Reading performance of animal radio frequency transponders

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Animal Identification standards: ISO 11784 & ISO 11785

ISO 24631-3: Radiofrequency identification of animals -- Part 3: Evaluation of performance of RFID transponders conforming with ISO 11784 and ISO 11785

ICAR Guidelines

INTERNATIONAL AGREEMENT OF RECORDING PRACTICES

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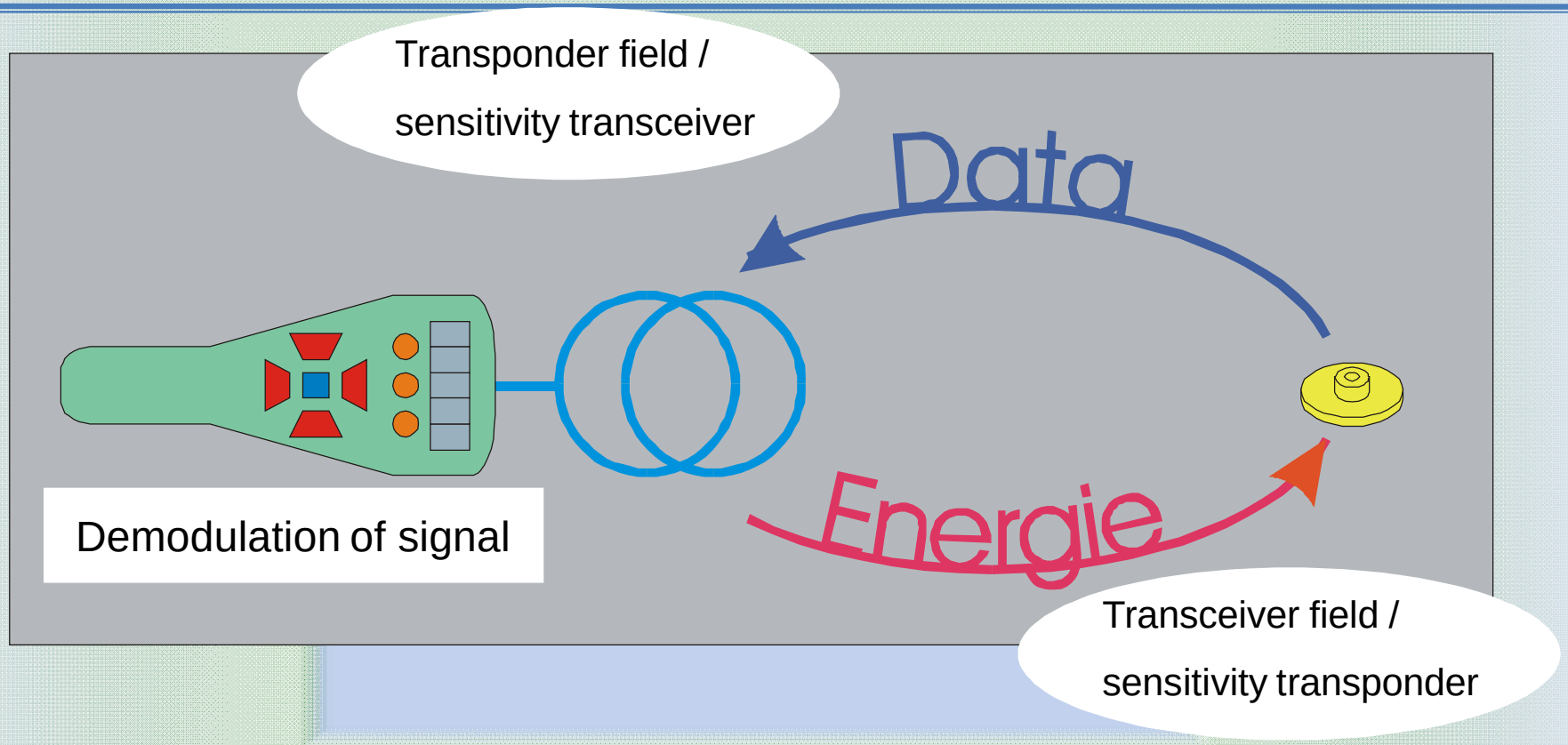
Principle of RFID (reading process)



Readability influenced by transceiver & transponder

➔ Independent testing

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Possible approaches test procedures

- Test every reader with every transponder
  - Complex
  - Expensive
  - What to use as approval criteria
- Use a ‘golden reader’ as reference
  - Who will provide such a reader (RFID manufacturer?)
  - Will it be available for every test center
  - How to calibrate
- Approach was chosen to measure physical parameters

“Electronic passports” and item management

➔ test procedures measuring physical parameters

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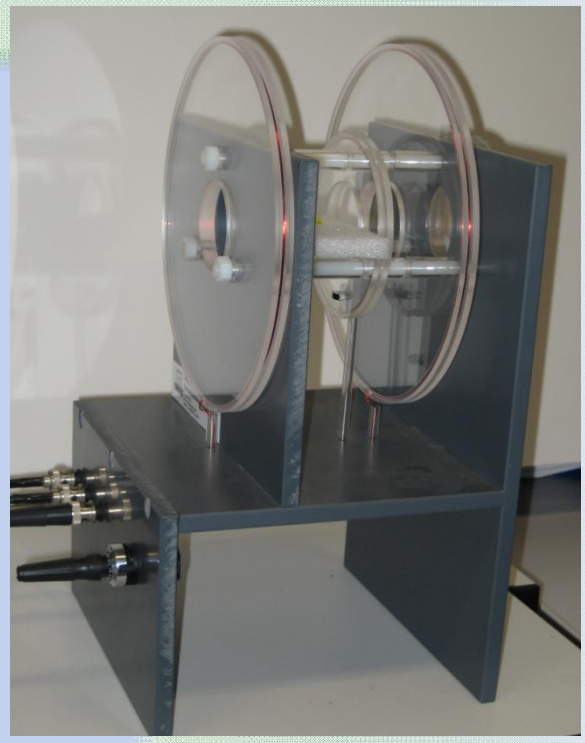
Parameters to be measured

