User's Guide

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MP500 PT1 NFC

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This tool must be used according to the user guide. Any operation related to maintenance, reparation or calibration must be carried out by qualified personnel. Consequently, in case of failure, contact MICROPROSS to find out about the procedure to follow.

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1. FIRST STEPS

1.1. Introduction

1.1.1. Introduction note from Micropross

Dear Customer,

Congratulations on your purchase of the Micropross MP500 PT1NFC and welcome to its user's guide. You will find here complete reference on all the features included in this highly customizable multi-protocol tester used with MPManager 3 which presents all PT1NFC functions in a graphical and user friendly environment. This guide will introduce you to:

- Create and save test projects,
- Edit and run script files,
- Configure and spy the communication between the PT1NFC and a DUT,
- Visualize the log spy events,
- Execute parametric tests for smart card characterization.

Developers who wish to develop advanced tests in their own testing environment should refer to the Developer's guide that lists all the APIs provided with the MP500 PT1NFC.

Wishing you the best testing experience,

Micropross

1.1.2. Instructional icons

NOTE notes, usage tips, or additional information

REFER TO pages with related information; for example: p12 (represents “see page 12”)

WARNING statements identify conditions or practices that could result in damage to the equipment or other property.

DANGER statements identify conditions or practices that could result in personal damage

1.1.3. Acronyms used

DUT	Device Under Test
MP	Micropross
PCD	Proximity Coupling Device (also named “Reader”)
PICC	Proximity Integrated Circuit Card
LDR	Low Data Rate (106 kbps)
HDR	High Data Rate (> 106 kbps)
VHBR	Very High Baud Rate (> 848 kbps)
RF	Resonance Frequency
SFDR	Spurious Free Dynamic Range
THD	Total Harmonic Distortion
Q	Quality Factor
OTA	Over the air

1.1.4. Where to find the information you may need

The following table describes where to get more service information.

To learn about	Do this
Technical support	Visit http://support.micropross.com for online Helpdesk support with our engineering team (English and French).
Software updates	Visit www.micropross.com/customer_area/ and use your personal access key to access to the download center
Finding your MP500 PT1NFC serial number	The serial number can be found on the rear panel of the PT1NFC *(MP5.XX.XX.XX)*
Returning your device to Micropross	Go to www.micropross.com/customer_area/ Contact the Micropross support to get a RMA form and attach it to your shipment to : Micropross, 11-21 Rue Hubble, Parc de la Haute Borne, 59650 Villeneuve d'Ascq, FRANCE

2. Unpacking

2.1. Package content

Mandatory Content			
1	MP500 PT1NFC [1]	907-1385	
2	SMA-SMA 50cm cable	907-9327	
1	HDMI 70cm cable	125-0212	
1	USB cable	907-9071	
1	Ethernet cable	125-0102	
1	MP500 power supply unit (12V, 3.75A) with Europe power plug	907-2107	
1	Firmware, software and samples for MP500 PT1NFC	907-4425	

[1] The color of enclosure may vary

OPTIONAL MATERIAL			
1	Card emulation software license (passive target) for PT1NFC (software option)	907-4421	
1	Analog measurement license for PT1NFC (software option)	907-4424	
1	Viewer license for PT1NFC (software option)	907-4423	
1	Dual PICC/PCD Antenna	907-2570	

2.2. Incoming inspection

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the content of the shipment has been checked for completeness and the product has been checked mechanically and electrically.

To avoid hazardous electrical shock, do not turn on the product when there are signs of shipping damage to any portion of the outer enclosure.

2.3. Operating conditions

Determine an appropriate location for the product. Allow at least 15 cm of clearance around the product for proper cooling.

This apparatus is designed to be safe in normal environmental conditions as per EN 61010-1:

Operating ambient temperature	5 °C to 40 °C
Operating relative humidity	80 % for temperatures up to 31 °C decreasing linearly to 50 % relative humidity at 40 °C
Maximum altitude	2,000 m (800 mbar) at 25 °C ambient temperature
Protection	IP20
Storage temperature	-10 °C to +50 °C
Pollution degree (EN 61010-1)	2
Mains supply voltage	fluctuations up to ±10 % of the nominal voltage
Transient overvoltage	up to the levels of overvoltage category II
Indoor use only	

To insure the specified EMC performance, operate this product with shielded cables and accessories. The length of all I/O cables must be no longer than 3 m (10 ft.).

This is a class A apparatus. In a domestic environment, it can generate electromagnetic interference. In such a case, it may be necessary to take appropriate measures.

2.4. Waste Electrical and Electronic

Equipment (WEEE) Directive 2002/96/EC
This product complies with the WEEE Directive (2002/96/EC) marking requirement. The affixed product label (see below) indicates that you must not discard this electrical/ electronic product in domestic household waste.
Product Category: With reference to the equipment types in the WEEE directive Annex 1, this product is classified as a "Monitoring and Control instrumentation" product.
Do not dispose in domestic household waste.
To return unwanted products, contact Micropross for more information.

3. REFERENCES

MP500 PT1^{NFC} API description and development guide	Please refer to the "MP500 PT1^{NFC} API Reference.pdf"

4. Hardware Installation

4.1. Starting your MP500 PT1NFC

Before connecting your PT1NFC to external power supply, it is completely powered off:

Connect the external power supply and press the “Power on” button to start the PT1NFC. The power LED of the button turns blue.

If the USB connection is used to connect the MP500 PT1NFC to the computer, the USB cable should be plugged between the MP500 PT1NFC and the computer before the power on of the MP500 PT1NFC.

Do not plug any accessory on AUX CPU connector during the power on, except the ISO test bench and the Automated Reference PICC Antenna.

4.2. MP500 PT1NFC at a glance

4.2.1. Front panel & LED significance

- **Power On**

The LED is lit up in blue when the MP500 PT1NFC is power on.
The LED flashes in blue in recovery mode.

- **CPU**

The LED is lit up in green when the MP500 PT1NFC is powered in nominal mode.
The LED is lit up in blue during the update of the device.
The LED is lit up in red if the MP500 PT1NFC is not fully started up (firmware issue, recovery mode…).
The LED is lit up in yellow if the temperature of the device is too high.
The LED blinks in purple if an IP address conflict is detected.

- **TX/RX** Used to connect a communication antenna (PICC testing) or a calibration coil (resonance frequency test)

The LED is lit up in blue when the RF field is on, and during a measurement.

- **RF/Q**: Used to connect a calibration coil
  - Impedance measurement
  - Resonance frequency and Q factor measurement

The LED is lit up in blue during the measurement.

- **ANALOG IN:** Used as external RX connector
  - RX channel in Card mode
  - Alternative RX channel in Reader mode
  - Scope function (data acquisition)

The LED is lit up if the Rx channel is activated.

- **TRIG 1/2/3**: Trigger out connectors
- **AUX 1/CPU:** Used to connect external accessories (NFC antenna, ISO Antenna, ISO Test bench …)

The LED is lit up if the corresponding channel is in use.

4.2.2. Back panel

- **12 V Supply:** Used to connect external power supply
- **Ethernet:** Used to connect the PT1NFC to network using RJ45 cable
- **USB:** Used to connect to your computer using USB link
- **Trig 4:** Trigger in connector
- **Sync IN/OUT:** Used to connect another tool
- **USB Host 1/2:** Used to connect an external USB device to the PT1NFC

4.3. Connect the MP500 PT1NFC with the antenna

Please refer to Manual for the complete description of the connection

5. TECHNICAL CHARACTERISTICS

MP500 PT1NFC is high end and ultra-performant Tester for contactless Devices (smart cards, NFC Devices, readers…).
It supports the following protocols:

- ISO 14443 A/B
- ISO 15693
- NFC-IP1/IP2
- FeliCa
- Mifare

The MP500 PT1NFC can be used to test and measure:

- Resonance frequency/ Q factor
- Complex impedance
- Accurate definition of test parameters
- Timing measurement

- Protocol verification (parity error, CRC…)
- Anti-tearing test
- All normative tests (ISO, ICAO, EMVCo…)

The accuracy is given at nominal test conditions, ambient temperature 23 °C ± 3 °C, in an open-air environment.

Warming up: at least 60 minutes before use for a correct accuracy. Micropross recommends checking the calibration of your TCL3 device every year, for normal use.

5.1. Physical characteristics

Height	50 mm
Width	165 mm
Length	277 mm
Weight	1.340 kg
Supply voltage	12 V_{CC}
Supply current	2 A
Consumption when idle	< 100 mW

5.2. Computer interfaces

Ethernet	10/100/1000 Base-T Ethernet RJ45 Connector
USB 2.0	2 x USB2.0 Host connectors (proprietary implementation) 1 x USB2.0 Slave compliant connector

5.3. 13.56 MHz signal generator

The accuracy is given at nominal test conditions, ambient temperature 23 °C ± 3 °C, in an open-air environment.

5.3.1. TX Channel

Signal output	
Connector	SMA – Tx/Rx Connector
RF Output impedance	50 Ω ± 5 %
Output Range	
Range	500 mV_{PP} to 19 V_{PP} on a 50 Ω load
Resolution	100 mV_{PP} (field strength in %)
Resolution	10 mV_{PP} (field strength in ‰)
Accuracy	From 0.5 to 2.4 V_{PP}: 120 mV_{PP}
	From 0.5 to 2.4 V_{PP}: 120 mV_{PP}
DAC	16 bits @ 135.6 MS/s
SFDR (Harmonic)	< 60 dBc
THD @ 13.56 MHz 50 Ω – 8 V_{pp}	< 0.15 %
Bandwidth	24 MHz (Low pass, 6th order)

Carrier Waveform (Sine Wave)	
Carrier frequency (fc)	
Range	12.56 MHz to 14.56 MHz
Resolution	2 Hz
Accuracy	100 Hz
Frequency Stability	< 2.5 ppm
Field rise time (starting slope)	
Range	From 0 to 100 µs – starting with no field applied
Resolution	10 µs
Accuracy	1 µs
Range	From 100 µs to 1 ms – starting with no field applied
Resolution	100 µs
Accuracy	1 µs
Range	From 1 ms to 5 ms – starting with no field applied
Resolution	1 ms
Accuracy	10 µs
Range	From 0 to 2.4 ms – starting with field applied
Resolution	1 ms
Accuracy	10 µs

Modulated Waveform	
Modulation Fall and Rise time	
Range	0 to 10 µs
Resolution	$\frac{1}{f_{carrier}}$
Accuracy	$\frac{1}{f_{carrier}}$
ASK modulation index (Modulation depth)	
Range	0 to 100 %
Resolution	1 %
Accuracy	0.1 %
Range	0 to 1,000 ‰
Resolution	1 ‰
Accuracy	0.1 %
Type A Timing (Pause width)	
Timing	t_1
Resolution	$\frac{1}{f_{carrier}}$
Accuracy	$\frac{1.3}{f_{carrier}}$
Timing	t_2, t_3, t_4, t_5
Resolution	$\frac{1}{f_{carrier}}$
Accuracy	$\frac{1}{2 \times f_{carrier}}$
Bit Rate (PCD to PICC)	
Range	106, 212, 424, 848 kbit/s
Accuracy	< 0.5 %
Programmable framing type B	
	SOF, EGT and EOF and each bit duration programmable in periods of the carrier
Resolution	$\frac{1}{f_{carrier}}$
Accuracy	$\frac{1}{2 \times f_{carrier}}$

5.3.2. Load Modulation Output

Square Wave Generator (LMA)	
Connector	HDMI (pin 4) – AUX1 Connector
Voltage level	
Range	0 V to 8 V_{DC} @ 50 Ω
Accuracy	10 mV + 2 %
DAC	14 bits @ 135.6 MS/s
Subcarrier Frequency	
Range	211.875 kHz, 423.75 kHz, 484.285 kHz or 847.5 kHz
Bit Rate (PCD to PICC)	
Range	$\frac{f_{carrier}}{64}, \frac{f_{carrier}}{32}, \frac{f_{carrier}}{28}, \frac{f_{carrier}}{16}$
Accuracy	0.2 % of subcarrier frequency
Impedance	50 Ω ± 2%
Rise & fall time	< 20 ns
Overshoot	< 5 % of the voltage level
Jitter	< 1 ns
Type B Timings	
Timings	$t_{PICC,S,1}$, $t_{PICC,S,2}$, $t_{PICC,S,E}$, t_{FSOFF}, EGT, TR0,TR1
Resolution	$\frac{1}{10 \times f_{carrier}}$
Accuracy	$\frac{1}{2 \times f_{carrier}}$
Frame Delay Time	
Timings	FDT_A
Resolution	$\frac{1}{10 \times f_{carrier}}$
Accuracy	$\frac{1}{f_{carrier}}$

The LMA signal is also available on Trigger Out 1 as a 0 V – 5 V signal

5.4. Triggers In/Out characteristics

Each trigger can be configured in Input or Output.
By default, TRIG1/2/3 are defined in output. TRIG4 is defined in Input

Trigger In/Out	
Connector	SMB
Output Voltage	Low level: 0 V High Level: 5 V
Input Voltage	Low level: 0 V min – 1.5 V max High Level: 3.5 V min – 5.5 V max

5.5. Analog Input characteristics

The accuracy is given at nominal test conditions, ambient temperature 23 °C ± 3 °C, in an open-air environment.

Input	
Connector	SMA – Analog In Connector
Data Acquisition	
Resolution	14 bits
Sample Rate	135.6 MS/s
Input Impedance	1 MΩ ± 1 % in parallel with 31 pF 50 Ω ± 2 %
Input Voltage Range	10 V_{PP} max
Bandwidth	24 MHz (Low pass, 6th order)
SFDR (@13.56 MHz – 1 V_{PP})	-60 dBc
Noise Floor (@13.56 MHz)	≈3 mV_{PP}
Noise Density (@13.56 MHz)	$< \frac{80\ \mathrm{nV}}{\sqrt{\mathrm{Hz}}}$ in the bandwidth $\pm \frac{f_{carrier}}{16}$
Internal Memory	Up to 256 kS
Voltage Accuracy[1]	5 %

[1] Full scale, 50 Ω input. The full scale settings are 500 mV_{PP}, 1 V_{PP}, 2 V_{PP}, 5 V_{PP} and 10 V_{PP}.

5.6. Electrical measurements

The accuracy is given at nominal test conditions, ambient temperature 23°C ± 3°C, in an open-air environment.

5.6.1. TX/RX Connector – RF/Q Connector

Parameter	Range	Resolution	Accuracy
Impedance measurement	Capacitor value from 10 pF to 200 pF Resistor value is given as informative value. Input max Voltage: 10 V_{PP}	0.1 pF	5 % + 2 pF
Resonance Frequency measurement (OTA only)	Power level from -16 dBm to +10 dBm Resonance frequency from 11 MHz to 24 MHz	1 dBm 5, 10, 20 or 50 kHz	0.5 dBm + 1 %
Q Factor (OTA only)	From 4 to 100 with the following condition: $\frac{11\,Q}{Q-1} < f_R < \frac{24\,Q}{Q+1}$ where f_R is the resonance frequency in MHz	0.1	15 %

5.6.2. ANALOG IN Connector

Parameter	Range	Resolution	Accuracy
Field measurement (OTA only)	From 500 mA/m to 8 A/m	10 mA/m	100 mA/m
Carrier frequency measurement	12.56 MHz to 14.56 MHz	1 Hz 10 Hz 100 Hz 1,000 Hz	2.5 ppm + 10 Hz 2.5 ppm + 100 Hz 2.5 ppm + 1,000 Hz 2.5 ppm + 10,000 Hz

5.6.3. AUX1 Connector

Parameter	Range	Accuracy
V_{DC} Measurement – V_{OV} (OTA only)	0 V to 12 V	1 % + 25 mV

5.7. NFC Measurements

Parameter	Description	Resolution	Accuracy
Field Strength (OTA only)	Measure carrier field strength (DUT as initiator) From 500 mA/m to 8 A/m	10 mA/m	100 mA/m
Carrier Frequency	Measure DUT frequency (DUT as initiator) 12.56 MHz to 14.56 MHz	1 Hz 10 Hz 100 Hz 1 kHz	2.5 ppm + 10 Hz 2.5 ppm + 100 Hz 2.5 ppm + 1 kHz 2.5 ppm + 10 kHz

Parameter	Description	Resolution	Accuracy
V_{DC} Measurement – V_{OV} (OTA only)	Measure DC voltage – 0 V to +12 V Sample rate: 200 kS/s		25 mV
Frame Delay Time	Measure DUT response time (DUT as target)		$\frac{1}{f_{carrier}}$ [1]
Modulation Depth / Index	Measure Waveform shape (DUT as initiator and target)		0.5 %[3]
Load Modulation Amplitude	Measure LMA (DUT as target)		< 10 % with a minimum of 1 mV
Initiator Waveform Timings	Measure rise/fall time, Overshoot/Undershoot, Ringing		$\frac{2}{f_{carrier}} + 0.5\ \%$ [3]
Initiator and Target Timings	Initiator Bit rate		0.2 %[3]
	Target Bit rate		0.02 % or 0.1 % (depending on the technology)[4]
	Bit coding		$\frac{2}{f_{carrier}}$ [4]
	Subcarrier		0.02 %[4]
Loading Effect	Measure the load of the DUT (DUT as target)		3 %[2]
RX Sensitivity	RF Settings : Min/Max field strength, carrier, waveform, load modulation (DUT as initiator and target)		
Power ON/OFF	Activation/Deactivation of the DUT (DUT as target)		
Payload Data	Provide results of received payload data (DUT as initiator and target)		
Error	Provide results of error : CRC, parity, invalid number of bits, errors (DUT as initiator and target)		
Stress tests	Analog stress during communication: EMD, interference, anti-tearing (DUT as initiator and target)		
Coding tests	Coding stress during communication: bit duration, EGT, SOF, EOF… (DUT as initiator and target)		

[1] Corresponds to the required accuracy for EMVCo and NFC Forum analog tests
[2] Corresponds to the required accuracy for EMVCo and NFC Forum analog tests

5.8. Protocol analyzer

The MP500TCL3 includes a protocol analyzer module, which captures events useful for analysis (carrier and subcarrier detection, sequence type A, character, ETU change, etc.).

