



NGW40T65H3DHP

650 V, 40 A trench field-stop IGBT with half rated silicon diode

Rev. 2 — 11 November 2025

Product data sheet

1. General description

The NGW40T65H3DHP is a robust Insulated-Gate Bipolar Transistor (IGBT) featuring third-generation technology. It combines carrier stored trench-gate and field-stop (FS) structures. The NGW40T65H3DHP is rated to 175 °C with optimized IGBT turn-off losses. This hard-switching 650 V, 40 A IGBT is optimized for high-voltage, high-frequency industrial power inverter applications.

2. Features

- IGBT collector current is rated at 40 A, diode forward current is rated at 20 A
- Low conduction and switching losses
- Stable and tight parameters for easy parallel operation
- Maximum junction temperature 175 °C
- Half 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

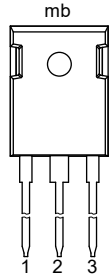
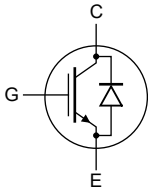
4. Quick reference data

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
NGW40T65H3DHP	TO-247-3	Plastic single-ended through-hole package; heatsink mounted; 1 mounting hole; 3-lead TO-247-3	SOT429-5

7. Marking

Table 4. Marking codes

Type number	Marking code
NGW40T65H3DHP	W40T65H3DHP

8. Limiting values

Table 5. 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] $T_c = 25\text{ °C}$	-	72	A
		$T_c = 100\text{ °C}$	-	47	A
I_{CRM}	repetitive peak collector current	[2]	-	160	A
V_{GE}	gate-emitter voltage		-20	20	V
P_{tot}	total power dissipation	$T_c = 25\text{ °C}$	-	275	W
		$T_c = 100\text{ °C}$	-	138	W
T_{vj}	operating junction temperature		-40	175	°C
T_{stg}	storage temperature		-55	150	°C
T_{solder}	soldering temperature		-	260	°C

Symbol	Parameter	Conditions	Min	Max	Unit
Diode					
I _F	diode forward current	[1] T _C = 25 °C	-	36	A
		T _C = 100 °C	-	21	A
I _{FRM}	repetitive peak forward current	[2]	-	80	A

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

9. Thermal characteristics

Table 6. 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	-	0.46	0.54	K/W
		diode	-	1.71	2.02	K/W
R _{th(j-a)}	thermal resistance from junction to ambient	in free air	-	-	40	K/W

10. Electrical characteristics

Table 7. Characteristics

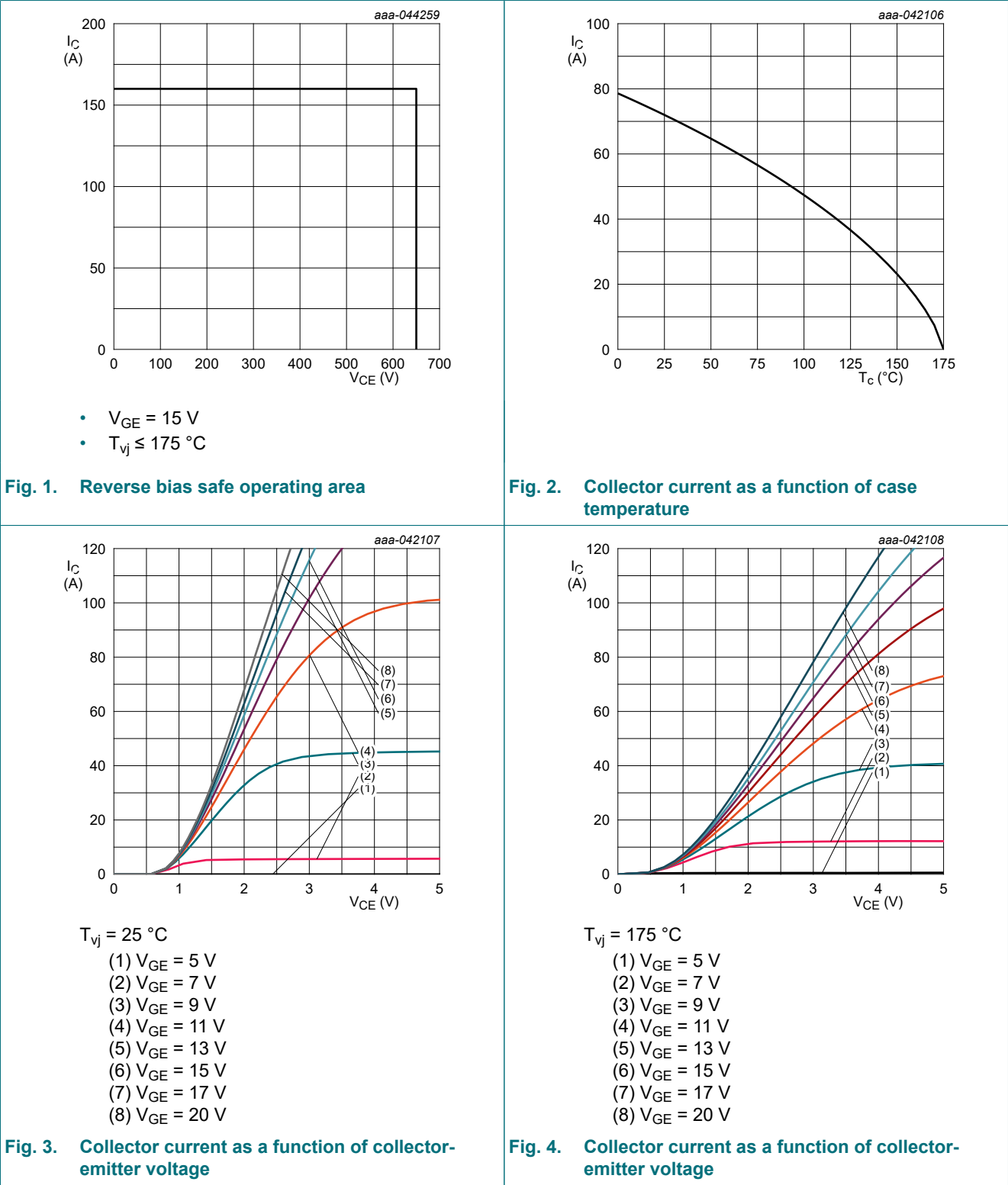
All values at T_{vj} = 25 °C, unless otherwise specified.

