

AccessionIndex: TCD-SCSS-T.20251216.002

Accession Date: 16-Dec-2025

Accession By: Dr.Brian Coghlan and Erturk Kocalar

Object name: Arduino shield for Intel 8088

Vintage: 2025

Synopsis: A board that enables execution of software by the 8088, identical to Intel's 8086 microprocessor except for an 8-bit external data bus instead of a 16-bit bus.

Description:

This Retroschild 8088 is one a series of Arduino shields (*retroschilds*) designed by Erturk Kocalar [1] to not only host early microprocessors but also to execute their original native software, an approach he has termed "Breadboarding in Software".

The RetroShield 8088 [2] is a daughter card that plugs into an Arduino Mega [3] or Teensy [4], see Fig.1. The Intel 8088 microprocessor [5] executes native 8088 code while the Arduino emulates 8088 system hardware. The choice of emulated 8088 system hardware is done by uploading relevant Arduino code. This enables the experience of old computer systems, the learning of low-level aspects of the early microprocessors, the keeping of valuable historical software alive, and even changing original native software simply by changing C code in the Arduino IDE, and use with other Arduino shields and libraries.

The Arduino Mega is an inexpensive platform with a 16MHz CPU that allows the retroschild's early microprocessor to run at about up to 400kHz, with over 200kB of emulated ROM and about 6kB of emulated RAM (reserving 2kB for the Arduino stack/heap). Peripherals like a UART, PIA, Timer, etc. can be emulated by the Arduino, and other Arduino *shields* can be used to add new features. The Arduino Mega operates at 5V TTL levels. The retroschild plugs into the Arduino Mega digital input/output connector.

The Teensy is a more expensive but faster platform with a 600MHz CPU that allows the retroschild's early microprocessor to run at full speed (e.g. 1MHz), with over 512kB of emulated ROM. Emulated RAM capacity depends on the Teensy version, 256kB for Teensy 3.5 or 3.6, 1MB for Teensy 4.1. It includes a microSD slot that can be used to emulate disk drives. Other peripherals like a UART, PIA, Timer, etc. can be emulated by the Arduino, and other Arduino *shields* can be used to add new features. The Teensy operates at 3.3V, but plugs into a Teensy daughter card designed by Erturk Kocalar that provides onboard 3.3V-to-5V TTL level shifting & vice-versa. The retroschild then plugs into that daughter card in the same way that it would into an Arduino Mega digital input/output connector.

The 8088 was identical to Intel's very successful 8086 microprocessor except for an 8-bit external data bus interface unit instead of a 16-bit bus interface. The 8088 had the same register set as the 8086, and was binary compatible with it. The major difference was that data was only multiplexed onto the lower 8-bits of the external address/data bus, allowing the use of 8-bit support and peripheral chips. As a result, the 8086's $\overline{\text{BHE}}$ (high-byte select) was replaced by $\overline{\text{SS0}}$ (maximum mode status), and $\overline{\text{IO/M}}$ was replace by its complement, the 6-byte prefetch queue of the 8086 was shortened to 4-bytes, and the prefetch algorithm was slightly modified. In general it was much simpler to design with, but as the bus became a major queuing bottleneck,

performance was greatly degraded. Nevertheless it became very famous once it was chosen as the CPU of the original IBM PC (the IBM5150). The Retrosshield 8088 design files are at [6].

The Retrosshield 8088 is designed to support both 80C88 and 80C86 chips. This item has an 80C88, which can run in minimum mode (maximum mode is also supported if desired), with 4kB of memory when used with the Arduino Mega 2560 (192kB with Teensy). It can execute Seattle Computer Products 8086 Monitor (version 1.5 3-19-82) by Tim Paterson [7]. The Retrosshield 8088 software is at [8].

Many thanks to Erturk Kocalar and Brian Coghlan for donating this item.

The homepage for this catalog is at: <https://www.scss.tcd.ie/SCSSTreasuresCatalog/>
Click '*Accession Index*' (1st column listed) for related folder, or '*About*' for further guidance.
Some of the items below may be more properly part of other categories of this catalog, but are listed here for convenience.

