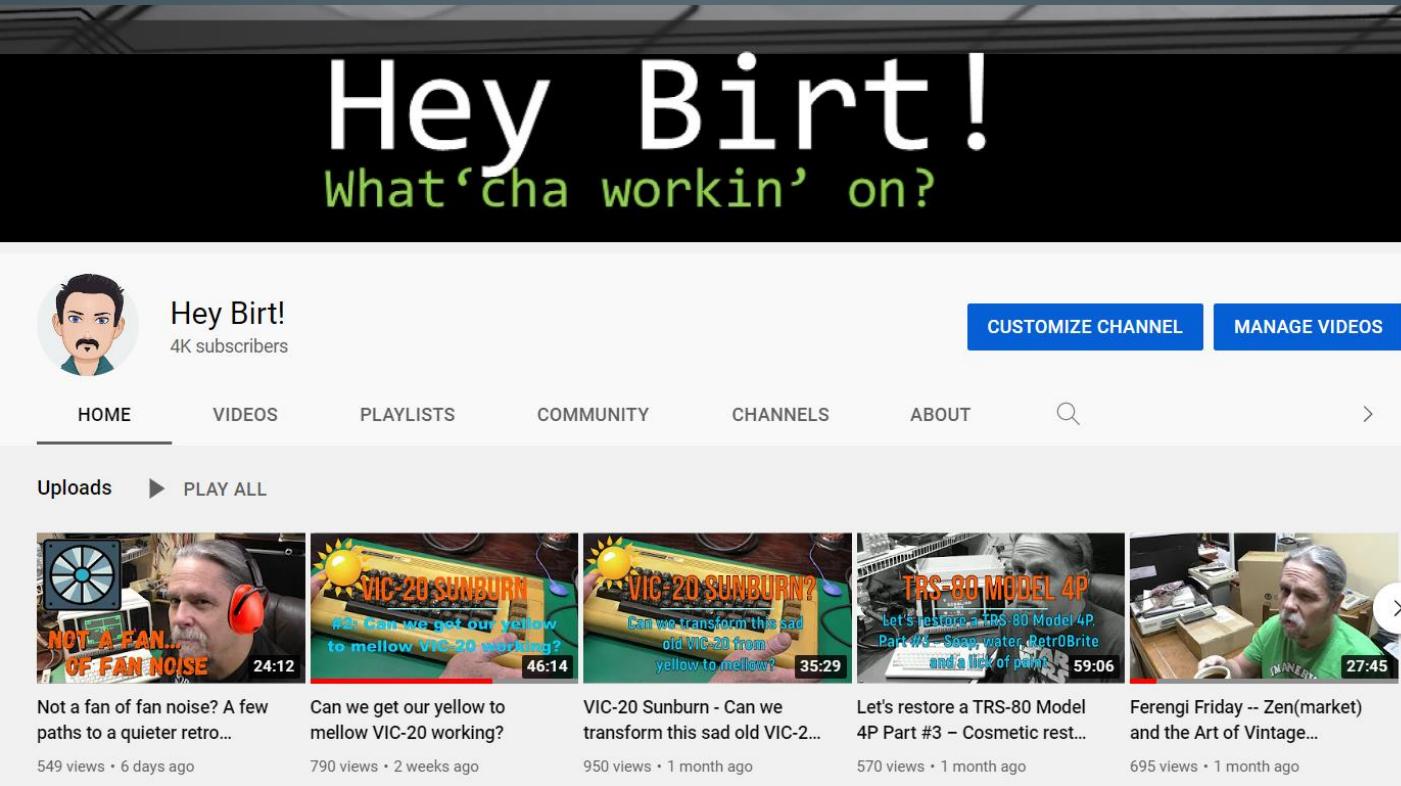


VINTAGE COMPUTER REPAIR 201



Tandy Assembly



VINTAGE COMPUTER REPAIR 101

Covered in Vintage Computer Repair 101

- A Systematic Approach
- PCR – Power, Clock, Reset
- BADS – Bus, Address Decoding, chip Selects

<https://www.youtube.com/watch?v=5gUDBbVxCSo>



VINTAGE COMPUTER REPAIR 201

Learned from Vintage Computer Repair 101

- These are foundational skills
- We are building upon them
- Not replacing them

<https://www.youtube.com/watch?v=5gUDBbVxCSo>



VINTAGE COMPUTER REPAIR 201

Covered in Vintage Computer Repair 201

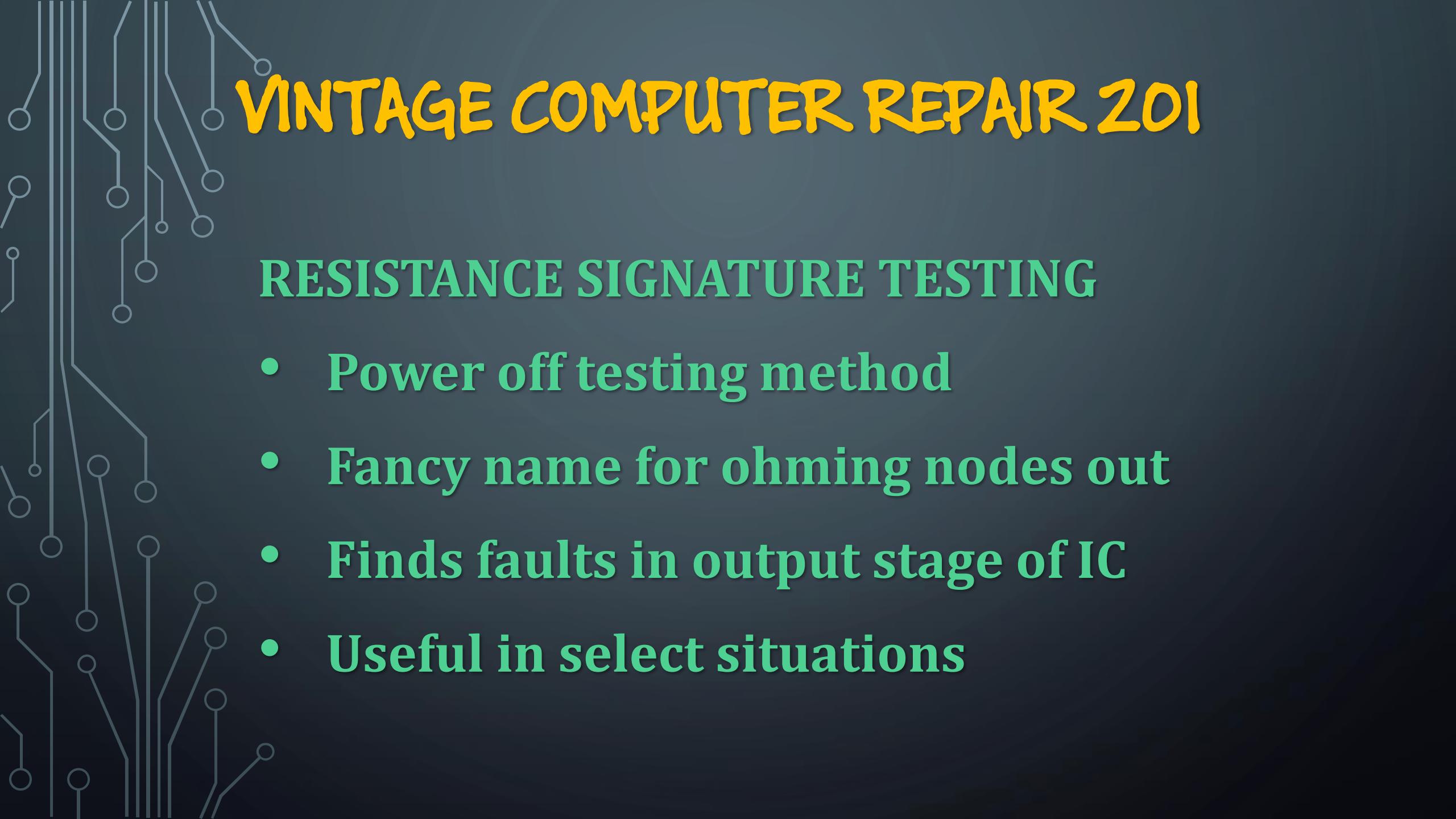
- Resistance Signature Testing
- Signature Analysis / Curve Tracing
- Locating Short Circuits
- Thermal Cameras



VINTAGE COMPUTER REPAIR 201

Covered in Vintage Computer Repair 201

- NOP Generator
- Diagnostic ROMs
- Processor/ROM simulators
- Logic Analyzer and Logic Comparator

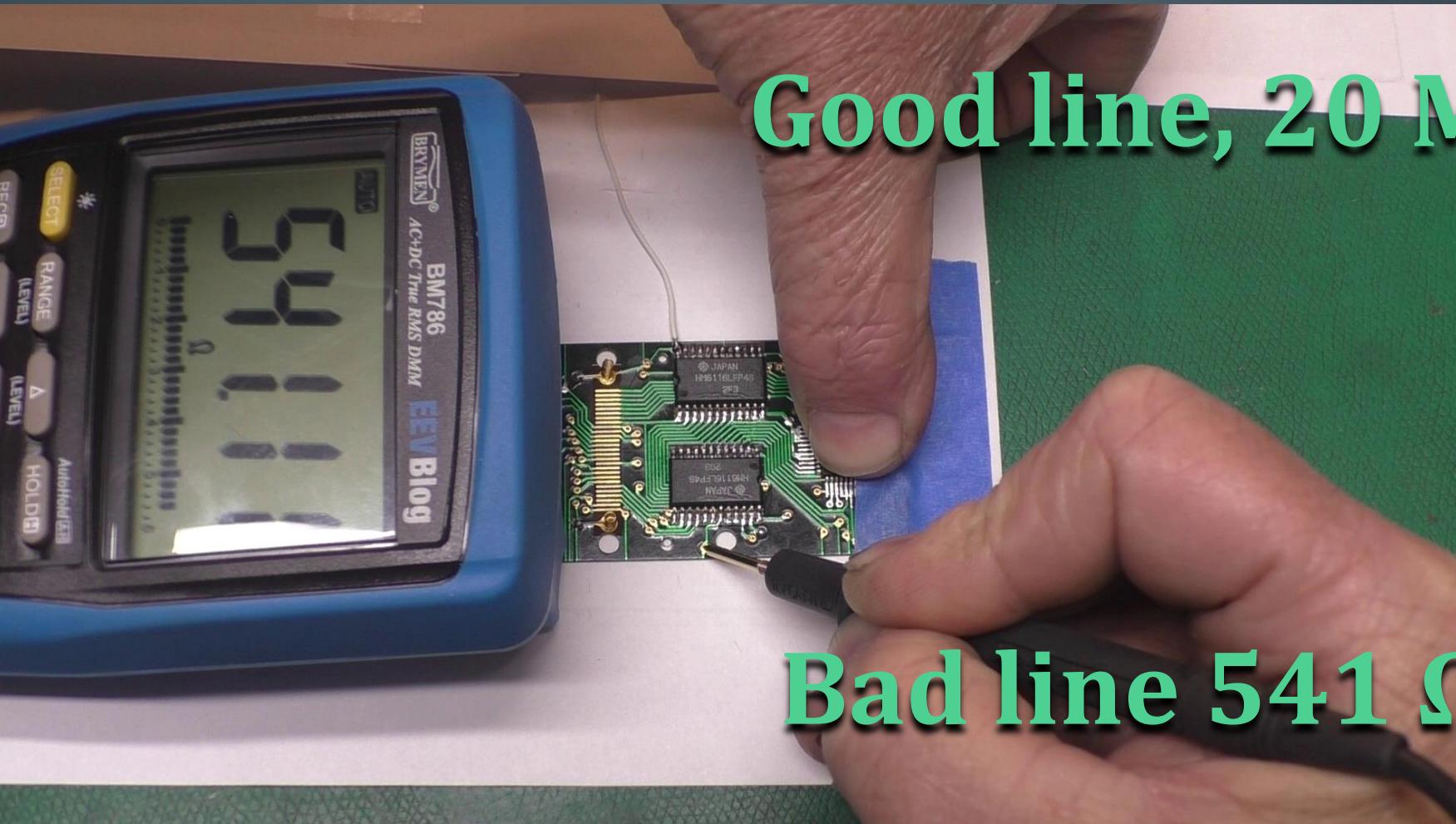


VINTAGE COMPUTER REPAIR 201

RESISTANCE SIGNATURE TESTING

- Power off testing method
- Fancy name for ohming nodes out
- Finds faults in output stage of IC
- Useful in select situations

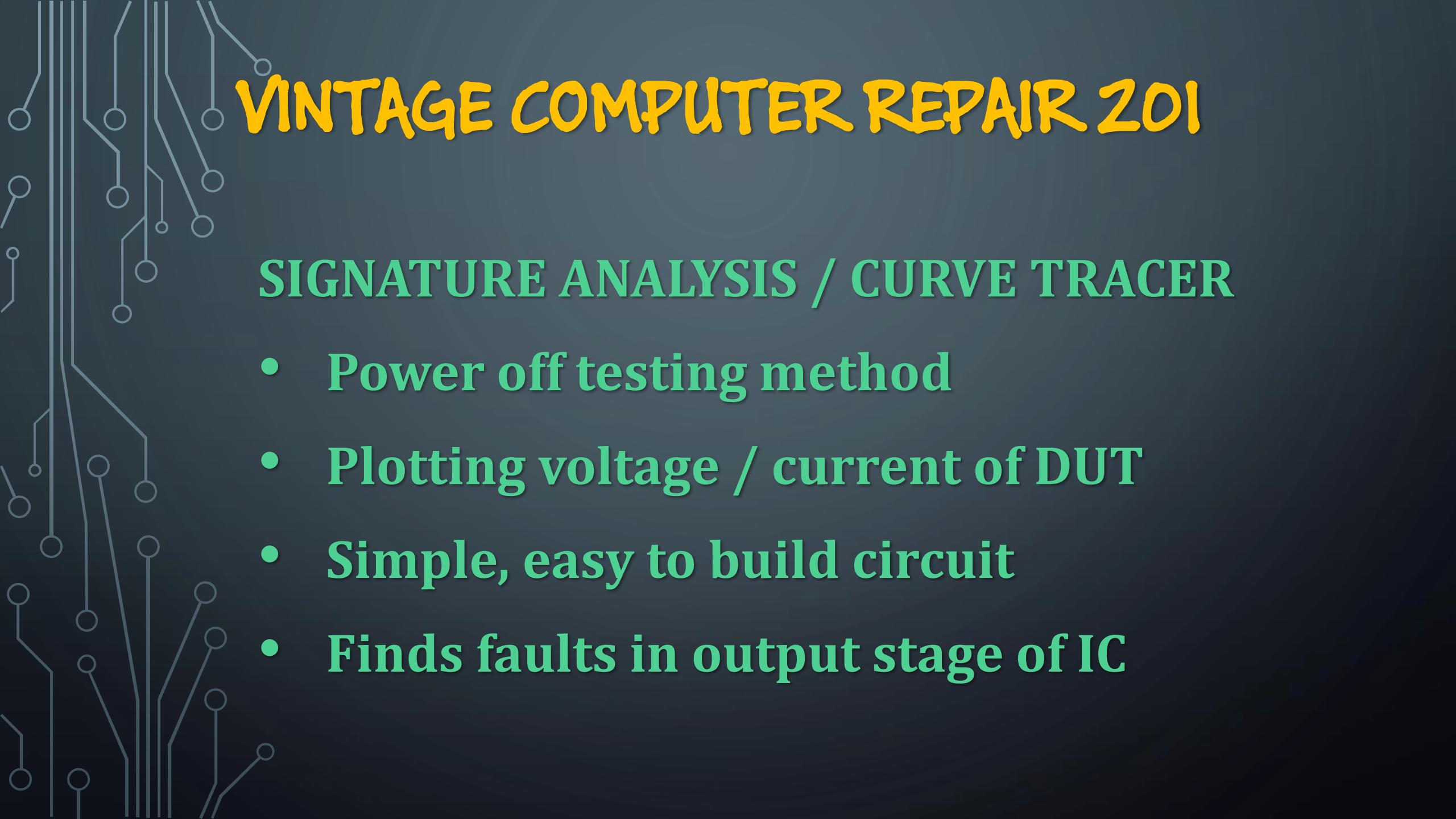
VINTAGE COMPUTER REPAIR 201



Good line, $20\text{ Meg}\Omega$

Bad line $541\ \Omega$

Bad address line



VINTAGE COMPUTER REPAIR 201

SIGNATURE ANALYSIS / CURVE TRACER

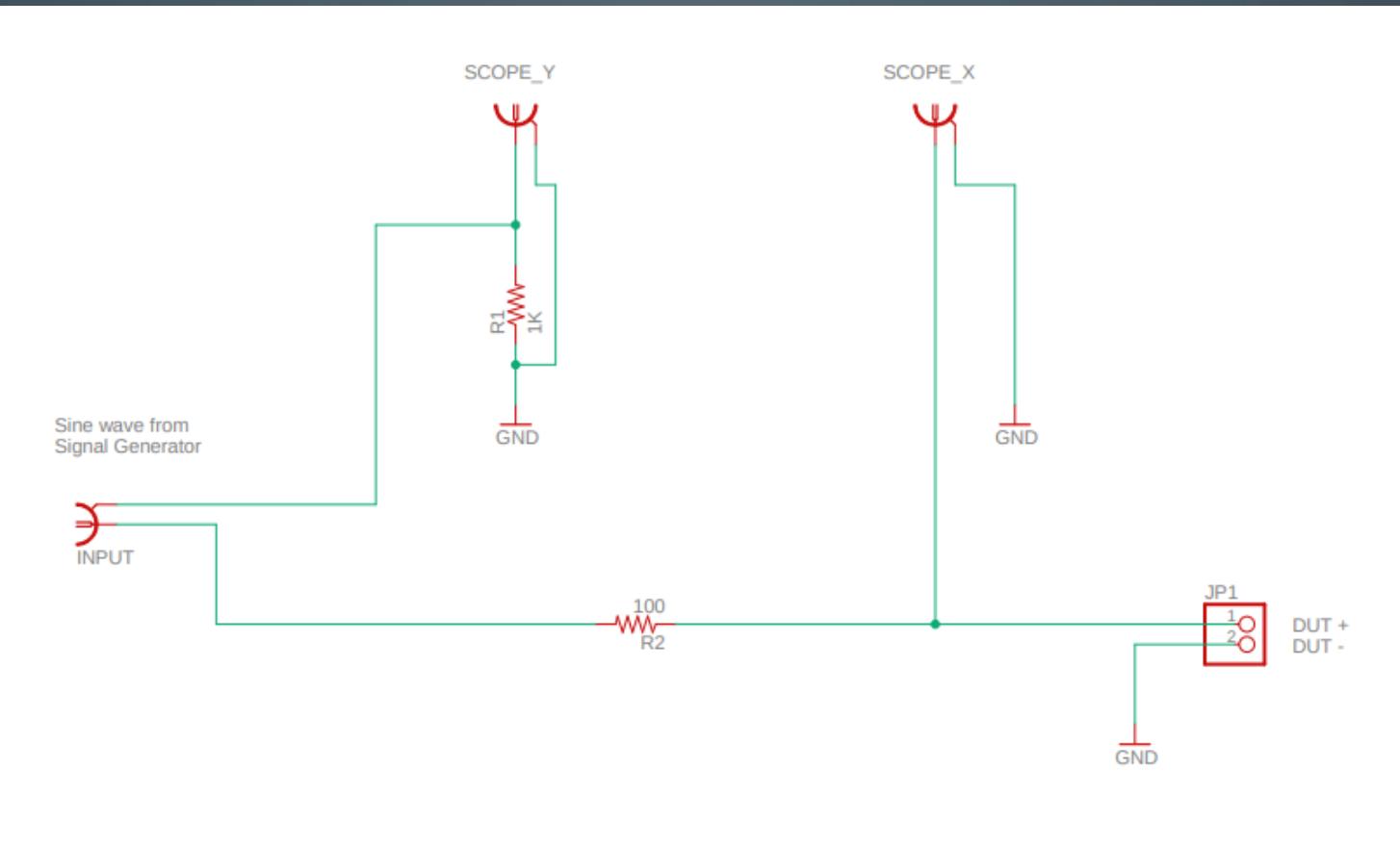
- Power off testing method
- Plotting voltage / current of DUT
- Simple, easy to build circuit
- Finds faults in output stage of IC

