COMMERCIAL-IN CONFIDENCE

SCIENCE RESEARCH COUNCIL
RUTHERFORD & APPLETON LABORATORIES

COMPUTING DIVISION

D I S T R I B U T E D C O M P U T I N G N O T E 3 8 6

PERQ
TECHNICAL NOTE 7

PERQ-PERQ Diagnostic Link

issued by
R W Witty

31 March 1981

Distribution:

F R A Hopgood
R W Witty
D A Duce
W P Sharpe
C J Prosser
J Brown
I D Benest
A S Williams
R Vinnicombe, ICL
E Fredkin, 3RCC

The following documentation was left by Ed Fredkin during his visit 23-25 March 1981. It refers to the diagnostic system which uses one PERQ to debug another by linking their two system buses.

TEST PROCEDURE

PERQ DIAGNOSTICS

Set up procedure using host PERQ with link.

1. Power both machines down and install link boards into I/O option slots.

   A. If no I/O board is present in unit under test, jumper must be installed from pin 178 to ground on backplane.

2. Connect links via 2-40 connector cables with P2 connected to P2 and P3 connected to P3. Top to bottom, bottom to top (OUT TO IN, IN TO OUT)

3. Apply power to both systems.

4. Boot host system. (occasionally remove P2)

5. Insert floppy disk with ODTPRQ.SEG file on it.

   NOTE: To check if ODTPRQ.SEG file is on floppy, do the following:

   A. Insert floppy.
   B. Type : PLX (PLX Header should appear)
   C. Type : DIR

6. After floppy with ODTPRQ.SEG is inserted, do the following at the host system:

   A. Type : PLX (PLX Header should appear)
   B. Type : Get ODTPRQ.SEG (Upon completion of transfer PLX should appear)
   C. Type : Q
   D. Type : Link ODTPRQ

      ODTPRQ.RUN written (should appear)
      :

   E. Type : ODTPRQ

   Host system is now ready to link to system under test.

7. Push the boot switch on the unit under test, then type: X on the host keyboard. S clears screen

   NOTE: Host should respond with bootstrap successful, interrupts enable loading SYSB.BIN. If host responds with "no done bit on receive" or other such message:

A. Recheck link connections.
B. Recheck jumper if no I/O board.
C. You may have a bad CPU.
D. You may have a bad memory.

8. You are now ready to load diagnostic programs. Type: L
Host will then prompt you for the filename you wish to load.

Using PLX GET BIN FILES BELOW

DIAGNOSTIC PROGRAMS

L VFY — Set R0=3 (Monitor Displays Pattern) R0/ 3↵
4001 G program runs continuously (hit boot switch on unit under test and type: X on host system to load another test).

L SHIFT — Type: S to clear monitor. — Bits left on screen indicates memory problem
Type: G monitor goes blank - this test runs for approximately 2 minutes and should return with breakpoint 110 or 100 if successful.
If failure occurs, a pattern appears on the monitor showing result of failing rotate or shift. To determine failing bit load R3 with pattern to test and type 100G.

L NXTI — Type: G
Program should return with breakpoint 100 if successful.

L REGT — Type: G
Program should return with breakpoint 100 if successful.

L NEXTOP — Load R0 = 0 Program should return with breakpoint 100,
Type: G if successful.

L RASTER OP: L - RAT (Load) R200 = 0 Halts on err.
0 - RO (Overlay) 1 Loops on err.
Set R200 = 3 3 Pause and cont. on error.
Type: G
Runs for about 2 hours. Pattern should appear on screen top. Diagonal line should be continuously expanding from top left to middle of screen.
To Terminate Boot test machine — type X

L HIGH Type: 2000 G
Program should respond with breakpoint 100 if successful.

MXXX/ opens memory loca

M - Lower

NOTE: You must hit the boot switch on the unit under test and type X on the host system to load the next test.

LOW? Type: 6000 G
Program should respond with breakpoint 100 if successful.

NOTE: You must hit the boot switch on the unit under test and type X on the host system to load the next test.

