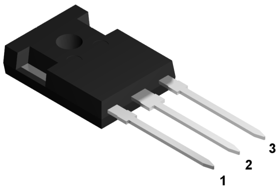
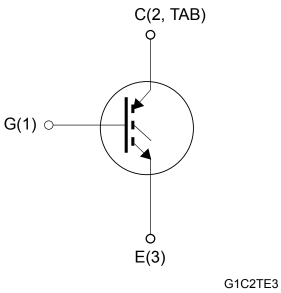
GWA40MS120F4AG

Datasheet

Automotive-grade trench gate field-stop, 1200 V, 40 A, low-loss MS series IGBT in a TO-247 long leads package



TO-247 long leads



Product status link
GWA40MS120F4AG

Product summary	
Order code	GWA40MS120F4AG
Marking	G40MS120F4AG
Package	TO-247 long leads
Packing	Tube

Features

- AEC-Q101 qualified
- 8 µs of short-circuit withstand time at V_{CC} = 800 V, V_{GE} = 15 V, T_J (start) = 175 °C
- $V_{CE(sat)}$ = 1.95 V (typ.) @ I_C = 40 A
- Tight parameter distribution
- Positive $V_{CE(sat)}$ temperature coefficient
- Low thermal resistance

Applications

- Auxiliary loads
- Thermal management
- PTC heaters

Description

This device is an IGBT developed using an advanced proprietary trench gate field-stop structure. The device is part of the MS series IGBTs, which represent an evolution of low-loss M series specifically designed for inverter system thanks to the outstanding short-circuit capability at high bus voltage value. Furthermore, the slightly positive $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	1200	V
I_C	Continuous collector current at T_C = 25 °C	80	A
	Continuous collector current at T_C = 100 °C	40	
I_{CP} (1)	Pulsed collector current	120	A
V_{GE}	Gate-emitter voltage	±20	V
P_{TOT}	Total power dissipation at T_C = 25 °C	536	W
T_{stg}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range	-55 to 175	°C

1. *Pulse width is limited by maximum junction temperature.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	0.28	°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	50	°C/W

2 Electrical characteristics

T_C = 25 °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 V, I_C = 2 mA	1200			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 40 A		1.95	2.3	V
		V_{GE} = 15 V, I_C = 40 A, T_J = 125 °C		2.25		
		V_{GE} = 15 V, I_C = 40 A, T_J = 175 °C		2.35		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 2 mA	5	6	7	V
I_{CES}	Collector cut-off current	V_{GE} = 0 V, V_{CE} = 1200 V			25	µA
I_{GES}	Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = ±20 V			250	nA

Table 4. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0 V	-	2700	-	pF
C_{oes}	Output capacitance		-	185	-	pF
C_{res}	Reverse transfer capacitance		-	101	-	pF
Q_g	Total gate charge	V_{CC} = 960 V, I_C = 40 A, V_{GE} = 0 to 15 V (see Figure 22. Gate charge test circuit)	-	147	-	nC
Q_{ge}	Gate-emitter charge		-	24	-	nC
Q_{gc}	Gate-collector charge		-	79.5	-	nC

Table 5. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CC} = 600 V, I_C = 40 A, V_{GE} = 15 V, R_G = 10 Ω (see Figure 21. Test circuit for inductive load switching)		35	-	ns
t_r	Current rise time			15	-	ns
$(di/dt)_{on}$	Turn-on current slope			2100	-	A/µs
$t_{d(off)}$	Turn-off delay time			140	-	ns
t_f	Current fall time			135	-	ns
E_{on}	Turn-on switching energy			1.5	-	mJ
E_{off} (1)	Turn-off switching energy			3.3	-	mJ
E_{ts}	Total switching energy			4.8	-	mJ
$t_{d(on)}$	Turn-on delay time	V_{CC} = 600 V, I_C = 40 A, V_{GE} = 15 V, R_G = 10 Ω, T_J = 175 °C (see Figure 21. Test circuit for inductive load switching)		35	-	ns
t_r	Current rise time			18	-	ns
$(di/dt)_{on}$	Turn-on current slope			1800	-	A/µs
$t_{d(off)}$	Turn-off delay time			150	-	ns
t_f	Current fall time			240	-	ns
E_{on}	Turn-on switching energy			2.8	-	mJ
E_{off} (1)	Turn-off switching energy			5.2	-	mJ
E_{ts}	Total switching energy			8.0	-	mJ
t_{sc}	Short-circuit withstand time	V_{CE} = 800 V, V_{GE} = 15 V, T_J (start) = 175 °C	8		-	µs

