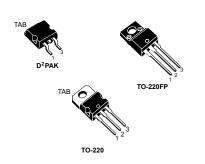
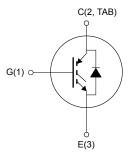




Datasheet

Trench gate field-stop 600 V, 10 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

- Motor control
- UPS
- PFC

NG1E3C2T

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 $V_{\text{CE(sat)}}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.



Product status link
STGB10H60DF
STGF10H60DF
STGP10H60DF



1 Electrical ratings

Table 1. Absolute maximum ratings

Complete	Davamatay	Valu	Value		
Symbol	Parameter	D ² PAK, TO-220	TO-220FP	Unit	
V _{CES}	Collector-emitter voltage (V _{GE} = 0 V)	60	0	V	
	Continuous collector current at T _C = 25 °C	20	20 (1)	_	
I _C	Continuous collector current at T _C = 100 °C	10	10 (1)	A	
I _{CP} (2)	Pulsed collector current	40	40	Α	
V	Gate-emitter voltage	±20		V	
V_{GE}	Transient gate-emitter voltage ±30		0	V	
	Continuous forward current T _C = 25 °C	20	20 (1)		
I _F	Continuous forward current at T _C = 100 °C	10	10 (1)	Α	
I _{FP} (2)	Pulsed forward current	40	40	Α	
V _{ISO}	Insulation with stand 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	115	30	W	
T _{STG}	Storage temperature range -55 to 150		°C		
TJ	Operating junction temperature range	nge -55 to 175		3C	

^{1.} Limited by maximum junction temperature.

Table 2. Thermal data

Cumbal	Parameter	Valu	Heit	
Symbol	Faranietei	D ² PAK, TO-220	TO-220FP	Unit
R _{thJC}	Thermal resistance junction-case IGBT	1.3	5	°C/W
R _{thJC}	Thermal resistance junction-case diode	2.78	6.25	°C/W
R _{thJA}	Thermal resistance junction-ambient	62.5	62.5	°C/W

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^{2.} Pulse width limited by maximum junction temperature.



2 Electrical characteristics

 T_C = 25 °C unless otherwise specified.

Table 3. Static

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
V _{(BR)CES}	Collector-emitter breakdown voltage	V _{GE} = 0 V, I _C = 2 mA	600			٧
		V _{GE} = 15 V, I _C = 10 A		1.50	1.95	
V _{CE(sat)}	Collector-emitter saturation voltage	V _{GE} = 15 V, I _C = 10 A, T _J = 125 °C		1.65		V
outuration rollage	3	V _{GE} = 15 V, I _C = 10 A, T _J = 175 °C		1.70		
V _{GE(th)}	Gate threshold voltage	V _{CE} = V _{GE} , I _C = 250 μA	5	6	7	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.	Тур.	Max.	Unit
C _{ies}	Input capacitance		-	1300	-	
C _{oes}	Output capacitance	V _{CE} = 25 V, f = 1 MHz, V _{GE} = 0 V		60		pF
C _{res}	Reverse transfer capacitance			30		
Qg	Total gate charge	V = 400 V L = 40 A V = 0 to 45 V		57	-	
Q _{ge}	Gate-emitter charge	V_{CC} = 480 V, I_C = 10 A, V_{GE} = 0 to 15 V (see Figure 33. Gate charge test circuit)	-	8		nC
Q _{gc}	Gate-collector charge	(See Figure 33. Gate charge test circuit)		27		

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Table 5. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
t _{d(on)}	Turn-on delay time	V_{CE} = 400 V, I_{C} = 10 A, R_{G} = 10 Ω ,		19.5		
t _r	Current rise time	V _{GE} = 15 V		6.9		ns
(di/dt)on	Turn-on current slope	(see Figure 32. Test circuit for inductive load switching and Figure 34. Switching waveform)		1170		A/µs
t _{d(on)}	Turn-on delay time	V_{CE} = 400 V, I_{C} = 10 A, R_{G} = 10 Ω ,	-	20	_	no
t _r	Current rise time	V _{GE} = 15 V, T _J = 175 °C		6.8		ns
(di/dt)on	Turn-on current slope	(see Figure 32. Test circuit for inductive load switching and Figure 34. Switching waveform)		1176		A/µs
t _{r(Voff)}	Off voltage rise time	V_{CE} = 400 V, I_{C} = 10 A, R_{G} = 10 Ω ,		19.6		
t _{d(off)}	Turn-off delay time	V _{GE} = 15 V		103		
t _f	Current fall time	(see Figure 32. Test circuit for inductive load switching and Figure 34. Switching waveform)		73		
t _{r(Voff)}	Off voltage rise time	V_{CE} = 400 V, I_{C} = 10 A, R_{G} = 10 Ω ,	-	28	-	ns
t _{d(off)}	Turn-off delay time	V _{GE} = 15 V, T _J = 175 °C		104		
t _f	Current fall time	(see Figure 32. Test circuit for inductive load switching and Figure 34. Switching waveform)		110		
t _{sc}	Short-circuit withstand time	$V_{CC} \le 360 \text{ V}, V_{GE} = 15 \text{ V}, R_G = 10 \Omega$	3	5	-	μs

