

TM 9-6920-483-34-2

TECHNICAL MANUAL

**DS AND GS MAINTENANCE MANUAL
FAULT ISOLATION INSTRUCTIONS
FOR IR TRANSMITTING SET M89**

**DRAGON MEDIUM
ANTITANK/ASSAULT WEAPON SYSTEM**

HEADQUARTERS, DEPARTMENT OF THE ARMY

JULY 1982

SAFETY SUMMARY

The following are general safety precautions that personnel must understand and apply during operation and maintenance.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must observe safety regulations at all times. Do not replace components or make adjustments inside the equipment with high voltage present. Under certain conditions, dangerous potentials may exist when the power control is in the OFF position. To avoid injury, remove power and discharge and ground a circuit before touching it.

DO NOT SERVICE OR ADJUST ALONE

Under no circumstances should any person reach into the enclosure for the purpose of servicing or adjusting the equipment except in the presence of someone who is capable of rendering aid.

RESUSCITATION

Personnel working with or near high voltages should be familiar with modern methods of resuscitation.

WARNING

Personnel must wear safety goggles when destroying the I R lamp assembly to prevent eye damage or loss of sight.

The lamp bulb in the I R source is pressurized to about 215 psi. Safety goggles shall be worn and a protective shield for the body (such as plexiglass panel) shall be used whenever disassembly beyond the filter retainers (i.e., within the housing) is necessary. If lamp bulb is to be handled, light gloves shall be worn. Failed bulbs shall be disposed of by enclosing them within a thick plastic bag before breaking with a tool with a flat surface such as a shovel. Disposal techniques similar to those for cathode ray tubes are recommended.

Technical Manual)
)
No. 9-6920-483 -34-2)

HEADQUARTERS,
DEPARTMENT OF THE ARMY
Washington, D. C., 27 July 1982

DS AND GS MAINTENANCE MANUAL:

FAULT ISOLATION INSTRUCTIONS FOR IR TRANSMITTING SET M89

(DRAGON MEDIUM ANTITANK/ASSAULT WEAPON SYSTEM)

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*This manual supersedes TM 9-6920-483-34-2, 31 January 1977, including all changes.

CHAPTER 1
INTRODUCTION

1-1. PURPOSE AND SCOPE.

This manual contains fault isolation instructions for, the direct support and general support maintenance of the M89 infrared transmitting set.

1-2. TROUBLESHOOTING PROCEDURES.

Troubleshooting and testing of the training equipment and subassemblies will be accomplished by the procedures contained in chapter 2, and the schematics in TM 9-6920-483-34-1.

1-3. FORMS, RECORDS, AND REPORTS.

All personnel and organizations responsible for operating and/or maintaining this equipment are also responsible for the preparation and disposition of appropriate forms, records, and reports.

1-4. SECURITY RESPONSIBILITIES.

- a. The security classification of the DRAGON Weapon System Equipment is UNCLASSIFIED. Portions of data relative to the DRAGON system are classified.
- b. The importance of security of classified material cannot be overemphasized. Security is an individual as well as a Command responsibility.
- c. Safeguarding of classified material will be accomplished in accordance with current directives.

1-5. REPORTS OF EQUIPMENT MANUAL IMPROVEMENTS.

Reports of errors, omissions, and recommendations for improving this publication by the individual user are encouraged. U.S. Marine Corps reports should be submitted on Form NAVMC 10772 in accordance with MCO 5600.4 1 _____. All other should be submitted on DA Form 2028, Recommended Changes to Publications, and forwarded directly to: Commander, U.S. Army Missile Command, ATTN: DRSMI-SNPM, Redstone Arsenal, Alabama 35898.

CHAPTER 2
FAULT ISOLATION

2-1. GENERAL.

- a.* This procedure is designed to be used by an electronics technician when the target source fails to perform correctly.
- b.* We strongly recommend that you start at the beginning of the procedure and work through, and not skip or omit anything unless instructed, because the procedure is designed to work effectively only in this sequence.

2-2. TEST SEQUENCE.

Test sequences referenced in the procedure are:

“Troubleshooting The Power Supply Modulator” Instructions	begin on page 2-10
Lamp - “Failure to Modulate” - Instructions	begin on page 2-27
“Troubleshooting the PCA Card” Instructions	begin on page 2-30
Output Power Calibration Instructions	begin on page 2-46

2-3. SPECIAL EQUIPMENT.

Two pieces of special equipment required to perform these tests are:

- Tektronix type 422 oscilloscope -or- equivalent (with a compensated probe)
- Fluke digital multimeter, type 853A-03 -or- equivalent

Additional piece of equipment required to perform PSM Output Power Calibration

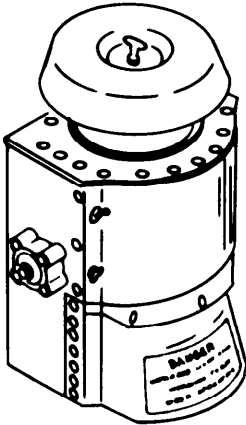
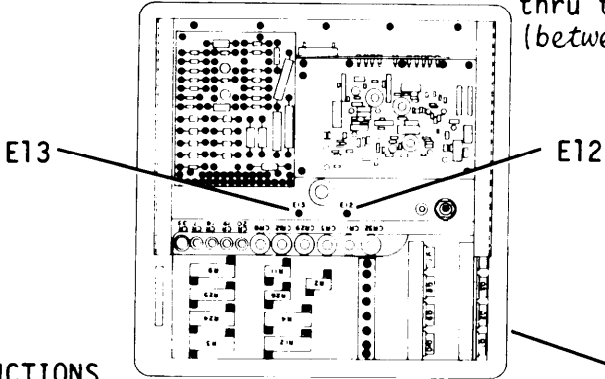
- Variable power supply 24 Vdc to 30 Vdc @ 30 Amps.

2-4. REPAIR PARTS.

Refer to TM 9-6920480-24P-1 for repair parts.

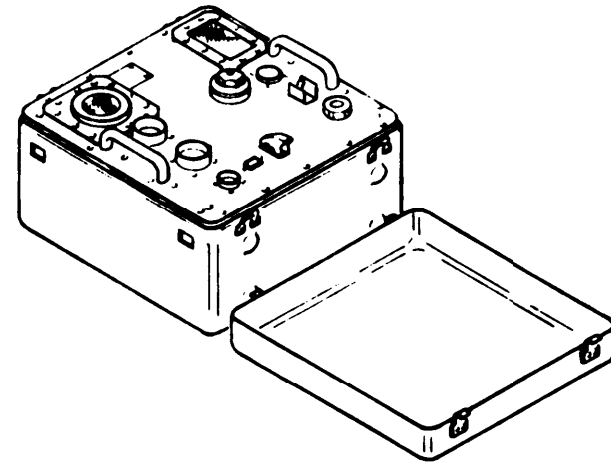
TO perform repairs on the TARGET SOURCE (TS)
& the POWER SUPPLY MODULATOR (PSM)
YOU need to understand each unit's purpose
& the functions it provides.

The TARGET SOURCE
houses/cool s the Xenon lamp
& provides optical filtering for the radiated light
has a high voltage power supply to light the lamp
thru the third electrode.
(between cathode & anode)



GENERAL INSTRUCTIONS

- BEFORE ANY ELECTRICAL TESTING
test all cables for continuity between appropriate pins
for shorts between adjacent pins
- IF ANY TEST FAILS TO FIND FAULTY COMPONENT
look for circuit wiring “OPENS”
look for circuit wiring ERRORS
look for circuit wiring “SHORTS”
- A FAILURE NOT UNCOVERED BY INSTRUCTIONS (during testing)
is cause to continue the test series (if possible)
as the failure is likely located by a later test
- VOLTAGE READINGS ARE TO GROUND
- ALWAYS USE E12 & E13 FOR GROUND CONNECTION
(chassis anodize may insulate "chassis ground")
- TO OBSERVE WAVE-FORMS
use Tektronix 422 oscilloscope or equivalent
use a compensated probe
(do NOT use coaxial cable/distort wave-forms)
- FOR DC VOLTAGE MEASUREMENT & CONTINUITY CHECKS
use Fluke Digital Multimeter or equivalent
- ALL RESISTANCE VALUES ARE IN OHMS



The POWER SUPPLY MODULATOR

provides cooling for itself
provides the lamp
with regulated/modulated power and its monitoring
& with controlled boost voltage for starting

has a DC-to-DC converter
has a modulation and power control card
has current and voltage control & switching for lamp starting
arc stabilizing
& normal operation.

GENERAL STRATEGY

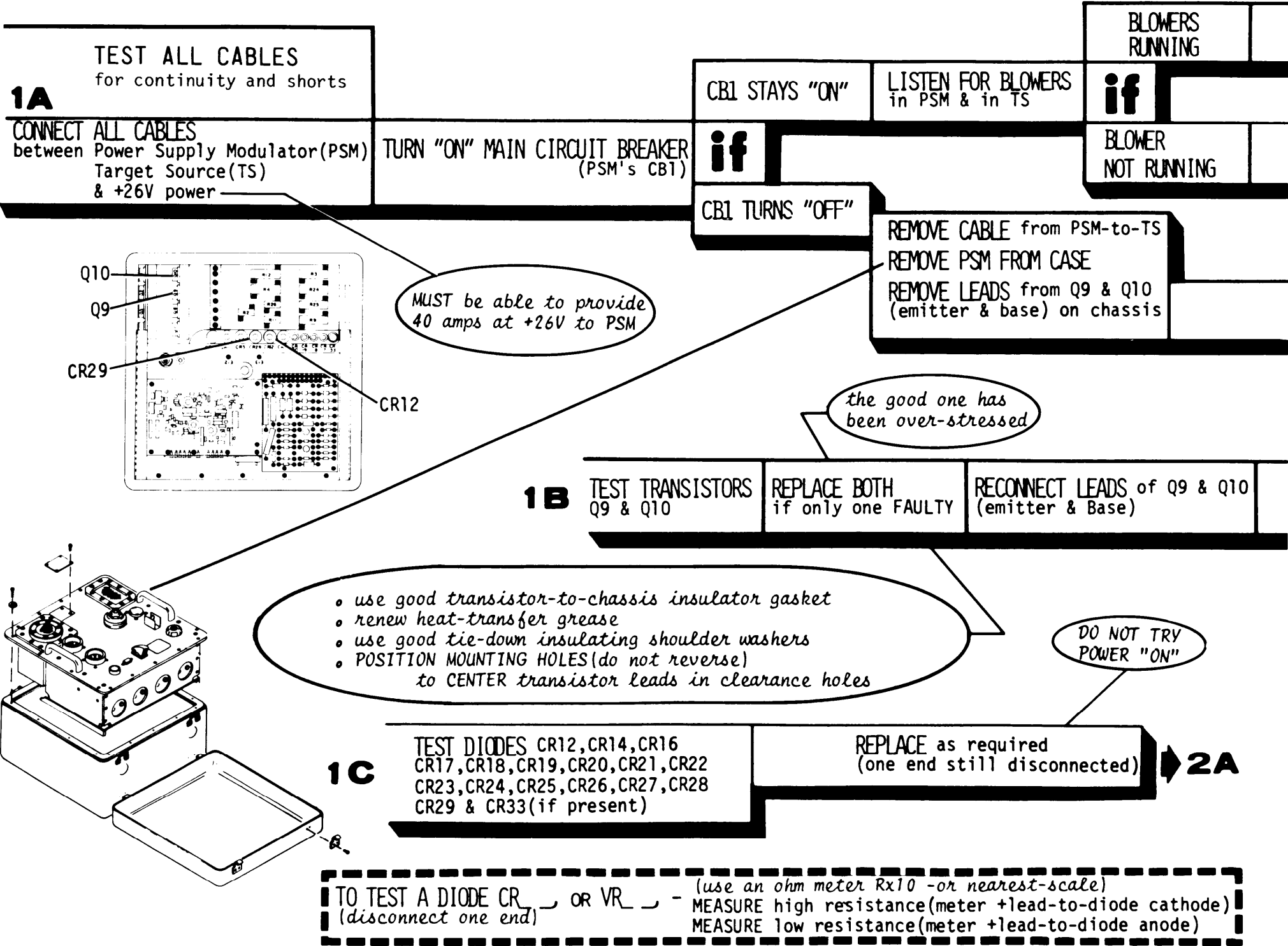
FIRST isolate the problem to the TARGET SOURCE(TS)
or POWER SUPPLY MODULATOR(PSM)
IF BOTH ARE FAULTY - repair the PSM first.

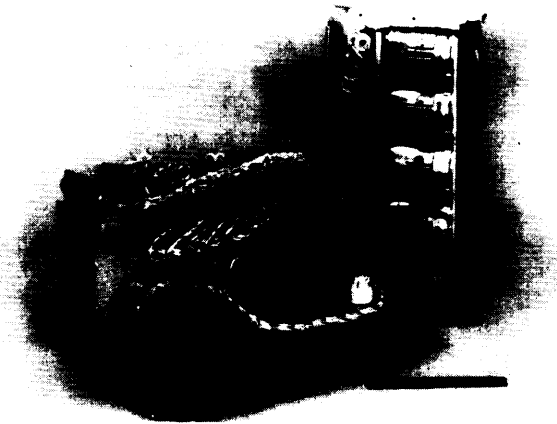
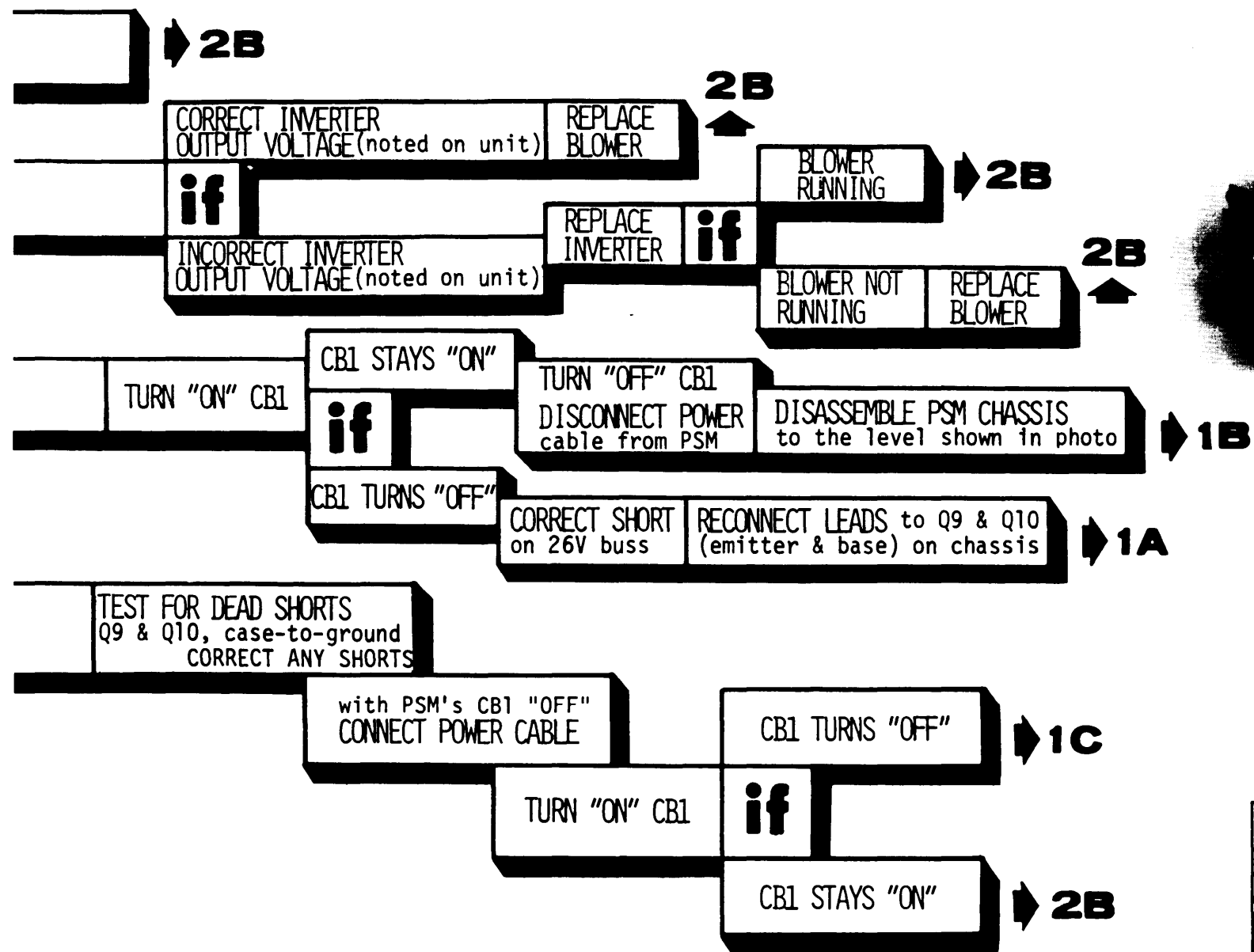
SECOND determine those basic functions not operating normally.

THIRD isolate the failed component
by checking the operation of all minor circuit functions
contributing to the faulty basic function.

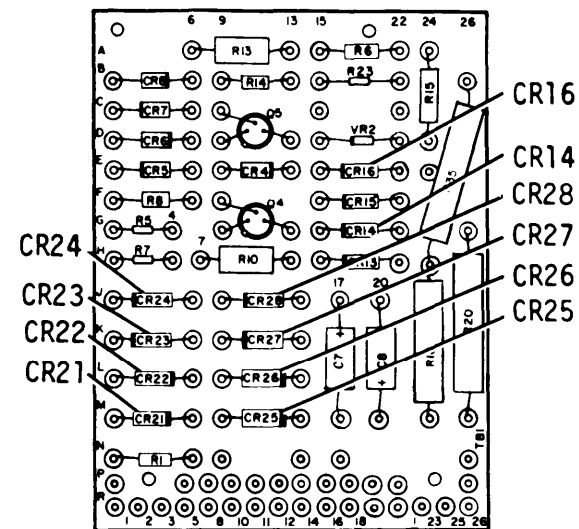


26V power cable leads





TO TEST A TRANSISTOR Q₉ - (use an ohm meter Rx10 -or nearest-scale)
 (±20% variation between parts is normal) - compare resistance readings to a new part
 (base-to-emitter/both directions)
 (base-to-collector/both directions)
 (collector-to-emitter/both directions)
 (used power transistors may have less resistance, collector-to-emitter)



WARNING

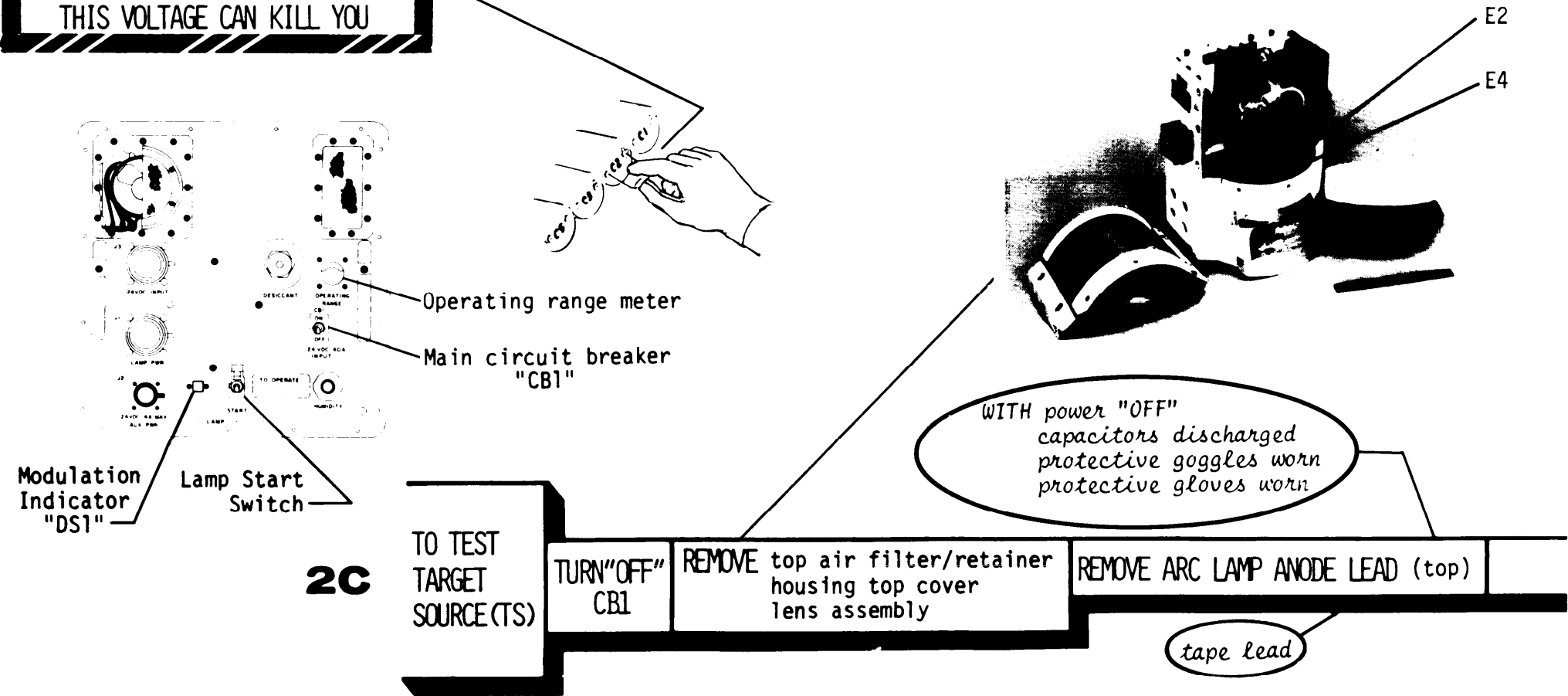
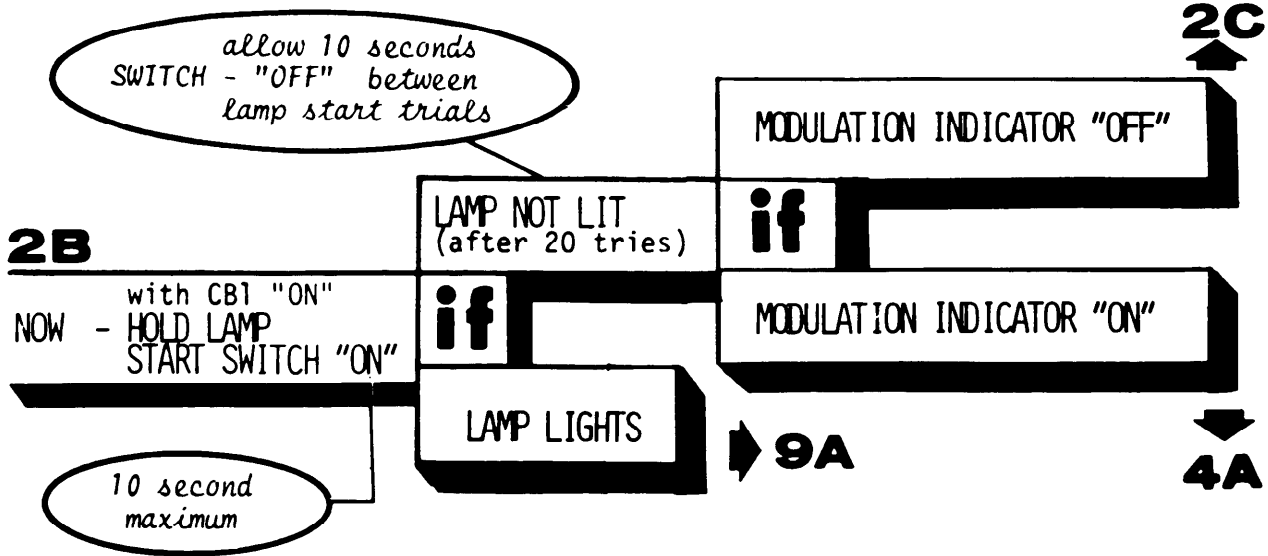
DO NOT LOOK AT LAMP DIRECTLY
(WITHOUT PROTECTIVE GOGGLES)