VINTAGE COMPUTER REPAIR 201



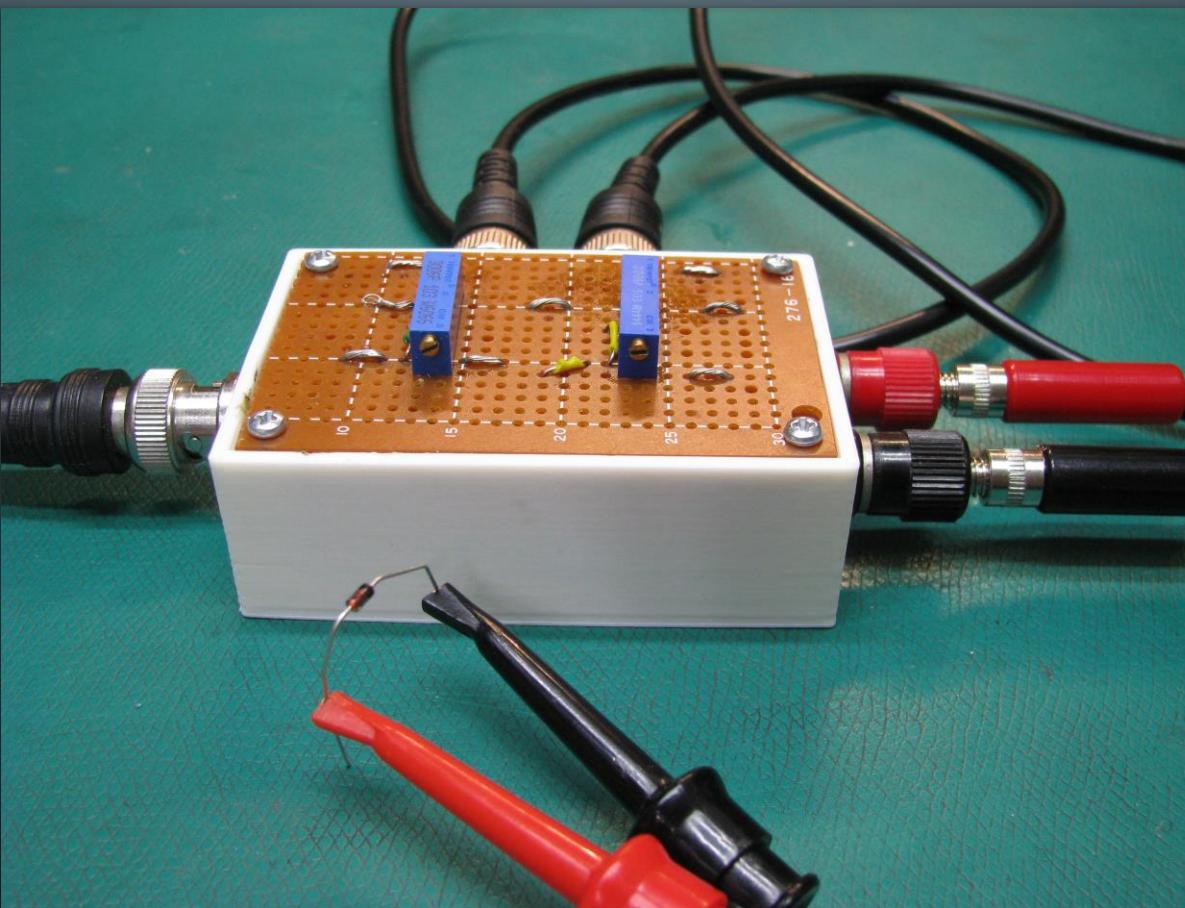
Huntron Tracker

VINTAGE COMPUTER REPAIR 201



Signal generator input, output to oscilloscope in XY mode

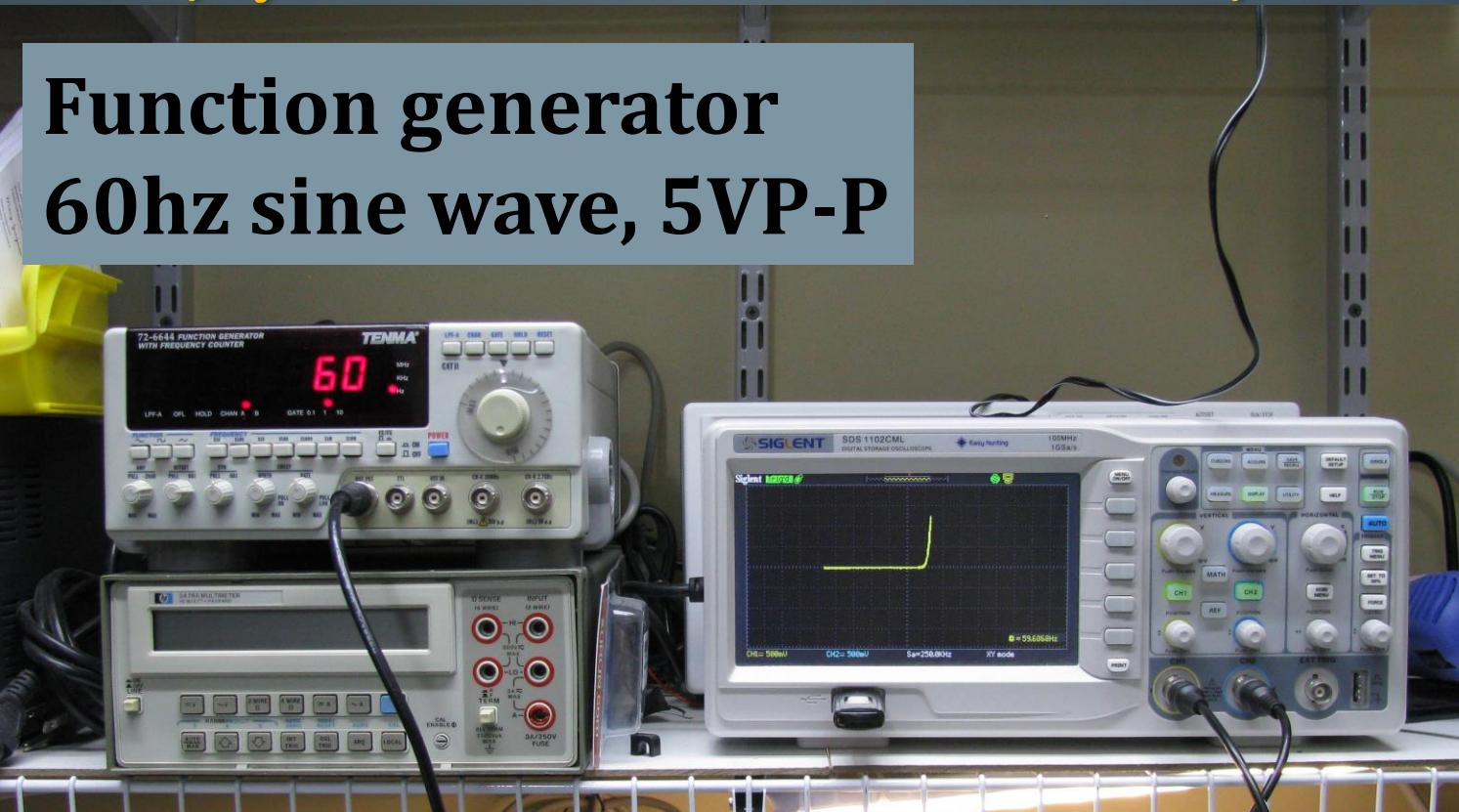
VINTAGE COMPUTER REPAIR 201



Simple DIY device

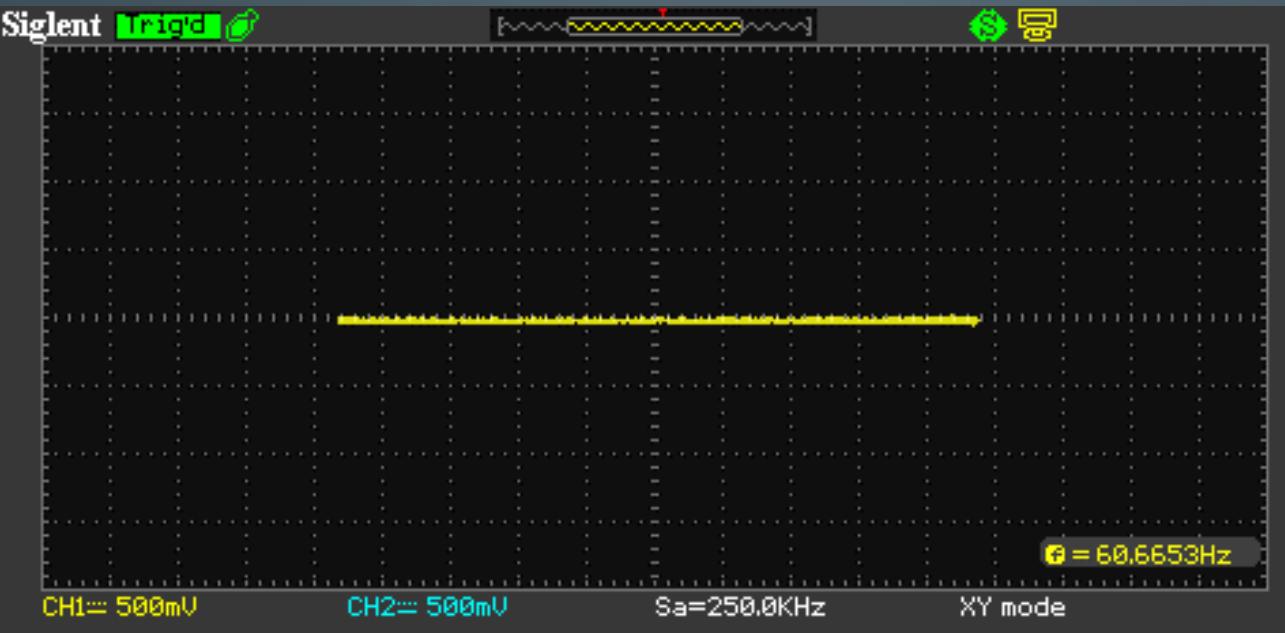
VINTAGE COMPUTER REPAIR 201

Function generator
60hz sine wave, 5VP-P



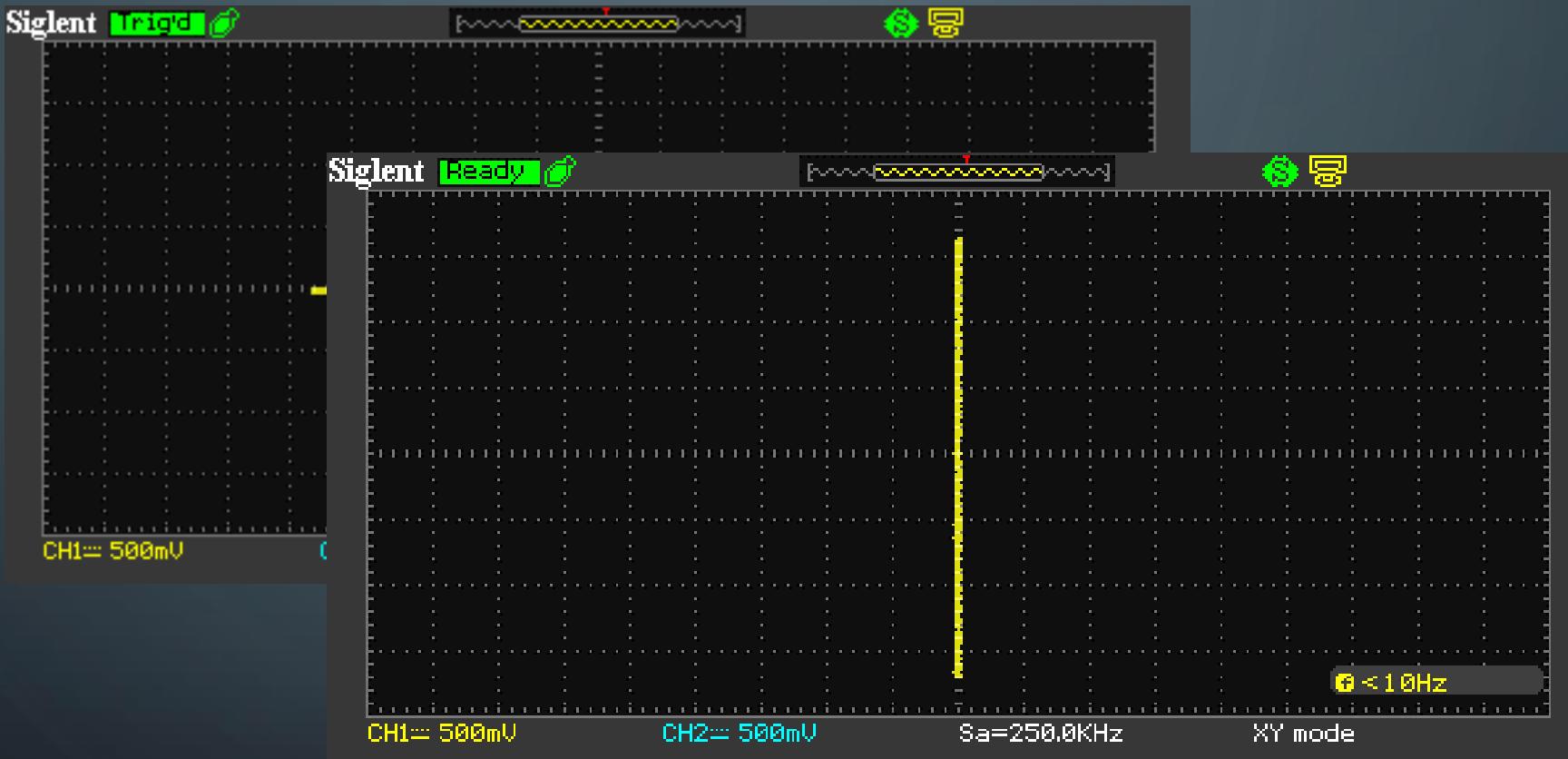
Oscilloscope in XY mode.
Y channel inverted

