Smart Metering Solutions

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What is Smart Metering?
Stakeholders in Smart Metering

- Governments rule regulations to reduce CO$_2$ emissions and energy consumption
- Utilities desire to have better peak load management
- Consumers benefit from energy awareness and can adapt accordingly
Market Drivers

- **Smart Metering Value Proposition to Utilities (energy generation & grid)**
  - Cost savings by efficient remote reading & billing
  - Better peak load management / more efficient grid usage
  - New tariff model offerings
  - Better protection against tampering / remote turn-on and turn-off
  - Possibility to combine remote reading of gas, water and electricity usage

- **Smart Metering Value Proposition to Consumers**
  - More accurate and frequent billing
  - Cost reduction by better insight into consumption
  - Ability to switch significant consumption to less expensive hours
  - Intelligent load management as a consumer / home automation

- **Smart Metering Value Proposition for Governments**
  - Contribution to committed CO2 emission reduction.
  - Increased awareness of energy consumption pattern leads to reduction of consumption
  - Investment in smart metering networks will stimulate economy
Evolving Smart Metering Networks

2000-2009
- Start of replacement of electromechanical by electronic meters
- First roll-outs of AMR networks based on one-way communication (US, Europe)

2010-2014
- Global phase-out of electromechanical meters
- Massive roll-out of bidirectional AMI networks in EU, US and China; simpler networks in developing countries
- Smart meter as simple home gateway for multi-utility AMR and load management

2015 & beyond
- Smart meter evolving into home gateway for building control (security, alarms…)
- Smart grid managing distributed energy generation (solar, wind) by households.
Market Segmentation & Characteristics

SMART Metering

- Industrial Meters
- Residential Meters
- Non-Billing Meters

Electricity Meters
- High End Implementation
- Low End Implementation
- Low End Integrated Implementation

Gas, Water & Heat Meters

- Meters that communicate
- Targeting improved energy management
Market Segmentation & Characteristics

- **SMART Metering**
  - **Industrial Meters**
  - **Residential Meters**
  - **Non-Billing Meters**

- **Electricity Meters**
  - High End Implementation
  - Low End Implementation
  - Low End Integrated Implementation

- **Gas, Water & Heat Meters**

  - **High End**
    - Highest performance
    - Many communication options
    - Targeting commercial real estate
Market Segmentation & Characteristics

SMART Metering

- Industrial Meters
- Residential Meters
- Non-Billing Meters

- Electricity Meters
  - High End Implementation
  - Low End Implementation
  - Low End Integrated Implementation

- Gas, Water & Heat Meters

- Optimized metrology inside
- Network connection optional
- Targeting consumers info
Market Segmentation & Characteristics

SMART Metering

Industrial Meters

Residential Meters

Non-Billing Meters

Electricity Meters

Gas, Water & Heat Meters

High End Implementation

Low End Implementation

Low End Integrated Implementation

- Highest volume segment
- Balance of comm. & cost
- Targeting private households
Market Segmentation & Characteristics

SMART Metering

- Industrial Meters
- Residential Meters
- Non-Billing Meters

Electricity Meters
- High End Implementation
- Low End Implementation
- Low End Integrated Implementation

Gas, Water & Heat Meters
- Battery operated low-power
- Wireless comm. only
Market Segmentation & Characteristics

SMART Metering

- Industrial Meters
- Residential Meters
- Non-Billing Meters

Electricity Meters

- High End Implementation
- Low End Implementation
- Low End Integrated Implementation

Gas, Water & Heat Meters

- Highest volume within residential
- Comm. hub for HAN/NAN
- Comm. option for sub-meters
Market Segmentation & Characteristics

- SMART Metering
  - Industrial Meters
  - Residential Meters
  - Non-Billing Meters
  - Electricity Meters
  - Gas, Water & Heat Meters
    - High End Implementation
      - Home automation gateway
      - Performance close to industrial
    - Low End Implementation
    - Low End Integrated Implementation
Market Segmentation & Characteristics

SMART Metering

- Industrial Meters
- Residential Meters
- Non-Billing Meters

- Electricity Meters
- Gas, Water & Heat Meters

  - High End Implementation
  - Low End Implementation
  - Low End Integrated Implementation

- • Comm. to utility only
- • Minimum required performance
Market Segmentation & Characteristics

SMART Metering

Industrial Meters

Residential Meters

Non-Billing Meters

Electricity Meters

Gas, Water & Heat Meters

- High End Implementation
- Low End Implementation
- Low End Integrated Implementation

- Comm. to utility only
- Minimum required performance
- AFE integrated where allowed
Smart Metering Building Blocks
Smart Metering Building Blocks
hyperlinks to www.NXP.com pages

<table>
<thead>
<tr>
<th>ARM Cortex M3</th>
<th>ARM7 LPC2000</th>
<th>Jennic JN5148 Zigbee Pro Transceiver</th>
<th>Lowest Power RTC</th>
<th>LCD Segment Driver</th>
<th>Power Supply ICs</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPC17xx family</td>
<td>LPC2000 family</td>
<td>2.4 GHz transceiver with built-in low power MCU for Zigbee Pro and JenNet SW stacks</td>
<td>PCF2123</td>
<td>PCF8562: 128 sgmt</td>
<td>Starplug TEA15xx</td>
</tr>
<tr>
<td>Samples end 2008</td>
<td>up to 72 MHz</td>
<td>(typ. 120nA, Tunable to +/-1ppm at room temp.)</td>
<td>PCF8576D: 160 sgmt</td>
<td>PCF8576D: 160 sgmt</td>
<td>with integrated</td>
</tr>
<tr>
<td>M3 Core release 2, 120 MHz</td>
<td>up to 1MB of Flash</td>
<td>Accurate RTC (aRTC) PCF2127.9</td>
<td>PCF8534A: 240 sgmt</td>
<td>Valley switching for incr. efficiency and less EMI</td>
<td></td>
</tr>
<tr>
<td>up to 64kB SRAM</td>
<td>up to 100kB of SRAM</td>
<td>temperature sensor with compens. (3ppm) Quartz oscillator integrated</td>
<td>LCD Character Driver</td>
<td>Contact and contactless Reader ICs</td>
<td></td>
</tr>
<tr>
<td>up to 512kB Flash</td>
<td>Rich peripheral set</td>
<td>PCF2113: 120 icons &amp; 2<em>12 / 1</em>24 (line*character)</td>
<td>PCF2119: 160 icons &amp; 2<em>16 (lines</em>characters)</td>
<td>RFID/NFC 13.56MHz</td>
<td></td>
</tr>
<tr>
<td>True 12bit ADC</td>
<td>Ethernet, USB, CAN on chip LCD Driver</td>
<td>Low Power, Low cost RTC, PCF8563/85 w/w.o. RAM, low power 250nA</td>
<td>LCD Graphic Driver</td>
<td>contact smart card readers for prepaid meters</td>
<td></td>
</tr>
<tr>
<td>True RTC (&lt;1μA)</td>
<td>10bit ADC</td>
<td>PCF8535: 65x133</td>
<td>PCF8535: 34x128</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethernet, USB, 5 UARTs</td>
<td>4 UARTs</td>
<td>LCD / SPI / I2C</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ARM9 LPC3000</th>
<th>RF M-Bus OL23xx Family</th>
<th>ARM Cortex M0</th>
<th>ARM7 LPC2000</th>
<th>LCD Display Driver</th>
<th>LCD Display Driver</th>
</tr>
</thead>
<tbody>
<tr>
<td>growing family, 270MHz</td>
<td>315 / 434 / 868 / 915 MHz operation</td>
<td>LPC11xx family</td>
<td>256KB RAM, LCD, Touch sc. Ethernet, (HS)USB, …</td>
<td>112 kcps to support all M-Bus protocols</td>
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</tr>
<tr>
<td>50 MHz</td>
<td>315 / 434 / 868 / 915 MHz operation</td>
<td>50 MHz</td>
<td>270MHz</td>
<td>LCD Segment Driver</td>
<td>LCD Segment Driver</td>
</tr>
<tr>
<td>up to 8kB SRAM</td>
<td>up to 32kB Flash UART / SPI / I2C</td>
<td>up to 32kB Flash UART / SPI / I2C</td>
<td>up to 1MB of Flash</td>
<td>PCF8562: 128 sgmt</td>
<td>LCD Segment Driver</td>
</tr>
<tr>
<td>LCD</td>
<td></td>
<td></td>
<td>up to 100kB of SRAM</td>
<td>PCF8576D: 160 sgmt</td>
<td>LCD Segment Driver</td>
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<tr>
<td>LCD</td>
<td></td>
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<tr>
<th>Microcontrollers</th>
<th>Connectivity</th>
<th>Real Time Clock</th>
<th>LCD Display Driver</th>
<th>Power Supply</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Logic ICs</th>
<th>Transistors, Diodes and ESD Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>largest portfolio of functions and packages</td>
<td>large portfolio, ultra small packages, Low $R_{D(ON)}$, MOSFETs, low $V_{CE(sat)}$ (BISS) trans., Low V, Schottky diodes, ESD protection diodes and arrays, Complex discretes: RETs, loadswitches, etc</td>
</tr>
</tbody>
</table>
Smart Metering Building Blocks

- RTC
- Analog Front End
- RFID UHF Connectivity
  - PCB Tracking ICs
- Smart Card Interface
  - Contactless reader ICs
- Logic
- Discrete Components
- Temperature Sensors
- Power Supply
  - (STARplug)

