



NGW50T65H3DFP

650 V, 50 A trench field-stop IGBT with full rated silicon diode

Rev. 1.1 — 3 March 2025

Product data sheet

1. General description

The NGW50T65H3DFP is a robust Insulated-Gate Bipolar Transistor (IGBT) featuring third-generation technology. It combines carrier stored trench-gate and field-stop (FS) structures. The NGW50T65H3DFP is rated to 175 °C with optimized IGBT turn-off losses,. This hard-switching 650 V, 50 A IGBT is optimized for high-voltage, high-frequency industrial power inverter applications.

2. Features

- Device current is rated at 50 A
- Low conduction and switching losses
- Stable and tight parameters for easy parallel operation
- Maximum junction temperature 175 °C
- Fully rated and fast reverse recovery diode
- HV-H3TRB qualified

3. Applications

- Power inverters such as
 - Uninterruptible Power Supply (UPS) inverter
 - EV charging converter
- Power Factor Correction (PFC)
- Induction heating
- Welding

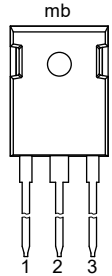
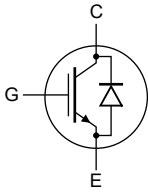
4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CES}	collector-emitter voltage	$T_{vj} = 25\text{ °C}$	-	650	V
T_{vj}	operating junction temperature		-40	175	°C

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate		 aaa-036518
2	C	collector		
3	E	emitter		
mb	C	mounting base; connected to collector		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
NGW50T65H3DFP	TO-247-3L	Plastic single-ended through-hole package; heatsink mounted; 1 mounting hole; 3-lead TO-247-3L	SOT429-2

7. Limiting values

Table 4. Limiting values

Symbol	Parameter	Conditions	Min	Max	Unit
IGBT					
V_{CES}	collector-emitter voltage	$T_{vj} = 25\text{ °C}$	-	650	V
I_C	collector current	[1] $T_c = 25\text{ °C}$	-	80	A
		$T_c = 100\text{ °C}$	-	54	A
I_{CRM}	repetitive peak collector current	[2]	-	200	A
V_{GE}	gate-emitter voltage		-20	20	V
P_{tot}	total power dissipation	$T_c = 25\text{ °C}$	-	340	W
		$T_c = 100\text{ °C}$	-	170	W
T_{vj}	operating junction temperature		-40	175	°C
T_{stg}	storage temperature		-55	150	°C
T_{solder}	soldering temperature		-	260	°C
Diode					
I_F	diode forward current	[1] $T_c = 25\text{ °C}$	-	80	A
		$T_c = 100\text{ °C}$	-	68	A
I_{FRM}	repetitive peak forward current	[2]		200	A

[1] Value is limited by bondwire and $T_{vj(max)}$.
[2] Time duration is limited by $T_{vj(max)}$.

8. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
M	mounting torque, M3 screw		-	0.6	-	Nm
R _{th(j-c)}	thermal resistance from junction to case	IGBT	-	0.37	0.44	K/W
		diode	-	0.52	0.64	K/W
R _{th(j-a)}	thermal resistance from junction to ambient	in free air	-	-	40	K/W

