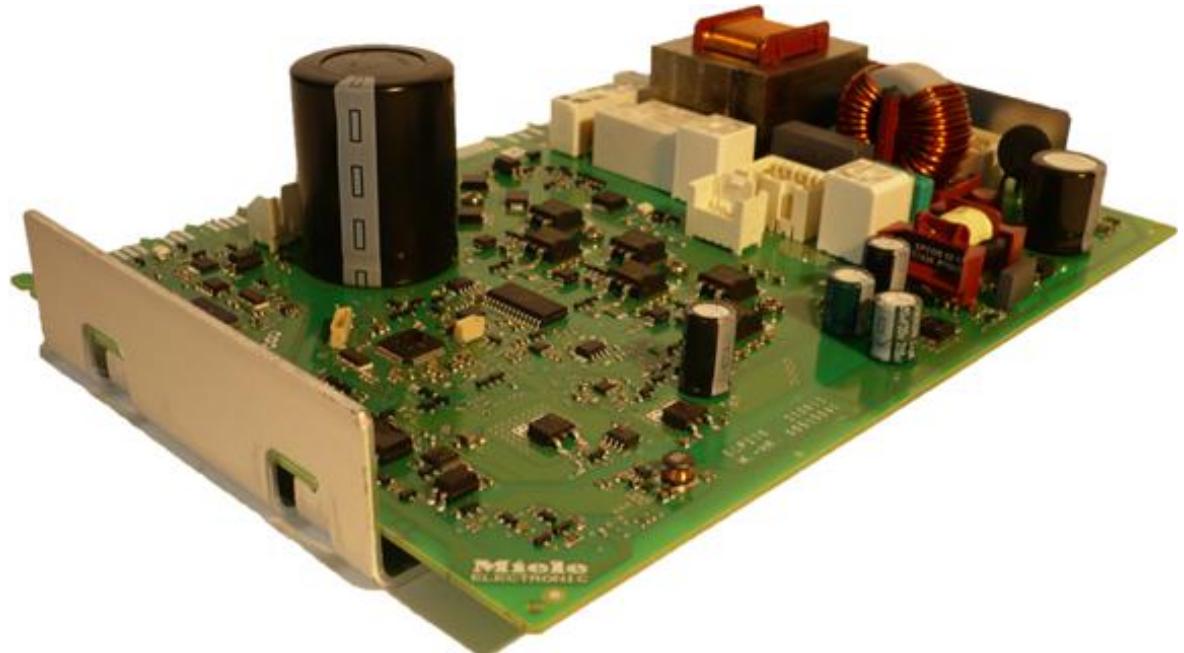


Miele

Smart electronics in home appliances



Brasov, 25.04.2013

Dominic Beier – Miele Electronic

Miele & Cie. KG

- ▶ Manufacturer of high-end home appliances and commercial machines
- ▶ Founded in 1899 by Carl Miele and Reinhard Zinkann in Herzebrock, Germany
- ▶ Still a family company owned by the founding families
- ▶ Central Headquarter: Gütersloh (since 1907)
- ▶ Employees: 16700 (August 2012)
- ▶ Turnover: 3,04 bn € (2011/2012)
- ▶ Production Plants at 12 Locations
- ▶ Sales subsidiaries in 47 countries

Locations



Miele sales subsidiaries in 47 countries

Home appliances



washing machines, tumble dryers



dishwashers



hoods



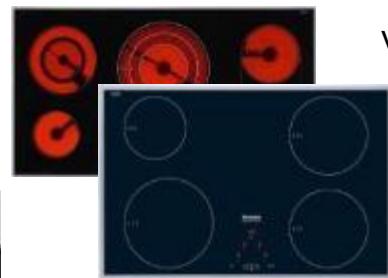
vacuum cleaners



refrigerators, freezers



ovens, steam ovens,
microwave ovens, coffee makers



hobs



ironers

Commercial machines

PROFESSIONAL

“Little Giants”



Laundry equipment
(washing machines, dryers,
ironers)



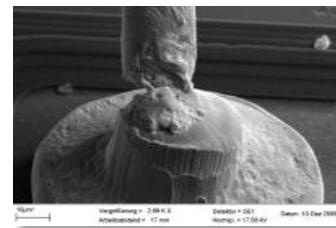
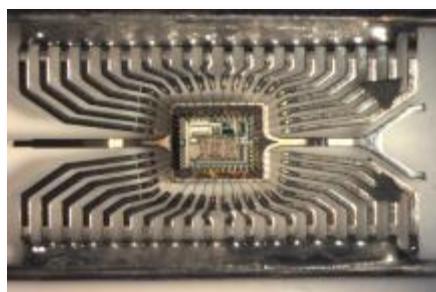
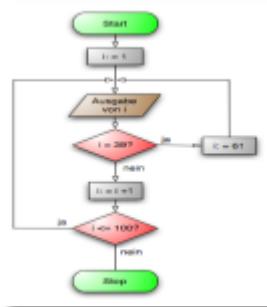
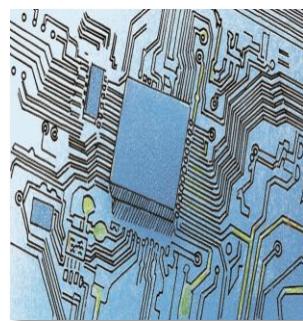
Cleaning and disinfection
(hospitals, dental practices,
laboratories)

Some reasons for the increased use of electronics in home appliances

- ▶ Perfect results (cleaning, drying, cooking etc.)
 - ▶ Highly automated and sensor controlled processes
 - ▶ Protection of laundry in washing machines or dishes in dishwashers
- ▶ Sustainability
 - ▶ Reducing consumption (saving of energy, water, detergents)
 - ▶ Reliability and longevity (designed for 20 years of lifetime)
 - ▶ Software updates to keep the machines on the latest state of development
- ▶ Comfort
 - ▶ Intuitive operation (e. g. human machine interface)
 - ▶ Easy handling and less user intervention
- ▶ Design
 - ▶ New possibilities
 - ▶ Flexibility

