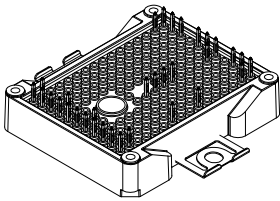
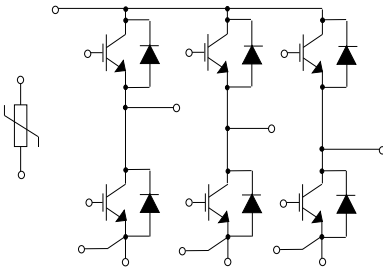


## ACEPACK™ 2 sixpack topology, 1200 V, 75 A trench gate field-stop IGBT M series, soft diode and NTC


**ACEPACK™ 2**


### 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
  - 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.

#### Product status

A2P75S12M3-F

#### Product summary

<b>Order code</b>	A2P75S12M3-F
<b>Marking</b>	A2P75S12M3-F
<b>Package</b>	ACEPACK™ 2
<b>Leads type</b>	Press fit contact pins

# 1 Electrical ratings

## 1.1 IGBT

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

**Table 1. 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 ( $t_p = 1\text{ ms}$ )	150	A
$V_{GE}$	Gate-emitter voltage	$\pm 20$	V
$P_{TOT}$	Total power dissipation of each IGBT ( $T_C = 25\text{ °C}$ , $T_J = 175\text{ °C}$ )	454.5	W
$T_{JMAX}$	Maximum junction temperature	175	$^{\circ}\text{C}$
$T_{Jop}$	Operating junction temperature range under switching conditions	-40 to 150	$^{\circ}\text{C}$

1. Pulse width limited by maximum junction temperature.

**Table 2. 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
$V_{CE(sat)}$ (terminal)	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		mJ
$t_{d(on)}$	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
$E_{on}^{(1)}$	Turn-on switching energy				6.28		mJ
$t_{d(off)}$	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
$E_{off}^{(2)}$	Turn-off switching energy				7.7		mJ
$t_{SC}$	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		$^\circ\text{C}/\text{W}$	

1. Including the reverse recovery of the diode.

2. Including the tail of the collector current.

## 1.2 Diode

Limiting values at  $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise specified.

**Table 3. Absolute maximum ratings of the diode**

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

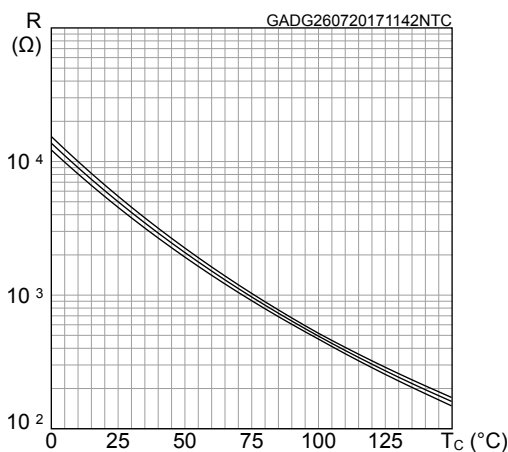
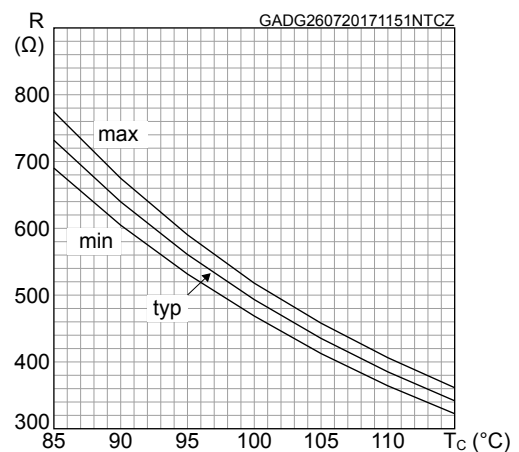
1. Pulse width limited by maximum junction temperature.

