



Rotor-AIDTM

LC100 Series

Rotor controller

Model LC102

Owner's Manual
(P/N 69279F)

October 2009

– SERVING THE MEDICAL X-RAY FIELD SINCE 1969 –

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SECTION 1.0 INTRODUCTION

1.0 INTRODUCTION

This manual covers the 2-tube radiographic and fluoroscopic configurations of the Rotor-AID LC100 Rotor Controller.

1.1 General Information

Rotor-AID LC100 Series Rotor Controllers provide the necessary control signals, interlocks and power outputs to drive the anode rotors of x-ray tubes to near 3600 rpm (60Hz) or 10,800 rpm (180Hz) and then to DC brake them. Both boost and brake are achieved in the shortest possible time periods which are digitally preset for each individual tube.

Solid state logic and microprocessor control is provided to accommodate all common procedures such as fluoroscopic, cine and spot film as well as radiographic, CT and digital.

An IPM with its internal IGBT's in an H-bridge configuration are used to accelerate the rotor to high speed. Line frequency is used to accelerate or decelerate the rotor to low speed.

Current sensing is provided to monitor main and phase stator currents during boost and run periods and to provide relay interlock contacts to prevent x-ray exposures if these currents are not present.

Medium size anode tubes with heat storage capacities of up to 1 million heat units can be rapidly accelerated to full speed.

SECTION 2.0 SPECIFICATIONS

2.0 SPECIFICATIONS

2.1 Control Interface Input Voltages

Field selectable jumpers for each input circuit permit nominal input levels of 5 volts to 30 volts AC or DC, or 30 volts to 120 volts AC or DC for each input circuit (refer to Section 3.3a). Loading is nominally 10mA for any input voltage selected.

2.2 Control Input Functions

(Refer to Figure 3.1 and Section 7.1 Interface Schematics.)

Input Command	Input Location
Rotor Start	61127A TB1 pins 1 & 2
High Speed Select	61127A TB1 pins 3 & 4
Cancel Continuance	61127A TB1 pins 5 & 6
Fluoro	61127A TB1 pins 7 & 8
Spot	61127A TB1 pins 9 & 10
Cine	61127A TB2 pins 1 & 2
Tube 2 Select	61127A TB2 pins 3 & 4

2.3 Control Interface Output

(Refer to Figure 3.1 and Section 7.1 Interface Schematics).

Relay Function	61127A Output Location
High Speed Verify	TB2, pins 5 & 6
Rotor Interlock	TB2, pins 7 & 8

All contacts are rated for 2A @ 30VDC, 0.6A @ 125VAC.
All relays are normally open contacts.

SECTION 2.0 SPECIFICATIONS

2.4 Power Requirements

Class I Equipment, continuous operation with intermittent loading.

Line voltages: Single phase 200VAC to 240VAC + 5% -10%, 50/60 Hz.
Refer to Section 4.9 for 50/60 Hz line frequency operation.

Input autotransformer input voltage taps: 200, 208, 220, and 240VAC

Nominal 20 Ampere service for “R” stators and 30 Ampere service for “Q” stators is required. It is preferable to wire the rotor controller from the same source as the generator rather than from the generator. Wiring should conform to local and national safety codes using #10 AWG wire for runs up to 115 feet (35m) in order to minimize voltage drops during operation.

Internal circuit breaker:
Time delay rated 20 Amperes 240VAC

2.5 Power Output

(Refer to the overall wiring diagram, WLC100, in Section 7.1.)

	“R” Stator	“Q” Stator
High Speed Boost	430VAC to 460VAC	340VAC to 360VAC
High Speed Run	100VAC to 115VAC	60VAC to 65VAC
High Speed Brake	60Hz low speed boost followed by low speed brake.	60Hz low speed boost followed by low speed brake.
Low Speed Boost	240VAC to 250VAC	220VAC to 230VAC
Low Speed Run	60VAC to 65VAC	40VAC to 45VAC
Low Speed Brake	100VDC to 120VDC	60VDC to 80VDC

Boost – Maximum available power output for high frequency – Nominally 5kW into most 3-wire split stator windings rated for intermittent power levels of up to about 1000VAC and up to 10 Amperes per winding.

Boost – Maximum available power output for low frequency – Nominally 5kW into most 3-wire split stator windings rated for intermittent power levels of up to about 250VAC and up to 10 Amperes per winding.

For high speed the output frequency is 180Hz \pm 2Hz.

For low speed the output frequency matches the line frequency.

SECTION 2.0 SPECIFICATIONS

2.6 Duty Cycle (continuous)

Boost 3.2 seconds
Run 10 seconds
Brake 6 seconds
Idle 80 seconds

2.7 Anode Rotation Maintained During Run

When the 61126B inverter board is factory/field programmed for a specific drive frequency, the anode rotation speed is near the programmed drive speed.

High speed near 10,800 RPM (180 Hz)

Low speed near 3,000/3,600 RPM (50/60 Hz) line dependent

2.8 Timer Adjustment Ranges

Individual timers are provided for each x-ray tube to set boost and brake times; additional timers are available to set continuance (holdover time) and to set holdover times for other functions such as fluoro and spot hold. Time intervals are set by DIP switches on the 61127A micro-controller board as follows.

Control	Usable Range	Resolution
Tube 1 Boost 61127A SW1 (1-5)	0.0 to 6.2 seconds	0.2 second
Tube 1 Brake 61127A SW2 (1-5)	0.0 to 6.2 seconds	0.2 second
Continuance 61127A SW5 (1-6)	0 to 10 minutes 30 seconds	10 seconds
Auxiliary 61127A SW6 (1-6)	0 to 10 minutes 30 seconds	10 seconds
Tube 2 Boost 61127A SW3 (1-5)	0.0 to 6.2 seconds	0.2 second
Tube 2 Brake 61127A SW4 (1-5)	0.0 to 6.2 seconds	0.2 second

2.9 Controls and Indicators

External Operator Controls - None

External Operator Indicators - None

Internal Indicators – Status 7-segment display, rotor interlock and high speed verify LEDs

2.10 Stator Drive

Tube drive is accomplished by means of an IPM with its internal IGBT's in an H-bridge configuration driving the main of an x-ray tube's split stator. The phase (auxiliary) winding is run off a phase shift capacitor.

SECTION 2.0 SPECIFICATIONS

2.11 Interlocks

Exposure interlocks are provided to prevent exposures under the following operating conditions:

- During boost and brake portions of the timing cycles and during tube switching.
- When any of the two stator outputs are not drawing sufficient current.

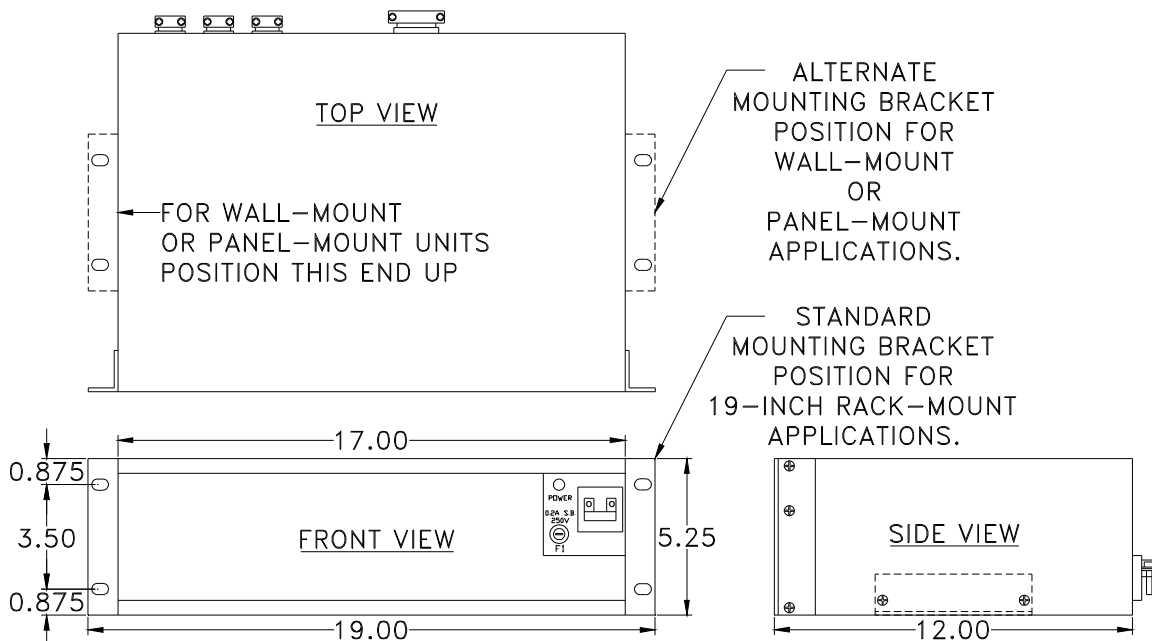
A high speed verify interlock is provided to indicate that a high speed select signal has been received and the rotor controller is in high speed run.