9. Electrical characteristics

Table 6. Characteristics

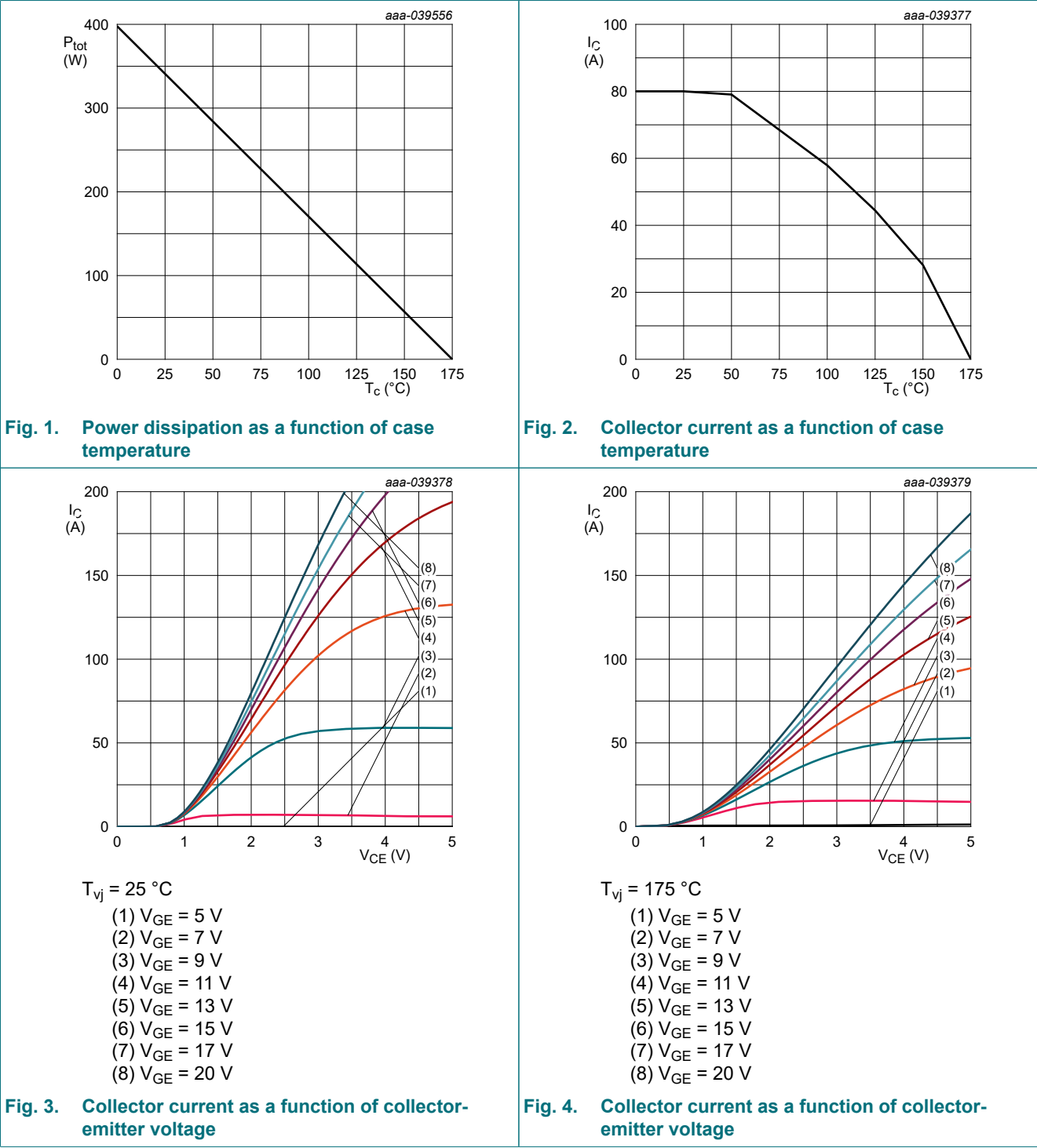
All values at T_{vj} = 25 °C, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
V _{(BR)CES}	collector-emitter breakdown voltage	V _{GE} = 0 V; I _C = 0.2 mA	650	-	-	V
V _{CEsat}	collector-emitter saturation voltage	V _{GE} = 15 V; I _C = 50 A; T _{vj} = 25 °C	-	1.72	2.2	V
		V _{GE} = 15 V; I _C = 50 A; T _{vj} = 175 °C	-	2.25	-	V
V _F	diode forward voltage	V _{GE} = 0 V; I _F = 50 A; T _{vj} = 25 °C	-	1.45	2.1	V
		V _{GE} = 0 V; I _F = 50 A; T _{vj} = 175 °C	-	1.2	-	V
V _{GE(th)}	gate-emitter threshold voltage	I _C = 0.5 mA; V _{CE} = V _{GE} ; T _{vj} = 25 °C	4.3	5	5.7	V
I _{CES}	zero gate voltage collector current	V _{CE} = 650 V; V _{GE} = 0 V; T _{vj} = 25 °C	-	10	-	nA
		V _{CE} = 650 V; V _{GE} = 0 V; T _{vj} = 175 °C	-	0.6	-	mA
I _{GES}	gate-emitter leakage current	V _{CE} = 0 V; V _{GE} = 20 V	-	-	100	nA
g _{fs}	transconductance	V _{CE} = 20 V; I _C = 50 A; T _{vj} = 25 °C	-	28	-	S
r _g	internal gate resistor		-	1.6	-	Ω
Dynamic characteristics						
C _{ies}	input capacitance	V _{CE} = 25 V; V _{GE} = 0 V; f = 1 MHz	-	2210	-	pF
C _{oes}	output capacitance		-	180	-	pF
C _{res}	reverse transfer capacitance		-	16.5	-	pF
Q _G	gate charge	V _{CC} = 520 V; V _{GE} = 15 V; I _C = 50 A	-	85	-	nC
L _{sCE}	internal stray inductance	measured 5 mm from case	-	7.9	-	nH

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
IGBT switching characteristics, inductive load							
t _{d(on)}	turn-on delay time	V _{GE} = 15 V to 0 V; V _{CC} = 400 V; I _C = 50 A; R _{G(on)} = 10 Ω; R _{G(off)} = 10 Ω; see Fig. 27 and Fig. 28	T _{vj} = 25 °C	-	20	-	ns
			T _{vj} = 175 °C	-	20	-	ns
t _r	rise time		T _{vj} = 25 °C	-	36	-	ns
			T _{vj} = 175 °C	-	36	-	ns
t _{d(off)}	turn-off delay time		T _{vj} = 25 °C	-	98	-	ns
			T _{vj} = 175 °C	-	125	-	ns
t _f	fall time		T _{vj} = 25 °C	-	32	-	ns
			T _{vj} = 175 °C	-	36	-	ns
E _{on}	turn-on switching energy loss		T _{vj} = 25 °C	-	1.70	-	mJ
			T _{vj} = 175 °C	-	3.52	-	mJ
E _{off}	turn-off switching energy loss		T _{vj} = 25 °C	-	0.50	-	mJ
			T _{vj} = 175 °C	-	0.76	-	mJ
E _{ts}	total switching energy loss		T _{vj} = 25 °C	-	2.20	-	mJ
			T _{vj} = 175 °C	-	4.28	-	mJ
Diode switching characteristics, inductive load							
t _{rr}	reverse recovery time	V _R = 400 V; I _F = 50 A; di _F /dt = 500 A/μs; see Fig. 26	T _{vj} = 25 °C	-	145	-	ns
			T _{vj} = 175 °C	-	260	-	ns
Q _{rr}	reverse recovery charge		T _{vj} = 25 °C	-	1170	-	nC
			T _{vj} = 175 °C	-	5370	-	nC
I _{rrm}	peak reverse recovery current		T _{vj} = 25 °C	-	20	-	A
			T _{vj} = 175 °C	-	37	-	A
E _{rec}	reverse recovery energy loss		T _{vj} = 25 °C	-	0.12	-	mJ
			T _{vj} = 175 °C	-	0.65	-	mJ
di _{rrf} /dt	fall rate of reverse recovery current		T _{vj} = 25 °C	-	160	-	A/μs
			T _{vj} = 175 °C	-	185	-	A/μs

