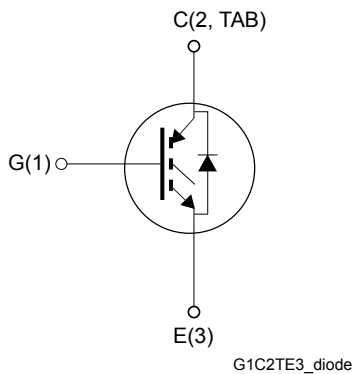
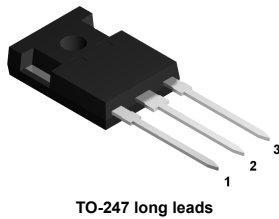



Automotive-grade trench gate field-stop 650 V, 30 A low-loss M series IGBT in a TO-247 long leads package



Features

- AEC-Q101 qualified 
- Maximum junction temperature: $T_J = 175\text{ }^\circ\text{C}$
- 6 μs of minimum short circuit withstand time
- Low $V_{CE(sat)} = 1.7\text{ V (typ.) @ } I_C = 30\text{ A}$
- Tight parameter distribution
- Low thermal resistance
- Soft and very fast-recovery antiparallel diode

Applications

- Motor control
- Auxiliary loads
- Thermal management
- General purpose inverter

Description

This device is an IGBT developed using an advanced proprietary trench gate field-stop structure. The device is part of the M series IGBTs, which represent an optimal balance between inverter system performance and efficiency where the low-loss and the short-circuit functionality is essential.



Product status link

[STGWA30M65DF2AG](#)

Product summary

Order code	STGWA30M65DF2AG
Marking	G30M65DF2AG
Package	TO-247 long leads
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage ($V_{GE} = 0$ V)	650	V
I_C	Continuous collector current at $T_C = 25$ °C	87	A
	Continuous collector current at $T_C = 100$ °C	57	
$I_{CP}^{(1)}$	Pulsed collector current ($t_p \leq 1$ μ s, $T_J < 175$ °C)	120	A
V_{GE}	Gate-emitter voltage	± 20	V
	Transient gate-emitter voltage ($t_p \leq 10$ μ s, $D < 0.01$)	± 30	
I_F	Continuous forward current at $T_C = 25$ °C	66	A
	Continuous forward current at $T_C = 100$ °C	40	
$I_{FP}^{(1)}$	Pulsed forward current	120	A
P_{TOT}	Total power dissipation at $T_C = 25$ °C	441	W
T_{STG}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range	-55 to 175	°C

1. Defined by R_{thJC} and limited by maximum junction temperature, not tested in production.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case, IGBT	0.34	°C/W
	Thermal resistance, junction-to-case, diode	0.86	
R_{thJA}	Thermal resistance, junction-to-ambient	50	°C/W

2 Electrical characteristics

$T_J = 25\text{ °C}$ unless otherwise specified.

Table 3. Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	$V_{GE} = 0\text{ V}$, $I_C = 250\text{ }\mu\text{A}$	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 30\text{ A}$		1.60	2.0	V
		$V_{GE} = 15\text{ V}$, $I_C = 30\text{ A}$, $T_J = 125\text{ °C}$		1.85		
		$V_{GE} = 15\text{ V}$, $I_C = 30\text{ A}$, $T_J = 175\text{ °C}$		2.02		
V_F	Forward on-voltage	$I_F = 30\text{ A}$		1.86	2.65	V
		$I_F = 30\text{ A}$, $T_J = 125\text{ °C}$		1.6		
		$I_F = 30\text{ A}$, $T_J = 175\text{ °C}$		1.5		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 1\text{ mA}$	5	6	7	V
I_{CES}	Collector cut-off current	$V_{GE} = 0\text{ V}$, $V_{CE} = 650\text{ V}$			25	μA
I_{GES}	Gate-emitter leakage current	$V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$			± 250	nA

Table 4. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$	-	2484	-	pF
C_{oes}	Output capacitance		-	148	-	pF
C_{res}	Reverse transfer capacitance		-	54	-	pF
Q_g	Total gate charge	$V_{CC} = 520\text{ V}$, $I_C = 30\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 26. Gate charge test circuit)	-	81.6	-	nC
Q_{ge}	Gate-emitter charge		-	20	-	nC
Q_{gc}	Gate-collector charge		-	36.6	-	nC