2.12 Physical Appearance and Dimensions

Zinc plated steel housing with yellow chromate finish.

	Physical Dimensions Height x Width x Depth	Weight of Basic Unit	Reference
LC100 models 19" rack mount units	5.25 x 19 x 12 (133 x 483 x 305 mm)	40 pounds (18 kg)	Figure 2.12a
P/N 705101 Wall-mount Cabinet	17 x 20 x 9 (432 x 508 x 229 mm)	20 pounds (9 kg)	Figure 2.12b

Figure 2.12a



SECTION 2.0 SPECIFICATIONS

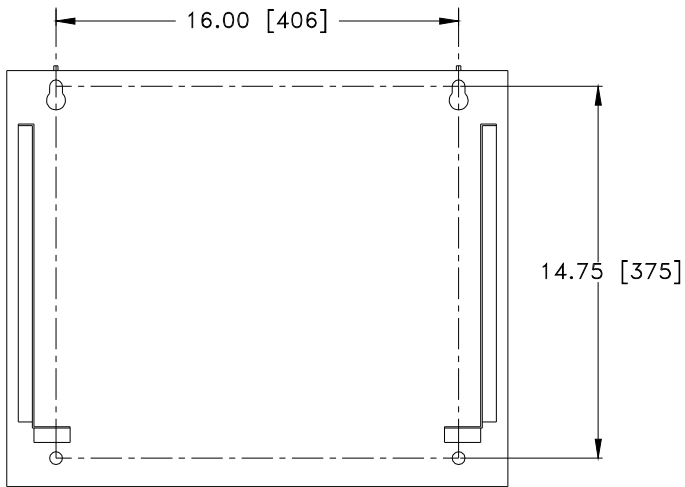
Figure 2.12b
Wall Mount Cabinet for LC102A



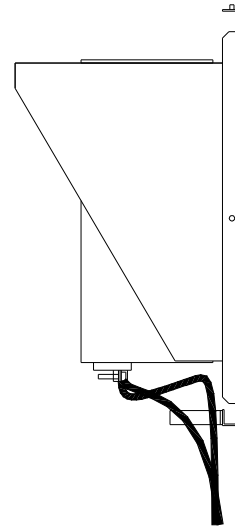
DIMENSIONS ARE IN INCHES AND [mm]

MOUNT BASE PANEL ON WALL.
MAINTAIN 5 INCHES [127] MIN. AIR CLEARANCE
ON ALL SIDES OF ROTOR CONTROLLER.

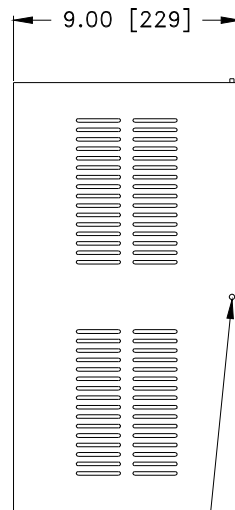
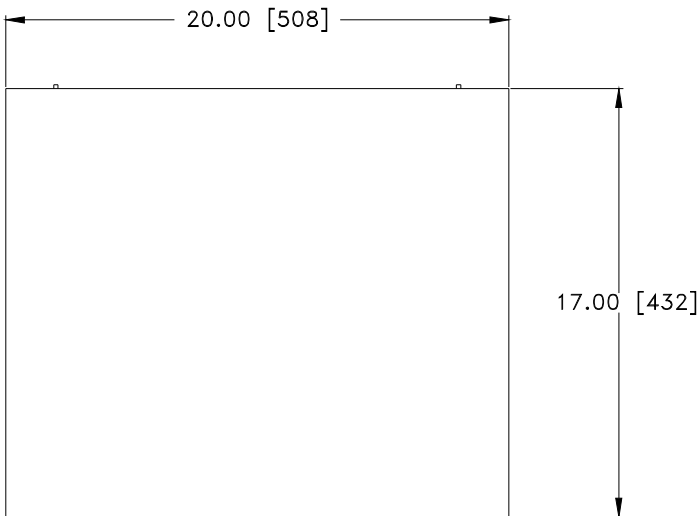
MOUNT ROTOR CONTROLLER TO BASE PANEL
USING 10-32 X 3/8 SCREWS.
(4 PLACES)



BASE PANEL MOUNTING HOLES ACCOMMODATE
3/8 DIA. [10] LAG SCREWS OR
MASONRY FASTENERS.



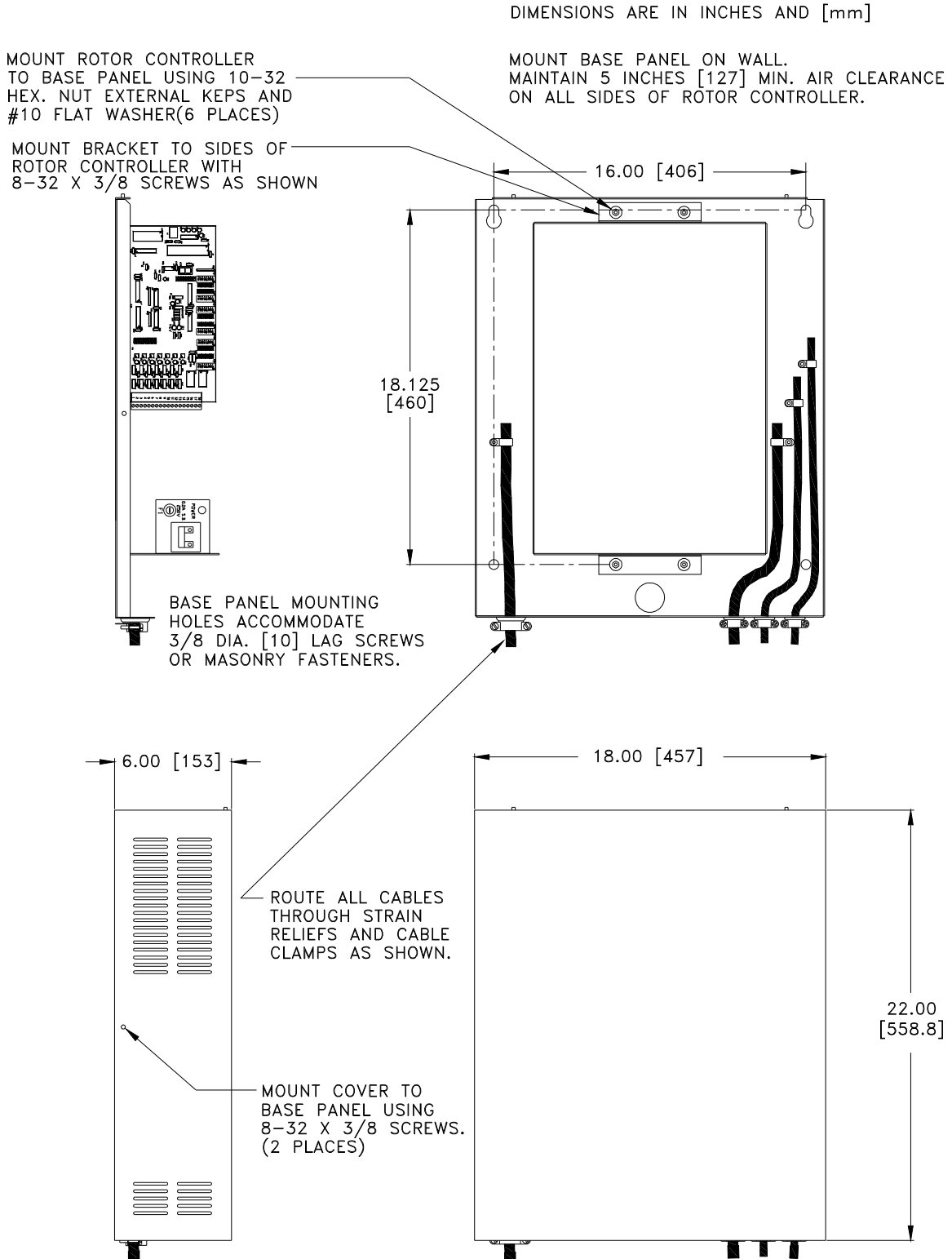
ROUTE ALL CABLES THROUGH CABLE GUIDE
AND STRAIN RELIEFS AS SHOWN.



