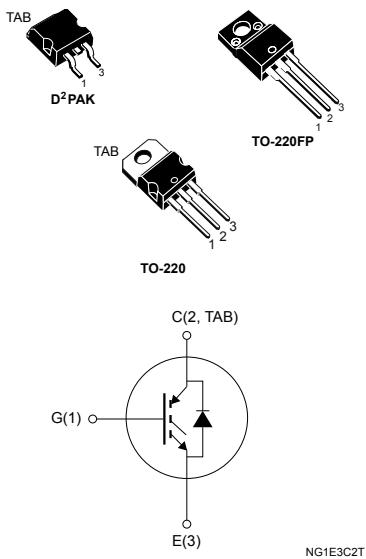


Trench gate field-stop 600 V, 10 A high speed H series IGBT



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

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 link

[STGB10H60DF](#)
[STGF10H60DF](#)
[STGP10H60DF](#)

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	20	20 ⁽¹⁾	A
	Continuous collector current at $T_C = 100$ °C	10	10 ⁽¹⁾	
I _{CP} ⁽²⁾	Pulsed collector current	40	40	A
V _{GE}	Gate-emitter voltage	±20		V
	Transient gate-emitter voltage	±30		
I _F	Continuous forward current $T_C = 25$ °C	20	20 ⁽¹⁾	A
	Continuous forward current at $T_C = 100$ °C	10	10 ⁽¹⁾	
I _{FP} ⁽²⁾	Pulsed forward current	40	40	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	115	30	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-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

2

Electrical characteristics

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

Table 3. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{CES}}$	Collector-emitter breakdown voltage	$V_{GE} = 0 \text{ V}, I_C = 2 \text{ mA}$	600			V
$V_{CE(\text{sat})}$	Collector-emitter saturation voltage	$V_{GE} = 15 \text{ V}, I_C = 5 \text{ A}$		1.5	1.95	V
		$V_{GE} = 15 \text{ V}, I_C = 5 \text{ A}, T_J = 125^\circ\text{C}$		1.65		
		$V_{GE} = 15 \text{ V}, I_C = 5 \text{ A}, T_J = 175^\circ\text{C}$		1.7		
$V_{GE(\text{th})}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 250 \mu\text{A}$	5.0	6.0	7.0	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	$V_{CE} = 25 \text{ V}, f = 1 \text{ MHz}, V_{GE} = 0 \text{ V}$	-	1300	-	pF
C_{oes}	Output capacitance			60		
C_{res}	Reverse transfer capacitance			30		
Q_g	Total gate charge	$V_{CC} = 480 \text{ V}, I_C = 5 \text{ A}, V_{GE} = 0 \text{ to } 15 \text{ V}$ (see Figure 33. Gate charge test circuit)	-	57	-	nC
Q_{ge}	Gate-emitter charge			8		
Q_{gc}	Gate-collector charge			27		

Table 5. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400 \text{ V}, I_C = 10 \text{ A}, R_G = 10 \Omega, V_{GE} = 15 \text{ V}$ (see Figure 32. Test circuit for inductive load switching and Figure 34. Switching waveform)	-	19.5	-	ns
t_r	Current rise time			6.9		
$(di/dt)on$	Turn-on current slope			1170		
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400 \text{ V}, I_C = 10 \text{ A}, R_G = 10 \Omega, V_{GE} = 15 \text{ V}, T_J = 175^\circ\text{C}$ (see Figure 32. Test circuit for inductive load switching and Figure 34. Switching waveform)	-	20	-	A/ μs
t_r	Current rise time			6.8		
$(di/dt)on$	Turn-on current slope			1176		

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{r(\text{off})}$	Off voltage rise time	$V_{CE} = 400 \text{ V}, I_C = 10 \text{ A}, R_G = 10 \Omega,$ $V_{GE} = 15 \text{ V}$ (see Figure 32. Test circuit for inductive load switching and Figure 34. Switching waveform)	19.6 103 73 28 104 110	-	ns	
$t_{d(\text{off})}$	Turn-off delay time					
t_f	Current fall time					
$t_{r(\text{off})}$	Off voltage rise time					
$t_{d(\text{off})}$	Turn-off delay time					
t_f	Current fall time					
t_{sc}	Short-circuit withstand time	$V_{CC} \leq 360 \text{ V}, V_{GE} = 15 \text{ V}, R_G = 10 \Omega$	3	5	-	μs

