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STPOWER

STTD6050H-12M2Y

single-phase half-controlled bridge rectifier

STTN6050H-12M1Y

Thyristor controlled half-bridge module

in ACEPACK SMIT module

Thyristor Product Family

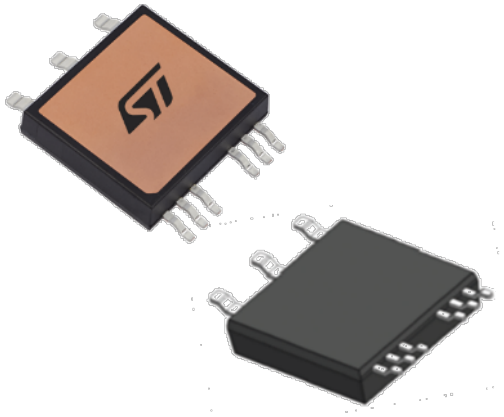
DFD Division , ADG group

March 2022

ACEPACK SMIT module application field

Power Integration of efficient mass-produced technologies

More mobility with less noxious emission



More energy with less waste

Automotive OBC

Charging station

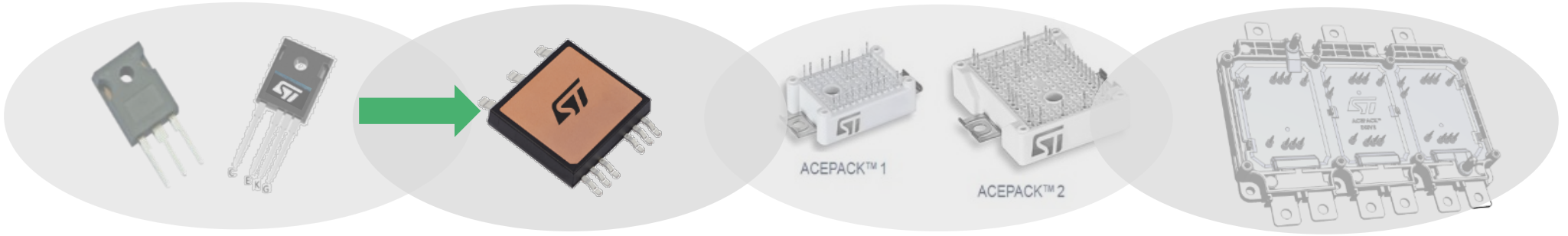
Industry 4.0

SMPS

E-Motor Drive

Innovation in power conversion

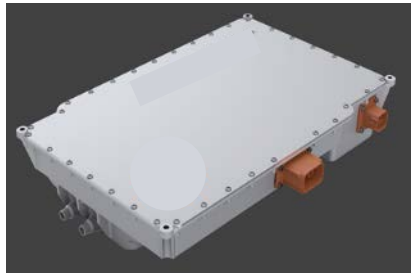
Discretes | **ACEPACK SMIT** | **Baseplate-less Modules** | **Baseplate Modules**



1kW | **10kW** | **50kW** | **100kW** | **300kW**

Applications Focus

Data Center Power



On Board Charger

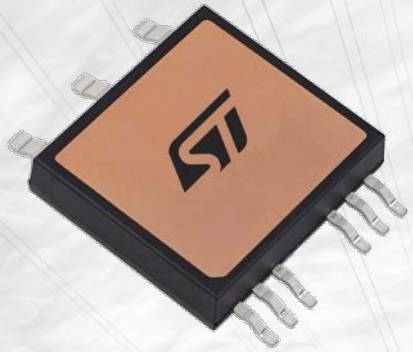
EV Charger

Electric Storage

Solar Energy

ACEPACK SMIT package overview

The Surface Mount with Isolated Top cooled package



- Size L x W x H : 33 x 25 x 5.5 mm^3
- Up to six dies on Direct Bond Copper (DBC) substrate
- Top side cooling with high thermal transfer
  - Lower total thermal resistance < 0.2°C/W
- Backside Insulated Ceramic
  - UL recognized, 4000V_{RMS}
- Surface Mount Device for automatic assembly
- High-Voltage creepage distances
  - 4 mm minimum lead-to-top
  - 6.6 mm minimum lead-to-lead