Table 5. IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$, $I_C = 30\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 10\ \Omega$ (see Figure 25. Test circuit for inductive load switching)		21.6	-	ns
t_r	Current rise time			24.5	-	ns
$di/dt_{(on)}$	Turn-on current slope			995	-	A/ μ s
$t_{d(off)}$	Turn-off delay time			138	-	ns
t_f	Current fall time			154	-	ns
$E_{on}^{(1)}$	Turn-on switching energy			756	-	μ J
$E_{off}^{(2)}$	Turn-off switching energy			1057	-	μ J
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$, $I_C = 30\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 10\ \Omega$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 25. Test circuit for inductive load switching)		21.2	-	ns
t_r	Current rise time			29.8	-	ns
$di/dt_{(on)}$	Turn-on current slope			838	-	A/ μ s
$t_{d(off)}$	Turn-off delay time			152.5	-	ns
t_f	Current fall time			266	-	ns
$E_{on}^{(1)}$	Turn-on switching energy			1334	-	μ J
$E_{off}^{(2)}$	Turn-off switching energy			1582	-	μ J
t_{sc}	Short-circuit withstand time	$V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, starting $T_J \leq 150\text{ }^\circ\text{C}$	6		-	μ s

1. Including the reverse recovery of the diode.
2. Including the tail of the collector current.

Table 6. Diode switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit	
t_{rr}	Reverse recovery time	$I_F = 30\text{ A}$, $V_R = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $di/dt = 1000\text{ A}/\mu\text{s}$ (see Figure 25. Test circuit for inductive load switching)	-	151	-	ns	
Q_{rr}	Reverse recovery charge			-	0.78	-	μ C
I_{rrm}	Reverse recovery current			-	10.5	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b			-	90	-	A/ μ s
E_{rr}	Reverse recovery energy			-	0.21	-	mJ
t_{rr}	Reverse recovery time	$I_F = 30\text{ A}$, $V_R = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $di/dt = 1000\text{ A}/\mu\text{s}$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 25. Test circuit for inductive load switching)	-	239	-	ns	
Q_{rr}	Reverse recovery charge			-	2.4	-	μ C
I_{rrm}	Reverse recovery current			-	25.2	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b			-	450	-	A/ μ s
E_{rr}	Reverse recovery energy			-	0.718	-	mJ

2.1 Electrical characteristics (curves)

Figure 1. Total power dissipation vs temperature

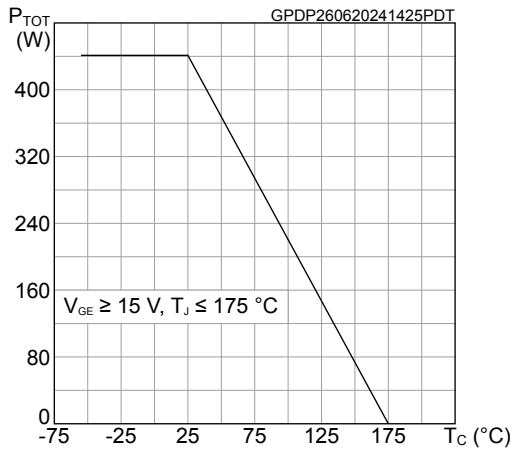


Figure 2. Collector current vs temperature

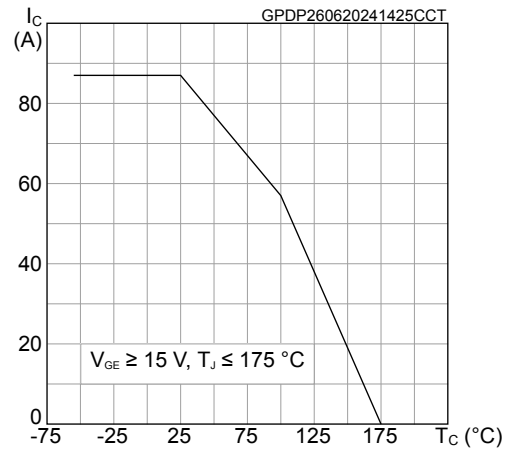


Figure 3. Typical output characteristics ($T_J = 25 \text{ }^\circ\text{C}$)