- Transponder minimum activating field strength
  - (energy needed for full telegram)
- Transponder modulation amplitude
  - (strength of the transponder signal)
- FDX-B bit length stability
- HDX frequency stability
  - (correct tuning antenna circuit)



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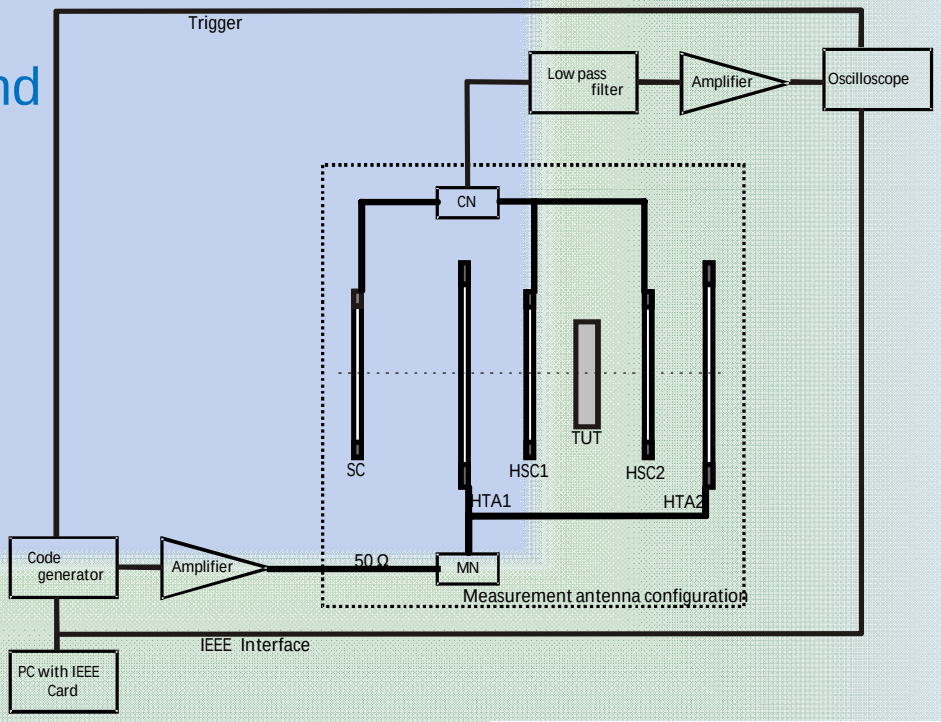
ISO 24631-3 test configuration

"Helmholtz Coils":

- Configuration can easily be configured
- Generates reproducible field
- Independent from a reader brand
- Balanced for FDX & HDX



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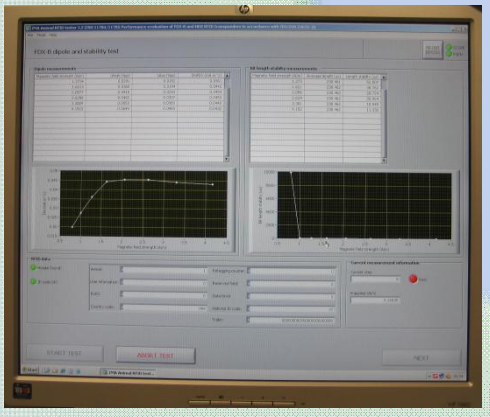
Overview equipment IMA-Wageningen is using