Development of electronics

- ▶ Hardware-Design and Layout
- ▶ Software-Design and Programming
- ▶ Global sourcing and qualification of electronic components/ failure analysis
- ▶ Test of electronics (e. g. test on module and system level, electromagnetic compatibility)



Production of Electronics in Gütersloh and Brașov

- ▶ Production of several thousand electronics each day in Brasov and Gütersloh based on very high quality standards
- ▶ Production lines for highly automated SMT and THT-processes
- ▶ Test equipment
 - ▶ in-circuit test
 - ▶ function test
 - ▶ automatic optical inspection



Production of Electronics (Gütersloh, Germany)



Miele Electronic
Gütersloh, Germany



Production lines in Gütersloh

Production of Electronics (Brașov, Romania)



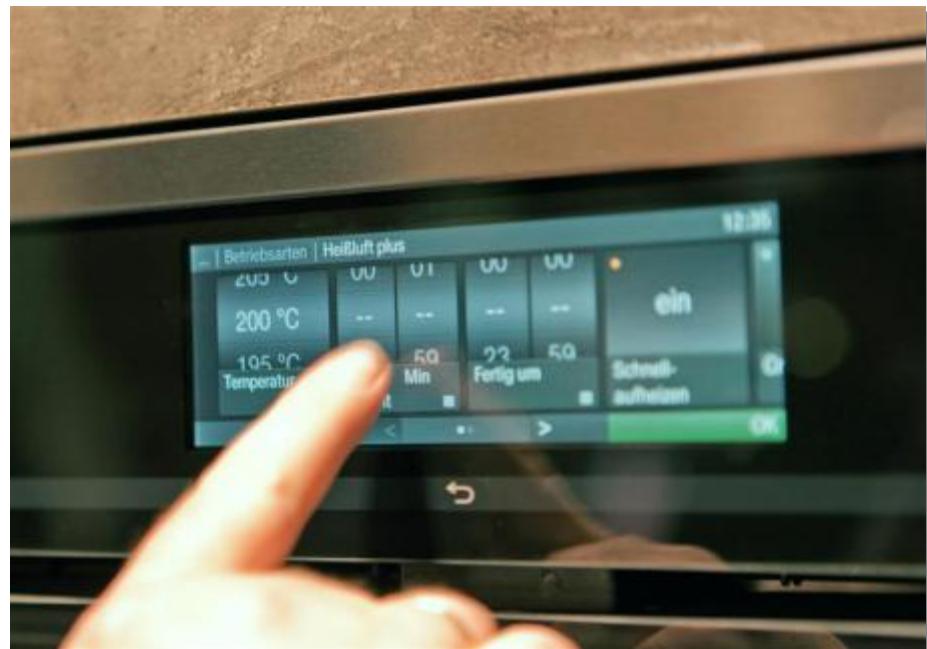
Miele Tehnica S.R.L
Str. Carl Miele 1
507065 Feldioara, Brașov – Romania



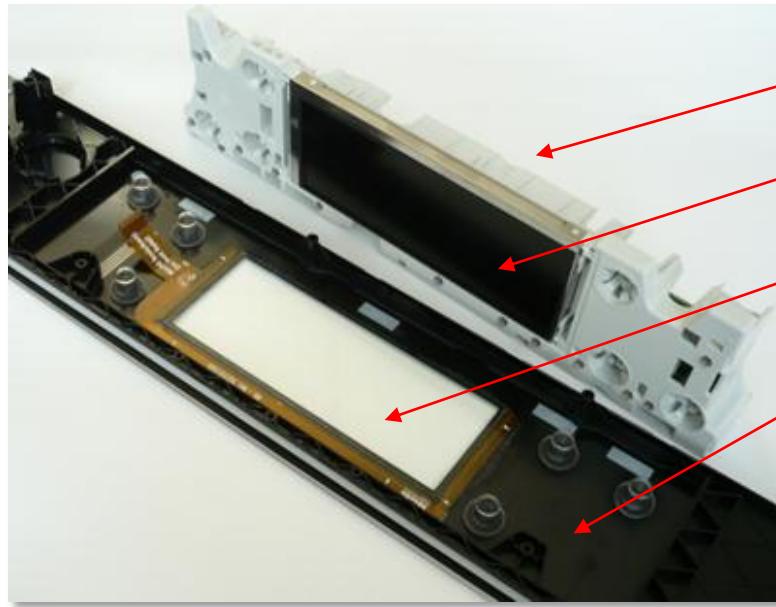
Production lines in Brașov

Generation 6000: New M-Touch Control

- ▶ New intuitive touch user interface for Miele appliances
- ▶ Selection options appear on a brilliant high-resolution screen
- ▶ Navigation through menus by finger-tip swiping and scrolling



Generation 6000: M-Touch – a look inside

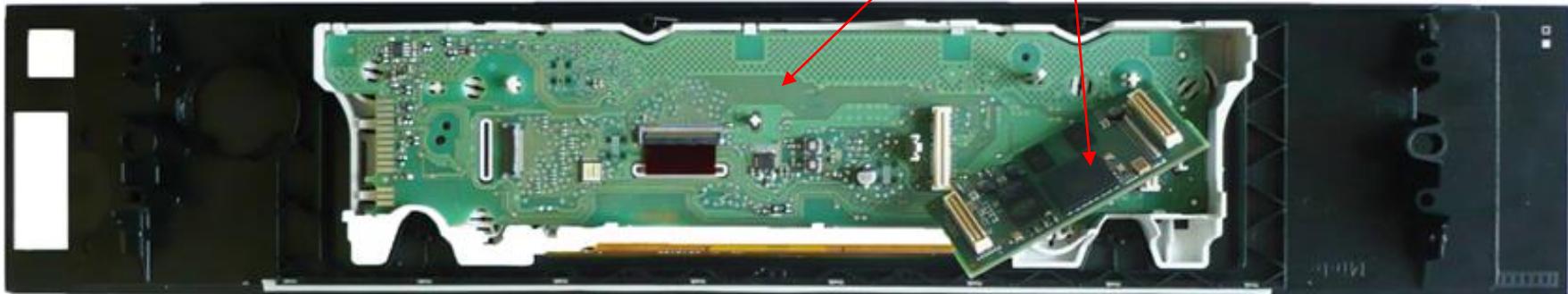


Control electronics

Color TFT-Display

Capacitive Touch Foil (transparent)

