P1 port Certifier (P1C-003)

Hands-on Training

2015-11-19

1 Agenda


Test in progress
Data received
P1 port certifier
P1C-003
STOP
RUN
Up
Left
Right
Down
test set
profile
menu
Power Good
Charging
USB

Hands-on training, Agenda

- General part
  1. Device overview
  2. Charging
  3. USB connection
  4. RJ-12 Cable
  5. USB stick with PC application

- PC application
  1. Installation
  2. File system
  3. SW update
  4. Firmware update
  5. Profile editor
     A. HW parameters
     B. Parser parameters
  6. Test suit editor
  7. Report generator
     A. Headers / footers
  8. Documentation

- Main MENU
  1. Single test menu
  2. Test suite menu
  3. Profile menu
  4. Settings menu
     A. Set time
  5. USB storage mode

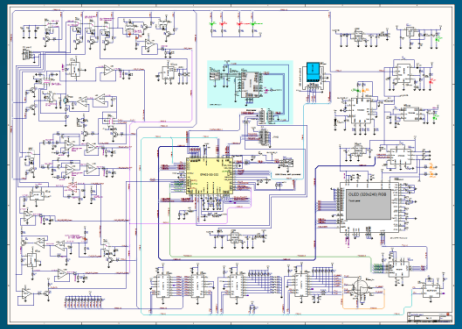
- Single test menu
  1. Load tests
  2. Voltage tests
  3. Current tests
  4. Noise tests
  5. Data tests
  6. OVP tests

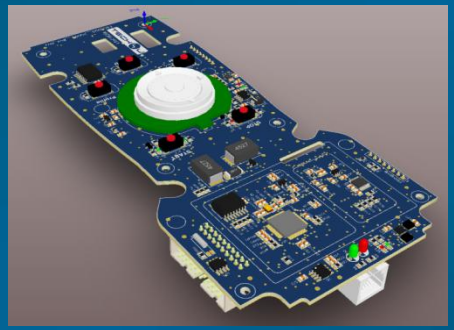
- Test cases
  1. Load tests
  2. Voltage tests
  3. Current tests
  4. Noise tests
  5. Data tests

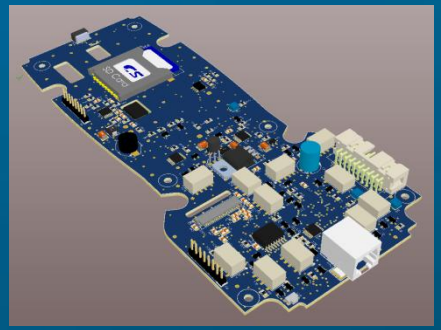
- Bug reporting system

2 Device overview

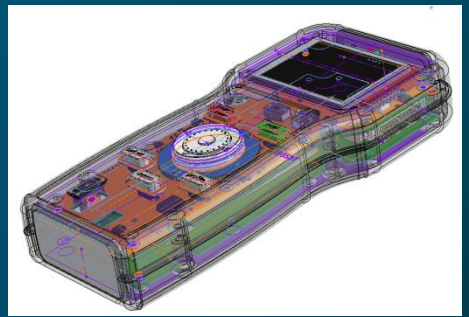
General part, Device overview



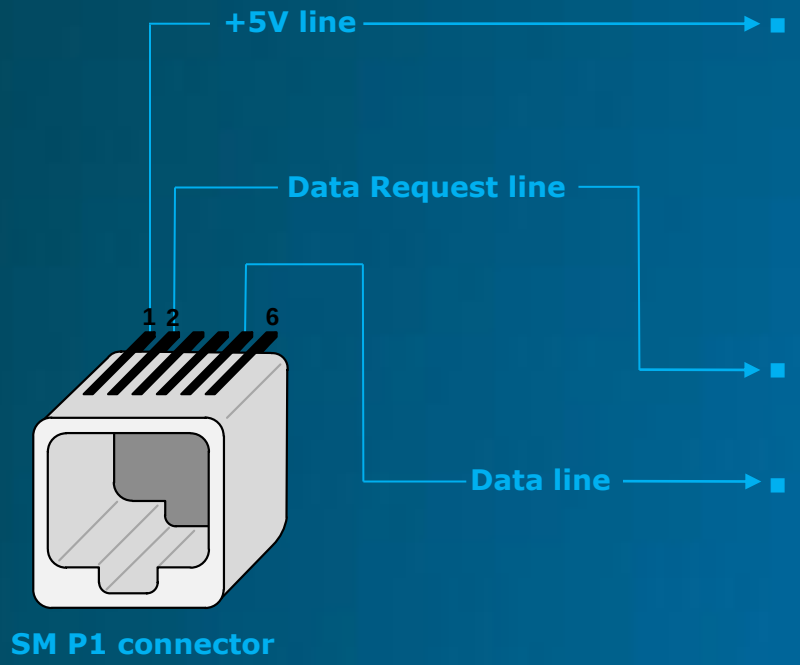




- More than 400 components (!)
- 9 different power sources (!)
- Super precise voltage source “on board” for voltage calibration V=5.000 V
- 14 Ultra low noise OpAmps
- 3 x Precise current sensor chips
- ARM microprocessor
- OLED display
- 11 micro relays (to increase measurement precision)
- 4GB SD card “on board”
- Large LiPo battery (2200 mAh)
- Low noise 4 layers PCB design



Measured physical parameters of P1 port lines:



- +5V line
  - ✓ Voltage
  - ✓ Current
  - ✓ Ripples
  - ✓ Noise
  - ✓ Overvoltage protection
- Data Request line
  - ✓ Current
- DATA line
  - ✓ Voltage levels
  - ✓ Current

General part, Device overview

RJ-11 (P1 port)

not used in P1C-003

OLED display

STOP button

START button

directional buttons

scroll button

Center /O.K. button

test set button

profile button

power on switch

menu button

Charging LED

Power good LED

micro USB

General part, charging

Power good

Charging

Charging almost ready

Battery fully charged

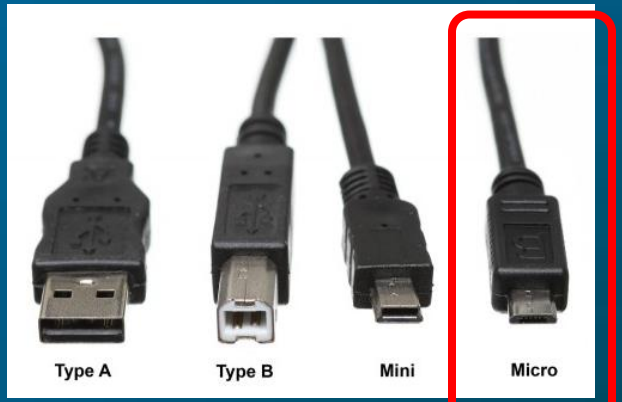
Device, overview

IMPORTANT !
It is very important to switch off the device after usage, to avoid deep discharge of the battery.

