TS-2000 Customisable Transmit Audio – Inject your own Transmit I.F.

This modification will allow you to bypass the D.S.P. and produce wider (between 6-7kHz wide maximum) and flatter TX audio from the Kenwood TS-2000. I discovered this method in 2010 and successfully used it on the air for many years.

Introduction

The Kenwood TS-2000 already produces quite nice audio and with a suitable microphone or other gear can attract unsolicited compliments. However for those who wish to customise their transmit audio signal further it can be rather limited since the D.S.P does not offer many options for this, and the capacitors used in the audio line mean that the audio can sometimes sound a little 'boxy' and flat.

I discovered this method of creating customised audio several years ago whilst studying the circuit diagrams.

Purpose
To allow licensed radio amateurs who are TS-2000 owners to:

1. Customise their transmit audio signal beyond the capabilities of the D.S.P. for general usage at narrower bandwidths (i.e. < 3kHz).
2. Experiment with wider modes in uncrowded band conditions should they wish to.

Preface

Using wider bandwidths for SSB can provide a nicer quality audio and it is perfectly acceptable and legal to do this. I have gone as far as contacting our local regulator Ofcom in the UK to confirm this. The RSGB additionally recognises 'ESSB' in the 'Notes' section of their band-plan. Like AM or other modes, it is all part of the spirit of amateur radio experimentation. Most modern radios offer up to 4kHz wide or greater for such purposes, in particular the SDRs. However it goes without saying that operators must be sensible and ensure that they do not cause interference to other stations. I would not recommend using wider bandwidths during crowded band conditions or for calling CQ. Many operators do not possess panadapters and will fail to understand that a wider transmission is not 'splatter' – they will see such wideband transmissions as selfish, quite rightly so particularly if the band is busy and space is at a premium. Additionally it is important that all operators understand that they are responsible for studying the circuit diagram themselves and ensuring that whatever modifications they do, their equipment is appropriately tested so that no unintended emissions occur from their station outside of their intended bandwidth. Failure to heed such advice will result in interference being caused. That being said, with this modification it is possible to create very nice sounding audio from the TS-2000 without any unnecessary interference providing these conditions are met.

Creating and customising a transmit I.F. signal for the Kenwood TS-2000 using a computer.

This article tells you how to feed your transmit audio into the TS-2000 using a computer to facilitate a wider bandwidth transmission when using SSB. It is the operator's responsibility to make sure that this modification is performed, tested and used properly. I take no responsibility for any loss, damage or interference caused.

The accessory socket at the rear of the TS-2000 allows us to feed audio in after the DSP providing the menu is set up correctly and we use a suitable interface.

We will use a piece of software that is downloadable from the internet called Reaper that contains some excellent features and plugins that will enable us to generate the audio by simply using our sound card and a microphone. I have provided the file that you need to use fully setup via this email; TS-2000 TX IF G7VKK.rpp

Then by taking the output from our soundcard and using a suitable padding resistor and 1:1 audio transformer we can input it into the accessory socket. You will need to use a separate PTT switch as the front 'SEND' and microphone PTT will bypass the audio inputted via the accessory socket.

Step 1.

Set your Kenwood TS-2000 menu settings as follows:

Menu settings 50E (Main / Sub band TNC = Main),

50F (Data Transfer Rate ; External TNC) = 9600bps.

Step 2.

Using an appropriate DIN socket, connect wires to pins 9 (GND via a switch) for PTT and pin 11 for the 'hot' audio against ground. A pin diagram for this socket is shown below. Be extremely careful to ensure that you do not inadvertently ground and/or send high voltages through any of these pins inappropriately. Additionally, I suggest a resistor in series with the audio wire to pad the voltage down and a 1:1 isolation transformer, such as those manufactured by Jensen. This will keep any noise out. You may wish to use decoupling capacitors.

ACC2
Front view
(Rear panel)

Pin No.	Pin Name	Function
1	SANO	AF output from the sub-receiver • Connect to the TNC or MCP receive data pin for digital operation. • AF output level is independent from SUB AF control setting. • AF output level can be changed by adjusting the Menu No. 50D value. • Output impedance: Approx. 10kΩ.
2	RTTY	RTTY key input
3	MANO	AF output from the main transceiver • Connect to the TNC or MCP receive data pin for digital operation. • AF output level is independent from the MAIN AF control setting. • AF output level can be changed by adjusting the Menu No. 50C value. • Output impedance: Approx. 10kΩ.
4	GND	Ground
5	MSQ	Main transceiver squelch control • Connect to the TNC or MCP squelch control pin for digital operation. • Prevents the TNC from transmitting while the transceiver squelch is open. • Squelch open: Low impedance • Squelch closed: High impedance
6	NC	No connection
7	SSQ	Sub-receiver squelch control • Connect to the TNC or MCP squelch control pin for digital operation. • Prevents the TNC from transmitting while the transceiver squelch is open. • Squelch open: Low impedance • Squelch closed: High impedance
8	GND	Ground
9	PKS	Transceiver PTT line control • Ground this terminal to transmit. • Connect to the TNC or MCP transmit/ receive switching pin for digital operation. • Microphone audio input mutes when the transceiver transmits.
10	NC	No connection
11	PKD	Microphone audio input • Connect to the TNC or MCP transmit data pin for digital operation.
12	GND	Ground
13	SS	PTT control • Ground this terminal to transmit. • For connecting a footswitch or other external controller (in parallel with MIC jack). • Microphone audio input does NOT mute when the transceiver transmits.