Accession Index	Object with Identification
TCD-SCSS-T.20251216.002	Arduino shield for Intel 8088. A board that enables execution of software by the 8088, identical to Intel's 8086 microprocessor except for an 8-bit external data bus instead of a 16-bit bus, 2025.
TCD-SCSS-T.20250918.004	Intel 8086 microprocessor and associated chips. Intel's very successful early 16-bit microprocessor. 1978.
TCD-SCSS-X.20250916.001	Dr.Brian Coghlan's Collection of Early Microprocessors. An extensive and nearly complete set of unused 1970s microprocessor chips, most accompanied with documentation, some with demonstration boards. 1971.

References:

1. Erturk Kocalar, *8bitforce*, erturkk@8bitforce.com, see:
<https://8bitforce.com/>
Also: <https://gitlab.com/8bitforce>
Last browsed to on 18-Sep-2025.
2. Erturk Kocalar, *Retrosshield 8088*, see:
<https://www.tindie.com/products/8bitforce/retrosshield-8088-for-arduino-mega/>
Last browsed to on 18-Sep-2025.
3. Arduino, *Arduino MEGA*, see:
<https://store-usa.arduino.cc/products/arduino-mega-2560-rev3>
Last browsed to on 18-Sep-2025.
4. PJRC, *Arduino Teensy*, see:
<https://www.pjrc.com/teensy/>
Last browsed to on 18-Sep-2025.
5. Wikipedia, *Intel 8088*, see:
https://en.wikipedia.org/wiki/Intel_8088
Last browsed to on 18-Sep-2025.
6. Erturk Kocalar, *Retrosshield-HW Design Files*, see:
<https://gitlab.com/8bitforce/retrosshield-hw>
Last browsed to on 18-Sep-2025.
7. Tim Paterson, *8086 Monitor*, Seattle Computer Products, see:
<https://www.scss.tcd.ie/SCSSTreasuresCatalog/hardware/TCD-SCSS-T.20251216.002/SCP-8086-Monitor-v1pt5A-TimPaterson-SeattleComputerProducts.pdf>
Last browsed to on 18-Sep-2025.
8. Erturk Kocalar, *Retrosshield 8088 Source Code*, see:
<https://gitlab.com/8bitforce/retrosshield-teensy/-/tree/master/t8088>
Last browsed to on 18-Sep-2025.