power on switch

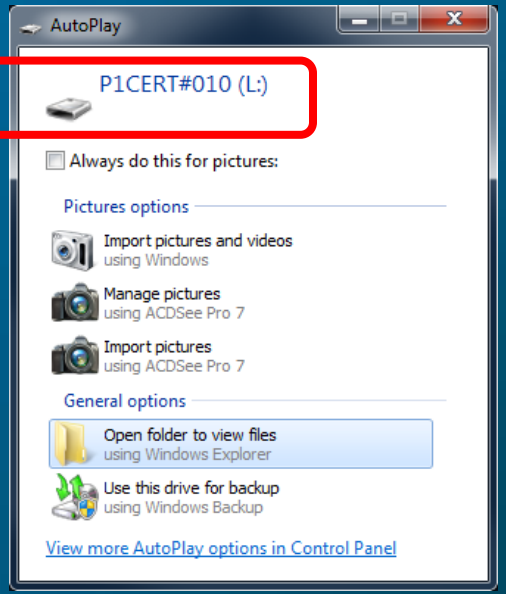
3 USB connection

General part, USB connection



Micro USB cable

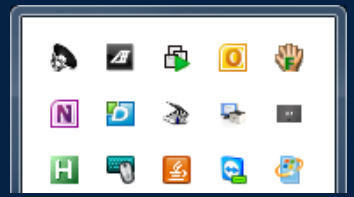
General part, USB connection

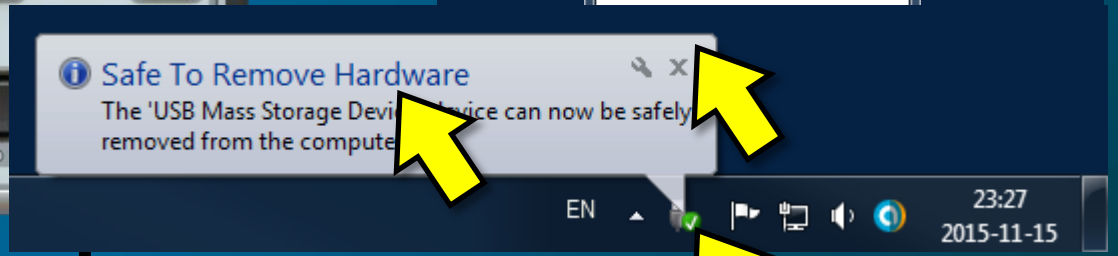


Micro USB cable

Connecting to PC

General part, USB connection





Micro USB cable

Disco ecting from PC

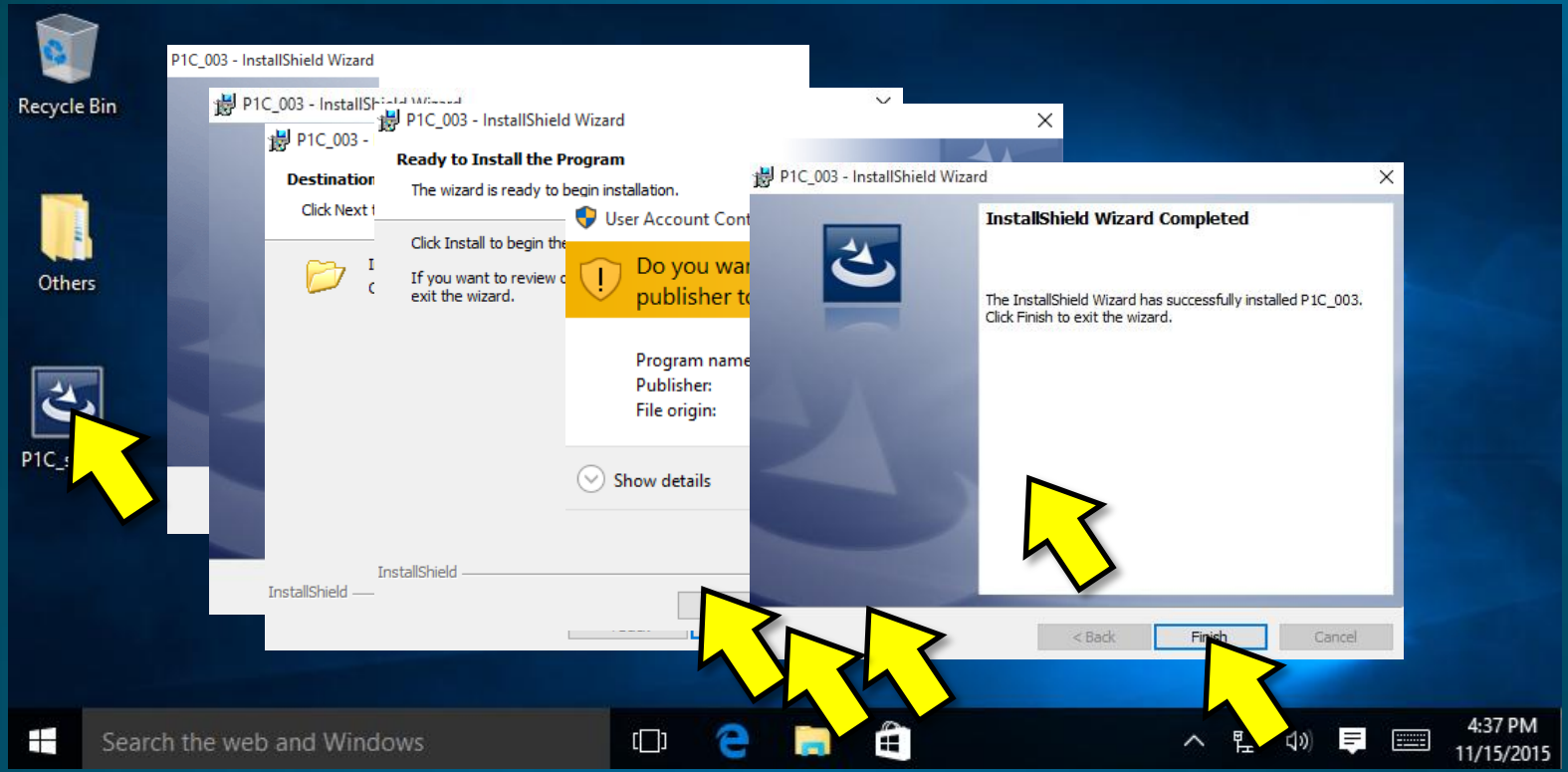
4 RJ-11 connection

General part, RJ-11 connection

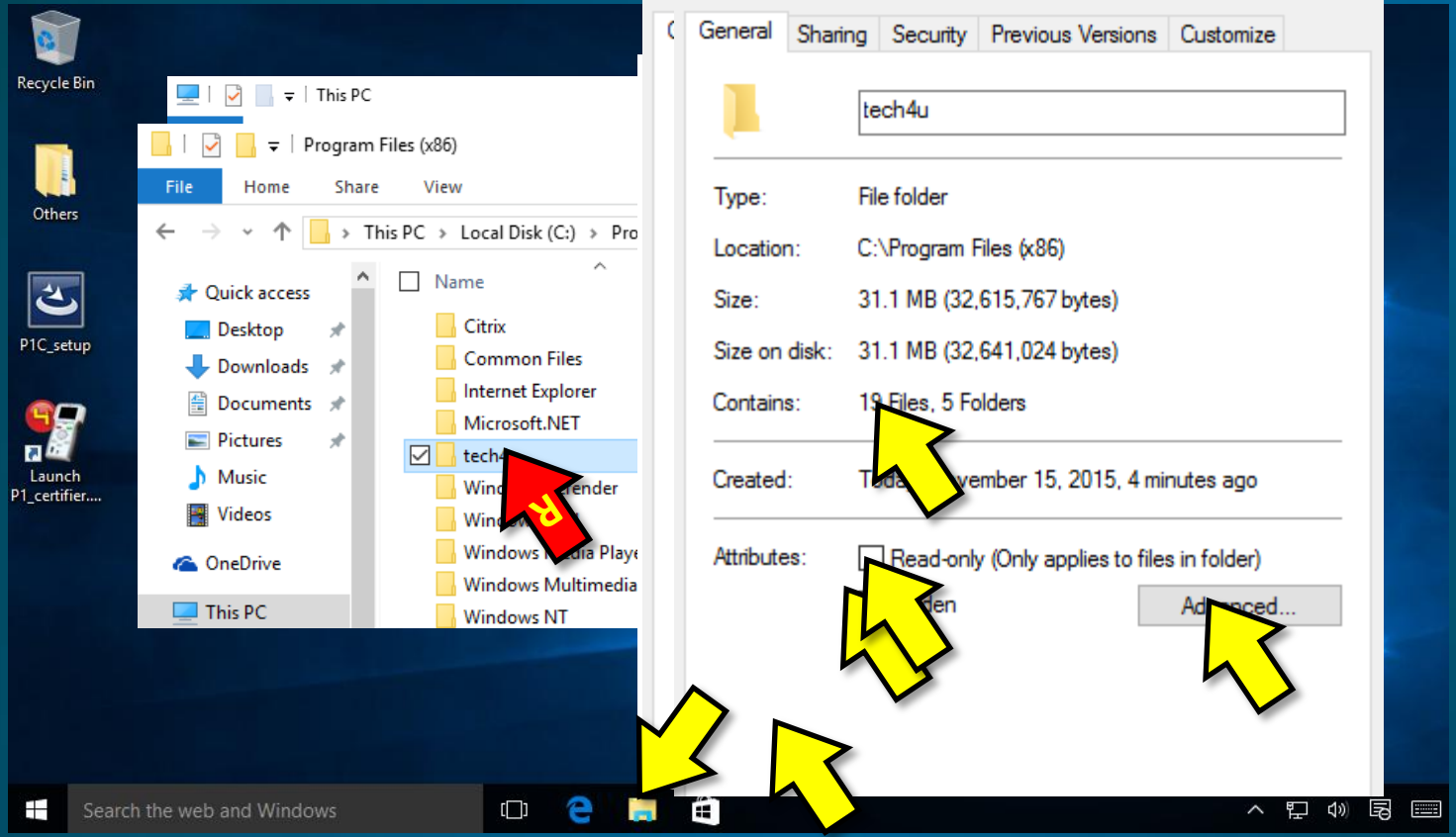
Connecting to SM

5 PC Application - installation

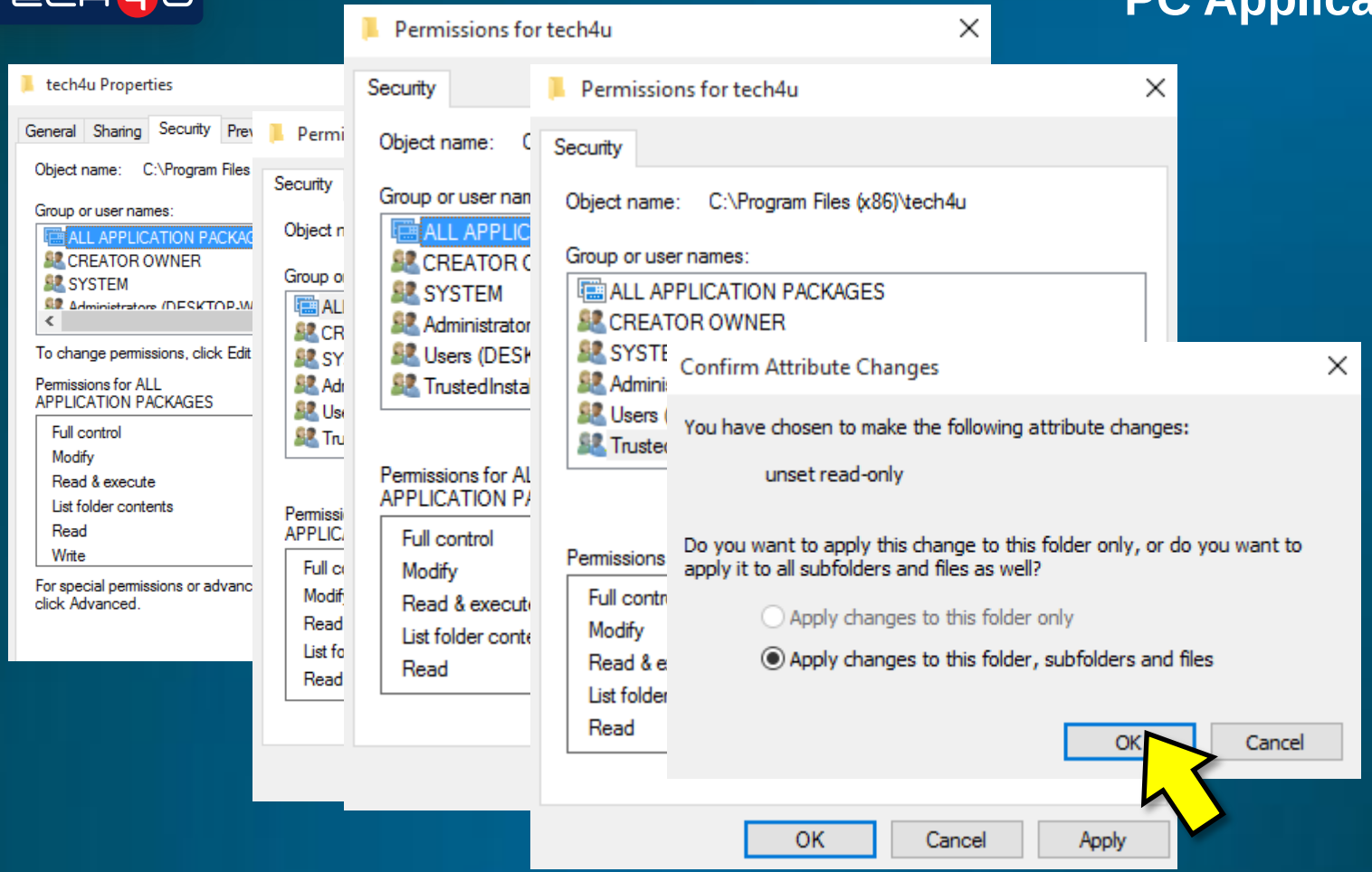
Installation on Windows 10



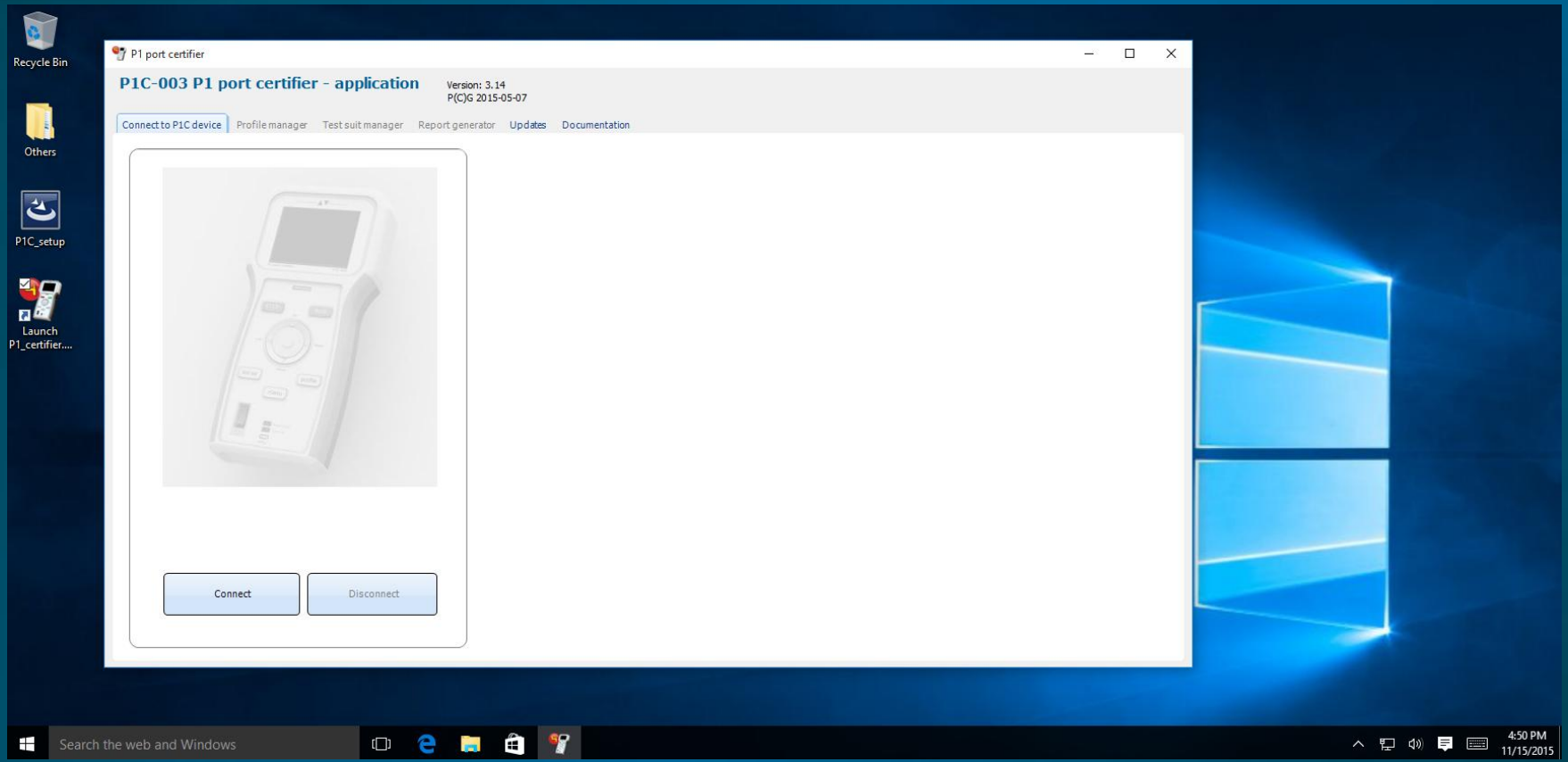
Installation on Windows 10



PC Application, installation



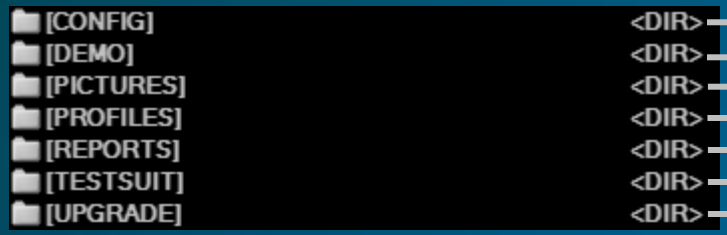
PC Application, installation



PC Application - installation
exercise

6 PC Application – File System

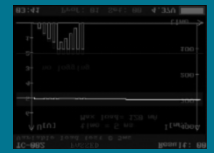
PC Application, device's file system



device internal data

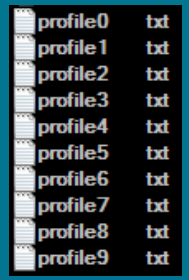
Bitmaps used for offline demo

Internal Bitmap storage for Report generation

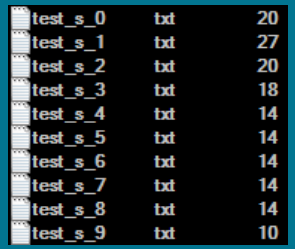


internal firmware upgrade files

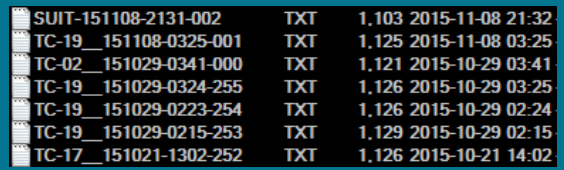
contains all the profile files



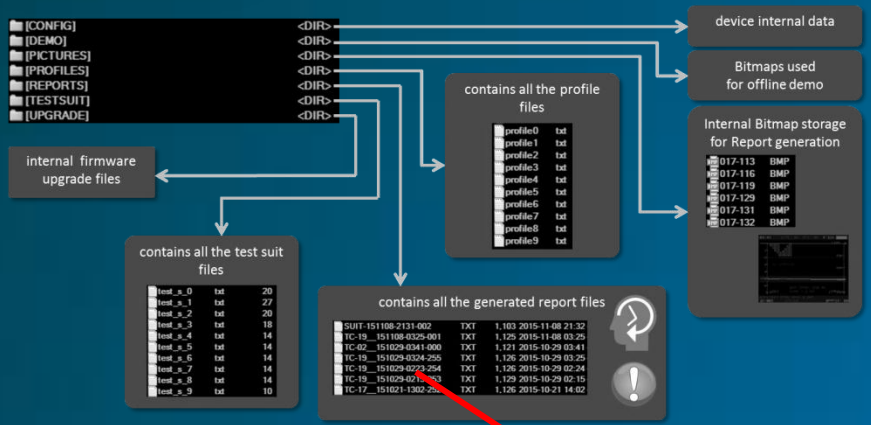
contains all the test suit files

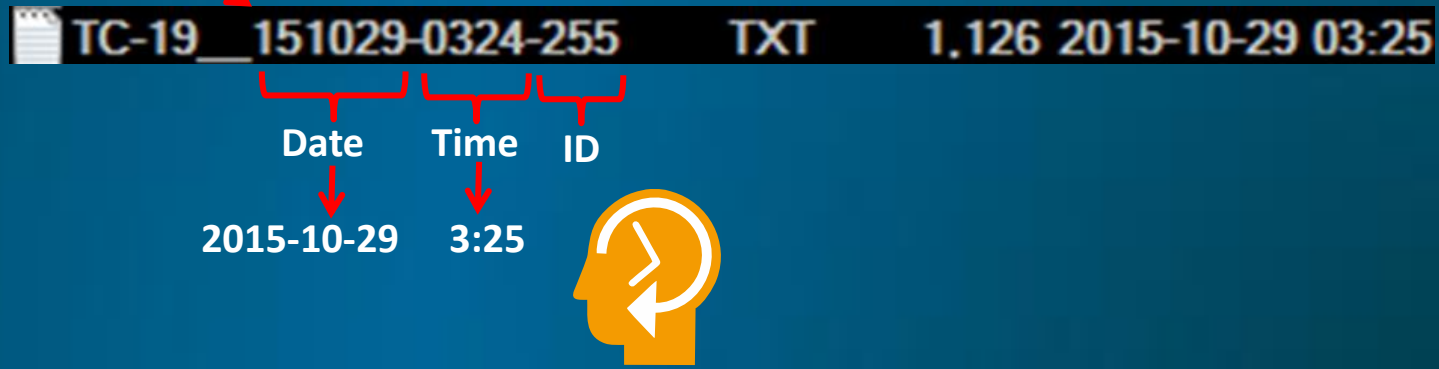


contains all the generated report files



PC Application, device's file system



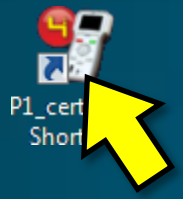


Test report – file name composition

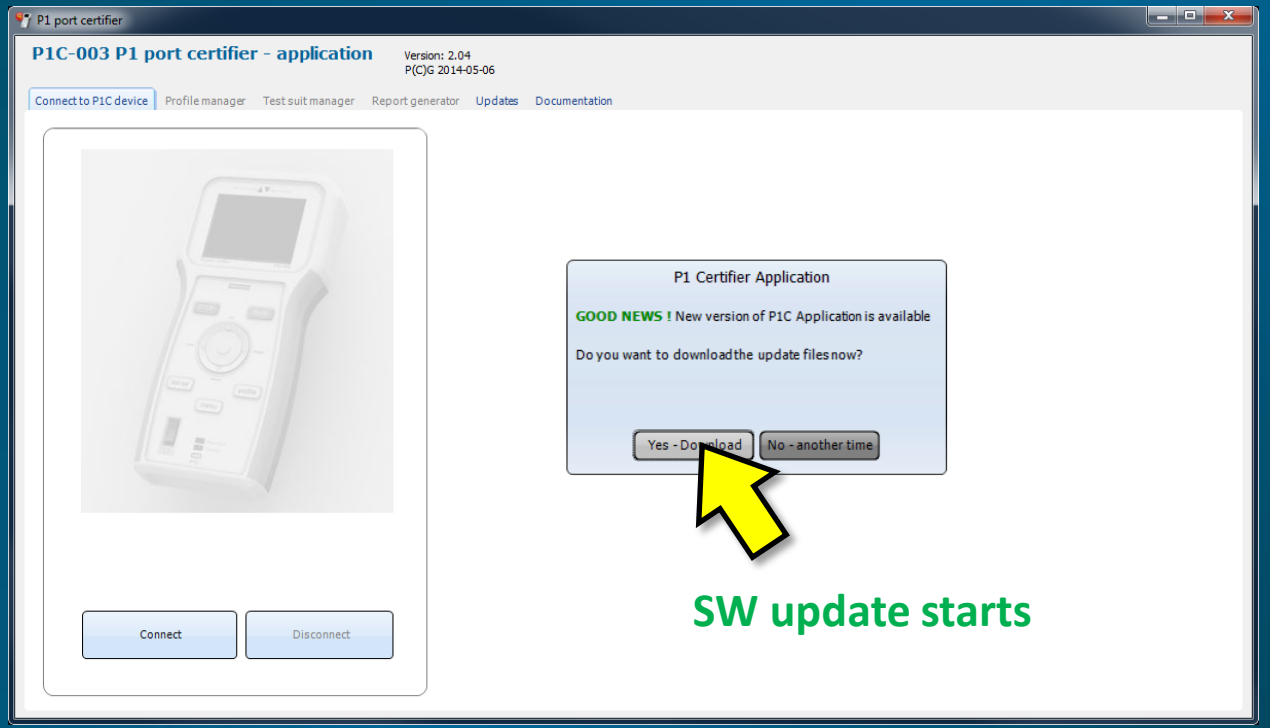
7 Software update

PC Application, SW update

Method 1



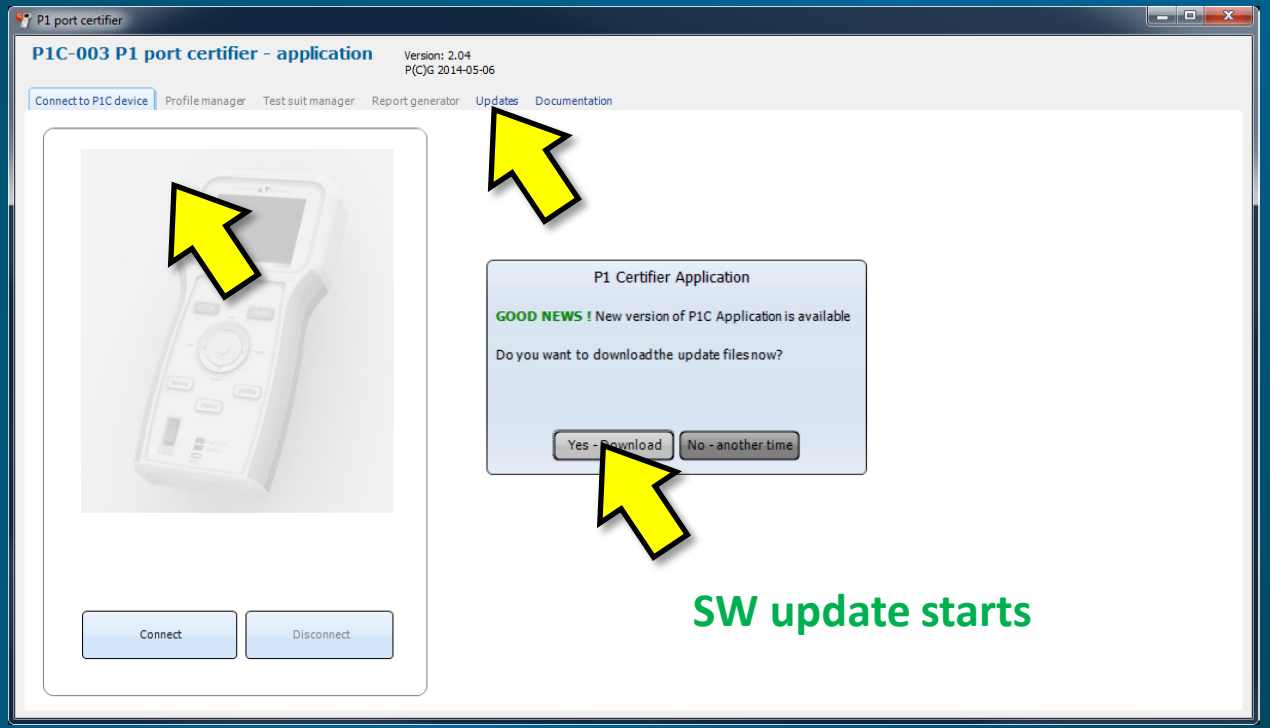
Double click



SW update starts

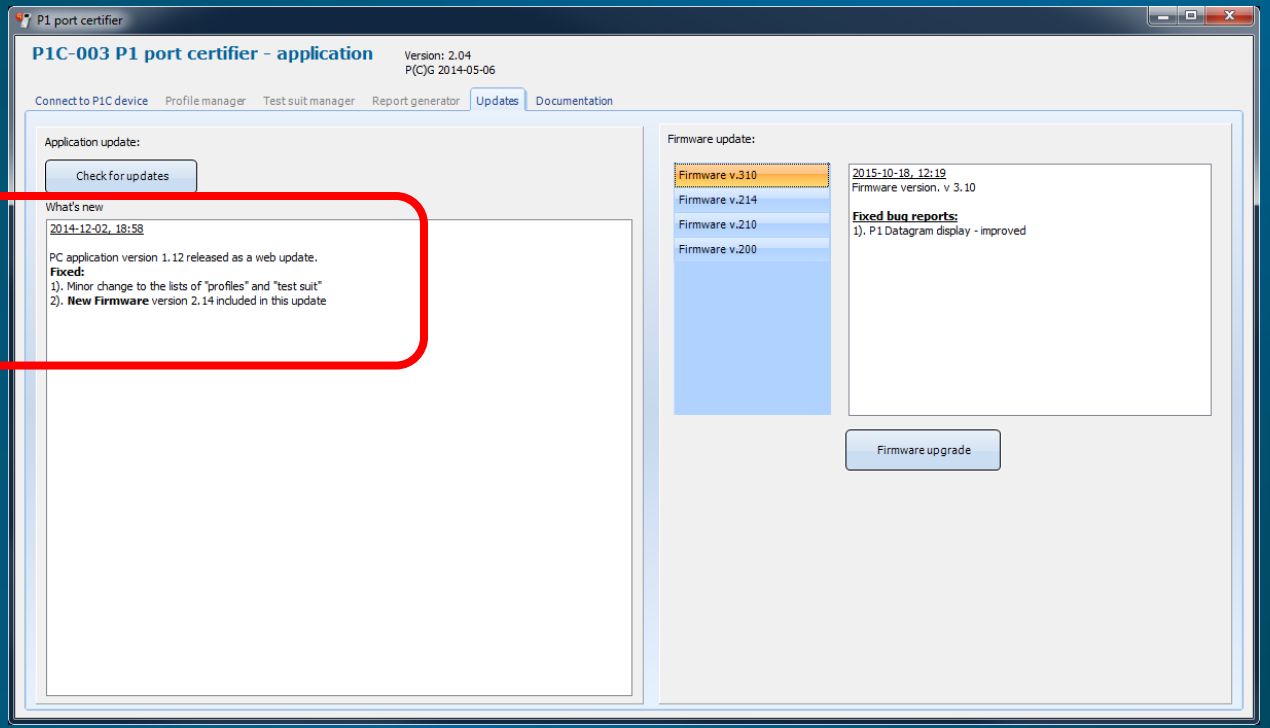
Method 2


P1_certifier -
Shortcut


P1 port certifier
P1C-003 P1 port certifier - application
Version: 2.04
P(C)G 2014-05-06
Connect to P1C device
Profile manager
Test suit manager
Report generator
Updates
Documentation
Connect
Disconnect
P1 Certifier Application
GOOD NEWS ! New version of P1C Application is available
Do you want to downloadthe update files now?
Yes - Download
No - another time
SW update starts