Programmable code generator Agilent 33220A

Agilent 54622D Oscilloscope

Amplifier Research 25A250A amplifier



Labview 8.2 software IMA Wageningen

Helmholtz coils IMA Wageningen

Rohde & Schwarz UHF attenuator

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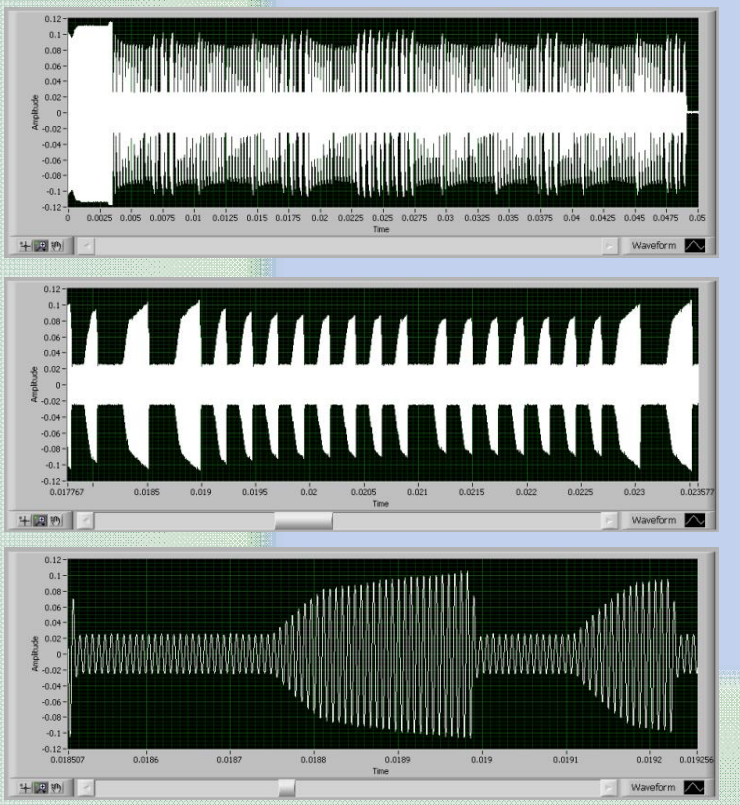
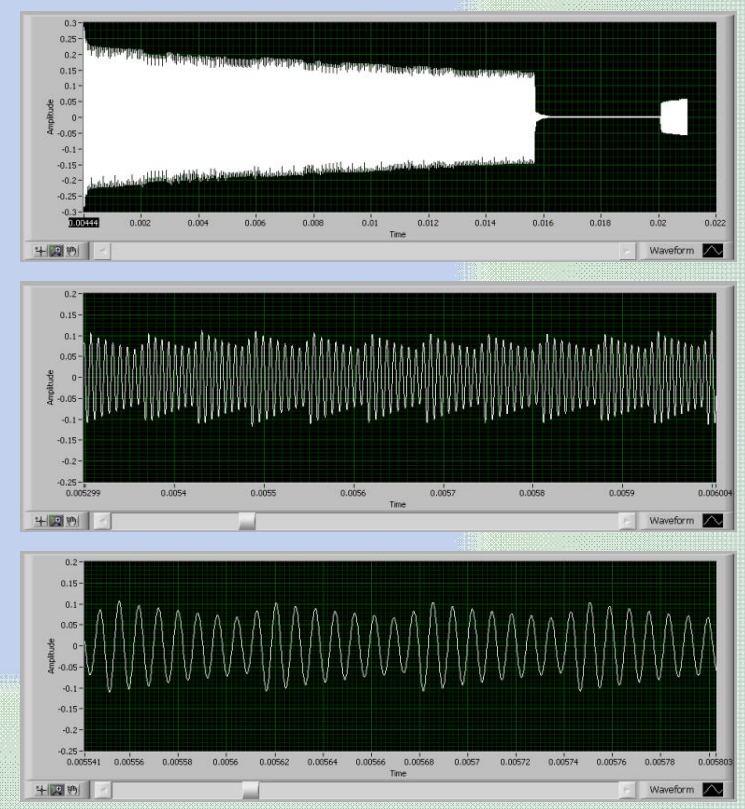
Transponder bit stream

FDX bit stream



HDX bit stream



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ISO 24631-3 information about:

- Transponder = f (field strength conditions)
  - ➢ Estimation of the readability range of the transponder
- Transponder modulation amplitude
  - ➢ Estimation of the impact of electromagnetic disturbances on readability
- FDX-B bit length stability / HDX frequency stability
  - ➢ Estimation of the readability of the transponder

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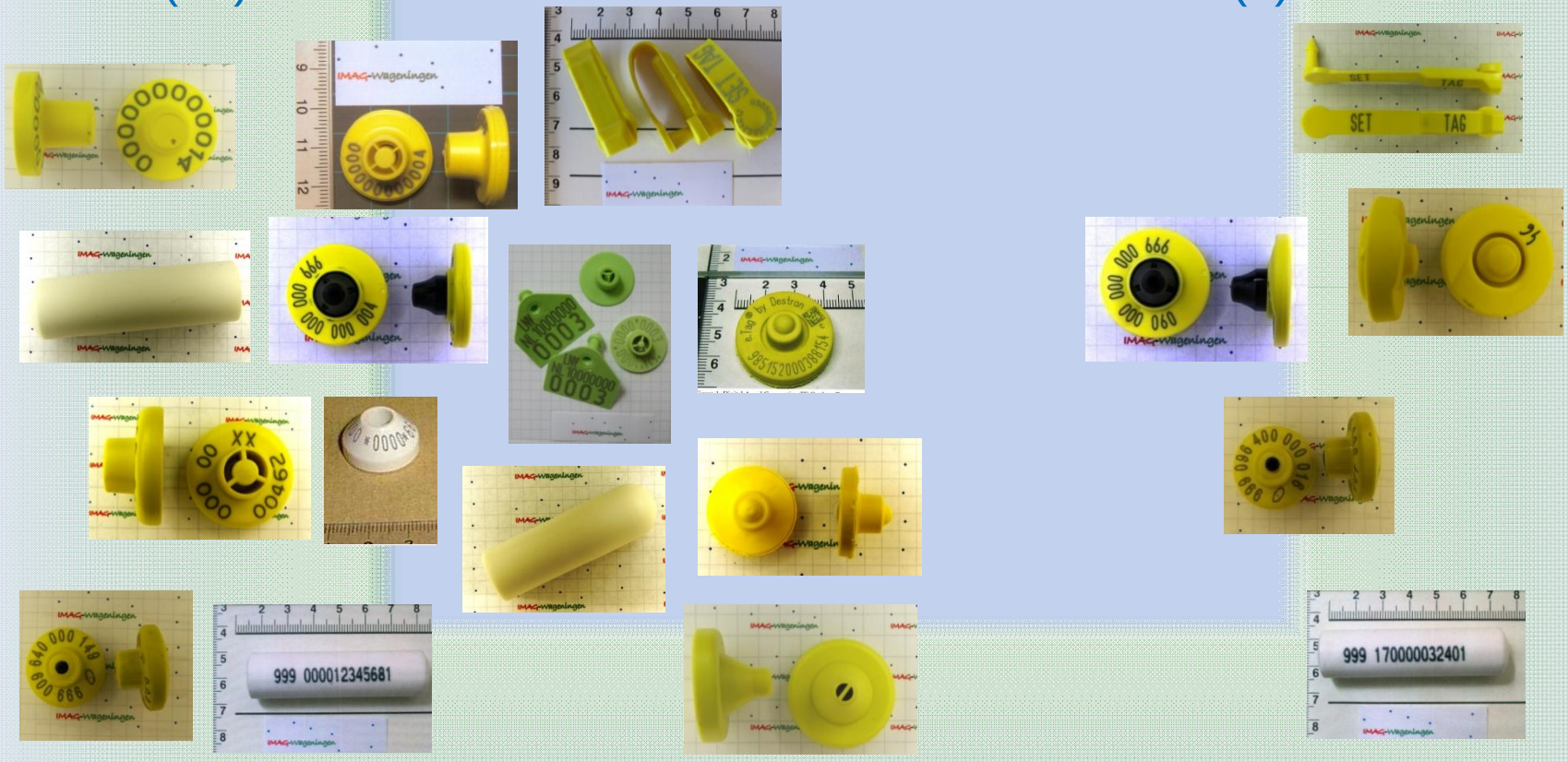
Samples of transponders were performance tested

