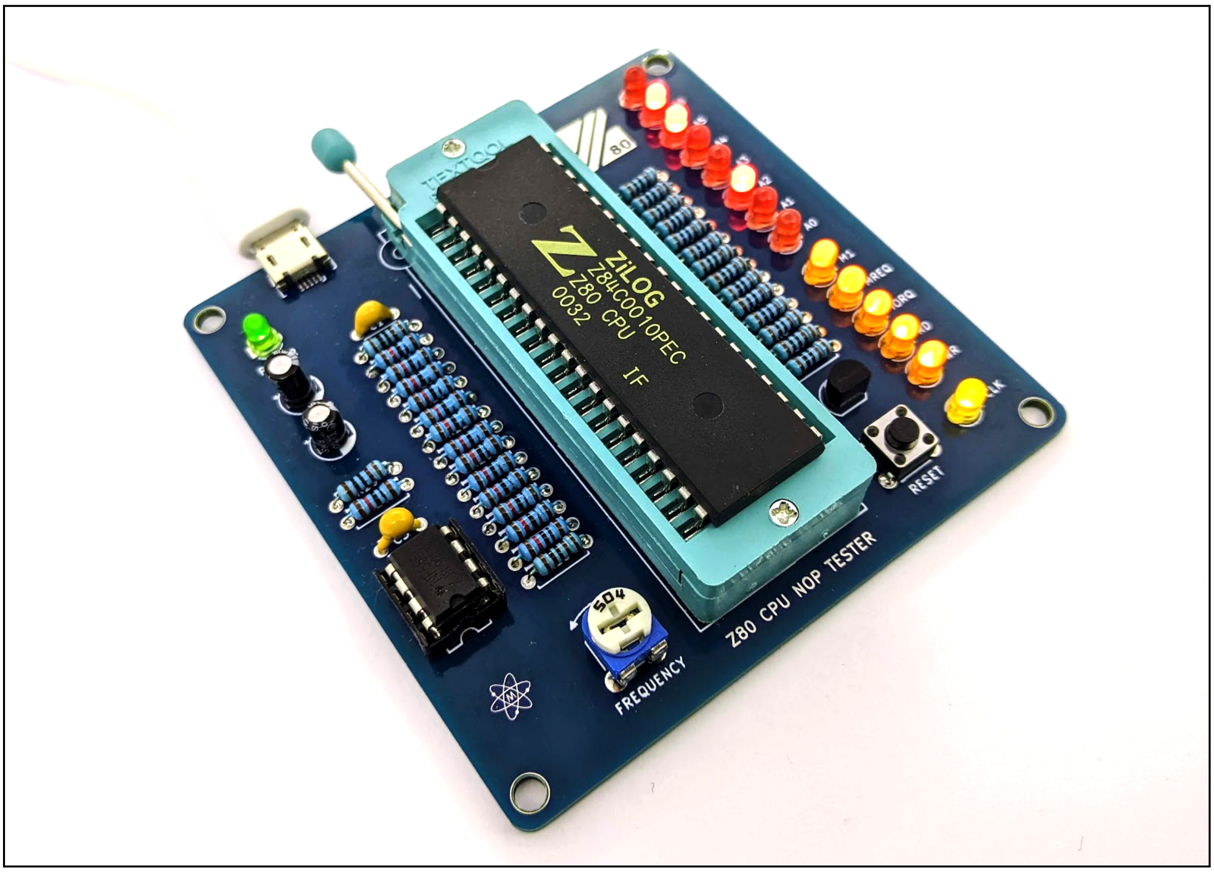
Z80 CPU NOP Generator Tester
Instruction Manual



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Introduction

This is a simple Z80 CPU tester which only executes NOP (No Operation) instructions to just check for basic functionality tests that the CPU can execute instructions.

Tester will not test all address lines and every function on the Z80, but gives you a quick indication if the CPU is trash or treasure. You can learn a lot about how CPU works by observing system control lines linked to LED’s.

