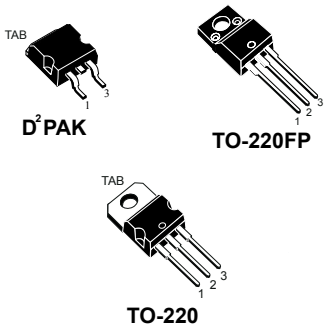
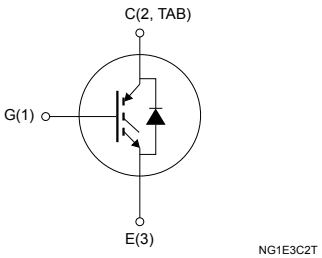
STGB20H60DF, STGF20H60DF, STGP20H60DF

Datasheet

Trench gate field-stop 600 V, 20 A high speed IGBT





Features

- Maximum junction temperature: T_J = 175 °C
- High speed switching
- Tight parameter distribution
- Safe paralleling
- Low thermal resistance
- Short-circuit rated
- Soft and fast recovery antiparallel diode

Applications

- Industrial motor control
- PFC converters, single phase input
- Uninterruptable power supplies (UPS)

Description

These devices are IGBTs developed using an advanced proprietary trench gate field-stop structure. These devices are part of the H series of IGBTs, which represents 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 links
STGB20H60DF
STGF20H60DF
STGP20H60DF

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D²PAK, 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	40	40(1)	A
	Continuous collector current at T_C = 100 °C	20	20(1)	
I_{CP}(2)	Pulsed collector current	80	80	A
V_{GE}	Gate-emitter voltage	±20		V
I_F	Diode RMS forward current at T_C = 25 °C	40	40(1)	A
	Diode RMS forward current at T_C = 100 °C	20	20(1)	
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s, T_C = 25 °C)	-	2.5	kV
I_{FP}(2)	Pulsed forward current	80	80	A
P_{TOT}	Total power dissipation at T_C = 25 °C	167	37	W
T_{STG}	Storage temperature range	-55 to 150		°C
T_J	Operating junction temperature range	-55 to 175		°C

1. *Limited by maximum junction temperature.*
2. *Pulse width limited by maximum junction temperature and turn-off within RBSOA.*

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		D²PAK, TO-220	TO-220FP	
R_{thJC}	Thermal resistance, junction-to-case IGBT	0.9	4	°C/W
	Thermal resistance, junction-to-case diode	2.5	5.6	
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 = 20 A	-	1.6	2.0	V
		V_{GE} = 15 V, I_C = 20 A, T_J = 125 °C	-	1.75	-	
		V_{GE} = 15 V, I_C = 20 A, T_J = 175 °C	-	1.8	-	
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 1 mA	5.0	6.0	7.0	V
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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0 V	-	2750	-	pF
C_{oes}	Output capacitance		-	110	-	pF
C_{res}	Reverse transfer capacitance		-	65	-	pF
Q_g	Total gate charge	V_{CC} = 390 V, I_C = 20 A, V_{GE} = 0 to 15 V (see the Figure 26. Gate charge test circuit)	-	115	-	nC
Q_{ge}	Gate-emitter charge		-	22	-	nC
Q_{gc}	Gate-collector charge		-	45	-	nC

Table 5. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CC} = 400 V, I_C = 20 A,	-	42.5	-	ns
t_r	Current rise time	R_G = 10 Ω, V_{GE} = 15 V	-	11.9	-	ns
$(di/dt)_{on}$	Turn-on current slope	(see the Figure 24. Test circuit for inductive load switching and Figure 27. Switching waveform)	-	1345	-	A/µs
$t_{d(on)}$	Turn-on delay time	V_{CC} = 400 V, I_C = 20 A,	-	42.5	-	ns
t_r	Current rise time	R_G = 10 Ω, V_{GE} = 15 V, T_J = 175 °C	-	13.4	-	ns
$(di/dt)_{on}$	Turn-on current slope	(see the the Figure 24. Test circuit for inductive load switching and Figure 27. Switching waveform)	-	1180	-	A/µs
$t_r(V_{off})$	Off voltage rise time	V_{CC} = 400 V, I_C = 20 A,	-	20	-	ns
$t_{d(off)}$	Turn-off delay time	R_G = 10 Ω, V_{GE} = 15 V	-	177	-	ns
t_f	Current fall time	(see the the Figure 24. Test circuit for inductive load switching and Figure 27. Switching waveform)	-	55	-	ns
$t_r(V_{off})$	Off voltage rise time	V_{CC} = 400 V, I_C = 20 A,	-	26	-	ns
$t_{d(off)}$	Turn-off delay time	R_G = 10 Ω, V_{GE} = 15 V, T_J = 175 °C	-	173	-	ns
t_f	Current fall time	(see the the Figure 24. Test circuit for inductive load switching and Figure 27. Switching waveform)	-	86	-	ns
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 = 20 A,	-	209	-	µJ
E_{off} (2)	Turn-off switching energy	R_G = 10 Ω, V_{GE} = 15 V	-	261	-	µJ
E_{ts}	Total switching energy	(see the Figure 27. Switching waveform)	-	470	-	µJ
E_{on} (1)	Turn-on switching energy	V_{CE} = 400 V, I_C = 20 A,	-	480	-	µJ
E_{off} (2)	Turn-off switching energy	R_G = 10 Ω, V_{GE} = 15 V, T_J = 175 °C	-	416	-	µJ
E_{ts}	Total switching energy	(see the Figure 27. Switching waveform)	-	896	-	µJ