Table 6. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
E _{on} (1)	Turn-on switching energy	V _{CE} = 400 V, I _C = 10 A,		83		
E _{off} (2)	Turn-off switching energy	$R_G = 10 \Omega$, $V_{GE} = 15 V$ (see Figure 32. Test circuit for inductive load		140		
E _{ts}	Total switching energy	switching)		223		μJ
E _{on} ⁽¹⁾	Turn-on switching energy	$V_{CE} = 400 \text{ V}, I_{C} = 10 \text{ A},$ $R_{G} = 10 \Omega, V_{GF} = 15 \text{ V}$	-	148	-	μυ
E _{off} (2)	Turn-off switching energy	T _J = 175 °C (see Figure 32. Test circuit for inductive load		214		
E _{ts}	Total switching energy	switching)		362		

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

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Table 7. Collector-emitter diode

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
V _F	Forward on-voltage	I _F = 10 A		1.7	2.2	V
VF	Forward on-voitage	I _F = 10 A, T _J = 175 °C	_	1.3		V
t _{rr}	Reverse recovery time	\(\tau = 60 \\ \tau \) = 10 \(\tau \) dia (dt = 100 \(\tau \) (us		107		ns
Q _{rr}	Reverse recovery charge	Vr = 60 V; I _F = 10 A, di _F /dt = 100 A / μs (see Figure 35. Diode reverse recovery waveform)		120		nC
I _{rrm}	Reverse recovery current			2.24		Α
t _{rr}	Reverse recovery time	$V_r = 60 \text{ V}; I_F = 10 \text{ A}, di_F/dt = 100 \text{ A} / \mu \text{s}$	_	161		ns
Q _{rr}	Reverse recovery charge	T _J = 175 °C (see Figure 35. Diode reverse recovery waveform)		362		nC
I _{rrm}	Reverse recovery current			4.5		А



2.1 Electrical characteristics (curves)

Ptot (W) 140 120 GIPD281020131339FSR

V_{GE}≥ 15V, T _J≤ 175 °C

20

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

GIPD230420191104MT

15

10

VGE ≥ 15V, TJ ≤ 175 °C

0
0
25
50
75
100
125
150
175
TC(°C)

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

75 100 125 150 175 Tc(°C)

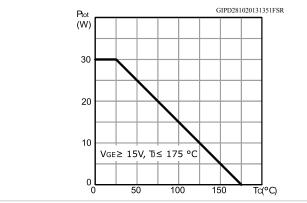


Figure 4. Collector current vs case temperature for TO-220FP

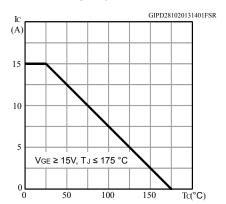


Figure 5. Output characteristics (T_J = 25°C)

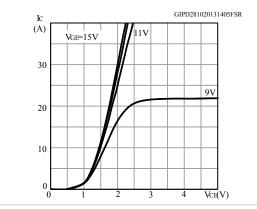
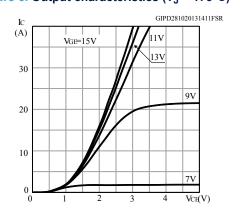


