Progeny, Inc.

1407 Barclay Blvd.
Buffalo Grove, IL 60089

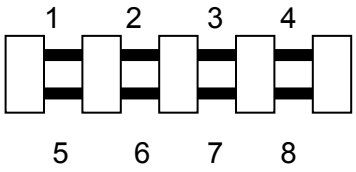
(847) 850-3800
FAX: (847) 850-3801

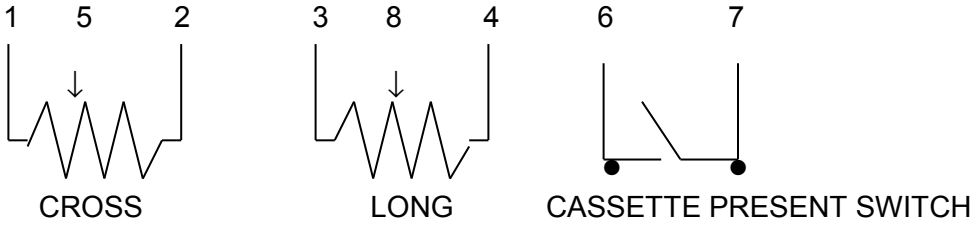
PLEASE READ!

The Eureka Collimators have been 100% tested and calibrated at the factory. Our intention is that you will only have to confirm operation, then re-adjust SID voltages to match the collimator and the image receptor (cassette tray) after the unit is installed.

We have calibrated the collimator around a cassette tray that is calibrated at 500 ohms for an 11" (12 – 1/8" outside) cassette. The 11" dimension represents exactly one-half excursion of the 1K ohm cassette tray potentiometer. We suggest that you check, and adjust, if necessary, your cassette tray(s). Below is the size-versus-ohms chart:

CASSETTE FILM/SIZE	OHMS @ PINS 1 & 5 AND 4 & 8
5"	60 ohms
7"	207 ohms
8"	280 ohms
10"	427 ohms
11"	500 ohms
12"	573 ohms
14"	720 ohms
17"	940 ohms





SHOULD YOU HAVE ANY QUESTIONS, PLEASE CALL PROGENY X-RAY FIELD APPLICATIONS: TONY BAVUSO (847) 850-3800 X239

EUREKA

Progeny, Inc.
1407 Barclay Blvd.
Buffalo Grove, IL 60089

Tel. (847) 850-3800
Fax (847) 850-3801

LINEAR™ II DIGITAL

OWNER/OPERATOR and INSTALLATION MANUAL

00-02-1559
Rev. S ECN: P1095
November 2005

PROGENY, INC.
Manufacturers of Eureka Collimators and Cables

INSTALLATION ADVISORY

TO: INSTALLERS, SERVICE PERSONNEL, AND USERS OF X-RAY SYSTEMS

COLLIMATOR MOUNTING INFORMATION

In order to ensure a safe and secure mounting of this collimator to the x-ray tube housing, the following installation guidelines must be followed:

1. Two different length screws are provided in the cloth bag containing the spacers. Determine the correct length of screw to use, taking into account the collimator spacing requirements and/or peculiarities of the tube housing port boss.

2. Clean the screws and housing port boss with alcohol and, if necessary, remove any debris which may be present in the tube housing mounting holes.

3. Securely fasten the upper mounting ring and spacers to the mounting surface located on the tube housing port. As a precaution, a medium strength thread locking compound such as Loctite #242, should be applied to the screws before fastening the collimator mounting ring to the tube housing. The screws provided have a Nylok patch, as vibration resistant mounting screws are strongly recommended.

   Verify that the collimator mounting screws engage the housing by at least five (5) threads when used with the any required collimator spacer plate(s).

4. In order to fasten the Collimator to the Tube Housing, it is necessary that the four (4) collimator detent ball plungers (located on the top of the collimator) are aligned with the detent holes located on the collimator tube mounting plate (i.e. collimator is mounted in either the 0, -90, or +90 degree swivel position).

   NOTE: It is much easier to mount the collimator when the tube is inverted (upside-down) or if the collimator is placed on the table top and the tube is lowered onto it.

5. Carefully support the collimator in place and attach the clamping ring. The hinge of the clamping ring must line up with the pin in the lower mounting ring. Securely fasten the #6-32 socket head cap screw locking the collar halves in place. **Use only the provided Collar Locking Screw (26-00752), do not replace with other hardware. In addition install two (2) Collar Locks (70-10038), which provides a fail-safe for the Collar/Screw Assembly.**

6. After mounting the collimator and/or performing any service to it or the tube housing, inspect the fit of the collimator and the tube housing. Grasp and attempt to move the collimator and then the tube housing assembly while inspecting for loose joints or gaps between the tube/collimator assembly, as well as other tube mounting areas. If a problem is found, consult factory personnel.

7. It is strongly recommended that a periodic inspection (at least every 12 months) should be made to ensure mounting integrity.

WARNING

Failure to adhere to the above guidelines may result in loosening, damaged screws or mount failure which could result in heavy components falling during use. Incidents of loose system components should be reported immediately to x-ray service personnel for repair.

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SECTION 1.0

INTRODUCTION

This product has been tested by Underwriter's Laboratories in conformance with standards set forth by UL 2601-1, CAN/CSA – C22.2 No. 601.1-M-90, and IEC 601-2-32. It has been found to comply with these standards and, therefore, bears the above "Recognized Component" symbol for UL and UL-C.

UL File No. E181750

FRONT PANEL INDICATORS & COLLIMATOR OPERATION

EXPOSURE HOLD INDICATOR
Indicates when:

- Shutters are not properly positioned
- When vertical SID is not positioned at 40" SID
- When horizontal SID is not positioned at standard SID's.

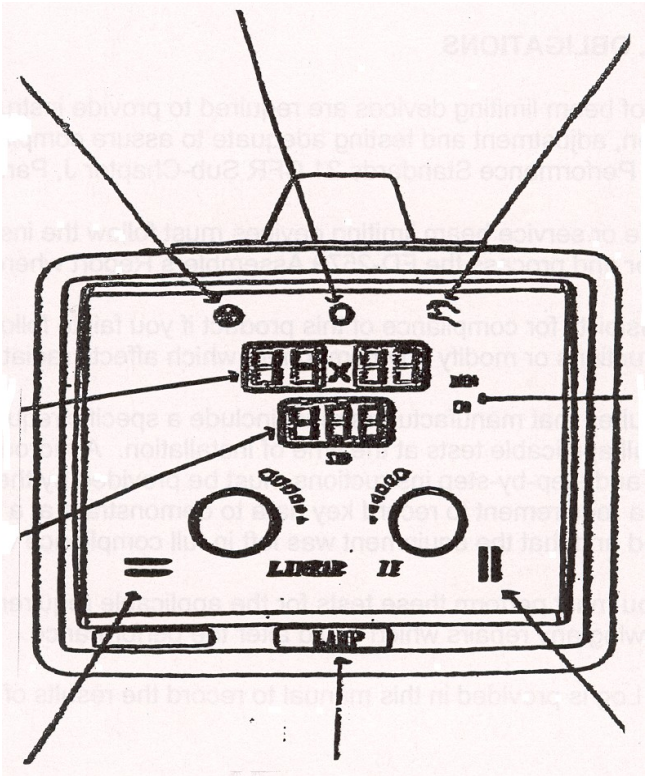
READY INDICATORS:
Dual lamps indicate when each shutter is properly positioned.

MANUAL Indicator:
Indicates when:

- Collimator is tilted greater than ± 10° Table is tilted 10° from vertical or horizontal
- Cassette is not located in cassette tray
- Cassette tray is not fully inserted
- External stereo/tomo command is supplied

Large 7 Segment Display Of Field Size

Large 7 Segment Display Of SID



LED Indication Selectable For English or Metric Units Of Measurement

This dial controls the cross shutters (=).

Push-button to start timed light-field display.

This dial controls the longitudinal shutters (II).

FIGURE 1.1

PBL OPERATION

- Insert cassette into cassette tray
- Press "lamp" pushbutton to activate light field and bucky centering light line. Properly center bucky/cassette.
- Indicators will go from MANUAL to EXP.HOLD while collimator shutters are moving, and then to READY when shutters are properly aligned.
- At this point you may reduce the x-ray field size if desired.

MANUAL OPERATION

- Press the "lamp" pushbutton to activate the light-field. Adjust the shutters (both longitudinal and cross) to a size not larger than the film to be used.
- Center light-field over cassette or anatomical area to be exposed.

1.0 INTRODUCTION

This manual contains information for the assembly, installation, adjustment, testing and maintenance of the LINEAR™ series of radiographic/fluoroscopic collimators manufactured by Progeny, Inc.

1.1 YOU HAVE LEGAL OBLIGATIONS

The manufacturers of beam limiting devices are required to provide instructions for the assembly, installation, adjustment and testing adequate to assure compliance with applicable provisions of DHHS Performance Standards 21 CFR Sub-Chapter J, Part 1020.

Those who assemble or service beam limiting devices must follow the instructions of the original manufacturer and process the FD-2579 Assemblers Report where applicable.

You assume responsibility for compliance of this product if you fail to follow the original manufacturer's instructions or modify any component which affects radiation safety.

The FDA (BRH) requires that manufacturers must include a specific requirement that the assembler perform all applicable tests at the time of installation. A thorough explanation of the equipment required and step-by-step instructions must be provided by the manufacturer. The instructions include a requirement to record key data to demonstrate at a later time that all tests were performed and that the equipment was left in full compliance with the standards.

As an assembler, you must perform these tests for the applicable requirements at the time of installation and following any repairs which could alter the performance.

A Compliance Data Log is provided in this manual to record the results of the tests.

1.2 BACKGROUND

An X-Ray collimator functions as an apparatus for regulating the cross-sectional size and shape of a beam of radiation which emerges from an X-Ray tube.

The source of radiation is virtually a point-source and, due to the tube housing design, emerges from the port as a solid diverging cone of radiation. The finite angle of the anode surface limits the X-Ray beam on the anode side (heel-effect) forming a "D" shaped X-Ray field, limiting the useful coverage.

In "collimating" a beam to a given size and shape, a geared pair of lead shutters are moved symmetrically into the beam to absorb the unwanted portion of the emerging beam. A second geared pair of shutters are positioned at right angles to the first pair, and again are moved symmetrically into the beam. In this manner, a continuously variable square/rectangular beam is formed.

The landing area of the beam will contain a radiographic image receptor located in a plane perpendicular to the beam at pre-determined distances from the radiation source (focal spot).

The size and shape of the image receptor will determine the maximum useful cross-sectional size and shape of the beam in the plane of the image receptor. The source-to-image receptor distance (SID) determines the actual shutter opening required to regulate the beam size and shape in the plane of the image receptor.

“Positive” beam-limiting (PBL) devices incorporate means to prevent X-Ray production until the beam limitation meets the applicable provisions of the Performance Standards.

Automatic PBL devices incorporate motors that regulate the shutter opening as required. Manual PBL devices require the operator to adjust the shutters by the use of knobs, levers, etc.

The primary objective of the electronic logic circuitry is to limit the beam to the size of the image receptor and to provide other standardized operations consistent with the DHHS Performance Standards 21 CFR Sub-Chapter J. This is accomplished by electrically measuring the size of the SID involved. The resultant signal is then compared to a signal which represents the collimator shutter opening to form a means of limiting the beam.

The second objective is to provide convenience features, such as a status indicator light to aid and guide the operator in the use of the collimator, particularly with a manual PBL device.

1.3 LINEAR™ SERIES COLLIMATOR FEATURES

1.3.1 SERVICEABILITY

The Linear™ series collimator logic provides a third objective not included with other similar products – serviceability. This new dimension is incorporated in a manner which allows a single positioning of the collimator above a table top for the diagnostic troubleshooting of the logic and collimator functions. All calibrations are then done by observing the light-field projected onto a test pattern provided with each collimator.

The test pattern, in conjunction with the indicators and miniature programming switches located on the logic circuit board, virtually eliminates the requirement for a digital voltmeter for calibrating the collimator. Instrumentation as a rule will only be required to pinpoint a fault identified by the indicators and programming switches and for external circuitry. Also, locating the logic board on the collimator allows troubleshooting and adjustment from a central location while observing the results. As always, confirming radiation exposures are made with all parties in a radiation-protected area.

After confirming that the logic board and collimator are functional and calibrated, external signals can be selectively applied to check for correct operation. After all external signal sources are confirmed, the programming switches are then set to the “OFF” position with the collimating system returned to the normal operating condition.

1.3.2 MIRROR RETRACTION FEATURE:

When the need arises to visually inspect the port of the X-Ray tube, the mirror may be retracted from the exposure position. Release of the mirror actuator restores the original position of the mirror.

1.4 STANDARD FEATURES (Model Linear II)

The Linear™ II automatic PBL collimation systems from EUREKA include all features required for diagnostic excellence…

… Rated for operation to 150 kVp
… Full manual operation for table-top radiography.
… Automatic PBL operation upon insertion of a cassette into the bucky tray.
… Manual field size reduction after automatic PBL cycle.
… Color coded lights to indicate modes of operation.
… Bright 150 Watt light-field illumination operated by an internal timer.
… Square or rectangular pattern continuously variable from 17" x 17" at 36" SID to fully close.
… Continuous size sensing capability for all metric and inch size cassettes.
… Compatible with Liebel-Flarsheim or Eureka MCT II cassette size sensing bucky and tray.
… Cone track provided for accessories.
… Swivel mount for angulated positioning.

1.5 ADVANCED FEATURES

The Linear™ collimation systems also incorporate features required for diagnostic convenience…

… Digital SID Indicator
… Digital Field Size Display Automatic
… Bright centering light-line which extends from the front of the extended cassette tray across the table-top to beyond the center of the patient, completely eliminates the need for mechanical "pointers".

1.6 TECHNICALLY ADVANCED FEATURES

The Linear™ collimation systems incorporate features for diagnostic down-time reduction…

… Push button for indicator lamp test function.
… Automatic, one-step calibration procedure
… An indicator lamp in the "light" switch will indicate when the field projector bulb requires replacement. A square lamp is provided inside the lamp housing and is easily replaced by the owner/operator.

1.7 SPECIFICATIONS (Model Linear II)

Operation:	Automatic (PBL) within 2 second, and manual.
SID's for PBL:	Vertical SID at 40", 40" and 72" horizontal.
SID Indicator:	Horizontal SID indicators at 40" and 72"
Radiation Shielding:	Rated for 150 kVp. Less than 50 mR/Hr/mA at one meter.
Film Coverage:	Continuously variable from 17" x 17" to 5" x 5" in PBL mode at all listed distances, 17" x 17" to closed in Manual mode.
Light Field:	More than 160 LUX (15 footcandles) with a minimum edge contrast ratio of 4:1 at one meter. Controlled by internal timer.
Accuracy:	2% of SID in use.
X-Ray Field Accuracy:	Within 2% of SID in use in length and width. (Sum less than 4%.)
Bucky Light-Line:	Bright center line extending from center of field to withdrawn tray.
PBL By-Pass:	Accepts by-pass signal from control for stereographic and tomographic operation.
Mirror/Filtration Retraction:	Mirror retraction for port viewing.
Inherent Filtration:	2.0 mm (min.) aluminum equivalent at 100 kVp and above.
Power Requirement:	230-250 or 115-125 VA, 50/60 Hz, 2 Amp, 3 Wire, 1 Phase
Light-Field Lamp:	Type DZE, 24 VAC, 150 WATT (GE).
Weight:	19 lbs. (collimator head only).

NOTE: Specifications subject to change without notice.

1.8 RADIATION AND MECHANICAL/ELECTRICAL WARNING (from NEMA Standards Publication/No. XR8-1979)

Radiation Warning for Diagnostic X-Ray Systems

X-rays are dangerous to both operator and others in the vicinity unless established, safe, exposure procedures are strictly observed.

The useful and scattered beams can produce serious, genetic or potentially fatal bodily injuries to any persons in the surrounding area if used by an unskilled operator. Adequate precautions must always be taken to avoid exposure to the useful beam, as well as to leakage radiation from within the source housing or to scattered radiation resulting from the passage of radiation through matter.

Those authorized to operate, test, participate in or supervise the operation of the equipment must be thoroughly familiar, and comply completely with the currently established safe exposure factors and procedures described in publications such as Sub-Chapter J of Title 21 of the Code of Federal Regulations, *"Diagnostic X-Ray Systems and their Major Components,"* and the National Council on Radiation Protection (NCRP) No. 33, *"Medical X-Ray and Gamma-Ray Protection for Energies up to 10 MeV-Equipment Design and Use,"* as revised or replaced in the future.

Failure to observe these warnings may cause serious, genetic or potentially fatal bodily injuries to the operator or those in the area

Mechanical-Electrical Warning for Diagnostic X-Ray Systems

All of the moveable assemblies and parts of X-Ray equipment should be operated with care.

Only properly trained and qualified personnel should be permitted access to any internal parts. Live electrical terminals are deadly; be sure line disconnect switches are opened and other appropriate precautions are taken before opening access doors, removing enclosure panels, or attaching accessories.

Do not remove the flexible high tension cables from the X-Ray tube housing, or high tension generator, or the access covers from the generator until the main and auxiliary power supplies have been disconnected.

When disconnecting high voltage cables, they must be grounded immediately in order to dissipate any electrical charge that may remain on the cables or the tube.

Failure to comply with the foregoing may result in serious or potentially fatal bodily injuries to the operator or those in the area.

1.9 COMPATIBILITY

The Linear™ series collimators are compatible and can be adapted for use with X-Ray tube/housing assemblies that meet all of the following factors:

1. Focal Distance of X-Ray Tube:

   The focal spot to collimator mounting flange distance must be 2.44 inches, $\pm$ 0.031 inches (1/32”). Four (4) spacers are supplies for adaptation:

   1 – 1/4 inch (0.25”) spacer

   3 – 1/16 inch (0.06”) spacer

   Use any of the above combination to achieve the requirements.

2. Leakage Radiation:

   Maximum leakage radiation from the X-Ray tube/housing assembly must not exceed 50 mR/hr at 100 cm (40 inches) at specified leakage technical factors. This collimator is compatible with all x-ray tube housing assemblies having leakage technique factors of 150 kV and 4 mA.

3. Inherent Filtration and Half-Value Layer:

   The Eureka Linear™ collimator has a minimum value of 2.0 mm aluminum equivalence at 100 kV. This value plus any tube inherent filtration plus any added filtration must meet the minimum requirements of 21 CFR Sub-Chapter J, Part 1020.30 (m)(1) Table 1 on beam quality (e.g. minimum HVL at 100 kV must be 2.7 mm Al.

4. Application:

   The intended application is for general purpose radiographic equipment, including tomographic and chest applications. Maximum tube rating must be 150 kV or less.

5. Installation:

   Must be made with supplied hardware, including mounting flange, spacers (as required) and four (4) ¼" x 20 bolts equally spaced on a 3.62" diameter bolt center.

1.10 MAINTENANCE

The Collimator system must be properly maintained to assure both compliance with BRH regulations and useful life.

Preventive maintenance is to be preformed once every twelve months. This includes inspection and lubrication of both the cassette tray(s) and collimator mechanism. The collimator mounting ring and locking screw (70-10036 and 26-00752) should be examined to ensure secure mounting of the collimator. **ONLY PROGENY P/N 26-00752 COLLAR LOCKING SCREW SHOULD BE USED.**

Checkout should also occur if any of the following conditions occur:

- Lamp replacement
- Premature electronic component failure
- When collimator is removed from tube/housing assembly
- When collimator and/or cassette tray have been subjected to external damage.

Refer to section 3.0 for collimator CHECK-OUT procedure, and refer to the cassette tray manual for tray maintenance.

1.11 COMPLIANCE REQUIREMENTS

It is necessary to the assembler to verify compliance. A series of tests, when performed at the time of installation, will indicate compliance with 21 CFR, Sub-Chapter J, Part 1020, Performance Standards. These tests which are described in Section 6.0, "Compliance Verification", must be performed before releasing the collimator for use. A Record Sheet is provided at the end of Section 6.0 and should be completed by the installer. In order to avoid wasted effort, the installation, checkout and adjustment procedures described in Sections 2.0 through 5.0 should be completed prior to performing the compliance tests.

1.12 EUROPEAN REPRESENTATIVE

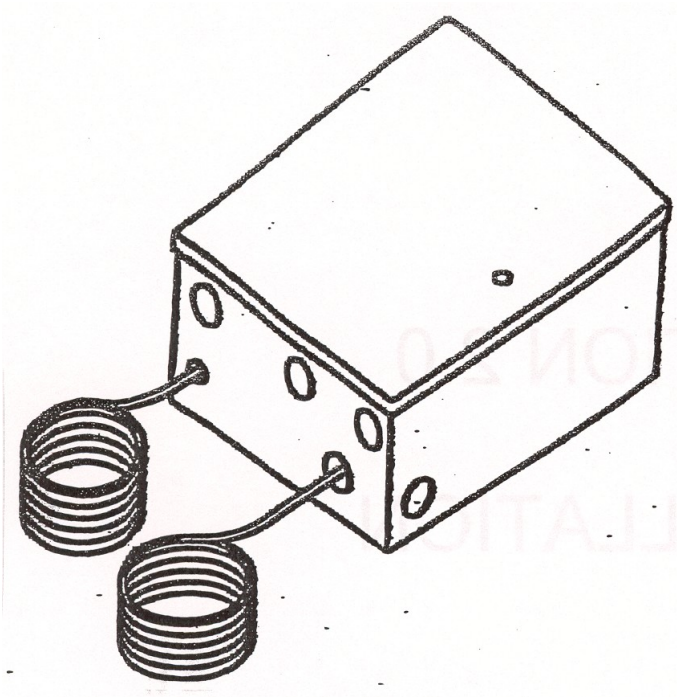
Progeny, Inc. has contracted with the following company to act as a European Authorized Representative relative to the requirements of EN46001 and the Medical Device Directive:

CE Partner 4U
Esdoornlaah 13
3951DB Maarn
The Netherlands
Phone: +31.343.442.524
Fax: +31.343.442.162

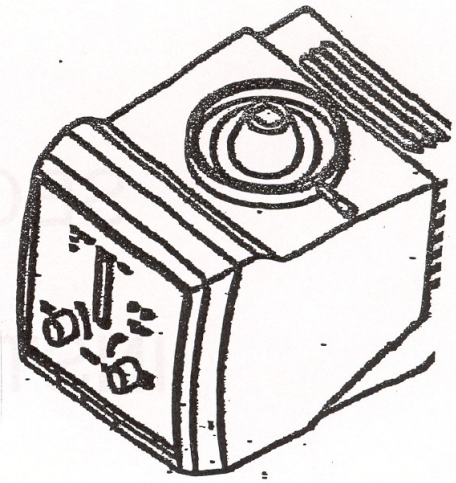
European customers should direct any customer complaints or requests for product technical files to CE Partner 4U.

SECTION 2.0

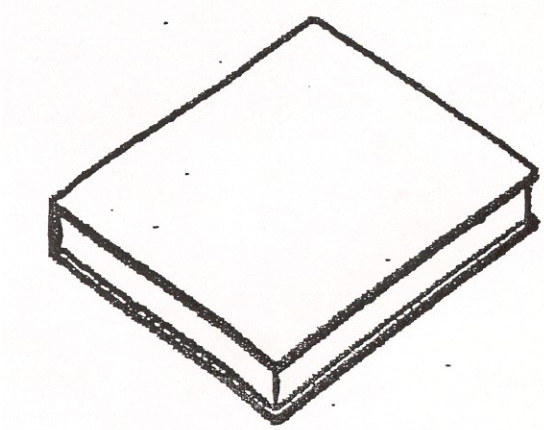
INSTALLATION



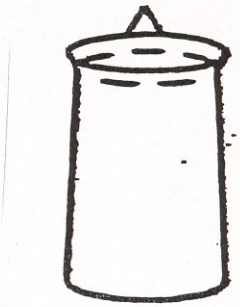
INTERCONNECTING CABLES AND POWER SUPPLY UNIT (OPTIONAL)



LINEAR II COLLIMATOR



MANUAL



SPACERS AND MOUNTING HARDWARE

COMPONENT IDENTIFICATION
FIGURE 2.1

2.0 INSTALLATION

2.1 UNPACKING

Carefully unpack the equipment and check for damage incurred during shipment. Any damage should be referred to the agency that delivered the product.

2.2 EQUIPMENT SUPPLIED

Refer to Figure 2-1 for component identification.

- Linear II Collimator
- Spacers and mounting hardware
- Interconnect and power supply unit
- Packet containing Instruction Manual, Assembler's Report FD-2579, Etc.

2.3 COLLIMATOR MOUNTING

Determine the collimator mounting surface to focal spot distance from the data supplied with the X-Ray tube (do not rely on an inscribed mark on the tube housing).

NOTE: The collimator will not perform properly unless the focal spot to upper swivel ring distance is 2-7/16" (2.44 inches, 62 mm) ± 1/32" (.031 inches, 1 mm). Be sure to include any permanent mounting plates in the focal spot to port boss distance stated in the tube manufacturer's data.

NOTE: The Linear II is designed to be used with a lead diaphragm or cone in the plastic port of the X-Ray tube.

If it is found that lead diaphragms or cones require removal or modification, consult the factory.

Determine the total thickness of the supplied spacer(s) that must be added between the upper swivel ring of the collimator mounting surface, to obtain a focal spot to upper swivel ring distance of 2 7/8" (2.44 inches, 62 mm) ± 1/32" (0.31 inches, 1 mm). Refer to Figure 2.2.

Remove the upper swivel ring from the collimator by removing the 6-32 socket head cap screw and opening the clamping ring.

Securely fasten the upper swivel ring from the collimator by removing the 6-32 socket head cap screw and opening the clamping ring.

Carefully support the collimator in place and re-attach the clamping ring. The hinge of the clamping ring must line up with the pin in the lower mounting ring.

2.4 POWER CHASSIS MOUNTING

The power chassis is a NEMA enclosure intended to be mounted on a wall or in an equipment cabinet. There are knock-outs on the sides and bottom of the enclosure for cable entry. Follow all local wiring codes and locate the enclosure in an area that will permit:

- Cable Bend Radius
- Convection Cooling
- Clearance for Cover Opening

All external connections to the system are made in this chassis. They include:

- AC Power Input
- Table Image Receptor Input
- Wall Image Receptor Input
- Horizontal SID Input
- 40” Vertical SID Input
- Table Tilt Monitor
- Generator Exposure Interlock
- Tomo/Stereo By-Pass Input

Refer to the Power Chassis drawing for mounting dimensions (Figure 2.3).

2.5 INTERCONNECT WIRING (Refer to Cabling Outline Figure 2.4)

CAUTION: You will be wiring 120/240 VAC into the power chassis. Be sure that the X-Ray generator is off before proceeding.

All connections are located inside the power chassis (Refer to terminal strip layout – Figure 2.5-a, b, c, and Schematic 70-08009).

2.5.1 120 VAC INPUT or 240 VAC INPUT

Connect the three wire cable supplied to the VAC source as follows:

Black	-	Hot
White	-	Neutral
Green	-	Ground

Progeny provides a switch on the power supply to match incoming power to either 120 VAC or 240 VAC depending on power source available. Ensure the switch is placed in the correct position for the power provided.

Remove the protective sheet metal cover.

Measure all AC power source with a RMS type voltmeter and record reading.

Connect the power source to the transformer tap closest to the power source voltage read. The taps are numbered as follows for:

120 VOLT OPERATION

Line VAC	L1 (Black)	L2 (White)
125	4 and 8	1 and 5
115	3 and 7	1 and 5
105	2 and 6	1 and 5

220 VOLT OPERATION

Line VAC	L1 (Black)	L2 (White)	Connect
250	8	1	4 and 5
230	7	1	3 and 5
210	6	1	2 and 5

The voltage selection switch inside the power supply chassis must be set to match the incoming line voltage.

2.5.2 EXPOSURE INTERLOCK

Connect the supplied cable to the exposure interlock circuit of the generator (refer to the generator manual). The collimator "Exposure Hold" is a set of normally open contacts that remain open in the "Hold" condition (Refer to Figure 2.6). The contacts are Form C with the normally closed contacts available.

2.5.3 TOMO/STEREO INPUT

If the X-Ray system is equipped with either Tomo or Stereo shift capability, it will be necessary to connect a signal to the collimator Tomo/Stereo by-pass input. This circuit accommodates a variety of signals. Determine the signal level available from the Generator Installation Manual. Connect as indicated in Figure 2.7.

2.5.4 TABLE IMAGE RECEPTOR INPUT

The Linear collimator systems are designed to operate with input characteristics as listed below.

Refer to the Cassette Tray Installation Manual and the appropriate Bucky Manual to assure proper operation of these devices.

Connect the table image receptor input as indicated in Figure 2.8.

ELECTRICAL SPECIFICATIONS
- Impedance – 1000 ohms, $\pm$ 5% total resistance
- Resistance Linearity – within 1.5%
- Output Voltage vs. Cassette Size with +5.0 volts applied at 40". SID is shown in the right-hand column in the table on the following page.

Cassette/Film Size		DC Output Voltage 40” SID (5.00 volts input)
INCH	CM (metric)	
	18	1.04
8		1.32
9		
	24	1.76
10		1.42
11		
	30	
12		
	35	3.20
14		3.32
	43	4.19
17		4.21

2.5.5 AUXILIARY WALL CASSETTE TRAY INSTALLATION

When an auxiliary wall cassette or size-sensing wall cassette holder is installed in the system, connect the inputs to the powers-chassis as indicated in Figure 2.8.

Identify the location of the auxilliary cassette tray or holder with respect to the collimator. Remove the collimator cover as shown on page 3-2.

Locate JP2 (See Figure 3-1, Logic PCB LED Locations) on the Linear II Microcontroller Board (70-08368). JP2-1 Jumper in for wall image receptor at foot end (right side facing collimator, JP2-2 Jumper in for wall image receptor at head end (left side facing collimator).

2.5.6 DISCRETE VERTICAL SID INSTALLATION (40” ONLY)

If the system is to be mounted on a variable SID tubestand, it is necessary to install a switch to be activated at the 40” vertical SID position as shown in Figure 2.5 (a).

The switch must be installed to activate within $\pm$0.2 inches of the 40 inch SID position.

Connect the Normally Open contacts to TS1-17 and TS1-19.

If the collimator is mounted at a permanent vertical SID position, connect a jumper wire between TS1-17 and TS1-19.

2.5.7 HORIZONTAL SID INSTALLATION

A switched signal is required at the horizontal SID positions to be used. Only one switched signal is to be present at any one time. Position each of the switches to close within ±.02 inches of their respective SIDs.

Connect the switches to the Power Chassis as indicated in Figure 2.9(a) for Non-Tilt Tables and 2.9(b) for Tilting Tables.

2.5.8 TABLE TILT MONITOR

If a tilting table is installed as part of the system, it is necessary to mount the table tilt monitor to transfer angular position information to the collimator. Proper orientation of the monitor is shown in Figure 2.10.

Remove the jumper between TS2-5 and TS2-10. Connect the table tilt monitor as in Figure 2.11.

