TS-590S TechNote: SSB Audio Handling

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Introduction

The aims of this TechNote are:

- To summarize the many features built into the Kenwood TS-590S for handling SSB audio.
- To dispel some of the myths and misunderstandings arising from Kenwood's inappropriate use of the word "DATA" in its documentation.

The emphasis in this document is on the *functionality* of the TS-590S, describing *what* it does, rather than how to operate it. For the most part, this document is not a HOWTO (although it does include step-by-step instructions for setting up TX and RX audio equalizer profiles using the ARCP-590 control program).

Familiarity with the TS-590S Instruction Manual [1] and ARCP-590 [2] is assumed.

Scope

This TechNote covers the processing of SSB audio (LSB/USB) in the TS-590S.

It specifically does *not* include the other TS-590S-supported modes: AM, FM, FSK or CW.

It also does *not* include information on the configuration of the PC operating system or application programs.

Note: Throughout this document, the word "data" in lower case refers to analog audio that represents digital information.
For detailed information on how to set up the audio, see the TS-590S HOWTO: SSB Audio Setup [4].

What is "audio"?

The TS-590S can handle SSB audio that originates from a microphone, a PC or an Interface Unit (such as SignaLink). There are many types of audio signal. For example:

- Microphone output
- Recordings of audio signals
- Canned messages (e.g. CQ calls)
- Audio tones representing digital data information (generated by programs such as Fldigi, mixW, etc.)
- Audio tones representing digital voice information (generated by programs such as FDMDV, WinDRM, etc.)
- Analog SSTV
- Audio tones representing digital SSTV (generated by programs such as EasyPal)
- Audio tones representing modulated CW (MCW)
- Audio tone representing PTT

The important point to recognize is that the TS-590S does not distinguish between these different types of audio – to the radio, they are just "audio", and they are all handled in exactly the same way.

Audio Input to the Radio

There are three ways of inputting audio to the radio. It is convenient to list them by the connector that they use:

- MIC audio – through the MIC socket on the front panel of the radio
- USB audio[1,2] – through the USB connector on the rear panel
- ACC2 audio – through the ACC2 connector on the rear panel

See Figure 1.
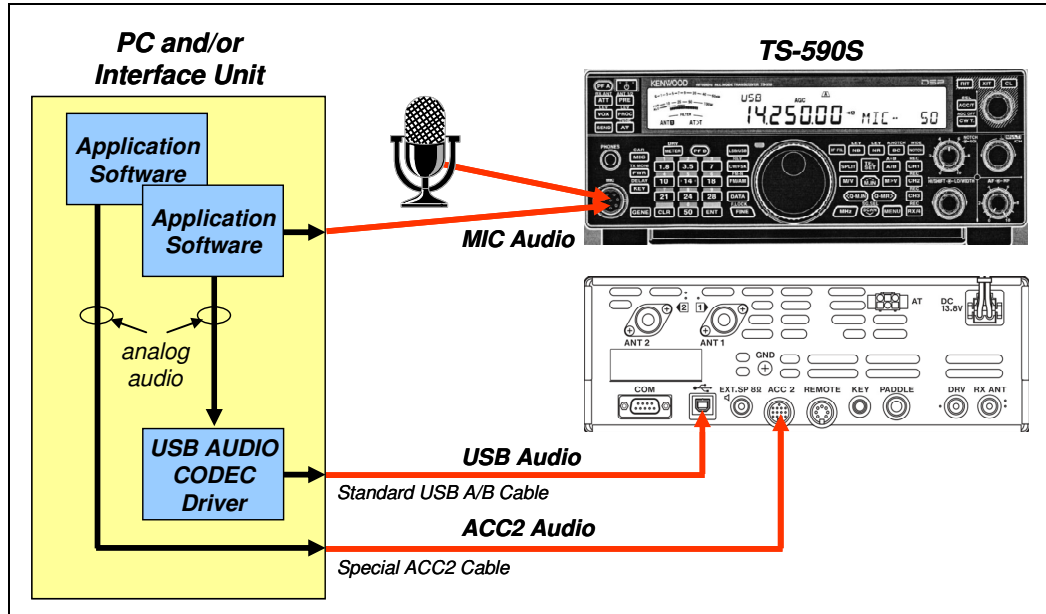
Figure 1: Audio inputs to the TS-590S

Remembering that the radio does not distinguish between different types of audio, you can input *any* type of audio into *any* of the three connectors:

- Although the MIC input is normally used for a microphone, you could alternatively use this input for the audio tones generated by Fldigi, for example.

- Conversely, while the USB and ACC2 inputs are normally used for audio tones representing some kind of digital information, you could instead, for example, use these inputs for analog voice or analog SSTV.

When using the USB connector, the analog audio originating from the application software is converted to a digital bit stream by a USB Audio Codec driver, prior to transfer across the USB cable. Inside the radio, an audio codec converts the digital bit stream back to the original analog audio. Thereafter the audio is handled in the same way as audio input to ACC2 or the microphone connector.

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[1] "USB" here means "Universal Serial Bus", not "Upper Sideband".
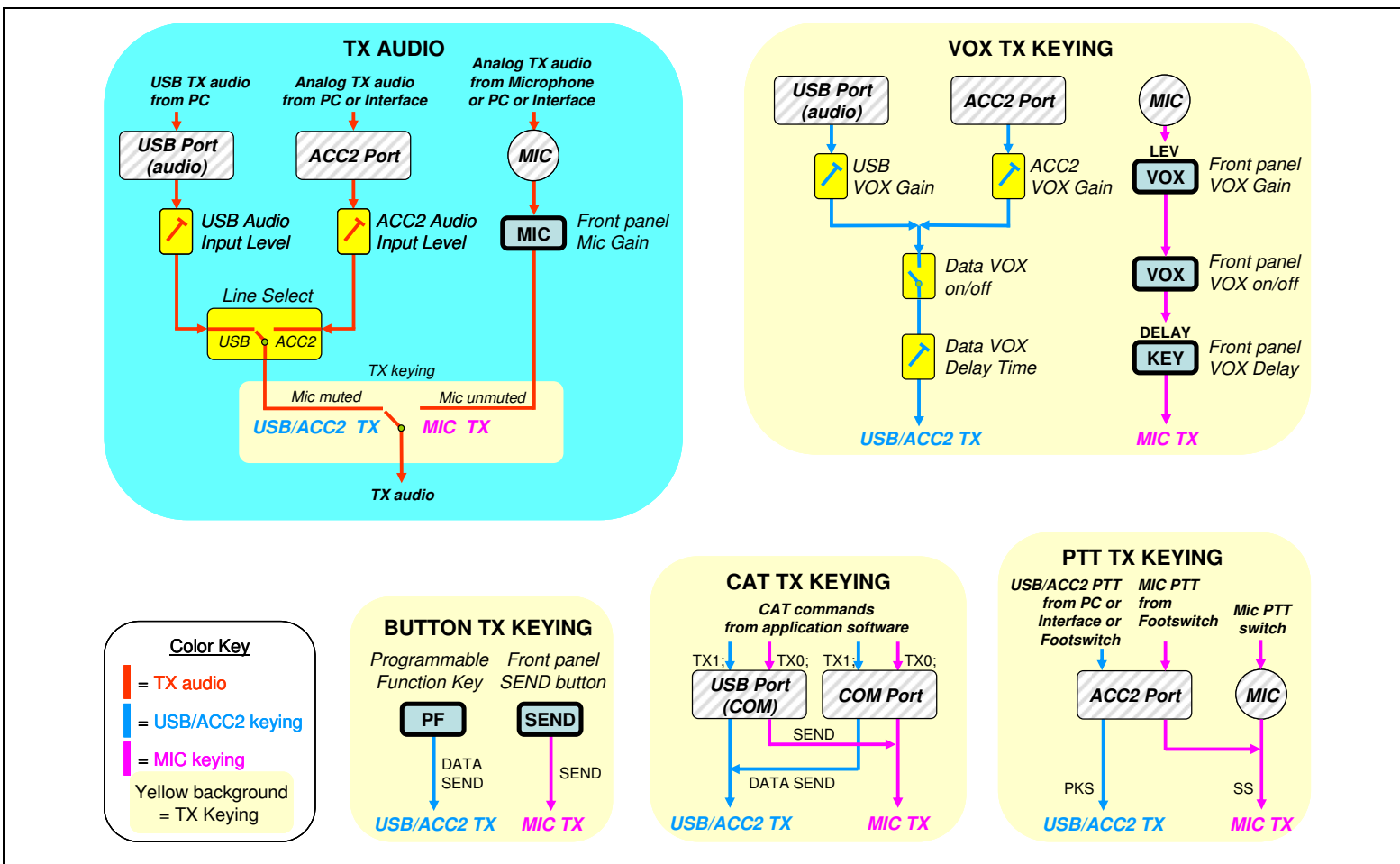[2] The USB port also functions as a serial COM port for CAT control commands.

TX AUDIO

USB TX audio from PC

Analog TX audio from PC or Interface

Analog TX audio from Microphone or PC or Interface

USB Port (audio)

ACC2 Port

MIC

USB Audio Input Level

ACC2 Audio Input Level

MIC — Front panel Mic Gain

Line Select

USB   ACC2

TX keying

Mic muted

Mic unmuted

USB/ACC2 TX   MIC TX

TX audio

VOX TX KEYING

USB Port (audio)

ACC2 Port

MIC

USB VOX Gain

ACC2 VOX Gain

LEV VOX — Front panel VOX Gain

Data VOX on/off

VOX — Front panel VOX on/off

Data VOX Delay Time

DELAY KEY — Front panel VOX Delay

USB/ACC2 TX

MIC TX

Color Key

| = TX audio

| = USB/ACC2 keying

| = MIC keying

Yellow background = TX Keying

BUTTON TX KEYING

Programmable Function Key

Front panel SEND button

PF

SEND

DATA SEND

SEND

USB/ACC2 TX   MIC TX

CAT TX KEYING

CAT commands from application software

TX1;   TX0;   TX1;   TX0;

USB Port (COM)

COM Port

SEND

DATA SEND

USB/ACC2 TX   MIC TX

PTT TX KEYING

USB/ACC2 PTT from PC or Interface or Footswitch

MIC PTT from Footswitch

Mic PTT switch

ACC2 Port

MIC

PKS

SS

USB/ACC2 TX   MIC TX

Figure 2: The big picture – TX audio input selection and TX keying by VOX, PTT, button push and external CAT commands.
   The yellow boxes are TS-590S menus

The Big Picture

Figure 2 is a high level view of the five principal parts of the TS-590S that handle audio inputs and TX keying. Clockwise in the diagram from top left:

- Audio input gain control, line selection and TX keying
- VOX keying
- PTT keying
- Keying by external CAT commands
- Button push keying

Audio Input Gain Control, Line Selection and TX Keying (top left of Figure 2)

Input Gain Control: Each of the three audio inputs has a separate audio gain control. The USB and ACC2 audio level controls are set independently through TS-590S menus, and the MIC audio gain control is set on the front panel.

