



NGW30T60M3DF

600 V, 30 A trench field-stop IGBT with full rated silicon diode

Rev. 1 — 3 July 2023

Product data sheet

1. General description

The NGW30T60M3DF is a robust Insulated-Gate Bipolar Transistor (IGBT) featuring third-generation technology. It combines carrier stored trench-gate and field-stop (FS) structures. The NGW30T60M3DF is rated to 175 °C with optimized IGBT turn-off losses, and has a short circuit withstand time of 5 μ s. This hard-switching 600 V, 30 A IGBT is optimized for high-voltage, low-frequency industrial power inverter and servo motor drive applications.

2. Features and benefits

- Collector current (I_C) rated at 30 A
- Low conduction and switching losses
- Stable and tight parameters for easy parallel operation
- Maximum junction temperature of 175 °C
- Fully rated as a soft fast reverse recovery diode
- 5 μ s short circuit withstand time
- RoHS compliant, lead-free plating

3. Applications

- Motor drives for industrial and consumer appliances
 - Servo motors operating between 5-20 kW (up to 20 kHz) for robotics, elevators, operating grippers, in-line manufacturing, etc.
- Power inverters
 - Uninterruptible Power Supply (UPS) inverter
 - Photovoltaic (PV) strings
 - EV charging
- Induction heating
- Welding

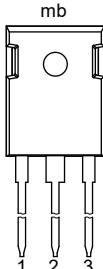
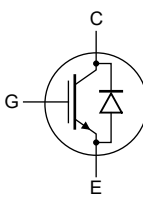
4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CE}	collector-emitter voltage	$T_j = 25\text{ °C}$	-	600	V
T_j	operating junction temperature		-40	+175	°C
t_{sc}	short circuit withstand time	$V_{GE} = 15\text{ V}; V_{CC} = 400\text{ V}; T_j \leq 150\text{ °C}$	-	5	μ s

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
NGW30T60M3DF	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

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
IGBT					
V_{CE}	collector-emitter voltage	$T_j = 25\text{ °C}$	-	600	V
I_C	collector current	$T_{case} = 25\text{ °C}$ [1]	-	75	A
		$T_{case} = 100\text{ °C}$ [1]	-	45	A
I_{Cpuls}	peak pulse collector current [2]		-	90	A
t_{sc}	short circuit withstand time	$V_{GE} = 15\text{ V}$; $V_{CC} = 400\text{ V}$; $T_j \leq 150\text{ °C}$	-	5.0	μs
V_{GS}	gate-source voltage		-20	+20	V
P_{tot}	total power dissipation	$T_{case} = 25\text{ °C}$	-	285	W
		$T_{case} = 100\text{ °C}$	-	142	W
T_j	operating junction temperature		-40	+175	$^{\circ}\text{C}$
T_{stg}	storage temperature		-55	+150	$^{\circ}\text{C}$
T_{solder}	soldering temperature		-	260	$^{\circ}\text{C}$
M	mounting torque, M3 screw		-	0.6	Nm
Diode					
I_F	diode forward current	$T_{case} = 25\text{ °C}$ [1]	-	80	A
		$T_{case} = 100\text{ °C}$ [1]	-	58	A
I_{Fpuls}	peak pulse diode current [2]	$T_{case} = 25\text{ °C}$		90	A

[1] Value limited by bondwire and $T_{j(max)}$.

[2] t_p limited by $T_{j(max)}$.

8. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
R _{th(j-c)}	thermal resistance from junction to case	IGBT	-	0.45	0.53	K/W
		diode	-	0.71	0.84	K/W
R _{th(j-a)}	thermal resistance from junction to ambient	in free air	-	-	40	K/W

9. Characteristics

Table 6. Characteristics

All values at T_j = 25 °C, unless otherwise specified.

