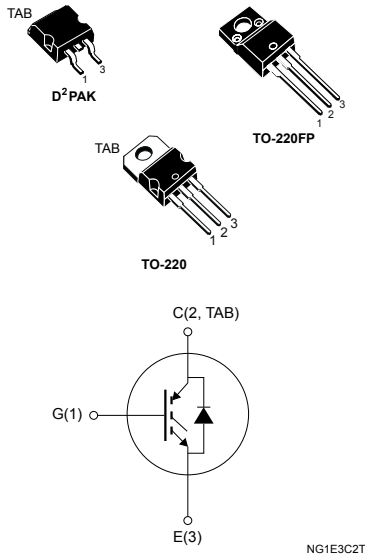




Trench gate field-stop 600 V, 7 A high speed H series IGBT



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 ² PAK, 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 ² PAK, 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

$T_C = 25\text{ °C}$ unless otherwise specified.

Table 3. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	$V_{GE} = 0\text{ V}$, $I_C = 2\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 7\text{ A}$		1.50	1.95	V
		$V_{GE} = 15\text{ V}$, $I_C = 7\text{ A}$, $T_J = 125\text{ °C}$		1.6		
		$V_{GE} = 15\text{ V}$, $I_C = 7\text{ A}$, $T_J = 175\text{ °C}$		1.70		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$	4.8	6.2	6.9	V
I_{CES}	Collector cut-off current	$V_{CE} = 600\text{ V}$, $V_{GE} = 0\text{ V}$			25	μA
I_{GES}	Gate-emitter leakage current	$V_{GE} = \pm 20\text{ V}$, $V_{CE} = 0\text{ V}$			± 250	nA

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$	-	1050	-	μF
C_{oes}	Output capacitance			51		
C_{res}	Reverse transfer capacitance			23		
Q_g	Total gate charge	$V_{CC} = 480\text{ V}$, $I_C = 7\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (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	$V_{CE} = 400\text{ V}$, $I_C = 7\text{ A}$, $R_G = 47\ \Omega$,	-	30	-	ns
t_r	Current rise time	$V_{GE} = 15\text{ V}$		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/ μ s
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$, $I_C = 7\text{ A}$, $R_G = 47\ \Omega$,		30		ns
t_r	Current rise time	$V_{GE} = 15\text{ V}$, $T_J = 175\text{ }^\circ\text{C}$		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/ μ s
$t_{r(Voff)}$	Off voltage rise time	$V_{CE} = 400\text{ V}$, $I_C = 7\text{ A}$, $R_G = 47\ \Omega$,	-	24	-	ns
$t_{d(off)}$	Turn-off delay time	$V_{GE} = 15\text{ V}$		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	$V_{CE} = 400\text{ V}$, $I_C = 7\text{ A}$, $R_G = 47\ \Omega$,		31		
$t_{d(off)}$	Turn-off delay time	$V_{GE} = 15\text{ V}$, $T_J = 175\text{ }^\circ\text{C}$		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	$V_{CC} \leq 360\text{ V}$, $V_{GE} = 15\text{ V}$, $R_G = 47\ \Omega$	3	5	-	μ s

Table 6. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching energy	$V_{CE} = 400\text{ V}$, $I_C = 7\text{ A}$, $R_G = 47\ \Omega$,	-	99	-	μ J
$E_{off}^{(2)}$	Turn-off switching energy	$V_{GE} = 15\text{ V}$		100		
E_{ts}	Total switching energy	(see Figure 34. Test circuit for inductive load switching)		199		
$E_{on}^{(1)}$	Turn-on switching energy	$V_{CE} = 400\text{ V}$, $I_C = 7\text{ A}$, $R_G = 47\ \Omega$,		202		
$E_{off}^{(2)}$	Turn-off switching energy	$V_{GE} = 15\text{ V}$, $T_J = 175\text{ }^\circ\text{C}$		149		
E_{ts}	Total switching energy	(see Figure 34. Test circuit for inductive load switching)		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	$I_F = 7\text{ A}$	-	1.5	2.1	V
		$I_F = 7\text{ A}$, $T_J = 175\text{ °C}$		1.15		
t_{rr}	Reverse recovery time	$V_{CC} = 400\text{ V}$; $I_F = 7\text{ A}$, $di_F/dt = 100\text{ A / } \mu\text{s}$ (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	$V_{CC} = 400\text{ V}$; $I_F = 7\text{ A}$, $di_F/dt = 100\text{ A / } \mu\text{s}$ $T_J = 175\text{ °C}$ (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