VINTAGE COMPUTER REPAIR 201



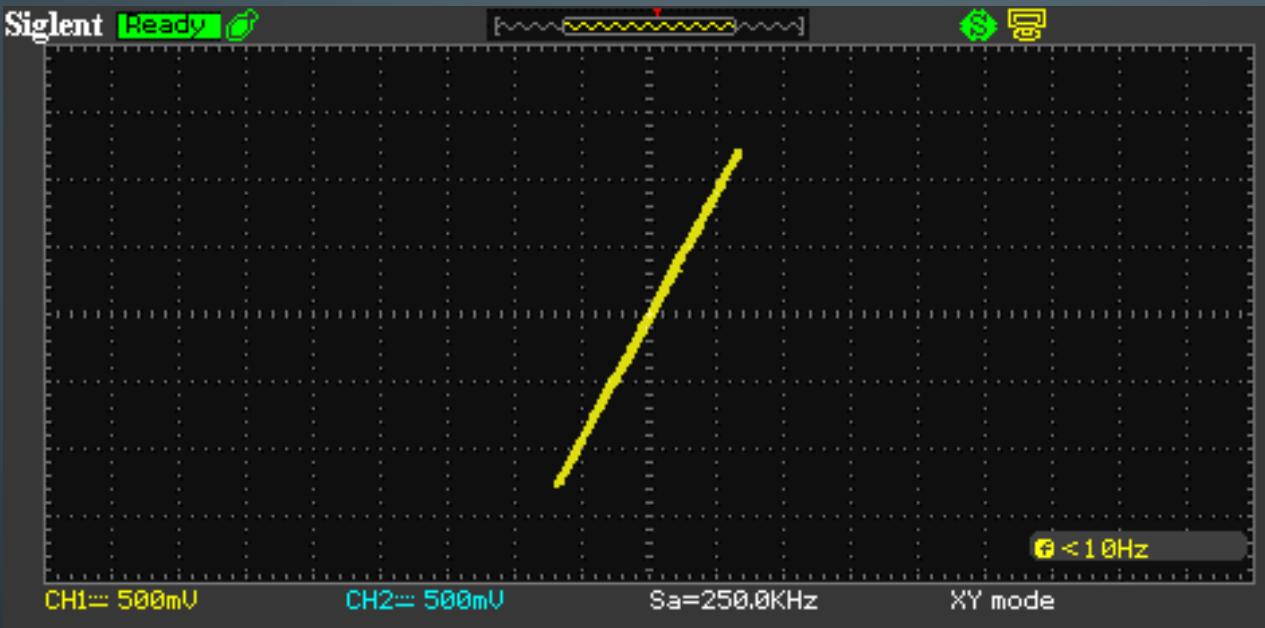
Open Circuit

VINTAGE COMPUTER REPAIR 201



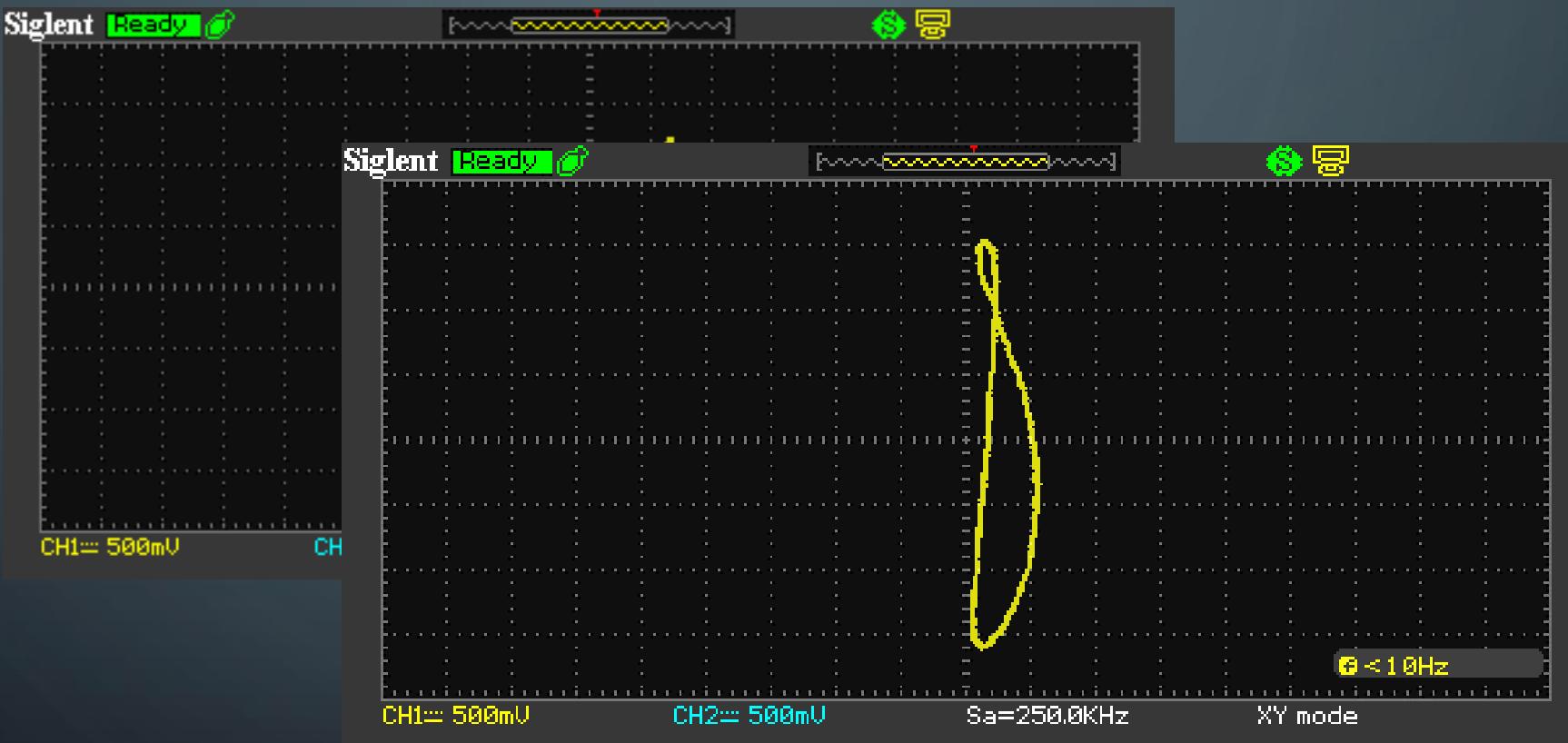
Short Circuit

VINTAGE COMPUTER REPAIR 201



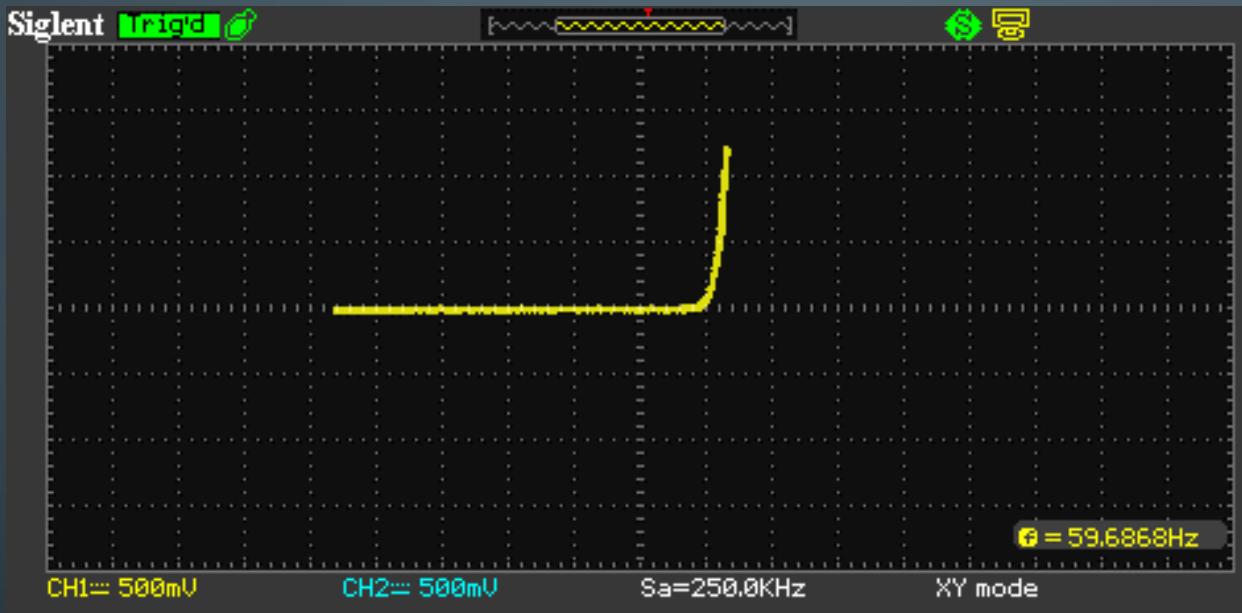
Resistor

VINTAGE COMPUTER REPAIR 201



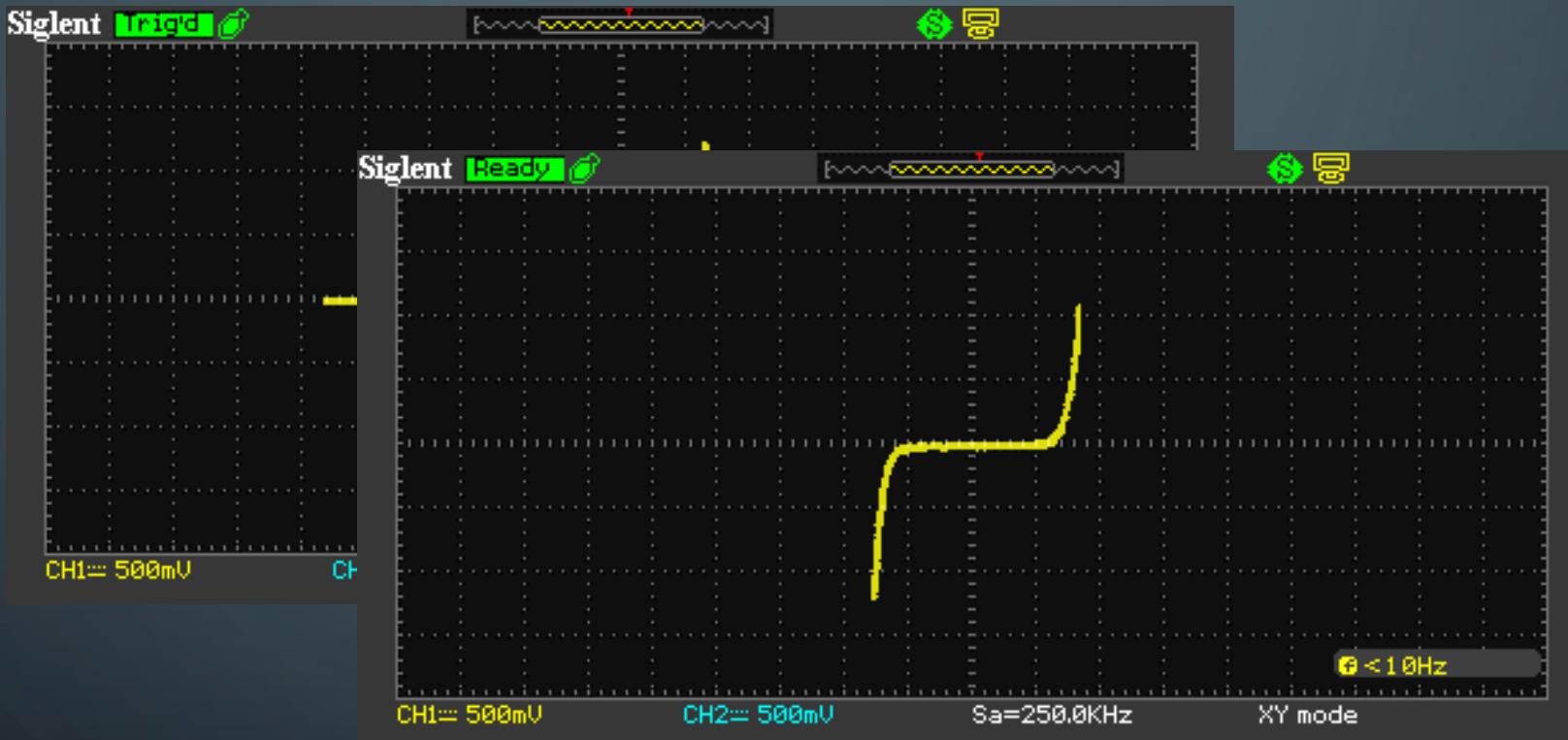
Capacitor

VINTAGE COMPUTER REPAIR 201



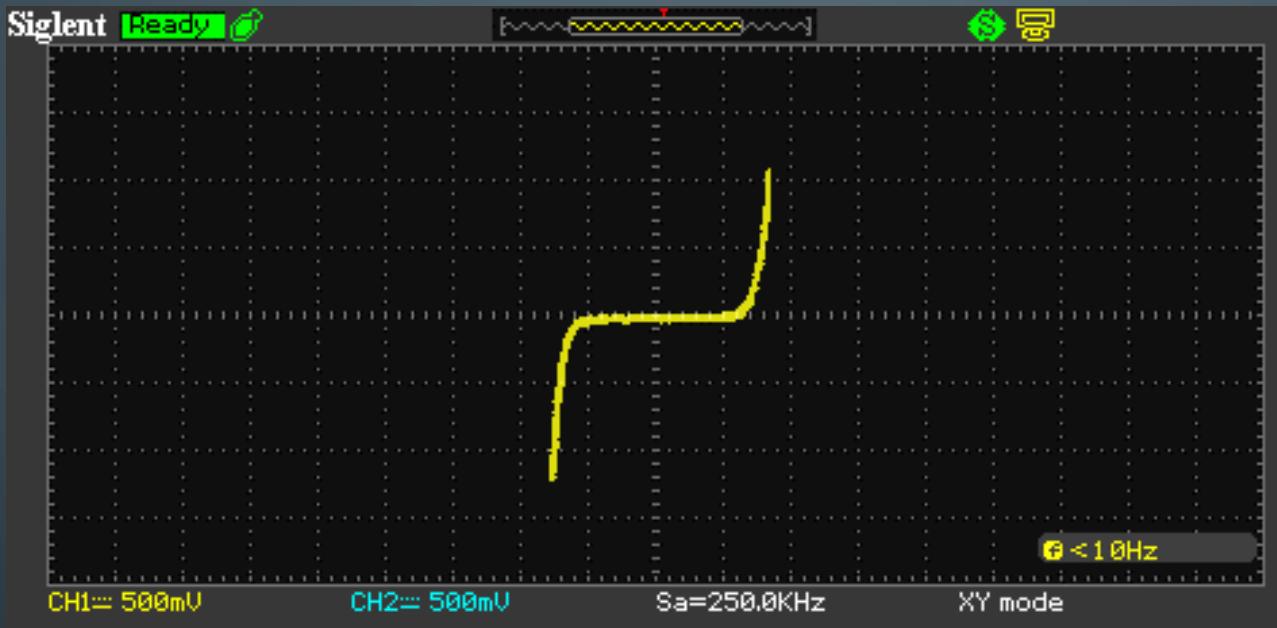
Diode

VINTAGE COMPUTER REPAIR 201



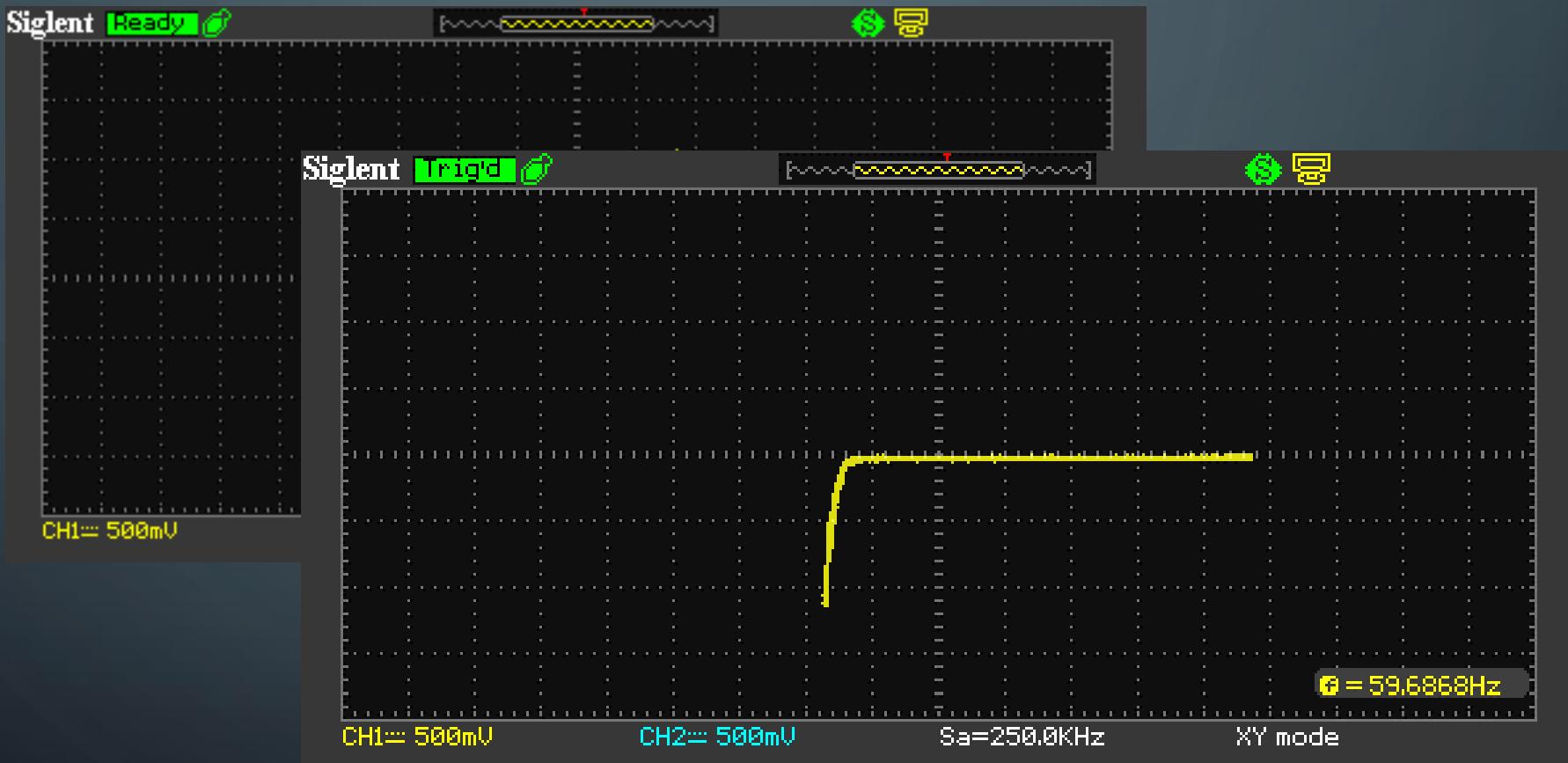
Zener Diode

VINTAGE COMPUTER REPAIR 201



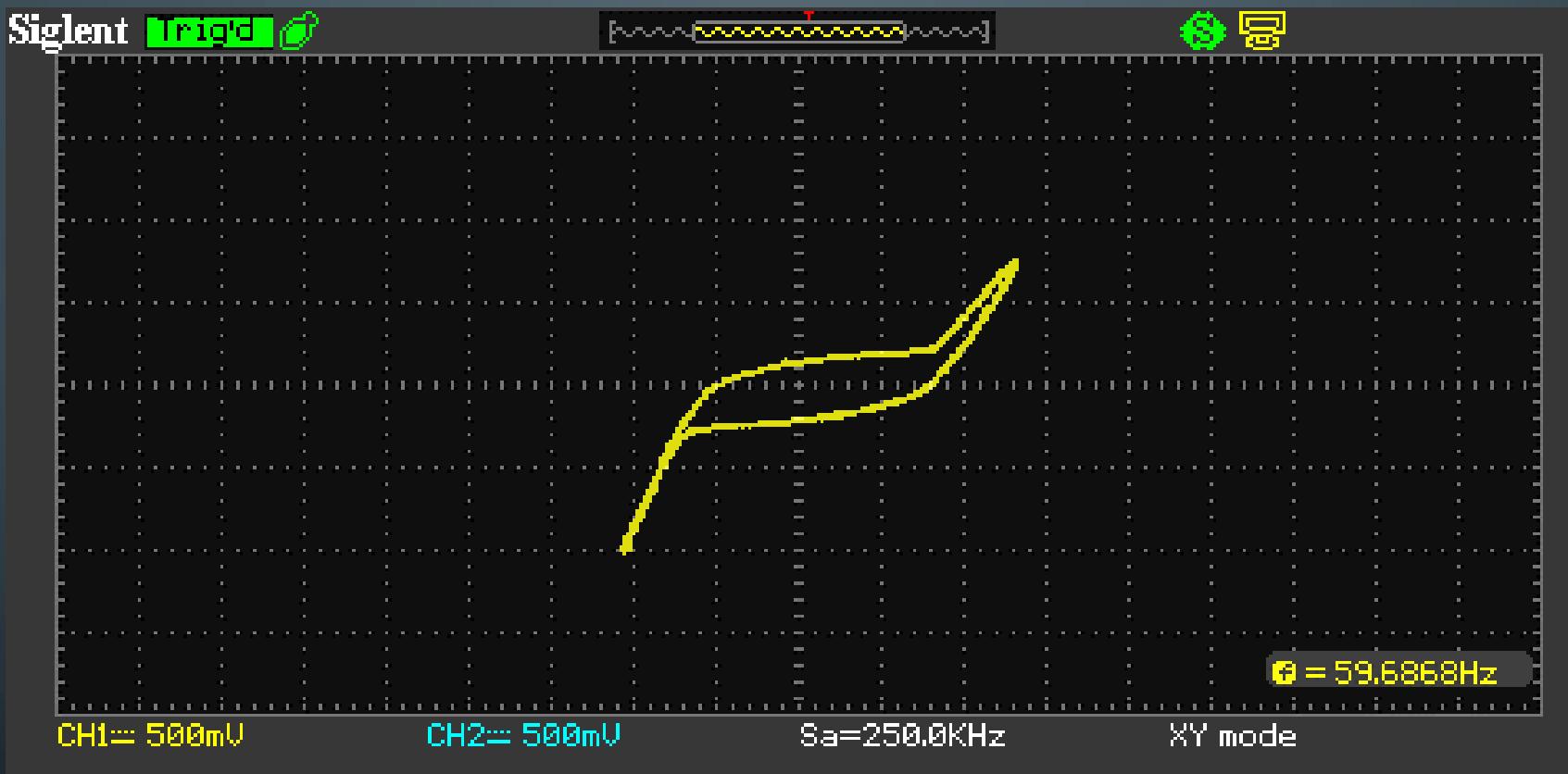
Good Pin Port B 6522 CIA

VINTAGE COMPUTER REPAIR 201

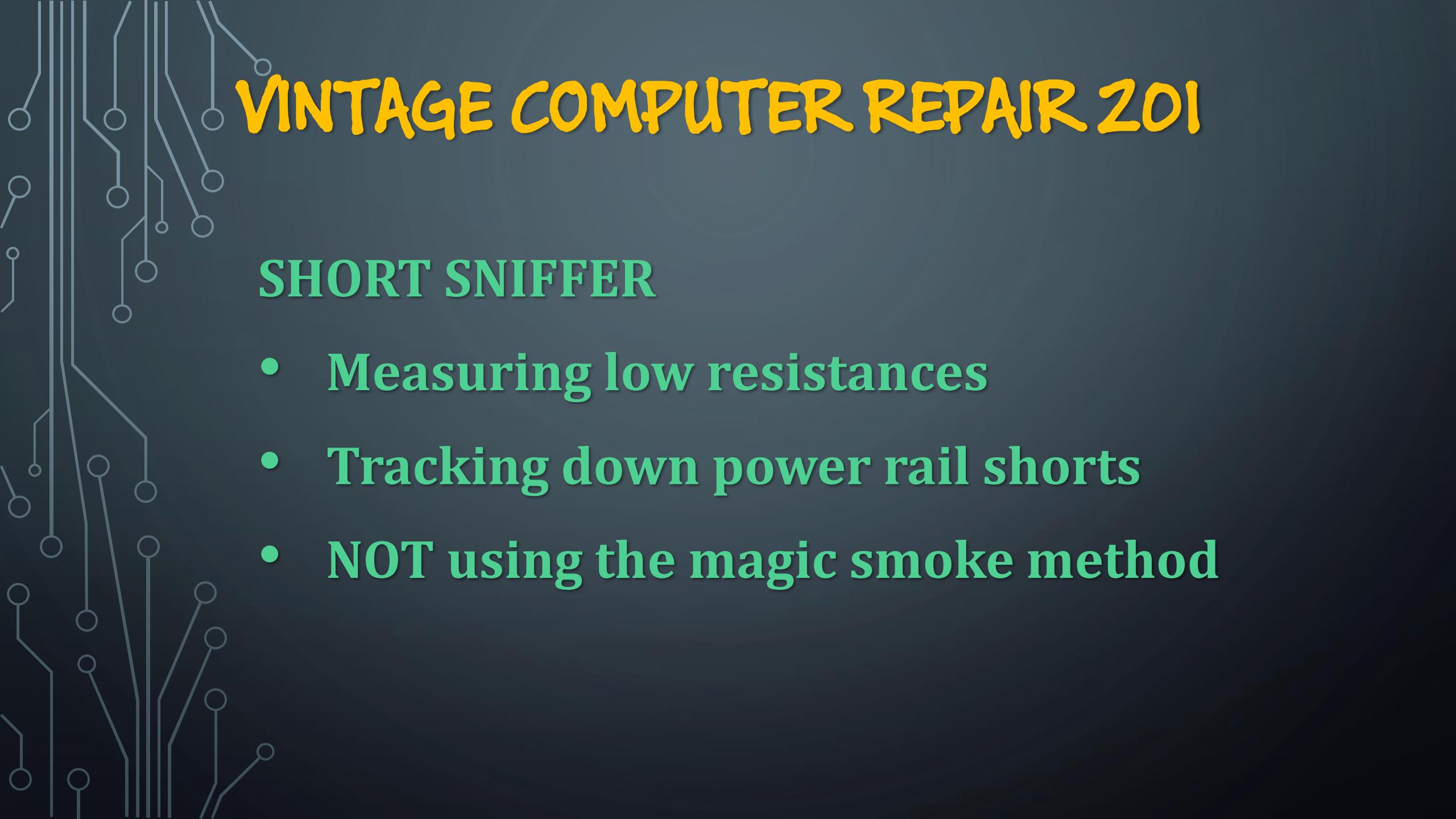


Bad Pin Port B 6522 CIA

