

## ACEPACK™ 2 - sixpack topology - 1200 V, 75 A trench gate field-stop IGBT M series, soft diode and NTC

Datasheet - preliminary data

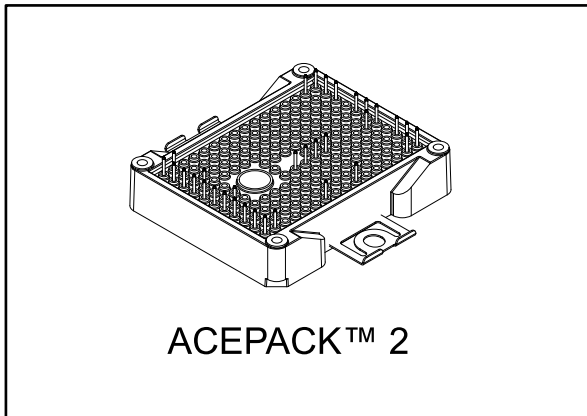
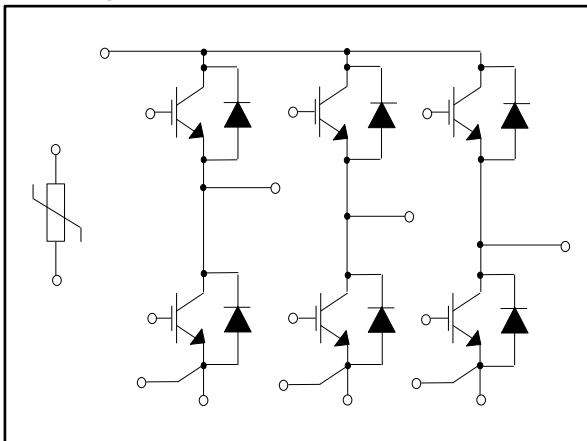


Figure 1: Internal electrical schematic



### Features

- ACEPACK™ 2 power module
  - DBC Cu Al<sub>2</sub>O<sub>3</sub> Cu
- Sixpack topology
  - 1200 V, 75 A IGBTs and diodes
  - $V_{CE(sat)}$ : 1.95 V @  $I_C = 75$  A
  - Soft and fast recovery diode
- Integrated NTC

### Applications

- Inverters
- Industrial
- Motor drives

### Description

This power module is a sixpack topology in an ACEPACK™ 2 package with NTC, integrating the advanced trench gate field-stop technologies from STMicroelectronics. This new IGBT technology represents the best compromise between conduction and switching loss, to maximize the efficiency of any converter system up to 20 kHz.

Table 1: Device summary

Order code	Marking	Package	Leads type
A2P75S12M3	A2P75S12M3	ACEPACK™ 2	Solder contact pins

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# 1 Electrical ratings

## 1.1 IGBT

Limiting values at  $T_j = 25\text{ °C}$ , unless otherwise specified.

**Table 2: Absolute maximum ratings of the IGBT**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{GE} = 0$ )	1200	V
$I_C$	Continuous collector current ( $T_C = 100\text{ °C}$ )	75	A
$I_{CP}^{(1)}$	Pulsed collector current	150	A
$V_{GE}$	Gate-emitter voltage	$\pm 20$	V
$P_{TOT}$	Total power dissipation	454.5	W
$T_{JMAX}$	Maximum junction temperature	175	$^{\circ}\text{C}$
$T_{Jop}$	Operative temperature range under switching conditions	-40 to 150	$^{\circ}\text{C}$

**Notes:**

<sup>(1)</sup>Pulse width limited by maximum junction temperature.

**Table 3: Electrical characteristics of the IGBT**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	$I_C = 1\text{ mA}$ , $V_{GE} = 0\text{ V}$	1200			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$ , $I_C = 75\text{ A}$		1.95	2.3	V
		$V_{GE} = 15\text{ V}$ , $I_C = 75\text{ A}$ , $T_J = 150\text{ °C}$		2.3		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$ , $I_C = 1\text{ mA}$	5	6	7	V
$I_{CES}$	Collector cut-off current	$V_{GE} = 0\text{ V}$ , $V_{CE} = 1200\text{ V}$			100	$\mu\text{A}$
$I_{GES}$	Gate-emitter leakage current	$V_{CE} = 0\text{ V}$ , $V_{GE} = \pm 20\text{ V}$			$\pm 500$	nA
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GE} = 0\text{ V}$		4700		pF
$C_{oes}$	Output capacitance			350		pF
$C_{res}$	Reverse transfer capacitance			190		pF
$Q_g$	Total gate charge	$V_{CC} = 960\text{ V}$ , $I_C = 75\text{ A}$ , $V_{GE} = \pm 15\text{ V}$		350		nC
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 600\text{ V}$ , $I_C = 75\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = \pm 15\text{ V}$ , $di/dt = 1900\text{ A}/\mu\text{s}$		198		ns
$t_r$	Current rise time			32		ns
$E_{on}^{(1)}$	Turn-on switching energy				3.59	

