Edition 1

Replacement Front End for TS700 - Early Version RPCB700ub

a product produced by Mutek pre 1989

Manual compiled by Clive Smith, GM4FZH for general circulation

Table of Contents

Compilers Note

This manual has been put together and designated Edition 1. The information has been obtained from various sources, including past owners and the Internet; **I cannot vouch for the accuracy of this information.** It is not intended to produce an updated version of this manual, if additional information becomes available it maybe provided as an addendum.

The products produced by Mutek were of high quality and many are still in service. However, please remember that this product came on to the market some 20-30 years ago and must now be regarded as obsolete.

The units described herein have been supplied in different versions which may mean some changes to component values and types. I have no further information.

This manual has no copyright but I would be grateful that if it is used the source is acknowledged. Please let me know if you have further details that would help with this or any other Mutek product.

****** PLEASE NOTE: ******

The information contained herein is provided in good faith and I will not be responsible for any outcomes arising from the use of it. I have put it together for use by the amateur radio fraternity.

The list of other manuals can be found on my website www.gm4fzh.co.uk or the Mutek Facebook group as they become available. I have no association with the firm Mutek and this manual has been produced at my own expense and without any payment.

If anyone has further information I can make the amendments or I can supply the original document which was written using LibreOffice v6.0.7.3 under Ubuntu. It was then converted to a .pdf format.

Clive Smith, GM4FZH, Jan 2021

The filename of this document is ***earlyfrontendITS700.pdf***.

Specification

Parameter	Before modification	After modification
Noise Figure	9dB	<2dB
Image rejection	60dB	>75dB
IMD free range	70dB	>90dB
Noise blanker	34dB	>56dB

All figures are considered typical and were obtained from the prototype installation

History of the PCB

After some research, the history of this pcb appears to be as follows, EOE.

PCB Type	**Notes**	**Approx. date of issue**
RPCB 700 Issue 1	Through hole components. Models TS700 and TS700G only.	Circa 1992
RPCB 700 Issue 2	SMD pcb. Models TS700, TS700G and TS700S.	Circa 1997
*RPCB271ub Iss.1	NOT covered by this manual. CAD design. L shaped board.	1989
*RPCB271ub Iss.2b	NOT covered by this manual. Rectangular pcb, not L shaped as all earlier boards	1995

* Denotes not covered by this manual.

Kit List

The kit contained the following items:-

PCB	
RPBC700 board	1 off
Cables	
Red wire	280mm
White wire	100mm
Blue wire	100mm
Brown wire	100mm
Yellow wire	100mm
Coaxial cable	170mm
Fixing	
M3 x 6mm machine screws	2 off
M3 x 25mm pillars	2 off
M3 x 0.5 tap	1 off
Components	
68k resistor	1 off
10pF capacitor	1 off

The coaxial cable may be used to replace the LO drive cable if the original is too short or damaged.

Tools Required

The following tools are required for installation:

Soldering iron, solder sucker	Side cutters
Flat blade screwdriver	Cross point screwdriver
Small pair of pliers	

TS700 Model Notes

Please note that the component references in the text apply to the TS700. References for the TS700G should be converted from the table below or from the relevant circuit diagrams.

Early TS700	TS700 and in text	TS700G
R5	R5	R8
R11	R11	R14
R16	R16	R20
	C47	C22
	TP2	TP1

Introduction

Mutek's replacement front end board has been designed to bring the receiver performance of the TS700 series transceivers up to a very high standard. The design has been adapted from the original replacement front end for the FT221 and has been used extensively for advanced experimental work and routine communication.

The original rf board fitted by Trio suffers from several deficiencies. The chief of these are a distinct deafness (noise figures of 8 - 10 dB are not unusual in unmodified rigs) and a considerable susceptibility to strong signal overload problems. Fitting an external preamplifier can help with the first problem but at the expense of dynamic range. Not all strong signal problems are identified as such but with a high level of 144 MHz activity there can be few operators who are able to completely disregard signal handling problems.

The Mutek rf board has been designed to eliminate the need for preamplifiers while vastly improving the dynamic range of the system. To overcome the design problems presented has required careful attention to the linearity of the mixer and amplifiers with particular care being given to gain distribution.

The circuit is constructed on a very high quality through hole plated glass epoxy board.

Circuit Description

The rf stage is a very low noise dual gate mosfet (BF988). This device is capable of a genuine (device) noise figure of 0.6 dB. The trade between noise figure and dynamic range has resulted in a system noise figure of about 2 dB or a little less. This is more than adequate for normal terrestrial operation, and with a good antenna system is probably satisfactory for most satellite operation.

