…more discrete power

Power & Analog program

European Multi System Market Competence Center

…more discrete power

- **MOSFETs**
  - SuperMESH / MDMesh techonologies
  - Fast Recovery Diode (FRED)
  - Package evolution
- **IGBTs**
- **AC SWITCH**
- **RECTIFIERS**
  - POWER SCHOTTKY
  - BIPOLAR AND ULTRAFAST

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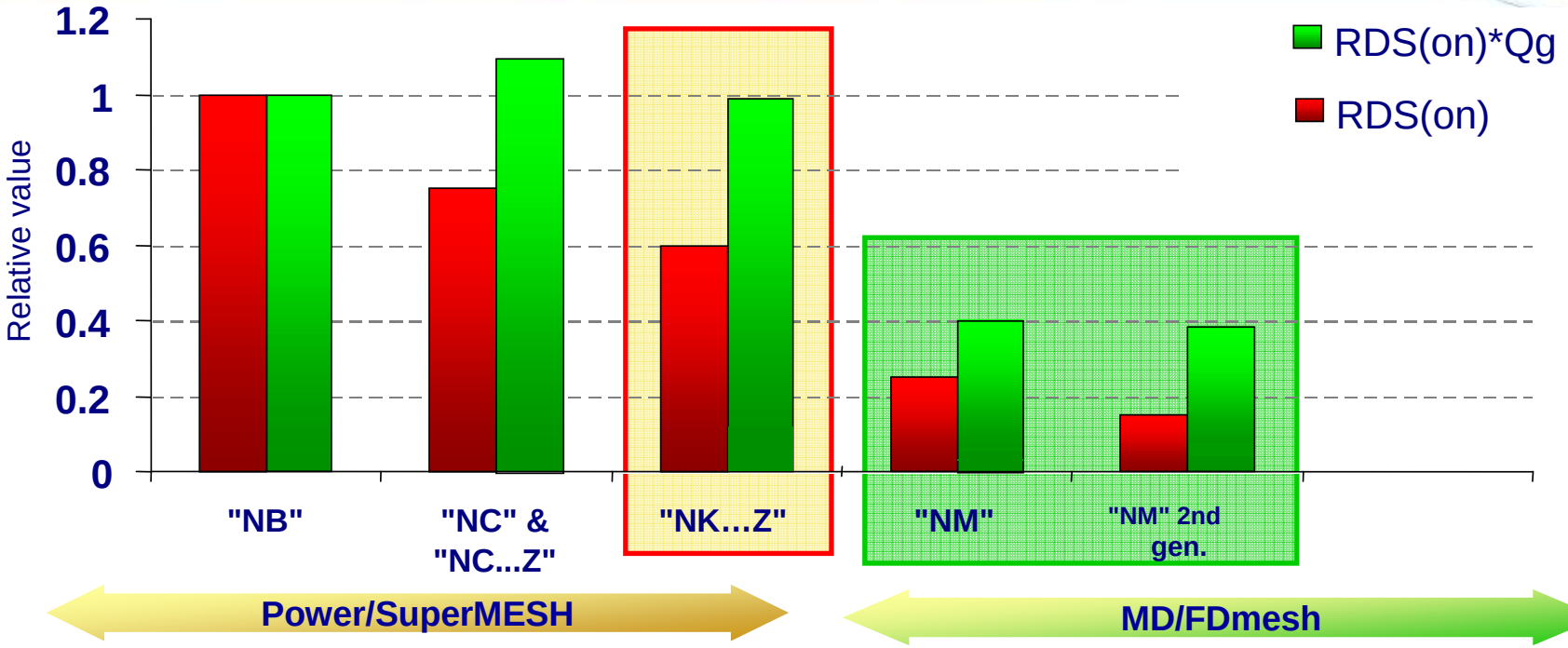
SuperMESH and MDMESH

Different technologies to cover different needs

	SuperMESH - "NK…Z" Series: STANDARD HV Tech.	MDmesh™ and MDmesh II™ Series: ENHANCED Tech.
Performances	• Outstanding RDS(on) x Area reduction • Back to Back Zener Diode for higher ESD capability	• Extremely low ON-Resistance • Superior dynamic performances • Excellent dV/dt • Minimized Gate resistance (Rg)
Benefit	• High reliability & ruggedness • Price competitiveness	• Improved system efficiency • Smaller heat-sinks
Portfolio	Massive product range from 300V to 1500V	Complete product range at 200, 500V, 600V, 650V
Versions	Also with Fast REcovery Diode	

High voltage series – figure of merit



- RDS(on)*Area:
  - > 20% average improvement
- RDS(ON)*Qg**:**
  - equivalent to former technologies (“NB”)
- ESD capability**:**
  - increased through G-S Zener Diode

- RDS(on)**:at least three-fold cut**
  - **conduction-losses reduction**
- Qg**:a third the size of Std MOS**
  - **switching-losses reduction**

ST MOSFETs in MDmesh ™ I & MDmesh ™ II Technologies

MDmesh I

Features

- Very low RDS(on)
- Low input capacitance and gate charge
- Vth range: 3V<Vth<5V
- Best-in-class in dynamic dv/dt
- Fast Recovery Diode version (FDmesh I)

Benefits

- Extremely low conduction losses
- Extremely low switching losses: improved system efficiency and smaller heat-sinks
- High avalanche ruggedness
- Reduced switching losses during intrinsic diode recovery phase

MDmesh II

Features

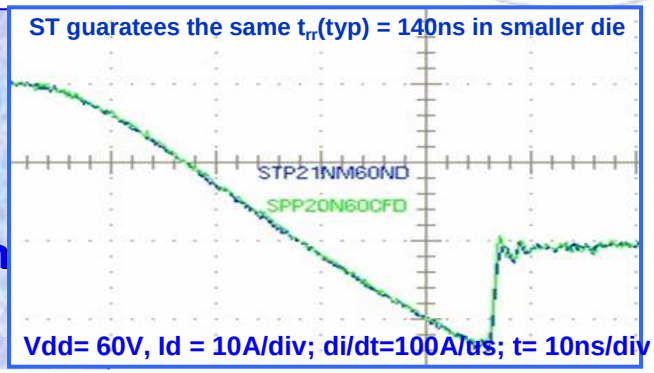
- Extremely low RDS(on) up to 40% Rds(on) reduction
- Low input capacitance and gate charge
- Vth range: **2V<Vth<4V**
- Best-in-class in dynamic dv/dt
- Fast Recovery Diode version (FDmesh II)

Benefits

- Extremely low conduction losses
- Extremely low switching losses: improved system efficiency and smaller heat-sinks
- Driver losses reduction and **driving optimization**: higher currents at lower Vgs and high noise immunity
- **High avalanche ruggedness**

FDmesh™ II for SMPS - The new FAST recovery diode series

STxyyNM60ND's are ST's most recent Power MOSFETs, which belong to the new FDmesh II fast recovery diode series; Thanks to their competitive conduction, switching performances and faster diode recovery phase, they're particularly suited for hard switching full bridge topologies in primary side sections of SMPS for Servers and also for Solar Inverters.



Worldwide best RDS(on)*area

V_{DS}	$R_{DS(on)}$ (max)	P/N	I_D (cont)	Package	Actual Status	Forecasted Full Maturity
[V]	[mΩ]		[A]			
600	220/160	STx21NM60ND STx25NM60ND	17/21	TO-220, TO-220FP, TO-247, I2PAK, D2PAK	Sample availability	Q2`08
600	60	STW55NM60ND	51	TO-247	Sample availability	Q2 `08

Features

- **The worldwide best RDS(on)*area amongst the fast recovery diode devices**
- **Low input and output capacitances and gate charge**
- **Extremely high dv/dt**

Benefits

- **Low conduction losses**
- **Low switching losses, high switching speed and reduced driving losses**
- **High avalanche capability**

FDmesh II

SuperMESH3 K3 series: vanguard HV planar MOSFET

MDmesh

- Low ON-Resistance

SuperMESH

- High UIS ruggedness
- High B_{Vdss}

SuperMESH3

Reduced ON-Resistance

Improved dynamic figures

Good UIS ruggedness

Additional margin GUARANTEED in BVdss

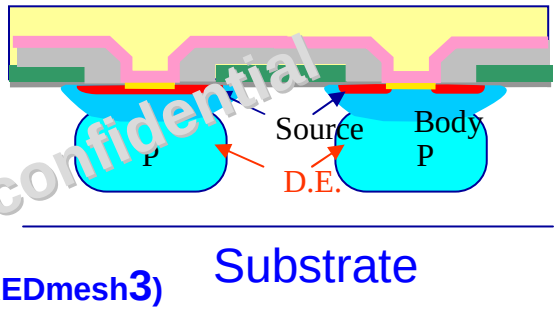
SOON ON YOUR APPLICATION

The right trade-off Price/Performances

SuperMESH3 STPzzNyyK3 Electrical Features

ABSOLUTE MAXIMUM Ratings	"NK…Z"	SuperMESH 3
V_{DSS}	500V, 600V, 700V	**525V, 620V, 720V**
V_{DSS}	800V, 900V, 1000V	**850V, 950V, 1050V**
V_{GS}	±30V	±30V
Diode dv/dt, di/dt	4.5V/ns, 200A/µs	9 V/ns,200A/µs
V_{th}	3V÷4.5V	3V÷4.5V

- **NEW STD** in the HV Market
- Fast DIODE available



525V,

STD7N52DK3: < 1.15Ω in DPAK, TO-220, TO-220FP @ 525V in development **(SuperFREDmesh3)**

STD7N52K3: < 0.98Ω in DPAK, TO-220 @ 525V in development

STD6N52K3: < 1.2Ω in DPAK @ 525V in development

620V,

STx17N62K3: < 0.38Ω in TO-247, TO-220, TO-220FP @ 620V eng. Samples

STx10N62K3 <0.75Ω in TO-220 , TO-220FP@ 620V (samples available)

STx6N62K3: < 1.28Ω in DPAK, TO-220,TO-220FP @ 620V in production

STx5N62DK3: < 1.6Ω in DPAK,TO-220,TO-220FP @ 620V in development **(SuperFREDmesh3)**

STx3N62K3: < 2.5Ω in DPAK, D2PAK, IPAK TO-220/FP @ 620V eng. samples

Features

- *HIGHER VDSS*
- *LOWER ON-RESISTANCE: 20% RDSON REDUCTION*
- *IMPROVED DYNAMIC PERFORMANCES (lower Qg and Ciss, Crss)*
- *REDUCED RECOVERY TIME Trr VERSUS STANDARD*
- *IMPROVED DIODE REVERSE RECOVERY CHARACTERISTICS*

