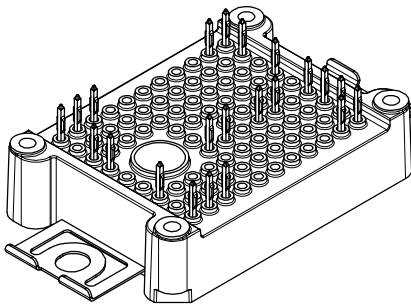
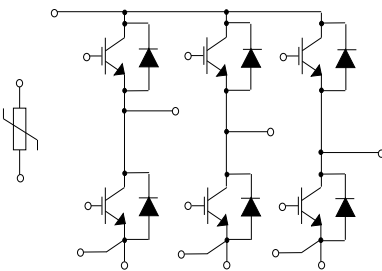


ACEPACK™ 1 sixpack topology, 1200 V, 35 A, trench gate field-stop M series IGBT with soft diode and NTC


ACEPACK™ 1


Features

- ACEPACK™ 1 power module
 - DBC Cu Al₂O₃ Cu
- Sixpack topology
 - 1200 V, 35 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™ 1 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

A1P35S12M3-F

Product summary

Order code	A1P35S12M3-F
Marking	A1P35S12M3-F
V_{CES}, I_C ratings	1200 V, 35 A
Package	ACEPACK™ 1
Packing	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 ($V_{GE} = 0\text{ V}$)	1200	V
I_C	Continuous collector current ($T_C = 100\text{ °C}$)	35	A
$I_{CP}^{(1)}$	Pulsed collector current ($t_p = 1\text{ ms}$)	70	A
V_{GE}	Gate-emitter voltage	± 20	V
P_{TOT}	Total power dissipation of each IGBT ($T_C = 25\text{ °C}$, $T_J = 175\text{ °C}$)	250	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	$V_{GE} = 15\text{ V}$, $I_C = 35\text{ A}$ $V_{GE} = 15\text{ V}$, $I_C = 35\text{ A}$, $T_J = 150\text{ °C}$		1.95 2.3	2.45	V
$V_{GE(th)}$	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	μA
I_{GES}	Gate-emitter leakage current	$V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$			± 500	nA
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$		2154		pF
C_{oes}	Output capacitance			164		pF
C_{res}	Reverse transfer capacitance			86		pF
Q_g	Total gate charge	$V_{CC} = 960\text{ V}$, $I_C = 35\text{ A}$, $V_{GE} = \pm 15\text{ V}$		163		nC
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 600\text{ V}$, $I_C = 35\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = \pm 15\text{ V}$,		122		ns
t_r	Current rise time			17		ns
$E_{on}^{(1)}$	Turn-on switching energy	$di/dt = 1900\text{ A}/\mu\text{s}$		1.21		mJ
$t_{d(off)}$	Turn-off delay time	$V_{CC} = 600\text{ V}$, $I_C = 35\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = \pm 15\text{ V}$,		142		ns
t_f	Current fall time			150		ns
$E_{off}^{(2)}$	Turn-off switching energy		$dv/dt = 7800\text{ V}/\mu\text{s}$		2.19	

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 600\text{ V}$, $I_C = 35\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = \pm 15\text{ V}$, $di/dt = 1533\text{ A}/\mu\text{s}$, $T_J = 150\text{ }^\circ\text{C}$		124		ns
t_r	Current rise time			18		ns
$E_{on}^{(1)}$	Turn-on switching energy				1.8	
$t_{d(off)}$	Turn-off delay time	$V_{CC} = 600\text{ V}$, $I_C = 35\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = \pm 15\text{ V}$, $dv/dt = 6700\text{ V}/\mu\text{s}$, $T_J = 150\text{ }^\circ\text{C}$		142		ns
t_f	Current fall time			256		ns
$E_{off}^{(2)}$	Turn-off switching energy				3.1	
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			μs
R_{THj-c}	Thermal resistance junction-to-case	Each IGBT		0.55	0.60	$^\circ\text{C}/\text{W}$
R_{THc-h}	Thermal resistance case-to-heatsink	Each IGBT, $\lambda_{grease} = 1\text{ W}/(\text{m}\cdot^\circ\text{C})$		0.70		$^\circ\text{C}/\text{W}$

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
I_F	Continuous forward current at $T_C = 100\text{ }^\circ\text{C}$	35	A
$I_{FP}^{(1)}$	Pulsed forward current ($t_p = 1\text{ ms}$)	70	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.