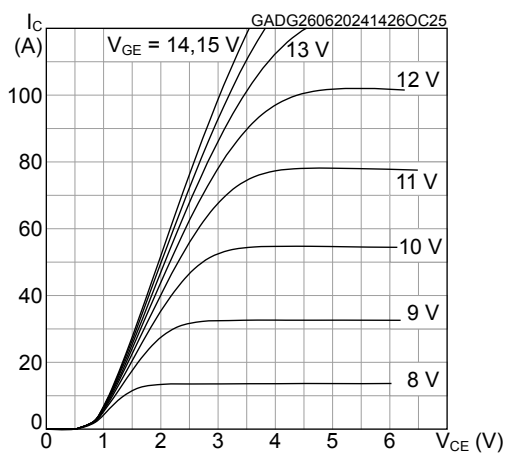


Figure 4. Typical output characteristics ($T_J = 175 \text{ }^\circ\text{C}$)

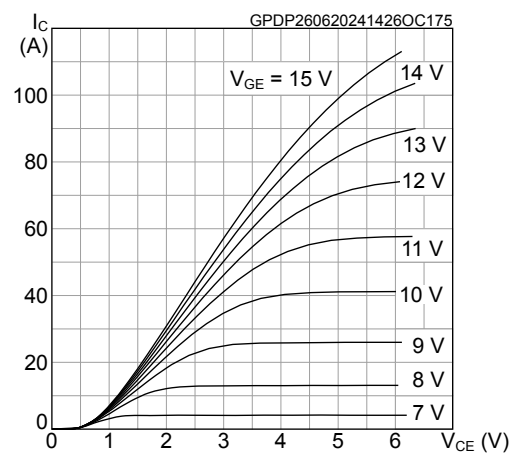


Figure 5. Typical transfer characteristics

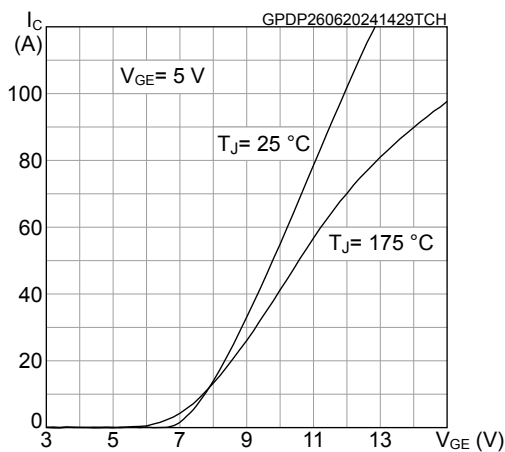


Figure 6. Typical $V_{CE(sat)}$ vs temperature