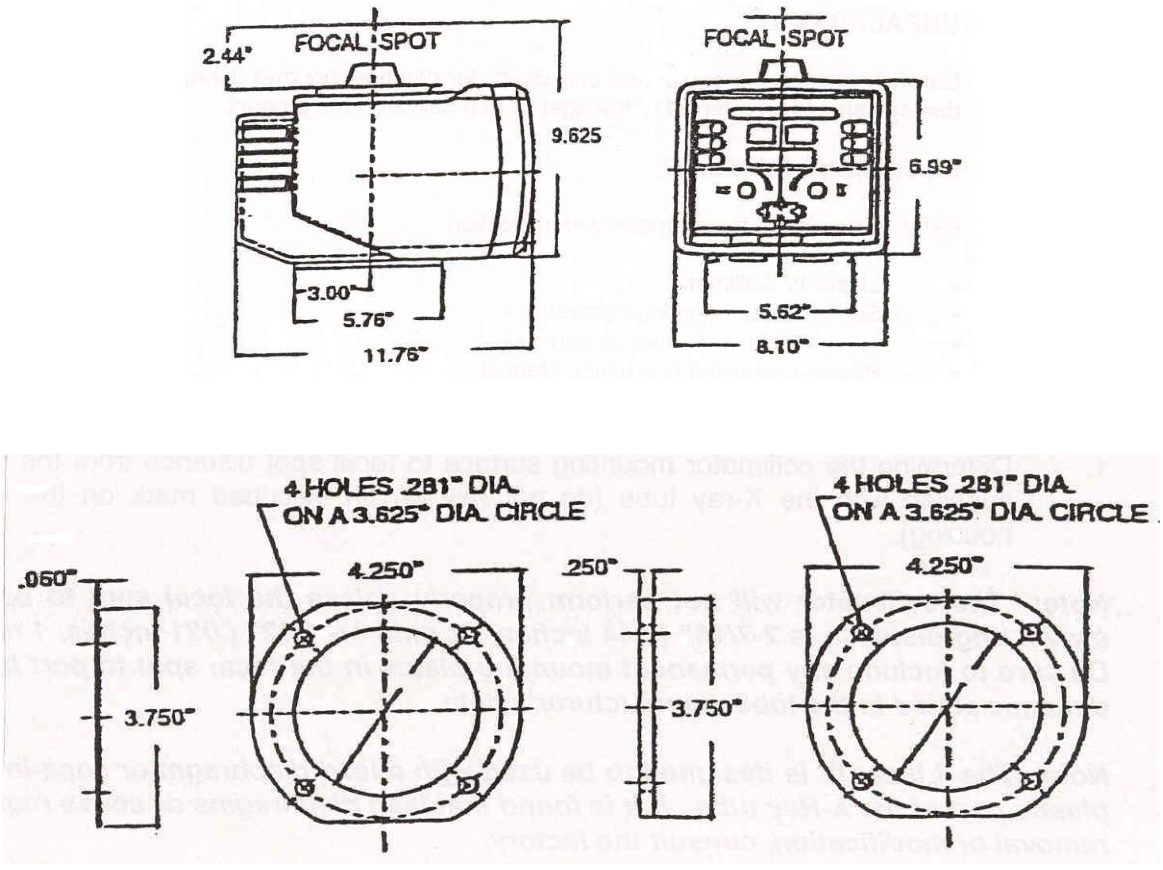


FIGURE 2.2

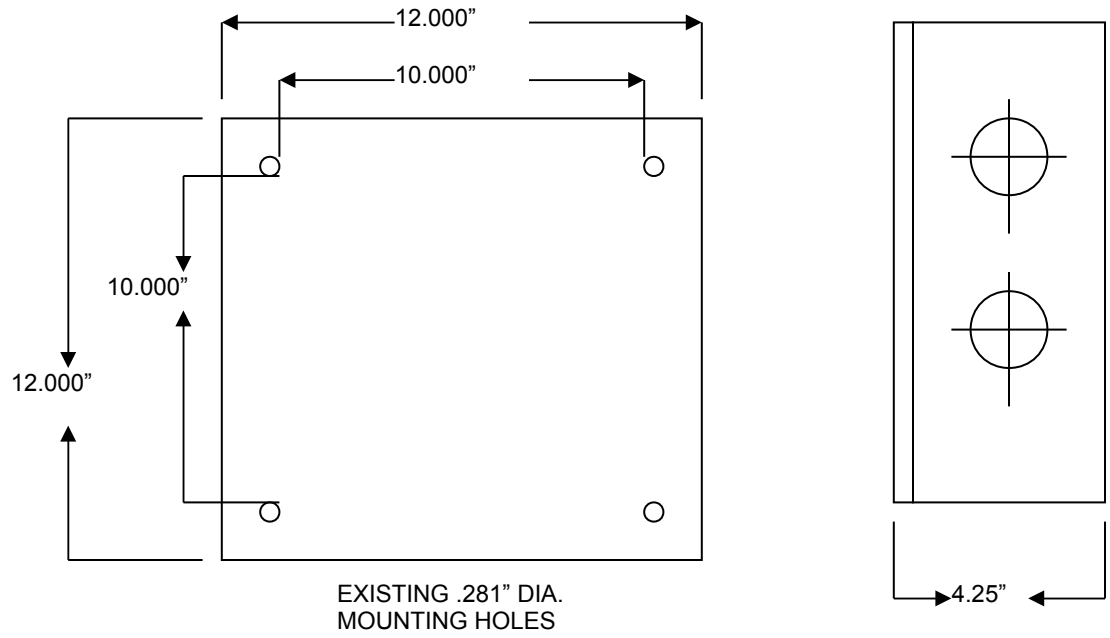
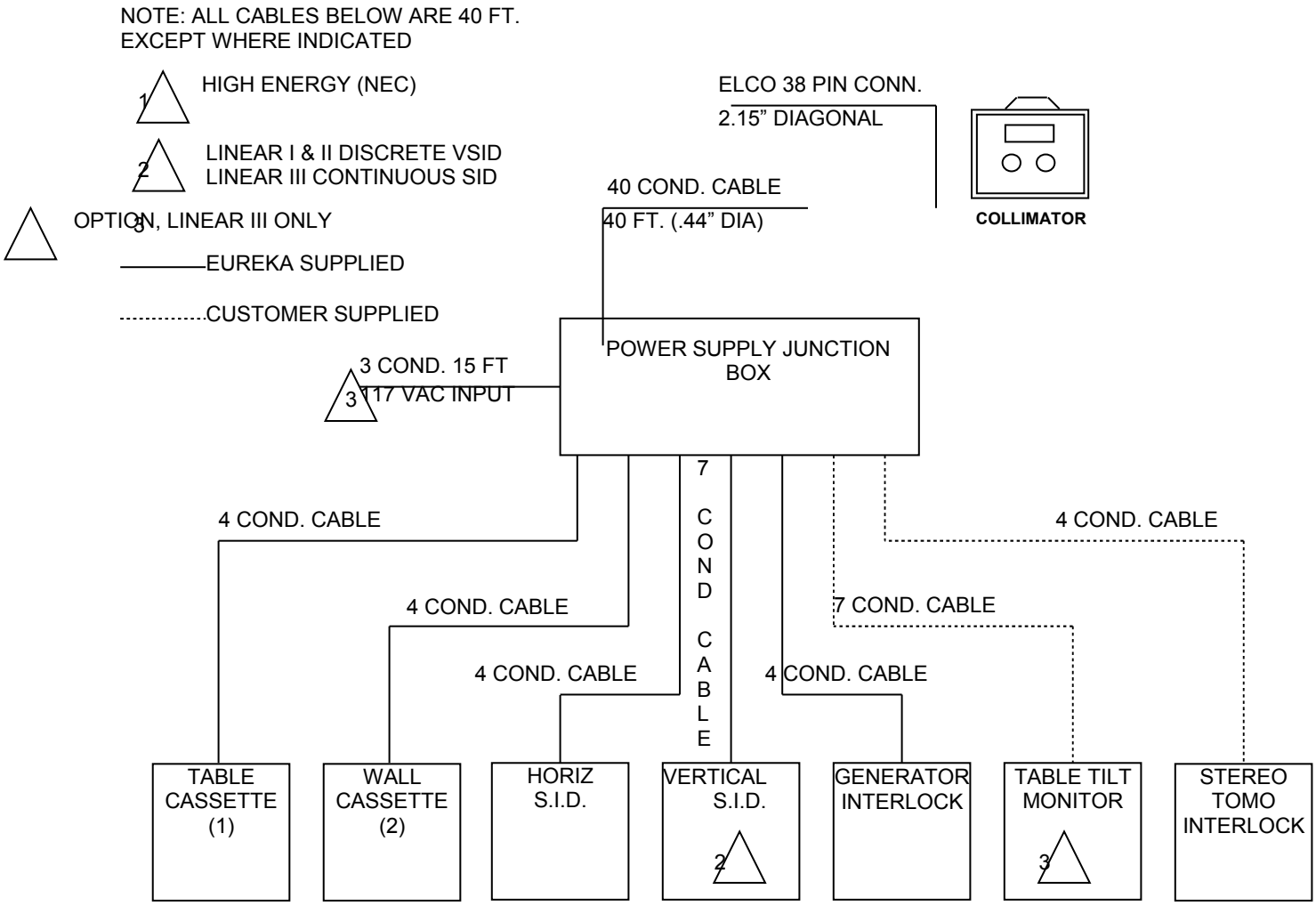


FIGURE 2.3

LINEAR I & II DISCRETE VSID
LINEAR III CONTINUOUS SID

3



CALE CONFIGURATION FROM 70-43000 LINEAR II
FIGURE 2.4

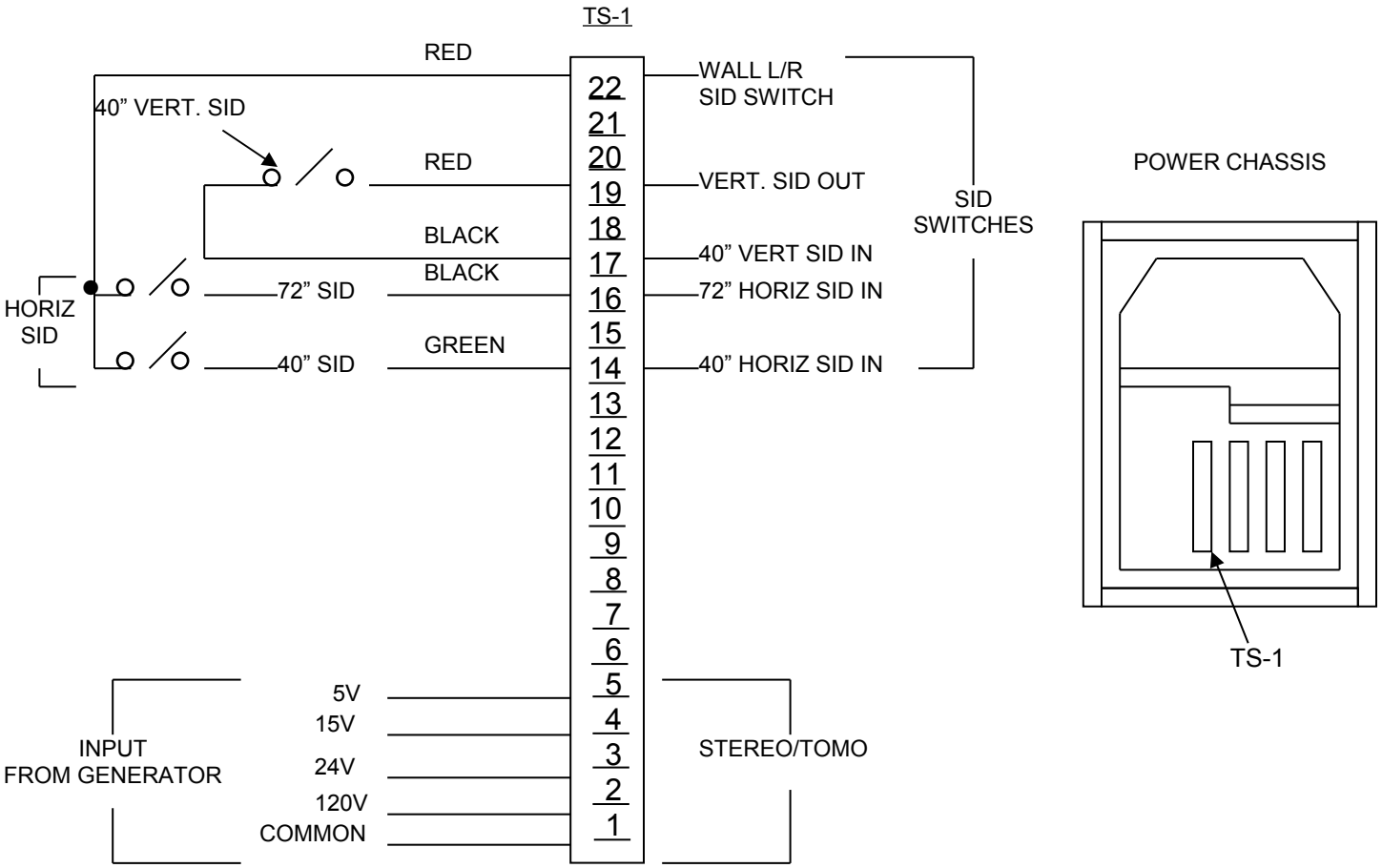


FIGURE 2.5A
TERMINAL STRIP – LINEAR I & II

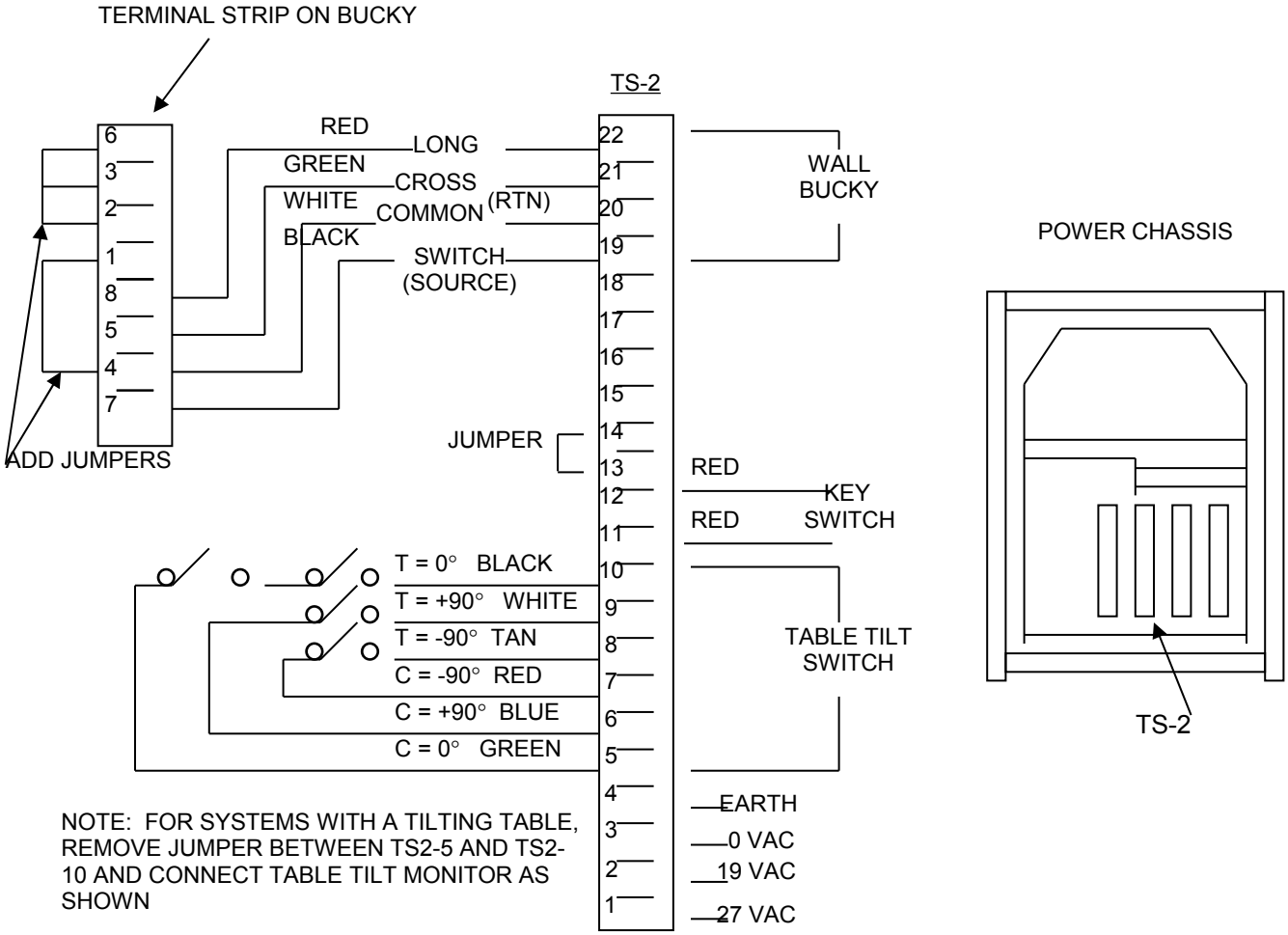


FIGURE 2.5B
TERMINAL STRIP 2 – LINEAR I &II

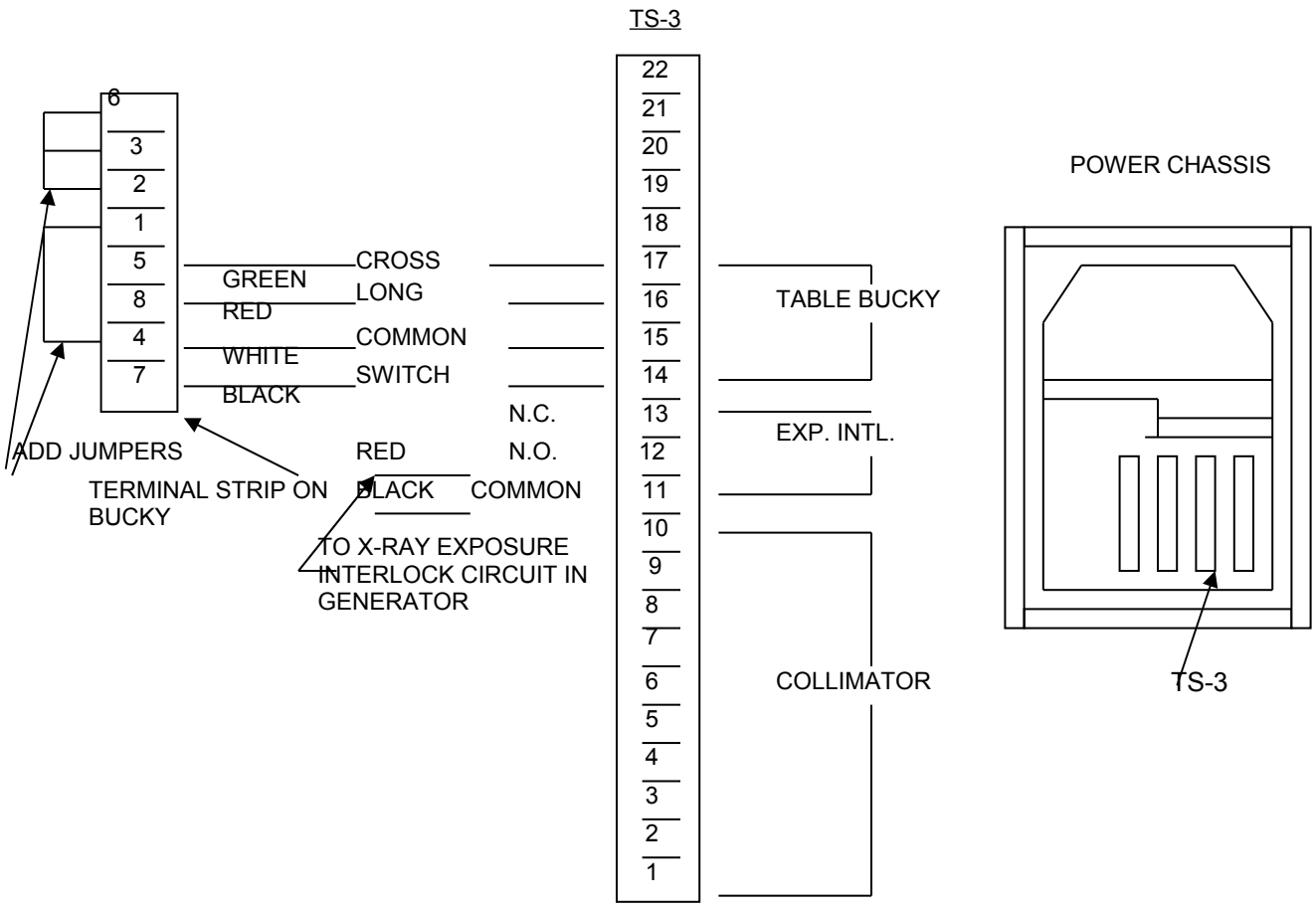


FIGURE 2.5C
TERMINAL STRIP 3 – LINEAR I & II

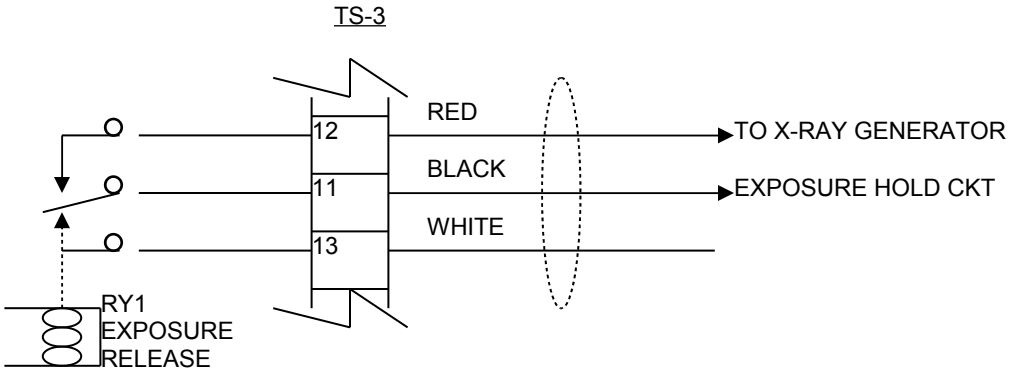


FIGURE 2.6
EXPOSURE HOLD CKT.

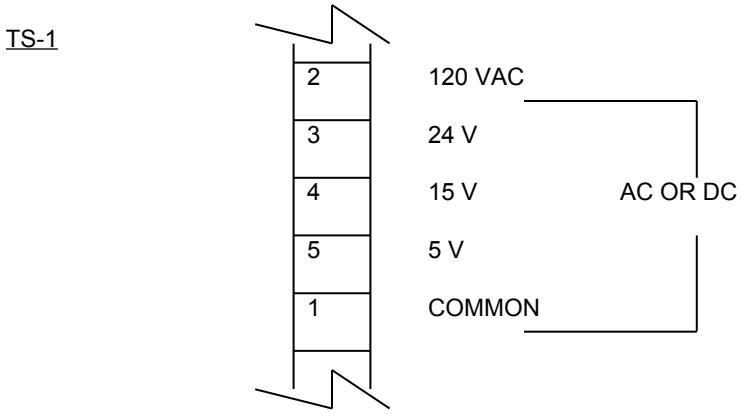


FIGURE 2.7
TOMO/STEREO BY-PASS

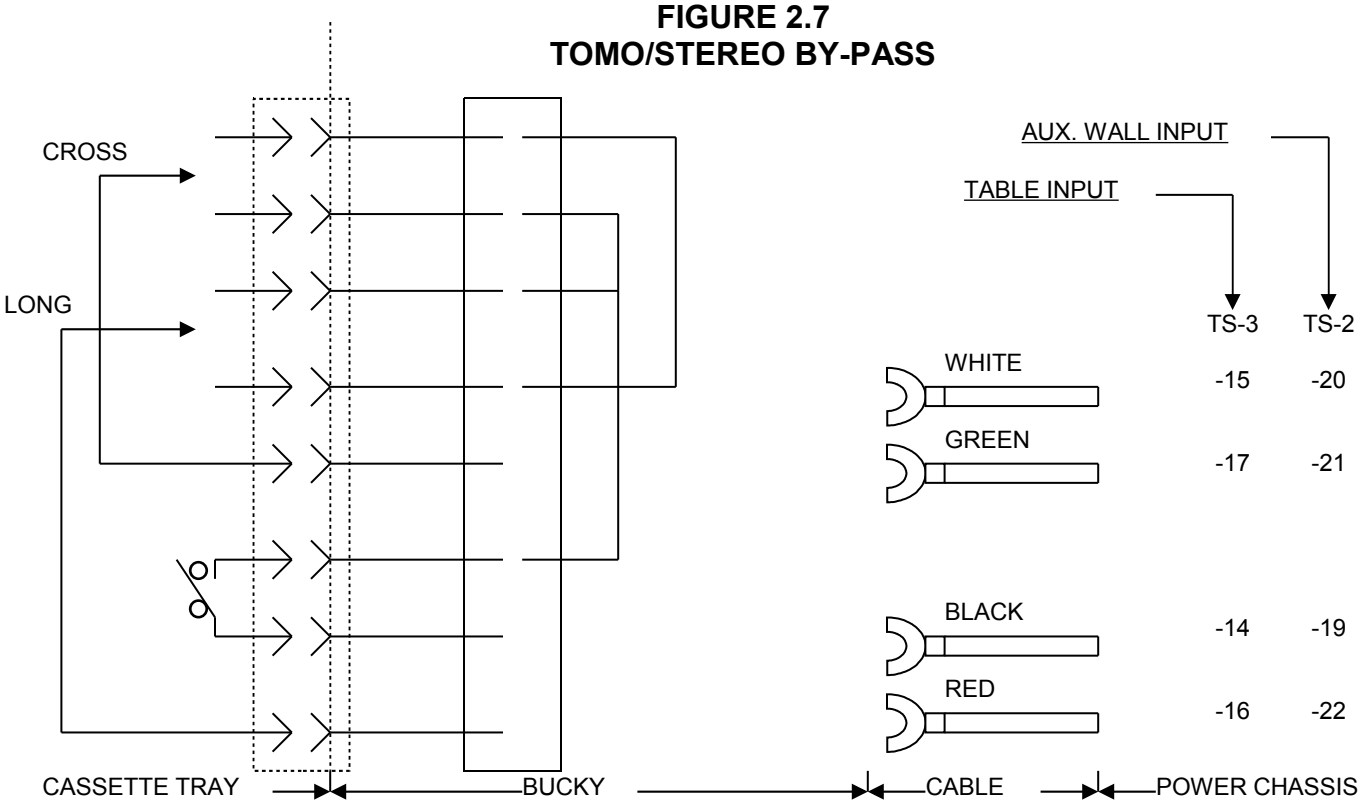


FIGURE 2.8 – CASSETTE TRAY CKT.

40” 72”

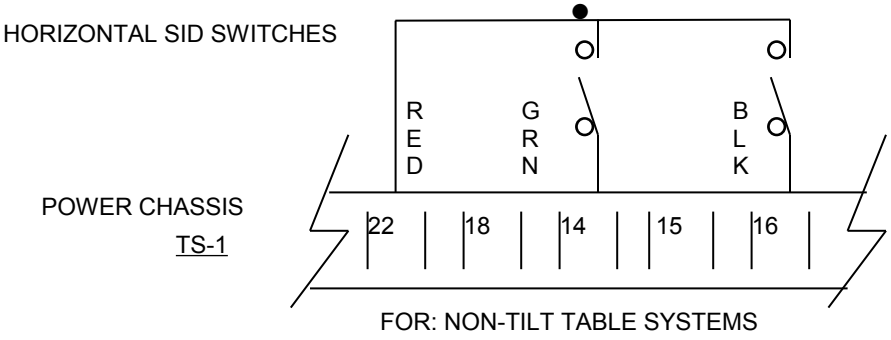


FIGURE 2.9A
HORIZONTAL SID SWITCH CKT

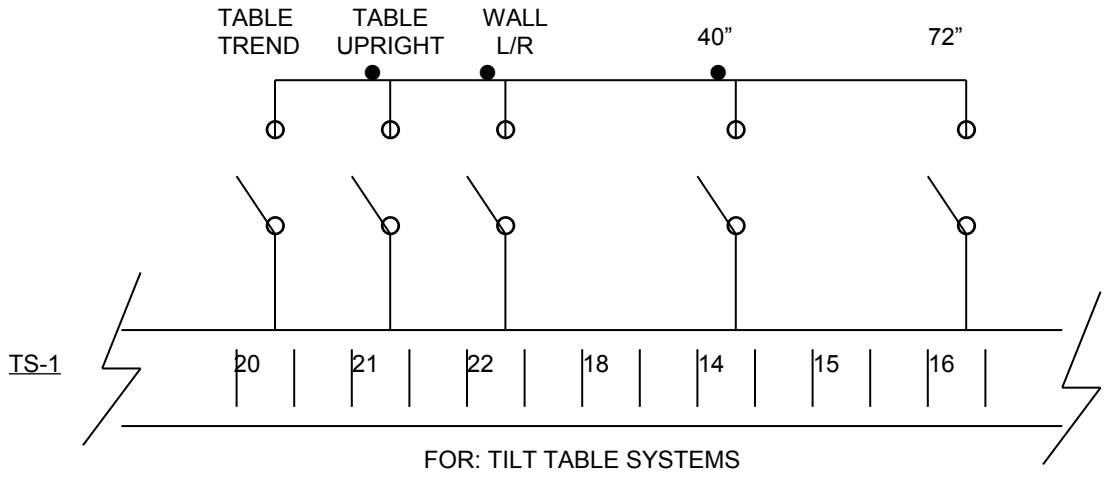


FIGURE 2.9 B
HORIZONTAL SWITCH CKT

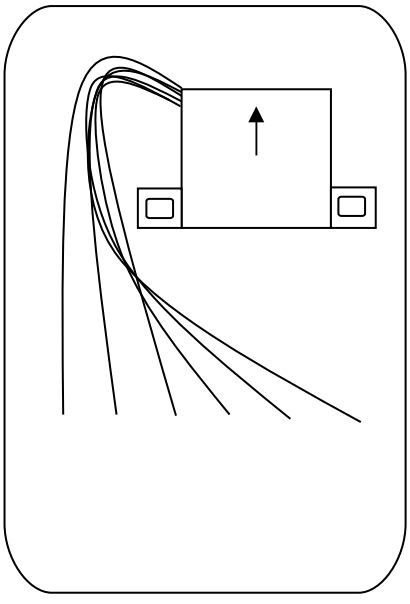


FIGURE 2.10

NOTE: FOR NON-TILT TABLE SYSTEMS
JUMPER TS2-5 TO TS2-10

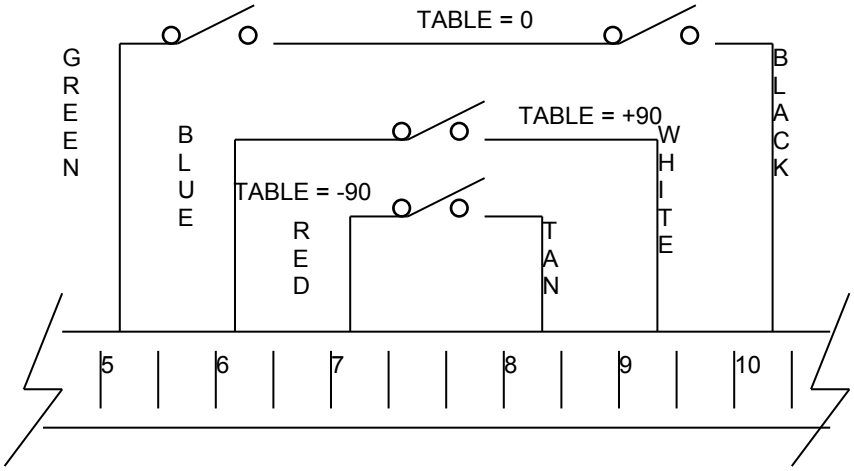


TABLE TILT MONITOR
FIGURE 2.11

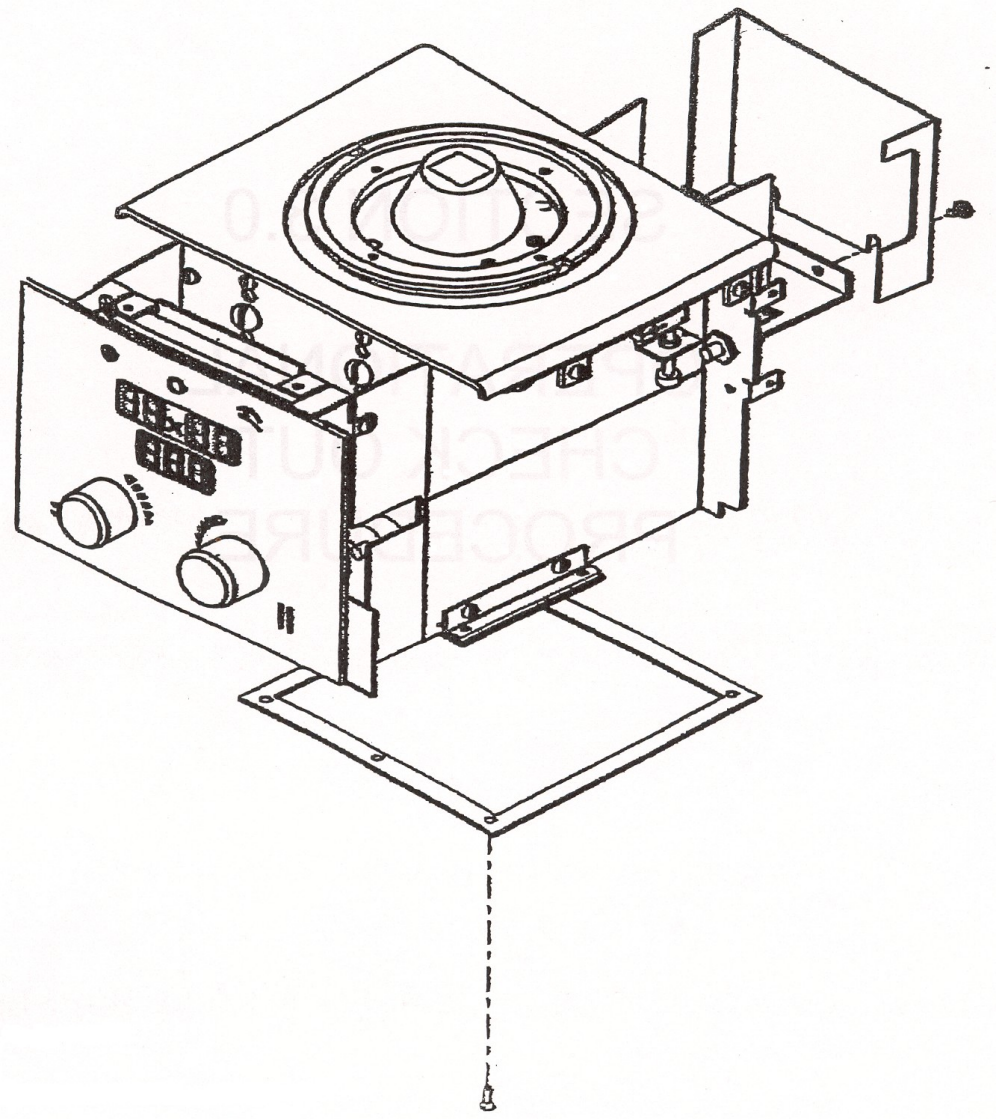
SECTION 3.0

OPERATIONAL CHECK OUT PROCEDURE

COVER REMOVAL

(TO GAIN ACCESS TO TOP HALF OF LOGIC PCB AND LAMP DRIVER PCB BEHIND FRONT PANEL)

1. Remove screws from front cover bezel, then pull out and up to remove. (You now have access to the lamp driver PCB).



For window alignment:

Remove (5) screws from cone track.

