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PHOTOMULTIPLIER DETECTION SYSTEM

MODEL 7070

Please read these instructions completely before operating this equipment. If there are any questions or problems regarding the use of this equipment, please contact: ORIEL INSTRUMENTS - or - the representative from whom this equipment was purchased.

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I. INTRODUCTION

The ORIEL Model 7070 Detection System is an instrument designed for a wide variety of applications in the measurement of light radiation. This highly sensitive, extremely stable unit, can, with the appropriate external sensor, enable measurements over the ultraviolet, visible and near infrared portions of the spectrum.

The 7070 has a self-contained, adjustable power supply, on the front panel, suitable for biasing both vacuum photodiode sensor (Oriel 7050-7056) and photomultiplier tubes (Oriel 77340-77361 Series).

Cables: High voltage and signal cables are supplied with Oriel photomultiplier housings. The signal cables are low noise type coaxial cable with BNC connectors. (Standard BNC cables produce currents of up to 100 pico amps due to handling and movement of laboratory personnel).

II. SPECIFICATIONS

NOTE: Allow a 15 minute warm-up period before critical measurements.

Radiometer Readout *

Operating Temperature Range:	14-40°C
Overall accuracy at 27 degrees C Ambient:	±1% (±1 digit)
Linearity:	.05%
Gain Drift vs Temperature:	0.07%/°C
Zero Drift:	± 1 digit

* NOTE: These specifications pertain to the readout circuit only. The performance of the entire system is visually limited by that of the photo sensors.

BCD Output Description:

The parallel BCD output lines are at +5V logic level (positive logic), capable of driving two LPTTL loads.

The multiplexed BCD output lines are at +5V logic level (negative logic), capable of driving four CMOS loads. The load pulses are at +5V logic level (positive logic), capable of driving two CMOS loads.

Analog Recorder Output:

100mV full scale, source impedance = 200 ohms

High Voltage Power Supply:

Output: Adjustable from -10V to -1000 VDC
Stability at 27°Ambient:±0.1%
Stability over operating temperature range: ±0.25%

III. AC LINE CONSIDERATION

The Oriel Model 7070 Radiometer is shipped wired for operation on 115 VAC, 50-60 Hz line voltage, unless the AC line cord is labeled otherwise. Just plug it into a standard three-prong wall outlet for immediate operation.

For 220/230 volt operation, perform the following steps:

WITH ALL POWER DISCONNECTED

NOTE: For shipments to Europe, the instrument may have already been converted for 220/240 volts input. This will be indicated by a tag on the AC line cord.

a) Remove the eight screws holding on the top cover, and then remove the top cover.

b) At the left rear corner of the main circuit card (near rear panel fuse holder), locate the four screw terminals and loosen the four top nuts.

c) Remove both shorting jumpers (1-2, and 3-4).

d) Replace one jumper across the two middle terminals (2-3), and discard the second jumper.

e) Tighten the four top nuts.

f) Replace cover and eight holding screws.

g) Cut off the three-pin AC plug at the end of the line cord, and replace it with a new 220/230 volt plug to match your AC line receptacle.

Connect wires as follows:

GREEN - earth ground
BLACK - high side of AC line
WHITE - low or neutral side of AC line

h) The Radiometer is now configured for operation on 220/230 volts, 50-60 Hz.

IV. CONTROLS AND FUNCTIONS

A. FRONT PANEL

Power Switch: (Illuminated) — Used to turn power on to the Radiometer.

Volts: — Used to set the high voltage power supply output level. This control has an integral lock, which reduces the possibility of erroneously changing the high voltage setting.

Measure: — Used to switch the digital front (Voltage/Current) panel readout between the high voltage power supply output (range 000 to -1000V) and the detector current readout (range .000-1.999 A).

Response: — Used to select system response time (fast/med/slow), from 5% to 95% of full signal): fast = 0.1 (0.4 on 10^{-9} ampere range);med = 1.s; slow = 10s.

Ambient Suppress: — Used to cancel out dark current of sensors, or to set sensor current to zero for any ambient light condition. Both coarse (rotary switch) and fine (potentiometer) controls are provided. This control has an integral dial lock.

Multiplier: — Used to select the desired sensitivity of photo detector in amperes.

Attenuation: — Used to attenuate the reading on the front panel meters. Range of operation is 0dB @ CAL, and over 20dB @ full CCW.

NOTE: This control must be in the CAL position for long term repeatability of measurements, or for absolute current readings.

Zero: (on/off)	Used to disconnect both sensor input and ambient suppress input, so that meter zeroing may be accomplished.
Zero: (potentiometer)	Used to zero panel meters when ZERO switch is on.
Digital Panel Meter:	Used to measure high voltage power supply output (000- -1000V) when the MEASURE switch is in the VOLTAGE position. Also measures sensor current (.000 to 1.999 times MULTIPLIER setting in amperes), when the MEASURE switch is in the CURRENT position.
Analog Panel Meter:	Used to measure sensor current at all times; convenient for output peaking. Range: 0 to 2.

B. **REAR PANEL**

Sensor Signal* Connector (BNC): [upper left]	Used to make connection with the external sensor.
Remote Readout Connector: pins)	Used to connect remote readout device(s), printer(s), computer interface, etc. Has both parallel and multiplexed BCD data from (25 front panel Digital Panel Meter.
High Voltage* Connector (High Voltage BNC) [lower right]:	Used to connect high voltage power supply output to sensor.

Recorder Jacks: (lower right corner) — Used to connect to external recorder or oscilloscope. This output is internally connected to the Analog Panel Meter.

* It is possible to plug a standard BNC cable into a high voltage BNC socket and vice versa. Be particularly careful about proper connection to these sockets.

V. OPERATION WITH A PHOTOMULTIPLIER SENSOR

To operate the photomultiplier detector with a photomultiplier sensor:

1. Connect the signal cable from the photomultiplier detector housing to the BNC jack on the rear panel (upper left hand corner).

2. Check that the VOLTS control on the front panel of the Radiometer is turned fully counter clockwise.

3. Check that the photomultiplier tube, in its housing, is shielded from any light source. Connect the high voltage cable from the photomultiplier detector housing to the high voltage BNC jack on the rear panel (bottom right hand corner).