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$	Turn-off delay time	$V_{CC} = 600\text{ V}$ , $I_C = 75\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = \pm 15\text{ V}$ , $dv/dt = 6000\text{ V}/\mu\text{s}$ ;		250		ns
$t_f$	Current fall time			159		ns
$E_{off}^{(2)}$	Turn-off switching energy				5.13	
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 600\text{ V}$ , $I_C = 75\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = \pm 15\text{ V}$ , $di/dt = 1718\text{ A}/\mu\text{s}$ , $T_J = 150\text{ }^\circ\text{C}$		200		ns
$t_r$	Current rise time			35		ns
$E_{on}$	Turn-on switching energy				6.28	
$t_{d(off)}$	Turn-off delay time	$V_{CC} = 600\text{ V}$ , $I_C = 75\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = \pm 15\text{ V}$ , $dv/dt = 4900\text{ V}/\mu\text{s}$ , $T_J = 150\text{ }^\circ\text{C}$		266		ns
$t_f$	Current fall time			251		ns
$E_{off}$	Turn-off switching energy				7.7	
$t_{sc}$	Short-circuit withstand time	$V_{CC} \leq 600\text{ V}$ , $V_{GE} \leq 15\text{ V}$ , $T_{Jstart} \leq 150\text{ }^\circ\text{C}$	10			$\mu\text{s}$
$R_{THj-c}$	Thermal resistance junction to case	Each IGBT		0.30	0.33	$^\circ\text{C}/\text{W}$
$R_{THc-h}$	Thermal resistance case to heatsink	Each IGBT, $\lambda_{grease} = 1\text{ W}/(\text{m}\cdot^\circ\text{C})$		0.60		$^\circ\text{C}/\text{W}$

**Notes:**

(1)Including the reverse recovery of the diode.

(2)Including the tail of the collector current.

## 1.2 Diode

Table 4: Absolute maximum ratings of the diode

Symbol	Parameter	Value	Unit
$V_{RRM}$	Repetitive peak reverse voltage	1200	V
$I_F$	Continuous forward current at ( $T_C = 100\text{ }^\circ\text{C}$ )	75	A
$I_{FP}^{(1)}$	Pulsed forward current	150	A
$T_{JMAX}$	Maximum junction temperature	175	$^\circ\text{C}$
$T_{Jop}$	Operative temperature range under switching conditions	-40 to 150	$^\circ\text{C}$

**Notes:**

(1)Pulse width limited by maximum junction temperature.

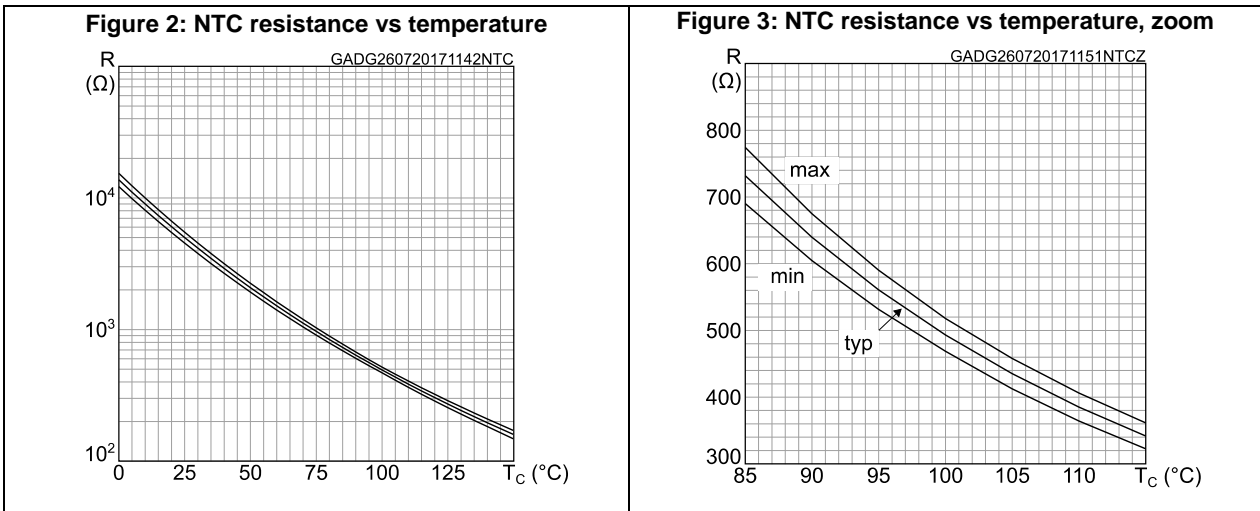
Table 5: Electrical characteristics of the diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V <sub>F</sub>	Forward voltage	I <sub>F</sub> = 75 A	-	2.95	4.1	V
		I <sub>F</sub> = 75 A, T <sub>J</sub> = 150 °C	-	2.3		
t <sub>rr</sub>	Reverse recovery time	I <sub>F</sub> = 75 A, V <sub>R</sub> = 600 V, V <sub>GE</sub> = ±15 V, di/dt = 1900 A/μs	-	200		ns
Q <sub>rr</sub>	Reverse recovery charge		-	6.0		μC
I <sub>rrm</sub>	Reverse recovery current		-	78		A
E <sub>rec</sub>	Reverse recovery energy		-	2.2		mJ
t <sub>rr</sub>	Reverse recovery time		I <sub>F</sub> = 75 A, V <sub>R</sub> = 600 V, V <sub>GE</sub> = ±15 V, di/dt = 1718 A/μs, T <sub>J</sub> = 150 °C	-	500	
Q <sub>rr</sub>	Reverse recovery charge	-		12.5		μC
I <sub>rrm</sub>	Reverse recovery current	-		90		A
E <sub>rec</sub>	Reverse recovery energy	-		5.2		mJ
R <sub>THj-c</sub>	Thermal resistance junction to case	Each diode		-	0.55	0.60
R <sub>THc-h</sub>	Thermal resistance case to heatsink	Each diode, λ <sub>grease</sub> = 1 W/(m·°C)	-	0.75		°C/W

