Eip WR-8 mixer home made by Bruce KG6OJI (also older microwave stuff 1950-1960)

Most of the millimeter wave fabrication work I accomplished was done in the late 1950's and early 1960's. At that time, I constructed multipliers to multiply the output of 25 and 33-1/3 GHz klystrons to 100 GHz. My detectors were first made by mounting a 1N26 crystal on WR-8 waveguide in such a way that a sleeve connector for the crystal pin passed through the waveguide to a bypass capacitor and BNC fitting on the opposite side. This is basically the way most commercial mounts for K-band were constructed. Of course, I had a moveable short at the end of the waveguide. These were round, with two quarter-wave chokes, driven by a 4-40 screw, and were carefully machined on a 10-inch lathe using a magnifier. Although the WR-8 waveguide I used was silver, all other parts were made of brass and un-plated.

The BNC connector assemblies with mica bypass capacitors I used were all taken from war-surplus X-band crystal mounts by cutting them away and cleaning them up in a lathe for re-soldering.

My next step was to disassemble the crystal cartridge (I was lucky to have obtained about 20 new 1N26 crystals from a surplus dealer) and to re-assemble these across the waveguide. The whisker end was fitted into a socket on the end of the BNC connector center-conductor, after the bypass, and the whisker protruded through about a 0.010-inch (0,254 mm) hole into the waveguide. I adjusted the whisker in the socket until it almost reached the opposite side of the waveguide. On the opposite side of the waveguide I soldered a brass cylinder drilled and tapped for a 0-80 screw. The silicon die from the 1N26 crystal was about, 0.015-inch (0,381 mm) square and soldered to the end of a 0-80 screw. I un-screwed the die from the crystal cartridge and carefully screwed it in my mount so as to protrude through about a 0.025-inch (0,635 mm) hole in the wave guide until it contacted the whisker. While doing this I monitored the DC conductivity with an ohmmeter connected to the BNC connector.

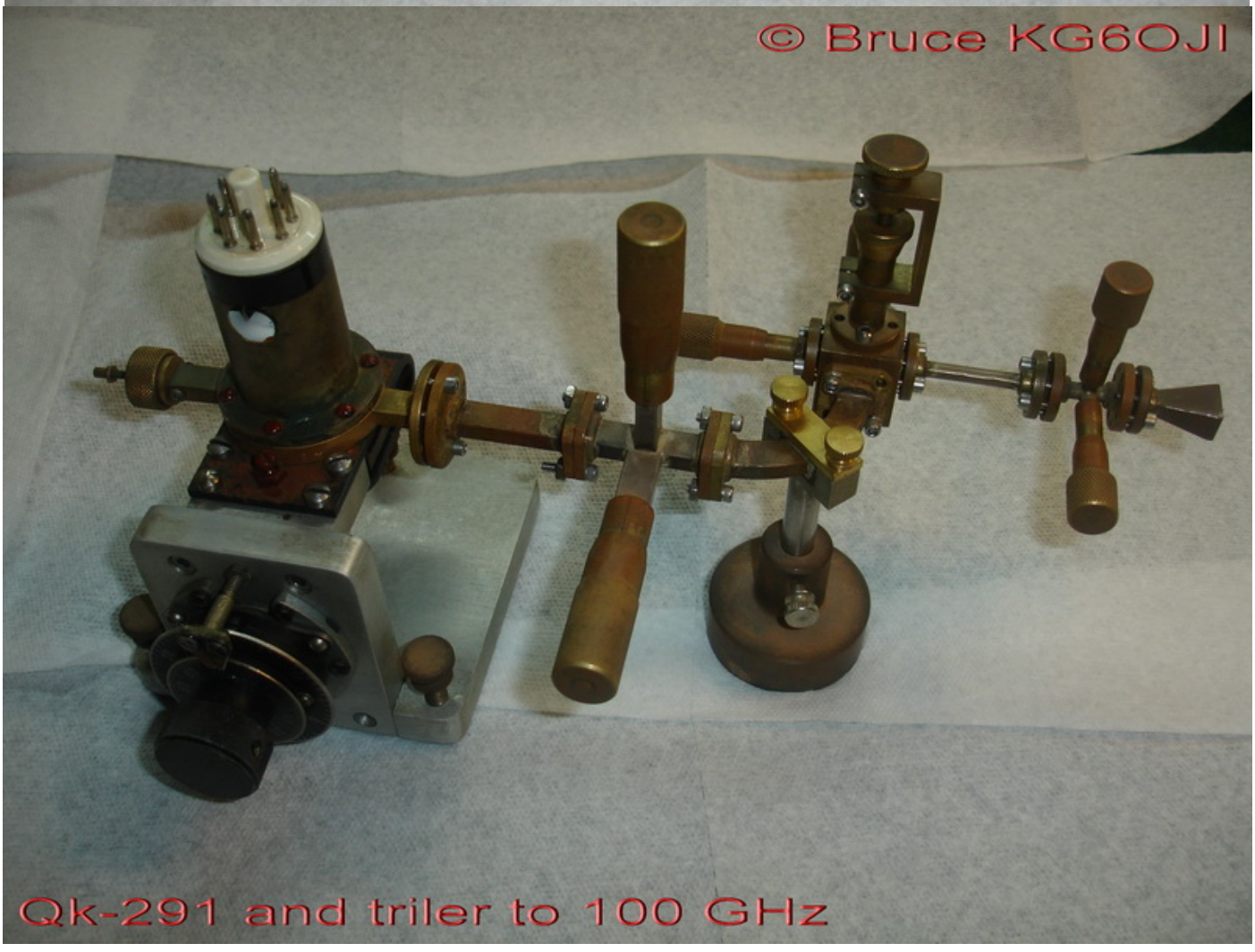
I found the crystals needed to be further adjusted for maximum output with microwave power. The process is very much like adjusting a cats-whisker on an old crystal radio, if you have \ever had this experience. I modulated the source with a 1000 Hz square-wave and used an HP 415A SWR indicator to monitor the detected signal while adjusting the crystal screw, back-short, and sometimes an E/H tuner included ahead of the crystal mount. I think the losses in my E/H tuners pretty much ate up any gain from improved matching.