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 = 40 A; T _{vj} = 25 °C	-	1.69	2.0	V
		V _{GE} = 15 V; I _C = 40 A; T _{vj} = 175 °C	-	2.22	-	V
V _F	diode forward voltage	V _{GE} = 0 V; I _F = 20 A; T _{vj} = 25 °C	-	1.69	2.0	V
		V _{GE} = 0 V; I _F = 20 A; T _{vj} = 175 °C	-	1.43	-	V
V _{GE(th)}	gate-emitter threshold voltage	I _C = 0.4 mA; V _{CE} = V _{GE} ; T _{vj} = 25 °C	4.3	5.0	5.7	V
I _{CES}	zero gate voltage collector current	V _{CE} = 650 V; V _{GE} = 0 V; T _{vj} = 25 °C	-	-	30	µA
		V _{CE} = 650 V; V _{GE} = 0 V; T _{vj} = 175 °C	-	0.3	-	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 = 40 A; T _{vj} = 25 °C	-	23.2	-	S
r _g	internal gate resistor		-	2.1	-	Ω
Dynamic characteristics						
C _{ies}	input capacitance	V _{CE} = 25 V; V _{GE} = 0 V; f = 1 MHz	-	1760	-	pF
C _{oes}	output capacitance		-	100	-	pF
C _{res}	reverse transfer capacitance		-	15	-	pF
Q _G	gate charge	V _{CC} = 520 V; V _{GE} = 15 V; I _C = 40 A	-	61	-	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} = 15/0 V; V _{CC} = 400 V; I _C = 40 A; R _{G(on)} = 10 Ω; R _{G(off)} = 10 Ω; see Fig. 27 .	T _{vj} = 25 °C	-	17	-	ns
			T _{vj} = 175 °C	-	16	-	ns
t _r	rise time		T _{vj} = 25 °C	-	28	-	ns
			T _{vj} = 175 °C	-	31	-	ns
t _{d(off)}	turn-off delay time		T _{vj} = 25 °C	-	76	-	ns
			T _{vj} = 175 °C	-	96	-	ns
t _f	fall time		T _{vj} = 25 °C	-	27	-	ns
			T _{vj} = 175 °C	-	38	-	ns
E _{on}	turn-on switching energy loss		T _{vj} = 25 °C	-	1.02	-	mJ
			T _{vj} = 175 °C	-	1.80	-	mJ
E _{off}	turn-off switching energy loss		T _{vj} = 25 °C	-	0.34	-	mJ
			T _{vj} = 175 °C	-	0.60	-	mJ
E _{ts}	total switching energy loss		T _{vj} = 25 °C	-	1.36	-	mJ
			T _{vj} = 175 °C	-	2.40	-	mJ
Diode switching characteristics, inductive load							
t _{rr}	reverse recovery time	V _R = 400 V; I _F = 20 A; di _F /dt = 500 A/μs; see Fig. 26 .	T _{vj} = 25 °C	-	96	-	ns
			T _{vj} = 175 °C	-	191	-	ns
Q _{rr}	reverse recovery charge		T _{vj} = 25 °C	-	550	-	nC
			T _{vj} = 175 °C	-	1863	-	nC
I _{rrm}	peak reverse recovery current		T _{vj} = 25 °C	-	14	-	A
			T _{vj} = 175 °C	-	25	-	A
E _{rec}	reverse recovery energy loss		T _{vj} = 25 °C	-	0.07	-	mJ
			T _{vj} = 175 °C	-	0.31	-	mJ
di _{rrf} /dt	fall rate of reverse recovery current		T _{vj} = 25 °C	-	276	-	A/μs
			T _{vj} = 175 °C	-	217	-	A/μs