### 1.3 NTC

Table 6: NTC temperature sensor, considered as stand-alone

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
R <sub>25</sub>	Resistance	T = 25°C		5		kΩ
R <sub>100</sub>	Resistance	T = 100°C		493		Ω
ΔR/R	Deviation of R <sub>100</sub>		-5		+5	%
B <sub>25/50</sub>	B-constant			3375		K
B <sub>25/80</sub>	B-constant			3411		K
T	Operating temperature range		-40		150	°C

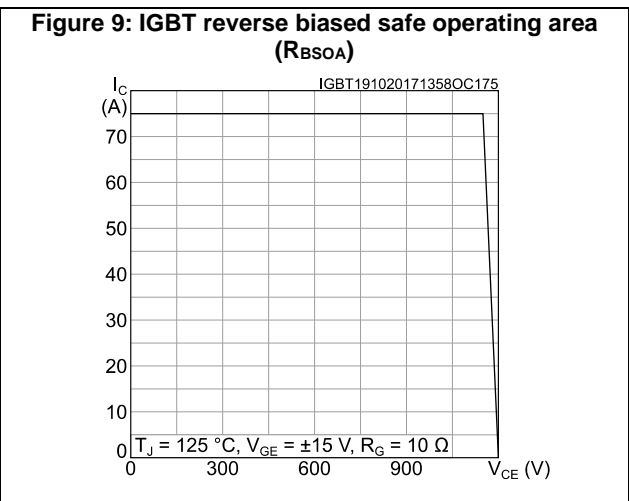
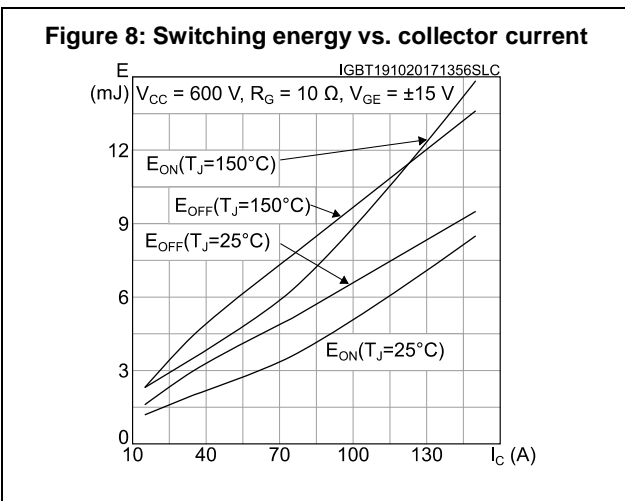
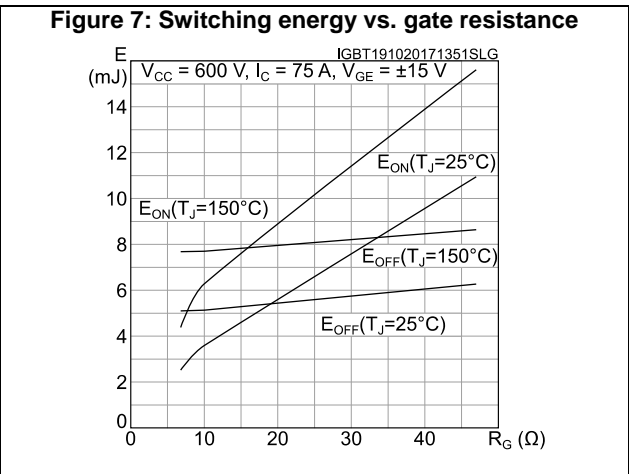
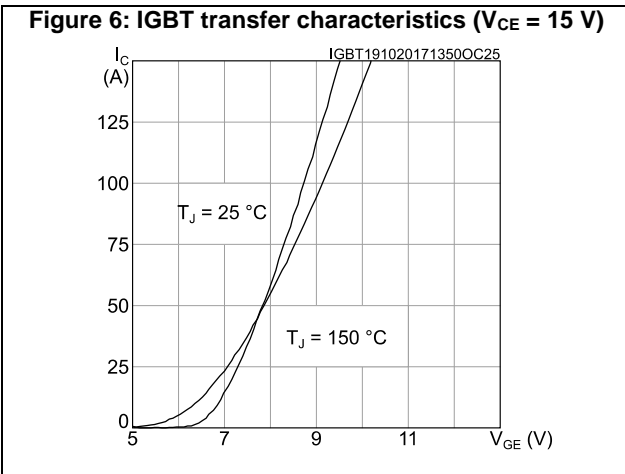
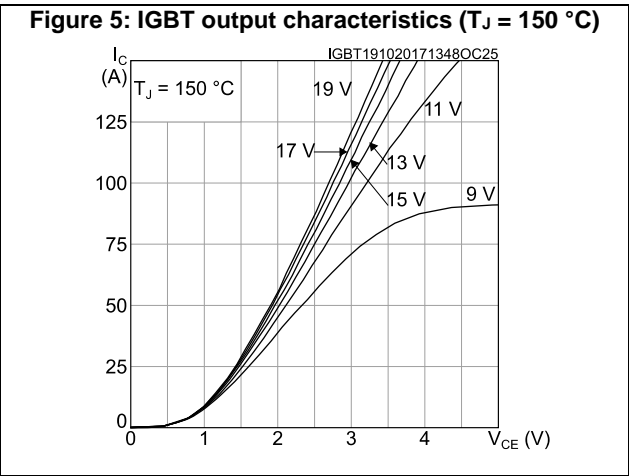
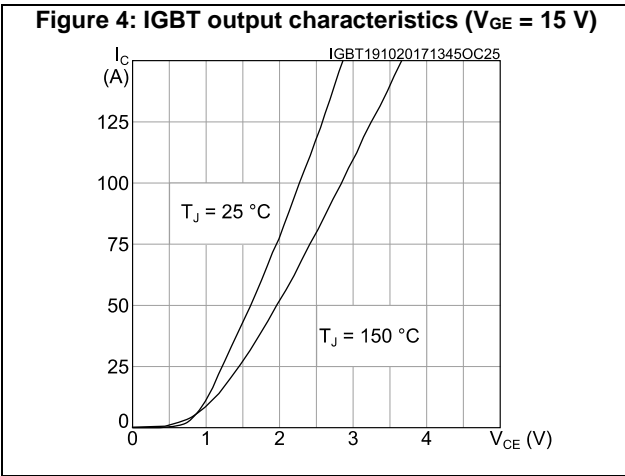