VINTAGE COMPUTER REPAIR 201



Convolved Signal

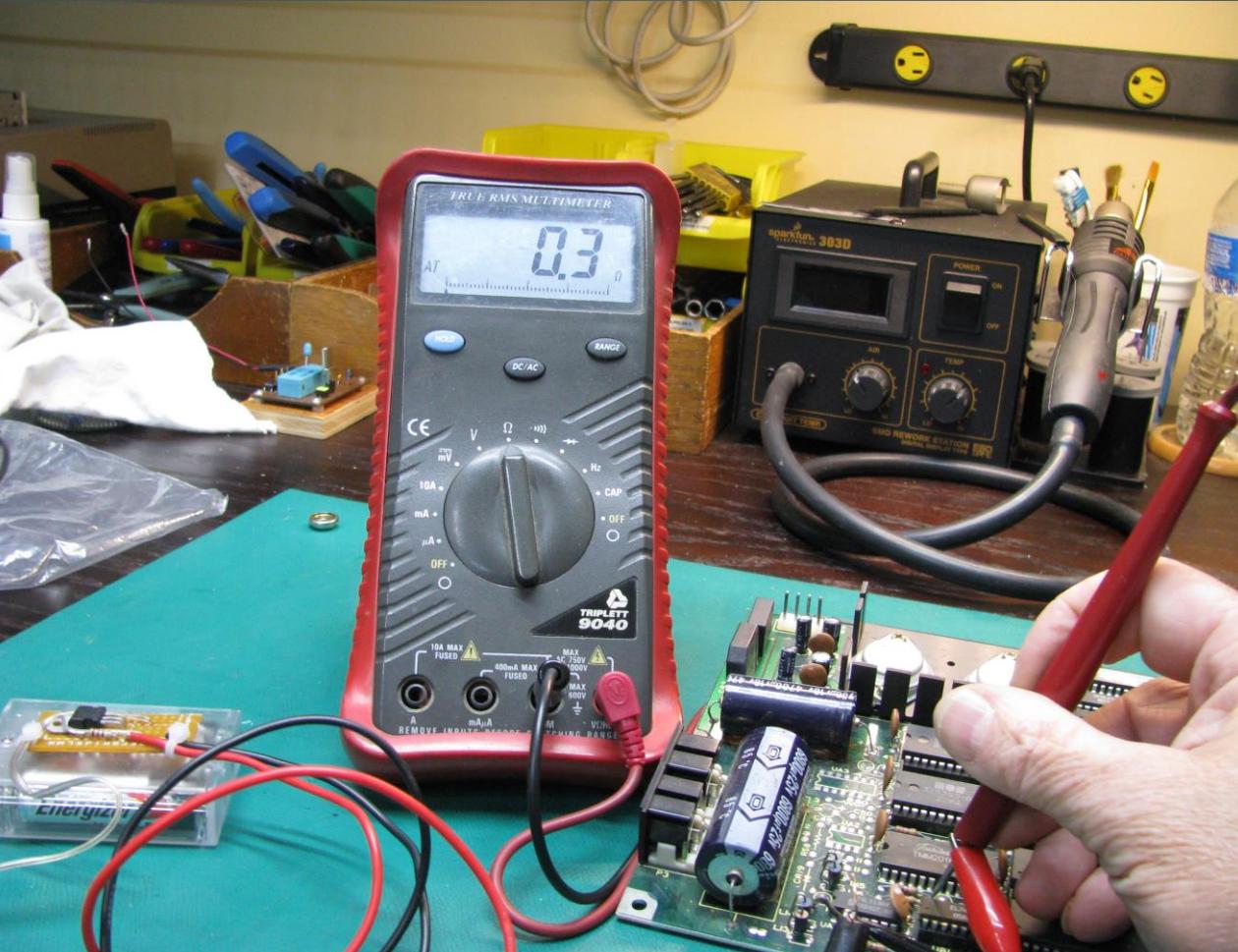


VINTAGE COMPUTER REPAIR 201

SHORT SNIFFER

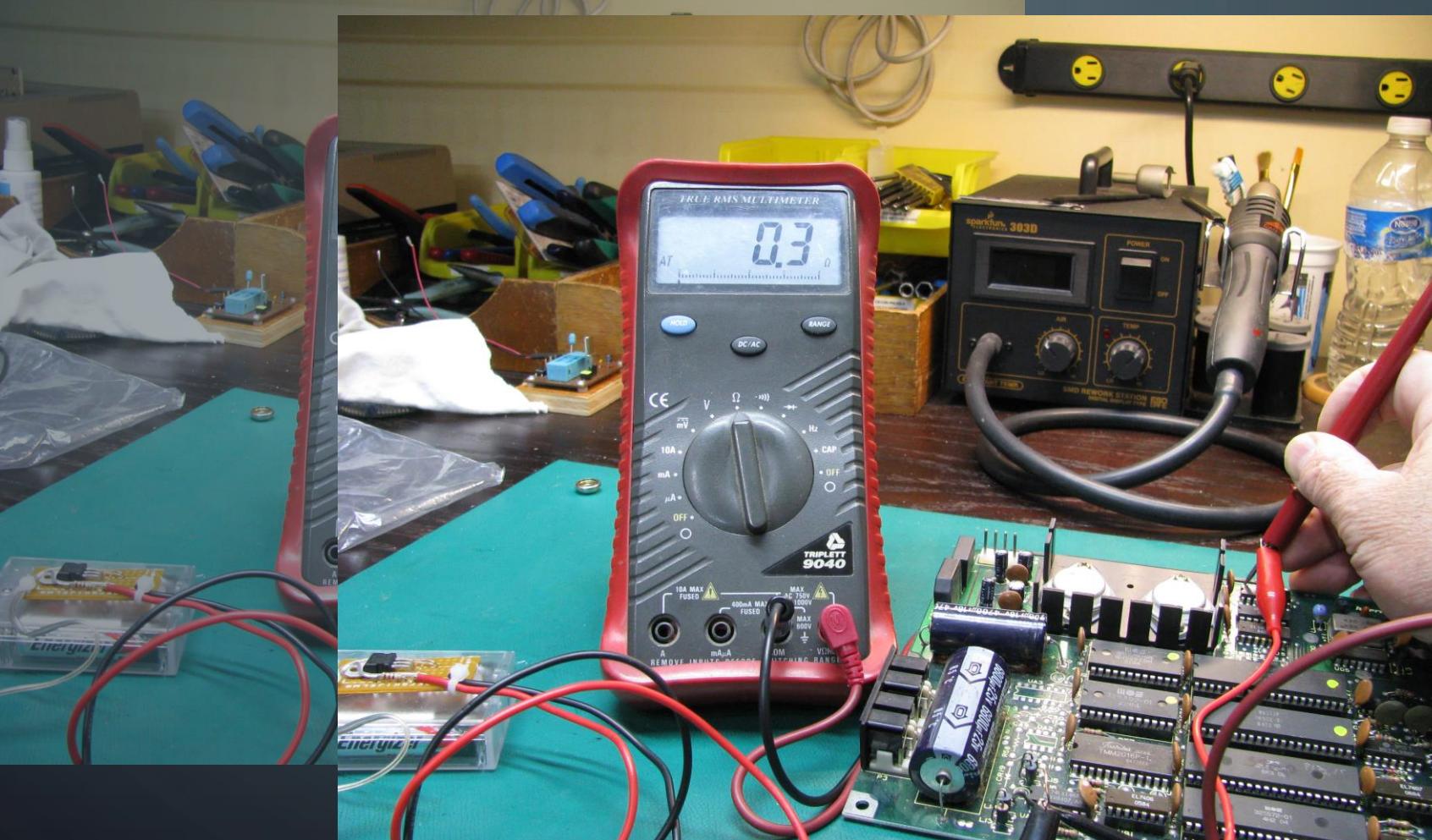
- Measuring low resistances
- Tracking down power rail shorts
- NOT using the magic smoke method

VINTAGE COMPUTER REPAIR 201



Ohm meter:
0.3 Ohms here

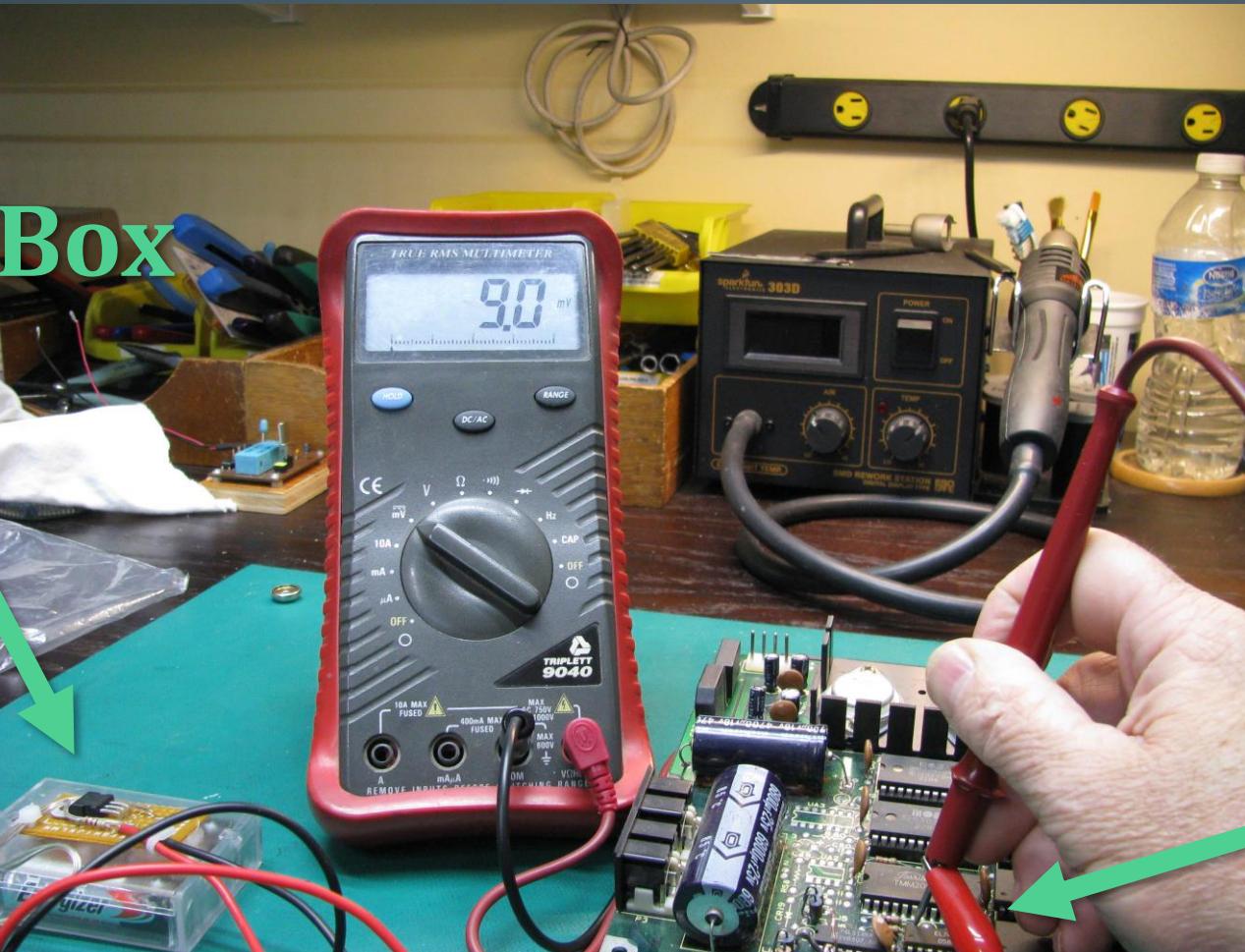
VINTAGE COMPUTER REPAIR 201



0.3 Ohms there

VINTAGE COMPUTER REPAIR 201

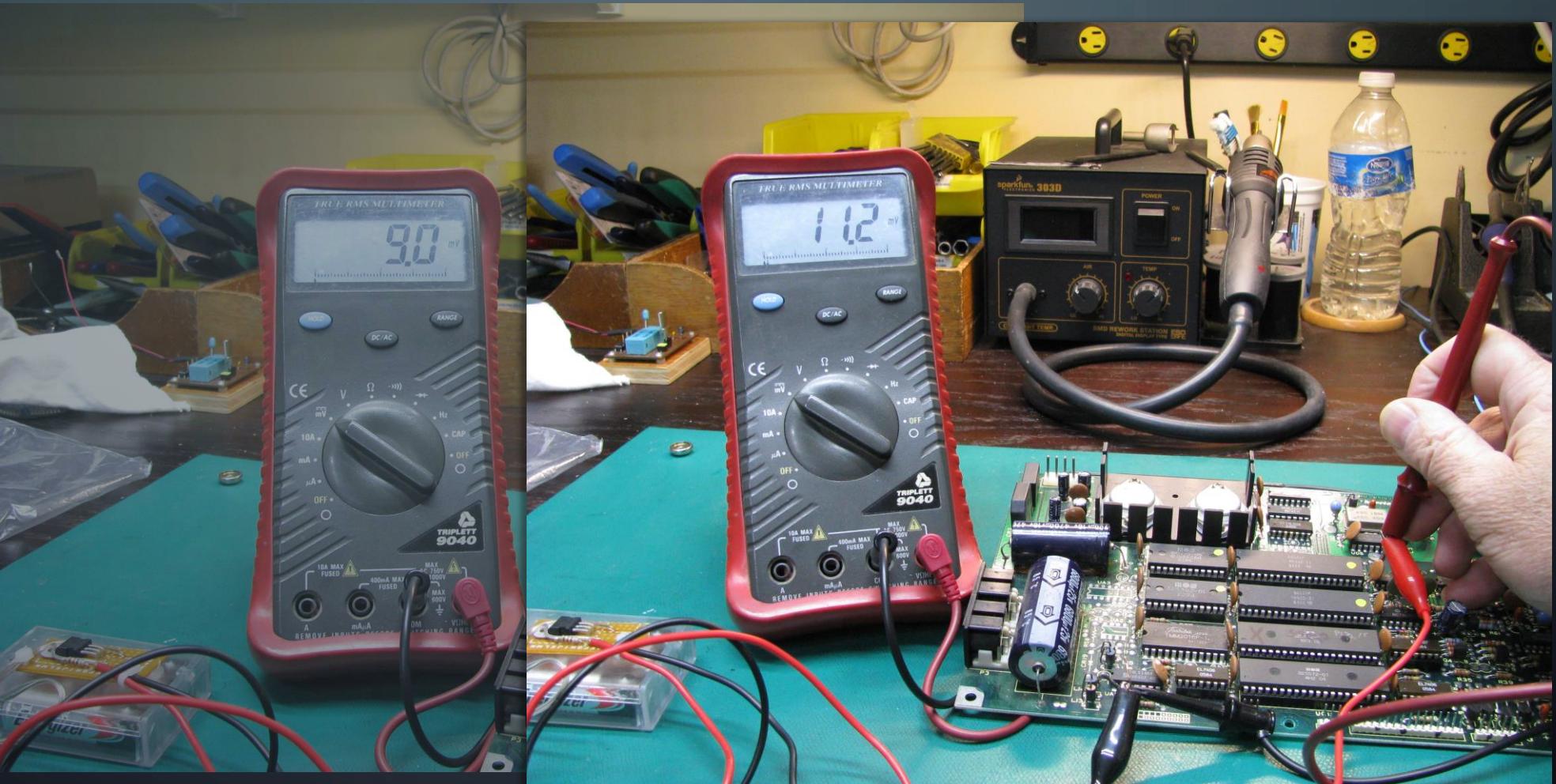
Magic Box



Voltmeter:
9.0mv here

Extra Clip

VINTAGE COMPUTER REPAIR 201



11.2mv here

VINTAGE COMPUTER REPAIR 201



4.9mv here

Getting close

VINTAGE COMPUTER REPAIR 201

Found It!