Benefits

- *HIGHER MARGIN & RUGGEDNESS*
- *LOWER CONDUCTION LOSSES*
- *LOWER SWITCHING LOSSES*
- *HIGHER SAFETY MARGIN*

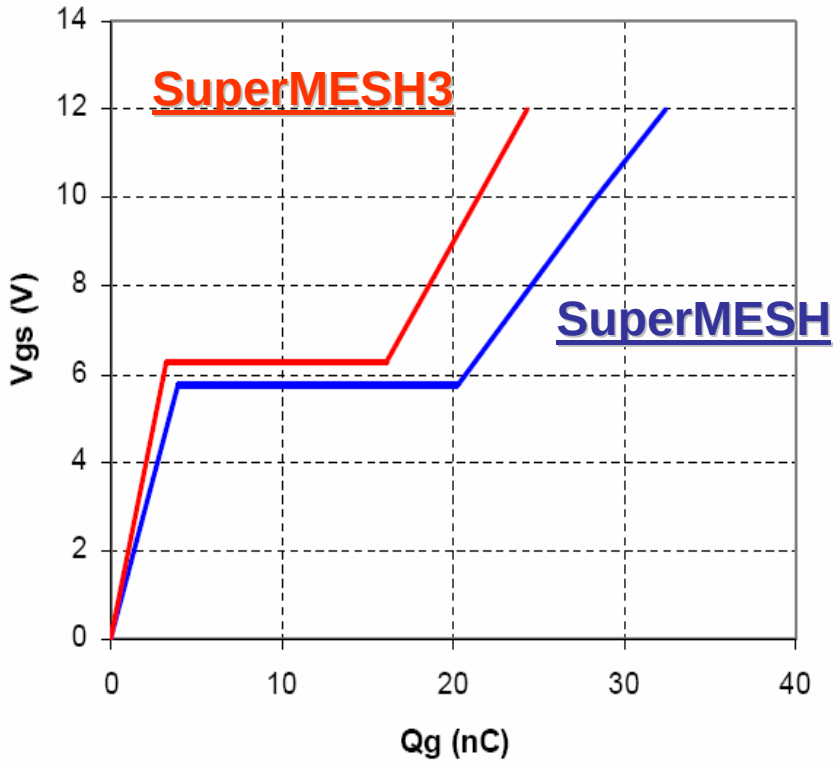
STx6N62K3 – Dynamic characterization

	Ciss	Coss	Crss
SuperMESH3	712	112	**8**
SuperMESH (similar Rdson)	920	114	**21**

Conditions : Vds=25V ; f=1MHz ; Vgs=0V ; Tj=25°C

SuperMESH3 Vs equivalent SuperMESH

FASTER Vds switch!!!



Features

- **Lower Gate Charge**

Benefits

- **Lower Switching losses**
- **Lower gate driving losses**

1500V Series Expansion

- **The target market for the 7Ω, 12Ω and 2.7Ω on-resistance devices is primarily** industrial**, in particular for all applications that require high input voltage:**
  - 3-phase auxiliary power supplies
  - Motor driving
  - Welding
  - Metering

New range features and benefit

- **Total compatibility, no need to redesign the application**
- **High** reliability **makes each solution easier and stronger**
- Wide **choice of packages**
- Lowest on-resistance **per area for low power dissipation**
- Avalanche ruggedness
- **Gate charge minimized**
- **Very** low intrinsic capacitances
- High speed switching

1500V Product Range

Part number	V_{DSS} [V]	I_D [A]	$R_{DS(on)}$ @ 10V [Ω]	Package
STW4N150	1500	4	<7	TO-247
STP4N150				TO-220
STFV4N150				TO-220FH
STW3N150		2.5	<12	TO-247
STP3N150				TO-220
STFV3N150				TO-220FH
STW9N150		8	<2.7	TO-247

Power MOSFET: Series IDENTIFICATION

STzzNXyy Technology

ST	P	20	NM	60		→ MDmesh I	→ 500V ≤ B_{VDSS} ≤ 800V 3V ≤ v_{th} ≤ 5V
ST	P	20	NM	60	D	→ FDmesh I	→ 500V ≤ B_{VDSS} ≤ 600V 3V ≤ v_{th} ≤ 5V
ST	P	21	NM	60	N	→ MDmesh II	→ 500V ≤ B_{VDSS} ≤ 650V 2V ≤ v_{th} ≤ 4V
ST	P	21	NM	60	ND	→ FDmesh II	→ B_{VDSS} = 600V 3V ≤ v_{th} ≤ 5V

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Why do we need a fast recovery diode MOSFET?

Every time we connect two devices in Half bridge
or in full bridge configuration and we drive an inductive load, then an hard switch situation requires a FRED FET for two reasons:

1)Power losses reduction through Qrr minimization;

2)Better system reliability through more dV/dt immune devices.

Typical is to use such devices in lighting application (Ballast), SMPS like servers in ZVS configurations, motor control etc, etc….

Fast recovery diode (FRED) technology

Drastic reduction of t_{rr} and Q_{rr}

Indicated for ZVT bridges

Available for both ST HV technologies:

MDmesh + FRED = FDmesh (NM..D)

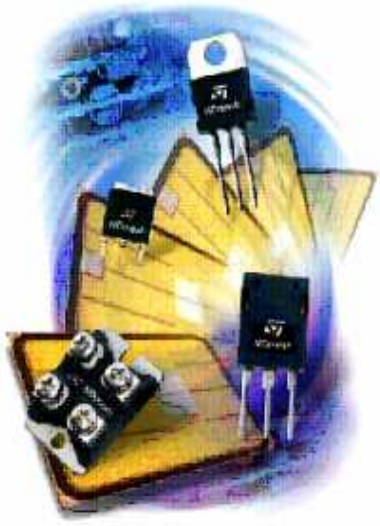
SuperMESH + FRED = SuperFREDmesh (NK…ZD)

- **New SuperFREDmesh (NK..ZD): improvement in dv/dt**

SuperMESH	4.5V/ns
MDmesh	15V/ns
SuperFREDmesh	15V/ns

- **STF4NK50ZD** (500V, 2.7Ohm)
- **STF5NK52ZD** (520V, 1.22Ohm)
- **STW29NK50ZD** (500V, 0.16Ohm)
- **STE45NK80ZD** (800V, 0.13Ohm)
- **STE40NK90ZD** (900V, 0.17 Ohm)

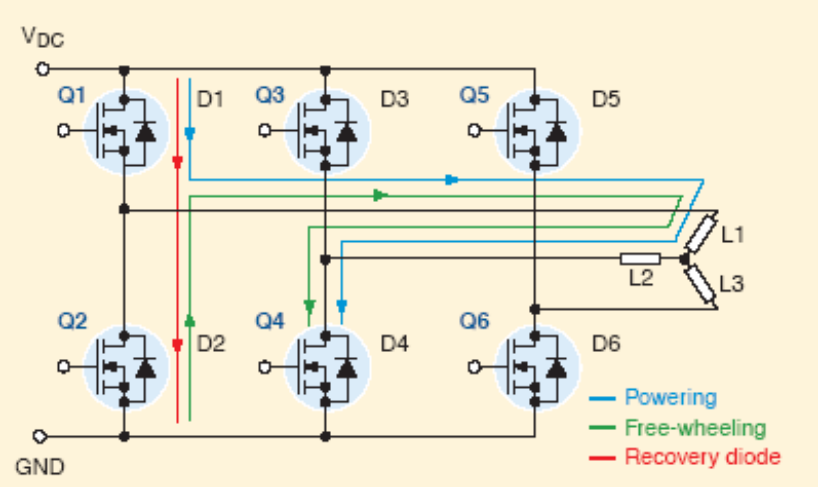
NEW



STx5NK52ZD - SuperFREDmeshTM for BLDC motors

Features

- Extremely high dv/dt capability
- Reduced on-resistance
- Very low intrinsic capacitances
- Zener gate protection
- 100% avalanche tested
- Good manufacturing reliability
- Improved ESD capability
- Wide variety of popular packages



Comparison between Power MOSFETs while driving BLDC motors (Q1,Q3 and Q5)

Product Range

Part number	V_{DSS} [V]	I_D [A]	$R_{DS(on)}$ @ 10V [Ω]	Status	Package
STD5NK52ZD	520	4.4	<1.5	Prod	DPAK
STD5NK52ZD-1					IPAK
STB5NK52ZD-1					I²PAK
STP5NK52ZD					TO-220
STx4NK50ZD	500	3	<2.7		IPAK, TO-220, TO-220FP

- Improving efficiency
- Conserving energy
- High reliability

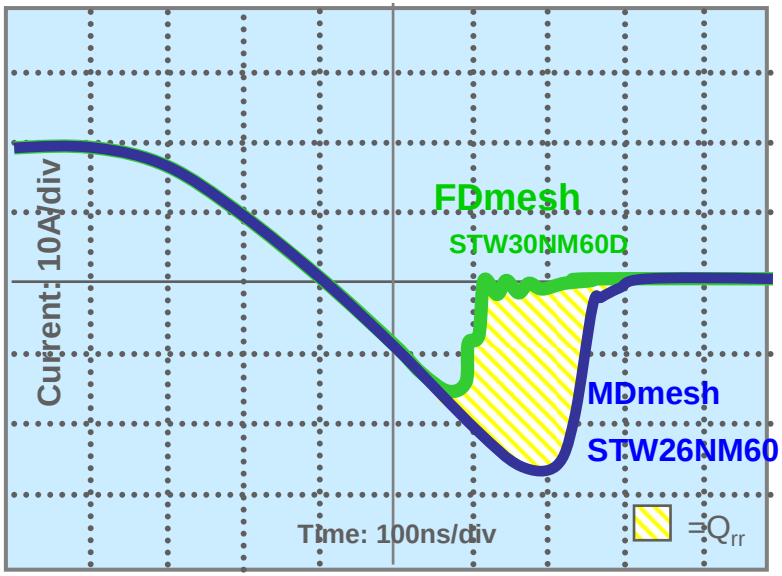
Standard Power MOSFET and the new STD5NK52ZD while driving a BLDC motor.

– Switching losses during turn-on were reduced by 65%.

