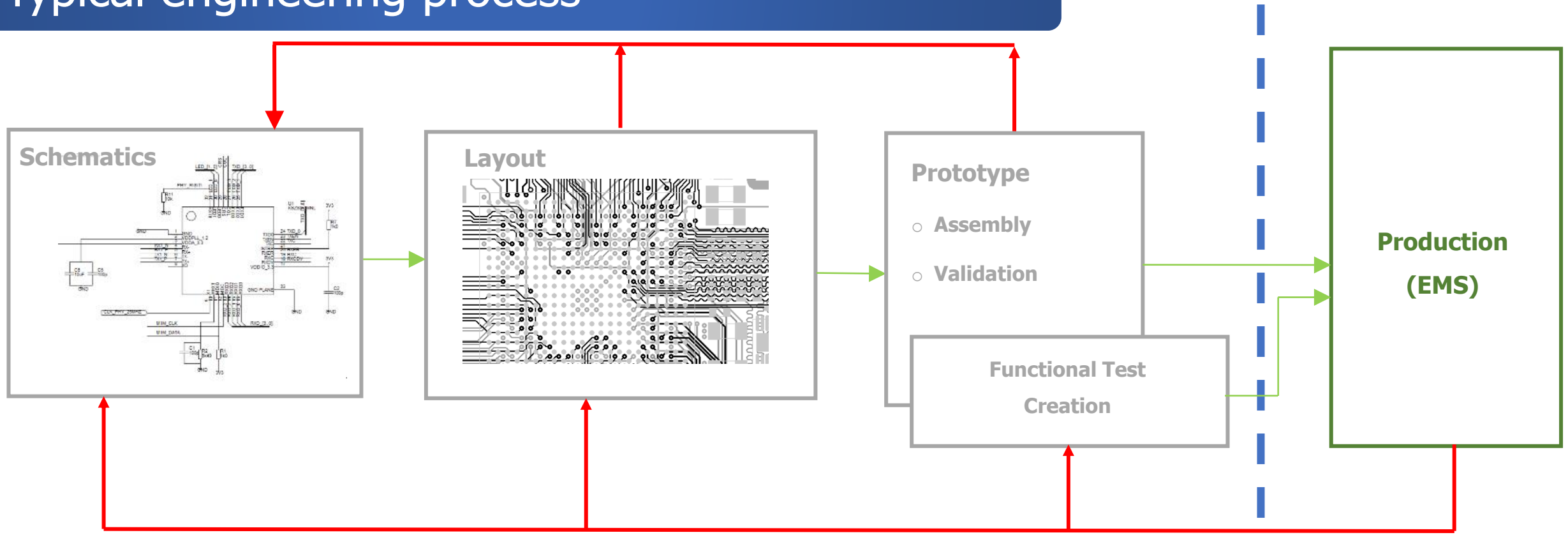
# De voordelen van de JTAG interface voor een project met complexere elektronica boarden

- Typical engineering process
- Test methods overview
- JTAG interface Chip level
- Circuits that can be tested well via the JTAG interface
- ISP possibilities via the JTAG interface
- JTAG Test - and ISP applications development process
- Benefits overview

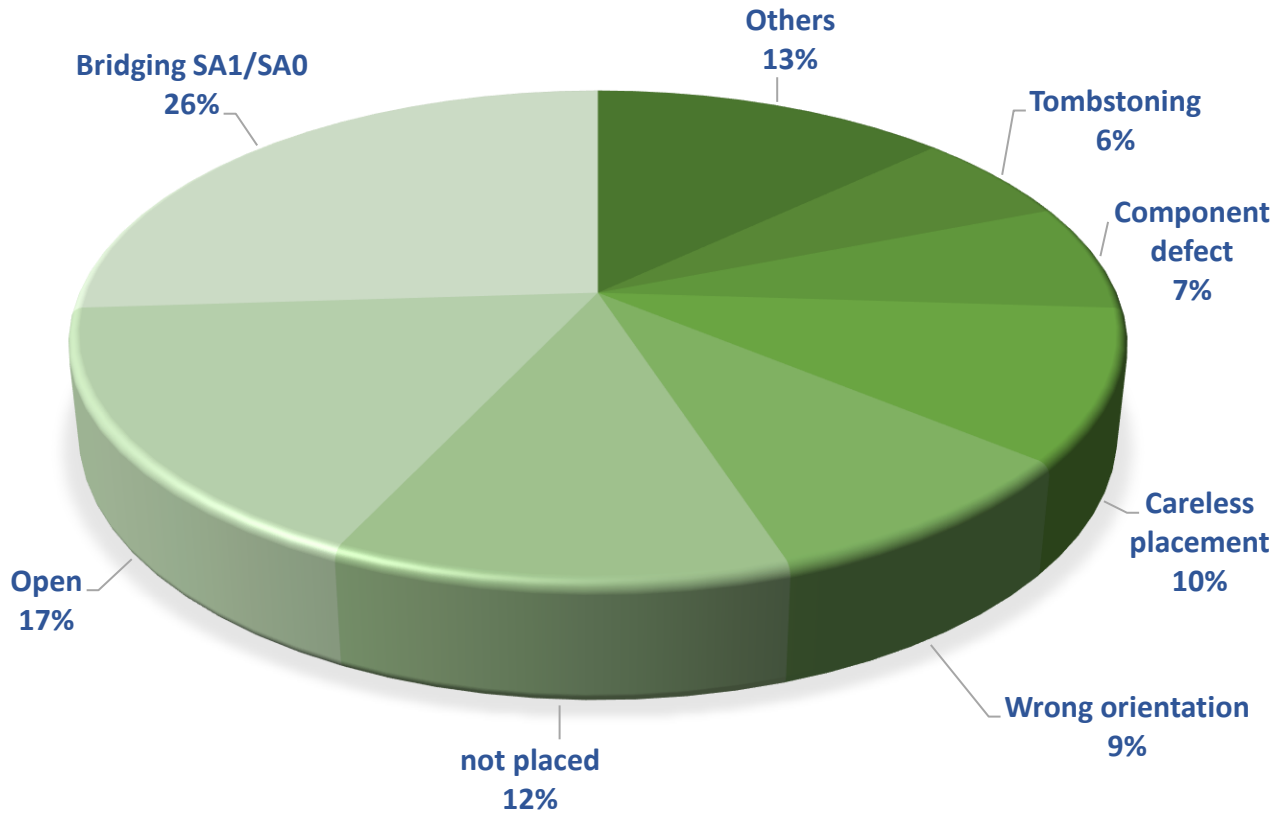
JTAG Technologies
Rik Doorneweert

# Typical engineering process




- PCBA's prototypes are delivered untested
- Firmware required to validate HW design
- Test development only starts after layout
- Design change requests for test improvements have (too) much impact

# Typical fault spectrum




Find the failures before your customers do !!!

# Various test methods used in production

**X-RAY**

Rontgen

**ICT**

In Circuit Test

**FP**

Flying Probe

**FCT**

Functional Test

**AOI**

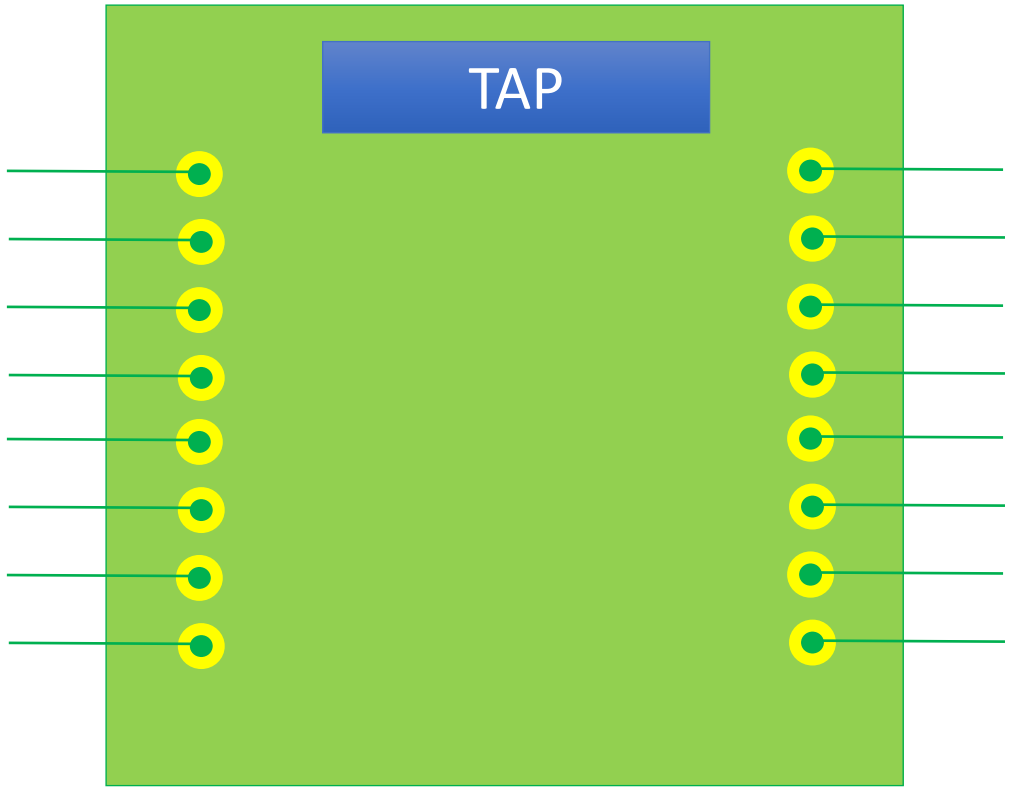
Automatic Optical Inspection

**JTAG**

Solutions

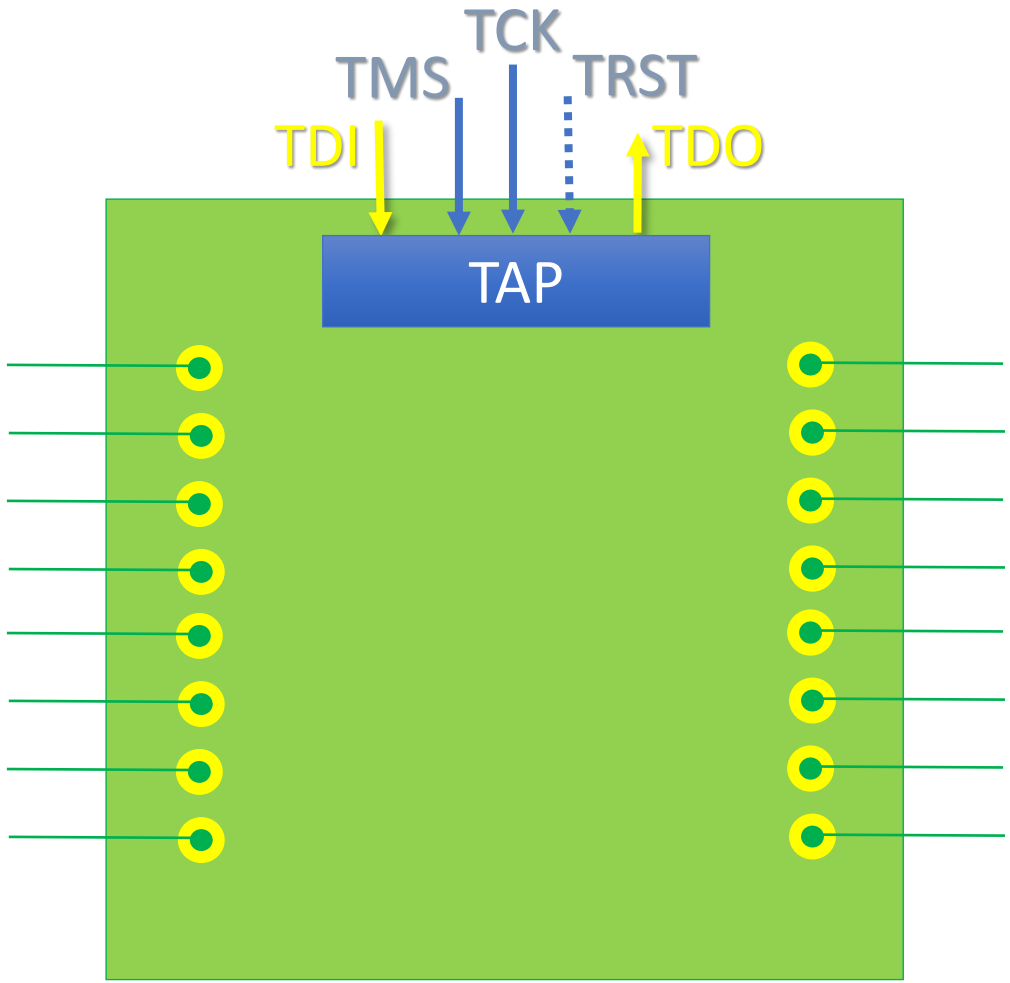
# Basics – Chip Level

- Test Access Port (TAP)



# Basics – Chip Level

- Test Access Port (TAP)
- TAP Signals:
  - Test Data Input
  - Test Data Output
  - Test Mode Signal
  - Test Clock
  - Test Reset