2. To gain access to the logic PCB, remove screws holding left and right side covers, then pull off.

3.0 OPERATIONAL CHECKOUT PROCEDURES – MODEL LINEAR II

The following procedures form a means to check operation of the collimating system and must be performed at the time of installation.

YOU HAVE LEGAL OBLIGATIONS PRIOR TO RELEASE OF THE SYSTEM TO THE USER, THE RESULTS OF EACH STEP MUST BE DEFINED.

ENTER THE APPROPRIATE DATA IN THE SPACES PROVIDED IN THE COMPLIANCE DATA LOG (LOCATED AT THE END OF SECTION SIX) AND RETAIN THIS INFORMATION FOR YOUR RECORDS AS PROOF THAT THESE TESTS WERE SUCCESSFULLY PERFORMED.

EQUIPMENT REQUIRED

- The X-Ray tube support and the table must include angulation indicators in order to comply with Part 1020.31 (d) (2) (i) and 1020-31 (e) (1) (ii). These indicators are to be used for the following tests.

- The X-Ray tube support device must also include SID indicating means in order to comply with 1020.31 (e)(1)(ii).

- Measuring tape (ruler). This is to be used as a backup for the SID indicating means and as an operational range measurement.

3.1 JUMPER SWITCH SETTINGS ON LINEAR II MICROCONTROLLER BOARD

Metric or Fractional Calibration
Refer to figure 3-1, and locate the 3 position jumper, JP1. With power off, set this jumper appropriately for Metric or Fractional calibration. Place the jumper between the first and second positions for Fractional cassettes or between the second and third positions for Metric cassettes. This must be set prior to calibration commencement.

Wallstand and Tilting Table positions
Refer to figure 3-1, and locate the 8 position jumper, JP2. These jumpers must be set appropriately for various system configurations. A summary of these is as follows:

JP2-1 Jumper in for wall image receptor at head end (left side facing collimator).
JP2-2 Jumper in for wall image receptor at foot end (right side facing collimator).
JP2-3 NOT USED
JP2-4 NOT USED
JP2-5 Lamp sense input. Do not place jumper in this location. Not user accessible.
JP2-6 Table Right SID Switch Output. Do not place jumper in this location.
JP2-7 Table Left SID Switch Output. Do not place jumper in this location.
JP2-8 NOT USED

Notes on jumper settings:

Position 1 and 2 are for use with wall stand receptors. If the collimator is to be used with a head end (wallstand on the left side) receptor, place a jumper in position 1. If the collimator is to be used with a foot end (wallstand on the right side) receptor, place a jumper in position 2.

NOTES FOR INSTALLING A NON-STANDARD WALL CASSETTE HOLDER:

If the system has a vertical image receptor that does not contain a continuous 1 kilo ohm potentiometer - such as the Poersch wall stand, do not use the jumper in JP2 position 1 and 2 during calibration. Remove this jumper. When performing the calibration and no jumper is located in position 1 and 2, the calibration will terminate at the end of the table image receptor cassette tray insertions. Note the voltages present at VIRC and VIRL for the table cassette calibration for sizes 8, 10, 14, and 17 inches. Then adjust the wall holder such that these voltages are present when the cassettes are inserted. Then, with system power off, replace the jumper in the JP2 header position 1 or 2. Return power and the system will respond to the wall image receptor.

If no wall image receptor is used, remove the JP2 jumper from positions 1 and 2. This will disable the function of a wallstand and also disable the wallstand calibration process.

3.1 CALIBRATION

The collimator is calibrated from the factory to the image receptor voltage levels as indicated on page 2-6. Before you perform a re-calibration, you should first check the collimator functions using the factory settings. After following the installation procedure, having all cables securely connected, turn on system power. Verify collimator operation by inserting several cassette sizes and checking the PBL operation. Verify operation on both the table and wall holder, if applicable.

If collimator field sizing is incorrect, you can recalibrate the sizing operation by performing the following calibration procedure. However, first ensure that the voltage levels from the image receptor to the collimator control PCB are valid. Do this by measuring the voltage on VIRL (TP4) and VIRC (TP5) and compare to the levels given on page 2-6.

Cassette positioning within the tray – The results of this calibration will be distorted if the cassette is not placed in the tray according to the diagrams and instructions. Incorrect placement will affect both the table and the wall calibration.

Shutter position adjustments – When positioning the shutters over the template markings, always open the shutters completely, and then close the shutters down to the required markings. Failure to open the shutters completely within each operation will result in an inaccurate calibration.

Incorrect size display – incorrect size indications are caused by placing the cassettes into the cassette tray in the wrong orientation or order. The size display will also be incorrect if the image receptor is miswired.

Fractional Cassettes – The fractional cassettes required for the calibration are 8” x 10” and 14” x 17”. Any other combination will result in an inaccurate calibration.

Metric Cassettes – The metric cassettes required for the calibration are 20 x 25 centimeters and 35 x 43 centimeters. Any other combination will result in an inaccurate calibration.

Collimator Front Panel display – As the calibration process proceeds, observe the front panel as advised in each step. Incorrect front panel patterns indicate an error in the calibration step. Either repeat the calibration or, consult with Progeny Technical Support.

FOR A NEW INSTALLATION, BEGIN CALIBRATION BY PRESSING THE SWITCH, S2, LOCATED ON THE BOTTOM RIGHT CORNER OF THE LOGIC PCB WHILE POWER IS TURNED ON.
Be advised, if an accidental “double strike” of the S2 switch occurs, the calibration result will be distorted. If this happens, power off the system for approximately 5 seconds and start the procedure from the beginning.

PERFORM THE ENTIRE CALIBRATION AT 40 INCH SID - THE ENCLOSED TEMPLATE IS PROVIDED TO INDICATE THE FIELD SIZE REQUESTED AT 72 INCH SID.

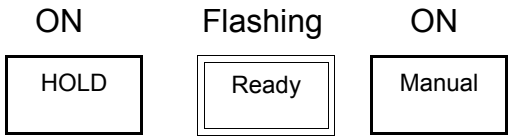
PLEASE NOTE: When performing the calibration, you will be using the collimator light field to set the size of the x-ray field. You must verify the x-ray and light field congruence as described in section 4.1 of this manual upon completion of calibration. If the light field had to be adjusted as a result of the congruence verification, you should repeat the calibration procedure.

Linear II Calibration Procedure:

ACTION TAKEN **FRONT PANEL DISPLAY**

1. Press Cal button on (S2) on the Logic PCB to begin the calibration procedure.

The display must indicate as:

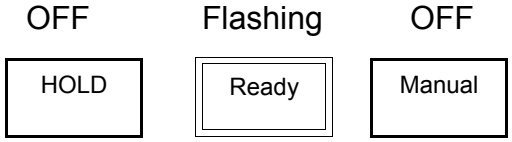


Open the shutters to the maximum field size and then completely close the collimator shutters. This will input the zero field size into the collimator memory.

Press the CAL Button (S2) on the Logic PCB to record this information.

2.

The display must indicate as:



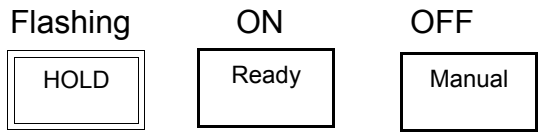
17 x 17 in. OR **43 x 43** cm.
40 in SID **100 cm SID**

Using the provided template, open the shutters to the maximum field size and then close them down to 17 x 17 inch size at 40 inch SID (or 43 x 43 centimeter size at 100 centimeter SID).

Press the CAL Button (S2) on the Logic PCB to record this information.

3.

The display must indicate as:



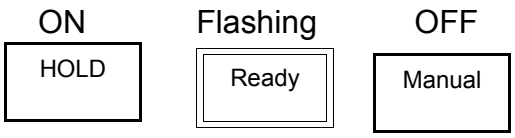
5 x 5 in. OR **13 x 13** cm.
40 in SID **100 cm SID**

Using the provided template, open the shutters to the maximum field size and then close them down to 5 x 5 inch size at 40 inch SID (or 13 x 13 centimeter size at 100 centimeter SID).

Press the CAL Button (S2) on the Logic PCB to record this information.

4.

The display must indicate as:



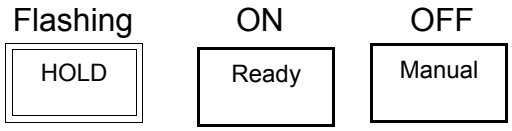
<u>17 x 17</u> in. OR **<u>43 x 43</u>** cm.
72 in SID **180 cm SID**

Leave the collimator at the 40 inch SID position. Using the provided template, open the shutters to the maximum field size and then close them down to 17 x 17 inch size at 72 inch SID (or 43 x 43 centimeter size at 180 centimeter SID) per the template markings.

Press the CAL Button (S2) on the Logic PCB to record this information.

5.

The display must indicate as:



<u>5 x 5</u> in. OR **<u>13 x 13</u>** cm.
72 in SID **180 cm SID**

Leave the collimator at the 40 inch SID position. Using the provided template, open the shutters to the maximum field size and then close them down to 5 x 5 inch size at 72 inch SID (or 13 x 13 centimeter size at 180 centimeter SID) per the template markings.

Press the CAL Button (S2) on the Logic PCB to record the information.

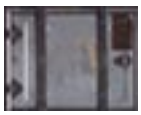
6. Now we will enter cassette sizes into memory. It no longer matters what the SID display reads. The system will only look at the cassette data and remember data points. You

may view the voltages entered for each of the cassette dimensions by placing a Voltmeter on the VIRL (IR long) and VIRC (IR Cross) test points on the logic PCB.

7. To set the first cassette size, use a 14 x 17 inch (35 x 43 centimeter) cassette. Insert the cassette into the size sensing tray. Ensure that the 17 inch (43 centimeter) dimension is in the cross table direction and the 14 inch (35 centimeter) dimension is in the long table direction.

The display must indicate as:

OFF	Flashing	ON
HOLD	Ready	Manual



14"

17"

17 x 14 in. OR **43 x 35**_ cm.

Press the CAL Button (S2) on the Logic PCB to record this information.

8. Remove the cassette and rotate it 90 degrees so that the 17 inch

The display will flash as:

Flash	OFF	ON
HOLD	Ready	Man

17"

14"

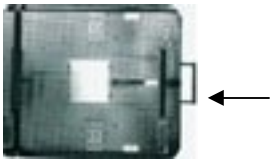
14 x 17 in. OR **35 x 43** cm.

Press the CAL Button (S2) on the Logic PCB to record this information.

9. To set the second cassette size, use a 8 x 10 inch (18 x 24 cm) cassette, insert the cassette into the table size sense tray. Ensure that the 10 inch (24 centimeter) dimension is in the cross table direction and the 8 inch (18 centimeter) dimension is in the long table direction.

The display must indicate as:

ON	Flashing	OFF
HOLD	Ready	Manual



8"

10"

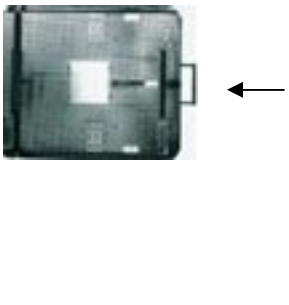
10 x 8 in. OR **25 x 20** cm.

Press the CAL Button (S2) on the Logic PCB to record this information.

10. Remove the cassette and rotate it 90 degrees so that the 8 inch (24 centimeter) dimension is in the long table direction and the 10 inch (24 centimeter) dimension is in the cross table direction.

The display must indicate as:

Flashing	ON	OFF
HOLD	Ready	Manual



10"

8"

8 x 10 in. OR **20 x 25** cm.

Press the CAL Button (S2) on the Logic PCB to record this information.

11. Now we will enter the Wall holder cassette sizes into memory. You may view the voltage entered for each of the cassette dimensions by placing a voltmeter on the VIRL (IR long) and VIRC (IR Cross) test points on the logic PCB.

12. To set first cassette size, use a 17 x 14 inch (35 x 43 centimeter) cassette. Insert the cassette into the wall size sense tray. Ensure that the 17 inch (43 centimeter) dimension is in the cross table direction and the 14 inch (35 centimeter) dimension is in the long table direction.

The display must indicate as:

OFF	Flashing	ON
HOLD	Ready	Manual

14" **17 x 14** in. OR **43 x 35** cm.

17"

Press the CAL Button (S2) on the Logic PCB to record this information.

13. Remove the cassette and rotate it 90 degrees so that the 17 inch (43 centimeter) dimension is in the long table direction and the 14 inch (35 centimeter) dimension is in the cross table direction.

The display must indicate as:

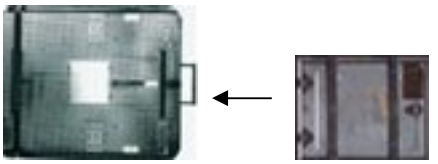
Flashing	OFF	ON
HOLD	Ready	Manual

17" **14 x 17** in. OR **35 x 43** cm.

14"

14. To set the second cassette size, use a 8 x 10 inch (18 x 24 centimeter) cassette, insert the cassette into the table size sense tray. Ensure that the 10 inch (24 centimeter) dimension is in the cross table direction and the 8 inch (18 centimeter) dimension is in the long table direction.

The display must indicate as:	ON	Flashing	OFF
	HOLD	Ready	Manual

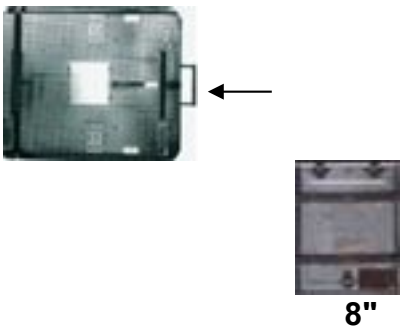


10 x 8 in. OR **25 x 20** cm.

Press the CAL Button (S2) on the Logic PCB to record this information.

15. Remove the cassette and rotate it 90 degrees so that the 8 inch (24 centimeter) dimension is in the long table direction and the 10 inch (24 centimeter) dimension is in the cross table direction.

The display must indicate as:	Flashing	ON	OFF
	HOLD	Ready	Manual



8 x 10 in. OR **20 x 25** cm.

Press the CAL Button (S2) on the Logic PCB to record this information.

16. The collimator should now return to its normal operational state, and automatically size to the cassette in the image receptor. Proceed to tilt switch checkout. Reinstall the cassette to resize the collimator. If the cassette sizes are not correct, review the instructions and notes at the beginning of this procedure. Incorrect sizing can be caused by miswired connections, double strikes of the calibration button, incorrect cassette orientation or incorrect cassettes.

3.2 COLLIMATOR TILT SWITCH CHECKOUT

Vertical Operation

Turn on system power. Insert a cassette in the system table image receptor cassette tray. Ensure the cassette tray is inserted in the image receptor. Angulate the collimator to a 0-degree beam-down position. Ensure the vertical SID switch is engaged. Verify the collimator opens to the correct cassette size and the green READY light is illuminated.

Slowly angulate the collimator + 20 deg. Toward a beam-left position and back to 20 deg. toward a beam-right position. Verify the green READY light is on and remains on for +11 deg. And –11 deg. angulations.

Troubleshooting tips:

If the tilt switch does not check out as described above, engage switch 3 position 2 (signal name \C=0_T=0) to the ON position. This will force the tilt switch signal to the ON state. If the image receptor and the SID switch are functioning properly, the READY light will illuminate. Place the switch in the OFF state for normal operation. If the READY light functions as described but does not when angulating the collimator, the tilt switch wiring in the power supply described in the installation section must be reviewed.

Horizontal Operation (if equipped)

Turn on system power. Insert a cassette in the system wall image receptor cassette tray. Ensure the cassette tray is inserted in the image receptor. Angulate the collimator to point to the wall receptor. Ensure the horizontal SID switch is engaged. Verify the collimator opens to the correct cassette size and the green READY light is illuminated.

Slowly angulate the collimator + 20 deg. toward a beam-down position and back to 20 deg. toward a beam-up position. Verify the green READY light is on and remains on for +11 deg. And –11 deg. angulations.

Troubleshooting tips:

If the tilt switch does not check out as described above, engage switch 3 position 3 (signal name \C=90) to the ON position if the wall receptor is on the right side when the operator faces the collimator (foot end of the table). Otherwise engage switch 3 position 4 (signal name \C=-90) to the ON position if the wall receptor is on the left side when the operator faces the collimator (head end of the table). This will force the tilt switch signal to the ON state. If the image receptor and the SID switch are functioning properly, the READY light will illuminate. Place the switch in the OFF state for normal operation. If the READY light functions as described but does not when angulating the collimator, the tilt switch wiring in the power supply described in the installation section must be reviewed.

3.3 TABLE TILT SWITCH CHECKOUT (FOR TILTING TABLES ONLY)

Prepare the system as described in the previous section for collimator tilt switch checkout.

3.3.1 Remove the jumper in the collimator power supply between TS2-5 and TS2-10. Angulate the collimator to 0 deg. Beam-down. Angulate the table to 0 deg. Horizontal and slowly tilt it to +20 deg. And –20 deg.

The green READY light must be on with the table at 0 deg. And remain on for +11 deg. And –11 deg. From horizontal.

3.3.2 Position the table at +90 deg. Upright (usually about an actual +85 deg.) and angulate the collimator to a +90 deg. beam-left position. Slowly tilt the table 20 deg. down from the maximum upright position (+70 deg.).

The green READY light must be on at maximum upright and remain on until the table is angulated down to +79 deg.

3.3.3 Angulate the table to –90 deg. trendelenberg and angulate the collimator to –90 deg. beam-right. Slowly tilt the table 20 deg. down from the maximum trendelenberg position.

The green READY light must be on and remain on until the table is angulated down to +79 deg.

3.3.4 The tilt monitors must meet the above requirements in order to comply with Part 1020.31 (d)(2)(I) and 1020.31 (e)(1)(ii) of the Performance Standards.

If the tilt monitors do not pass each requirement listed, corrective action must be taken. DO NOT PROCEED with the testing until all requirements are met. Refer to Section 2.5.8, Figure 2.10 and 2.11.

3.4 IMAGE RECEPTOR SIGNALS CHECKOUT

Table Image Receptor

Connect a voltmeter across TP1 “Vref”, and TP2 “AGND” on the Linear II Controller PCB. Vref should be 5.00 volts. Adjust R6 as necessary.

Connect a voltmeter to TP8 “VIR”. VIR should be 5.00 volts.

Connect a voltmeter to TP4 “VIRL”. Insert a 17 inch (43 cm) cassette in the image receptor cassette tray such that the 17 inch dimension is aligned with the length of the table. VIRL should read 4.5 volts. Refer to Section 2.5.4 for other cassette dimension voltages. It is permissible for VIR to be increased over 5.0 volts to achieve the required VIRL.

Connect a voltmeter to TP5 “VIRC”. Insert a 17 inch (43 cm) cassette in the image receptor cassette tray such that the 17 inch dimension is aligned with the length of the table. VIRC should read 4.5 volts. Refer to Section 2.5.4 for other cassette dimension voltages. It is permissible for VIR to be increased over 5.0 volts to achieve the required VIRC. Verify linearly varying voltages are present for other cassette sizes, referring to Section 2.5.4 for other cassette dimension voltages.

Troubleshooting tips:

If there is VIR being supplied as measured at TP8, but there is no reading at TP4 or TP5, use the voltmeter to measure the voltages at VIRL and VIRC at the collimator power supply, TS3-16 and TS3-17 respectively. If the voltages are there, then there is a problem in the power supply or collimator cabling. If the voltages are not there, then the connection or usage of the cassette tray has not been properly implemented.

WALL IMAGE RECEPTOR

It should not be necessary to make any additional adjustments in the image receptor voltages. This checkout procedure only verifies the presence of appropriate voltages when the wall receptor is selected.

Rotate the collimator 90 degrees to point at the wall receptor.

Connect a voltmeter to TP5 “VIRC”. Insert a 17 inch (43 cm) cassette in the wall image receptor cassette tray such that the 17 inch dimension is aligned with the width of the table. VIRC should read 4.5 volts. Refer to Section 2.5.4 for other cassette dimension voltages.

Connect a voltmeter to TP4 “VIRL”. Insert a 17 inch (43 cm) cassette in the image receptor cassette tray such that the 17 inch dimension is aligned with the length of the table. VIRC should read 4.5 volts. Verify linearly varying voltages are present for other cassette sizes, referring to Section 2.5.4 for other cassette dimension voltages.

Troubleshooting tips:

If there is VIR being supplied as measured at TP8, but there is no reading at TP6 or TP7, use the voltmeter to measure the voltages at VIRL and VIRC at the collimator power supply, TS2-22 and TS2-21 respectively. If the voltages are there, then there is a problem in the power supply or collimator cabling. If the voltages are not there, then the connection or usage of the cassette tray has not been properly implemented.

3.5 COLLIMATOR INTERNAL SHUTTER SIGNALS CHECKOUT

Proper sensing of the collimator internal shutters may be determined by this procedure.

Connect a voltmeter across TP1 “Vref”, and TP2 “AGND” on the Linear II Controller PCB. Vref should be 5.00 volts. Adjust R6 as necessary.

Connect a voltmeter to TP6 “VXFL”. Rotate the LONG shutters using the manual knob on the front panel of the collimator. The voltage should vary from approximately 4 volts (+/- .5) when fully open to 0.8 volts (+/- .5) when closed.

Connect a voltmeter to TP7 “VXFC”. Rotate the CROSS shutters using the manual knob on the front panel of the collimator. The voltage should vary from approximately 4 volts (+/- .5) when fully open to 0.8 volts (+/- .5) when closed.

Troubleshooting Note:

The setting is not adjustable and is factory set by the position of the shutter feedback potentiometer on to the shutter gear shaft. It is only necessary to verify that the varying voltage is present as the shutters are moved.

3.6 EXTERNAL SID SIGNAL CHECKOUT

Vertical Operation

Turn on system power. Insert a cassette in the system table image receptor cassette tray. Ensure the cassette tray is inserted in the image receptor. Angulate the collimator to a 0 degree beam-down position. Ensure the vertical SID switch is engaged. Verify the collimator opens to the correct cassette size and the green READY light is illuminated. The SID display should read 40 (100 cm).

Release the x-ray source assembly locks and move the assembly up or down until the SID switch is OFF. Verify the green READY light is turned OFF and the yellow HOLD light is ON. The SID display is blank.

Troubleshooting tips:

If the SID switch does not check out as described above, engage switch 3 position 7 (signal name 40in) to the ON position. This will force the SID switch signal to the ON state. If the image receptor and the tilt switch are functioning properly, the READY light will illuminate. Place the switch in the OFF state for normal operation. If the READY light functions as described but does not when moving the collimator, the SID switch wiring in the power supply described in the installation section must be reviewed.

Horizontal Operation (if equipped)

Turn on system power. Insert a cassette in the system wall image receptor cassette tray. Ensure the cassette tray is inserted in the image receptor. Angulate the collimator to point to the wall receptor. Ensure the horizontal 40 inch SID switch is engaged. Verify the collimator opens to the correct cassette size and the green READY light is illuminated. The SID display should read 40 (100 cm).

Release the x-ray source assembly locks and move the assembly until the SID switch is OFF. Verify the green READY light is turned OFF and the yellow HOLD light is ON. The SID display is blank.

Move the source assembly to engage the 72 inch SID switch. Verify the collimator opens to the correct cassette size and the green READY light is illuminated. Release the x-ray source assembly locks and move the assembly until the SID switch is OFF. Verify the green READY light is turned OFF and the yellow HOLD light is ON.

Troubleshooting tips:

If the SID switch does not check out as described above, engage switch 3 position 7 (signal name 40in) to the ON position. This will force the SID switch signal to the ON state. If the image receptor and the tilt switch are functioning properly, the READY light will illuminate. Place the switch in the OFF state for normal operation. If the READY light functions as described but does not when moving the collimator, the SID switch wiring in the power supply described in the installation section must be reviewed.

This can also be accomplished by engaging switch 3 position 8 (signal name 72in) to test the 72 inch horizontal SID switch setting.

3.7 TILTING TABLE RECEPTOR SID SIGNAL CHECKOUT – (FOR TILTING TABLES ONLY)

Angulate the table to a full upright position. Angulate the collimator to point the X-Ray beam at the upright table cassette tray.

Move the collimator horizontally to a 40 inch SID, engaging the SID switch. Verify the collimator opens to the correct cassette size and the green READY light is illuminated. The SID display should read 40 (100 cm).

Move the collimator horizontally to a greater and then to a lesser SID, disengaging the SID switch. Verify the SID display is blank, the green READY light is turned OFF, and the yellow HOLD light is ON.

3.8 STEREO/TOMO BYPASS SIGNAL CHECKOUT

Angulate the collimator 0 degree beam-down direction with a measured SID of 40 inches. For tilting tables, angulate the table to 0-degree horizontal.

Insert a cassette in the holder and fully insert the tray into the bucky.

Verify the collimator sizes to the cassette and the green READY light is illuminated.

Activate the Stereo / Tomo switch on the generator. Verify the READY light is not illuminated and the yellow MANUAL light is illuminated.

3.9 COLLIMATOR CHECKOUT CONCLUSION

Ensure that all positions of switch 3 on the Logic PCB are in the OFF position for normal operation.

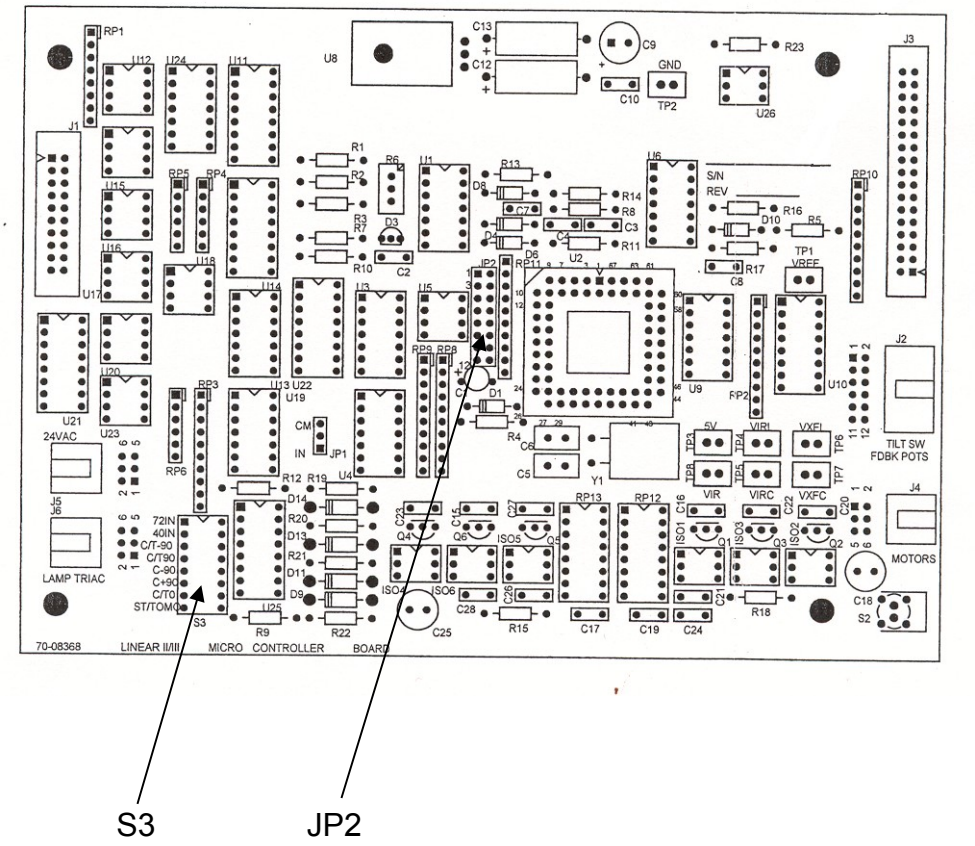


FIGURE 3-1
LOGIC PCB SWITCH LOCATIONS

(NO TEXT)

SECTION 4.0

ADJUSTMENT PROCEDURES

4.0 ADJUSTMENT PROCEDURES

The following adjustment procedures are performed with the collimator located in a single fixed position above a test pattern located on the table top.