Parameter	Range	Resolution	Accuracy
Event absolute dating	From 0 to +∞	10 ns	$\frac{1}{f_{carrier}} + 2.5\ ppm$
Event relative dating	From 0 to +∞	10 ns	$\frac{1}{f_{carrier}}$
Type Events	ISO 14443 A/B - ISO 15693 - NFC-IP1/IP2 FeliCa – Mifare – Qi		
FDT_{PICC} measurement	Any duration	10 ns	$\frac{1.5}{f_{carrier}}$

$f_{carrier}$ depends on the protocol being used:

- When spying NFC exchanges, $f_{carrier}$ represents f_c
- When spying WPC Qi exchanges, $f_{carrier}$ represents f_{op}

User's Guide

MICROPROSS
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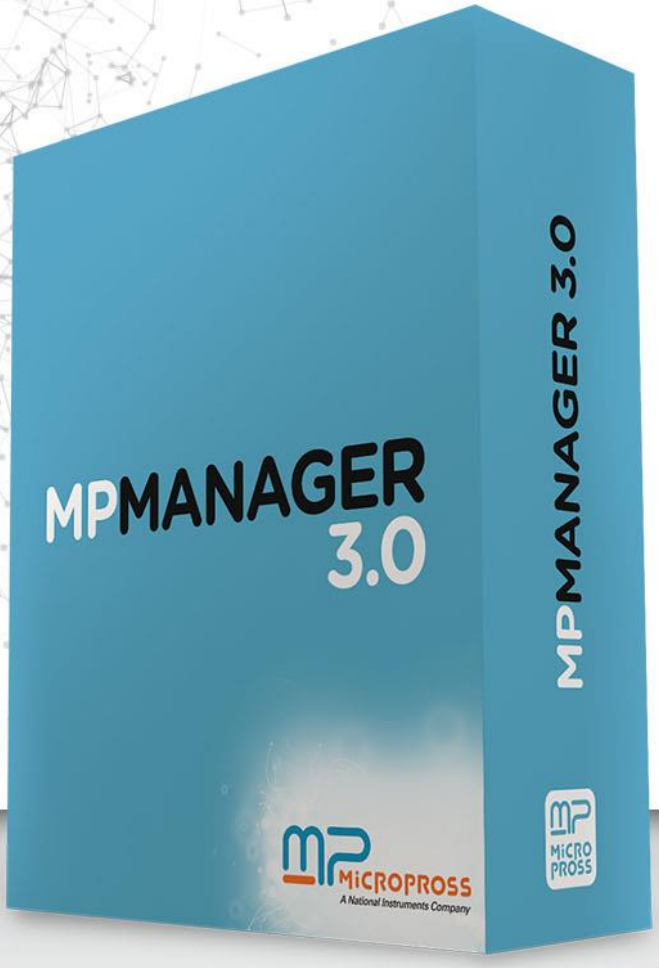
MPManager 3



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6. MPMANAGER 3

6.1. Installation

6.1.1. System requirement

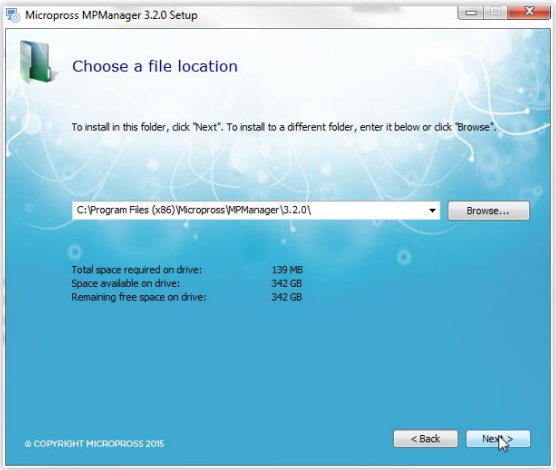
System part	Minimum	Recommended
MS Windows	Windows XP SP3	Windows 7 SP1
DirectX	10	11
CPU	Intel Core i3 or later	Intel Core i3 or later
RAM	2 GB	4GB
HDD	100 GB / 500 GB for analog test suite	100 GB / 500 GB for analog test suite
Screen & resolution	17'' 1280x1024 display	19'' 1600x900 display or superior

6.1.2. Installation and handling of MPManager 3.x licenses

The "MPManager 3.2.0 x86" application launches the Setup Wizard:

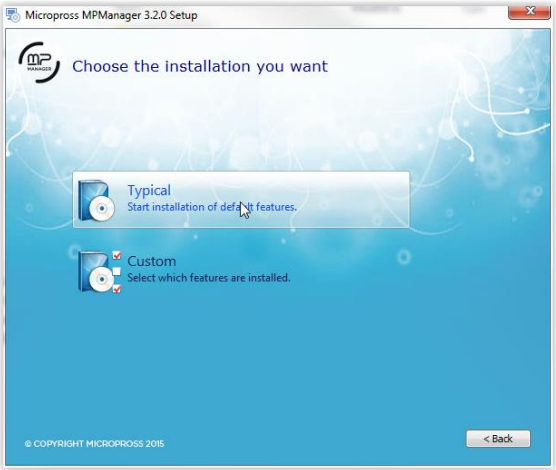
After clicking on the "Next" button, you can choose if you want to remove older versions or install this version side by side with the others.

Then, you can choose a file location:

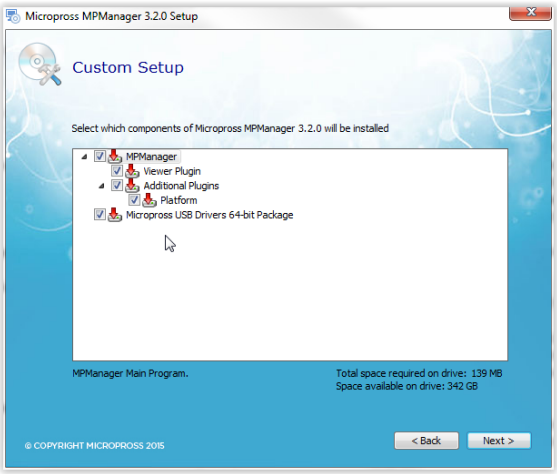


And you can select the installation you want:

➔ Typical installation: default features will be installed



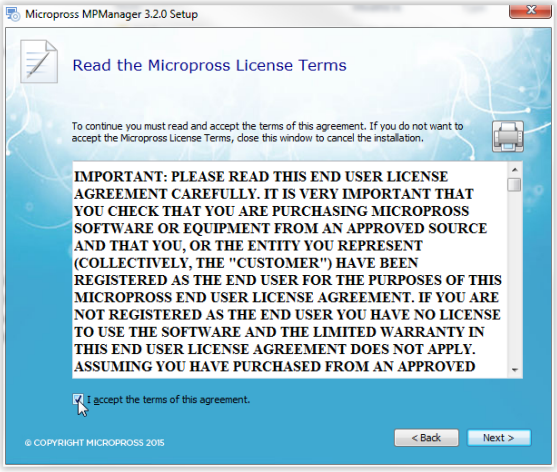
➔ Custom installation: you can select only the features you need



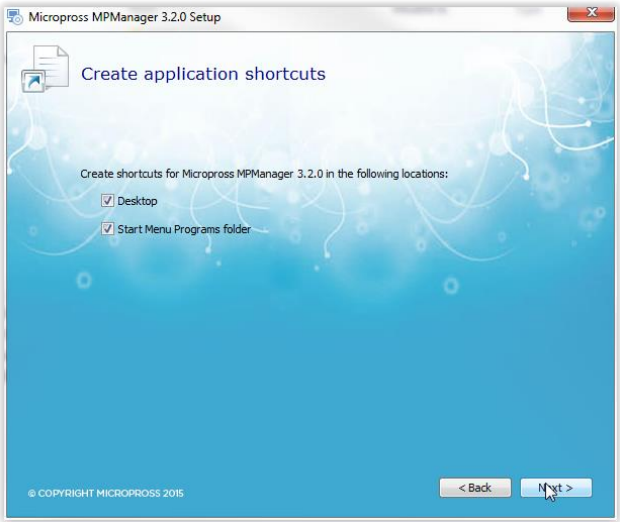
Available features are:

- Viewer plugin: letting only this feature check will, install a fast, lightweight viewer only edition of MPManager, without requiring a Micropross hardware to function.

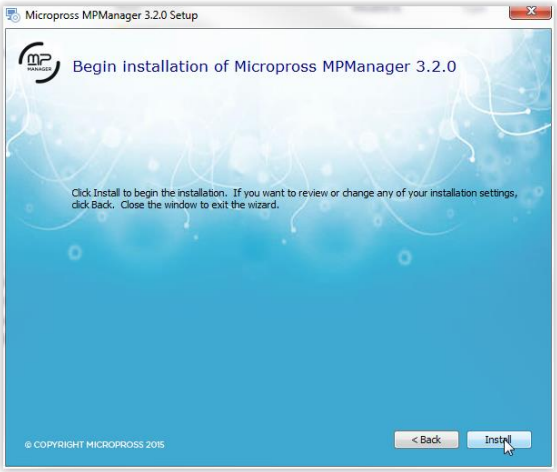
- Additional plugins: Choose to install individual MPManager plugins (scripts / tests and platform). Script and tests plugins must be connected to a Micropross hardware to be used and platform requires a valid MP dongle.



By ticking the checkbox “I accept the terms of this agreement” and after clicking on the next button, you have to select the shortcuts you want to create:

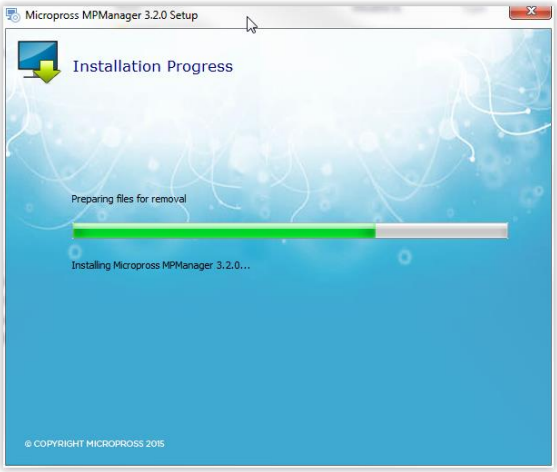


Then you have to click on the “Install” button to begin the installation.

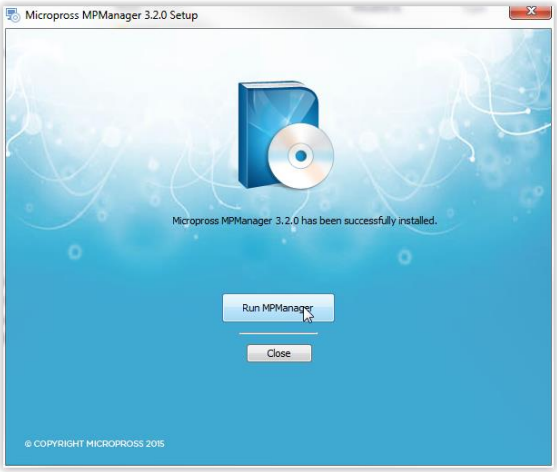


If you want to review or change any of your installation settings, you have to click on the “Back” button. You can also exit the wizard by closing the window.

A window shows you the installation progress:



And at the end of the installation, you can launch MPManager 3.x or close the window.



If you want to launch MPManager 3.2, the following window appears:

And then, three options are available:

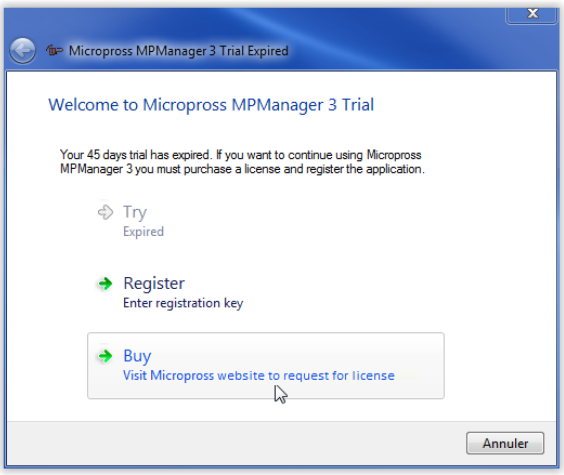
- Try MPManager 3.x
- Register MPManager 3.x
- Buy MPManager 3.x

6.1.3. Try MPManager

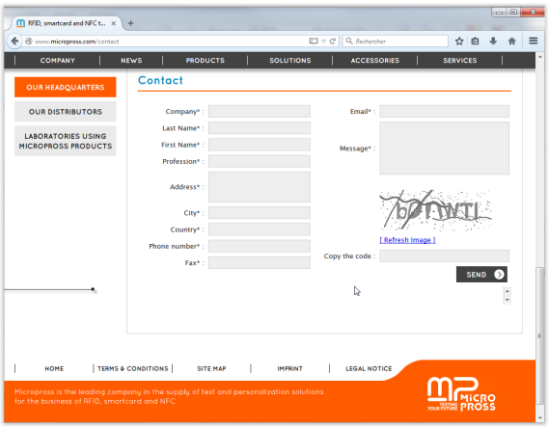
By clicking on the « Try » button, you can use the trial version of MPManager 3.X for 30 days

On MPManager, the “About” information indicates the number of days remaining to your trial period.

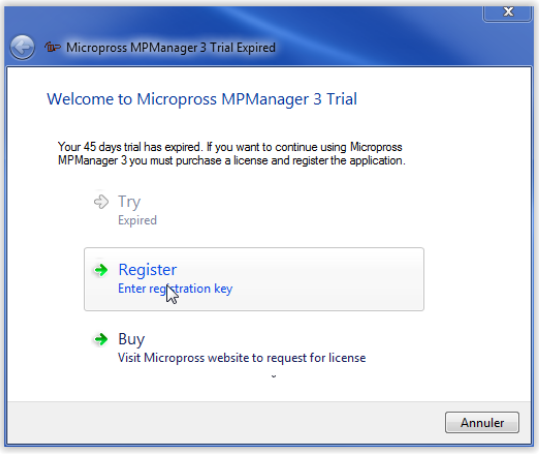
6.1.4. Buy MPManager



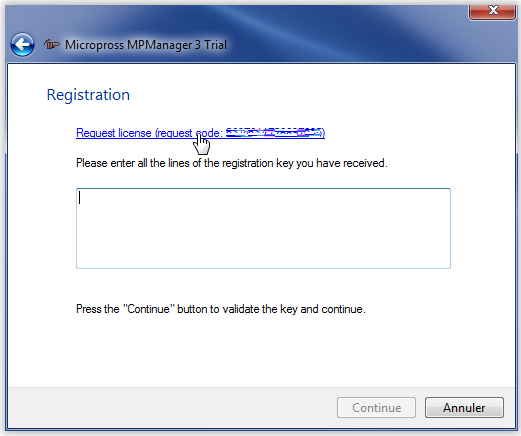
This option will bring you to the “contact page” of our Micropross website:



6.1.5. Register MPManager



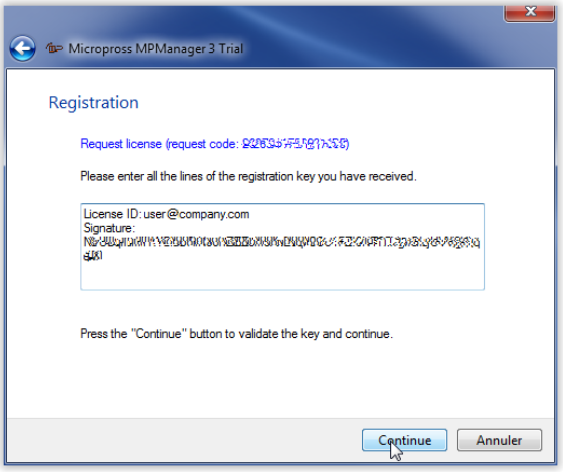
You can install a registered version by clicking on the “Register” button



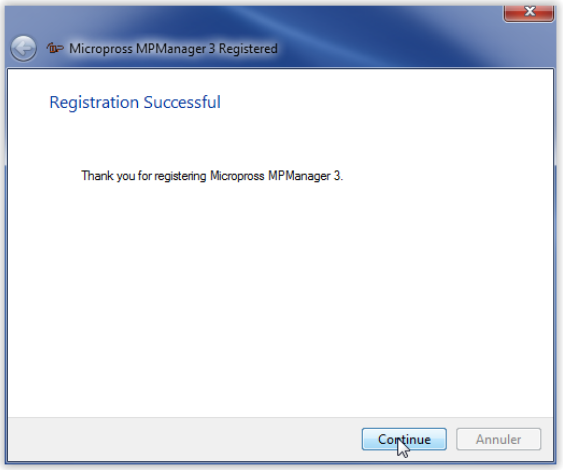
By clicking on the “request license” link, an email with a specific request code is automatically generated in your default email client and ready to send to the Micropross Helpdesk through the license-request@micropross.com email address. If your email address is already linked to a helpdesk account, a new ticket is automatically created for you.

When you received a response through the helpdesk and/or by email, copy all lines of the registration key you have received in the text area.

If you have no default email client installed on your computer, you'll have to communicate the license request code to Micropross.



If you want to enter the License ID and the Signature manually, you have to hold down [CTRL] and [Enter] together to make a line break.



Then, you can finish the installation of MPManager 3.X registered version and launch MPManager 3.x by clicking on the "Continue" button.

6.1.6. MPManager in a few words

MPManager is an optional part of the MP300 PT1NFC software package. It presents PT1NFC functions in a graphical and user friendly environment to:

- Create and save test projects,
- Adjust all signal generation parameters, for both PICC and PCD emulation
- Start spy sessions
- Edit and run advanced script files,
- Execute parametric tests for smart card characterization.