PC Application, SW update

P1_certifier - Shortcut

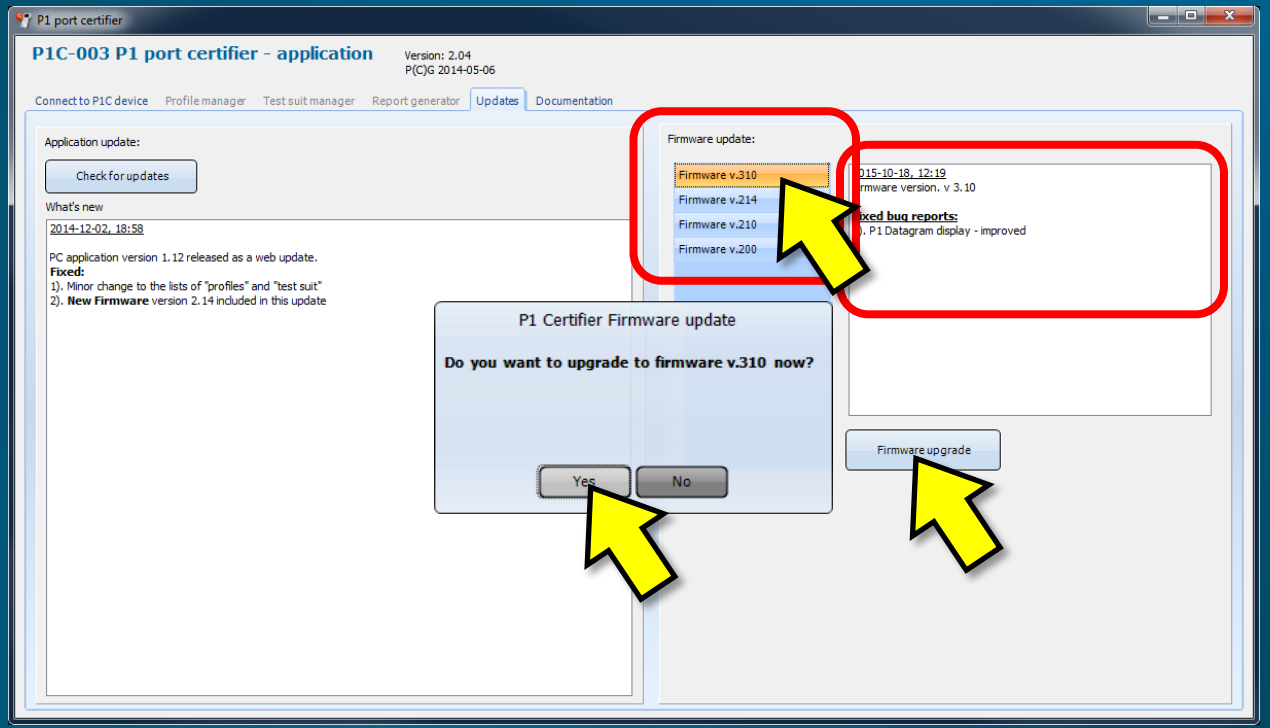


PC Application – SW update
exercise

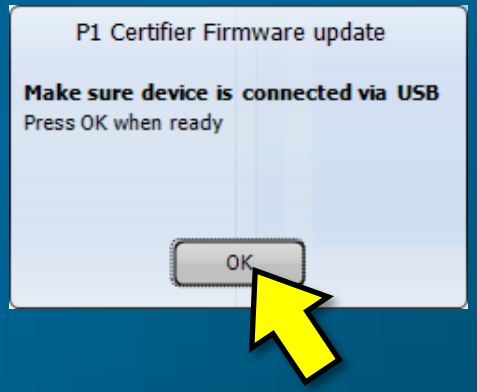
8 Firmware update

PC Application, Firmware update

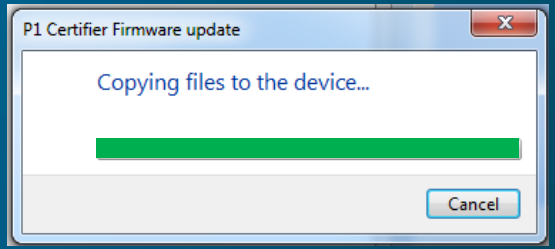
P1_certifier - Shortcut



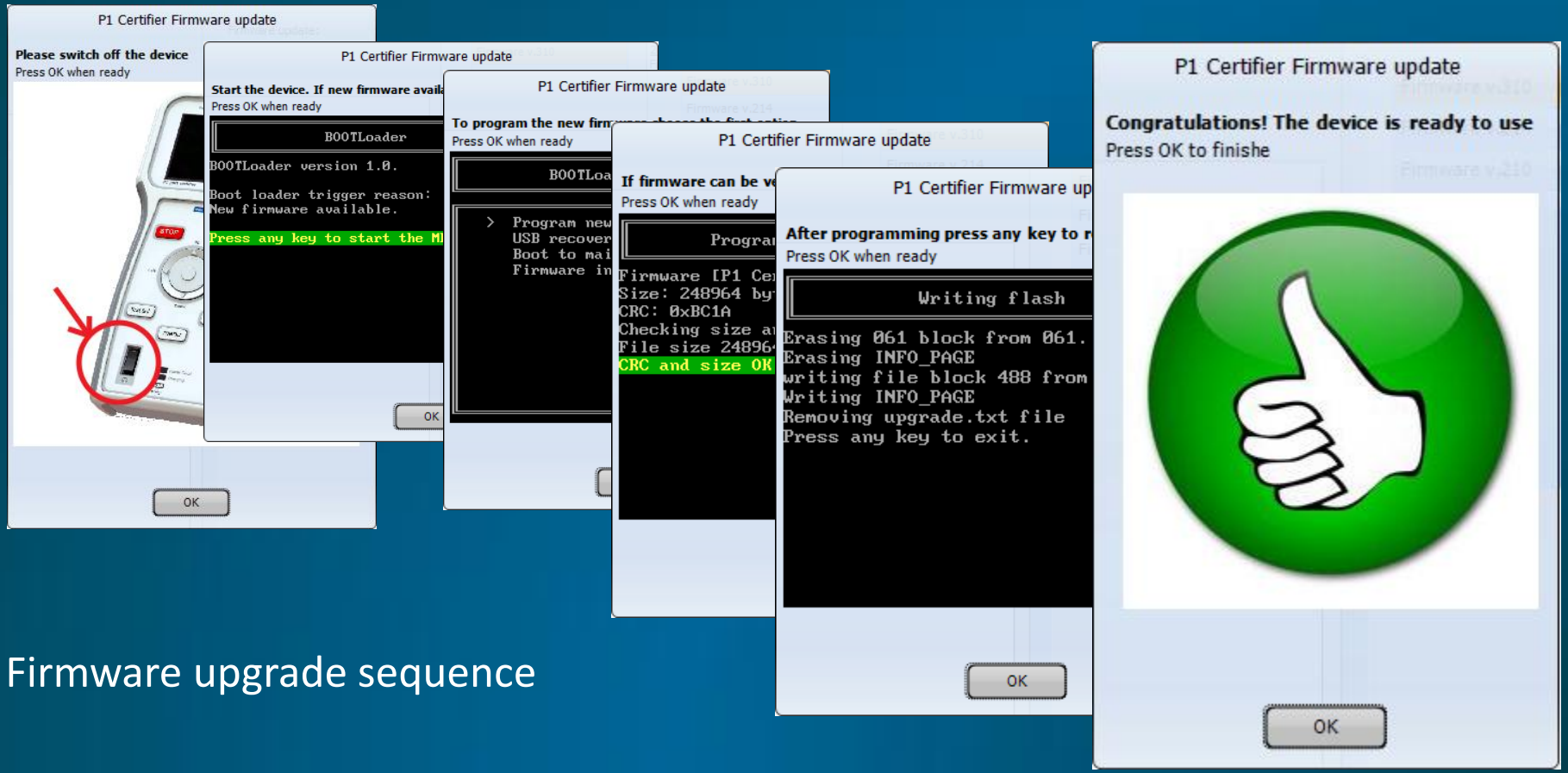
PC Application, Firmware update



USB cable



PC Application, Firmware update

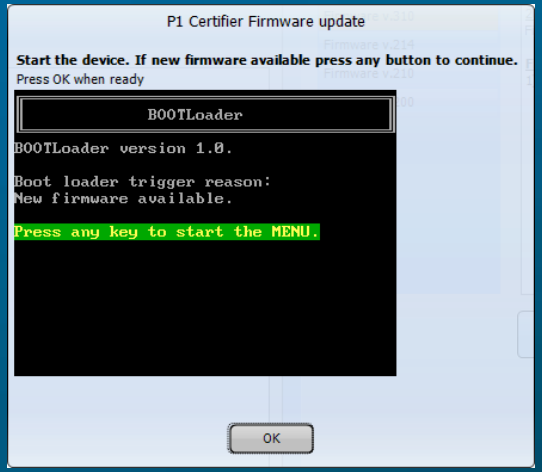


Firmware upgrade sequence

PC Application, Firmware update

switch on the device

press and keep both buttons down

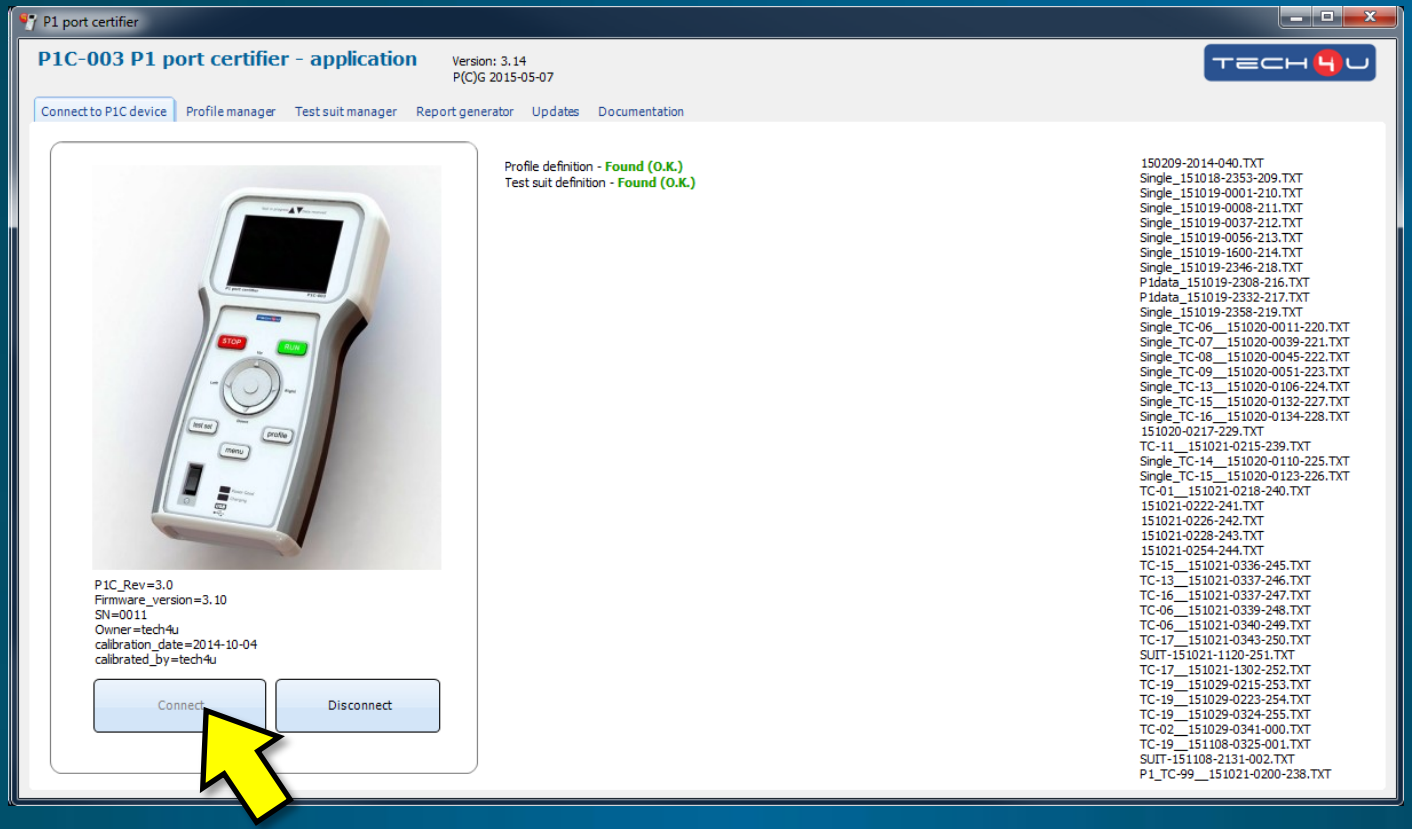


Firmware upgrade sequence – another method

PC Application – Firmware update
exercise

9 Profile editor – HW parameters

PC Application, Profile editor



DSMR requirements – Netbeheer Netherland

DSMR 4.0

4.2 Power supply

The power supply for the P1 port shall be able to withstand short circuits. Manipulation of the power supply lines shall never influence any other part of the meter,
When no device is connected through the P1 port, the power consumption of the P1 circuitry shall not be included in the register values. When a device is connected to the P1 port, the power consumption of the P1 circuitry shall be included in the register values. The P1 port will function and supply power independent of the state of the E-breaker.
The power supply will supply a maximum current of 100 mA at 5 Volt. Overload protection shall be implemented as a current limiting mechanism.

DSMR 2.2

4.4 Measuring device response time

The measuring device must complete a data transfer within eight seconds.

4.5 Signals

All signals are compliant with CMOS levels.
Max current IH(max) = 30mA

4.6 Physical connector

The connector is RJ11. The Metering System holds a female connector, the customer can plug in a standard RJ11 plug. Note that the connector in the metering system is physically accessible at all times and should not be sealed or protected by a sealed cover.

Pin #	Signal name	Description
1		
2	Request	Input
3	GND	Ground
4	N.C.	Not Connected
5	Data	Output
6		

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devices will need a hub. The hub is outside the scope of the P1 document, but a basic schematic is shown in Appendix I.

4.5 Measuring device transfer time

The measuring device must complete a data transfer to the P1 device within eight seconds, because the data has to be sent by the P1 port to the P1 device every ten seconds. This means at a minimum there is a pause of two seconds between messages.

4.6 Signals

All signals are compliant with following levels (different from the NTA8130!) Operating range per (P1) device as seen from the meter:

		Meter			OSM			
Symbol	Parameter	Min	Typ	Max	Min	Typ	Max	Units
Vi request	Request voltage				4	5	5.5	V
Ii request	Current supplied to the request pin				4	5	10	mA
Vol data	Low level output voltage of the Data pin			1				V
Ii data	Input current sinked, supplied by the Data pin per OSM		5	6				mA

Table 4-1: Signal Levels

Limit values:
Max Voltage: opto coupler: 15V, driver 6V
Max current sink (data output) : max = 30mA
Logical levels are specified as follows:
SPACE "0" as > 4V
MARK "1" as < 1 V

ESMR 5.0

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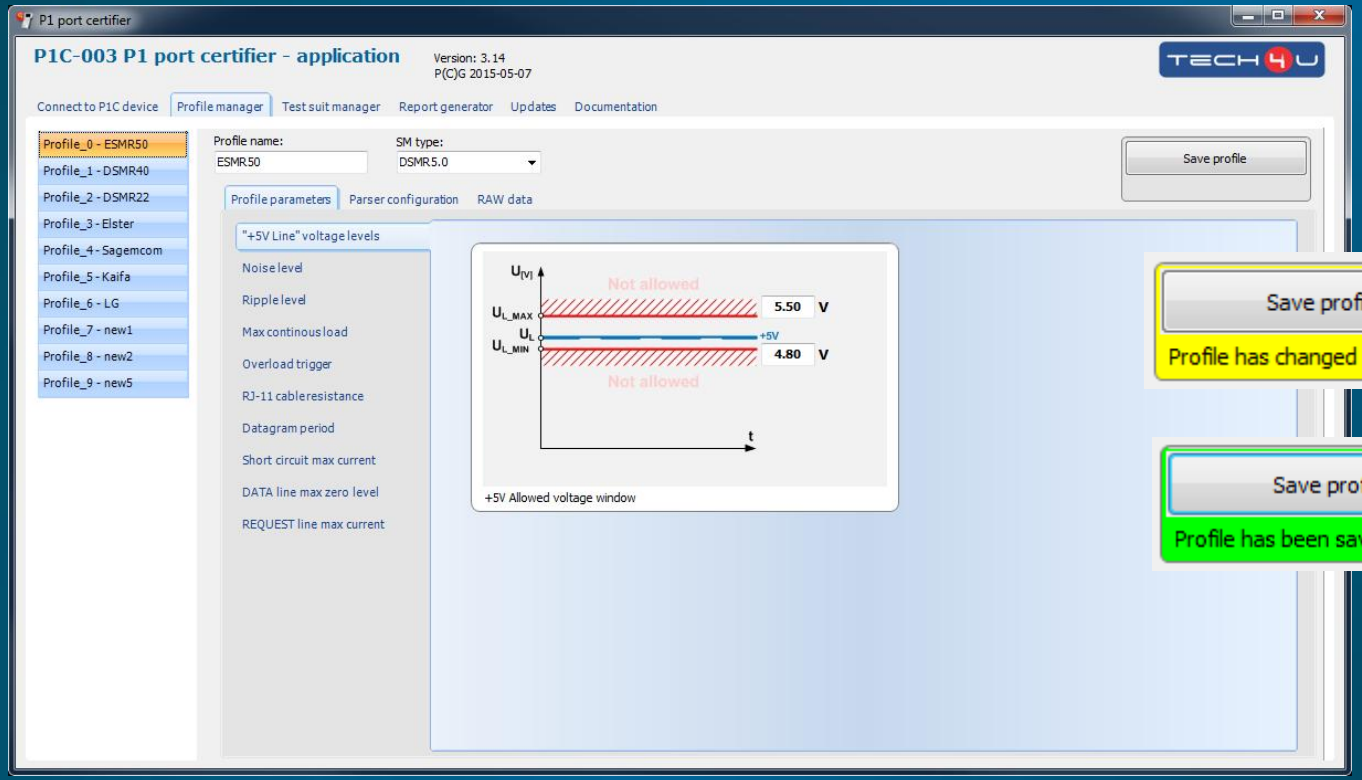
5.8 P1 signal levels

		Requirement for the Meter			Requirement for OSM			
Symbol	Description	Min	Typical	Max	Min	Typical	Max	Units
U_{DR_1}	"Data request" line - HIGH level	-	-	5,5	4,0	5,0	5,5	V
I_{DR_1}	"Data request" line current	-	5	10	4	5	10	mA
U_{D_0}	"Data" line – LOW level	0	0,2	1	0	0,2	1	V
U_{D_1}	"Data" line – HIGH level	-	5,0	-	-	5,0	-	V
$I_{D\_0\_MAX}$	"Data" line max current	-	-	30	-	-	5	mA
U_L	"+5V" power supply – voltage	4,9	5	5,3	4,9	5	5,3	V
U_{RIPPLE_MAX}	"+5V" line maximum ripple voltage	-	-	100	-	-	100	mV
U_{NOISE_MAX}	"+5V" line- maximum noise	-	-	50	-	-	100	mV
U_{OVP}	OVP level ("+5V" and "Data request" lines)	5,8	5,9	6	-	-	-	V
I_{L_CONT}	"+5V" maximum continuous current	250		260	-	-	250	mA
I_{L_MAX}	"+5V" line overload protection trigger	260	-	3000	-	-	-	mA
I_{SC}	"+5V" line Short Circuit current	-	-	50	-	-	-	mA

