The Signal

OFFICIAL MAGAZINE OF THE
COLLINS COLLECTORS ASSOCIATION
Q3 2019 Issue #95

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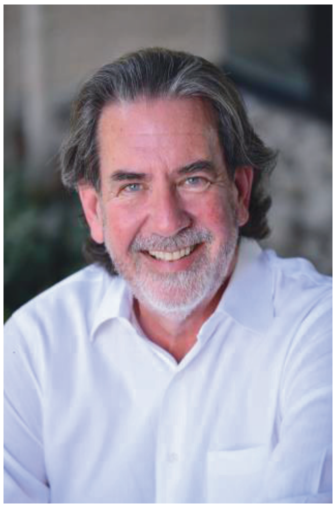
Collins Collectors Association

From the President's Desk...



Normally this is a quiet time of the year for the CCA but several things have been happening behind the scenes. Jim Stitzinger will be terming out on his four year limit for being on the board. He will have to sit out at least one year before he can rejoin the CCA board so we need someone to step up and volunteer. We have lots of opportunities to serve in the CCA and we are always looking for someone to step up and take over a job. Since Bill Carns, N7OTQ is also stepping down, we need a couple of people. Dennis Kidder, W6DQ is throwing his hat in the ring and looks like he will take over as Secretary. Thanks Dennis! I look forward to working with you again. Email me if you are interested in participating.

Bill Carns had stepped up to fill an open Board slot and we appreciate Bill taking time to serve again. He is going to spend quite a bit of time traveling in the next few years so his 'Collins' time is going to be very limited. Bill got the HFCOMM group up and running but will be giving that up also. Asa Jay Laughlin, W7TSC has agreed take take over the HFCOMM group. Asa has tremendous experience in Collins Military and Commercial equipment as does our Vice President, Francesco Ledda, K5URG.

Each of them have two -- yes -- two Collins shelters that are operational. See Asa's article later in this publication and you will see that we have a real authority serving in this position. Asa is usually there in his TSC shelter for the Sunday net so tune in when we call for the 7's and you can hear one in operation. Thanks Asa for taking this on!

If you are new to the URG/HF80/URC32/KWT6/718 and so on gear drop Asa or Francesco an email and get involved. This stuff is lots of fun!

We could really use some fresh voices as Net Controls. The weekday and Friday night SSB nets are doing fine as is the First Wednesday AM net, but we really need some Sunday afternoon 20 meter net controls. If you have not been a net control before - have no fear - it is not hard. I get tongue tied and also miss some call signs each time I run a net so do not hesitate to give it a try. Email Jim Holibaugh - W6TMU, our twenty meter net manager, at: jimhollis@pop.prodigy.net if you have an interest.

de - Scott KE1RR

The Signal Magazine

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The Signal Magazine

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*Tuesday 3805 kHz at 8pm CST
*Thursday 3805 kHz at 8pm CST
*Friday [West Coast] 3895 kHz at 10pm CST
*Sunday 29.050 MHz at 10am CST

From the Editor

Dear Friends,

The thing I have always loved about Collins was the breath of their portfolio. We go from Ham Radio to Commercial transmitters, military radios, avionics, space and computing. No matter what we are looking at, it will always be technologically awesome, marvelously manufactured and beautiful.

After the Dayton issue, we go back to S-Line, an unusual 51J-4 and a top of the line high dollar HF-80 system. The Article about the HF-80 is from our friend Asa Jay Laughton W7TSC; he was a user of Collins equipment in the US Air Force, and he shares his experience with us.

As always, we are looking for contributors to the Signal. Please, share your stories, your projects and help us maintain this magazine rich and alive.

Best Regards,
Francesco Ledda, K5URG
Editor & Vice President, CCA
k5urg@yahoo.com

AN/TSC-60(V)9 - A Short Story

By Asa Jay Laughton – W7TSC

Out of the dampness of a misty, cold Pacific Northwest morning, the outline of an old S280 shelter on the back of an ex-military deuce came into view. Weather-beaten, with evergreen mold growing on the sides and a light cover of snow, it sat quiet, yet familiar. Memories from 20 years past came to mind as I surveyed the rear of the shelter and its familiar RF/Signal entry panel, it's six HN bulkhead connectors, coupler control jacks, signal punch-downs and 407L cable hawks. Before I even got close enough to read the identification tag riveted to the door, it was unmistakable; this was an AN/TSC-60(V) HF communications shelter.

It was early January 2015, nearly 12 years since I retired from the Washington Air National Guard and 20 years since I'd last seen a TSC-60 facility. I stood there, my breath visible in the cold air while a retired friend from my same Guard unit removed the lock and opened the door to show me this aging disused facility. The inside was a little different than what I had been used to.

I entered the service of the Washington Air National Guard in 1982 after graduating high school. Six weeks of basic training at Lackland and several months of electronics school at Keesler later, I was back home doing duty as a weekend warrior. It was then I found out what I was really in for.

Our radio shop at the time had several KWM-2A systems that were deployable, a handful of R-390 receivers, a TRC-136 that was barely working, and a TSC-60. Of these, I was first assigned to work with the TRC-136, filled with what I believe was early URG-1 HF gear. I was also asked to fill in when needed on the K2s (what we called the KWM-2A radios).

Unfortunately, at about this time, Keesler wasn't doing much training of ground radio airmen on the art of the tube radio; other than some tube theory, at least as far as I recall. I do remember training on many different VHF and UHF radios used in Air Traffic Control systems, but I don't remember much HF. Now, in 1983, I found myself in the middle of a shop that pretty much only took care of HF equipment.

At this point let me say that I'm not an engineer. I've not had any undergraduate coursework in electrical, mechanical or software engineering. What I know about radios and electronics, Uncle Sam taught me. I've considered myself more a "jack of all trades," except these days, I say I'm a general engineering specialist and I'm employed as a software product manager. I can read a schematic and get a general idea of what's going on, but if I need to know specifics, I call for help. None of this, however, kept me away from the excitement of troubleshooting problematic radios and getting them to work again during my time in the Air National Guard.

In January 1986 I was re-assigned from the TRC-136 to the AN/TSC-60. As part of that move, I was offered the chance to attend the specialized TSC-60 school at Keesler, AFB, Mississippi that focused on (V)1 and (V)2 facilities. The only 60 my unit had was a (V)2 and the school would prove to be a great boost to my knowledge, understanding and abilities to operate and maintain it. My class was held January through February of 1986.

January 1986 was bittersweet for many of us. On January 28, the space shuttle Challenger exploded as it climbed toward space. I was taking a block test at the time when one of our two instructors came in, sat down, and looked upset. When asked, he told us the tragic news, which some of us found hard to believe. After finishing the day, some of us went to the Airman's club for a snack and found ourselves watching the constant replays of the disaster on the news. I graduated from 60 school a month later, on February 26, 1986, with top honors. Out of all the block tests, I missed only one test question the entire course.

