

Automotive & Industrial

May 14, 2002

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business unit Power Management & Supply
business group Automotive & Industrial



Never stop thinking.

Agenda

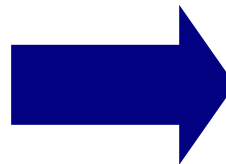
- Power Consumption & Savings Potential
- Infineon's Power Management & Supply:
Focus & Strategy
 - AC/DC & DC/DC: Desktop PC, an example
 - Drives: New TrenchStop IGBT
- Industry & Market Recognition

Power Consumption & Savings potential

The estimated total power consumed by electronic equipment in approximately 30 million households in Germany, is 14Gigawatt.

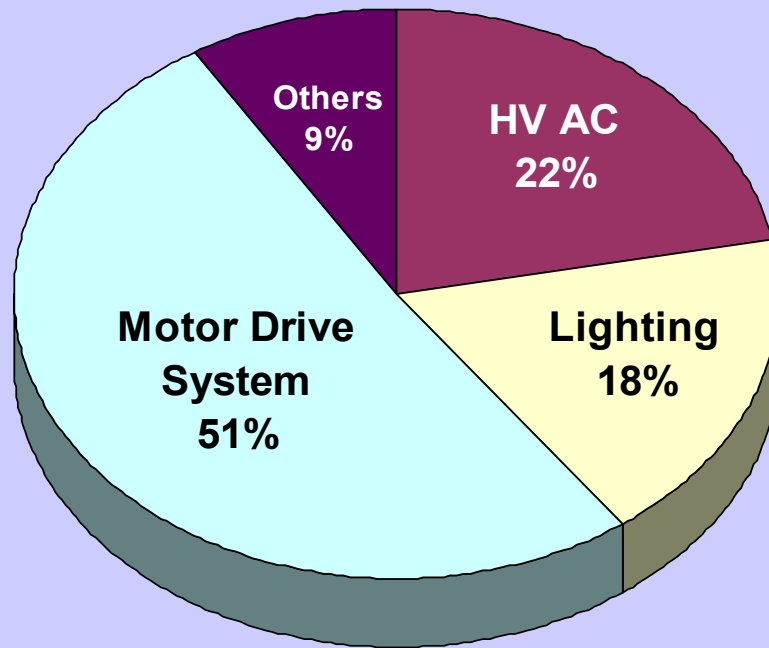
Saving of 10% would result in 1.4 Gigawatt of power per year

► We would need up to ONE less Nuclear Reactor



Energy Saving Potential with New Power Semiconductor Devices and Optimized Converter Technologies

Consumption of electrical energy



Source: US Energy State Dept.2000

- **Today: less than 20% of motors are controlled by Variable Speed Drives (VSD)**
 - Energy saving potential: 80 Bill. US \$/year by 100% VSD
- **Lighting**
 - Energy saving potential: 40 Bill. US \$/year by energy saving lamps
- **HV AC**
 - Energy saving potential: 45 Bill. US \$/year by new HV AC systems

Infineon Technologies offers the right Power Semiconductors:

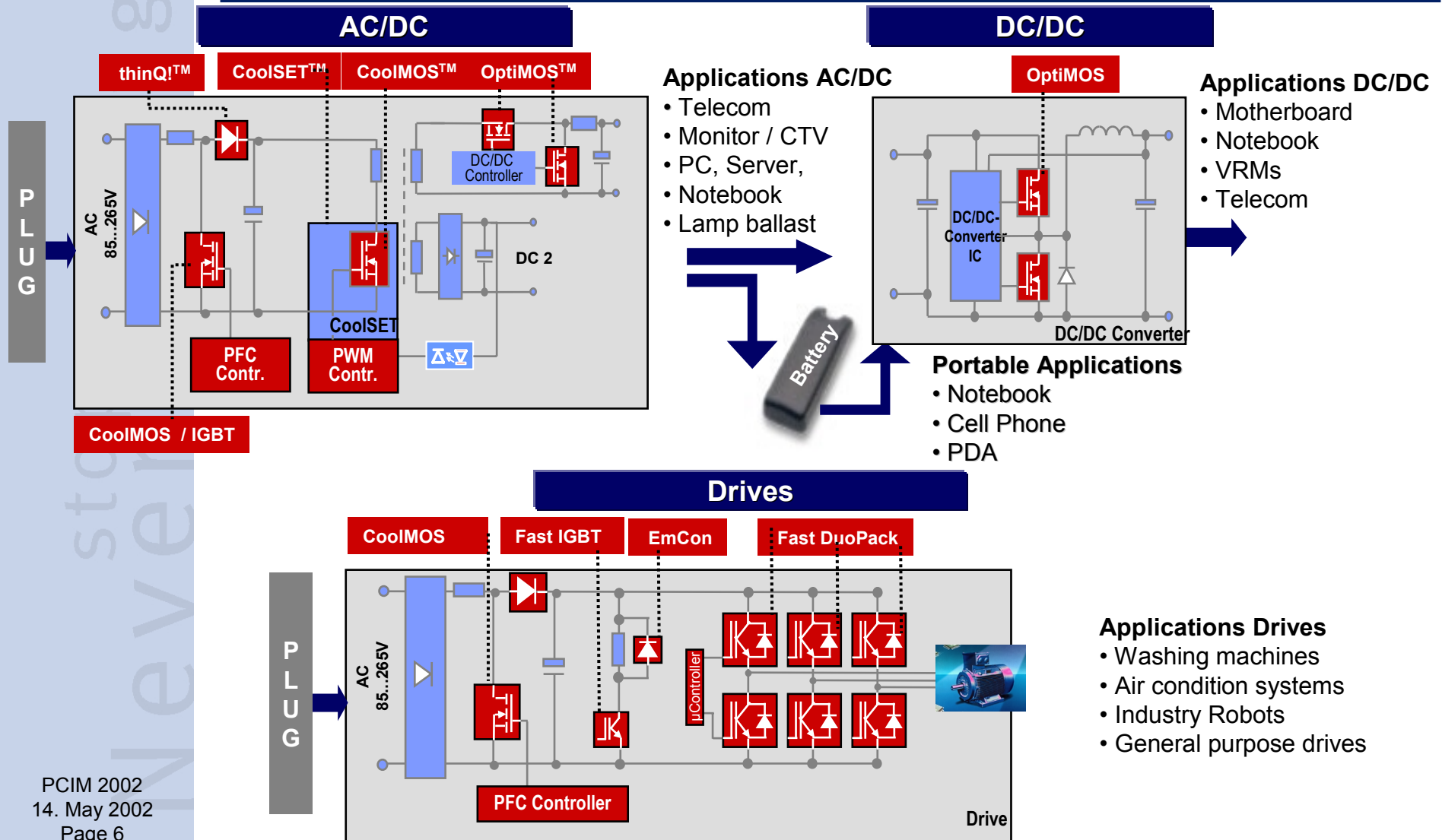
- ➔ Insulated Gate Bipolar Transistors (IGBT) & Silicon Carbide Devices (SiC) in various Packages (Discretes, DuoPacks, Modules, ...)
- ➔ Super Junction MOSFETs (CoolMOS) in Discrete as well as in multi-chip packages (CoolSET with optimised gate drive, ...)

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Power Management & Supply

Focus Segments: AC/DC, DC/DC, Drives applications



Power Management & Supply Strategy

Technology Leadership with best-in-class products
e.g. CoolMOS, CoolSET, OptiMOS, NPT-IGBT, TrenchStop, EmCON
Diodes, thinQ! (SiC Schottky diodes)

System miniaturisation & efficiency improvement
with integration in standard packages

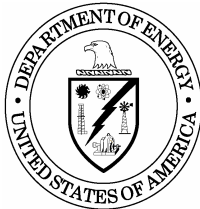
Excellent price-performance ratio

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The Desktop PC

Energy Cost Savings by enabling Power Management



Energy Efficiency and Renewable Energy Federal Energy Management Program

Computer Cost-Effectiveness Example (Desktop PC, 500+ Mhz, 300 W Power Supply)

<i>Performance</i>	<i>Base Model (No Power Management)</i>	<i>Recommended Level (Power Management Enabled)</i>
<i>Annual Energy Use</i>	252 kWh	133 kWh
<i>Annual Energy Cost</i>	\$15	\$8
<i>Lifetime Energy Cost</i>	\$53	\$28
<i>Lifetime Energy Cost Savings^a</i>	–	\$25

a) These savings do not include the benefit from reduced air-conditioning costs, which depend on location and building type.