Part number	Technology	E on [µJ]	E off [µJ]	Tmp. [°C]
STD5NK50Z	STD MOSFET	165.11	7.6	56
STD5NK52ZD	SuperFREDmesh	58.8	7.1	48

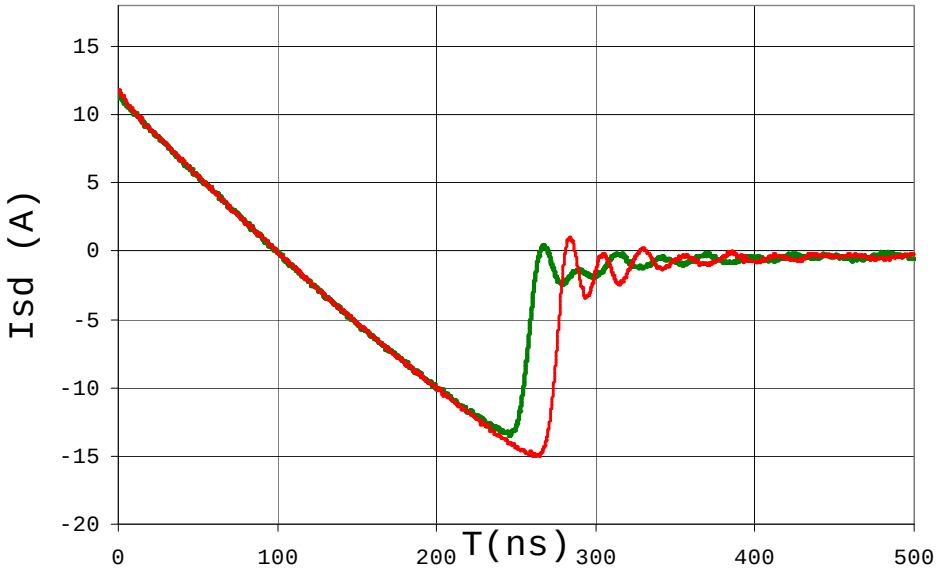
Fast recovery diode (FRED) technology

- **FDmesh vs. MDmesh**



* Typ @ 25 degree	I_{rrm} (A)*	t_{rr} (ns)*	Q_{rr} (µC)*
STW26NM60	30.5	450	7
STW30NM60D	11.5	240	1.4
STP9NK60Z	14.5	480	3.5
STP9NK60ZD	9.6	194	0.9

- **FDmesh vs. best competitor**



STW30NM60 showes better trr, Qrr, Irm and dv/dt versus competition at same di/dt test condition

	dI/dt [A/us]	dV/dt [V/ns]	Irrm [A]	Tirm [ns]	Trr [ns]	Qrr [nC]
STW30NM60D	100	31	13.5	147	161	1087
Best competitor	100	22	15	161	178	1335

Introducing MDmesh V

- **ST is a pioneer in super junction HV MOSFET technology.**
- **MDmesh V is the latest HV power MOSFET family: 650V devices with the best known RDS(on) available in the most popular packages.**
- **Main applications include:**
  - SMPS (computers, very high efficiency notebook adaptors, telecommunications)
  - Lighting (electrical ballast, HID)
  - Display (TV, monitors)
  - Solar Converters

Introducing MDmesh V

V_{DS} [V]	$R_{DS(on)}$ (max) [Ω]	MDmesh V P/N	Id [A]	Package	Status
650	0.022	STY112N65M5	93	MAX247	Samples April '09
	0.038	STW77N65M5	66	TO-247	Samples April '09
	0.079	STx42N65M5	33	TO-220/TO-220FP/D²PAK/I²PAK/ TO-247	Production
	0.098	STx35N65M5	27	TO-220/TO-220FP/D²PAK/I²PAK/ TO-247	Samples April '09
	0.119	STx32N65M5	24	TO-220/TO-220FP/D²PAK/I²PAK/ TO-247	Samples April '09
	0.139	STx30N65M5	21	TO-220/TO-220FP/D²PAK/I²PAK/ TO-247	Samples June '09
	0.179	STx21N65M5	17.5	TO-220/TO-220FP/D²PAK/I²PAK/ TO-247	Samples June '09
	0.299	STx16N65M5	12	TO-220/TO-220FP/DPAK/IPAK	Production
	0.375	STx12N65M5	9	TO-220/TO-220FP/DPAK/IPAK	Samples June '09

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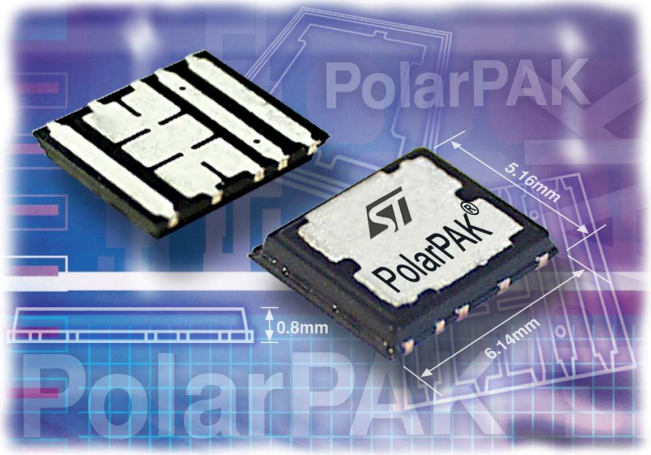
SMD package evolution – PolarPAK®

Advances in packaging need to be developed in tandem with silicon technology improvements.

The PolarPAK package, with its superior thermal handling capability**, represents a remarkable evolution in assembly technology allowing designers to increase efficiency and power density.**



FEATURES

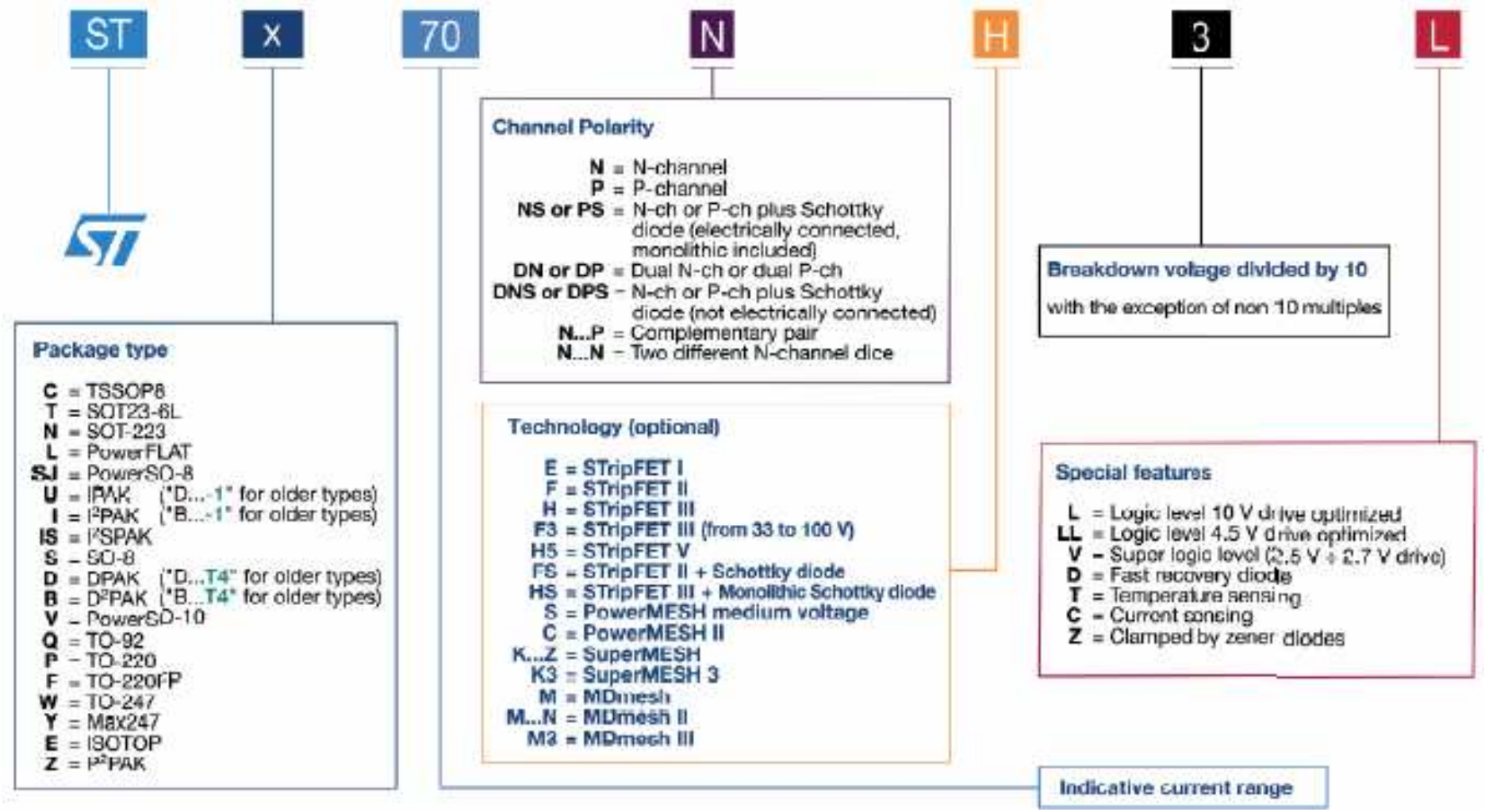
- Top / bottom heat dissipation paths
- Fully encapsulated silicon
- Same footprint of standard packages
- Low profile (0.8 mm)
- Superior thermal performance

BENEFITS

- Low operating temperature
- Good die protection and easy handling manufacturability
- Enabled end products density increase
- Twice current handling capability than standard packages with same footprint
- Customer's flexibility by designing with multi-sources

Part Number	V_{DS} [V]	R_{DS}(on) typ/max [mΩ] @4.5V	@10V	Qg typ @4.5V [nC]	Rthj-c Top typ/max ℃/W Drain	Rthj-c Bottom typ/max ℃/W Source
STK850	30	2.9/3.5	2.4/2.9	24	0.8/1	2.2/2.7
STK800	30	7/9.8	6/7.8	11	1/1.2	2.8/3.4

MOSFET nomenclature



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- **MOSFETs**
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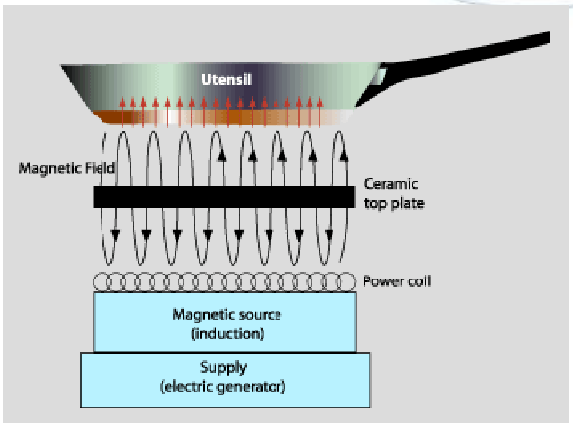
IGBTs – applications

