INSTRUCTION MANUAL
2-20 Carrier Current System

1.0 INTRODUCTION

LPB's 2-20 Carrier Current System is totally new in design and concept. The TX2-20 Transmitter is completely solid state and adjustable from 2 to 20 watts output power. This variable power output feature affords a new dimension of flexibility in carrier current systems. One unit now serves all building size requirements, contains built-in flexibility for system growth and future changes, and allows exact change in output power for your specific requirement.

The T-8 Power Line Interface is an advance in carrier current coupling; a simple SWR bridge system actually measures the power system impedance and indicates when 50 ohm match is obtained by showing a null on the meter. The combination of TX2-20 Transmitter and T-8 Power Line Interface unit enables the user to quickly and efficiently set up a carrier current system without the use of external test equipment.

Both the TX2-20 Transmitter and T-8 Power Line Interface unit are carefully engineered and constructed of high quality components designed to give years of trouble free service when properly installed. This manual, supplemented by instructions printed on the inside covers of both units, makes correct power line coupling and good system performance available to all users.

2.0 GUARANTEE

The complex circuitry of this equipment is, in general, NOT USER SERVICABLE. If any malfunction arises or is suspected, we urge your return of the equipment to the factory for proper and thorough repairs.

Upon receipt of this equipment, we guarantee that you will find the appearance, workmanship and standards of material and construction in keeping with the application and with good standards of commercial practice.

For a period of one year from date of delivery, we guarantee this equipment against any form of failure, provided that, in the opinion of the manufacturer, no improper use of, or modification to, this equipment is at fault. The validity of this guarantee also requires that this transmitter be matched into the AC power distribution system using only the LPB T-8 Power Line Interface and the LPB T-1 series Power Splitters (where required). During this period we shall furnish materials and labor in our shops to correct any failure.

If need for service arises, CONTACT THE MANUFACTURER for permission to return and for shipping instructions BEFORE shipping.

After the expiration of this warranty, service will continue to be available from LPB at a nominal cost.

WORDS OF WISDOM

It cannot be stressed too highly that any modification or adjustments other than those specified in the instructions will only result in degradation of the signal or destruction of the transmitter.

The unit was designed for optimum results and minimum failures. If any problem or question should arise, call or write, but do not touch.

If you feel you must touch, then the consequences are yours to bear.

WARNING!

Radiation from this equipment is regulated by Part 15 of the Rules and Regulations of the Federal Communications Commission, and they are enforced! Applicable excerpts from Part 15 are found later in this manual. Many stations have been closed down for excessive radiation, yet there is no need for this in a properly designed system.

The services and experience of LPB engineers are always available to customers for assistance in the proper application of this and related equipment.

3.0 CIRCUIT DESCRIPTION

Unless the user is very familiar with solid state circuitry of the type used in the TX2-20 Transmitter, we do not suggest any repairs be attempted. For those who are, the following circuit description is provided. Refer to the circuit diagram in this manual while reading this section.

Voltages indicated are typical DC values as measured with a high-input-impedance voltmeter with the transmitter connected to a matched load and properly tuned. Element numbers and color codes are also shown.

Summary: The TX2-20 Transmitter uses modern integrated circuit techniques to generate a high-stability signal at six times the desired carrier frequency. Digital count-down circuits produce a carrier frequency which is AM modulated at low power level. A linear RF power amplifier then increases the output to 20 watts maximum carrier power output. Taking advantage of the characteristics of the linear RF power amplifier, this output power is variable downwards from maximum.

An internal meter directly indicates Percent Modulation (see details in 3.2 following) or Relative RF Power Output to facilitate tuning and maintenance.

The companion T-8 Power Line Interface provides protective fusing, coupling into the power system, isolation from 60 Hz feedback from the power line and accurate metering for proper cancellation of power line inductances found at AM broadcast frequencies.

3.1 POWER SUPPLY

The power supply is a standard full-wave bridge circuit using a series pass transistor for regulation. It employs both primary and B+ fusing for better protection. The transformer is center tapped and supplies the low power low voltage states from this center tap source. The pilot light is a long-life LED.

3.2 AUDIO

The audio section of the TX2-20 utilizes an input transformer to give an isolated and balanced 600 ohm input. The transformer drives an op-amp which is in the inverting mode. The output then feeds an integrated circuit modulator and meter. The meter is calibrated to indicate 0 VU at 100% modulation only when a steady tone (1 kHz typical) is connected to the TX2-20 Transmitter audio input. Note that typical program material with various frequency and amplitude components results in a quite different response of this modulation meter. When using program, the meter should reach not more than approximately 50% on peaks to prevent over-modulation.