# Basics – Chip Level

- Test Access Port (TAP)
- TAP Signals:
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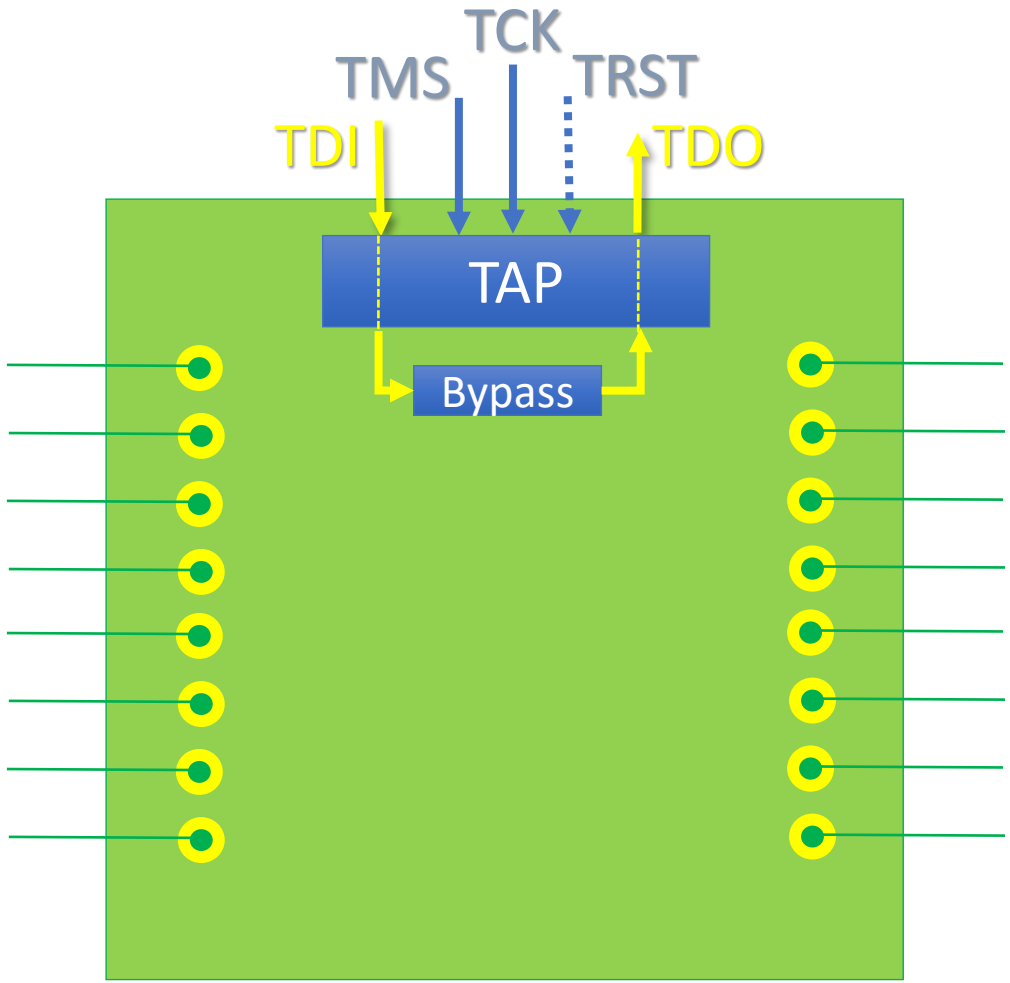
  - Test Data Output
  - Test Mode Signal
  - Test Clock
  - Test Reset
- Bypass register



# Basics – Chip Level

- Test Access Port (TAP)
- TAP Signals:
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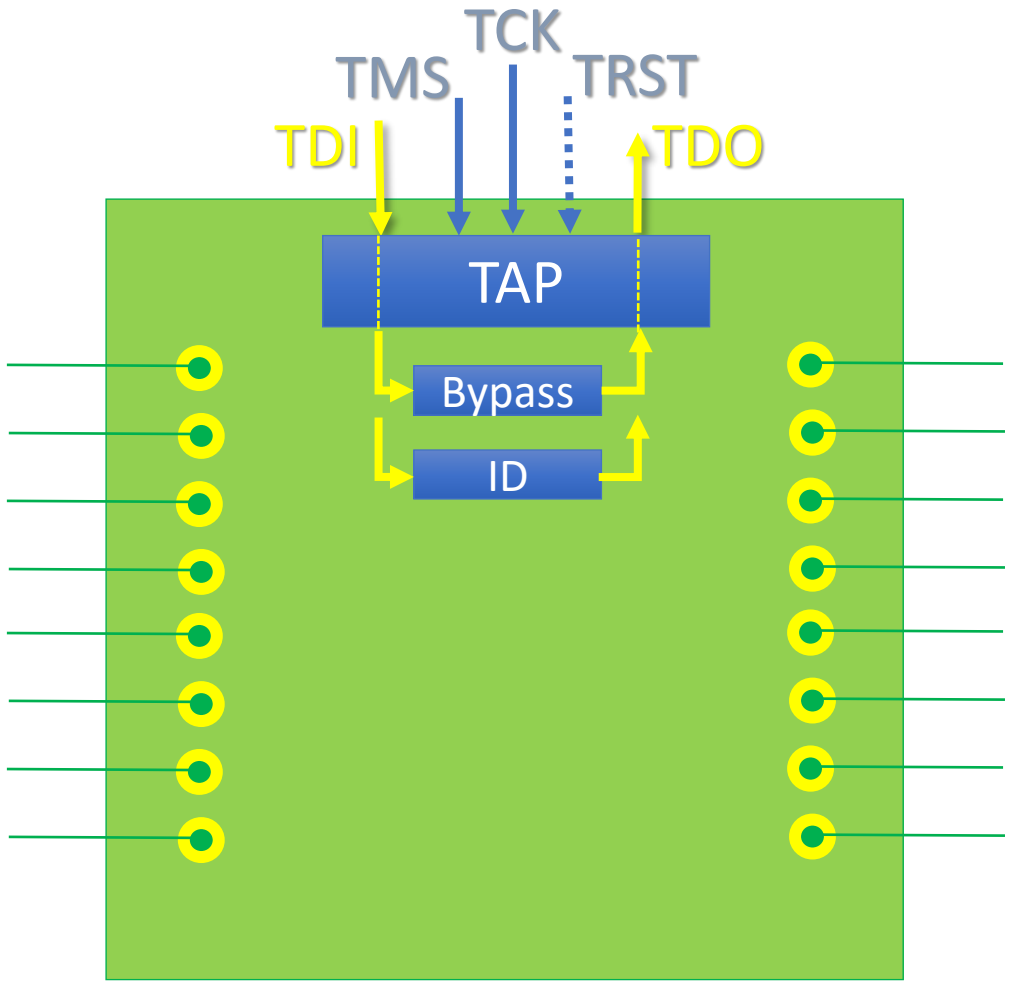
  - Test Reset
- Bypass register
- Identification register



# Basics – Chip Level

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- Identification register
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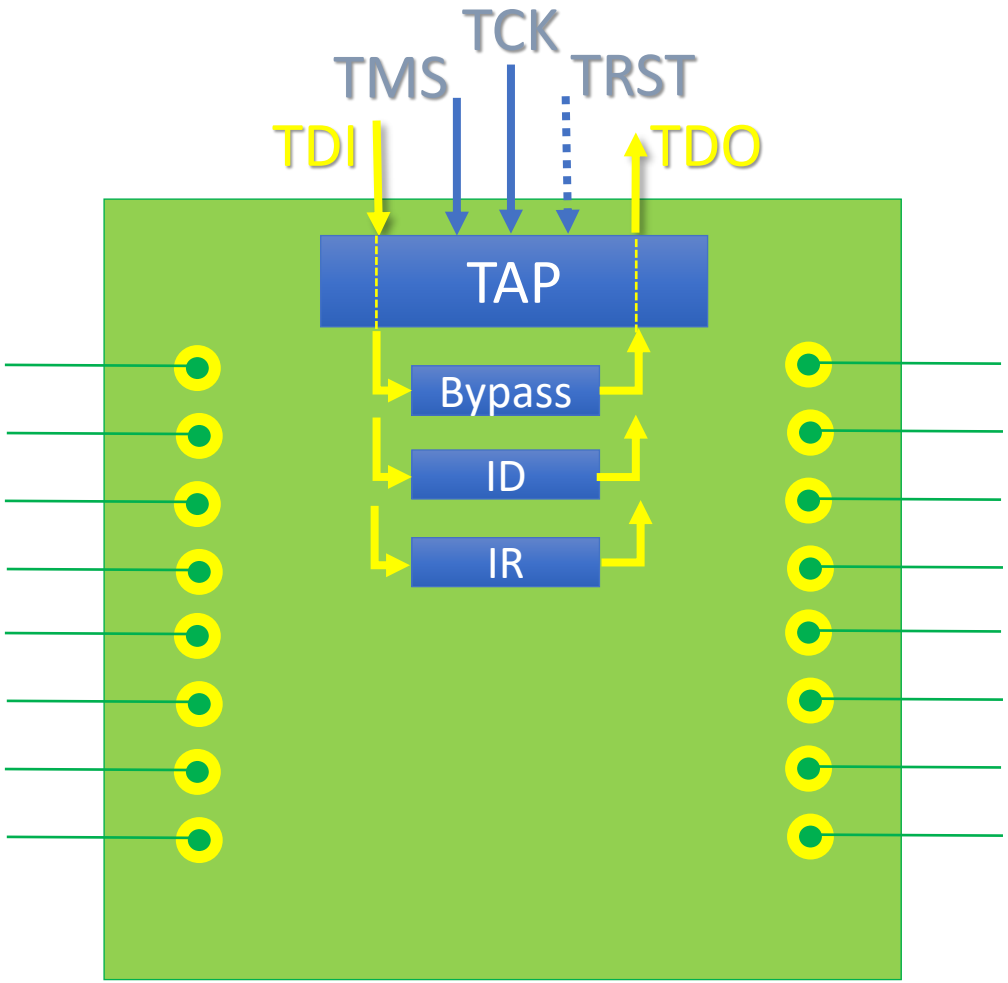

# Basics – Chip Level

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- TAP Signals:
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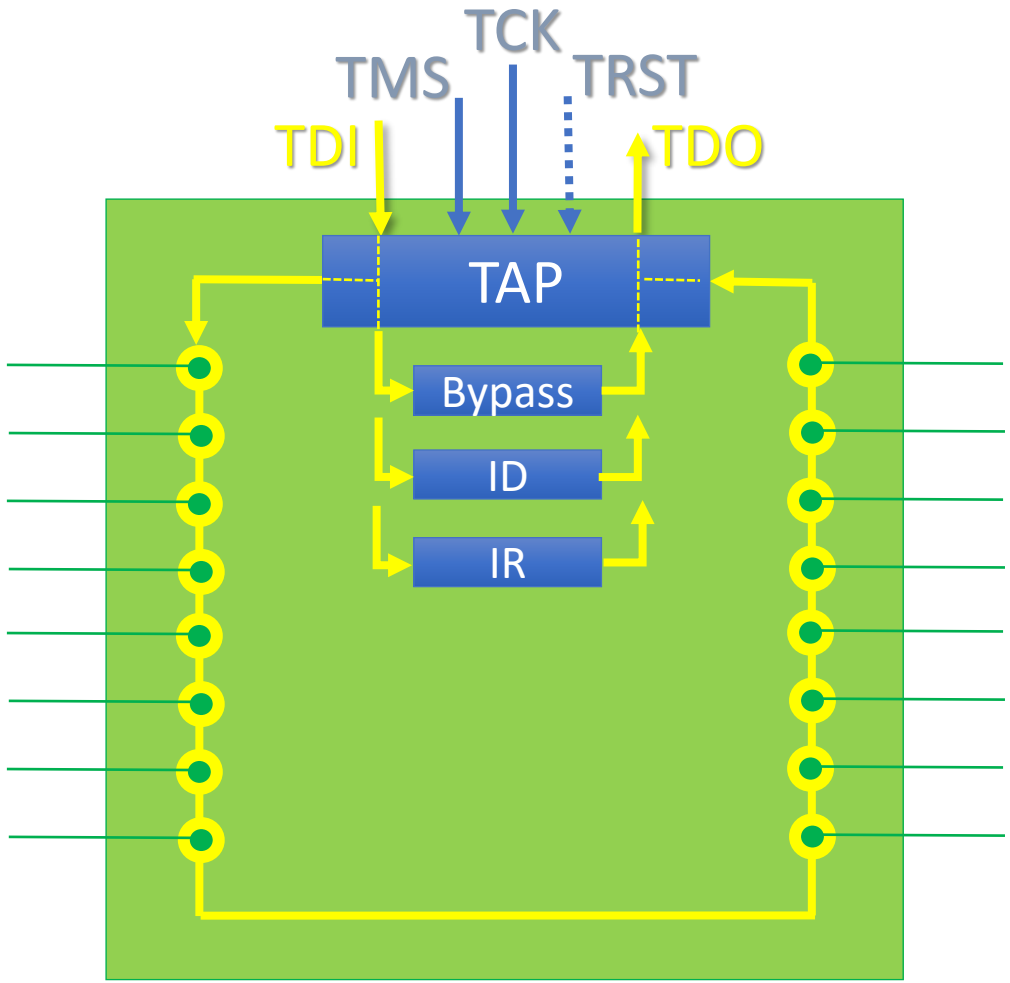
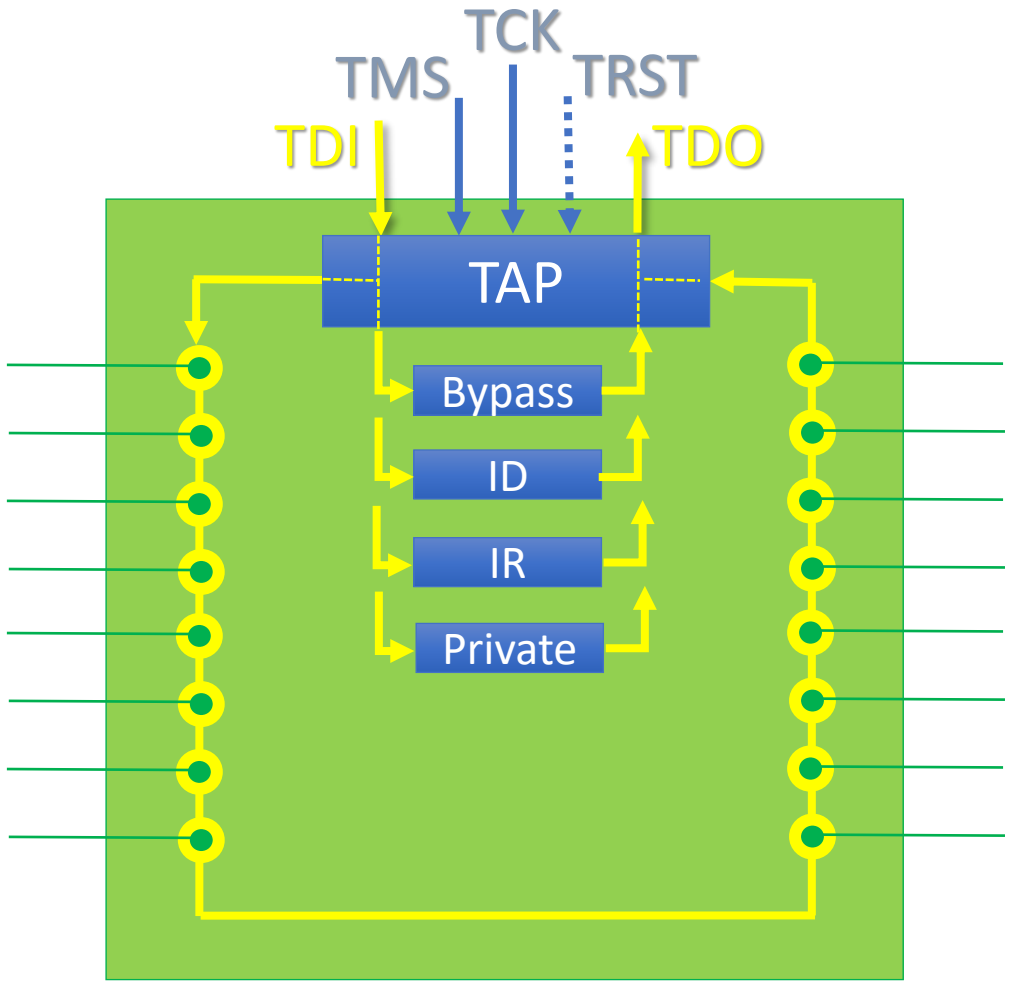
  - Test Reset
- Bypass register
- Identification register
- Instruction register
- Boundary Scan register



