



Intelligent
Power
Modules

SLLIMM™ - nano Series

Small Low-Loss Intelligent Molded Module

SLLIMM™ - nano series

2

Discover the ST's IPM SLLIMM- nano series, specifically designed for high performances and best efficiency in 3-phase inverter motor drives and in general, in home appliances application.

You will learn:



What's make the SLLIMMs very interesting



Features and Benefits of SLLIMM- nano series



Different package options to target a wider power range and different applications



Power and thermal performances of SLLIMM- nano 2nd series vs Competitor



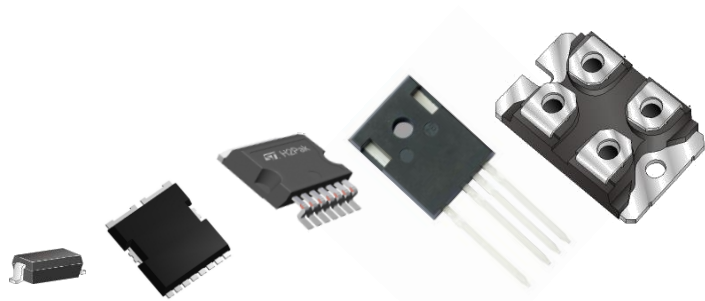
Tools and software dedicated to our IPMs

Power Transistor Division

Power Product Portfolio

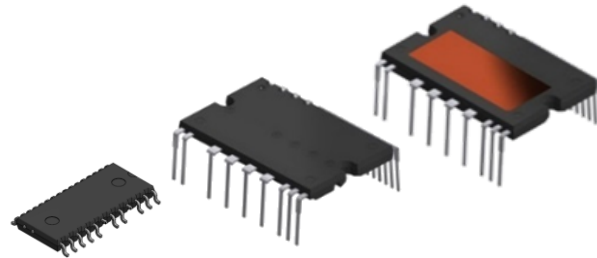
3

From Discrete to Power Modules, ST leads the innovation



Discrete & Drivers & SIP

Typical power: 10 W to 5 kW



SLLIMM™ IPM

Typical power: 20 W to 3 kW

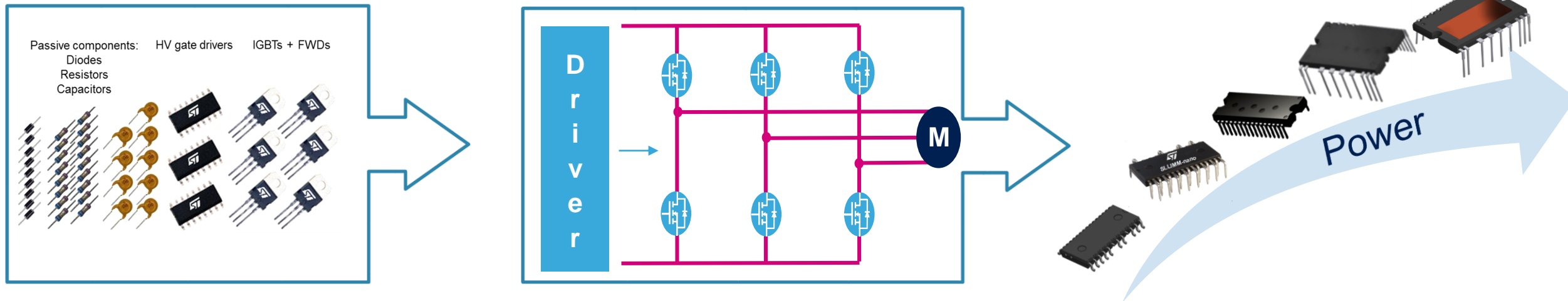


ACEPACK™ Power Modules

Typical power: 3 to 30 kW



Integration as a fundamental requirement to address the market needs



High Power dissipation

Lower losses and EMI noise

Reduced design time

Improved reliability

Improved manufacturability and PCB routing



SLLIMM -nano Series

Small Low-Loss Intelligent Molded Modules

5

The best IPM offer for Home Appliances 3-phase inverter



A complete product portfolio

- ❑ Technology & Flexibility to address market needs
- ❑ 100% controlled by ST for silicon (Driver IC, MOSFET, IGBT and Diode)
- ❑ Current level from 1 A to 8 A
- ❑ Package compactness and thermal performance



High flexibility & Enhanced efficiency

IGBT , MOSFET & SJ MOSFET based technology

Current availability up to 8A at 25°C

Through hole (TH) and SMD packages

NTC thermistor option



Very high robustness and reliability

Protections embedded inside power module

Package compactness and thermal performance

Cover a larger customer's PCB solutions

3-phase inverter for motor drives as Fan, Roller shutter, Refrigerator, Compressor, Washing machine up to 500W

SLLIMM -nano Series

7

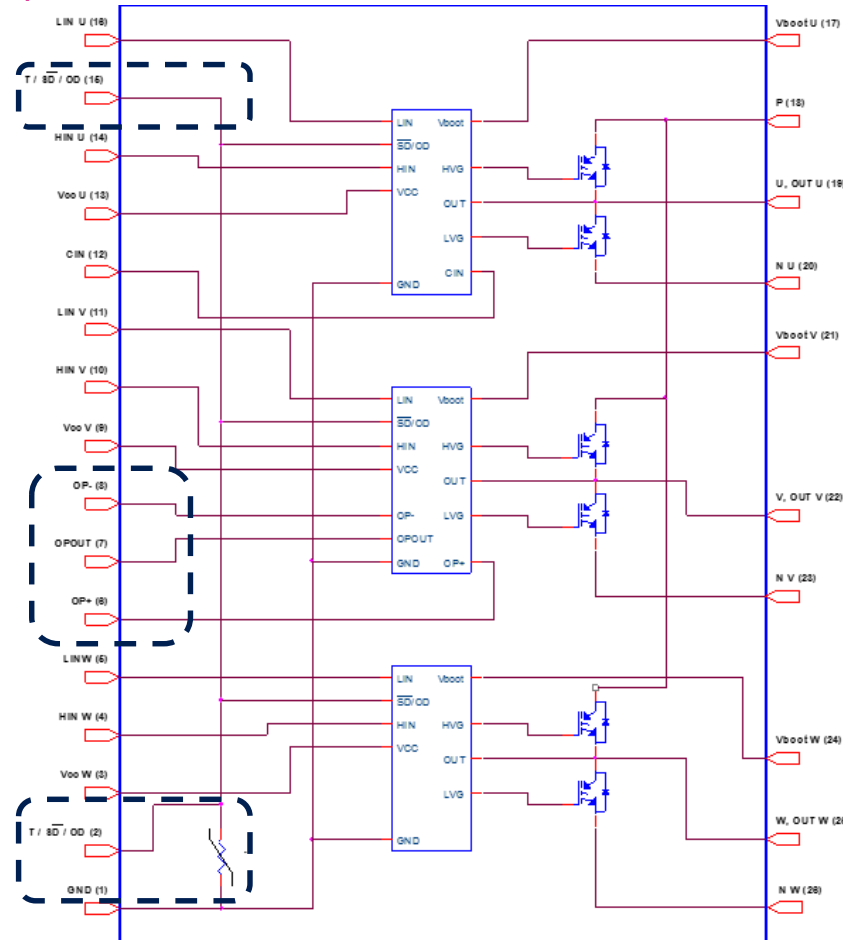
Technology & Flexibility to address market needs

Main Features

- Optimized voltage drop in conduction
- IGBT (planar,TFS) and Mosfet (UltraFast, SJ-Mosfet) based
- 600V and 500V breakdown voltage
- Current availability up to 8 A at 25°C
- Comparator for fault protection
- OpAmp for advanced current sensing
- Open emitter configuration for individual phase current sensing
- Internal bootstrap diodes
- Interlocking function and undervoltage lockout
- Through hole and **SMD** packages
- Mounted slots package options
- In line and zig-zag leads options (w/wo stand-off)

