Printed Electronics – from Vision to First Products

PolyIC
The chip printers

RFID SysTech 2007, Duisburg

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PolyIC GmbH & Co. KG

We are member of

oe-a Organic Electronics Association

EPCglobal

Printing meets Electronics Industry

Quelle: MAN

Quelle: Infineon

Printed **Electronics**

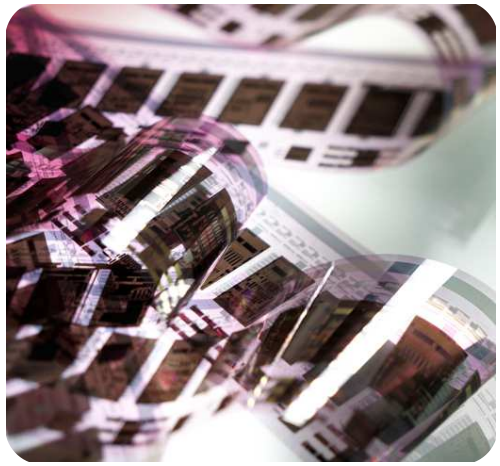
PolyIC – The chip printers

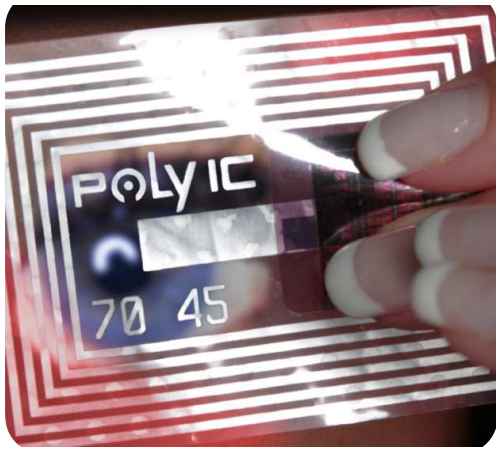
Printed electronics make

- Thin and flexible
- Inexpensive and simple
- Pervasive and disposable

Electronics come true

Challenges





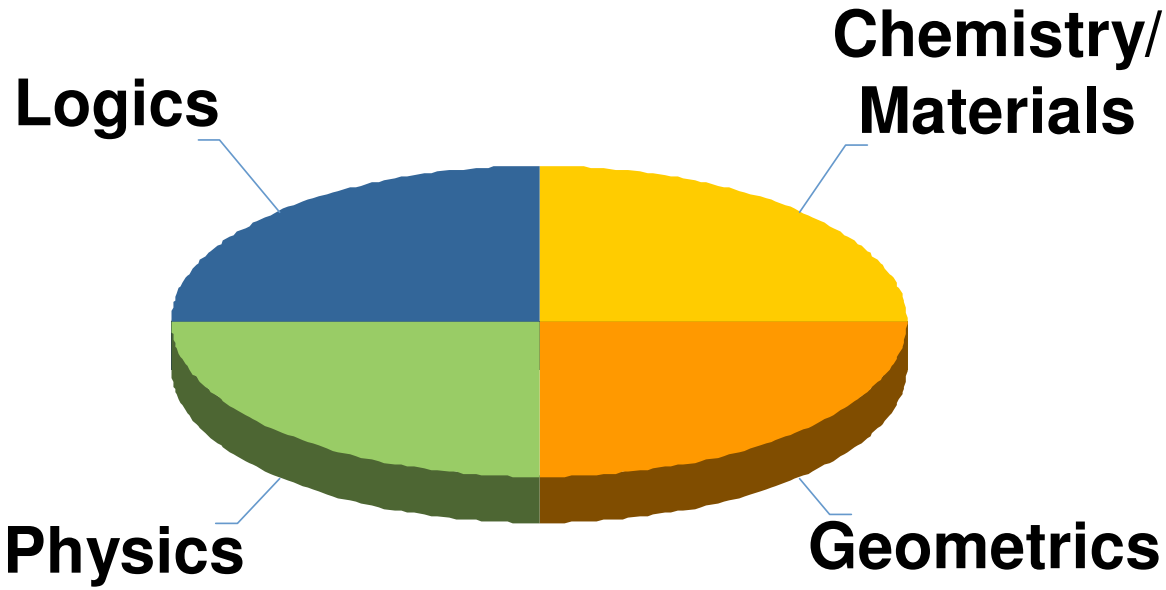
Parameters to achieve high performance and reliable printed electronics

- Often simplified to
  - single parameters
    (e.g. mobility or channel length)
  - simple functionality (e.g. transistor performance)
- Optimization of single parameters influence the whole system

