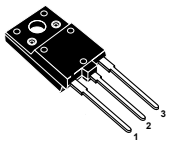
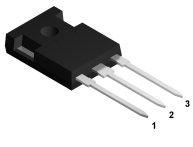
STGFW50HP65FB2, STGWA50HP65FB2

Datasheet

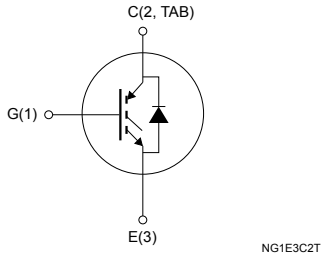
Trench gate field-stop, 650 V, 50 A, high-speed HB2 series IGBT in TO-3PF and TO-247 long leads packages



TO-3PF



TO-247 long leads



Features

- Maximum junction temperature: T_J = 175 °C
- Low $V_{CE(sat)}$ = 1.55 V(typ.) @ I_C = 50 A
- Co-packaged protection diode
- Minimized tail current
- Tight parameter distribution
- Low thermal resistance
- Positive $V_{CE(sat)}$ temperature coefficient

Applications

- Welding
- Power factor correction

Description

The newest IGBT 650 V HB2 series represents an evolution of the advanced proprietary trench gate field-stop structure. The performance of the HB2 series is optimized in terms of conduction, thanks to a better $V_{CE(sat)}$ behavior at low current values, as well as in terms of reduced switching energy. A diode used for protection purposes only is co-packaged in antiparallel with the IGBT. The result is a product specifically designed to maximize efficiency for a wide range of fast applications.

Product status links
STGFW50HP65FB2
STGWA50HP65FB2

Product summary	
Order code	**STGFW50HP65FB2**
Marking	G50HP65FB2
Package	TO-3PF
Packing	Tube
Order code	**STGWA50HP65FB2**
Marking	G50HP65FB2
Package	TO-247 long leads
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-3PF	TO-247 long leads	
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	650		V
I_C	Continuous collector current at T_C = 25 °C	43	86	A
	Continuous collector current at T_C = 100 °C	25	53	
I_{CP} (1)	Pulsed collector current (t_p ≤1 µs, T_J < 175 °C)	150		A
V_{GE}	Gate-emitter voltage	±20		V
	Transient gate-emitter voltage (t_p ≤10 µs, D <0.01)	±30		
I_F	Continuous forward current at T_C = 25 °C	5		A
	Continuous forward current at T_C = 100 °C	5		
I_{FP}(1)	Pulsed forward current (t_p ≤1 µs, T_J <175 °C)	10		A
P_{TOT}	Total power dissipation at T_C = 25 °C	94	272	W
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T_C = 25 °C)	3.5		kV
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
		TO-3PF	TO-247 long leads	
R_{thJC}	Thermal resistance junction-case IGBT	1.59	0.55	°C/W
	Thermal resistance junction-case diode	5		
R_{thJA}	Thermal resistance junction-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 = 1 mA	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 50 A		1.55	2	V
		V_{GE} = 15 V, I_C = 50 A, T_J = 125 °C		1.8		
		V_{GE} = 15 V, I_C = 50 A, T_J = 175 °C		1.9		
V_F	Forward on-voltage	I_F = 5 A		2.6	3.5	V
		I_F = 5 A, T_J = 125 °C		2.3		
		I_F = 5 A, T_J = 175 °C		2.2		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 1 mA	5	6	7	V
I_{CES}	Collector cut-off current	V_{GE} = 0 V, V_{CE} = 650 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	-	2928	-	pF
C_{oes}	Output capacitance		-	162	-	pF
C_{res}	Reverse transfer capacitance		-	78	-	pF
Q_g	Total gate charge	V_{CC} = 520 V, I_C = 50 A, V_{GE} = 0 to 15 V (see Figure 30. Gate charge test circuit)	-	151	-	nC
Q_{ge}	Gate-emitter charge		-	30	-	nC
Q_{gc}	Gate-collector charge		-	63	-	nC

Table 5. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$	Turn-off delay time	V_{CC} = 400 V, I_C = 50 A, V_{GE} = 15 V, R_G = 4.7 Ω (see Figure 29. Test circuit for inductive load switching)	-	115	-	ns
t_f	Current fall time		-	40	-	ns
E_{off} (1)	Turn-off switching energy		-	580	-	µJ
$t_{d(off)}$	Turn-off delay time	V_{CC} = 400 V, I_C = 50 A, V_{GE} = 15 V, R_G = 4.7 Ω, T_J = 175 °C (see Figure 29. Test circuit for inductive load switching)	-	135	-	ns
t_f	Current fall time		-	90	-	ns
E_{off} (1)	Turn-off switching energy		-	1090	-	µJ

1. *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 = 5 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 1000 A/µs (see Figure 32. Diode reverse recovery waveform)	-	140	-	ns
Q_{rr}	Reverse recovery charge		-	21	-	nC
I_{rrm}	Reverse recovery current		-	6.6	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	430	-	A/µs
E_{rr}	Reverse recovery energy		-	1.6	-	µJ
t_{rr}	Reverse recovery time	I_F = 5 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 1000 A/µs, T_J = 175 °C (see Figure 32. Diode reverse recovery waveform)	-	200	-	ns
Q_{rr}	Reverse recovery charge		-	47.3	-	nC
I_{rrm}	Reverse recovery current		-	9.6	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	428	-	A/µs
E_{rr}	Reverse recovery energy		-	3.2	-	µJ