The adjustments are made while observing the light field edges, therefore, it is necessary to confirm that the light field accurately represents the X-Ray field. By establishing a defined light field and exposing a film to produce a density of 1.0, the X-Ray field (image) can be compared to the light field).

The Performance Standards 1020.30(b)(22) and (45) define the edges of the light field as the focus of points at which the illumination is one-fourth of the maximum and the edges of the X-Ray field as the focus of points at which the exposure focus of points to which the exposure rate is one-fourth of the maximum.

The X-Ray field should be determined by exposing a film to a density of 1.0 on the developed image and observing the points at which the density is just visibly increased above the base fog background of the film.

In a similar manner, the light field edges should be determined by observing the light field on a white background. By observing the points at which the light field is just visibly increased over the background illumination, and comparing this with the X-Ray field (and to the tolerance marks on the pattern), comparisons may be made.

PLEASE NOTE: Eureka collimators are 100% tested and calibrated at the factory. Our intention is that you will only have to confirm operation, then readjust the SID voltages to match the collimator and the Image Receptor (cassette tray) after the unit is installed.

Section 3 of the Manual (Operational Checkout) walks you through the procedure to ensure proper system operation.

EQUIPMENT REQUIRED:

A. LINEAR collimator test pattern 70-09015 contained in this manual.
B. Measuring tape (ruler)
C. 14” x 17” X-Ray film cassette
D. Densitometer (or a 1.0 neutral density filter for density comparison.

4.1 LIGHT FIELD / X-RAY CONGRUENCE TEST

Place the X-Ray source-to-table distance at 40" SID and lock in place.

4.1.1 Locate a cassette on the table top and accurately center the cassette to the light field. Mark the position of the cassette on the table top.

4.1.2 Manually reduce the size of the light / X-Ray field to the next smaller film size.

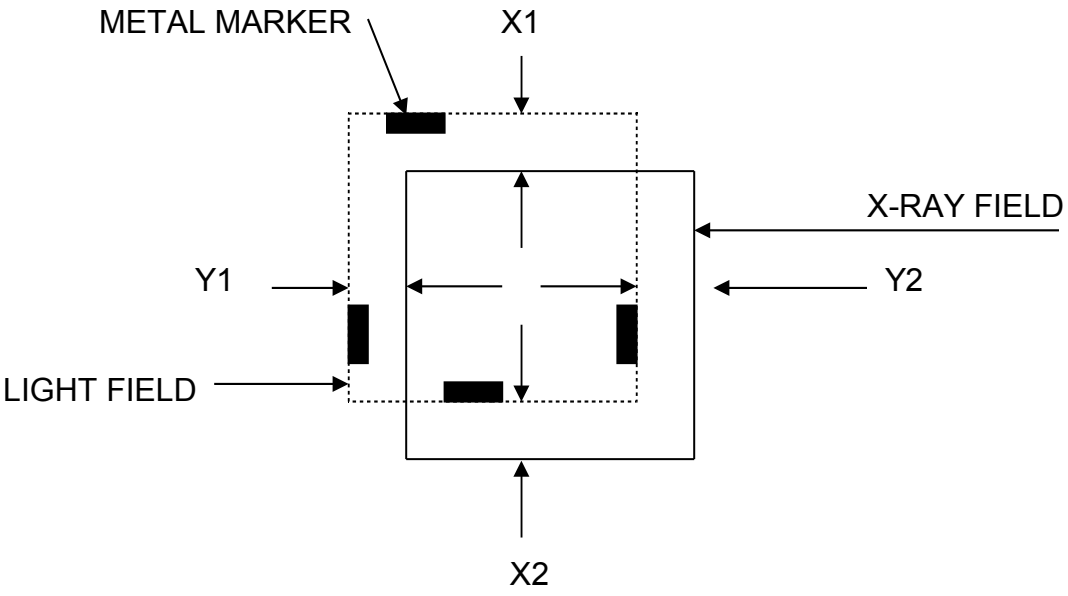
4.1.3 Identify the light field edges and carefully mark the edges by placing metal markers as illustrated below in Figure 4.1.

4.1.4 Expose the film to a density of 1.0 and develop.

4.1.5 Carefully identify the X-Ray field edges and measure the difference between the X-Ray field edges and the light field edges.

4.1.6 The sum of the long axis difference shall not exceed 2 percent of the SID, and the sum of the cross axis difference shall not exceed 2 percent of the SID. See Figure 4.1.

4.1.7 If adjustment is necessary, refer to Section 5.0, 5.1 through 5.1.8.



X1 + X2 MUST BE LESS THAN 2% OF THE SID
Y1 + Y2 MUST BE LESS THAN 2% OF THE SID
FIGURE 4.1

4.1.8 Angulate the collimator to 0° beam-down position and table top to 0° horizontal. Remove the LINEAR collimator table-top TEST PATTERN 1 (70-09015) from this manual and position it on the table-top with the edges parallel to the table-top edges. Flatten the creases and tape it into position at the corners in a manner that will not damage it upon removal. (Figure 4.1).

4.1.9 Position the collimator at a focal spot distance of 40" ± 1/16" by measuring from the center of the exit window to the center of the light-field on the table-top: this distance should be 30 – 5/8" ± 1/16".

If necessary, remove the collimator covers to gain access to the program switches on the Logic PCB. See COVER REMOVAL INSTRUCTIONS, Figure 3.0, Section 3.

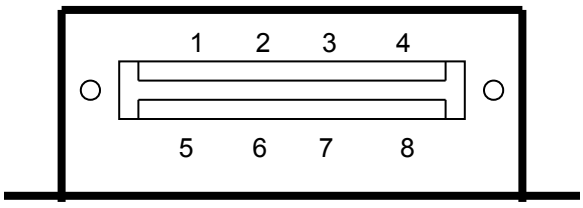
4.2 CASSETTE TRAY ADJUSTMENT

PLEASE NOTE: With tilting tables, the table and wall cassette tray potentiometers must be set exactly the same because there is only one HSID adjustment in the collimator for a given distance to either bucky.

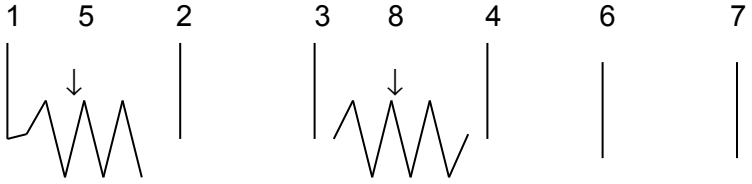
We have calibrated the collimator around a cassette tray that is calibrated at 500 ohms for an 11 inch (12 1/8" outside) cassette. The 11" dimension represents exactly one-half of the 1K ohm cassette tray potentiometer. We strongly suggest that you check, and adjust if necessary, your cassette trays. Consult the tray manufacturer's manual for adjustment procedures.

Following is the size vs. ohms chart:

Cassette Size	Ohms Between Pins 1-5 and 408
5"	60 ohms
7"	207 ohms
8"	280 ohms
10"	427 ohms
11"	500 ohms
12"	573 ohms
14"	720 ohms
17"	940 ohms



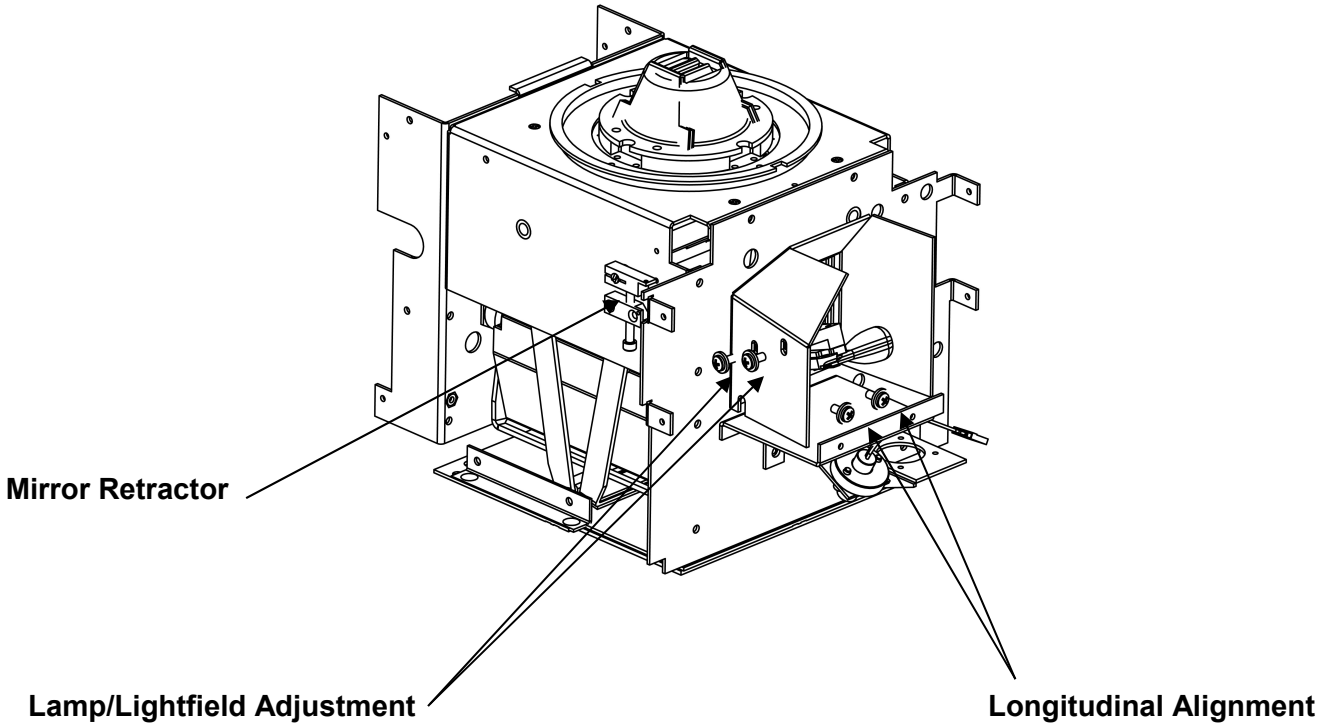
Rear View of Tray Connector



SECTION 5.0

ALIGNMENT PROCEDURES

Cover Removed



CROSS ALIGNMENT

1. Adjust two #6-32 screws for light-field adjustment.
2. (Option) Add Loctite to set in position.

LONGITUDINAL ALIGNMENT

1. Slightly loosen the two #6-32 screws.
2. Position lamp bracket laterally for light-field alignment, left to right.
3. Tighten the two #6-32 screws.

FIGURE 5.1 - LIGHT-FIELD ADJUSTMENT

WARNING! THE LAMP AND HEAT DEFLECTORS MAY BE HOT ENOUGH TO CAUSE SEVERE BURNS. DO NOT TOUCH ANY OBJECT IN THE LAMP AREA WITH BARE SKIN.

WARNING! THE INTENSITY OF LIGHT OUTPUT IS SUFFICIENT TO TEMPORARILY IMPAIR YOUR VISION IF ALLOWED TO ENTER THE EYES DIRECTLY. MAINTAIN A POSITION IN WHICH YOU CAN SEE NEITHER THE FILAMENT WHEN IT IS OFF, NOR ALLOW LIGHT TO DIRECTLY ENTER YOUR FIELD OF VISION WHEN IT IS ON.

WARNING! BOTH CROSS AND LONG SHUTTERS MUST BE FULLY OPEN FOR ANY MIRROR RETRACTION – FORCING THE MIRROR WILL MISCALIBRATE THE LIGHT-FIELD.

5.0 ALIGNMENT PROCEDURES

5.1 FIELD PROJECTION LAMP AND MIRROR ADJUSTMENT

These test must be performed when the field projection lamp is altered from it's original position or replaced.

These tests must also be performed if the original mirror angle has been altered and if any edge of the developed X-Ray image is outside of the tolerance marks as defined in Section 4.1.6.

5.1.1 Steps 4.1 through 4.1.6 should be carefully reviewed or repeated prior to a lamp or mirror adjustment attempt. This is particularly important if only a single testing indicates a failure to meet the requirements defined in Step 4.1.6.

5.1.2 The collimator position and the developed X-Ray film must remain undisturbed from the position defined in Steps 4.1 through 4.1.9.

5.1.3 Remove the rear cover and the lamp housing heat shield.

WARNING! THE LAMP AND HEAT DEFLECTORS MAY BE HOT ENOUGH TO CAUSE SEVERE BURNS. DO NOT TOUCH ANY OBJECT IN THE LAMP AREA WITH BARE SKIN.

WARNING! THE INTENSITY OF THE LIGHT OUTPUT IS SUFFICIENT TO TEMPORARILY IMPAIR YOUR VISION IF ALLOWED TO ENTER THE EYES DIRECTLY. MAINTAIN A POSITION IN WHICH YOU CAN SEE NEITHER THE FILAMENT WHEN IT IS OFF, NOR ALLOW LIGHT TO DIRECTLY ENTER YOUR FIELD OF VISION WHEN IT IS ON.

5.1.4 If the developed X-Ray image (Step 4.1.6) is off-center in the longitudinal direction, loosen the two screws securing the lamp housing.

5.1.5 Use a pair of long nose pliers to move the lamp housing slightly until ***the light field has shifted*** to a position that is centered to the developed X-Ray image (4.1.6) in the longitudinal direction. Tighten the two screws securing the lamp bracket.

5.1.6 If the developed X-Ray image (Step 4.1.6) is in error in the cross-table direction, adjust the angle of the mirror (using the knurled knobs as shown in Figure 5.1) until ***the light field has shifted*** to a position that is centered to the developed X-Ray image (4.1.6).

5.1.7 Repeat steps 1 through 9 in section 3.1 to confirm the results of the above adjustment procedures.

5.1.8 Tighten the lamp bracket screws and replace the lamp housing cover.

5.2 CROSS HAIR WINDOW ADJUSTMENT

5.2.1 These procedures are to be performed if the cross hair shadows are not centered to the light field.

5.2.2 Remove the cone-adapter rails and the lower half of the collimator case (Figure 3.0).

5.2.3 Loosen the screws securing the plastic window.

5.2.4 Move the plastic window to align and center the cross hair pattern to the light field (center lines on the test pattern).

5.2.5 Tighten the screws and reassemble the collimator covers.

5.3 BUCKY CENTERING LIGHT-LINE ADJUSTMENT

These procedures are to be performed if the centering light-line is not centered to the ***correctly adjusted light-field.***

5.3.1 Remove the lamp housing cover.

WARNING: THE LAMP AND HEAT DETECTORS MAY BE HOT ENOUGH TO CAUSE SEVERE BURNS. DO NOT TOUCH ANY OBJECT IN THE LAMP AREA WITH BARE SKIN.

WARNING: THE INTENSITY OF THE LIGHT OUTPUT IS SUFFICIENT TO TEMPORARILY IMPAIR YOUR VISION IF ALLOWED TO ENTER THE EYES DIRECTLY. MAINTAIN A POSITION IN WHICH YOU CAN SEE NEITHER THE FILAMENE WHEN IT IS OFF, NOR ALLOW LIGHT TO DIRECTLY ENTER YOUR FIELD OF VISION WHEN IT IS ON.

5.3.2 If the centering light-line is off-center to the correctly centered light-field or exhibits a rainbow of colors along one edge, loosen the two screws securing the prism/slit bracket. See Figure 5.1.4.

5.3.3 Use a pair of long-nose pliers to move the bracket as required to center the light-line to the correctly adjusted light-field.

NOTE: IN ORDER TO AVOID THE RAINBOW OF COLORS ALONG THE EDGE, OR TO ELIMINATE THESE COLORS, MAINTAIN THE PRISM IN A POSITION THAT IS CENTERED TO THE BRIGHT LIGHT-LINE OBSERVED ON THE BRACKET AT THE BASE OF THE PRISM WHILE ADJUSTING THE BRACKET.

5.3.4 Tighten the screws and replace the collimator covers.

SECTION 6.0

COMPLIANCE VERIFICATION

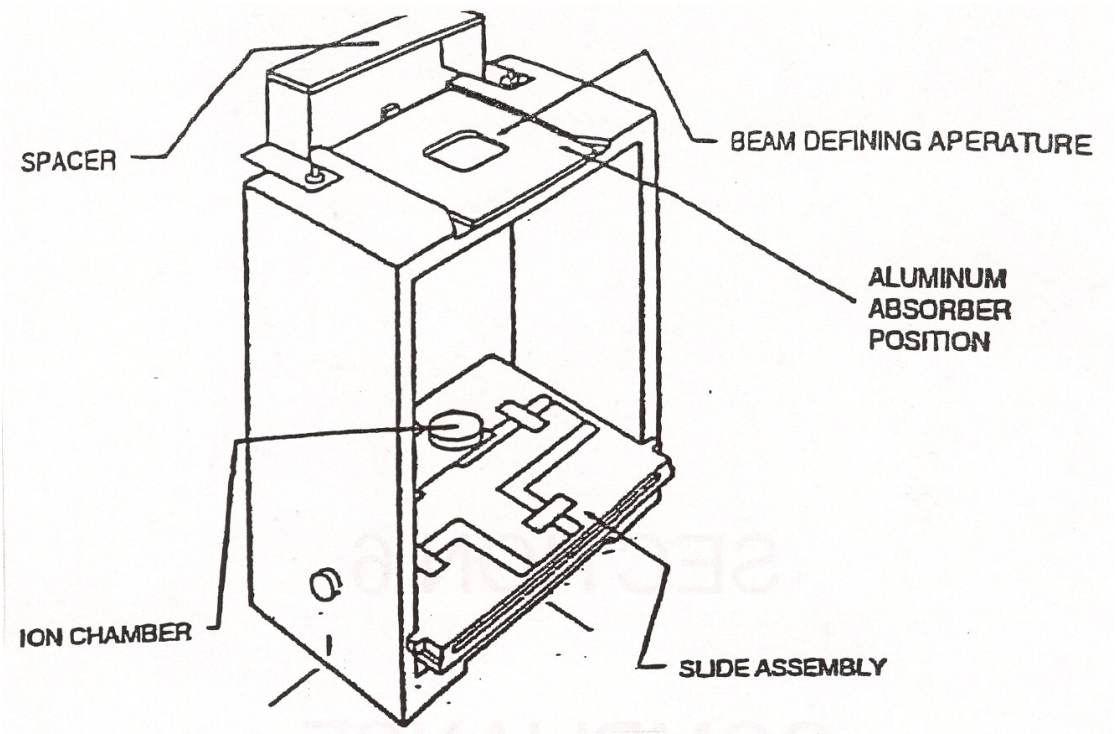
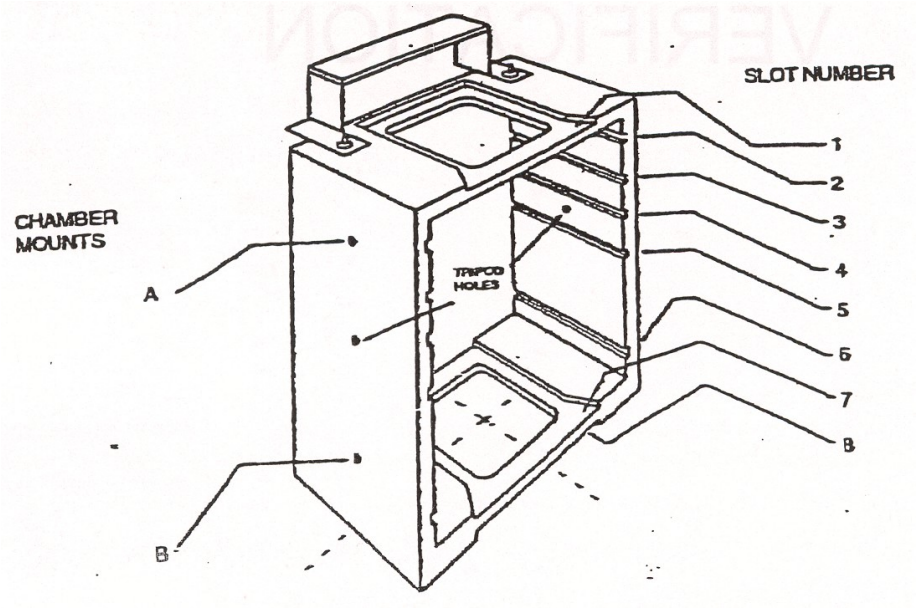

SPACER
BEAM DEFINING APERATURE
ALUMINUM
ABSORBER
POSITION
ION CHAMBER
SLIDE ASSEMBLY

FIGURE 6.1



LEFT SIDE MOUNTING HOLES FOR COMPLIANCE TESTING
FIGURE 6.2

6.0 COMPLIANCE VERIFICATION

It is necessary for the assembler to verify compliance. A series of tests, when performed at the time of installation, will indicate compliance with CFR, Sub-Chapter J, Part 1020, Performance Standards.

The following test are from NEMA Standards Publication, No. X-8-1979 (Test Methods for Diagnostic X-Ray Machines for Use During Initial Installation).

For each compliance item, there may be a variety of test methods described. Which method is used will depend on the tester's experience, availability of equipment, time or special requirements of the Eureka Linear Collimator. Any reference to tolerances on compliance items are referenced directly from 21 CFR, Sub-Chapter J, Regulations. They do not take into account inaccuracies brought about by the test equipment, instrumentation, or the human element. These factors must be considered when these tests are performed and the compliance of equipment is being determined.

6.1 VERIFICATION TESTS TO BE PERFORMED:

Test Procedure or Requirement		Applicable Paragraph
1.	Visual Definition of X-Ray Light Field	XR8/2.14
2.	Intensity of Light Field Illumination	XR8/2.15
3.	Minimum Field Size	XR8/2.16
4.	X-Ray Field/Receptor Center Alignment	XR8/2.17
5.	Indication of Field Size	XR8/2.18
6.	Positive Beam Limitation (PBL)	XR8/2.19

7.	X-Ray Field Limitation and Alignment	XR8/2.20
8.	Return to PBL with Image Receptor Change	XR8/2.21
9.	Keylock PBL Override	XR8/2.22
10.	Beam Quality	XR8/2.09

RECORD THE RESULTS ON THE *RECORD SHEET* SUPPLIED AT THE END OF THIS SECTION.

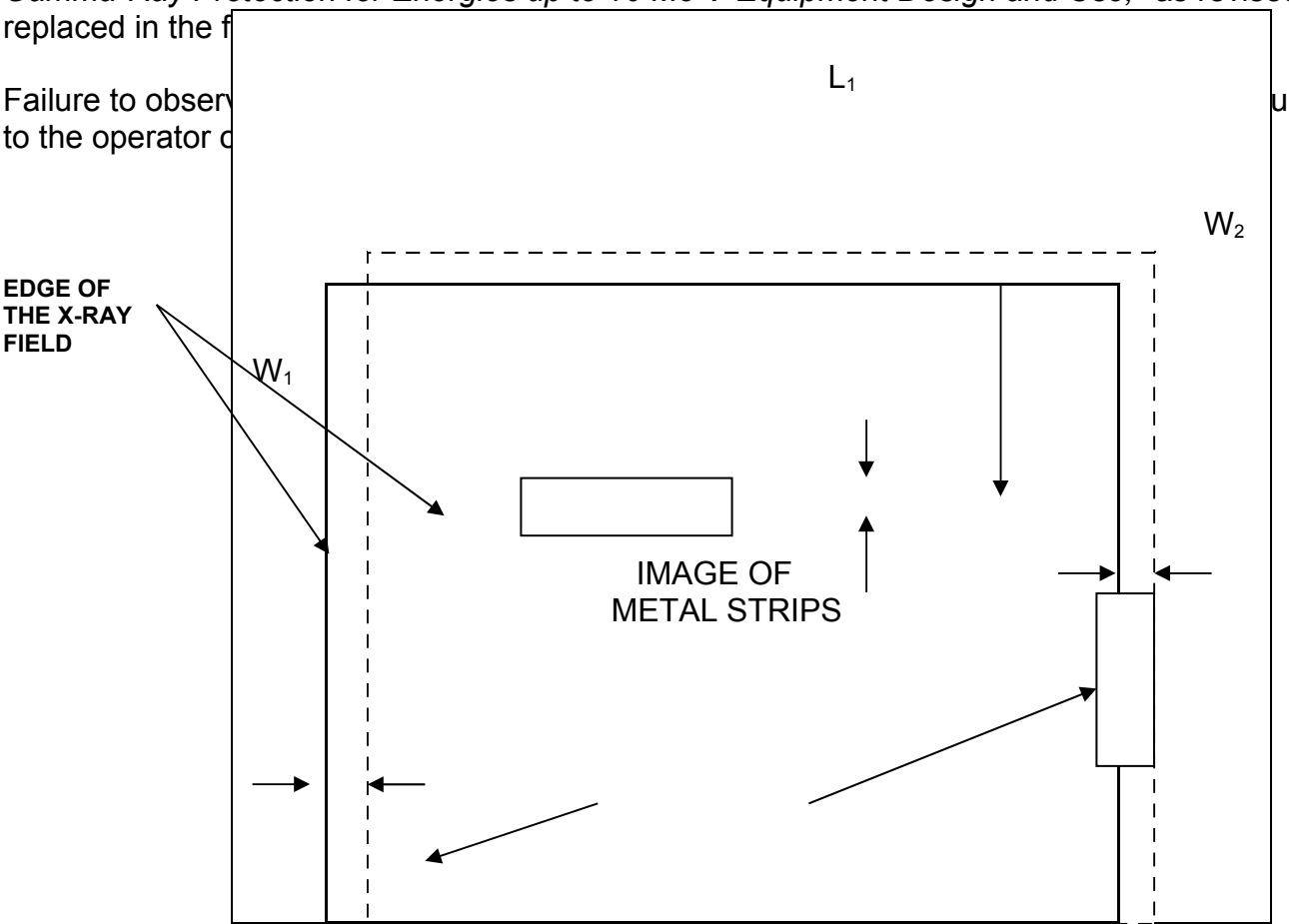
Radiation Warning for Diagnostic X-Ray Systems

X-Rays are dangerous for both the operator and others in the vicinity unless established safe exposure procedures are strictly observed.

The useful and scattered beams can produce serious, genetic or potentially fatal bodily injuries to any persons in the surrounding area if used by an unskilled operator. Adequate precautions must always be taken to avoid exposure to the useful beam, as well as leakage radiation from within the source housing or to scattered radiation resulting from the passage of radiation through matter.

Those authorized to operate, test, participate in or supervise the operation of the equipment must be thoroughly familiar and comply completely with the currently established safe exposure factors and procedures described in publications such as Sub-Chapter J of Title 21 of the Code of Federal Regulations, *"Diagnostic X-Ray Systems and their Major Components,"* and the National Council on Radiation Protection (NCRP) No. 33, *"Medical X-Ray and Gamma-Ray Protection for Energies up to 10 Me V-Equipment Design and Use,"* as revised or replaced in the f

Failure to observ uries to the operator c



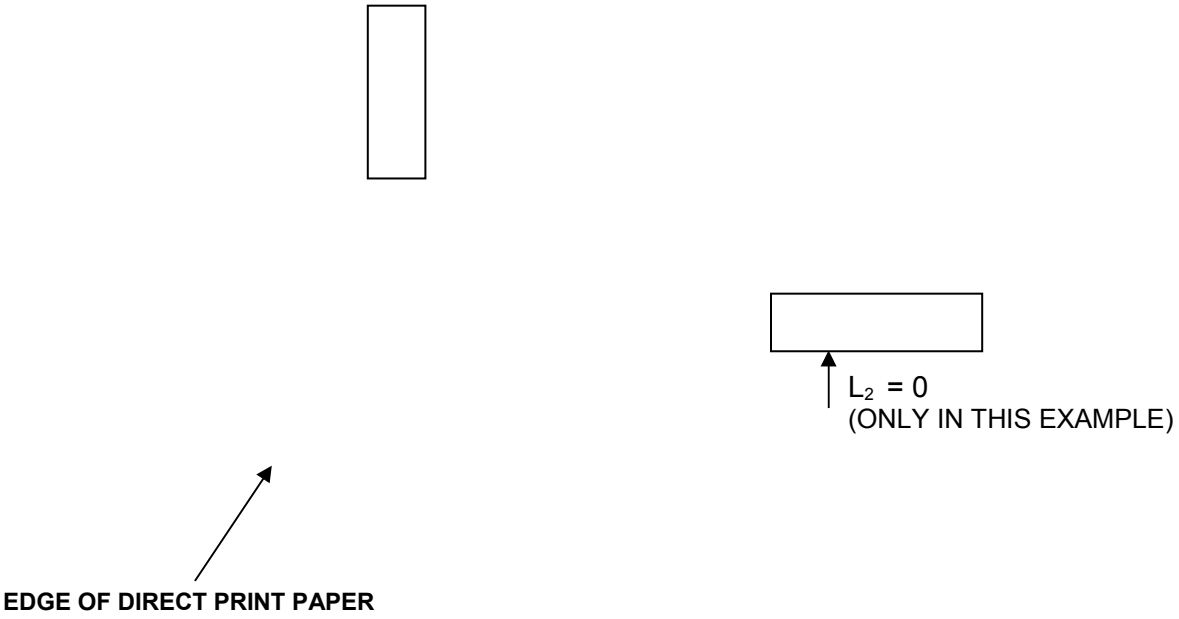


FIGURE 6.3

XR 8-2.14 VISUAL DEFINITION (RADIOGRAPHIC) OF X-RAY LIGHT FIELD

REQUIREMENT – Means shall be provided for visually defining the perimeter of the X-Ray field. The total misalignment of the edges of the visually defined field with the respective edges of the X-Ray field along either the length or width of the visually defined field shall not exceed 2 percent of the distance from the source to the center of this visually defined field when the surface upon which it appears is perpendicular to the axis of the X-Ray beam (see 21 CFR 1020.3 (d) (2)).

.01 METHOD 1 – BRH-FDA COMPLIANCE TEST METHOD

A. EQUIPMENT REQUIRED

1. BRH/FDA compliance test stand (including slide assembly)
2. Four metal marker strips
3. Plastic cassette, loaded with direct print paper or film

B. PROCEDURE

1. Attach the spacer, positioned out of the primary beam to the test stand. Center the stand on the table. Center the source over the stand, assure by the means provided that the axis of the X-Ray beam is perpendicular to the plane of the image receptor, and bring the beam-limiting device down into firm contact with the spacer. Select the MANUAL mode of operation (there must not be a cassette in the cassette holder).

2. Insert the slide assembly, grid side up, into slot 6 of the test stand and the focal spot assembly into slot 1 (Figure 6.2). Place a cassette loaded with direct print paper or film into the slide assembly.

3. Adjust the collimator so that no part of the light-field intersects any portion of the top of the test stand. (Further collimation to a light field or less than 15 by 20 centimeters (6 by 8 inches) on the side assembly grid may be desirable to assure that the X-Ray field will be fully contained on the direct print paper for film in the slide assembly).

4. Position the outer edge of each metal strip to correspond with each side of the light-field. One end of the metal strip shall extend to the center line of the respective grid arm.

5. Select proper technique factors and make an exposure (may require several exposures to obtain 1 R to the direct print paper).

6. Develop the direct print paper or film.

C. VERIFICATION OF COMPLIANCE

For determination of misalignment, compare the edges of the X-Ray field o the edges of the light-field as defined by the outer edges of the metal strips. On each side of the rectangular fields, measure the separation between the X-Ray field and the outside edge on the image of the respective metal strip. Sum these measured separations for opposite sides of the X-Ray field to yield a total misalignment and width misalignment, both without regard to sign (see Paragraph D and Figure 6-3).

