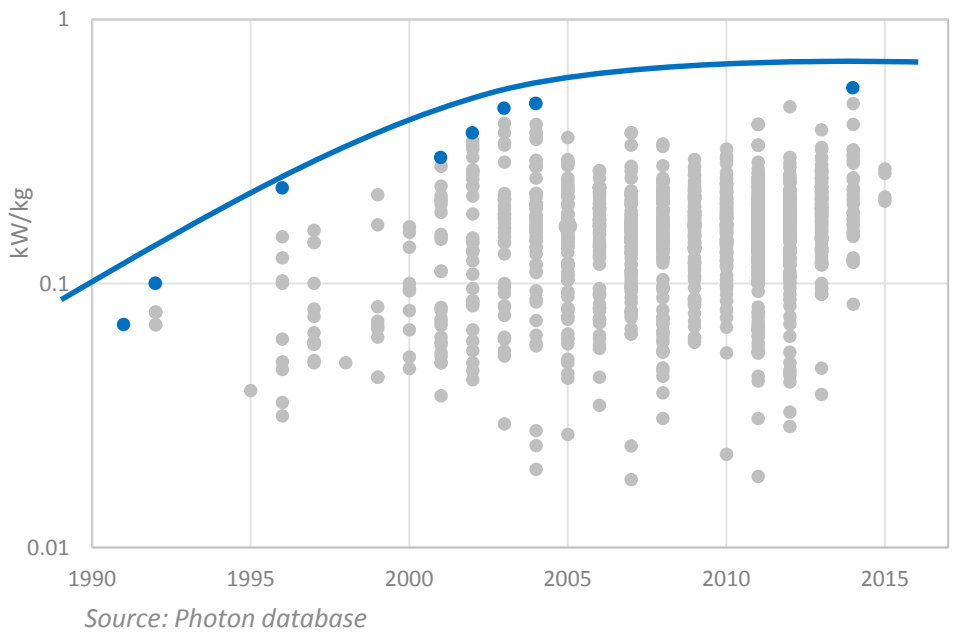
Introducing HD-Wave Technology

September, 2015

PV Inverters – Slow Pace of Change

- PV inverter technology has made limited progress in improving size, efficiency, and manufacturing costs
  - For example, the maximum power per kg ratio* improved by only 5x
- Compare this to the computer industry, which has seen a doubling in processing power every 18-24 months



* Measures power per weight
* Very good metric for inverter cost structure

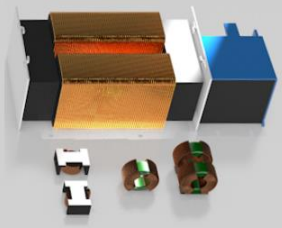
What is Holding Back Progress?

- Conversion design has remained fundamentally unchanged
- Existing technologies force the usage of large magnetics and cooling elements
  - This makes inverters expensive to manufacture and install

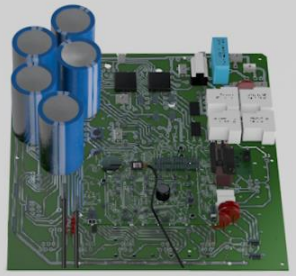
Current Inverter

Cooling Components

Magnetics



Electronics



Inverters & TVs: A Comparable History

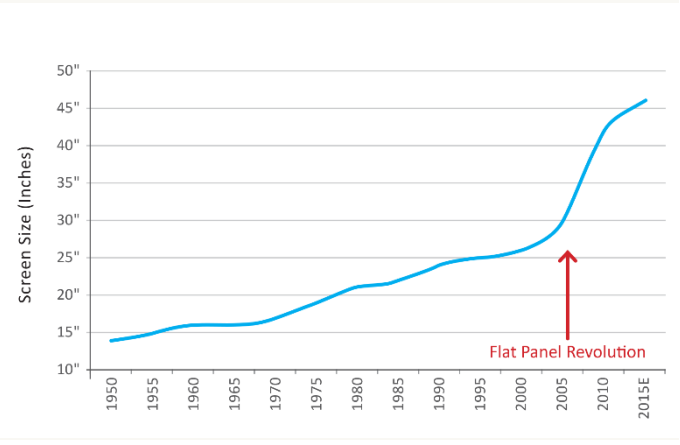
- Since the 1930s, TV technology was dominated by CRTs
- Even the best TVs were bulky, power hungry, used heavy glass and magnetics and were bound to mechanical constraints
- Improvements were limited:
  - Size due to physical nature of the components
  - Resolution due to analogue imaging
  - Difficult to manufacture
  - Costly components