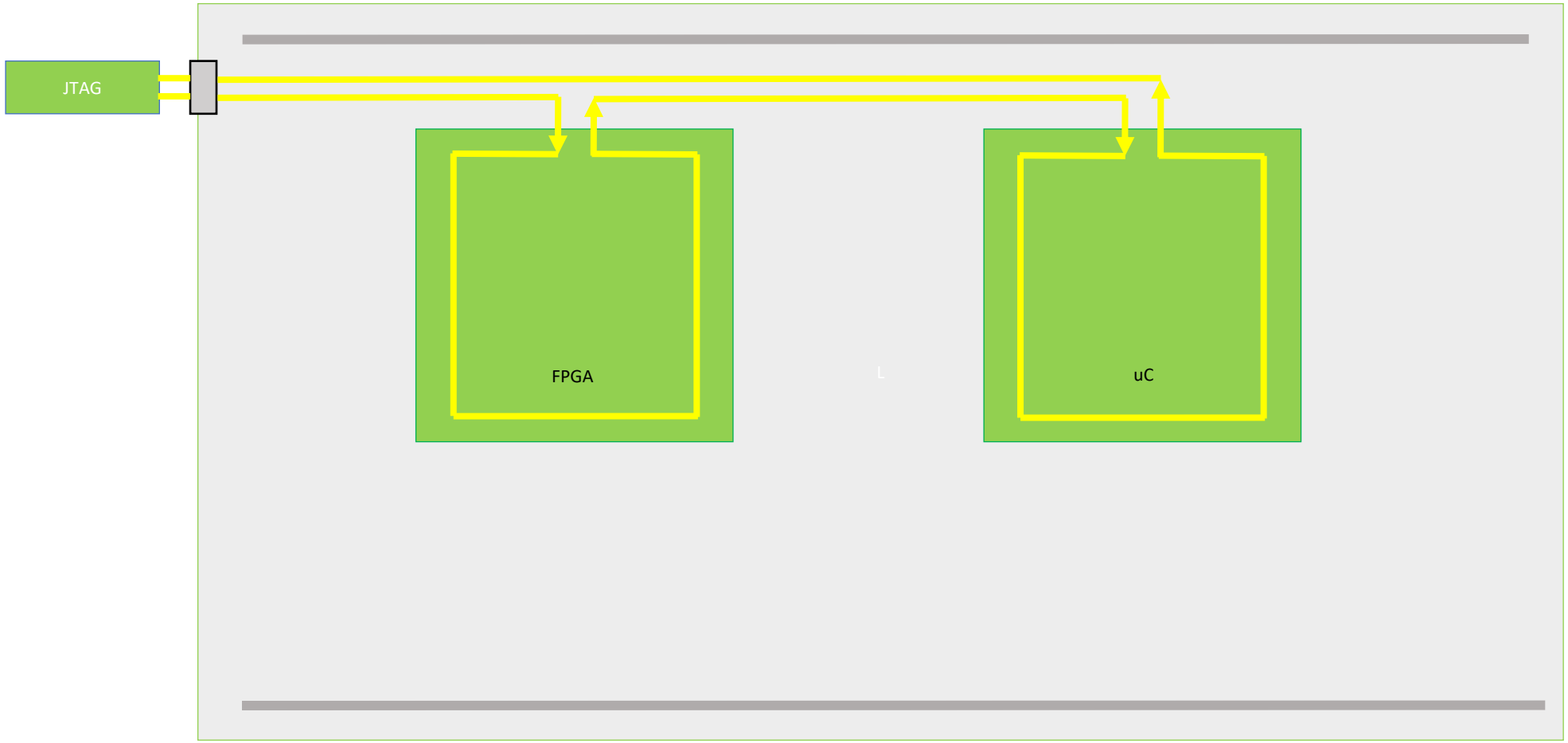
# Basics – Chip Level

- Test Access Port (TAP)
- TAP Signals:
  - Test Data Input
  - Test Data Output
  - Test Mode Signal
  - Test Clock
  - Test Reset
- Bypass register
- Identification register
- Instruction register
- Boundary Scan register
- Private



# Basics - Test Applications

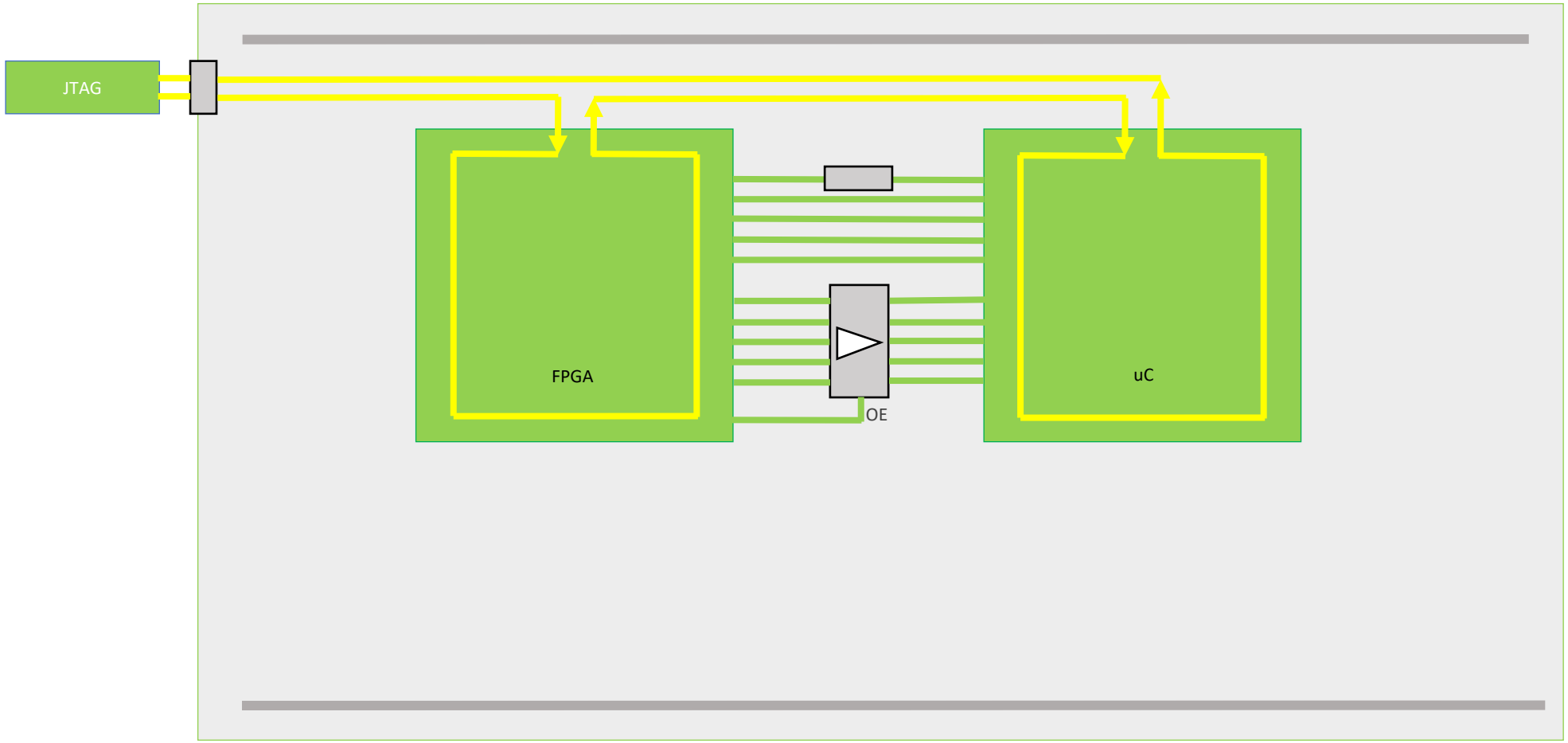
- Chain




Capture value | Identification value | TRST connection | Boundary Scan Register length

# Basics - Test Applications

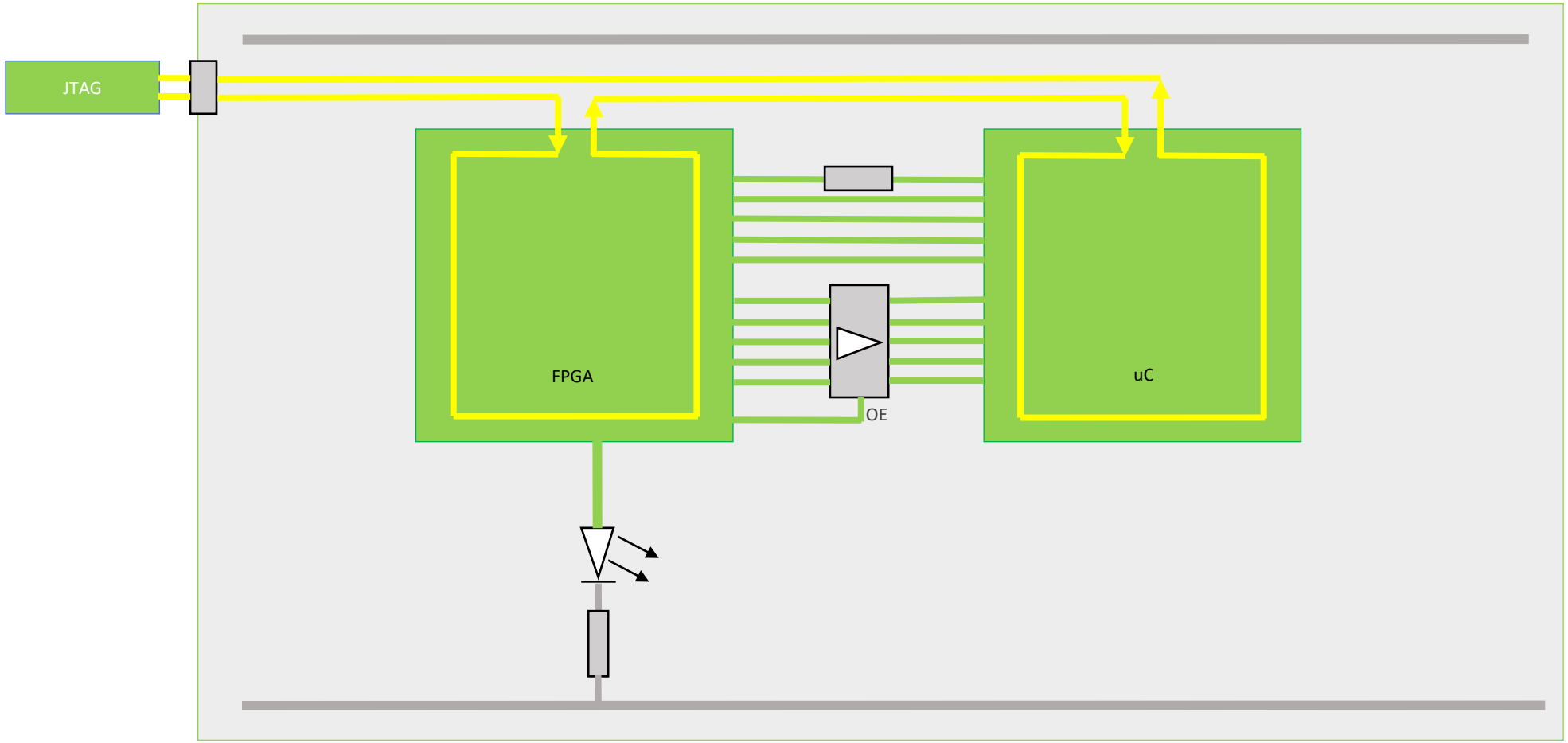
- Chain
- Interconnect




Testing on: Opens, Shorts , Stuck at 1 (SA1), Stuck at 0 (SAO)

