TITLE: HANDBOOK CONTENTS

SHEET

TITLE: HANDBOOK CONTENTS

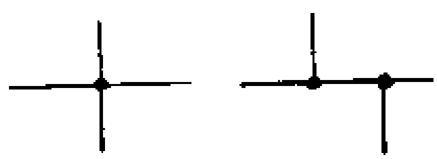
TITLE: HANDBOOK CONTENTS

SECTION "C" CALIBRATION AND MAINTENANCE

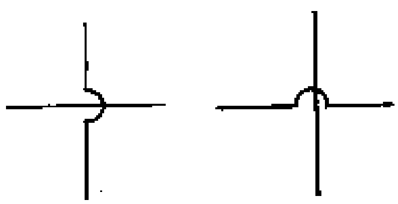
TITLE: HANDBOOK DIAGRAM CONVENTIONS

CONNECTOR W/ PLUG & JACK DESIGNATIONS, PIN #'S CIRCLED

DOTTED LINES SEPARATE MAJOR MODULES, HARNESSES & CIRCUIT BOARDS



ALL CIRCUIT* CONNECTIONS ARE DOTTED

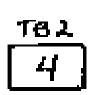


ALL NON-CONNECTING INTERSECTIONS ARE "JUMPERED" FOR CLARITY

SCHEMATICS	USED
32E2007	DC HARNESS
32E2065	MP

EACH DIAGRAM PROVIDES A LIST OF PRINTS USED TO PRODUCE THAT PARTICULAR DIAGRAM.

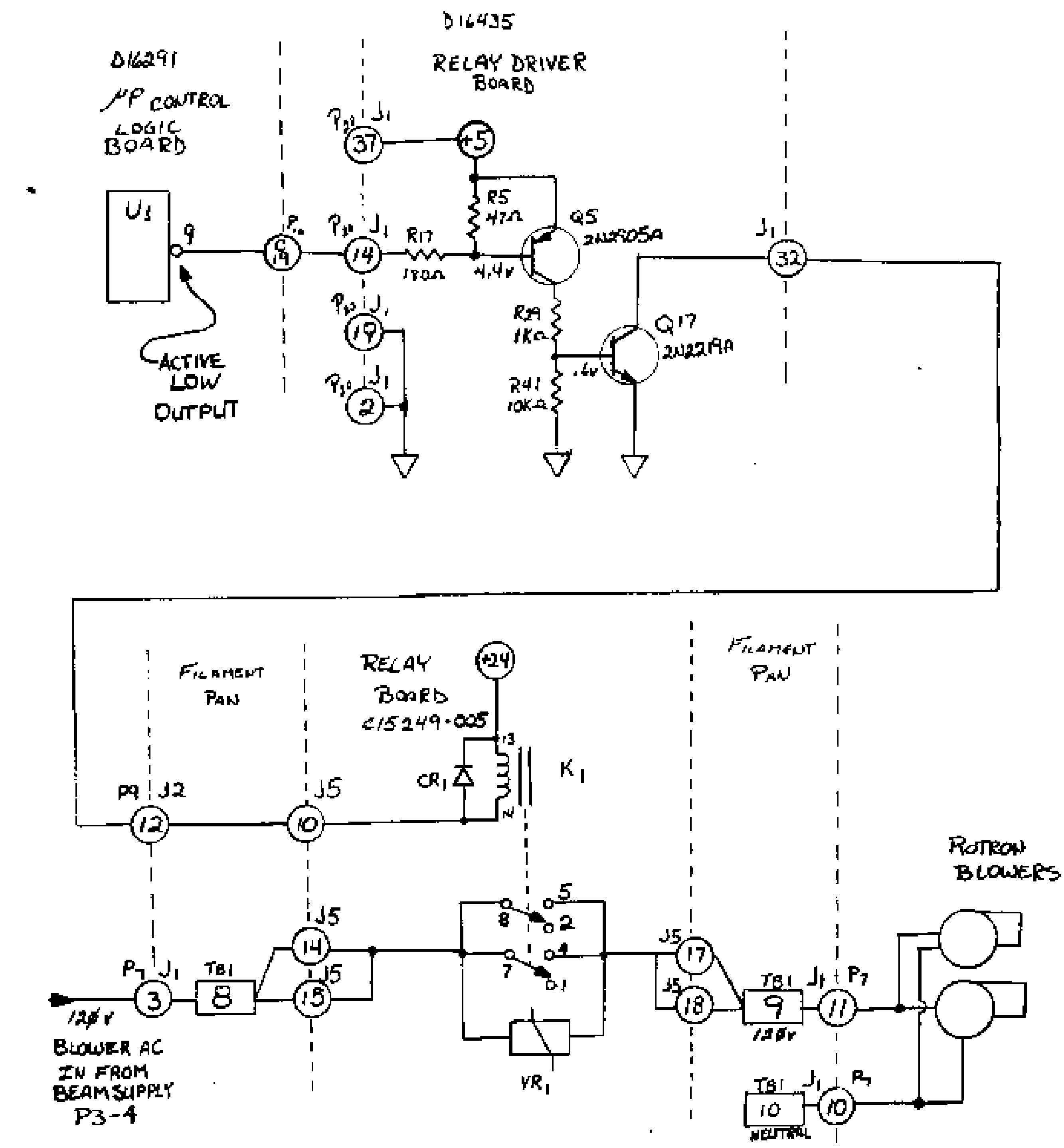
★ NOTE: SCHEMATICS & HANDBOOK DIAGRAMS MAY NOT TOTALLY AGREE AS ANY ERRORS FOUND IN SCHEMATICS WERE CORRECTED. HANDBOOK DIAGRAMS REFLECT THESE CORRECTIONS.