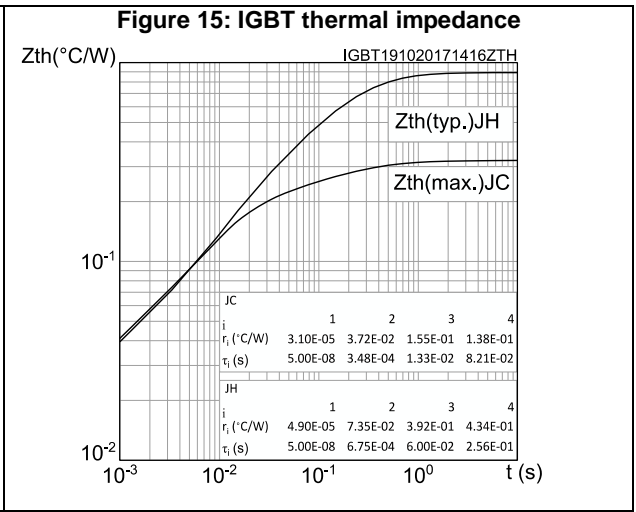
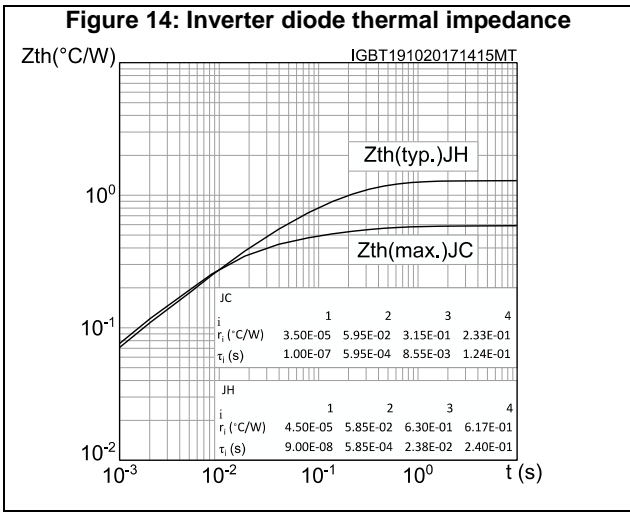
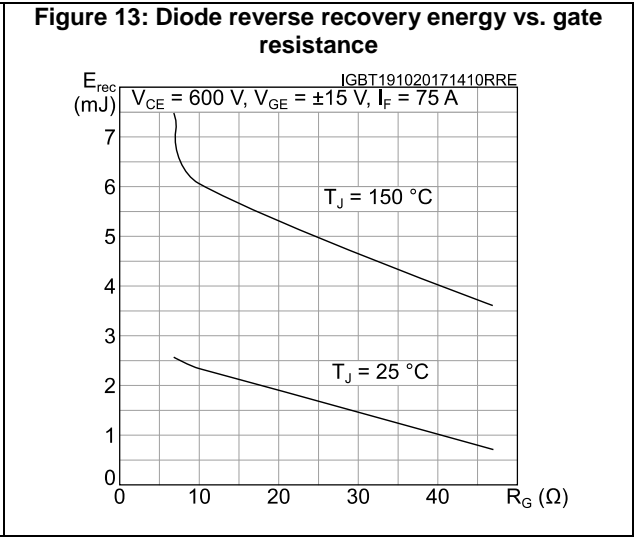
