

INTRODUCTION (TO 2-M)

While presenting to you the circuitry for the 2-M-FM receiver and transmitter, I wish to make it clear at the outset that this is neither my idea or design in anyway. In fact, the circuit was provided to me by Dr. Ashutosh Singh - VU2IF, New Delhi, along with PCB, IC, Xtals and a few difficult to get items through VU2ATN with whose persuasion I assembled the set. Therefore, before proceeding further, I record my profound thanks to Dr. Ashutosh Singh for providing such an excellent circuit for the common home-brewer.

PERFORMANCE

The performance of this set is compatible to any commercial set, the only limitation is that it has provision for two channels. However, with ones ingenuity and resources these can be further increased if required. In our region, 4 such sets are in operation, 2 nos. of which were obtained in a fully assembled condition (with VU2DPD Haldia & VU2BD, DumDum) and two were home-brewed (with VU2KFR & myself - both at Ballygunge) DPD has been able to establish 2-way contact with USR (Uttarpara) and MKI (Salt Lake). Both have directional antenna. I have heard DPD 5/5 with my slip-shod 1/4 wave Ground plane. But I do have a regular 2-way contact with USR with 5/7 to 5/9 RST, also with BD who also uses a G.P. antenna. And for a set with a power output of around 1 watt, it is really commendable.

ON THE BLOCK

The block diagram will help you in knowing what goes on where. The TX circuitry is fairly simple. The frequency used in Calcutta for 2-M is 145.200 MHZ. This is known as the calling frequency for establishing contact with any station giving a call. Guests visiting our city give a call on this frequency and contact is established. Since the activity on 2-M at present is quite insignificant, the use of an alternate operating frequency is hardly required.

As such, the TX uses a Xtal having a frequency of 18.150 MHz. The first stage is the Xtal Oscillator stage (Colpitt Osc.) The 2nd stage is the modulator, where the frequency is phase modulated at the Xtal frequency level followed by 3 stages of multipliers (2 x 2x 2) reaching 145.2 MHz. The signal is then amplified for power output in further 3 stages to reach the antenna. All multiplier and amplifier stages work on Class C operation. Adequate use of Band Pass Filters (BPF) has been made in all the multiplier stages, to suppress unwanted frequencies. Further, because of Class C operation all the multiplier and amplifier stages are left on the 12V supply bus. Switching to transmit mode is done by supplying 12V TX line to the Osc. Audio and phase modulator stages only.

The receiver is a double conversion receiver. The 1st I.F. is 10.7 MHz and the 2nd I.F. is 455 KHz.

Therefore :-

Incoming Signal		145.200	
Local Osc. Freq.	-	<u>134.500</u>	(Xtal: 44.833 X 3)
		10.700	
2nd L.O. Freq.	-	<u>10.245</u>	(Xtal: 10.245)
2nd I.F.		0.455	Which is slope detected for Audio recovery.

Incoming signals from the ant. are amplified by a single stage tuned R.F. amplifier (3N200) and to the mixer. The mixer also receives a signal from the L.O. built around Xtal 44.833 Mhz, the o/P of which is taken through a B.P.F. and multiplied 3 times in a single stage, filtered through a BPF and applied to the other gate of the mixer. The mixer delivers an output at 10.7 MHz which is again passed through BPF into the I.C. MC3359. Here the I.C. takes over while you relax. It does the following functions : 1) Limiter (2) Local Osc. for 10.245 MHz (3) Mixer (4) 2nd I.F. amplification (5) F.M. Detection (6) Audio Amplification (7) Generation of squelch and noise muting voltages (8) and many other activities with which we are not bothered.

The audio O/P derived is further amplified by IC LM 380 which works into a 8 ohm speaker, giving you real Hi-Fi audio.

GETTING STARTED

It will be of advantage if you have your antenna erected first because you will be using the other Man's signals as a reference source in getting your set tuned and aligned. A simple ground plane with cable TV coax^x would be adequate. (I am using the thin variety - it costs less). Next build the Power Supply for regulated 12VDC output. A 500 ma. transformer would be adequate. You can use 7812 as the regulator chip.

Get yourself well acquainted with the PCB's and the circuitry before heating your iron. Have all the coils made. Tin the leads of all air core coils beforehand. Proceed stage by stage. Check each stage by applying power.