Collins Collectors Association

Returning to the 242 Combat Communications Squadron at Geiger Field, on the South side of Spokane International Airport, I began working as part of our team to operate and maintain our AN/TSC-60(V)2 facility in earnest. This was one of the most fascinating pieces of military equipment I'd ever had the pleasure to work on. We would deploy, set up, operate, maintain and tear down. In most operations we "got the shot in" and then turned everything over to Tech Control.

What I enjoyed most was using the OK-145 control heads to operate the two URG-II radio levels with 2.5kW amplifiers. We typically operated it with various signaling equipment including FTA-28 phone signalers, a BR-6029C time diversity modem, and various cryptographic equipment for secure communications. I simply enjoyed making things work, getting a circuit in over three thousand miles to a distant end and getting the data across.

During the next several years, we deployed our 60 van to various locations, including Myrtle Beach and March Air Force Base. We performed 36-hour exercises and two-week summer camps, a few of which were Operational Readiness Inspections (ORIs). I would at one point become the facility chief and later oversee turning our original, and might I say "perfect" (V)2 van over to depot. When it never came back to us, we ended up obtaining a rather used looking (V)4 in need of some TLC. A few years later, I would end up turning that one in as all the older 60 vans were being pulled. By 1996 I was the supervisor of a new tactical HF communications shelter, the TSC-122, but I would never forget the thrill I had with the 60, and the many bouts of melancholy when preparing them for turn-in.

The 60 I now stood inside was a (V)9 facility, sporting HF-80 radios, a GRiD computer control, and an Environmental Control Unit (ECU) that slid out the side of the left wall. Partly familiar and partly not, I was there to inspect the facility as a piece of surplus equipment before taking delivery of it to my home. It was also then that I discovered the requirement for Continuous Wave (CW) had been dropped for obtaining an Amateur license.

I know there are many folks who think Amateur Radio without knowing CW is a sacrilege, that real messages and real decoding only comes from between the ears and using your thumb and fingers. I respect those folks who can didda-da to their hearts content and pass traffic like I probably never will. I tried learning CW twice, and for various reasons that I'll admit some may call excuses, it never worked out for me, so I never tried for my Amateur license. Now I had the opportunity, which later gave me more to do in a service capacity.

So there I was, not only would I be saving this old TSC-60 facility for posterity, I could get my Amateur radio license and actually operate it. All this began a deeper dive into learning more about the AN/TSC-60(V) series of HF communications facilities.

Prior to discovering the Collins Collections Association (CCA), I did all my research on the Internet. There isn't much to be gleaned regarding the TSC-60 line of communication shelters; however, I did find some valuable nuggets that got me rolling.

The (V)9 series of HF communications shelters was a continuation of the long-haul comm shelters provided to the military. HF-80 radios were again used like the version immediately before it, along with 1KW amplifiers. Several voice-telegraph units were also part of the shelter and used to send digital voice or teletype signaling between stations up to thousands of miles away. And although they also came with Signaling Telegraph Units (STU-5), those had been removed from the shelter I had found and was taking possession of.

The (V)9, like other shelters before it, contains two radio levels or groups. Each group contains several separate pieces that make up the whole. These are:

- HF-8014A Transmitter
- HF-8054A Receiver
- HF-8032 PA Power Supply
- HF-8023 Power Amplifier
- HF-8064B Preselector
- HF-8040 Antenna Coupler (doubles as a base for a vertical fiberglass whip or NVIS antenna)

The history of the shelter I now own, serial number 006, is unknown past the facts I do know. Sometime in the late 80's or early 90's it was allocated to the 105th communication squadron, Washington Air National Guard. 006 was one of three (V)9 facilities allocated to the 105th, along with serial number 0036 and 0072.

In September of 1995 the allocation appeared to be reduced to one, and the 105th had to "turn-in" two of their existing vans. However, this conflicts with additional paperwork indicating all three were to be turned over to DRMO. Exactly what happened to all three is unclear. What is clear, however, is that two of the 60s ended up with the Department of Emergency Management in Spokane County Washington. Note that the paperwork I've located shows 0006, 0072 and 0036 (four digits) whereas the actual serial numbers on the shelters were stamped as three digits (omitting the first zero).

Spokane County tried using the TSC-60's for HF communication links to western Washington during various emergency activations. After several years of disuse and disinterest, the facility was offered to me as excess non-allocated (not asset tracked) equipment. A friend from my Air National Guard unit, who worked as an employee for the county, helped arrange the transaction.

It's now four years later. The ground is dry as the shelter stands proud and silent on her four leveling jacks. She's cabled to a 100 amp disconnect switch for 240 VAC, single-phase instead of the 208, 3-phase she came ready for.

Her ECU has been replaced with a 240V, single-phase unit that looks like it came with the shelter from the factory. Not far away stands a 30-foot fiberglass whip on a fully functional HF-8040 antenna coupler cabled to the Signal Entry Panel on the rear of the shelter. As I approach, I feel her reach out to me, taking my hand to bring her to life.

I worked diligently during the first days of ownership to understand what turned her on, and how I could do it again without the use of 208, 3-phase power. It wasn't hard once I got into the schematics. The HF-8032 Power supplies can be strapped for several different voltages, and the ECU could be replaced. All the work to do that was simple, and easily reversed if necessary. Without cutting or splicing any wires, it was all done by disconnecting or moving connections around to put single-phase power where it needed to be. And everything was documented with text and photos.

As I switch on the main breakers for the PA, the RCVR/EXTR rack and the ECU, I feel I can hear a gentle sigh as the power begins to surge through her veins. She's come to know a gentle and slow turn-on procedure as I work my way down the console from right-to-left, making my way toward her soul, the radio equipment rack.

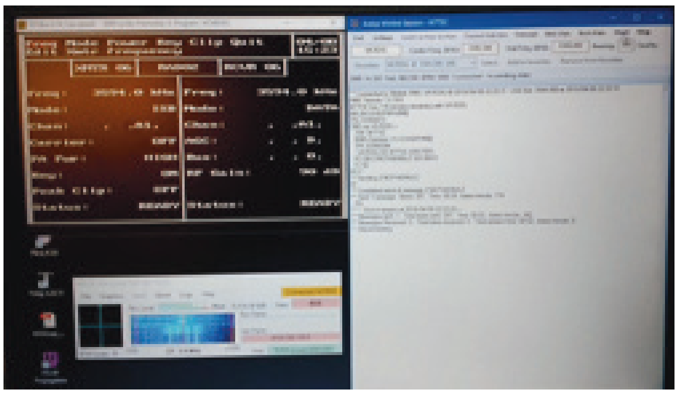
I toggle her RCVR/EXTR breakers and press the PWR button on each HF-8014A and HF-8054A, watching as the LEDs and the meters illumninate, like gently waking from slumber. I then move to the PA rack, first engaging the MAIN breaker, then each successive breaker in turn. Left-to-right, gently and methodically the power comes on and the blowers begin their gentle whirr.