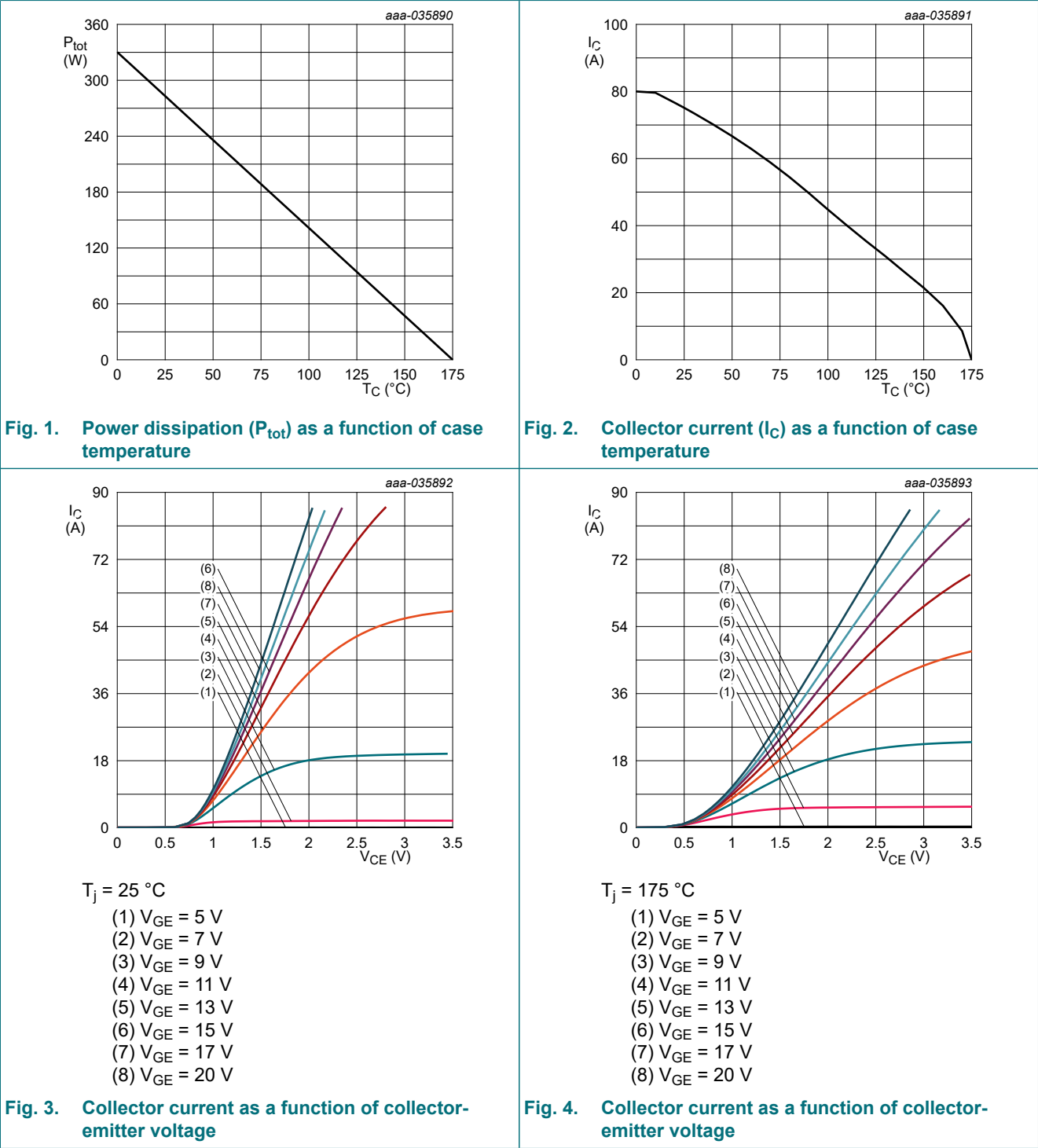
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
V _{(BR)CE}	collector-emitter breakdown voltage	V _{GE} = 0 V; I _C = 0.2 mA	600	-	-	V
V _{CEsat}	collector-emitter saturation voltage	V _{GE} = 15 V; I _C = 30 A; T _j = 25 °C	-	1.4	1.7	V
		V _{GE} = 15 V; I _C = 30 A; T _j = 175 °C	-	1.7	-	V
V _F	diode forward voltage	V _{GE} = 0 V; I _F = 30 A; T _j = 25 °C	-	1.5	2.2	V
		V _{GE} = 0 V; I _F = 30 A; T _j = 175 °C	-	1.2	-	V
V _{GE(th)}	gate-emitter threshold voltage	I _C = 0.3 mA; V _{CE} = V _{GE} ; T _j = 25 °C	4	5	7	V
I _{CES}	zero gate voltage collector current	V _{CE} = 600 V; V _{GE} = 0 V; T _j = 25 °C	-	-	400	µA
		V _{CE} = 600 V; V _{GE} = 0 V; T _j = 175 °C	-	-	10	mA
I _{GES}	gate-emitter leakage current	V _{CE} = 0 V; V _{GE} = 20 V	-	-	200	nA
g _{fs}	transconductance	V _{CE} = 20 V; I _C = 30 A; T _j = 25 °C	-	18.5	-	S
r _G	integrated gate resistor		-	0.9	-	Ω
Dynamic characteristics						
C _{ies}	input capacitance	V _{CE} = 25 V; V _{GE} = 0 V; f = 1 MHz	-	2040	-	pF
C _{oes}	output capacitance		-	136	-	pF
C _{res}	reverse transfer capacitance		-	31	-	pF
Q _G	gate charge	V _{CC} = 480 V; V _{GE} = 15 V; I _C = 30 A	-	130	-	nC
L _{sCE}	internal stray inductance	Measured 5 mm from case	-	7.9	-	nH
I _{C(sc)}	short circuit collector current	V _{GE} = 15 V; V _{CC} = 400 V; t _{sc} ≤ 5 µs; T _j ≤ 150 °C	-	130	-	A

600 V, 30 A trench field-stop IGBT with full rated silicon diode

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 = 30 A; r _{G(on)} = 10 Ω; r _{G(off)} = 10 Ω; see Fig. 26 and Fig. 27	T _j = 25 °C	-	60	-	ns
			T _j = 175 °C	-	60	-	ns
t _r	rise time		T _j = 25 °C	-	40	-	ns
			T _j = 175 °C	-	45	-	ns
t _{d(off)}	turn-off delay time		T _j = 25 °C	-	180	-	ns
			T _j = 175 °C	-	225	-	ns
t _f	fall time		T _j = 25 °C	-	15	-	ns
			T _j = 175 °C	-	45	-	ns
E _{on}	turn-on switching loss		T _j = 25 °C	-	0.7	-	mJ
			T _j = 175 °C	-	0.85	-	mJ
E _{off}	turn-off switching loss		T _j = 25 °C	-	0.4	-	mJ
			T _j = 175 °C	-	0.75	-	mJ
E _{ts}	total switching loss		T _j = 25 °C	-	1.1	-	mJ
			T _j = 175 °C	-	1.6	-	mJ
Diode switching characteristics, inductive load							
t _{rr}	diode reverse recovery time	V _R = 400 V; I _F = 30 A; ΔI _F /Δt = 500 A/μs; see Fig. 25	T _j = 25 °C	-	110	-	ns
			T _j = 175 °C	-	195	-	ns
Q _{rr}	diode reverse recovery charge		T _j = 25 °C	-	850	-	nC
			T _j = 175 °C	-	3250	-	nC
I _{rrm}	diode peak reverse recovery current		T _j = 25 °C	-	13	-	A
			T _j = 175 °C	-	25	-	A
E _{rr}	reverse recovery energy		T _j = 25 °C	-	0.15	-	mJ
			T _j = 175 °C	-	0.55	-	mJ
di _{rr} /dt	diode peak rate of fall of reverse recovery current		T _j = 25 °C	-	650	-	A/μs
			T _j = 175 °C	-	760	-	A/μs

