI-BEAM sensors are model MQDC-415 (straight connector) or MQDC-415RA (right-angled connector). Cables are supplied in a standard length of 5 m (15'). For more information on QD cables, see page 8.

MINI-BEAM Dimension Information

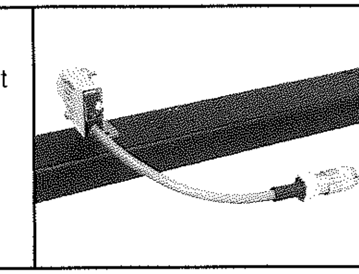
MINI-BEAM DC Sensor with Integral Cable



MINI-BEAM DC Sensor with Quick-Disconnect

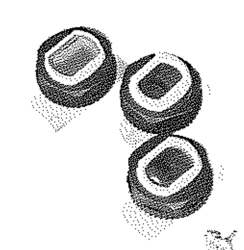


MINI-BEAM Modifications

Model Suffix	Modification	Description		Example of Model Number
W/30	9 meter (30') cable	All MINI-BEAM sensors may be ordered with an integral 9 m (30') cable in place of the standard 2 m (6.5') cable		SM312LP W/30
MHS	Modified for High Speed	Standard dc MINI-BEAM sensors with 1 millisecond output response may be modified for 0.3 millisecond (300 µs) response. NOTE: Faster response comes at the expense of lower excess gain. Also, operating temperature range becomes -20° to +50°C (-4° to +122°F)		SM312LPMHS
QDP	Pigtail Quick Disconnect	All MINI-BEAMs may be built with a 150 mm (6") long integral cable which is terminated with the appropriate QD connector.		SM312LPQDP

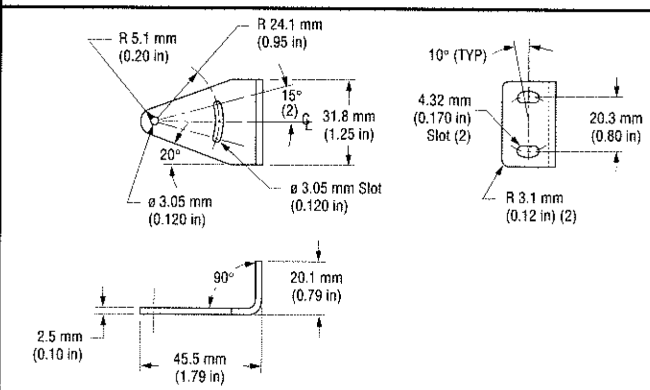
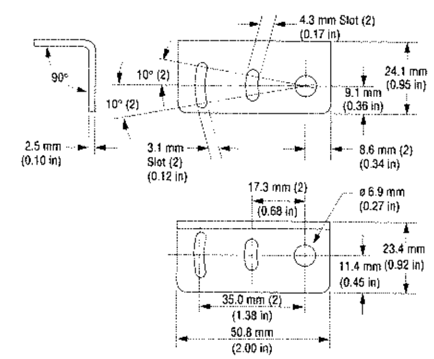
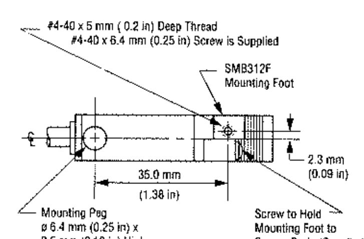
Replacement Lens Assemblies

MINI-BEAM lens assemblies are field-replaceable.

Model	Description	
UC-300AG	Replacement lens for LVAG	
UC-300L	Replacement lens for LV	
UC-300LP	Replacement lens for LP	

Retroreflective Targets

Banner offers a wide selection of high-quality retroreflective targets. See the Banner Photoelectric Sensors Catalog.