Lighting

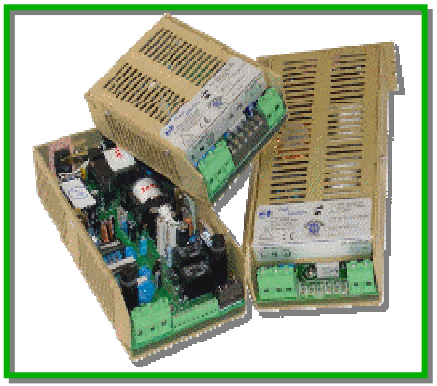
Motor Control



Principle ofinduction heating

Induction Cooking

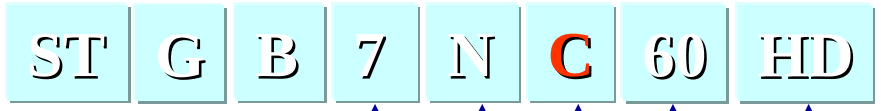
UPS



SMPS

Welding

IGBTs nomenclature



Special Features

L = Logic Level
Z = Fully Clamped
S = Low Drop,
(freq < 1 KHz; Vcesat < 1.5 V)
H = " " " 60 KHz
K = " " " 60 KHz Short-circuit Proof
V = " " " 60 KHz High Power
D = Co-Packaged Freewheeling Diode

IGBT Family

V_{CE} VOLTAGE divided by 10

Package Type:

D...T4 = DPAK (Tape & Reel)
B...T4 = D^2PAK (Tape & Reel)
D...-1 = IPAK
B...-1 = I^2PAK
P = TO-220
P...FP = TO-220FP
F = TO-220FP for new products
W = TO-247
Y = Max247
E = ISOTOP
S = SO-8

TECHNOLOGY (OPTIONAL)

B = PowerMESH™
C = PowerMESH plus electron irradiation

Channel Polarity

Old system: I_C = test condition for V_{CEsat}

New system: I_C = collector current @ 100 °C

IGBTs nomenclature

	"NB" technology	"NC" technology	"NC" technology Ultra fast W series	"NC_S" Medium Frequency series
Typical V_{CEsat}	2.4 Volt	1.9 Volt	2.0 Volt	1.55 Volts
Fall Time @ T_J = 25 °C Fall Time @ T_J = 125 °C	~ 120ns ~ 255ns	~ 75ns ~ 130ns	~ 32ns ~ 55ns	~ 210 ns ~ 280 ns
E_{Off} @ T_J = 25 °C E_{Off} @ T_J = 125 °C	680 mJ 1290 mJ	370 mJ 770 mJ	205 mJ 368 mJ	~ 850 µJ ~ 1120 µJ
Typical UIS	20A	28.4A	31A	27 A
Cross Conduction	Yes Crss/Ciss High	No Crss/Ciss Low	No Crss/Ciss Low	No Crss/Ciss Low

IGBTs – voltage vs. application

Application / Voltage	Very Low frequency **e.g. HID, LF, PDP**	Low/medium frequency **e.g. BLDC Motor Control, Soft switching,**	High frequency **e.g. Induction motor control, UPS, AC drives, Induction cookers**	Very High frequency **e.g. Welding, HF Ballast, PFC, power supply, Induction cookers**
600V	Low Drop IGBT: **STGxx**NB**60**S**x** **STGxx**N**60**S**x**	Low frequency IGBT**:** **STGxx**NC**60**S**x**	Very Fast IGBT: **STGxx**NC**60**H(K)**x** **STGxx**NC**60**V**x**	Ultra Fast IGBT: **STGxx**NC**60**W**x**
1200V	Low Drop IGBT: **STGxx**NB**120**S**x**	Low frequency IGBT: **STGxx**NC**120**H**x**	Very Fast IGBT: **STGxx**NC**120**V**x**	Ultra Fast IGBT**:** **STGxx**NC**120**W**x**

New Complete 600V “H” and “K” series for Motor Control and H

✓ Complete IGBT product portfolio

- ***STGx30NC60S**** : Medium Frequency IGBT 30A@100℃
- **STGx19NC60S* :** Medium Frequency IGBT 20A@100℃
- **STGW39NC60VD (STGW39NC60KD*): Fast IGBT (Short Circuit rugged, tsc=5µs) 40A@100℃**
- ***STGW20NC60VD (STGW30NC60KD*) :*** Fast IGBT (Short Circuit rugged, tsc=5µs) 30A@100℃
- ***STGx19NC60HD (STGx19NC60KD*) :*** Fast IGBT (Short Circuit rugged, tsc=5µs) 20A@100℃
- ***STGx7NC60HD (STGx14NC60KD)***: Fast IGBT (Short Circuit rugged, tsc=5µs) 14A @100℃
- ***STGx10NC60HD (STGx10NC60KD)***: Fast IGBT (Short Circuit rugged, tsc=5µs) 10A @100℃
- ***STGx6NC60HD***: Fast IGBT (Short Circuit rugged, tsc=5µs) 6A @100℃
- ***STGx8NC60HD (STGx8NC60KD)***: Fast IGBT (Short Circuit rugged, tsc=5µs) 8A @100℃

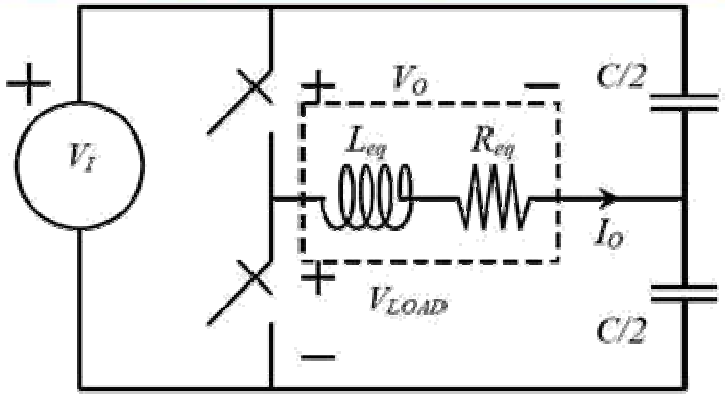
✓ Main Features

- Very low collector emitter saturation voltage, Vce(sat)
- PT Technology: Vce(sat) decreases with Temperature Optimized Cres/Cies ratio
- Very low current fall time, Tfall and Eoff
- Ruggedness

✓ Customer Benefit

- **Minimizing the total conduction losses, higher system efficiency**
- **No cross conduction susceptibility**
- **Minimizing turn-off switching losses**
- **Higher reliability**

Higher Power Induction Cooking Systems



IGBTs Offering

Very Fast IGBT

STGW20NC60VD
TO-247, 600V, $V_{CE(SAT)}$= 1.85V, Ic=30A @100°C

STGW39NC60VD
TO-247, 600V, $V_{CE(SAT)}$= 1.95V, Ic=40A @100℃

STGY40NC60VD
Max247, 600V, $V_{CE(SAT)}$= 2.0V, Ic=50A @100°C

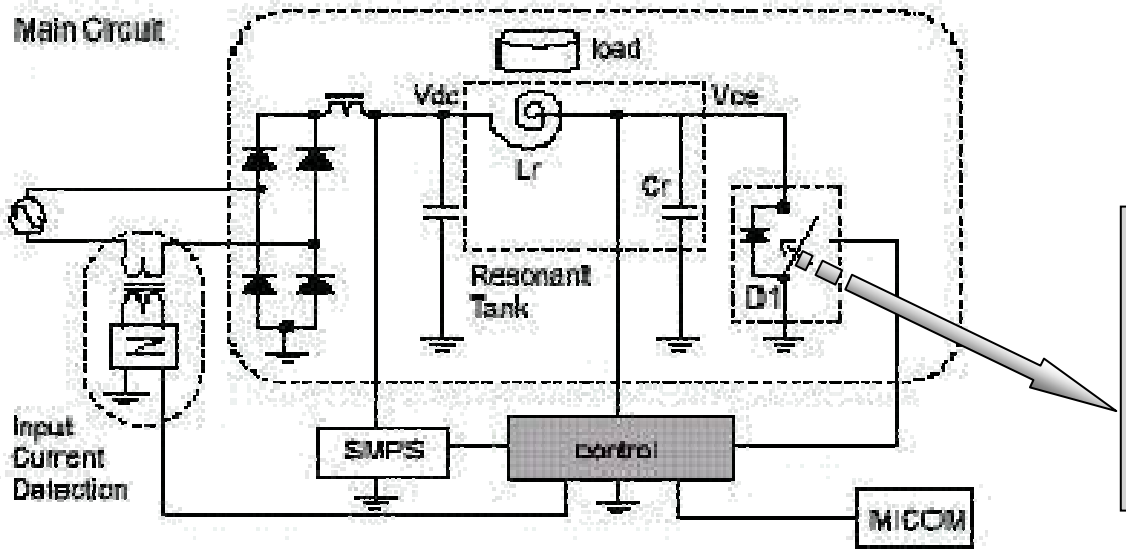
Ultra Fast IGBT

STGW30NC60WD
TO-247, 600V, $V_{CE(SAT)}$= 2.1V, Ic=30A @100°C

STGW40NC60WD
TO-247, 600V, $V_{CE(SAT)}$= 2.3V, Ic=40A @100℃

STGY50NC60WD
TO-247, 600V, $V_{CE(SAT)}$= 2.4V, Ic=50A @100℃

Single switch Induction Cooking Systems



IGBTs Offering

STGW33IH120D
1200V/30A, in TO247

QR Systems Main characteristic

IH Cooker
•STD Systems run @ 30kHz (ZVS with snubber)

New 1200V IGBT for high frequency application

PFC
UPS
SPS Server/Workstation
Telecom Power System

P/N	Vce(sat) typ @100℃ [V]	Ic @25℃ [A]	Ic @100℃ [A]	BVce [V]
STGW30NC120HD	2.1	60	30	1200
STGW33IH120D	2.1	60	30	1200

New Ultra Fast IGBTs for Welding

Target Requested:

- ✓ Operating frequency: > 60 kHz
- ✓ Lower Switching Losses
- ✓ I_C = 30A to 60A nominal
- ✓ Freewheeling diode requested

Requirement:

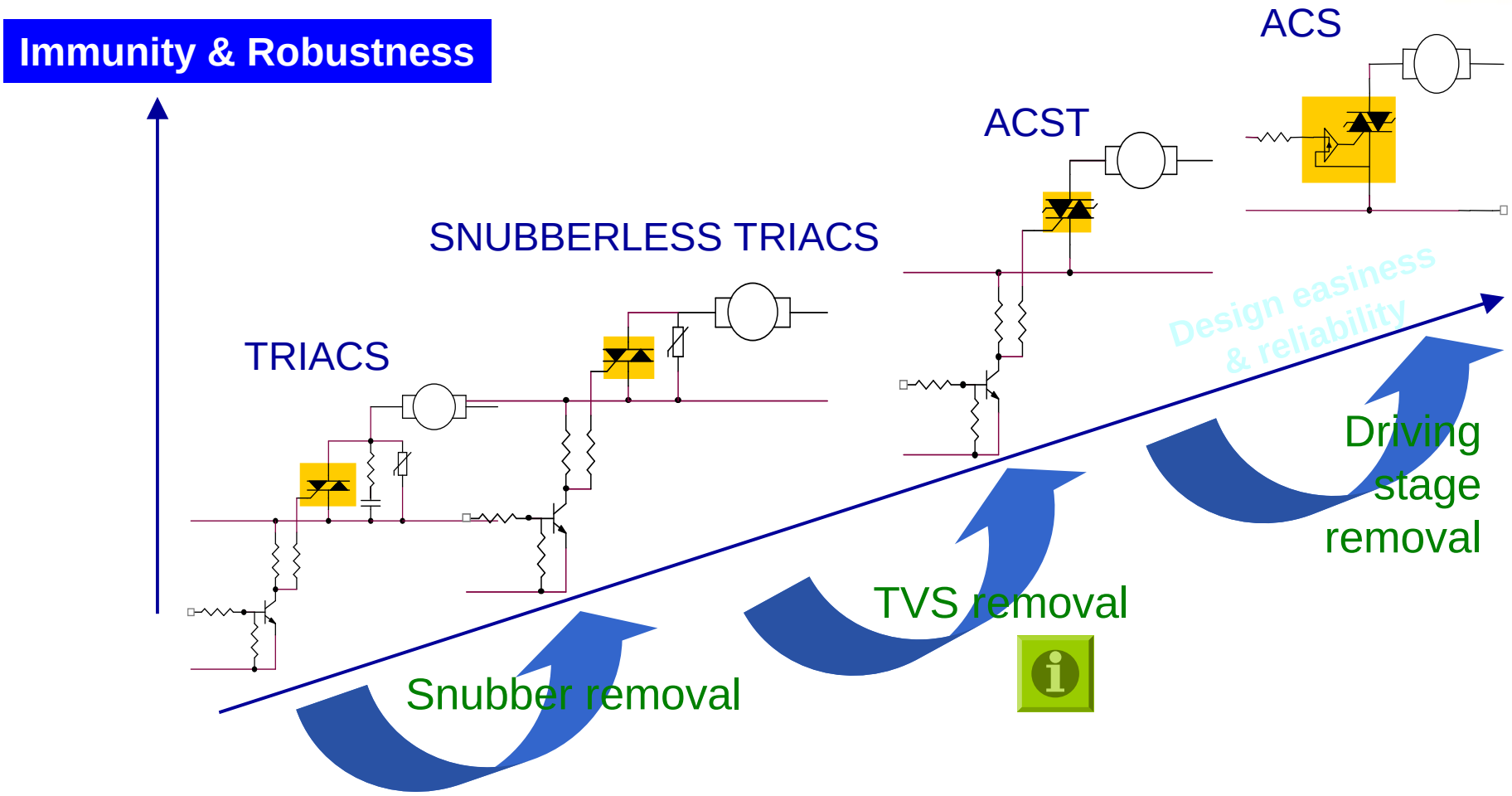
Needs the best compromise in terms of conduction and switching losses: E_{TS} vs. V_{CESAT} trade-off!!

P/N	BV_{CES} (V)	I_C @ 100°C (A)	$V_{CE(SAT)}$ @ V_{GE}= 15V, I_C= 20A (V)	T_{FALL} (ns)	Integrated Diode	Package
STGW30NC60WD	**600**	**30**	**<2.5**	**40**	**Yes**	**TO-247**
STGW40NC60WD	**600**	**40**	**<2.5**	**40**	**Yes**	**TO-247**
STGW50NC60W	**600**	**50**	**<2.5**	**40**	**No**	**TO-247**

…more discrete power

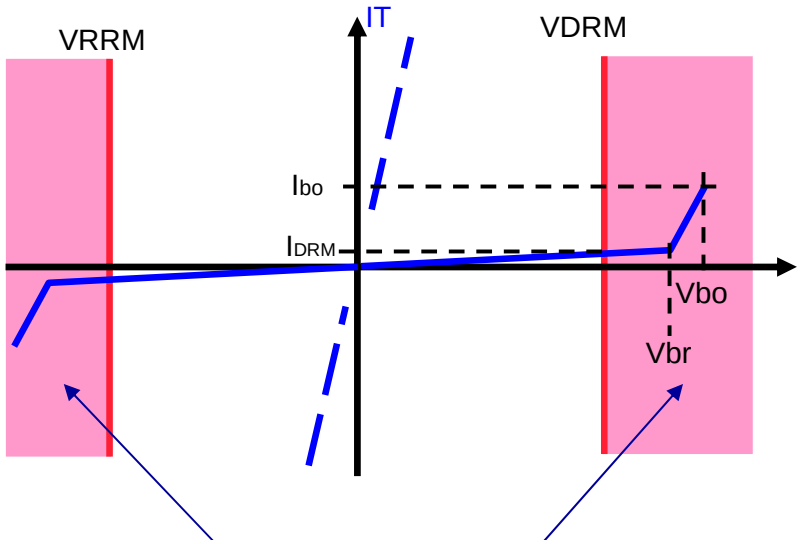
- **MOSFETs**
  - SuperMESH / MDMesh techonologies
  - Fast Recovery Diode (FRED)
  - Package evolution
- **IGBTs**
- AC SWITCH
- **RECTIFIERS**
  - POWER SCHOTTKY
  - BIPOLAR AND ULTRAFAST

Evolution of ACSwitch



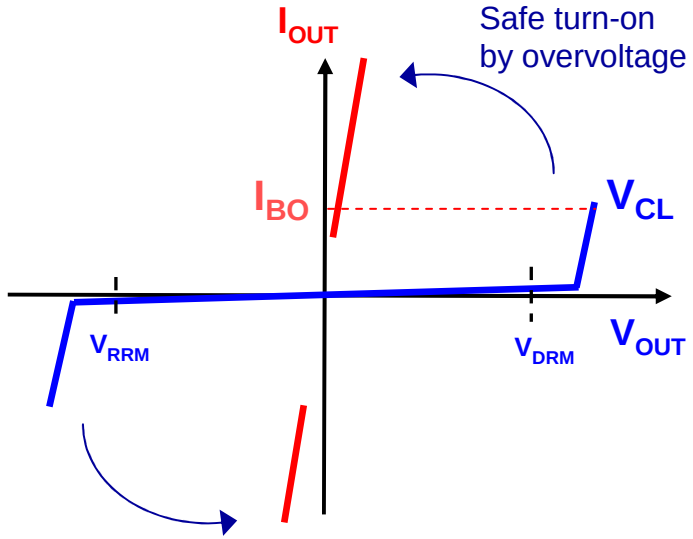
From TRIAC to ACS / ACST…crowbar

TRIAC



FORBIDDEN
OPERATING AREA

ACS / ACST



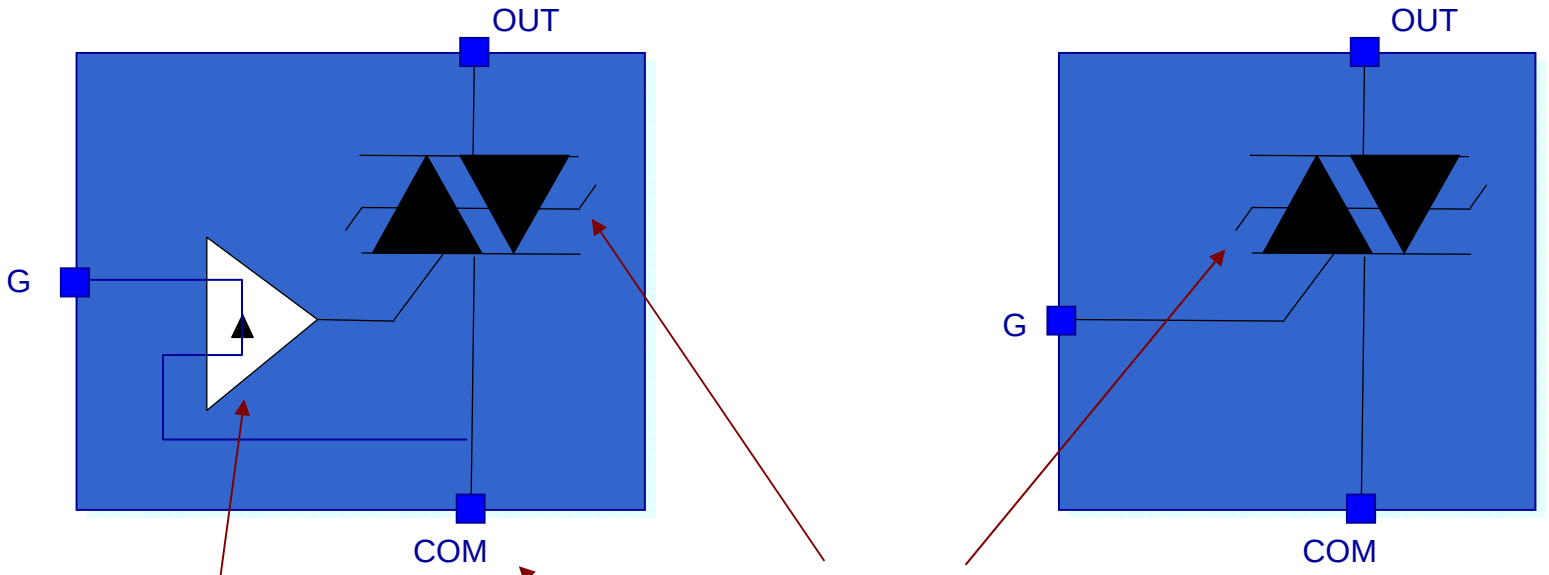
NO MORE
FORBIDDEN AREA

- **The ACS/ACST embeds an integrated crowbar protection**
- **The surge energy is dissipated through the load, and not through a varistor**
- **ACST & ACS successfully withstand voltage surges up to 2kV (IEC61000-4-5)**

From ACST to ACS

ACS FOR LOW POWER ACTUATORS

ACST FOR HIGH CURRENTS LOADS



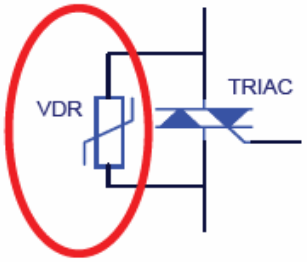
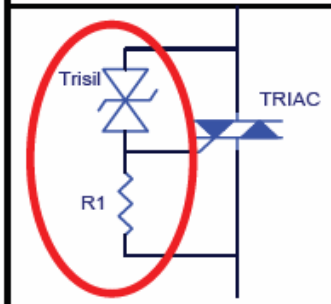
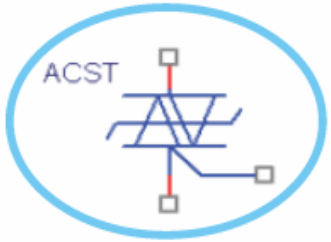
GATE INTERFACE