The modulator IC then performs the amplitude modulation and, since there are no transformers involved, the distortion is very low and the response is flat. At the output of the modulator is a miniature AM transmitter. Although the output is square wave, rich in harmonics, this could be listened to on a radio. Both the modulator and the audio input stage are fed from a regulated power supply for stability.

3.3 OSCILLATOR

The oscillator in the TX2-20 employs the latest state-of-the-art design. The crystal is a high-stability high-frequency crystal, and the oscillator itself is a single integrated circuit. The oscillator runs at six times the carrier frequency. This square wave signal from the oscillator is fed directly to the input of a divide-by-six counter. The output of the counter is a square wave at the carrier frequency.

3.4 DRIVER AMPLIFIER

The driver amplifier consists of an emitter follower transistor which feeds a power transistor operating Class A. The first tuned circuit is in the collector

of this power transistor. The tuned circuit filters harmonics from the square waves and results in a carrier output which is a sine wave with little harmonic content. A Drive level control is employed in the driver amplifier to adjust the power output of the transmitter. The output of the driver amplifier itself is capable of one-half-watt carrier.

3.5 POWER AMPLIFIER

The power amplifier utilizes a matched pair of special balanced-emitter transistors. Operating bias for the transistors is supplied by a regulated supply (and a temperature control diode). The output stage is broad-band and, to filter any harmonics, an elliptic-function filter is used. Since this stage is push-pull and the transistors are matched, a high degree of second harmonic rejection is achieved. The RF output is also sampled at this point and can be metered by switching the meter circuit on the main PC board to Relative RF Power Output.

4.0 OPERATION OF THE 2-20 CARRIER CURRENT SYSTEM

It is important to note that the TX2-20 Transmitter must be used with the T-8 Power Line Interface. There are no matching and tuning controls on the transmitter, therefore, the only way to match the power line to the transmitter is with the T-8. Any attempt to modify either of the units to perform in another manner can easily result in damage to the transmitter and would void the warranty on this equipment.

4.1 OPERATION WITH POWER SPLITTERS

Your requirements may make it practical to operate several adjacent buildings from a single centrally located TX2-20 Transmitter. In such cases, the transmitter output power is divided, using a T-1A Power Splitter, for routing to the buildings via 50-ohm coaxial cable, preferably type RG-8/U. A T-8 Power Line Interface will then be required in each building. See LPB Tech Note #1 (in the Appendix of this manual) for a discussion of this type of operation.

Note that systems such as described above are initially made operational only by taking the TX2-20 Transmitter initially to each T-8 for the same sequence of initial adjustments as would be the case when only a single T-8 were used. The power line coupling adjustments are made at each T-8 location, then the several buildings are interconnected via the coaxial cable and the TX2-20 Transmitter is placed at the central location. This will probably be the same location as the T-1A Power Splitter and one of the T-8 Power Line Interface units.

4.2 INITIAL CONNECTION TO THE POWER SYSTEM

Properly connect the T-8 Power Line Interface to the power distribution system. See, especially, LPB Tech Note #1, Section VIII, and LPB Tech Note #4 (in the Appendix of this manual) for a detailed discussion of the choice of

connection point and manner of achieving this connection. NOTE that these Tech Notes speak in terms of the prior tube-type models 6B and 25C Transmitters and the former model T2C Matching and Coupling Unit. The reader can readily interpret these into the improved TX2-20 Transmitter and T-8 Power Line Interface. All of the discussion and manner of connections remains unchanged.

For your convenient reference, the following pages show:

TX2-20 interior - TX2-20 inside cover Operating Instructions

T-8 interior - T-8 inside cover Operating Instructions

Simply follow these Operating Instructions for best results. They have also been attached to the inside front cover of each unit of equipment for your convenience of adjustment and maintenance without need to have this manual with you at all times.

NOTE that extended mismatch of the TX2-20 Transmitter output (beyond about 2 minutes) may cause the fuse F2 to blow. This fuse is wired in series with the power amplifier as another measure of protection. See TX2-20 interior drawing for fuse location.