Source: www.eren.doe.gov/femp/procurement

JULY 2000

- ➔ Based on above, energy cost savings per computer, per year = $\$ 25 / 3.5 = \$ 7.14$
- ➔ World-wide PC production(source: Gartner) in 2001 = 129 million units
- ➔ **Yearly saving in energy cost**, on above calculation model = 129 million x \$ 7.14
= ~ **\$ 920 Million**

The Desktop PC

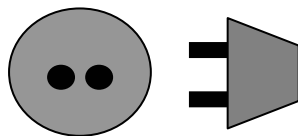
Typical Power Consumption

Desktop PC



CPU+VR	85W
DVD	15W
CDR	15W
AGP	25W
FDD	5W
PCI	25Wx3
HDD	20W
Memory	14W
MB	15W
Fans	10W
Total	>275W

AC 110V/230V



SMPS „silver box“



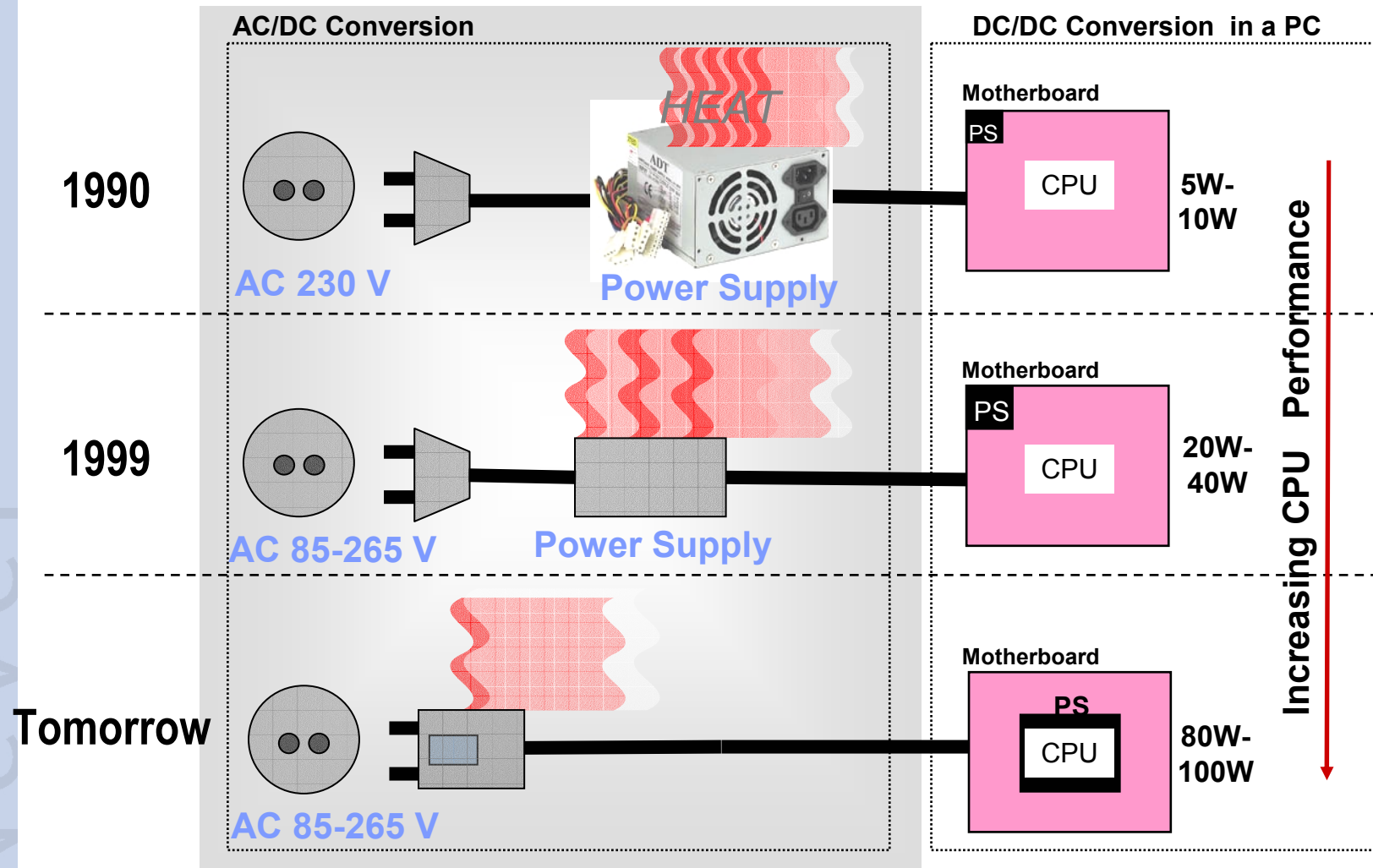
PC Motherboard



AC/DC Power Conversion

DC/DC Power Conversion

The Desktop PC: System miniaturisation and increasing power density are Key Drivers



The Desktop PC

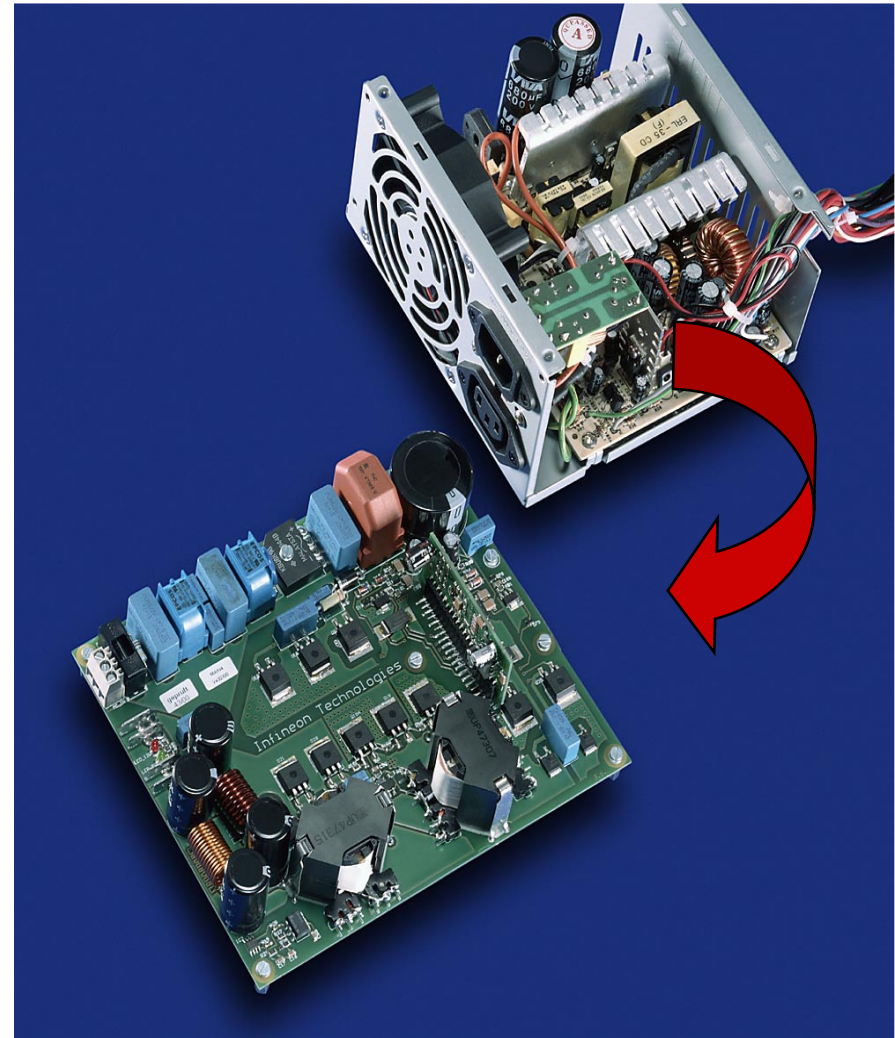
Efficiency improvement in AC/DC section

Standard 'Silver Box' 200W SMPS:

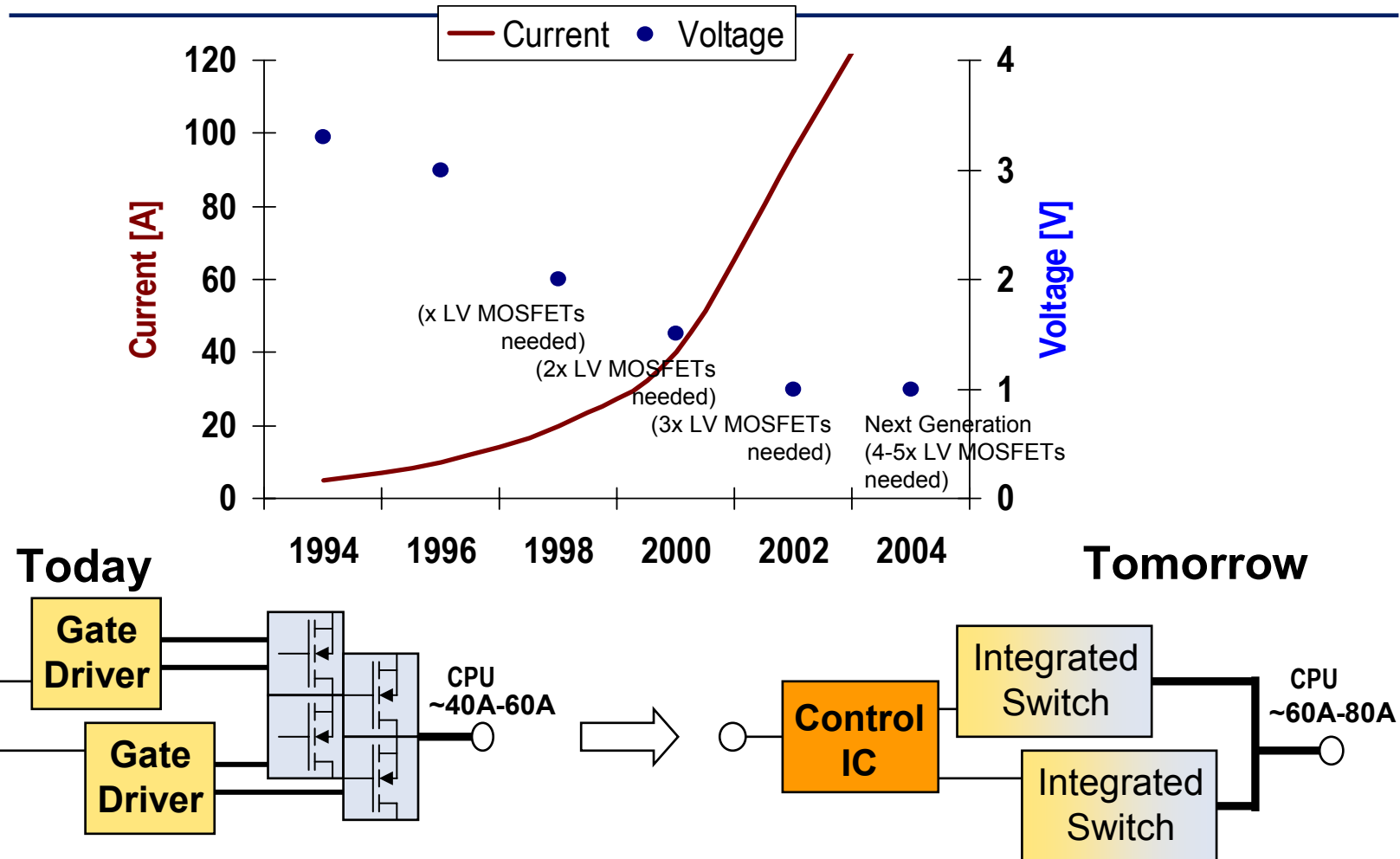
- **efficiency** > 65%
- switching frequency 70kHz
- heat sinks and fan for cooling

Optimised 200W demoboard using new Power Management & Supply devices:

- High **efficiency** >80%
- **CoolMOS** in PFC and PWM sections
- **thinQ!** Silicon Carbide Schottky diode in PFC
- **OptiMOS** in synchronous rectifier
- PFC+PWM in one controller (**TDA16888**)
- No external heat sink required
- No minimum output load required
- Output over-load protected
- Output short-circuit protected