9.1. Output characteristics

Table 7. Waveforms and output characteristics



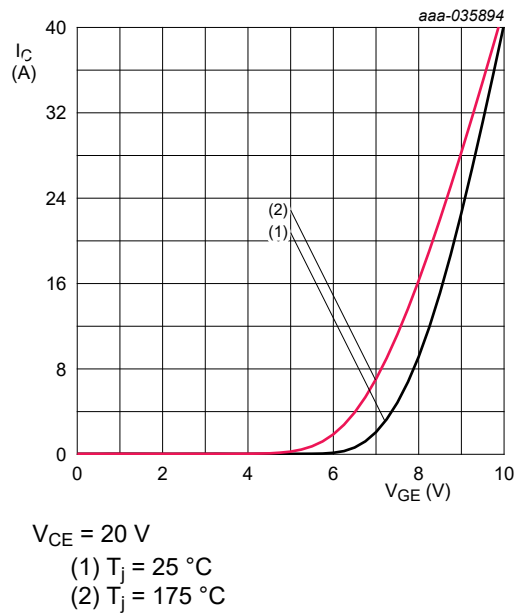


Fig. 5. Collector current as a function of gate-emitter voltage; typical values

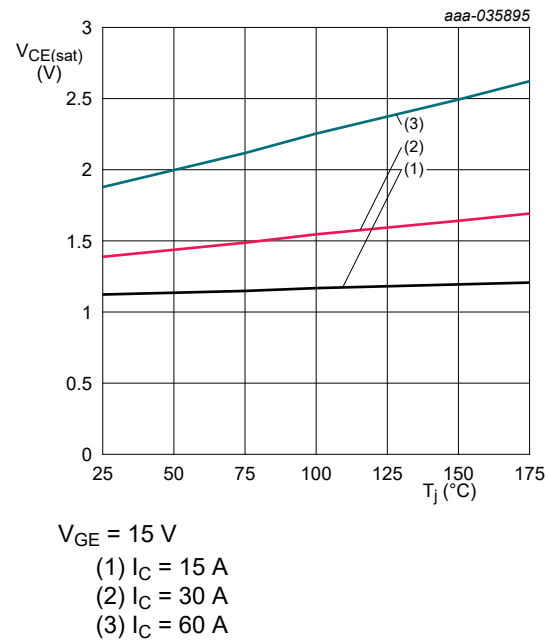


Fig. 6. Collector-emitter saturation voltage as a function of junction temperature; typical values

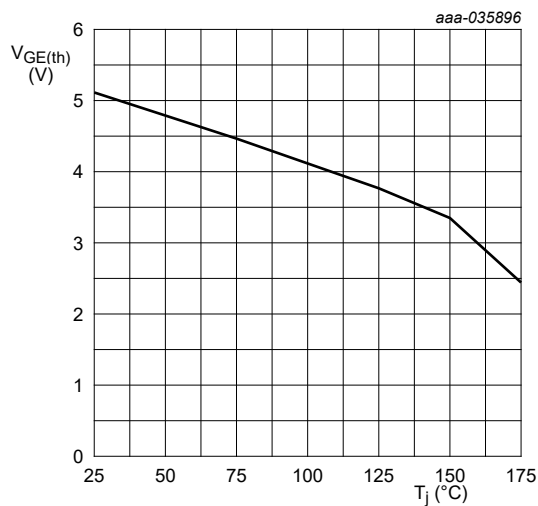


Fig. 7. Gate-emitter threshold voltage as a function of junction temperature

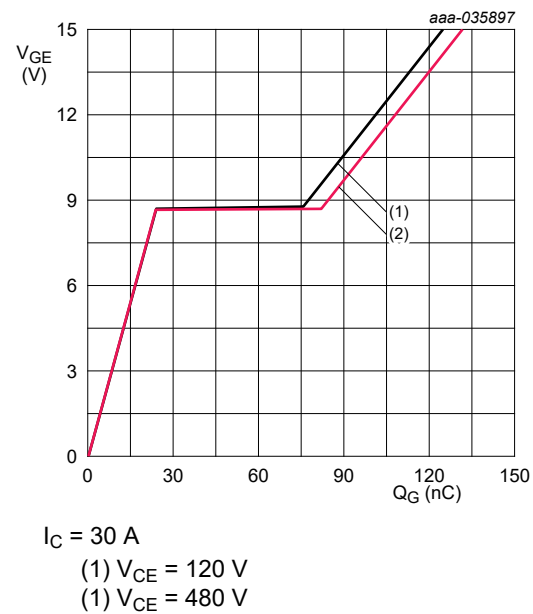
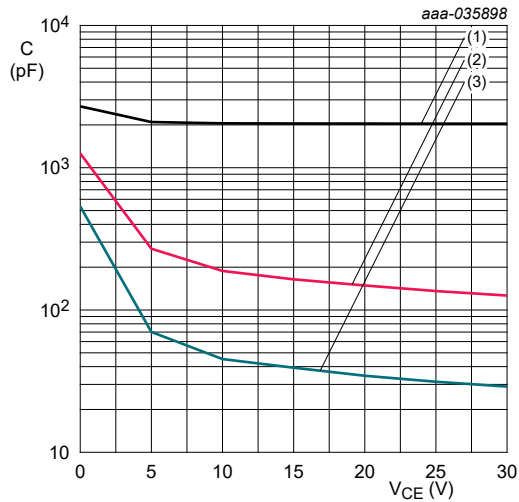


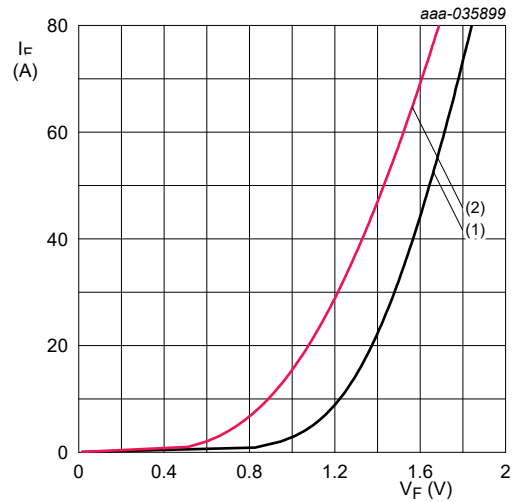
Fig. 8. Gate-emitter voltage as a function of gate charge; typical values