Topology in SLLIMM - nano Series

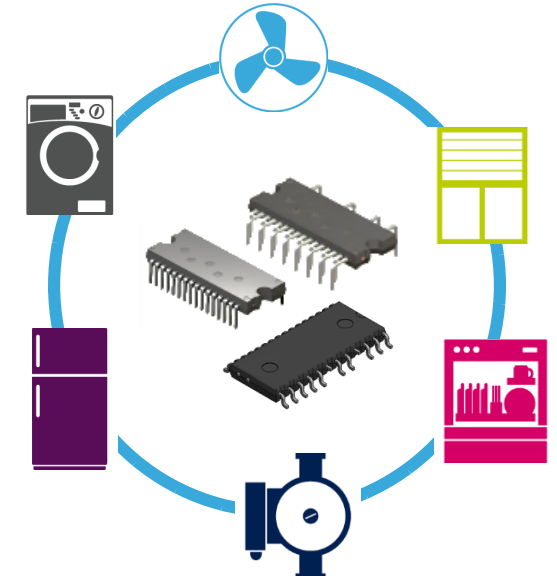
NTC shares the same SD pin, three pins for Operational amplifier



Ideal for

3-phase inverters for motor drives

- Small fans
- Roller shutters
- Dish washer
- Compressor
- Pumps
- Refrigerators
- Washing machine



SLLIMM -nano Series

8

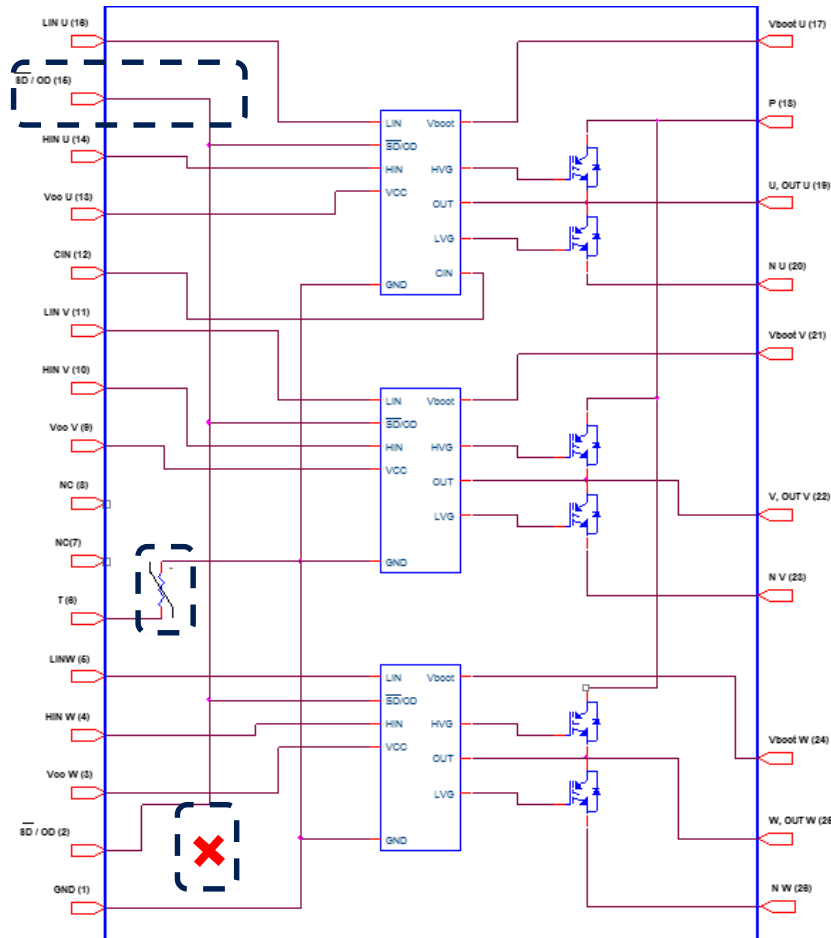
Technology & Flexibility to address market needs

Main Features

- Optimized voltage drop in conduction
- IGBT (planar,TFS) and Mosfet (UltraFast, SJ-Mosfet) based
- 600V and 500V breakdown voltage
- Current availability up to 8 A at 25°C
- Comparator for fault protection
- OpAmp for advanced current sensing
- Open emitter configuration for individual phase current sensing
- Internal bootstrap diodes
- Interlocking function and undervoltage lockout
- Through hole and **SMD** packages
- Mounted slots package options
- In line and zig-zag leads options (w/wo stand-off)

Topology in SLLIMM - nano Series

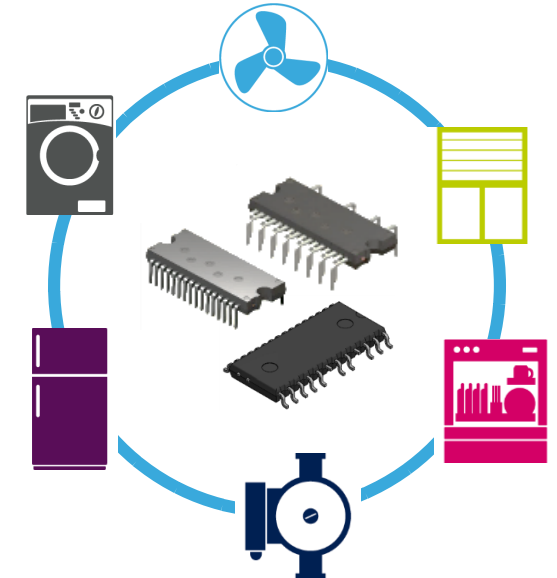
NTC and SD are separated, no for Operational amplifier



Ideal for

3-phase inverters for motor drives

- Small fans
- Roller shutters
- Dish washer
- Compressor
- Pumps
- Refrigerators
- Washing machine



SLLIMM -nano Through Hole

What's new!?

9

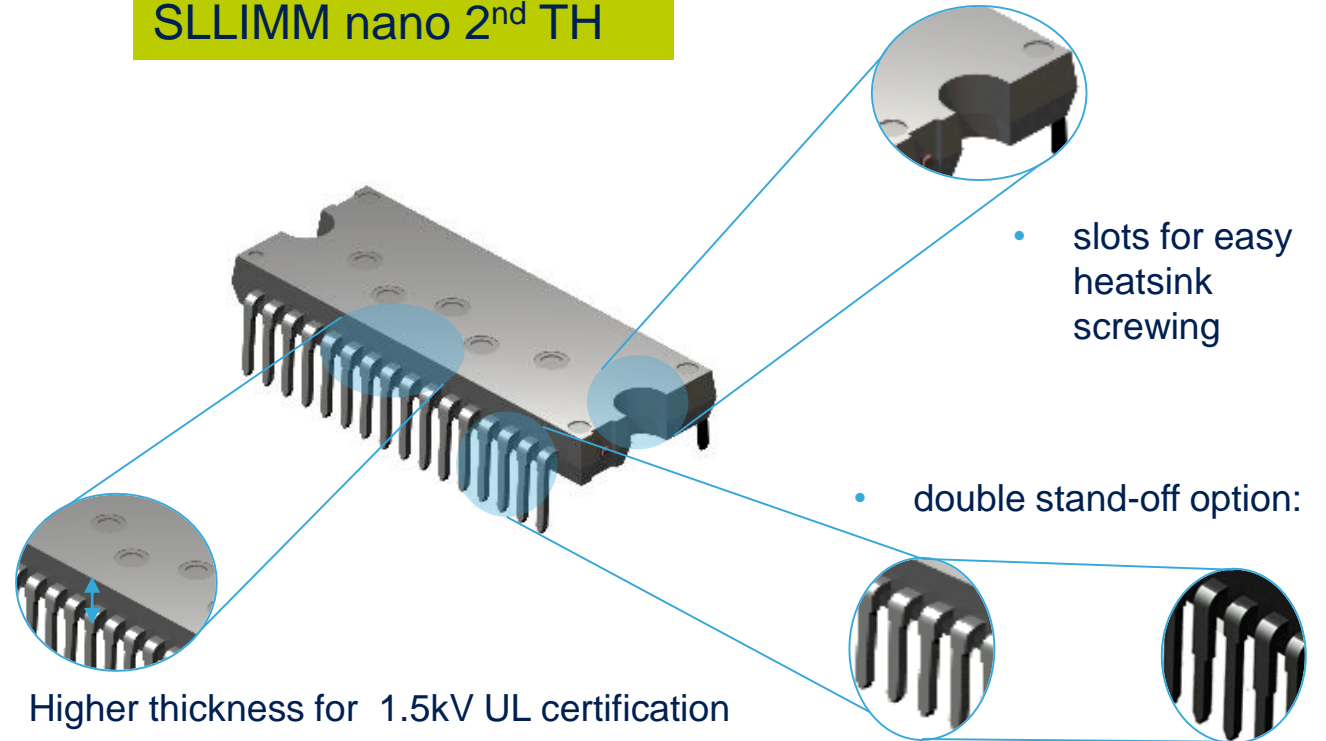
SLLIMM -nano 2nd series to boost power capability