CRT = Cathode Ray Tubes

Digital Electronics Changed the Picture

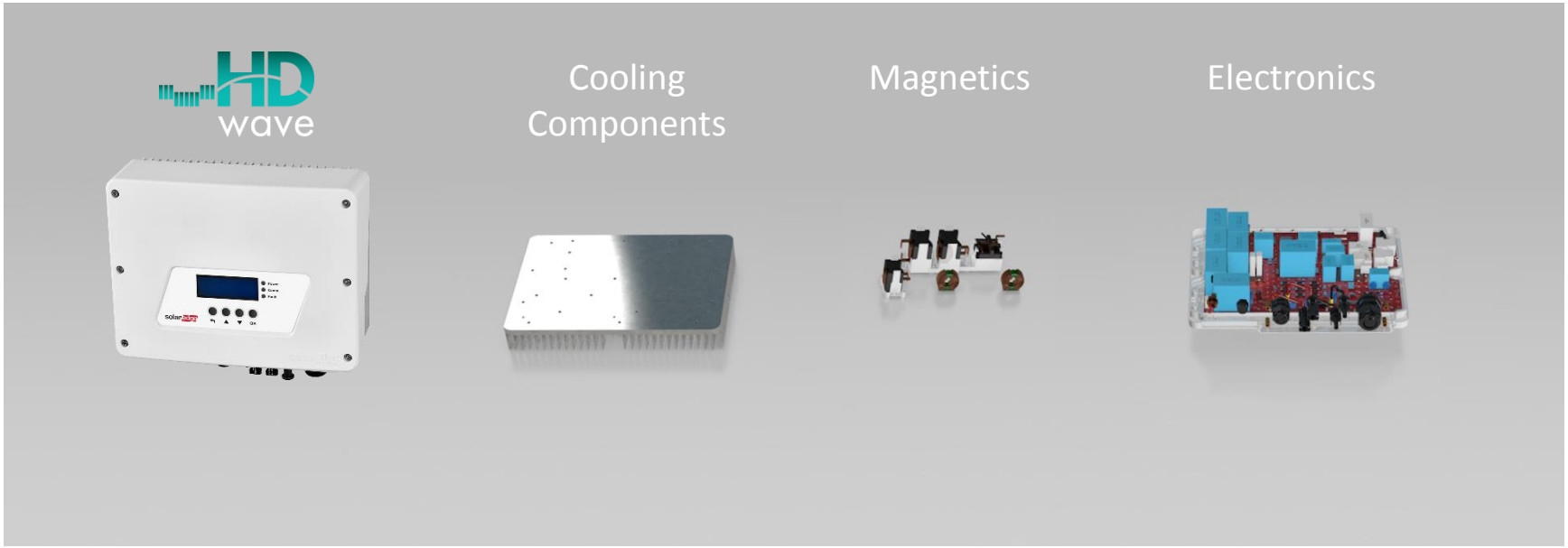
- In the 2000s, flat screen TVs unlocked the industry by replacing CRT and magnetics with electronic components allowing:
  - Slimmer and lighter TV sets, for wall-mounting
  - Higher resolution using digital processing
  - Scalable manufacturing
  - Lower cost

Average Living Room Television Size by Year



A New Era for Inverters – HD-Wave

Distributed switching and powerful DSP processing to synthesize a clean sine wave for a dramatic reduction in the magnetics and heavy cooling elements