Back at the console, I've started the modern HP laptop with Microsoft Windows 10. Her original GRiD laptop is kept safe and occasionally used, but not for our everyday play. Swiping my finger across a fingerprint reader, the operating system logs me in and starts a session of DOSbox that contains the Rockwell-Collins radio control system. As it initiates, so too do the radios, with each frequency display magically turning from 0000.0 to the last frequency used in the software.

Using the remote control, I set the PA power to high and watch the tune sequence. I set the sidebands and frequency, punch the right switches on the Audio Control Unit, and we are ready. This old girl feels young again as she gets excited and amped up.

In the passing years since I've come to know her, and without making any irreversible changes, I've added additional DC power supplies, VHF and UHF radios, a Packet controller TNC and an Integrated Sound modem (Signalink) to the console. For Internet, I've removed the OZ-11 bulkhead connector, used for signaling a 10K PA in a separate shelter, and replaced it with an Ethernet bulkhead connector. This allows me to use a Ubiquiti wireless node to the house for network connectivity.

All these extras make this AN/TSC-60(V)9 shelter, a real working Ham Shack. She's helped me do Winlink global email on HF via the HF-80 radios and HF modes such as Winmor and Ardop, in my case specifically for EMCOMM. We've done packet connections together, checked in to the Collins Collectors Association Sunday net, and the Washington State Emergency Net. And the most exciting thing we've done lately, is the new FT8 mode, where she's managed contacts as far away as European Russia, New Zealand and Argentina; all on a 30' whip antenna and HF-80 radios.



It was just four years ago I obtained my Amateur license, passing both the Technician and General in one sitting. Before my first local VHF transmission or getting the 60 running, I obtained my vanity call sign, W7TSC. I then began checking in to the local Amateur Radio Emergency Service (ARES) net.

It was several months later I got the 60 working. During that time, I joined the local ARES group, serving Spokane County. Though it's a group made up of nearly a hundred members, I rapidly became appointed an Assistant Emergency Coordinator and really dug into the idea of preparedness for emergency communications. This last February, 2019, I was asked to take over as the Emergency Coordinator for Spokane County, and it's a position I still hold as of writing this.

Me being connected to a local EMCOMM organization, brings this TSC-60 back into a genuine service role, though under private direction. She may not be the youngest radio in EMCOMM, she may not be as portable as the shiny new radios, but she still has it where it counts, and she still makes contact when needed.

What does the future hold? As much as I've come to appreciate and work this (V)9 shelter, my dream is to one day find a (V)2 or 4 that I can take home and bring back to life like I did this little girl. I think there is just a little more soul in the URG-II; a fondness I have for the control and power it wields. In the sense of preserving this sliver of military and Collins history, it would be humbling to create an entire TSC-60 collection for others to see.

Maybe. Maybe someday.

73,
Asa Jay – W7TSC
See more at http://www.w7tsc.org/

Post-Log
A couple weeks after finishing this article, I came into contact with another old friend from the 105th squadron who I also went to 60 school with. I talked about my (V)9 van and how I knew where the other one was located. Without prompting, he was suddenly on the phone with a buddy of his who worked for the agency who had it. Two weeks later, AN/TSC-60(V)9 SN# 072 is parked right next to SN# 006. SN# 072 is essentially, nearly-complete. It came with two HF-8040 antenna couplers, a complete Receive Orthogonal antenna and what looks to be a complete set of Tech Orders (TOs). This new girl needs some love to clean her up, find what's wrong and make things work. I feel she's in much better hands now and will again see life anew.

Above: Receive Orthogonal mast, wires and rope. Two HF-8040 Antenna Couplers. All of which need some refurbishment. Below: SN# 072 attached to the mobilizer used to bring her home. Not shown is SN# 006 that sits on her skids just to the left. Next page, interior photos including the console, radios and power amplifiers.

Collins Collectors Association

Rockwell International

Collins Defense Communications

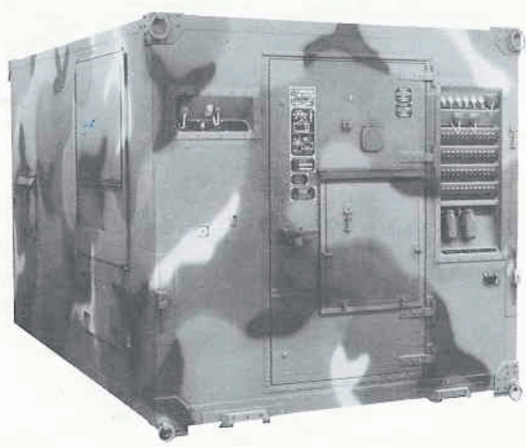
product information

AN/TSC-60(V)9 Communication Central

The AN/TSC-60(V)9 Communication Central is a transportable high-frequency communication system providing dual 1-kW transmission capability. The system uses Rockwell 4-channel HF-80 equipments and is compatible for use in DCS entry applications. The equipment is protected at the system level, and provides a highly reliable communication system for optimum operation in tactical military environments.

FEATURES

- 280,000 RF frequency selections in 0.1-kHz increments
- Automatic tuning
- Plug-in modular construction
- Multichannel TTY modem with speech-plus capability
- BITE isolation to card level
- Telephone signaling converters
- Expandability for adaptive communication techniques
- Environmentally controlled interior with self-contained ECU
- Transportable by helicopter, fixed-wing aircraft, mobilizer, and 2½-ton truck



SYSTEM DESCRIPTION

The AN/TSC-60(V)9 Communication Central provides full duplex voice/data communication in the 2.0- to 29.9999-MHz HF band. Modes of operation include ISB, SSB, voice, continuous wave (CW), multichannel TTY, AM, and compatibility with TADIL-A data links. The radio system can be remotely controlled from a distance of 7 km.

Except for antennas and primary power, all equipment required for full system operation is housed in an S-280 shelter. Two AS-2459/TSC-60(V) fiberglass whip antennas are supplied. All equipment is rack mounted, with rack assemblies mounted on helically wound shock isolators to attenuate external shock and vibration below levels harmful to the equipment. Cable retractors and trays protect the system wiring, and specially designed brackets support the equipment. Outside air circulated over the power amplifier equipment permits near specification performance in extreme temperatures without environmental control units. Rfi filtering is provided at both signal and power entry ports, and spark gaps or surge protectors protect all external signal interface from lightning-induced currents.