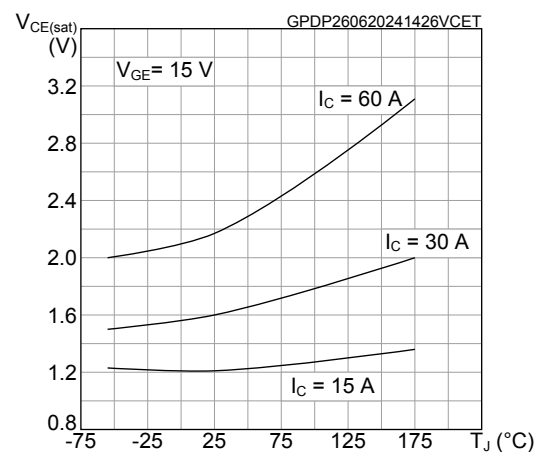


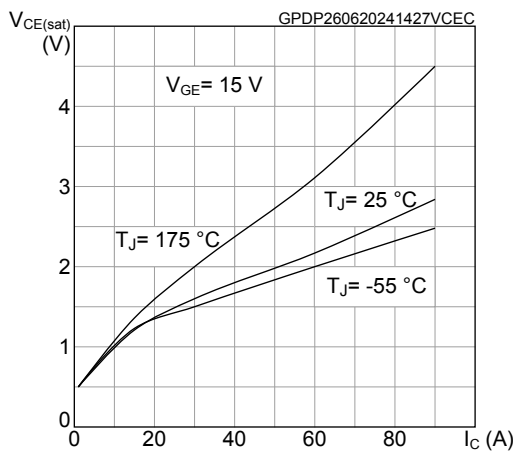
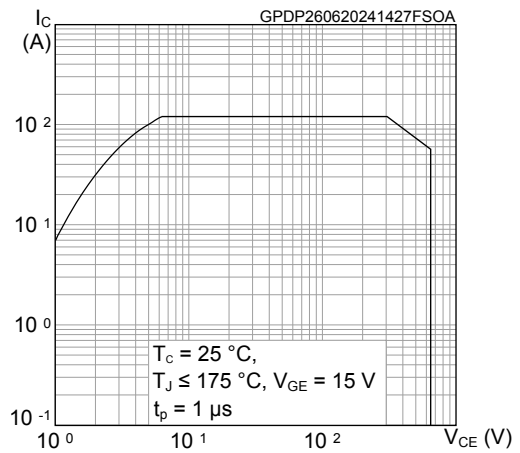
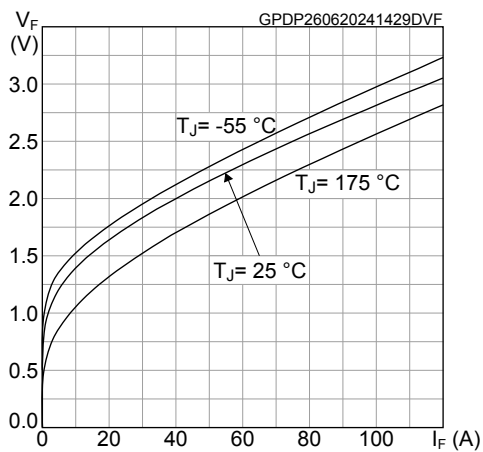
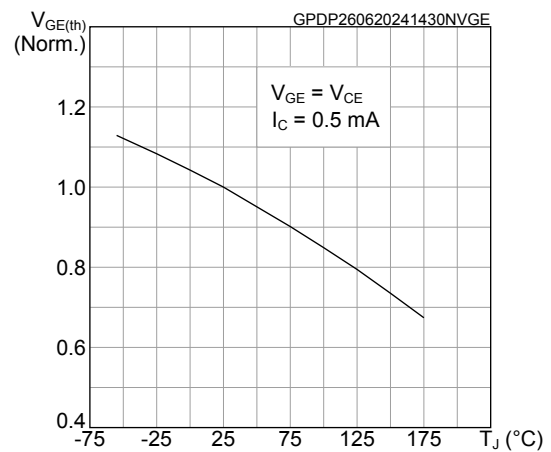
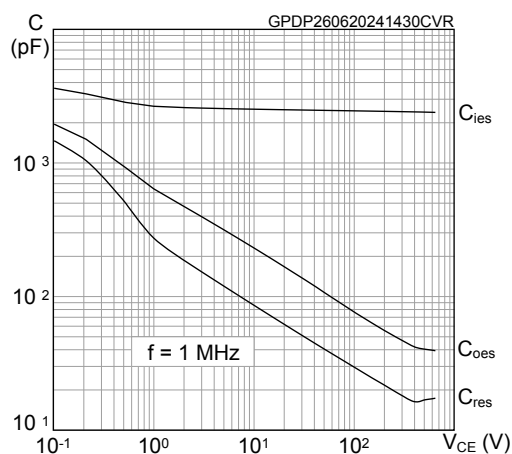
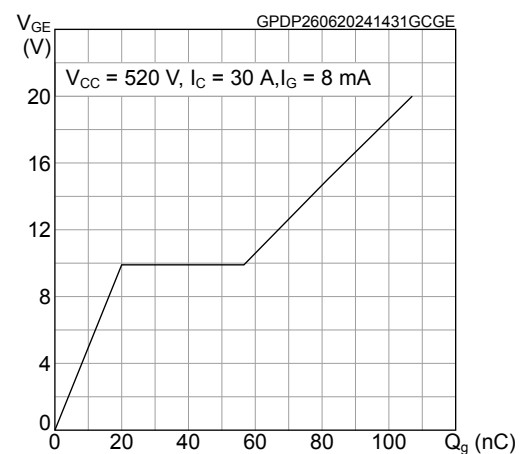
Figure 7. Typical $V_{CE(sat)}$ vs collector current