Once you have wired up to the audio, you will need to configure Reaper to play through your sound card. If you load the file sent with this document, it will set up your audio appropriately to be input directly as the TX IF. You can also set up effects such as equalisation as you would with a rack! Reaper is an excellent piece of software which includes many simple but highly effective plugin effects.

Ensure that the track in Reaper is record armed (red 'R') and that you can see microphone input from your microphone through to Reaper. You will also need to press the small grey speaker icon so that your 'monitor' input audio is heard in real time on the output. It is useful to test the output using headphones first. You will hear a high-pitched version of yourself at 12khz! See Figure 1 below:
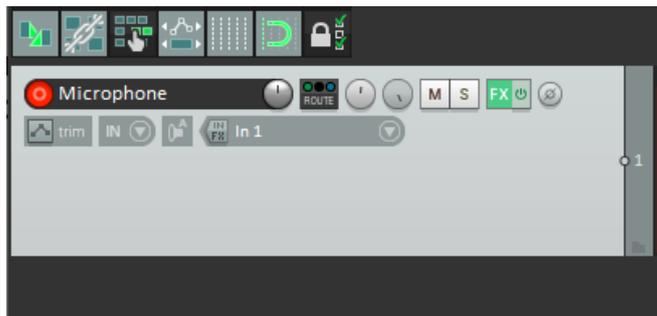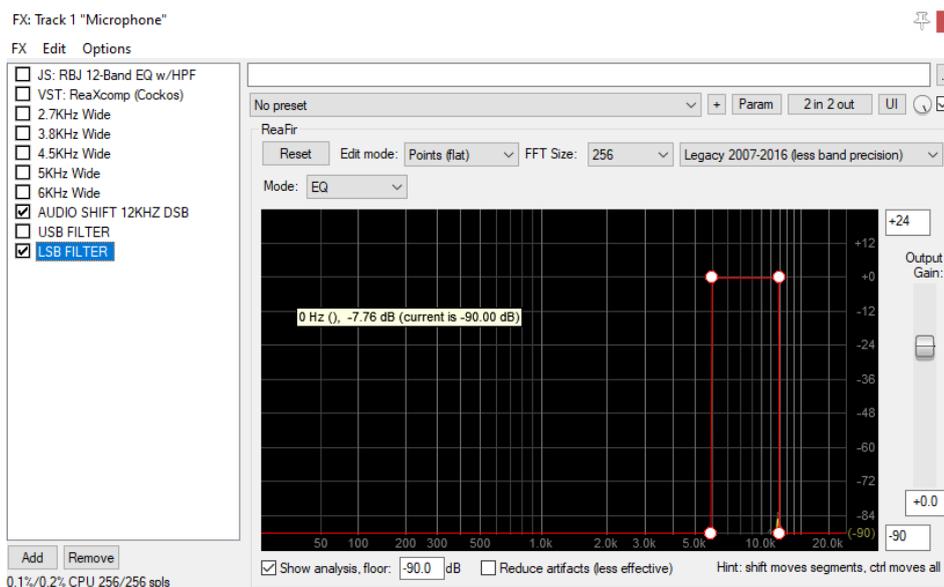
Figure 1:

Figure 2:

Within Reaper, you need to click on the green 'FX' button for the track and you will see a number of plugins – see Figures 1 and 2:

Start by transmitting on low power into a dummy load and do not attempt to go on the air until you have fully tested your station! This includes testing for harmonics and spurious emissions outside of your intended bandpass! The plugins on the left of Figure 2 can be activated and deactivated using the tick boxes. You will need to spend some time to become familiar with the Reaper software. There are plenty of videos online about this excellent software.

The 'Audio Shift' plugin must be ticked all of the time – this shifts audio coming through the microphone up to 12khz for the transmit I.F. It effectively creates a DSB signal at 12khz. The corresponding LSB and USB filters will filter off the other sideband of the DSB signal created. The radio must be selected to the required mode (such as LSB or USB) AND the appropriate USB or LSB filter will need to be ticked in the plugins. So for example, to use LSB, ensure that you have the radio in 'LSB' and you have ticked the LSB filter above. Any bandwidth filter such as '2.7khz Wide' etc can additionally be selected. You will need to monitor the RF output of your radio using another receiver as the TX monitor will not produce audio since it relies on the front microphone socket and associated circuitry. You can of course add further plugins such as equalisation and compression so long as they are IN FRONT of the plugins listed above. I have added the 'JS: RBJ 12-Band EQ' and 'VST: ReaXComp' as a starting point. These can be deleted but do not delete the rest! As has been previously mentioned, you can only PTT with an external switch connected with the above mentioned pins in the accessory socket. The front microphone plug and front 'SEND' button will bypass all of the above.

Further thoughts

In due course, I am sure that a circuit could be designed to perform the same function. The key point here is that a system for mode switching would have to be devised since the IF would have to be reversed.

It is a rather complicated set up but does provide a solution if one already owns a TS-2000. However, long term I would suggest that operators interested in high quality transmit audio would look to the SDR range of transceivers which can cater for such needs with great ease.

Please do not hesitate to contact me should you have any further queries.

73.

G7VKK.

email@g7vkk.com