1. *Including the tail of the collector current.*

2.1 Electrical characteristics (curves)

Figure 1. **Power dissipation vs case temperature**

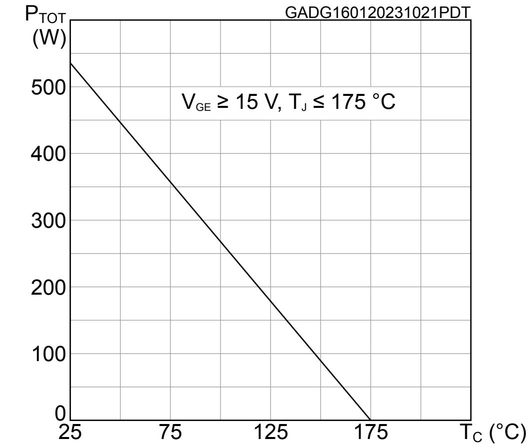


Figure 2. **Collector current vs case temperature**

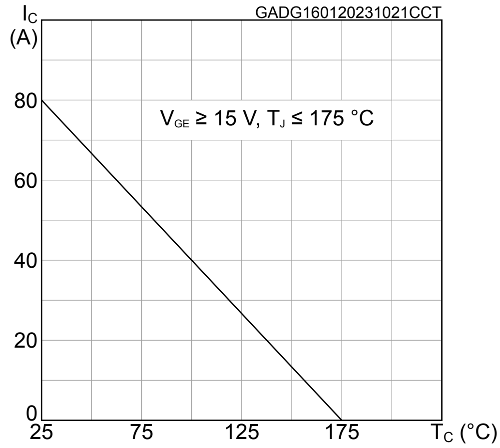


Figure 3. **Typical output characteristics (T_J = 25 °C)**

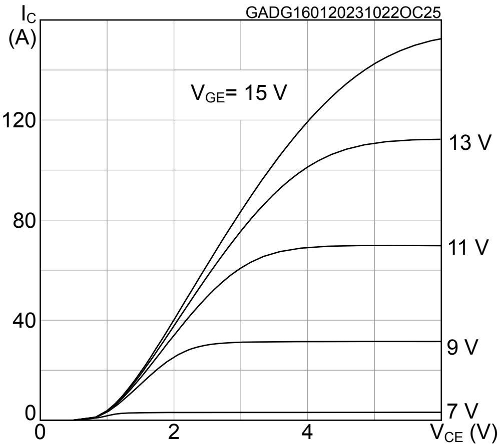


Figure 4. **Typical output characteristics (T_J = 175 °C)**

