| J077 MANUAL REVISION HISTORY | | |
|---|---|---|
| D | REVISED TO MEET UL60601-1 STANDARDS | OCTOBER 2003<br>ECR 3570 |
| E | SEPARATED COVERSHEET FROM MANUAL | JULY 2005<br>ECR 4670 |
| F | UDATED ADDRESS TO NILES, IL ON COVER SHEET | JUNE 2017<br>ECR 9600 |

# 1.0 SPECIFICATIONS

## 1.1 ELECTRICAL SPECIFICATIONS

LINE VOLTAGE: 115 VAC ± 10% @ 50/60 Hz⎓
(A 230 VAC ± 10% @ 50/60 Hz model is also available)
EXPOSURE RELAY: 250 VAC maximum, 5 ampere maximum (non-inductive)

## 1.2 MECHANICAL SPECIFICATIONS

STROKE LENGTH: 0.876"
AVERAGE GRID VELOCITY: 2.7 in/sec (during full stroke)
MAXIMUM GRID VELOCITY: 4.5 in/sec
HOME POSITION: Midpoint of stroke
GRID SIZE: 17.25" x 18.88"

## 1.3 CLASSIFICATION DATA

This equipment is not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide.

Type of protection against electric shock is Class 1.

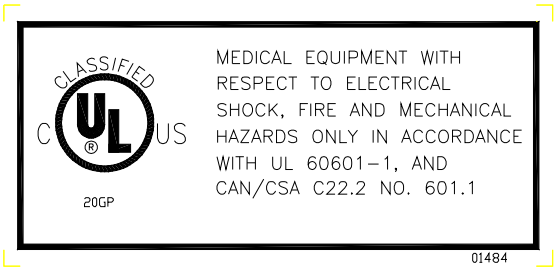
Degree of protection against electric shock is Type B. 

Degree of protection against the ingress of water is IPXO / ordinary.

The function and intended application of this equipment is general radiography for human use.

Environmental conditions for transport, storage and operation:
Temperature: 40° F to 100° F (10° C to 40° C)
Relative humidity: 5% to 95%, con-condensing
Atmospheric pressure: sea level to 8000 feet (700 – 1100 hPa)

The symbol  is used to alert the installer and/or operator of conditions where personal safety or possible equipment damage is a consideration.



The bucky is intended for use with an intermittent duty cycle of 10%

### 1.4 PERFORMANCE

The purpose of a reciprocating bucky is to eliminate the appearance of grid lines on a radiograph. This is achieved by moving the grid back and forth with respect to the film during the exposure. The J500 bucky, when operating properly, will consistently eliminate visible grid lines on radiographs for exposures longer than 35 milliseconds.

## 2.0 INSTALLATION

**...WARNING...**

The x-ray grid travels at a high speed. Never place any object, or part of your body in its path. All maintenance must be performed by qualified personnel. Dangerous voltages are present on the electrical components of this bucky. Power must be removed from the bucky before attempting any maintenance.

### 2.1 BUCKY CABLE

The bucky is pre-wired with a six conductor interface cable 25 feet in length.
The cable is connected to the bucky by the following color code:

B1---BLUE B2---BROWN B3---RED B4---WHITE B6---GREEN/YELLOW B8---BLACK

### 2.2 ELECTRICAL CONNECTIONS

The bucky may be connected to function in either the recommended "six wire" mode or the optional "five wire" mode. Select a wiring configuration from Figure 2A below.

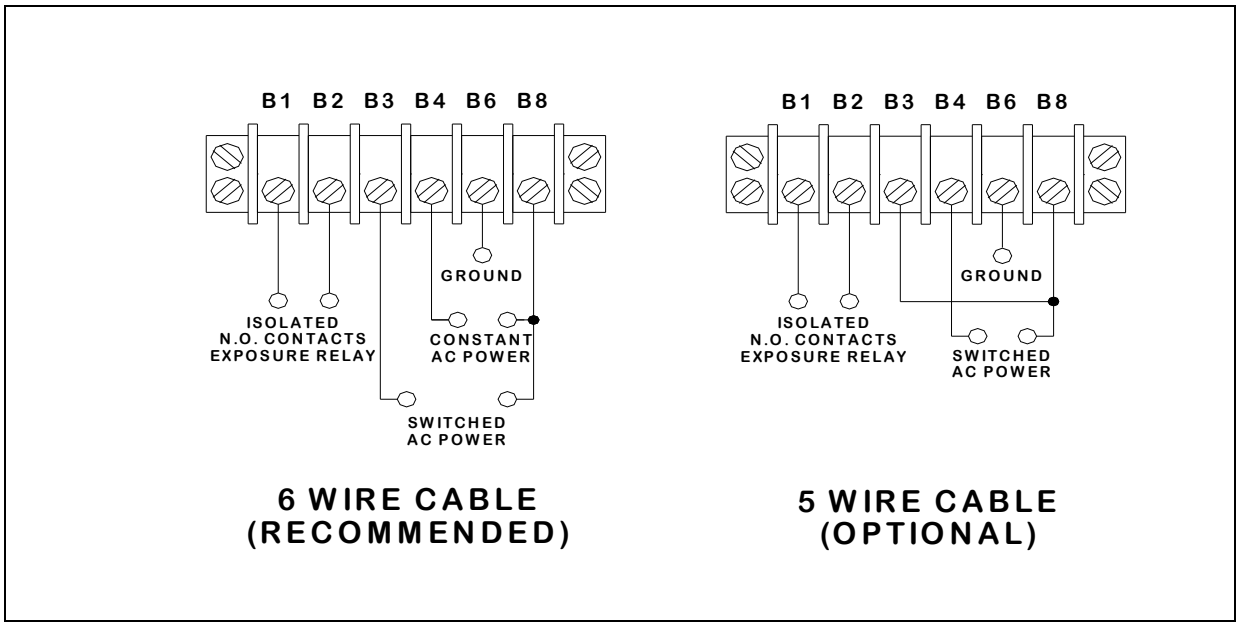



**FIGURE 2A**

2.2.1 SIX-WIRE MODE (RECOMMENDED)

In "six wire" mode, the grid is always parked in the "home" position due to the constant voltage applied to B4 and B8. When 115VAC power is applied to B4 and B3, the grid will begin to reciprocate. As the grid passes the exposure position, the exposure relay will close contacts between B1 and B2 to signal the generator that exposure can begin. Since the bucky will always begin reciprocation from the "home" position, there will consistently be almost no delay before the exposure start signal.

2.2.2 FIVE WIRE MODE (optional)

In "five wire" mode, as 115VAC power is applied to B4 and B3/B8, the grid will begin to reciprocate, moving first to and past "home" then to and past the exposure position. Once the grid has reached the exposure position, the exposure relay will close contacts between B1 and B2 to signal the generator that an exposure can begin. Since the grid may start anywhere in its range of travel, there will be a variable delay between grid reciprocation and exposure start.

