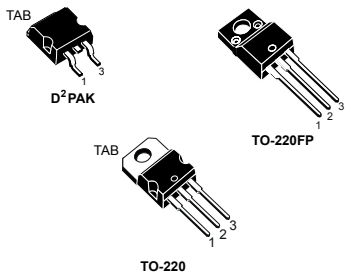
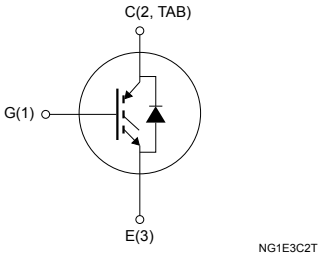
STGB7H60DF, STGF7H60DF, STGP7H60DF

Datasheet

Trench gate field-stop 600 V, 7 A high speed H series IGBT





Features

- High speed switching
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance
- Short-circuit rated
- Ultrafast soft recovery antiparallel diode

Applications

- High-frequency motor controls
- SMPS and PFC in both hard switch and resonant topologies

Description

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

Product status link
STGB7H60DF
STGF7H60DF
STGP7H60DF

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D^2PAK, TO-220	TO-220FP	
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	600		V
I_C	Continuous collector current at T_C = 25 °C	14	14 (1)	A
	Continuous collector current at T_C = 100 °C	7	7 (1)	
I_{CP} (2)	Pulsed collector current	28	28	A
V_{GE}	Gate-emitter voltage	±20		V
I_F	Continuous forward current at T_C = 25 °C	14	14 (1)	A
	Continuous forward current at T_C = 100 °C	7	7 (1)	
I_{FP} (2)	Pulsed forward current	28	28	A
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T_c = 25 °C)		2.5	kV
P_{TOT}	Total power dissipation at T_C = 25 °C	88	24	W
T_{STG}	Storage temperature range	-55 to 150		°C
T_J	Operating junction temperature range	-55 to 175		

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

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		D^2PAK, TO-220	TO-220FP	
R_{thJC}	Thermal resistance, junction-to-case IGBT	1.7	6.2	°C/W
R_{thJC}	Thermal resistance, junction-to-case diode	2.8	6.25	°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	62.5		°C/W

2 Electrical characteristics

T_C = 25 °C unless otherwise specified.

Table 3. Static

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= 7 A		1.50	1.95	V
		V_{GE} = 15 V, I_C = 7 A, T_J = 125 °C		1.6		
		V_{GE} = 15 V, I_C = 7 A, T_J = 175 °C		1.70		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 250 µA	4.8	6.2	6.9	V
I_{CES}	Collector cut-off current	V_{CE} = 600 V, V_{GE} = 0 V			25	µA
I_{GES}	Gate-emitter leakage current	V_{GE} = ±20 V, V_{CE} = 0 V			±250	nA

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0 V	-	1050	-	pF
C_{oes}	Output capacitance			51		
C_{res}	Reverse transfer capacitance			23		
Q_g	Total gate charge	V_{CC} = 480 V, I_C = 7 A, V_{GE} = 0 to 15 V (see Figure 35. Gate charge test circuit)	-	46	-	nC
Q_{ge}	Gate-emitter charge			7		
Q_{gc}	Gate-collector charge			21		

Table 5. 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 = 7 A, R_G = 47 Ω,		30		ns
t_r	Current rise time	V_{GE} = 15 V		12.2		
(di/dt)on	Turn-on current slope	(see Figure 34. Test circuit for inductive load switching and Figure 36. Switching waveform)		459		A/µs
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 7 A, R_G = 47 Ω,	-	30	-	ns
t_r	Current rise time	V_{GE} = 15 V, T_J = 175 °C		12.8		
(di/dt)on	Turn-on current slope	(see Figure 34. Test circuit for inductive load switching and Figure 36. Switching waveform)		440		A/µs
$t_{r(Voff)}$	Off voltage rise time	V_{CE} = 400 V, I_C = 7 A, R_G = 47 Ω,		24		ns
$t_{d(off)}$	Turn-off delay time	V_{GE} = 15 V		160		
t_f	Current fall time	(see Figure 34. Test circuit for inductive load switching and Figure 36. Switching waveform)		69		
$t_{r(Voff)}$	Off voltage rise time	V_{CE} = 400 V, I_C = 7 A, R_G = 47 Ω,	-	31	-	
$t_{d(off)}$	Turn-off delay time	V_{GE} = 15 V, T_J = 175 °C		164		
t_f	Current fall time	(see Figure 34. Test circuit for inductive load switching and Figure 36. Switching waveform)		99		
t_{sc}	Short-circuit withstand time	V_{CC} ≤ 360 V, V_{GE} = 15 V, R_G = 47 Ω	3	5	-	µs

Table 6. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on} (1)	Turn-on switching energy	V_{CE} = 400 V, I_C = 7 A, R_G = 47 Ω,		99		µJ
E_{off} (2)	Turn-off switching energy	V_{GE} = 15 V (see Figure 34. Test circuit for inductive load switching)		100		
E_{ts}	Total switching energy			199		
E_{on} (1)	Turn-on switching energy	V_{CE} = 400 V, I_C = 7 A, R_G = 47 Ω,	-	202	-	
E_{off} (2)	Turn-off switching energy	V_{GE} = 15 V, T_J = 175 °C (see Figure 34. Test circuit for inductive load switching)		149		
E_{ts}	Total switching energy			351		

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

Table 7. Collector-emitter diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_F	Forward on-voltage	I_F = 7 A	-	1.5	2.1	V
		I_F = 7 A, T_J = 175 °C		1.15		
t_{rr}	Reverse recovery time	V_{CC} = 400 V; I_F = 7 A, di_F/dt = 100 A / µs (see Figure 37. Diode reverse recovery waveform)	-	136	-	ns
Q_{rr}	Reverse recovery charge			104		nC
I_{rrm}	Reverse recovery current			2.25		A
t_{rr}	Reverse recovery time	V_{CC} = 400 V; I_F = 7 A, di_F/dt = 100 A / µs T_J = 175 °C (see Figure 37. Diode reverse recovery waveform)		154		ns
Q_{rr}	Reverse recovery charge			388		nC
I_{rrm}	Reverse recovery current			4.6		A

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs case temperature for D²PAK and TO-220

