German Magnetron Tubes

The use of magnetron tubes for radio-localization transmitters took place very early in Germany. In 1934 GEMA started experimenting 50 cm systems based upon split-anode magnetron in the transmitter section. Virtually any kind of magnetron was investigated in the thirties both by industries and in universities, including water-cooled split-anode types, similar to the 5J29 manufactured by General Electric during the war and used to jam German radars. Due to the poor stability of split-anode magnetron generators and even to more reliable system operation at somewhat lower frequencies, VHF and UHF transmitting triodes were eventually preferred. From 1936 onwards, Germany concentrated all its efforts to prepare for the war upon sets operating approximately from 100 to 600 MHz, at the same time abandoning any further research on higher frequencies, as British did.

Germans learned of the British magnetron in the February 1943, when a Stirling bomber, equipped with the 10-cm H2S radar S/N 6, was shot down near Rotterdam. They soon started copying the entire system, including the CV64 magnetron. Time was spent to adapt the British design to their different technologies, a necessary step due to shortage of strategic materials, as the cobalt used by Allies in their permanent magnets. As result, several details were changed in the Rotterdam copies. The big magnet was replaced by an electro-magnet driven by a controlled current and the klystron in the receiver was replaced by a small interdigital magnetron, the RD2Md. By May 1943 at least four LMS 10, the Telefunken copy of CV64, had been delivered. Anyway, even due to the supply difficulties for many parts, the production of the Rotterdam sets was very low. The major manufacturer of LMS 10, Sanitas, and the same Telefunken plant at Schulze-Wechsungen were damaged by air bombings. Telefunken average production of LMS 10 was very low, around five units per month. By early 1944 a new airborne set, the Berlin A of entirely German design, was ready for production. But, after the invasion of Normandy, the war was at the door and German industry was suffering accurate bombardments, mostly directed by X-band Allied radars. At the end of the war, few hundreds Berlin 10-cm sets had been built, with an estimated production of LMS 10 not exceeding 1000 units.

Even more obstacles were encountered in designing 3-cm German sets. The capture of an American X-band set from a crashed plane near Meddo, a small village in Holland, took place in January 1944. Early samples of LMS 12, the X-band magnetron designed by Telefunken, were delivered around August 1944. At the end of the war, only few tens of the 3-cm Berlin-D sets had been delivered. We can assume that, likely, less than one hundred LMS 12 samples were built. We know that several multi-cavity and power magnetron types were hastily designed and built before the end of the war, but time was going to expire. Probably they were not even thoroughly tested or someway used in operational sets. The collection includes three WWII German magnetrons recently come back to light after more than seventy years, so rare as to be considered the only ones existing today.

LMS 12 - Telefunken 3-cm multicavity magnetron.

Not known the influence of the captured Meddo set on its design. It radically departs from that of LMS 10 which was a copy of the British 10-cm CV64. LMS 12 uses 18 cavities, while British and American X-band magnetrons were 12-cavity designs. Likely its anode block was calculated to operate in a relatively low magnetic field. Its shape, that vaguely resembles a British micropup triode, suggests that the magnetic field was generated by a coil surrounding the anode block. Also an annular magnet could have done the job, but the 2000 gauss required field is quite high and we know that the cobalt needed for strong magnets was not available in Germany at the time.

Fig. 1 - This sample of LMS 12 looks unused. On the glass bulb an alternate marking as LM 566/3 is well visible. It still retains its US War Department classification tag, dated 1946. The rod on the left looks to be the center conductor of the coaxial output. The two heater/cathode pins are on the right of the large glass bulb. Click on the image for more details.

Looking at the few summary data available on this device, we note that its efficiency was quite low, under 10%. This could derive from spurious resonating modes caused by the high number of resonators. We know that the first 3-cm magnetron developed at MIT in the summer of 1941 had 18 resonators. It gave 5 kW peak power but Fisk in his article on the BSTJ, April 1946 reports ‘the design suffered from a confusion of many modes in the resonator system...’.

According to the few data available on the production of Berlin D sets and of its experimental installation on other sets, we can assume that a total quantity barely exceeding 100 units was manufactured before the end of the war. Today this sample, preserved in perfect shape, is believed to be the only one still surviving.