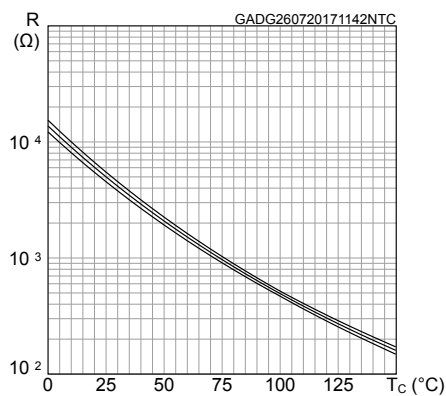
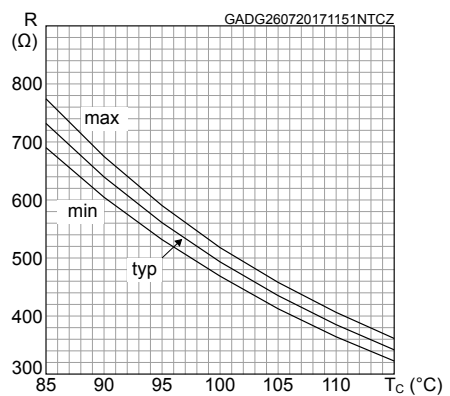
Table 4. Electrical characteristics of the diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_F (terminal)	Forward voltage	$I_F = 35\text{ A}$	-	2.95	4.1	V
		$I_F = 35\text{ A}$, $T_J = 150\text{ }^\circ\text{C}$	-	2.3		
t_{rr}	Reverse recovery time	$I_F = 35\text{ A}$, $V_R = 600\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $di/dt = 1900\text{ A}/\mu\text{s}$	-	140		ns
Q_{rr}	Reverse recovery charge		-	2.62		μC
I_{rrm}	Reverse recovery current		-	54		A
E_{rec}	Reverse recovery energy		-	1.2		mJ

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_{rr}	Reverse recovery time	$I_F = 35\text{ A}$, $V_R = 600\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $di/dt = 1533\text{ A}/\mu\text{s}$, $T_J = 150\text{ }^\circ\text{C}$	-	350		ns
Q_{rr}	Reverse recovery charge		-	6.6		μC
I_{rrm}	Reverse recovery current		-	63		A
E_{rec}	Reverse recovery energy		-	3.2		mJ
R_{THj-c}	Thermal resistance junction-to-case	Each diode	-	0.8	0.9	$^\circ\text{C}/\text{W}$
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	$T = 25^\circ\text{C}$		5		k Ω
R_{100}	Resistance	$T = 100^\circ\text{C}$		493		Ω
$\Delta R/R$	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™ 1 package

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{isol}	Isolation voltage (AC voltage, $t = 60$ s)			2500	Vrms
T_{stg}	Storage temperature	-40		125	°C
CTI	Comparative tracking index	200			
L_s	Stray inductance module P1 - EW loop		28.7		nH
R_s	Module single lead resistance, terminal-to-chip		3.9		mΩ

2 Electrical characteristics (curves)

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

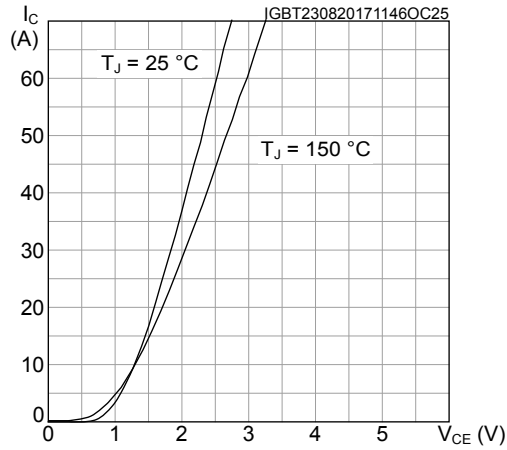


Figure 4. IGBT output characteristics ($T_J = 150\text{ °C}$, terminal)

