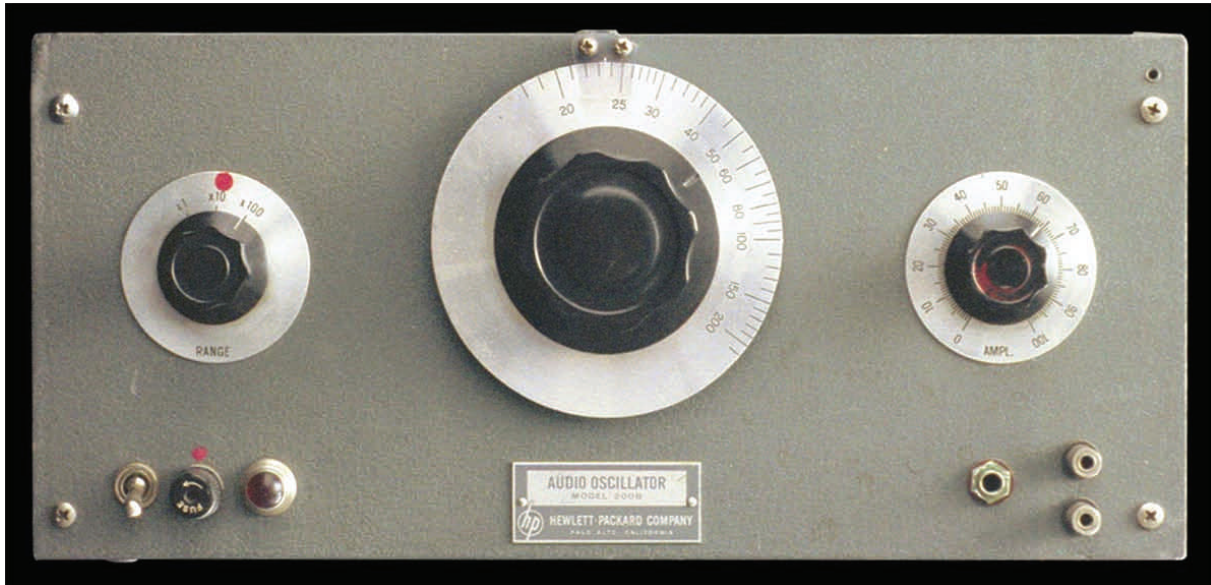


Electronics – William (Bill) Hewlett



This new series of articles on electronics will place emphasis on the second word in the name of this magazine "Electronics".

The electronics subjects we will cover will include security electronics and general electronics, both analogue and digital, old and new technologies, electronics books, etc. We will also cover some of the interesting past and present electronics industry characters and equipment. We will keep it simple, interesting and fun because, "If it isn't fun it ain't worth doing". (George Thorogood - R&B Guitarist 1978)

When I first discussed this series with the Editor he was tentative, probably because there is no firm structure and a very broad subject range, even so articles will only appear on an occasional basis.

We start this series with a name every one knows. The recent amalgamation of Hewlett Packard and Compaq and the strong advertising campaign HP is currently undertaking caused me to think it might be time to mention a few interesting things about to Mr William (Bill) Hewlett and some HP equipment you may not have heard a lot about.

The HP 200 series low distortion resistance-capacitance audio oscillator directly descended from HP co-founder Bill Hewlett's masters degree thesis at Stanford University in 1939. It was HP's first product, manufactured in 1939 and in various shapes and sizes it lasted in the HP product range for nearly 50 years, yes 50 years! (Current electronic designers and manufacturers please note: The number 50 is not a typo).

This machine is real electronics history. It provided a direction methods and standards that have been reflected in HP products to this day. The HP 200 series also shows that if an electronic product is designed and manufactured to the highest possible standards it will satisfy the market and remain in a manufacturer's product range for many years. This can only add up to market satisfaction and profit!

The HP 200 is an amazing mixture of theoretical ideas, inspired design, careful engineering and dedicated execution. It answered a market need for a superior solution. The contribution was genuine with the rewards evenly divided between HP and its customers. The HP 200 design and manufacture process showed the

high quality and long product life possible with electronic equipment.

Hewlett's oscillator used a resonant RC circuit originated by Max Wien which was developed in 1891 (no typo's here either) (do you tech heads remember the Wien Bridge?) In 1891 Wien had no source of electronic gain so he couldn't readily get anything to oscillate. Wien went on to develop a network for AC bridge measurements.

In 1939 Hewlett saw that Wien's network, combined with suitable electronic gain, offered advantages over previous approaches to make high quality audio oscillators. These included dynamic tuning range, amplitude and frequency stability, low distortion and simplicity. Hewlett also used Harold Black's feedback amplifier theory. Therefore, Hewlett had something else besides electronic gain being available - he also had amplifier feedback! Hewlett also had Nyquist's regeneration theory which described the conditions necessary for oscillation.

Hewlett synthesised all this to show that Wien's network could be made to oscillate. He then added a simple crucial element. The oscillators gain must be care-

fully controlled to support stable sinusoidal oscillation. If gain is too low oscillation will not occur and excessive gain will limit cycles, creating a square wave oscillator. The problem is to introduce an amplitude regulation mechanism that does not generate output waveform distortion.

Hewlett used a normal low wattage lamp in this case because lamp resistance increases with an increase in current. The HP 200 is very well-designed because of its hardware simplicity. More importantly it's smart because it's a striking example of lateral thinking. The whole problem was considered in an interdisciplinary spirit, not just an electronic one. This is the signature of superior problem solving and very good engineering practice.

David Packard and his wife rented the first floor flat of a house at 367 Addison Avenue, Palo Alto, California and Bill Hewlett rented the cottage behind the house. Bill and Dave began part-time work in the garage with \$538.00 in working capital. When Hewlett finished his design and thoroughly proved the prototype he and Dave went to their garage and started manufacturing the HP 200 low distortion resistance-capacitance audio oscillator and the rest is history.

Eight of the first HP 200's off the production line were purchased by Walt Disney Studios, who used them to develop and test an innovative sound system for the movie Fantasia. 30 years after the release of the HP 200, HP's first computer the 2116B was released in 1969.

One rainy Sunday afternoon 50 years after Hewlett and Packard started production of the HP 200 in their garage, Jim Williams, an eminent scientist employed at Linear Technology Corporation, who is also the chief editor of several books in the EDN Series for Design Engineers, set out to make an oscillator similar to Hewlett's HP 200 using the latest technology ICs. Hewlett's two pentode valves were a 6J7 and a 6F6 Williams replaced them with two ICs which had a combined 94 transistors (progress?). It was found that the new IC technology, 50 years later, offered only a slight improvement in most areas with a reasonably significant improvement with distortion. Jim



Williams's detailed description shows how he had a fun time even though he came up against problems with Op Amps that Hewlett had solved with vacuum tube valves 50 years before and his detailed description of his design process shows how difficult it was to replicate and improve on Hewlett's original HP 200.

It's worth noting that in 1998 Jim Williams owned 28 Tektronix Oscilloscopes (he probably owns many more now!) similar to the one shown here and the amazing thing is they were all kept in his home. His hobby is buying and restoring old Tektronix Oscilloscopes. It appears he keeps the

majority of Tektronix Oscilloscopes he restores and I can understand that!

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