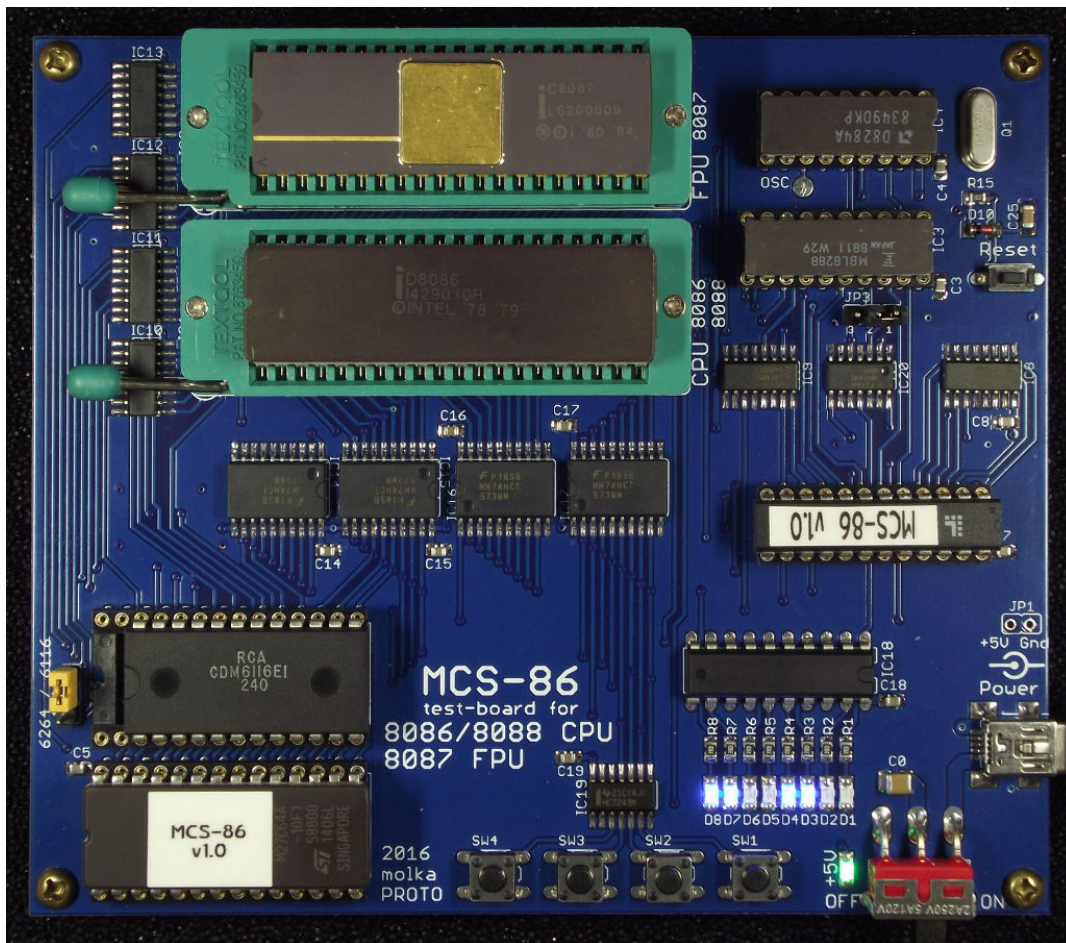


intel

MCS-86 family CPU tester



i8086/i8088 CPU & i8087 FPU Test Board User's Manual

2016-Jun-4 Ver.1.0
by molka

Overview

The MCS-86 test board is intended to test the working condition of Intel MCS-86 system's i8086 or i8088 and compatible CPUs, and optionally, the i8087 and compatible FPUs. i8086/8088 CPUs may be tested alone, without inserting an i8087 FPU into the ZIF socket labeled FPU 8087. For testing an i8087 FPU a working i8086/8088 CPU must be inserted into the ZIF socket labeled CPU 8086/8088.