2.1 Electrical characteristics (curves)

Figure 1. TO-3PF total power dissipation vs case temperature

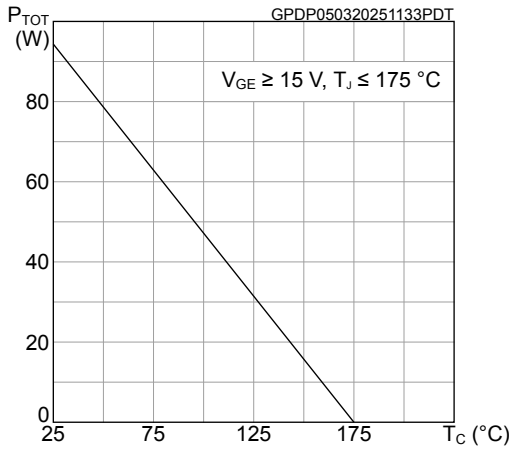


Figure 2. TO-3PF maximun continuous collector current vs case temperature

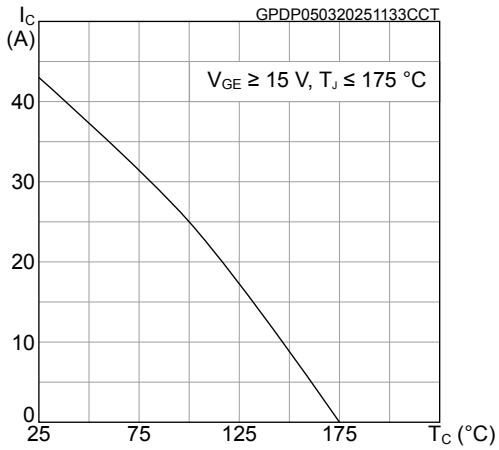


Figure 3. TO-247 long leads total power dissipation vs case temperature

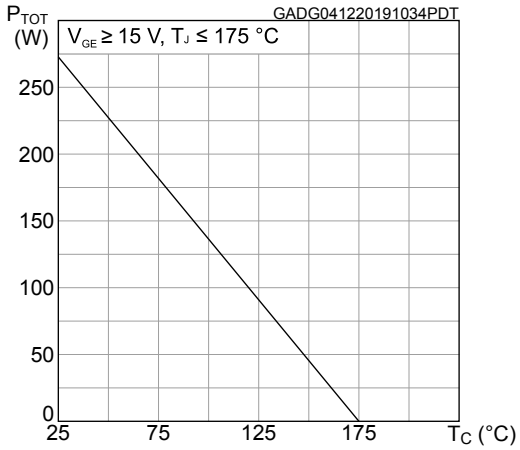


Figure 4. TO-247 long leads maximun continuous collector current vs case temperature

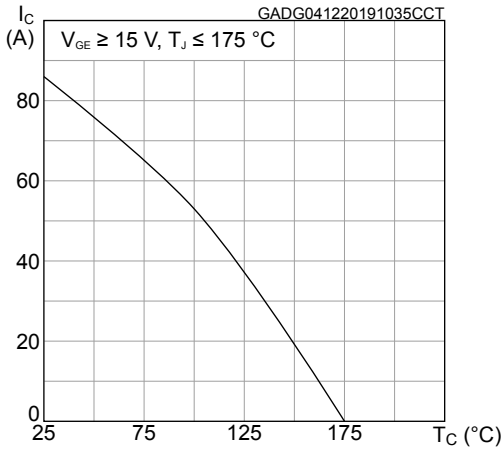


Figure 5. Typical output characteristics (T_J = 25 °C)

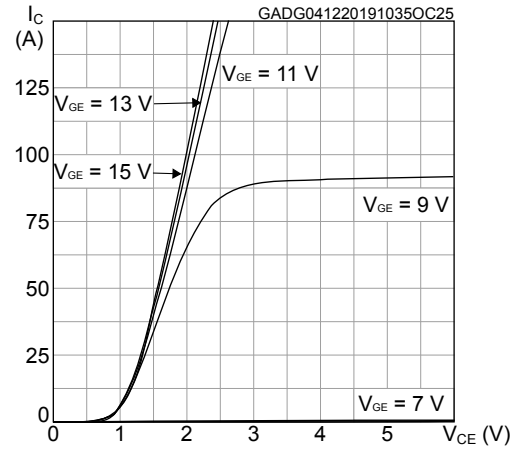


Figure 6. Typical output characteristics (T_J = 175 °C)