9.1. Characteristic diagrams

Table 7. Waveforms and output characteristics



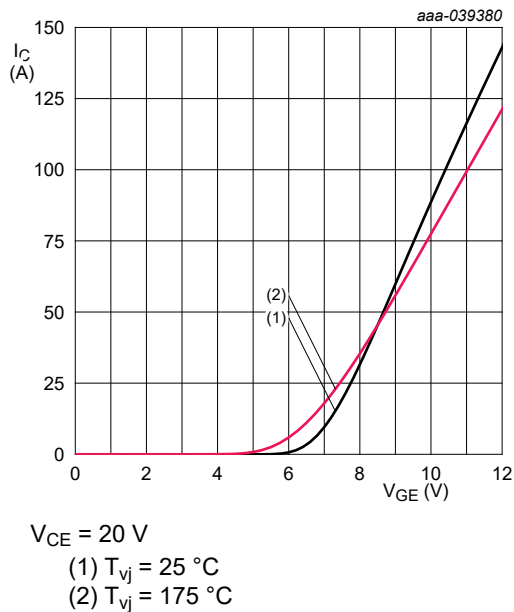


Fig. 5. Collector current as a function of gate-emitter voltage

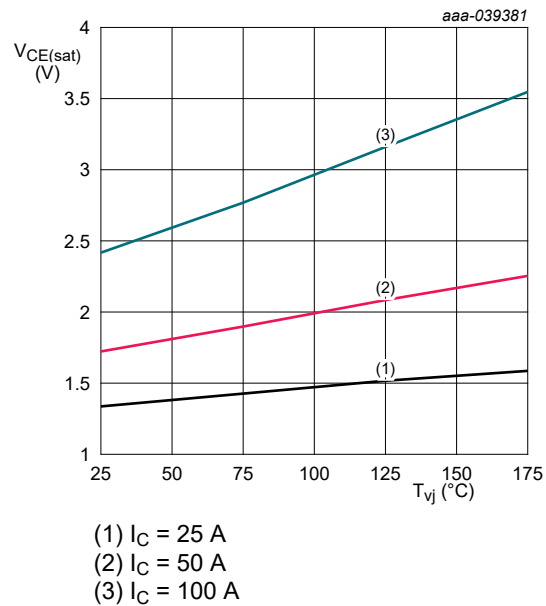


Fig. 6. Collector-emitter saturation voltage as a function of junction temperature

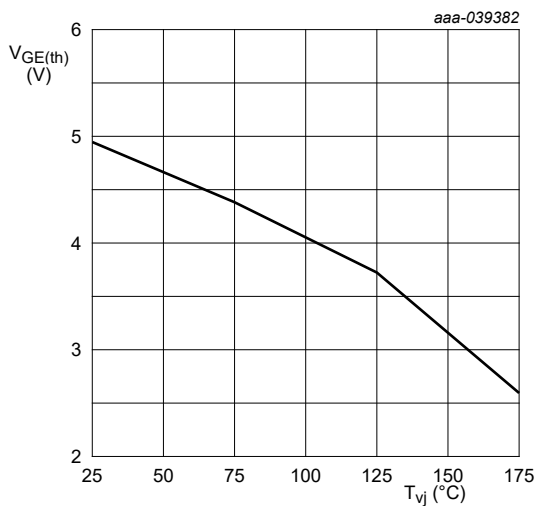


Fig. 7. Gate-emitter threshold voltage as a function of junction temperature

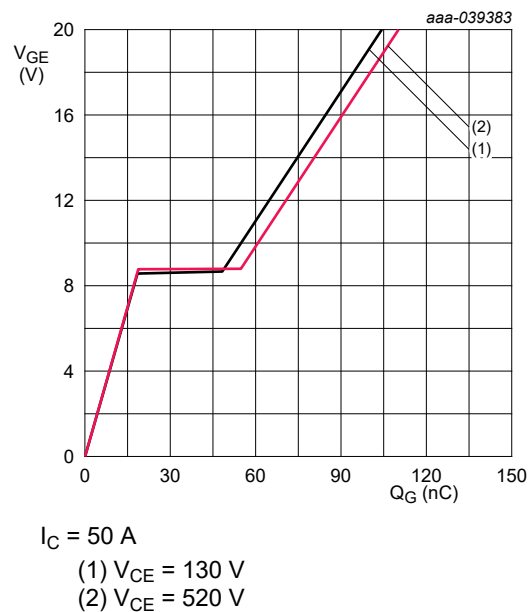
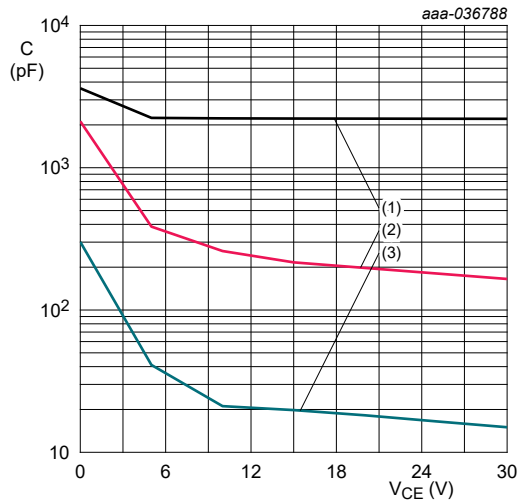


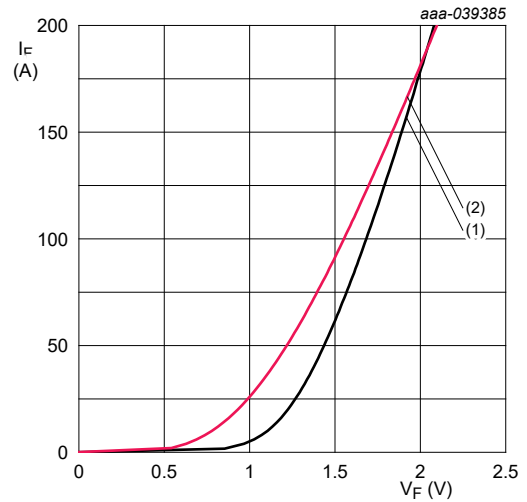
Fig. 8. Gate-emitter voltage as a function of gate charge



$V_{GE} = 0 \text{ V}$; $f = 1 \text{ MHz}$

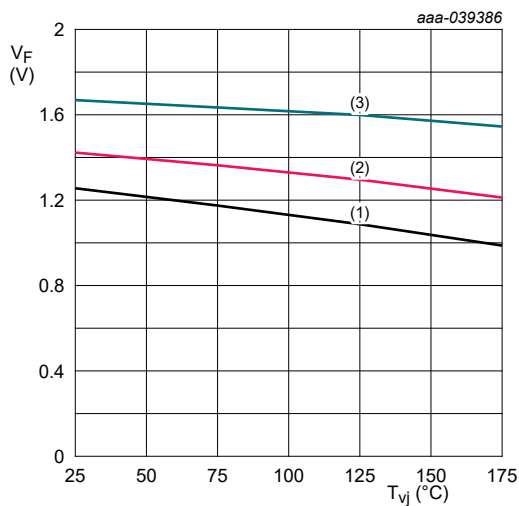
- (1) C_{ies}
- (2) C_{oes}
- (3) C_{res}