**Note:** Some generators require this exposure relay B1/B2 switch closure to pass 120VAC back to the generator, while other generators require this B1/B2 switch closure to pass a GROUND signal back to the generator. **Insure that the bucky is interfaced correctly by referring to the generator manual, or significant component damage could result.**

## 2.3 MOUNTING

The cabinet of the bucky has been designed with mounting holes to accommodate most in-table or chest stand mounting configurations. Select suitable unused holes in the bucky cabinet to secure the unit.

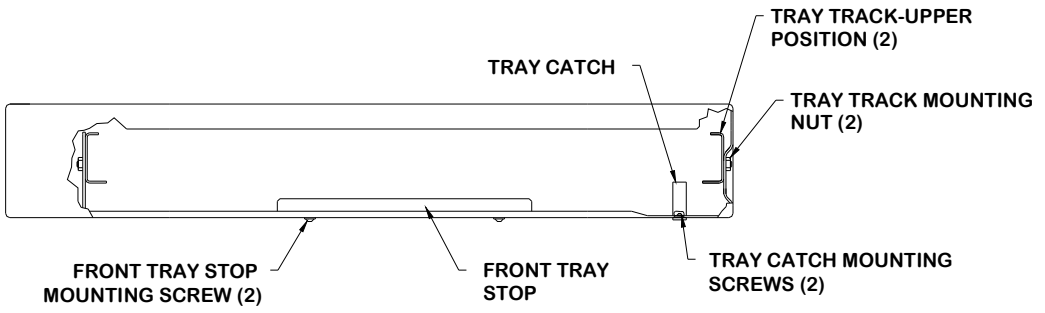
## 2.4 TRAY TRACK POSITION

The tray tracks have two possible positions, high or low. The high track position is preferred, since it allows the shortest patient-to-film distance, but the low track position must be used when an AEC ion chamber is installed in the bucky.

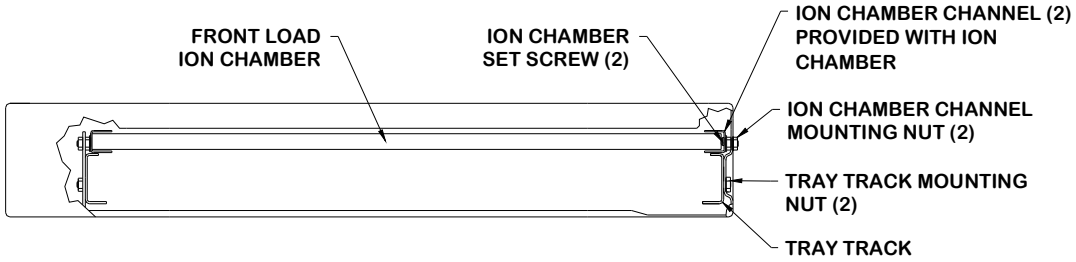
## 2.5 ION CHAMBER

The bucky is designed to accept an ion chamber. The ion chamber can be either front or side-loading. The tray tracks must be in the lower position and the front tray stop and taller tray catch must be removed, as shown in Figure 2B.

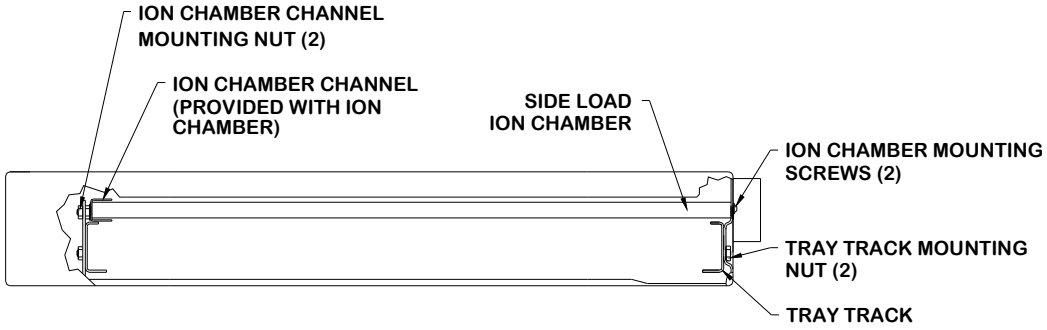
In order to convert from high to low track position, remove the four nuts that mount each tray track. Move the tracks to the lower set of holes and replace the nuts and washers. The front tray stop and tall tray catch must also be removed.




**TRAY TRACKS IN HIGH POSITION-NO ION CHAMBER (FRONT VIEW)**




**TRAY TRACKS IN LOW POSITION-FRONT LOAD ION CHAMBER (FRONT VIEW)**




**TRAY TRACKS IN LOW POSITION-SIDE LOAD ION CHAMBER (FRONT VIEW)**

**FIGURE 2B**

2.5.1 FRONT LOADING ION CHAMBER INSTALLATION

Mount the ion chamber tracks using the upper set of tray track mounting holes. Slide the ion chamber into place and clamp it in place with the set screw provided in the middle of the ion chamber tracks.

2.5.2 SIDE LOADING ION CHAMBER INSTALLATION

Installing a side loading ion chamber requires only one ion chamber track. Mount this track to the upper set of track mounting holes on the drive mechanism side of the bucky. Insert the ion chamber through the slot in the opposite side of the bucky. Push the chamber completely in so that the leading edge inserts into the track, and screw the faceplate to the side of the bucky.

## 2.6 RIGHT-TO-LEFT AND LEFT-TO-RIGHT CONVERSION

Each J500 bucky can be converted from right-handed to left-handed and vice versa. In a right-handed bucky, the film tray slot is to the right of the drive mechanism when viewed from the front, as shown in Figure 2C. In a left-handed bucky, the film tray slot is to the left of the drive mechanism.

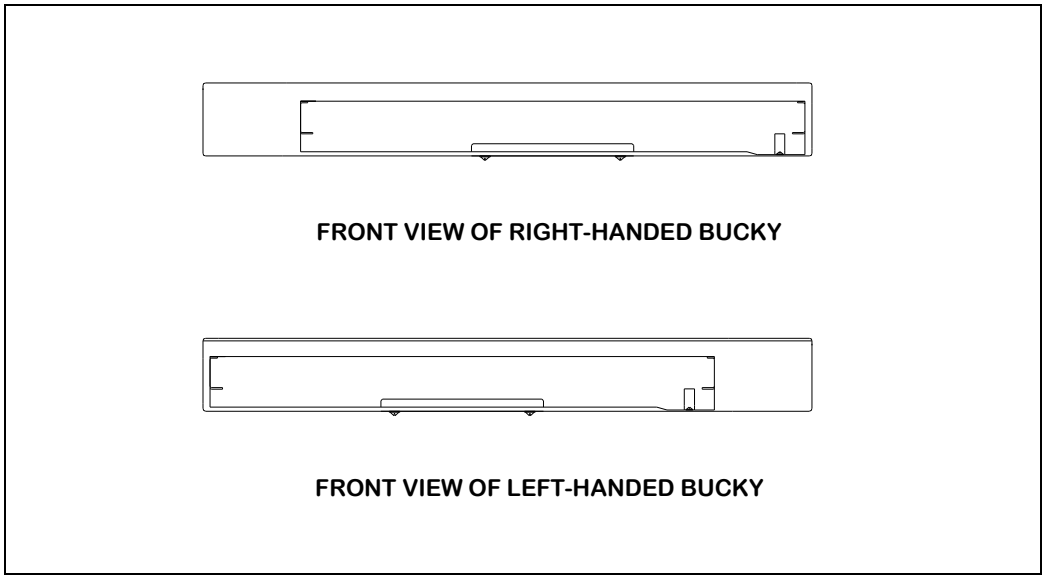



**FIGURE 2C**

2.6.1 LEFT-TO-RIGHT CONVERSION - (NO ION CHAMBER)

Remove the front tray stop, rear tray stop, and tray catch. Re-install them as shown in Figure 2D so that each is mounted on the opposite tray slot from where it was.