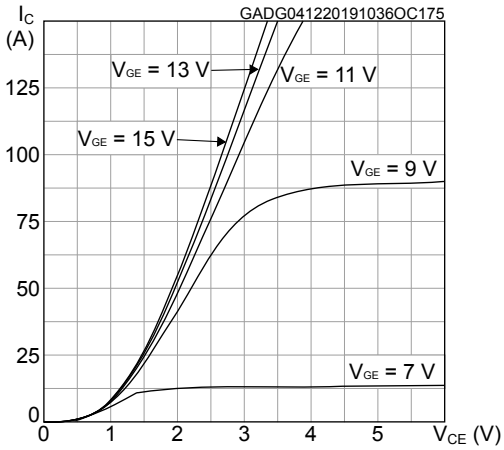


Figure 7. Typical $V_{CE(sat)}$ vs temperature

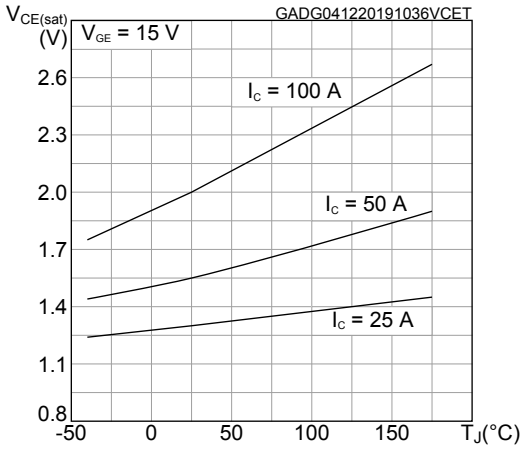


Figure 8. Typical $V_{CE(sat)}$ vs collector current

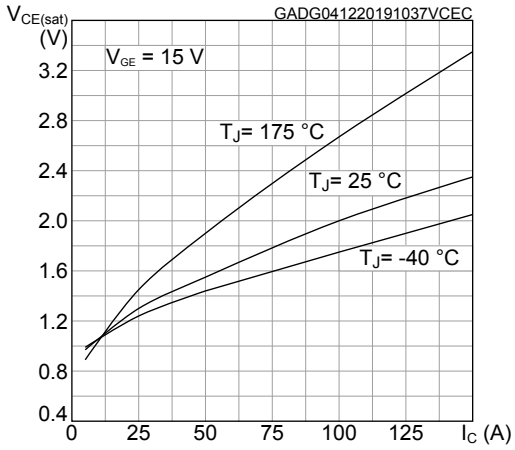


Figure 9. TO-3PF forward bias safe operating area

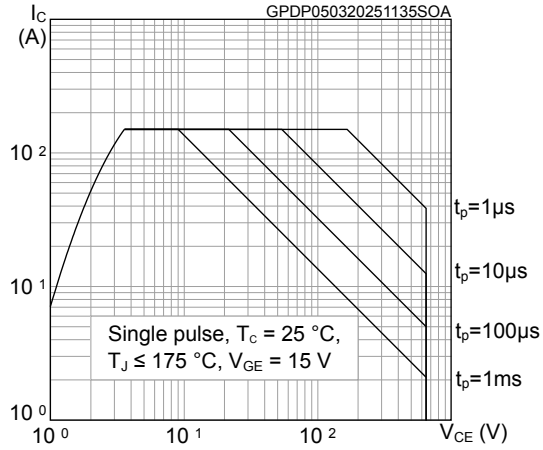


Figure 10. TO-247 long leads forward bias safe operating area

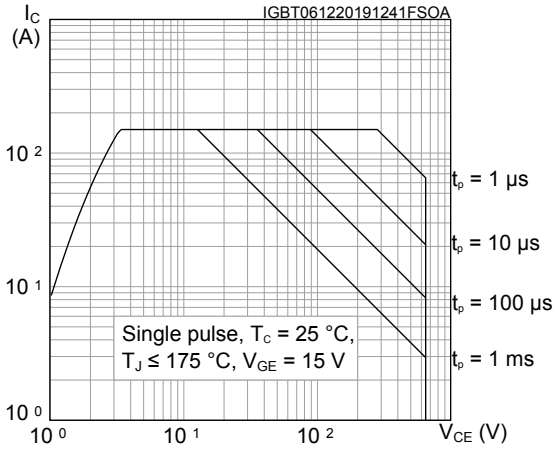


Figure 11. Typical transfer characteristics

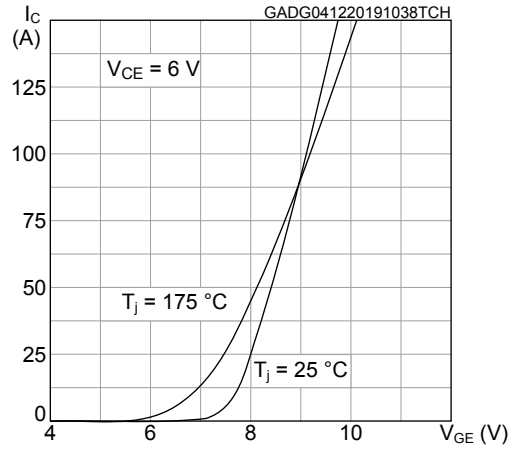


Figure 12. Normalized gate threshold vs temperature