MOUNT COVER TO BASE PANEL
USING 8-32 X 3/8 SCREWS.
(2 PLACES)

SECTION 2.0 SPECIFICATIONS

Figure 2.12c
Wall Mount Model LC102C



SECTION 2.0 SPECIFICATIONS

2.13 Environmental Characteristics

Ambient Temperature, storage: -20 to +65 °C

Ambient Temperature, operating: +10 to +40 °C

Humidity: 10% to 95%, non-condensing

2.13A Shipping: IEC601 (10.1)

2.14 2-tube Radiographic and Fluoroscopic Model

2-tube switching - utilizing tube select signals from the x-ray generator, the rotor controller provides stator switching and tube changeover logic. Different boost and brake time adjustments are provided for each tube.

2.15 Regulatory Compliance

ITS Intertek Testing Services, Inc.

This product complies with the applicable requirements of the Standard for X-ray Equipment:

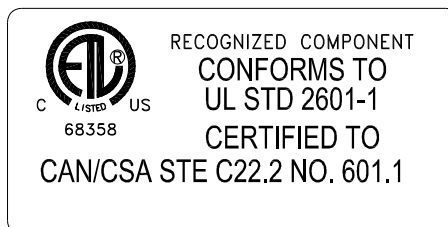
UL 2601-1 – UL Standard for Safety Medical Electrical Equipment, Part 1: General Requirements for Safety Second Edition.

CSA 22.2 No. 601.1.1 - M90 Medical Electrical Equipment Part 1: General Requirements for Safety.

CENELEC EN 60601-1; 1989: Medical Electrical Equipment; Part 1: General Requirements for Safety. Collateral Standard: Safety Requirements for Medical Electrical Systems Includes Amendment A1: 1996; IEC 601-1-1: 1992+ A1:1995

CENELEC EN 60601-1-2: Medical Electrical Equipment Part 1: General Requirements for Safety 2. Collateral Standard Electromagnetic Compatibility – Requirements and tests (IEC 601-1-2 : 1993)

When so labeled:



3.0 INSTALLATION AND SUPPORT REQUIREMENTS

3.0 INSTALLATION AND SUPPORT REQUIREMENTS

Electrical Service - 200VAC to 240VAC, Nominal 20 Ampere service required, preferably wired from the same source as the generator power rather than from the generator. Wiring for Class I Equipment should conform to local and national safety codes using #10AWG wire for runs up to 115 feet (35m) in order to minimize voltage drops during boost.

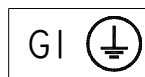
External Wiring - Control signals - #18AWG, 300VAC, 100 feet (30.5m) maximum length. If control signals are 120VAC, each line must be fused for 5 Amperes or less at the source.

3.1 Tools and Materials Required

- Standard field service tool kit.
- A true RMS digital voltmeter AC/DC.
- Oscilloscope with 10X and 100X probes.
- Bolts or studs suitable for rack mounting or for mounting the optional wall mount cabinet.

3.2 Power Connections (Refer to Figures 3.2 and 3.3)

Connect single phase power (200VAC to 240VAC) to line filter (L1 and L2). Note that a 20 Ampere service is required by the rotor controller. Make a ground connection to the 8-32 ground stud, G1, marked with a ground symbol.



Position the input line voltage selector (brown wire with blue fork lug) on the bottom side of TS1 to select the appropriate tap of the input autotransformer matching the line voltage to the input requirement of the rotor controller (200, 208, 220, or 240 VAC). This selection is factory set at 240VAC, unless otherwise requested.

3.0 INSTALLATION AND SUPPORT REQUIREMENTS

3.3 Interconnections to X-Ray Control

(refer to Figures 3.1, 3.2, 3.4 and 3.5 for component locations and Section 4.5 for programming options).

NOTE: The circuit breaker must be turned OFF whenever making any connections to or disconnections from the rotor controller or x-ray tube.

3.3a) Inputs commands to the Rotor Controller

(refer to Figure 3.1 for input signal information).

For input command signals greater than 30 volts remove the appropriate jumpers W3-W9

All input signals to the rotor controller may be simulated by jumpering the appropriate test point to TP1. Remove any simulated signals before initiating a tube change. Refer to figure 3.1 and to signal descriptions below for input signal test point designations.

ROTOR START - For all radiographic work connect to 61127A TB1 pins 1 and 2. For DC input signals pin 1 is positive and pin 2 is common. This signal will cause the rotor controller to begin the sequence of boost and run. Removal of the rotor start signal will initiate brake. *Simulate rotor start at 61127A TP2.*

HIGH SPEED SELECT - Connect to 61127A TB1 pins 3 and 4. For DC input signals pin 3 is positive and pin 4 is common. This signal determines the speed at which the rotor will run. Absence of the high speed select signal will cause low speed operation and the presence of it causes high speed operation. *Simulate high speed select at 61127A TP3.*

CANCEL CONTINUANCE - Connect to 61127A TB1 pins 5 and 6. For DC input signals pin 5 is positive and pin 6 is common. A cancel continuance input will cause the rotor controller to terminate a continuance run and initiate a brake sequence. *Simulate the cancel continuance command at 61127A TP4.*

FLUORO INPUT - Connect to 61127A TB1 pins 7 and 8. For DC input signals pin 7 is positive and pin 8 is common. The fluoro command is used to initiate a boost-run sequence and activate a fluoro continuance timer for the duration of the timer switch settings at 61127A SW5. Fluoro work will occur at the selected speed (either low speed or high speed). *Simulate the fluoro command at 61127A TP5.*

SPOT INPUT - Connect to 61127A TB1 pins 9 and 10. For DC input signals pin 9 is positive and pin 10 is common. The spot command is used to supply a rotor start and high speed select signal to the rotor controller. The spot command also activates the spot continuance timer for the duration of the timer switch settings at