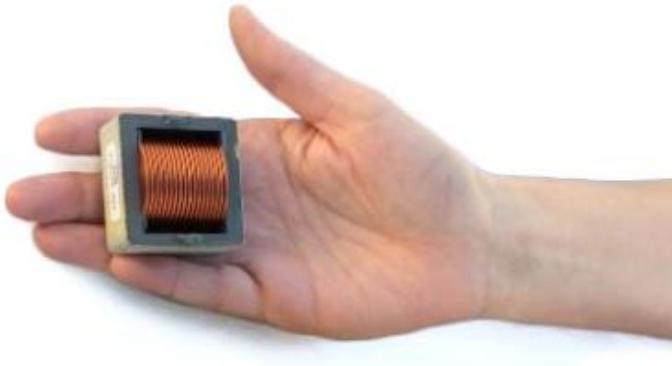
Breaking the Mold

Magnetics and cooling elements are no longer the barriers to progress

Current Technology

16 x less magnetics

HD-Wave Technology



Breaking the Mold

Magnetics and cooling elements are no longer the barriers to progress

Current Technology

2.5 x less cooling

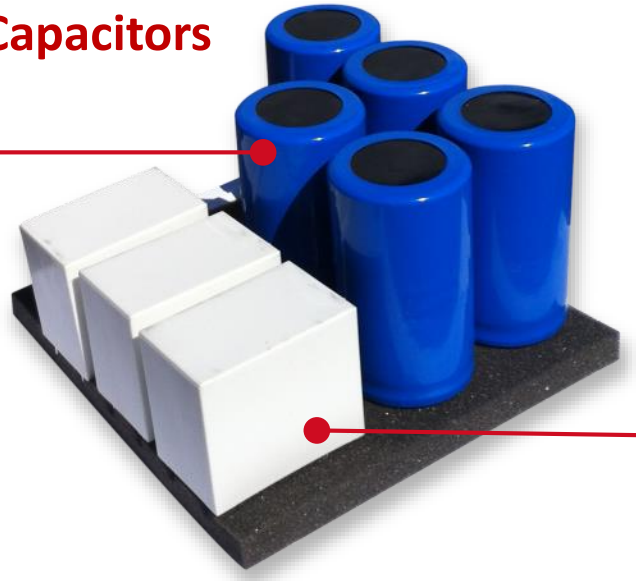
HD-Wave Technology

More Reliable Internal Components

Capacitors

Current Technology

Utilizes electrolytic capacitors as industry standard



HD-Wave Technology

Utilizes thin-film instead of electrolytic capacitors

Switching Elements

Current Technology

Bulky and medium-performing transistor switches

HD-Wave Technology

Much smaller, efficient and cost effective standard silicon switches

Powered by HD-Wave

Inverter with DC Disconnect Switch

Current SolarEdge Inverter *

Power: **7.6 kW**

Volume: **46.3 liters / 12.2 gallons**

Weight: **25 kg / 55 lbs**

Efficiency CEC: **98%**

** Already one of the smallest string inverters on the market*

Next Gen HD-Wave Inverter

Power: **7.6 kW**

Volume: **22.5 liters / 5.9 gallons**