The board consists of the base components of an MCS-86 system:

- **40-pin ZIF Socket labeled CPU 8086/8088:** Provides easy replacement of the CPU to be tested.
- **40-pin ZIF Socket labeled FPU 8087:** Provides easy replacement of the FPU to be tested.
- **i8284 clock generator:** Provides 4MHz system clock.
- **i8288 BUS controller:** Provides command and control timing generation.
- **8 LEDs:** Output devices.
- **4 Push Buttons:** Input devices.
- **Memory:** 8KB ROM and 2/8 KB RAM.

A 2764 8KB EPROM holds the test program. This program supports 4 push buttons as inputs, and 8 LEDs as output devices. It also provides basic and special feature test routines.

The board requires a single +5V power supply (600-800mA) provided through a mini-USB connector or an Ø5.5mm*2.1mm Power Jack connector. Take care of the power level and polarity if you use a power adapter. The test board requires DC 5V power.

Picture 1 shows the connector polarity.

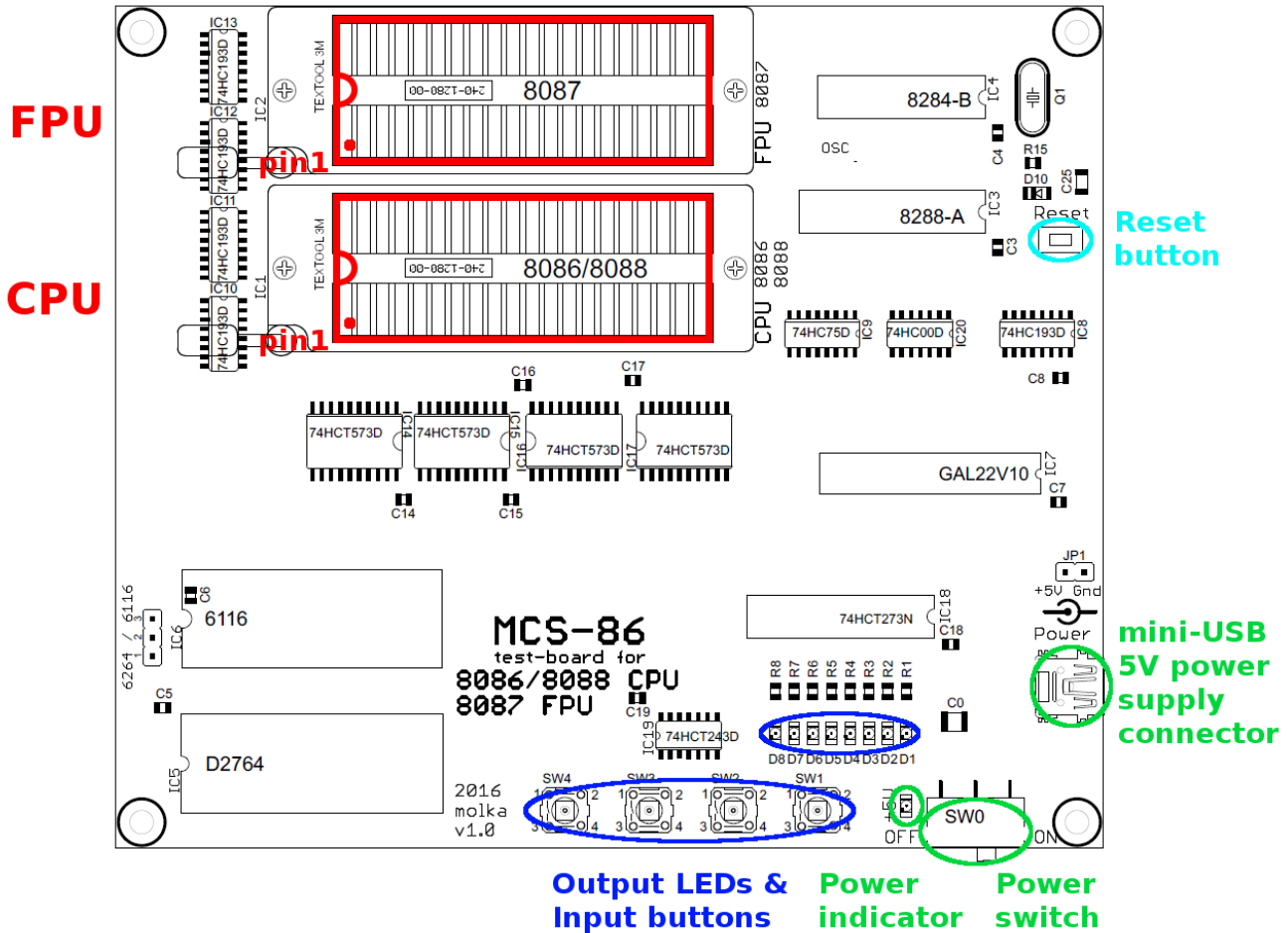
The test board's power consumption depends on the CPU and FPU type and technology (NMOS/CMOS).