LEAVE LENS GUARD IN PLACE
BELOW SURROUNDING TEMPERATURES
OF 86°F/30°C

ALWAYS WEAR PROTECTIVE GOGGLES
NEAR TARGET SOURCE - IF LENS
GUARD IS NOT IN PLACE

NEVER TOUCH LAMP BULB ANODE
LEAD - UNLESS ALL POWER IS "OFF"
-- AND CAPACITORS C1 C2 C3 C5
ARE FIRST DISCHARGED THROUGH AN
APPROX. 100 OHM/2 WATT RESISTOR

THIS VOLTAGE CAN KILL YOU



2A

WITH ONE END OF ALL DIODES
STILL DISCONNECTED

TEST FOR SHORTS-TO-GROUND from +side of C7,C9,C12
from -side of C8,C10
from J2-B(front panel) to ground

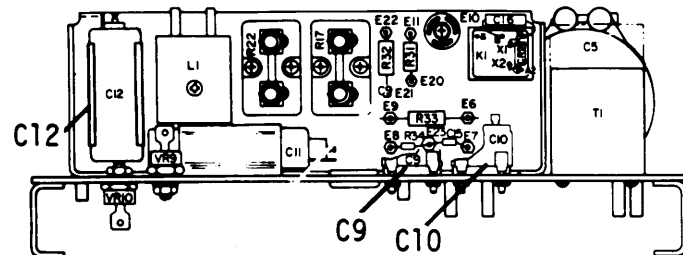
REPAIR shorts to ground

DO NOT TRY
POWER "ON"

RECONNECT ALL
DIODE WIRES

REMOVE LEADS from Q9 & Q10
(emitter & base)

➡ **1B**



CHECK CABLE
CONNECTOR
W1P2 AT TS

prepare to
SAFELY OBSERVE voltages
and high voltage sparking
in the Target Source

TURN "ON"
CB1

USE W1P2 CABLE AT TS
for checking voltages

on High Voltage Power Supply
MONITOR VOLTAGE (with voltmeter)
Pin 4 to Pin 8 $+400 \pm 80V$
Pin 3 to Pin 8 $+26 \pm 2V$
WHILE HOLDING
LAMP START SWITCH "ON"

BOTH VOLTAGES CORRECT

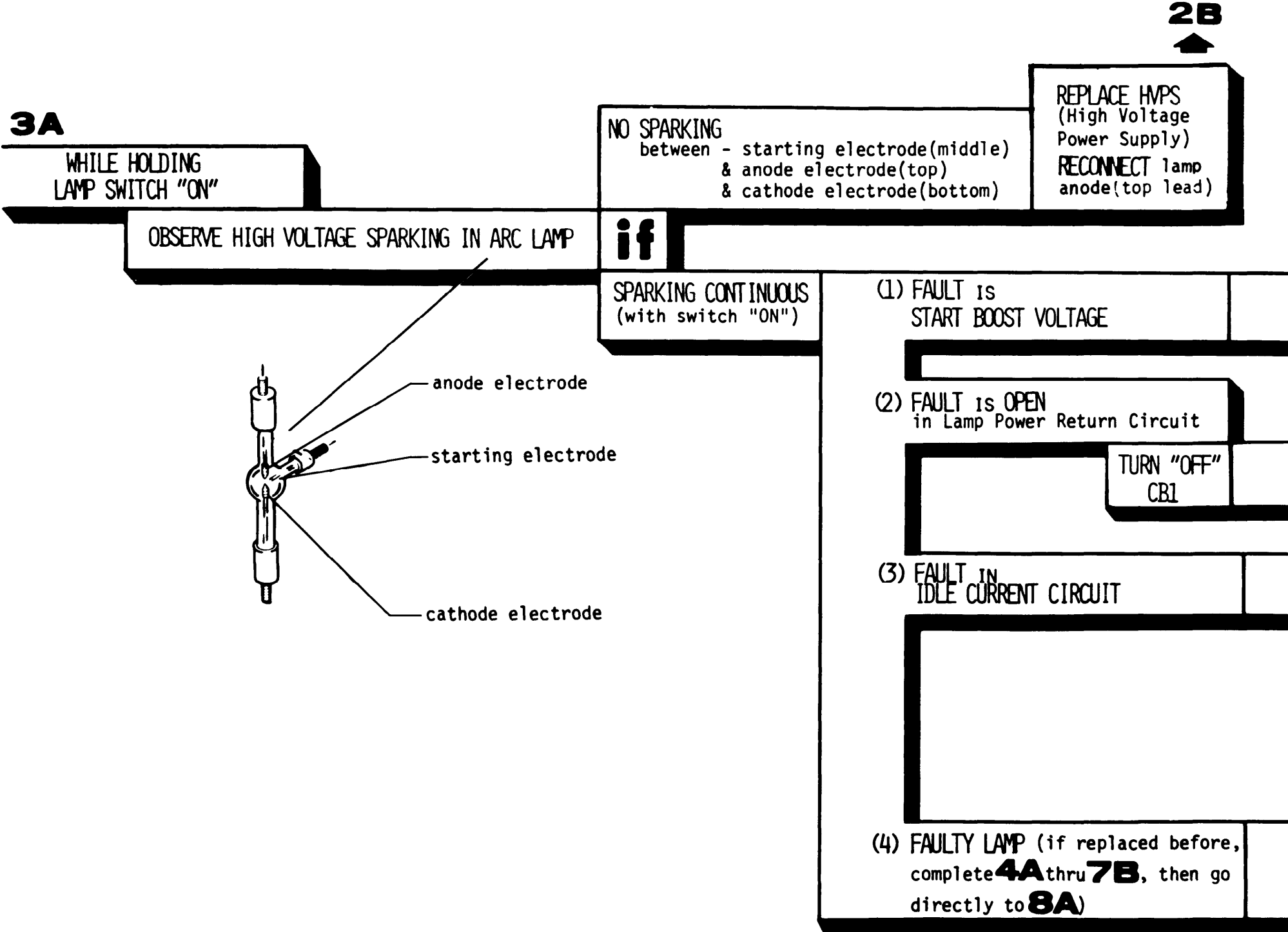
➡ **3A**

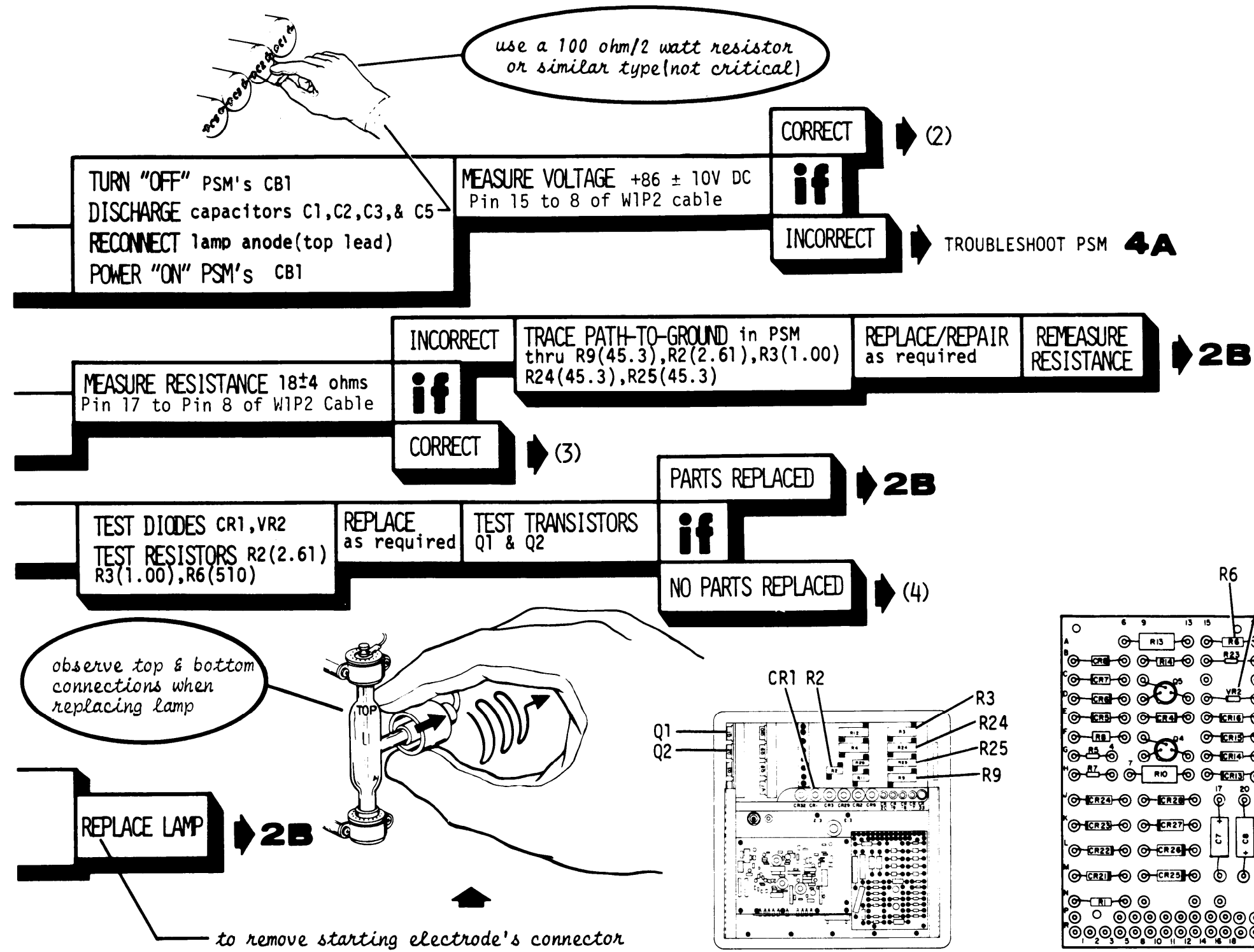
if

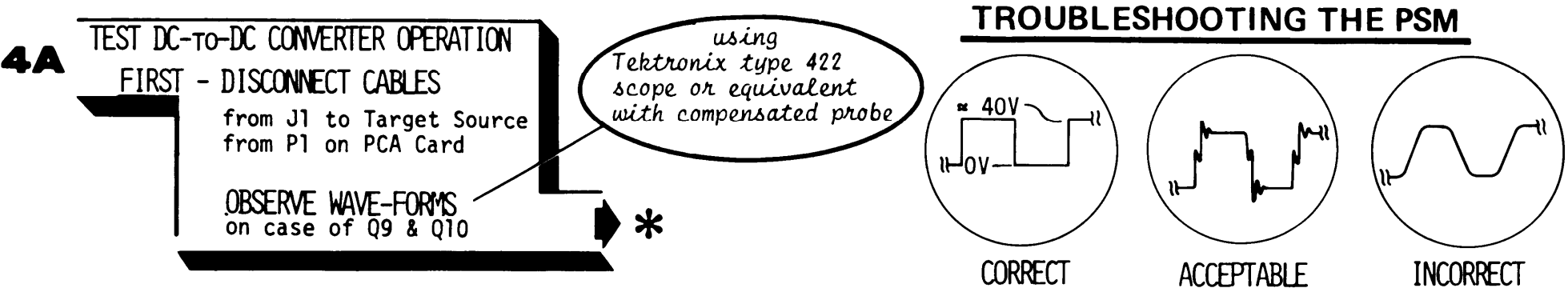
EITHER BOTH
INCORRECT

TROUBLESHOOT
PSM

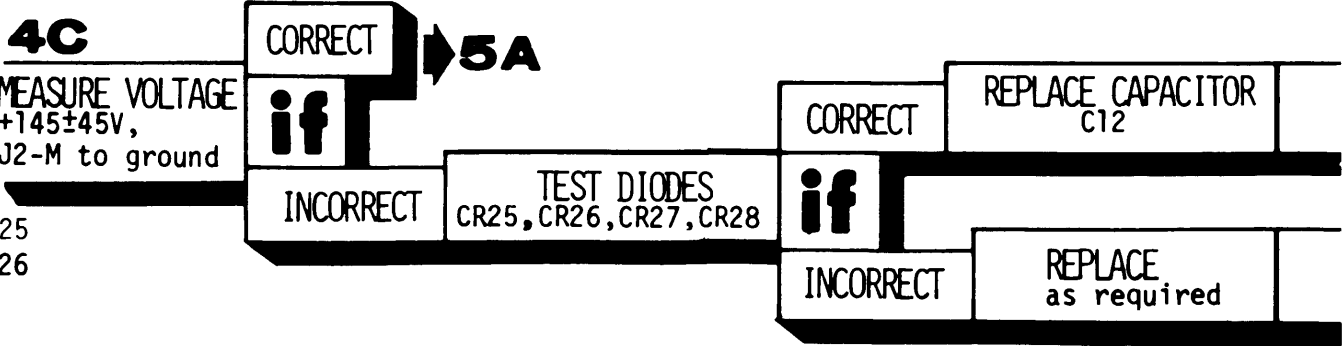
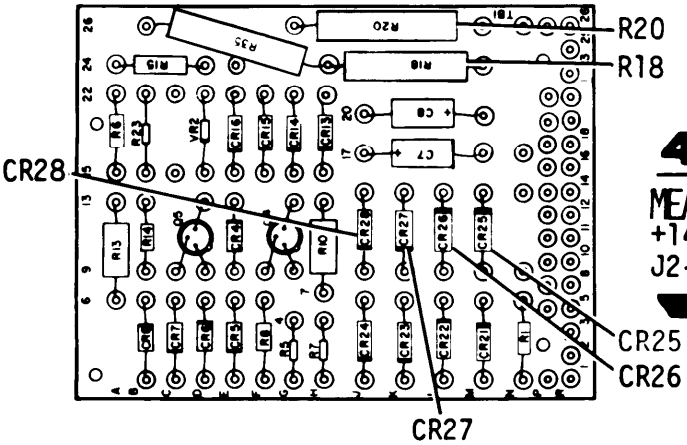
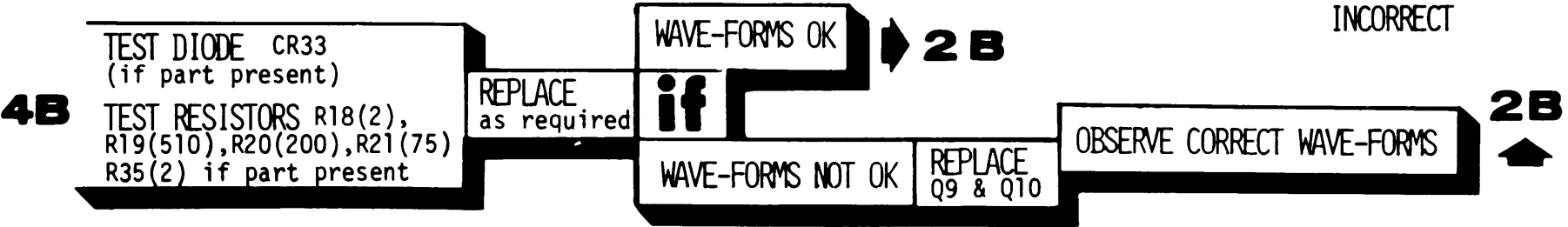
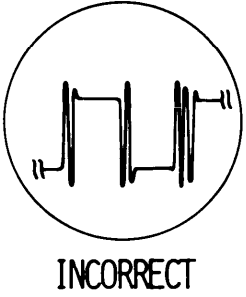
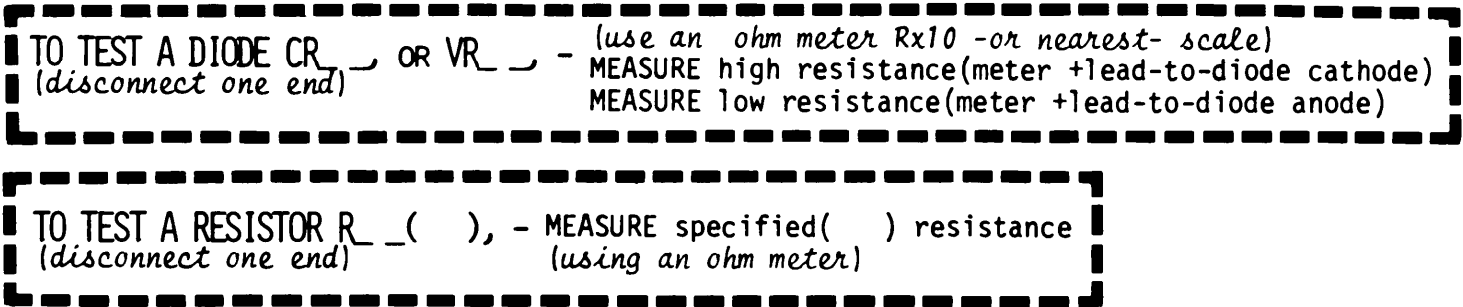
⬆ **4A**

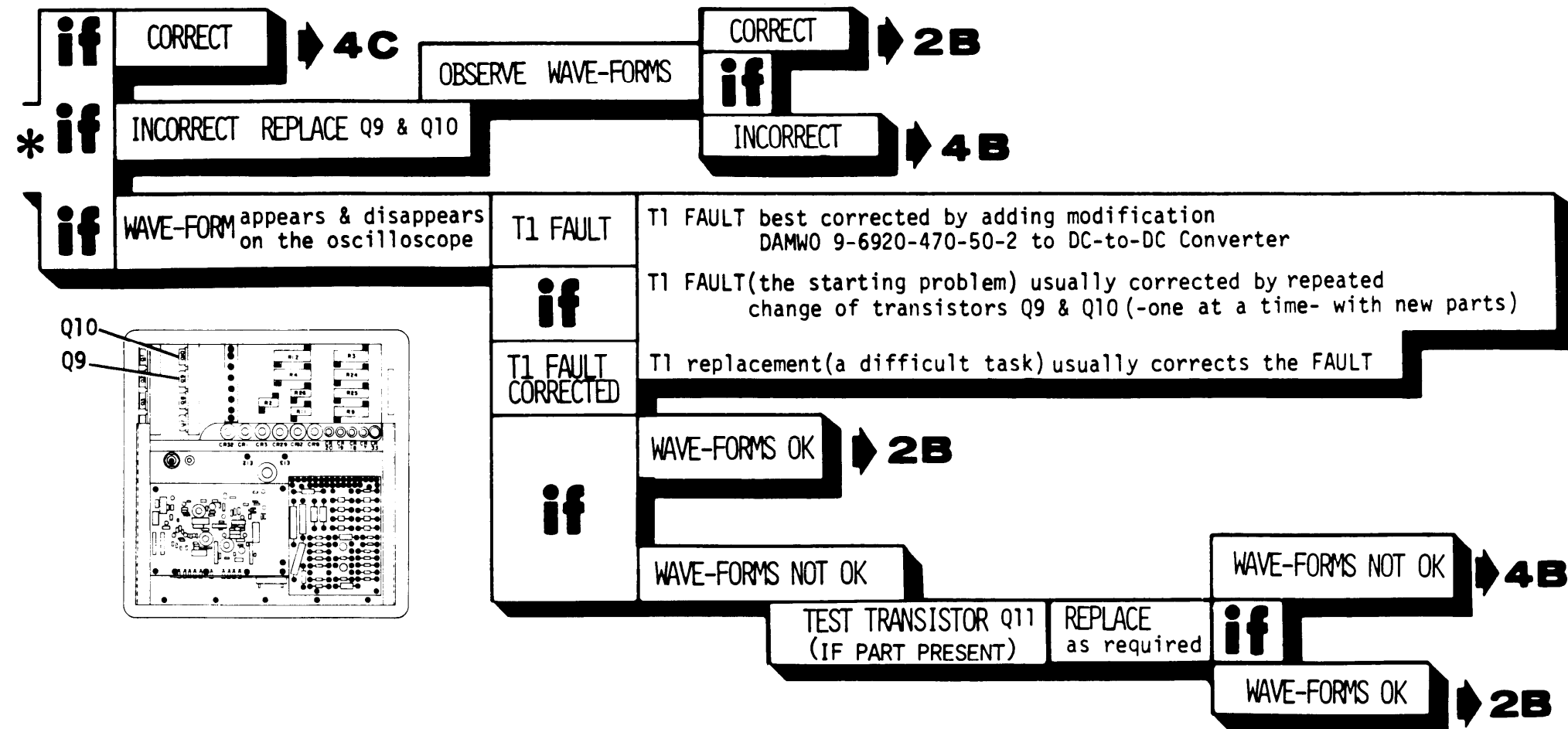






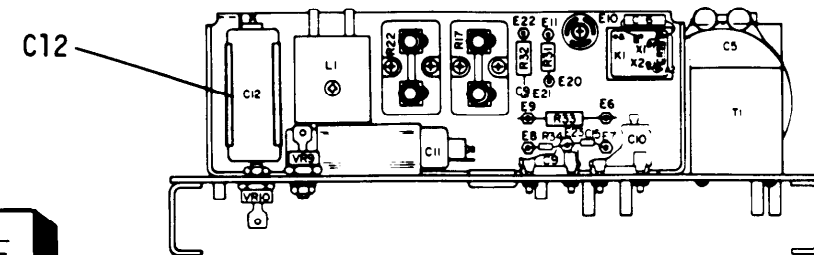
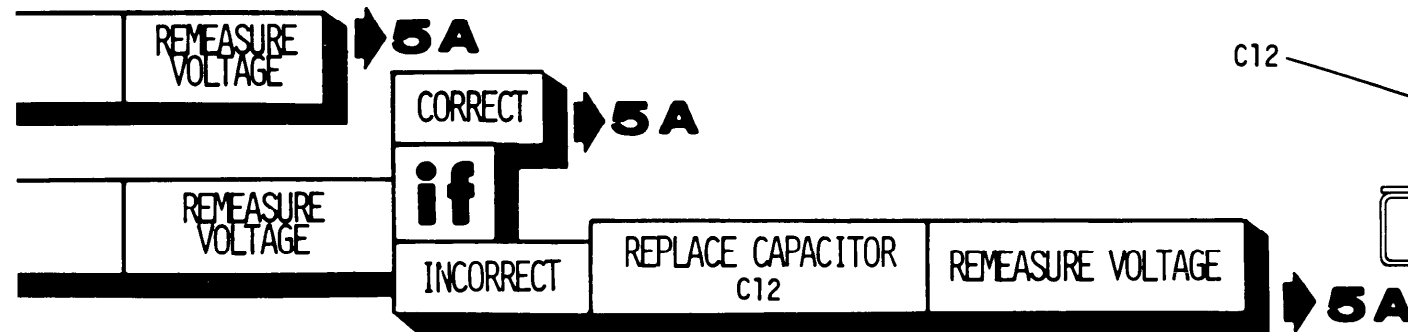
TROUBLESHOOTING THE PSM