D. CALCULATIONS

Calculate the source to image distance (SID) per the following formula (to slot 6) as the indicated source-to-table top distance minus 4.7 centimeters (1.85 inches) and record. Calculate 2 percent of this SID and record. Both the length and width misalignment must be less than 2 percent of SID (to slot 6).

$$\frac{2.5}{S} = \frac{X}{X + 13.95}$$

$2.5X + (2.5)\ 13.95 = XS$

$(2.5)\ 13.95 = XS - 2.5X$ See Figure 6-4

$34.875 = X\ (S - 2.5)$

$$X = \frac{34.875}{S - 2.5}$$

The misalignments are calculated as follows:

Length misalignment = $L_1 + L_2 \leq$ 2% SID
Width misalignment = $W_1 + W_2 \leq$ 2% SID

Calculate 2% of the measured SID. Each of the misalignments, length or width, must be less than or equal to 2% of the measured SID for compliance.

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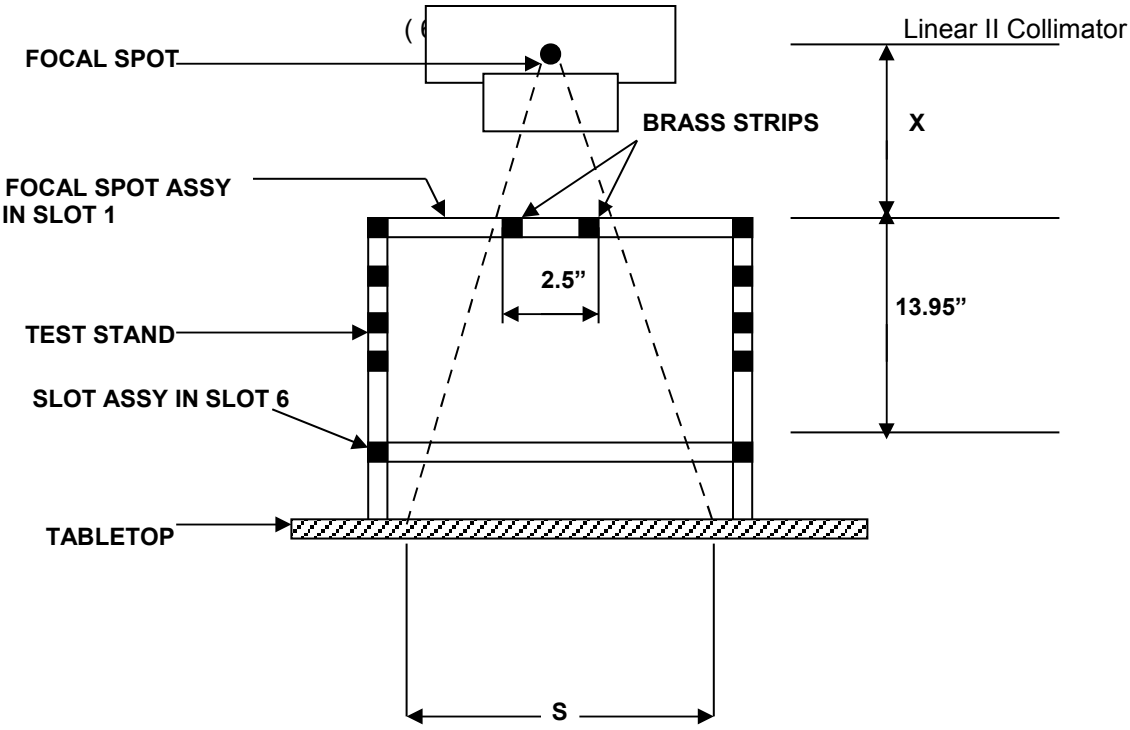

FIGURE 6.4

DOTTED LINE COINCIDES WITH THE OUTER EDGE OF THE METAL STRIPS AND IS THE PERIMETER OF THE LIGHT FIELD.

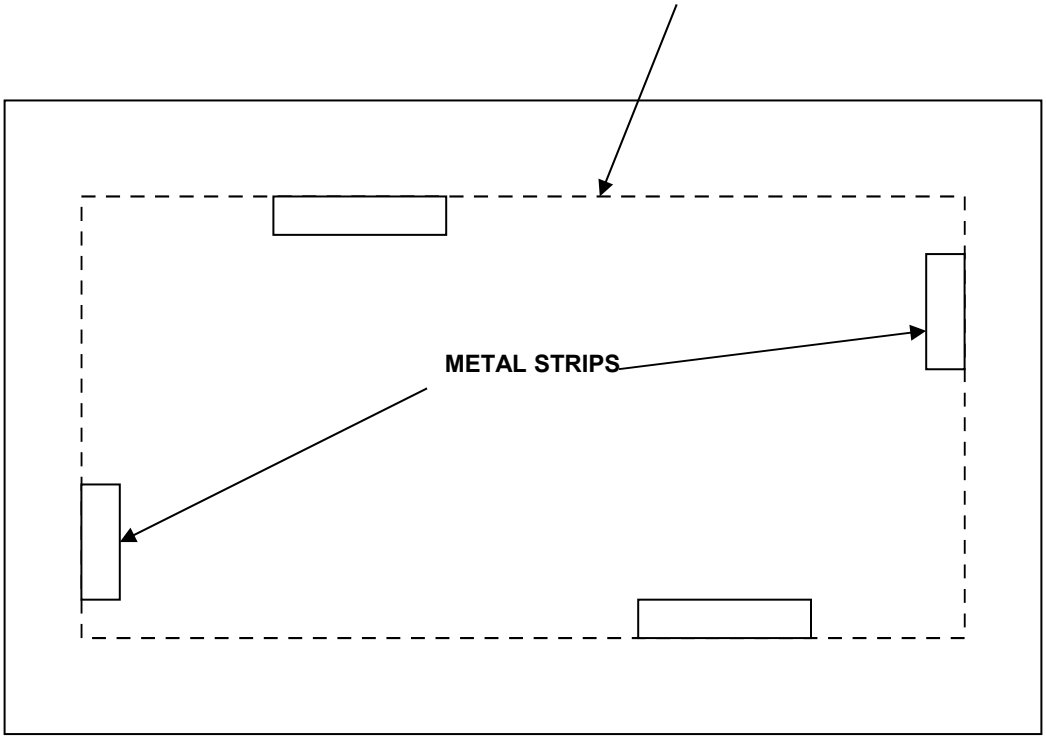

FIGURE 6.5

.02 METHOD II – METAL MARKER METHOD

A. GENERAL

The actual versus indicated source-to-image receptor distance (SID) test must be performed prior to attempting this test.

B. EQUIPMENT

1. Plastic cassette with direct paper or film
2. Radio-opaque markers*

* Each marker is approximately 1/32 inch galvanized sheet metal having the dimensions of 1.5 by 1.5 inches.

C. PROCEDURE

1. Adjust the source assembly and the beam-limiting device so that they are approximately centered over the table and perpendicular to the table top. Then position the beam-limiting device to the SID previously determined and record the indicated value.

2. Insert the cassette and turn on the light-field.** Adjust the beam-limiting device to the next size smaller than the cassette size being used.

** Make a note to record the field size indicated on the dial of the beam-limiting device for the SID being used.

3. Position the outer edge of each metal marker on the table top to correspond with each side of the light-field (Figure 6-5).

4. Select the appropriate technique factors and make an exposure.

5. Develop film on direct-print paper.

D. VERIFICATION OF COMPLIANCE

For determination of misalignment, compare the edges of the X-Ray field to the edges of the light field as defined by the outer edges of the metal strips. On each side of the rectangular fields, measure the separation between the X-Ray field and the outside edges of the image of the respective metal strip. Sum these measured separations for opposite sides of the X-Ray field to yield a total misalignment in the length and width dimensions. Record the length misalignment and width misalignment, both without regard to sign (see Par. E and Figure 6-3).

E. CALCULATIONS

Calculate the SID per the following formula (to slot 6) as the indicated source-to-tabletop distance minus 4.7 centimeters (1.85 inches) and record. Calculate 2 percent of this SID and record. Both the length and width misalignment must be less than 2 percent of SID (to slot 6).

$$\frac{2.5}{S} = \frac{X}{X + 13.95}$$

$2.5X + (2.5)\ 13.95 = XS$

$(2.5)\ 13.95 = XS - 2.5X$ See Figure 6-4

$34.876 = X\ (S - 2.5)$

$$X = \frac{34.875}{S - 2.5}$$

The misalignments are calculated as follows:

Length misalignment = $L_1 + L_2 \leq$ 2% SID
Width misalignment = $W_1 + W_2 \leq$ 2% SID

Calculate 2% of the measured SID. Each of the misalignments, length or width, must be less than or equal to 2% of the measured SID for compliance.

NEMA Standards 05.15.79

.03 METHOD III – ALTERNATE TEST STAND METHOD

A. GENERAL

1. The image of the radiation field on the film must be of uniform density with sharply defined edges.

2. The graduated template is utilized to minimize the amount of error introduced into the measurement of the X-Ray field size.

3. The actual versus indicated SID must be determined prior to performing this test.

B. EQUIPMENT

1. Manufacturer's recommended test stand
2. Cassettes and film.
3. Graduated template

C. PROCEDURE

1. Align the tube unit and image receptor and set the SID with the normal operating aids (detents, scales, lights, etc.).

2. Load cassette and insert into image receptor.

3. Close shutters to a size smaller than that of the cassette placed into the image receptor.

4. Position the test stand in accordance with the manufacturer's instructions.

5. Energize the field light and record or define the position of the four light field edges as shown on the graduated template or position four metal markers so that the outer edge of each metal marker corresponds to an edge on each side of the light-field or both.

6. Select proper technique factors, make an exposure, and develop film.

D. VERIFICATION OF COMPLIANCE

1. Calculate 2 percent of the actual SID and record.

2. Compare the edges of the X-Ray field to the edges of the light field as defined by the outer edges of the metal markers or by the graduated scale.

3. Measure the distance between the edges of the two fields for each side of the rectangular fields (see Figure 6.3).

4. Arithmetically sum the misalignment of opposite sides, regardless of sign, of the rectangles, to yield misalignment in each of the two directions.
Length misalignment = $L_1 + L_2 \leq$ 2% SID
Width misalignment = $W_1 + W_2 \leq$ 2% SID
Both the length and width misalignment must be less than 2 percent SID as calculated in Step 1.

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XR 8-2.15 INTENSITY OF LIGHT FIELD ILLUMINATION

REQUIREMENT – When a light localizer is used to define the X-Ray field, it shall provide an average illumination of not less than 160 lux (15 footcandles) at 100 centimeters or at the maximum SID, whichever is less. The average illumination shall be based on measurements in the approximate center of each quadrant of the light field (See 32 CFR 1020.31 (d) (2) (ii)).

.01 METHOD 1 – DIRECT TEST

A. GENERAL

1. Make certain that all surfaces in the light path are clean.
2. Reduce ambient light level as much as is feasible.

B. EQUIPMENT

Photometer capable of measuring 160 lux (15 footcandles)

C. PROCEDURE

1. Place the photometer on the tabletop and set the diagnostic source assembly so that the sensing area of the photometer is at 100 centimeters or the maximum SID, whichever is less.

2. Open the beam-limiting device to assure that each quadrant of the light field is larger than the sensing area of the photometer.

3. Refer to the manufacturer's instructions for proper use of the photometer.

4. Turn on the light localizer.

5. At or near the center of a light field quadrant, determine the illuminance by subtracting the ambient light level from the corresponding light level as measured when the light localizer is energized. Do not move the photometer between measurements.

6. Repeat the procedure for the remaining three quadrants.

7. Determine the average illuminance of the four light field quadrants.

8. Record the model number, serial number, and the date of calibration of test instrument.

D. VERIFICATION OF COMPLIANCE

Verify that the average illumination is not less than 160 lux (15 footcandles).

NEMA Standards 05.15.79

.02 METHOD II – INDIRECT TEST

A. GENERAL

1. This indirect test is feasible after the correlation between light output and voltage is made; the manufacturer then specifies a voltage to be measured or adjusted, or both.

2. Make certain that all surfaces in the light path are clean and unobstructed.

B. EQUIPMENT

Digital Voltmeter

C. PROCEDURE

1. Remove trim covers to gain access to the lamp socket.

2. Verify that the specified lamp is in the socket.

3. With the light-field energized, measure the voltage across the lamp socket terminals.

4. Record the voltage measured.

5. Record the model number, serial number and calibration date of the digital voltmeter.

D. VERIFICATION OF COMPLIANCE

The voltage recorded shall be within the tolerances specified by the manufacturer.

NOTE: THE AC VOLTAGE AT THE LAMP SOCKET MUST NOT BE LESS THA N19.5 VAC RMS

XR 8-2.16 MINIMUM FIELD SIZE

REQUIREMENT – Minimum field size at 100 centimeters (radiographic) or the maximum SID (fluoroscopic) shall be less than or equal to 5 by 5 centimeters (see 21 CFR 1020.31 (e)(2), and 1020.32 (b)(2)).

.01 METHOD 1 – FILM METHOD

A. GENERAL

1. The following test is to be used for radiographic, fluoroscopic, and spotfilm devices.

2. This procedure need not be performed if it is apparent by visual means that the beam-limiting device can be adjusted to a size less than 5 by 5 centimeters at the specified SID.

B. EQUIPMENT

1. Cassette
2. X-Ray film or direct-print paper

C. PROCEDURE 1 – RADIOGRAPHIC AND SPOTFILM DEVICES

1. Adjust the maximum SID obtainable (spotfilm devices or 100 centimeter radiographic devices).

2. Adjust the beam-limiting device to the smallest field size obtainable.

3. Load cassette and set proper technique factors.

4. Make an exposure.

5. Process film.

D. PROCEDURE 2 – FLUOROSCOPIC

1. Set fluoroscopic system for maximum SID and lock into position.

2. Remove all compression cones from the beam.

3. With the X-Ray beam off, attach beam attenuator to the input surface of the image receptor.

4. Attached cassette to the bottom of the attenuator.

5. Close shutters as far as possible.

6. Set technique factors to assure proper exposure of the film.

7. Make exposure.

8. Process film.

E. VERIFICATION OF COMPLIANCE

Measure the X-Ray field produced on film and verify that the field size is less than or equal to 5 by 5 centimeters.

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1. Set SID for maximum obtainable and lock in place.

2. Position beam attenuator to intercept entire X-Ray beam.

3. Set appropriate technique factors (both spotfilm and fluoroscopic).

4. Close shutters to smallest size obtainable and make an exposure.

5. Verify on viewing device that there is no visible indication of radiation. If any radiation field is discernible, Method I must be utilized to determine minimum field size.

F. VERIFICATION OF COMPLIANCE

Verify that no visual indication of the radiation field is discernible.

XR 8.17 X-RAY FIELD/RECEPTOR CENTER ALIGNMENT

REQUIREMENT – Means shall be provided to align the center of the X-Ray field with respect to the image receptor to within 2 percent of the SID (See 21 CFR 1020.31 (e)(1)).

A. GENERAL

1. All exposures taken during this test must have a uniform film density of approximately 1.0.

2. Actual versus indicated SID must be determined prior to performing this test.

B. EQUIPEMENT

Radiographic cassette loaded with film (8 by 10 inches).

C. PROCEDURE

1. Load cassette with film and place into the bucky tray.

2. Assure the X-Ray beam is perpendicular to the image receptor and centered over the bucky tray.

3. Set the SID to the value determined in the actual versus indicated SID test.

4. Reduce the X-Ray field to approximately 6 by 8 inches.

5. Make an exposure and develop the film.

6. To determine as accurately as possible the corners of the image recorded on the film, locate two points on each of the four sides of the image. Through the two points on each side draw a straight line. These four lines, when extended, intersect making a rectangle which is a close approximation of the actual X-Ray field. Draw a diagonal across the image to determine the center of the X-Ray image.

7. To determine the center of the X-Ray film draw diagnosis across the film (the point where these two lines cross is the center of the film), or fold the film into quarters (the point where the two folds cross is the center of the film).

8. The distance from the film center mark to the image center mark is measured and recorded as the linear displacement or misalignment of the centers of the X-Ray field and the image receptor.

D. VERIFICATION OF COMPLIANCE

Verify that this distance is less than or equal to 2 percent of the SID.

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XR 8-2.18 INDICATION OF X-RAY FIELD SIZE

REQUIREMENT – Means shall be provided on the beam-limiting device to indicate field size in the image receptor plane to within 2 percent of the SID (see 21 CFR 1020.31 (e) (1)).

A. GENERAL

The actual versus indicated SID test must be performed prior to beginning this test.

B. EQUIPMENT

A 24 by 30 centimeter or a 10 by 12 inch cassette with film.

C. PROCEDURE

1. Set the SID to the value determined in the actual versus indicated SID test.

2. Center the film cassette in the cassette tray and insert into position.

3. Adjust the film size to 15 by 15 centimeters or 8 by 8 inches by means of the numerical indicators on the beam-limiting device.

4. Make an exposure and develop film.

5. Measure and record the length and width dimensions of the image.

D. VERIFICATION OF COMPLIANCE

The deviation of any of the recorded dimensions must not exceed 2 percent of the SID in Step 1.

NEMA Standards 05.15.79

XR 8-2.19 POSITIVE BEAM LIMITATION (PBL)

REQUIREMENT – Means shall be provided for positive-beam limitation (PBL) which will, at the SID for which the device is designed, either cause automatic adjustment of the X-Ray field in the plane of the image receptor to the image receptor size within five seconds after insertion of the image receptor, or if adjustment is accomplished automatically in a time interval greater than 5 seconds or is manual, will prevent production of X-Rays until such adjustment is completed. At SID's at which the device is not intended to operate, the device shall prevent the production of X-Rays (see 21 CFR 1020.31 (e)(2)).

A. GENERAL

The PBL requirement must be met if both the beam axis and table angulation are within plus or minus 10 degrees of the horizontal or vertical and the film is used in the cassette tray.

B. EQUIPMENT

Large size cassette

C. PROCEDURE

1. Set the source assembly to a SID where the PBL system is intended to operate.

2. Place the largest film cassette with which the system is intended to operate into the cassette tray; do not insert cassette tray at this time.

3. Turn on the light localizer and adjust the beam-limiting device to the smallest obtainable field size.

4. Insert the cassette tray and measure the time elapsed from the insertion of the cassette tray with the cassette inserted to the adjustment of the X-Ray field to the image receptor size.

5. The adjustment must be accomplished within 5 seconds.

6. If the adjustment is not accomplished within 5 seconds or the beam-limiting device is of the manual type, select low-range values of the tube potential and tube current and attempt to make an exposure. The production of X-Rays must be prevented until the PBL adjustment is completed.

7. Move the source assembly to a SID where the PBL system is not intended to operate (see manufacturer's specifications) and attempt to make an exposure. Exposures must not be possible.

XR 8-2.20 X-RAY FIELD LIMITATION AND ALIGNMENT

REQUIREMENT – The X-Ray field size in the plane of the image receptor, whether automatically or manually adjusted, shall be such that neither the length nor the width of the X-Ray field differs from that of the image receptor by greater than 3 percent of the SID and that the sum of the length and width differences without regard to sign be no greater than 4 percent of the SID, when the equipment indicates that the beam axis is perpendicular to the plane of the image receptor (see 21 CFR 1020.31 (e)(2)(ii)).

.01 METHOD 1 – BRH/FDA TEST STAND METHOD

A. EQUIPMENT

1. BRH/FDA compliance test stand with accessories.

2. Slide assembly

3. Plastic cassette containing a sheet of direct print paper or X-Ray film.

4. Ruler

5. Cassette (preferably 8 to 10 inches or smaller).

B. PROCEDURE

1. Using the means provided, align the source assembly so that the beam axis is perpendicular to the image receptor.

2. Place the test stand on the table.

3. Position the spacer so that it does not intersect the primary beam and secure with the pushbutton connectors.

4. Center the source assembly over the test stand using the means provided, e.g. bucky light.

5. Bring the source assembly down into firm contact with the spacer.

6. Center the cassette tray with the source assembly using the means provided, e.g. bucky light.

7. Insert the plastic cassette into the slide assembly. Then insert the slide assembly into slot 5 (see Figure 6-2).

8. Center the film cassette in the cassette tray and insert into position. If the positive beam limitation will not operate at this SID, raise the source assembly and lock in position at the first operable SID.

9. Make an exposure. Develop the image. Measure and record the length and width dimensions of the image.

10. Calculate the field size correction factor as the SID/A where:

    a. SID is the indicated source-to-image receptor distance, and

    b. A is the indicated source-to-tabletop distance less 7.7 inches. Multiply each of the measured dimensions by the correction factor.

    $$\text{X-Ray field length at undertable image receptor} = \frac{SID}{A} \times (\text{X-Ray field length at slot 5})$$

    $$\text{X-Ray field width at undertable image receptor} = \frac{SID}{A} \times (\text{X-Ray field width at slot 5})$$

    Determine the difference without regard to sign between the corrected length and width dimensions and the corresponding cassette film size dimensions (8 by 10, 5 by 7, etc.) Each of these differences must be less than 3 percent of the SID, and the sum of these differences must be less than 4 percent of the SID.

NEMA Standards 05.15.79

.02 METHOD II – ALTERNATE TEST STAND METHOD

A. GENERAL

Prior to performing this test, the magnification factor must be determined in accordance with the X-Ray/light field alignment test – Method III.

B. EQUIPMENT

1. Manufacturer's recommended test stand
2. Cassette with film

C. PROCEDURE

1. Align the tube unit and image receptor and set SID to the value determined in the actual versus indicated SID test.

2. Insert empty 8 by 10 inch cassette into bucky tray.

3. Position test stand in accordance with manufacturer's instructions.

4. Load a second cassette and place in the designated position.

5. Select the proper technique factors, make an exposure, and develop film.

6. Measure the length and width of the X-Ray image on the film.

7. Multiply each measurement by the magnification factor previously determined.

D. VERIFICATION OF COMPLIANCE

Verify that the X-Ray field size in the plane of the image receptor does not differ from that of the image receptor by greater than 3 percent of the SID and that the sum of the length and width differences without regard to sign is not greater than 4 percent of the SID.

NEMA Standards 05.15.79

.03 METHOD III – CASSETTE METHOD

A. GENERAL

This procedure can be used only when a capability is provided for overriding positive beam limitation.

B. EQUIPMENT

1. Large cassette with film
2. Small cassette, empty

C. PROCEDURE

1. Insert empty smaller cassette into bucky tray.

2. Switch system to the override mode.

3. Remove the smaller cassette and insert the loaded large cassette.

4. Select the proper technique factors, make an exposure, and develop film.

5. Measure the length and width of the X-Ray image on the film.

D. VERIFICATION OF COMPLIANCE

Verify that the X-Ray field size in the plane of the image receptor does not differ from that of the image receptor (smaller cassette) by greater than 3 percent of the SID and that the sum of the length and width differences without regard to sign is not greater than 4 percent of the SID.

NEMA Standards 05.15.79

XR 8-2.21 RETURN TO POSITIVE-BEAM LIMITATION (PBL) WITH IMAGE RECEPTOR CHANGE

REQUIREMENT – Return to positive-beam limitation (PBL) shall occur with a change in image receptor size (see 21 CFR 1020.31 (e)(2)(iii)).

A. EQUIPMENT

Medium size cassette.

B. PROCEDURE

1. Select positive-beam limitation mode.

2. Insert the medium size cassette into the bucky tray and record the field size indication.

3. Collimate down to a field size smaller than the cassette.

4. Remove and reinsert the cassette.

C. VERIFICATION OF COMPLIANCE

Verify that the system has returned to positive-beam limitation. Record the field size indication and verify that it is equal to the previously recorded field size.

NEMA Standards 05.15.79

XR 8-2.22 KEY LOCK TO POSITIVE-BEAM LIMITATION OVERRIDE

REQUIREMENT – If a capability is provided to override positive-beam limitation, a key shall be required to override the positive mode, and the key shall be captive while the positive mode is overridden (See 21 CFR 1020.31 (e)(2)(v)).

A. GENERAL

This test can be performed only if a capability is provided for overriding positive-beam limiting.

B. EQUIPMENT

None

C. PROCEDURE

1. Verify that a key is required in order to select the override mode.

2. Select the override mode using the key.

3. Verify that while in this mode the key is captive.

XR 8-2.09 BEAM QUALITY (HALF-VALUE LAYER (HVL))

REQUIREMENT - The minimum beam quality requirements listed in Table 6-1 shall be met (see 21 CFR 1020.30 (m)).

.01 METHOD 1 – VISUAL DETERMINATION OF HALF-VALUE LAYER (HVL)

A. GENERAL

The above HVL requirement will be considered to have been met if it can be demonstrated that the aluminum equivalent of the total filtration in the primary beam is not less than that shown in Table 6.2.

B. EQUIPMENT

None required.

TABLE 6-1 MINIMUM BEAM QUALITY REQUIREMENTS

KVp Range	Measured kVp	HVL (mmAL*)
Below 50……..	30	0.3
	40	0.4
	49	0.5
50 to 70…….	50	1.2
	60	1.3
	70	1.5
Above 70……	71	2.1
	80	2.3
	90	2.5
	100	2.7
	110	3.0
	120	3.2
	130	3.5
	140	3.8
	150	4.1

* Type 1100 aluminum alloy as given in Aluminum Association Publication No. ASD-1, Aluminum Standards and Data.

TABLE 6-2 ALUMINUM EQUIVALENT OF PRIMARY BEAM TOTAL FILTRATION

Operating Voltage (kVp)	Total Filtration (mm Al Equivalent)
Below 50	0.5
50 – 70	1.5
Above 70	2.5

C. PROCEDURE

Visually inspect the system and determine the aluminum equivalence of the total filtration in the primary beam. This includes the inherent filtration of the X-Ray tube, X-Ray tube housing, beam-limiting device, and any additional filtration that may have been added in the useful beam (in fluoroscopic systems the tabletop is included as part of the added filtration).

D. VERIFICATION OF COMPLIANCE

The aluminum equivalence of the total filtration must be equal to or greater than the amount specified in Table 6-2.

NEMA Standard 05.15.1979

.02 METHOD II – STANDARD ABSORBER METHOD

A. GENERAL

This test is to be used when the surveyor cannot remove or see the total filtration equivalence.

The HVL determinations obtained from the following procedures are to be compared with those illustrated in Table 6-1. The HVL in millimeters of aluminum of the system being tested must be greater than or equal to the values shown in Table 6-1.

B. EQUIPMENT

1. Radiation detector

2. Standard absorber with equivalent filtration of 2.5 millimeters of aluminum.

C. PROCEDURE

1. With the detection device positioned horizontally, an exposure is made at a preselected technique factor of 80 kVp an appropriate mA and time. The reading of the radiation output is recorded.

2. Position a total of 2.5 millimeters of aluminum at the port of the beam-limiting device and repeat the exposure using the same technique factors. Record the radiation output.

   For X-Ray units operating at low kVp (less than 50) and for mammography units, it will be necessary to use an aluminum absorber of 0.6 millimeters at 49 kVp.

D. VERIFICATION OF COMPLIANCE

Verify that the radiation output in Step 2 is greater than or equal to 50 percent of the radiation output in Step 1.

NEMA Standard 05.15.98

.03 METHOD III – FDA/CDRH COMPLIANCE TEST

A. GENERAL

The HVL determinations obtained from the following procedures are to be compared with those illustrated in Table 6-1. The HVL in millimeters of aluminum of the system being tested must be greater than or equal to the values shown in Table 6.1.

B. EQUIPMENT

1. FDA/CDRH compliance test stand with accessories (Figure 6.1).

2. Survey meter adapted for use with stand with an ion chamber.

3. Several sheets of aluminum, each having a thickness of 0.5 or 1.0 millimeter.

C. PROCEDURE

1. Attach the spacer, positioned out of the primary beam, to the test stand. Center the stand on the table. Center the source of the stand and bring the beam-limiting device down into firm contact with the spacer. Select the MANUAL mode of operation (there must not be a cassette in the cassette tray). Insert the beam-defining assembly in slot 1 of the stand with the leaded side up (see Figure 6.2). Adjust the beam-limiting device so that the X-Ray field slightly exceeds the aperture of the beam-defining assembly. Mount the ion chamber at position B with the chamber facing upward. Connect the chamber and meter with the cable provided. Select a tube potential that is commonly used and is in the highest kVp range of the X-Ray system.

2. With no added filtration in the beam, make an exposure and record the reading. For all diagnostic X-Ray equipment, use Table 6-3 to determine increments of filtration required to perform the half-value layer procedure. Make an exposure and record the reading for each total thickness.

TABLE 6-3 HIGHEST DESIGN OPERATING RANGE

Total Added Filtration, mm Al

Below 50 kVp	50-70 kVp	Above 70 kVp
0.5	1.0	1.5
1.0	1.5	2.5
1.5	2.5	3.5
2.0	3.5	4.5

The recorded data is plotted on semi-log graph paper (Examples A and B, Fig. 6.6) and the half-value layer is read directly from the graph.

D. VERIFICATION OF COMPLIANCE

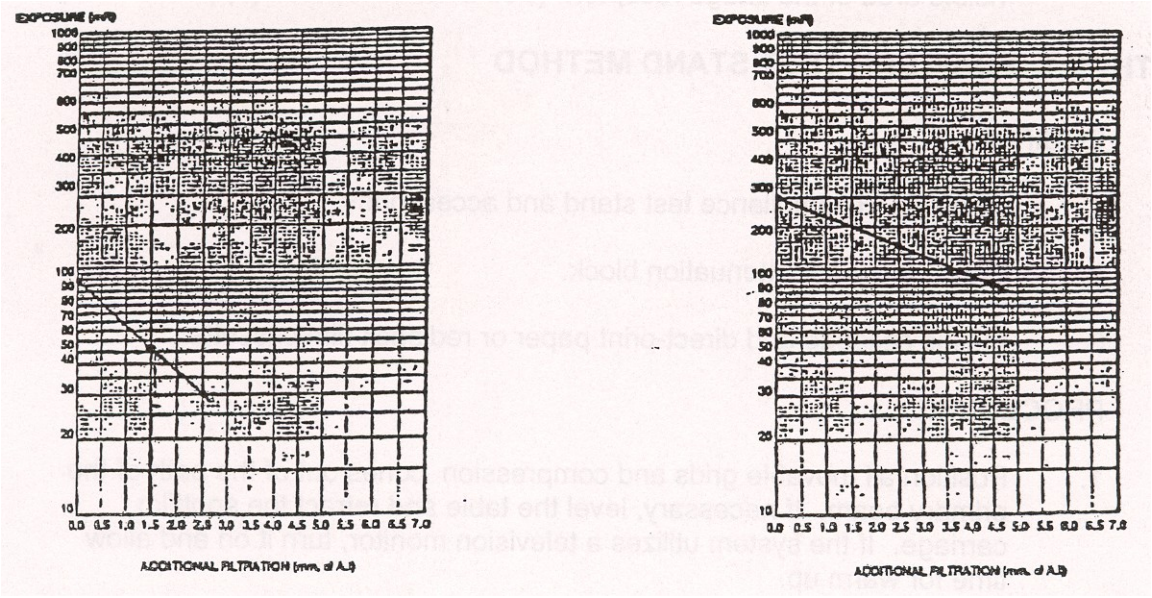
Verify that the half-value layer of the useful beam for a given X-Ray tube potential is not less than the values shown in Table 6-1.