# Basics - Test Applications

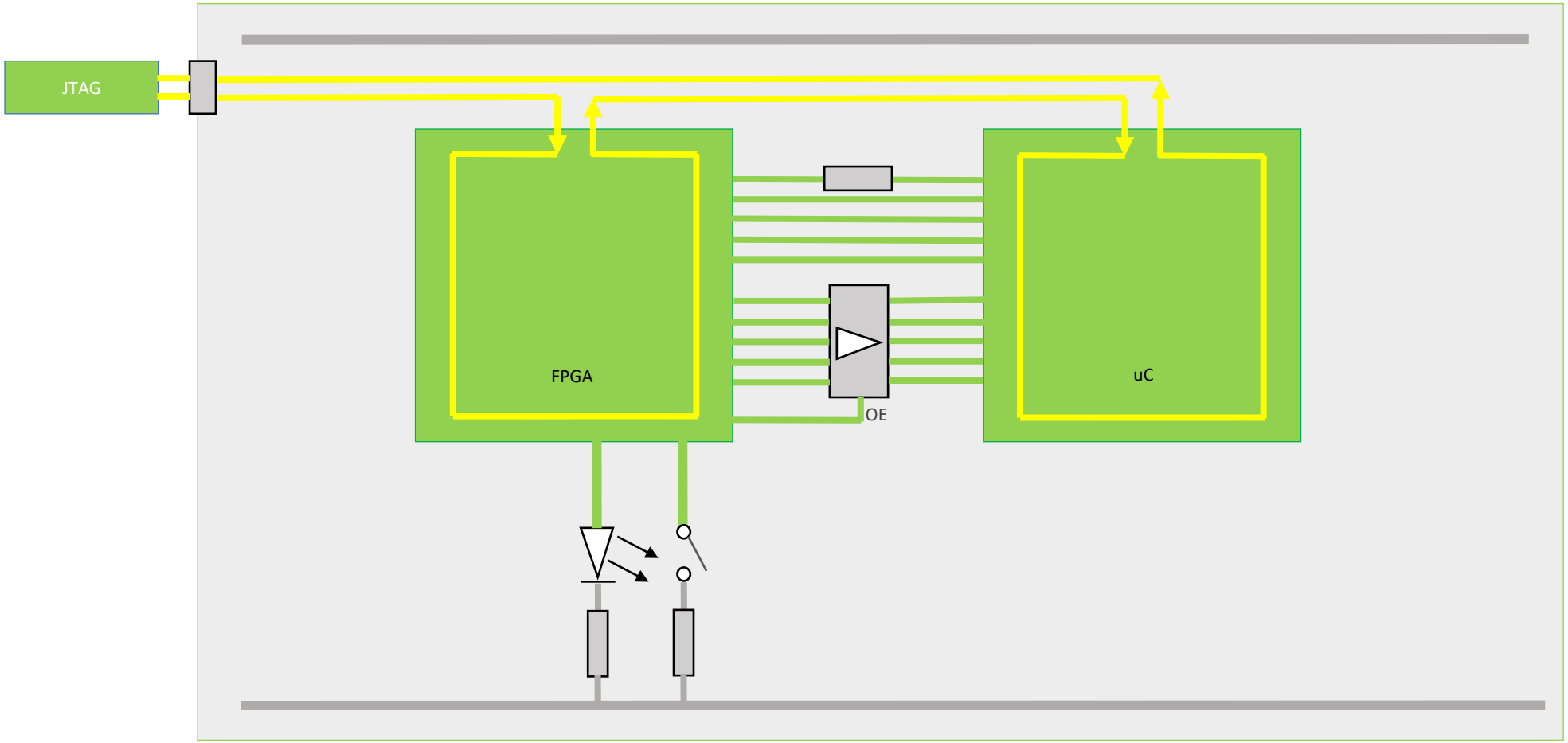
- Chain
- Interconnect
- LEDs




Drive LEDs – observe LEDs manually or by LED analyzer

# Basics - Test Applications

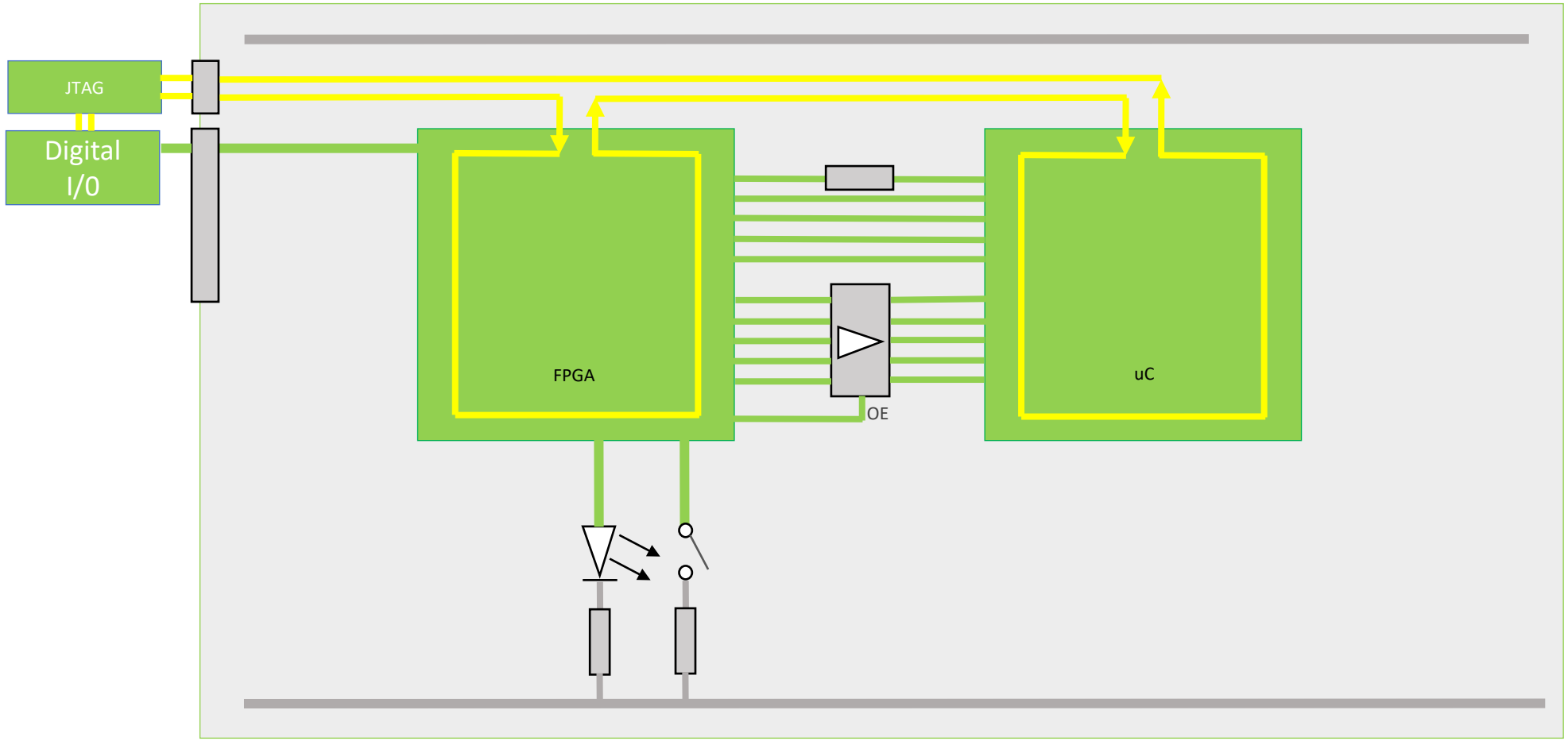
- Chain
- Interconnect
- LEDs
- Switches




Testing switch positions

# Basics - Test Applications

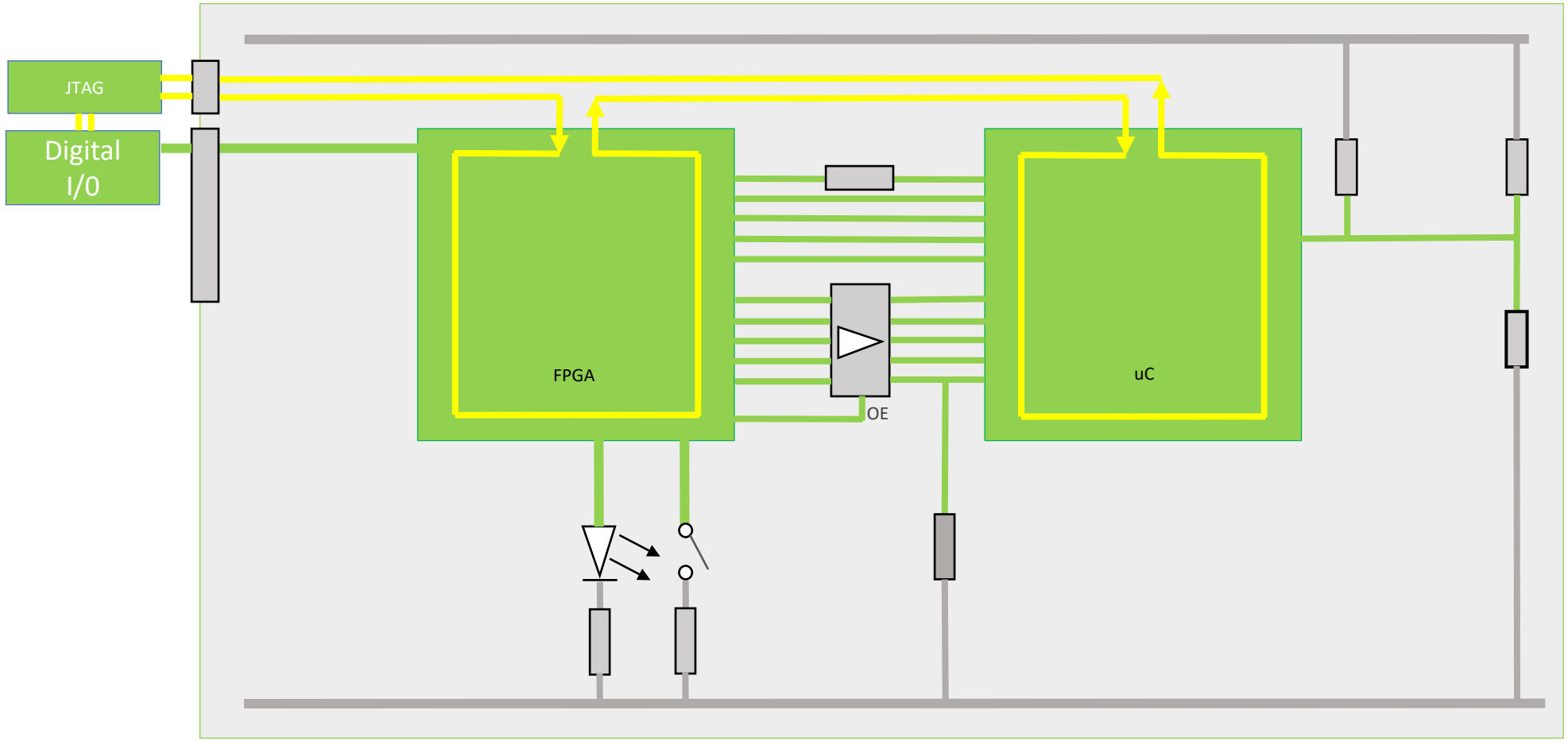
- Chain
- Interconnect
- LEDs
- Switches
- Connectors