   NOTE: Do not confuse the signal and high voltage BNCs. The high voltage BNC connector is significantly taller than the signal type, but it is possible to achieve a potentially disastrous cross connection.

4. Turn the MULTIPLIER switch to 10^{-5}, and check that the attenuator is turned fully clockwise to the detented CAL position.

5. Turn the Radiometer power switch to ON, and set the MEASURE switch to the CURRENT position.

6. Set the ZERO switch to ON, and adjust ZERO control for .000 on the digital panel meter.

   NOTE: Meter may be zeroed on the 10^{-9} MULTIPLIER position, and will usually retain zero, ±.001 for all other scales.

7. Set the ZERO switch to OFF, and allow a 15 minute warm-up period before proceeding to Step 8.

8. While observing both the digital and analog panel meters, adjust the VOLTS control (displayed on the digital panel meter) from 0 (zero) to the proper voltage level for the photomultiplier detector. This voltage usually ranges from 500 to 800 volts for the standard Oriel detectors. The analog panel meter displays detector current, which should not be allowed to exceed 1×10^{-5} amperes.

9. Set the integral lock on the VOLTS control, and set the MEASURE switch to CURRENT. The digital panel meter will now display detector current, providing more precise readings than are available on the analog panel meter.

NOTE: After the operating range is known, adjust the high voltage to the proper value and turn the instrument off and on as desired.

The detector sensitivity will increased as voltage increases. Operation between 100 and 1000 volts allows a very wide range of sensitivity, to match a given radiation level. The noise and dark current for many photomultiplier tubes also increase as drive voltage increases. Generally, the best signal/noise ratio is observed for bias voltages in the range from 500 to 700 volts for Oriel photomultipliers normally used with this instrument.

<<<< CAUTION >>>>

If source intensity of measurement is unknown, the 10-5 Amp maximum current could be exceeded, resulting in damage to the photo tube. When in doubt, proceed as in Step 8.

Never turn on the 7070 and apply bias to a photomultiplier tube if you do not know what the light level incident or the photomultiplier tube is (and therefore the ampified photo current). If the photo current exceeds 10^{-5}A, permanent damage to the tube may result. Even if the tube is not destroyed, exposure to high light levels can result in permanent loss of sensitivity and increased dark current. The dark current level can recover after several days if the tube is not exposed.

10. The photomultiplier detectors have some signal current without any light input due to fundamental quantum effects. This "Dark Current" varies with tube voltage. This current, or current resulting from ambient light, may be canceled out by using the AMBIENT SUPPRESS controls. With the source or detector optically blanked, set the AMBIENT SUPPRESS switch to the appropriate full scale range. That is, if the current is 0.5×10^{-8} amperes, set the AMBIENT SUPPRESS switch to 10^{-8}. Then, turn the AMBIENT SUPPRESS poteniometer to zero the meter.

11. When making relative light measurements, it is often good to set an arbitrary light level at half scale (1.000) on the meter(s). This is particularly true when setting a reference for making direct transmittance or reflectance measurements. The Attenuation control allows continuously adjustable sensitivity of the measuring circuit.

VI. OPERATION WITH AN A-D BOARD

Operation of much scientific laboratory equipment is simplified by use of computer interface in today's research environment. The most popular computer found in most laboratories today is the IBM Personal Computer (PC-XT, PC-AT, or 386) and an large array of clones. We support the interface of IBM XT/AT/386 personal computers and fully compatible clones to the Oriel Model 7070 Detection System in two ways. In the 7070 there is an interface to the BCD output of the Display Panel Meter, which is entirely digital in nature; this will be covered in further depth in this manual. For those researchers lacking an interface to BCD output, an analog output is provided to drive either an A-D board or chart pen recorder.

The 7070 has two recorder jacks located on the lower right corner on the rear panel of the unit. This output is internally connected to the Analog Panel Meter and provides a remote voltage representing the displayed scale. The full scale output from this jack is 100 millivolts corresponding to a display of 1.000 on the panel meter. The time constant response for the recorder jack output is the same as the display, 0.1 seconds for fast, 1 second medium, 10 seconds slow.

This output is designed for chart pen recorders and A-D converter interface. There are a large variety of custom interface boards on the market which digitize analog waveforms. Any of these products can be interfaced to the 7070 Detection System; however, a few important guidelines should be followed to guarantee that the data recorded in the computer accurately reflects the signal.

A dual-banana jack on the rear of the 7070 can be mated to a BNC connector with a dual-banana to BNC adapter, and the signal coupled to the A-D board through a normal length of coaxial cable. The use of coax to connect the signal is highly recommended. The input of the A-D converter board should be able to accept signals in the range 0-100 millivolts. For maximum resolution of the signal, the input voltage range of the A-D board should match the output of the recorder jacks. Some A-D boards actually contain pre-amplifiers to match the input range. The standard input for most commercial A-D converters is 10 volts; therefore, a gain of 100 will match the input and output signal level most effectively.

For A-D boards which have a binary gain, use a gain of 64 or the next highest possible gain. Be cautious of signal levels so low as to lose the signal in the digital bit resolution, and likewise so high as to saturate the maximum gain scale. This may require judicious adjustment of the Multiplier Scale setting to follow these two rules.

The following is a list of required conditions:

1. The output impedance of the Recorder Jacks is 200 ohms. The input impedance of the A-D board must be greater than 20,000 ohms to affect the signal less than one percent. For measurements at 12-bits A-D resolution, an input impedance of 1 Megohm is recommended to keep from loading the output.

2. The band width of the output signal is controlled by the Response switch on the front panel of the 7070. The A-D conversion rate should be limited to no greater than the response time. For a sequenced recordings of output followed by a change in wavelength, the signal must settle to a new value before taking a measurement. This wait time should be equal to at least 3 times the system response time (Use 0.3 seconds for fast, 3 seconds for medium, and 30 seconds for slow).

3. If the A-D board has a choice between single ended, or differential input, us the differential input mode with the return path connected to the barrel of the BNC connector. This will prevent the possibility of ground loops and 60 hertz pickup.