There is a power switch and power indicator LED in the upper left corner of the test board.

Picture 1. DC Connector, polarity center positive.



Board layout and parts



5V Power Supply Connectors: The board consumes around 600-800mA current so a computer USB connector or cell phone charger that can provide at least 800mA may be used as a power source through the **Mini-USB connector**. Alternatively a 5V DC power adapter can be connected through an Ø5.5mm*2.1mm **power jack connector** may be used.

- **Switch:** Power supply can be turned on and off by the sliding switch at the bottom right corner.
- **Green LED:** Next to the power switch, indicates the 5V power level.
- **Reset Button:** The board contains a Power-Up reset circuit, but can be reset manually by pressing Reset button.
- **40-pin ZIF socket (labeled CPU 8086/8088):** for the 8086/8088 CPU to be tested.
- **40-pin ZIF socket (labeled FPU 8087):** for the 8087 FPU to be tested.

Ensure proper CPU/FPU position and orientation!!!

The pin-1 is at lower-left corner, next to the release lever of the socket.

- **Eight output LEDs:** – Show simple animations/flashes to indicate that the CPU is working.
- **Four push buttons:** Used for testing inputs and changing animation sequences.

Usage

- Before changing the CPU/FPU in the ZIF socket, make sure the power is off. **The power indicator LED should be off!**
- Place the CPU/FPU into the proper socket (socket lever should be in the **UP** position). Ensure proper orientation to prevent damage to the test board and CPU! **Pin 1 must be at the lower-left corner**, next to the release lever of the ZIF socket. Then lock the socket by moving the lever **down** into the lock position.
- Connect the power through the USB or Power Jack connector and switch the power switch to ON.
- The green power indicator LED should be illuminated.
- If the CPU is in working condition than the 4 output LEDs (D1-D4) should be flashing (1sec on/1sec off pattern).
- If an FPU is inserted and it is in working condition the other 4 output LEDs (D5-D8) will also be flashing.
- **At this point the CPU/FPU can be considered WORKING. Congrats!**

Base Function Test

- At start-up a component check is performed. It contains CPU check, FPU detection and check, ROM check-sum validation and RAM check.
The test result is indicated on LEDs D1-D8. See Table 1.
In case of any error (**Table 1** 1-4) a HLT instruction is performed. In this state the test program can be restarted by **Reset** button.
- The successful component check is indicated by flashing 4 or 8 LEDs. **Table 1** 5-6
- When you press any of the four push buttons (SW1 – 4) the output LEDs copy the state of the buttons, duplicated in the low and high nibbles.
- Releasing the buttons causes one of the four different animation sequences to start, corresponding to the button released last.

Special Feature Test

- To activate the special feature test SW1 and SW4 should be pressed together and held for 3 seconds.
- This test checks the inserted CPU type. It detects if the CPU is 8086, 8088, V20, V30 or 80186, 80188. (80186/80188 CPU can only be tested with 80186/80188 expansion tool. See Appendix I.) The result is shown in Table 2.