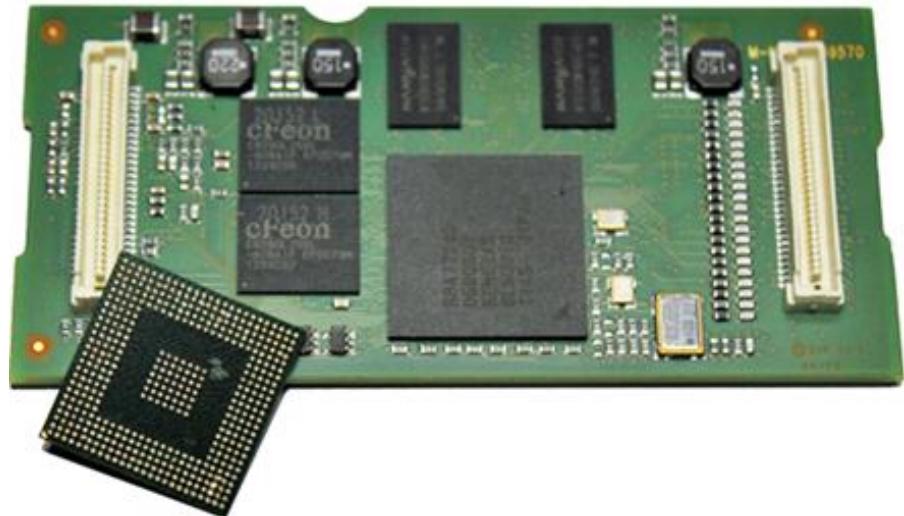
Panel (backside)



Control electronics

Generation 6000: M-Touch – a look inside

- ▶ SuperH - Processor
 - ▶ High performance (900 MIPS)
 - ▶ Internal LCD Controller
- ▶ External NOR-Flash
- ▶ External DDR2-RAM
- ▶ Multilayer PCB
- ▶ Ball Grid Array – packages (BGA)
- ▶ Software based on embedded Linux and Flash Lite



Smart Sensors: Wireless Food Probe

- ▶ Core temperature measurement of the meat to ensure perfect cooking results
- ▶ Easy handling (no cable, placed in door)
- ▶ No battery, no electronic circuits inside the probe
- ▶ Resistant up to 260°C

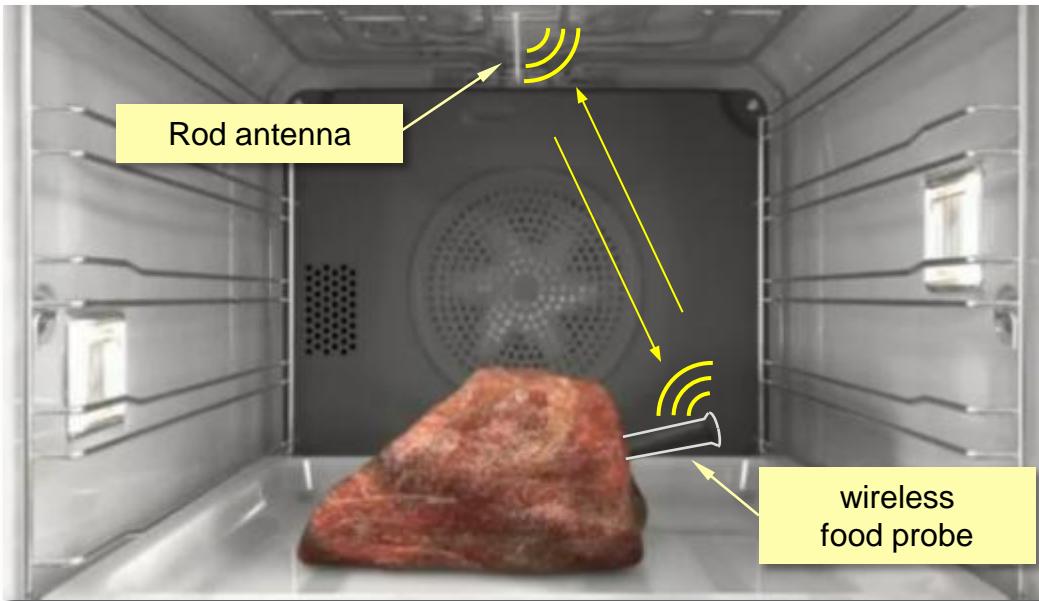


Wireless Food Probe: System overview

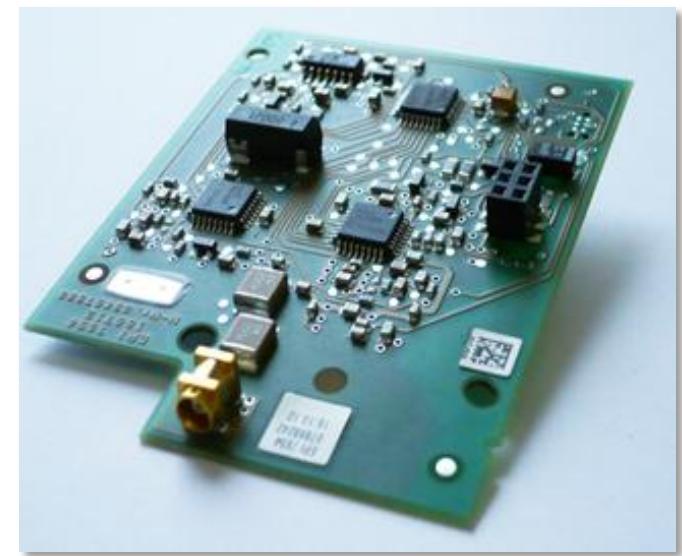
- ▶ Wireless Food Probe
- ▶ Rod antenna near to the heater
- ▶ Low cost sensor electronics



