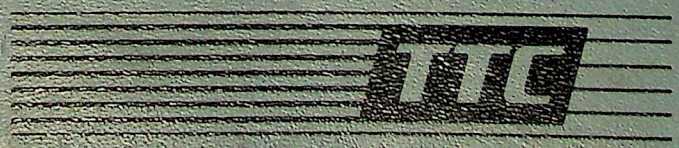
TECHNICAL MANUAL

FM 10000J

FM BROADCAST TRANSMITTER



TELEVISION TECHNOLOGY CORPORATION
6SO SOUTH TAYLOR AVENUE
LOUISVILLE, CO USA
80027

TTC
An International Company
Serving Radio and Television

TELEVISION TECHNOLOGY DIVISION
WILKINSON RADIO DIVISION
SILVERLINE DIVISION
AMPRO AUDIO DIVISION
SCULLY TAPE DIVISION

650 S. TAYLOR AVENUE
LOUISVILLE, CO 80027
(303)665-8000
TWX:910-938-0396 TTC COLO

TECHNICAL MANUAL

FM 10000J

FM BROADCAST TRANSMITTER

WARNING

HIGH VOLTAGE EQUIPMENT CAN INSTANTLY PRODUCE DEATH. The following servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.

Serial Number_____

FM5/7.5/10KWJ

Customer WEGS Serial 4103-0689-37

FREQ. 91.7 Output, Inc. 100% = 84w Ref. .5

PA PLATE I. 1.75 PA PLATE E 5900 EFF.% 77%

PA GRID E -500 PA SCREEN E 620

PA GRID I 50 PA SCREEN I 120ma

IPA PLATE E 1950 IPA SCREEN E 200

IPA CATHODE 205 IPA SCREEN I 30 IPA GRID I 3/

EXCITER INC. 100% REF. 0 LINE 205 208 209

PA FILAMENT E 7.5

EXCITER E 27.9 I 1.55 FOWARD WATTS 10.1 REF. .1

100% = 10KW
RH 10/12/90

50 Hz.	+10.9	dbm	.07 %
100 Hz.	+10.2	dbm	.07 %
400 Hz.	+10.0	dbm	.06 %
1 Khz.	+9.2	dbm	.06 %
5 Khz.	+1.9	dbm	.08 %
7.5 Khz.	-1.0	dbm	.11 %
10 Khz.	-3.5	dbm	.15 %
15 Khz.	-6.1	dbm	.2 %

FM NOISE >-70 db

AM NOISE >-59 db

TESTED BY JD DATE 6-27-89

WO 10320

TELEVISION TECHNOLOGY DIVISION
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Serving Radio and Television

VSWR PROTECTION KIT

4502-1100

Serial Number_____

VSWR PROTECTION KIT

SPECIAL NOTE: Before installing note plate E, plate I, and final effiecincy of transmitter in order to calibrate output meter in the setup of VSWR protection circuit.

CAUTION: TURN OFF MAIN POWER TO TRANSMITTER BEFORE PROCEEDING....

Parts supplied:

1. VSWR/IPA rack panel complete ....
2. VSWR/xmtr interfacing harness....
3. Two control door hook up wires.....
4. Installation procedure , operating procedure VSWR schematic and Ty wraps....

A. INSTALLATION PROCEDURE:

Step 1. Remove existing IPA output panel...

2. Install VSWR/IPA rack panel....

3. Run VSWR harness along existing xmtr harness securing with Ty wraps supplied....
   a. note : wires number 6, 7, 14, 15, 1, 21 run to back of PA box 2TB....
   b. wires number 11, 10, 20, 17 run down along 3TB....

4. Counting from top to bottom of 3TB you should find that terminals 3TB21 thru 3TB24 are blank.. Connect VSWR harness to them as follows....

TERMINAL	WIRE
3TB21	17
3TB22	20
3TB23	10
3TB24	11

5. Counting from left to right on 2TB unhook wires #72 from 2TB11 and wire #73 from 2TB12..Next wire in VSWR harness as follows.....

TERMINAL	WIRE
2TB11	7
2TB12	14
2TB14	1
2TB23	21

6. Next plug unhooked wire #72 into wire #6 of VSWR harness and plug unhooked wire #73 into wire #15 of VSWR harness..

7. With remaining two wires supplied in kit connect one wire from control pc bd terminal number 10 to 3TB22. Connect the other wire from control pc bd terminal number 11 to 3TB21.....

8. Installing is now complete-- recheck wiring before applying power...

8. Note: 3TB23 and 3TB24 can now be used for remote output metering , 3TB23 FWD and 3TB24 REF....

9. Proceed to set up procedure...

SET UP PROCEDURE

Control presets:
R117 maximum counterclockwise rotation
R113,R128,R106 maximum clockwise rotation

1. Turn the plate switch ON and set the output power meter switch to INC position. Adjust R128 for an indication of 100% foward power on meter. Turn plate OFF...

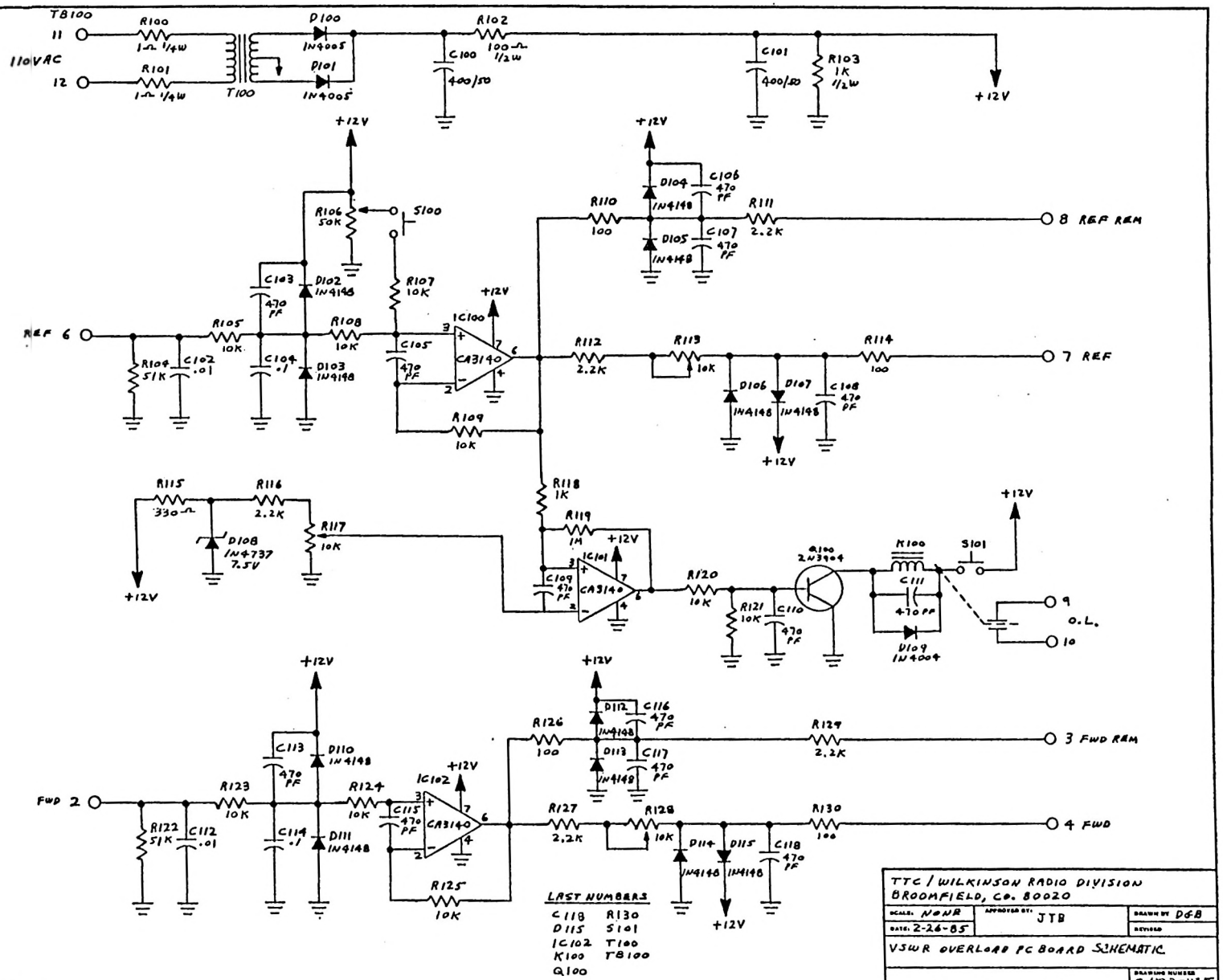
2. Reverse the BNC cables on the output directional coupler ports. Set the output power meter switch to REF and turn plate switch ON. Adjust R113 for an indication of 100% on output power meter , which is still set to the REF position. Turn plate OFF.....

3. Press cal button and adjust R106 for a reading of 10% as shown on output meter(still in ref postion).

4. Press cal button and adjust R117 slowly clockwise until reset light on control door illuminates.

5. Release button and reverse the BNC cables on the output directional coupler (thus placing them in their original location).

6. VSWR protection circuit is now operational....


TB100
11
12
110VAC
R100
1Ω 1/4W
R101
1Ω 1/4W
T100
D100
1N4005
D101
1N4005
R102
100Ω 1/2W
C100
400/50
C101
400/50
R103
1K 1/2W
+12V
R106
50K
S100
R107
10K
C103
470 PF
D102
1N4148
C104
.1
D103
1N4148
R105
10K
R108
10K
C105
470 PF
IC100
CA3140
R109
10K
REF 6
R104
51K
C102
.01
D104
1N4148
C106
470 PF
D105
1N4148
C107
470 PF
R110
100
R111
2.2K
8 REF RTN
R112
2.2K
R113
10K
R114
100
7 REF
D106
1N4148
D107
1N4148
C108
470 PF
R115
330Ω
R116
2.2K
R117
10K
D108
1N4737
7.5V
R118
1K
R119
1M
IC101
CA3140
C109
470 PF
R120
10K
Q100
2N3904
K100
C111
470 PF
D109
1N4004
S101
9
O.L.
10
R121
10K
C110
470 PF
D110
1N4148
C113
470 PF
C114
.1
D111
1N4148
R123
10K
R124
10K
C115
470 PF
IC102
CA3140
R125
10K
FWD 2
R122
51K
C112
.01
D112
1N4148
C116
470 PF
D113
1N4148
C117
470 PF
R126
100
R129
2.2K
3 FWD RTN
R127
2.2K
R128
10K
R130
100
4 FWD
D114
1N4148
D115
1N4148
C118
470 PF
LAST NUMBERS
C118 R130
D115 S101
IC102 T100
K100 TB100
Q100
TTC / WILKINSON RADIO DIVISION
BROOMFIELD, CO. 80020
SCALE: NONE
APPROVED BY: JTB
DRAWN BY D&B
DATE: 2-26-85
REVISED
VSWR OVERLOAD PC BOARD SCHEMATIC
DRAWING NUMBER
C 1572-1135

TTC LIMITED WARRANTY

All TTC equipment, except as otherwise noted below, carries a warranty against defects in material or workmanship, which arise under proper and normal use from the date of installation as per the attached Schedule A. This limited warranty begins upon installation or within two (2) months from the date of factory shipment, whichever occurs first.

Liability is limited to repairing/replacing at its plant part(s) or products(s) found by TTC in its sole judgement to be defective. All shipping charges in connection with such repair or replacement of part(s) are the responsibility of the purchaser. Tubes, klystrons and semiconductors are warranted by the respective manufacturers. Fuses and lamps are not covered by this warranty. TTC may request the return of defective parts replaced under warranty. Should such parts not be returned in a timely manner, TTC will bill customer for the full value of the parts.

Failure to maintain equipment properly, including failure to perform recommended service or operation of equipment without proper ventilation or at ambient temperatures outside the published temperature range will void this warranty. Damage caused by but not limited to acts of God (such as lightning, wind, earthquake, flood, rain, snow), shipping, abuse, accidents, water, incorrect power application, over or under voltage, are specifically excluded from this warranty. This warranty may be cancelled at TTC's option, when equipment is found to be altered without prior authorization from TTC.

TTC products designed for three-phase AC line operation specify closed Delta or Wye power service to be used. Operation of TTC three-phase transmitters on open Delta power service will void TTC's limited warranty. When products have turn-on service or proof-of-performance testing provided by TTC, Customer will void warranty if power is applied before TTC's representative is present and approves installation.

This warranty, with respect to TTC equipment, is in lieu of all other warranties, expressed or implied (except as to title) and constitutes all of TTC's liability with respect to its equipment. Equipment produced by other manufacturers and used as an integral part of a TTC system is warranted under the terms of that manu- facturer's limited warranty and the warranty provided by such manufacturer shall be the measure of TTC's obligation.

All TTC products are manufactured to commercial and industrial standards. Safety precautions have been incorporated with the express intent that users will be knowledgeable and experienced in the operation of this type of equipment. TTC assumes no liability for injury, death, or damages arising from the use, operation or installation of these products.

WARNING!

THIS EQUIPMENT UTILIZES HAZARDOUS VOLTAGES, WHICH CAN CAUSE INSTANT DEATH BY ELECTROCUTION! NO ATTEMPT SHOULD BE MADE TO DEFEAT THE PROTECTIVE INTERLOCK SYSTEM OR ANY OTHER PROTECTIVE CIRCUITS OR SYSTEMS. INSTALLATION, ADJUSTMENT AND MAINTENANCE OF THIS EQUIPMENT MUST BE PERFORMED BY A QUALIFIED BROADCAST TECHNICIAN FAMILIAR WITH THE OPERATIONS AND HAZARDS OF HIGH POWER TRANSMITTING EQUIPMENT.

CAUTION!

international (IEC) Standards require the owner of broadcast equipment to employ broadcast technicians familiar with the operation and maintenance of this type of industrial equipment. If the technician is not familiar with this equipment, the owner must provide adequate supervision and training for the technician's safety.

SCHEDULE A: TTC LIMITED WARRANTY

TTC High Power UHF-TV Transmitters	2 Years
TTC Translators/Boosters/Low Power TV Transmitters	1 Year
TTC Model X FM Exciter	2 Years
TTC/Wilkinson AM/FM Transmitters	1 Year
TTC/Wilkinson AM/FM Transmitters (When used with S1A Series AC Line Surge Protector)	2 Years
TTC Rectifier Stack Assemblies	1 Year
All Other TTC Products	1 Year

TTC SERVICE

During normal business hours (7:30 a.m. to 5:30 p.m. Mountain Time), TTC provides telephone service and parts ordering support through TTC's business telephone number. Outside of normal business hours, including weekends and holidays, TTC service personnel may be reach through TTC's emergency answering service number.

TTC's Main Number: (303) 665-8000 EXT. 500
FAX: (303) 673-9900

Emergency Number: (303) 692-6099

GETTING TO KNOW YOUR MANUAL

This manual is the best way the equipment manufacturer has of communicating with the user of the equipment. Therefore, it is extremely important to read and understand the details covered here before operating the equipment. PLEASE TAKE TIME TO READ AND UNDERSTAND IT BEFORE ATTEMPTING TO OPERATE THE EQUIPMENT.

The manual is organized into six parts...Parts One and Two are primarily introductory, and Parts Three through Six address themselves to specific portions of the unit. Part Three explains the equipment's operation, Part Four deals only with maintenance and repair, and Part five is parts lists.

Most of the illustrations and photographs, except the frontispiece, are in Part Six.

If you are OFF-THE-AIR, rapid troubleshooting procedures are near the beginning of Part 4. These pages are color-coded for easy location.

Here is an important note regarding the part numbering system. Parts in this manual are numbered "6T2," etc...The "6" at the beginning of the part informs you that it's in the IPA plate/PA screen supply. Here is the WILKINSON parts location scheme:

FIRST DIGIT

1.....not used in this manual.
2.....PA Box
3.....Control Door
4.....Right Side Panel
5.....Left Side Panel
6.....Base and Cabinet

This manual, like all manuals, requires input and information for its survival. If you have had an experience or made an observation in the field that could enhance this publication, please share it with us. This allows us to provide the best information with our products.

There are several "flags" in this manual that are important. As this manual deals with high-power, high voltage equipment, you will note occurrences of the following in various places throughout the manual.

When you see...

WARNING

...The information which follows relates to the protection of human life and safety.

When you see...

CAUTION

...The material to follow addresses itself to the safety of the equipment or to compliance with applicable regulations.

When you see...

...NOTE...

...The material which follows is of an important informational nature, but will not refer to matters which affect safety, property, or regulations.

During normal product improvement, an updated schematic or parts identification may be included with this manual during the transition process. If you have two schematics or other diagrams for a particular circuit, inspect your circuit closely and retain the schematic that agrees with yours. There are a couple of ways of making this determination. The number etched on the PC board, if one is involved, should agree with numbering on the schematic. Failing that, a component and wiring comparison will inform you.

IT IS IMPORTANT THAT YOU READ AND UNDERSTAND THE ENTIRE MANUAL BEFORE ATTEMPTING TO OPERATE OR PERFORM MAINTENANCE ON THE EQUIPMENT.

FM10000E

FACTORY TEST DATA SHEET

CUSTOMER: WEGS SERIAL#: 4103-0689-32

LINE VOLTS 205/208/208

Operating Frequency: 91.7 MHz Date: 6-29-89

Output Power (Inc.) 10070=8K W (Refl.) .5 W

PA PLATE 1.75 I INPUT _____ W

PA PLATE 5900 E EFF. 77 %

PA VOLTS GRID 500 SCREEN 620

PA CURRENT GRID 50 SCREEN 120 ma

IPA VOLTS PLATE 19.50 SCREEN 200

IPA CATHODE 205

IPA CURRENT GRID 31 SCREEN 30

EXCITER.....

Output Power (Inc.) 10.1 (Refl.) .1

FME-10 AFC

I +15 LO _____

E -15 LO _____

I +15 HI _____

E Final _____

RF out _____

Tested by: JD

Other exciter or additional equipment readings (please identify)

OPERATING AND SERVICE MANUAL
WILKINSON FM TRANSMITTERS

FM10000E

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

SECTION FOUR...MAINTENANCE

SECTION FIVE...PARTS LISTS

SECTION SIX...ILLUSTRATIONS

(ILLUSTRATIONS ALSO FOUND IN SECTIONS TWO AND FOUR)

THESE INSTRUCTIONS ARE TO BE USED IN CONJUNCTION WITH ANY INSTRUCTIONS ACCOMPANYING EXCITER AND ANCILLARY EQUIPMENT.

SECTION ONE

INTRODUCTION

GENERAL DESCRIPTION:

OVERALL DESIGN: The TTC/WILKINSON FM10000E FM broadcast transmitters are conservatively designed units having characteristics suitable for full-fidelity stereo and SCA operations with the appropriate accessory equipment.

Using the FME-10 Exciter, the transmitter includes a subcarrier modulator and can be used with the SCA-1 generator and the SG-1E stereo generator for subcarrier operations to include stereophonic broadcasting.

If equipped with another exciter, the transmitter will be known as the FM10000J series. The above features will continue to be true of the unit, and the exciter's instruction book should be used in conjunction with the transmitter.

The simplified circuitry and efficient mechanical layout produce a transmitter that is both high-power and compact. Air-cooled tubes are used in the driver and final RF amplifiers, allowing the use of only two tubes...the balance of the equipment is solid-state. This allows long, trouble-free service and a high degree of serviceability.

Designed for unattended operation, the transmitter's metering and control functions can be performed at a remote location with the use of appropriate remote control accessories, such as the 4039-1000 Remote Rheostat Assembly or the Interface Panel which will allow the use of a Moseley or Marti remote control system. The Wilkinson Extended Metering and Control Panel is also available as a useful accessory. Other accessories, such as a filament running time meter and remote/local switching are also available from the factory to make operation of the FM10000E simpler, more efficient, and better suited to individual circumstances.

CONSTRUCTION: The entire transmitter consists of one main cabinet. Access to the equipment is gained by opening the rear interlocked door or any of the front interlocked doors. Maximum accessibility is an important concept used in the design of this equipment. Vertical chassis-type layout is employed, with surface-mounting of components and wiring harnesses. This allows speedy circuit tracing and convenient servicing if necessary.

Safety of personnel is of utmost consideration in this design, with all access doors for high voltage or high power areas protected with interlocks. DO NOT EVER ATTEMPT TO DEFEAT THEM. The interlocks shut down the high voltage in the event a protected door is opened.

The equipment is cooled with forced air. The fan is located at the rear of the PA cabinet and its airflow is routed to the intermediate power amplifier (IPA) and the the final power amplifier (PA). If the airflow decreases, an interlock switch will shut off the plate, filament and screen voltages before damage from overheating ensues. To save yourself unnecessary trips to the transmitter, be sure the airflow routes in and out of the transmitter remain clear of obstructions.

An external harmonic filter, elbow, and directional coupler are, when the installation is complete, mounted on the top of the main cabinet.

SPECIFICATIONS

FM10000E FM BROADCAST TRANSMITTER

EMISSION	F3/F9
OPERATING FREQUENCY	88-108 MHz
POWER OUTPUT	10000 watts
PLATE EFFICIENCY	72% NOMINAL
RF OUTPUT IMPEDANCE	50 Ω (1-5/8" EIA flange)
AUDIO INPUT IMPEDANCE	600 Ω
AUDIO INPUT LEVEL	8-12 dBM
AUDIO FREQUENCY RESPONSE	±1dB, 50-15,000 Hz 75μ sec pre-emphasis
AUDIO DISTORTION	0.5% THD 50-15,000 Hz
CARRIER STABILITY	±1000 Hz
MODULATION CAPABILITY, MAIN CHANNEL	±75 kHz deviation
SUBCHANNEL	±75 kHz deviation
FM NOISE	-65 dB below 100%
AM NOISE	-55 dB below carrier

ELECTRICAL REQUIREMENTS

POWER LINE VOLTAGE	208/220/240 VAC 3-Phase, 50-60 Hz
SLOW LINE VARIATIONS	±5%
POWER SUPPLY REGULATION	3%
POWER REQUIREMENTS	16 KW nominal
POWER FACTOR	90% nominal
OPERATING ALTITUDE	10,000 feet (3048 meters)
AMBIENT TEMPERATURE RANGE	-20° to +45° C.

TUBE COMPLEMENT..... 1-4CX250B
1-4CX10000D

COOLING SYSTEM

HIGH-CAPACITY, 500 CFM

DIMENSIONS

MAIN CABINET (all versions) 34-1/4" wide X 76" high X 37" deep
(87 cm X 193 cm X 68.6 cm)

WEIGHT, OPERATING....1200 Lbs. (540 KG.) nominal

RULES AND INFORMATION:

For operation of this equipment within the United States or its Possessions, the rules governing its operation are found in Title 47, Code of Federal Regulations, Part 73. Many changes have been made in Part 73 in the recent past and so it is important to have a current copy. Copies are available from the Superintendent of Documents, Washington, D. C. (20554), from a Government Printing Office Bookstore, or from various commercial sources. Be sure you have a copy in your possession. Additionally, there are several periodical publications which outline changes in the Rules as they occur. Subscriptions to one or more of these may be helpful.

TREATIES:

The United States has treaties with Canada and Mexico regarding the use of radio frequencies, and the restrictions provided by these treaties are normally reflected in Part 73.

CITATIONS:

Here is a short list of the most commonly needed rule citations.

Concerning:	Consult 47CFR:
Operator requirements	73.265
Remote control	73.274 73.275
SCA	73.293 73.294 73.295
Stereo	73.297
FM transmitting system standards	73.317
SCA standards	73.319
Stereo standards	73.322
EBS	73.900 series
Antenna marking/lighting	73.1213
FCC inspection	73.1225
Frequency measurements tolerance	73.1540 73.1545
Modulation levels	73.1570
Equipment Performance Measurements	73.1590

A more compresensive guide to the Rules, their involvement in your station operation and the performance of certain required operations is found in the FCC's "CHECKLIST"...available from the FCC in Washington or the local FCC field office.

SECTION TWO

FAMILIARIZATION AND INITIALIZATION

UNPACKING:

Careful reading of the material in this section will assure the user that he has not overlooked any important points regarding the equipment's unpacking, initial setup, or initial operation. There are some general points to be observed when initially receiving equipment...points which will tend to prevent problems down the road.

Look the outside of the carton over carefully. Other cautions to be followed immediately upon receiving the item are outlined below.

UNPACKING CAUTIONS....PLEASE READ CAREFULLY!!

We cannot stress too strongly the importance of IMMEDIATE careful inspection of your new received goods and the subsequent IMMEDIATE filing of claims against the carrier in the event of a damaged or incomplete shipment. WE CANNOT GUARANTEE A CARRIER'S PERFORMANCE.

INSPECTION OF GOODS:

In the presence of the shipper's delivery person, inspect for the following:

...Damage to the cartons.
...Signs of repacking.
...Concealed damage.
...Missing items...check ALL against the Bill of Lading.

...If possible, NOTE any damage on the shipping bill as you sign it. Protect your investment.

With respect to small items such as connectors, look carefully within the packing for them...they hide in small places. Retain the packing material if it becomes necessary to ship the unit anywhere.

IN CASE OF DAMAGE OR LOSS IN SHIPMENT:

Remember, the carrier is your first area of recourse in the event of damage or loss. If, for ANY reason, the unit must be returned to the factory, a RETURN AUTHORIZATION must be obtained. We will accept no returns without one.

FIRST FAMILIARIZATION: Study of the layout of the controls and indicating devices on the front of the piece of equipment will often clear up questions about its operation. THINK through the operation as represented by the controls and the operating concepts should become reasonably clear. See the following information.

RULES AND REGULATIONS: Many sections of this manual address themselves to standards imposed by the Federal Communications Commission. It is most important that the licensee perform these tasks correctly and in good faith. The FCC is not known for its understanding when its rules are broken. In any case of doubt, inform yourself thoroughly about Part 73 of the Rules...at least, those sections applicable to your installation. If any further doubt exists, carry out your actions in the most conservative manner possible.

DON'T TAKE CHANCES WITH YOUR LICENSE.

GENERAL:

If your new WILKINSON transmitter is replacing an older, similarly powerful unit, chances are you will have most environmental requirements under control. However, it is wise for you to review the material presented here to be sure that is the case. If your installation is new or if you are upgrading from a Class A, the quality of the transmitter's environment is of great importance if you are to expect long life and adequate continued performance from your transmitter. The building must be:

CLEAN	TEMPERATURE CONTROLLED
SECURE	DRY
FIRE-PROTECTED	

Any money you attempt to save on the above features may indeed end up being spent on equipment maintenance.

SPACE REQUIREMENTS: The floor space made available for the unit must leave enough room on all sides for adequate ventilation and service. It should be arranged so that there is at least the width of the rear door between the rear and the wall and about five feet available in front of the unit. If you are using a raised platform to allow wiring into the bottom of the cabinet, be sure that platform is STRONG.

Once the area for the transmitter has been determined, don't forget to allow plenty of space for additional racks to house ancillary transmitting, audio processing or test equipment. Plan for plenty of workbench area, for line requlating transformers if needed, ladders, stepstools, equipment/parts storage, a good first-aid kit, an emergency generator if required, as well as heating/cooling devices and other needs that may be unique to your installation.

THE ROOF: If you are constructing or remodeling, a sloping roof will tend to develop leaks less rapidly. Your transmitter building should be well-roofed with good material. The cooling load will be lowered with reflective or light-colored roofing material. Another important consideration is a roof strong enough to withstand the impact of ice falling on it from the tower. That consideration also suggests that a hard hat be kept on the site for the engineer's winter ensemble.

VENTILATION:

The temperature environment provided for the transmitter will contribute in great measure to the length of the equipment's life. Briefly,

...IF YOU ARE COMFORTABLE IN THE BUILDING WHILE THE TRANSMITTER IS OPERATING, THE EQUIPMENT SHOULD BE.
...AVOID SUDDEN CHANGES OF TEMPERATURE.