2.6.2 LEFT-TO-RIGHT CONVERSION - (WITH ION CHAMBER)

Remove the rear tray stop and re-install it on the opposite tray slot.

2.6.3 RIGHT-TO-LEFT CONVERSION - (NO ION CHAMBER)

Reverse the steps in section 2.5.1

2.6.4 RIGHT-TO-LEFT CONVERSION - (WITH ION CHAMBER)

Reverse the steps in section 2.5.2

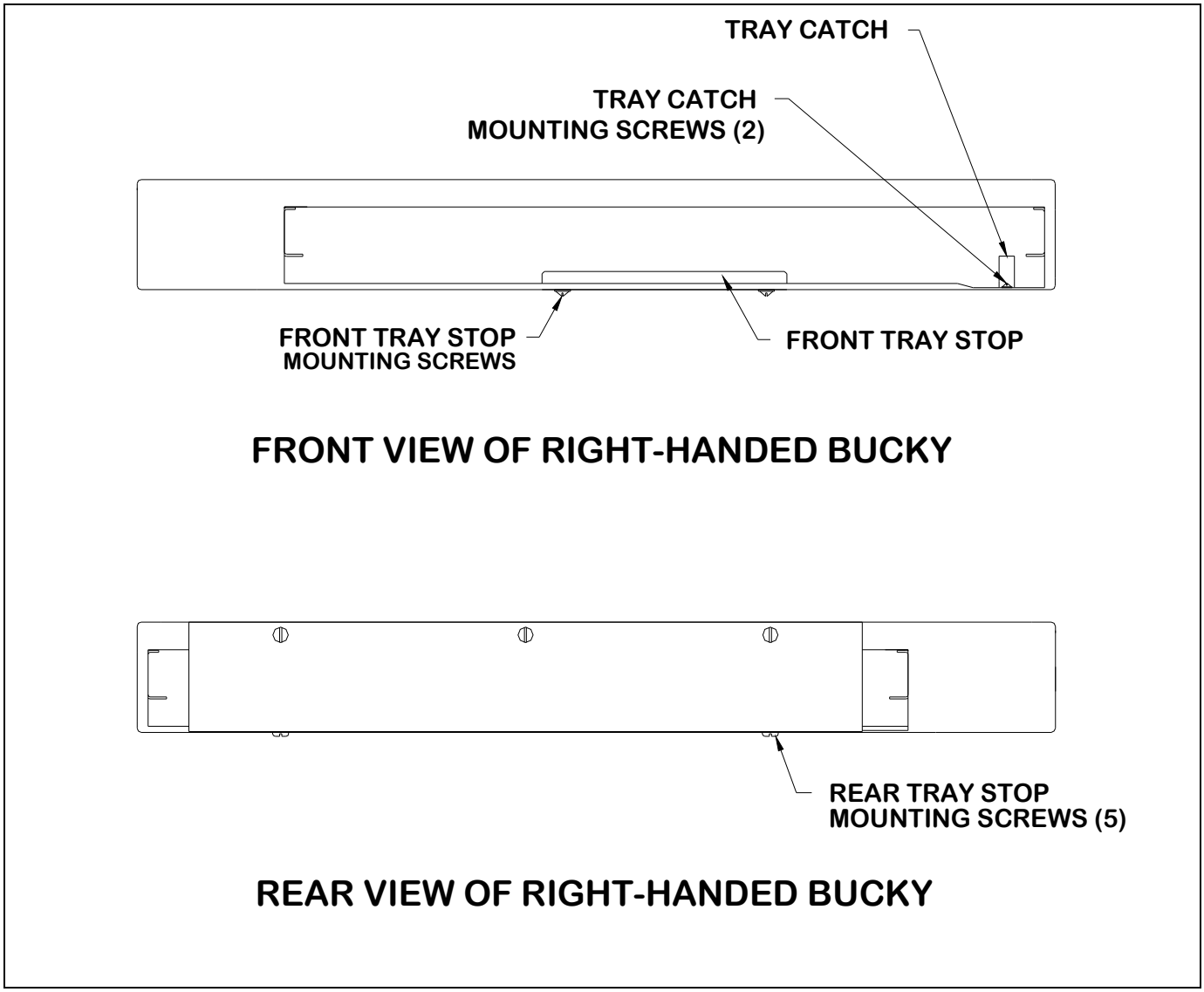



**FIGURE 2D**

### 2.7 WALLSTAND BUCKY MOUNTING

The bucky motor mechanism should be oriented downward when mounting a bucky on a vertical wallstand. This orientation will provide the shortest possible distance from the chin rest to the film edge.

# 3.0 SERVICE AND MAINTENANCE

**...WARNING...**

The x-ray grid travels at a high speed. Never place any object, or part of your body in its path.

All maintenance must be performed by qualified personnel. Dangerous voltages are present on the electrical components of the bucky. Power must be removed from the bucky before attempting any maintenance.

### 3.1 REPLACEMENT PARTS LIST

No lubrication or routine maintenance should be necessary. Check the voltage rating on the serial plate tag to confirm appropriate input voltage.If the bucky does require servicing, the following parts can be replaced as needed:

J100-01 Standard Circuit board - 115 VAC External
J100-02 Optional Circuit board - 230 VAC External
(Only one of the above boards will be installed in any one bucky)

J206 Internal Power cable
J502 Grid frame
J503 DC motor

J540 Crank mechanism {
- Motor crank
- Grid frame connecting block
- Shoulder screws (2)
- Connecting rod

## 3.2 CIRCUIT BOARD REPLACEMENT

### 3.2.1 CIRCUIT BOARD REMOVAL

Figure 3A illustrates the following circuit board removal procedure. First, unplug the three connectors attached to the board: the ground wire, the motor cable, and the power cable. The optical switch blocker (attached to the moving grid frame) must be removed by removing its two mounting screws. The six circuit board mounting screws can then be removed and the circuit board can be removed by tilting it and lifting it out of the enclosure.