Table 6. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching energy	$V_{CE} = 400 \text{ V}, I_C = 10 \text{ A},$ $R_G = 10 \Omega, V_{GE} = 15 \text{ V}$ (see Figure 32. Test circuit for inductive load switching)	83 140 223 148 214 362	-	-	μJ
$E_{off}^{(2)}$	Turn-off switching energy					
E_{ts}	Total switching energy					
$E_{on}^{(1)}$	Turn-on switching energy					
$E_{off}^{(2)}$	Turn-off switching energy					
E_{ts}	Total switching energy					

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	$I_F = 10 \text{ A}$	-	1.7	2.2	V
		$I_F = 10 \text{ A}, T_J = 175 \text{ }^\circ\text{C}$		1.3		
t_{rr}	Reverse recovery time	$V_r = 60 \text{ V}; I_F = 10 \text{ A}, dI_F/dt = 100 \text{ A} / \mu\text{s}$ (see Figure 35. Diode reverse recovery waveform)	-	107		ns
				120		
Q_{rr}	Reverse recovery charge	$T_J = 175 \text{ }^\circ\text{C}$ (see Figure 35. Diode reverse recovery waveform)	-	2.24		nC
				161		
I_{rrm}	Reverse recovery current	$V_r = 60 \text{ V}; I_F = 10 \text{ A}, dI_F/dt = 100 \text{ A} / \mu\text{s}$ (see Figure 35. Diode reverse recovery waveform)	-	362		nC
				4.5		
t_{rr}	Reverse recovery time	$V_r = 60 \text{ V}; I_F = 10 \text{ A}, dI_F/dt = 100 \text{ A} / \mu\text{s}$ (see Figure 35. Diode reverse recovery waveform)	-	2.24		A
				161		
Q_{rr}	Reverse recovery charge	$T_J = 175 \text{ }^\circ\text{C}$ (see Figure 35. Diode reverse recovery waveform)	-	362		A
				4.5		

2.1 Electrical characteristics (curves)

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

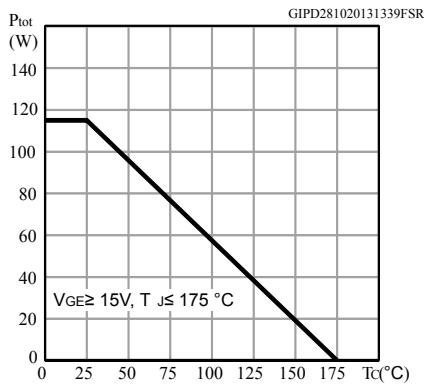


Figure 2. Collector current vs case temperature for D²PAK and TO-220

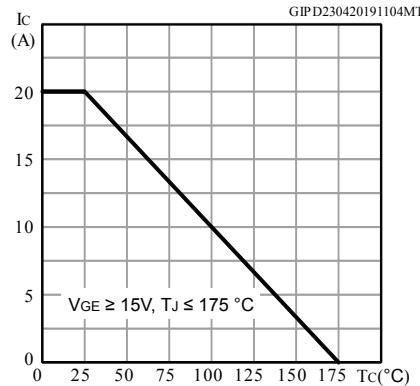


Figure 3. Power dissipation vs case temperature for TO-220FP

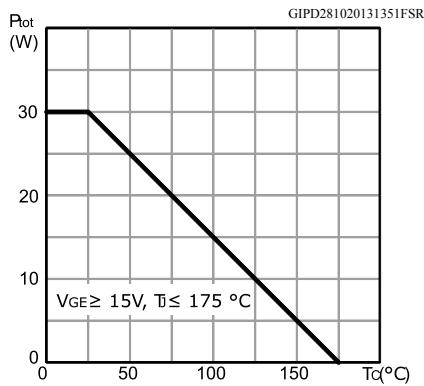


Figure 4. Collector current vs case temperature for TO-220FP

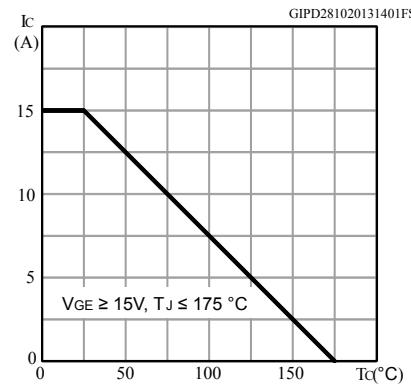


Figure 5. Output characteristics ($T_J = 25^\circ\text{C}$)