SLLIMM nano TH



- expanded line-up to 5 A and 8 A respectively with SJ-MOSFET and trench field stop (TFS) IGBT technologies for efficiency improvement
- improved isolation voltage rating to 1.5 kVrms/min

SLLIMM nano 2nd TH



- Higher thickness for 1.5kV UL certification

- slots for easy heatsink screwing

- double stand-off option:

No Stand-off

with Stand-off

Save Space in Energy-Efficient Motor Drives

IGBT and MOSFET based

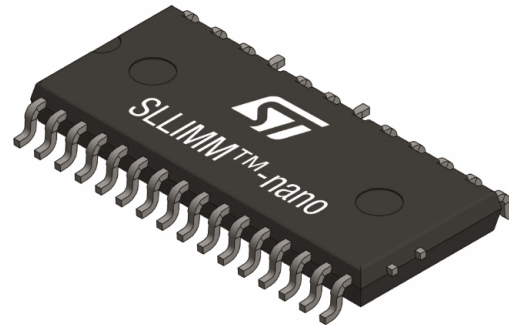
600 V and 500 V breakdown voltage

Current availability up to 3 A at 25°C

Optimized voltage drop in conduction

Optimized for low electromagnetic interference

Surface-mounted
Intelligent Power Modules



High energy efficiency and
excellent reliability

Space-saving device

Heatsink-free design

Safety isolation

Low-noise performance



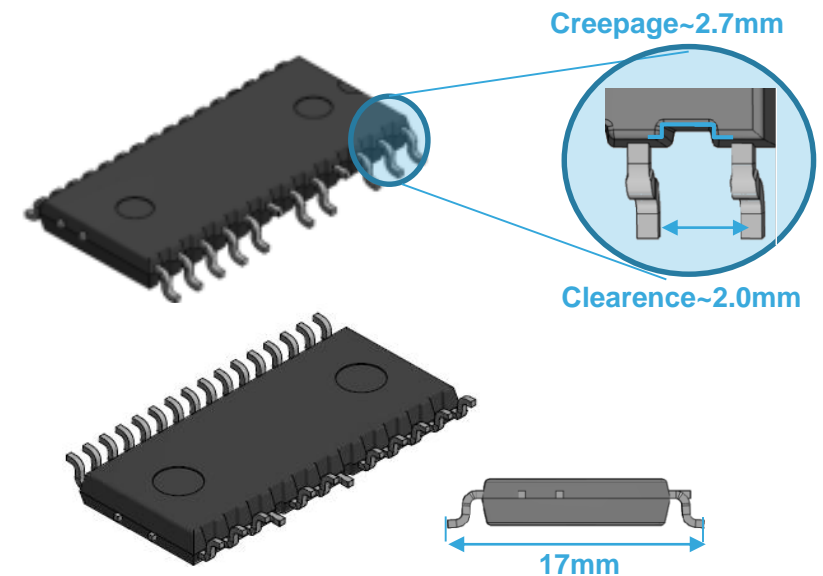
Package compactness and thermal performance for low power rating



Surface Mounted Device (SMD)

The thermally efficient package enhances reliability and allows heatsink-free design, while 2.7 mm creepage and 2 mm clearance ensure safety isolation within the compact dual-inline SMD footprint.

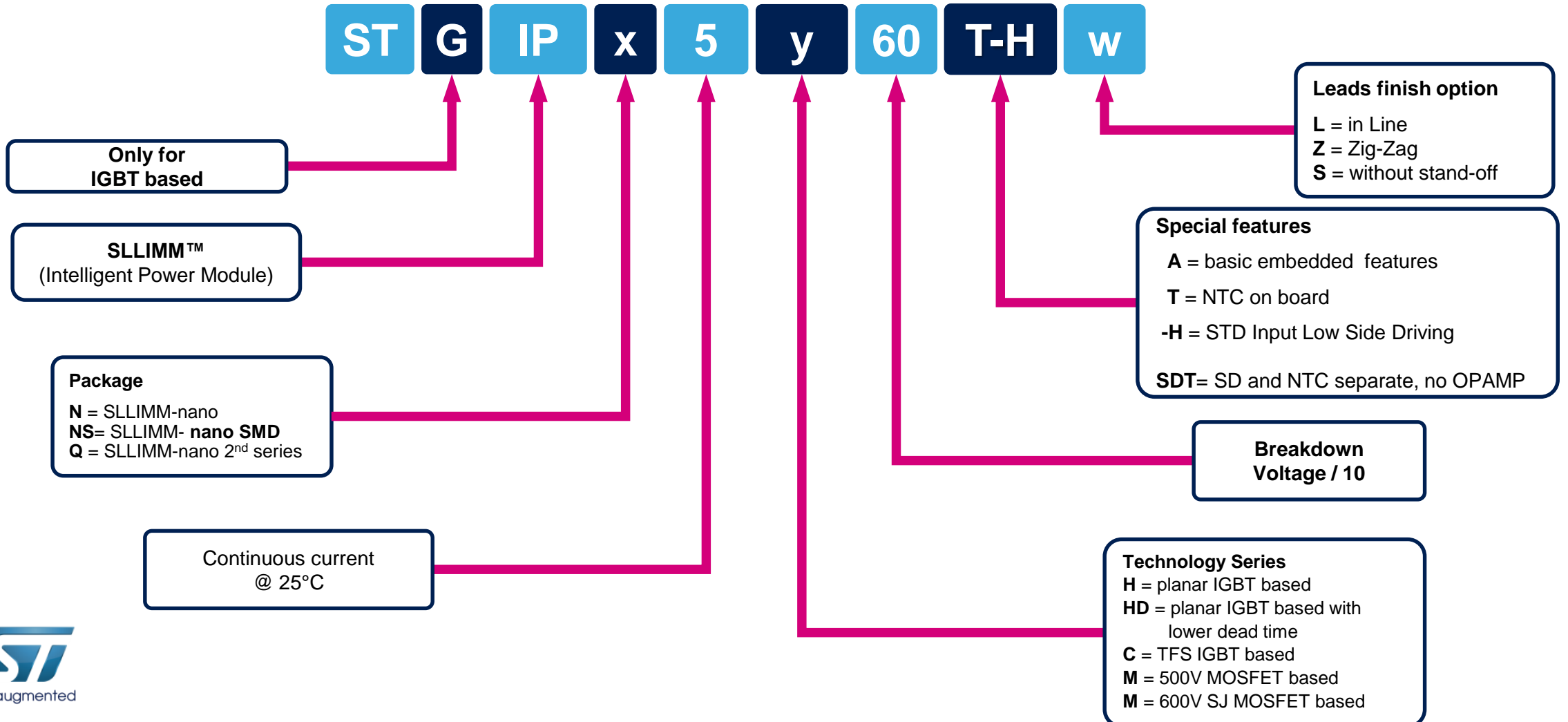
The compact dual-inline SMD footprint is ideal for application boards where reflow and/or wave soldering processes are mandatory