My last improvement was to add a differential-screw mechanism to control whisker penetration. This made the mounts a little more stable and easier to adjust. I also sharpened the whiskers electrolytically.

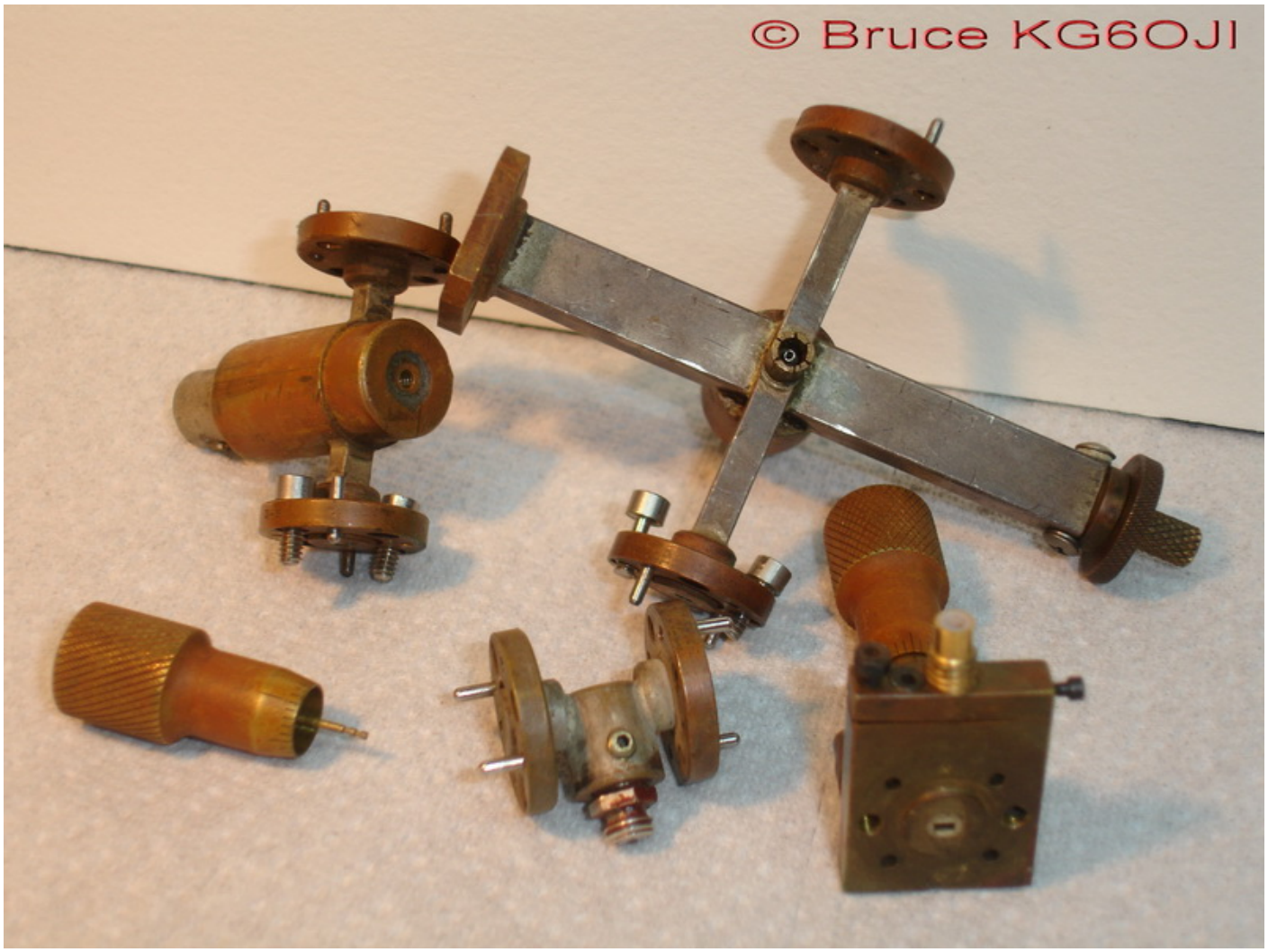
My WR-8 thermistor mount was constructed similarly to the crystal mounts in that one end of the tiny thermistor bead was soldered to the center-conductor of a small connector fitted with a mica-washer bypass capacitor. The thermistor and protruding other lead, were carefully threaded through holes in both sides of the waveguide (again while monitoring with an ohmmeter connected to the jack). This was used with an adjustable backshort and an HP 430C power meter. Although it was crude and lossy, it gave an indication of relative power. The thermistors I used were taken from replacement probes intended for HP signal generator power monitor circuits. I do not remember the specifics, but breaking the glass housing gave access to the tiny thermistor which was about 0.01-inch (0,254 mm) in diameter and had short axial leads. This is likely the same thermistor type employed in HP coaxial and WG thermistor mounts. The operating resistance is about 1000 ohms.

Next two pictures of some of my old apparatus;