**Table 4. Electrical characteristics of the diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_F$ (terminal)	Forward voltage	$I_F = 75\text{ A}$	-	2.95	4.1	V
		$I_F = 75\text{ A}, T_J = 150\text{ °C}$	-	2.3		
$t_{rr}$	Reverse recovery time	$I_F = 75\text{ A}, V_R = 600\text{ V},$ $V_{GE} = \pm 15\text{ V},$ $di/dt = 1900\text{ A}/\mu\text{s}$	-	200		ns
$Q_{rr}$	Reverse recovery charge		-	6.0		$\mu\text{C}$
$I_{rrm}$	Reverse recovery current		-	78		A
$E_{rec}$	Reverse recovery energy		-	2.2		mJ
$t_{rr}$	Reverse recovery time	$I_F = 75\text{ A}, V_R = 600\text{ V},$ $V_{GE} = \pm 15\text{ V},$ $di/dt = 1718\text{ A}/\mu\text{s},$ $T_J = 150\text{ °C}$	-	500		ns
$Q_{rr}$	Reverse recovery charge		-	12.5		$\mu\text{C}$
$I_{rrm}$	Reverse recovery current		-	90		A
$E_{rec}$	Reverse recovery energy		-	5.2		mJ
$R_{THj-c}$	Thermal resistance junction-to-case	Each diode	-	0.55	0.60	$^{\circ}\text{C}/\text{W}$
$R_{THc-h}$	Thermal resistance case-to-heatsink	Each diode, $\lambda_{grease} = 1\text{ W}/(\text{m}\cdot^{\circ}\text{C})$	-	0.75		$^{\circ}\text{C}/\text{W}$

**1.3**
**NTC**
**Table 5. NTC temperature sensor, considered as stand-alone**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$R_{25}$	Resistance	$T = 25\text{ °C}$		5		k $\Omega$
$R_{100}$	Resistance	$T = 100\text{ °C}$		493		$\Omega$
$\Delta R/R$	Deviation of $R_{100}$		-5		+5	%
$B_{25/50}$	B-constant			3375		K
$B_{25/80}$	B-constant			3411		K
T	Operating temperature range		-40		150	$^{\circ}\text{C}$

**Figure 1. NTC resistance vs temperature**

**Figure 2. NTC resistance vs temperature, zoom**


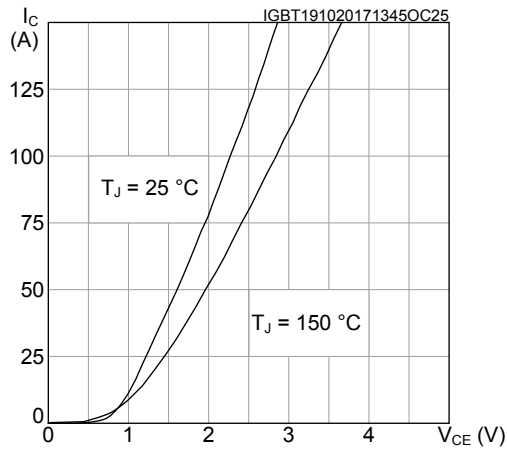
## 1.4 Package

**Table 6. ACEPACK™ 2 package**

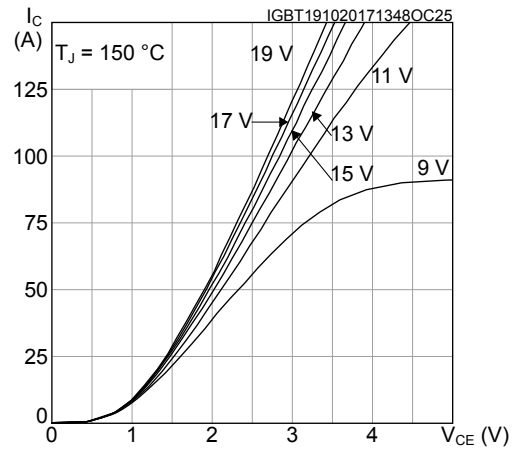
Symbol	Parameter	Min.	Typ.	Max.	Unit
$V_{isol}$	Isolation voltage (AC voltage, $t = 60$ s)			2500	$V_{rms}$
$T_{stg}$	Storage temperature	-40		125	°C
CTI	Comparative tracking index	200			
$L_s$	Stray inductance module P1 - EW loop		33.5		nH
$R_s$	Module single lead resistance, terminal to chip		3.6	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