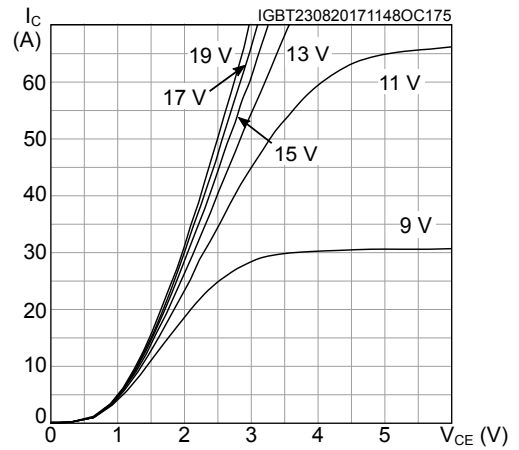


Figure 5. IGBT transfer characteristics ($V_{CE} = 15V$, terminal)

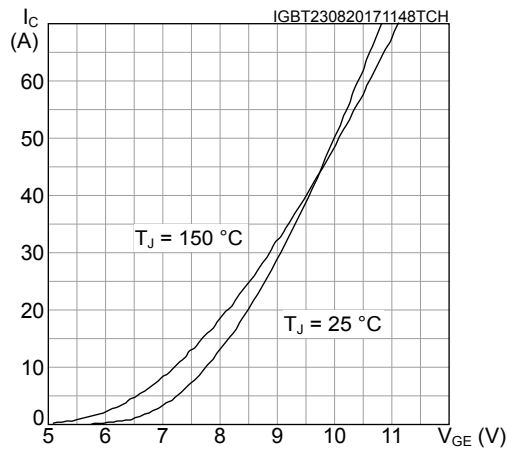


Figure 6. IGBT collector current vs case temperature

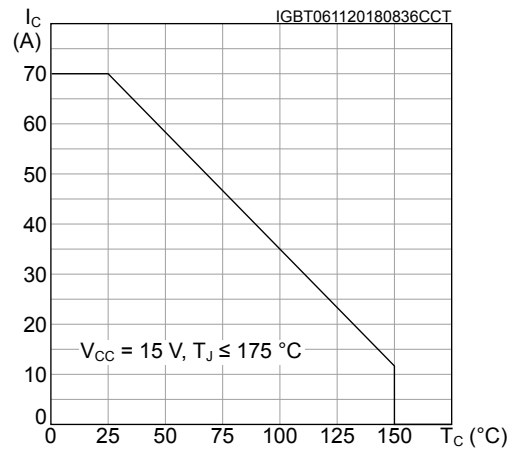


Figure 7. Switching energy vs gate resistance

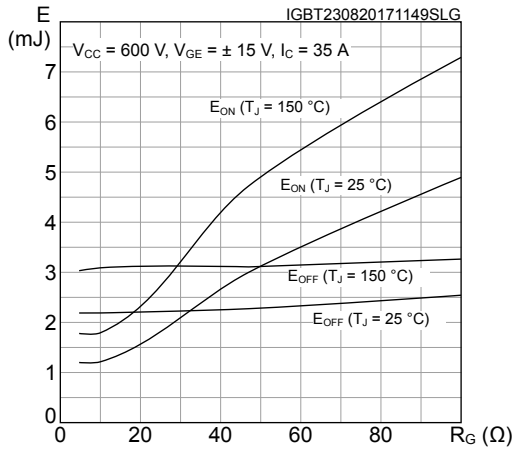


Figure 8. Switching energy vs collector current

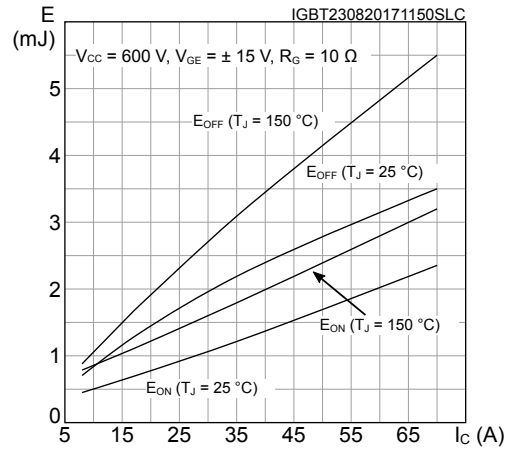


Figure 9. IGBT reverse biased safe operating area (RBSOA)