6.1.7. How to update MP Manager

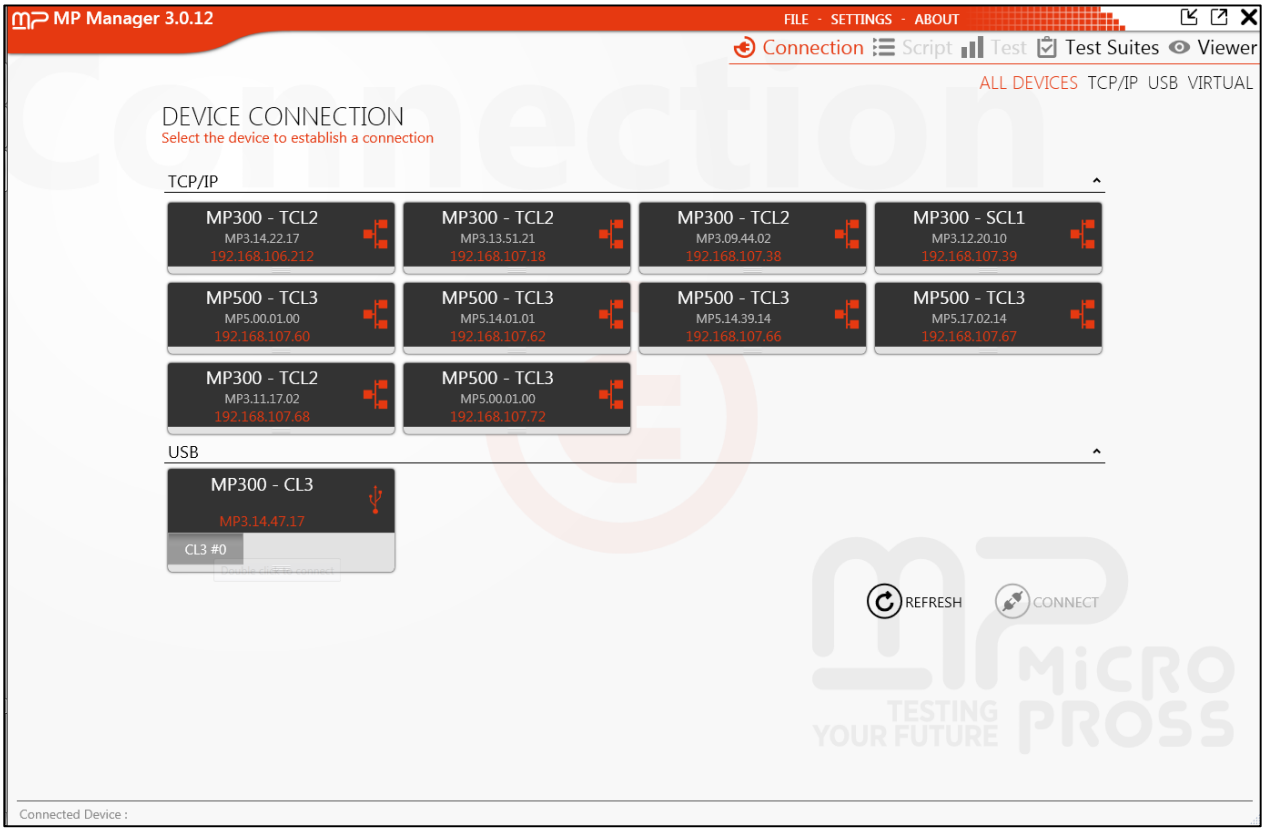
If the computer is connected to Internet (and the option activated in *settings > project* menu), a popup will rise whenever a new MPManager version is available on the Micropross download center.

Otherwise, please regularly check new versions by visiting the download center.

To access the download center and download MPManager, please refer to the document entitled *Micropross download center user's guide.*

6.2. Detailed MPManager Functionalities

When you launch MPManager, the default window is the Connection window:



This is where you can select the device to establish a connection (in TCP/IP or USB) or connect to a virtual device.

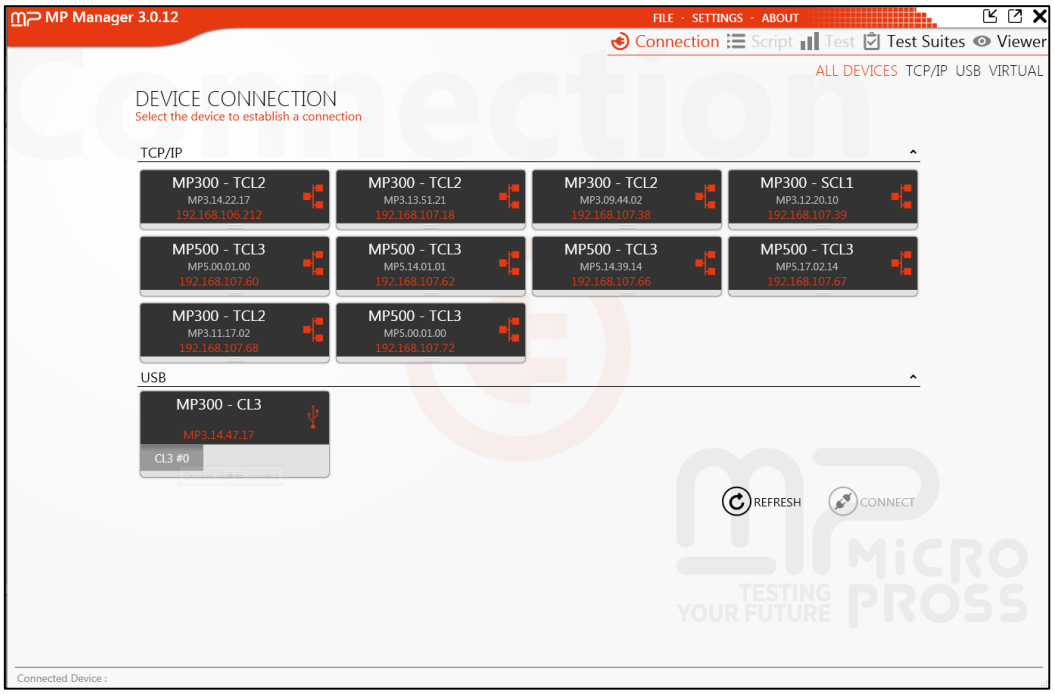
Once connected, The following panels are available:

configuration :	Manages the signal generation parameters
spy :	Configure, launch and stop the spy anytime (optional)
Script :	Write, run and analyze exchanges between the PT1NFC and the device under test.
Spy & Play :	Spy an exchange between a reader and a card, and replay it afterwards (not available using the PT1NFC).
Test :	Run parametric tests like Shmoo, antenna impedance measurement or card resonance frequency measurement
Viewer :	Analyze the exchanges spied by the PT1NFC.

Configuration and spy can be accessed while navigating in the other windows, as well as “File”, “Settings” and “About” buttons.

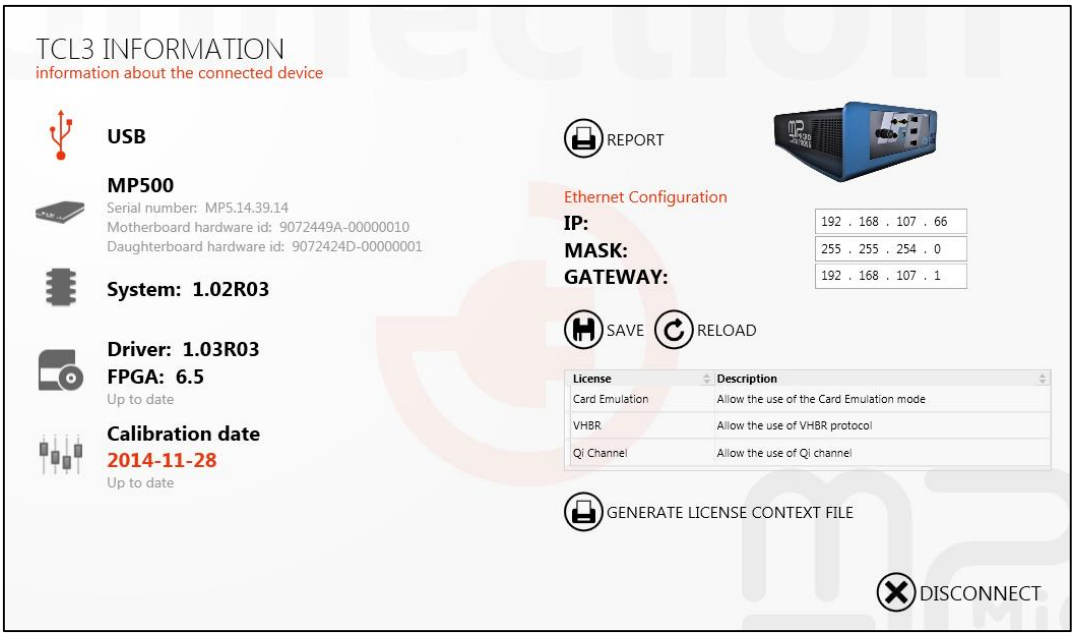
6.2.1. Connection to a device

MPManager will automatically detect the devices connected to your computer or accessible through the network. In order to connect to your PT1NFC, just select it in the list and double click on the coupler number (*"PT1NFC #0" on below screenshot*):



Another option is to select the coupler number, and click on "Connect" at the bottom right.
At the top right of the window, this is possible to filter on USB or TCP/IP devices, as well as connecting to a virtual device (in order to write a script even if you don't have a physical PT1NFC available, for example).

Once connected, the window will change:



In the device information, we will find the following:

- Connection type
- PT1NFC hardware information (serial number, UC and Coupler identifiers) and firmware version, as well as the latest calibration date.
- Network settings (IP, Mask, Gateway) adjustment
- Additional embedded licenses (card emulation, VHBR…).

Eventually the “Report” button will generate a document with complete device status (hardware version, firmware version…).

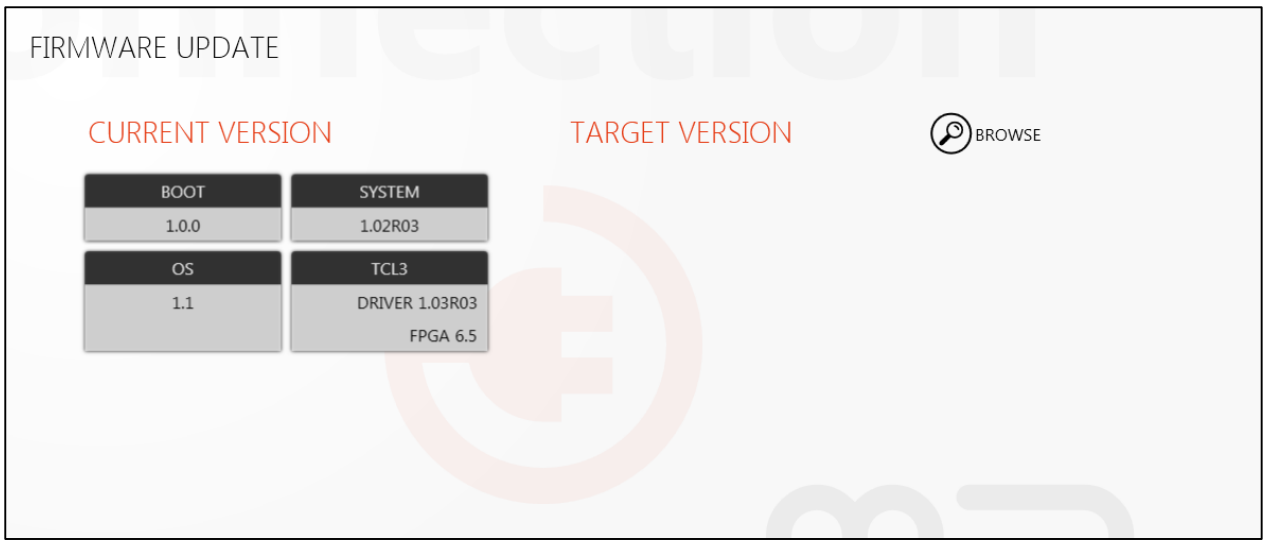
6.2.2. Firmware update

To take advantage of new features and bug fixes, the user will probably need to update the firmware of the MP500 PT1NFC. Micropross provides these updates on the download center for all devices under maintenance contract.

Visit http://support.micropross.com for firmware updates.

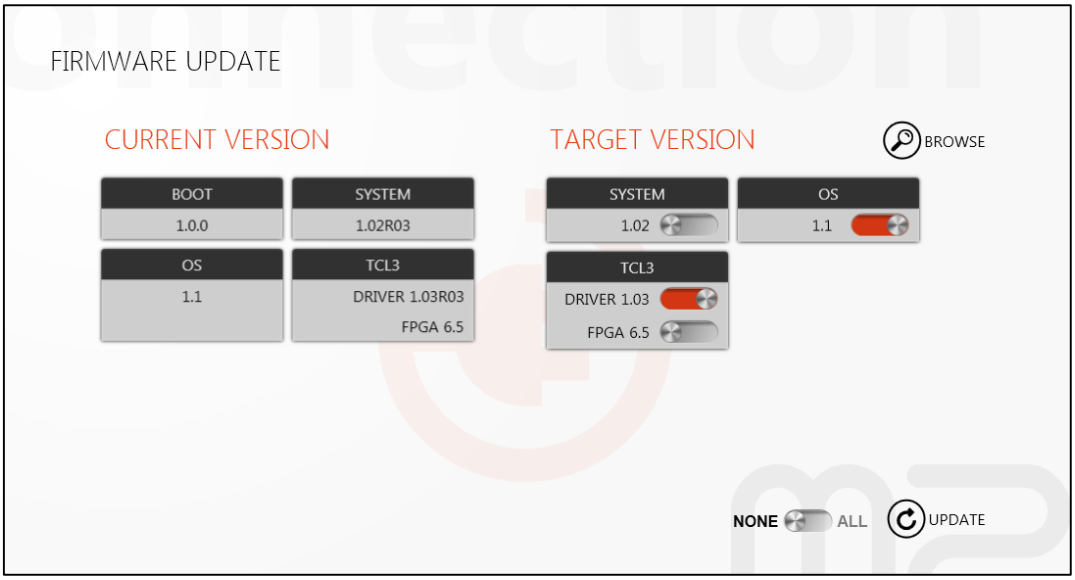
The PT1NFC information panel indicates the current firmware status of the device (Up to date or Outdated)

Launch MPManager. Connect to your MP500.
Select the “Firmware update” panel in the Connection window to display the following window:



The left part of the screen displays detailed information about the current firmware of your MP500.

To apply a firmware update released by Micropross, click on the “Browse” button and select a compliant update file (.mpfirm). The information relative to the update package, if available, is displayed under the “Target version” label as follows:



Select all or part of the firmware package to update using the switch controllers and click on “update” to proceed with the firmware upgrade.

The operation may last several minutes. Restart your MP500 after the firmware update for the changes to take effect.

The MPManager 3 firmware update function is available for .mpfirm update packages only. Legacy .dat packages shall be used with MPUpdate.

6.2.3. Recovery mode

In case of failure or unexpected problem during the update process, the Micropross support could ask to put your MP500 in recovery mode:

- Power off your device
- Press and hold the start button till the LED lights orange (metallic housing) or just blinks (plastic housing)
- Release the start button. The power LED blinks regularly (both housings)

Your MP500 is now in recovery mode. Power off/on again the device to switch back to the standard mode.

Activate only the recovery mode when asked by a Micropross representative.

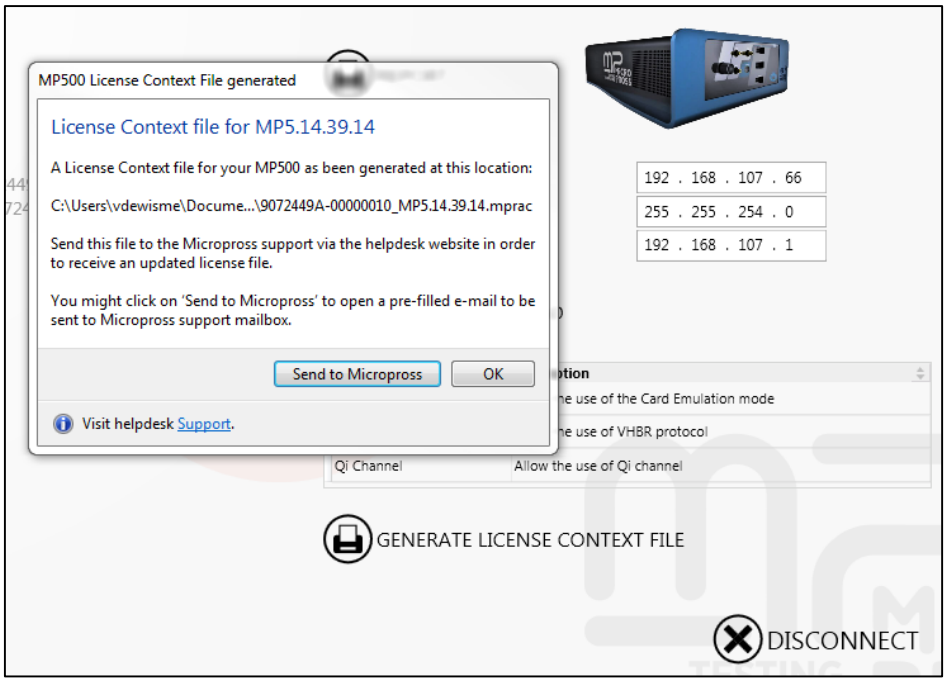
6.3. Embedded license management and update

Some features of the MP500 PT1NFC are subject to embedded licenses to be used:

- **Card Emulation license**: Unlock the PICC/Listener emulation features of the MP500 PT1NFC (NFC, 13.56 MHz).
- **Viewer**: Unlock the viewer functionality (cf. Viewer).

At any time, users can purchase additional licenses and install them on their MP500 Hardware. To do so, they need to contact their Micropross sales representative and exchange license files with the Micropross support.

6.3.1. Generate an embedded context file



- Go to the information panel and click on *"Generate license context file"*
- A *.mprac* context file is generated on the Hard Drive
- Click on "Send to Micropross" to send a license request to the Micropross support using your default email client (The generated email will automatically create a ticket on your behalf on the Micropross Helpdesk) or visit the helpdesk at http://support.micropross.com to open a ticket with the context file.

Your request is then checked and handled by the Micropross support agent.