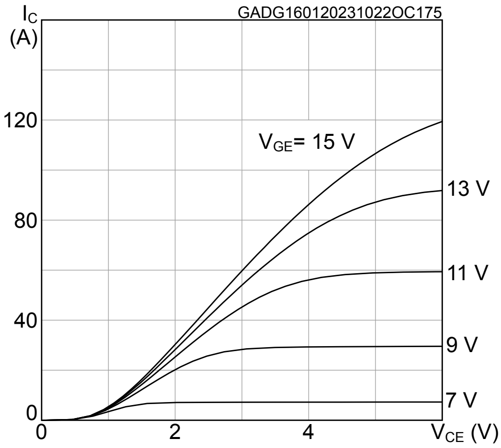


Figure 5. **$V_{CE(sat)}$ vs junction temperature**

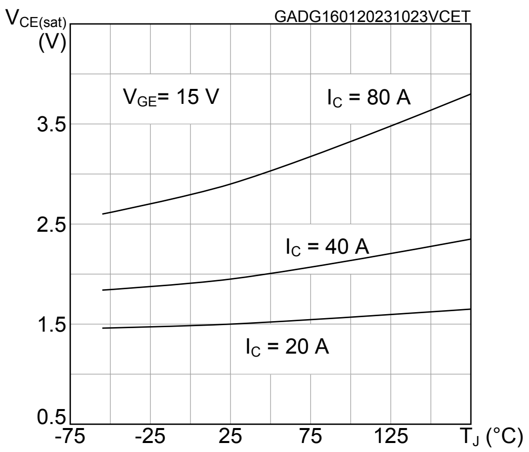


Figure 6. **$V_{CE(sat)}$ vs collector current**

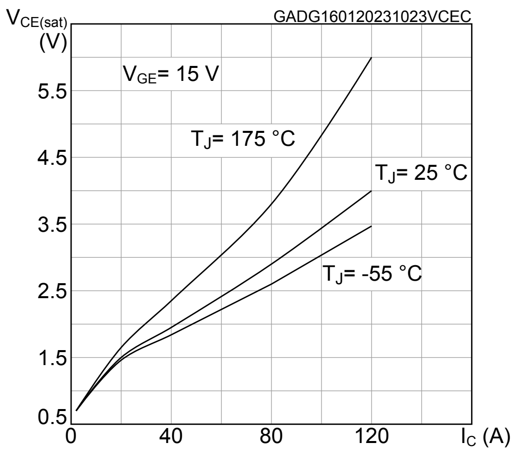


Figure 7. Forward bias safe operating area

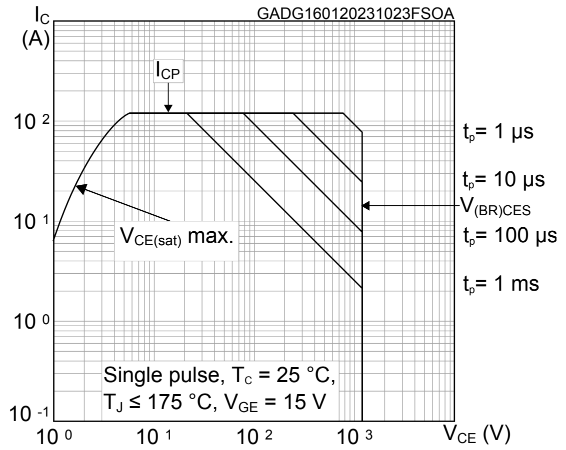


Figure 8. Collector current vs switching frequency

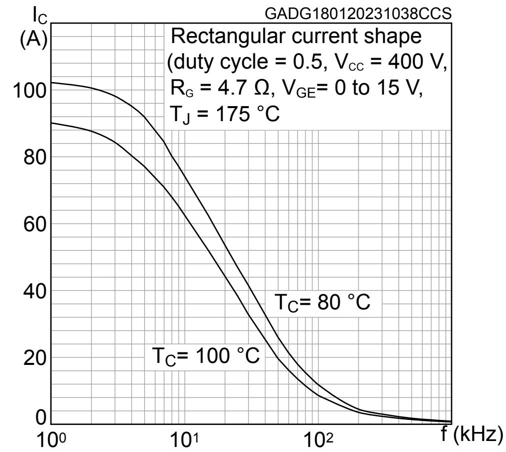


Figure 9. Typical transfer characteristics