3.0 INSTALLATION AND SUPPORT REQUIREMENTS

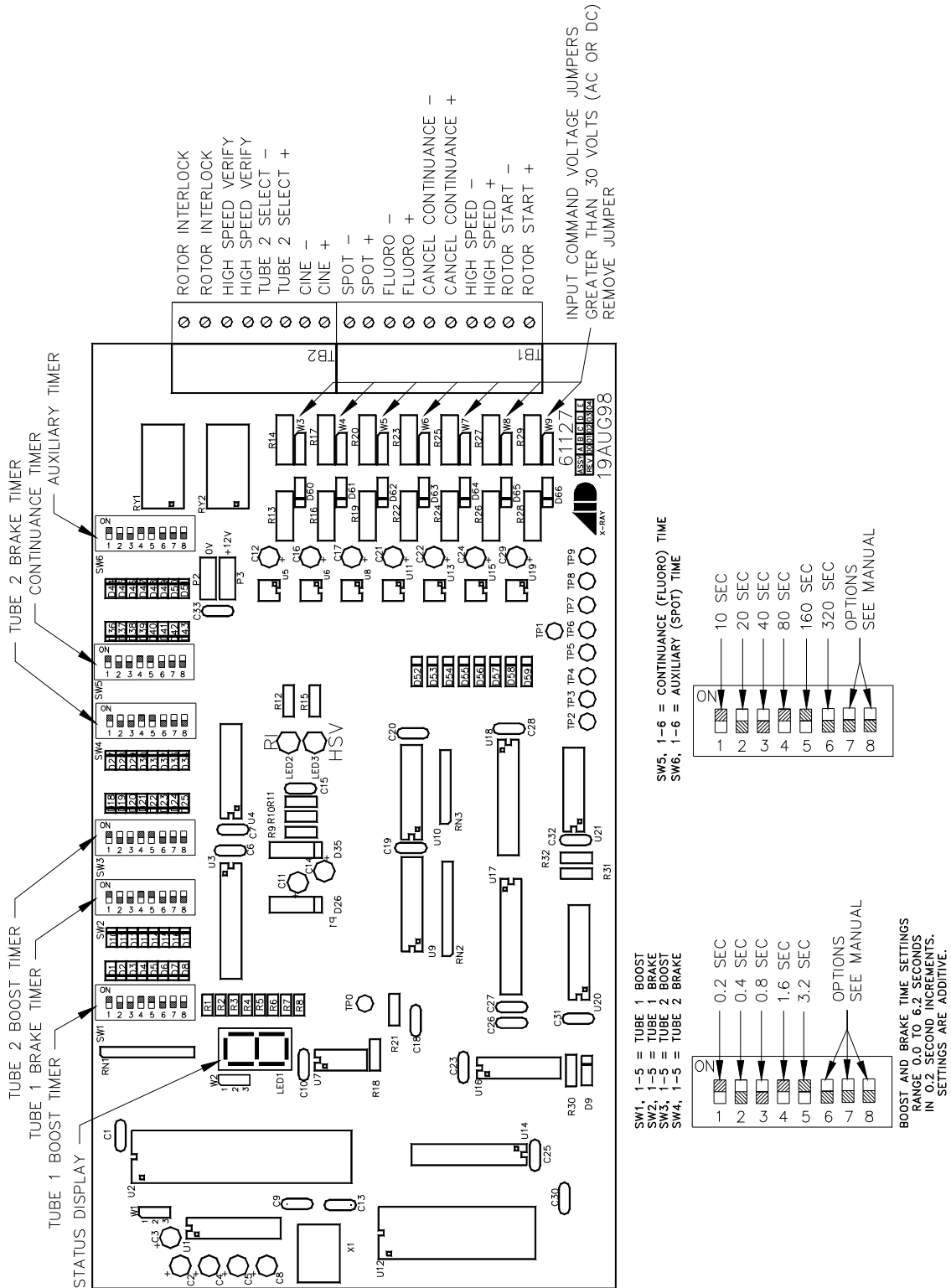
61127A SW6. The fluoro continuance timer may be initiated at the end of spot continuance. *Simulate the spot command at 61127A TP6.*

CINE INPUT - Connect to 61127A TB2 pins 1 and 2. For DC input signals pin 1 is positive and pin 2 is common. The cine command may be used to supply a high speed select and a rotor start signal to the rotor controller. *Simulate the cine command at 61127A TP7.*

TUBE 2 SELECT - Connect to 61127A TB2 pins 3 and 4. For DC input signals pin 3 is positive and pin 4 is common. If a boost, run, brake sequence is in progress when a tube selection change is made, the rotor controller will switch its output to the tube selected after the boost, run, brake sequence has been completed. The tube select signal is also used to select the appropriate set of boost and brake time settings for that tube. The tube select signal will also cancel any continuance timers. *Simulate tube 2 select at 61127A TP8.*

3.0 INSTALLATION AND SUPPORT REQUIREMENTS

Figure 3.1



3.0 INSTALLATION AND SUPPORT REQUIREMENTS

3.3b) Outputs from the Rotor Controller (refer to Figure 3.1 for output signal information).

All relay contacts for outputs from the rotor controller are rated at 2 Amperes at 30VDC, and 0.6 Amperes at 125VAC.

ROTOR INTERLOCK - Rotor interlock is available at 61127A TB2 pins 7 and 8. These contacts are used to allow an exposure when activated. Normally open contacts are used.

HIGH SPEED VERIFIED - Available at 61127A TB2 pins 5 and 6 as an interlock to verify that the rotor controller is operating in the high speed mode. This set of contacts will be activated when the rotor controller has received a high speed select signal and rotor interlock has been activated. Normally open contacts are used. This connection does not eliminate the need for the rotor interlock function. (See ROTOR INTERLOCK above).

3.4 Tube Stator Connections

NOTE: The circuit breaker must be turned OFF whenever making any connections to or disconnections from the rotor controller or x-ray tube.

Make stator connections as indicated in table below:

Stator Wire Color	TS2	Description
White	1	Tube 1, H9, Stator Common
Black	2	Tube 1, H7, Main Stator
Green (Red)	3	Tube 1, H8, Phase Stator
White	4	Tube 2, H9, Stator Common
Black	5	Tube 2, H7, Main Stator
Green (Red)	6	Tube 2, H8, Phase Stator

Connect stator cable shields to the ground stud marked "G2" (refer to Figure 3.2).

3.0 INSTALLATION AND SUPPORT REQUIREMENTS

Figure 3.2

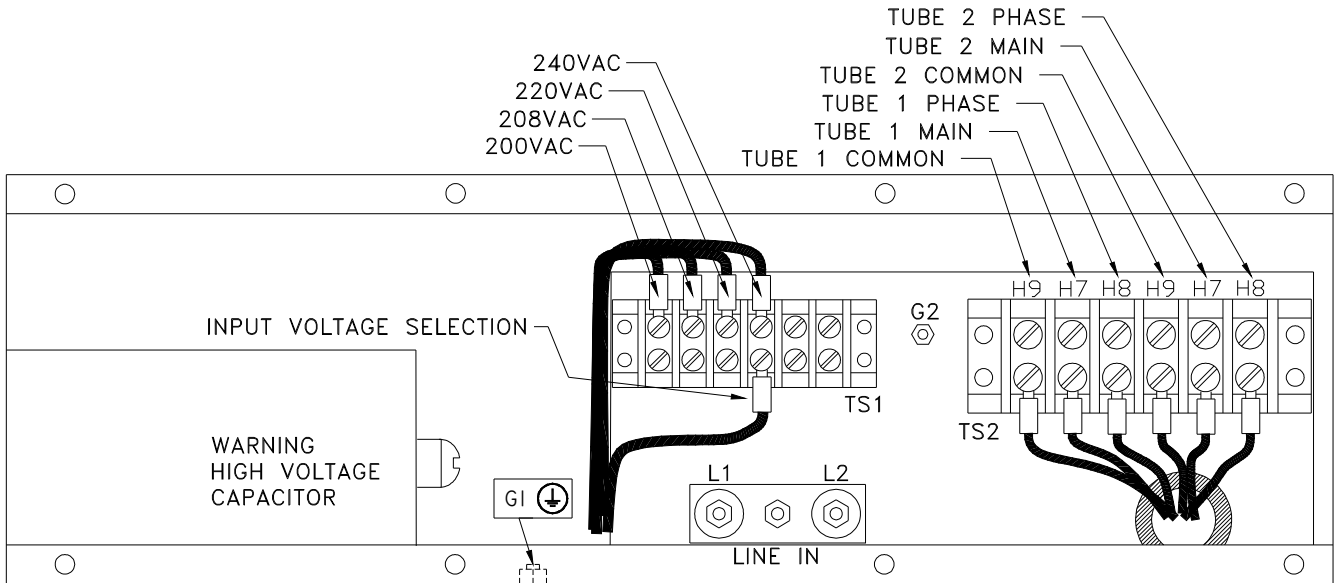
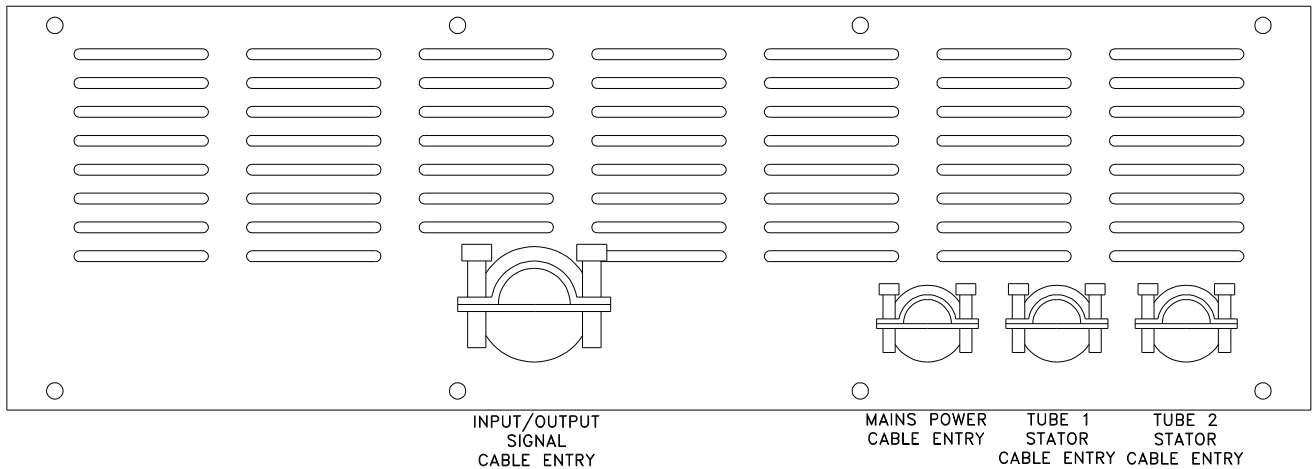