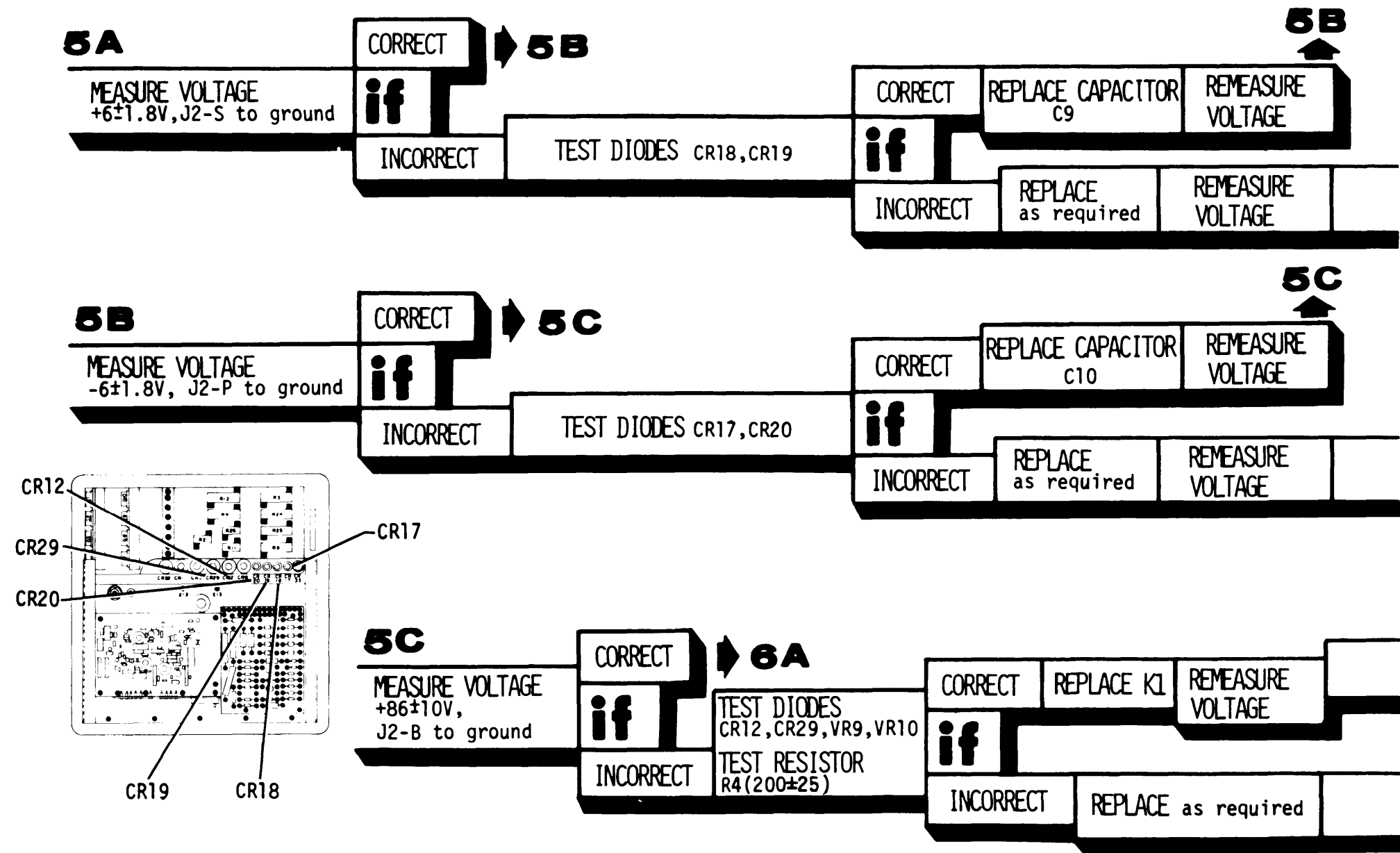


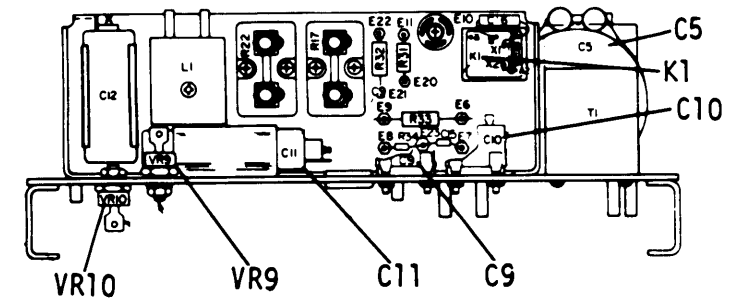
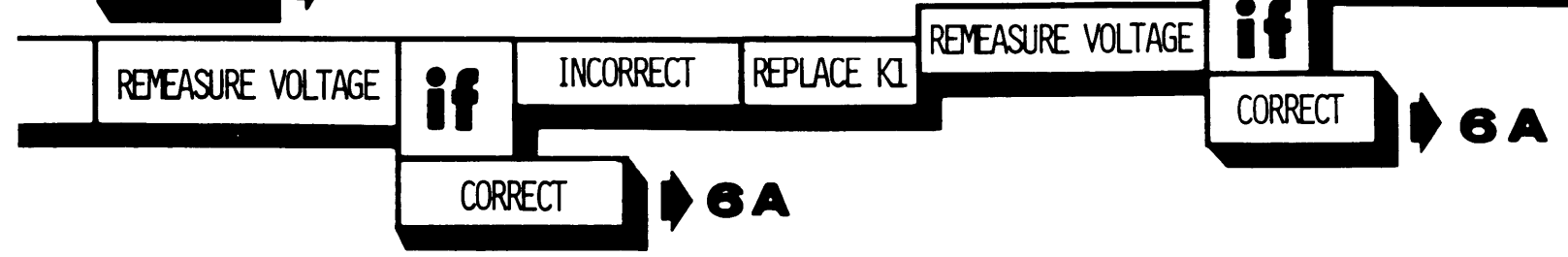
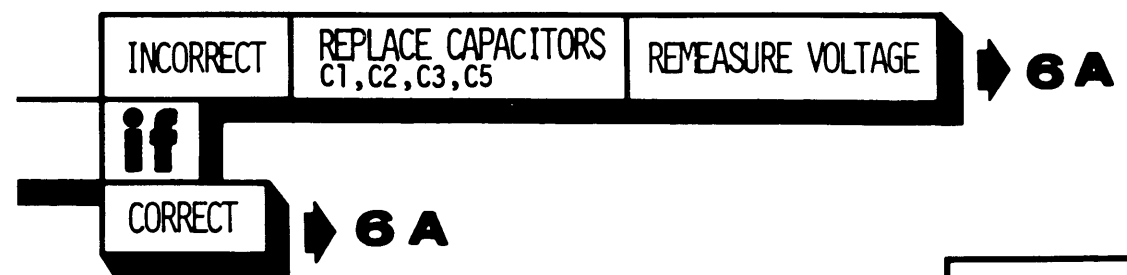
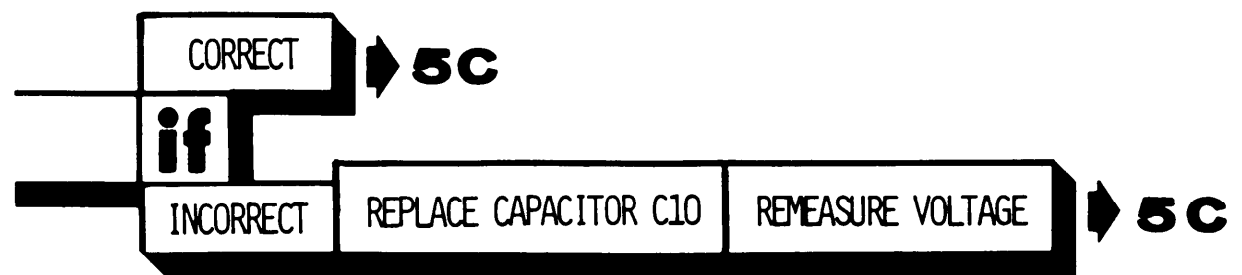
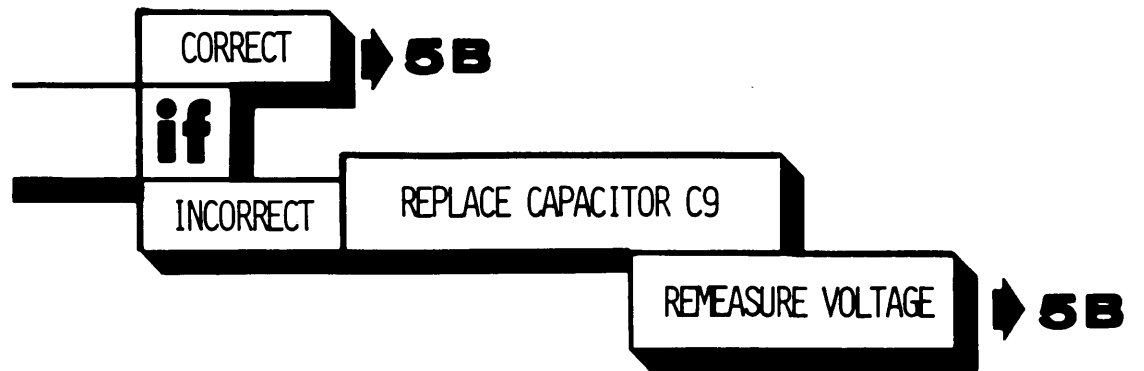


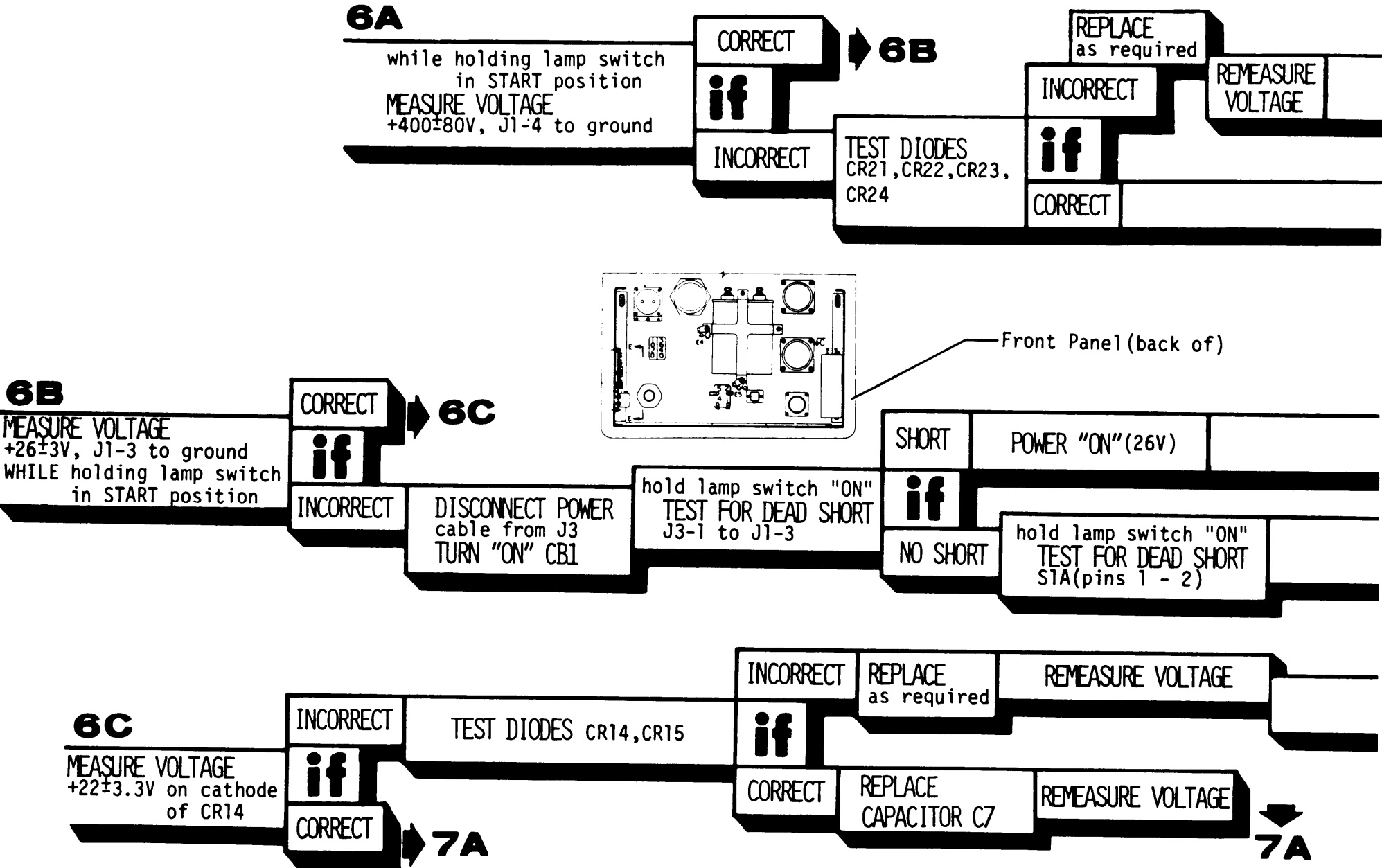
T1 FAULTY - if voltage measurements at steps 4C, 5A, 5B, 6A, 6C, 7A and 9B remain incorrect after testing (and replacing) the called out components, T1 is faulty. Replace T1 and remeasure the voltages.

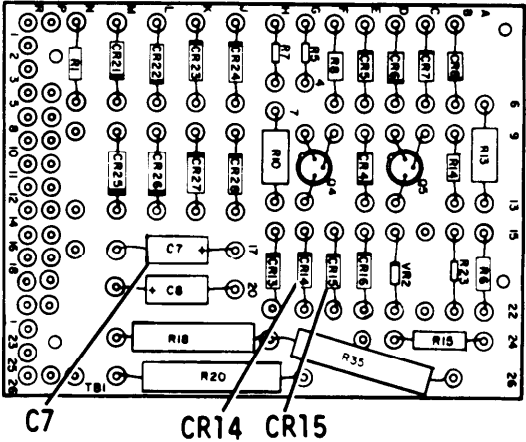
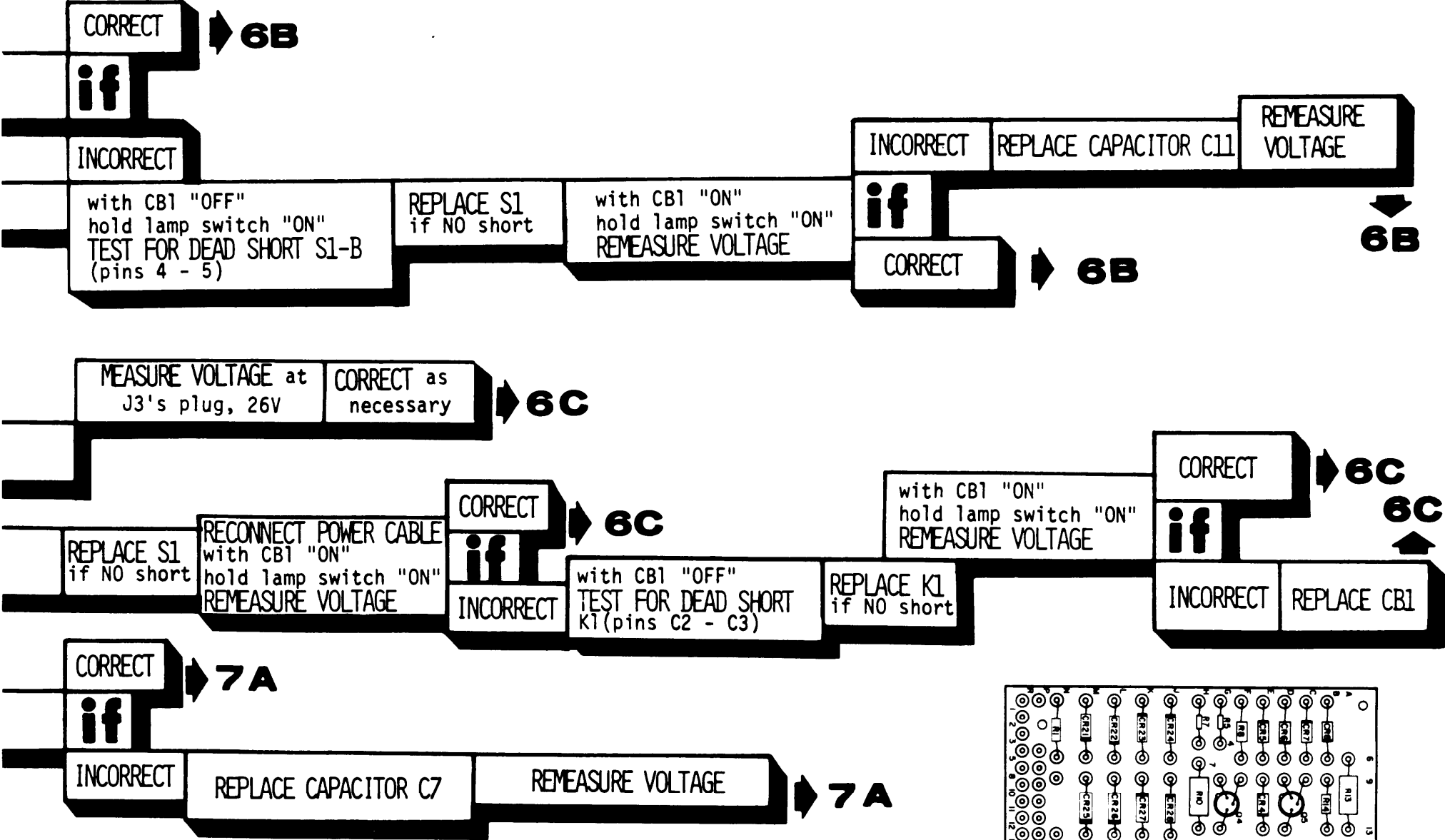
TO TEST A CAPACITOR C₁₂ - SUBSTITUTE a new part (disconnect one end) & REMEASURE required voltage

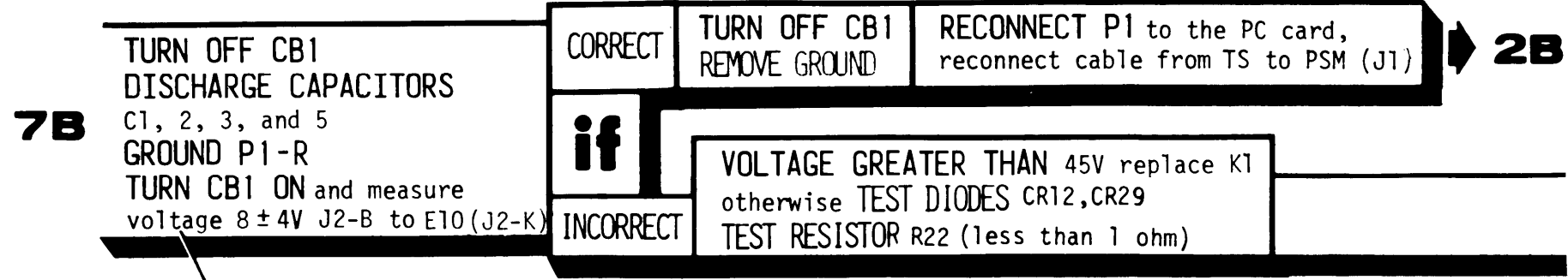
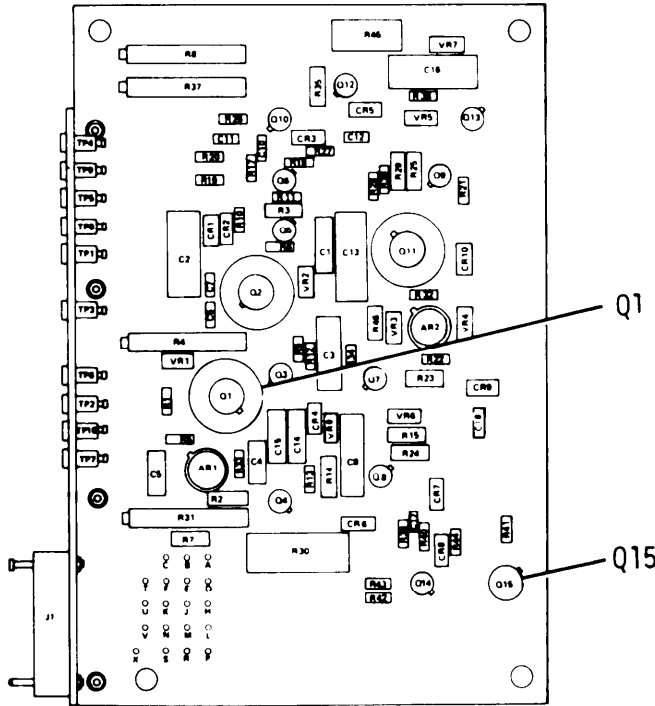
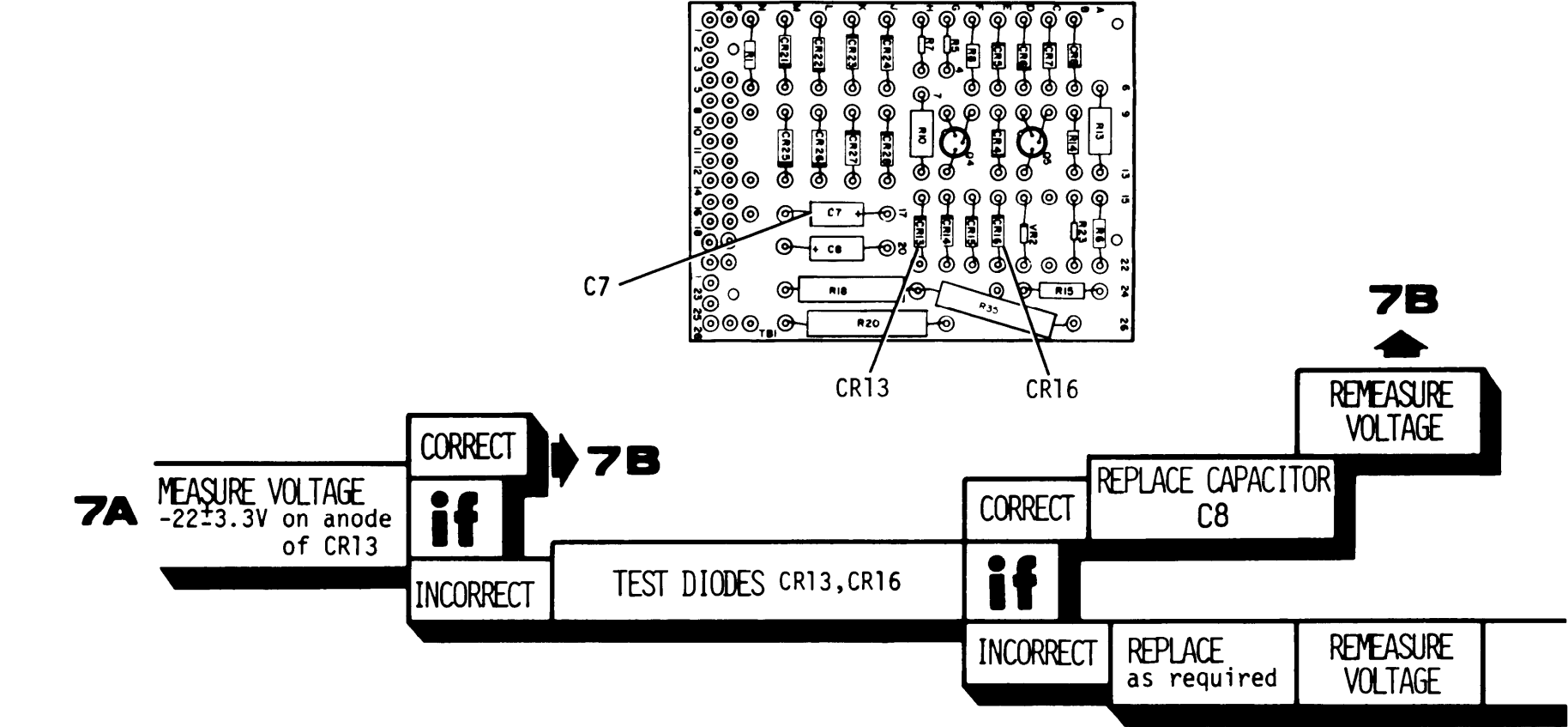