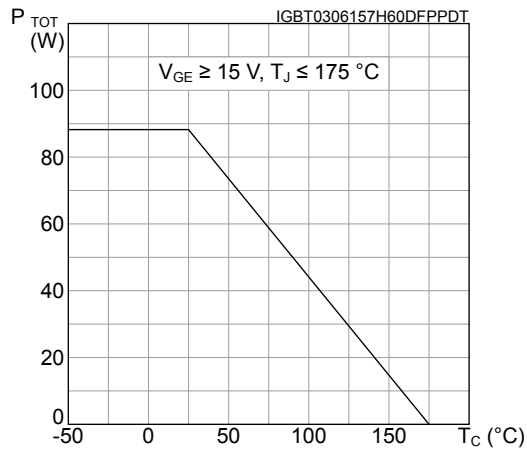


Figure 2. Collector current vs case temperature for D²PAK and TO-220

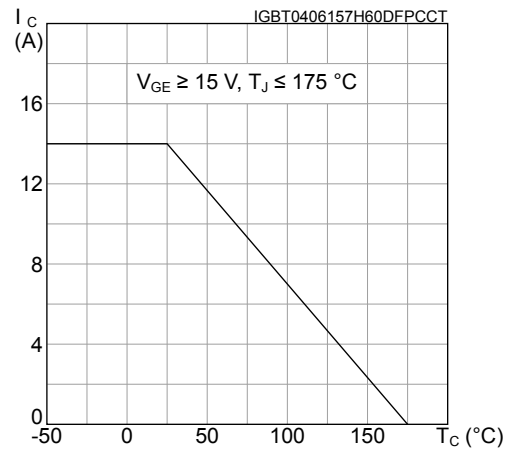


Figure 3. Power dissipation vs case temperature for TO-220FP

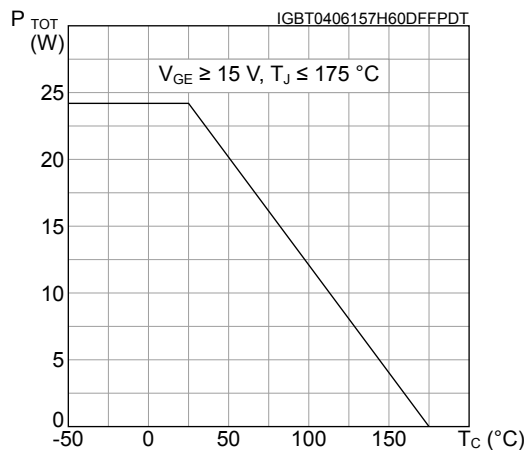


Figure 4. Collector current vs case temperature for TO-220FP

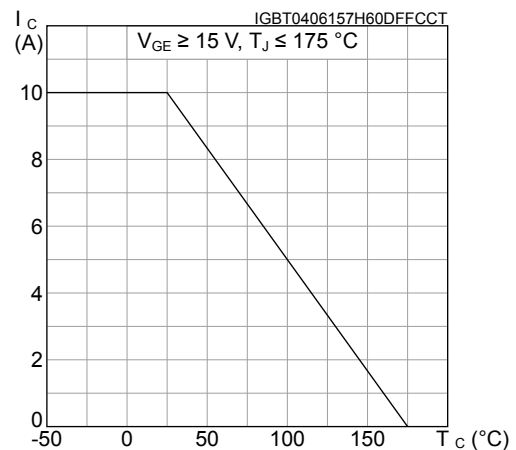


Figure 5. Output characteristics ($T_J = 25^{\circ}\text{C}$)

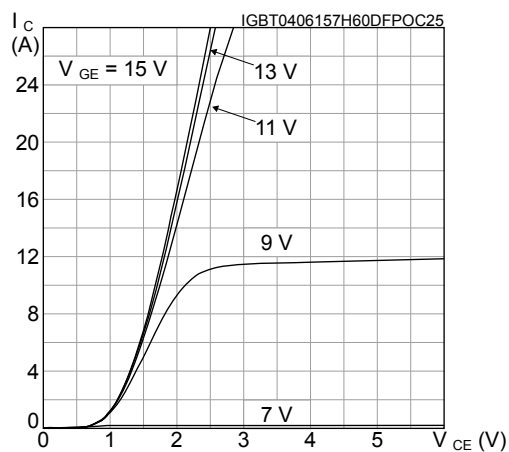


Figure 6. Output characteristics ($T_J = 175^{\circ}\text{C}$)

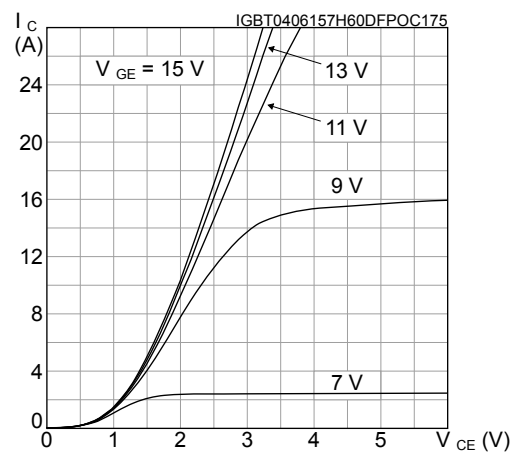


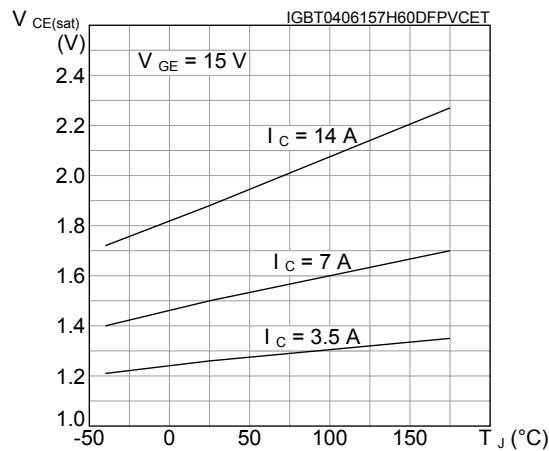
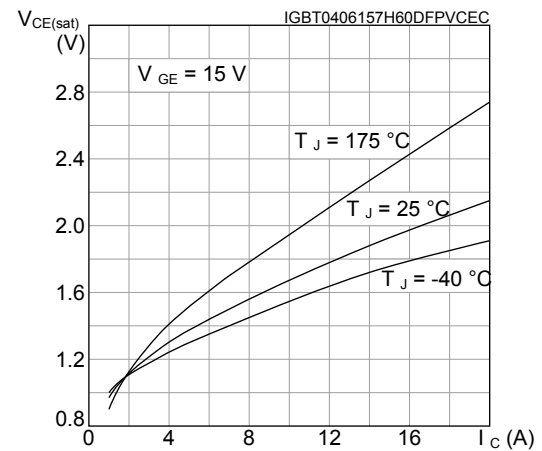
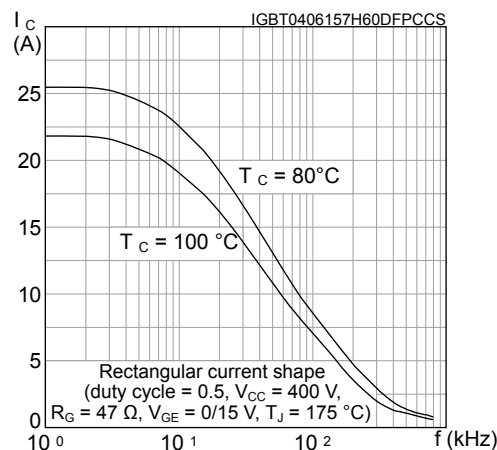
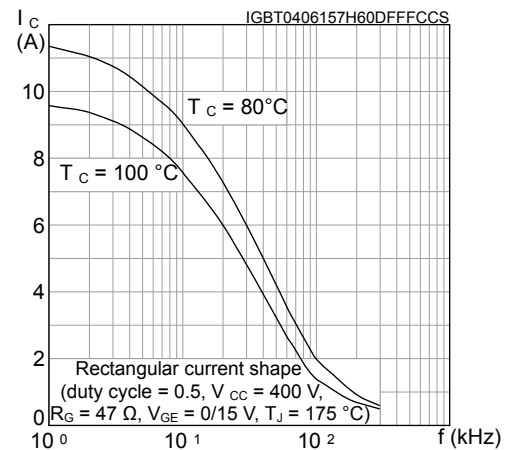
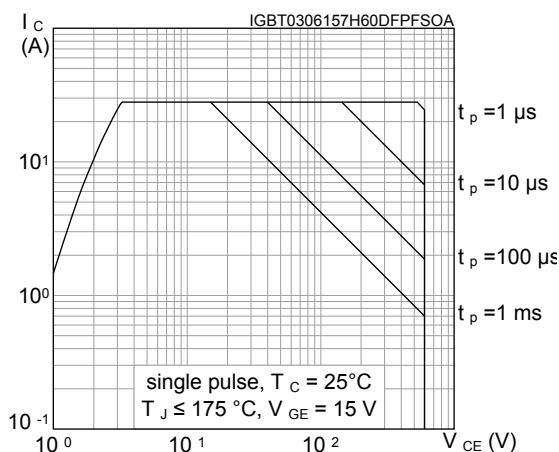
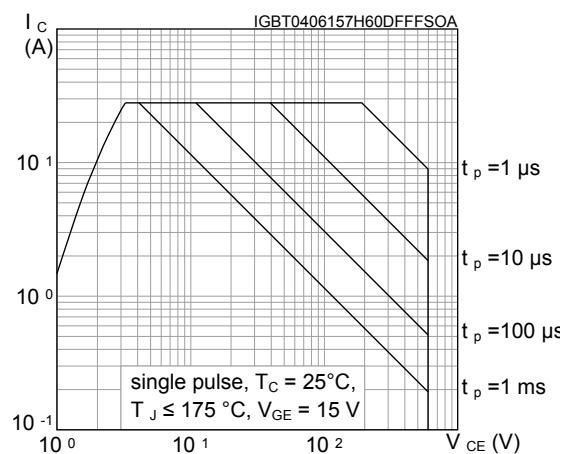
Figure 7. $V_{CE(sat)}$ vs junction temperature

