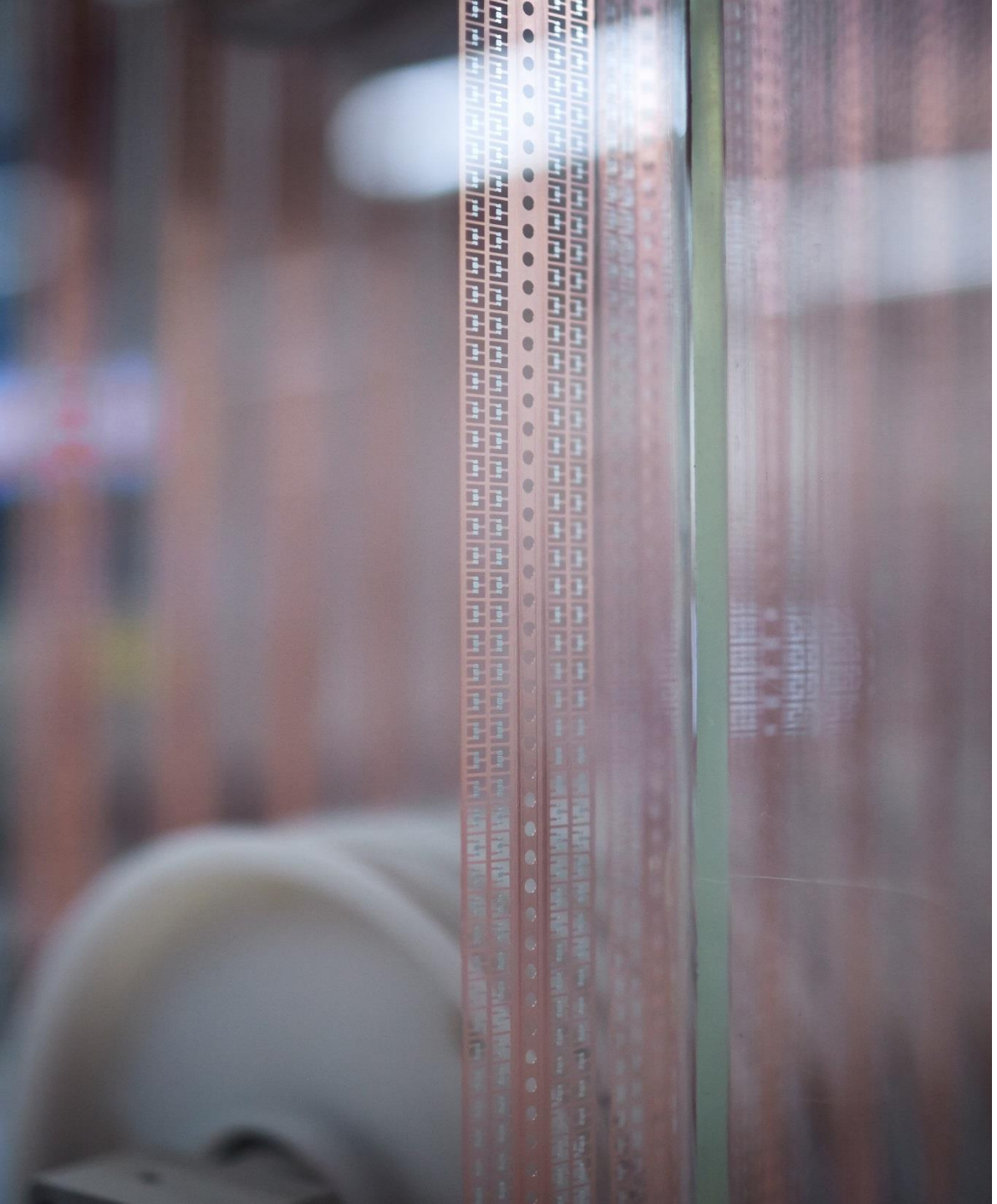
MIGRATION TO EMVCO 3.0

NFC TECHNICAL III

PABLO FUENTES

JULY 2019



Agenda

- Introduction
- Test equipment
- EMV L1 Analog tests
- Interoperability tests
- NXP Debugging support
- NXP product portfolio

Introduction

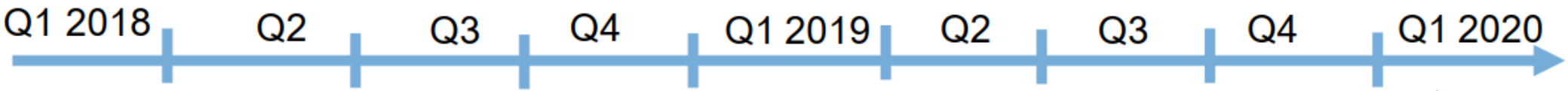
Introduction
Why EMV v3.0?

- With the appearance of contactless payments and card digitization, manufacturers enable new payment devices in a wide variety of form factors.
- In their v3.0, EMVCo updates their contactless specifications for POS terminals (PCD) to guarantee the correct operation with new devices in the market.
- POS terminals are now tested using 3 different reference antennas to verify the performance against different antenna sizes.
- Interoperability tests with several phones on the market were added and made mandatory from 2019Q1.

Training Mobile Knowledge

Introduction
EMV v3.0 Timeline

Schedule for the migration to EMV v3.0



April

- Specifications public
- Test case development
- Final validation of tests cases

January

- First test tools validated
- Interoperability tests mandatory for EMV v2.6

April

- Test tools qualified
- First certification possible

January

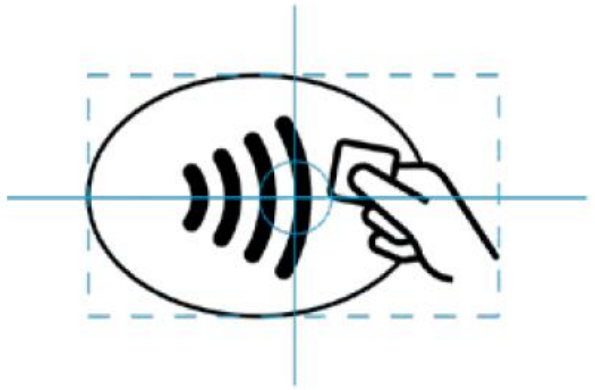
- **<u>EMV 3.0 Mandatory</u>**

EMV 2.6b certification submission possible until Dec 31st 2019
(needs to be completed before Q2 2020)

Training Mobile Knowledge

Introduction
Contactless Symbol

- Identifies the interface area where the user should tap his card.
- Contactless symbol marks the center of the landing plane.
- Minimum size: 13mm height x 22 mm width.
- Aspect ratio should be kept.



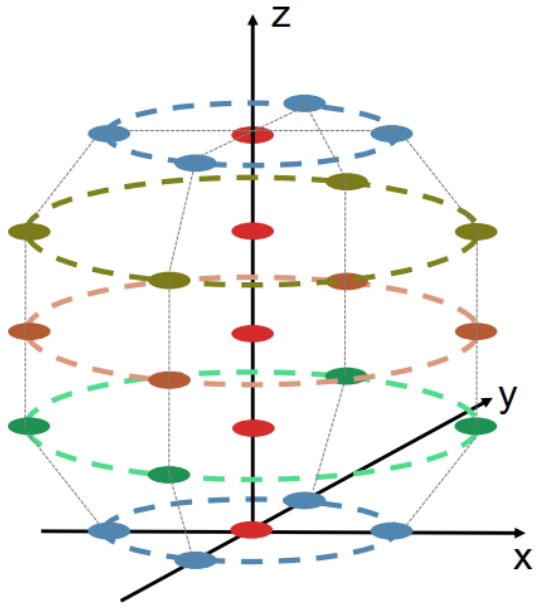
Introduction
Operating volume

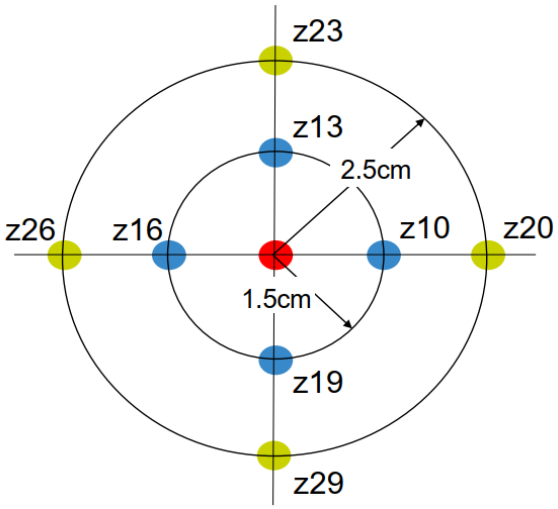
- Contactless Symbol is used to define an operating volume for the tests.
- Positions are expressed with the format (z, r, φ)