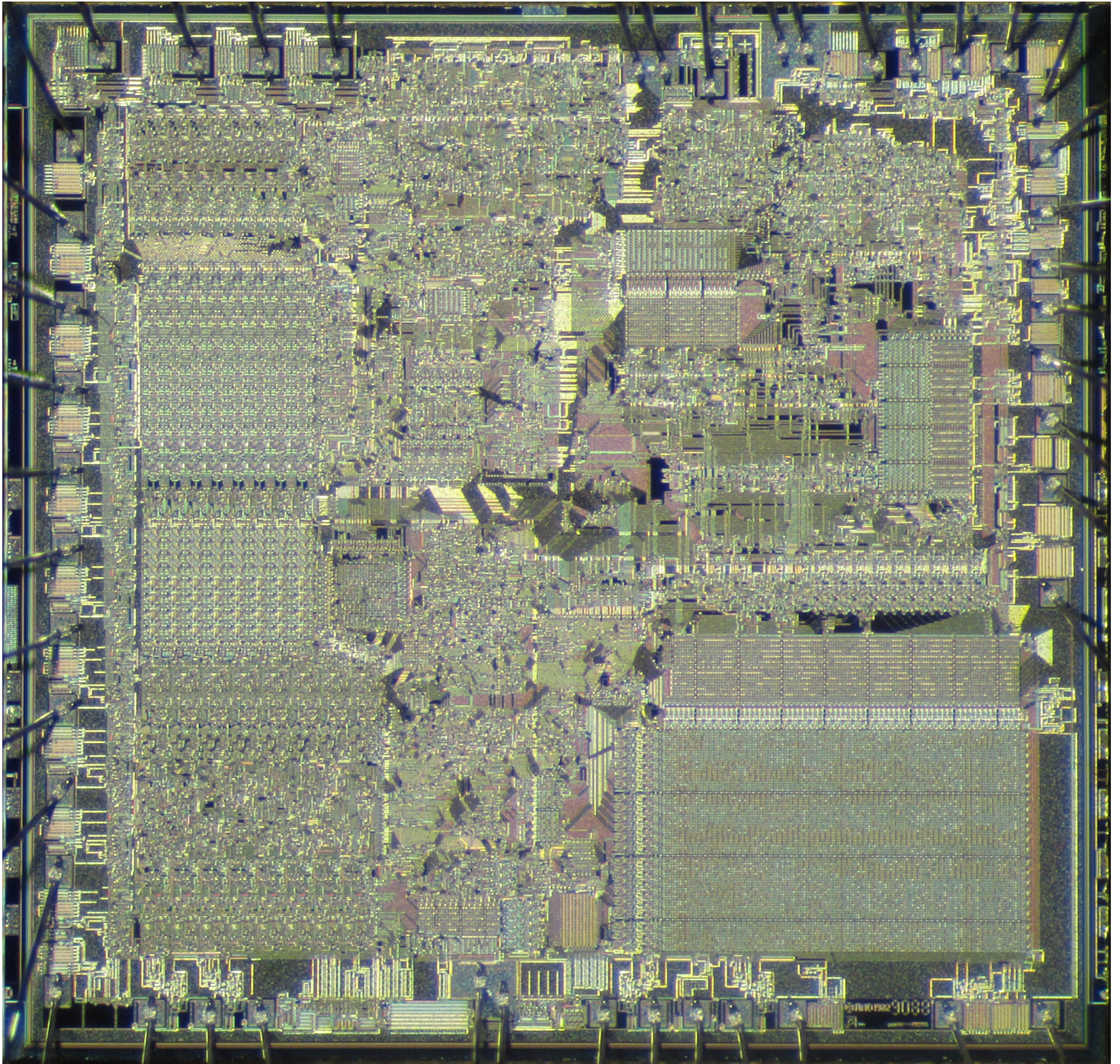


Figure 1: AMD 8088 chip die micrograph (from Wikipedia).