SLLIMM -nano

Nomenclature

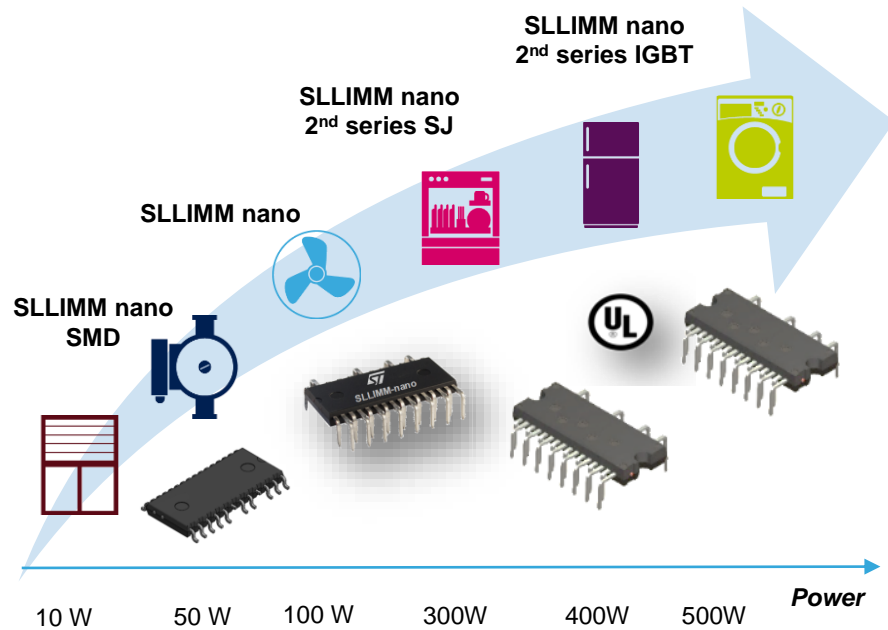
12



SLLIMM -nano

Products Table

13



Leads finish option

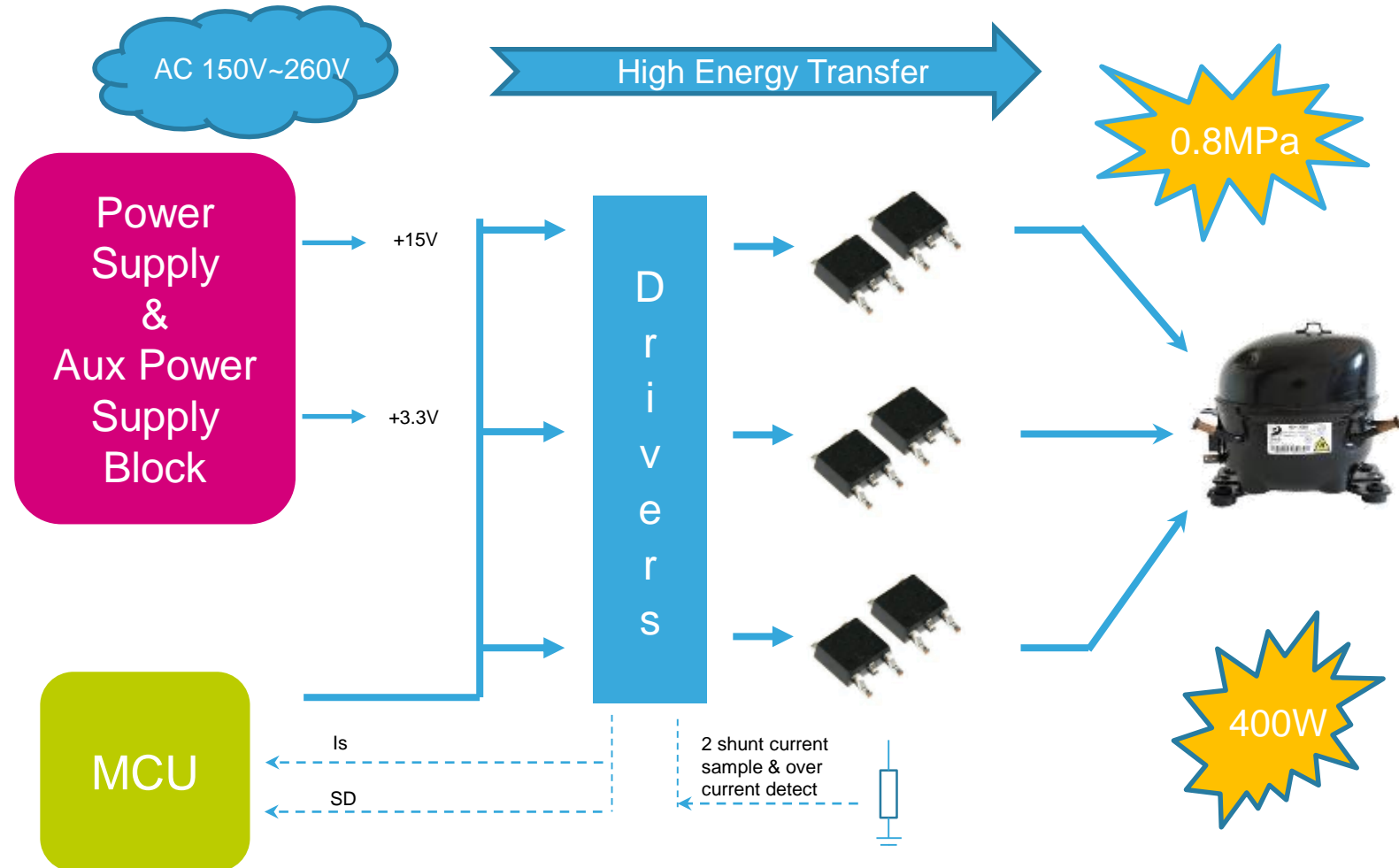
Z = zig zag leads
L = in line
S = without stand-off option

Special Features

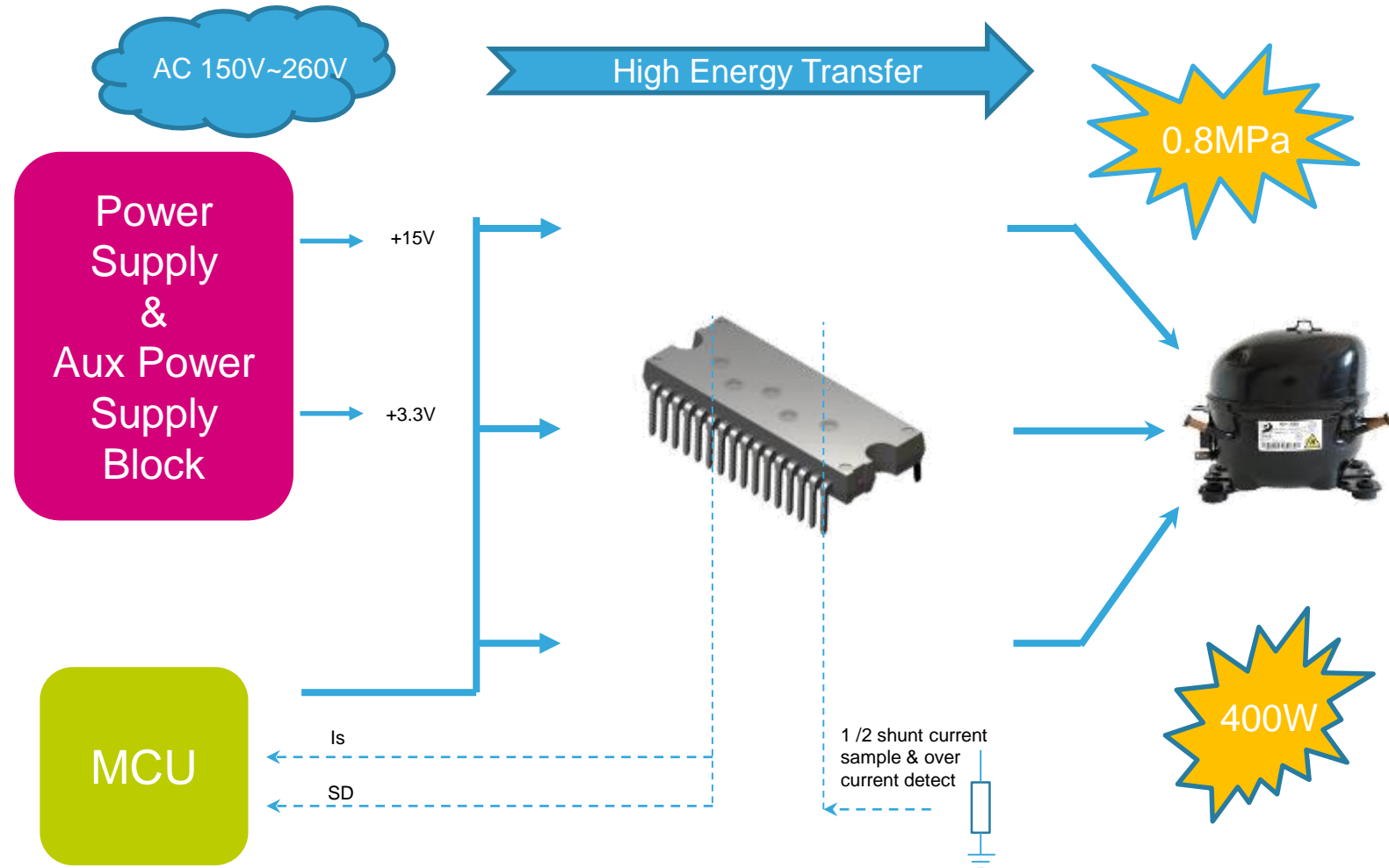
T = NTC on board
-H = STD Input Low Side Driving
SDT = SD and NTC separate

