

Test Plan Reference

PLT

0.5.6

2019-08-19

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Revision History

Revision History

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<ul style="list-style-type: none">• Document retry mechanism for test items and test item steps• Document GATT-level BLE commands• Document `image` command test step to set background images• Document setting Label substitutions with the `label` command test step• add AVRATmega168P/PB targets	
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Preface

Document describing the test suite definition for use with the Production Line Tool.

1. Test Suite Reference

1.1 Test Suites

Example: A minimal test suite, with a single test item, scanning a bar code.

```
title: "PLT demo: Scan"
suite:
  - ident: SCAN-T1
    title: Scan MAC address
    steps:
      - command: scan MAC_ADDRESS
```

1.1.1 Test Suite Structure

PLT test suites are encoded as YAML text files, starting with the test suite title.

```
title: "PLT demo: Scan"
```

The `title:` is followed by the `suite:` section, containing the test items in the test plan.

1.1.1.1 Test Items

Test items are identified with an `ident:` line, can contain a descriptive `title`, and should contain one or more test item steps.

During test execution, all test item steps need to complete successfully for the test item to succeed.

1.1.1.2 Test Item Steps

Test item steps consist of `command:` or `uartcmd:` blocks. A Test Item can contain multiple Test Item steps.

1.1.1.3 Retries

Retry counts can be set for at the test item or test item step level, by adding a `retry:` field.

```
title: "Retries"
suite:
  - ident: T1
    title: Test Item retries
    retry: 3
    steps:
      - command: sleepms 1000
      - command: operator Manual
  - ident: T2
    title: Test Item retries
    steps:
      - command: sleepms 1000
      - command: operator Manual
    retry: 3
```

1.1.2 Basic Example

A basic In-Circuit Test suite for the PLT demo board.

```
title: "v0.1.8 (Green)"
suite:
  - ident: ICT-T1
    title: Identify DUT
    steps:
      - command: identify nRF52
  - ident: ICT-T2
    title: Erase nRF52 with FT2232H Mini Module
    steps:
      - command: erase nRF52
  - ident: ICT-T3
    title: Program DEMO-BOARD FW nRF52 with FT2232H Mini Module
    steps:
      - command: program nRF52 s132_nrf52_6.0.0_softdevice.hex,ly10-demo-fw-
0.1.8.hex,none
  - ident: ICT-T4
    title: BLE discovery
    steps:
      - command: bledis %BLEMAC% 30 # Wait up to 30 seconds for BLE discovery to
complete
```

1.2 Test Commands

1.2.1 ble - GATT-level BLE Tests

Perform GATT-level BLE interactions with the DUT.

Usage:

```
ble gatt connect addr:<address> [<timeout> [<minRSSI>]]
ble gatt connect name:<name> [<timeout> [<minRSSI>]]
ble gatt disconnect
ble gatt discover
ble gatt match char:<charUUID> <matchHex>
ble gatt read char:<charUUID> <matchHex>
ble gatt sub char:<charUUID>
ble gatt write char:<charUUID> <valueHex>
```

Argument	Description
<i>name</i>	GAP name advertised by DUT.
<i>address</i>	BLE MAC address used by the DUT.
<i>timeout</i>	Timeout, in seconds
<i>minRSSI</i>	RSSI treshold (optional)
connect	Connect to GATT peripheral
disconnect	Disconnect from GATT peripheral
discover	Discover GATT services and characteristics
match	Match a value for a subscribed characteristic
read	Read a GATT characteristic
sub	Subscribe to notifications from a GATT characteristic
write	Write to a GATT characteristic