3.0mv here

VINTAGE COMPUTER REPAIR 201

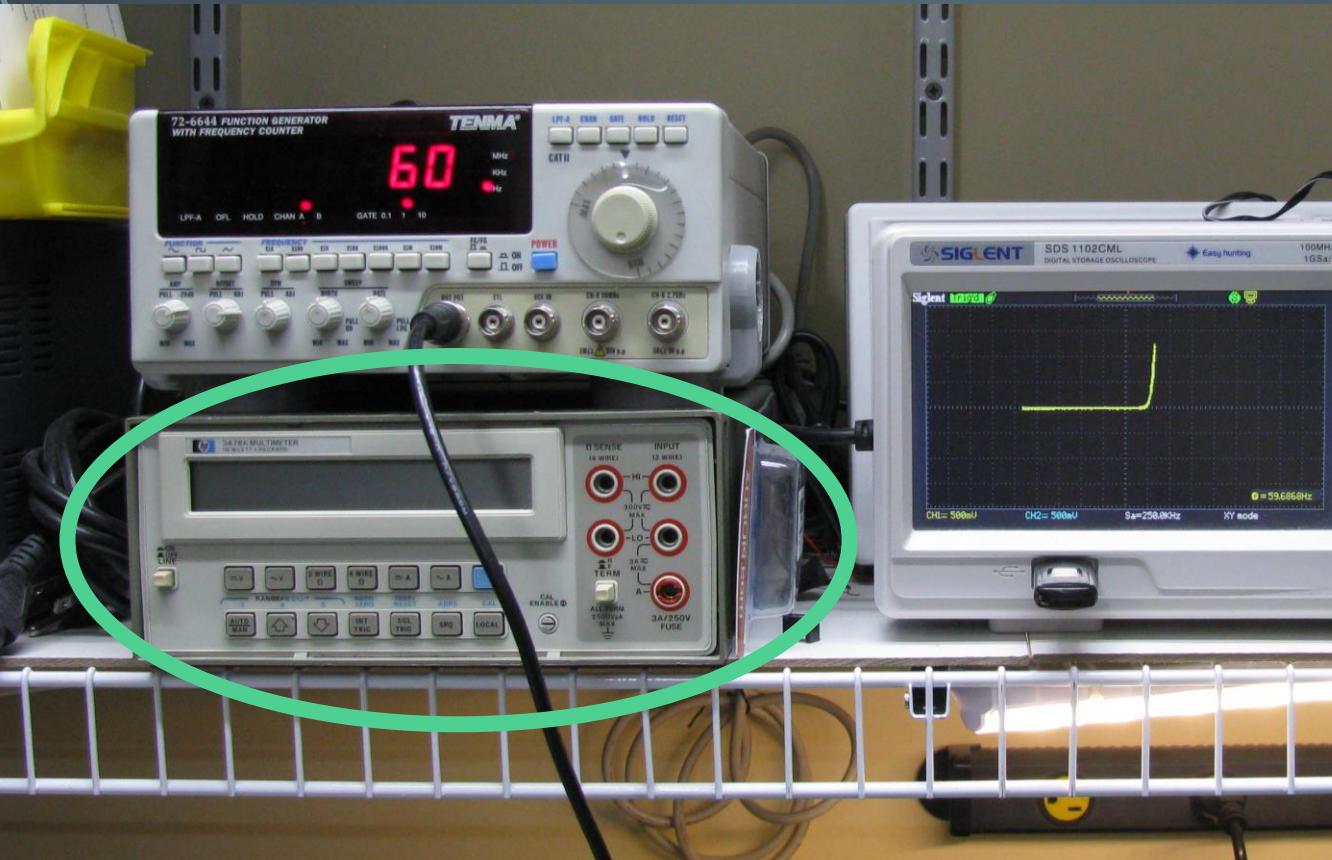
Short Sniffer

- We found the short
- How does this work?
- Like a high current ohm meter

Paper by Bob Nuckolls, Raytheon

http://www.aeroelectric.com/articles/LowOhmsAdapter_3.pdf

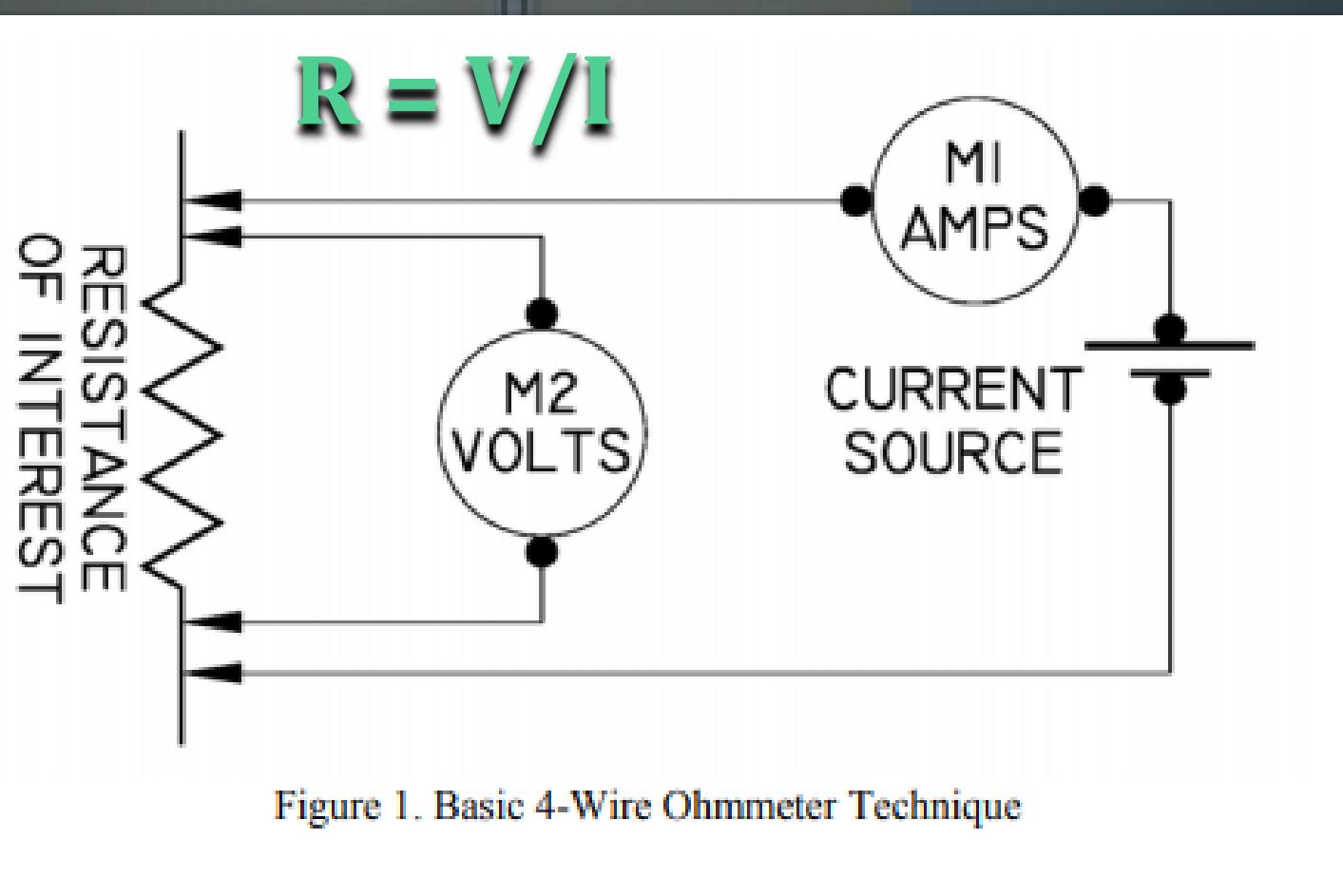
VINTAGE COMPUTER REPAIR 201



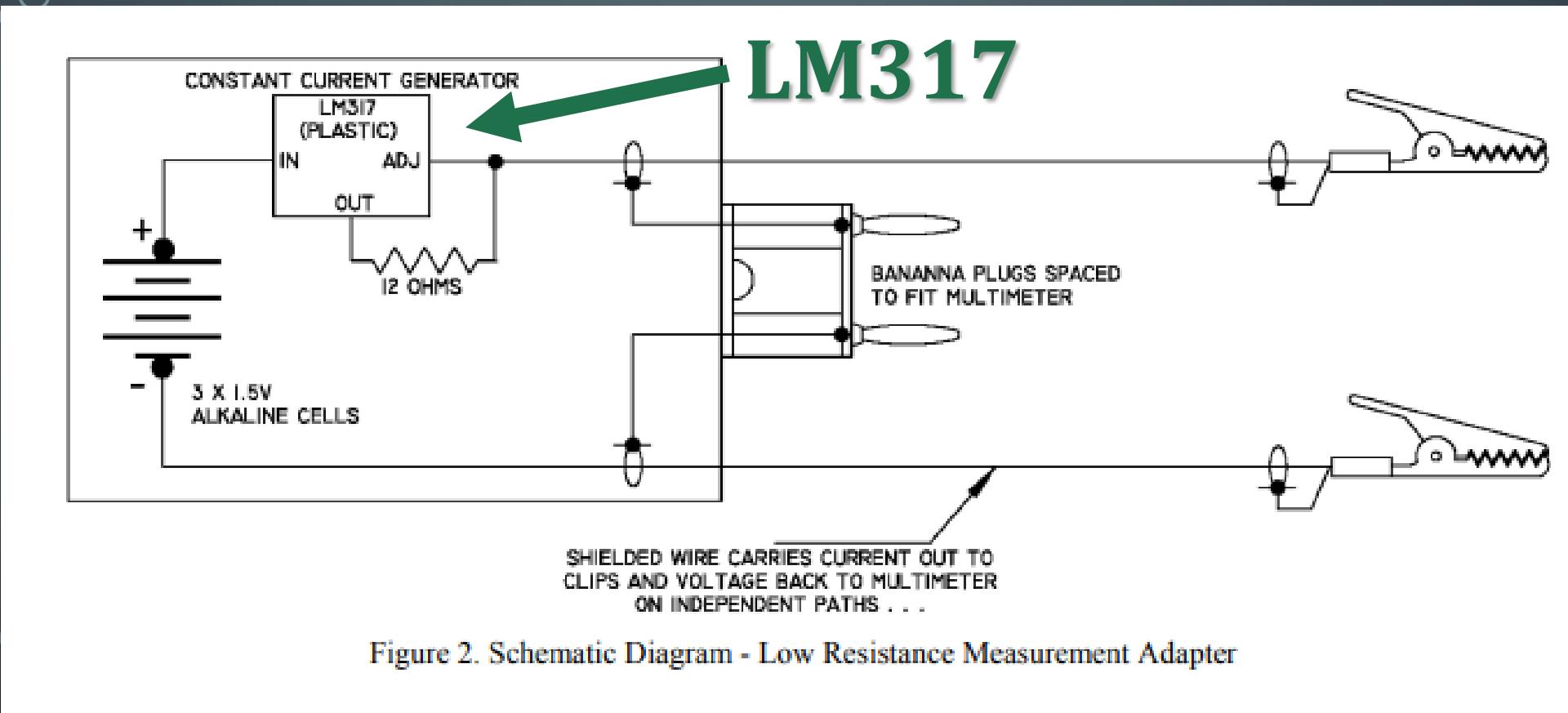
4-wire
resistance
measurement
on fancy
meter

VINTAGE COMPUTER REPAIR 201

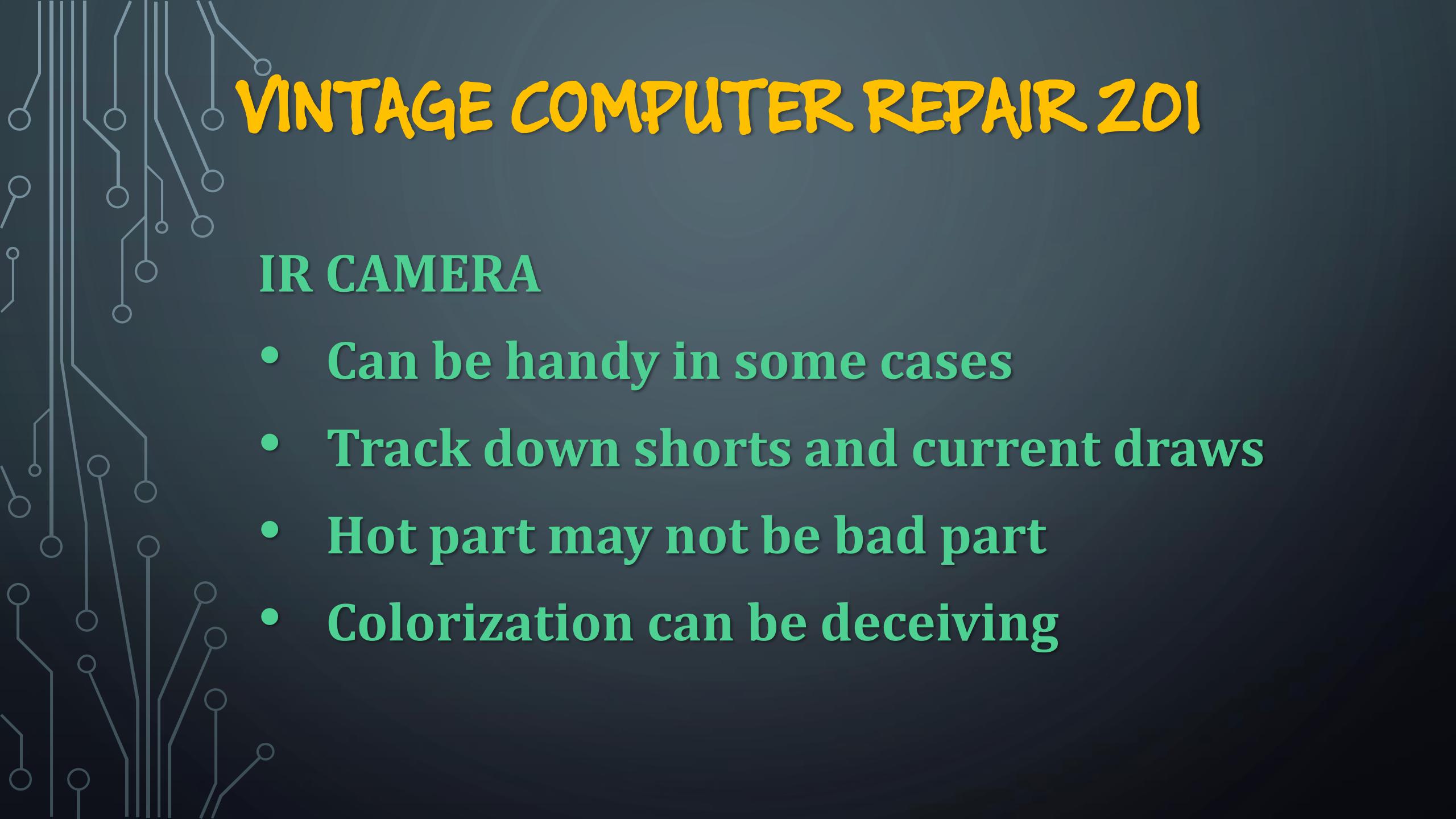
4-wire
resistance
measurement
on fancy
meter



VINTAGE COMPUTER REPAIR 201



Very easy to build your own

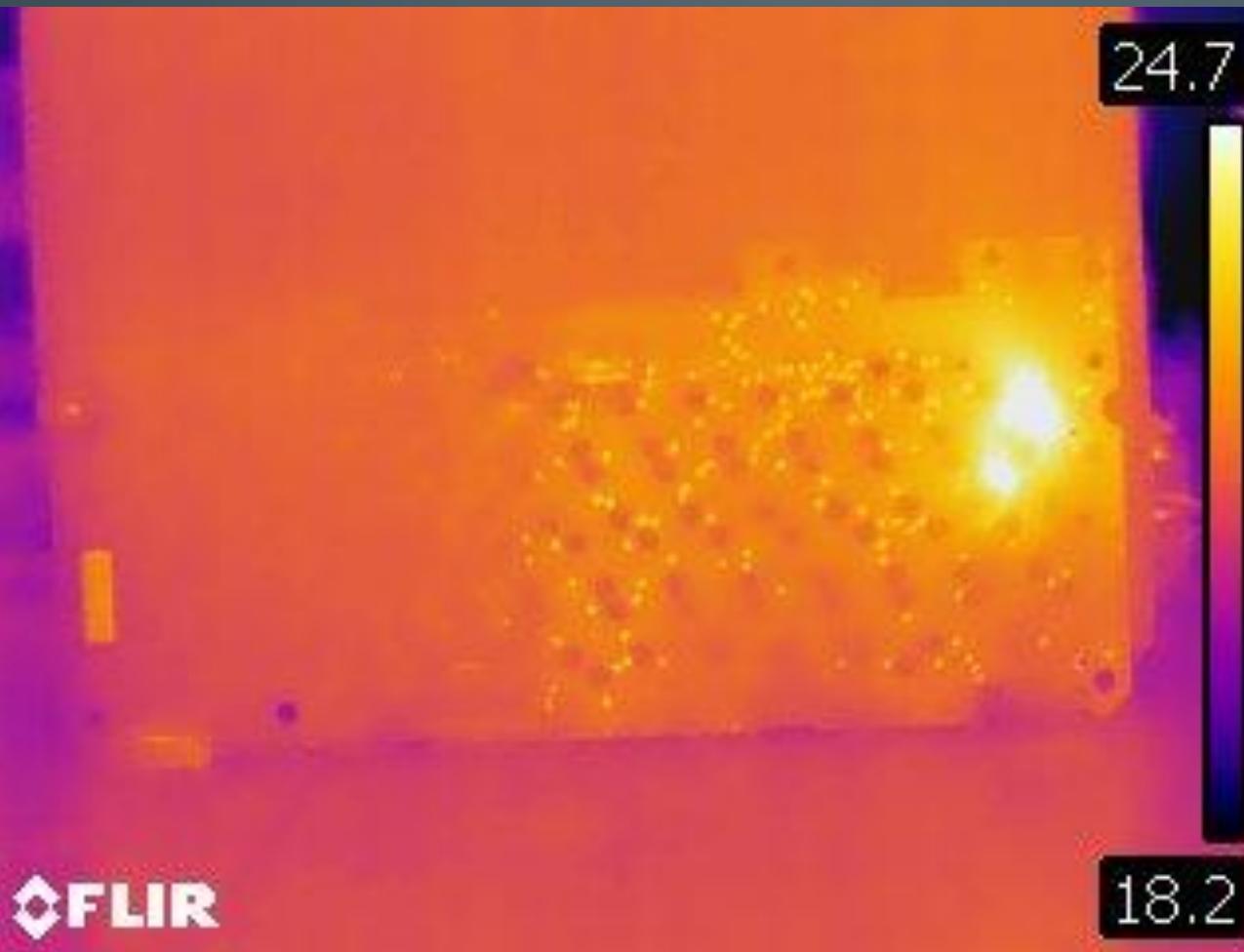


VINTAGE COMPUTER REPAIR 201

IR CAMERA

- Can be handy in some cases
- Track down shorts and current draws
- Hot part may not be bad part
- Colorization can be deceiving