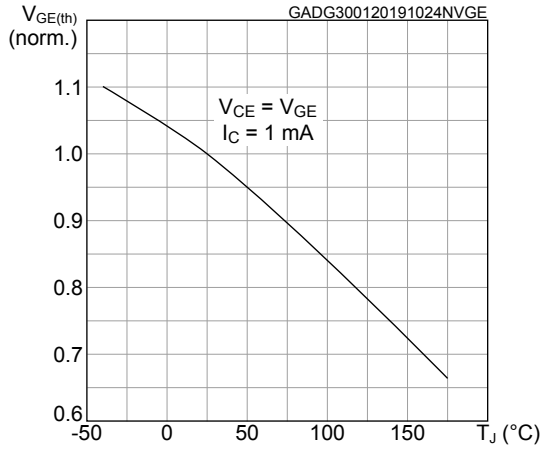


Figure 13. Normalized breakdown voltage vs temperature

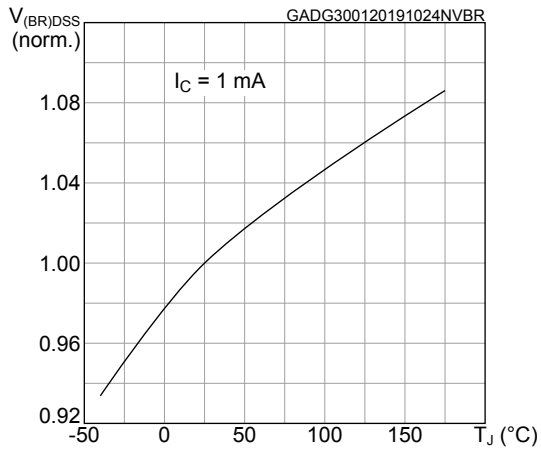


Figure 14. Typical capacitance characteristics

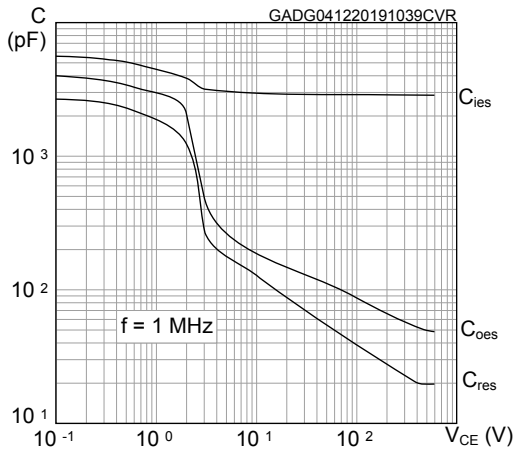


Figure 15. Typical gate charge vs gate-emitter voltage

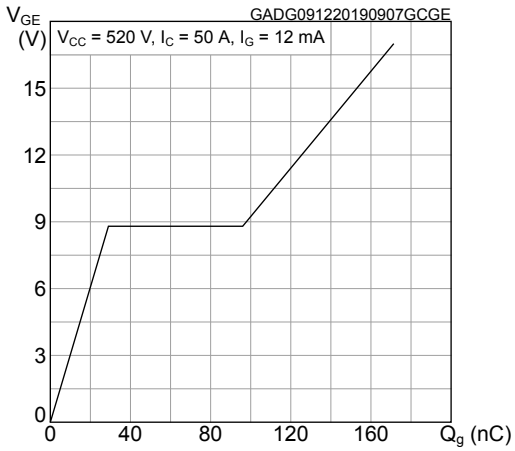


Figure 16. Typical switching energy vs collector current

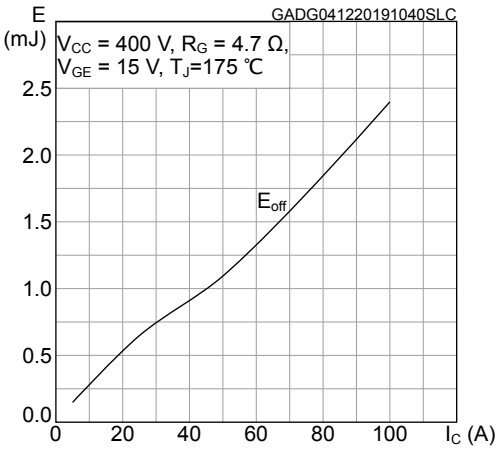


Figure 17. Typical switching energy vs temperature

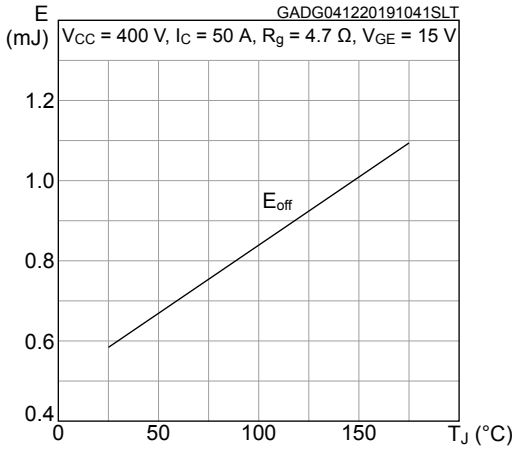