10.1. Characteristic diagrams

Table 8. Waveforms and output characteristics



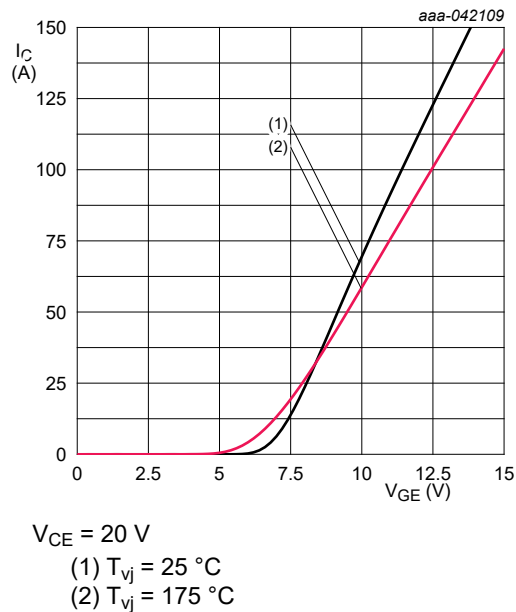


Fig. 5. Collector current as a function of gate-emitter voltage

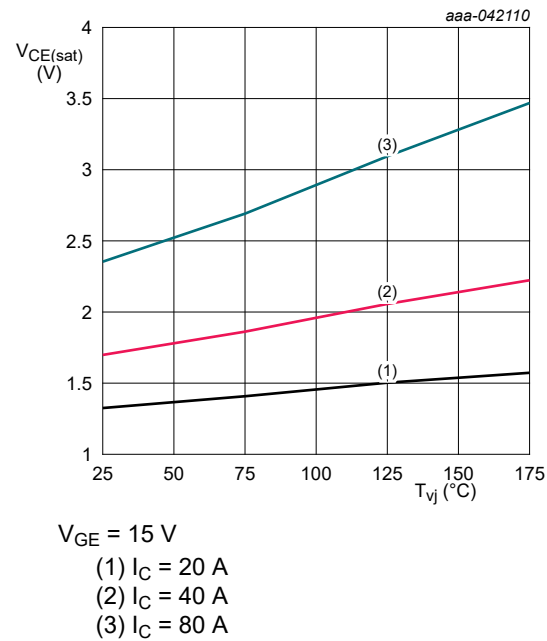


Fig. 6. Collector-emitter saturation voltage as a function of junction temperature

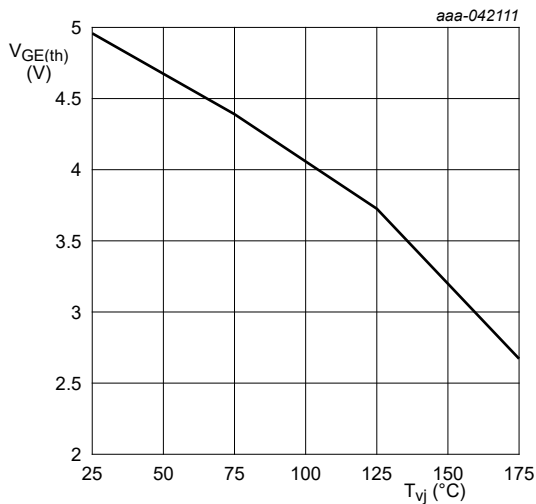


Fig. 7. Gate-emitter threshold voltage as a function of junction temperature

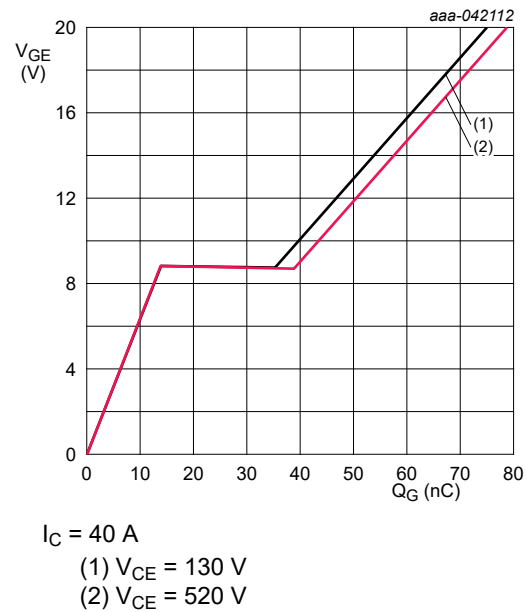
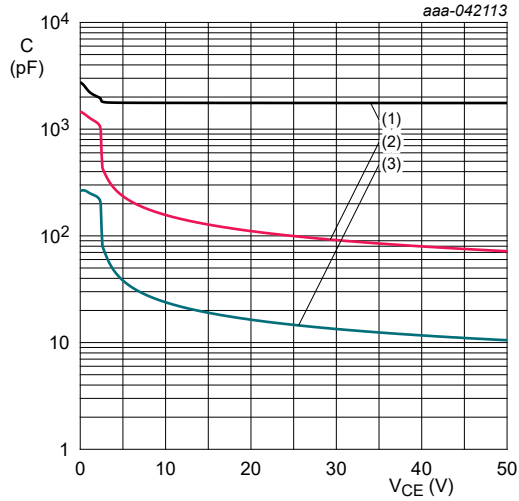


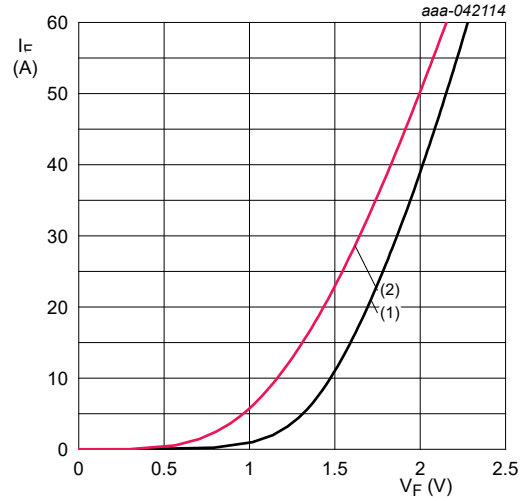
Fig. 8. Gate-emitter voltage as a function of gate charge