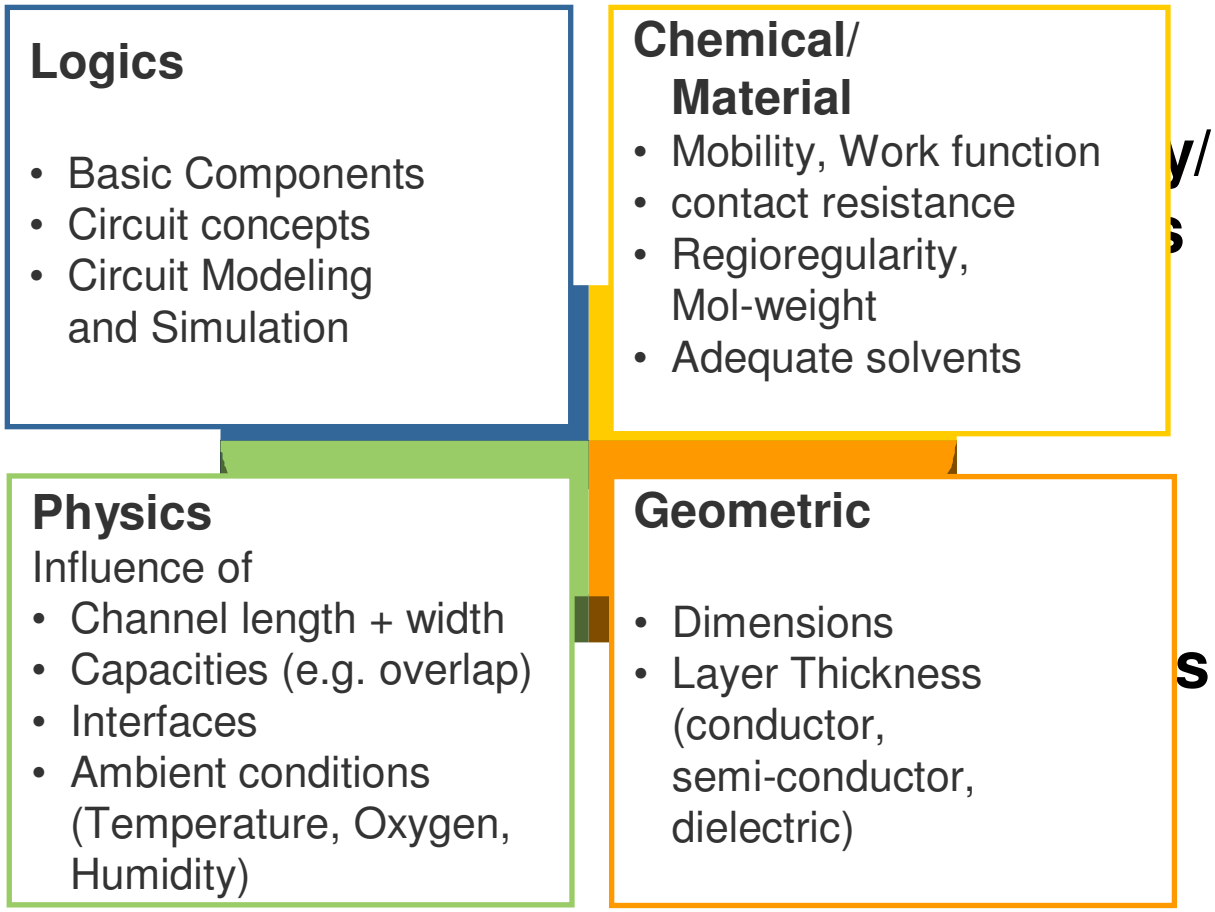
→ Complex system of about 40 parameters

- to be measured, managed and optimized

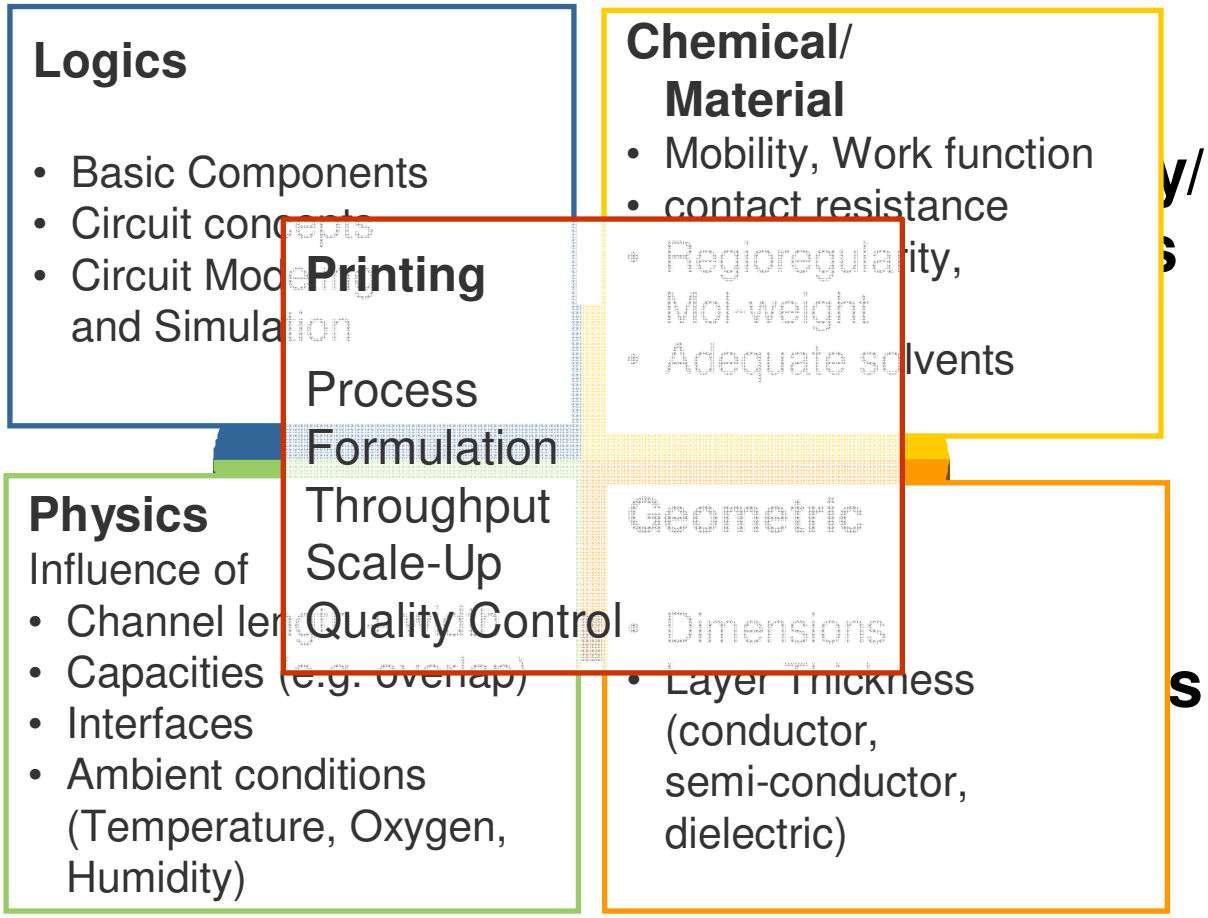
Four Dimensions of controlled parameters



Four Dimensions of controlled parameters



Next level of complexity - Printing



Understanding and Optimizing a model for Printed Electronics

- Target of PolyIC
  - Understand the parameters and their influence
  - Build a system model
  - Optimize the model for future circuits
  - Extend the model to printing processes
- Progress
  - Performance
  - Components per Circuit