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


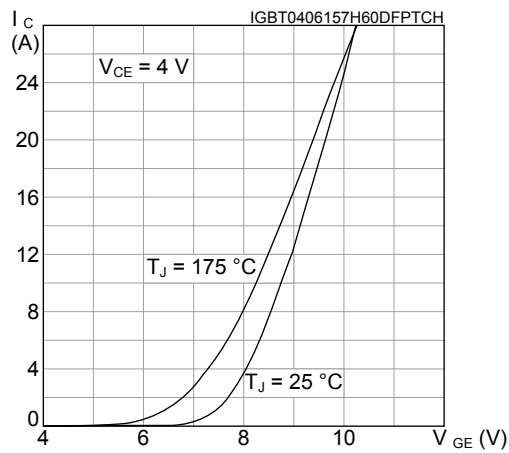
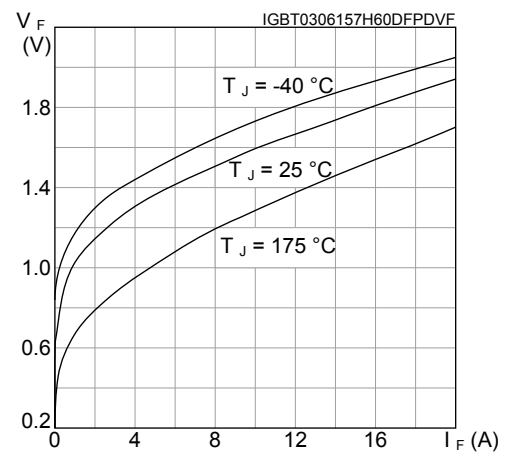
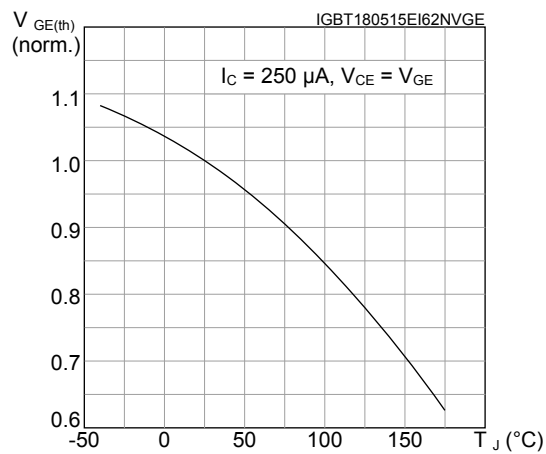
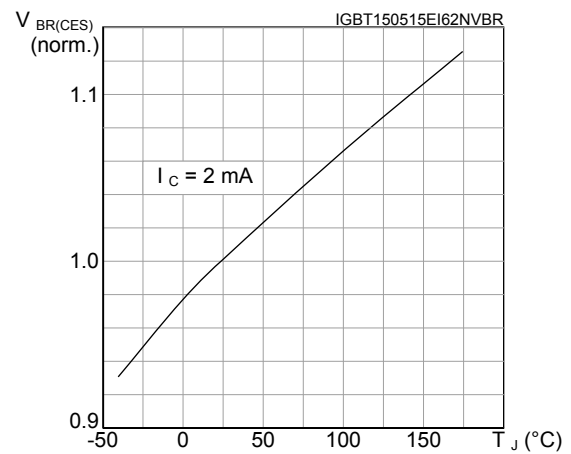
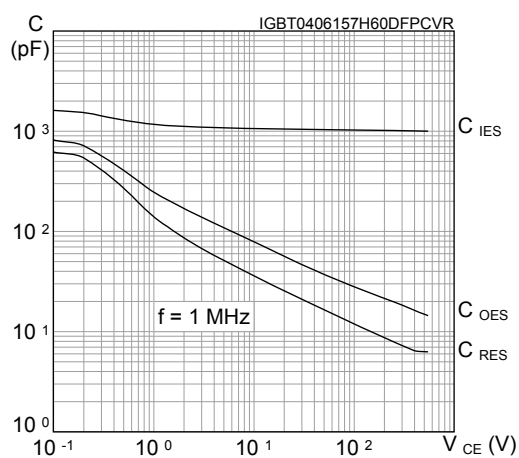
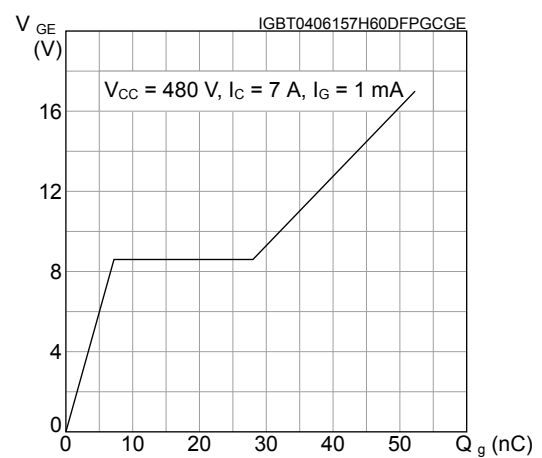
Figure 13. Transfer characteristics