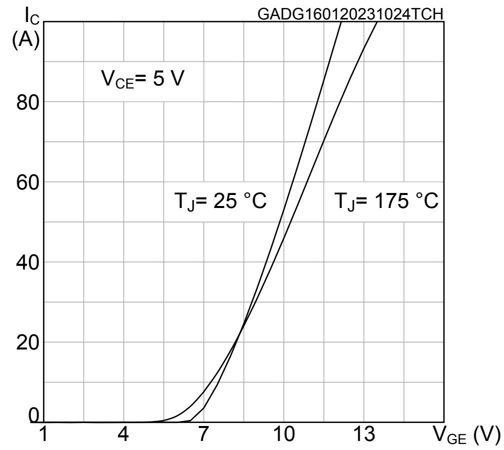


Figure 10. Normalized $V_{GE(th)}$ vs junction temperature

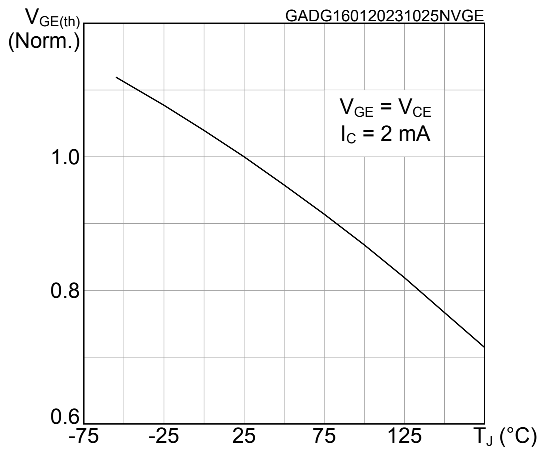


Figure 11. Normalized $V_{(BR)CES}$ vs junction temperature

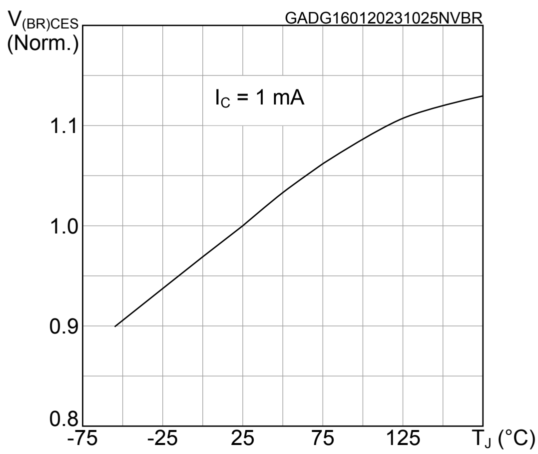


Figure 12. Typical capacitance variations

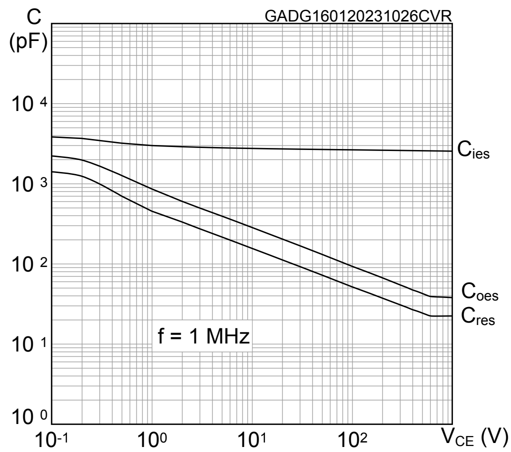


Figure 13. Typical gate charge characteristics

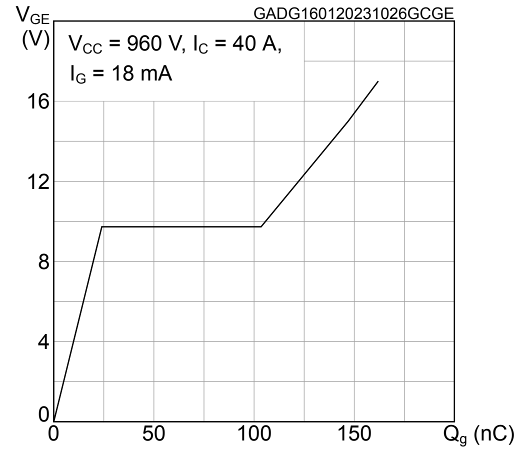


