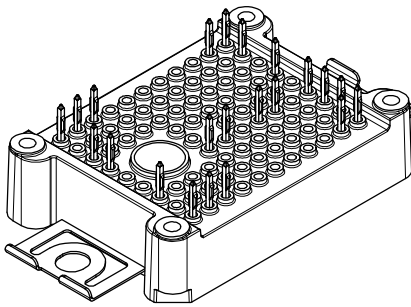
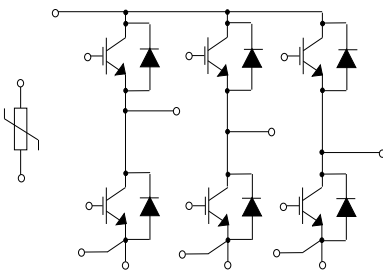


ACEPACK™ 1 sixpack topology, 1200 V, 25 A, trench gate field-stop M series IGBT with soft diode and NTC



ACEPACK™ 1



Features

- ACEPACK™ 1 power module
 - DBC Cu Al₂O₃ Cu
- Sixpack topology
 - 1200 V, 25 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

A1P25S12M3-F

Product summary

Order code	A1P25S12M3-F
Marking	A1P25S12M3-F
Package	ACEPACK™ 1
Leads type	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 ($T_C = 100\text{ °C}$)	25	A
$I_{CP}^{(1)}$	Pulsed collector current ($t_p = 1\text{ ms}$)	50	A
V_{GE}	Gate-emitter voltage	± 20	V
P_{TOT}	Total power dissipation of each IGBT ($T_C = 25\text{ °C}$, $T_J = 175\text{ °C}$)	197	W
T_{JMAX}	Maximum junction temperature	175	°C
T_{Jop}	Operating junction temperature range under switching conditions	-40 to 150	°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	$V_{GE} = 15\text{ V}$, $I_C = 25\text{ A}$		1.95	2.45	V
		$V_{GE} = 15\text{ V}$, $I_C = 25\text{ A}$, $T_J = 150\text{ °C}$		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	μA
I_{GES}	Gate-emitter leakage current	$V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$			± 500	nA
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$		1550		pF
C_{oes}	Output capacitance			130		pF
C_{res}	Reverse transfer capacitance			65		pF
Q_g	Total gate charge	$V_{CC} = 960\text{ V}$, $I_C = 25\text{ A}$, $V_{GE} = \pm 15\text{ V}$		122		nC
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 600\text{ V}$, $I_C = 25\text{ A}$, $R_G = 15\text{ }\Omega$, $V_{GE} = \pm 15\text{ V}$, $di/dt = 1247\text{ A}/\mu\text{s}$		121		ns
t_r	Current rise time			17		ns
$E_{on}^{(1)}$	Turn-on switching energy			1.08		mJ
$t_{d(off)}$	Turn-off delay time	$V_{CC} = 600\text{ V}$, $I_C = 25\text{ A}$, $R_G = 15\text{ }\Omega$, $V_{GE} = \pm 15\text{ V}$, $dv/dt = 10200\text{ V}/\mu\text{s}$		119		ns
t_f	Current fall time			127		ns
$E_{off}^{(2)}$	Turn-off switching energy			1.12		mJ

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 600\text{ V}$, $I_C = 25\text{ A}$, $R_G = 15\ \Omega$, $V_{GE} = \pm 15\text{ V}$, $di/dt = 1100\text{ A}/\mu\text{s}$, $T_J = 150\text{ }^\circ\text{C}$		121		ns
t_r	Current rise time			18		ns
$E_{on}^{(1)}$	Turn-on switching energy			1.65		mJ
$t_{d(off)}$	Turn-off delay time	$V_{CC} = 600\text{ V}$, $I_C = 25\text{ A}$, $R_G = 15\ \Omega$, $V_{GE} = \pm 15\text{ V}$, $dv/dt = 8300\text{ V}/\mu\text{s}$, $T_J = 150\text{ }^\circ\text{C}$		125		ns
t_f	Current fall time			201		ns
$E_{off}^{(2)}$	Turn-off switching energy			1.66		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			μs
R_{THj-c}	Thermal resistance junction-to-case	Each IGBT		0.69	0.76	$^\circ\text{C}/\text{W}$
R_{THc-h}	Thermal resistance case-to-heatsink	Each IGBT, $\lambda_{grease} = 1\text{ W}/(\text{m} \cdot ^\circ\text{C})$		0.79		$^\circ\text{C}/\text{W}$