  - Milestones to Application: Approaching Printed RFID

Parameters are identified and developed for the 1st generation of products

Logics developed

- Simulation and Modeling Software developed
- Polymer based circuits for RFID tags demonstrated (125kHz, 13.56 MHz, 8Bit@7.5cm)

Chemistry / Materials identified

- Identified 1st Generation Material Set
  - Polythiophen
  - Polyester
  - conducting and insulating materials

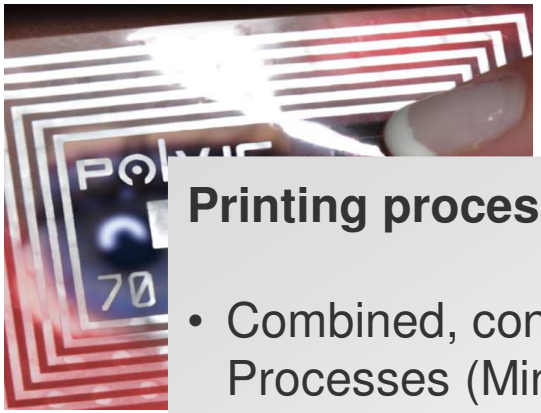
Physical Parameters identified

- Lifetime >> several month
- Survived 85/85/85 test
- Circuits work at LowVoltage (10-20V)