FDX (14)

HDX (5)



Ear tag: 15, bolus: 4 (3 transponders of every type)

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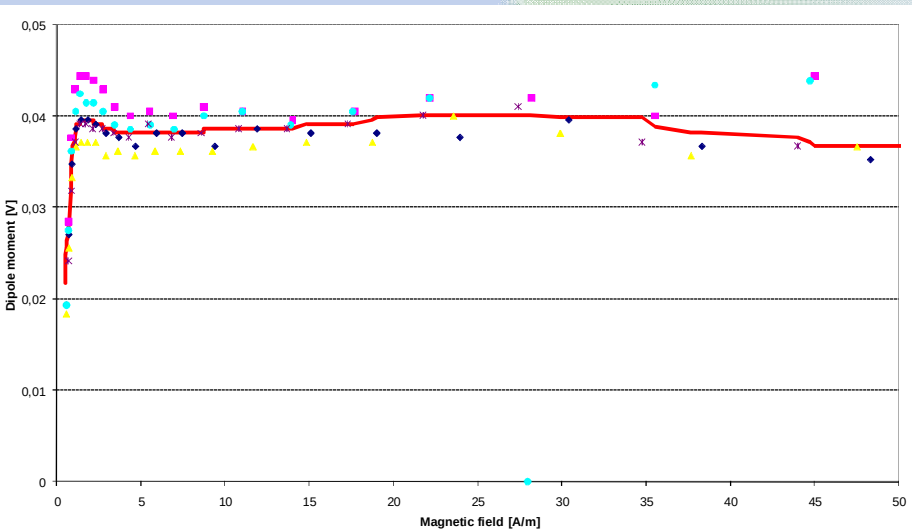
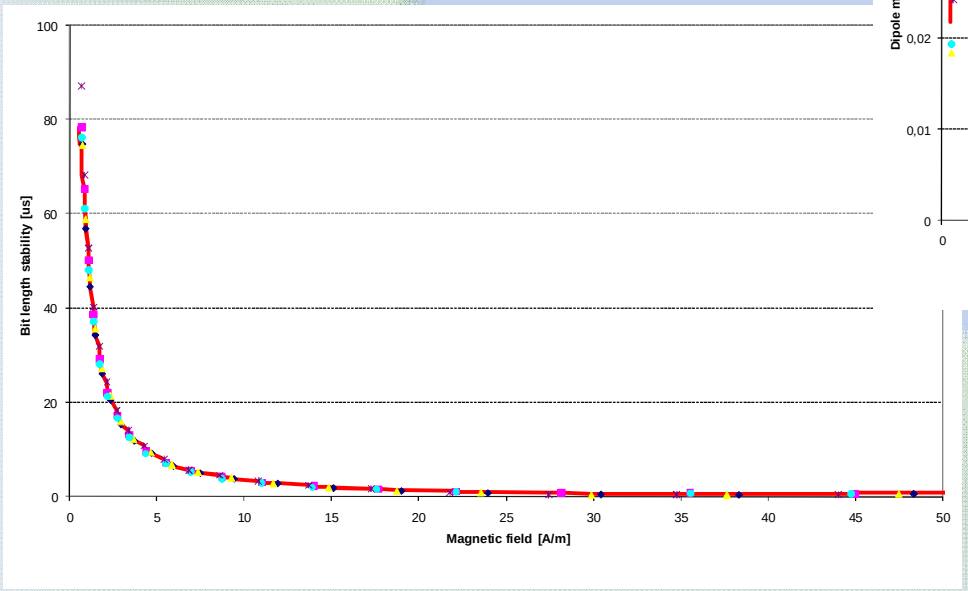
ISO 24631-3 FDX transponder performance:

- Activation field strength: e.g. 585, 622, 543, 527, 615 mA/m
- Transponder modulation amplitude
- Bit length stability





