ADAM System Final Test Module

Complete Technical Documentation

Unit #15 • Assembly T-1638 • PCB T-1132 REV0

Firmware Revision 3.3

Reverse Engineering, Restoration & Preservation Project

Restoration & 68701 Firmware Dump: John Lundy (Lundy Electronics)
Test Data Pack Creation & Documentation: Rich DiRocco
Original Equipment from: Philip Kosowsky (Coleco Test Lab)

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1. Overview

The ADAM System Final Test Module (Coleco Assembly #T-1638, PCB #T-1132 REV0) is a factory diagnostic system used by Coleco Industries to verify ADAM computers during manufacturing and service. This document presents the complete story of Unit #15: its origins at Coleco, decades in storage, and successful restoration to full working condition in 2026.

1.1 What is the Final Test Module?

The test module is a specialized hardware fixture designed for factory production-line testing. It is housed in a modified Atari Expansion Module #1 enclosure and contains a custom circuit board with a Motorola 68701 microcontroller, associated test circuitry, and multiple cables for interfacing with the ADAM under test. The T-1638 was internal Coleco factory equipment – not a consumer product – used to verify that each ADAM unit functioned correctly before shipping.

1.2 System Components

1. **T-1638 Test Module Assembly** – Modified Atari Expansion Module #1 enclosure containing PCB T-1132 REV0
2. **Controller Port Loopback Cables** – Two DB-9 connectors for controller ports 1 and 2
3. **DB-37 Interface Connector** – Connects to the main test harness cable assembly to interface Data Drive 2, DIN, and joystick connections
4. **DIN Connector Cable** – Standard audio, video, and ground connection
5. **ADAMnet Port** – Connects to console under test (left side ADAMnet port)
6. **16-Pin Data Drive Extension** – Extension of data drive connection signals to reach the tester
7. **Dual Data Drive Test Fixture** (option) – Spring-loaded fixture with integrated Data Drive 2
8. **ADAM Final Test Rev 3.3 Cartridge** – 16KB cartridge test program ROM
9. **Test Data Pack** – Special 5-block checksum tape created for testing

1.3 Key Operating Requirements

- **Boot from CV side only:** The ADAM will not boot from the ADAM side with test hardware installed and requires resetting to ColecoVision mode
- **Printer Required:** A Coleco printer must be attached and detected for the device to operate. All test results are printed in real-time as a permanent record
- **Standard Keyboard:** A standard ADAM keyboard attaches to the regular front ADAMnet port

2. Provenance & History

Figure 1: Unit #15 Bottom Label – Property of Coleco Industries

2.1 Unit Identification

Property	Value
Unit Number	#15 (hand-written on case)
Serial Number	A0125009
FCC ID	BNV8432405
Property Tag	08514 – Coleco Industries
Internal Number	4639 (hand-written)
PCB Designation	T-1132 REV0 / TECH-1
Assembly Number	T-1638

2.2 Origin

This unit was originally the property of **Philip Kosowsky**, an employee at the Coleco Test Laboratory. The "Property of 08514 / Coleco Industries" label indicates it was assigned equipment. After Coleco's bankruptcy in 1988, the unit remained in storage for decades until being acquired for preservation.

2.3 Test Cartridge ROM Revisions

Multiple revisions of the test software are known to exist. The Coleco Repair Guide Equipment Listing (8/16/85) references System Test Cartridge Rev. 3.1 and Rev. 3.3. This unit includes the Rev 3.3 cartridge, believed to be the final production version.

3. Restoration by John Lundy

In late 2025, the test module was sent to John Lundy of Lundy Electronics for restoration and firmware preservation. This section documents the complete restoration process based on John's notes from January-February 2026.

3.1 Initial Assessment & Cleaning

The unit arrived in unknown condition – supposedly working but untested and uncleaned for years. John's approach was deliberately conservative: "*I only ultrasonically cleaned the connector ends that attach to the data drive ports and a mild wipe down of other things. I wanted to preserve the way it was for the sake of nostalgia purposes and not damage any labels.*"

3.2 68701 Firmware Dump (December 29, 2025)

The Motorola MC68701 microcontroller contains 2KB of internal ROM space. John read/dumped the contents using a **hand-built reader/writer based on the LP130 from Lucid Technologies**. The dump verified with checksum $A38B, matching the label on the chip.