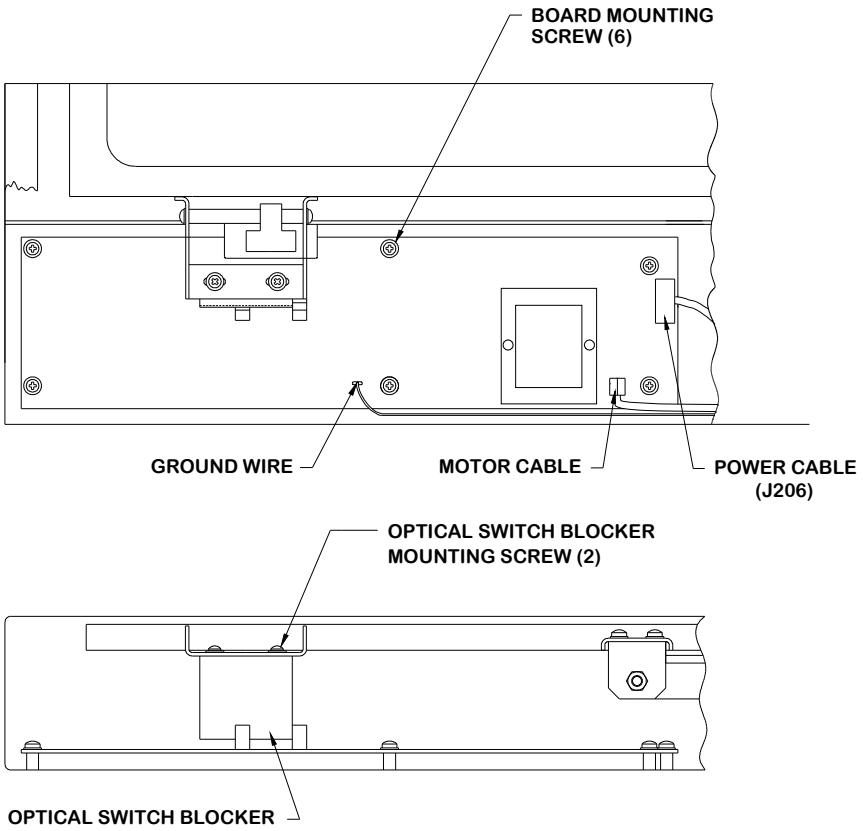



**FIGURE 3A**

### 3.2.2 CIRCUIT BOARD INSTALLATION

Mount the circuit board by lowering it into the enclosure with the transformer end closest to the drive motor and replacing its six mounting screws. Remount the optical switch blocker with its two screws, making sure it is aligned with the optical switches as shown in Figure 3B. Reconnect the ground wire, the motor cable, and the bucky cable.

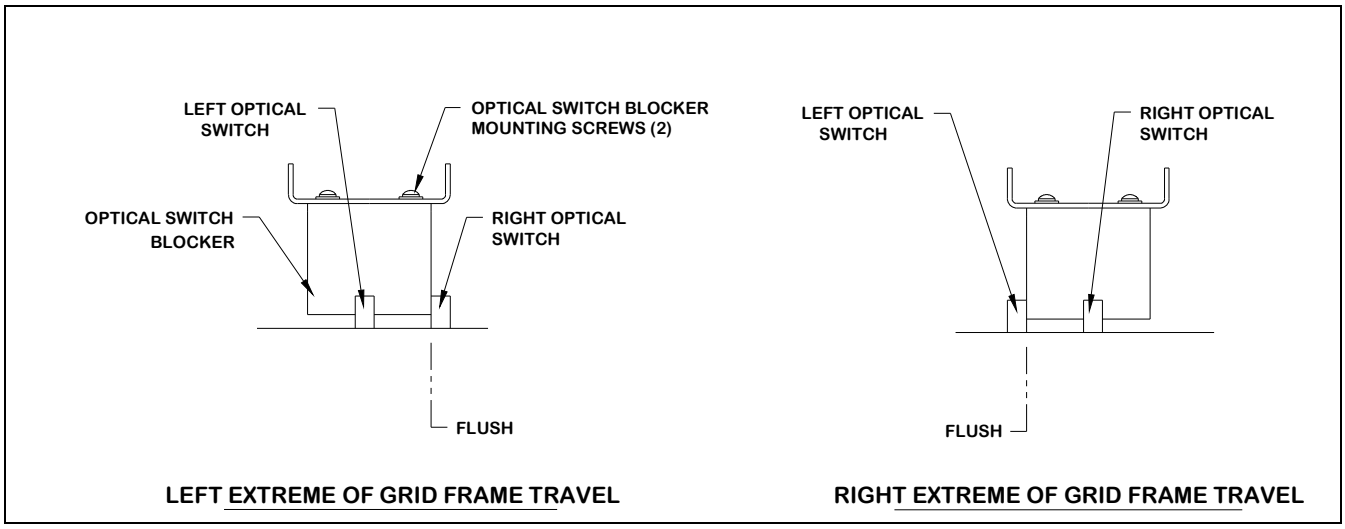



**FIGURE 3B**

## 3.3 BUCKY CABLE REPLACEMENT

The Internal Power cable can be removed and reconnected as shown in Figure 3C.