Figure 6. Output characteristics $(T_J = 175^{\circ}C)$



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

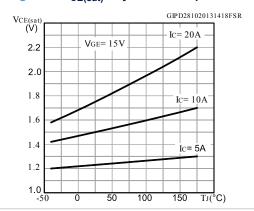


Figure 8. V_{CE(sat)} vs collector current

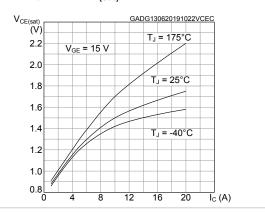


Figure 9. Collector current vs switching frequency for D²PAK and TO-220

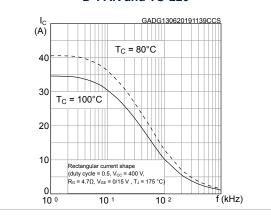


Figure 10. Collector current vs switching frequency for TO-220FP

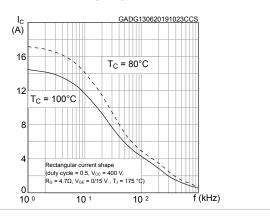


Figure 11. Forward bias safe operating area for D²PAK and TO-220

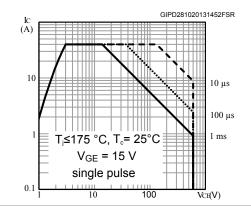
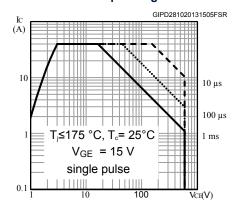


Figure 12. Forward bias safe operating area for TO-220FP



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Figure 13. Transfer characteristics

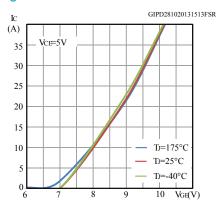


Figure 14. Diode V_F vs forward current

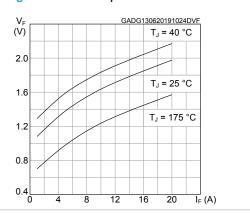


Figure 15. Normalized $V_{\text{GE}(\text{th})}$ vs junction temperature

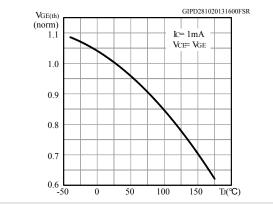


Figure 16. Normalized $V_{(BR)CES}$ vs junction temperature

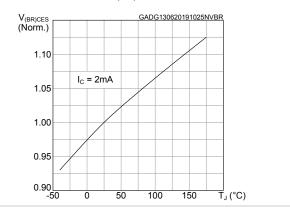


Figure 17. Capacitance variation

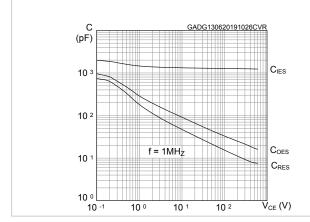
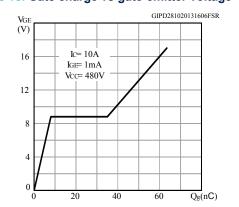


Figure 18. Gate charge vs gate-emitter voltage



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Figure 19. Switching energy vs collector current

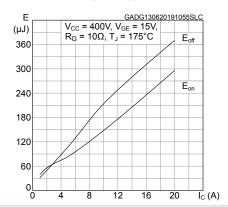


Figure 20. Switching energy vs gate resistance

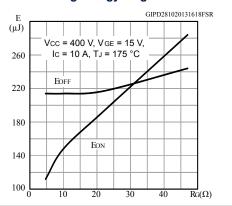


Figure 21. Switching energy vs temperature

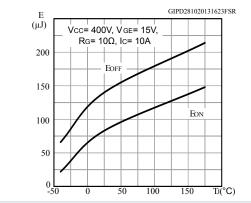


Figure 22. Switching energy vs collector-emitter voltage

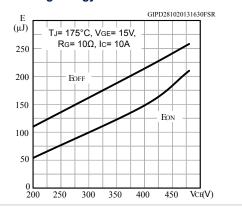


Figure 23. Short circuit time and current vs V_{GE}

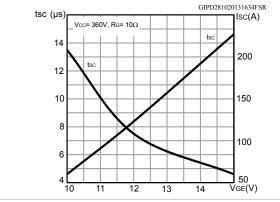
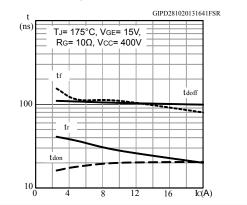


Figure 24. Switching times vs collector current



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Figure 25. Switching times vs gate resistance

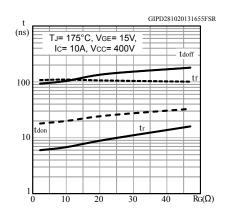


Figure 26. Reverse recovery current vs diode current slope

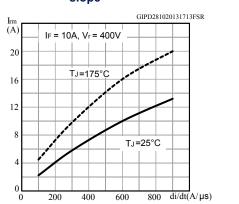


Figure 27. Reverse recovery time vs diode current slope

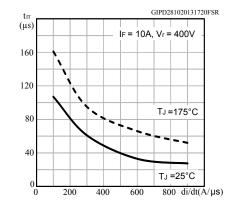


Figure 28. Reverse recovery charge vs diode current slope

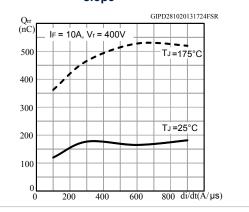
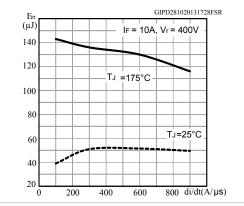