3.3 Testing Challenges

January 18, 2026: Initial testing revealed the system would step through tests individually but consistently failed at "FAIL 5-BLOCK TAPE CHECK-SUM". Multiple tapes were tried including SmartBASIC and center directory tapes – none worked.

Key Discovery: The test requires a special "5-BLOCK" test tape with specific checksum data. This tape did not exist and had to be recreated.

January 23, 2026: Multiple attempts to fool the checksum test failed. The data simply wasn't there.

3.4 Test Tape Creation

January 24, 2026: Rich DiRocco successfully created the required test tape based on analysis of the Z80 ROM code. The tape passed checksum verification! John reported: "You did it! You got it passed the tape checksum checks. It goes for quite a while during the process and the text on the screen seems to change colors with each verification."

3.5 Controller Port Failure

After passing tape tests, the system errored with "CONTROLLER PORT #1 FAILURE". John's process of elimination:

10. Replaced test connector cable assembly with alternate set – same error
11. Traced all joystick connector wiring to PCB – all connections verified good
12. Focus shifted to PCB circuitry itself

3.6 Root Cause: Failed Multiplexer Chips

February 1, 2026: Tracing the circuitry further, John found the actual problem: **two bad CD4052BE analog multiplexer chips**. These were the *only* defective components in the entire unit. Both chips were dedicated to joystick testing circuitry.

Probable Cause: John theorizes the damage was caused by electrostatic discharge (ESD). The joystick test cables connect directly from the outside world to the multiplexer inputs with no protection circuitry. During dry New England winters at Coleco's Connecticut facility, workers walking the test floor would build up static charges and discharge them when touching the connector ends.

3.7 Repair Completed

February 1, 2026: "*The ADAM System Final Test Module is now 100% working!*"

Repairs performed:

- Replaced two CD4052BE multiplexer chips (only defective components)
- Ultrasonic cleaning of data drive port connector ends
- Mild wipe down (preserving original labels and patina)

4. Physical Hardware Description

4.1 Main Unit Enclosure

The test module is housed in a modified ADAM Memory Console enclosure with a white label reading "Adam System Final Test" on the top. The enclosure provides a cartridge slot for the test ROM, Data Pack bay, and multiple cable exit points.

Figure 3: Test Module attached to ADAM Memory Console showing label and cable routing

4.2 Test Module PCB (T-1132 REV0)

The main circuit board is marked "COLECO T-1132 REV0" with "TECH-1" designation on the solder side. The board connects to the ADAM via a card-edge expansion slot connector.