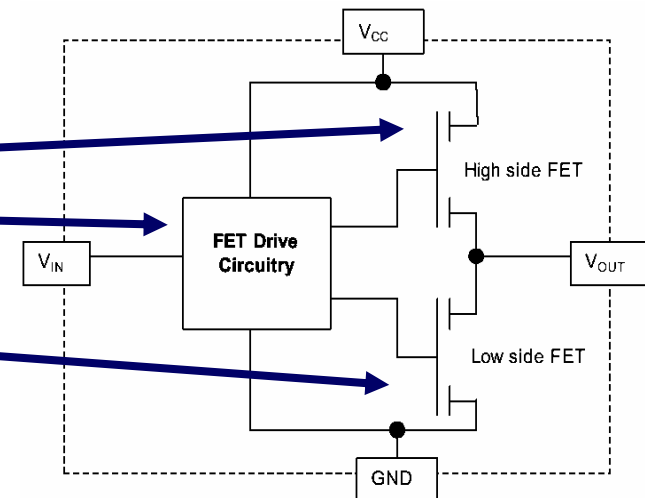
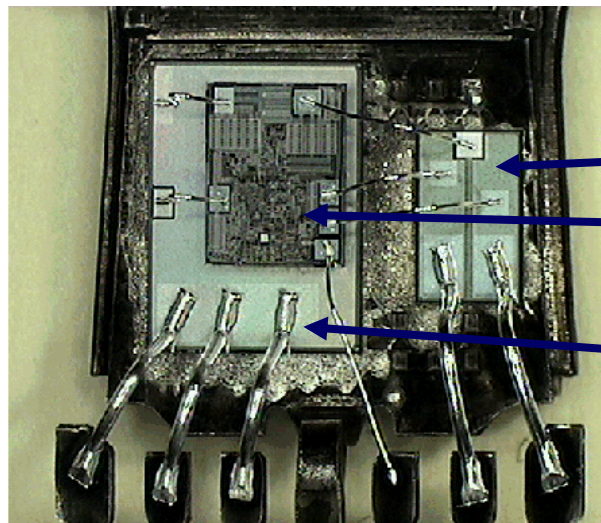
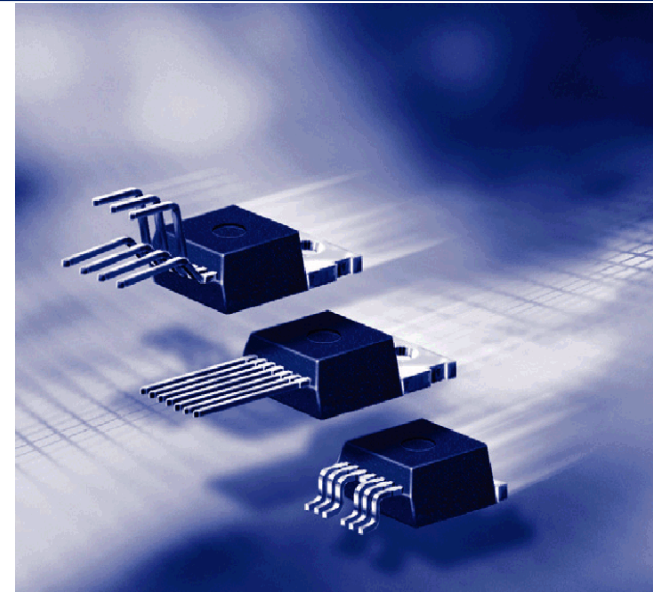
The Desktop PC: Typical CPU current consumption drives the trend in DC/DC



Increasing demand for LV MOSFETs, Gate Drivers & Control ICs, lead to a “space challenge” on the motherboards

The Desktop PC: Integrated Switch enables high power density & high efficiency

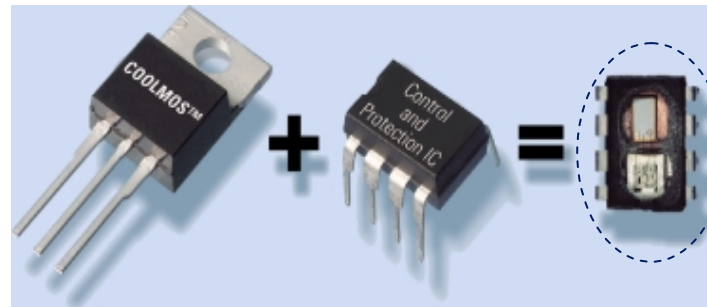
- TDA21201 = Gate driver + OptiMOS
- Chip-by-Chip & Chip-on-Chip
- Standard TO220-X Package
- Max. current 30A (Heatsink), 18A (SMD)
- Efficiency >85%
- Easy board layout
- Highest integration and current density