Logical levels are specified as follows:
SPACE "0" usually > 4V
MARK "1" as < 1 V

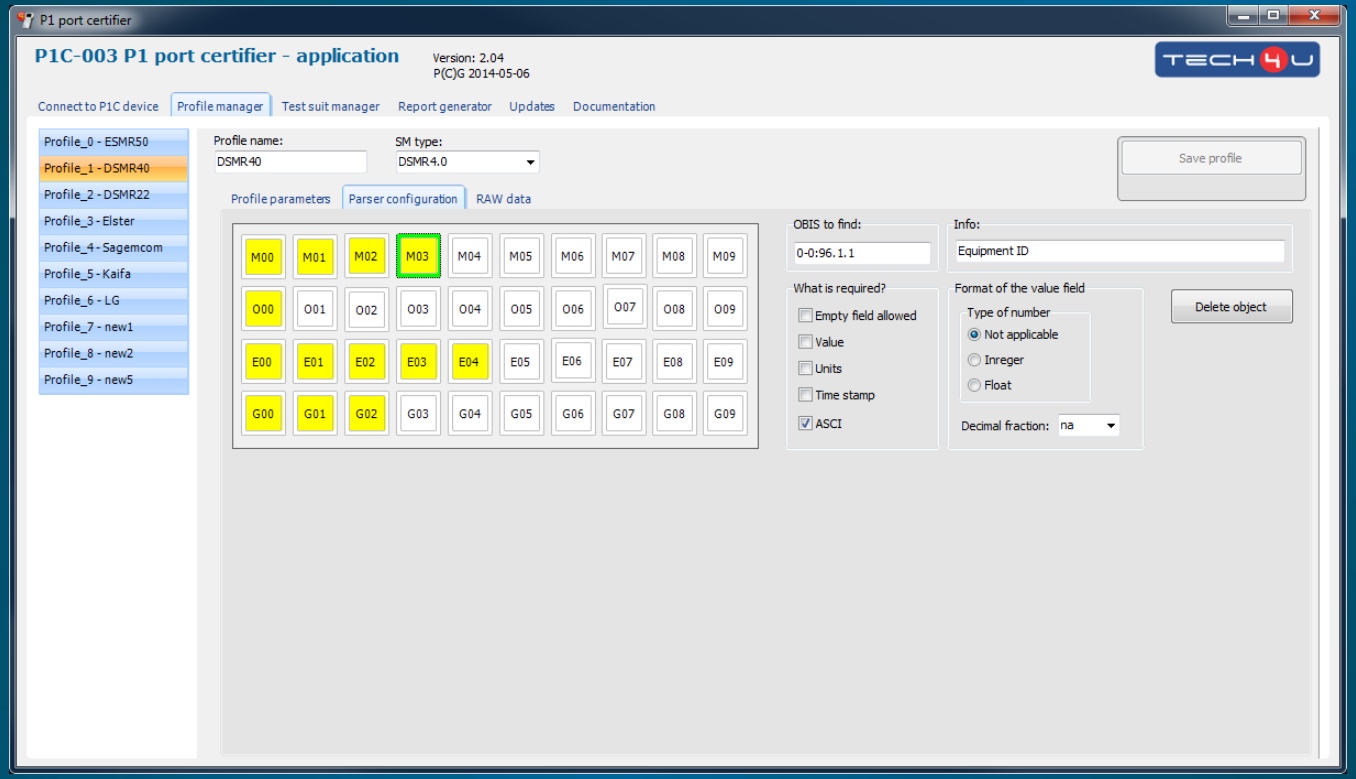
PC Application, Profile editor



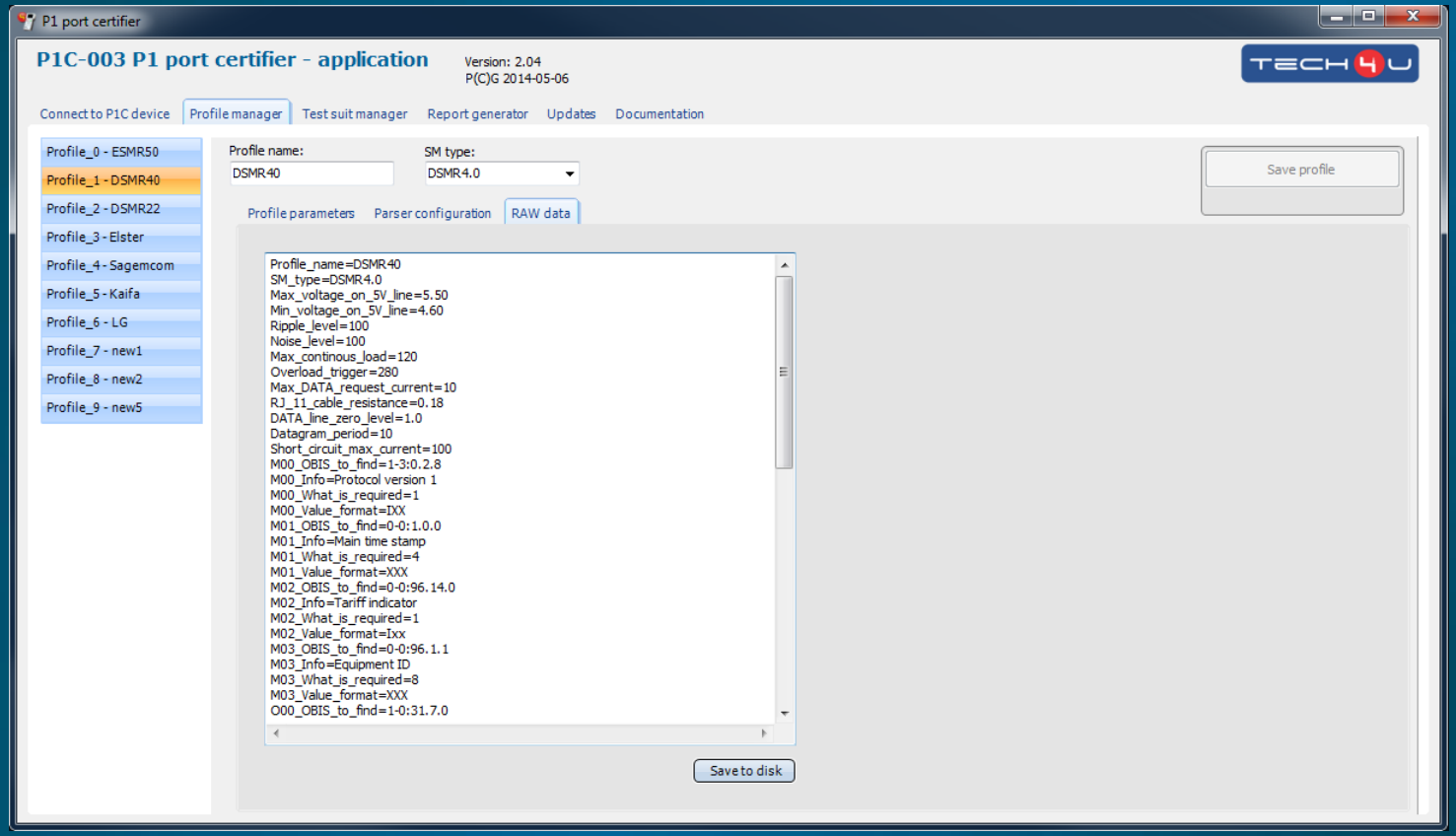
10

Profile editor – Parser configuration

PC Application, Profile editor



PC Application, Profile editor

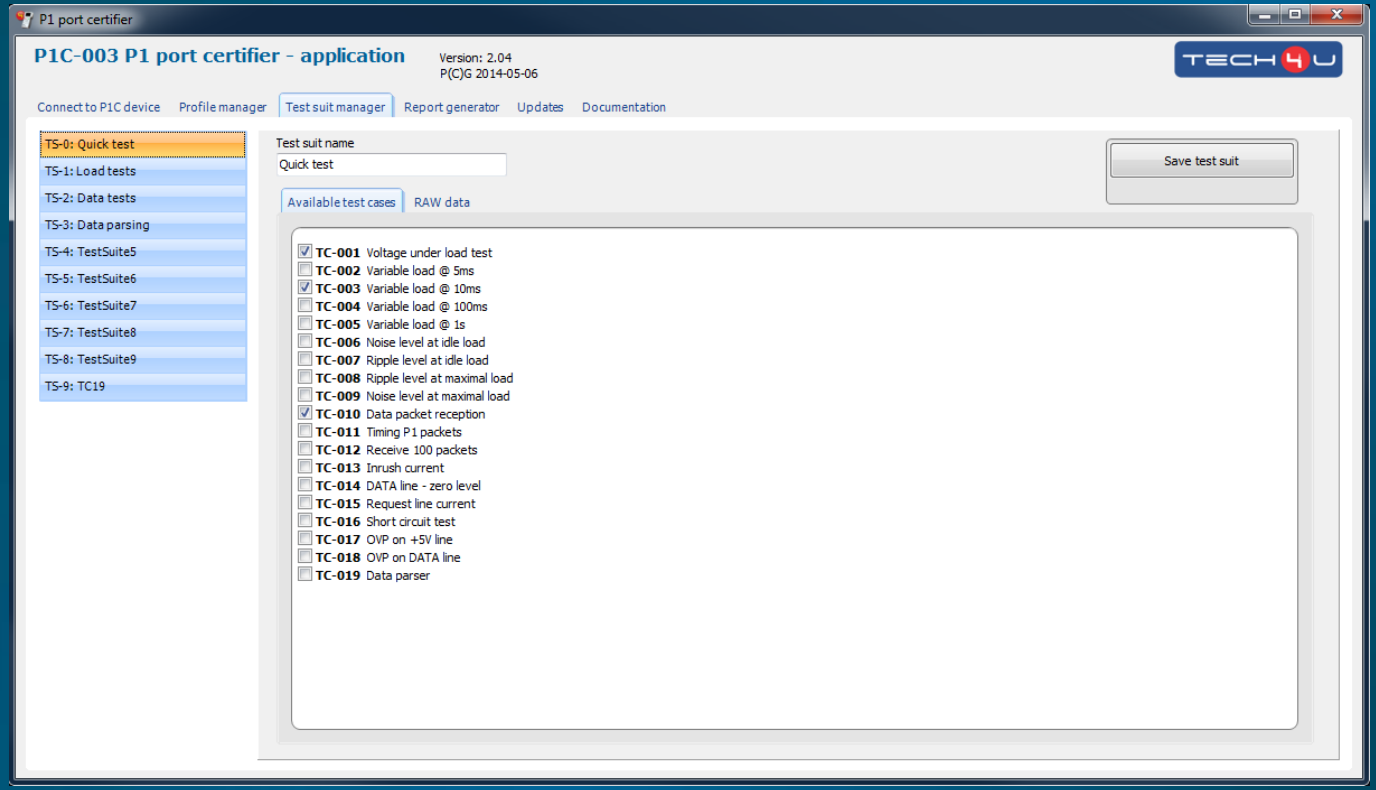


PC Application – Configuring parameters
exercise

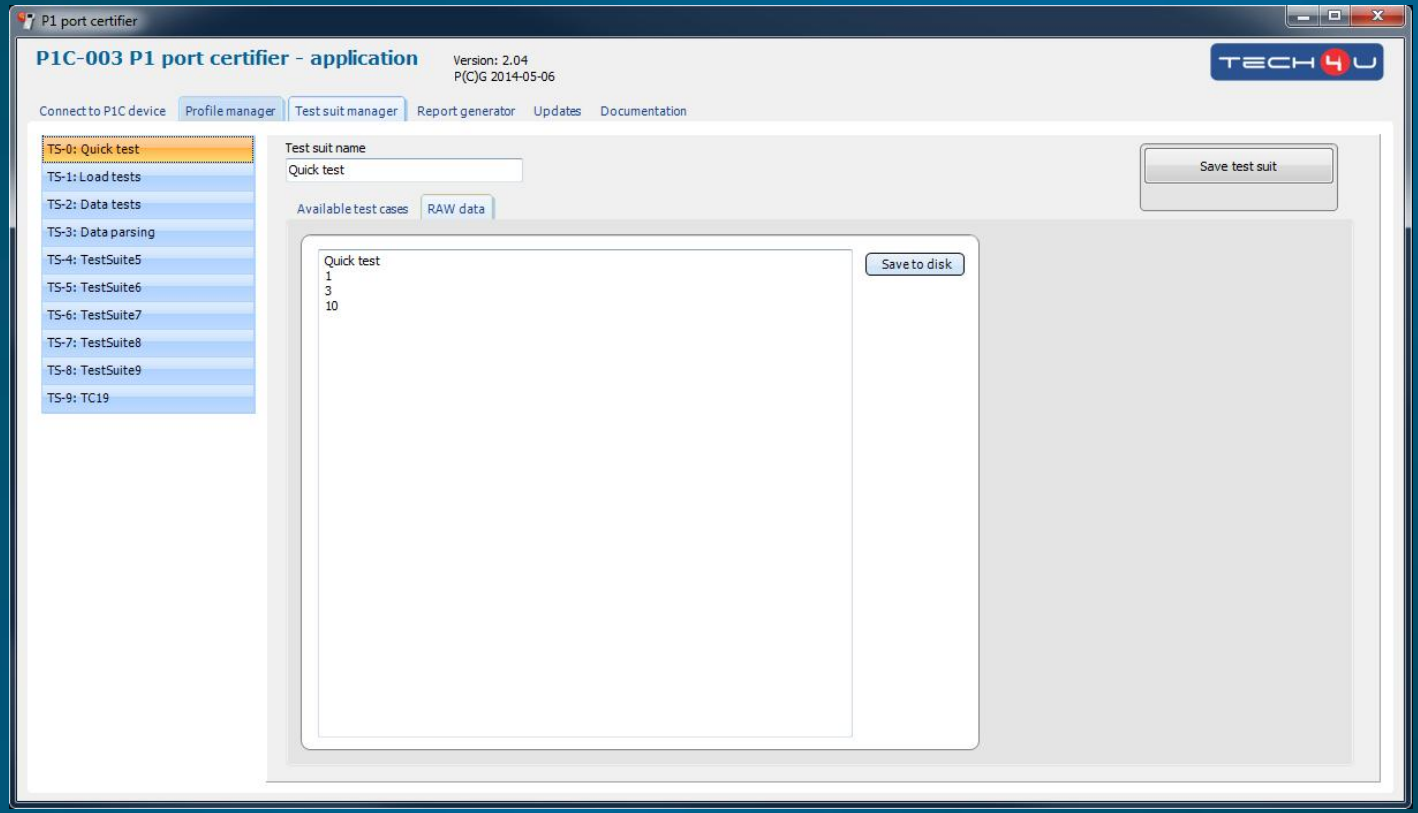
11

Test suite editor

PC Application, Test suite editor



PC Application, Test suite editor

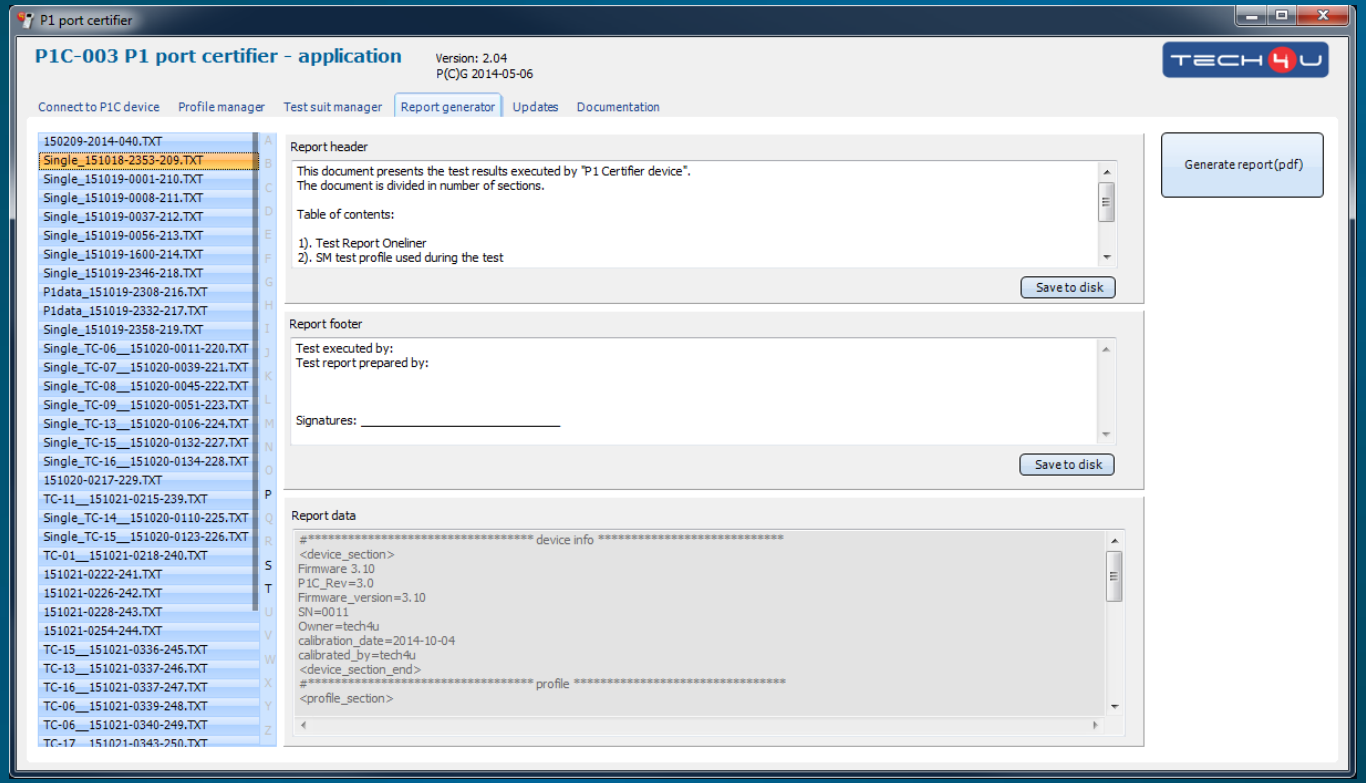


PC Application – Test suite creation
exercise

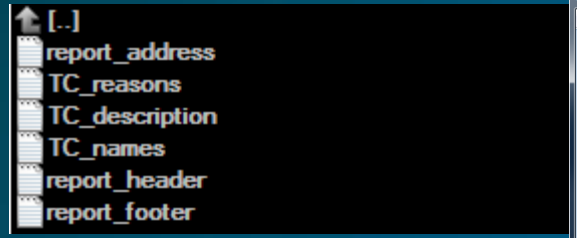
12

Report generator

PC Application, Report generator



PC Application, Report generator



TC_description - Notepad

File Edit Format View Help

```
1=The intenction of TC-001 is to check correctness of overload protection mechanism. During the test, voltage on the "+5V line" is measured at continously
increasing load.
2=This testcase simulates variable load on +5V line at period of 5 milisecond.
3=This testcase simulates variable load on +5V line at period of 10 milisecond.
4=This testcase simulates variable load on +5V line at period of 100 milisecond.
5=This testcase simulates variable load on +5V line at period of 1 second.
6=Test case measures the noise level when there is no load on +5V line.
7=Test case measures the ripple level when there is no load on +5V line.
8=Test case measures the ripple level when +5V line is loaded at level of maximal continous load.
9=Test case measures the noise level when +5V line is loaded at level of maximal continous load.
10=This testcase analyzes the P1 datagram and checks its CRC code when needed.
11=This testcase measures the time period between two consecutive datagrams.
12=This test case checks the error rate of P1 datagrams. 100 consecutive packets are analyzed.
13=This test case verifies the behaviour of the SM under "inrush current" circumstances.
14=This TC measures the logical "zero" level on the DATA line, under variable load.
15=This TC measures power consumption by the REQUEST line, under variable voltage.
16=This testcase measures the Short Circuit current of the +5V line.
17=This testcase check the behaviour of the +5V line under overvoltage situation. The 20V overvoltage is applied for a period of 200ms.
18=This testcase check the behaviour of the DATA line under overvoltage situation. The 20V overvoltage is applied for a period of 200ms.
19=DATA parser test
```

Lister - [c:\P1Certifier_3-13\Report_files\TC_reasons.txt]

File Edit Options Encoding Help 100 %

```
0=Testcase executed correctly. No errors found.
1=Maximal allowed voltage exceeded
2=Minimal allowed voltage exceeded
3=Min and Max allowed voltage exceeded
4=Maximal allowed current exceeded
5=Maximal allowed current and voltage exceeded
6=Maximal allowed current and minimal voltage exceeded
7=All allowed parameters exceeded!
8=CRC of the datagram incorrect
16=Maximal allowed noise level exceeded
32=Maximal ripple level exceeded
64=Maximal short circuit current exceeded
128=Wrong voltage after short circuit
129=wrong voltage after inrush current
130=Zero level on DATA line is too high
132=No datagrams received on time
144=REQUEST line current too high
145=No datagrams received
```

Lister - [e:\PCB\000_SW_Delphi\302_P1C_003_certifier\Report_files\report_header.txt]

File Edit Options Encoding Help 100 %

```
This document presents the test results executed by "P1 Certifier device".
The document is divided in number of sections.

Table of contents:

1). Test Report Oneliner
2). SM test profile used during the test
3). Test case set used during the test
4). TC details
5). Recorded datagram
6). Conclusion
```

Lister - [e:\PCB\000_SW_Delphi\302_P1C_003...