Fig. 9. Typical capacitance as a function of collector-emitter voltage



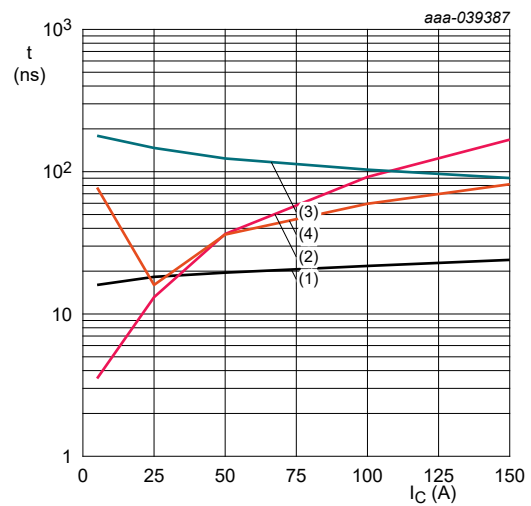
- (1) $T_{vj} = 25 \text{ °C}$
- (2) $T_{vj} = 175 \text{ °C}$

Fig. 10. Typical diode forward current as a function of forward voltage



- (1) $I_F = 25 \text{ A}$
- (2) $I_F = 50 \text{ A}$
- (3) $I_F = 100 \text{ A}$

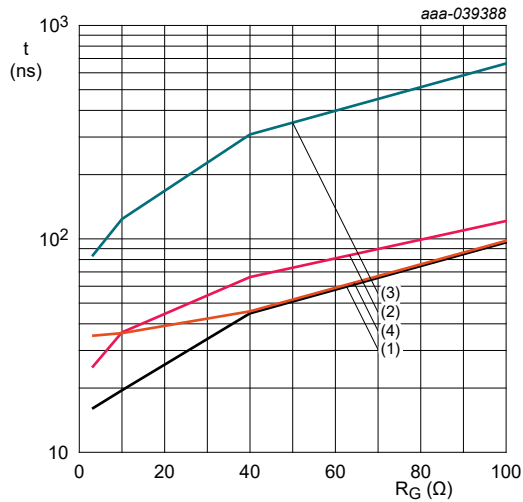
Fig. 11. Typical diode forward voltage as a function of junction temperature



$V_{GE} = 15 \text{ V to } 0 \text{ V}$; $V_{CC} = 400 \text{ V}$; $R_{G(on)} = 10 \text{ } \Omega$;
 $R_{G(off)} = 10 \text{ } \Omega$

- (1) $t_{d(on)}$
- (2) t_r
- (3) $t_{d(off)}$
- (4) t_f

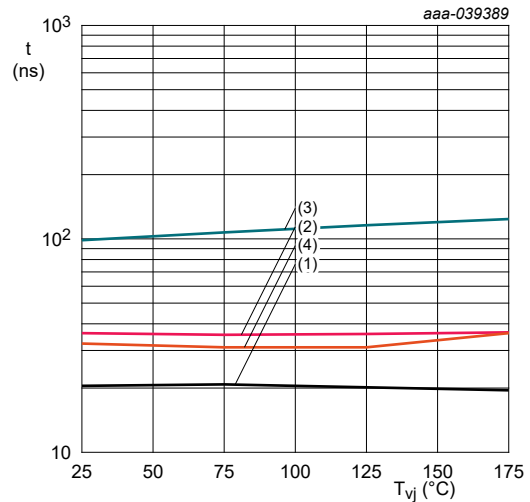
Fig. 12. Typical switching times as a function of collector current



$V_{GE} = 15 \text{ V to } 0 \text{ V}$; $V_{CC} = 400 \text{ V}$; $I_C = 50 \text{ A}$;
 $T_{vj} = 175 \text{ }^\circ\text{C}$

- (1) $t_{d(on)}$
- (2) t_r
- (3) $t_{d(off)}$
- (4) t_f

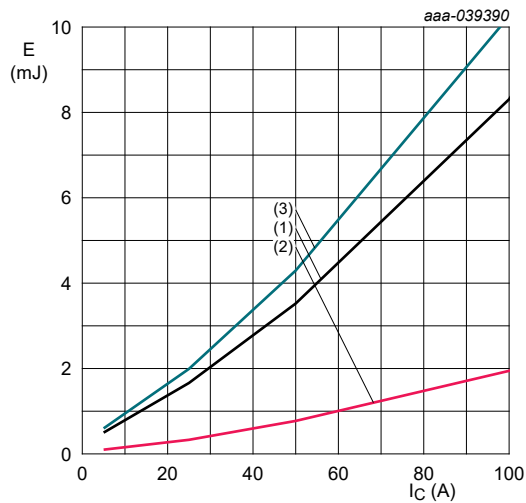
Fig. 13. Typical switching times as a function of gate resistance



$V_{GE} = 15 \text{ V to } 0 \text{ V}$; $I_C = 50 \text{ A}$; $V_{CC} = 400 \text{ V}$;
 $R_{G(on)} = 10 \text{ } \Omega$; $R_{G(off)} = 10 \text{ } \Omega$