Line Selection: The Line Select menu lets you choose either the USB input or the ACC2 input; you cannot use both at the same time.

TX Keying: This part of the diagram shows the audio path that is selected for different methods of keying the TX for SSB transmission. There are two different TX keying methods:

TX Keying Method	TX Audio Selected	USB/ACC2 Inputs muted/unmuted	MIC muted/unmuted
USB/ACC2 TX	USB or ACC2	Unmuted	Muted
MIC TX	MIC	Muted	Unmuted

To decide which method to use:

1. Choose the audio source:
   - If it is USB or ACC2, then select the USB/ACC2 TX keying method. Any input to the front panel microphone socket will be muted.
   - If you are using the microphone input, then select the MIC TX keying method. The microphone input will be unmuted, and any inputs to USB or ACC2 will be muted.
2. Having chosen the audio source, now decide whether to use VOX, PTT, externally generated CAT commands or a button to key the TX, as described on the next two pages.

VOX TX Keying (top right of Figure 2)

VOX Gain Control: Each of the three audio inputs has a VOX gain control. The USB and ACC2 VOX gain controls are set independently through TS-590S menus, and the MIC VOX gain control is set on the front panel.

VOX On/Off: There is a common on/off switch for USB and ACC2 VOX, accessible through a menu (Data VOX on/off). The MIC VOX on/off switch is on the front panel.

VOX Delay: The USB and ACC2 inputs share a common delay time, adjustable through a menu (Data VOX delay time). The delay time for MIC VOX is adjustable on the front panel.

In summary:

VOX Type	TX Audio Transmitted	TX Keying Method
USB/ACC2	USB or ACC2	USB/ACC2 TX
MIC	MIC	MIC TX

PTT TX Keying (bottom right of Figure 2)

There are two methods of achieving PTT keying in the TS-590S:
- By activating the PKS signal
- By activating the SS signal

The essential difference between them is that PKS is used with USB and ACC2 audio (and the MIC input is muted), whereas SS is used for audio from the MIC input.

If the MIC input is used, the PTT signal may originate from ACC2 (SS) or the MIC PTT switch

In summary:

PTT Signal	PTT Source	TX Audio Transmitted	TX Keying Method
PKS	ACC2 (PKS) – pin 9	USB or ACC2	USB/ACC2 TX
SS	ACC2 (SS) – pin 13	MIC	MIC TX
SS	MIC PTT – pin 2	MIC	MIC TX

External CAT Command TX Keying (bottom of Figure 2, right of center)

Many digital communications programs can be configured to send CAT commands to the radio to control TX keying, through the USB (COM) port or the serial COM port.

The DATA SEND command (TX1;) is used for USB and ACC2 audio (and the MIC input is muted), whereas the SEND command (TX0; or TX;) is used for audio from the MIC input.

In summary:

CAT Command	TX Audio Transmitted	TX Keying Method
DATA SEND: TX1;	USB or ACC2	USB/ACC2 TX
SEND: TX0; (or TX;)	MIC	MIC TX

Button TX Keying (bottom of Figure 2, left of center)

The programmable function keys (**PF A** or **PF B** on the front panel, or **PF1**-**PF4** on the microphone) can be programmed with menu 205: DATA SEND. Pressing such a programmed key will select USB or ACC2 audio for transmission.

The SEND button on the front panel will select MIC audio for transmission.

In summary:

Button	TX Audio Transmitted	TX Keying Method
PF key programmed to DATA SEND (menu 205)	USB or ACC2	USB/ACC2 TX
Front panel SEND key	MIC	MIC TX

Audio Input Gain Control and Line Selection in Detail

Depending on which of the three inputs you use to connect the audio to the TS-590S, you will need to set up the radio to select the correct input and adjust the audio gain. See Figure 3.
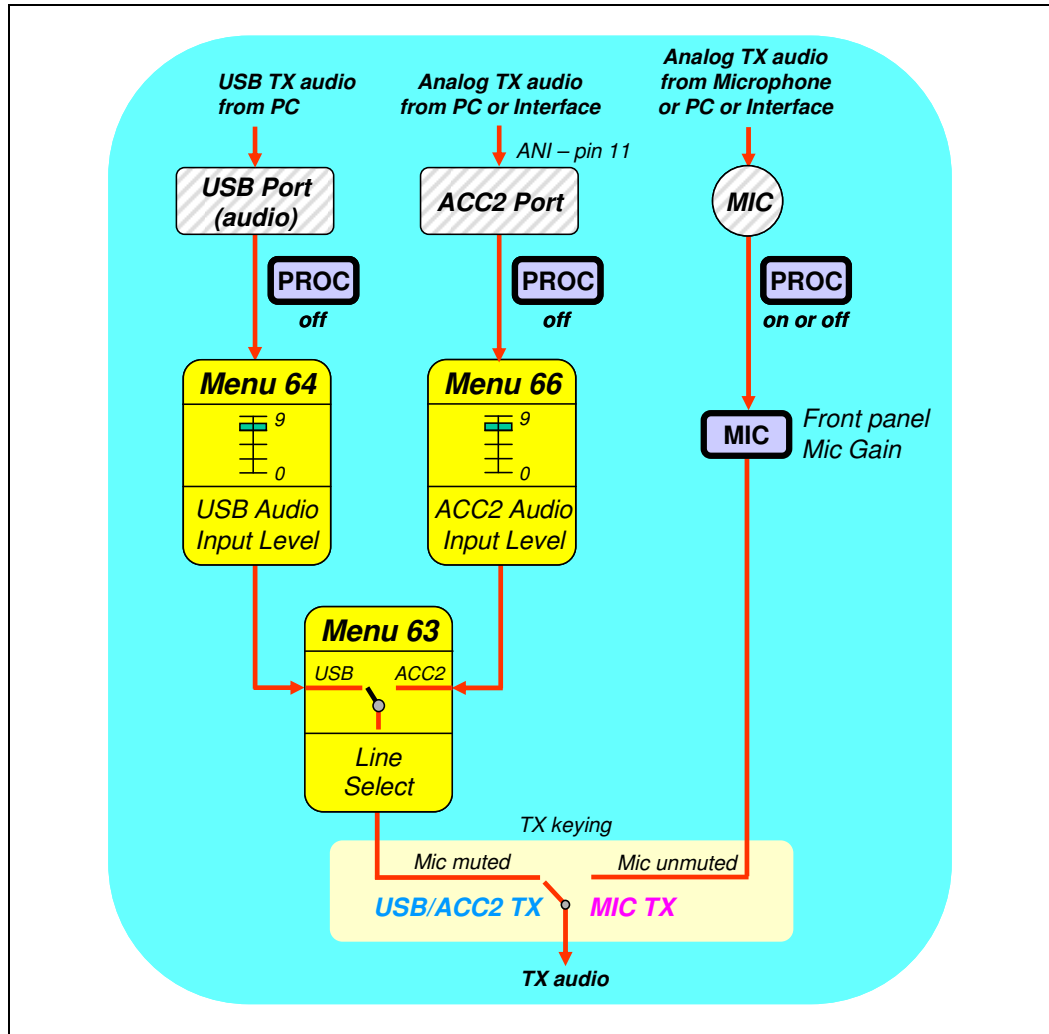
Figure 3: Audio gain setting and input selection

Audio Gain: There are three independent audio input gain controls in the radio:

- USB Audio Input Level – Menu 64
- ACC2 Audio Input Level – Menu 66
- MIC Audio Gain Control – on the front panel

- **Note that when using the USB or ACC2 inputs for "data" transmission, the speech processor (PROC) should be set to off. If PROC is set to on, this will introduce clipping/compression that will cause unacceptable distortion to the signal.**

- **If PROC is set to on, the USB and ACC2 input level controls do not function – the input levels have to be controlled externally.**

Audio Input Selection: If you use either the USB port or the ACC2 port, you need to select the chosen input through the "Line Select" menu (Menu 63).

TX Keying: This part of Figure 3 shows that the audio path depends on the method of TX keying:

- When USB/ACC2 audio is selected, the microphone input is muted.
- When MIC audio is selected, the microphone input is enabled.

Left and Right Audio Channels – Transmit

The USB audio connection between the PC and the TS-590S is actually a *stereo* connection, with independent Left and Right channels[3]. See Figure 4.
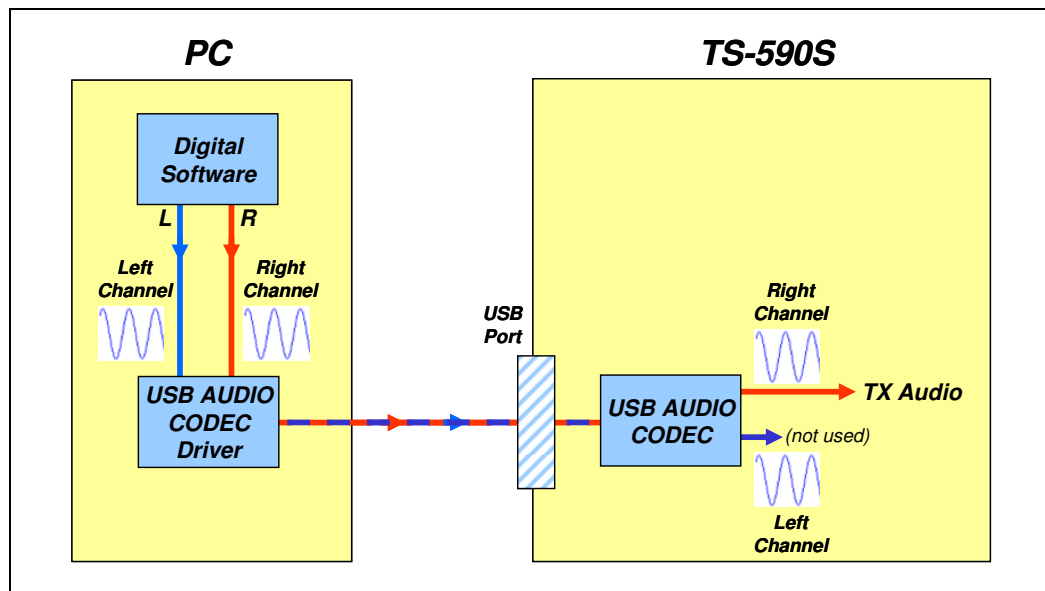
Figure 4: TX audio Left and Right channels

However, inside the radio, only the _Right_ channel is used. Any audio on the Left channel is ignored.