Geometrical parameters achieved

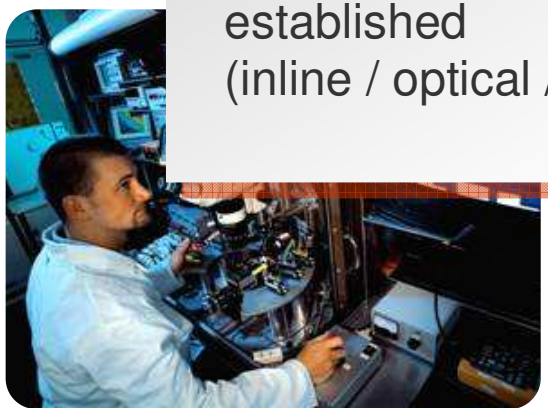
- < 20µ channel
- Overlaps
- Layer thickness
- Registration

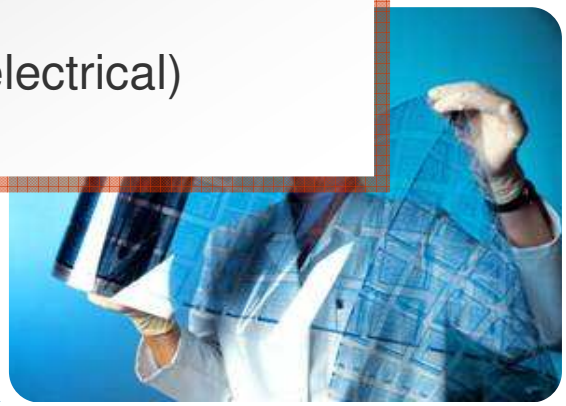
Parameters are identified and developed for the 1st generation of products



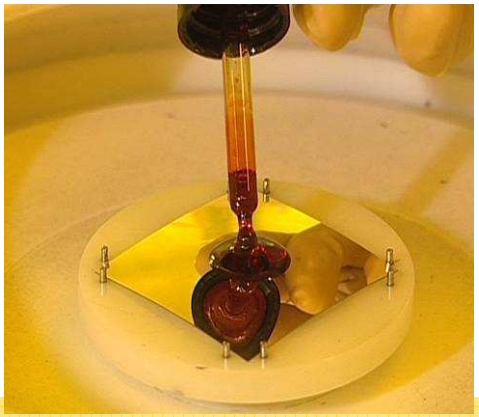
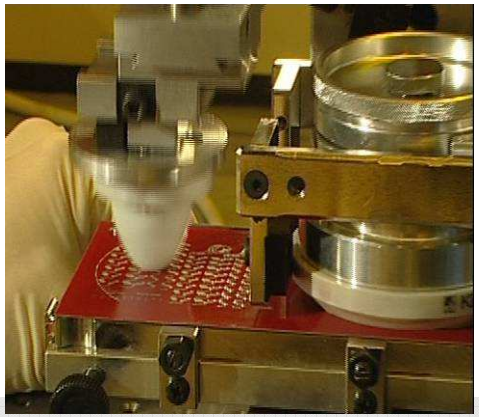
Printing process identified

- Combined, continuous Roll2Roll Processes (Min. 20m/min)
- First methods for Quality Control established (inline / optical / electrical)