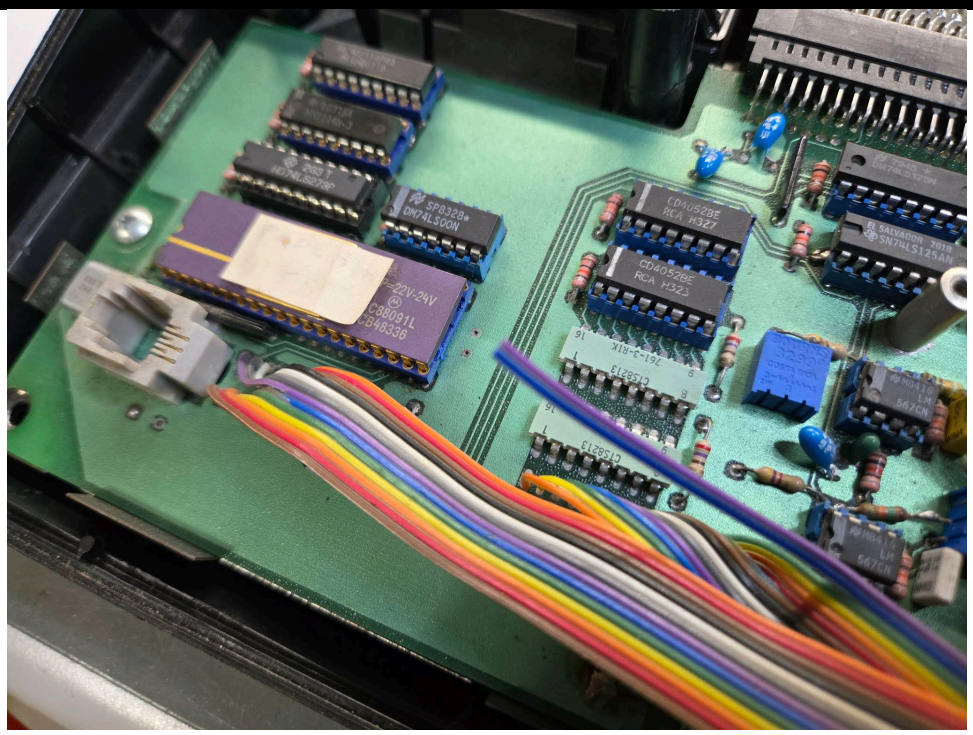

Figure 4: T-1132 REV0 PCB showing MC68701, CD4052 multiplexers, and ribbon cable

Integrated Circuits

Location	Part Number	Function
U1	MC68701 (C88091L/CB48336)	Main test MCU, 2KB internal ROM
U2, U3	M5M5114 / MK2114N-3	1K×4 Static RAM (two chips)
U4	HD74LS273P	Octal D-type flip-flop latch
U5	DM74LS00N	Quad 2-input NAND gate
U6, U7	CD4052BE (RCA)	Dual 4-ch analog MUX (REPLACED)
U8	74LS138N	3-to-8 line decoder
U9	SN74LS125AN	Quad bus buffer
-	LM567CN (x2)	Tone decoder ICs
-	CTS761-3-R1K (x2)	DIP 1K ohm resistor array

Note: The two CD4052BE chips (U6, U7) were replaced during restoration. These handle analog multiplexing for the joystick port testing and were potentially damaged by electrostatic discharge at some point.

4.3 Cable Assembly

Figure 5: Complete cable assembly with all connectors

- **Two DB-9 Joystick Connectors** – Controller port loopback cables with gray ribbed sheathing
- **Clear Junction Box** – Central distribution point; transparent housing shows color-coded wiring
- **DB-37 Connector** – 37-pin D-sub labeled "3485-24DD" for test harness connection
- **DIN Connector** – Standard ADAMnet 5-pin DIN for peripheral bus testing
- **Rainbow Ribbon Cable** – Multi-conductor cable to PCB header

4.4 Dual Data Drive Test Fixture

Figure 6: Dual Data Drive Test Fixture with integrated tape drive mounted on ADAM

The dual fixture includes an integrated Digital Data Drive and spring-loaded pogo pins for connection to the ADAM's internal data drive ports. John noted: "The dual attachment has to go in at a slight angle and then straightened in place to slip in the captive case top lid holes to keep it from springing up from all the spring loaded connector pins."