Wireless Food Probe



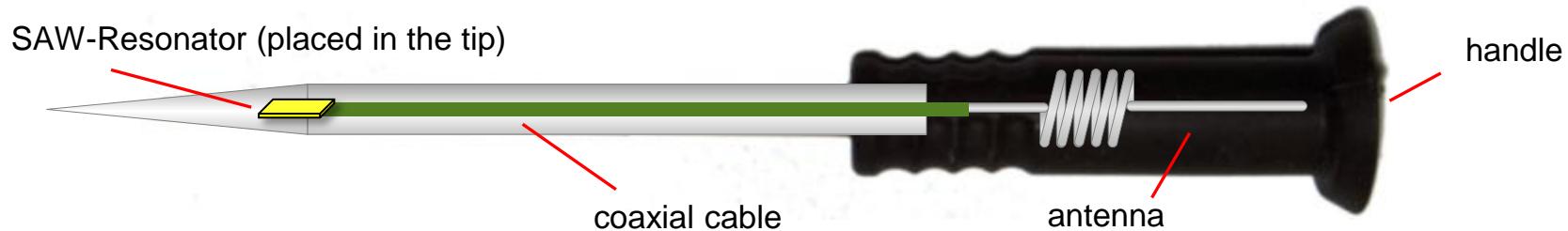
Look inside an oven



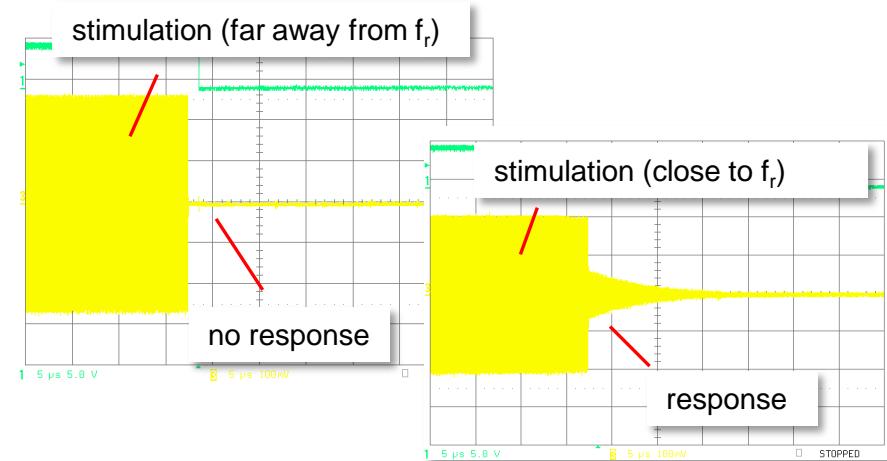
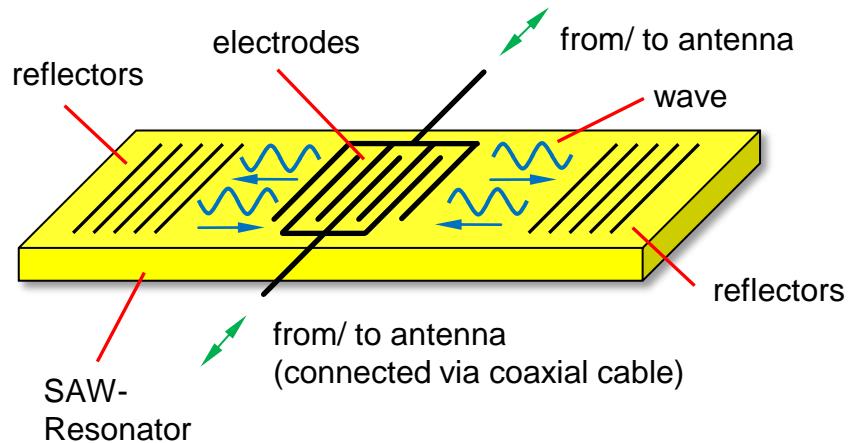
Low cost sensor electronics

Wireless Food Probe: Principle

- ▶ Basic principle: Surface Acoustic Wave (SAW) – Resonator (433 MHz)
- ▶ Measurement of the temperature-dependent shift of the resonant frequency f_r ($\sim 7 \text{ kHz/K}$)



SAW-Resonator (principle drawing):



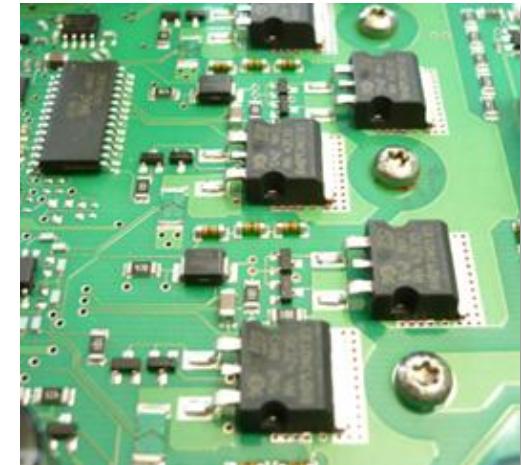
Motor control: Overview

- ▶ Power electronics for controlling the drive of
 - ▶ washing machine and tumble dryer drums
 - ▶ pumps
 - ▶ compressors
 - ▶ fans
- ▶ Different motor types
 - ▶ DC Motors (PWM)
 - ▶ AC induction motors (single phase, three phase)
 - ▶ Permanent magnet synchronous motors (three phase)
- ▶ Different types of control
 - ▶ speed control (tacho generator)
 - ▶ field oriented, sensorless control
- ▶ Thermal protection (hardware on board or safety software)