TERMINAL BLOCKS/STRIPS W/ # DESIGNATION

NOTE: THIS SYMBOL MAY ALSO DESIGNATE A HIGH VOLTAGE CONNECTOR

TITLE: BLOWER DRIVE CIRCUIT

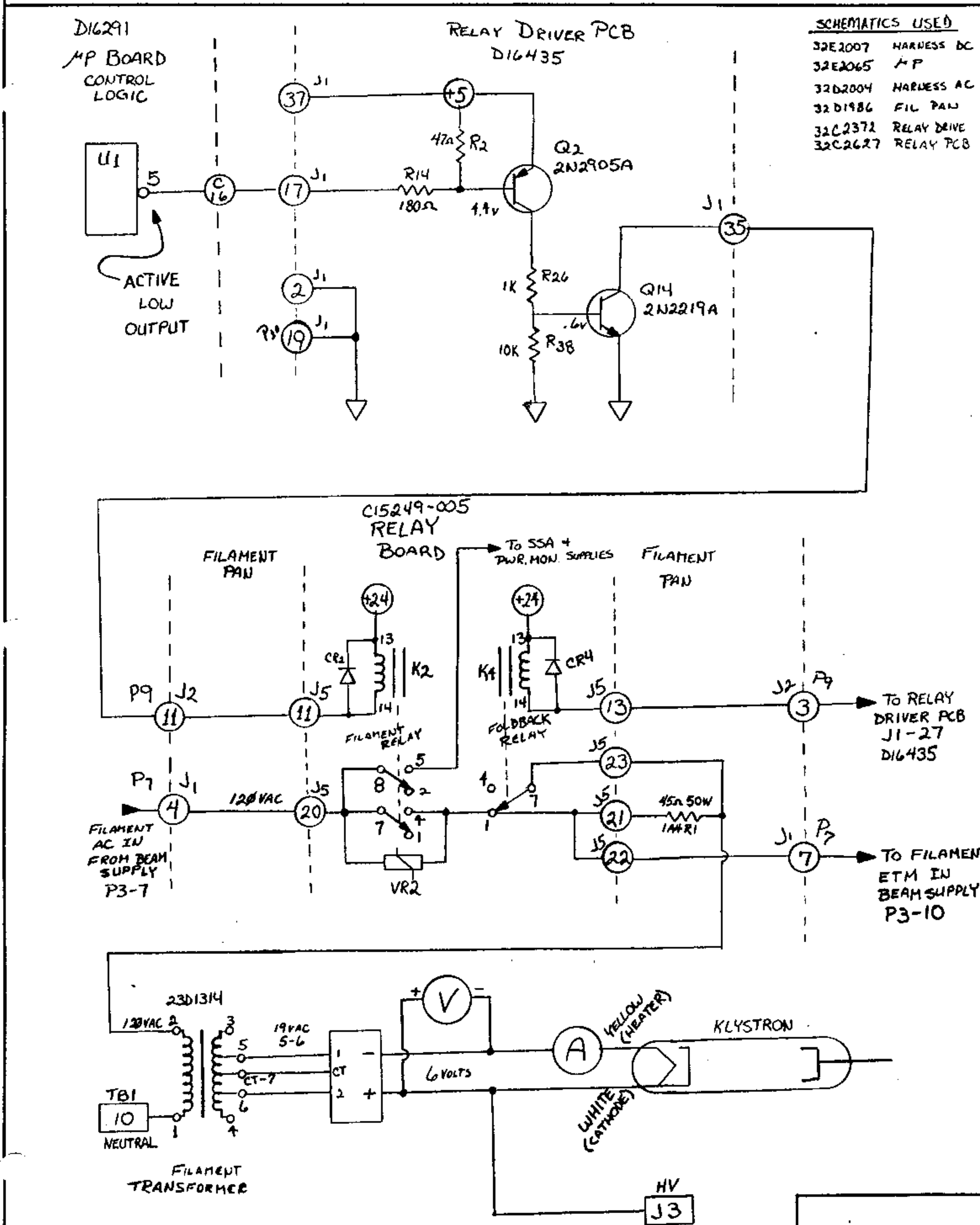


SCHEMATICS USED

32E2007	HARNESS DC
32E2065	μP
32D2004	HARNESS AC
32D1586	FIL PAN
32C2372	RELAY DRIVE
32C2627	RELAY PCB

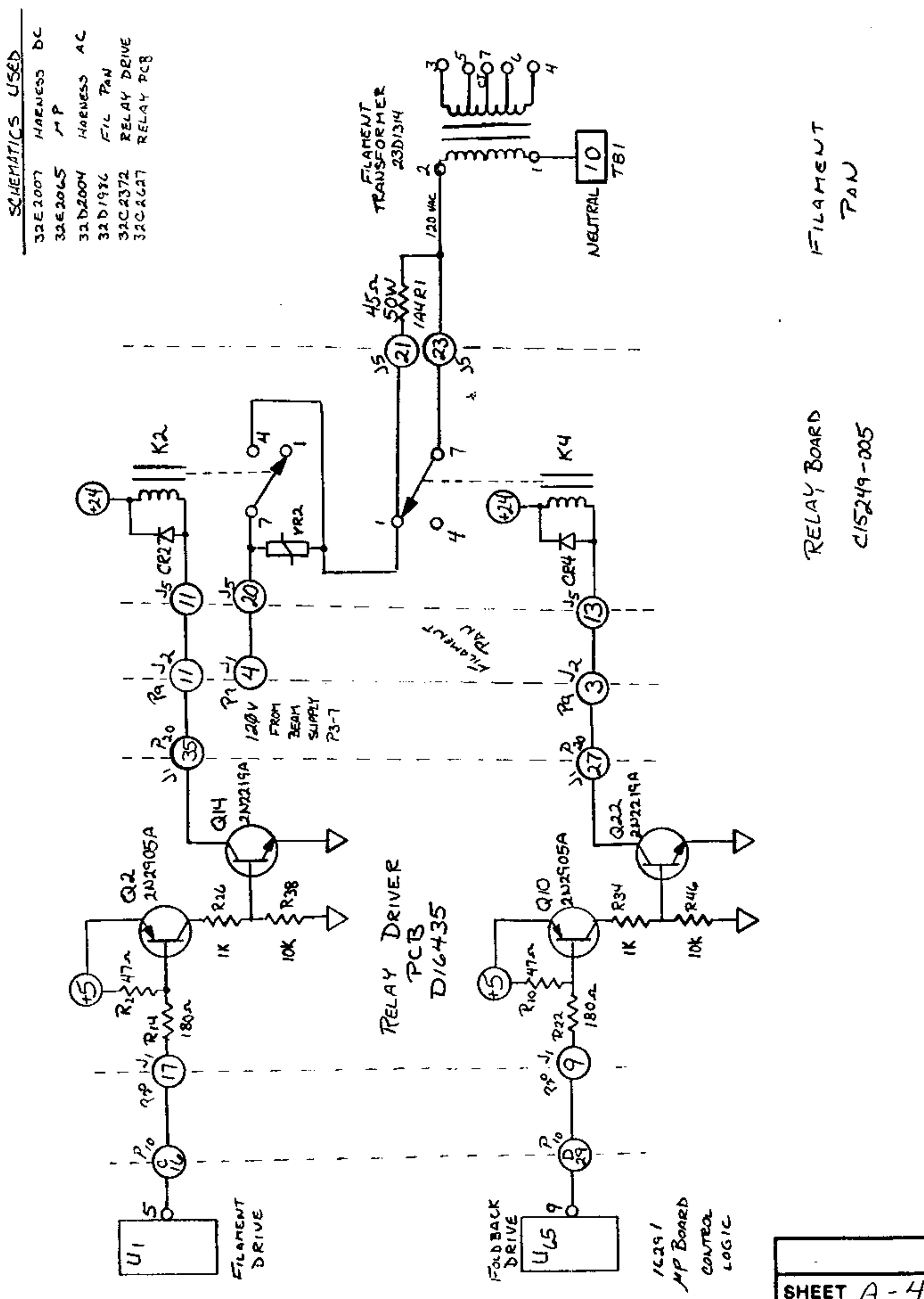
SHEET A-2

TITLE: FILAMENT DRIVE CIRCUIT



SHEET A-3

TITLE: Filament/Foldback Drive Circuit *

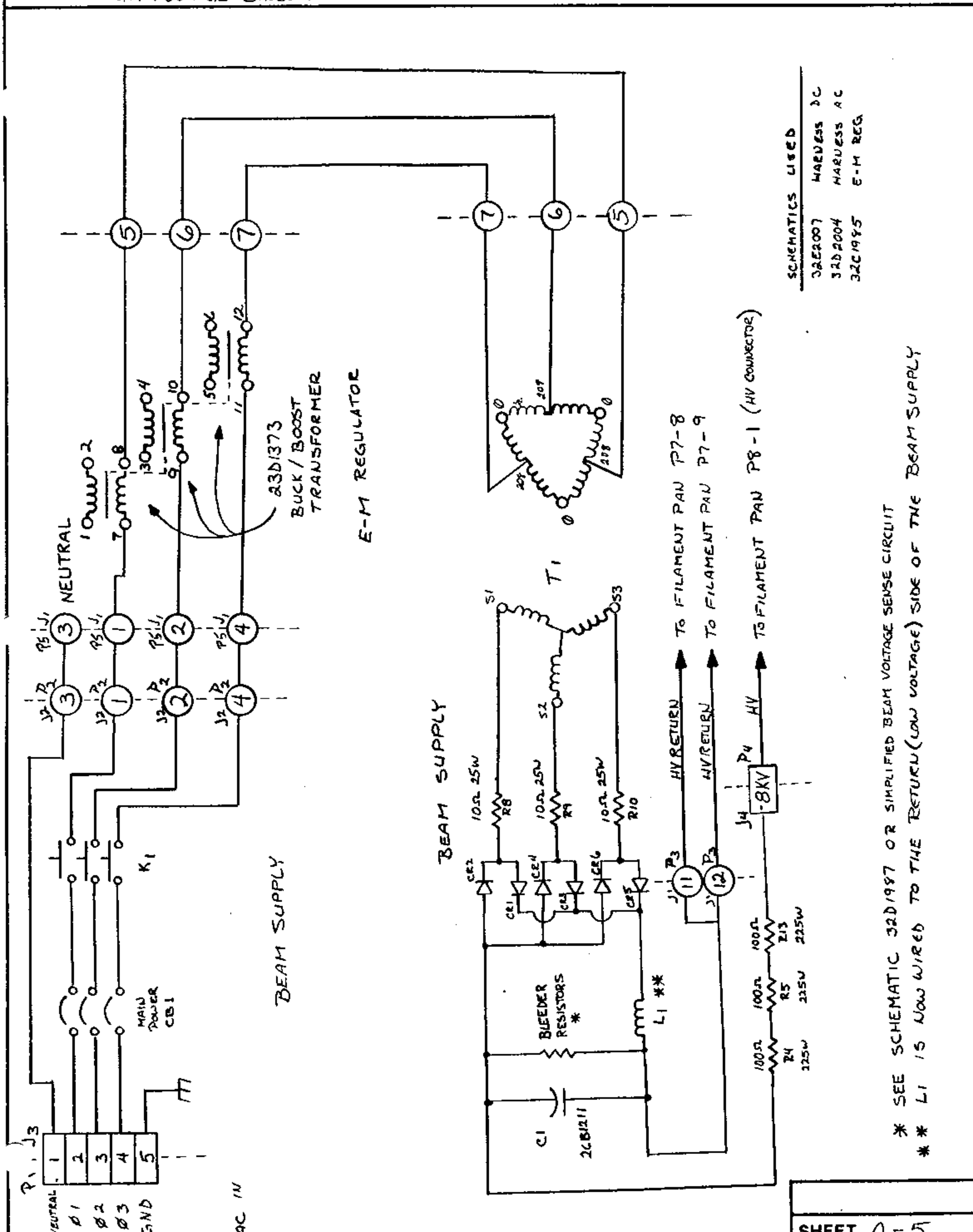


* ENABLED AFTER 30 MINUTES IN STANDBY

SHEET A-4

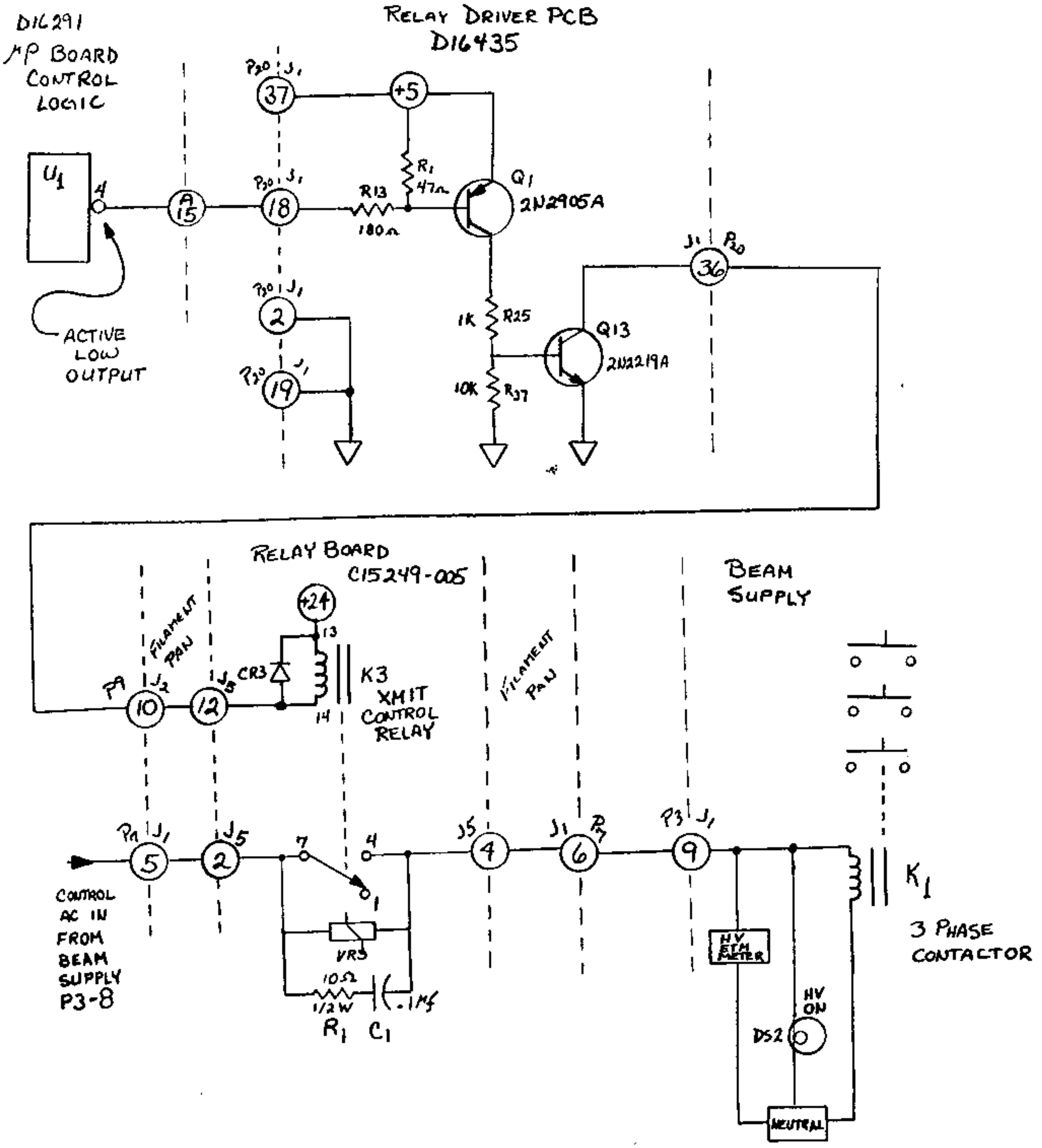
MCL/INC

TITLE: *High Voltage Circuit*



SHEET A-5

TITLE: HIGH VOLTAGE DRIVE CIRCUIT

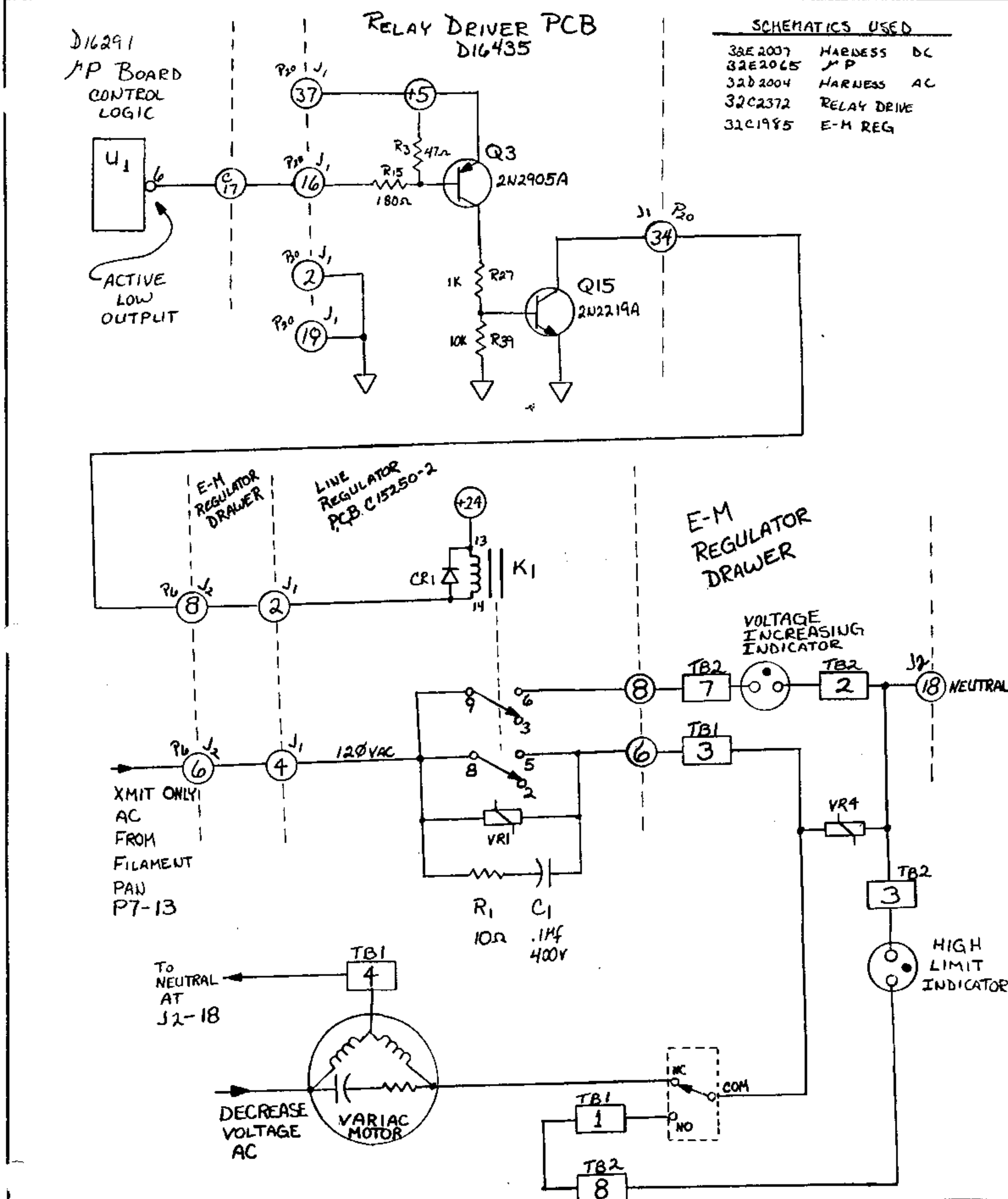


SCHEMATICS USED

32E2007	HARNESS DC
32E2065	μP
32D2004	HARNESS AC
32D1986	FIL PAN
32C2372	RELAY DRIVE
32D1987	BEAM SUPPLY
32C2627	RELAY PCB