The rf stage feeds a three pole bandpass filter; this has been dimensioned to give a 2MHz bandwidth centred on 145MHz (4MHz on 146MHz for export versions) with excellent stop-band performance. The filter is terminated with a resistive pad. This simultaneously ensures that the filter is correctly terminated and provides an essential broad band termination for the input port of the mixer.

A diode ring mixer was chosen to replace the more usual fet mixer for two reasons: the most obvious of which is that it is easier to achieve the required dynamic range with the ring mixer. A second and more subtle reason is that the balanced structure of the ring results in cancellation of local oscillator am noise.

Correct termination of the mixer is essential for reproducible high performance operation. The local oscillator is terminated with a 5dB pad ensuring a good broadband match at this port also. There is enough power available at the output of the class A local oscillator buffer to ensure proper mixer performance. The mixer port which requires most careful termination is the if output. The termination network here has several functions; it must transform the 50 Ω output impedance of the mixer to the optimum source impedance required by the mosfet post amplifier; it must ensure the mixer has a dc earth and it must provide a satisfactory termination for the VHF and UHF products generated by the mixing process.

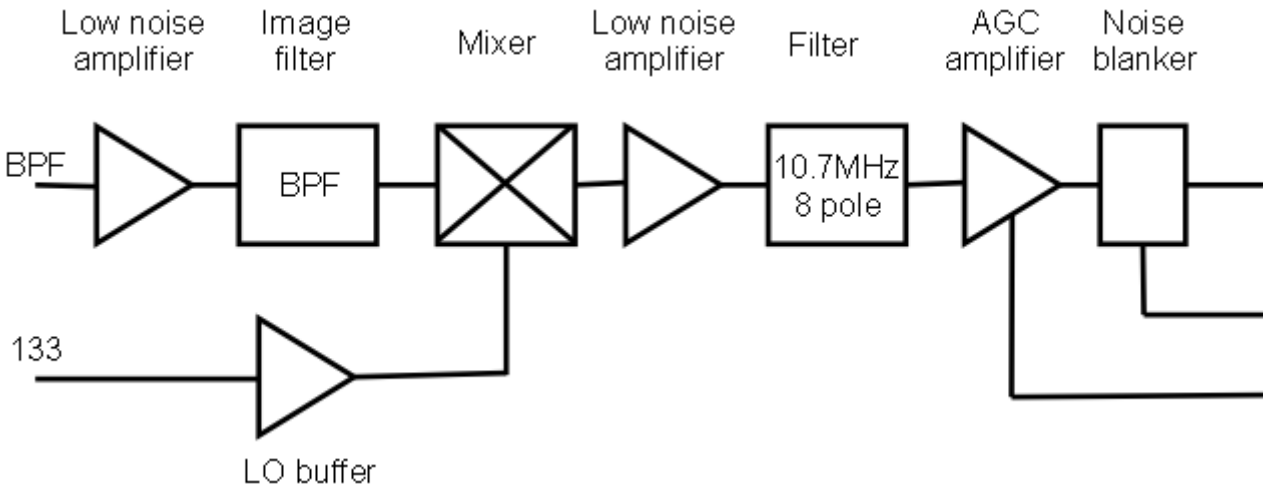

Figure 1: RPCB700 Block Diagram

The mixer post amplifier is a low noise mosfet operated at a high drain current for good intermodulation performance. Although some degradation of the noise figure can be seen, it is still very low and has a minimal effect on the mixer noise figure. The device also provides the correct source impedance for the following six pole crystal filter.

After the filter the linearity requirements become less severe,but the same circuit techniques are employed. A dual gate mosfet is used for the if output amplifier. The output of the amplifier is followed by a noise blanker gate.

Installation Notes

Fitting the installation is relatively straightforward and, if done with care, there should be no problem. Early models of the TS700 had a different noise blanker/agc circuit, please see inset in next section.

Detailed Installation

DISCONNECT THE MAINS CABLE BEFORE STARTING!

1) Unplug the loud speaker cable from the Phono/RCA socket and remove the four screws fixing the top cover of the transceiver.
2) Remove two, screws from the original rf board as shown in Fig,2. Using the M3 tap provided, cut a new thread in the two locations 'B' which had sheet metal screws in them. The tap is best held in the chuck of a hand drill.