4.3 TRANSMITTER LOCATION AND MOUNTING

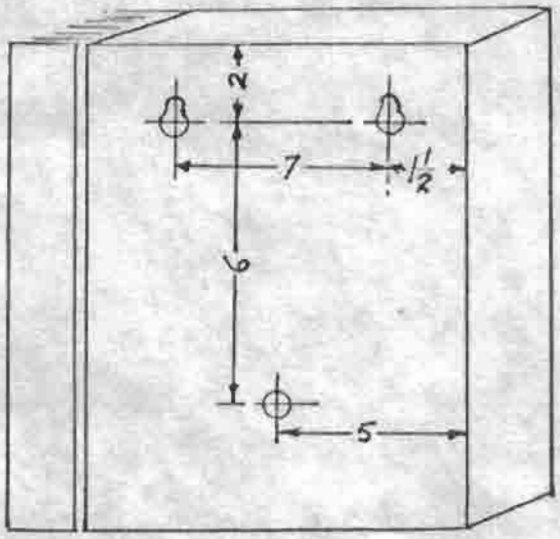
Select a location which will provide several inches of clearance on all sides of the TX2-20 Transmitter cabinet. This is especially important for the top, bottom and right side (heat sink).

Do not block vent holes on top and bottom of Transmitter cabinet. Do not shelf mount the Transmitter as this blocks the bottom vent holes.

If the ambient temperature of the room in which the Transmitter is to be located exceeds 100 degrees Fahrenheit, we recommend that the front door of the Transmitter cabinet be secured in an OPEN position. Alternately, contact the factory for specific instructions for high temperature environment operation.

Holes are provided in the rear of the Transmitter cabinet for three screws to mount the Transmitter to a wall surface. We suggest 1" #12 sheet metal screws or similar. First mount the TWO TOP SCREWS in the wall in accord with the dimensions shown in the following sketch. Drive the screws into the wall, stopping with the heads about 1/8" from flush with the wall surface, so that the Transmitter cabinet can be hung on these two screws. Then install the bottom screw thru the cabinet to lock the Transmitter into position.

Note that a hasp is provided on the cover for a padlock if security is a problem in your TX2-20 Transmitter location area.



Rear View of TX2-20 Transmitter,

Showing Mounting Screw Locations

(see 4.3)