Example: Validate BLE Device Information Service


```

title: "DIS Validation"
suite:
  - ident: ICT-T1
    title: Identify DUT
    steps:
      - command: identify nRF52
  - ident: ICT-T2
    title: Program LY10-DEMO-BOARD FW nRF52 with FT2232H Mini Module
    steps:
      - command: program nRF52 s132_nrf52_6.0.0_softdevice.hex, ly10-demo-fw-0.1.7.hex, none
  - ident: ICT-T3
    title: Validate BLE DIS
    steps:
      - command: ble gatt connect addr:%ble_mac% 10
      - command: ble gatt discover
      # GAP:Device Name
      - command: ble gatt read char:2a00 4c5931302d44454d4f5f424f415244 # "LY10-DEMO_BOARD"
      # GAP Appearance
      - command: ble gatt read char:2a01 0000
      # GAP:Peripheral Preferred Connection Parameters
      - command: ble gatt read char:2a04 0600080200009001
      # GAP:Central Address Resolution
      - command: ble gatt read char:2aa6 01
      # DIS:Manufacturer Name String
      - command: ble gatt read char:2a29 424344 # "BCD"
      # DIS:Model Number String
      - command: ble gatt read char:2a24 4c5931302d44454d4f5f424f415244 # "LY10-DEMO_BOARD"
      # DIS:Hardware Revision String
      - command: ble gatt read char:2a27 32303139 # "2019"
      # DIS:Firmware Revision String
      - command: ble gatt read char:2a26 302e312e37 # "0.1.7"
      # DIS:Software Revision String
      - command: ble gatt read char:2a28 312e322e33 # "1.2.3"
      - command: ble gatt disconnect

```

1.2.2 bledis - Test BLE Discovery

Establishes a BLE connection to the DUT and discovers GATT services.

Usage:

```
bledis %BLEMAC% [<name> [<timeout> [<minRSSI>]]
```

Argument	Description
<i>name</i>	GAP name advertised by DUT. %BLEMAC% to specify the DUT's BLE MAC address instead
<i>timeout</i>	Timeout, in seconds
<i>minRSSI</i>	RSSI treshold (optional)

Example: BLE discovery of identified BLE HW MAC address.

```

- ident: ICT-T1
  title: Identify DUT
  steps:
    - command: identify nRF52
- ident: ICT-T2
  title: BLE Discovery
  steps:
    - command: bledis %BLEMAC% 30 -60

```

1.2.3 define - Define user key

Manually defines a test plan key, which will be emedded in the test report and serial number requests performed as part of the current test plan.

Usage:

define <key> <value>

Argument	Description
<i>key</i>	Name of the test plan key.
<i>value</i>	Value for the key; can be any kind of string value.

- ident: ICT-T0
title: Set variables
steps:
 - command: define work_order 1011X02
- ident: ICT-T1
title: Request serial
steps:
 - command: request serial

1.2.4 erase - Erase DUT Flash

Erase DUT MCU on-board flash.

Usage:

erase <target> [UART0|UART1]

Argument	Description
<i>target</i>	Target to erase
UART0, UART1	Port for UART targets

Supported *target* values:

<i>target</i>	Description
AVRATmega168P_ISP	Atmel AVR ATmega168P(A) (JTAG:ISP)
AVRATmega168P_XPm	Atmel AVR ATmega168P(A) (USB, XPmini)
AVRATmega168PB_ISP	Atmel AVR ATmega168PB (JTAG:ISP)
AVRATmega168PB_XPm	Atmel AVR ATmega168PB (USB, XPmini)
CC1352	TI CC1352 RFSoc
DA14580	Dialog DA14580 RFSoc
ESP32	Espressif ESP32 RFSoc (JTAG)
ESP32_HomeKit	Espressif ESP32 RFSoc (JTAG; HomeKit)
ESP32_JTAG	Espressif ESP32 RFSoc (JTAG)
ESP32_UART	Espressif ESP32 RFSoc (esptool)
nRF52	Nordic nRF52 RFSoc (SWD)
nRF52_DevKit	Nordic nRF52 RFSoc (USB, JLink)
STM32F4	ST STM32F4xx MCU (SWD)
STM32F4_DevKit	ST STM32F4xx MCU (USB, JLink)
STM32L4	ST STM32L4xx MCU (SWD)
STM32L4_DevKit	ST STM32L4xx MCU (USB, JLink)

Example: Erase STM32L4 on-board flash.

- ident: ICT-T1
title: Erase
steps:
 - command: erase STM32L4

1.2.5 extflash_write - Write Peripheral Flash

Write DUT periperal flash.