z	Height
0	0 mm
1	10 mm
2	20 mm
3	30 mm
4	40 mm

r	Radius
0	0 mm
1	15 mm
2	25 mm

φ	Angle
0	0
3	π / 2
6	π
9	3π / 2

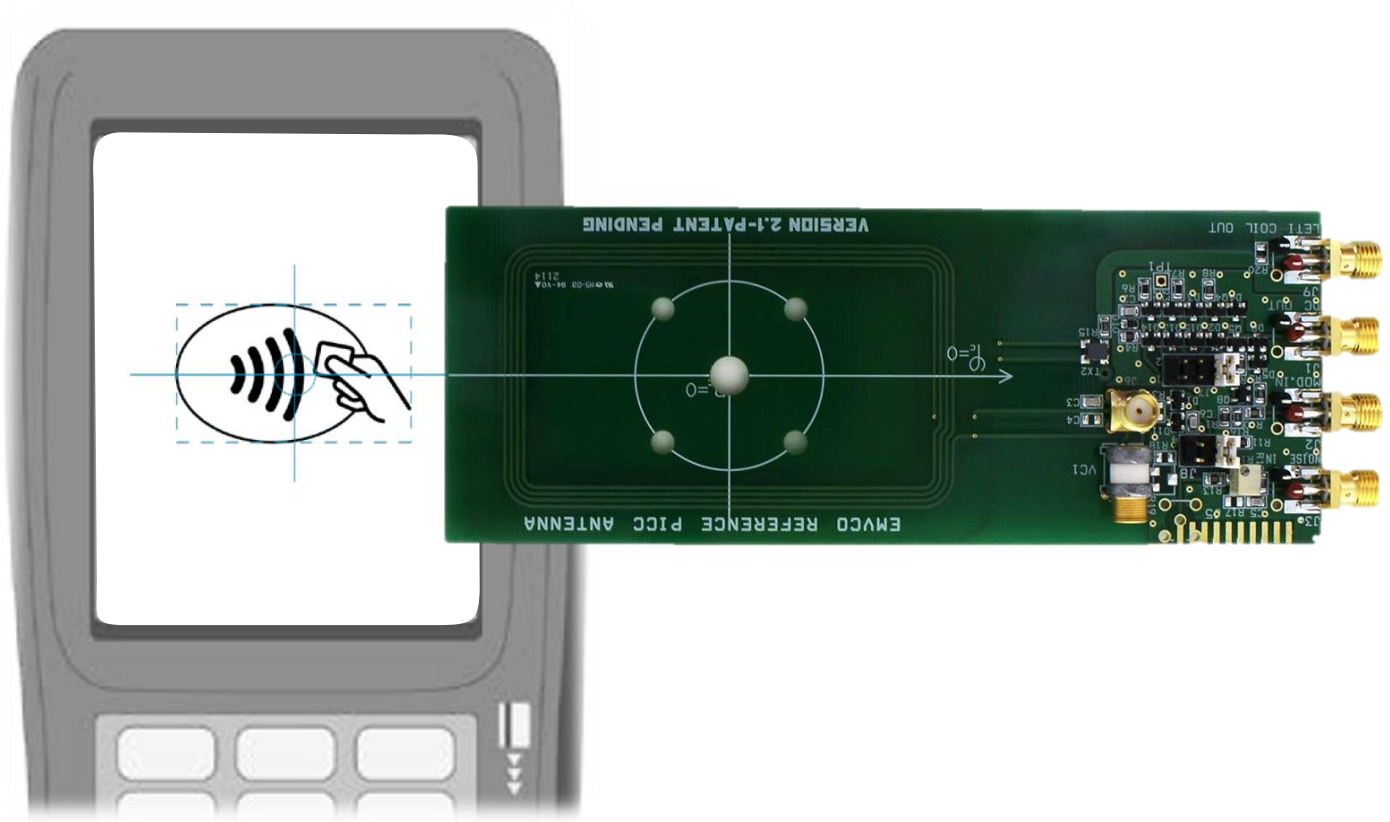




Training Mobile Knowledge

Introduction
TestPICC Positioning

- TestPICC should attack from the right side



Training Mobile Knowledge

Test equipment

Test equipment
Test PICCs

EMV v2.6

Ref PICC

EMV v3.0

PICC1
Class 1
16.1MHz

PICC2
Class 1
13.56MHz

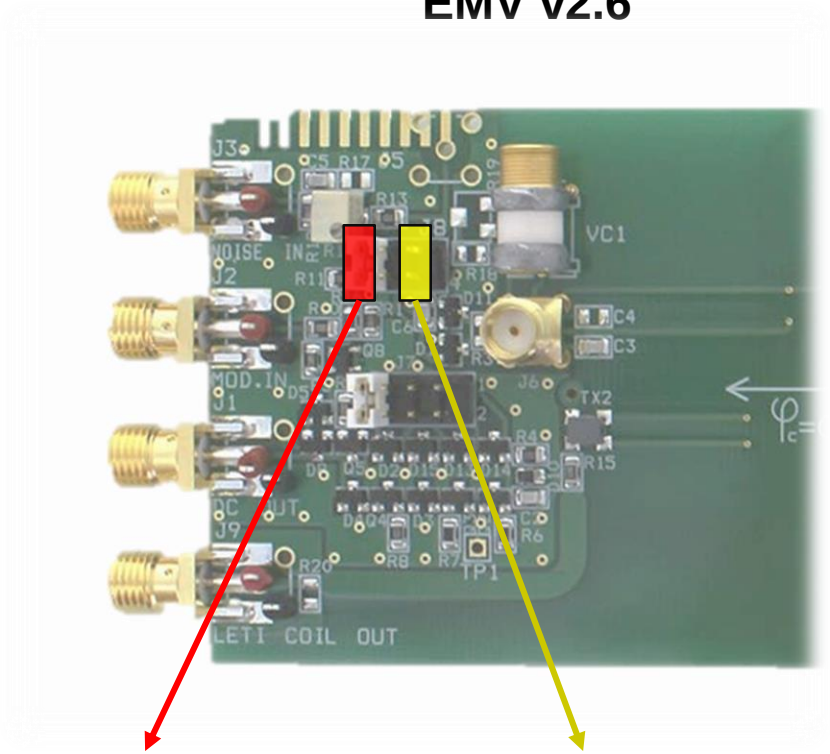
PICC3
Class 3
13.56MHz

- For 3.0 tests are performed using 3 different PICCs instead of only 1
- New PICCs are tuned to 13.56 MHz
- Included a PICC Class 3 antenna

Training Mobile Knowledge

Test equipment
Load settings

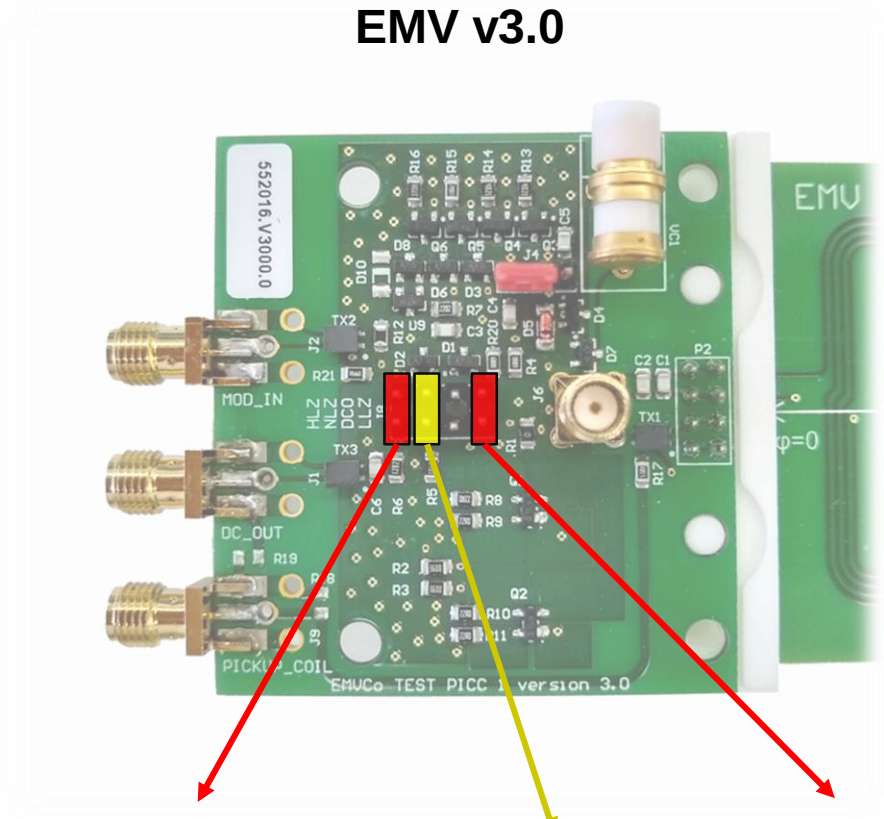
EMV v2.6



Linear Load
Wave Shape Tests

Non-Linear Load
Power and LMA tests

EMV v3.0



HLZ
Wave Shape

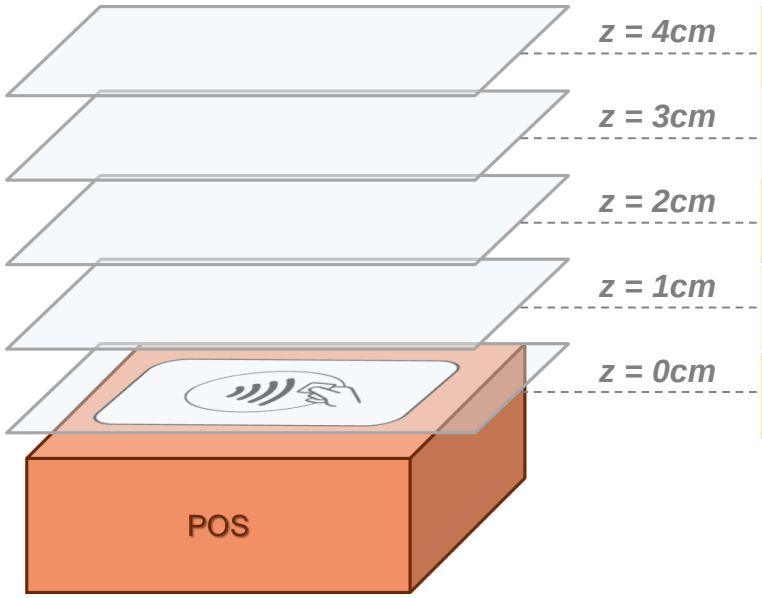
NLZ
Power and
LMA tests

LLZ
Wave Shape

Training Mobile Knowledge

EMV L1 Analog Tests

Power transfer tests
Differences – v2.6 vs v3.0



Minimum (V)

