Message. Dated: 05/21/86 at 0917.
Subject: Nostalgia
Sender: John MINCK / HP0400/02 Contents: 3.

Part 1.

TO: Rey ROSENBERG / HP8029/BA
Roger ROXBY / HP8010/A1

CC: Dean ABRAMSON / HP4500/MK

Part 2.

Rey asked me to reflect and Roger asked Dean. Actually, just as I was ready to send my list and comments, I read Dean's list and like it better.

But I thought I might as well send mine anyway.

Dean, I thought it was a social disease that ravaged the mind. I know you don't drink that much.

The circa dates I used were the Journal publication dates, and those usually follow the true introduction by as much as a year. Use Dean's dates.

Anyway, for what it's worth. And Cheers,

Part 3.

Some Microwave Milestones from Hewlett-Packard

Circa
Product Number and Name
Contribution and Comments

1952
HP 752 Series Directional Couplers
Based on Bill Hewlett's patent for multi-hole coupling between waveguides, this coupler design offered ultra-high directivity over the entire 1.5 to 1 waveguide frequency band.
ref: HP Journal, March-April 1952

1955
HP 382 Series Rotary-Vane Attenuators
Designed by Phil Hand, these attenuators obeyed a cosine-square law of rotation, as long as the center section had at least 60 to 70 dB of basic attenuation when straight-up in the guide. They were critical to early rf-substitution methods of full-band waveguide swept measurements in the 1960s.
ref: HP Journal, Jan. 1955

1957
HP 680 Series BWO Signal Sources
Sweeping sources started out with mechanically-driven klystron cavities of the HP 670 Series. Meanwhile, Alfred Company was supplying a sweeping power supply to drive backward-wave-oscillators which were electro-magnet type heavy monsters, later to be packaged into band "heads". The HP 680

Series were directly-calibrated units which alieviated the problem of looking up the frequency end-points by referring to a calibration chart.

Alfred of course countered with frequency dials on the front of the their panels, and finally used pots for end point set.
ref: HP Journal, Feb. 1957

1958
HP 340 Series Noise Figure Meters
Based on a novel circuit design Bill Hewlett purchased from Magnetic AB, HP improved on their ideas to create a highly-stable ratio-meter which used AGC to keep full-scale reference (infinite dB) constant by merely turning off the source periodically to create the infinite dB condition. It thus allowed the easy calibration of scale end-points by artificially creating the zero and infinite NF conditions. Contributions were also made on thermally-limited diode noise sources and ultra-low SWR waveguide sources. Finally, we also designed a well-matched coaxial gas discharge source, the HP 349A.
ref: HP Journal, Jan 1958

1960
Time-Domain Reflectometry with HP 185 Sampling Scopes
While not a new idea in theory, Barney Oliver saw the possibilities of this new diagnostic measuring technique when the technology of the 1000 MHz sampling scopes came along. The first executions were using lashed up rigs with the HP 185 and then later came a specially designed plug-in for the HP 140 scope. This powerful picture of transmission line reflections allowed for many production-floor "tweaking" functions like compensating inside the HP 355 attenuators.
ref: HP Journal Jan 1960

1961
HP 431A Power Meter
While HP's earlier Model 430 Power Meter probably made contributions in ease of power measurements in the 1950s, especially in the use of thermistors for dc-substitution techniques, any of us who used them cried out for getting rid of the drift and re-balancing needed.

The dual-channel thermal balance of the 431 was a God-send for microwave engineers. It allowed the increase of sensitivity by a factor of 100, and made power measurements a pleasure. Naturally the development included the dual-thermistor 478 and 486 series sensors, while maintaining the dc and then ac substitution method. The technique was never really challanged until the advent of the thermocouple meters of the late 70s which gave much more sensitivity and lower SWR.
ref: HP Journal, June 1961