Figure 3.3



SECTION 4.0 TESTS AND ADJUSTMENTS

4.0 TESTS AND ADJUSTMENTS

Adjustment Notes:

CAUTION

Exceeding the duty cycle of the rotor controller may cause damage to either the rotor controller or the x-ray tube.

SERVICE MODE SETUP: Excessive boosting and braking will add unnecessary heat to the x-ray tube stator. During calibration it may be advantageous to maintain a continuous rotation of the x-ray tube anode. Low speed continuous rotation may be achieved by connecting a jumper from 61127A TP2, Rotor Start, to 61127A TP1. High speed continuous rotation may be achieved by connecting jumpers from 61127A TP2, Rotor Start, and TP3, High Speed Select, to TP1. When calibration is complete remove the jumpers for normal operation.

The stator output voltage is fixed.

The boost time is set on dip-switches (see Section 4.5).

If an oscilloscope is used for troubleshooting or to make adjustments, it must have a differential mode of operation or equivalent, dual trace capability with algebraic addition features, and 100X probes.

4.1 Autotransformer Tap Selections

Refer to Figure 3.2. An input autotransformer is provided to adjust the available line voltage to ensure that the LC100 Series Rotor Controller operates at 240VAC as intended. Move the autotransformer input lead with the blue fork connector to the appropriate pin of the TS1 terminal strip (200, 208, 220, or 240VAC) to match the input line voltage. This selection is factory set at 240VAC, unless otherwise requested.

4.2 Control Signal Input Voltage Programming (refer to Figure 3.1)

Remove input command voltage setting jumpers if input commands exceed 30V AC or DC.

4.3 Input Autotransformer Selection

Stator output voltages Boost, Run, and Brake are dependant on Autoformer tap selections. If output voltages other than the ones the unit is programmed for are needed please consult with the factory.

SECTION 4.0 TESTS AND ADJUSTMENTS

4.4 Functional Programming Information

Refer to Figure 3.1 and Sections 3.4 and 4.9 for jumper selection detail.

ROTOR START OPTIONS - The presence of an input signal at 61127A TB1 pins 1 and 2 is used to initiate rotor start. The fluoro, spot and/or cine inputs may also be used to initiate a rotor start. The presence of any one of these input signals will force a rotor start.

HIGH SPEED SELECT OPTIONS - The cine input will force the rotor controller into a high speed condition. The fluoro and spot inputs may also be used to force a high speed condition. Fluoro forces high speed when 61127A SW5-8 is set to the ON position. Spot forces high speed when 61127A SW6-8 is set to the ON position.

FLUORO FORCES LOW SPEED - The high speed select input may be deactivated during fluoro by setting 61127A SW5-7. Leaving 61127A SW5, 7 and 8 OFF allows either high speed or low speed fluoroscopic operation depending upon the presence or absence of a high speed selection signal at 61127A TB1 pins 3 and 4.

Same for Spot using 61127A SW6 instead of SW5.

SECTION 4.0 TESTS AND ADJUSTMENTS

4.5 Boost/Brake Timer Adjustments

Boost Time Setting:

Refer to the timer switch selection detail on the 61127A board in Figure 3.1. The timer switch selections are additive. To set the boost time for tube 1, locate 61127A SW1. Turn on the switches that cumulatively add up to the high speed boost time desired. If the required boost time is unknown, start at a low setting, then progressively increase the boost time until high speed is attained from a dead stop within the boost time. Typically, tubes with 4" anodes up to 1 million heat units require less than 3 seconds to reach 9600 rpm.

Refer to Figure 3.1 and repeat this process for tube 2 if used.

Set the fluoroscopic continuance timer switch, 61127A SW5, and spot auxiliary timer switch, 61127A SW6, switch settings, as needed, referring to Figure 3.1 for timer switch selection detail.

Brake Time Setting:

Boost the x-ray tube anode to high speed run and remove the rotor start command. The high speed brake utilizes a low speed boost (2/3 of the boost timer setting) to decelerate the anode to low speed followed by a DC brake. The DC brake time should be set long enough to bring anode speed to less than 500 rpm. Excessive brake time should be avoided.

The brake timer is adjusted by means of dip switches on the 61127A board. Refer to Figure 3.1

TIMER SWITCHES	BOOST	BRAKE
TUBE 1	61127A SW1 (1-5)	61127A SW2 (1-5)
TUBE 2	61127A SW3 (1-5)	61127A SW4 (1-5)

4.6 Functional Test

Use a reed tachometer or the tube manufacturer's recommended speed measurement equipment to make sure the tube is up to speed. The tube must reach the manufacturer's recommended speed before making exposures; however, excessive boost time should be avoided as it puts unnecessary heat into the x-ray tube stator and reduces the duty cycle capability of the system. The boost time may be adjusted for any time between 0.0 and 6.2 seconds, as required, by setting dip switches corresponding to the selected tube. See Section 4.5 for Boost/Brake Timer Adjustments.

Check this up-to-speed time for all tubes connected to the system.

SECTION 4.0 TESTS AND ADJUSTMENTS

4.7 Programmable Jumper Selections

Table 4.3 lists all programmable jumpers in the RC100 Series Rotor-AID Rotor Controllers. These jumpers are set at the factory to customer specifications. Under normal conditions these jumpers need not be adjusted in the field.

Table 4.3
PROGRAMMABLE JUMPERS AND SWITCHES
Refer to figure 3.1

JUMPER/ SWITCH	POSITION	FUNCTION
61127A SW1	1-5	TUBE 1 BOOST TIMER SWITCH RANGE: 0 TO 6.2 SECONDS 0.2 SECOND INCREMENTS
	6	N/A
	7	N/A
	8	DISABLE CASSETTE DELAY
61127A SW2	1-5	TUBE 1 BRAKE TIMER SWITCH RANGE: 0 TO 6.2 SECONDS 0.2 SECOND INCREMENTS
	6	N/A
	7	N/A
	8	N/A
61127A SW3	1-5	TUBE 2 BOOST TIMER SWITCH RANGE: 0 TO 6.2 SECONDS 0.2 SECOND INCREMENTS
	6	N/A
	7	N/A
	8	N/A
61127A SW4	1-5	TUBE 2 BRAKE TIMER SWITCH RANGE: 0 TO 6.2 SECONDS 0.2 SECOND INCREMENTS
	6	N/A
	7	N/A
	8	N/A
61127A SW5	1-6	CONTINUANCE (FLUORO) TIMER SWITCH RANGE: 0 TO 10 MINUTES 30 SECONDS 10 SECOND INCREMENTS
	7	FLUORO FORCES LOW
	8	FLUORO FORCES HIGH SPEED
61127A SW6	1-6	AUXILIARY (SPOT) TIMER SWITCH RANGE: 0 TO 10 MINUTES 30 SECONDS 10 SECOND INCREMENTS
	7	SPOT FORCES LOW SPEED
	8	SPOT FORCES HIGH SPEED