Testing connections through connectors and via physical test points

# Basics - Test Applications

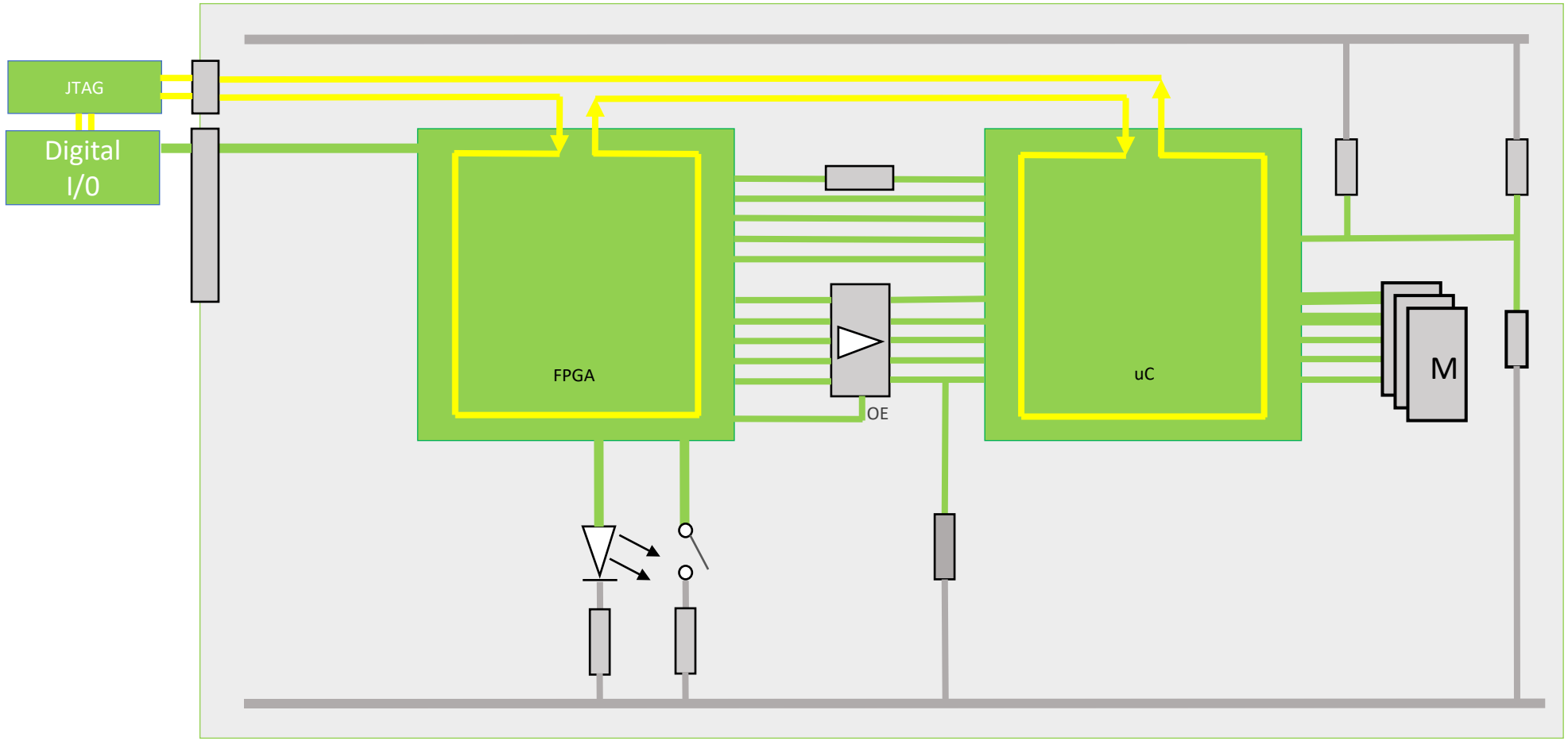
- Chain
- Interconnect
- LEDs
- Switches
- Connectors
- Resistors presence




Check presence of Pull up / Pull down resistors

# Basics - Test Applications

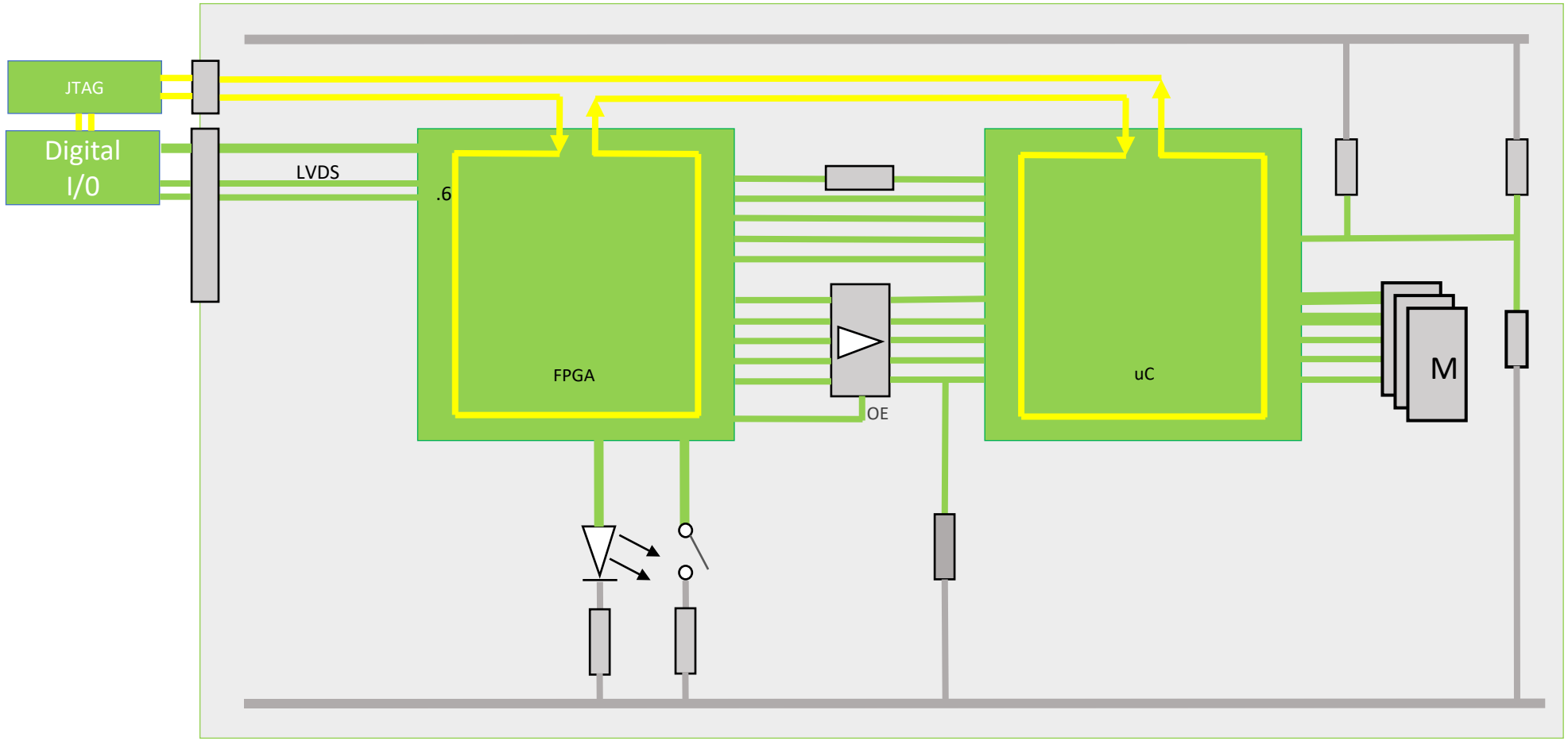
- Chain
- Interconnect
- LEDs
- Switches
- Connectors
- Resistors presence
- Memory connections




Test address - , data – and control lines of SRAM, DRAM, SDRAM, DDR2/3/4 etc.

# Basics - Test Applications

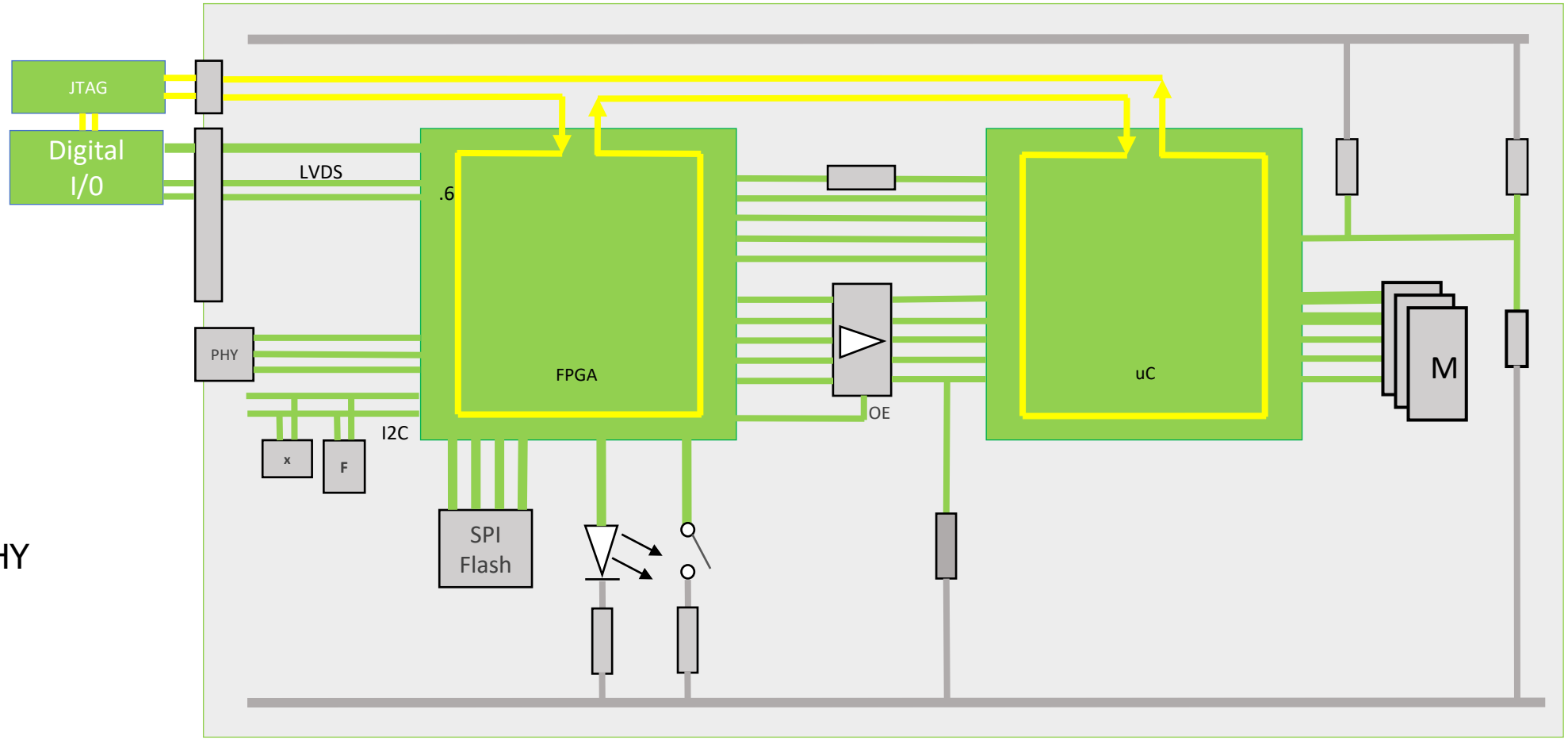
- Chain
- Interconnect
- LEDs
- Switches
- Connectors
- Resistors presence
- Memory connections
- LVDS




LVDS connections (IEEE 1149.6)