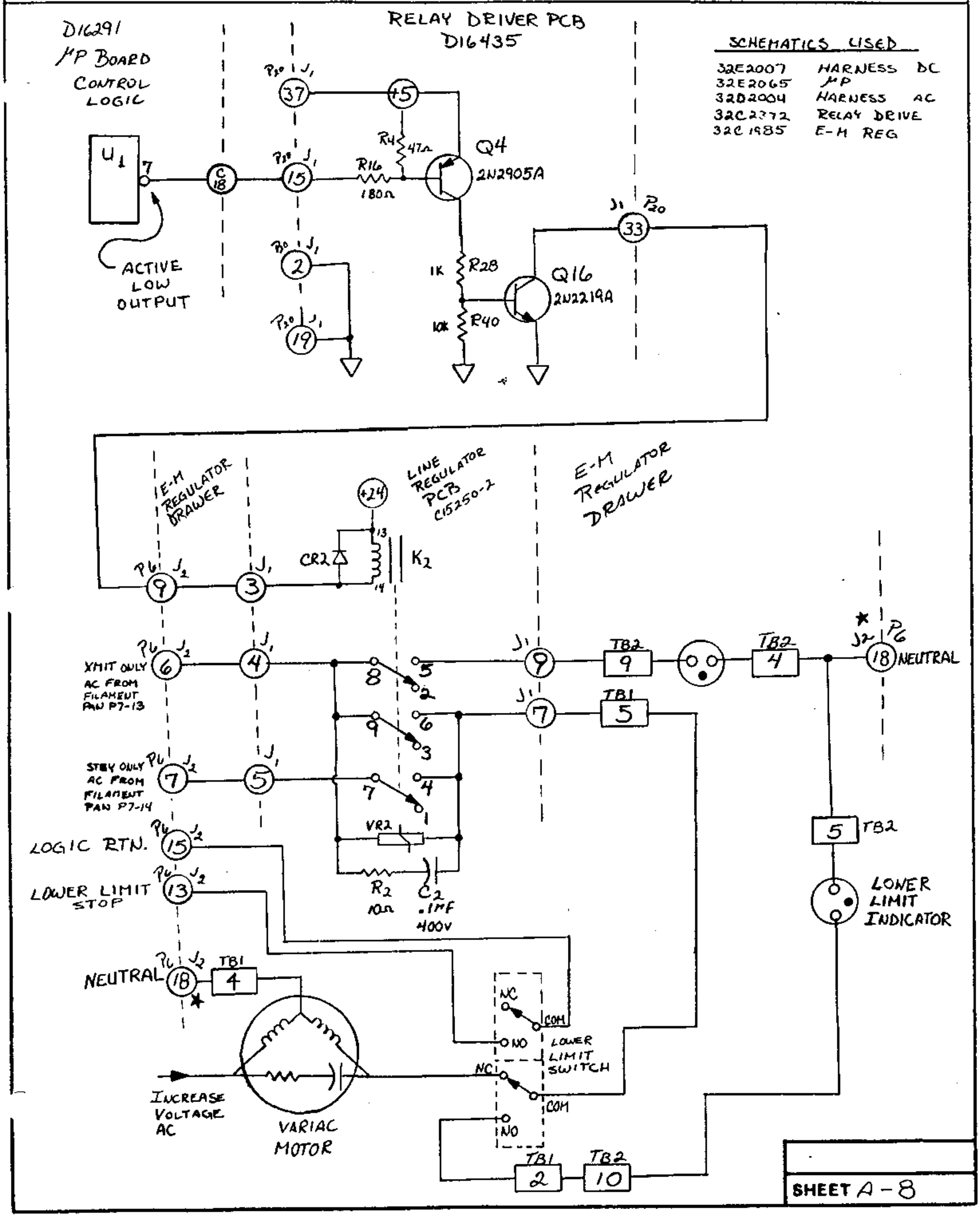
SHEET A-6

TITLE: LINE REGULATION VOLTAGE INCREASE DRIVE CIRCUIT



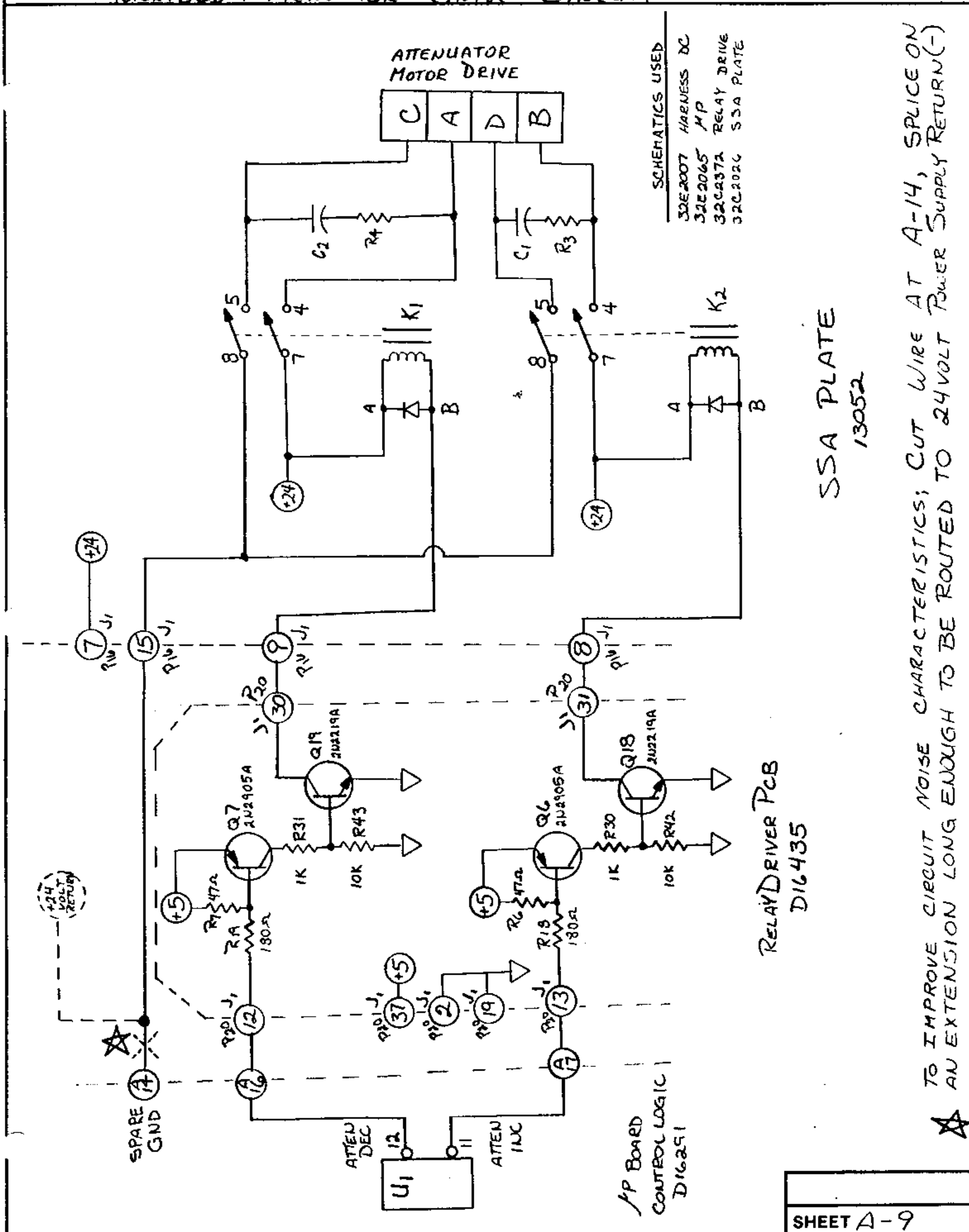
SHEET A-7

TITLE: LINE REGULATION VOLTAGE DECREASE DRIVE CIRCUIT



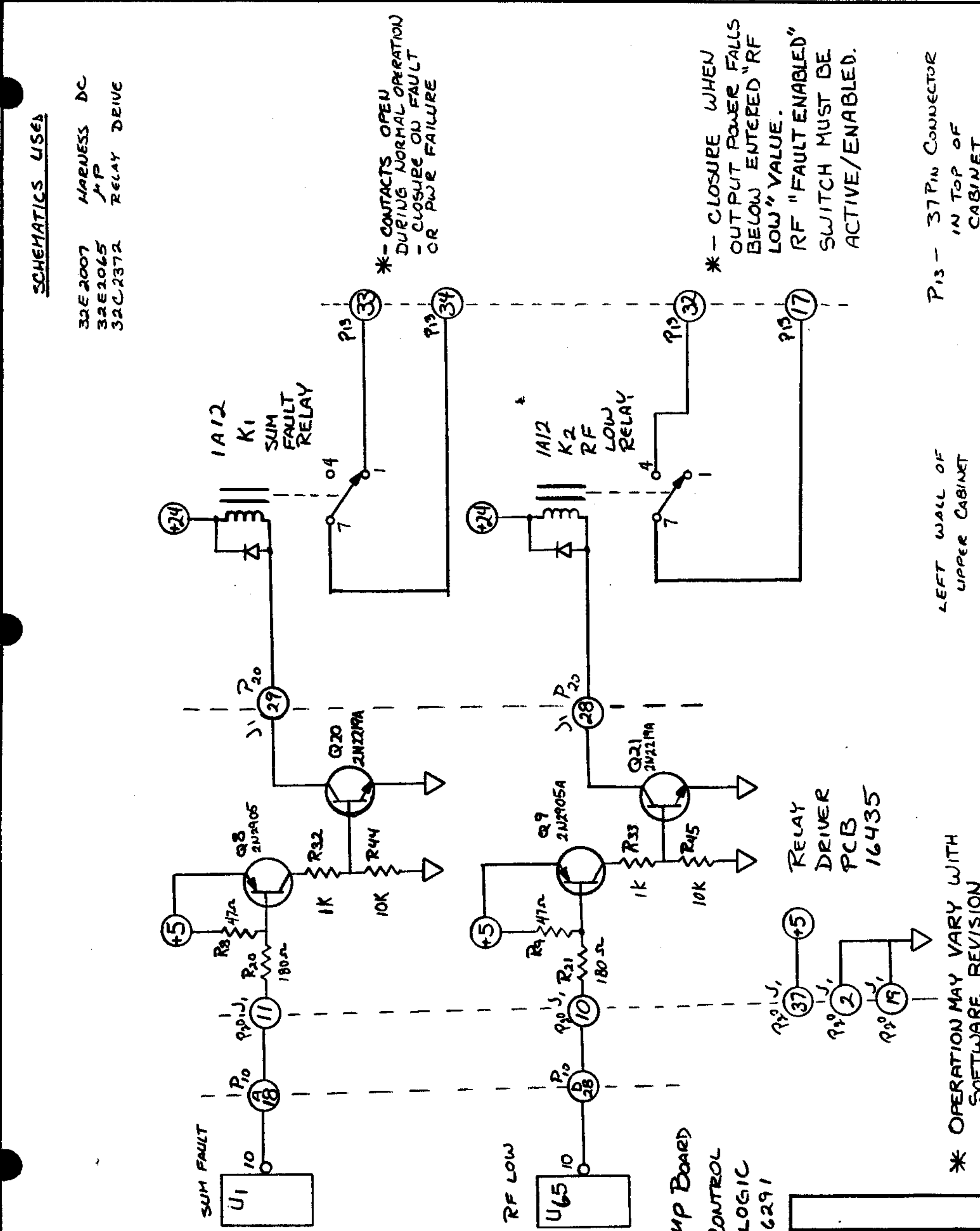
SHEET A-8

TITLE: MOTORIZED ATTENUATOR DRIVE CIRCUIT



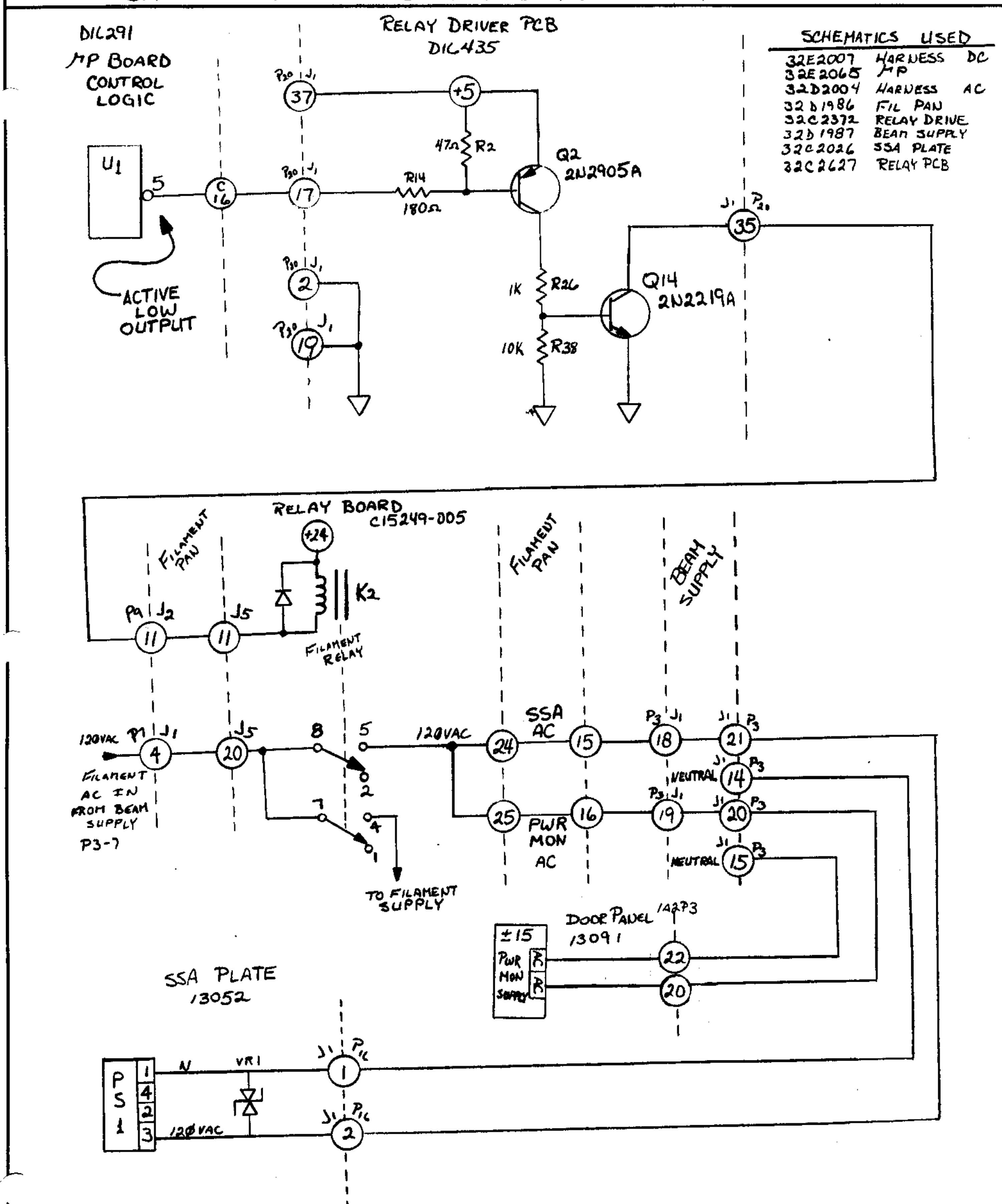
SHEET A-9

TITLE: SUM FAULT & RF LOW RELAY DRIVE CIRCUITS



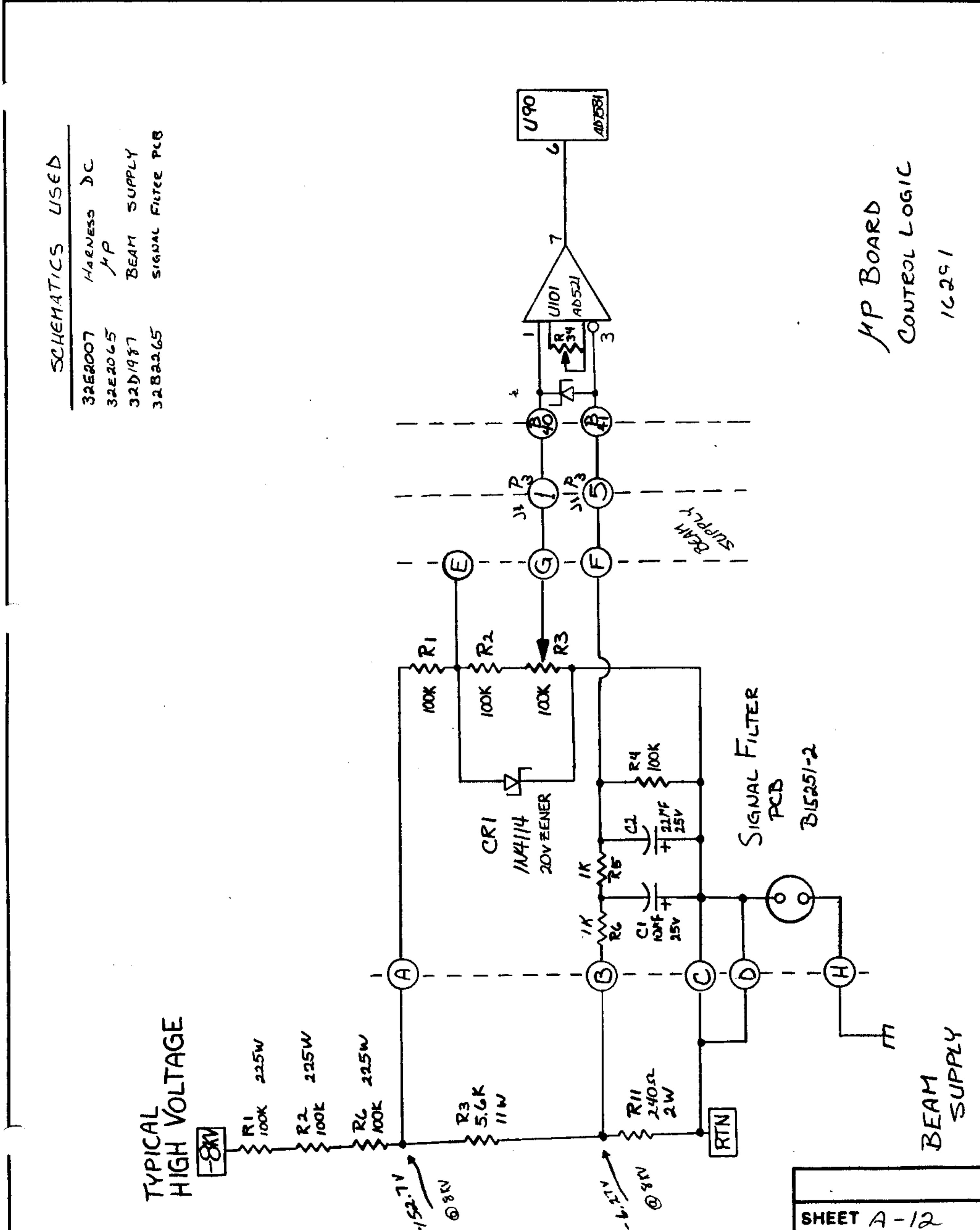
SHEET A-10

TITLE: SSA + POWER MONITOR SUPPLY DRIVE CIRCUIT



SHEET A-11

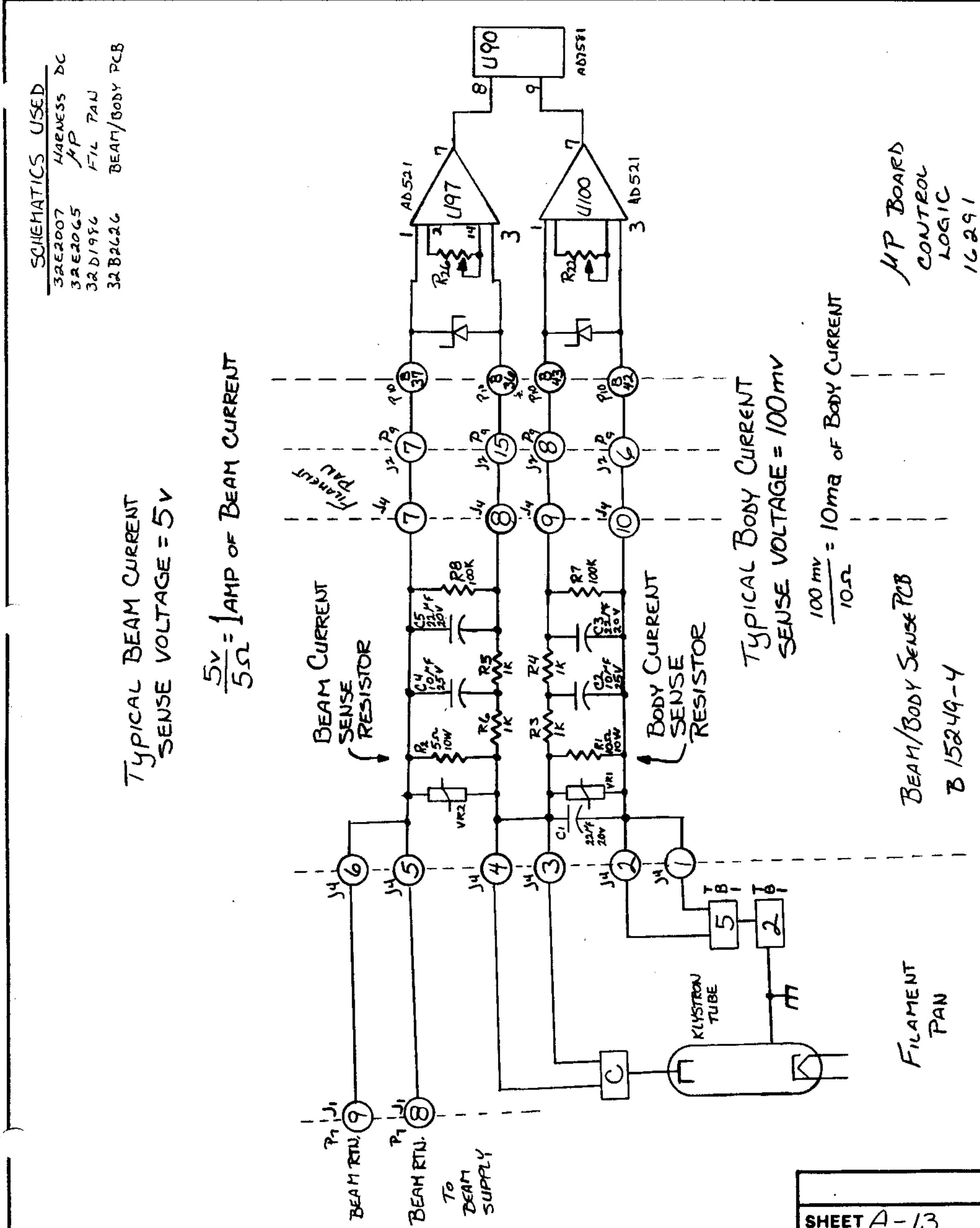
TITLE: BEAM VOLTAGE SENSE CIRCUIT



SHEET A-12

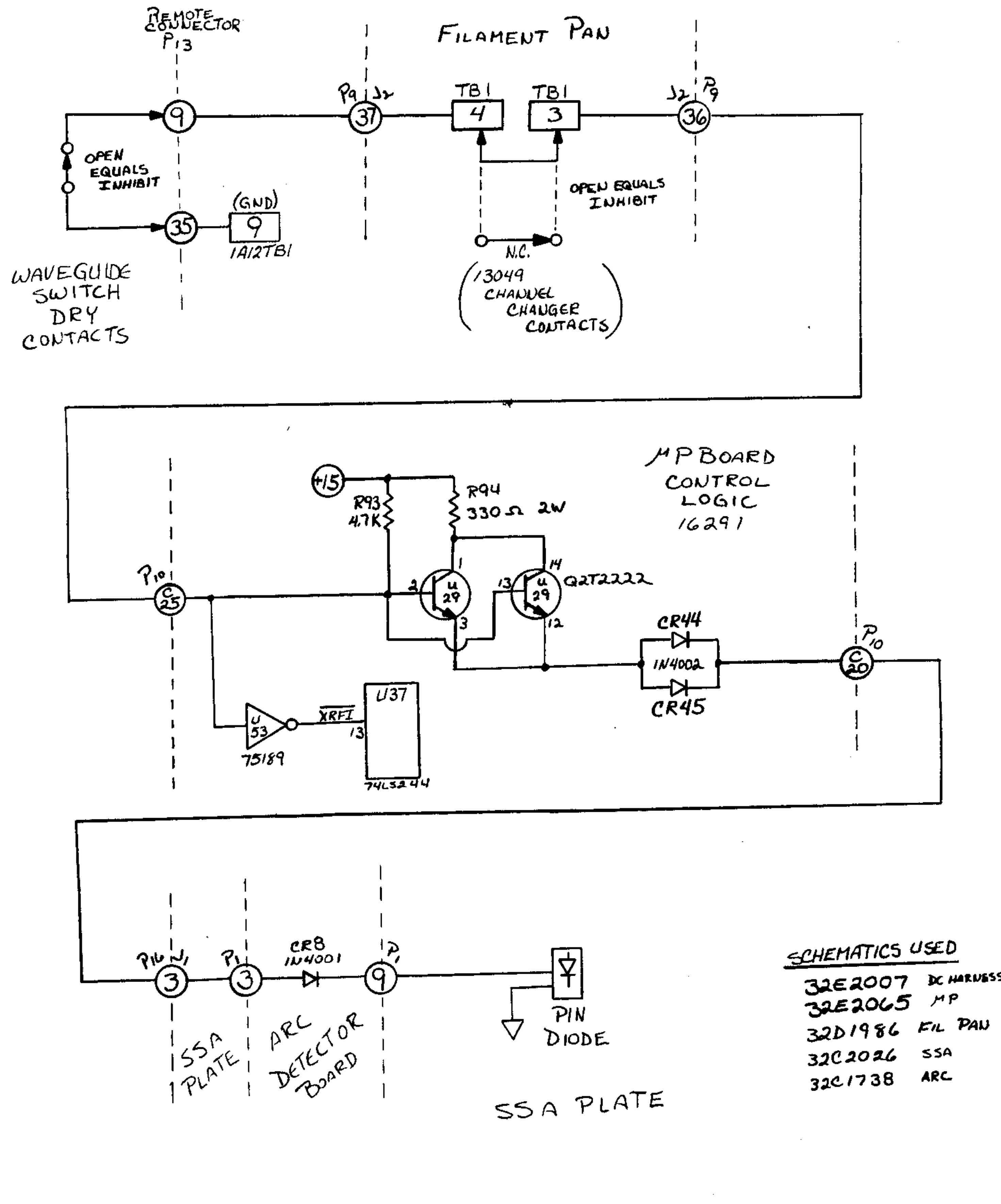
MCL / INC

TITLE: BEAM & BODY CURRENT SENSE CIRCUITS



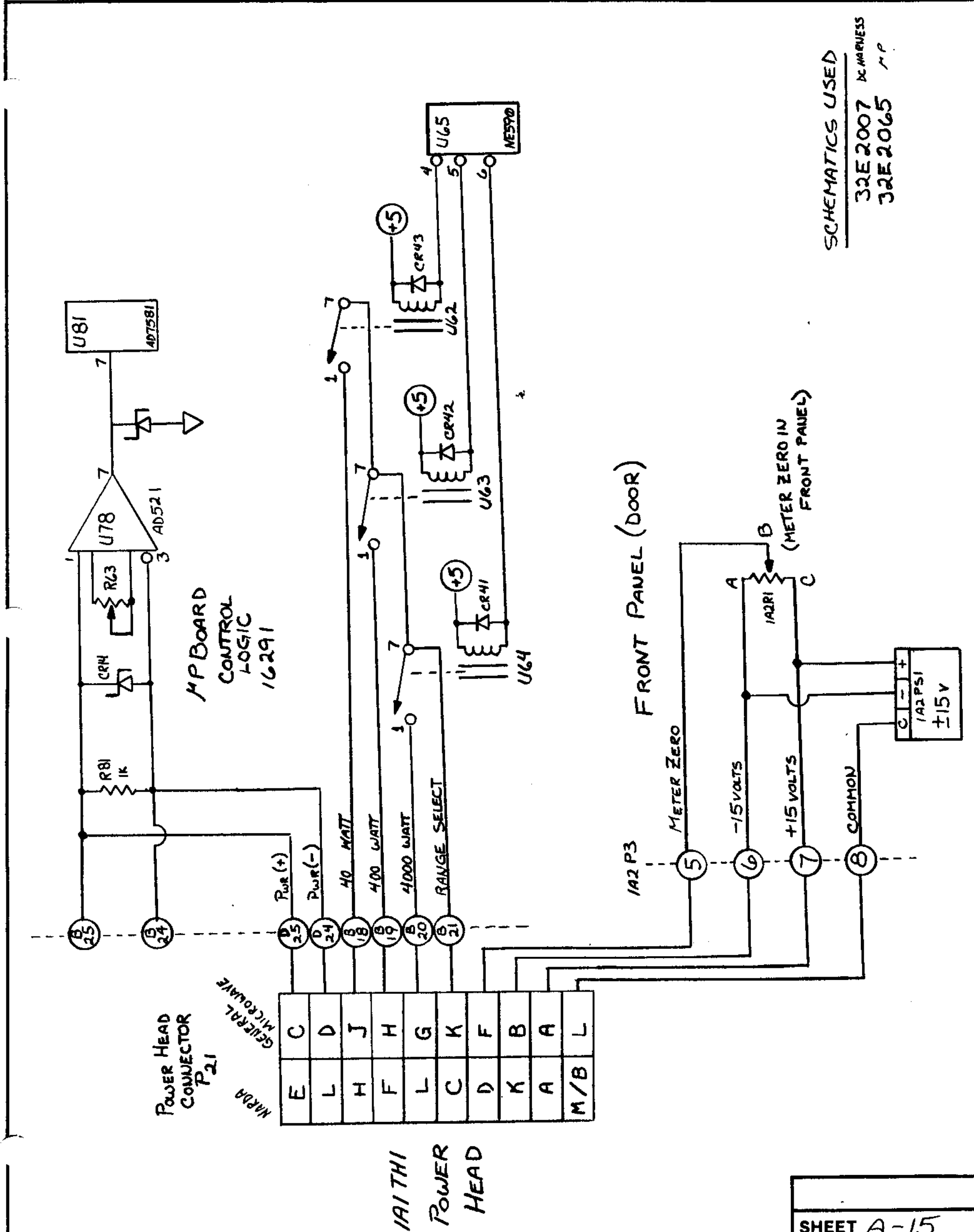
SHEET A-13

TITLE: EXTERNAL RF INHIBIT CIRCUIT



SHEET A-14

TITLE: OUTPUT POWER SENSE CIRCUIT

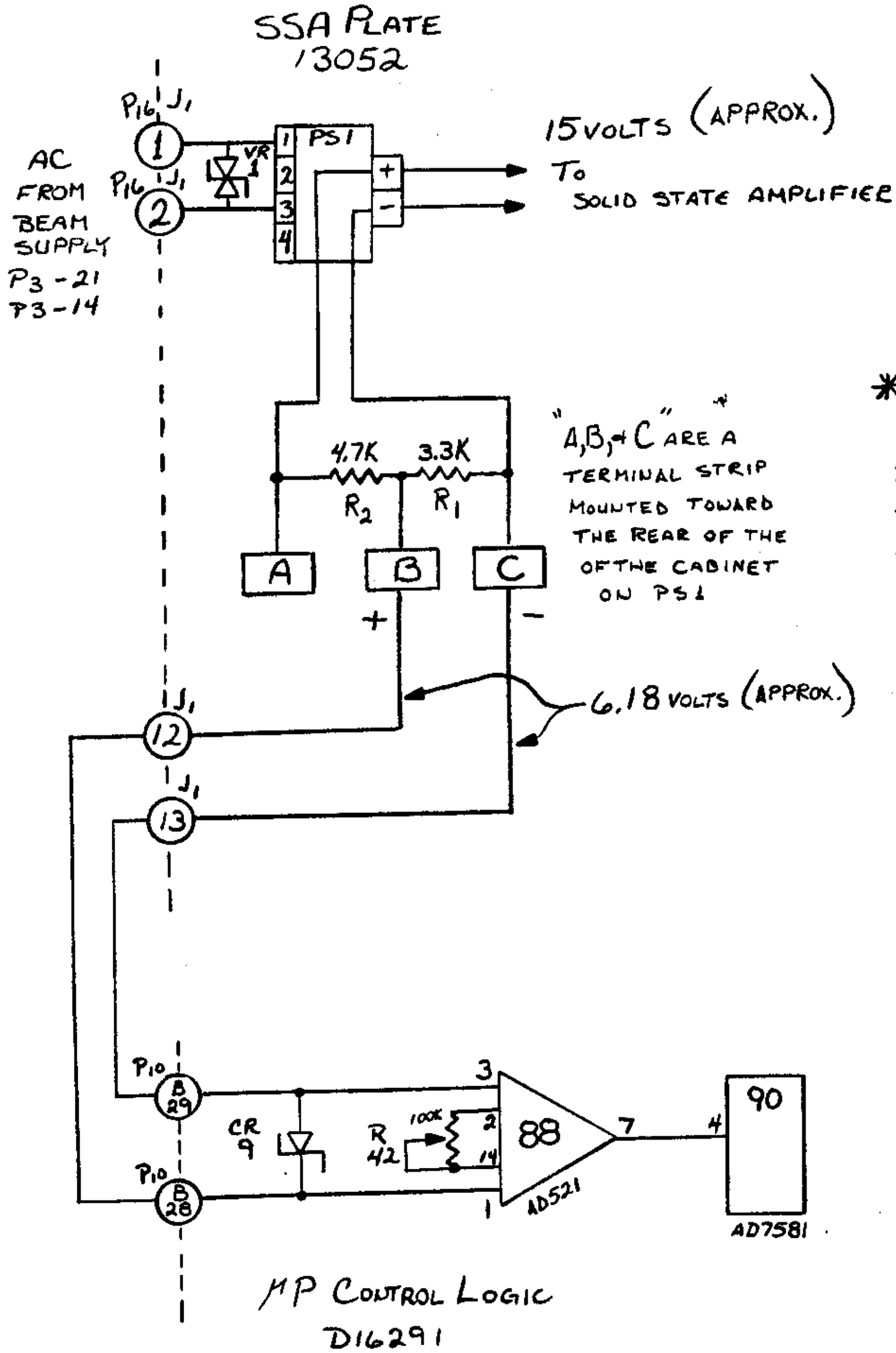


SHEET A-15

TITLE: IPA POWER SUPPLY SENSE CIRCUIT

Schematics Used

32E2007 DC HARNESS
32E2065 μP
32C2026 SSA PLATE



* NOTE: THE IPA SENSE VALUE CAN ONLY BE SEEN IN THE "RS" (REPORT STATUS) ROUTINE ACCESSED VIA THE RS232 PORT.