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


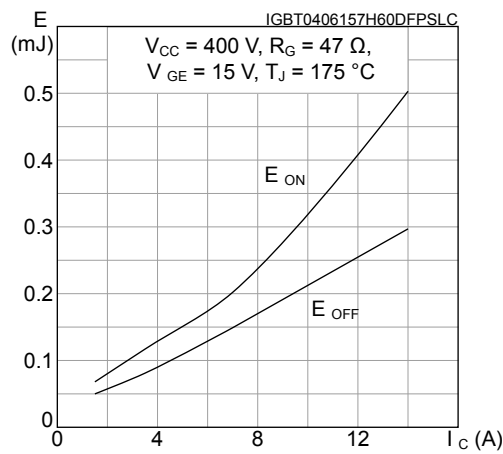
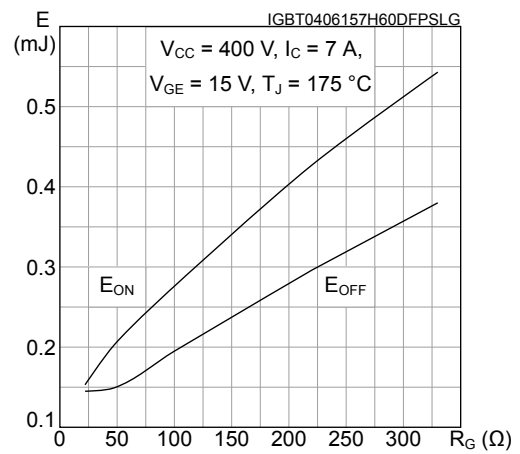
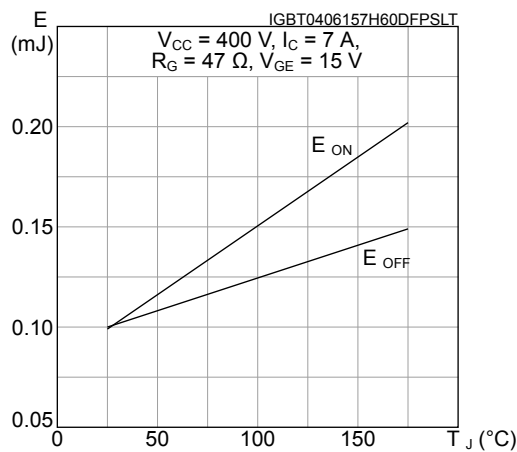
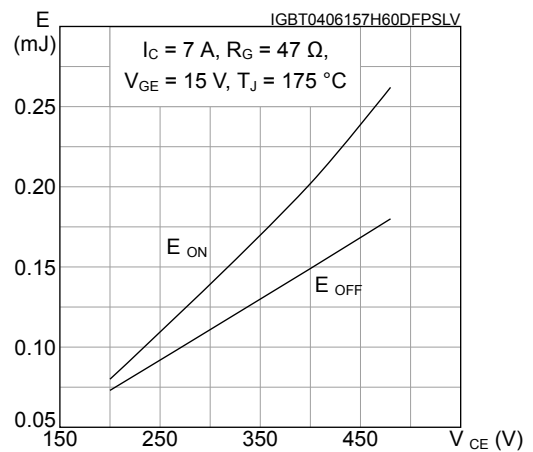
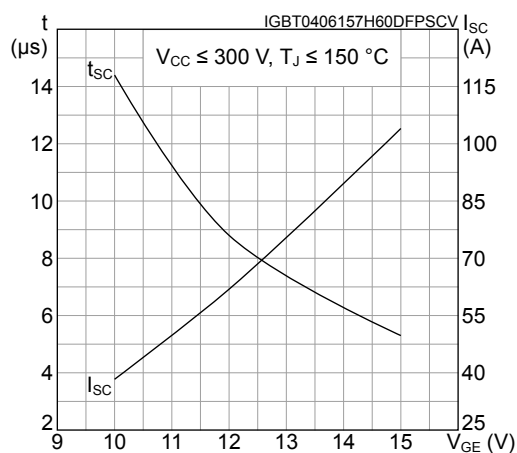
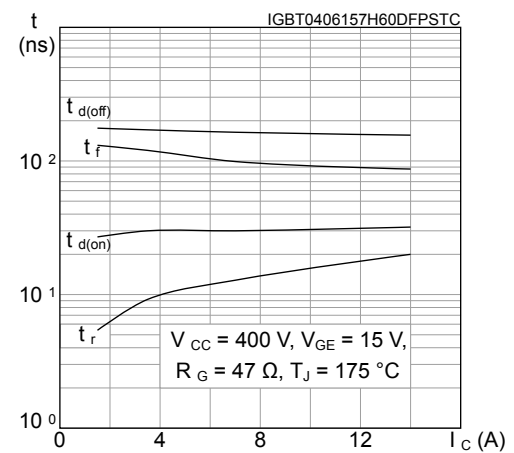
Figure 19. Switching energy vs collector current

