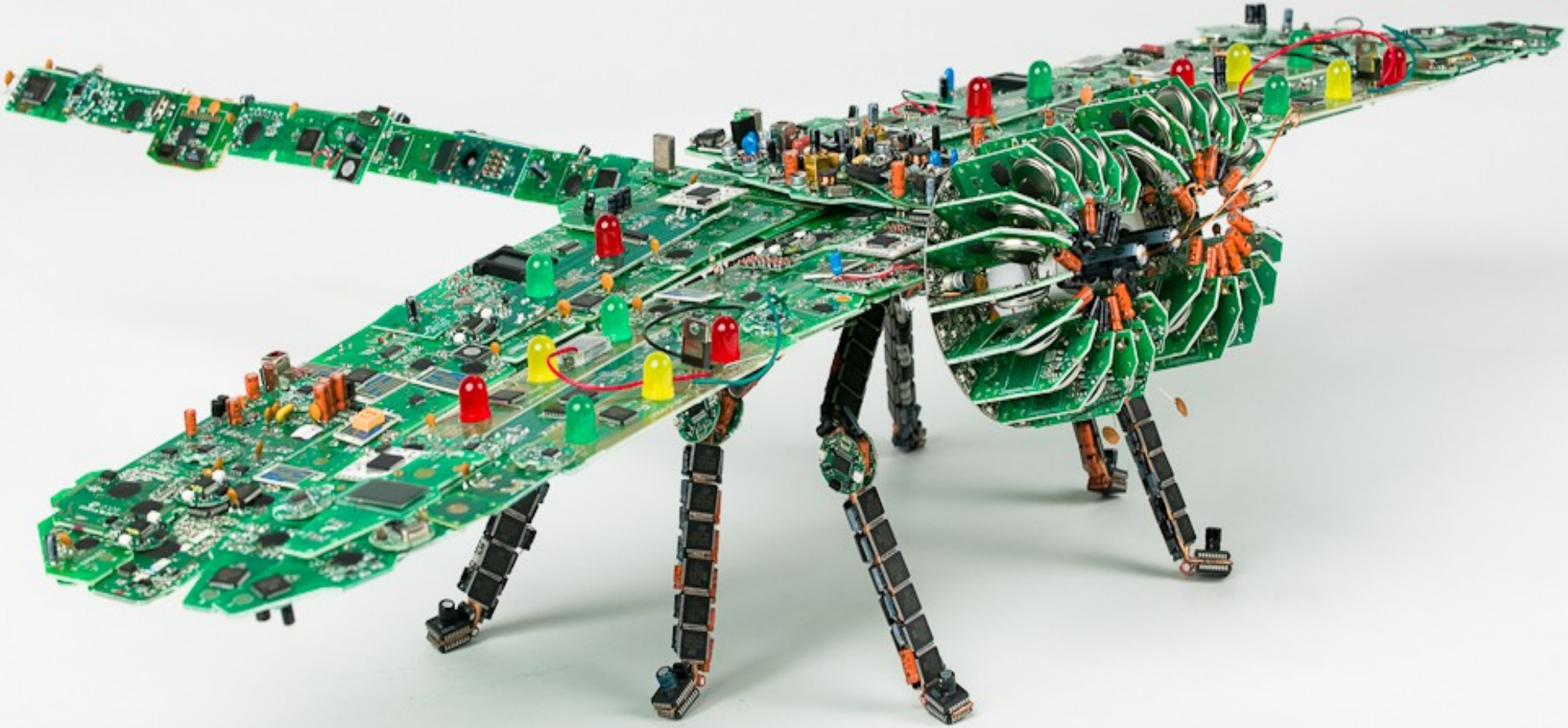
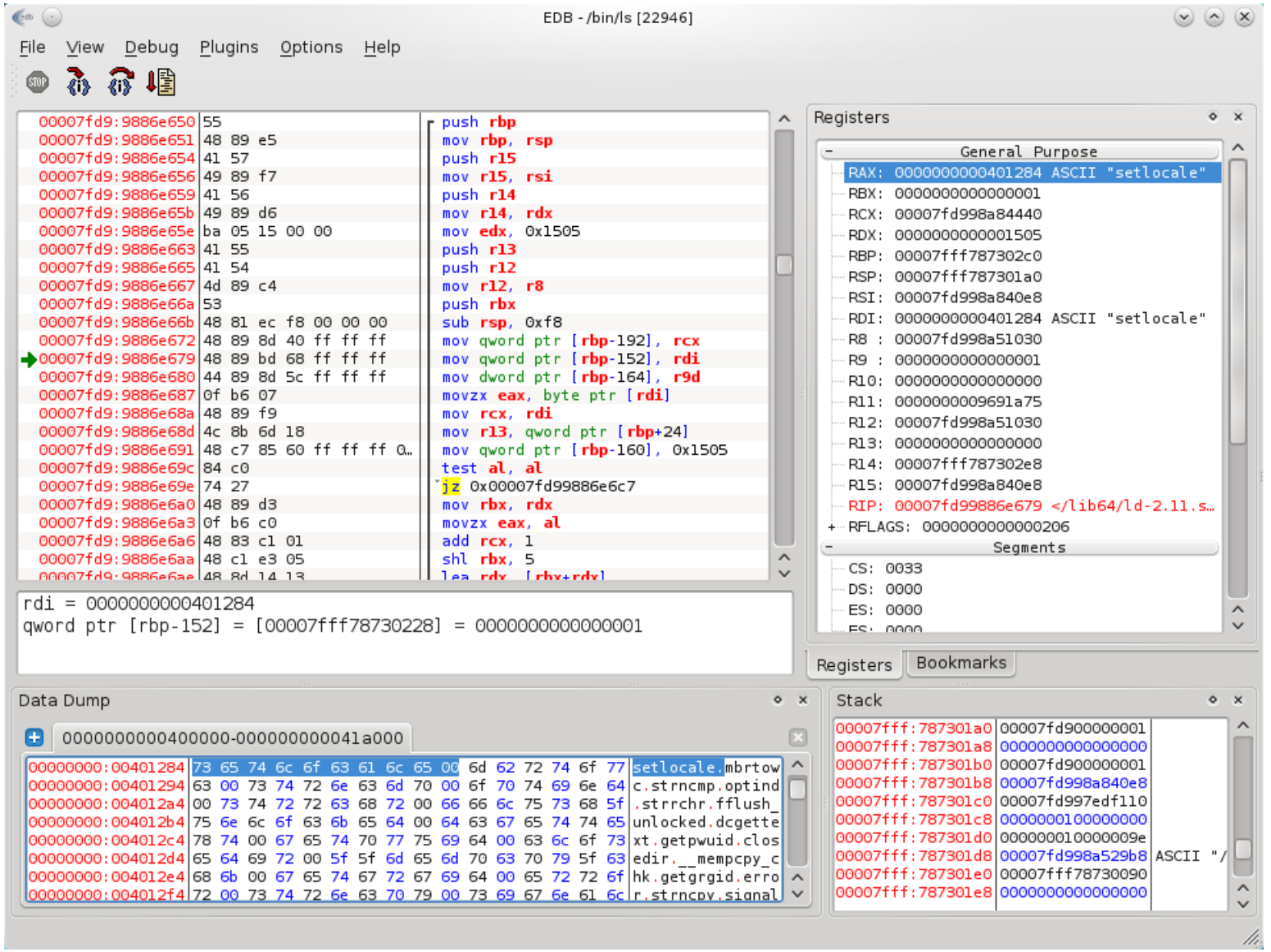
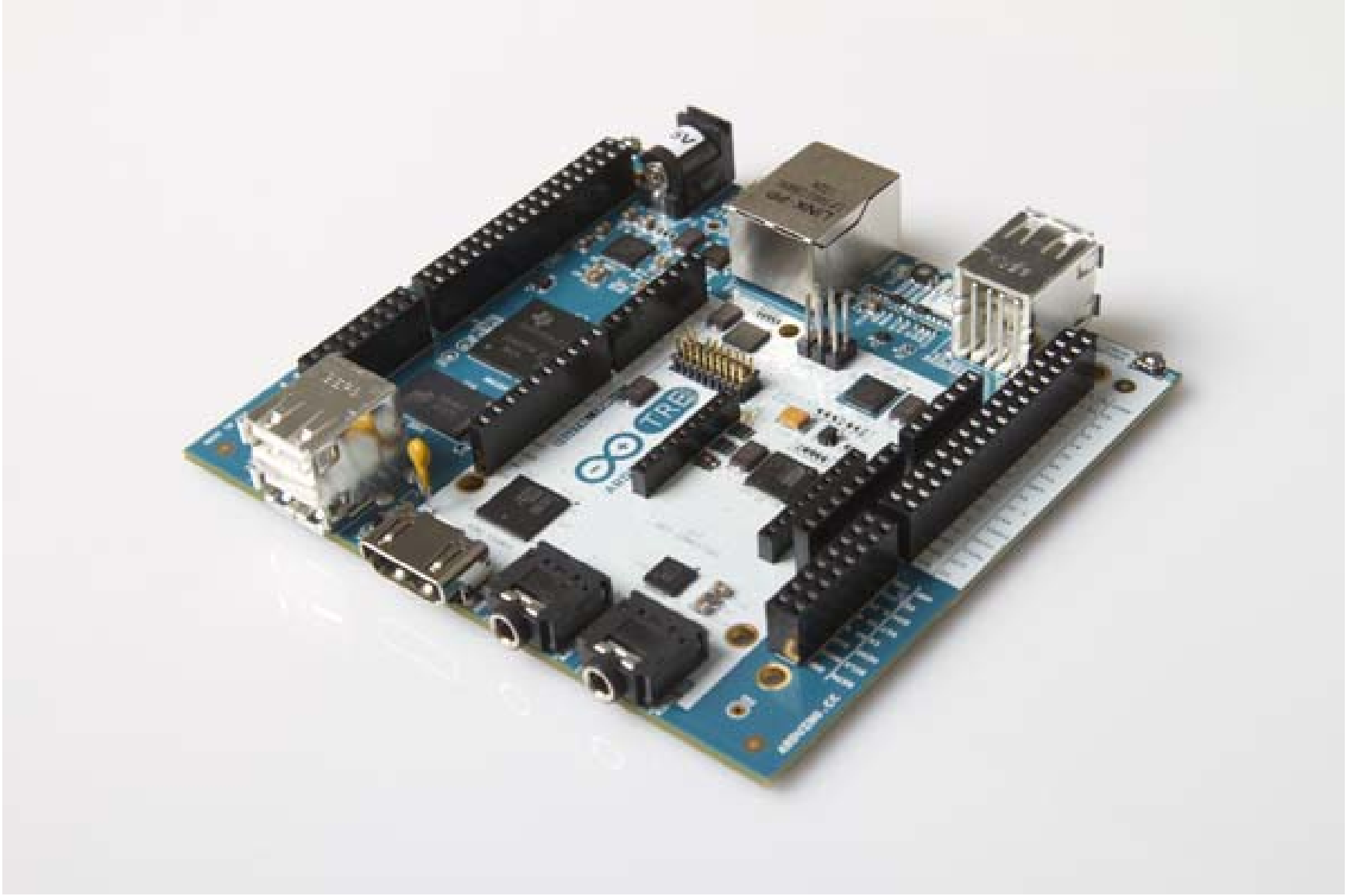
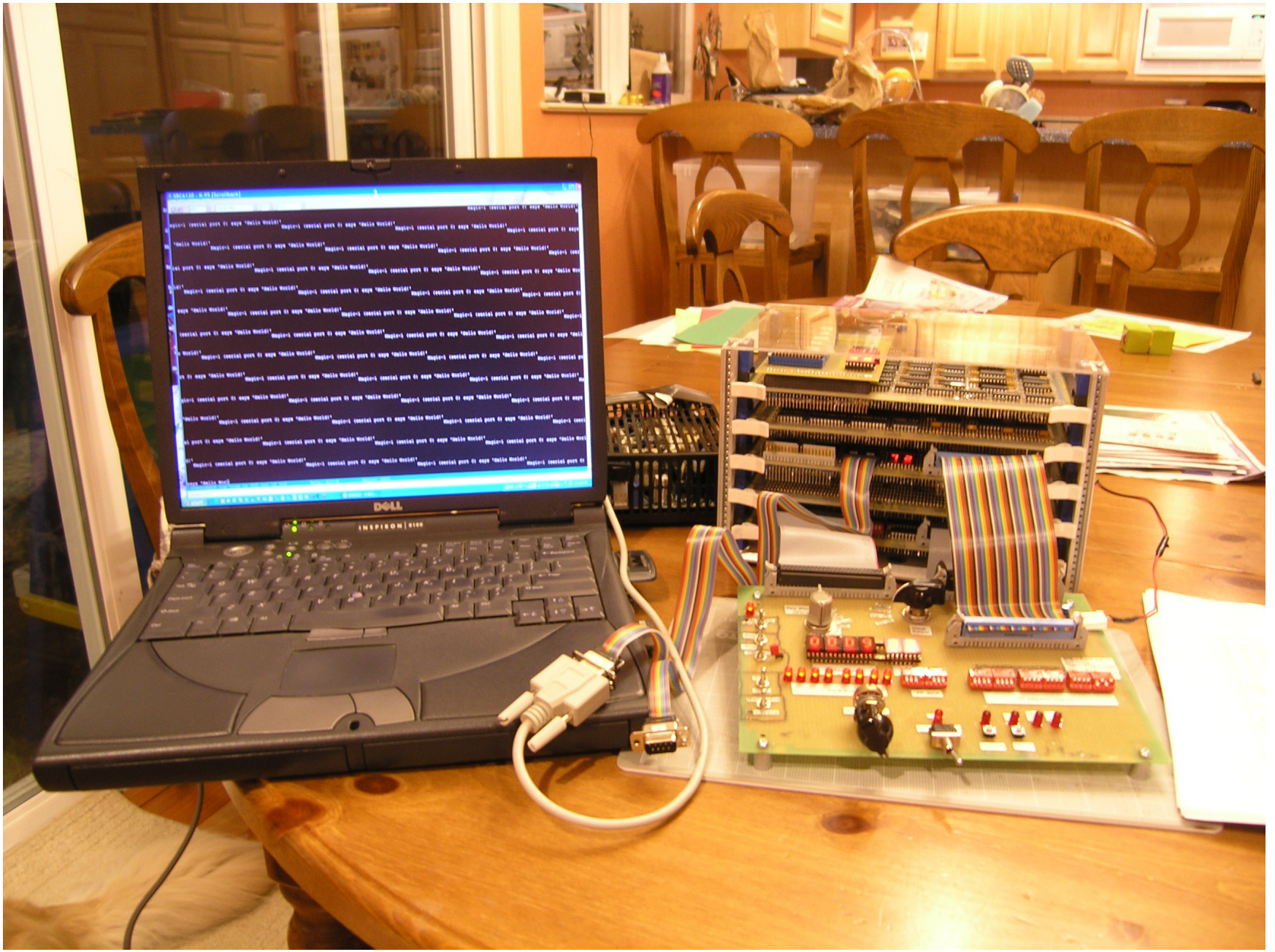
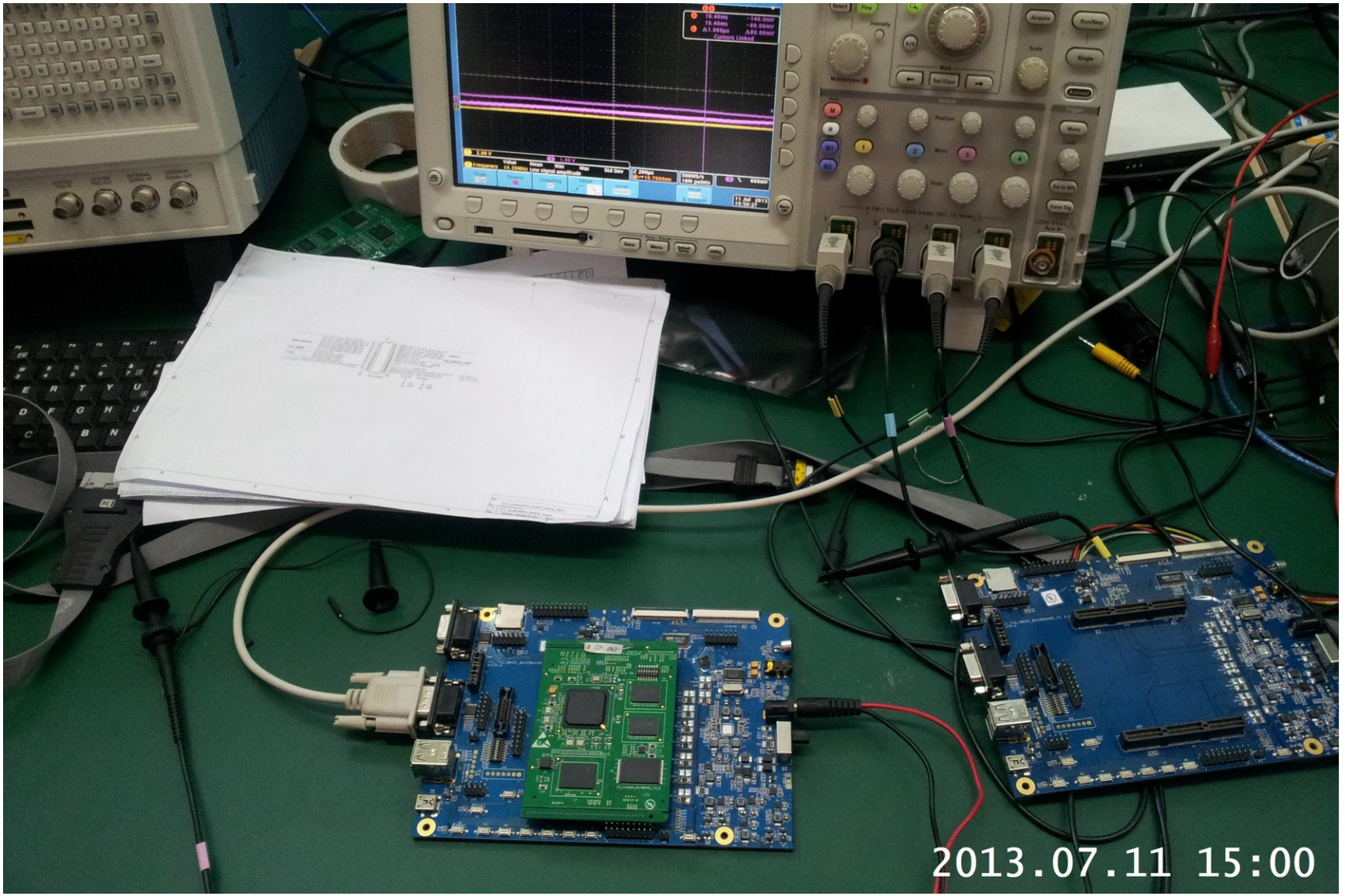
# Debugging Electronics for the Software Engineer




