Octo probe

Testing with Hardware in the Loop (HIL)

- Motivation Hans
- Micropython
- Octoprobe: testbed_micropython
- Octoprobe: tentacle
- How to use in your project

2025-09-26, Hans Märki

Micropython

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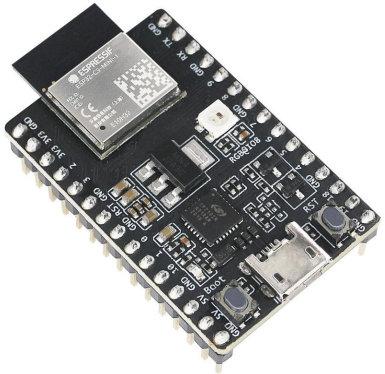
Micropython
192 supported boards
36 cpu



Micropython repo
Python implementation
Ports
Tests

Maintainers role
PR 17946
reports.octoprobe.org

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Automated HIL testing

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When do I need fully automated HIL testing?

- SW runs on multiple HW
- Tests may not be abstracted from HW
- Developers do not have full access/overview to HW

- Fast feedback loop
- Keep code quality
- Make sure existing code will not break

Downsides

- Implement infra
- Effort to write/maintain tests

SKIP: Micropython test

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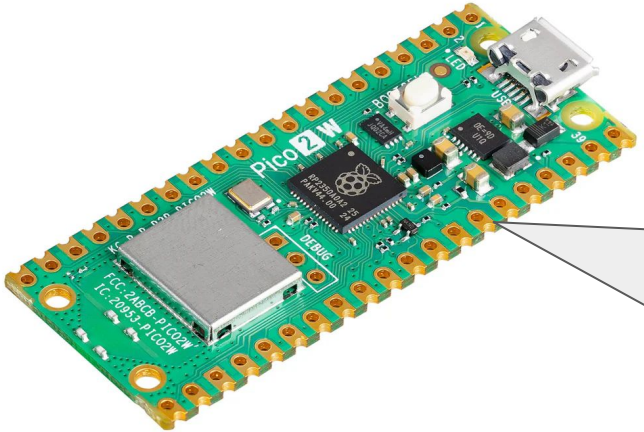



```
…
pass  thread/thread_stacksize1.py
pass  thread/thread_start1.py
pass  thread/thread_start2.py
pass  thread/thread_stdin.py
878 tests performed (25131 individual
testcases)
878 tests passed
90 tests skipped
1 tests failed: machine_i2s_rate
```

Why?

Problems?

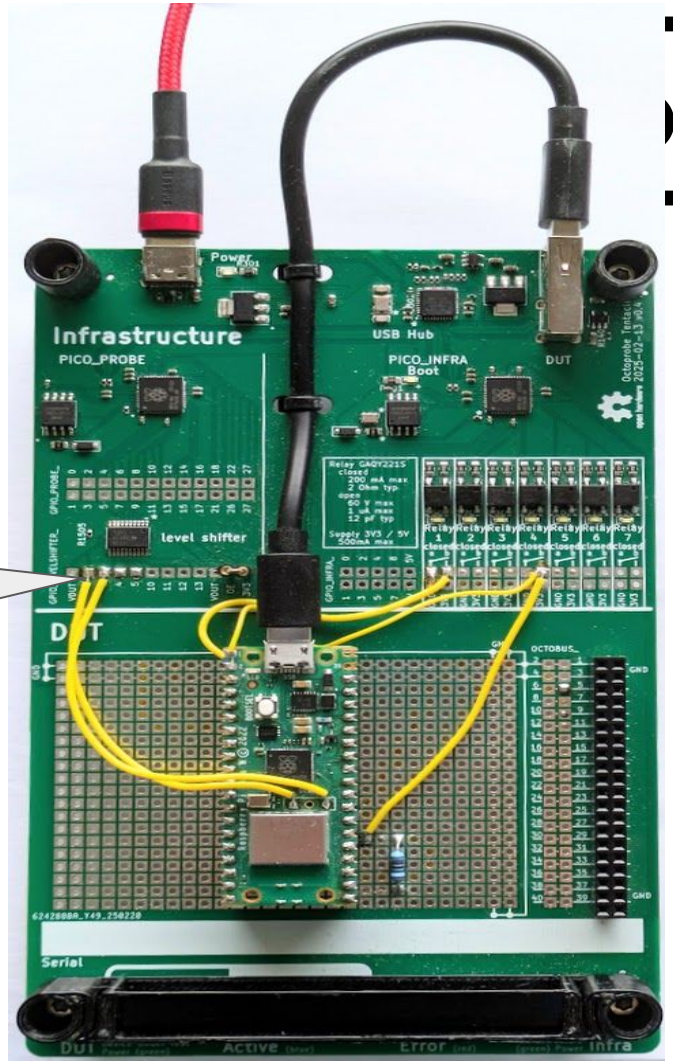
Octoprobe Tentacle

Features:

Powercycle
Flashing (boot button)
USB 2.0 FS
7 opto relays

UART
SWD
DAQ

Fully automated
unattended



testbed_micropython

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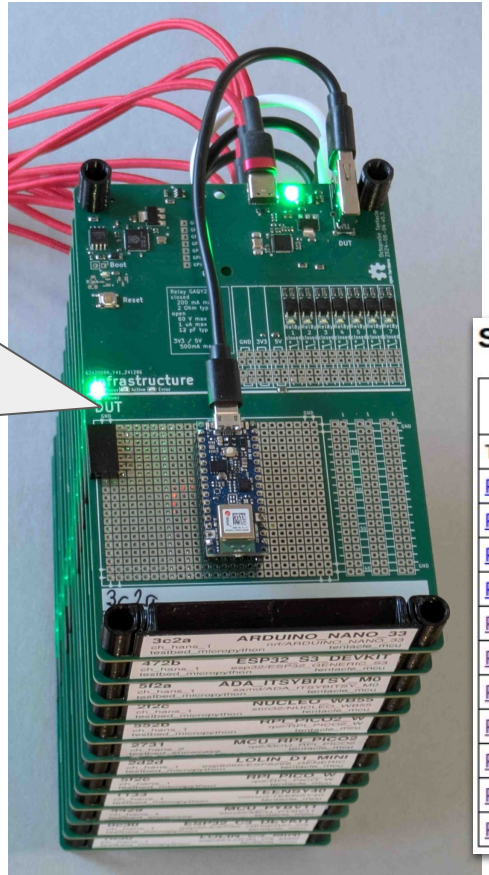
Action (30min):

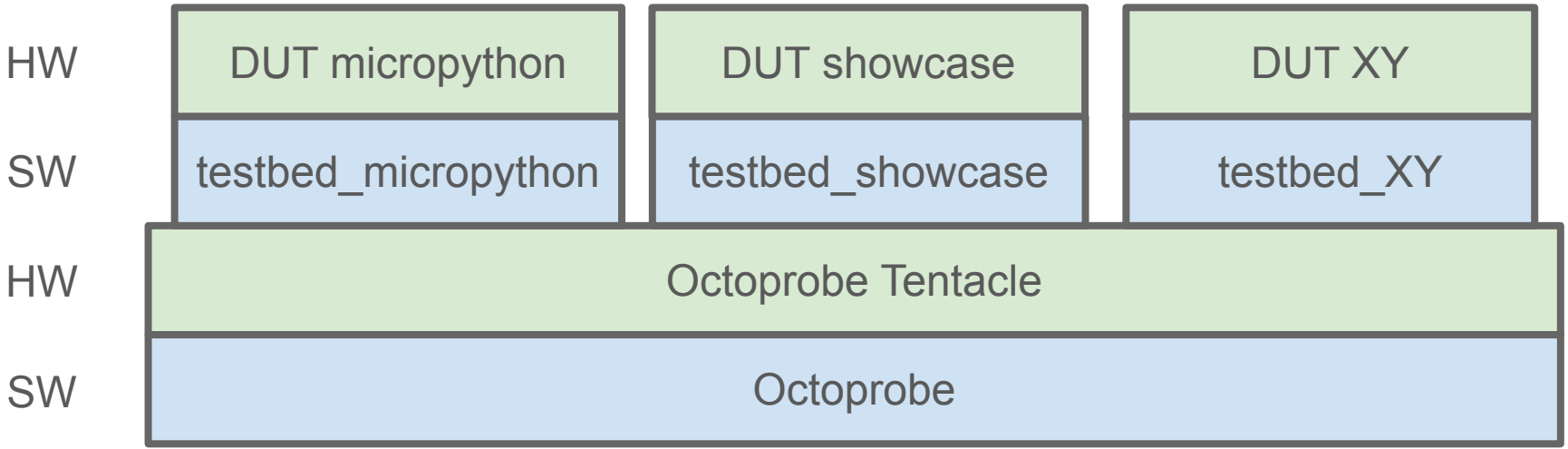
- git checkout
- Build required firmware / variants
- Flash tentacles
- Run tests
- collect testresults
- Summary report



Summary

Test	Groups run	Groups skipped	Groups error	Tests passed	Tests skipped	Tests failed
Total	74	9	**29**	18269	1956	**595**
RUN-MULTITESTS_MULTIBLUETOOTH	6					
RUN-MULTITESTS_MULTINET		2	**8**			
RUN-NATMODTESTS	10		**2**			
RUN-PERFBENCH	10		**2**			
RUN-TESTS_EXTMOD_HARDWARE_NATIVE	8	1	**3**	10	7	**15**
RUN-TESTS_EXTMOD_HARDWARE	8	1	**3**	15	12	**5**
RUN-TESTS_NET_HOSTED	5	1		45	4	**1**
RUN-TESTS_NET_INET	5	1		57	1	**7**
RUN-TESTS_STANDARD_NATIVE	5	1	**6**	3787	526	**362**
RUN-TESTS_STANDARD_VIA_MPY	8	1	**3**	6664	652	**185**
RUN-TESTS_STANDARD	9	1	**2**	7691	754	**20**

Layering


HW
SW
HW
SW
DUT micropython
DUT showcase
DUT XY
testbed_micropython
testbed_showcase
testbed_XY
Octoprobe Tentacle
Octoprobe