Usage:

```
extflash_write UART0|UART1 <filename>
```

Argument	Description
UART0, UART1	Port for UART targets
<i>filename</i>	Firmware Element Filename

1.2.6 freq - Frequency Monitor Control

Set the channel to use for frequency measurements.

Usage:

```
freq 0|1
```

Argument	Description
0	Use CLK0
1	Use CLK1

Example: Measure CLK1 frequency

```
suite:
- ident: ICT-T1
  title: Measure CLK1 frequency
  steps:
  - command: freq 1
  - command: sleepms 1000
  - command: measure frequency 7.90-8.10MHz
```

1.2.7 identify - Identify DUT

Identify DUT MCU and/or RF peripherals.

Usage:

```
identify <target> [UART0|UART1]
```

Argument	Description
<i>target</i>	Target to identify
UART0, UART1	Port for UART targets

Supported *target* values:

<i>target</i>	Description
AVRATmega168P_ISP	Atmel AVR ATmega168P(A) (JTAG:ISP)
AVRATmega168P_XPm	Atmel AVR ATmega168P(A) (USB, XPmini)
AVRATmega168PB_ISP	Atmel AVR ATmega168PB (JTAG:ISP)
AVRATmega168PB_XPm	Atmel AVR ATmega168PB (USB, XPmini)
CC1352	TI CC1352 RFSoc
DA14580	Dialog DA14580 RFSoc
ESP32	Espressif ESP32 RFSoc (JTAG)
ESP32_HomeKit	Espressif ESP32 RFSoc (JTAG; HomeKit)

target	Description
ESP32_JTAG	Espressif ESP32 RFSoc (JTAG)
ESP32_UART	Espressif ESP32 RFSoc (esptool)
nRF52	Nordic nRF52 RFSoc (SWD)
nRF52_DevKit	Nordic nRF52 RFSoc (USB, JLink)
STM32F4	ST STM32F4xx MCU (SWD)
STM32F4_DevKit	ST STM32F4xx MCU (USB, JLink)
STM32L4	ST STM32L4xx MCU (SWD)
STM32L4_DevKit	ST STM32L4xx MCU (USB, JLink)

1.2.8 image - Set background image

Usage:

```
image set <filename>
image clear
```

Argument	Description
set	Set background image
clear	Clear background image
filename	Filename of the PNG or JPEG element to show

Example: Background for operator test

```
title: "OLED Image"
suite:
- ident: ICT-T1
  title: Show image
  steps:
  - command: image set fighter.png
  - command: operator "Manual test"
```

1.2.9 label - Set Label Substitutions

Usage:

```
label keys <key> [<key>...]
```

Example: Substitute CODE

```
title: "Custom barcode substitution"
suite:
- ident: ICT-T0
  title: Define label keys
  steps:
  - command: define CODE 12345
  - command: label keys CODE
```

1.2.10 measure - Probe Measurement

Usage:

```
measure <channel> [<signal>] <range> [<reference>]
```

Argument	Description
channel	Measurement channel
signal	DDTPxx or RDTPxx probe for pin measurement
range	Acceptable range

Argument	Description
<i>reference</i>	Reference value

The `measure` command supports the following channels:

<i>channel</i>	Description
<code>current3V3</code>	3V3 current draw
<code>current5V</code>	5V current draw
<code>currentVARV</code>	VARV current draw
<code>frequency</code>	Frequency (CLK0 or CLK1)
<code>impedance</code>	Impedance measurement (RVREF/RA)
<code>pin</code>	Digital pin measurement (DDTPxx/RDTPxx)
<code>voltageDATP07</code>	DATP07 voltage
<code>voltageDATP08</code>	DATP08 voltage
<code>voltageDATP09</code>	DATP09 voltage
<code>voltageDATP10</code>	DATP10 voltage
<code>voltageDATP11</code>	DATP11 voltage
<code>voltageDATP12</code>	DATP12 voltage
<code>voltageMUX0</code>	MUX0 voltage
<code>voltageMUX1</code>	MUX1 voltage
<code>voltageMUX2</code>	MUX2 voltage
<code>voltageMUX3</code>	MUX3 voltage