Graphs: 5 transponders
same type

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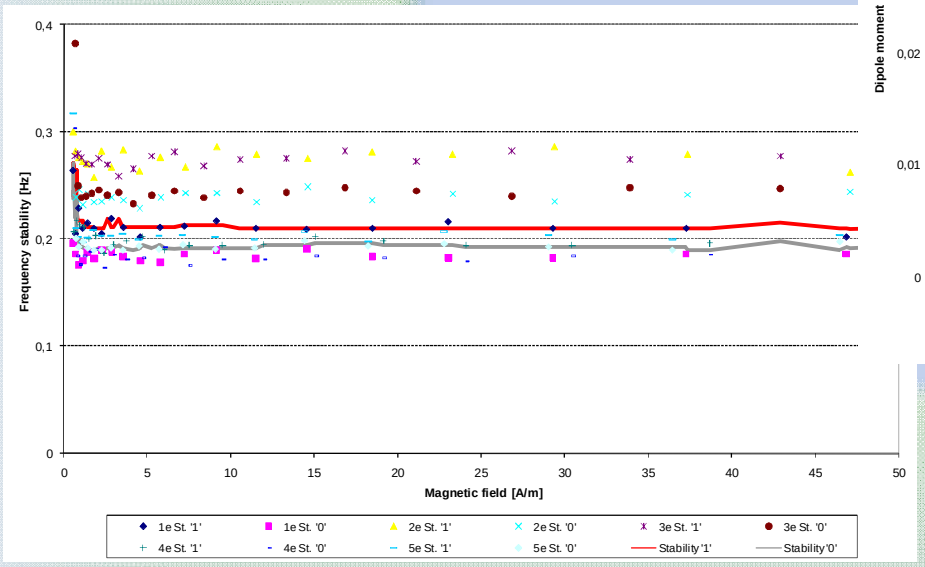
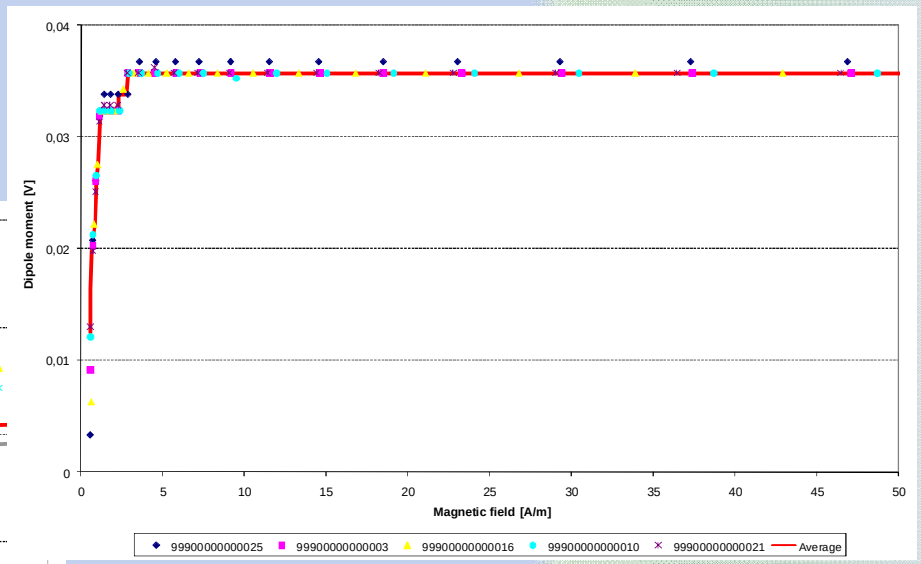
ISO 24631-3 HDX transponder performance:

- Activation field strength: e.g. 565, 649, 565, 586, 555 mA/m
- Transponder modulation amplitude
- Frequency stability





Graphs: 5 transponders same type

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ISO 24631-3 <> reading distance

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Activation field & Modulation amplitude ➔ Reading distance

T.	MA [mV]	F. [A/m]	F. [A/m]	A [cm]	B [cm]	C [cm]	Average [cm]
F	31	0.77	0.77	31	25	44	33.3
F	30	0.74	0.74	32	25	43	33.3
F	30	0.73	0.73	32	21	39	30.7
F	43	0.60	0.60	29	18	36	27.7
F	42	0.54	0.54	29	19	40	29.3
F	48	0.48	0.48	31	18	39	29.3
F	129	0.25	0.25	45	29	52	42.0
F	113	0.24	0.24	47	32	57	45.3
F	115	0.24	0.24	47	29	54	43.3
F	29	1.07	1.07	29	20	40	29.7
F	30	1.10	1.10	28	19	38	28.3
F	27	1.12	1.12	29	20	37	28.7
F	29	0.77	0.77	33	20	42	31.7
F	28	0.73	0.73	30	20	38	29.3
F	28	0.79	0.79	32	18	40	30.0
F	19	1.52	1.52	26	19	34	26.3
F	21	1.46	1.46	26	17	31	24.7
F	19	1.45	1.45	26	16	33	25.0
F	10	0.30	1.90	27	15	28	23.3
F	11	0.31	2.00	25	12	29	22.0
F	11	0.29	1.80	24	12	25	20.3
F	26	0.82	0.82	31	24	43	32.7
F	27	0.78	0.78	30	20	43	31.0
F	27	0.77	0.77	32	20	41	31.0
F	31	0.67	0.67	32	21	46	33.0
F	32	0.62	0.62	32	24	42	32.7
F	32	0.67	0.67	31	18	44	31.0
F	40	0.57	0.57	28	18	38	28.0
F	40	0.54	0.54	32	18	38	29.3
F	39	0.53	0.53	31	21	38	30.0
F	31	0.78	0.78	33	25	42	33.3
F	32	0.75	0.75	33	21	40	31.3
F	31	0.74	0.74	33	18	41	30.7
F	44	0.46	0.55	31	21	41	31.0
F	44	0.48	0.60	30	20	40	30.0
F	44	0.46	0.55	29	20	39	29.3
F	39	0.64	0.64	34	22	45	33.7
F	38	0.66	0.66	34	23	42	33.0
F	40	0.65	0.65	34	22	42	32.7
F	53	0.35	0.44	34	23	42	33.0
F	52	0.36	0.45	31	23	36	30.0
F	52	0.30	0.47	33	23	38	31.3