4. Sometimes it is advisable to average several signal readings together to improve the signal to noise ratio. The SNR will increase as the square root of the integration time (the number of samples), the minimum time should be at least 3 times the system response time.

5. The length of cable between the A-D board and the Model 7070 Detection System should be limited to a maximum of six feet. Further lengths allow external pickup of power hum, switching power supplies, etc.

6. Some custom user boards allows a filter frequency to be programmed to reduce the possibility of signal aliasing. If this feature is present on your selected board, set the time period of the roll-off filter equal to the system response time (0.1 seconds fast, 1 second medium, 10 seconds slow).

Boards which have been tested with the output of the Recorder Jacks on the 7070 are the DT-1000 by Data Translation in Marlboro, MA ($1100); and the AD-1000 Industrial Control Card by Real Time Devices in State College, PA ($300).

VII. CIRCUIT DESCRIPTION

Drawing number 7070-4-1001-1 is a complete schematic diagram of the 7070 Radiometer. The sensor current processing is accomplished in three stages: at the input buffer amplifier, the system response amplifier, and the front panel digital volt-meter.

The input buffer amplifier (A104) is a very stable, high input impedance operational amplifier. Using selected scaling resistors, it converts detector current to voltage.

The system response amplifier (A105) amplifies the output of A104. Using selected feedback capacitors, it establishes system response. The output of the response amplifier is connected to the analog panel meter, to a scaling circuit for the external recorder output, and, via the MEASURE selector switch, to the digital panel meter. The digital panel meter is a digital voltmeter which converts the scaled analog voltage to a digital readout. The meter also generates multiplexed BCD information, which is converted to parallel BCD format on the BCD Latch Circuit card.

The output from the BCD Latch Circuit card is connected to J106 on the rear panel. The functions are listed below by pin number:

J106-1	+	(parallel) J1006-14 .001	(parallel)
J106-2	1	(parallel) J106-15 2 EXP3 (Lo)	(mux'd)
J106-3	.8	(parallel) J106-16 2 EXP2 (LO)	(mux'd)
J106-4	.4	(parallel) J106-17 2 EXP1 (LO)	(mux'd)
J106-5	.2	(parallel) J106-18 2 EXP0 (LO)	(mux'd)
J106-6	.1	(parallel) J106-19 MINUS	(mux'd)
J106-7	.08	(parallel) J106-20 1 STROBE	(mux'd)
J106-8	.04	(parallel) J106-21 .1 STROBE	(mux'd)
J106-9	.02	(parallel) J106-22 .01 STROBE	(mux'd)
J106-10	.01	(parallel) J106-23 .001 STROBE	(mux'd)
J106-11	.008	(parallel) J106-24 No Contact	
J107-12	.004	(parallel) J106-25 Ground	

The unit has a low voltage power supply and a high voltage power supply. The low voltage power supply provides internal voltage levels of +5VDC, +15VDC and -15VDC). The major elements of the high voltage power supply are a voltage comparator (A103) and a series pass transistor (Q101). An additional active component (Q102) senses excess current drain on the power supply (approximately 4 milliamperes) and turns off the series pass transistor (Q101).

One input to the voltage comparator is the attenuated high volt age output, and the other input is the wiper of the front panel VOLTS control. The voltage comparator controls the conduction of the series pass transistor, increasing or decreasing conduction as necessary to increase or decrease the high voltage output, to maintain equality across the voltage regulator input terminals.

VIII. TROUBLESHOOTING

SYSTEM PROBLEMS

Since this unit is to be used with a photomultiplier detector, you should first consider "Systems Problems". The most common system failure made is a faulty signal cable due to failure of the end connectors. Check this first. Then check that the photomultiplier tube is "alive". To do this, check the unit for output voltage and sensitivity to input current.

INTERNAL REPAIRS TO THE 7070

Only an experienced electrical technician should attempt to make repairs or internal adjustments to this equipment. Improper use of test equipment or tools can easily damage components within the unit or compound existing problems.

If you find a problem, remove the top cover and visually inspect the equipment made for shorts, broken wires, and obviously damaged or broken components. If nothing is obviously wrong, check the items listed below.

A) **Check input buffer stage:**

1. Zero check

   a. Set ZERO switch ON.
   b. Set Attenuator control to CAL.
   c. Locate termination point, on main circuit card, of grey wire originating within the can on the front panel.
   d. Connect a voltmeter or oscilloscope between that point and ground.

   NOTE: The black binding post on the rear panel is a convenient ground reference point. Adjusting the front panel ZERO control should allow zeroing on all positions of the MULTIPLIER switch.

2. Gain check

   a. Using a precision current source (or precision voltage source with appropriate series resistor), connect -1 x 10^{-8} Amperes (-10uA) into the BNC input jack at the upper left hand corner of the rear panel.
   b. Check that ZERO is OFF and ambient SUPPRESS is OFF.
   c. Position MULTIPLIER to 10^{-5}. The voltage reading on the termination grey wire (with respect to ground) should be +VDC,±.005V.

3. Calibration check

   a. Using a precision current source (or precision voltage source with appropriate series resistor), connect -1 x 10^{-7} Amperes (-0.1uA) into the BNC input jack at the upper left corner of the rear panel.
   b. Check that ZERO is OFF, AMBIENT SUPPRESS is OFF, and MULTIPLIER is positioned to 10^{-7}. The voltage reading on the termination point of the grey wire (with respect to ground) should be +1VDC,±.005V.

   If steps 1 and 2 show normal performance, but step 3 is out of tolerance, the unit probably requires calibration. See SECTION VIII, CALIBRATION PROCEDURES. If adequate test equipment is not available, send the unit to ORIEL for calibration.

B) **Check Response Amplifier:**

1. Zero check

   a. Set ZERO switch ON.
   b. Set Attenuator Control to CAL.
   c. Locate termination point on main circuit, card of grey wire originating within the can on the front panel.
   d. Connect a voltmeter or oscilloscope between that point and ground.
   e. Turn Attenuator control fully counter clockwise.
   f. Connect voltmeter between MEASURE switch terminal (WH/BRN/BLK wire) and ground.
   g. Adjust R141 (50K trimpot in right rear area of main circuit card)for0 volt reading.