1963
HP 8714A Microwave PIN Modulator
Turning on a Klystron to get pulsed signal simulation always produced FM and jitter in traditional signal generators. The work by Nick Kuhn in use of Positive-Intrinsic-Negative PIN diodes allowed the Klystron to run continuously and to be pulsed on and off. Getting 80 dB plus broadband and with low SWR was not trivial. By using quarter-wave spacing for the diodes along a coaxial transmission line they were able to achieve the right performance and yielded rise/fall times in the order of 10 to 50 nanoseconds. Other than a transistorized Noise Figure Meter HP 344, this was the first transistorized microwave instrument. The first regular instrument was the HP 302A Audio Analyzer.
ref: HP Journal, Mar 1963

1964
HP 5100/5100 Frequency Synthesizers
This instrument was the first direct-switching model with 50 MHz capability. It was a maze of filters, mixers, and switching diodes, and a marvel of the time. The military loved it. It was an Al Bagley contribution, but designed by Vic Van Duzer. Incidentally, Vic was the designer of the double-balanced mixers (10514/10534), although I don't know if he invented them. They were much in use inside the synthesizer.
ref: HP Journal, May 1964

1964
HP 8551/851 Microwave Spectrum Analyzer
The first spectrum analyzer was probably invented in WWII at the Radiation Lab and I think Art Fong might have been somewhere around. The main supplier in the early 60s was Polarad. The entire market was 5 million per year. A company Panoramic was also building a multi-band version using a klystron first LO with harmonic mixing. The intersecting multiple responses were mind boggling, with clear rules about tuning clockwise and watching for right-movement on the screen. I can't remember if that meant a real or false response.

The world was ready for the first "frequency-domain oscilloscope", but it was still a concept-sell. The legendary Lyle Jevons put a unit in the back of a Ford Econoline station wagon and spent about 6 months on the road in the US and perhaps an equal time in Europe to work with individual field engineers in front of real customers to show how this 2000 MHz sweep with direct calibrated display and honest calibrated 60dB dynamic range could do things that hadn't been done before.
ref: HP Journal, Aug. 1964

1966
HP 8405A Vector Voltmeter
The contribution here was the use of the sampling diodes from the sampling scope earlier. By using two channels and a dc IF, the phase could be compared across a very wide HF range to 1000 MHz. In a real sense, this was the forerunner of the 8410 from a design engineer standpoint. In fact, one of the first application notes was the method of using a dual-coupler to sample the forward and reverse signal for both magnitude and phase. Unfortunately, it didn't give smith charts in real time, but you could plot them from the math data.
ref: HP Journal, May 1966

1967
HP 8410 Network Analyzer
This was the Paul Ely campaign to "stamp out slotted lines". And it succeeded to an extent that most of us didn't fully appreciate at the time. Many notables were involved including His Emminance Dick Anderson. The contribution was the dual sampler with mixing broadband to 18 GHz, and the auto-tracking local oscillator which followed the sweeping input signals. Almost equally important, but usually ignored was the variety of test accessories that went along with the 8410, the couplers, rotary arms, calibration standards, and ultimately the APC-7 connector.
ref: HP Journal, Feb. 1967

1970
HP 8540/2A Automatic Network Analyzer
This is the idea that launched a design revolution for microwave folks. Looking back, the first units were slow and expensive, but the effect was

profound. The thought-leaders of the MW community picked it up right away. I think a vote on the most significant milestone of all from HP microwave would have to be this product. Not that the spectrum analyzers aren't charming and useful. But the 8540 progeny are changing the face of the earth.
ref: HP Journal, Feb. 1970

In a sense, the 70s didn't create the several blockbusters of the 60s. The intersection of two technologies did change the landscape however. Computing power inside instruments plus the sapphire microcircuit technology were the underpinnings. Computer-aided-design gave us the design insight to build better components and circuits. But the real output of the 70s was a vast broadening and deepening of all instruments. But almost all were more in the form of evolution rather than revolution.

Here are a few of the more significant of the events of the 70s for SPD:

HP 8970 Noise Figure Meter
HP 8672A Synthesized Generator and 8620 Sweeper
Edge-line coaxial transmission switching technology
Thermocouple power sensor technology for 435/436.
Phase-noise made easy
AWS
Vector Stuff

I'm sure there are more from Dean too. I think your own background can fill in the best stuff from the 70s and 80s.