EMV v2.6	EMV v3.0		
	TP1	TP2	TP3
2.55	3.84	4.6	3.23
2.775	4.02	4.6	3.47
3	4.2	4.6	3.71
3.05	4.25	4.6	3.91
3.1	4.3	4.6	4.11

Maximum (V)

EMV v2.6	EMV v3.0		
	TP1	TP2	TP3
8.1	7.35	6.95	8.75

TP = TestPICC

Training Mobile Knowledge

Power transfer tests
EMV 2.6 vs 3.0 (TestPICC1 & 3)

EMV 2.6

z	z00	Min	Max
4	3.58	2.55	8.10
3	5.06	2.775	8.10
2	5.84	3.00	8.10
1	5.35	3.05	8.10
0	3.66	3.10	8.10

EMV 3.0
TestPICC1

z	z00	Min	Max
4	4.46	3.84	7.35
3	5.37	4.02	7.35
2	5.86	4.20	7.35
1	5.62	4.25	7.35
0	4.54	4.30	7.35

EMV 3.0
TestPICC3

z	z00	Min	Max
4	4.07	3.23	8.75
3	5.39	3.47	8.75
2	6.16	3.71	8.75
1	5.90	3.91	8.75
0	6.44	4.11	8.75

- ✓ Same device
- ✓ Same configuration

Power transfer tests
EMV 2.6 vs 3.0 (TestPICC2)

EMV 2.6

z	z00	Min	Max
4	3.58	2.55	8.10
3	5.06	2.775	8.10
2	5.84	3.00	8.10
1	5.35	3.05	8.10
0	3.66	3.10	8.10

EMV 3.0
TestPICC2

z	z00	Min	Max
4	5.18	4.60	6.95
3	5.47	4.60	6.95
2	5.44	4.60	6.95
1	5.45	4.60	6.95
0	4.24	4.60	6.95

EMV 3.0
TestPICC2

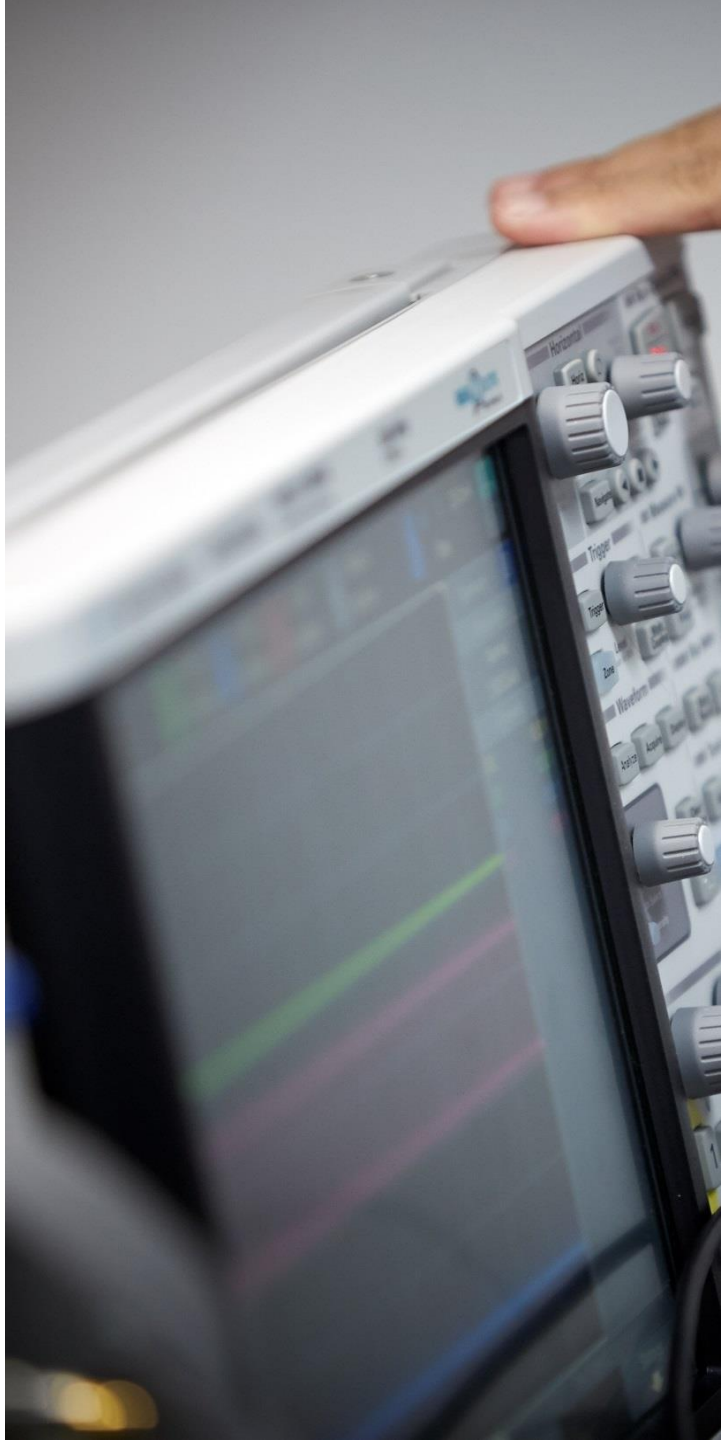
z	z00	Min	Max
4	5.18	4.60	6.95
3	5.47	4.60	6.95
2	5.44	4.60	6.95
1	5.45	4.60	6.95
0	4.88	4.60	6.95

Power transfer tests
Considerations

- Although voltage limits change in v3.0, different loads cause different measurements of voltage levels for the same RF power transmitted.
- Overall, new power transfer requirements are similar for TESTPICC1 and TESTPICC3. For TESTPICC2, device might require more power in positions at close distance.
- For migrations from EMV v2.6 to v3.0, it might be possible to fit new power transfer requirements just by changing DPC configuration (if supported).

Wave shape tests
Differences – v2.6 vs v3.0

- Same test cases as for EMV v2.6. Limits are the same, with slight changes in ringing, overshoot and undershoot test cases.
- In v3.0, all tests must be passed with the 2 different loadings (HLZ & LLZ) for all TESTPICCs. These two configurations aim at simulating the behavior of the reader against cards integrating chips with different load.
- Results show that EMV 3.0 specifications are more exigent in terms of waveform shape, especially when measured with TESTPICC2.
- Short distance positions seem to be the most challenging as the new TESTPICC loads present a low coupling with the PCD antenna in comparison with Reference PICC from v2.6.



Wave shape tests
Results with PNEV5180B (TestPICC 1)

Type A

z = 1cm

	Measured	Lower Limit	Upper Limit
t1	2.52	2.06	2.99
t2	1.41	0.52	2.52
t3	0.74	0	1.18
t4	0.35	0	0.44
Overshoot LLZ [%]	0	0	6.84
Overshoot HLZ [%]	0	0	6.84
Undershoot LLZ [%]	0	0	6.84
Undershoot HLZ [%]	0	0	6.84
ASK Mod. Depth [%]	99.37	95	100
Monotony	Pass		
Ringing	Pass		

HLZ

Measured	Lower Limit	Upper Limit
2.52	2.06	2.99
1.45	0.52	2.52
0.71	0	1.18
0.37	0	0.44
0	0	6.97
0	0	6.97
0	0	6.97
0	0	6.97
99.46	95	100
Pass		
Pass		

LLZ

Type B

z = 4cm

	Measured	Lower Limit	Upper Limit
Modulation Index [%]	12.8	9	14
tf	0.8	0	1.18
tr	0.64	0	1.18
Undershoot LLZ [%]	0.3	0	6.62
Undershoot HLZ [%]	0.3	0	6.62
Overshoot LLZ [%]	1.8	0	6.62
Overshoot HLZ [%]	1.8	0	6.62
Monotony falling	Pass		
Monotony rising	Pass		

HLZ

Measured	Lower Limit	Upper Limit
12.8	9	14
0.8	0	1.18
0.65	0	1.18
0.4	0	6.62
0.4	0	6.62
2.2	0	6.62
2.2	0	6.62
Pass		
Pass		

LLZ

Wave shape tests
Results with PNEV5180B

Possible issues:

- At close distances like 0 and 1 cm, the pick-up coil does not capture enough signal due to the low coupling with PCD antenna. This issue was already present in previous versions of the specifications, but it is accentuated with the tuning frequency and shape of the new antenas for v3.0.
- It is solved by using an external sniffer instead of the LETI Coil output of the TESTPICC antennas.
- Is important to notice that this issue is due to a measurement error, so any compensation to fit requirements under these conditions may lead to a bad behavior of the terminal in the field.