TITLE: µP (MICRO-PROCESSOR) PCB REAR (SOLDER) SIDE

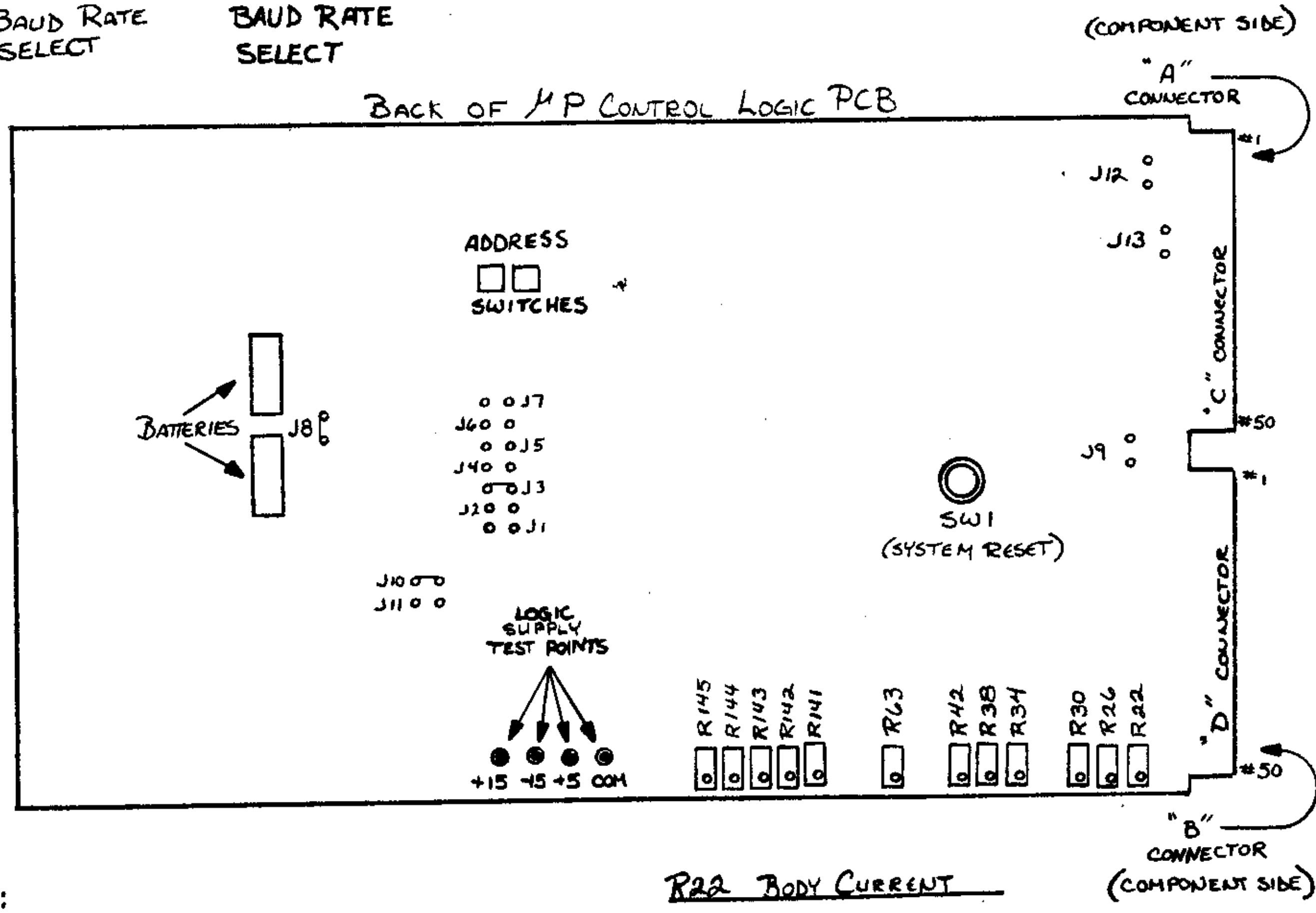
J1	300
J2	600
J3	1200
J4	2400
J5	4800
J6	9600
J7	19200

RS232
BAUD RATE
SELECT

J10	9600
J11	1200

RS422 (SA OR CSP BUS)
BAUD RATE
SELECT

J8	BATTERY CLIP
J9	SA OR CSP TERMINATOR
J12	EXT INT'L
J13	EXT INH



NOTES:

1. OLDER REV. BOARDS MAY NOT INCLUDE R141 TO R145
2. THESE POTENTIOMETERS CALIBRATE DISPLAYS ONLY! DISPLAYS MUST BE CALIBRATED TO PROVIDE RELIABLE PROTECTION TO THE SYSTEM.

R22	BODY CURRENT
R26	BEAM CURRENT
R30	REFLECTED PWR.
R34	BEAM VOLTAGE
R38	I.P.A. OUTPUT
R42	I.P.A. PWR. SUP.
R63	RF OUTPUT PWR.
R141	+15 PWR. MON. SUP.
R142	-15 PWR. MON. SUP.
R143	+15 LOGIC SUP.
R144	+5 LOGIC SUP.
R145	-15 LOGIC SUP.

TITLE: MP (MICRO-PROCESSOR) PCB REAR (SOLDER) SIDE LATE 1987 REV.

J1	300
J2	600
J3	1200
J4	2400
J5	4800
J6	9600
J7	19200

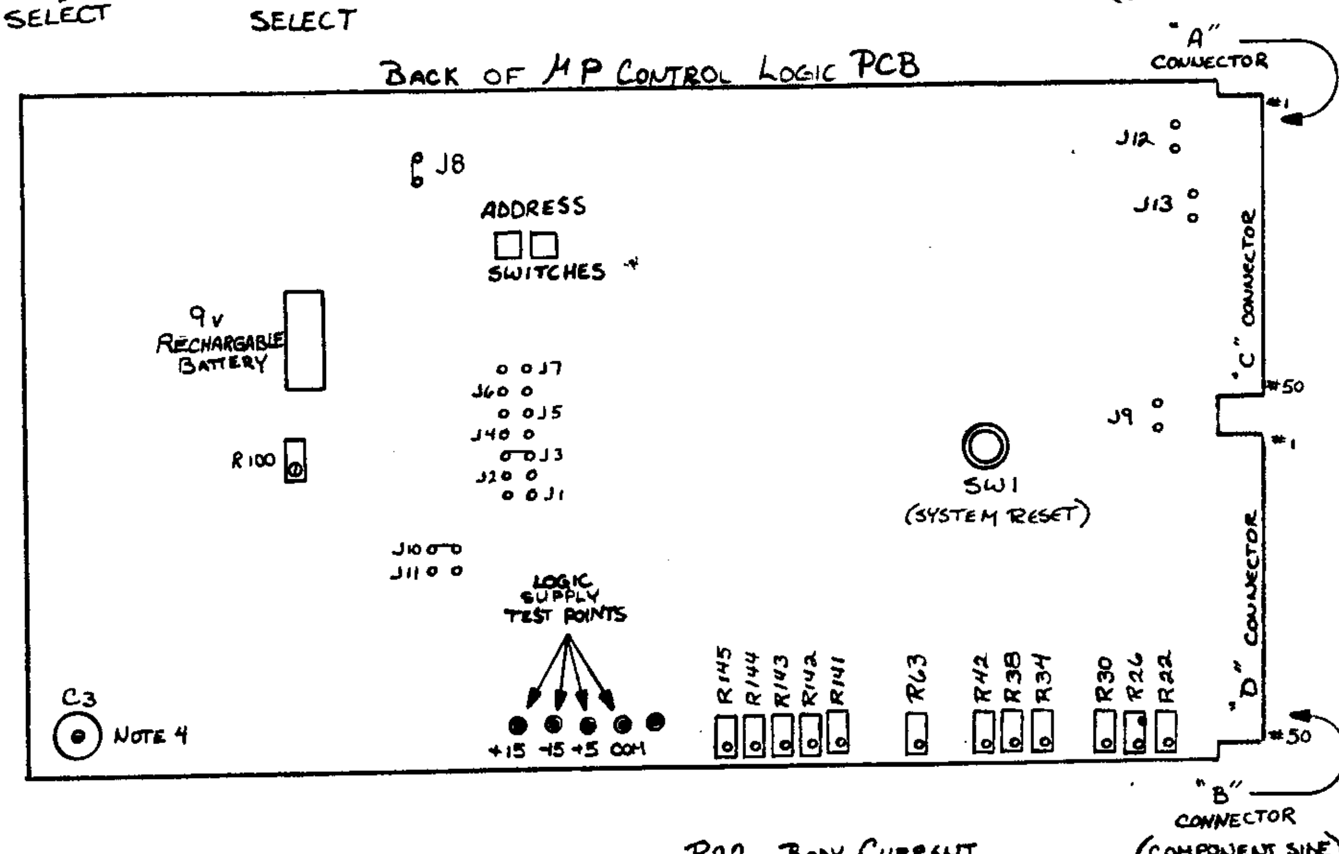
RS232 BAUD RATE SELECT

J10	9600
J11	1200

RS422 (SA OR CSP BUS) BAUD RATE SELECT

J8	BATTERY CLIP
J9	SA OR CSP TERMINATOR
J12	EXT INT'L
J13	EXT INH

BACK OF MP CONTROL LOGIC PCB



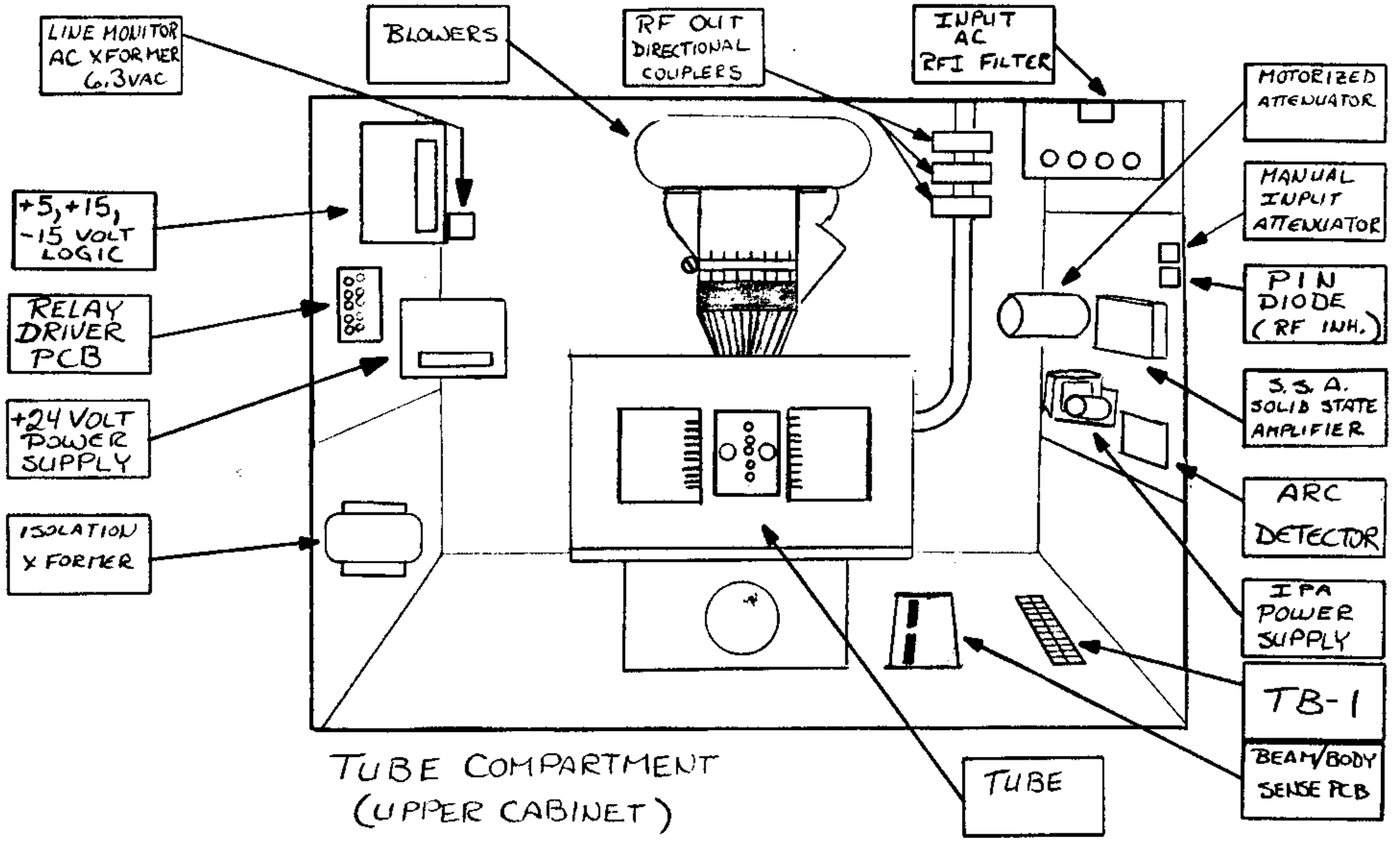
NOTES:

1. OLDER REV. BOARDS MAY NOT INCLUDE R141 TO R145
2. THESE POTENTIOMETERS CALIBRATE DISPLAYS ONLY! DISPLAYS MUST BE CALIBRATED TO PROVIDE RELIABLE PROTECTION TO THE SYSTEM.
3. R100 ADJUSTS THE BATTERY CHARGE THRESHOLD ADJUST FOR 9.60 VOLTS AT THE BASE OF Q4
4. C3 ADJUSTS THE CRYSTAL OSCILLATOR FOR THE REAL TIME CLOCK

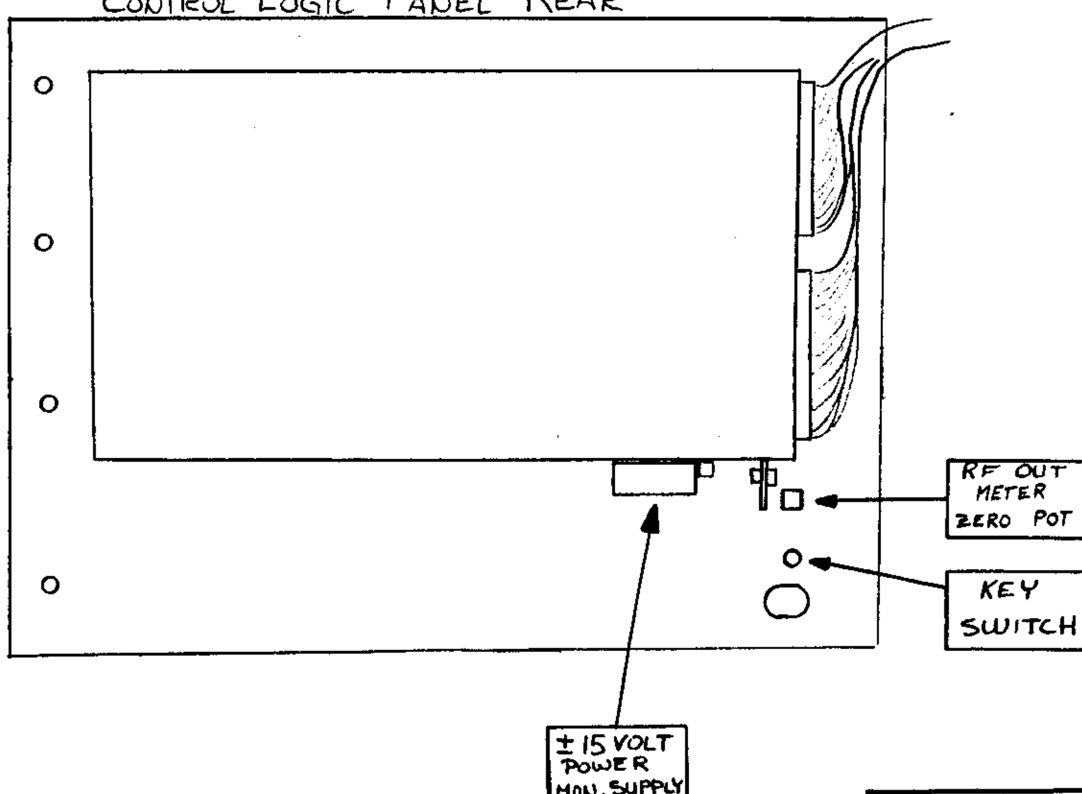
R22	BODY CURRENT
R26	BEAM CURRENT
R30	REFLECTED PWR.
R34	BEAM VOLTAGE
R38	I.P.A. OUTPUT
R42	I.P.A. PWR. SUP.
R63	RF OUTPUT PWR.
R141	+15 PWR. MON. SUP
R142	-15 PWR. MON. SUP.
R143	+15 LOGIC SUP.
R144	+5 LOGIC SUP.
R145	-15 LOGIC SUP.
R100	BATTERY CHARGE THRESHOLD NOTE 3

SHEET A-17-A

TITLE: TUBE COMPARTMENT LAYOUT



CONTROL LOGIC PANEL REAR

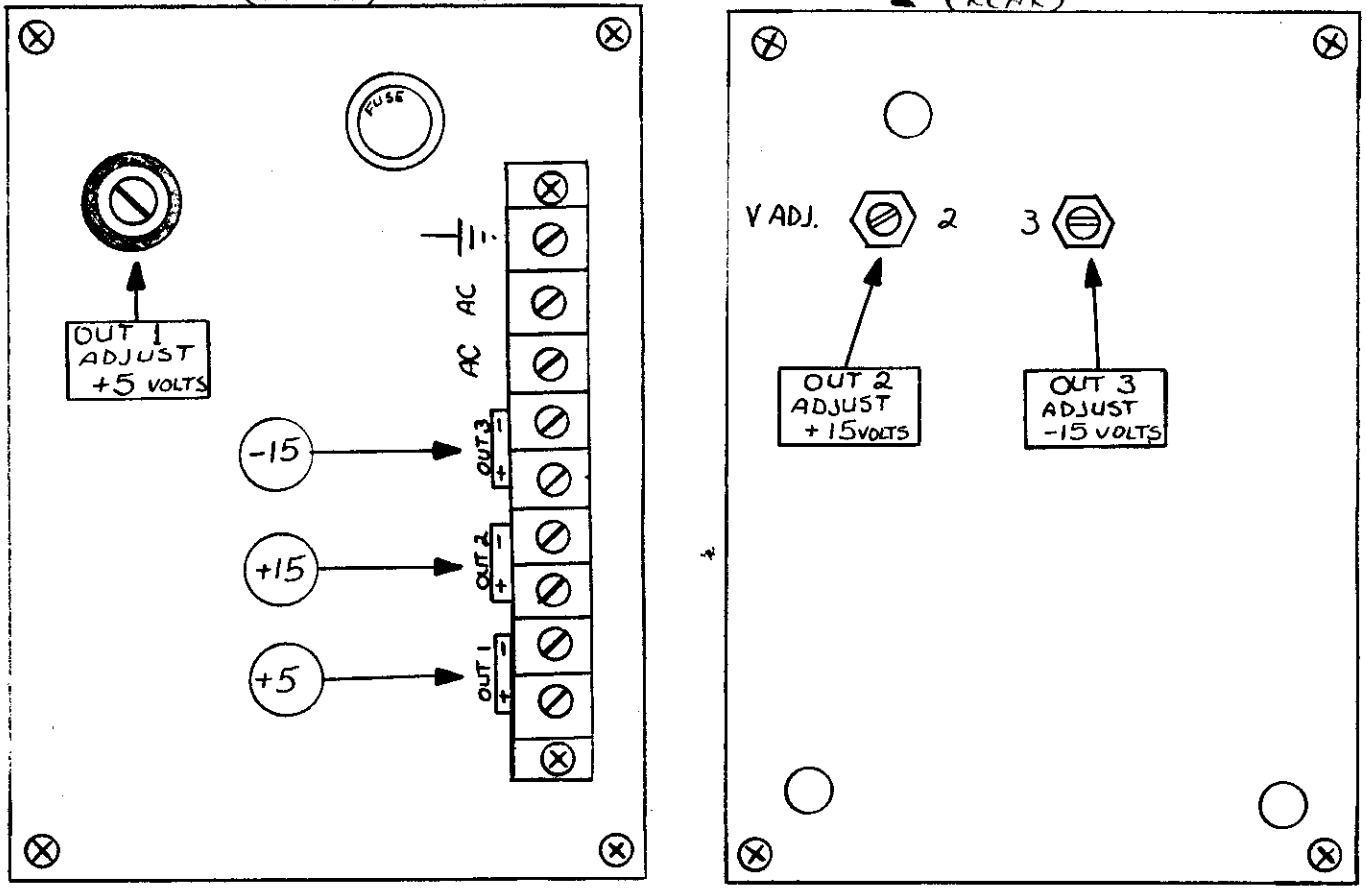


SHEET A-18

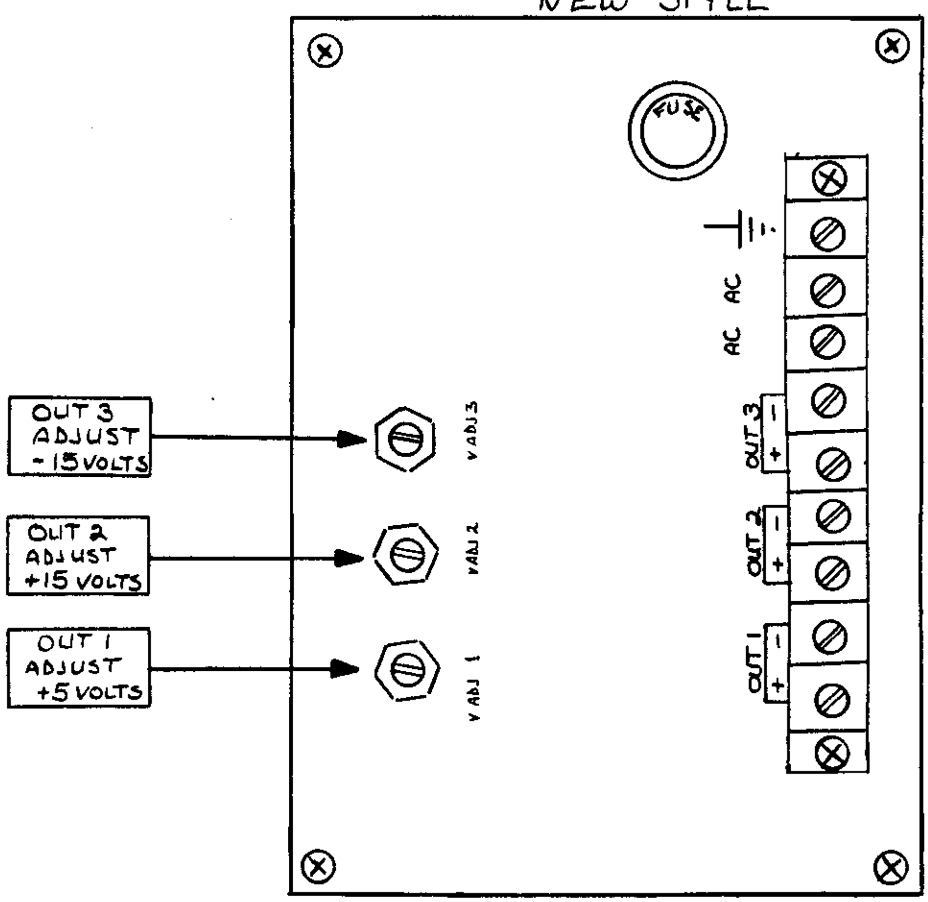
TITLE: +5, +15, & −15 VOLT LOGIC POWER SUPPLY ADJUSTMENT LOCATIONS

OLD STYLE

(FRONT) (REAR)



NEW STYLE



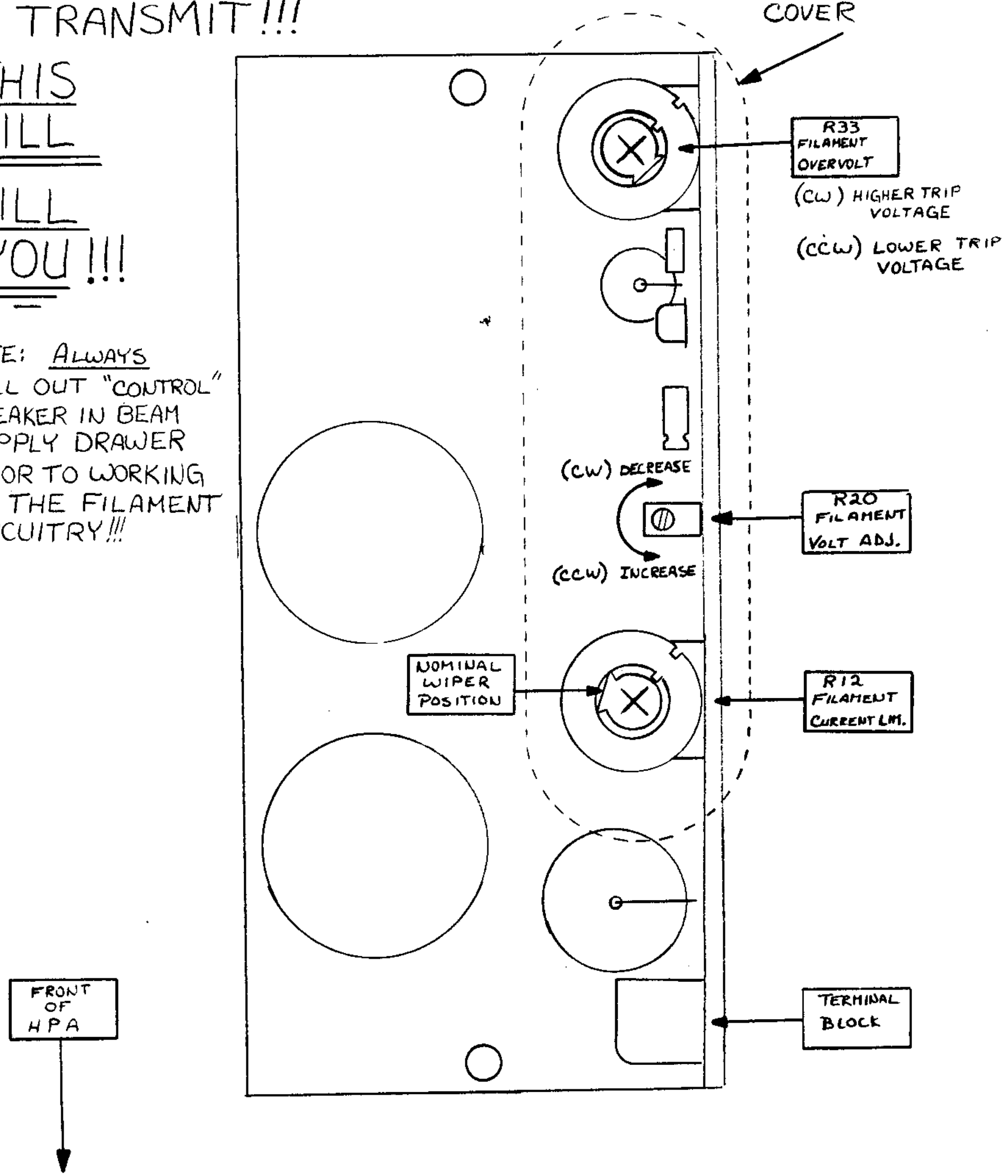
TITLE: FILAMENT SUPPLY POTENTIOMETER LOCATIONS

CAUTION!!: NEVER ADJUST FILAMENT SUPPLY WHEN IN TRANSMIT!!!

THIS WILL KILL YOU!!!

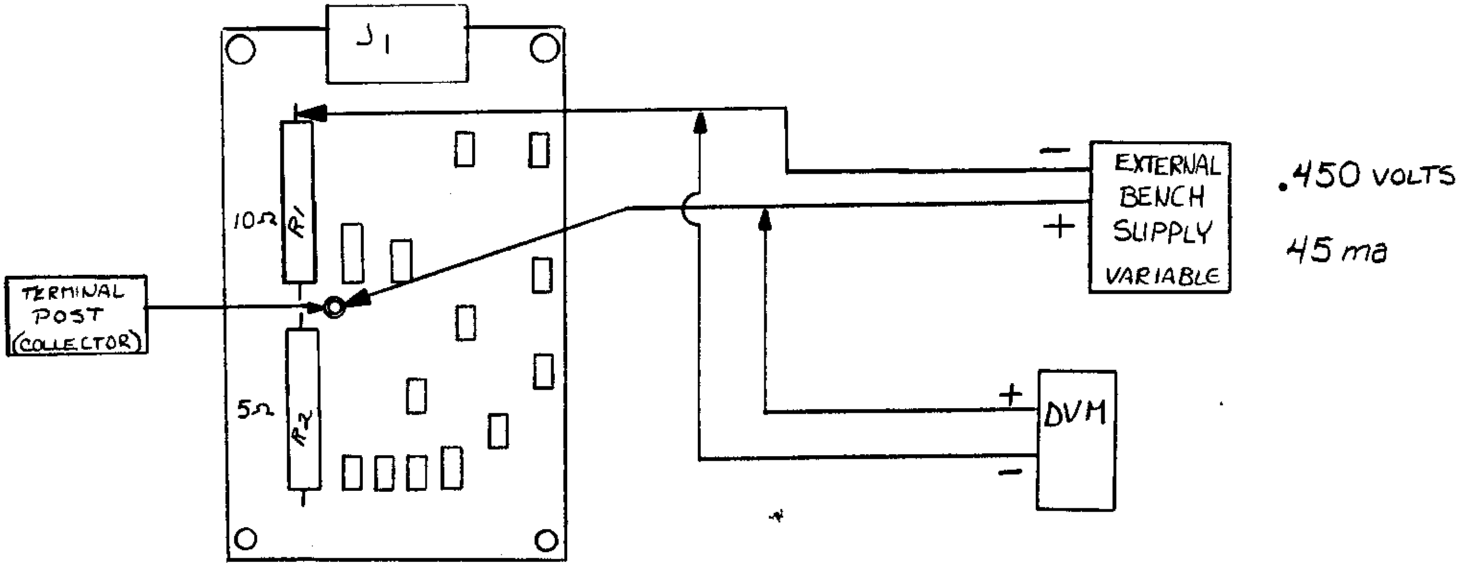
NOTE: DOTTED LINE REPRESENTS CUTOUT IN PROTECTIVE PLEXIGLASS COVER

NOTE: ALWAYS PULL OUT "CONTROL" BREAKER IN BEAM SUPPLY DRAWER PRIOR TO WORKING ON THE FILAMENT CIRCUITRY!!!