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

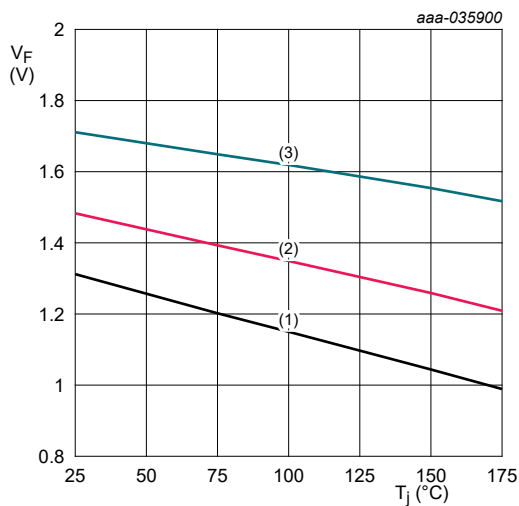
- (1) C_{ies}
- (2) C_{oes}
- (3) C_{res}

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



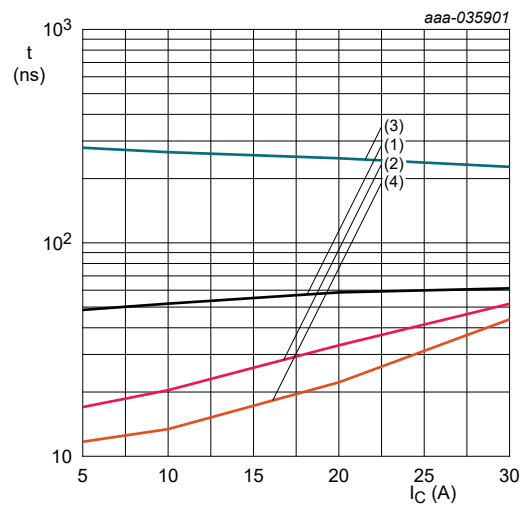
- (1) $T_{amb} = 25 \text{ °C}$
- (2) $T_{amb} = 175 \text{ °C}$

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



- (1) $I_F = 15 \text{ A}$
- (2) $I_F = 30 \text{ A}$
- (3) $I_F = 60 \text{ A}$

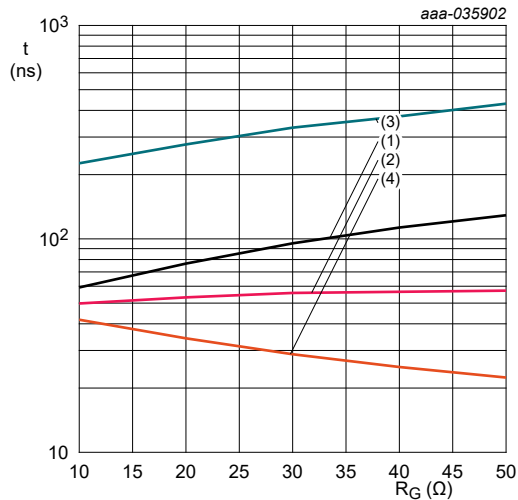
Fig. 11. Typical diode forward voltage as a function of junction temperature



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

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

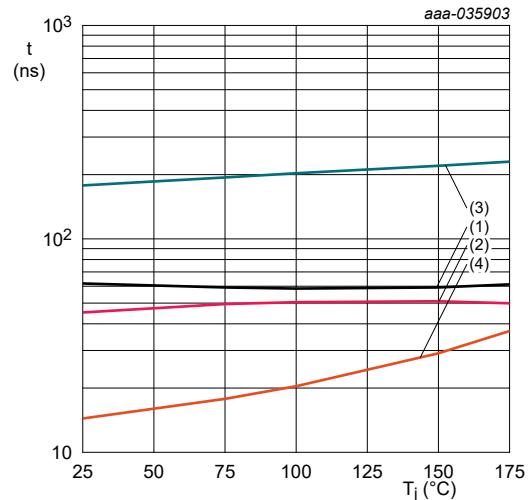
Fig. 12. Typical switching times as a function of collector current



$V_{GE} = 15 \text{ V to } 0 \text{ V}; V_{CC} = 400 \text{ V}; I_C = 30 \text{ A};$
 $T_j = 175 \text{ }^\circ\text{C}$

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

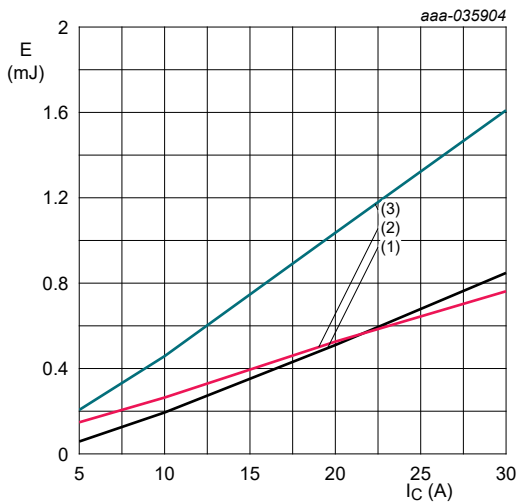
Fig. 13. Typical switching times as a function of gate resistor



$V_{GE} = 15 \text{ V to } 0 \text{ V}; I_C = 30 \text{ A}; V_{CC} = 400 \text{ V};$
 $r_{G(on)} = 10 \text{ } \Omega; r_{G(off)} = 10 \text{ } \Omega$