Start with the RX Card first. Solder the LM-380 directly on the PCB - the board provides the heat sink. Solder in all the external components to this IC, check minutely for bridging and apply 12V D.C. On touching Pin 6 of the IC you would get the familiar hum of low intensity. It is O.K. Disconnect Power and speaker as you will not like to have it dangling about. Move on to the MC 3359 region. Solder in the 18 Pin IC Base only (not the IC). See that the notch of the IC-Base is in the proper direction. Place all the components of the IC. Go in a systematic way - from Pin 1 to Pin 18. External hook-up wire will have to be used on the copper side of the board to connect pin 16 to junction of .04 and 100K audio gain control. Similarly, between 8.2 V Bus of the IC to the open end of the 2 M resistor coming from the squelch control potentiometer. Clean flux, see your soldering through a lens, check and re-check thoroughly. Remember, the IC is a difficult replacement. Without inserting the IC apply power. Pin 4 should read 8.2 V. Disconnect. Do not forget to cut one of the secondary legs of L-9 before mounting.

Now, move on to the L.O. stage. Wire up the LO stage. Take a 1N34 diode, attach it to your meter probe and peak the output voltage at the collector - L5 junction by adjusting L5 slug.

Similarly peak voltage at base-33pf-68pf junction of next transistor. Repeat process for L7 and L8, in this case by adjusting their respective 22 pf trimmers.

Next wire up the R.F. Amp. and Mixer stages. Disconnect soldering iron from mains while soldering the 3N200's.

Now insert the IC 3359 in this socket in proper configuration. Connect the speaker. Connect a piece of flexible wire at point A to serve as antenna. Set squelch potentiometer to min. position. Audio gain control to be slightly advanced. Apply power at both 12V and 12 V RX terminals. You should receive the familiar VHF noise.

If you have a signal generator GDO or a signal source set to 10.7 MHz. This is loose coupled with your receiver. Peak coils L3, L4 and L9. You will notice that the receiver becomes quiet. Reduce injection and fine peak. L9 will peak within 1/4 to 1/2 turn. Now switch off the injection. The noise returns. Advance your squelch potentiometer. At a certain point and beyond your set will seemingly go dead - the LED turns off. Switch on the injection, the LED will light up. If you happen to receive some commercial broadcast at this stage do not get disheartened. It will automatically disappear when the card finds its enclosure. This is more pronounced during the evenings.

Now connect your regular antenna to point A. Ring up the VHF operator nearest to you and ask him to give you a long transmission incase he is not operating. Start adjusting the trimmer which is in series with the 44.833 MHz Xtal. Start from fully open position closing in. At some stage you would be hearing his signals. He might sound distorted, but don't complain. Now quickly tune the trimmers at the front end and peak up the signal in coils L1 and L2. The signal level will increase. Now carefully adjust L9 to get rid of the distortion. Now don't sit there thunderstruck. Dial your friend again thank him and give his report.

Now wait for a distant station to come up fine tune the front end and Xtal frequency. After this, do not disturb the setting of the coils or trimmers of the RX board.

Now take the transmitter board. First wire up the electronic switch with the BEL 187 & 188. See that it works with application of supply and press of P.T.I. Wire up the Osc. stage (18.150MHz). Check with probe. If you detect R.F. it is oscillating. Proceed next with the audio amplifier and modulator stages. LM1458 is directly soldered to the PCB. Note that these stages operate on 9.1 V through the 100 ohms and zenner.