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


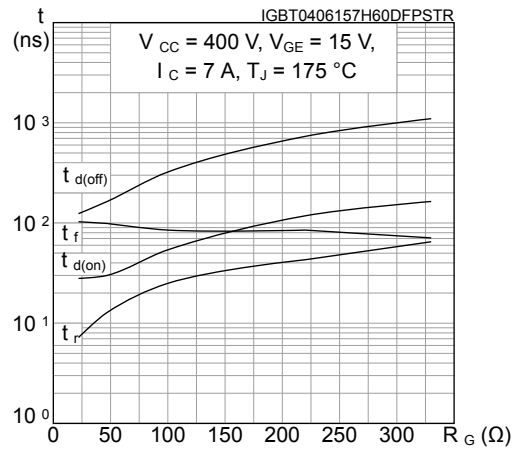
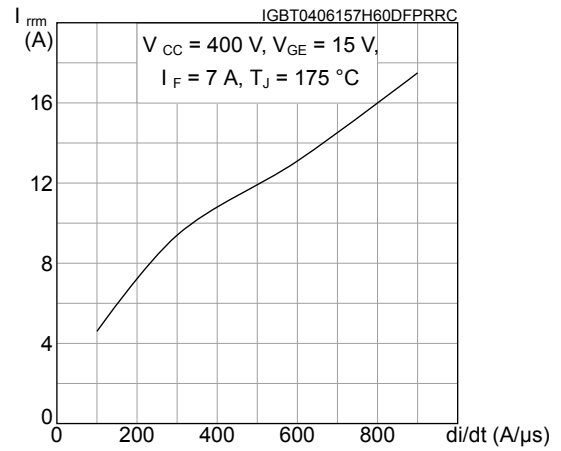
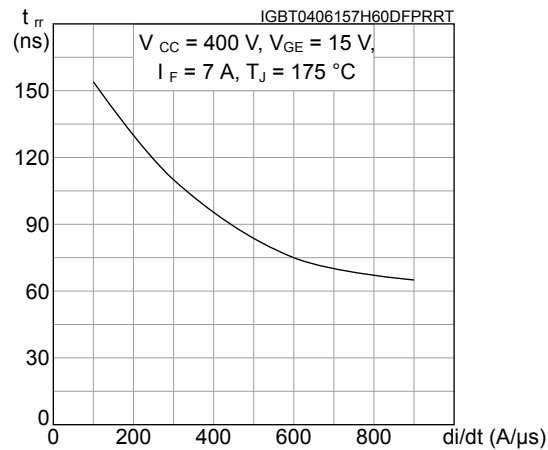
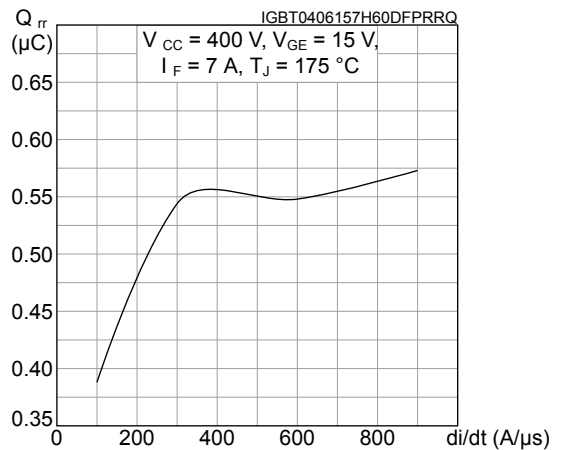
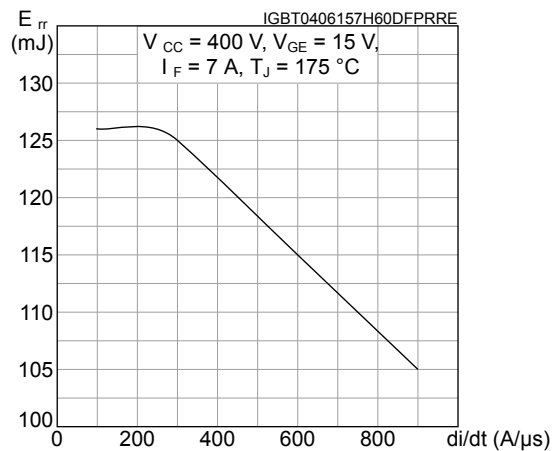
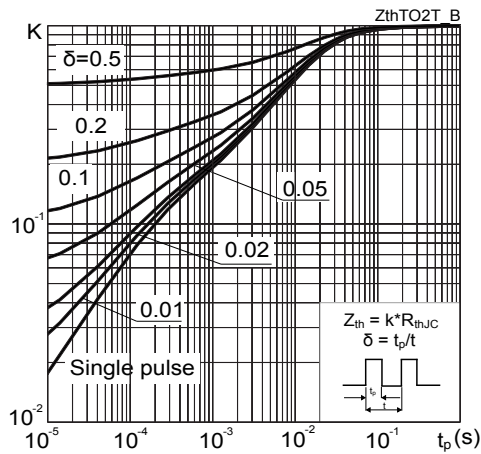
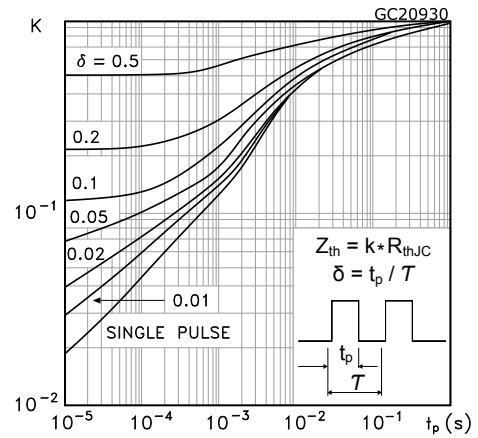
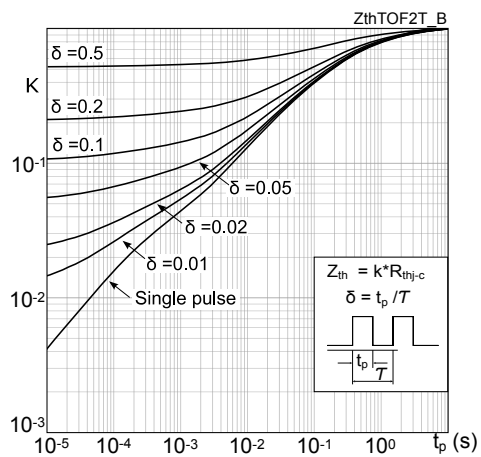
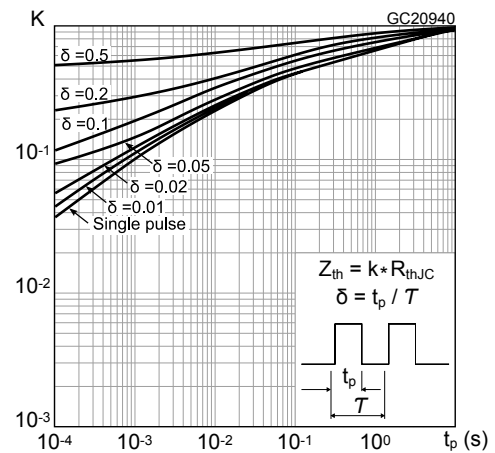
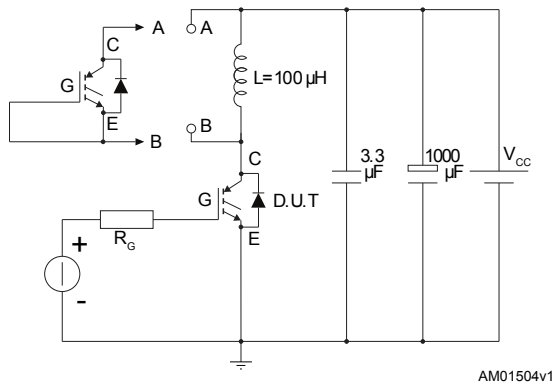
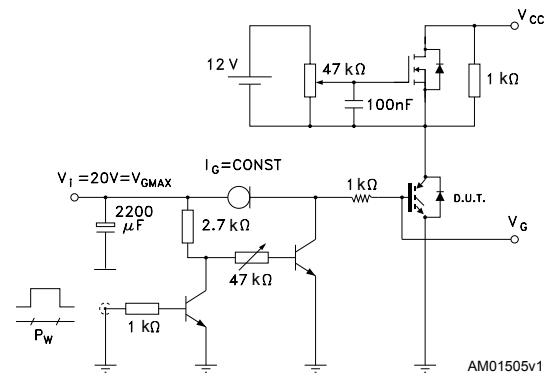
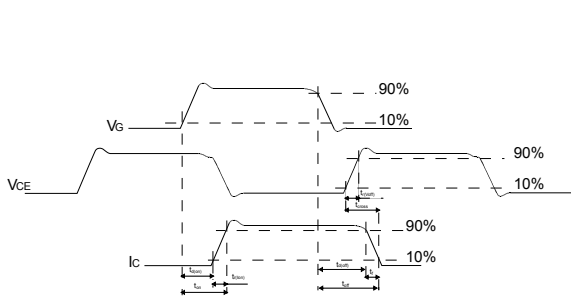
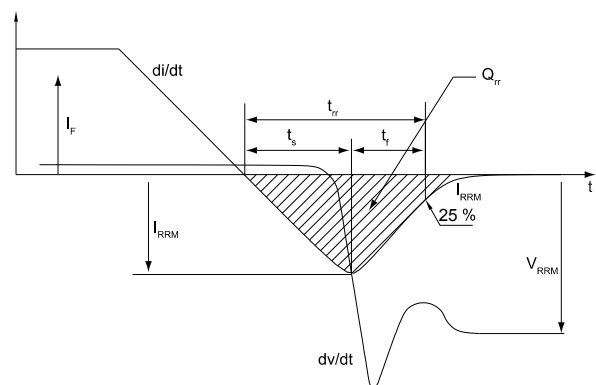
Figure 25. Switching times vs gate resistance