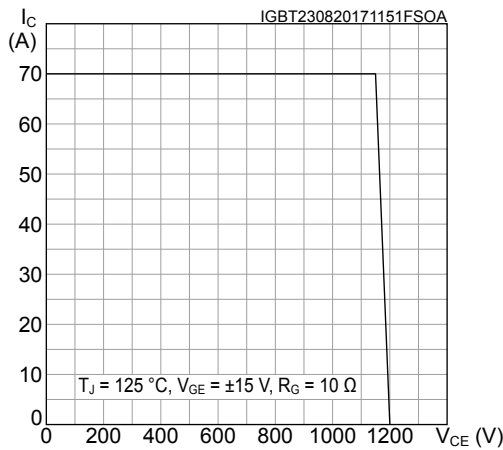


Figure 10. Diode forward characteristics (terminal)

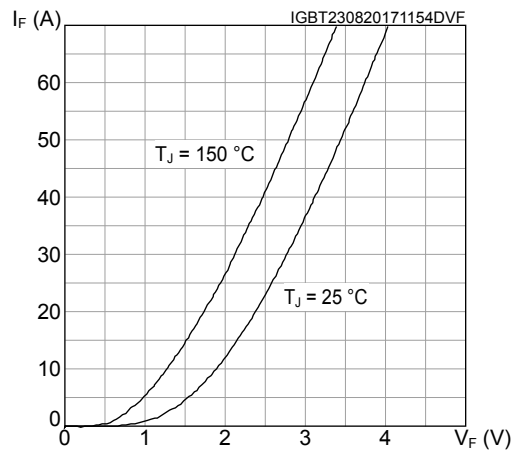


Figure 11. Diode reverse recovery energy vs diode current slope

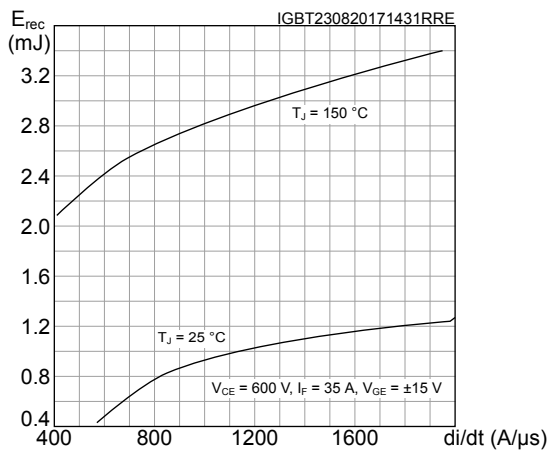


Figure 12. Diode reverse recovery energy vs forward current

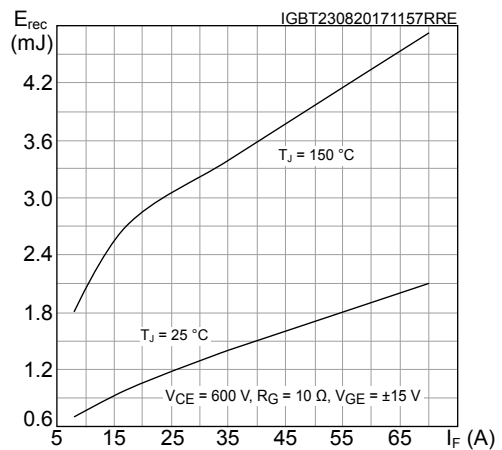