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 ($T_C = 100\text{ }^\circ\text{C}$)	25	A
$I_{FP}^{(1)}$	Pulsed forward current ($t_p = 1\text{ ms}$)	50	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.

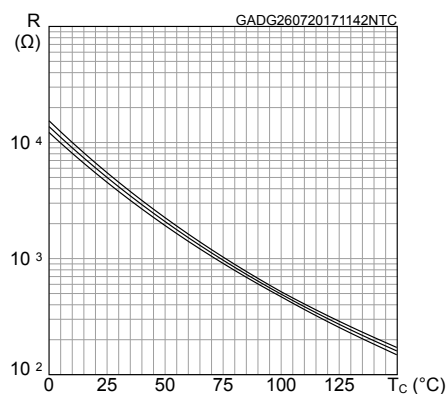
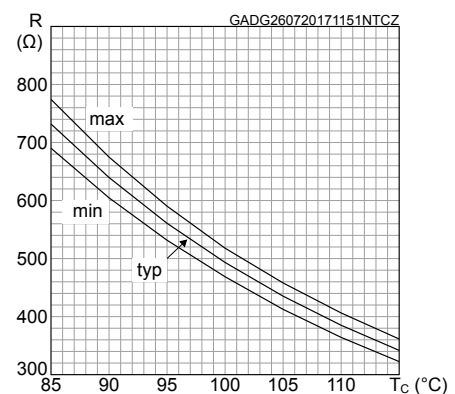
Table 4. Electrical characteristics of the diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_F (terminal)	Forward voltage	$I_F = 25\text{ A}$	-	2.95	4.1	V
		$I_F = 25\text{ A}$, $T_J = 150\text{ °C}$	-	2.3		
t_{rr}	Reverse recovery time	$I_F = 25\text{ A}$, $V_R = 600\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $di/dt = 1247\text{ A}/\mu\text{s}$	-	190		ns
Q_{rr}	Reverse recovery charge		-	1.55		μC
I_{rrm}	Reverse recovery current		-	29		A
E_{rec}	Reverse recovery energy		-	0.71		mJ
t_{rr}	Reverse recovery time	$I_F = 25\text{ A}$, $V_R = 600\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $di/dt = 1100\text{ A}/\mu\text{s}$, $T_J = 150\text{ °C}$	-	400		ns
Q_{rr}	Reverse recovery charge		-	4.0		μC
I_{rrm}	Reverse recovery current		-	37		A
E_{rec}	Reverse recovery energy		-	2.05		mJ
R_{THj-c}	Thermal resistance junction-to-case	Each diode	-	1.05	1.16	$^{\circ}\text{C}/\text{W}$
R_{THc-h}	Thermal resistance case-to-heatsink	Each diode, $\lambda_{grease} = 1\text{ W}/(\text{m}\cdot^{\circ}\text{C})$	-	0.85		$^{\circ}\text{C}/\text{W}$

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 Ω
R_{100}	Resistance	$T = 100\text{ °C}$		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	V
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
($V_{GE} = 15\text{ V}$, terminal)

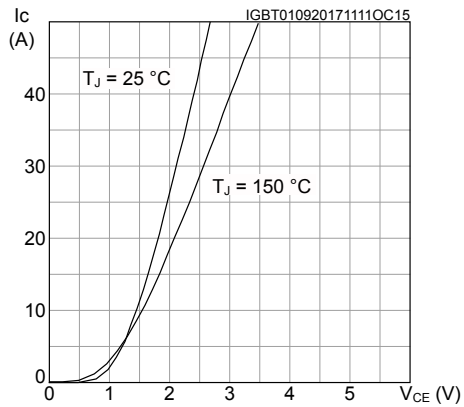


Figure 4. IGBT output characteristics
($T_J = 150\text{ °C}$, terminal)