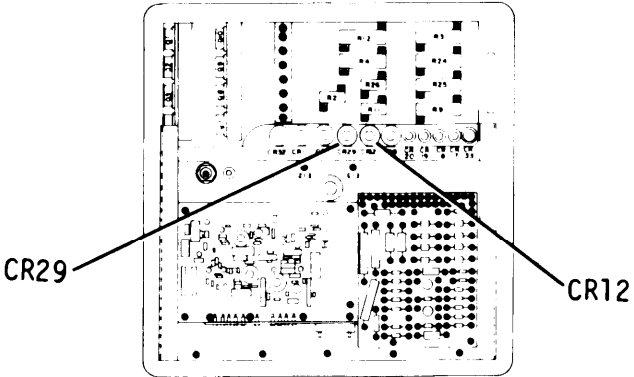


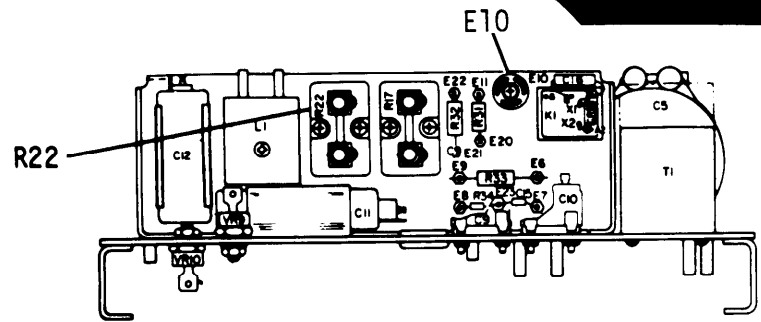
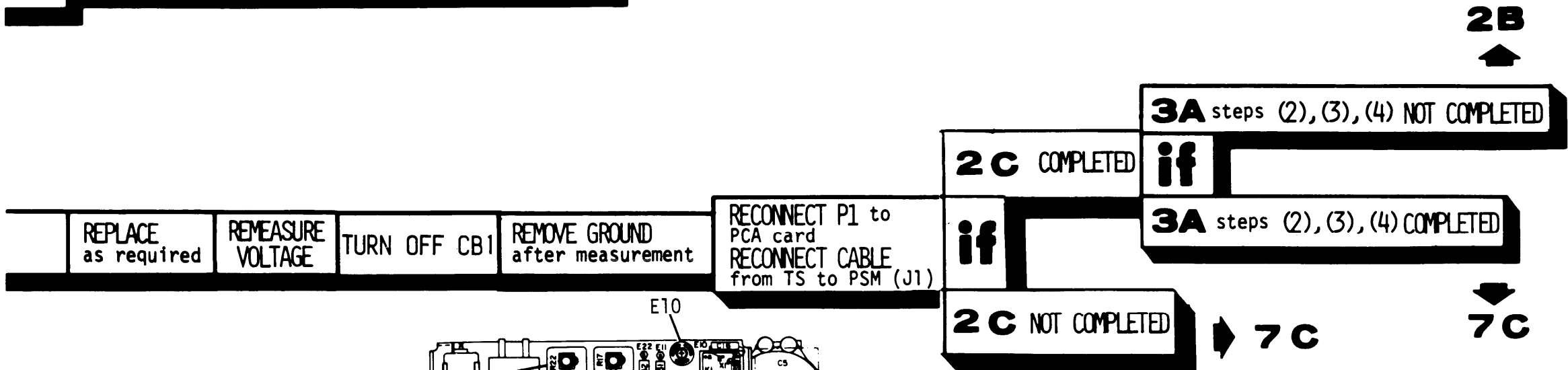
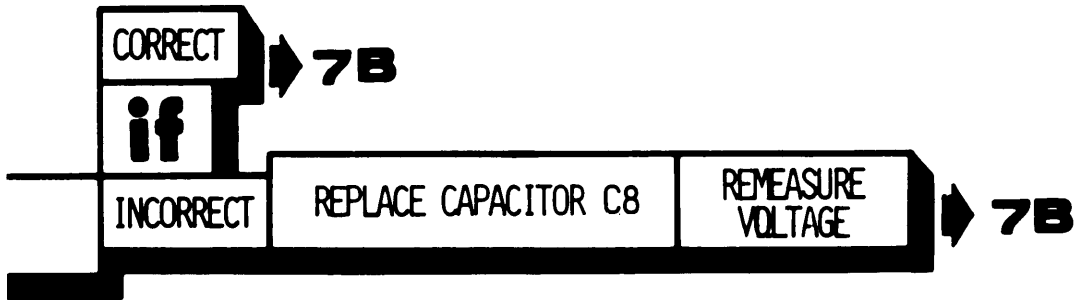


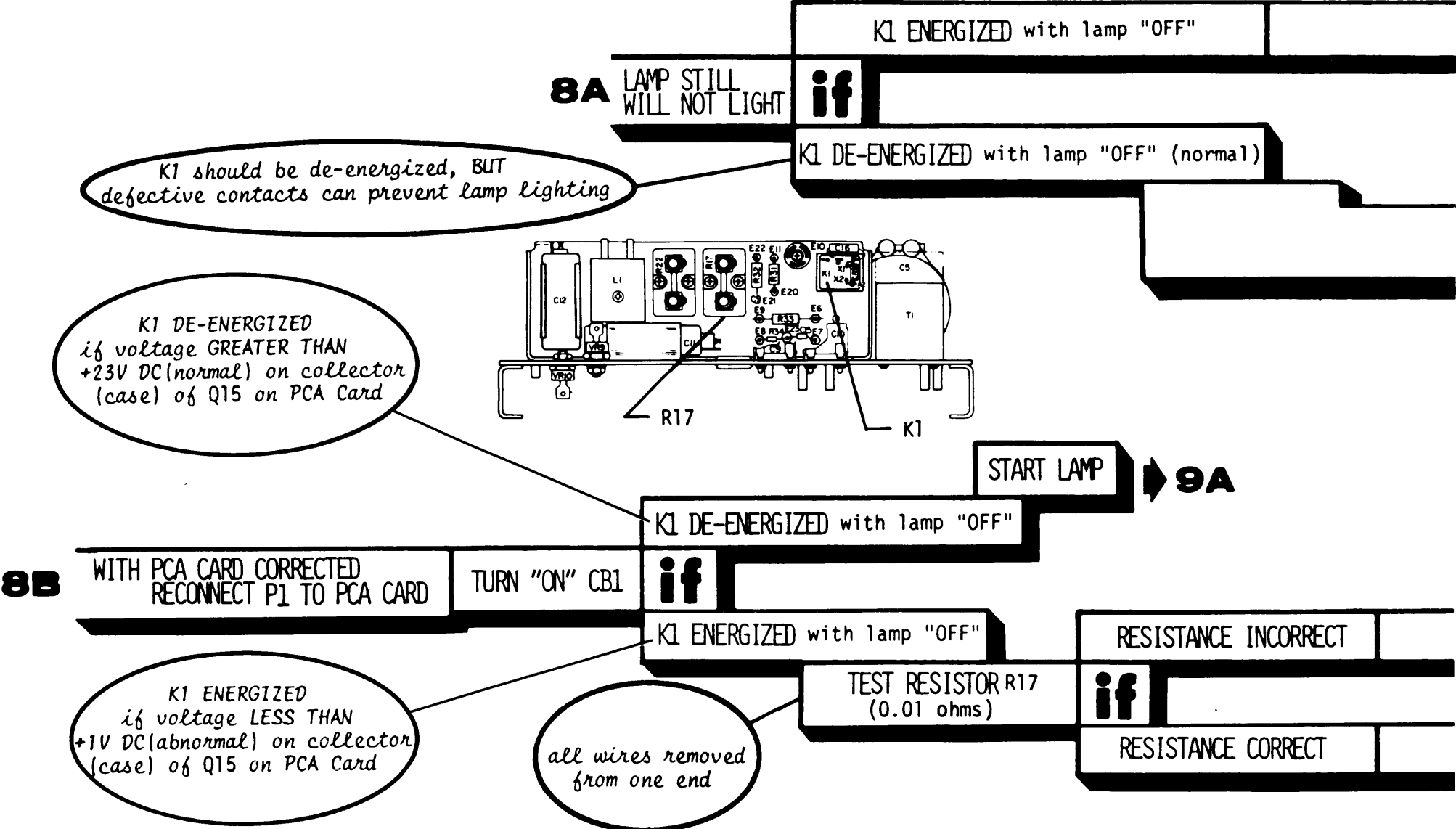


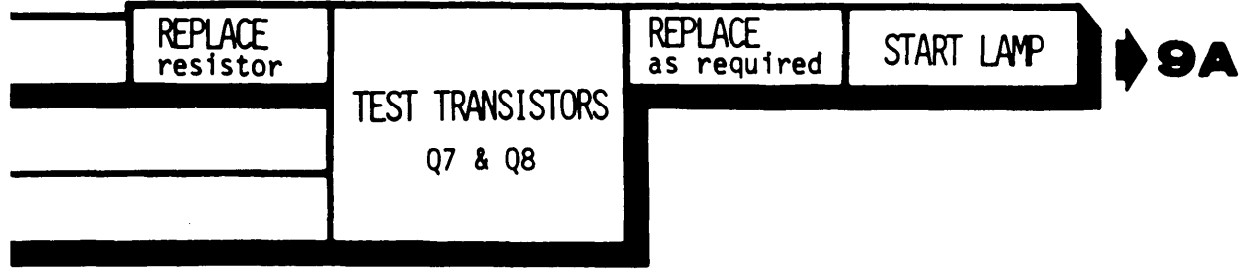
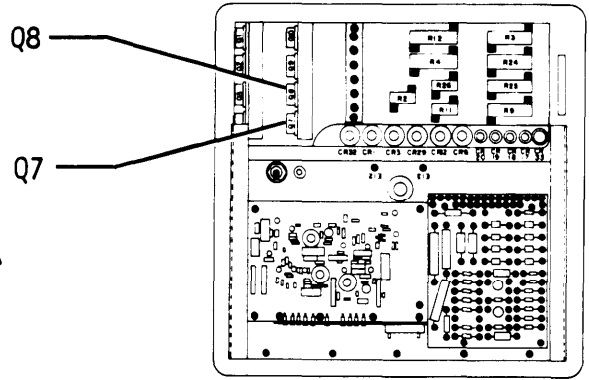
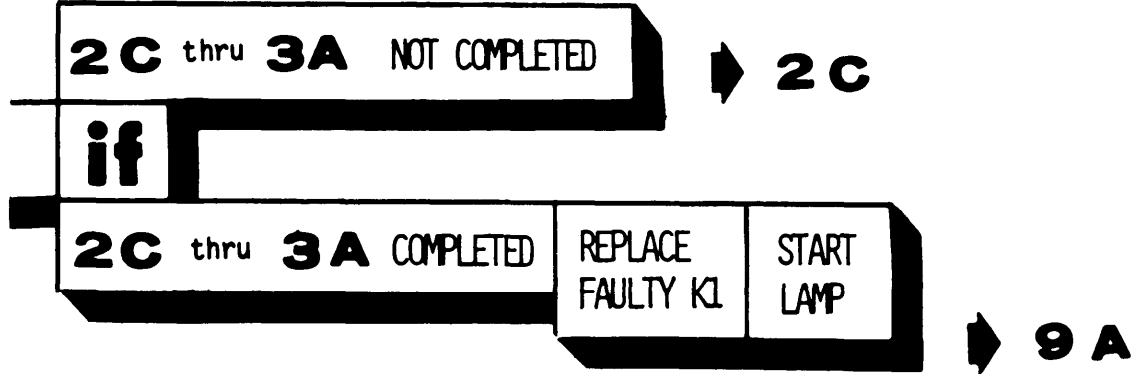
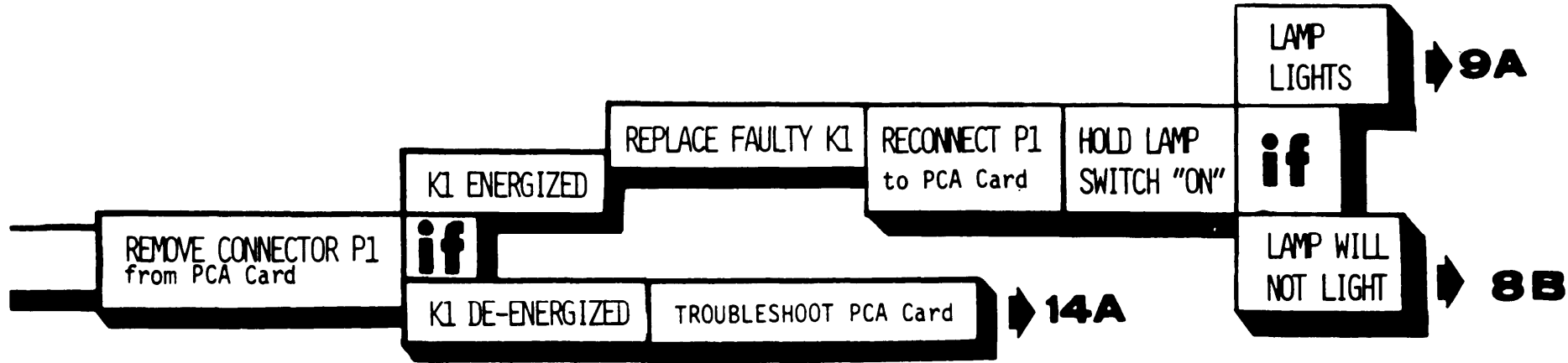


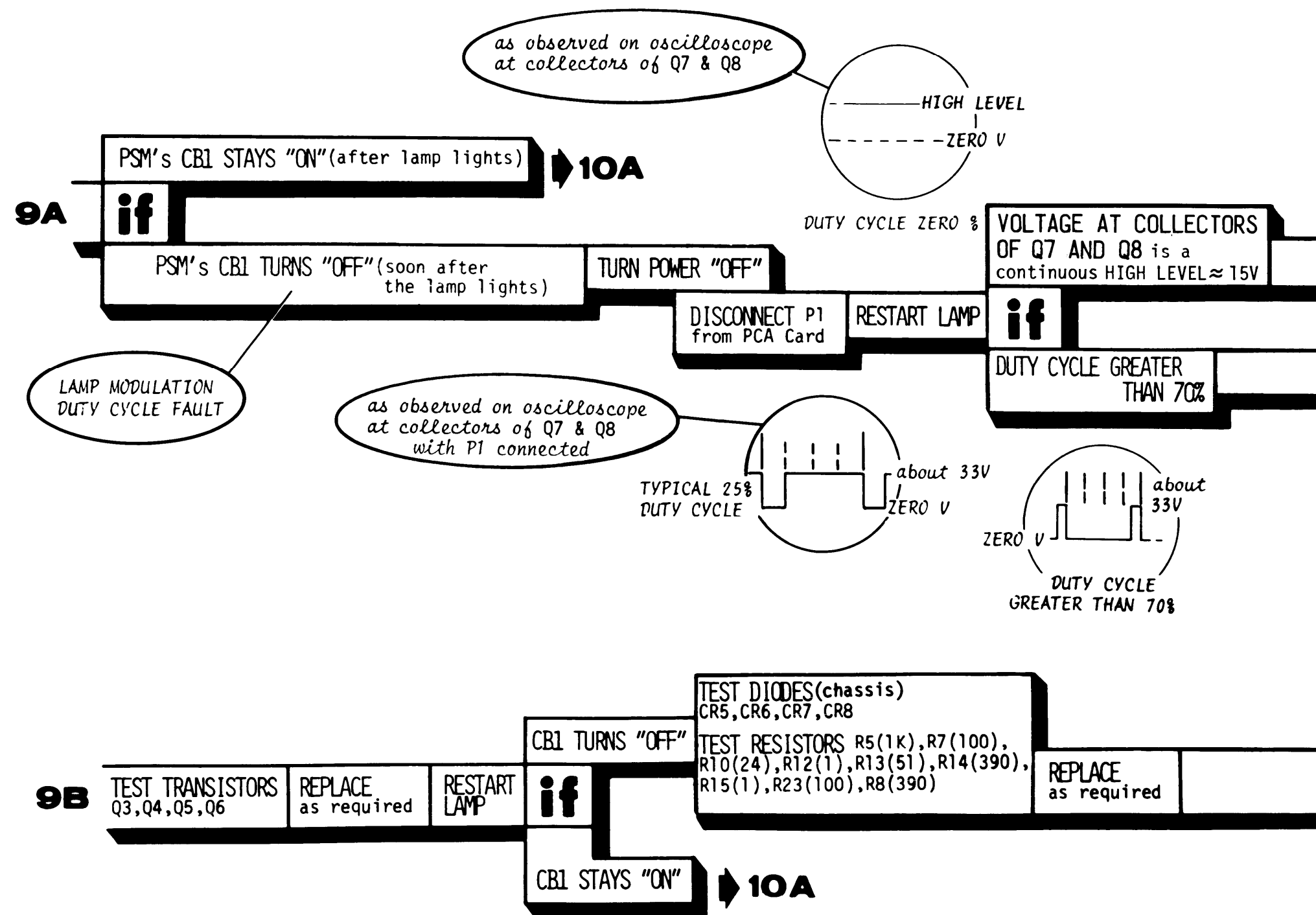
NOTE Voltage will continue to increase to ≈60V because of a no load condition. Take reading immediately after turning CB1 on.

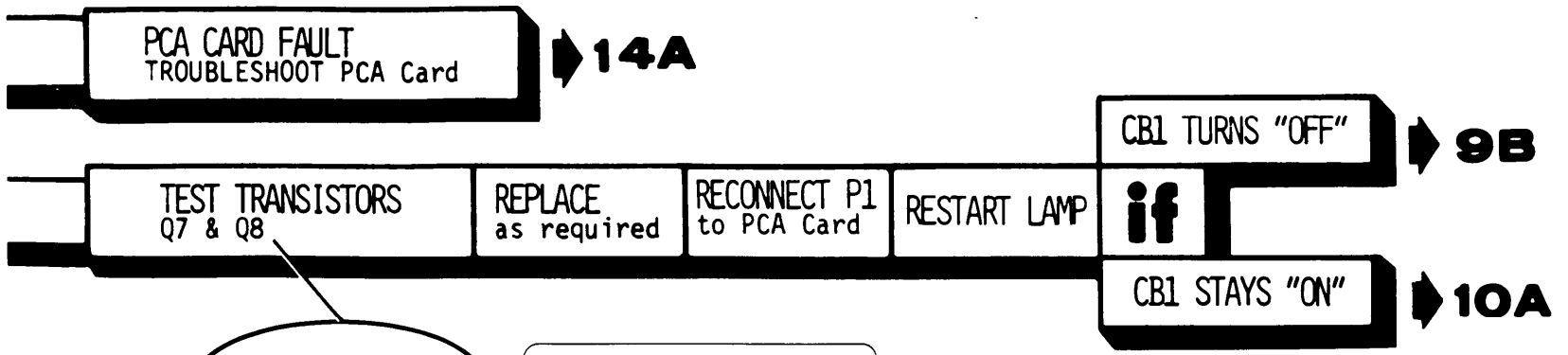




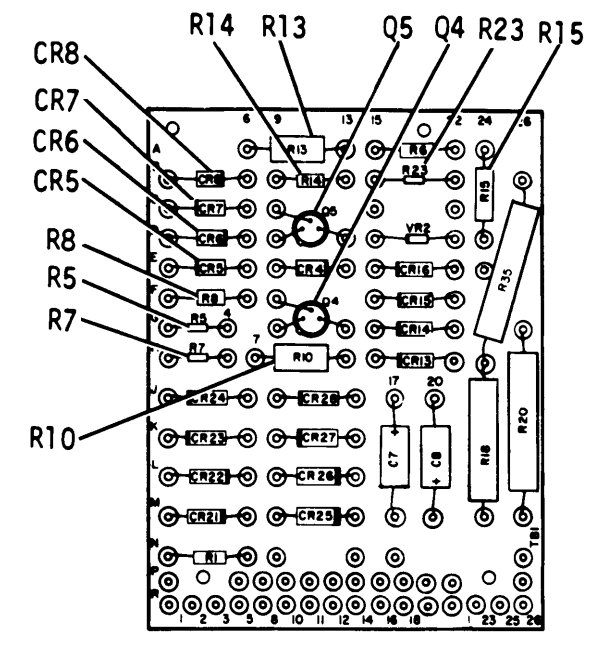
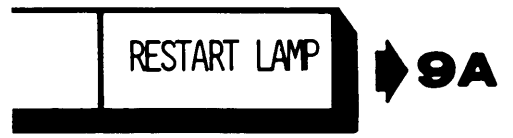
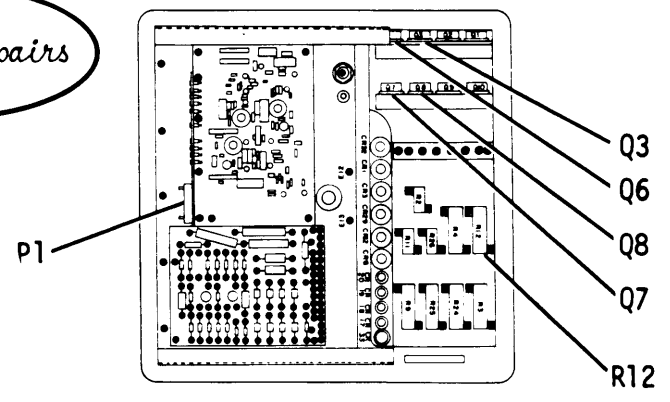


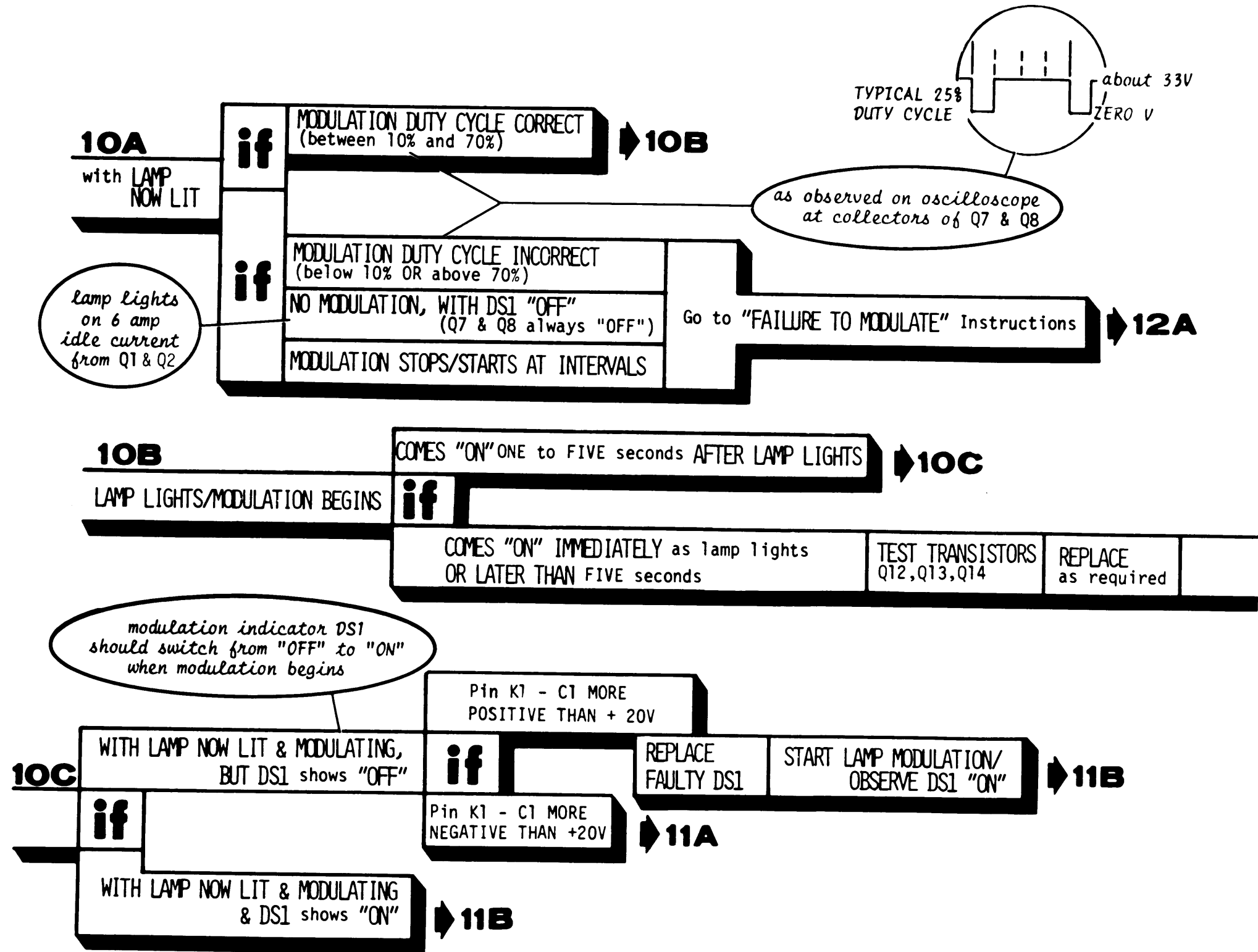


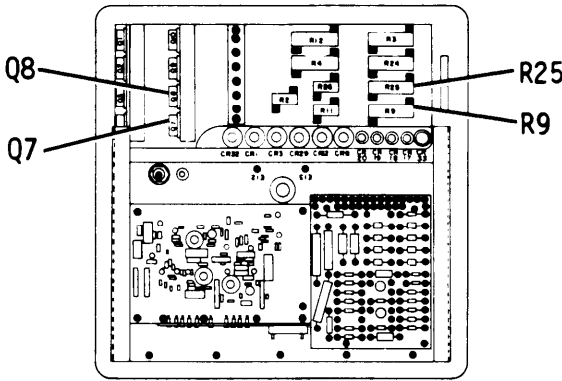
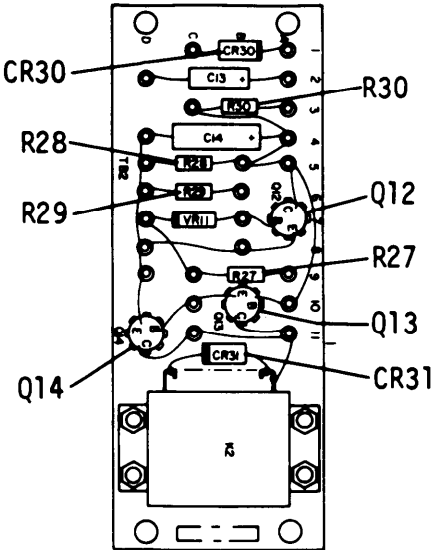