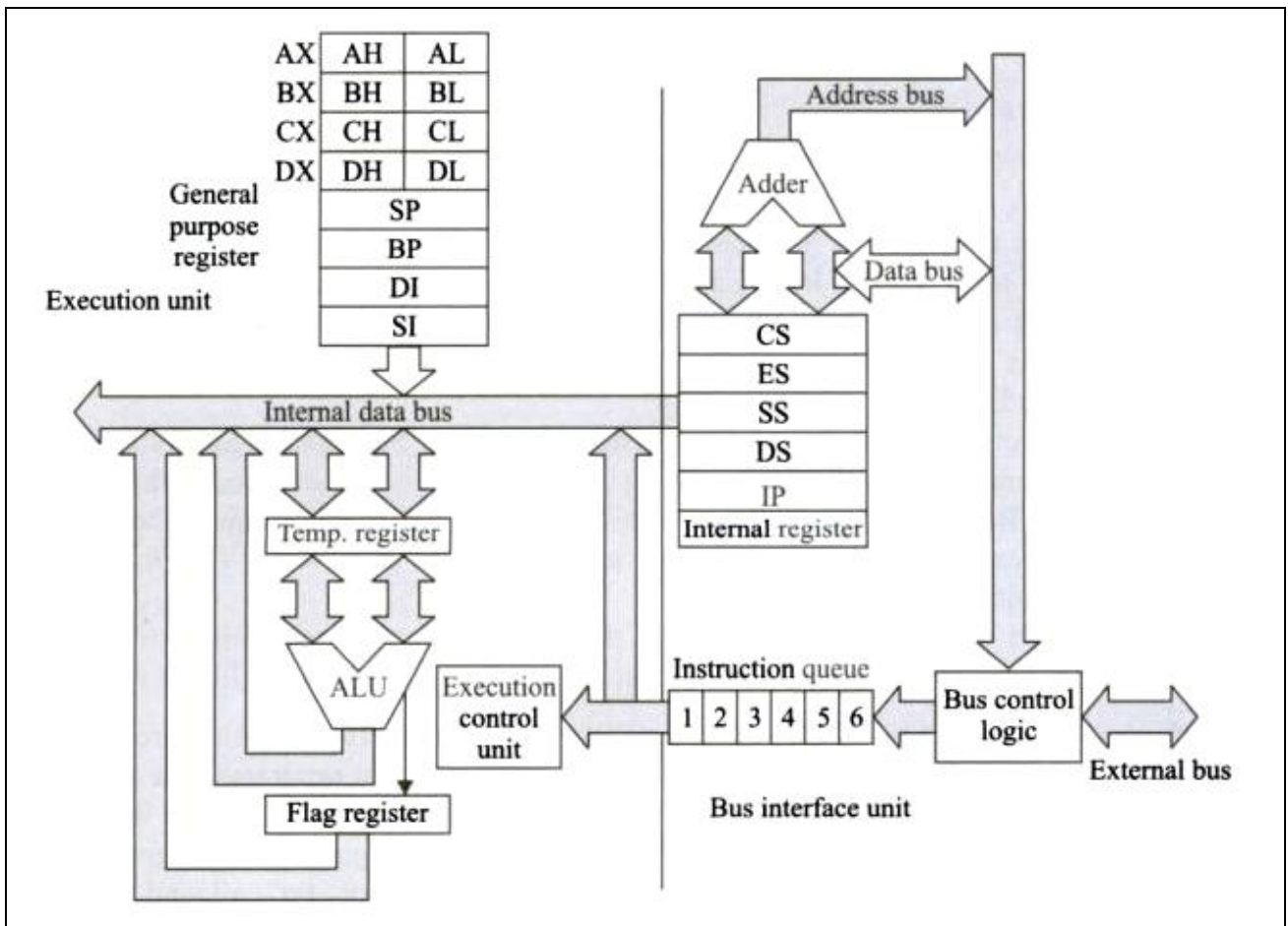


Figure 2: Intel 8088 architecture, identical to that for the 8086 (from Wikipedia).

Intel 8086 registers

1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 (bit position)			
9 8 7 6 5 4 3 2 1 0 9 8 7 6 5 4 3 2 1 0			
Main registers			
	AH	AL	AX (accumulator)
	CH	CL	CX (counter)
	DH	DL	DX (extended acc)
0 0 0 0	BH	BL	BX (base)
Index registers			
0 0 0 0	SP		Stack Pointer
0 0 0 0	BP		Base Pointer
0 0 0 0	SI		Source Index
0 0 0 0	DI		Destination Index
Program counter			
0 0 0 0	IP		Instruction Pointer
Segment registers			
	ES	0 0 0 0	Extra Segment
	CS	0 0 0 0	Code Segment
	SS	0 0 0 0	Stack Segment
	DS	0 0 0 0	Data Segment
Status register			
	- - - -	O D I T S Z - A - P - C	Flags

Figure 3: Intel 8088 registers, identical to those for the 8086 (from Wikipedia).

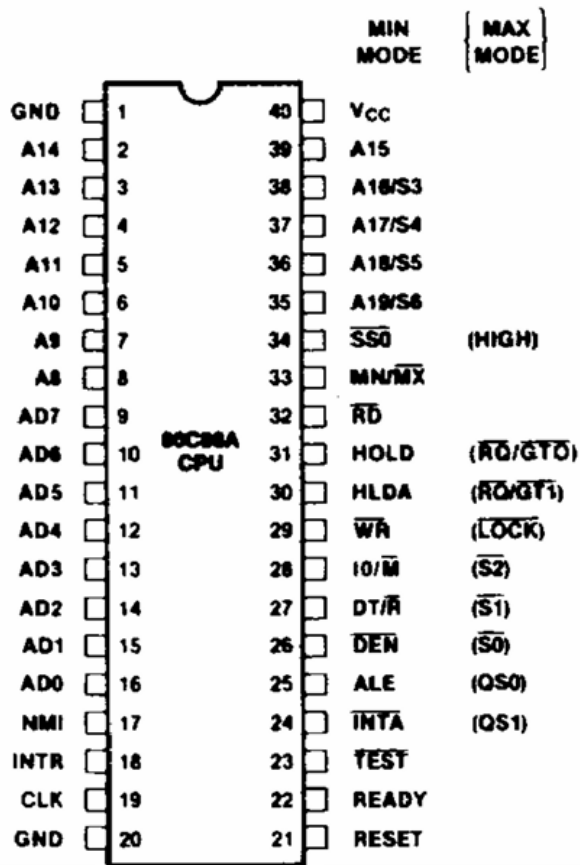


Figure 4: Intel 8088 pinout (from Intel datasheet).