Most of the well-known digital packages (such as mixW, Digipan, V4 Chat etc.) generate TX audio on both channels, but the radio only uses the Right channel. Fldigi is a notable exception – by default it only generates audio on the Left channel. In this case you will need to configure Fldigi to use the Right channel, or "Modem signal on left and right channels".

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[3] For this reason, if the USB audio codec driver has a mono/stereo option, you should select stereo.

VOX TX Keying in Detail

Each of the three analog inputs to the radio can be independently controlled by VOX. See Figure 5.
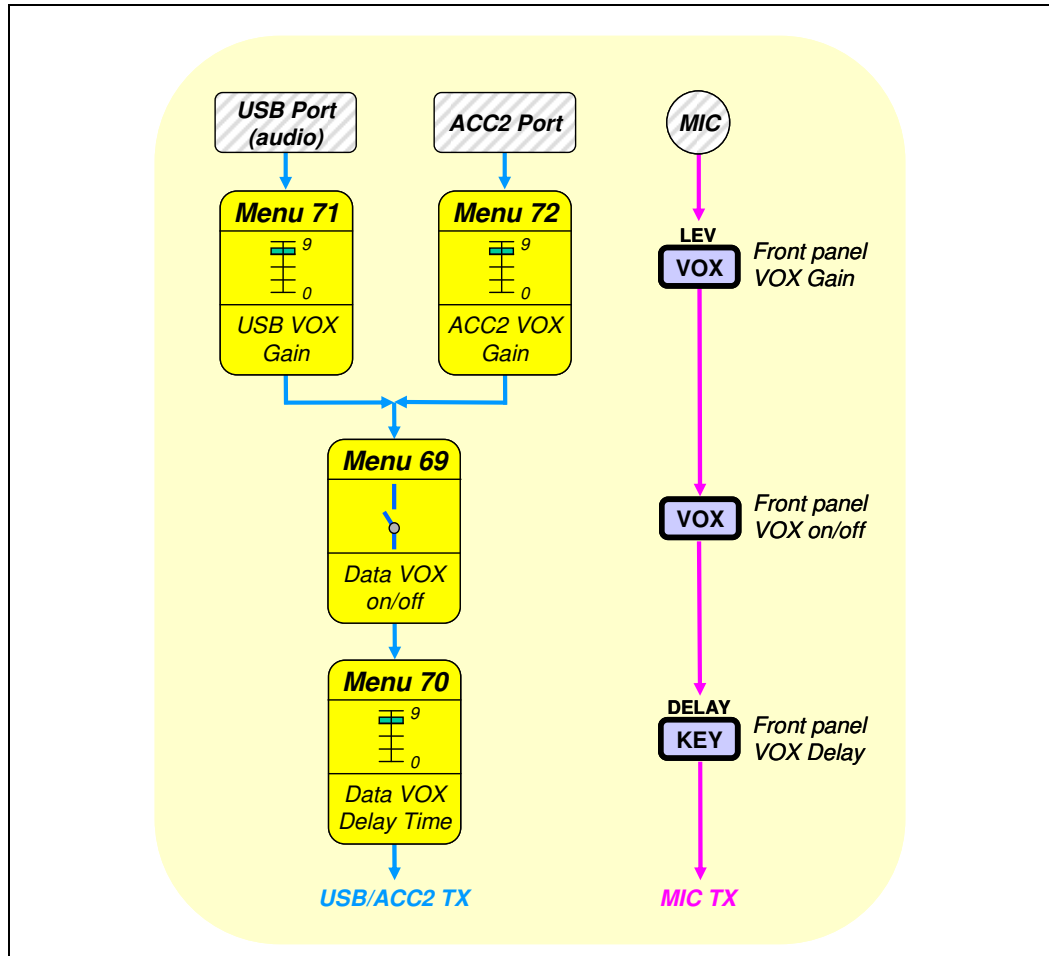
Figure 5: VOX Control. The so-called "Data VOX" on/off control (Menu 69) and "Data VOX Delay Time" (Menu 70) apply to _any_ audio input via the USB or ACC2 port, not just "data"

For audio input via the USB or ACC2 port, Menus 71 and 72 adjust the VOX gain.

Menu 69 switches the USB/ACC2 VOX on and off, and Menu 70 adjusts the USB/ACC2 VOX release delay time.

For audio input via the microphone socket, there are similar front panel controls.

- **Note that "Data VOX" does _not_ mean VOX for "data" modes.**

- **The two "Data VOX" controls operate on _any_ type of audio that is input to the USB or ACC2 port. This audio _may_ represent some kind of "data", but it could also be analog voice or other analog signal like analog SSTV.**

PTT TX Keying in Detail

There are two methods of achieving PTT in the TS-590S:
- By activating the PKS signal, for USB/ACC2 audio
- By activating the SS signal, for MIC audio

See Figure 6.
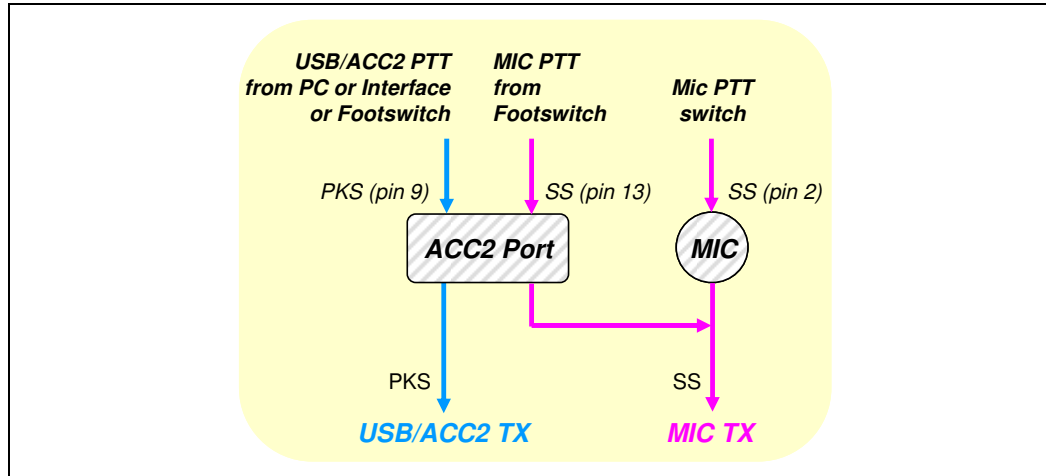
Figure 6: PTT Control

USB/ACC2 audio: The preferred method[4] of activating the PKS signal to transmit USB/ACC2 audio is to ground the PKS input on the ACC2 connector (pin 9).

For example, you could connect a footswitch to pin 9. See Figure 7.
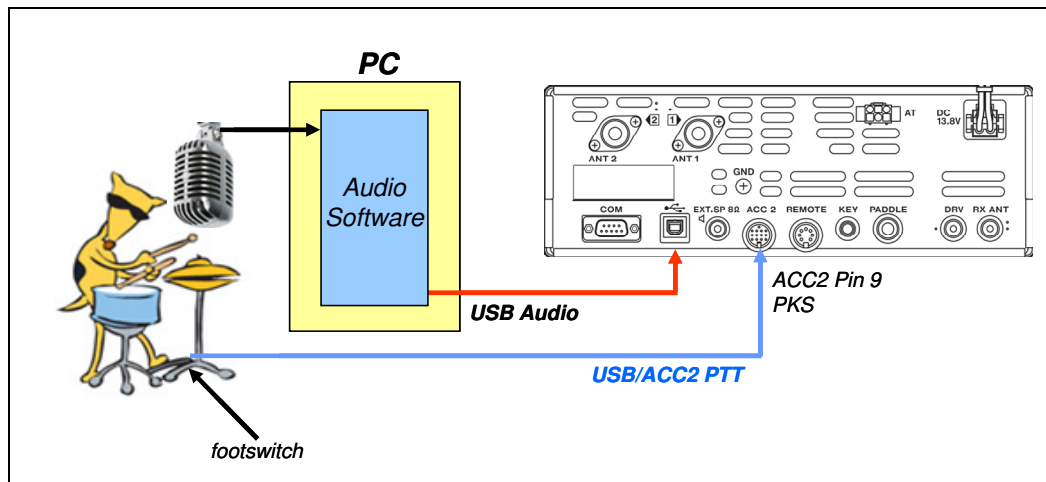
Figure 7: PTT Control for USB audio

The microphone is connected to a PC that is running audio processing software (such as Kristal or Romac) for equalization, compression and noise gate functions. In Figure 7 the audio output from the software is directed to the USB audio input on the radio, but it could be input to ACC2 instead..

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[4] There is an alternative method of generating a PKS signal for PTT, involving reconfiguring the COM port. However, this method is not recommended, as it changes the normal functionality of the COM port. See "CHANGING THE SIGNAL FOR THE COM TERMINAL" on page 58 of the TS-590S Instruction Manual [1].