NEMA Standards 05.15.79

TABLE 6-4 HALF VALUE LAYERS AS A FUNCTION OF FILTRATION AND TUBE POTENTIAL FOR DIAGNOSTIC UNITS*

Total Filtration mm Al	Peak Potential (kVp)									
	30	40	50	60	70	80	90	100	110	120
	Typical Half-Value Layers (mm Al)									
0.5	0.36†	0.47†	0.58	0.67	0.76	0.84	0.92	1.00	1.08	1.16
1.0	0.55	0.78	0.95	1.08	1.21	1.33	1.46	1.58	1.70	1.82
1.5	0.78	1.04	1.25†	1.42†	1.59†	1.75	1.90	2.08	2.25	2.42
2.0	0.92	1.22	1.49	1.70	1.90	2.10	2.28	2.48	2.70	2.90
2.5	1.02	1.38	1.69	1.95	2.16	2.37†‡	2.58†‡	2.82†‡	3.06†‡	3.30†‡
3.0	…	1.49	1.87	2.16	2.40	2.62	2.86	3.12	3.38	3.65
3.5	…	1.58	2.00	2.34	2.60	2.86	3.12	3.40	3.68	3.95

*For full-wave rectified potential.
† Recommended minimum HVL for radiographic units.
‡ Recommended minimum HVL for fluoroscopes.



EXAMPLE A EXAMPLE B

FIGURE 6.6

RECORD SHEET

This sheet is to be used by the assembler to assure that all points of compliance are covered. It will also serve as a maintenance log.

HOSPITAL _____ ROOM # _____

DATE OF INSTALLATION _____ ASSEMBLER _____

Requirement	Applicable Paragraph	Installation Date	Date	Date	Date	Date
1. Visual definition of X-Ray light field	XR8/2.14					
2. Intensity of light-field	XR8/2.15					
3. Min. Field Size	XR8/2.16					
4. X-Ray field/receptor						

center alignment	XR8/2.17
5. Indication of field size	XR8/2.18
6. Positive beam limitation	XR8/2.19
7. X-Ray field limitation and alignment	XR8/2.20
8. Return to PBL	XR8/2.21
9. Keylock PBL override	XR8/2.22
10. Half value layer	XR8/2.09
11. Cassette Tray inspection/cleaning	
12. Electrical Cable inspection	
13. SID Monitor inspection	
INITIALS:	
NOTES:	

(NO TEXT)

SECTION 7.0

RENEWAL
PARTS LIST

LINEAR™ II

REPLACEMENT PARTS LIST

PROGENY P/N	DESCRIPTION
	COLLIMATOR
70-11201	Swivel Mounting Ring – Tube Side
70-10036	Swivel Ring
26-00854	Thumb Screw
70-11089	Window – Cross Hair
70-08374	Switch – Push Button Switch – Light Field
70-11026*	Cover – Front Bezel
70-11127*	Cover – Top
70-11028*	Cover - Rear
70-04571	Lamp–Light Field – DZE 24 Vac, 150 W *(mfg. before December 2003)*
70-04300	Lamp–Light Field – FCS 24 Vac, 150 W *(mfg. after November 2003)*
70-04572	Socket – Lamp *(mfg. before December 2003)*

70-04299	Socket – Lamp *(mfg. after November 2003)*
70-01901	Current Limit Resistor
70-03051	Triac, 15 Amp, Lamp Timer
70-10096	Prism, Centering Light-Line
70-10147	Mercury Tilt Switch
70-11129*	Cover, Left Side
70-11130*	Cover, Right Side
70-20024	Mirror/Bracket Assembly
70-10049	Spacer – ¼"
70-10050	Spacer – 1/16"
70-11083	Spring – Ext., Mirror
70-11075	Tape Measure
70-08366	Display PCB
70-08368	Linear II Logic & Driver PCB
70-10135	Motor, Shutter Drive – 24 VAC
70-10810	Thumbscrew – Rear Cover
70-06018	Transformer – Power 27/19 VAC
70-04621	Fuse Holder
70-04603	Fuse – 2 Amp SloBlo – Power
70-04607	Fuse – 8 Amp SloBlo – Lamp
70-04001	Relay – 24 VDC
70-08009	Master PCB Assy. (Power Supply PCB)
70-04602	Fuse – 1 Amp SloBlo (Master PCB Logic)

Specify Color: Lt. Gray, Dk. Gray, Allied Tan, White.

(NO TEXT)

SECTION 8.0

THEORY OF OPERATION

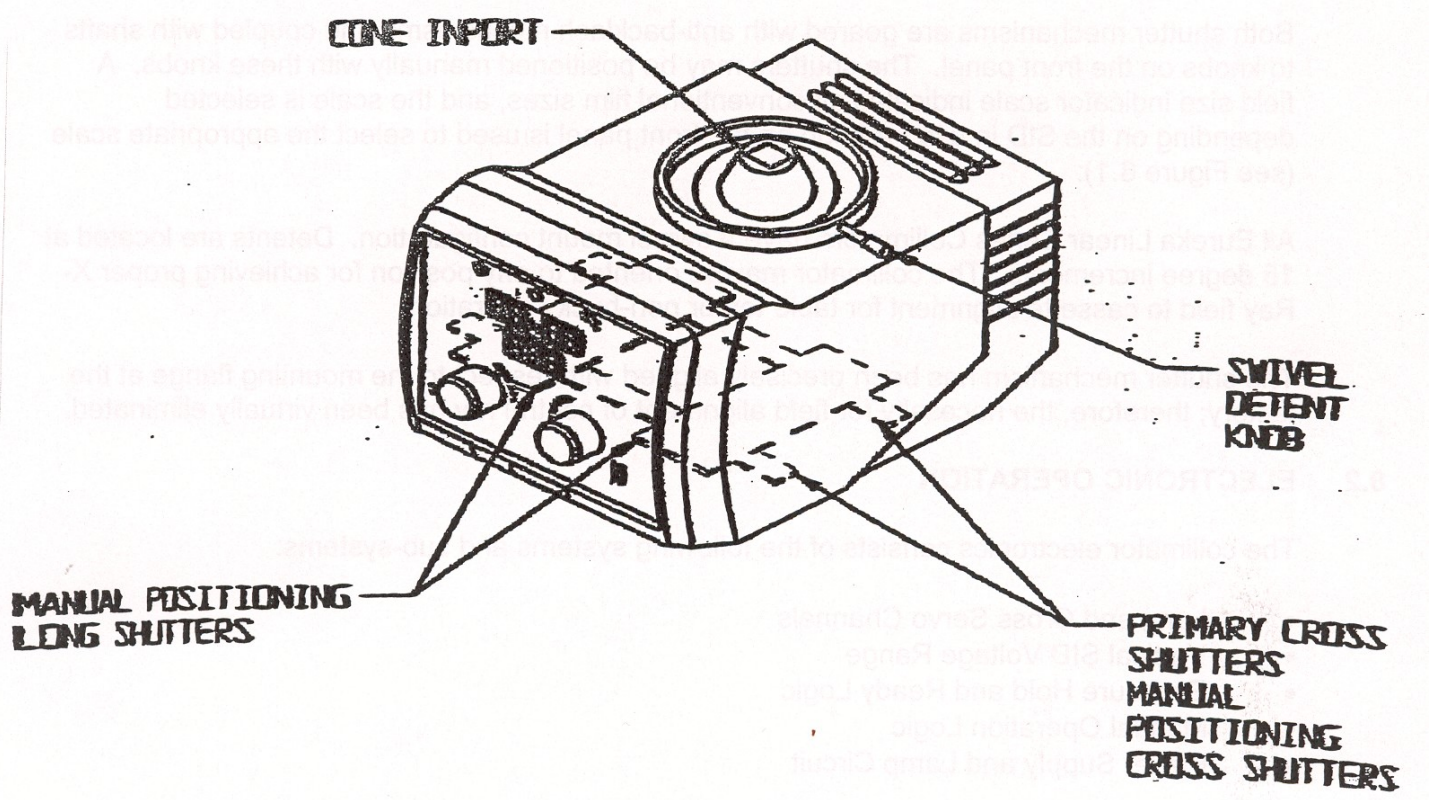


FIGURE 8.1

8.0 THEORY OF OPERATION

8.1 MECHANICAL OPERATIONS

The Eureka Linear II Series Collimator contains two major sets of shutters, long and cross, which define the absolute X-Ray field size. There is also a fixed lead cone which protrudes into the port of the X-Ray tube to help reduce the effects of off-focus radiation.

Both shutter mechanisms are geared with anti-backlash mechanisms and coupled with shafts to knobs on the front panel. The shutters may be positioned manually with these knobs. A field size indicator scale indicates all conventional film sizes, and the scale is selected depending on the SID in use. A knob on the front panel is used to select the appropriate scale (see Figure 8.1).

All Eureka Linear Series Collimators have a swivel mount configuration. Detents are located at 15 degree increments. The collimator may be oriented to any position for achieving proper X-Ray field to cassette alignment for table top or non-bucky operation.

The shutter mechanism has been precisely aligned with respect to the mounting flange at the factory; therefore, the necessity for field alignment of central ray has been virtually eliminated.

8.2 ELECTRONIC OPERATION

The collimator electronics consists of the following systems and sub-systems:

- Long and Cross Servo Channels
- Vertical SID Voltage Range
- Exposure Hold and Ready Logic
- Manual Operation Logic
- Power Supply and Lamp Circuit

8.2.1 Power Supplies – Schematic 70-08009

There are two power supplies for the collimator operation, a 27 volt AC supply protected by fuse F2 for the light field lamp and servo motors, and a low voltage, 15 volt DC regulated supply for the electronics.

The power transformer T1 is the source for both supplies with the 27 AC tap supplying the lamp and motors. The 19 VAC tap voltage is rectified by bridge B2 to an unregulated 28 VDC. This 28 VDC supplies the front panel lamps and VR1, a 3-terminal 15 volt 7815 IC voltage regulator. This supply is located on the master printed circuit board located in the power chassis (See Schematic 70-08009).

8.2.2 Light Field Lamp Circuit – Schematic 70-08325

The light-field lamp voltage is switched on and off by the 15 amp triac located on the lamp bracket. The gate signal is controlled by the output of IC4 (555 Timer) with an “ON” time of 25 seconds controlled by R18 and C7. The timer is triggered by the front panel “LAMP” push button switch. The output of IC4 drives the Opto-Isolator, IC8, which shorts bridge B1 to supply gate current to the triac. The surge resistor in series with the lamp filament offers high resistance at turn-on, reducing the in-rush current and greatly extending the lamp life.

8.2.3 Shutter Servo System – Schematic 70-08367

The logic PCB provides a voltage to the cassette size sense tray, VSID_OUT, which is adjusted by potentiometer R6. This is the same voltage that is provided to the analog to digital converter of U2 to be used as a reference voltage. It can be measured at TP1 on the logic PCB and also in the power supply at TS3-4. This voltage does not need to be adjusted unless the cassette tray size sense potentiometers are not providing the correct voltages as described in the next paragraph.

The source voltage, VSID_OUT, is provided to the cassette size sense tray as the potentiometer source voltage. The cassette size in the long direction is then measured as a fraction of the source voltage as VIRL on pin 8 of U1. The cassette size in the cross direction is then measured as a fraction of the source voltage as VIRC on pin 7 of U1.

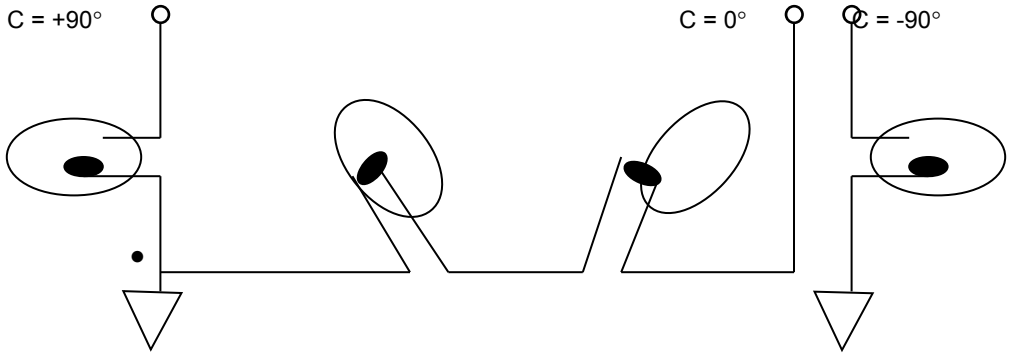
U2 compares the voltage from the image receptor cassette size sense potentiometer to the voltages stored during calibration. U2 then calculates the cassette size from these numbers.

In a similar fashion, The source voltage, VSID_OUT, is provided to the collimator shutter potentiometers as a source voltage. The collimator shutter size in the long direction is then measured as a fraction of the source voltage as VXFL on pin 1 of U6. The collimator shutter size in the cross direction is then measured as a fraction of the source voltage as VXFC on pin 14 of U1.

U2 compares the collimator shutter size to the cassette size and opens or closes the shutters appropriately. It does this by activating signals, /CROSS_OPEN, /CROSS_CLOSED, /LONG_OPEN, and /LONG_CLOSED (refer to U4 on page 1 of schematic). These signals control the motor drive circuitry shown on page 3 of the schematic.

8.2.4 Tilt Monitors – Schematic 70-08009

The collimator has an angulation sensing switch assembly mounted on the inner front housing panel. There are four (4) mercury switches in the following configuration:



Where: C = +90° means collimator CW 90° from vertical (beam left)

C = - 90° means collimator CCW 90° from vertical (beam right)

C = 0° means collimator in vertical position

The switches C = +90° and C = -90° actually activate 10° before the 90° positions. The two C = 0° switches activate at plus and minus 10° from the zero degree position.

It is these switch signals along with an identical table tilt monitor switch (if the collimator is installed with a tilting table) that selects the appropriate SID circuit to apply the voltage (VSID) to the cassette tray input (Image Receptor).

NOTE: If the collimator is positioned between +10° and +80°, or -10° and -80°, the collimator is placed into "MANUAL" operation. It is also this switch which selects the appropriate Image Receptor, table or wall (relay K2 on the master board), for cassette size sensing.

THE FOLLOWING TABLE SHOWS THE TILT MONITORS SID SELECTION MATRIX WHERE:

V	=	VERTICAL SID SELECTION
H(T)	=	HORIZONTAL SID, TABLE IMAGE RECEPTOR
H(W)	=	HORIZONTAL SID, WALL IMAGE RECEPTOR
M	=	MANUAL OPERATION

COLLIMATOR ANGULATION

	C = -90° -90° TO –80°	-79° TO –11°	C = 0° -10°, 0°, 10°	11° TO 79°	C = 90° 80° TO 90°
T = -90° -90° TO –80°	H(T)	M	M	M	M
-79° TO –11°	M	M	M	M	M
T = 0° 10°, 0°, 10°	H(W)	M	V	M	H(W)
+11° TO +79°	M	M	M	M	M
T = +90° +80° TO +90°	M	M	M	M	H (T)

- CAN BE H(W) WITH BEAM AT WALL
  ONLY ONE RECEPTOR CAN BE SELECTED. THIS IS DETERMINED UPON INSTALLATIN AND SWITCH SW2-5 (BUCKY RIGHT) OR SW3-5 (BUCKY LEFT) IS SELECTED FOR THE APPROPRIATE INSTALLATIN CONFIGURATION.

8.2.5 SID Voltages – Schematics 70-08002 & 70-08009

Because the collimator is at +90°, the mercury tilt switches, via P/J1-6 (C = 0°, T = 0°, LED 4 “OFF”), a logic “1” is applied to Inverter 14A, pin 1. The logic “1” output of 14A, pin 2 causes SW2 to select the 40” SID voltage, supplied by R23, to Buffer IC3A. The output of IC3A is supplied to the correct cassette tray input via P/J1-25, TS3-4 and TS3-14 (TABLE) or TS2-19 (WALL).

8.2.6 Exposure Hold and Manual Circuits – Schematic 70-08002

The collimator is placed into “MANUAL” operation upon the following conditions: (X-Ray exposure is permitted)

A) When NO cassette is present.
B) Collimator or table NOT at -90°, 0°, or +90°
C) An external signal for STEREO/TOMO operation is present

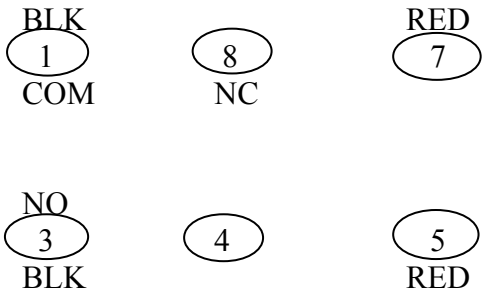
The collimator is placed into “EXPOSURE HOLD” when:

A) Cassette is present but servo system is NOT sized properly. This occurs during cycling of shutter blades.
B) If the collimator is NOT positioned at one of the permitted SIDs, i.e., 40” or 72” SID, and the cassette is present.

Parts List

1	70-04256	Keyswitch	
2	70-06510	Red Wire	2 pieces 18 inch each
3	70-06509	Black Wire	2 pieces 18 inch each
4	70-06604	Heatshrink tubing	4 pieces

DIGITAL LINEAR II POWER SUPPLY: 70-08227 KEYSWITCH WIRING



Assembly Instructions:

Solder each of the 4 wires to the keyswitch solder lugs according to the above chart.

Install heatshrink tubing over each solder connection (4).

Wire connections for the keyswitch (70-08227) in the power supply

Install separate piece of jumper hookup wire in TS2-13 and TS2-14.

Connect one black wire from keyswitch (70-08227) to TS4-11 and the other to TS4-4.

Connect the 2 red keyswitch wires to connected to TS2-11 and TS2-12.

Eureka Progeny Inc.• 1407 Barclay Blvd. •Buffalo Grove, IL 60089

BILL OF MATERIAL

Bill of Material No. 70-08009
Rev. R ECN P1173

ITEM NO.	QTY	DWG SIZE	PART NO.	ITEM CLS	DESCRIPTION	Vendor Part No.	Ref. Designator
0001	1	D	70-06257	ID	Master PCB		
0002	4	A	70-04521	HV	Terminal Strip, 22 Pos.	ULN2004A (XR 2204)	TS1-4
0003	2	A	70-04003	HN	Clip, Retaining		
0004	2	C	70-04001	NN	Relay, 24V, 4 Form C		K1, 2
0005	1	A	70-03041	HG	IC, 6 Pin Dip Transistor Array	ML2	IC1
0006	2	A	70-03201	HJ	IC, 16 Pin Dip Transistor Array	UNL2004A	IC2, 4
0007	1	A	70-03202	HJ	IC, 16 Pin Dip Transistor Array	NL2032A	IC3
0008	1	A	70-03304	HL	Voltage Reg. 15V	MC7815	VR1
0009	2	A	70-03032	HF	Bridge Rectifier, 6A, KBPC 104	KBPC104	B1, 2
0010	2	A	70-04002	HT	Socket, Relay		K1, 2
0011	1	A	70-04503	HT	16 Pin IC Socket		J1
0012	1	A	70-02505	HB	Capacitor, Elect. 2000µF, 35v		C1
0013	1	A	70-02503	HB	Capacitor, Elect. 1000µF, 16v		C2
0014	2	A	70-02509	HB	Cap. Solid Tatalum 200 µF, 35 WVDC		C3, 23
0015	1	A	70-02508	HB	Capacitor, Elect. 1000 µF, 25v		C6
0016	16	A	70-02010	HB	Capacitor, Ceram., .1µF, 50 v		C4, 5, 7, 10-22
0017	3	A	70-03012	HC	Diode, 1 Amp, 100 VRRM	IN4002	D1, 2, 3
0018	1	A	70-00401	HA	Resistor, 5w, 3.3 kΩ		R1
0019	1	C	70-00220	HA	Resistor, ½ w, 390 Ω + 5%		R2
0020	2	C	70-00018	HA	Resistor, ¼ w, 100 Ω + 5%		R3, 4
0021	10	C	70-00064	HA	Resistor, ¼ w, 10 kΩ + 5%		R5-9, 14, 23-26
0022	8	C	70-00045	HA	Resistor, ¼ w, 1.5 kΩ + 5%		R10-13, 27-30

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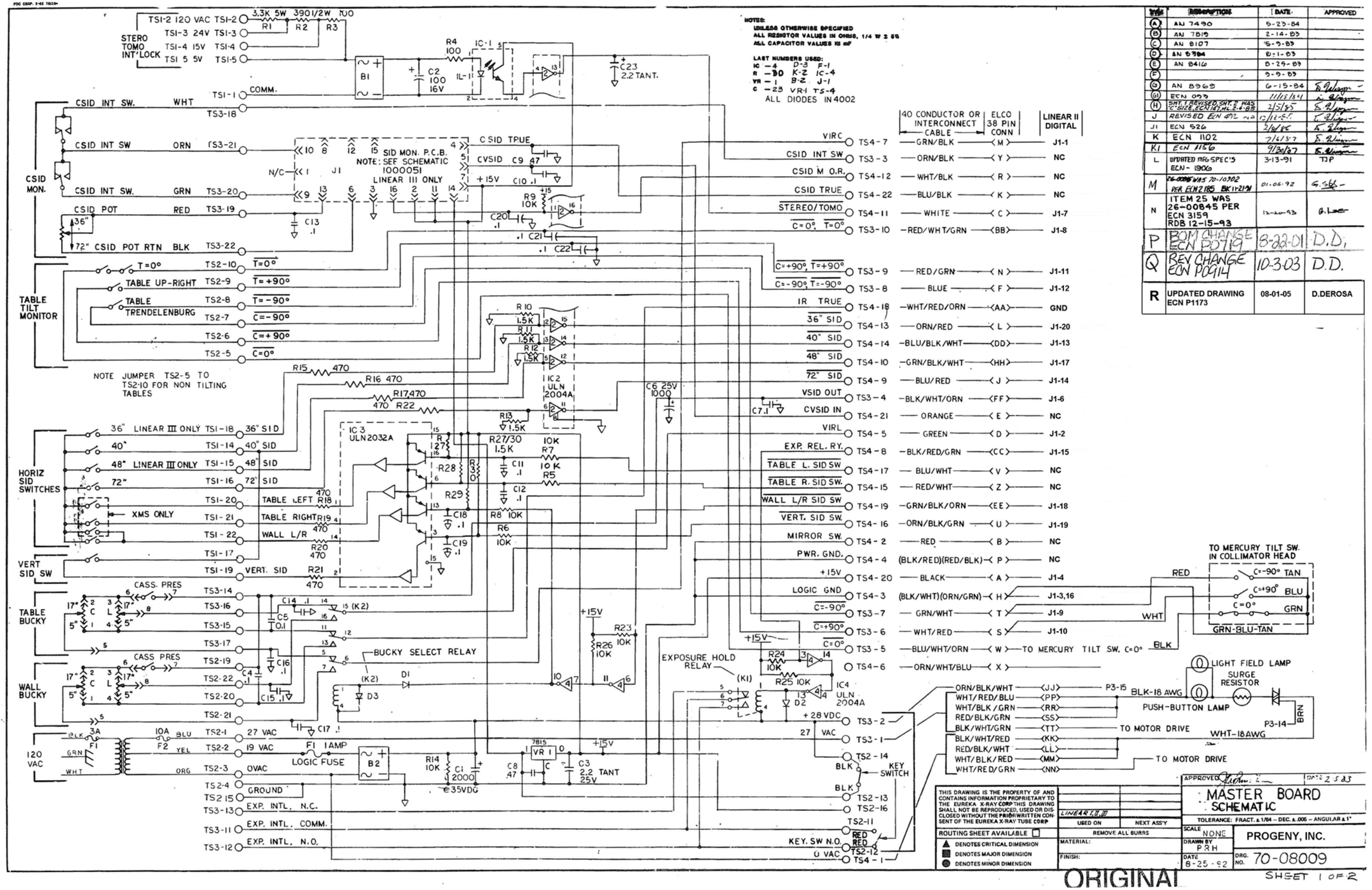
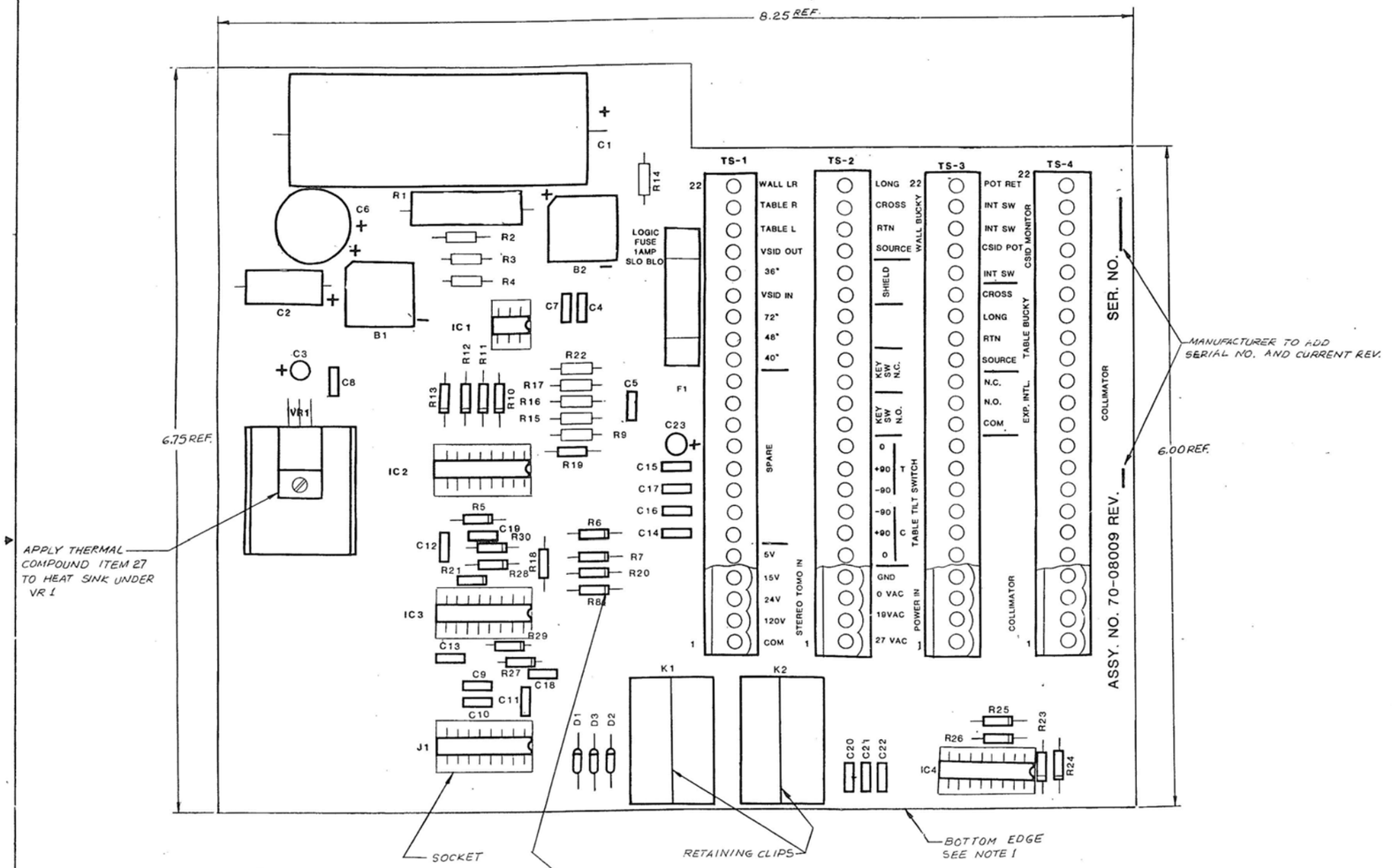
BILL OF MATERIAL

Bill of Material No. 70-08009
Rev. R ECN P1173

ITEM NO.	QTY	DWG SIZE	PART NO.	ITEM CLS	DESCRIPTION	Vendor Part No.	Ref. Designator
0023	8	C	70-00034	HA	Resistor, ¼ w, 470 Ω ± 5%		R15-22
0024	2	A	70-02011	HB	Capacitor, Ceram., .47μF, 50 v		C8, 9
0025	1	A	26-00830	EF	Screw, 6-32 x ¼ Phillips Pan Head		
0026	1	A	70-10815	EC	Nut, Hex 6-32		
0027	0	A	70-10726	CG	Thermal Compound		
0028	2	A	70-04635	HY	Fuse Holder		
0029	1	A	70-04602	HY	Fuse, 1 Amp		F1
0030	1	A	70-04585	HX	Heat Sink		
	Ref	D	70-08009	AE	Assy Dwg, Schematic		



SYM	DESCRIPTION	DATE	APPROVED
A	AN 7490	9-23-84	
B	AN 7815	2-14-85	
C	AN 8107	5-9-85	
D	AN 8384	8-1-85	
E	AN 8416	8-29-85	
F		9-9-85	
G	AN 8963	6-15-84	
GI	ECN 093	11/15/84	
H	SHT 1 REVISED SHT 2 WAS C-SIDE ECN 1167 ML 2-4-85	2/5/85	
J	REVISED ECN 492	12/12-5-7	
J1	ECN 526	3/6/85	
K	ECN 1102	7/6/87	
K1	ECN 1156	9/30/87	
L	UPDATED MFG SPEC'S ECN - 1906	3-13-91	TJP
M	26-00845 WAS 70-10302 PER ECN 2185 BK 11-21-91	01.06.92	
N	ITEM 25 WAS 26-00845 PER ECN 3159 RDB 12-15-93	12-20-93	
P	BOM CHANGE ECN P0719	8-22-01	D.D.
Q	REV CHANGE ECN P0914	10-3-03	D.D.
R	UPDATED DRAWING ECN P1173	08-01-05	D.DEROSA



NOTE :
PULL THE FOLLOWING NUMBERED PINS FROM EACH TERMINAL STRIP BEFORE SOLDERING: TS 1 PULL PIN 12; TS2 PULL PIN 18; TS 3 NONE; TS4 PULL PIN 6.

NOTES
UNLESS OTHERWISE SPECIFIED:

1. ALL COLOR CODED RESISTORS TO BE INSERTED WITH TOLERANCE BAND TOWARD BOTTOM OR RIGHT HAND SIDE OF PCB.
2. ALL 1% RESISTORS TO BE INSERTED SO THAT RESISTANCE VALUE IS VISIBLE WHEN LOOKING DOWN ON COMPONENT SIDE OF PCB
3. ALL CAPACITORS, DIODES ETC TO BE INSERTED WITH VALUE AND/OR TYPE VISIBLE WHEN LOOKING DOWN ON COMPONENT SIDE OF PCB

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE: FRACTIONAL ±1/64 DECIMALS .XX ±.01 .XXX ±.005 ANGLES ±1°
MATERIAL
FINISH
DO NOT SCALE DRAWING.