EDB - /bin/ls [22946]
File View Debug Plugins Options Help
00007fd9:9886e650 55 push rbp
00007fd9:9886e651 48 89 e5 mov rbp, rsp
00007fd9:9886e654 41 57 push r15
00007fd9:9886e656 49 89 f7 mov r15, rsi
00007fd9:9886e659 41 56 push r14
00007fd9:9886e65b 49 89 d6 mov r14, rdx
00007fd9:9886e65e ba 05 15 00 00 mov edx, 0x1505
00007fd9:9886e663 41 55 push r13
00007fd9:9886e665 41 54 push r12
00007fd9:9886e667 4d 89 c4 mov r12, r8
00007fd9:9886e66a 53 push rbx
00007fd9:9886e66b 48 81 ec f8 00 00 00 sub rsp, 0xf8
00007fd9:9886e672 48 89 8d 40 ff ff ff mov qword ptr [rbp-192], rcx
00007fd9:9886e679 48 89 bd 68 ff ff ff mov qword ptr [rbp-152], rdi
00007fd9:9886e680 44 89 8d 5c ff ff ff mov dword ptr [rbp-164], r9d
00007fd9:9886e687 0f b6 07 movzx eax, byte ptr [rdi]
00007fd9:9886e68a 48 89 f9 mov rcx, rdi
00007fd9:9886e68d 4c 8b 6d 18 mov r13, qword ptr [rbp+24]
00007fd9:9886e691 48 c7 85 60 ff ff ff 0… mov qword ptr [rbp-160], 0x1505
00007fd9:9886e69c 84 c0 test al, al
00007fd9:9886e69e 74 27 jz 0x00007fd99886e6c7
00007fd9:9886e6a0 48 89 d3 mov rbx, rdx
00007fd9:9886e6a3 0f b6 c0 movzx eax, al
00007fd9:9886e6a6 48 83 c1 01 add rcx, 1
00007fd9:9886e6aa 48 c1 e3 05 shl rbx, 5
rdi = 0000000000401284
qword ptr [rbp-152] = [00007fff78730228] = 0000000000000001
Registers
General Purpose
RAX: 0000000000401284 ASCII "setlocale"
RBX: 0000000000000001
RCX: 00007fd998a84440
RDX: 0000000000001505
RBP: 00007fff787302c0
RSP: 00007fff787301a0
RSI: 00007fd998a840e8
RDI: 0000000000401284 ASCII "setlocale"
R8 : 00007fd998a51030
R9 : 0000000000000001
R10: 0000000000000000
R11: 000000009691a75
R12: 00007fd998a51030
R13: 0000000000000000
R14: 00007fff787302e8
R15: 00007fd998a840e8
RIP: 00007fd99886e679 </lib64/ld-2.11.s…
RFLAGS: 0000000000000206
Segments
CS: 0033
DS: 0000
ES: 0000
Registers
Bookmarks
Data Dump
0000000000400000-000000000041a000
00000000:00401284 73 65 74 6c 6f 63 61 6c 65 00 6d 62 72 74 6f 77 setlocale.mbrtow
00000000:00401294 63 00 73 74 72 6e 63 6d 70 00 6f 70 74 69 6e 64 c.strncmp.optind
00000000:004012a4 00 73 74 72 72 63 68 72 00 66 66 6c 75 73 68 5f .strrchr.fflush_
00000000:004012b4 75 6e 6c 6f 63 6b 65 64 00 64 63 67 65 74 74 65 unlocked.dcgette
00000000:004012c4 78 74 00 67 65 74 70 77 75 69 64 00 63 6c 6f 73 xt.getpwuid.clos
00000000:004012d4 65 64 69 72 00 5f 5f 6d 65 6d 70 63 70 79 5f 63 edir.__mempcpy_c
00000000:004012e4 68 6b 00 67 65 74 67 72 67 69 64 00 65 72 72 6f hk.getgrgid.erro
00000000:004012f4 72 00 73 74 72 6e 63 70 79 00 73 69 67 6e 61 6c r.strncpy.signal
Stack
00007fff:787301a0 00007fd900000001
00007fff:787301a8 0000000000000000
00007fff:787301b0 00007fd900000001
00007fff:787301b8 00007fd998a840e8
00007fff:787301c0 00007fd997edf110
00007fff:787301c8 0000000100000000
00007fff:787301d0 000000010000009e
00007fff:787301d8 00007fd998a529b8 ASCII "/
00007fff:787301e0 00007fff78730090
00007fff:787301e8 0000000000000000