The CPU tester works with all NMOS and CMOS types of Z80 CPUs and compatible clones.

How does it work?

All data bus pins (A0-A7) are pulled to ground by pull-down resistors and the CPU executes NOP instructions (opcode 0x00) when the memory is read in an endless loop. The CPU starts executing these commands from address 0 after reset or data jump.

Addresses A0 to A7 are connected to LED's for visual display and will pulse on and off when the memory locations are checked. If the CPU executes the NOPs, the addresses A0 to A7 should be continuously incremented and CPU acts as a crude BCD counter, where A0 = 1, A1 = 2, A3 = 4, A4 = 8 and so on.
You might be spooked by LED A7 flashing. Please don’t be, this is a standard artifact. Z80 executes a periodical memory refresh cycle, where memory access and memory refresh run synchronously.

The clock signal is generated by a 555 timer with variable frequency from 1 - 1200 Hz, so you can determine if the Z80 is executing instructions at different clock speeds. Address locations A0 - A7 are tested in about 3 seconds (1 operation per 4 cycles).

Please be aware, that since the CPU is under-clocked below specification, it is quite possible that in extreme cases the NOP tester might give you incorrect indication.

What are all the LED’s for anyways?

- **M1** - Machine Cycle One (output, active Low). M1, together with MREQ, indicates that the current machine cycle is the op code fetch cycle of an instruction execution. M1, when operating together with IORQ, indicates an interrupt acknowledge cycle.
- **MREQ** - Memory Request (output, active Low, tristate). MREQ indicates that the address bus holds a valid address for a memory read or a memory write operation.
- **IORQ** - Input/Output Request (output, active Low, tristate). IORQ indicates that the lower half of the address bus holds a valid I/O address for an I/O read or write operation.
- IORQ is also generated concurrently with M1 during an interrupt acknowledge cycle to indicate that an interrupt response vector can be placed on the data bus.
- **RD -** Read (output, active Low, tristate). RD indicates that the CPU wants to read data from memory or an I/O device. The addressed I/O device or memory should use this signal to
- gate data onto the CPU data bus.
- **WR** - Write (output, active Low, tristate). WR indicates that the CPU data bus contains valid data to be stored at the addressed memory or I/O location.
- **CLK -** Clock (input). Single-phase MOS-level clock. Four clock cycles per one machine cycle operation.

What is NOP instruction?

NOP does nothing for 4 clock cycles. It is Useful for a short time waster (for example, it's common to put 8 clock cycles between output and input from the Key Port).

A NOP is most commonly used for timing purposes, to force memory alignment (may be used for pipeline synchronization), to prevent hazards, to occupy a branch delay slot, to render void an existing instruction such as a jump, as a target of an execute instruction, or as a place-holder to be replaced by active instructions later on in program development (or to replace removed instructions when reorganizing would be problematic or time-consuming).

Instruction mnemonic: NOP, Bytes: 1, Opcode 0x00, Notes: There are some other instructions without any effect (and the same timing): LD A, A, LD B, B etc.

How to test CPU?

