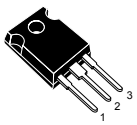
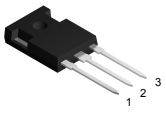
STGW60V60DF, STGWA60V60DF

Datasheet

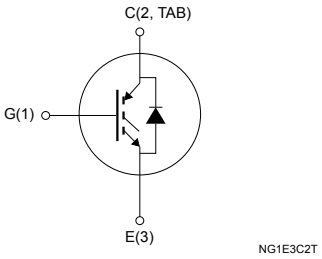
Trench gate field-stop 650 V, 60 A high speed V series IGBT in a TO-247 and TO-247 long leads packages



TO-247



TO-247 long leads



Features

- Maximum junction temperature: T_J = 175 °C
- Tail-less switching off
- $V_{CE(sat)}$ = 1.85 V (typ.) @ I_C = 60 A
- Tight parameter distribution
- Safe paralleling
- Low thermal resistance
- Very fast soft recovery antiparallel diode

Applications

- Photovoltaic inverters
- Uninterruptible power supply
- Welding
- Power factor correction
- Very high frequency converters

Description

These devices are IGBTs developed using an advanced proprietary trench gate field-stop structure. The device is part of the V series IGBTs, which represent an optimum compromise between conduction and switching losses to maximize the efficiency of very high frequency converters. Furthermore, the positive VCE(sat) temperature coefficient and very tight parameter distribution result in safer paralleling operation.

Product status links
STGW60V60DF
STGWA60V60DF

Product summary	
Order code	**STGW60V60DF**
Marking	GW60V60DF
Package	TO-247
Packing	Tube
Order code	**STGWA60V60DF**
Marking	G60V60DF
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)	600	V
I_C	Continuous collector current at T_C = 25 °C	80(1)	A
	Continuous collector current at T_C = 100 °C	60	
I_{CP}(2)	Pulsed collector current	240	A
V_{GE}	Gate-emitter voltage	±20	V
I_F	Continuous forward current at T_C = 25 °C	80(1)	A
	Continuous forward current at T_C = 100 °C	60	
I_{FP}(2)	Pulsed forward current	240	A
P_{TOT}	Total power dissipation at T_C = 25 °C	375	W
T_{STG}	Storage temperature range	- 55 to 150	°C
T_J	Operating junction temperature range	- 55 to 175	

1. *Limited by bonding wires.*
2. *Pulse width limited by maximum junction temperature.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case IGBT.	0.4	°C/W
	Thermal resistance, junction-to-case diode.	1.14	
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	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 60 A		1.85	2.30	V
		V_{GE} = 15 V, I_C = 60 A, T_J = 125 °C		2.15		
		V_{GE} = 15 V, I_C = 60 A, T_J = 175 °C		2.35		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 1 mA	5	6	7	V
V_F	Forward on-voltage	I_F = 60 A		2	2.6	V
		I_F = 60 A, T_J = 125 °C		1.7		
		I_F = 60 A, T_J = 175 °C		1.6		
I_{CES}	Collector cut-off current	V_{GE} = 0 V, V_{CE} = 600 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	-	8000	-	pF
C_{oes}	Output capacitance		-	280	-	pF
C_{res}	Reverse transfer capacitance		-	170	-	pF
Q_g	Total gate charge	V_{CC} = 480 V, I_C = 60 A, V_{GE} = 0 to 15 V (see Figure 28)	-	334	-	nC
Q_{ge}	Gate-emitter charge		-	130	-	nC
Q_{gc}	Gate-collector charge		-	58	-	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 V, I_C = 60 A, R_G = 4.7 Ω, V_{GE} = 15 V (see Figure 27)	-	60	-	ns
t_r	Current rise time		-	20	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	2365	-	A/µs
$t_{d(off)}$	Turn-off delay time		-	208	-	ns
t_f	Current fall time		-	14	-	ns
E_{on} (1)	Turn-on switching energy		-	0.75	-	mJ
E_{off} (2)	Turn-off switching energy		-	0.55	-	mJ
E_{ts}	Total switching energy		-	1.3	-	mJ
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 60 A, R_G = 4.7 Ω, V_{GE} = 15 V, T_J = 175 °C (see Figure 27)	-	57	-	ns
t_r	Current rise time		-	23	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	2191		A/µs
$t_{d(off)}$	Turn-off delay time		-	216		ns
t_f	Current fall time		-	27		ns
E_{on} (1)	Turn-on switching energy		-	1.5		mJ
E_{off} (2)	Turn-off switching energy		-	0.8		mJ
E_{ts}	Total switching energy		-	2.3		mJ