Example: Electrical measurements

```

suite:
- ident: ICT-T1
  title: Measure CLK0 frequency
  steps:
    - command: freq 0
    - command: sleepms 1000
    - command: measure frequency 32.75-32.78kHz
- ident: ICT-T2
  title: Measure Impedance
  steps:
    - command: mux 0 RATP02
    - command: mux 1 RATP03
    - command: mux 2 RA
    - command: mux 3 RVREF
    - command: short 0 2 set
    - command: short 1 3 set
    - command: measure impedance 750-1000m0hm 3.3V
    - command: short 0 2 release
    - command: short 1 3 release
    - command: sleepms 1500
    - command: measure impedance 2-100hm 3300
- ident: ICT-T3
  title: Measure Currents
  steps:
    - command: measure current3V3 <1A
    - command: measure current5V 0.1-0.5A
    - command: measure currentVARV >100mA
- ident: ICT-T4
  title: Measure Voltages
  steps:
    - command: mux 0 DATP00
    - command: mux 1 DATP01
    - command: mux 2 RATP00
    - command: mux 3 RATP17
    - command: measure voltageMUX0 >1V
    - command: measure voltageMUX1 <3300mV
    - command: measure voltageMUX2 >100mV
    - command: measure voltageMUX3 1500-1800mV
    - command: measure voltageDATP07 200-6000mV
    - command: measure voltageDATP08 -0.2-0.1V
    - command: measure voltageDATP09 0-4V
    - command: measure voltageDATP10 -0.1-3.3V
    - command: measure voltageDATP11 0-3.4V
    - command: measure voltageDATP12 -0.1-3.4V

```

Example: Digital pin measurement

```

suite:
- ident: ICT-T1
  title: Set Digital pins
  steps:
    - command: pin RDTP21 input pullup
    - command: pin DDTP04 input
- ident: ICT-T2
  title: Read Digital pins
  steps:
    - command: measure pin RDTP21 low
    - command: measure pin DDTP04 high

```

1.2.11 mux - Multiplex Control

Select a probe or signal for a multiplex channel.

Usage:

mux <channel> <signal>

Argument	Description
----------	-------------

Argument	Description
<i>channel</i>	Multiplex channel (0..3)
<i>signal</i>	Probe or signal

The following signals and probes can be assigned to a multiplex channel:

<i>signal</i>	MUX	Description
DATP00..DATP06	0, 1	Direct Analog Test Probes
RATP00..RATP31	0, 1	Routed Analog Test Probes
DDTP00..DDTP08	2, 3	Direct Digital Test Probes
RVREF	all	Impedance measurement, reference voltage
RA	all	Impedance measurement, test voltage
GND	all	Ground
3V3OUT	all	3.3V power rail
5VOUT	all	5.0V power rail
VARVDIV	all	VARV power rail, after 1/3 voltage divider

Example: Multiplex control

```
suite:
- ident: ICT-T1
  title: Setup MUX
  steps:
    - command: mux 0 DATP02
    - command: mux 1 DATP03
    - command: mux 2 RA
    - command: mux 3 RVREF
    - command: short 0 2 set
    - command: short 1 3 set
- ident: ICT-T2
  title: Measure impedance DATP02..DATP03
  steps:
    - command: measure impedance 10-200k0hm
```

1.2.12 nfc - NFC Handling

Manipulate NFC cards.

Usage:

```
nfc write <TAGTYPE> <payload>...
```

Argument	Description
<i>tagtype</i>	Tag type (NTAG203, NTAG213 or NTAG216)
<i>payload</i>	NDEF payload (text:....)

Example: Program NDEF message with two text records.

```
- ident: ICT-T1
  title: Write NFC
  steps:
    - command: define CODE 123
    - command: nfc write NTAG213 text:"Sample Text" text:%CODE%
```

1.2.13 operator - Operator Test

Instruct operator to perform a manual test step.

Usage:

operator <message>

Example: Instruct operator inspect housing.

```
- ident: ICT-T1
  title: Visual Inspection (manual)
  steps:
    - command: operator "Inspect Housing"
```

1.2.14 pin - Digital pin control

Configure a Digital probe.