# Basics - Test Applications

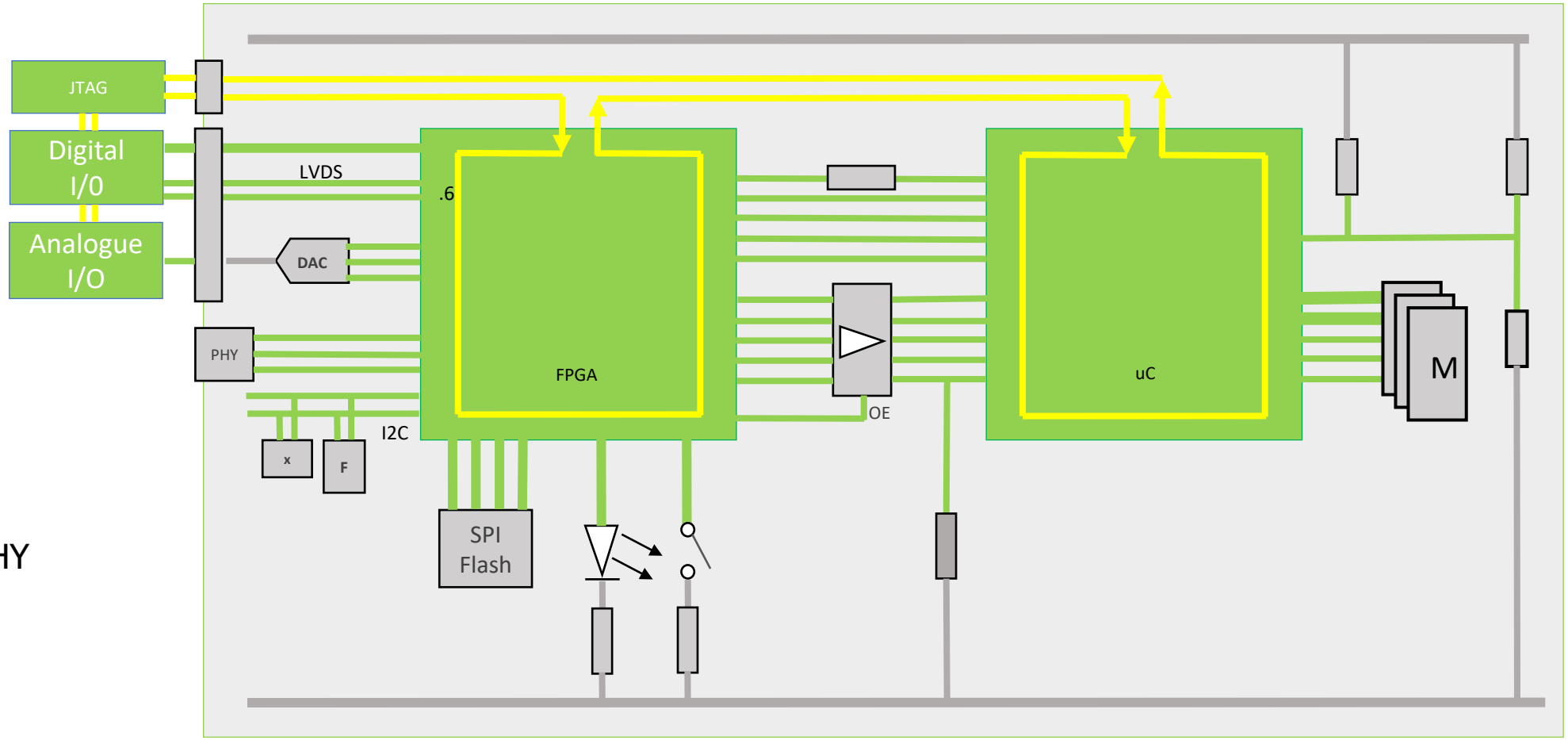
- Chain
- Interconnect
- LEDs
- Switches
- Connectors
- Resistors presence
- Memory connections
- LVDS
- Presence I²C, SPI, PHY




Serial bus tests (I²C, SPI ect.)

# Basics - Test Applications

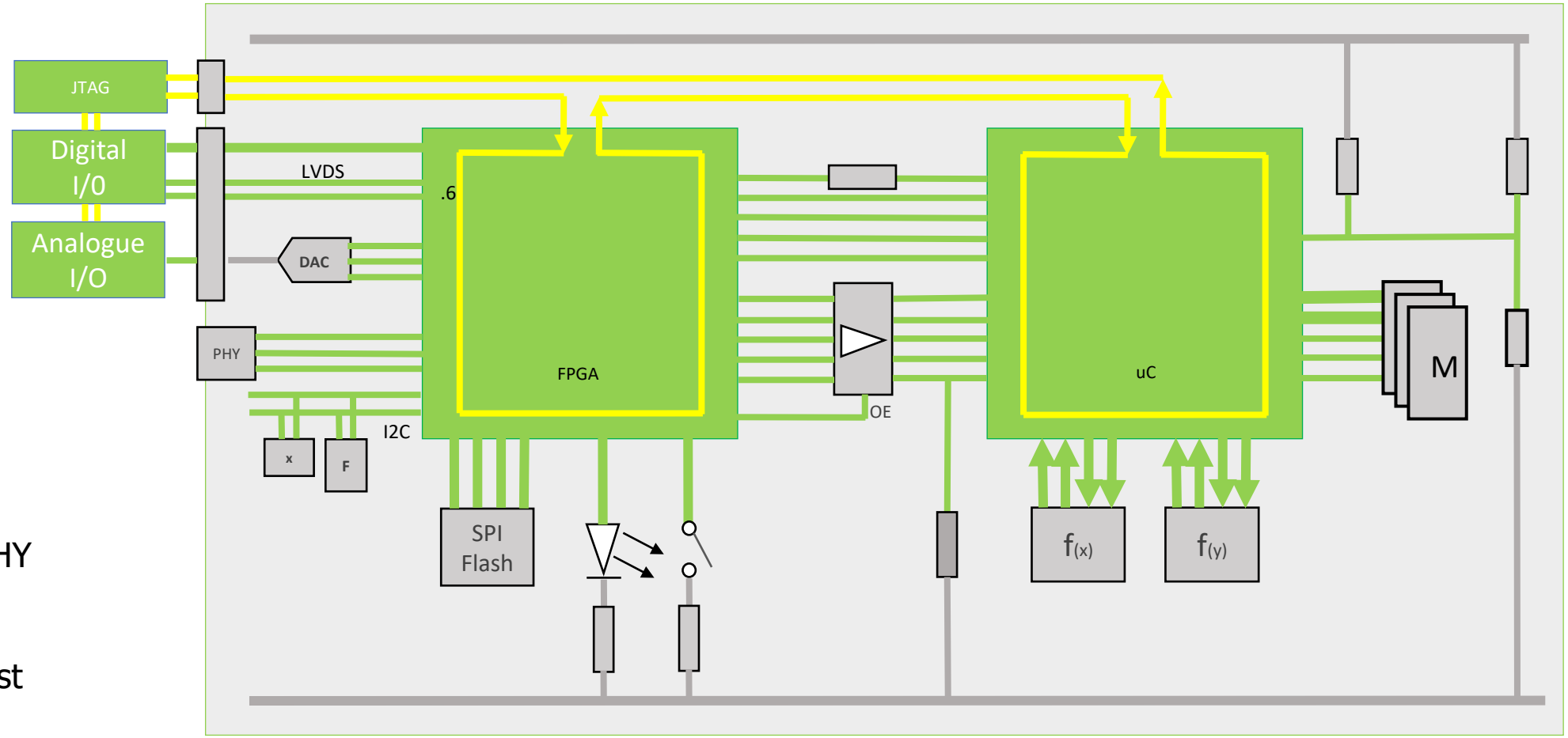
- Chain
- Interconnect
- LEDs
- Switches
- Connectors
- Resistors presence
- Memory connections
- LVDS
- Presence I²C, SPI, PHY
- Voltage, Freq, PWM




Increase Test coverage with external analogue driving and sense capabilities (ADC/DAC, PWM ect.)

# Basics - Test Applications

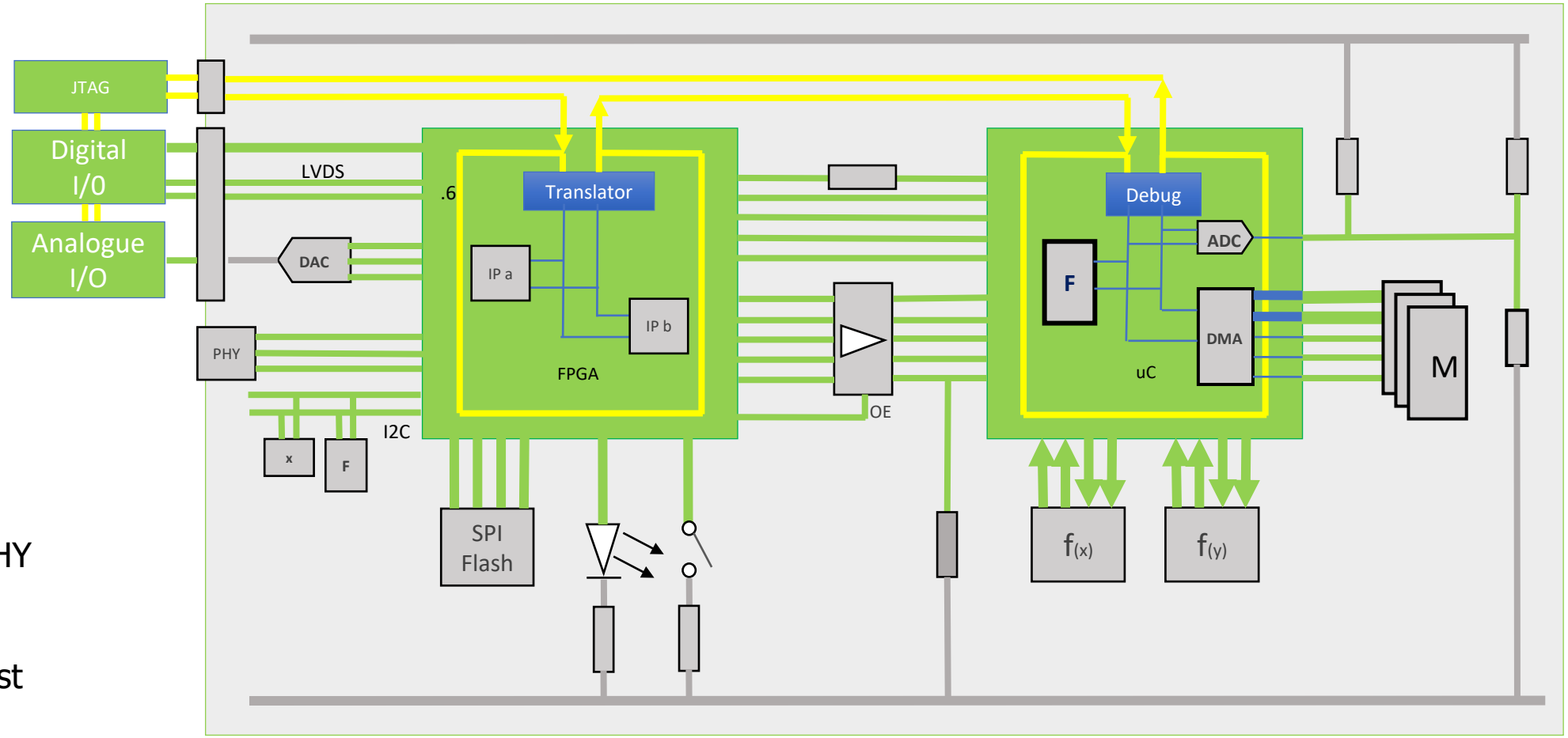
- Chain
- Interconnect
- LEDs
- Switches
- Connectors
- Resistors presence
- Memory connections
- LVDS
- Presence I²C, SPI, PHY
- Voltage, Freq, PWM
- Python Functional Test




Testing functions with Python based scripts, using Bscan accessible nodes as variable

# Basics - Test Applications

- Chain
- Interconnect
- LEDs
- Switches
- Connectors
- Resistors presence
- Memory connections
- LVDS
- Presence I²C, SPI, PHY
- Voltage, Freq, PWM
- Python Functional Test
- Emulative