DELL
INSPIRON

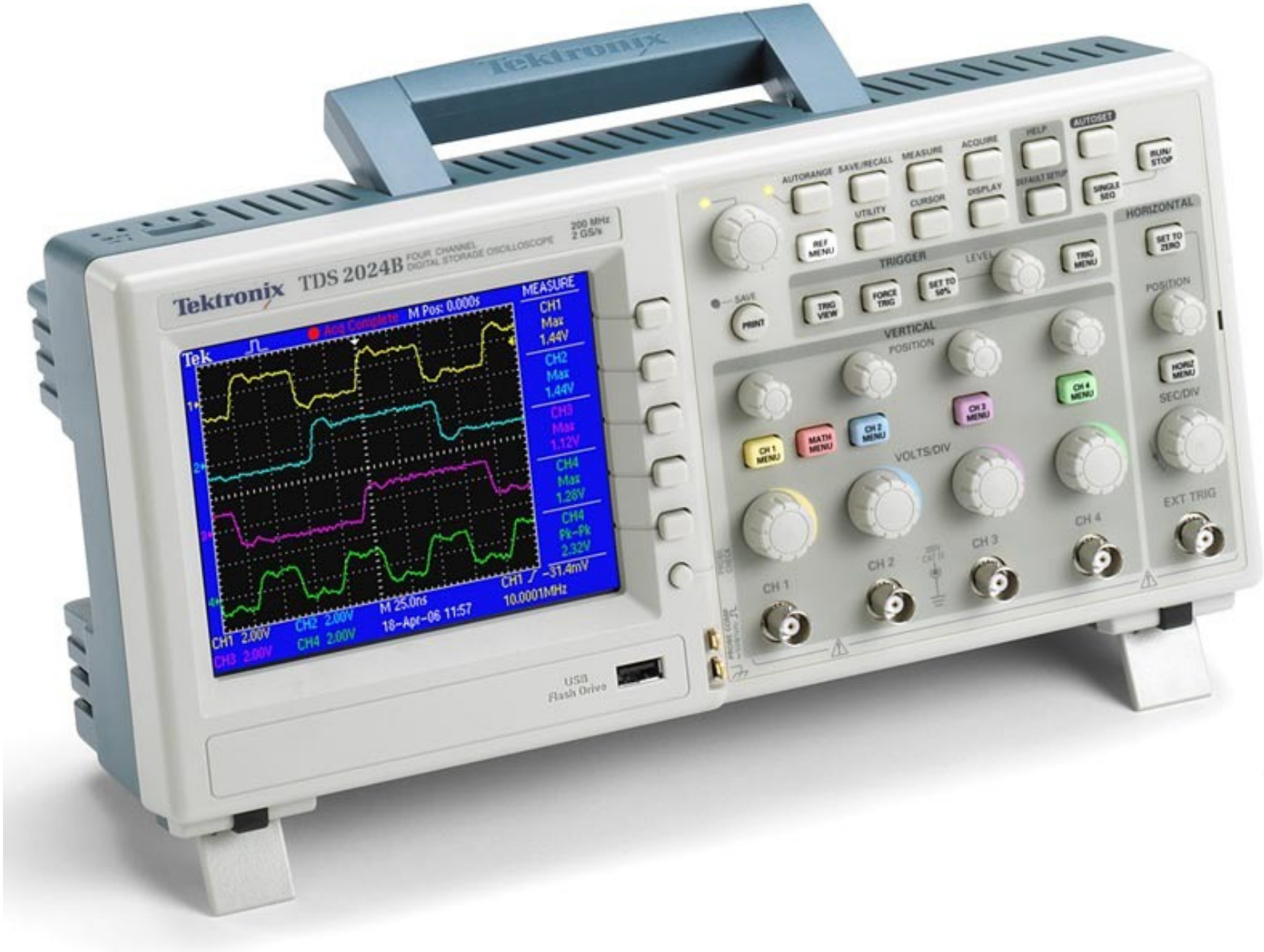

2013.07.11 15:00

# What will you learn here?

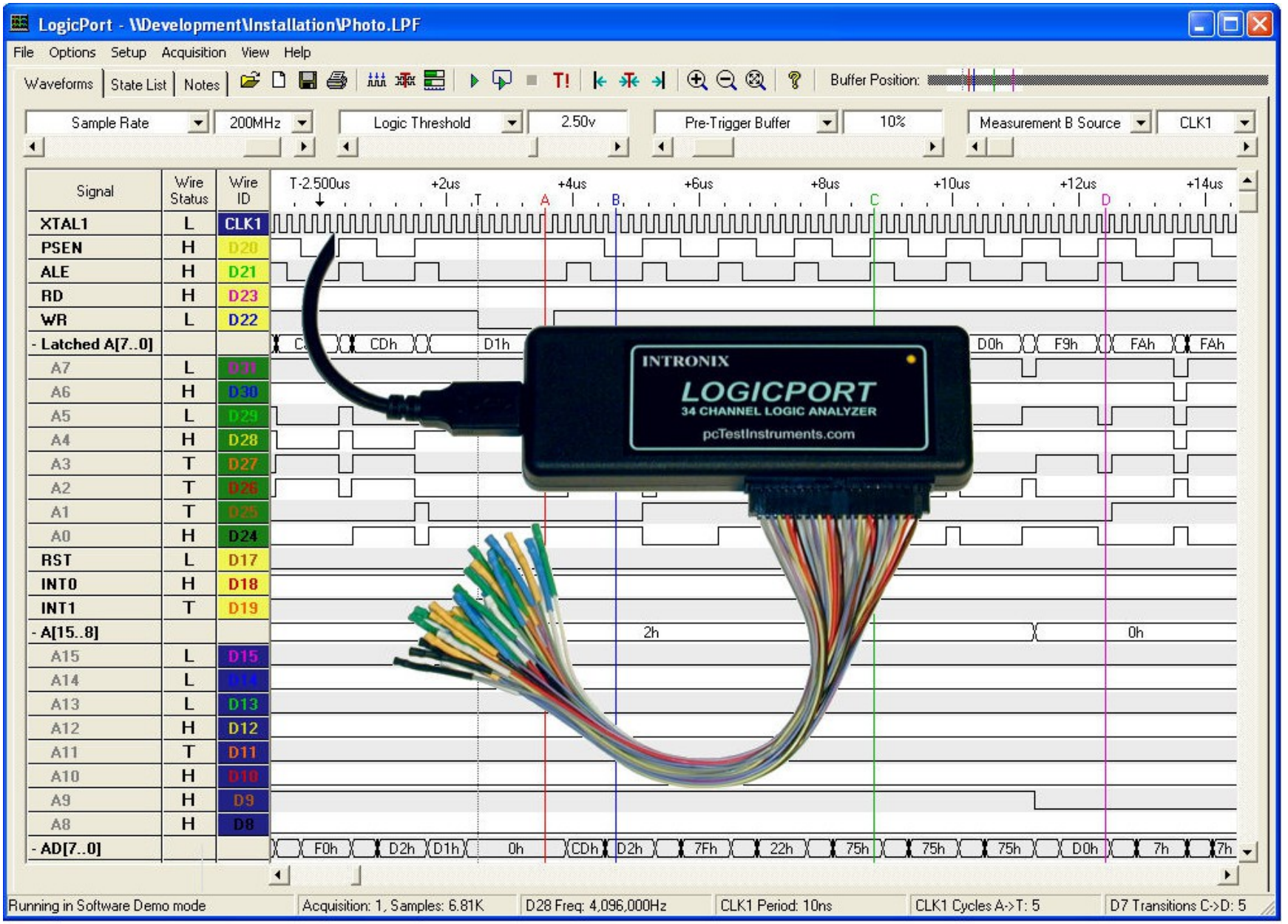
- No basic electronics
  - You know what a resistor is
  - You have a hardware guy to support you
- No advanced electronics either
  - That what you have the hardware guy for
- Just a couple of tricks your hardware guy should have told you a long time ago

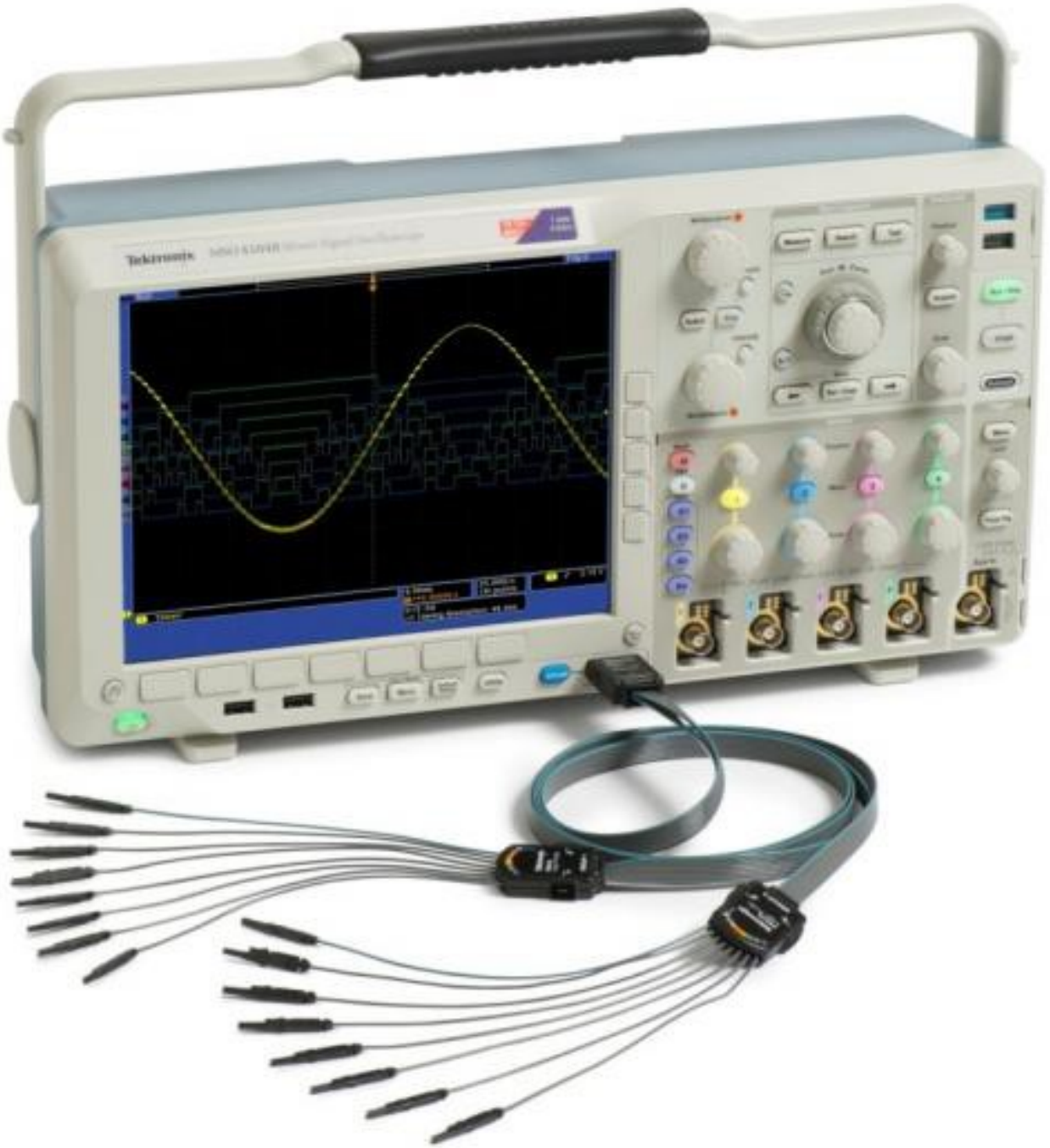

Ulrich Tietze
Christoph Schenk
Eberhard Gamm
Halbleiter-Schaltungstechnik
Mit DVD
14. Auflage
Springer Vieweg