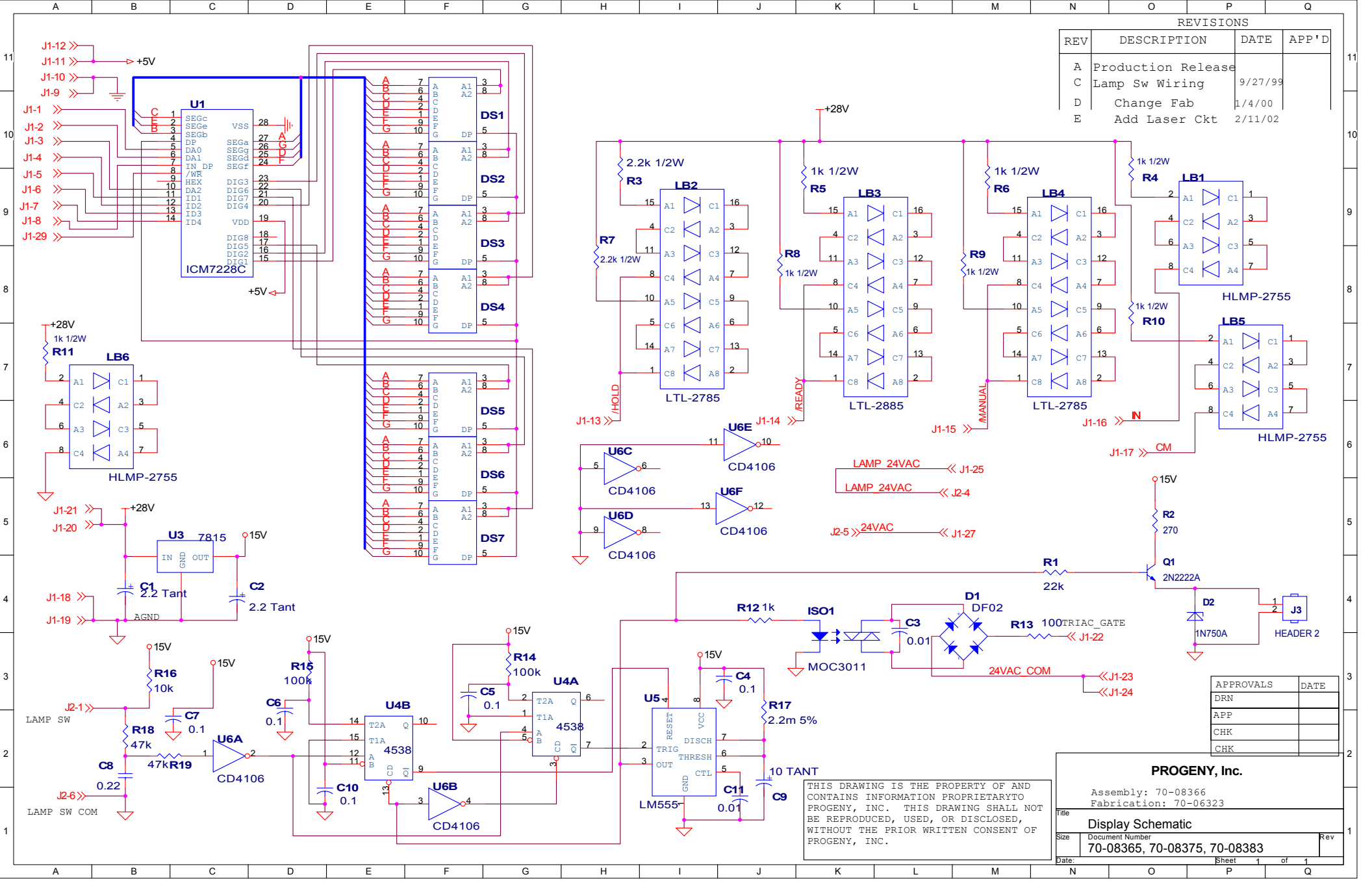
ORIGINAL PRODUCT
APPROVALS DATE
DRAWN M.LACH 9-11-87
CHECKED
ENGR'D

PROGENY, INC.

ASSY, MASTER P.C.B.

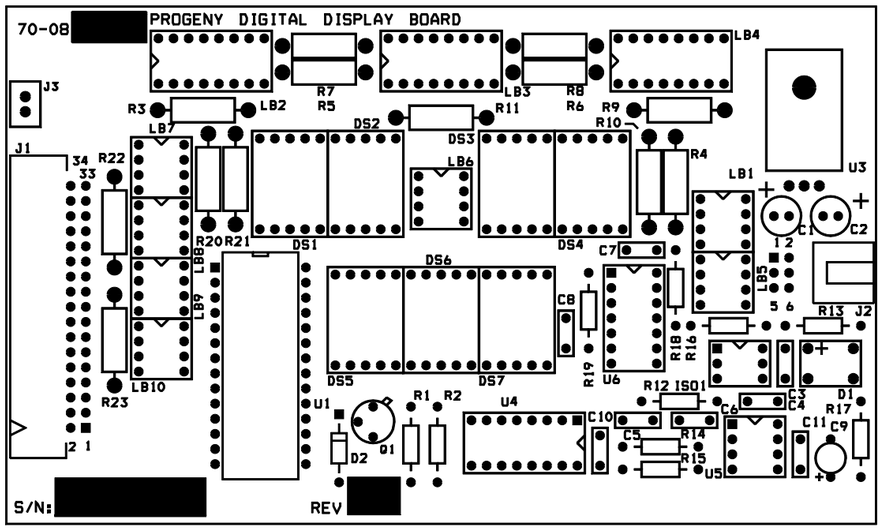
SIZE D | ITEM OR CLASS AE | DWG NO. 70-08009 | SCALE 1:2 | SHEET 2 OF 2

ORIGINAL


REVISIONS
REV | DESCRIPTION | DATE | APP'D
A | Production Release
C | Lamp Sw Wiring | 9/27/99
D | Change Fab | 1/4/00
E | Add Laser Ckt | 2/11/02
U1
ICM7228C
DS1
DS2
DS3
DS4
DS5
DS6
DS7
LB1
LB2
LB3
LB4
LB5
LB6
HLMP-2755
LTL-2785
LTL-2885
R3 2.2k 1/2W
R4 1k 1/2W
R5 1k 1/2W
R6 1k 1/2W
R7 2.2k 1/2W
R8 1k 1/2W
R9 1k 1/2W
R10 1k 1/2W
R11 1k 1/2W
+28V
+5V
/HOLD
/READY
MANUAL
IN
CM
U3 7815
C1 2.2 Tant
C2 2.2 Tant
AGND
U6C CD4106
U6D CD4106
U6E CD4106
U6F CD4106
LAMP_24VAC
24VAC
R1 22k
R2 270
Q1 2N2222A
D1 DF02
D2 1N750A
J3 HEADER 2
R12 1k
ISO1 MOC3011
C3 0.01
R13 100
TRIAC_GATE
24VAC_COM
R14 100k
R15 100k
R16 10k
R17 2.2m 5%
R18 47k
R19 47k
C4 0.1
C5 0.1
C6 0.1
C7 0.1
C8 0.22
C9 10 TANT
C10 0.1
C11 0.01
U4A 4538
U4B 4538
U5 LM555
U6A CD4106
U6B CD4106
LAMP SW
LAMP SW COM
APPROVALS | DATE
DRN
APP
CHK
CHK
PROGENY, Inc.
Assembly: 70-08366
Fabrication: 70-06323
Title
Display Schematic
Size
Document Number
70-08365, 70-08375, 70-08383
Rev
Date:
Sheet 1 of 1
THIS DRAWING IS THE PROPERTY OF AND CONTAINS INFORMATION PROPRIETARYTO PROGENY, INC. THIS DRAWING SHALL NOT BE REPRODUCED, USED, OR DISCLOSED, WITHOUT THE PRIOR WRITTEN CONSENT OF PROGENY, INC.

REVISIONS			
REV	DESCRIPTION	DATE	APP'D
A	RELEASE FOR PRODUCTION	10/26/98	A. KREMA
B	NETLIST, PCB SIZE CHANGE	5/16/99	A. KREMA
C	CHANGED J2 CONNECTIONS	9/27/99	A. KREMA
D	CHANGED TO 70-06323 PCB	1/4/00	A. KREMA
E	SILKSCREEN CHG, J1-26 CHG	1/8/01	A. KREMA
F	ADD LASER CIRCUIT	2/10/02	A. KREMA
G	ECN PO914 Remove IC sockets	9/19/03	A. KREMA

MANUFACTURER TO ADD REMAINDER OF ASSEMBLY NUMBER 366.



MANUFACTURER TO ADD SERIAL NUMBER AND CURRENT REVISION.

NOTES:

1. ALL COLOR CODED RESISTORS TO BE INSERTED WITH TOLERANCE BAND TOWARD THE BOTTOM OR RIGHT HAND SIDE OF THE PCB.
2. ALL PRINTED RESISTORS TO BE INSERTED WITH THE RESISTANCE VALUE VISIBLE AND ORIENTED SUCH THAT THE BOTTOM OF THE TEXT IS TOWARD THE BOTTOM OR RIGHT HAND SIDE OF THE PCB.
3. ALL CAPACITORS, DIODES, ETC. TO BE INSERTED WITH THE VALUE AND/OR TYPE VISIBLE AND ORIENTED AS DESCRIBED IN NOTE 2.
4. SCHEMATIC 70-08365
   FABRICATION 70-06323

ORIGINAL PRODUCT

APPROVALS		DATE
DRN	KT	10/25/98
CHK	AK	10/26/98
APP	CH	10/26/98

PROGENY INCORPORATED

LINEAR II
DIGITAL DISPLAY ASSEMBLY

SIZE	ITEM CLASS	DRAWING NO.
B		70-08366

SCALE | FILENAME:7006321.MAX | SHEET 1 OF 1

Eureka Progeny Inc.• 1407 Barclay Blvd. •Buffalo Grove, IL 60089

BILL OF MATERIAL

Bill of Material No. 70-08366
Rev. G ECN P0914

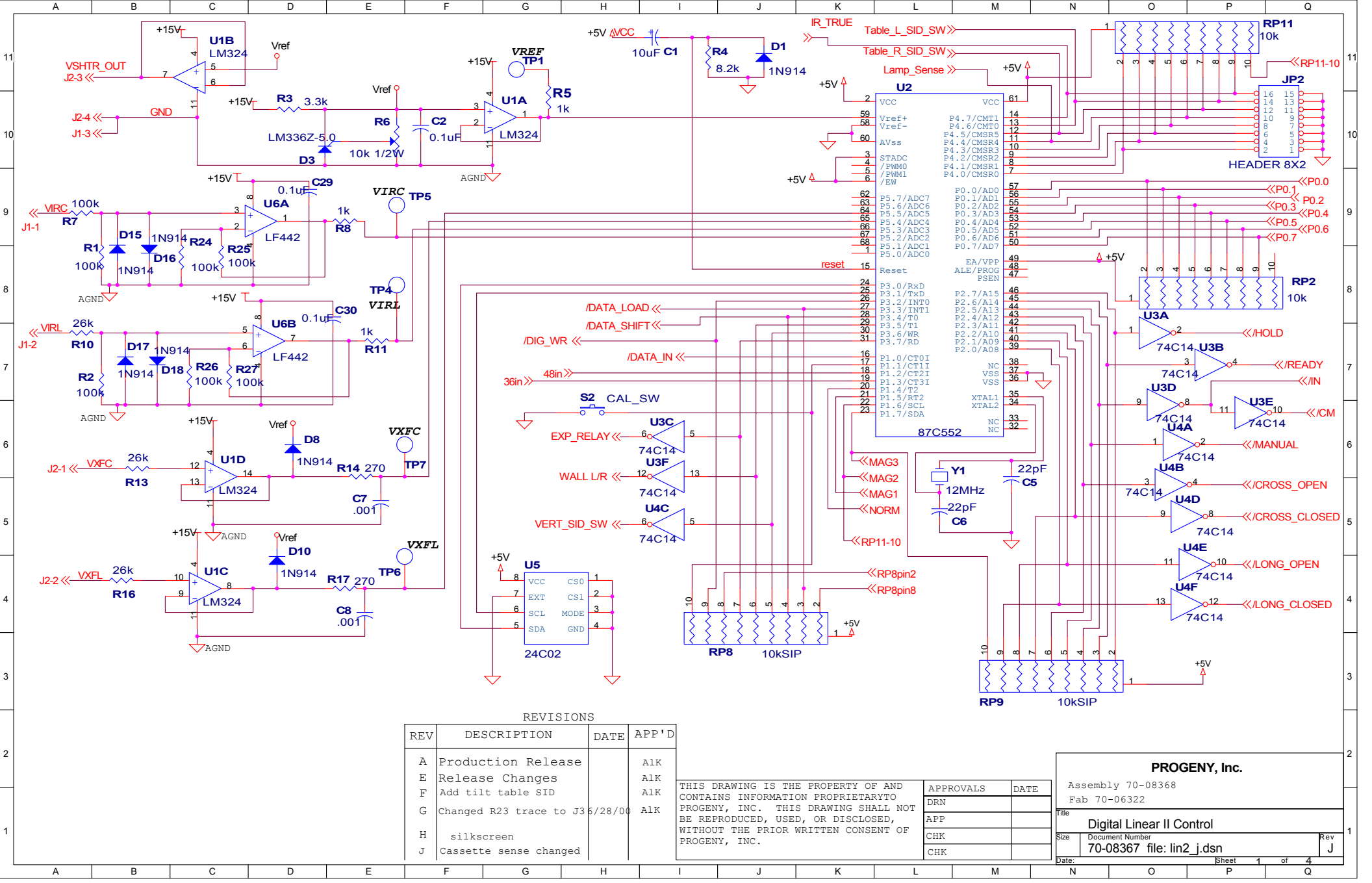
ITEM NO.	QTY	DWG SIZE	PART NO.	ITEM CLS	DESCRIPTION	Vendor Part No.	Ref. Designator
Ref.	0	B	70-08365		Schematic, Linear II Digital Display Assy.		
1	1	B	70-06323		Fabrication, Linear II Digital Display PCB		
2	2	A	70-02509		Capacitor, Tantalum 2.2 uF 35V		C1, C2
3	2	A	70-02012		Capacitor, Ceramic .01 uF 100V		C11, C3
4	5	A	70-02010		Capacitor, Ceramic .1 uF 50V		C4, C5, C6, C7, C10
5	1	A	70-02021		Capacitor, Ceramic .22 uF 50V		C8
6	1	A	70-02511		Capacitor, Tantalum 10 uF 35V		C9
7	7	A	70-03089		.56” Seven Segment Display, HDSP-5601	HDSP-5601	DS1 – DS7
8	1	A	70-03030		Bridge Rectifier	DF02	D1
9	1	A	70-03043		Opti-Triac 6 Pin Dip	MOC3011	ISO1
10	2	A	70-03066		LED Light Bar, Yellow, 8 Pin Dip	HLMP2755	LB1, LB5
11	2	A	70-03063		LED Light Bar, Yellow, 16 Pin Dip	HLMP2785	LB2, LB4
12	1	A	70-03067		LED Light Bar, Green, 16 Pin Dip	HLMP2885	LB3
14	2	A	70-00229		Resistor, Carbon 2.2K 5% ½ W		R3, R7
15	7	A	70-00225		Resistor, Carbon 1K 5% ½ W		R4, R5, R6, R8, R9, R10, R11
16	1	D	70-00042		Resistor, Carbon Film, 1 K ohms, ± 5%		R12
17	1	D	70-00018		Resistor, Carbon 100 5% ¼ W		R13
18	2	D	70-00086		Resistor, Carbon 100K 5% ¼ W		R14, R15
19	1	D	70-00064		Resistor, Carbon 10K 5% ¼ W		R16

Eureka Progeny Inc.• 1407 Barclay Blvd. •Buffalo Grove, IL 60089

BILL OF MATERIAL

Bill of Material No. 70-08366
Rev. G ECN P0914

ITEM NO.	QTY	DWG SIZE	PART NO.	ITEM CLS	DESCRIPTION	Vendor Part No.	Ref. Designator
20	1	D	70-00110		Resistor, Carbon 2.2M 5% ¼ W		R17
21	2	D	70-00078		Resistor, Carbon Film 270 Ohms, 5%	47 K	R18,R19
22	1	A	70-03163		IC Display Driver ICM7228CIPI		U1
23	1	A	70-03304		Voltage Regulator +15V	MC7815	U3
24	1	A	70-03115		IC Dual Timer, Dip 16	CD4538	U4
25	1	A	70-03353		IC Timer, Dip 8	LM555	U5
26	1	B	70-03161		IC INV Schmit Trigger, Dip 14	CD40106	U6
27	1	A	70-04733		Connector, 34 Pin Header, Right Angle		J1
28	1	A	70-04730		Connector, 6 Pin		J2
29	1	A	70-04778		Heat Sink		U3
30	3	A	70-04217		Socket, 16 Pin Dip		LB2,LB3,LB4
33	7	A	70-04754		Socket, Terminal Strip, 10 Pin		DS1-DS7
34	3	A	70-42222		Socket, 8 Pin Dip		LB1,LB5,LB6
35	1	A	70-03064		LED Light Bar, Green 8 Pin Dip		LB6
36	1	A	E1-02022		Header, Right Angle .100” Pitch, 2 Pos.		J3
37	1	A	70-00071		Resistor, 24K Ohms, 1/4W, 5%		R1
38	1	A	70-03021		Diode-Zener Reg. 1/4W, 4.7V		D2
39	1	A	70-03402		Transistor 2N2222		Q1
40	1	A	70-00028		Resistor, 270 Ohms		R2
41	1	A	26-00830		Screw, #6-32 x ¼ Phillips Pan Head		U3
42	1	A	70-11166		Nut, Hex #6-32 Thin		U3



REVISIONS

REV	DESCRIPTION	DATE	APP'D
A	Production Release		AlK
E	Release Changes		AlK
F	Add tilt table SID		AlK
G	Changed R23 trace to J3	6/28/00	AlK
H	silkscreen		
J	Cassette sense changed		

APPROVALS	DATE
DRN	
APP	
CHK	
CHK	

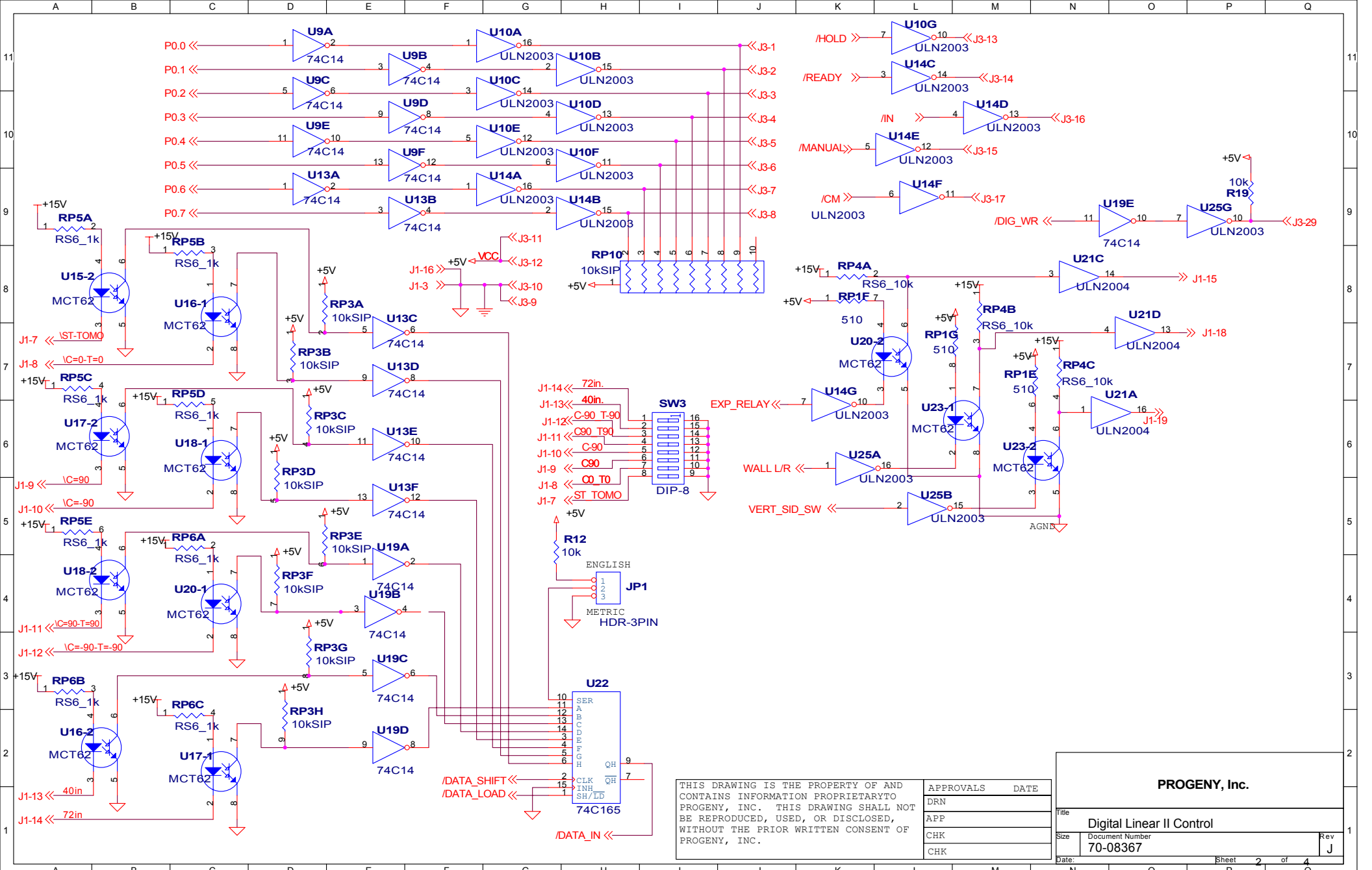
PROGENY, Inc.

Assembly 70-08368
Fab 70-06322

Title: Digital Linear II Control

Size | Document Number: 70-08367 file: lin2_j.dsn | Rev: J

Date: | Sheet 1 of 4



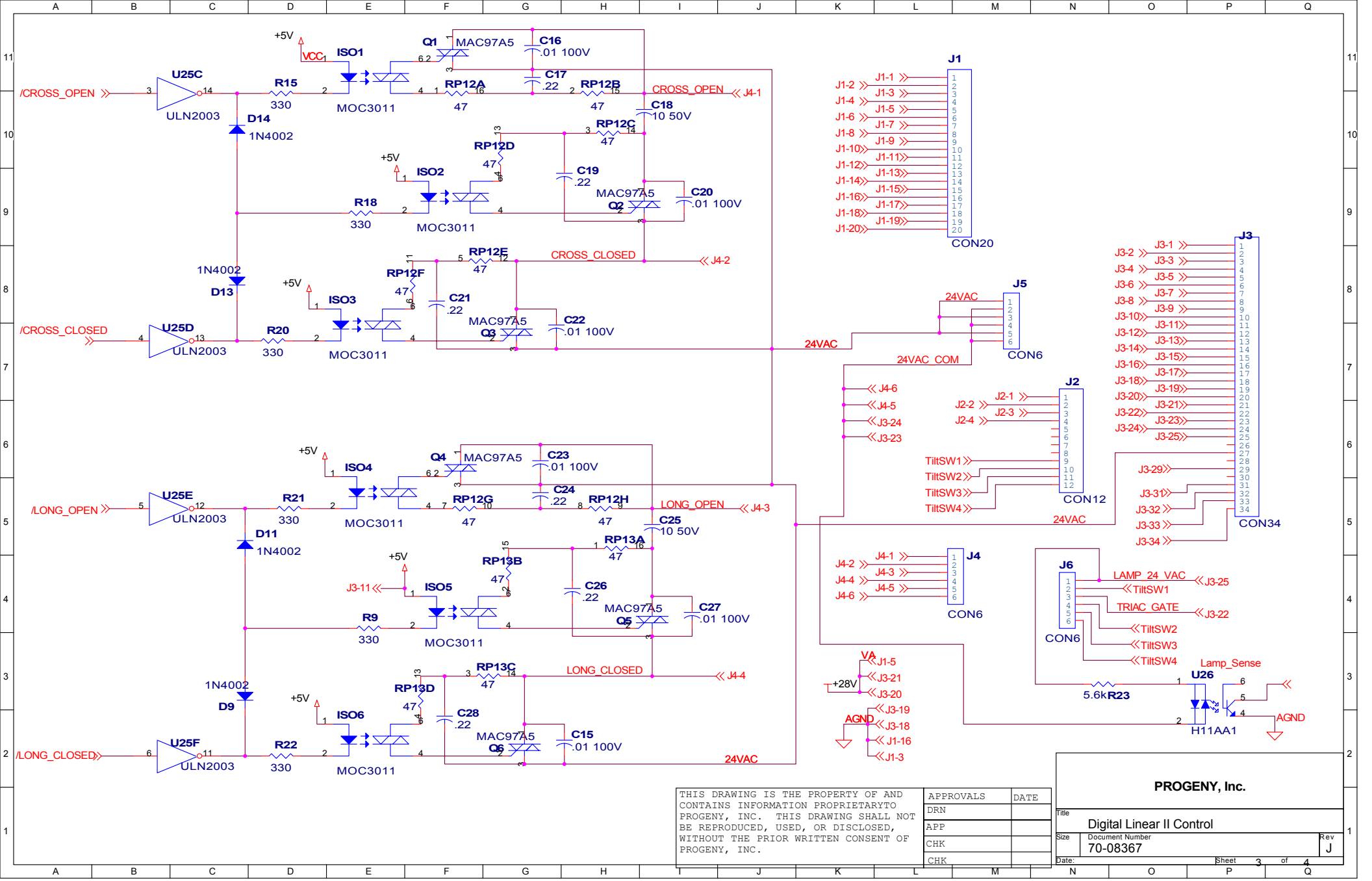
APPROVALS	DATE
DRN	
APP	
CHK	
CHK	

PROGENY, Inc.

Title: Digital Linear II Control

Size: | Document Number: 70-08367 | Rev: J

Date: | Sheet 2 of 4



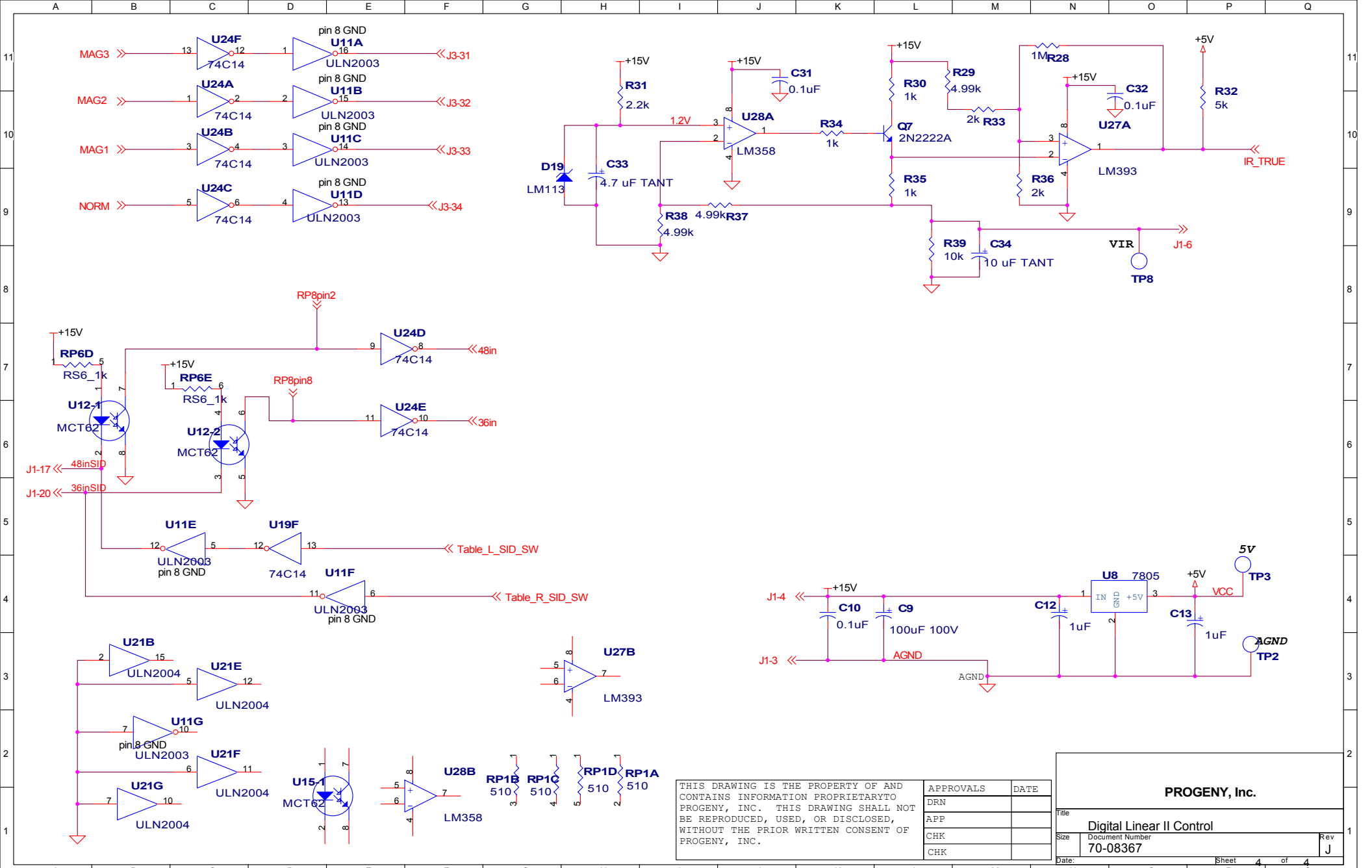
APPROVALS	DATE
DRN	
APP	
CHK	
CHK	

PROGENY, Inc.

Title: Digital Linear II Control

Size | Document Number: 70-08367 | Rev: J

Date: | Sheet 3 of 4



APPROVALS	DATE
DRN	
APP	
CHK	
CHK	

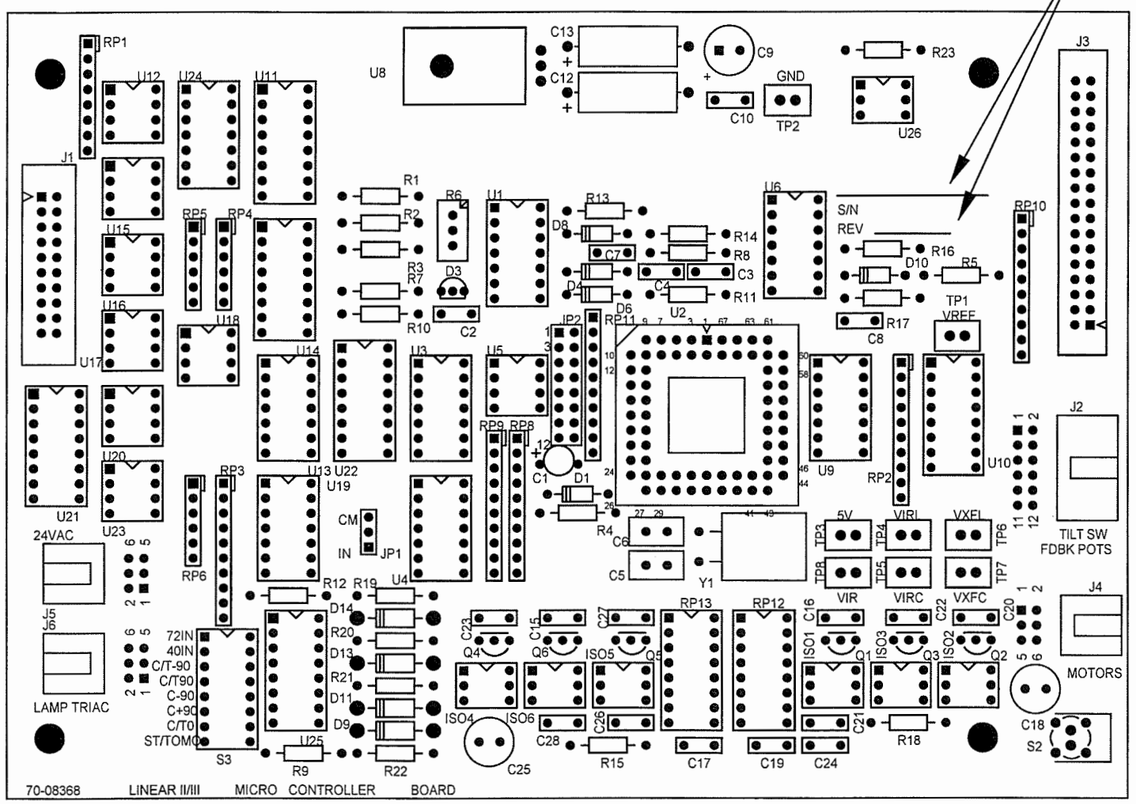
PROGENY, Inc.