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 = 60 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 1000 A/µs (see Figure 27)	-	74	-	ns
Q_{rr}	Reverse recovery charge		-	703	-	nC
I_{rrm}	Reverse recovery current		-	19	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	714	-	A/µs
E_{rr}	Reverse recovery energy		-	184	-	µJ
t_{rr}	Reverse recovery time	I_F = 60 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 1000 A/µs, T_J = 175 °C (see Figure 27)	-	131	-	ns
Q_{rr}	Reverse recovery charge		-	2816	-	nC
I_{rrm}	Reverse recovery current		-	43	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	404	-	A/µs
E_{rr}	Reverse recovery energy		-	821	-	µJ

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs case temperature

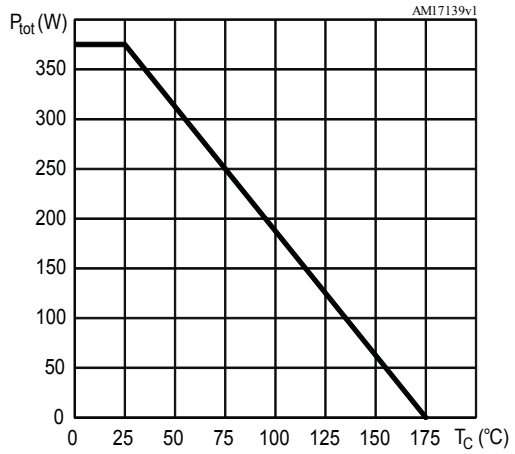


Figure 2. Collector current vs case temperature

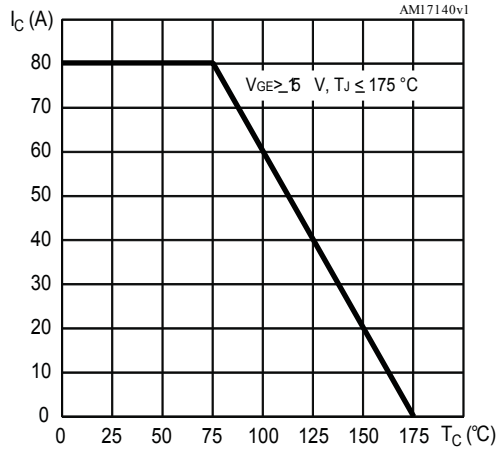


Figure 3. Output characteristics (T_J = 25 °C)

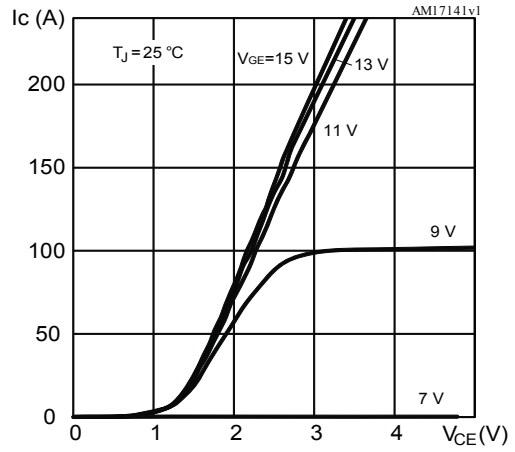


Figure 4. Output characteristics (T_J = 175 °C)