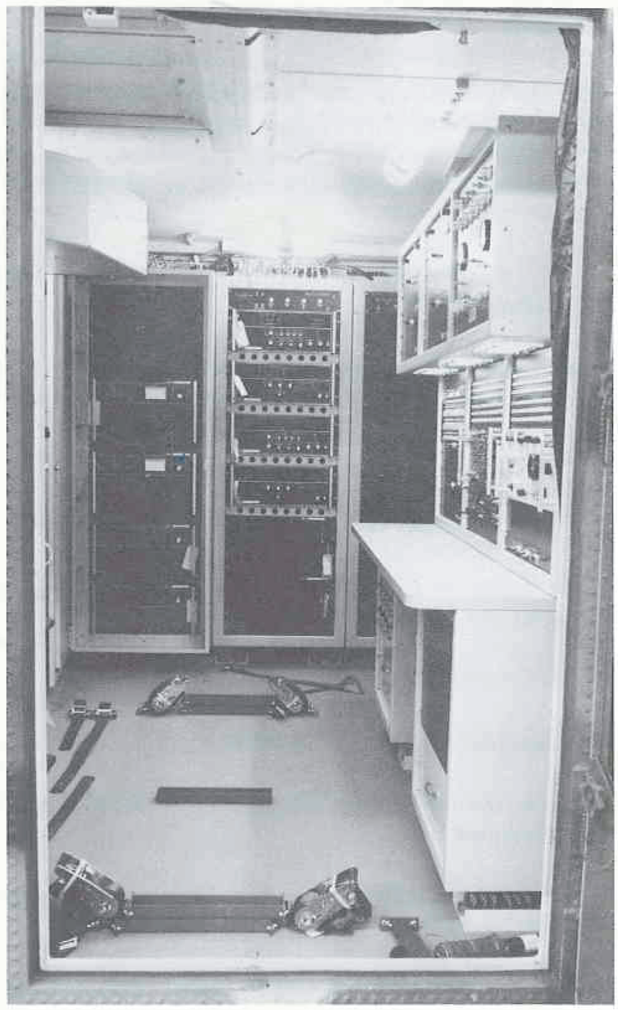
OPERATIONAL CHARACTERISTICS

The AN/TSC-60(V)9 can be locally controlled from the receiver and exciter front panels, or from the shelter-mounted remote control. The remote control may also be removed from the shelter to operate from a distance of 7 km. The system consists of two receivers, two exciters, two 1-kW power amplifiers, vftg terminal equipment, and a telephone converter. Operation in conjunction with the OZ-11A/TSC-60(V) allows 10-kW power output for one 4-channel radio system.

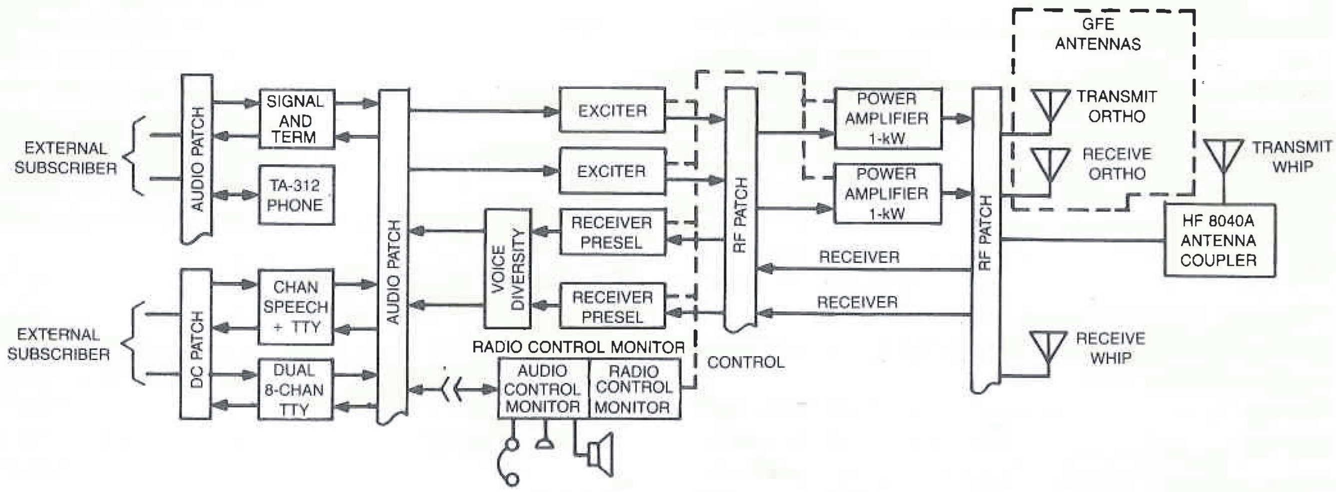
Built-In Test Equipment (BITE) capability to the circuit card/module level is provided by the status display located on the radio remote control unit and by the performance monitor built into each 1-kW power amplifier.

The environmental control unit is stowed internally for shipment but pushes out easily into its operating position.

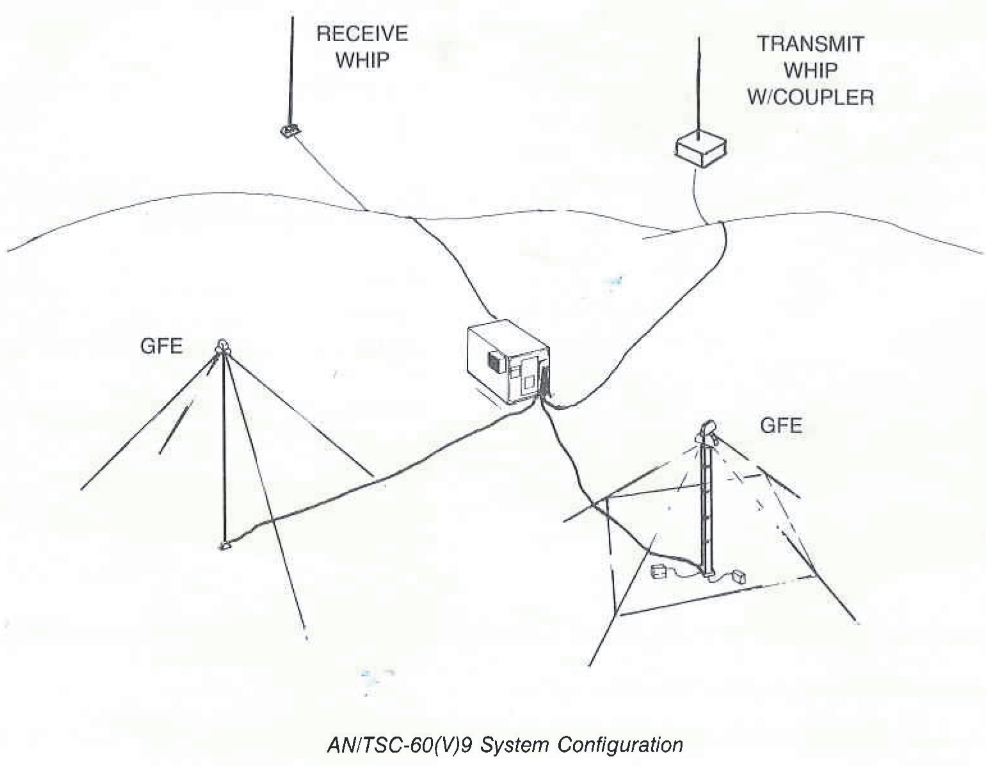
All operational hardware is in easy reach for the system operator.