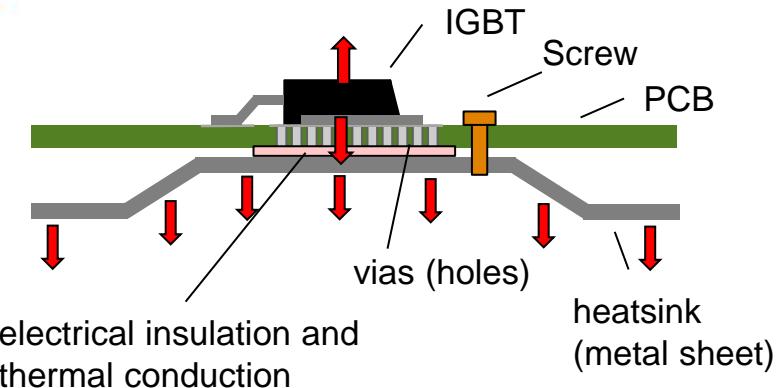


Motor Control: Power electronics inside washing machines

- ▶ Power electronics with inverter for three phase motors
- ▶ Focus on simple manufacturing
- ▶ Heat dissipation through the PCB



SMD Power Transistors



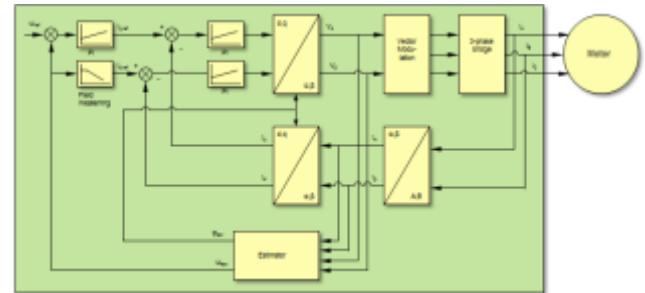
Motor Control: Dishwasher Circulation Pump

- ▶ Circulation of the water and the rotation of the spray arms
- ▶ Three phase inverter inside the pump housing

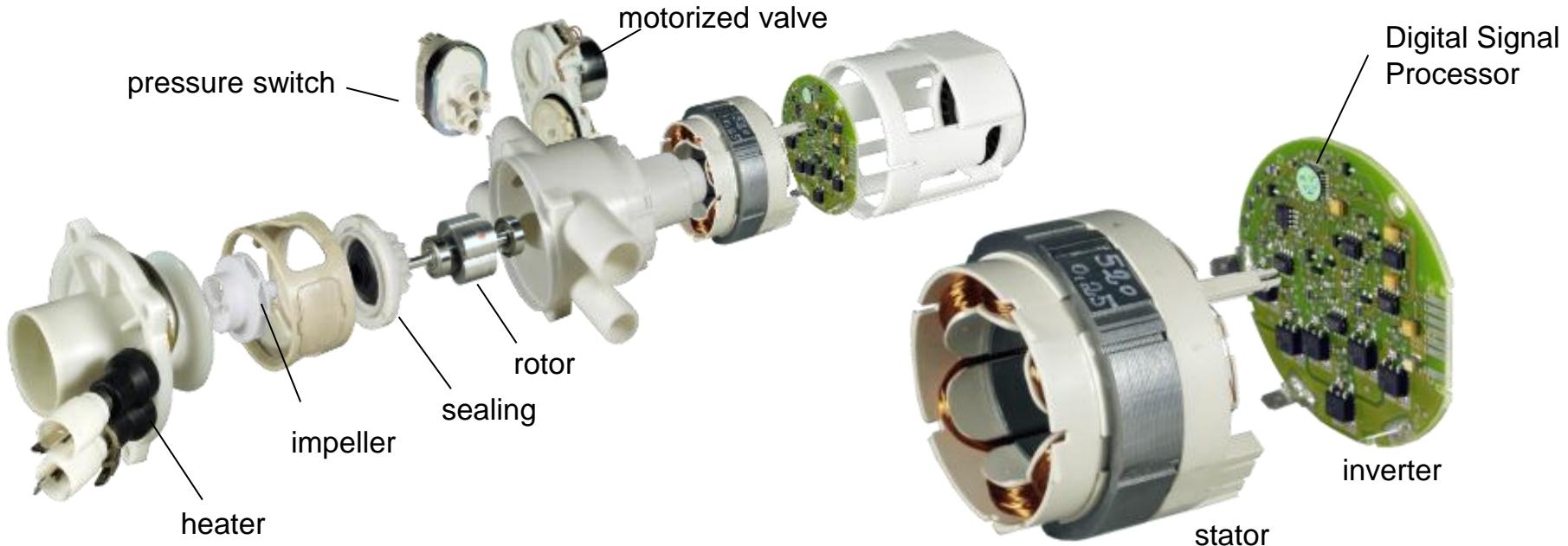


Motor Control: Dishwasher Circulation Pump

- ▶ Circulation of the water and the rotation of the spray arms
- ▶ Three phase inverter inside the pump housing
- ▶ Sensorless, field oriented control
- ▶ Thermal motor protection



Field oriented control (sensorless)



Optical Interface



- ▶ Serial connection between control electronics and a PC
- Usage:
 - ▶ customer service (diagnostics and program update)
 - ▶ end of line testing
 - ▶ laboratory (development phase)