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

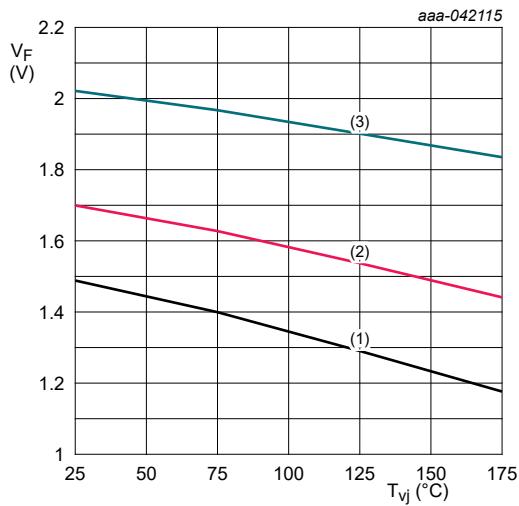
- (1) C_{ies}
- (2) C_{oes}
- (3) C_{res}

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



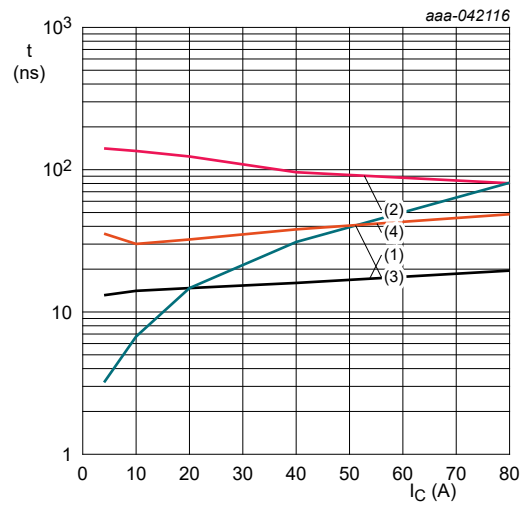
- (1) $T_{vj} = 25 \text{ °C}$
- (2) $T_{vj} = 175 \text{ °C}$

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



- (1) $I_F = 10 \text{ A}$
- (2) $I_F = 20 \text{ A}$
- (3) $I_F = 40 \text{ A}$

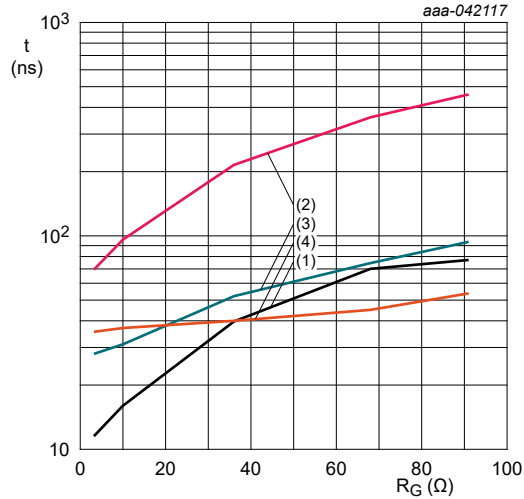
Fig. 11. Typical diode forward voltage as a function of junction temperature



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

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

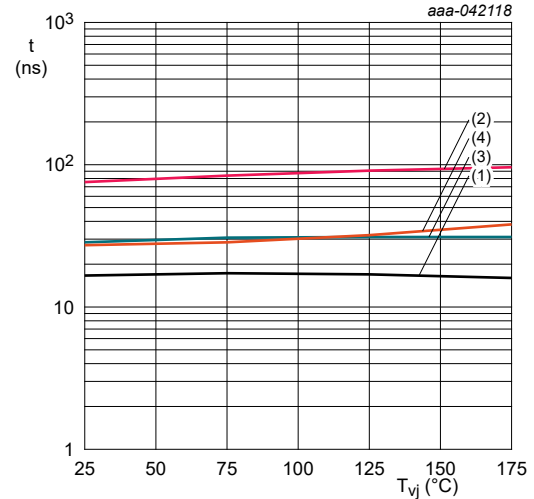
Fig. 12. Typical switching times as a function of collector current



$V_{GE} = 15 \text{ V to } 0 \text{ V}; V_{CC} = 400 \text{ V}; I_C = 40 \text{ A};$
 $T_{vj} = 175 \text{ }^\circ\text{C}$

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

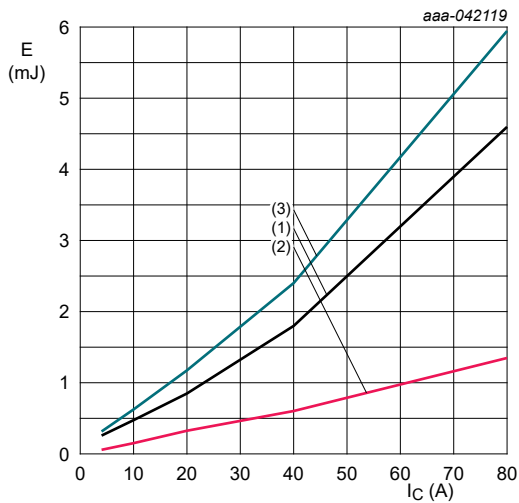
Fig. 13. Typical switching times as a function of gate resistance