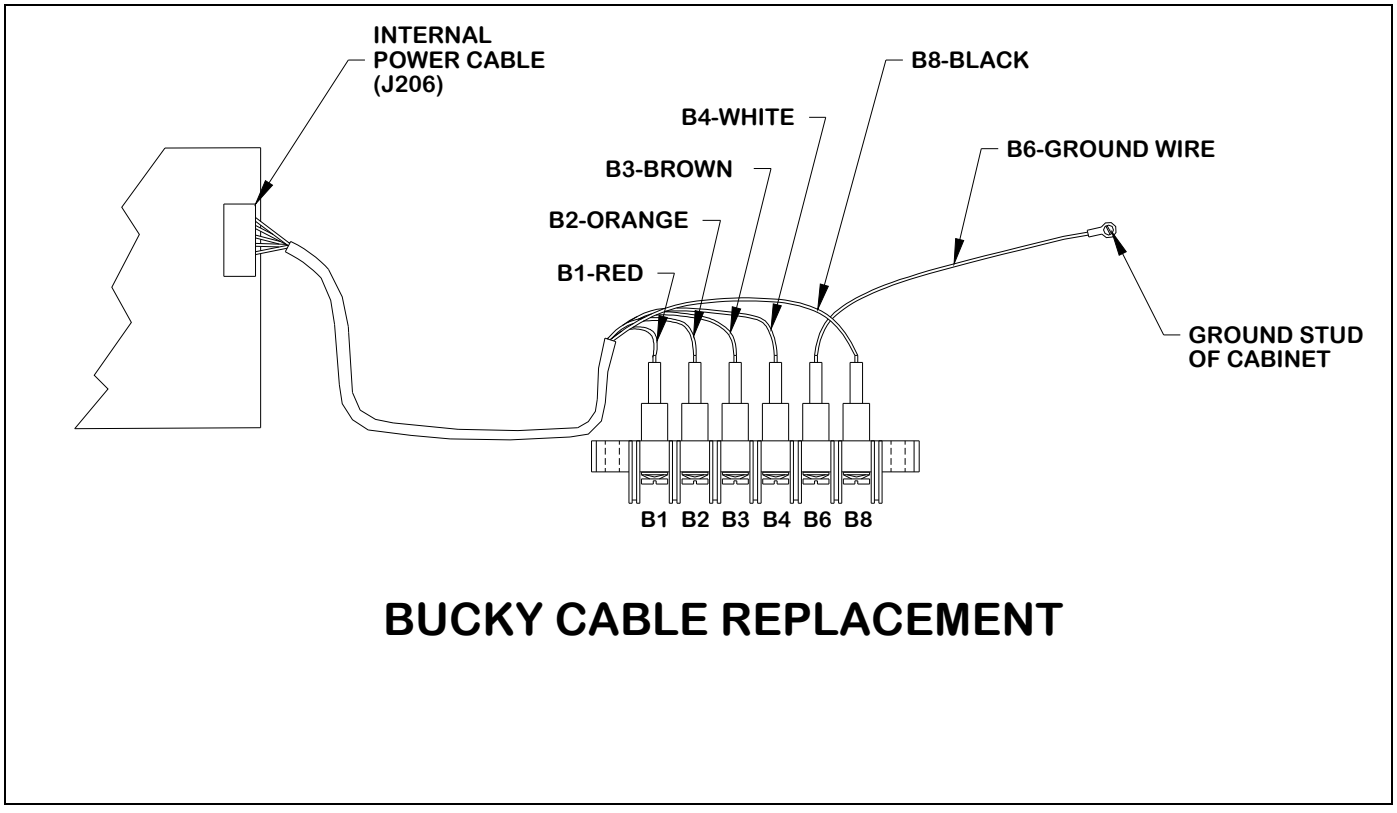



**FIGURE 3C**

## 3.4 GRID FRAME REPLACEMENT

### 3.4.1 BUCKY GRID FRAME REMOVAL

Figure 3D illustrates the following bucky grid frame removal procedure. The bucky grid frame can be removed by first removing the four bearing rod mounting screws and the two connecting block mounting screws. Tilt the side of the grid frame closest to the drive mechanism upward and pull the frame free of the bucky.

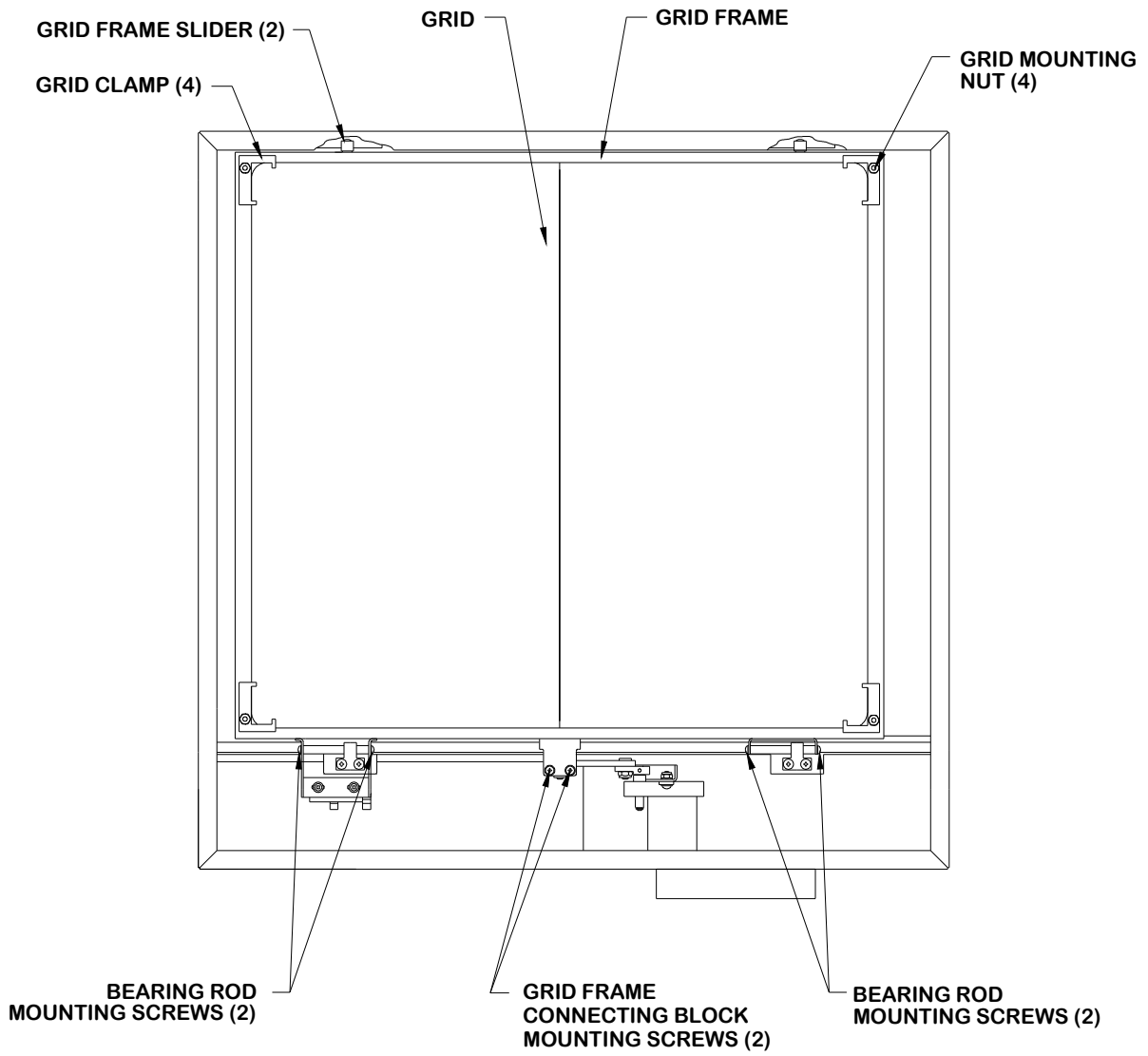



**FIGURE 3D**

3.4.2 BUCKY GRID FRAME INSTALLATION

The bucky grid frame is installed by pushing the frame sliders into the tracks and connecting the two bearing rods to the frame. Make sure the rods are aligned by pushing the frame back and forth while uncoupled from the drive mechanism. The frame should slide easily back and forth with less than one ounce of applied force. Once the rods are aligned, tighten their mounting screws and reconnect the frame to the drive mechanism by remounting the connecting block with its two mounting screws.