TESTPICC LETI Coil

*

	Measured	Lower Limit	Upper Limit
t1	2.89	2.06	2.99
t2	2.54	0.52	2.89
t3	0.18	0	1.18
t4	0.14	0	0.12
Overshoot LLZ [%]	17.74	0	9.25
Overshoot HLZ [%]	17.74	0	15.22
Undershoot LLZ [%]	0	0	9.25
Undershoot HLZ [%]	0	0	15.22
ASK Mod. Depth [%]	99.34	95	100
Monotony	Pass		
Ringing	Pass		

External Sniffer

	Measured	Lower Limit	Upper Limit
t1	2.88	2.06	2.99
t2	2.61	0.52	2.88
t3	0.29	0	1.18
t4	0.16	0	0.19
Overshoot LLZ [%]	5.17	0	8.77
Overshoot HLZ [%]	5.17	0	12.2
Undershoot LLZ [%]	0.59	0	8.77
Undershoot HLZ [%]	0.59	0	12.2
ASK Mod. Depth [%]	98.2	95	100
Monotony	Pass		
Ringing	Pass		

* TESTPICC2, HLZ, Type A, 0 cm

LMA tests
Differences – v2.6 vs v3.0

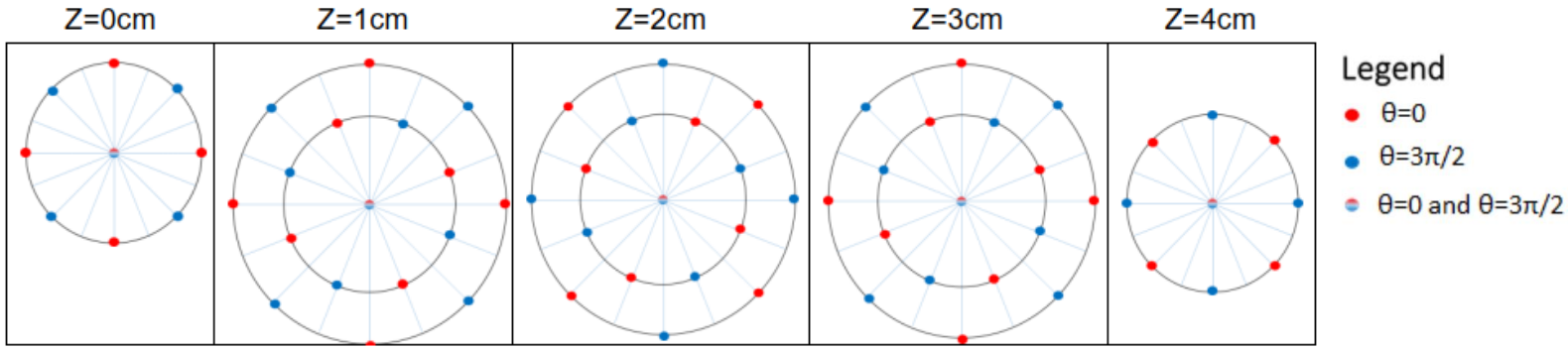
- For v3.0, LMA limits for minimum modulation are more ‘relaxed’ than for v2.6. However, limits for maximum modulation are slightly more restrictive.
- LMA limits remain the same for TestPICCs 1 and 2.
- For TestPICC 3 limits are less restrictive.

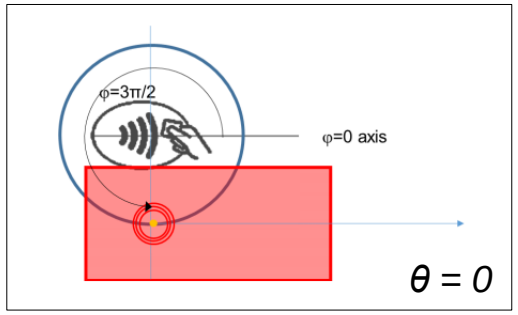
		EMV v2.6	EMV v3.0		
			TP1	TP2	TP3
PCD Nominal Power		5.53	5.74		
VS1,pp	MIN	5.5	5.5	5.5	6.0
	NOM	20	20		
	MAX	85	85	85	85
VS2,pp	MIN	3.5	3.5	3.5	4.5
	NOM	20	20		
	MAX	40	40	40	33

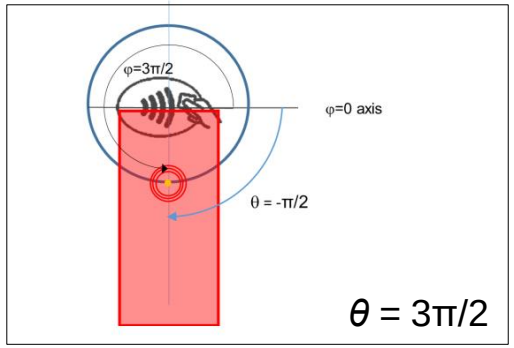
Interoperability tests

Interoperability tests
Test positions and orientation

- New tests included to verify performance against 8 different phones at L1 level.
- Applicable for 2.6b since Q1 of 2019.
- Testing positions:







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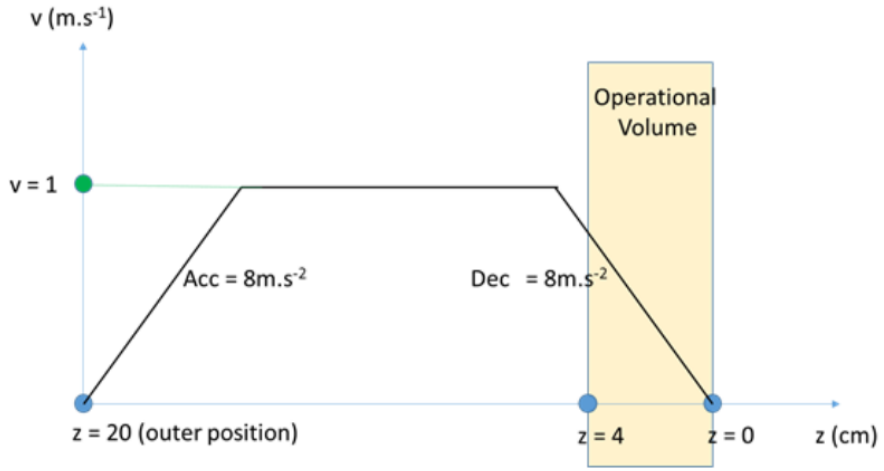
Interoperability tests
Summary

- Tested with 8 different phones
- Motion requirements
  - Phone in testing position for 1.5 seconds to pass the test
- 37 positions for each orientation (74 positions in total)
- For every smartphone it must achieve:
  - > 50% successful transactions in z=0
  - > 83% successful transactions for all positions (including z=0)
    - The average score is weighted depending on how close the testing position is to plane z=0.