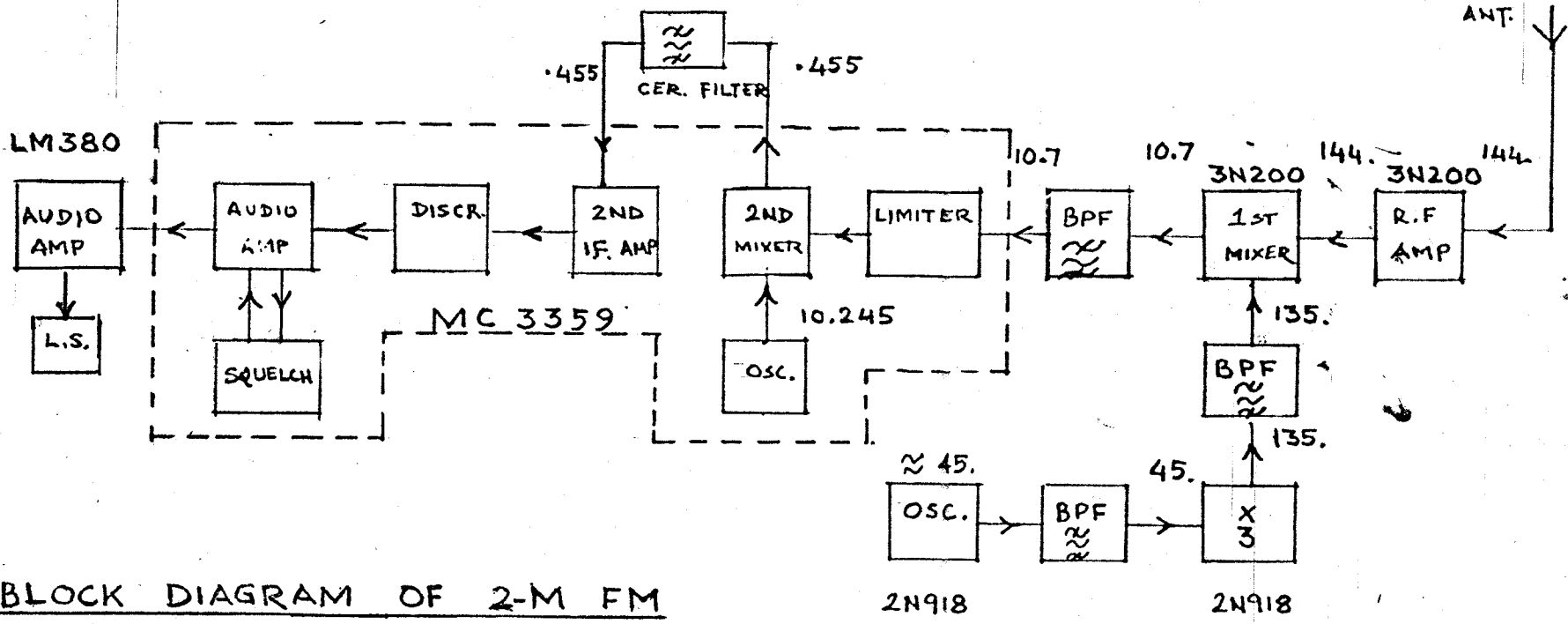
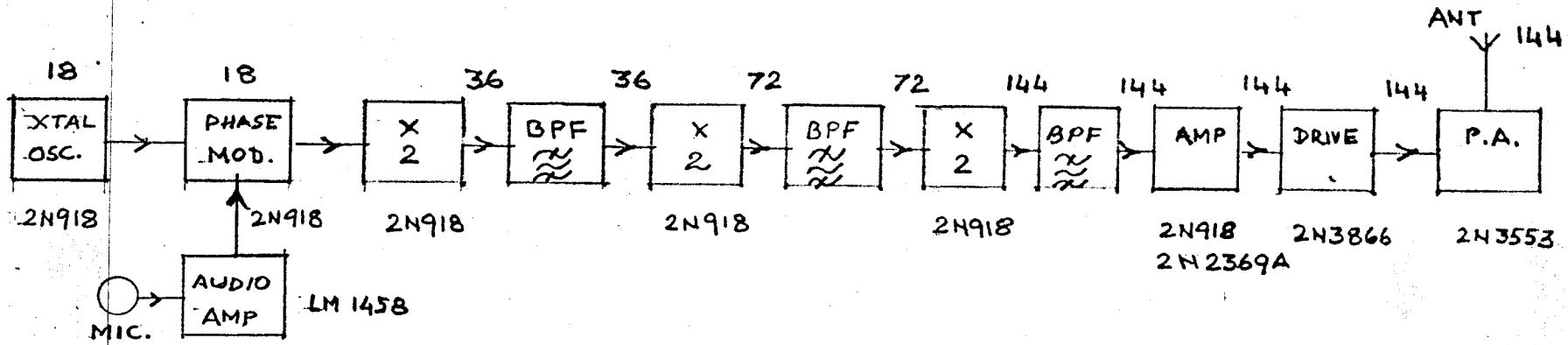
At this stage switch on your receiver with the flexible wire as the antenna. Bring the ant. wire near the modulator transistor. If the carrier is not detected in the receiver, start adjusting the trimmer in series with the Xtal 18.150. Once detected, tap the crystal gently with your screwdriver. The tapping noise will be reproduced in your receiver. Adjust position of trimmer for max clarity. Reduce coupling and adjust again. Your transmitting frequency is aligned, more or less.