Wireless Connectivity
- Zigbee Solutions
- M-Bus Solutions
- GSM / GPRS Solutions
- Long Range RF Solutions

Wired Connectivity
- Power Line Carrier

Available
Under Consideration
## Evolving Metering MCU Family Roadmap

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Features</th>
<th>Regions</th>
</tr>
</thead>
</table>
| Gas Water & Heat Metering MCU| • Ultra Low Power Platform  
                             • All Regions  
                             • Under Consideration                                                  | All Regions                                   |
| Integrated LE Metering MCU   | • 3-Phase with AFE Included  
                             • India and Eastern Europe  
                             • Under Consideration                                                  | Under Consideration                           |
| Industrial Metering MCU      | • Ethernet IP Metering  
                             • All Regions  
                             • Q4-2010                                                                | Q4-2010                                      |
| HE Residential Metering MCU  | • Anti-Tampering 3-Phase  
                             • Western Europe and USA  
                             • Q4-2010                                                                | Anti-Tampering 3-Phase Western Europe and USA Q4-2010 |
| LE Residential Metering MCU  | • Single Phase Metering  
                             • China and Eastern Europe  
                             • Q3-2010                                                                | Single Phase Metering China and Eastern Europe Q3-2010 |
| Non-Billing Energy Metering IC| • Single-Phase Non-Billing  
                             • All Regions  
                             • EM773 Available NOW!!!                                                | Single-Phase Non-Billing All Regions EM773 Available NOW!!! |
Energy Metering IC for Non-Billing Meters
EM773

- Perfect solution for non-billing metering apps
  - Plug meters
  - SMART appliances
  - Industrial sub-meters

- Exceeds market requirements with better than 1% metering accuracy

- Most integrated and cost efficient solution

- No metering know-how required

- Fast time-to-market with demo designs

- Product differentiation via application SW

- Wireless M-Bus demonstrator design
Energy Metering IC for Non-Billing Meters
EM773

Optimized metrology inside with optional network connection

- Built-in metrology engine hardware and software
- Application programmable
- UART available for communications port
- Standard ARM support ecosystem available for easy development

33-pin HVQFN

Available NOW!!!
Energy Metering IC Firmware

Integrated and Programmable E-Meter Solution

- Single phase measured hardware parameters:
  - W, VA, VAr, kWh, kVAh, kVArh, V, I, frequency, cosφ
  - Correct reactive power, also for non-sinusoidal currents
  - Registers for consumed, produced and total energy
  - Indication of energy costs (total and day counters)
    Optionally Real Time Clock for tariff differentiation

- Wireless M-Bus output (SPI to OL2381)

- Serial output (I2C / UART / SSP / SPI)

- Programmable device: enables customized applications
  - Low CPU load, other applications can run in-parallel with meter application
  - Example software with Low cost Real Time Operating System

- Low cost front end: Resistive voltage divider and shunt resistor (or current transformer for very high currents when required)
  - Multiple operational amplifier gain channels for large dynamic range
  - Depending on mains isolation requirements: Voltage transformer
Energy Metering IC EM773
Principle block diagram

- **Power supply**
  - 3.3V as $V_{DD}$ required

- **Analog circuitry for current measurement**
  - accuracy options

- **Analog circuitry for voltage measurement**

- **Oscillator**

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![Block diagram of the EM773 Energy Metering IC](image)
Energy Metering IC EM773
Analog input circuits options

Voltage measurement circuit

- Voltage Divider
  - Cost efficient solution

- Transformer
  - Full galvanic isolation

Current measurement circuit

- Shunt Resistor
  - Series resistor with defined low resistance
  - Cost efficient solution

- Current Transformer
  - Low dissipation at high current
  - Standalone or PCB mounted
Energy Metering IC EM773
Metrology engine – Key functionality

- Embedded calculation of all relevant energy measurement parameters
  - \( P_{real} \), \( P_{reactive} \), \( P_{apparent} \), \( V_{rms} \), \( I_{rms} \)

- Accuracy better than 1% for 1:400 power range. Examples:
  - 0.1 W accuracy at 10 W load for a 4000 W\(_{max}\) meter
  - 0.092 W accuracy at 9.2 W for a 3680 W\(_{max}\) (230V 16A) plugmeter
  - 0.058 W accuracy at 5.8 W load for a 2300 W\(_{max}\) (115V 20A) appliance

- Improved accuracy for top end of the specified power range

- Automatic DC offset tracking

- Measurements include harmonics of the mains
  - Up to 40 harmonics for 50 Hz net frequency
  - Up to 33 harmonics for 60 Hz net frequency

- Correct reactive power calculation for non-sinusoidal currents (e.g. switched mode power supplies)
Energy Metering IC EM773
Definition of API input values

- **API Input: Voltage and Current**
  - Start Metrology Engine with standard settings for Vpp, I1pp and I2pp derived from input circuits
  - Measure voltage and current from a calibrated source
  - Correct the voltage and current ranges Vpp, I1pp and I2pp with the relative difference

- **API Input: Phase Correction**
  - Measure the phase difference between voltage and current channels for two resistive loads (high current and low current) and enter this value Phi1 and Phi2 as the required phase correction
Energy Metering IC EM773 Calibration

- Real time calibration adjustments
  - The calibration parameters can be adjusted real-time by the application running on the Cortex M0 processor core.
  - This feature can for example be used to implement temperature compensation or to switch between different measurement inputs
Energy Metering IC EM773
Definition of API output values

- Instantaneous values:
  - Real Power (P) [W]
  - Reactive Power (Q) [VAR]
  - Apparent Power (|S|) [VA]
  - Voltage (V) [V]
  - Current (I) [A]
  - Power factor = Real / Apparent Power \( \Rightarrow \cos(\Phi) \)

- Accumulated over time in application SW
  - Energy [kWh]
Energy Metering IC EM773
Application software options

- Process $P_{\text{real}}$, $P_{\text{reactive}}$, $P_{\text{apparent}}$, $V_{\text{rms}}$, $I_{\text{rms}}$ from Metrology Engine
  - Calculate kWh energy registers for one or more tariffs (T1, T2, \ldots)
  - 4-quadrant meter, measures both consumed energy (+T1, +T2, \ldots) and produced energy (-T1,-T2, \ldots)

- Energy-Creep filtering
  - Thresholds can be configured to prevent measuring noise energy

- Positive-accumulate-only option
  - Some applications require 2-quadrant operation

- Fully programmable to enable a multitude of output devices
  - Examples for Wireless M-bus, I2C LCD, UART output
  - Use the 50 MHz Cortex M0 processor core in the Energy Metering IC with up to 32 kB flash and 8 kB SRAM memory
EM773 Tool Highlights

- Evaluation boards
  - Plug meter with EM773 and OL2381
  - USB transceiver with LPC1343 and OL2381
  - Wireless M-Bus S1 Mode Software Included!

- IDEs Supporting EMxxx Metrology Engine
  - IAR Embedded Workbench for ARM (NOW!!!)
  - Keil and Code Red (Coming soon!)

- SWD debuggers
  - All debuggers supporting Cortex-M0
MCU Residential & Industrial Electricity Meters
LPC17xx – Available NOW!!!

Highest performance with many options including ethernet

- Optimized solution for industrial metering
- Advanced apps with superior MCU performance
- Ultimate flexibility for modular development
- Integrated ethernet MAC for IP network connection

Up to 512 KB Flash
Cortex-M3 120 MHz
Up to 64 KB SRAM

Ethernet
Advanced Peripheral Bus
12-bit / 8-ch ADC
3x SPI
2x I²C
4x UART
RS485 / IrDA
RTC

80/100-pin LQFP

http://ics.nxp.com/products/lpc1000/lpc17xx/
LPC1700 Tools Highlights

- Evaluation boards
  - Embedded Artists
  - Hitex LPC17xx-Stick
  - IAR KSDK-LPC17xx
  - Keil MCB17xx
  - mBed LPC1768

- IDEs
  - IAR Embedded Workbench for ARM
  - ARM/Keil µVision4
  - CodeRed RedSuite
  - Hitex HiTOP

- JTAG debuggers
  - All debuggers supporting Cortex-M3

- Plus many more tools available!
MCU Smart Metering Communications Modules
LPC13xx & LPC11xx – Available NOW!!!

Perfect MCU options for adding communications to existing meters

- Optimized solution for communications module
- Integrated USB option with LPC13xx family
- Demo USB keys available with LPC1343 and OL2381

Up to 32 KB Flash
M0: 50 MHz
M3: 72 MHz
Up to 8 KB SRAM

USB

Advanced Peripheral Bus

10-bit / 8-ch ADC
2x SPI
1x I²C
1x UART
RS485 / IrDA

33-pin QFN / 48-pin LQFP

http://ics.nxp.com/products/lpc1000/lpc11xx/
http://ics.nxp.com/products/lpc1000/lpc13xx/
LPC1300/1100 Tools Highlights

- Evaluation boards
  - LPC Xpresso
  - Hitex Sticks
  - IAR Kickstart Kits
  - Keil MCB1000

- IDEs
  - IAR Embedded Workbench for ARM
  - ARM/Keil μVision4
  - CodeRed RedSuite
  - Hitex HiTOP

- JTAG debuggers
  - All debuggers supporting Cortex-M0/M3

- Plus many more tools available!
Where to get started?