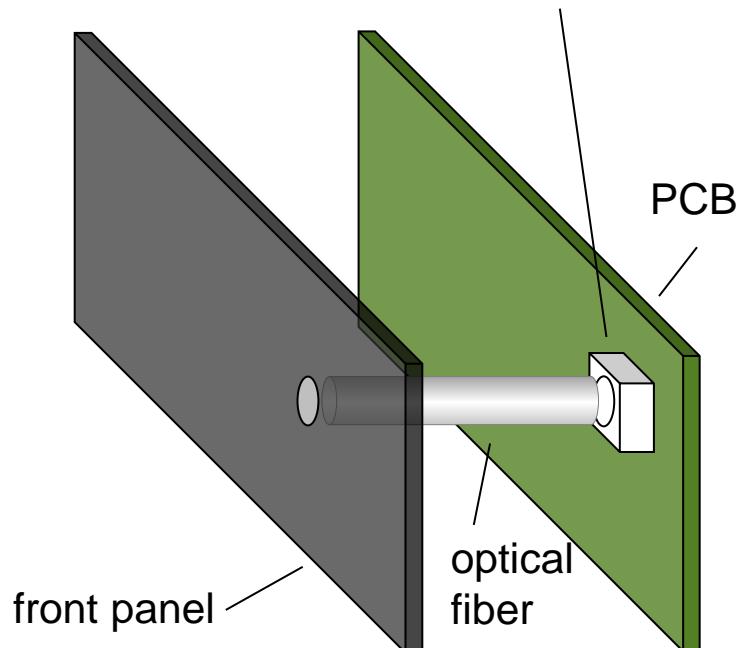
optical interface (PC symbol)

Optical Interface

- ▶ Data transfer via infrared (IR) light pulses
- ▶ Connection through the front panel of the machine (IR transparent area)
- ▶ Advantages:
 - ▶ No connector and no hole in the front panel
 - ▶ Simple manufacturing (surface mounted device)



SMT-Multi-TOPLED
(Infrared Emitter, Si-
Phototransistor)