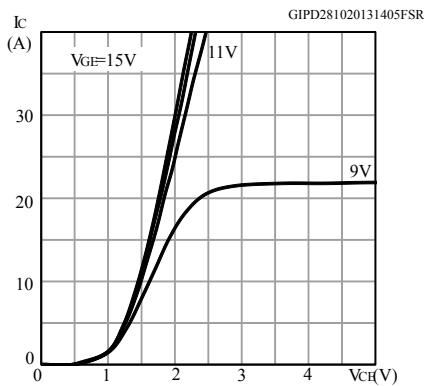


Figure 6. Output characteristics ($T_J = 175^\circ\text{C}$)

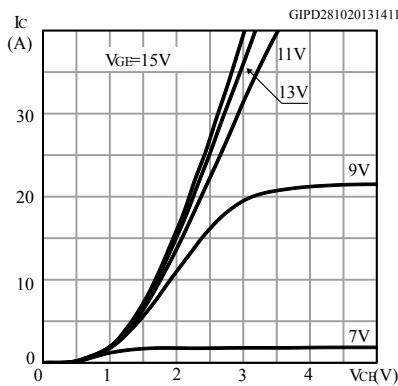


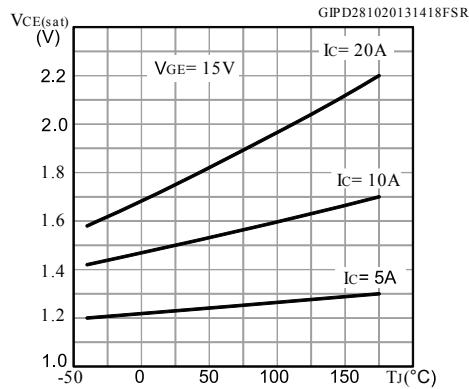
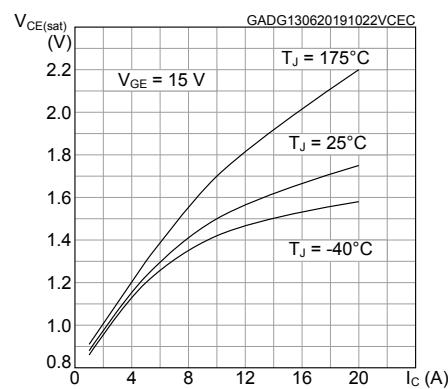
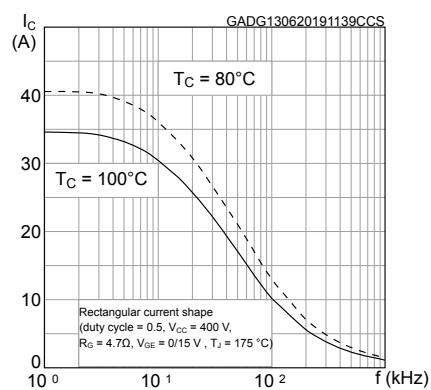
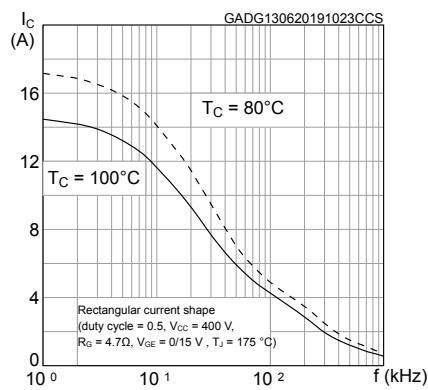
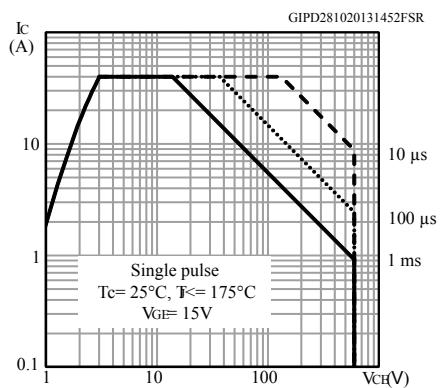
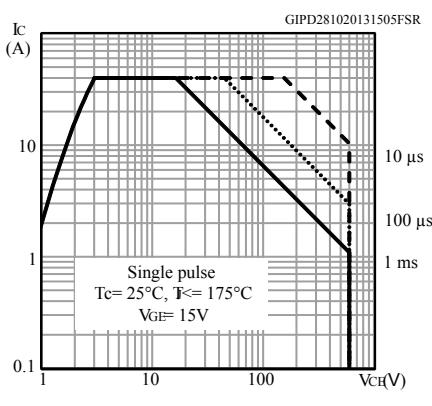
Figure 7. $V_{CE(sat)}$ vs junction temperature

