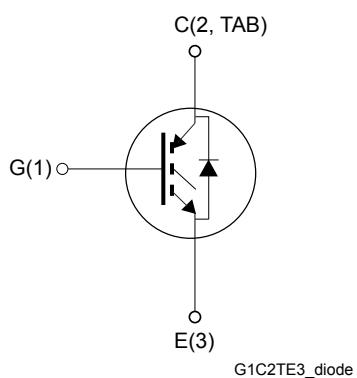
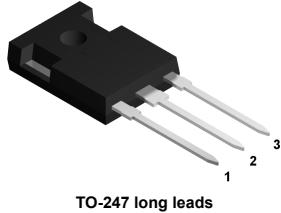


Automotive-grade trench gate field-stop 650 V, 30 A low-loss M series IGBT in a TO-247 long leads package

Features



- AEC-Q101 qualified
- Maximum junction temperature: $T_J = 175 \text{ }^{\circ}\text{C}$
- 6 μs of minimum short circuit withstand time
- Low $V_{CE(\text{sat})} = 1.7 \text{ V (typ.)} @ I_C = 30 \text{ A}$
- 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 ($t_p \leq 1$ µs, $T_J < 175$ °C)	120	A
V_{GE}	Gate-emitter voltage	±20	V
	Transient gate-emitter voltage ($t_p \leq 10$ µs, $D < 0.01$)	±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

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

Table 3. Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{CES}}$	Collector-emitter breakdown voltage	$V_{GE} = 0 \text{ V}, I_C = 250 \mu\text{A}$	650			V
$V_{CE(\text{sat})}$	Collector-emitter saturation voltage	$V_{GE} = 15 \text{ V}, I_C = 30 \text{ A}$		1.60	2.0	V
		$V_{GE} = 15 \text{ V}, I_C = 30 \text{ A}, T_J = 125^\circ\text{C}$		1.85		
		$V_{GE} = 15 \text{ V}, I_C = 30 \text{ A}, T_J = 175^\circ\text{C}$		2.02		
V_F	Forward on-voltage	$I_F = 30 \text{ A}$		1.86	2.65	V
		$I_F = 30 \text{ A}, T_J = 125^\circ\text{C}$		1.6		
		$I_F = 30 \text{ A}, T_J = 175^\circ\text{C}$		1.5		
$V_{GE(\text{th})}$	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/μs	
$t_{d(off)}$	Turn-off delay time		138	-	ns	
t_f	Current fall time		154	-	ns	
$E_{on}^{(1)}$	Turn-on switching energy		756	-	μJ	
$E_{off}^{(2)}$	Turn-off switching energy		1057	-	μJ	
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400 \text{ V}, I_C = 30 \text{ A}, V_{GE} = 15 \text{ V}, R_G = 10 \Omega, T_J = 175 \text{ °C}$ (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/μs	
$t_{d(off)}$	Turn-off delay time		152.5	-	ns	
t_f	Current fall time		266	-	ns	
$E_{on}^{(1)}$	Turn-on switching energy		1334	-	μJ	
$E_{off}^{(2)}$	Turn-off switching energy		1582	-	μJ	
t_{sc}	Short-circuit withstand time	$V_{CC} = 400 \text{ V}, V_{GE} = 15 \text{ V}$, starting $T_J \leq 150 \text{ °C}$	6		-	μs