Table 1. Component check error codes:


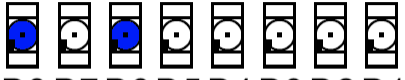
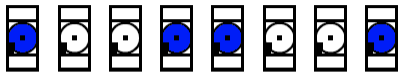
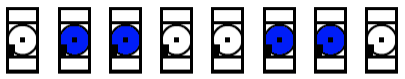
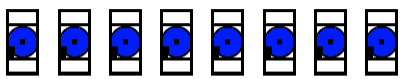
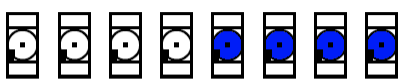

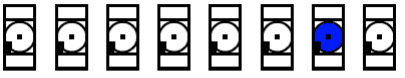
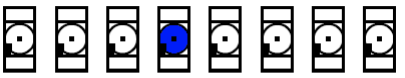
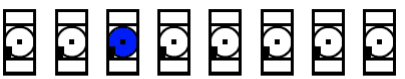
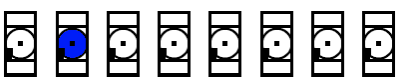
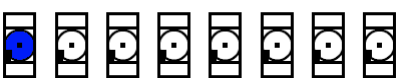
1.	CPU error detected	 D8 D7 D6 D5 D4 D3 D2 D1
2.	FPU error detected	 D8 D7 D6 D5 D4 D3 D2 D1
3.	ROM check-sum failure	 D8 D7 D6 D5 D4 D3 D2 D1
4.	RAM test failure	 D8 D7 D6 D5 D4 D3 D2 D1
5.	Both CPU and FPU working (blinking)	 D8 D7 D6 D5 D4 D3 D2 D1
6.	CPU working but no FPU detected (blinking)	 D8 D7 D6 D5 D4 D3 D2 D1

Table 2. CPU detection results:

8086 CPU detected	 D8 D7 D6 D5 D4 D3 D2 D1
8088 CPU detected	 D8 D7 D6 D5 D4 D3 D2 D1
V30 CPU detected	 D8 D7 D6 D5 D4 D3 D2 D1
V20 CPU detected	 D8 D7 D6 D5 D4 D3 D2 D1
80186 CPU detected	 D8 D7 D6 D5 D4 D3 D2 D1
80188 CPU detected	 D8 D7 D6 D5 D4 D3 D2 D1

PLCC – DIP converter

A PLCC44 -> DIP40 converter is available to make possible testing 8086/8088 CPUs in package PLCC44.

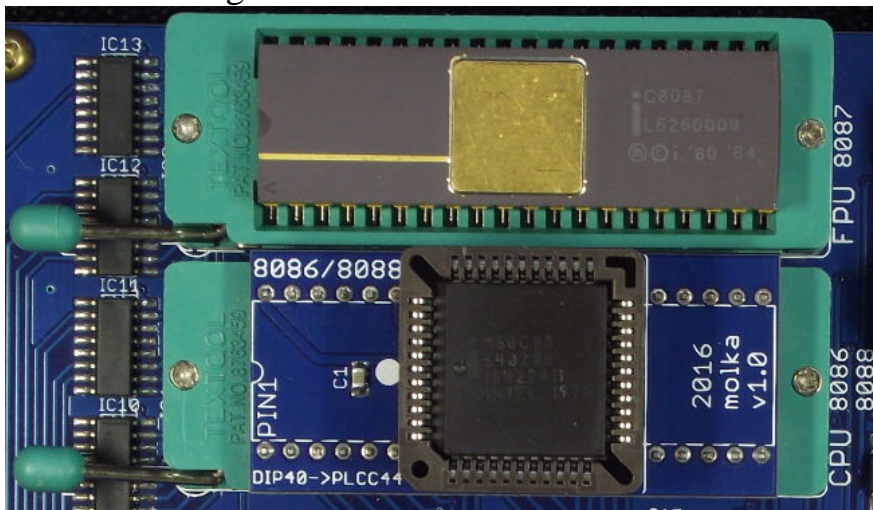
The white dot on the converter shows the position of pin 1 of PLCC package. Note: Pin one is not on the corner of the PLCC44 package, rather it is on the center of one of the sides, indicated by a dot or recess in the package. Align this dot with the white dot on the adapter.

The PIN1 label on converter shows the direction how the converter needs to be inserted into the ZIF socket of 8086/8088 CPU on the MCS-86 test-board.