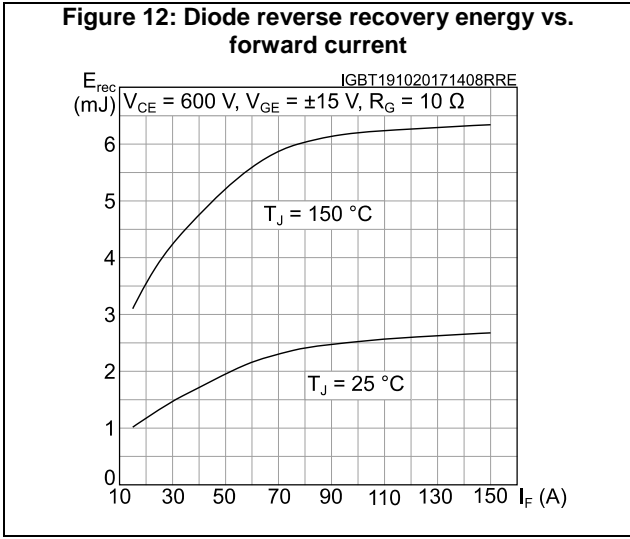
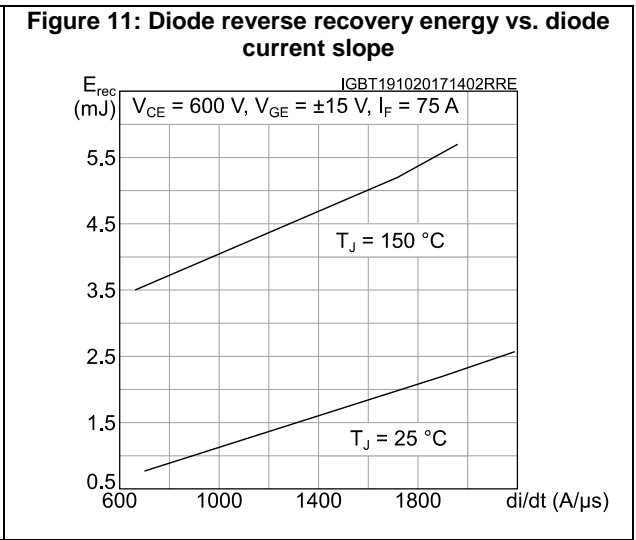
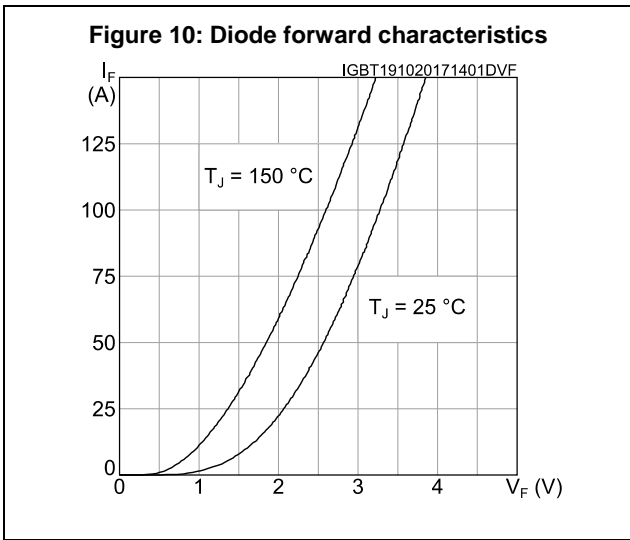
## 1.4 Package