Figure 18. Typical switching energy vs collector emitter voltage

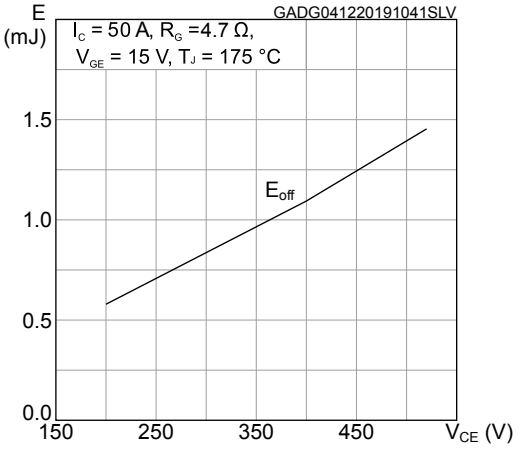


Figure 19. Typical switching energy vs gate resistance

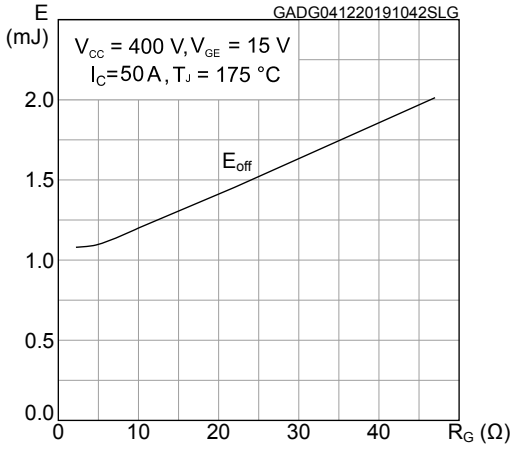


Figure 20. Typical switching times vs collector current

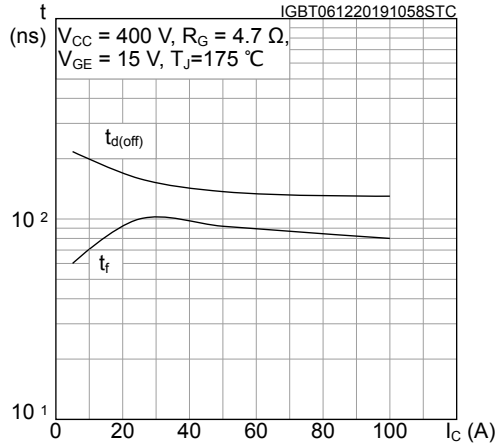


Figure 21. Typical switching times vs gate resistance

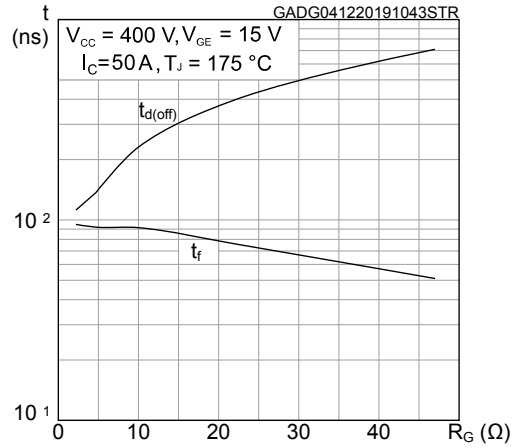


Figure 22. Typical reverse recovery current vs diode current slope

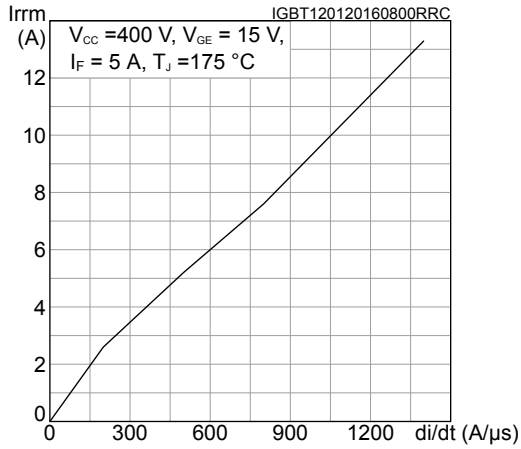


Figure 23. Typical reverse recovery time vs diode current slope