Title: Digital Linear II Control

Size | Document Number: 70-08367 | Rev: J

Date: | Sheet 4 of 4

MANUFACTURER TO ADD SERIAL NUMBER AND CURRENT REVISION.



REVISIONS			
REV	DESCRIPTION	DATE	APP'D
A	RELEASE FOR PRODUCTION	11/2/98	A. KREMA
B	ADD VIR ADJUSTMENT	3/25/99	A. KREMA
C	CHANGED CPU PACKAGE	4/25/99	A. KREMA
D	MOVED J5, J6	5/14/99	A. KREMA
E	CHANGED J2, J4, U12, U24, U11	9/24/99	A. KREMA
F	CHANGED Va, ADD LAMP DETECT	3/12/00	A. KREMA
G	CHANGED R23 TRACE TO J3	6/25/00	A. KREMA
H	BOM CHANGE ECNP0d61	6-12-01	D. DEROSA
J	REMOVE U26 ECNP0703	6-27-01	D. DEROSA
K	BOM CHANGE ECN P0719	8-22-01	D. DEROSA
L	BOM CHANGE ECN P0944	2-14-03	D. DEROSA

NOTES:

1. ALL COLOR CODED RESISTORS TO BE INSERTED WITH TOLERANCE BAND TOWARD THE BOTTOM OR RIGHT HAND SIDE OF THE PCB.
2. ALL PRINTED RESISTORS TO BE INSERTED WITH THE RESISTANCE VALUE VISIBLE AND ORIENTED SUCH THAT THE BOTTOM OF THE TEXT IS TOWARD THE BOTTOM OR RIGHT HAND SIDE OF THE PCB.
3. ALL CAPACITORS, DIODES, ETC. TO BE INSERTED WITH THE VALUE AND/OR TYPE VISIBLE AND ORIENTED AS DESCRIBED IN NOTE 2.
4. SCHEMATIC 70-08367
   FABRICATION 70-06322

ORIGINAL PRODUCT

APPROVALS		DATE
DRN	KT	11/1/98
CHK	AK	11/2/98
APP	CH	11/2/98

PROGENY INCORPORATED

LINEAR II/III
MICROCONTROLLER ASSEMBLY

SIZE	ITEM CLASS	DRAWING NO.
B		70-08368

SCALE | FILENAME:7006322.MAX | SHEET 1 OF 1

ORIGINAL

Eureka Progeny Inc.• 1407 Barclay Blvd. •Buffalo Grove, IL 60089

BILL OF MATERIAL

70-08368 Linear II Microcontroller Assy.
Rev. L ECN P0844

ITEM NO.	QTY	DWG SIZE	PART NO.	ITEM CLS	DESCRIPTION	Vendor Part No.	Ref. Designator
0	0	B	70-08367		Schematic, Linear II Control		
1	1	B	70-06322		Fabrication, PCB Linear II Microcontroller		
2	2	A	70-04806		Shunt		JP1,JP2
3	1	A	70-02511		Capacitor, Tantalum 10 uF 35V		C1
4	2	A	70-02010		Capacitor, Ceramic .1 uF 50V		C2, C10
5	4	A	70-02030		Cap., Ceramic CK05, .001MFD, 200WVDC		C3,C4,C7,C8
6	2	A	70-02031		Capacitor, Mica, 300 WVDC,22pF		C5, C6
7	1	B	70-02524		Capacitor, Aluminum 63 WVDC, 100 uF		C9
8	2	A	70-02501		Capacitor, Electrolytic, 1uF, 50v		C12, C13
10	6	A	70-02012		Capacitor, Ceramic .01 uF 100V		C15, C16, C20, C22, C23, C27
11	6	A	70-02021		Capacitor, Ceramic .22 uF 50V		C17, C19, C21, C24, C26, C28
12	2	A	70-02101		Capacitor, 50 WVDC		C18, C25
13	5	A	70-03001		Diode, 1N914		D1, D4,D6,D8, D10
15	1	A	70-03358		LM336Z-5.0 Reference Diode		D3
16	4	A	70-03012		IN4002 Diode	IN4002	D9, D11, D13, D14
18	6	A	70-03043		Opti-Triac 6 Pin Dip	MOC3011	ISO1 – ISO6
19	1	A	70-04807		Header, 3 Pin Breakaway, Single Row		JP1

BILL OF MATERIAL

70-08368 Linear II Microcontroller Assy.
Rev. L ECN P0844

ITEM NO.	QTY	DWG SIZE	PART NO.	ITEM CLS	DESCRIPTION	Vendor Part No.	Ref. Designator
20	2		10-04001		Header, 4 x 2 Pin		JP2
21	1	A	70-04726		Header 20 Pin		J1
22	3	A	70-04730		Connector, 6 Pin		J4, J5, J6
23	1	A	70-04526		Connector, Header 34 Pin		J3
24	1	A	70-04731		Connector, Header 12 Pin, Right Angle		J2
25	6	A	70-03052		Triac	MAC97A6	Q1 – Q6
26	1	A	70-00511		Resistor, Array, 6 Pin sip, 10K Ohms		RP4
27	6	A	70-00510		Resistor, Array, 10 Pin sip, 10K Ohms		RP2, RP3, RP8, RP9, RP10, RP11
28	2	A	70-00518		R-Pak, 1K Sip 6		RP5, RP6
29	1	A	70-00520		Resistor, Array, 8 Pin Sip, 510 Ohms		RP1
30	2	D	70-00064		Resistor – ¼ Watt, 5%	10K	R12, R19
31	1	D	70-00052		Resistor – ¼ Watt, 5%	3.3K	R3
32	1	D	70-00062		Resistor, Carbon Film, 1/4W +/- 1%	8.2 K	R4
33	1	D	70-00042		Resistor, Carbon Film 1/4W +/- 5%	1 K	R5
34	1	A	70-00654-3		Resistor, Var. 5K OHMS Slim Pk Orig.	Var 5K	R6
35	4	D	70-00071		Resistor - ¼ Watt, 5%	24K	R7, R10 R13, R16
36	4	D	70-00028		Resistor, 270 OHMS, ¼ W +/- 5%	270	R8, R11, R14, R17
37	6	A	70-00032		Resistor, 390 OHMS, ¼ W +/- 5%	390	R9, R15, R18, R20, R21, R22
38	2	A	70-00508		Resistor Array 470HM, 16 Pin Dip		RP12, RP13
39	1	D	70-00058		Resistor, Carbon Film ¼ W 5%	5.6K	R23
40	8		70-06524		Jumper, Buss Bar, 24 Awg.		TP1 – TP8

BILL OF MATERIAL

70-08368 Linear II Microcontroller Assy.
Rev. L ECN P0844

ITEM NO.	QTY	DWG SIZE	PART NO.	ITEM CLS	DESCRIPTION	Vendor Part No.	Ref. Designator
41	2	A	70-03359		LM324 Quad Op Amp		U1, U6
42	1	A	70-04205		Dip Switch, 8 Position		S3
43	2		70-00091		Resistor, 200K Ohms 1/4W 5%		R1,R2
44	1	A	70-08217		68 Pin Programmed Logic Device Lin. II		U2
45	6	B	70-03161		I.C., Inv. Schmit Trigger, DIP 14	CD40106	U3, U4, U9, U13, U19, U24
46	1	A	70-03165		2 Wire Serial EEPROM	24C02	U5
48	1	A	70-03303		5 V - 3 Terminal Pos.	7805	U8
49	1	A	70-04778		Heatsink for U7		U8
50	4	A	70-03146		I.C., 16 Pin DIP	ULN2003	U10,U11,U14,U25
51	1		70-03201		Transistor Array	ULN2004	U21
52	7	B	70-03094		Opto-Isolator	MCT62	U12, U15, U16, U17, U18, U20, U23
53	1	A	70-03166		74C165 Parallel to Serial Converter		U22
54	1	A	70-03154		Crystal, 10 MHz		Y1
55	1	A	70-04282		Socket Square for PLCC 68 Pin		U2
56	6	A	70-04217		Socket, 16 Pin Dip		U10, U25, U11, U14, U21, U22
57	8	A	70-04216		Socket, 14 Pin Dip		U1,U6, U9, U3, U4, U13, U14, U24
58	8	A	70-04222		Socket, 8 Pin Dip		U5, U12, U15, U16, U17, U18, U20, U23
59	6	A	70-04506		Socket, 6 Pin Dip		ISO1-ISO6
60	1	A	70-04295		Switch, Pushbutton, Right Angle		S-2

BILL OF MATERIAL

70-08368 Linear II Microcontroller Assy.
Rev. L ECN P0844

ITEM NO.	QTY	DWG SIZE	PART NO.	ITEM CLS	DESCRIPTION	Vendor Part No.	Ref. Designator
61	1	A	26-00830		Screw, 6-32 x ¼ Phillips Pan Head		U8
62	1	A	70-11166		Nut, 6-32		U8

Cable	ELCO	NAME	CNTRL PCB
GRN/BLK	M	VIRC	J1-1
WHT	C	STEREO/TOMO	J1-7
RED/WHT/GRN	BB	C=0,T=0	J1-8
RED/GRN	N	C=90,T=90	J1-11
BLUE	F	C=-90,T=-90	J1-12
WHT/RED/ORN	AA		
BLU/BLK/WHT	DD	40" SID	J1-13
BLU/RED	J	72" SID	J1-14
BLK/WHT/ORN	FF	VSID OUT/VIR	J1-6
GRN	D	VIRL	J1-2
BLK/RED/GRN	CC	EXP REL RELAY	J1-15
GRN/BLK/ORN	EE	WALL L/R SID SW	J1-18
ORN/BLK/GRN	U	VERT SID SW	J1-19
BLK/RED	P	AGND	J1-3
RED/BLK	P	AGND	J1-16
BLK	A	15V	J1-4
BLK/WHT	H	15V GND	
ORN/GRN	H	15V GND	
GRN/WHT	T	C=-90	J1-10
WHT/RED	S	C=90	J1-9
BLU/WHT/ORN	W	C=0	
ORN/BLK/WHT	JJ	28VDC	J1-5
WHT/RED/BLU	PP	24 VAC	
WHT/BLK/GRN	RR	24 VAC	J5-5
RED/BLK/GRN	SS	24 VAC	J5-3
BLK/WHT/GRN	TT	24 VAC	J5-1
BLK/WHT/RED	KK	0 VAC	J5-2
RED/BLK/WHT	LL	0 VAC	J5-4
WHT/BLK/RED	MM	0 VAC	J5-6
WHT/RED/GRN	NN	0 VAC	

CNTRL PCB			Display PCB
J2-1	VXFC		
J2-2	VXFL		
J2-3	VSID_OUT		
J2-4	AGND		
J2-9		Tilt SW 1 (ORG)	
J2-10		Tilt SW 2 (BLK)	
J2-11		Tilt SW 3 (WHT)	
J2-12		Tilt SW 4 (RED)	
J4-1	CROSS_OPEN	RED	
J4-2	CROSS_CLOSED	ORG	
J4-5	0 VAC	WHT	
J4-3	LONG_OPEN	BLK	
J4-4	LONG_CLOSED	GRY	
J3-1	DATA 0	J1-1	J2-1 LAMP SW
J3-2	DATA 1	J1-2	J2-2 LAMP SW COM
J3-3	DATA 2	J1-3	J2-3
J3-4	DATA 3	J1-4	J2-4
J3-5	DATA 4	J1-5	J2-5 24 VAC COM
J3-6	DATA 5	J1-6	J2-6 LAMP 24 VAC
J3-7	DATA 6	J1-7	
J3-8	DATA 7	J1-8	
J3-9	5V GND	J1-9	
J3-10	5V GND	J1-10	
J3-11	5V	J1-11	
J3-12	5V	J1-12	
J3-13	/HOLD	J1-13	
J3-14	/READY	J1-14	
J3-15	/MANUAL	J1-15	
J3-16	/IN	J1-16	
J3-17	/CM	J1-17	
J3-18	AGND	J1-18	
J3-19	AGND	J1-19	
J3-20	28 VDC	J1-20	
J3-21	28 VDC	J1-21	
J3-22	TRIAC GATE	J1-22	
J3-23	24 VAC COM	J1-23	
J3-24	24 VAC COM	J1-24	
J3-25	LAMP_24VAC	J1-25	
J3-26	LAMP_24VAC	J1-26	
J3-29	DIG_WR	J1-29	

R?
CROSS_FDBK
LONG_FDBK
R?
CROSS MOTOR
LONG MOTOR

GND ORG Tilt SW 1
C=0 BLK Tilt SW 2
C=90 WHT Tilt SW 3
C=-90 RED Tilt SW 4

J6-2
J6-4
J6-5
J6-6
J6-3 Lamp On
J6-1 Triac Gate

LAMP
RESISTOR
ELCO PP 28VAC
TRIAC
ELCO KK
0 VAC

NOTES

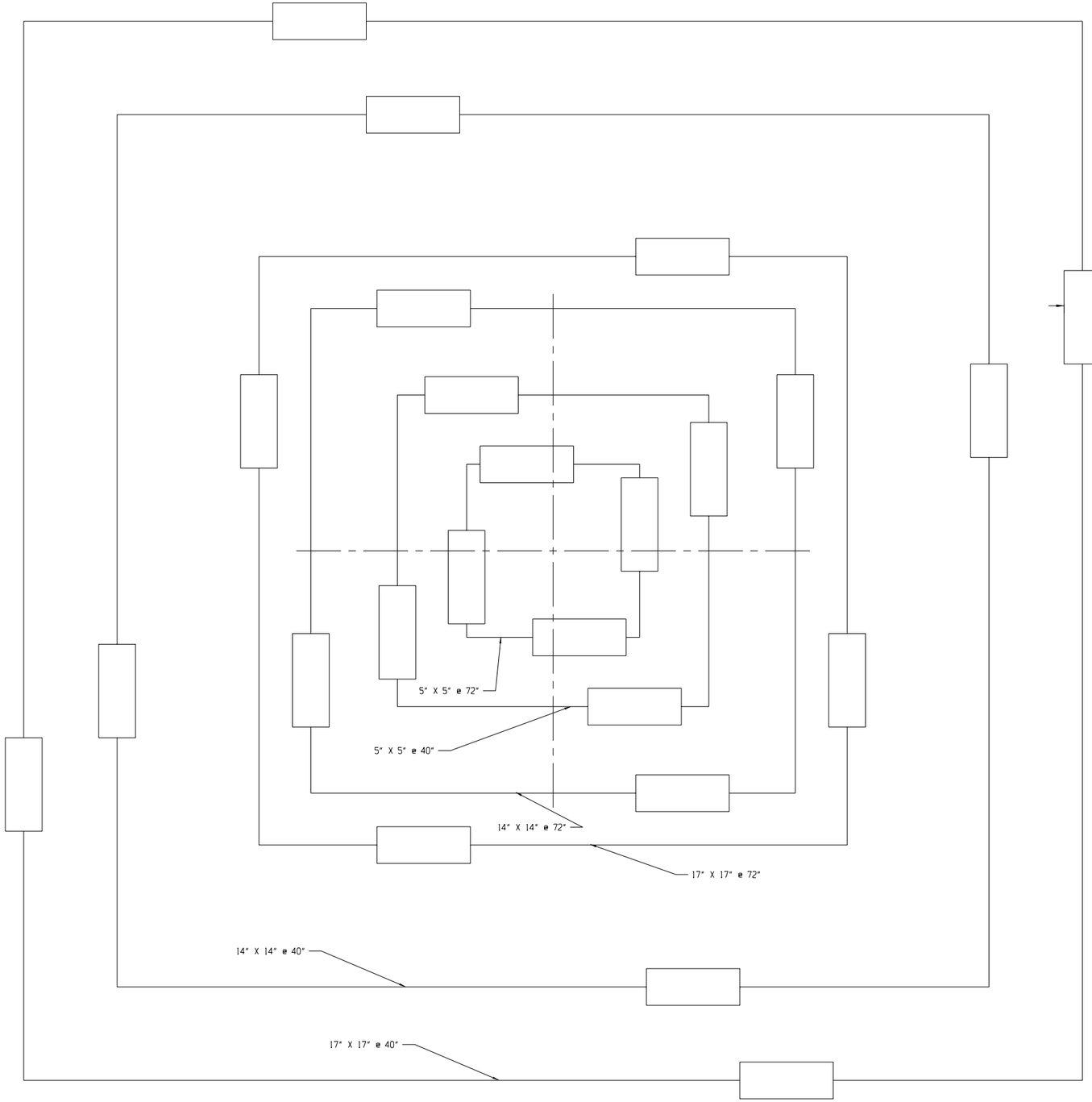
1. This diagram is used for Linear II heads containing control PCB 70-08368 Rev. "e".

PROGENY, Inc.

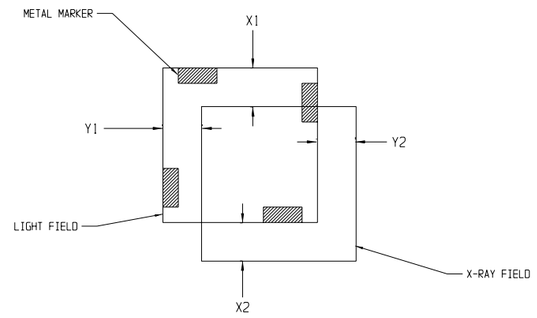
Title: Schematic - Linear II Collimator Harness

Size: B | Document Number: 70-08377 | Rev: B

Date: | Sheet 1 of 1



THIS DIMENSION REPRESENTS 1.5 % OF 40" SID.
THE BRH REQUIREMENTS FOR LIGHT FIELD SIZE
VS X-RAY FIELD SIZE. AND X-RAY FIELD SIZE
VS IMAGE RECEPTOR SIZE IS LIMITED
(SEE XR8-2.18 AND XR8-2.20 REQUIREMETS)



X1 + X2 MUST BE LESS THAN 2 % OF THE SID
Y1 + Y2 MUST BE LESS THAN 2% OF THE SID

XR 8-2.18 INDICATION OF X-RAY FIELD SIZE

REQUIREMENT- MEANS SHALL BE PROVIDED ON THE BEAM-LIMITING DEVICE TO INDICATE FIELD SIZE IN THE IMAGE RECEPTOR PLANE TO WITHIN 2% OF THE SOURCE TO IMAGE DISTANCE (SID). (SEE 21 CFR 1020.31(e)(1))

XR 8-2.20 X-RAY FIELD LIMITATION AND ALIGNMENT

REQUIREMENT - THE X-RAY FIELD SIZE IN THE PLANE OF THE IMAGE RECEPTOR, WHETHER AUTOMATICALLY OR MANUALLY ADJUSTED, SHALL BE SUCH THAT NEITHER THE LENGTH NOR THE WIDH OF THE X-RAY FIELD DIFFERS FROM THAT OF THE IMAGE RECEPTOR BY GREATER THAT 3% OF THE SOURCE TO IMAGE DISTANCE (SID) AND THE SUM OF THE LENGTH AND WIDTH DIFFERENCES WITHOUT REGARD TO SIGN BE NO GREATER THAN 4% OF THE SID, WHEN THE EQUIPMENT INDICATES THAT THE BEAM AXIS IS PERPENDICULAR TO THE PLANE OF THE IMAGE RECEPTOR. (SEE 21 CFR 1020.31 (e)(2)(ii))

NOTE:
PATTERN FOR REFERENCE ONLY
NOT TO SCALE

NOTE: USE THIS TEST PATTERN AT 40" SID

THE MAGNIFICATION FACTOR FOR 72" SID AT 40" SID = 40/72 = .556

THEREFORE: 5" X 5" @ 72" SID IS 2.778" X 2.778"
14" X 14" @ 72" SID IS 7.778" X 7.778"
17" X 17" @ 72" SID IS 9.444" X 9.444"

REV.	ECN	DESCRIPTION	CHG.	DATE
C	P1033	ADDED NOTE, FOR REFERENCE ONLY	DD	07-14-04
B	P0473	ADDED 17"X17" PATTERN & REDRAWN	AZ	02-21-00

REVISIONS

PROGENY, INC.

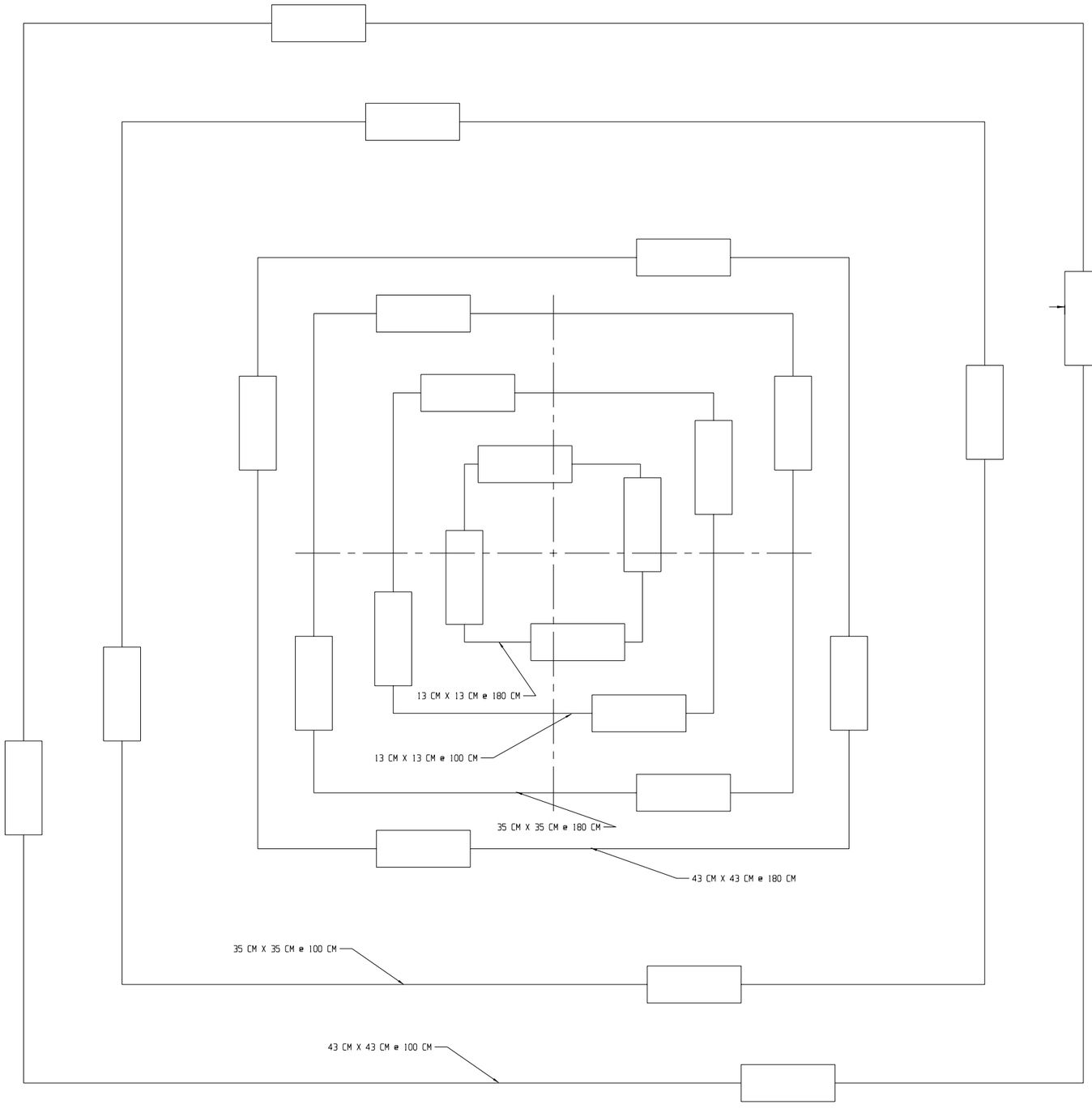
APPROVALS	DATE
DRN. A. ZVEREV	02-21-00
CHK.	
APP.	

ORIGINAL PRODUCT
LINEARS

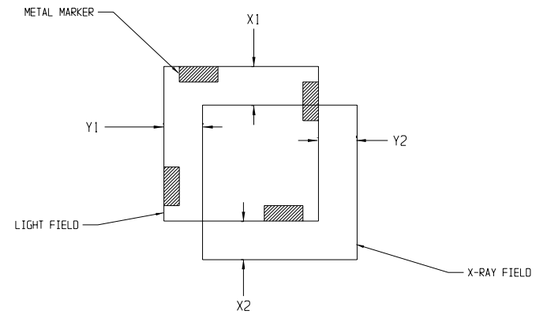
TEST PATTERN #1
FOR 40" AND 72" SID ADJUSTMENTS

SIZE	ASSEMBLY:	OPERATION SCHEDULE:	DRAWING NO.	REV
D	NONE	20-34-003	70-09021	C

REL.ECN 1-31-90 | SCALE 1:1 | FILENAME 70-09021 | SHEET 1 OF 1



THIS DIMENSION REPRESENTS 1.5 % OF 100 CM SID.
THE BRH REQUIREMENTS FOR LIGHT FIELD SIZE
VS X-RAY FIELD SIZE. AND X-RAY FIELD SIZE
VS IMAGE RECEPTOR SIZE IS LIMITED.
(SEE XR8-2.18 AND XR8-2.20 REQUIREMETS)



X1 + X2 MUST BE LESS THAN 2 % OF THE SID
Y1 + Y2 MUST BE LESS THAN 2% OF THE SID

XR 8-2.18 INDICATION OF X-RAY FIELD SIZE

REQUIREMENT- MEANS SHALL BE PROVIDED ON THE BEAM-LIMITING DEVICE TO INDICATE FIELD SIZE IN THE IMAGE RECEPTOR PLANE TO WITHIN 2% OF THE SOURCE TO IMAGE DISTANCE (SID). (SEE 21 CFR 1020.31(e)(1))

XR 8-2.20 X-RAY FIELD LIMITATION AND ALIGNMENT

REQUIREMENT - THE X-RAY FIELD SIZE IN THE PLANE OF THE IMAGE RECEPTOR, WHETHER AUTOMATICALLY OR MANUALLY ADJUSTED, SHALL BE SUCH THAT NEITHER THE LENGTH NOR THE WIDH OF THE X-RAY FIELD DIFFERS FROM THAT OF THE IMAGE RECEPTOR BY GREATER THAT 3% OF THE SOURCE TO IMAGE DISTANCE (SID) AND THE SUM OF THE LENGTH AND WIDTH DIFFERENCES WITHOUT REGARD TO SIGN BE NO GREATER THAN 4% OF THE SID, WHEN THE EQUIPMENT INDICATES THAT THE BEAM AXIS IS PERPENDICULAR TO THE PLANE OF THE IMAGE RECEPTOR. (SEE 21 CFR 1020.31 (e)(2)(ii))

NOTE:
PATTERN FOR REFERENCE ONLY
NOT TO SCALE

NOTE: USE THIS TEST PATTERN AT 100 CM SID

THE MAGNIFICATION FACTOR FOR 180 CM SID AT 100 CM SID = 100/180 = .556

THEREFORE: 13 CM X 13 CM @ 180 CM SID IS 7.222 CM X 7.222 CM
35 CM X 35 CM @ 180 CM SID IS 19.444 CM X 19.444 CM
43 CM X 43 CM @ 180 CM SID IS 23.889 CM X 23.889 CM

REV.	ECN	DESCRIPTION	CHG.	DATE
C	P1033	ADDED NOTE, FOR REFERENCE ONLY	DD	07-14-04
B	P0492	ADDED 43 CM X 43 CM PATTERN & REDRAWN	AZ	03-20-00

REVISIONS

PROGENY, INC.

APPROVALS	DATE
DRN. A. ZVEREV	03-20-00
CHK.	
APP.	

ORIGINAL PRODUCT: LINEARS

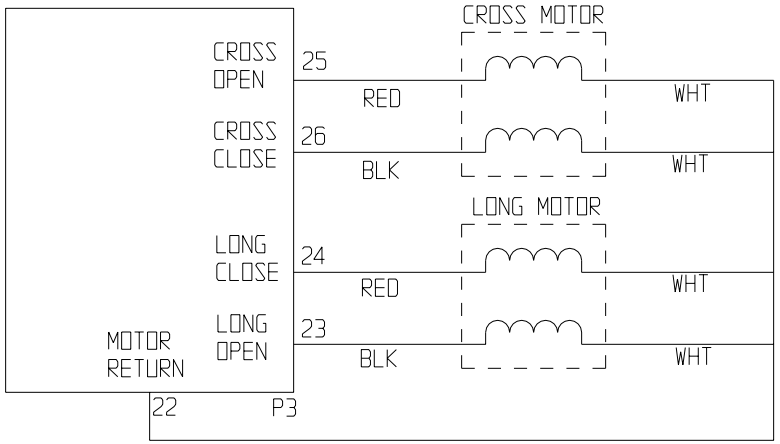
METRIC TEST PATTERN
FOR 100CM AND 180CM SID ADJUSTMENTS

SIZE	ASSEMBLY:	OPERATION SCHEDULE:	DRAWING NO.	REV
D	NONE		70-09025	C

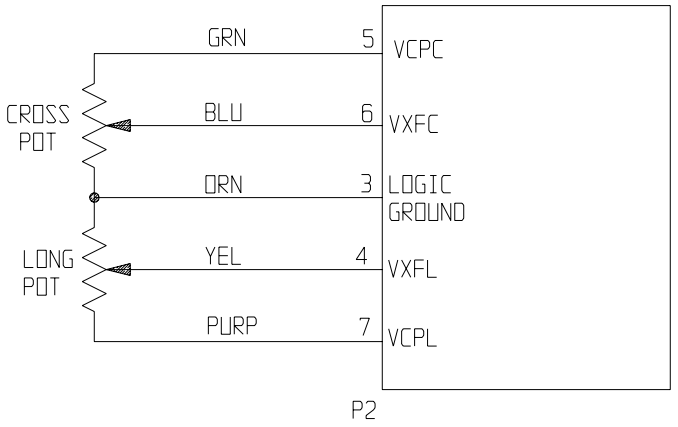
REL. ECN P0280 | SCALE 1:1 | FILENAME 70-09025 | SHEET 1 OF 1

DRAWING NO. 70-09038

LINEAR II, III
LAMP & DRIVER PCB



LINEAR I, II, III LOGIC PCB



REV	DESCRIPTION	DATE	APP'D
A	REDRAWN - NO CHANGES		
A	RELEASE PER 9024	07-30-94	T.J.M.

REVISIONS

PACKAGE:
VENDOR SHALL SUPPLY THE PARTS SUFFICIENTLY PACKAGED TO PROTECT THE FINISH AND INTEGRITY DURING SHIPMENT AND STORAGE. THE OUTSIDE OF THE PACKAGE SHALL BE PROMINENTLY MARKED WITH PART NUMBER AND REVISION.

REMOVE ALL BURRS AND SHARP EDGES

DECIMALS	(MM)	ANGLES	MACHINE FINISH
XX = ±.01	(± 0.25)	1°	32
XXX= ±.005	(± 0.127)		

UNLESS OTHERWISE SPECIFIED

MATERIAL:

ORIGINAL PRODUCT

APPROVALS	DATE
DRN. M.L.	7-30-84
CHK.	
ENG.	
APP.	
APP.	

FINISH:

DO NOT SCALE DRAWING

PROGENY, INC.

FEEDBACK POT & MOTOR WIRING DIAGRAM

SIZE	ITEM CLASS	DRAWING NO.
A		70-09038

SCALE	FILENAME	SHEET
NONE	7009038	1 OF 1