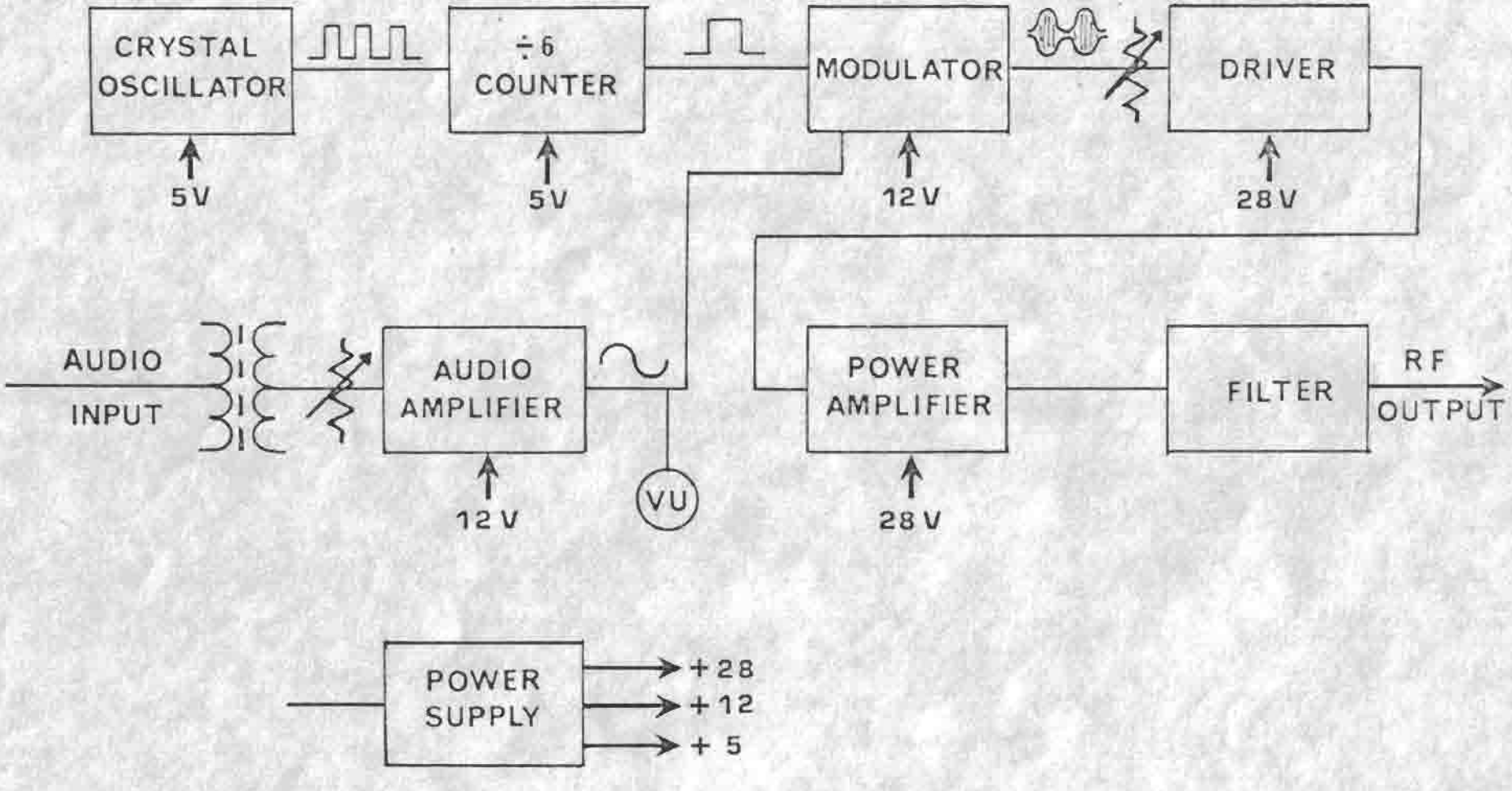
4.4 TROUBLESHOOTING CHART

	PROBLEM:	POSSIBLE CAUSE:
1.	Pilot light does not light.	Fuse F1 and/or F2 blown.
2.	No RF output indication.	Blown fuse F1 and/or F2. Shorted output cable. Drive level all the way down. Crystal not in socket.
3.	RF output reads off-scale when T-8 Function switch in Match Position.	Open RF output cable.
4.	Fuse F2 blows after short period of operation.	Output mismatched badly.
5.	No modulation indication with RF output OK.	No audio input. Audio gain turned down to min.
6.	Audio distortion heard on radio receiver.	Audio gain set too high.