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

Table 7. Diode switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_F	Forward on-voltage	I_F = 20 A	-	1.8	2.2	V
		I_F = 20 A, T_J =175 °C	-	1.3	-	
t_{rr}	Reverse recovery time	I_F = 20 A, V_R = 60 V, di/dt = 100 A/µs (see the Figure 25. Diode reverse recovery waveform)	-	90	-	ns
Q_{rr}	Reverse recovery charge		-	110	-	nC
I_{rrm}	Reverse recovery current		-	2.4	-	A
t_{rr}	Reverse recovery time	I_F = 20 A, V_R = 60 V, di/dt = 100 A/µs, T_J = 175 °C (see the Figure 25. Diode reverse recovery waveform)	-	180	-	ns
Q_{rr}	Reverse recovery charge		-	466	-	nC
I_{rr}	Reverse recovery current		-	5.2	-	A

2.1 Electrical characteristics (curves)

Figure 1. Total power dissipation vs temperature D²PAK and TO-220

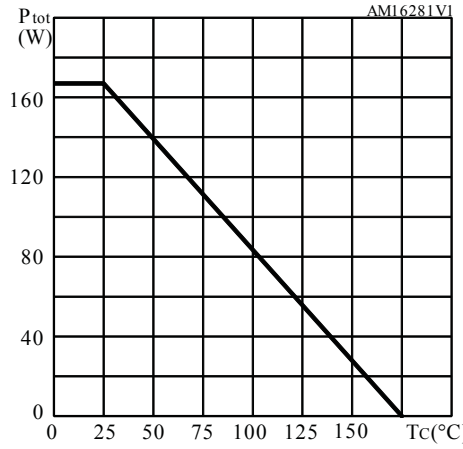


Figure 2. Collector current vs case temperature for TO-220FP

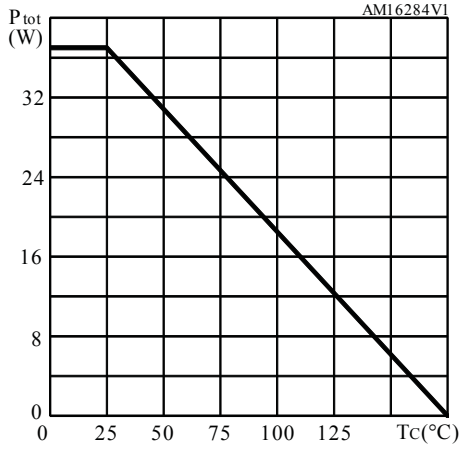


Figure 3. Collector current vs case temperature for D²PAK and TO-220

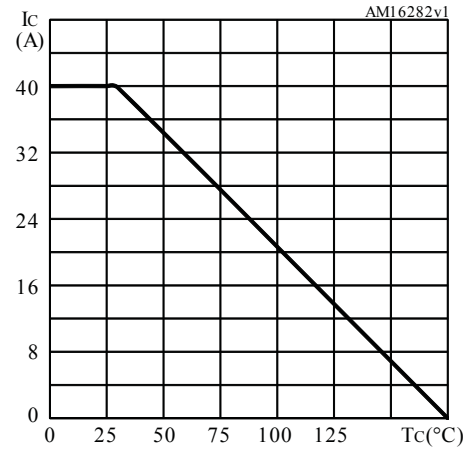


Figure 4. Collector current vs case temperature for TO-220FP

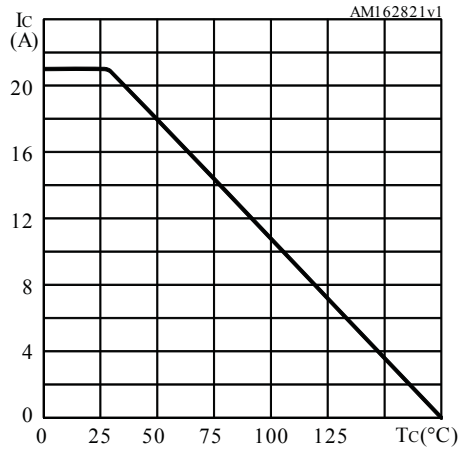


Figure 5. Collector current vs switching frequency for D²PAK and TO-220

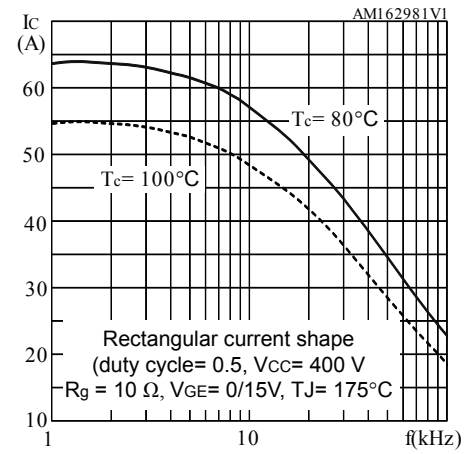


Figure 6. Collector current vs switching frequency for TO-220FP

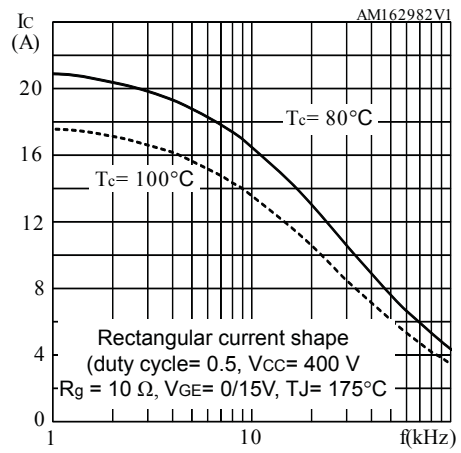


Figure 7. Output characteristics (T_J = 25 °C)