Message. Dated: 05/20/86 at 1928.
Subject: HP RF & Microwave Firsts
Sender: Dean ABRAMSON / HP4500/MK Contents: 2.

Part 1.

FROM: Dean ABRAMSON / HP4500/MK

TO: Roger ROXBY / HP8010/A1

CC: Jim FITZPATRICK / HP4500/MK
John MINCK / HP0400/02
Rey ROSENBERG / HP8029/BA

Part 2.

'Tis time for nostalgia.

NOTE: For items marked with *, I only THINK we were first but wouldn't swear to it. Brain gets mushy, you know, from the ravages of years and demon rum).

1946: First commercially-available, direct-reading microwave signal generator (HP 616A).

1948: First parallel-plane coaxial slotted line (HP 805A).

1950: First commercially-available direct-reading VHF impedance bridge (HP 803A).

1952: First multi-hole high-directivity waveguide directional couplers (HP 752 series).

1953: * First commercially-available waveguide rotary-vane precision attenuator (HP 382A series).

1954: * First commercially-available waveguide rotary-dielectric precision phase shifter (HP 885A series).

1958: * First commercially-available direct-reading automatic dc-to-12.4 GHz calorimetric power meter (HP 434A).

1964: * First commercially-available time-domain-reflectometer oscilloscope (HP 140/1415A).

1964: * First commercially-available swept-first LO wide span high reolution microwave spectrum analyzer (HP 8551/851A).

1966: First commercially-available automatic-tuning wideband (1-1000 MHz) RF vector voltmeter (HP 8405A).

1967: First commercially-available automatic-tuning multi-octave microwave vector network analyzer (HP 8410).

1967: First commercially-available computer-controlled error-correcting microwave automatic network analyzer (HP 8540A).

1968: * First commercially-available RF spectrum analyzers with absolute amplitude (as well as frequency) calibration (HP 8553L & 8554L).

1970: * First commercially-available microwave spectrum analyzer with absolute amplitude (as well as frequency) calibration (HP 8555A).

As best I can tell, virtually all of the MCG product developments since 1970 have essentially been improvements on the types of instruments listed above (or improvements on instrument types not first developed by HP). So the nature of the "firsts" changes.

1975: 500 kHz-to-1.3 GHz HP-IB programmable vector network analyzer with built-in signal source, 100 dB dynamic range and direct readout of magnitude, phase, group delay and deviation from linear phase (HP 8505A).

1977: 100 Hz-to-1.5 GHz synthesizer-based spectrum analyzer with 10 Hz resolution bandwidth and >85 dB dynamic range (HP 8568A).

1978: 100 Hz-to-22 GHz synthesizer-based spectrum analyzer with 10 Hz resolution bandwidth, signal preselection and >80 dB dynamic range (HP 8566A).

1982: 10 MHz-to-26.5 GHz microwave synthesizer with 1 Hz frequency resolution to 7 GHz, 4 Hz resolution at 26.5 GHz (HP 8340A).

1984: 45 MHz-to-26.5 GHz vector network analyzer for real-time, error-corrected measurements in frequency and time domains (HP 8510).

1986: 300 kHz-to-3 GHz vector network analyzer with built-in 1 Hz resolution synthesized signal source for real-time, error-corrected measurements in frequency and time domains (HP 8753A).

And while the items below are not HP products, they were HP developments that made significant microwave contributions.

1964: Developed precision 7 mm coax connector for precision measurement applications to 18 GHz. (Connector now manufactured and sold by Amphenol Products as APC-7 series).

1977: Developed precision 3.5 mm coax connector for precision measurement applications to 34 GHz. (Connector now manufactured and sold by Amphenol Products as APC-3.5 series).

1986: Developed 2.4 mm coax connector interface for 50 GHz connectors for use in systems applications, in test & measurement applications and in metrology and standards applications. (Metrology-grade products come from HP; Amphenol Products manufactures and sells the instrument grade "APC-2.4" series, and M/A-COM Omni Spectra produces and sells the production grade "OS-50" series).

I'm afraid I have scraped the bottom of the barrel. Hope these entries help (and also bring back fond memories).

Best regards,

Dean Abramson