- [www.nxp.com/microcontrollers](http://www.nxp.com/microcontrollers) – MCU homepage
- [www.nxp.com/lpczone](http://www.nxp.com/lpczone) – Product updates and training
- [www.nxp.com/lpcxpresso](http://www.nxp.com/lpcxpresso)
- [www.mbed.org](http://www.mbed.org)
Social media for NXP microcontrollers

http://twitter.com/LPCZone
- Online community for NXP LPC microcontrollers.
- Follow LPCZone and you will have the most up-to-date information on the LPC product families.

http://www.youtube.com/user/LPCZone
- Design videos, trainings, interviews, fun

http://tech.groups.yahoo.com/group/lpc2000/
- More than 8,700 registered members (as of May 24, 2010)
- The #1 active Microcontroller user forum on Yahoo!
Smart Metering Building Blocks

- RTC
- Analog Front End
- RFID UHF Connectivity
  - PCB Tracking ICs
- Smart Card Interface
  - Contactless reader ICs
- Logic
- Discrete Components
- Temperature Sensors
- Power Supply (STARplug)

- AFE
- UART
- I²C
- SPI
- Flash
- Ethernet
- RS485

- MCU
- LCD Driver
- LCD Segment Drivers

- Wireless Connectivity
  - Zigbee Solutions
  - M-Bus Solutions
  - GSM / GPRS Solutions
  - Long Range RF Solutions

- Wired Connectivity
  - Power Line Carrier

Available

Under Consideration
NXP Wireless M-Bus Product offering

- Use Cases for In-house communication
  - Wireless Display -- Sub-Meters (Gas / Water / Heat)
  - Smart Appliances -- Remote Switches
  - USB dongle to access meter data by PC / mobile devices

- Advantages of Wireless M-Bus
  - Reliable and cost-efficient wireless solution
  - Technical advantages over Zigbee
  - Less installation cost

- NXP products for Wireless M-Bus solutions
  - OL2300: RF Transmitter
  - OL2311: RF Receiver
  - OL2381: RF Transceiver

- Full Wireless M-Bus Compliance
- Reference design available
NXP RF Products for Wireless M-BUS
Value Propositions

- **Efficient Transmitter Power Amp** *(required for S1 and S1m M-BUS modes)*
  - Programmable power output for optimal performance in every M-BUS Tx Class

- **Highly Sensitive Receiver** *(required for all receiving M-bus modes)*
  - Programmable receiver gain for optimal reception performance / current consumption balance.

- **Flexible Data Rate** *(required for T M-BUS modes)*
  - Up to 112kcps data rate for compatibility with all M-bus modes

- **Polling Timer & Preamble Detection** *(required for all M-BUS modes)*
  - Flexible Signal Monitors prevent ‘false wakeups’ & allow long system battery life.

- **Multi-Channel Operation** *(required for R2 M-BUS mode)*
  - Entire RF Range can be programmed on-the-fly to operate on different radio channels (jammer avoidance)
OL2300 Overview

- Fractional N PLL based RF Transmitter Solution
- 315 / 434 / 868 / 915 MHz operation
- Auto Antenna Tuning capability
- Data Rate up to 112kchips/s
- Fully software configurable
- HVQFN 16
  Small package outline
  3mm x 3 mm
Transceiver - Bidirectional
OL2381 Overview

• Two Way RF Transceiver Solution (half duplex)
• Fractional N PLL: 315 / 434 / 868 / 915 MHz
• Value Proposition
  • Fully software configurable, including On-Chip programmable IF-Filter
  • Low Power Polling timer and preamble detection
  • High RX Sensitivity & High TX Efficiency
• HVQFN32 Package

Quick Reference Data
Supply Voltage: 2.1V … 3.6V
Receive Current: 16.5 mA
Transmit Current: 9mA @ 0dBm
Sensitivity ASK -118 dBm @2.4kbps (50kHz BW)
Sensitivity FSK -112 dBm @2.4kbps (50kHz BW)
Lo Frequency Step Width: 150 Hz
IF Channel BW: 50/75/100/150/200/300kHz
RSSI Dynamic Range: 80 dB
Frequency Change Latency Time: 150µs

Wide band required
Narrow band desired
w/ optional multi-channel use
Key Application Strengths: Size and Integration

- LNA
- IF Polyphase Variable Channel Filter
- VCO +TANK
- PA
- SPI Interface
Application Strength – Low System Power Consumption with Intelligent Polling

Average System Current Consumption (mA)*

\[ \frac{(16.5 \text{mA} \times 10 \text{ms}) + (5 \mu \text{A} \times 90 \text{ms})}{100 \text{ms}} = 1.65 \text{mA} \]

*Communication protocol and application dependent
# Product Range Overview

<table>
<thead>
<tr>
<th>Type Number</th>
<th>OL2300</th>
<th>OL2311</th>
<th>OL2381</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product Type</strong></td>
<td>Transmitter</td>
<td>Receiver</td>
<td>Transceiver</td>
</tr>
<tr>
<td><strong>Supply Voltage</strong></td>
<td>2.1 V to 3.6 V</td>
<td>2.1 V to 3.6 V</td>
<td>2.1 V to 3.6 V</td>
</tr>
<tr>
<td><strong>Operating Temperature</strong></td>
<td>25 °C to + 85 °C</td>
<td>25 °C to + 85 °C</td>
<td>25 °C to + 85 °C</td>
</tr>
<tr>
<td><strong>Power Down Current</strong></td>
<td>50 nA</td>
<td>500 nA</td>
<td>500 nA</td>
</tr>
<tr>
<td><strong>UHF Carrier Frequency</strong></td>
<td>300 - 920 MHz</td>
<td>300 - 928 MHz</td>
<td>300 - 928 MHz</td>
</tr>
<tr>
<td><strong>Xtal Frequency</strong></td>
<td>9 - 19 MHz</td>
<td>16 MHz</td>
<td>16 MHz</td>
</tr>
<tr>
<td><strong>Transmitter</strong></td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Supply Current</strong></td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Max Output Power</strong></td>
<td>up to 12dBm</td>
<td>up to 10dBm</td>
<td>up to 10dBm</td>
</tr>
<tr>
<td><strong>Data Rate</strong></td>
<td>up to 112 kcps</td>
<td>up to 112 kcps</td>
<td>up to 112 kcps</td>
</tr>
<tr>
<td><strong>Modulation</strong></td>
<td>ASK, FSK</td>
<td>ASK, FSK</td>
<td>ASK, FSK</td>
</tr>
<tr>
<td><strong>Phase Noise</strong></td>
<td>@100kHz</td>
<td>-76 dBc</td>
<td>-86 dBc</td>
</tr>
<tr>
<td></td>
<td>@10MHz</td>
<td>-115 dBc</td>
<td>-130 dBc</td>
</tr>
<tr>
<td><strong>Receiver</strong></td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Supply Current</strong></td>
<td>16.5 mA</td>
<td>16.5 mA</td>
<td>16.5 mA</td>
</tr>
<tr>
<td><strong>Data Rate</strong></td>
<td>up to 112 kcps</td>
<td>up to 112 kcps</td>
<td>up to 112 kcps</td>
</tr>
<tr>
<td><strong>Modulation</strong></td>
<td>ASK, FSK</td>
<td>ASK, FSK</td>
<td>ASK, FSK</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Adjacent channel rejection</strong></td>
<td>10 dB</td>
<td>10 dB</td>
<td>10 dB</td>
</tr>
<tr>
<td><strong>Image channel rejection</strong></td>
<td>calibrated</td>
<td>calibrated</td>
<td>calibrated</td>
</tr>
<tr>
<td><strong>Channel Filter BW</strong></td>
<td>40 dB</td>
<td>40 dB</td>
<td>40 dB</td>
</tr>
<tr>
<td><strong>Polling Timer Period</strong></td>
<td>50 to 300 kHz</td>
<td>50 to 300 kHz</td>
<td>50 to 300 kHz</td>
</tr>
<tr>
<td><strong>RSSI</strong></td>
<td>Dynamic Range</td>
<td>Dynamic Range</td>
<td>Dynamic Range</td>
</tr>
<tr>
<td></td>
<td>80 dB</td>
<td>80 dB</td>
<td>80 dB</td>
</tr>
<tr>
<td></td>
<td>±12 dB / ±3 dB</td>
<td>±12 dB / ±3 dB</td>
<td>±12 dB / ±3 dB</td>
</tr>
<tr>
<td><strong>Package</strong></td>
<td>HVQFN16</td>
<td>HVQFN32</td>
<td>HVQFN32</td>
</tr>
</tbody>
</table>
OL23xx Tool Highlights

- Evaluation boards
  - Plug meter with EM773 and OL2381
  - USB transceiver with LPC1343 and OL2381
  - Wireless M-Bus S1 Mode Software Included!

- IDEs Supporting EMxxx Metrology Engine
  - IAR Embedded Workbench for ARM (NOW!!!)
  - Keil and Code Red (Coming soon!)

- IDEs Supporting Wireless M-Bus Stack
  - IAR Embedded Workbench for ARM (NOW!!!)
  - Keil and Code Red (Coming soon!)