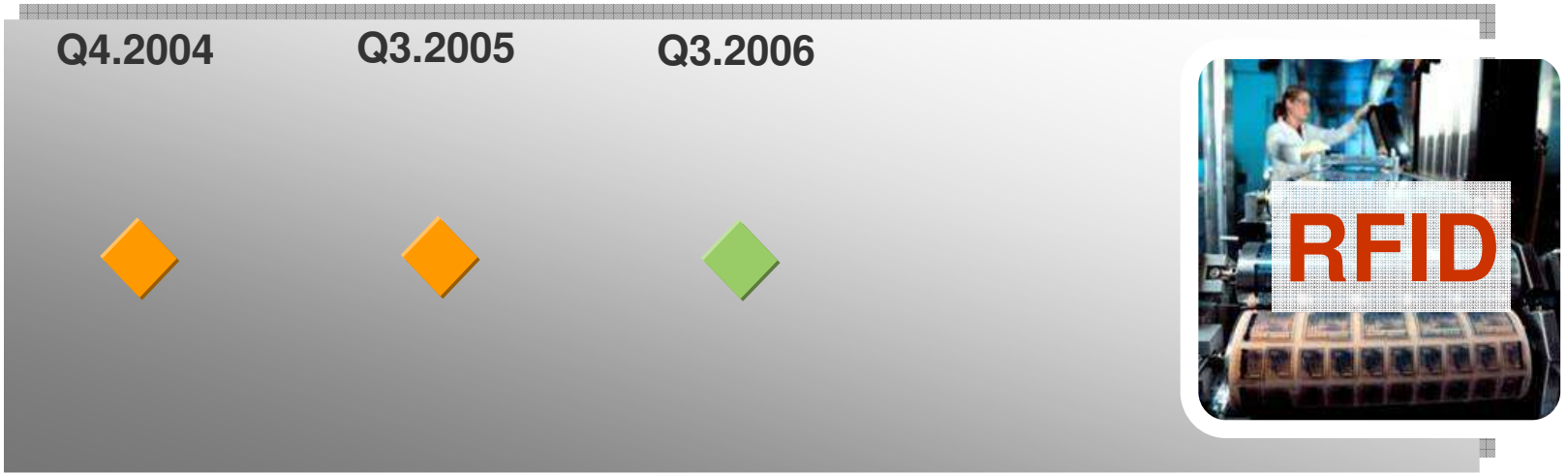




The Fabrication of Polymer ICs at PolyIC

	Clean room	Lab printing	Production process
			
Technology	Spin Coating Photo Lithography Evaporation Wet Etching …	Pad Printing Doctor Blade Gravure Printing Screen Printing …	Flexographic Printing Offset Printing Gravure Printing Screen Printing …
Results	Fast Circuits & Rectifiers High Yield & Stability RFID Demonstrators	Printed Transistors Printed Inverters Printed Ring Oscillators	Printed RFID Tags: Prototypes 2006 First products 2007
Goal	Development of Chip Design and Materials	Identify & Test Formulation for Printing Process	Low cost high volume Product$

Milestones to Application: Approaching printed RFID



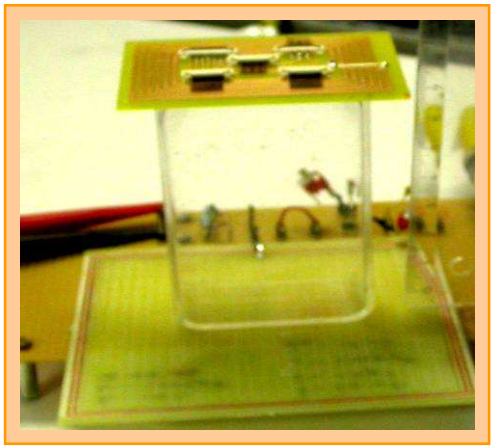
PolyIC presents Miles of printed MHz Tags

- Prototype
  13.56 MHz RF Tags
  - full flexible and thin
  - Roll-to-Roll manufactured with adapted printing processes
    High Speed (up to 20m/min)

- Roll-to-Roll printed logic circuits
  - Ring Oscillators
    (needed for 13.56MHz RFID Tags)