It is highly recommended to purchase a PLCC EXTRACTOR tool.

See picture 2 that shows the proper placing of PLCC-DIP converter into the CPU's ZIF socket.

Picture 2. Usage of PLCC – DIP converter.



Troubleshooting

- After connecting the power supply the power indicator LED remains off.
Turn off the power immediately!

This may be caused by:

- The power supply is unable to provide enough current. Check that it can provide at least 800mA. (1000mA or higher recommended)
Considering the high power consumption of the tested CPU/FPU a DC Power Supply Adapter usage is recommended. Use DC adapter that can provide at least 1.5-2A.
 - Thin, poor quality USB cable can also cause this problem.
 - There is a short-circuit (fault) in the CPU.
-
- The 4/8 output LEDs do not start flashing.
 - Check the self-test result code in Table 1.
 - Press the Reset button. If the output LEDs continue to remain off then the CPU may be faulty.
 - Check the CPU pins, if they are dirty or dusty, clean them, and try testing again.
 - It may help to press firmly on the CPU while lowering the lock level to ensure it is properly seated in the socket.

Tested CPUs:

Manufacturer

Variant

Intel	DIP: D8086, D8086-1, D8086-2, P8086, P80C86A-2 D8088, LD8088, D8088-2, QD8088-2 P8088, P8088-2, P80C88, P80C88AL, 80C88A-2 PLCC: N80C86AL-2 N80C88, N80C88AL, N80C88AL-2
AMD	DIP: D8086, D8086-1, D8086-2 P8086-2 D8088, QM8088-2D1, P8088, P8088-1, P8088-2 PLCC: N8086-2 N8088-2
Fujitsu	DIP: MBL8086-2 MBL8088, MBL8088-1, MBL8088-2
Harris	DIP: IP80C86 CD80C88, CP80C88, IP80C88 PLCC: CS80C86-2 CS80C88
Intersil	DIP: IP80C88
MHS	DIP: D-8086, 8088, D-8088, P-8088
Mitsubishi	DIP: M5L8086S
NEC	DIP: D8086D, D8086D-2, V30: D70116C-8, D70116D-8 D8088D, D8088D-2 V20: D70108D-5, D70108C-8, D70108C-10
OKI	DIP: M80C86, M80C86A-10 M80C88, M80C88-2, M80C88A-10 PLCC: M80C88A, M80C88A-10
Siemens	DIP: SAB8086-C, SAB8086-1-C, SAB8086-2-C, SAB8086-4-C SAB8086-P, SAB8086-1-P, SAB8086-2-P SAB8088D, SAB8088-P, SAB8088-1-P, SAB8088-2-P, SAB8088-12-P
Sony	DIP: V20: CXQ70108D-8, CXQ70108P-8
CCCP	DIP: KM1810BM86, KP1810BM86 KP1810BM88

Tested FPUs:

Intel

DIP: C8087, C8087-1, C8087-2, C8087-3, C8087-6
D8087, D8087-1, D8087-2

Other compatible CPU/FPU's should be testable as well, but have not yet been verified.