MIC audio: If you use the MIC input, the PTT signal may originate from:
- ACC2 (SS)
- The MIC PTT switch

Again, you could use a footswitch for PTT, but this time it is connected to pin 13 of ACC2. See Figure 8.
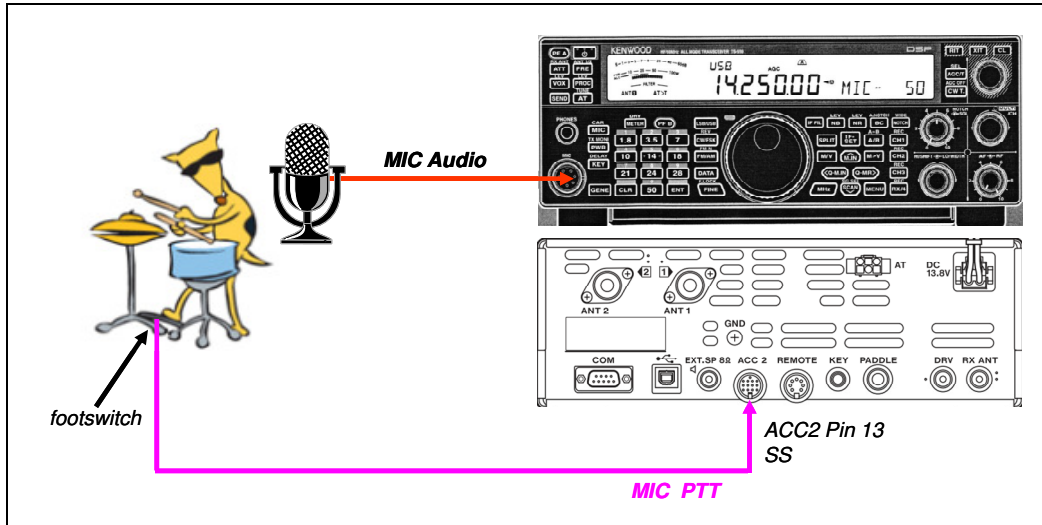
Figure 8: PTT Control for MIC audio

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External CAT Command TX Keying in Detail

It is possible to key the TX through CAT commands [3] originating from external software. The commands can be input to the radio through the USB COM port and/or the serial COM port.

There are two CAT commands to key the TX[5]:

- DATA SEND (TX1;) – used for USB and ACC2 audio (and the MIC input is muted). This has the same effect as keying the TX with PKS PTT.

- SEND (TX0; or TX;) – used for audio from the MIC input. This has the same effect as keying the TX with SS PTT.

See Figure 9.
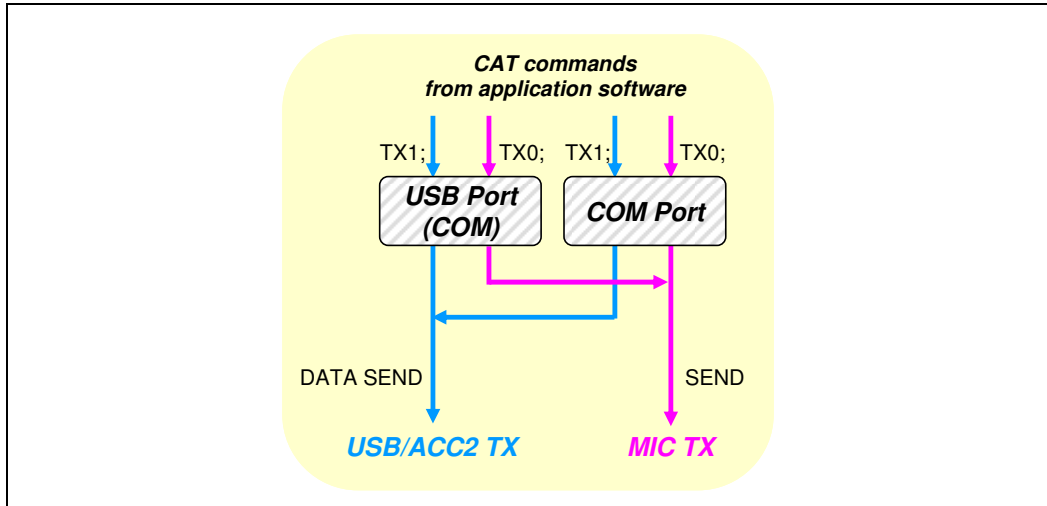
Figure 9: TX keying with CAT commands

- **Note that "DATA SEND" does _not_ mean "send data".**

- **"DATA SEND" tells the radio to transmit _any_ type of audio that is input to the USB or ACC2 port. This audio _may_ represent some kind of "data", but it could also be analog voice or other analog signal like analog SSTV.**

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[5] The RX; CAT command returns the radio to the receive state.

Button TX Keying in Detail

There are two ways to key the TX by pressing a button:

- For USB/ACC2 audio you can assign the DATA SEND command (menu function 205) to either of the front panel function keys (**PF A** or **PF B**) or to any of the four microphone programmable function keys (**PF1**-**PF4**). This has the same effect as keying the TX with PKS PTT.

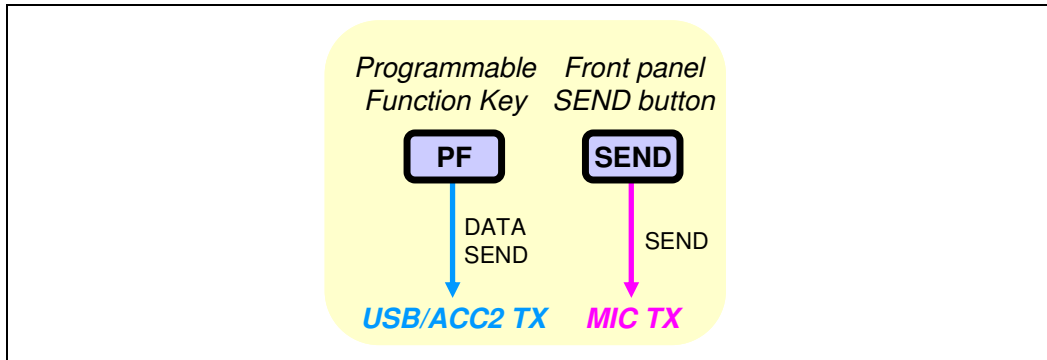- For MIC audio you can press the **SEND** button on the front panel. This has the same effect as keying the TX with SS PTT.

See Figure 10.

Programmable   Front panel
Function Key   SEND button

PF   SEND

DATA   SEND
SEND

USB/ACC2 TX   MIC TX

Figure 10: Using the programmable function keys and the SEND button to transmit

Audio Equalization and Filtering

The TS-590S provides a means of tailoring the transmitted audio, through an equalizer and low/high audio cut-off filters. See Figure 11.
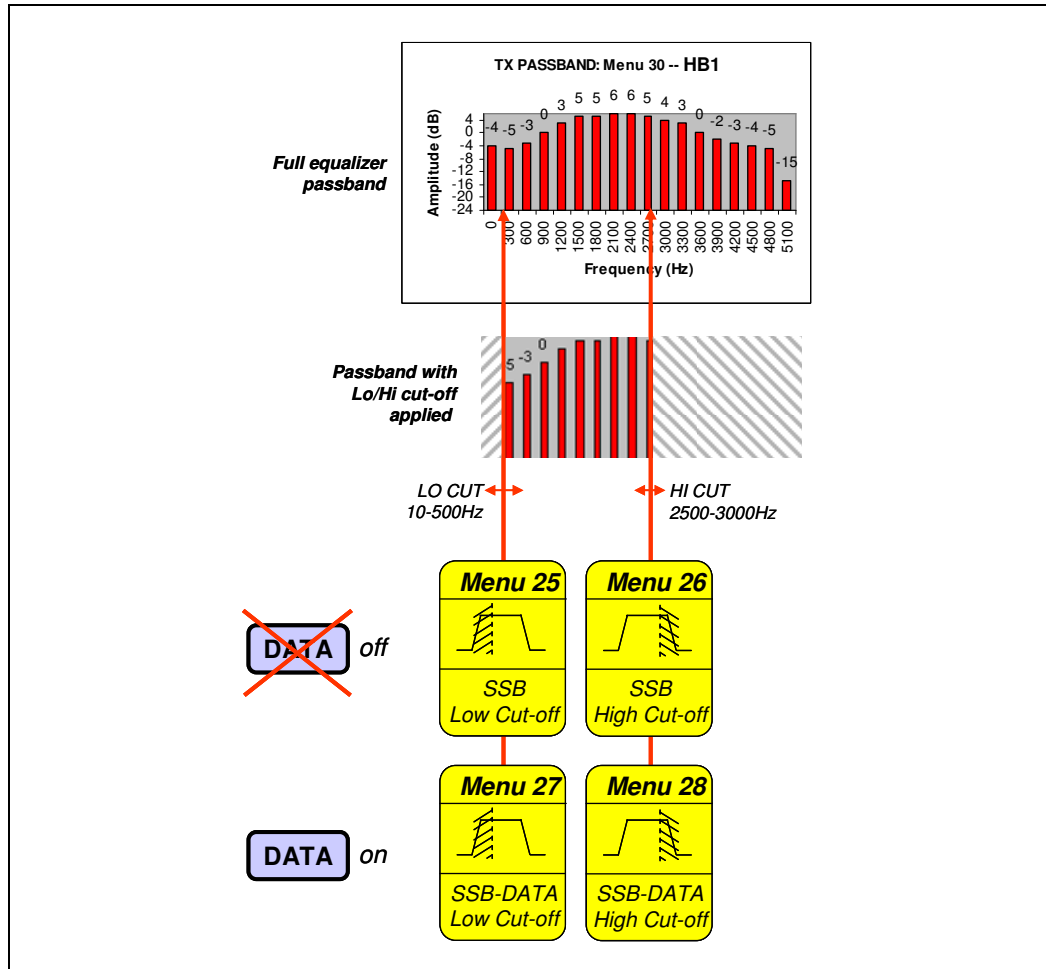
Figure 11: Audio equalization and filtering. Menus 25, 26, 27 and 28 filter the audio from _any_ input (USB, ACC2 or MIC), and the audio may be of _any_ type, not just "data"

With Menu 30 you can select one of eight equalizers (for example, HB1 in Figure 11) for a suitable audio profile that covers 0-5100 Hz. The four cut-off filters remove unwanted low and high audio frequencies.

