Modification of the Watkins Johnson WJ8617B-17 for Reduced Susceptibility to Overload

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Background

The WJ8617B-17 is a version of the 8617B that incorporate S-1 microprocessor functionality as well as a number of modifications that were intended to tailor the receiver for use as part of an EMI/EMC receiving setup. This modification included replacement of the antenna switch module with a non-switched dual amplifier module between the antenna input connectors and the receiver preselector modules. This resulted in a very 'hot' receiver designed for use in controlled RFI measurements (such as within a screen room or anechoic chamber). These may have seen limited used for surveillance applications where antennas were quite inefficient and where ambient RF levels were very low (say Asmira, Ethiopia or other remote monitoring post).

This higher sensitivity design has the side effect of greatly increasing the receiver's susceptibility to overloading (likely second and third order IM) in the presence of strong signals. I happen to live within line-of-sight of quite a number of FM broadcast and television transmitters (some being as close as four or five miles from my residence) in the Seattle, Washington area. These have traditionally clobbered my higher end consumer receivers, like my ICOM R7000, R7100 and R8500 receivers. These same signal levels also test some of the 'better' surveillance receivers as well.

These signal sources greatly overloaded my two 8617B-17's, especially when listening in the FM broadcast band. Insertion of significant attenuation ahead of the receiver input was required to even hear local FM broadcast stations without severe interference. No amount of manual gain control adjustment resolved this issue. My 'normal' 861XA/B receivers had only slight overloading problems receiving airband signals in the adjacent air band. These problems became essentially 'no problem' once an FM trap was introduced to reduce the FM broadcast signals to a reasonable level.

Modification

In an effort to reduce the significant overloading present in this 'low noise figure' version of the 8617B, I decided to try modifying the front end to reduce front end gain. I wanted to keep the basic operation of the receiver the same, as well as maintain its overall configuration. It was clear that removing the added gain from in front of the receiver front end was key.

My modification took the form of eliminating the two MMIC amplifiers that precede the VHF and UHF preselectors. In my receivers, and I suspect this is the case in essentially all 8617B-17 receivers, I have the LFE and FE options (1)

present. In the 8617B-17 receivers, the antenna switching function is disabled and each antenna port has a fixed reception range. In this receiver, this means that one receive 'channel' is fixed at 500 KHz through 500 MHz and the second receive port is a fixed 500 MHz-1100 MHz path. Each uses a single MMIC for additional gain prior to preselection.

These amplifiers are located in the module that normally serves as the antenna switch. This switch function is replaced in the -17 with the two amplifiers. One could leave the amplifier intact and route new antenna inputs directly to the receiver front end but I elected to retain the same physical configuration and proceed with removing the amplifiers while keeping the mechanical configuration the same. Some owners might elect the different approach of removing the amplifier module and running cables into the front end modules through the holes created in the rear panel by the removal of the amplifier module, however, I *knew* I *never* wanted to reuse the WJ preamplifier again. My approach maintains the appearance and physical configuration of the original.

I carefully disassembled the rear of the receiver to give myself enough room to slide the amplifier module out of the receiver chassis. This means removing four screws that attach the module to the rear panel and then taking out an additional 15 screws or so and allowing the rear panel to dangle from the attached cabling. You can then remove the two SM-series connectors from the module, unplug the power lead that runs down to the motherboard at the bottom of the receiver and remove the module.

Remove the module and remove the four screws holding the cover. You will see a small circuit board inside with power, ground, ANT 1 in and ANT 2 in connectors. Unsolder each of these. Unsolder the center pin of the SM-series connectors that exits the module. Remove the visible Phillips-head screws. Now flip the module over and unscrew the eight screws holding the N connectors to the module. Remove these. You will note a number of countersunk Phillips-head screws. These attach to two aluminum 'rails' that support the RF amplifier circuit board. Loosen but don’t remove these to allow some 'wiggle' room to remove the circuit board.

Flip the module over and carefully work the circuit board free. Once removed from the module, unsolder the two MMIC modules carefully. Save the MMIC's and hardware in case you want to restore the unit to its original configuration (but why?). Now jumper across the pads that tie to the input and output connectors for each antenna input. Reassemble the module and reinstall in reverse order into the receiver.

Alignment

No RF/IF section alignment is thought to be required. The modification does not change signal levels between RF/IF modules in any way (other than reducing gain ahead of the preselectors and mixers).

Results
The receiver performs perfectly in the face of high ambient signal levels (matching my other WJ receivers) with one exception. The microprocessor signal level input from the AGC board has been modified in the -17 (actually, it's the Receiver Interface Board with the modifications) to properly 'scale' the signal strength indication for the normal -17 added gain stage. Removing the gain stage drops the receiver sensitivity and causes the receiver signal strength to read around 12-16 db low. There is a voltage divider that sets the input to the micro that appears to be easy to change so that the front panel signal strength indications are again correct. I am investigating the proper values to scale the signal indication from the AGC board so that I return the receiver to signal strength indications that match a standard 8617B/8618B series receiver.

Notes:
1. There are a variety of variations as to how HF and LF coverage was provided in WJ8617B/WJ8618B receivers. These included use of upconverters as well as simple modifications of the VHF Low Band Preselector board that extended the low frequency limit of the first bandpass filter downward from the normal 20-30 MHz range. These included modest bandpass filtering that expanded the bandpass to include the 2 MHz to 30 MHz range, as well as some form of either a bandpass filter or lowpass filter that extended low end coverage down to 500 KHz.

Finally, there were versions of the LFE option (typified by the 8617B-17) that simply replaced all filtering for the 500 KHz-30 MHz range with a wire. I have documentation that shows the standard filter, the HFE option (2-30 MHz bandpass) and the 8617B-17 'wire' approach but have not seen complete documentation on the LFE that provides bandpass filtering from 500 KHz to 30 MHz. These approaches likely provide 'modest' HF/LF performance when compared with true HF/LF receivers. Terry O'Laughlin also refers to true upconverters that may provide significantly improved HF and/or LF operation. I have not sent any documentation on these versions.