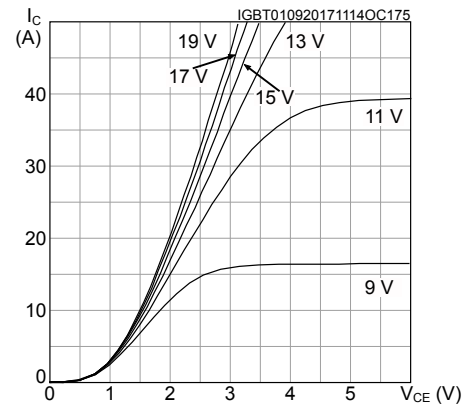


Figure 5. IGBT transfer characteristics
($V_{CE} = 15\text{ V}$, terminal)

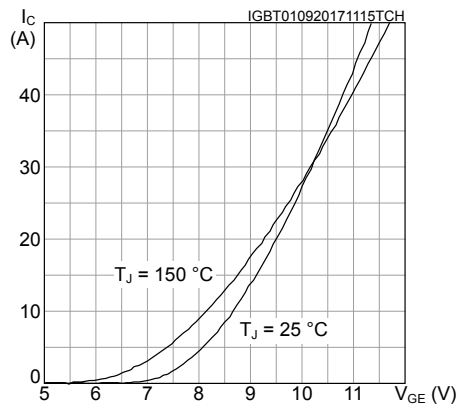


Figure 6. IGBT collector current vs case temperature

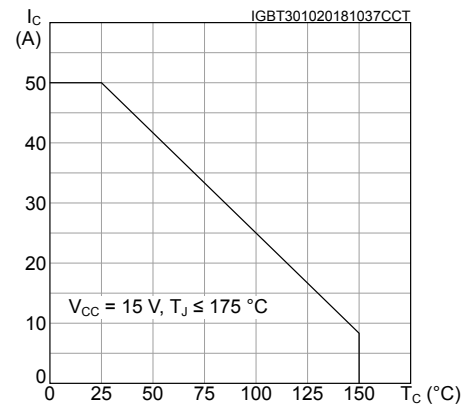


Figure 7. Switching energy vs gate resistance

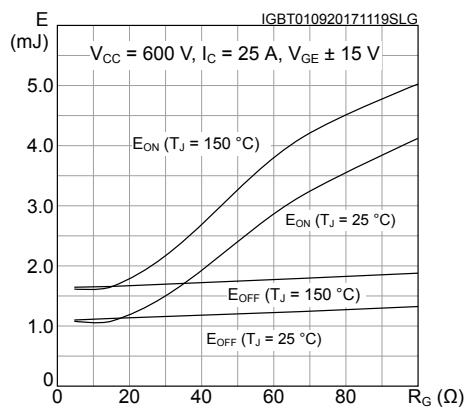


Figure 8. Switching energy vs collector current

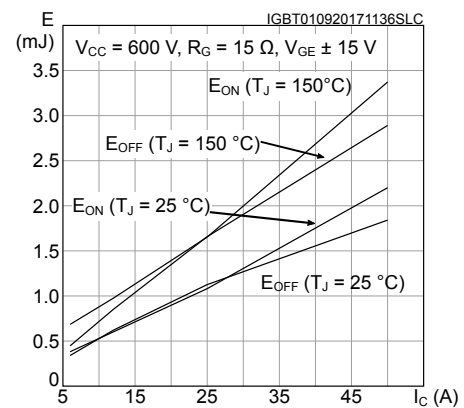


Figure 9. IGBT reverse biased safe operating area (RBSOA)