| Product PN | Package type | Switch type | BV | I _{CN} | V _{cesat} typ /Max R _{DS(on)} | t _{dead} min |
|----------------------|--------------------------|-------------|-------|-----------------|---|-----------------------|
| STIPNS1M50T-H | SMD | MOSFET | 500 V | 1A | 3.6Ω | 1μs |
| STIPNS1M50SDT-H | | | | 1A | 3.6Ω | 1 μs |
| STIPNS2M50(T)-H | | | | 2A | 1.7Ω | 1μs |
| STGIPNS3H60T-H | | IGBT | 600 V | 3A | 2.15 V | 1.5 μs |
| STGIPNS3HD60-H | | | | 3A | 2.15 V | 1μs |
| STIPN1M50T-H | TH | MOSFET | 500 V | 1A | 3.6Ω | 1μs |
| STIPN2M50T-H/L | | | | 2A | 1.7Ω | 1μs |
| STGIPN3H60(A)(T)-(H) | | IGBT | 600 V | 3A | 2.15 V | 1.5 μs |
| STGIPN3HD60-H | | | | 3A | 2.15 V | 1μs |
| STIPQ3M60T-HZ/L | UL TH nano 2nd series | SJ-MOSFET | 600 V | 3A | 1,6Ω | 1 μs |
| STIPQ5M60T-HZ/L | | | | 5A | 1Ω | 1 μs |
| STGIPQ3H60T-HZ/L(S) | | IGBT | 600 V | 3A | 2.15 V | 1.5 μs |
| STGIPQ3HD60-HZ/L | | | | 3A | 2.15 V | 1 μs |
| STGIPQ5C60T-HZ/L(S) | | | | 5A | 1.65V | 1.5 μs |
| STGIPQ8C60T-HZ | | | | 8A | 2 V | 1 μs |

Compressor for Fridge – 3-phase Motor High Voltage



Compressor for Fridge – 3-phase Motor High Voltage



Application Benchmark- Simulations

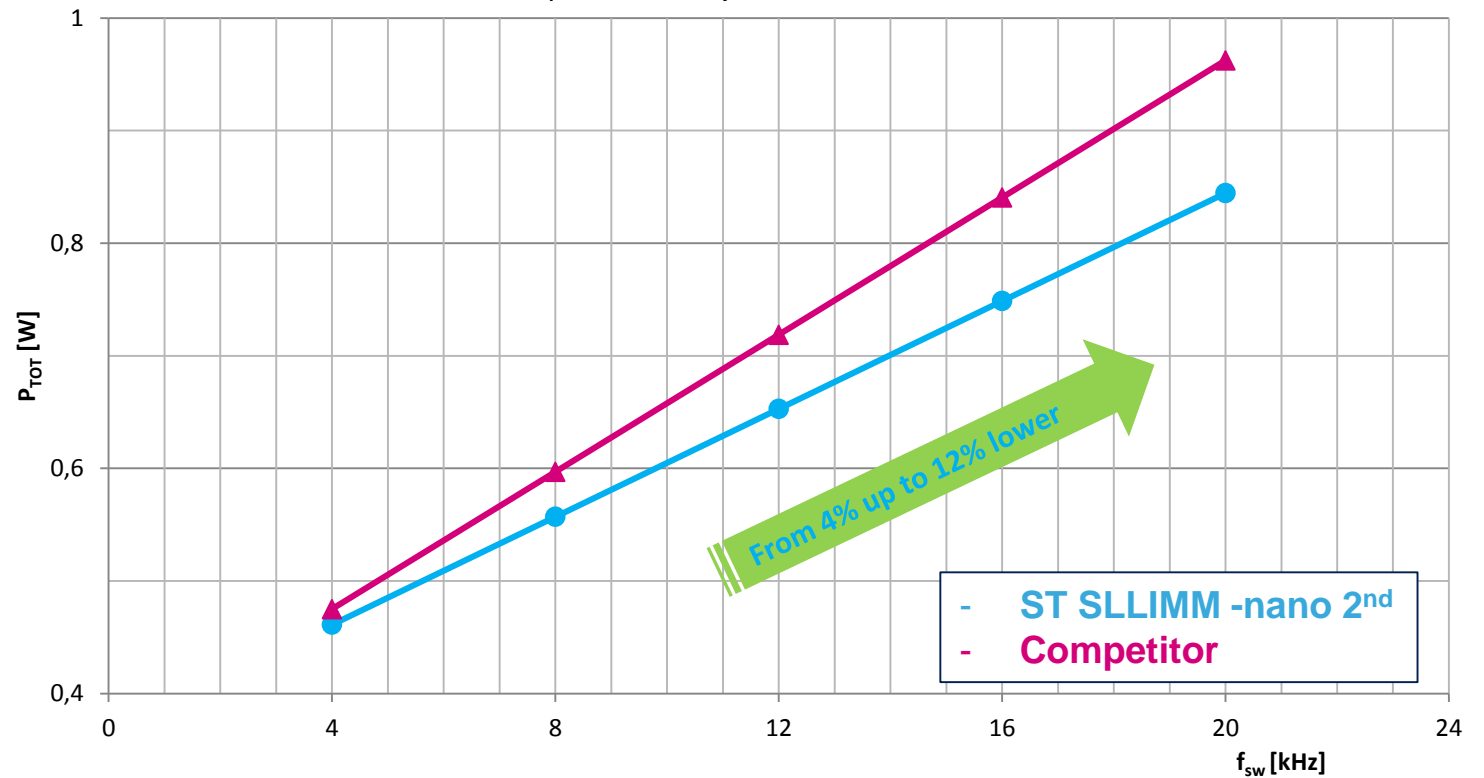
16

Simulation Conditions

- $V_{bus} = 300V$
- $ma = 0.9$
- $PF = 0.9$
- $f_{sine} = 60Hz$
- $f_{sw} = \text{up to } 20kHz$
- $I_{peak} = 1.13A$
- V_{CEsat} , V_F = typical values measured @ $25^\circ C$ & $125^\circ C$
- E_{ON} , E_{OFF} = typical values measured @ $25^\circ C$ & $125^\circ C$



IGBT + FW Diode power loss:
@ $I_{peak} = 1.13 A$, $T_j = 125^\circ C$



ST IPM shows **best overall performance**, saving around **12%** of power per switch over the competition, at maximum frequency.