Usage:

```
pin <probe> input [pullup]
pin <probe> output [low|high]
```

Argument	Description
<i>probe</i>	Probe (DDTPxx or RDTPxx)
input	Configure as input
pullup	Enable pull-up (only for RDTPxx pins)
output	Configure as output
low	Set low
high	Set high

Example: Control digital pins

```
suite:
- ident: ICT-T1
  title: Configure digital inputs
  steps:
    - command: pin DDTP05 input
    - command: pin DDTP03 input
    - command: pin RDTP04 input pullup
- ident: ICT-T2
  title: Control digital outputs
  steps:
    - command: pin DDTP00 output
    - command: pin DDTP02 output low
    - command: pin RDTP01 output high
```

1.2.15 power - Power Control

Control power applied to the Device Under Test.

Usage:

```
power off
power <rail> [on|off|<level>]
```

Argument	Description
<i>rail</i>	Power rail
on	Turn on the specified power rail
off	Turn off all or specified power rail
<i>level</i>	Voltage level for VARV: 2..12.0

Supported *rail* values:

<i>rail</i>	Description
-------------	-------------

<i>rail</i>	Description
3V3	3.3V power rail
5V	5V power rail
VARV	Variable power rail
12V	12V power rail
SWD	SWD (3.3V) power rail
JTAG	JTAG (3.3V) power rail
UART0	UART0 (3.3V) power rail
UART1	UART1 (3.3V) power rail

Example: Apply power

suite:

- ident: ICT-T1
 - title: Apply power
 - steps:
 - command: power 3V3 on
 - command: power 5V on
 - command: power VARV 10.2
- ident: ICT-T2
 - title: Wait
 - steps:
 - command: sleepsms 1000
- ident: ICT-T3
 - title: Power off
 - steps:
 - command: power off

1.2.16 program - Program DUT

Erase and Program DUT MCU on-board flash.

Usage:

program <target> [UART0|UART1] [offset1:]<img1>,[offset2:]<img2>,[offset3:]<img3>[, ...]

Argument	Description
<i>target</i>	Target to program
UART0, UART1	Port for UART targets
<i>offset1</i> Opti	onal: Offset for 1st image
<i>img1</i>	Firmware Element (Bootloader)
<i>offset2</i> Opti	onal: Offset for 2nd image
<i>img2</i>	Firmware Element (Application)
<i>offset3</i> Opti	onal: Offset for 3rd image
<i>img3</i>	Firmware Element (Partitioning)
...	Optional: Additional offsets, images

Supported *target* values:

<i>target</i>	Description
AVRATmega168P_ISP	Atmel AVR ATmega168P(A) (JTAG:ISP)
AVRATmega168P_XPm	Atmel AVR ATmega168P(A) (USB, XPmini)
AVRATmega168PB_ISP	Atmel AVR ATmega168PB (JTAG:ISP)
AVRATmega168PB_XPm	Atmel AVR ATmega168PB (USB, XPmini)
CC1352	TI CC1352 RFSoc

target	Description
DA14580	Dialog DA14580 RFSoc
ESP32	Espressif ESP32 RFSoc (JTAG)
ESP32_HomeKit	Espressif ESP32 RFSoc (JTAG; HomeKit)
ESP32_JTAG	Espressif ESP32 RFSoc (JTAG)
ESP32_UART	Espressif ESP32 RFSoc (esptool)
nRF52	Nordic nRF52 RFSoc (SWD)
nRF52_DevKit	Nordic nRF52 RFSoc (USB, JLink)
STM32F4	ST STM32F4xx MCU (SWD)
STM32F4_DevKit	ST STM32F4xx MCU (USB, JLink)
STM32L4	ST STM32L4xx MCU (SWD)
STM32L4_DevKit	ST STM32L4xx MCU (USB, JLink)

1.2.17 scan - Scan Barcode

Scan a barcode using USB-attached barcode scanner.

Usage:

`scan <format>`

Argument	Description
<i>format</i>	Format of code to scan

Supported *format* values:

format	Description
%MAC_ADDRESS%	48-bit MAC address (XX:XX:XX:XX:XX:XX)

1.2.18 serial - Request serial number

Request a serial number through PLTcloud. Under Project Settings in PLTcloud, serial number allocation can be configured to use either monotonic counters, or through a WebHook.