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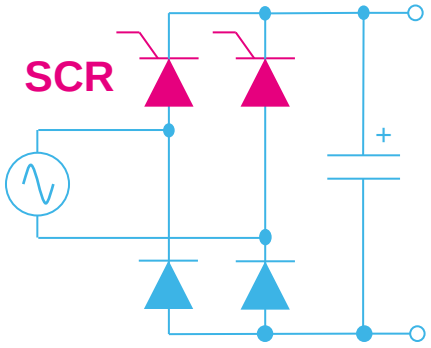
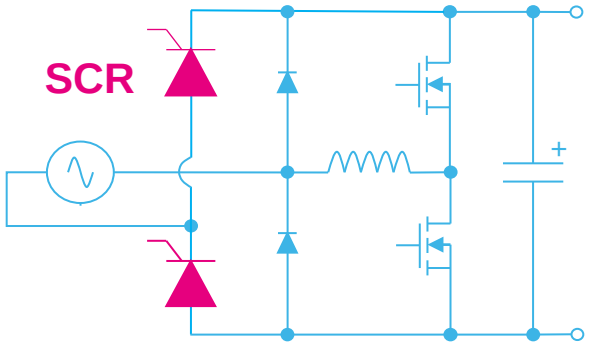
Thyristor Functions in Power Conversion



Mixed SCR bridge

Charging Station

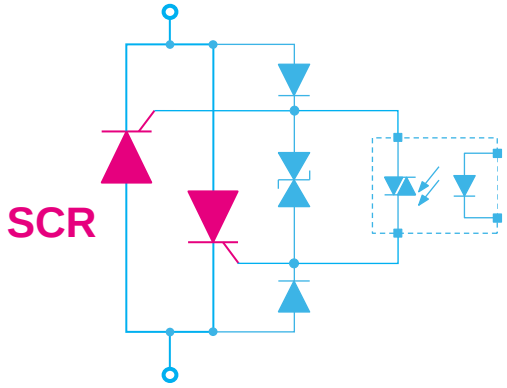
Inrush Current Limitation
Up to 30 kW per phase



Single-phase Totem Pole

OBC / TV SMPS

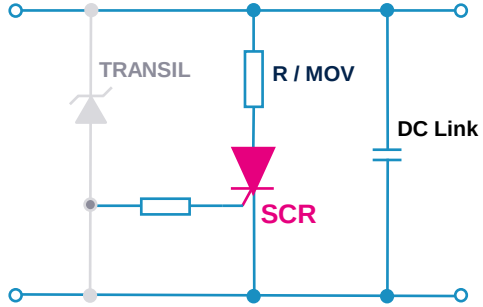
Inrush Current Limitation
Up to 8 kW per phase



Solid State Relay

UPS / Renewable

Bypass / Hybrid relay
Up to 35 kW



Overvoltage / Discharge

Lighting / SMPS

10 kV Surge voltage protection
3000 A / 1 ms power bus discharge

1200V 150°C SCR Thyristor challenges
in Industrial and Automotive

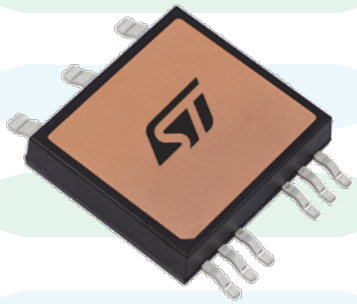
CHALLENGE	SOLUTION	BENEFIT
Unsensitive to Vibrations	No-move Solid-state SCR	Improved Reliability
Reduce Inrush Currents IEC61000-3-3 compliant	SCR in Phase Control	Smart Control, Fast Startup
125 °C Operating Ambient	Max T_J = 150°C @ 1200 V	Shrink cooling system size

Thyristor Innovation in Power Conversion

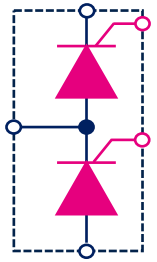
ACEPACK **SMIT**, **S**urface **M**ount **I**nsulated **T**op cooled package