Application Benchmark- Simulations

17

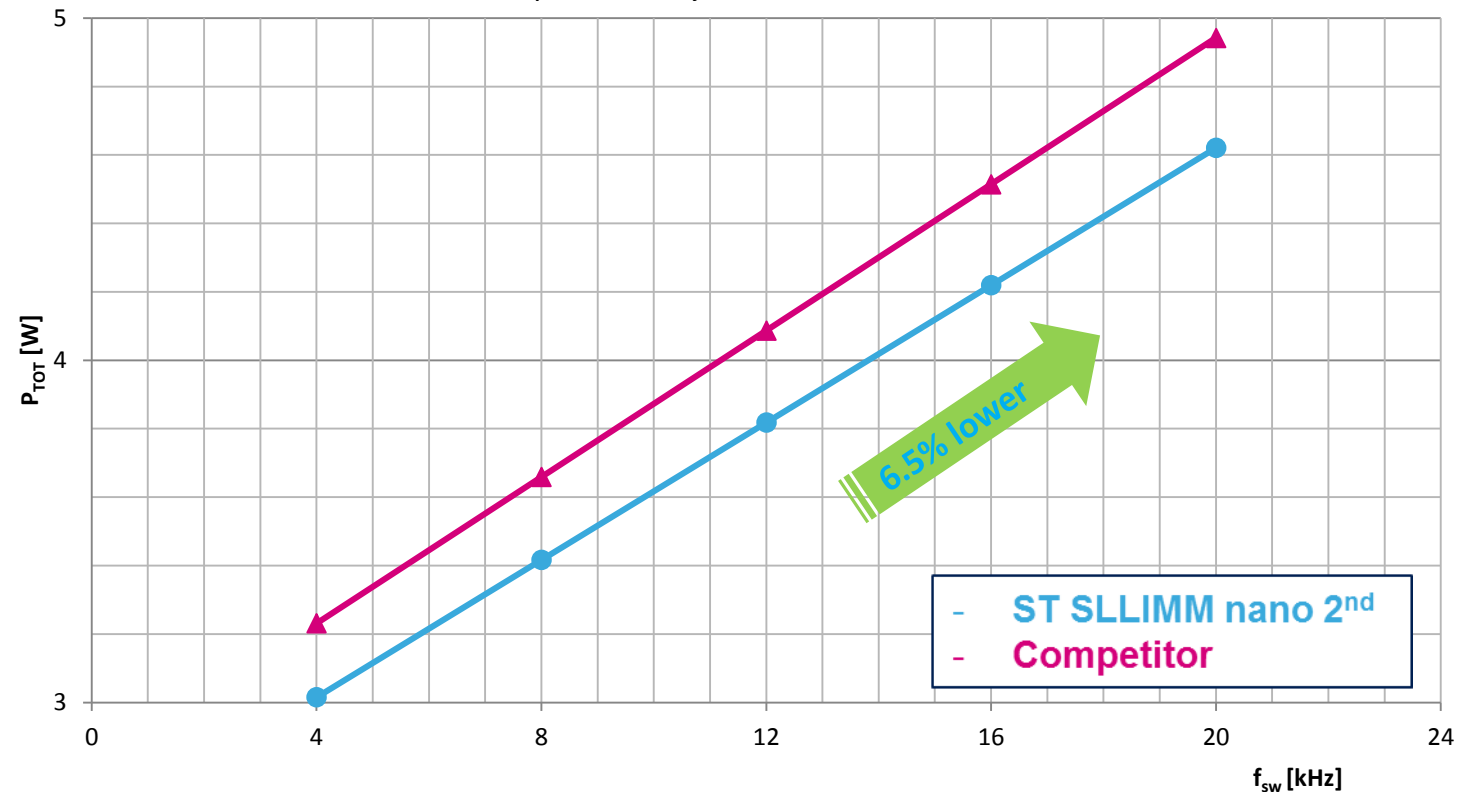
Simulation Conditions



- $V_{bus} = 320V$
- $ma = 1$
- $PF = 0.98$
- $f_{sine} = 60Hz$
- $f_{sw} = \text{up to } 20kHz$
- $I_{peak} = 4.9A$
- $V_{CEsat}, V_F = \text{typical values measured @ } 25^\circ C \text{ \& } 125^\circ C$
- $E_{ON}, E_{OFF} = \text{typical values measured @ } 25^\circ C \text{ \& } 125^\circ C$



IGBT + FW Diode power loss:
@ $I_{peak} = 4.9 A$, $T_j = 125^\circ C$



ST IPM shows **best overall performance**, saving around **6.5%** of power per switch over the competition.

IGBT or MOSFET?

18

Real case study – how to decide where to use IGBT and SJ MOSFET

STGIPQ3H60T-HL

IGBT - Saturation voltage

Different power losses on current dependence:

$$P = V_{CE} \cdot I_E$$

Power losses of IGBT are linear to emitter current

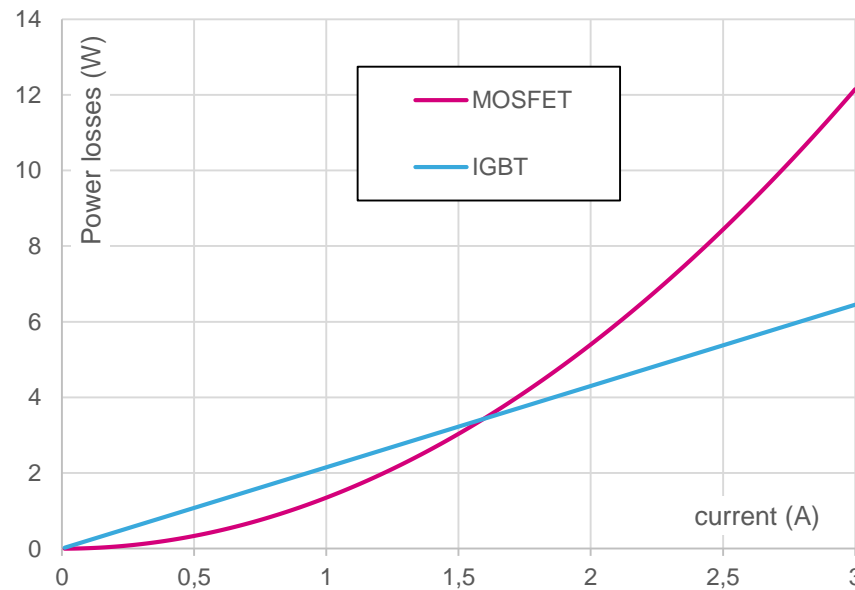
STIPQ3M60T-HL

MOSFET - Drain source resistance

Different power losses on current dependence:

$$P = R_{DSon} \cdot I_D^2$$

Power losses of SJ MOSFET are exponential to drain-source current



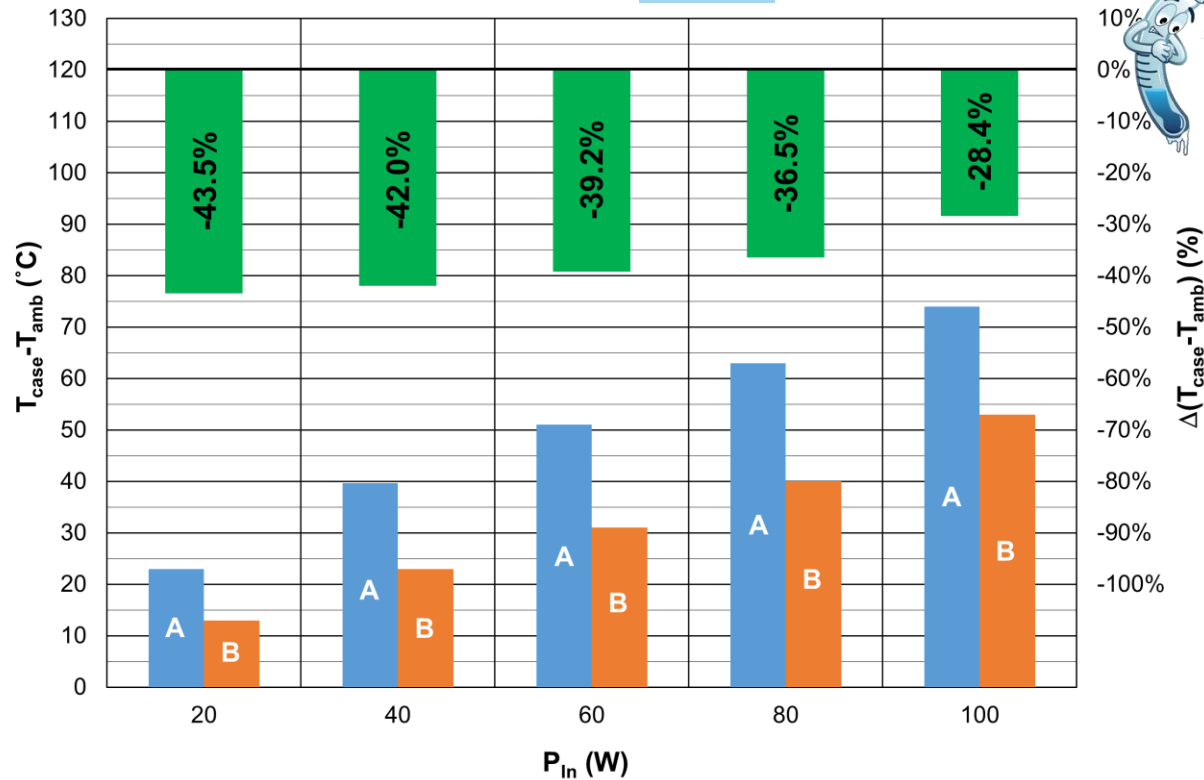
ST PowerStudio!!!