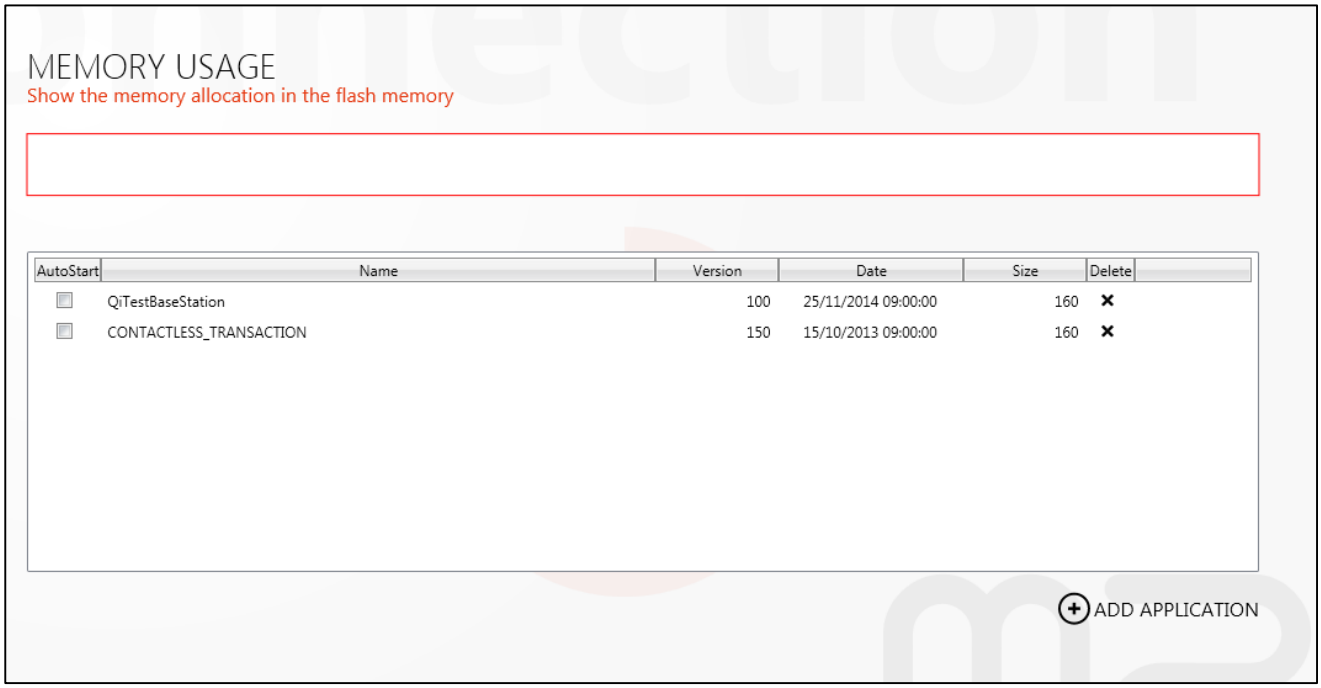
6.3.2. Upload embedded licenses

Once you received the *.mprau* file from your Micropross support contact, go to the firmware update page and click on "Browse" to open the file. Then, click on update to add the embedded license.

Restart your PT1NFC, and check again in the information page for the license presence.

6.4. Embedded applications

Embedded applications are installed in the non-volatile Memory of your device. Use *the embedded applications panel* to manage them:



The overall memory usage of the device is indicated alongside with detailed information for each application:

- AutoStart status: Check / Uncheck the control to put an application in autostart mode. When setted in autostart mode, an application is launched once the MP500 has booted.
- Application name
- Application version
- Application date
- Click on the Delete control (**X**) to erase an application from the MP500 internal memory

Click on “Add application” to store an application in the MP500 internal memory.

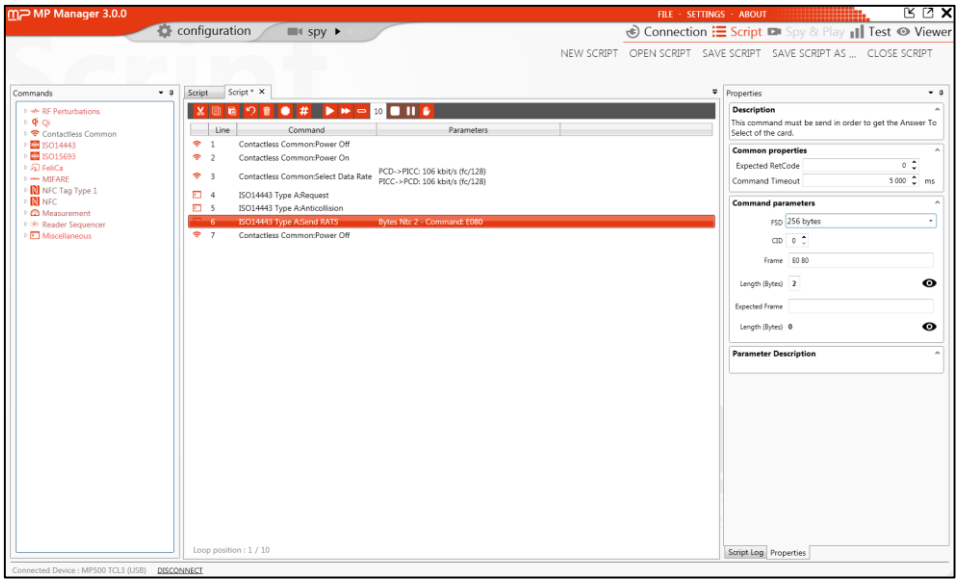
6.5. Script

This window is very useful as it allows you to build a scenario that will be played between the PT1NFC and the DUT.
First, click on “New script” or “Open script” depending if you want to start from scratch or from an existing script (several samples are provided with the PT1NFC).

MPManager 3 is able to open MP Manager 2 script files *(.mpscr)* and convert on the fly into the new script file format *(.mpscript)*. **Every unsupported command will be replaced by a comment in the converted script.**

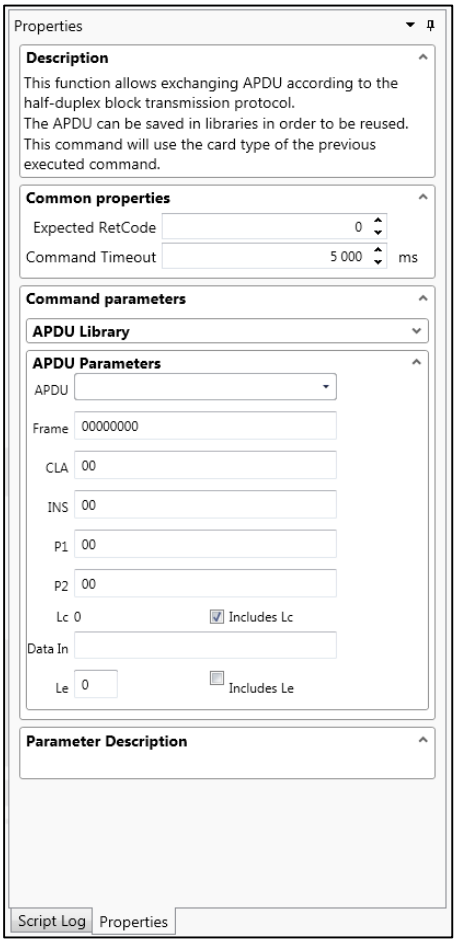
Build and complete your script by adding some commands from the left panel. In order to help you build your script, the commands are regrouped under categories issued from the different standards:

Contactless common
ISO 14443
Mifare
Measurement
Etc…

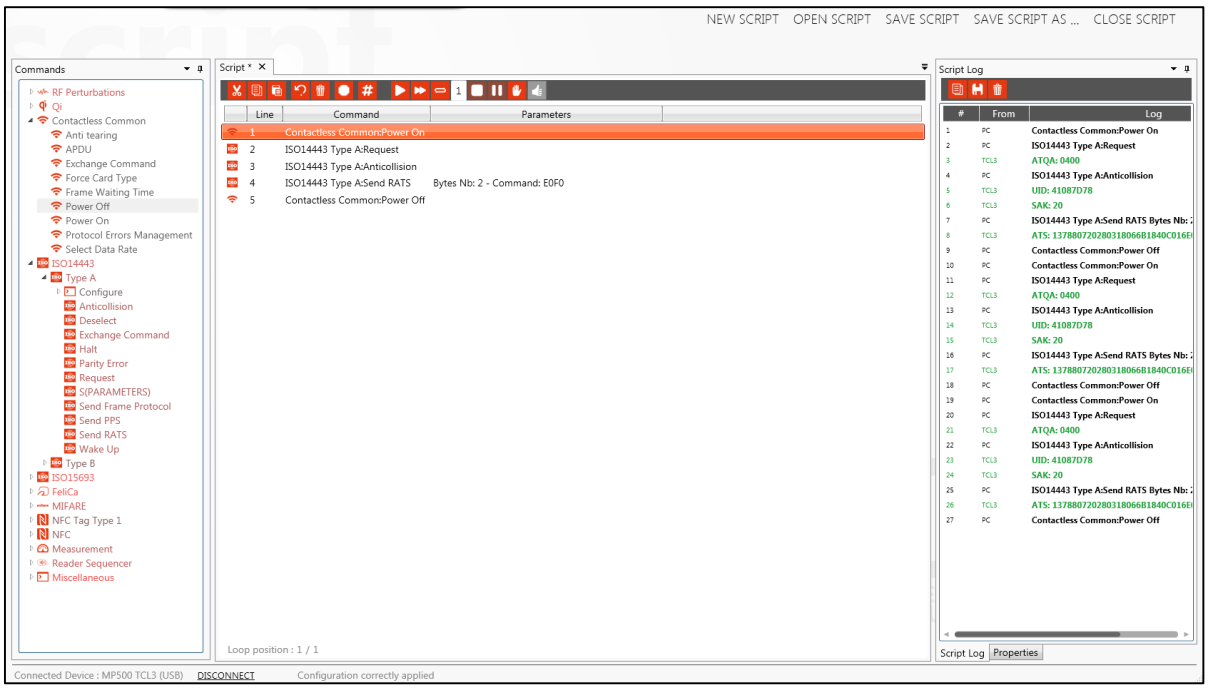


In order to add a command to the script, “drag and drop” it in the central panel (or double click on it). Shortly after adding a command, the “properties” window appears in which you’ll specify the command timeout and the Return Code (in case you plan to face an error with the command).

For some APIs, the Properties window is much more complete and enables you to fill the parameters of the command:



During script execution, the right panel will automatically switch to “Script log” window and display the exchanges between the PT1NFC and the DUT (DUT answers are interpreted by MPManager decoders automatically).



A tool bar is also available to help you building and running your script:

: Cut
: Copy
: Paste
: Undo
: Delete
: Breakpoint
: Comment / Uncomment
: Execute step
: Execute script from current position
: Execute script in loop from the beginning
1 : Loop number
: Stop (loop mode only)
: Pause (loop mode only)
: Stop on script command when an error occurs
: Skip script command when an error occurs.

As well as some options for "Script log":

: Copy to clipboard
: Export log
: Clear log

Eventually, save the script and/or close it by using top right buttons:

NEW SCRIPT OPEN SCRIPT SAVE SCRIPT SAVE SCRIPT AS ... CLOSE SCRIPT

6.5.1. Script commands

They are specific to the smartcard technologies supported by the device. The PT1NFC supports the following command groups:

- Contactless Common (field switch, data rate…)
- ISO14443 (Type A & Type B commands, protocol handling)
- ISO15693 (Vicinity commands, coding mode)
- FeliCa (Configuration and exchange commands)
- Mifare (Configuration and exchange commands)
- NFC Tag Type 1 (Configuration and exchange commands)
- NFC (reader emulation, NFC-A, B and F & protocol handling)
- Measurement (PICC response time & analog capture)
- Reader sequencer
- Card emulation sequencer
- Miscellaneous
- RF Perturbations
- Qi functions (hardware configuration & protocol handling)

6.5.2. Measurement commands

6.5.2.1. PICC Response Time

This function is used to get the time between the end of the last frame sent by the PCD and the beginning of the PICC response.

6.5.2.2. Start Analog Capture

Enable the analog spy feature of the PT1NFC. The acquisition could be started immediately or triggered on the following conditions with an optional delay in µs:

- RF field ON
- RF field OFF
- Start of transmission
- Start of reception
- End of transmission
- End of reception
- Trigger IN

It is mandatory to start a spying session prior to execute the "Start analog capture" script command. Analog spy results are displayed in the viewer.

6.5.3. Miscellaneous commands

6.5.3.1. Comment

Add a free comment to document your scripts. All comments will appear in green in the script listing and won't interfere during the script execution.

6.5.3.2. Delay

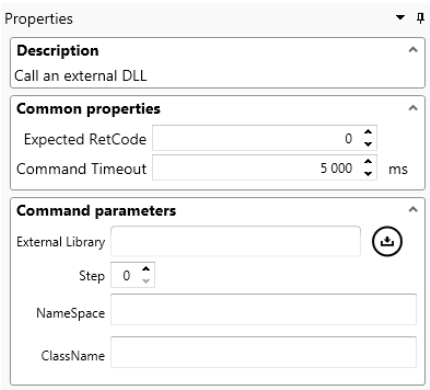
Add a waiting command, in ms, to the script.

6.5.3.3. Execute script

Execute another script in the current script in one step. Browse for the script file to run in the properties.

6.5.3.4. External Call

Call an external method from a C# assembly.



Specify the assembly name and path, Namespace and class name. Choose the value of the step parameter described below.
Each "External call" will consist in two successive C# method calls. Methods prototypes shall not be changed.
External library sample code:

```
namespace ExternalLibrarySample
{
        public static class MPManagerExternalCallSample
        {

            public static string GetNextCommand(string previousAnswer, byte step)
            {
            }

            public static bool IsAnswerInvalid(string answer, byte step)
            {
            }
....
```

- A first call is made to GetNextCommand() containing the last answer from the MP300, and a step from the command parameters window. Change the step to your match your assembly's code.
- Another call is made to isAnswerInvalid() containing the command answer to the GextNextCommand() method and a step number. Use this method to test the previous result and returns true or false to highlight in green or red the whole "Execute call" in the execution log.

Please refer to the External library software sample provided with MP Manager 3 for your tests.

6.5.3.5. Load config

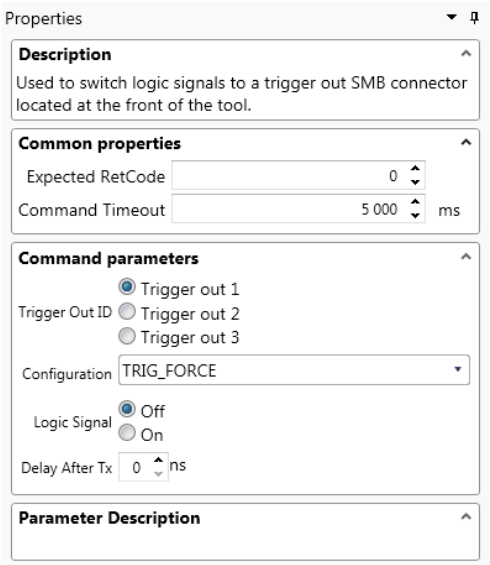
Load a config file saved in the configuration plugin and applies the parameters included in the file to the hardware.

6.5.3.6. Remote command

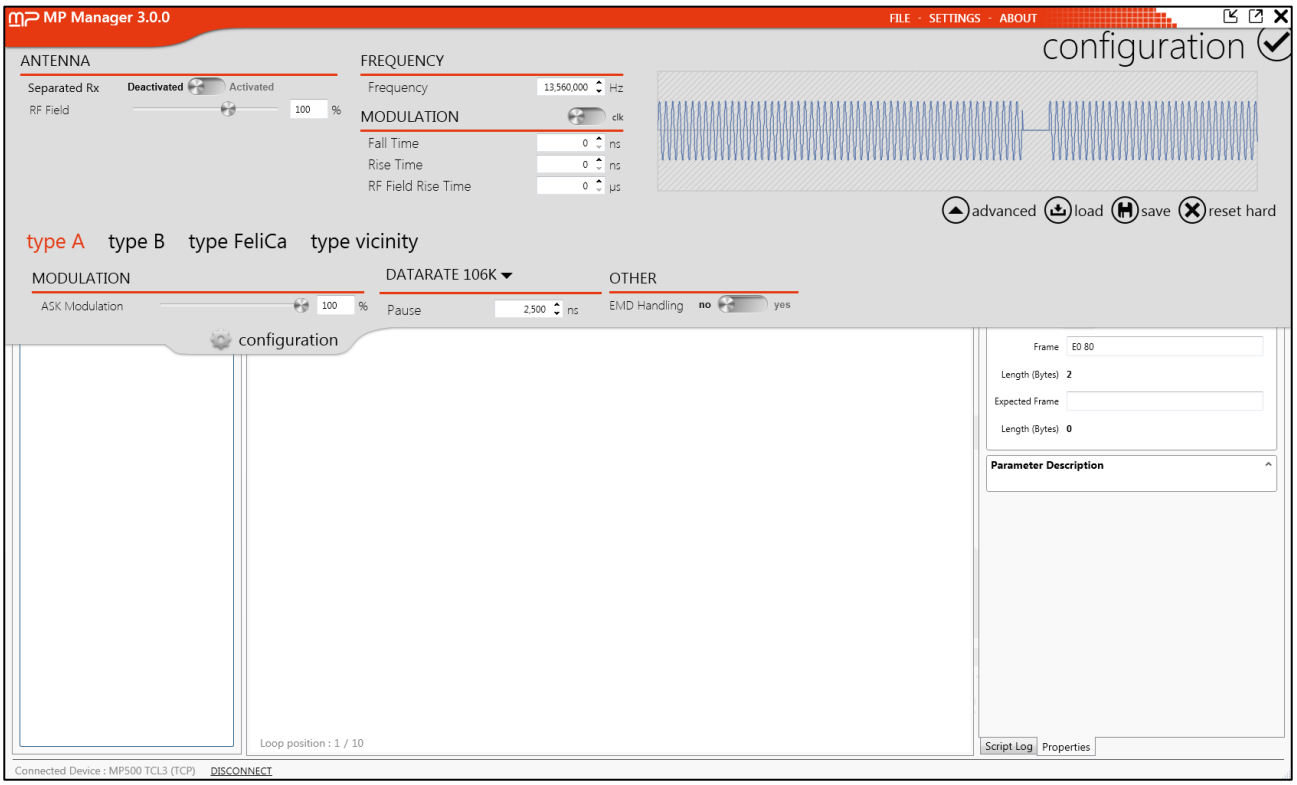
Enter a remote command to send to the device. Please refer to the device API's reference for a description of all the remote commands of the devices.

6.5.3.7. Trigger Out

Drive the different output triggers of the device. The user is able to define triggering conditions, signal and delay in the following window.



6.6. Configuration



The configuration window can be accessed while navigating in another window at the same time. This is where the PT1NFC generated signal parameters are handled.

6.6.1. Antenna

The “Separated Rx” option must be activated when the user plan to use 2 different antennas: one to generate the field and send the signal to the card, and another one to pick the card’s answer.