$V_{GE} = 15 \text{ V to } 0 \text{ V}; I_C = 40 \text{ A}; V_{CC} = 400 \text{ V};$
 $R_{G(on)} = 10 \text{ } \Omega; R_{G(off)} = 10 \text{ } \Omega$

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

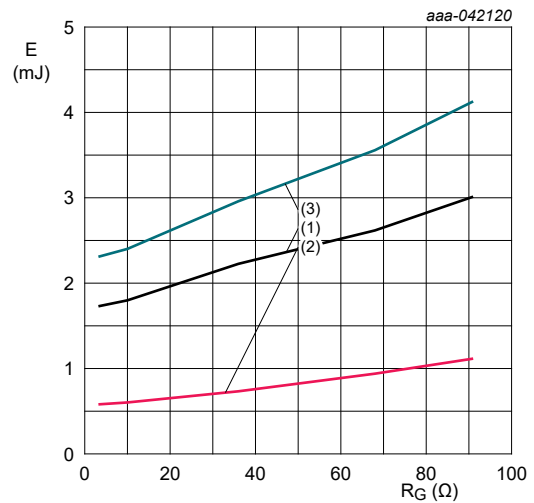
Fig. 14. Typical switching times as a function of junction temperature



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

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

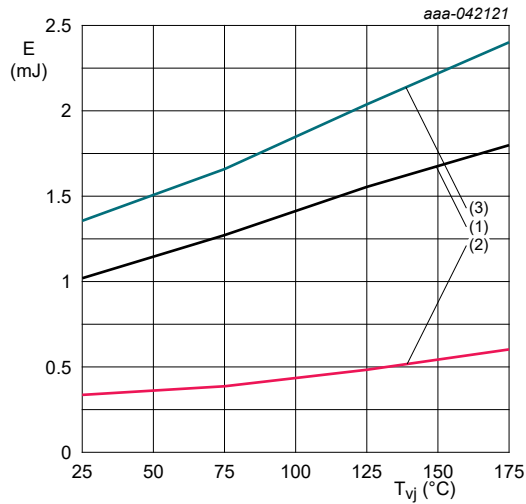
Fig. 15. Typical switching energy losses as a function of collector current



$V_{GE} = 15 \text{ V to } 0 \text{ V}; V_{CC} = 400 \text{ V}; I_C = 40 \text{ A};$
 $T_{vj} = 175 \text{ }^\circ\text{C}$

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

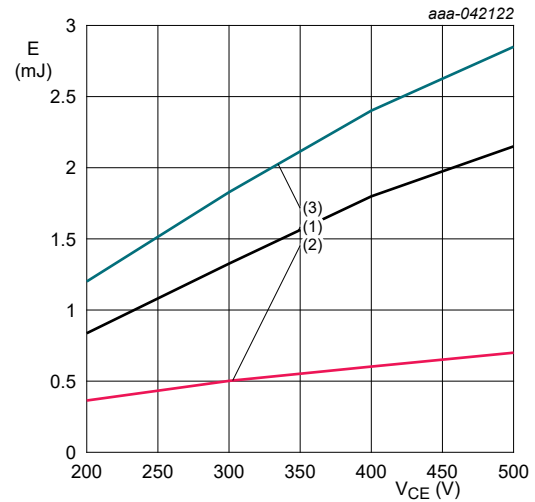
Fig. 16. Typical switching energy losses as a function of gate resistance



$V_{GE} = 15 \text{ V to } 0 \text{ V}$; $I_C = 40 \text{ A}$; $V_{CC} = 400 \text{ V}$;
 $R_{G(on)} = 10 \text{ } \Omega$; $R_{G(off)} = 10 \text{ } \Omega$

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

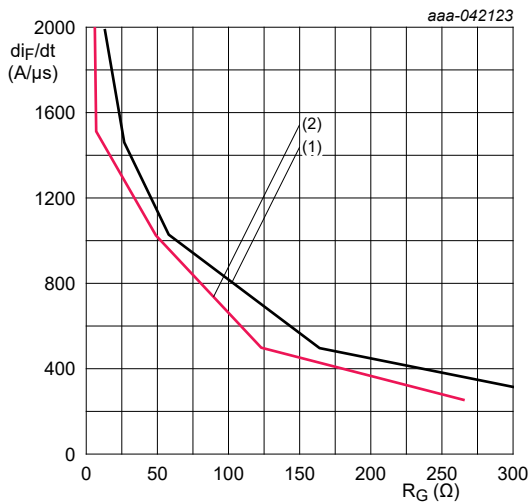
Fig. 17. Typical switching energy losses as a function of junction temperature



$V_{GE} = 15 \text{ V to } 0 \text{ V}$; $I_C = 40 \text{ A}$; $R_{G(on)} = 10 \text{ } \Omega$;
 $R_{G(off)} = 10 \text{ } \Omega$; $T_{vj} = 175 \text{ } ^\circ\text{C}$

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

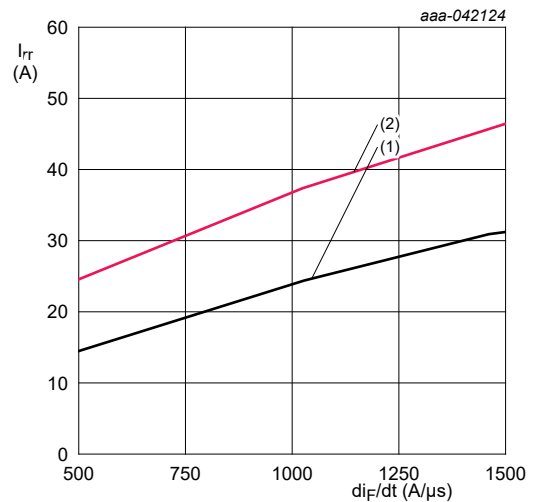
Fig. 18. Typical switching energy losses as a function of collector-emitter voltage