Interior view showing transmit and receive racks at the rear and operator console to the immediate right.



AN/TSC-60(V)9 Communication Central, Simplified Block Diagram



AN/TSC-60(V)9 System Configuration

AN/TSC-60(V)9 communication central

SPECIFICATIONS

Operational Characteristics

Transmitter Power .... 1-kW PEP or average RF output
Frequency Range .... 2.0000 to 29.9999 MHz
Tuning Increments .... 0.1 kHz
Tuning Mode .... Fully automatic
Frequency Stability .... Not less than 1 part in 10^8 over specified temperature range
Frequency Tune Time, Transmitter* .... 10 ms nominal, 15 ms maximum
Frequency Tune Time, Receiver** .... 10 ms nominal, 15 ms maximum
Channels .... Four 3-kHz radio channels per radio
Modes of Operation .... ISB, USB or LSB, and CW
Information Types ..... Voice/TTY, TADIL-A compatible
Power .... 120/208 V ac, 50/60 or 400 Hz, 3-phase, 4-wire
Audio System
External Lines .... Eight each, 2- to 4-wire local battery lines
Line Signaling (ring through) .... Eight lines, 20 or 50 Hz
Radio Signaling (ring through) .... Eight lines, switchable to 1600-Hz, 2600-Hz or an FM 2150/2450-Hz signal shifted at a 69-Hz rate
Telephone .... One each, TA-312/PT field telephone

VFTG Terminal Equipment

Speech-Plus TTY .... Eight speech plus eight TTY channels (85-Hz shift) at 2805 ±42.5 Hz
Dual TTY Terminals (2 each 8-channels) .... 8 channels (85-Hz shift) vftg channels (switchable to 4-channel diversity and split operation)

Data Circuits .... All loops full-duplex compatible with 60/20-mA neutral or 20-mA polar dc circuits and 1275 ±42.5-Hz vftg audio circuits
Loop Supply .... Loop battery provided for all lines, external battery operation is selectable

Environmental Characteristics

Temperature
Operating .... −40° to +52°C (−40° to +125°F)
Non-operating .... −57° to +70°C (−70° to +158°F)
Humidity
Operating .... 95% (without condensation)
Altitude
Operating .... Sea level to 3000 m (9843 ft)
Non-operating .... Sea level to 12,000 m (39,370 ft)
Shock/Vibration .... As encountered in transport by land, sea, or air
Solar Radiation .... 0 to 1120 watts per square meter (MIL-STD-810C)

Sand and Dust .... Desert conditions (MIL-STD-810C Method 510.1)

Physical Characteristics

Shelter S-280C/G
Length .... 3.73 m (147 in.)
Width .... 2.21 m (87 in.)
Height .... 2.19 m (86.38 in.)
Weight .... 2655 kg (5900 lb)

*Tune time for transmitter includes exciter. CU-2294 antenna coupler tuning time is 3 seconds nominal, 7 seconds maximum.

**Tune time for receiver includes receiver and preselector.

Rockwell reserves the right to alter or improve the design or construction of the described products without reference to this bulletin.

Build a 75S-3B T9 Substitute

By Don Jackson, W5QN

Recently I decided to upgrade my early WE 75S-3B with Service Bulletin 1. I had already installed SB2, but SB1 further improves the receiver's performance in crowded HF, strong signal environments. This performance is typically characterized by a 3rd Order Spur Free Dynamic Range (SFDR) measurement. SB1 accomplishes this by removing about 17 dB of gain from the front end of the receiver (prior to the mechanical filter), and adding it into the IF gain section of the receiver. You can see the evidence of this by comparing the signal levels shown in the schematics of early 75S-3B schematics compared to late versions. In both cases the total active receiver gain is 125 dB, but the gain is distributed differently. In theory, this modification increases the 3rd Order Input Intercept Point (IIP3) of the receiver by 17 dB, which creates an increase in SFDR of 2/3 of that, or about 11 dB.

Front end gain reduction in SB1 is accomplished by modifying the C82/C83 capacitive divider (-6.3 dB) and the 1st IF filter and 2nd Mixer (-11.5 dB). Adding gain to the IF section is accomplished in two steps. The first installs T9 in the V5 Q-Multiplier circuit (+6 dB). This gain increase is created by using T9 to provide an impedance match between the plate of V5A and the cathode of V5B. Also, this stage is neutralized, providing better isolation between the mechanical filter and the impedance at the plate of V5B. The second step of the gain increase is a modification to IF Amplifier V6 (+11 dB). Directly grounding the cathode of V6 is primarily responsible for this gain increase.

So, what is the main roadblock to installing SB1? As many of you know, the Collins T9 part is virtually unavailable without purchasing a "parts only" 75S-3B and pulling T9 out of it. At least, I couldn't locate one. I decided to determine if a suitable T9 substitute could be created. Down the rabbit hole we go!

In my junk box I had an ancient kit of Toko variable inductors to experiment with. It included an inductor with a nominal value of 220 uH, which is close to the 230 uH that should resonate at 455 kHz with C159 and C160. Fortunately, although the Toko unit was a single inductor, not a transformer, it had the desired 5 pins on its header in the same configuration as the Collins T9. Unfortunately, the primary inductor was wired to the wrong leads, but after disassembling the Toko unit, the leads were easily moved to the proper pins. I use the term "easily" loosely because the wires were AWG 40, and there is nothing "easy" about working with wire this fine.

The next task was to determine the inductance and number of turns for the tapped secondary winding. Not having a Collins T9 to measure, I asked Bob Jefferis, KF6BC, if he could help. Bob has precision resistance instruments, and was able to give me DC resistance measurements for each winding. With this info in hand, I could roughly determine the turns ratio and number of turns on each winding. A surprising result was that the portion of the secondary winding between the tap and C162 is so small that it appears to be essentially useless. In other words, you could eliminate this winding altogether and the function would be essentially the same. A Spice simulation of the V5 circuit confirmed this to be true. If the inductance value of that portion of the secondary were much larger, it could provide a limit on the low end of the IF Gain adjustment, but this is not the case with the Collins T9. I'm not sure how this all went down in the original SB1 design process, but it is what it is. A few weeks later Dick Weber, K5IU, unsoldered T9 in one of his radios and allowed me to make inductance measurements with my RigExpert AA-230 ZOOM analyzer, and the results agreed with the approximate calculations based on Bob's resistance measurements.