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

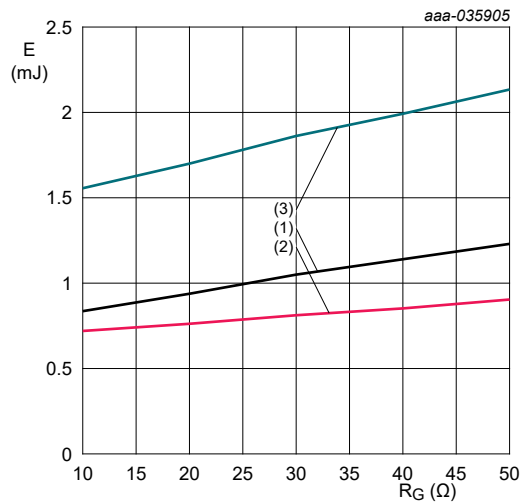
Fig. 14. Typical switching times as a function of junction temperature



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

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

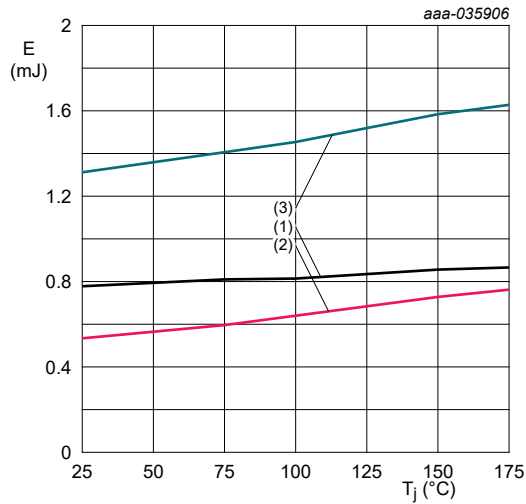
Fig. 15. Typical switching energy losses as a function of collector current



$V_{GE} = 15 \text{ V to } 0 \text{ V}; V_{CC} = 400 \text{ V}; I_C = 30 \text{ A};$
 $T_j = 175 \text{ }^\circ\text{C}$

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

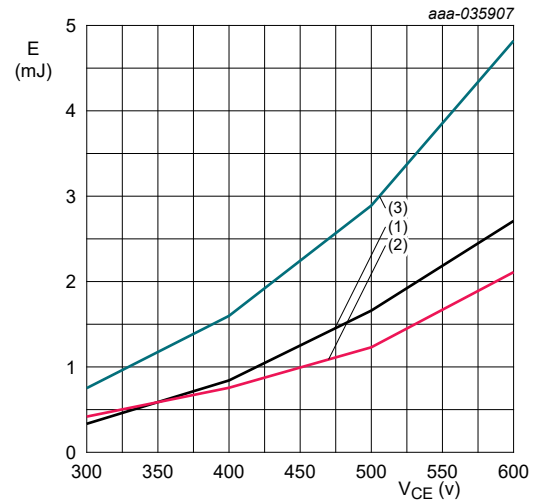
Fig. 16. Typical switching energy losses as a function of gate resistance



$V_{GE} = 15 \text{ V to } 0 \text{ V}$; $I_C = 30 \text{ A}$; $V_{CC} = 400 \text{ V}$;
 $r_{G(on)} = 10 \Omega$; $r_{G(off)} = 10 \Omega$

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

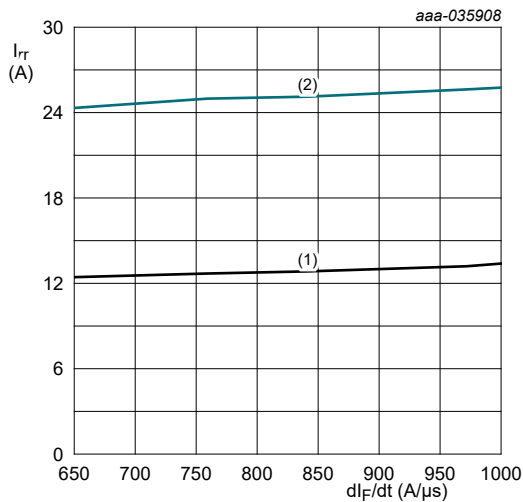
Fig. 17. Typical switching energy losses as a function of junction temperature



$V_{GE} = 15 \text{ V to } 0 \text{ V}$; $I_C = 30 \text{ A}$; $r_{G(on)} = 10 \Omega$;
 $r_{G(off)} = 10 \Omega$; $T_j = 175 \text{ °C}$

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

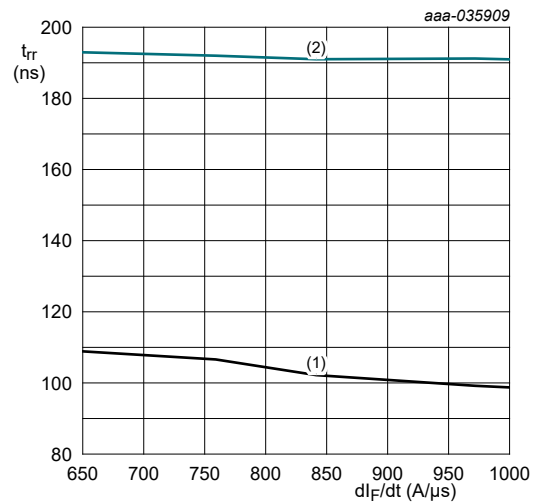
Fig. 18. Typical switching energy losses as a function of collector-emitter voltage