## 2 Electrical characteristics curves

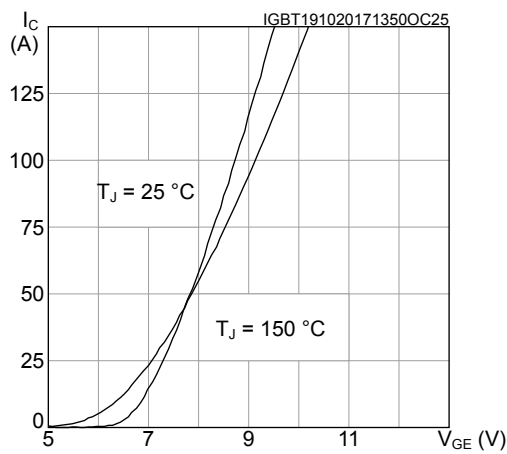
**Figure 3. IGBT output characteristics**  
( $V_{GE} = 15\text{ V}$ , terminal)



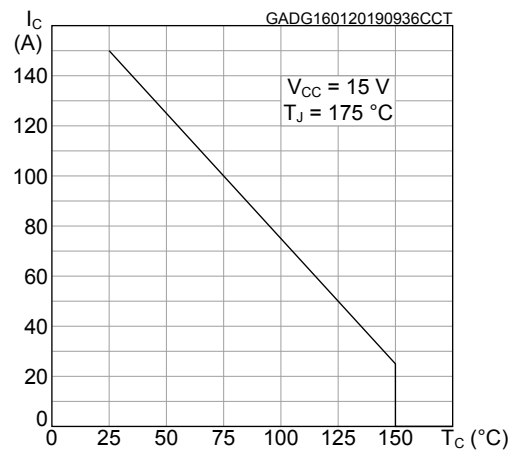
**Figure 4. IGBT output characteristics**  
( $T_J = 150^\circ\text{C}$ , terminal)



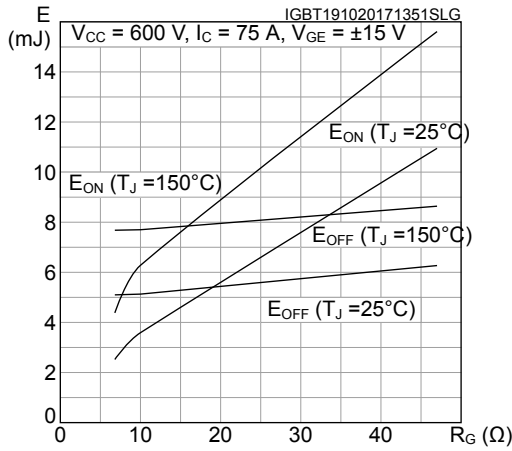
**Figure 5. IGBT transfer characteristics**  
( $V_{CE} = 15\text{ V}$ , terminal)



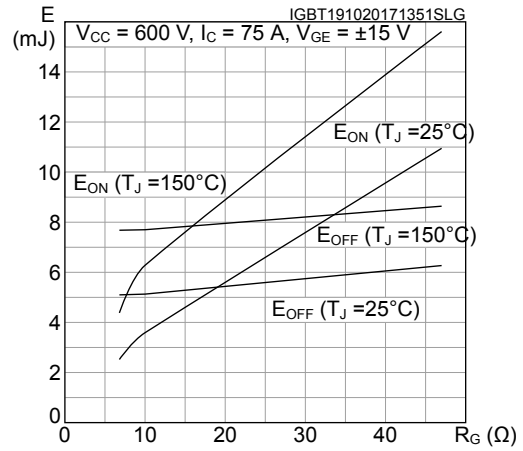
**Figure 6. IGBT collector current vs case temperature**



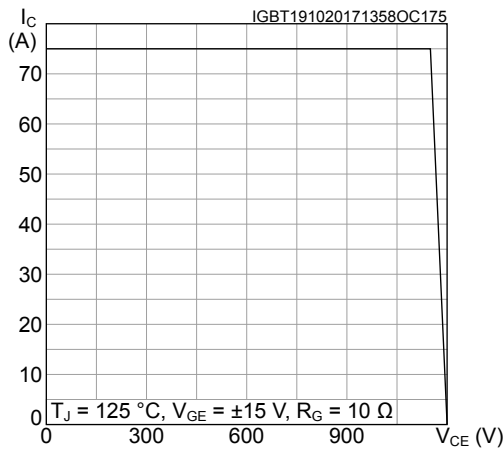
**Figure 7. Switching energy vs gate resistance**



