LET'S GET THOSE KENWOODS BACK ONLINE!

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K6IOK Support > TS-930 & TS-940 Iss... > TS-930S - Random no...

TS-930S - Random noise with the antenna disconnected - This is a long journey!!!

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ak6ok

(@ak6ok)

Member

Admin

Dave - KB7JS spent days and night staying up late looking for a few errant signals within a TS-930S. I hope you have a lot of time - This post is going to last a while!

Quote

Posted : 10/10/2018 12:18 am

dave phillips

(@dave-phillips)

Member

There is a long story that can be told about the search to identify the audacious noise that can be found in the TS-930 receiver, especially in the 2.0 to 4.0 Mhz frequency range.   If you are interested in how it was identified and located, you can read this entire missive and travel the path of enlightenment as I did.

If you lack the patience to take this trip, jump to the end, where I explain the source and the simple and

Moderator

effective fix.

The frequencies between 2000 kHz and 4000 kHz are historically where the most noise plagues Amateur Radio enthusiasts, especially during summer months when atmospheric noise is greatest. Add to this the plethora of noise growing in this band space as a result of “Modern” electric and electronic devices such as LED Lighting, Wireless Alarm systems, Personal beauty and Hygiene products, and even Juvenile toys. Most of us have simply come to accept that these frequencies are the land of noise, and those who operate there need to use lots of power to overcome it.

The Problem

However, when you disconnect the antenna from your TS-930, maybe even terminate it with a 50 Ohm load, then turn the Attenuator on at the 30 dB level, you will still find several fairly strong, and annoying noise signals in this frequency range. Where do they come from? There was some concern voiced that this noise would be attributable to Switching Regulator power supply modifications to this proud old flagship from Kenwood, and I undertook some long nights of research to find out if that were true, and if not, where it was coming from.

With the rare exception of unfiltered power line noise or high power near field RF, any received signal that remains strong, or actually increases in strength, when the receiver attenuator is engaged is a sure indication it is being generated within the radio itself. Since there is an abundance of relatively strong RF signals generated within any modern transceiver, it is quite possible that one or more of these can generate harmonic images. This kind of interference or noise is typically associated with Intermodulation products caused by the mixing of various different signals within the circuits, producing images at their sum and product harmonic frequencies. Most quality transceivers are engineered to limit this type of IMD to absolute minimums, and the TS-930 is among the best. Yet, here it was, audacious noise, especially in the 2.5 through 3.0 MHz range, these noise images are variant in frequency and very wideband, difficult to identify, at different frequencies in every radio, thus resulting in great difficulty determining where they might originate.

The Hunt for the Source

These "noise" signals are typically well below -100 dBm, less than 2 microvolts in amplitude, extremely difficult to identify and track using conventional RF signal visualization with an Oscilloscope or Spectrum Analyzer. However, since the TS-930 has a very low natural noise floor, they are easily detected and heard in the receiver. Still, I needed a method to visualize them in order to track them through the receiver signal path.

Luckily, I happened to locate a very nice Hewlett Packard 8347A RF amplifier in fine condition on eBay for the reasonable ransom, and with it, developed a method of sorting out very weak signals in the receive IF path. What I discovered was alarming, several very prominent noise signatures, the most prominent a very wide-band multi-harmonic signal, spanning from 2.7 MHz to 3.5 MHz, with multiple peaks, the greatest peak amplitude of approximately -105 dBm (1.0 uV). I found this signal at the Receive Antenna Input port “RAT” of the Signal Unit, with the antenna cable disconnected and terminated at 50 Ohms. This signal simply "appeared" in the BPF stage.

Next, I took steps to totally isolate the BPF stage from any potential RF contribution leaking from the mixer stage in the 1st RF Amp by simply removing them. That made no difference. I then isolated any possibility that this noise was coming from the power supply system by replacing all of the primary and derived voltages (28V, 21V, 8V) with batteries. This made no difference at all, the gremlin lived on.

