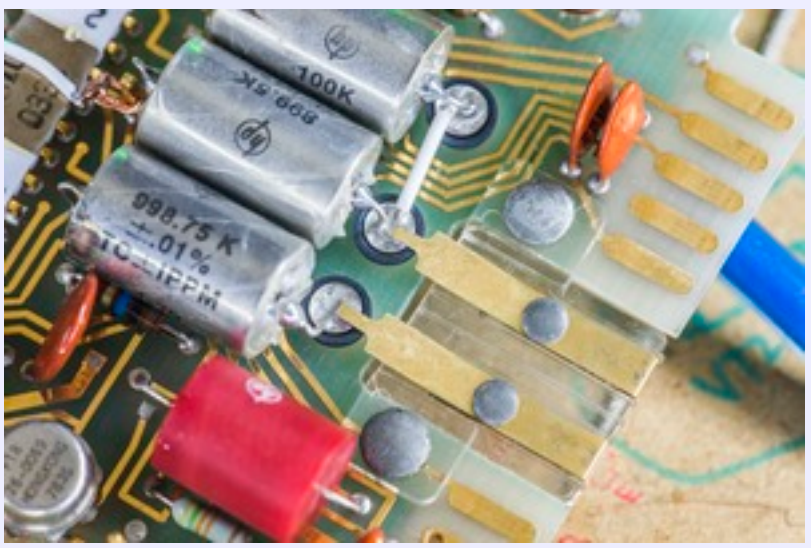
multimeter features amazing performance and stability, gn date back those years. But this article not about multimeter itself, but about optional reference module, which used to calibrate internal voltage and resistance measurement circuitry to higher stability source. Welcome HP 11177 module, let's take a look.

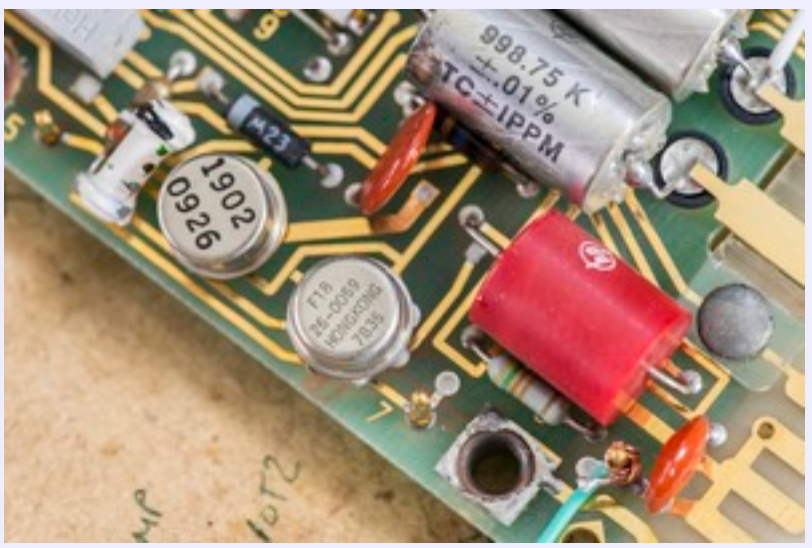
HP 3455A DMM Operating and Service manual, P/N 03455-90003, July 1979, with schematics

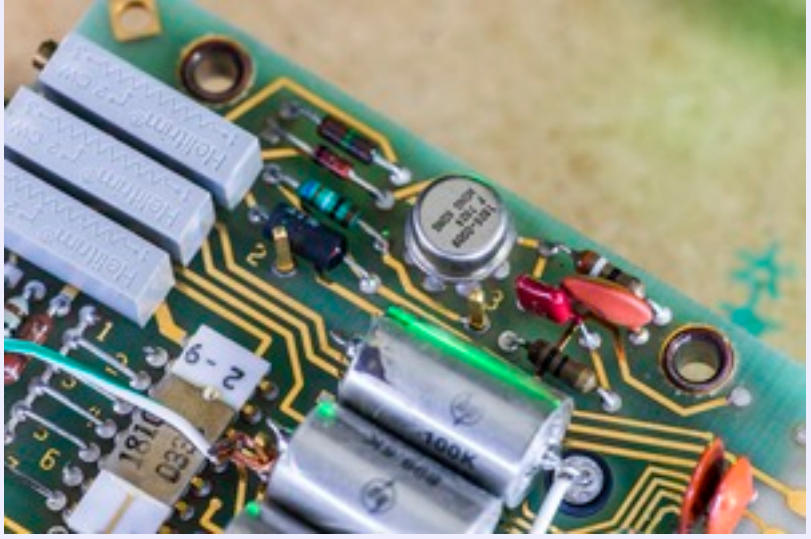
There are at least 4 different versions of these modules, with differences listed in table:

	HP 11177A Rev.A	HP 11177A Rev.B	HP 11177B Rev.A	HP 11177B Rev.B
Used voltage reference	Selected LM399	Selected LM399	Custom ovenized zener	Custom ovenized zener

Photo courtesy: HP memory project

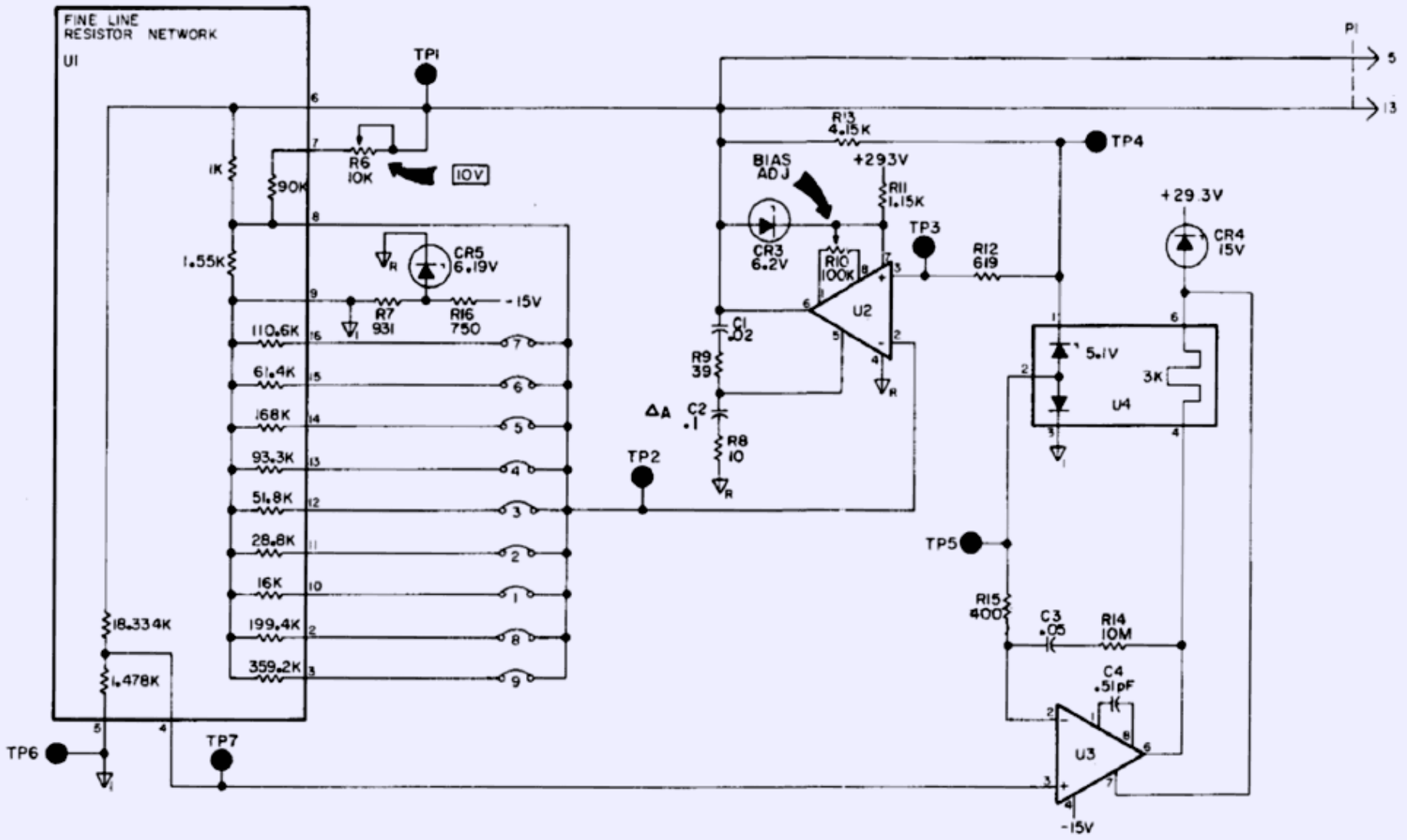






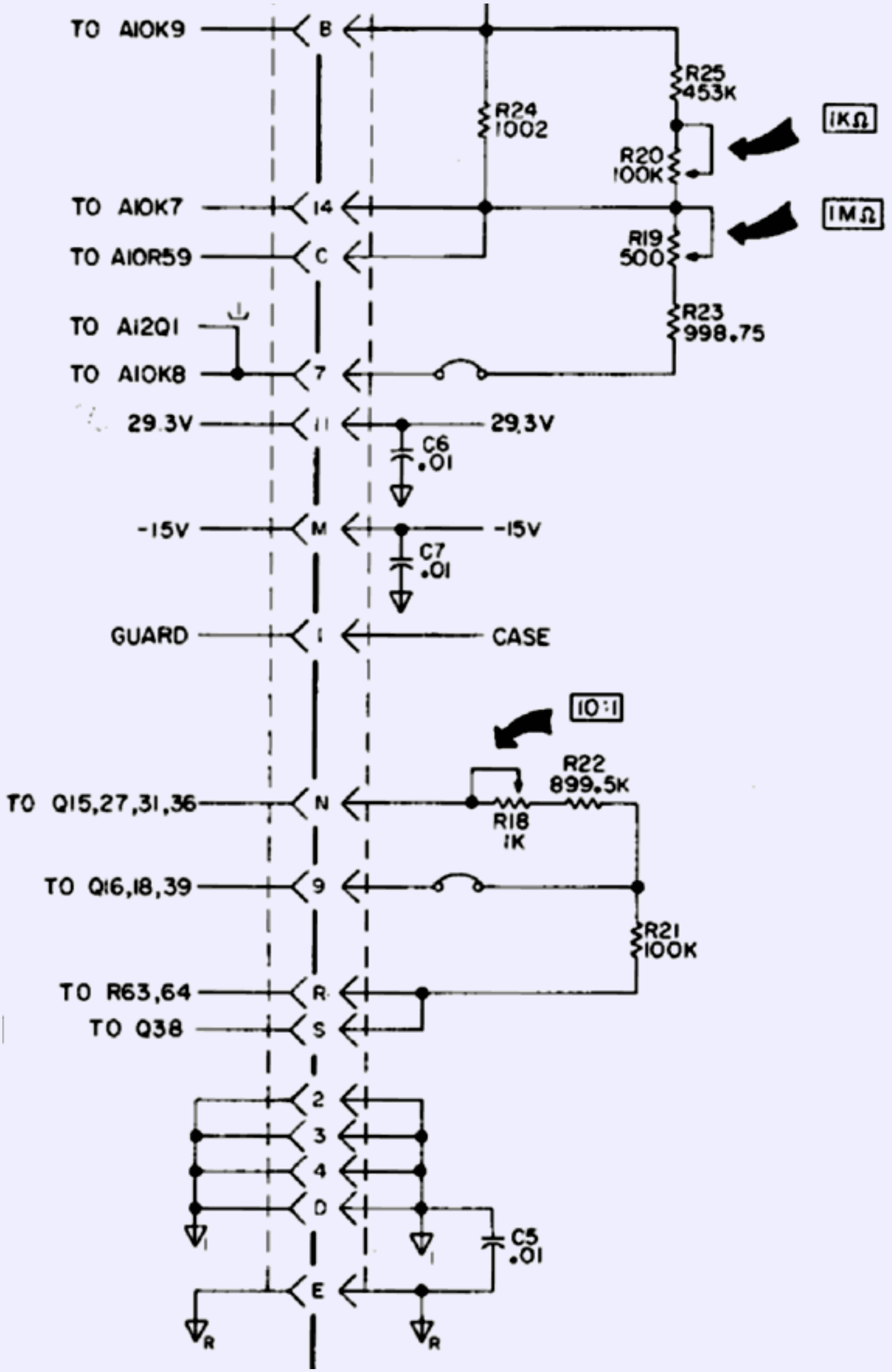
10V voltage reference circuitry:

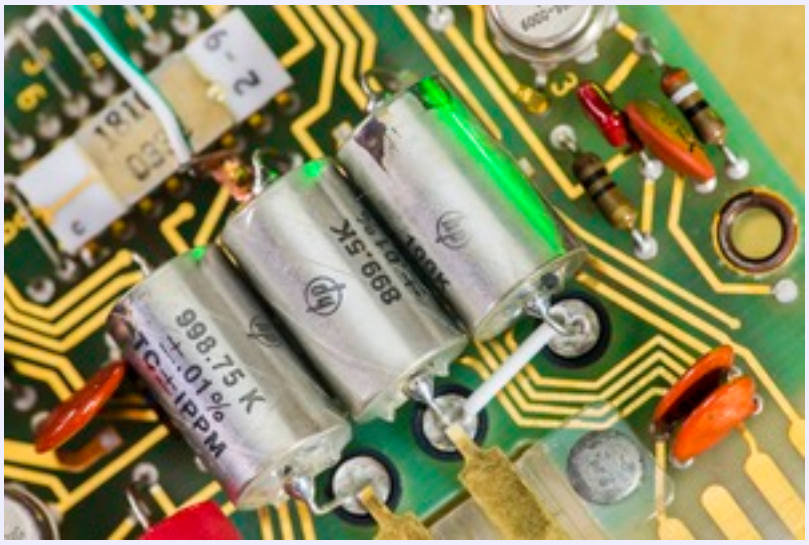
Reference IC is custom HP 1902-0926 5-leg metal TO-99 can. It does run little warm by touch, but not nearly as hot as LM399.
Zener diode is marked on schematics 5.1V, actual measured voltage was 5.2485 VDC. Can have marking 6355 on side, can it be 55 week of 1963 ?
U2 opamp is remarked with HP part number – 1826-0059, made in HONGKONG, date code 35 week 1978.
Another opamp U3, remarked with HP P/N 1826-0009, date code 24 week 1978 is driving heater element inside VREF IC.