JUMP? Type: 6000 G
Program should respond with breakpoint 100 if successful.

DISPATCH? Type: G
Program should respond with breakpoint 100 if successful.

STACK? Type: G
Program should respond with breakpoint 100 if successful.

PART? Type: G

(To be used with Parity Memory Only) Program will run continuously until rebooted. Random data pattern will appear on screen following an all white pattern when started.

DSK2: Type: ØG Initializes write buffer with count
Type: 7ØG Writes track
Type: ØG Inits
Type: 6ØG Reads 1 sector

WR Buffer 3ØØØ
RD Buffer 5ØØØ

R6 specifies track
R7 specifies head
R1Ø specifies sector

Upon completion check R12 - if lower 6 bits read 2Ø it was successful.
Check 5ØØØ for correct data.

DTSTPAR R Ø:24 for 24mb disk. Type Ø G
R37/150000 PAR
Watch disk: DTST writes format on first pass of disk heads over surface and reads (checks) format on second pass. If successful it will then randomly move heads writing and reading.

Rxx/ Reg xx
Mxx/ memory location xx
)xx/ memory location 200000 + xx

After this runs for a while - 10 minutes? - reboot system under test and start DTST again.

After first pass of heads over surface and before completion of second pass, reboot system under test. The disk will now be formatted and ready for booting disk-up floppy.

If error occurs, R12 contains error type in lower 3 bits.

Errors:
1 Phy. hdr. err.
2 CRC Phy. Adrs.
3 Logical hdr. mismatch WD1
4 Logical hdr. mismatch WD2
5 Log. Hdr. CRC
6 Data CRC err.
7 busy not an error
0 data error (dtst only) Must do 63G to get failing address.

R14 MA of failure
Rd. Buff: 1000 - 1377
R17: Correct Data

R6 TRACK
R7 Head
R10 Sector

VMI ALIGNMENT PROCEDURE

Chuck Eckenrode

I. Equipment

1. Untested VMI Monitor (with completed mods).
2. Oscilloscope.
3. Alignment tool ("Diddle Stick").
4. Short #2 Phillips Screwdriver.
5. Small Blade Screwdriver.
6. Crosshatch Generator with Power Supply. +55v 1.7A per Monitor
7. Monitor Test Cable.

II. Procedure

1. Hook up the crosshatch generator to the VMI, using the monitor test cable. Load crosshatch program, type 13, 13, Y
2. Be sure there is a 55V supply connected to the crosshatch generator's D-connector via the black and white wires with eyelugs on their ends. If you use PERQ supply, load +5 to allow regulation.
3. Turn on the power supply and plug in the crosshatch generator. There is a pilot light on the front to indicate the unit is "on" and a switch to allow either: (a) white crosshatch on black background or (b) black crosshatch on white background. Set this for (b).
4. Turn on the oscilloscope - set up for 10 V/div and 20 us/div.
5. Refer to figure VMI-A and attach the scope lead to A to ground. This is collector of Z4.
6. Adjust P20 high voltage range for 46 volts.
7. Move the scope lead to "B" to ground. This is the end of R17 that connects to the Q6 collector.
8. Adjust P1 and P2 (Bias and Gain) for a signal of +12V to +38V on the scope.
9. Set the brightness pot on the cable for maximum.

10. Move the scope to point "C" (Figure VMI-B). This is the R40 - R41 node.

11. Adjust "BRT RANGE" pot (P3) on the circuit board until the R40 - R41 node shows - 55 VDC on the scope. The screen will become fairly dark at this point.

12. Adjust G-2 (P4) until black becomes slightly gray and retrace lines become slightly visible around the edges of the screen or as closely as possible. At this point you should have nearly full range adjustability with the brightness pot on the cable.

13. Look at the screen. If there is a bright white line down either side or the screen appears to be "folded", adjust the H DLY (horizontal delay) pot until the screen looks centered. (Centered in G2 gray background.)

14. Using a small phillips screwdriver in the "H CNT" and "V CNT" pots in the center of the circuit board, position the picture in the center of the pots.