Table 7: ACEPACK™ 2 package

Symbol	Parameter	Min.	Typ.	Max.	Unit
$V_{isol}$	Isolation voltage (AC voltage, $t = 60$ s)			2500	V
$M_d$	Screw mounting torque	40		80	Nm
$T_{stg}$	Storage temperature	-40		125	°C
CTI	Comparative tracking index	200			
$L_s$	Stray inductance module P1 - EW loop		33.5		nH
$R_s$	Module lead resistance, terminal to chip		3.6		mΩ

## 2 Electrical characteristics curves

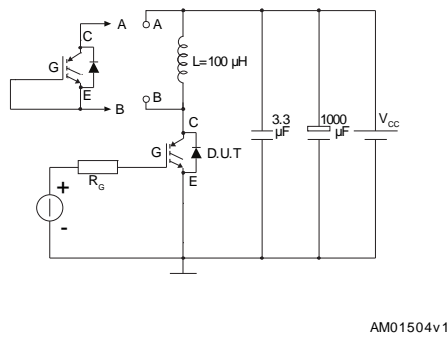




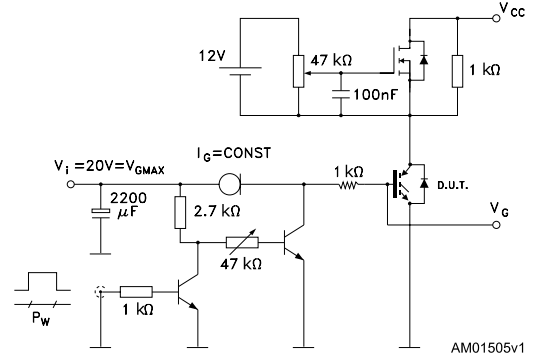


### 3 Test circuits

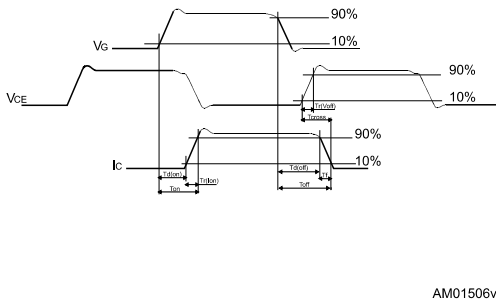
**Figure 16: Test circuit for inductive load switching**