- SWD debuggers
  - All debuggers supporting Cortex-M0
Smart Metering Building Blocks

- RTC
- Analog Front End
- RFID UHF Connectivity
  - PCB Tracking ICs
- Smart Card Interface
  - Contactless reader ICs
- Logic
- Discrete Components
- Temperature Sensors
- Power Supply
  - (STARplug)
- AFE
- I²C
- SPI
- Flash
- Ethernet
- RS485
- UART
- LCD Driver
- LCD Segment Drivers

Wireless Connectivity
- Zigbee Solutions
- M-Bus Solutions
- GSM / GPRS Solutions
- Long Range RF Solutions

Wired Connectivity
- Power Line Carrier

Available
- Under Consideration
NXP Value Proposition for Real Time Clocks (RTC)

- Application context / why does timing matter?
  - Tariff switching
  - Time stamping (e.g. billing, anti tampering etc.)

- Timing accuracy levels
  - The accuracy of normal RTC’s is temperature dependant
  - Options to achieve higher accuracy
    - Temperature compensation
    - Synchronization via network
  - Rule of thumb: longer / no synchronization intervals – higher accuracy needed

- NXP most recommended parts
  - PCF2127A / PCF2129A (highly accurate)
  - PCF2123 / PCF8523 (ultra low power)

- Advantages:
  - Integrated crystal
  - Temperature compensated (incl. calibration)
  - Ultra low power consumption (key for battery operated / backed systems)
**CWG Realtime Clocks**

*Low-power RTC Family*

- **PCF2123 Ultra-low Power RTC** (100nA (typ.) at Vdd = 2.0V and T_{amb} = 25°C)

**Key Features:**

- Ultra low power **100nA/2V** (typ.)
- Large voltage range 1.5…5.5V
- SPI bus up to 6MHz
- Clock from seconds to 99 years
- Programmable Timer
- Frequency output with output enable pin
- Electronic tuning
- Small packages TSSOP14, HVQFN16 and U (die only)
**Selection Table High Accuracy**

- Highly accurate time reference independent of temperature
- To enable accurate tariff switching in utility metering systems

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Interface</th>
<th>Accuracy (typ.)</th>
<th>Package</th>
<th>Status</th>
</tr>
</thead>
</table>
| PCF2127A   | real time clock/calendar; integrated RAM; temperature compensation; integrated quartz crystal; power management support; operating temperature range -40°C to +85°C | I²C & SPI | +/- 3ppm -15°C to +60°C
          & +/- 5ppm -25°C to -15°C
          & +/- 5ppm +60°C to +65°C | SO20     | released |
| PCF2129A   | real time clock/calendar; temperature compensation; integrated quartz crystal; automotive option available; operating temperature range -40°C to +85°C | I²C & SPI | +/- 3ppm -15°C to +60°C
          & +/- 5ppm -25°C to -15°C
          & +/- 5ppm +60°C to +65°C | SO20     | released |

**PCF2129A and PCF2127A NOW released and in volume production !!!**
**CWG Realtime Clocks**

*Accurate RTC Family*

- **PCF2129A/27A** Highly accurate RTC (±3 ppm (typ.) over T<sub>amb</sub> = -15°C to +60°C)

**Key Features:**

- ±3 ppm accuracy -15°C to +60°C (typ.)
- Integrated Quartz Crystal
- Temperature Compensation
- Factory calibrated
- 512 Byte of on-chip RAM (PCF2127A)
- SPI & I2C Interface
- SO20 Package
### PCF2129A/27A Highly accurate RTC

(±3 ppm (typ.) over T<sub>amb</sub> = -15°C to +60°C)

<table>
<thead>
<tr>
<th>Type</th>
<th>PCF2127A</th>
<th>PCF2129A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Temp. Range</td>
<td>-40°C, ..., +85°C</td>
<td>-40°C, ..., +85°C</td>
</tr>
<tr>
<td>Accuracy (typ.)</td>
<td>+/- 3 ppm -15°C to +60°C</td>
<td>+/- 3 ppm -15°C to +60°C</td>
</tr>
<tr>
<td></td>
<td>+/- 5 ppm -25°C to -15°C</td>
<td>+/- 5 ppm -25°C to -15°C</td>
</tr>
<tr>
<td></td>
<td>+/- 5 ppm +60°C to +65°C</td>
<td>+/- 5 ppm +60°C to +65°C</td>
</tr>
<tr>
<td>Interface</td>
<td>I²C and SPI</td>
<td>I²C and SPI</td>
</tr>
<tr>
<td>RAM</td>
<td>512 Byte</td>
<td>–</td>
</tr>
<tr>
<td>Package</td>
<td>SO20</td>
<td>SO20</td>
</tr>
<tr>
<td>Supply Voltage Range VDD</td>
<td>1.8V – 4.2V</td>
<td>1.8V – 4.2V</td>
</tr>
<tr>
<td>Battery Supply Voltage Range VBat</td>
<td>1.8V – 4.2V</td>
<td>1.8V – 4.2V</td>
</tr>
<tr>
<td>Supply Current (typ.)</td>
<td>650nA @ 3.0V and Tamb=25C</td>
<td>650nA @ 3.0V and Tamb=25C</td>
</tr>
<tr>
<td>Battery Switch over function</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Battery Low-Detection Function</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Extra Power Fail Detection Function</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Battery backed Output Voltage Pin</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Reset Output Pin</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Countdown timer and watch dog function</td>
<td>Yes</td>
<td>Watchdog only</td>
</tr>
<tr>
<td>Time Stamp Function</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

The 5V version of PCF2127 formerly named PCF2128 is currently not in focus.
More Information:
– http://ics.nxp.com/products/real.time.clock.calendars/
Smart Metering Building Blocks

- RTC
- Analog Front End
- RFID UHF Connectivity
  • PCB Tracking ICs
- Smart Card Interface
  • Contactless reader ICs
- Logic
- Discrete Components
- Temperature Sensors
- Power Supply (STARplug)

**Wireless Connectivity**
- Zigbee Solutions
- M-Bus Solutions
- GSM / GPRS Solutions
- Long Range RF Solutions

**Wired Connectivity**
- Power Line Carrier

- LCD Segment Drivers
- AFE
- UART
- I²C
- SPI
- Flash
- Ethernet
- RS485
- MCU
- LCD Driver

Available
Under Consideration
NXP Value Proposition for LCD Display Driver

- Application context
  - Display drivers are used to show the meter measurement data
  - Typical requirement is 128 to 160 segment display in the meter

- Implementation options
  - Integrated in MCU
  - Chip-on-Glass / Chip-on-Board
  - Stand-alone devices

- NXP most recommended stand-alone parts
  - PCF85162: 128 segment driver (4 x 32 segments)
  - PCF85176: 160 segment driver (4 x 40 segments)

- Advantages:
  - Low power consumption
  - Design flexibility (placement of DD vs. display)
  - Support of various displays technologies
## LCD Drivers: Key Products

### Segment Drivers
- **PCF85162** 4 x 32 Segments
- **PCF85176** 4 x 40 Segments
- **PCF85134** 4 x 60 Segments
- **PCF85133** 4 x 80 Segments
- **PCF85132** 4 x 160 Segments
- **PCA9620** 8 x 60 Segments

### Character Drivers
- **PCF2113** 2-line x 12-Character
  Plus 120 icons
- **PCF2116** 2-line x 24-Character
- **PCF2119** 2-line x 16-Character
  Plus 160 icons

### Graphic (Dot Matrix) Drivers
- **PCF8531** 34 x 128
  Small 4-x-20 Text Characters
  Full Graphics
- **PCF8811** 80 x 128
  Large Universal display

---

For Details, see the LCD Drivers Selection Guide

[1] In Development
**CWG LCD Drivers**

**Segment Driver Family**

- **LCD Segment Drivers**

### Features

- Drives wide range of displays from 128, 160, 240, 320, 480 up to 640 segments
- Supports four different Multiplex Rates: 1:1 (static), 1:2, 1:3 and 1:4 (PCA9620 additionally Mux 1:8)
- On-chip RAM with auto incremental addressing
- Low power consumption
- Wide power supply range
- Two selectable frame frequency ranges: 82Hz typically or 110Hz typically (PCF85133)
- Programmable frame frequency from 60Hz to 90Hz (PCF85132)
- Internal charge pump and VLCD temperature compensation for better optical performance (PCA9620)

### Key Products

- **PCF85162** 4 x 32 segments
- **PCF85176** 4 x 40 segments
- **PCF85134** 4 x 60 segments
- **PCF85133** 4 x 80 segments
- **PCF85132** 4 x 160 segments
- **PCA9620** 8x 60 segments (in development)

[Link to product page](http://ics.nxp.com/products/lcd.drivers/segments/)
**PCA9620  60x8 COG LCD Segment Driver** (supports up to 480 segments)

**Key Features:**
- 480 Segment Drive in Mux 1:8 Mode
- I2C Interface
- Integrated charge pump
- Integrated temperature sensor
- On-chip VLCD generation
- Temperature compensated VLCD voltage
- Programmable and calibrated frame frequency
- Wide frame frequency range 60Hz to 300Hz
- Wide digital power supply range 1.8V to 5.5V
- Wide analog power supply range 2.5V to 5.5V
- Wide VLCD range 2.5V to 9.0V
- Wide operating temp range -40 to +95°C
- 12 x 12 x 1.4 mm LQFP80 package
LCD Character Drivers

Key products
- PCF2113 2 line by 12 characters + 120 icons
- PCF2119 2 line by 16 characters + 160 icons

Features
- On-chip character generator
- On-chip temperature compensation
- On-chip character ROM and RAM
- Low power consumption
- Minimum of external components
- On-chip LCD bias voltage generation
- Cursor support

http://ics.nxp.com/products/lcd.drivers/characters/
LCD Graphics Drivers

Key products
- PCF8531 34 x 128 small 4 x 20 chars of text, full graphic
- PCF8811 80 x 128 large universal display

Features
- Wide range of mux rates to optimize power and display size
- On-chip generation of LCD bias voltages
- Low number of external components
- Low power consumption
- Temperature compensation

http://ics.nxp.com/products/lcd.drivers/graphics/
NXP Value Proposition for Power Supply
Switch Mode Power Supply (SMPS)

- **Application context**
  - Power supplies in metering applications need to stay operational during over-voltage situations
  - Voltages up to 1200 V can occur in 3-phase meters!