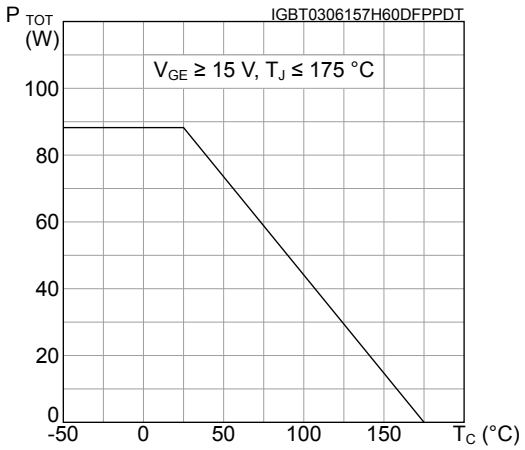


Figure 2. Collector current vs case temperature for D²PAK and TO-220

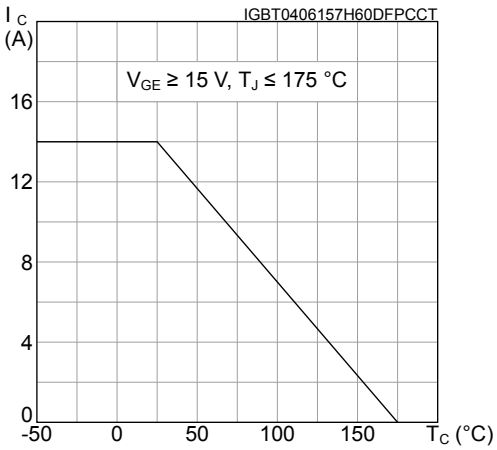


Figure 3. Power dissipation vs case temperature for TO-220FP

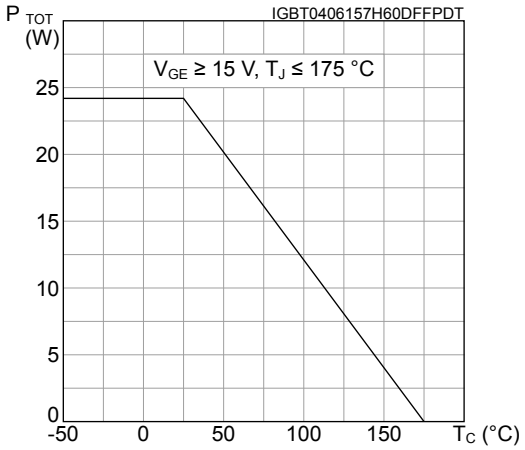


Figure 4. Collector current vs case temperature for TO-220FP

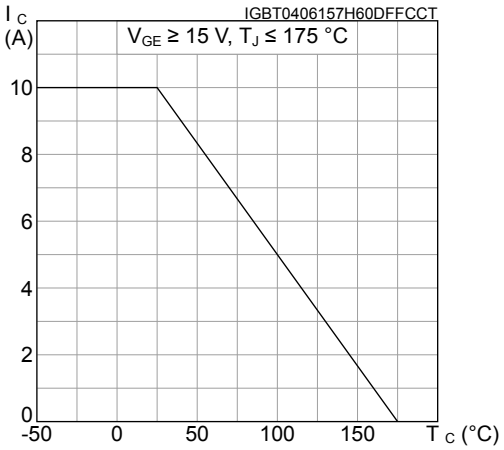


Figure 5. Output characteristics (T_J = 25°C)

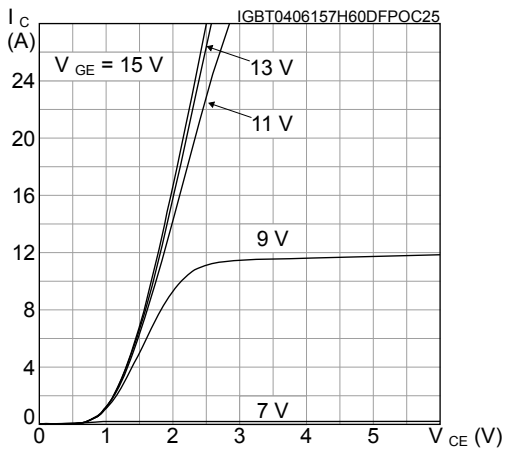


Figure 6. Output characteristics (T_J = 175°C)