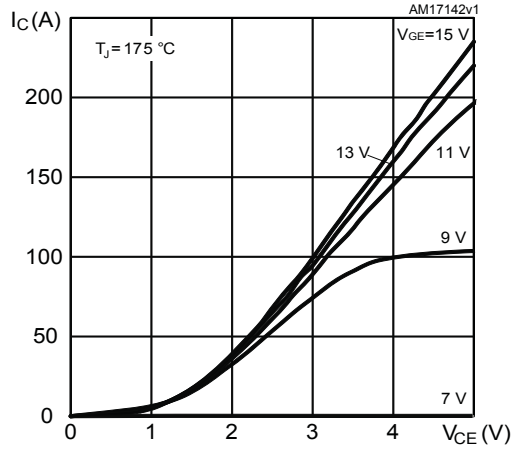


Figure 5. $V_{CE(sat)}$ vs junction temperature

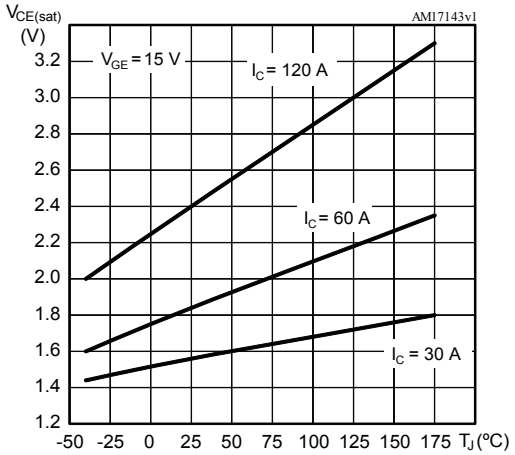


Figure 6. $V_{CE(sat)}$ vs collector current

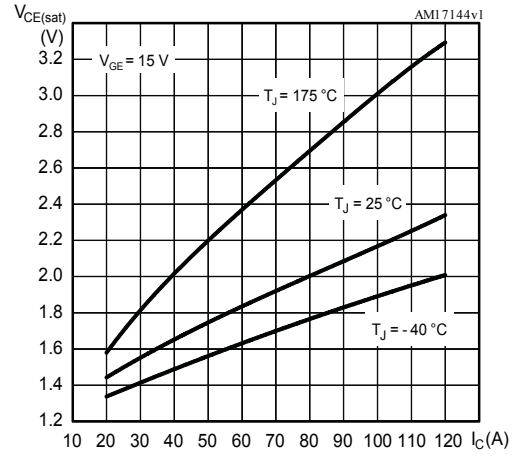


Figure 7. Collector current vs. switching frequency

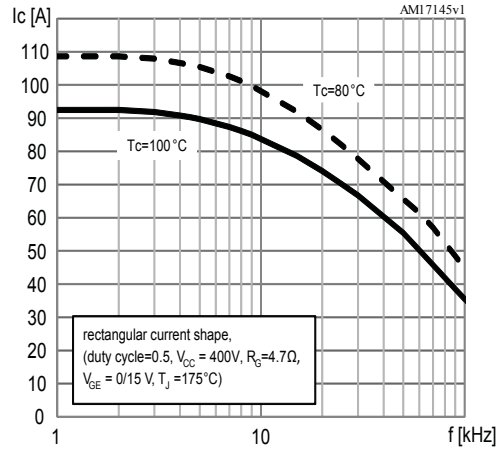


Figure 8. Safe operating area

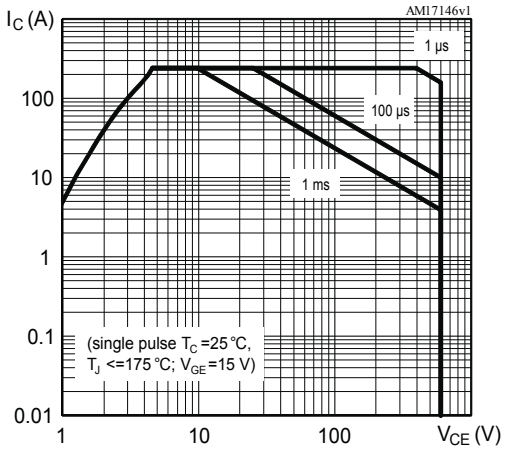


Figure 9. Transfer characteristics

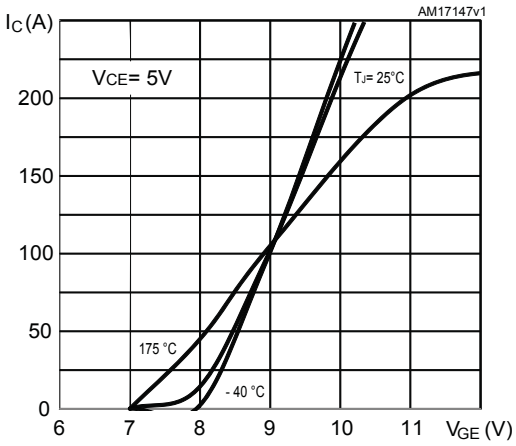


Figure 10. Diode V_F vs. forward current

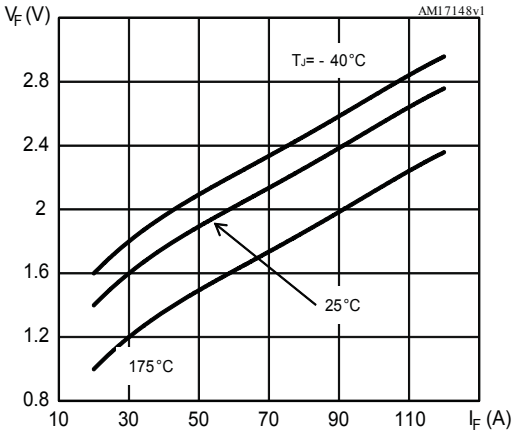


Figure 11. Normalized $V_{GE(th)}$ vs junction temperature