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

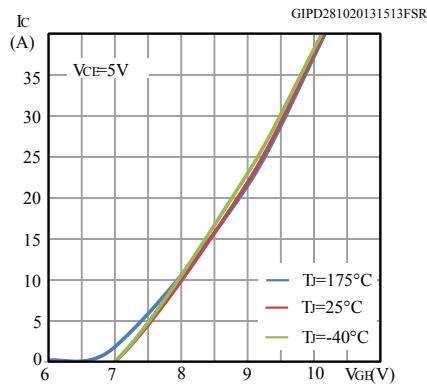


Figure 14. Diode V_F vs forward current

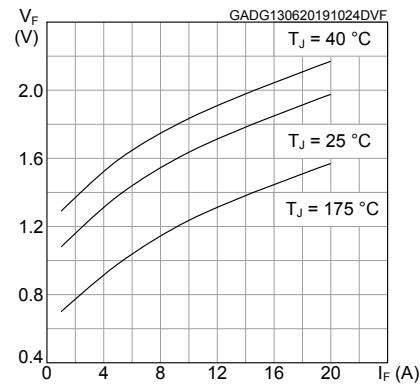


Figure 15. Normalized V_{GE(th)} vs junction temperature

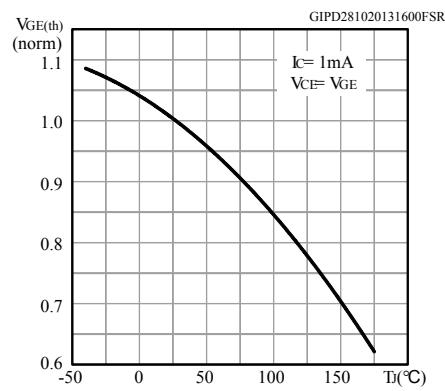


Figure 16. Normalized V_{(BR)CES} vs junction temperature

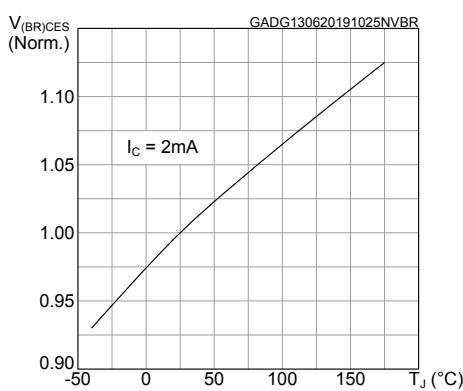


Figure 17. Capacitance variation

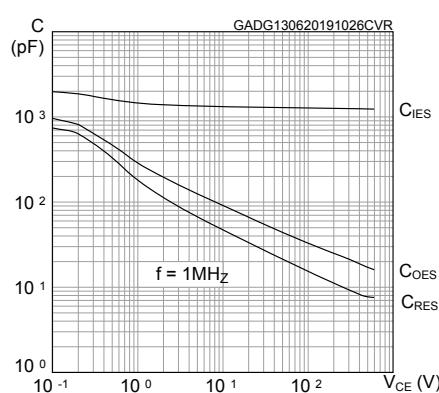


Figure 18. Gate charge vs gate-emitter voltage

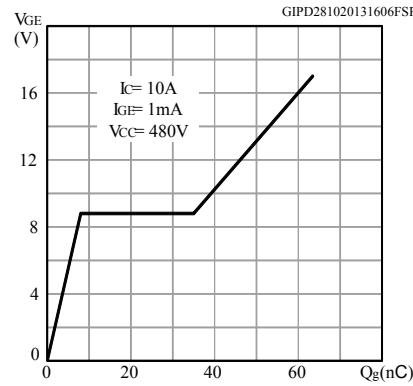