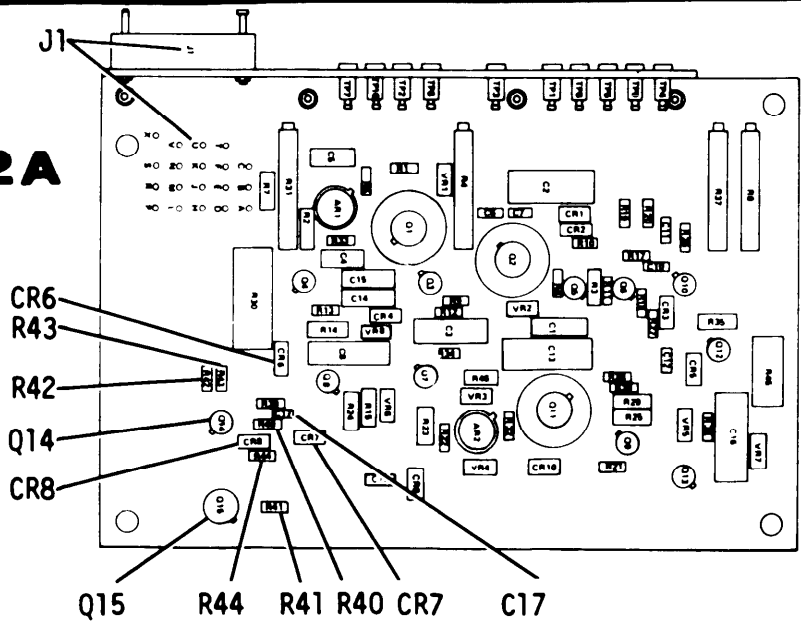
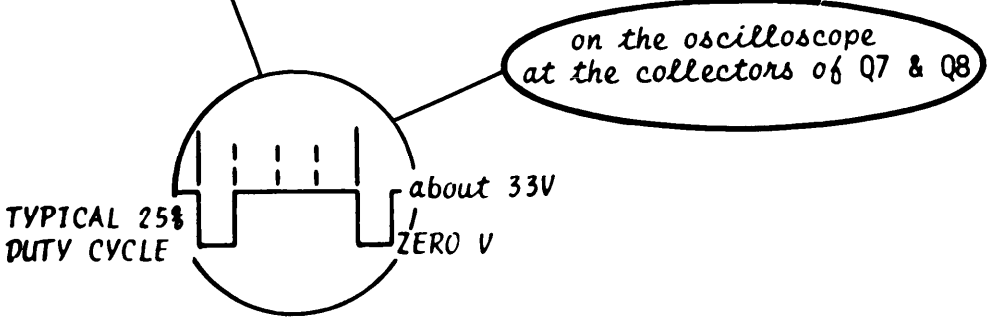
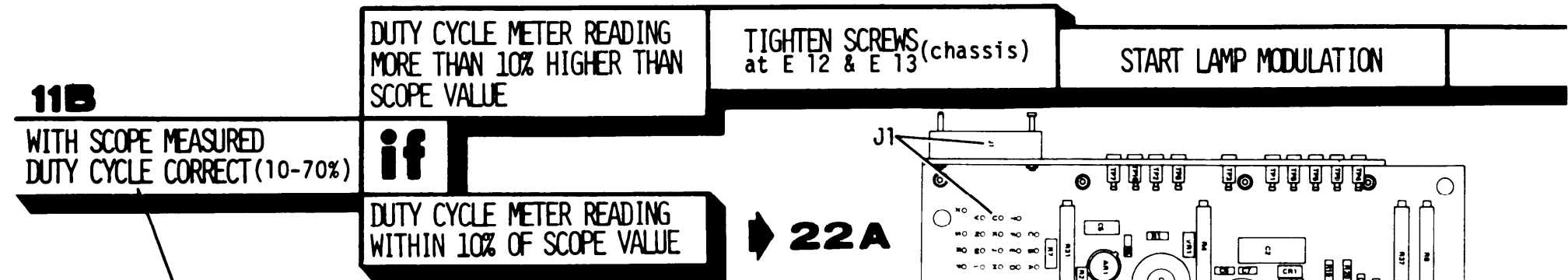
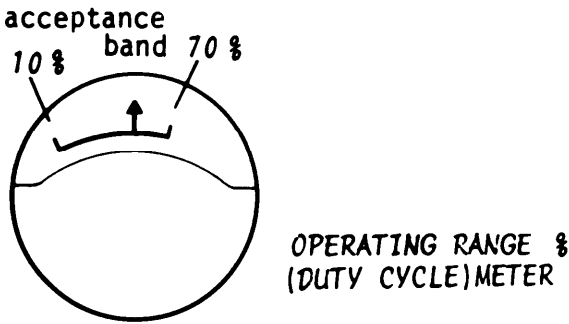
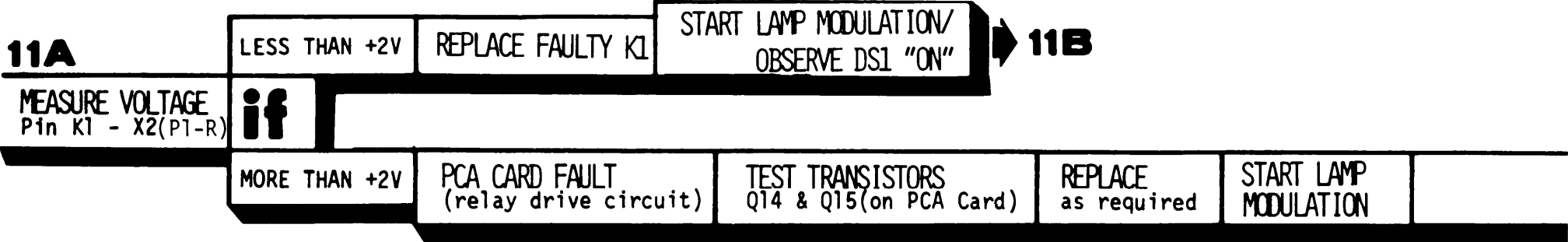
Replace in pairs

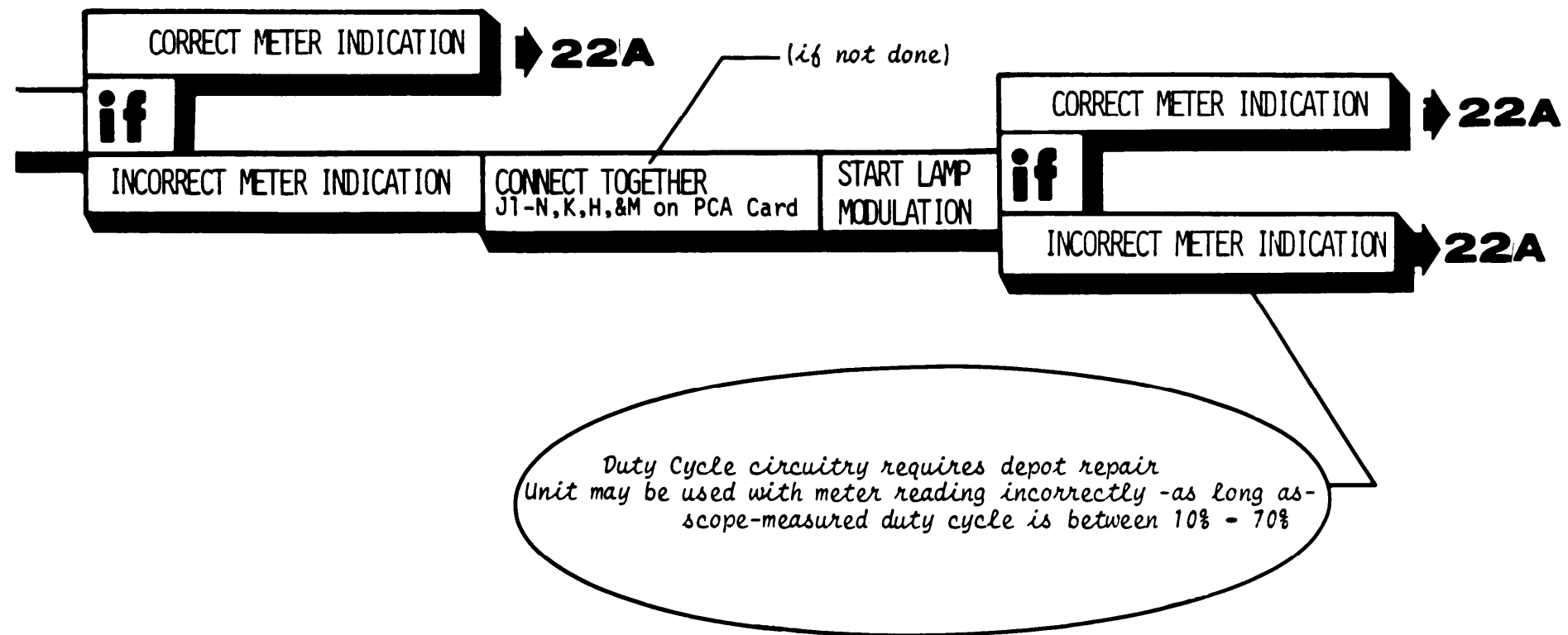
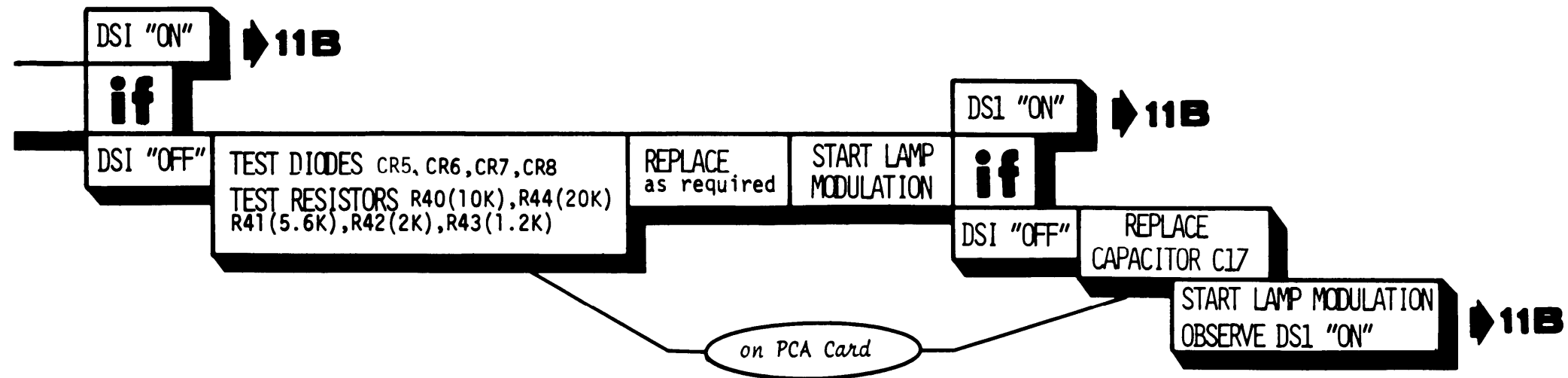






PARTS REPLACED		➡ 10B
if	TEST DIODES CR30, CR31	
	TEST RESISTORS R9(45.3), R24(45.3), R25(45.3), R27(470K), R28(51K), R29(51K), R30(68K)	
NO PARTS REPLACED		OBSERVE MODULATION BEGIN ONE to FIVE seconds AFTER lamp lights ➡ 10C





12A

DISCONNECT LEADS(base & emitter)
of transistors Q7 & Q8
from chassis terminals

TO TEST A TRANSISTOR Q₁ - compare resistance readings to a new part
($\pm 20\%$ variation between parts is normal)
(base-to-emitter/both directions)
(base-to-collector/both directions)
(collector-to-emitter/both directions)
(used power transistors may have less resistance, collector-to-emitter)

TEST TRANSISTORS
Q7 & Q8

REPLACE
as required

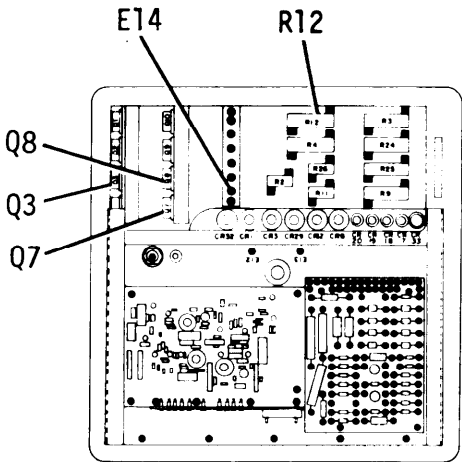
DISCONNECT P1
from PCA Card

GROUND ANODE
of CR5 on chassis

TURN "ON" CB1

MEASURE VOLTAGE $-6V \pm 3V$
at E 14 (R12 - R15 junction)

DO NOT reconnect leads
of Q7 & Q8 at this time

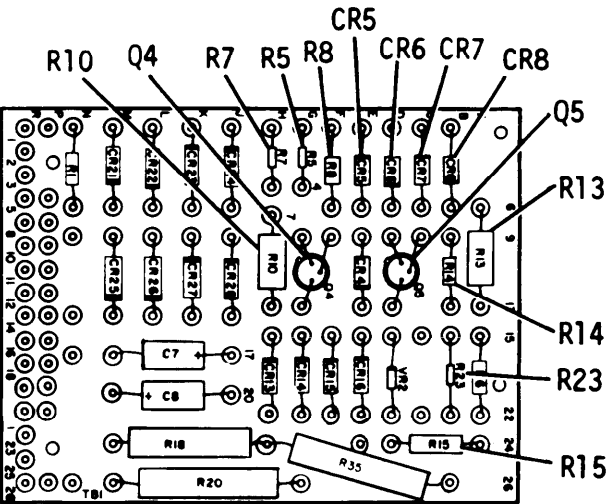


12B

REMOVE CR5
GROUND

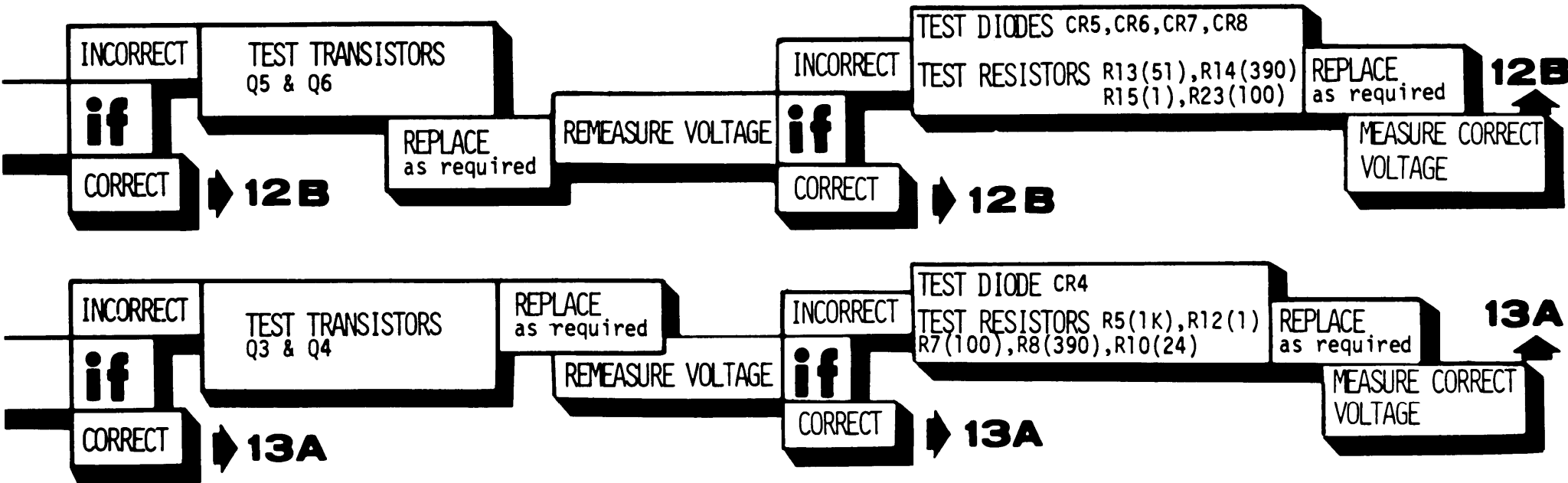
CONNECT CR5
ANODE to J2-S

MEASURE VOLTAGE $+6V \pm 3V$
at E 14(R12 - R15 junction)

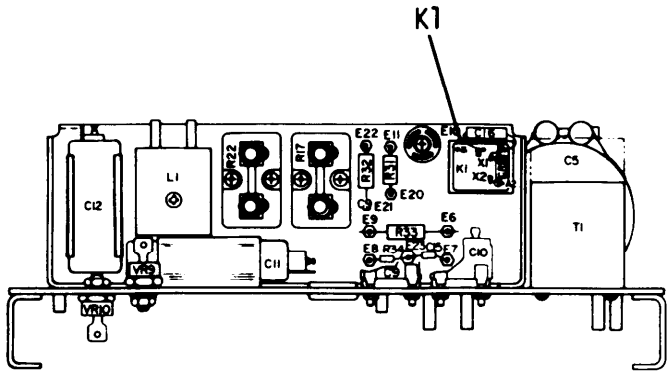
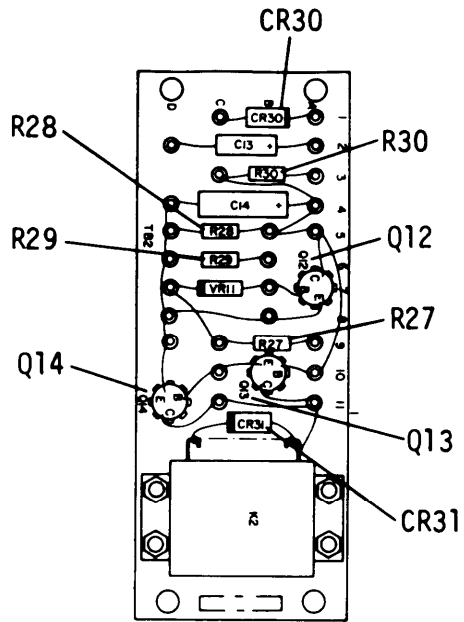
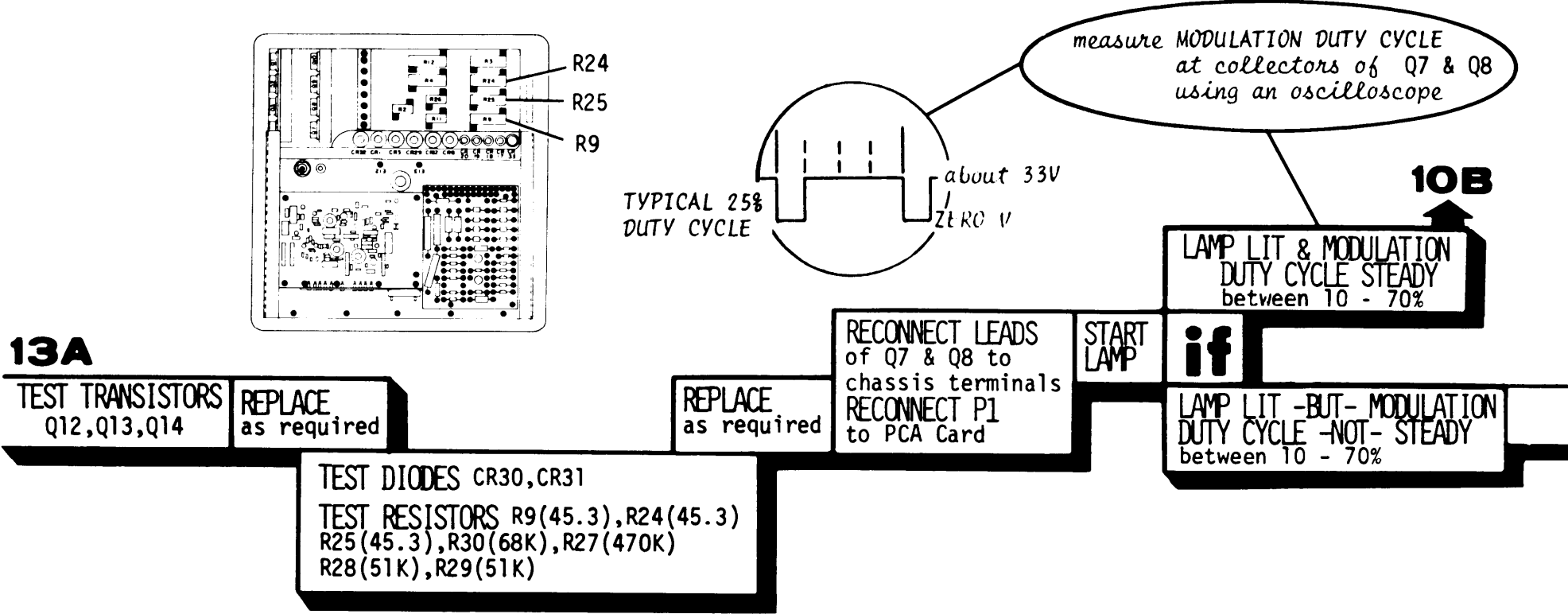


LAMP – “FAILURE TO MODULATE” – INSTRUCTIONS

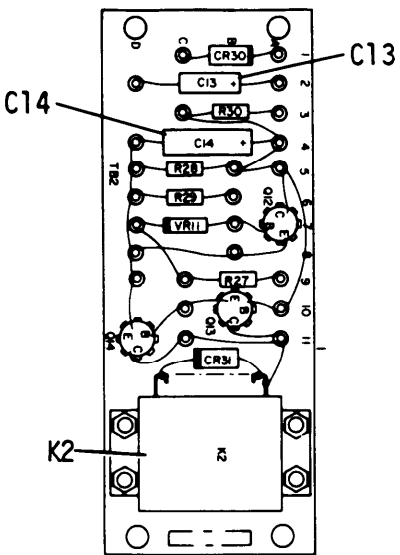
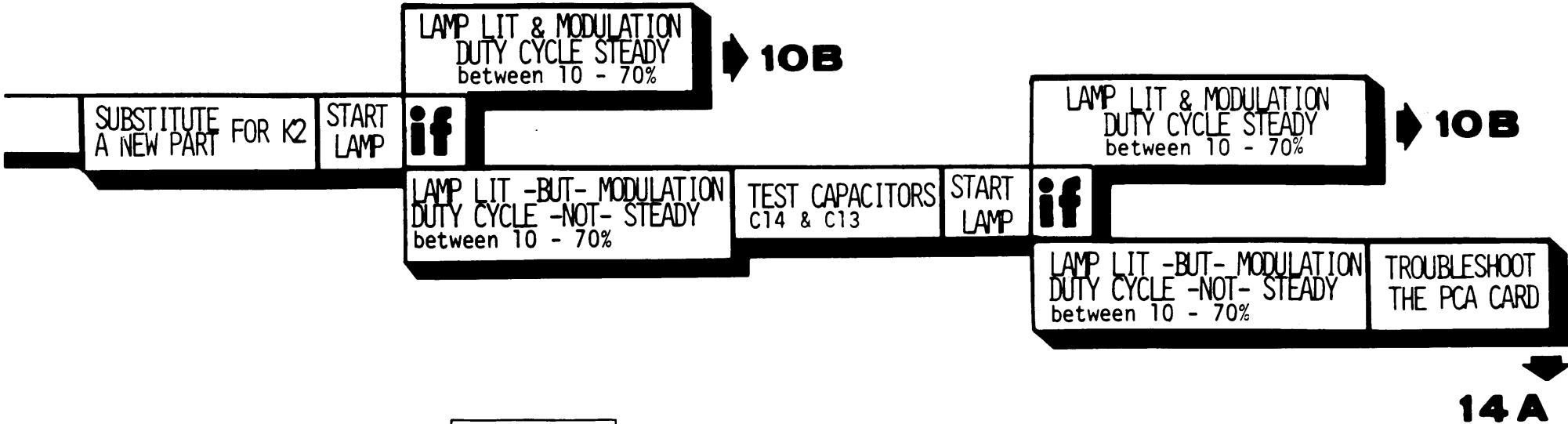
TO TEST A RESISTOR R_ (), - MEASURE specified() resistance
(disconnect one end) (using an ohm meter)