T.	MA [mV]	F. [A/m]	F. [A/m]	A [cm]	B [cm]	C [cm]	Average [cm]
H	19	1.02	1.20	28	21	39	29.3
H	19	1.02	1.22	28	21	42	30.3
H	19	1.05	1.30	27	21	41	29.7
H	56	0.47	0.47	40	30	56	42.0
H	53	0.45	0.45	37	31	59	42.3
H	51	0.46	0.46	37	31	58	42.0
H	32	0.79	0.79	30	23	44	32.3
H	33	0.79	0.79	31	26	47	34.7
H	33	0.68	0.68	34	27	45	35.3
H	34	0.63	0.63	31	24	47	34.0
H	36	0.58	0.58	30	25	50	35.0
H	37	0.54	0.54	31	25	48	34.7
H	45	0.77	0.77	34	26	51	37.0
H	46	0.79	0.79	34	25	48	35.7
H	48	0.72	0.72	34	26	51	37.0

T: HDX or FDX

MA: Modulation amplitude at 10 A/m

1st F: Activation field strength

2nd F: Activation field strength
&
Modulation amplitude > 10 mV

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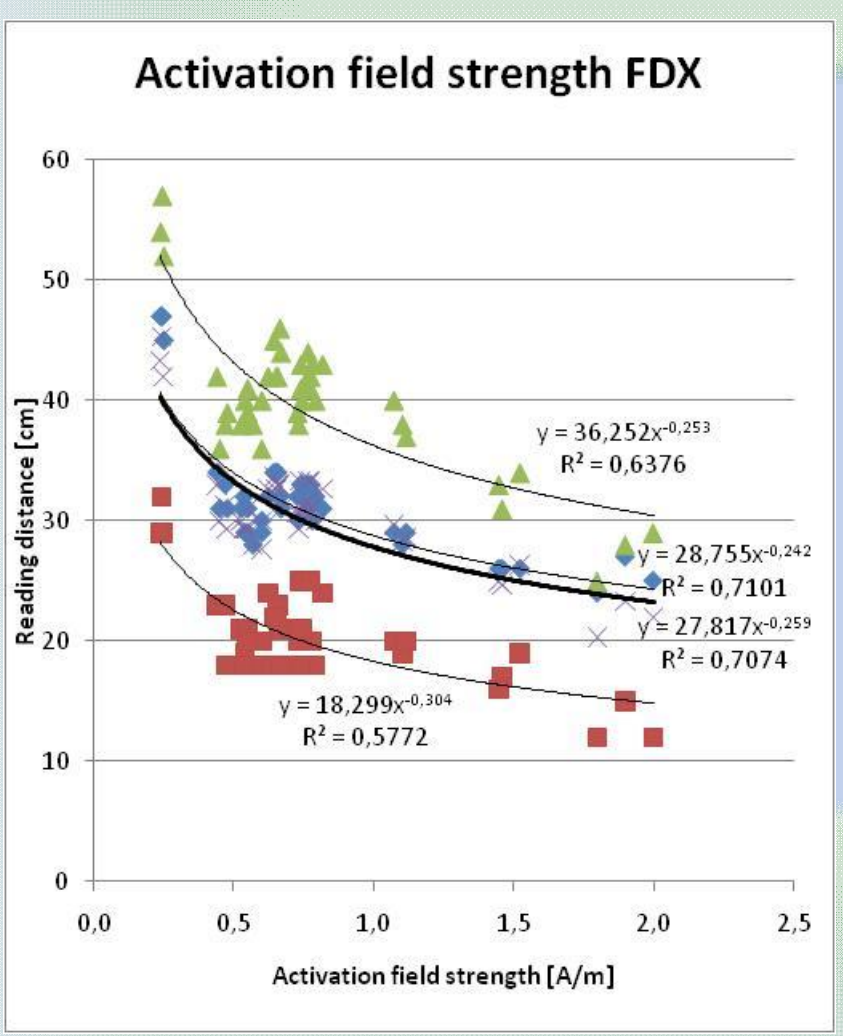
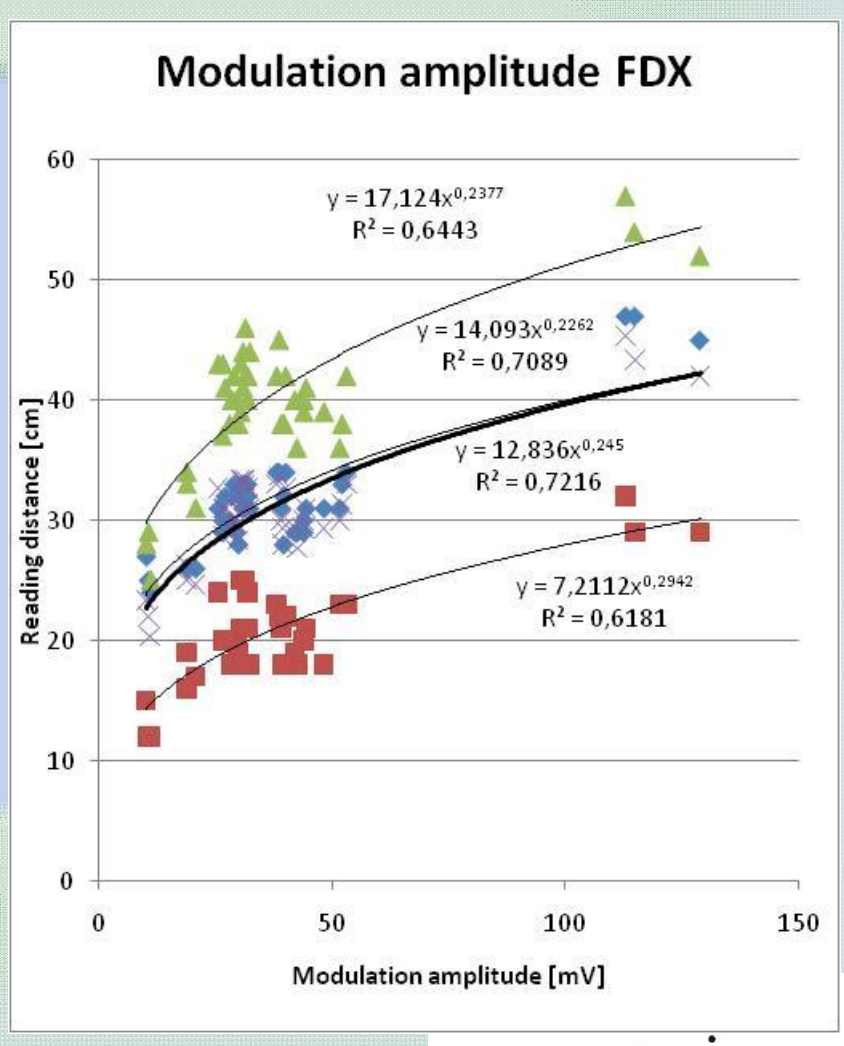
Results FDX