The cut-off filters are in pairs, selectable by the **DATA** button on the front panel of the radio.

1. When **DATA** is _not_ selected, the filters are controlled by Menus 25 and 26.

2. When **DATA** _is_ selected, the filters are controlled by Menus 27 and 28

- **Note that DATA does not mean "data".**

- _**Both**_ pairs of cut-off filters operate on _**any**_ audio from _**all**_ input sources (USB, ACC2 or MIC).

But this is only half the story. The TS-590S actually has _two_ independent sets of equalizers and _two_ independent sets of cut-off filters. You select the set you want to use by toggling the **A/B** Menu button on the front panel of the radio[6]. See Figure 12.
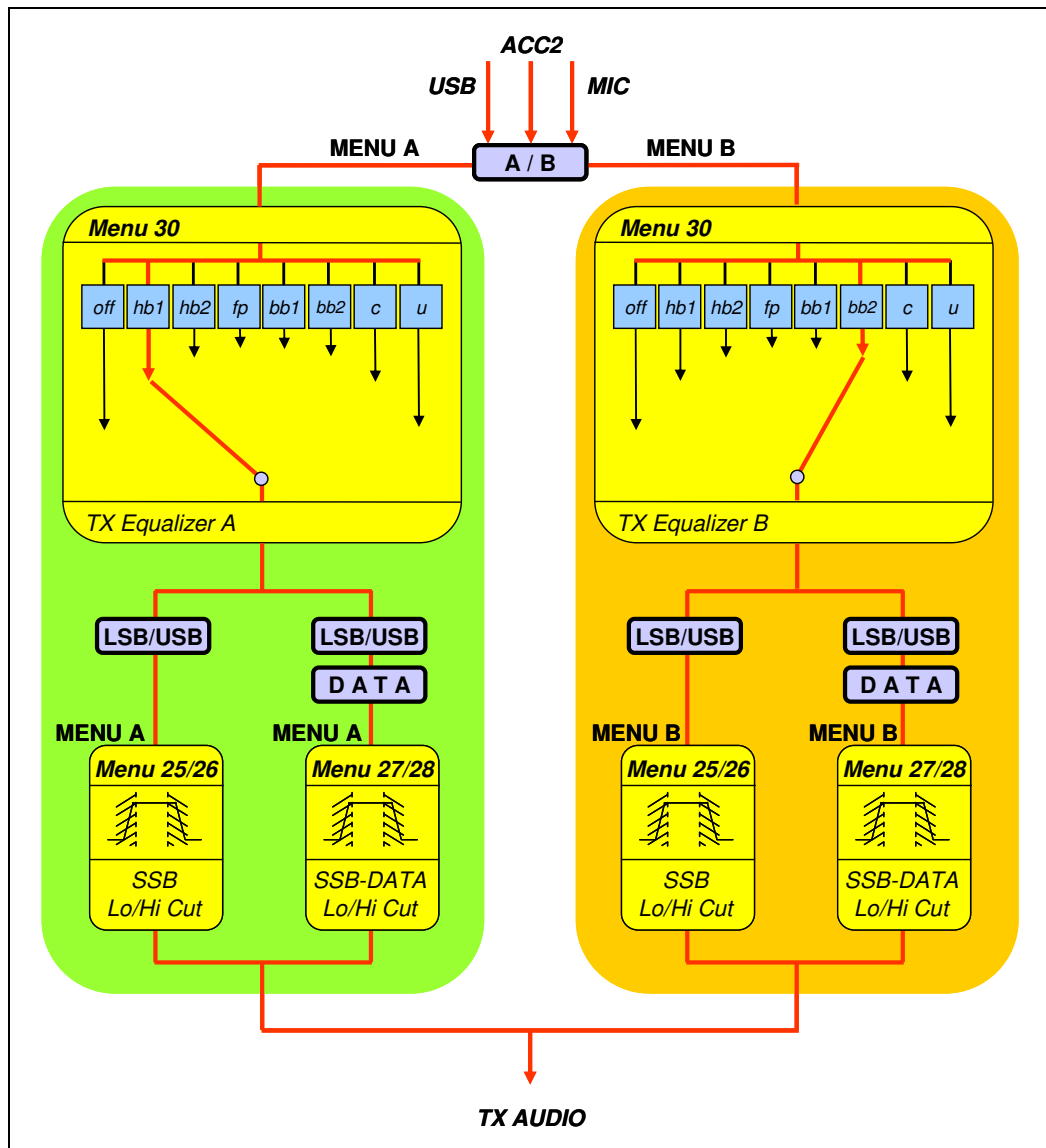

Figure 12: The full TX audio equalization and filtering picture

- **Note that you can set up the equalizer profile and cut-off Menus 25, 26, 27 and 28 in Menu A completely independently from the equalizer profile and Menus 25, 26, 27 and 28 in Menu B.**

- **This means you can define _four_ different TX audio profiles at one time, individually selectable by appropriate choice of menu (A/B) and cut-off filter pair (DATA on or off).**

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[6] To distinguish between Menu A and Menu B, it helps to select a different display backlight color for each menu, using Menu 01.

The DATA Button

Summarizing the basic functions of the **DATA** button on the front panel of the TS-590S:

- **The DATA button is inappropriately named. It has _nothing_ to do with "data" operation [7].**

- **If you press the DATA button to select the DATA option, the radio uses one set of audio cut-off filters.**

- **If you press the button again to de-select the option, the radio uses another set of audio cut-off filters.**

- **That is basically _all_ the DATA button does. It is an audio filter selector.**

- **Selecting or de-selecting the DATA option has the same effect on _any_ type of TX audio, irrespective of whether the audio is input via the USB port, the ACC2 port or the MIC socket.**

- **Selecting or de-selecting the DATA option has the same effect on _any_ type of RX audio.**

Putting the **DATA** options into a table:

Operation	DATA de-selected	DATA selected
TX	**Menu 25** selects the **low** audio cut-off frequency (10-500Hz) **Menu 26** selects the **high** audio cut-off frequency (2500-3000Hz)	**Menu 27** selects the **low** audio cut-off frequency (10-500Hz) **Menu 28** selects the **high** audio cut-off frequency (2500-3000Hz)
RX	The **LO/WIDTH** control lets you adjust the **low** cut-off frequency (0-1000Hz) The **HI/SHIFT** control lets you adjust the **high** cut-off frequency (1000-5000Hz)	The **LO/WIDTH** control lets you adjust the **width** of the audio passband (50-2500Hz) The **HI/SHIFT** control lets you adjust the **center** frequency of the audio passband (1000-2210Hz)

That said, most people will probably select **DATA** anyway when transmitting and receiving "data" signals. This has the advantage that when receiving you can conveniently set up a very narrow passband filter, using the front panel **LO/WIDTH** and **HI/SHIFT** controls.

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[7] It is unfortunate that Kenwood used the word **DATA** for this button. It would have been much more meaningful to name the button something like **AF FIL**, to toggle between audio filter sets 1 and 2.

The Speech Processor

The **PROC** button on the front panel of the radio lets you switch the speech processor on and off. Its operation is described in detail in the TS-590S Instruction Manual.

There are, however, three consequences of using the **PROC** button that may not be immediately obvious from the documentation:

1. "Data" operation: You should never turn **PROC** on when transmitting "data" signals. Without exception this will cause severe and unacceptable distortion to your signals.

2. The **DATA** button: Whenever you toggle the **DATA** button, the radio remembers the current **PROC** setting. If you decide to select the **DATA** option for "data" transmission, you should turn **PROC** off. Thereafter, whenever you re-select **DATA**, the radio will automatically turn off the speech processor.

3. Audio input level: The USB and ACC2 Audio Input Level controls (Menus 64 and 66) are only operational when **PROC** is switched off. When you switch on the speech processor, these controls are not functional, and it will be necessary to control the audio levels externally (in the PC or the Interface Unit). See Figure 16.
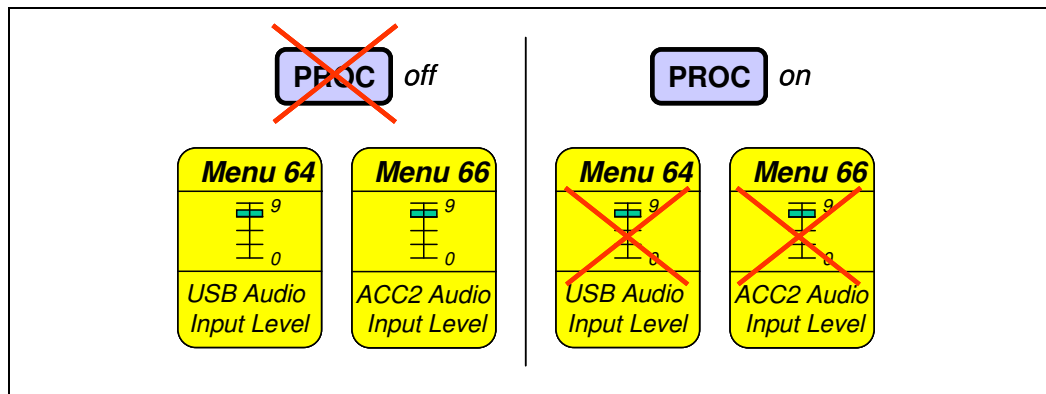
Figure 16: When the speech processor is switched on, the USB and ACC2 audio input level controls (Menus 64 and 64) are not functional