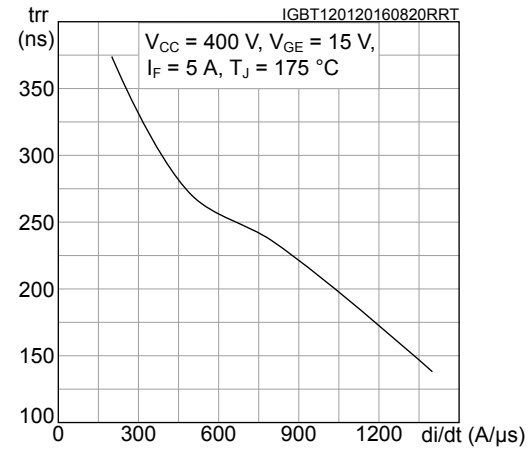


Figure 24. Typical reverse recovery charge vs diode current slope

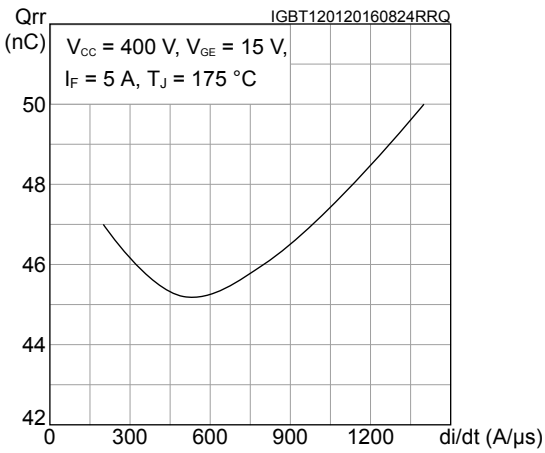


Figure 25. Typical reverse recovery energy vs diode current slope

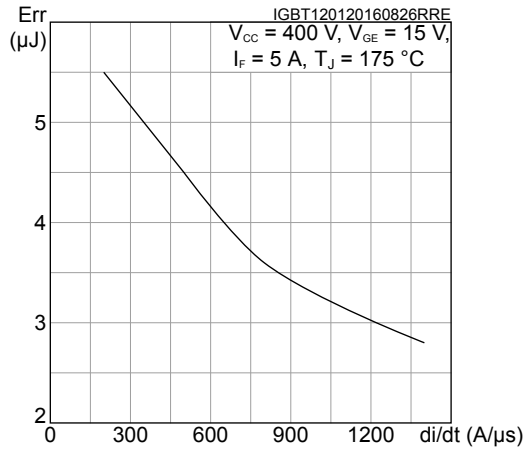


Figure 26. TO-3PF maximum transient thermal impedance for IGBT

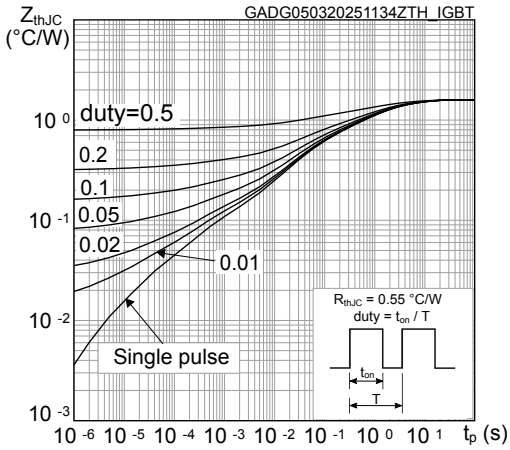


Figure 27. TO-247 long leads normalized transient thermal impedance for IGBT

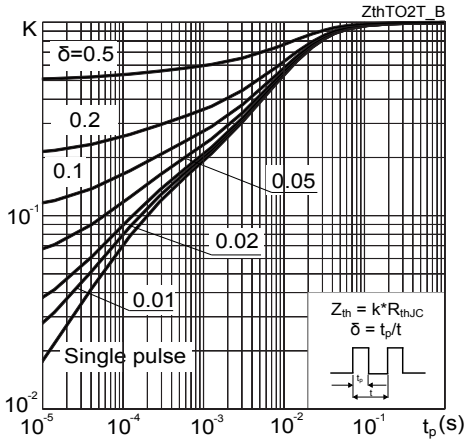
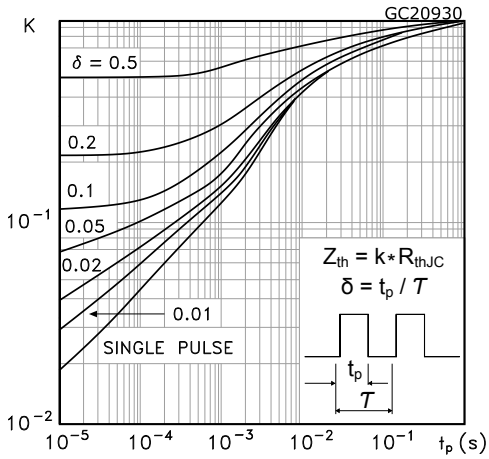