Early 100GHz Appartus

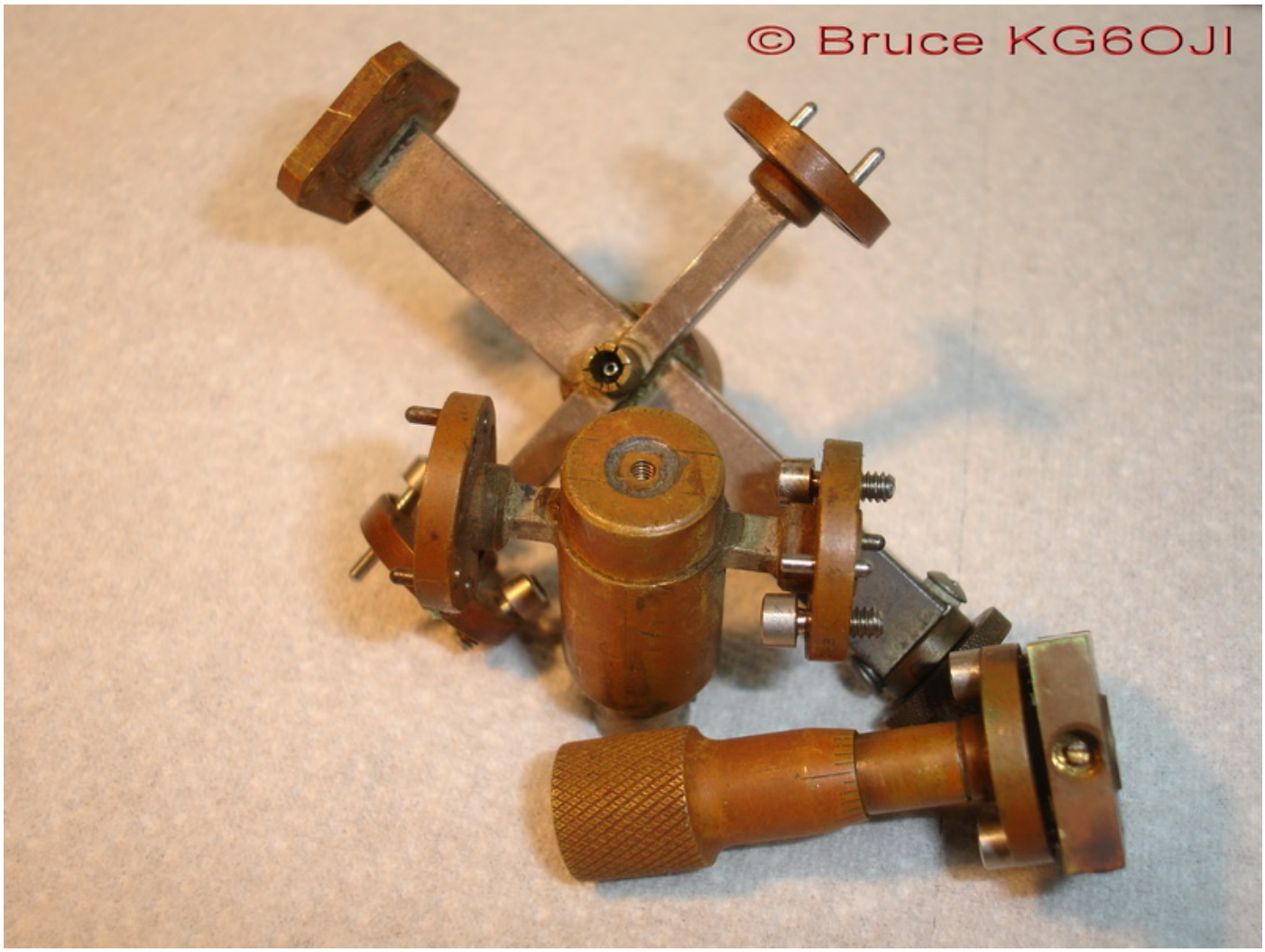


Qk-291 and triler to 100 GHz



Upper left: WR-8 detector with silicon die on 2-56 screw inserted from the top. Upper right: Cross-guide multiplier with socket for 1N26 (included to illustrate this method). Bottom left: WR-8 adjustable hoke short. Bottom Center: WR-8 thermistor mount constructed as I described above in my message. Bottom right: Stable WR-8 detector.

Multiplier assembly in background included to illustrate differential screw mechanism. Center: WR-8 adjustable short from E/H tuner to its right. Bottom: Bottom side of "very stable" detector showing 2-56 screw carrying silicon die inserted from bottom.



Top: 1N26 socket in WR-28/WR-8 tripler. Center: 2-56 threaded hole in WR-8 detector, for insertion of silicon die on screw. Bottom left: WR-8 adjustable hoke short. Bottom Center: WR-8 thermistor mount constructed as I described in my earlier message. Bottom right: Stable WR-8 detector.

NOTE;

Reason for compiling and publishing the provided information by Bruce in this article is, to learn more how to make "home brew" multipliers, mixers and detectors at very high frequencies. Very interesting to see how this development and experiments taking place in the "old days" and still good to use in the 21th century. We are still looking for ideas, examples, etc. for measurements with spectrum analyzers, counters, powerdetectors and so on. Also information about other applications and repairing old power sensors and mixers HP/Agilent, Millitech, Hughes, Tektronix etc. is very welcome! If you have further information, please contact us. 73' Eene@pa3ceg.nl and John pa7jb@xs4all.nl