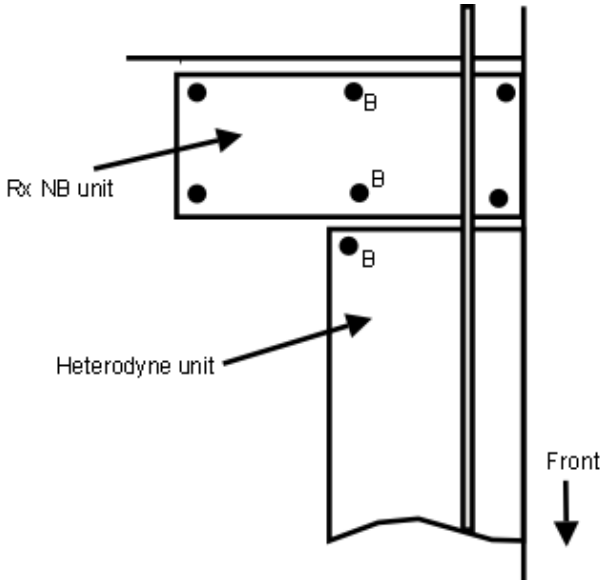

Figure 2: IC271 Internal Layout

Additional note

*Carry this out now for **<u>early model TS700 ONLY</u>***

These models are identified by the presence of T4 and T8 as shown below.

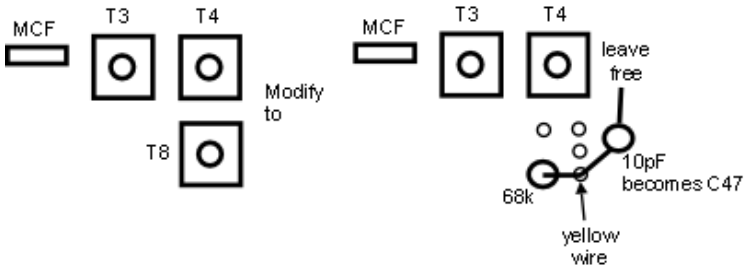

Figure 3: Early TS700 Modification

a) Remove the remaining two screws from the Rx-NB pcb and extract the board such that the underside is visible.

b) Carefully de-solder T8 and remove from pcb.

c) Solder 68k provided from the gate of Q6 to ground using holes vacated by T8. Solder one leg of the 10pF to the leg of the 68k soldered to Q6. This capacitor becomes C47 at step 12.

d) Replace Rx-NB pcb in the rig and secure with the two screws in a)

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3. Replace the screws with the two M3 X 25 pillars provided.
4. Identify and cut one leg of: R5, R11 and R16. This disables the original front end.
5. Unsolder the receiver input cable (BPF) from the tag strip or pins and top of screening can. Mark the cable for later identification. Also remove any cable ties that hold the cable along the edge of the TX compartment.
6. Unsolder the cable from the Local Oscillator input pins (133). Again mark the cable.
7. Unsolder the I.F. output (NBO) from its two pins. Connect this cable to the new front end PCB.
8. Solder the Yellow wire to the AGC pin on the original board and to the AGC input on the new board. DO NOT disconnect the original wiring as this will prevent the S meter from

working.

9. Solder the Local Oscillator cable (133) to the holes marked 133 on the new board. The cable should be routed such that it passes under the new board when fitted.
10. Locate TP2 on the original board and solder the Blue wire to this. Solder the other end to the TP2 hole on the new board.
11. Locate C47 on the original board and cut the leg closest to T3, as close to the pcb as possible. solder the White wire to this leg. Solder the other end of the white wire to the hole marked C47 on the new board. This should be connected to the underside (track side) of the PCB (Fig.4 and 5).
12. Connect the red wire to the hole marked +20V on the new pcb.

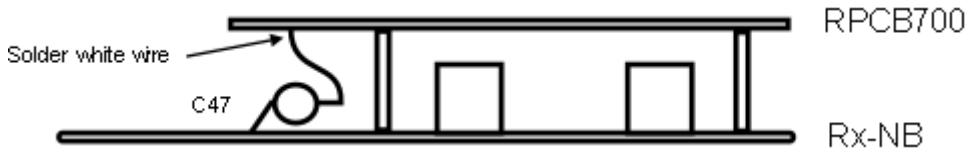

Figure 4: C47 connection between pcbs

13. Solder the Brown wire to the RXB pin on the original pcb, and to the RXB input on the new board (Fig.5.). Again do not disturb the original wiring.
14. Connect the receiver input cable (BPF) to the BPF holes on the new pcb.
15. Screw the new PCB to the top of the pillars with the 4 M3X6 screws provided.
16. Connect the free end of the red wire to the end of the fuse FS2, which is located on top of the transformer, nearest the side of the case.
17. Check all of the connections and route the Receive input cable as shown in Fig.5.. This will keep it clear of the output from the RF amplifier on the PCB.
18. Replace the top cover of the transceiver. Remember to reconnect the loud speaker lead! Reconnect the mains lead and antenna cable, turn on and test. The final tune control still has an effect on the receive performance, but the 'drive' control now has no effect, as the new board has a wide band amplifier.