Play with a power SMD platform for compact up to 50kW converter

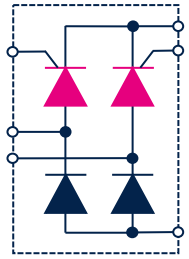
- Top cooled with excellent heat transfer
- Power surface mount integrating up to 6 dies
- 4 kV insulation, 4mm lead-heatsink distance
- 1200 V 150 °C robust SCR Thyristor



- Control more current in a smaller converter
- Increase Quality and UPH throughput
- 277 V, 480 V AC operation without isolated pad
- Higher system robustness vs disturbances



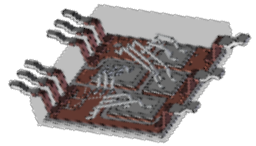
STTN6050H-12M1Y



STTD6050H-12M2Y

- V_{DRM} & V_{RRM} = 1200 V
- V_{DSM} & V_{RSM} = 1400 V
- T_J : - 40 to +150 °C
- I_{TSM} = 600 A
- dV/dt = 1 kV/µs @ 150 °C

AEC Q101 – AQG 324 compliant



STTD6050H-12M2Y in ACEPACK SMIT

60 A 1200 V single-phase half-controlled bridge rectifier AQG 324 module

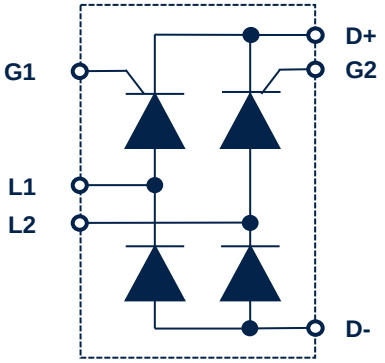
APPLICATION

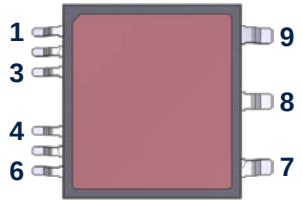
- Single phase half-controlled bridge rectifier for :
  - Boost PFC of power supply and Battery Charger
  - Inverter driven motor
- AC Line current up to 80 A RMS
  - Embeds two TN6050HP-12Y and two STBR6012Y
- UL recognized for insulation, UL1557
- Smaller size than four TO-247 or four D²PAK

Automotive OBC | Industry 4.0 | Charging station | E-Motor Drive

PRODUCT FEATURES

- V_{DRM} : 1200 V
- I_{TRMS} / I_{FRMS} : 60 A
- I_{TSM} : 500 A
- I_{GT} : 50 mA
- T_J : 150 °C
- $R_{TH\ JC}$ per device : 0.75 °C/W
- Isolation : 4000 V_{RMS}





TOP VIEW

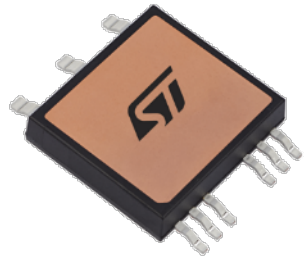
1	2	3	4	5	6	7	8	9
NC	G1	G2	D-	D-	D-	L2	L1	D+

NC : Not Connected

The STTD6050H-12M2Y in ACEPACK SMIT

60 A 1200 V single-phase half-controlled bridge rectifier AQG 324 module

Increase the bridge rectifier power with the AQG 324 module STTD6050H-12M2Y



- Shrink converter size & ease its assembly
- Increase output current vs discrete +35 %
- Run at 480 V_{RMS} AC with reinforced isolation

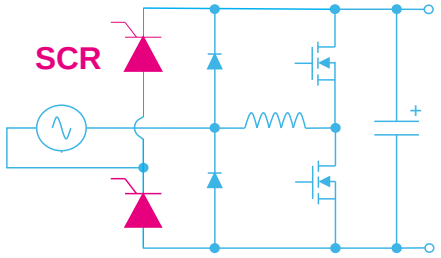
STTN6050H-12M1Y in ACEPACK SMIT

60 A 1200 V Thyristor controlled half-bridge AQG 324 module

APPLICATION

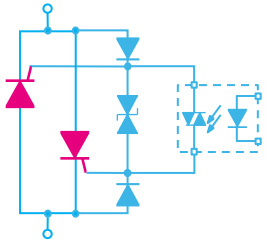
APPLICATIONS

- On Board Battery Charger
- Bridgeless totem pole boost
- 3-Phase rectifier bridge
- Solid State Relay