4.5 Test Cartridge

Figure 7: ADAM System Final Test Cartridge Rev 3.3 in printer cartridge slot

4.6 Controller Port Loopback Wiring

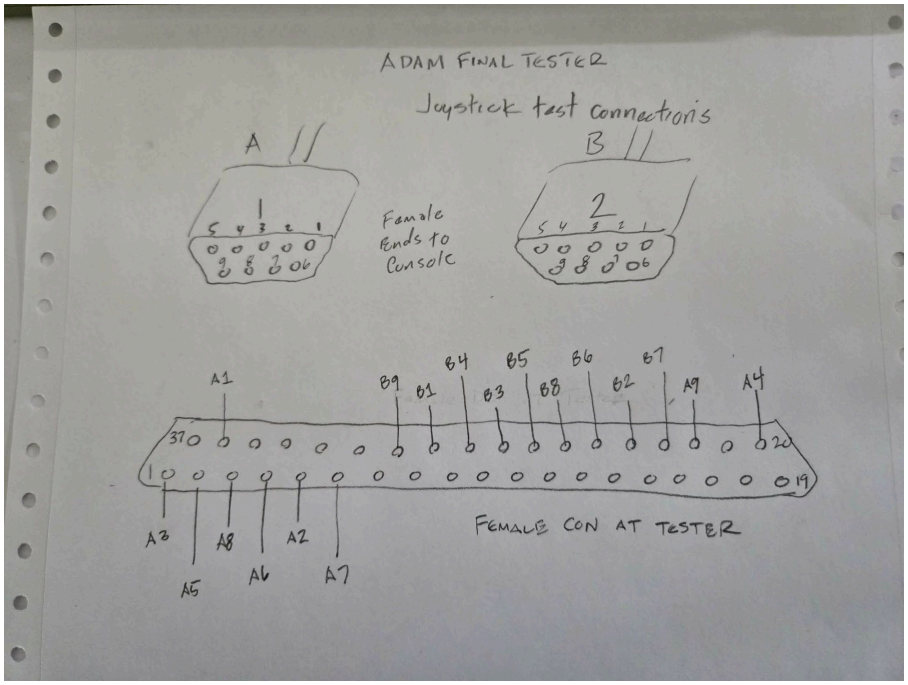

Figure 8: Pin Out Schematic – Joystick Test Connections

5. Setup and Connection

Figure 9: Complete test setup with ADAM, test module, keyboard, and display

5.1 Required Equipment

- ADAM Computer System (standalone or Expansion Module #3)
- ADAM System Final Test Module (T-1638)
- Test Cartridge Rev 3.3
- 5-Block Test Data Pack
- DB-37 Interface Cable set
- Dual Data Drive test fixture (or single fixture with separate drive)
- Color TV/monitor (Unit under test RF video connection must be used during testing)

5.2 Connection Procedure

13. **Power OFF** the ADAM system completely
14. Insert the Test Module into the ADAM's side I/O expansion port
15. Connect controller loopback cables to Controller Ports 1 and 2
16. Install the Dual Data Drive test fixture – insert at slight angle, then straighten
17. Insert Test Cartridge Rev 3.3 into the cartridge slot
18. **Power ON** unit under test and reset to ColecoVision mode (ADAM side will not boot)
19. Insert the 5-Block Test Data Pack into the test fixture's tape drive

20. System should display "ADAM SYSTEM FINAL TEST REV 3.3" and prompt for Station ID

5.3 Important Notes

- **Boot from CV side only:** The ADAM will not boot normally with test hardware installed
- **Fixture seating:** If the system doesn't detect the drive, it hangs at "INSERT TAPE". Reset and reseat the fixture
- **Spring pins:** The dual fixture uses spring-loaded pogo pins that require proper seating to make contact

6. Test Software Screens

The following screenshots document the actual test software interface as captured during restoration testing.

6.1 Station ID Entry

Figure 10: Station ID Entry Screen

Upon boot, the system prompts for a Station ID number (1-9). This identifies the test station in a multi-station factory environment. The ID is printed on test results for quality tracking.

6.2 ADAM or Expansion Module Selection

Figure 11: ADAM or Expansion Module Selection

A = Standalone ADAM: Full test including controller ports (joystick ports are in the Memory Console)

E = Expansion Module: Bypasses controller port tests (joystick ports are in the ColecoVision console)