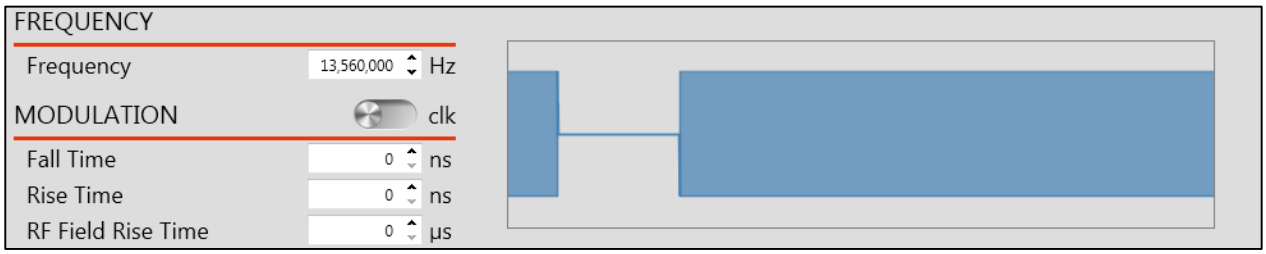
This configuration must be used if the signal is going from the PT1NFC through an amplifier to the emitting antenna: in that case, a reception antenna is mandatory.

6.6.2. Frequency

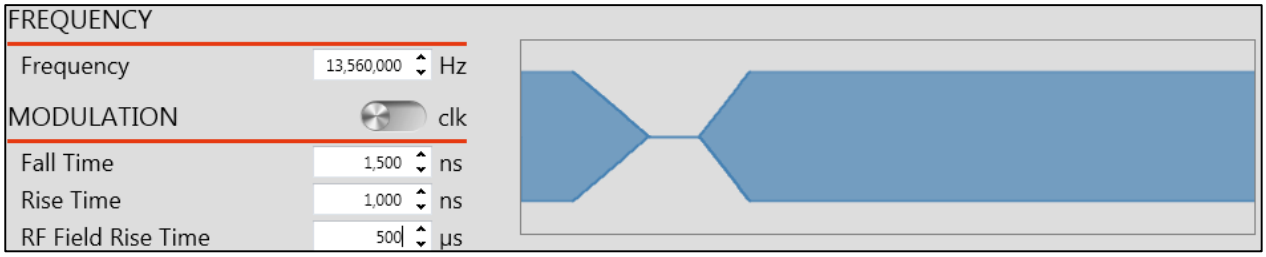
The “Frequency” modifies the carrier frequency of the signal generated by the PT1NFC.

6.6.3. Modulation

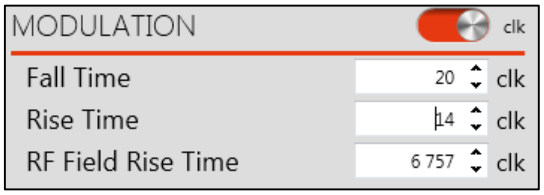
The “RF Field” configures the field level emitted by the PT1NFC. 100 % corresponds to 9.7 V_{PP} on a 50 Ω resistor.



The “Modulation” option allows configuring the reader modulation of the PT1NFC.
By changing the fall time, rise time, and the Field rise time, you will see the influence on generated signals:



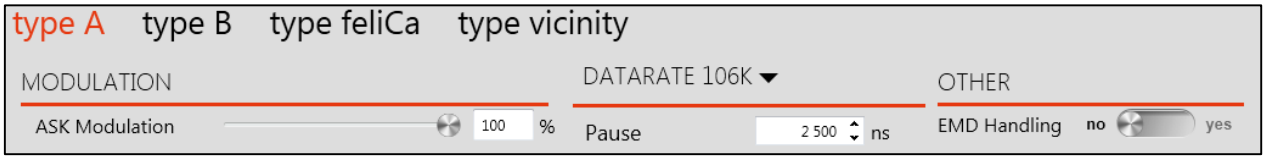
This setting can also be configured in clock cycles:



6.6.4. Advanced

By clicking on “Advanced” button, the panel will be extended, which gives you access to more options specific to card type.

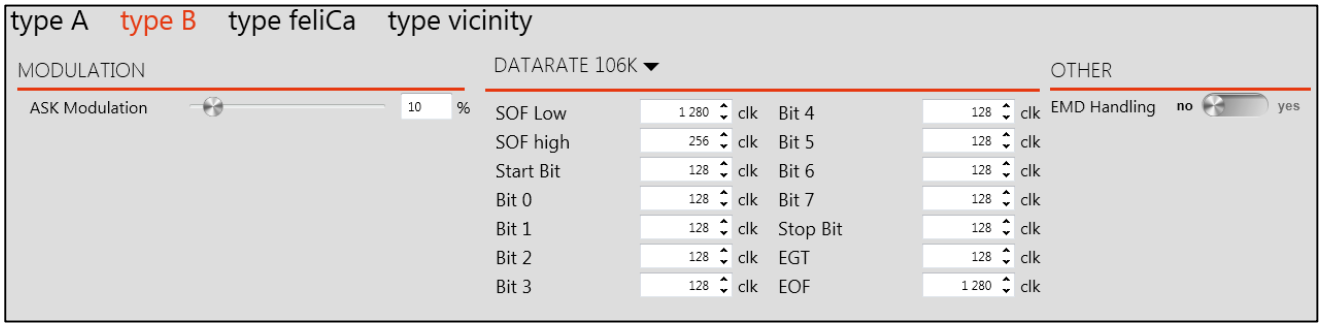
6.6.4.1. Type A



The adjustable type A parameters are (for each data rate):

- The Modulation index (from 0 to 100 %),
- The Pause time (as defined in ISO standard) from 100 ns to 4,500 ns,
- The EMD handling (please refer to MP500 PT1NFC API Reference: *CPP_ANTI_EMD*).

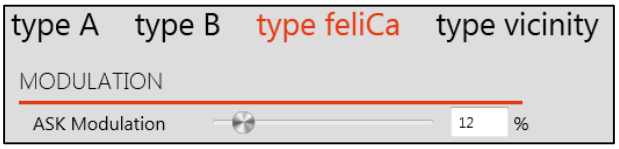
6.6.4.2. Type B



The type B parameters you can configure are (for each data rate):

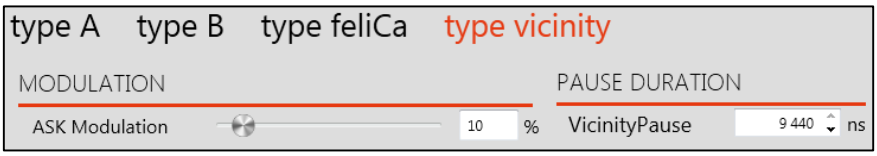
- The Modulation index (from 0 to 100 %),
- The timings (SOF, Start bit, bit 0… bit 7, stop bit, EGT, EOF),
- The EMD handling (please refer to MP500 PT1NFC API Reference: *CPP_ANTI_EMD*).

6.6.4.3. Type FeliCa



In feliCa type, the only adjustable parameter is the Modulation index (from 0 to 100 %).

6.6.4.4. Type Vicinity

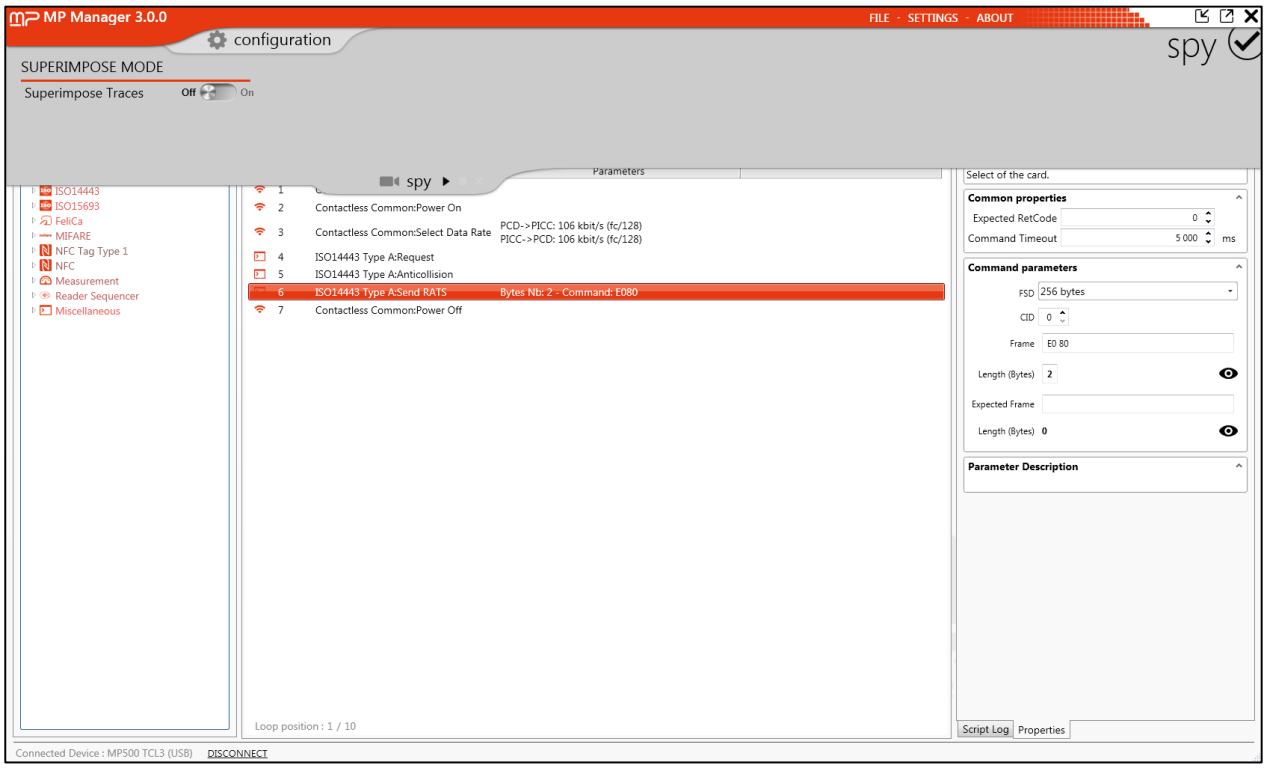


In vicinity type, two parameters are adjustable:

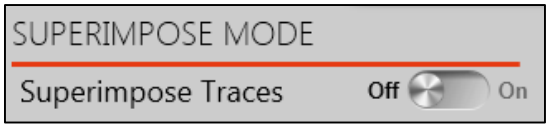
- The Modulation index (from 0 to 100 %),
- The Pause Duration (as defined in ISO standard) from 500 ns to 9,440 ns.

Eventually, the configuration can be saved in a .cfg file that you will be able to load for a future testing session. The “Reset hard” button will reinitialize the default configuration.

6.7. Spy (optional)



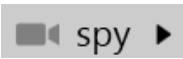
Just like configuration panel, the spy window can be accessed while navigating in another window at the same time. This is where the spying option is managed.



The superimpose mode is used to synchronize two MP500 devices in order to spy contactless and contact transaction at the same time.

Please refer to the MP500 Synchronization procedure

In order to launch the spy, you just have to click on “start”:

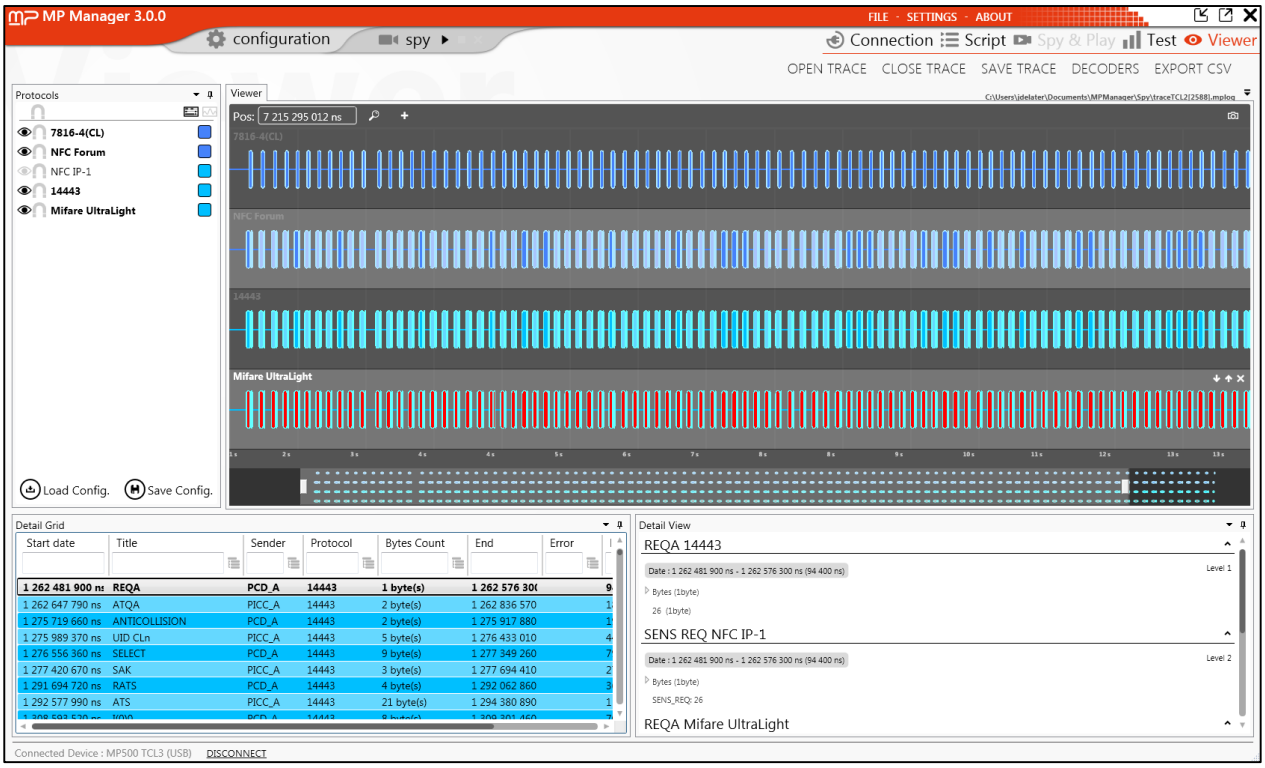


Then, execute your script and stop the spy (or cancel it):

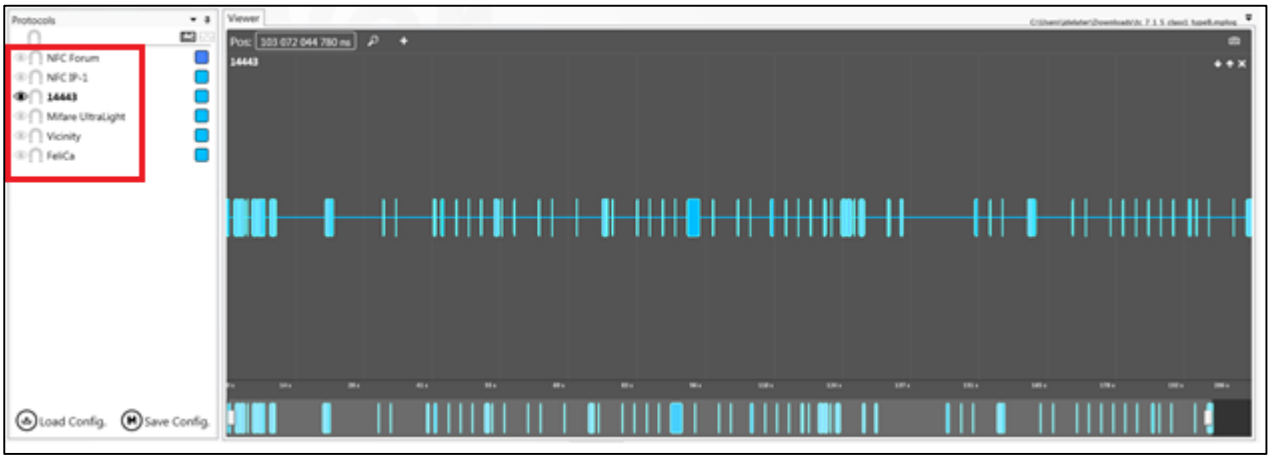
The spied exchange is automatically saved in default directory: *C:\Users\XXX\Documents\MPManager\Spy* (this directory can be modified in *Settings > Spy*)
In order to analyze it, you will have to open the viewer window.

6.8. Viewer (optional)

The trace from latest spy session is automatically opened during the first display of the viewer panel.



On the left, several protocols that were automatically decoded are listed. Enable or disable the decoding with the following buttons:

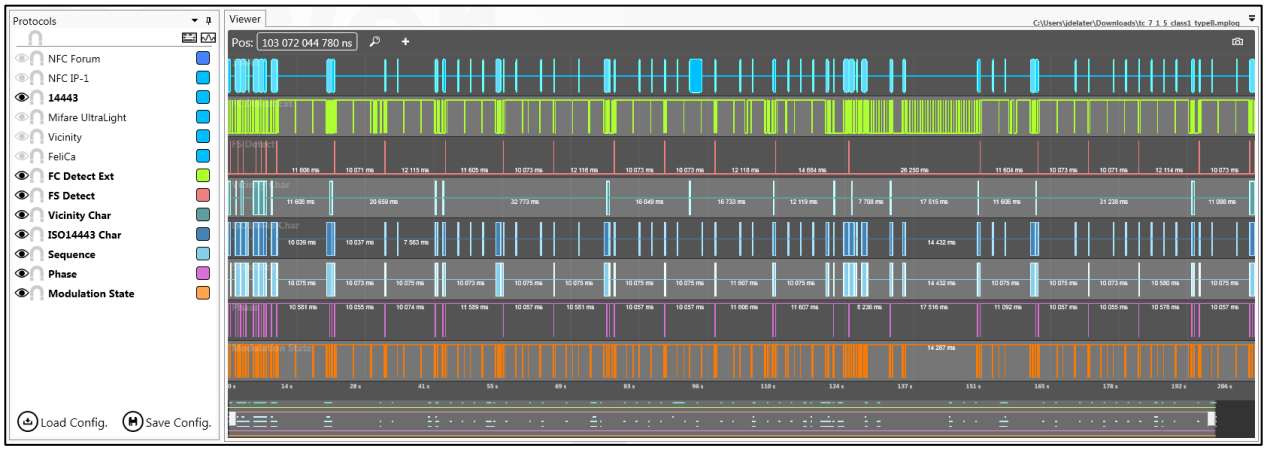


: Enable decoder : Disable decoder

It is also possible to load a specific decoder using the “decoders” button at the top right of the window.