Such an enormous amount of progress has been made in the art of heating and cooling through natural means that it is suggested you study some of the available data for possible use at your site. Heating and cooling either by means of or augmented by geothermal or solar energy might naturally lend themselves to your installation. Remember...a high power transmitter exchanges a LOT of heat.

IF SEVERAL TRANSMITTERS ARE OPERATING WITHIN THE SAME BUILDING, ADEQUATE AIRFLOW MUST BE SUPPLIED FOR THEM ALL. This may require fans to force new air into the building. If so, install them. This measure may extend the service life of your equipment substantially. Allow enough for ALL transmitters' air exchange rates PLUS about 20%. This compensates for airflow loading due to dirty filters or other, similar causes.

If you have designed a building flow-through type ventilation system, there must be no sharp bends in any air hose or vent that departs the building from the vents on the top of your transmitter. Additionally, the hose or vent must be no more than four to five feet long unless it is graduated to a larger size. Back pressure MUST be avoided.

VENTILATION (continued):

The building air intake (FILTERED) must have capacity for ALL airflow in the building PLUS about 20%. The FM10000 exchanges approximately 500 cubic feet of air per minute. Keep the building air intake below the roof to avoid intaking solar heated air, and intake and exhaust must be on the same side of the building to avoid a pressure differential during windy conditions. Lastly, do not locate the intake near the preheated air emanating from the exhaust.

AIR CONDITIONING: The needs of the transmitter MUST be met while not overburdening your utilities budget or your electrical circuits. In the event the outside temperature often runs over 90 degrees fahrenheit, air conditioning may well be required despite all attempts to avoid it. If so, discuss the situation with a qualified HVAC technician. The sun's heat load requires one ton - or 12,000 BTUs - to cool about 500 empty square feet to a comfortable level. For transmitter buildings, add all the electrical power figures used by all equipment in normal operation and subtract the total combined RF output power. Multiply this number by 3.4 to find the necessary additional BTUs required for the equipment load.

ELECTRICAL SERVICE TO YOUR TRANSMITTER BUILDING:

A qualified, licensed LOCAL electrician might well be consulted for the electrical service. We stress "local" for several reasons: (1) he knows the local codes, (2) he can be on-site readily, and (3) you'll get better overall support if you give what business you can to local suppliers. Use only copper wire, minimum AWG #2, having four conductors and DO NOT connect the unit to an open delta primary power supply. The severe voltage fluctuations could harm the unit. All electrical service should be installed in accordance with the National Electrical Code, any applicable state or local codes and good engineering practice. Special consideration should be given to lightning protection of all systems in view of the vulnerability of many transmitter sites to lightning. Play it safe and install lightning arrestors in the service entrance and use straight, short ground runs. See to it that the electrical service is itself well-grounded.

Branch your circuits wisely. Do not allow anything to share the transmitter circuit. There should be two lighting circuits, so that a failure in one will not plunge you into total darkness. Primary three-phase breakers should be magnetic/thermal type, capable of handling an inrush current of 1650 Amps, in a load center with a master switch. Thermal fuses may be the most economical approach. Instantaneous protection of your equipment will, in this event, still be provided by the built-in circuit breakers. Similarly, use a separate breaker for the lights and the workbench so that, if a workbench plug is overloaded, the lights won't go out.

Provide an ample supply of outlets at the workbench and anywhere test equipment or tools may be needed. Two foursquare boxes, each having two duplex outlets, should be adequate at the bench.

SECURITY:

The FCC requires that the transmitter be secure from entry or control by unauthorized persons, and that any hazardous voltages or other dangers (including most tower bases) be protected by locks, fences, etc., as necessary to protect personnel and prevent unauthorized operation or tampering.

Security of the building further implies that it, if remotely located, be secure from the local wildlife. The persistence of animals and insects is amazing if they have a week or so of steady time to work. They can claw, chew, rub or dig their way into the most inaccessible places, so use sturdy construction materials, including sheet metal if necessary. Holes around conduit, cable and other similar entry points may be stuffed with steel wool and caulked. This caution extends itself to insects. Bees are deadly to many people with allergies and thus even small holes should be sealed.

SECURITY (continued):

Other features of security for your building may include its location with respect to the prevailing wind conditions. A location leeward of some natural topographical feature will prevent wind damage, but will create conditions that may worsen snowdrifts. Check the soil and runoff conditions that may slow or hasten wind or water erosion...and other concerns that may be unique to your location. Try to think of everything.

IN CASE OF EMERGENCY: Weather changes, transportation failures or injuries may require an operator to extend his stay at the site. If it is remote, the stay may quickly become dangerous without certain survival and related items. It is wise to leave on site the following:

5 gallons of water in some sort of freezable container
A sleeping bag designed for the coldest temperatures expected
A supply of dried/canned foods
A can opener
An empty coffee can
Some candles and stick matches
A reliable flashlight and spare batteries
Basic First-Aid items
Some hand tools

Nice to have:

A small portable catalytic or propane heater with fuel (safely stored!)
A CB radio or telephone
A change of clothing

Dangerous and foolish to have:

Any alcoholic beverages or other recreational drugs...why? The effects of hypothermia are swifter and more pronounced with their use and their use is, of course, dangerous in the vicinity of hazardous voltages...rather like being pickled and then fried, we should guess.

FIRE PROTECTION:

The generation of substantial heat within operating electronic equipment is always a matter of concern with respect to the possibility of fire. Although a fire extinguisher or automatic system for that purpose can preserve life and property, recent events have shown that the traditional approach can be unnecessarily destructive in the event of a conflagration developing within electronic circuitry. Not many years ago, a TV station lost well over a million dollars' worth of equipment...10% of the cash damage was due to the fire...90% was due to corrosion caused by the ammonium phosphate used in traditional dry chemical "ABC" type fire extinguishers that had been used on the blaze.

Thus, it appears clear that the most effective approach to fire protection in an electronic environment employs extinguishers or systems using HALON as the first preference or CO2 as the chemical of second choice. HALON 1301 is a trade name which describes Bromotrifluoromethane (CBrF3), part of the commonly known FREON family. It will cause the least corrosive damage to equipment in whose vicinity it is used.

Check with your insurance carrier and local fire protection officials to determine the economics of the matter as it affects you, but the following points have become evident:

.... Fire protection is an ecomomically sound and safe idea.
.... Do not, however, allow "DRY CHEMICAL" fire extinguishers or systems ANYWHERE NEAR your electronic equipment. Their use, in the most literal sense, is "Throwing the baby out with the bath."

ANTENNA, FEEDLINE AND TOWER:

Your preliminary engineering workup will establish your antenna and tower requirements. Construction of the best tower system you can afford will pay off in terms of coverage of your service area, the overall quality and salability of your signal, and reduced maintenance expenses.

Transmitting antennas can enhance or seriously impair the transmitter's output. It is assumed one has been selected prior to system installation, but the best-designed antenna system will function poorly if shortcuts and compromises are used during installation. FOLLOW THE MANUFACTURER'S INSTRUCTIONS EXACTLY...ALONG WITH ALL ENGINEERING DATA PREPARED FOR THE SITE.

FEEDLINE: The selection, routing and length of feedline is of supreme importance in your installation. If there is a 3 dB line loss in the cable between your unit's output and the transmitting antenna, you will have halved the output of your transmitter. Buy the BEST cable you can obtain, route it via the SHORTEST way to the antenna, and keep it STRAIGHT...do not form it into sharp bends on its way. Do not use any more cable fittings for your installation than absolutely necessary, and avoid oddball adaptors. Upon entering the building with an above-ground level cable, allow the cable to dip BELOW the entry point before entry, so that moisture will drip off the dip (drip loop) and not follow the cable into the building and/or transmitter.

TOWER REGULATIONS: With respect to towers, the applicable rules are found in Title 47, Code of Federal Regulations, Parts 17.43 through 17.56. Be sure your installation is in compliance with this document...if you have doubt, contact your local office of the Federal Aviation Administration.

The better known tower manufacturers offer complete technical and safety documentation with their towers. Be sure, through whatever means, that you have this information as it regards wind loading, guying, etc. Be absolutely safe and certain about this aspect of your installation...human lives may be at stake.

Although logging requirements were relaxed in late 1983, a record of tower lamp failures must be maintained. In section 4 of this book we comment on the suitability of logging vs. not logging...we'll not rehash it, but an operating or maintenance log IS a good place to keep tower light information.

REMOTE CONTROL:

The FM10000E has all the necessary provisions for remote control operation. The table below outlines these connections. Refer to the appropriate drawings for the location and arrangement of the terminal board.

REMOTE FUNCTION	CONNECTIONS
START	Momentary contact closure - 5TBA-1 to 5TBA-2
STOP	Momentary contact opening - 5TBA-2 to 5TBA-3
PLATE ON/OFF	Nonmomentary contact close/open - 5TBA-8 to 5TBA-9
INTERLOCK	Connection 5TBA-4 - 5TBA-5
RESET	Connection 5TBA-6 - 5TBA-7
POWER ADJUST	Motorized rheostat between 5TBA-10 and 5TBA-11
METERING	
PA Ep	5TBA-15 to 5TBA-16
PA Ip	5TBA-14 to 5TBA-16
POWER (note)	Forward, 5TBA-12 Reflected, 5TBA-13 Common, 5TBA-16

note...Set INC/REF switch in center-off position (2S6)

STEREO AND SCA:

Stereo and SCA equipment connections are, of course, made at the stereo generator or exciter. For your convenience, a mono exciter audio input and right and left stereo audio stereo generator inputs are found on Terminal Board 5TB of the transmitter. See the instructions supplied with the stereo and SCA generators and the exciter. It is important that the transmitter be very carefully adjusted for use in these applications.

Another caution regarding the use of your SCA...Its use in the radio paging services may subject you to STATE regulation as a "Common Carrier".

.....

NOTES

INSTALLATION AND CONNECTION:

Once you have established the new home for the transmitter, and once you are sure it meets the unit's needs and requirements, place the transmitter in its location. Dress and label wiring/cabling into the cabinet or area.

CAUTION

DO NOT REMOVE TEFLON INSULATOR FROM THE FINAL AMPLIFIER COMPARTMENT.

Thoroughly inspect fittings and hardware to be certain nothing worked loose in the shipping process. Set, if necessary, the mechanical zero of panel meters.

OUTPUT CONNECTIONS: Connect the station antenna or a suitable dummy load to the output port of the directional coupler. Connect the harmonic filter to the transmitter's output port located on the transmitter cabinet roof.

CAUTION

THE DIRECTIONAL COUPLER MUST BE CONNECTED ON THE ANTENNA SIDE OF THE HARMONIC FILTER, NOT BETWEEN THE FILTER AND THE TRANSMITTER.

...NOTE...

At certain frequencies, the length of the transmission cable installed between the transmitter's output port and the harmonic filter can become critical with respect to the harmonic attenuation and output tank tuning. It is strongly recommended that this line length be kept as short as possible...usually limited to a 90° elbow.

REMOTE CONTROL CONNECTIONS: These are shown in table form on page 2-5. Consult that page for details.

INPUT,, STEREO, SCA CONNECTIONS: Consult the manual for the exciter provided with the transmitter.

ELECTRICAL PRIMARY CONNECTIONS:

It is assumed you have now provided electrical service as outlined on page 2-3. The transformer primaries of 6T3 (PA plate), 6T2 (IPA plate), 2T1 (PA fil), and 6T1, (Control) have been wired at the factory for the voltage specified by the customer. Before wiring the primary power to the transmitter, CHECK the actual line voltage with an accurate AC voltmeter to be sure the primary transformer taps match it. If not, adjust them accordingly. Once you are satisfied that they match, the 3-phase power may be connected to terminals 4TB on the right side panel inside the cabinet.

CAUTION

DO NOT WIRE HOT

.....

IT IS IMPERATIVE THAT A CORRECT LOAD BE PROPERLY CONNECTED TO THE OUTPUT CONNECTOR PRIOR TO APPLYING POWER TO THIS OR ANY RADIO TRANSMITTER.

.....

Before going on to the next section, CHECK your work.

INSTALLATION OF TUBES:

The 4CX250B and the 4CX10000D have been installed by the factory. It is wise to check to see that they have not worked loose in shipment to you. If you must handle the tubes, handle them by their metal anodes only. Skin oil on the ceramic material can produce low-RF resistance paths that may burn "tracks" on the ceramic surface, thus causing premature overheating, RF arcing, and ultimate tube failure. If the tubes must be reinserted, set them into their sockets absolutely straight or damage will surely ensue. For detailed instructions, see page 4-8. The chimney is installed at the same time as the 4CX250B tube. Be sure both tubes are properly seated in their sockets or RF arcing and premature failure may result.

CAUTION

BEFORE ATTEMPTING TO DELIVER FULL POWER FROM THE TRANSMITTER, BE SURE THAT CHIMNEYS ARE INSTALLED AROUND POWER TUBES AND VENTILATOR IS ON.

CONTROLS, SWITCHES AND INDICATORS

FRONT PANEL...SEE ILLUSTRATION ON PAGE 2-9:

Divided into modular sections, we will deal with each section individually. The engraving with each meter and control will indicate its scale and function, and that information is reiterated here.

1. IPA OUTPUT CONTROL PANEL:
   The control on it adjusts the screen voltage applied to the IPA, which is read on meter F.

2. EXCITER:
   The control arrangement is in the manual which accompanies the exciter.

3. FILAMENT CONTROL PANEL:
   The FIL ADJ control is the filament voltage adjustment...the PA FIL meter (K), 0-10 volts, reads the actual voltage applied to the filament.

4. PRIMARY AND CONTROL CIRCUITS CONTROL PANEL:
   Meter J indicates the LINE voltage; the rotary switch below it selects the phase being indicated. To its left is the CONTROL circuit breaker. The four grouped pushbuttons to its right are: upper left, START. Lower left, STOP. Upper right, PLATE. Lower right, RESET. Their operation is explained in detail in the initial power-up procedure which follows. Inside this panel are two additional switches...the TEST/NORMAL switch and the SCREEN OFF/ON switch. These are used during the tuning procedure. The two lamps, INTERLOCK and READY, are explained during the initial power-up phase.

5. METERING PANEL:
   On the drawing, the meters are lettered for reference. The proper readings for your transmitter will be shown on the Factory Proof Sheet.

   Meter A is the OUTPUT power meter, the scale of which is 0-105%. Below the meter is a switch which selects the parameter to be metered.
   INC...forward or incident power.
   REF...reflected power.

   Meter B is the PA PLATE current meter, reading 0-3 Amps

   Meter C is the PA PLATE voltage meter, reading 0-7.5 kV.

   The control directly beneath this meter, the PA OUTPUT control, is 2R19 and adjusts the screen voltage applied to the 4CX10000D.

   Meter D is a dual-function meter, PA VOLTAGE, GRID (0-1 kV) and SCREEN (0-1 kV). The switch below it selects its function.

METERING PANEL (continued)

Meter E is also dual function, PA CURRENT, (GRID) (0-100 mA) and SCREEN (0-1 A), also switch-selected.

Meter F is the IPA VOLTAGE meter, switch-selected. The functions are PLATE (0-10 kV) and SCREEN (0-1 kV).

Meter G is the IPA CATHODE CURRENT...0-300 mA.

Meter H is a dual-purpose meter...IPA CURRENT (GRID) and (SCREEN). It reads 0-100 mA.

Meter I, EXCITER POWER, also dual-purpose, reads the output of the exciter. INC/REF behave as on meter A.

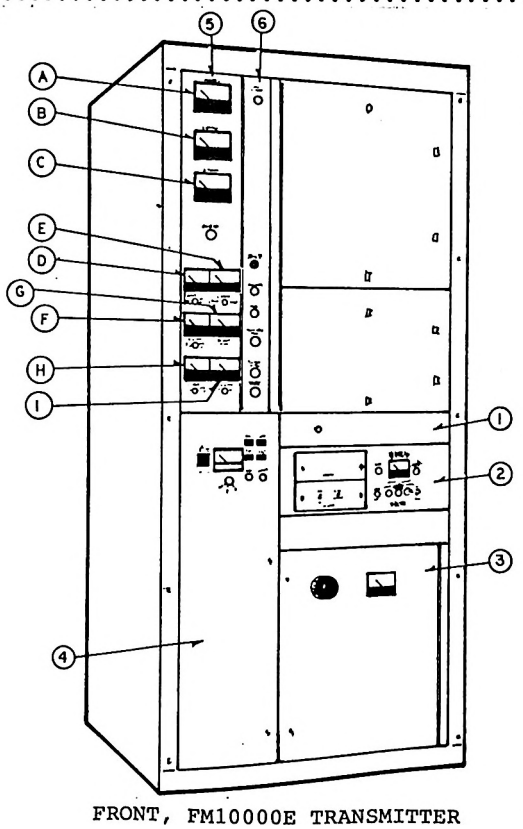
Meter J, AC LINE VOLTAGE

Meter K, PA FIL VOLTS

6. CONTROL STRIP:
From top to bottom, the controls are:

PA TUNING (tunes the plate circuit)
PA LOADING
PLATE indicator lamp
TEST indicator lamp
IPA PLATE TUNING
IPA GRID TUNING
IPA GRID LOADING

The lamps are explained in the next section and the controls are explained there and in the tuning procedure starting on page 4-9.



FRONT, FM10000E TRANSMITTER

BEFORE SETTING ANY CONTROLS, BE SURE MAIN AND CONTROL CIRCUIT BREAKERS ARE TURNED OFF!

CONTROL PRESETS:

CONTROL	SET TO...
EXCITER switches	Both OFF
EXCITER, % POWER	INC
IPA GRID I	GRID
IPA VOLTS	PLATE
IPA OUTPUT	Fully Counterclockwise
PA OUTPUT	Fully Counterclockwise
TEST SWITCH	TEST
PA SCREEN SWITCH	OFF
PA FIL CONTROL	Fully Counterclockwise

...the controls are now preset for the next step.

CONTROL CHECKOUT:

CLOSE the CONTROL circuit breaker.

CHECK the voltmeter on the primary control door. It should read the correct primary voltage as determined when you set the transformer taps.

PRESS the START button on the primary control door. The blower will start and, if all interlocks are closed, the INTERLOCK lamp will illuminate. If it does not, check all door closures.

If the PLATE switch illuminates, press it to inhibit the plate voltage.

CHECK the interlocks by opening the cabinet doors, one at a time.

SET the filament voltage to exactly 7.5 volts with the control (6R3) located on the filament control door.

PRESS the STOP switch. After an approximate three minute delay, the transmitter will shut off.

TEMPORARY HIGH VOLTAGE DISABLE:

Remove the plate caps from all the diodes located in the base of the transmitter and secure them to prevent their coming in contact with anything or with each other. BE THOROUGH when doing this, as high voltage will be present in these circuits during the next phase of the system checkout. When finished, close all doors.

Before this series of steps, confirm that the switch presets are as above.

START the transmitter. After approximately one minute the READY lamp will illuminate.

PRESS the PLATE switch. Low voltage contactor 5K1 will engage and the TEST lamp will illuminate.

TURN OFF the PLATE switch. Set the TEST switch to OPERATE. TURN ON the PLATE switch again and low voltage contactor 5K1 will engage, as should 4K1, the high voltage contactor. Note now that the PLATE lamp is illuminated and the TEST lamp is not.

continues on following page

CONTROL CHECKOUT (continued)

On the exciter...
Turn ON the DRIVE and FINAL switches.

On the transmitter...
Turn OFF the PLATE switch. Set the TEST switch again to TEST. Observe that the exciter's FINAL lamp will illuminate with the PLATE switch set to OFF.

Now, Turn OFF the exciter's FINAL switch.

If your observations of the behavior of your transmitter match the above description, your control checkout is complete. If not, recheck your presets and your understanding of the above sequence and give it another try.

OVERLOAD CIRCUITS:

DESCRIPTION: The overload circuit used in this equipment protects both the high voltage plate supply and its associated circuits via 3K4 and the low voltage power supply and its associated circuits via 3K5. An overload recycle system will return the transmitter to operation following ONE overload cycle. If another overload occurs within one minute, the transmitter will be held OFF. If, however, it does not, the overload recycle system will restore operation to the mode it was in before the FIRST overload occurred. Therefore, TWO overloads within any ONE minute period are required to keep the transmitter off the air.

.....

NOTES

SECTION THREE

THEORY OF OPERATION

OVERALL OPERATION:

GENERAL: The FM10000E employs two high-gain tetrodes to deliver a power output of up to 10 kW of RF to the 1-5/8" antenna flange. The IPA employs a 4CX250B tetrode to deliver approximately 300 watts to the 4CX10000D final PA. Both tubes operate in a straightforward grounded cathode configuration. Output of the transmitter may be set to the desired level by varying the screen supply. Each stage has this feature.

POWER SUPPLIES: Conservatively rated silicon rectifiers are used throughout. For the exciter and IPA supplies, the circuitry is full wave, single-phase. A full wave three-phase supply is used for the PA plate. Note varistor 6R2. This is present solely because it protects the operator and the equipment should the plate current meter open. Otherwise, the low side of the power supply would rise toward 6000 volts or more above ground if that meter were to open.

STARTUP CONTROL AND OVERLOAD CIRCUITS: The startup control sequence prevents the application of plate voltage until the blower has reached operating speed, the filaments are fully warmed up and the exciter operation has stabilized. Overload protection is provided by these same circuits, which automatically return the transmitter to the air following the occurence of one overload. If another occurs within a minute, the transmitter will be shut down until manual reset occurs and, if another overload does not occur, the circuits will be reset to their condition prior to the first overload. Thus, a one-minute "window" is established for overload timing. The idea behind this is to provide maximum protection for both your transmitter and your station billings.

To look at the control circuitry in greater detail, refer to the schematic diagrams for the time delay circuits, power supply, control door, control PC board, and RF amplifiers. Each will be discussed in greater detail starting on page 3-2.

POWER TURNON: Power is applied from the 3-phase power line connection from the main circuit breaker to the terminal board, 4TB, located inside the cabinet on the right side panel. This subsequently applies power to the control circuit breaker 3S1, located on the lower left front door of the transmitter. The meter at this location, 3M1, measures the incoming 3-phase voltage. All power except that for the PA plate is controlled by circuit breaker 3S1.

CONTROL SEQUENCE: Closing the control circuit breaker applies primary voltage to control transformer 6T1, which provides for the control functions, bias supply, and other associated circuits. When the START switch is depressed, power is applied to the blower relay. One of the four contact sets on this relay is a holding set...in parallel with the START switch. Two sets, wired in parallel, operate the blower and the control ladder. The fourth set operates the bias supply and the exciter's low power stages.

After the blower starts, airflow through the lower PA compartment actuates the air interlock switch which in turn applies power to the PA filament relay, the time delay start connection, and the door interlock loop which, when closed, will allow the INTERLOCK light to illuminate. After one minute the time delay relay will operate, allowing the READY lamp to illuminate and the PLATE to be turned on. When the STOP switch is depressed, a three-minute timer keeps the blower motor running to allow the tubes to cool.

INTERMEDIATE POWER AMPLIFIER (IPA):

GRID CIRCUIT: The IPA tube, 2V1, is a 4CX250B ceramic power tetrode. Its grid circuit is double series-tuned by capacitors 2C4 and 2C5, allowing exact tuning. This will be indicated by two readings...(1) the lowest reflected power being shown on exciter power meter 2M9 and (2) the highest grid current as read on the IPA GRID CURRENT meter.

PLATE CIRCUIT: The output of the IPA stage is tuned with a PI-network consisting of IPA plate tuning capacitor 2C6, adjustable inductor 2L7, and the input capacitance of the final amplifier tube. The output capacitance of the IPA also shunts the input leg.

FINAL AMPLIFIER:

GRID CIRCUIT: This tube is a 4CX10000D tetrode. 2C6, the IPA plate tuning capacitor, also tunes the grid of the final. Inductor 2L3 adjusts the grid input capacitance by partially cancelling the grid capacitance of the 4CX10000D, leaving enough for it to act as the output loading shunt of the IPA plate PI-network, discussed above.

SCREEN NEUTRALIZATION: This is accomplished through inductor 2L11 and the capacity of the tube socket assembly. The final tube's custom-fabricated socket assembly is an extremely important part of the proper tuning and neutralization of the PA stage. This assembly is not to be modified and it is not available as a stock assembly from any source other than The WILKINSON Radio Division.

PLATE CIRCUIT: This, like the IPA plate circuit, is a PI-network set up as follows: 2C14, 2C15 and 2C16 are fixed vacuum capacitors which together are the output shunt leg. The series leg is variable inductor 2L9 and the input shunt leg is inductor 2L10 which partially cancels the tube output capacitance. Inductor 2L8 and the vacuum variable capacitor, 2C18 make up the PA plate tuning control and, electrically, are the trimmer for 2L10.

THE TUNING INSTRUCTIONS ARE IN SECTION FOUR OF THIS MANUAL.

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THEORY OF OPERATION...INDIVIDUAL CIRCUITS

POWER SUPPLIES:

POWER SUPPLY...HIGH VOLTAGE

PA PLATE SUPPLY: The base contains only one of the power supplies in the equipment...the high voltage plate supply for the 4CX10000D tube. Three-phase power enters at 4TB1, 2, and 3, and 4TB4 is ground. The power is then applied to the contacts of 4K1, the plate contactor which, when energized, connects the delta-primary of 6T3. The secondary supplies rectifier stacks 6D5 through 6D10, wired in pairs in a full wave configuration.

DIODE RECTIFIER STACKS: On the schematic diagram, you will note that the diode rectifier stacks, 6D5 through 6D10, are illustrated as single diodes...they are, in reality, diode stacks in a plug-in base reminiscent of the old mercury vapor rectifier tubes...which they were designed to directly replace in older equipment. Series-wired, each stack contains eighteen diode rectifiers, each bridged by a resistor, a capacitor, and a neon lamp. During normal operation, the lamps illuminate and will extinguish in the event of failure, locating the defective stack.

6R2 is a 130-volt varistor which keeps the low side of the plate supply from rising more than 6 kV above ground in the event of failure in the 2M2 circuit.

SHUTDOWN SURGE SUPPRESSION AND FILTERING: 6R6 and 6C6 provide suppression of any voltage surges which may come from the collapse of the field in filter choke 6L4 when the equipment is shut off.

5R1 and 5R2 are the HV bleeder resistors.

4K1 is the plate contactor and is started by 4K3, the "soft-start" contactor, which energizes the primary of 6T3 through resistors 4R4, 4R5, and 4R6 at the same time. The normal mechanical delay in 4K1 allows the plate transformer to be thus "soft-started" as the above resistors are shunted by 4K1 momentarily after the initial power-up and full voltage is applied.

TRANSMITTER CABINET POWER SUPPLIES

IPA PLATE POWER SUPPLY, COMMON SCREEN SUPPLY:

Transformer 6T2 provides about 2 KV AC to full wave bridge 6D1, 6D2, 6D3, and 6D4. These are stacked rectifier assemblies. In the event of a stack failure, the appropriate indicator lamps will go out. The junction of 6D1 and 6D4 is the low side of this supply, the medium voltage (approximately 1 KV) positive connection is at the center tap of transformer 6T2, and the 2 KV supply for the IPA plate is at the junction of 6D2 and 6D3.

IPA PLATE SECTION: Following the junction of 6D2 and 6D3, 4R3 and 4C1 provide shutdown surge protection for the rectifier stack. Filtering is provided by a double L-section network consisting of 6L2 and 6C3, 6L3 and 6C4. 4R1 is the supply bleeder resistor, and 6R5 and 6R7 protect the circuit. The overload threshold adjustment is provided by 4R2.

SCREEN SECTION: A positive voltage of about 1 KV appears at the center tap of 6T2. Its primary is adjustment-tapped in order to allow it to be set for local voltage variations and still provide the required output voltage. Filtered by 6L1 and 6C2, it passes through protective resistor 6R1 and is routed to 2R3, a series dropping resistor to voltage divider 6R4 and 2R4 to the screen circuit of the IPA tube. 6R4 is the adjustment (output) control for the stage.