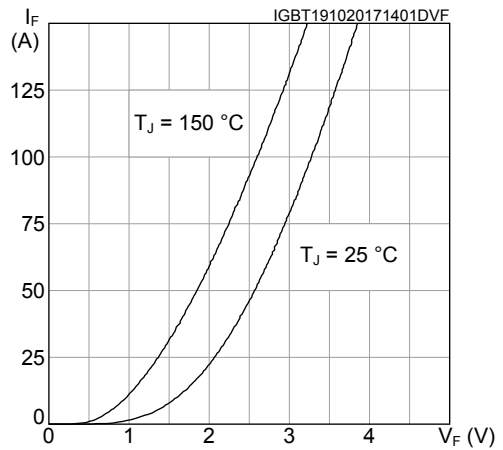
**Figure 8. Switching energy vs gate resistance**



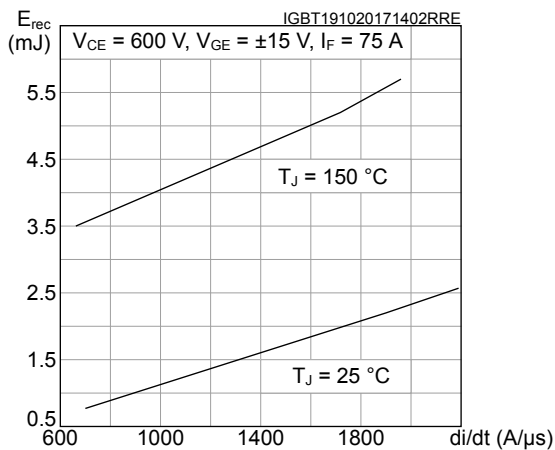
**Figure 9. IGBT reverse biased safe operating area (RBSOA)**