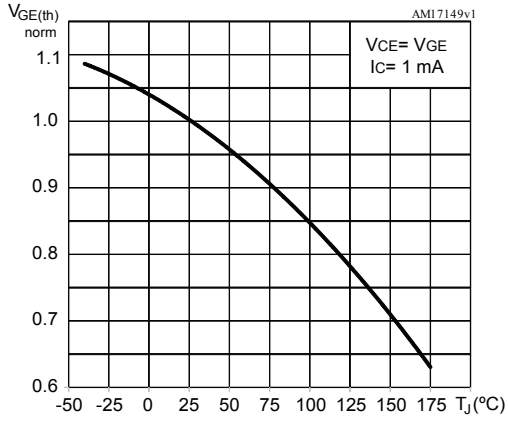


Figure 12. Normalized $V_{(BR)CES}$ vs junction temperature

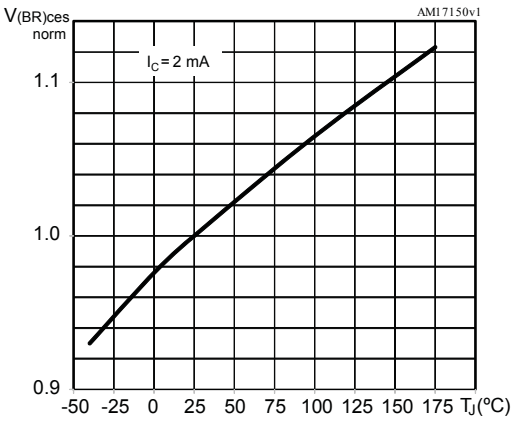


Figure 13. Capacitance variations

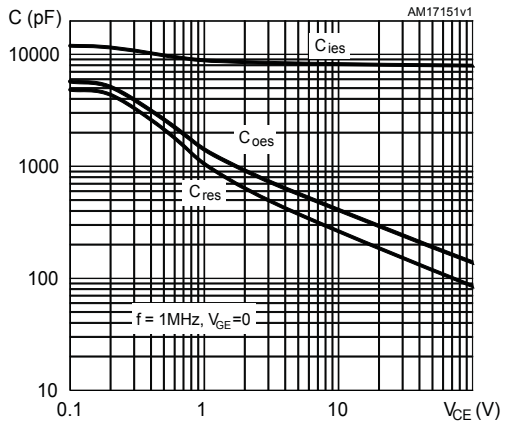


Figure 14. Gate charge vs gate-emitter voltage

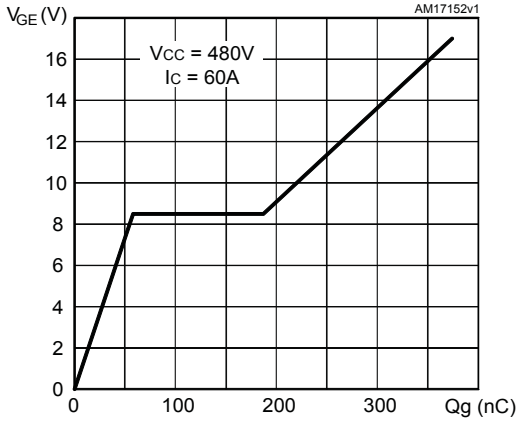


Figure 15. Switching energy vs collector current

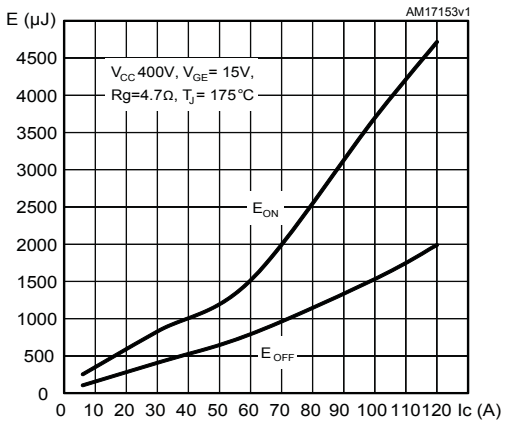


Figure 16. Switching energy vs gate resistance

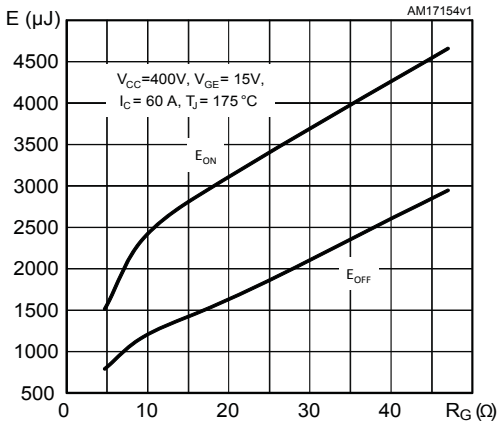


Figure 17. Switching energy vs junction temperature

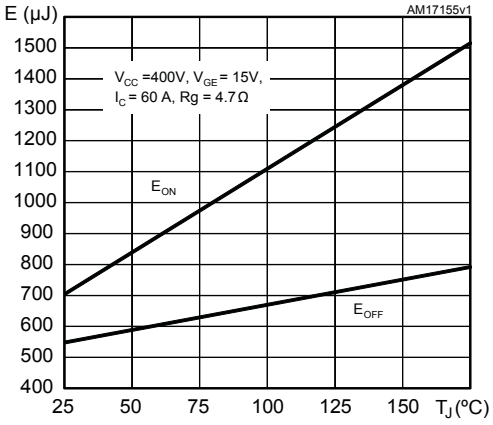