Figure 19. Switching energy vs collector current

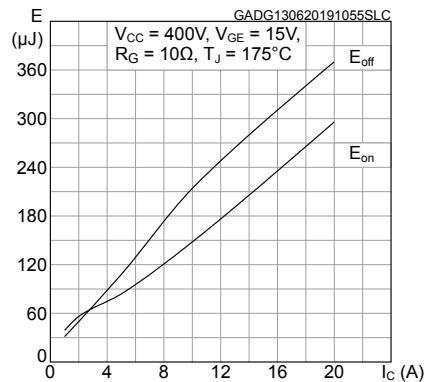


Figure 20. Switching energy vs gate resistance

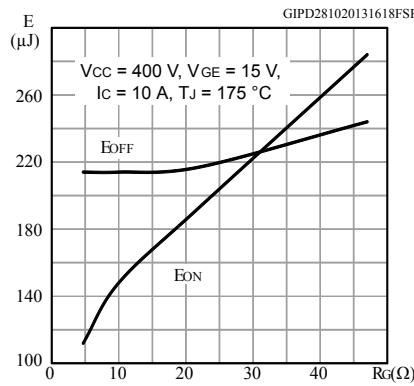


Figure 21. Switching energy vs temperature

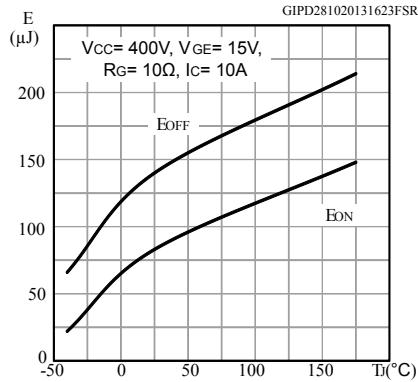


Figure 22. Switching energy vs collector-emitter voltage

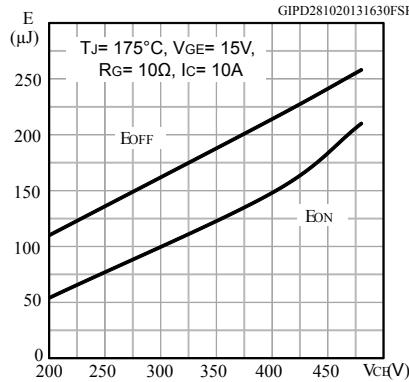


Figure 23. Short circuit time and current vs V_{GE}

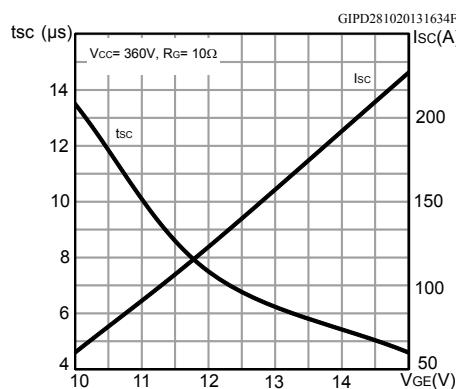


Figure 24. Switching times vs collector current

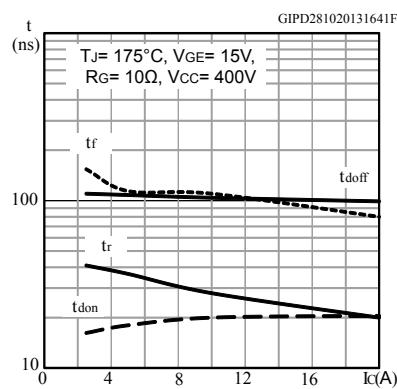


Figure 25. Switching times vs gate resistance