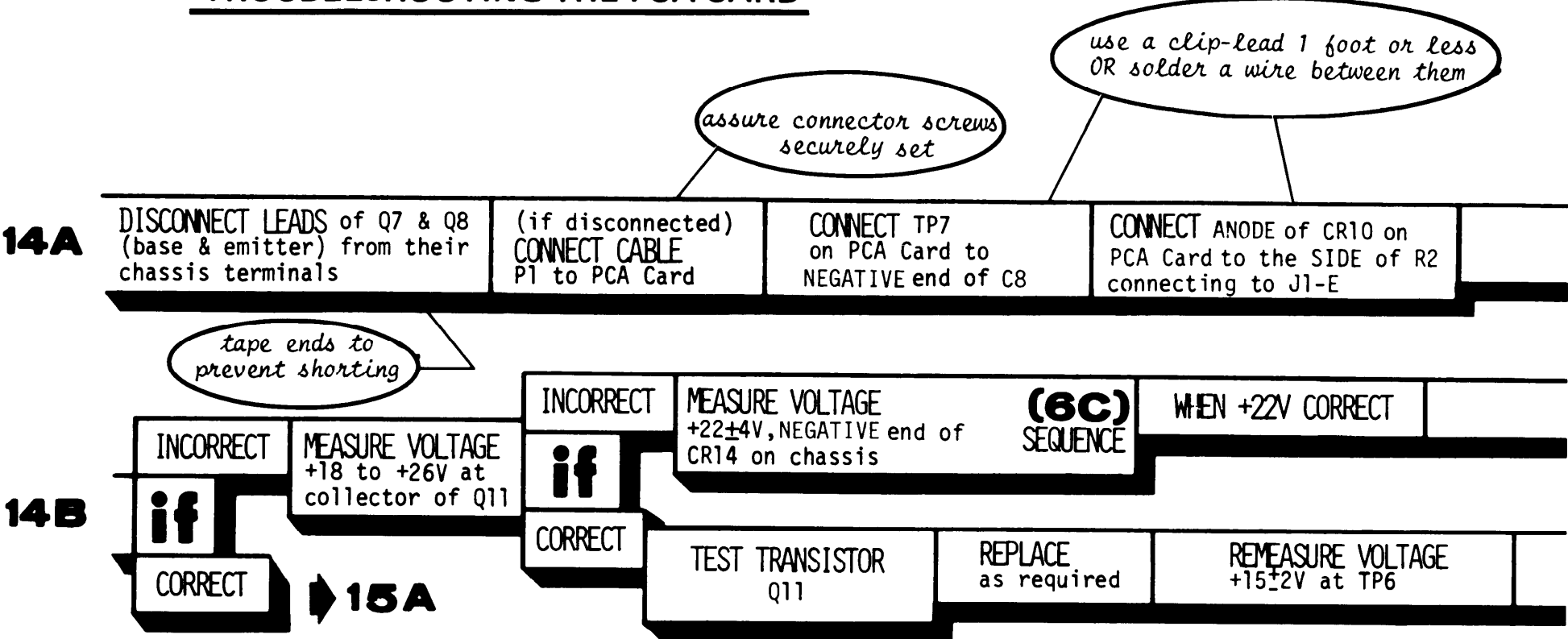
TO TEST A DIODE CR_ OR VR_ (use an ohm meter Rx10 -or nearest- scale)
(disconnect one end) - MEASURE high resistance(meter +lead-to-diode cathode)
MEASURE low resistance(meter +lead-to-diode anode)



TO TEST A CAPACITOR C_ - SUBSTITUTE a new part
(disconnect one end) & REMEASURE required voltage
OR repeat prior test

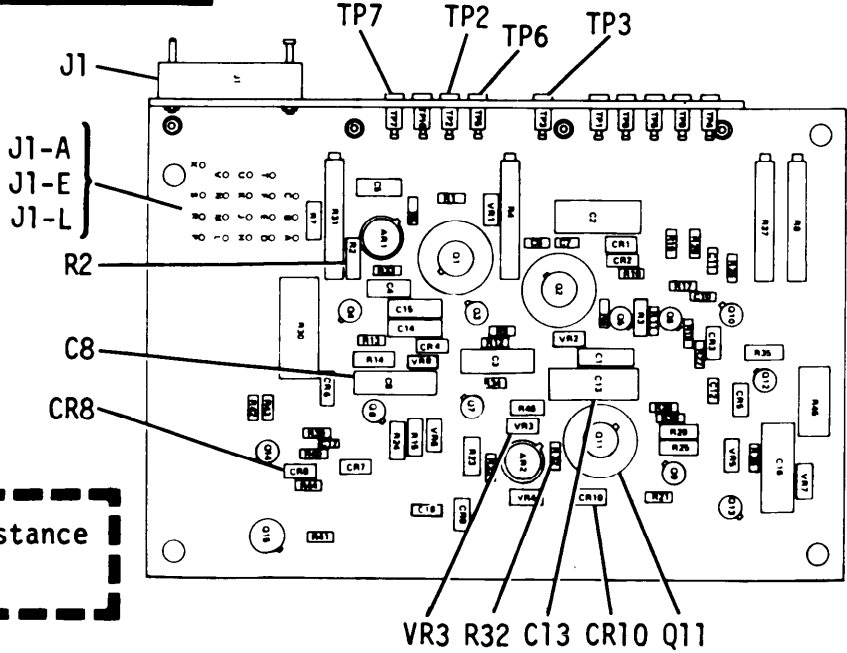


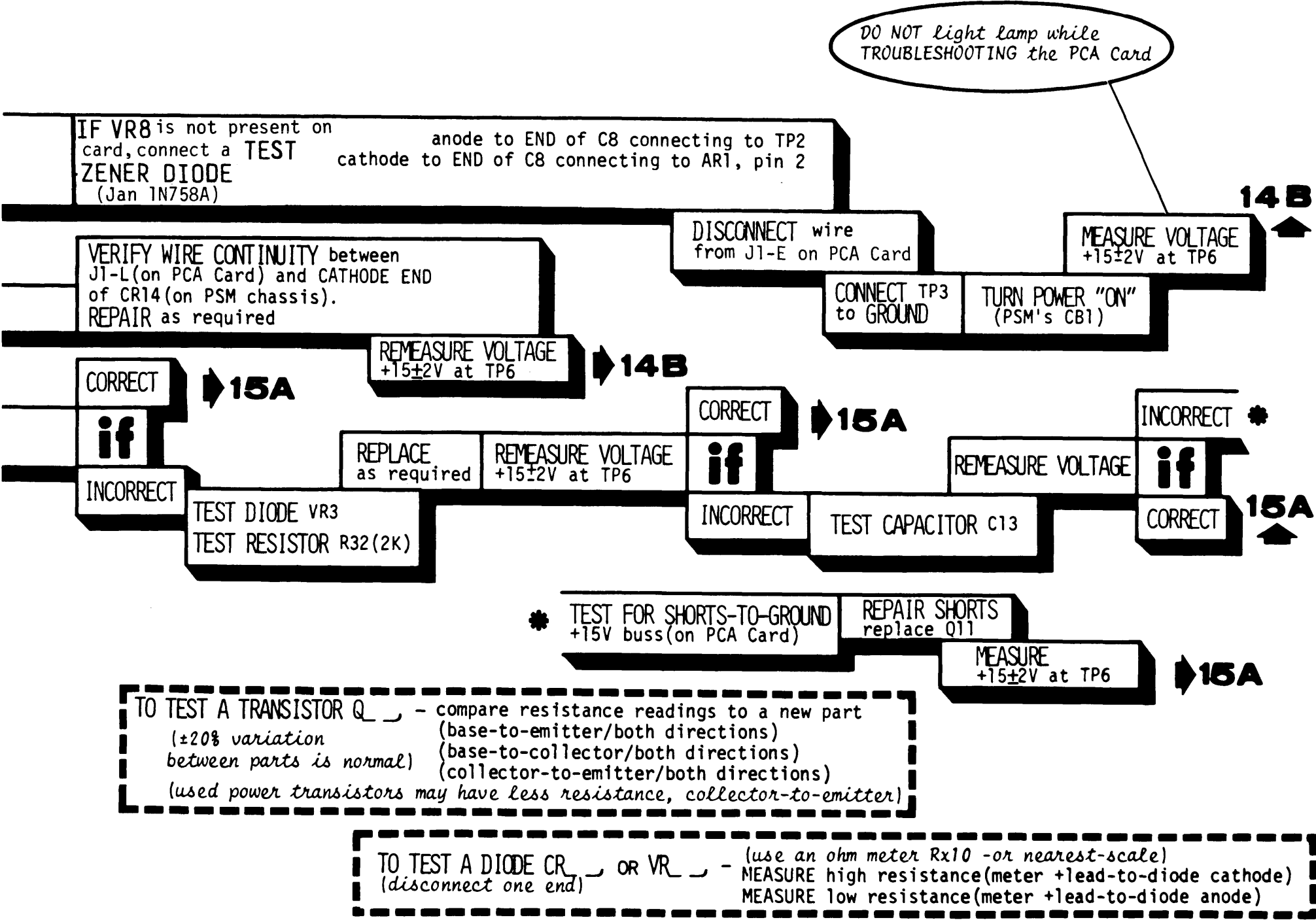
TROUBLESHOOTING THE PCA CARD

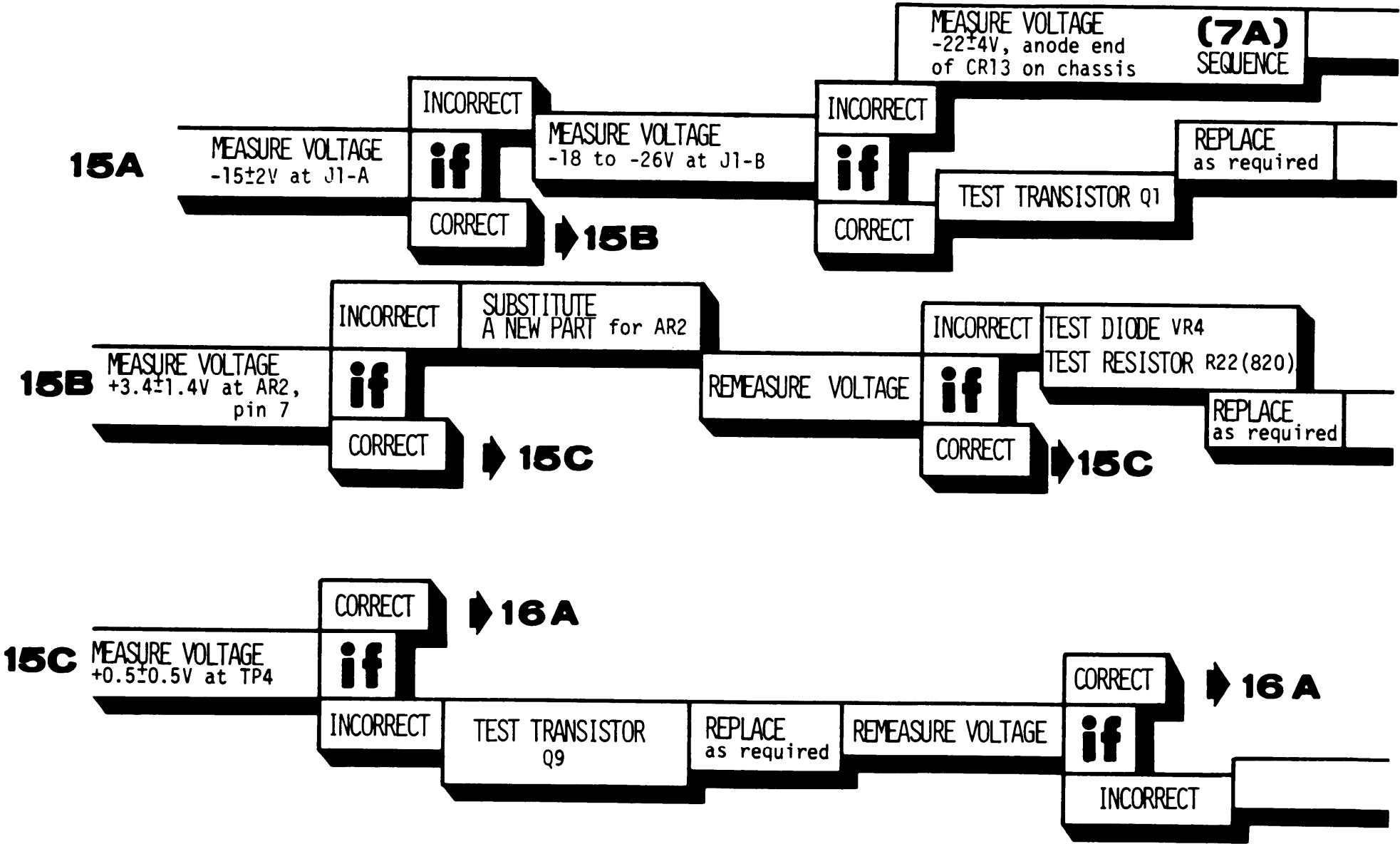


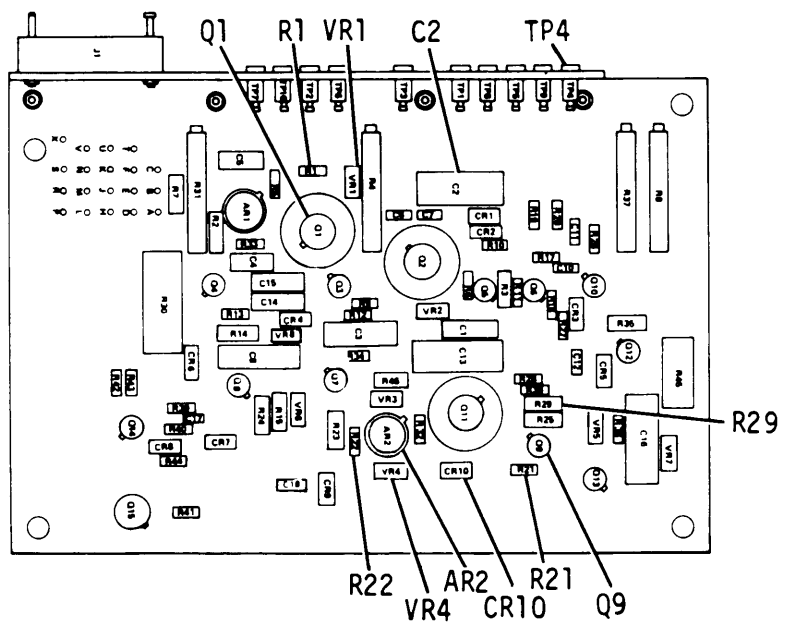
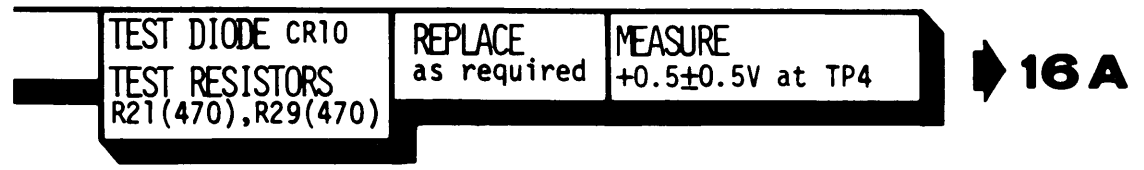
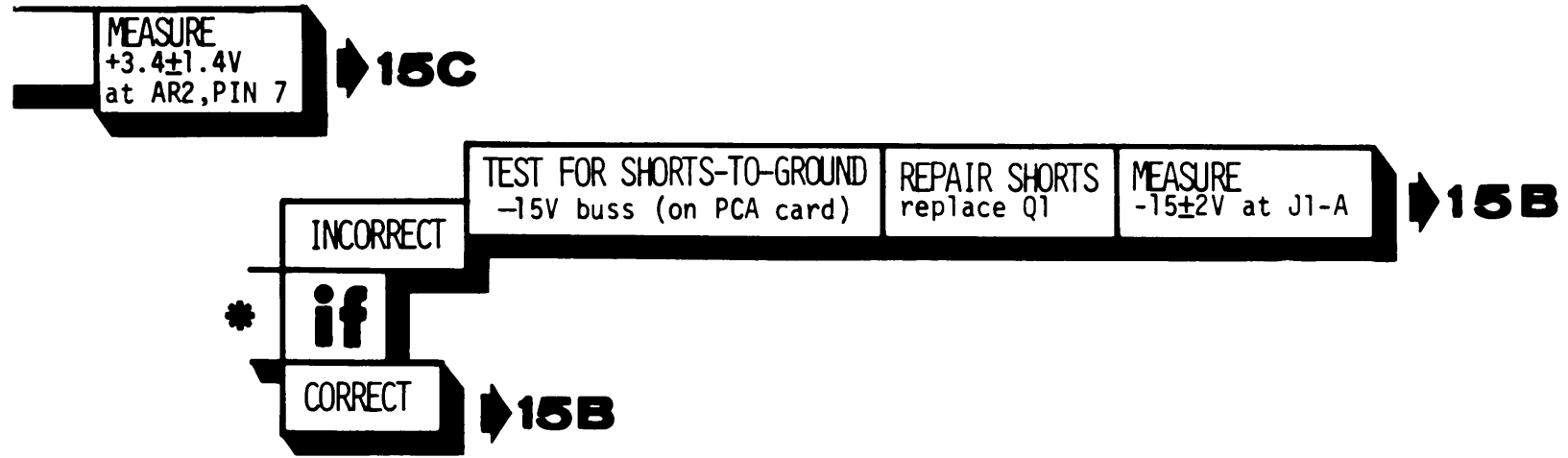
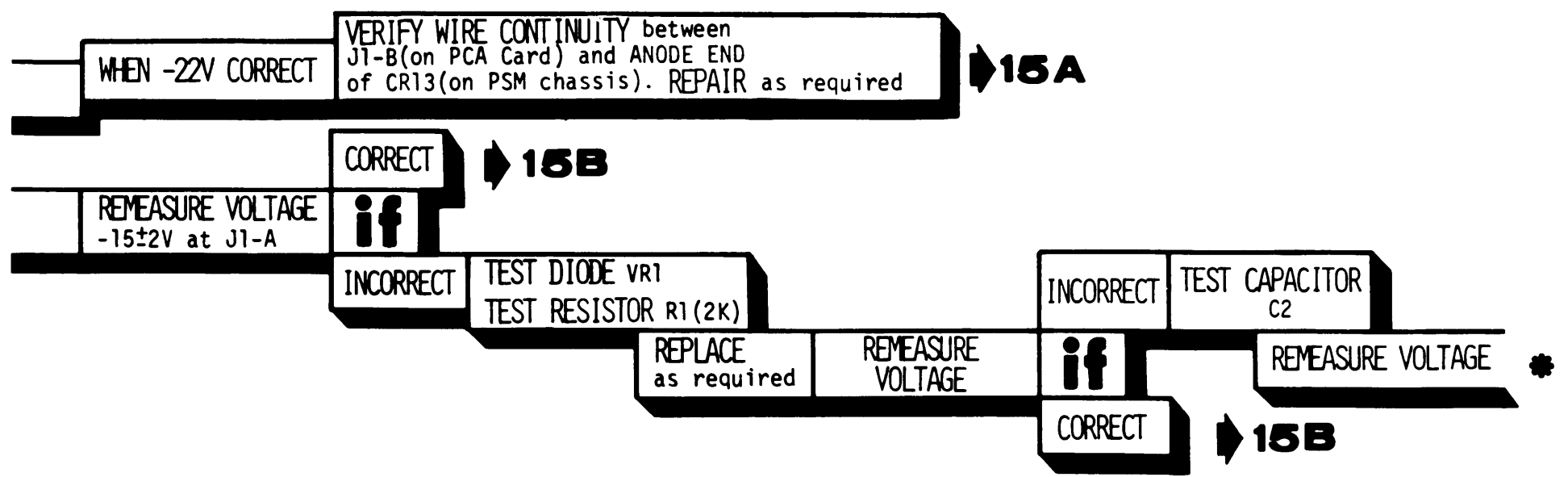
TO TEST A CAPACITOR C_ _ - SUBSTITUTE a new part (disconnect one end) & REMEASURE required voltage

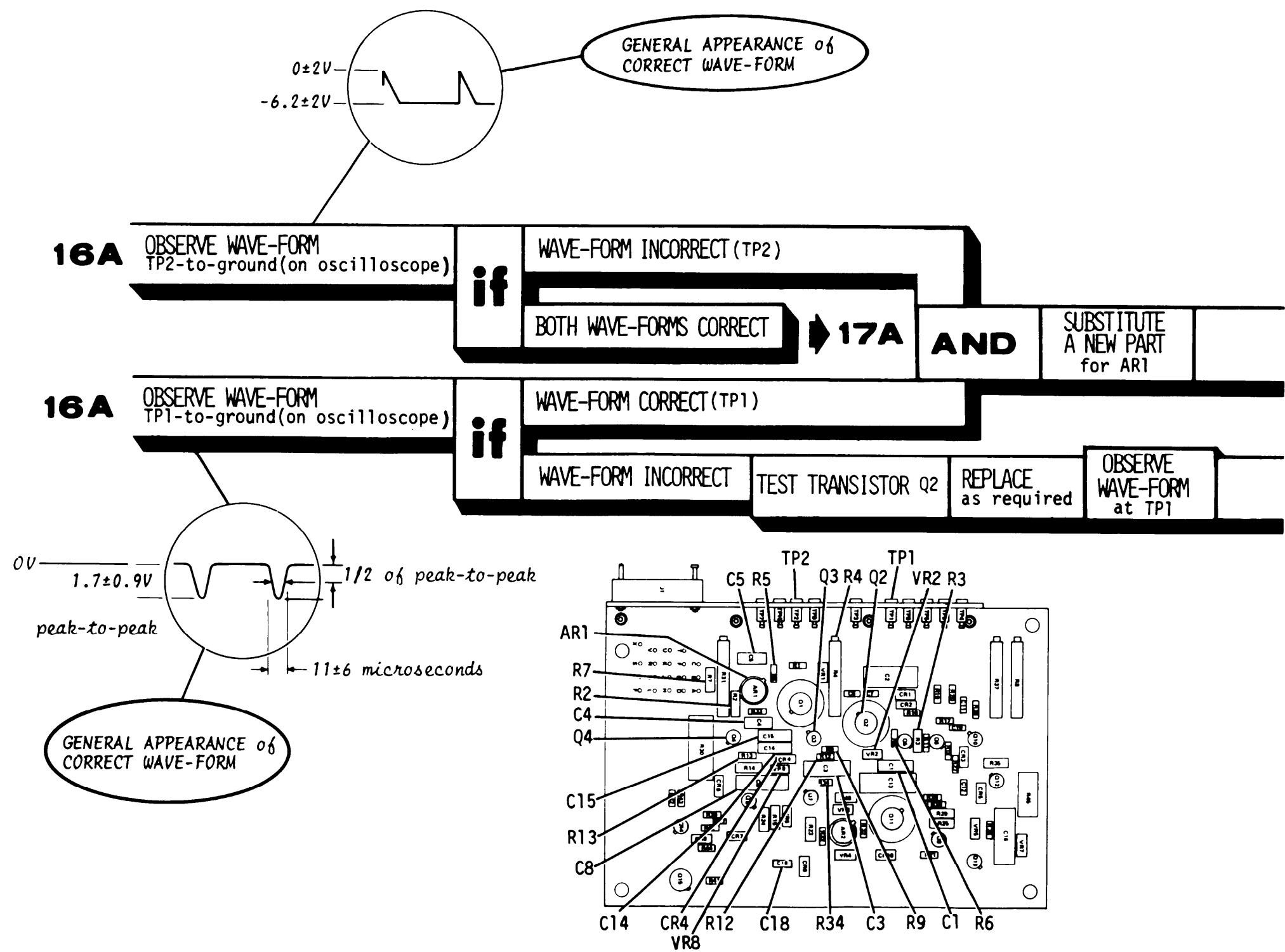
TO TEST A RESISTOR R_ _ (), - MEASURE specified() resistance (disconnect one end) (using an ohm meter)