6.3 Manufacturing Test Options Menu

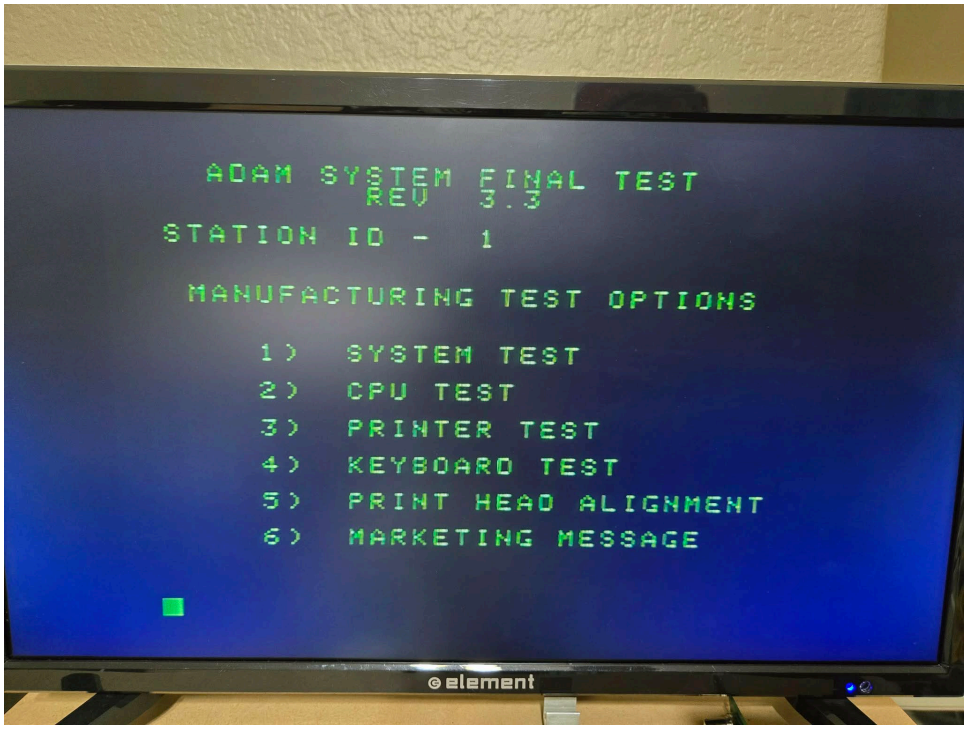

Figure 12: Manufacturing Test Options Menu

The main menu provides six test options. Option 1 (System Test) runs the complete automated test sequence. Options 2-6 allow individual subsystem testing.

6.4 Test In Progress

Figure 13: Test In Progress Display

During testing, the screen displays "TEST IN PROGRESS" while the system performs automated verification. John noted that during tape checksum verification, "the text on the screen seems to change colors with each verification."

6.5 Marketing Message Prompt

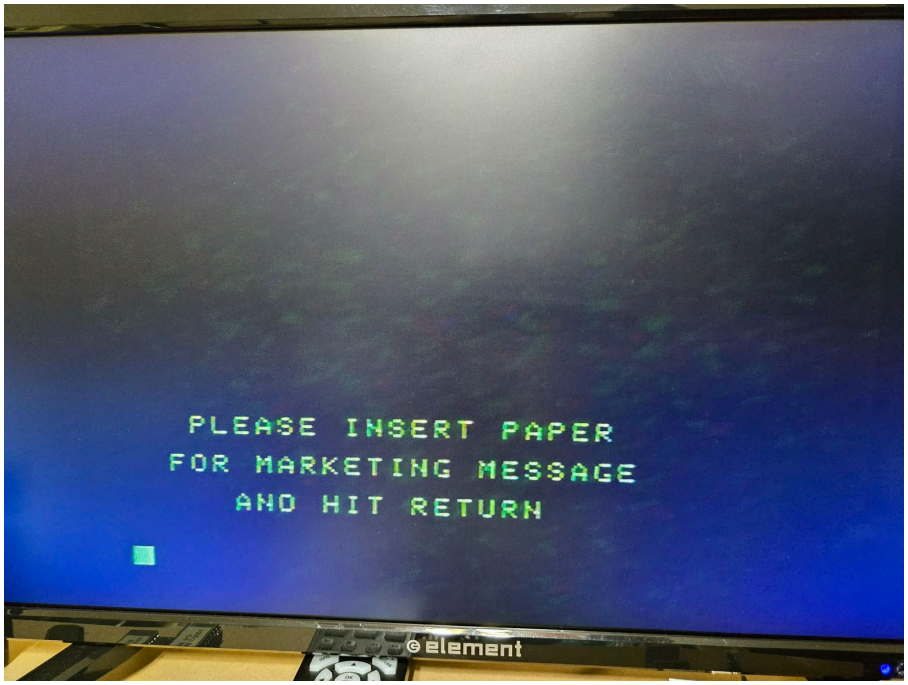

Figure 14: Marketing Message Printer Prompt

At the end of successful testing, the system offers to print a "Marketing Message" – a welcome letter for the customer. This was included with each new ADAM as proof the unit passed factory testing.