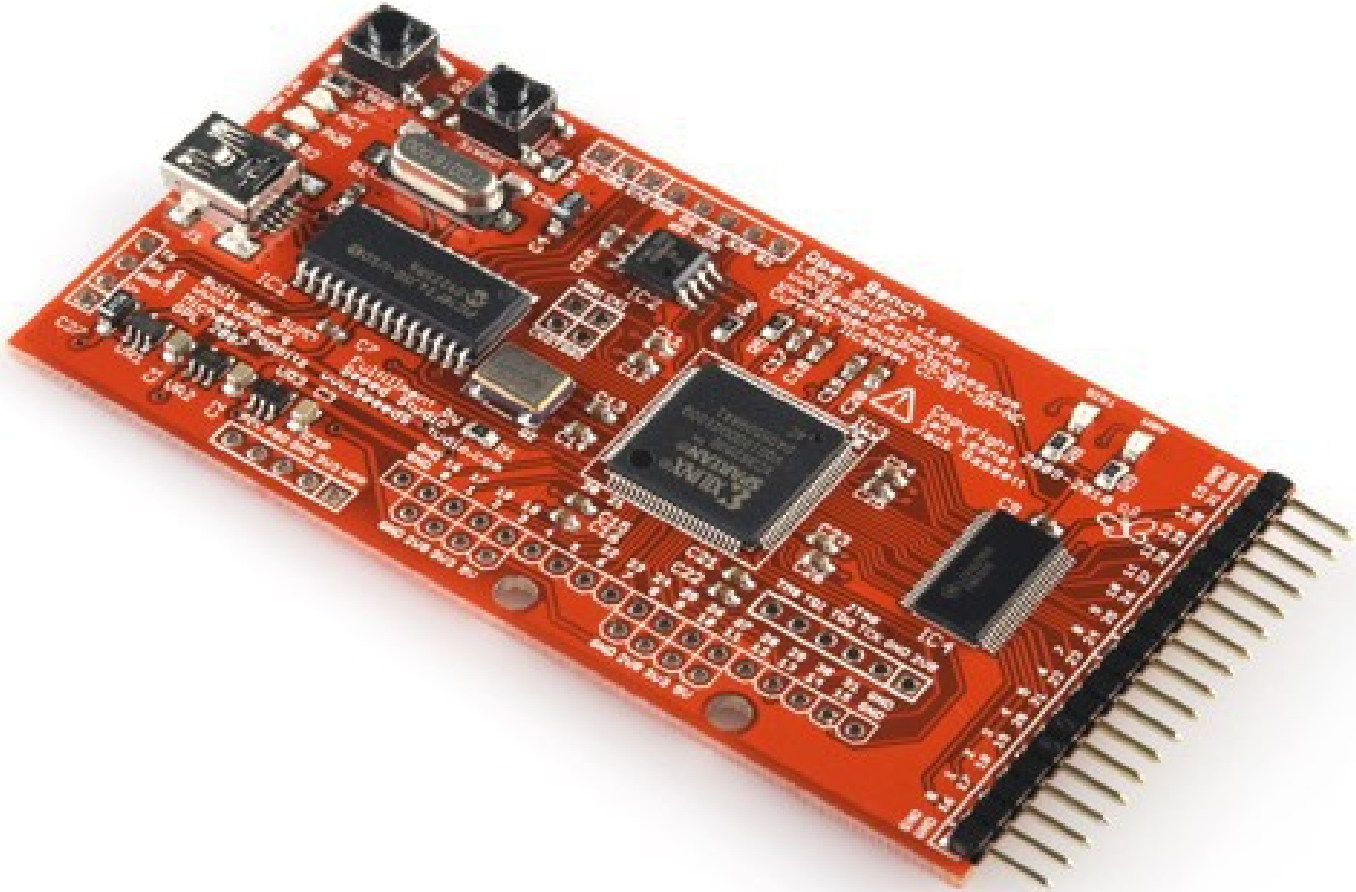

HV
000
DCV
1000
200
20
2000 m
200 m
750 ACV
200
1.5V(4.0mA)
9V(25mA)
DCA
200µ
2000µ
20m
200m
10A
2000k
Ω
200k
20k
2000
200
hFE
E
B
C
NPN
PNP
OFF
ON
CE
10ADC
10A max
VΩmA
750VAC
1000VDC
200mAmax
COM
CAT. II
CEN-TECH
DIGITAL
MULTIMETER


Tektronix
Tektronix TDS 2024B FOUR CHANNEL DIGITAL STORAGE OSCILLOSCOPE
200 MHz 2 GS/s
MEASURE
CH1 Max 1.44V
CH2 Max 1.44V
CH3 Max 1.12V
CH4 Max 1.28V
CH4 Pk-Pk 2.32V
CH1 -31.4mV
Acq Complete M Pos: 0.000s
CH1 2.00V
CH2 2.00V
CH3 2.00V
CH4 2.00V
M 25.0ns
18-Apr-06 11:57
CH1 10.0001MHz
USB Flash Drive
AUTORANGE
SAVE/RECALL
MEASURE
ACQUIRE
HELP
AUTOSET
UTILITY
CURSOR
DISPLAY
DEFAULT SETUP
RUN/ STOP
SINGLE SEQ
REF MENU
HORIZONTAL
SET TO ZERO
TRIGGER
LEVEL
TRIG MENU
SAVE
PRINT
TRIG VIEW
FORCE TRIG
SET TO 50%
POSITION
VERTICAL
HORIZ MENU
SEC/DIV
CH 4 MENU
CH 3 MENU
CH 2 MENU
MATH MENU
CH 1 MENU
VOLTS/DIV
EXT TRIG
CH 1
CH 2
CH 3
CH 4


Pico
Technology
PicoScope 3000 Series
www.picotech.com
A
B
C
D
Ext


LogicPort - \\Development\Installation\Photo.LPF
File Options Setup Acquisition View Help
Waveforms State List Notes
Buffer Position:
Sample Rate 200MHz
Logic Threshold 2.50v
Pre-Trigger Buffer 10%
Measurement B Source CLK1
Signal
Wire Status
Wire ID
T-2.500us
+2us
+4us
+6us
+8us
+10us
+12us
+14us
XTAL1 L CLK1
PSEN H D20
ALE H D21
RD H D23
WR L D22
- Latched A[7..0]
A7 L D31
A6 H D30
A5 L D29
A4 H D28
A3 T D27
A2 T D26
A1 T D25
A0 H D24
RST L D17
INT0 H D18
INT1 T D19
- A[15..8]
A15 L D15
A14 L D14
A13 L D13
A12 H D12
A11 T D11
A10 H D10
A9 H D9
A8 H D8
- AD[7..0]
F0h D2h D1h 0h CDh D2h 7Fh 22h 75h 75h 75h D0h 7h 7h
CDh D1h D0h F9h FAh FAh
2h 0h
INTRONIX
LOGICPORT
34 CHANNEL LOGIC ANALYZER
pcTestInstruments.com
Running in Software Demo mode
Acquisition: 1, Samples: 6.81K
D28 Freq: 4,096,000Hz
CLK1 Period: 10ns
CLK1 Cycles A->T: 5
D7 Transitions C->D: 5



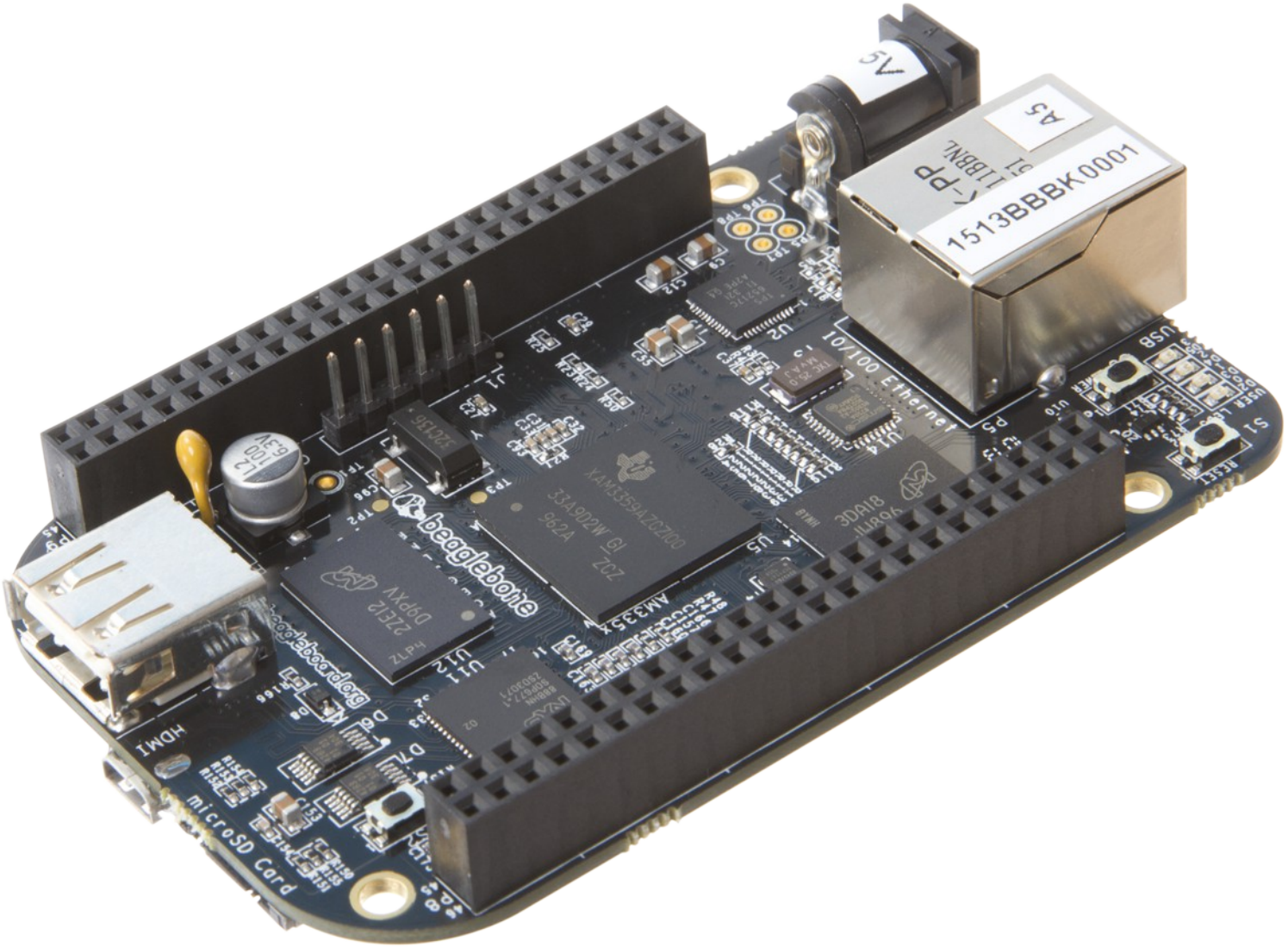



SIGMA 2
LOGIC ANALYSER
ON-LINE / BUSY
TRIGGER STATUS
GO


BEAGLE™
USB 480
TOTAL PHASE
www.totalphase.com


HEWLETT PACKARD
E3631A
TRIPLE OUTPUT DC POWER SUPPLY
6.004V
0.001A
FUNCTION
SELECT
+6V
+25V
-25V
Track
Display Limit
Recall
Store
Error
I/O Config
Output On/Off
Local
Power
On
Off
6V
25V
COM


MIKE LUCKOVICH
PRELIMINARY RESULTS INDICATE THESE CRASHES ARE LINKED TO THE SAME ELECTRONIC COMPONENTS...
CELLPHONES.