Figure 13. Diode reverse recovery energy vs gate resistance

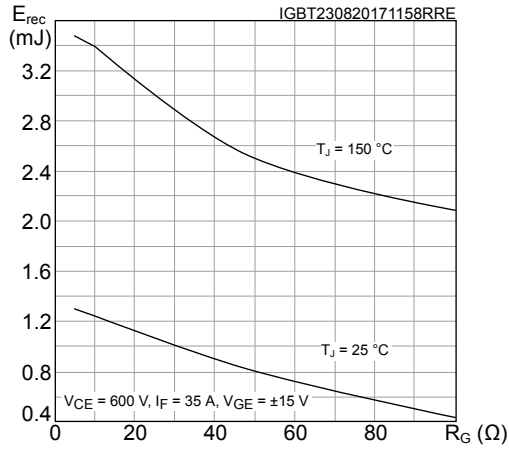


Figure 14. Inverter diode thermal impedance

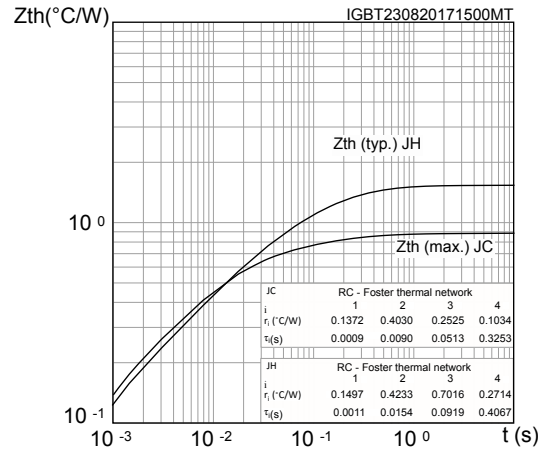
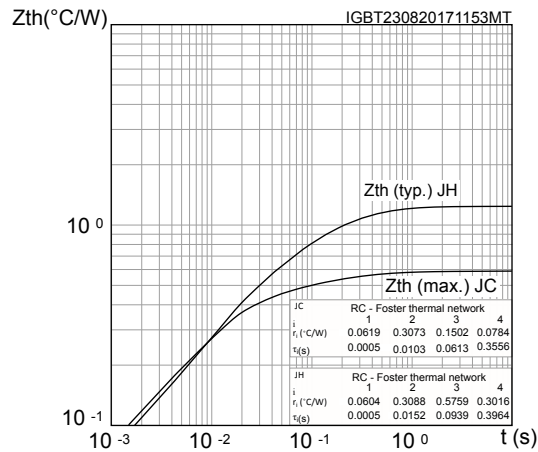
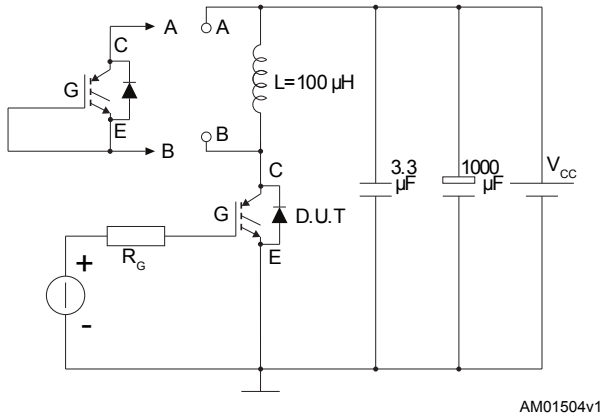
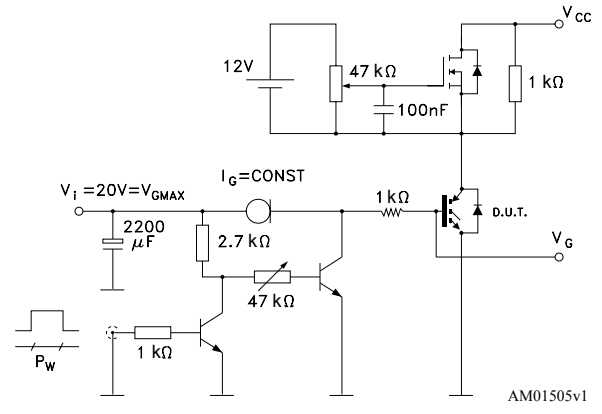
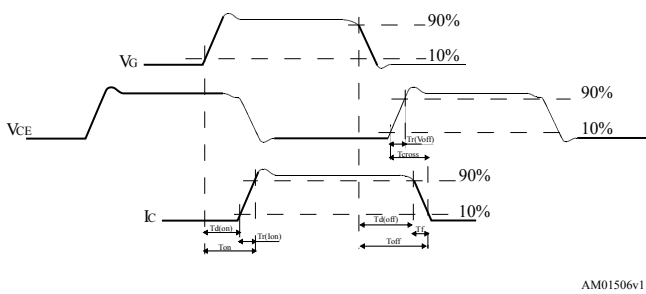
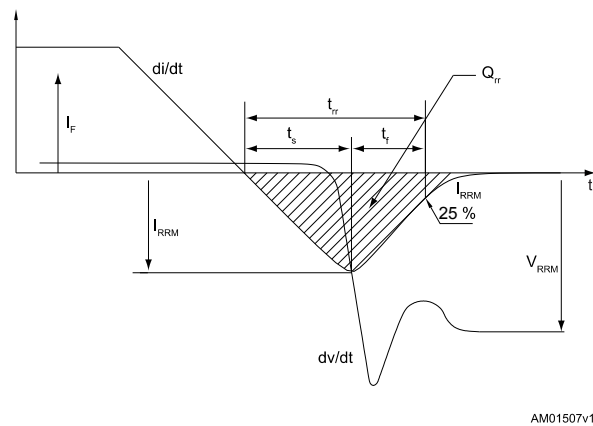