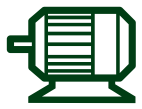
FUNCTIONS

- 80A dual SCR half-bridge leg
- Inrush current limiter
- Back-to-back SCR Switch



Automotive OBC

Charging station

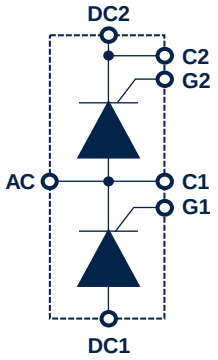


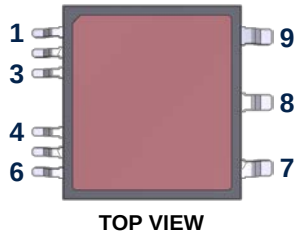
E-Motor Drive

Solid State Relay

PRODUCT FEATURES

- V_{DRM} : 1200 V
- I_{TRMS} : 60 A
- I_{TSM} : 600 A
- T_J max : 150 °C
- I_{GT} : 50 mA
- dV/dt : 1 kV/µs @ 150°C
- $R_{TH\ JC}$ per SCR : 0.75 °C/W
- Isolation : 4000 V_{RMS}





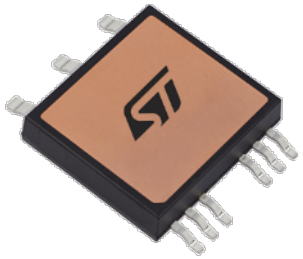
TOP VIEW

1	2	3	4	5	6	7	8	9
C2	NC	G2	G1	NC	C1	DC1	DC2	AC

NC : Not Connected

The STTN6050H-12M1Y in ACEPACK SMIT

60 A 1200 V Thyristor controlled half-bridge AQG 324 module



Control more power from AC line in less space with the STTN6050H-12M1Y

- Shrink converter size & ease its assembly
- Increase output current vs discrete +35 %
- Run on 480 V_{RMS} AC with reinforced isolation

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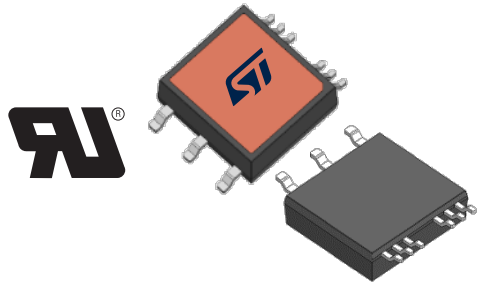
ST complementary offer in ACEPACK SMIT

The power isolated SMD module for Electric Vehicle and Smart grid

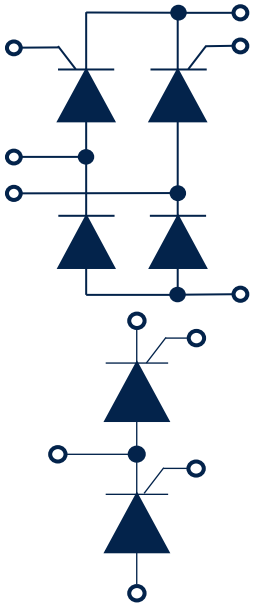


- **TOP side cooling**
- **0.2 °C/W thermal resistance**
- **4kV UL-isolated SMD**
- **Automotive grade quality**
  - **AEC Q101 qualified dies**
  - **AQG 324 qualified module**

STTD6050H-12M2Y

1-Φ Half-controlled Bridge Rectifier

76 A - 4 x 60 A – 1200 V



STTN6050H-12M1Y

Thyristor Controlled Half-bridge

76 A - 2 x 60 A - 1200 V

STTH60RQ06-M2Y

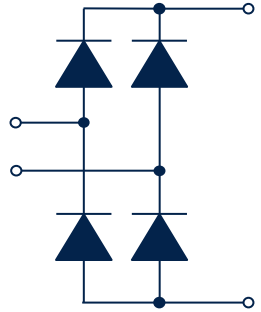
LLC Output Bridge Rectifier

60 A - 4 x 30 - 600 V

STTH120RQ06-M2Y (♦)

