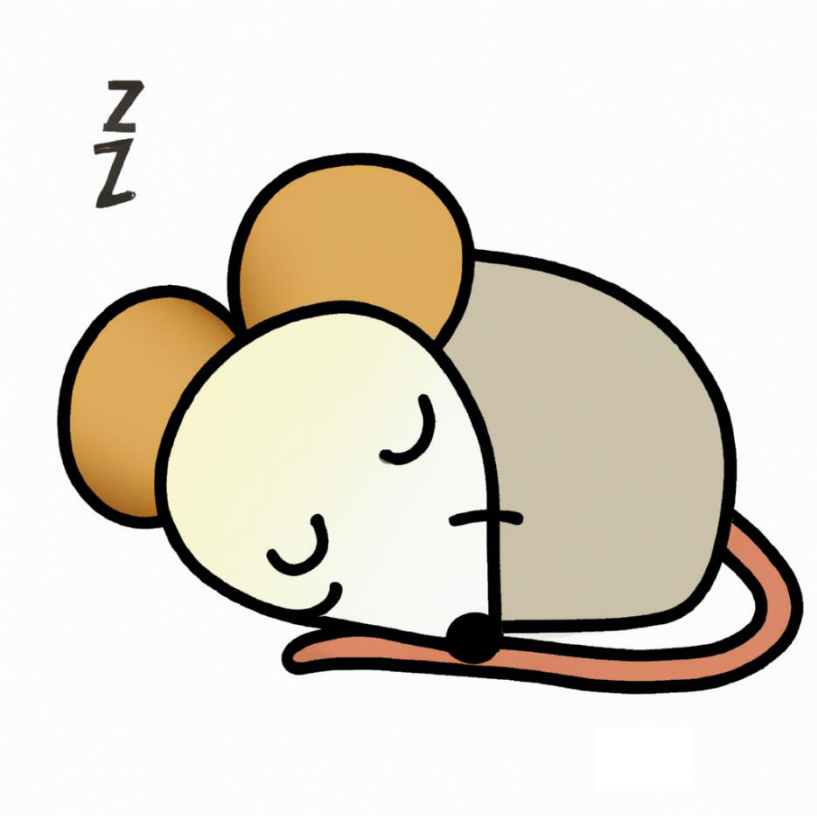
Z80 NOP Instruction Tester

Instruction Manual & Functional Description



Document History

Date	Reason
11-Aug-2025	Original release
04-Oct-2025	Minor corrections
08-Jan-2026	Additional capacitor to clock speed selections

Contents

1 Introduction

A Z80 NOP tester is a simple diagnostic tool used to check whether a Z80 microprocessor is basically functional — specifically, whether it can fetch and execute instructions from memory.

1.1 NOP Instruction

In Z80 assembly, NOP (No Operation) is the opcode 0x00.

When executed, the CPU does nothing for one machine cycle and then increments the program counter (PC) to fetch the next instruction.

1.2 The Tester's Trick

The tester provides the Z80 with a "fake" memory where every address returns 0x00 (NOP).

1.3 Expected Behavior

With only NOPs available, the Z80 should:

- Continuously fetch opcodes (all NOPs).
- Increment the PC from 0x0000 to 0xFFFF, then wrap around.
- Output the address on the address bus sequentially, one step per instruction cycle.

1.4 What it Tests

- Clock circuit (CPU is being driven).
- Reset circuit (PC starts at 0x0000).
- Address bus (sequential counting).
- Basic instruction fetch and decode mechanism.

1.5 What You Can See

- A display of the address bus contents as it increments
- Status of RFSH, M1, MREQ and RD signals

1.6 What You Can Measure

- Test points for clock, 0V and 5V
- Test points for s RFSH, M1, MREQ, RD IORQ, WR, HALT, BUSACK (Useful if your Z80 is mis-behaving)

With this it is possible to confirm basic IC functionality while looking at expected signal quality (if you have a scope to hand)