2. Gain check

   a. Set ZERO to OFF.
   b. Set MULTIPLIER to 10-5.
   c. Set AMBIENT SUPPRESS to 10-5.
   d. Turn AMBIENT SUPPRESS potentiometer fully counter clockwise.
   e. Connect a voltmeter between the MEASURE switch terminal (WH/BRN/BLK wire) and the main circuit termination point of grey wire originating within the front panel can. The voltage reading between these two points should be 0 VDC, ±.040.

   If the readings in steps 1 or 2 are not correct, operational amplifier A105 is probably faulty, and should be replaced. If you replace A105, calibrate it according to the instructions in Section VIII.

C) **Check Digital Panel Meter:**

1. Zero check

   a. Connect clip lead from MEASURE switch wiper (WH/RED/BLK wire) to ground. Digital Panel Meter reading should be .000 ±.002. Remove clip lead.

2. Gain check

   a. Set ZERO to OFF.
   b. Set MULTIPLIER to 10^{-5}.
   c. Set AMBIENT SUPPRESS switch to 10^{-5}.
   d. Set MEASURE switch to CURRENT.
   e. Connect voltmeter between MEASURE switch wiper (WH/RED/BLK wire) and ground.
   f. Adjust AMBIENT SUPPRESS potentiometer for a voltmeter reading of -1VDC. Digital Panel Meter should read -1.000 ±.040.

If steps 1 or 2 are slightly out of tolerance, try to calibrate the unit. However, if the readings are badly out of tolerance, the meter is probably faulty and should be replaced.

D) **Check High Voltage Power Supply:**

1. Connect voltmeter between high voltage BNC output connector (lower right hand corner of rear panel) and ground.

2. Turn the front panel VOLTS control full clockwise. Output voltage should be -1000 $\pm$3 VDC. If the reading is far out of tolerance, or if regulation is erratic, the voltage comparator (A103) is probably faulty and should be replaced.

3. Turn the front panel VOLTS control fully counter-clockwise. The reading should drop to -1, $\pm$1 VDC. If the reading is extremely high, the series pass transistor (Q101) is probably leaking, and should be replaced.

4. Turn the front panel VOLTS control five full turns clockwise. Check the reading; it should be -500 $\pm$25VDC.

5. Set the MEASURE switch to VOLTAGE. The front panel digital meter should repeat the output voltage, $\pm$2. If the digital meter reading is out of tolerance, calibrate the unit (see Section VIII).

IX. CALIBRATION PROCEDURE

Calibrate the entire unit in the order shown; some adjustments depend on the accuracy of other settings within the unit.

NOTE: Proper calibration requires the use of a precision current source (accuracy of ±.01% or better) or a precision voltage source and precision resistor combination (combined accuracy of ±.01% or better). Calibrating without both of these tools will result in incorrect calibration and degraded performance. If you do not have both tools, send the unit to ORIEL for proper calibration.

A) Current Metering Circuitry:

1. Make the following initial front panel adjustments:

MEASURE:	CURRENT
VOLTS:	Full CCW
MULTIPLIER:	10^{-9}
MULTIPLIER ATTENUATOR:	CAL (full CW)
AMBIENT SUPPRESS:	OFF
RESPONSE:	FAST
ZERO Switch:	ON

2. Adjust ZERO potentiometer for .000 on the digital meter.

3. Turn Attenuator control fully counter clockwise. Digital panel meter should be no more than ±.001. If the reading is out of tolerance, adjust R141 (50K trimpot at right rear of main circuit card).

4. Set Attenuator control back to CAL (full CW), ZERO switch to OFF, and MULTIPLIER to 10^{-8}.

5. Connect a precision 10 microampere current source (or precision -10V voltage source with precision 1 Megohm resistor in series) to the signal input BNC connector (upper left corner of the rear panel).

6. The digital panel meter should read 1.000 $\pm$.001. If the meter reading is off, adjust the digital panel meter gain potentiometer (accessible via hole in rear meter panel).

7. Change the setting on the precision current source to -1 microampere (voltage source to -1V). Set MULTIPLIER to 10^{-6}. Slide off metal can on front panel switch, without letting it to touch any active circuitry.

8. Adjust R127 (100k trimpot, most CW in position of the set of 4 poteniometers on the rear of the MULTIPLIER switch) for a digital panel meter reading of 1.000.

9. Change the setting on the precision current source to -0.1 microamperes (voltage source to -0.1V). Set MULTIPLIER to 10^{-7}.

10. Adjust R129 (1 MEG trimpot, adjacent to R127 above) to a digital panel meter reading of 1.000.

11. Change the setting on the precision current source to -.01 microamperes (voltage source to -.01V). Set MULTIPLIER to 10^{-8}.

12. Adjust R137 (1k trimpot, adjacent to R129 above) to a digital panel meter reading of 1.000.

13. Change the setting on the precision current source to .001 microamperes (voltage source to -.001V). Set MULTIPLIER to 10^{-9}.

14. Adjust R134 (10K trimpot, adjacent to R137 above) for a digital meter reading of 1.000.

NOTE: The two most sensitive ranges of the MULTIPLIER (10^{-8} and 10^{-9}) are highly susceptible to noise induced errors when the protective can cover is removed. The accuracy of the gain settings may be impaired, and should be checked with the can cover in place. You may need to repeat the calibration for these two positions.

15. Shut off Radiometer's power replace can, and restore power.

B) **High Voltage Power Supply:**

1. Connect a precision voltmeter (accuracy of 0.1% or better) between the high voltage output connector center pin and ground.

2. Slowly turn the front panel VOLTS control clockwise, observing the meter reading. The output should never go higher than -1005 VDC.

   NOTE: If output reaches 1000 volts before VOLTS control is at the maximum CW travel, reduce the output by adjusting R110 (2k trim pot, located just below and to the left of the front panel metal can, on the front of the main circuit card).

3. With the VOLTS control set at maximum CW travel, adjust R110 (2k trimpot referenced in above note) for an output reading of -1002 VCD.