Proceed with the multiplier stages, stage by stage, tuning the coils for max. r.f. as done in the receiver L.O. chain. When you reach this stage, switch on your receiver again at a distance keeping the antenna away from the TX card, and start talking into the microphone. Gradually increase the deviation control. Leave it at the point just below where distortion sets in.

Now wire up the remaining portion of the TX. Connect a 47 ohm 2 watt resistor as a dummy load between antenna and ground terminals, apply power through the electronic switch to the TX card and peak up the R.F. voltage across the load resistor by tuning the trimmers of the driver and power output stages.

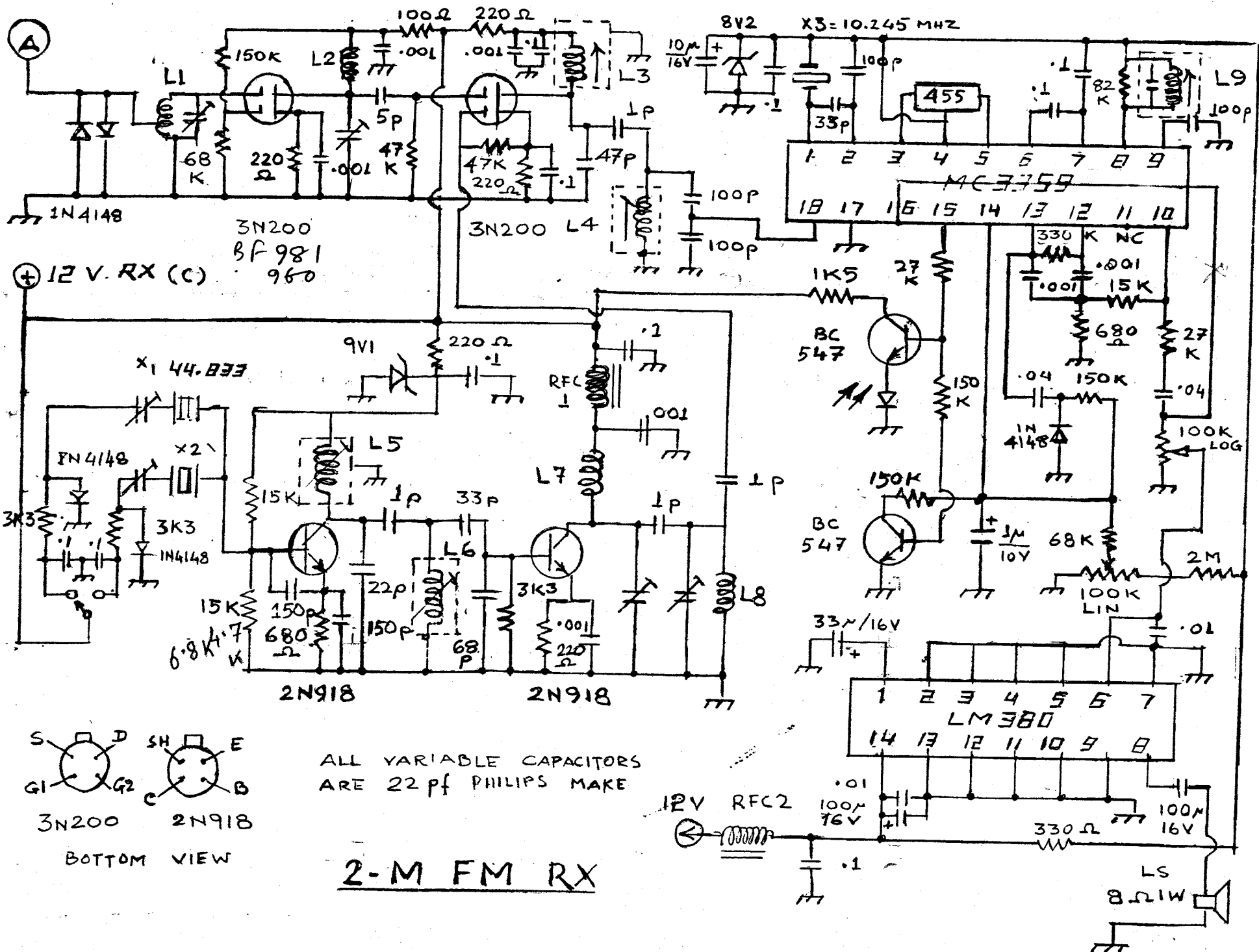
Remove the 47 ohm resistor, make the interconnections in the RX-TX cards - point A to A by shielded wire, the 12 V RX (C) and 12 V RX supply lines from TX card to Rx card. Box up both the cards.