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

2.1 Electrical characteristics (curves)

Figure 1. Total power dissipation vs temperature

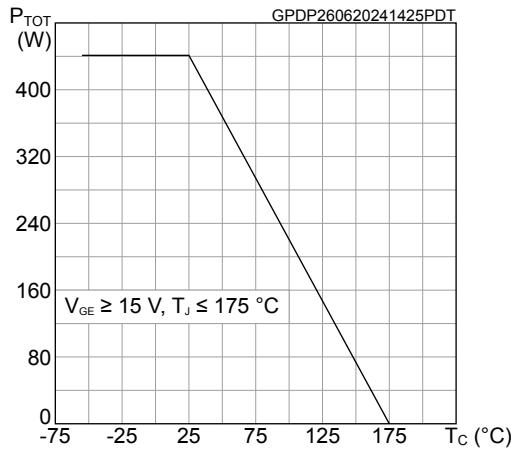


Figure 2. Collector current vs temperature

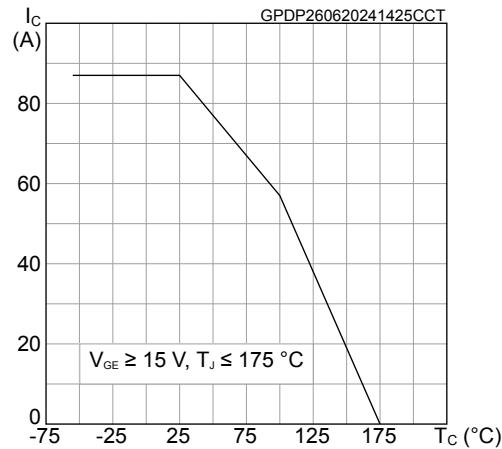


Figure 3. Typical output characteristics ($T_J = 25 \text{ }^{\circ}\text{C}$)

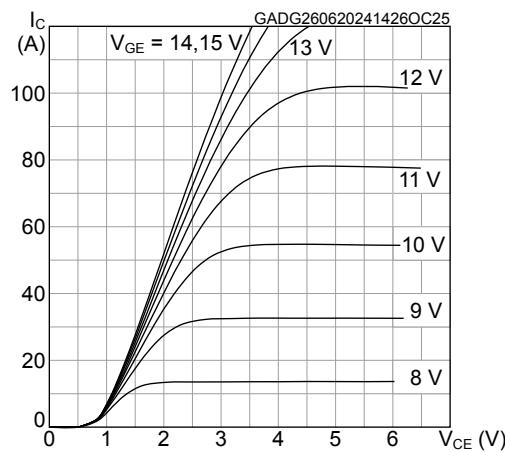


Figure 4. Typical output characteristics ($T_J = 175 \text{ }^{\circ}\text{C}$)