7. Test Menu Options

7.1 Option 1: System Test

Runs the complete automated test sequence including ROM checksums, RAM test, video test, tape read/write verification, controller ports, keyboard, and printer. This is the primary production line test.

7.2 Option 2: CPU Test

Comprehensive console specific tests, except printer and keyboard tests. Requires the special 5-block test tape.

7.3 Option 3: Printer Test

Comprehensive daisy wheel printer verification including character printing, carriage movement, and print head operation. John discovered that "what looked like junk in the v3.3 test ROM actually gets printed during the manual printer test!"

7.4 Option 4: Keyboard Test

Tests specific keyboard keys and the keyboard controller. Verifies scan matrix and key detection.

7.5 Option 5: Print Head Alignment

Prints calibration "H" patterns left, center, and right for adjusting the daisy wheel printer head. Prompts "CONTINUE PRINT ALIGNMENT? (Y or N)" and "PRINT QUALITY O.K.? (Y or N)" for operator feedback.

7.6 Option 6: Marketing Message

Prints the customer welcome letter: "Your new ADAM Family Computer System is now ready to make your life easier, more organized and more fun than ever."

8. System Test Sequence

When Option 1 (System Test) is selected, the following tests are performed in sequence:

Test	Description
ROM CHECKSUM	Verifies internal ROMs (CV OS, ALF1-3, EOS)
RAM TEST	Tests system RAM with pattern writes/reads
VIDEO TEST	Verifies TMS9928A VDP operation
SYNC TEST	Tests 68701/6801 synchronization
5-BLOCK TAPE CHECKSUM	Reads blocks 0-4 from test tape, verifies checksums
TAPE WRITE TEST	Writes test patterns to blocks 32, 64, 128
TAPE READ VERIFY	Reads back written data and verifies
CONTROLLER PORT #1	Tests joystick port 1 via loopback (ADAM mode only)
CONTROLLER PORT #2	Tests joystick port 2 via loopback (ADAM mode only)
KEYBOARD TEST	Verifies keyboard controller communication
PRINTER TEST	Tests printer operation and print head

If any test fails, the system displays the failure (e.g., "FAIL CONTROLLER PORT #1") and testing stops. In Expansion mode (E), controller port tests are skipped since those ports are in the ColecoVision console.

9. Test Tape Requirements

The CPU Test and System Test require a specially formatted "5-Block" test tape. Standard ADAM tapes (SmartBASIC, center directory tapes) will not work.

9.1 Test Tape Structure

The test tape contains pre-recorded blocks with known checksums:

- **Blocks 0-4:** Read-only test blocks with calculated checksums for verification
- **Blocks 32, 64, 128:** Designated write test target blocks

9.2 Creating the Test Tape

The test tape was recreated in January 2026 by Rich DiRocco based on analysis of the Z80 test ROM code. The creation requires a working ADAM system and the tape creation utility developed from the ROM analysis.

10. Tape Write Test Results

During the tape write test phase, the system writes test patterns to blocks 32, 64, and 128, then reads them back to verify correct write operation. The test verifies:

- Data integrity (written data matches read data)
- Head alignment (write head properly aligned with tape tracks)
- Drive motor speed (consistent tape transport)

11. Controller Port Tests

The controller port tests use the loopback cables to verify joystick port functionality. The test module's 68701 MCU drives signals through the CD4052 analog multiplexers to simulate joystick inputs, which are then read back by the Z80 test program.

11.1 Test Signals

Each controller port is tested for: UP, DOWN, LEFT, RIGHT directional inputs; Fire buttons; Keypad matrix (* through #, 0-9).

11.2 ADAM vs Expansion Mode

ADAM Mode (A): Controller ports are tested because they are in the Memory Console being tested.

Expansion Mode (E): Controller ports are SKIPPED because they are in the ColecoVision console, not the Expansion Module.

11.3 Known Issue: ESD Vulnerability

The controller port test circuitry is vulnerable to electrostatic discharge. The test cables connect directly to the CD4052 multiplexers with no protection. John Lundy found both CD4052 chips damaged in Unit #15, likely from accumulated ESD events during factory use.