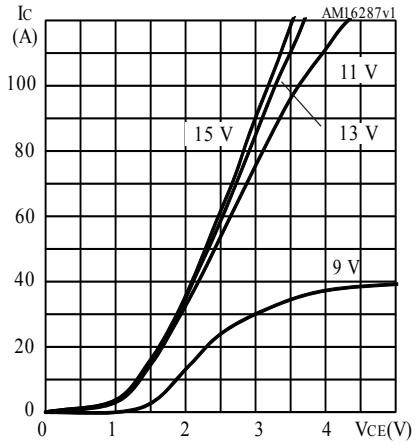


Figure 8. Output characteristics (T_J = 175 °C)

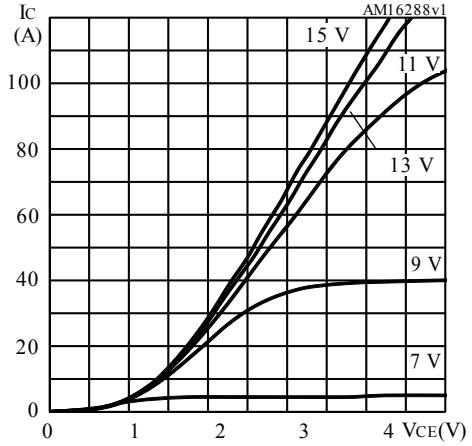


Figure 9. $V_{CE(sat)}$ vs junction temperature

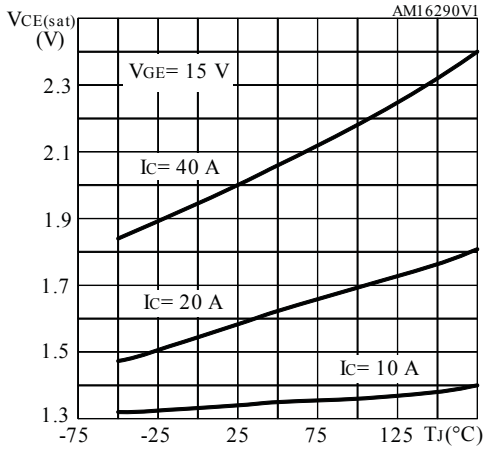


Figure 10. $V_{CE(sat)}$ vs collector current

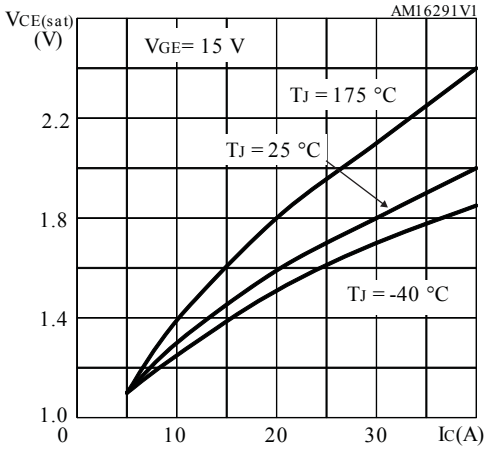


Figure 11. Safe operating area for D²PAK and TO-220

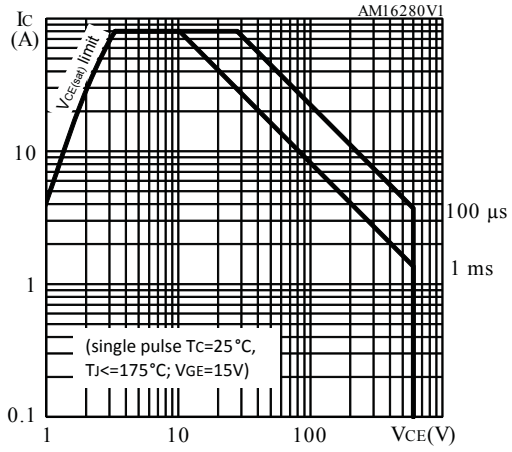


Figure 12. Safe operating area for TO-220FP

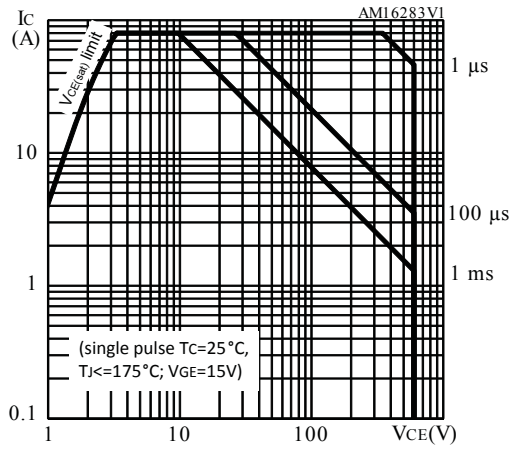


Figure 13. Thermal impedance for D2PAK and TO-220

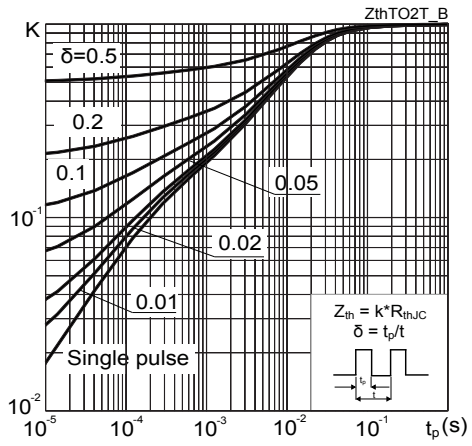