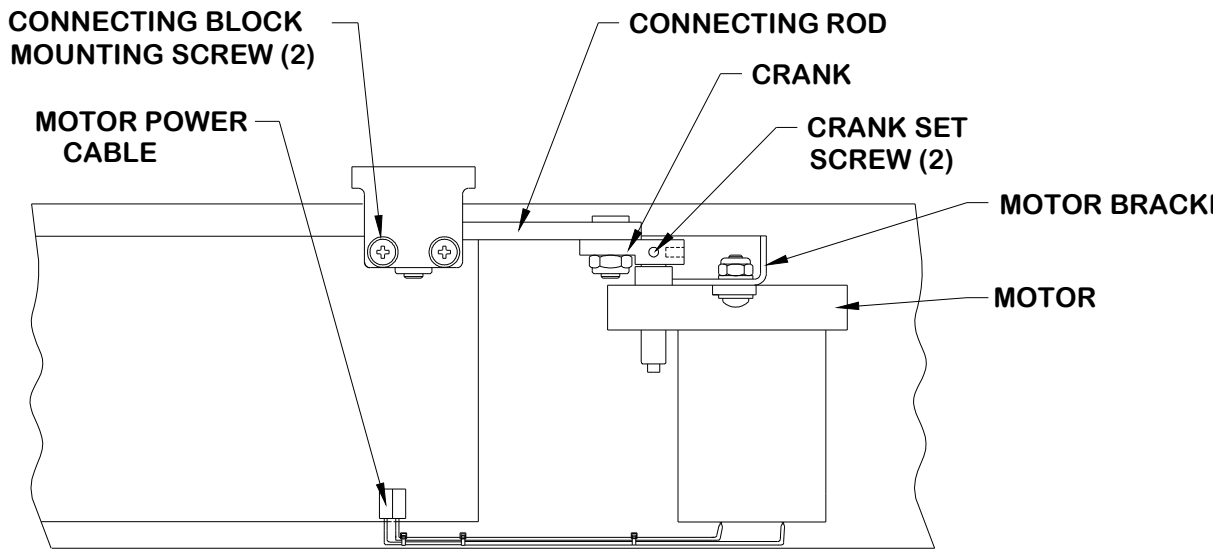
## 3.5 MOTOR / CRANK MECHANISM REPLACEMENT

3.5.1 MOTOR / CRANK MECHANISM REMOVAL

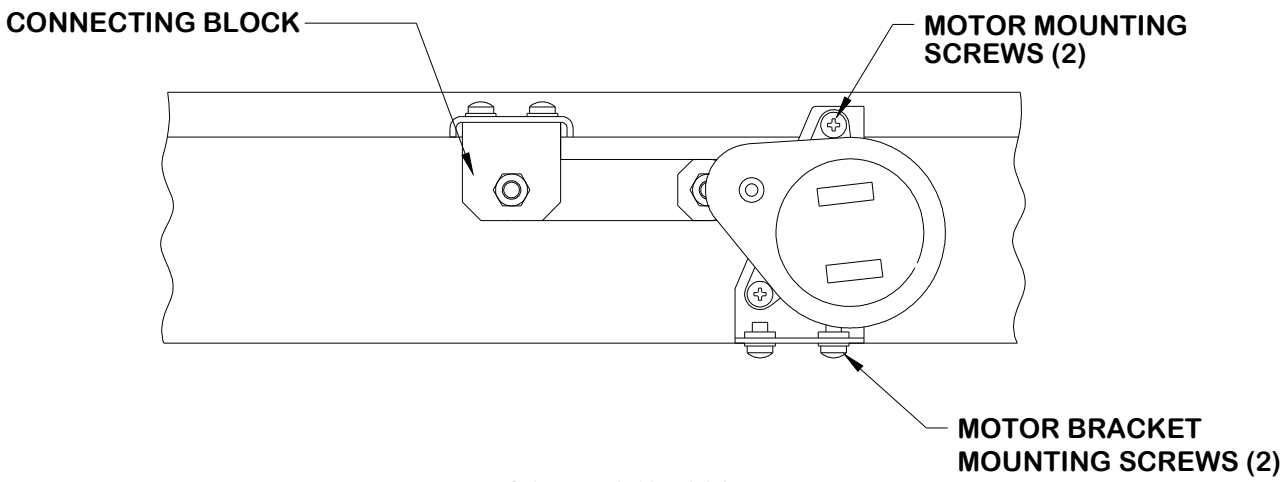
Figure 3E illustrates the following motor removal procedure. The motor and crank mechanism must be removed together from the bucky before further disassembly can be done. First, disconnect the motor cable from the circuit board. Next, remove the two connecting block mounting screws and the two motor mounting screws. Lift the motor out of the enclosure. The crank mechanism can then be removed from the motor by loosening the two motor crank set screws.

3.5.2 MOTOR / CRANK MECHANISM INSTALLATION

Mount the crank mechanism to the motor by tightening the two motor crank set screws onto the motor shaft, making sure there is .030" ± .015" between the crank and the motor shaft bushing. Remount the motor using the two motor mounting screws. Remount the connecting block to the grid frame using the two mounting screws. Finally, reconnect the motor cable to the circuit board.




**TOP VIEW**




**SIDE VIEW**

**FIGURE 3E**

# 4.0 TROUBLE SHOOTING / RE-CALIBRATION

This section is intended to be a trouble shooting reference only. Re-calibration should only be performed if the bucky is producing unsatisfactory results.

There are eight stages of calibration:

1. SETUP
2. POWER SUPPLIES
3. BUCKY START VOLTAGE
4. OPTICAL SWITCHES
5. EXPOSURE ENABLE SIGNAL
6. TURN-AROUND SPEED
7. HOMING POSITION
8. EXPOSE POSITION

Each stage is separated into the following sections:

SYMPTOMS
TESTING
IF TEST FAILS
IF TEST SUCCEEDS YET PROBLEM PERSISTS

Before any trouble shooting can be performed, the SET UP and POWER SUPPLIES portions of the re-calibration procedure must be performed.

## 4.1 TROUBLESHOOTING QUICK REFERENCE

The Summit bucky is factory tested and calibrated before it is sent out. If the bucky is not operating properly make note of the symptoms and attempt to match them with the troubleshooting section of this procedure. If the symptom is not listed, then a full re-calibration should be performed.

- Any DC voltage which is to be measured can be referenced to TP1, ground.

- The motor crank turns counter-clockwise when viewed from the motor end of the bucky. At the centered "home" position, the motor crank is typically pointed downward. This causes the grid to first move right from the centered "home" position, then reciprocate left and right. It is at this first turn around, from right to left motion, that the exposure release signal occurs.

| SYMPTOM | POSSIBLE CAUSE | GO TO SECTION |
|---|---|---|
| Bucky will neither drive home nor reciprocate. | No power.<br><br>Bucky Start Voltage not present. | POWER SUPPLY or Electrical Connections (section 2.2)<br><br>BUCKY START VOLTAGE |
| Bucky grid not centering properly. | Adjustment of home position is necessary. | HOMING POSITION |
| Bucky reciprocating, no exposure is allowed. | K1 relay not activating properly. | EXPOSURE ENABLE SIGNAL |
| Bucky always reciprocating. | Optical switches are not operating properly.<br><br>Bucky supply voltage connected improperly. | OPTICAL SWITCHES<br><br>Electrical Connections (Section 2.2) |
| Non-uniform films<br><br>(sections of film darker than other sections). | Improper homing.<br><br>Bucky is not perpendicular to central ray. Grid mounted upside down. Grid focal distance does not match SID. | HOMING POSITION<br><br>Confirm Alignments and Tracking to Image Receptor |
| Gridlines visible for short duration exposures (>35mSec). | Exposure occurring at a turn-around point. | EXPOSE POSITION |
| Gridlines visible | Motor voltage is improperly set.<br><br>Optical switch is not responding properly.<br><br>Turn-around speed is too slow. | POWER SUPPLIES<br><br>OPTICAL SWITCHES<br><br>TURN-AROUND SPEED |