$V_R = 400 \text{ V}$; $I_F = 30 \text{ A}$

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

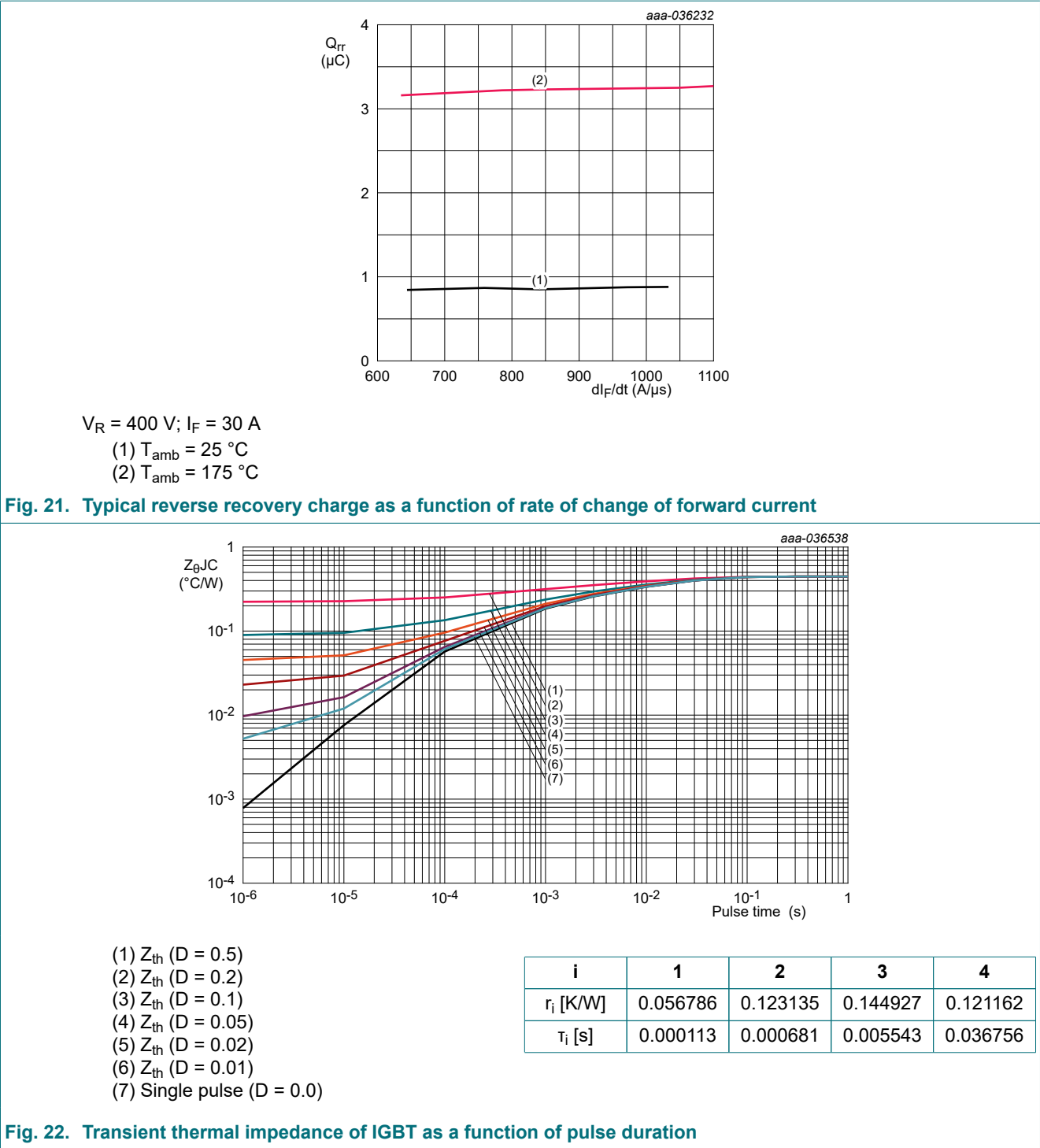
Fig. 19. Typical reverse recovery current as a function of rate of change of forward current