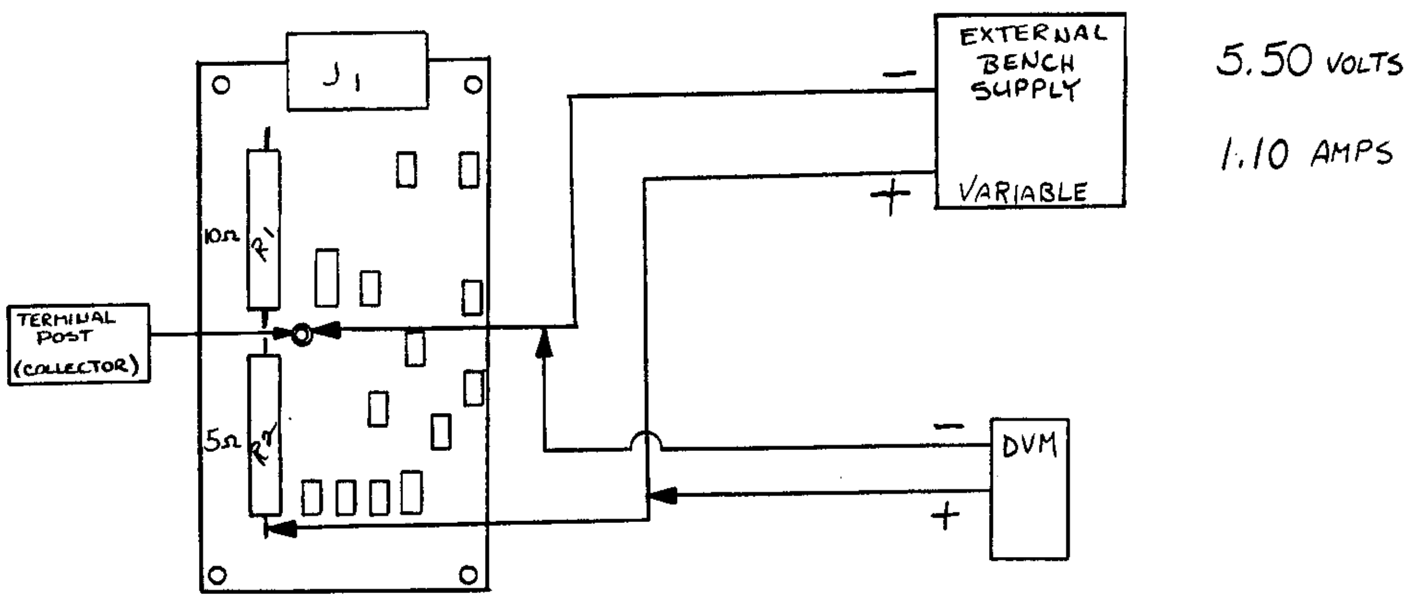
TITLE: BEAM & BODY CURRENT CALIBRATION SETUPS

BODY CURRENT CALIBRATION SET UP



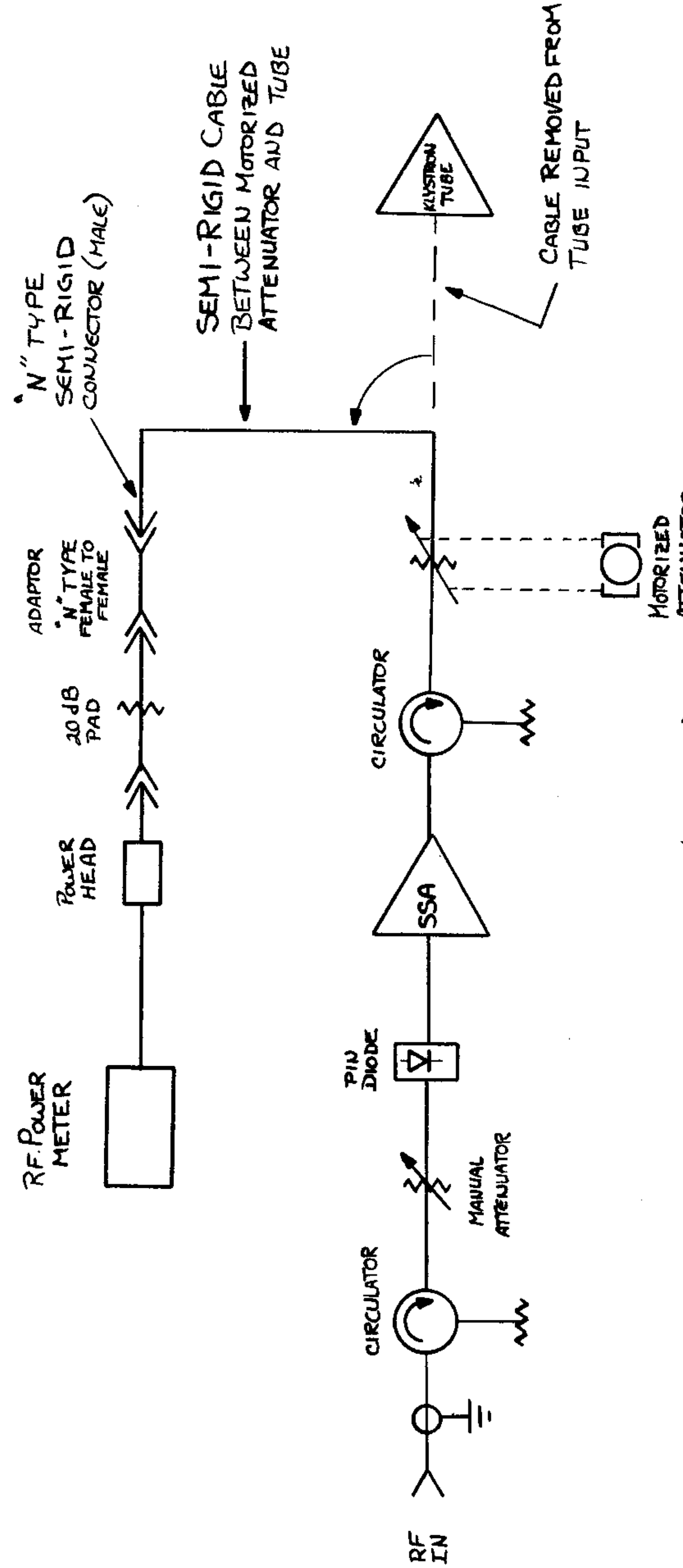
BEAM/BODY SENSE PCB

BEAM CURRENT CALIBRATION SET UP



BEAM/BODY SENSE PCB

TITLE: IPA OUTPUT POWER CALIBRATION SETUP



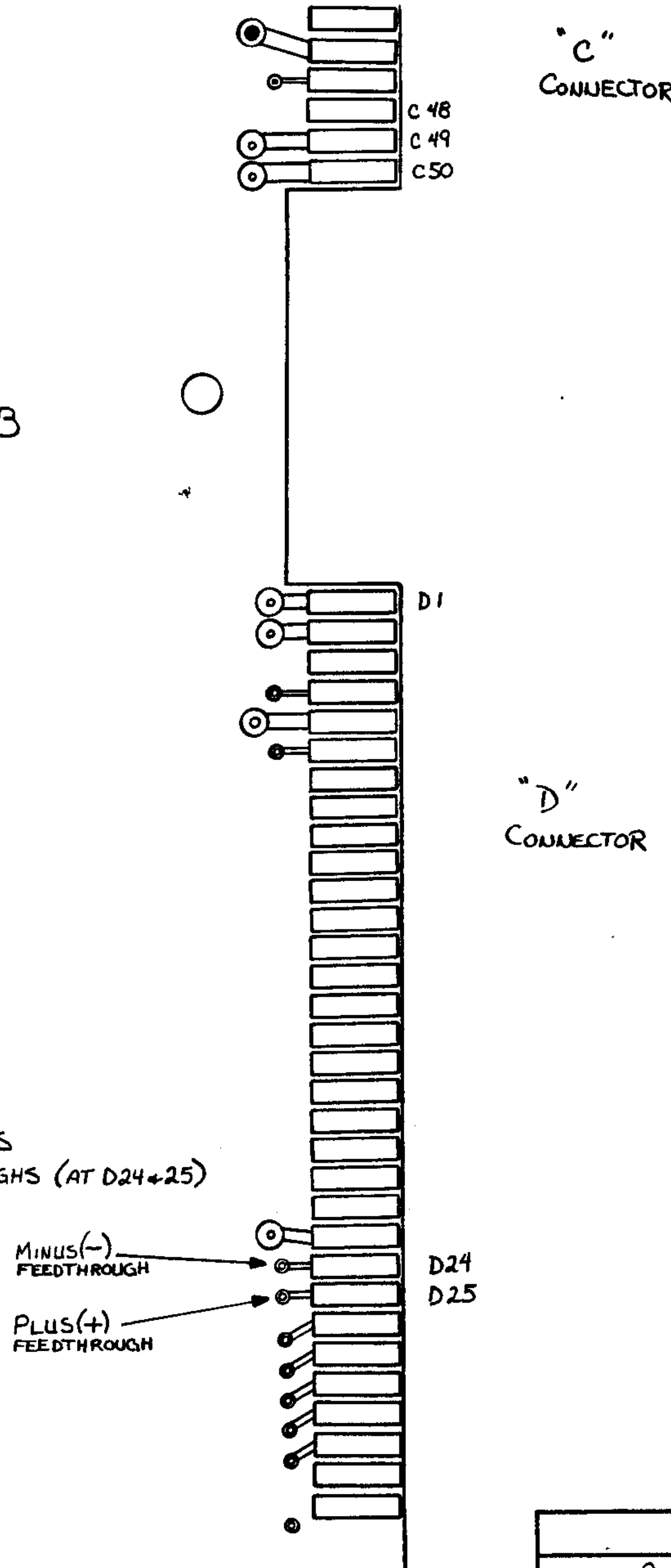
NOTES: 1. <u>CALIBRATE IPA RF OUT AT 450mw (26.53 dBm)</u>

THIS MEANS YOUR RF POWER METER WILL DISPLAY +6.53 dBm. (IF A 20dB PAD IS USED AS SHOWN) IF ANY OTHER VALUE PAD IS USED, THE MEASURED RF WILL VARY ACCORDINGLY.

2. MOTORIZED ATTENUATOR <u>MUST</u> BE AT MINIMUM ATTENUATION.

TITLE: RF OUTPUT CALIBRATION TEST POINTS

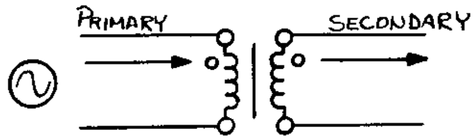
SOLDER SIDE
OF μP CONTROL PCB



INSTALL SHORT LENGTHS OF SOLDER INTO FEEDTHROUGHS (AT D24 + 25) TO CLIP METER LEADS ON.

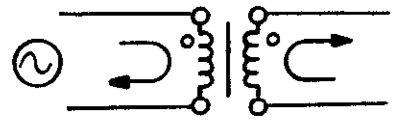
TITLE: BUCK/BOOST THEORY OF OPERATION

(1)



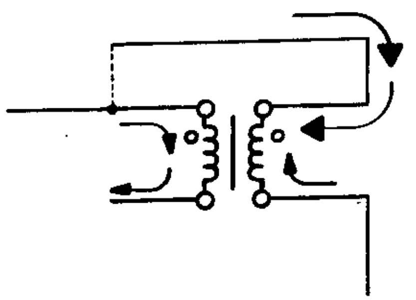
Transformer has "Dot (input)" indications showing current directions in primary and secondary windings. Current going into dot on primary yields current out of dot on secondary.

(2)



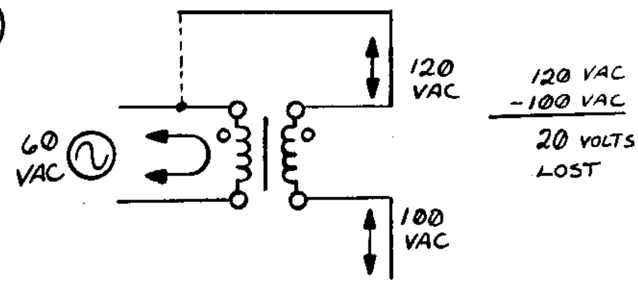
This also means the current in the primary winding is opposite that of the secondary.

(3)



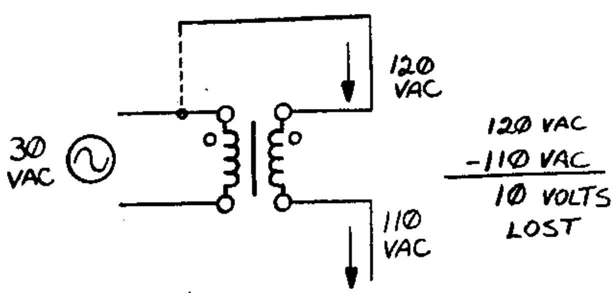
Pushing a current into the primary and secondary "Dots" simultaneously, results in opposing or bucking currents in the secondary winding.

(4)



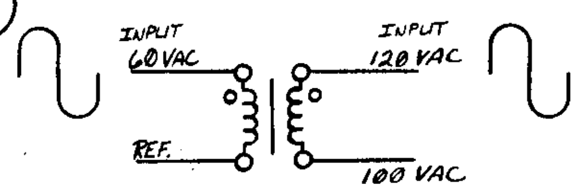
These opposing currents result in a loss of energy through subtraction. 120 VAC applied to the input of the secondary yields 100 VAC at the output when 60 VAC is applied at the primary.

(5)



Reducing the input voltage on the primary **reduces** the **loss** on the secondary.

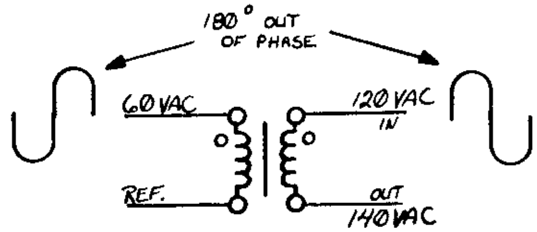
(6)



This bucking condition occurs when the input voltages are in phase with each other.

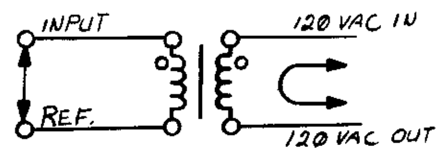
TITLE: BUCK/BOOST THEORY (CONT.)

(7)



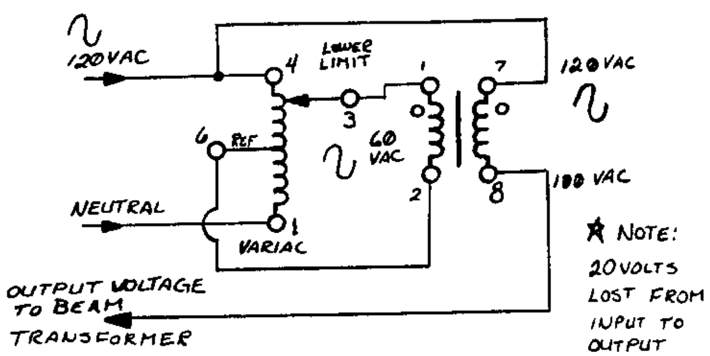
When the input voltages are 180° out of phase, the output voltage of the secondary is "boosted". This is because the secondary current, produced by the primary, is in phase with the applied current at the secondary input.

(8)



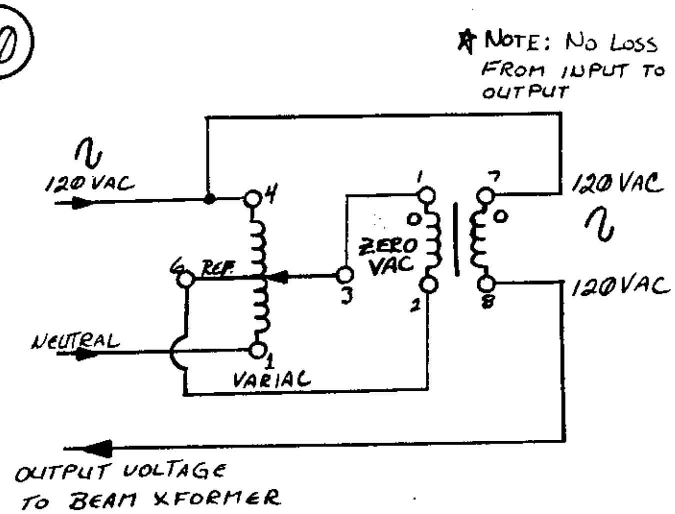
Shorting the transformer primary provides no energy in the secondary that will affect current flow in the secondary windings. The net effect is virtually no loss of voltage between the input and output of the secondary.