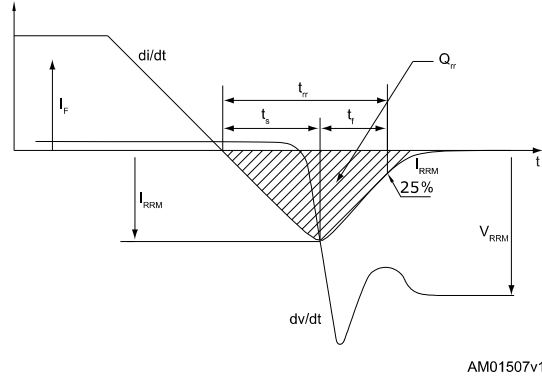
**Figure 17: Gate charge test circuit**



**Figure 18: Switching waveform**



**Figure 19: Diode reverse recovery waveform**



# 4 Topology and pin description

Figure 20: Electrical topology and pin description

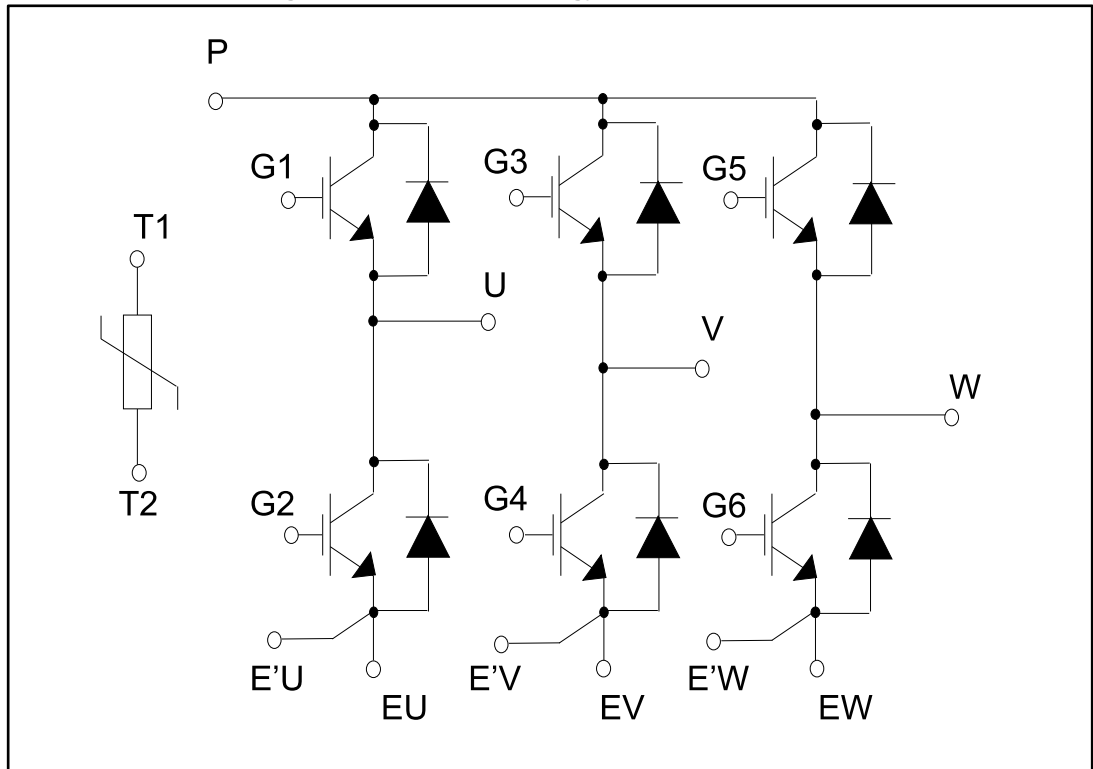
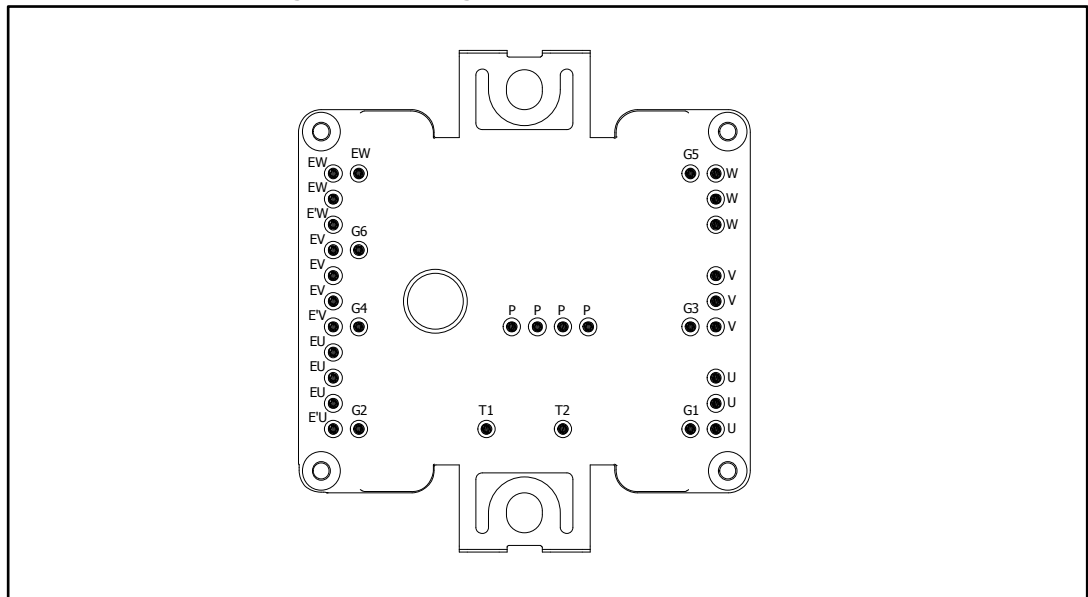