Looking at the schematic of the Signal Unit, there is only one other logical path that RF energy could enter the BPF stage, through the Marker Signal input, which is injected directly after the attenuator stage, a major clue that dawned on me quite late in the search. I moved the Spectrum Analyzer input to the Marker signal connector and noted that the noise signature was still there.

Rationalizing that the problem might be Phase Noise from the PLL Unit, I disconnected the Marker cable from its source point on the PLL Unit. To my amazement, the amplitude of the noise signal at the Signal Unit increased by almost 6 dB. This truly qualified the noise as a Gremlin.

The Source is Found

Examination of the Signal Unit schematic shows that the 100 kHz Marker is fed directly into the receive signal path just after the attenuator. The source of the Marker signal is derived from the 20 Mhz reference frequency through a 1/10 decade counter array on the PLL Unit. The output of the Marker is gated through a transistor switch on the PLL unit which is enabled by a switch mounted on the speaker frame.

Kenwood apparently wanted to avoid using a TTL square wave pulse produced by the decade counter chip as a Marker signal injected into the receiver, so they implemented a bipolar transistor combination switch and driver , Q40, to shape the marker as a variant voltage sine wave, and then feed it to connector J6, then over a coaxial cable to J2 on the Signal Unit. Note on the schematic you can see that the shield of the coax cable is connected to the emitter of Q40, and DC Isolated from ground by C1. The only time this shield is clamped to ground is when the Maker signal is turned on by the switch on the Speaker frame, which pulls this line to ground, biasing the transistor, and enabling transmission of the signal. So, when the Marker is not in use, this cable does not have its shield tied to ground, it is a pure bipolar line held at a DC level, and as such, provides a reasonably good and sensitive antenna that absorbs low-level energy as it passes near several active circuits on its way to the Signal Unit.

The Fix

Alas, the Marker signal cable is an auxiliary antenna that feeds random RF energy into the receive signal path. The fix to this problem is to obviously necessary to remove or dampen induced common mode RF on the Marker coaxial cable to prevent it entering the receive path. One sure way to fix this problem is to simply disconnect the cable at the Signal Unit. No input, No noise, No Problem.

I attempted to relocate the coaxial cable to position it away from sources of RF, even routing the cable around the outside of the chassis. These actions had a tremendous impact on the level of the noise signal at the input to the BPF on the Signal Unit but did not remove it entirely.

Assuming that the noise was being induced onto the cable RF radiation along its length, I decided to try adding a simple Ferrite filter on the end of the cable nearest the Signal Unit. I carefully removed the two contacts from the connector at J2, threaded the coax cable through a Ferrite tube for one loop, then reinserted the pins in the connector. I then covered the Ferrite tube with shrink tubing and reinstalled the connection.

Success

Alas, the ferrite filter removed the noise signal entirely, it could no longer be detected on the Spectrum Analyzer even at 50 dB of amplification of the input. This is a simple fix, easy to apply, and results in a significant reduction in noise in the low-frequency bands.

Cheers
Dave

Reply Quote

Posted : 10/10/2018 9:25 am

dave phillips

(@dave-phillips)

Member

Moderator

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But, as useless as it may be most of the time, some folks like having a Marker capability, so I decided to find a permanent fix without deleting it. I attempted to relocate the Marker coaxial cable to position it away from sources of RF, even routing the cable around the outside of the chassis. These actions had a tremendous impact on the level of the noise signal at the input to the BPF on the Signal Unit but did not remove it entirely.

Assuming that the noise was being induced onto the cable by RF radiation along its length, I decided to try adding a simple Ferrite filter on the end of the cable nearest the Signal Unit. I carefully removed the two contacts from the connector at J2, threaded the coax cable through a Ferrite tube for one loop, then reinserted the pins in the connector. I then covered the Ferrite tube with shrink tubing and reinstalled the connection.

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Cheers

Dave Phillips

KB7JS

Reply Quote

Posted : 10/10/2018 9:39 am

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