## 4.2 TOOLS REQUIRED

MULTIMETER (A model with a frequency counter is preferred)
Small Flathead Screwdriver
Soldering Iron
Solder
Solder removal wick
Needlenose pliers

## 4.3 PARTS THAT MAY NEED REPLACEMENT

5 x 20mm 0.160A fuse ..... F1
LM317 adj. voltage regulator (TO-220 Package) ..... VR1& VR2
4N35 Optocoupler (Digikey #4N35QT-ND) ..... OC1
78L05A +5V 100mA, voltage regulator (TO-92 Package) .....VR3
OMRON G5LE-114P-PS-DC12 relay (Digikey #Z777-ND) .....K2,K3
OR AROMAT CORP. JS1-12V (Digikey #255-1104-ND)

## 4.4 OVERALL CALIBRATION AND TESTING

### 4.4.1 SETUP

*** * * WARNING * * ***

In these procedures, measurements will be taken on an active, installed bucky. It will be necessary to disable the generator's ability to make x-rays or take other appropriate shielding precautions in order to prevent accidental radiation exposure to personnel.

**...WARNING...**

The x-ray grid travels at a high speed. Never place any object, or part of your body in its path.

All maintenance must be performed by qualified personnel. Dangerous voltages are present on the electrical components of the bucky.

Connect bucky as specified in the wiring configuration of Figure 4A.

1. Disconnect any EXTERNAL wires at B1 and B2 on TS1 of bucky.
2. Access the bucky controller board.
3. Set up the generator to allow bucky operating conditions without necessarily generating x-rays if possible. The following will typically do this.

**To disable exposure but energize the bucky on most generators:**
Disconnect B1 and B2 leads between the generator and the bucky. This will set off an interrupt that will prevent exposure but allow the bucky to respond to voltages from the generator to start grid reciprocation.

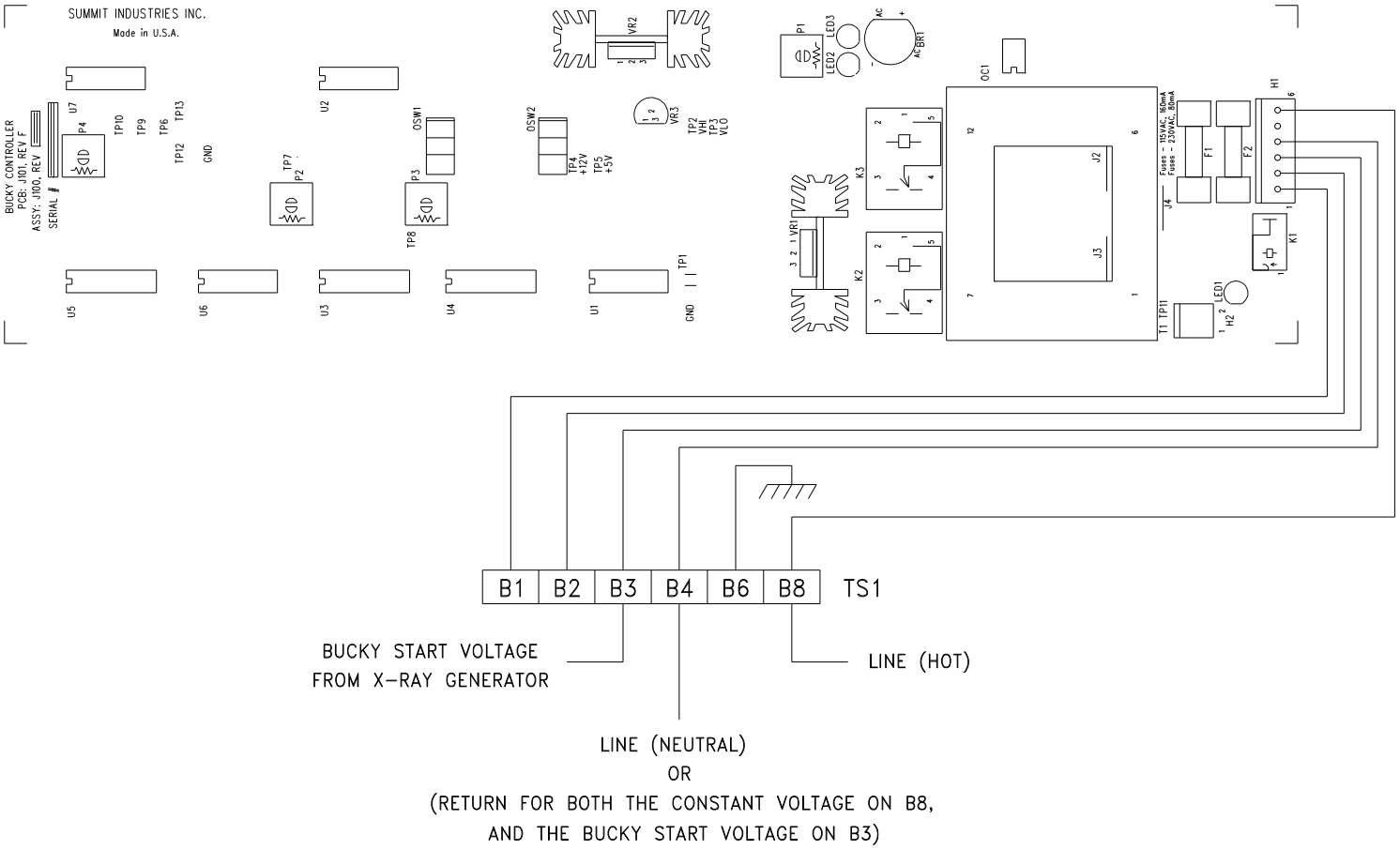



**FIGURE 4A**

### 4.4.2 POWER SUPPLIES

SYMPTOMS: No Bucky reciprocation
No expose return signal
Poor homing (grid not centered when not in motion)
Gridlines visible

The power supplies are integrated in every aspect of product performance. It is therefore always necessary to first and foremost insure proper operation of all power supplies.

(115VAC between B8 and B4 is required for the bucky to drive "home"
115VAC between B3 and B4 is required for the bucky to reciprocate).

Set MULTIMETER for DC voltage and place the negative lead of the MULTIMETER to TP1 (Ground).

With 115VAC between B8 and B4, measure Voltage at TP2, TP3, TP4, and TP5. Compare these values to the chart below.

| Test Point | Value | Operation |
|---|---|---|
| TP2 | 27.00 " 5.00 VDC | Unregulated motor voltage during kick (across C1). |
| TP3 | 12.50 " 0.50 VDC | Adjustable motor voltage (VR1). |
| TP4 | 12.00 " 1.00 VDC | Voltage regulator for relays (VR2 & VR3). |
| TP5 | 5.00 " 0.25 VDC | Voltage regulator for I.C.=s (VR3). |

IF TEST FAILS:

If the voltage on TP3 is out of range, adjust P1 CCW to increase or CW to decrease the voltage value.