12. Firmware Analysis: Cartridge Test ROM

The Cartridge Test ROM (Rev 3.3) is a 16KB program that runs on the ADAM's CPU and orchestrates all test operations.

12.1 ROM Specifications

Property	Value
File	ADAM_Final_Test_Rev_3_3.rom
Size	16,384 bytes (16KB)
Load Address	$8000
Header	$55 $AA (ColecoVision signature)
Processor	Z80

12.2 Key Messages in ROM

- "ADAM SYSTEM FINAL TEST REV 3.3"
- "MANUFACTURING TEST OPTIONS"
- "CAN'T SYNC-UP WITH MASTER!!!" (68701 not responding)
- "PASSED MANUFACTURING TEST" / "FAILED MANUFACTURING TEST"
- Individual pass/fail messages for each subsystem

13. Firmware Analysis: 68701 MCU

The MC68701 microcontroller provides intelligent test functions and interfaces with the ADAM's Master 6801.

13.1 MCU Specifications

Property	Value
File	ADAM System Final Test Module ($A38B).bin
Chip	MC68701 (C88091L / CB48336)
Size	2,048 bytes (2KB)
ROM Address	$F800-$FFFF
Checksum	$A38B (verified)
Dump Date	December 29, 2025
Dumped By	John Lundy (Lundy Electronics)
Dump Method	LP130-based reader/writer (hand-built)

13.2 Memory Map

Range	Size	Description
$0000-$001F	32 bytes	Internal I/O Registers
$0080-$00FF	128 bytes	Internal RAM
$0400-$07FF	1KB	External test RAM area
$F800-$FFFF	2KB	Internal ROM (this firmware)

13.3 Z80/68701 Communication

The ADAM console Z80 and the test module's 68701 communicate via a **parallel connection through the I/O port**. The specific communication protocol is encoded in the cartridge ROM and 68701 firmware. No logic analyzer investigation was performed to determine communication specifics.

13.4 EPROM Replacement Option

For those needing to replace a damaged MC68701, an equivalent configuration can be built using a **HD68P01V07 controller IC with a 2732 EPROM** programmed with the firmware dump. The 2732 EPROM piggybacks on top of the HD68P01V07 in the lower position leaving the upper four pin sockets unpopulated.

14. Printer Test Outputs

The test module produces several printer outputs during testing. **A Coleco printer must be attached and detected for the device to operate.** All test results are printed in real-time as a permanent record of testing.

14.1 Print Head Alignment

Prints calibration "H" patterns left, center, and right for print head adjustment. The operator is prompted to evaluate print quality.

14.2 Marketing Message

The marketing message prints a welcome message. John noted: "What I thought looked like junk in the v3.3 test ROM actually gets printed during the manual printer test!" He also provided: "Attaching a complete printer output of the whole process of what it would have looked like back in the day on the testing line."

15. Official Coleco Equipment

From the Coleco Industries Inc. Repair Guide Equipment Listing (Preliminary Draft: 8/16/85):

15.1 Test Fixtures

Assembly #	Description
T-1638	Adam System Final Tester
T-1721	Board Level System Tester
T-1658	Data Drive Azimuth Check Fixture
T-1710	Data Drive Switchbox

15.2 Test Cartridges

Cartridge	Version	Purpose
System Test Cartridge	Rev. 3.3	Main system test
CPU Burn-In Cartridge	Rev. 5.0	Extended CPU testing
Game Board Final Test	Rev. 3.1	ColecoVision tests
Gamma Debug Cartridge	Rev. 1.0	Memory debugging

16. Technical Reference

16.1 CD4052 Multiplexer Function

The two CD4052BE analog multiplexer ICs are controlled by the 68701 to **simulate and test all possible directional movements and button presses** of each joystick port. The 68701 drives the multiplexer select lines to route test signals through the loopback cables, then reads the results back to verify the port circuitry.

16.2 2114 SRAM Function

The test unit's 68701 uses two 2114 SRAM chips for simulation of Data Drive 2 within the test unit during testing.