4. Set MEASURE switch to VOLTAGE, and observe the reading on the front panel digital meter.

5. Adjust R115 (10k trimpot at the front of the main circuit card. between and below the two front panel meters) for a digital panel meter reading of -1002.

X DRAWINGS

This manual includes the following drawings:

7070-4-1001-1	Radiometer Diagram
7070-4-1300-1	Main Board Assembly
7070-3-1400	BCD Latch Assembly
7070-2-1401	BCD Latch Circuit

WARRANTY AND RETURNS

WARRANTY

Oriel Corporation warrants that all goods described in this manual (except consumables such as lamps, bulbs, filters, ellipses, etc.) shall be free from defects in material and workmanship. Such defects must become apparent within the following period:

1. All products described here, except spare parts: one (1) year or 3000 hours of operation, whichever comes first, after delivery of the goods to buyer.

2. Spare parts: ninety (90) days after delivery of goods to buyer.

Oriel Corporation's liability under this warranty is limited to the adjustment, repair and/or replacement of the defective part(s). During the above listed warranty period, Oriel Corporation shall provide all materials to accomplish the repaired adjustment, repair or replacement. Oriel Corporation shall provide the labor required during the above listed warranty period to adjust, repair and/or replace the defective goods at no cost to the buyer ONLY IF the defective goods are returned, freight prepaid, to an Oriel Corporation designated facility. If goods are not returned to Oriel Corporation, and user chooses to have repairs made at their premises, Oriel Corporation shall provide labor for field adjustment, repair and/or replacement at prevailing rates for field service, on a portal-to-portal basis.

Oriel Corporation shall be relieved of all obligations and liability under this warranty if:

1. The user operates the device with any accessory, equipment or part not specifically approved or manufactured or specified by Oriel Corporation unless buyer furnishes reasonable evidence that such installations were not a cause of the defect. This provision shall not apply to any accessory, equipment or part which does not affect the safe operation of the device.

2. The goods are not operated or maintained in accordance with Oriel's instructions and specifications.

3. The goods have been repaired, altered or modified by other than Oriel authorized personnel.

4. Buyer does not return the defective goods, freight prepaid, to Oriel repair facility within the applicable warranty period.

IT IS EXPRESSLY AGREED THAT THIS WARRANTY SHALL REPLACE ALL WARRANTIES OF FITNESS AND MERCHANTABILITY. BUYER HEREBY WAIVES ALL OTHER WARRANTIES, GUARANTIES, CONDITIONS OR LIABILITIES, EXPRESSED OR IMPLIED, ARISING BY LAW OR OTHERWISE, WHETHER OR NOT OCCASIONED BY ORIEL'S NEGLIGENCE.

This warranty shall not be extended, altered or varied except by a written document signed by both parties. If any portion of this agreement is invalidated, the remainder of the agreement shall remain in full force and effect.

CONSEQUENTIAL DAMAGES -

Oriel Corporation shall not be responsible for consequential damages resulting from misfunctions or malfunctions of the goods described in this manual. Oriel's total responsibility is limited to repairing or replacing the misfunctioning or malfunctioning goods under the terms and conditions of the above described warranty.

INSURANCE -

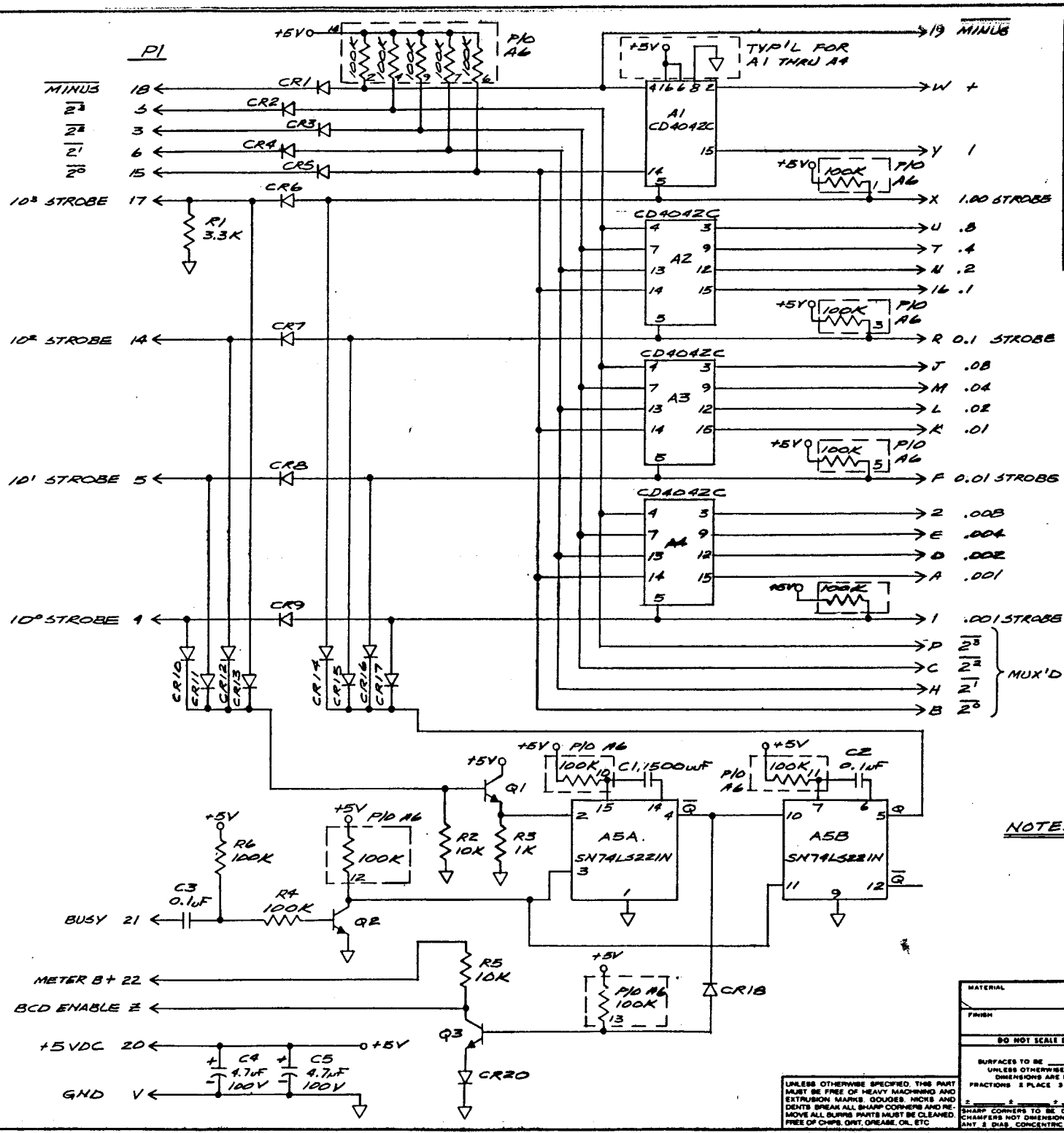
Persons receiving goods for demonstrations, demo loan, temporary use or in any manner in which title is not transferred from Oriel, shall assume full responsibility for any and all damage while in their care, custody and control. If damage occurs, unrelated to the proper and warranted use and performance of the goods, recipient of the goods accepts full responsibility for restoring the goods to their condition upon original delivery, and for assuming all costs and charges.