File Edit Options Encoding Help 100 %

```
Test executed by:
Test report prepared by:


Signatures: _____
```

report_address - Notepad

File Edit Format View Help

```
Tech4u
Nispenstraat 3
5045MR, Tilburg
The Netherlands
```

PC Application, Report generator

Test report generated by "P1 port certification device"

Report template v 1.0

Enexis B.V.
Hogeloerenlaan 115
5223 MB 's-Hertogenbosch

ENEXIS

1). Document description

This document presents the test results executed by "P1 Certifier device".
The document is divided in number of sections.

Table of contents:

2). P1 Certifier device information

Firmware 3.11
P1C Rev=3.0
Firmware version=3.10
SN=0011
Owner=tech4u
calibration date=2014-10-04
calibrated by=tech4u

3). Profile parameters used during the test

profile number=1
DSMR40
Max voltage on 5V line=5.500
Min voltage on 5V line=4.600
Ripple level=100
Noise level=100
Max continous load=120
Overload trigger=280
RJ_11_cable_resistance=0.180
Datagram_period=10
Short_circuit_max_current=100.000
Max_DATA_request_current=10.000
DATA_line_zero_level=1.000

4). Test set used during the test

test suit number=0
test_suit_name=Quick test

1	Voltage under load test
3	Variable load @ 10ms
10	Data packet reception

5). One page report

1	**PASSED**	Voltage under load test	Testcase executed correctly. No errors found.
3	**PASSED**	Variable load @ 10ms	Testcase executed correctly. No errors found.
10	**PASSED**	Data packet reception	Testcase executed correctly. No errors found.

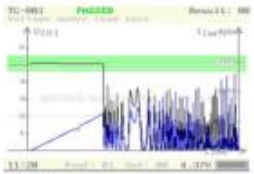
6). TC details and graphs

Below all the executed tests are detailed.
Related graphs are displayed where applicable.

TC-001 Voltage under load test

The intention of TC-001 is to check correctness of overload protection mechanism. During the test, voltage on the "+5V line" is measured at continously increasing load.

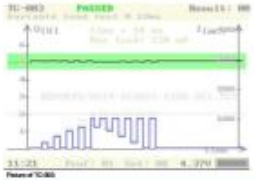
Result = **PASSED**
Reason = Testcase executed correctly. No errors found.



TC-003 Variable load @ 10ms

This testcase simulates variable load on +5V line at period of 10 millisecond.

Result = **PASSED**
Reason = Testcase executed correctly. No errors found.



TC-010 Data packet reception

This testcase analyzes the P1 datagram and checks its CRC code when needed.

Result = **PASSED**
Reason = Testcase executed correctly. No errors found.

PC Application – Report generation
exercise

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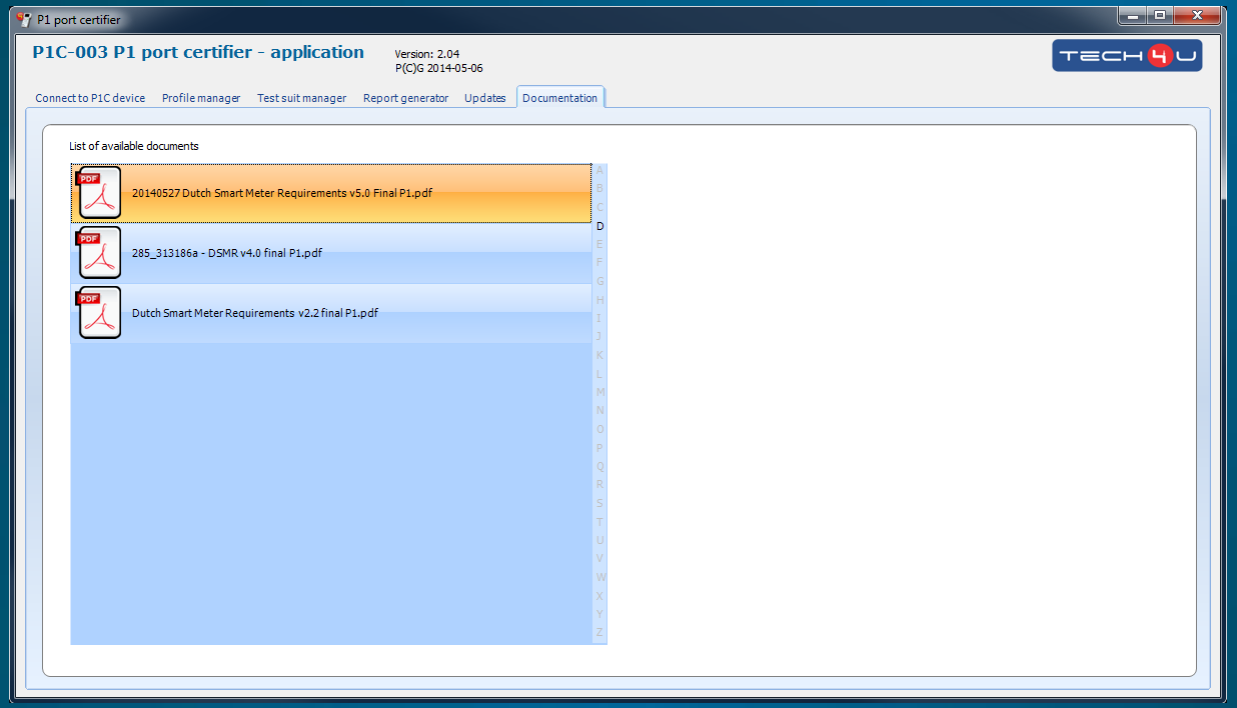
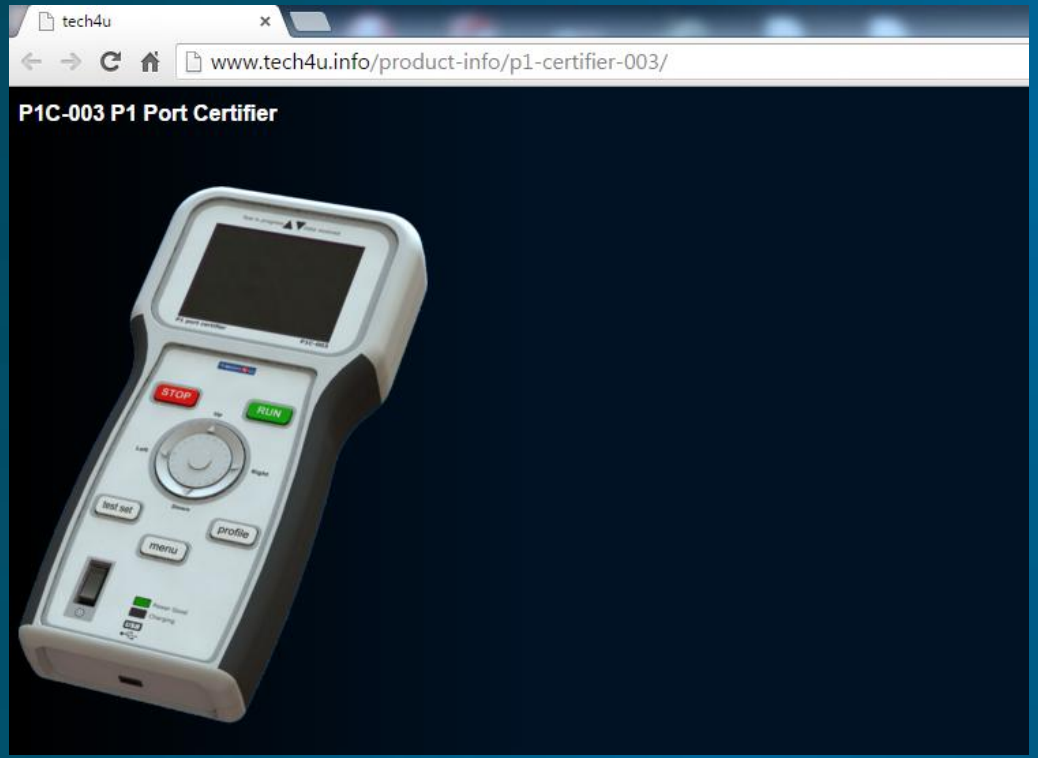
PC Application - Documentation

PC Application, Documentation



PC Application, Documentation



http://www.tech4u.info/product-info/p1-certifier-003/

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MENU System

Menu system, MAIN menu

```
MAIN menu

> Single test menu
  Test suite menu
  Profile menu
  Settings menu
  USB storage mode

22:15:44 Prof: 00 Set: 00 4.37V
```

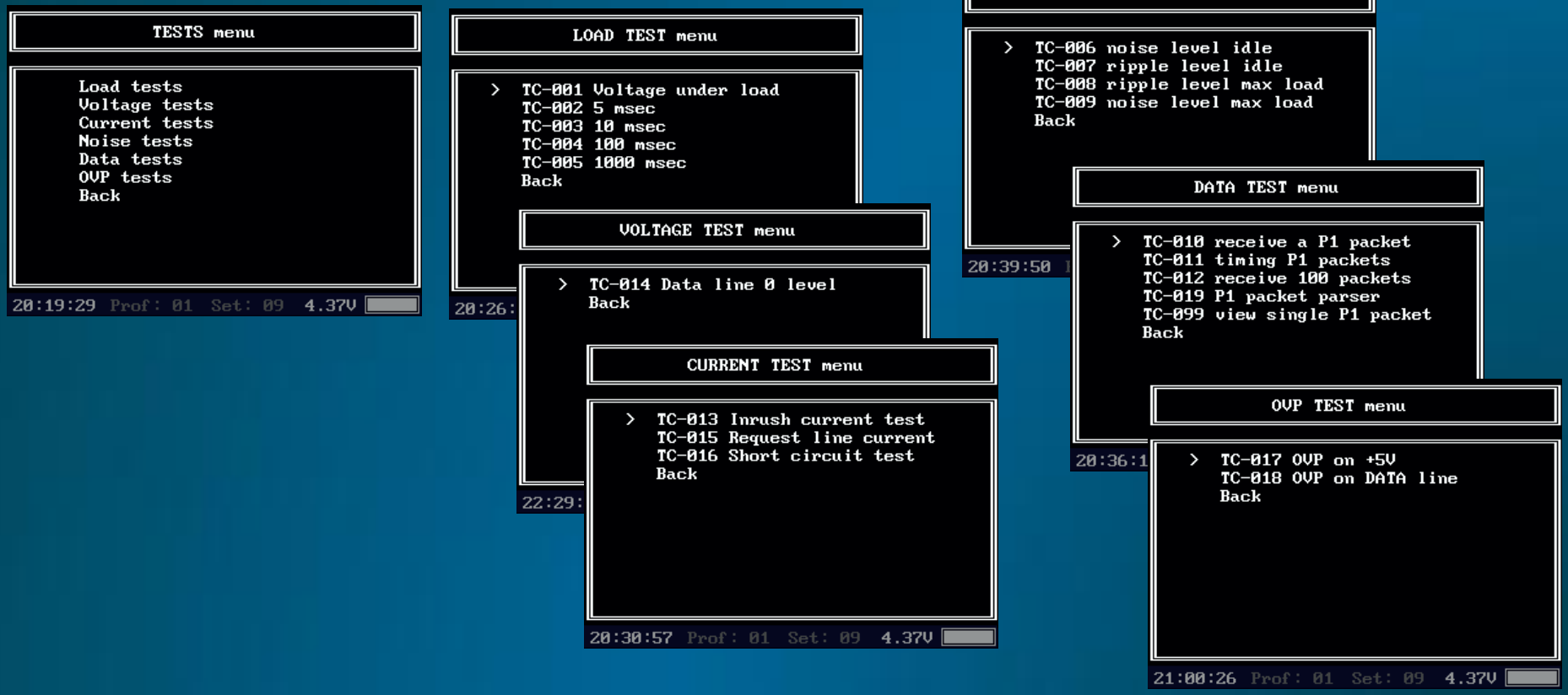
```
TESTS menu

  Load tests
  Voltage tests
  Current tests
  Noise tests
  Data tests
  OVP tests
  Back

20:19:29 Prof: 01 Set: 09 4.37V
```

```
TEST SUITS menu

> Quick test
  Load tests
  Data tests
  Data parsing
  TestSuite5
  TestSuite6
  TestSuite7
  TestSuite8
  TestSuite9
  TC19

21:25:24 Prof: 01 Set: 00 4.37V
```

```
Profile select menu

> ESMR50
  DSMR40
  DSMR22
  Elster
  Sagemcom
  Kaifa
  LG
  new1
  new2
  new5

21:25:49 Prof: 00 Set: 00 4.37V
```

```
SETTINGS menu

> Set time
  Calibrate devic
  DEMO
  Back

21:28:20 Prof: 00 Set
```

Menu system, TESTS menu



Menu system, Settings menu

Coffee break...

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TEST cases

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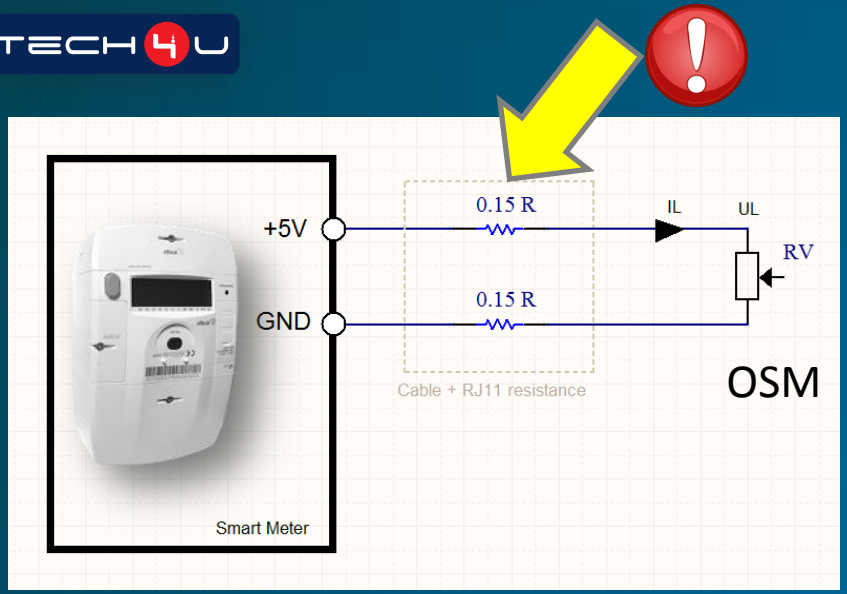
TC-001 Voltage under load

Load test cases, TC-001 – Voltage under load



Real circuit

100 mA

DSMR 4.0

4.2 **Power supply**

The power supply for the P1 port shall be able to withstand short circuits. Manipulation of the power supply lines shall never influence any other part of the meter.
When no device is connected through the P1 port, the power consumption of the P1 circuitry shall not be included in the register values. When a device is connected to the P1 port, the power consumption of the P1 circuitry shall be included in the register values. The P1 port will function and supply power independent of the position of the breaker.
The power supply will supply a maximum current of 100 mA at 5 V. Overload protection shall be implemented as a current limiting mechanism.

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devices will need a hub. The hub is outside the scope of the P1 document, but a basic schematic is shown in Appendix I.

4.5 **Measuring device transfer time**

The measuring device must complete a data transfer to the P1 device within eight seconds, because the data has to be sent by the P1 port to the P1 device every ten seconds. This means at a minimum there is a pause of two seconds between messages.