$V_R = 400 \text{ V}$; $I_F = 20 \text{ A}$

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

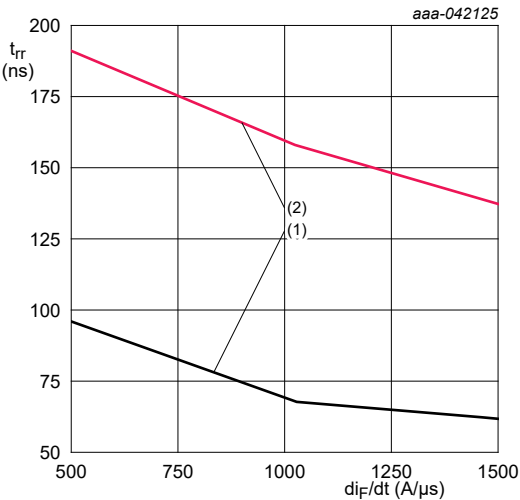
Fig. 19. Typical rate of change of forward current as a function of change of gate resistance



$V_R = 400 \text{ V}$; $I_F = 20 \text{ A}$

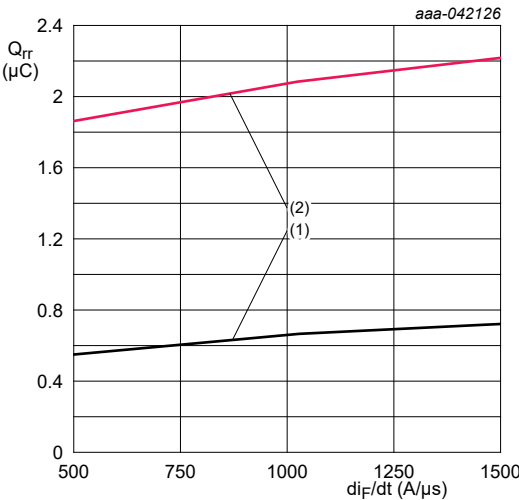
- (1) $T_{vj} = 25 \text{ } ^\circ\text{C}$
- (2) $T_{vj} = 175 \text{ } ^\circ\text{C}$

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



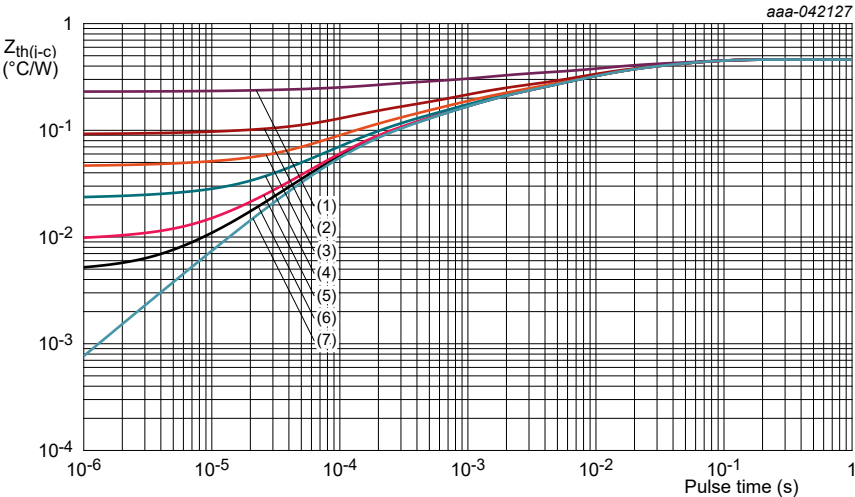
$V_R = 400\text{ V}; I_F = 20\text{ A}$
(1) $T_{vj} = 25\text{ °C}$
(2) $T_{vj} = 175\text{ °C}$

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



$V_R = 400\text{ V}; I_F = 20\text{ A}$
(1) $T_{vj} = 25\text{ °C}$
(2) $T_{vj} = 175\text{ °C}$