5V
1513BBBK0001
10/100 Ethernet
USB
HDMI
microSD Card
beagleboard.org
beaglebone

COMMODORE SEMICONDUCTOR GROUP
a division of Commodore Business Machines, Inc.
950 Rittenhouse Road, Norristown, PA 19403 • 215/666-7950 • TWX 510-660-4168

# NMOS

## 6500 MICROPROCESSORS



### THE 6500 MICROPROCESSOR FAMILY CONCEPT —

The 6500 Series Microprocessors represent the first totally software compatible microprocessor family. This family of products includes a range of software compatible microprocessors which provide a selection of addressable memory range, interrupt input options and on-chip clock oscillators and drivers. All of the microprocessors in the 6500 group are software compatible within the group and are bus compatible with the M6800 product offering.

The family includes six microprocessors with on-board clock oscillators and drivers and four microprocessors driven by external clocks. The on-chip clock versions are aimed at high performance, low cost applications where single phase inputs, crystal or RC inputs provide the time base. The external clock versions are geared for the multi processor system applications where maximum timing control is mandatory. All versions of the microprocessors are available in 1 MHz, 2 MHz ("A" suffix on product numbers), 3 MHz ("B" suffix on product numbers), and 4 MHz ("C" suffix on product numbers) maximum operating frequencies.

### FEATURES OF THE 6500 FAMILY

- Single +5 volt supply
- N channel, silicon gate, depletion load technology
- Eight bit parallel processing
- 56 Instructions
- Decimal and binary arithmetic
- Thirteen addressing modes
- True indexing capability
- Programmable stack pointer
- Variable length stack
- Interrupt capability
- Non-maskable interrupt
- Use with any type or speed memory
- 8 BIT Bi-directional Data Bus
- Addressable memory range of up to 65K bytes
- "Ready" input (for single cycle execution)
- Direct memory access capability
- Bus compatible with M6800
- Choice of external or on-board clocks
- 1 MHz, 2 MHz, 3 MHz and 4 MHz operation
- On-the-chip clock options
  - External single clock input
  - RC time base input
  - Crystal time base input
- Pipeline architecture

### MEMBERS OF THE 6500 MICROPROCESSOR (CPU) FAMILY

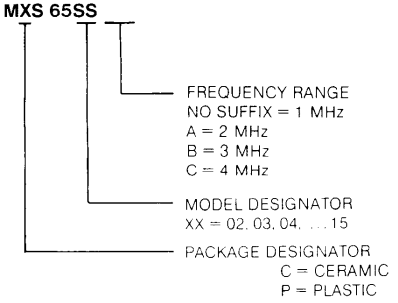
Microprocessors with On-Chip Clock Oscillator

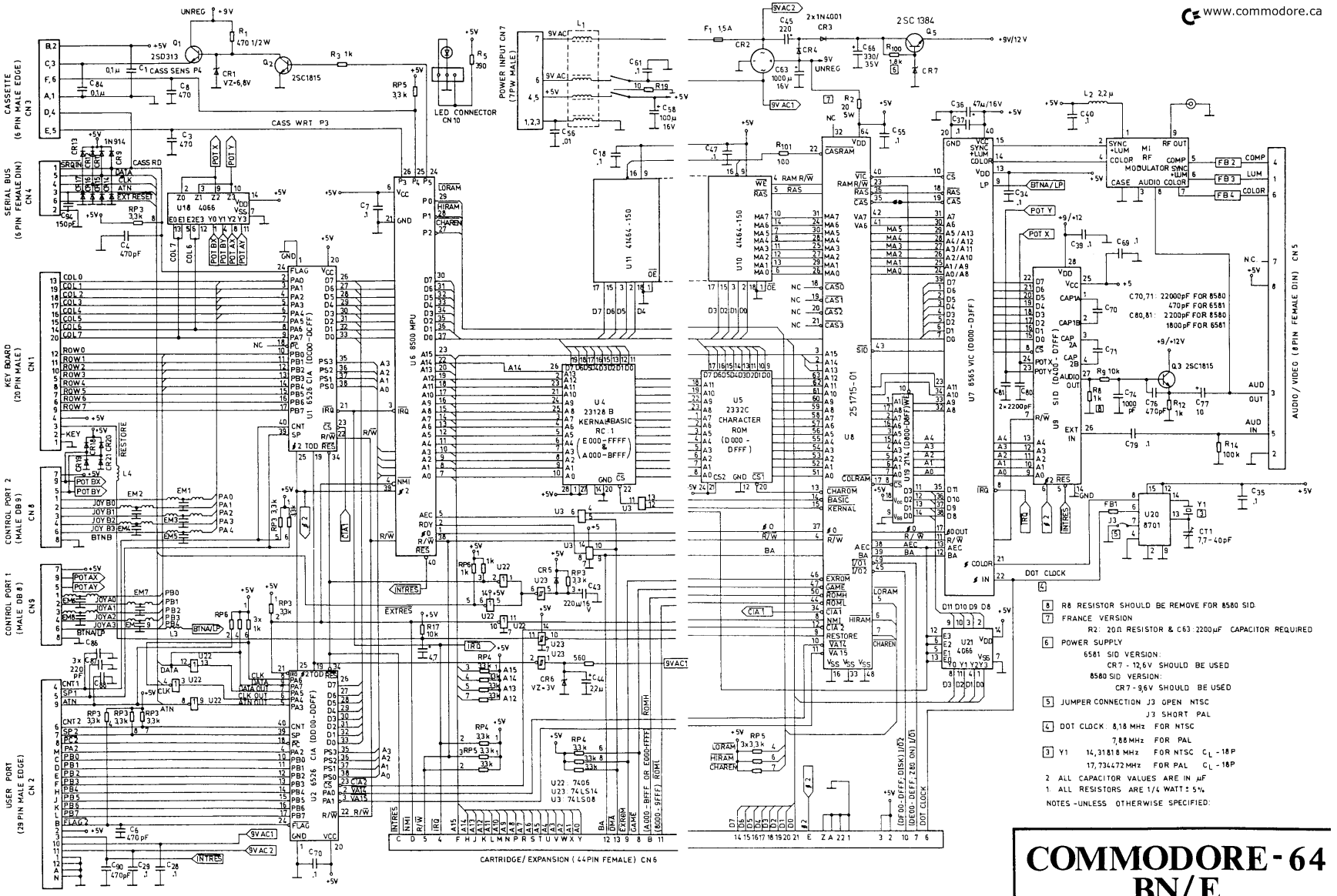
| Model | Addressable Memory |
|---|---|
| R6502 | 65K Bytes |
| R6503 | 4K Bytes |
| R6504 | 8K Bytes |
| R6505 | 4K Bytes |
| R6506 | 4K Bytes |
| R6507 | 8K Bytes |

Microprocessors with External Two Phase Clock Inputs

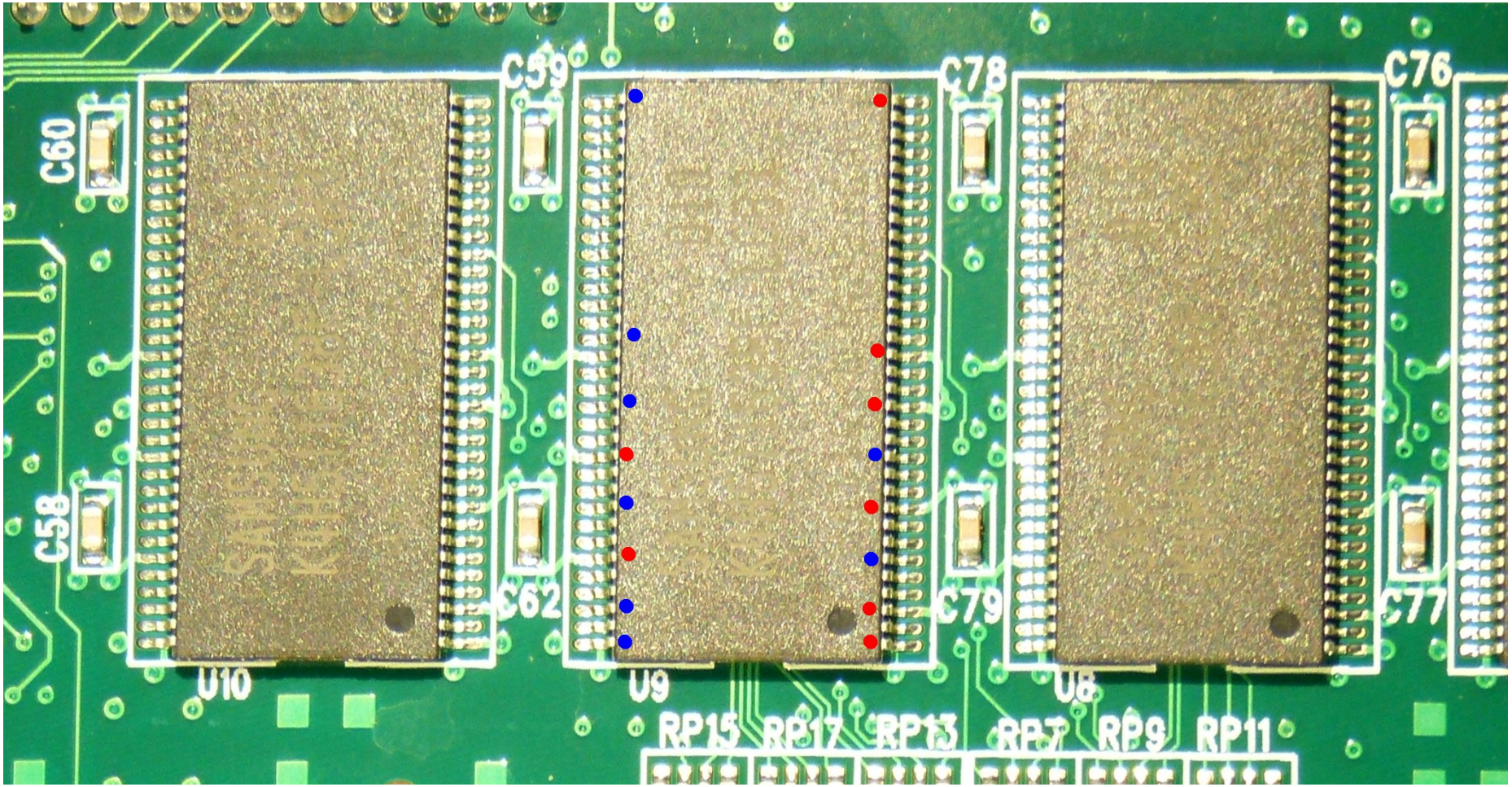
| Model | Addressable Memory |
|---|---|
| R6512 | 65K Bytes |
| R6513 | 4K Bytes |
| R6514 | 8 Bytes |
| R6515 | 4K Bytes |