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

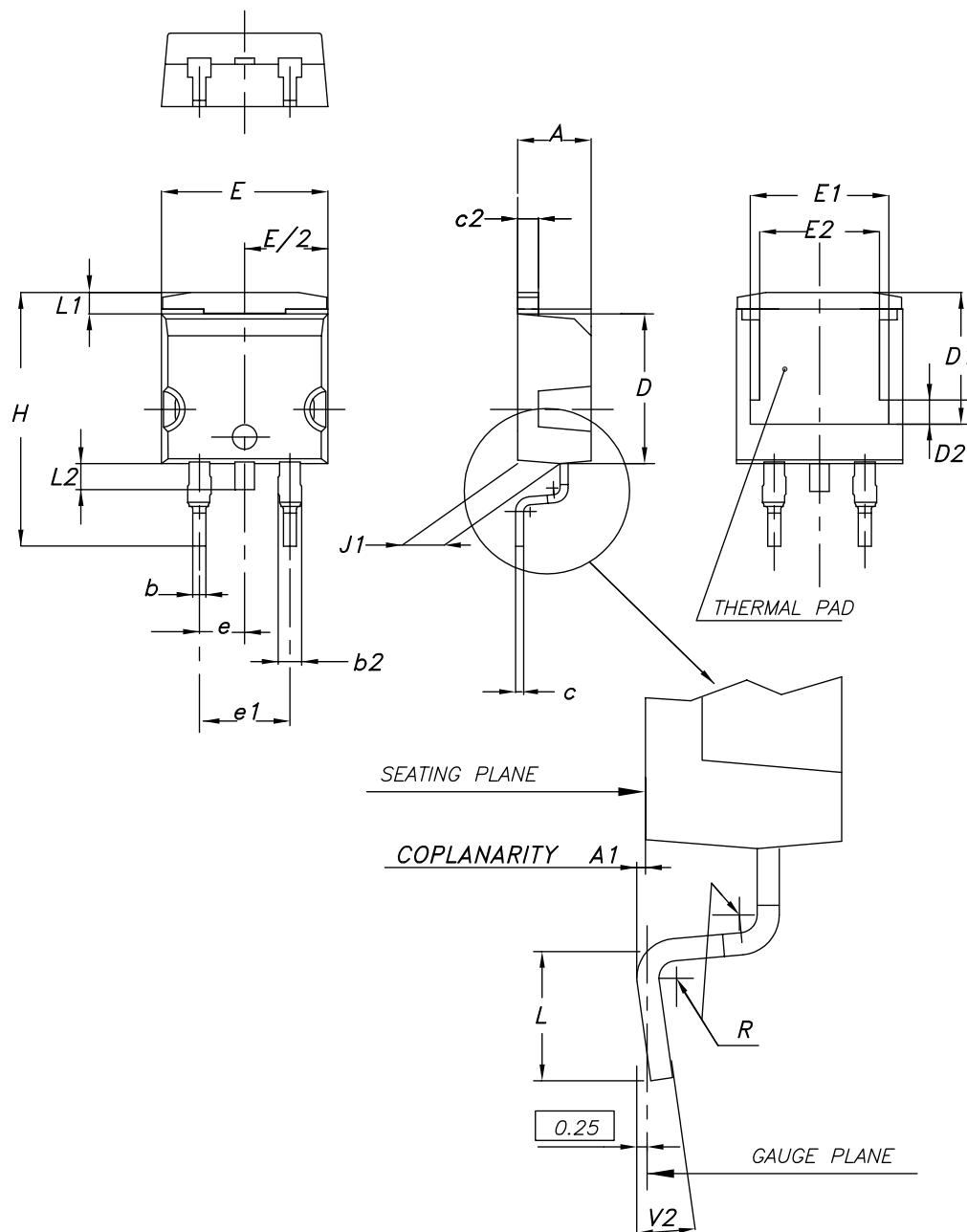
Figure 34. Test circuit for inductive load switching