Training Mobile Knowledge

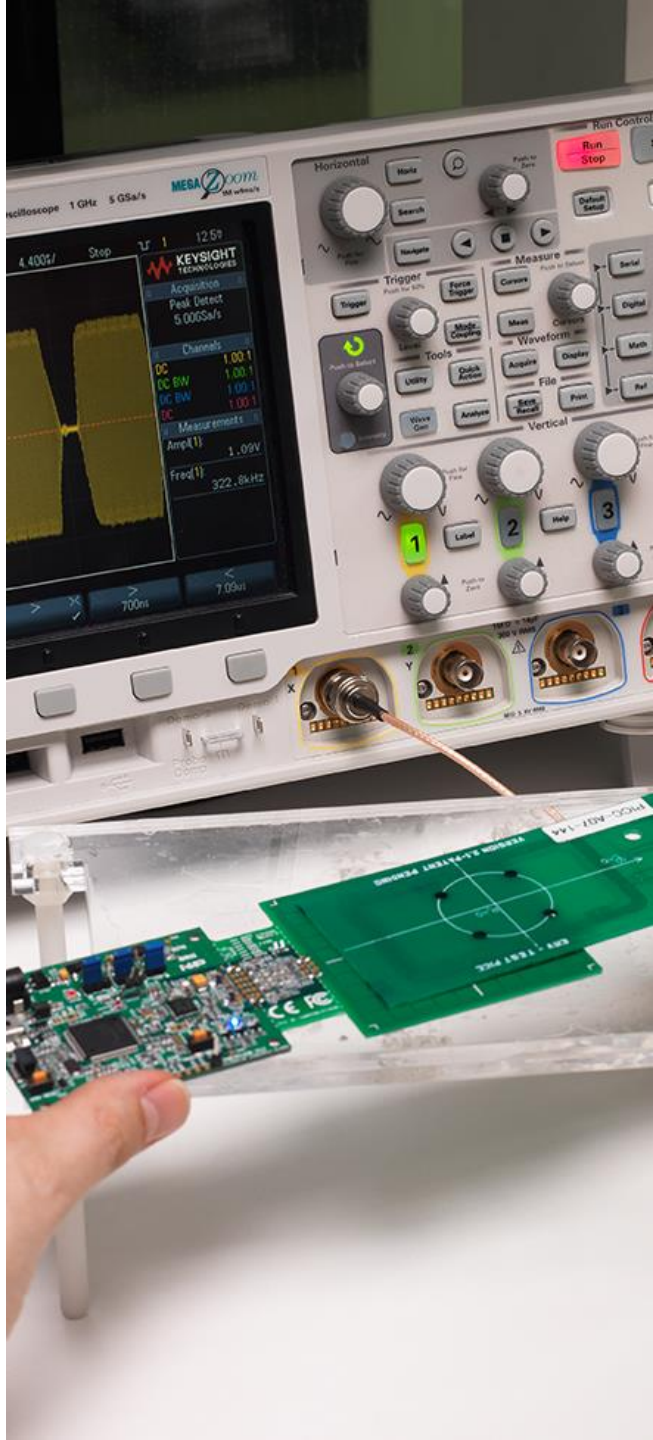
NXP Optimization support

NXP Optimization support
Advantages

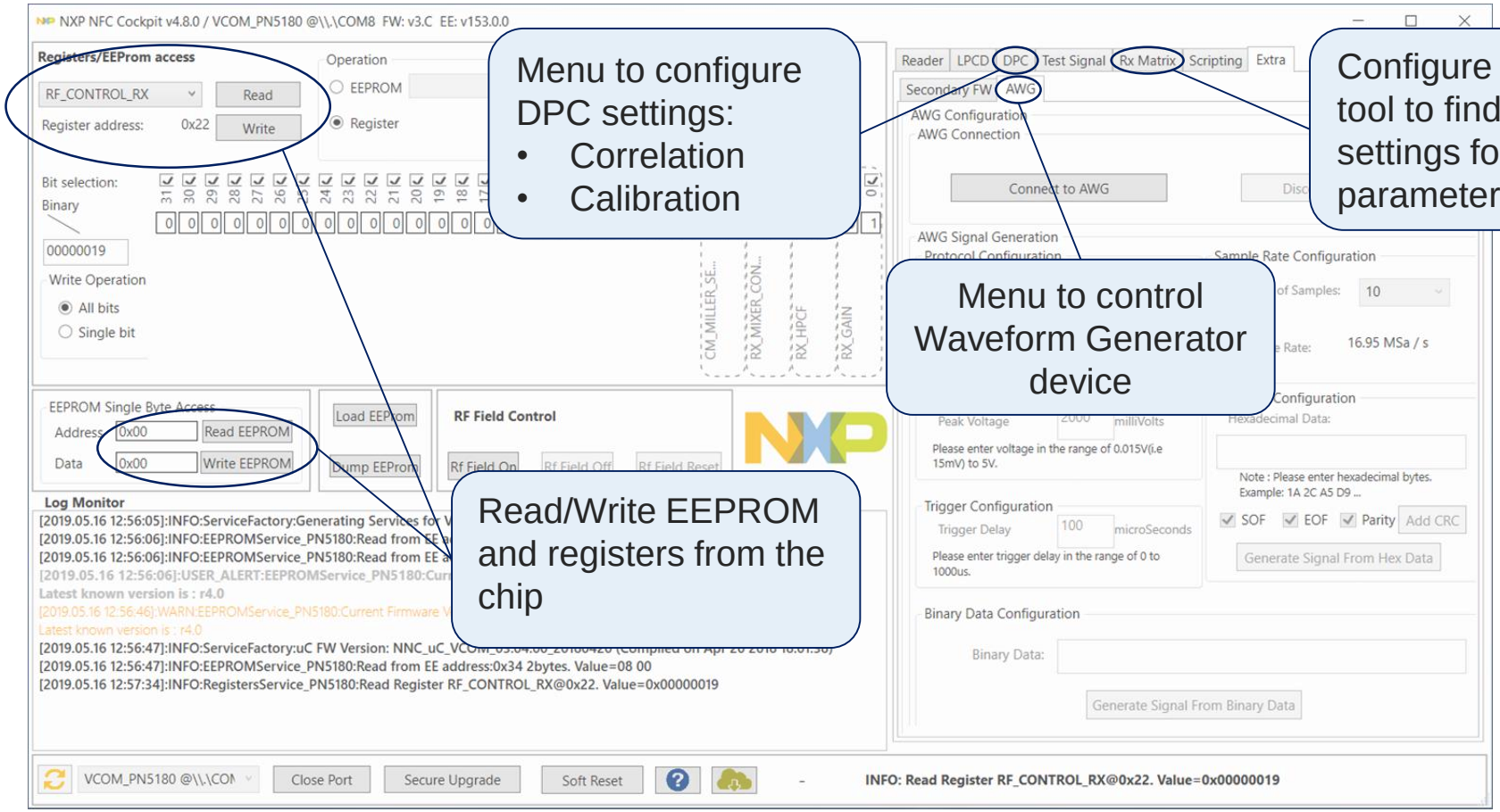
NXP offers a set of SW tools integrated in NXP NFC Cockpit to help debugging and optimizing terminal configuration for EMV L1 Analog test cases

- Intuitive GUI to configure and adapt IC settings
- Rx Matrix → Tool to test different receiver settings and find optimum values.
- AWG Control → To control and automatize Waveform Generator used for tests.
- SW to control mechanical TESTPICC positioning, using economic robot.