If the voltage on TP2 is out of range then the trouble probably lies in BR1, T1, or the jumper configuration before T1.

If the voltage on TP4 is out of range then VR2 has probably failed. Replace it.

If TP5 is out of range then VR3 has probably failed. Replace it.

IF TEST SUCCEEDS YET PROBLEM PERSISTS:

Continue with calibration and test procedures.

4.4.3 BUCKY START VOLTAGE

SYMPTOMS: No Bucky reciprocation
Gridlines visible

The Bucky Start Voltage test is used to ensure that a bucky start signal from the x-ray generator is recognized by the bucky controller board.
(115VAC is required between B4 and B3 for the bucky to reciprocate).

Set the multimeter to measure DC voltage and measure the voltage at TP6 with respect to TP1. The value should be in the region of 0.00 ± 0.05 VDC.

Select low power x-ray techniques on x-ray control and shield x-ray source as required.

Press and hold the Exposure Button.

Once again measure the DC voltage at TP6. The value should be in the range of 5.00 ± 0.25 VDC.

Release the Exposure Button.

IF TEST FAILS:

A 115VAC signal, coming from the generator and into the bucky at B3 and B4, is rectified and filtered become a 170VDC signal fed into R7 and OC1. The output of OC1 is a +5V logic signal measured at TP6 when this input voltage is applied. If the test fails to indicate a low at TP6 in "idle" which goes to +5VDC with input voltage applied, the problem may be with the optocoupler.

IF TEST SUCCEEDS YET PROBLEM PERSISTS:

Measure for motor voltage when the expose button is pressed:

Attach multimeter to TP11 and press the expose button. The voltage should be fluctuating in the range of 12 to 24VDC.

If TP11 passes, continue with calibration.

If the voltage is out of range, contact the factory.

### 4.4.4 OPTICAL SWITCHES

SYMPTOMS: Continuous bucky reciprocation
Gridlines visible.

The optical switch test is used to confirm that the optical switches are operating properly. This test is used to attain a rough measurement of the grid speed. If a multimeter with a frequency counter is not available go immediately to the "IF TEST FAILS" section.

Connect the positive terminal of the multimeter to TP9, negative to TP1.

Set the multimeter to measure DC voltage and press the Hz key (measure frequency).

Press and hold the expose button.

Measure the value at TP9. The value should read 3.0 ± 0.50 Hz.

Let go of the expose button.

IF TEST FAILS:

Check for any kind of binding of the shaft connecting the motor and grid. Check for any other kind of binding that might be slowing down the grid.

If TP9 is out of range another problem could be that at least one of the optical switches is not operating properly.

The optical switches can be tested individually by measuring Pin 8 of U2 for OSW1 and Pin 10 of U2 for OSW2. When something is blocking the optical switch there should by a value of 0V at the corresponding pin on U2. If nothing is blocking the optical switch there should be a value of +5V.

IF TEST SUCCEEDS YET PROBLEM PERSISTS:

Contact the factory.

4.4.5 EXPOSURE ENABLE SIGNAL

SYMPTOMS: No exposure signal to generator.
Generator will not take X-rays.
Bucky does not reciprocate but generator will expose.

The exposure enable signal is the signal that is sent by the bucky informing the generator to take X-rays.

Insure no wires are externally connected to B1 or B2 of the Buckys' terminal strip.

Set the multimeter to measure resistance (ohms, Ω).

Attach the positive lead of the multimeter to B1 and the negative lead to B2.

Measure the resistance. The meter should read an open circuit (>1MΩ).

Press and hold the expose button. The meter should display a reading of about zero Ω (short circuit).

Release the expose button.

IF TEST FAILS:

The problem could be the exposure relay K1, or U1, the relay driver. Perform the above test except measure for a change in voltage at U1 pin 11 instead of resistance at B1 and B2.

Contact the factory with your findings.

IF TEST SUCCEEDS YET PROBLEM PERSISTS:

Problem most likely lies in the generator or wiring at terminal block. Consult generator manual to see if closed switch or 120VAC return signal is expected.

4.4.6 TURN-AROUND SPEED

SYMPTOMS: Gridlines visible

| |
|---|
| Note: Normal operation may result in gridlines being visible when exposure times are 35 milliseconds or less. |

The turn around speed is the rate at which the bucky slows down and changes direction at each end of travel. Fast turn-arounds are important to fully erase grid lines from the radiograph. Turn-arounds which are too slow may result in grid lines showing up on the film.

Shut off all power going to the Bucky.

Set the multimeter to measure resistance. Attach the positive test lead to TP5 and the negative lead to TP10. Wait for the meter to stabilize and check the reading. The value should be in the region of 14.5 ± 0.5 KΩ.

IF TEST FAILS:

If TP10 is out of range, adjust P4 CCW to increase or CW to decrease the resistance value.

IF TEST SUCCEEDS YET PROBLEM PERSISTS:

The problem probably lies in the speed of the bucky. A full re-calibration must be performed. If the problem persists call the factory.

### 4.4.7 HOMING POSITION

SYMPTOMS: Grid not centering.
Non-uniform density films
(Some section of the film is darker or lighter than other sections).

The homing position refers to where the grid begins and finishes its travel. The factory settings correspond to the grid being placed in the center of travel (±1/8") for optimal grid alignment when bucky is not in use.

Make sure there is no power coming into the bucky.

Set the multimeter to measure resistance and measure TP5 with respect to TP7. The value should be in the region of 137.5 ± 0.5 KΩ.

IF TEST FAILS:

If the resistance at TP7 is out of range, adjust P2 CCW to increase or CW to decrease the resistance value.

IF TEST SUCCEEDS YET PROBLEM PERSISTS:

A full re-calibration must be performed in order to properly set all the timing variables and motor speeds.

The grid may not be perpendicular to the central ray.

The grid may be installed upside down.

The grid may have the wrong focal range for the application.

### 4.4.8 EXPOSE POSITION

SYMPTOMS: Gridlines visible for short exposures

| Note: Normal operation may result in gridlines being visible when exposure times are 35 milliseconds or less. |
|---|

The expose position refers to the grid position where the bucky returns the exposure enable signal to the generator. The factory setting corresponds to the bucky allowing exposure immediately following a grid turn-around in order to have maximum grid line erasure.

Set the multimeter to measure the resistance at TP5 with respect to TP8. The value should be in the region of 36.5 ±0.5KΩ.

IF TEST FAILS:

If the resistance is out of range, adjust P3 CCW to increase or CW to decrease the resistance value.

IF TEST SUCCEEDS YET PROBLEM PERSISTS:

A full re-calibration must be performed in order to properly set all the timing variables and motor speeds.

The grid may not be perpendicular to the central ray.

The grid may be installed upside down.

The grid may have the wrong focal range for the application.