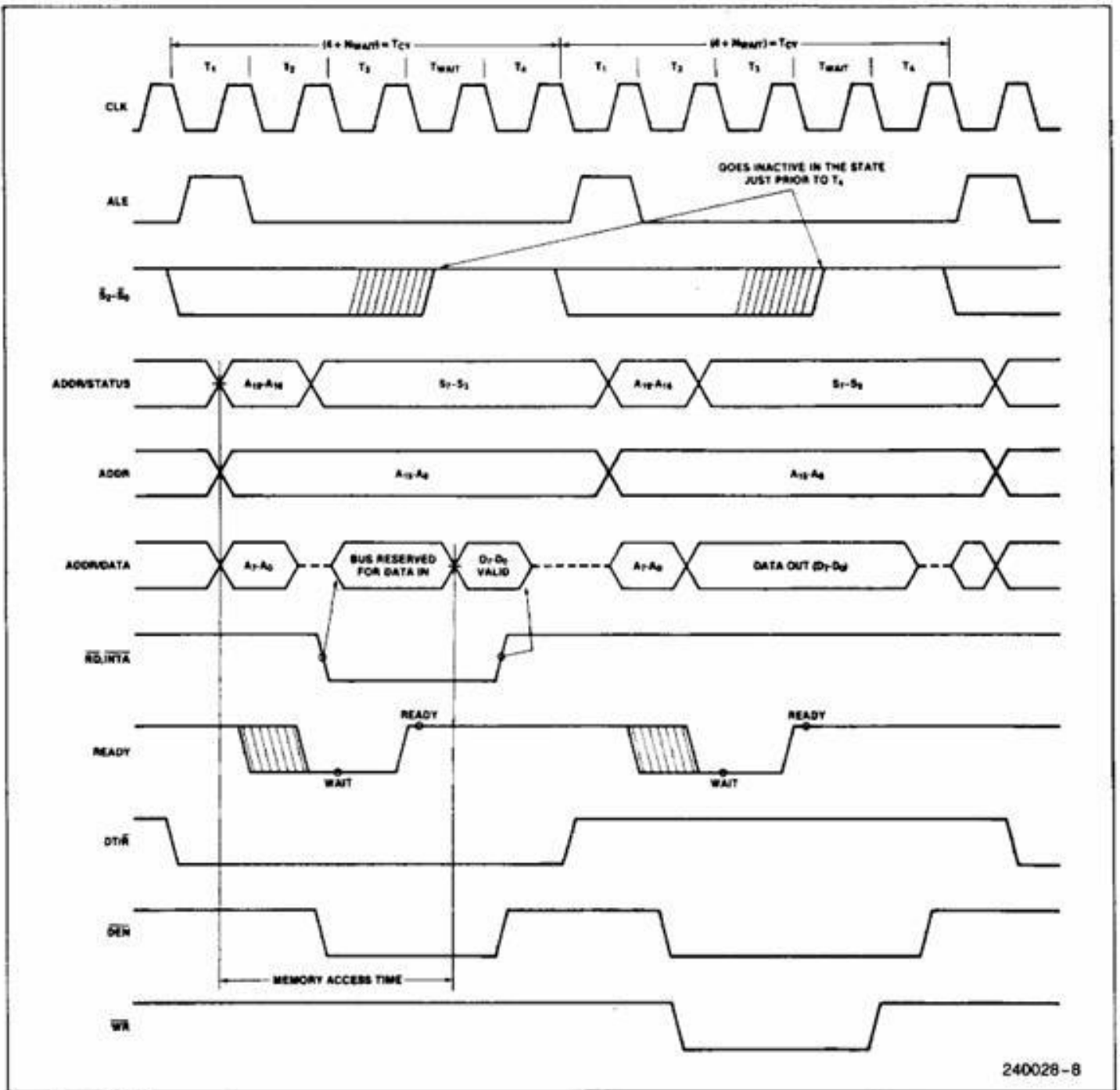


Figure 5: Intel 8088 instruction cycle (from Intel datasheet).