- (1) $t_{d(on)}$
- (2) t_r
- (3) $t_{d(off)}$
- (4) t_f

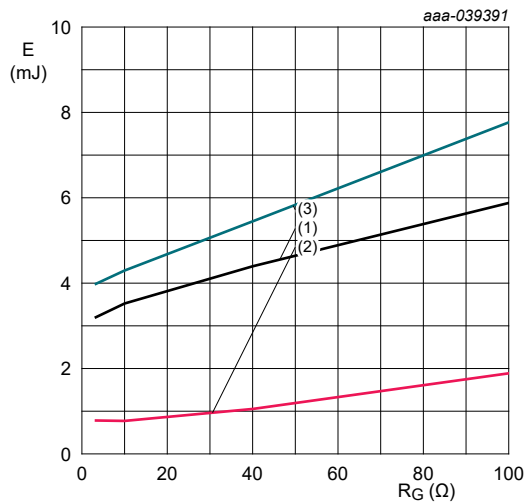
Fig. 14. Typical switching times as a function of junction temperature



$V_{GE} = 15 \text{ V to } 0 \text{ V}$; $V_{CC} = 400 \text{ V}$; $R_{G(on)} = 10 \text{ } \Omega$;
 $R_{G(off)} = 10 \text{ } \Omega$; $T_{vj} = 175 \text{ }^\circ\text{C}$

- (1) E_{on}
- (2) E_{off}
- (3) E_{ts}

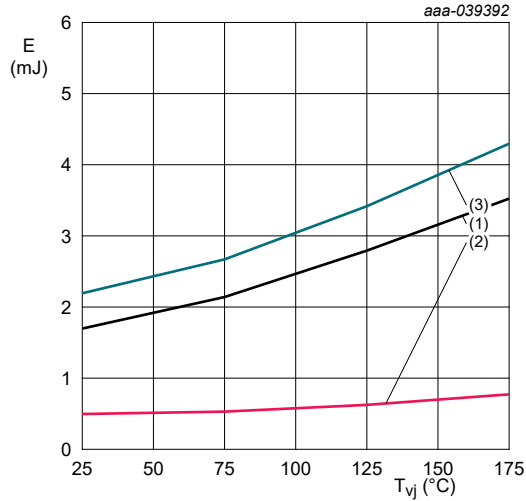
Fig. 15. Typical switching energy losses as a function of collector current



$V_{GE} = 15 \text{ V to } 0 \text{ V}$; $V_{CC} = 400 \text{ V}$; $I_C = 50 \text{ A}$;
 $T_{vj} = 175 \text{ }^\circ\text{C}$

- (1) E_{on}
- (2) E_{off}
- (3) E_{ts}

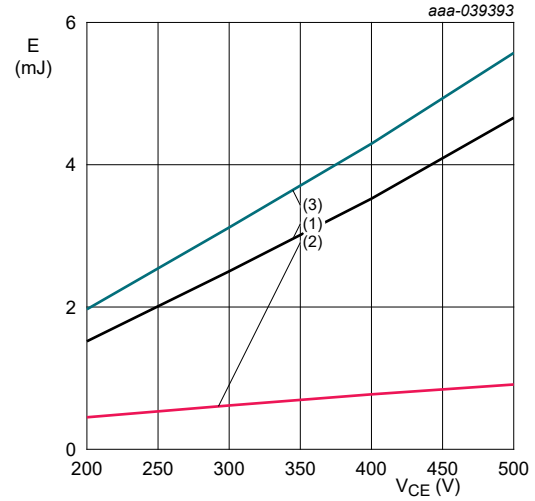
Fig. 16. Typical switching energy losses as a function of gate resistance



$V_{GE} = 15 \text{ V to } 0 \text{ V}$; $I_C = 50 \text{ A}$; $V_{CC} = 400 \text{ V}$;
 $R_{G(on)} = 10 \Omega$; $R_{G(off)} = 10 \Omega$

- (1) E_{on}
- (2) E_{off}
- (3) E_{ts}

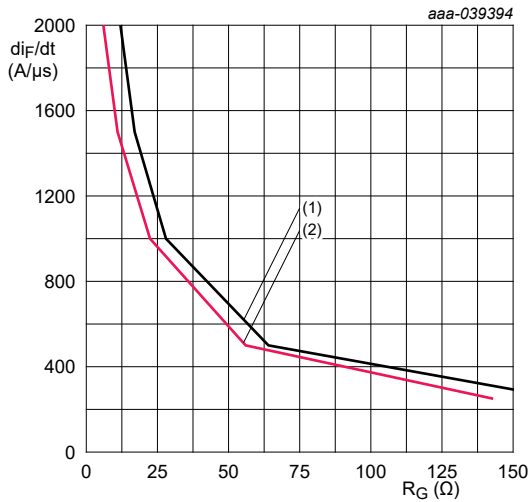
Fig. 17. Typical switching energy losses as a function of junction temperature



$V_{GE} = 15 \text{ V to } 0 \text{ V}$; $I_C = 50 \text{ A}$; $R_{G(on)} = 10 \Omega$;
 $R_{G(off)} = 10 \Omega$; $T_{vj} = 175 \text{ °C}$

- (1) E_{on}
- (2) E_{off}
- (3) E_{ts}

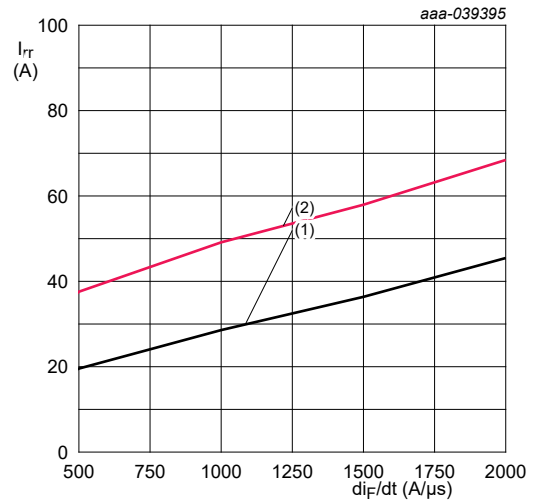
Fig. 18. Typical switching energy losses as a function of collector-emitter voltage