LLC Output Bridge Rectifier

120 A - 4 x 60 - 600 V



STPSC40H12-M2Y (♦)

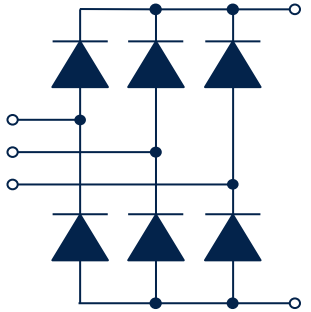
LLC Output Bridge Rectifier

SiC – 40 A - 4 x 20 A - 1200 V

STPSC60H12-M3Y (♦)

3-Φ bridge for Vienna PFC

SiC - 60 A - 6 x 20 A - 1200 V



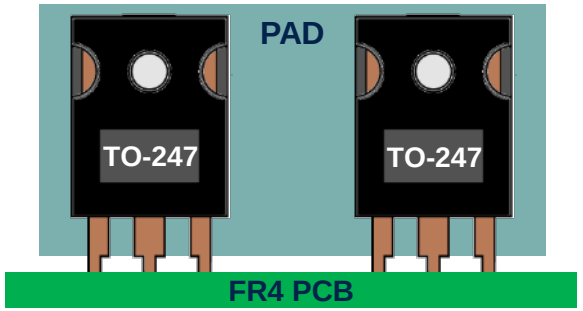
Note ♦: in Development

Power dissipation versus delivered input power
with STTN6050H-12M1Y module

STTN6050H-12M1Y extracts more heat then delivers more current (+35%)

Two TO-247 TN6050HP-12WY

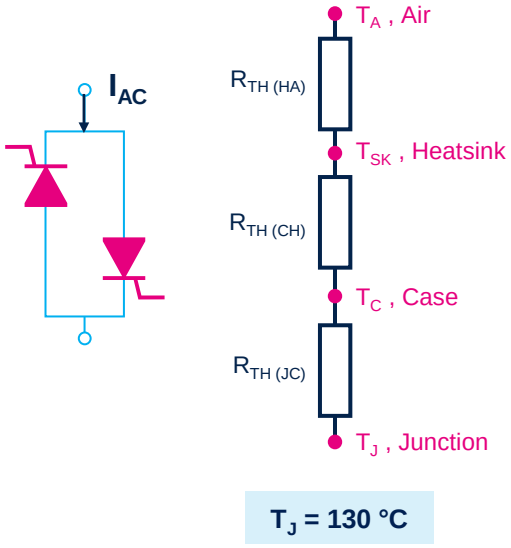
$R_{TH\ (JC)} + R_{TH\ (PAD)} = 1.45$ °C/W



$T_{SK} = 108$°C @ 32 A AC line

$I_{AC} = 41$ A @ $T_{SK} = 100$°C

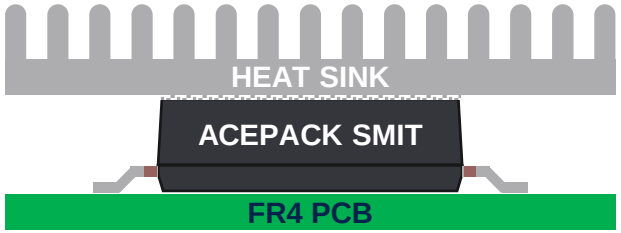
$R_{TH\ (CH)} = R_{TH\ (PAD)} = 1.15$°C/W



$T_J = 130$ °C

STTN6050H-12M1Y

$R_{TH\ (JC)} + R_{TH\ (CONTACT)} = 1$ °C/W



$T_{SK} = 115$°C @ 32 A AC line

$I_{AC} = 55$ A @ $T_{SK} = 100$°C

$R_{TH\ (CH)} = R_{TH\ (CONTACT)} = 0.25$°C/W

ACEPACK SMIT creepage distances with STTD6050H-12M2Y

STTD6050HP-12M2Y offers reinforced insulation on 277 V AC Line operation

- Following IEC60664-1
- Pollution degree 2
- Material group 2
- Heat sink to earth
- V_{DRM} = 1200V limits to 690V_{AC}