Figure 18. Switching energy vs collector-emitter voltage

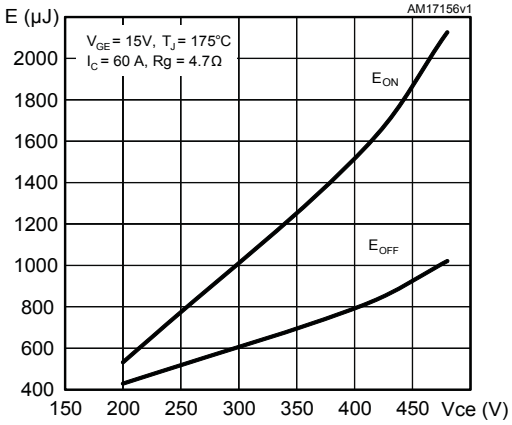


Figure 19. Switching times vs collector current

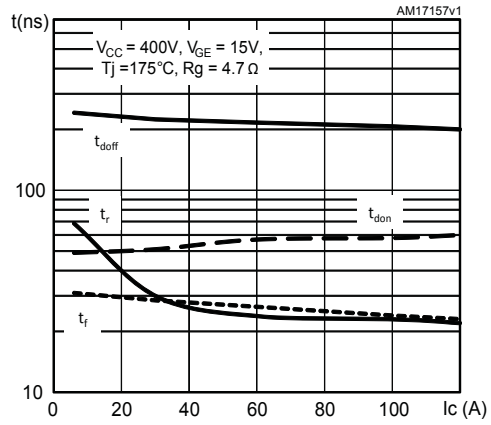


Figure 20. Switching times vs gate resistance

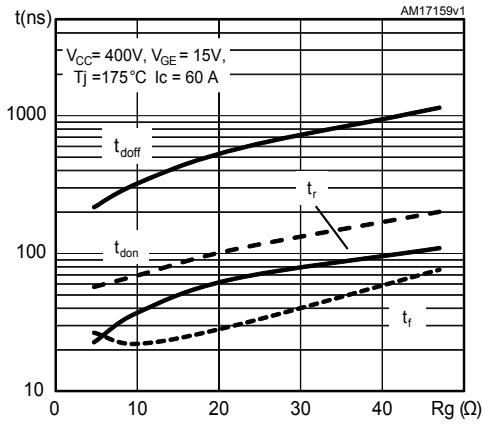


Figure 21. Reverse recovery current vs. diode current slope

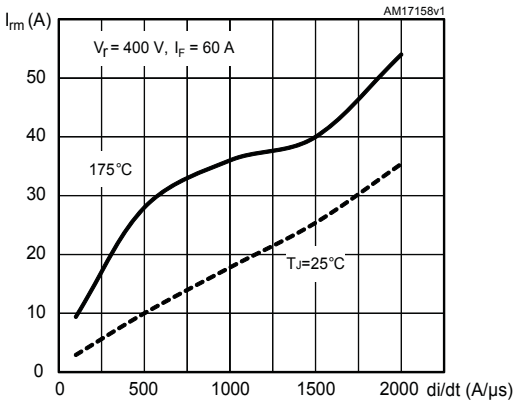


Figure 22. Reverse recovery time vs. diode current slope

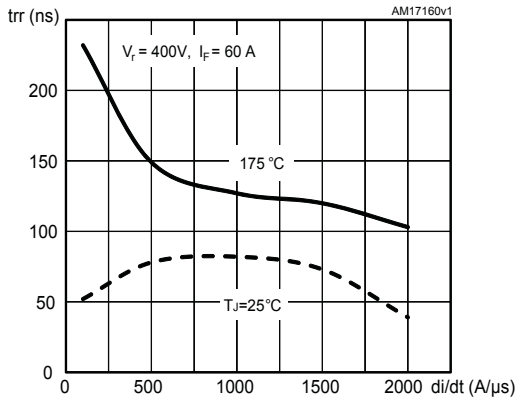


Figure 23. Reverse recovery charge vs. diode current slope

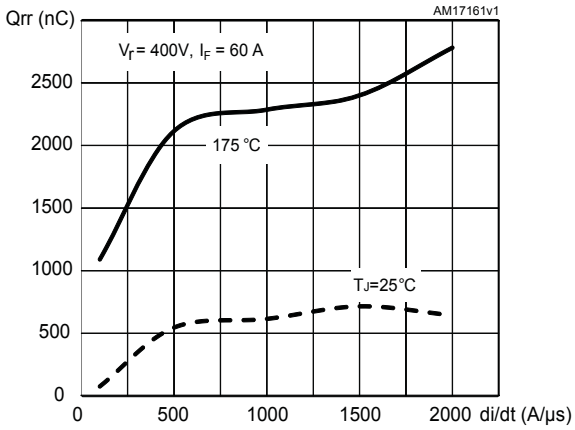