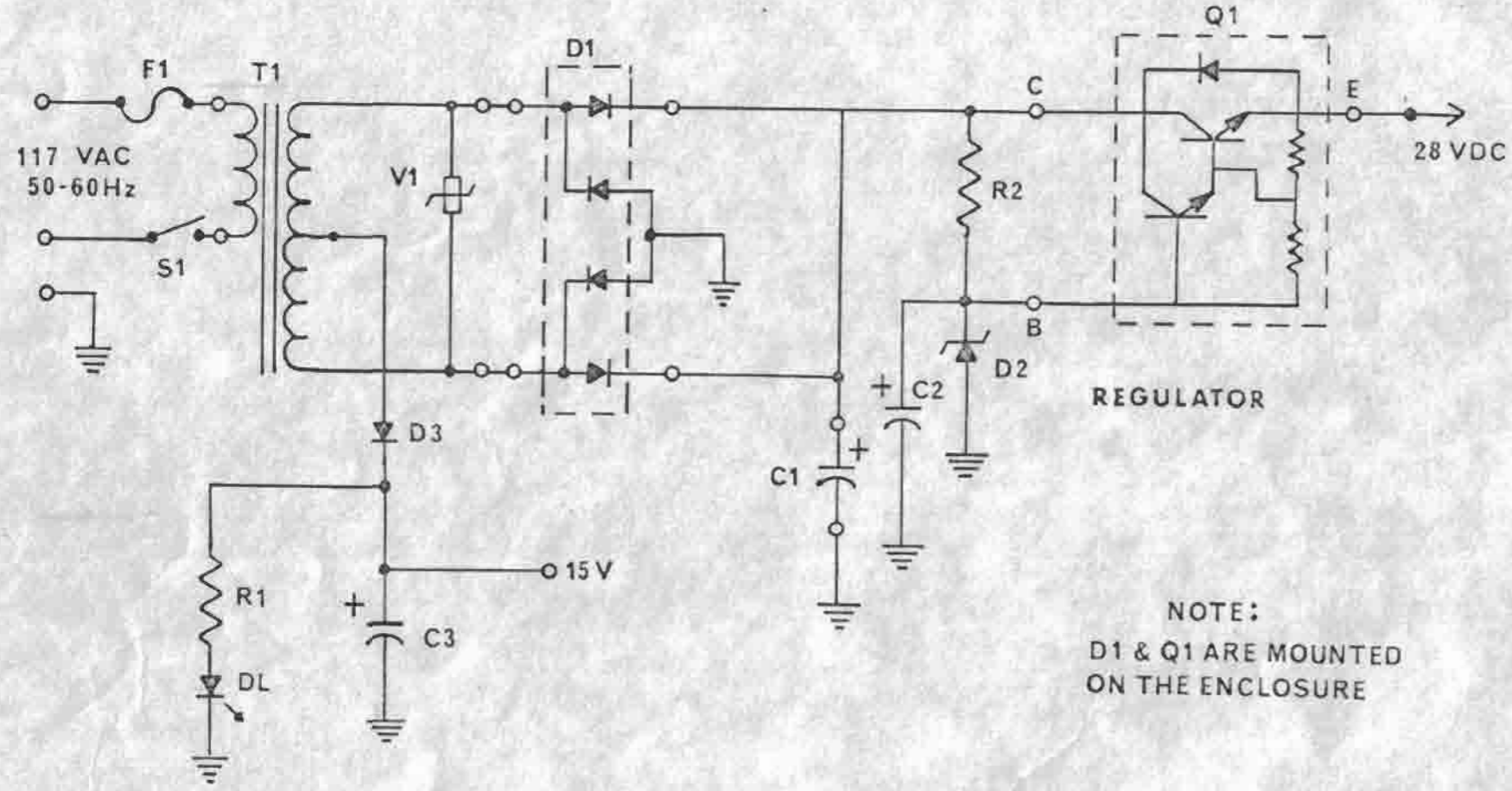
4.5 USE OF T-8 WITH TUBE-TYPE TRANSMITTERS

Since discontinuance of prior models of tube-type carrier current transmitters and related accessories, users who continue to operate tube-type transmitters may wish to utilize the T-8 Power Line Interface where the prior T2C and T4 might have been used. The T-8 is clearly advantageous over these prior items for use with tube-type transmitters. Special T-8 Operating Instructions are provided for use with these older transmitters, both with the T-8 as an alternative inside front cover self-adhesive and on page 19 of this manual for your ready reference.