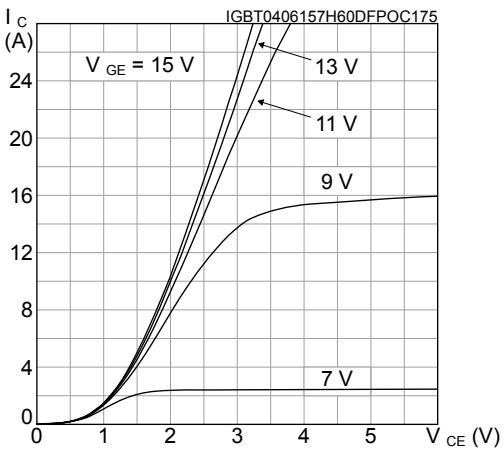


Figure 7. $V_{CE(sat)}$ vs junction temperature

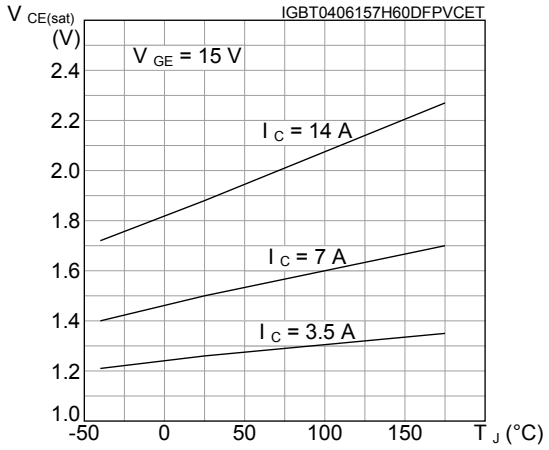


Figure 8. $V_{CE(sat)}$ vs collector current

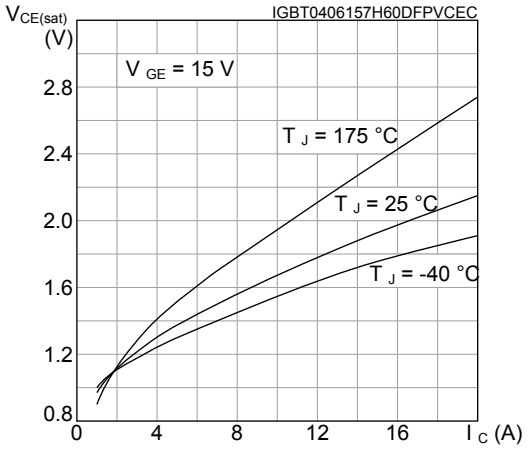


Figure 9. Collector current vs switching frequency for D²PAK and TO-220

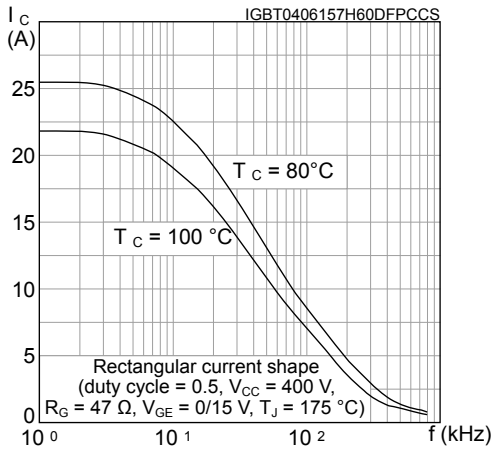


Figure 10. Collector current vs switching frequency for TO-220FP

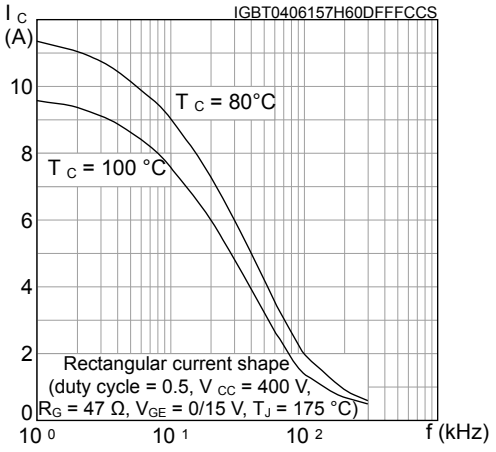


Figure 11. Forward bias safe operating area for D²PAK and TO-220

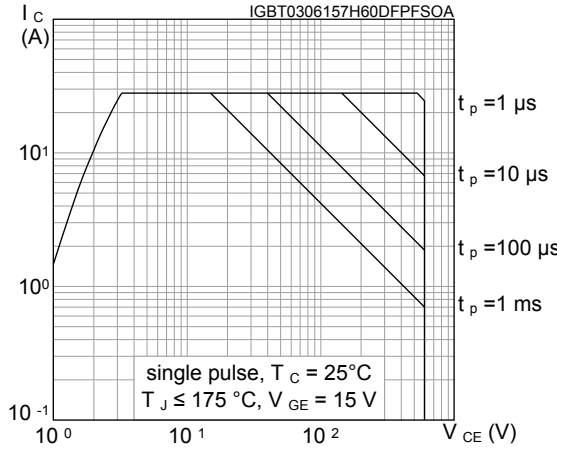


Figure 12. Forward bias safe operating area for TO-220FP

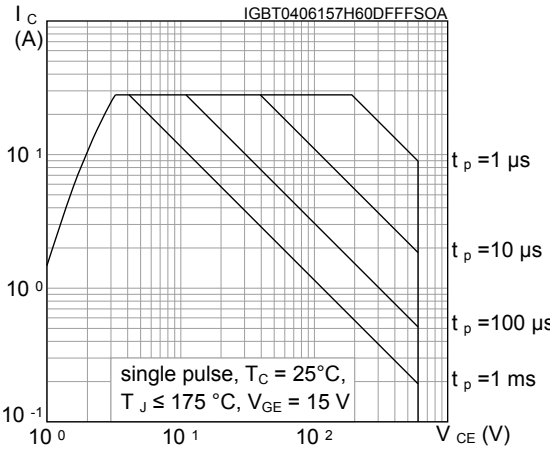


Figure 13. Transfer characteristics

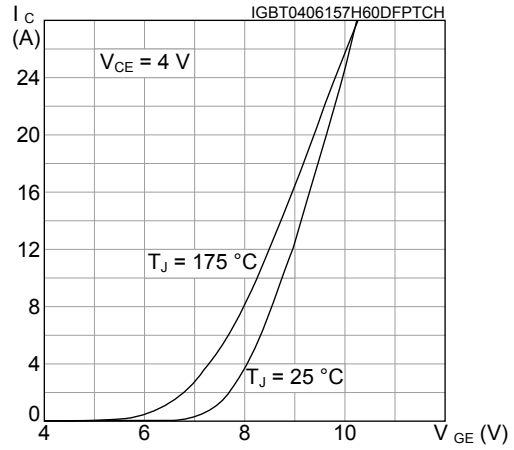


Figure 14. Diode V_F vs forward current

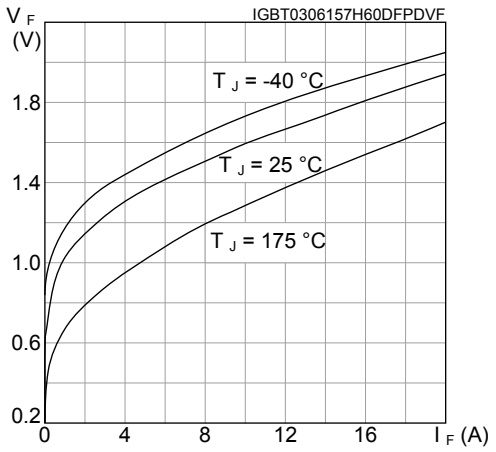


Figure 15. Normalized $V_{GE(th)}$ vs junction temperature

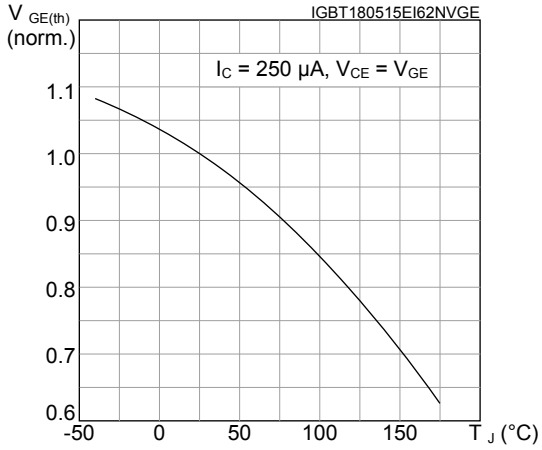