Figure 24. Reverse recovery current vs. energy current slope

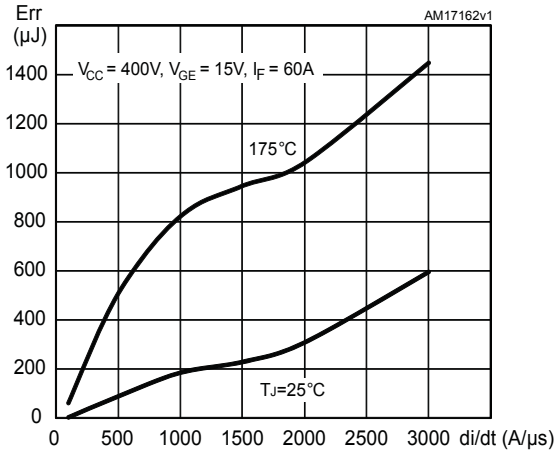


Figure 25. **Thermal impedance for IGBT**

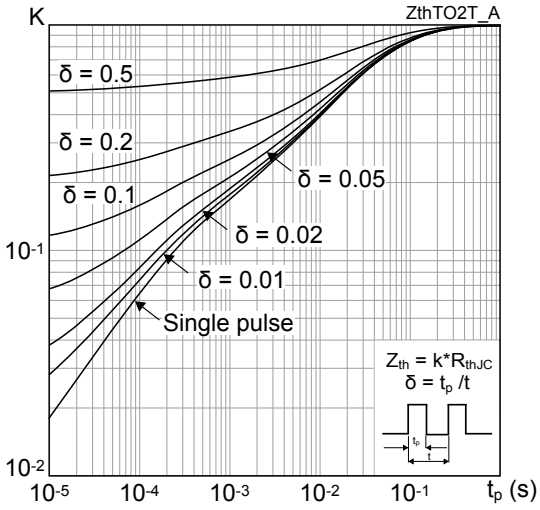
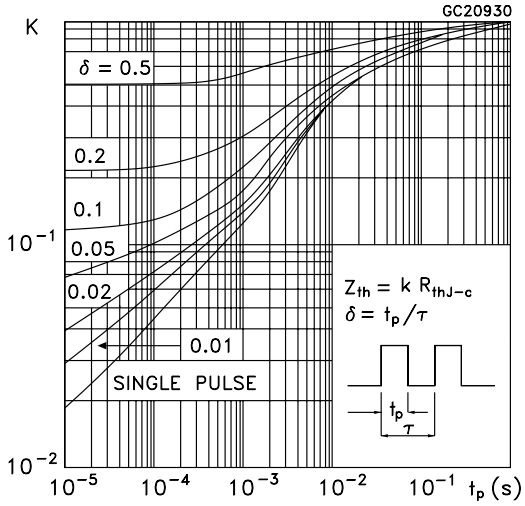


Figure 26. **Thermal impedance for diode**



3 Test circuits

Figure 27. Test circuit for inductive load switching

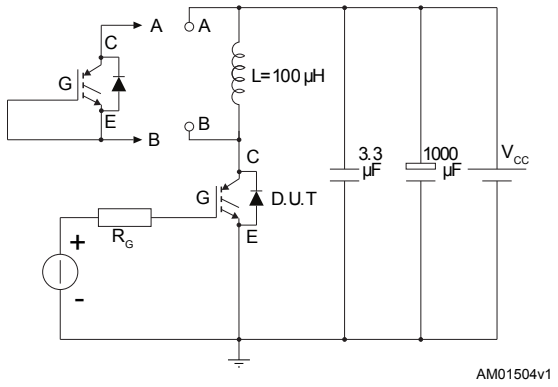


Figure 28. Gate charge test circuit

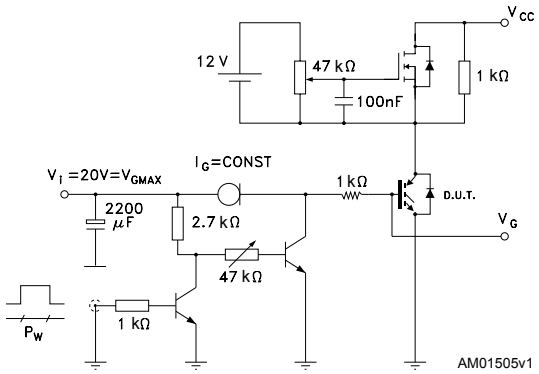


Figure 29. Switching waveform

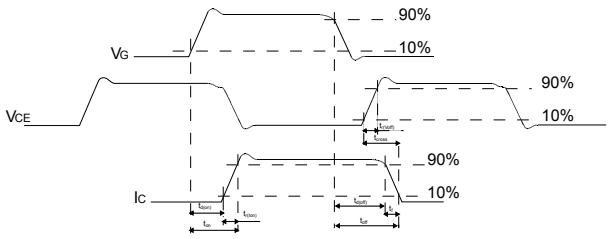
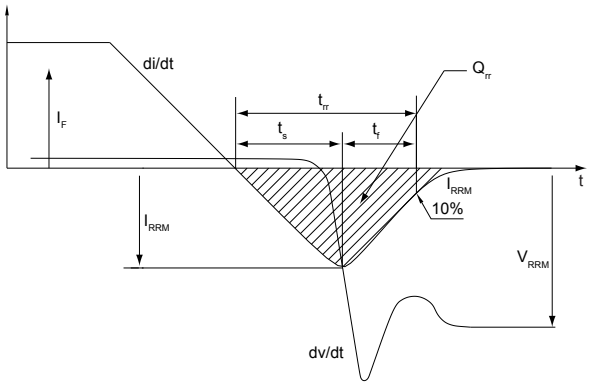