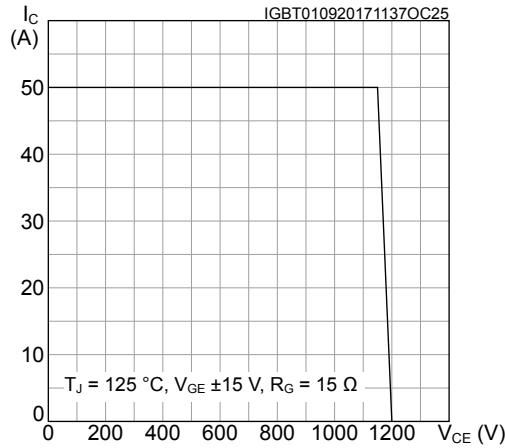


Figure 10. Diode forward characteristics (terminal)

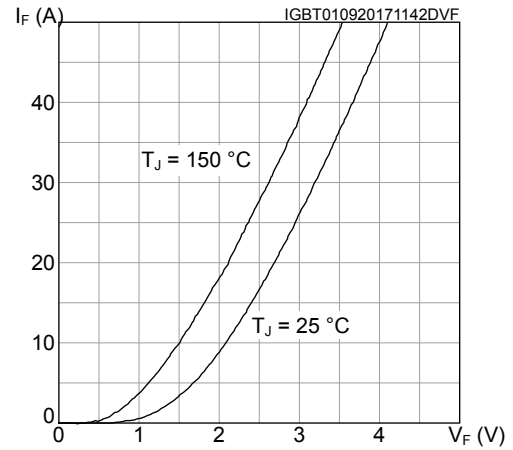


Figure 11. Diode reverse recovery energy vs diode current slope

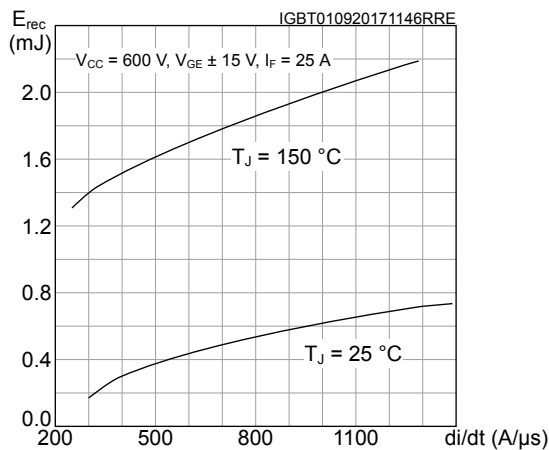


Figure 12. Diode reverse recovery energy vs forward current