Figure 16. Normalized $V_{(BR)CES}$ vs junction temperature

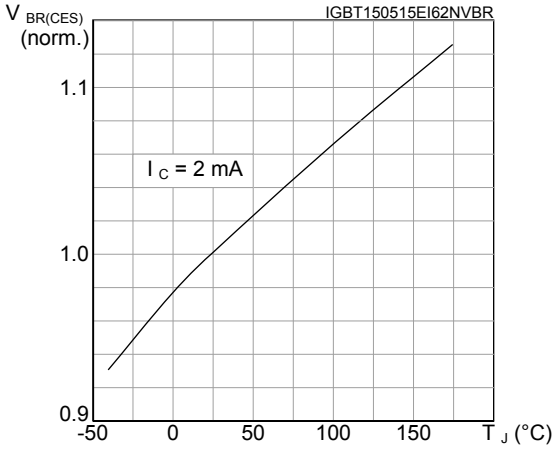


Figure 17. Capacitance variation

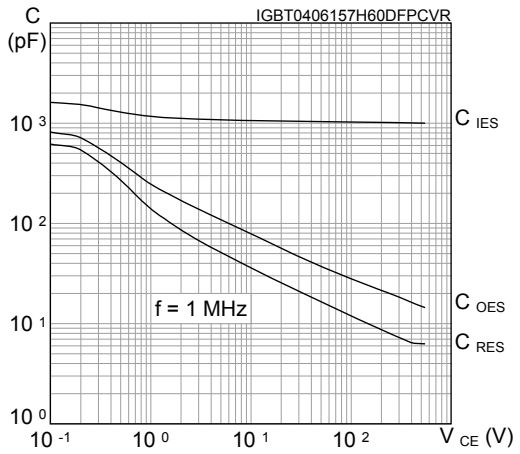


Figure 18. Gate charge vs gate-emitter voltage

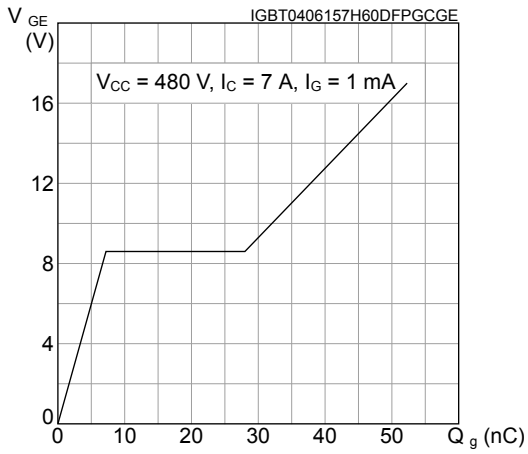


Figure 19. Switching energy vs collector current

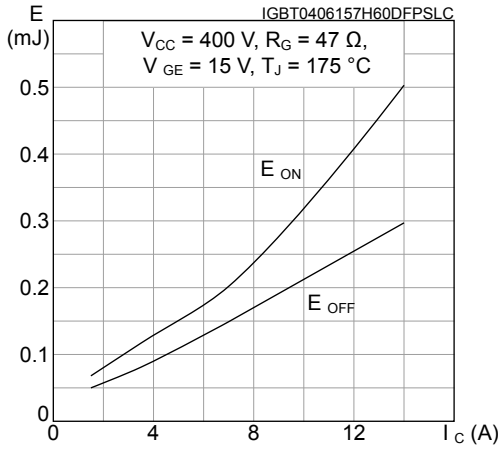


Figure 20. Switching energy vs gate resistance

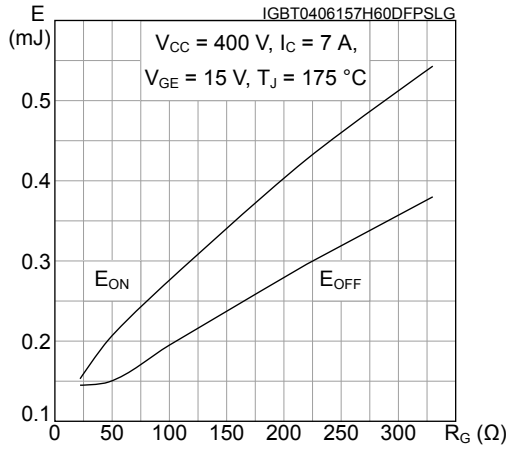


Figure 21. Switching energy vs temperature

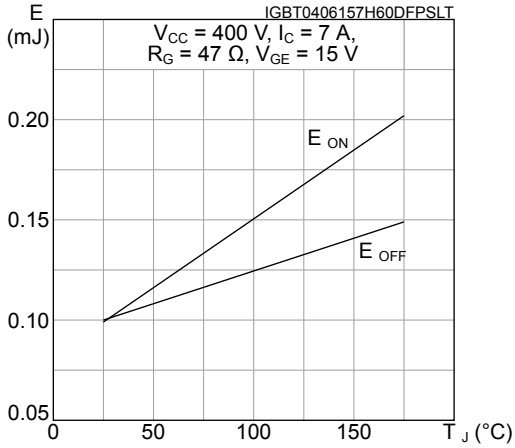


Figure 22. Switching energy vs collector-emitter voltage

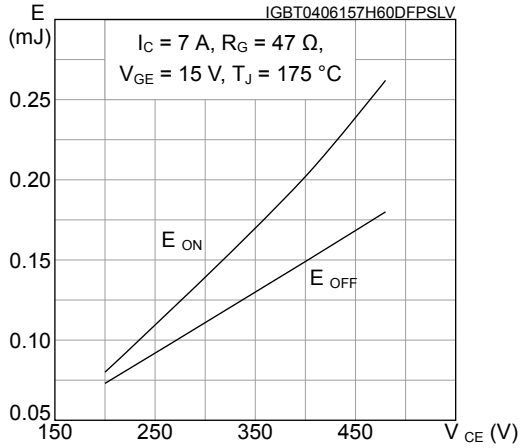


Figure 23. Short circuit time and current vs V_{GE}

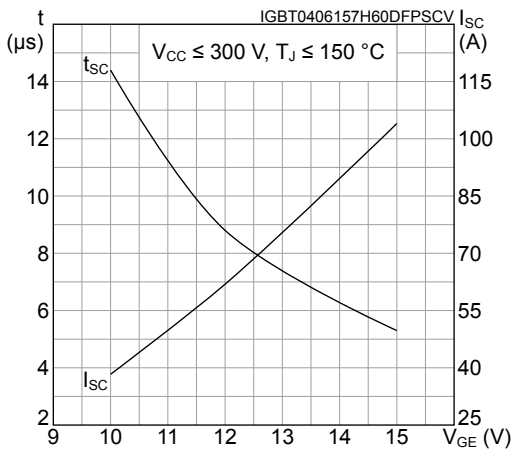


Figure 24. Switching times vs collector current

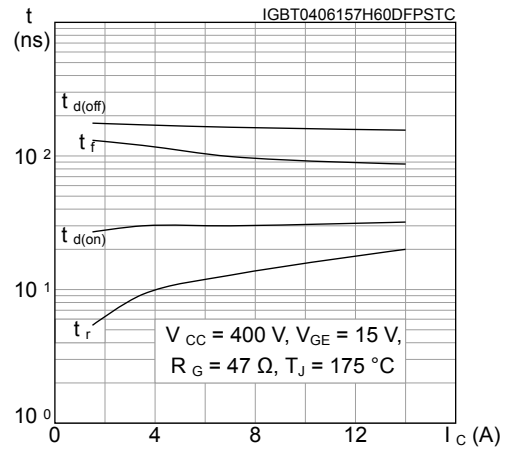


Figure 25. Switching times vs gate resistance