Reinforced insulation up to 285 V_{AC}

Without insulated heatsink pad

Lead-to-heatsink $D_{creepage}$ > 4 mm

In pollution degree 2 STTD6050H-12 runs:

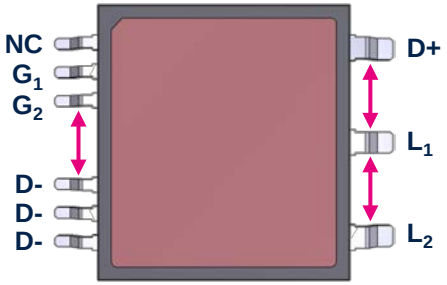
- **Up to 277 V_{AC} single phase mains**
- **Up to 480 V_{AC} 3-Φ neutral-earthed mains**

UL recognized, File E81734

V_{INS} = 4000 V

Reinforced insulation up to 690 V_{AC}

With insulated tab-to-heatsink pad



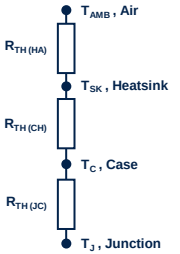
Lead-to-lead $D_{creepage}$ > 6.6 mm

In pollution degree 2 STTD6050H-12 runs :

- **Up to 690 V_{AC} 3-Φ neutral-earthed mains**
- **Up to 930 V_{AC} functional insulation**

How the STTD6050H-12M2Y fits various cooling types

STTD6050H-12M2Y maximizes the converter power 11 kW @ 103°C



- T_{AMB} or T_{COOL} = 103 °C
- T_J = 130 °C
- $R_{TH\ (CH)}$ = 0.3 °C/W (grease)
- $R_{TH\ (JC)}$ = 0.75 °C/W
- Tightening torque = 0.5 N.m

Water cooling

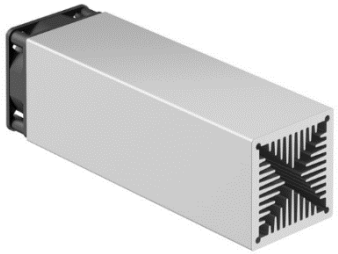
$R_{TH\ (HA)} \approx 0$ °C/W

Converter power on 230 V_{AC} :

Up to 11 kW

With $R_{TH\ JA}$ = 1.05°C/W

Active cooling



$R_{TH\ (HA)} \approx 1$ °C/W

Converter power on 230 V_{AC} :

- **Up to 6.2 kW**

With $R_{TH\ JA}$ = 2.05°C/W

Passive cooling

$R_{TH\ (HA)} \approx 2.5$ °C/W

Converter power on 230 V_{AC} :

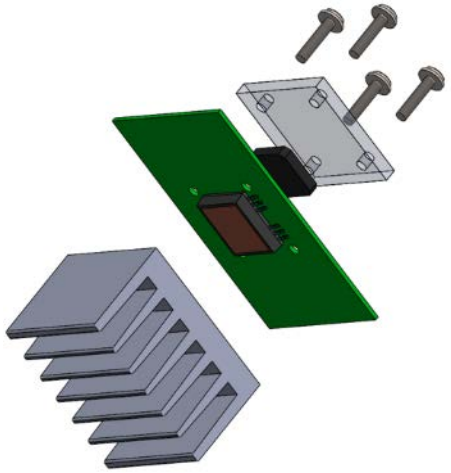
- **Up to 3.8 kW**

With $R_{TH\ JA}$ = 3.55°C/W

ACEPACK SMIT : a platform for mass production

Surface Mount Technology → **Allow automatic assembly** → **Increase production uph & quality**