Figure 14. Thermal impedance for TO-220FP

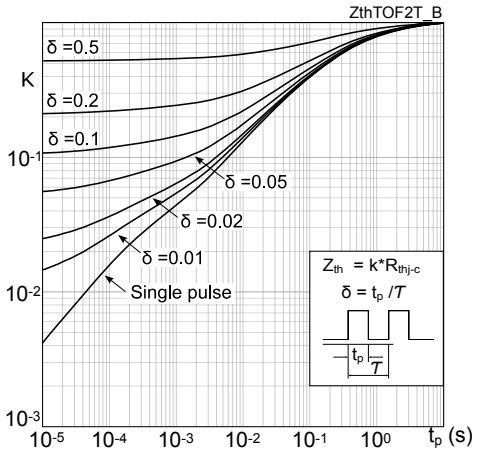


Figure 15. Transfer characteristics

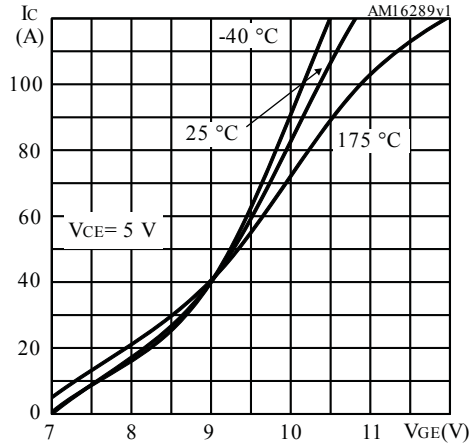


Figure 16. Diode V_F vs forward current

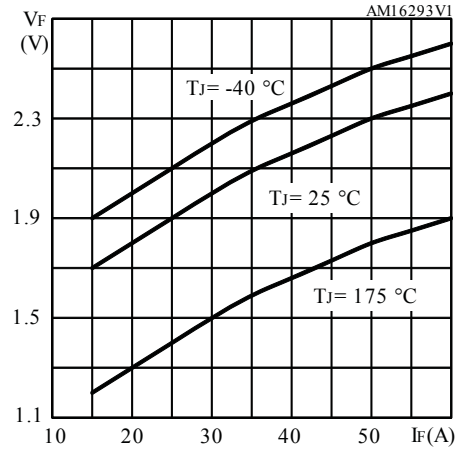


Figure 17. Normalized $V_{GE(th)}$ vs junction temperature

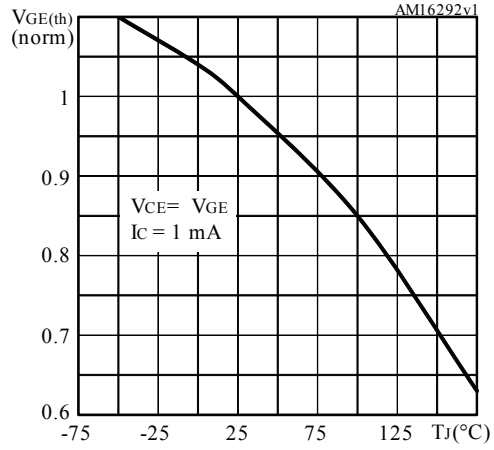


Figure 18. Short-circuit time and current vs V_{GE}

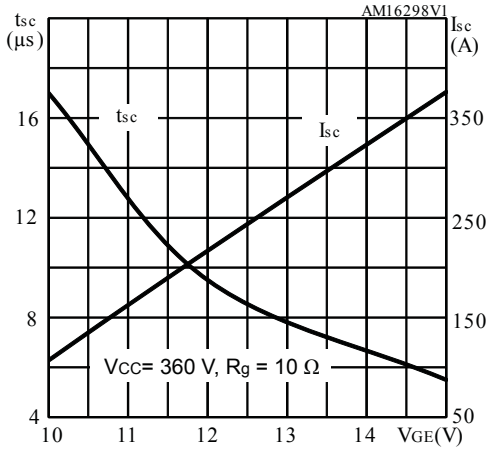


Figure 19. Capacitance variations

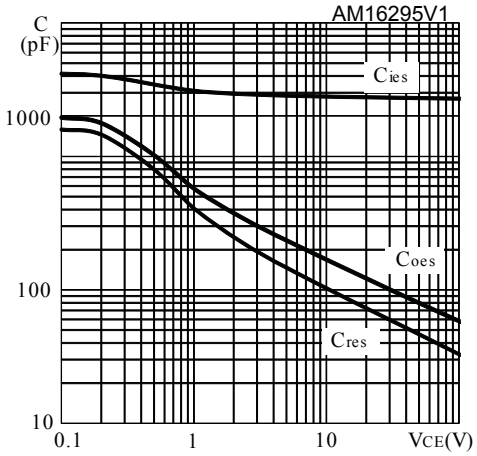


Figure 20. Gate charge vs gate-emitter voltage

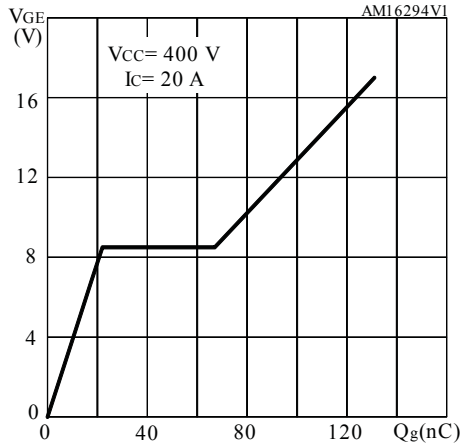