1. Slot the Zilog Z80 CPU into the ZIF socket. CPU should fall into the ZIF socket without force.

2. Please Make sure the Z80 is inserted correctly. Pin 1 CPU is top left by the lever.

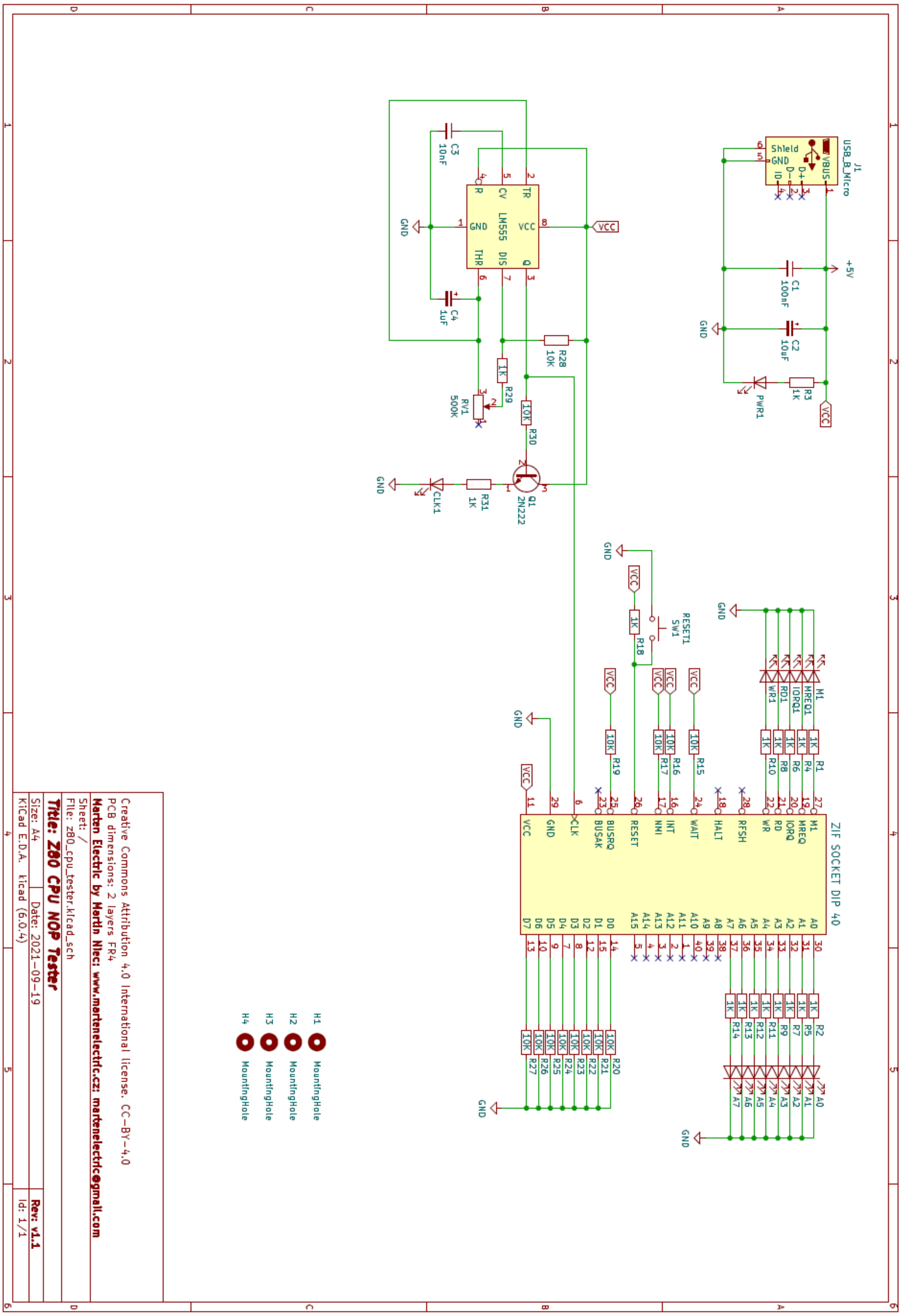
3. Power up the CPU tester by inserting a Mini USB Type B cable from the PC or use standard +5VDC USB phone charger.

