Notes on a conversation with Jeff Kalb,
Standard logic design engineer/manager at TI and National Semiconductor

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Jeff worked at TI from 1961 to 1967, when he left to join National Semiconductor to launch their entry into standard logic. Jeff joined TI as a student in college and was hired as a permanent employee when he graduated. From tehj discussion jeff was one of those designers that had a "gut feel" for how circuits work. He worked on TTL starting in late 1963 with the "Phoenix Gate" a dual four input TTL gate. There were lots of problems with the multi-emitter input configuration. The emitters interacted with each other. After some modeling he was able to design around this. Another problem was the gold doping that was used in TTL logic designs to reduce the minority carrier lifetime. They couldn't control it enough to get it to work as a system. Jeff mentioned three problems that they were dealing with in 1965; gold doping, the flip flops didn't work, and they couldn't wire circuits because of noise problems. They removed N+ doping that they were using as part of the solution to the gold doping problem and got it to work. Jeff then designed two flip-flops that worked. The noise problem was due in part to the relatively fase edges of TTL and the large voltage swings. Jeff told me a story of an example of the affect of the wiring problem. TI was involved in a project to design of the controller for a land based catapult for aircraft. Apparently the wiring noise was bad enough that the catapult would not "fire" the same way twice. It took TI a long time to solve all of the problems involved with designing and manufacturing TTL. They still had problems in 1967 when National Semiconductor hired him to manage their TTL design group. They had introduced the 7490 and 7493 counter devices, but cold not manufacture them. Jeff said that at the time they still weren't sure TTL would win the logic race because of the noise. At the time the thinking was that Motorola still had a chance to win with its MECL line. They understood transmission line techniques and wrote a book on designing with ECL that made the design techniques clear to design engineers. Of course you had to eb an RF designer to understand it. I asked Jeff when they realized that TTL would be the winning standard logic technology. He said in 1968 or 1969 when TTL became the largest selling logic family. Jeff also mentioned a project TI did for IBM that resulted in the D flip flop, which became widely used in logic circuit design.

When Jeff went to National he made their first priority to fix the problems TI was having. They incorporated a clamp diode on the inputs which helped with the noise problems. They also focused on the MSI functions. For a time National was shipping the MSI functions and TI was left with the simpler SSI functions. He started designing 74LS logic at National in 1968. He said that LS was used in the color camera on the Lunar Module (I would assume in the early 1970s). They also did a development project to make an IC based calculator for Frieden. They developed an up/down counter that worked for this system. He also mentioned that at this time Fairchild came out with the 9310 and 9316 counters that used dual layer metal and worked but couldn't be manufactured. In 1974 Nationsal split the design groiup into two parts, one focused on bipolar and one on MOS. Jeff took the group that focused on MOS while Jim Smaha took the bipolar group. Later

on he started the memory design group. In 1977 Jeff left national to join Digital Equipment where he was responsible for their semiconductor operation.