4.6 **Signals**

All signals are compliant with following levels (different from the NTA8130!) Operating range per (P1) device as seen from the meter:

		Meter			OSM			
Symbol	Parameter	Min	Typ	Max	Min	Typ	Max	Units
Vi request	Request voltage				4	5	5.5	V
Ii request	Current supplied to the request pin				4	5	10	mA
Vol data	Low level output voltage of the Data pin			1				V
Ii data	Input current sinked, supplied by the Data pin per OSM		5	6				mA

Table 4-1: Signal Levels

Limit values:
Max Voltage: opto coupler: 15V, driver 6V
Max current sink (data output) : max = 30mA
Logical levels are specified as follows:
SPACE "0" as > 4V
MARK "1" as < 1 V

ESMR 5.0

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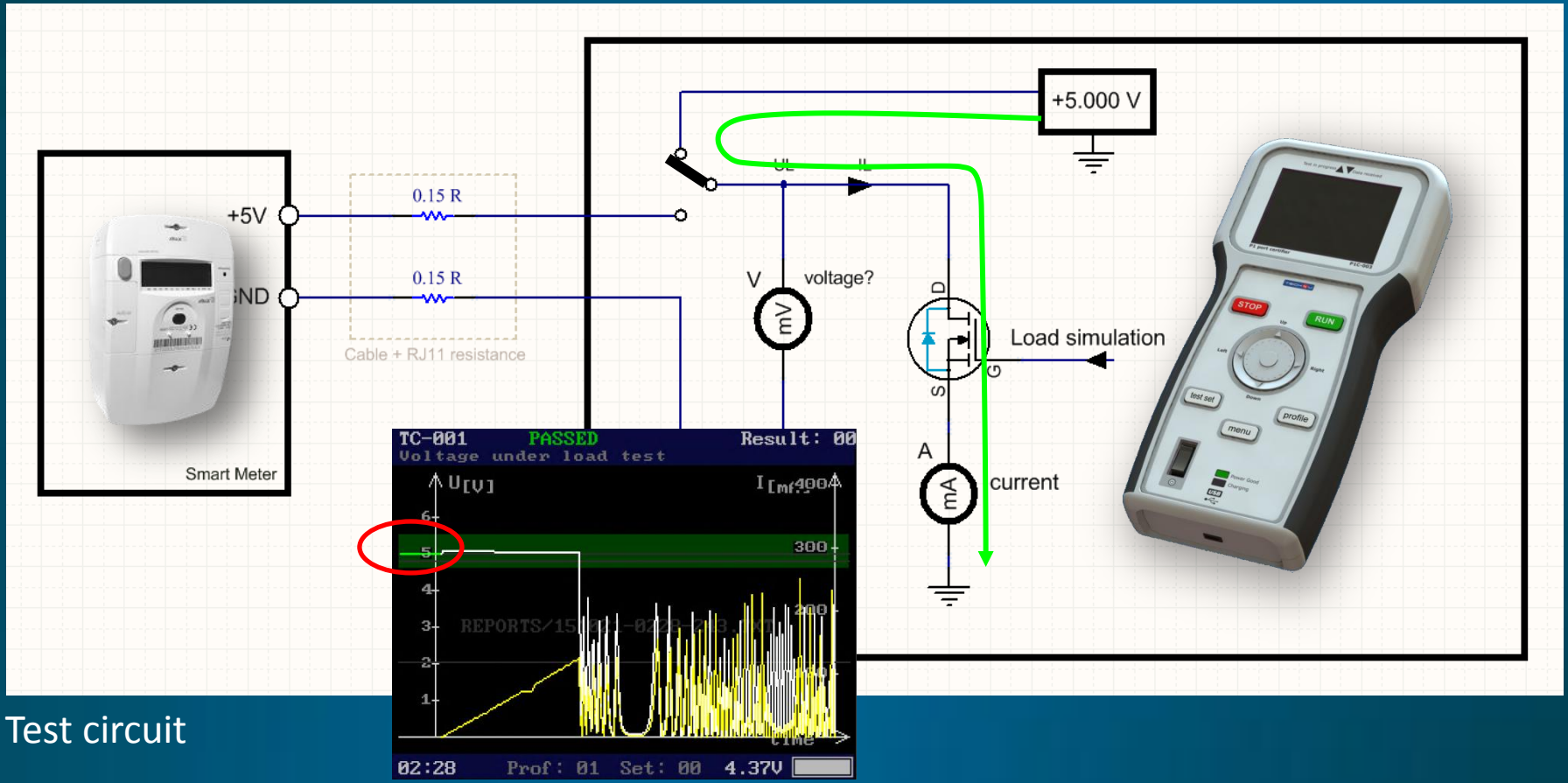
5.8 **P1 signal levels**

		Requirement for the Meter			Requirement for OSM			
Symbol	Description	Min	Typical	Max	Min	Typical	Max	Units
U_{DR_1}	"Data request" line - HIGH level	-	-	5,5	4,0	5,0	5,5	V
I_{DR_1}	"Data request" line current	-	5	10	4	5	10	mA
U_{D_0}	"Data" line – LOW level	0	0,2	1	0	0,2	1	V
U_{D_1}	"Data" line – HIGH level	-	5,0	-	-	5,0	-	V
$I_{D\_0\_MAX}$	"Data" line max current	-	-	30	-	-	5	mA
U_L	"+5V" power supply – voltage	4,9	5	5,3	4,9	5	5,3	V
U_{RIPPLE_MAX}	"+5V" line maximum ripple voltage	-	-	100	-	-	100	mV
U_{NOISE_MAX}	"+5V" line- maximum noise	-	-	50	-	-	100	mV
U_{OVP}	OVP level ("+5V" and "Data request" lines)	5,8	5,9	6	-	-	-	V
I_{L_CONT}	"+5V" maximum continuous current	250		260	-	-	250	mA
I_{L_MAX}	"+5V" line overload protection trigger	260	-	3000	-	-	-	mA
I_{SC}	"+5V" line Short Circuit current	-	-	50	-	-	-	mA

Logical levels are specified as follows:
SPACE "0" usually > 4V
MARK "1" as < 1 V