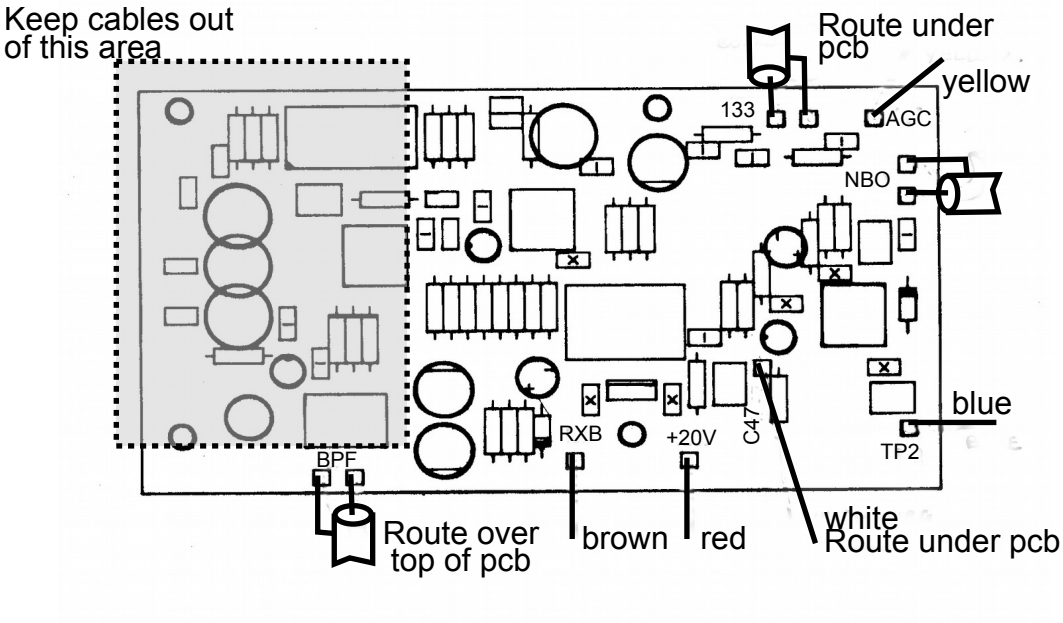

Figure 5: RPCB700 Cable Connections

Additional Notes

I. It may well be necessary to reset the S meter zero and full-scale adjustments.

II. The addition of a relatively narrow band crystal prior to the noise amplifier inevitably causes some deterioration of the noise blanker performance. The new biasing of the noise blanker gate minimises this effect. Some reduction in performance can be expected, particularly with low level pulses. It has also been observed that when the original rf board is used with a preamplifier the dynamic range is so small that the rf board has been acting as an rf noise limiter.

III If a louder signal is required from the calibrate function, a one inch length of wire should be soldered to the old position of the BPF cable on the tag strip. This should then be positioned for the required signal.

Table 1: Component Values

Ref.	Value	Ref.	Value	Ref.	Value	Ref.	Value	Ref.	Value
R1	39k	R22	39k	C7	100p	C28	10n	L9	KACS4520
R2	82k	R23	100R	C8	12p	C29	12p	L10	KACS4520
R3	150R	R24	100R	C9	47p	C30		L11	KACS4520
R4	470R	R25	10k	C10	10p	C31		L12	Ind
R5	470R	R26	39k	C11	1n0	C32			
R6	150R	R27	100R	C12	1n0	C33			
R7	180R	R28	10R	C13	1n0	C34		Q1	BF199
R8	180R	R29	51R	C14	68p	C35		Q2	BF988
R9	27R	R30	10k	C15	100p			Q3	BF988
R10	10k	R31	1k5	C16	1n0			Q4	BF988
R11	4k7	R32	10k	C17	1n0			Q5	2N3906
R12	33k	R33	1k	C18	10n			Q6	BC547
R13	330k	R34	2k2	C19	1n0	L1	Tap.Ind		
R14	39k	R35	100R	C20	10n	L2	Ind	D1	HP
R15	39R			C21	10n	L3	Ind	D2	Zener 5V6
R16	39k	C1	2/10p	C22	2u2	L4	Ind		
R17	82k	C2	1n0	C23	1n0	L5	220uH	U1	LM7812
R18	1k5	C3	8p2	C24	1n0	L6	22uH		
R19	10R	C4	1n0	C25	10n	L7	15uH	XF1	Filter
R20	1k5	C5	12p	C26	2u2	L8	47uH		
R21	3k3	C6	1n0	C27	10n			X1	SBL-1

Figure 6: RPCB700 Circuit Diagram