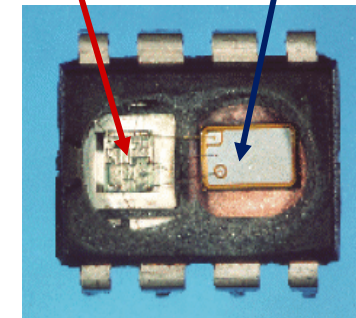
System Miniaturisation - AC/DC

CoolSET - typical SMPS application

$P_{OUT} \sim$
10W-45W

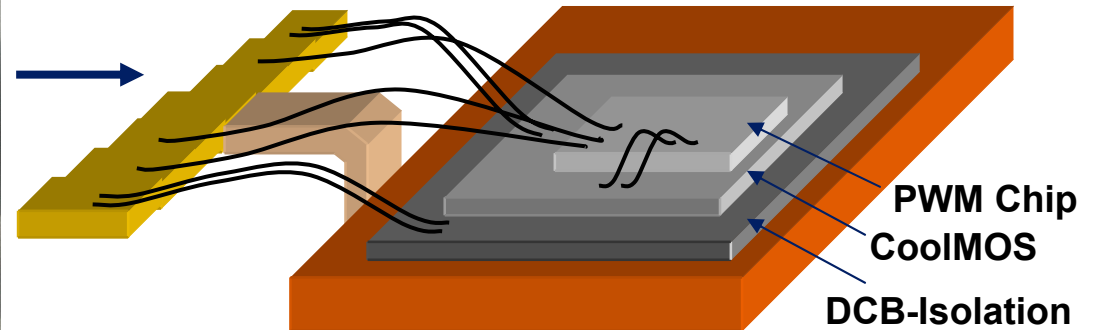
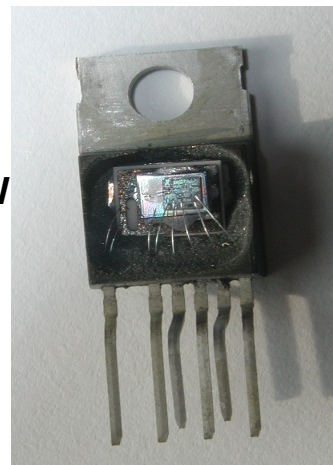


PWM IC CoolMOS



Standard P-DIP-8 package

$P_{OUT} \sim$
50W-200W



TO-220-6 ISOdrain package

CoolSET enables incorporates not just chip-by-chip, but also chip-on-chip technologies to make possible system miniaturization in industry standard packages

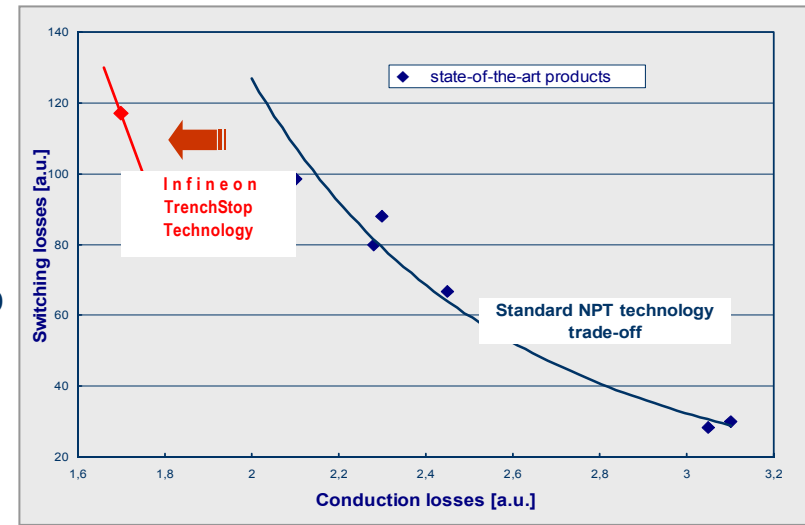
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Technology Leader with TrenchStop™ IGBT

1200V TrenchStop IGBT optimised
for applications with frequency
<20kHz

**Superior trade-off through
technological leadership. TrenchStop
IGBTs make possible lowest losses
in drive applications.**



Key Features

- Significant **lower saturation voltage** than competing standard Non-Punch-Through (NPT) IGBTs
- Breakthrough in **energy efficiency** for drive applications
- Combination of Infineon's outstanding Trench- and Fieldstop-Technologies.