Connect up your regular antenna and welcome on 2-M.



BLOCK DIAGRAM OF 2-M FM
TX & RX

RCVD ON 10-2-93 FROM VUZEM
VIA MRS. M.SANYAL.



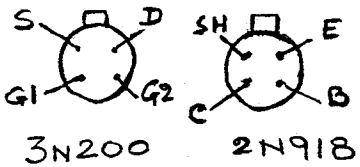
12 V. RX (C)

3N200
BF 981
960

X1 44.833

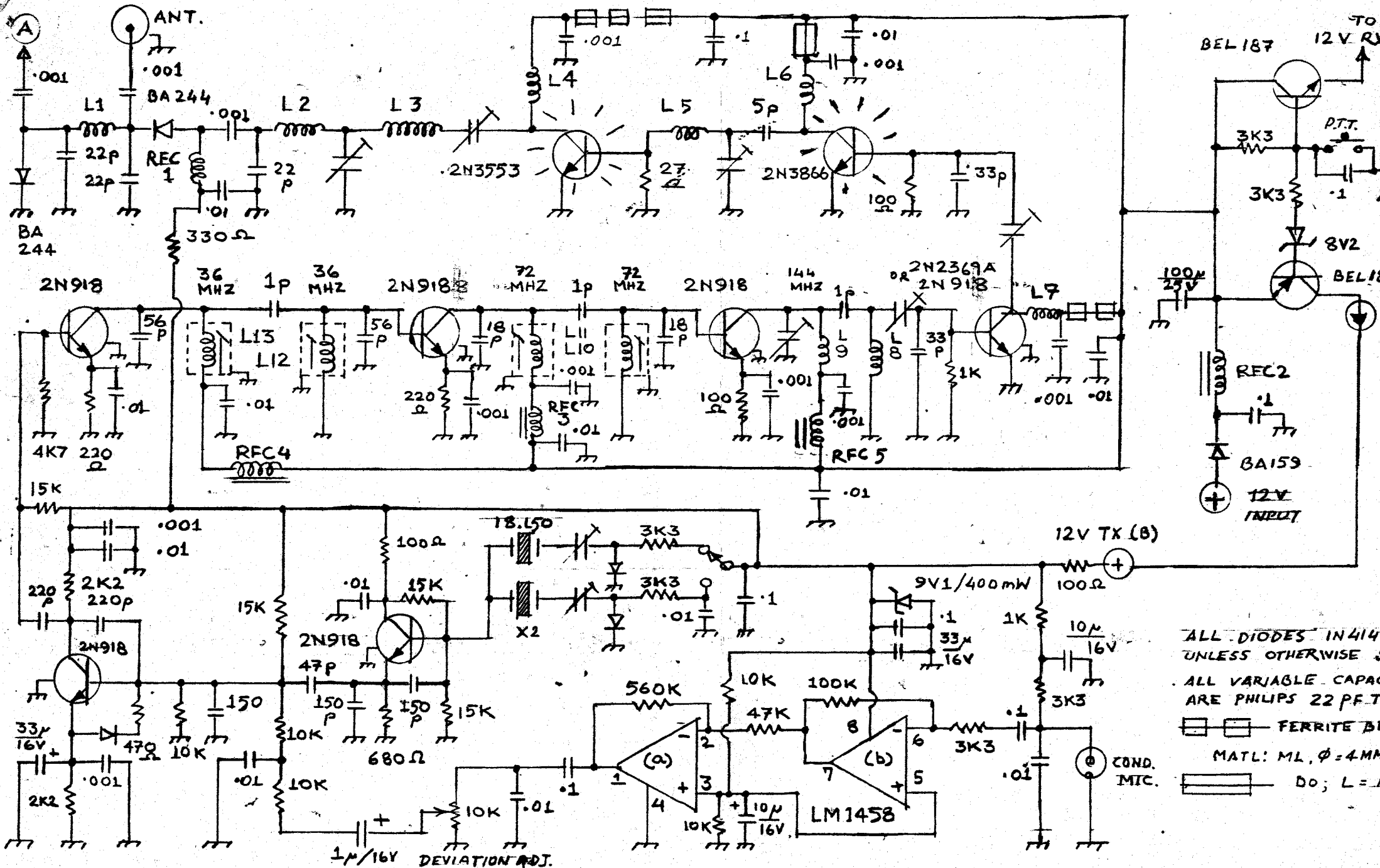
ALL VARIABLE CAPACITORS
ARE 22 pf PHILIPS MAKE