SECTION 4.0 TESTS AND ADJUSTMENTS

JUMPER/ SWITCH	POSITION	FUNCTION
61127A W1	N/A	N/A
61127A W2	1-2	EPROM FACTORY SETTING ONLY
	2-3	FLASH FACTORY SETTING ONLY
61127A W3	IN	TUBE 2 COMMAND LESS THAN 30V
	OUT	TUBE 2 COMMAND GREATER THAN 30V
61127A W4	IN	CINE COMMAND LESS THAN 30V
	OUT	CINE COMMAND GREATER THAN 30V
61127A W5	IN	SPOT COMMAND LESS THAN 30V
	OUT	SPOT COMMAND GREATER THAN 30V
61127A W6	IN	FLUORO COMMAND LESS THAN 30V
	OUT	FLUORO COMMAND GREATER THAN 30V
61127A W7	IN	CANCEL CONTINUANCE LESS THAN 30V
	OUT	CANCEL CONTINUANCE GREATER THAN 30V
61127A W8	IN	HIGH SPEED COMMAND LESS THAN 30V
	OUT	HIGH SPEED COMMAND GREATER THAN 30V
61127A W9	IN	ROTOR START COMMAND LESS THAN 30V
	OUT	ROTOR START COMMAND GREATER THAN 30V

4.8 Status Display

Display	Function
1	High Speed Boost
2	Low Speed Boost
3	High Speed Run
4	Low Speed Run
5	High Speed Brake
6	Low Speed Brake
S	Stack Overflow Error
F	Inverter Fault
E	Interlock Error
C	Checksum Error

4.9 50/60 Hz. Line Frequency Operation

Refer to the LC100 Overall Schematic: For a 60Hz line input; use only the 30MF low speed phase shift capacitor (factory standard configuration).

For a 50Hz line input; connect the 15MF capacitor in parallel with the 30MF low speed phase shift capacitor.

SECTION 5.0 PRINCIPLES OF OPERATION

5.0 PRINCIPLES OF OPERATION

5.1 Functional Description

In high speed mode the Rotor-AID LC100 Series Rotor Controllers use an IPM with its internak IGBT's set up in an H-bridge configuration to supply 180 Hz power to accelerate an x-ray tube's anode rotor rapidly to its operational speed of near 10,800 RPM. In low speed mode line frequency is used to accelerate an x-ray tube's anode rotor rapidly to its operational speed of near 3600 RPM (60 Hz line) or 3000 RPM (50 Hz line). Refer to Section 4.9 for 50/60 Hz line frequency operation.

5.2 Basic Timing/Logic Cycle:

As shown in Figures 5.1 and 5.2, an externally derived rotor start signal initiates a boost time period during which maximum power is delivered to the tube stator/rotor. The setting of the boost time period is determined by the physical characteristics of the tube as a motor. At the conclusion of the boost time, the anode rotor continues to run with minimum power applied until the external rotor start signal is removed. During this interim run time, exposures may be taken.

At the conclusion of run the controller may optionally:

1. Automatically brake for a period of time preset to bring the rotor to near zero rpm.
2. Continue to provide run power (continuance) for a preset period of time which maintains rotation at the correct speed thus allowing exposures to be made immediately without the need for subsequent boost periods. At the conclusion of the continuance time, the controller will automatically brake to stop rotation as described above.

5.3 Applications

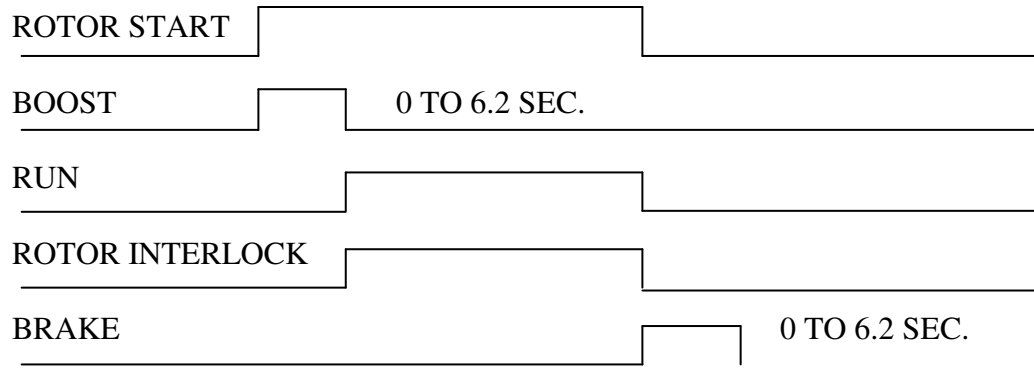
RADIOGRAPHIC MODE - In the radiographic mode, the basic boost-run-(continuance)- brake cycle is used with either high or low speed selected. Figure 5.1 represents the basic timing cycle. Figure 5.2 details the basic functions when switching between low speed and high speed operation.

In addition to the basic timing cycle, several special application modes are accommodated. Figures 5.3 to 5.5 illustrate a few of the many possible application variations.

SECTION 5.0 PRINCIPLES OF OPERATION

Figure 5.1

BASIC TIMING LOGIC WITHOUT CONTINUANCE



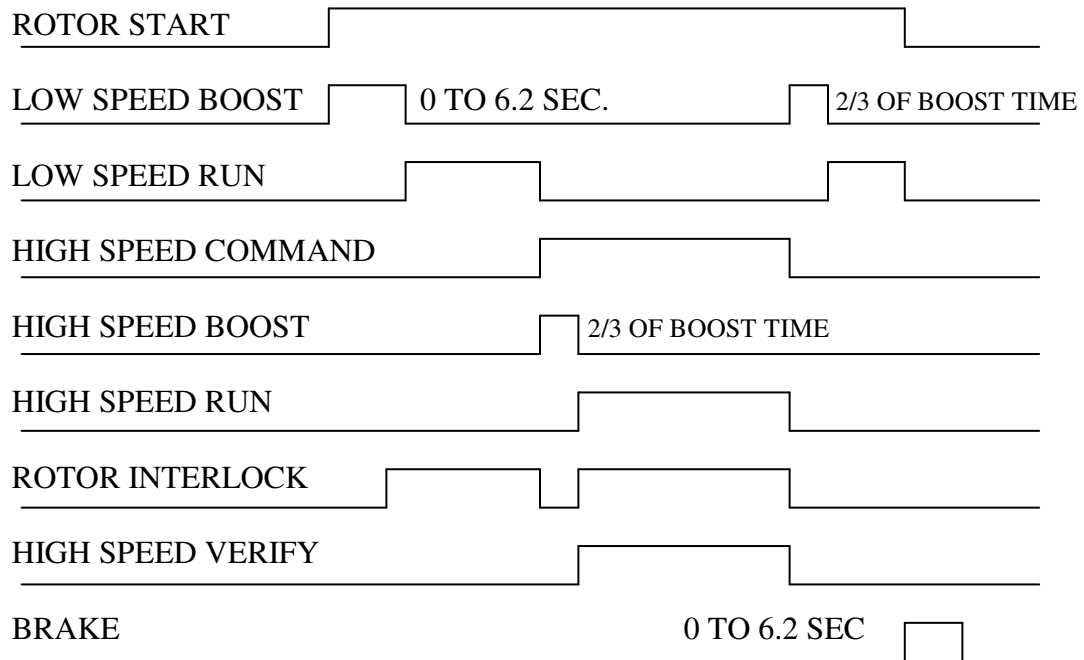
Notes:

1. Times listed indicate programming ranges accommodated by the Rotor-AID Rotor Controller.
2. Start and run times depend upon exposure duration and the operator's "rotor prep" control.