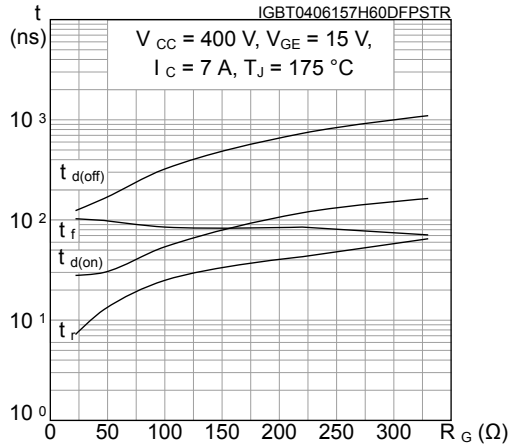


Figure 26. Reverse recovery current vs diode current slope

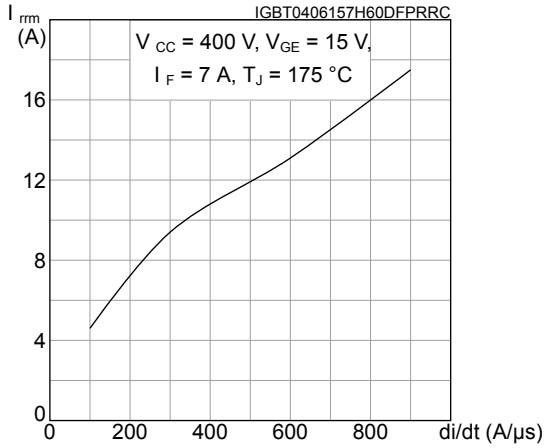


Figure 27. Reverse recovery time vs diode current slope

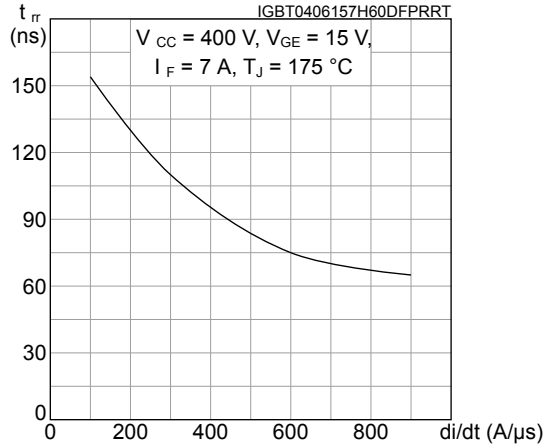


Figure 28. Reverse recovery charge vs diode current slope

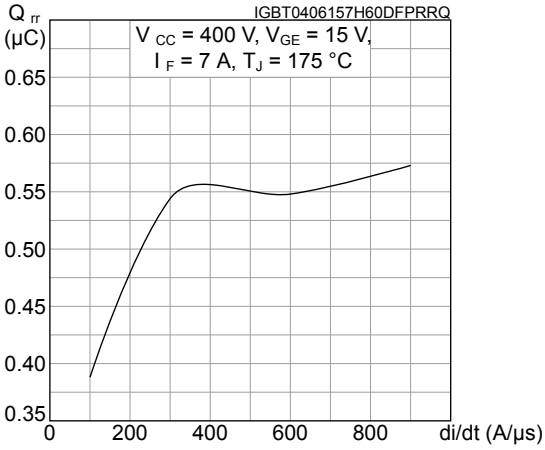


Figure 29. Reverse recovery energy vs diode current slope

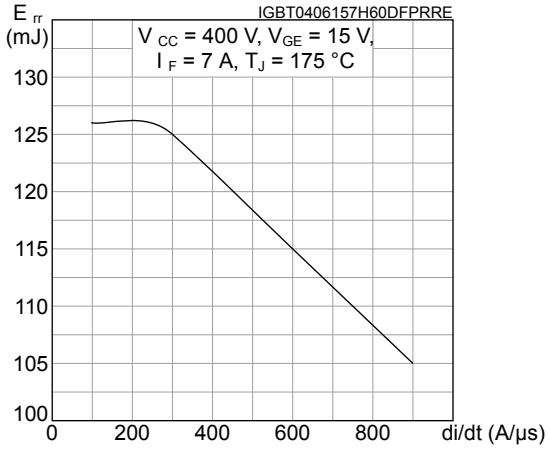


Figure 30. Normalized transient thermal impedance for TO-220 and D²PAK (IGBT)

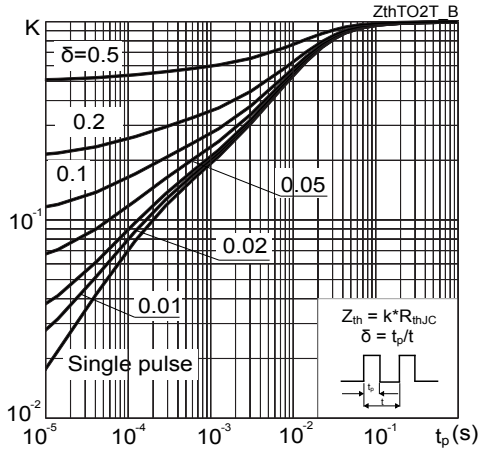


Figure 31. Normalized transient thermal impedance for TO-220 and D²PAK (diode)

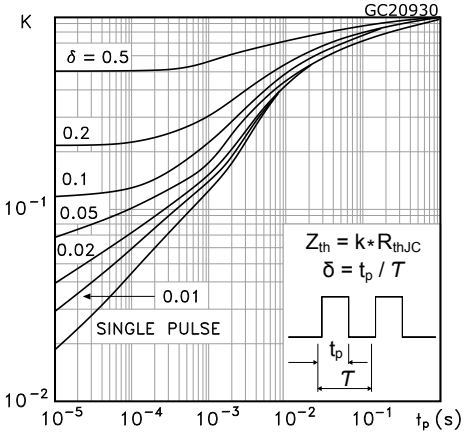


Figure 32. Normalized transient thermal impedance for TO-220FP (IGBT)

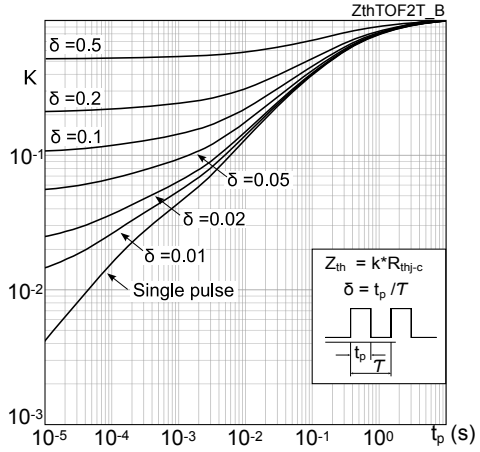
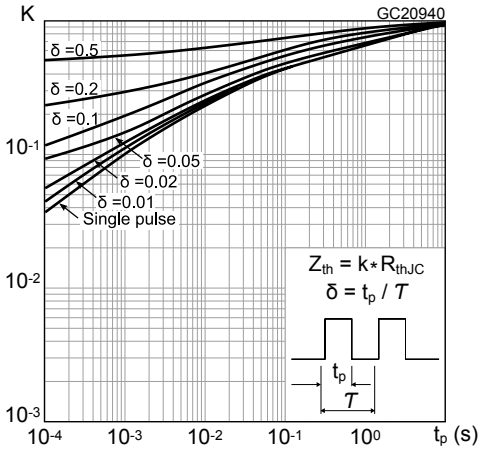


Figure 33. Normalized transient thermal impedance for TO-220FP (diode)