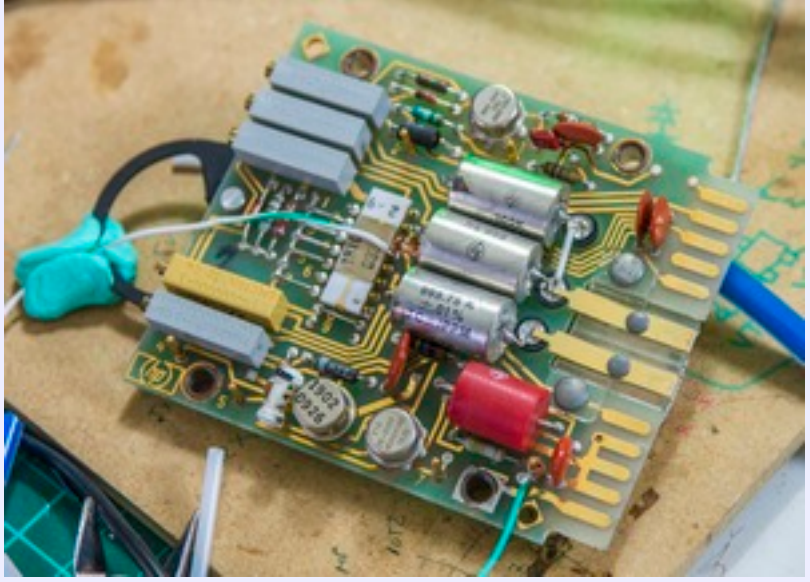


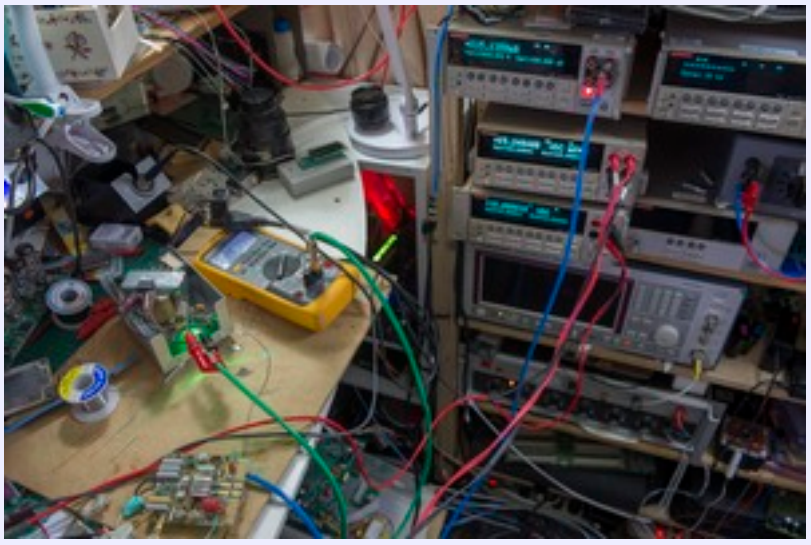
Precision resistance circuitry.

- R24 is epoxy encapsulated wire-wound 1.0020K 0.01% 1ppm/°C beast
- R21,R22,R23 are metal hermetic 0.01% 1ppm/°C resistors



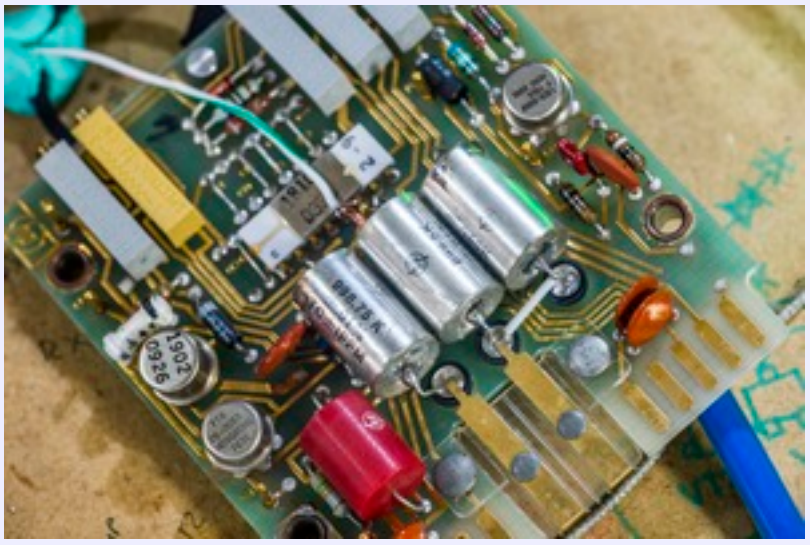






Test setup:

- Linear transformer PSU with 7915 powering -15V input on board. Current consumption according to my Fluke 87V was ~15.8 mADC...
- Keithley 2400 is providing +29.300 VDC and reading +15.38mADC on this rail.
- 10V output measured by one of Keithley 2001 (roughly calibrated it myself, as my primary 2001 with Tek cal is busy at moment gathering data from ESI DB52 bridge).



Output was ~9.99975 VDC when it was powered on as is and let settle for 15 minutes. Little fiddled with R6 trimpot to set 10.000000VDC.
Now after ~1 hour 2001 showing Max: 10.000011 VDC, min voltage 9.999967 VDC.

Author: Illya Tsemenko
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References

1. EEVBlog : HP 3455A teardown thread from daqq
2. HP 3455A Instruction manual with schematics
3. Daqq's article about 3455A with 11177A module
4. EEVBlog : Sale thread link
5.

Comments