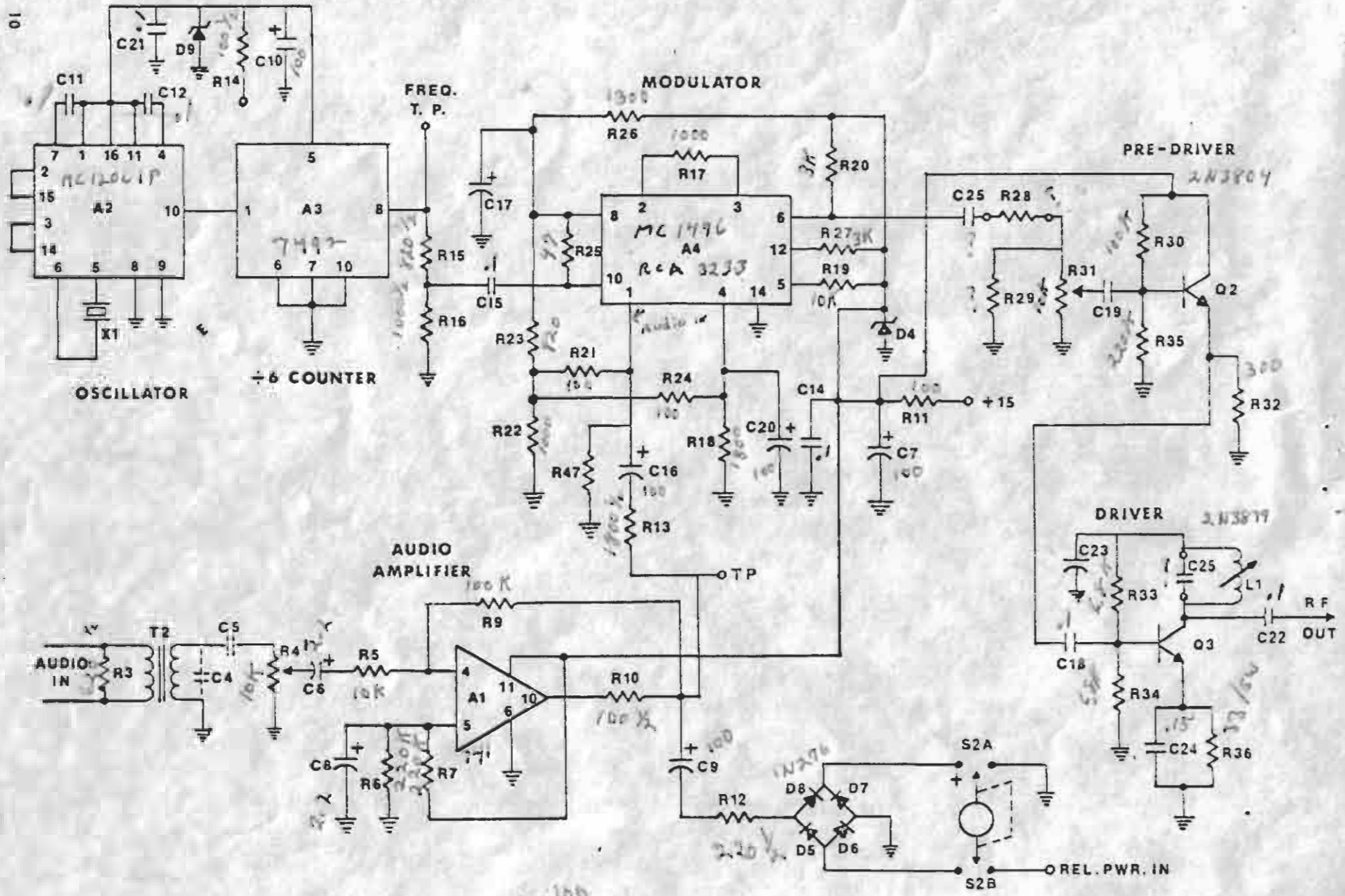
Some tube-type transmitters manufactured prior to 1973 (LPB models 6A, 5A and Mark III) and tube-type linear RF amplifiers (LPB models 4A, 4B and 4C) do not have plate current meters to assist tuning. They all do, however, have internal NE-2 neon indicators functioning as tuning indicators. As described in the respective manuals, these neon indicators are wired as RF voltmeters across the output of the unit, hence maximum brilliance is the equivalent of the resonance dip that would be indicated on a plate current meter. This should cause no difficulty in using the T-8.