SECTION 5.0 PRINCIPLES OF OPERATION

Figure 5.2

BASIC LOW SPEED / HIGH SPEED TIMING LOGIC



Notes:

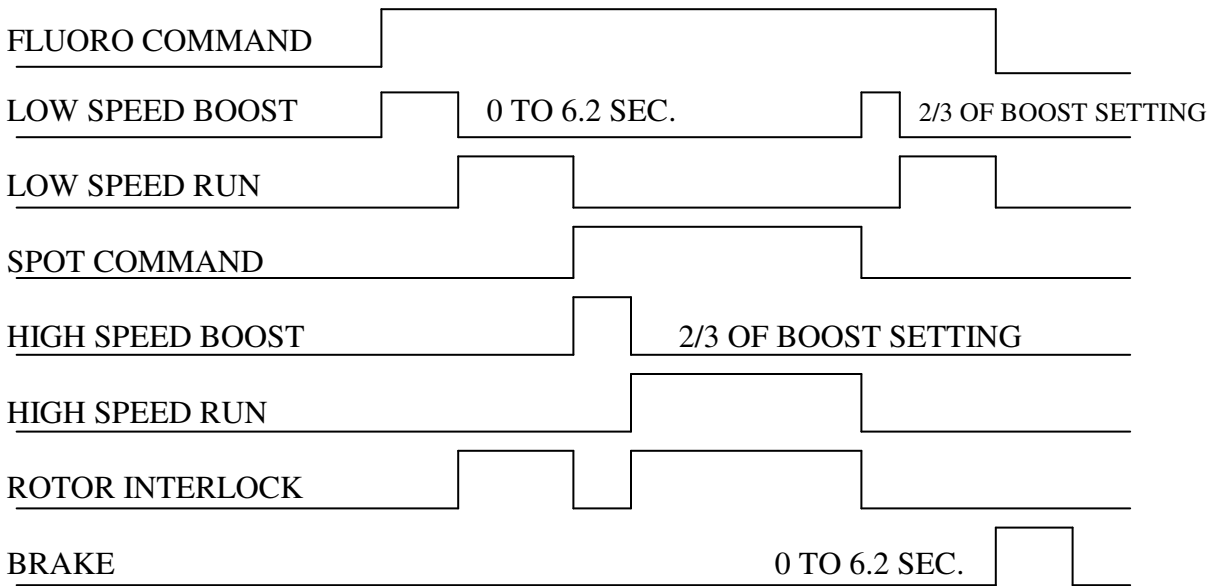
1. Times listed indicate programming ranges accommodated by the Rotor-AID Rotor Controller.
2. Start and run times depend upon exposure duration and the operator's "rotor prep" control.
3. A low speed boost is used to decelerate the tube from high speed to low speed. The boost times from low speed to high speed and from high speed to low speed are automatically adjusted to 2/3 of the boost time setting.

SECTION 5.0 PRINCIPLES OF OPERATION

FLUORO / SPOT FILM MODE - Radiographic and Fluoroscopic

As shown in Figure 5.3 the spot film mode is often preceded by fluoro mode operation, the anode is then taken from low speed to high speed rotation. A low speed boost is used to decelerate the anode from spot back to the fluoro mode. The boost times from low speed to high speed and from high speed to low speed are automatically adjusted to $2/3$ of the boost time setting.

Figure 5.3



Note: If the spot continuance (auxiliary) timer is set, the rotor will remain in high speed between spot film exposures avoiding the delays required to accelerate between low and high speeds. Separate continuance times may be set for fluoro, 61127A SW5, and spot, 61127A SW6. Refer to Figure 3.1, Section 4.5 and Table 4.3 for timer switch details.

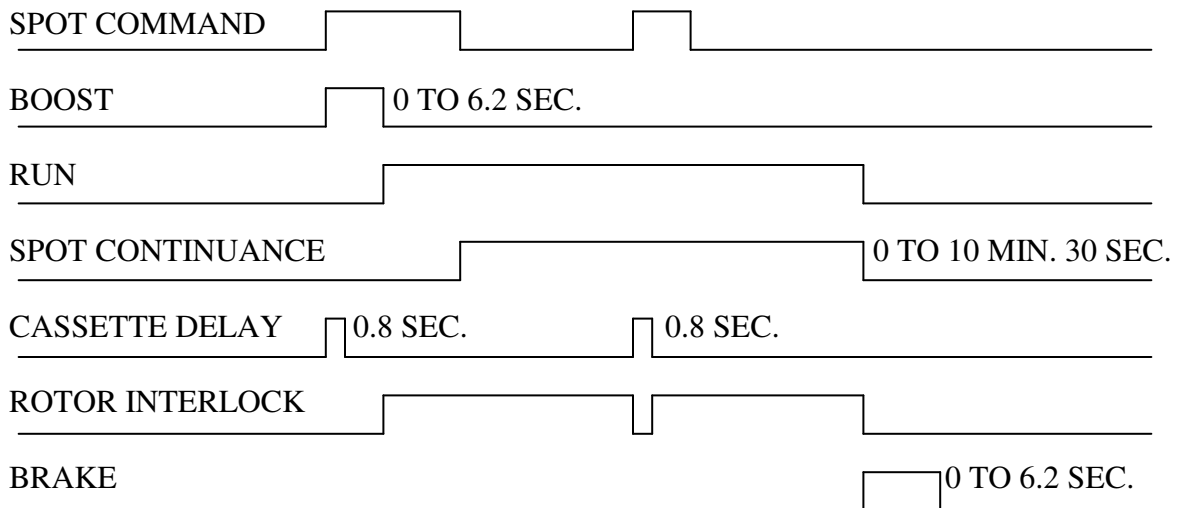
SECTION 5.0 PRINCIPLES OF OPERATION

SPOT FILM MODE - Radiographic and Fluoroscopic

Spot may be used to force a high speed boost directly as illustrated in Figure 5.4. The cassette delay is activated each time a spot command is given. If 61127A SW1 (8) is ON, it disables the cassette delay feature.

Figure 5.4

SPOT FILM TIMING LOGIC WITH CASSETTE DELAY



Notes:

1. Times listed indicate programming ranges accommodated by the Rotor-AID Rotor Controller.
2. Start and run times depend upon exposure duration and the operator's "rotor prep" control.

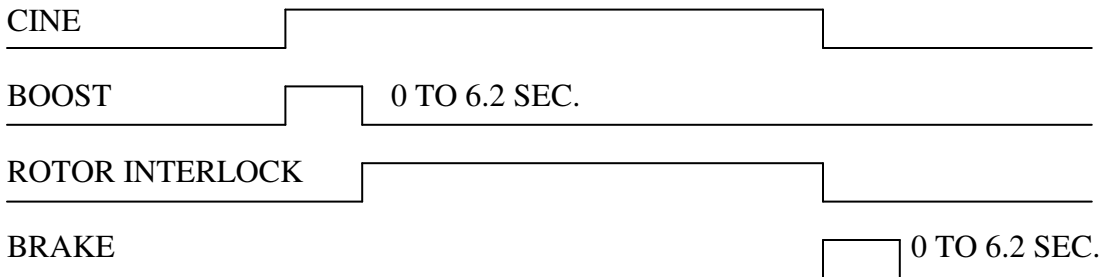
SECTION 5.0 PRINCIPLES OF OPERATION

CINE MODE - Radiographic and Fluoroscopic

Cine is a high speed rotor start command as illustrated in Figure 5.5. Cine may be preceded by the system being in the fluoro mode in which case the boost and brake times are automatically adjusted to 2/3 the times required from and to zero speed.

Figure 5.5

CINE TIMING LOGIC



Notes:

1. Times listed indicate programming ranges accommodated by the Rotor-AID Rotor Controller.
2. Start and run times depend upon exposure duration and the operator's "rotor prep" control.
3. When going from the spot or cine mode (high speed) back to the fluoro mode (low speed), the low speed boost is used to brake the tube to the low speed. The boost times from low speed to high speed and from high speed to low speed are automatically adjusted to 2/3 of the boost time setting.

SECTION 6.0 TROUBLE SHOOTING GUIDE

6.0 TROUBLE SHOOTING GUIDE

The following is a list of possible problems and their likely corrections. The list is not all-inclusive, but covers field serviceable problems. Additional questions should be referred to the factory or service center.