15. Center the screen on the picture tube with purity rings. Set L4 to as wide as the picture will go using the diddle stick. Set P11 (V Shape) all the way clockwise + set P12 (VL in) for the same size squares from top to bottom. (If unable to match size, readjust P11 counterclockwise and repeat.)

16. Using "V SIZE" (P10), "WIDTH" (L3) controls, and purity rings, make the picture be 8½" x 11" (putting a piece of 8½" x 11" paper or mylar over the screen will help in doing this). For finer adjustment, use the V cent (P33) and Horiz Cent (P7) controls. (Do not leave diddle stick in width control L3).

17. Place housing on unit and allow to burn-in for 2 hours. Then redo step 16.
Top & Left edge will expand ≈ ¼" from temp change.

18. Play with focus (P5). Adjust for best focus in the center of the screen, then check the corners. If the corners are best when the center is best, the yoke passes. If the corners get better and the center gets worse, the yoke fails. ALL TUBES SHOULD BE MADE BY CLINTON. Set crosshatch lines straight up and down using the cross on the clear plastic by loosening the screw on the yoke and twisting it.

19. Remove housing on unit and play with pin cushion magnets to make the picture rectangled. Preferably to push the corners in and not pull the sides out. Start with the (23) gauss magnet. Get picture as rectangular as possible then put housing back on for 2 hours, Remove housing and go on to (5) gauss.

20. Complete WIP Tag and return to stockroom.

when done, if character or keytest shows dark shadows or smear then adjust bias to dim picture, & g2 to compensate ~~at~~ until smear is gone.

VMI ALIGNMENT PROCEDURE

Chuck Eckenrode

I. Equipment

1. Untested VMI Monitor (with completed mods).
2. Oscilloscope.
3. Alignment tool ("Diddle Stick").
4. Short #2 Phillips Screwdriver.
5. Small Blade Screwdriver.
6. Crosshatch Generator with Power Supply. +55v 1.7A per Monitor
7. Monitor Test Cable.

II. Procedure

1. Hook up the crosshatch generator to the VMI, using the monitor test cable.
2. Be sure there is a 55V supply connected to the crosshatch generator's D-connector via the black and white wires with eyelugs on their ends. If you use PERQ supply, load +5 to allow regulation.
3. Turn on the power supply and plug in the crosshatch generator. There is a pilot light on the front to indicate the unit is "on" and a switch to allow either: (a) white crosshatch on black background or (b) black crosshatch on white background. Set this for (b).
4. Turn on the oscilloscope - set up for 10 V/div and 20 us/div.
5. Refer to figure VMI-A and attach the scope lead to A to ground. This is collector of Z4.
6. Adjust P20 high voltage range for 46 volts.
7. Move the scope lead to "B" to ground. This is the end of R17 that connects to the Q6 collector.
8. Adjust P1 and P2 (Bias and Gain) for a signal of +12V to +38V on the scope.
9. Set the brightness pot on the cable for maximum.

10. Move the scope to point "C" (Figure VMI-B). This is the R40 - R41 node.

11. Adjust "BRT RANGE" pot (P3) on the circuit board until the R40 - R41 node shows - 55 VDC on the scope. The screen will become fairly dark at this point.

12. Adjust G-2 (P4) until black becomes slightly gray and retrace lines become slightly visible around the edges of the screen or as closely as possible. At this point you should have nearly full range adjustability with the brightness pot on the cable.

13. Look at the screen. If there is a bright white line down either side or the screen appears to be "folded", adjust the H DLY (horizontal delay) pot until the screen looks centered. (Centered in G2 gray background.)

14. Using a small phillips screwdriver in the "H CNT" and "V CNT" pots in the center of the circuit board, position the picture in the center of the pots.

15. Center the screen on the picture tube with purity rings. Set L4 to as wide as the picture will go using the diddle stick. Set P11 (V Shape) all the way clockwise + set P12 (VL in) for the same size squares from top to bottom. (If unable to match size, readjust P11 counterclockwise and repeat.)