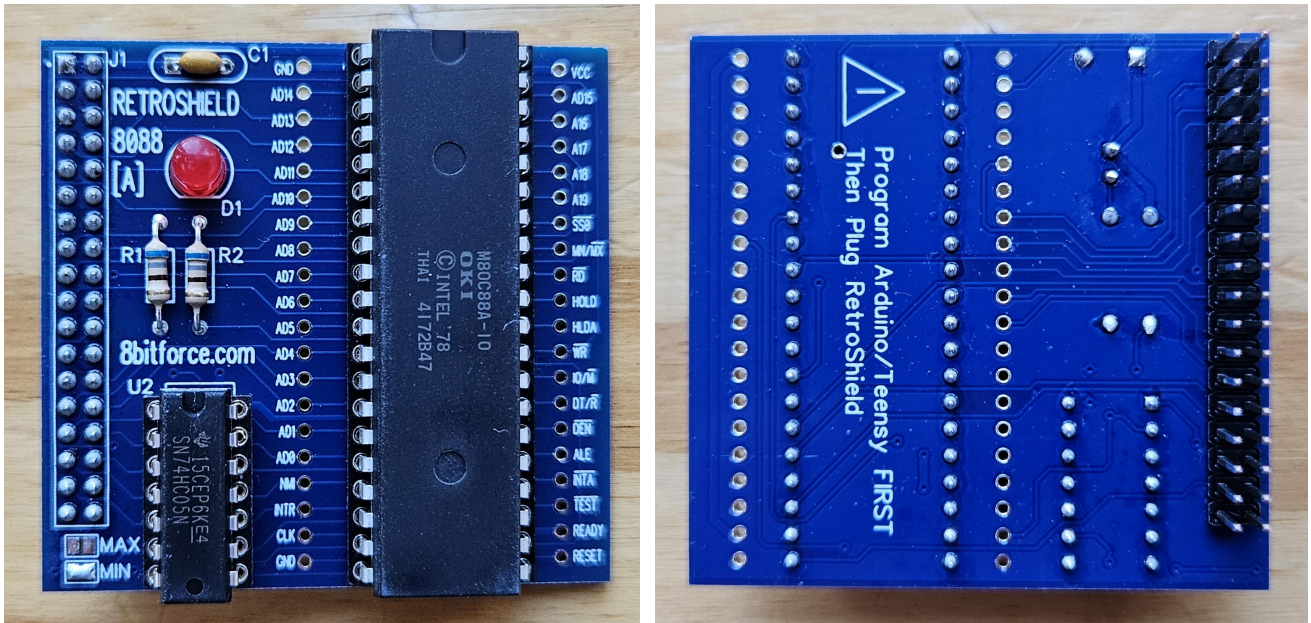


Figure 6: 8bitforce Retroschild 8088 (from 8bitforce).

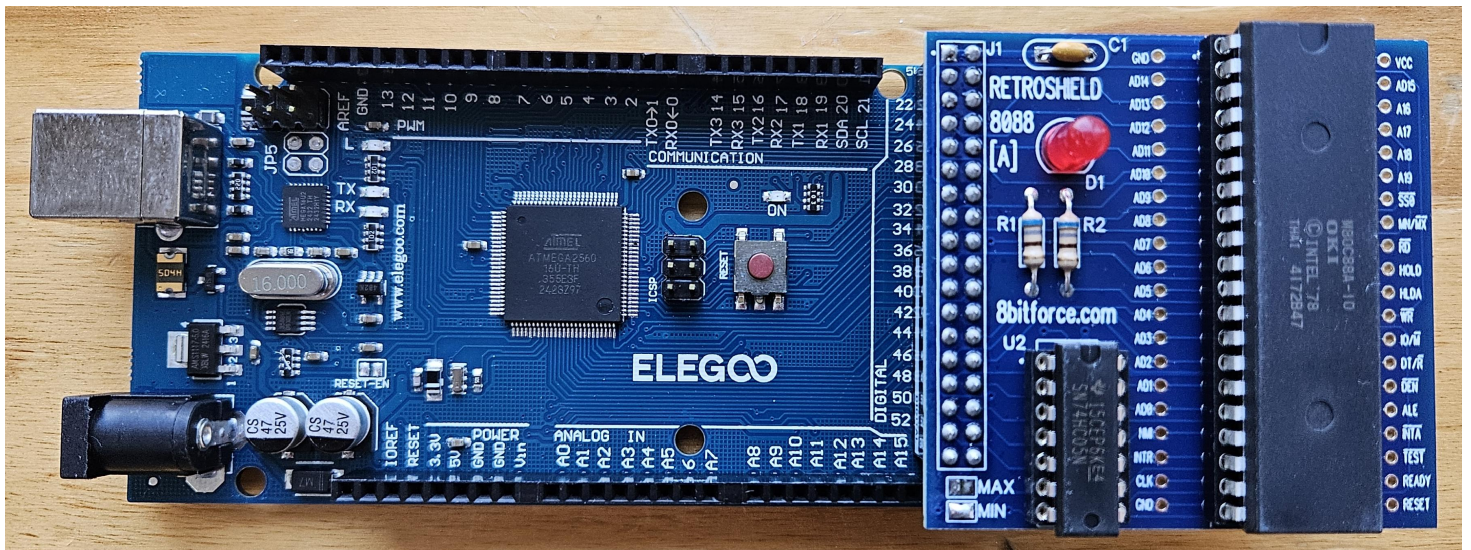


Figure 7: 8bitforce Retroschild 8088 coupled with Arduino Mega.