At this point, I was ready to wind a secondary on my Toko prototype. Although the primary had perhaps 100 turns or so, the secondary only required about 18 turns, so it was reasonably "easy" to wind this tapped secondary over the existing primary winding. Now I had an electrical prototype. The next task was determining a method for installing the unit into my 75S-3B. SB1 calls for two 2-56 screw mounting holes drilled into the receiver chassis that have a spacing of 9/32". By the way, SB1 is silent on a third hole, which is the hole for tuning T9, but you must drill that as well. It was clear to me that I needed some sort of mounting "ears" that could be fastened to the can of the Toko unit. Here is where I used up a year's worth of good luck. I had some 3/16" square brass stock in the junk box which seemed like it might work, but I would probably have to do some off-center drilling to achieve the overall 9/32" spacing. To my amazement, center drilling (and tapping) the brass stock resulted in a hole spacing almost exactly 9/32"! To be precise, attaching the center drilled mounting ears to the Toko shield produced a hole-to-hole spacing of .58550", whereas 9/32" works out to be .59375". This is an error of only about .008", which is better than my amateur drilling accuracy. Close enough! I cut the ears to an approximate length of .30", and sweat soldered them to the Toko can, being careful to leave maybe .03" between the ends of the ears and the Toko can. You only want the ears directly contacting the chassis, not the shield. Although sweat soldering is a very strong method of attachment, I believe attachment with J-B Kwik Weld or something similar would suffice as well.

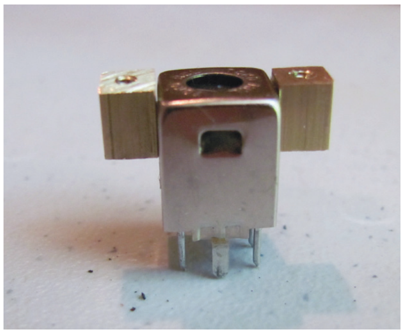


Figure 1 –
Prototype with Mounting Ears

That method allows use of aluminum (although I haven't been able to locate any 3/16" square stock) rather than solderable brass, and would also make it easier to fashion a fixture to temporarily hold the ears in place, since J-B Kwik Weld does not require the high temperatures that are necessary with a soldering process. Once the mounting ears are fastened to the shield can, I recommend using a grinder on the ears to ensure that the mounting surfaces of both ears are in the same plane. This will ensure there is no undue stress on the assembly when it is screwed onto the receiver chassis.

Figure 1 shows the resulting mechanical assembly of the Toko prototype.

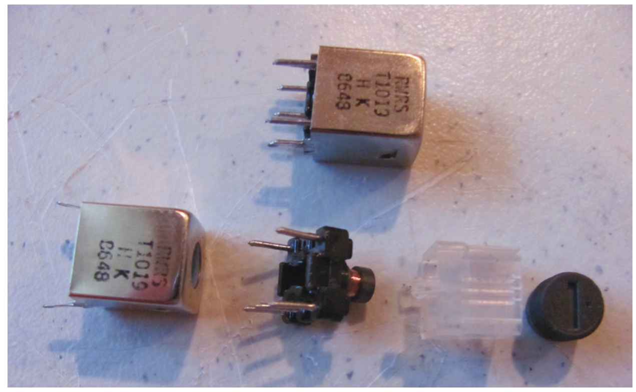


Figure 2 –
Internal Coil Components

Figure 2 shows the various components internal to the Toko coil used in the prototype. The windings are wound on a ferrite core that I bonded to the plastic header with Krazy Glue, which is a gel form of "super glue". Super glue of most any type should suffice, but the gel version is a bit easier to work with.

The next problem to solve was how to obtain the components to build the substitute T9. It turns out that Toko no longer produces the coil I used in the prototype, which is their type "10EZ". Fortunately, Lodestone Pacific (www.lodestonepacific.com) offers a product that is essentially identical, their L48. There are a couple of ferrite mixes you can purchase for the L48 "kit", but only the #52 ferrite mix is still supported.

Fortunately, the #52 ferrite is very close to the Toko ferrite mix I used in the prototype unit.

One thing that makes winding the coil tedious is the AWG 40 wire used in the Toko prototype. The first task was to determine the largest diameter magnet wire that will fit into the ferrite core winding area. In short, this turned out to be AWG 36 wire. If you purchase this wire, be sure that its insulation can be stripped using a soldering iron. Another approach is to strip with a suitable chemical stripper, but this is pretty messy and I don't recommend it unless you are familiar with using this type of stripper.

Figure 3 is a summary of electrical parameters comparing the Collins T9 with the substitute L48 version. The far right column shows the proper number of turns for each winding using the L48 with #52 ferrite.

	Collins T9	L48		# Turns (L48)
Lprimary	245	245	uH	95
Lsec (main)	4.8	4.5	uH	14
sec (tap)	0.05	0.1	uH	2
SRF	4.7	5.1	MHz	
Q	70	58		

Figure 3 – Comparison Chart for Collins T9 and L48 Substitute

Figure 3 shows acceptable agreement of all the important electrical parameters of the T9 versions. SRF (self resonant frequency) of the L48 is slightly better than the Collins T9. Although the Q of both units is high enough that it has no practical affect on the circuit, measurements show the Collins part to be better.

Further Q measurements showed that the primary difference is due to the metal shield can of the L48.

Removing the shield from the L48 assembly increases its Q to 67, very close to that of the Collins part, which, to my knowledge, has no shield.

Figure 4 is a close up of the L48 showing the secondary windings. Even though you don't actually need the small 2 turn secondary winding, I included it in the interest of producing a true electrical equivalent to the Collins T9.

Figure 5 is a photo of the L48 installed in my 75S-3B. You can see that I spray painted it a flat black to make it look a bit better aesthetically, and cover up any minor sweat soldering imperfections.

In order to do a good job winding this coil, having some sort of coil winding apparatus is strongly recommended. I kluged together a winder from my junk box that works pretty well for this task, but it is still a tedious job. Fairly strong optics are also recommended so that the number of turns can be efficiently placed so that they will fit reasonably well on the ferrite core.