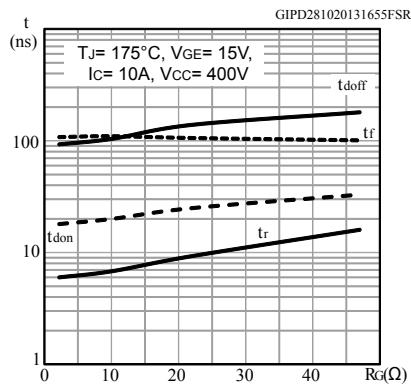


Figure 26. Reverse recovery current vs diode current slope

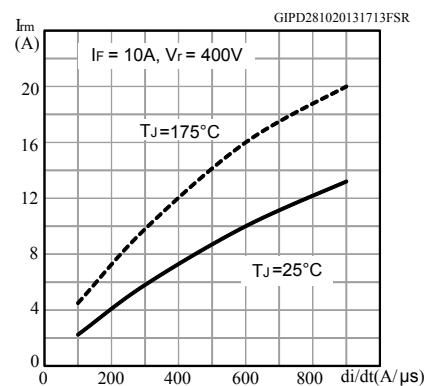


Figure 27. Reverse recovery time vs diode current slope

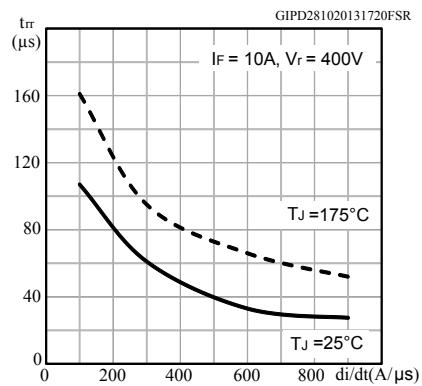


Figure 28. Reverse recovery charge vs diode current slope

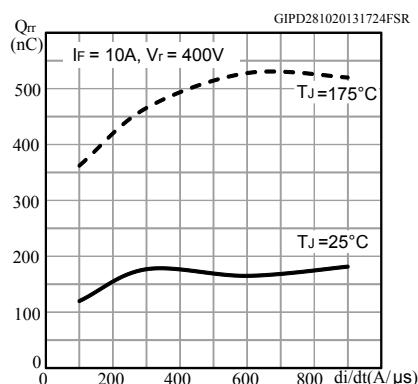


Figure 29. Reverse recovery energy vs diode current slope

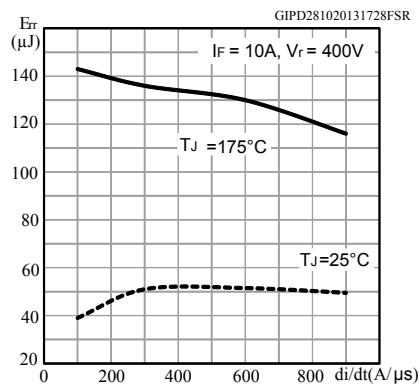
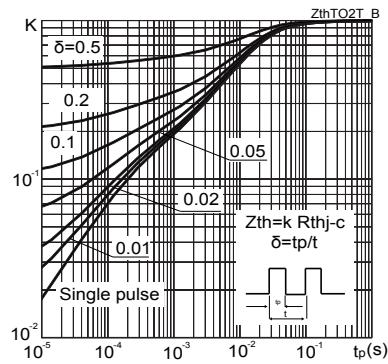
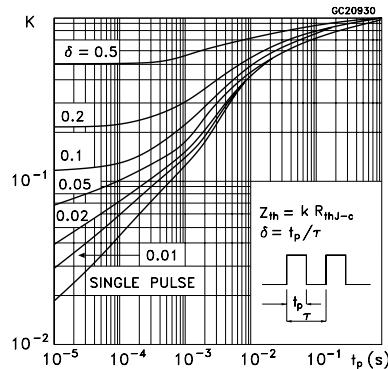
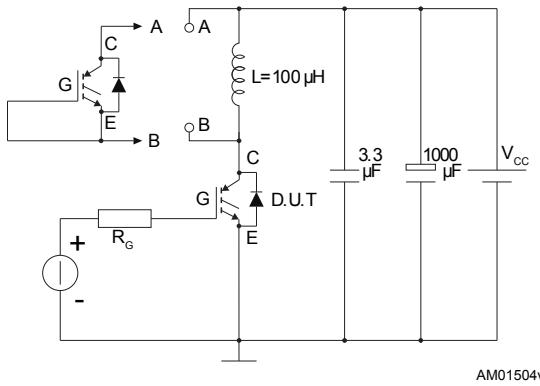