2 Components

Reference	Value	Qty	Part
BAR1,BAR2	LED_Bar_10	2	OSX10201-G
C1	100nF	1	Ceramic
C2	1nf	1	Ceramic (*)
C3	100uF	1	Electrolytic
J1	USB_C_Receptacle_PowerOnly_6P	1	USB4125-GF-A
J2	USB_A	1	KUSBX-AS1N
J5	Barrel Jack	1	Wurth 694108301002
R1	22K	1	
R3	1K	1	
R4	4.7K	1	
R6, R7	5.1K	2	Optional on J1 being fitted
RN1	4.7K	1	4609M-101-472LF
RN2, RN3	1K	2	4609M-101-102LF
RN4	1K	1	4605X-101-102LF
RV1	2M	1	PT10LV10-205A2020-S
SW1	Switch Push	1	D6L90 F2 LFS
TP1	5V	1	
TP2	0V	1	
TP3	Clock	1	
TP4	BUSACK	1	
TP5	IORQ	1	
TP6	HALT	1	
TP7	WR	1	
TP8	RD	1	
TP9	MREQ	1	
TP10	M1	1	
TP11	RFSH	1	
U1	555 Timer	1	LM555CN
U2	Z80	1	Test Item

(*) Can be changed to give a different clock range. See section 5

3 Construction

3.1 Before you start construction

Inspect the PCB for any visible signs of damage

Select your components:

- Turned pin sockets are recommended due to robustness and reliability

3.2 Order of construction

The recommended order of construction is:

- Resistors
- Sockets
- Resistor packs
- LED's
- Power connectors
- Reset switch
- ZIF Socket
- Insert IC

3.3 Note on USB C

If the USB C connector is not to be fitted then the two 5.1K resistors (R6 & R7) are also not required.

4 Functionality

4.1 Order of Operation

To test a CPU, the following steps are required

- Put the CPU in the ZIF socket and clamp it
- Apply power via one of the power inputs
- Press the reset button

4.2 Expected Output

The LED's representing A0 through A15 should now count in the sequence as the CPU runs through addresses 0000 to FFFF

Depending on the clock speed selected A0 may appear fully lit or flicker due to the rate of change

The time taken / speed of operation is controlled by the variable resistor RV1. In standard configuration this gives an approximate clock of between 325Hz and 22KHz

It is possible to change C1 and C2 to give other ranges if required. For example, using C1 @ 47nF and C2 at 2.2nF gives an approximate clock of between 150Hz and 10KHz

The original C1, C2 values have been chosen to give reasonable time performance while making the address bus changes visible.

The four LED's representing RFSH, M1, MREQ and RD should all stay lit. They do change state but too quickly to be easily visible. Using a scope on their test points if recommended if exact operation needs to be observed.

5 Notes on Components

All the components used have been selected at time of design to be readily available via eBay and other sources.

All components with the exception of the USB C connector are through hole so specialist tooling is not required

It is recommended that all through hole resistors are rated at 0.5W for over-rating reliability

The ZIF socket can be soldered directly to the board. You may wish to consider using a socket to mount the ZIF socket into as they can be expensive and easy to damage via soldering.

Make sure the reset button is oriented correctly before soldering

Not all 555's seem to be created equal. I strongly recommend using an LM555CN

Th e capacitor at C2 is set to 1nF. This gives a range of approximately 325Hz to 22KHz. This may be changes as follows:

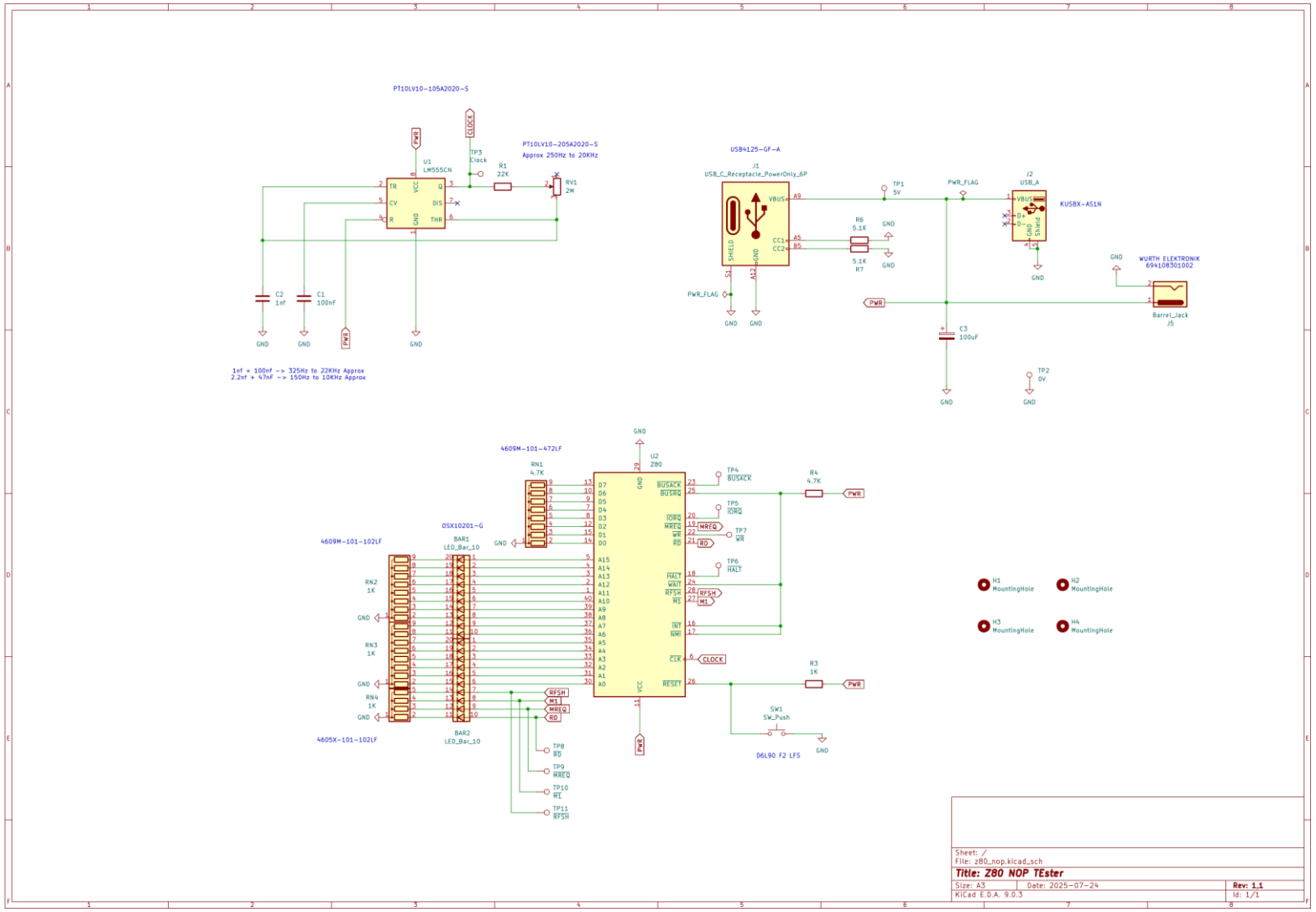
Capacitor	**Approx Min**	**Approx Max**
1nF	325Hz	22KHz
2.2nF	150Hz	10KHz
4.7nF	75Hz	5KHz