PA SCREEN: After leaving 6R1, the positive voltage is also routed to a jumper on the remote control terminal board, then to the combination bleeder/divider network made up of 2R19, 2R20, and 2R13. 2R19 adjusts the voltage entering the PA screen circuit.

PA CONTROL GRID BIAS SUPPLY: The secondary of the control transformer, 6T1, supplies the circuit. On the bias supply PC board itself, C1, D1, D2, and C2 constitute a voltage tripler circuit feeding a capacitor input filter, providing about -400 volts to the input side of R2. C3 completes the filter and R3 bleeds the supply. Routed through R4 to 3K6, the presence of bias voltage energizes it, closing one segment of the interlock loop. The output of the supply is also routed through PA bias adjustment 2R12 to the PA grid circuit.

CONTROL VOLTAGE: This is supplied by transformer 6T1 also. The control voltage is 115-125 VAC, and the primary is tapped to allow adjustment. NOTE...adjustment of the primary taps of 6T1 will also affect the below circuit and may necessitate a corresponding adjustment of 2T2. Additionally, 6T1's adjustment will also affect the bias voltage.

FILAMENT VOLTAGE: The IPA filament is supplied by transformer 2T2 wired in an autotransformer fashion. 2T2 is supplied from the secondary of 6T1 through the air interlock switch. It will not come on until the fan comes up to speed. The primary voltage, and hence the IPA filament voltage may be varied somewhat with 2R43, and 2R48 is the filament current-limiting resistor.

The PA filament is provided by 2T1, driven by one phase of the primary power. 6R3 varies the primary and thus the PA filament voltage. 6M1, bypassed by 6C7, meters the voltage and the secondary center tap is the remote cathode monitoring point, as the 4CX10000D is a filament cathode tube.

CONTROL DOOR AND PC BOARD:

OVERVIEW: Please consult schematic C12234 for this analysis. Contained within the dotted line at the schematic's right is the timer PC board. To the left of the dotted line is the schematic of the door components themselves. These components are either directly on the door or are adjacent to it. The function of the Control Door and PC Board circuit is to provide control over startup and shutdown switching. Two solid-state timers are utilized along with relay sequencing to provide a power-up plate voltage delay and a shutdown blower motor delay. Protection of the tubes is thus provided.

TIMER CIRCUITS

ONE MINUTE STARTUP: 3Q1 and 3Q2 are the transistor timer circuits. 3Q2 and its associated circuitry provide the one-minute warm-up delay, allowing the tubes to heat to operating temperature before the plate voltage may be applied. The completion of this circuit's cycle is indicated by the illumination of the "ready" lamp, which comes on with the closure of relay 3K2. The one-minute cycle begins when voltage is applied to PC-7 through the start relay/blower interlock switch. The relay/interlock sequencing will be discussed later. Voltage at PC-7 is routed through rectifier diode 3D2, through 3K2 relay coil and will begin to charge 3C6 through 3R12. The time constant of this circuit is about one minute. When 3C6 is charged, the NE2 neon bulb at 3Q2's base will conduct, biasing 3Q2 to conduct, pulling its emitter to ground potential and thus pulling in 3K2. The contact set adjacent to the 3K2's coil on the schematic is a holding set, which holds 3K2 energized until the voltage at PC-7 is interrupted. The second set brings a 620 ohm resistor path to ground into the charging circuit, thus cutting off 3Q2 and holding the circuit discharged so it will go through its full one-minute cycle upon a new application of power. The third set applies voltage to the READY lamp and to one side of the PLATE switch.

THREE MINUTE SHUTDOWN: 3Q1 is the three-minute timer which allows the blower to remain in operation for three minutes after shutdown to complete the cooling of the tubes.

OVERLOAD RECYCLE BOARD:

OVERVIEW: This PC board provides the overload cycle "window" which allows the transmitter to recycle itself in the event of an overload. If an overload occurs twice within a one-minute period, this PC board will shut down the transmitter; if it is a one-time occurrence, the overload PC board will reset itself to await the next pair of overloads before shutting down. In other words, it will restore operation to normal as though no overload had occurred.

CIRCUIT OPERATION: The circuit is triggered into operation via the closure of either 3K4 (plate overload) or 3K5 (screen overload) but will not operate unless 3K3 is also closed. 3K3 is the RESET relay and will close upon an overload. When it does, the control voltage to the PLATE switch is interrupted, thus dropping out the plate contactor. At the same time, a voltage of 115 VAC is applied to K1 through its normally closed contacts and to K3 through its normally closed contacts. K2 will see the voltage through K4's normally closed contacts. K4 will see the voltage only when K3 closes. The coil of K2 routes voltage to the one-minute charging circuit; the coil of K3 routes voltage to the one-second circuit. K1, having pulled in, allows the one-minute charging circuit to operate by removing the ground from R4. If K1 opens, it discharges the one-minute circuit and allows a full circuit reset. The one-second circuit needs no such feature.

In the one-second circuit, C1 charges through R2. When charged after about one second, C1 allows the voltage on its positive terminal to rise to the extent that the NE2 in Q1's base circuit will fire, raising Q1's base voltage to allow it to conduct and pull in K3. When K3 pulls in, its holding contacts (K3C) keep it energized until control voltage disappears from the SENSE line.

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NOTES

RELAY OPERATION:

TABLE OF RELAY NUMBERS AND FUNCTIONS

NOTE: The numbering system of the relays in this transmitter is consistent with the other parts numbers. Thus, the first digit in the relay number identifies its location.

3K1 This is the START relay. It energizes when the START button is depressed and it applies power to:
4K2
3K7
the PA bias supply
the exciter
the pilot lamp side of the PLATE switch
the interlock loop
itself, via holding contacts

3K2 This is the PLATE ENABLE relay. It energizes after the fan comes up to speed and after the one-minute time delay in its ground return has cycled. It applies power to:
the other side of the PLATE switch

3K3 This is the OVERLOAD PLATE INTERRUPTOR relay. It energizes if either 3K4 or 3K5 energize and it remains closed as long as either remains closed or there is control voltage on the SENSE line of the Overload PC board. Its normally closed (de-energized) contacts will, when its coil energizes, remove control voltage from the plate contactor half of the plate switch.

3K4 This is the PLATE OVERLOAD relay. It energizes when the voltage on the plate current metering line rises above its pull-in voltage, thus indicating the flow of excessive PA plate current. It will apply power to:
3K3
the RESET lamp

3K5 This is the SCREEN OVERLOAD relay and operates from the PA screen circuit in the same fashion as 3K4.

3K6 This is the BIAS VOLTAGE INTERLOCK relay. It energizes when bias voltage for the PA tube is present. Its function is to close one more step in the interlock loop.

3K7 This is the SHUTDOWN CYCLE relay. It energizes when 3K1 does, and will hold itself closed as long as control voltage is present, and until 3K8 momentarily closes and interrupts it about three minutes after the STOP button is pressed. 3K7 applies power to:
the three minute timer through the coil of 3K8
itself, through holding contacts
blower relay 4K2

3K8 This is the THREE-MINUTE INTERRUPTOR relay. It energizes, momentarily, about three minutes after the transmitter is shut down. Its function is to momentarily lift 3K7's coil off ground, thus interrupting its holding contacts and shutting 3K7 off until the START button is again depressed.

4K1 This is the PLATE CONTACTOR for the PA. It energizes only after 4K3, the "soft-start" relay, has energized. Three of the contacts shunt "soft-start" resistors 4R4, 5, and 6 and thus fully close the three primary circuit phase legs of the HV transformer 6T3. The fourth contact energizes the vault fan motor.

4K2 This is the BLOWER relay. It is energized any time either 3K1 or 3K7 is and it applies power to the IPA and PA amplifier cooling blower.

4K3 This is the "soft-start" relay. It energizes when the interlock loop is secure, the one-minute time delay has passed, there is no overload condition, and the PLATE switch is on. Three of its contacts engage the plate transformer through resistors 4R4, 5, and 6 and thus apply primary voltage "softly" to 6T3, and the fourth contact energizes 4K1.

5K1 This is the IPA PLATE CONTACTOR. It energizes when the interlock loop is secure, there is no overload condition, the PLATE switch is depressed, and the TEST/NORMAL switch is in either position. It applies power to the primary of 6T2.

5K2 This is the PA FILAMENT relay. It energizes when the air interlock switch closes, indicating full fan speed, and at the same time as the IPA filament (which uses no relay).

The relays on the automatic recycle PC board are discussed in the section covering that board. See page 3-5.

.....

NOTES

DRIVER AMPLIFIER (IPA):

TUBE: A single 4CX250B tube is employed in this stage. It is a ceramic and metal tube designed for forced-air cooling. Its plate will dissipate 250 watts and, in the configuration used here, the tube will deliver nearly 400 watts RF to its output load. The design of the FM-10000E transmitter is such that approximately 300 watts output is required of the tube. Its heater requires 2.4 Amps at 6 volts, its plate voltage is 2000 volts, and its screen voltage is 240-250 volts. Approximately sixty seconds are required for the tube to warm up to operating temperature.

OPERATING CIRCUIT: The IPA tube is operated in a standard grid-driven configuration. The loading of the grid circuit is controlled by series-tuned circuit 2L5/2C4 and tuning is in 2L6/2C5. 2C4 appears on the front panel as IPA GRID LOADING and 2C5 appears on the front panel as IPA GRID TUNING. Control grid bias is provided through 2R36, 2L1 and 2R44. It is set by meter resistor 2R6 and potentiometer 2R7. The voltage across 2R6 increases as current through it increases, thus providing a tracking indication of grid current in 2M8, if selected by 2S2. Screen voltage is picked up at the wiper of 6R4, as discussed previously. 6R4 appears on the front panel as the IPA OUTPUT control. 2R2 is the meter resistor and functions in the same manner as 2R6. The cathode current is metered through 2M7...the tube cathode itself is held about 26 volts off ground through 2R9 during typical operation.

IPA PLATE/PA GRID CIRCUIT: Essentially this is a PI-type circuit shared by both tubes. It is treated as one circuit and is tuned as one. The tuning instructions for this circuit found on page 4-8 explain the relationship further. Basically, the plate capacitance, in parallel with 2C6, form the input shunt leg of the PI-type tuning network. The series leg is 2L7, and the output shunt leg is the grid capacitance of the PA tube, reduced and trimmed by 2L3. 2L3 is the sliding shorting bar in the bracket below the final amplifier socket. Thus the interelectrode capacitance of the 4CX10000D final amplifier tube is an essential part of the loading of the IPA plate.

2C6 appears on the front panel as IPA PLATE TUNING; 2L7 and 2L3 are within the PA enclosure and they are adjusted by means of sliding shorts. (NOT the kind with the bad elastic)

Plate voltage is delivered to the tube via two parasitic suppressor networks. Of those networks, 2R37/2L14 are inside the enclosure, and 2R42/2L13 outside it.

FINAL AMPLIFIER (PA):

TUBE: This tube is a 4CX10000D ceramic/metal radial beam power tetrode. It is designed for forced-air cooling, sharing the cooling system with the IPA tube, and its filament operates at 7.5 VAC, 75 Amperes. Its plate is capable of dissipating 10,000 watts and the tube is capable of delivering over 10 KW of RF to a load (class C operation). In the configuration utilized in the FM10000E transmitter, the tube is operated conservatively for enhanced life. All the figures appropriate to your transmitter will be found on the Factory Proof or EPM sheet.

PA CIRCUIT: The input section has been discussed previously. Grid bias voltage is delivered to the tube via 2L3. The bias supply is RF bypassed within the enclosure by 2L15 and 2C8. Varying grid current appears as varying voltage across 2R17, thus allowing a reading on 2M5. Control 2R12, the grid voltage pot, is internal to the transmitter. Control 2R19 appears on the front panel as PA OUTPUT. It adjusts the screen voltage and resistor 2R15 provides the metering voltage-drop function for the screen circuit. The screen voltage is delivered to the tube via parasitic suppressor 2L16 and 2R21. Note that 2L11, the neutralizing coil, is a part of the tube socket assembly. 2L16 and 2C25 RF bypass the screen. Note that 2C25 is also part of the socket assembly.

CATHODE CIRCUIT: The cathode is also the filament of the 4CX10000D, returning to ground via the secondary center tap of 2T1 (the filament transformer) and resistor 2R39.

TUBE SOCKET ASSEMBLY: This assembly is NOT a stock tube socket for a 4CX10000D. If such a socket is used for replacement of the WILKINSON original equipment socket, the tube and several other components will very quickly and dramatically "go south" and leave you with a transmitter that is silent and smells a little unusual. Detailed drawings of the tube socket assembly are provided in the rear of this manual. TTC/WILKINSON has specially modified this socket to work properly with this circuit design, thus minimizing parts count, enhancing controllability and making neutralization easier. Inductor 2L11 is actually the two sliding shorting bars found on the socket assembly itself. Filament and screen bypassing capacitors are factory-installed mica spacers in the socket assembly.

PLATE CIRCUIT: Plate voltage is applied to the tube through 2R35, 2L12, and 2L4. 2L12 and 2R35 are the parasitic suppressor and 2L4 is the plate load inductor. The output tuning circuit consists of a PI-network with its input shunt leg made up of the plate capacitance of the 4CX10000D, partially cancelled and controlled by inductor 2L10. 2L8 and 2C18 together comprise the trimmer for 2L10. 2C18 appears on the front panel as PA TUNING. The series leg is inductor 2L9, and the output shunt is the trio of capacitors 2C14, 2C15, and 2C16. Depending on the assigned frequency of the transmitter, one of the three capacitors may not be used. Capacitor 2C20 keeps the plate voltage off the output circuit.

OUTPUT CIRCUIT: The output flange, on top of the unit, is to be field-connected to the harmonic filter, followed by the directional coupler. The directional coupler provides four functional output ports...the main output, to be connected to the station antenna array, the REF output, which is to be connected to the power meter as shown, the INC output, also connected as shown, and the MONITOR output, for connection to station monitoring equipment. The harmonic filter and the directional coupler are installed OUTSIDE the cabinet. 2C19 is the output loading control operated from the front panel.

SECTION FOUR
MAINTENANCE, TUNING, AND SERVICE

WARNINGS

IF YOUR TRANSMITTER IS OPERATED BY REMOTE CONTROL, NEVER PERFORM ANY KIND OF MAINTENANCE ON IT WITHOUT SWITCHING THE CONTROL TO "LOCAL" OR OTHERWISE DISABLING ANY REMOTE CONTROL POINT. THIS PREVENTS AN OPERATOR FROM INADVERTENTLY APPLYING VOLTAGE TO THE EQUIPMENT OR TO YOU.

USE THE GROUNDING STICK BEFORE ENTERING HV CIRCUITS WITH HAND TOOLS!

HIGH VOLTAGE KILLS. PLEASE EXERCISE ALL CONCEIVABLE CAUTION.

GENERAL PM... The art of preventive maintenance is among the highest arts in the broadcasting business. Prevention of failure may seem mundane, but it is often the difference between profit and loss in a station operation.

LOGS... In late 1983 the FCC eliminated the transmitter and maintenance logging requirements, thus leaving the station licensee up to his own devices to assure compliance with the technical standards, WHICH HAVE NOT CHANGED. As a result, it may be tempting to reduce the paperwork load by discontinuing the practice of logging meter readings and equipment adjustments, but it is felt that this is not a good idea. If you are contemplating a change in your logging practices, now may be a good time to initiate one if it still allows your engineering department to obtain some historical operating data sufficient to pinpoint failures and sufficient to prove to the FCC that any violations are NOT "willful and repeated." The absence of logs allows great latitude in the issuance of any citations...more or less putting the licensee at the mercy of the Commission's field engineer. Additionally, EBS tests still need to be logged in some fashion. Most licensees put them on the operating log...why not continue?

IN SUMMARY, THEN, ONE OF THE BEST PREVENTIVE MAINTENANCE PROTECTIONS YOU CAN HAVE IS A USABLE SET OF OPERATING AND MAINTENANCE LOGS.

CLEANLINESS IS NEXT TO... All electromechanical equipment works best when clean and properly lubricated. Transmitting equipment is particularly susceptible as high DC voltages tend to attract dust particles. Filters, then, should be renewed when a visual inspection indicates their having done their job. These include air filters entering the building and any at the air intakes of the equipment. Depending on the filter, renewal will consist of replacement of disposable filters or washing and re-coating of permanent-type filters. Once an interval has been determined...it will vary with location... establish that interval as part of your regular maintenance schedule.

MAINTENANCE SCHEDULE... The maintenance schedule used with ancillary transmitting equipment such as exciters, stereo and SCA generators, final audio processing equipment, monitors and remote control equipment should be set up in accordance with the schedule for your high-power transmitting gear. The reason for this is that, during the main transmitter maintenance, you have the opportunity for maintenance to the other equipment in the transmitter room, too. The following schedule applies to all types of transmitting equipment. Extract from it those items which apply to the equipment you have.

DAILY

Read and record all meter readings. In the section on logs, above, a suggestion is made as to the style of your records. Whatever you do, DO NOT FAIL TO KEEP SOME RECORD OF OPERATION.

Physically inspect the outside of the equipment and any noninterlocked areas within it. Use your nose to detect the typical prefailure odors of ozone or burned material. Look for chemical drips on the cabinet under potted components, under transformer windings, and under electrolytic capacitors.

Clean the floor in the room. It is suggested that a damp-mop is the most dust-free method. If this is done daily, you can be sure that any filters will need cleaning or changing less frequently.

MAINTENANCE SCHEDULE...(continued)

WEEKLY

SERVICE SHUTDOWN To assure continued reliable operation of the equipment, it is suggested that it be shut down once weekly for cleaning and a thorough physical inspection. Immediately after shutdown the primary power should be fully disconnected at the building circuit breaker serving the equipment.

EXERCISE GREAT CAUTION! USE THE GROUNDING STICK!

INSPECTION Power supply components and wiring should be inspected for signs of overheating, as should RF and AF power amplifiers and drivers. Cavities should be so inspected. Inspect PA and IPA anode fins and heat sinks for dust which will reduce their cooling efficiency. Inspect for loose connections, paying particular attention to high-current connections...typically PA filament, PA plate contactor, PA plate transformer, and B+ wires to solid-state drivers/outputs. If a connection is found to be loose, it may have overheated, oxidizing the lug or terminal. Burnish, replace, and tighten as necessary.

CLEANING Thoroughly vacuum or blow dust from cabinet and power supply vault. Remove residual dust from cabinet and dust from high voltage insulators with a clean, dry cloth. Oiled dusting cloths or chemical solvents are NOT to be used as they may leave residue which could produce arcing. Service the air intake filter as necessary and wipe dust from the vanes/fins of the blower itself.

CABINET Inspect the finger stock around the doors of the cabinet for signs of burning. Wipe clean and, if burning is evident, it is suggested that the affected door may not be latching firmly. Tighten the latch as necessary.

METERING Check for mechanical zero on the panel meters and adjust if necessary. Static buildup can occur if the meter faces have been dusted with a dry cloth. Moisten the tip of your finger and touch the meter face if this has occurred. If your equipment is operated via remote control, it is suggested that you perform a remote-indicating meter calibration at the power-up following the weekly maintenance. Of course, it is wise to allow the equipment to stabilize before doing this.

EXTERNAL Check connections on the external fusebox, disconnect box, and any voltage-regulating equipment for signs of overheating.

MONTHLY

Wipe painted surfaces with a damp cloth. Chemical solvents may harm paint, so do not use them.

SEMIANNUALLY

LUBRICATION Put a drop or two of light machine oil on door hinges and fasteners and on drawer slides and latches. A couple of drops of oil will also help the gears of the PA tuning/loading capacitors work smoothly, if the equipment is so fitted.

BLOWER Thoroughly clean the blower assembly and lubricate if the motor is fitted with oil passages. Many blowers are permanently lubricated and will thus need no oil during their lifetime, but if yours is a replacement blower motor, check it or its instruction sheet for its lubrication requirements.

OFF THE AIR!

(Please read this before it happens)

NOTE TO THE CHIEF ENGINEER....

It is strongly suggested that you establish a station-wide basic trouble checklist that you post at the control point. It will pay for itself the first time it reminds the operator to turn on a switch he forgot and not have to awaken you at 3 AM. It should include the basic checks in the following charts plus any information indigenous to your station operation.

TROUBLESHOOTING IN THE SHORTEST TIME

The first and most important aspect of troubleshooting ANYTHING, from a furnace to a transmitter, is to be SYSTEMATIC. Don't skip around from assembly to assembly in a wild attempt to find the problem in the shortest time...you won't. What you WILL find is that you have forgotten half the places you looked and will have to check them again, anyway.

Obviously, the first step is to be prepared for what you are likely to find. KEEP THE FOLLOWING ITEMS NEAR YOUR TRANSMITTER:

The recommended spare parts kit
Some hand tools suitable to the purpose
Any test equipment you have suitable to the purpose
THE INSTRUCTION MANUAL
Pencil and paper for notes
THE LAST OPERATING SET OF FULL METER READINGS.

First, make a physical inspection of the equipment for obvious problems.

Is the AC power on to the site and to the equipment?
Are all switches in correct operating position?
Inspect the transmitter...smell or hear anything strange?
Do you see any signs of obvious damage within the equipment?
Is the tower/antenna still up and firmly connected to the feedline?
(Winter) deicers operational?

READ and RECORD each and every meter reading and the STATUS of each and every pilot light. Compare your readings to those that came with the transmitter from the factory, those you made when you first put the equipment in, and those you made most recently. In all likelihood, a failure will produce a strange reading, and that reading will take you to the area of the difficulty. Your meters and pilot lights are your BEST indicators of trouble and its location. Read them carefully.

Thus, the key factors in making a decision about what has failed are:

1. A thorough PHYSICAL inspection.
2. Careful EVALUATION of the transmitted signal, if any.
3. DETAILED and CAREFUL reading of the meters and lights.
4. COMPARISON of readings to KNOWN GOOD readings.

There are some basics to locating trouble that apply to almost anything electrical...basics that should be reviewed here.

1. Look FIRST for the obvious, such as power failure, damage, blown fuses, disconnected items, radio station under water...
2. Be SYSTEMATIC in your search. NOTE where you have looked and what you found.
3. Watch for simple symptoms MASQUERADING as more complex ones.
4. Think of the recent HISTORY...was there a TREND developing in the meter readings? Did someone install another unit in your building? Was there recent service work, digging, etc., in the area of your building? A lightning storm or heavy snow? Check the pressure in your feedline...with no pressure, it could have water in it. Could anyone have been shooting at your antenna? There are many possibilities...these are some we have encountered.

LOSS OF OUTPUT...may be caused by any of the problems below, not necessarily listed in the frequency of occurrence.

TRIPPED BREAKER/BLOWN FUSE.....	Visually noticeable, missing voltages. May be caused by below...WATCH when resetting!
POWER SUPPLY FAILURE	Missing power supply voltages on meter. May trip breaker/fuse.
IPA OR PA TUBE OR COMPONENT FAILURE	Indicated by improper meter readings. (Plate current low or zero) May trip breaker/fuse.
ANTENNA/FEEDLINE PROBLEM.....	Indicated by excessive VSWR, overload cycling.
LOSS OF SIGNAL	Check exciter, audio processor, input signal, STL, Telco feed.

COMPARE ALL READINGS WITH FACTORY READINGS!

NOTES

TROUBLESHOOTING CHART

Not all problems have the same degree of probability, but following the chart below will probably take you to the problem in a reasonably short time.

The chart below outlines problems not necessarily associated with the 4CX10000D socket. Specific problems in it are outlined on the following page.

SYMPTOM	CHECK/REPAIR
No RF output.	All meter readings. Exciter Meter readings.
Exciter failure.	Go to trouble chart in exciter manual.
Control breaker tripped.	Reset, bringing transmitter up step by step, watching all readings. Check blower to see if it overloads the CB.
Main breaker tripped.	Reset as above.
PA Ep normal, plate current low or zero.	4CX100000D.
IPA Ep normal, plate current low or zero.	4CX250B.
No plate voltage, final	6D5-6D10 lighted? If not, problem in base. Check 4K1, 6T3.
No plate voltage, IPA	Check 6R5, 6R7. 6D1-6D4 lighted? If not, check 5K1, 6T2, 6C1.
No screen voltage, final	Check 6R1, remote pwr adj equipment, 2R19. (2R19 may overheat and burn out with the use of remote power adj as it is often left at one setting permanently.) Also check parasitic suppressor 2L16/2R21.
IPA plate voltage running high.	Check 6L2. Should be 90 ohms DC resistance.
PA plate voltage erratic or incorrect. Circuit may seem difficult to tune.	Check for carbon path across 2C17, carbon path across 2R22-31, failure of 2R35.
IPA plate voltage erratic or incorrect. Circuit may seem difficult to tune.	Check for carbon path across 2R11 and 2C9, failure in parasitic suppressor 2R42/2L13 or 2R37/2L14.
Evidence or report of Lightning Strike	2C14, 15, 16, 18. If any appears cloudy, replace. Check also 2C20. If transmitter is run for any length of time with a failed 2C18, 2L8 may have failed.

SOME TROUBLESHOOTING PHANTOMS CAPTURED IN THE FIELD:

IF YOU SEE NO GRID CURRENT OR POWER OUTPUT...	Check 2R39; if open, no grid current path exists.
IF THE PARASITIC SUPPRESSOR 2R37/2L14 REPEATEDLY BURN OR OVERHEAT..	There is an improper L/C ratio of 2C6 and 2L7. Adjust them properly per the IPA OUTPUT/PA INPUT section of the tuning instructions which follow.
IF THE TRANSMITTER SEEMS TO "DRIFT" BUT THE EXCITER IS OPERATING PROPERLY...	Transmitters don't drift unless continuity/connections are bad somewhere...Look FIRST in the PA socket for loose hardware connections.
IF TRANSMITTER TUNING SEEMS ERRATIC AND HV ARCING IS HEARD OCCASIONALLY...	Inspect 2C17. It may have a carbon trail and require replacement.
IF 2L4 SHOWS SIGNS OF EXCESSIVE HEATING...	May be due to loose connections in PA cavity (note 2C18), high VSWR causing high final current, or improper tuning.

TROUBLESHOOTING THE SOCKET, 4CX10000D:

The socket for the final RF amplifier tube in this transmitter is custom-assembled to provide proper performance. It is essential that these structural relationships be maintained and inasmuch as several of the capacitive and inductive components of the PA stage are within the assembly of the socket itself, their symptoms are separated from others and outlined below. Consult the drawings in the rear of this manual for detailed information about the construction of the socket before attempting any repairs to it.

SYMPTOM	CHECK/REPAIR
PA, high screen current, low screen voltage	Replace mica screen ring on socket
PA, high plate current, overload cycling, circuit breaker trips	Replace teflon plate blocker
IPA will not load properly	2L3...be sure it is firm and straight

RECOMMENDED KIT OF SPARE PARTS
FM10000E FM TRANSMITTERS

For simplicity, only circuit symbols or functional identifiers are used here...see Section Five for part numbers.

1 EACH	2V1	4CX250B TUBE
1 EACH	2V2	4CX10000D TUBE
1 SET		MICA FOR SOCKET ASSEMBLY
1 SET		TEFLON COMPONENTS FOR SOCKET ASSEMBLY
1 EACH	2C14 2C15 2C16 if used	OUTPUT LOADING CAPACITORS
1 EACH	2R21 2R37 2R42	PARASITIC SUPPRESSOR RESISTORS
1 EACH	2L13 2L14 2L16	PARASITIC SUPPRESSOR INDUCTORS
1 EACH	6L2	IPA PLATE CHOKE
4 EACH	3K1	FOUR-POLE CONTROL RELAYS...CAN BE USED INTERCHANGEABLY
3 EACH	6R1, 6R5, 6R7	CURRENT LIMITING RESISTORS
5 FOR EACH		FUSE IN ANY ASSOCIATED EQUIPMENT
4 EACH	SWITCH MODULES, FRONT PANEL (THEY SNAP ON THE REAR OF THE ACTUATORS)	
1 BOX FINGER STOCK FOR VARIOUS LOCATIONS		
1 QUANTITY OF ANODE STRAP		
5 EACH	REPLACEMENTS FOR EACH STYLE PILOT LAMP IN TRANSMITTER	
2 EACH	6D5	RECTIFIER STACKS
2 EACH	6D1	RECTIFIER STACKS
1 EACH	4R3/4C1	SPIKE SUPPRESSOR
1 EACH	6R6/6C6	SPIKE SUPPRESSOR

-NOTE-

It is not considered normal if installation of a replacement tube requires substantial retuning or neutralization. This is cause to immediately suspect the reassembly of the components taken apart for the tube change. They must be reassembled exactly as disassembled and tightened firmly.