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

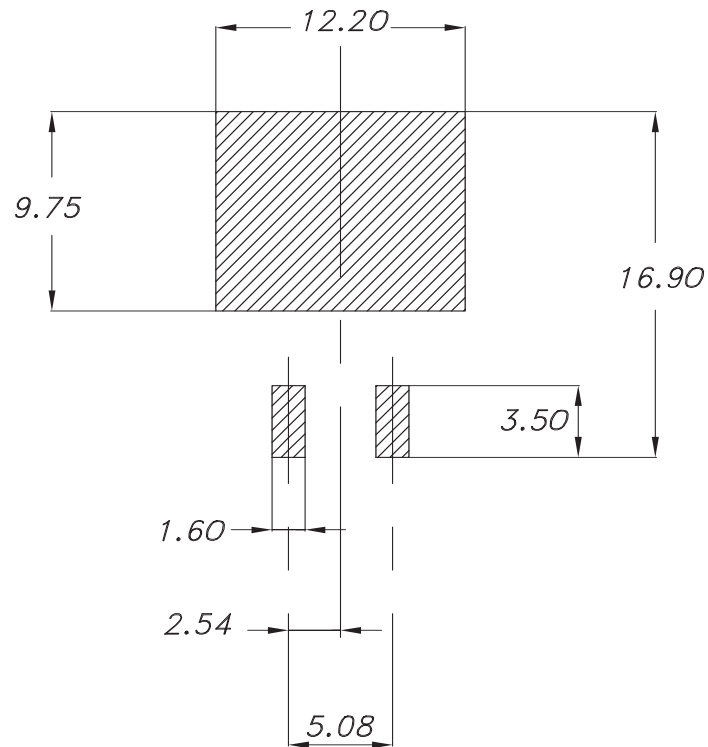


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Table 8. D²PAK (TO-263) type A2 package mechanical data

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°

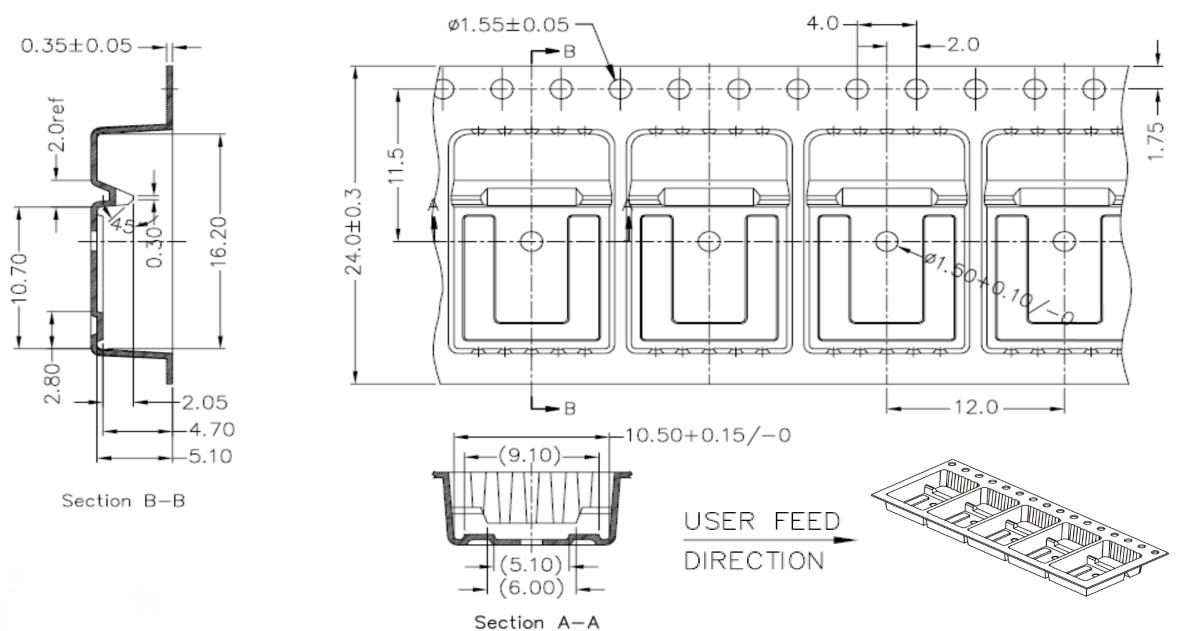
Figure 39. D²PAK (TO-263) recommended footprint (dimensions are in mm)



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4.2 D²PAK packing information