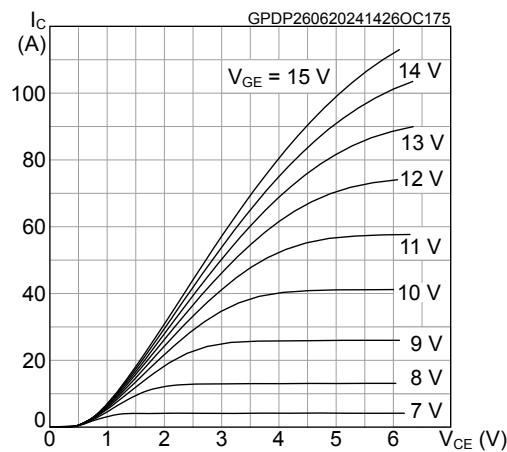


Figure 5. Typical transfer characteristics

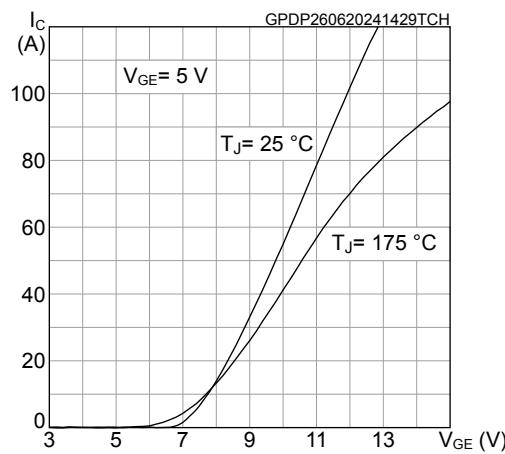


Figure 6. Typical $V_{CE(sat)}$ vs temperature

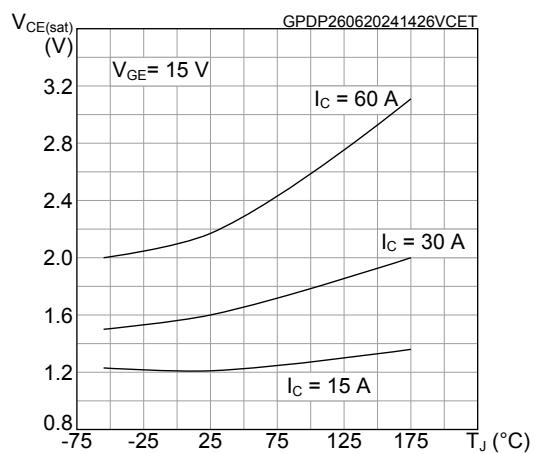


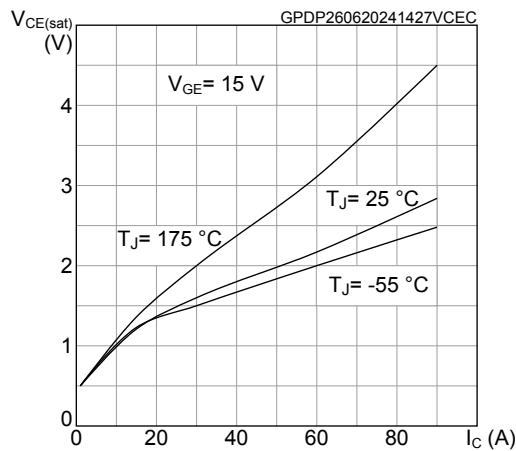
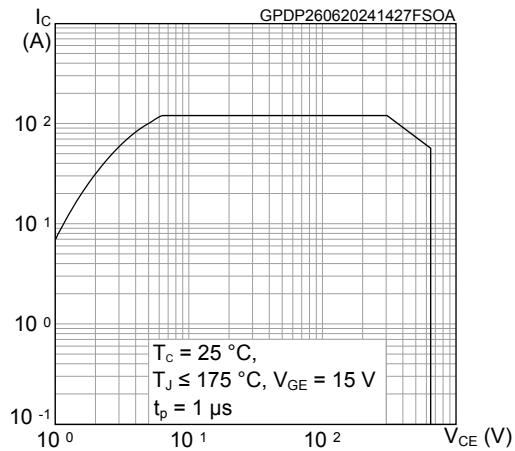
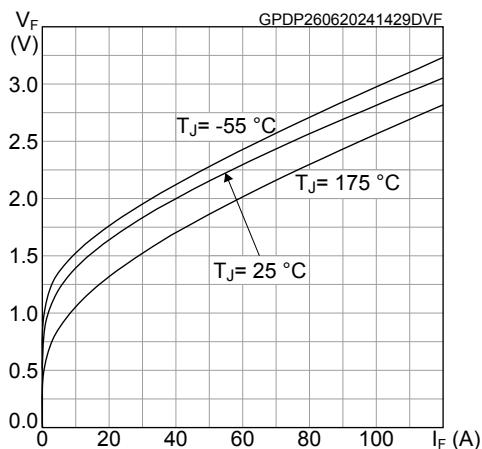
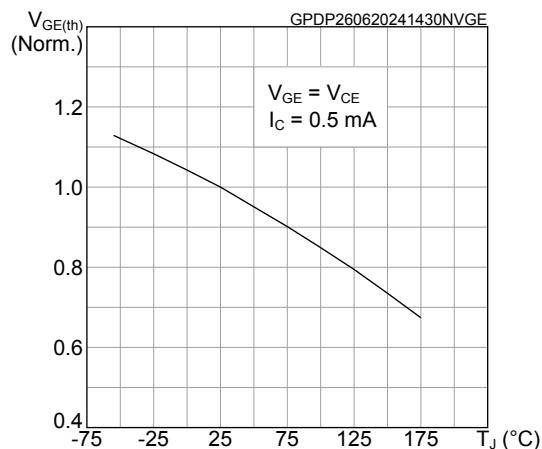
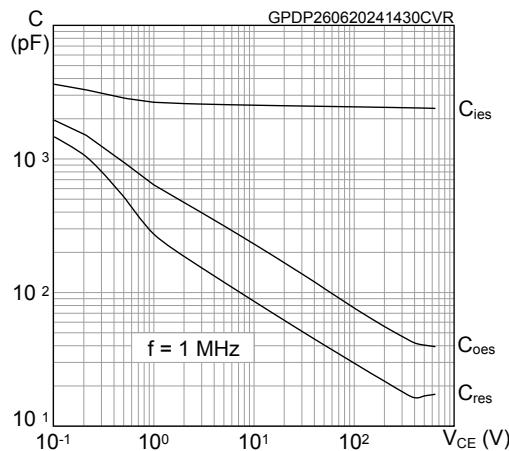
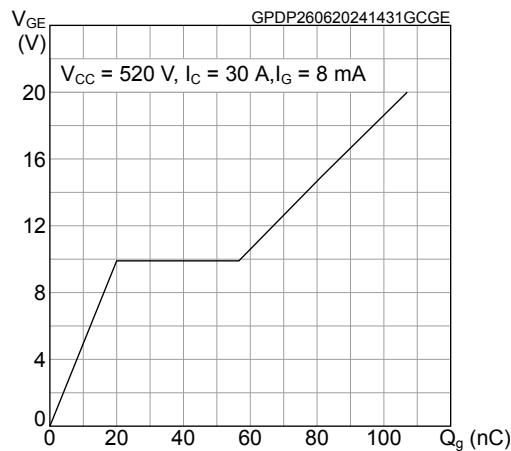
Figure 7. Typical $V_{CE(sat)}$ vs collector current