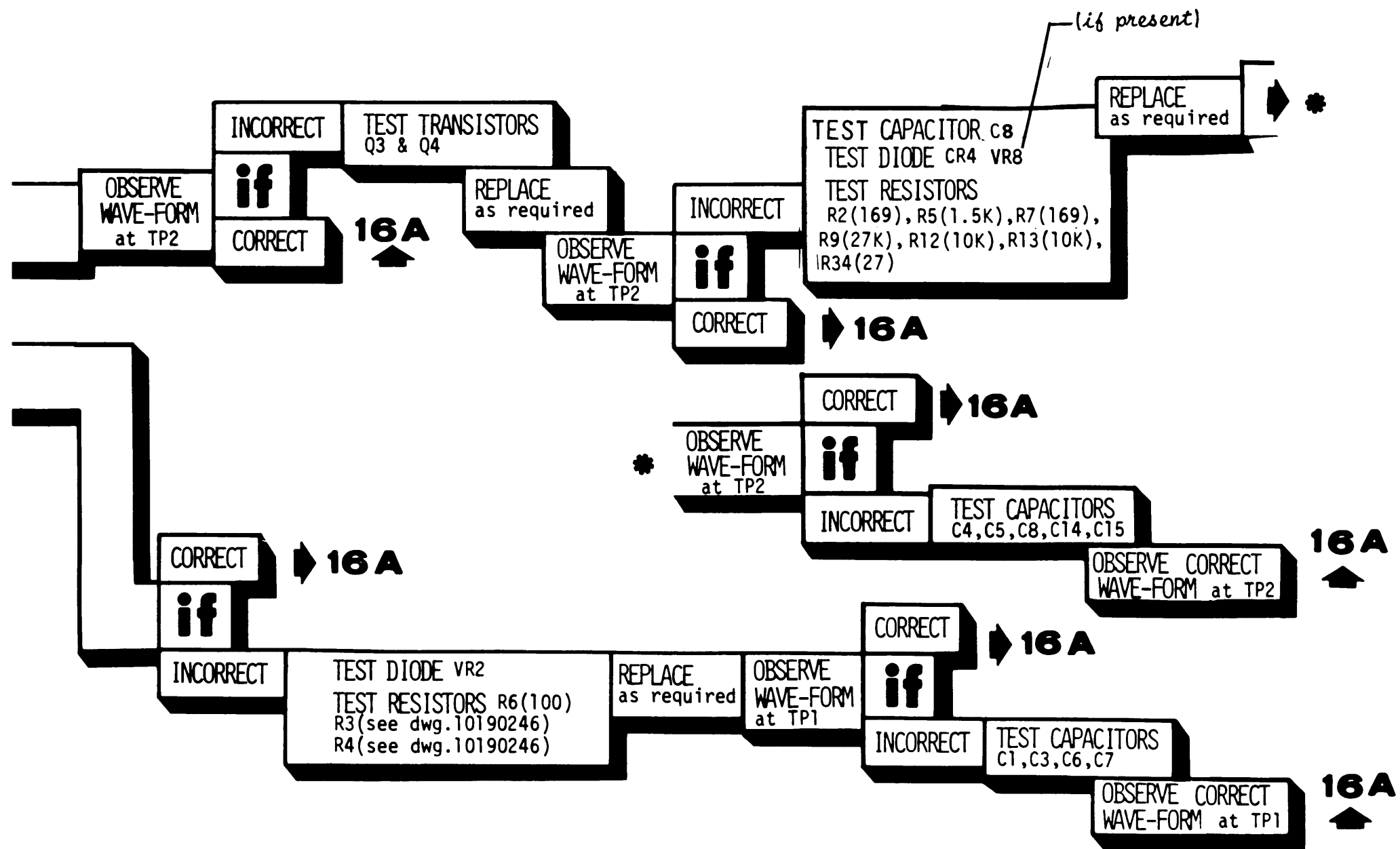








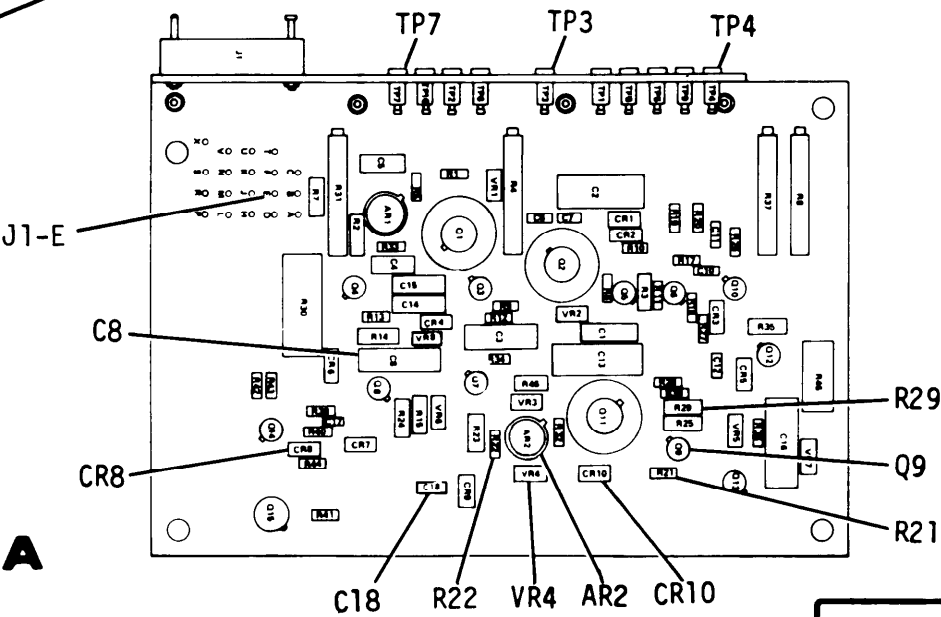




17A

REMOVE JUMPER WIRES at C8 & CR10	REMOVE TEST ZENER DIODE at C8 if in- stalled in step 14A.	REMOVE GROUND at TP3	CONNECT OSCILLOSCOPE CALIBRATOR OUTPUT (2 ± 0.2 V peak-to-peak of 1 ± 0.2 KHz square-wave, to TP7 thru a 6.8 MFD (or larger) capacitor	RECONNECT WIRES to J1-E on PCA CARD
-------------------------------------	---	-------------------------	--	---

amplitude of square-wave
will normally decrease after this



17B

OBSERVE SQUARE-WAVE at TP4
 1 ± 0.2 KHz frequency
 14.3 ± 3 V PEAK-to-PEAK amplitude

CORRECT
if
INCORRECT

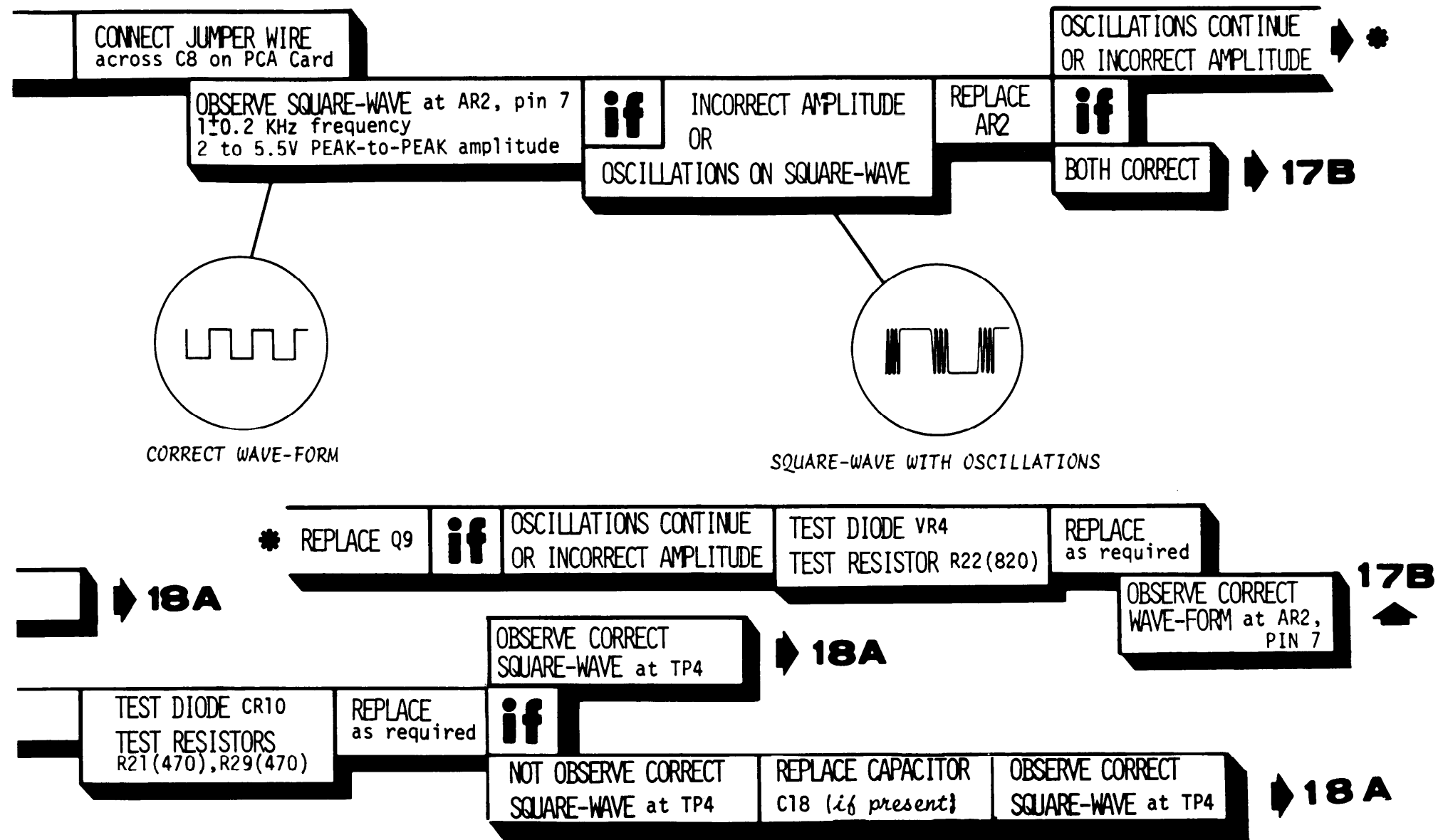
18A

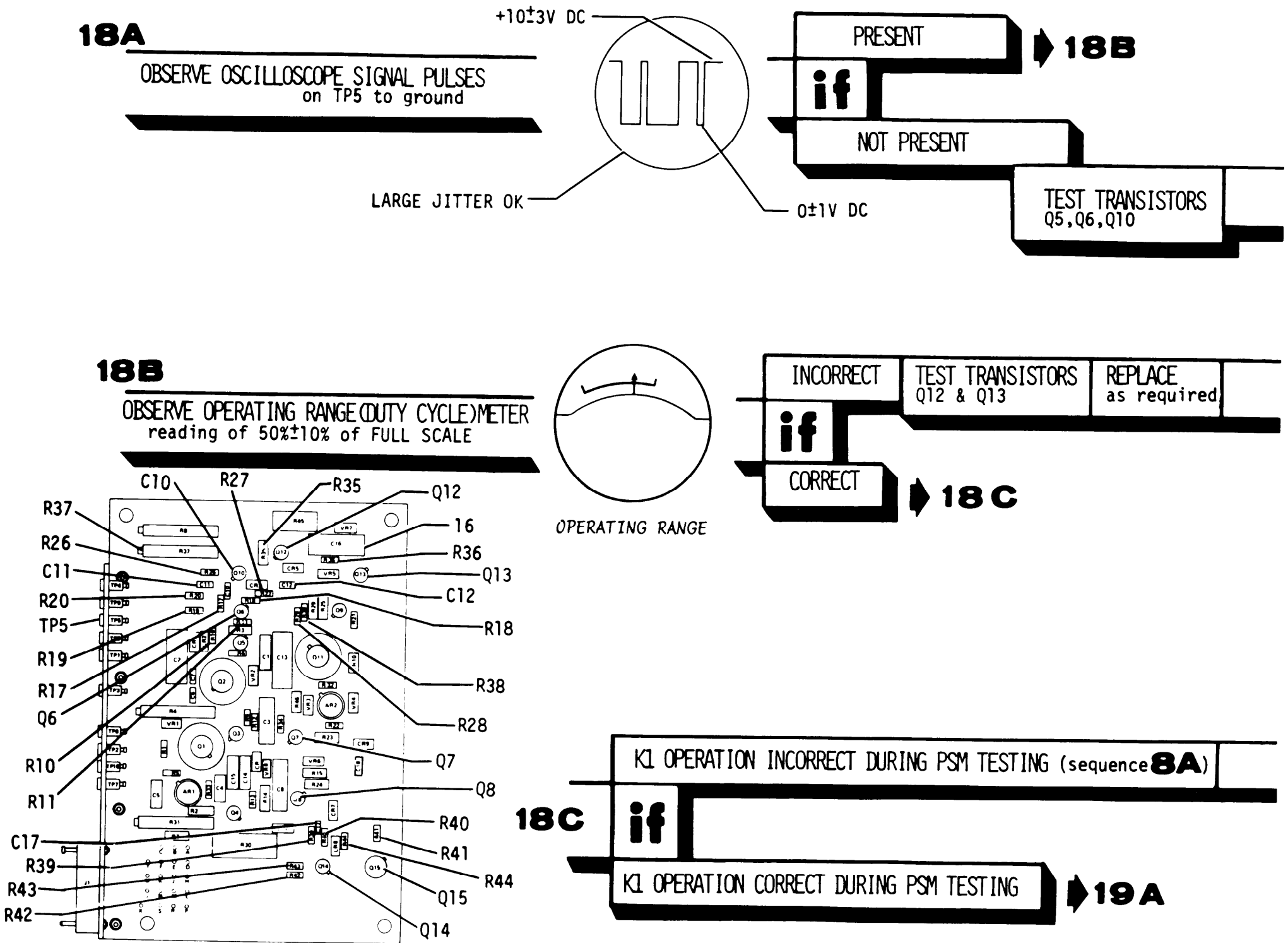
TEST TRANSISTOR Q9

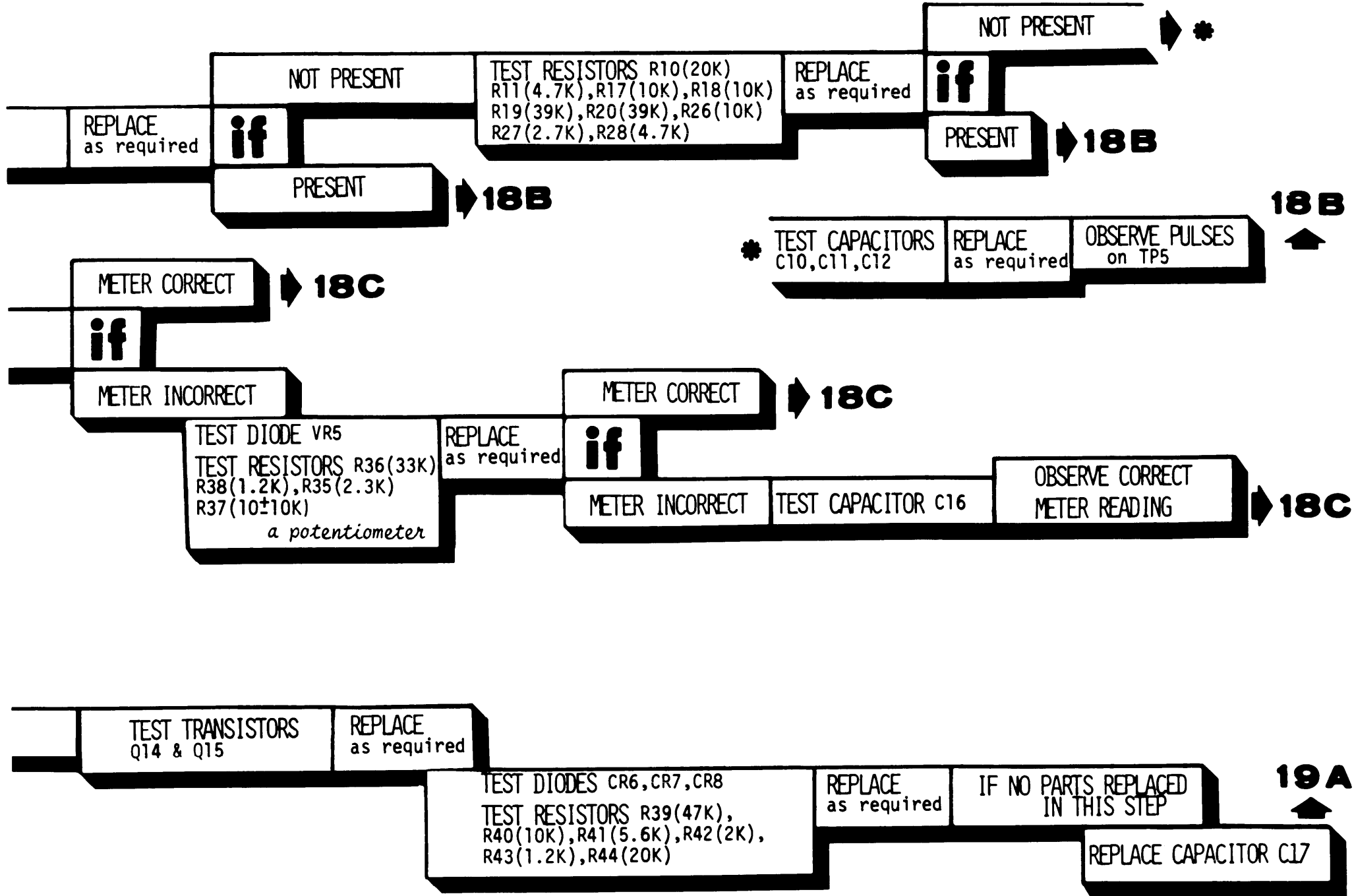
REPLACE
as required

OBSERVE SQUARE-WAVE

CORRECT
if
INCORRECT

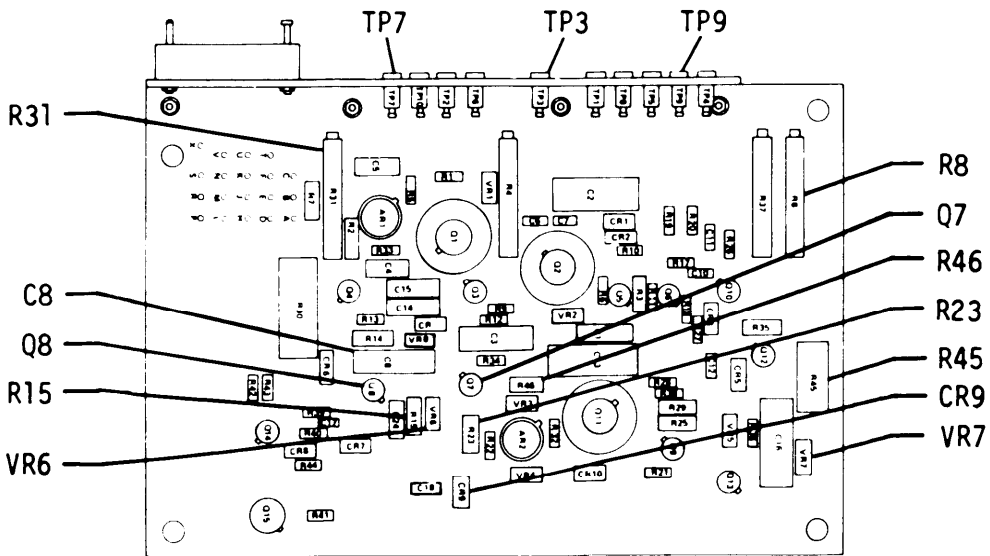


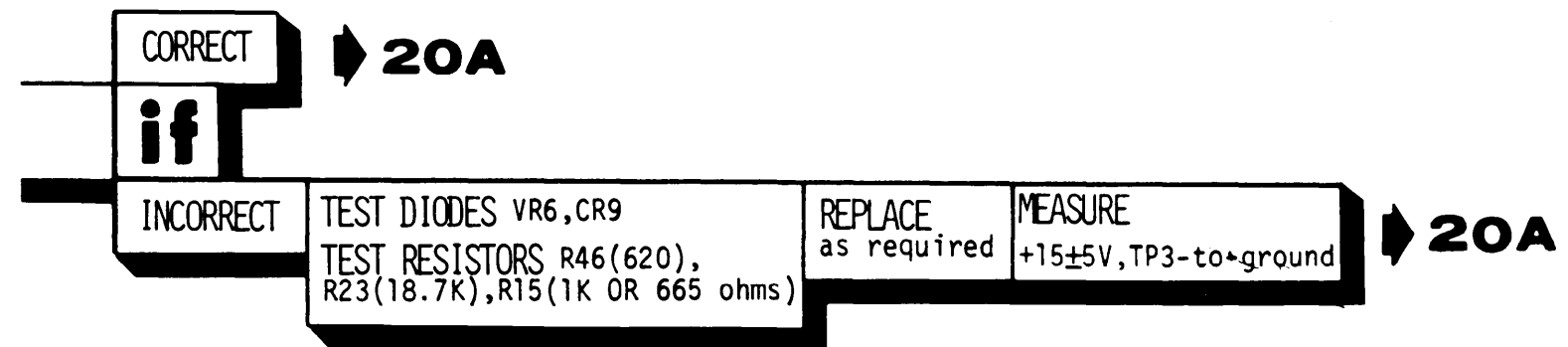
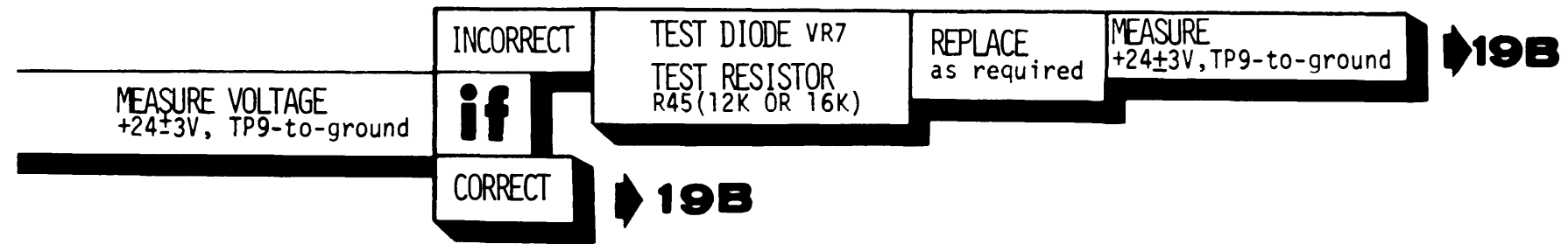


