Conrad Jutson Discusses The Planning and Design of the P780

In 1958, all portable transistor radio performance and specifications compared very unfavorably with tube radios, so Ralph Brown (along with Lee Berberian, product planning and Dick Montmead, industrial design), decided that the department should design a radio that was both rugged (durable) with high sensitivity, selectivity and very good sound. The result was the P780 and Frank Banovic and I were assigned the circuit design responsibility.

SENSITIVITY

Sensitivity is the ability to pick up (receive) distant stations, and for AM radios in our day was measured in microvolts per meter input to the antenna for a given power output to the speaker (50 milliwatts for the P780).

A large ferrite rod antenna was used to provide maximum capture of the radio frequency signals, and we used a grounded-base configuration PNP transistor as the RF (radio frequency) amplifier (TR1) amplifying the signal before the mixer stage (TR2). On almost all consumer radios, the antenna output was fed directly into the mixer stage. Following the mixer are two IF (intermediate frequency) amplifier stages (TR3 & 4). These were fixed 455 KHz amplifiers to deliver maximum signal strength to the detector stage (D1). Audio amplification starts with the pre-amp (TR5), followed by the driver stage

a full range of audio sounds from an AM radio a bandwidth of + or - 20 KHz is desirable so the P780 design was a careful balance between good ACA and bandwidth performance.

SIGNAL-TO-NOISE RATIO

The radio frequency spectrum is full of noise signals both natural and man-made, and radios must be designed to reject them. FM (frequency modulation) radios have a huge advantage, because most noise is in the form of amplitude modulation. Much of the noise is picked up in various parts of the radio circuitry; therefore the P780 ability to amplify the desired signal at the RF and IF stages contributed to its excellent noise rejection capability.

SOUND REPRODUCTION

With all of the criticism of "tinny sounding" transistor portables in that era, good sound reproduction was at the top of our design consideration priorities. So the P780 had many firsts in transistor radio audio performance. To reproduce the widest range of audio frequencies possible at the best power output available, the P780 had a special speaker designed with a large magnet for high efficiency with a 5-inch cone diameter, for low frequency (bass) sound reproduction. The speaker performance was also enhanced by the chrome plated metal front made of a new metal alloy material called Zamack which acted as a solid baffle. At the back of the cabinet

(TR6), and ending with TR7 & 8 which are push-pull Class B biased output transistors. Since the P780 was designed to produce up to one watt output (most transistor portables were less than 100 milliwatts), the output transistors had heat sinks and used a thermistor in the bias circuit to control and limit current if overheating occurred.

The end performance was a radio with average sensitivity across the AM band of 10 to 20 microvolts per meter, which was as good as tube radios and considerably better than any transistor portable on the market. This ability to pick up distant stations was one of the key factors for the model's outstanding sales performance, and we had reports of its performance from remote (desert) locations picking up stations that were previously out of range. At a later date an external whip antenna was added to further improve sensitivity at the high end of the AM band.

SELECTIVITY

The ability of a radio to pick up the desired station (frequency) and reject unwanted signals is its measure of selectivity. All radio stations are assigned specific frequencies on which to transmit. Because there are so many, they are spaced (separated) over the AM broadcast spectrum by 10 KHz intervals. Also, because of the limited number of available channels in the AM broadcast band, many stations that are geographically separated must share the same frequency; thus the need to limit radiated power, and also to operate at reduced power at night when the Heaviside ionosphere layer causes radio waves to travel further. Most major cities have at least one station that is allowed to transmit at higher power (for better coverage) and these so-called clear channel stations are separated by a 20Khz spacing. *(Note: Former clear-channel stations are no longer protected in this way--*

(ABS plastic), we designed venting slots that allowed airflow to circulate from the back of the speaker cone to improve the reproduction of low frequencies. The driver stage (TR6) incorporated a negative feedback circuit to provide a bass boost for the audio signal, and the potentiometer R23 acted as a treble cut to allow balancing for the ear. We custom-designed the audio transformers T5 and T6. And the whole acoustical design was accomplished working in a special sound-proof acoustic chamber.

GE Radio Receiver Department Personnel Mr. Jutson Worked With:

General Manager

Bob Wilson (until ~1964)
Bill Lynch (after 1964)

Marketing

Jack Chamberlain, Manager
Jack Hunter, Manager-Sales
Chuck Kepler, Manager-Sales
Thad Kane-Manager,Advertising
Bob Whitehouse-HQ Sales
Phil Geygan-HQ Sales
Jack Wilson-HQ Sales
John Shields-HQ Sales
Tom Macmanus-Product Planning
Rolf Zerlinsky-Product Planning
Byron Werges-Advertising
John Stang-Marketing Administration

Manufacturing

Joe Drodz, Manager-QC
Frank Trotta, QC Test Manager
Bob Traeger, Manager Manufacturing
John Hajec, Foreman
Len Hughes, Foreman
Walt Yonker, Manager-Purchasing
Hugh Skelly, Manager-Purchasing
Alex Brack, Import Administrator

Ed.)

The ability of the radio to select a desired station was determined by the characteristic of the RF
tuned circuits, first the antenna (L1 & C1A) followed by the RF stage tuned circuit (T1 & C1E). Rejection of adjacent signals, (called adjacent
channel attenuation (ACA) and measured by how many dB (decibels) the adjacent signal was below the selected signal) was determined by the selectivity of the tuned IF transformers T2, 3 & 4. In the P780 the latter two were "double-tuned" providing higher performance.

Another characteristic of selectivity is the bandwidth measurement, which defines the spectrum of frequency range for the audio signals. To reproduce

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Engineering

Jack Philips, Manager
Howie Moore, Manager
Frank Cole, Manager
Dave Weatherby, Electrical Engineer
Howie Teller, Electrical Engineer
Tommy Thompson, Mechanical Engineer
Ed Hughes, Mechanical Design
Bill Wight, Electrical Engineer/Manager
Ted Koski, Electrical Engineer/Manager
Stan Peters, Technician
Jim Deblois, Technician
Ann Wolak, Technician
Carroll Hardy, Mechanical Engineer
Sig Zuerker, Electrical Engineer-Audio
Harry Atwood, Electrical Engineer/Manager
Joe Cacciola, Electrical Engineer
Tony Csicsatka, Electrical Engineer
(*Mr. Csicsatka is the inventor of FM Stereo)*
Bob Linz, Electrical Engineer