Weight: **11.5 kg / 25 lbs**

Efficiency CEC: **99%**

Powered by HD-Wave

Current SolarEdge Inverter *

Power: **6 kW**

Volume: **29.9 liters / 7.9 gallons**

Weight: **22 kg / 48.5 lbs**

Efficiency: **97.5%**

** Already one of the smallest string inverters on the market*

Next Gen HD-Wave Inverter

Power: **6 kW**

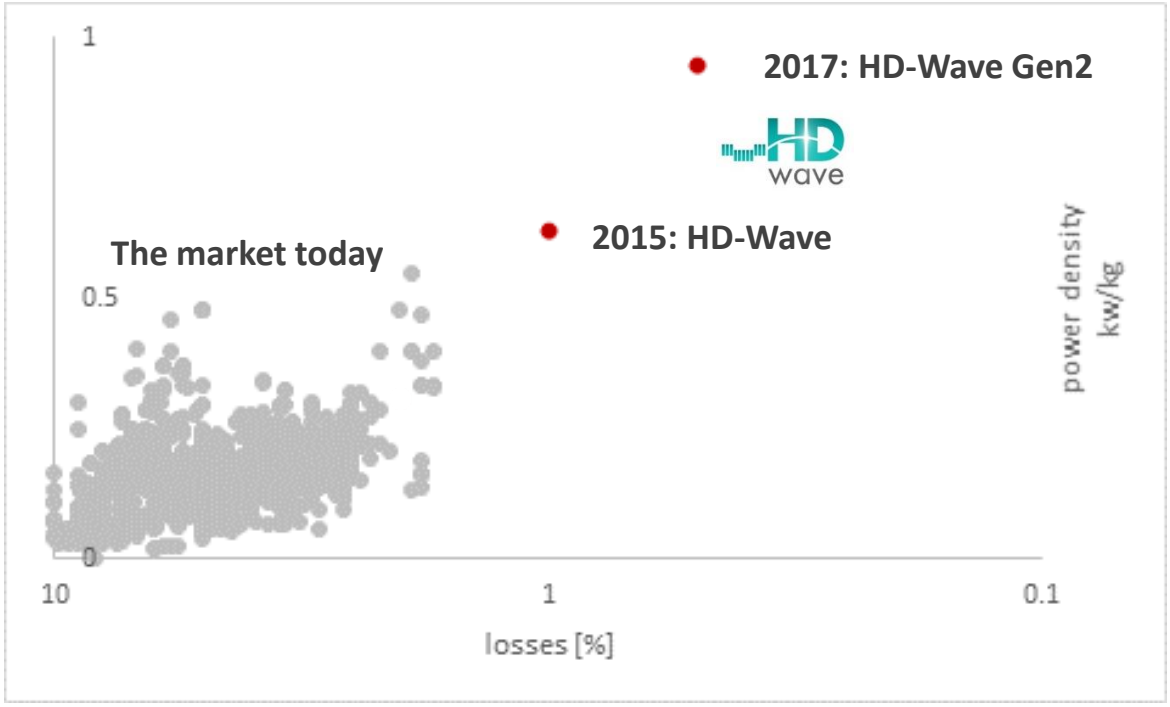
Volume: **14.5 liters / 3.8 gallons**

Weight: **9.5 kg / 21 lbs**

Efficiency: **99%**

What Does the Future Hold?

- HD-Wave will separate even further from the pack in efficiency and power per weight ratings
- Continuous improvement based on increased processing power and silicon integration



Source: Photon database

A New Era for PV Inverters

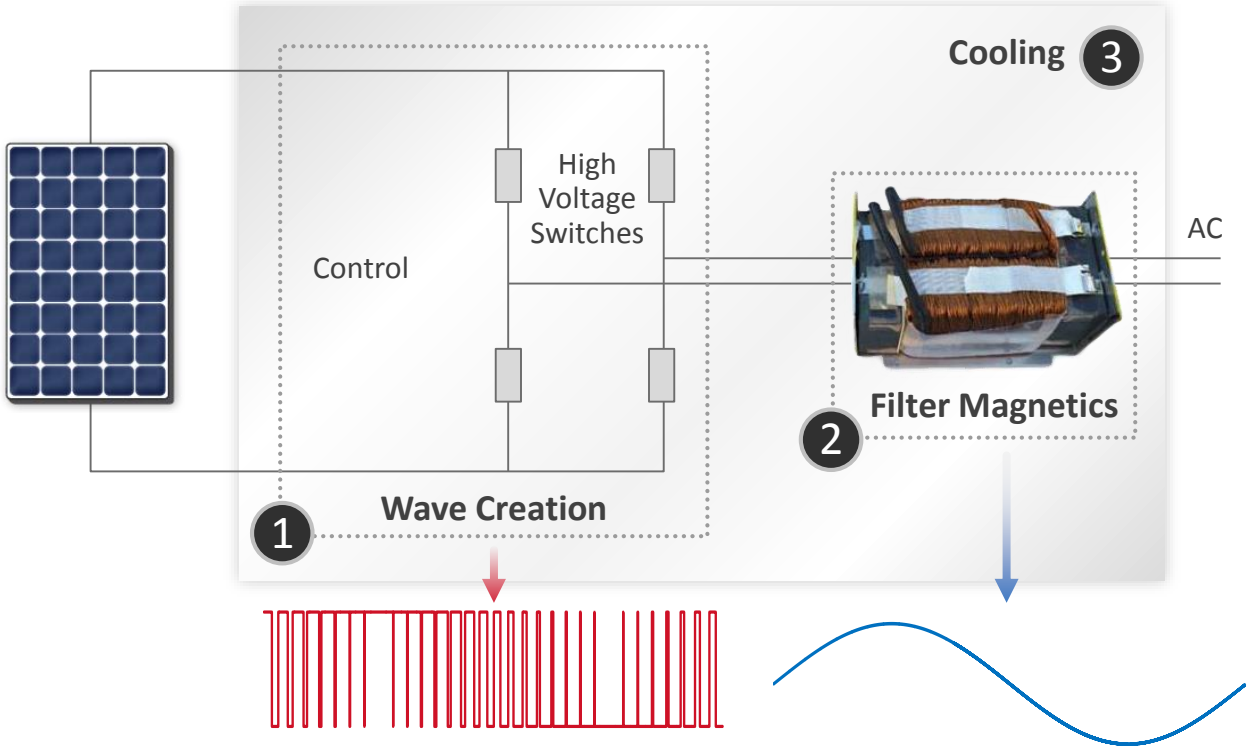
- Small and lightweight at <10 kg
- 99% weighted efficiency (33%-50% less losses than the market)
- Built-in meter with ±0.5% accuracy
- Up to 1.5 kW self-sustaining power outlet option (for backup power)
- Superb reliability due to lower heat dissipation & thin-film instead of electrolytic capacitors
- Up to 165% oversizing allowed