<u>This provides semi-automatic register optimization for compatible NXP ICs</u>

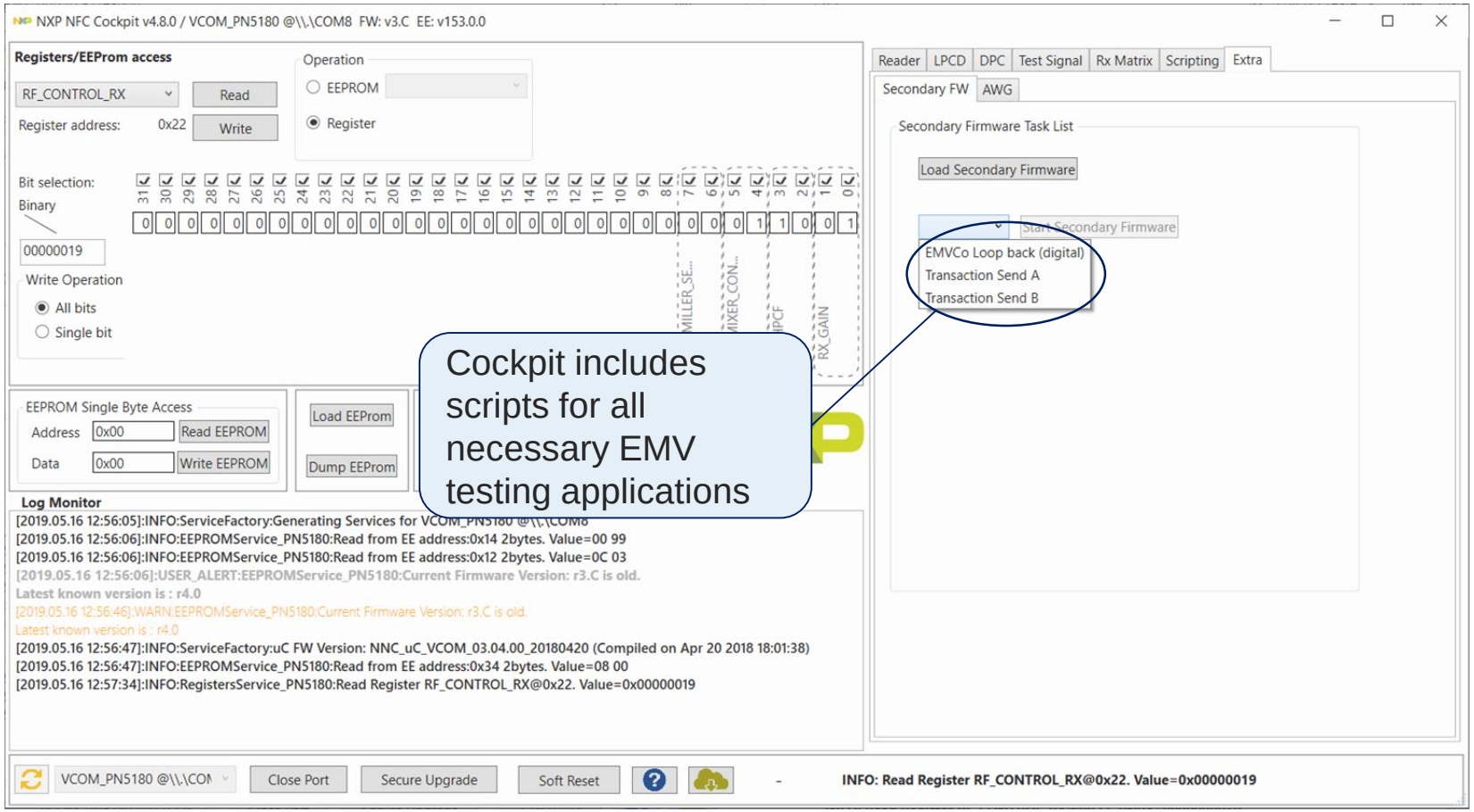


NXP Optimization support
NFC Cockpit



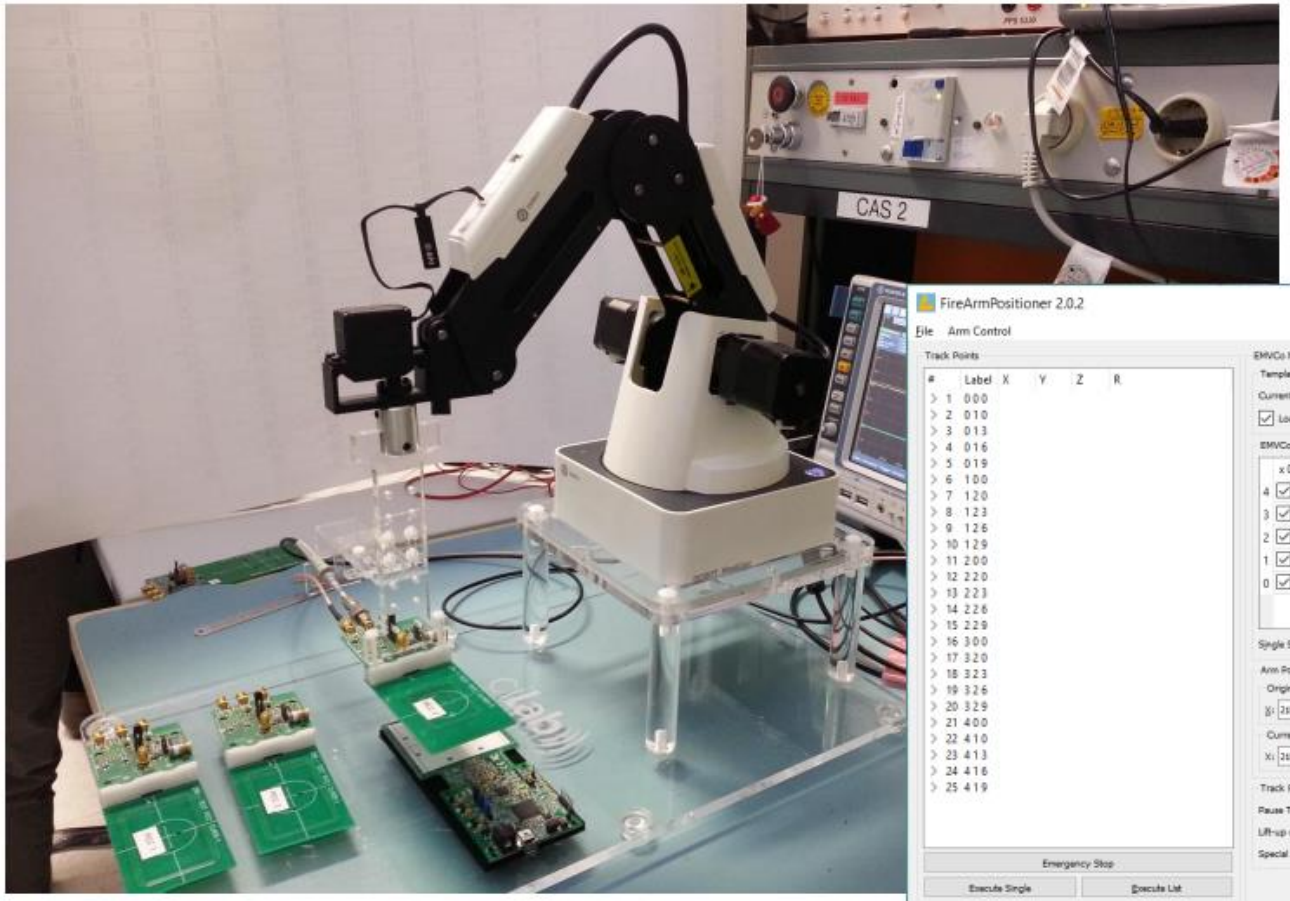
Training Mobile Knowledge

NXP Optimization support
NFC Cockpit

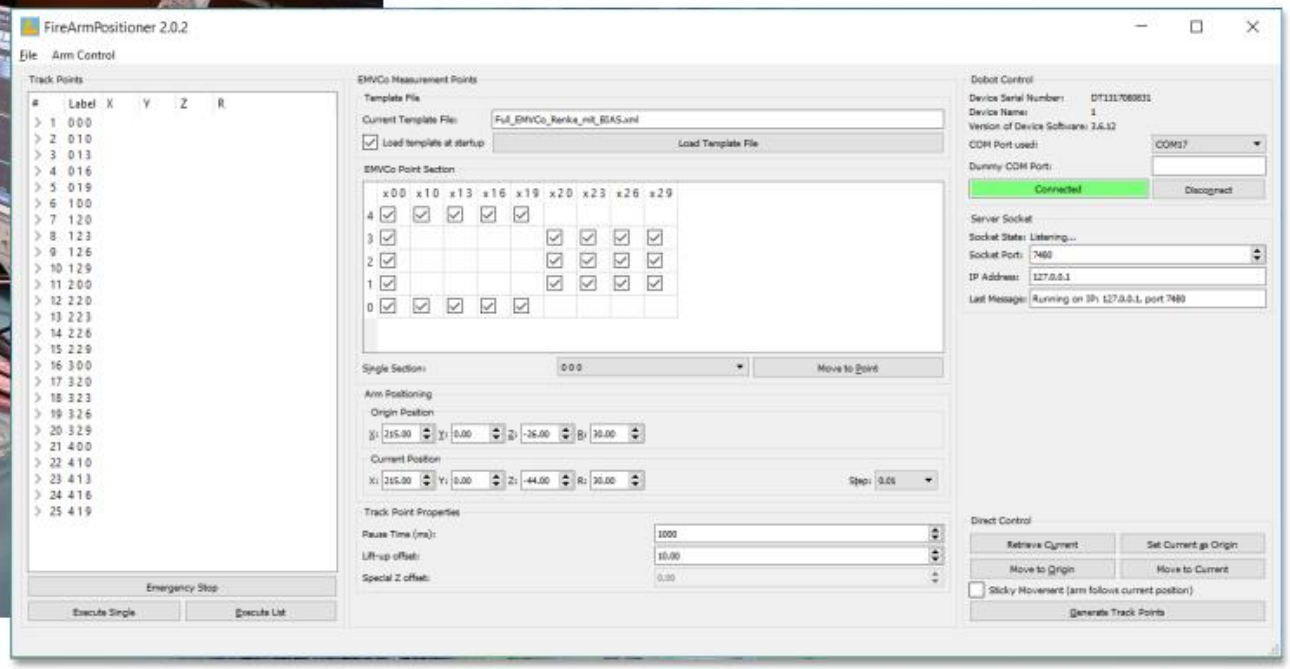


Training Mobile Knowledge

NXP Optimization support
DOBOT Magician



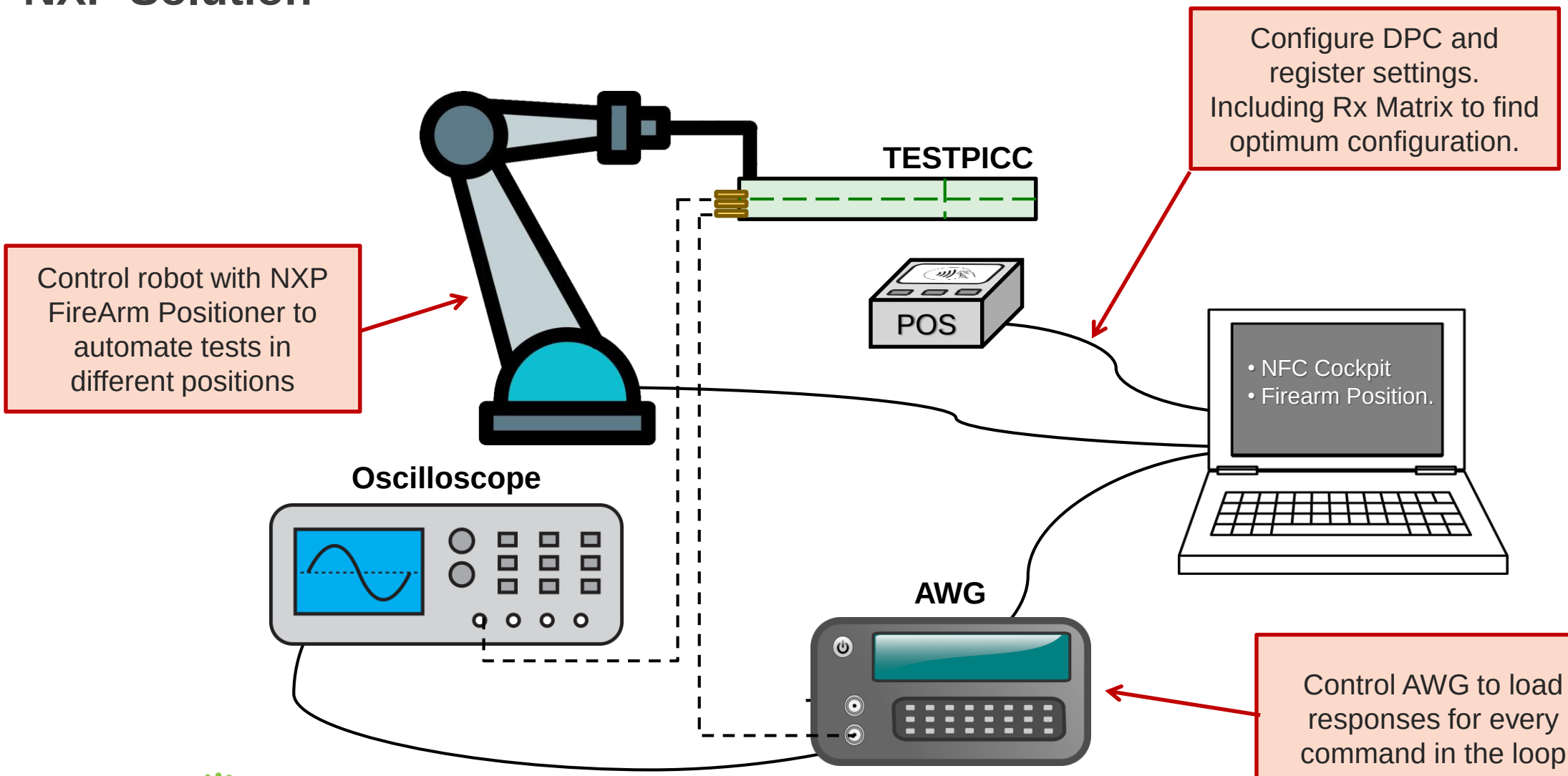
NXP FireArm Positioner to control DOBOT



Training Mobile Knowledge

NXP Optimization support

NXP Solution



Training Mobile Knowledge

NXP Optimization support
NXP Solution

Provided by NXP

NXP NFC Cockpit:
- Drives PN5180, PN7462 or CLRC663 (+ derivatives)
- AWG
- RxMatrix