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


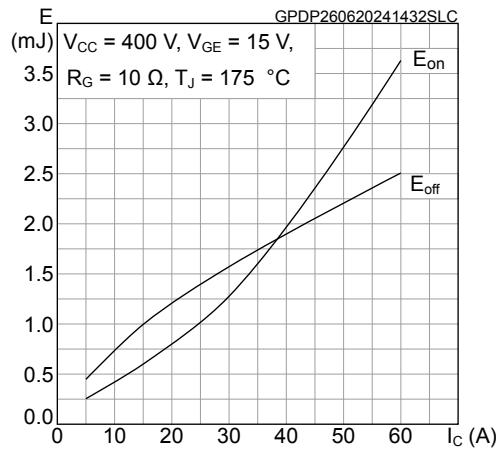
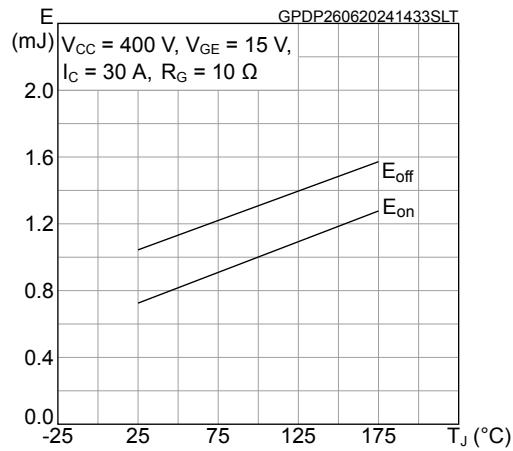
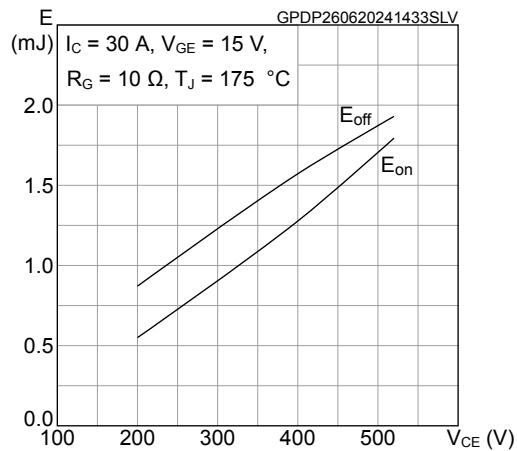
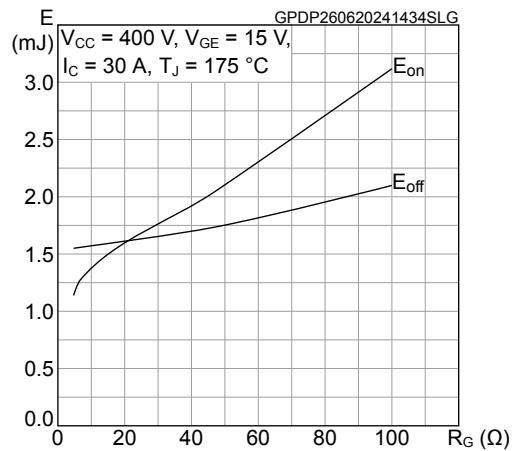
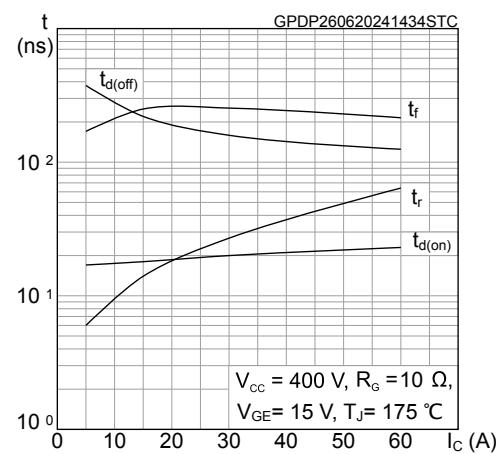
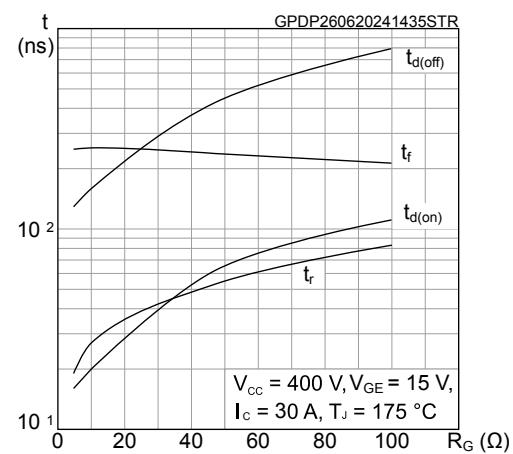
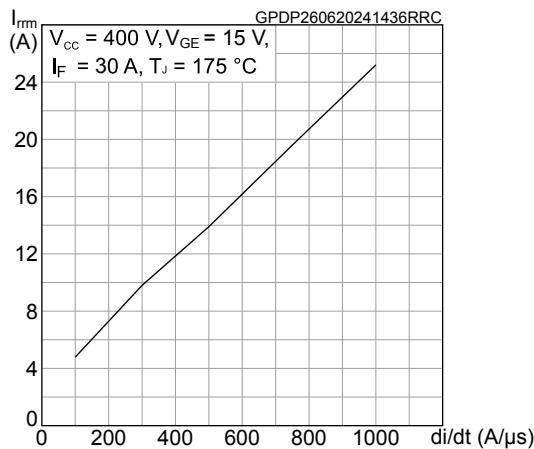
