SLLIMM™- nano Series

Small Low-Loss Intelligent Molded Module
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

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

Ideal solutions for Industrial & Robotic Drives, Home Appliances, Welding, Pumps, Fans & Blowers, and Air Conditioning
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

The best IPM offer for Home Appliances 3-phase inverter

- 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

nano SMD

nano TH
SLLIMM - nano Series
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
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Topology in SLLIMM - nano Series
NTC and SD are separated, no for Operational amplifier

Ideal for
3-phase inverters for motor drives
- Small fans
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SLLIMM -nano Through Hole

What’s new!?

SLLIMM -nano 2\textsuperscript{nd} series to boost power capability

- 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 TH

- Higher thickness for 1.5kV UL certification

SLLIMM nano 2\textsuperscript{nd} TH

- slots for easy heatsink screwing
- double stand-off option:
  - No Stand-off
  - with Stand-off

Up to 500W
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
- High energy efficiency and excellent reliability
- Space-saving device
- Heatsink-free design
- Safety isolation
- Low-noise performance
SLLIMM -nano SMD

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.
**Special Features**

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

**Leads finish option**

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

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### SLLIMM -nano Products Table

<table>
<thead>
<tr>
<th>Product PN</th>
<th>Package type</th>
<th>Switch type</th>
<th>BV</th>
<th>I&lt;sub&gt;CN&lt;/sub&gt;</th>
<th>V&lt;sub&gt;cesat&lt;/sub&gt; typ /Max R&lt;sub&gt;DS(on)&lt;/sub&gt;</th>
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<tbody>
<tr>
<td>STIPNS1M50T-H</td>
<td>SMD</td>
<td>MOSFET</td>
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Application Example

Compressor for Fridge – 3-phase Motor High Voltage

AC 150V~260V  

High Energy Transfer  

0.8MPa

Power Supply & Aux Power Supply Block

+15V  

+3.3V

MCU

Drivers

Is

SD

2 shunt current sample & over current detection

400W
Application Example

Compressor for Fridge – 3-phase Motor High Voltage

AC 150V~260V

High Energy Transfer

Power Supply & Aux Power Supply Block

MCU

+15V

+3.3V

Is

SD

1/2 shunt current sample & over current detect

0.8MPa

400W

93% Energy Transfer
Simulation Conditions

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

Total Power Loss: FW Diode + IGBT Power Loss

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

Simulation Conditions

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

ST IPM shows best overall performance, saving around 6.5% of power per switch over the competition.
IGBT or MOSFET?

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!!!
SLLIMM -nano
from conventional switches to SJ MOSFET

Thermal performances improvements in fridge compressor

PWM (FOC), $V_{bus} = 320$ V, $f_{sw} = 8$ kHz, $T_{case} = 25$ °C, $T_{Amb} = 135$ Hz, still air

$R_{DS(ON)} = 1.6 \Omega$
SLLIMM -nano
from conventional switches to SJ MOSFET

Thermal performances improvements in fridge compressor

To address higher power ranges

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

![Graph showing Case Temperature vs Input Power for SJ MOSFET vs TFS IGBT]
ST Power Board
The easy way to get familiar with SLLIMM™

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
Support Material

- Flyers and Technical notes
- Evaluation Tool Software
- Promotional plastic panels
- Presentations and e-presentations
- Reference designs
For additional information, please visit the web site www.st.com