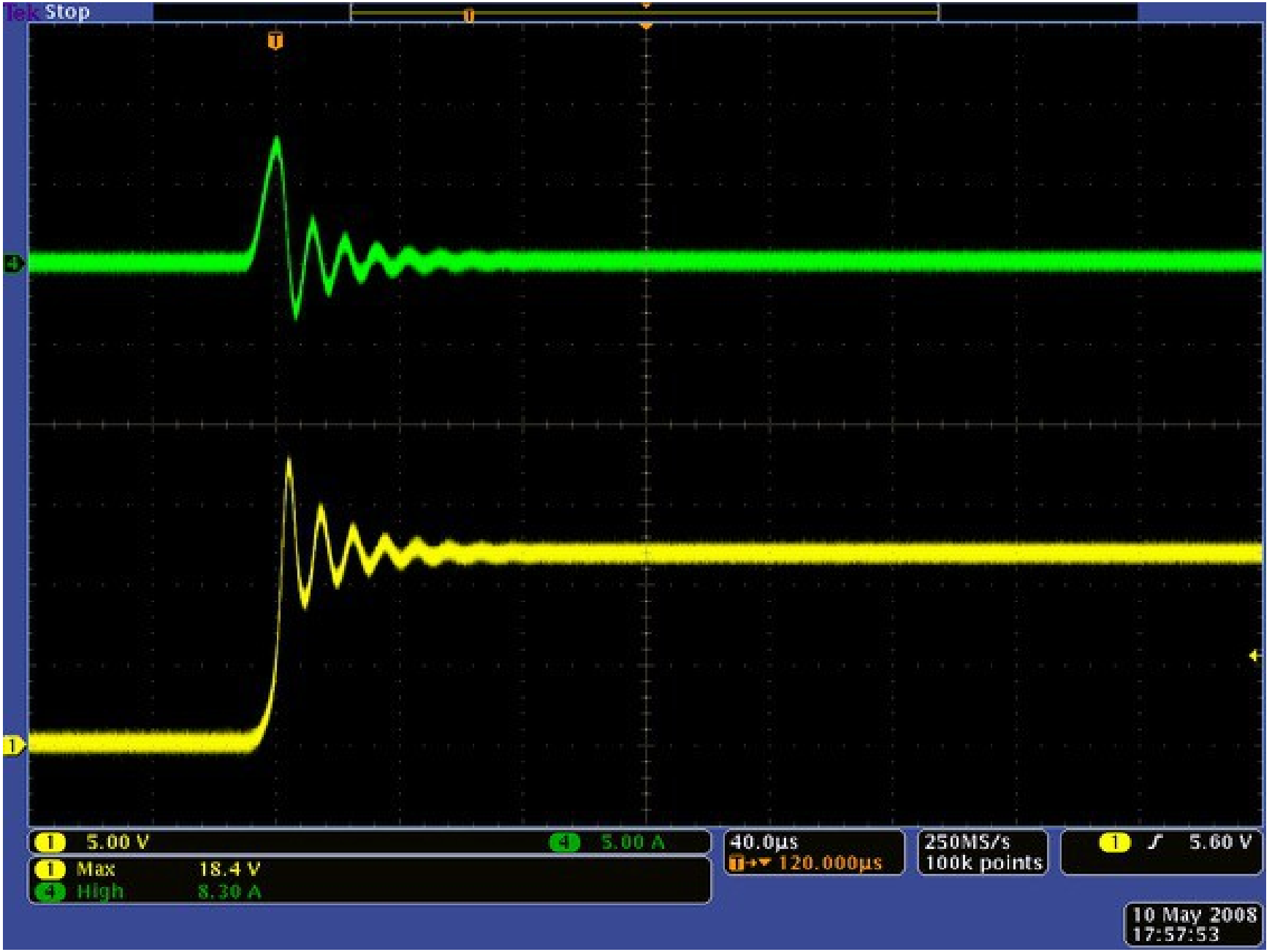
### ORDER NUMBER MXS 65SS

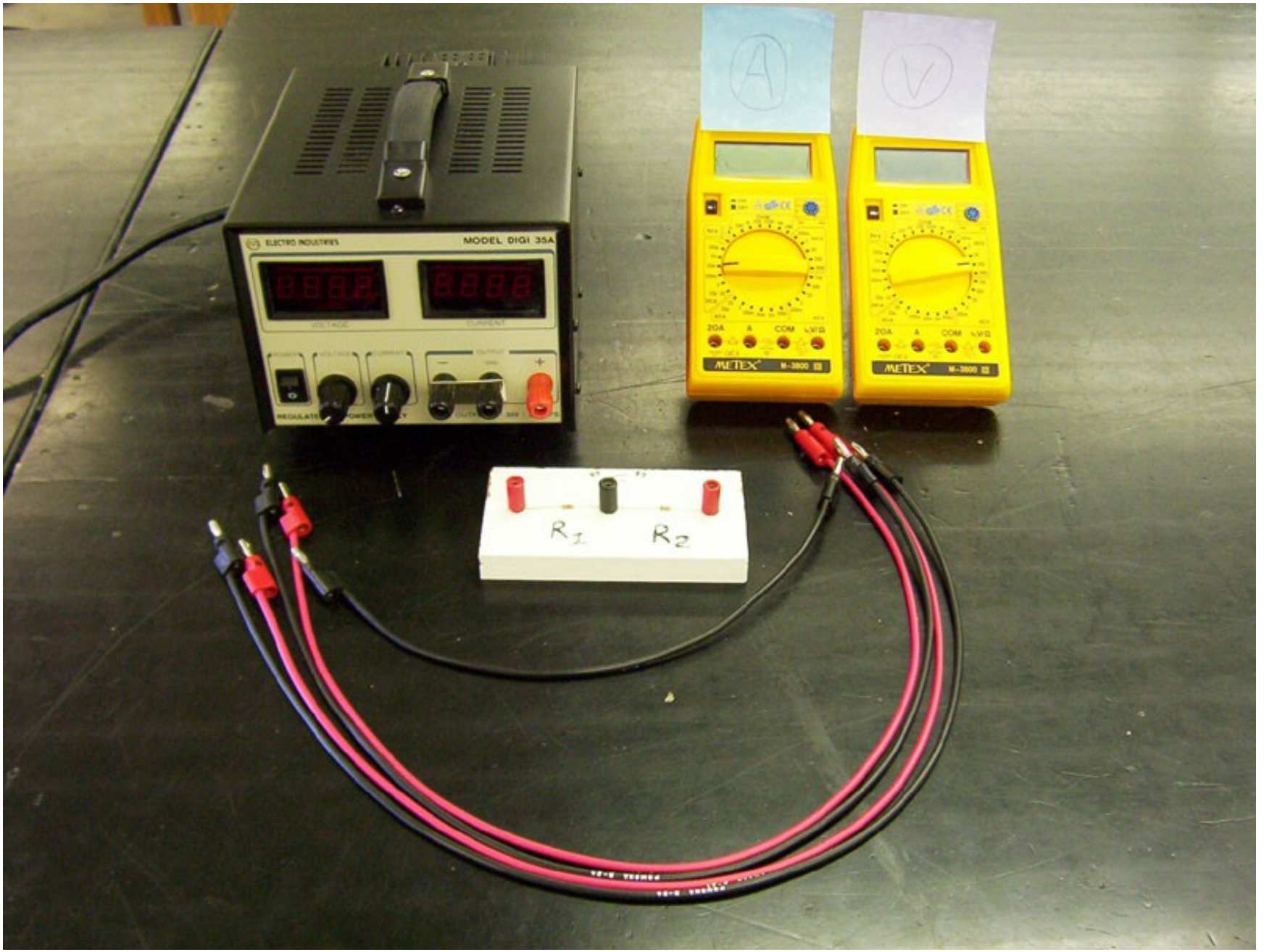


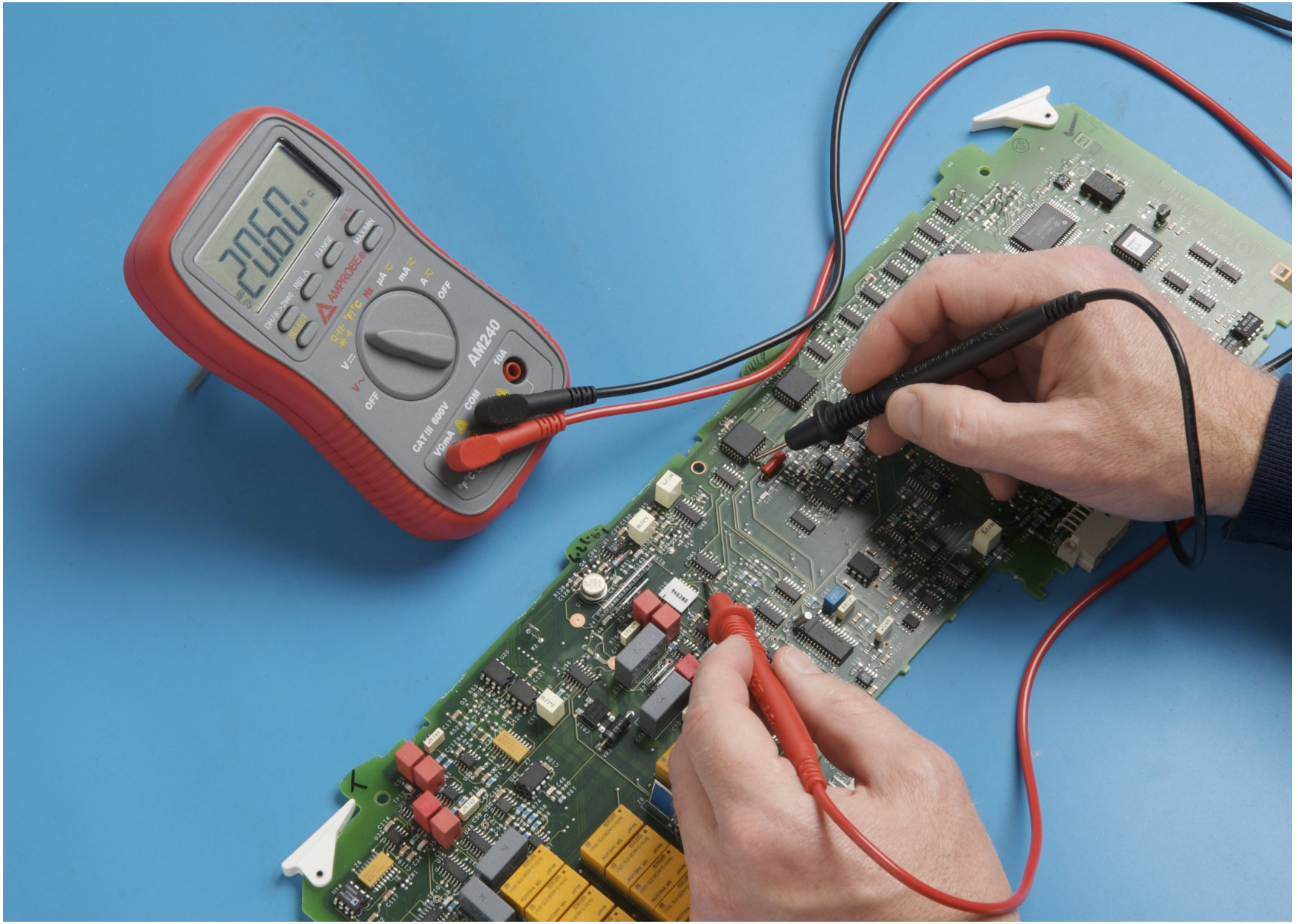


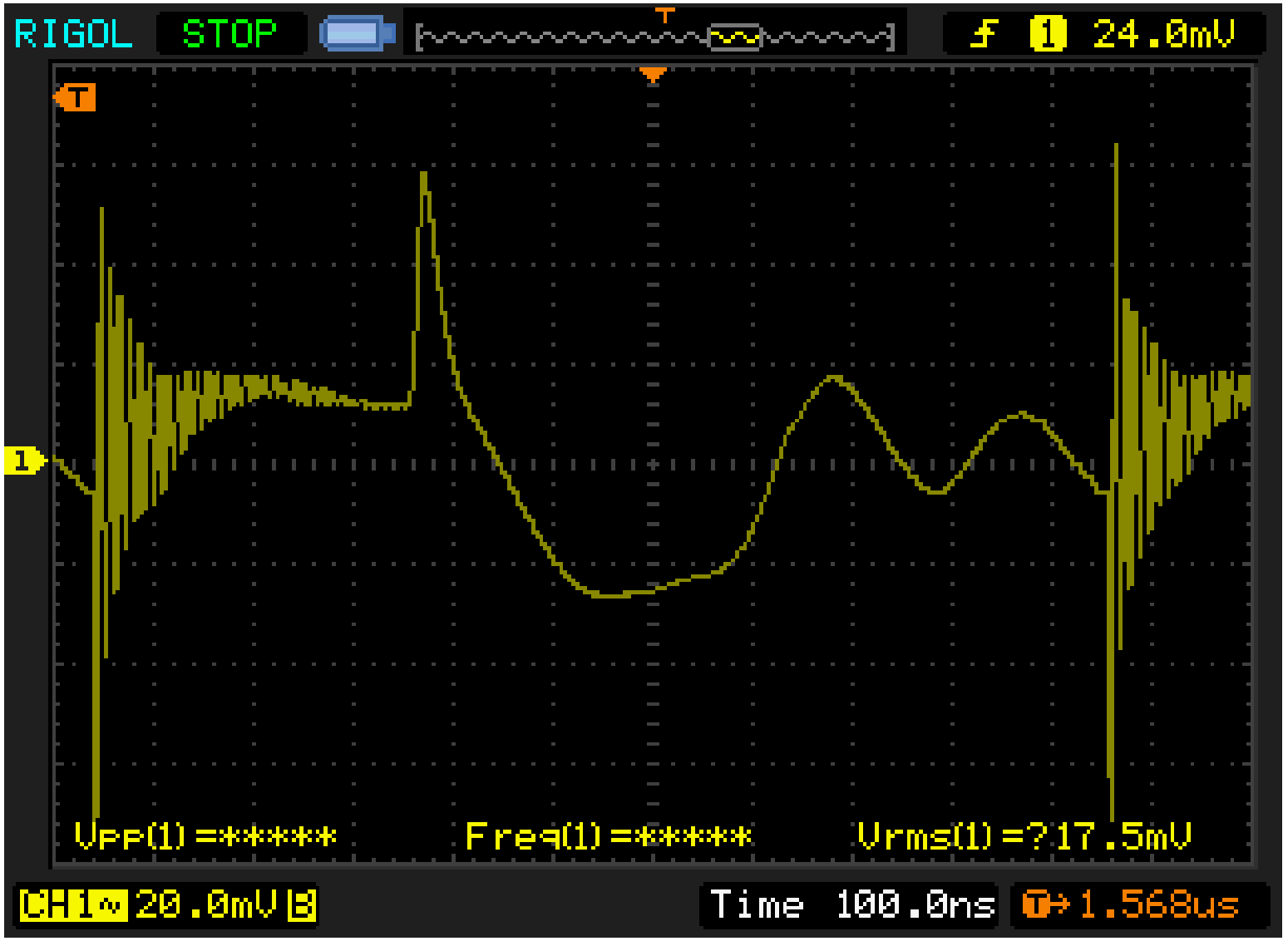

# COMMODORE - 64
# BN/E

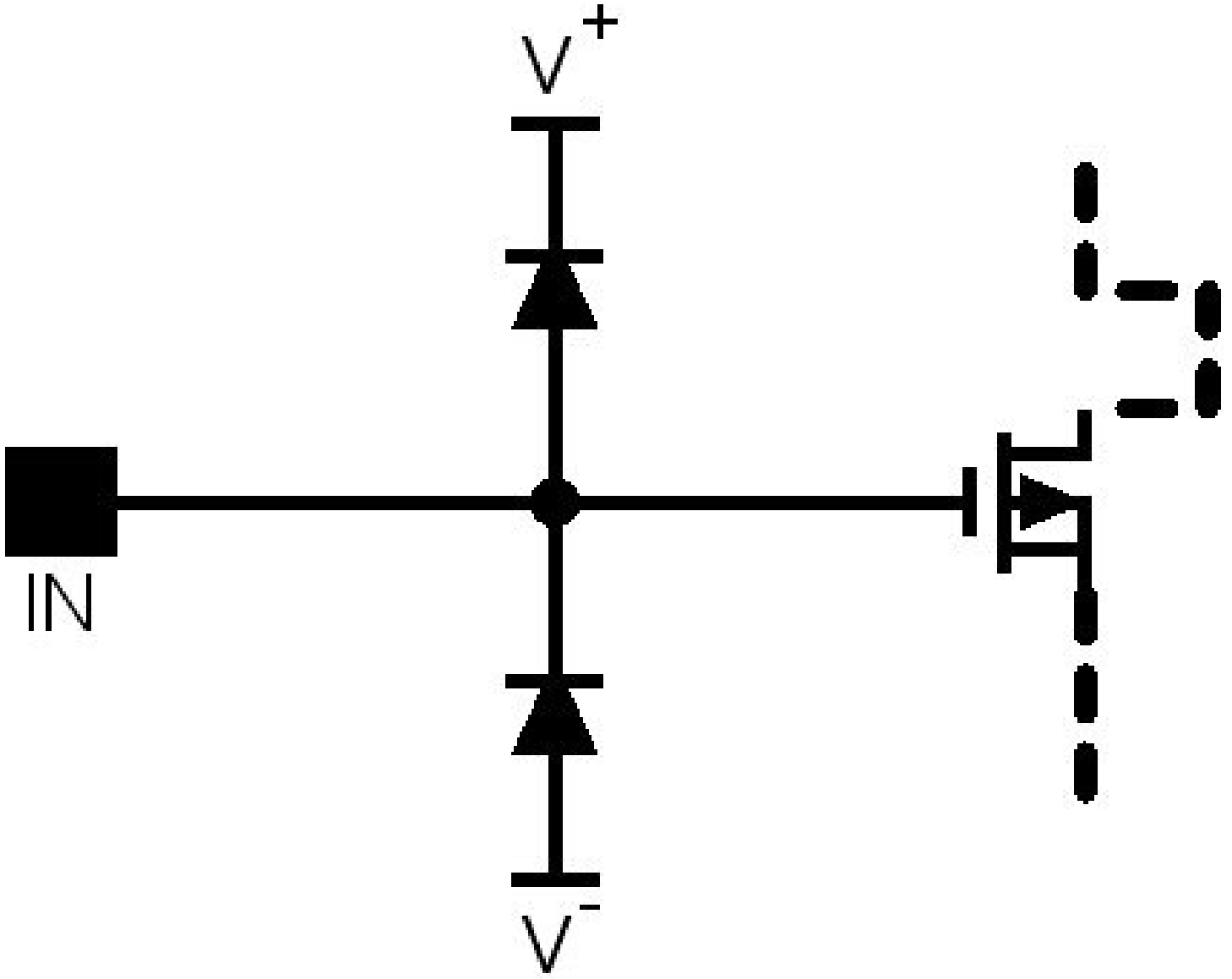