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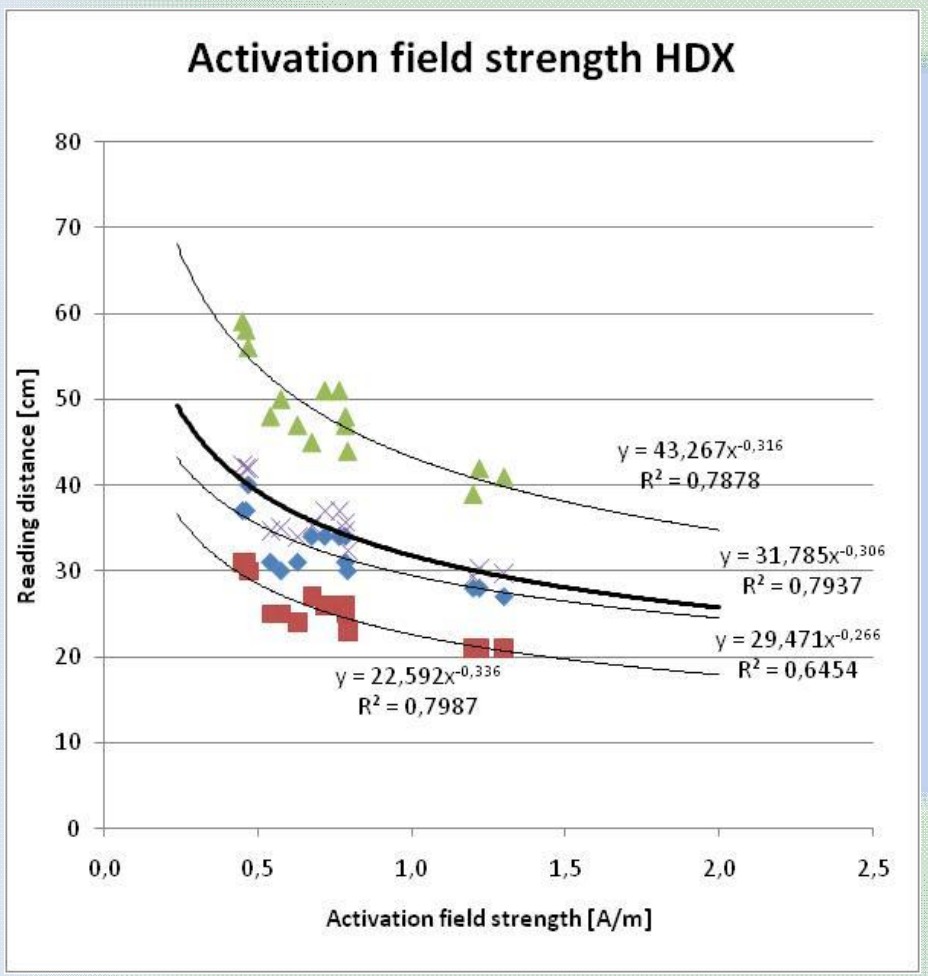
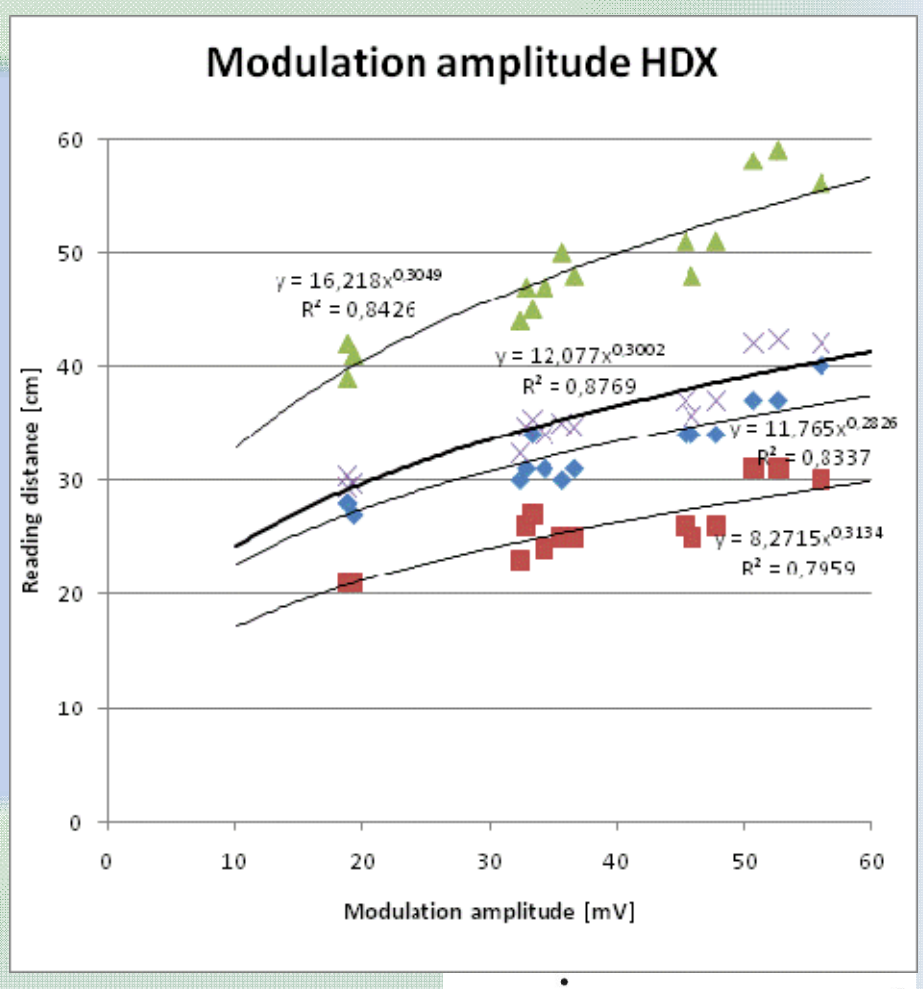
Results HDX