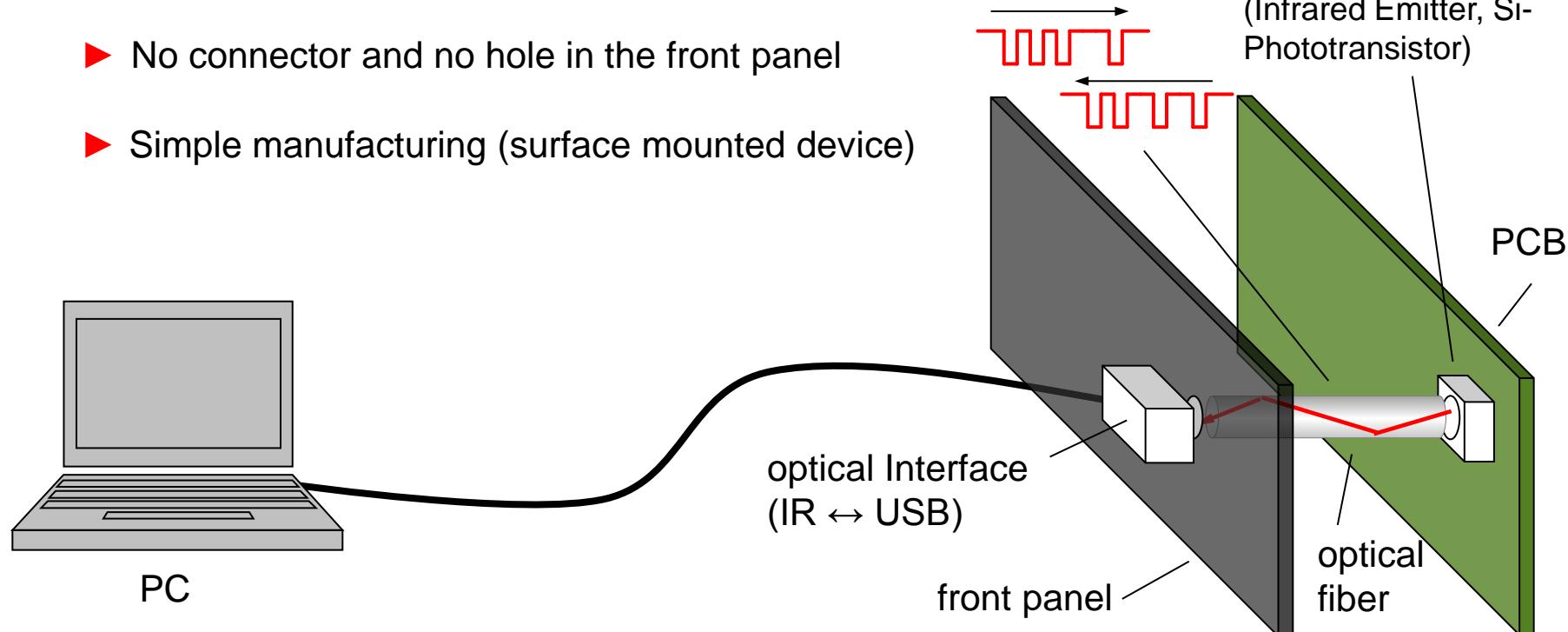


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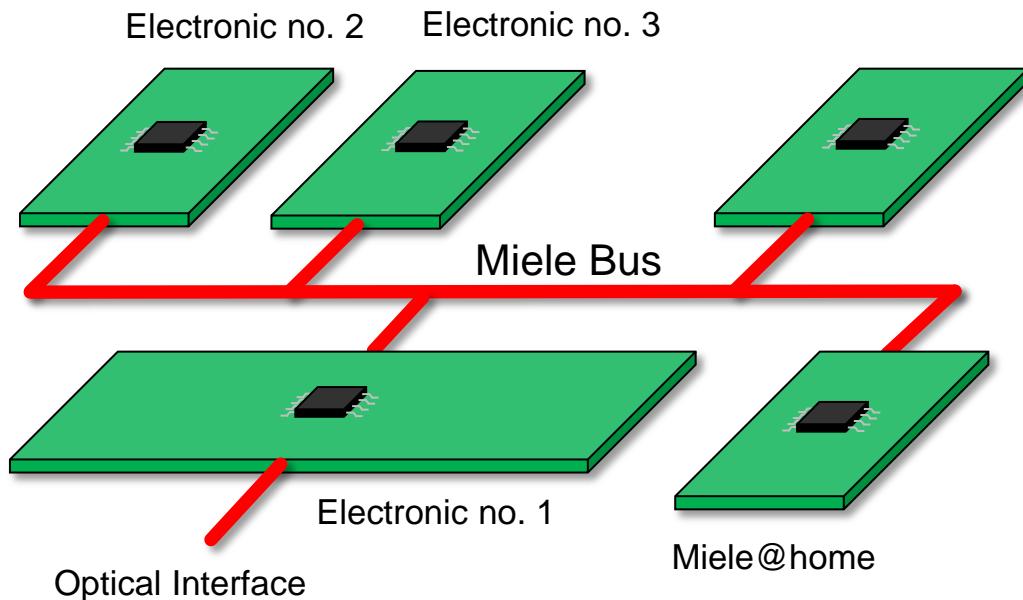


SMT-Multi-TOPLED
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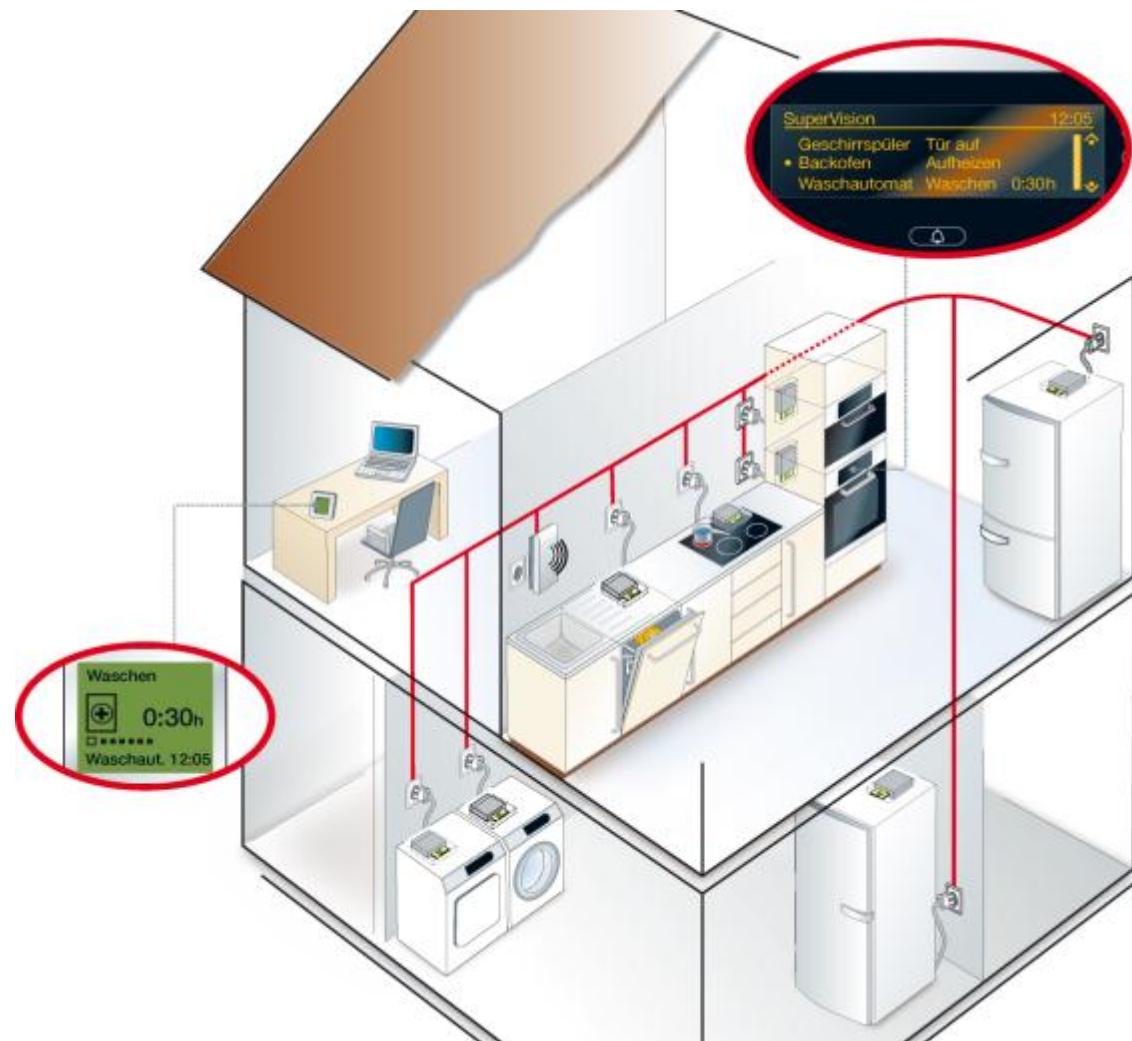


Optical interface and internal bus communication

- ▶ Internal communication between electronics via “Miele-Bus”
- ▶ Serial, “1-wire” bus system
- ▶ Baudrate: 57600 (115200) bps
- ▶ Up to 16 participating electronics

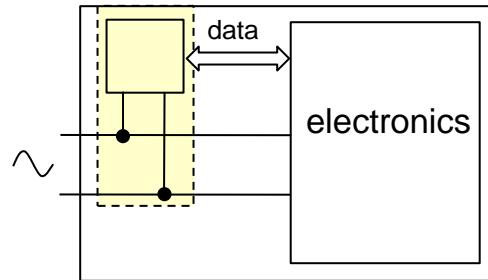
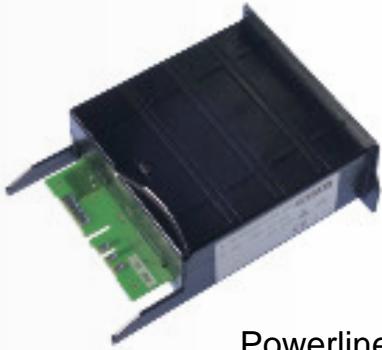