Mounting Brackets		
Model	**Description**	**Dimensions**
SMB312S	Stainless steel 2-axis, side mounting bracket	
SMB312B	Stainless steel 2-axis, bottom mounting bracket Includes SMB12F (below)	
SMB312F	• A mounting foot used to attach to bottom surface of any MINI-BEAM sensor to a flat mounting surface • Attaches securely beneath the MINI-BEAM sensor's barrel using a special extra-long upper cover mounting screw (supplied)	

MINI-BEAM DC Product Specifications	
Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than 25mA (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Bipolar: One current sourcing (PNP) and one current sinking (NPN) open-collector transistor
Output Rating	150mA maximum each output at 25°C, derated to 100mA at 70°C (derate ≈1mA per °C) **Off-state leakage current** less than 1 microamp **Output saturation voltage** (PNP output) less than 1 volt at 10mA and less than 2 volts at 150mA **Output saturation voltage** (NPN output) less than 200 millivolts at 10mA and less than 1 volt at 150mA
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short-circuit of outputs
Output Response Time	Sensors will respond to either a "light" or a "dark" signal of 1 millisecond or longer duration, 500Hz max. 0.3 millisecond response modification is available. See Note below. 100 millisecond delay on power-up; outputs do not conduct during this time.
Repeatability	0.3 milliseconds. Response time and repeatability specifications are independent of signal strength.
Adjustments	LIGHT/DARK OPERATE select switch, and 15-turn slotted brass screw GAIN (sensitivity) adjustment potentiometer (clutched at both ends of travel). Both controls are located on rear panel of sensor and protected by a gasketed, clear acrylic cover.
Indicators	Exclusive, patented Alignment Indicating Device system (AID™, US patent #4356393) lights a rear-panel mounted red LED indicator whenever the sensor sees a "light" condition, with a superimposed pulse rate proportional to the light signal strength (the stronger the signal, the faster the pulse rate).
Construction	Reinforced PBT thermoplastic polyester housing, totally encapsulated, o-ring sealing, acrylic lenses, and stainless steel screws.
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 6, 12, and 13; IEC IP67
Connections	PVC-jacketed 4-conductor 2 m (6.5') or 9 m (30') cables, or 4-pin Euro-style quick disconnect (QD) fitting are available. QD cables are ordered separately. See page 8.
Operating Temperature	**Temperature:** -20° to +70° C (-4° to +158° F) **Maximum relative humidity:** 90% at 50° C (non-condensing)
Application Notes	The NPN (current sinking) output of dc MINI-BEAM sensors is directly compatible as an input to Banner logic modules, including all non-amplified MAXI-AMP and MICRO-AMP modules. MINI-BEAMs are TTL compatible.
Certifications	CE

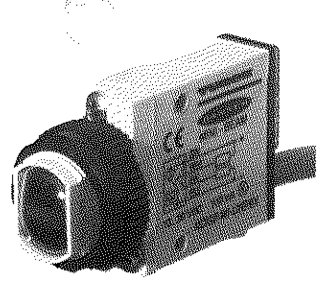
NOTES:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g., **SM312LP W/30**).

ii) Standard models have 1 millisecond output response; models with 0.3 millisecond (300 microsecond) response are available by adding suffix **"MHS"** to the model number (e.g., **SM312LPMHS**). Note that this modification reduces the maximum operating temperature to +50° C (122° F).

iii) A 150 mm (6") long pigtail cable with attached QD connector is available by adding suffix "QDP" to the model number (e.g., **SM312LPQDP**).

iv) A model with a QD connector requires an optional mating cable (see accessories, page 8).



MINI-BEAM

Installatio Sheet
Einbauhinweise
Consiglio d'installazione
Conseils d'installation
取扱説明書
Folleto de instalación

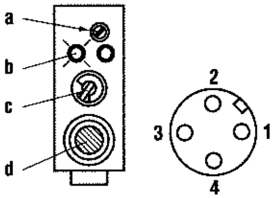
BANNER®
the photoelectric specialist
9714 Tenth Avenue North
Minneapolis. MN 55441 USA
Telephone: (763) 544-3164
Fax: (763) 544-3213