Additional HD-Wave Slides

Traditional PV Inverter

Current technology is based on:

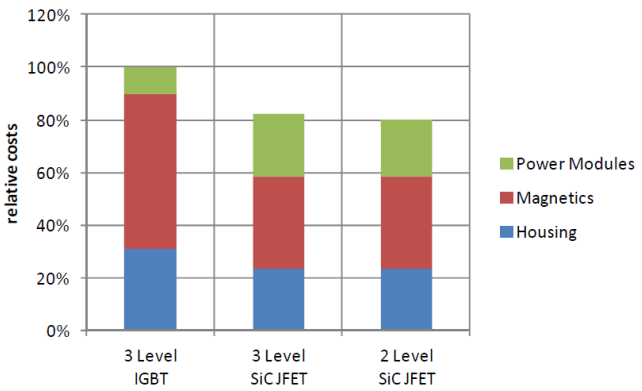
1. Silicon-based electronics to create a **crude** sine wave
2. Magnetics to filter a sine wave
3. Metallic enclosures, cooling systems and fans to dissipate heat



Magnetics and cooling hold back inverter technology today

False Dawn of Advanced Components

- Emergence of SiC & GaN switching devices heralded as breakthrough in power electronics, bringing:
  - Increased inverter efficiency, resulting in smaller heatsink
  - Estimated 20 to 50% reduced inverter costs
- However, any improvements in efficiency overshadowed by:
  - 2-5x higher pricing, negating savings in magnetics & heatsink cost
  - Limited sourcing – a risk for inverter suppliers
  - Unproven reliability