- First demonstration and show at OEC06
  Sep 25-27, Frankfurt

Polymer 8-Bit 13.56 MHz RFID-Tag with 7.5 cm reading distance

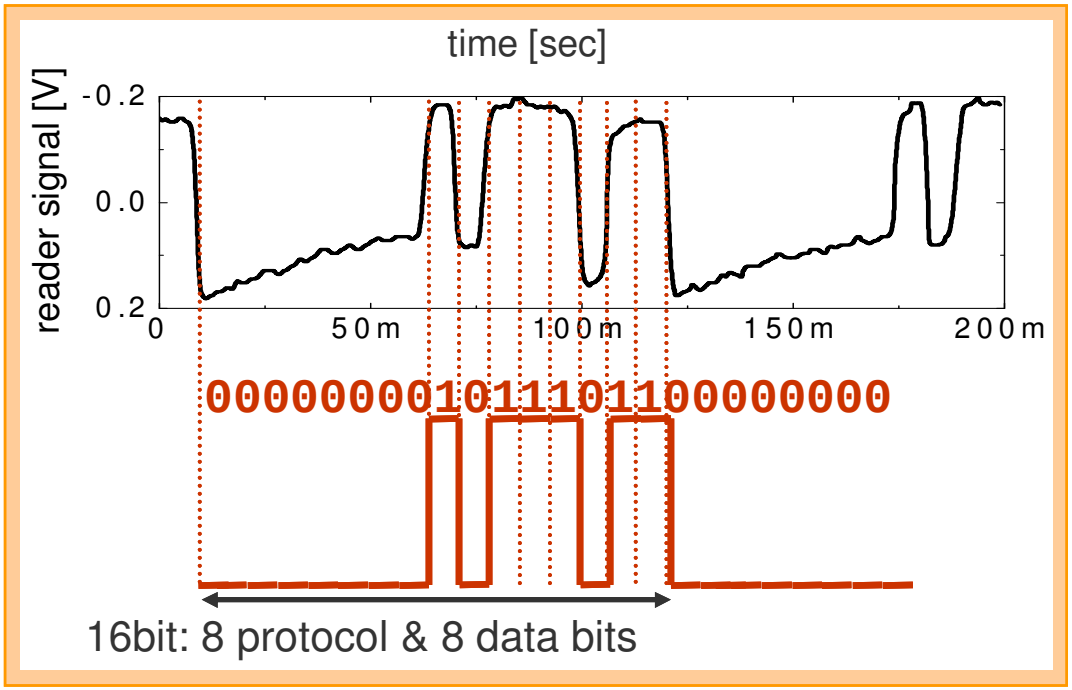


Inductive coupled RFID Tag with 13.56 MHz rectifier, clock generator, counter, multiplexer, 8-bit ROM and modulator:

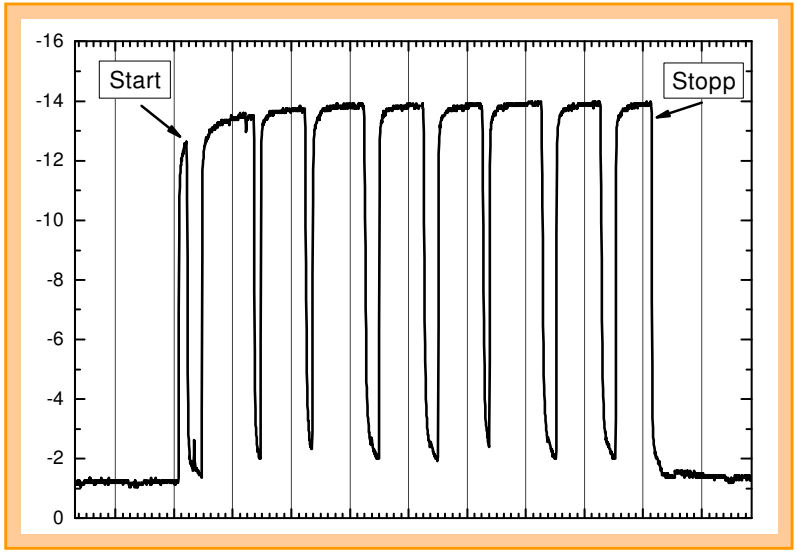
- 16 Bit: 8 protocol & 8 data bits: 00000000-10111011
- ~0.1 s read time
- 7.5 cm reading distance
- measured 3 month after fabrication

All layers and devices are made of polymers except antenna, tracks and electrodes

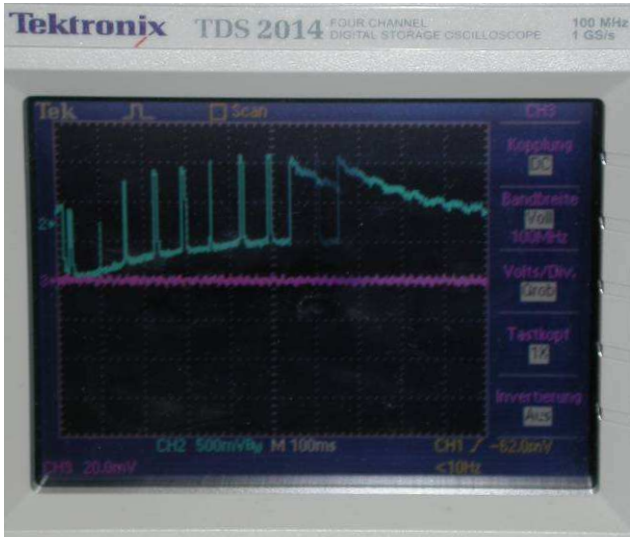
Reader operating with only 1.2 W power supply (allowed 2 W)



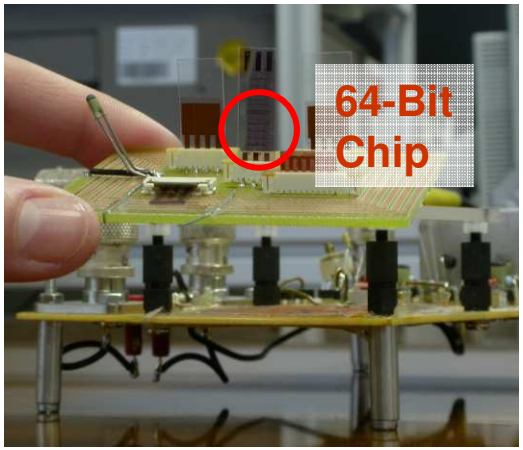
Polymer 64-Bit 13.56 MHz RFID-Tag with 3 cm reading distance, inductive coupled