(9) The following examples depict buck/boost conditions as utilizied in the klystron E-M regulator drawers.



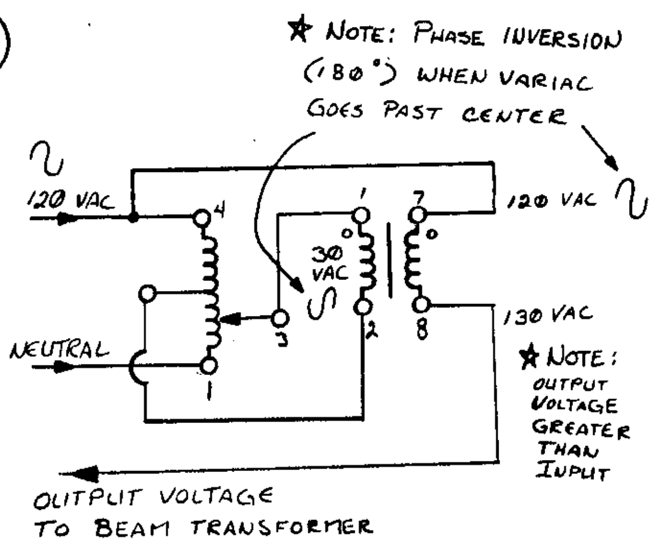
Variac at 11 o'clock position.

(10)



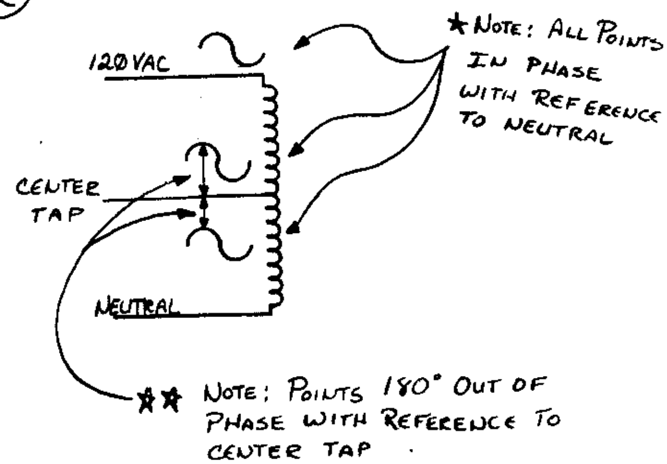
Variac at 6 o'clock position.

(11)



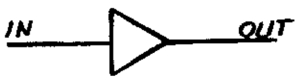
Variac at 3 o'clock position.

(12) Phase inverting on a variac.



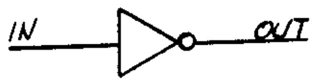
TITLE: STANDARD LOGIC WITH TRUTH TABLES

BUFFER



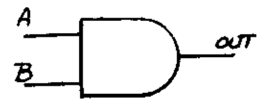
IN	OUT
L	L
H	H

INVERTER



IN	OUT
L	H
H	L

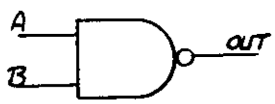
AND GATE



A	B	OUT
L	L	L
H	L	L
L	H	L
H	H	H

NOTE: ALL INPUTS OF AN AND GATE MUST BE HIGH TO GET A HIGH OUTPUT.

NAND GATE



A	B	OUT
L	L	H
H	L	H
L	H	H
H	H	L

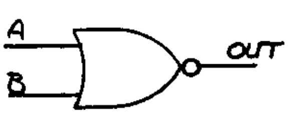
NOTE: ALL INPUTS MUST BE HIGH TO GET A LOW OUTPUT POWER.

OR GATE

A	B	OUT
L	L	L
H	L	H
L	H	H
H	H	H

NOTE: A HIGH ON ANY INPUT PRODUCES A HIGH OUTPUT.

NOR GATE



A	B	OUT
L	L	H
H	L	L
L	H	L
H	H	L

NOTE: A HIGH ON ANY INPUT PRODUCES A LOW OUTPUT.

L = LOW = 0 = ZERO = LOW VOLTAGE (< 1 VOLT TYPICALLY)

H = HIGH = 1 = ONE = HIGH VOLTAGE (CLOSE TO POWER SUPPLY "+" VALUE)

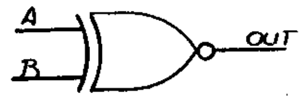
TITLE: LOGIC (CONTINUED)

EXCLUSIVE OR GATE

A	B	OUT
L	L	L
H	L	H
L	H	H
H	H	L

NOTE: IF ANY ONE INPUT IS HIGH (ONE & ONLY ONE) THE OUTPUT WILL BE HIGH.

EXCLUSIVE NOR GATE



A	B	OUT
L	L	H
H	L	L
L	H	L
H	H	H

NOTE: IF ANY ONE INPUT IS HIGH (ONE & ONLY ONE) THE OUTPUT WILL BE LOW.

SHEET

TITLE: OHM's LAW (AN AID TO TROUBLE SHOOTING DC CIRCUITS)

YOU'VE HEARD OF GETTING A "PIE IN THE EYE"

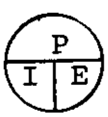
OHM's LAW WILL GIVE YOU A: "PIE IN THE EAR" (OR IN THIS CASE EIR!)

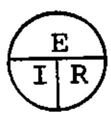
P=POWER IN WATTS

I=CURRENT IN AMPS

E=ELECTROMOTIVE FORCE IN VOLTS

R=RESISTANCE IN OHM's





"PIE" CHARTS CAN HELP WITH DERIVING FORMULAS.

$P = I x E$

$\frac{P}{I} = E$

$\frac{P}{E} = I$

$E = I x R$

$\frac{E}{I} = R$

$\frac{E}{R} = I$

MORE FORMULAS:

$E = \sqrt{RP}$

$I = \sqrt{P/R}$

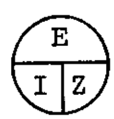
$P = \frac{E^2}{R}$

$P = I^2 R$

$R = \frac{E^2}{P}$

$R = \frac{P}{I^2}$

OHM's LAW FOR "AC"



$E = I x Z$

$\frac{E}{I} = Z$

$\frac{E}{Z} = I$

Z= IMPEDANCE IN OHM's

SHEET B-3

TITLE: CALIBRATION AND MAINTENANCE CHECKLIST (PHOTOCOPY THIS PAGE)

System Model Number 10667

System Serial Number ______________

Date ______________

Technician ______________

A LOGIC POWER SUPPLIES

○ 1. +5 Volt Logic power supply = +5.1 Volts ± .05 VDC

○ 2. +5 Volt Logic display = Measured value?

○ 3. +15 Volt Logic power supply = +15.0 Volts ± .1 VDC

○ 4. +15 Volt Logic display = Measured value?

○ 5. -15 Volt Logic power supply = 15.0 Volts ± .1 VDC

○ 6. -15 Volt Logic display = Measured value?

○ 7. +15 Volt Power monitor supply ≈ +15 VDC

○ 8. +15 Volt Power monitor display = Measured value?

○ 9. -15 Volt Power monitor supply ≈ -15 VDC

○ 10. -15 Volt Power monitor display = Measured value?

○ 11. B13 to B14 ≈ 6.3 VAC

○ 12. B13 to Chassis ground ≈ 3 VAC

○ 13. B14 to Chassis ground ≈ 3 VAC

B FILAMENT POWER SUPPLY CHECKLIST

○ 1. Current limit adjustment

○ 2. Filament overvolt adjustment

○ 3. Filament undervolt adjustment

○ 4. Filament voltage calibration

TITLE: CALIBRATION AND MAINTENANCE CHECKLIST (PHOTOCOPY THIS PAGE)

System Model Number 10667

System Serial Number ____________

Date ____________

Technician ____________

C ANALOG INPUT CALIBRATION CHECKLIST

- ○ 1. Body Current
- ○ 2. Beam Current
- ○ 3. Beam Voltage
- ○ 4. IPA Power Supply
- ○ 5. IPA RF Out
- ○ 6. Reflected Power (VSWR)
- ○ 7. RF Output Power

TITLE: CALIBRATION AND MAINTENANCE CHECKLIST (PHOTOCOPY THIS PAGE)

System Model Number 10667

System Serial Number ____________

Date ____________________

Technician ____________________

D DIGITAL FAULT INPUT CHECKLIST

- ○ 1. System Interlocks
- ○ 2. Airflow/Blower
- ○ 3. FPA Temp
- ○ 4. External Interlock
- ○ 5. External RF Inhibit
- ○ 6. AC Phase Imbalance

E WAVEGUIDE ARC CHECKLIST

- ○ 1. Waveguide Arc PCB Calibration
- ○ 2. Functional Test

TITLE: CALIBRATION PROCEDURE

A. LOGIC POWER SUPPLIES

A1. +5 VOLT LOGIC SUPPLY CALIBRATION

1.) Measure voltage at +5 volt test point on back of µp board. (See diagram A-17 for location)

2.) Adjust +5 volt logic supply to +5.1 volts ±.05 VDC (Power supply located in upper left corner of HPA cabinet- See diagrams A-18, A-19)

A2. +5 VOLT LOGIC DISPLAY ADJUSTMENT

1.) Using **R144** on the µp board (See diagram A-17) Adjust the +5 bolt logic display to match the measured value of the +5 volt logic supply.

A3. +15 VOLT LOGIC POWER SUPPLY CALIBRATION

1.) Measure voltage at +15 volt test point on back of µp board. (See diagram A-17 for location)

2.) Adjust +15 volt logic supply to +15.0 volts ± .1 VDC (Power supply located in upper left corner of HPA cabinet- See diagrams A-18, A-19)

A4. +15 VOLT LOGIC DISPLAY ADJUSTMENT

1.) Using **R143** on the µp board, (See diagram A-17) Adjust the +15 volt logic display to match the measured value of the +15 volt logic supply

A5. -15 VOLT LOGIC POWER SUPPLY CALIBRATION

1.) Measure voltage at -15 volt test point on back of µp board. (See diagram A-17 for location)

2.) Adjust -15 volt logic supply to -15 volts ±.1 VDC (Power supply located in upper left corner of HPA cabinet- See diagrams A-18, A-19)

(A6.) -15 VOLT LOGIC DISPLAY ADJUSTMENT

1.) Using **R145** on the µp board (See diagram A-17) Adjust the -15 volt display to match the measured value of the -15 volt logic supply

(A7.) +15 VOLT POWER MONITOR SUPPLY

Note: This supply has a fixed, regulated output. It typically works or it doesn't! No adjustment or repair is possible.

1.) Measure the "Plus (+)" output of the power monitor supply (See diagram A-18 for supply location) with reference to the "com" terminal. The voltage should be +15 volts (within 1 or 2 tenths of a volt)

(A8.) +15 VOLT POWER MONITOR DISPLAY

Note: This display is active only after the system is out of "delay" and in teh "standby" mode. During the "delay" period this display is available via the RS232 port under the "RS" (Report Status) command. However, the "RS" function must be done using successive updates of the "Report Status".

1.) Using **R141** on the µp board (See diagram A-17), Adjust the +15 volt power monitor display to match the measured value of the +15 volt power monitor supply.

(A9.) -15 VOLT POWER MONITOR SUPPLY

Note: See "Note" in A7

1.) Measure the "minus (-)" output of the power monitor supply (See diagram A-18 for supply location) with reference to the "com" terminal. The voltage should be -15 volts (within 1 or 2 tenths of a volt)

TITLE: CALIBRATION PROCEDURE

(A10) **-15 VOLT POWER MONITOR DISPLAY**

NOTE: See "NOTE" in A8

1.) Using **R142** on the µp board (See diagram A-17), Adjust the -15 volt power monitor display to match the measured value of the -15 volt power monitor supply.

(A11) **LINE MONITOR AC (B13-B14)**

NOTE: The µp board uses an AC input from a small stepdown transformer (See A-18 for location) to monitor the line voltage. This tells the µp when a power failure is occurring. This allows the µp to store all pertinent operational info prior to the loss of all DC supplies during a power failure.

1.) Measure the **AC** voltage across B13 and B14 on the lower, component side connector of the µp board. The voltage should be ≈ 6.3 VAC. (See diagram A-17 for connector location.)

(A12) **LINE MONITOR AC (B13 TO GROUND)**

1.) Measure the **AC** voltage from B13 to Chassis Ground on the lower, component side connector of the µp board. The voltage should be ≈ 3 VAC. (See diagram A-17 for connector location.)

(A13) **LINE MONITOR AC (B14 TO GROUND)**

1.) Measure the **AC** voltage from B14 to Chassis Ground on the lower, component side connector of the µp board. The voltage should be ≈ 3 VAC. (See diagram A-17 for connector location.)

B. FILAMENT POWER SUPPLY CALIBRATION

NOTE: See assembly print **D15249** for filament pan layout.

The complete filament pan schematic is **32C1986**

CAUTION !!!!

NEVER, EVER, WORK

ON ANY FILAMENT CIRCUITRY

WHEN THE AMPLIFIER IS IN

TRANSMIT !!!

THIS INCLUDES ANY

CALIBRATIONS OR

FILAMENT VOLTAGE ADJUSTMENTS !!!

THE HIGH VOLTAGE POTENTIALS

PRESENT WILL KILL YOU !!!!

SAFETY TIP: ALWAYS PULL OUT

THE "CONTROL" BREAKER IN THE

BEAM SUPPLY DRAWER! THIS WILL

DISABLE THE HIGH VOLTAGE CONTACTOR

WHICH APPLIES THE INPUT AC

VOLTAGE TO GENERATE THE

BEAM VOLTAGE.

(B1.) FILAMENT CURRENT LIMIT ADJUSTMENT

1.) Adjust **R12** on the filament supply (See diagram A-20 for location) approximately 2/3 of a turn clockwise from the fully counter clockwise position.

NOTE: Diagram of R12 in A-20 shows the wiper of R12 in a valid operating position. Duplicating this position on your supply should provide adequate operation.

(B2.) FILAMENT OVERVOLT ADJUSTMENT (6.6 Volts)

1.) Using **R20** on the filament supply (See diagram A-20), increase the filament supply output to **6.6 Volts** as metered by the front filament voltage panel meter. (R20-counter clockwise=Voltage Increase)

2.) Filament voltage should "crowbar" at this point and drop back to approximately 1 volt and draw 1 to 2 amps of filament current.

3.) If the circuit works normally (overvoltage trip at 6.6 volts), decrease the filament voltage by adjusting **R20** on the filament supply (See diagram A-20) "CW" approximately 1 turn. Then reset the power supply by pulling out the "filament" breaker in the beam supply drawer and then pushing it back in. The filament voltmeter will probably read between 6.0 and 6.6 volts. Adjust the filament voltage to 6.0 volts using **R20** and continue to procedure (B3).

TITLE: CALIBRATION PROCEDURE

4.) If the power supply does not trip out at 6.6 volts, adjust **R33** (See diagram A-20) slowly counter clockwise until the filament supply "crowbars" at 6.6 volts. (NOTE: Higher trip levels will cause severe tube damage in the event filament voltage exceeds 6.6 volts.) Reset filament voltage by adjusting R20 approximately 1 turn CW. Then pull out the "filament" breaker in the beam supply drawer and push it back in. Adjust R20 for a 6.0 volt reading on the filament voltage panel meter.

5.) If the filament supply "crowbars" prematurely (< 6.6 volts), adjust **R33** slightly clockwise (See diagram A-20) and reset the filament supply by pulling out the "filament" breaker in the beam supply drawer and then pushing it back in. Increase the filament voltage to 6.6 volts and follow the instructions in the previous step (B2-4).

B3. <u>FILAMENT UNDERVOLT ADJUSTMENT</u> (4.4 volts)

1.) Using PC board assembly print **B15060-022** or **B16466** clip your digital volt meter (DVM) leads across the opto-isolator output leads: C-collector and E-emitter. (NOTE: Filament undervolt sense PCB is located directly behind and attached to the filament voltage panel meter in front. See filament pan assembly print D15249).

TITLE: CALIBRATION PROCEDURE

2.) Using **R20** on the filament supply (See diagram A-20) reduce the filament voltage to 4.4 volts as displayed on the filament voltage panel meter.

3.) Adjust **R3** on the filament undervolt sense PCB (See assembly print B15060-022 or B16466 for location) to "Just" obtain a logic high condition on the output leads of the opto-isolator. This will be approximately 2-3 volts on your DVM.

(B4) **FILAMENT VOLTAGE CALIBRATION** (6.0 volts)

1.) Using **R20** on the filament supply (See diagram A-20) adjust the filament voltage to **6.0** volts as displayed on the front filament voltage panel meter.

C. ANALOG INPUT CALIBRATIONS

C1. BODY CURRENT CALIBRATION

1.) Set up an external bench power supply as shown in diagram A-21.

2.) Pull out the "control" breaker in the beam supply drawer, (this keeps the high voltage from coming up.)

3.) Bring system into "logic" transmit by pressing the "xmit" button after the system goes into the standby mode. The system will appear to be in transmit at this time. However, a number of displays will give eroneous indications because of the absence of high voltage.

4.) Increase the output voltage of the external bench supply to **.450** volts as measured by your digital volt meter (DVM).

5.) Using **R22** on the µp board (See diagram A-17 for location) adjust the body current display for a reading of 45 milliamps. Body current display is now calibrated.

NOTE: ALTERNATE METHOD FOR CALIBRATING BODY CURRENT.

6.) Push in the "control" breaker in the beam supply. (This will enable the 3-phase contactor and allow the high voltage to come up.)

TITLE: CALIBRATION PROCEDURE

7.) Bring system into transmit. NOTE: Be sure system is transmitting into a dummy load.

8.) Apply RF at a normal operating level. (This will help to elevate the body current level slightly.)

9.) Using your "DVM", measure the voltage across R1 on the beam/body sense board. (The 10 ohm resistor-see diagram A-21 or print #B15249.)

10.) Using Ohm's Law, calculate the current through R1.