Figure 28. Normalized transient thermal impedance for diode



3 Test circuits

Figure 29. Test circuit for inductive load switching

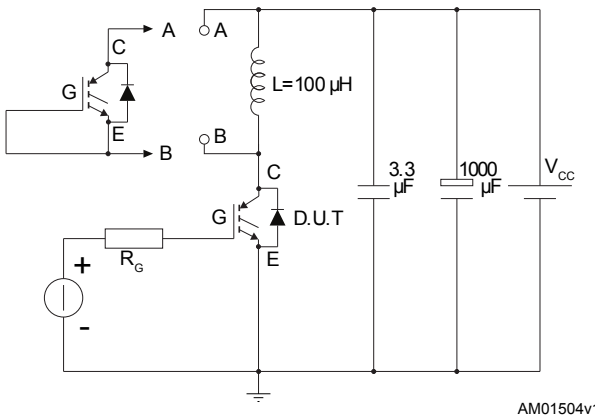


Figure 30. Gate charge test circuit

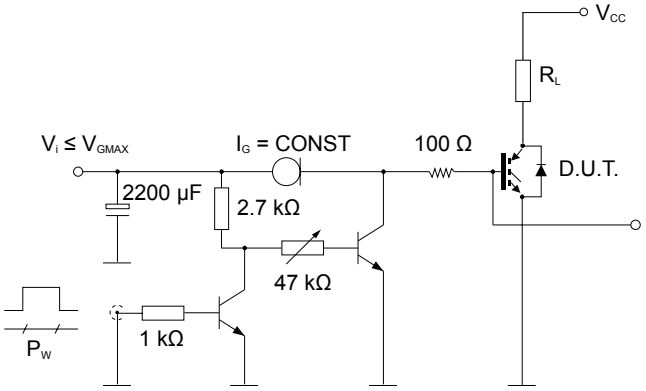


Figure 31. Switching waveform

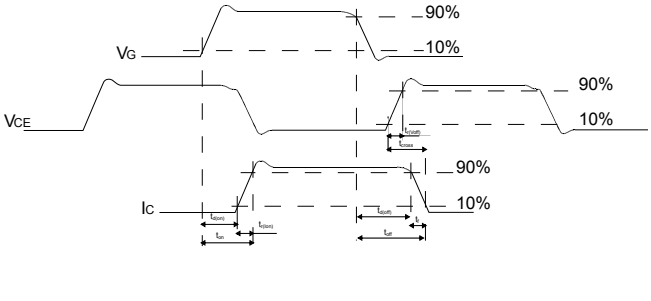
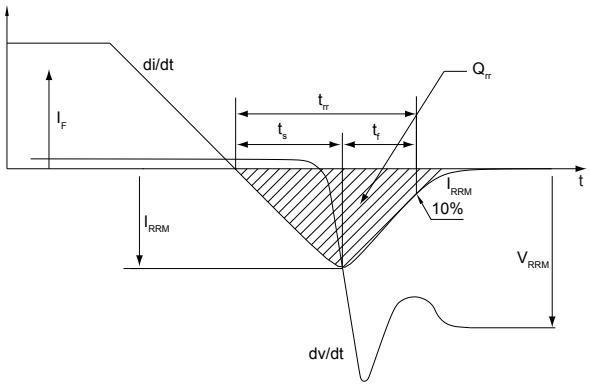


Figure 32. Diode reverse recovery waveform



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-3PF type A package information

Figure 33. TO-3PF type A package outline

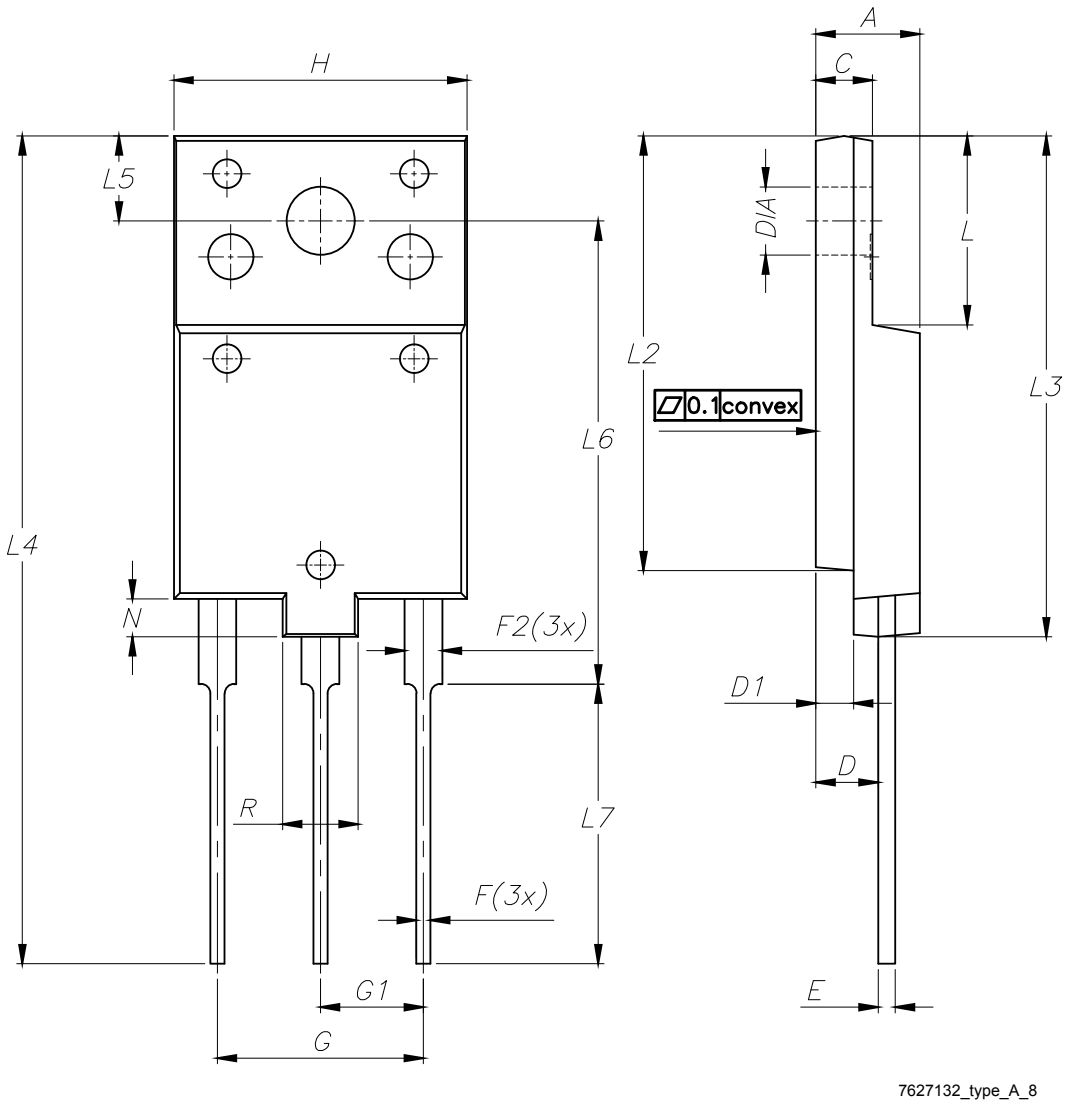


Table 7. **TO-3PF type A mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	5.30		5.70
C	2.80		3.20
D	3.10		3.50
D1	1.80		2.20
E	0.80		1.00
F	0.65		0.85
F2	1.80		2.20
G	10.80		11.00
G1	5.35	5.45	5.55
H	15.30		15.70
L	9.80	10.00	10.20
L2	22.80		23.20
L3	26.30		26.70
L4	43.60		44.00
L5	4.30		4.70
L6	24.30		24.70
L7	14.60		15.00
N	1.80		2.20
R	3.80		4.20
Dia	3.40		3.80