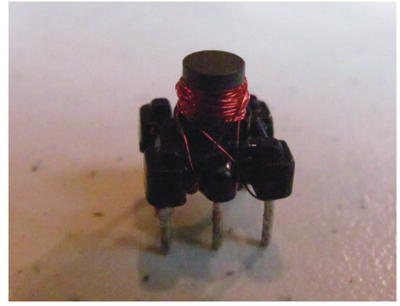


Figure 4 – L48 Coil Windings

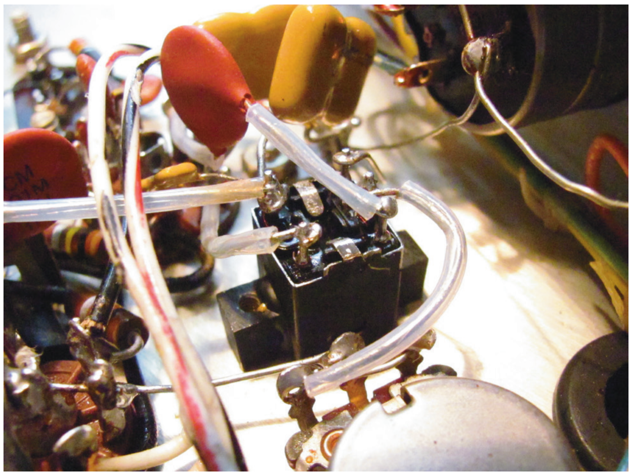


Figure 5 – L48 Installed in 75S-3B

Figure 6 is a photo of my winder, which has a feeder spool for the AWG 36 wire and a magnetic reed switch and magnet for counting turns. Actually, the turn counter is optional, as it is fairly easy to count to 95. But, if you choose to use the relay, be warned that its output needs to be cleaned up to avoid counting errors due to contact bounce. I wound up using the relay to trigger my pulse generator, which was then used to drive my electronic pulse counter. Note that L48 is plugged into a 16-pin dual inline IC socket mounted to the shaft of the coil winder. That the L48 plugs into the IC socket is yet another piece of good fortune! An IC socket with fewer pins can also be used, but I had a 16-pin socket in the junk box. Figure 6 is a photo of my coil counter. Not visible in this photo is the AA-size battery and BNC connector on the other side of the reed relay mount that drives the electronic counting equipment.

One more tidbit that I gleaned from my Spice simulation is confirmation that T9 is indeed optimized to create a decent impedance match between the V5A plate and V5B cathode. Figure 7 shows a plot of gain from the grid of V5A to the grid of V6, as a function of T9 secondary inductance. Notice that maximum gain occurs in the 4 uH region, which reasonably agrees with the secondary inductance value shown in the chart of Figure 3.

If you are going to build more than a couple substitute T9 transformers, it is much easier if you have a fixture for fastening the mounting ears to the shield can. Figure 8 shows a fixture that I cooked up from my junk box that is intended to be used with J-B Kwik Weld (or something similar) as the bonding material.

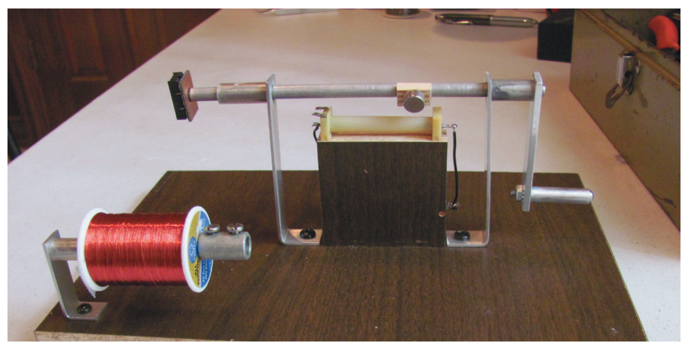


Figure 6 – Coil Winder

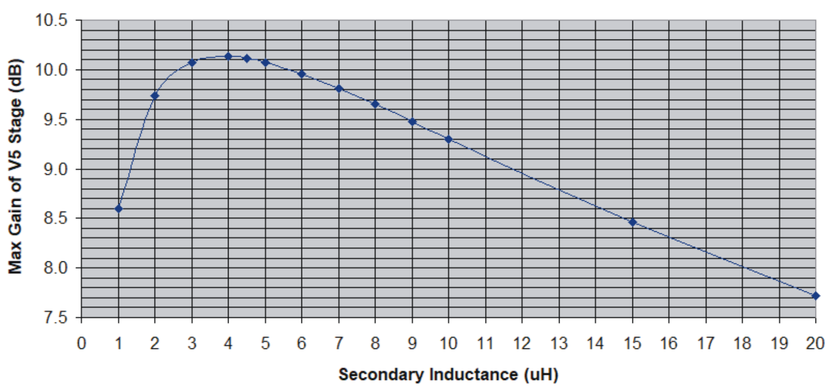


Figure 7 - Maximum Gain of V5 Stage vs. T9 Secondary Inductance

All the necessary spacers were constructed to set the ears in the proper location relative to the shield can. The black knob adjusts a “mini-vise” that clamps the ears and shield can against an aluminum “fence”. Although it would be nice to have the ear spacers mounted to the base of the fixture, I worried that the J-B Kwik Weld might flow onto the spacers, resulting in the T9 assembly bonded to the fixture. Since this potential goof is clearly to be avoided, the spacers are removable. Once the vise has clamped the ears and shield can firmly in place, the spacers are removed and can be cleaned of any excess bonding material.

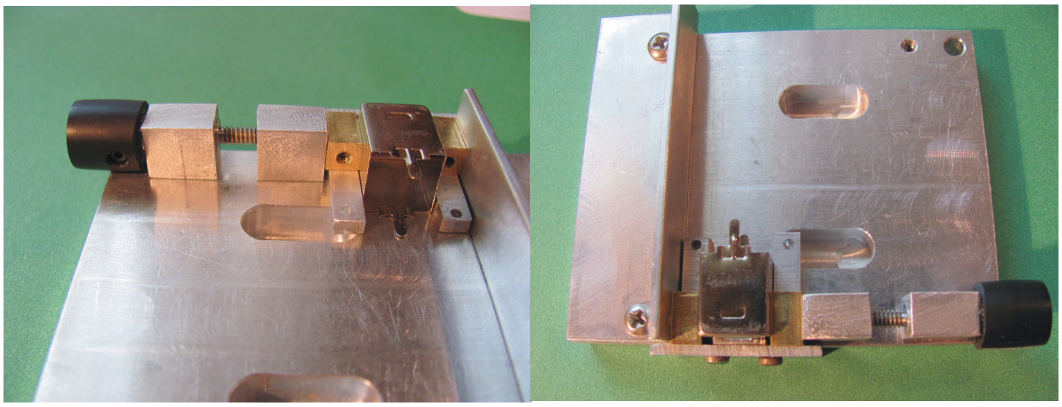


Figure 8 – Mounting Ear Assembly Fixture

When I actually built a few transformers using this fixture, I was very happy that the spacers could be removed, as that turned out to be necessary. Please ignore all the extraneous holes and slots. These just happened to be in my piece of junk aluminum I used as the fixture base.