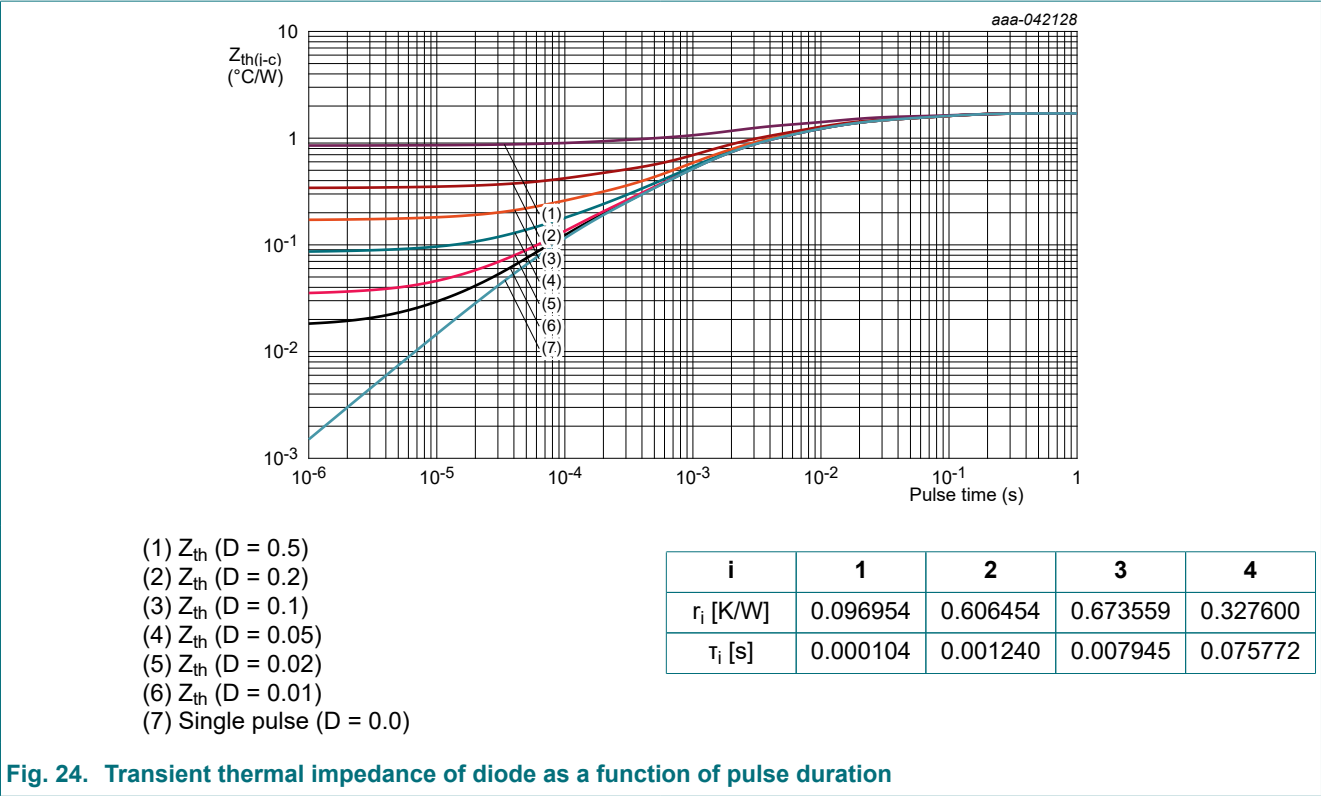
Fig. 22. Typical reverse recovery charge as a function of rate of change of forward current



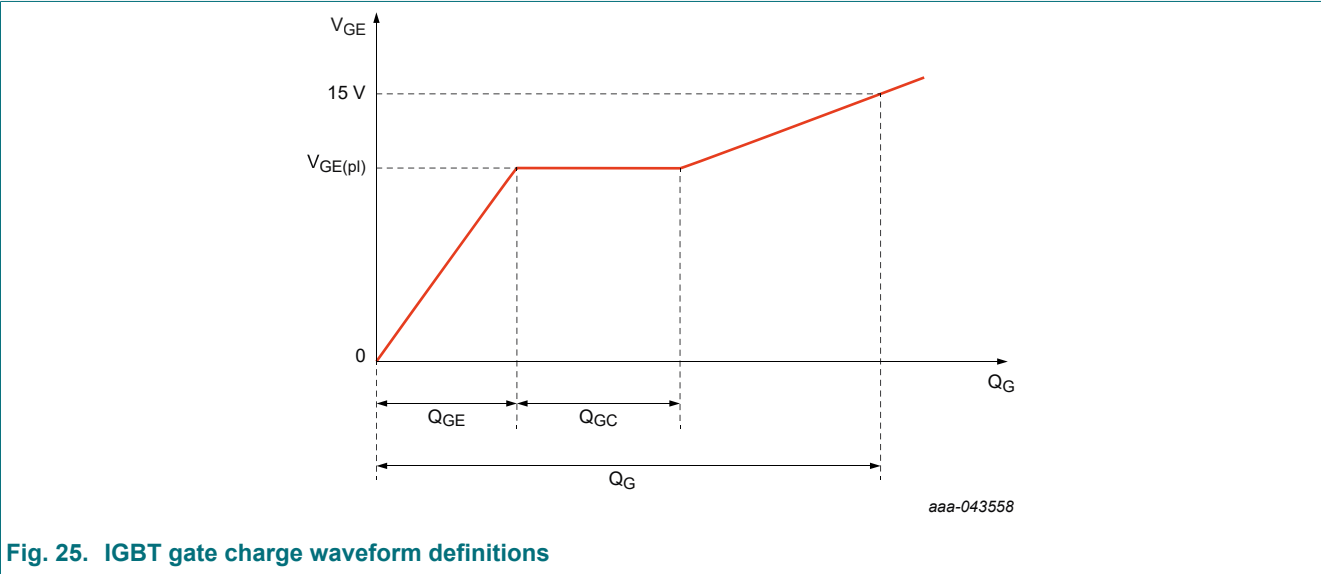
- (1) $Z_{th} (D = 0.5)$
- (2) $Z_{th} (D = 0.2)$
- (3) $Z_{th} (D = 0.1)$
- (4) $Z_{th} (D = 0.05)$
- (5) $Z_{th} (D = 0.02)$
- (6) $Z_{th} (D = 0.01)$
- (7) Single pulse ($D = 0.0$)

i	1	2	3	4
r_i [K/W]	0.068497	0.107215	0.156203	0.128591
τ_i [s]	0.000112	0.000823	0.007026	0.039094