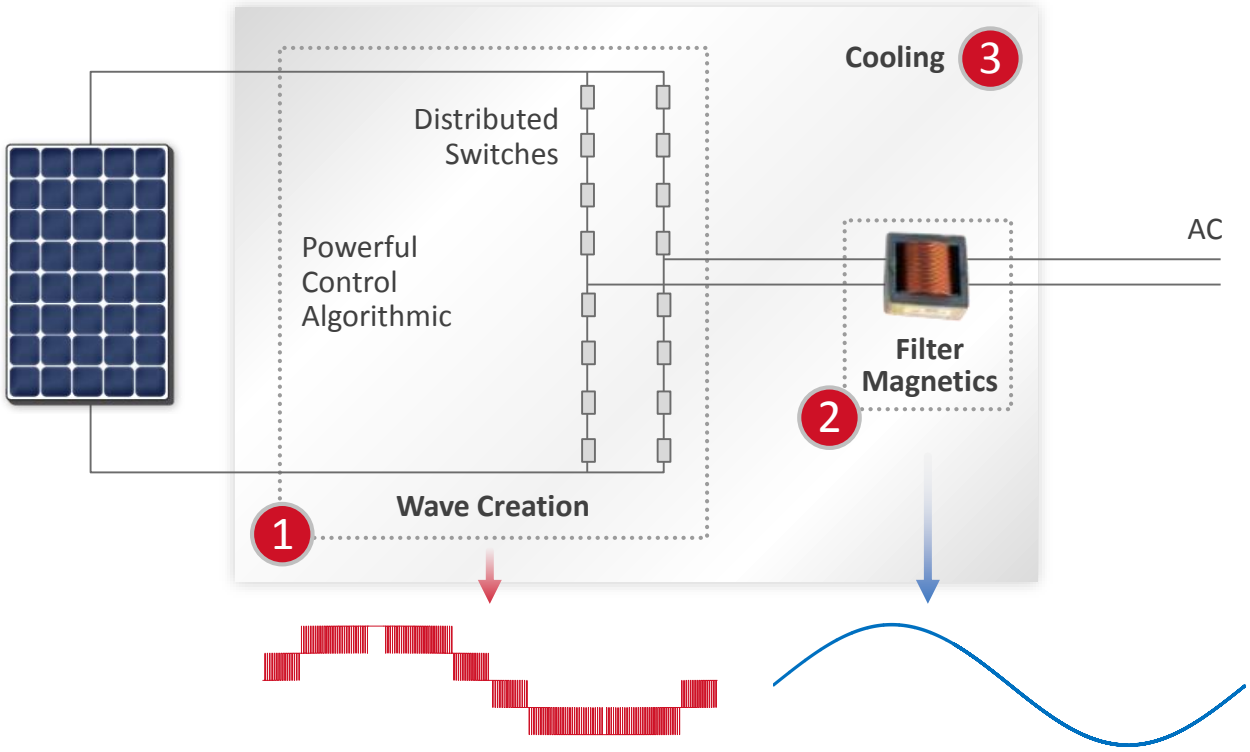
Only 20% SiC cost reduction in 5 years since release

Source: System Benefits for Solar Inverters using SiC Semiconductor Modules Infineon Technologies, May 2014

The HD-Wave Revolution

SolarEdge technology based on:

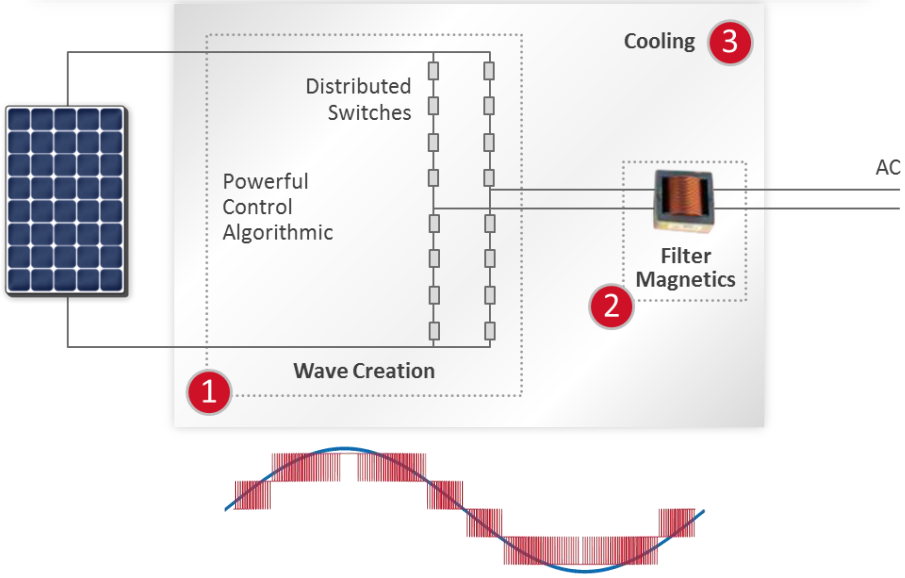
1. Distributed **multi-level switching** elements to create a sine wave
   - Powerful DSP processor synthesizes a **clean** sine wave
2. Less magnetics is required to create the AC sine wave
3. Highly efficient design with minimal heat loss to reduce cooling requirements