- **DIRECT MCU DRIVE**
- **HIGH NOISE IMMUNITY**

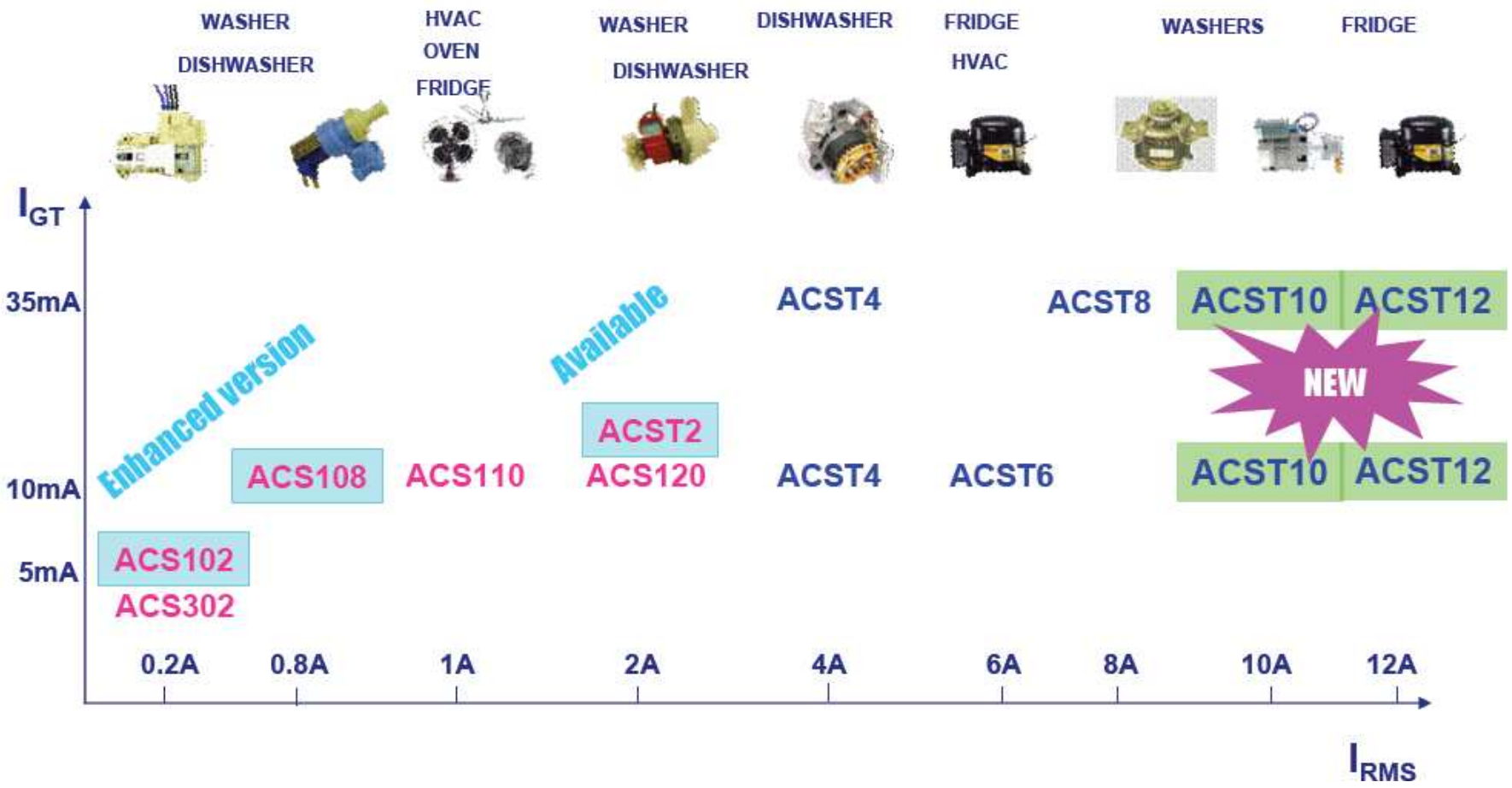
OVERVOLTAGE PROTECTION

REFERENCE FOR COMMON TAB

From ACST to ACS

	BENEFITS	DRAWBACKS
	Only 1 additional component	Protection not constant with VDR ageing
	Accuracy	2 components cost
	Auto protected switch	None

Evolution of ACSwitch



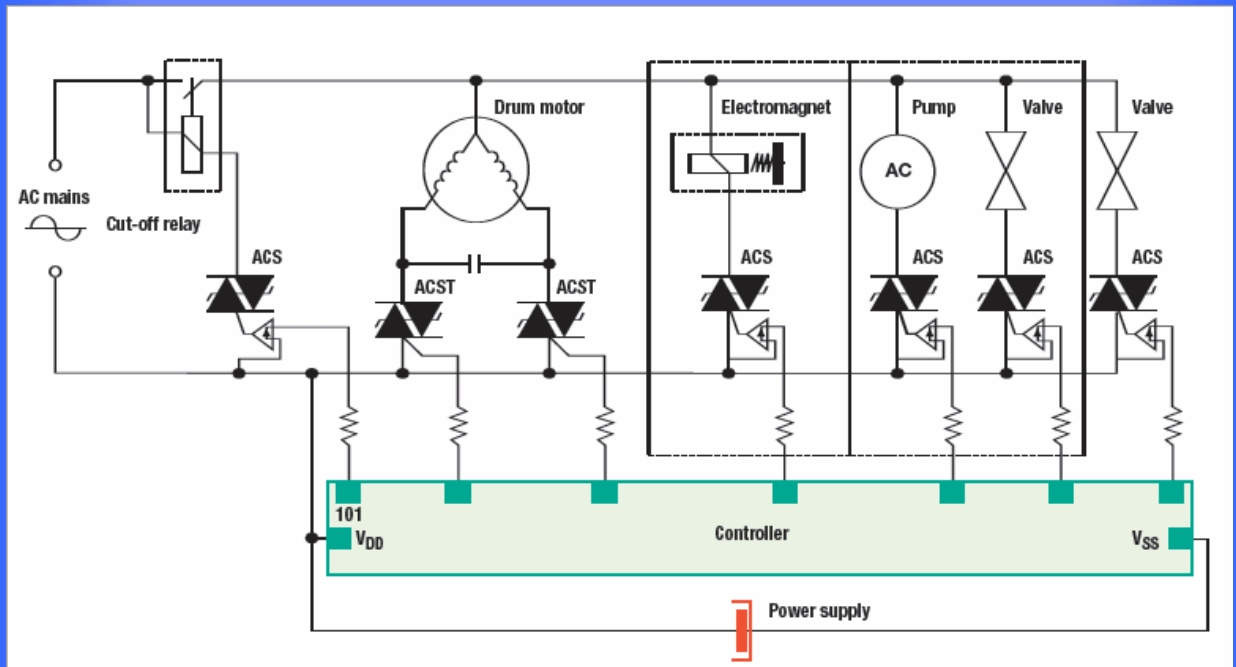
Evolution of ACSwitch

- **New** 600V ACS family
  - **Wet** appliances (Washing machines, dishwashers, dryers)
  - **Hot** appliances (Ovens, cooking ranges, coffee machines)
  - **Cold** appliances (Refrigerators, freezers, air conditioners)

Benefits

- **Gate drive consumption decreased by 50%**
- **No need of external protection snubber nor varistor**
- **Enables equipment to meet** IEC 61000-4-5
- **Reduces component count up to 80%**
- **T up to 125°C**
- Interfaces directly with the microcontroller
- **Common package tab connection allows connection of several ACS on same cooling pad**

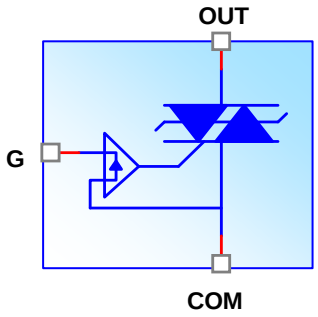
AC switches typical application
Vertical axis washer with AC switch devices



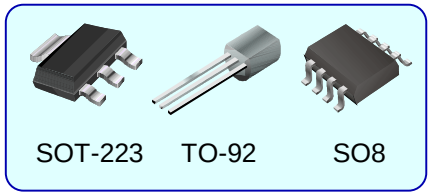
Centralized loads control

Single switch ACS102/108

For decentralized power section

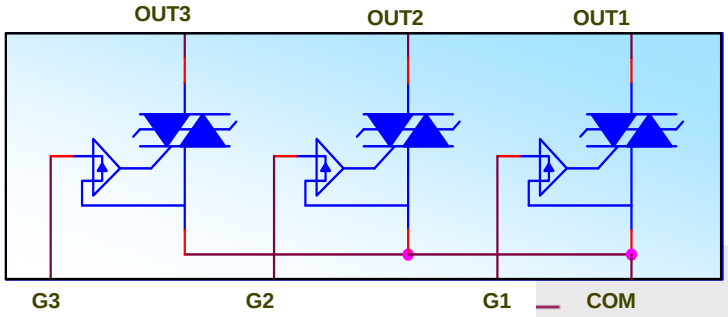


0.8A, 500V AC Switch in TO92 & SOT223

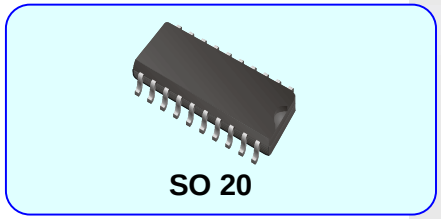


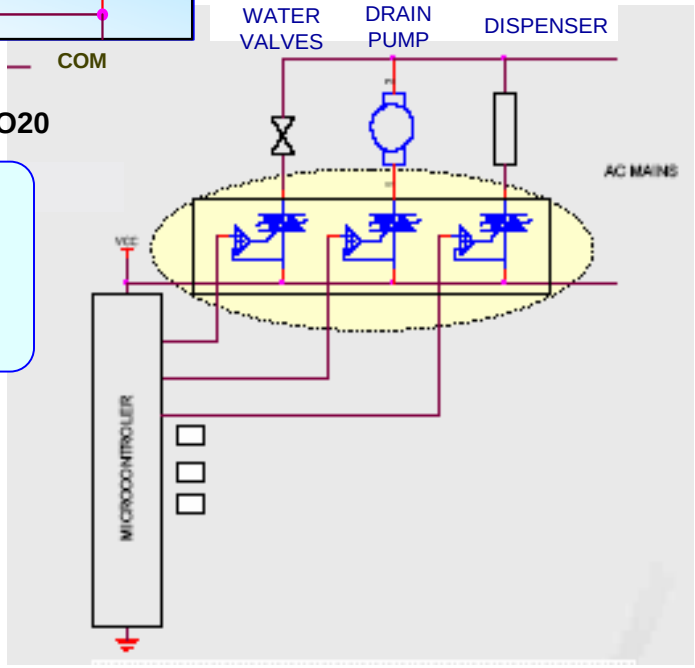
Switch array ACS302

For centralized & compact power section



3 x 0.2A, 500 V AC Switch in SO20





ACST2

- **800 V**
  - Avoids premature firing
- **IH= 10 mA**
  - Inductive loads compatible
- **(di/dt)c= 0.5 A/ms**
  - Designed for pumps
- **Standards**
  - Immunity and robustness designed for IEC 61000-4-X and IEC 60335-1