6 Errata

None so far …

7 Design Files

https://github.com/codesqueak/Z80_NOP


PT10LV10-105A2020-S
PT10LV10-205A2020-S
Approx 250Hz to 20KHz
1nf + 100nf -> 325Hz to 22KHz Approx
2.2nf + 47nf -> 150Hz to 10KHz Approx
US84125-GF-A
USB_C_Receptacle_PowerOnly_6P
KUSBX-AS1N
WURTH ELEKTRONIK
694108301002
Barrel_Jack
4609M-101-472LF
4609M-101-102LF
4605X-101-102LF
OSX10201-G
D6L90 F2 LFS
MountingHole
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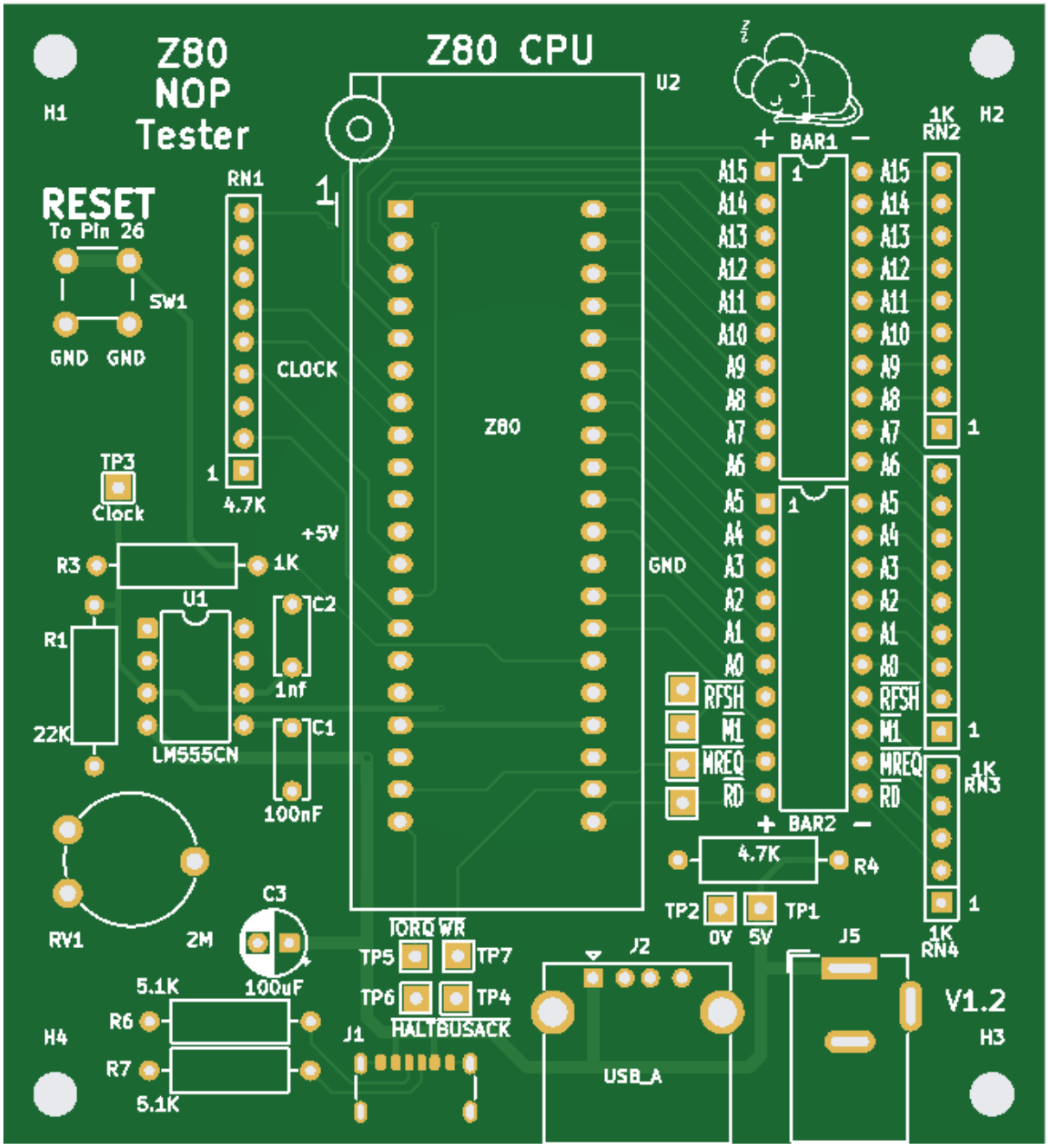