$\frac{E}{R} = I$

$$\frac{\text{(voltage measured across R1)}}{\text{10 Ohm}} = \text{Body Current}$$

11.) Using **R22** on the μp board (See diagram A-17 for location) adjust the body current to reflect the calculated value of the body current.

TITLE: CALIBRATION PROCEDURE

C2. BEAM CURENT CALIBRATION

1.) Set up an external bench power supply as shown in diagram A-21.

2.) Pull out the "control" breaker in the beam supply drawer. (This keeps the high voltage from coming up.)

3.) Bring system into "logic transmit by pressing the "xmit" button after the system goes into the standby mode. The system will appear to be in transmit at this time. However, a number of displays will give eroneous indications because of the absence of high voltage.

4.) Increase the output voltage of the external bench supply to **5.50** volts as measured by your digital volt meter (DVM).

5.) Using **R26** on the μp board (See diagram A-17 for location) adjust the beam current display for a reading of 1.10 amps. The current display is now calibrated.

NOTE: ALTERNATE METHOD FOR CALIBRATING BEAM CURRENT.

6.) Push in the "control" breaker in the beam supply. (This will enable the 3-phase contactor and allow the high voltage to come up.)

7.) Bring the system into transmit. NOTE: Be sure system is transmitting into a dummy load.

8.) Using your "DVM", measure the voltage across **R2** on the beam/body sense board. (The 5 ohm resistor-see

TITLE: CALIBRATION PROCEDURE

diagram A-21 or print #B15249.)

9.) Using Ohm's Law, calculate the current going through R2.

$$\frac{E}{R} = I \qquad \frac{\text{(voltage measured across R2}}{\text{5 ohm}} = \text{Beam Current}$$

10.) Using **R26** on the μp board (See diagram A-17 for location) adjust the beam current display to reflect the calculated value of the beam current.

TITLE: CALIBRATION PROCEDURE

C3. BEAM VOLTAGE CALIBRATION

This is a very DANGEROUS procedure!!! High Voltage will be exposed!!! Extreme Caution is Advised!!!

NOTE: This procedure is best done with the aid of a terminal attached to the RS232 port (The 25 pin connector on top of the HPA in the front, left, corner)

CAUTION: LETHAL VOLTAGES WILL BE PRESENT DURING THIS PROCEDURE !!!

1.) Remove all AC voltages from the HPA and pull out the beam supply drawer.

2.) Remove safety cage.

3.) Reapply AC power and bring the system into standby. Be sure the "control" breaker in the beam supply is pushed in.

4.) Enter the "sp" routine via the RS232 terminal and change the beam voltage parameter (the first parameter to come up) to "7000". Then exit the routine by hitting "return" and escape".

NOTE: 7000 volts is the lowest voltage that can be understood and implemented by the micro processor as the regulation range is typically 7000 to 9000 volts. Entering 7000 will keep the variac from ramping up even if the actual beam voltage is much lower than 7000 volts at the minimum variac position.

5.) Insert your HV probe into the right hand solder terminal hole of the top resistor in the beam supply bleeder stack. (See B4 section 3 or print number E15251, R4-terminal "A" for location.) Attach the HV probe reference lead to pwr supply return. (The front lead of the 5ohm resistor on the beam/body sense pcb. See A18, A19, and print number's C16540 and D15249 for location.)

6.) Bring the system into transmit by pressing the "xmit" button.

CAUTION !!!

LETHAL VOLTAGES NOW

PRESENT !!!

Follow all High Voltage Safety precautions! Be sure to have another person present to assist you! Know what you're doing before you start!!! The Voltages present ARE LIFE THREATENING!!!!

7.) Take a voltage measurement reading from your digital voltmeter.

8.) If the measured HV is less than 7000 volts access the "sp" routine as in step #4 and increase the beam voltage in 100 volt increments until the measured beam voltage is approximately 7100 volts. (NOTE: If the measured beam voltage approaches 8000 volts with no increase in the digital display value, place system in standby by hitting the "stby" button immediately! Do Not let the variac run away with the beam voltage. Call MCL customer service for advice before continuing at (630) 759-9500.) You may also call Green Satellite Systems at (630) 554-0800.

9.) If the measured HV is greater than or equal to 7000 volts, adjust R3 on the signal filter pc board to make the µp beam voltage display match the measured high voltage. (NOTE: While making display adjustments, it is common for the variac to "ramp" causing the measured beam voltage to change. This is okay and should be expected. Allow the system to stabilize and continue the adjustment as necessary to make the display match the measured voltage.) (See print number E15251 and B15251-2 for location of pcb and R3.)

10.) Enter the "sp" routine again and enter a beam voltage value of "7500". (or 300 volts above present value up to "8000" if present value is greater than or equal to 7400.) NOTE: **Do Not Let Measured Beam Voltage Go Above 8300 Volts!!!** Adjust R34 on the µp board to make the beam voltage display match the measured beam voltage. (See A-17 for potentiometer location) again; expect the variac to "ramp" and the measured beam voltage to change.

11.) Enter the "sp" routine again as in step number 4 and enter a beam voltage parameter of "7100". Adjust R3 on the signal filter pcb to make the µp beam voltage display match the measured beam voltage.

12.) Enter the "sp" routine again as in step number 4 and enter a beam voltage parameter of "8200". Adjust R34 on the µp board to make the µp beam voltage display match the measured beam voltage.

13.) Repeat steps number 11 and 12 two more times or until the beam voltage display and the measured beam voltage track within ½ % (about 40 volts).

C4 IPA POWER SUPPLY CALIBRATION

NOTE: The IPA power supply calibration can ONLY be seen by accessing the "RS" (report status) routine via the RS232 port on top of the HPA in the left front corner. (25 pin connector)

1.) Measure the IPA power supply voltage at the +15 volt input terminals of the solid state amplifier (IPA). (See A-18 for location of the IPA.)

2.) Note the voltage.

3.) Using the "RS" (report status) routine via the RS232 port, compare the measured voltage to the "RS" value.

4.) If the two values are approximately equal, (within a volt of each other) no adjustment is necessary.

5.) If necessary, adjustment may be accomplished by increasing or decreasing the "RS" value. This is done by adjusting R42 on the μp board (See A-17 for location).

6.) CW= increase, CCW= decrease.

7.) Adjust R42 in small increments taking a status report ("RS") after each adjustment until the reported value is approximately equal to the measured value.

(C5) IPA RF OUTPUT CALIBRATION

1.) Pull out "control" breaker in beam supply. (lower left cormer of beam supply. Also see print number E15251 CB3 designation for location.) Bring system into "standby".

2.) Remove "N" type semi-rigid connector from klystron tube RF input. (on back of tube.)

3.) Install a 20dB pad and a female to female type "N" adapter (bullet) into the end of the semi-rigid RF cable. (See A-22)

4.) Increase input attenuation of HPA to maximum position by adjusting the manual input attenuator fully counter-clockwise. (CCW)

5.) The motorized attenuator MUST be set to minimum attenuation (maximum RF out) position. This may be accomplished by pressing and holding the "dec atten" (decrease attenuation) button on the front control panel for about 30 or 40 seconds.

6.) Attach a power meter, RF sensor (power head) to the output of the assembly described in step number 3. (Be sure to set meter to the highest range to start-digital meters are auto ranged.)

7.) Apply RF to the system input. (Preferably CW at midband-6165 MHZ) -15 dBm should be sufficient.

8.) Reduce power meter scale (if not digital) to the +10 scale. (Check that analog meters do not "peg".)

TITLE: CALIBRATION PROCEDURE

9.) Using the manual input attenuator, increase the RF level by turning the adjustment shaft clockwise (CW) until the RF power meter indicates an RF level of +26.53 dBm.

NOTE 1: This will appear as +6.53 dBm on a digital RF power meter or -3.5 dBm on an analog power meter set to the +10 dBm scale.

NOTE 2: The RF input source may be an RF sweep generator set to mid-band continous wave (CW)-E.G. 6165 MHZ, or an exciter set to CW on transponder (channel) 12.

10.) Using R38 on the μp board (see A-17 for location), adjust the "IPA power" display to 450 (a value within 2 or 3 MW is accurate enough).

TITLE: CALIBRATION PROCEDURE

(C6) REFLECTED POWER (VSWR) CALIBRATION

1. Pull out the "control" breaker in the lower left hand corner of the beam supply.
2. Install a shorting plate on the output flange of the klystron waveguide ass'y in the rear, right corner on top of the HPA. (Use at least 4 screws to safely secure the plate, one on each side of the flange).
3. Go to maximum RF attenuation on both the input, manual attenuator (Fully CCW) and the motorized attenuator (press "atten inc" buttom for 30 to 40 seconds).
4. Install the power sensor of an RF power meter on the lowest crossguide directional coupler of the system, output waveguide. (This is the forward power port and normally has the system power monitor attached. The coupling factor is typically 46dB).
5. Push in the "control" breaker and bring system into xmit.
6. Apply a midband CW signal (E.G. 6165 MHZ) or use channel twelve from your exciter (un-modulated).
7. After the beam voltage has stabilized somewhat (3-4 minutes into xmit mode), slowly increase the output power to 250 watts using the motorized and manual attenuators.

   NOTE: 250 Watts = 54 dBm. 54dBm minus 46 dB coupling factor equals + 8.0 dBm measured with RF power meter.

TITLE: CALIBRATION PROCEDURE

8. Using R30 on the μp board (See A17 for location) adjust the "reflected power" display for a 250 watt reading. VSWR is now calibrated.

NOTE: Be sure to shut down the system and remove the shorting plate at the output flange before continuing.

An alternative method for Calibrating Reflected Power that requires no shorting plate or High Voltage.

Description: Since the coupling factor on the Reflected port is typically 39 dBM (be sure to check the label on the directional coupler), You may simulate reflected power by driving the Reflected Power Crystal Detector to +15 dBm. Even though the Control Breaker is out, and the Unit is in Logic transmit, the HPA thinks there is 250 Watts of reflected power.

1) Remove Crystal Detector from Reflected Power Directional Coupler.
2) Turn on HPA and bring into Stby.
3) Pull out "Control" Breaker in Beam Supply

NOTE: If you don't have an RF Source that will go up to +15dBm, you can use the Solid State Amplifier (IPA) that's on the right side of the cabinet. Be Careful though! It is a 1 Watt SSA (+30 dBm) and fully capable of destroying a Power Meter Sensor or even the Crystal Detector! Know your Power Meter's Limits and use an attenuator/pad if necessary.

4) Install a cable that will eventually mate with the Male SMA Crystal Input onto your source.
5) Use a power meter to measure +15 dBm (or the difference between the coupler, coupling factor, and +54 dBm which is 250 [251 actually] Watts) at the end of that cable and raise power accordingly (freq. = 6165 MHz).
6) Install the crystal onto the source cable.
7) Bring unit into "logic xmit." (Xmit indication on but no High Voltage because the Control Breaker has been disabled)
8) Adjust R30 on the back of the uP Board so the Reflected Power display indicates 250 Watts.
9) Increase the drive slowly and be sure that the unit trips at about 260 Watts of reflected power.
10) Restore unit to normal.

TITLE: CALIBRATION PROCEDURE

(C7.) **RF OUTPUT CALIBRATION**

1.) With HPA in standby install DVM test leads at µp board "D" connector, pins 24 and 25 (See A-23).

2.) Install the power head of an RF power meter at the calibrated sample port behind the front door panel. (It's best if the front door panel is wide open as access to the µp board and tube compartment are necessary during this procedure).

NOTE: If the sample port has been damaged (cable or connector) use the sample port directional coupler on the output waveguide. This is the last directional coupler prior to the HPA output flange. (Approximate coupling factor equal to 56 dB). This also applies to systems that have had their cal stickers peel off or systems that have had their sample ports moved to another location in the uplink facility by the installation contractor.

3.) Bring the HPA into XMIT without drive. (shut off, remove or inhibit drive) using a small screwdriver or and alignment tool (tweaker) turn the "meter zero adjust" potentiometer found on the left side of the front door panel for a zero voltage reading on your DVM (.000 volts on the MV scale).

4.) Apply drive to the HPA at midband (transponder 12 or 13) and increase power for 60.0 dBm output level as measured by your RF power meter at a calibrated port. (60.0 dBm-coupling factor = RF power meter reading).

TITLE: CALIBRATION PROCEDURE

5.) Adjust the "cal adjust" pot in the Narda or General Microwave power monitor for a .250 volt display on your DVM. (Be sure your output power has not deviated from 60.0 dBm).

6.) Calibrate your front panel "RF output" display to "1003" using R63 on the µp board. (See A-17 for location). Calibration complete.

TITLE: CALIBRATION PROCEDURE

D. DIGITAL FAULT INPUT CHECKLIST

D1. SYSTEM INTERLOCKS

(**NOTE:** See schematic 32E2007 and A-24)

1. The system interlock switches are 3 position switches located on the right, front, angle iron, bracket in the system cabinet.

2. Switches are located behind the:

   Control panel door

   Filament pan cover

   E-M regulator drawer

   Beam supply drawer

3. To test switches:

   A.) Bring system into delay or standby.

   B.) Open panels listed in **D1-2,** one at a time, checking for an interlock fault.Each time a panel is opened and a fault is observed, close and secure the panel and press the "fault reset" button. This will clear the red indicator if the panel has been properly secured and allow you to proceed to the next check.

TITLE: CALIBRATION PROCEDURE

D2. AIRFLOW/BLOWER

1. The airflow fault may be tested by bringing the system into standby and by pulling out the "blower" circuit breaker in the lower left corner of the beam supply drawer.

2. The following fault indications should occur:

   Airflow

   Filament

   IPA power supply

   Power monitor +15 V

   Power monitor -15 V

   RF inhibited

   (**NOTE:** It may take several seconds for the blowers to slow down and the airflow vane switch to trip)

3. During an airflow fault please note that the filament relay is opened, dropping out the filament supply, the IPA power supply, and the power monitor supply.

4. Reset the blower circuit breaker by pushing it in and the associated fault indications by pressing "fault reset".

TITLE: CALIBRATION PROCEDURE

(D3) FPA TEMP

1. The FPA (final power amplifier) temp fault occurs when an open is sensed (by the µp pcb) in the FPA temp circuit.
2. The klystron tube manufacturer has provided a temperature switch which is mounted on the top of the klystron collector. This is a normally closed switch which typically opens at 265°C and closes at about 240°C.
3. To simulate a failure you need only remove one of the fork lugs marked "K1" or "K2" from the small terminal block mounted to the tube tuning mechanism while the unit is in standby.
4. Replace the fork lug and press "fault reset" to clear the fault.

TITLE: CALIBRATION PROCEDURE

D4 EXTERNAL INTERLOCK

1. P13-13 (The remote connector, pin 13) is normally tied to ground (P13-35) to complete the circuit. Removal of this jumper or any plug in the remote connector, should trigger the "external interlock" fault. (See schematic 32E2007.)

D5 EXTERNAL RF INHIBIT

NOTE: See A14

1. P13-9 (the remote connector, pin 9) is normally tied to ground (P13-35) through a network of waveguide switch contacts, switchover assemblies, or manual RF inhibit switches to kill the RF during times when RF output is not desired while high voltage is enabled (xmit).
2. The best time to test the RF inhibit circuit is when RF is applied to the system and the SSA output is being monitored (See C5, IPA RF out calibration).
3. Using an "RF power meter" to monitor the output of the IPA (SSA) (See A-22 for setup) enable the RF inhibit by turning a waveguide switch halfway, removing the plug from the remote connector, or removing the jumper between TB1-3 and TB1-4 in the filament pan.
4. When the inhibit is enabled the monitored RF should drop to less than 1 milliwatt.

TITLE: CALIBRATION PROCEDURE

D6 AC PHASE IMBALANCE

1. AC phase imbalance is merely an indication of the 10 amp buck/boost circuit breaker in the E-M regulator drawer having tripped. There is an additional switch built into the buck/boost breaker whose contacts are closed when the breaker is in the enabled (up) position. When the breaker trips, the contacts open and a fault is registered on the µp fault display.
2. To test this fault, simply flip the buck/boost breaker in the E-M regulator drawer to the **down** position while in the standby mode. A fault should appear.

TITLE: CALIBRATION PROCEDURE

E WAVEGUIDE ARC PCB

E1. WAVEGUIDE ARC PCB CALIBRATION

NOTE 1: See section B-4 for a basic circuit description.

NOTE 2: This board does not need frequent recalibration.
It may be advantageous to do a functional test.
(E2) first, to determine if calibration is needed.

ASSY#	SCHEM#	Q1 SENSITIVITY (DARK CURRENT)	Q2 SENSITIVITY (DARK CURRENT)	DRIVER TRANSISTOR BASE DRIVE (GAIN)
C16296	32C1738	R15	R16	R12, R13
C16326	32C2140	R11	R12	R7, R8

1. Adjust the driver transistor pots (The two pots farthest from the photo fets, Q1 and Q2) to approximately 50%. This is about 10 turns from either end of each potentiometer.

2. Adjust both "dark current" pots (The two pots closest to the photo fets Q1 and Q2) until DS1 (The "LED" closest to the photo fets Q1 and Q2) is totally darkened.

3. Adjust either "dark current" pot to "just" illuminate DS1. (The little silicon chip in the led will appear red with clearly defined edges.)

4. Adjust the same pot to "just" turn off the LED.

5. Repeat steps 3 and 4 for the other "dark current" pot.

TITLE: CALIBRATION PROCEDURE

(E2.) WAVEGUIDE ARC PCB FUNCTIONAL TEST

1. To check the function of the waveguide arc pcb, remove the fiber-optic cables from the arc detector elbow directly behind the klystron tube output flange.
2. Be sure the system is in either the delay or standby mode.
3. Wave a flashlight (lighted of course) across the end of each Fiber-optic cable while shielding the other cable from any light source. Each time DS2 on the waveguide pcb should flash momentarily. At the same time a waveguide arc fault should register on the front panel and can be cleared by pressing the fault reset button.
4. Do step 3 several times on each fiber-optic cable to be sure that the pcb is functioning satisfactorily.