Figure 29. Reverse recovery energy vs diode current slope



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Figure 30. Thermal impedance for IGBT

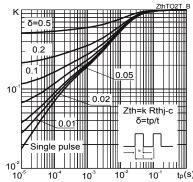
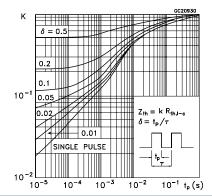


Figure 31. Thermal impedance for diode



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3 Test circuits

Figure 32. Test circuit for inductive load switching

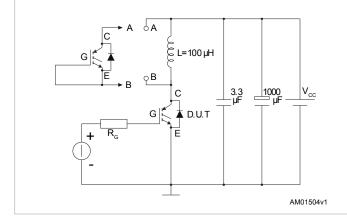


Figure 33. Gate charge test circuit $V_1 = 20V = V_{GMAX}$ $V_2 = 20V = V_{GMAX}$ $V_3 = 2200$ $V_4 = 20V = V_{GMAX}$ $V_6 = V_{CMAX}$ $V_6 = V_{CMAX}$ $V_7 = V_{CMAX}$ $V_8 = V_8$ $V_$

Figure 34. Switching waveform

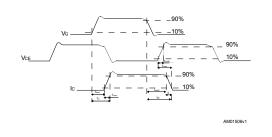


Figure 35. Diode reverse recovery waveform

Output

Ou



4 Package information

In order 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

c2-D1 Ī*D2* THERMAL PAD *b2* e 1 SEATING PLANE COPLANARITY 0.25 GAUGE PLANE

Figure 36. D²PAK (TO-263) type A2 package outline

0079457_A2_26

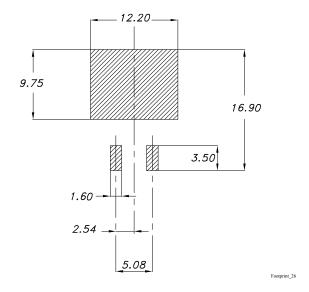
Downloaded from Arrow.com.



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

Dim	mm				
Dim.	Min.	Тур.	Max.		
А	4.40		4.60		
A1	0.03		0.23		
b	0.70		0.93		
b2	1.14		1.70		
С	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		
е		2.54			
e1	4.88		5.28		
Н	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 37. D²PAK (TO-263) recommended footprint (dimensions are in mm)

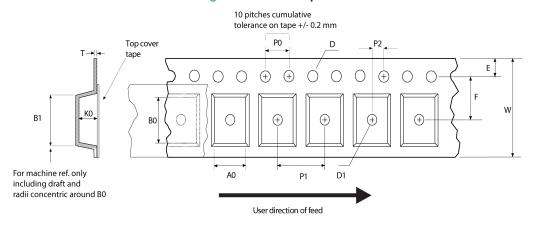


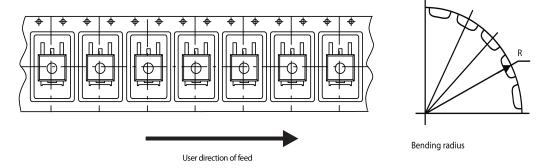
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4.2 D²PAK packing information

Figure 38. D²PAK tape outline



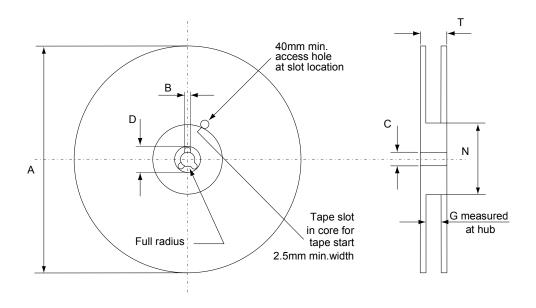


AM08852v1

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Figure 39. D²PAK reel outline