3 Test circuits

Figure 34. Test circuit for inductive load switching

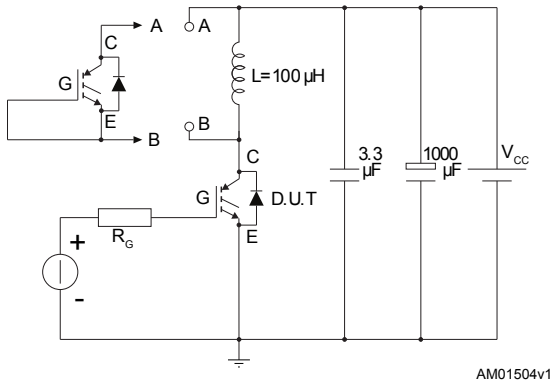


Figure 35. Gate charge test circuit

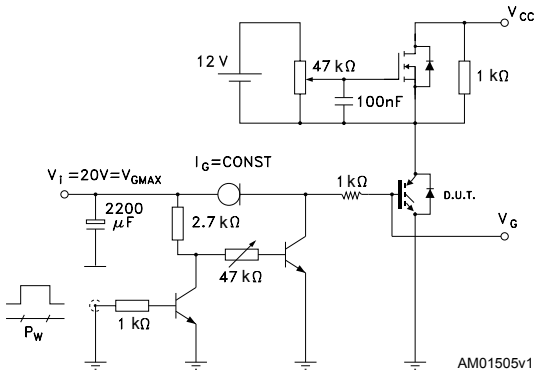


Figure 36. Switching waveform

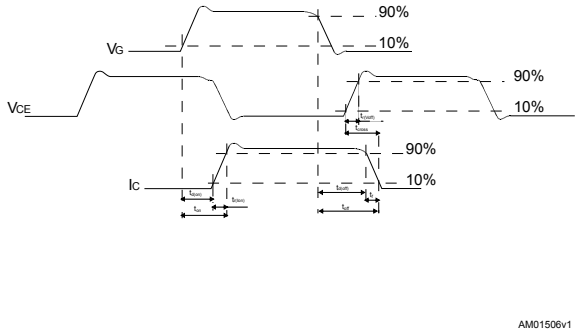
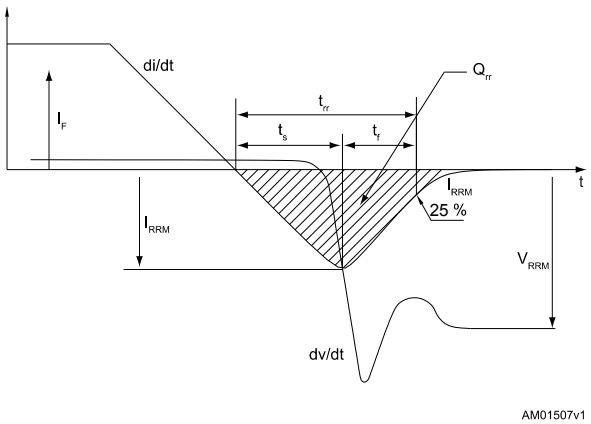


Figure 37. Diode reverse recovery waveform

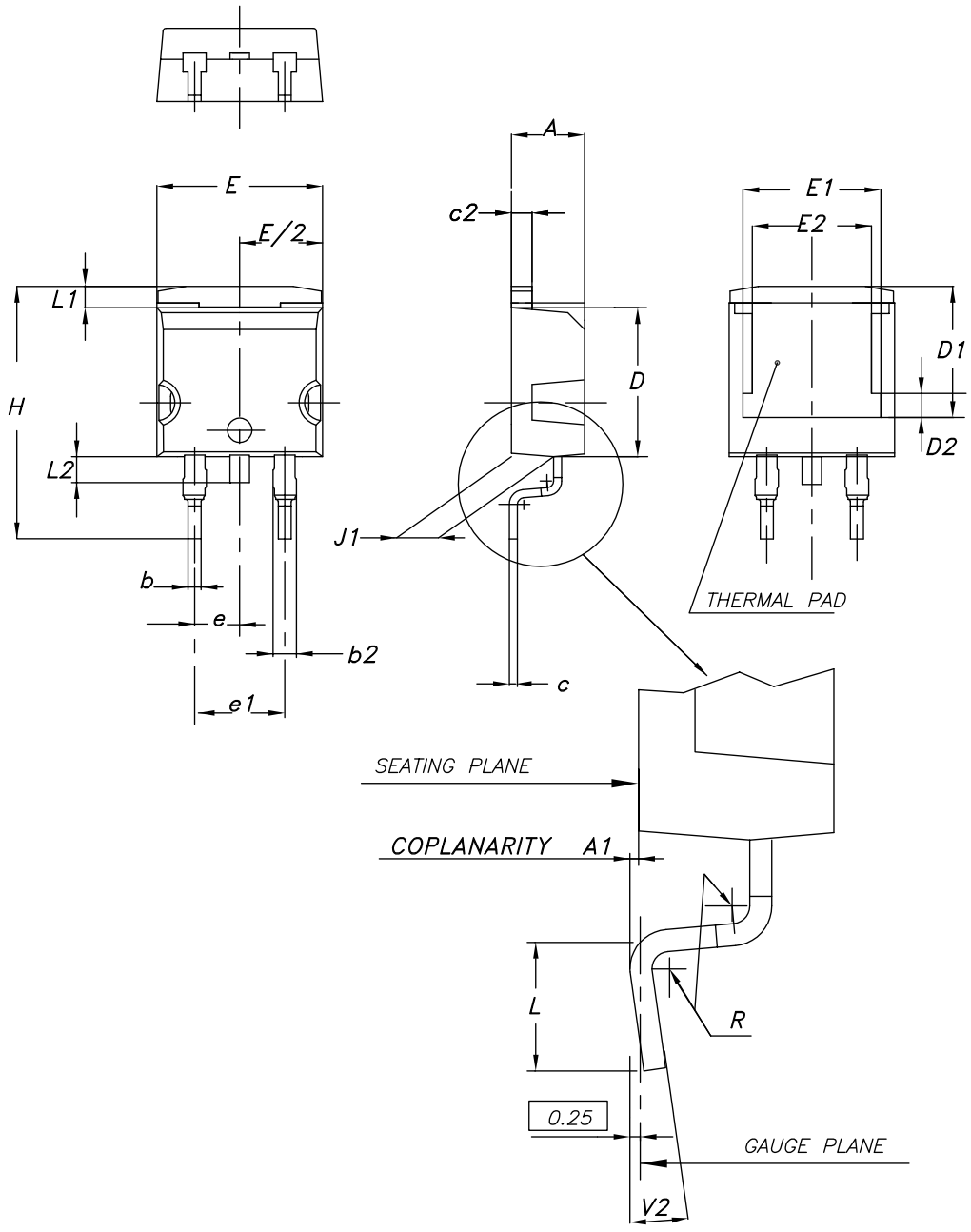


4 Package information

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 D²PAK (TO-263) type A2 package information