RETURNS

Before returning equipment to Oriel for repair, please call the Customer Service Department at (203) 377-8282. Have your purchase order number available before calling Oriel. The Customer Service Representative will give you a Return Material Authorization number (RMA). Having an RMA will shorten the time required for the repair, because it ensures that your equipment will be properly processed. Write the RMA on the returned equipment's box. Equipment returned without a RMA may be rejected by the Oriel Receiving Department. Equipment returned under warranty will be returned with no charge for the repair or shipping. Oriel will notify you of repairs not covered by warranty, with the cost of the repair, before starting the work.

Please return equipment in the original (or equivalent) packaging. You will be responsible for damage incurred from inadequate packaging, if the original packaging is not used.

Include the cables, connector caps and antistatic materials sent and/or used with the equipment, so that Oriel can verify correct operation of these accessories.



REV	DESCRIPTION	DATE	BY
A	REV NUMBERS & LETTERS ON P1	2-1-77	WW
B	CHANGED A1-A4, & A6, RENUMBER SOME PINS	2-17-77	AS
C	MOVED C3 & CHANGED VALUE, ADDED R6, CHANGED VALUE OF C1, DELETED CR19	4-1-77	AS
D	R1 WAS 1K ERR 1406	7-1-82	BLS
E	C2 WAS 150 PF ERR2792	3-7-83	BLS
F	RE-DRAW SCHEMATIC ERR10322	4-25-87	JW

NOTES: 1) ALL DIODES ARE IN914
2) ALL RESISTORS ARE 1/4W
3) ALL TRANSISTORS ARE 2N4123

UNLESS OTHERWISE SPECIFIED, THIS PART MUST BE FREE OF HEAVY MACHINING AND EXTRUSION MARKS, GOUGES, NICKS AND DENTS. BREAK ALL SHARP CORNERS AND REMOVE ALL BURRS. PARTS MUST BE CLEANED FREE OF CHIPS, GRIT, GREASE, OIL, ETC.

MATERIAL
FINISH
DO NOT SCALE DRAWING
SURFACES TO BE ____ √ RMS UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
FRACTIONS 2 PLACE 3 PLACE ANGLES
SHARP CORNERS TO BE .005" MAX RADIUS
CHAMFERS NOT DIMENSIONED TO BE .02X45°
ANY 2 DIAS. CONCENTRIC WITHIN .005 TIR