- **NXP recommended parts**
  - TEA1520T AC/DC converter from StarPlug™ family

- **Implementation**
  - StarPlug™ + cascaded MOS-FET (to cope with the 1200 V)

- **Metering Reference Design available (can be used for 3-phase systems)**

- **Advantages:**
  - Designed for reliability
  - Universal design for ww mains supply
  - Low radiation (EMI)
  - Good efficiency, exceeds Energy Star standard
Universal 3-phase Mains SMPS w/ STARplug
(Specifically intended for E-Metering applications)

- Supports all Global Mains Electricity Utility Networks (1-, 2- and 3-Phase).
- At least 20% additional voltage margin on the input stage and switching stage.
- Highly reliable
- Efficiency and no load power fully compliant with Energy Star 2.0
- EMI fully compliant with EN55022A
## Power Supply STARplug™ portfolio

<table>
<thead>
<tr>
<th>Type</th>
<th>Package</th>
<th>$R_{DS(on)}$</th>
<th>Max. output power</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEA1520T/N2</td>
<td>SO-14</td>
<td>48</td>
<td>2 - 5W</td>
</tr>
<tr>
<td>TEA1520P/N2</td>
<td>DIP-8</td>
<td>48</td>
<td>2 - 5W</td>
</tr>
<tr>
<td>TEA1521T/N2</td>
<td>SO-14</td>
<td>24</td>
<td>3 - 7W</td>
</tr>
<tr>
<td>TEA1521P/N2</td>
<td>DIP-8</td>
<td>24</td>
<td>3 - 7W</td>
</tr>
<tr>
<td>TEA1522T/N2</td>
<td>SO-14</td>
<td>12</td>
<td>7 - 9W</td>
</tr>
<tr>
<td>TEA1522P/N2</td>
<td>DIP-8</td>
<td>12</td>
<td>7 - 9W</td>
</tr>
<tr>
<td>TEA1523P/N2</td>
<td>DIP-8</td>
<td>6,5</td>
<td>9 - 12W</td>
</tr>
<tr>
<td>TEA1620P/N1</td>
<td>DIP-8</td>
<td>48</td>
<td>2 - 5W</td>
</tr>
<tr>
<td>TEA1622P/N1</td>
<td>DIP-8</td>
<td>12</td>
<td>7 - 9W</td>
</tr>
<tr>
<td>TEA1623P/N1</td>
<td>DIP-8</td>
<td>6,5</td>
<td>9 - 12W</td>
</tr>
<tr>
<td>TEA1623PH/N1</td>
<td>HDIP-16</td>
<td>6,5</td>
<td>12 - 30W</td>
</tr>
</tbody>
</table>
Smart Metering Building Blocks

- RTC
- Analog Front End
- RFID UHF Connectivity
  - PCB Tracking ICs
- Smart Card Interface
  - Contactless reader ICs
- Logic
- Discrete Components
- Temperature Sensors
- Power Supply
  - (STARplug)

**RTC**

**Analog Front End**

**RFID UHF Connectivity**
- PCB Tracking ICs

**Smart Card Interface**
- Contactless reader ICs

**Logic**

**Discrete Components**

**Temperature Sensors**

**Power Supply**
- (STARplug)

**Wireless Connectivity**

- Zigbee Solutions
- M-Bus Solutions
- GSM / GPRS Solutions
- Long Range RF Solutions

**Wired Connectivity**

- Power Line Carrier

**Available**

**Under Consideration**

---

**MCU**

- AFE
- I²C
- SPI
- Flash
- Ethernet
- RS485
- UART
- LCD Driver
- LCD Segment Drivers
Leverage Selling Logic Products
The solutions to tune and complete a design quickly

- **Control and Interface logic**
  - AND, OR, NAND, NOR, INV, BUF . . .
  - 1, 2, 4, 8, 16 & 32-bit solutions
  - 5.0 V HC/T, AHC/T; 3.3 V LVC; 1.8 V AUP

- **Analogue Switches**
  - Low leakage for sensor multiplexing
  - Low attenuation and distortion
  - NX3, NX5, HEF, HC/T, LV, LVC

- **Level translators**
  - Bi-directional translation
  - 1, 2, 4, 8, 16 & 20-bit solutions
  - 74LVCnT, 1.5 V ↔ 5.5 V
  - 74AVCnT, 1.2 V ↔ 3.6 V

- **Innovation in Packages**
  - SO & TSSOP
  - Small footprint DQFN
    - 0.5 mm & 0.4 mm pitch
  - Picogates and MicroPak
    - 0.5 mm, 0.35 mm & 0.3 mm pitch
Smart Metering Building Blocks

- RTC
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  - (STARplug)

**Wireless Connectivity**
- Zigbee Solutions
- M-Bus Solutions
- GSM / GPRS Solutions
- Long Range RF Solutions

**Wired Connectivity**
- Power Line Carrier

**Available**
- LCD
  - Driver
- Temperature Sensors
- Long Range RF Solutions

**Under Consideration**
- LCD Segment Drivers
- AFE
- I^2C
- SPI
- Flash
- Ethernet
- UART
- RS485
- MCU
Leverage Selling Discrete Components
GA's broad portfolio offers one-stop shopping possibility

- **Flatpower packages:** SOD123W, SOD128
- **Leadless packages:** SOD882, SOT883, SOT886

**Innovation in Packaging**
- superior size/performance ratio
- increased design options

**Energy-efficient**
- Eco-friendly
- lower power consumption
- generate less heat
- halogen-free

**Small-scale integration**
- reduce part count
- save costs
- increase reliability

**ESD protection**
- EMI filtering
- safeguard sensitive ICs
- match the triangle small size, low line capacity, robust protection

**MEGA Schottky diodes**
- PMEG-series
- Low V_{CEsat} (BISS) Transistors
- PBSS-series

**Flatpower packages:**
- SOD123W, SOD128

**Leadless packages:**
- SOD882, SOT883, SOT886

**ESD protection**
- PESD-series

**TVS protection**
- PTVS-series

**Double RET’s / double Transistors**
- Double / Triple / Quad Diodes
- Loadswitches, MosFet drivers
General Application Discretes

Broadliner in standard products

Diodes
- Low $V_F$ (MEGA) Schottky diodes
- Zener diodes
- Small-signal switching diodes

Protection and signal conditioning
- ESD protection diodes, TVS diodes
- EMI and ESD filters, Integrated Discretes
- HDMI Transceiver / Receiver

Transistors
- Low $V_{C\text{esat}}$ (BISS) transistors
- Resistor-equipped transistors (RETs)
- Small-signal and medium power bipolar transistors

Small-signal MOSFETs

Standard Linear products
- Adjustable shunt voltage regulator ICs
- Voltage regulators

.... in 43 packages
- Ultra-small leadless
- Medium power leadless
- FlatPower and Flat-lead
- Standard industry packages

... over 384,000 km
All discretes produced in three years easily cover the distance from earth to moon
ESD protection, TVS diodes
New IC technology is vulnerable for ESD, NXP has the right solution

- ESD protection Diodes,
  - There are many interface connectors, NXP will protect them with there best in class PESD devices, for single and multiple lines
  - Protection diodes with low \( (C_d) \) capacitance for high speed data lines like USB. Special devices for HDMI

- 400W TVS diodes to protect against surge charges.
  - Best in class value for surge/PCB area - double compared to competition
  - Smallest package offering 400 W surge capability
  - Low maximum leakage current –10x lower than competition
Integration
The way forward to make it Cost effective & Reliable

- Pick & Place cost
  - This is becoming a large part of the total cost, when product prices are close to 0.01€

- Less components improve the quality
  - Thermal stress on the solder joins leads to 50% of the malfunctions of electronic equipment

- Solution:
  - Voltage regulators
  - Loadswitches
  - RET’s & double RET’s
  - Mosfet Drivers
  - Matched Pairs Transistors

- Combination:
  - Triple & Quad Diodes
  - Double Transistors
  - Double Low $V_{CE_{sat}}$
  - Low $V_{CE_{sat}}$ / Low $V_F$ Modules

Small-scale integration
- reduce part count
- save costs
- increase reliability

RETs
PDTC/A-series
PBRN/P-series
Complex discretes e.g. PBLS-, PMD-, PMP-series
Smart Metering Building Blocks

- RTC
- Analog Front End
- RFID UHF Connectivity
  - PCB Tracking ICs
- Smart Card Interface
  - Contactless reader ICs
- Logic
- Discrete Components
- Temperature Sensors
- Power Supply
  - (STARplug)

**Available**

- AFE
- I2C
- SPI
- Flash
- Ethernet
- RS485
- UART
- LCD Driver
- LCD Segment Drivers

**Wireless Connectivity**
- Zigbee Solutions
- M-Bus Solutions
- GSM / GPRS Solutions
- Long Range RF Solutions

**Wired Connectivity**
- Power Line Carrier

**Under Consideration**
Principle of Prepaid Contactless Metering
NXP Value Proposition in Prepaid Metering

- Current solutions for prepaid meters
  - Magnetic cards - Tokens
  - Contact smart cards - Keypad / Numeric tokens