**Figure 10. Diode forward characteristics (terminal)**



**Figure 11. Diode reverse recovery energy vs diode current slope**



**Figure 12. Diode reverse recovery energy vs forward current**

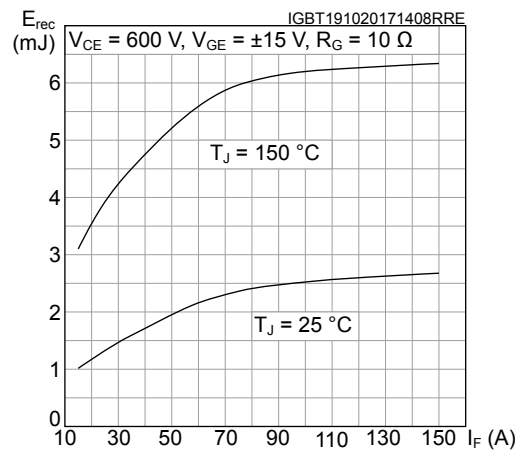


Figure 13. Diode reverse recovery energy vs gate resistance

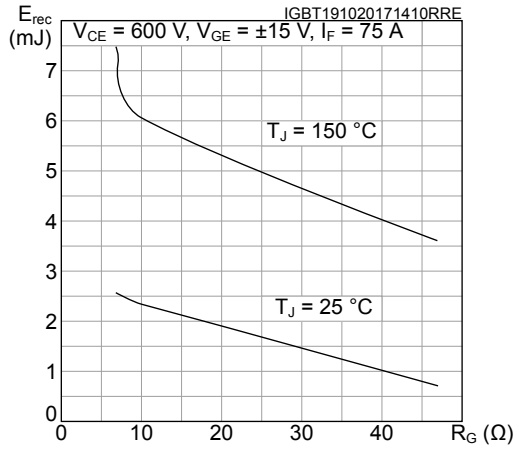


Figure 14. IGBT thermal impedance

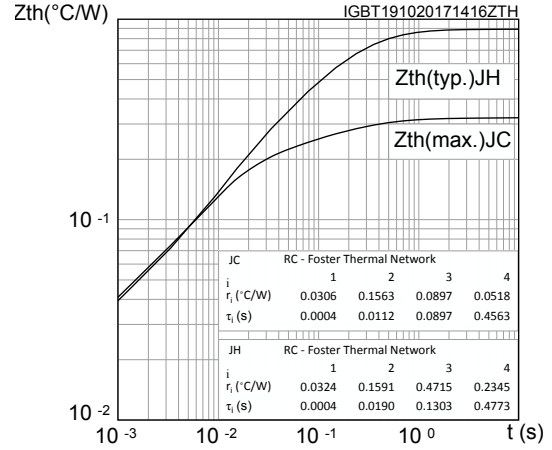
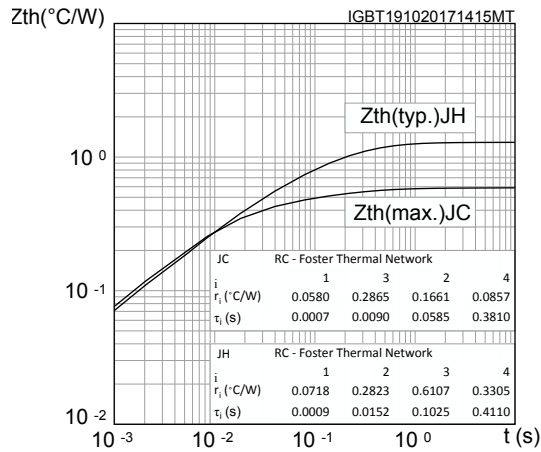
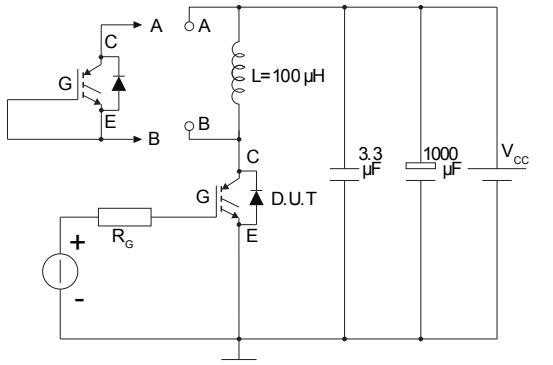
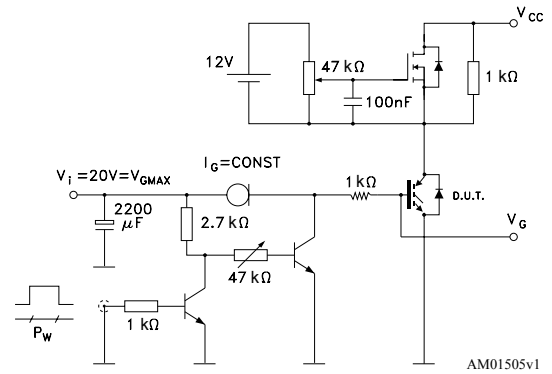
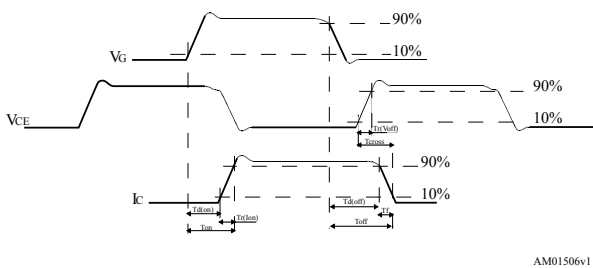
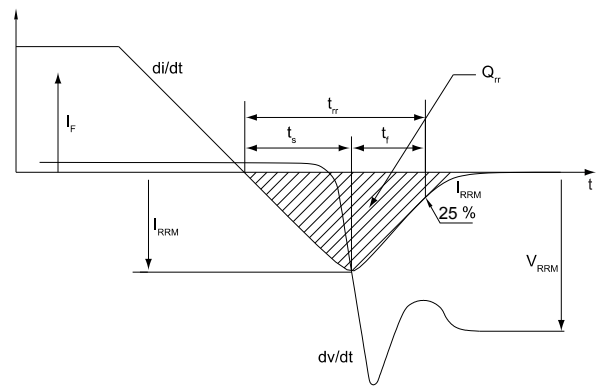