SKIP: Layer: Octoprobe

```
op udev
Monitoring tty, usb and block events...
subsystem=tty device_event.action='remove'
device_event.sys_path='/sys/devices/pci0000:00/0000:00:14.0/usb1/1-7/1-7.3/1
-7.3.4/1-7.3.4.3/1-7.3.4.3:1.0/tty/ttyACM7'
  usb_location (parsed sys_path)=1-7.3.4.3
  device_event.device_node='/dev/ttyACM7'
  device_event.device_type=None

device.properties['ID_USB_VENDOR_ID/ID_USB_MODEL_ID']=0x2E8A(11914)/0x0005(5
)
subsystem=usb device_event.action='unbind'
device_event.sys_path='/sys/devices/pci0000:00/0000:00:14.0/usb1/1-7/1-7.3/1
-7.3.4/1-7.3.4.3'
  usb_location (parsed sys_path)=1-7.3.4.3
  device_event.device_node='/dev/bus/usb/001/051'
  device_event.device_type='usb_device'
  device.properties['ID_USB_VENDOR_ID/ID_USB_MODEL_ID']=-/-
```

op query
Tentacle e46414481338-3a21 v0.3
on USB 1-7.4.4 /dev/ttyACM8
Tentacle e46414481355-552b v0.3
on USB 1-7.4.3 /dev/ttyACM3

Layer: testbed_micropython

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```
mptest list-tentacles
  Tentacle 552b-RPI_PICO2
      infra: 1-7.4.3.1 /dev/ttyACM3
      dut:   1-7.4.3.3 -
    variants=RPI_PICO2,RPI_PICO2_W-RISCV
    futs=FUT_MCU_ONLY,FUT_EXTMOD_HARDWARE
  Tentacle 0c30-ESP32_C3_DEVKIT
      infra: 1-7.3.2.1 /dev/ttyACM2
      dut:   1-7.3.2.3 /dev/ttyUSB1 - CP2102N USB to UART Bridge Controller
    variants=ESP32_GENERIC_C3
    futs=FUT_MCU_ONLY,FUT_EXTMOD_HARDWARE,FUT_WLAN,FUT_BLE
```

FUT - Feature under Test

- FUT_MCU_ONLY
- FUT_EXTMOD_HARDWARE: UART loopback, PWM loopback
- FUT_WLAN
- FUT_BLE

```
mptest test --only-board ESP32_GENERIC_S3 --only-test RUN-PERFBENCH
```

How to implement HIL

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Define test cases. Group them by FUT (Feature under Test)
Draw schematics, solder Tentacles
Write `testbed_myusecase` (flash, run test, collect results…)
Write tests

Octoprobe

- Many details are solved by octoprobe
- Use testframework as pytest, ceedling, …
- Open Source/Open Hardware
- Adapt tentacle (KiCad, JLCPCB)

Octoprobe

- Linux only

Fragen - Ideen - Feedback

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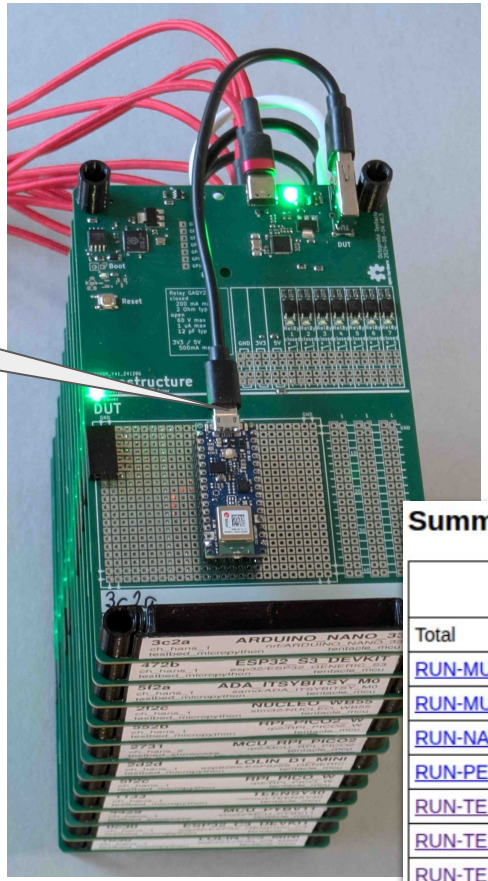
SKIP mptest

cd micropython
mptest test



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Work in progress:
Goal 0 failures

Why?

Problems?

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SKIP github action

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mptest test
--firmware-build=https://github.com/micropython/micropython.git@v1.26.0-preview

Action (30min):
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- Build required firmware / variants
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selfhosted runner

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SKIP: Next steps

- Fix all tests: Goal is 0 errors
- Run on PR, Attach Report to PR

Goals archived:

Keep good code quality
Faster feedback for maintainers (PR's)
Release testing got simpler
Good showcase for HIL testing

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Future

Octo probe

Use octoprobe regression testing for

- Higher level tests: I2C, SPI, driver testing, library testing
- regression testing: circuit python
- regression testing: tinyusb

Interested to contribute?