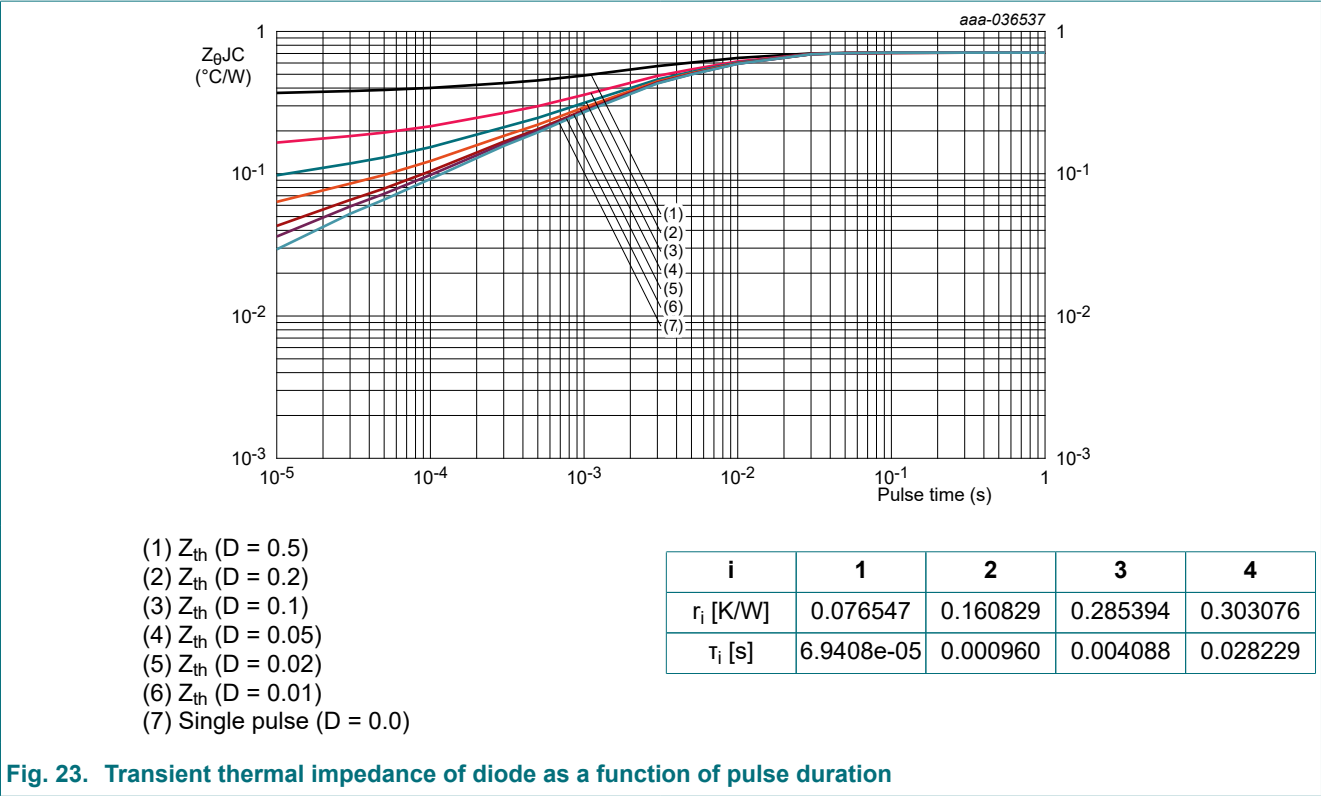


$V_R = 400 \text{ V}$; $I_F = 30 \text{ A}$

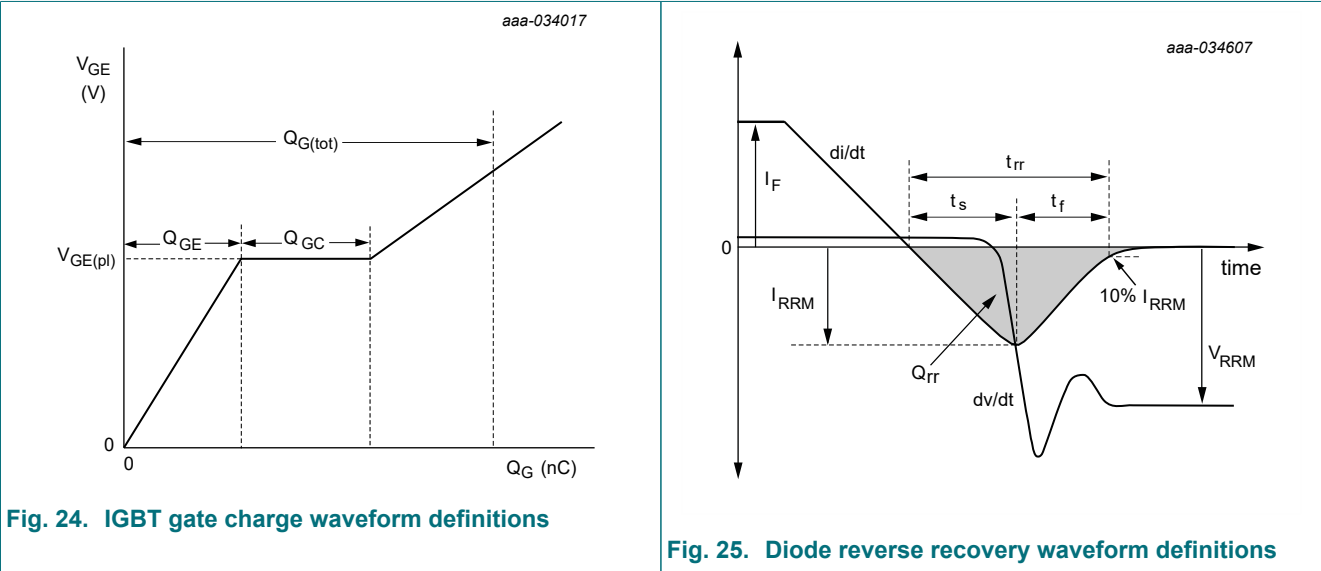
- (1) $T_{amb} = 25 \text{ °C}$
- (2) $T_{amb} = 175 \text{ °C}$

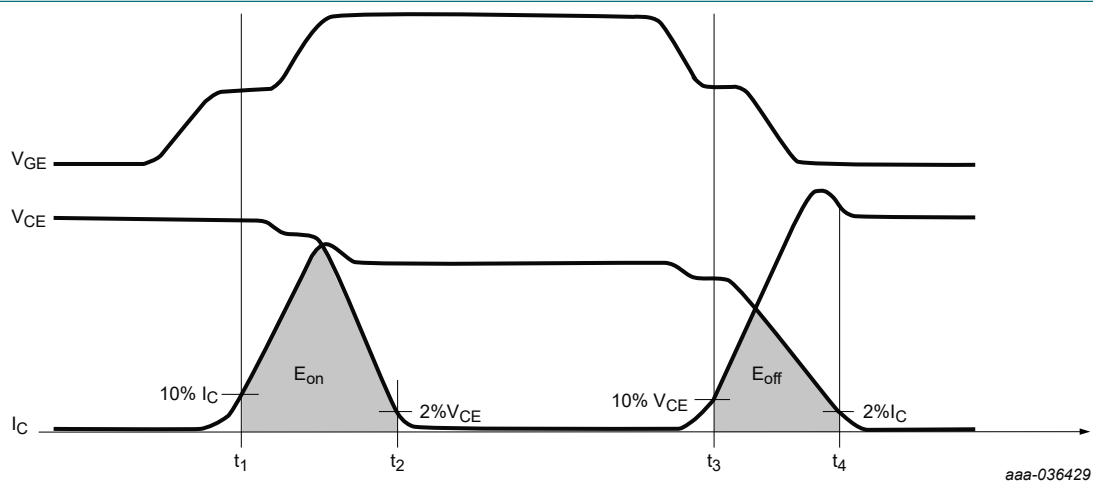
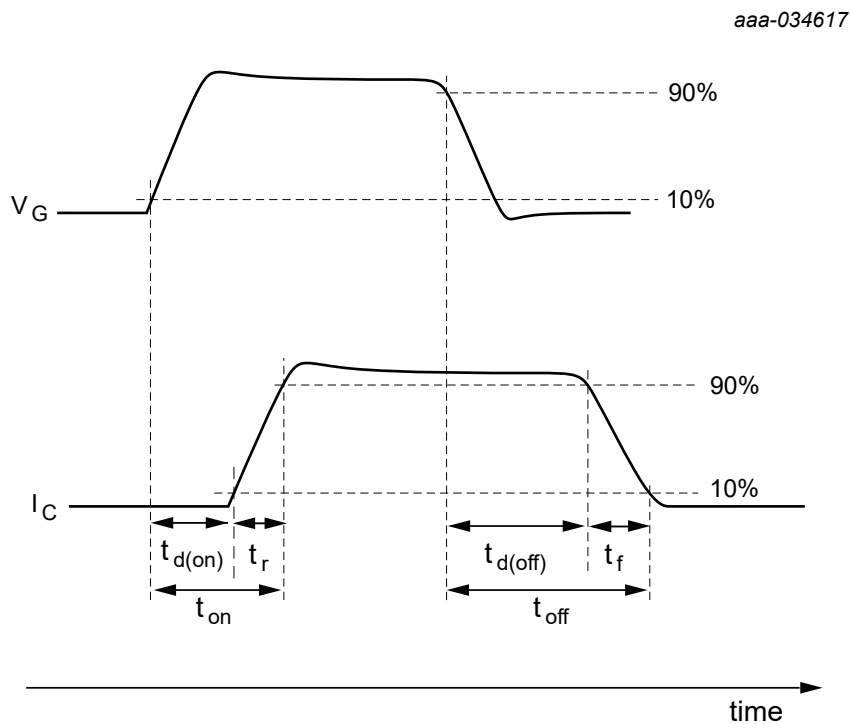
Fig. 20. Typical reverse recovery time as a function of rate of change of forward current