HANDLING: As mentioned previously, the ceramic-bodied power tube is a device which does not take kindly to mishandling. Shock and rough treatment will produce broken filaments and tube bodies. They are shipped carefully packed and should so remain until time for their use. Storing them in a cold storage environment and then inserting a cold tube into a hot transmitter is unwise practice and should be avoided. Instead, store them near the transmitter where the ambient temperature is likely to be a bit higher than normal. Their initial dismay at suddenly becoming hot in use is thereby substantially lessened.

Do not handle a ceramic tube by its body. Fingerprints leave miniscule dirt and oil deposits on the tube and, when high voltage and RF are applied, these deposits serve as low-resistance paths and are likely to produce uneven heating, carbon trails and eventual arcing across the body of the tube. These factors will initially make the tube somewhat more difficult to tune up, and eventually overheat and will destroy the tube at a distressingly young age.

INSERTION: The two tubes in this transmitter are not difficult to insert in the transmitter, but CARE is the overriding consideration. The IPA tube is keyed into the socket and insertion is not difficult. When it is pushed into the socket, it will feel "home" when it reaches bottom. At this time turn the tube clockwise until the stop is felt...about 1/4 turn. Visually inspect the tube as it is installed. It should appear straight upright with respect to the chassis and the tapered ceramic ring which goes around it. In the unlikely event that it is not, carefully remove it and check the contacts for bending. If it is, after placing the collar around the tube, attach the top finned connector to the tube. The finned connector then may be attached to the RF strap using a Phillips screwdriver. Note that the chassis above the tube is punched to allow use of a full length screwdriver.

The PA tube must be inserted with extreme caution. It is important that it be inserted ABSOLUTELY STRAIGHT into its socket. Failure to do so may destroy the tube when powering up the equipment. One way of double checking this is to note the bias voltage before applying plate voltage. An improper reading here should indicate that it is wise to check the installation again.

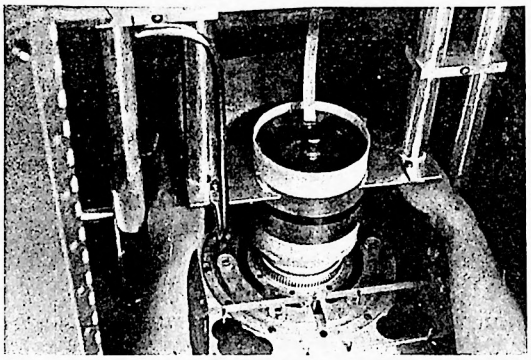
WARNING

RF POWER DEVICES, INCLUDING TUBES AND TRANSISTORS, OFTEN USE A CERAMIC MATERIAL MADE OF BERYLLIUM OXIDE. THIS MATERIAL IS A KNOWN CARCINOGENIC SUBSTANCE AND MUST NOT BE SUBJECTED TO ANY OPERATION WHICH WILL PRODUCE DUST OR OTHER PARTICLES WHICH MAY BE ASPIRATED.

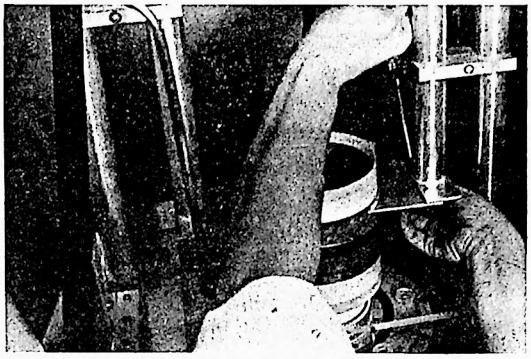
RF POWER AMPLIFYING TUBES REMAIN VERY HOT FOR LONG PERIODS OF TIME FOLLOWING REMOVAL OF THE POWER AND ALL VOLTAGES. WAIT A RESPECTABLE PERIOD BEFORE HANDLING THESE TUBES.

HIGH VOLTAGE KILLS! DO NOT ATTEMPT TO DEFEAT ANY INTERLOCKS.

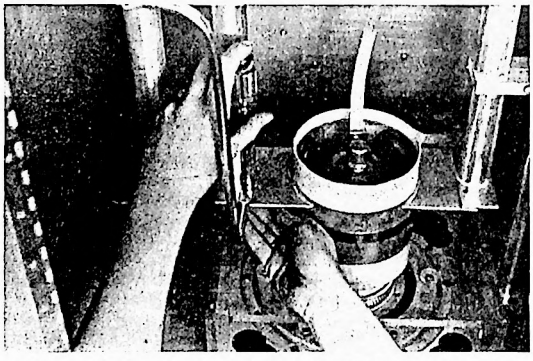
SEE THE PHOTOS ON THE FOLLOWING PAGES FOR TUBE SERVICE.



1. Remove both red air covers as shown

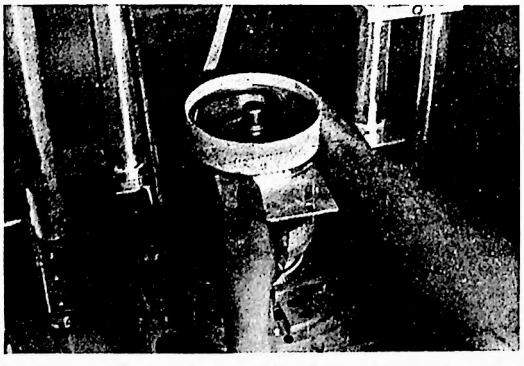


2. Carefully unbolt ring from tuning circuits



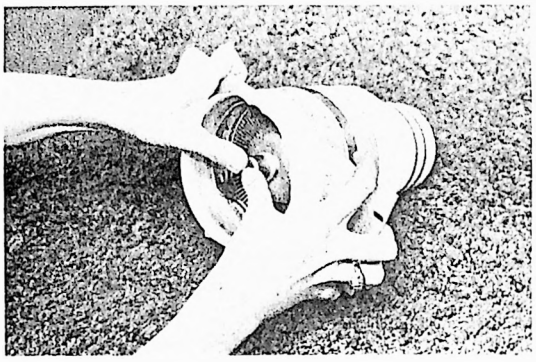
3. Remove all nuts and bolts and set aside carefully

4. Remove anode connector

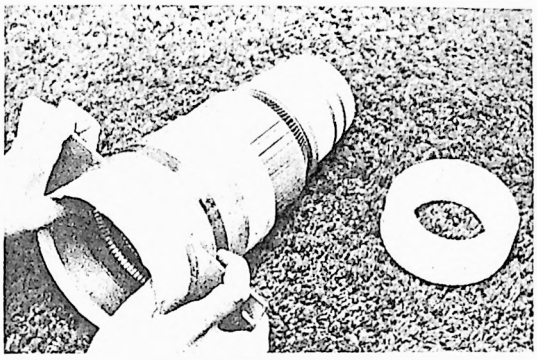


5. Rotate tube and ring 90 degrees counterclockwise

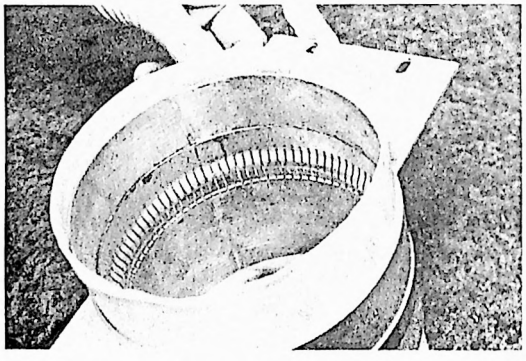
6. Pull STRAIGHT upward to release



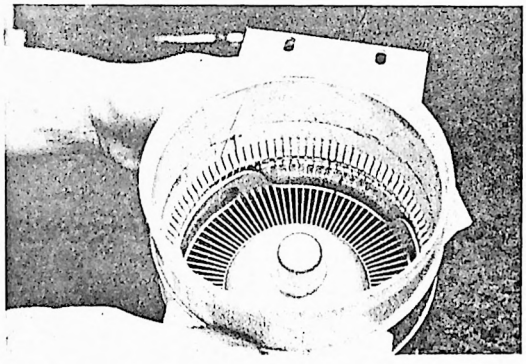
1. On bench, slide tube DOWN through ring.



2. Slide all the way out

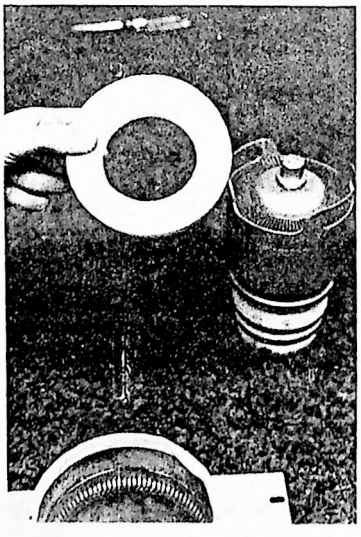


3. Note direction of finger stock



4. DO NOT reinsert tube this way; note tube will destroy fingers

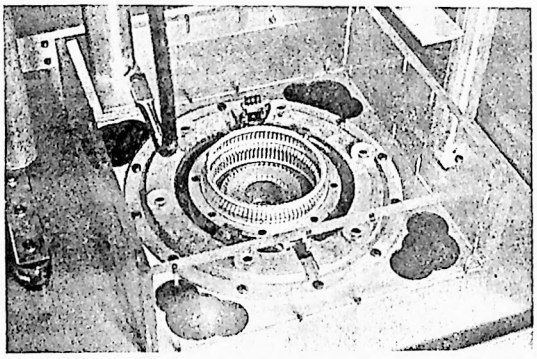
Place foam on bench; invert tube on it



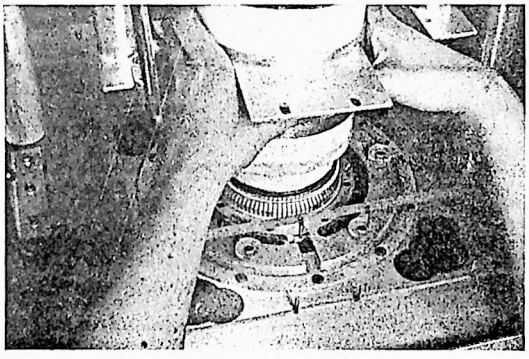
Invert ring and slide over tube bottom first; exact reversal of removal.

7. Slide ring all the way down to...

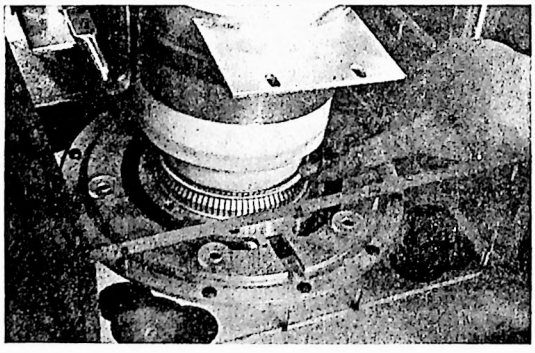
8. end up with alignment like this



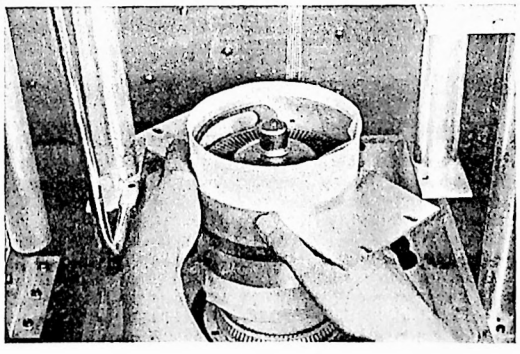
9. Be sure socket area is clear prior to reinsertion



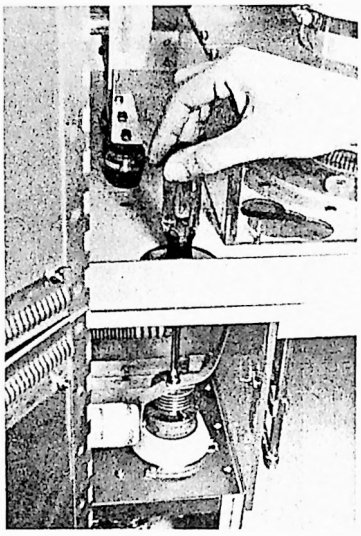
10. Insert tube STRAIGHT downward with steady pressure...



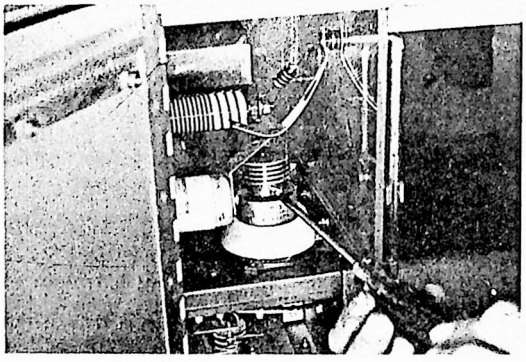
11. until tube ring is even with base fingers



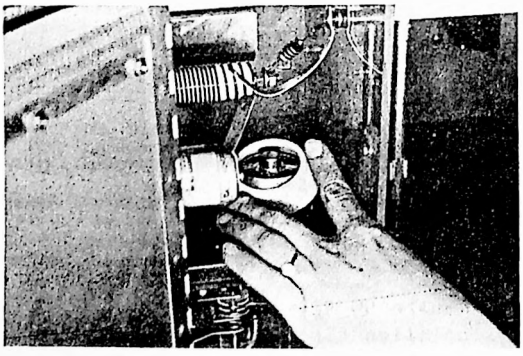
12. Rotate 90 degrees clockwise again to align fittings; reassemble



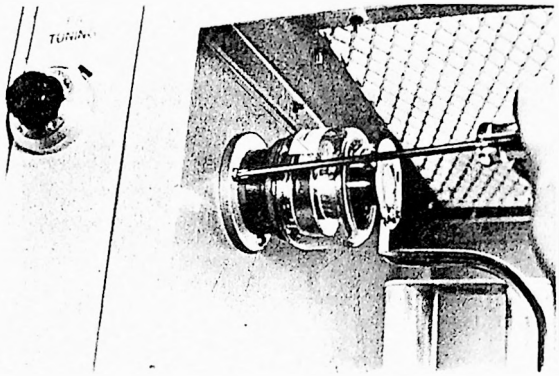
1. Remove RF strap as shown



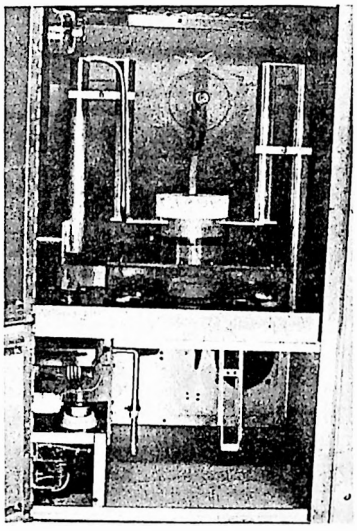
2. Remove finned anode cap



3. Remove porcelain ring and then remove tube; reverse to replace



PA tuning capacitor may be replaced by removing strap, three bolts/nuts from ring as shown, and unscrewing like a light bulb



Reference photo, IPA/PA enclosu
This is a 5 KW model but all ar
virtually identical

GENERAL: Tuning the FM10000E is a procedure that is not complicated. It will arrive pretuned and should not require large adjustments. It is, however, important to realize the relationships that exist between various tuning functions. Understanding that one tuning operation or control will affect the action of another and how this happens will save much time and frustration. Once you become familiar with the unit, you will be able to determine what tuning efforts must be made at EPM time or other such intervals as seem appropriate to you. That decision must, of course, be made on-site, but review of the information presented here should assist in making it.

FACTORY TUNING: This transmitter has been factory-tuned to the correct frequency. This procedure was accomplished using a 50 ohm dummy load. A copy of the results obtained is bound in this manual. In most cases, it should be possible to produce readings of your own which nearly duplicate those obtained at the factory with relatively small adjustments. If major retuning is required, the complete tuning procedure presented here must be followed exactly for correct results.

COMPLETE TUNING PROCEDURE:

PRESETS...

1. A PROPER LOAD MUST BE CONNECTED TO THE ANTENNA CONNECTOR.

2. To begin, place the TEST switch in the TEST position. This allows the exciter and the IPA to operate but disables the final.

3. Place REMOTE/LOCAL switch on your remote control panel, if used, to LOCAL.

4. Turn the IPA screen control (OUTPUT) all the way counterclockwise; the PA LOADING control about midrange.

5. Set, if necessary, the PA plate tank circuit to the operating frequency with a grid dip meter.

6. Place a resistor (10K, 50W,) across the the Remote Power Adjust terminals 5TBA10 and 5TBA11.

7. Ground the side of 2R19 that is connected to 2R20.

Steps 6 and 7 above are an important precaution to prevent hitting the final with about 6 kW of power when it is first turned on. Excessive dissipation in the plate or screen circuits and subsequent tube damage would be the likely result.

TUNING THE IPA:

IPA GRID: Place the PA screen switch in the OFF position. START the transmitter and, after the READY lamp illuminates, turn ON the exciter. Allow 30-60 seconds to stabilize and tune the IPA GRID TUNING to peak the IPA grid current. Repeat the process using the IPA GRID LOADING control. Go back and forth once or twice more, trying to obtain a meter reading in the center of the peak.

EXCITER OUTPUT METER CALIBRATION: This adjustment was performed at the factory and should not normally require readjustment. In the event it does, follow these instructions.

To adjust the exciter % POWER calibration control (a screwdriver-adjust pot accessible through a hole above the meter) for an indication of 100% on the % POWER meter, you first disconnect the cable in the IPA enclosure from the BNC connector in its lower left quadrant. Install a 50 ohm terminator in its place, thus properly terminating the output of the exciter. Adjust the screwdriver control to read 100% on the exciter output meter when the exciter is putting out the required number of watts to drive your transmitter to its rated/licensed output.

...calibration continued next page...

This value will appear on the Factory Proof Sheet. Now switch the meter to read the reflected power. Adjust the IPA GRID TUNING to achieve the lowest meter reading. The final point of this adjustment should be at or very near the highest IPA GRID current reading.

IPA OUTPUT/PA INPUT: These circuits are tuned as a unit because PA grid capacitance is an integral part of the IPA loading. The first adjustment is made in the PA grid circuit. Disconnect capacitor 2C7 from the PA grid. Using a grid dip meter, adjust 2L3 to resonate at a frequency 10 MHz below the operating frequency. 2L3 is located on the RIGHT side of the PA socket in the lower PA compartment. Once adjusted, reconnect 2C7. Next, set the IPA plate tuning capacitor, 2C6, to near minimum capacity. With the grid dip meter coupled to 2L3, adjust the sliding short on 2L7 to the operating frequency.

Now, START the transmitter and when the READY lamp illuminates, turn on the PLATE switch. Turn up the IPA output control, 6R4, until IPA cathode current reads 100 mA. Adjust 2C6, the IPA plate tuning capacitor for a pronounced dip in cathode current. If you are unable to produce a dip in this manner, the tuning range of this circuit is too far off center. Capacitor 2C6, a ceramic vacuum variable, decreases its capacity with clockwise rotation; hence, the frequency of its operation will increase. The inverse is true of CCW rotation. If its tendency is to approach dip fully CCW, move the sliding short on 2L7 DOWN slightly, adding some inductance to the circuit. If the CW position seems to show promise, move the sliding short UP. This short acts as a range adjustment.

The final desired result of these adjustments is for the IPA plate tuning capacitor to be near (but not AT!) its minimum capacity when the dip is achieved. Now, advance the IPA output control (6R4) slowly until 150 mA cathode current or 20 mA screen current is reached...whichever comes first.

At this time you should note some PA grid current. The desired grid current is 40 to 60 mA, below which it is evident that there is too little loading on the IPA. To confirm this, check the relationship between IPA screen current and IPA cathode current. Chances are, you stopped at 20 mA screen current long before 150 mA cathode current was reached. If you read ABOVE 40 to 60 mA grid current, the loading is too great and the IPA cathode/screen current relationship will be skewed the other way.

To correct either condition, use 2L3, the IPA loading adjustment. Sliding the short lower will INCREASE the inductance and DECREASE the loading...and conversely. Move this adjustment NO MORE than 1/8" at a time until the proper loading is achieved.

Look for a PA grid current as much over 40 mA as possible WITHOUT exceeding an IPA cathode current of 240 mA or an IPA screen current of 20 mA. You will note some interaction between 2L3 and 2C6 when adjusting 2L5, the IPA plate loading inductor. To keep 2C6 in range, adjust 2L7 so that when adjustment is nearly complete, 2C6 ends up near its minimum capacity.

NEUTRALIZATION:

GENERAL: The screen circuit of the 4CX10000D must act as a barrier between the tube's input and output circuits at the operating frequency. When this condition exists, the stage is properly neutralized. To achieve it, the screen-to-ground capacitance and the inductance found in the screen connection to the PA socket must be series-tuned to the operating frequency. This tuning is basically accomplished by applying RF drive to the PA grid and adjusting the PA screen sliding shorts to eliminate interaction between the PA plate and grid circuits.

STEP-BY-STEP NEUTRALIZATION: Place the SCREEN switch in the OFF position. BE SURE! Remove the top cover of the PA air chimney to gain access to the screen tuning shorts. Turn the transmitter ON and adjust the output tuning for maximum power, which should read very low on the OUTPUT % POWER meter, 2M1. Note the PA grid current and the IPA cathode current as you adjust the PA tuning control. If the neutralization is proper, the interaction will be very slight. Should large meter changes occur, move the screen tuning sliding shorts a SMALL amount and recheck the interaction.

Keep the neutralizing shorts 180° apart when adjusting them. This is to say that when one short is moved toward the FRONT of the PA tube, the other should be moved to the REAR by a corresponding amount. At some point in this process, interaction will be minimal and you may turn the SCREEN switch ON and adjust the OUTPUT control to its fully counterclockwise position. Turn ON the transmitter and check for interaction. If you have neutralized the equipment properly, adjustment of the OUTPUT TUNING control through a range of about ±200 mA will have little effect on the PA grid current or the IPA cathode current.

Replace the PA tube air chimney before using full transmitter power.

PRIOR TO FINAL PLATE CIRCUIT TUNING: After all the above adjustments have been made, you will have established a tuning "baseline" that will need some further adjustment when plate voltage is applied to the final. When that voltage is applied, it is most likely that the screen current of the IPA will go UP and the IPA's cathode current will go DOWN, indicating an under-loaded condition. In order to correct this, the PA grid tuning and loading will have to be touched up in order to arrive at the proper readings. This begins with sliding the short on 2L3 UP to increase the loading and adjusting the IPA tuning to follow the dip, keeping in mind the proper ending relationships between the controls. This procedure may have to be followed several times to bring the controls into line.

PA TUNING:

GENERAL: The PA plate is tuned by modified PI-network consisting of the plate-to-ground capacitance of the tube, a variable inductor (2L9) and the set of three vacuum capacitors 2C14, 2C15, and 2C16, if all are used...2C15 is not needed for some operating frequencies. 2L10, a variable inductor, controls the plate-to-ground capacitance and 2L8 and 2C18 (the PLATE TUNING control) act as a trimmer for 2L10. Inductor 2L9 acts as a loading control.

TUNING CHECKUP DURING OPERATION: Adjust 2C18 to obtain a plate current dip and adjust 2L9 for more or less loading as required. The best loading condition is indicated by obtaining the required output power with PA plate current and screen voltages as low as possible. Adjust the PA screen voltage with the OUTPUT control to obtain the screen current shown ON THE FACTORY PROOF SHEET for your particular transmitter. It will be on the order of 350 mA.

TRANSMITTER RETUNING:

TUNING: The proper setting of the PA TUNING control, 2C18, is near its maximum capacity. If 2C18 is nearer its minimum capacity, then 2L10 must be adjusted to provide less inductance. To do so, move 2L10's sliding short DOWNWARD until 2C18 is satisfied. If 2C18 is at maximum capacity, then move the 2L10 sliding short UPWARD.

Advance the PA OUTPUT control, 2R19, clockwise and tune the PLATE TUNING capacitor, 2C18, for a dip in plate current corresponding with a peak in power output. The maximum power output at this time should be on the order of 4 KW, with plate efficiency running around 50%.

Once you are satisfied with the adjustments above, you may REMOVE the 10K, 50-Watt resistor and the grounding jumper.

Turn the OUTPUT control fully counterclockwise and press the PLATE switch.

NEUTRALIZATION CHECKOUT: Adjust the PLATE TUNING through the the plate-current dip. Your baseline power should now be 3 to 4KW output at about 60% plate efficiency. As you pass through the dip, note the PA grid current and the IPA cathode current. If a considerable change occurs in these readings, neutralization must be adjusted. The procedure is discussed in detail on page 4-8. Note...different power levels tend to affect neutralization.

TUNING AND LOADING UNDER POWER: Slowly advance the PA OUTPUT control and observe the PA screen current and voltage. If both current and voltage rise and efficiency thus drops or if increases in plate and screen voltage and screen current do not produce an increase in output power, then the PA loading is insufficient. Increase it by moving the sliding short on 2L9 downward and the one on 2L10 upward. Remember, they must be moved in an equal and OPPOSITE manner. As these changes are made in SMALL (1/8") increments, be sure 2C18 stays in range.

The objective of the above is to obtain the required power output with the PA plate current and the PA screen voltage as low as possible.

PA OUTPUT LOADING CONTROL: Adjust this control, along with the PLATE TUNING and POWER OUTPUT controls to provide maximum plate efficiency. Repeat this adjustment as these controls are interactive.

FINAL GRID SATURATION: The grid of the final tube should be driven into saturation. To check this, back off the IPA output adjustment pot and observe the power output. It should INCREASE slightly and then begin to drop off as you continue turning the pot down. This minimizes stage interaction and thus enhances stability.

GUIDELINE TABLE OF POWER OUTPUTS v. METER READINGS

This table is to be used as a general guide...the exact relationships for your transmitter are to be found on the Factory Proof Sheet for it.

OUTPUT PWR KW	10
Ip AMPS	1.91
Ep KV	7500
Esg VOLTS	750-800
Isg mA	70
Eg VOLTS	230
Ig mA	23

With regard to the voltages found OUTSIDE the final amplifier, expect the following nominal figures. Your Factory Proof sheet will be exact:

IPA:

Ep	2000 volts
Esg	240 volts
Ik	150 mA
Isg	20-30 mA
Ig	20 mA

EXCITER:

INC	100%=10 Watts
REF	10% of above MAXIMUM

.....

If your transmitter readings agree with the above tables and the transmitter behaves normally, you may safely assume you have tuned it properly...if not, start over. Do not assume you knew where it went wrong and attempt to restart your tuning procedure at that point. That assumption will throw all your baselines off and is a virtual guarantee of having to start over...perhaps more than once.

POWER SUPPLIES: There are several power supplies in this transmitter...we shall deal with each in turn.

WARNING

VOLTAGES ARE PRESENT IN THIS EQUIPMENT THAT CAN CAUSE INSTANTANEOUS DEATH OR SERIOUS INJURY. SERVICE ON THE HIGH-VOLTAGE SECTION OF THE TRANSMITTER MUST BE PERFORMED WITH ALL DUE RESPECT TO SAFETY. IT IS SUGGESTED THAT THIS AREA OF THE TRANSMITTER NOT BE SERVICED ALONE... THAT AN ASSISTANT BE NEARBY IN CASE OF DIFFICULTY. BE SURE TO TAG OUT ALL HIGH POTENTIAL CIRCUITS AFTER EQUIPMENT SHUTDOWN AND, IF POSSIBLE, WAIT AN APPROPRIATE PERIOD OF TIME FOR THE EQUIPMENT TO COOL BEFORE SERVICING.