$V_R = 400 \text{ V}$; $I_F = 50 \text{ A}$

- (1) $T_{vj} = 25 \text{ °C}$
- (2) $T_{vj} = 175 \text{ °C}$

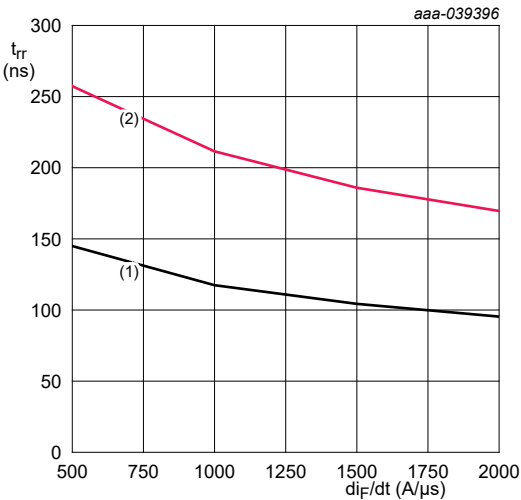
Fig. 19. Typical rate of change of forward current as a function of gate resistance



$V_R = 400 \text{ V}$; $I_F = 50 \text{ A}$

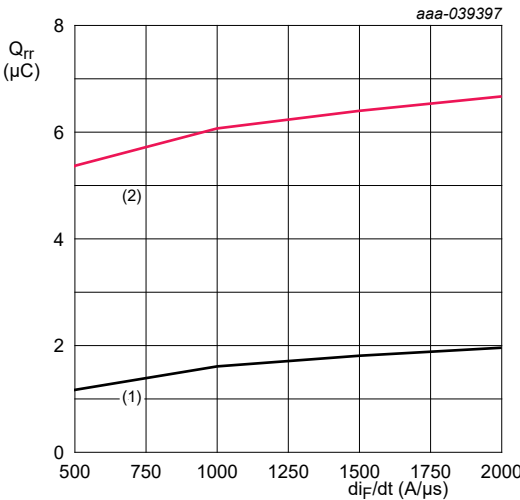
- (1) $T_{vj} = 25 \text{ °C}$
- (2) $T_{vj} = 175 \text{ °C}$

Fig. 20. Typical reverse recovery current as a function of rate of change of forward current



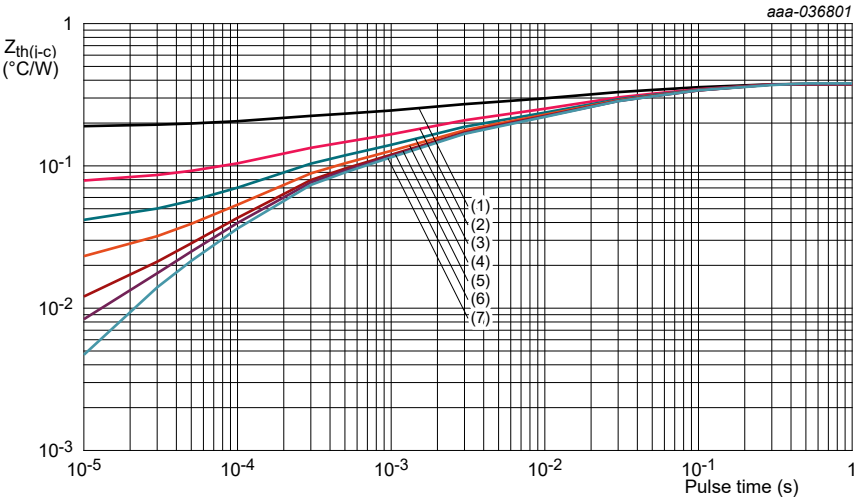
$V_R = 400\text{ V}; I_F = 50\text{ A}$
(1) $T_{vj} = 25\text{ °C}$
(2) $T_{vj} = 175\text{ °C}$

Fig. 21. Typical reverse recovery time as a function of rate of change of forward current



$V_R = 400\text{ V}; I_F = 50\text{ A}$
(1) $T_{vj} = 25\text{ °C}$
(2) $T_{vj} = 175\text{ °C}$

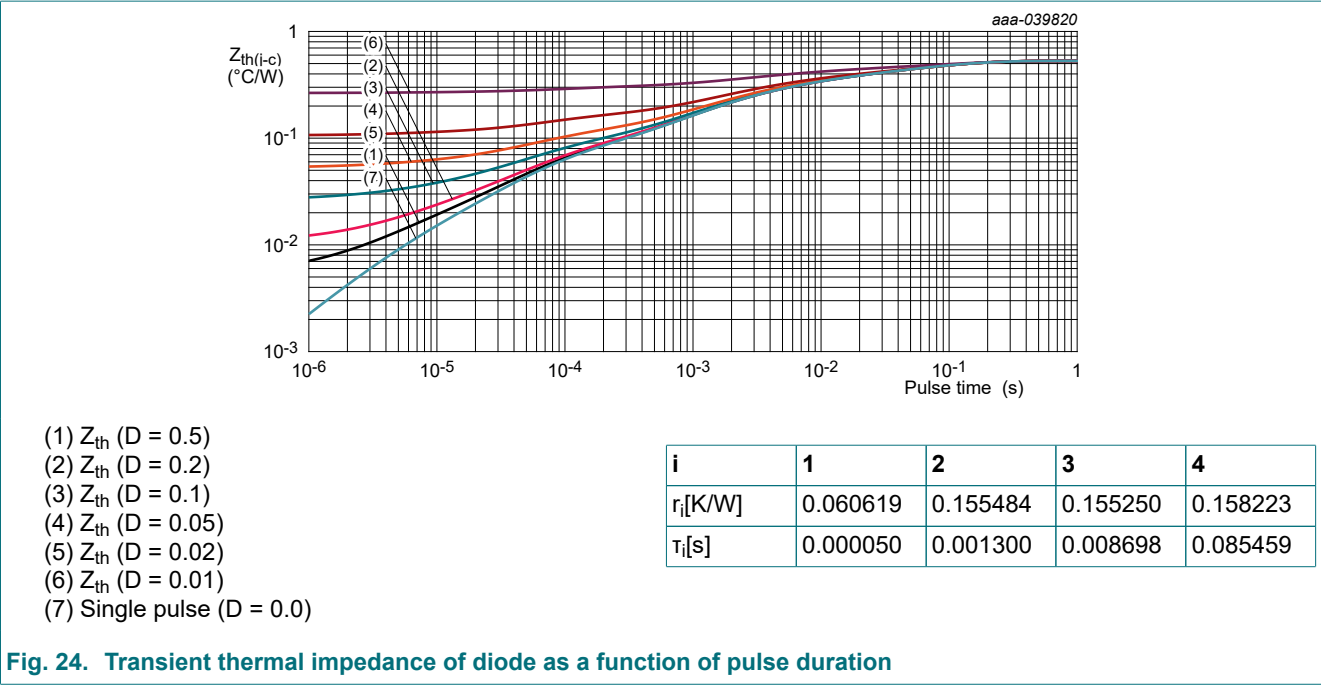
Fig. 22. Typical reverse recovery charge as a function of rate of change of forward current