16. Using "V SIZE" (P10), "WIDTH" (L3) controls, and purity rings, make the picture be 8½" x 11" (putting a piece of 8½" x 11" paper or mylar over the screen will help in doing this). For finer adjustment, use the V cent (P33) and Horiz Cent (P7) controls. (Do not leave diddle stick in width control L3).

17. Place housing on unit and allow to burn-in for 2 hours. Then redo step 16.

18. Play with focus (P5). Adjust for best focus in the center of the screen, then check the corners. If the corners are best when the center is best, the yoke passes. If the corners get better and the center gets worse, the yoke fails. ALL TUBES SHOULD BE MADE BY CLINTON. Set crosshatch lines straight up and down using the cross on the clear plastic by loosening the screw on the yoke and twisting it.

19. Remove housing on unit and play with pin cushion magnets to make the picture rectangled. Preferably to push the corners in and not pull the sides out. Start with the (23) gauss magnet. Get picture as rectangular as possible then put housing back on for 2 hours, Remove housing and go on to (5) gauss.

20. Complete WIP Tag and return to stockroom.

Perq Fault Dictionary - The key to the diagnostic display (DDS) 24 Oct 80.

As of 24 Oct 80, the DDS is meaningful only when booting from the hard disk, not when booting from floppy disk.

Display	Description
000	Boot never got going, StackReset doesn't work or other major problem in the processor baord.
001	Simple Branches fail
002	Main Data Path Failure
003	Dual Address failure on Registers
004	Y Ram Failure
005	Const/Carry Propogate failure
006	ALU failure
007	Conditional Branch failure
008	Looping failure
009	Control Store (or Write Control Store) failure
010	Hung in Disk Boot
011	Memory Data Error
012	Memory Address Error
013	Disk didn't come ready
014	Couldn't boot from either disks
015 - 020	Bad Interrupts Reading Floppy Disk Data
030	VFY Hung
050	Bad Error Message from VFY
051	Empty stack bit not working
052	Could not load TOS
053	Push did not work
054	Stack Empty did not go off
055	Data error in push
056	Empty or Full set when that is not the case
057	Data error in bit 15 of the stack
058	Stack empty set when the stack is full
059	Data error on stack
060	Data error after POP. Bit 14
061	Data error after POP. Bit 13
062	Data error after POP. Bit 12
063	Data error after POP. Bit 11
064	Data error after POP. Bit 10
065	Data error after POP. Bit 9
066	Data error after POP. Bit 8
067	Data error after POP. Bit 7

```
068     Data error after POP.  Bit 6
069     Data error after POP.  Bit 5
070     Data error after POP.  Bit 4
071     Data error after POP.  Bit 3
072     Data error after POP.  Bit 2
073     Empty wrong.
074     Data error after POP.  Bit 1
075     Data error after POP.  Bit 0
076     Empty not set after all pops.
077     Call test falied
078     Odd didn't jump on a 1.
079     Odd jumped on a 0.
080     Byte sign didn't jump on 200.
081     Byte sign jumped on 0.
082     C19 didn't jump when it should have.
083     BCP[3] didn't jump when it should have.
084     C19 jumped when it shouldn't have.
085     BCP[3] jumped when it shouldn't have.
086     GTR didn't jump.
087     GTR jumped when it shouldn't have.
088     GEQ didn't jump.
089     GEQ jumped when it shouldn't have.
090     LSS didn't jump when it should have.
091     LSS jumped when it shouldn't have.
092     LEQ didn't jump.
093     LEQ jumped when it shouldn't have.
094     GEQ didn't jump on equal.
095     LEQ didn't jump on equal.
096     Carry didn't jump when it should have.
097     Carry jumped when it shouldn't have.
098     Overflow didn't jump when it should have.
099     Overflow jumped when it shouldn't have.
100     And-Not ALU function failed.
101     Or ALU function failed.
102     Or-Not ALU function failed.
103     And ALU function failed.
104     Or-Not ALU function failed.
105     Not-A ALU function failed.
106     Not-B ALU function failed.
107     Xor ALU function failed.
108     Xnor ALU function failed.
109     OldCarry-Add ALU function failed.
110     OldCarry-Sub ALU function failed.
111     OldCarry-Add /w No OldCarry failed.
112     Fetch error on Force Bad Parity.
113     Unexpected Parity error.
114     No parity errors on force bad parity.
115     Wrong address on force bad parity.
116     Upper 4 bit test failed.
117     MDX test failed.
118     Stack upper bits test failed.
119     Dual Addr/Fetch4 test failed.
120     Unexpected refill.
```