AM06038v1

Table 9. D2PAK tape and reel mechanical data

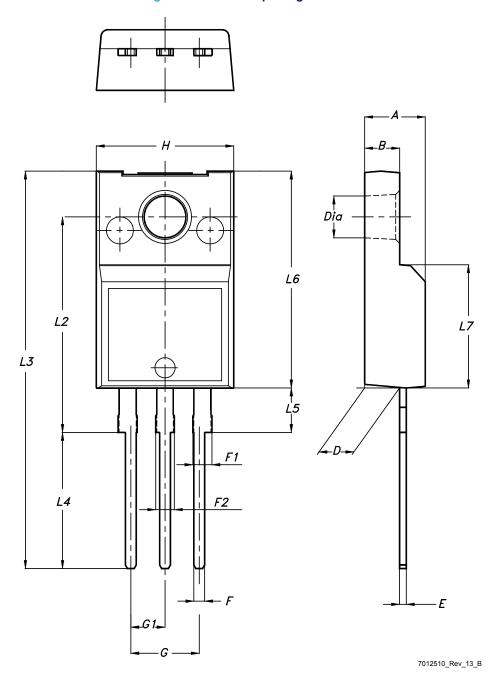
Таре			Reel		
Dim.	mm		Dim.	mr	n
Dilli.	Min.	Max.	Dilli.	Min.	Max.
A0	10.5	10.7	А		330
В0	15.7	15.9	В	1.5	
D	1.5	1.6	С	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	Т		30.4
P0	3.9	4.1			
P1	11.9	12.1	Base q	uantity	1000
P2	1.9	2.1	Bulk quantity		1000
R	50				
Т	0.25	0.35			
W	23.7	24.3			

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4.3 TO-220FP package information

Figure 40. TO-220FP package outline



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Table 10. TO-220FP package mechanical data

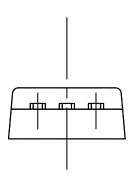
Dim.		mm	
Dim.	Min.	Тур.	Max.
Α	4.40		4.60
В	2.50		2.70
D	2.50		2.75
Е	0.45		0.70
F	0.75		1.00
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.20
G1	2.40		2.70
Н	10.00		10.40
L2		16.00	
L3	28.60		30.60
L4	9.80		10.60
L5	2.90		3.60
L6	15.90		16.40
L7	9.00		9.30
Dia	3.00		3.20

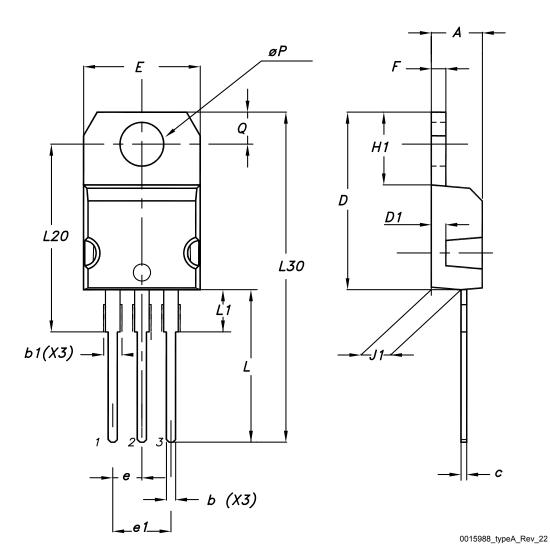
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4.4 TO-220 type A package information

Figure 41. TO-220 type A package outline





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Table 11. TO-220 type A package mechanical data

Dim.		mm	
DIM.	Min.	Тур.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
С	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10.00		10.40
е	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	
øΡ	3.75		3.85
Q	2.65		2.95

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5 Ordering information

Table 12. Order codes

Order code	Marking	Package	Packing	
STGB10H60DF	GB10H60DF	D ² PAK	Tape and reel	
STGF10H60DF	GF10H60DF	TO-220FP	Tube	
STGP10H60DF	GP10H60DF	TO-220	Tube	

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Revision history

Table 13. Document revision history

Date	Version	Changes	
12-Aug-2013	1	Initial release.	
31-Oct-2013	2	Document status promoted from preliminary to production data.	
		Inserted Section 2.1: Electrical characteristics (curves).	
		Minor text changes.	
20-Jun-2019	3	Updated title, applications and description in cover page.	
		Added Section 5 Ordering information.	
		Updated Section 2.1 Electrical characteristics (curves).	
		Minor text changes.	
05-Mar-2020	4	Updated Table 3. Static and Table 4. Dynamic.	
		Minor text changes.	

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	4.1	D²PAK (TO-263) type A2 package information	13				
	4.2	D²PAK packing information	15				
	4.3	TO-220FP package information	17				
	4.4	TO-220 type A package information	19				
5	Ord	Ordering information					
Re	evision history						



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