64-Bit Chip Output signal (U_{supply} -16V)



Demodulated reader signal (U_{supply} -14V)



RFID - Tag & Reader

Detail:

- 64 Data bit followed by 64 "Zero" - bits
- Bit width: 6.5ms → 420ms @ -16V for 64-bit
- Bit width: 8ms → 520ms @ -14V for 64-bit
- Chip area ~ 35mm²
- Supply voltage min. -14V
- Reader / RFID distance ~ 3cm

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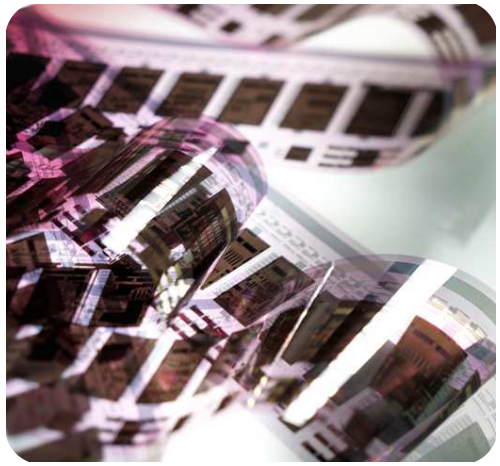
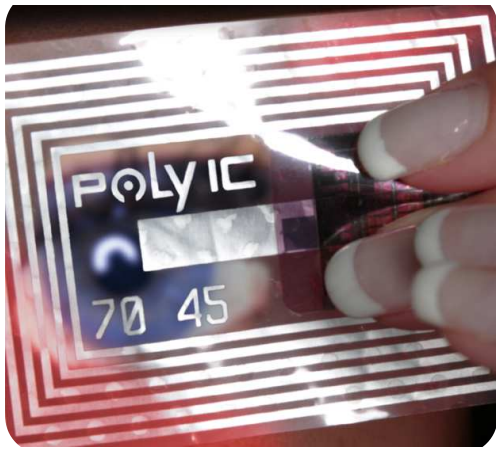
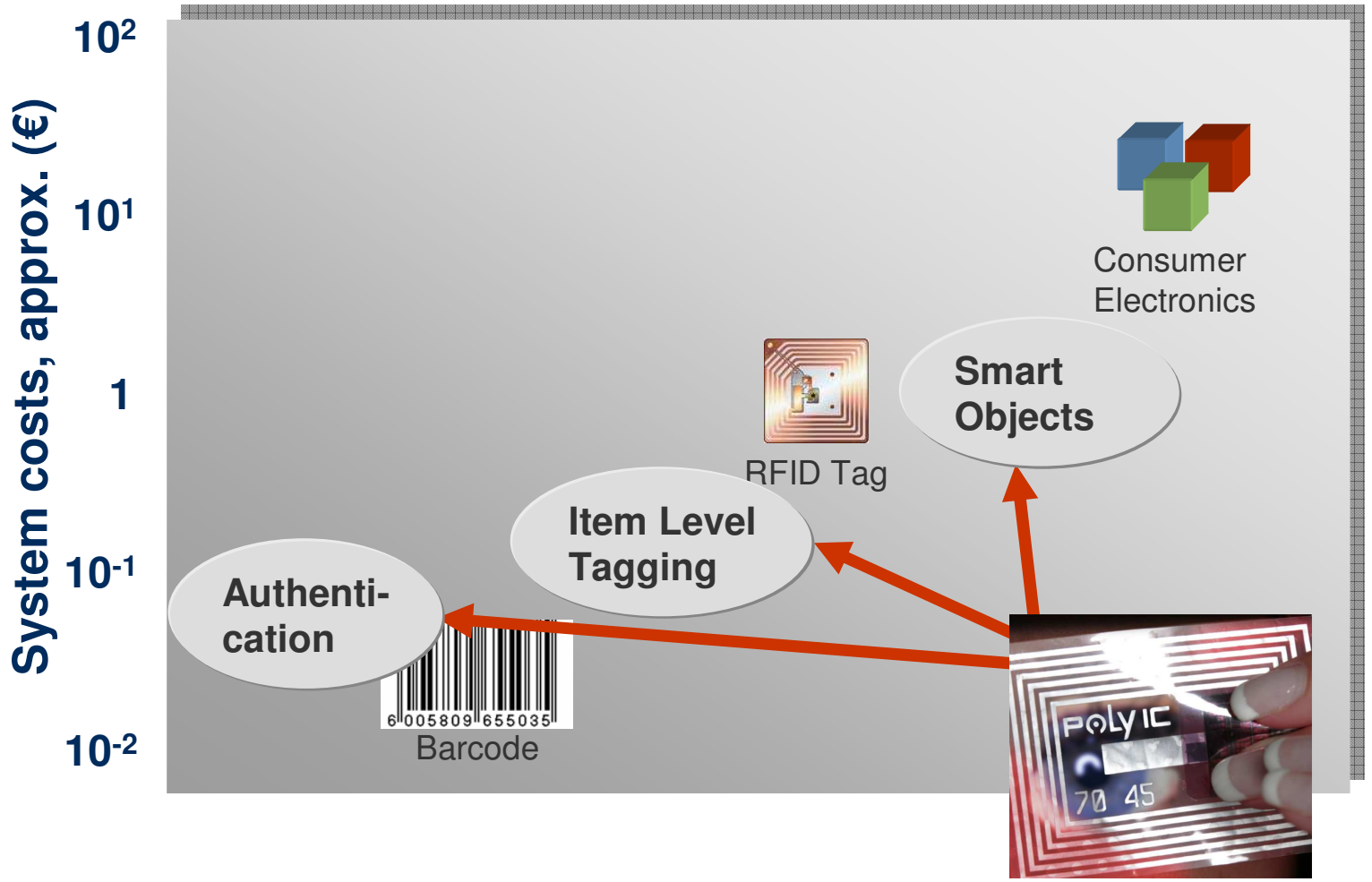
Electronics come true