Figure 30. Thermal impedance for IGBT**Figure 31. Thermal impedance for diode**

3

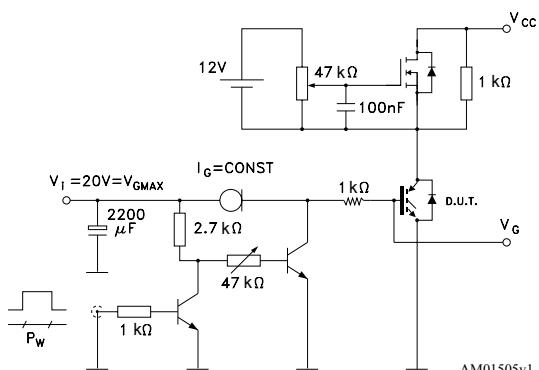
Test circuits

Figure 32. Test circuit for inductive load switching



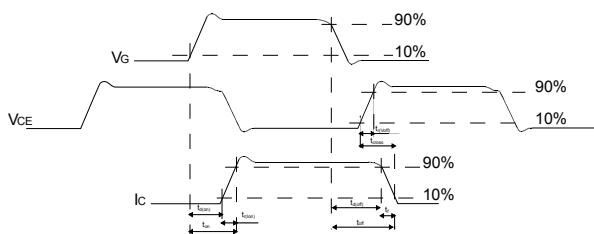
AM01504v1

Figure 33. Gate charge test circuit



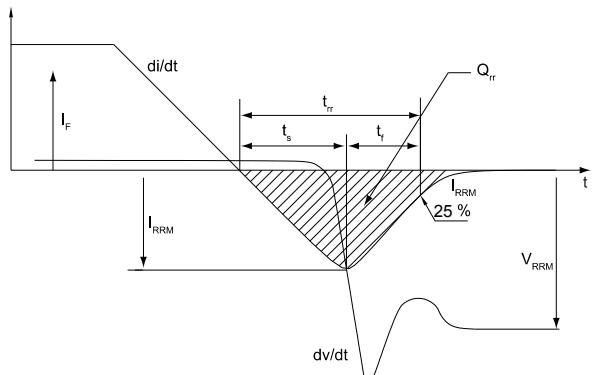
AM01505v1

Figure 34. Switching waveform