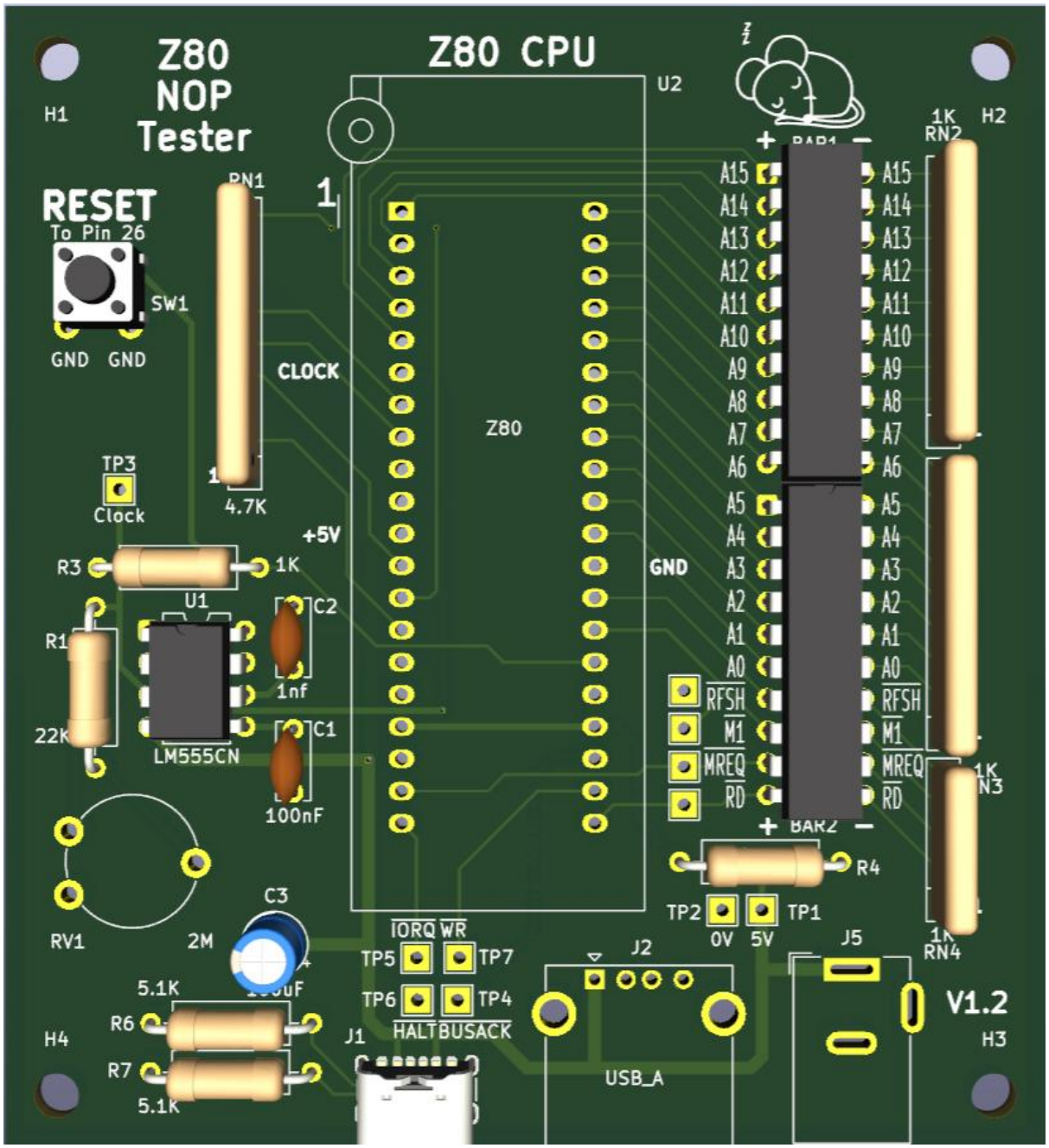
Title: Z80 NOP TEster
Size: A3
Date: 2025-07-24
KiCad E.D.A. 9.0.3
Rev: 1.1
Id: 1/1

8 Reference Images

8.1 PCB



8.2 Built


Z80
NOP
Tester
Z80 CPU
U2
H1
H2
H3
H4
RESET
To Pin 26
SW1
GND
GND
PN1
CLOCK
4.7K
TP3
Clock
+5V
R3
1K
U1
LM555CN
R1
22K
C2
1nf
C1
100nF
RV1
C3
2M
5.1K
R6
R7
5.1K
Z80
GND
A15
A14
A13
A12
A11
A10
A9
A8
A7
A6
A5
A4
A3
A2
A1
A0
RFSH
M1
MREQ
RD
BAR2
R4
TP2
0V
TP1
5V
IORQ
WR
TP5
TP7
TP6
TP4
HALT
BUSACK
J1
J2
USB_A
J5
1K
RN2
1K
RN3
1K
RN4
V1.2