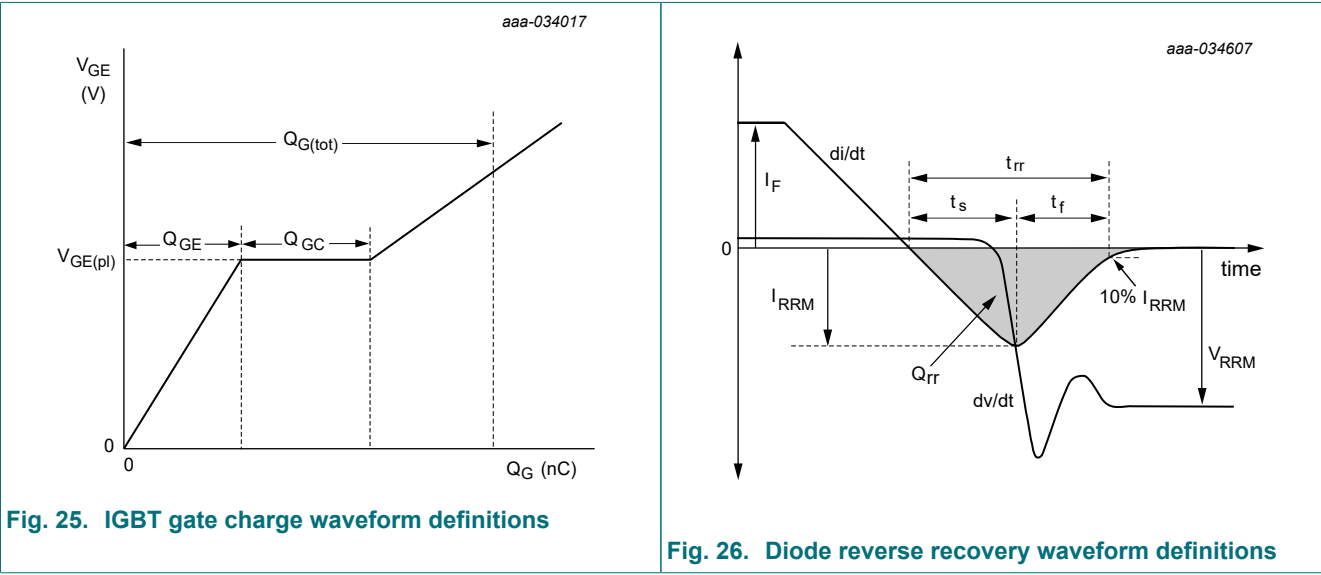
- (1) Z_{th} ($D = 0.5$)
- (2) Z_{th} ($D = 0.2$)
- (3) Z_{th} ($D = 0.1$)
- (4) Z_{th} ($D = 0.05$)
- (5) Z_{th} ($D = 0.02$)
- (6) Z_{th} ($D = 0.01$)
- (7) Single pulse ($D = 0.0$)

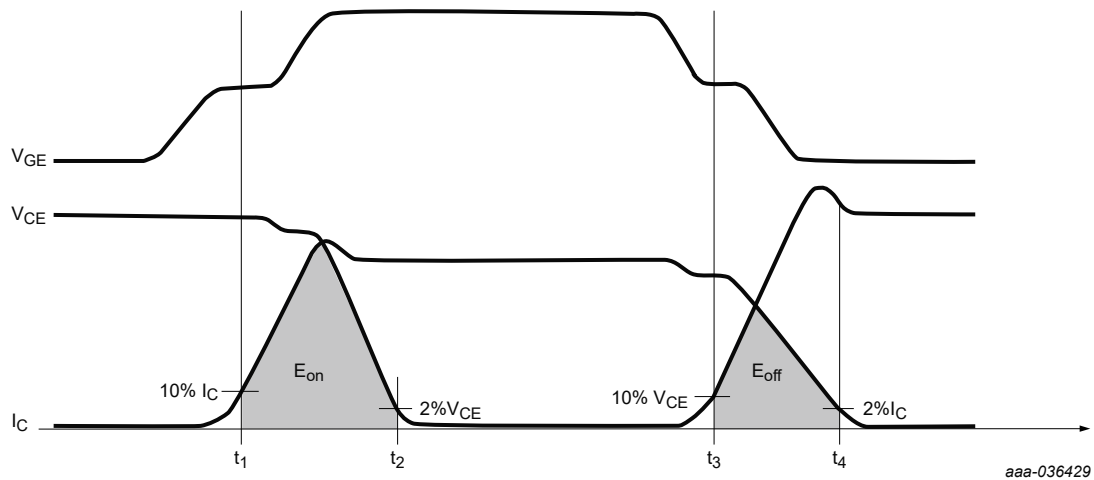
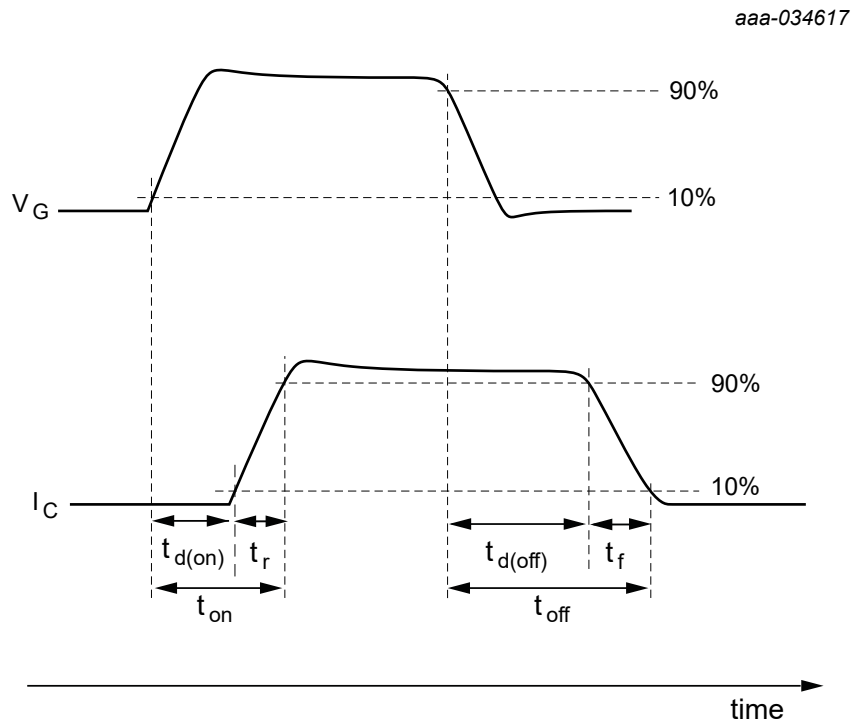
i	1	2	3	4
r_i [K/W]	0.055995	0.084465	0.107529	0.127726
τ_i [s]	0.000141	0.001220	0.010526	0.080745