- Advantages of contactless technology
  - Better protection against environmental effects (dust, humidity, etc.)
  - Longer lifetime, no maintenance
  - User convenience

- NXP offers a broad card IC and reader IC portfolio for prepaid metering

- Most recommended solutions

Reader ICs
- MFRC530
- MICORE I
- ISO 14443A

MFRC522
- MICORE II
- ISO 14443A

MIFARE
- Plus
- MF1 S61
- MF1 S71

MIFARE
- DESFire (EV1)
- MF3 D21
- MF3 D41
- MF3 D81

Card ICs
NXP supports prepaid metering with a broad card IC and reader IC portfolio

**Most recommended reader ICs**

<table>
<thead>
<tr>
<th>MFRC530 MICORE I ISO 14443A</th>
<th>MFRC522 MICORE II ISO 14443A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating Distance</strong></td>
<td>Up to 10 cm</td>
</tr>
<tr>
<td><strong>Power Supply</strong></td>
<td>3,3 / 5 V</td>
</tr>
<tr>
<td><strong>RF Interface Power</strong></td>
<td>Up to 500 mW</td>
</tr>
<tr>
<td><strong>Serial Interface</strong></td>
<td>8 bit parallel, 3,3 V digital supply, SPI</td>
</tr>
<tr>
<td><strong>Power Supply</strong></td>
<td>Up to 500 mW w. amplifier</td>
</tr>
<tr>
<td><strong>RFC Interface</strong></td>
<td>I2C, SPI, RS232, 3,3 V digital supply</td>
</tr>
</tbody>
</table>

**Most recommended card ICs**

<table>
<thead>
<tr>
<th>MIFARE Plus MF1 S61 MF1 S71</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating Distance</strong></td>
</tr>
<tr>
<td><strong>Power Supply</strong></td>
</tr>
<tr>
<td><strong>RF Interface</strong></td>
</tr>
<tr>
<td><strong>Serial Interface</strong></td>
</tr>
<tr>
<td><strong>Power Supply</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MIFARE DESFire (EV1) MF3 D21 MF3 D41 MF3 D81</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating Distance</strong></td>
</tr>
<tr>
<td><strong>Power Supply</strong></td>
</tr>
<tr>
<td><strong>RF Interface</strong></td>
</tr>
<tr>
<td><strong>Serial Interface</strong></td>
</tr>
</tbody>
</table>

**Certification**

- HW Crypto
- EEPROM
- Special Features
- Certification
MFRC522 – MIFARE Reader

Customer Benefits
- Low cost RF front-end IC
- ISO14443 A, MIFARE
- Provided with SW BFL (Basic Function library)
- Easy integration

Supported RF protocols

Reader/Writer mode
- ISO/IEC A R/W support up to 848 kbit/s
- R/W support for MIFARE 1K, 4K
- ISO/IEC 14443-3 (ULC)
- ISO/IEC 14443-4 (DESFire, Plus)

Features
- 64 Byte FIFO
- Interrupts using IRQ pin
- Dedicated ID for every Operating Mode
- 2.5 V - 3.6 V power supply, typ. 3.3V
- PVDD interface supply voltage down to 1.6V
- Low cost packages HVQFN32
- Basic Function Library (source code)

Interfaces
- SPI, I²C, Serial UART

Market
- Infrastructure Contactless Reader
- Portable equipment, consumer device
- Metering

Customer Benefits

Supported RF protocols

Reader/Writer mode

Features

Interfaces
MFRC530
MIFARE Reader

Customer Benefits
- High Power RF front-end IC
- ISO14443 A support
- Provided with SW BFL (Basic Function library)
- Easy integration

Supported RF protocols

Reader/Writer mode
- ISO/IEC14443A R/W support up to 424 kbit/s
- R/W support for MIFARE 1K, 4K
- ISO/IEC 14443-3 (ULC)
- ISO/IEC 14443-4 (DESFire, Plus)

Features
- 64 Byte FIFO
- Interrupts using IRQ pin
- Dedicated ID for every Operating Mode
- 2.5 V - 3.6 V or 4.5V - 5.5V power supply
- SO 32 High power package
- Basic Function Library (source code)
- Unique serial number

Interfaces
- SPI, 8 bit parallel interface

Market
- Infrastructure Contactless Reader
- consumer device
- Metering

Customer Benefits
- High Power RF front-end IC
- ISO14443 A support
- Provided with SW BFL (Basic Function library)
- Easy integration

Supported RF protocols

Reader/Writer mode
- ISO/IEC14443A R/W support up to 424 kbit/s
- R/W support for MIFARE 1K, 4K
- ISO/IEC 14443-3 (ULC)
- ISO/IEC 14443-4 (DESFire, Plus)

Features
- 64 Byte FIFO
- Interrupts using IRQ pin
- Dedicated ID for every Operating Mode
- 2.5 V - 3.6 V or 4.5V - 5.5V power supply
- SO 32 High power package
- Basic Function Library (source code)
- Unique serial number

Interfaces
- SPI, 8 bit parallel interface
Smart Metering Building Blocks

- RTC
- Analog Front End
- RFID UHF Connectivity
  PCB Tracking ICs
- Smart Card Interface
  Contactless reader ICs
- Logic
- Discrete Components
- Temperature Sensors
- Power Supply
  (STARplug)

**Available**

**Under Consideration**

**Wireless Connectivity**
- Zigbee Solutions
- M-Bus Solutions
- GSM / GPRS Solutions
- Long Range RF Solutions

**Wired Connectivity**
- Power Line Carrier

**Connectivity Interfaces**
- AFE
- I²C
- SPI
- Flash
- RS485
- Ethernet
- UART
- LCD Driver
- LCD Segment Drivers
Temperature Sensor Value Proposition

- **Why used?**
  - Determine the temperature
  - Set window for Interrupt, alarm, fan control, shutdown, etc.

- **Where used?**
  - Instrumentation for front-end data calibration
  - On-board temperature measurement for system management

- **Why NXP Thermal Sensor?**
  - Large selection of commonly used local sensor and local/remote sensor thermal sensors in a wide range of packages
  - Invented the I²C-bus, very proficient designers with bullet proof designs
  - Continuous innovation with new low price LM75B local sensor in small 2 x 3 mm package

### Table: Accuracy and SMBus Timeout

<table>
<thead>
<tr>
<th>Part #</th>
<th>Accuracy</th>
<th>SMBus Timeout</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM75A / 75B</td>
<td>±2 °C</td>
<td>A = No; B = Yes</td>
</tr>
<tr>
<td>SE95</td>
<td>±1 °C</td>
<td>No</td>
</tr>
<tr>
<td>SE98A / 98B</td>
<td>±1 °C</td>
<td>Yes</td>
</tr>
<tr>
<td>SE97 / 97B*</td>
<td>±1 °C</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Table: Local and Remote Sensor Accuracy

<table>
<thead>
<tr>
<th>Part #</th>
<th>Local Sensor Accuracy</th>
<th>Remote Sensor Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>NE1617A</td>
<td>±2 °C</td>
<td>±3 °C</td>
</tr>
<tr>
<td>NE1619**</td>
<td>±3 °C</td>
<td>±5 °C</td>
</tr>
<tr>
<td>SA56004</td>
<td>±2 °C</td>
<td>±1 °C</td>
</tr>
</tbody>
</table>

Note: * With 2Kbit EEPROM; ** With voltage monitors
**LM75B**

Local Digital Temp. Sensor & Thermal Watchdog

**Features**
- Pin-for-pin replacement for industry standard LM75 and LM75A
- I²C-bus interface - 8 devices on the same bus
- Power supply range from 2.8 V to 5.5 V
- Temperatures range from -55 °C to +125 °C
- Frequency range 20 Hz to 400 kHz with bus fault time-out to prevent hanging up the bus
- 11-bit ADC - temperature resolution of 0.125 °C
- Temperature accuracy of:
  - ±2 °C from -25 °C to +100 °C
  - ±3 °C from -55 °C to +125 °C
- Programmable temperature threshold and hysteresis set points
- Max supply current of 1.0 µA in shutdown mode
- Stand-alone operation as thermostat at power-up
- ESD protection exceeds 4500 V HBM per JESD22-A114, 450 V MM per JESD22-A115 and 2000 V CDM per JESD22-C101
- Small 8-pin package types: SO8 and TSSOP8

<table>
<thead>
<tr>
<th>Type number</th>
<th>Topside mark</th>
<th>Package</th>
<th>Description</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM75BD</td>
<td>LM7BD</td>
<td>SO8</td>
<td>plastic small outline package, 8 leads, body width 3.9 mm</td>
<td>SOT706-1</td>
</tr>
<tr>
<td>LM76BOP</td>
<td>LM76B</td>
<td>TSSOP8</td>
<td>plastic thin shrink small outline package, 8 leads, body width 3 mm</td>
<td>SOT585-1</td>
</tr>
<tr>
<td>LM76B0D</td>
<td>756</td>
<td>XSON8U</td>
<td>plastic extremely thin small outline package, no leads, 8 terminals, UTLP based, body 3 x 2 x 0.6 mm</td>
<td>SOT995-2</td>
</tr>
</tbody>
</table>
Smart Metering Building Blocks

- RTC
- Analog Front End
- RFID UHF Connectivity
- Smart Card Interface
- Logic
- Discrete Components
- Temperature Sensors
- Power Supply (STARplug)

Wireless Connectivity
- Zigbee Solutions
- M-Bus Solutions
- GSM / GPRS Solutions
- Long Range RF Solutions

Wired Connectivity
- Power Line Carrier

LCD Segment Drivers

AFE
I^2C
SPI
Flash
Ethernet
RS485
UART

Available
Under Consideration
Why RFID in Consumer Electronics

Who benefits?