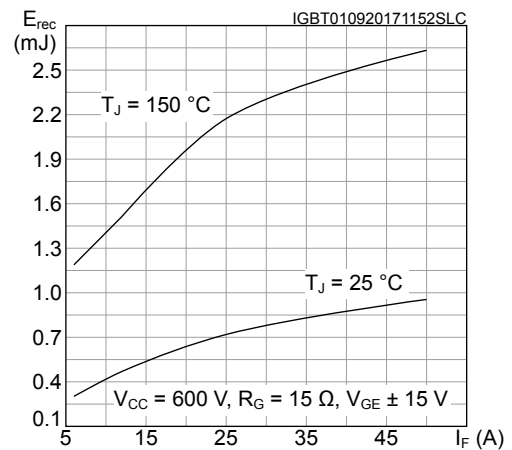


Figure 13. Diode reverse recovery energy vs gate resistance

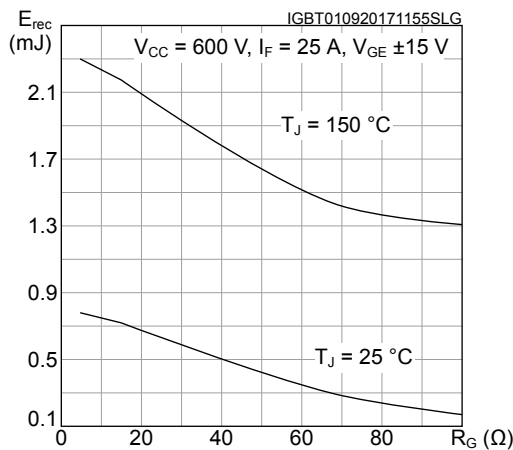


Figure 14. Inverter diode thermal impedance

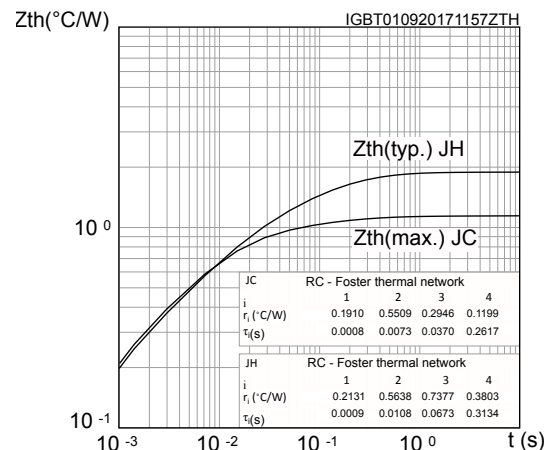
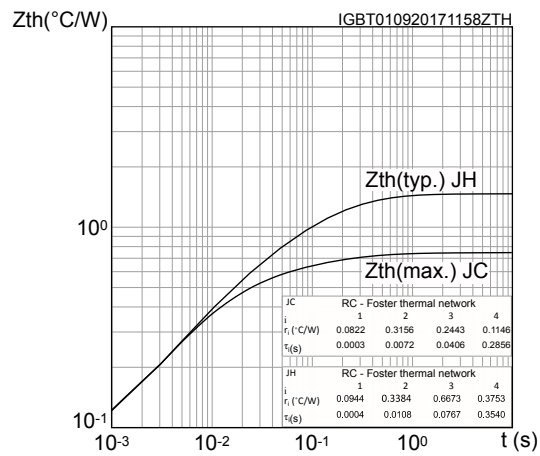