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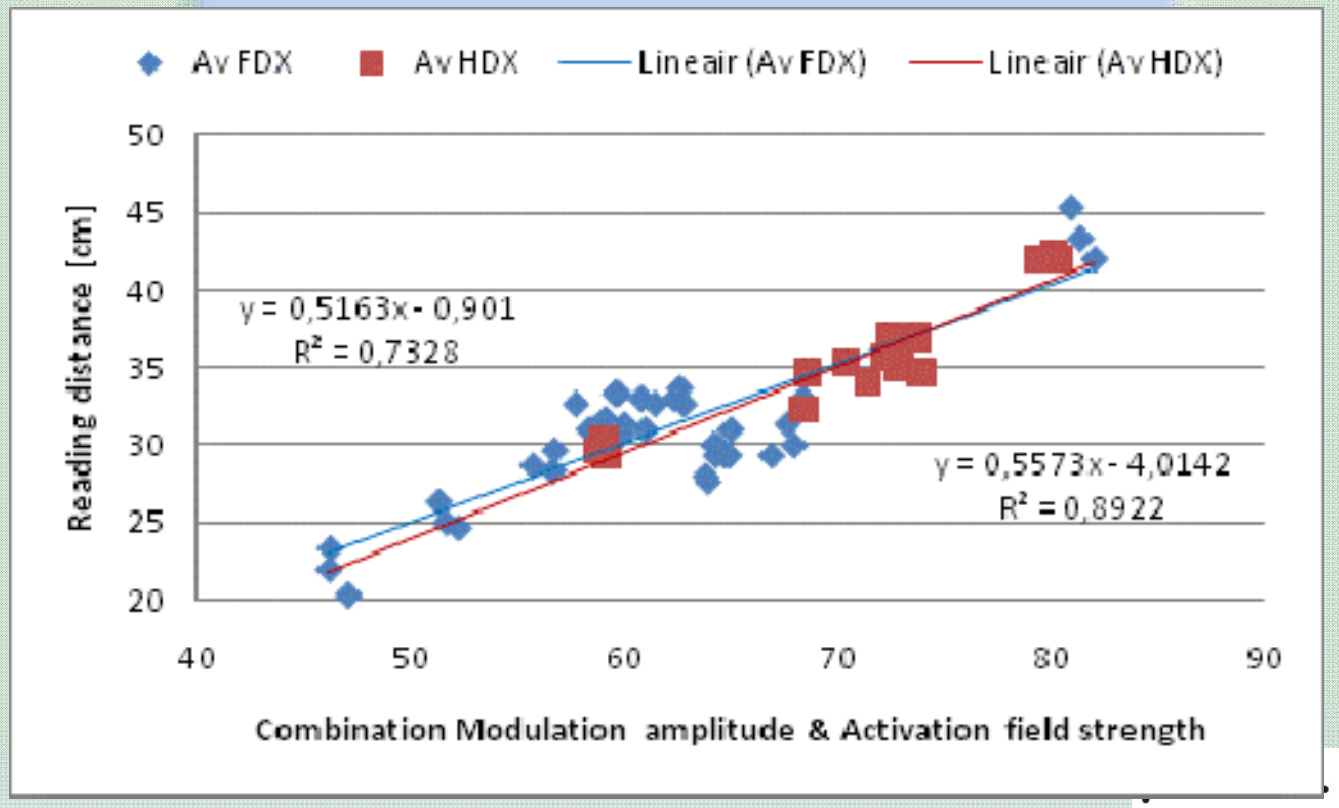
Combination of Activation field & Modulation amplitude

FDX: 27.817 * ActField ^ -0.259 + 12.836 * MA ^ 0.245

HDX: 31.785 * ActField ^ -0.306 + 12.077 * MA ^ 0.300



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Conclusions and remarks

- Performance test ISO 24631-3 is available in ISO store
- The ISO 24631-3 transponder performance test is:
  - Technology independent
  - Test results are reproducible
  - Equipment is not complex & commercially available
  - ISO 24631-3 test results show high correlation with reading distance
- Additional tests:
  - More transponders types
  - Some additional transceivers (including stationary)

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Questions

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