Figure 8. Forward bias safe operating area

Figure 9. Diode typical forward characteristics

Figure 10. Normalized gate threshold vs temperature

Figure 11. Typical capacitance characteristics

Figure 12. Typical gate charge characteristics


Figure 13. Typical switching energy vs collector current

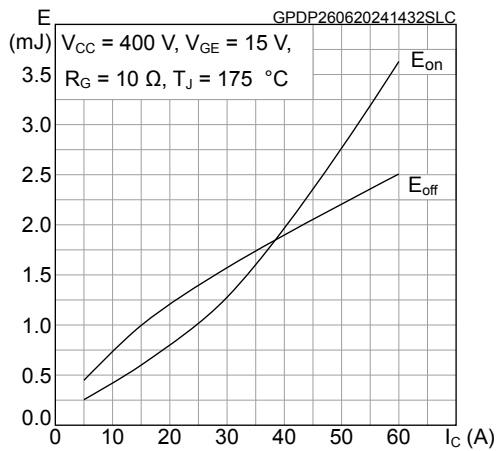


Figure 14. Typical switching energy vs temperature

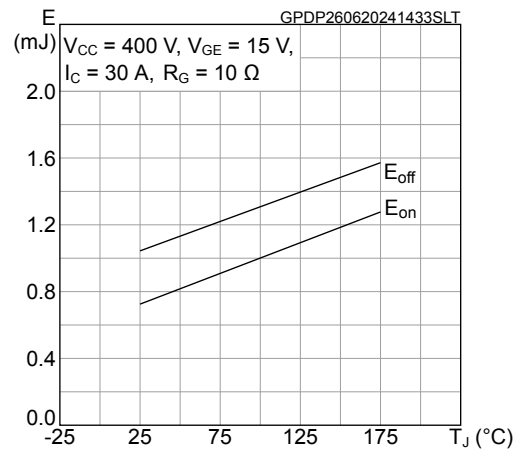


Figure 15. Typical switching energy vs supply voltage

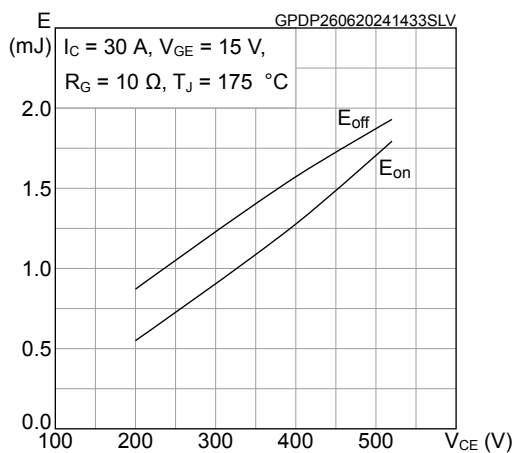