Figure 15. IGBT thermal impedance



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

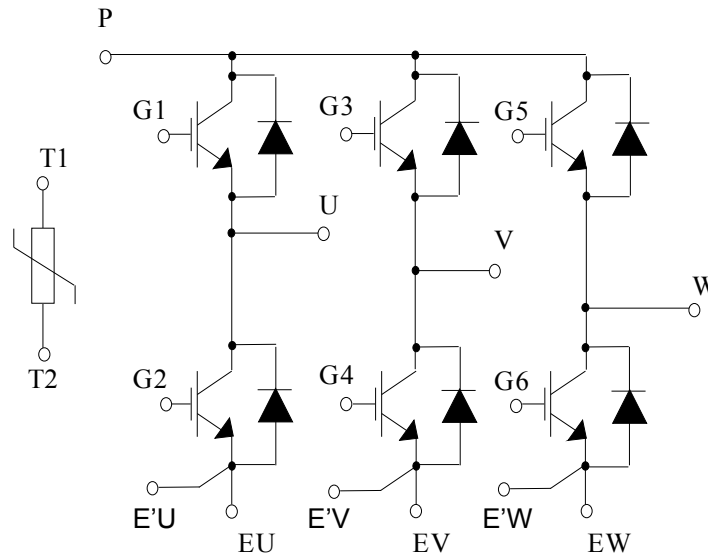
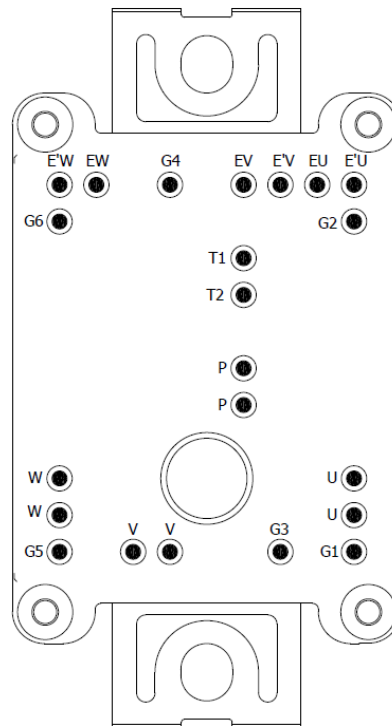