Figure 15. IGBT thermal impedance



3 Topology and pin description

Figure 16. Electrical topology and pin description

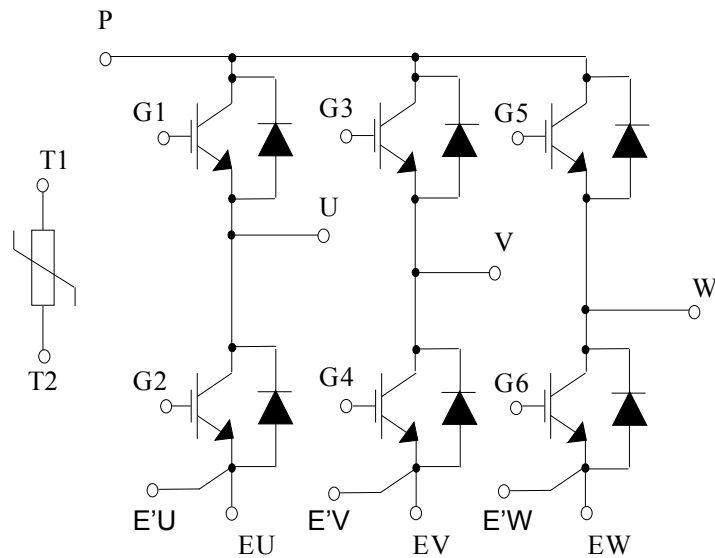
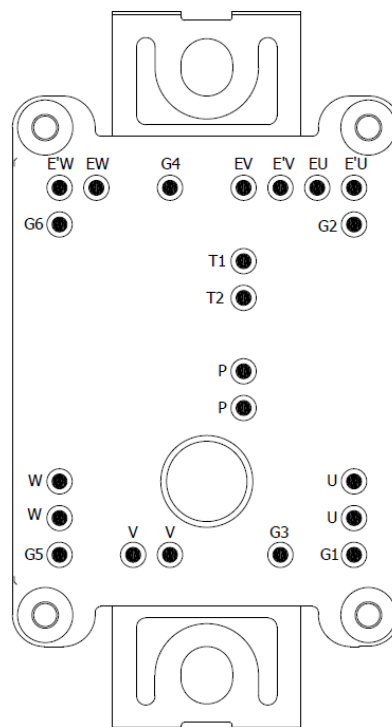
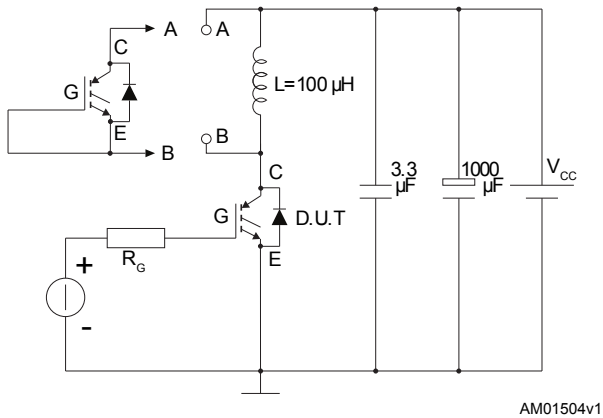
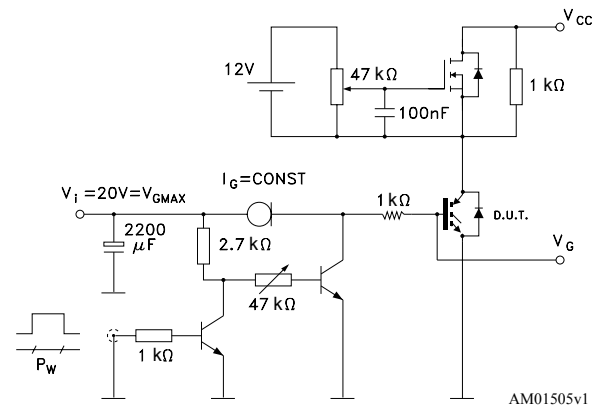
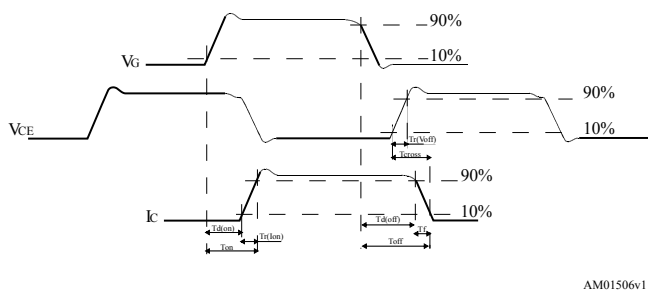
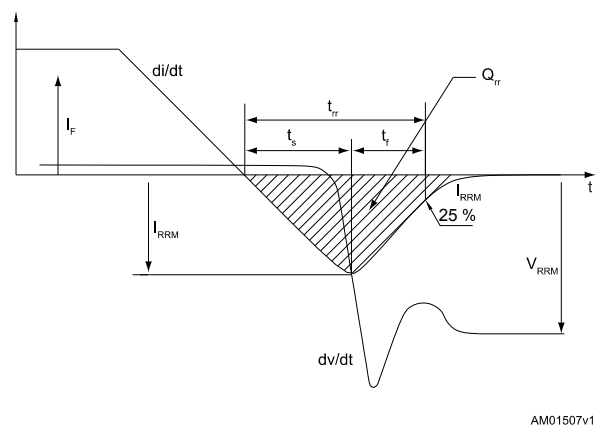