RFID chip → PCB manufacturing → Electronic Manuf. Service → Brand Owner (Prime Decision Maker)

- Higher degree of automation for tracking and quality management, increased throughput time
- Configuration: RFID based generation of derivatives: Less Inventory, shorter lead times
- Brand Protection: Grey Markets reached 13% of global phone market in 2009
- Theft Deterrence (Disable/Enable)

Recycling → Consumer → Retailer

- Reduce Cost - increase speed for sorting operation
- Read out Warranty info directly from the product
- Theft deterrence (EAS+ Disable/Enable)
- Inventory Management
Use Case: Product Configuration

Reduction of order lead times as well as cost of stock keeping

- Use RFID to configure/modify the product at late stage in supply chain
- Create commercial derivatives in the warehouse, while device is already packaged and inside the box
Use Case: Service Efficiency

- Fast check via RFID if warranty does apply for the product
  - Has the product been sold through an authorized sales channel?
  - Has warranty time period exceeded?

- Write service operation history into the RFID memory

- Safe time during service with product specific info stored on RFID chip
  - Which firmware version was used, production lot number, etc.

- Read-out of basic product information stored on the RFID chip in case electronics device doesn’t boot anymore.
RFID easy to use on PCBs

- Mounting of the RFID IC onto of the PCB
- RFID chip embedded inside the PCB
- The RFID antenna is part of the PCB
Why NXP? – Our offering

- Superior product portfolio with special features tailored to the requirements for RFID in the electronics device market
- NXP provides technical support
  - RFID system optimization and reference antenna designs

<table>
<thead>
<tr>
<th>Product Offering</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCODE G2XL, G2XM</td>
<td>PCB tracking and tracing, theft deterrence, production control</td>
</tr>
<tr>
<td>512 bit user memory</td>
<td></td>
</tr>
<tr>
<td>UCODE G2iL, G2iL+</td>
<td>Product Configuration, PCB tracking and tracing, theft deterrence, production control</td>
</tr>
<tr>
<td>data transfer, digital switch</td>
<td></td>
</tr>
</tbody>
</table>

Note: for further information on UCODE products please refer to the UCODE product presentation
Comparison RFID v. Barcode

- RFID advantages:
  - no line of sight
  - Fast read outs, bulk reading
  - Data storage

<table>
<thead>
<tr>
<th></th>
<th>Scan technology</th>
<th>PCB area required</th>
<th>Scan - Speed</th>
<th>Degree of Automation</th>
<th>Flexibility</th>
<th>Long Term Data Retention</th>
<th>Robust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barcode</td>
<td>Optically – requires line of sight</td>
<td>1 cm2 for 2-D barcode</td>
<td>Slow, only one at a time – often done manually</td>
<td>Need to Re-adjust scanner for product changeover</td>
<td>Stores fixed Identification number only. New barcode needed for derivative generation</td>
<td>Can be removed, or get lost – Labels are only stucked to the product</td>
<td>No small parts of dirt lead to read failures</td>
</tr>
<tr>
<td>RFID</td>
<td>Electro-Magnetically Can read through everything except Metal</td>
<td>1 cm2 for antenna</td>
<td>Fast 100+/second</td>
<td>No re-adjustment Reader &quot;finds&quot; the RFID tag in the antenna field independent from its location</td>
<td>Fixed unique ID number + read/write Memory Write derivative UID into memory and lock it.</td>
<td>RFID chip is an invisible fixed part of the product and stays with the product until recycling</td>
<td>Yes No line of sight required Chip embedded inside the PCB</td>
</tr>
</tbody>
</table>

RFID benefits:
- No line of sight
- Fast read outs, bulk reading
- Data storage

Barcode benefits:
- Optically
- Electro-Magnetically
- Fixed unique ID number + read/write Memory
- No line of sight required
- Chip embedded inside the PCB

Comparison RFID v. Barcode
Smart Metering Building Blocks

RTC

Analog Front End

RFID UHF Connectivity
PCB Tracking ICs

Smart Card Interface
Contactless reader ICs

Logic

Discrete Components

Temperature Sensors

Power Supply
(STARTplug)

M-Bus Solutions

LCD Segment Drivers

GSM / GPRS Solutions

Discrete Components

RTC

LCD Driver

Power Line Carrier

Wireless Connectivity

Zigbee Solutions

M-Bus Solutions

GSM / GPRS Solutions

Long Range RF Solutions

Wired Connectivity

Available

Under Consideration

AFE

UART

I²C

SPI

Flash

Ethernet

RS485

MCU

TCP
Long Range RF in Smart Metering
NXP Solutions for Sensitivity and Antenna Range Extension

Recommended products
- LNA: BGU7003, BGA2001, MMIC; BFU6/7xxF, SiGe:C RF Tr, SOT343F
- PA: BGA7024 (24dBm), BGA7027 (27dBm), MMIC, SOT89

Available NOW!
0.25W (24dBm)
0.5W (27dBm)

JN5148 or OL2381

Need more choice? www.nxp.com/rfmanual (p. 36)
400-2700MHz Medium Power Amplifiers (MPA)

**Released**

**BGA2031**
- 5th generation Medium Power Variable Gain Amplifier MMIC
- *Gain up to 23 dB*
- *Gain Control Range 56 dB*
- *P1dB up to 13 dBm*

**BGA6589**
- 5th gen Medium Power MMIC Amplifier
- *Gain up to 17 dB*
- *P1dB up to 20 dBm*

**BFG21W**
- 5th gen RF Transistor MPA
- *Gain up to 12 dB*
- *P1dB up to 24 dBm*

*for detail pls. refer to datasheet

**NEW Products**

**24 and 27dBm 6th generation MMIC Medium Power Amplifier**

**BGA7124 – 0.25W**
- BGA7127 – 0.5W
- SOT908
  - Plastic thermal enhanced very thin small outline package
  - Body 3 x 3 x 0.85 mm

**In Development**

**30, 33dBm 6th generation Medium Power Amplifiers**

<table>
<thead>
<tr>
<th>BGA</th>
<th>7x27</th>
<th>7x30</th>
<th>7x33</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1dB</td>
<td>27</td>
<td>30</td>
<td>33</td>
</tr>
<tr>
<td>Gain</td>
<td>16</td>
<td>13</td>
<td>13</td>
</tr>
</tbody>
</table>

- Wideband, 400MHz to 2700MHz
- Single stage, gain @ 2GHz

**BGA7204 6th generation Variable Gain amplifier**
- P1dB 27dBm
- Wide frequency range, 400-2750MHz
- Small-signal gain, 20dB @ 2GHz
- Broad gain-control range, 30dB
- OIP3 40dBm
- NF 5dB at maximum gain setting

*for detail pls. refer to datasheet
BGU7003 7th generation LNA MMIC

- Applicable between 40 MHz and 6 GHz
- Integrated, temperature-stabilized bias for easy design
- Bias current configurable with external resistor
- Low noise figure (NF): 0.80 dB at 1.575 GHz
- High insertion power gain: 18.3 dB at 1.575 GHz
- Optimized performance at low 5 mA supply current
- ESD protection > 1 kV Human Body Model (HBM) on all pins
- Low current consumption in power-down mode (<1 μA)
- Supply voltage: 2.2 to 2.85 V
- Small, 6-pin SOT891 leadless package (1.0 x 1.0 x 0.5 mm)
- Proven, robust QUBiC4X SiGeC process technology (fT = 110 GHz)
# 6th & 7th Generation Wideband Transistors

## LNAs (BFU710, 610, 730, 630)

### BFU710
- **High Gain**: 17.3 dB @ 12 GHz
- **$f_T$**: 43 GHz @ 12 mA
- **$V_{CEO}$ max**: 2.8 V
- **Applications**: Ku-band LNA, 1st stage LNA SDARS
- **Competitors**: IFX: BFP720

### BFU790
- **Gain**: 21 dB @ 1.5 GHz
- **$f_T$**: 25 GHz @ 100 mA
- **$V_{CEO}$ max**: 2.8 V
- **Applications**: High linearity amplifiers
- **Competitors**:

## Drivers & Discrete PA

### BFU610
- **High Gain**: 20.2 dB @ 5.8 GHz
- **$f_T$**: 15 GHz @ 4 mA
- **$V_{CEO}$ max**: 5.0 V
- **Applications**: DRO satellite LNB
- **Competitors**: NEC: NESG2021M05

### BFU630
- **High Gain**: 26 dB @ 1.8 GHz
- **$f_T$**: 21 GHz @ 10 mA
- **$V_{CEO}$ max**: 5.0 V
- **Applications**: WLAN, WiMax, SDARS, LTE
- **Competitors**: IFX: BFP640, NESG2031M05

### BFU690
- **Gain**: 13.7 dB @ 1.8 GHz
- **$f_T$**: 18 GHz @ 50 mA
- **$V_{CEO}$ max**: 5.0 V
- **Applications**: High linearity amplifiers
- **Competitors**: IFX: BFP650