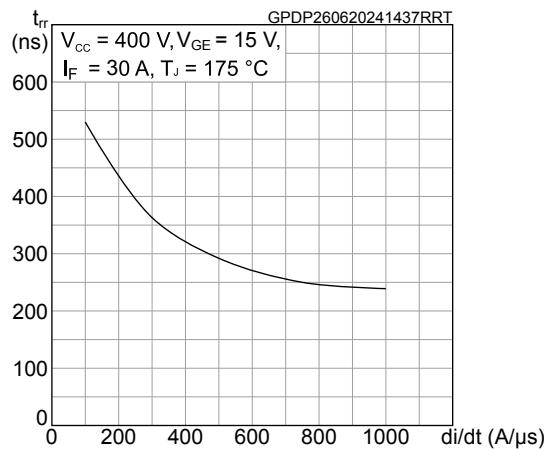
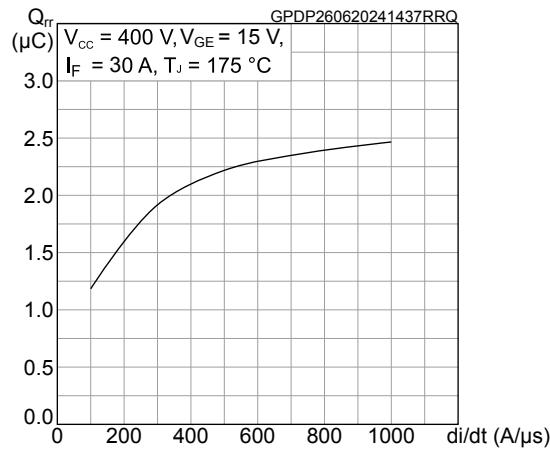
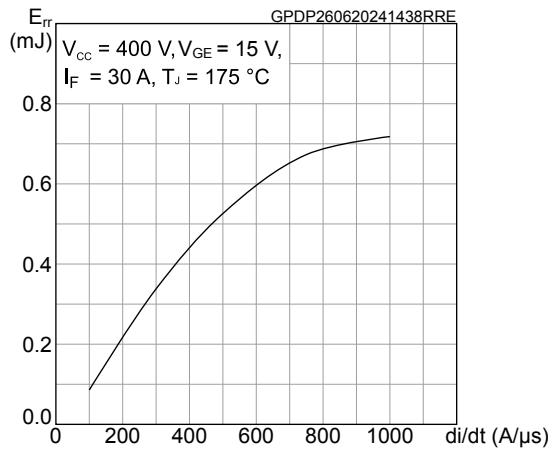
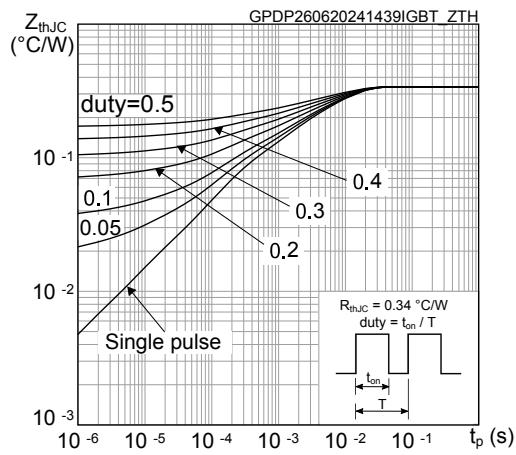
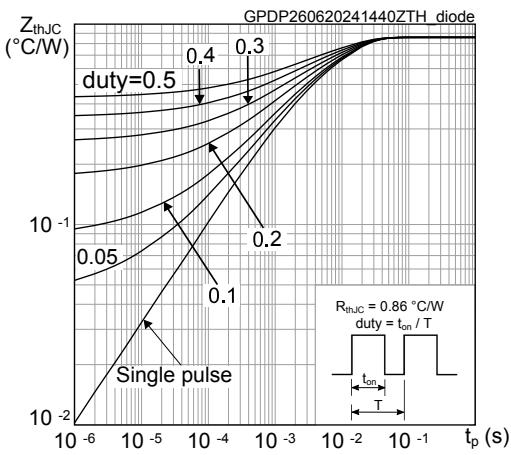
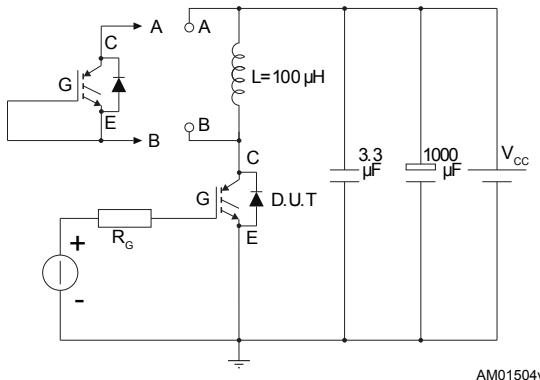
Figure 13. Typical switching energy vs collector current