4. Press Reset button. CPU starts from zero count state.

5. Fiddle with the potentiometer to achieve the clock speed you require for your experiments.

6. **Enjoy!**

Schematic



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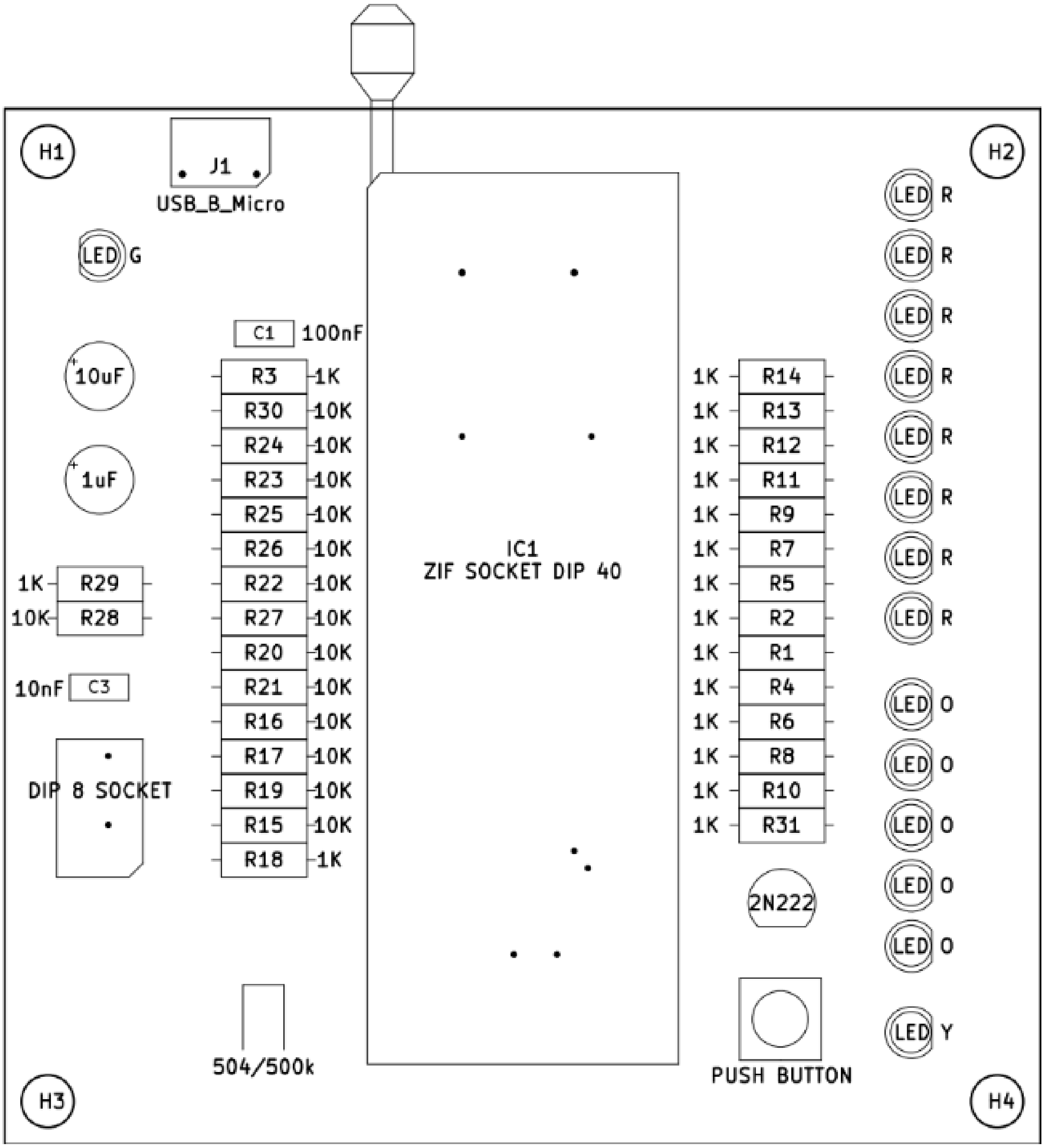
PCB dimensions: 2 layers FR4
Marten Electric by Martin Nlec: www.martenelectric.cz: martenelectric@gmail.com
Sheet: /
File: z80_cpu_tester.kicad_sch
Title: Z80 CPU NOP Tester
Size: A4
Date: 2021-09-19
Rev: v1.1
KiCad E.D.A. kicad (6.0.4)
Id: 1/1
LM555
ZIF SOCKET DIP 40
USB_B_Micro
RESET1
SW1
MountingHole