121	BPC test failed.
122	Fetch4 test failed.
123	Fetch4R test failed
124	Store4 test failed.
125	Fetch2 test failed.
126	Store2 test failed.
127	NextOp test failed.
128	Fetch/Store overlap failed.
129	Bad interrupt Loc 4.
130	Bad interrupt Loc 14.
131	Bad interrupt Loc 20.
132	Bad interrupt Loc 30.
133	Memory error on No Dual Addr test.
134	Memory error on No Dual Addr Invert.
135	Field didn't work
136	Dispatch did not jump
137	Wrong Dispatch target
150	Sysb not loaded correctly or hung
151	Sysb did not complete
152	Disk Error
153	CheckSum error in microcode
154	CheckSum error in QCode
199	System not entered - calls or assignments don't work.
200	System entered, InitMemory to be called.
201	InitMemory entered.
202	System version number set.
203	Memory manager output file opened.
204	SAT and SIT pointers initialized, StackSegment number initialized.
205	Before marking booted segments in-use.
206	Booted segments marked in-use.
207	Segment created to sit on the unused memory.
210	Before building SIT.
211	SIT entries built.
212	SIT entries linked together.
213	Unused segment numbers linked together into the freelist.
214	SIT built.
215	InitMemory complete, ready to return to System.
300	InitIO to be called.
301	InitIO entered.
302	IO segment allocated and locked down.
303	Buffers allocated.
310	InitInterruptVectors to be called.
320	InitInterruptVectors complete, InitDeviceTable to be called.
330	InitDeviceTable complete, InitScreen to be called.

340	InitScreen complete, InitTablet to be called.
350	InitTablet complete, InitCursor to be called.
360	InitTablet complete.
370	Microcode informed that the device table has been initialized, IO microcode initialization complete, IO microcode initialization complete, LocateDskHeads to be called.
371	LocateDskHeads entered, buffers allocated.
372	Microcode instructed to consider current position as cylinder 0.
373	Disk heads at cylinder 0 or disk busted.
374	Disk heads at cylinder 0 (not busted).
375	Microcode instructed to consider current position as cylinder 0.
376	Dummy read of cylinder 0, sector 0 complete, about to dispose buffers and exit LocateDskHeads.
380	LocateDskHeads complete, FindSize to be called.
381	FindSize entered and buffers allocated.
382	Size of disk determined, about to dispose buffers and exit FindSize.
390	FindSize complete.
400	Keyboard enabled.
410	EnableTablet to be called.
411	EnableTablet entered, Stanley tablet enabled, buffers allocated.
412	First GPIB command built.
413	First GPIB command sent to Z80.
414	Second GPIB command built.
415	Second GPIB command sent to Z80.
416	Third GPIB command built
417	Third GPIB command sent to Z80.
418	Fourth GPIB command built
419	Fourth GPIB command sent to Z80, about to dispose buffers and exit EnableTablet.
420	EnableTablet complete.
499	Clock enabled, about to exit InitIO.
500	InitIO complete, InitStream to be called.
600	InitStream complete, FSInit to be called.
700	FSInit complete.
800	Command file and Console opened.
999	System fully initialized, system title line to be printed.

VIDEO MONITORS INC.	
	9-19-73
TOTAL PARTS LAYOUT	970002 REV. B

* NOT ON ALL MODELS
‡ WHEN NO Q-14 JUMP C-E