Thermal performances improvements in fridge compressor

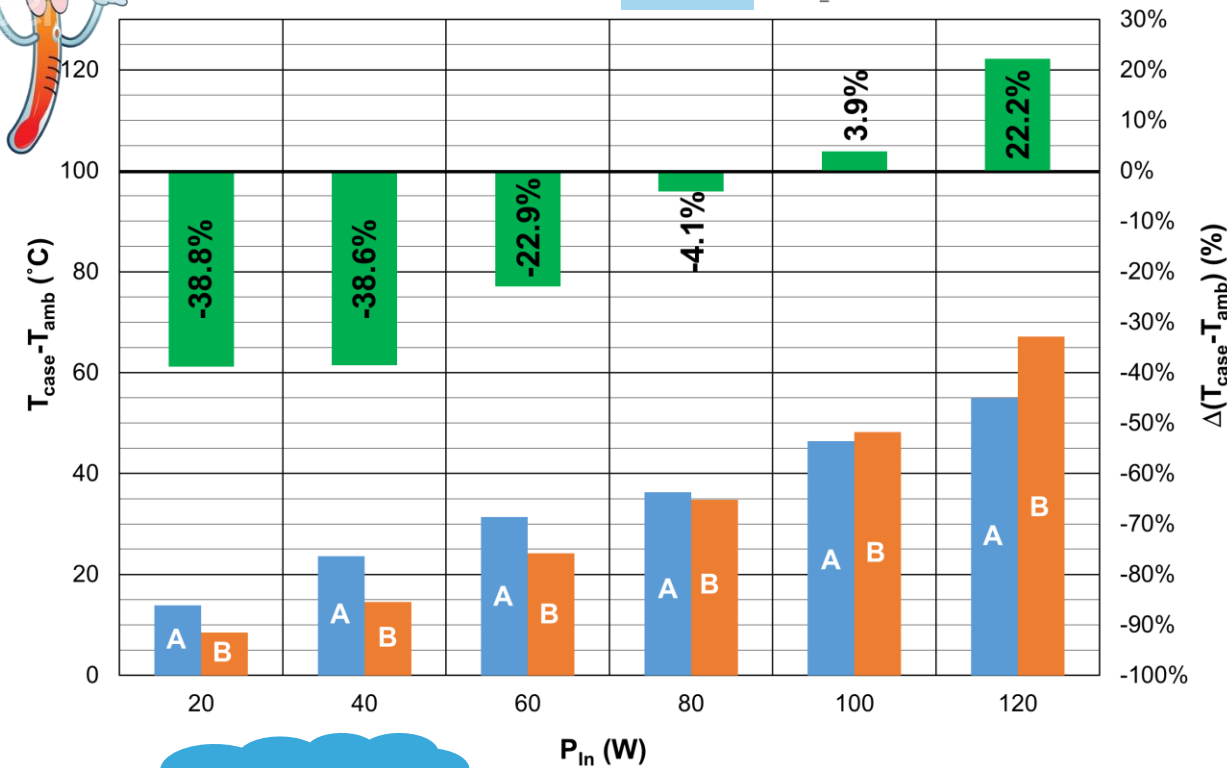
Case Temperature vs Input Power

PWM (FOC), $V_{bus} = 320\text{ V}$, $f_{sw} = 8\text{ kHz}$, $T_{amb} = 25\text{ }^{\circ}\text{C}$, $f_{sine} = 135\text{ Hz}$, still air



Case Temperature vs Input Power

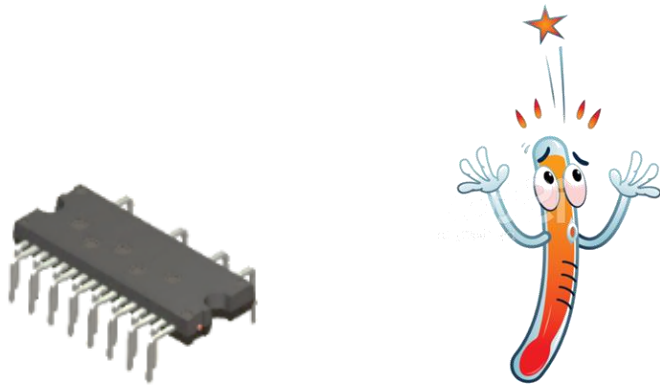
PWM (FOC), $V_{bus} = 300\text{ V}$, $f_{sw} = 8\text{ kHz}$, $T_{amb} = 70\text{ }^{\circ}\text{C}$, $R_{TH_heatsink} = 9\text{ }^{\circ}\text{C/W}$



- A STGIPQ3H60T-x (PowerMESH IGBT)
- B STIPQ3M60T-x (Super-Junction MOSFET)
- Green bar $\Delta(T_{case} - T_{amb})$ (%): SJ MOSFET vs PowerMESH IGBT