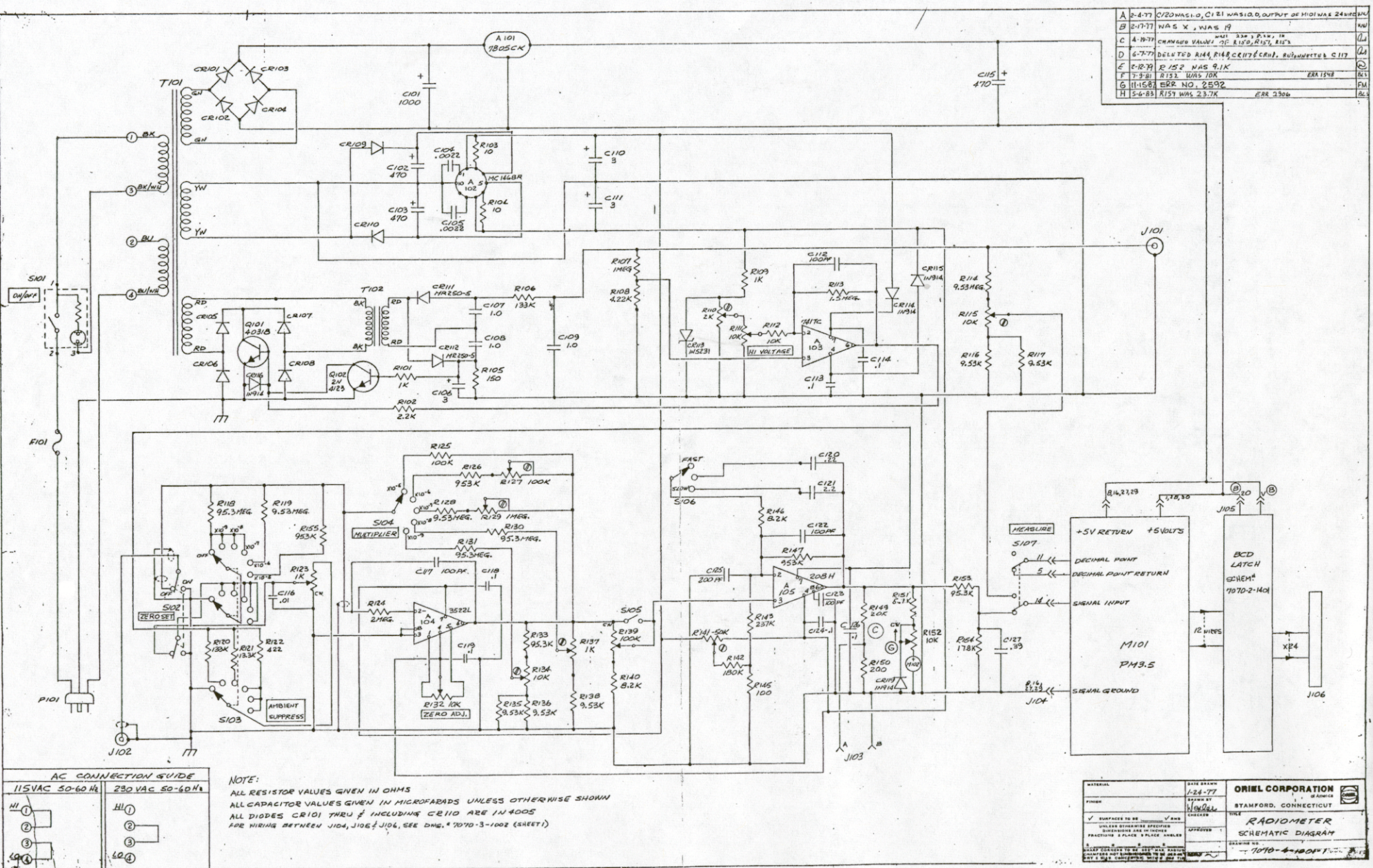
DATE DRAWN 3-25-87
DRAWN BY J. WARHOLA
CHECKED
SCALE

ORIEL CORPORATION
STRATFORD, CONNECTICUT

TITLE BCD LATCH CIRCUIT SCHEMATIC

DRAWING NO 7070-3-1401

Design Products Co. Inc. Chesshire



A	2-4-77	C120 WAS 1.0, C121 WAS 1.0, OUTPUT OF HI01 WAS 24 WIRE	KW
B	2-17-77	WAS X, WAS 19	KW
C	4-19-77	CHANGED VALUES OF R150, R151, R153 WAS 330 ± 5%, 1W	CL
D	6-7-77	DELETED R144, R148, CR117 & CR118, BUS JUMPERED & C117	CL
E	2-12-79	R152 WAS 9.1K	CL
F	7-9-81	R153 WAS 10K ERR 1548	RAS
G	11-1582	ERR NO. 2592	FM
H	5-6-83	R154 WAS 23.7K ERR 2906	AL

AC CONNECTION GUIDE

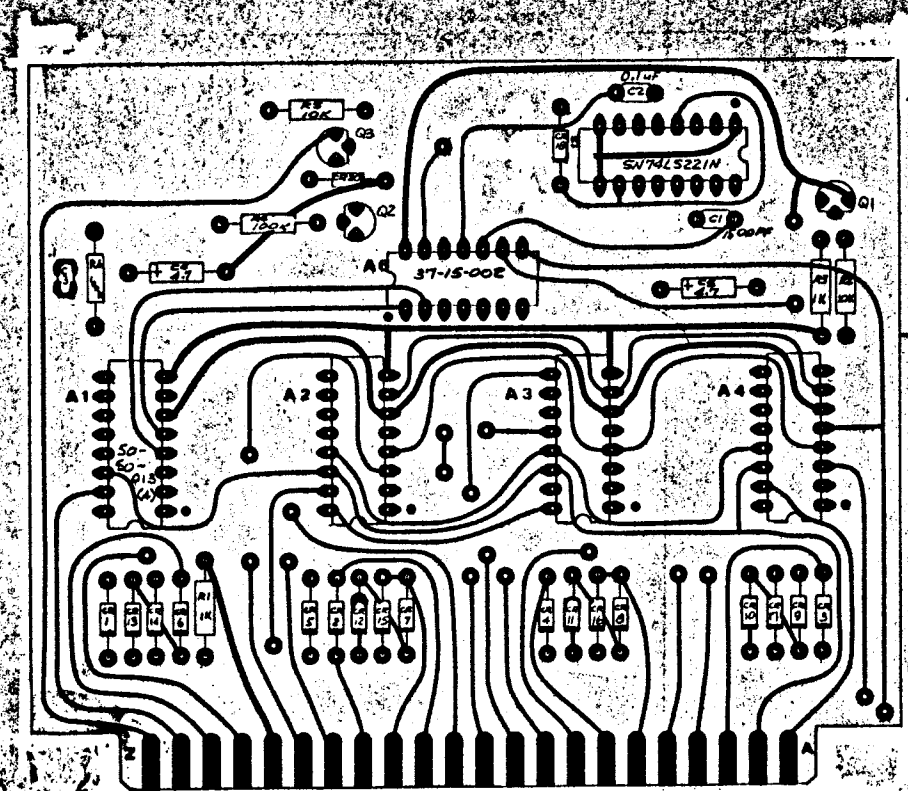
115 VAC 50-60 Hz	230 VAC 50-60 Hz
HI ①	HI ①
②	②
③	③
LO ④	LO ④

NOTE:
ALL RESISTOR VALUES GIVEN IN OHMS
ALL CAPACITOR VALUES GIVEN IN MICROFARADS UNLESS OTHERWISE SHOWN
ALL DIODES CR101 THRU 7 INCLUDING CR110 ARE 1N4005
FOR WIRING BETWEEN J104, J106 & J106, SEE DWG.# 7070-3-1002 (SHEET 1)

MATERIAL
FINISH
√ SURFACES TO BE ___ √ RMS
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
FRACTIONS ± PLACE ± PLACE ANGLES
SHARP CORNERS TO BE .005" MAX. RADIUS
CHAMFERS NOT DIMENSIONED TO BE .005 X 45°
DATE DRAWN 1-24-77
DRAWN BY KW
CHECKED
APPROVED

ORIEL CORPORATION of AMERICA
STAMFORD, CONNECTICUT
TITLE RADIOMETER SCHEMATIC DIAGRAM
DRAWING NO. 7070-4-1001 REV. H

B	3-17-77	REVISED CIRCUIT BOARD	VM
C	4-1-77	DELETED LOCK WASHERS ON ALL SCREWS AND CHANGED VALVE ASSY.	VM
D	6-7-77	ADDED INFORMATION ON PIN CARRIERS	VM
E	3-7-83	C2 WAS 150PF ; ECN 2792	BLC



NOTE:

(P) INSERT 16 PIN CARRIERS IN HOLES FOR A1 THRU A6
REMOVE 2 END PINS FROM CARRIER FOR A6 (PINS FOR 94 HOLES)

ALL DIODES ITT IN914 OR EQUIV. SIMI.