ACST10

Symbol	Test conditions	Temp		Value		Unit
$I_{T(RMS)}$	full cycle	Tc = 104°C	MAX	10		A
I_{TSM}	20ms	Tj initial = 25°C	MAX	100		A
dI/dt	f = 120Hz	Tj = 125°C	MAX	100		A/µs
I_{GT}	V_{OUT} = 12V, RL = 33Ω	Tj = 25°C	MAX	10	35	mA
dV/dt	V_{OUT} = 67% VDRM, gate open	Tj = 125°C	MIN	200	2000	V/µs
(dI/dt)c	(dV/dt)c = 15V/µs ⇔ Logic Level	Tj = 125°C	MIN	4.4		A/ms
	Snubberless				12	

Reminder : Nominal rate of decrease of $10A_{RMS}$: $(di/dt)c = I_{RMS} \cdot \sqrt{2} \cdot (2 \cdot \pi \cdot f) = 4.4A/ms$

Non sensitive version is specified at **3 x nominal** rate of decrease

➔ **Perfect choice for Universal motor**

ACST12

Symbol	Test conditions	Temp		Value		Unit
$I_{T(RMS)}$	full cycle	Tc = 104°C	MAX	12		A
I_{TSM}	20ms	Tj initial = 25°C	MAX	120		A
dI/dt	f = 120Hz	Tj = 125°C	MAX	100		A/µs
I_{GT}	V_{OUT} = 12V, RL = 33Ω	Tj = 25°C	MAX	10	35	mA
dV/dt	V_{OUT} = 67% VDRM, gate open	Tj = 125°C	MIN	200	2000	V/µs
(dI/dt)c	(dV/dt)c = 15V/µs ⇔ Logic Level	Tj = 125°C	MIN	5.3		A/ms
	Snubberless				14	

Reminder : Nominal rate of decrease of $12A_{RMS}$: $(di/dt)c = I_{RMS} \cdot \sqrt{2} \cdot (2 \cdot \pi \cdot f) = 5.3A/ms$

Non sensitive version is specified at **3 x nominal** rate of decrease

➔ **Perfect choice for Universal motor**

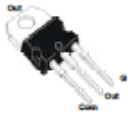
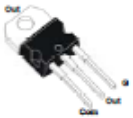
ACST10/12 benefits

- Intrinsic voltage protection by Design
  - ➔ ACST self protected structure
  - ➔ Validated by functional tests (Inrush, stalled rotor, dI/dt, surge voltage)

- Operating Life Test data from ST
  - ➔ experimental added value verified : 450kcycles Inrush
    - ⇔ more than 5 cycles per hour during 10 years
    - ⇔ a relay offers in the range of 80kcycles only on Inductive load !

- Easy to design and qualify
  - ➔ Just select the best trade-off required in the application:
    - ⇔ Sensitive version I_{GT} = 10mA to limit power supply size with no compromise with immunity level
    - ⇔ Strong Immunity with static dV/dt > 2,000 V/µs (I_{GT} = 35mA)

ACST10/12 benefits

CP	ACST10-7Sx	ACST10-7Cx	ACST12-7Sx	ACST12-7Cx
Current Rating	10		12	
Voltage Rating	700 self protection against overvoltage, V_{CL} > 850V			
I_{GT} (mA)	10	35	10	35
Immunity	200 V/µs MIN	2,000 V/µs MIN	200 /µs MIN	2,000 V/µs MIN
Commutation	4.4 A/ms Logic Level	12 A/ms Snubberless	5.3 A/ms Logic Level	14 A/ms Snubberless
Package offer	TO-220AB  TO-220FPAB 		TO-220AB  D²PAK 	

High temperature triac

WHY?

- AC switching **solution in case of**
  - **High current density** implemented on the PCB
  - **Hot** temperature environments
  - **Heatsink**reduction or **die size** optimization application requirement

- **These requirements are more and more usual in:**
  - **Motor control** application (vacuum cleaner, drum motor, …)
  - **AC actuators** control in small appliances
  - Control of **electric heater** in appliances and industrial applications

- **Propose improved** dynamic performances **vs application requirement.**

- Differentiated from compet **with full specification and** no derating **with the junction temperature (what you read is what you get)**

High temperature triac

$$dI_{Requ}/dt = IT_{RMS} \cdot \sqrt{2} \cdot (2 \cdot \pi \cdot f)$$

Current version of HiTj T1635H-600T

Table 2. Electrical characteristics (T_j = 25° C, unless otherwise specified)

Symbol	Test conditions	Quadrant		Value	Unit
I_{GT} (1)	V_D = 12 V, R_L = 33 Ω	II - III	MAX	35	mA
dV/dt (2)	V_D = 67% V_{DRM}, gate open, T_j = 150° C		MIN	3[illegible]	V/µs
(dI/dt)c (2)	Without snubber, T_j = 150° C		MIN	7.1	A/ms

New device HiTj T1635H-6x

Table 2 Electrical characteristics (Tj = 25°C, unless otherwise specified)

Symbol	Test conditions	Quadrant		Value		Unit
				T1635H	T1650H	
I_{GT} (1)	V_D = 12V R_L = 33Ω	I – II - III	MAX	35	50	mA
dV/dt (2)	V_D = 67%V_{DRM} gate open	Tj = 150°C	MIN	1000	1500	V/µs
(dI/dt)c (2)	Without snubber	Tj = 150°C	MIN	21	29	A/ms

… 3 times better turn-off capability @ Tj = 150° C

With ST new High Tj triacs, you can both:

- remove totally the RC snubber circuit
- secure the control of your appli 3 times > before (much bigger design margin)

High temperature triac

Current version of HiTj T1635H-600T

$$dI_{Requ}/dt = IT_{RMS} \cdot \sqrt{2} \cdot (2 \cdot \pi \cdot f)$$

Table 2. Electrical characteristics (T_j = 25° C, unless otherwise specified)

Symbol	Test conditions	Quadrant		Value	Unit
I_{GT} (1)	V_D = 12 V, R_L = 33 Ω	II - III	MAX	35	mA
dV/dt (2)	V_D = 67% V_{DRM}, gate open, T_j = 150° C		MIN	3[illegible]	V/µs
(dI/dt)c (2)	Without snubber, T_j = 150° C		MIN	7.1	A/ms

New device HiTj T1635H-6x

Table 2 Electrical characteristics (Tj = 25°C, unless otherwise specified)

Symbol	Test conditions		Quadrant		Value		Unit
					T1635H	T1650H	
I_{GT} (1)	V_D = 12V	R_L = 33Ω	I – II - III	MAX	35	50	mA
dV/dt (2)	V_D = 67%V_{DRM}	gate open	Tj = 150°C	MIN	1000	1500	V/µs
(dI/dt)c (2)	Without snubber		Tj = 150°C	MIN	21	28	A/ms

… & even 4 times better turn-off capability @ Tj = 150° C

With ST new High Tj triacs, you can both:

- remove totally the RC snubber circuit
- secure the control of your appli 3 to 4 times > before (much bigger design margin)

High temperature triac

Symbol	Unit	T10xxH-6y	T12xxH-6y	T16xxH-6y	T20xxH-6T
$I_{T(RMS)}$	A	10	12	16	20
V_{DRM}/V_{RRM}	V	600			
I_{GT}	mA	either 35 mA or 50 mA			
$T_{J\ MAX}$	°C	150°C			

TO-220AB	x	x	x	x
TO-200AB ins	x	x	x	
D²PAK	x	x	x	

TO-220AB
(TxxyyH-6T)

D²PAK
(TxxyyH-6G)

TO-220AB
(TxxyyH-6I)

New High Tj triacs generation:

- High turn-off capability: up to 4 times the specified I_{TRMS} (nominal)
- High immunity @ 150° C: up to 1500 V/µs

…more discrete power

- **MOSFETs**
  - SuperMESH / MDMesh techonologies
  - Fast Recovery Diode (FRED)
  - SAFeFET
  - Package evolution
- **IGBTs**
- **AC SWITCH**
- RECTIFIERS
  - **POWER SCHOTTKY**
  - **BIPOLAR AND ULTRAFAST**

Silicon Carbide diodes

- **Thanks to:**
  - tiny dynamic reverse recovery current, stable when the junction temperature varies.
  - Forward voltage drop at high temperature and nominal forward current of a SiC diode is 10% lower than that of the Tandem diode.

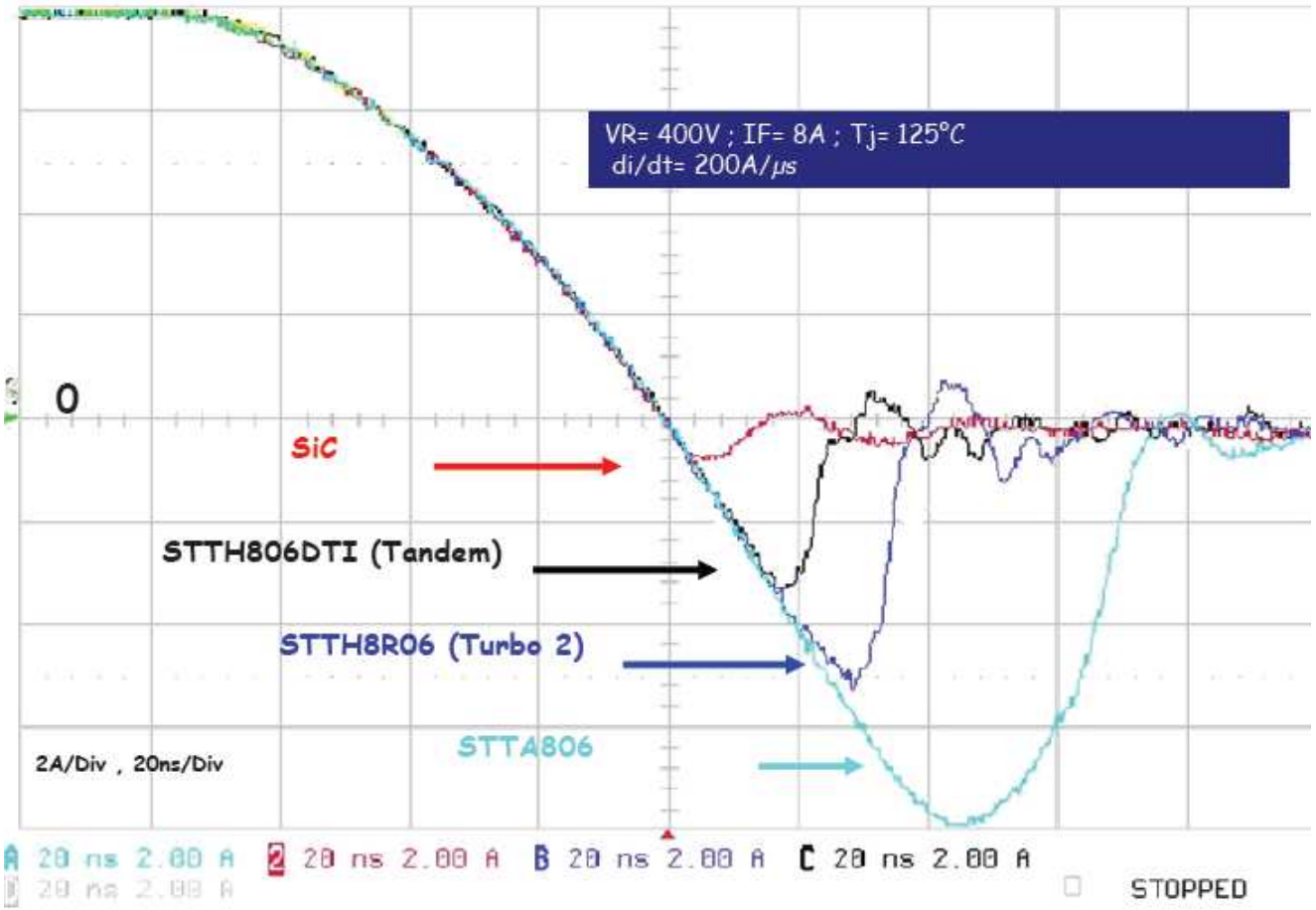
➔ ***efficiency and thermal performance improvement***

