恩智浦在智能白色家电中的应用

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From White Goods to **Smart** Home Appliance
从 “白电” 到 “智能家电”

**Market drivers**
- Rising energy prices
- Smart grid initiatives
- Government green regulations
- Consumer convenience

**Technology enablers**
- Low power affordable wireless networking
- Low power affordable sensors
- Smart phone/tablets offer intuitive user interface
Smart Appliance in today’s trend in WG market
“智能家电”是市场趋势

- Account for more than 50% of the energy consumption in the home
- Home appliances are key in any home automation concept

Smart appliance customer benefits

<table>
<thead>
<tr>
<th>Technologies</th>
<th>Smart grid ready</th>
<th>Power monitoring</th>
<th>RFID detection</th>
<th>NFC connect</th>
<th>Power supply</th>
<th>Advanced Motor Control</th>
<th>Smart sensors</th>
<th>RF Remote Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green environment</td>
<td>✔</td>
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<td>User convenience</td>
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</tbody>
</table>
Generic smart home architecture
What’s the “Smart Appliance”
什么是“智能家电”

**Smart Power**
- High efficiency
- Low standby power and quick wake-up
- Easy to design

**Smart Connection**
- Wireless connectivity with NFC
- Remote controller with Zigbee

**Smart Interface**
- Cap. touch, touch screen with TFT LCD and smart GUI

**Smart controller**
- One MCU handle system mgt., UI, motor & load control
- AC power measurement and remote diagnostics
- High noise immunity and temperature & overload protection
Example: Smart washing machine demonstrator
示例：智能洗衣机演示

Smart Power
- Power supply - Greenchip

Smart Connection
- NFC based maintenance
- Fabric & Detergent detection
- Smart remote controller with Zigbee

Smart Interface
- Cap. touch
- Advanced user interface with LCD touch screen

Smart controller
- 32-bit ARM MCU graphic U/I, system mgr. and motor & load control
- AC power metering
- TOPTriac
- Smart sensor
Example: Smart washing machine demonstrator

示例：智能洗衣机的设计分析

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Power Supply – Greenchip
智能电源

Customer benefits

- Low standby power
- High efficiency
- Quick wake-up from stand-by to full operational mode
- Easy to design, less components in power solution

NXP solution

- TEA172x with integrated MOSFET
- Rectifiers & diodes
- Fly-back and Buck/boost topologies available
- <10mW standby power on circuit level
- Efficiency exceeding EnergyStar and Ecodesign

![TEA1721 typical no-load power consumption](chart)

<table>
<thead>
<tr>
<th>Input Voltage (V)</th>
<th>No load power (mW)</th>
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</thead>
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<td>85</td>
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<td>105</td>
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<td>205</td>
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<td>225</td>
<td>12</td>
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<tr>
<td>245</td>
<td>13</td>
</tr>
<tr>
<td>265</td>
<td>(demo board optimized for 3W)</td>
</tr>
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Smart Connection – NFC based maintenance
智能连接 - 基于NFC的应用

Customer benefits
- Connectivity with NFC enabled phone
- Read/change machine status wirelessly
- App communicates with service center

NXP solution
- CLRC663: NFC & RFID single chip solution
- Compact NFC stack
- NFC stack running on system controller (LPC1200)
Smart Connection – Fabric and detergent recognition

智能连接 – 纤维及清洁剂的辨识

Customer benefits

- Read fabric type/color of tagged clothing
- Read detergent characteristics
- Optimize washing program
- Avoid mixing white & dark laundry
- Reduce detergent/water usage

NXP solution

- CLRC663: NFC & RFID single chip solution
- Compact RFID stack
- RFID stack running on existing system controller (LPC1200)
- Innovative antenna design for reliable tag detection
- RFID tags integrated into clothing buttons
RFID & NFC will change the HA future!