Figure 17. Package top view with sixpack pinout



4 Test circuits

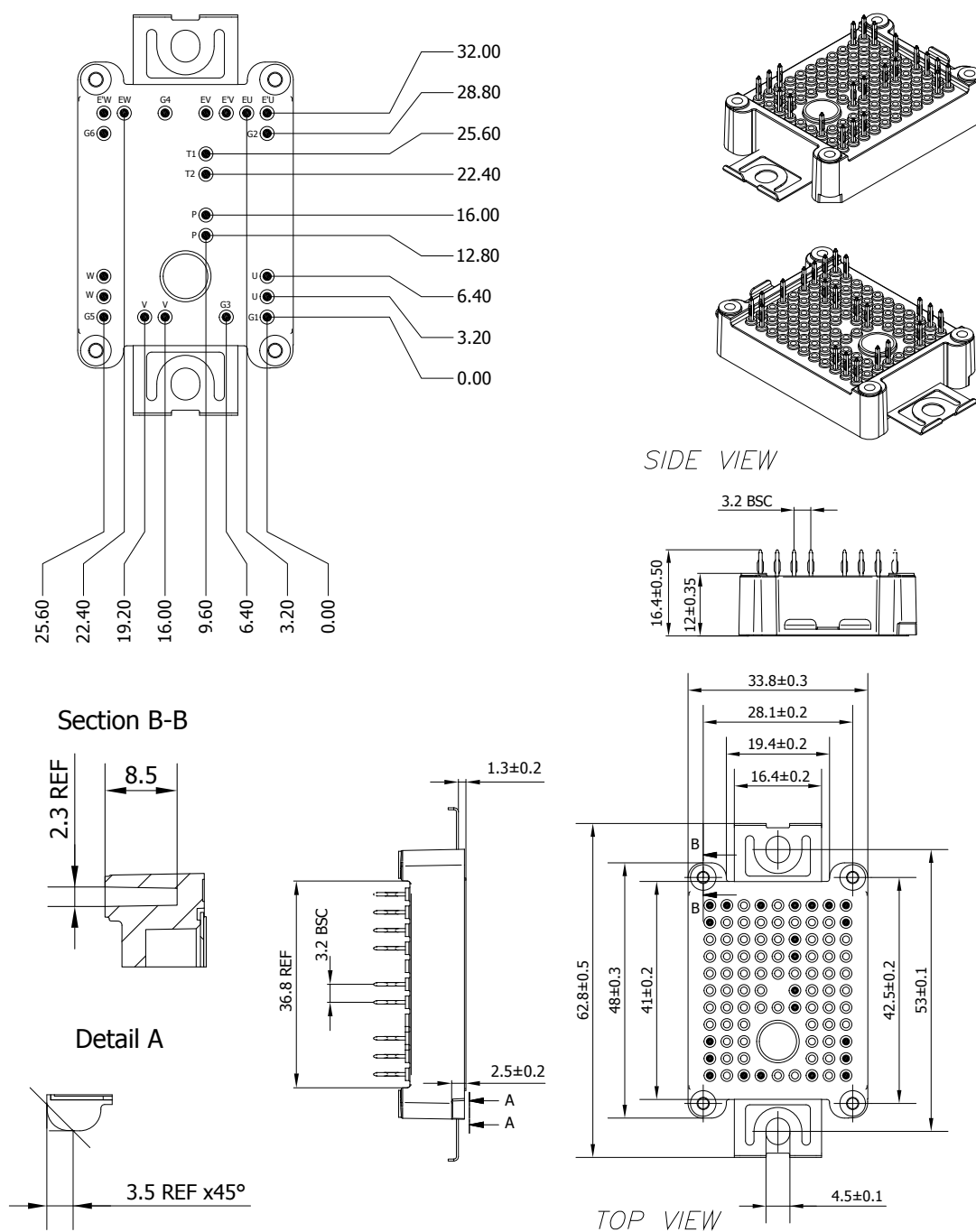
Figure 18. Test circuit for inductive load switching