Figure 21. Switching energy vs collector current

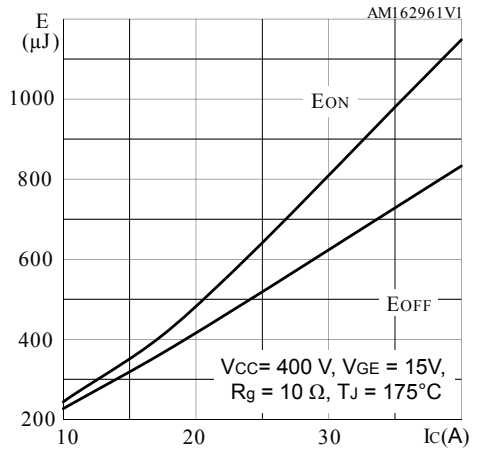


Figure 22. Switching energy vs gate resistance

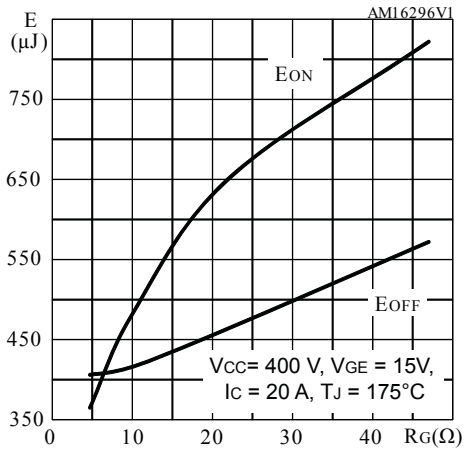
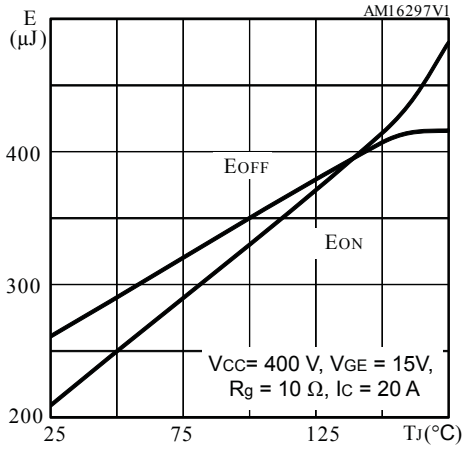


Figure 23. Switching energy vs temperature



3 Test circuits

Figure 24. Test circuit for inductive load switching

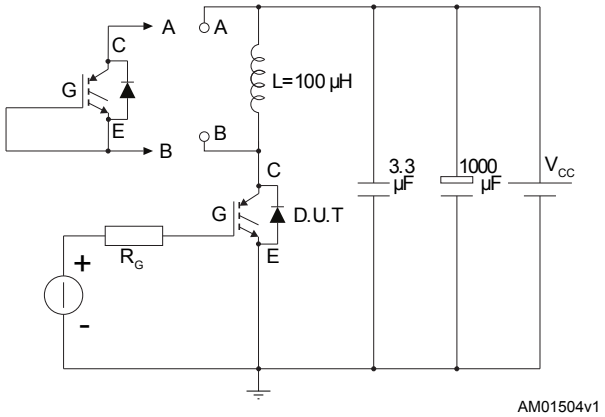


Figure 25. Diode reverse recovery waveform

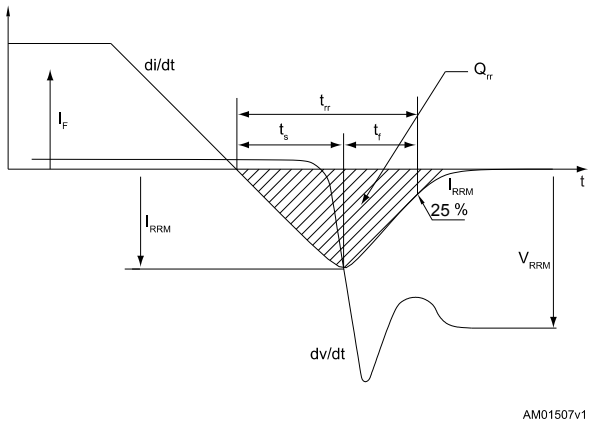


Figure 26. Gate charge test circuit

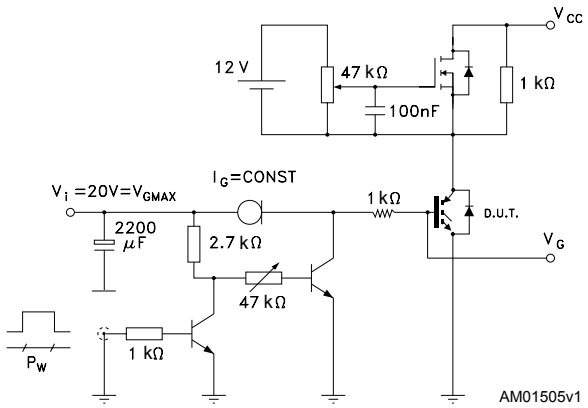
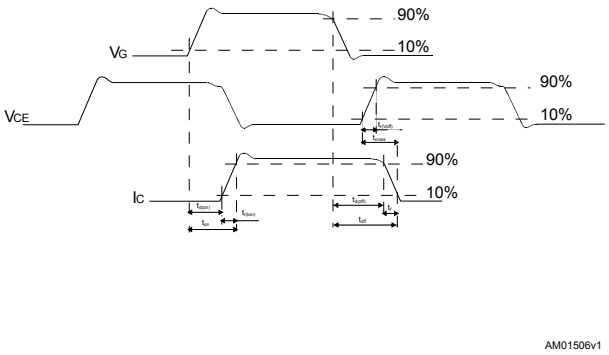