Appendix I. 80186/80188 Expansion Tool

Overview

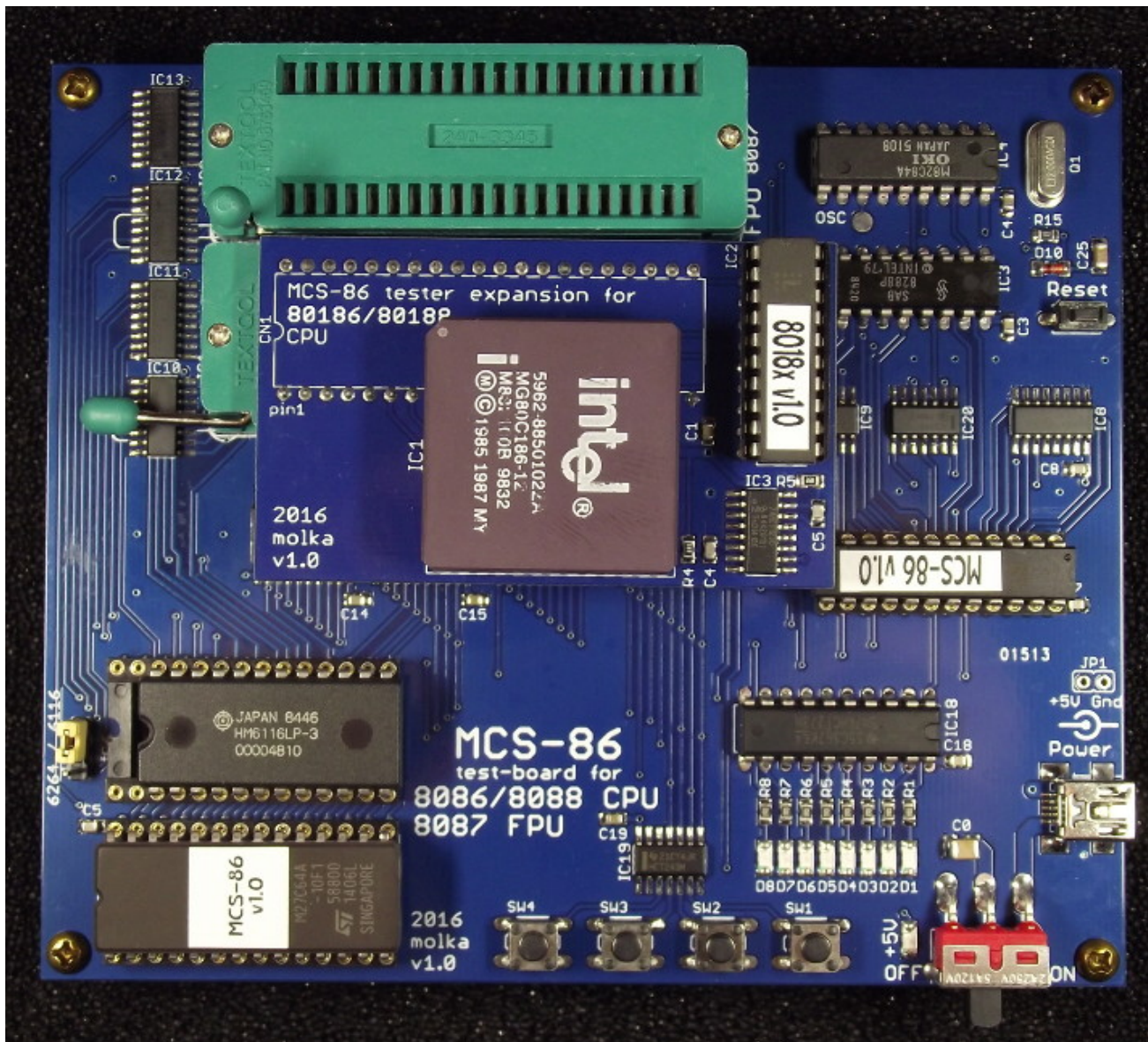
The 80186/80188 expansion tool allows the MCS-86 test-board to test the working state of Intel (and compatible) 80186 and 80188 CPUs. It supports PGA, PLCC and CLCC type CPUs.

The test tool is connected via the ZIF socket for the 8086/8088 CPU on the MCS-86 test-board. The expansion tool has a PGA-68 socket soldered on to it, so that PGA68 socketed CPUs may be inserted directly.

For testing PLCC or CLCC CPUs the appropriate socket should be inserted into the PGA socket and the CPU can then be inserted into the mounted socket.

The 80186/80188 CPUs are not compatible with 8087 FPU, no FPU should be inserted into the ZIF socket of 8087 FPU on MCS-86 test-board while using the expansion tool.