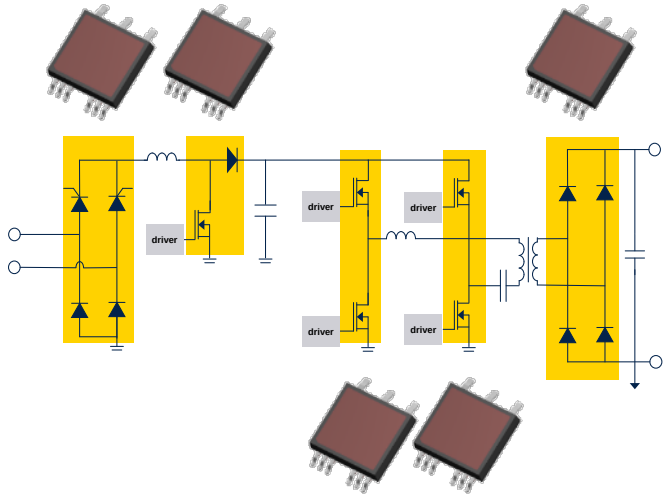
Full Automatic Mounting



Simplify converter layers stack

Application note AN5384

An ***ST*** kit with all power discretes

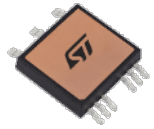


Propose a modular power platform

ACEPACK SMIT Thyristor in charger power range

3-phase

Totem-pole
Interleaved Boost
Vienna Relay



STTN6050H-12M1Y / STTD6050H-12M2Y

TN6050HP-12WY

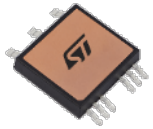
TN4050HP-12WY

TN3050H-12WY

Single-phase

Totem-pole /
Interleaved Boost

STTD6050H-12M2Y / STTN6050H-12M1Y



TN6050HP-12WY

TN4050HP-12G(2)Y

TN3050H-12GY

POWER

2 kW **3.7 kW** **7.4 kW** **11 kW** **22 kW** **50 kW**

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The ACEPACK SMIT package challenges
in Renewable and Mobility

CHALLENGE	SOLUTION	BENEFIT
Increase power density	Size equal to two TO-247	Cut foot-print surface by two
Increase heat extraction	Large top side pad $R_{TH\ JC} < 0.2\ ^oC/W$	Low heat stress on PCB Increase controlled current
Run on 480V AC Line	Enlarge creepage distance 4kV tab isolation	Reinforced isolation no isolated pad needed
Design large scale 50 kW converter	Power surface mount, embed 2 to 6 dies	Increase Quality and UPH throughput

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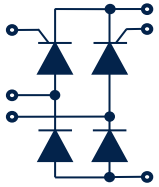
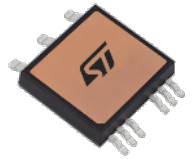
ACEPACK SMIT Thyristor modules: part numbers

ST	TN	60	50	H		-	12	M	Y
Brand	Thyristor	Current	Sensitivity	Junction	Index		Voltage	Package	Grade
	SCR / Diode	$I_{T(RMS)}$	I_{GT}	$T_{J\ MAX}$	Series		V_{DRM}/V_{RRM}	ACEPACK SMIT	Quality
	T : SCR TN : SCR D : Diode	60 : 60 A	50 : 50 mA	H : 150°C	Blank : Premium		12 : 1200 V	M1 : 1 leg M2 : 2 legs	Y : Automotive

ST	TN	60	50	H		-	12	M1	Y



ST	TD	60	50	H		-	12	M2	Y



Take away: STTD6050H-12M2Y & STTN6050H-12M1Y

for industrial and automotive power conversion

- ACEPACK SMIT = Top cooled surface Mount module for automated assembly
- ACEPACK SMIT is a module platform for SiC, FET, IGBT, Rectifier and Thyristor
- ACEPACK SMIT shrinks converter size thanks to increased creepage distance 4.4 and 6.6 mm
  - It embeds 4 power discrete devices whereas its surface equals only two TO-247
- Both STTN6050H-12M1Y & STTD6050H-12M2Y run on 277 V_{AC} without extra isolation
  - STTD6050H-12M2Y suitable for 11 kW single phase
  - Also suitable for 480Vac 3-phase neutral-earthed AC DC converters
  - With its lower thermal resistance, it extracts more dissipation losses than TO-247 discretes
  - It drives 35% more current to the switching converter
  - Its case-junction warming up is 7°C less than discretes version at 32 A AC line current

Our technology starts with You

Find out more at High Temperature Thyristor (SCR)

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