Figure 19. Gate charge test circuit

Figure 20. Switching waveform

Figure 21. Diode reverse recovery waveform


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

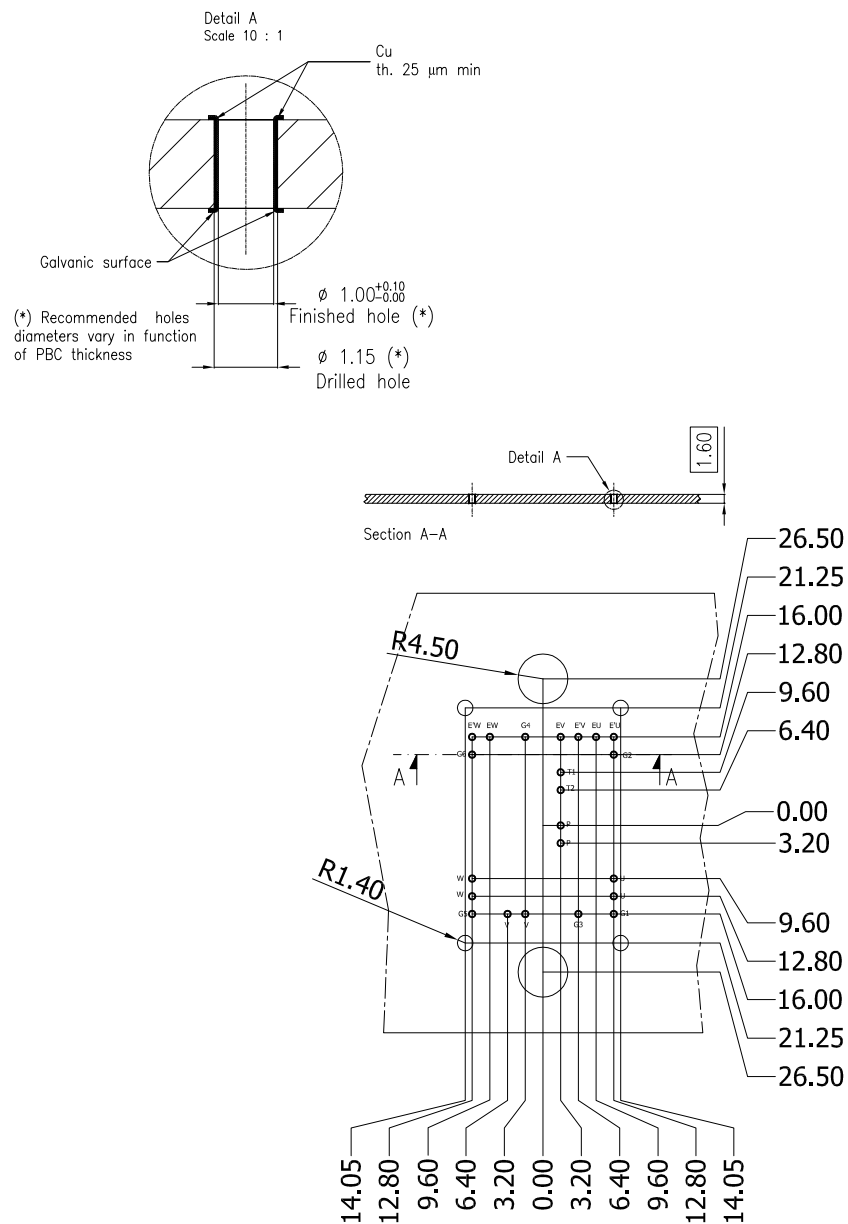
Figure 22. ACEPACK™ 1 sixpack press fit pins package outline (dimensions are in mm)



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	Version	Changes
04-Sep-2017	1	Initial release.
03-Oct-2017	2	Document status promoted from preliminary data to production data. Updated <i>Table 7: "ACEPACK™ 1 package"</i> and <i>Section 2: "Electrical characteristics curves"</i> . Minor text changes.
02-Mar-2018	3	Removed maturity status indication from cover page. Updated <i>Figure 13. Inverter diode thermal impedance</i> and <i>Figure 14. IGBT thermal impedance</i> . Updated <i>Section 5.1 ACEPACK™ 1 sixpack press fit pins package information</i> . Minor text changes.
09-Apr-2018	4	Updated title in cover page. Minor text changes.
14-Nov-2018	5	Added Figure 6. IGBT collector current vs case temperature . Minor text changes

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