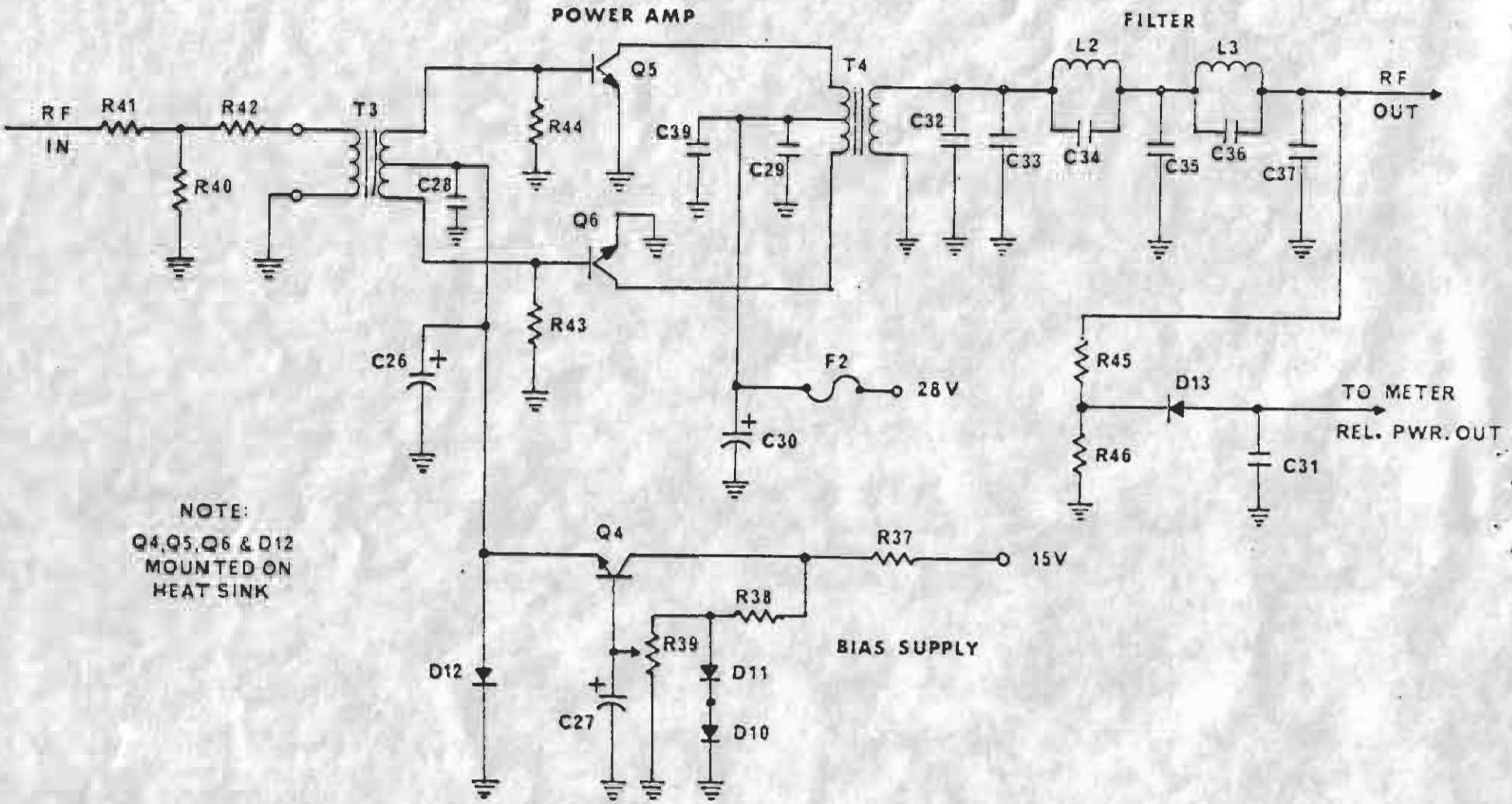
BLOCK DIAGRAM, TX2-20 TRANSMITTER



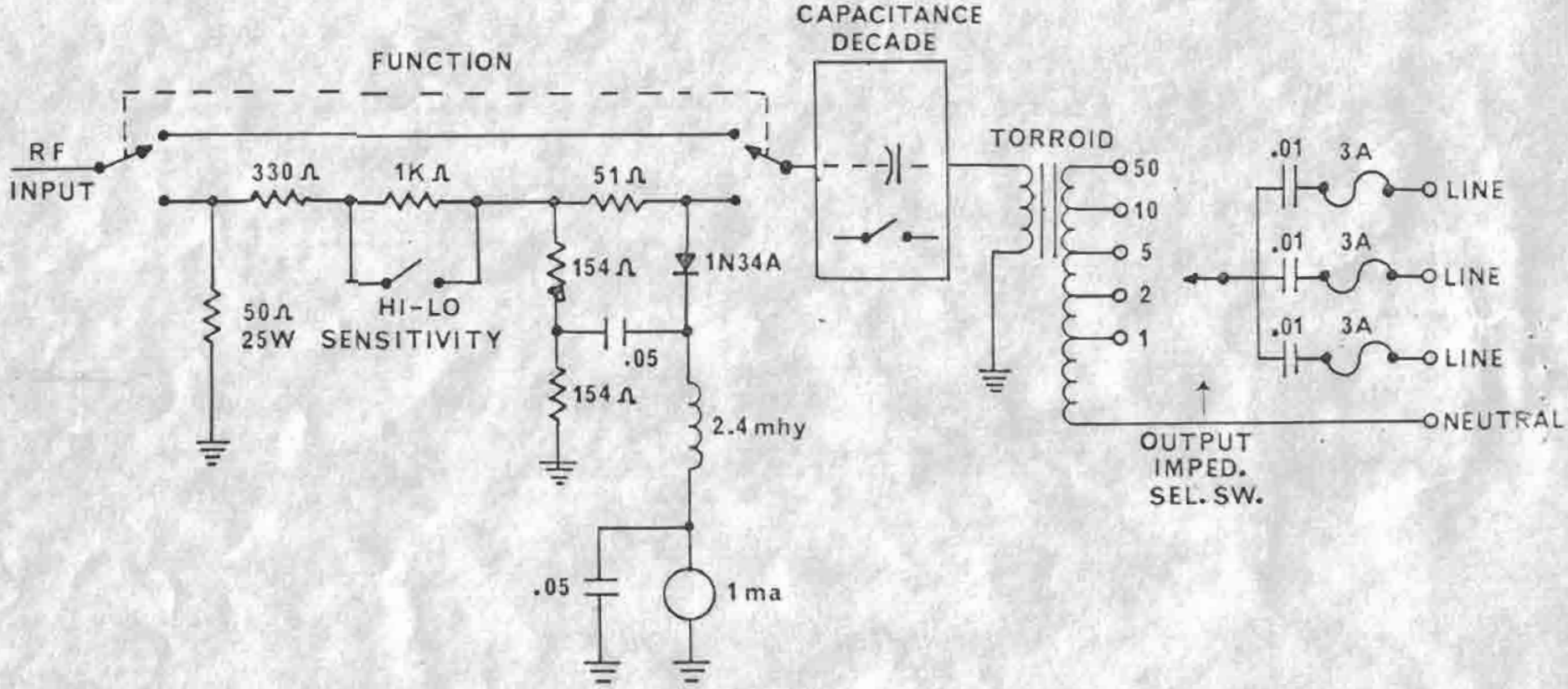
TX2-20 POWER SUPPLY SCHEMATIC



TX2-20 EXCITER SCHEMATIC



TX2-20 RF AMPLIFIER SCHEMATIC



MODEL T-8 POWER LINE INTERFACE SCHEMATIC

TX2-20 TRANSMITTER

PARTS LIST

R1	1,000 1/2 W.
R2	150 1/2 W.
R3	620 1/2 W.
R4	10,000 1/4 W. Pot
R5	10,000 1/2 W.
R6	220,000 1/2 W.
R7	220,000 1/2 W.
R9	100,000 1/2 W.
R10	100 1/2 W.
R11	100 1/2 W.
R12	220 1/2 W.
R13	1,800 1/2 W.
R14	100 2 W.
R15	820 1/2 W.
R16	1,000 1/2 W.
R17	1,000 1/2 W.
R18	1,800 1/2 W.
R19	10,000 1/2 W.
R20	3,000 1/2 W.
R21	100 1/2 W.
R22	1,000 1/2 W.
R23	820 1/2 W.
R24	100 1/2 W.
R25	47 1/2 W.
R26	1,300 1/2 W.
R27	3,000 1/2 W.
R28	Factory Select
R29	Factory Select
R30	100,000 1/2 W.
R31	10,000 1/4 W. Pot
R32	300 1/2 W.
R33	6,800 1/2 W.