Home Appliance Network: “Miele@home”



- ▶ Network for home appliances
- ▶ Communication via powerline and RF modules
- ▶ Functions:
 - ▶ Info Control Plus
 - ▶ Super Vision
 - ▶ Con@ctivity
 - ▶ Smart Start
 - ▶ Info Service

Miele@home: Powerline Communication



Powerline module



Info Control +

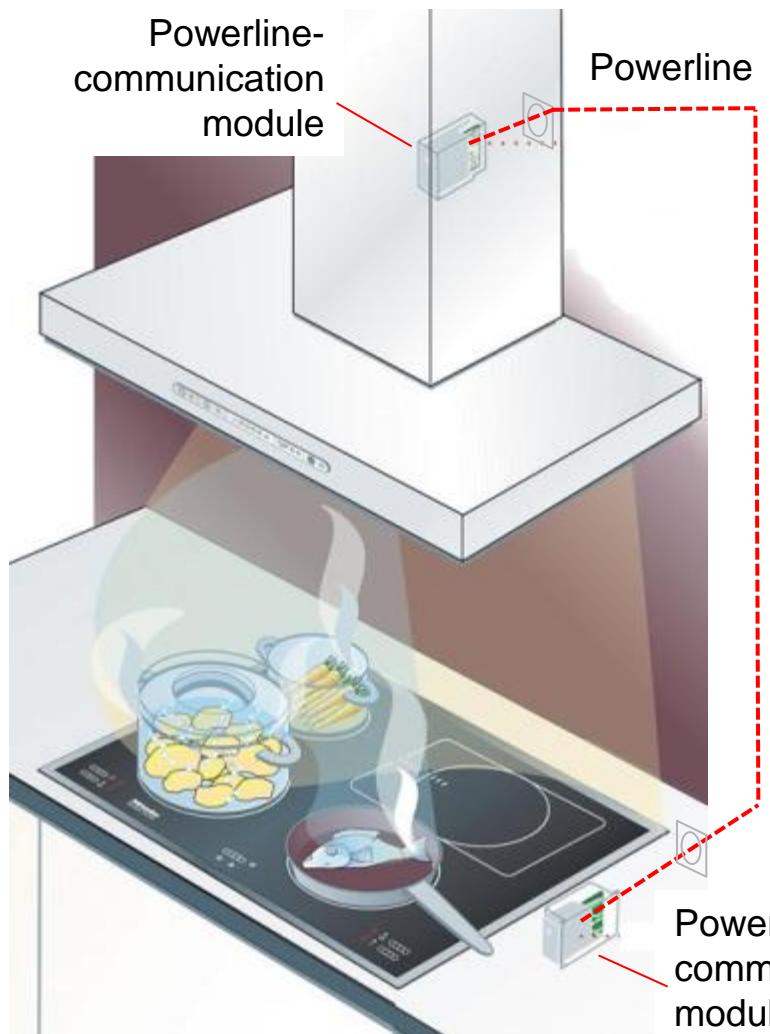


Module slot (side or rear wall)

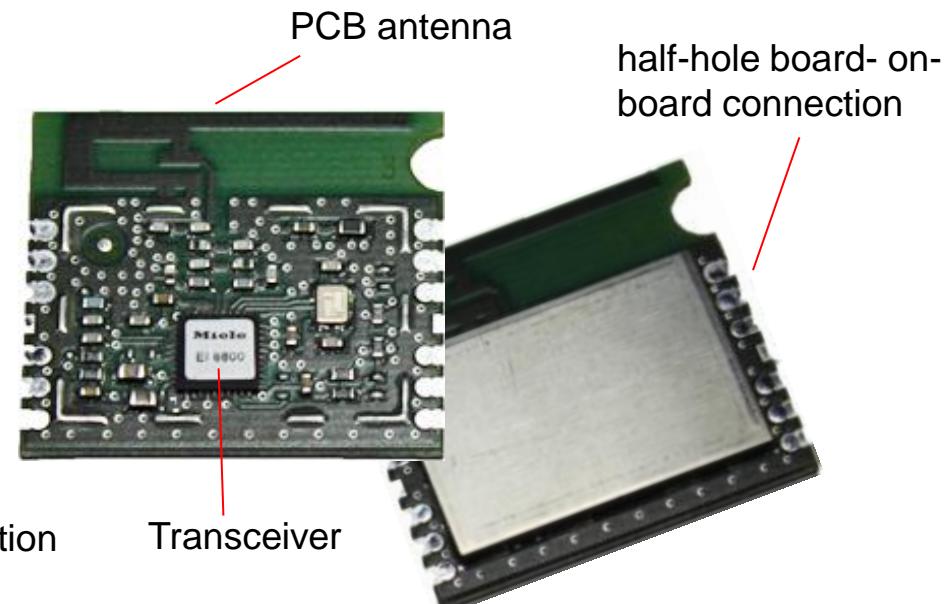
Miele@home: Info Control Plus



Miele@home: “Con@ctivity”



- ▶ Control of the hood based on hob information (state and power level of cooking zones)
- ▶ Con@ctivity: communication via powerline
- ▶ Con@ctivity 2.0: communication via RF-module (2.4 GHz)



Conclusion

- ▶ Electronics inside home appliances offer a variety of possibilities
 - ▶ to guarantee perfect results
 - ▶ to reduce consumption
 - ▶ to operate more comfortable
 - ▶ to create excellent designs and innovative products
- ▶ Electronics are indispensable parts of modern home appliances

Thanks for your attention ...

for further information please visit

www.mieleromania.ro
www.miele.de