Figure 38. **D²PAK (TO-263) type A2 package outline**

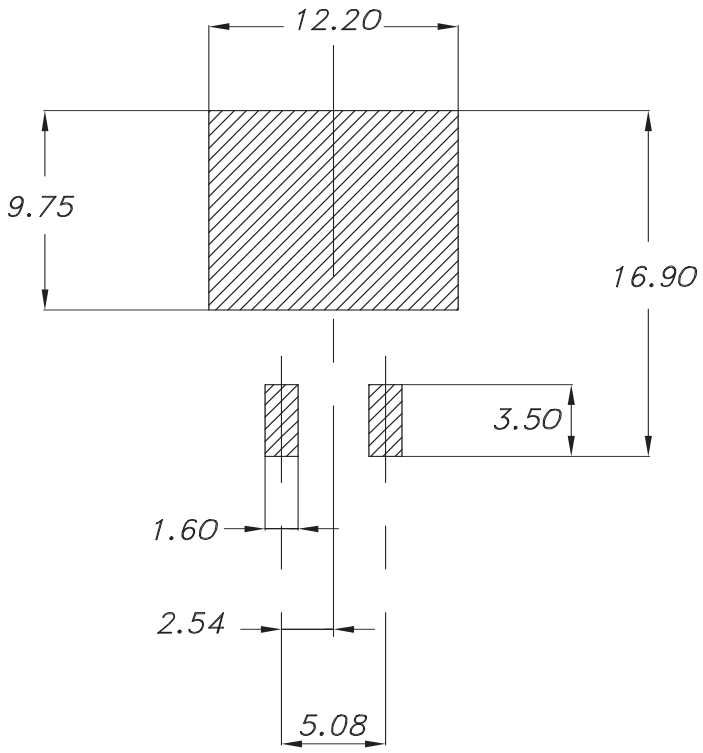


0079457_A2_27

Table 8. **D²PAK (TO-263) type A2 package mechanical data**

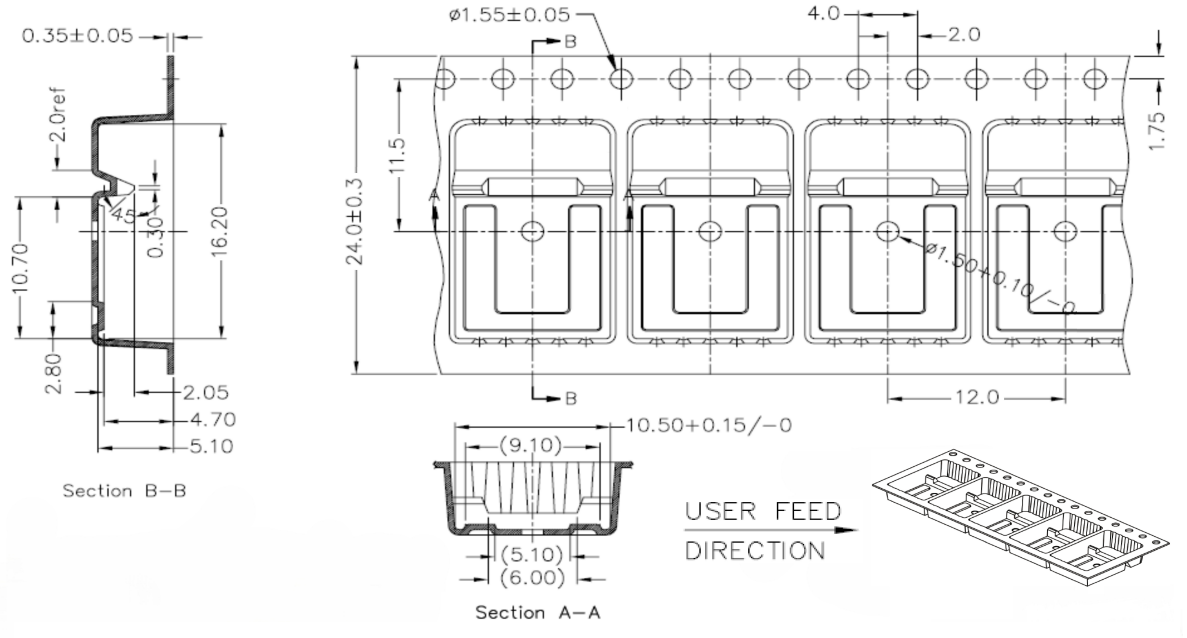
Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50	7.75	8.00
D2	1.10	1.30	1.50
E	10.00		10.40
E1	8.70	8.90	9.10
E2	7.30	7.50	7.70
e		2.54	
e1	4.88		5.28
H	15.00		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.40	
V2	0°		8°