Figure 27. Switching waveform

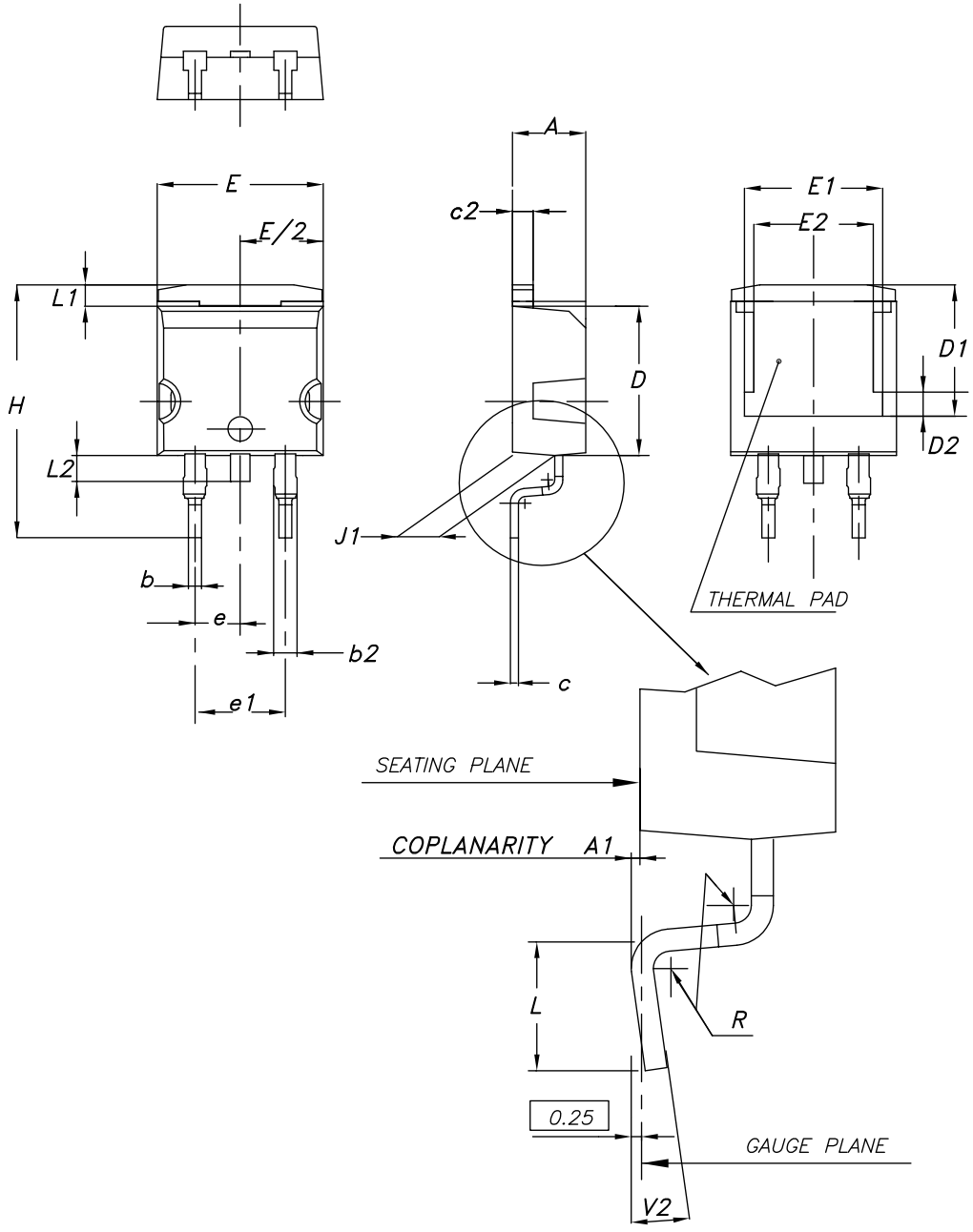


4 Package information

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

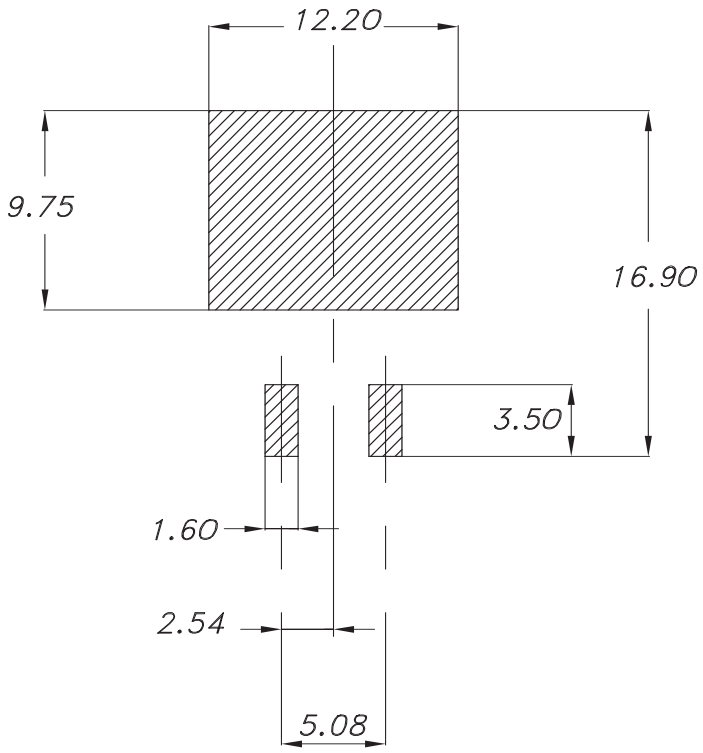


0079457_A2_27

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



4.2 TO-220FP type B package information

Figure 30. **TO-220FP type B package outline**

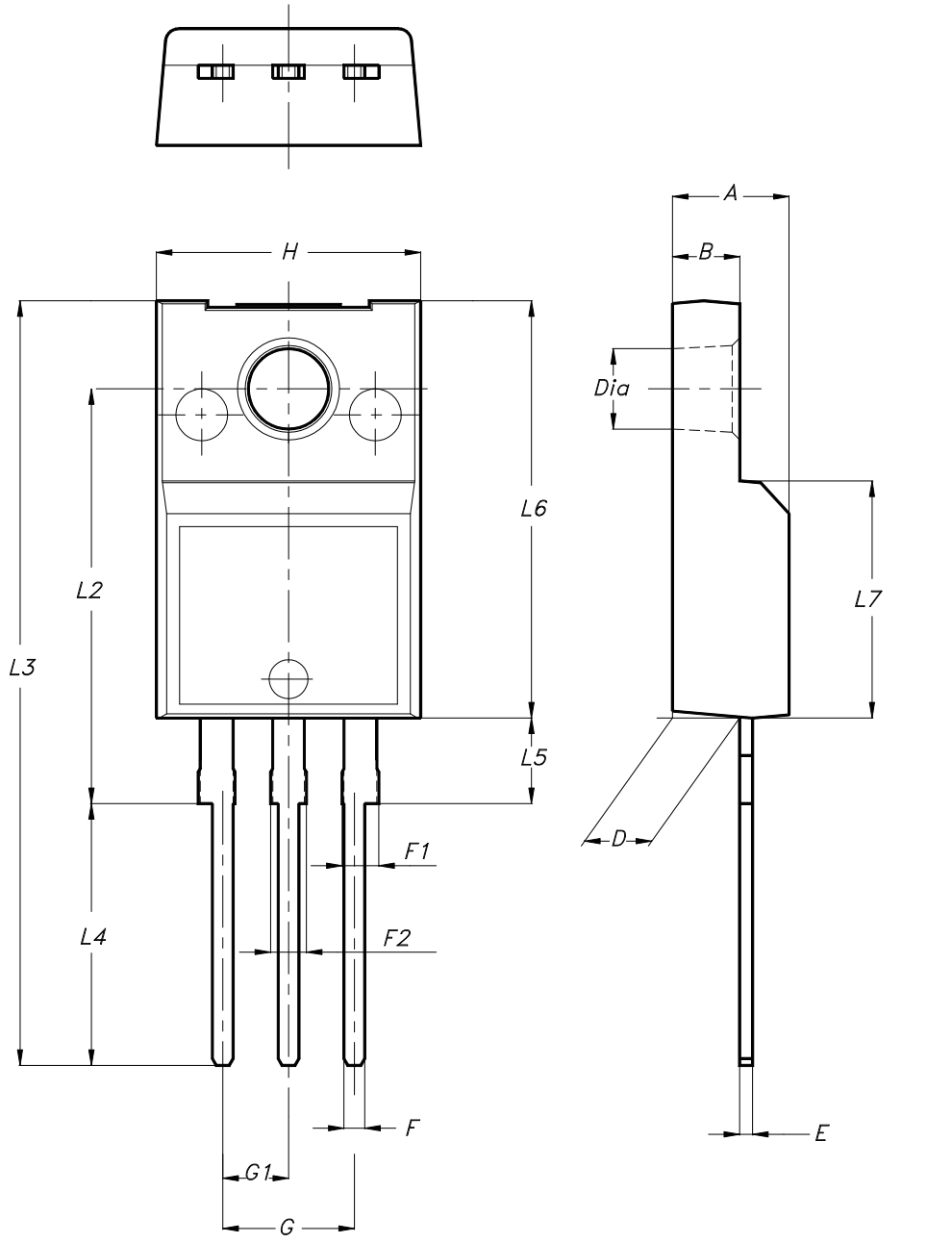


Table 9. **TO-220FP type B package mechanical data**

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

4.3 TO-220 type A package information

Figure 31. **TO-220 type A package outline**