Emulative Test for firmware independent @speed Test

# Basics - Test Applications

- Chain
- Interconnect
- LEDs
- Switches
- Connectors
- Resistors presence
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- Python Functional Test
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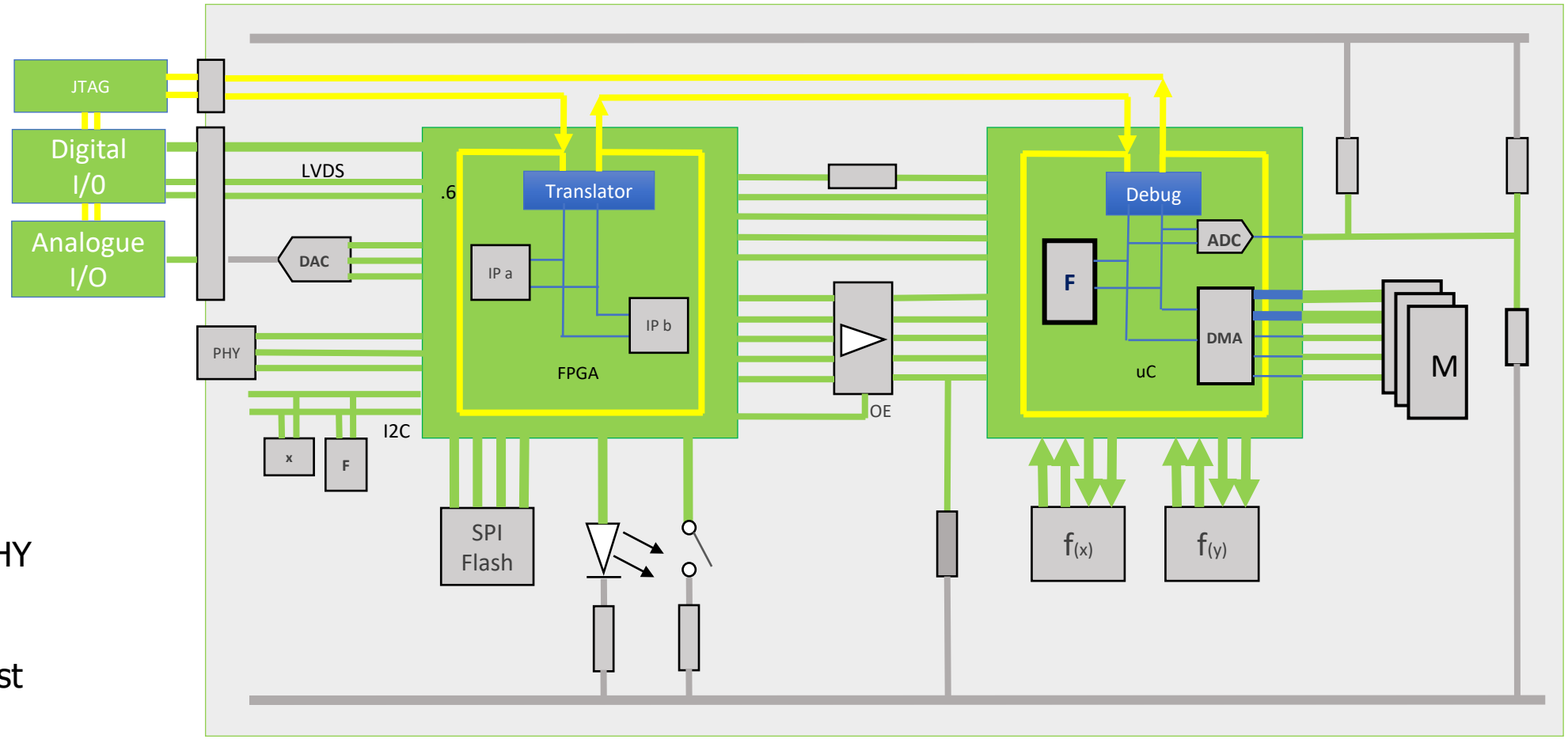
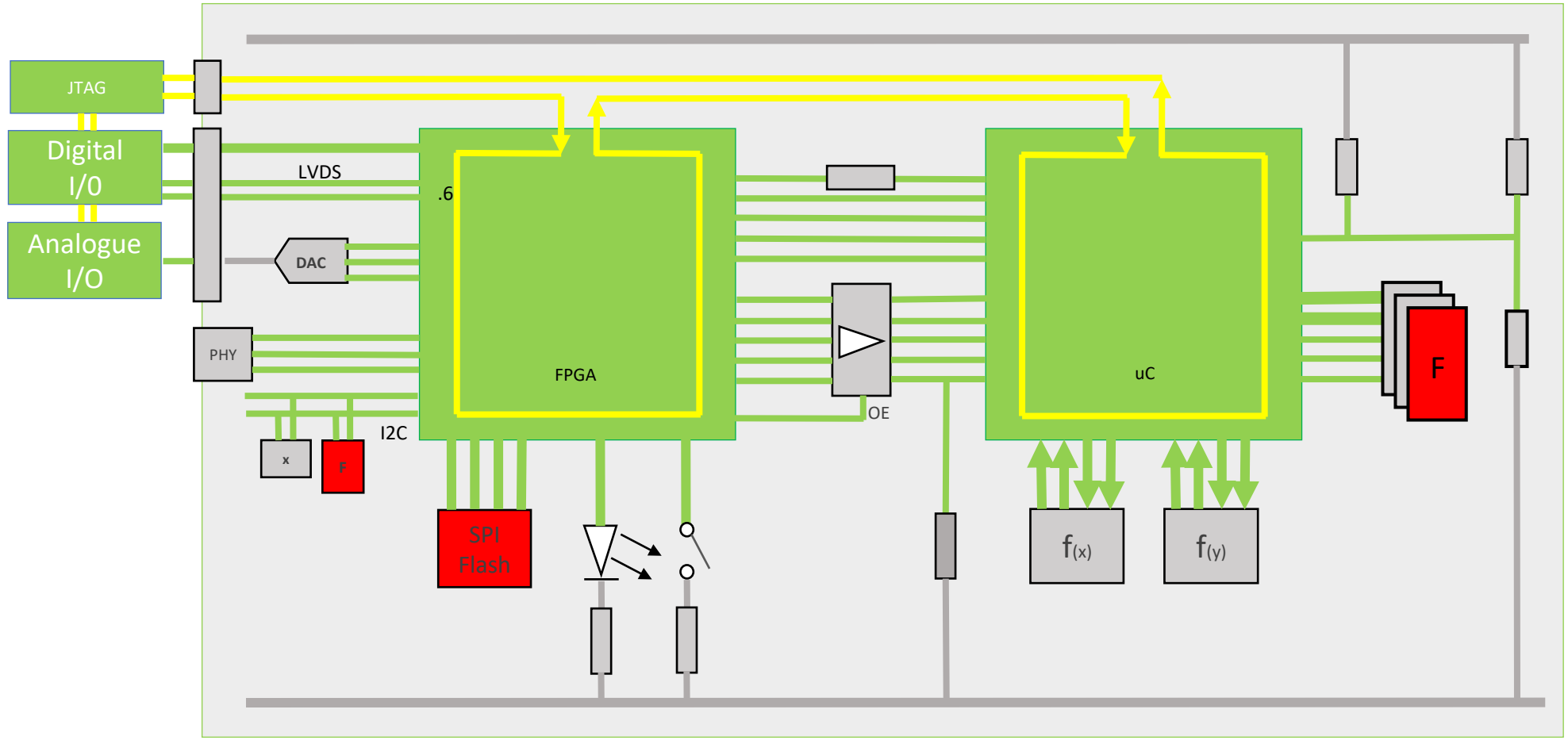


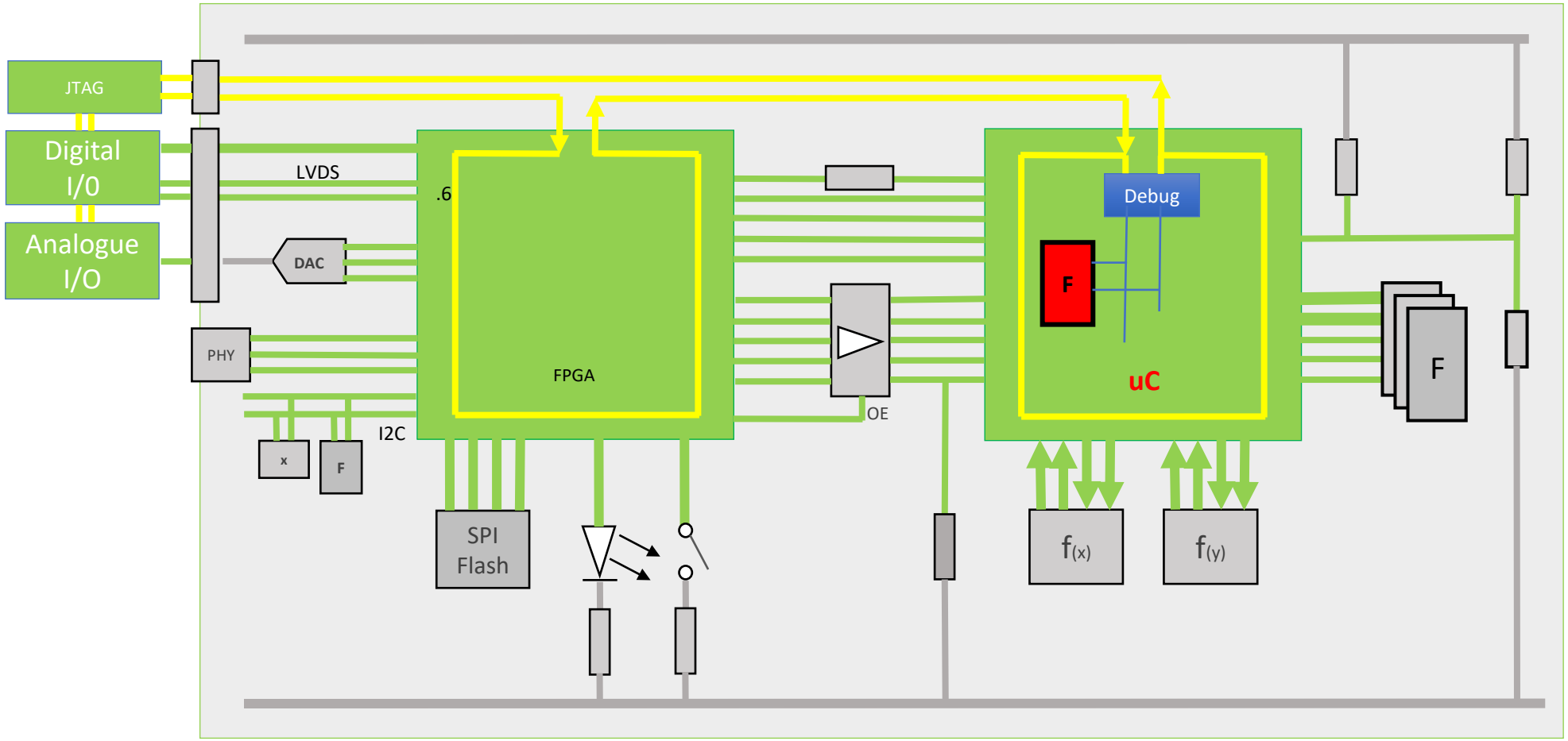
# In-System Programming – via Bscan register

- Flash
- I²C Flash
- SPI Flash



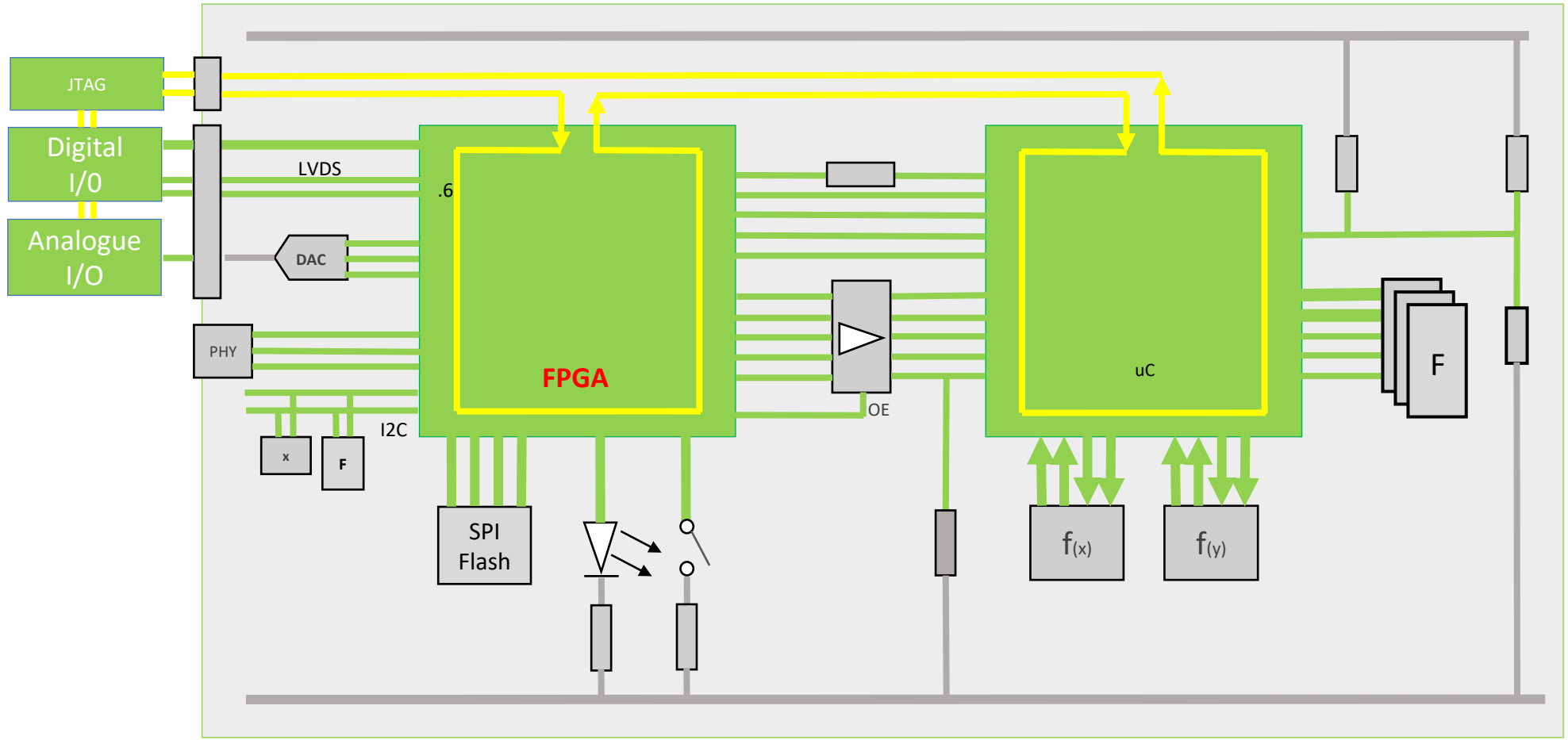
# In-System Programming – micro controllers