4.2 TO-247 long leads package information

Figure 34. **TO-247 long leads package outline**

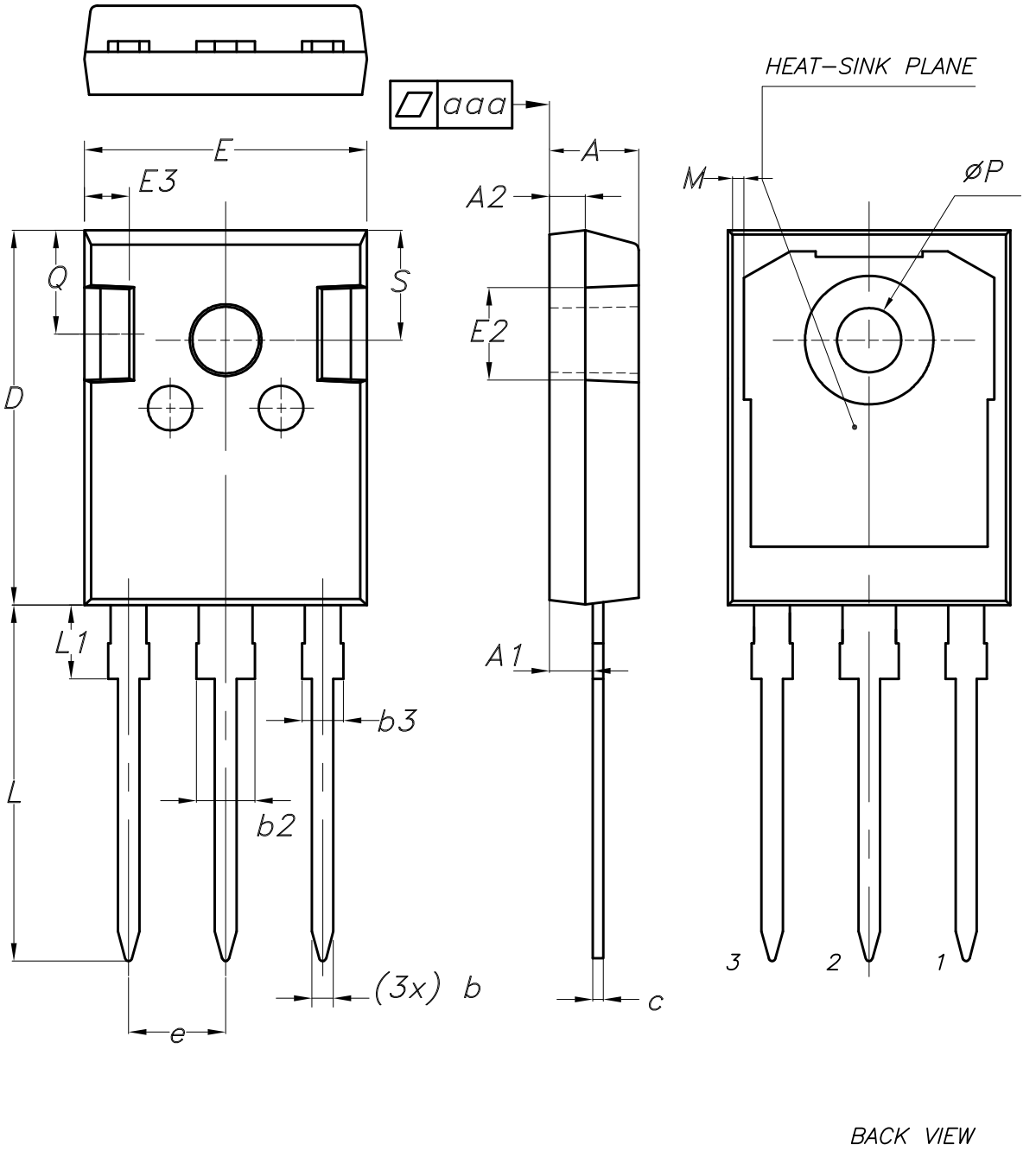


Table 8. **TO-247 long leads package mechanical data**

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	Version	Changes
05-Dec-2019	1	First release.
03-Oct-2024	2	Updated *Section 4.1: TO-247 long leads package information*. Minor text changes
21-Nov-2024	3	Updated *Table 3. Static characteristics*. Removed figure *Diode V_F vs forward current*
05-Mar-2025	4	Added TO-3PF package on cover page and datasheet modified accordingly. Updated Section 1: Electrical ratings. Added Figure 1. TO-3PF total power dissipation vs case temperature, Figure 2. TO-3PF maximun continuous collector current vs case temperature, Figure 9. TO-3PF forward bias safe operating area and Figure 26. TO-3PF maximum transient thermal impedance for IGBT. Minor text changes.

Contents