Figure 8: 8bitforce Retroschild 8088 assembly instructions.

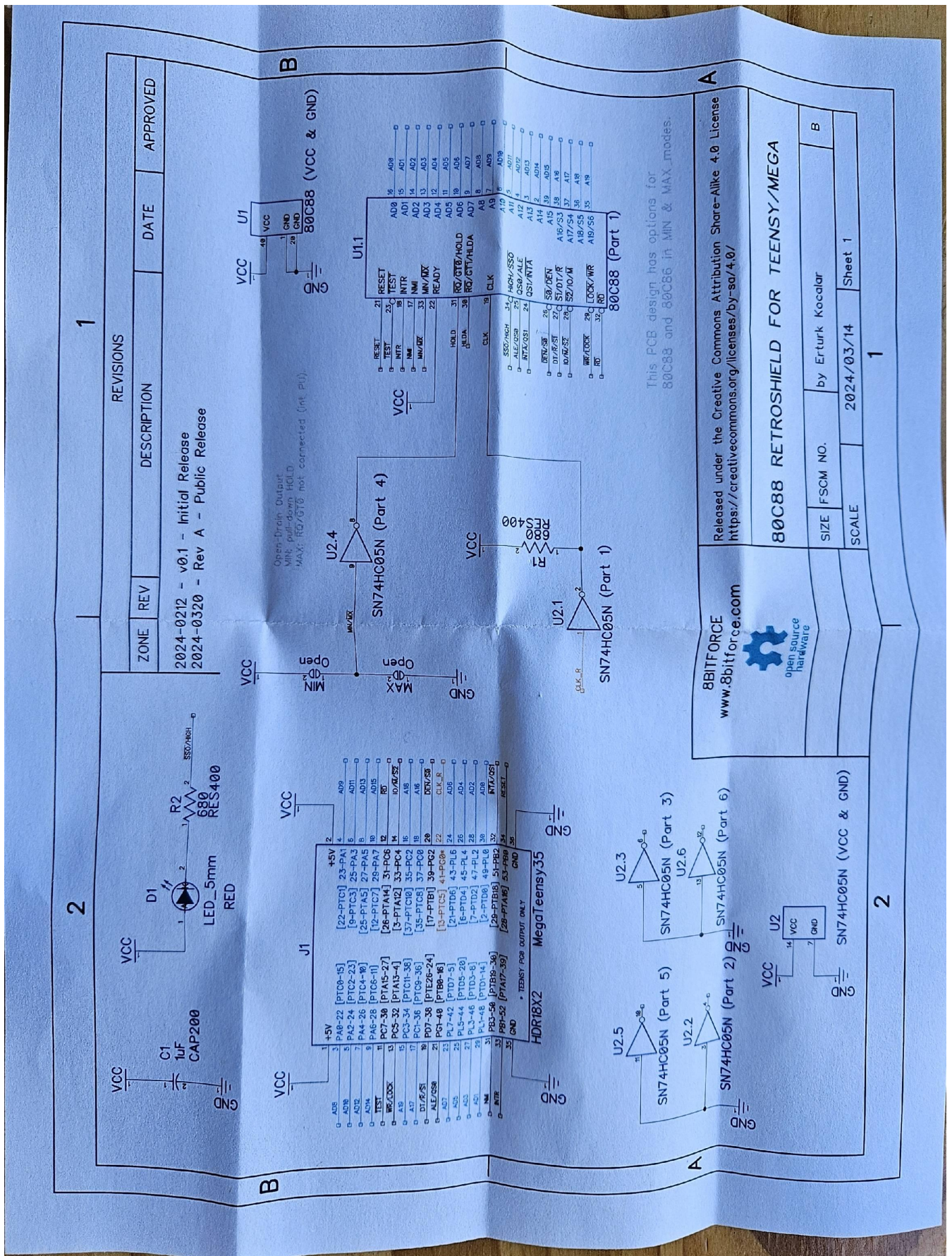


Figure 9: 8bitforce Retroschild 8088 schematic.