APPLICATIONS: PFC boost converters, freewheeling in motor drives, as well as all industrial applications requiring very high performance.

Part number	Current rating	V_F [V]	Q_G [nC]	Package
STPSC806D	8	1.7	15	TO-220AC
STPSC1006D	10	1.7	20	TO-220AC

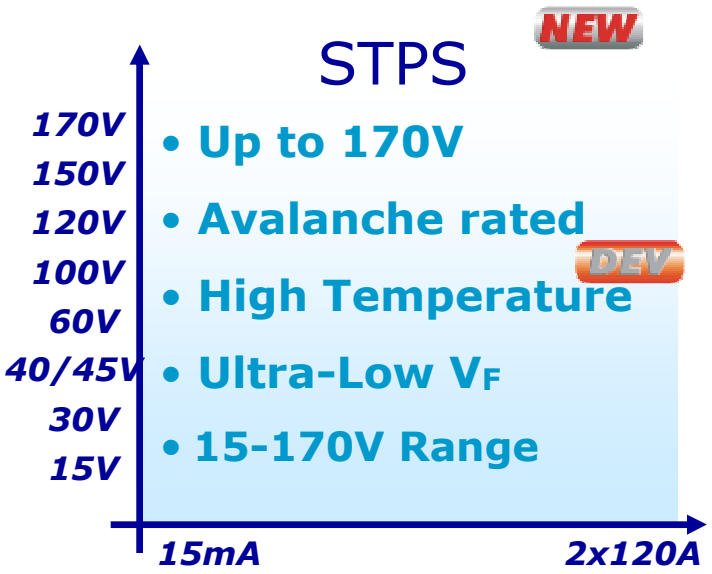
SiC (Silicon Carbide) diodes

Recovery time improvement

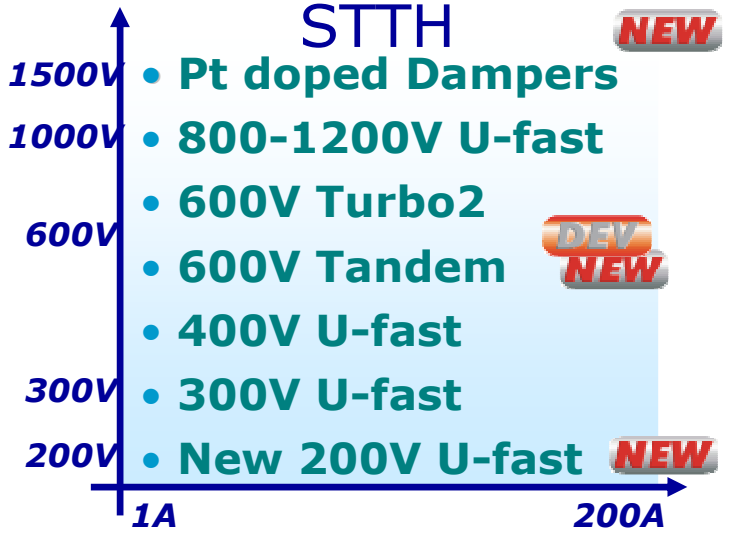


RECTIFIERS

- Signal & Power Schottky:



- Ultrafast & Dampers:

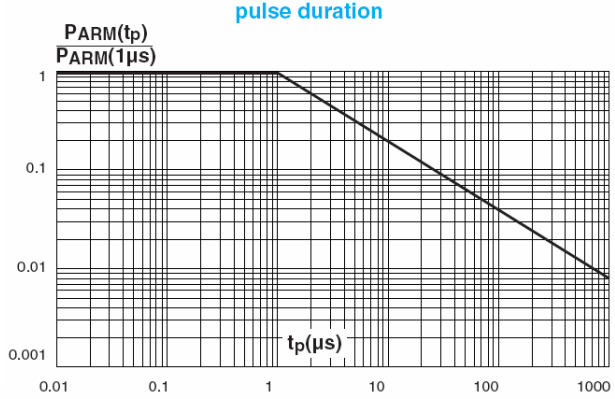


Micropackages

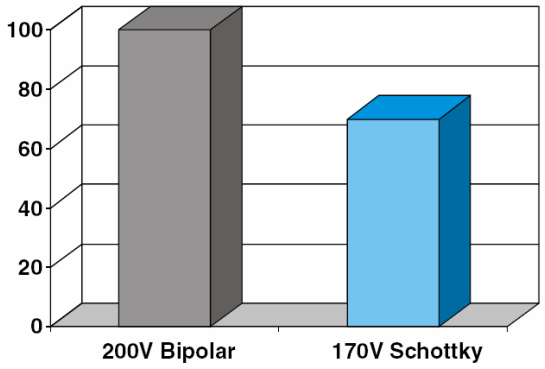
POWER SCHOTTKY - STPSxxx

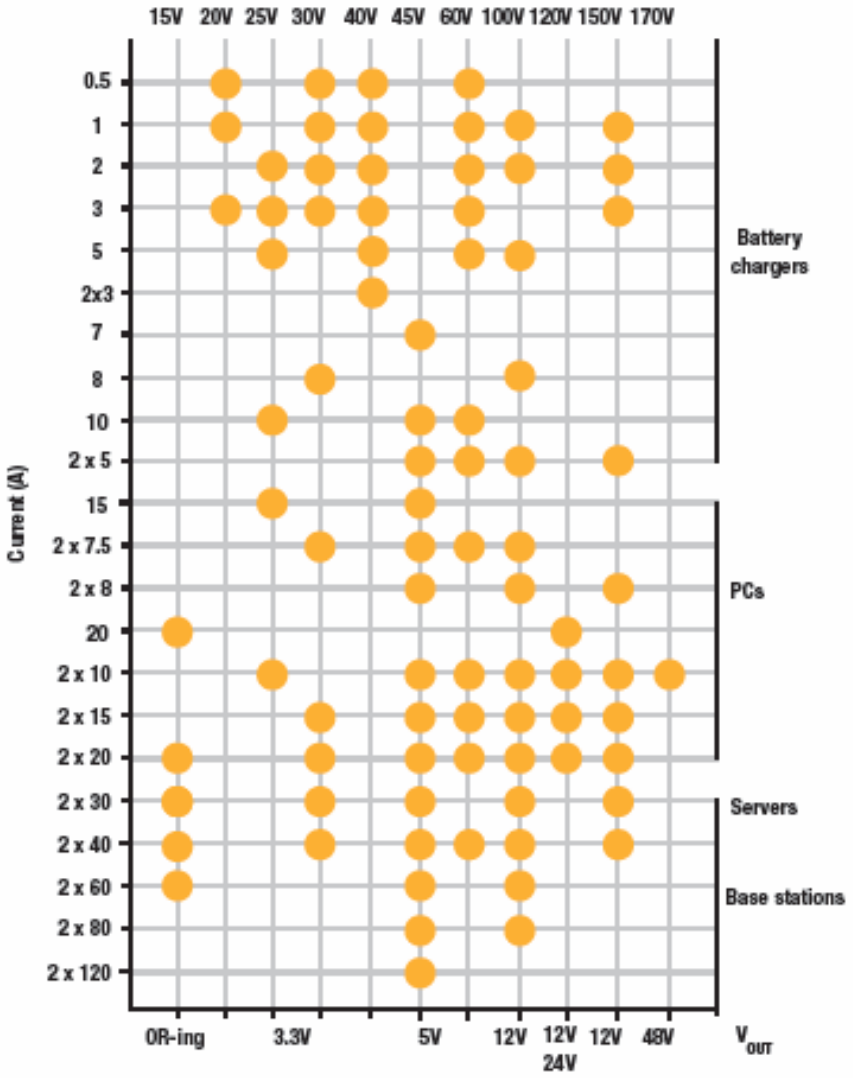
- **Low voltage drop characteristics with negligible or no recovery.**
- **broad package offer**
- Avalanche specification of all types

Normalized avalanche power derating versus pulse duration



% Power losses





POWER SCHOTTKY - STPSxxx

- **ST offers a complete range of Power Schottky diodes with explicit avalanche specification.**
- **ST Schottky diodes avalanche ratings ensure a precise match for the power converter voltage spikes to be handle**

Choose between efficiency and cost savings:

	Applications improvements examples with Avalanche		
280 W SMPS	Reference design	Efficiency improvement	Cost saving
3.3 V / 10 A	STPS3045CT	STPS3030CT	STPS2030CT
5.0 V / 25 A	STPS6045CW	STPS6030CW	STPS3030CT
12 V / 10 A	STPS20H100CT	STPS20L60CT	STPS10L60CT
Efficiency	Nominal	+2%	Unchanged
Diode Cost	Nominal	Unchanged	From -15% to -25%
SMPS Cost	Nominal	Unchanged	-2%

- 2% efficiency improvement
- Or up to 2% cost saving

STTHxxx – bipolar and ultrafast

- **Complete bipolar and ultrafast families renewal**
- **New platinum doping process**
  - Lower VF
  - Lower leakage current (10 to 100 times)
  - Operating up to 175°
  - Best V_F / I_R ratio on the market