HIGH VOLTAGE SUPPLY: This supply's sole purpose is to provide plate voltage to the 4CX10000D final amplifier. If the rated current capacity is exceeded, normally the plate overload relay 3K4 will engage, dropping out the plate contactor. Service for this problem will normally be performed in or around the PA enclosure.

IPA PLATE/PA AND IPA SCREEN SUPPLY: This supply, located in the transmitter cabinet, is a multi-purpose supply, powered by 6T2 (identified on the schematic as the "low-voltage" transformer) and using diode stacks 6D1-6D4 to provide two basic output voltages. For the plate of the IPA tube, all four diode stacks are used as a full-wave bridge, and for the screen supplies, 6D1 and 6D4 are wired in a full-wave parallel arrangement, with the positive cycle delivered at the center tap of 6T2. This arrangement provides a common negative point for both voltages. Failure of the power transformer or its primary circuit will disable both portions of the supply as will failure of 6D1 and 6D4. The panel meters and the explanation above will help you easily find the defective component. Two checkpoints have been found to be helpful in field experience.

1. If you are troubleshooting, check the DC resistance of 6L2. It must be 90 ohms.

2. If the transmitter is operated with a "remote power adjust" feature, the contact at the wiper point of 2R19 may oxidize from disuse and cause overheating and subsequent failure. Check it periodically.

GRID BIAS, PA: This supply is fed from control transformer 6T1. Failure of 6T1 will be immediately noticeable as the transmitter simply will not operate. Failure of a PC board component will show up as altered or nonexistent PA GRID voltage. Check C1, C2, and C3 first, followed by the diodes. Failure of this board will disable the plate voltage through the control circuit. DO NOT ATTEMPT TO BYPASS THE CONTROL CIRCUIT IN ITS MISSION AS OPERATION OF AN UNBIASED PA TUBE IS FATAL TO THE TUBE.

FILAMENT SUPPLIES, IPA AND PA: Both supplies are AC, with the filament of each tube having its own transformer. Transformer 2T2, whose primary is in the secondary circuit of the control transformer, is the IPA filament transformer whose AC output voltage passes through current limiting resistor 2R38. Periodically inspect 2R38 for discoloration and replace if necessary. The PA is supplied from 2T1, whose primary is connected directly to the same phase of the primary voltage as the control transformer's primary. Note that 2T1's secondary is center-tapped to allow a cathode return to ground through 2R39. The 4CX10000D is a heater/cathode tube, while the 4CX250B IPA has a separate cathode.

CONTROL VOLTAGE: 6T1 is the control transformer. Connected across one phase of the primary voltage, it provides a nominal 117VAC to operate relays, pilot lights, and the control circuitry. Some versions of 6T1 have been delivered with a 7 ampere fuse mounted to the primary side. If so, check it and add the fuse to your list of recommended spares. If it blows, NOTHING WILL HAPPEN when you depress the START switch.

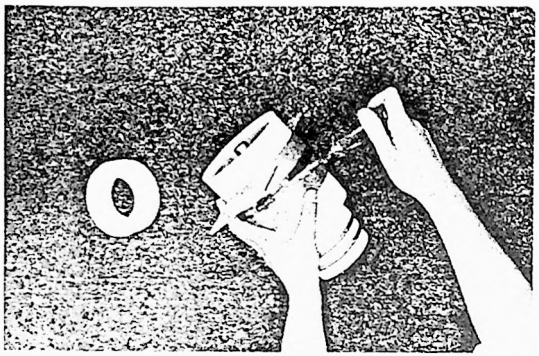
CONTROL, PLATE, SCREEN, AND PA FILAMENT TRANSFORMERS: Each of these has voltage-varying taps; typically, 0 ±10, 200-220-230 volts...check each one for its exact configuration but this is one way to alter the voltage relationships within the transmitter if the range of other adjustments is inadequate. Remember, the control transformer will affect the IPA filament transformer and the PA bias supply.

CONTROL DOOR AND PC BOARD:

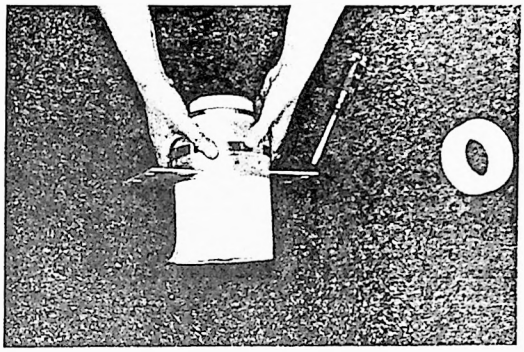
This circuit is a stable, highly reliable one and should require no special attention. It is obvious that during regular maintenance it should be inspected for pitted relay contacts, component overheating, and other obvious signs of impending possible failure. A run-through of the Control Checkout and the Overload Circuits and their Checkout on pages 2-10 and 2-11 will confirm and locate any weaknesses in these circuits.

DRIVER AND FINAL AMPLIFIER:

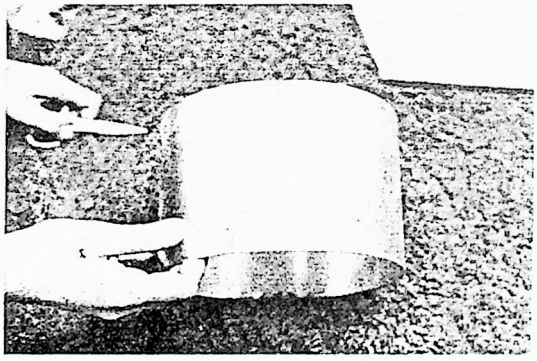
The service data for these areas of your transmitter are located in the tuning instructions, in the tube replacement and in the troubleshooting instructions earlier in this section. Again, regular maintenance requires that these areas be inspected for the matters discussed in the troubleshooting section...to save off-the-air time. Many early failures can be found and corrected during routine maintenance and no downtime need be suffered. You know that because this equipment is high-power, high-voltage, and high-temperature equipment, it WILL NOT RUN FOREVER without some maintenance and repairs.



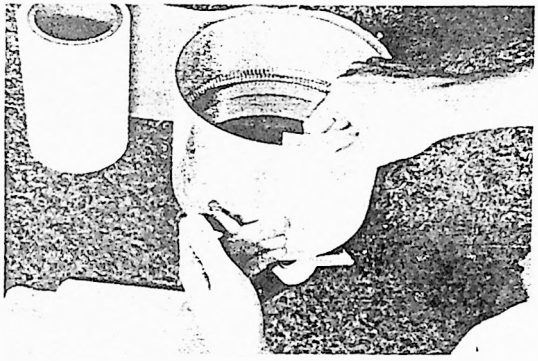
1. After tube removal, loosen strap



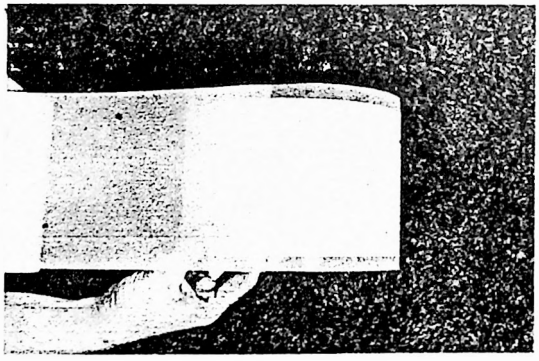
2. Slide outer ring off teflon



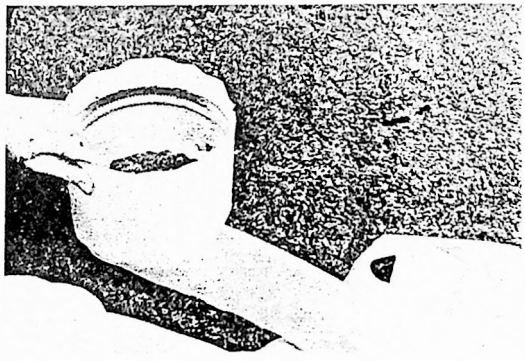
3. Discard old teflon and clean ring



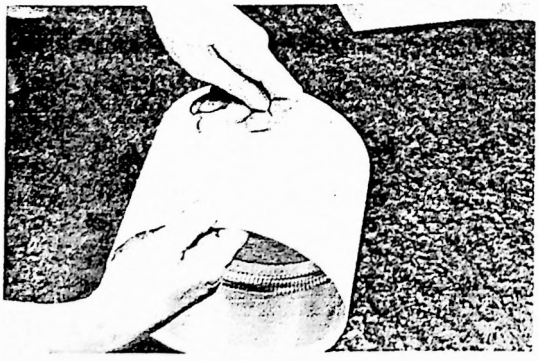
4. Start new teflon on ring as shown



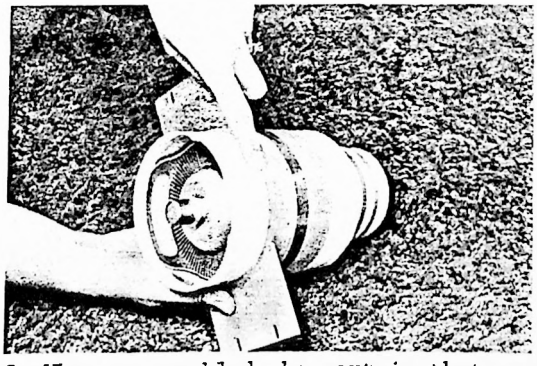
5. Wrap evenly and snugly all teflon



6. Be sure teflon is even



7. Pull tightly and tape as shown



8. When reassembled, be certain that no buckling shows at ring gap

GRID LOADING CIRCUIT ADJUSTMENT

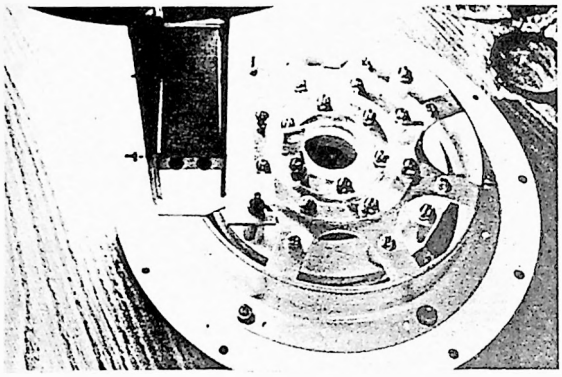


Photo above shows shorting bar NOT SNUG; will produce underloading and difficult tuning

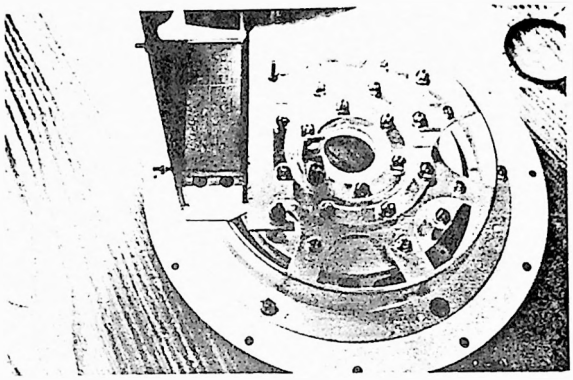
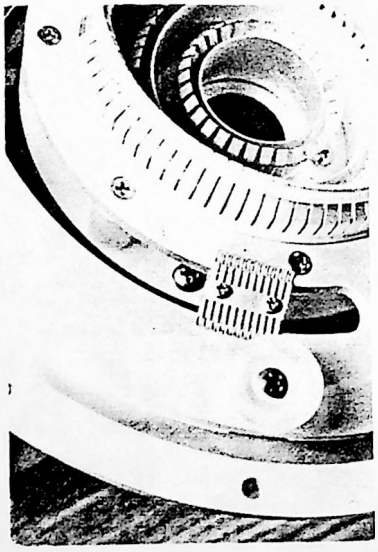
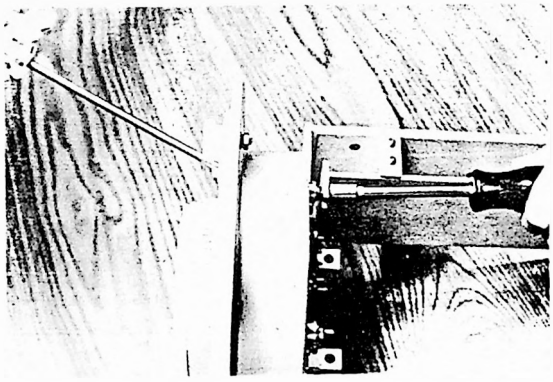


Photo above shows properly tightened grid loading circuit; will tune easily and hold



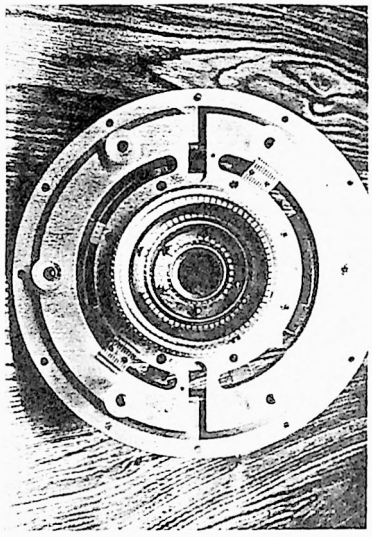
Note bolt head for grid loading circuit at left of neutralizing short

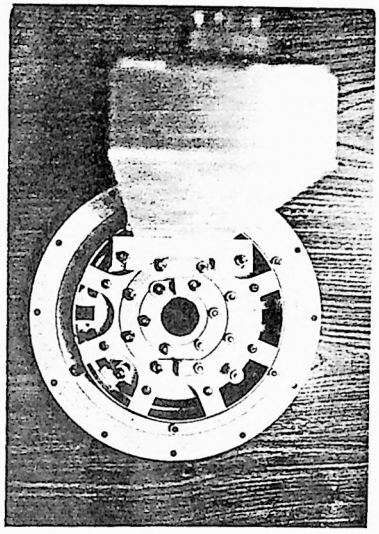


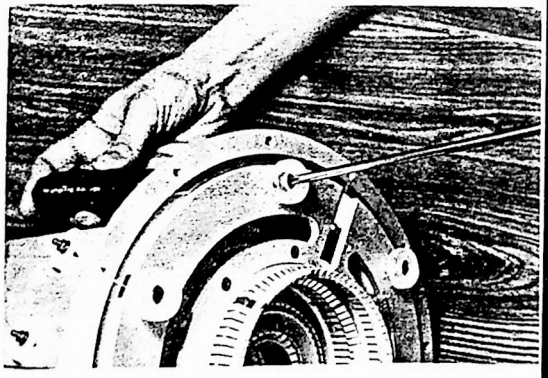
Adjusting for proper tightness

PA TUBE SOCKET SHOWN
REMOVED FROM TRANSMITTER

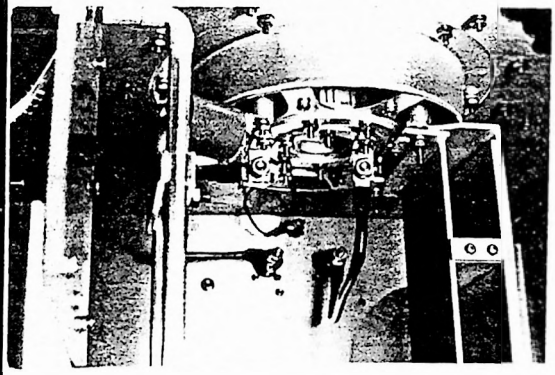
Note presence of nuts on all bolts. All must be present and tight for proper operation. In left photo, note the neutralizing sliders which must be maintained 180 degrees apart.







Bolts may be removed and replaced, one by one, to see if arcing has occurred within any of them



Underside, installed tube socket

SECTION 5

PARTS LISTS

5.0: Guidelines for obtaining replacement parts.

Replacement of Components

5.0.1: Television Technology Corporation will supply replacement components at current prices. Some components, notably fixed resistors and capacitors, may be available locally. You may utilize these sources of components only if the part obtained locally is the exact equivalent. Capacitors and resistors should be replaced only with the same type and tolerance. For instance, a 22pF NPO disk ceramic capacitor may not be replaced with a 22pF Z5U disk capacitor or even with a 22pF silver mica capacitor.

5.0.2: Use of replacement type semiconductors (i.e. HEP, EGC, SK Series) is discouraged. If you have to use these types, use them only in control and DC circuits. Use of replacement semiconductors in RF circuitry may cause it to become completely inoperable.

5.0.3: When ordering parts from our factory, please supply the model and serial number of the equipment for which you require the parts.

5.0.4: On the parts list itself, the TTC part number is shown in the column identified as "part number" or "TTC part number." When ordering, please supply that number AND the description of the part...such as ".22 µF monolithic capacitor". Additionally, the circuit board, circuit area and circuit designator would also be most helpful...such as "C430 in the UHF Upconvertor." This allows us to be responsive if any technical changes or updates have occurred in the equipment.

5.0.5: To assure speedy routing and handling of any mailed parts orders or confirmations of orders, mark the front of your envelope "PARTS ORDER" and any mailed confirmations of telephone or TWX orders should be so marked on the document to avoid unnecessary duplication.

5.0.6: Mail orders to:

TELEVISION TECHNOLOGY CORPORATION

650 S. Taylor
Louisville, CO 80027

Mail:
P.O. Box 1385
Broomfield, CO 80020 - 8385

Telephone: 303-665-8000
FAX: 673-9900
Telex: 910-9380396 TTC COLO

5.0.7: IMPORTANT...The technical improvements made in some modules may produce parts lists that vary with the frequency range of the module. Those modules that may be so affected, such as the ULO local oscillator module, have their parts lists all in the same section of the manual, but the section is further subdivided. For example, the ULO module's parts are all listed in Section 5.6 of the manual, but sections a, b, c, and d of Section 5.6 refer to different frequency ranges of the same module. BE SURE YOU ARE LOOKING AT THE PARTS LIST FOR THE MODULE YOU HAVE.

DRIVER AND FINAL AMPLIFIER 4502-2000 (EPL5288K1 REF)

CIRCUIT SYMBOL	DESCSRIPTION	PART NUMBER
2B1	Blower	8176-302
2C1	Capacitor, RF, 1kpF @ 5kV	8131-827
2C2	Capacitor, Feedthru, 1kpF @ 500V	8131-092
2C3	Capacitor, Feedthru, 1kpF @ 500V	8131-092
2C4	Capacitor, Air Variable, 5-35 pF	8135-305
2C5	Capacitor, Air Variable, 5-35 pF	8135-305
2C6	Capacitor, Vacuum Variable, 5-30pF	8131-738
2C7	Capacitor, RF, 100 pF @ 15kV	8131-842
2C8	SEE TUBE SOCKET ASSEMBLY	
2C9	Capacitor, RF, Feedthru, 680pF @ 6kV	8131-828
2C10	Capacitor, Feedthru, 1kpF @ 500V	8131-092
2C11	Capacitor, RF, Feedthru, 680pF @ 6kV	8131-828
2C12	Capacitor, Feedthru, 1kpF @ 3kV	4502-2055
2C13	Capacitor, Feedthru, 1kpF @ 3kV	4502-2055
2C14	Capacitor, Vacuum, 25pF, 15kV	8135-330
2C15	Capacitor, Vacuum (Frequency Determined by Factory)	
2C16	Capacitor, Vacuum, 25pF, 15kV	8135-330
2C17	Assy, Capacitor, Feedthru, H.V., 800pF @ 10kV	4500-2150
2C18	Capacitor, Vacuum Variable, 110pF	8131-734
2C19	Capacitor, Vacuum Variable, 110pF	8131-734
2C20	Assy, Plate Blocker, Capacitor	4103-2300
2C21	NOT USED	
2C22	Capacitor, Feedthru, 1kpF @ 500V	8131-092
2C23	Capacitor, Feedthru, 1kpF @ 500V	8131-092
2C24	Capacitor, Oil Filled, 10µF @ 1kV DC	8135-956
2C25	SEE TUBE SOCKET ASSEMBLY	
2C26	Capacitor, Oil Filled, .05µF @ 10kV	8135-927
2C27	Capacitor, Oil Filled, .05µF @ 3kV	8135-909
2C28	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
2C29	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
2C30	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
2C31	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
2C32	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
2C33	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
2C34	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
2C35	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
2C36	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
2C37	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
2C38	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
2C39	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
2C40	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
2C41	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
2C42	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
2C43	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
2C44	Capacitor, Feedthru, 1kpF @ 500V	8131-092
2C45	Capacitor, Feedthru, 1kpF @ 500V	8131-092
2DC1	Assy, Directional Coupler, 10 watt	4250-1600
2I1	Lamp, PA Plate	8225-NE51H
2I2	Lamp, Test	8225-NE51H
2J1	Connector, Plug, UG414/U	8151-738

DRIVER AND FINAL AMPLIFIER - Continued

CIRCUIT SYMBOL	DESCRIPTION	PART NUMBER
2L1	Choke, RF, 35-110 MHz	8232-004
2L2	Assy, Choke, RF, IPA Plate	4502-9346
2L3	SEE TUBE SOCKET ASSEMBLY	
2L4	Assy, Choke, RF, PA Plate	4250-9346
2L5	Assy, IPA Grid Loading Inductor	4502-2242
2L6	Assy, IPA Grid Tuning Inductor	4502-2243
2L7	SEE TUBE SOCKET ASSEMBLY	
2L8	Assy, Plate Tuning	4502-2044
2L9	Assy, PA Plate Tuning - Low Frequency	4502-2400
2L9	Assy, PA Plate Tuning - High Frequency	4502-2500
2L10	Assy, Output Loading	4502-2600
2L11	SEE TUBE SOCKET ASSEMBLY	
2L12	Choke, Filter, 1.2µH, 5A	8232-084
2L13	Choke, RF Coil, 100µH, 400mA	8232-080
2L14	Assy, Choke, Parasitic Suppressor (with 2R21)	4502-2050
2L15	Choke, RF, 35 - 110 MHz	8232-004
2L16	Assy, Choke, Parasitic Suppressor (with 2R37)	4502-2050
2L17	Inductor, Loading Strap	4502-2046
2L18	Inductor, Loading Control Strap	4502-2061
2M1	Meter, Output, 0 - 105%	8137-345
2M2	Meter, PA Plate Current, 0 - 3 Amp	8137-353
2M3	Meter, PA Plate Voltage, 0 - 7.5 kV	8137-341
2M4	Meter, PA Voltage, 0 - 1kV DC	8137-317
2M5	Meter, PA Current, 0 - 1mA DC	8137-321
2M6	Meter, IPA Voltage, 0 - 1kV DC	8137-317
2M7	Meter, IPA Cathode Current, 0 - 300mA DC	8137-310
2M8	Meter, IPA Current, 0 - 1mA DC	8137-321
2M9	Meter, Exciter Output, 0 - 105%	8137-319
2R1	Pot, 10kΩ, 2W	8154-006
2R2	Resistor, 10Ω, 2W, 5%	8620-10A5
2R3	Resistor, Fixed, 7.5kΩ, 100W	8154-513
2R4	Resistor, Fixed, 10kΩ, 50W	8154-494
2R5	Resistor, 910Ω, 2W, 5%	8620-910A5
2R6	Resistor, 10Ω, 2W, 5%	8620-10A5
2R7	Resistor, Adj., 5kΩ, 25W	8154-623
2R8	Resistor, 1.0MΩ, 2W, 5%	8620-1.0M5
2R9	Resistor, Fixed, 150Ω, 25W	8154-458
2R10	Resistor, 10kΩ, 2W, 5%	8620-10K5
2R11	Resistor, 10MΩ, 1W, 1%	8610-10M1
2R12	Resistor, Adj, 7.5kΩ, 50W	8154-638
2R13	Resistor, Fixed, 10kΩ, 50W	8154-494
2R14	Resistor, 910Ω, 2W, 5%	8620-910A5
2R15	Resistor, Axial Lead, 2Ω, 5W	8154-325
2R16	Resistor, 1.0MΩ, 2W, 5%	8620-1.0M5
2R17	Resistor, 10Ω, 2W, 5%	8620-10A5
2R18	Resistor, 1.0MΩ, 2W, 5%	8620-1.0M5
2R19	Rheostat, 7.5K, 150W	8154-749
2R20	Resistor, Fixed, 10kΩ, 50W	8154-494
2R21	Resistor, 47Ω, 2W, 5% (with 2L14)	8620-47A5
2R22	NOT USED	
2R23	NOT USED	
2R24	Resistor, 1MΩ, 2W, 1%	8620-1.0M1
2R25	Resistor, 1MΩ, 2W, 1%	8620-1.0M1
2R26	Resistor, 1MΩ, 2W, 1%	8620-1.0M1
2R27	Resistor, 1MΩ, 2W, 1%	8620-1.0M1
2R28	Resistor, 1MΩ, 2W, 1%	8620-1.0M1
2R29	Resistor, 1MΩ, 2W, 1%	8620-1.0M1
2R30	Resistor, 1MΩ, 2W, 1%	8620-1.0M1

CIRCUIT SYMBOL	DESCRIPTION	PART NUMBER
2R31	Resistor, 500k Ω, 2W, 1%	8620-500K1
2R32	Resistor, 100k, 2W, 5%	8620-100K5
2R33	Resistor, 1kΩ, 2W, 5%	8620-1.0K5
2R34	Pot, 50kΩ, 2W	8154-159
2R35	Resistor, Noninductive, 10Ω, 50W	8154-220
2R36	Resistor, 4.7kΩ, 2W, 5%	8620-4.7K5
2R37	Resistor, 47Ω, 2W, 5% (with 2L16)	8620-47A5
2R38	Resistor, 0.1Ω, 5W, 1%	8650-0.1A1
2R39	Resistor, Fixed, 1Ω, 25W	8154-451
2R40	Resistor, 56kΩ, .50W, 5%	8605-56K5
2R41	Resistor, 56kΩ, .50W, 5%	8605-56K5
2R42	Resistor, 47Ω, 2W, 5%	8620-47A5
2R43	Resistor, Adj, 250Ω, 25W	8154-557
2R44	Resistor, 4.7kΩ, 2W, 5%	8620-4.7K5
2R45	Resistor, Adj, 1Ω, 25W	8154-548
2S1	Switch, Toggle, SPDT, Ctr. Off	8125-975
2S2	Switch, Toggle, DPDT	8125-977
2S3	Switch, Toggle, SPDT	8125-976
2S4	Switch, Toggle, DPDT	8125-977
2S5	Switch, Toggle, DPDT	8125-977
2S6	Switch, Toggle, SPDT, Ctr. Off	8125-975
2S7	Switch, Air Flow Interlock	8125-409
2S8	Switch, Interlock	8125-595
2T1	Transformer, PA, Filament	8162-370
2T2	Transformer, IPA, Filament	8162-517
2TB	Terminal Board	8139-255
2V1	Tube, IPA	8163-4CX250B
2V2	Tube, PA	8163-4CX10000D

MISCELLANEOUS ITEMS

Schematic, Power Amplifier (C13233 REF)	C4502-2035
Plate Blocker Assembly, Consisting of:	4103-2300
Outer Conductor, Plate Blocker (B10826A)	4103-2305
Inner Conductor, Plate Blocker (B12450A)	4103-2306
Clamp, Adj, 1/2" Wide, Stainless Steel	8138-247
Teflon Dielectric	4103-2308
Shaft, Extension for 2C18	4502-2047
Tube Socket Assembly, consisting of:	4502-2100
Tube socket, customized with	
2C25 Capacitor, Silver Mica, 1kpF	8131-858
2L11 Neutralizing Ring	4502-2106
NCI Dielectric, Filament bypass	4502-2110
NCI Assy, sliding neutralizing shorts	4502-2126

Parts associated with tube socket but not shipped with it:

2C8 Dielectric insulator on IPA grid loading circuit	4502-2119
2L3 Assembly, IPA Plate Loading	4502-2123
2L7 Assembly, IPA Plate Tuning	4502-2124

CONTROL DOOR 4502-3000 (EPL5363 REF)

CIRCUIT SYMBOL	DESCRIPTION	PART NUMBER
3C9	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
3C10	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
3C11	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
3I1	Lamp, 334 @ 24V (Part of 3S3)	8225-334
3I2	Lamp, 334 @ 24V (Part of 3S5)	8225-334
3I3	Lamp, 334 @ 24V (Part of 3S6)	8225-334
3I4	Lamp, Interlock	8225-NE51H
3I5	Lamp, Ready	8225-NE51H
3M1	Meter, Line, 0 - 300 VAC	8137-323
3R13	Resistor, Axial Lead, 3KΩ, 10W	8154-428
3R14	Resistor, Axial Lead, 3KΩ, 10W	8154-428
3R15	Resistor, Axial Lead, 3KΩ, 10W	8154-428
3R16	Resistor, 56KΩ, 50W, 5%	8605-56K5
3R17	Resistor, 56KΩ, 50W, 5%	8605-56K5
3S1	Circuit Breaker, 15 Amp	8228-148
3S2	Switch, Rotary, Line	8125-250
3S3	Switch, Momentary, Start	8125-820
3S4	Switch, Momentary, Stop	8125-820
3S5	Switch, Alternate Action, Plate	8125-825
3S6	Switch, Momentary, Reset	8125-820

MISCELLANEOUS ITEMS

Schematic, Control Door (C13,234 REF)	C4502-3035
Switch, Contact Block	8125-830

CONTROL P.C. BOARD 4502-3125 (EPL5477 REF)

CIRCUIT SYMBOL	DESCRIPTION	PART NUMBER
3C1	Capacitor, Electrolytic, 20µF @ 250V	8131-616
3C2	Capacitor, Mylar, 5.0µF @ 200V	8136-133
3C3	Capacitor, Paper, 1.0µF @ 200V	8136-127
3C4	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
3C5	Capacitor, Electrolytic, 20µF @ 250V	8131-616
3C6	Capacitor, Mylar, 4µF @ 200V	8136-131
3C7	Capacitor, Disc Ceramic, .01µF @ 1kV	8131-009
3C8	Capacitor, Paper, 1.0µF @ 200V	8136-127
3D1	Diode, 1 Amp, 1kV	8216-033
3D2	Diode, 1 Amp, 1kV	8216-033
3K1	Relay, 120V, 4PDT, 3A	8148-186
3K2	Relay, 120V, 4PDT, 3A	8148-186
3K3	Relay, 120V, 4PDT, 3A	8148-186
3K4	Relay, 6V, 4PDT, 3A	8148-187
3K5	Relay, 6V, 4PDT, 3A	8148-187
3K6	Relay, 120V, 4PDT, 3A	8148-186
3K7	Relay, 120V, 4PDT, 3A	8148-186
3K8	Relay, 120V, 4PDT, 3A	8148-186
3Q1	Transistor	8218-2N3439
3Q2	Transistor	8218-2N3439
3R1	Resistor, Axial Lead, 1KΩ, 10W	8154-424
3R2	Resistor, Axial Lead, 20KΩ, 10W	8154-434
3R3	Resistor, 2.7KΩ, .50W, 5%	8605-2.7K5
3R4	Resistor, 220 Ω, .50W, 5%	8605-220A5
3R5	Resistor, 15K Ω, .50W, 5%	8605-15K5
3R6	Resistor, 22M Ω, .50W, 5%	8605-22M5
3R7	Resistor, Axial Lead, 1KΩ, 10W	8154-424
3R8	Resistor, Axial Lead, 20KΩ, 10W	8154-434
3R9	Resistor, 2.7KΩ, .50W, 5%	8605-2.7K5
3R10	Resistor, 620 Ω, .50W, 5%	8605-620A5
3R11	Resistor, 15K Ω, .50W, 5%	8605-15K5
3R12	Resistor, 22M Ω, .50W, 5%	8605-22M5
TB1	Terminal Board	8139-217
TB2	Terminal Board	8139-096

MISCELLANEOUS ITEMS

Lamp, NE2	8225-NE2
Schematic, Control P.C. Board (B12,288 REF)	B4502-3125

OVERLOAD AND RECYCLE - 4500-3325 (EPL5165 REF)

CIRCUIT SYMBOL	DESCRIPTION	PART NUMBER
C1	Capacitor, Paper, 2.0μF @ 200V	8136-129
C2	Capacitor, Paper, 1.0μF @ 200V	8136-127
C3	Capacitor, Milar, 4.0μF @ 200V	8136-131
C4	Capacitor, Ceramic, Flat, .01μF @ 400V	8135-162
C5	Capacitor, Ceramic, Flat, .01μF @ 400V	8135-162
D1	Diode, 1 Amp, 1kV	8216-033
D2	Diode, 1 Amp, 1kV	8216-033
K1	Relay, 120V, 4 PDT, 3A	8148-186
K2	Relay, 120V, 4 PDT, 3A	8148-186
K3	Relay, 120V, 4 PDT, 3A	8148-186
K4	Relay, 120V, 4 PDT, 3A	8148-186
Q1	Transistor	8218-2N3439
Q2	Transistor	8218-2N3439
R1	Resistor, 620 Ω, .50W, 5%	8605-620A5
R2	Resistor, 240KΩ, .50W, 5%	8605-240K5
R3	Resistor, 15KΩ, .50W, 5%	8605-15K5
R4	Resistor, 620 Ω, .50W, 5%	8605-620A5
R5	Resistor, 2.7KΩ, .50W, 5%	8605-2.7K5
R6	Resistor, 22MΩ, .50W, 5%	8605-22M5
R7	Resistor, 15KΩ, .50W, 5%	8605-15K5
R8	Resistor, 1.0MΩ, .50W, 5%	8605-1.0M5
TB1	Terminal Board	8139-107

MISCELLANEOUS ITEMS

Schematic, P.C. Board (B10872 REF)	B4500-3335
Lamp, NE2	8225-NE2

RIGHT SIDE PANEL ASSEMBLY 4502-4000 (EPL 5295K1 REF)

CIRCUIT SYMBOL	DESCRIPTION	PART NUMBER
4C1	Capacitor, Oil Filled, .01µF @ 5kV	8135-911
4K1	Contactor Plate	8148-913
4K2	Relay, 120V, DPDT-NO, 25A	8148-179
4K3	Contactor, Soft Start	8148-909
4R1	Resistor, Fixed, 100KΩ, 100W	8154-516
4R2	Resistor, Adj, 10Ω, 25W	8154-551
4R3	Resistor, Fixed, 3KΩ, 50W	8154-491
4R4	Resistor, Fixed, 1Ω, 50W	8154-505
4R5	Resistor, Fixed, 1Ω, 50W	8154-505
4R6	Resistor, Fixed, 1Ω, 50W	8154-505
4TB	Terminal Board	8139-266
	MISCELLANEOUS ITMES	
	Standoffs, Ceramic, 1/2 x 1	8140-740

LEFT SIDE PANEL ASSEMBLY - 4502-5000 (EPL 5293 REF)

CIRCUIT SYMBOL	DESCRIPTION	PART NUMBER
5F1	Fuse, AGC 1/4", 0.25A	8166-025
5K1	Relay, 120V, DPDT-NO, 25A	8148-179
5K2	Relay, 120V, DPDT-NO, 25A	8148-179
5R1	Resistor, Fixed, 100K Ω, 225W	8154-527
5R2	Resistor, Fixed, 100K Ω, 225W	8154-527
5TB	Terminal Board	8139-240
3TB	Terminal Board	8139-254
5TBA	Terminal Board	8139-257
	MISCELLANEOUS ITEMS	
	Ceramic Standoffs, 3/4 x 1-1/2	8140-748

BIAS SUPPLY P.C. BOARD - 4502-5125 (EPL 5471 REF)

CIRCUIT SYMBOL	DESCRIPTION	PART NUMBER
C1	Capacitor, Electrolytic, 30μF @ 350V	8131-676
C2	Capacitor, Electrolytic, 30μF @ 350V	8131-676
C3	Capacitor, Electrolytic, 30μF @ 350V	8131-676
D1	Diode, 1 Amp, 1kV	8216-033
D2	Diode, 1 Amp, 1kV	8216-033
R1	Resistor, 27Ω, 2W, 5%	8620-27A5
R2	Resistor, Axial Lead, 400Ω, 5W	8154-333
R3	Resistor, Fixed, 5kΩ, 20W	8154-446
R4	Resistor, Axial Lead, 8kΩ, 10W	8154-430
TB1	Terminal Board	8139-103
	MISCELLANEOUS ITEMS	
	Schematic, Bias Supply (A12167 REF)	A4502-5135

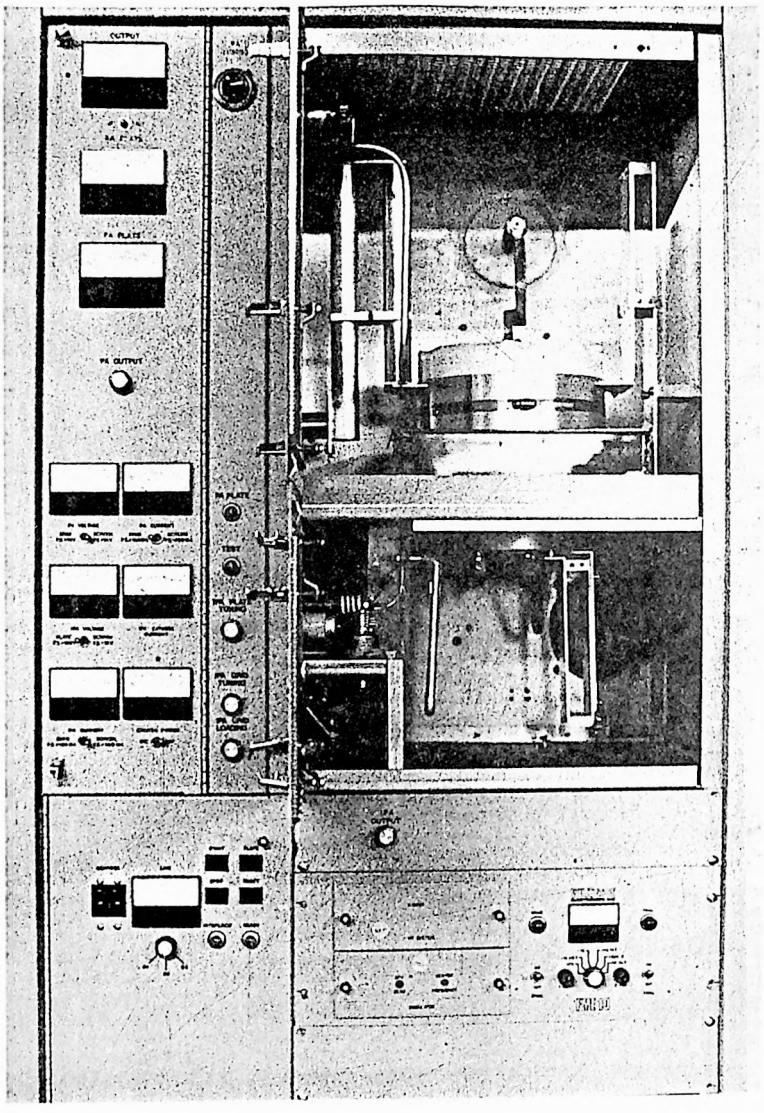
CABINET COMPONENTS - 4502-1001 (EPL 5294K1 REF)

CIRCUIT SYMBOL	DESCRIPTION	PART NUMBER
6C2	Capacitor, Oil Filled, 25μF @ 2kV	8135-961
6C3	Capacitor, Oil Filled, 10μF @ 3kV	8135-963
6C4	Capacitor, Oil Filled, 10μF @ 3kV	8135-963
6C5	Capacitor, Oil Filled, 4μF @ 10kV	8135-978
6C6	Capacitor, Oil Filled, .01μF @ 10kV	8135-919
6C7	Capacitor, Disc Ceramic, .01μF @ 1kV	8131-009
6C8	Capacitor, Disc Ceramic, .01μF, 1kV	8131-009
6C9	Capacitor, Disc Ceramic, .01μF, 1kV	8131-009
6D1	Assembly, Silicon Rectifier, 8-1	4000-0080
6D2	Assembly, Silicon Rectifier, 8-1	4000-0080
6D3	Assembly, Silicon Rectifier, 8-1	4000-0080
6D4	Assembly, Silicon Rectifier, 8-1	4000-0080
6D5	Assembly, Silicon Rectifier, 14-6	4000-0140-6
6D6	Assembly, Silicon Rectifier, 14-6	4000-0140-6
6D7	Assembly, Silicon Rectifier, 14-6	4000-0140-6
6D8	Assembly, Silicon Rectifier, 14-6	4000-0140-6
6D9	Assembly, Silicon Rectifier, 14-6	4000-0140-6
6D10	Assembly, Silicon Rectifier, 14-6	4000-0140-6
2DC1	See Driver and Final Amplifier	
6DC1	Directional Coupler, 10kW	8518-060
6HF1	Harmonic Filter, 10kW	8520-160
6L1	Choke, 12Hy, 600mA	8162-757
6L2	Choke, 8Hy, 300mA	8162-179
6L3	Choke, 8Hy, 300mA	8162-179
6L4	Choke, 12Hy, 600mA	8162-360
6M1	Meter, Filament, 0 - 10 VAC	8137-314
6R1	Resistor, 2Ω, 1.5W	8154-265
6R2	Varistor, 12mA, 6V	8215-255
6R3	Rheostat, 10Ω, 150W	8154-745
6R4	Rheostat, 10kΩ, 50W	8154-737
6R5	Resistor, 2Ω, 1.5W	8154-265
6R6	Resistor, Fixed, 5kΩ, 50W	8154-500
6R7	Resistor, 2Ω, 1.5W	8154-265
6S1	Switch, PA, 4PDT	8125-978
6S2	Switch, Screen, SPDT	8125-976
6S3	Switch, Interlock, Left Control Door	8125-595
6S4	Switch, Interlock, Right Control Door	8125-595
6S5	Switch, Interlock, PA Meter Panel	8125-595
6S6	Switch, Interlock, Rear Door	8125-595
6T1	Transformer, Control	8162-726
6T2	Transformer, Low Voltage	8162-718
6T3	Transformer, Plate	8162-590
	MISCELLANEOUS ITEMS	
	Ceramic Standoffs, 1/2 x 1 (Chokes)	8140-740
	Ceramic Standoffs, (Rectifiers)	8140-742
	Ceramic Standoffs, (Rectifiers)	8140-748
	Ceramic Standoffs, 1 x 1-1/4 (Choke)	8140-752

SECTION SIX
ILLUSTRATIONS

About the wiring harnesses in this equipment...

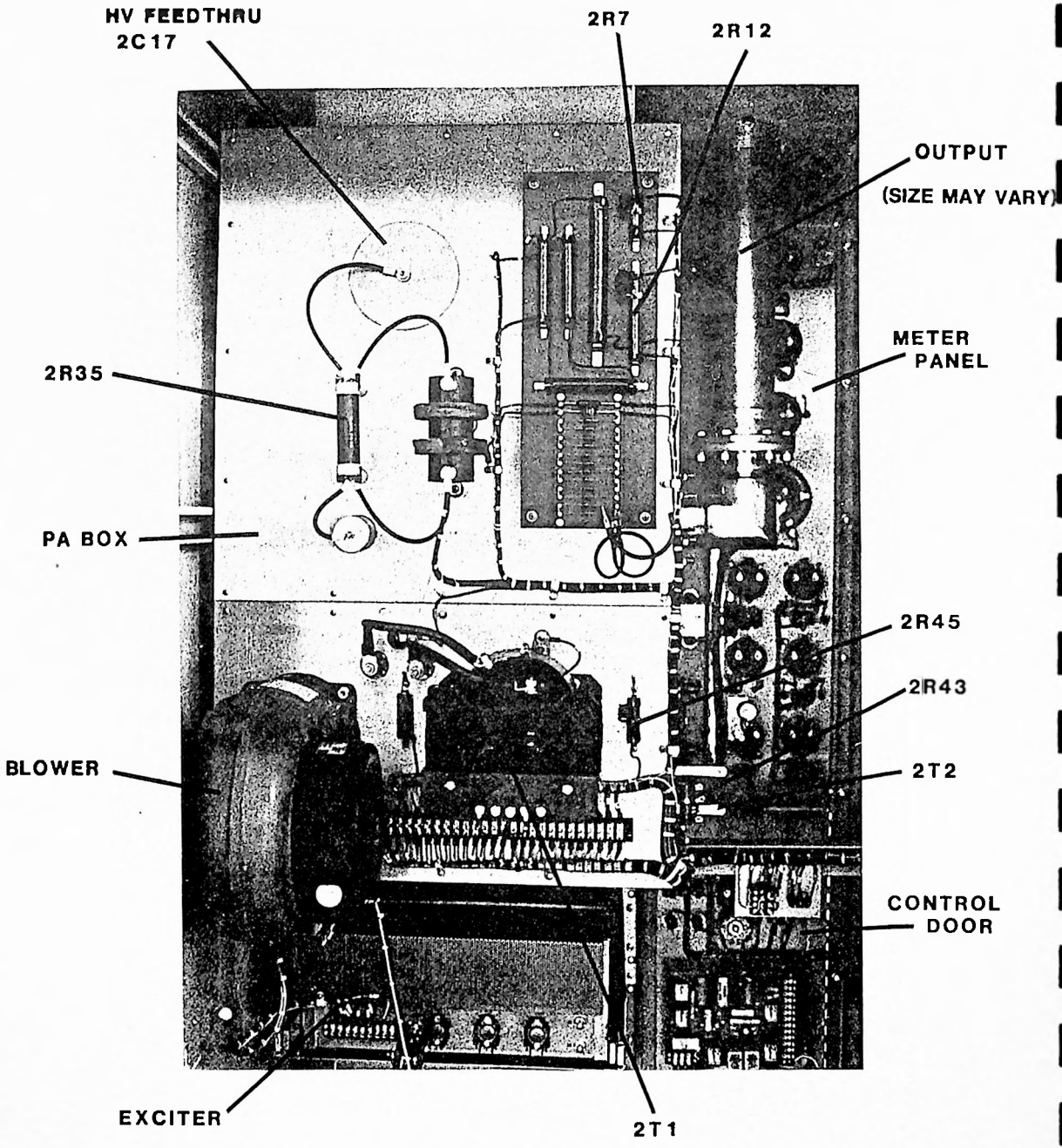
The numbering plan used places a number "1" at one end of a wire within a harness and a number "2" at the other end of the same wire...and so on until the last wire in a harness is in place; thus, if there are sixteen wires in a harness, the highest label number will be 32. This allows not only the wire to be identified, but the exact connection to be identified by number. Please see the WIRING HARNESS DRAWINGS for additional information.