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



10.2. Waveform definitions



11. Package outline

Plastic single-ended through-hole package; heatsink mounted; 1 mounting hole; 3-lead TO-247-3 SOT429-5

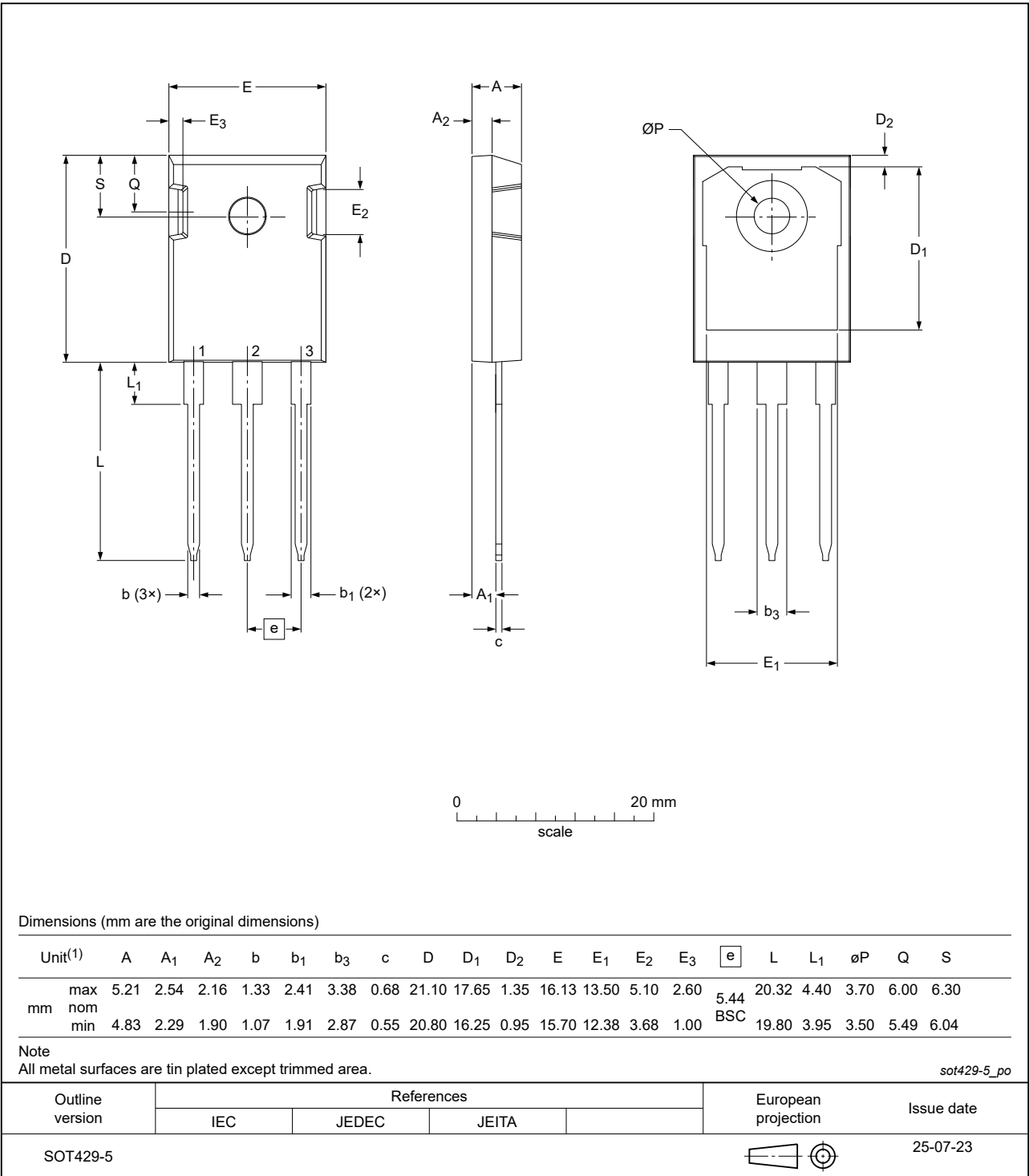


Fig. 28. Package outline TO-247-3 (SOT429-5)

12. Revision history

Table 9. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NGW40T65H3DHP v. 2	20251111	Product data sheet	-	NGW40T65H3DHP v. 1
Modifications	- Updated the 3D package on the first page. - Added new section Section 7. - Replaced "Power dissipation as a function of case temperature" chart with "Reverse bias safe operating area" in Section 10.1. - Updated the value of I_{CES} in Section 10. - Updated the package information in Section 6. - Updated the waveform definitions in Section 10.2. - Updated the package outline in Section 11.			
NGW40T65H3DHP v. 1	20250117	Product data sheet	-	-

13. 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.

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
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Contents

1. General description..... 1

2. Features..... 1

3. Applications..... 1

4. Quick reference data..... 1

5. Pinning information..... 2

6. Ordering information..... 2

7. Marking..... 2

8. Limiting values..... 2

9. Thermal characteristics..... 3

10. Electrical characteristics..... 3

10.1. Characteristic diagrams..... 5

10.2. Waveform definitions..... 11

11. Package outline..... 13

12. Revision history..... 14

13. Legal information..... 15

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Date of release: 11 November 2025