Usage:

`serial request`

Argument	Description
<code>request</code>	Request serial number through PLTcloud backend

When a webhook is selected in PLTcloud, a JSON request will be sent containing:

```
{
  "dut_id": "<DUT IDENTIFIER>",
  "serial_number": "<SERIAL NUMBER>",
  "ble_mac": "<BLE MAC>",
  "mcu_id": "<MCU ID>",
  "MYCUSTOMKEY": "my custom value"
}
```

The API endpoint should return something like:

```
{
  "serial_number": "<SERIAL NUMBER>"
}
```

1.2.19 short - Connect Multiplex channels

Usage:

```
short <muxA> <muxB> set|release
```

Argument	Description
<i>muxA</i>	Multiplex channel (0..3)
<i>muxB</i>	Multiplex channel (0..3)
set	Short specified multiplex channels
release	Release short between specified multiplex channels

Example: connect multiplex channels

suite:

- ident: ICT-T1
title: Control shorts
steps:
 - command: short 0 1 set
 - command: short 1 3 set
 - command: sleepms 1000
- ident: ICT-T1
title: 0-2 instead of 0-1
 - command: short 0 1 release
 - command: short 0 2 set

1.2.20 sleepms - Delay

Temporarily suspend test suite execution.

Usage:

```
sleepms <duration>
```

Argument	Description
<i>duration</i>	Duration, in milliseconds

1.2.21 uart - Send and Extract UART response

Extract data from UART.

Usage:

```
uartcmd: uart UART0|UART1  
  [[expect: <expectText>  
    [extract: <extractText>  
      extractKey: <extractKey>]]  
  [send: <sendText>]
```

Argument	Description
UART0, UART1	UART port
<i>expectText</i>	Text to expect, prior to extraction
<i>extractText</i>	Regular expression to extract
<i>extractKey</i>	Key in which to store extracted text
<i>sendText</i>	Text to send prior to extraction

Example: extract ICCID from cellular modem, storing in the **ICCID** key.

```
- uartcmd: uart UART0
  expect: "+CCID:"
  extract: "CCID: (\\d{20})\\r\\n"
  extractKey: ICCID
  send: "AT+ICCID\\r\\n"
```

1.2.22 uartAwait - Await UART response

Wait for a specific UART response.

Usage:

```
uartAwait UART0|UART1 <seconds>
```

Argument	Description
UART0, UART1	UART port
seconds	Time to await response, in seconds

Example:

```
- command: uartExpect UART0 Pressed
- command: operator "Press button"
- command: uartAwait UART0 1
```

1.2.23 uartCfg - Configure UART

Configure a UART port.

Usage:

```
uartCfg UART0|UART1 <speed> [<triplet>]
uartCfg UART0 tp
```

Argument	Description
UART0, UART1	UART port
<i>speed</i>	Baud rate
<i>triplet</i>	UART configuration triplet: 8N1 or 7E1
tp	Use alternate test points instead of UART. (Only for UART0)

Example:

```
- command: uartCfg UART1 9600 8N1
- command: uartCfg UART0 tp
```

1.2.24 uartExpect - Set expectation for uartAwait

Set a UART response to wait for with the `uartAwait` command.

Usage:

```
uartExpect UART0|UART1 <expect>
```

Argument	Description
UART0, UART1	UART port
<i>expect</i>	String to expect with subsequent <code>uartAwait</code> command

Example:

```
- command: uartExpect UART0 Pressed
- command: operator "Press button"
- command: uartAwait UART0 1
```

1.2.25 uartReadTimeout - Test if UART is not transmitting

Test if nothing is received from UART.

Usage:

```
uartReadTimeout UART0|UART1 <seconds> [<sendText>]
```

Argument	Description
UART0, UART1	UART port
<i>seconds</i>	Number of seconds to wait for incoming data
<i>sendText</i>	Text to send before waiting

Example: Test if modem is shut down.

```
- command: uartReadTimeout UART0 1 "AT"
```