2-M FM RX



BOTTOM VIEW

Scanned by



ALL DIODES IN 4148
 UNLESS OTHERWISE S
 ALL VARIABLE CAPAC
 ARE PHILIPS 22 PF. TR
 FERRITE BE
 MATL: ML, $\phi = 4$ MM
 DO; L = 1

2-M-FM-TX

TX - COIL & RFC DATA

<u>COIL NO.</u>	<u>NO. OF TURNS</u>	<u>COIL DIA.</u>	<u>WIRE SWG.</u>	<u>REMARKS</u>
L 1	8 T	3 mm	22	Close wound Air Core. (Wind on 3 mm or 1/8" machine screw.) Coils L 1 through L 9.
L 2	9 T	"	"	
L 3	13 T	"	"	
L 4	5 T	"	"	
L 5	4 T	"	"	
L 6	5 T	"	"	
L 7	6 T	"	"	
L 8	8 T	"	"	
L 9	8 T	"	"	
L10	5 T	*	36	*Wind on 5 mm Coil Forma with ferrite slug. Close wind 3 turns, leave a gap of 3 mm and close wind remaining turns.
L11	5 T	*	"	
L12	6 T	*	"	
L13	6 T	*	"	
RFC1	25 T	**	28	**Wind on 100 K, 1/2 W resistor.
RFC2	15 T	●	22	● Wound on 455Khz IFT dumbell (red dot type)
RFC3	50 T	●●	36	●● Wound on yellow dot dumbell MH81.
RFC4	50 T	●●	36	- do -