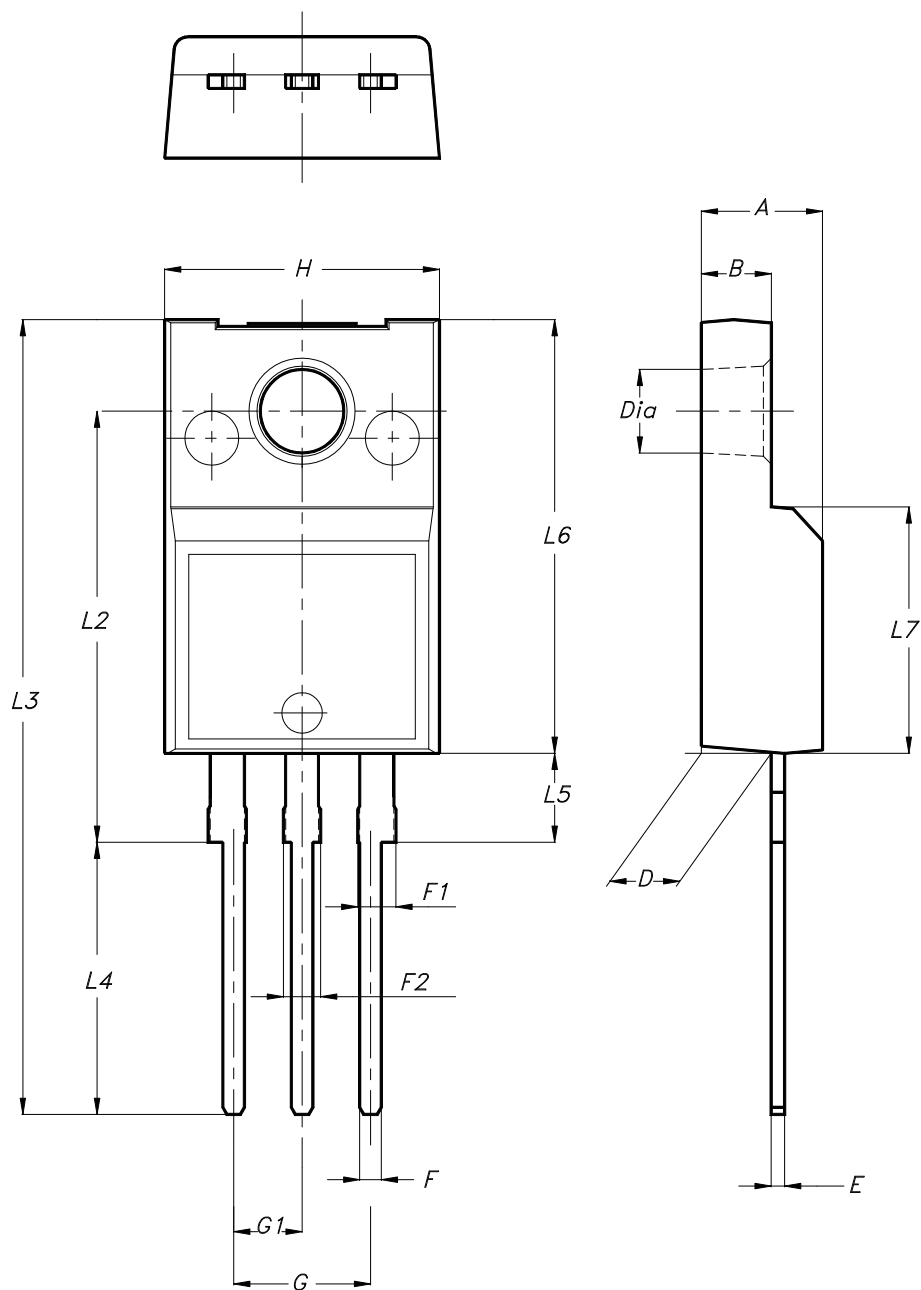
Figure 40. D²PAK tape drawing (dimensions are in mm)



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4.3 TO-220FP type B package information

Figure 41. TO-220FP type B package outline



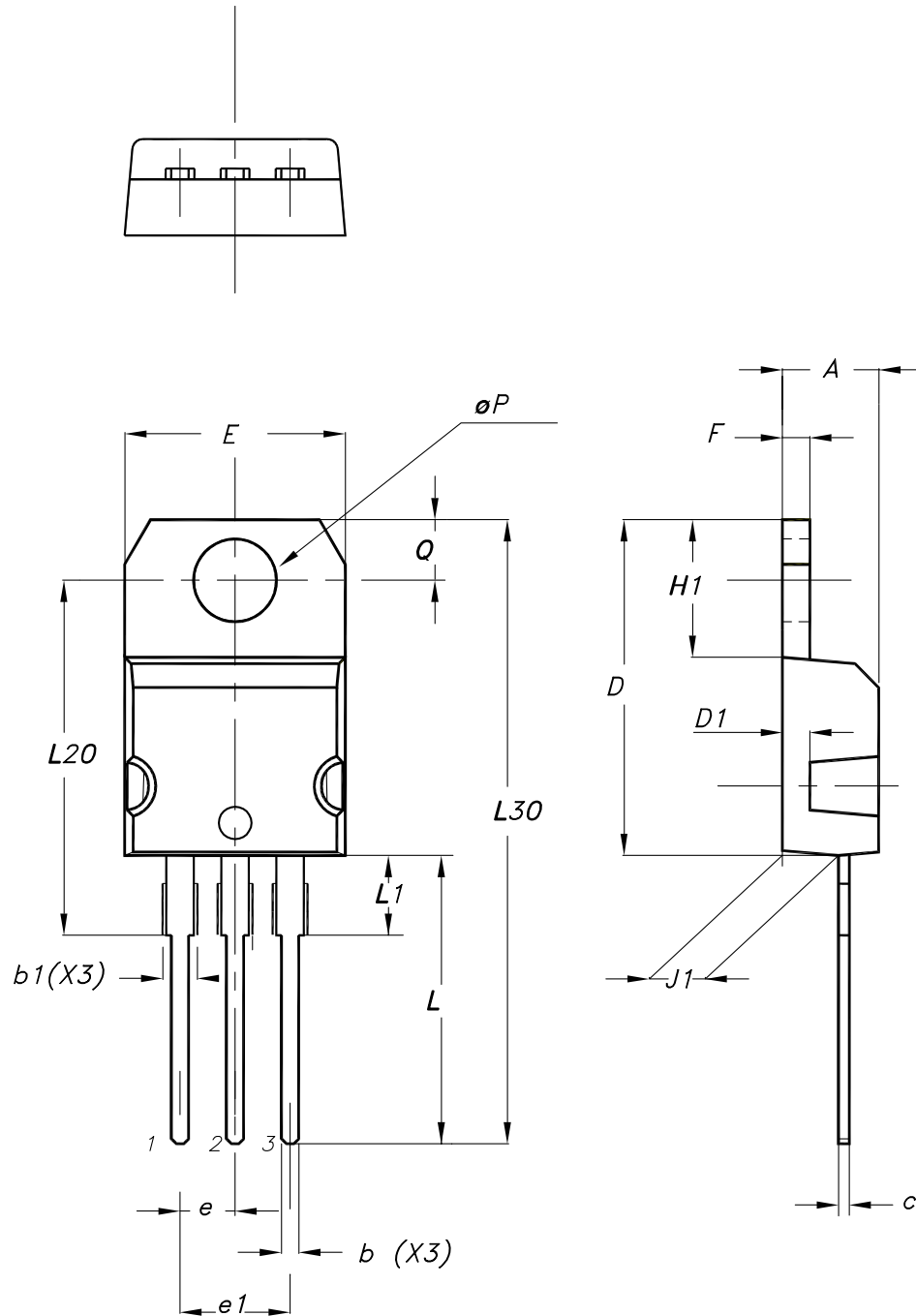
7012510_B_rev.14

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



0015988_typeA_Rev_24

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 ² PAK	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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