Figure 14. Typical switching energy vs collector current

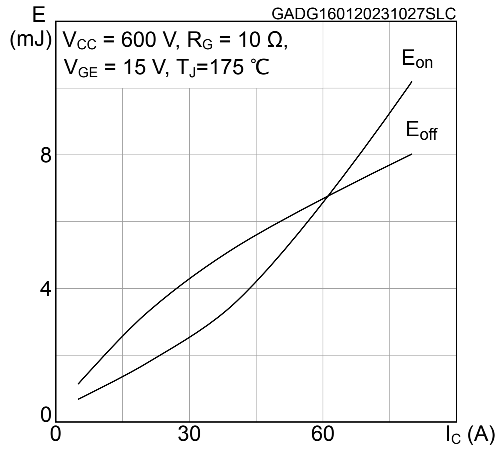


Figure 15. Typical switching energy vs temperature

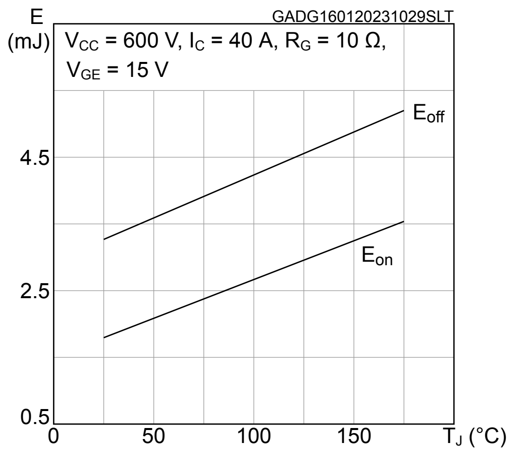


Figure 16. Typical switching energy vs collector emitter voltage

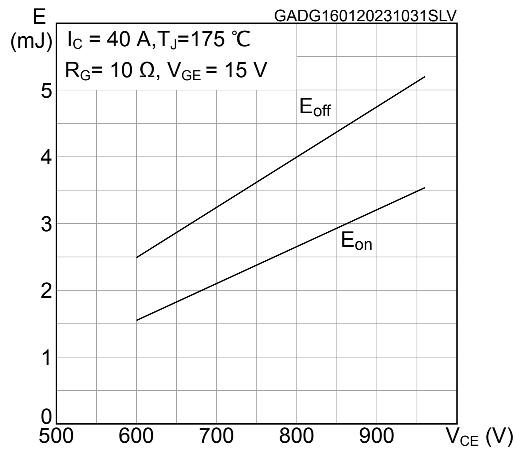


Figure 17. Typical switching energy vs gate resistance

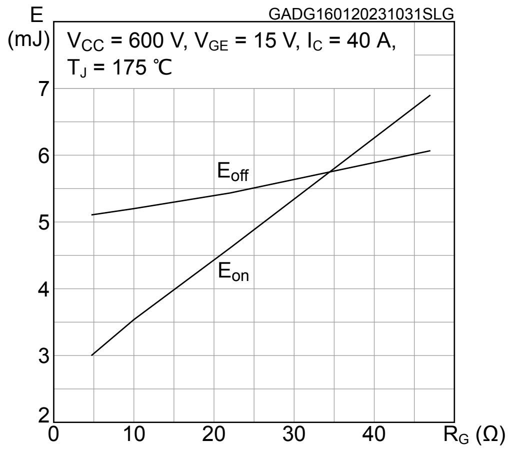


Figure 18. Typical switching times vs collector current