VINTAGE COMPUTER REPAIR 201



6C Delta T

Colorization
can be
deceiving

Fancy FLIR borrowed from work

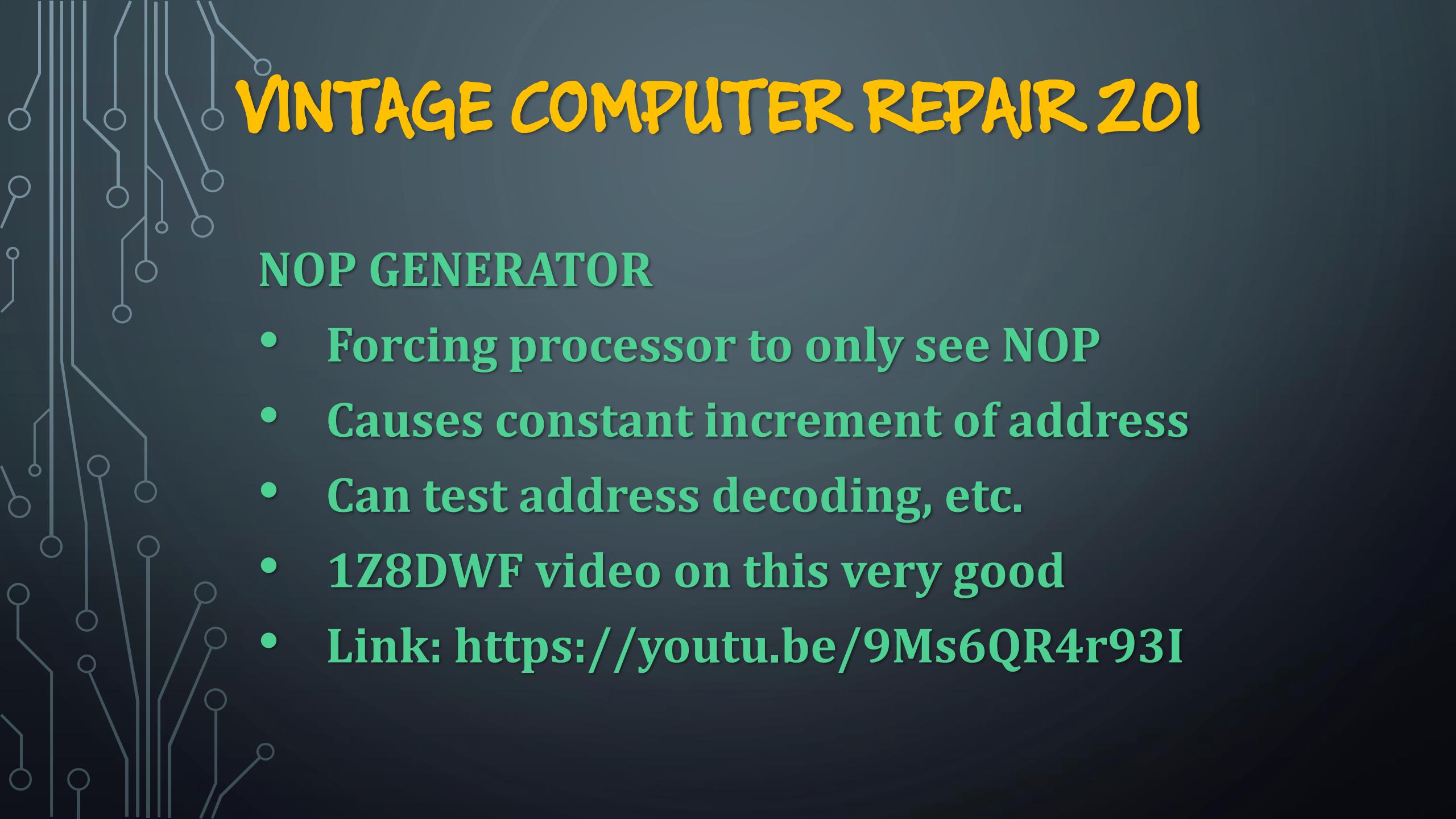
VINTAGE COMPUTER REPAIR 201



\$10,000



\$300

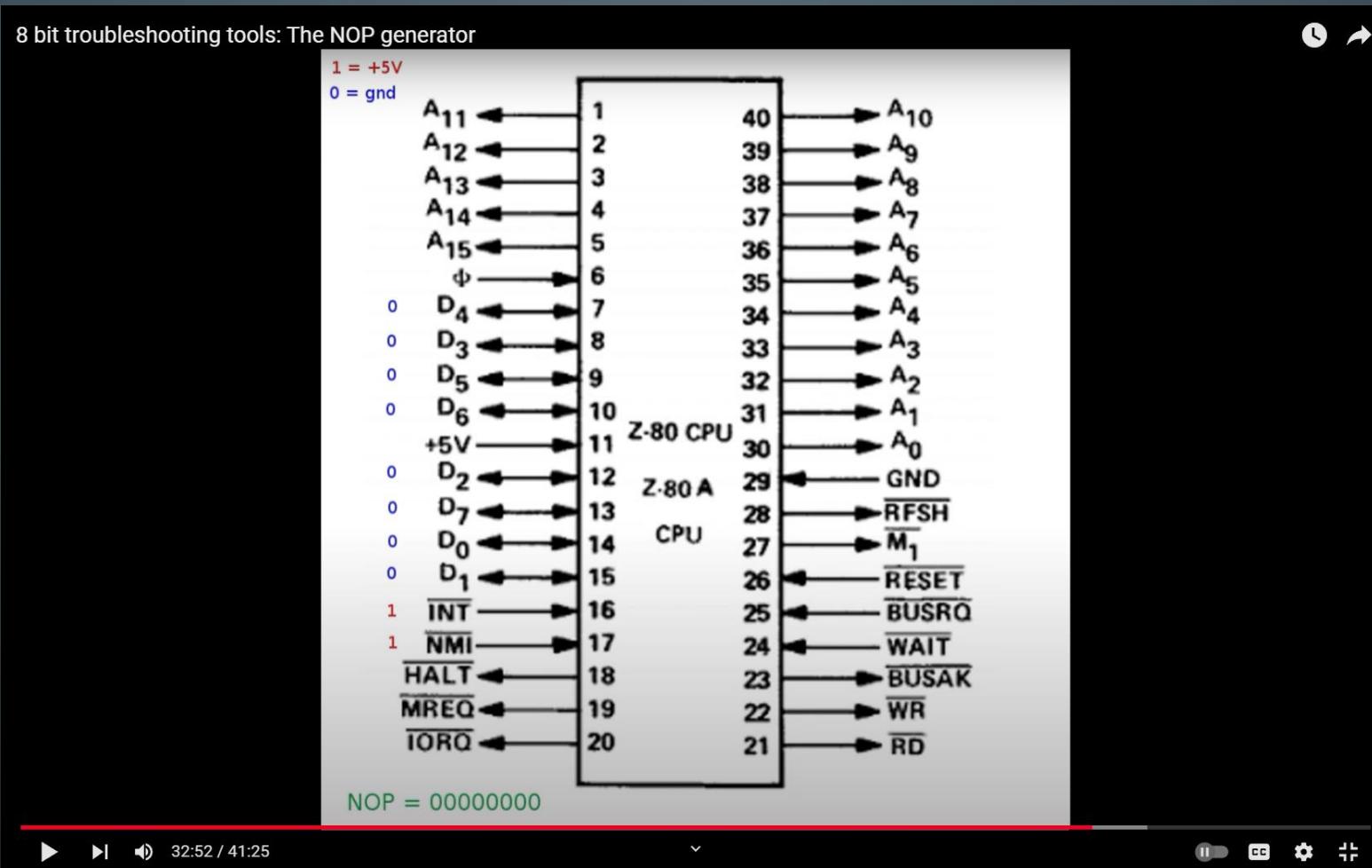
A faint, light-gray circuit board pattern serves as the background for the slide.

VINTAGE COMPUTER REPAIR 201

NOP GENERATOR

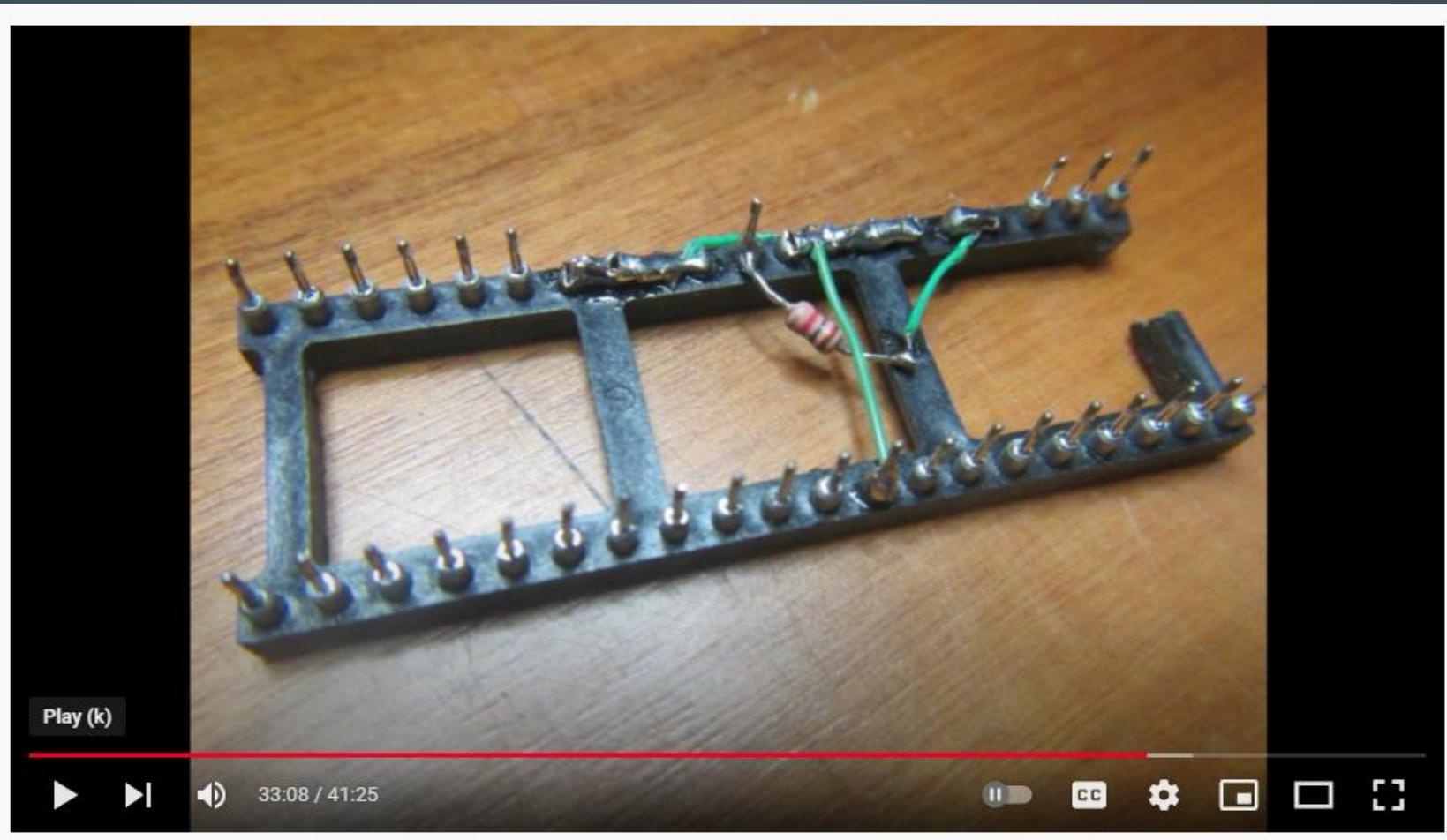
- Forcing processor to only see NOP
- Causes constant increment of address
- Can test address decoding, etc.
- 1Z8DWF video on this very good
- Link: <https://youtu.be/9Ms6QR4r93I>

VINTAGE COMPUTER REPAIR 201



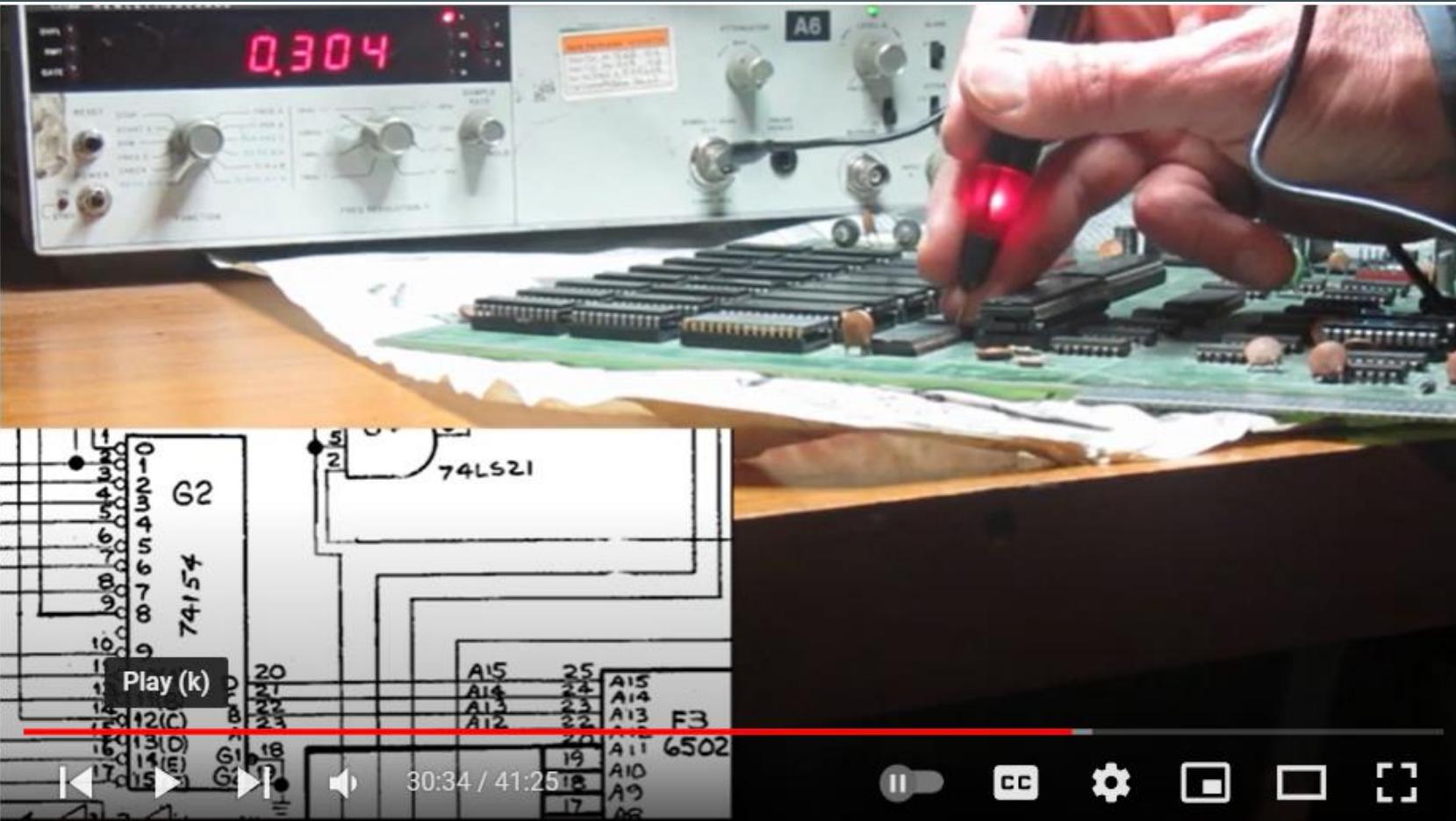
Pins tied hi/low for Z80 NOP generator

VINTAGE COMPUTER REPAIR 201



Socket used to make NOP generator

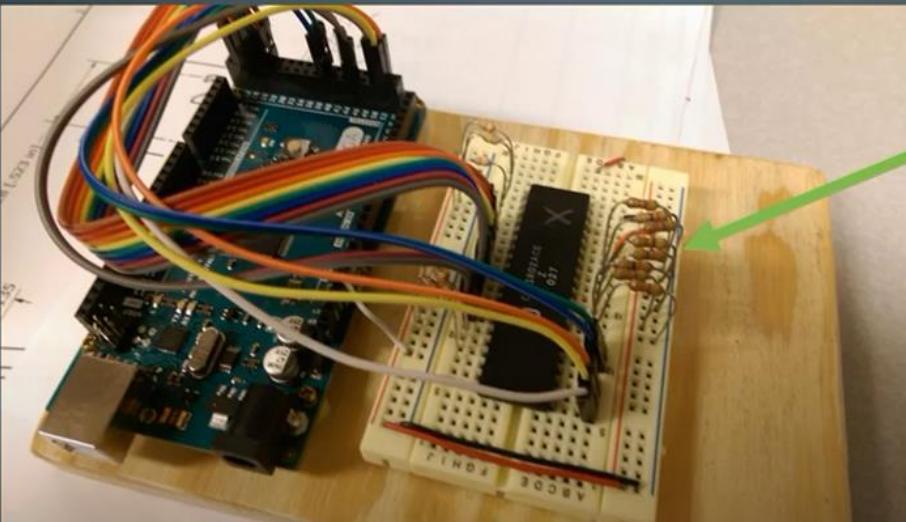
VINTAGE COMPUTER REPAIR 201



Checking address pins with logic probe

VINTAGE COMPUTER REPAIR 201

INITIAL SET UP



Data lines pulled
up/down
for a NOP
command.



Testing RCA 1802 with NOP generator

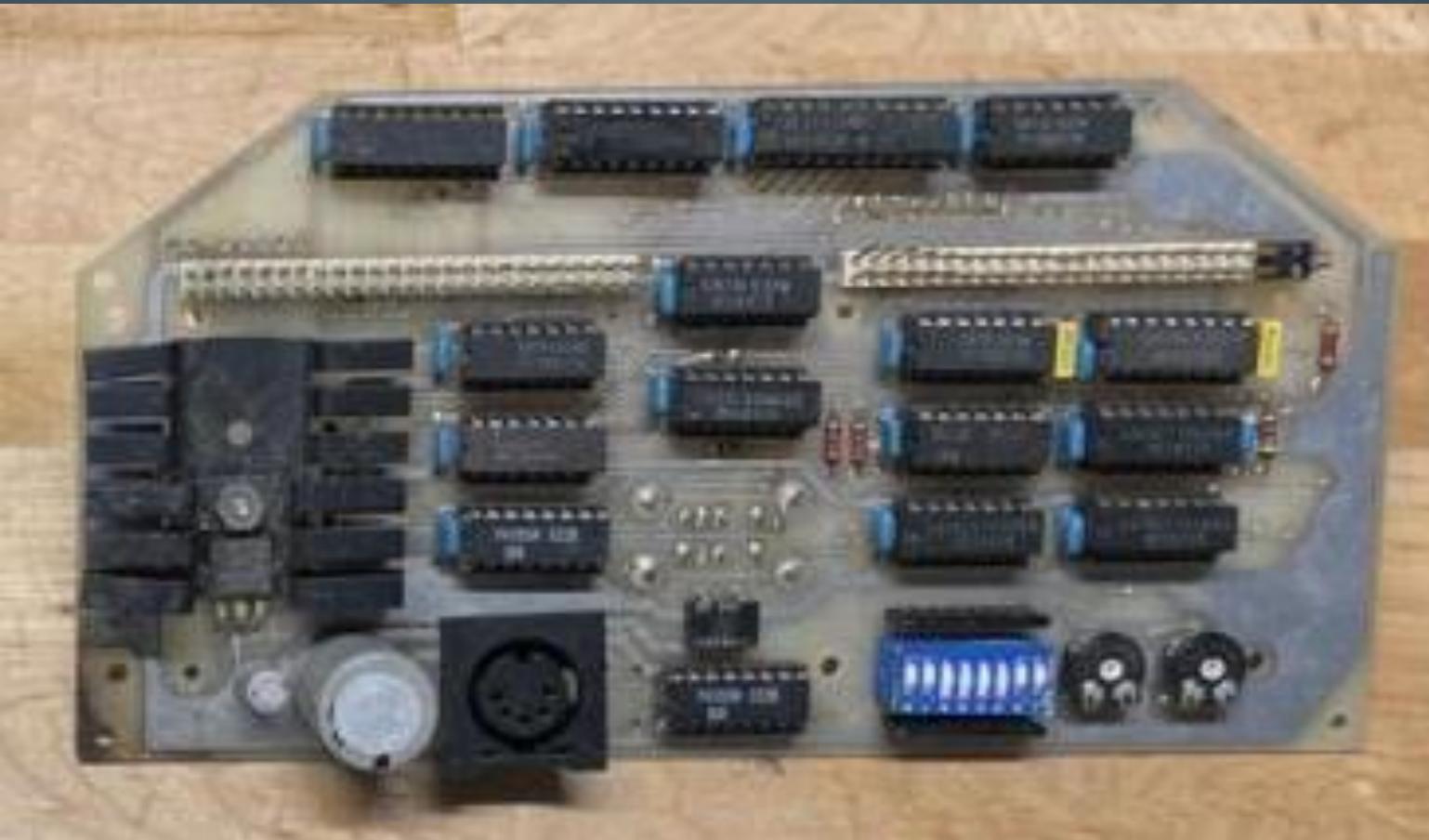


VINTAGE COMPUTER REPAIR 201

DIAGNOSTIC ROM (TEST HARNESS)

- Vintage Model 3-4 diagnostic board
- M100 Test ROM / Harness
- A new diagnostic ROM for M1/2/3
- Tricky to write diagnostic code