Figure 15. Inverter diode thermal impedance





### 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

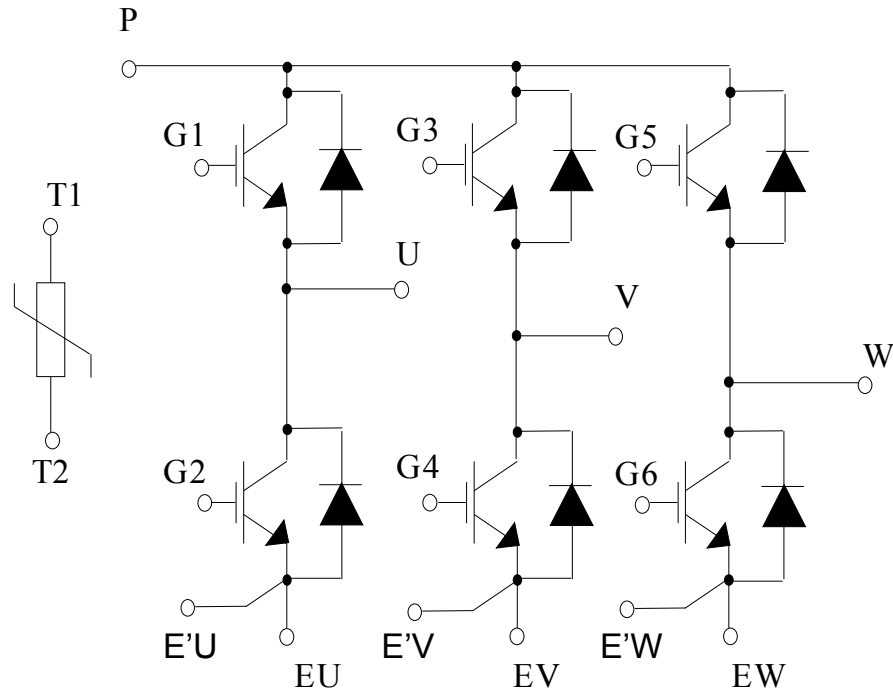
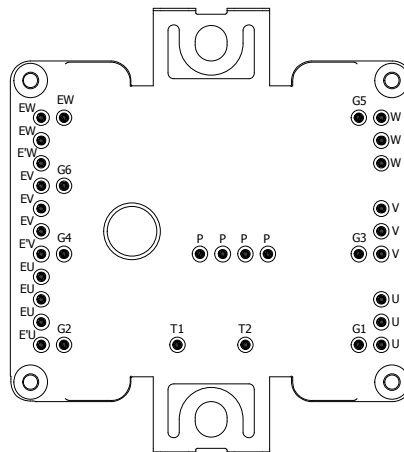


Figure 21. Package top view with sixpack pinout

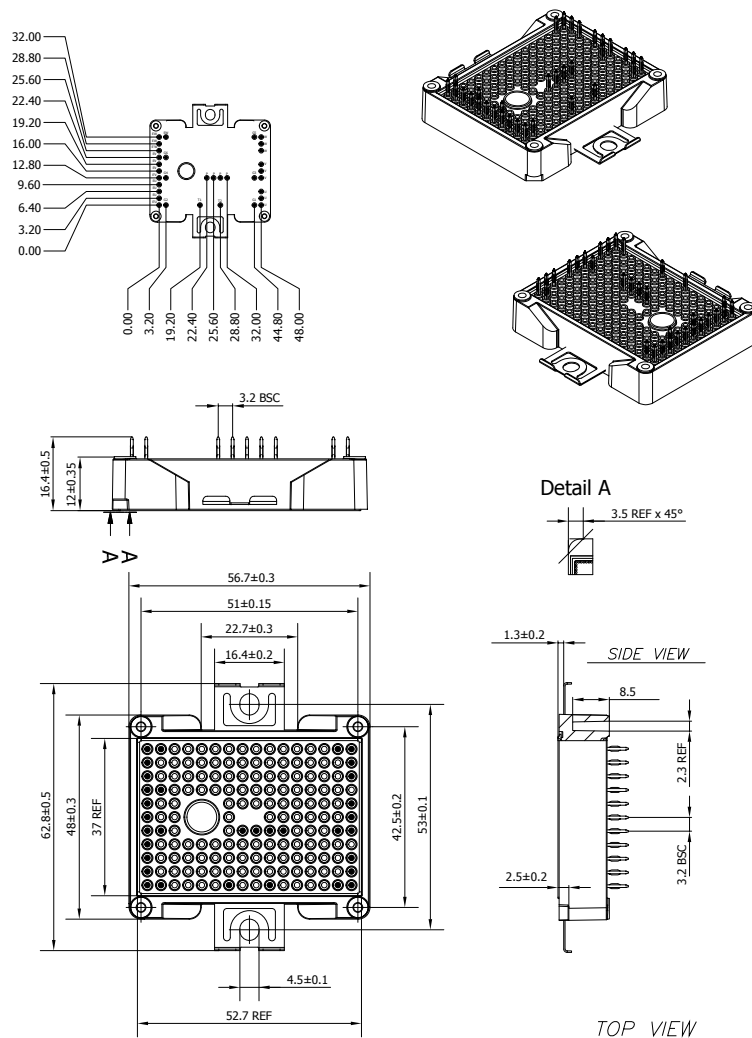


## 5 Package information

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.