Refer to Section 7.0 for schematics. Refer to the figures in Section 3.0 for component locations.

Note: The circuit breaker must be turned OFF whenever making connections to or disconnections from the rotor controller or the x-ray tube.

6.1 Preliminary Checks

Check all external connections to the rotor controller for proper wiring and secure connections. (See Section 3.0).

Check to see that all selectable dip switches are programmed correctly (See Section 4.9).

Check the input power voltage and make sure that the input power voltage tap of the input autotransformer is properly selected.

Check to see that the circuit breaker is switched to the ON position and that the Power On indicator on the circuit breaker assembly is lighted. If it is not lighted, check input power lines to the rotor controller and correct any problems.

Check to see that the low voltage power supply fuse, F1 (0.2A slow-blow), is not open.

Check to see that the low speed power fuse, F2 (10A slow-blow) inside the unit is not open.

Check the boost, continuance and brake time settings.

Note: Whenever replacing parts, boards or assemblies make note of their EXACT wiring before removing them. DO NOT install or remove PC boards when the power is on.

SECTION 6.0 TROUBLE SHOOTING GUIDE

6.2 Trouble-shooting Procedures

SYMPTOM: NOTHING SEEMS TO WORK

Does the Micro-controller click 6 relays and then display a “0” when power is applied to the unit?

If no then:

- Check the power supply voltages at test points 61126B TP11 (+12V), 61126B TP10 (+5V) referenced to TP0.

Does the Fault indicator, “F” display, light?

- See trouble shooting section on faults.

SYMPTOM: NO BOOST

Check the stator leads to make sure they are not shorted and are properly connected.

Does the display show a boost and then run state during a rotor start signal?

If yes, then:

- Check to see that the boost time is set properly.

If no, then:

- Make sure the proper tube is selected.
- Check the interface wiring.
- Check for the presence of the rotor start signal.
- Make sure that the 61127A shunts (jumpers) are programmed for the correct input voltages.

If the unit faults, “F” is displayed, see trouble shooting section on faults.

SYMPTOM: NO RUN

- Check to see that the continuance time is set correctly.

If the unit faults, “F” is displayed, see trouble shooting section on faults.

SYMPTOM: NO BRAKE

- Check to see that the brake time is set correctly.

SECTION 6.0 TROUBLE SHOOTING GUIDE

SYMPTOM: FAULT OCCURS DURING BOOST OR RUN

A fault condition is indicated by the “F” on the display.

- Check to see that the stator or stator cord is properly connected and not shorted.
- Check to see that the proper phase shift capacitor is selected
- The duty cycle may have been exceeded. Wait for the unit to cool.

Tube arcs may cause a fault condition. Occasional faults will automatically reset. If several faults occur within a short period of time the unit will latch-up as an indication of a persistent problem. Once the problem has been corrected, the fault condition may be manually reset by supplying a Cancel Continuance command, by changing the tube selection or by removing power from the unit either at its source or at the unit’s circuit breaker. If, after resetting the fault condition, the problem recurs:

- Check the status of the rotor interlock test point.
- Check stator connections to the stator as listed in Section 3.4.

SYMPTOM: CIRCUIT BREAKER TRIPS

- Duty cycle of unit exceeded (refer to Section 2.6).
- Replace the circuit breaker (45080).

SECTION 7.0 DOCUMENTATION

7.0 DOCUMENTATION

Advanced Instrument Development Inc. (AID) will make available on request any information which will assist the user's appropriately qualified technical personnel to repair those parts of this equipment which are designated by AID as repairable.

7.1 Interface Schematics

DRAWING	DESCRIPTION
WLC100	LC100 WIRING DIAGRAM
61126B	MAIN BOARD
61127A	MICROCONTROLLER BOARD

7.2 Spare Parts List

The following spare parts lists are recommended for all field service personnel.

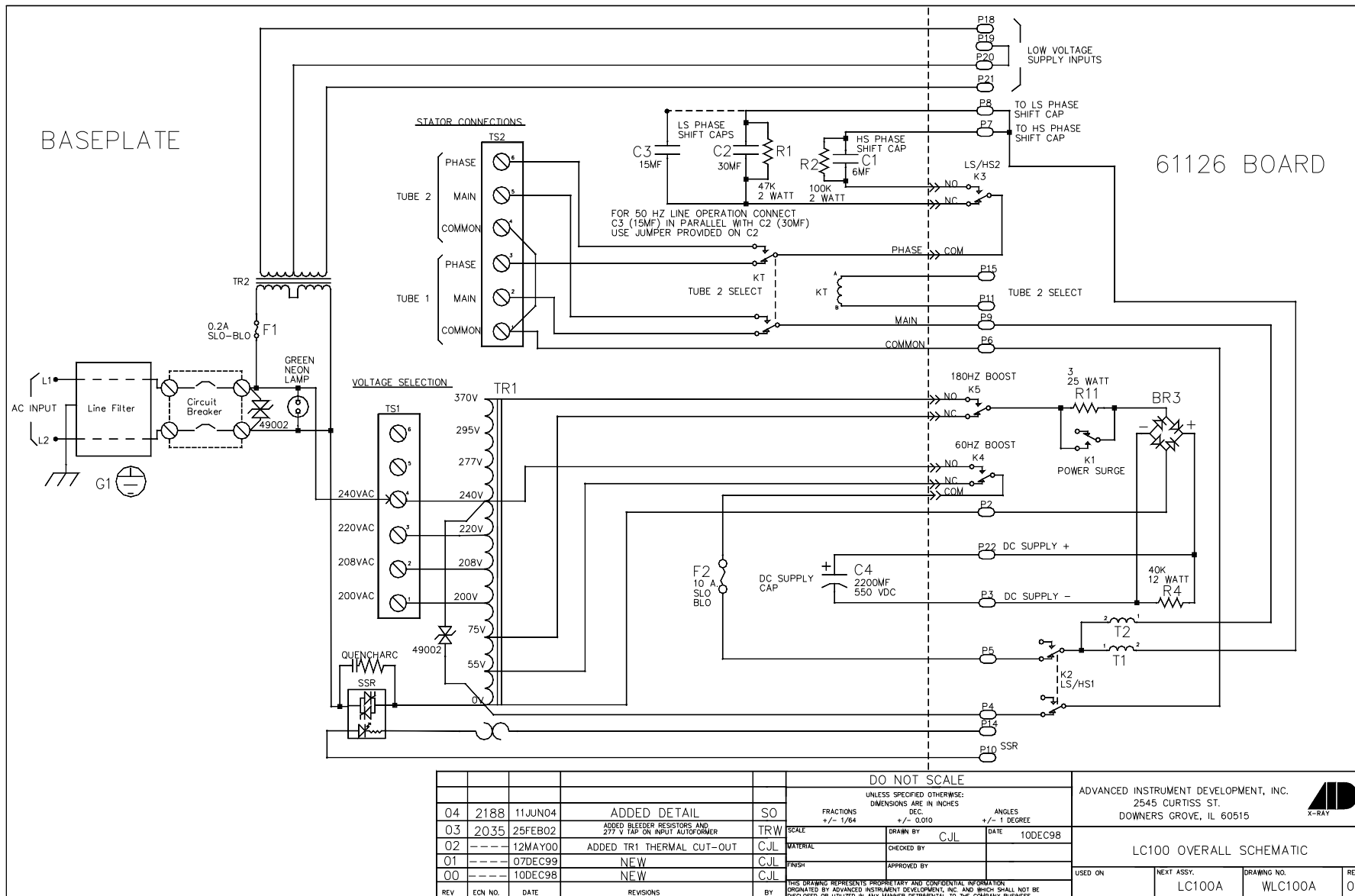
Printed Circuit Boards:

PART NO.	DESCRIPTION
61126B	MAIN BOARD
61127A	MICROCONTROLLER BOARD

Miscellaneous:

PART NO.	DESCRIPTION
45024	10A Slow Blow Fuse
45081	0.2A Fuse

SECTION 7.0 DOCUMENTATION



SECTION 7.0 DOCUMENTATION