R34	6,800 1/2 W.
R35	220,000 1/2 W.
R36	33 5 W.
R37	25 5 W.
R38	220 2 W.
R39	500 1/2 W.
R40	100 1/2 W.
R41	22 1/2 W.
R42	22 1/2 W.
R43	10 1/2 W.
R44	10 1/2 W.
R45	10,000 1/2 W.
R46	620 1/2 W.

C1	10,000 mfd 50V
C2	250 mfd 50V
C3	2,000 mfd 25V
C4	Factory Select
C5	Factory Select (Jumpered)
C6	2.2 mfd 20V
C7	100 mfd 20V
C8	2.2 mfd 20V
C9	100 mfd 20V
C10	100 mfd 20V
C11	0.1 mfd
C12	0.1 mfd
C13	not used
C14	0.1 mfd
C15	0.1 mfd
C16	100 mfd 20V
C17	33 mfd 20V
C18	0.1 mfd
C19	0.001 mfd
C20	100 mfd
C21	0.1 mfd
C22	0.1 mfd
C23	0.33 mfd
C24	0.15 mfd
C25	Factory Select (frequency dependent)
C26	2000 mfd 25V
C27	2000 mfd 25V
C28	0.33 mfd
C29	0.33 mfd
C30	2,000 mfd 50V
C31	0.1 mfd
C32 - C37	Silver mica 500V (frequency dependent)

L1	2.0 uh slug tuned inductor
L2	1-3/4" Dia. 16 TPI Air inductor
L3	1-3/4" Dia. 16 TPI Air inductor