TYPE	ALTERNATE TYPE	DESCRIPTION	BESCHREIBUNG	DESCRIZIONE	DESCRIPTION	検出距離・モード	DESCRIPCIÓN
ROS5m-Mi-UNP6X	SM312LV	5 m Retro-reflective	5 m Reflexionslichtschranke	5 m Catarifrangenti	5 m Rétro-réflectif	5m 回帰反射形	5 m Retroreflex
ROS5m-Mi-UNP6X-H1141	SM312LVQD						
ROP3m-Mi-UNP6X	SM312LVAG	2 m Polarized retro-reflective	2 m Reflexlichtschr. mit Polarisationsfilter	2 m Catarifrangenti con filtro polarizzatore	2 m Rétro-réflectif avec filtre de polarisation	2m 偏光回帰反射形	2 m Retroreflex con filtro de polarización
ROP3m-Mi-UNP6X-H1141	SM312LVAGQD						
ROPL3m-Mi-UNP6X	SM312LP	3 m Polarized retro-reflective	3 m Reflexlichtschr. mit Polarisationsfilter	3 m Catarifrangenti con filtro polarizzatore	3 m Rétro-réflectif avec filtre de polarisation	3m 偏光回帰反射形	3 m Retroreflex con filtro de polarización
ROPL3m-Mi-UNP6X-H1141	SM312LPQD						
NO10-Mi-UNP6X	SM312W	13 cm Divergent diffuse	13 cm divergenter Reflescionslichttaster	13 cm A divergente diffusione	13 cm Divergent diffus	130 mm 拡散反射形	13 cm Detección directa divergente
NO10-Mi-UNP6X-H1141	SM312WQD						
NO30-Mi-UNP6X	SM312D	38 cm Diffuse	38 cm Reflexionslichttaster	38 cm A diffusione	38 cm Diffus	380 mm 拡散反射形	38 cm Palpación directa
NO30-Mi-UNP6X-H1141	SM312DQD						
KOS2-Mi-UNP6X	SM312CV	16 mm Convergent red	16 mm Winkellichttaster - rot	16 mm Convergente - rosso	16 mm Convergent - rouge	16mm 限定反射形 赤色可視光	16 mm Focalizada - rojo
KOS2-Mi-UNP6X-H1141	SM312CVQD						
KOS4-Mi-UNP6X	SM312CV2	43 mm Convergent red	43 mm Winkellichttaster - rot	43 mm Convergente - rosso	43 mm Convergent - rouge	43mm 限定反射形 赤色可視光	43 mm Focalizada - rojo
KOS4-Mi-UNP6X-H1141	SM312CV2QD						
KOG2-Mi-UNP6X	SM312CVG	16 mm Convergent green	16 mm Winkellichttaster - grün	16 mm Convergente - verde	16 mm Convergent - vert	16mm 限定反射形 緑色可視光	16 mm Focalizada - verde
KOG2-Mi-UNP6X-H1141	SM312CVGQD						
KOB2-Mi-UNP6X	SM312CVB	16 mm Convergent blue	16 mm Winkellichttaster - blau	16 mm Convergente - blu	16 mm Convergent - bleu	16mm 限定反射形 青色可視光	16 mm Focalizada - azul
KOB2-Mi-UNP6X-H1141	SM312CVBQD						
SO3m-Mi-6	SM31E	3 m Opposed emitter	3 m Einweglichtschranke Sender	3 m Barriera emettitori	3 m Barrière émetteur	3m 透過形 投光器	3 m Barrera emisor
SO3m-Mi-6-H1141	SM31EQD						
EO3m-Mi-UNP6X	SM31R	3 m Opposed receiver	3 m Einweglichtschranke Empfänger	3 m Barriera ricevitori	3 m Barrière récepteur	3m 透過形 受光器	3 m Barrera receptor
EO3m-Mi-UNP6X-H1141	SM31RQD						
SO10m-Mi-6	SM31EL	30 m Opposed emitter	30 m Einweglichtschranke Sender	30 m Barriera emettitori	30 m Barrière émetteur	30m 透過形 投光器	30 m Barrera emisor
SO10m-Mi-6-H1141	SM31ELQD						
EO10m-Mi-UNP6X	SM31RL	30 m Opposed receiver	30 m Einweglichtschranke Empfänger	30 m Barriera ricevitori	30 m Barrière récepteur	30m 透過形 受光器	30 m Barrera receptor
EO10m-Mi-UNP6X-H1141	SM31RLQD						
FO-Mi-UNP6X	SM312F	Glass fibre optic infrared	Glas Lichtwellenleiter - infrarot	Fibre ottiche di vetro - infrarosso	Fibres optiques en verre - infrarouge	グラスファイバ用アンプ 赤外光	Fibras ópticas de vidrio - infrarojo
FO-Mi-UNP6X-H1141	SM312FQD						
FOS-Mi-UNP6X	SM312FV	Glass fibre optic red	Glas Lichtwellenleiter - rot	Fibre ottiche di vetro - rosso	Fibres optiques en verre - rouge	グラスファイバ用アンプ 赤色可視光	Fibras ópticas de vidrio - rojo
FOS-Mi-UNP6X-H1141	SM312FVQD						
FOB-Mi-UNP6X	SM312FVB	Glass fibre optic blue	Glas Lichtwellenleiter - blau	Fibre ottiche di vetro - blu	Fibres optiques en verre - bleu	グラスファイバ用アンプ 青色可視光	Fibras ópticas de vidrio - azul
FOB-Mi-UNP6X-H1141	SM312FVBQD						
FOP-Mi-UNP6X	SM312FP	Plastic fibre optic red	Kunststoff Lichtwellenleiter - rot	Fibre ottiche di plastica - rosso	Fibres optiques en plastique - rouge	プラスチックファイバ用アンプ 赤色可視光	Fibras ópticas de plástico - rojo
FOP-Mi-UNP6X-H1141	SM312FPQD						
FOBP-Mi-UNP6X	SM312FPB	Plastic fibre optic blue	Kunststoff Lichtwellenleiter - blau	Fibre ottiche di plastica - blu	Fibres optiques en plastique - bleu	プラスチックファイバ用アンプ 青色可視光	Fibras ópticas de plástico - azul
FOBP-Mi-UNP6X-H1141	SM312FPBQD						