C60
C59
C78
C76
C58
C62
C79
C77
U10
U9
U8
RP15
RP17
RP13
RP7
RP9
RP11

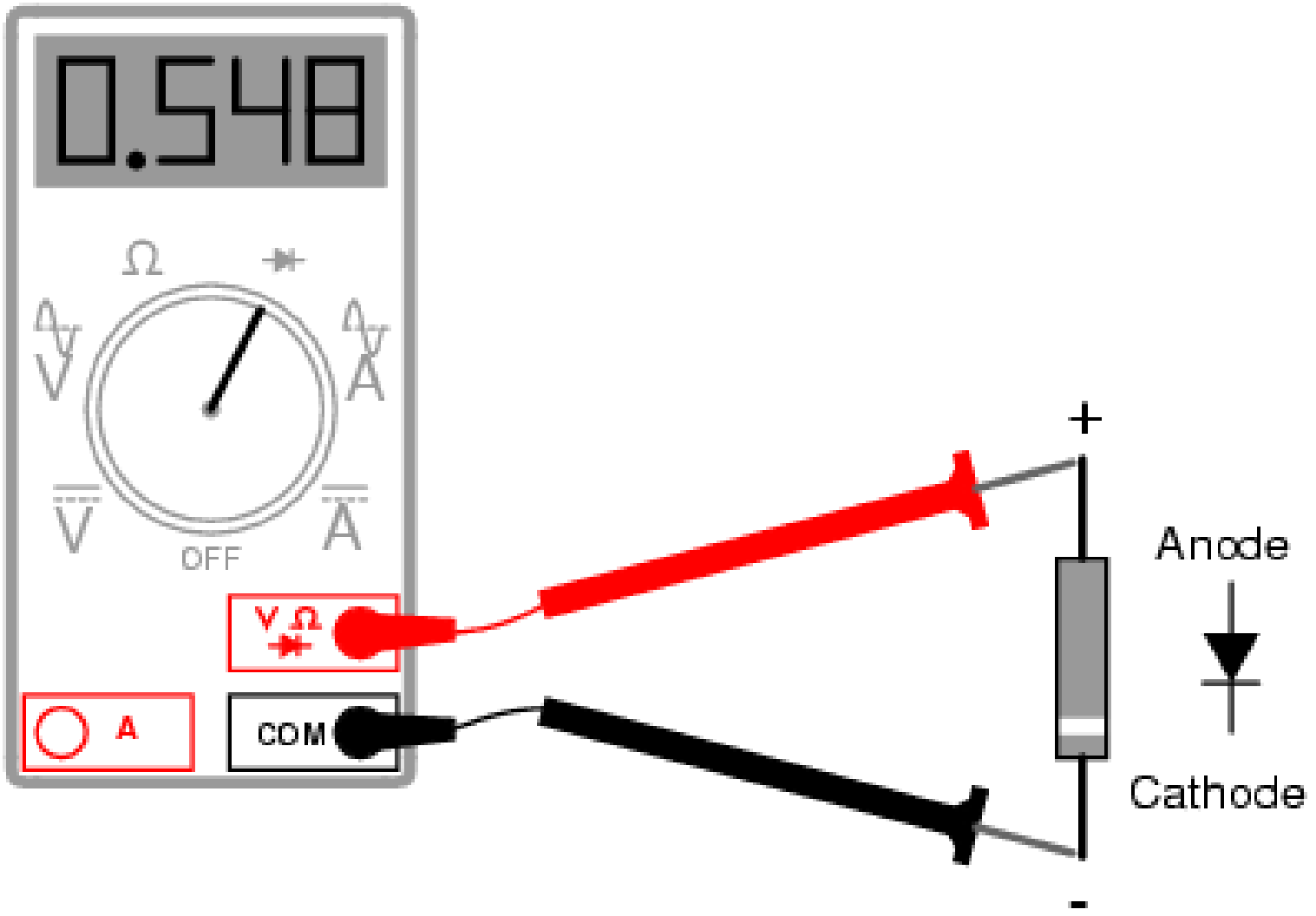

Tek Stop
1 5.00 V
4 5.00 A
1 Max 18.4 V
4 High 8.30 A
40.0µs
120.000µs
250MS/s
100k points
1 5.60 V
10 May 2008
17:57:53