Fig. 23. Transient thermal impedance of IGBT as a function of pulse duration



9.2. Waveform definitions





10. Package outline

Plastic single-ended through-hole package; heatsink mounted; 1 mounting hole; 3-lead TO-247-3L SOT429-2

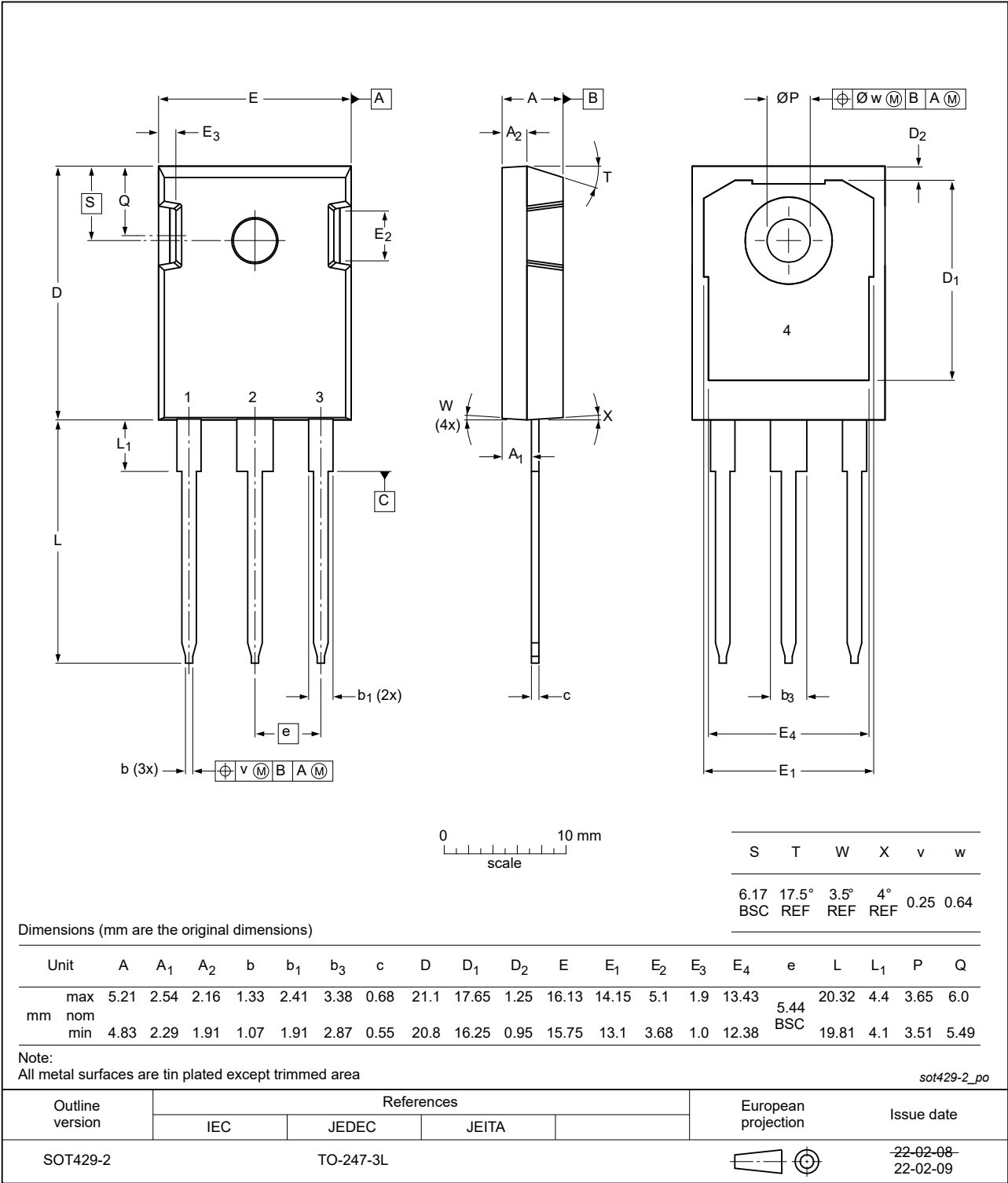


Fig. 29. Package outline TO-247-3L (SOT429-2)

11. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NGW50T65H3DFP v. 1.1	20250303	Preliminary data sheet	-	-
Modifications	• Naming conventions and brought into alignment with other datasheets.			
NGW50T65H3DFP v. 1	20240628	Preliminary data sheet	-	-

12. Legal information

Data sheet status

Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

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- [2] The term 'short data sheet' is explained in section "Definitions".
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