Figure 21. Package top view with sixpack pinout

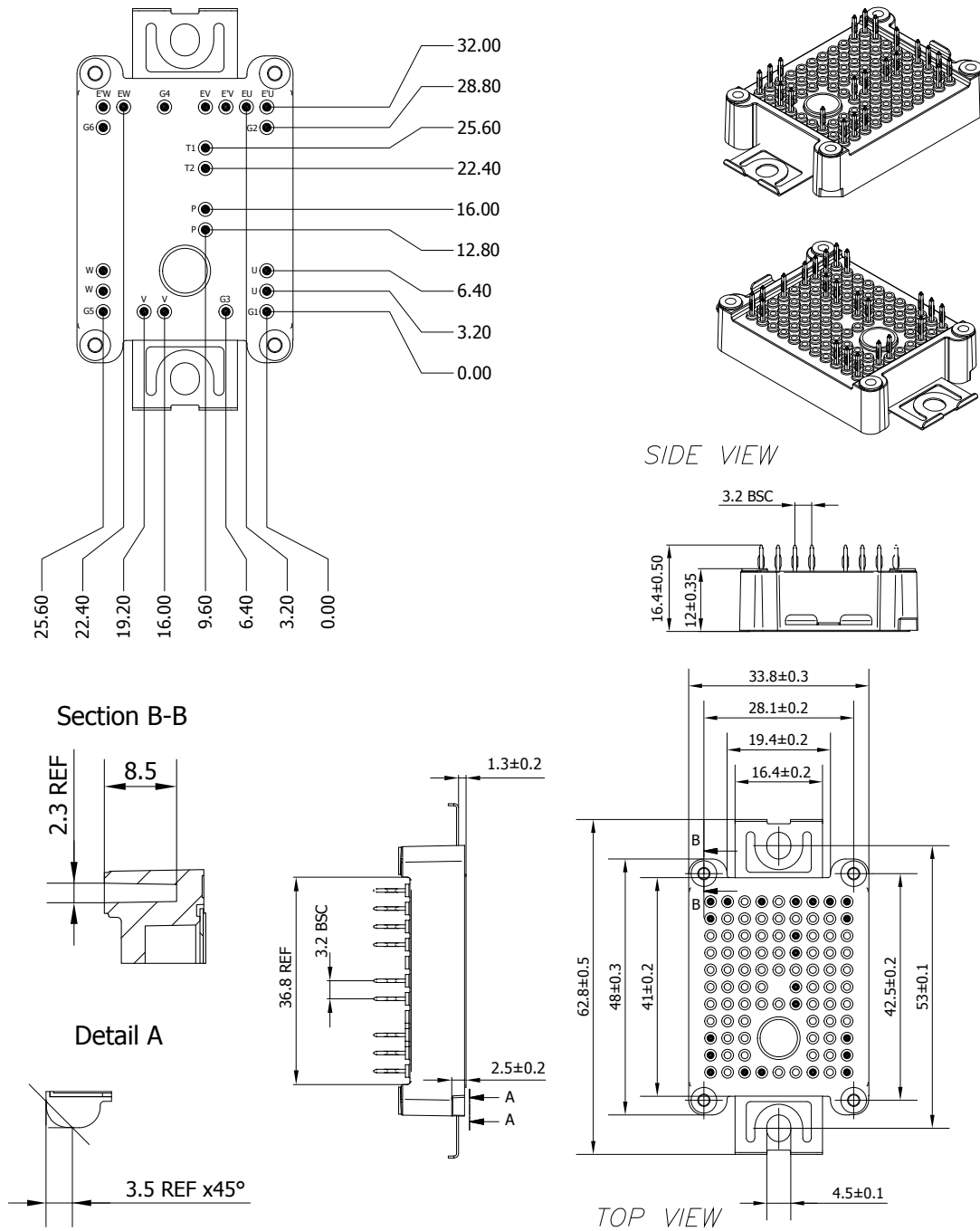


5 Package information

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. ECOPACK® is an ST trademark.

