Smart electronics in home appliances
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

Production Plants:
Germany: Gütersloh (Headquarter), Bielefeld, Euskirchen, Lehrte, Warendorf, Oelde, Arnsberg, Bünde
Austria: Bürmoos
Czech Republic: Unicov
China: Dongguan
Romania: Brașov (since 2009)

Miele sales subsidiaries in 47 countries
Home appliances

- washing machines, tumble dryers
- dishwashers
- hoods
- vacuum cleaners
- ovens, steam ovens, microwave ovens, coffee makers
- hobs
- ironers
- refrigerators, freezers
Commercial machines

“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

Look inside an oven

Wireless Food Probe

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 $f_r$ ($\sim 7$ kHz/K)

SAW-Resonator (placed in the tip)

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
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
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)
Optical Interface

► Data transfer via infrared (IR) light pulses
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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 Gateway  WLAN-Router

kommunikationsfähige Hausgeräte
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