VINTAGE COMPUTER REPAIR 201



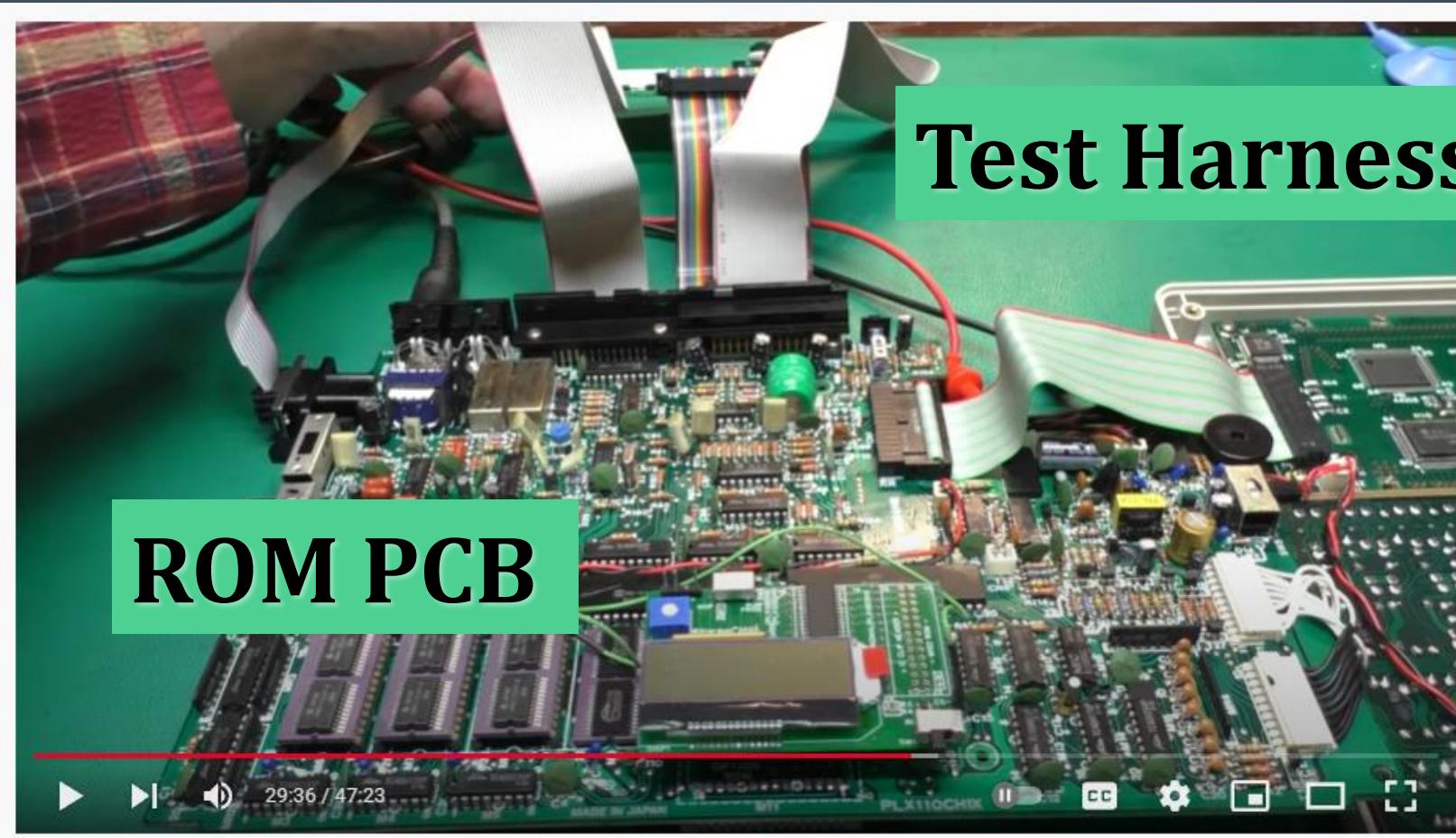
Model 3 & 4 Diagnostic Board

VINTAGE COMPUTER REPAIR 201



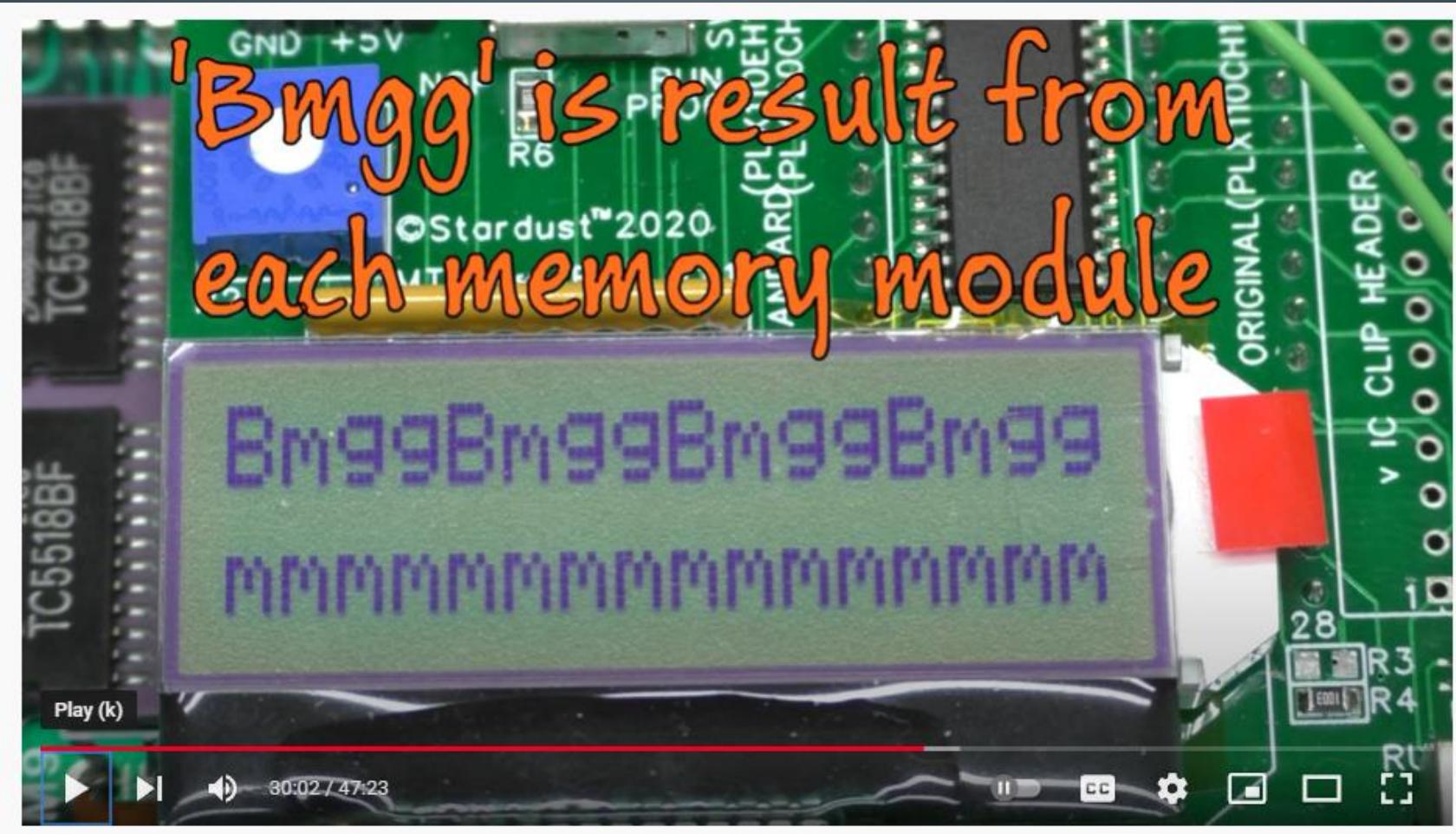
Model 4P built in RAM test used
in conjunction with logic probe.

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Model 100 Diagnostic Harness

VINTAGE COMPUTER REPAIR 201



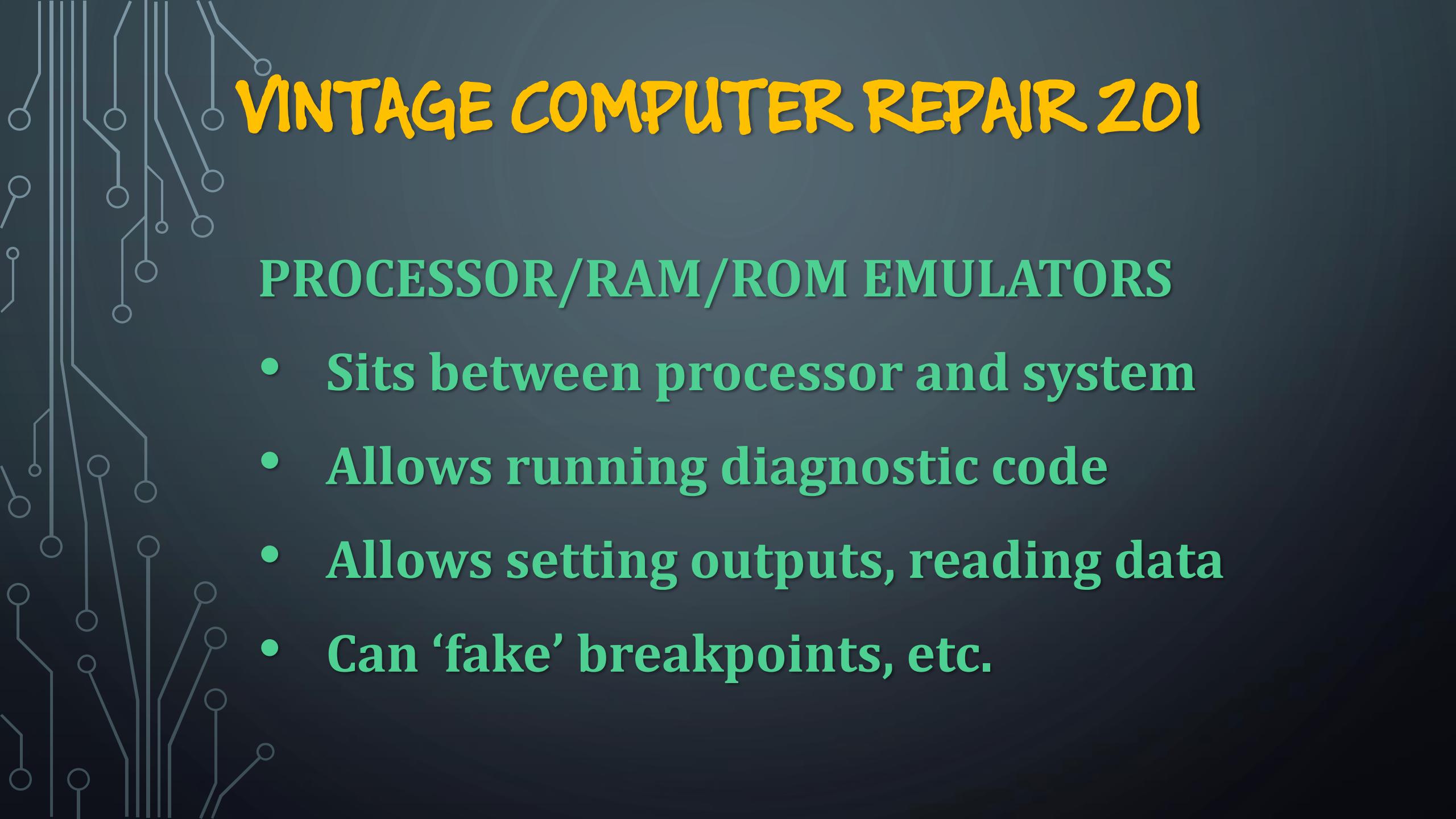
Model 100 Diagnostic Harness

VINTAGE COMPUTER REPAIR 201



Model 1,2,3 Diagnostic ROMs

<https://github.com/misterblack1/trs80-diagnosticrom>



VINTAGE COMPUTER REPAIR 201

PROCESSOR/RAM/ROM EMULATORS

- Sits between processor and system
- Allows running diagnostic code
- Allows setting outputs, reading data
- Can ‘fake’ breakpoints, etc.