Figure 16. Typical switching energy vs gate resistance

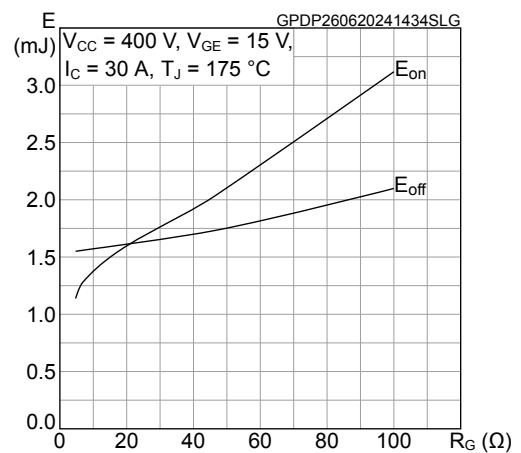


Figure 17. Typical switching times vs collector current

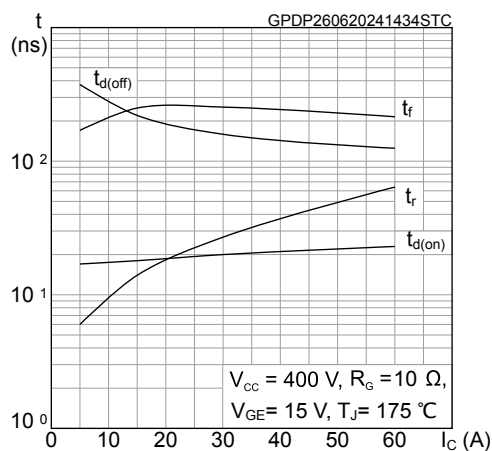


Figure 18. Typical switching times vs gate resistance

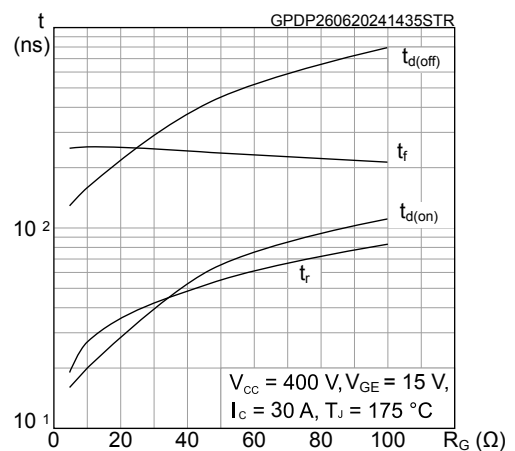
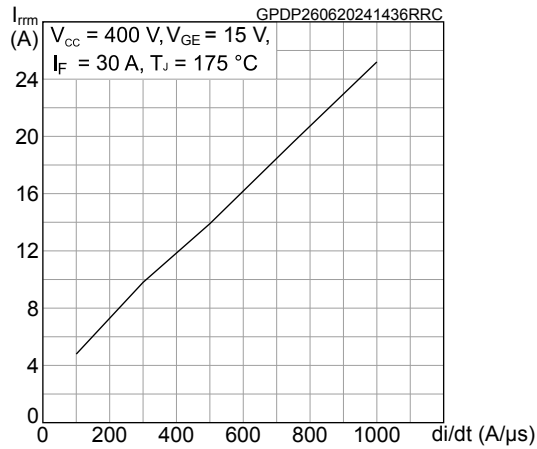
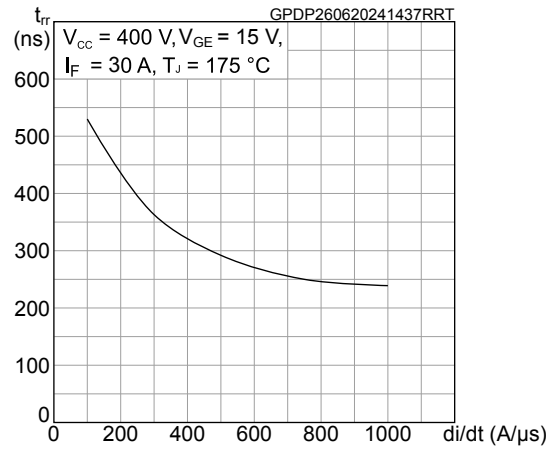
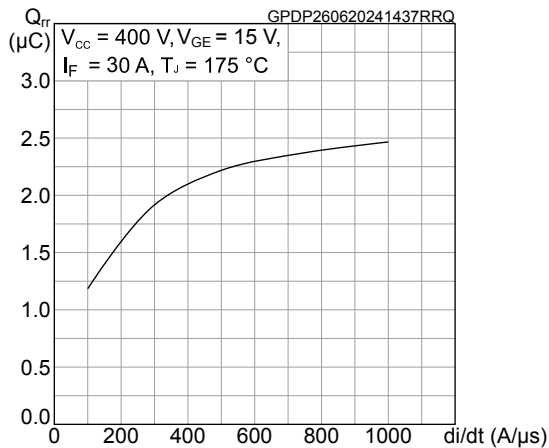
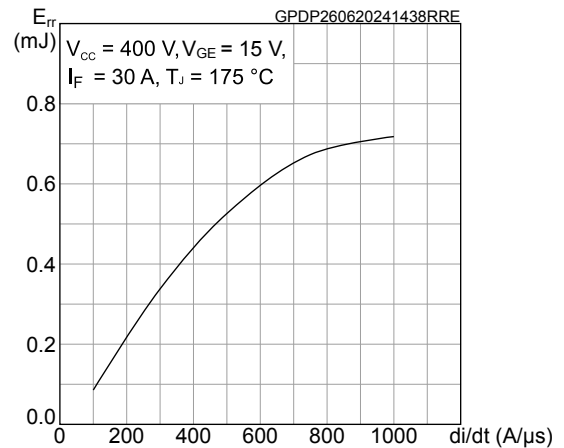
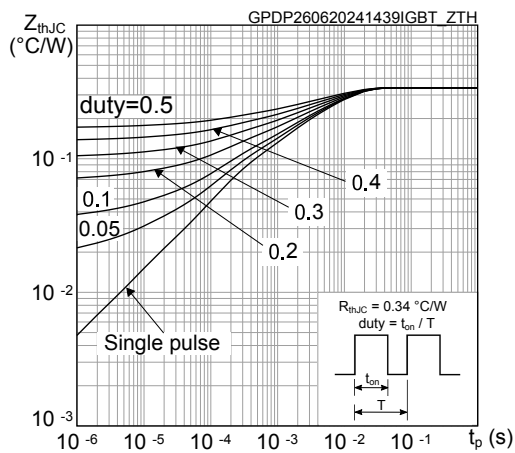
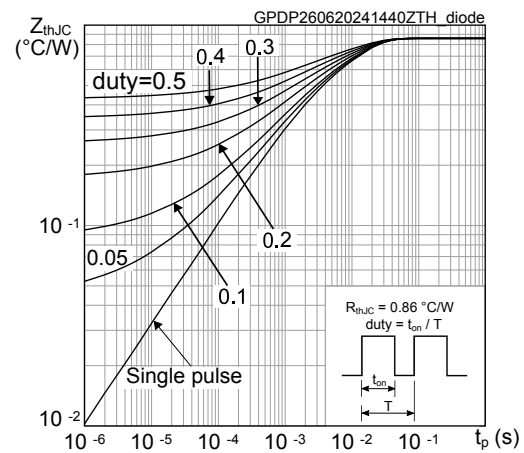