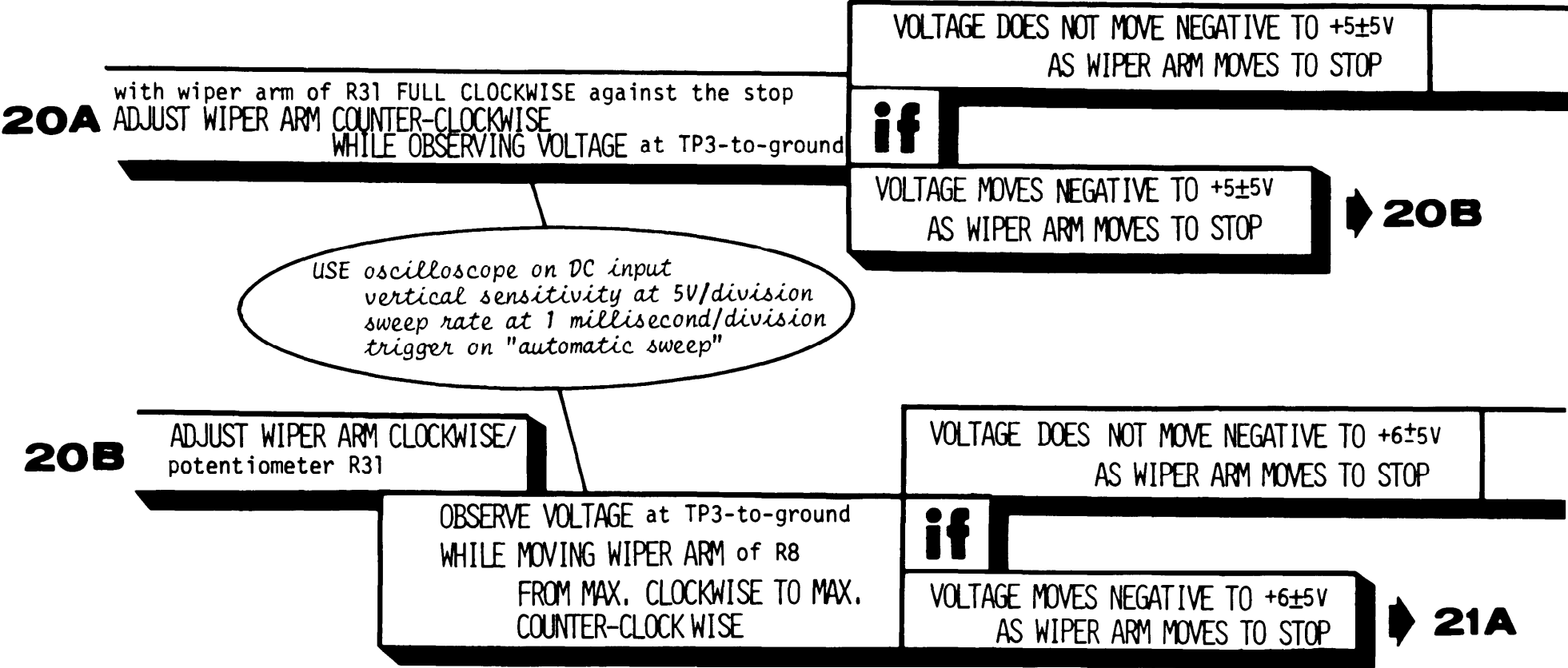


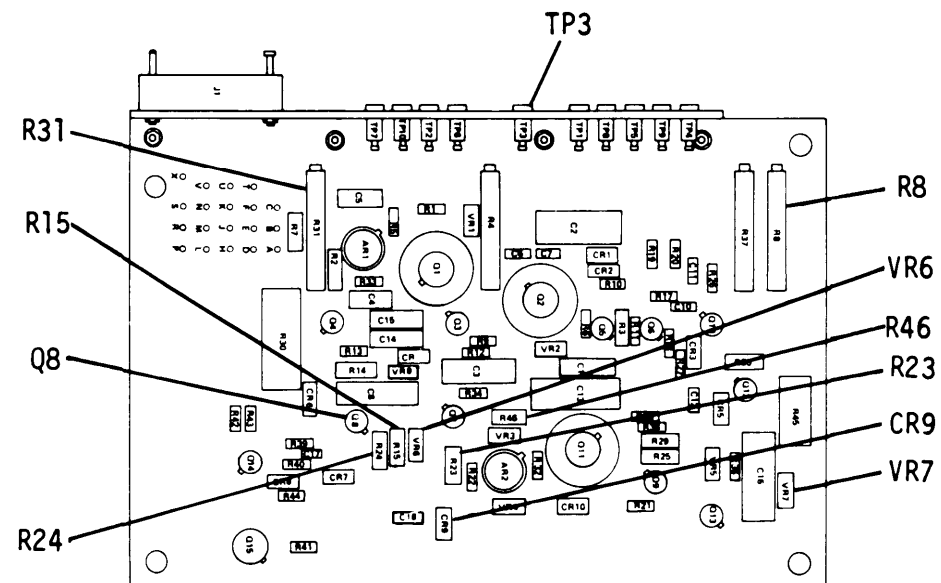
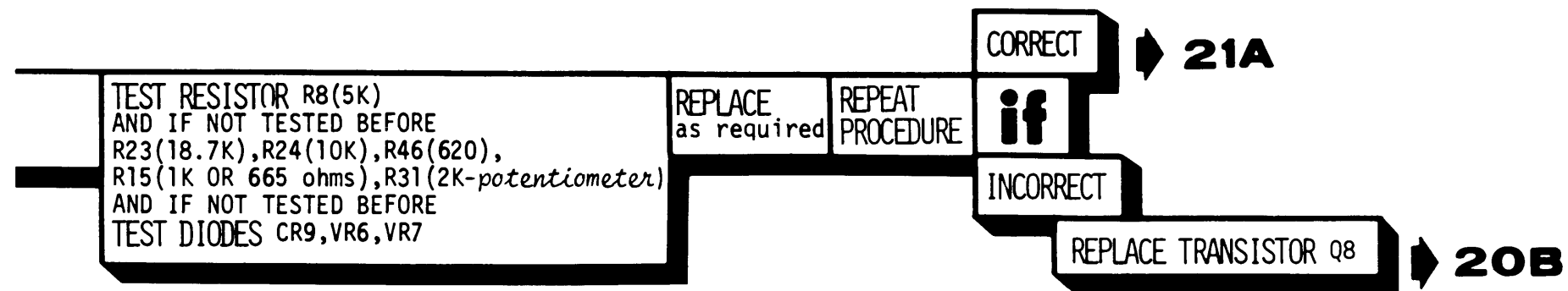
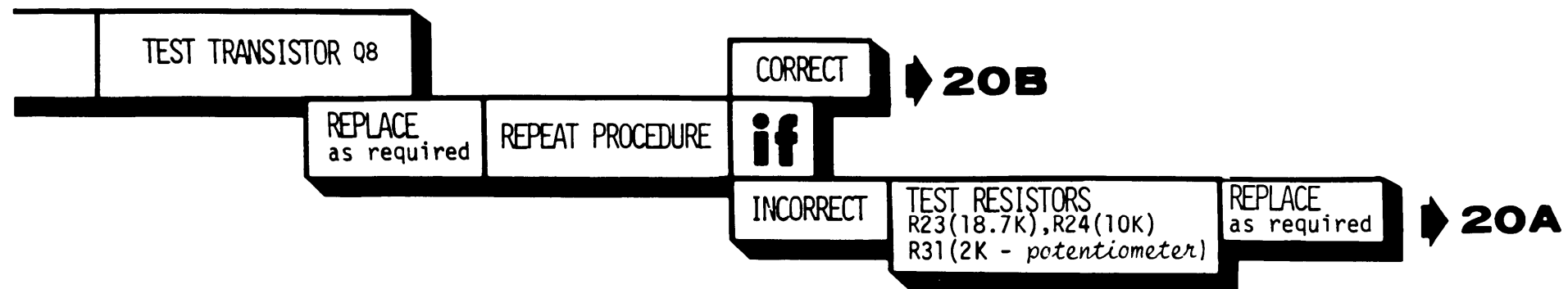
19A	REMOVE SQUARE-WAVE SIGNAL from TP7	REMOVE JUMPER WIRE from across C8	ADJUST WIPER ARM MAX. CLOCKWISE/ potentiometer R31 ADJUST WIPER ARM MAX. CLOCKWISE/ potentiometer R8	

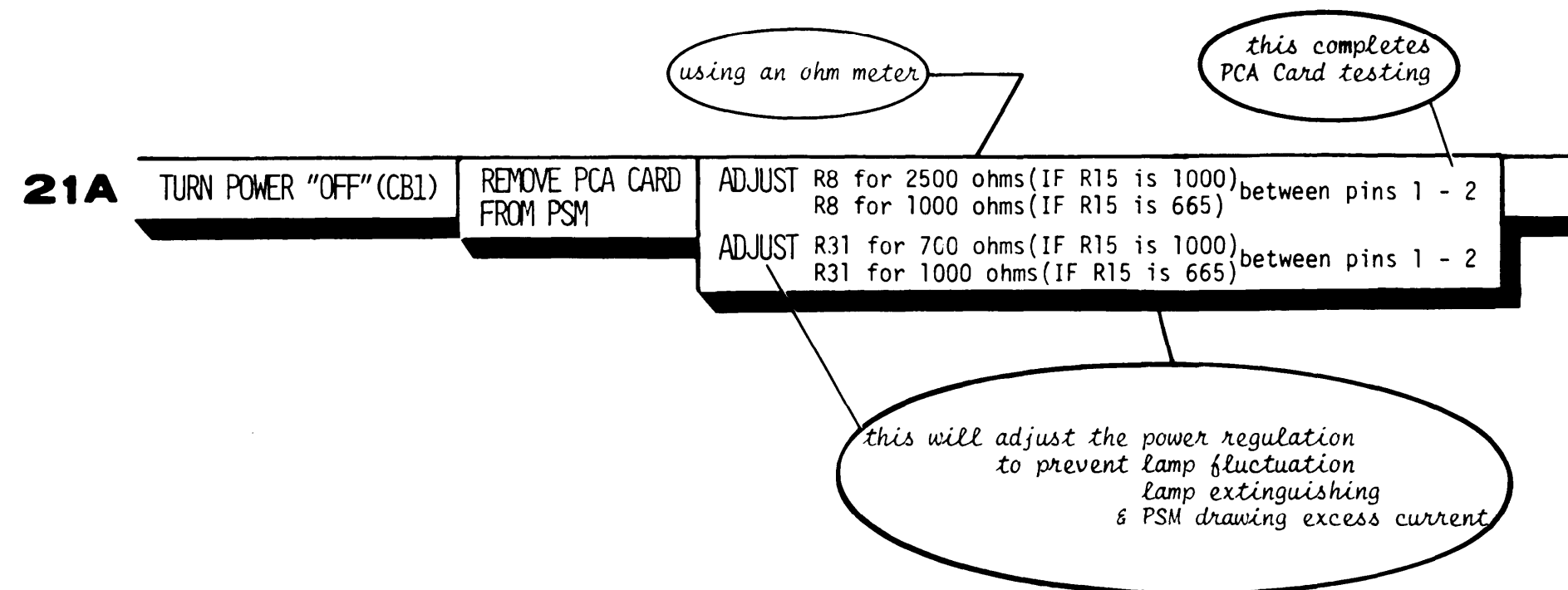
19B		CORRECT	➡ 20A		
	MEASURE VOLTAGE +15±5V, TP3-to-ground	if			
		INCORRECT	TEST TRANSISTORS Q7 & Q8	REPLACE as required	REMEASURE VOLTAGE







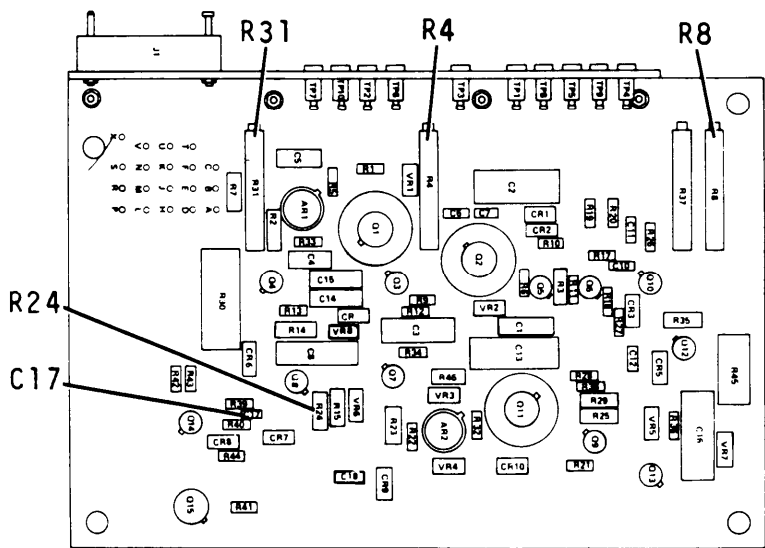




REINSTALL PCA CARD IN PSM

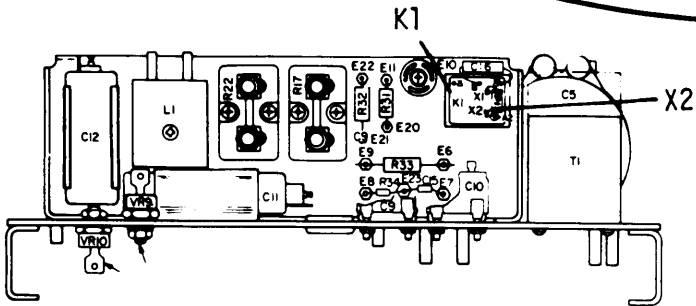
RECONNECT P1
RECONNECT LEADS of Q7 & Q8
to PSM's chassis terminals

8B

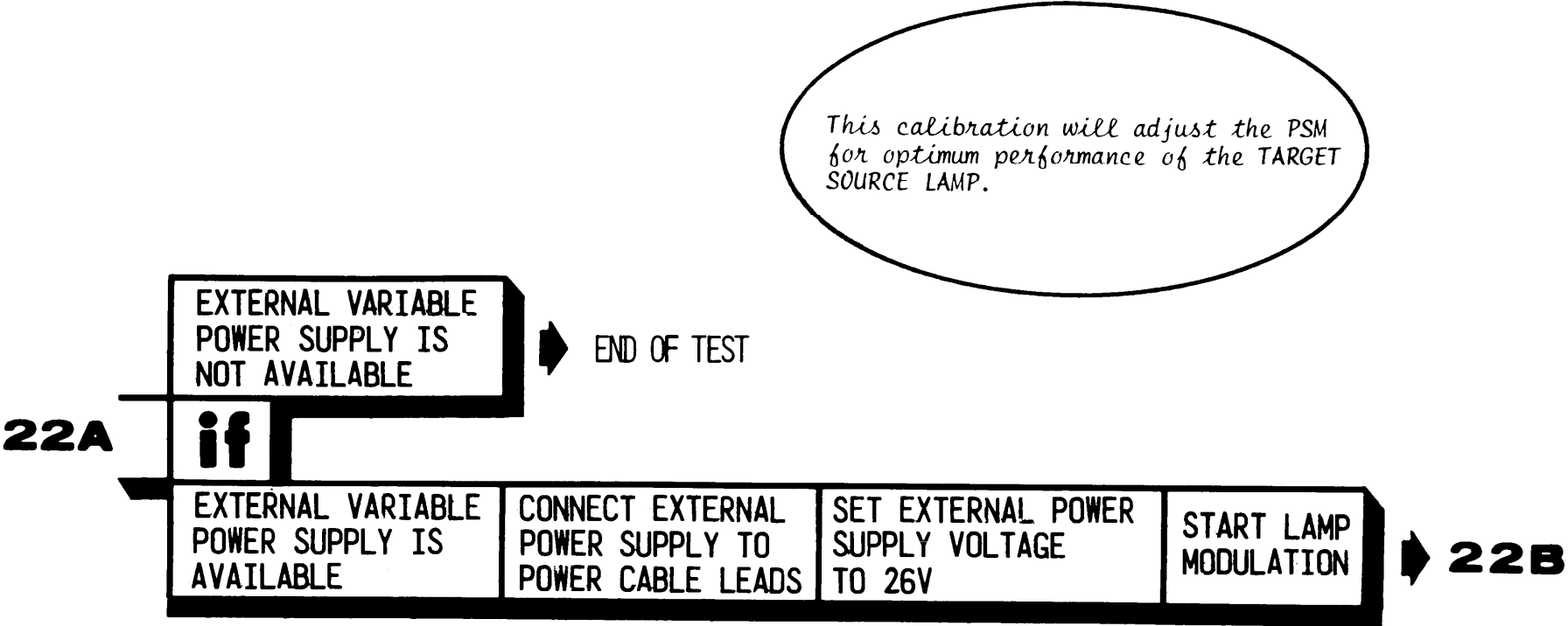


BEFORE installing chassis in case

- check all wire connections
- P1 connector on PCA Card
- wires on E12 & E13



OUTPUT POWER CALIBRATION

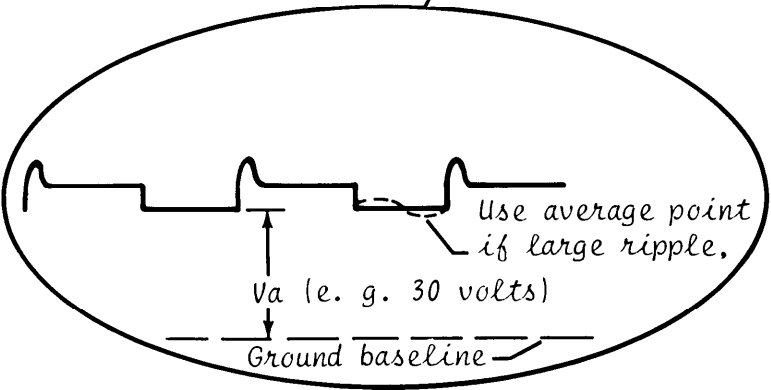


22B

ADJUST EXTERNAL
POWER SUPPLY
VOLTAGE TO 24V

USING OSCILLOSCOPE,
OBSERVE LAMP ANODE
VOLTAGE (J2-J TO J2-L)
and RECORD THE VOLTAGE
as V_a .

MEASURE LAMP CURRENT AVERAGE
VOLTAGE V_i (J2-B TO J2-A).
CALCULATE TOTAL CURRENT A_t ,
by multiplying the voltage (V_i)
by 300. RECORD A_t .



MEASURE IDLE CURRENT AVERAGE
VOLTAGE v_i (J2-G TO J2-L).
CALCULATE IDLE CURRENT A_i , by multiplying
the voltage (V_i) by 0.383 RECORD A_i .

➡ **23A**

TYPICAL CALIBRATION VALUES

V_a = 30v
 V_i = 0.040v
 V_i = 5V
 A_t = 12 amps
 A_i = 1.92 amps

23A

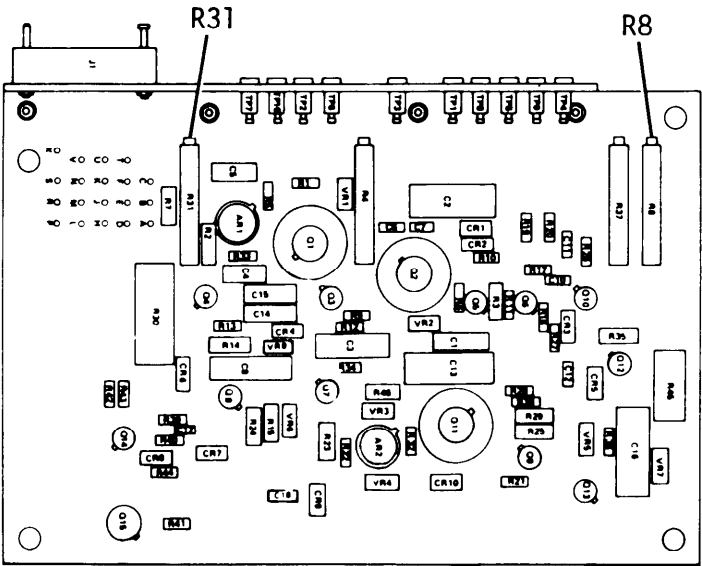
CALCULATE LAMP POWER OUTPUT by multiplying the LAMP ANODE VOLTAGE (V_a) by the TOTAL CURRENT (A_t) less the IDLE CURRENT A_i
i.e. LAMP POWER OUTPUT $=V_a(A_t-A_i)$

LAMP POWER OUTPUT
 300 ± 30 watts

INCORRECT

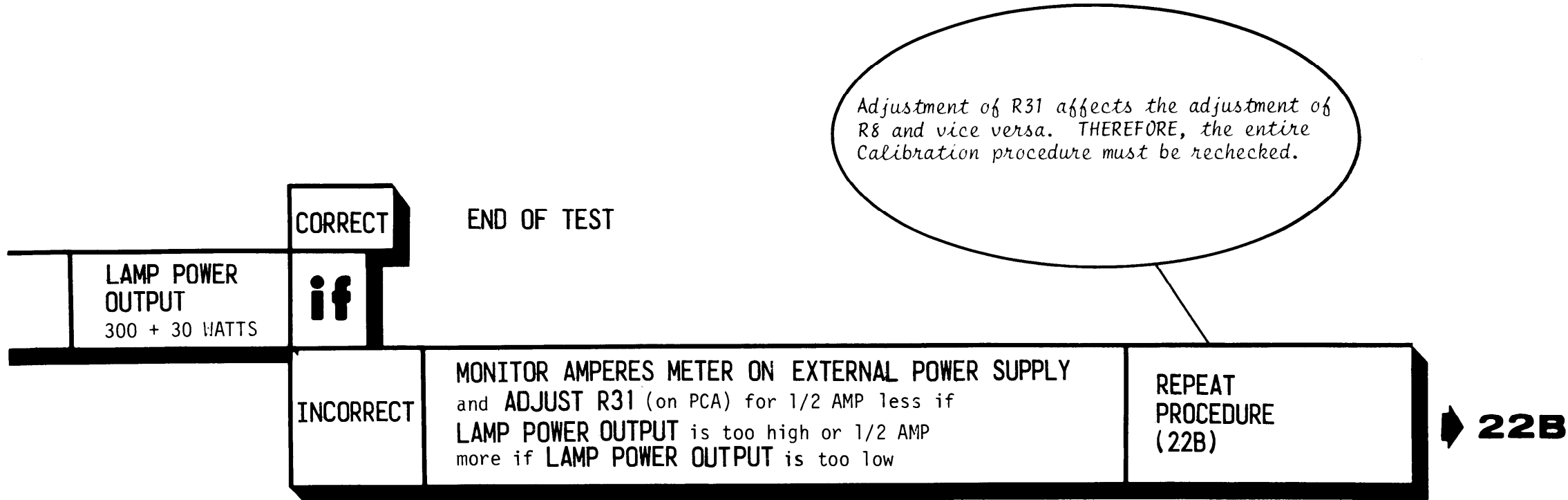
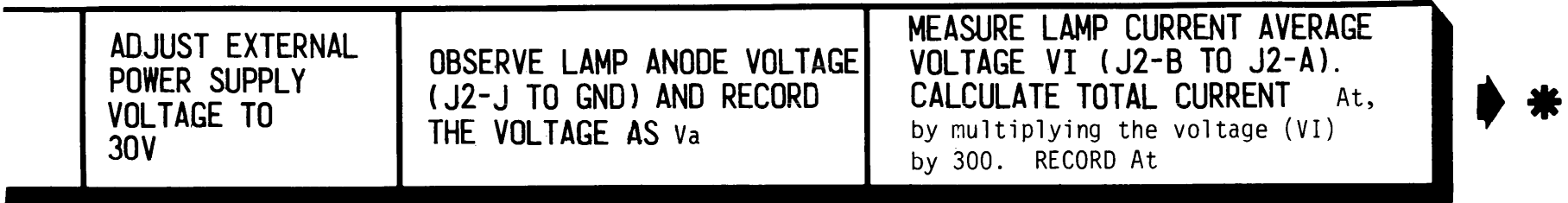
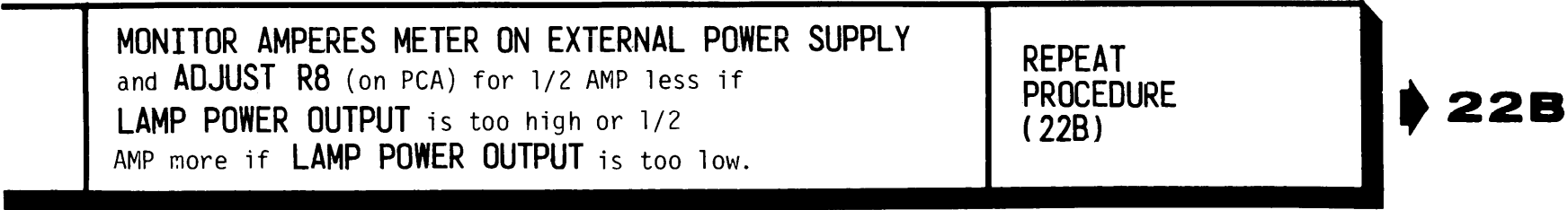
if

CORRECT



MEASURE IDLE CURRENT AVERAGE VOLTAGE V_i (J2-G TO J2-L)
CALCULATE IDLE CURRENT A_i by multiplying the voltage (V_i) by 0.383. RECORD A_i .

CALCULATE LAMP POWER OUTPUT by multiplying the LAMP ANODE VOLTAGE (V_a) by the TOTAL CURRENT (A_t) less the IDLE CURRENT A_i .
i.e. LAMP POWER OUTPUT $=V_a(A_t-A_i)$



By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:

ROBERT M. JOYCE
Brigadier General, United States Army
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