9.2. Waveforms





10. Package outline

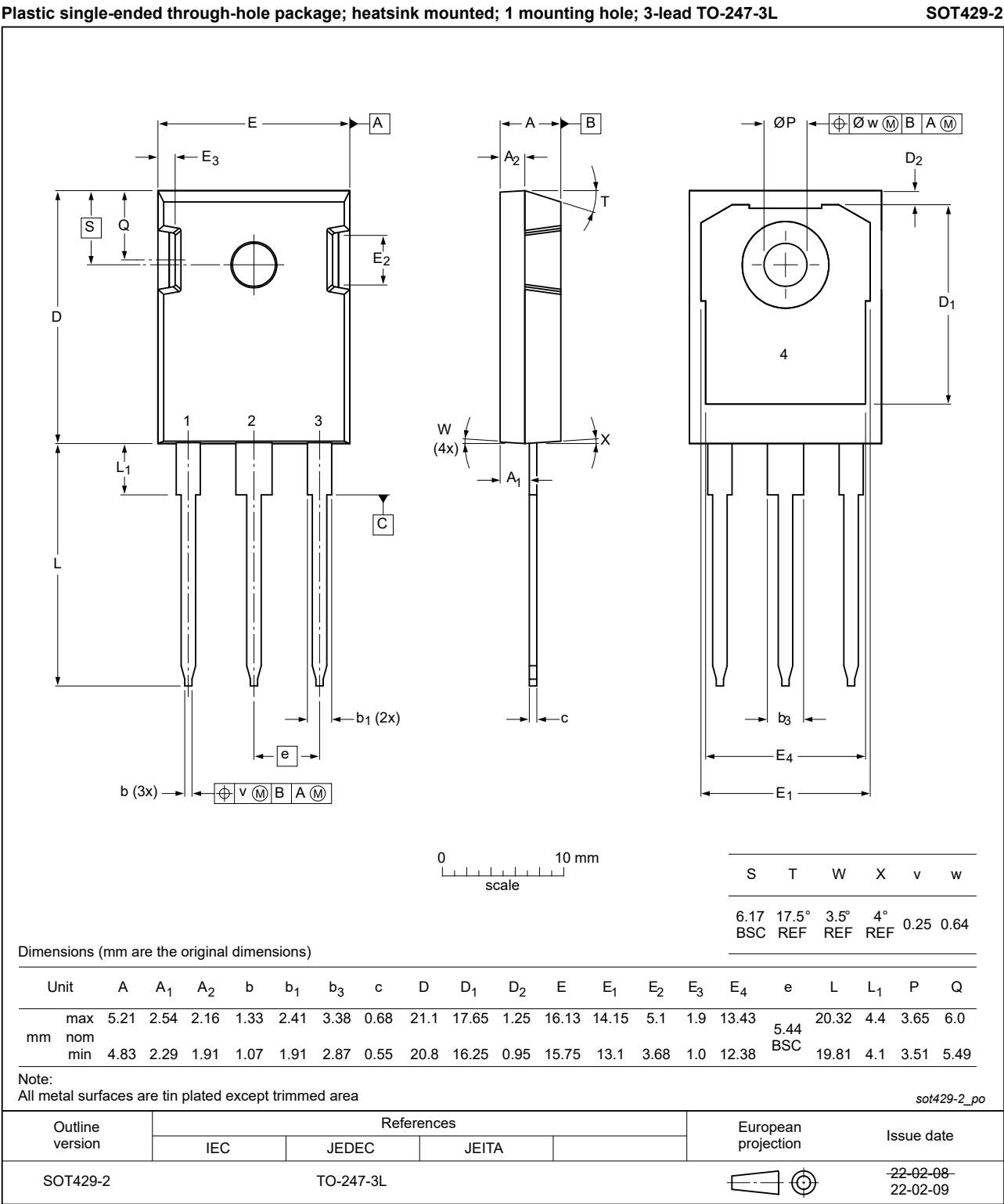


Fig. 28. Package outline TO-247-3L (SOT429-2)

11. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NGW30T60M3DF v. 1	20230703	Product 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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