### BFU730
- **High Gain**: 20.1 dB @ 5.8 GHz
- **$f_T$**: 55 GHz @ 25 mA
- **$V_{CEO}$ max**: 2.8 V
- **Applications**: Ku-band LNA, 5-GHz WLAN, LTE
- **Competitors**: IFX: BFP740, NESG3031M05

### BFU760
- **Gain**: 24.0 dB @ 1.8 GHz
- **$f_T$**: 45 GHz @ 55 mA
- **$V_{CEO}$ max**: 2.8 V
- **Applications**: High linearity amplifiers
- **Competitors**: IFX: BFP750

### BFU660
- **Gain**: 23.7 dB @ 1.8 GHz
- **$f_T$**: 21 GHz @ 20 mA
- **$V_{CEO}$ max**: 5.0 V
- **Applications**: High linearity amplifiers
- **Competitors**: NESG2101M05

### BFU690
- **Gain**: 21 dB @ 1.8 GHz
- **$f_T$**: 25 GHz @ 100 mA
- **$V_{CEO}$ max**: 2.8 V
- **Applications**:
- **Competitors**: IFX: BFP650
5th Generation Medium Power MMICs

<table>
<thead>
<tr>
<th>Type</th>
<th>OIP3 @ 850 MHz</th>
<th>P1dB @ 850 MHz</th>
<th>OIP3 @ 2400 MHz</th>
<th>P1dB @ 2400 MHz</th>
<th>NF @ 850 MHz</th>
<th>NF @ 1950 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>BGA6289</td>
<td>31.4</td>
<td>16.6</td>
<td>24.5</td>
<td>15.1</td>
<td>3.8</td>
<td>4.05</td>
</tr>
<tr>
<td>BGA6489</td>
<td>33.2</td>
<td>20.4</td>
<td>27</td>
<td>17.4</td>
<td>3.29</td>
<td>3.5</td>
</tr>
<tr>
<td>BGA6589</td>
<td>33.5</td>
<td>20.1</td>
<td>30.5</td>
<td>19.9</td>
<td>3.25</td>
<td>3.45</td>
</tr>
</tbody>
</table>

- **Features**
  - high linearity
  - In *cost effective* bipolar silicon process
  - 50 ohm in/out
  - 20 dBm output pwr
  - single supply
## 5th Generation MMICs

### Low Noise Wideband Amplifiers

<table>
<thead>
<tr>
<th>Type</th>
<th>Limits</th>
<th>@ 900MHz</th>
<th>@ 1800 MHz</th>
<th>Gain@3 (dB)</th>
<th>@ 1 GHz</th>
<th>2.6 ghz</th>
<th>3.0 ghz</th>
<th>Vs (V)</th>
<th>Is (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BGA2001</td>
<td>4.5</td>
<td>30</td>
<td>135</td>
<td>1.3</td>
<td>22&lt;sup&gt;1)&lt;/sup&gt;</td>
<td>-7.4</td>
<td>1.3</td>
<td>19.5&lt;sup&gt;1)&lt;/sup&gt;</td>
<td>-4.5</td>
</tr>
<tr>
<td>BGA2003</td>
<td>4.5</td>
<td>30</td>
<td>135</td>
<td>1.8</td>
<td>24&lt;sup&gt;1)&lt;/sup&gt;</td>
<td>-6.5</td>
<td>1.8</td>
<td>16&lt;sup&gt;1)&lt;/sup&gt;</td>
<td>-4.8</td>
</tr>
<tr>
<td>BGA2011</td>
<td>4.5</td>
<td>30</td>
<td>135</td>
<td>1.5</td>
<td>19&lt;sup&gt;3)&lt;/sup&gt;</td>
<td>10</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>BGA2012</td>
<td>4.5</td>
<td>15</td>
<td>70</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.7</td>
<td>16&lt;sup&gt;3)&lt;/sup&gt;</td>
<td>10</td>
</tr>
</tbody>
</table>

Notes: 1. MSG 2. Adjustable bias 3. |S<sub>21| | <sup>2</sup> 4. Under development

### 2 Stage Variable Gain Linear Amplifier

<table>
<thead>
<tr>
<th>Type</th>
<th>Limits</th>
<th>Frequency Range (MHz)</th>
<th>@ 900MHz</th>
<th>@ 1900 MHz</th>
<th>@</th>
</tr>
</thead>
<tbody>
<tr>
<td>BGA2031/1</td>
<td>3.3</td>
<td>800-2500</td>
<td>24</td>
<td>62</td>
<td>11</td>
</tr>
</tbody>
</table>

Notes: 1. Gain = G<sub>P</sub>, power gain. 2. ΔG = Gain control range

### Wideband Linear Mixer

<table>
<thead>
<tr>
<th>Type</th>
<th>Limits</th>
<th>RF Input Range (MHz)</th>
<th>IF Output Range (MHz)</th>
<th>@ 880MHz</th>
<th>@2450 MHz</th>
<th>@</th>
</tr>
</thead>
<tbody>
<tr>
<td>BGA2022</td>
<td>4</td>
<td>0-2500</td>
<td>0-500</td>
<td>9</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

Notes: 1. Gain = G<sub>C</sub>, Conversion gain
Smart Metering Building Blocks

- RTC
- Analog Front End
- RFID UHF Connectivity
- Smart Card Interface
- Logic
- Discrete Components
- Temperature Sensors
- Power Supply (STARplug)

Wireless Connectivity
- Zigbee Solutions
- M-Bus Solutions
- GSM / GPRS Solutions
- Long Range RF Solutions

Wired Connectivity
- Power Line Carrier

Available
- LCD
- Driver

Under Consideration
- Temperature Sensors
- Long Range RF Solutions
- Power Line Carrier

Components:
- AFE
- UART
- I²C
- SPI
- Flash
- Ethernet
- RS485
- MCU
- LCD Driver
- LCD Segment Drivers
Jennic JN5148 Low Power Zigbee Wireless

- **Single Chip Device:**
- **Microcontroller:**
  - High Performance 32-bit RISC CPU core – programmable clock, 4-32MHz
  - *Rich User Peripherals* – mixed digital and analogue
    - UARTs, SPI, 2-Wire Serial (I²C), GPIO, Timers, PWM, 12-bit ADC, DAC, Comparators
    - JTAG debug port,
    - Large memory footprint - 128kBytes RAM
    - 128kBytes ROM for 15.4 MAC, stacks
- **IEEE802.15.4 2.4GHz transceiver**
  - 98dB link budget, achieving 30-50m indoors
  - 128-bit AES encryption, highly secure networking
- **System implementation**
  - Low sleep power consumption - 1.3uA with timer
  - Low power - 15mA TX, 18mA RX (35% less than competition)
  - External BOM (<50c) – Crystal, Discretes, Serial Flash
Jennic JN5148 Module Product Range

- All modules include JN5148 chip, plus support components

- Standard power modules:
  - With integrated printed antenna: JN5148-001-M00
  - With uFl connector: JN5148-001-M03

- High power module:
  - High Power with uFl connector: JN5148-001-M
    - +20dBm

» Module value proposition
  - Fast time to market
  - Ready approved to FCC and EU regulations
  - No need for RF design resource for board and test design
  - Overall cheaper cost of implementation up to 20-50ku
Jennic JN5148 Product Cycle

**Evaluation Kits**
- Proof of concept
- Prototype development
- Easy to develop - works out of the box

**Modules**
- Pre-certified and tested
- Cost effective for medium volume production
- RF design issues solved

**Single Chip**
- Customer does their own PCB layout, certification etc
- Lowest cost for high volume production
- Jennic provides reference design
Software: JenNet Network Stack

- Proprietary network stack
  - No Alliance membership fee
  - No additional cost for product certification

- For JN5148 family of chips and modules
  - Proprietary network - supports star, tree and linear topologies
    - 85kB code space for application on coordinator/router
    - 95kB code space for application on end device
  - Recommended maximum network size is 500 nodes
  - Reliable and robust communication
  - Advanced network management and self repair mechanism
  - Easy to use compared to ZigBee PRO
Software: ZigBee PRO

- ZigBee software stacks are developed and managed by the ZigBee Alliance
  - Feature rich, but very complicated to use
  - Recommended only if interoperability is the key requirement

- ZigBee PRO
  - Standardised mesh networking stack with profiles to address specific applications
    • Ensures interoperability
  - Focus market is the emerging Smart Energy market
    • Other profiles include Home Automation, Commercial Building Automation
  - Provides features to support real world scenarios
    • Frequency agility, enhanced security

- The ZigBee Alliance operate a rigorous certification process
  - To ensure interoperability at a platform and system level
  - Provide a recognisable logo / branding

- NXP ZigBee PRO solution provides:
  - ZigBee Compliant Platform using JN5148
  - Smart Energy profiles for In-Premises Display (IPD)
  - Smart Energy Load Control and Demand Response
  - Home Automation profiles
JN5148 Evaluation Kit

- **Hardware**
  - Controller and 4 sensor boards

- **Eclipse IDE**
  - Graphical software development tool
  - C compiler, assembler, debugger
  - Home sensor demo out of the box
  - IEEE802.15.4 Protocol stack
  - Stacks supplied as object library with APIs

- **JenNet kit**
  - JenNet Library

- **ZigBee PRO kit**
  - ZigBee PRO networking library
    - Smart Energy profile on request
    - Home Automation profile on request

Evaluation kit roll-out into distribution on October 1st