Conclusions

Installation of the L48 substitute for T9 produced the desired results. SFDR improved to about 85 dB (with 2 kHz bandwidth selected), and there is plenty of total receiver gain to allow setting the AGC threshold to the desired level. There is some degradation in measured Noise Figure when a 250 Hz filter is selected. This is the result of reducing the gain in front of the filter by 17 dB, which marginalizes the "noise dominance" of the 250 Hz noise over the higher equivalent input noise of the IF stages following the filter. But, that is a subject for another day.

I have purchased a number of L48 kits from Lodestone Pacific for CCA members who really need a T9 to install SB1 or need a replacement for a damaged original T9. I have no interest in winding more than a few of these items, but I am willing to wind a few. My current thought is to only wind the transformers, leaving construction of the mounting ears to the buyer. Lodestone Pacific has a $50 total order minimum for the L48 kits, but I will sell L48 kits (no windings) from my limited supply for $5 each. Price for an L48 transformer with windings (tested, no mounting ears) is $20 each. I've also built a few complete (tested, with mounting ears, painted, ready to install) transformers which I'll sell for $40 each. Prices do not include shipping. Please limit your purchase request to what you actually need. By the way, if anyone out there would like to produce and sell complete T9 assemblies, let me know. We can probably work out a deal for my coil winder and assembly fixture.

Cheers,

Don, W5QN

Mystery G-133A - An Unusual Collins 51J-4

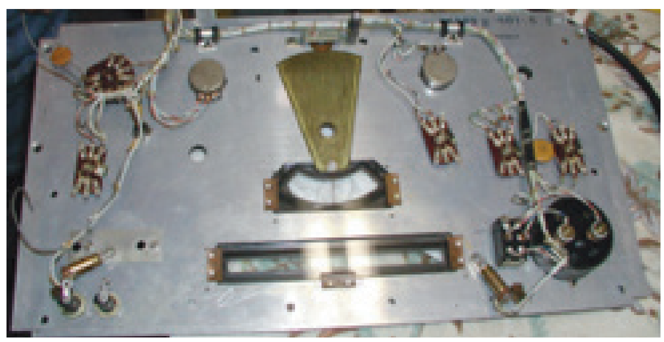
By Francesco Ledda, K5URG

A few years ago, my dear friend Jim Stitzinger called me and whispered about a "secret" surplus radio garage sale in Fort Worth Texas. I rushed there and unable to control myself I bought what looked like an airborne version of a 51J-4 receiver. The first question was about its manufacturing origins, since it had A TEMCO Aircraft tag. A summary inspection revealed the typical Collins wiring and manufacturing stencils with a front panel with a TEMCO part number.

Other differences included:

- Not rack mount configuration
- Amphenol type connectors, in the front panel
- Two fuse holders, in the front panel
- Aircraft type cabinet
- Modified tuning light for external brightness control
- TEMCO G-133A Identification Tag

A search on the internet revealed another example of this unique radio. Below are two pictures, (Courtesy of Nick England), of a similar 51J-4/G-133. There are differences between the one I have here and the one from Nick's web site; these are no AN-type connectors nor ARINC brackets. Notice the G-133 part number printed on the top right of the inside of the front panel.
http://www.navy-radio.com/rcvrs/51j4-mys.htm



G-133A, TEMCO Aircraft Corporation, Greenville Texas
People in North Texas are familiar with TEMCO. TEMCO later acquired LTV, an aircraft manufacturer South West of Dallas that produced aircrafts like the F-8 Crusader and the A-7 Corsair.

TEMCO also had a "secretive" plant in Greenville TX; this was/is located on a WW II pilot training base. There, they produced ELINT solutions for many government agencies. This facility changed name and ownership several times; in the 70s, it was E-Systems, later it was purchased by Raytheon. Now, the factory belongs to L3; often, parked on their ramp, it is possible seeing aircrafts such as Boeing E-4s, RC-135 and other "more famous" unnamed aircrafts.

From the 50s, TEMCO developed some airborne ELINT solutions for the US Air Force, US Army and other government agencies. There designed and manufactured some of the more specialized hardware and often utilized off the shelf radios from Collins and other suppliers like Watkins Johnson. Since WW2, the US Government realized that "real time" field radio monitoring and directional finding was of paramount importance to gain a combat edge on the adversary.

In 1947, a few B-17 Ferret ELINT were deployed in Germany to monitor the USSR, later B-29s were modified to provide additional capabilities, followed by ELINT version of the B-36; (RB-36D) later few a few C-54s and EC-97 were added.

Where Was The G-133A Deployed?
I was unable to find any information about the possible use of this receiver. I did discover a few facts that may allow one to guess its probable usage.

1) In 1956, TEMCO completed the conversion of the RB-50 ELINT; the RB-50, which was primarily a voice intercept platform. I consulted the manual of the RB-50F (TO 1B-50F-1), and it doesn't show the G-133A installed.

2) In 1957, TEMCO was awarded a contract to modify few "brand new" C-130As as SIGINT collection platform. A search has not shown any data about its avionics configuration.

3) By 1957, the 51J-4 was had reached full maturity, and the R-390A/URR was peaking.

4) The R390A/URR was repackaged by TEMCO as the G-133B, and its usage is confirmed on the RC-47 in 1965 (Classified Program named Drill Press - USAF RC-47 Tails 43-16254 and 43-49680).

5) There are some unverified reports that a famous three letter agency was a loyal customer of LTV-TEMCO and operated this type of G-133A in foreign stations.

6) There are known airborne deployment of the Collins R-390/URR. Below is a picture of a R-390/URR installed on an US Army U-6A De Havilland Beaver.

So far, I have been unable to guess where the 51J-4/G-133A was utilized, but the search continues. Reality is that there were so many classified programs that its true usage may never be known.

A More Known TEMCO Conversion - G-133F aka 51S-1

Later during the Vietnam war, EC-47s Gooney Birds (Also known as DC-3 and Dakota) supported the ELINT mission, in the SEA (South East Asia) war theatre. Collins equipment found its way to this bird; the 51S-1 was modified by LTV with an electroluminescent front panel and renamed G-133F. [The photo is courtesy of: http://www.ec47.com]

The picture [LEFT] shows an airborne Collins R-390/URR installed on a US Army U-6A De Havilland Beaver. This was used for directional finding.

This the story of an awesome radio recruited to do some real secret work for the benefit of the country. This is the tip of an iceberg with never to be known depth. If you know more about this unique version of the 51J-4, please let us know, and we will provide an update on a future issue of the Signal.


W7TCG