Figure 21: Package top view with sixpack pinout

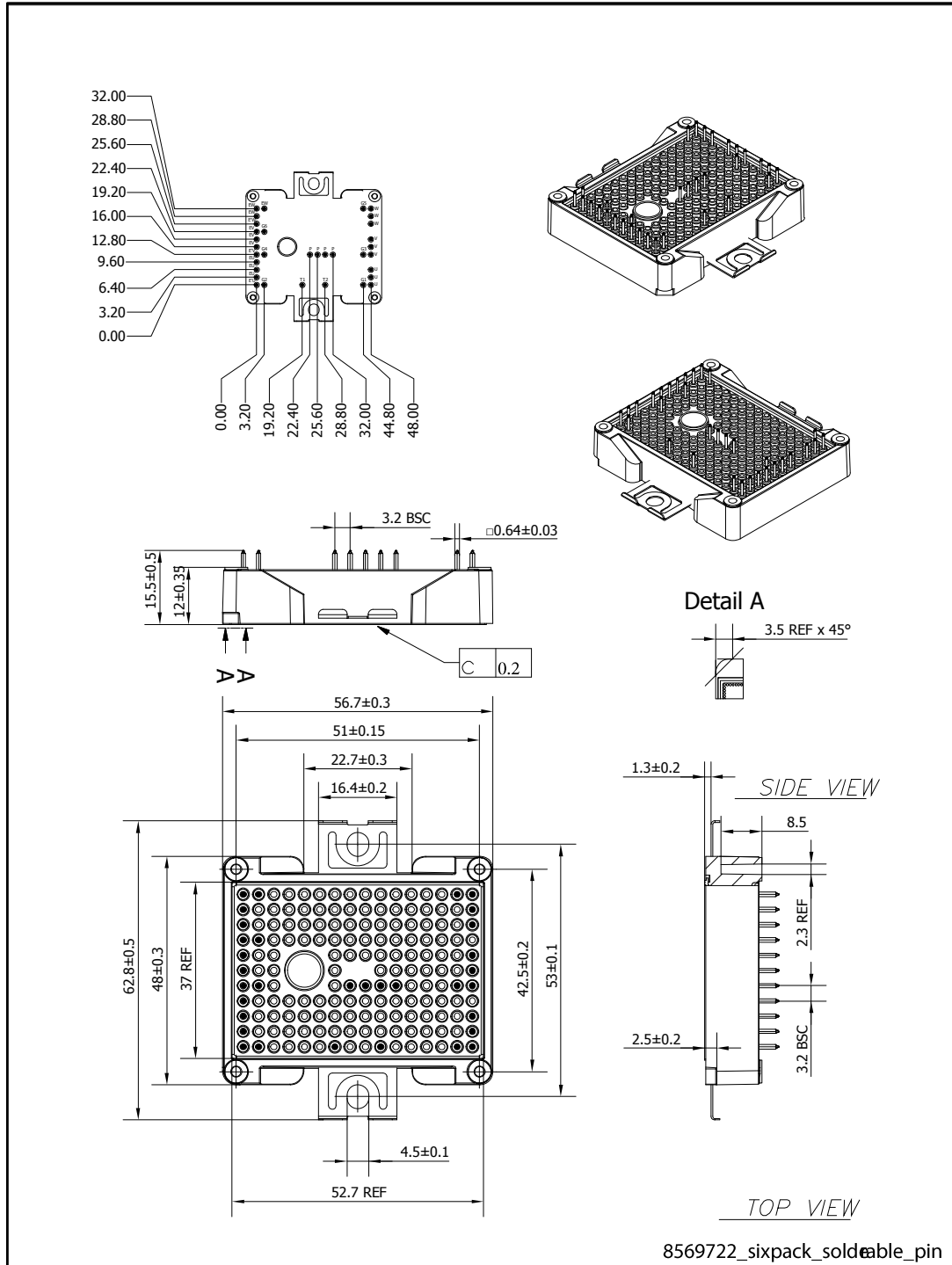


## 5 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK® is an ST trademark.

### 5.1 ACEPACK™ 2 sixpack solder pins package information

Figure 22: ACEPACK™ 2 sixpack solder pins package outline (dimensions are in mm)



- The lead size includes the thickness of the lead plating material.
- Dimensions do not include mold protrusion.
- Package dimensions do not include any eventual metal burrs.

## 6 Revision history

**Table 8: Document revision history**

Date	Revision	Changes
19-May-2016	1	Initial release.
24-May-2016	2	Updated <i>Table 5: "Electrical characteristics of the diode"</i> . Minor text changes.
01-Feb-2017	3	Added <i>Figure 19: "Package top view with pinout"</i> and <i>Section 2: "Electrical characteristics (curves)"</i> . Minor text changes.
19-Oct-2017	4	Updated <i>Section 1: "Electrical ratings"</i> , <i>Section 2: "Electrical characteristics curves"</i> , and <i>Section 5: "Package information"</i> . Minor text changes.

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