6.8.1. Viewer details

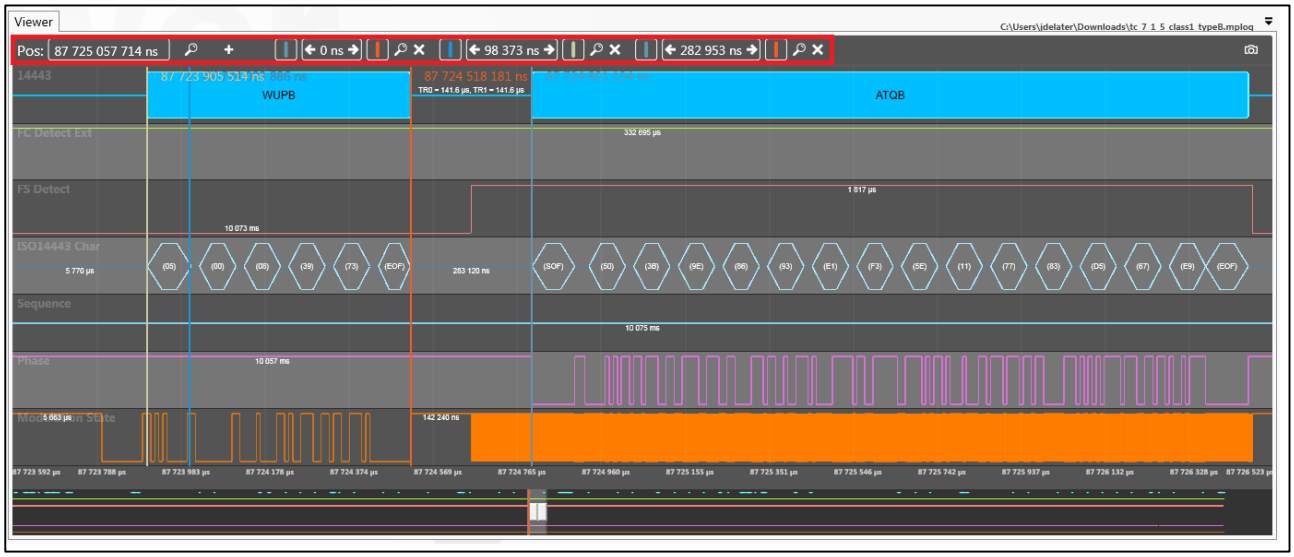
To see the low-level information (modulations, field strength detection, Sequence…) click on the “Show/Hide low level protocols” button:



The mouse shall be used to browse the trace:

- Scroll up: zoom in
- Scroll down: zoom out
- Right click and move: move to the left / right
- Left click and drag: select a zone to zoom in

Here is a view after zoom-in:

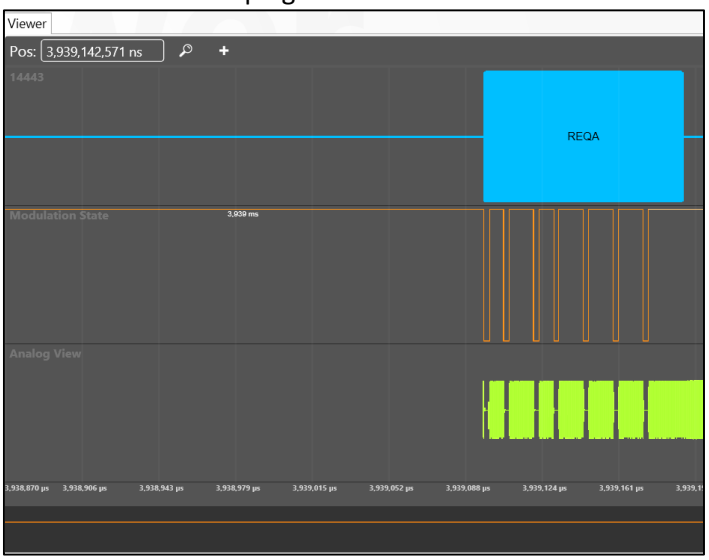


Several options are available in low-level view:

+	Enable/Add cursors
Pos: 5 942 786 699 ns	Reach a specific position
	Zoom fit
← 283 100 ns →	Show/Hide cursor, time difference information
✕	Disable cursors
	Take a screenshot of viewer window
/	Enable or disable magnetic cursors mode
	Change protocol color
Load Config.	Load protocol configuration
Save Config.	Save protocol configuration
	Zoom minimap

6.8.2. Analog spy results (low level)

Analog capture is started with the “Start analog capture” command from the script plugin. The results are displayed in the low level view of the viewer plugin as follows:



Timings can be analyzed with cursors for both high level and analog spy results.

The analog capture presents the waveform “as seen” by the PT1NFC, using one coil of the communication antenna (depending on the external Rx channel configuration, a different coil is used).

The analog view does not provide any amplitude value.

6.8.3. Detail Grid and Detail View

The detail grid provides some useful details regarding protocol level:

Detail Grid

Start date	Title	Sender	Protocol	Bytes Count	End	Error
292 793 520 ns	WUPB	PCD_B	14443	5 byte(s)	293 405 800 n	6
800 546 420 ns	REQA	PCD_A	14443	1 byte(s)	800 640 820 n	9
806 392 160 ns	**WUPB**	**PCD_B**	**14443**	**5 byte(s)**	**807 004 420 ı**	**6**
807 287 540 ns	ATQB	PICC_B	14443	14 byte(s)	808 953 580 n	1
1 829 792 460 ns	REQA	PCD_A	14443	1 byte(s)	1 829 886 860	9
1 835 638 000 ns	WUPB	PCD_B	14443	5 byte(s)	1 836 250 200	6
2 341 804 980 ns	REQA	PCD_A	14443	1 byte(s)	2 341 899 380	9
2 347 651 040 ns	WUPB	PCD_B	14443	5 byte(s)	2 348 263 600	6
2 348 546 260 ns	ATQB	PICC_B	14443	14 byte(s)	2 350 212 320	1
2 855 456 900 ns	REQA	PCD_A	14443	1 byte(s)	2 855 551 300	9
2 861 302 820 ns	WUPB	PCD_B	14443	5 byte(s)	2 861 914 660	6
3 369 067 900 ns	REQA	PCD_A	14443	1 byte(s)	3 369 162 300	9
3 374 914 980 ns	WUPB	PCD_B	14443	5 byte(s)	3 375 526 880	6
3 375 810 280 ns	ATQB	PICC_B	14443	14 byte(s)	3 377 476 340	1
3 882 648 420 ns	REQA	PCD_A	14443	1 byte(s)	3 882 742 820	9

Commands can be organized and filtered by Start date, Sender (PCD/PICC), Command, Protocol…

Detail Grid

Start date	Title	Sender	Protocol	Bytes Count	End	Error
		PCD_A				
14443 (68 Messages)						
125 625 007 540 ı	REQA	PCD_A	14443	1 byte(s)	125 625 101 9	9
126 137 712 980 ı	REQA	PCD_A	14443	1 byte(s)	126 137 807 3	9
124 598 352 540 ı	REQA	PCD_A	14443	1 byte(s)	124 598 446 9	9
125 110 239 100 ı	REQA	PCD_A	14443	1 byte(s)	125 110 333 5	9
128 186 679 260 ı	REQA	PCD_A	14443	1 byte(s)	128 186 773 6	9
132 819 933 420 ı	REQA	PCD_A	14443	1 byte(s)	132 820 027 8	9

When you select a command line in the detail grid, the detail view will provide even more information regarding protocol decoding:

Detail View

WUPB 14443

Date : 806 392 160 ns - 807 004 420 ns (612 260 ns) Level 1

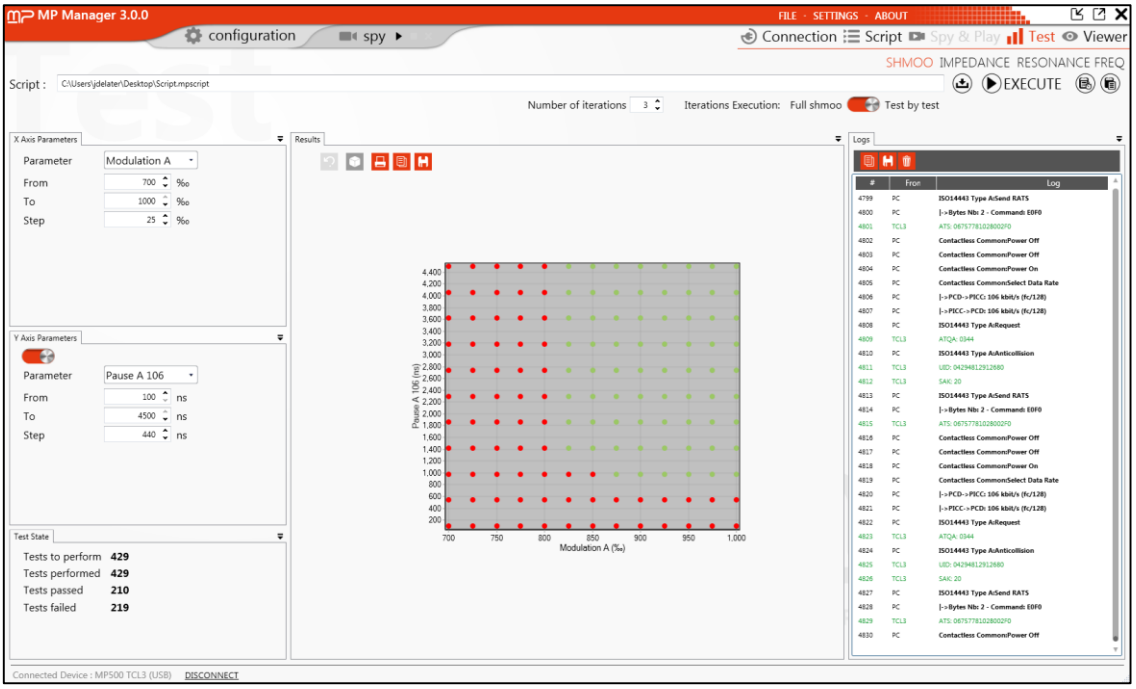
Bytes (5 bytes)
05 00 08 39 73 (5 bytes)
APf: 05 (1byte)
AFI = 00 (All families and sub-families) (1byte)
Param: 08 (1byte)
Extended ATQB not supported
Nb of slots: 1
CRC B: OK (2 bytes)
39 73 (2 bytes)
Timings
EGT PCD = 9.5 µs
EGT PCD = 9.4 µs
EGT PCD = 9.4 µs
EGT PCD = 9.4 µs

The Detail Grid data can be exported to a CSV file using “Export CSV” button at the top right of the window.

6.9. Test

The PT1NFC embeds several “parametric tests” functionalities, such as Impedance measurement and Resonance Frequency measurement. MPManager also provides a functionality called “Shmoo” where the same script is ran several times when adjusting analog parameters between each execution.

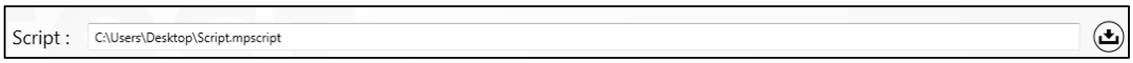
6.10. Shmoo



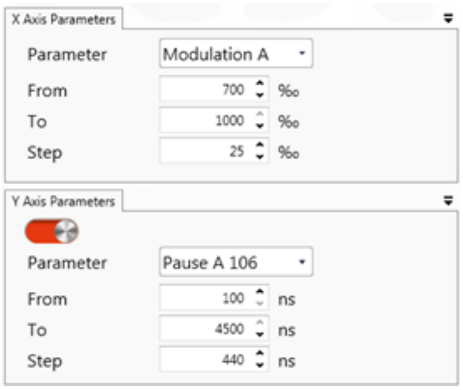
Only *.mpscript files can be opened with the shmoo.
The *.MPSCr files needs to be opened in the script section and saved as a *.mpscript to be usable in the shmoo.

The shmoo adapt two analog parameters of the PT1NFC when executing a script. The aim is to characterize your card regarding interoperability with readers.

In order to run a shmoo test, you first have to load a script



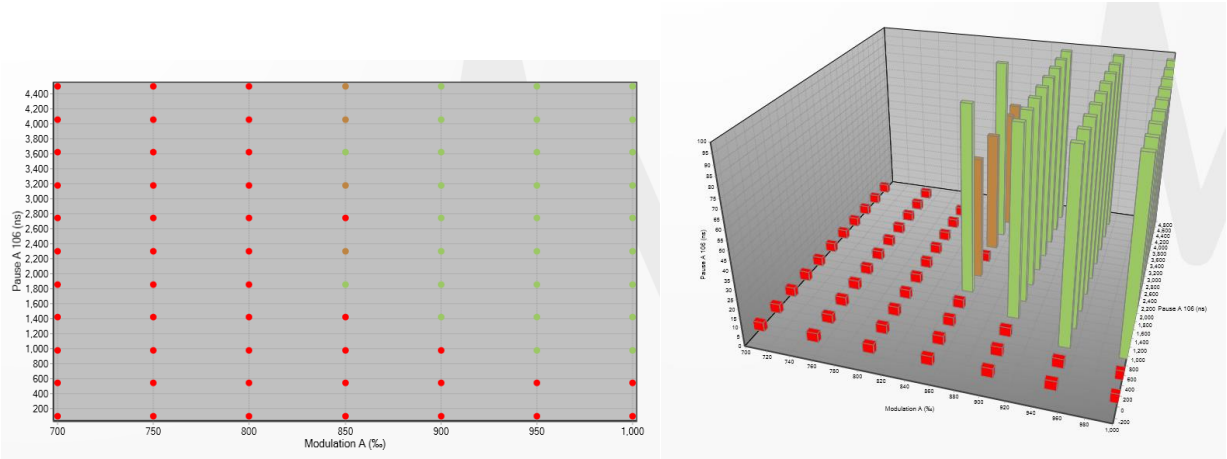
Then, select the X and Y axis parameters (Y is optional), and configure them.



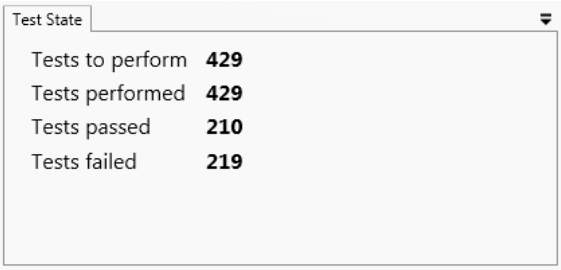
The different parameters are: Rise time, Fall Time, Frequency, Field Rise Time, Modulation A, Modulation B, Modulation FeliCa, Modulation Vicinity, Pause A 212, Pause A 424, Pause A 848, Pause Vicinity, Field Strength. For each parameter, minimum and maximum value, as well as the step, can be configured.

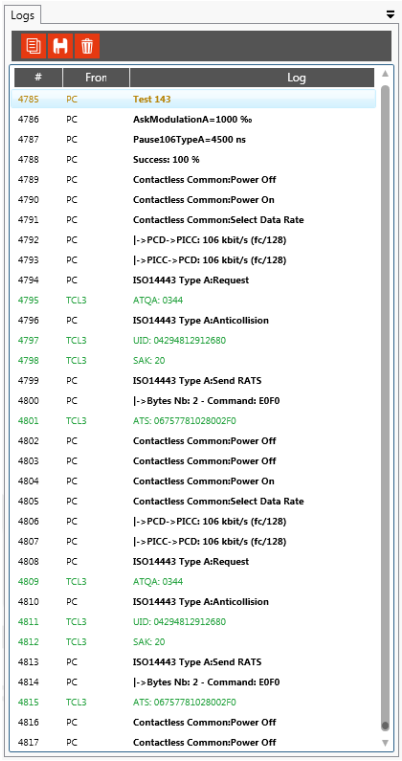
Once the parameters are configured, click on execute button:

During execution, the graph will show real-time results, and provide a complete status at the end:



Just below the parameters, the "test state" provides a result summary. Each plotted test result is clickable in the graph. The applied parameters for a specific graph position are recalled in the log.



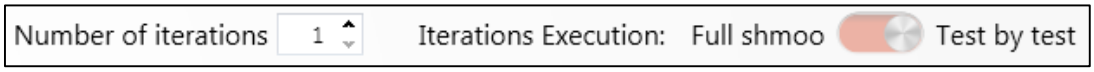


Eventually, a report can be generated in .xml or .csv format:

: Generate report

: Open report

Several options are available in this shmoo test. The first one is the possibility to execute each test several times, adding a third “dimension” to the test:



Full shmoo: execute the full shmoo for each number of iterations.
Test by test: execute each test for each number of iterations, before moving to the next test.

: Switch between fixed and rotative mode (3D mode only)

: Switch between 3D and normal mode

: Print the graph

: Copy the graph to clipboard (as a screenshot)

: Export to file (as a screenshot)

Some options are also available for the execution log :

: Copy to clipboard

: Export to file (in .txt)

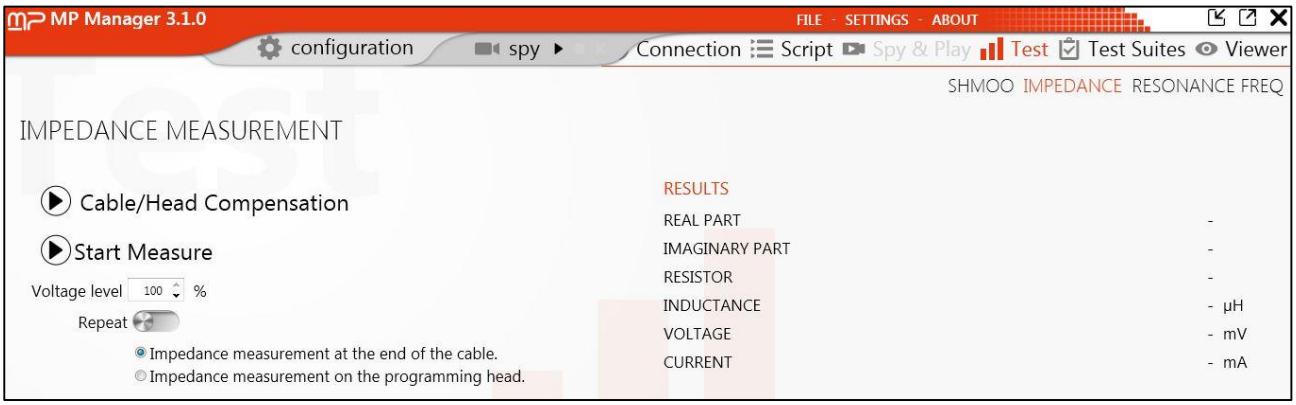
: Clear the log

6.11. Impedance measurement

Cable/Head compensation must be performed before any impedance measurement.