- Internal uC Flash



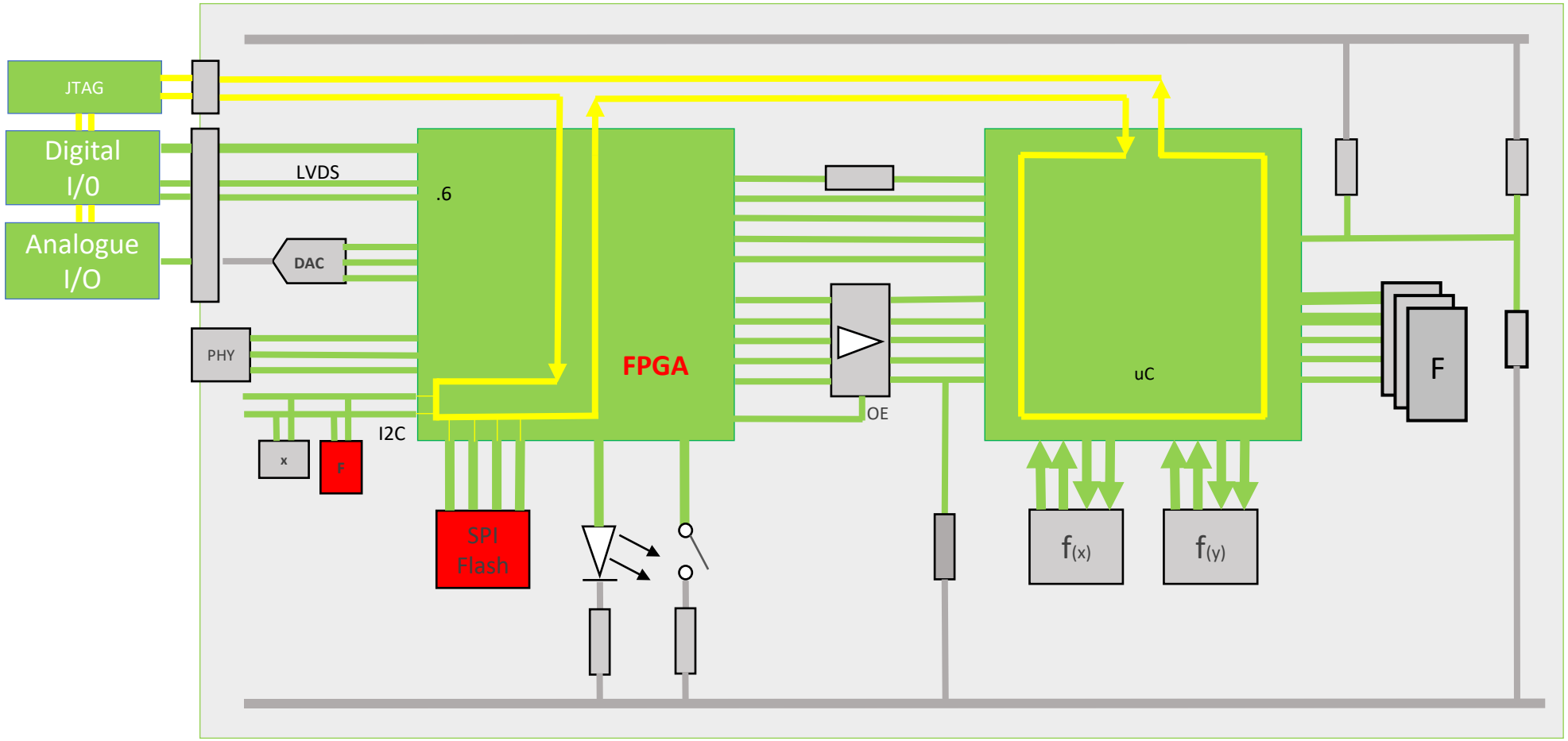
# In-System Programming – logic devices

- SVF
- JAM
- STAPL
- Jedec
- IEEE 1532



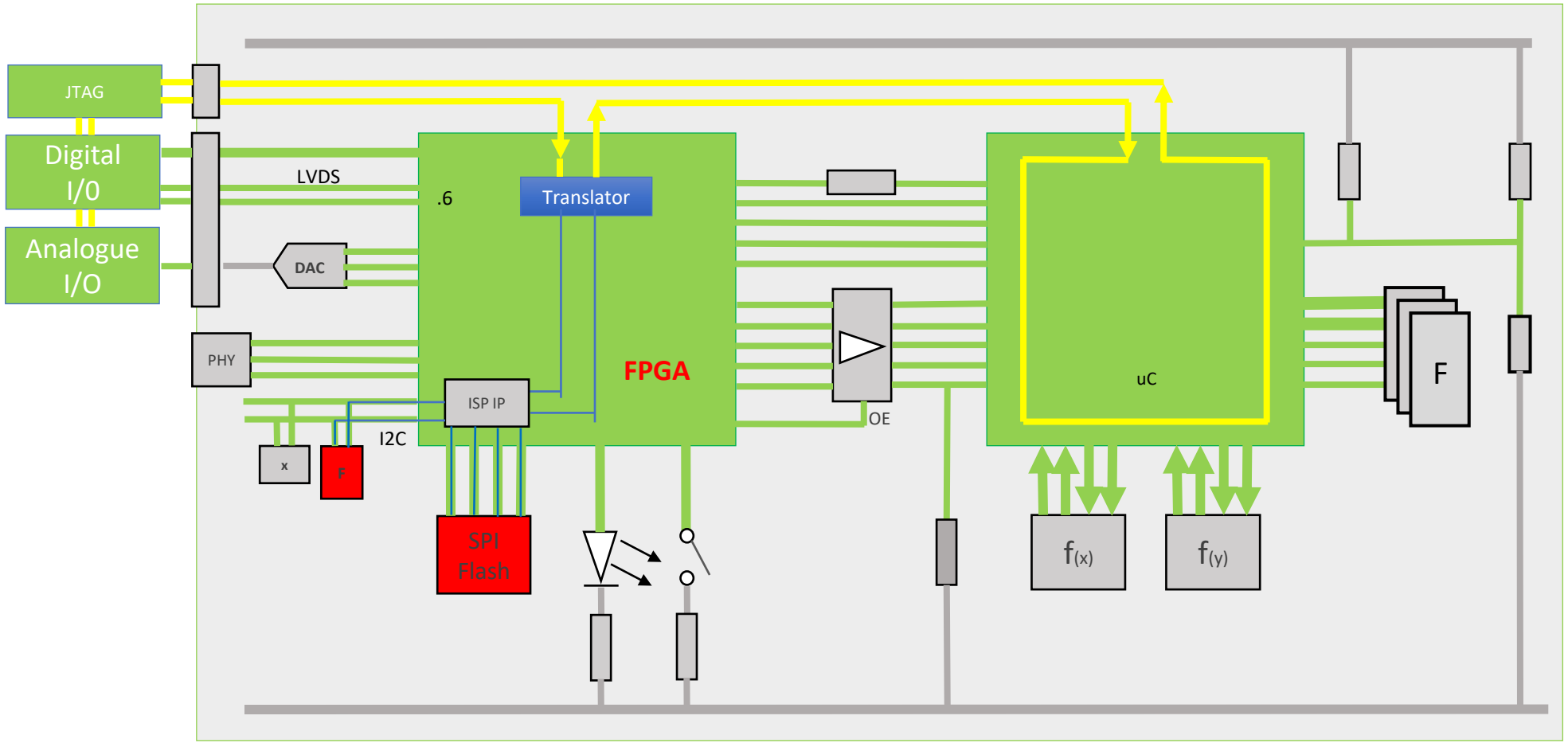
# In-System Programming – via short chain

- Flash
- I²C Flash
- SPI Flash

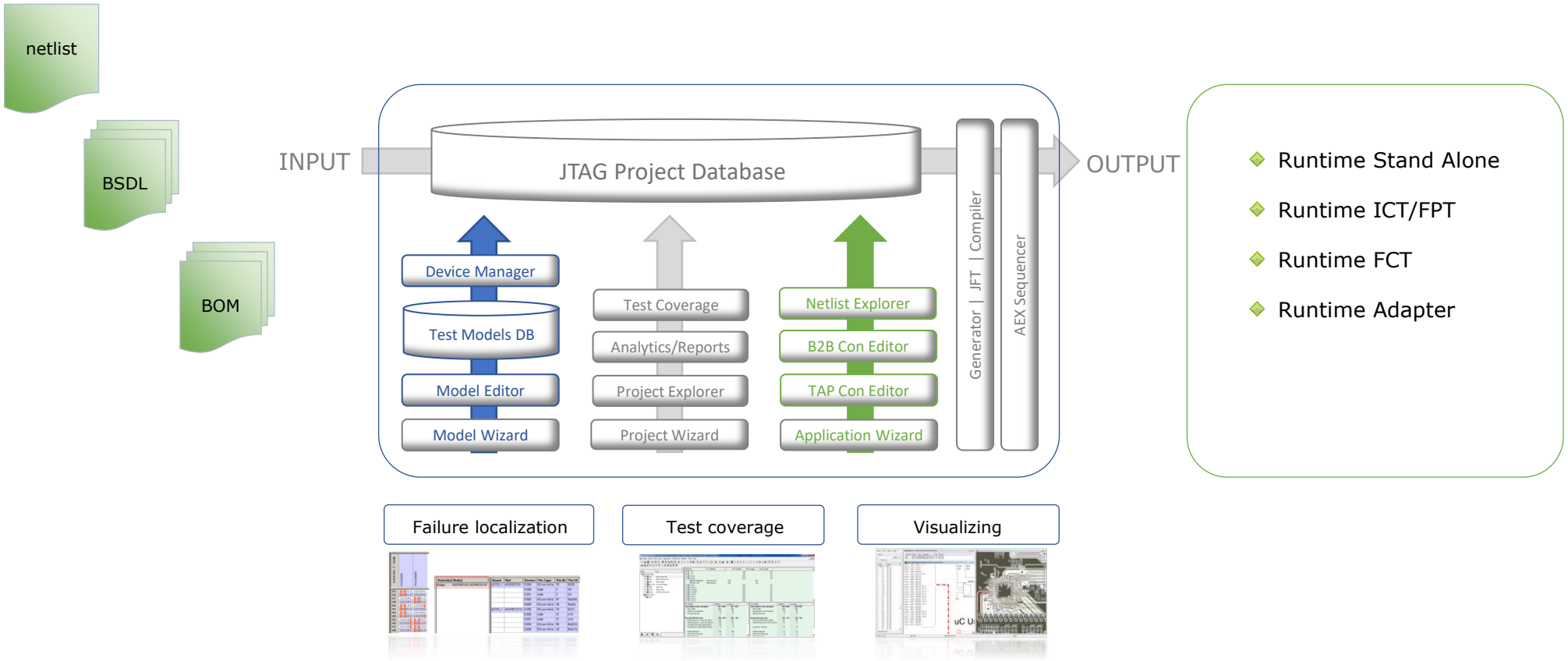


# In-System Programming – via embedded programmer

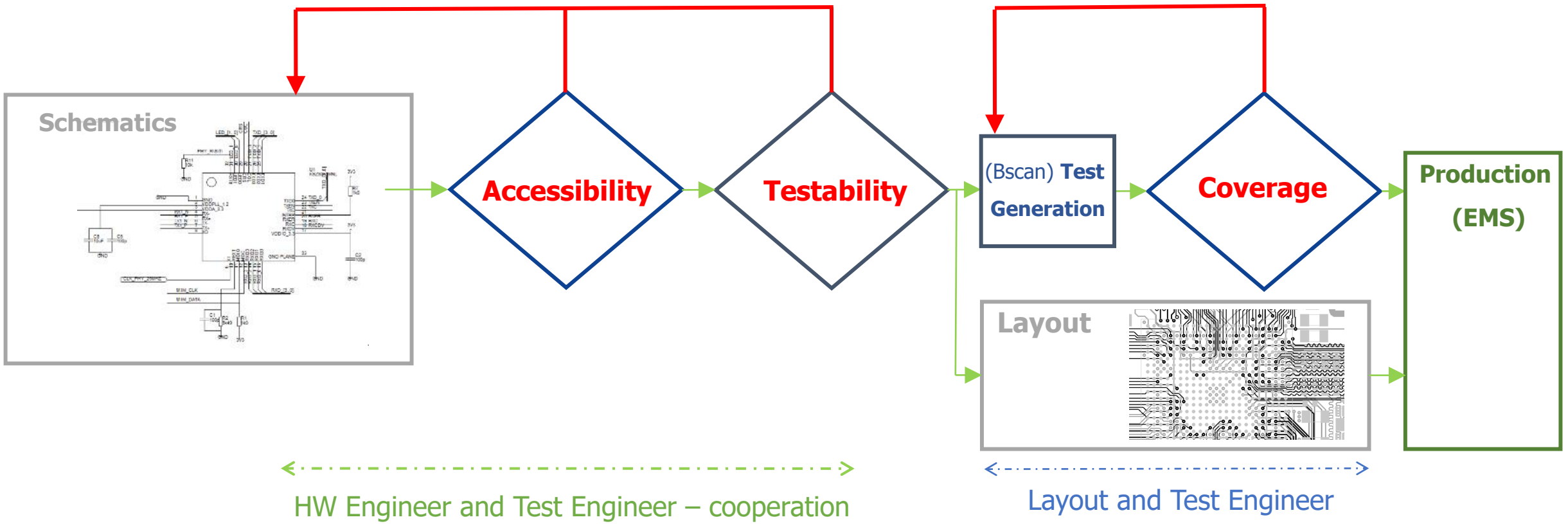
- I²C Flash
- SPI Flash
- Other…



# JTAG applications development process



# HW engineering process with JTAG



# JTAG benefits for engineering

**HW Engineer:**

- Prototype boards tested on production failures
- No firmware required to proof that HW design is correct
- Less DFT rules
- Less or no assistance required for repairs during production process or field returns
- Less or no test pads required

**Test Engineer:**

- Faster production test development
- Higher and known fault coverage
- Better failure localization

# JTAG benefits for the company

**Time to market:**

- One Test method that can be used for all product life cycle stages:
  - Prototype
  - Pre-Production
  - Production
  - Field returns
- Minimizes risk on design iterations

**Lower cost:**

- JTAG test equipment can be used for all board types with at least 1 JTAG device
- Less unrepairable boards

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