VINTAGE COMPUTER REPAIR 201

Processor/RAM/ROM Emulators

- Fluke 9010A, vintage favorite
- ROMulator
- PocketTRS?
- Others

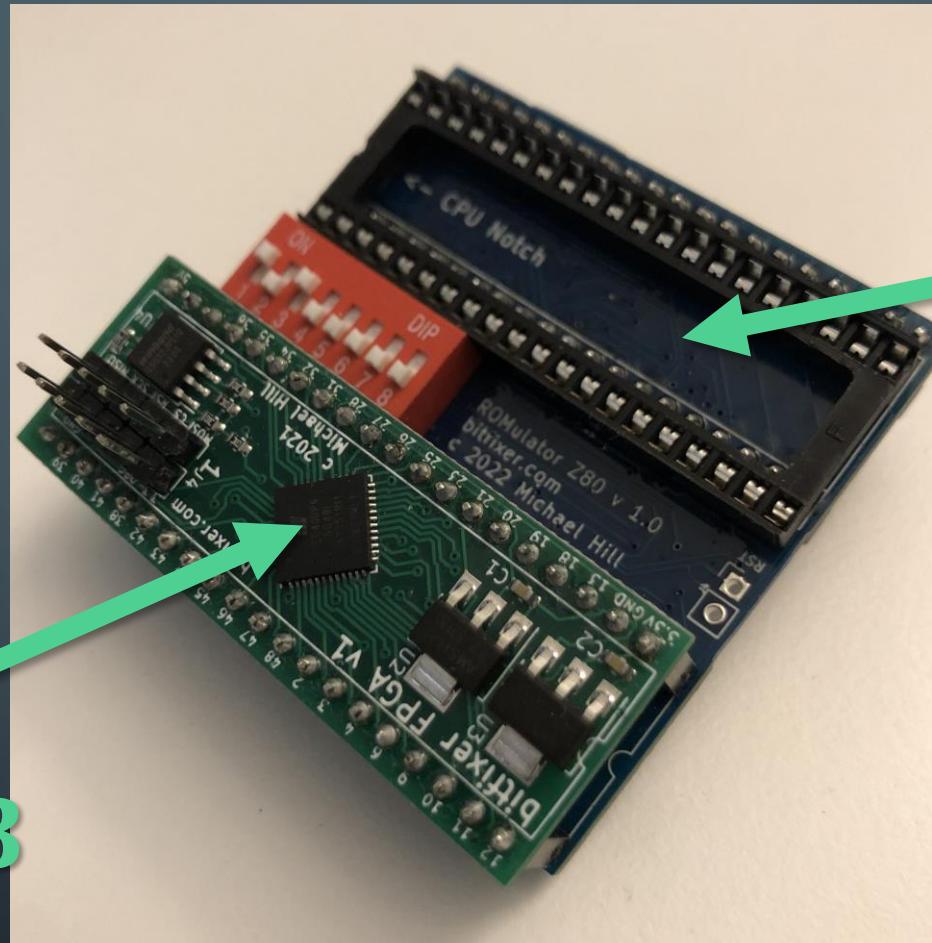
VINTAGE COMPUTER REPAIR 201



Fluke 9010A

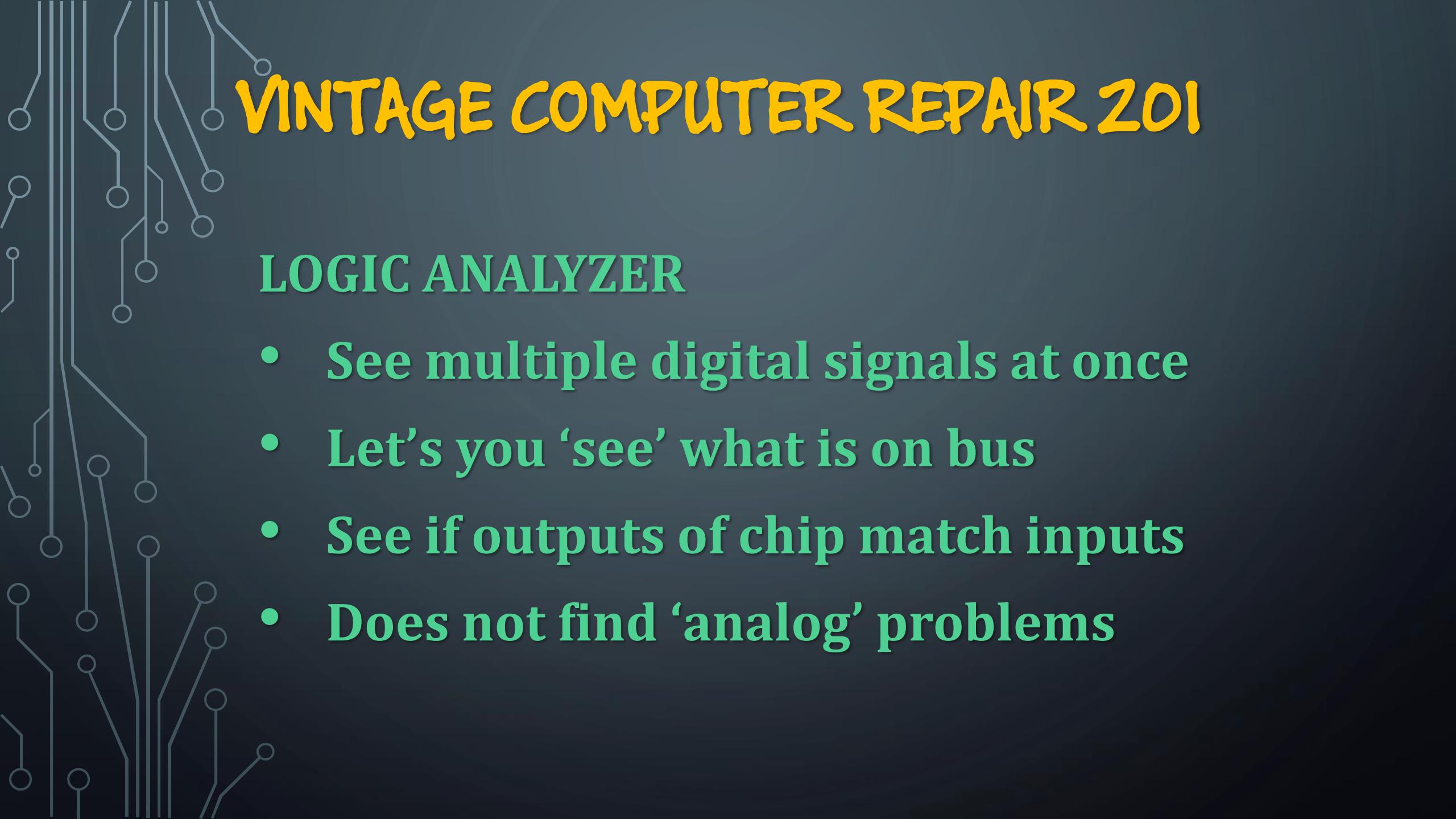
VINTAGE COMPUTER REPAIR 201

FPGA PCB



Z80 plugs in

ROMulator



VINTAGE COMPUTER REPAIR 201

LOGIC ANALYZER

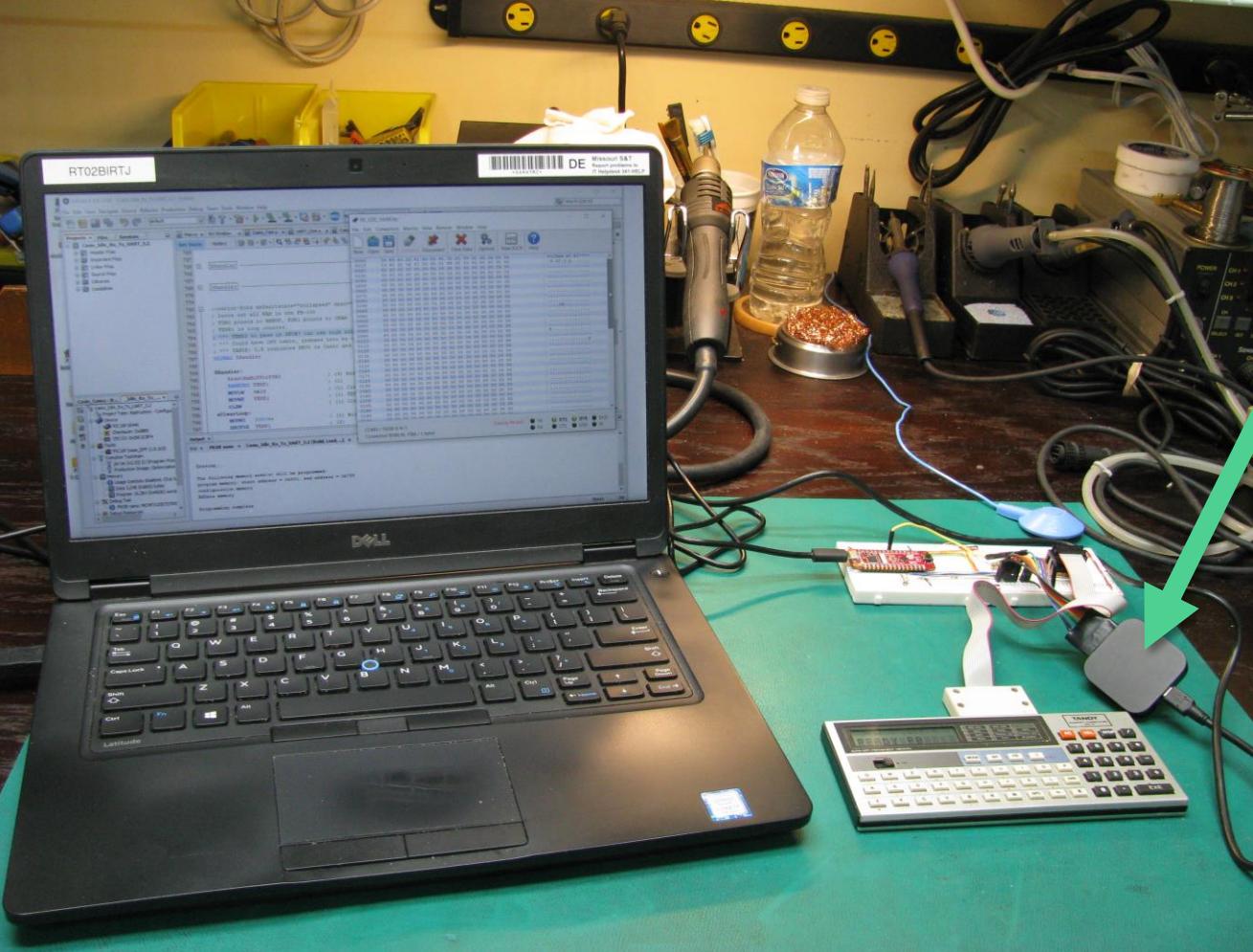
- See multiple digital signals at once
- Let's you 'see' what is on bus
- See if outputs of chip match inputs
- Does not find 'analog' problems

VINTAGE COMPUTER REPAIR 201



HP 1664A Logic Analyzer

VINTAGE COMPUTER REPAIR 201



Logic 8

Saleae Logic 8 Logic Analyzer

VINTAGE COMPUTER REPAIR 201

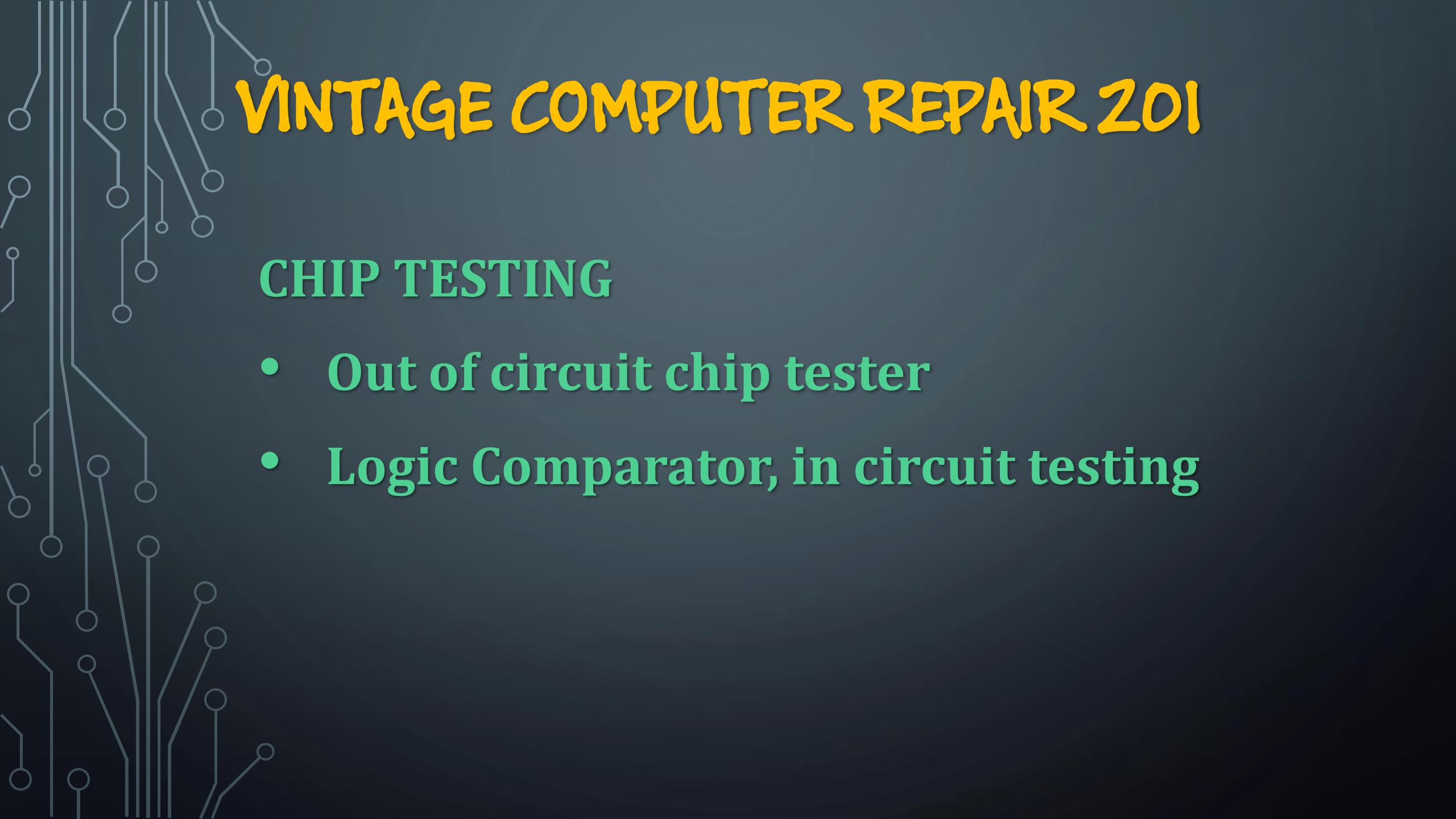


Monitoring data bus on M100

VINTAGE COMPUTER REPAIR 201



Monitoring data bus on M100

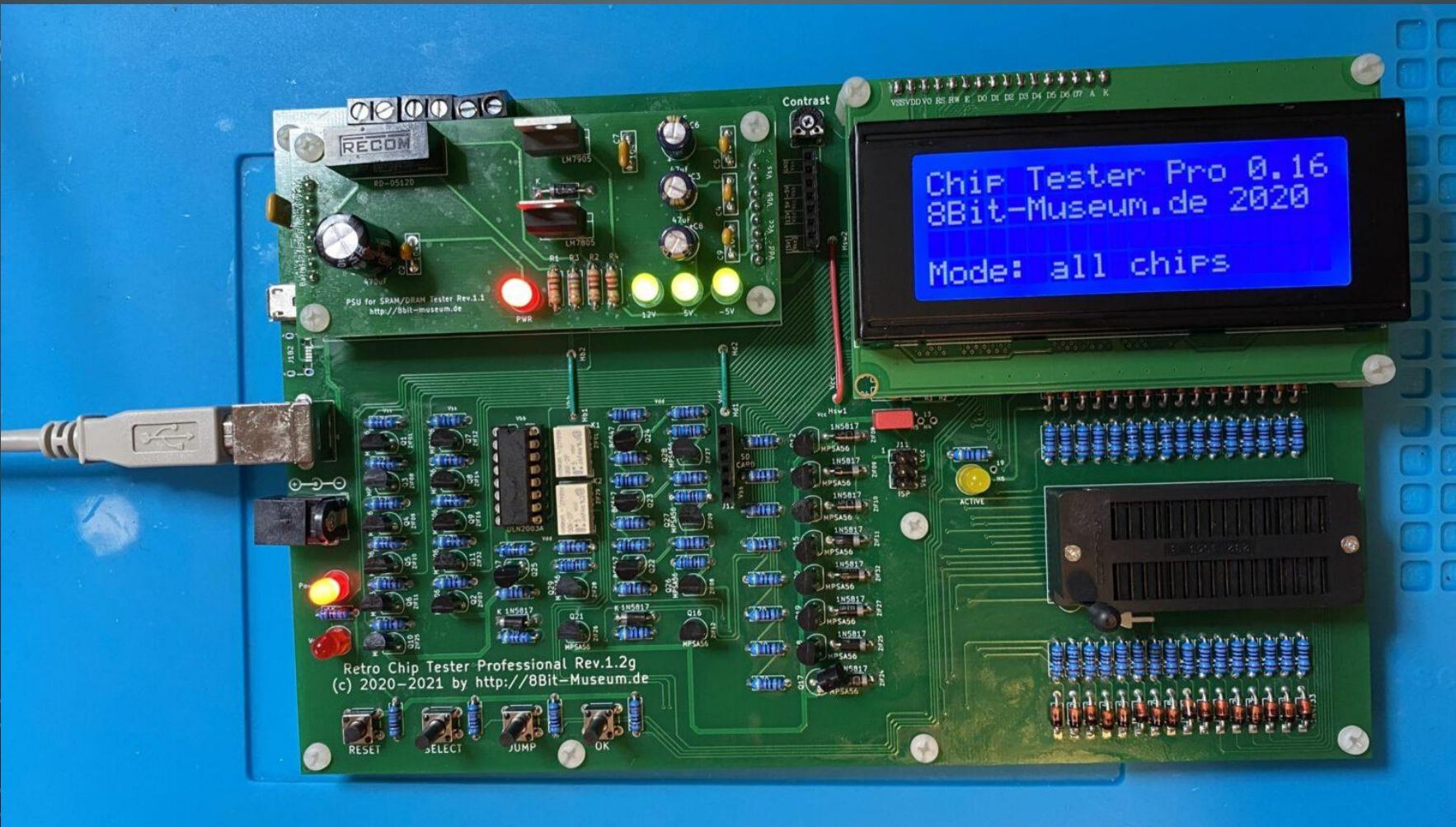


VINTAGE COMPUTER REPAIR 201

CHIP TESTING

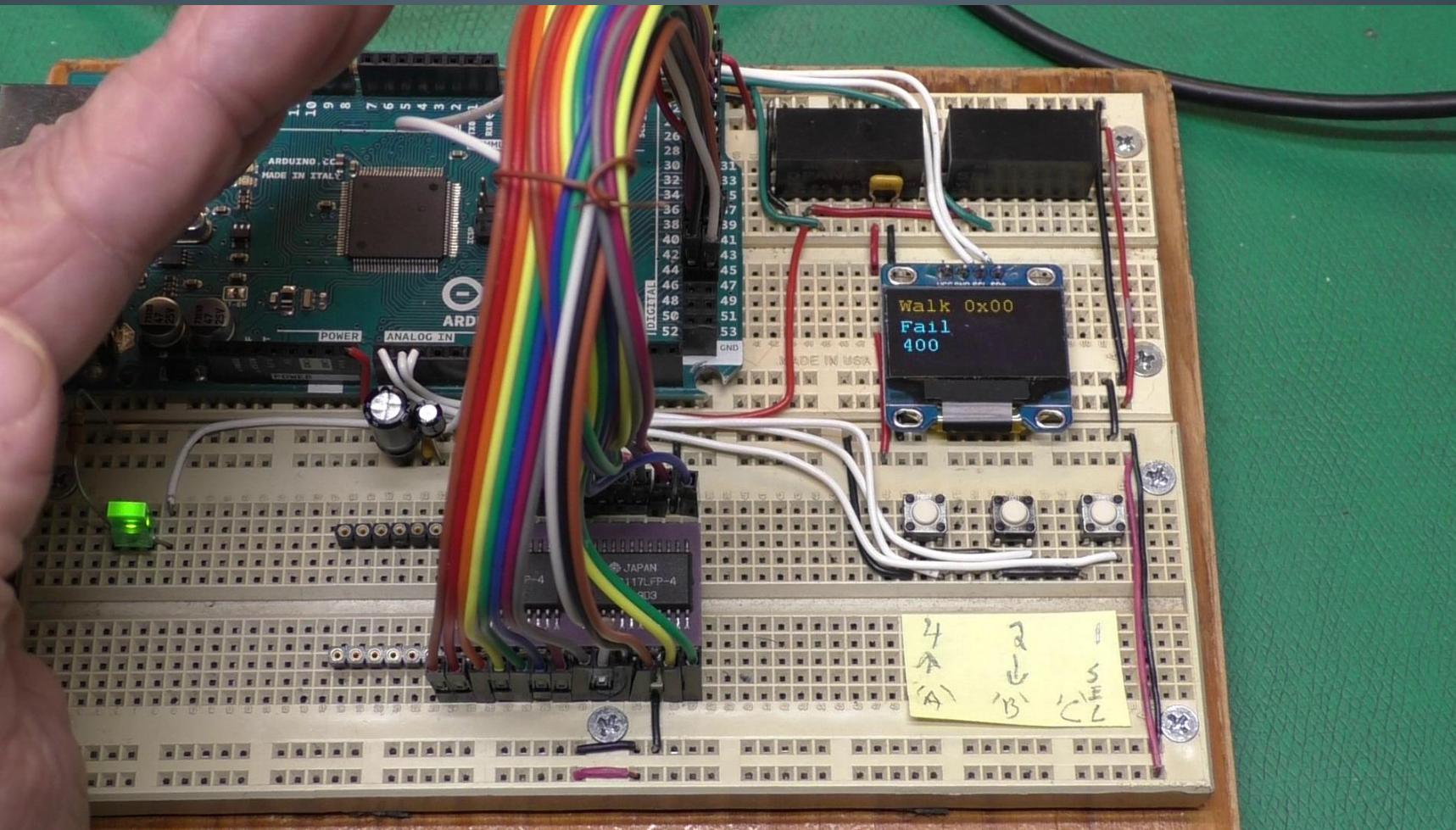
- Out of circuit chip tester
- Logic Comparator, in circuit testing

VINTAGE COMPUTER REPAIR 201



e.g. Chip Tester Pro

VINTAGE COMPUTER REPAIR 201

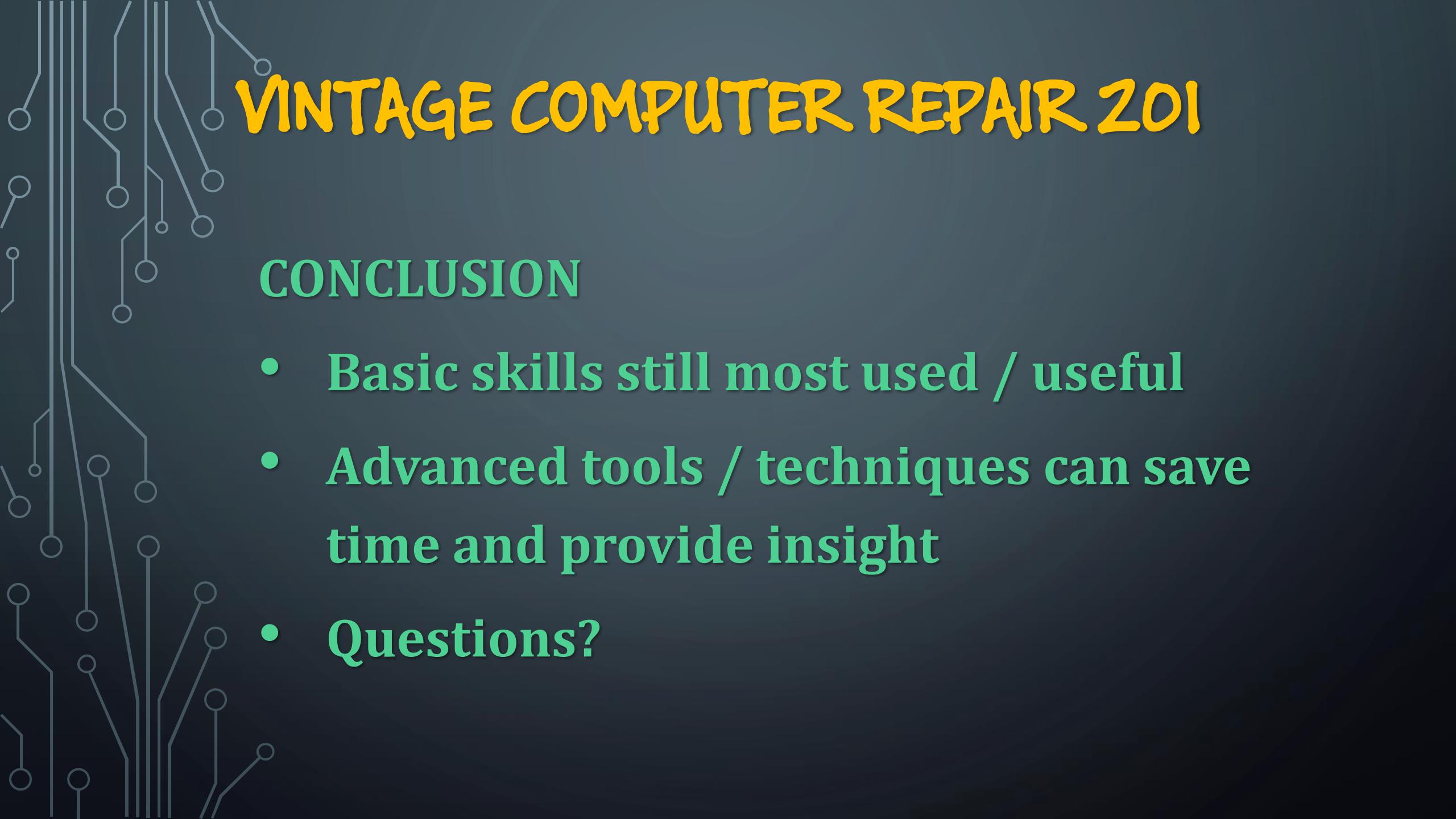


Homemade M100 SRAM module tester

VINTAGE COMPUTER REPAIR 201



HP 10529A Logic Comparator



VINTAGE COMPUTER REPAIR 201

CONCLUSION

- Basic skills still **most used / useful**
- Advanced tools / techniques can save time and provide insight
- Questions?

VINTAGE COMPUTER REPAIR 201

LINKS

- Vintage Computer Repair 101:
<https://www.youtube.com/watch?v=5gUDBbVxCS0>
- Short Sniffer paper:
http://www.aeroelectric.com/articles/LowOhmsAdapter_3.pdf
- IZ8DWF NOP video: <https://youtu.be/9Ms6QR4r93I>
- TRS-80 Model 1,2,3 diagnostic ROM:
<HTTPS://GITHUB.COM/MISTERBLACK1/TRS80-DIAGNOSTICROM>