The PT1NFC is able to measure the impedance of an antenna or module connected to the Tx/Rx front connector through a RF cable (which must be compensated). In order to do so, set the voltage level to 50 %, select Impedance measurement at the end of the cable and then click on “Start Measure”. The results will appear on the right.

Enable the repeat switch to perform a continuous impedance measurement.



6.11.1.Cable/Head compensation

The cable compensation procedure is used to compensate the offset inducted by the cable connected to the Tx/Rx front connector. It must be performed prior to any antenna impedance measurement.
The head compensation procedure is used in production environment to compensate the offset inducted by a test head connected to a RF cable. It should be performed after a cable compensation and before any measurement with a test head.

Use the calibration kit provided with your PT1NFC to perform the cable/head compensation.

Calibration kit

The cable compensation consists in the following steps:

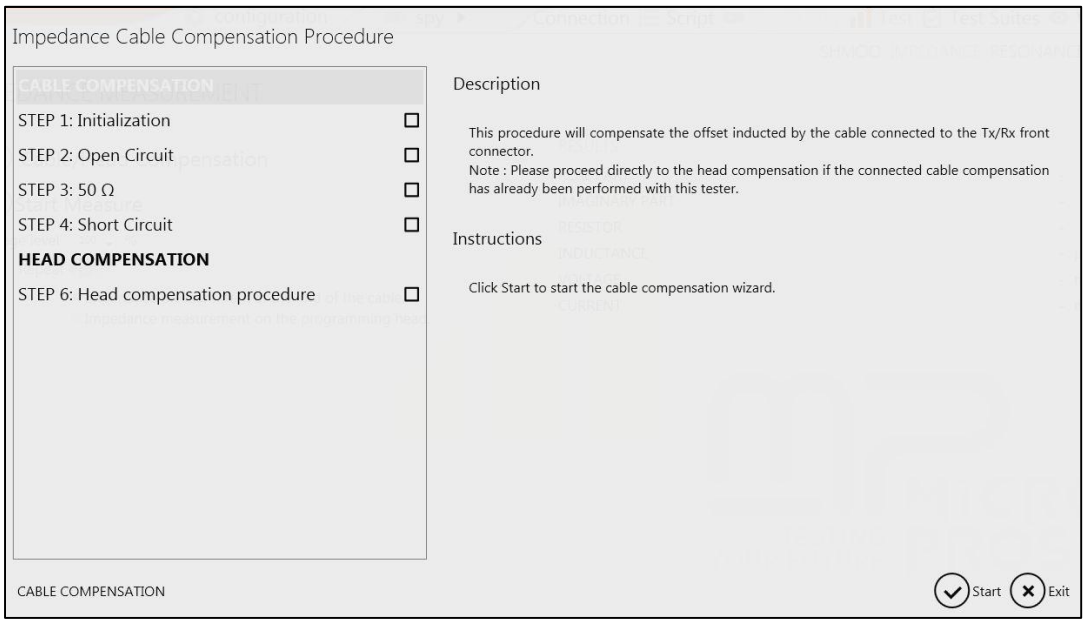
- Open circuit impedance measurement
- 50 Ω resistor measurement
- Impedance measurement in short circuit

The head compensation consists in the following steps:

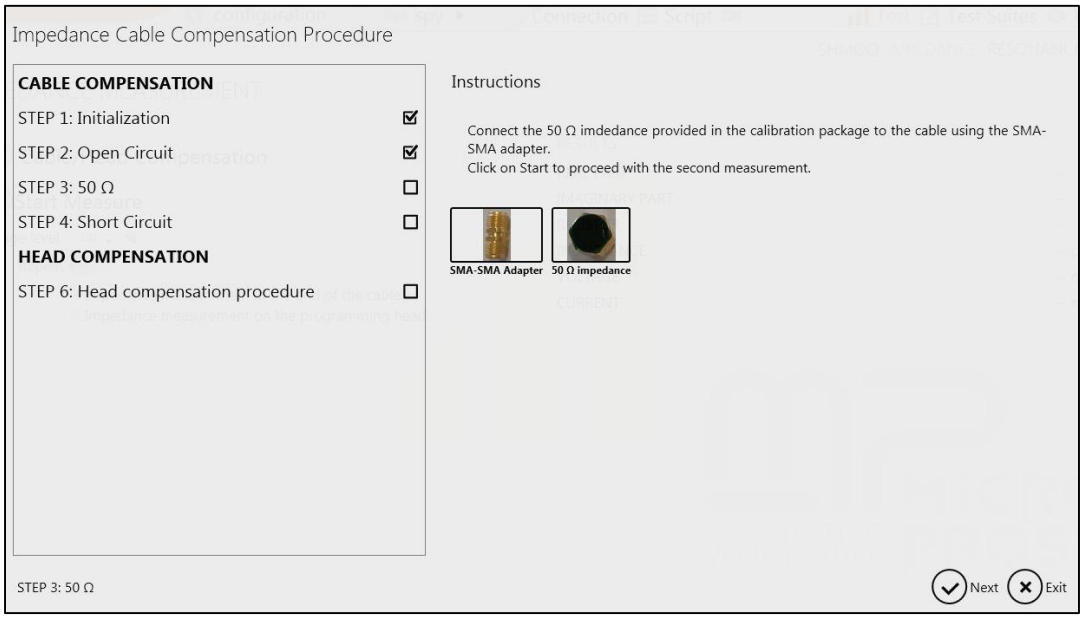
- Impedance measurement with test head connected

All the results are stored in the device non-volatile memory to be reused after restart.

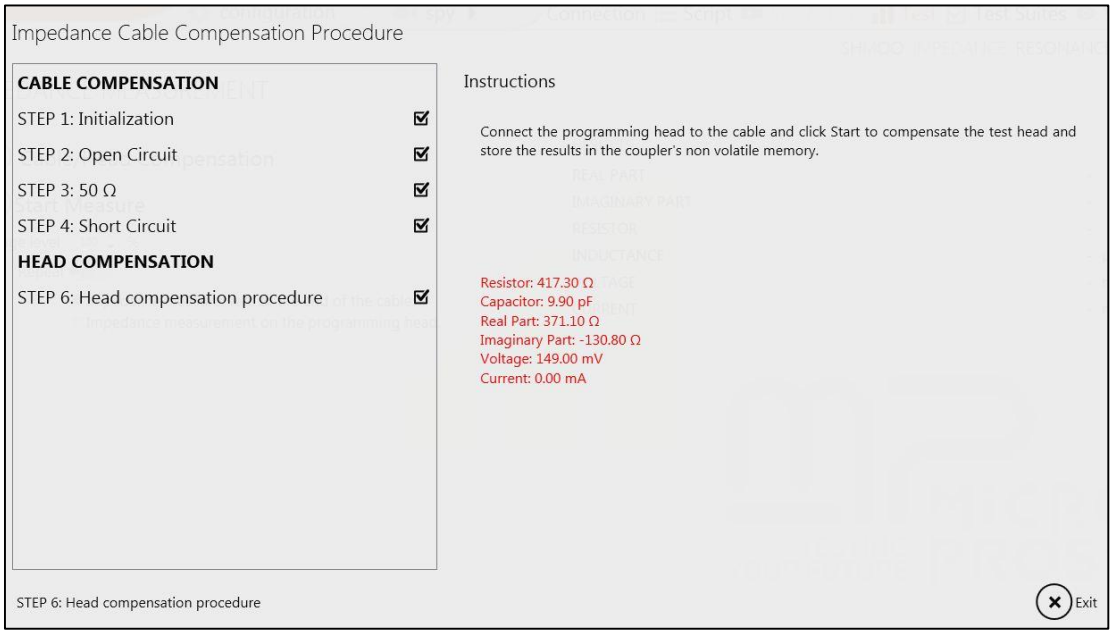
1) Launch the cable/head compensation wizard by clicking on the cable/head compensation label.



2) Follow the instructions detailed in the compensation wizard. Step are performed successively



3) If you're proceeding to the end of the test head compensation, measurement results are displayed in the last information page.



6.12. Resonance Frequency measurement

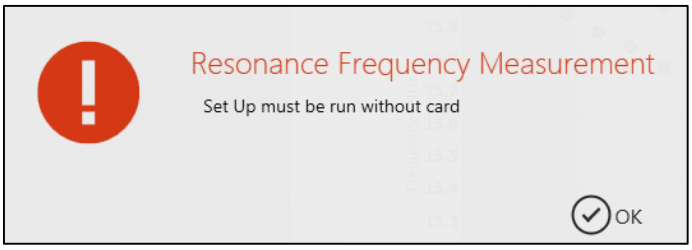
The resonance frequency measurement must be executed using the provided cable and Calibration Coil 1 antenna

The resonance frequency measurement window is articulated in 3 parts: the setup, the resonance frequency measurement for a fixed power, and the frequency per power variation.

6.12.1.Setup

The “Dual antenna” option is only used with a dual communication/resonance frequency measurement antenna. It does not concern MP500 PT1NFC.

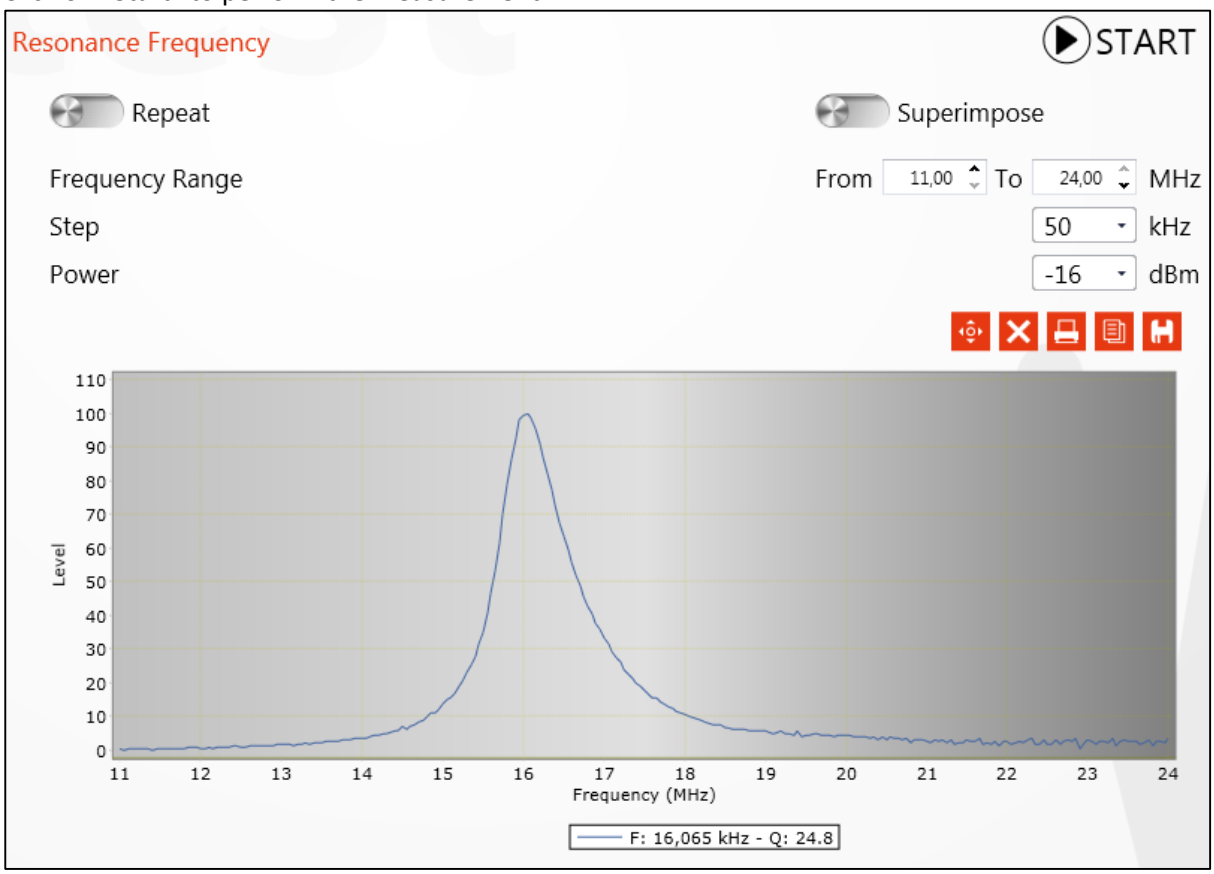
- Connect the 907-2475 (Calibration Coil 1) antenna to the PT1NFC “RF/Q” connector
- Run the setup. A warning appears to make sure that there is no card positioned close to the antenna:



6.12.1.1.Resonance Frequency

In order to realize a correct Resonance Frequency measurement, the card must be placed one centimeter over the Calibration Coil 1 antenna using an adequate spacer.

Click on “Start” to perform the measurement:



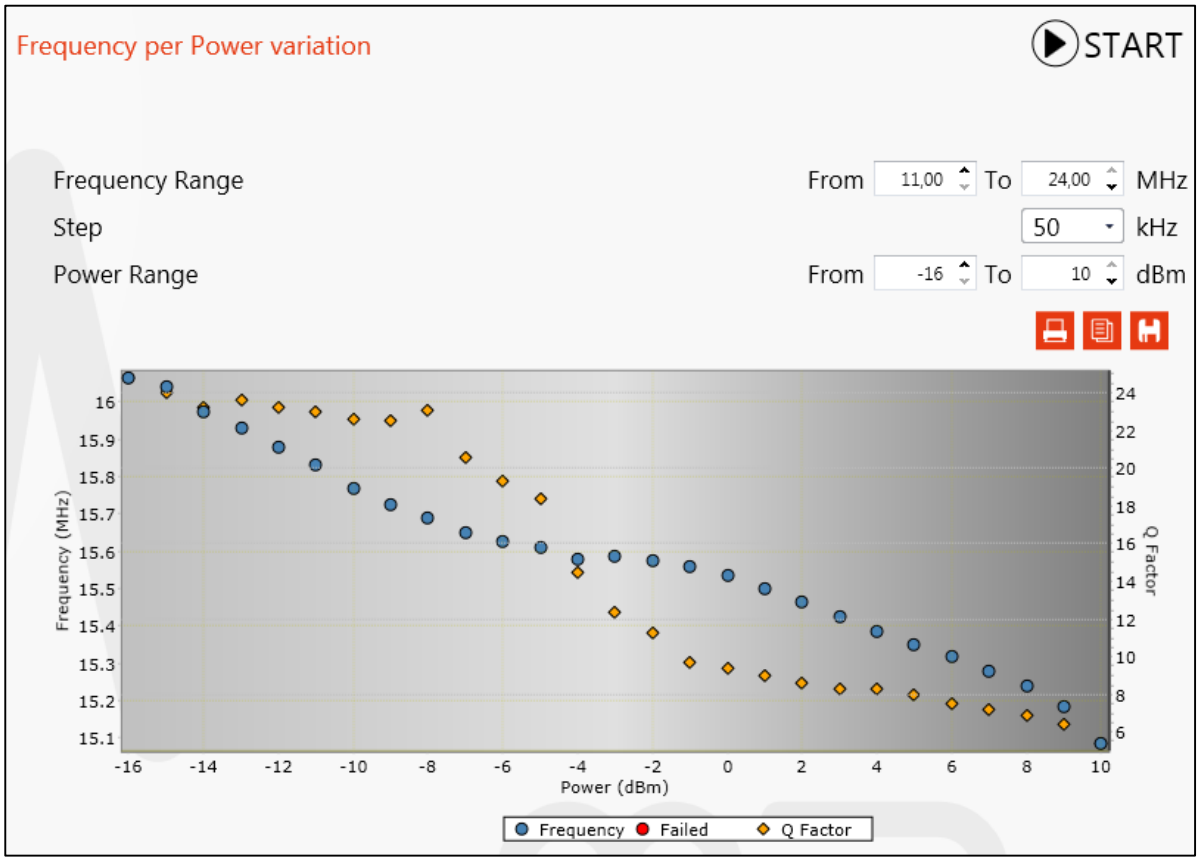
The function will return the Resonance Frequency as well as the antenna Q factor.

Several options are available before running the test:

- Repeat: the measurement will be repeated every second,
- Superimpose: every measurement result is kept on the graph (useful to compare several cards),
- Frequency range: define the minimum and maximum measurement limit,
- Step: define the sampling value,
- Power: level of the signal emitted by the PT1NFC to realize the measurement.
- : Change the graphical view
- : Clear the graph
- : Print the graph
- : Copy the graph (as an image)
- : Export the data to a .xml file

6.12.1.2.Frequency per Power variation

This functionality is useful to characterize your card resonance frequency and quality factor depending on the generated signal level.



Several options are available before running the test:

- Frequency range: define the minimum and maximum measurement limit,
- Step: define the sampling value,
- Power range: level of the signal emitted by the PT1NFC to realize the measurement.
- Print the graph
- Copy the graph (as an image)
- Export the data to a .xml file

6.12.1.3.RF field measurement (ISO10373-6 method equivalent)

The PT1NFC is able to measure a 13.56 MHz reader field strength (including its own) using a calibration coil antenna connected to the Analog IN connector of the front panel.