Figure 30. Diode reverse recovery waveform

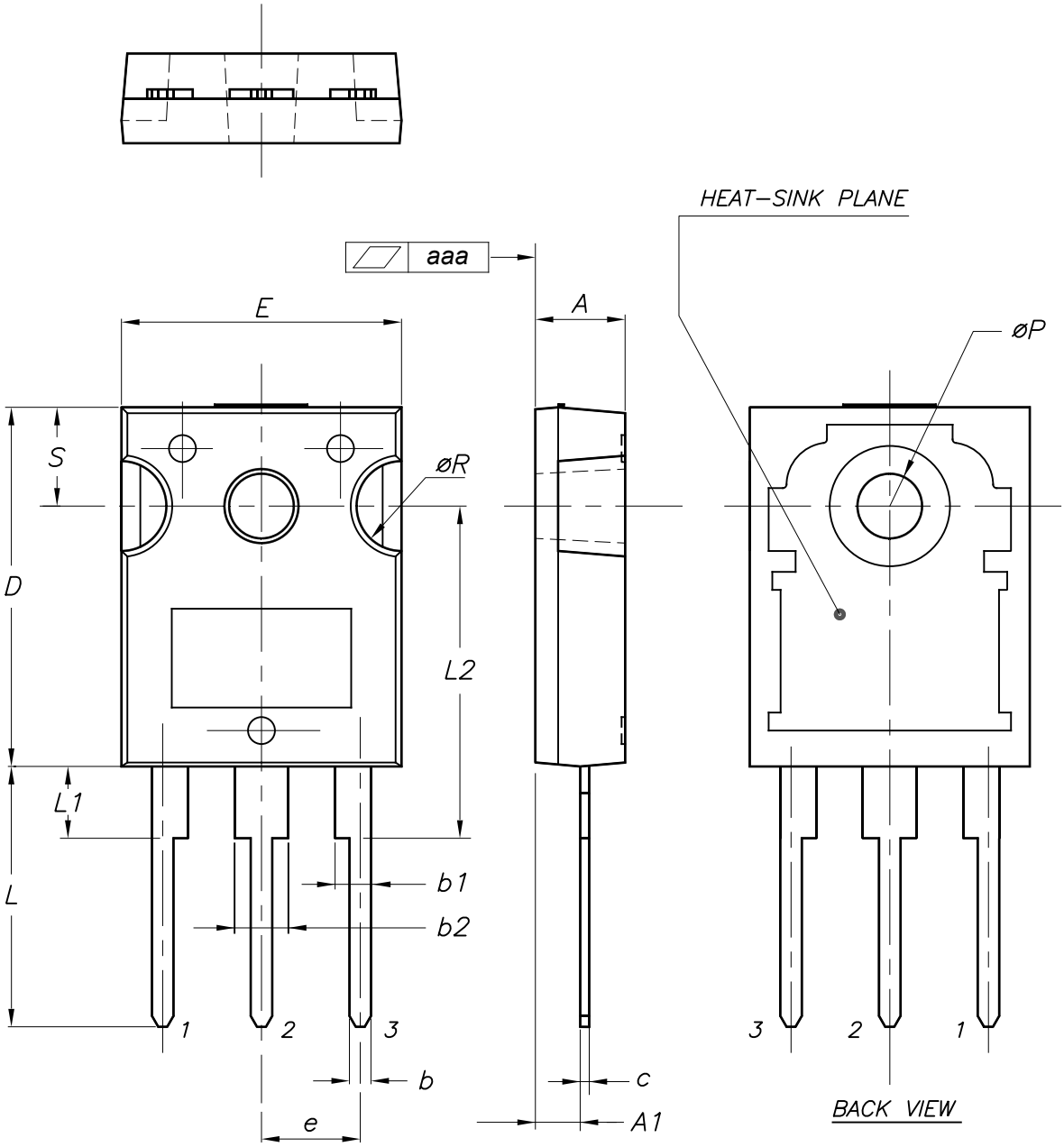


4 Package information

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 package information

Figure 31. TO-247 package outline



0075325_10

Table 7. **TO-247 package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70
aaa		0.04	0.10