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


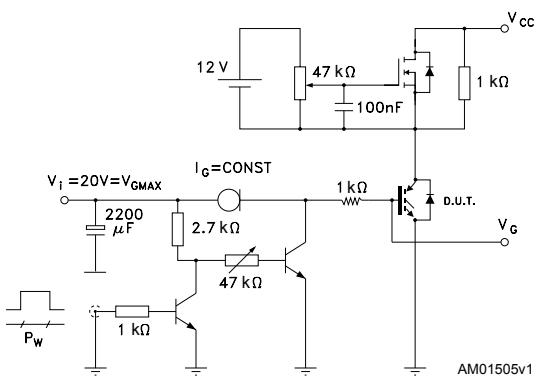
3 Test circuits

Figure 25. Test circuit for inductive load switching



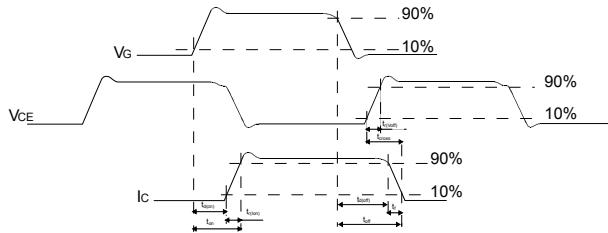
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Figure 26. Gate charge test circuit



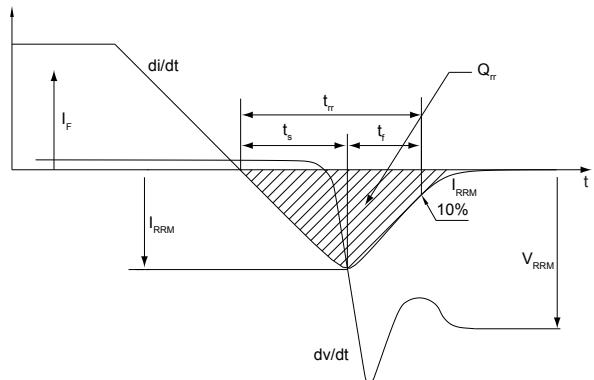
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Figure 27. Switching waveform