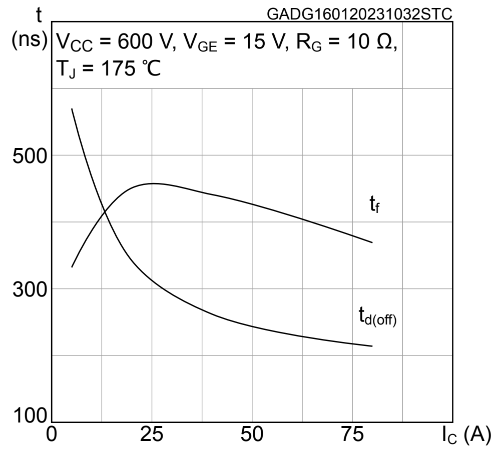


Figure 19. Typical switching times vs gate resistance

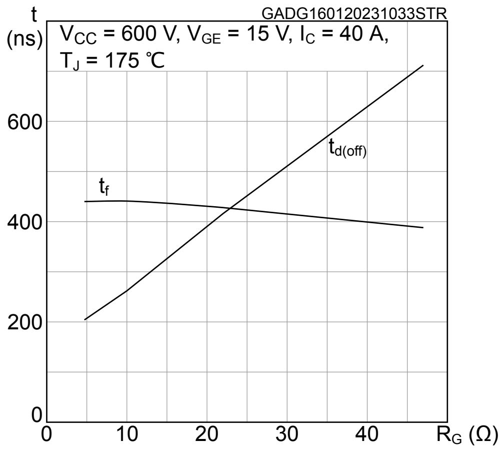
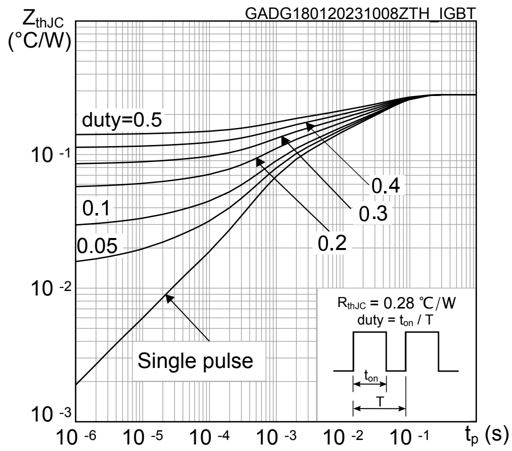


Figure 20. Maximum transient thermal impedance



3 Test circuits

Figure 21. Test circuit for inductive load switching

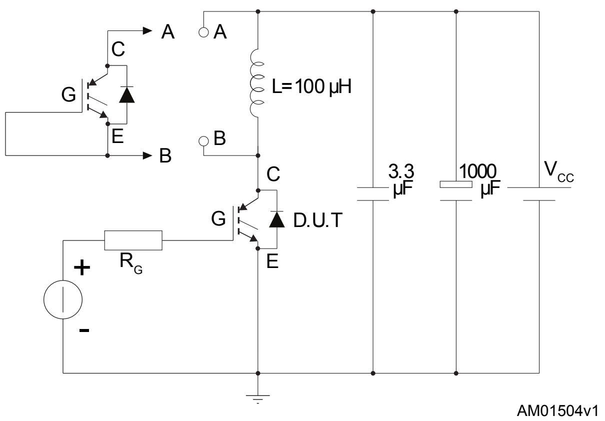


Figure 22. Gate charge test circuit

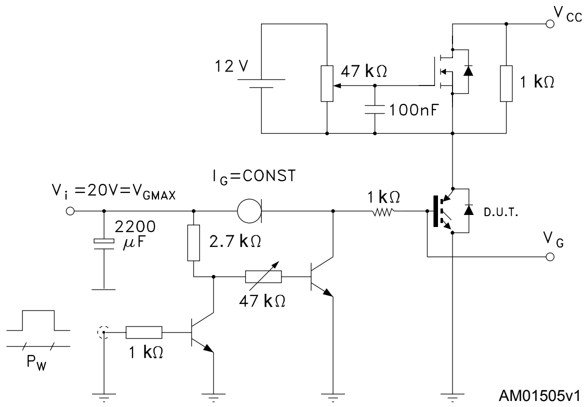
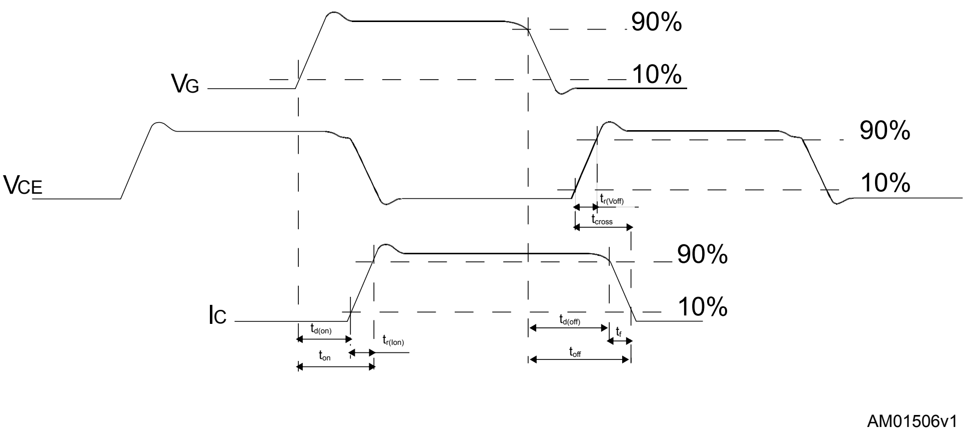