RFID和NFC将会改变家电的未来！

**Configuration management**
- Fewer production derivatives
- Higher supply flexibility

**Activation and Authentication**
- Enable the device at the POS (theft deterrence)
- Authenticity check via RFID

**Track & Trace**
- Production control
- Quality and return management
How it works | Wireless access to electronics

- Mount RFID chip onto the PCB
- RFID chip embedded inside the PCB

RFID air interface

Chip on PCB

PCB antenna
Smart Connection – Smart Remote Controller with Zigbee
智能连接 – 基于Zigbee的智能遥控器

Customer benefits

- Ultra low power
- FCC/ETS certified modules
- Choice of protocol stacks available
- Free open source

NXP solution

- Single-chip IEEE802.15.4, 2.4 GHz Radio and 32-bit MCU
- Free protocol stack license
- Range of software stacks for customers to choose from:
  - ZigBee PRO Smart Energy and Home Automation
  - JenNet – IP IPv6 based protocol
  - RF4CE for remote controls
Example: Smart washing machine demonstrator
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- Wireless communication
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Smart Interface – advance user interface with cap touch and LCD touch screen
智能界面 – 使用容触控和LCD触屏技术的人机界面

Customer benefits

- Intuitive user interface
- IPod-like look and feel
- Reduced standby power

NXP solution

- Broad MCU portfolio
  - Cortex-M0 for driving LEDs and Seg./Graphic display
  - High performing M3 and M4 for TFT driving
  - Industry’s fastest flash
  - Free professional Graphical Library (Segger)
- Low current cap touch IC and LDC drivers
Example: Smart washing machine demonstrator
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Smart Control – 32-bit ARM MCU for U/I, system mgr. and motor & load control
智能控制 – 32位ARM MCU用于人机界面、系统管理、马达及负载控制

Customer benefits

- Handle complex washing programs
- One MCU handling system mgt, U/I, motor & load control
- Reliable control

NXP solution

- AC power measurement implemented on host controller (LPC1227)
- API interface to appliance software
- Alternative : EM773 dedicated Energy Metering IC measuring 12 power quality parameters (power factor, blind power, power factor, …)
Smart Control - TOPTriac™

**Temperature and Overload Protected Triac**

**Customer benefits**
- Protects application and Triac from damage during overload
- No need to over-specify Triac and heatsink
- Avoids loss of control at high temperature
- Status monitoring with help of microcontroller
- Reduced Triac and system PPM

**NXP solution**
- Over temperature protection
- Overload / overcurrent protection
- High commutation / high noise immunity
Smart Control - AC power metering
智能控制 – 交流电源计量

Customer benefits
- Consumer energy awareness
- Remote diagnostics
- Cost effective AC power measurement
- No need to write or configure software

NXP solution
- MCU with 32-bit ARM Cortex-M0 - LPC1227
- Up to 50% better code density
- ROM division library in LPC1227
- High current GPIO
- IEC60730 safety compliant
- BTA316/ACT108 triacs for motor/load control
- High noise immunity triacs
Smart Control – Smart sensor
智能控制 - 智能传感器

Customer benefits
- Ultra Low Power consumption
- Cost effective integration
- Sensor fusion to improve accuracy and robustness

NXP solution
- NXP developing low power CMOS sensors
- Integrates 11 sensors on one IC
  - 1 ultra accurate Temperature (± 0.1°C)
  - 4 high accurate Relative Humidity sensors (± 2%)
  - 6 light directors for Ambient, UV near-IR detection
    Enables 360° directional light and proximity detection
- World class energy consumption
- Digital interface for easy connection
**User Interface**
- Dedicated Cortex-M0 MCU
- Capacitive touch
- TFT driving with Cortex-M3/M4
- RF remote control
- NFC based programming
- Display drivers, RTC, LED drivers
- Mux/Demux, ESD protection

**System Management**
- Dedicated Cortex-M0 MCU
- TRIACS high/low current
- Smart sensors
- I2C / UART

**Smart Appliance**
- 802.15.4 / Zigbee, <GHz ISM, PLC
- AC Power monitoring
- Fabric & detergent detection (RFID)
- NFC based maintenance
- Secure device identity

**Moto Control**
- TRIACS high current
- Evolving MCU portfolio

**Power Supply**
- TEA 17xx based SMPS solutions, PFC
- Mega Schottky, BISS, TVS/ESD, HV, …
Conclusion 总结

- Electronics are increasingly enabling key differentiators in the appliances industry
- NXP’s mixed signal technology portfolio matches very well with the (future) needs of the appliance industry

NXP

- Combines technologies from different business units to create innovative solutions for customers
- Partners with leading customers to create new solutions
- Invests in application know-how
- Supports the robust quality and long life cycles that appliance makers need to be competitive