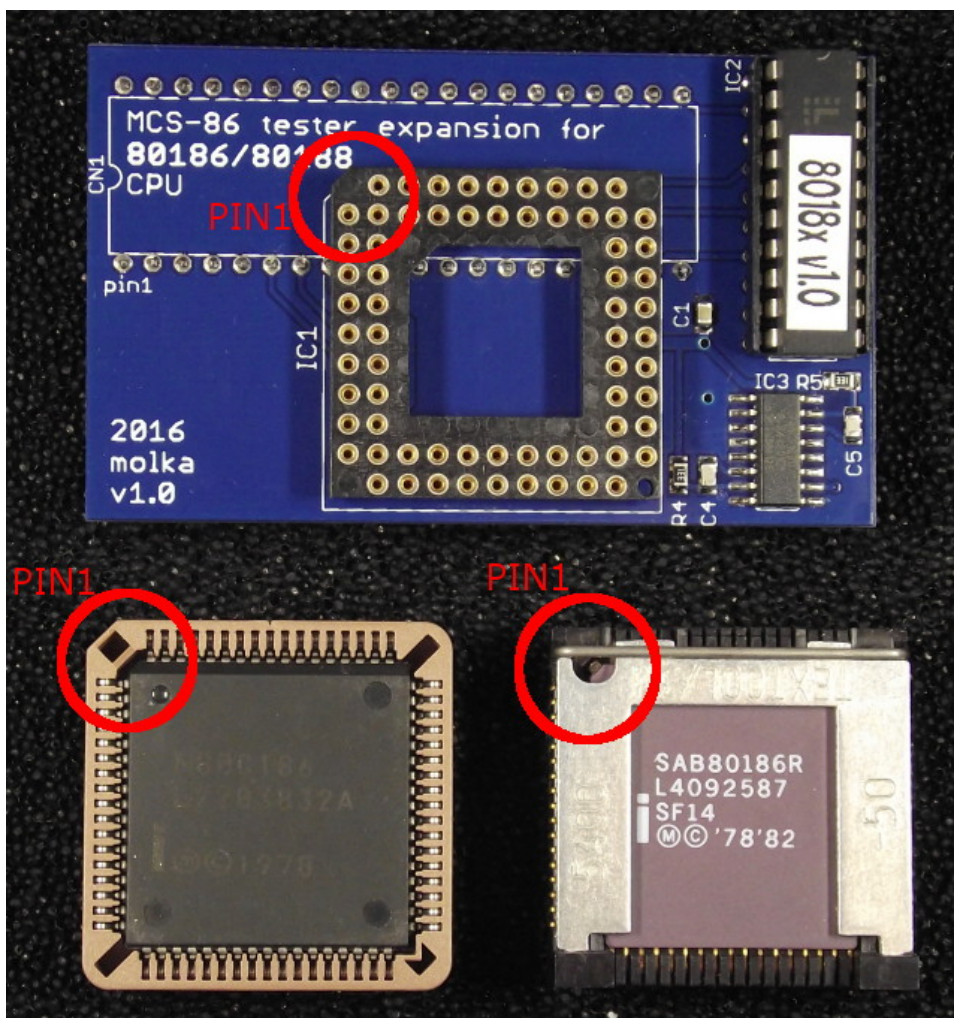
Picture 3. The inserted 80186/80188 expansion tool.



Usage of the Expansion Tool

- Turn off the power of MCS-86 test-board and unplug the power cord.
- Remove the 8087 FPU from the ZIF socket.
- Remove the 8086/8088 CPU and leave the release lever of the ZIF socket open.
- In case of testing PGA socket 80186/80188 CPU:
 - o Insert the CPU into the PGA-68 socket of expansion tool.
- If testing PLCC or CLCC type CPUs:
 - o The appropriate socket should be inserted into the PGA-68 socket and the CPU can then be inserted into the mounted socket.
- Ensure proper orientation to prevent damage to the test board and CPU! **Pin 1 must be at the upper-left corner.**
- Insert the pins of the expansion tool carefully into the ZIF socket of 8086/8088 CPU.
- When the pins of expansion tool are inserted properly lock the ZIF socket.
- Plug in the power supply and switch on the power of the MCS-86 test-board.
- The same behavior of test-board should be discerned as testing an 8086/8088 CPU.

Picture 4. Shows PIN1 location of different sockets



Thanks to CPUShack for review and advises!

Feel free to write an e-mail to me at molnar.kalman@freemail.hu or send a PM to molka at CPU-World forum if you have any question.