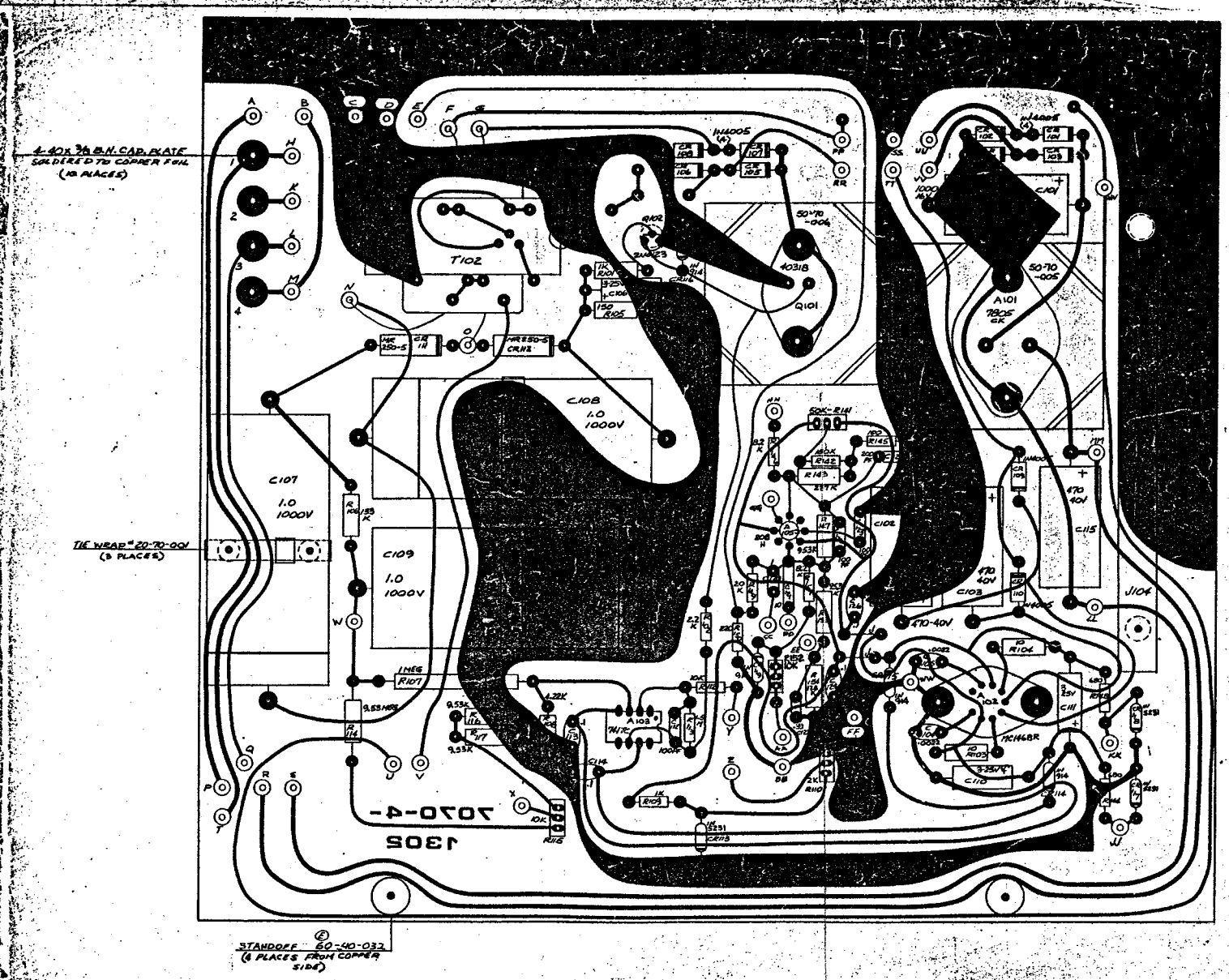
ALL TRANSISTORS 2N4123

ALL RESISTORS 1/4 WATT

FILL ALL BLANK HOLES WITH SOLDER BEFORE INSERTING COMPONENTS

(1) PRINTED CIRCUIT BOARD 7070-3-1402

MATERIAL	DATE DRAWN 1-18-77	DREL CORPORATION of America
FINISH	DRAWN BY Wallace	STAMFORD, CONNECTICUT
✓ SURFACES TO BE ✓ RMS	CHECKED	TITLE PRINTED CIRCUIT BOARD ASSEMBLY RCB LATCH - BUFFER
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONS 2 PLACE ± PLACE ± ANGLES	APPROVED	
SHARP CORNERS TO BE .005" MAX RADIUS CHAMFERS NOT DIMENSIONED TO BE .015 X 45° ANY 2 DIAS CONCENTRIC WITHIN .005 TIR	SCALE 2/1	DRAWING NO 7070-3-1402


4-40 X 3/16 B.H. CAD. PLATE SOLDERED TO COPPER FOIL (10 PLACES)
TIE WRAP #20-70-001 (3 PLACES)
STANDOFF (E) 60-40-032 (4 PLACES FROM COPPER SIDE)
7070-4-
1305
T102
Q102
Q101
40318
C108 1.0 1000V
C107 1.0 1000V
C109 1.0 1000V
A101 7805 CK
A102 MC1468R
C101
C102
C103
C111
C113
C115
J104
R105
R106/89 K
R107
R110
R143
50K-R141
50-70-005
50-70-004
1N4005
470 40V
470-40V
9.53K
1.22K
2K
20K
22K
2.2K
953R
100K
10K
1K
1000 MFD

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