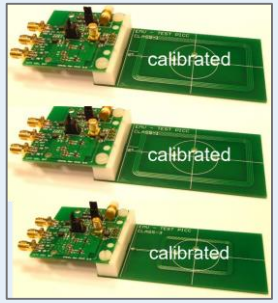
NXP Firearm Positioner:
- Allows to automate the EMV positions for testing
- Compatible with ‘Dobot’ (~2k€)

Additional tools needed

AWG

ROBOT

TESTPICCs



AWG	2000€
TestPICCs	4000€
Dobot	2000€
Total	**8000€**

Training Mobile Knowledge

NXP Product Portfolio for EMV

NXP Product Portfolio for EMV

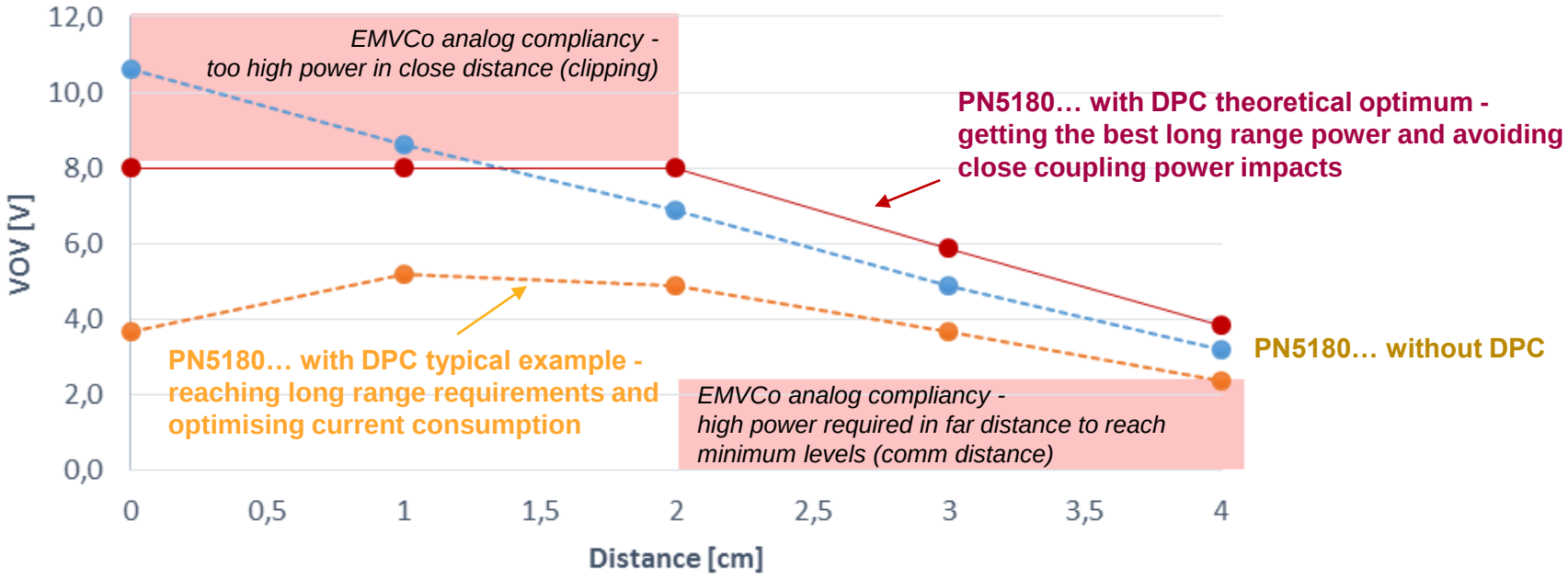
PN5180 – Key Features

- Contactless high power NFC
- Dynamic Power Control - strong RF performance in harsh environments
- NFC Cockpit design-in tool
- NFC Forum, EMVCo and ISO/IEC compliant library
- NFC frontend development kit OM25180FDK

Training Mobile Knowledge

NXP Product Portfolio for EMV

PN5180 – DPC in detail



Dynamic Regulation of…	Transmitter current for detuning compensation
	H-Field within the operating volume
	Modulation index and rise/fall times

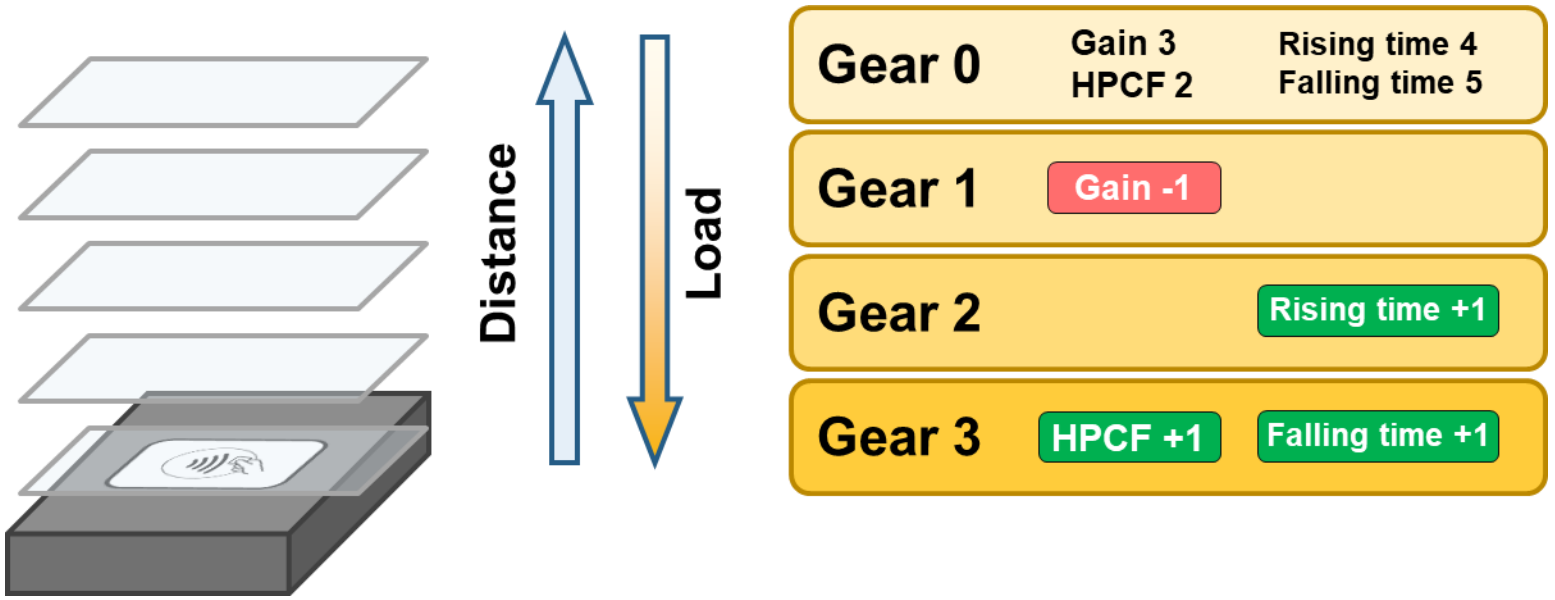
Dynamic Power Control enables up to 30% increase of the nominal driver current at same max driver spec

Training Mobile Knowledge

NXP Product Portfolio for EMV

PN5180 – ARC and AWC

- Adaptative Waveform Control (AWC) and Adaptative Receiver Control (ARC) allows you to dynamically configure and adjust parameters involved in waveform generation and reception.
- Using the different gears defined in the DPC, a correction can be applied to several parameters depending on the gear used.