Figure 23. Switching waveform



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 24. **TO-247 long leads package outline**

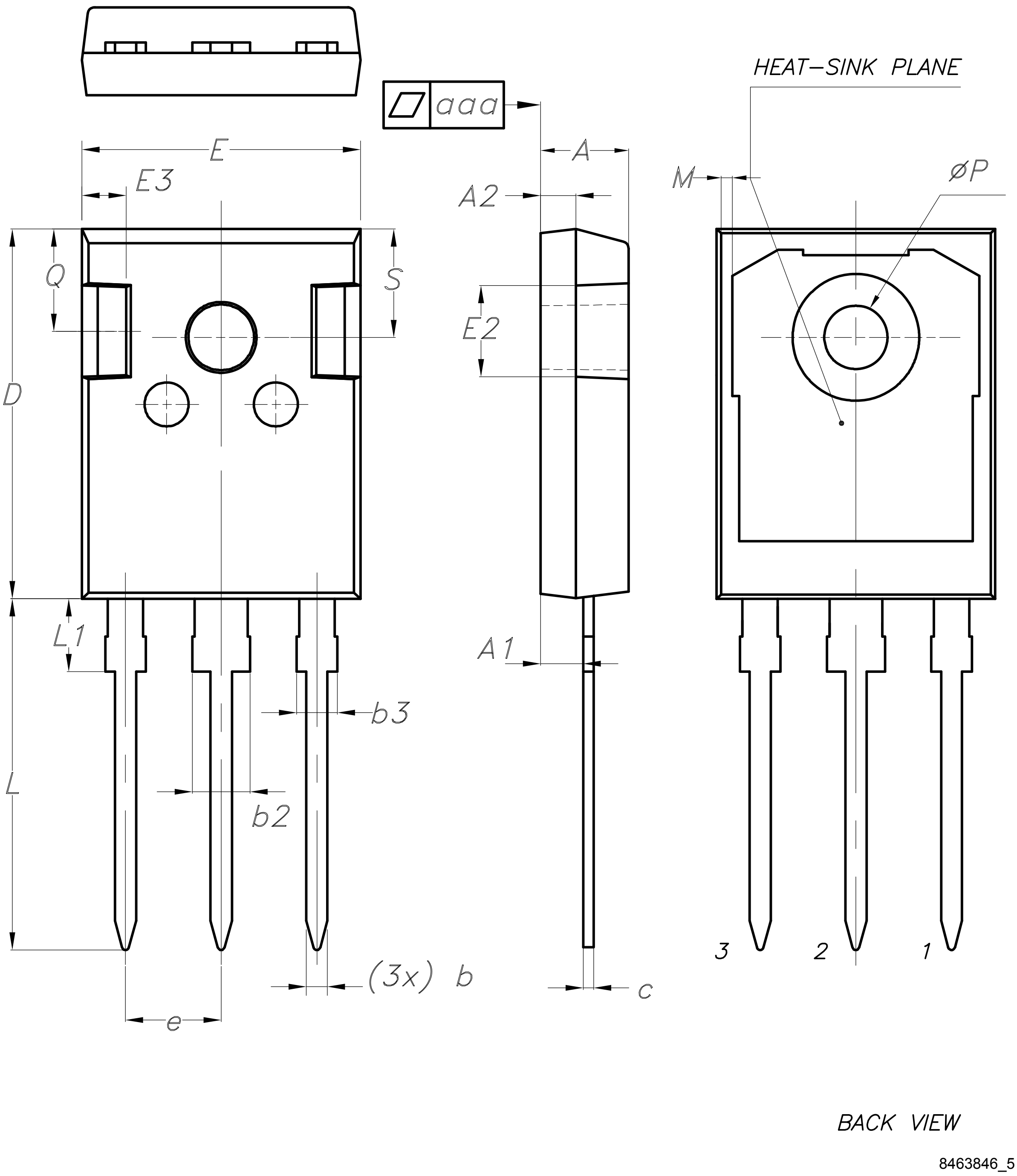


Table 6. **TO-247 long leads package mechanical data**

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 7. Document revision history

Date	Revision	Changes
13-Sep-2023	1	First release.

Contents

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