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Figure 28. Diode reverse recovery waveform



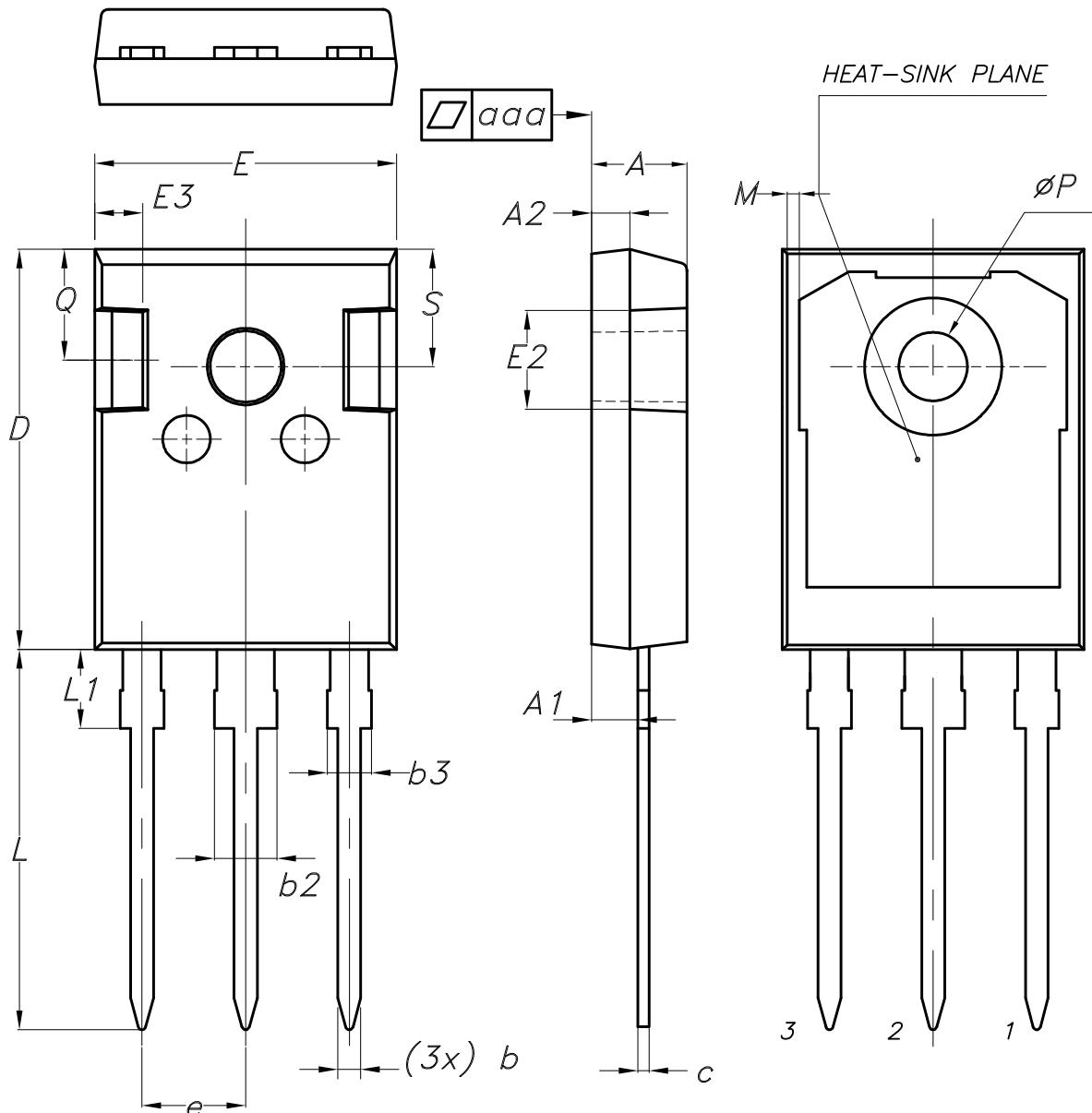
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4 Package information

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 Features and Description. Modified Section 1: Electrical ratings, Section 2: Electrical characteristics. Added Section 2.1: Electrical characteristics (curves). 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

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