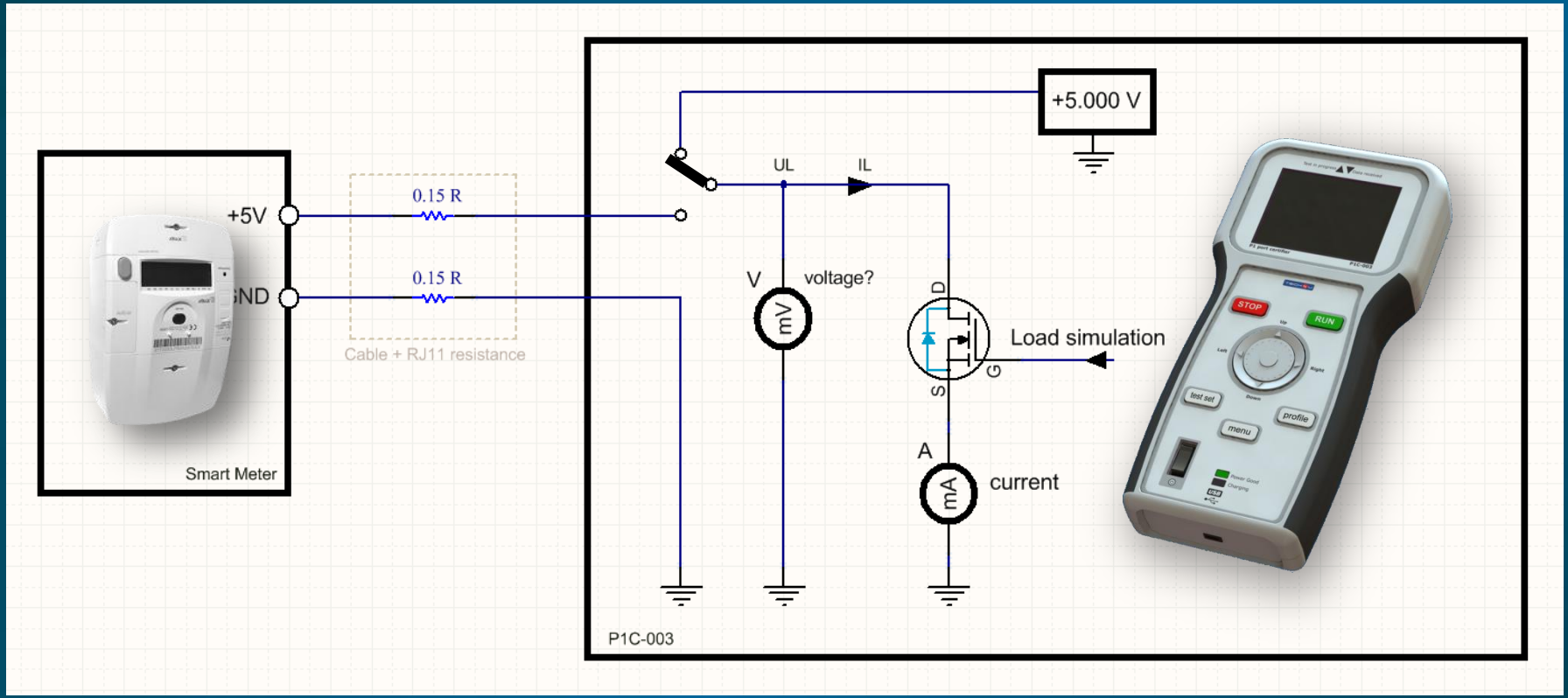
250 mA

Load test cases, TC-001 – Voltage under load



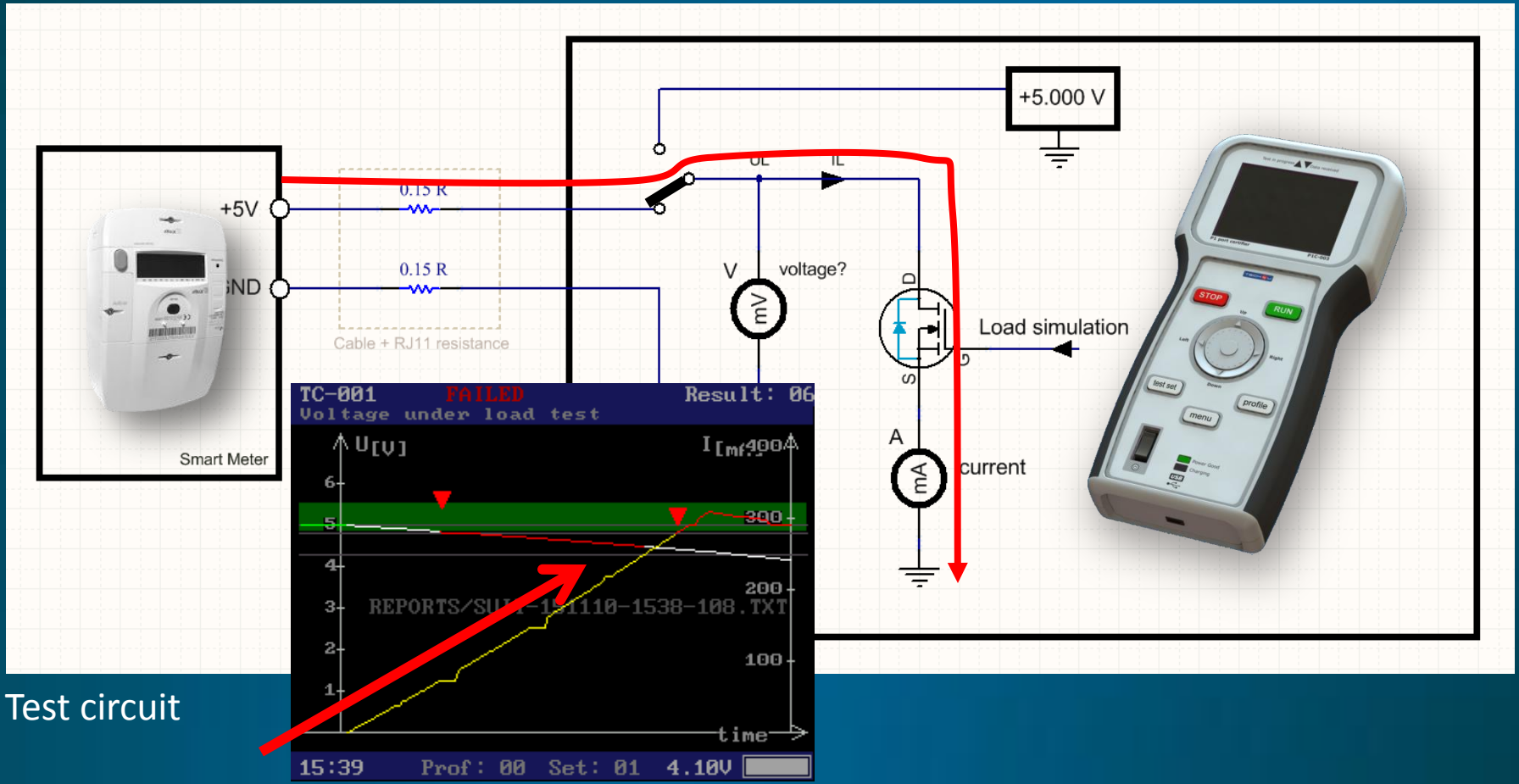
Test circuit

Load test cases, TC-001 – Voltage under load



Test circuit

Load test cases, TC-001 – Voltage under load



Test circuit

Load test cases, TC-001 – Voltage under load, DISPLAY

Number of the Test Case

Test result

Test result's reason/reasons

Name of the Test Case

Name of the Report file

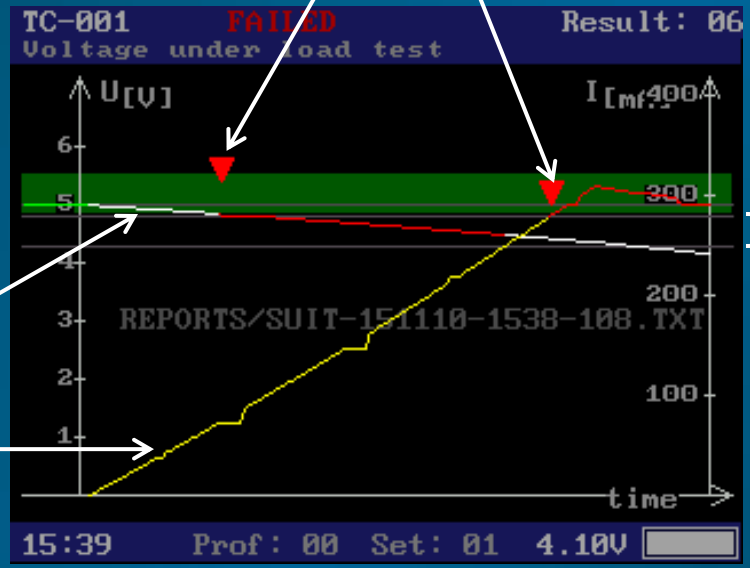
Current time

Chosen profile

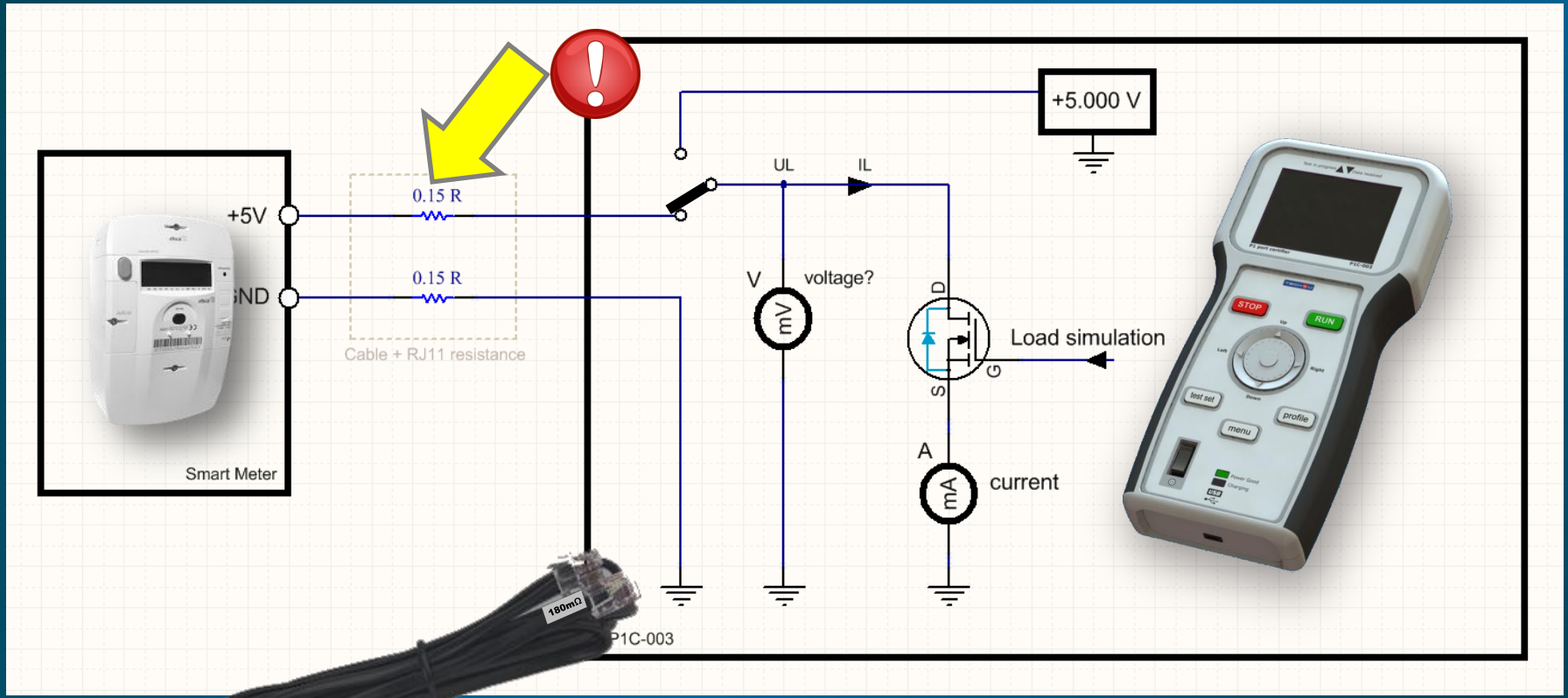
Chosen test suite

Battery indicator

Load test cases, TC-001 – Voltage under load, DISPLAY

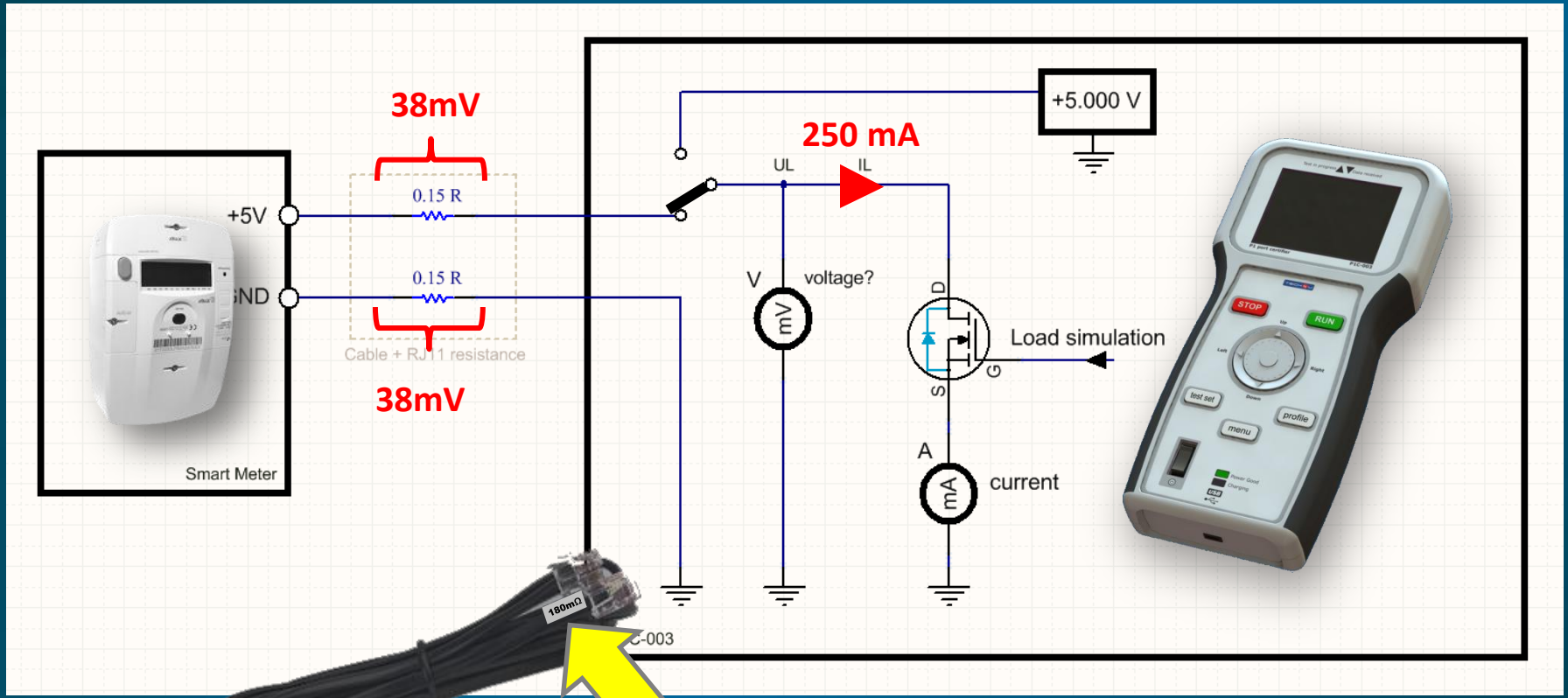


Load test cases, TC-001 – Voltage under load



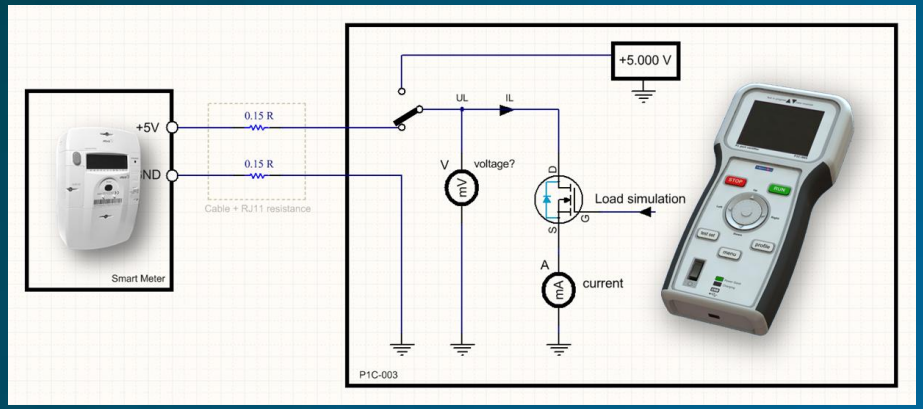
Test circuit

Load test cases, TC-001 – Voltage under load

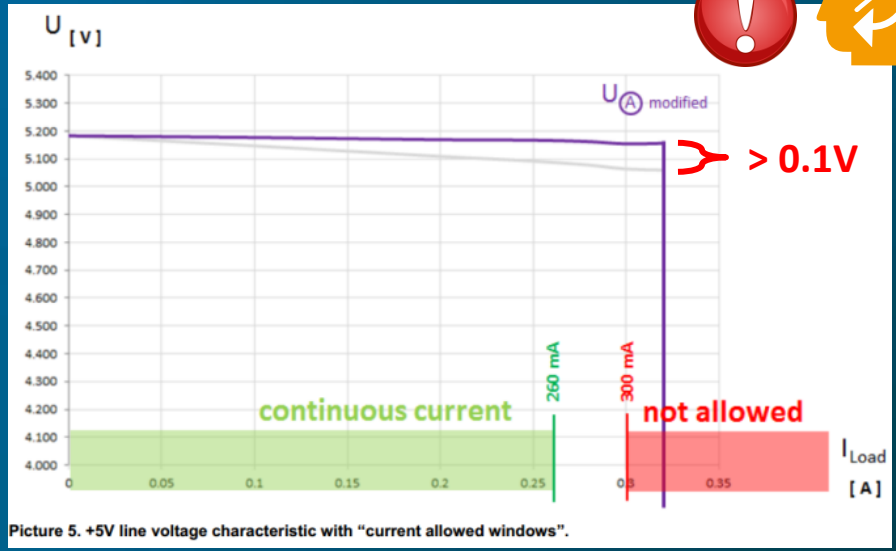


Test circuit

Load test cases, TC-001 – Voltage under load



RJ-11 cable resistance - impact



Picture 5. +5V line voltage characteristic with "current allowed windows".

TC-001 Voltage under load
exercise

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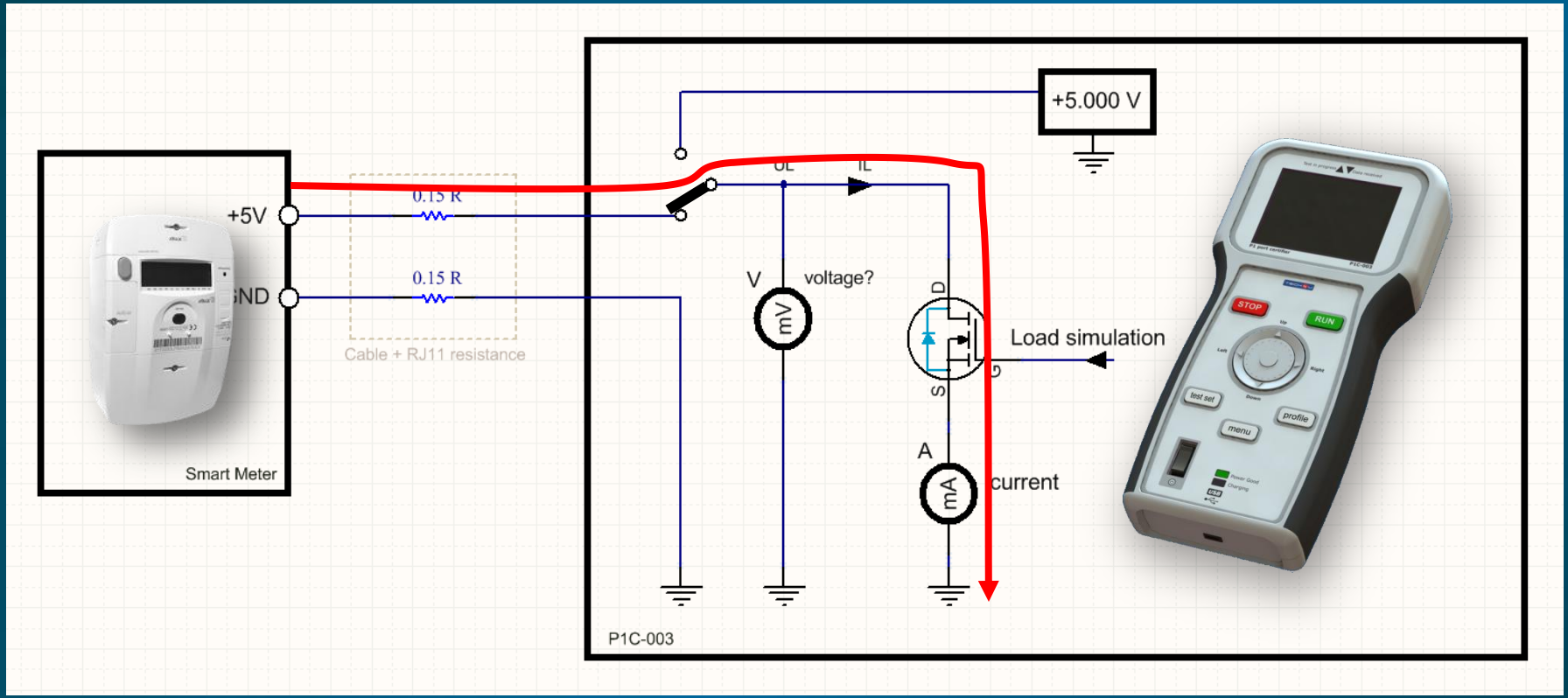
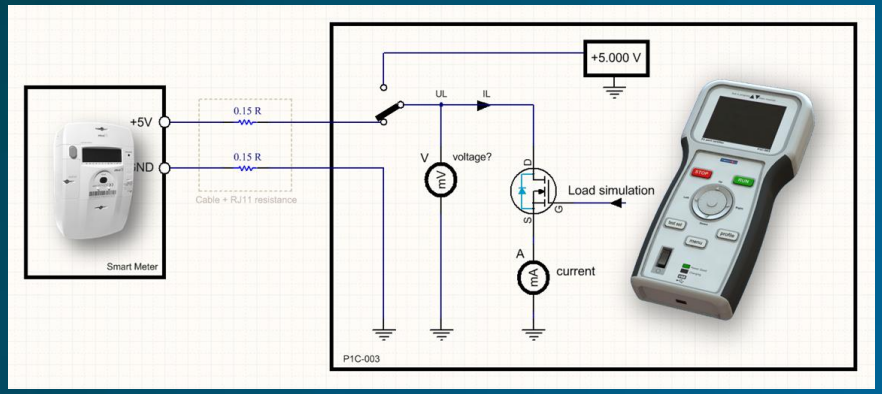
TC-002..5 Variable load tests

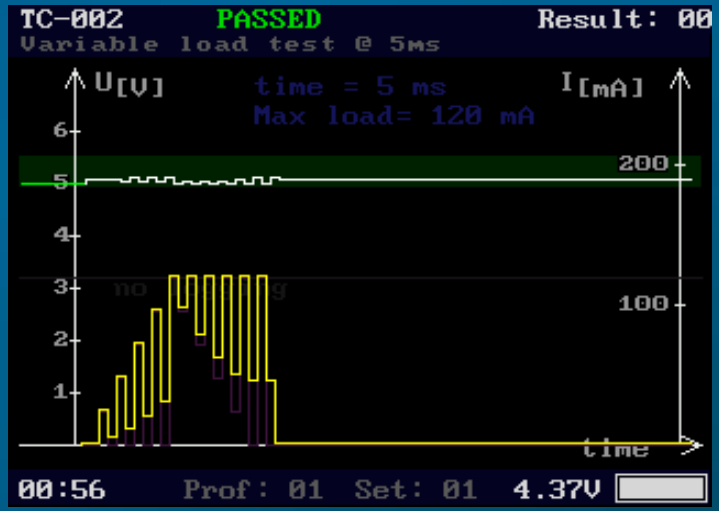
Load test cases, TC-001..5 – Variable load tests



Test circuit

Load test cases, TC-001..5 – Variable load tests





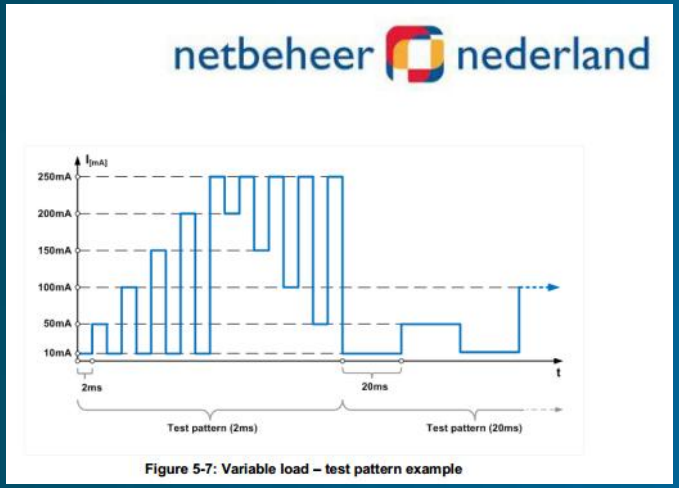
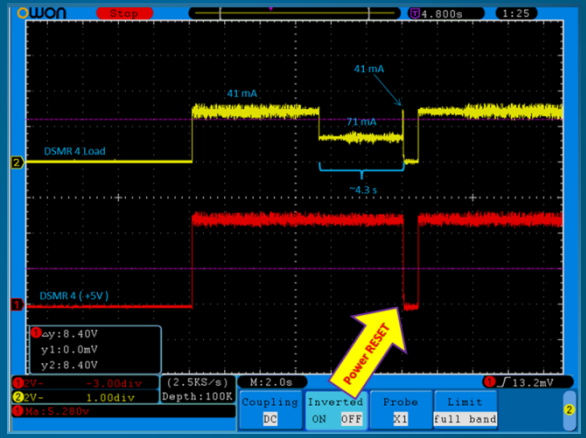
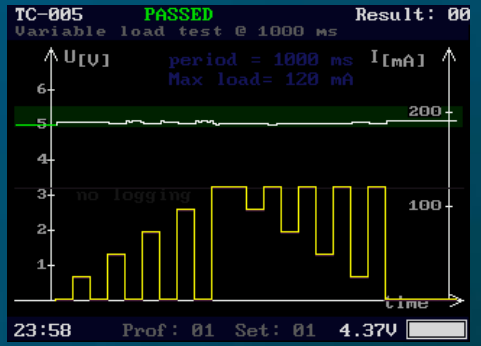


Figure 5-7: Variable load – test pattern example





TC-002..5 Variable load tests

exercise

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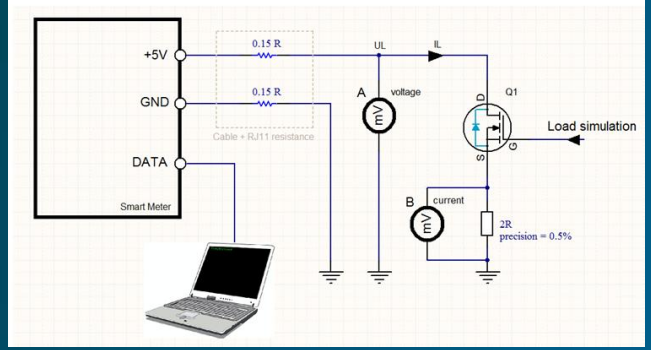
TC-006..9 Noise and ripple tests

Load/Noise/Ripple test cases, TC-006..9 – Noise and ripple tests

The following test circuit has been used to measure "+5V line" voltage characteristics under load:



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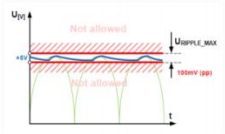


Figure 5-4: Ripple voltage window.

The "Noise Level" U_{NOISE_MAX} must not exceed <= 50mV peak to peak, for frequencies higher than 50 kHz. Defined at pure resistive load.

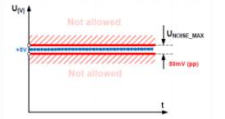
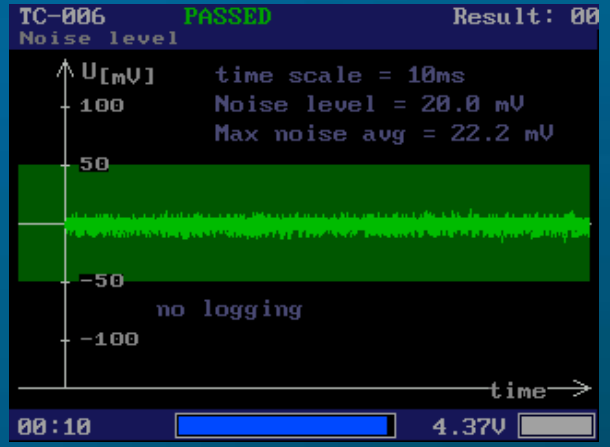
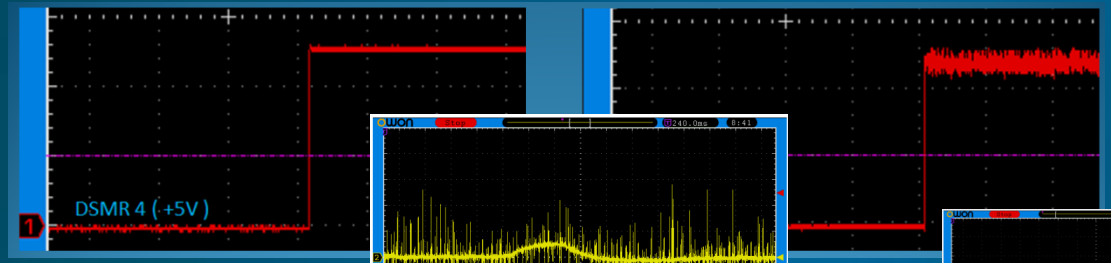
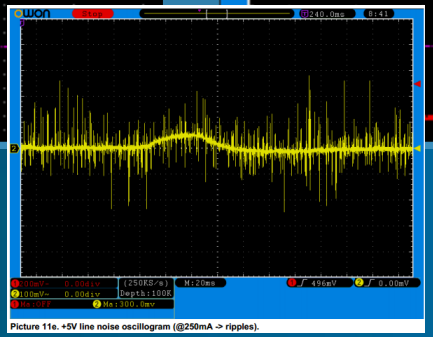


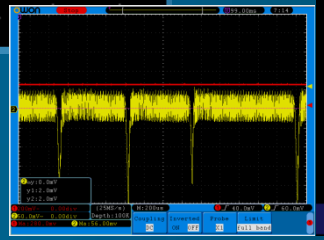
Figure 5-5: Noise level window.

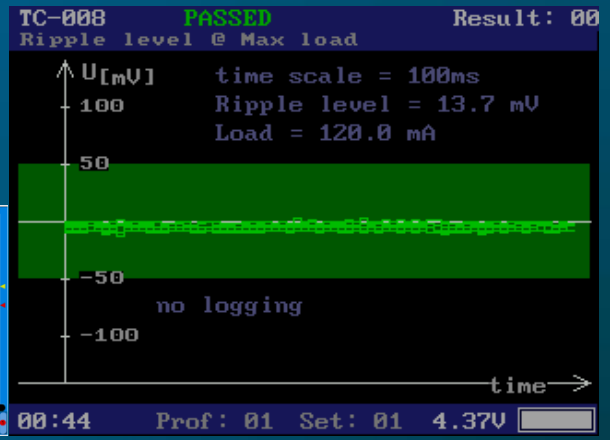






Picture 11e. +5V line noise oscillogram (@250mA -> ripples).





TC-006...9 Noise and ripple tests
exercise

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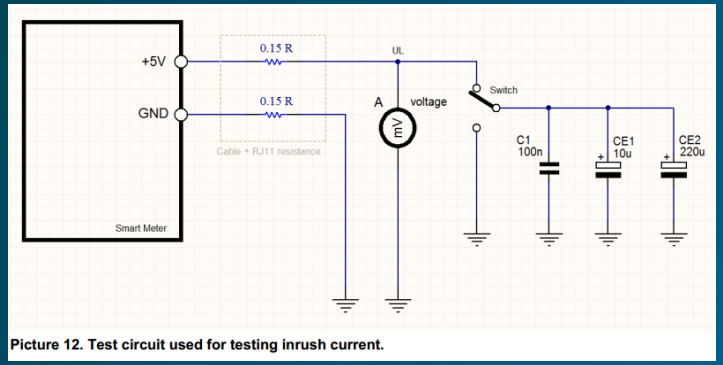
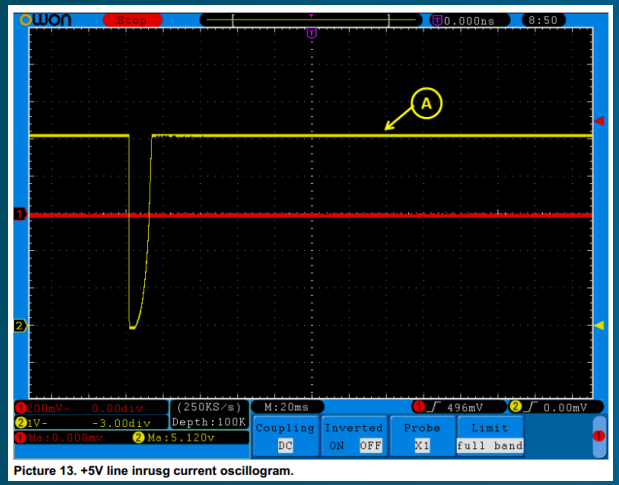
TC-013 Inrush current test

Current test cases, TC-013 – Inrush current test



Picture 12. Test circuit used for testing inrush current.



Picture 13. +5V line inrusg current oscillogram.

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5.3.2.1 Inrush Current

Once the OSM device is connected to the P1 port (depends on OSM internal design), its power supply unit may require to use an excessive current for a very short period of time (usually for less than 1 ms). Such current is often called: an "Inrush current".

The power supply must be able to cope with an Inrush current, caused by the OSM.

The E-meter must be able to withstand a typical "Inrush curent" from a circuit as presented in the picture below.