LMS 13 - Telefunken 1.5-cm multicavity magnetron.

No doubt that LMS 13 is one of the rarest and most fascinating witness of the progress made in a few months by Germans in the microwaves. It looks to be a scaled-down variant of LMS 12, rated for 5 kW peak at 18 GHz: similar shape and similar internal resonating system. It was first announced at the end of July 1944 and likely early samples were delivered by the end of that year. At the end of the war it was listed as being in pre-production, with a planned capacity of 10 units per month.

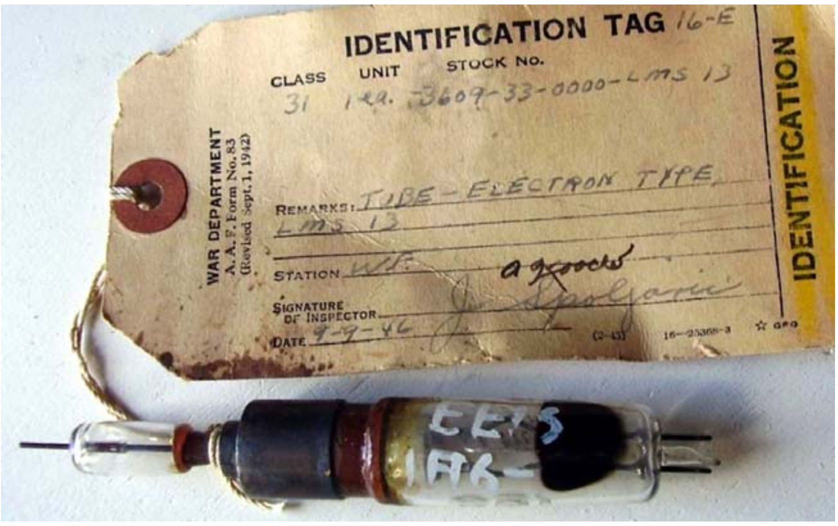

Fig. 2 - LMS 13 sample in like-new condition, still retaining its US War Department classification tag, dated 1946. 1.625 cm, 5 kW. 18-resonator anode system. Click on image for full available information.

RM 4025 - 3-cm split-anode, internal resonator pulse magnetron

The RM4025 is a quasi-experimental magnetron designed by Siemens & Halske. The sample looks unused, with an US War department label that indicates in 1946 the date when it was classified.

Fig. 3 - Siemens RM4025 looks to be a split-anode, self-contained resonating system magnetron. It was designed for operation at 3 cm. Still in evaluation phase at the end of the war. The sample still retains its US War Dept. classification tag, dated 1946. Click on image for full available information.

The purpose of this magnetron is hard to guess. Likely the bulb is hard glass, with long X-shaped press which supports the tiny filament and the self-contained resonating system. The structure, although looking very sturdy, is typical of low-power CW devices. On the contrary, the few data available, 2 kV and 4 A max anode ratings, talk of power levels not compatible with its size and its apparent heat dissipation capabilities. Likely it was designed either for pulsed mode, with pulses longer than usual, or for CW mode, with power limited to a reddish coloration of the anode. The resonant frequency of its internal system is fixed, excluding any reasonable use in jammers or in instrumentation. Also to be excluded is its use as local oscillator in a microwave receiver. Probably it was intended for a kind of active guidance system or for pulse modulated telemetering, designed to operate full power only for a short while, maybe on one of the latest guided rockets developed by Germany, such as the Bachem Ba349 Natter. Unfortunately these are just conjectures, since no info can be found even on the period in which this device was designed.

Interdigital magnetrons

Starting from the split-anode Philips magnetron introduced around the mid thirties, the German industry developed many interdigital types for frequencies between 300 Mhz and about 5 GHz and for output power up to a few tens of watts. A couple of them are on display in the museum.

Fig. 4 - Left, the RD2Mh could deliver 300 mW CW from 4.3 to 5.5 GHz. It was capacitively coupled to the external resonator. A similar device the RD2Md was used as local oscillator, as off-the-shelf replacement for the British klystron, in the receiver of the Berlin microwave set. Right, MD4Ma was designed to operate from 1.1 to 1.6 GHz, delivering about 15 W CW. Click on each image to access available data.

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