Figure 39. **D²PAK (TO-263) recommended footprint (dimensions are in mm)**



4.2 D²PAK packing information

Figure 40. **D²PAK tape drawing (dimensions are in mm)**



4.3 TO-220FP type B package information

Figure 41. **TO-220FP type B package outline**

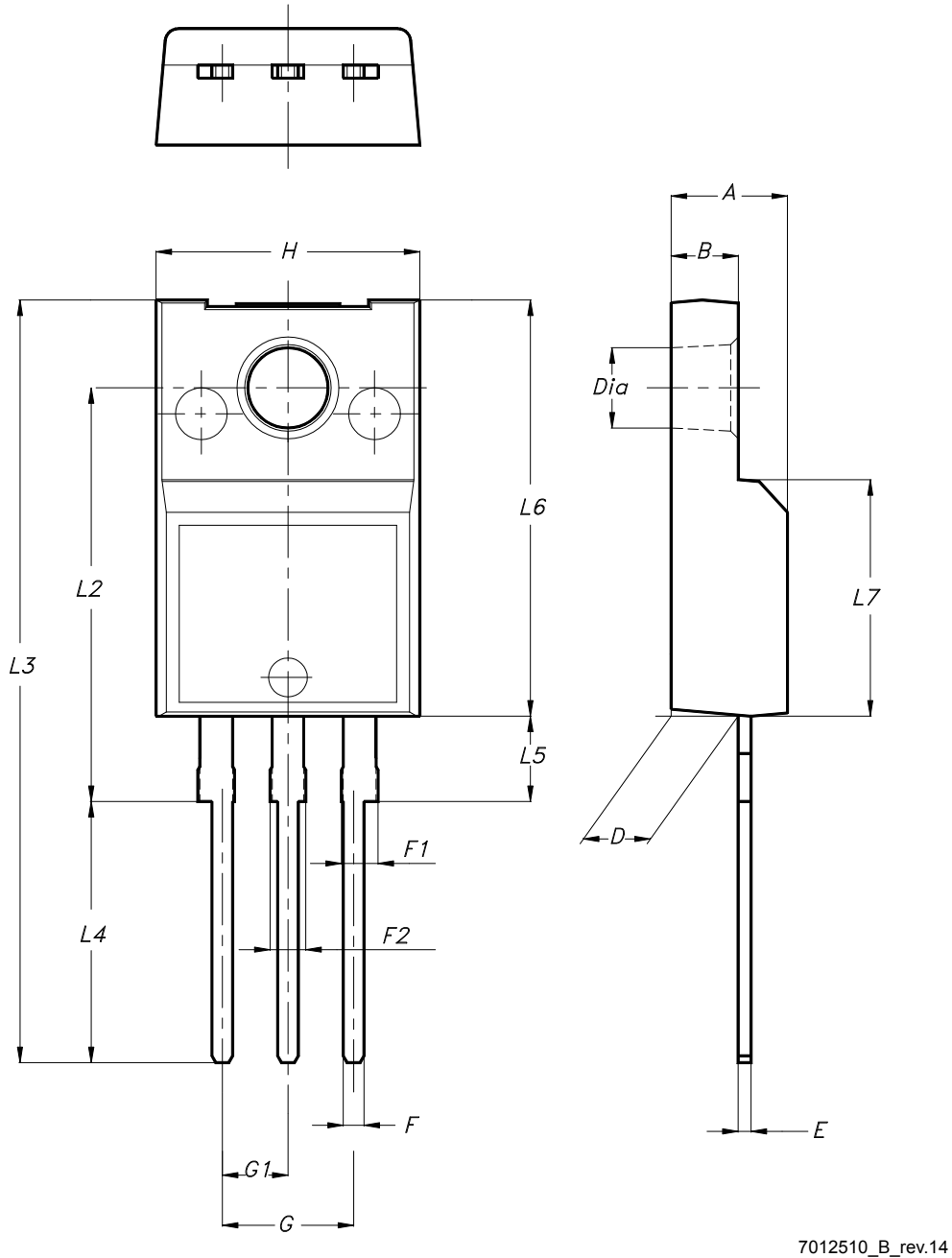


Table 9. **TO-220FP type B package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
B	2.50		2.70
D	2.50		2.75
E	0.45		0.70
F	0.75		1.00
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.20
G1	2.40		2.70
H	10.00		10.40
L2		16.00	
L3	28.60		30.60
L4	9.80		10.60
L5	2.90		3.60
L6	15.90		16.40
L7	9.00		9.30
Dia	3.00		3.20

4.4 TO-220 type A package information

Figure 42. **TO-220 type A package outline**

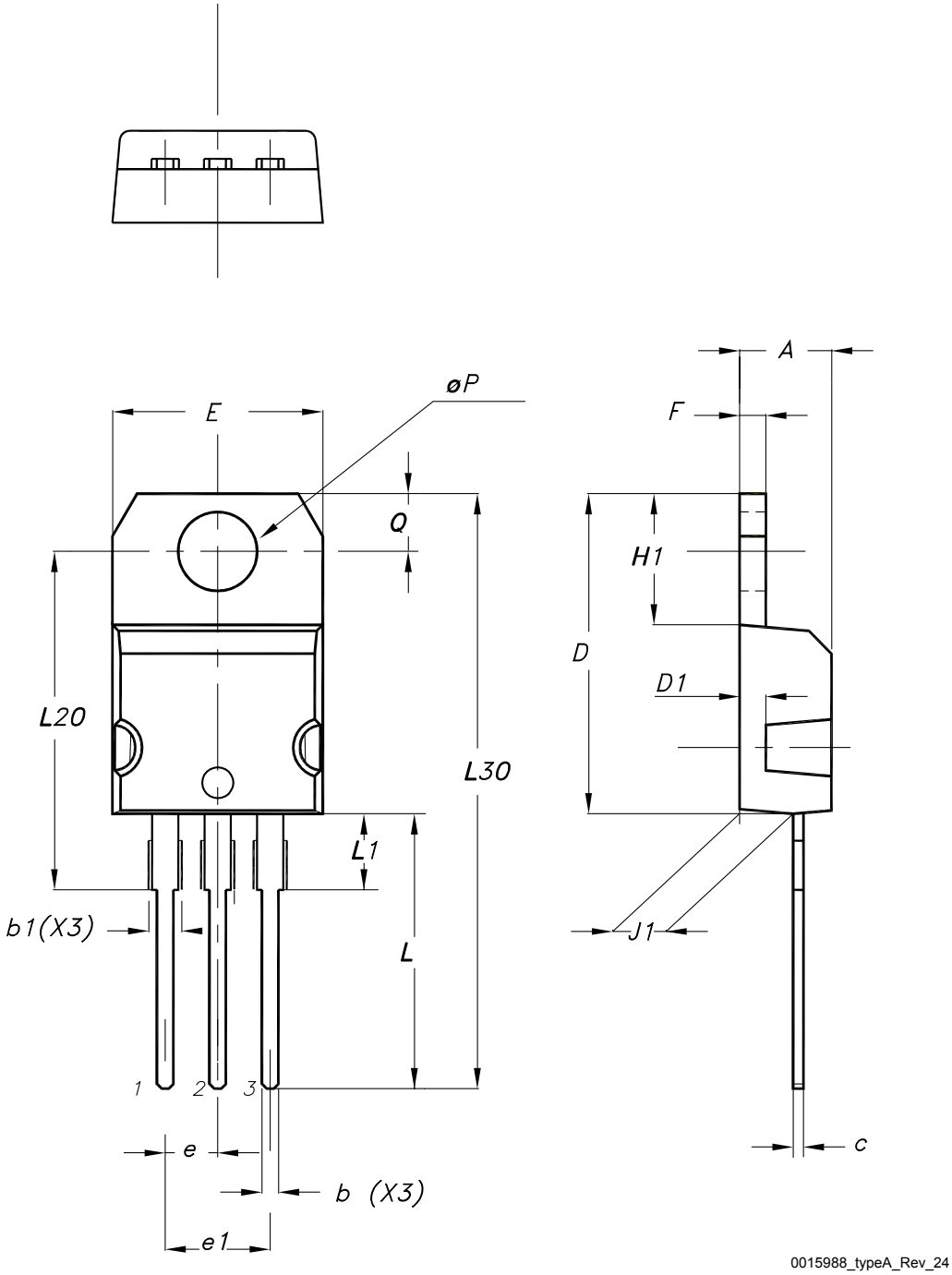


Table 10. **TO-220 type A package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10.00		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13.00		14.00
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95
Slug flatness		0.03	0.10

5 Ordering information

Table 11. **Order codes**

Order code	Marking	Package	Packing
STGB7H60DF	GB7H60DF	D^2PAK	Tape and reel
STGF7H60DF	GF7H60DF	TO-220FP	Tube
STGP7H60DF	GP7H60DF	TO-220	

Revision history

Table 12. **Document revision history**

Date	Version	Changes
24-Feb-2015	1	Initial release.
05-Jun-2015	2	Text and formatting changes throughout document In Section 1: Electrical ratings • updated Table 3 In Section 2: Electrical characteristics • updated Table 4, Table 5, Table 6, Table 7 and Table 8 • added Section 2.1: Electrical characteristics (curves)
05-May-2025	3	Updated Section 4: Package information chapter. Minor text changes.

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