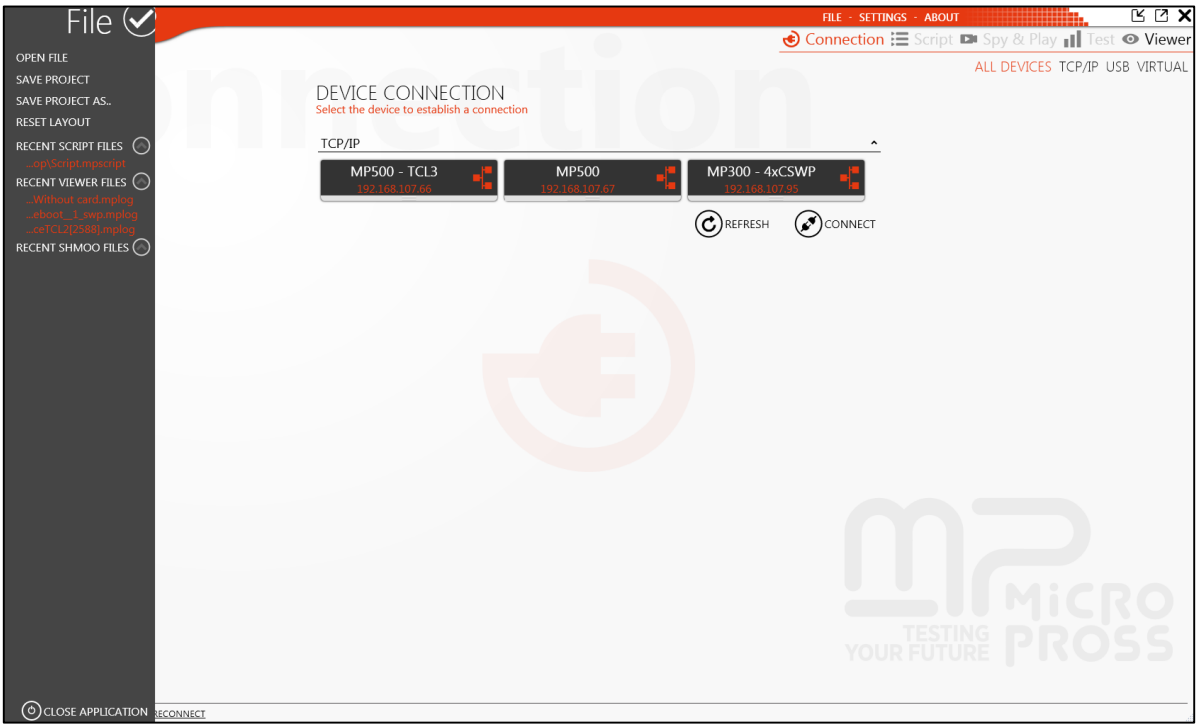
- Position either the Calibration coil 1 – for classes from 1 to 3 emulation - or calibration coil 2 – for classes from 4 to 6 emulation- in the immediate proximity of the contactless reader.
- Select the calibration coil used
- Start the measure

The measurement is calibrated in Micropross premises using an ISO test bench and its result given in A/m.

6.13. Menus

6.13.1.File

The file menu is used to open a file, create and save a project, or open a recent file (script, viewer, shmoo).

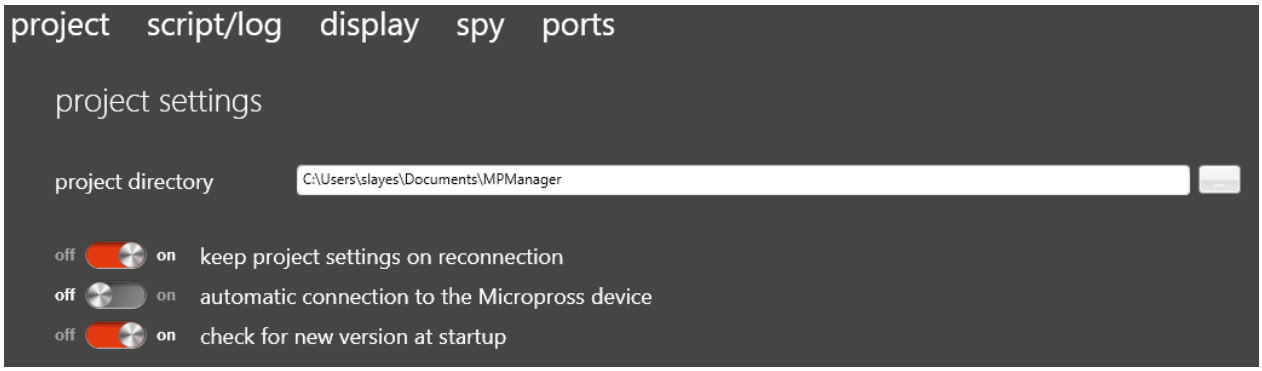


The « reset layout » button can be useful to reset default positioning for all the windows.

6.13.2.Settings

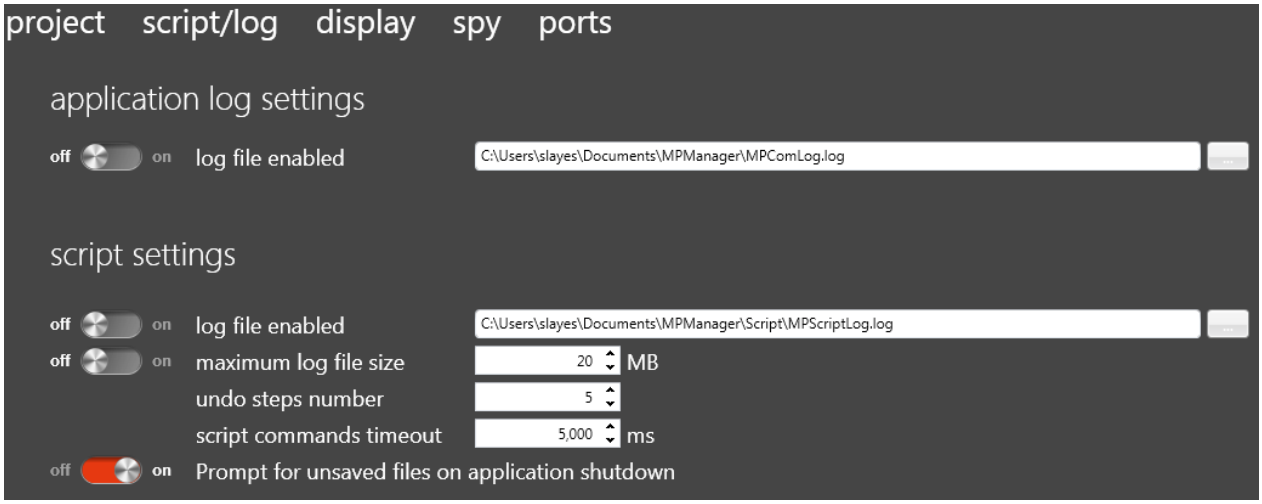
The settings menu is divided in 4 parts: project, script/log, display, and spy.

6.13.2.1.Project



- Project directory: Modify the project file directory
- Automatic connection to the Micropross device: If this option is set to “on”, MPManager will automatically reconnect to the Micropross device linked to your current project.
- Check for new version at startup: If this option is set to “on”, MPManager will automatically check if a new version is available at startup.

6.13.2.2.Script/Log



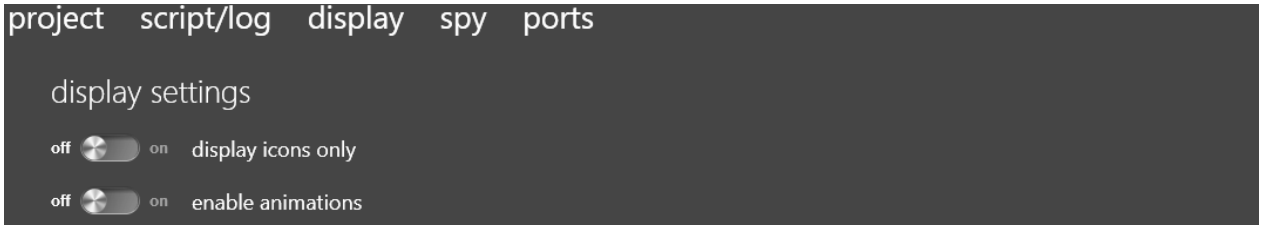
- *Application log settings*

- Log file enabled: If this option is set to “on”, a log file will save all the remote commands exchanged between MPManager and the PT1NFC.

- *Script settings*

- Log file enabled: If this option is set to “on”, the scripts execution log will be also saved in a log file directly.
- Maximum file size : The log file can be configured with a maximum log file size.
- Undo steps number: Maximum number of “Undo” iterations.
- Script command timeout: Default timeout for the script commands.
- Prompt for unsaved files on application shutdown: Will ask the user to save (or not) any unsaved file before closing the application.

6.13.2.3.Display



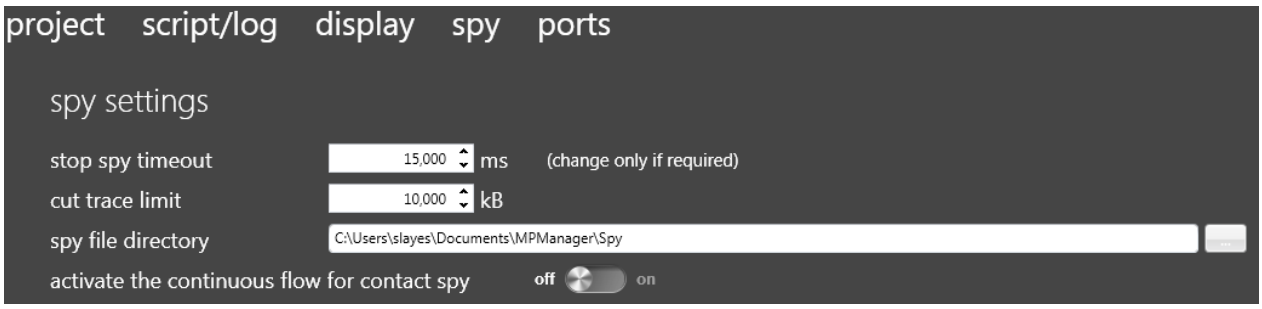
- Display Icons Only: Enable or disable « icons only » mode.
  - Enabled:

  - Disabled :

- Enable animations: Enable or disable the animations during navigation.

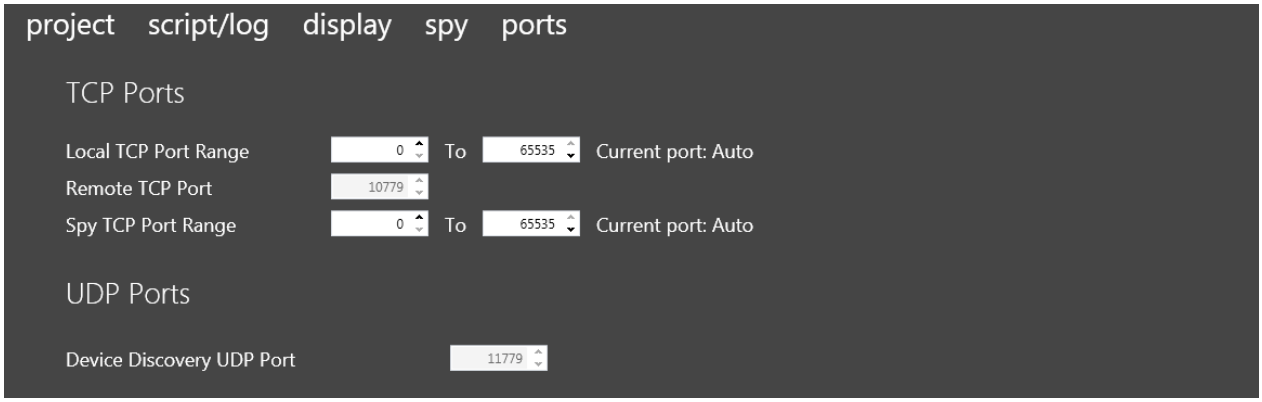
Disable animations can increase MPManager performance on low-performance PCs.

6.13.2.4.Spy



- Stop spy timeout: This timeout is used to stop the spy automatically if “stop spy” button is not able to stop it normally.
- Cut trace limit: If the trace exceed this size, a popup will propose to cut the trace when opened in the viewer.
- Spy file directory: Change the default spy file directory.
- Activate the continuous flow for contact spy (not used with PT1NFC): This option, only available with contact spying devices, will activate continuous flow in viewer window.

6.13.2.5.Ports



Adjust these parameters to adapt MP Manager to your local TCP/IP network policy.

- TCP Ports
  - Local TCP Port range : Specify a local TCP port range used by MP Manager to establish a communication with the device. Automatically chosen by default.
  - Remote TCP Port : TCP port to connect to to establish a communication to the device.
  - Spy TCP Port range : TCP port range used by MP Manager to download events form the device during a spy session. Automatically chosen by default.
- UDP Ports
  - Device discovery UDP Port : TCP port used by MP Manager for the device discovery broadcasting service (used to auto-detect devices on the connection page).

7. Support, Maintenance & Safety

7.1. Hardware warranty

Your MP500 PT1NFC comes with a 2-year hardware warranty.

7.2. Micropross support

Don't hesitate to visit our interactive helpdesk at http://support.micropross.com. You'll be able to:

- Get all the answers to your questions with the online helpdesk (*3 months of software support are free of charge from the delivery date*). Our engineers accompany you during your projects development to ease our tools integration.
- Download the latest software and resources available in the download center.

7.3. Maintenance agreement

To get benefit from a full technical support of your products, feel free to request a quotation at smartcards@micropross.com

7.4. Preventive maintenance

7.4.1. Cable/Head compensation procedures

Cable and Head compensation procedures are essential to guarantee the accuracy and the validity of the measurement performed by the coupler. Please observe the following rules:

Cable compensation **must be performed** when the cable from the tester to the test head is replaced, or at least once per year.

Head compensation **must be performed** when the test head evolves.

Resonance frequency setup **must be performed** when a cable is replaced, and at least once per month.

All setups results are stored in the non-volatile memory of the coupler.

7.4.2. Cleaning and preventive maintenance

Preventive maintenance consists of periodic cleaning and inspection. It should be performed as often as the operating environment dictates. If the product has been subjected to abnormally dirty conditions, interior cleaning and inspection by service operators may be needed. Exterior cleaning may be performed by the operator. Dust the exterior surfaces with a dry, lint-free cloth or a soft bristle brush. Do not use abrasive compounds on any part of the enclosure.

Any maintenance operation, including cleaning, must be performed with power cord disconnected. To prevent water from getting inside the enclosure, do not use water or chemical agents.

8. SAFETY NOTES

The general safety information in this summary is for operating and servicing personnel. Specific warnings and caution can be found throughout the manual where they apply and may not appear in this summary.

8.1. Terms as marked on the equipment

CAUTION indicates a hazard to property, including the equipment itself, and could cause minor personal injury.
WARNING indicates solely a personal injury hazard not immediately accessible as you read the marking
DANGER indicates a personal injury hazard immediately accessible as you read the marking.

8.2. Symbols as marked on equipment

DANGER – High voltage

Protective ground (earth) terminal

ATTENTION – REFER TO MANUAL

8.3. Grounding the product

This product is intended to operate from a power source that does not apply more than 250 V_{RMS} between the supply conductors or between supply conductor and ground.

WARNING: This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle. A protective-ground connection by way of the grounding conductor in the power cord is essential for safe operation.

8.4. Danger arising from loss of ground

Upon loss of the protective-ground connection, all accessible conductive parts can render an electric shock.

8.5. Power disconnect

The main power disconnect is by means of the power cord or, if provided, an AC power switch. Always keep free access to the main socket in order to disconnect the power cord.

8.6. Use the proper power supply

If your product requires an AC/DC adapter, use only the adapter specified for your product.

WARNING: The AC/DC adapter provided insures correct grounding of the product. To avoid electrical shock, your product must be grounded.

8.7. Use the proper power cord

Use only the power cord and connector specified for your product. Use only a power cord that is in good condition.

8.8. Remove loose objects.

During disassembly or installation procedures, screws or other small objects may fall to the bottom of the mainframe. To avoid shorting out the power supply, do not power up the instrument until such objects have been removed.

8.9. Do not operate without covers

To avoid personal injury, remove jewelry such as rings, watches and other metallic objects before removing the cover. Do not touch exposed connections and components within the product while the power cord is connected. Always remove the power cord before removing the cover.

8.10. Remove from operation

If you have reason to believe that the instrument has suffered a component failure, do not operate the instrument until the cause of failure has been determined and corrected.

8.11. Do not operate in explosive atmosphere

To avoid explosion, do not operate this product in an explosive atmosphere.

8.12. Keep away from live circuits

Operating personnel must not remove instrument covers. Components replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with the power cable connected. To avoid injuries, always disconnect power and discharge circuits before touching them.

8.13. Do not service or adjust alone

Do not attempt internal service or adjustment unless another person, capable of rendering aid and resuscitation, is present.

8.14. Tested configuration

This equipment is tested with stand-alone condition or with the combination with the accessories supplied by Micropross against the requirement of the standards described in the Declaration of Conformity. If it is used as a system component, compliance of related regulations and safety requirements are to be confirmed by the builder of the system.

9. SOFTWARE LICENSES

This product contains the following open-source libraries.

Package	Version	License
busybox	1.21.0	GPLv2
e2fsprogs	1.42.7	GPLv2 libuuid BSD-3c libss and libet MIT-like with advertising clause
gnupg	1.4.7	GPLv2
i2c-tools	3.1.0	GPLv2
iperf	2.0.5	BSD
libassuan	2.0.3	LGPLv2.1+
libgpg-error	1.1	LGPLv2.1+
libgpgme	1.3.2	LGPLv2.1+
lm-sensors	3.3.3	GPLv2+
lzo	2.06	GPLv2+
openssl	1.0.1e	OpenSSL plus SSLeay
pciutils	3.1.10	GPLv2+
stress	1.0.4	GPLv2
util-linux	2.20.1	GPLv2+ BSD-4c libblkid and libmount LGPLv2.1+ libuuid BSD-3c
zlib	1.2.7	zlib license
linux	3.0.35-Q7_IMX6-14.03.01	GPLv2
u-boot	2013.07-Q7_IMX6-14.03.01	GPLv2+

These libraries source code is available on https://github.com/Micropross/MP500_OpenSource.

9.1. GPL v2

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9.2. e2fsprogs

9.2.1. libuuid

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Iperf performance test
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Feng Qin
Kevin Gibbs
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University of Illinois at Urbana-Champaign
http://www.ncsa.uiuc.edu

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(For example, a function in a library to compute square roots has

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9.5. openssl

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9.6. zlib

```
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jloup@gzip.org          madler@alumni.caltech.edu
```

The data format used by the zlib library is described by RFCs (Request for Comments) 1950 to 1952 in the files http://tools.ietf.org/html/rfc1950 (zlib format), rfc1951 (deflate format) and rfc1952 (gzip format).

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9.7. util-linux

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9.7.1. libuuid

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