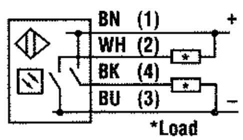
SPECIFICATION	CHARAKTERISTIKEN	SPECIFICHE	CARACTÉRISTIQUES	仕様	CARACTERÍSTICAS	
Supply Voltage	Betriebsspannung	Tensione di alimentazione	Tension d'alimentation	電源電圧	Tensión de alimentación	10...30 VDC
Load Current (max.)	Bemessungsbetriebsstrom	Corrente a carico continuo	Courant de charge	負荷電流	Corriente de carga continua	150 mA
Enclosure	Schutzart	Classe di protezione	Mode de protection	保護構造	Tipo de protección	IP67
Circuit Protection*	Schutzschaltungen	Protezione	Protection	保護回路	Protección	A+B *
Temperature Rating	Zul. Umgebungstemperatur	Temperature di funzionamento	Température ambiante admissible	使用周囲温度範囲	Intervalo de temperatura	-20...+70°C
*Reverse polarity (A) *Short-circuit (B)	*Verpolschutz (A) *Kurzschlussschutz (B)	*Inversione di polarità (A) *Cortocircuito (B)	*Inversion de polarité (A) *Courts-circuits (B)	＊逆配 (A) ＊短絡 (B)	*Inversión de polaridad (A) *Cortocircuitos (B)	

PACKING LIST	LIEFERUMFANG	[illegible]NG LIST	LIVRAISON	同梱品リスト	A[illegible]RAN
Sensor	Sensor	Sensore	Détecteur	センサ	Sensor
Data sheet	Datenblatt	Data sheet	Notice technique	データシート	Hoja de caracteristicas
Screws M18, AF24*	Montagemutter M18, SW24*	Dado di fissaggio M18, CH24*	Ecrous de montage M18, clé 24*	締付ナット M18x1＊	Tuerca de montaje M18, CH24*

*Except for SM312FP and SM312W — *Nicht für FOP-... und N010 — *Non valido per SM312FP ne per SM312W — *Sauf pour SM312FP et SM312W — ＊SM312FPとSM312Wを除く — *No para SM312FP y SM312W

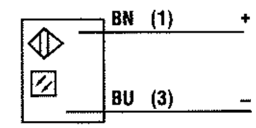


a	Sensitivity adjustment	Empfindlichkeitseinstellung	Sensibilità regolabile	Réglage de sensibilité	感度調整ボリューム	Calibración de sensibilidad
b	AID LED	AID LED	AID LED	AID LED	受光量表示（赤）	AID LED
c	Light/Dark operate switch	wahlweise hell-/dunkelschaltend	Funzionamento buio o luce	Commutation sombre/claire	ライトオン/ダークオン切替スイッチ	Activación con y sin luz
d	Cable or Quick Disconnect (QD)	Kabel oder *Eurofast* Steckverbinder	Cavo o connettore *Eurofast*	Câble ou connecteur *Eurofast*	ケーブルまたはQDコネクタ	Cable o conector *Eurofast*