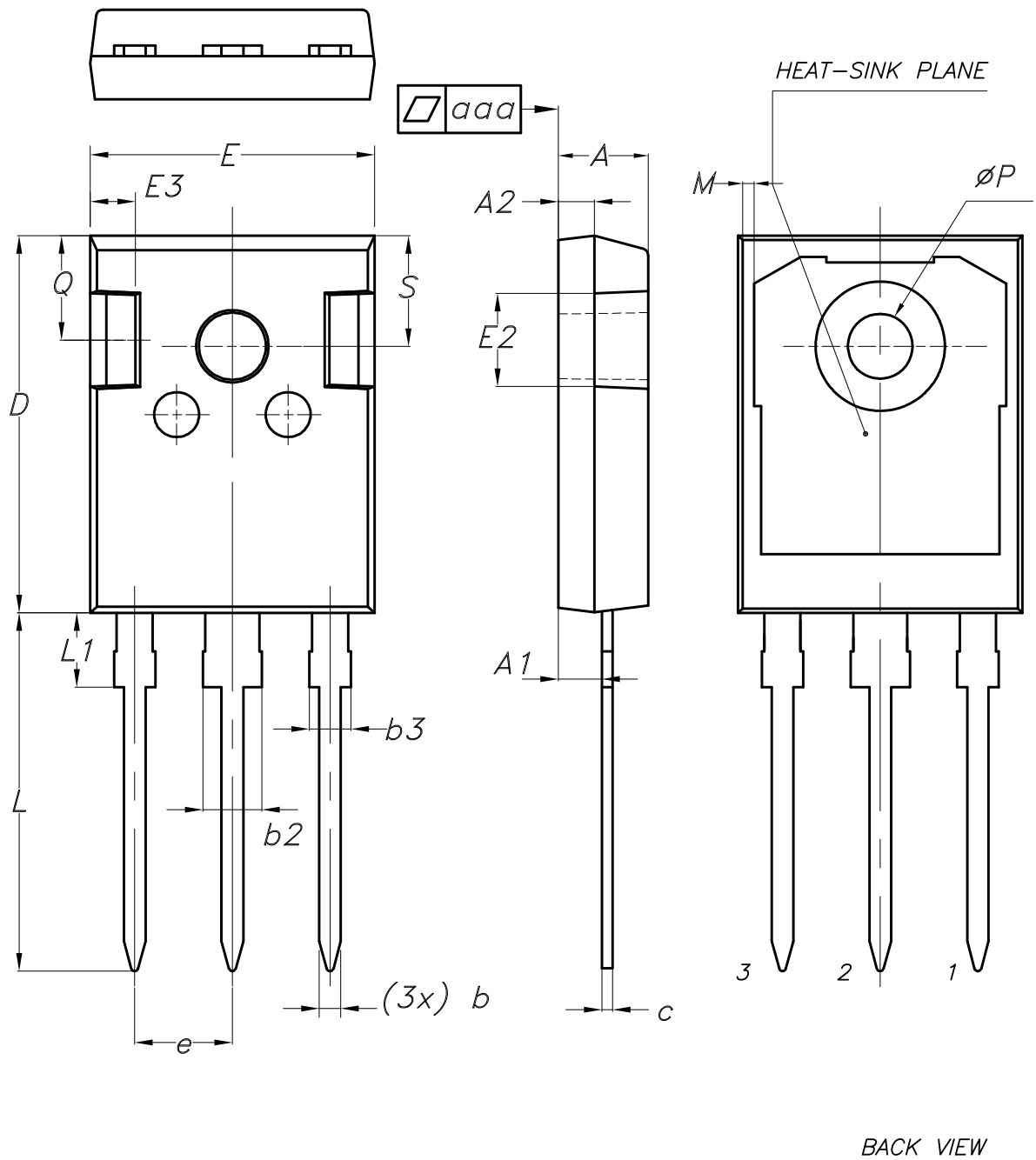
Figure 19. Typical reverse recovery current vs diode current slope