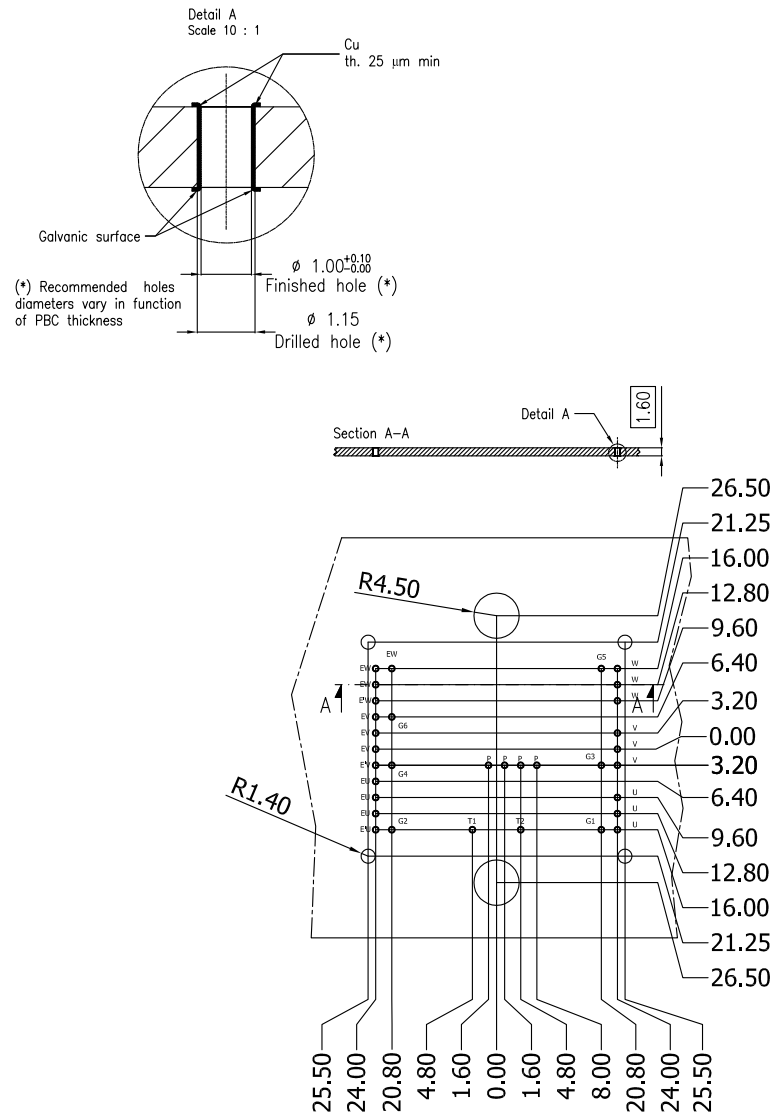
### 5.1 ACEPACK™ 2 sixpack press fit contact pins package information

Figure 22. ACEPACK™ 2 sixpack press fit contact pins package outline (dimensions are in mm)



8569722 rev.4

- 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.

**Figure 23. ACEPACK™ 2 sixpack press fit contact pins recommended PCB holes layout (dimension are in mm)**


8569722 rev.4

## Revision history

**Table 7. Document revision history**

Date	Revision	Changes
19-May-2016	1	Initial release.
24-May-2016	2	Updated <a href="#">Table 5</a> : "Electrical characteristics of the diode".
24-Oct-2017	3	Updated <a href="#">Section 1</a> : "Electrical ratings", <a href="#">Section 2</a> : "Electrical characteristics curves" and <a href="#">Section 5</a> : "Package information". Minor text changes.
20-Mar-2018	4	Removed maturity status indication from cover page. The document status is production data. Updated features in cover page, <a href="#">Section 1.1 IGBT</a> , <a href="#">Section 1.2 Diode</a> , <a href="#">Section 1.4 Package</a> , <a href="#">Section 2 Electrical characteristics curves</a> and <a href="#">Section 5.1 ACEPACK™ 2 sixpack press fit contact pins package information</a> . Minor text changes.
16-Jan-2019	5	Added <a href="#">Figure 6</a> . Minor text changes.

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