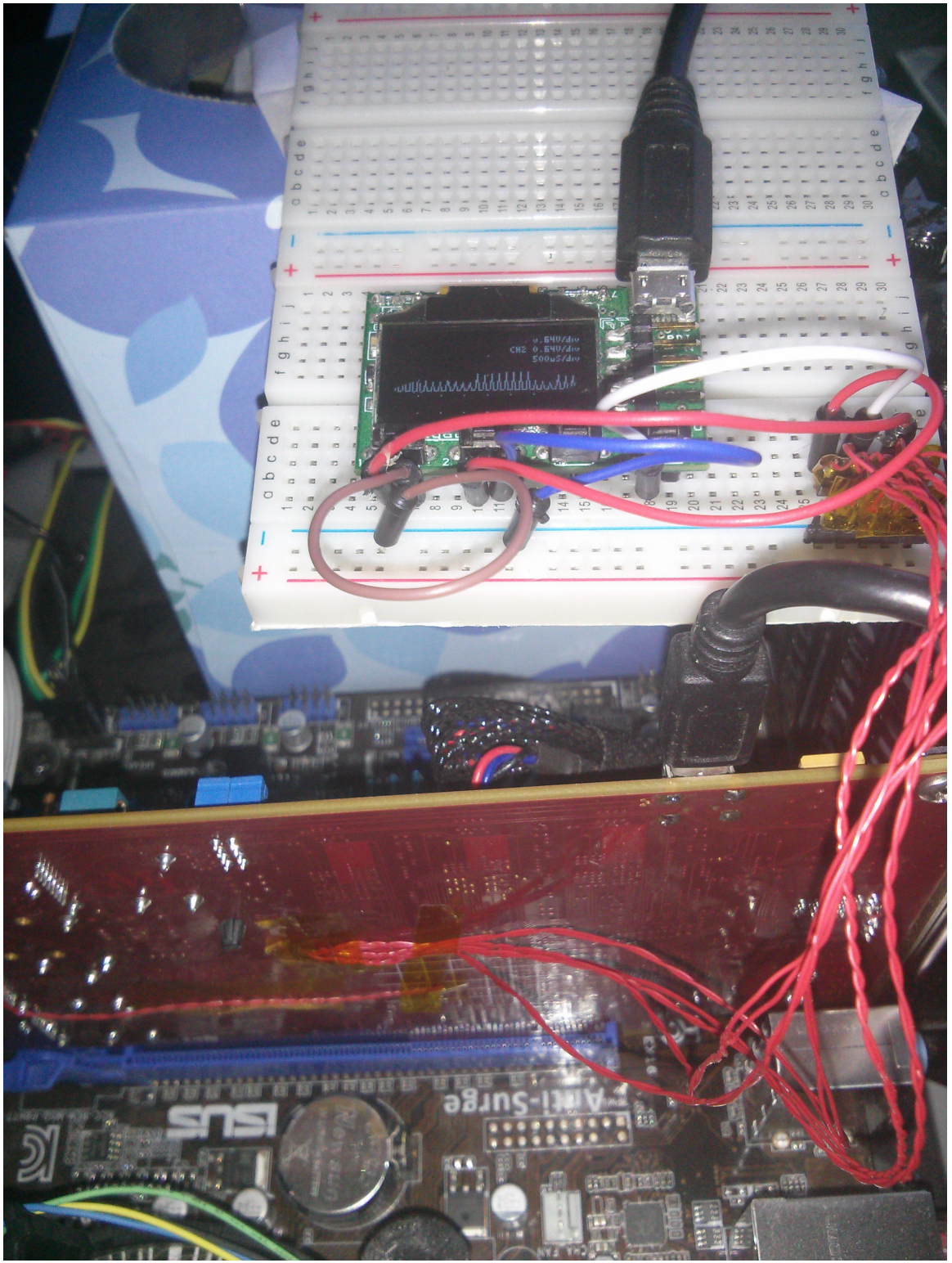

ELECTRO INDUSTRIES
MODEL DIGI 35A
VOLTAGE
CURRENT
A
V
20A
A
COM
METEX
M-3800
METEX
M-3800
R1
R2

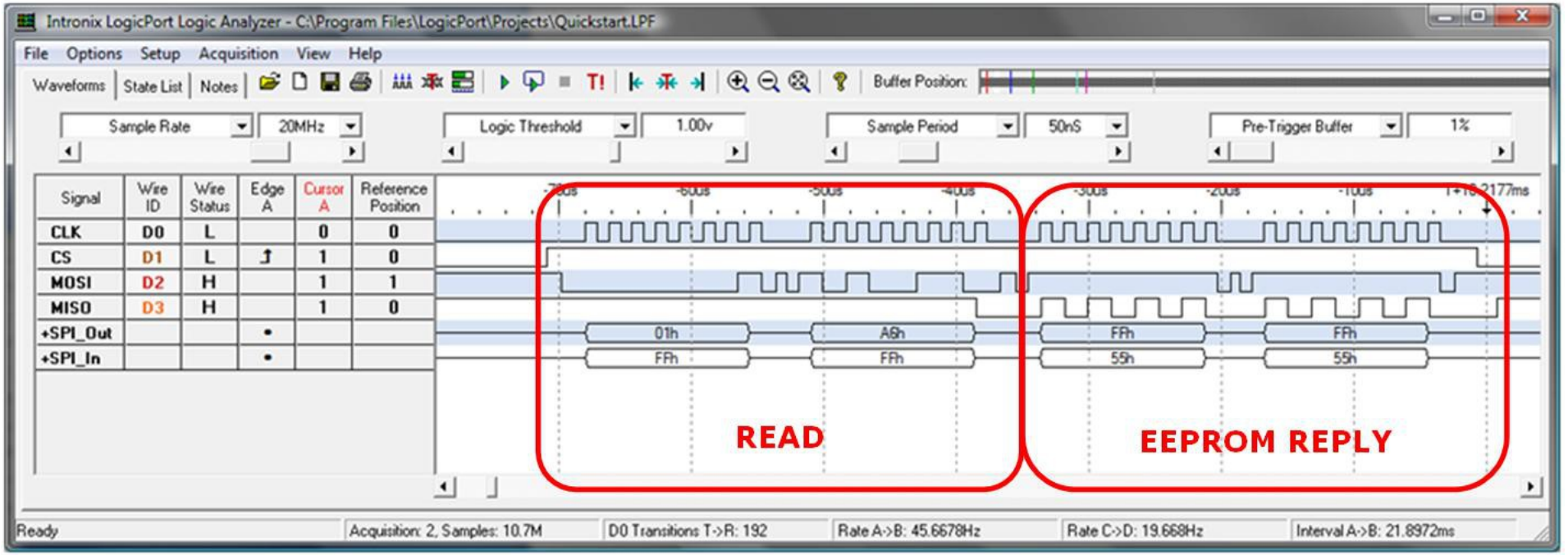

AMPROBE
AM240
OFF
RANGE
REL Δ
MAX/MIN
10A
COM
CAT III 600V

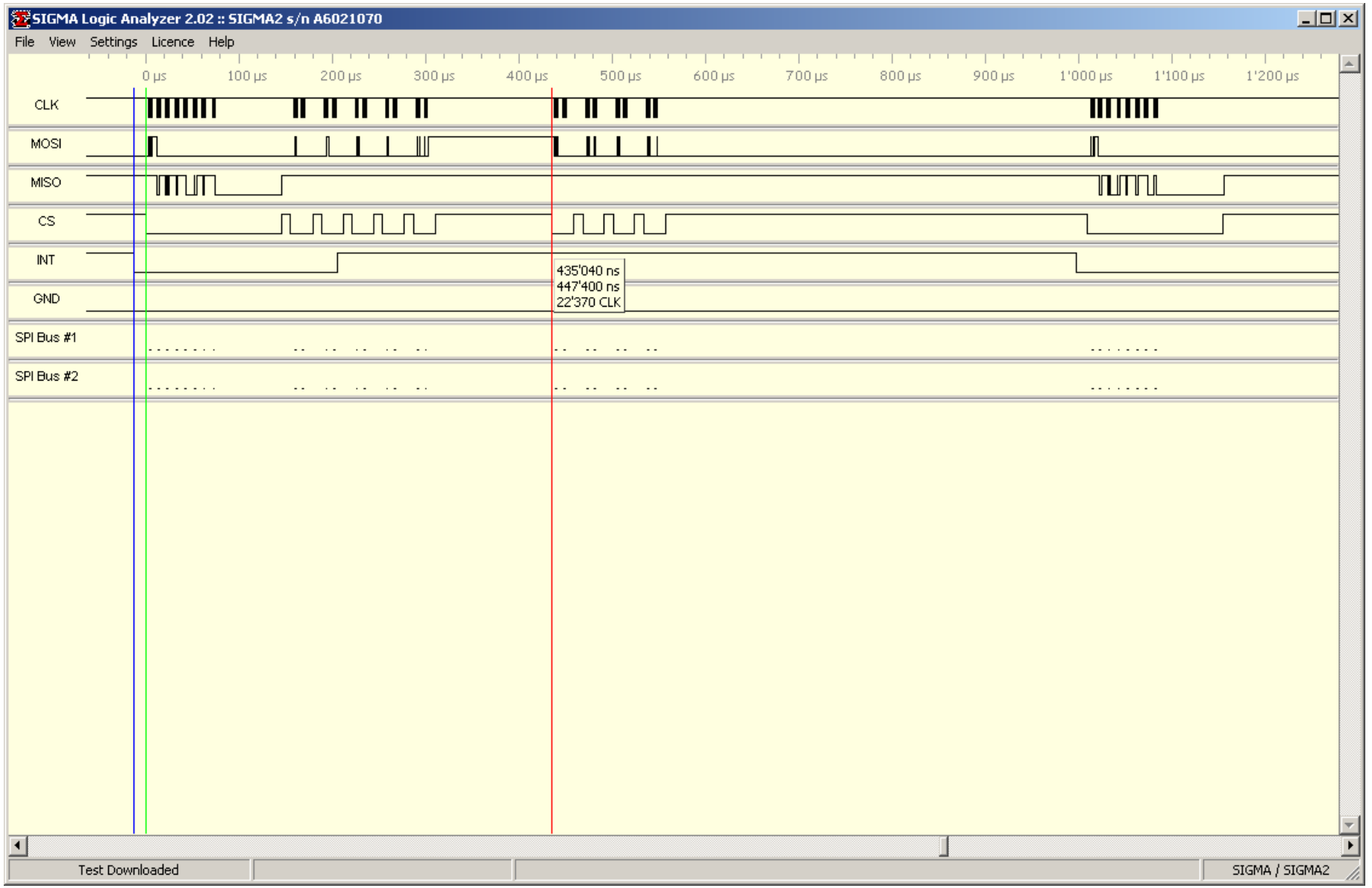

RIGOL
STOP
1
24.0mV
Vpp(1)=*****
Freq(1)=*****
Vrms(1)=?17.5mV
CH1
20.0mV
Time 100.0ns
1.568us


V+
IN
V−


0.548
Ω
V
A
V
A
OFF
V Ω
A
COM
+
Anode
Cathode
-


CH1 0.64V/div
CH2 0.64V/div
500uS/div
Anti-Surge


Intronix LogicPort Logic Analyzer - C:\Program Files\LogicPort\Projects\Quickstart.LPF
File Options Setup Acquisition View Help
Waveforms State List Notes
Buffer Position:
Sample Rate 20MHz
Logic Threshold 1.00v
Sample Period 50nS
Pre-Trigger Buffer 1%
Signal
Wire ID
Wire Status
Edge A
Cursor A
Reference Position
CLK D0 L 0 0
CS D1 L 1 0
MOSI D2 H 1 1
MISO D3 H 1 0
+SPI_Out 01h A6h FFh FFh
+SPI_In FFh FFh 55h 55h
READ
EEPROM REPLY
Ready
Acquisition: 2, Samples: 10.7M
D0 Transitions T->R: 192
Rate A->B: 45.6678Hz
Rate C->D: 19.668Hz
Interval A->B: 21.8972ms


SIGMA Logic Analyzer 2.02 :: SIGMA2 s/n A6021070
File View Settings Licence Help
0 µs 100 µs 200 µs 300 µs 400 µs 500 µs 600 µs 700 µs 800 µs 900 µs 1'000 µs 1'100 µs 1'200 µs
CLK
MOSI
MISO
CS
INT
GND
SPI Bus #1
SPI Bus #2
435'040 ns
447'400 ns
22'370 CLK
Test Downloaded
SIGMA / SIGMA2


LOST
CONFUSED
UNSURE
UNCLEAR
PERPLEXED
DISORIENTED
BEWILDERED