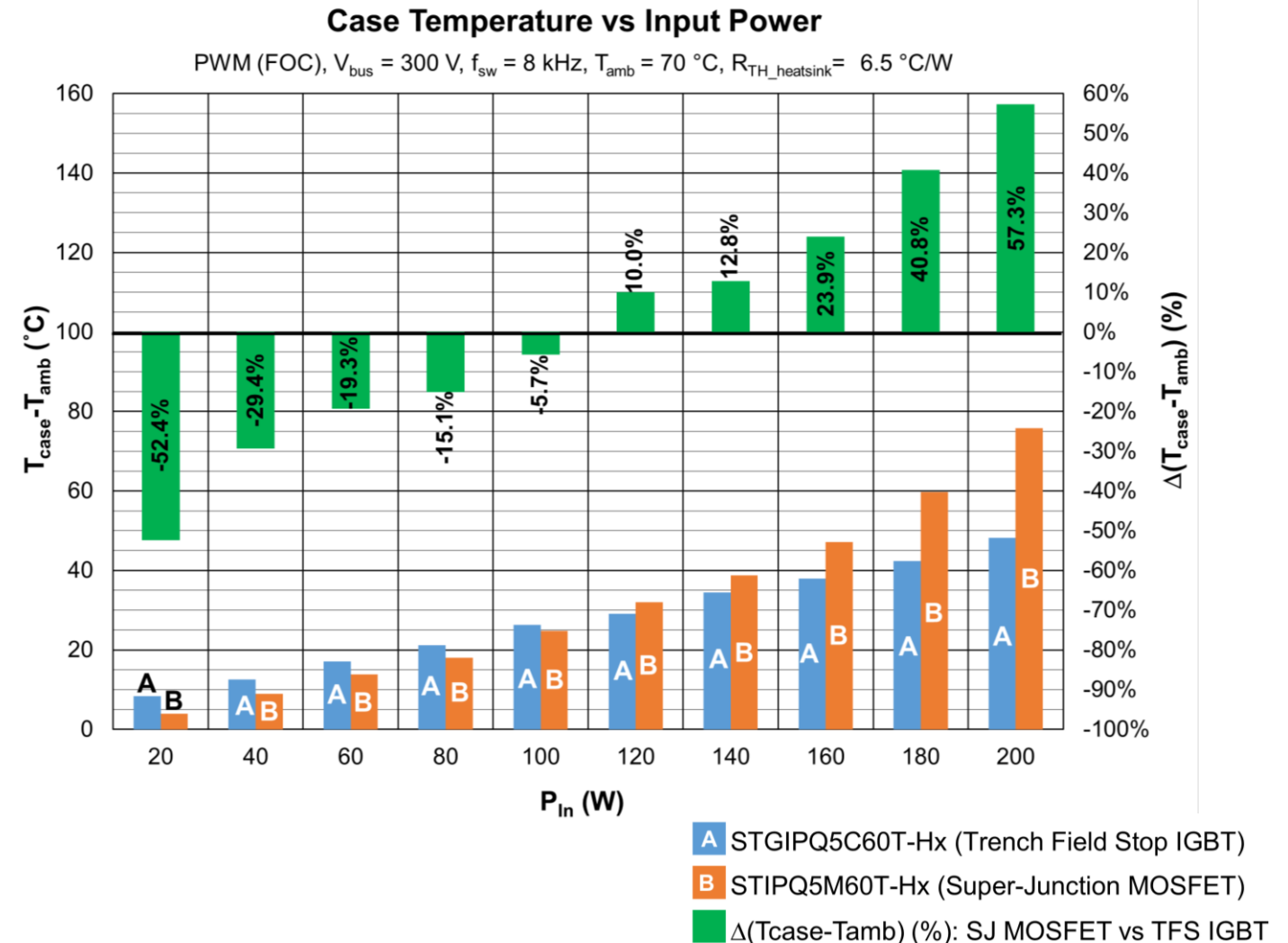
$R_{DS(ON)} = 1.6\Omega$

Thermal performances improvements in fridge compressor



To address higher power ranges

$R_{DS(ON)}$
37.5%
Lower

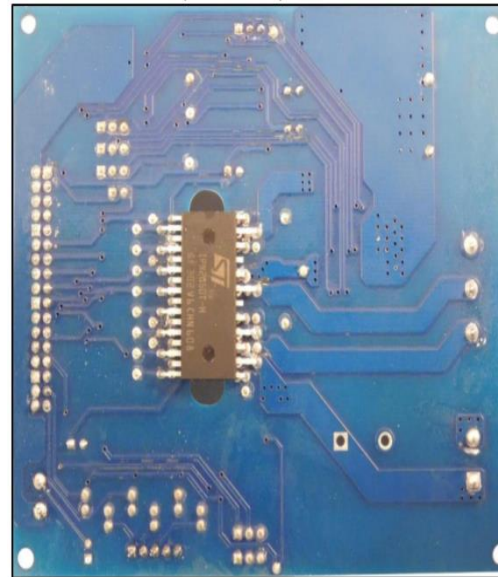
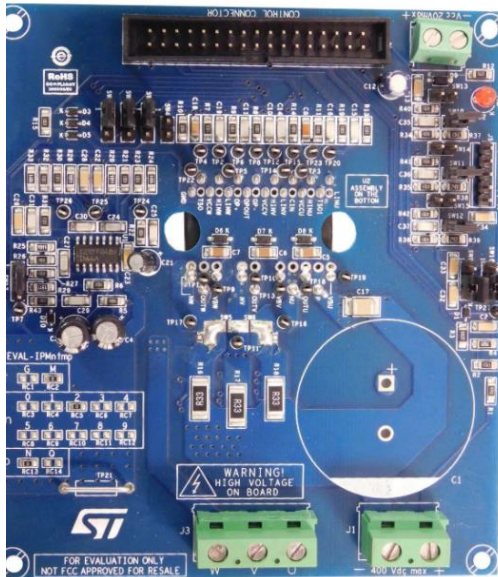


ST Power Board

The easy way to get familiar with **SLLIMM™**

21

STEVAL-IPMx motor control power board based on the SLLIMM -nano series



Board includes:

interface circuit (BUS and Vcc connectors), bootstrap capacitors, snubber capacitor, short-circuit protection, fault event circuit, temperature monitoring, single/three shunt resistors and filters for input signals, hall sensor

easy-to-use solution for driving low-medium power motors

Minimal BOM and high efficiency

Overvoltage and Overload protections

IPM temperature monitoring and protection

Interfacing with ST MCU boards

- The dynamic electro-thermal simulation software dedicated to ST power devices

Developed for

- SLLIMM, ACEPACK, Discrete*
- Several Applications
- Windows, MAC OS X*, Android* and iOS*

Powerful and flexible

- Dynamic load simulation (up to 10 steps)
- Long mission profile duration of hours
- Several thermal setup

Connectivity

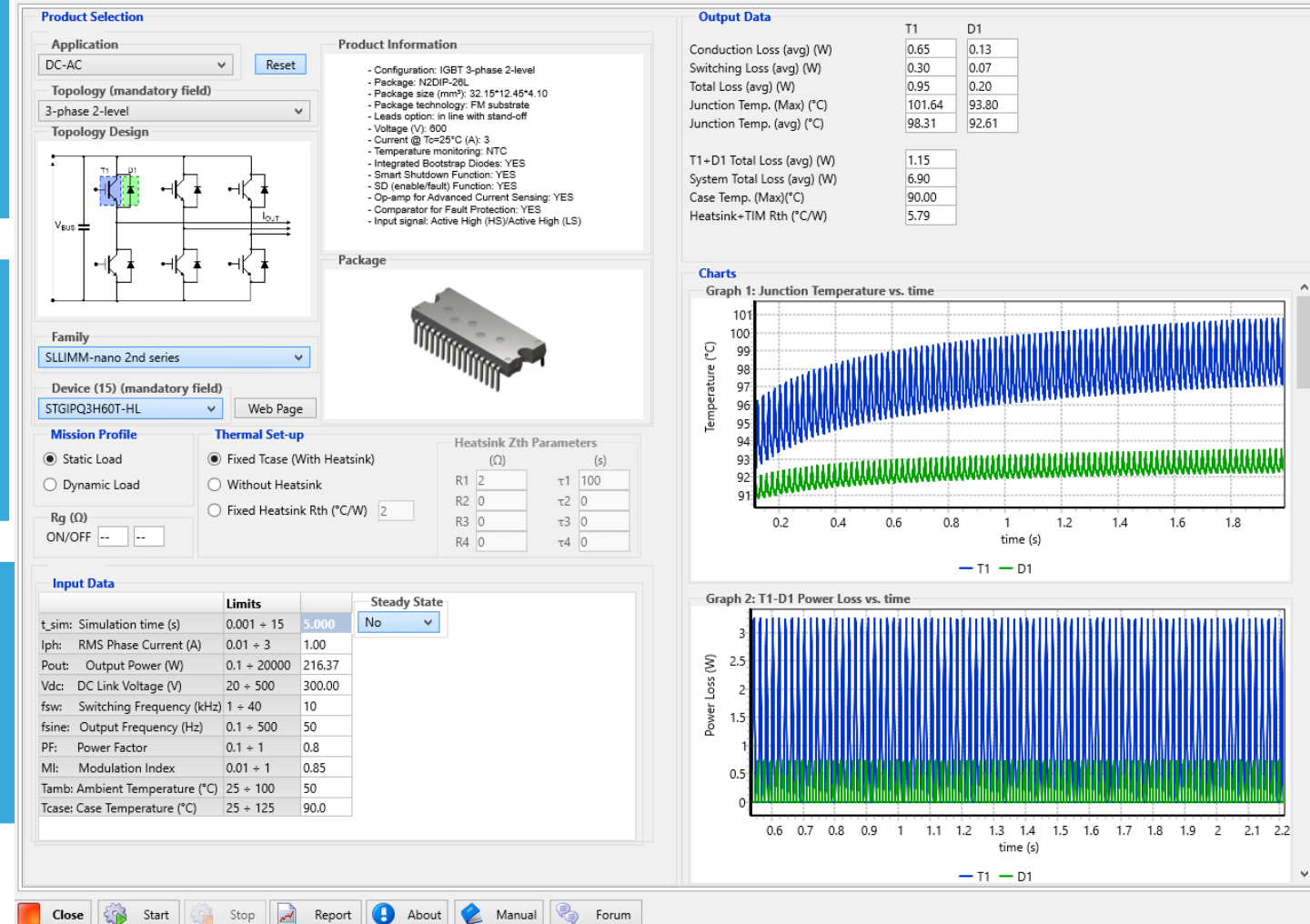
- Multilanguage (English, Chinese*, Japan*)
- Quick link with st.com documents
- PDF Output Report



* Available in the next releases

ST PowerStudio

STSW-POWERSTUDIO



- Flyers and Technical notes
- Evaluation Tool Software
- Promotional plastic panels
- Presentations and e-presentations
- Reference designs



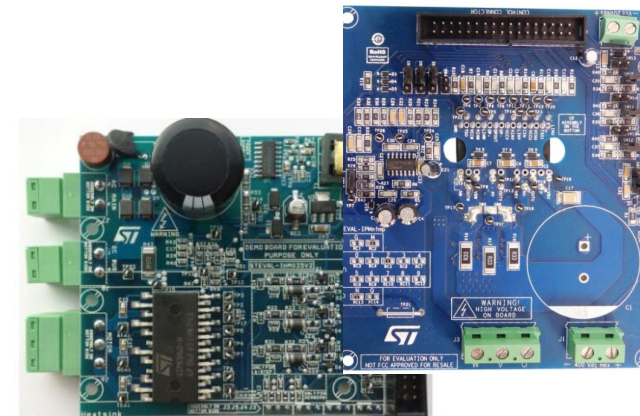
Plastic Panels



Technical Literature



Promotional Boards
STDEMOSLLIMM161



STEVAL-IHMx/IPMx



life.augmented

For additional information, please visit the web site www.st.com