Key Benefits

- Easy paralleling capability due to a positive temperature coefficient
- Short circuit ruggedness for more safety and robustness in your designs
- Tight parameter distribution at best cost through elimination of epitaxial process.

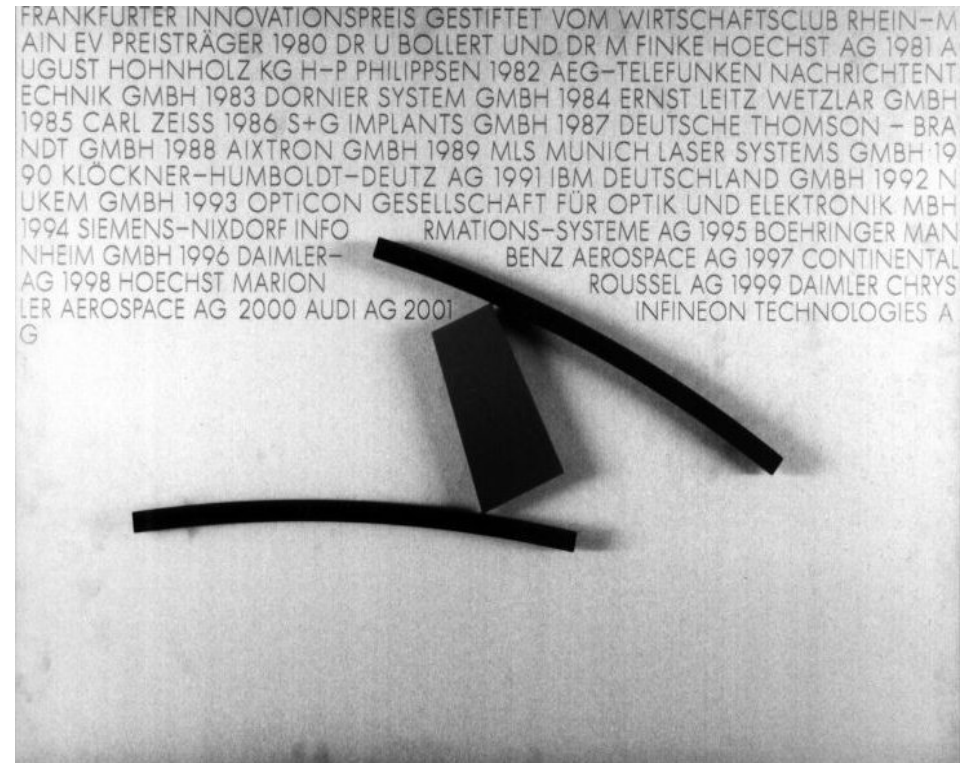
TrenchStop™ IGBT sets new benchmark in energy efficiency in drive applications

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Industry Recognition: CoolMOS and IGBT received German Trade Innovation Award

CoolMOS and IGBT received the prestigious “Innovationspreis der Deutschen Wirtschaft” for 2001. The two power semiconductors were named as Best Technological Innovation in 2001 by the German Trade and Industry Group “Deutscher Wirtschaftsclub Rhein-Main”.



CoolMOS & IGBT - the world's leading power transistors

Market Recognition

Market & Market Share Development 2000 vs. 2001

All figures in Million US Dollars	2000	2001
Power Transistor (Field Effect)	3143,5	2585,5
Market change		-18%
Infineon`s market share growth		~ 50%
Small Signal Transistor (Field Effect)	539,1	290
Market change		-46%
Infineon`s market share growth		~ 50%
Power Transistor (IGBT w/o Module)	197,3	197,7
Market change		0%
Infineon`s market share growth		~100%

Source: WSTS 10/01, 03/02.