Receive Audio

Receive audio is output from the radio via the USB or ACC2 port, or via the headphones. It is also available on the internal speaker. The RX audio goes to all outputs – it is not switchable or selectable in any way. See Figure 17.
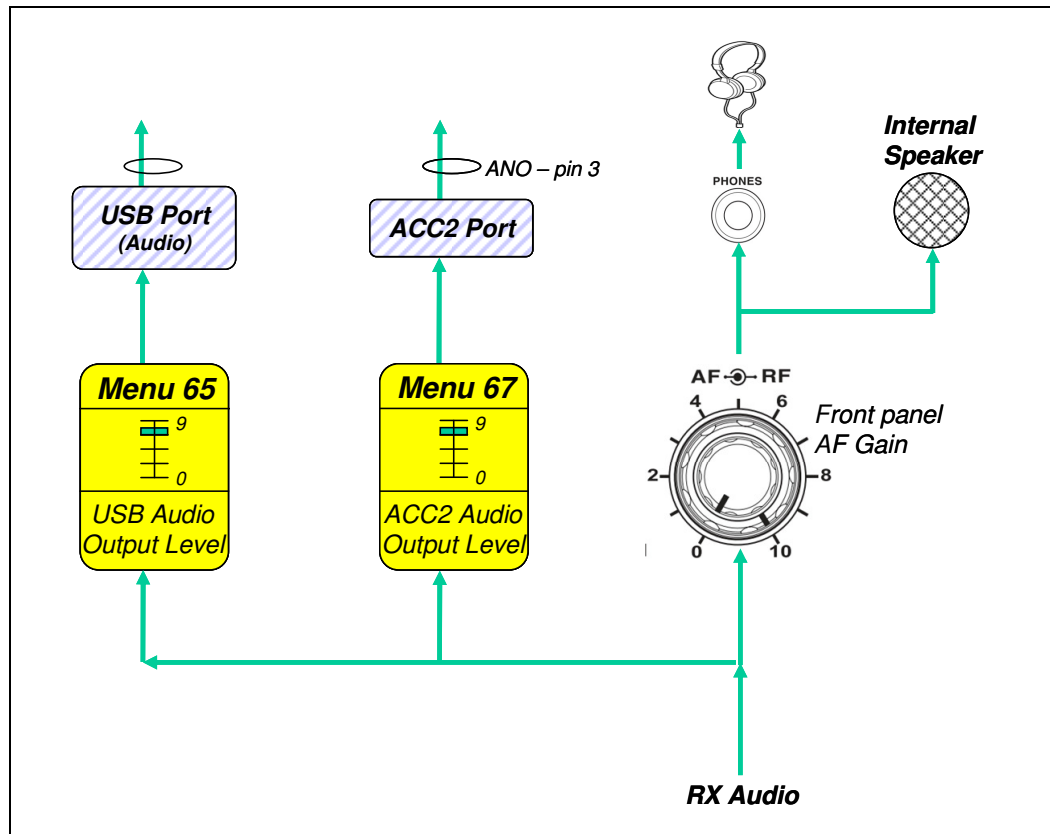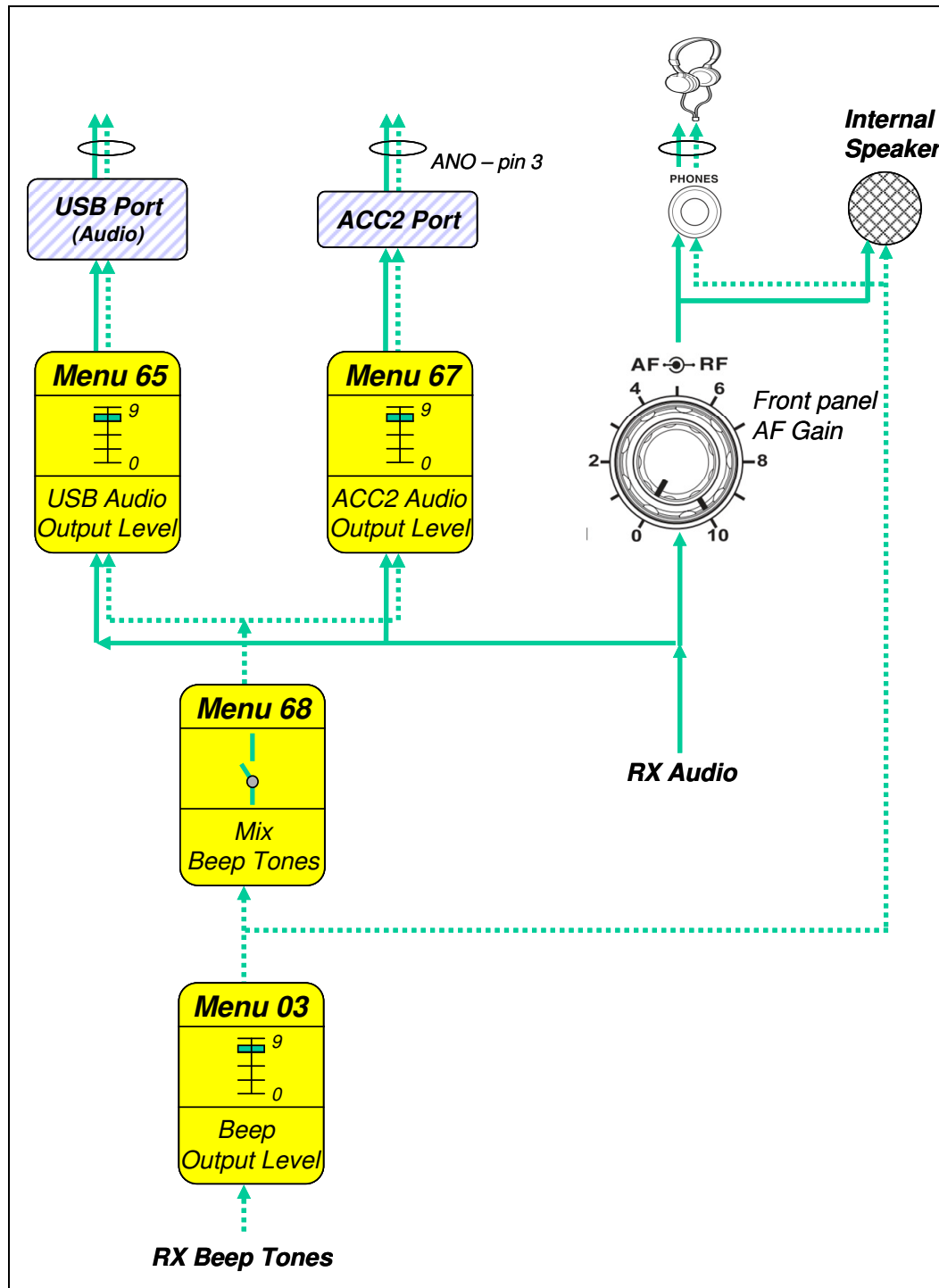

Figure 17: Receive audio. The audio is available on all outputs

RX audio output levels are controlled as follows:

- USB port: via Menu 65
- ACC2 port: via Menu 67
- Headphones/speaker: via the front panel AF gain control

In addition, the radio internally generates beep tones that, for example, indicate changes in mode or sideband selection, or error conditions. See Figure 18.

Figure 18: Receive audio, with beep tones

By default the beep tones only go to the headphones and speaker, but you can also send them to the USB and ACC2 ports by setting Menu 68 to ON.

Menu 03 controls the output level of the beeps.

Further, you can also feed the TX Monitor audio to the USB and ACC2 ports. This is useful when you want to record your transmitted audio as well as the received audio. See Figure 19.
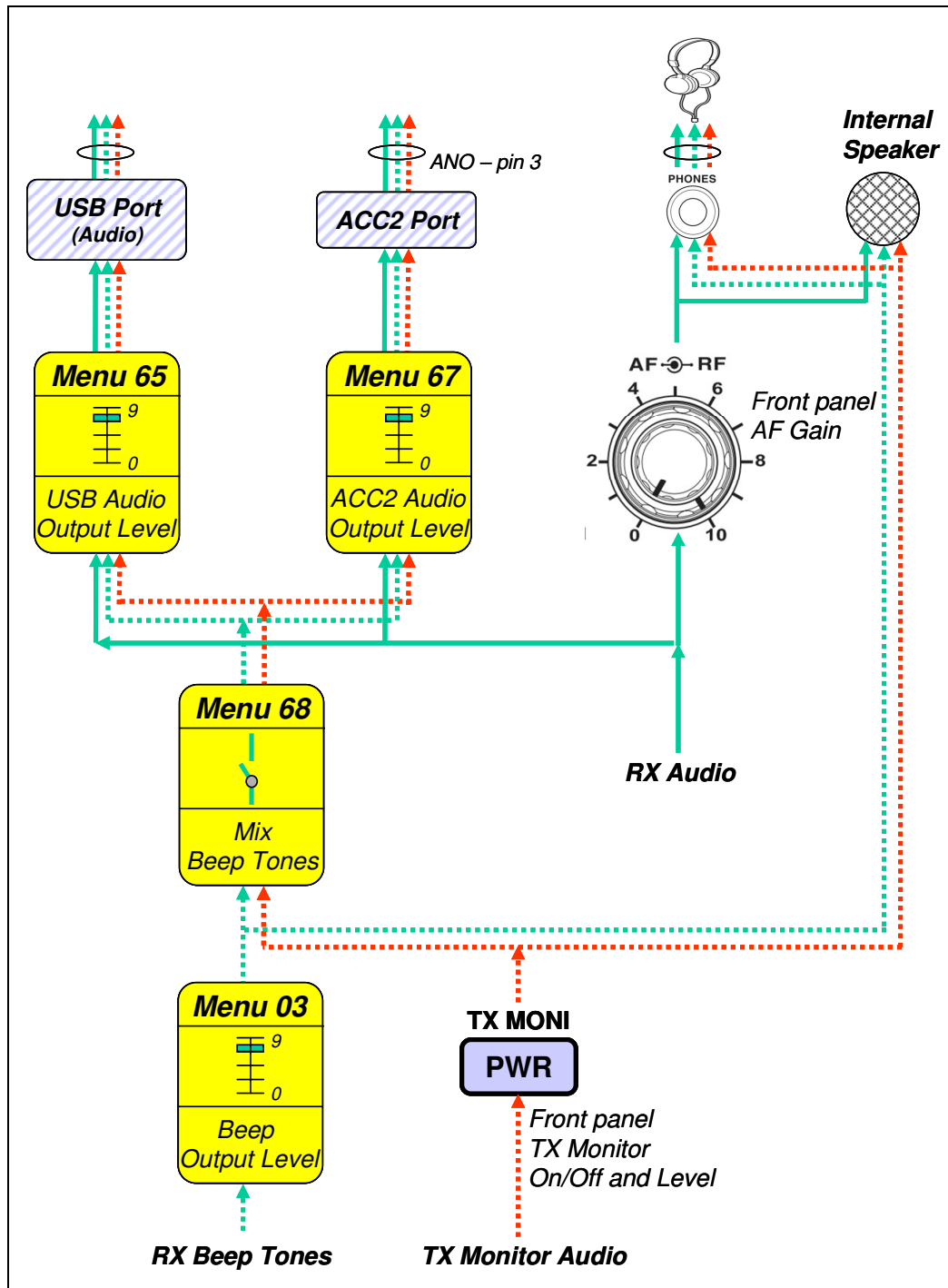
Figure 19: Receive audio, with beep tones and TX Monitor audio

The TX Monitor level is controlled from the front panel, and Menu 68 allows the monitor audio to be switched to the USB and ACC2 ports.