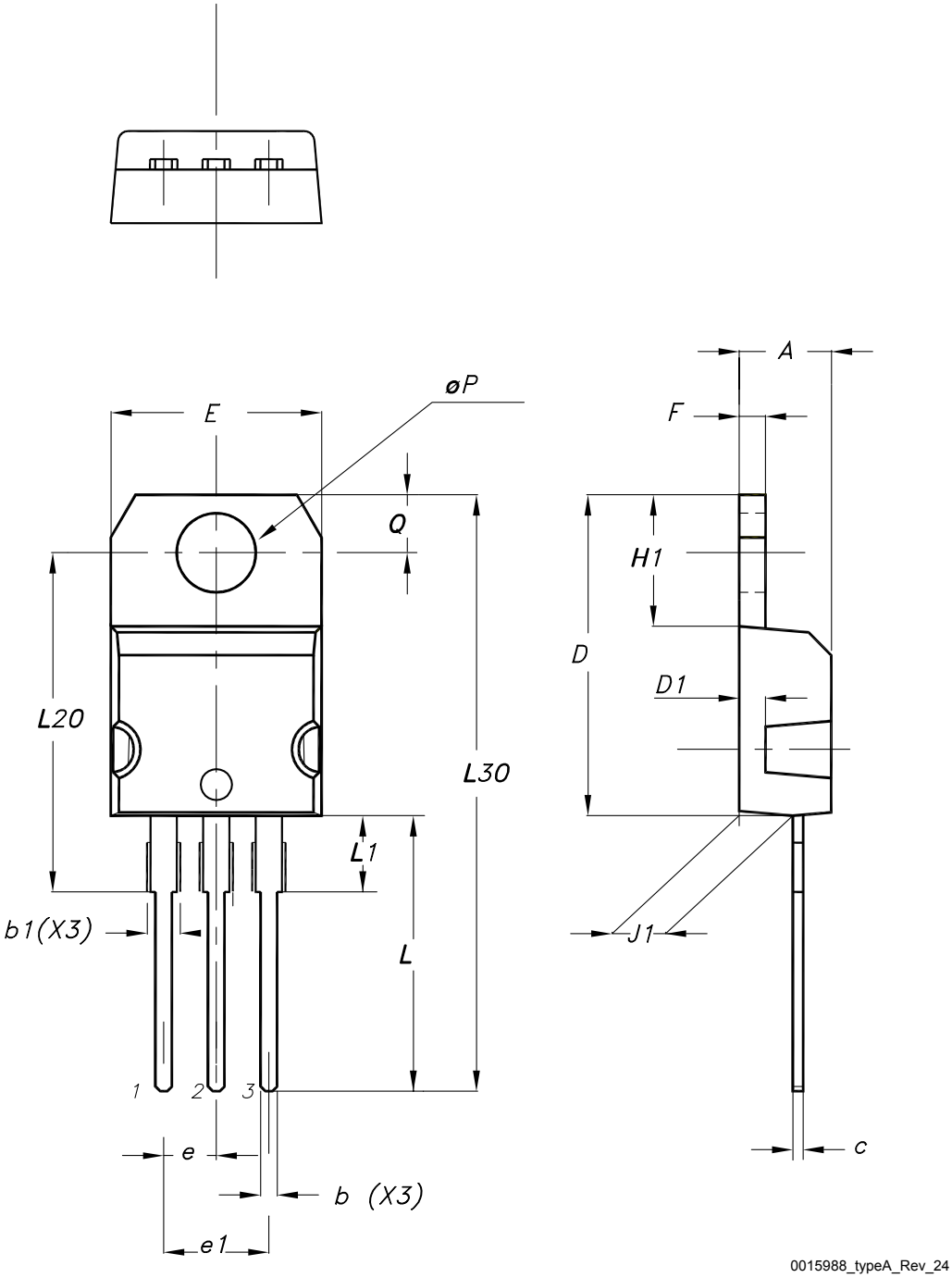
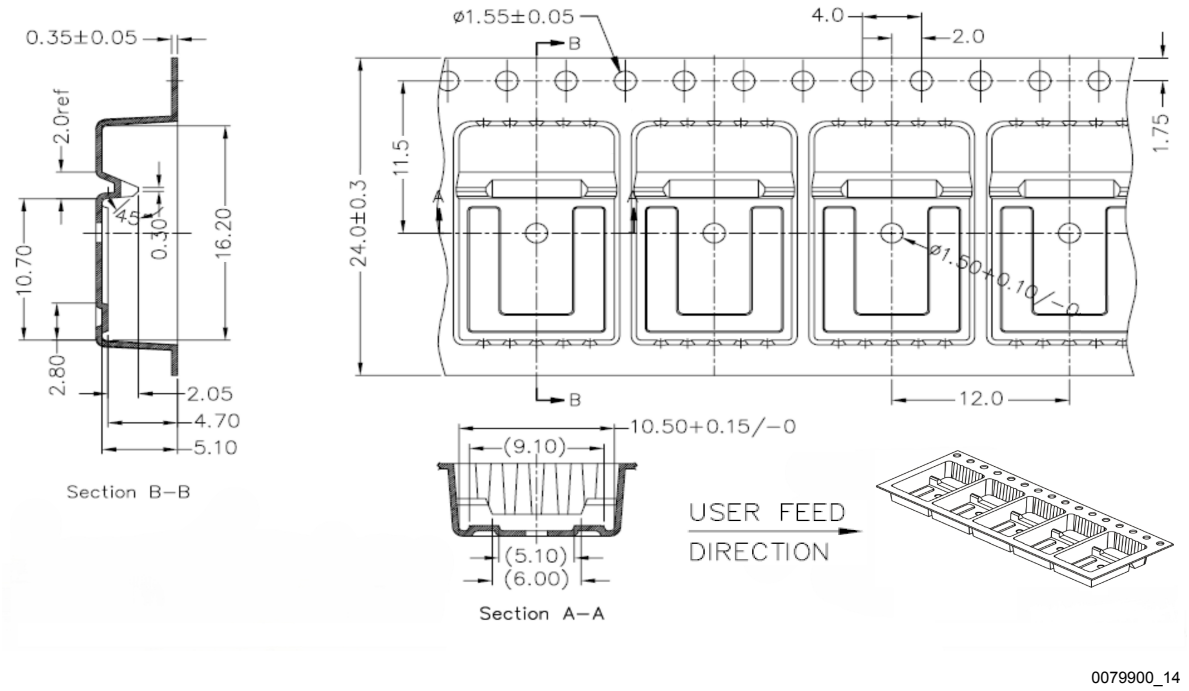


Table 10. **TO-220 type A package mechanical data**

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

4.4 D²PAK packing information

Figure 32. **D²PAK tape drawing (dimensions are in mm)**



5 Ordering information

Table 11. **Order codes**

Order codes	Marking	Package	Packing
STGB20H60DF	GB20H60DF	D²PAK	Tape and reel
STGF20H60DF	GF20H60DF	TO-220FP	Tube
STGP20H60DF	GP20H60DF	TO-220	

Revision history

Table 12. **Document revision history**

Date	Revision	Changes
03-Oct-2012	1	Initial release.
18-Mar-2013	2	Added new order code STGF20H60DF, mechanical data *Table 9* and *Figure 29* on page 14. Added *Chapter 2.1: Electrical characteristics (curves)*.
22-Mar-2013	3	Document status promoted from preliminary to production data.
03-Jun-2013	4	Updated PTOT in *Table 2: Absolute maximum ratings*, RthJC in *Table 3: Thermal data* and *Figure 10: Power dissipation vs. case temperature for D²PAK and TO-220*. Updated *Section 4: Package mechanical data* for TO-220.
23-May-2025	5	Updated *Table 1. Absolute maximum ratings* and *Section 4: Package information.*.
12-Jun-2025	6	Updated Table 1. Absolute maximum ratings.

Contents