Applications

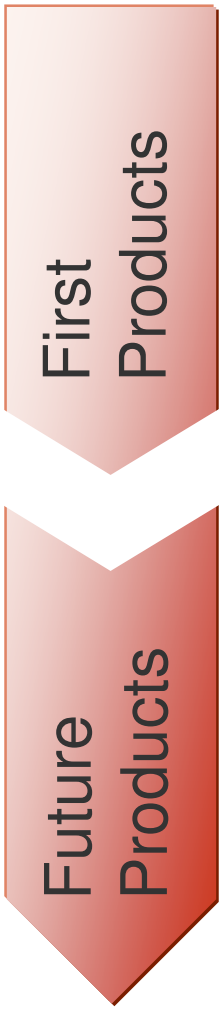




Printed Electronics open new markets



Why Printed RFID?



Content Verification

- Check if a box contains a product

Electronic Authentication

- Check if a product is a counterfeit

Tracking & Tracing

- Track a product through the supply chain from production to the retail store

Inventory Control

- Acquire product data automatically without human interaction

Our two product line trademarks: PolyID™ and PolyLogo™

POLYID

- **RFID**

PolyIC – product line PolyID:

POLYID

POLYLOGO

- **Smart Objects and Display**

PolyIC – product line PolyLogo:

POLYLOGO

Our long term target applications: PolyID™: EPC – PolyLogo™: Smart Cards

POLYID

EPC™ (Electronic Product Code)

- Applications
  - Item Level Tagging
  - Supply chain
  - Inventory Control

POLYLOGO

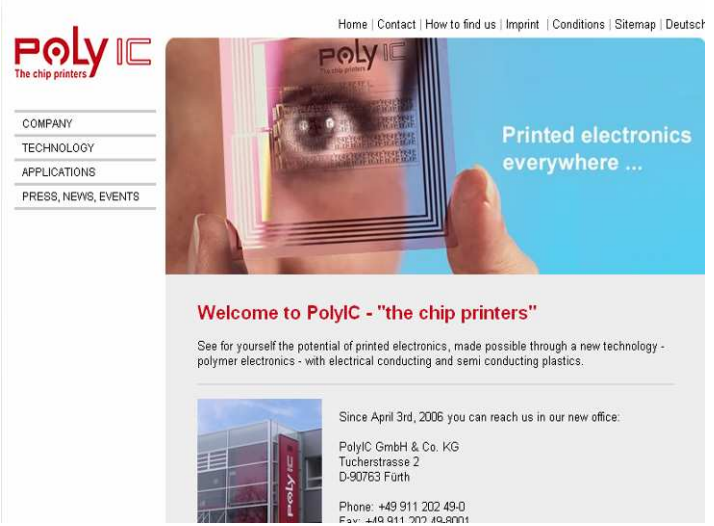
Smart card / Intelligent sensor

- Applications
  - Single use sensors
  - Combined optical / RFID function
  - smart package

Contact us – live or virtual

live

virtual



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