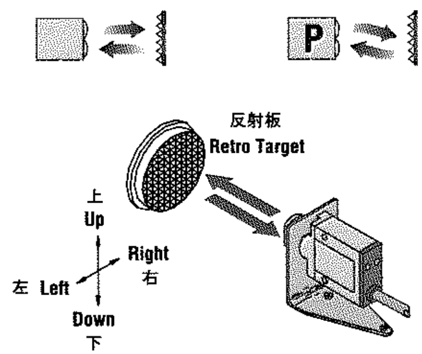


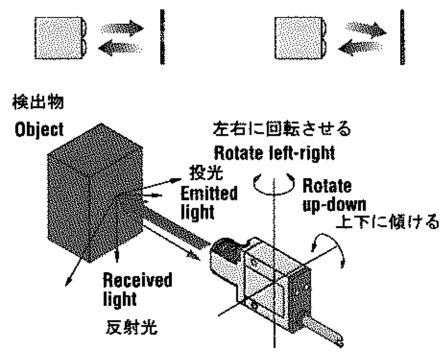
	CONNECTIONS	ANSCHLUSS	CONNESSIONE	RACCORDEMENT	配線	CONEXIONES
BN	Brown	braun	marrone	brun	茶	marrón
WH	White	weiß	bianco	blanc	白	blanco
BK	Black	schwarz	nero	noir	黒	negro
BU	Blue	blau	blu	bleu	青	azul
*LOAD	Load	Last	Carico	Charge	負荷	Carga

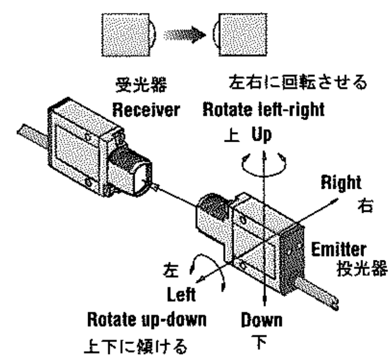
Emitter only 投光器側配線



ALIGNMENT
JUSTAGE
ALLINEAMENTO
REGLAGE
光軸調整
ALINEACION







IMPORTANT SAFETY WARNING !	The sensors described in this data sheet do NOT include the self-checking redundant circuitry necessary to allow their use in personnel safety applications. A sensor failure or malfunction can result in either an energised or de-energised output condition. Never use these products as sensing devices for personnel safety.
WARNUNG, BITTE BEACHTEN !	Die in diesem Beipackzettel beschriebenen Sensoren dürfen nicht für Personenschutz-Einrichtungen eingesetzt werden. Sie verfügen weder über die dafür notwendigen redundanten Sicherheitskomponenten, noch liegen für sie die notwendigen gesetzlich vorgeschriebenen Zulassungen vor.
IMPORTANTE AVVISO DI SICUREZZA !	I sensori descritti in questo prospetto NON contengono i circuiti di auto-diagnosi ridondante necessari per consentire il loro uso in applicazioni antinfortunistiche. Il mancato o difettoso funzionamento di un sensore può verificarsi sia in presenza che in assenza di corrente. Non usare mai questi prodotti come sensori di protezione di sicurezza.
ATTENTION !	Les détecteurs décrits dans le présent document ne disposent pas de dispositifs nécessaires pour pouvoir être utilisés dans des applications de protection de personnes. Une panne du détecteur peut commuter ou non la sortie. Ces appareils ne doivent jamais être utilisés comme détecteurs de protection de personnes.
安全上の重要な警告	この取扱説明書に記載されているセンサは、安全用として必要な自己診断や二重化の回路を含んでおりません。センサの故障や動作異常による出力の状態は、導通であったり、非導通になり得ます。これらのセンサは、決して人身安全用の検出機器として使用しないでください。
ADVERTENCIA !	Estos sensores fotoeléctricos de presencia NO incluyen los circuitos redundantes de autocomprobación necesarios para usarlos en situaciones que comprometan la seguridad de las personas. El fallo o mal funcionamiento de un sensor puede hacer que sus bornes de salida queden en condición tanto activa como inactiva.