Training Mobile Knowledge

NXP Product Portfolio for EMV

PN7462 – Key Features

State-of-the-art reader solution on a single chip
Contact and contactless interfaces with full MIFARE family support powered by an ARM Cortex-M0 core

All integrated although highly customizable
160/80kB Flash memory, USB, GPIOs, various host and master interfaces

Faster time-to-market
Complete support package including NFC Forum compliant SW library and source code of typical applications

Smaller footprint at lower system BOM
Reducing system components and PCB by up to 50% in typical applications

NFC controller development kit OM27462CDKP

Training Mobile Knowledge

NXP Product Portfolio for EMV

CLRC663 *plus* – Key Features

Best performance at lowest power consumption

Extended Low Power Card Detection range with new configuration options. Low supply voltage for battery support down to 2.5V

Design flexibility

Max. operating transmitter current of 350mA with limiting value of 500mA broad temperature range from -40°C to +105°C

Backward compatible to CLRC663

Pin-to-pin and software compatible to CLRC663

Faster time-to-market

Complete support package including EMVCo compliant NFC SW library and NFC Cockpit with VCOM interface and easy antenna configuration

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NXP Product Portfolio for EMV

Summary

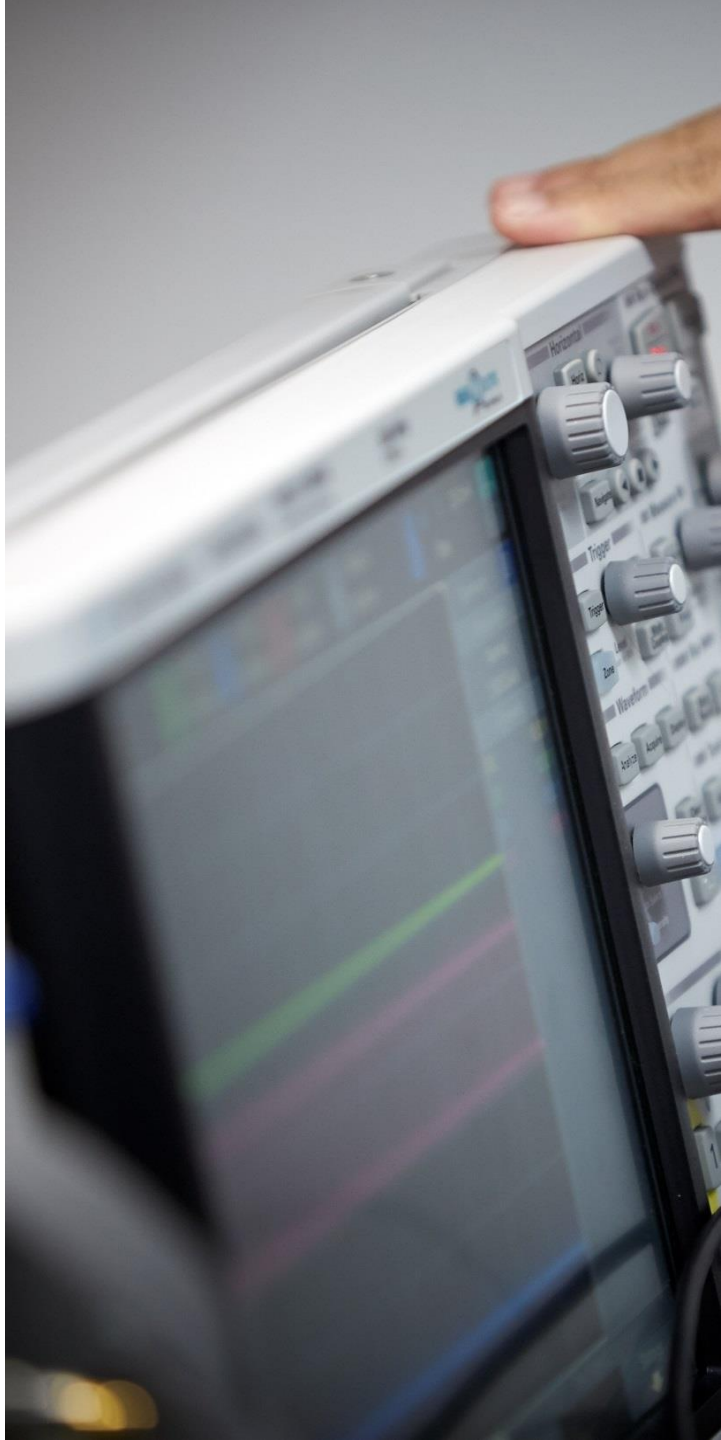
- NXP plans to have qualified their family of NFC chips for payment by 2020

  PN5180 → Already qualified for EMV v3.0!

  PN7462 → In process

  CLRC66303 → In process

- New **PN5190** designed specifically to meet EMV 3.0 requirements; Samples to be available before end of year
- Digital compliance is done.
- NFC Library is upgraded to support EMV 3.0 (From v05.19.00)



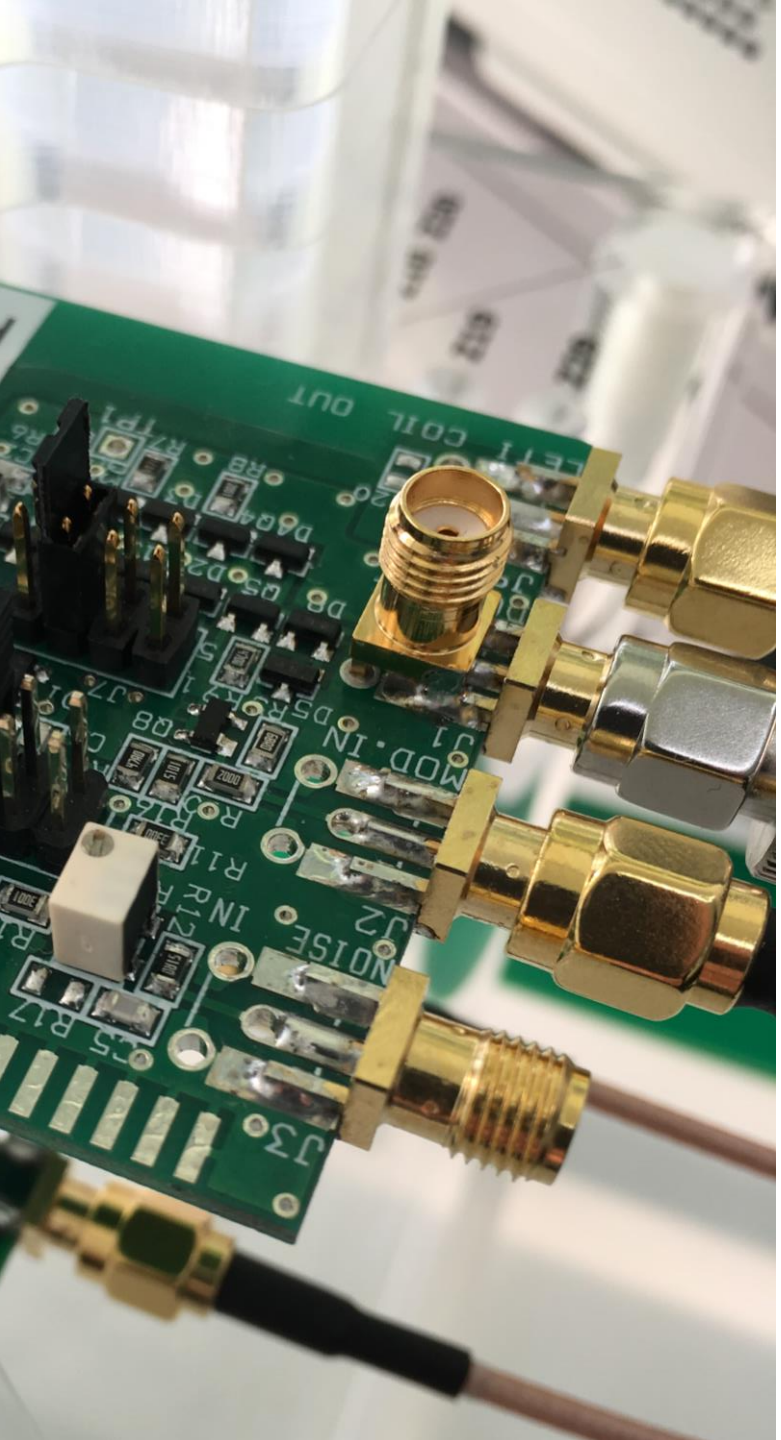
More support

NXP

Relevant resources regarding POS

Certification	NXP support	End customer
EMVCo L1 contact analog	Application notes; demo board; Report from test house Customer schematic validation	Final device needs to be tested at a certified lab
EMVCo L1 contact digital	Application note; source code; ICS example; internal test report Support on NXP stack integration Support on EMV test suite errors	Final device needs to be tested at a certified lab
EMVCo L2 contact	Link to partners for stack ; Pre integration support if NXP L1 stack is used	Final device needs to be tested at a certified lab

Certification	NXP support	End customer
EMVCo L1 contactless analog	Antenna design guide, loop back example; internal test report; demo board Antenna design support & RF support from CAS team	Final device needs to be tested at a certified lab
EMVCo L1 contactless digital	Source code; application note ICS example; internal test report Support on NXP stack integration Support on EMV test suite errors	Final device needs to be tested at a certified lab
EMVCo L2 contactless	Link to partners for stack ; Pre integration support if NXP L1 stack is used	Final device needs to be tested at a certified lab



MobileKnowledge

Contact

We are your ideal **Engineering consultant** for any specific support in connection with your **EMV L1** approval process.

If you want to:

- Design a PCD L1, Mobile/Wearable L1 compliant device
- Design and optimize the performance of your contactless antenna
- Debug your device to make sure it is EMV L1 compliant
- Accelerate your time to market and avoid never-ending test processes

We have the tools and expertise to help you achieve EMV 3.0 compliance

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Get ahead with NXP’s PN5180 Frontend - Design your POS terminal with EMVCo (L1) certification

Pablo Fuentes (Speaker)
Angela Gemio (Host)

Time for

Q & A

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Thank you for your kind attention!

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