Component placement



Bill of Materials (BOM)

Reference	**Value**	**Footprint**	**Qty**	**Notes**
Printed Circuit Board		PCB 76.2 x 76.2 mm, M3 mounting holes	1	v1.2
LED PWR	Green	LED_THT:LED_D3.0mm	1	
LED A0-A7	Red	LED_THT:LED_D3.0mm	8	
LED M1-WR	Orange	LED_THT:LED_D3.0mm	5	
LED CLK	Yellow	LED_THT:LED_D3.0mm	1	
C1	100nF	Capacitor_THT:C_Disc_D4.3mm_W1.9mm_P5.00mm	1	
C2	10uF	Capacitor_THT:CP_Radial_D5.0mm_P2.50mm	1	
C3	10nF	Capacitor_THT:C_Disc_D4.3mm_W1.9mm_P5.00mm	1	
C4	1uF	Capacitor_THT:CP_Radial_D5.0mm_P2.50mm	1	
R1-R14,R18,R29,R31	1K	Resistor_THT:R_Axial_DIN0207_L6.3mm_D2.5mm_P7.62mm_Horizontal	17	
R15-R17,R19-R28,R30	10K	Resistor_THT:R_Axial_DIN0207_L6.3mm_D2.5mm_P7.62mm_Horizontal	14	
Q1	2N222	Package_TO_SOT_THT:TO-92_Inline	1	NPN Transistor, Alternative 2N3904
SW1	Reset	Button_Switch_THT:SW_PUSH_6mm_H5mm	1	Momentary Push Button Switch
RV1	500K / 504	Potentiometer_THT:Potentiometer_ACP_CA9-H5_Horizontal	1	Frequency adjust
U1	NE555	Package_DIP:DIP-8_W7.62mm	1	Precision timer monostable NE555 / LM555 Datasheet
U1	DIP 8	Package_DIP:DIP-8_W7.62mm	1	Socket
IC1	ZIF	Socket:DIP_Socket-40_W11.9_W12.7_W15.24_W17.78_W18.5_3M_240-1280-00-0602J	1	DIP40 ZIF Socket, any DIP40 socket can be used
J1	USB_B_Micro	Connector_USB:USB_Micro-B_Amphenol_10118194_Horizontal	1	
		Components in total	**57**	

Assembly instructions and notes

■ Gerber files contain " JLCJLCJLCJLC" to the silk layer. You can specify a location of the order number, select the "Specify a location" option when you place an order. Only if you order via JLCPCB

■ Use a temperature-controlled soldering station and quality solder, use plenty of flux. Take care not to leave solder bridges as any short circuit will most likely lead to failures

■ Use a temperature-controlled heat gun station and quality solder paste, use plenty of flux. Take care not to leave solder bridges as any short circuit will most likely lead to failures

■ Use quality ZIF Socket for CPU, alternative machined socket with golden plated pin headers is recommended, they are rather cheap and will protect your precious DIP socket. 555 timer can be soldered directly, however little DIP8 socket is recommended.

■ Use little screwdriver to adjust frequency of 555 Timer

Assembly

1 - First start with USB B connector: Hold socket in place and dab a bit of solder on the little connector, it's fiddly due to the nature and size of SMD components so you might want to use a solder wick if you overdo it. Test for solder bridges just in case. Alternatively use solder paste and hot air.

2 - Start from the physically lowest component: Resistors, caps, LEDs, transistor, button etc. Solder ZIF socket as a last component.

3 - Clean the flux residue and crap with IPA

4 - Test for voltages prior to first use, just in case... because the last thing you want is to fry your CPU

5 - Insert CPU, plug in USB power plug and Enjoy!