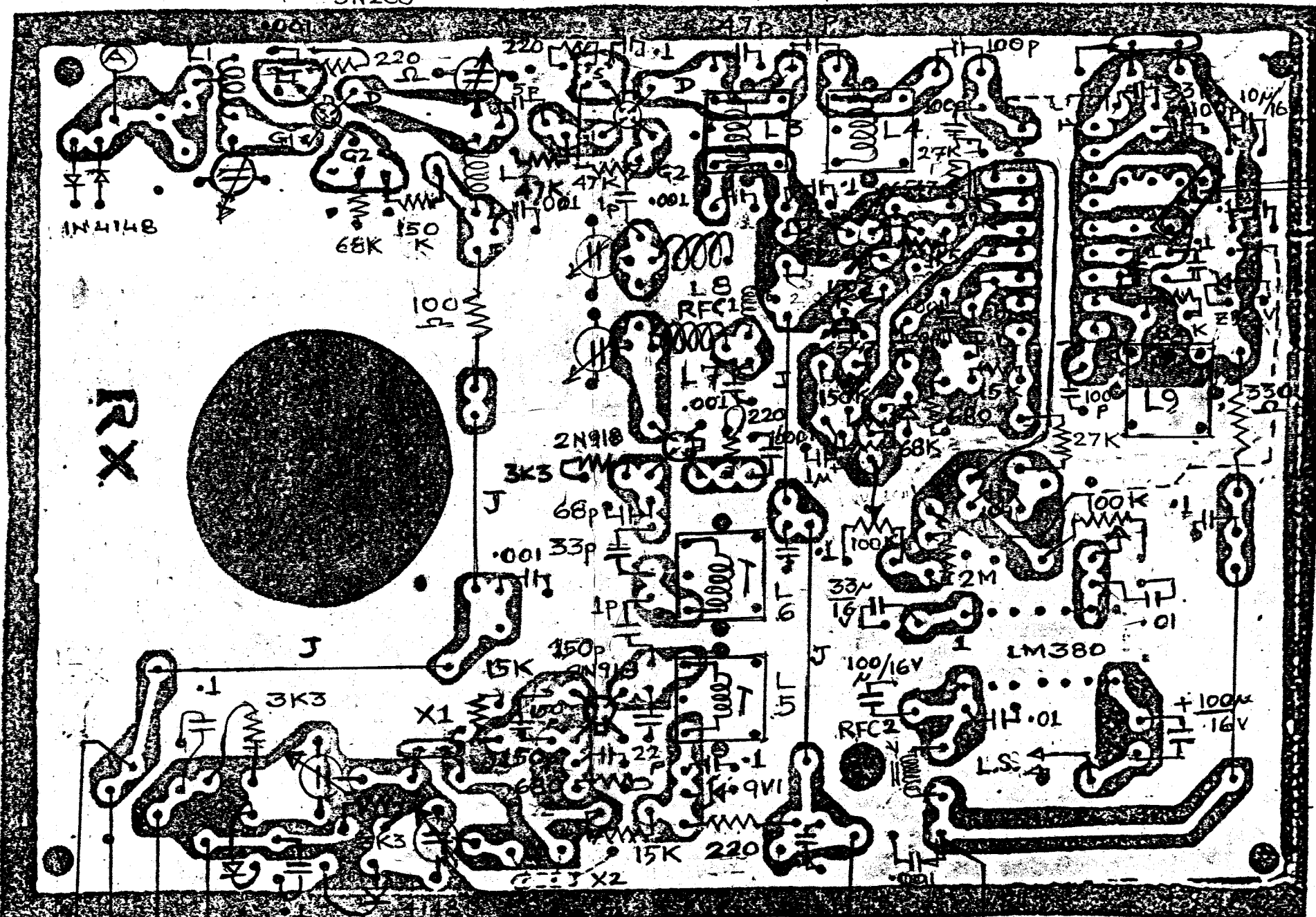
<u>R</u>	<u>RX</u>	<u>TX</u>	<u>TOTAL</u>	<u>C</u>	<u>RX</u>	<u>TX</u>	<u>TOTAL</u>
2 M	1	-	1	.1 mfd	10	7	17
560 K	-	1	1	.01 mfd	2	12	14
330 K	1	-	1	.001 mfd	7	12	19
150 K	4	-	4	.04 mfd	2	-	2
100 K	-	1	1	220 pf	-	2	2
82 K	1	-	1	150 pf	2	3	5
68 K	2	-	2	100 pf	4	-	4
47 K	1	1	2	68 pf	1	-	1
27 K	2	-	2	56 pf	-	2	2
15 K	3	4	7	47 pf	1	1	2
10 K	-	5	5	33 pf	2	2	4
4K7	-	1	1	22 pf	1	3	4
3K3	2	6	8	18 pf	-	2	2
2K2	-	2	2	5 pf	1	1	2
1K5	1	-	1	1 pf	4	3	7
1K	-	2	2				
680	2	1	3	<u>TRIMMER</u>			
470	-	1	1	22 pf	6	8	14
330	1	1	2				
220	5	2	7	<u>Electrolytics</u>			
100	1	4	5	100 mfd/25V	2	1	3
27	-	1	1	33 mfd/16V	1	2	3
100 K ½W		1	1	10 mfd/16V	1	2	3
Pot 100 K log	1	-	1				
Pot 100 K lin	1	-	1	1 mfd/16V	1	1	2
Trim Pot 10 K lin	-	1	1				
	<u>29</u>	<u>35</u>	<u>64</u>				<u>112</u>

NB : All resistors ½ Watt unless specified
All capacitors disc ceramic unless specified.

3N200

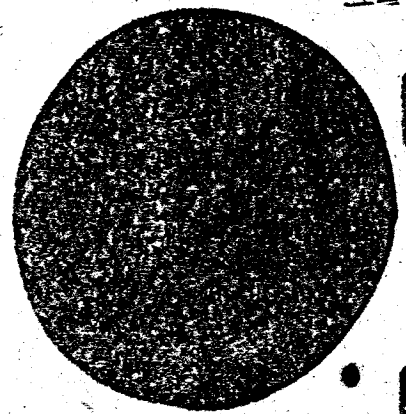
3N200

XTAL 10-245



FILTER 455

RX



Sl2

X1 = XTAL 44.833

X2 = FOR 2ND CHANNEL

12V
RX

12V

COPPER
SIDE