16.3 PCB Bodge Wires

The hand-soldered bodge wires visible on the PCB solder side are factory modifications correcting:

- ADAMnet connections
- Tape control circuitry
- Other unknown modifications/corrections

16.4 Connector Functions

Connector	Function
DB-37	Test harness assembly (includes: Data Drive 2, DIN, and joystick test cable connection)
DIN	Standard audio, video, and ground
ADAMnet Port	Connects to console left-side ADAMnet port
16-Pin Molex	Extension of Data Drive 2 signals to reach tester
DB-9 (x2)	Controller port loopback cables

17. Files Produced

The following files have been produced as part of this preservation project and are available at **AdamArchive.org**:

17.1 Firmware Dumps

File	Description
ADAM System Final Test Module ($A38B).bin	68701 MCU ROM dump (2KB)
ADAM_Final_Test_Rev_3_3.rom	Z80 Test Cartridge ROM (16KB)

17.2 Test Media

File	Description
5-Block Test Tape.ddp	Recreated test Data Pack image

17.3 Documentation

File	Description
ADAM Repair Guide Equipment Listing.pdf	Coleco official document (8/16/85)
This document	Complete technical documentation

Appendix A: 68701 Firmware Notes

The complete 68701 firmware has been preserved and disassembled. Key entry points and routines identified include:

- **$F800-$F891:** Data tables (test patterns, state tables, jump table)
- **$F8B1:** Reset entry point – initializes SCI, stack, and ports
- **$F8C7:** Port initialization routine
- **$F926-$F968:** Status flag builder from PORT1/PORT4
- **$F969-$F9A5:** Test mode decoder (8 test modes based on status flags)
- **$F9C0+:** Individual test routines for RAM, serial I/O, sync, etc.

A complete annotated disassembly listing is available separately.

Appendix B: John Lundy Restoration Notes

The following are John Lundy's original notes from the restoration process, preserved verbatim for historical record.

January 18, 2026

"I made some progress on it this morning. I have figured things out to make it pass testing steps one by one, but now I'm stuck on 'FAIL 5-BLOCK TAPE CHECK-SUM' and it will not go to the next step. I've tried a couple center directory tapes, including a SmartBASIC tape and can't get passed this step. Do you know if it needs a special test tape?"

"What I thought looked like junk in the v3.3 test ROM actually gets printed during the manual printer test! I can do manual tests other than the CPU test because it requires a special tape. I'm now confident all the test hardware is working fine and we just need the tape. It's crazy that this thing survived and is in working order!"

"Another interesting thing is the ADAM side will not boot at all with all the testing hardware gear installed and must be run from the CV side."

January 24, 2026

"You did it! You got it passed the tape checksum checks. It goes for quite a while during the process and the text on the screen seems to change colors with each verification. After that, it errors with a controller port #1 failure. I sure wish it would allow skipping to the next test."

"Success! Well, mostly… In the beginning of testing, it asks if you are testing <A> or <E>. That is obviously standalone or expansion ADAM. I have been selecting <A> for all my previous testing. If I select expansion test, it bypasses the controller tests since that is in the CV, but the rest seems to remain."

February 1, 2026 – Success!

"The ADAM System Final Test Module is now 100% working!"

"Tracing the circuitry, I found two bad CD4052BE multiplexer (MUX) chips that happened to be dedicated to just joystick testing. My guess is to have both chips bad is associated to static discharge damage. The joystick test cables go directly from the outside world to the internal circuitry with no protection. I would imagine nice dry winters at Coleco and people walking the testing area floor building up a static charge and touching the connector ends while inserting them to the console eventually got them."

Credits & Acknowledgments

Restoration & Firmware Preservation

John Lundy – Lundy Electronics

68701 firmware dump, hardware restoration, troubleshooting, and repair. Detailed documentation of the restoration process.

Test Tape Recreation & Documentation

Rich DiRocco – ColecoVision & ADAM Archive

Z80 ROM analysis, test tape creation, documentation compilation, and preservation coordination.

Original Equipment

Philip Kosowsky – Former Coleco Test Laboratory Employee

Original custodian of Unit #15 after Coleco's closure.

This document represents a collaborative effort to preserve an important piece of ADAM computer history. The ADAM System Final Test Module is now fully operational and documented for future generations of vintage computing enthusiasts.

Document Version: 5.0 – February 2026