Left and Right Audio Channels – Receive

When receiving audio via the USB connection, the RX audio in the radio is connected to both the Left and Right channel, so that the digital software receives the same audio on both channels. See Figure 20.
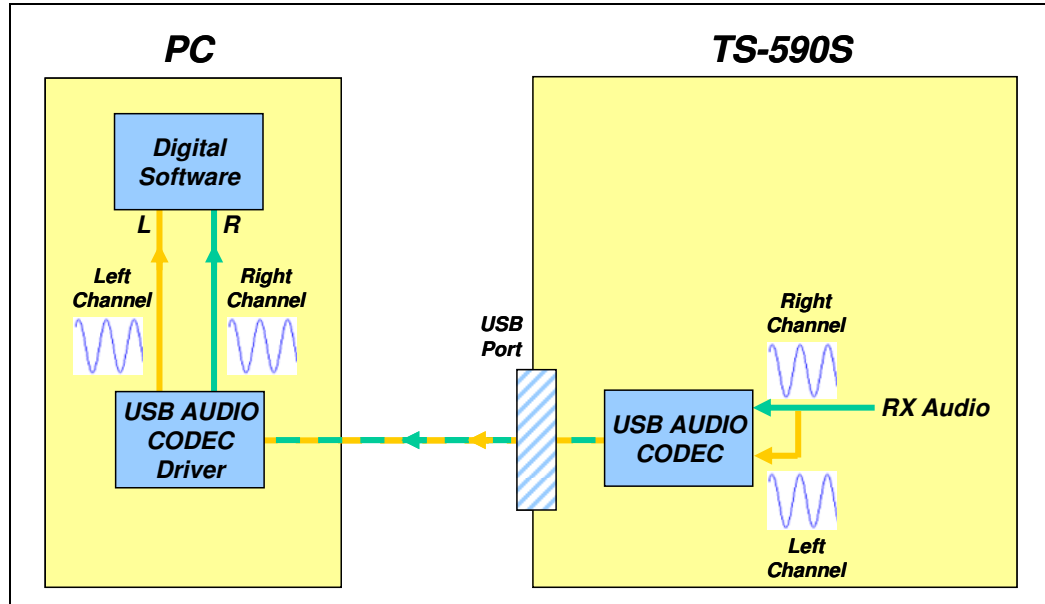
Figure 20: RX audio in the radio is connected to both the Left and the Right channel

RX Audio Tailoring

1. RX Audio Equalizer: The process for selecting an RX equalizer profile is essentially the same as for TX. You can set up two different RX equalizers**:** one for Menu A and the other for Menu B. See Figure 21.
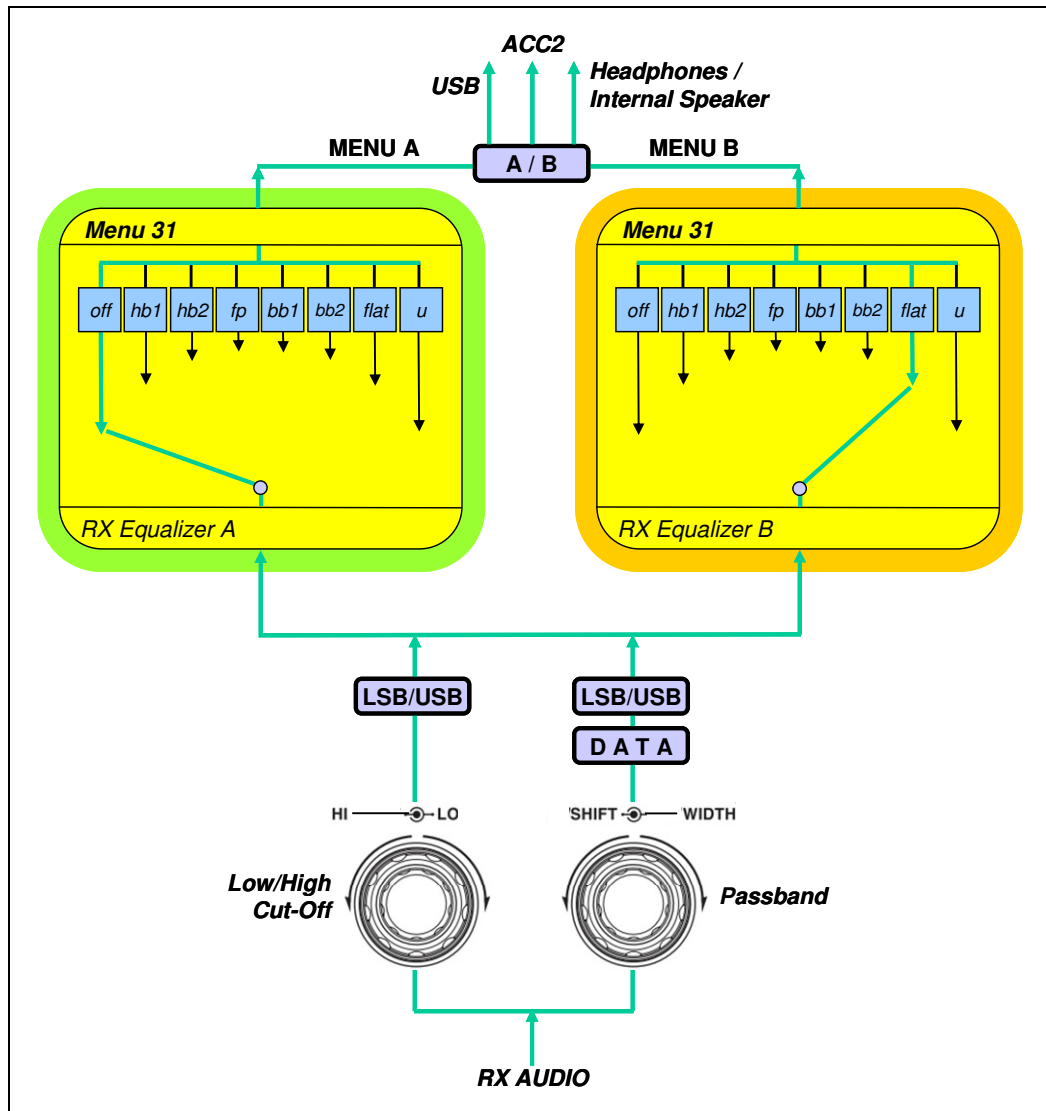
Figure 21: RX audio processing. You can select different equalizers (one for Menu A and another for Menu B), but the low/high cut-off and passband filters are shared between the two menus.

The procedures for setting up the profiles are essentially as previously described, except that when selecting the profiles via the front panel, you use Menu 31 (instead of Menu 30). If you use ARCP-590, click on the **RX Equalizer** button (instead of **TX Equalizer**) before selecting the required profile from the dropdown list.

Note: When receiving "data" signals, the RX audio equalizer should be set to OFF, to minimize distortion.

RX Audio Filters: Unlike for TX audio processing, there is only one set of audio filters for received audio. These filters are set up using the **HI**/**SHIFT** and **LO**/**WIDTH** controls, together with the **DATA** button, on the front panel:

- If **DATA** is _not_ selected, the **HI**/**SHIFT** and **LO**/**WIDTH** control settings determine the low and high cut-off audio frequencies.

- If **DATA** _is_ selected, the **HI**/**SHIFT** and **LO**/**WIDTH** control settings determine the center frequency and width of the audio passband. See Figure 22.

  - The **HI**/**SHIFT** control sets the center frequency of the filter.
  - The **LO**/**WIDTH** control sets the width of the filter.
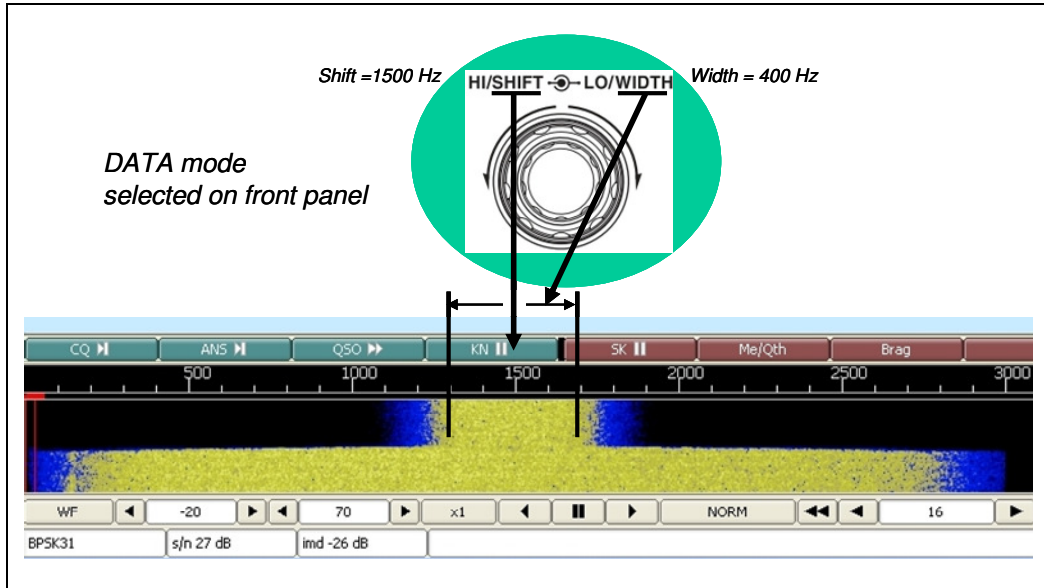
Figure 22: The RX audio passband filter in operation (with Fldigi). The radio must be set to DATA mode

THE BOTTOM LINE

The TS-590S handles audio. "Audio" can be microphone output, recordings of audio signals, canned messages, tones representing any kind of digital "data", analog sstv, modulated CW, etc etc ....