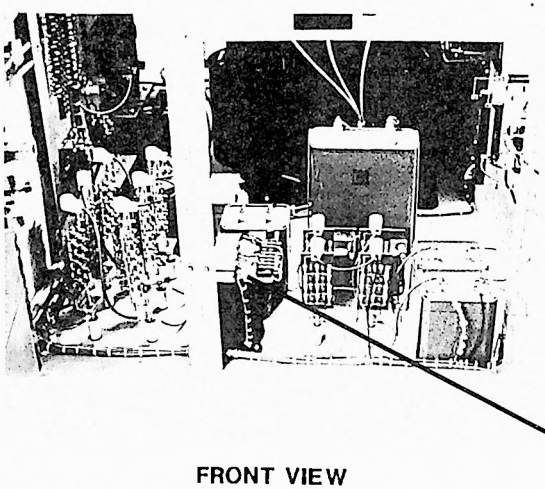
FRONT PANEL AND PA COMPARTMENT

FM5000E
FM7500E
FM10000E
FM20000E
FM25000E

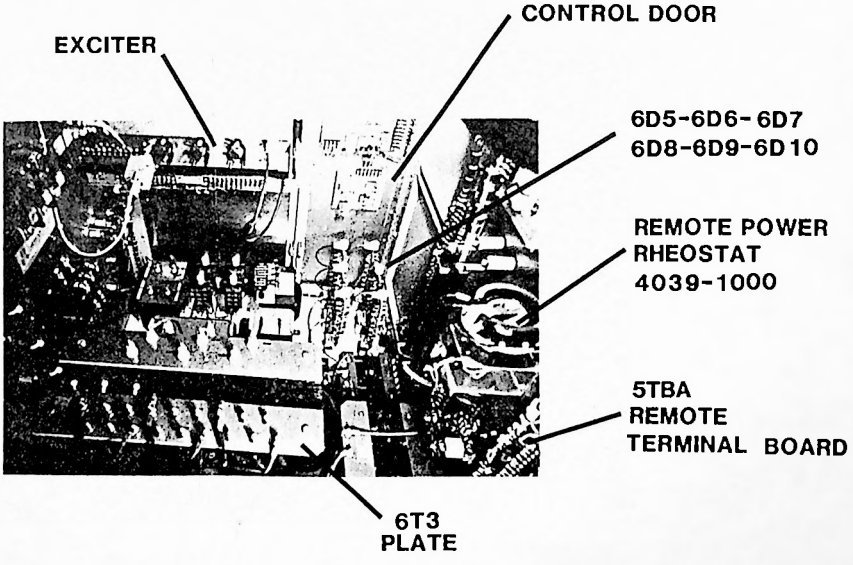
SOME COMPONENTS MAY VARY IN SIZE BETWEEN MODELS


HV FEEDTHRU
2C17
2R7
2R12
OUTPUT
(SIZE MAY VARY)
METER
PANEL
2R35
PA BOX
2R45
2R43
BLOWER
2T2
CONTROL
DOOR
EXCITER
2T1

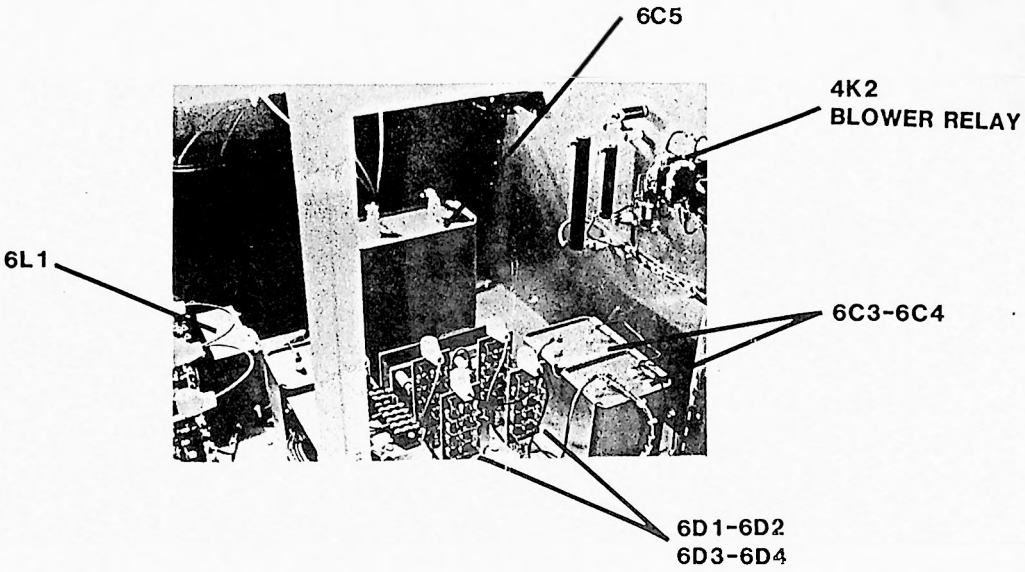
UPPER REAR

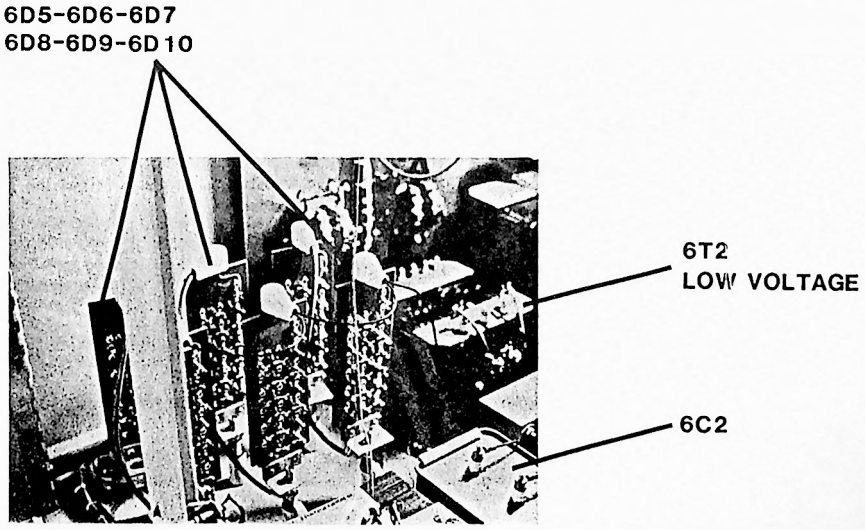


FRONT VIEW

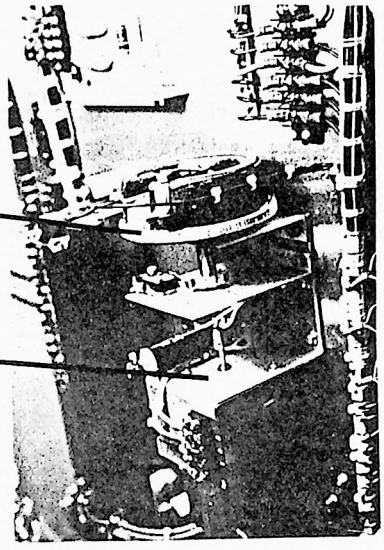


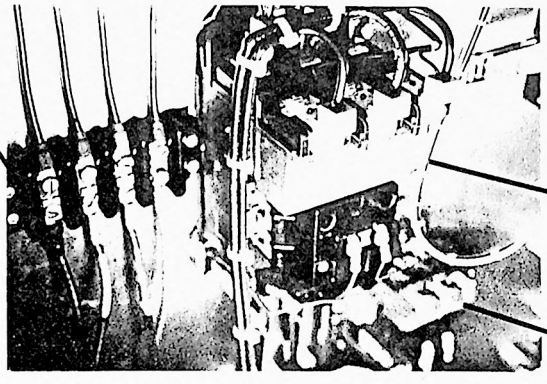
LOWER PORTION, FM5000E/7500E

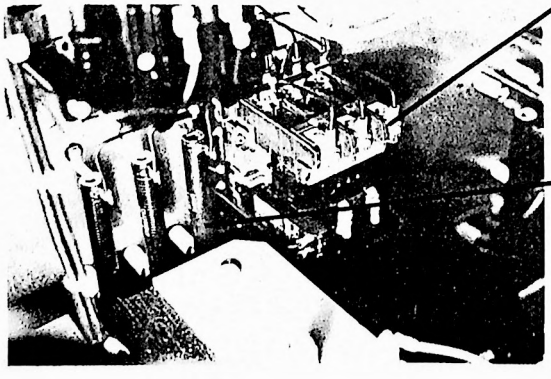


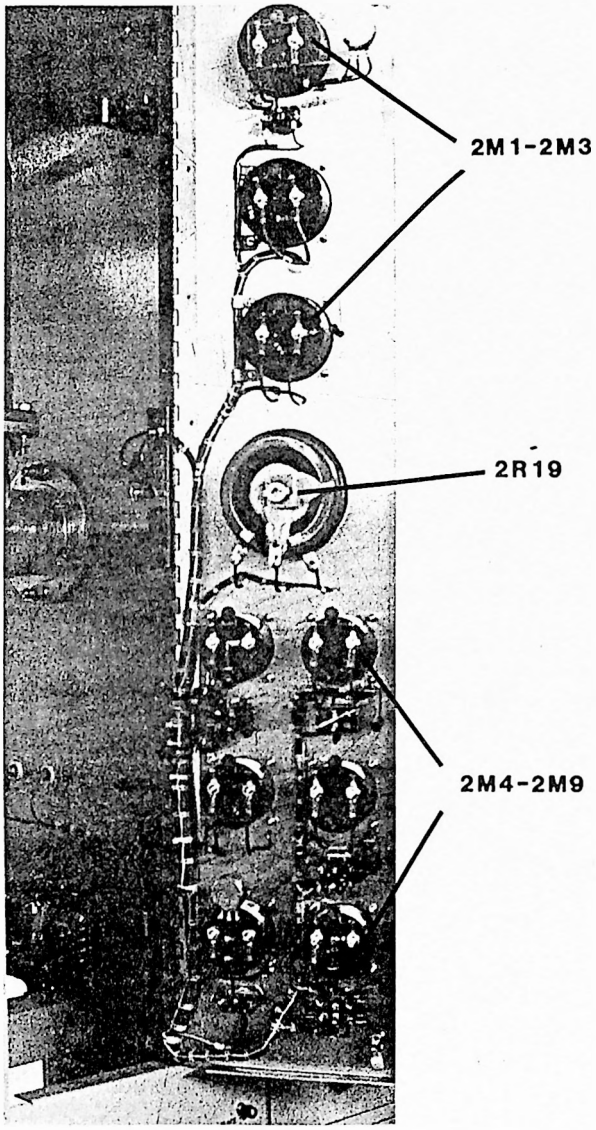


FLOOR DETAIL, FM5000E/7500E CABINET

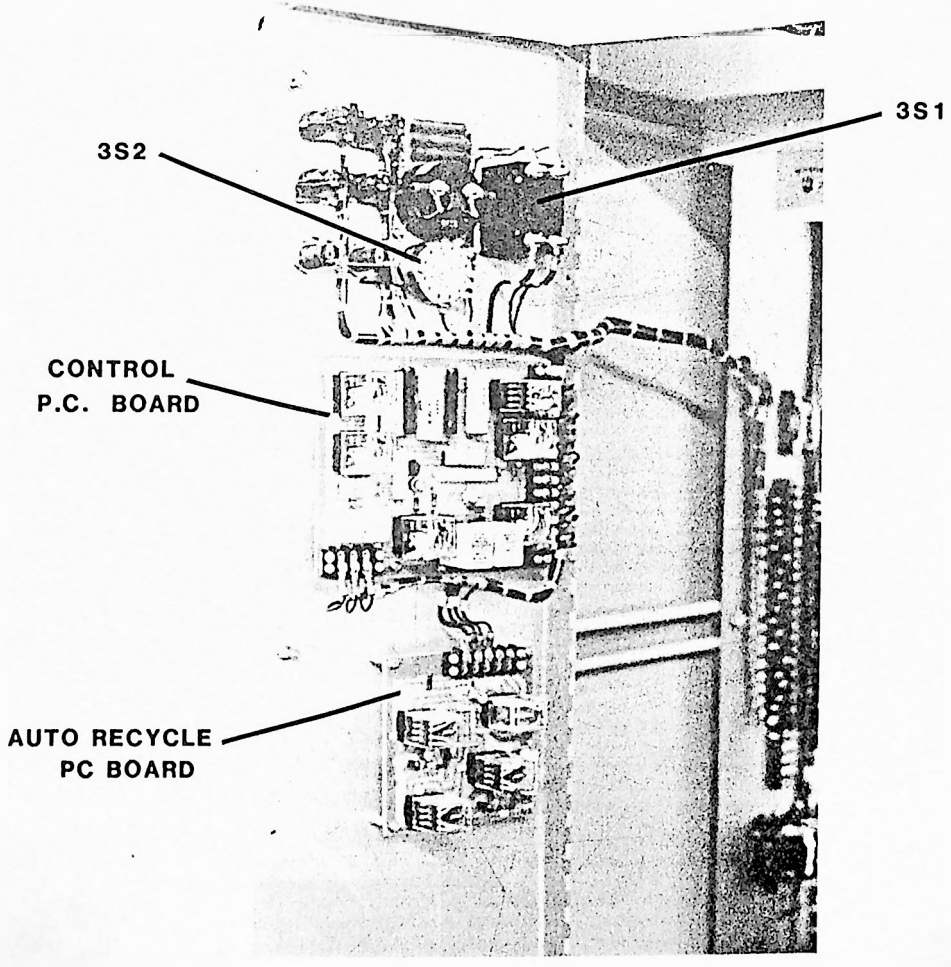

REMOTE POWER ADJUSTMENT
RHEOSTAT
MOTOR


4TB
SOFT-START ASSEMBLY
4K1
PLATE CONTACTOR
4K3
SOFT-START CONTACTOR

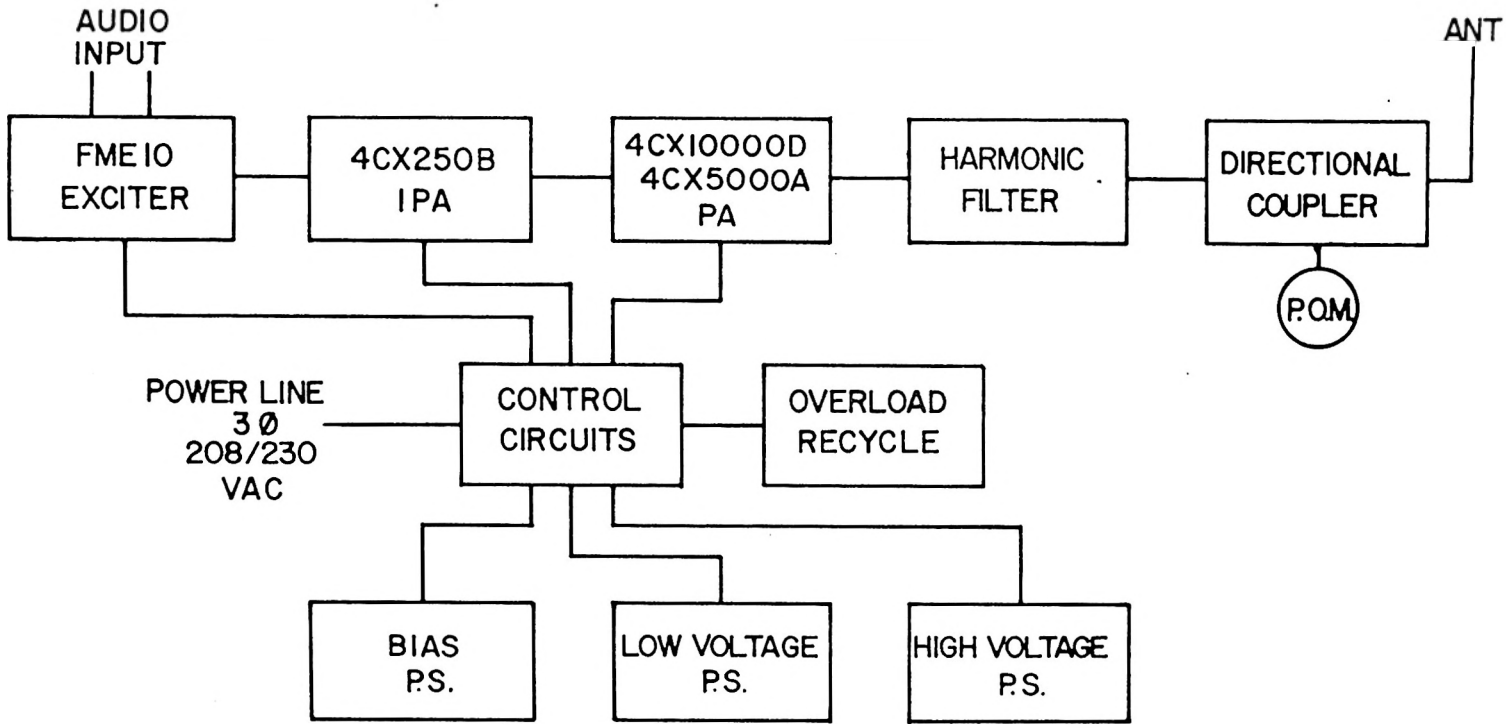

4R4-4R5-4R6
SOFT-START



METER PANEL

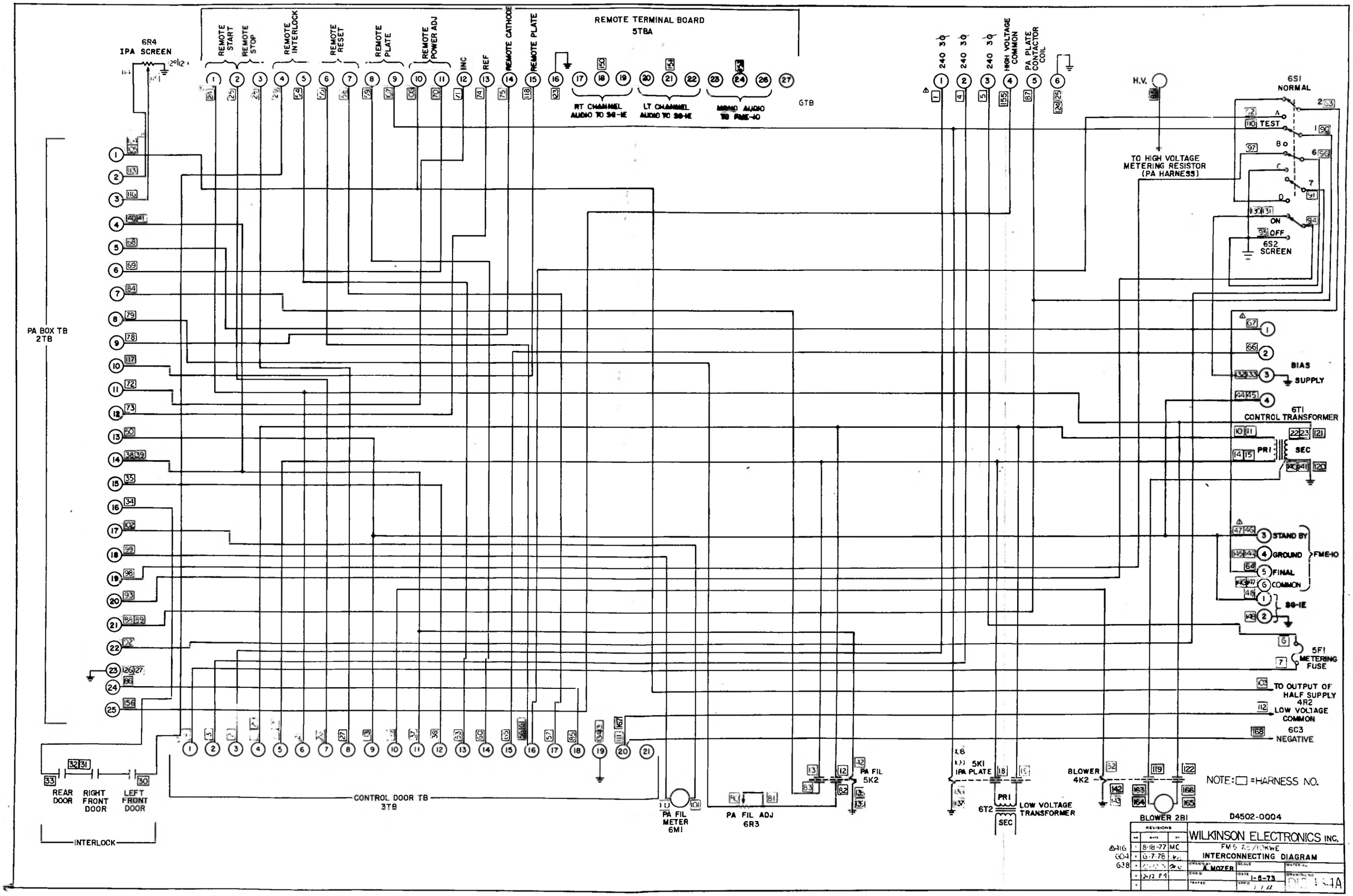


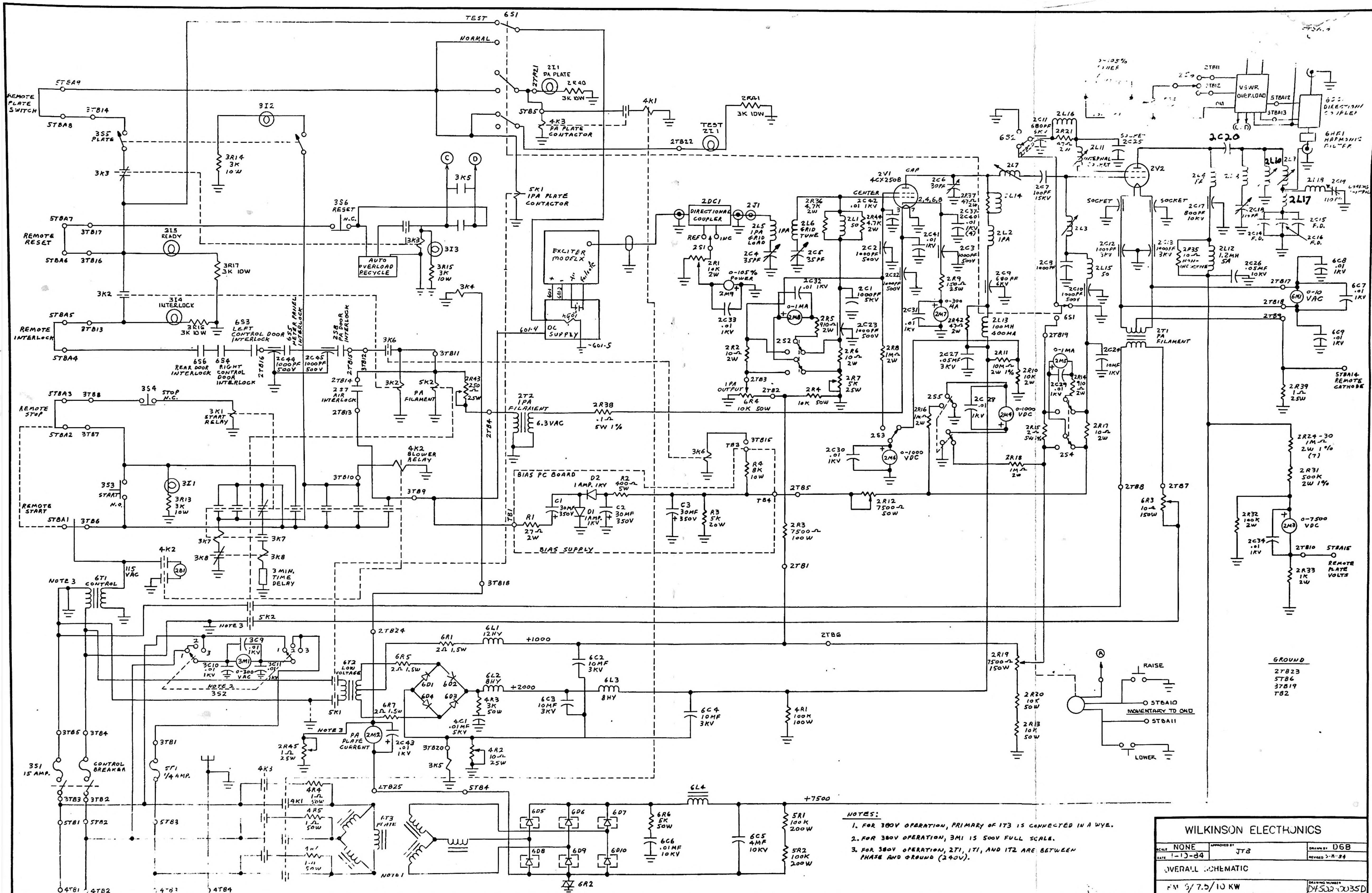
CONTROL DOOR

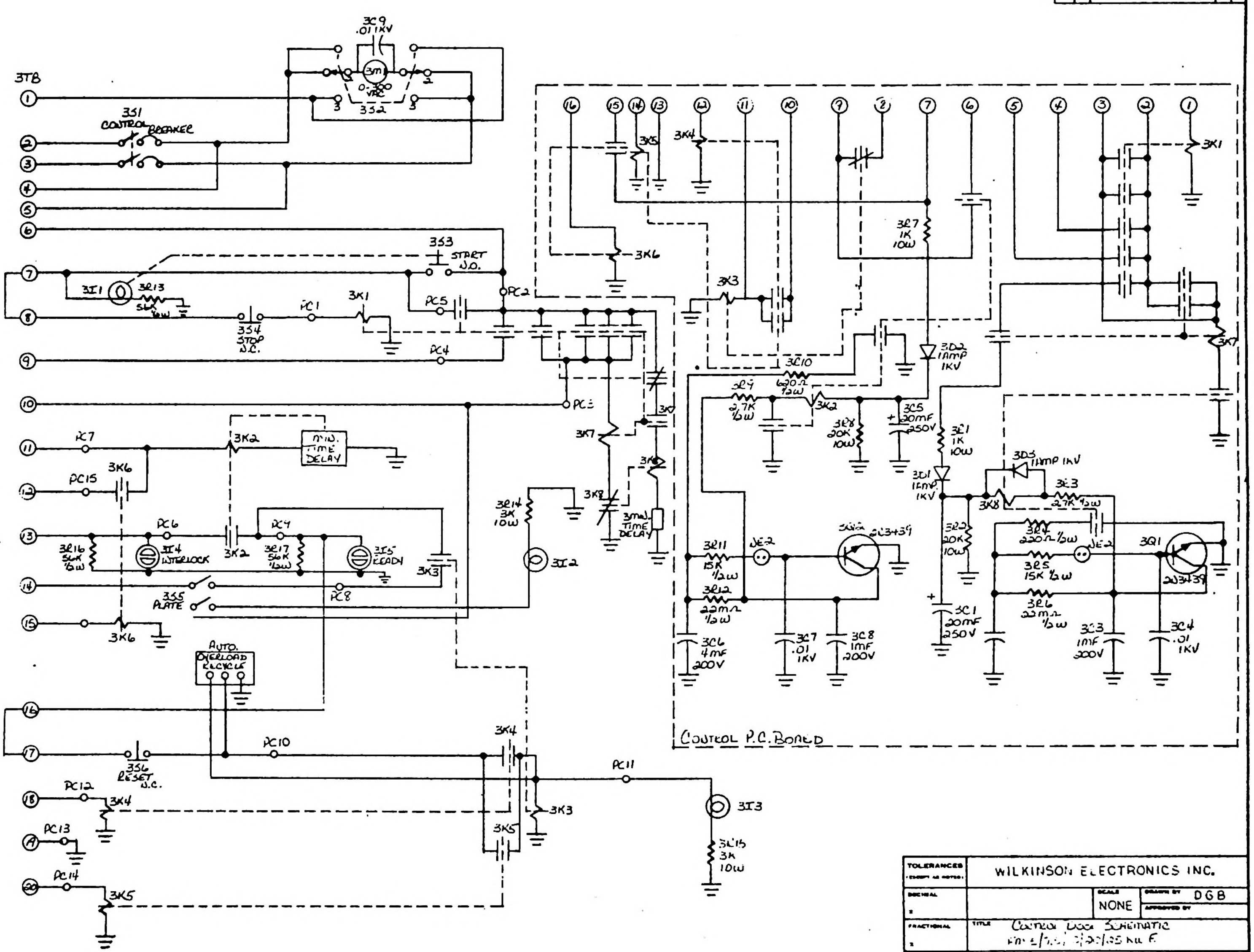


A4502-0002

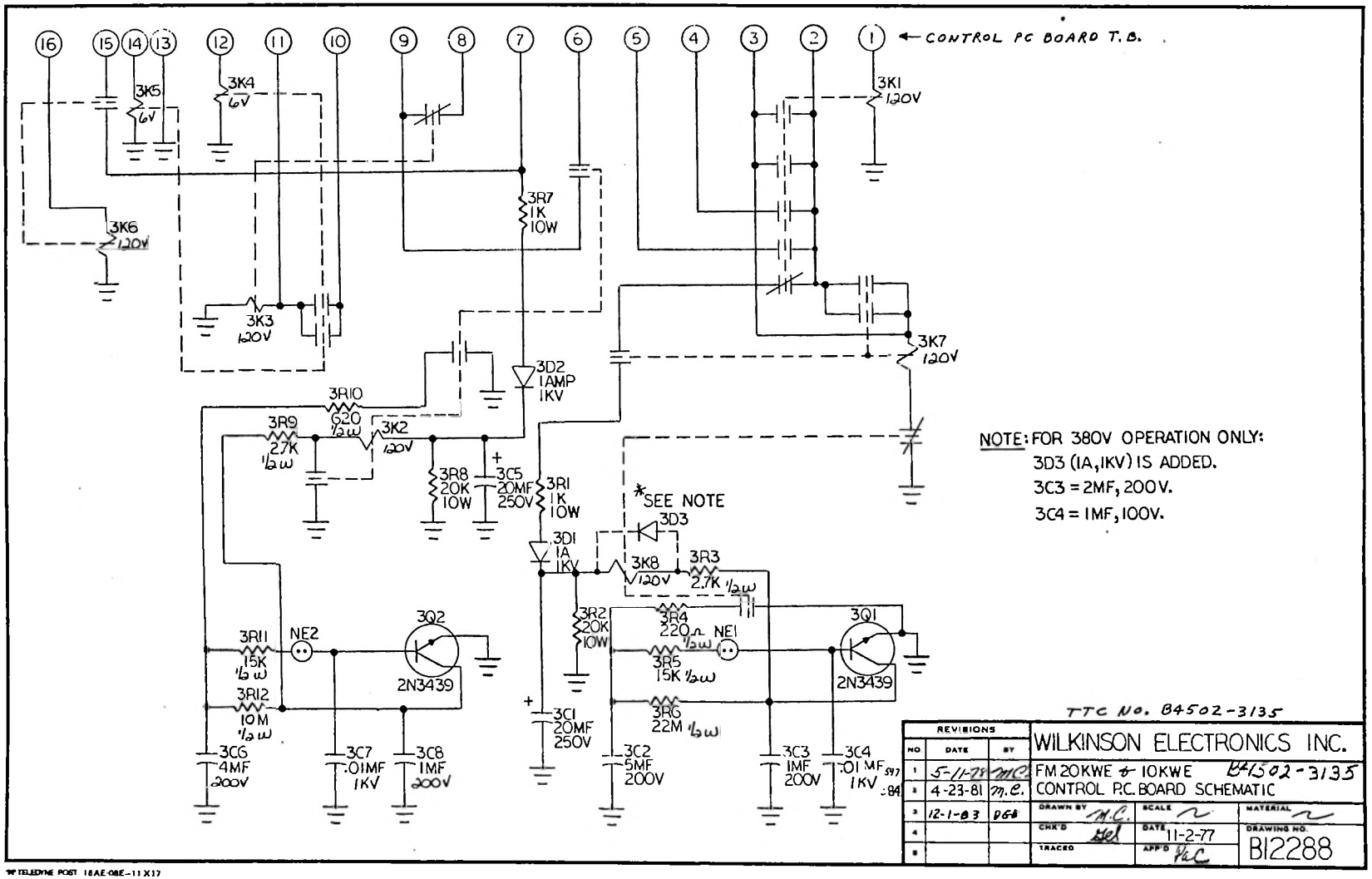
WILKINSON ELECTRONICS, INC.		
		N.J.Ernest
11/7/75		
BLOCK DIAGRAM		
FM 5/7.5/10KWE		A11905A


6R4
IPA SCREEN
REMOTE START
REMOTE STOP
REMOTE INTERLOCK
REMOTE RESET
REMOTE PLATE
REMOTE POWER ADJ
INC
REF
REMOTE CATHODE
REMOTE PLATE
REMOTE TERMINAL BOARD
5TBA
RT CHANNEL AUDIO TO 316-1E
LT CHANNEL AUDIO TO 316-1E
MONO AUDIO TO FME-10
6TB
240 3Φ
240 3Φ
240 3Φ
HIGH VOLTAGE COMMON
PA PLATE CONTACTOR COIL
H.V.
TO HIGH VOLTAGE METERING RESISTOR (PA HARNESS)
6S1
NORMAL
TEST
ON
OFF
6S2
SCREEN
PA BOX TB
2TB
BIAS
SUPPLY
6T1
CONTROL TRANSFORMER
PRI
SEC
STAND BY
GROUND
FINAL
COMMON
FME-10
316-1E
5F1
METERING FUSE
TO OUTPUT OF HALF SUPPLY 4R2
LOW VOLTAGE COMMON
6C3
NEGATIVE
REAR DOOR
RIGHT FRONT DOOR
LEFT FRONT DOOR
INTERLOCK
CONTROL DOOR TB
3TB
PA FIL METER
6M1
PA FIL ADJ
6R3
PA FIL
5K2
5K1
IPA PLATE
6T2
LOW VOLTAGE TRANSFORMER
SEC
BLOWER
4K2
BLOWER 2B1
NOTE: □ = HARNESS NO.
D4502-0004
WILKINSON ELECTRONICS INC.
FM 5 7.5/10KWE
INTERCONNECTING DIAGRAM
A. MOZER
1-6-73
8-18-77 MC
6-7-78
2-12-81


NOTES:
1. FOR 380V OPERATION, PRIMARY OF 1T3 IS CONNECTED IN A WYE.
2. FOR 380V OPERATION, 3M1 IS 500V FULL SCALE.
3. FOR 380V OPERATION, 2T1, 1T1, AND 1T2 ARE BETWEEN PHASE AND GROUND (240V).
GROUND
2TB23
5TB6
3TB19
TB2
WILKINSON ELECTRONICS
SCALE NONE
APPROVED BY JTB
DRAWN BY DGB
DATE 1-13-84
REVISED 5-8-84
OVERALL SCHEMATIC
FM 5/7.5/10 KW
D4502-0035D



TOLERANCES (EXCEPT AS NOTED)	WILKINSON ELECTRONICS INC.		
DECIMAL ±		SCALE NONE	DRAWN BY DGB
			APPROVED BY
FRACTIONAL ±	TITLE Control Deck Schematic		
ANGULAR ±	DATE 6-9-83	DRAWING NUMBER	C13,234



NOTE: FOR 380V OPERATION ONLY:
3D3 (1A, 1KV) IS ADDED.
3C3 = 2MF, 200V.
3C4 = 1MF, 100V.