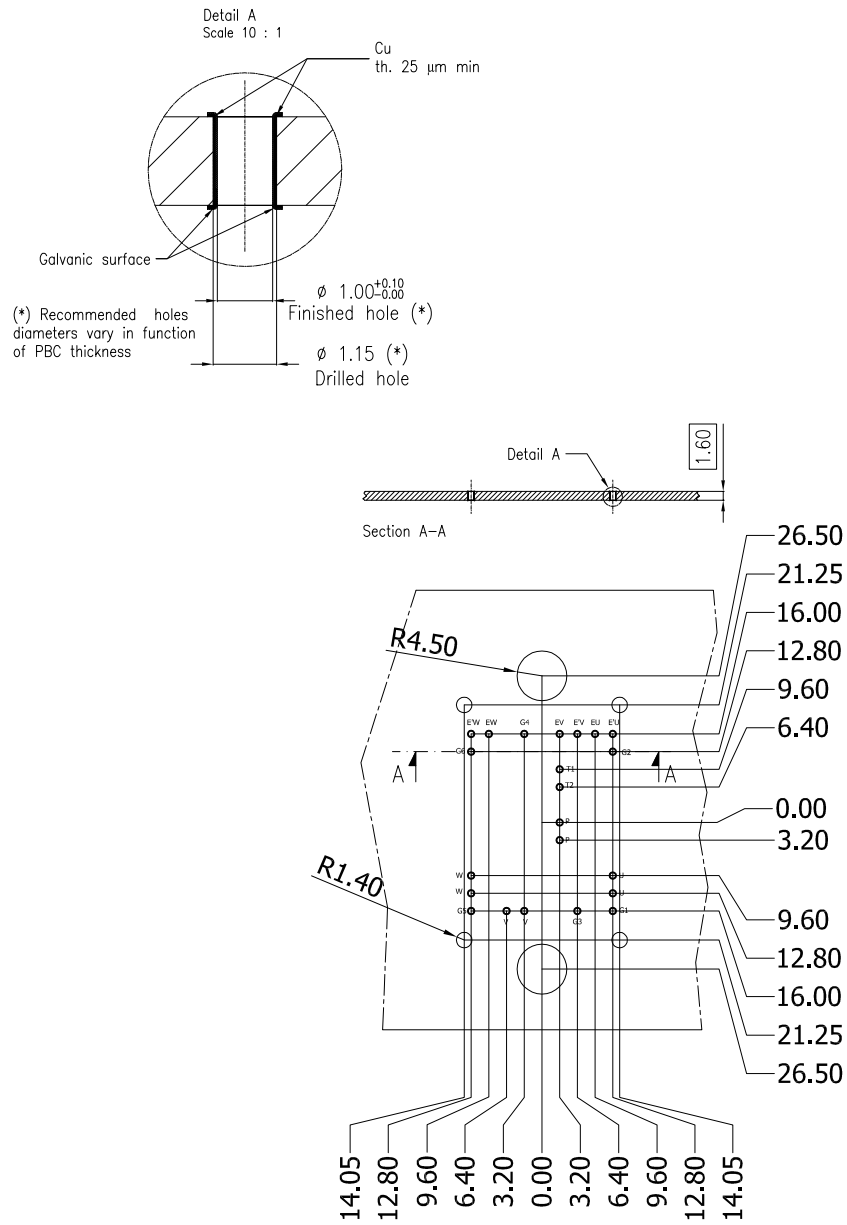
5.1 ACEPACK™ 1 sixpack press fit pins package information

Figure 22. ACEPACK™ 1 sixpack press fit pins package outline (dimensions are in mm)



GADG260220181307MT_8569715_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™ 1 sixpack press fit pins recommended PCB holes layout (dimensions are in mm)


GADG260220181409MT_8569715_4

Revision history

Table 7. Document revision history

Date	Revision	Changes
04-May-2016	1	Initial release.
24-Aug-2017	2	Updated title, features, description and Table 1: "Device summary" in cover page. Updated Section 1: "Electrical ratings". Added Section 2: "Electrical characteristics curves", Section 3: "Test circuits", Section 4: "Topology and pin description" and Section 5: "Package information". Minor text changes.
03-Oct-2017	3	Updated Table 7: "ACEPACK™ 1 package" and Section 2: "Electrical characteristics curves". Minor text changes.
02-Mar-2018	4	Removed maturity status indication from cover page. The document status is production data. Updated silhouette in cover page and <i>Section 5.1 ACEPACK™ 1 sixpack press fit pins package information</i> . Minor text changes.
14-Nov-2018	5	Added Figure 6. IGBT collector current vs case temperature . Minor text changes

Contents

1	Electrical ratings	2
1.1	IGBT	2
1.2	Diode	3
1.3	NTC.....	4
1.4	Package	5
2	Electrical characteristics (curves)	6
3	Test circuits	9
4	Topology and pin description	10
5	Package information	11
5.1	ACEPACK™ 1 sixpack press fit pins package information	12
	Revision history	14

IMPORTANT NOTICE – PLEASE READ CAREFULLY

STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST’s terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers’ products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2018 STMicroelectronics – All rights reserved

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: ocean@oceanchips.ru

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А