Inverter design no longer restrained by mechanical components

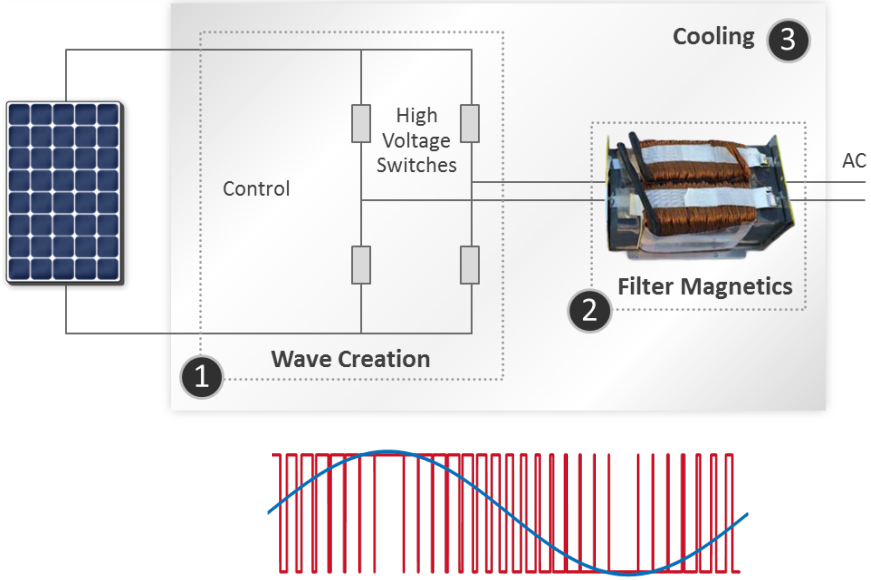
HD-Wave vs. Traditional Technology

HD-Wave Technology



1. **Distributed multi-level switching** elements creates a sine wave
   - Powerful DSP processor synthesizes a **clean** sine wave
2. Less magnetics is required for filtering
3. Highly efficient design with minimal heat loss reduces cooling requirements

Traditional Technology

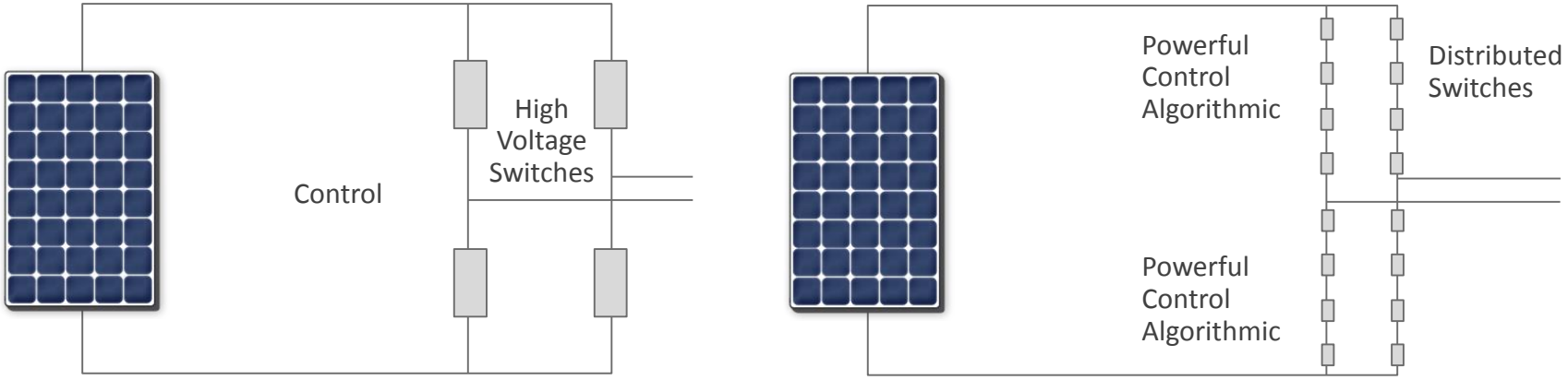


1. Today, inverter switching elements create a **crude** sine wave
2. Magnetics filter a sine wave
3. Metallic enclosures, cooling systems and fans dissipate heat

What is Distributed Switching?

- Many silicon transistors and a powerful DSP processor to synthesize a clean sinus wave

From Single to Multi-Level Switches



- The distributed switching elements are highly efficient
  - Reduced heat losses eliminates need for large and heavy aluminum heatsink

Thank you

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