TTC No. B4502-3135

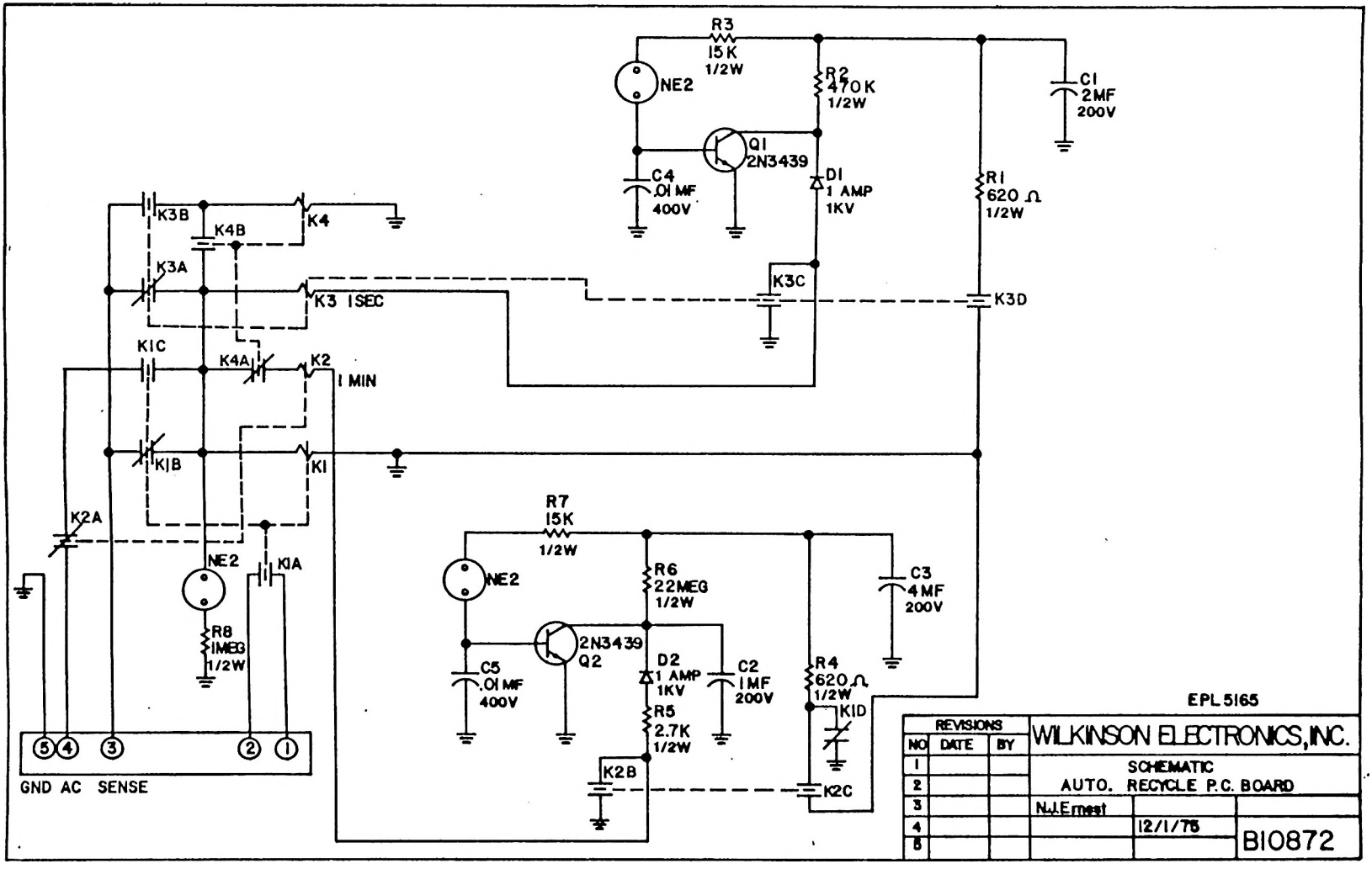
REVISIONS			
NO	DATE	BY	
1	5-11-79	M.C.	
2	4-23-81	M.C.	
3	12-1-83	DGB	
4			
5			

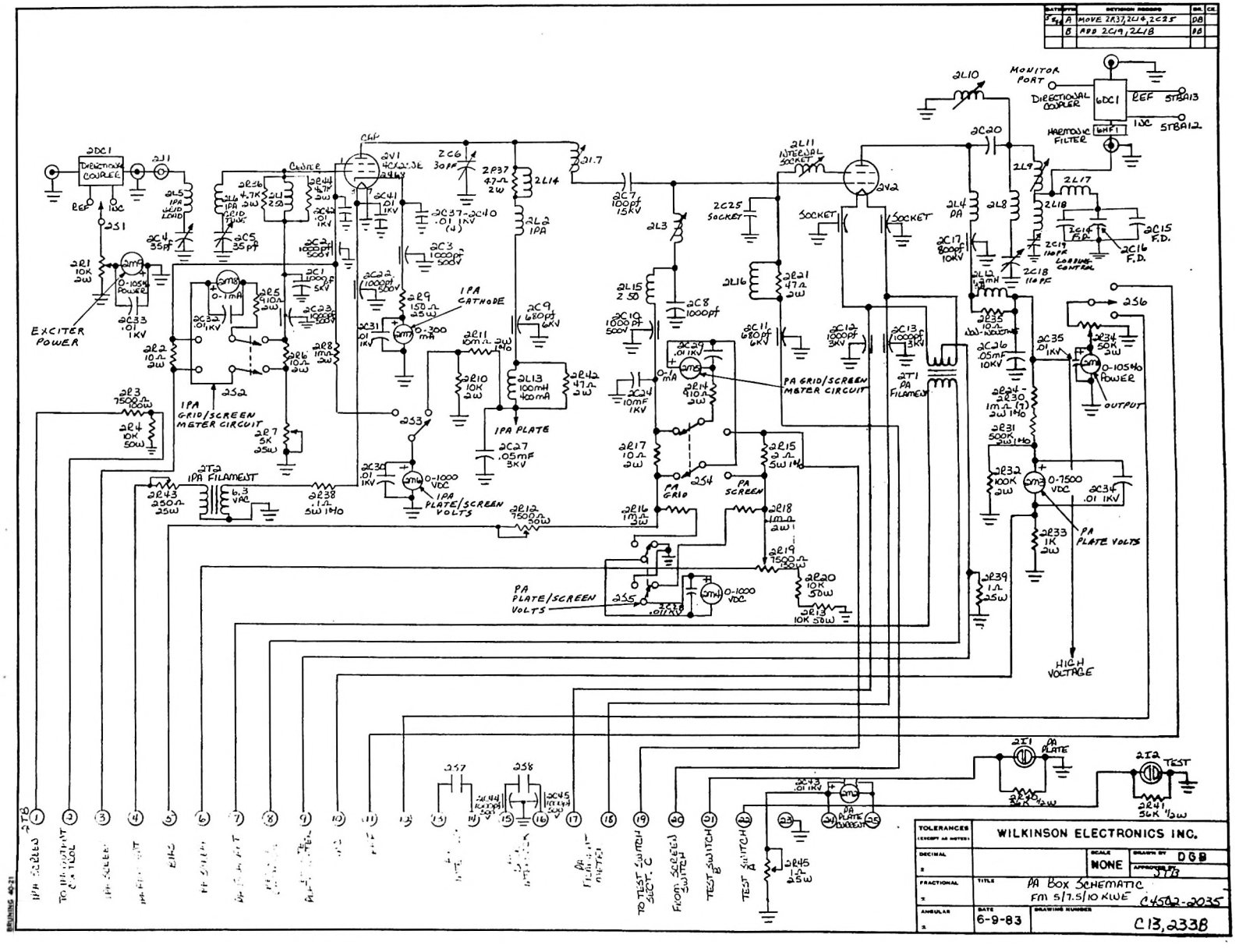
WILKINSON ELECTRONICS INC.

FM 20KWE & 10KWE B4502-3135
CONTROL P.C. BOARD SCHEMATIC

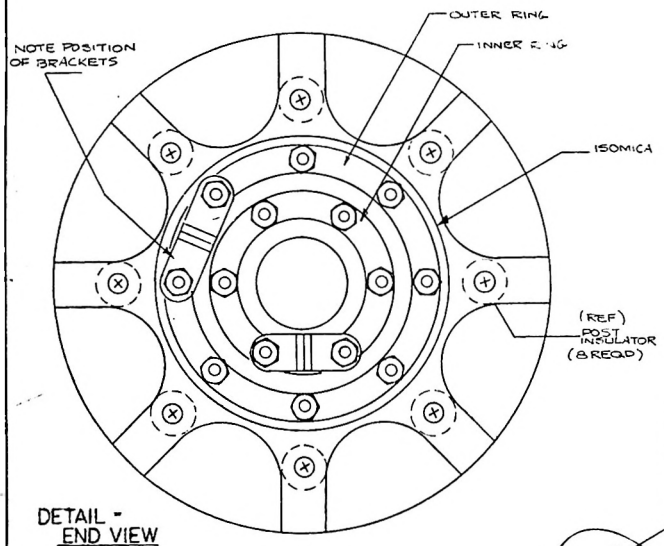
DRAWN BY M.C. | SCALE ~ | MATERIAL ~
CHK'D Hel | DATE 11-2-77 | DRAWING NO. B12288
TRACED | APP'D M.C.

TELEDYNE POST 18AE-08E-11X17


R3
15K
1/2W
NE2
R2
470K
1/2W
C1
2MF
200V
Q1
2N3439
C4
.01 MF
400V
D1
1 AMP
1KV
R1
620 Ω
1/2W
K3B
K4B
K4
K3A
K3 1SEC
K3C
K3D
K1C
K4A
K2
1 MIN
K1B
K1
K2A
NE2
K1A
R8
1MEG
1/2W
R7
15K
1/2W
NE2
R6
22MEG
1/2W
C3
4MF
200V
2N3439
Q2
C5
.01MF
400V
D2
1 AMP
1KV
C2
1MF
200V
R4
620Ω
1/2W
K1D
R5
2.7K
1/2W
K2B
K2C
5 4 3 2 1
GND AC SENSE
EPL 5165
REVISIONS
NO DATE BY
1
2
3
4
5
WILKINSON ELECTRONICS, INC.
SCHEMATIC
AUTO. RECYCLE P.C. BOARD
N.J.Ernest
12/1/75
B10872


EXCITER POWER
IPA GRID/SCREEN METER CIRCUIT
IPA CATHODE
IPA PLATE
IPA PLATE/SCREEN VOLTS
IPA FILAMENT
PA GRID/SCREEN METER CIRCUIT
PA PLATE/SCREEN VOLTS
PA GRID
PA SCREEN
PA FILAMENT
MONITOR PORT
DIRECTIONAL COUPLER
HARMONIC FILTER
OUTPUT
PA PLATE VOLTS
HIGH VOLTAGE
TO TEST SWITCH SECT. C
FROM SCREEN SWITCH
TEST SWITCH B
TEST SWITCH A
WILKINSON ELECTRONICS INC.
PA BOX SCHEMATIC
FM 5/7.5/10 KW
C4502-2035
C13,2338
6-9-83
DGB
NONE

DATE	BY	REVISION RECORD	DR.	CK.



DETAIL - END VIEW

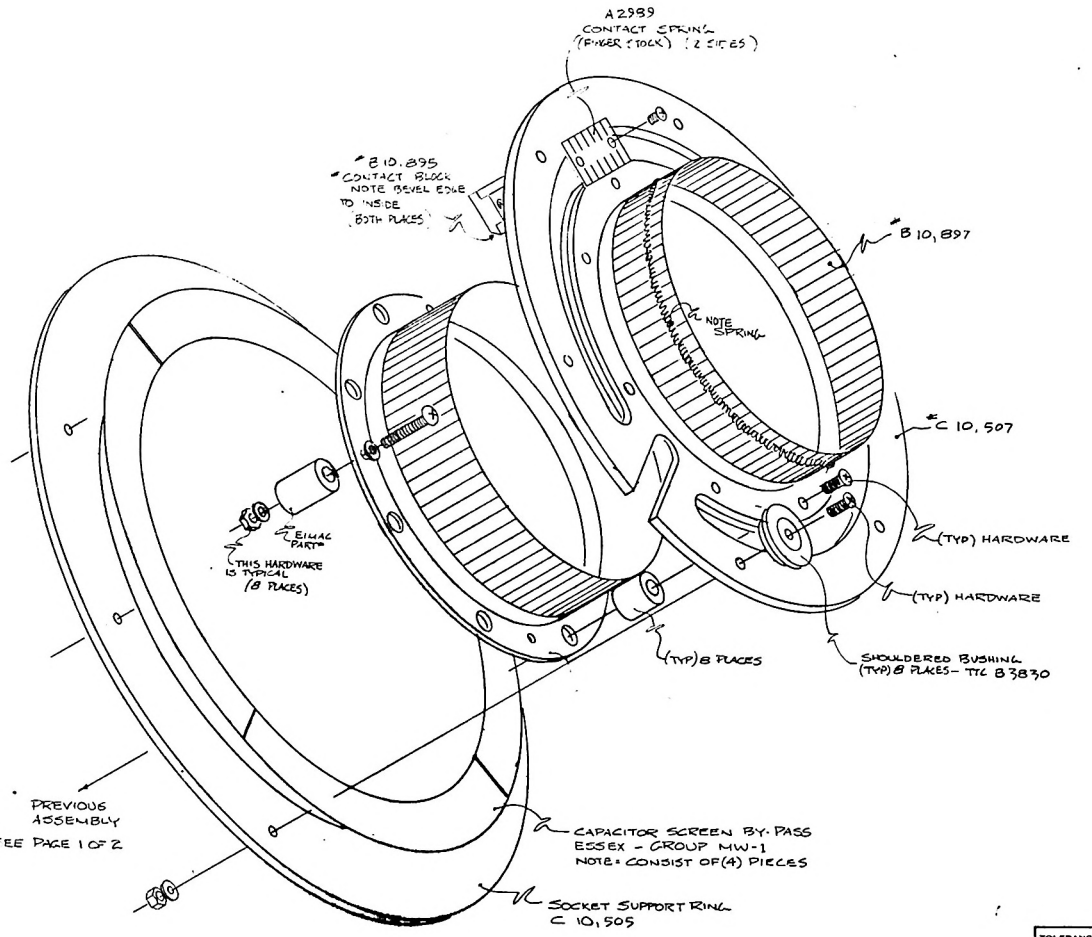
1ST ASSEMBLY

SPECIAL INSTRUCTIONS & NOTES -

1.

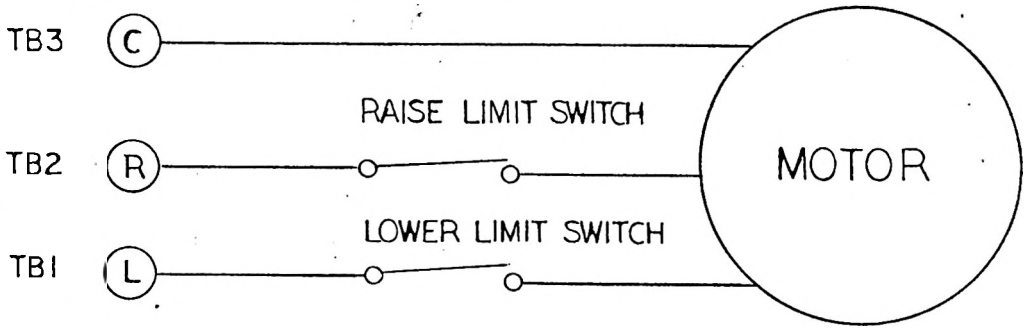
TOLERANCES (EXCEPT AS NOTED)	TTC / WILKINSON BROOMFIELD, COLO. 80020		
DECIMAL ± .X		SCALE APRUX FULL	DRAWN BY MAJOR
			APPROVED BY JTB
FRACTIONAL ±	TITLE ASSY DRAWING - TUBE SOCKET		
ANGULAR ±	DATE 11-23-83	DRAWING NUMBER C 4502-2100	

DATE	BY	REVISION RECORD	DR.	CK.



NOTE =
NOT ALL DETAILS ARE SHOWN.

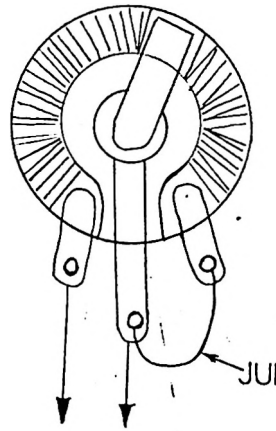
TOLERANCES (EXCEPT AS NOTED)	TTC/ WILKINSON BROOMFIELD COLO 80030		
DECIMAL ±		SCALE —	DRAWN BY MAJOR
			APPROVED BY JT3
FRACTIONAL ±	TITLE ASSY DWG - TUBE SOCKET		
ANGULAR ±	DATE 11-28-83	DRAWING NUMBER C4502-2100	



CONNECT 120V AC BETWEEN:

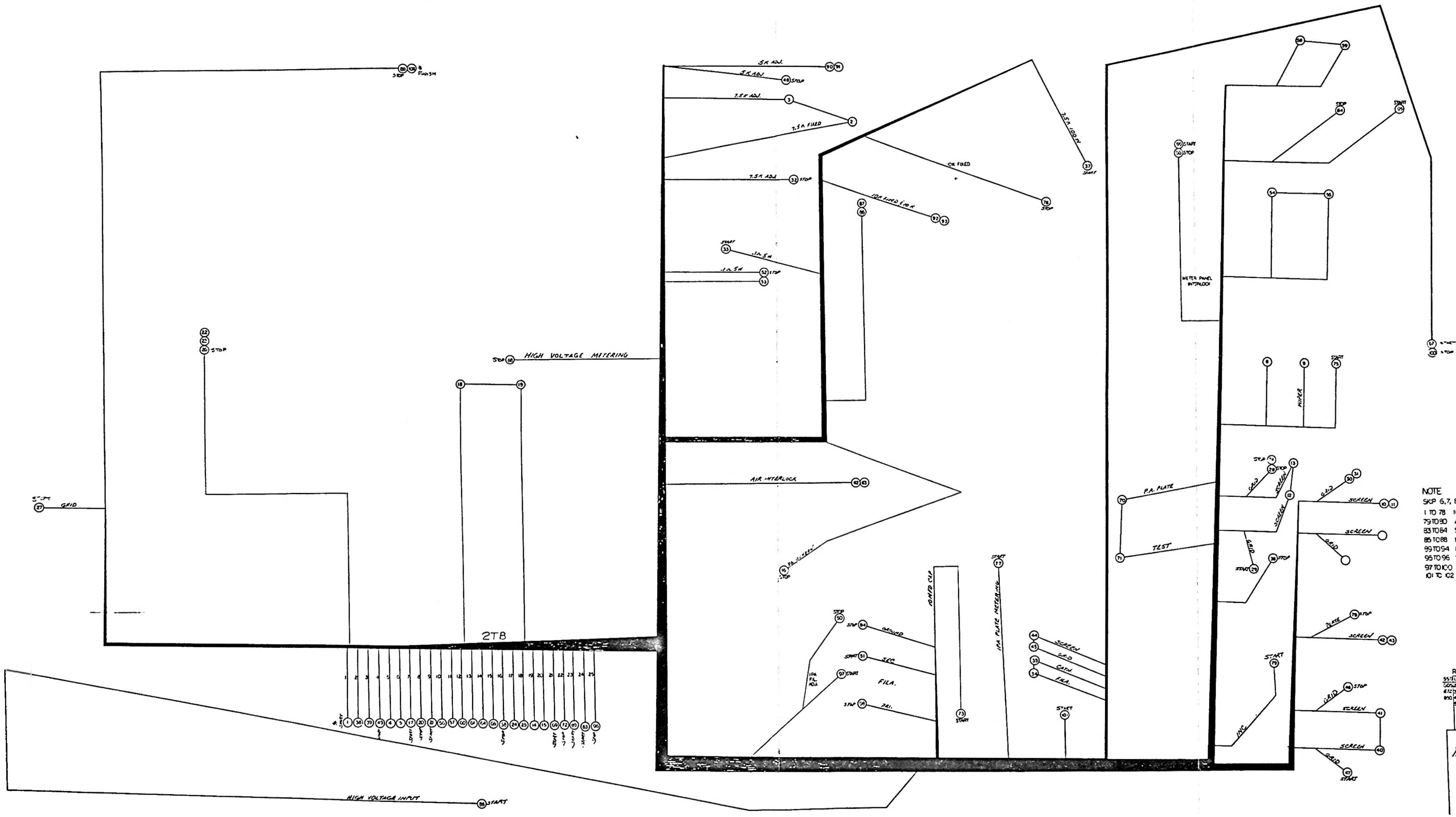
"C" AND "R" TO RAISE POWER

"C" AND "L" TO LOWER POWER



CONNECT TO
REMOTE POWER ADJ.
TERMINALS

REVISIONS			WILKINSON ELECTRONICS INC.		
NO.	DATE	BY			
1			REMOTE RHEOSTAT WIRING		
2					
3			DRAWN BY M.C.	SCALE ~	MATERIAL ~
4			CHK'D	DATE 6-26-78	DRAWING NO. A4035-1004
5			TRACED	APP'D	



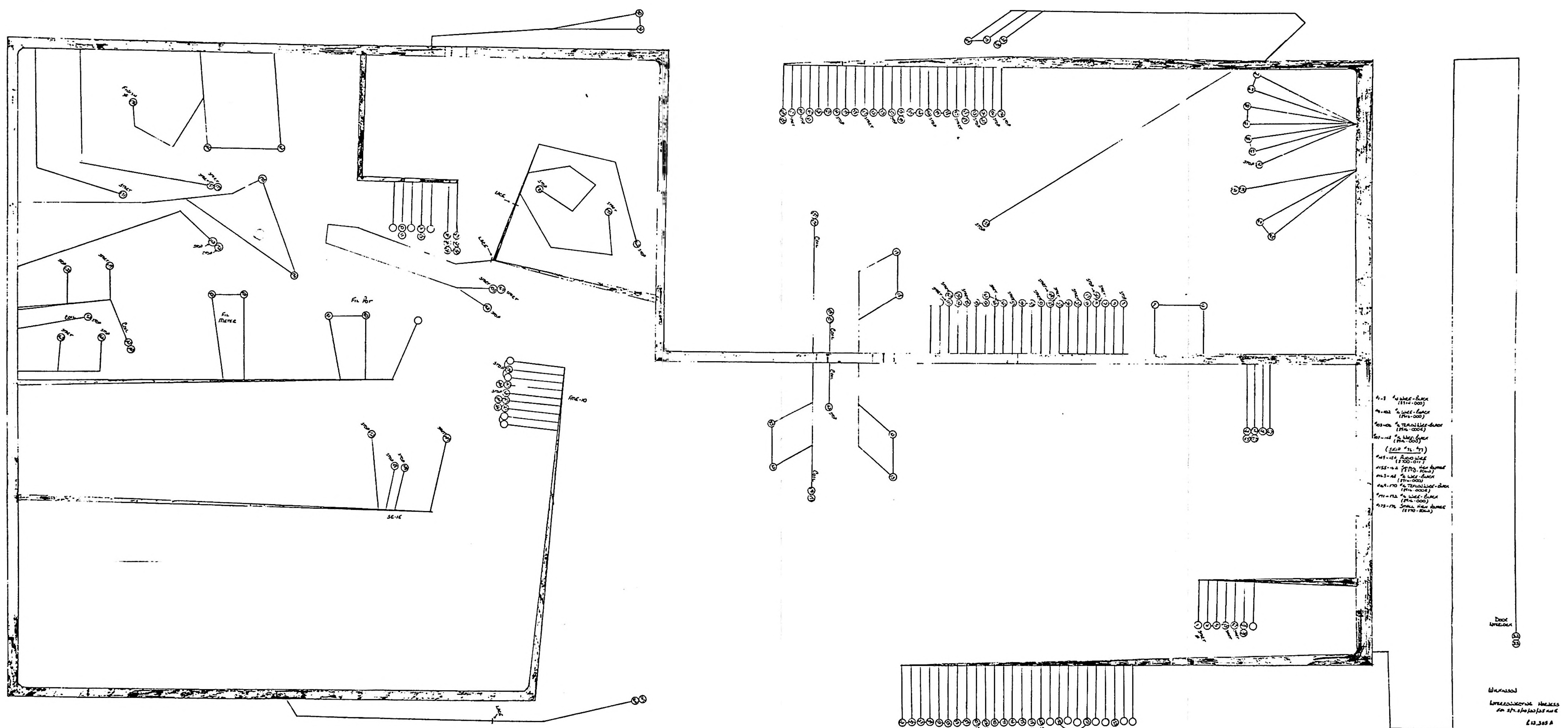
NOTE
SKIP 6,7, 81,82
1 TO 78 16GAUGE
79 TO 80 AUDIO WIRE
83 TO 84 SMALL HV WIRE
85 TO 88 LARGE HV WIRE
99 TO 94 16 GAUGE
95 TO 96 SMALL HV WIRE
97 TO 100 16 GAUGE
101 TO 102 RG 59 A/U

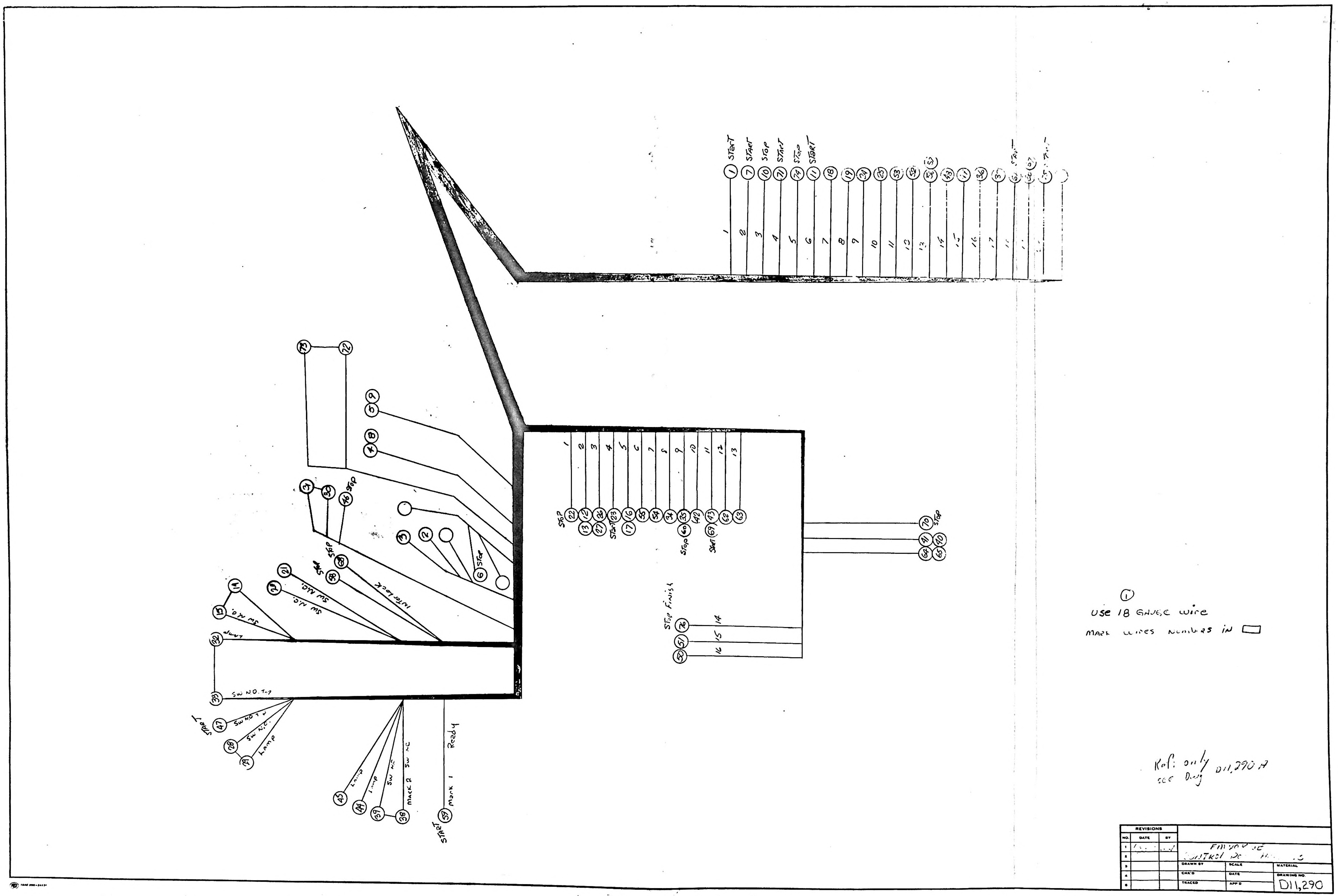
REV

559	1	1-9-78	MC
605	2	10-2-79	MC
672	3	11-3-79	MC
850	4	7-9-80	MC
	5		

S/N 805 AND ABOVE

FM 20KWE
P.A. BOX HARNESS
11/11/75
C 4602-2038
R12343


FIL POT
FIL METER
START
STOP
COIL
DOOR INTERLOCK
WILKINSON
INTERCONNECTING HARNESS



Use 18 Gauge wire
Mark wires numbers in □
Ref. only see Dwg D11,290 A
REVISIONS
NO.
DATE
BY
DRAWN BY
SCALE
MATERIAL
CHK'D
DATE
DRAWING NO.
TRACED
APP'D
D11,290