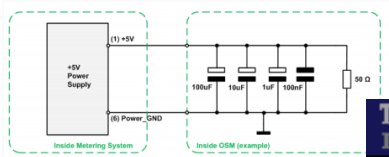
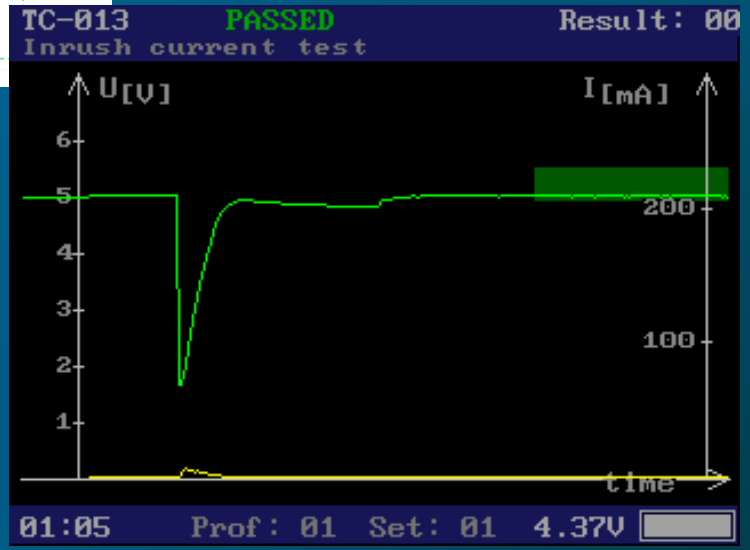


Figure 5-6: Inrush current circuit example.



TC-013 Inrush current test
exercise

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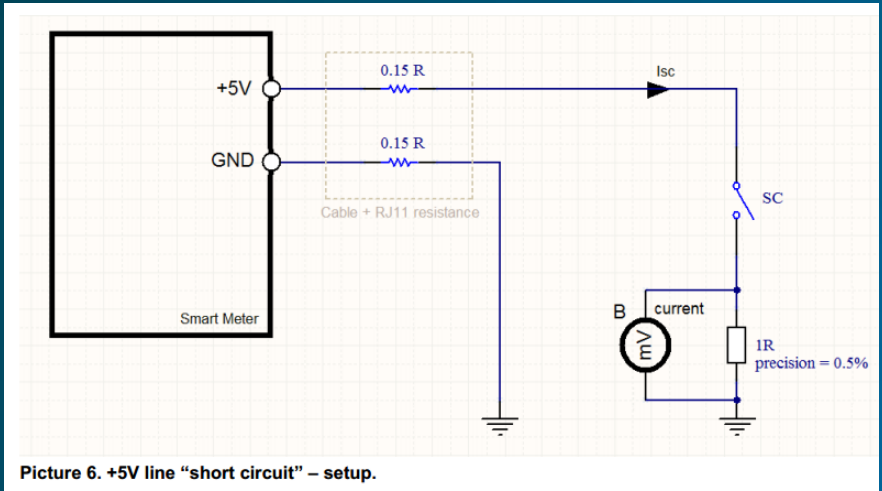
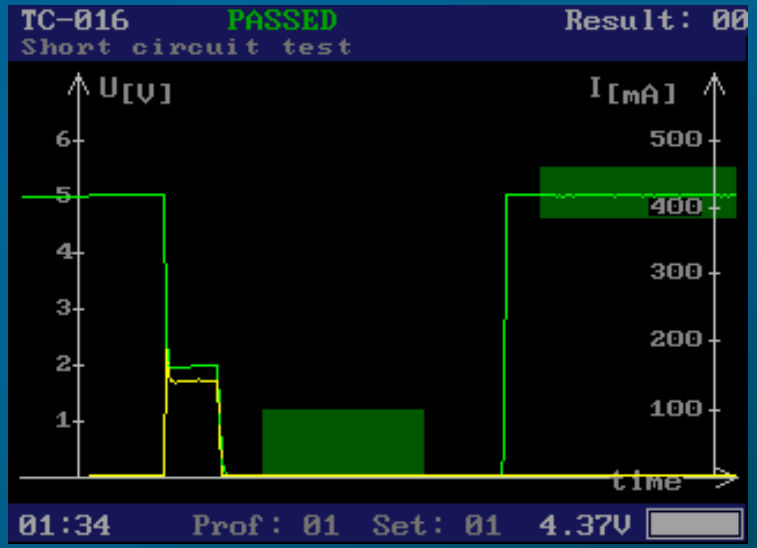
TC-016 Short circuit test

Current test cases, TC-016 – Short circuit test



Picture 6. +5V line "short circuit" – setup.



5.5.2 **Short circuits**

The "+5V" power supply line of the P1 port shall be able to withstand long lasting short circuits.

The maximum "short circuit current" has to be limited to 50 mA. I_{SC} <= 50 mA.

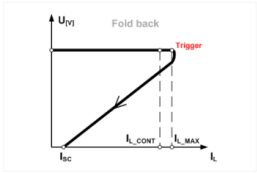
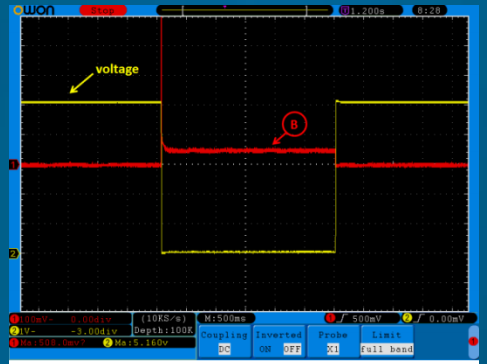


Figure 5-8: Over current / short circuit graph example.



Picture 7. +5V line "short circuit" – oscillogram.

		Requirement for the Meter			Requirement for OSM			
Symbol	Description	Min	Typical	Max	Min	Typical	Max	Units
I_{SC}	"+5V" line Short Circuit current	-	-	50	-	-	-	mA

TC-016 Short circuit test
exercise

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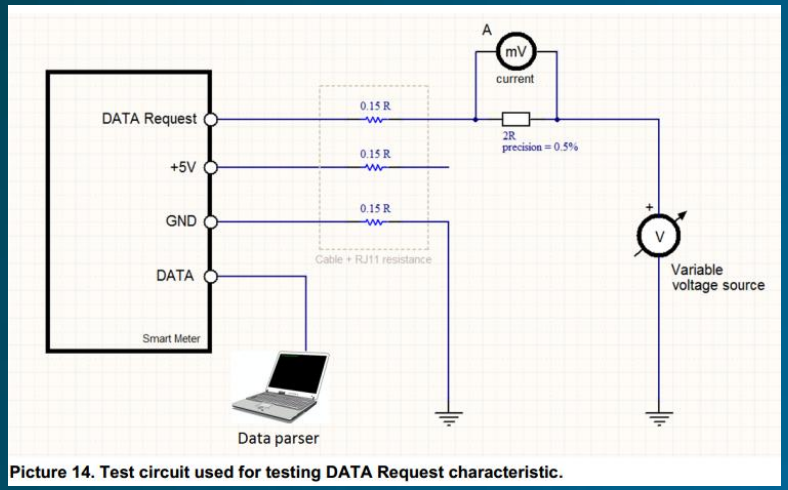
TC-015 Request line current test

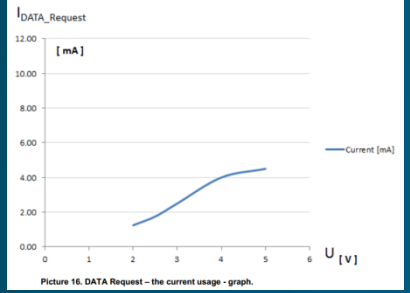
Current test cases, TC-015 – Request line current



Picture 14. Test circuit used for testing DATA Request characteristic.

Voltage [V]	5	4	3	2.5	2
Current [mA]	4.50	4.00	2.50	1.75	1.25
Received data	OK	OK	OK	OK	OK
RSEULT	OK	OK	OK	OK	OK

Table 5. DATA Request – measurements.



Picture 16. DATA Request – the current usage - graph.

5.8 P1 signal levels

		Requirement for the Meter			Requirement for OSM			
Symbol	Description	Min	Typical	Max	Min	Typical	Max	Units
U_{DR_1}	"Data request" line - HIGH level	-	-	5,5	4,0	5,0	5,5	V
I_{DR_1}	"Data request" line current	-	5	10	4	5	10	mA

TC-015 Request line current test
exercise

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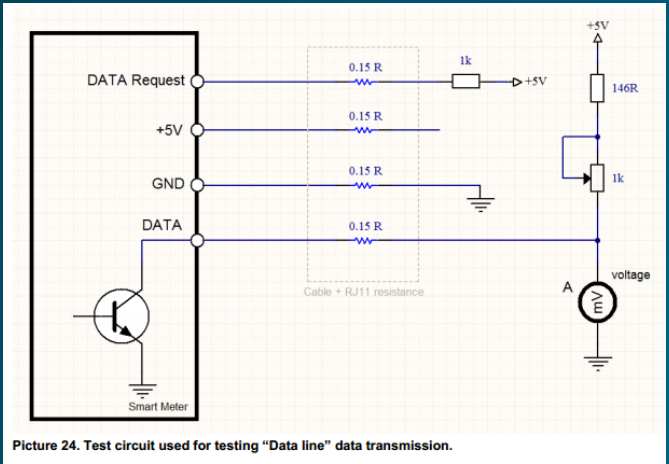
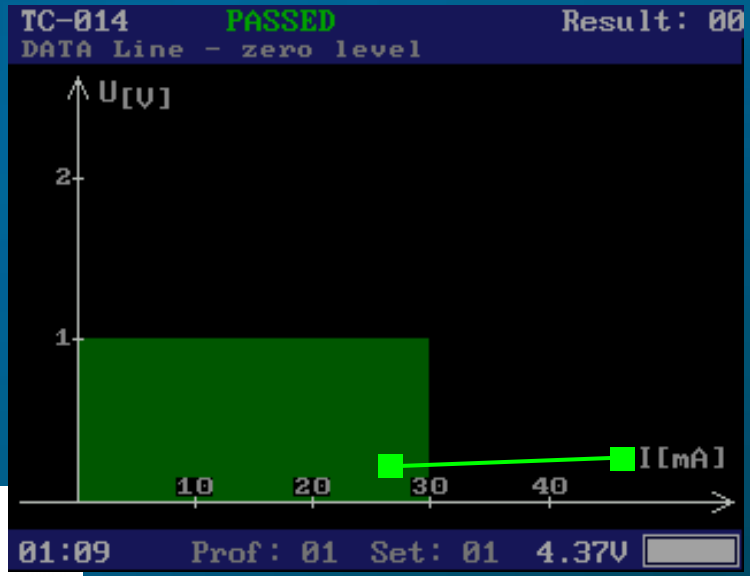
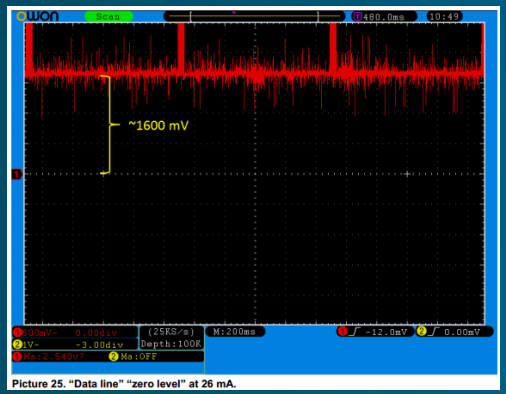
TC-014 DATA line “zero-level” test

Voltage test cases, TC-014 – DATA line zero level

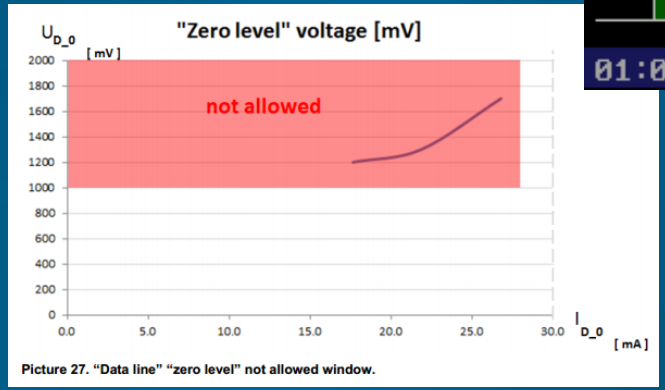


Picture 24. Test circuit used for testing "Data line" data transmission.





Picture 25. "Data line" "zero level" at 26 mA.



Picture 27. "Data line" "zero level" not allowed window.

TC-014 - DATA line “zero level” test
exercise

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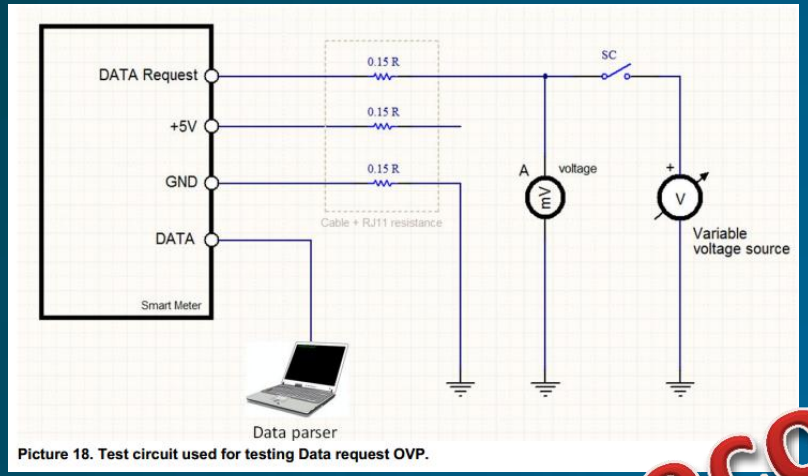
TC-017..18 Overvoltage tests

Voltage test cases, TC-017..18 – Overvoltage tests



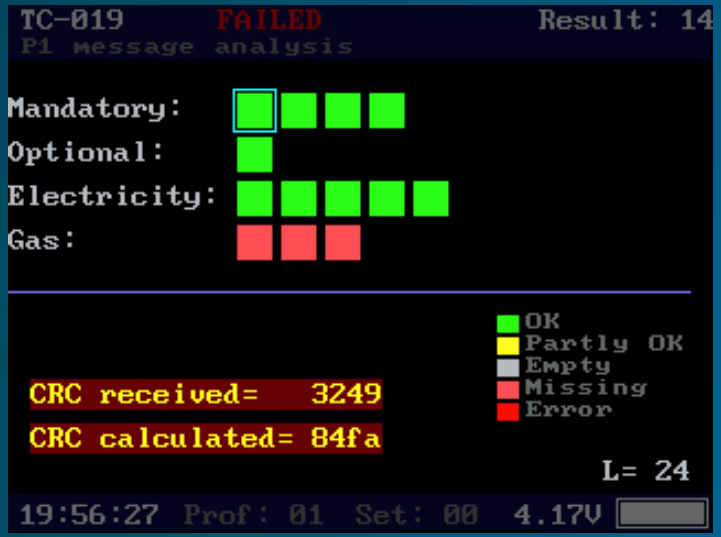
Picture 18. Test circuit used for testing Data request OVP.

Not recommended !

24 DATA tests

DATA test cases, TC-019 – Parser test

DATA test cases, TC-019 – Parser test



http://www.scadacore.com/field-applications/programming-calculators/online-checksum-calculator

CRC-16-IBM

(Bisync, Modbus, USB, ANSI X3.28, many others; also known as CRC-16 and CRC-16-ANSI)

Generator Type	Big Endian (ABCD)	Little Endian (DCBA)
Normal 0x8005	AD AF	AF AD
Reversed 0xA001	3D BB	BB 3D
Reversed Reciprocal 0xC002	9E 77	77 9E

TC-019 – P1 parser
exercise

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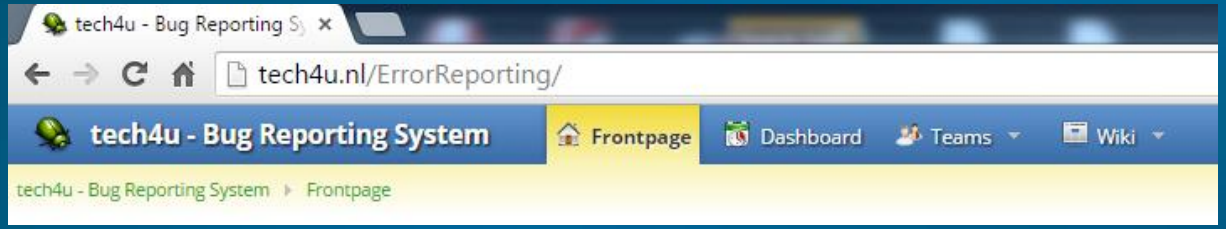
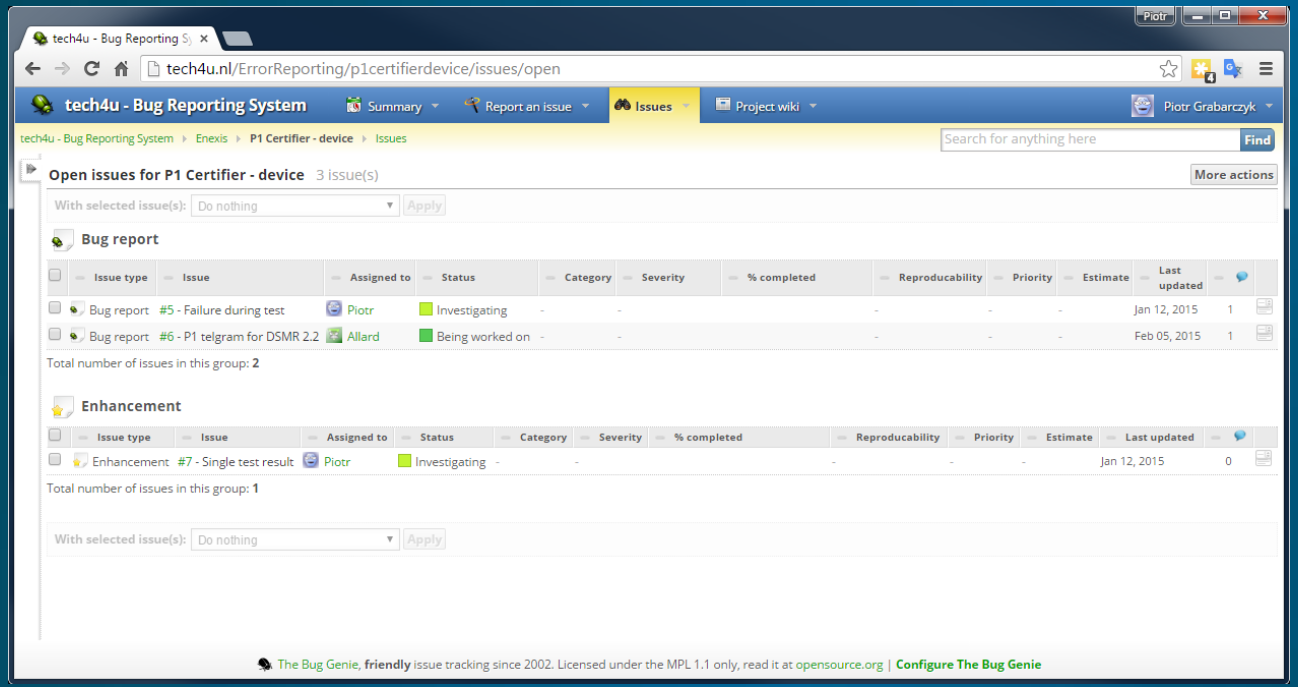
Bug reporting system





http://www.tech4u.nl/ErrorReporting/

Bug reporting
exercise

Hands-on training, questions

Questions ?

Thank you for your attention