Figure 20. Typical reverse recovery time vs diode current slope

Figure 21. Typical reverse recovery charge vs diode current slope

Figure 22. Typical reverse recovery energy vs diode current slope

Figure 23. IGBT maximum transient thermal impedance

Figure 24. Diode maximum transient thermal impedance


4 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.

4.1 TO-247 long leads package information

Figure 29. TO-247 long leads package outline



BACK VIEW

8463846_5

Table 7. TO-247 long leads package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
b	1.16		1.26
b2			3.25
b3			2.25
c	0.59		0.66
D	20.90	21.00	21.10
E	15.70	15.80	15.90
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
e	5.34	5.44	5.54
L	19.80	19.92	20.10
L1			4.30
M	0.35		0.95
P	3.50	3.60	3.70
Q	5.60		6.00
S	6.05	6.15	6.25
aaa		0.04	0.10

Revision history

Table 8. Document revision history

Date	Revision	Changes
20-May-2016	1	First release.
26-Jun-2023	2	Updated <i>Section 4.1 TO-247 long leads package information</i> . Minor text changes.
01-Jul-2024	3	Modified <i>Features and Description</i> . Modified <i>Section 1: Electrical ratings, Section 2: Electrical characteristics</i> . Added <i>Section 2.1: Electrical characteristics (curves)</i> . Minor text changes.

Contents

1	Electrical ratings	2
2	Electrical characteristics	3
2.1	Electrical characteristics (curves)	5
3	Test circuits	9
4	Package information	10
4.1	TO-247 long leads package information	10
	Revision history	12

IMPORTANT NOTICE – 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 acknowledgment.

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. For additional information about ST trademarks, refer to www.st.com/trademarks. 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.

© 2024 STMicroelectronics – All rights reserved