4.2 TO-247 long leads package information

Figure 32. **TO-247 long leads package outline**

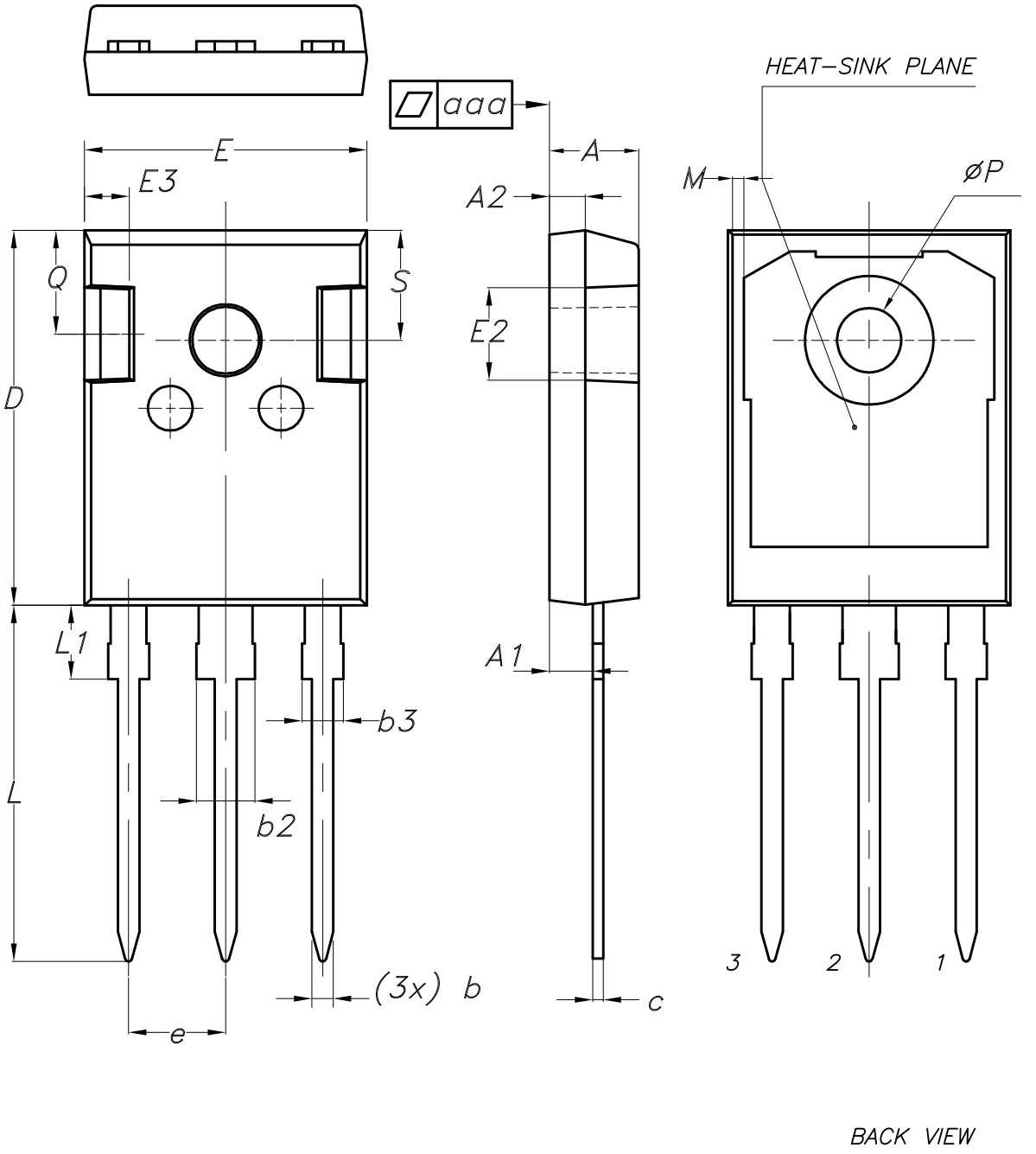


Table 8. **TO-247 long leads package mechanical data**

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 9. **Document revision history**

Date	Revision	Changes
15-Jan-2013	1	Initial release.
23-Apr-2013	2	Added: – New order code STGWT60V60DF and new package mechanical data TO-3P Table 9 on page 16, Figure 33 on page 15. – Section 2.1: Electrical characteristics (curves) on page 6.
04-Jun-2013	3	Updated Table 4: Static characteristics and Figure 12 on page 7. Document status changed from preliminary to production data.
21-Jun-2013	4	Updated Figure 3: Collector current vs. temperature case.
12-Jul-2013	5	Updated R_{thJC} value for Diode in Table 3: Thermal data.
21-Oct-2013	6	Updated title, features and description in cover page.
28-Sep-2016	7	Added part number STGWA60V60DF and TO-247 long leads package information. Updated Table 2 Table 4 and Table 6. Updated Figure 10: Transfer characteristics. Minor text changes.
20-Jan-2025	8	Updated Section 4.1: TO-247 package information, and Section 4.2: TO-247 long leads package information. Removed TO-3P package information. Updated document title on cover page. Minor text changes.

Contents