The TS-590S treats them all the same.

The TS-590S does not understand the difference between voice and digital "data".

ON TX

The important distinction lies in how the audio enters the radio: Is it via the USB port, the ACC2 port or the MIC socket?

Any type of audio may enter the USB port – it may be "data" tones, it may be voice.
Any type of audio may enter the ACC2 port – it may be "data" tones, it may be voice.
Any type of audio may enter the MIC socket – it may be voice, it may be "data" tones.

Wherever Kenwood says "DATA", think "any type of USB/ACC2 audio".

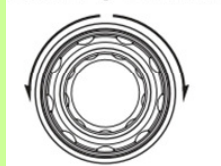Wherever Kenwood says "VOICE", think "any type of MIC audio".

any type of
USB/ACC2
audio

any type of
MIC
audio

**Kenwood
DATA**

**Kenwood
VOICE**

ON RX

Wherever Kenwood says "DATA", think "SHIFT/WIDTH filter".

HI/SHIFT -◉- LO/WIDTH

Appendix 1: Built-In Transmit and Receive Equalizer Profiles

This appendix provides a graphical representation of the pre-defined transmit and receive equalizer profiles that are built in to the TS-590S.

The charts were obtained by reading the 18 levels for each profile, using the "UR" CAT command – see page 25 in the TS-590S PC Control Command Reference [1] [8].
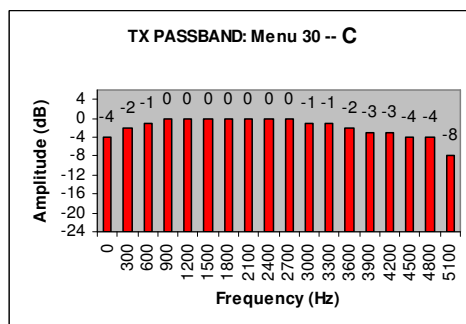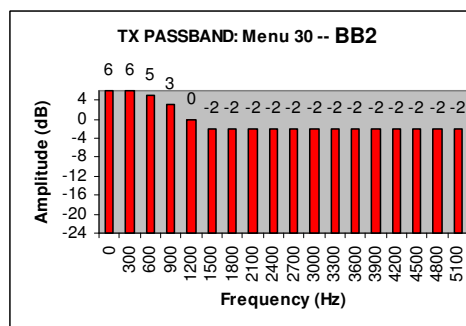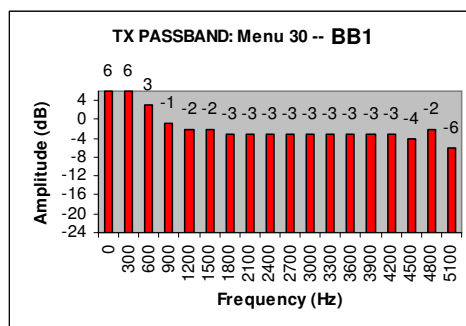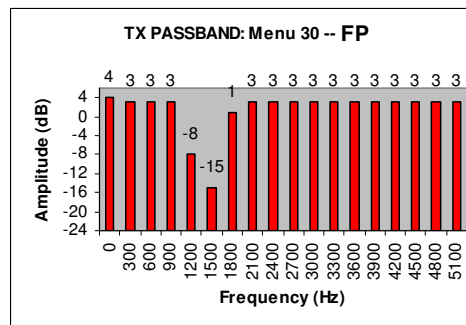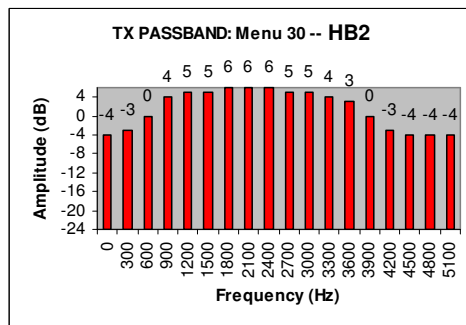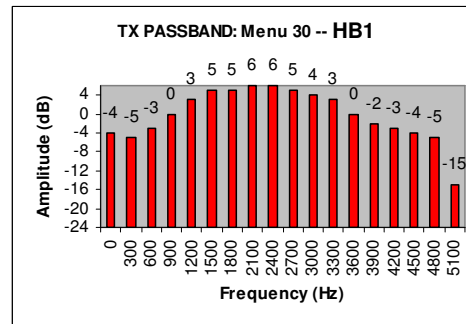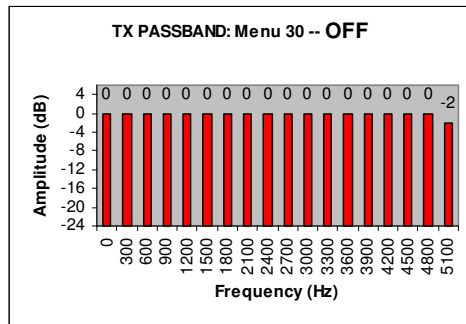
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[8] Note that there is an error in the Reference Guide. The description for the "UR/UT" commands says:

> Each parameter has a range from 00 ~ 30 (where 00 is -24dB .... to a maximum of +6dB at 30)
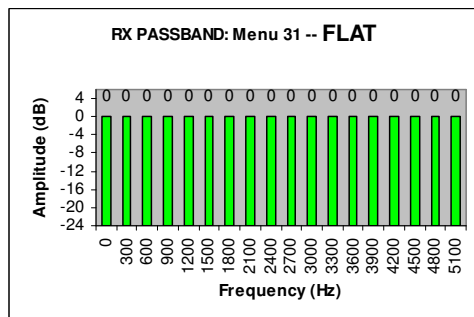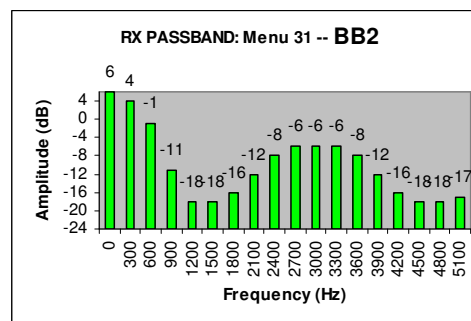
In fact, the values are inverted. The description should say instead:

> Each parameter has a range from 00 ~ 30 (where 00 is **+6dB** .... to a **minimum** of **-24dB** at 30)

Transmit Equalizer Profiles

TX PASSBAND: Menu 30 -- **OFF**

TX PASSBAND: Menu 30 -- **HB1**

TX PASSBAND: Menu 30 -- **HB2**

TX PASSBAND: Menu 30 -- **FP**

TX PASSBAND: Menu 30 -- **BB1**

TX PASSBAND: Menu 30 -- **BB2**

TX PASSBAND: Menu 30 -- **C**

Receive Equalizer Profiles

RX PASSBAND: Menu 31 -- OFF

Amplitude (dB) vs Frequency (Hz): values 0, 0, 0, 0, -1, -2, -3, -4, -5, -6, -7, -8, -9, -10, -11, -12, -13, -14

RX PASSBAND: Menu 31 -- HB1

Amplitude (dB) vs Frequency (Hz): values -5, -4, -5, -3, 2, 5, 6, 6, 6, 6, 6, 6, 6, 6, 4, -5, -24

RX PASSBAND: Menu 31 -- HB2

Amplitude (dB) vs Frequency (Hz): values 1, 1, 1, 1, 3, 5, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6

RX PASSBAND: Menu 31 -- FP

Amplitude (dB) vs Frequency (Hz): values 3, 3, 3, 1, -10, -18, 0, 3, 3, 3, 3, 3, 3, 3, 3, -5, -24

RX PASSBAND: Menu 31 -- BB1

Amplitude (dB) vs Frequency (Hz): values 6, 2, -8, -11, -11, -12, -11, -11, -11, -11, -12, -11, -11, -11, -11, -12, -11, -15

RX PASSBAND: Menu 31 -- BB2

Amplitude (dB) vs Frequency (Hz): values 6, 4, -1, -11, -18, -18, -16, -12, -8, -6, -6, -6, -8, -12, -16, -18, -18, -17

RX PASSBAND: Menu 31 -- FLAT

Amplitude (dB) vs Frequency (Hz): values 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

References

	Resource	URL
[1]	TS-590S Instruction Manual	Go to the TS-590S Resources Page:
		http://homepage.ntlworld.com/wadei/ts-590s.htm
		Click the KENWOOD TS-590S DOCUMENTATION button, then click on the link "Instruction Manual"
[2]	ARCP-590 Control Program	Go to the TS-590S Resources Page:
		http://homepage.ntlworld.com/wadei/ts-590s.htm
		Click on the KENWOOD TS-590S SOFTWARE button, then click on the "TS-590S Software" link. Then follow the Kenwood link to the ARCP-590 program
[3]	TS-590S PC Control Command Reference Manual	Go to the TS-590S Resources Page:
		http://homepage.ntlworld.com/wadei/ts-590s.htm
		Click the KENWOOD TS-590S DOCUMENTATION button, then click on the link "TS-590S PC Control Command Reference"
[4]	TS-590S HOWTO: SSB Audio Setup	Go to the TS-590S Resources Page:
		http://homepage.ntlworld.com/wadei/ts-590s.htm
		Click the TECHNOTES button, then click on the link "TS-590S HOWTO: SSB Audio Setup"

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Thank you.

Document Version History

Version	Date	History
1.0	22 April 2012	First public release
1.1	20 October 2012	Moved the instructions for setting up the User-defined equalizer using ARCP-590 to the SSB Audio Setup HOWTO [4]
		Added Appendix 1 containing the built-in TX and RX equalizer profiles