AM01506v1

Figure 35. Diode reverse recovery waveform



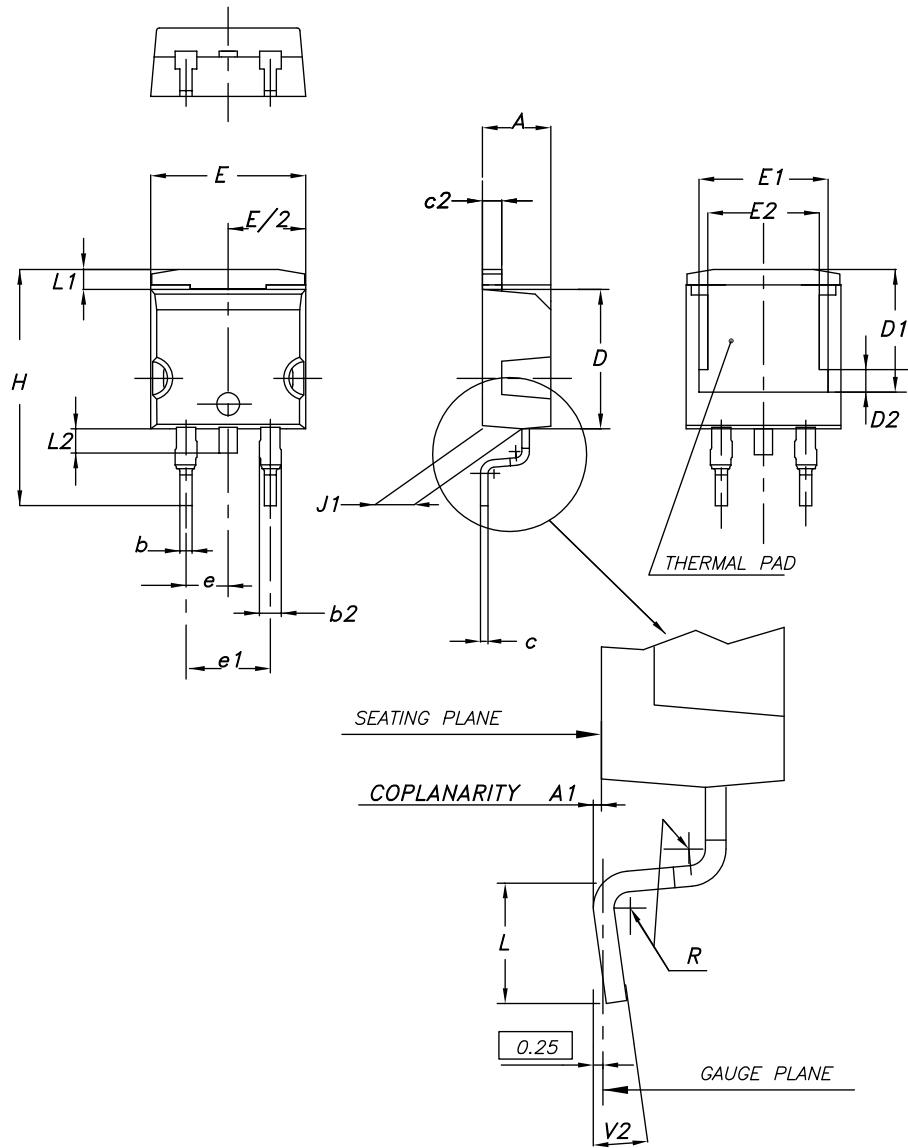
AM01507v1

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

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

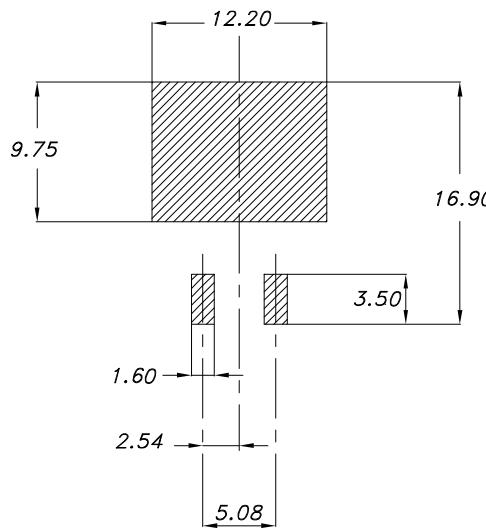


0079457_A2_26

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°

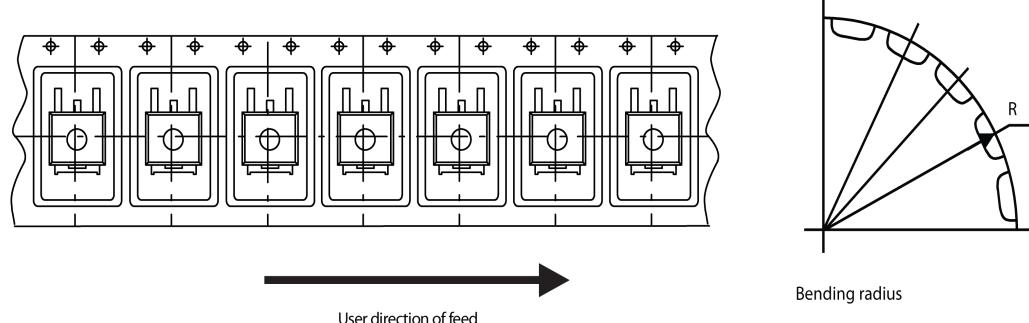
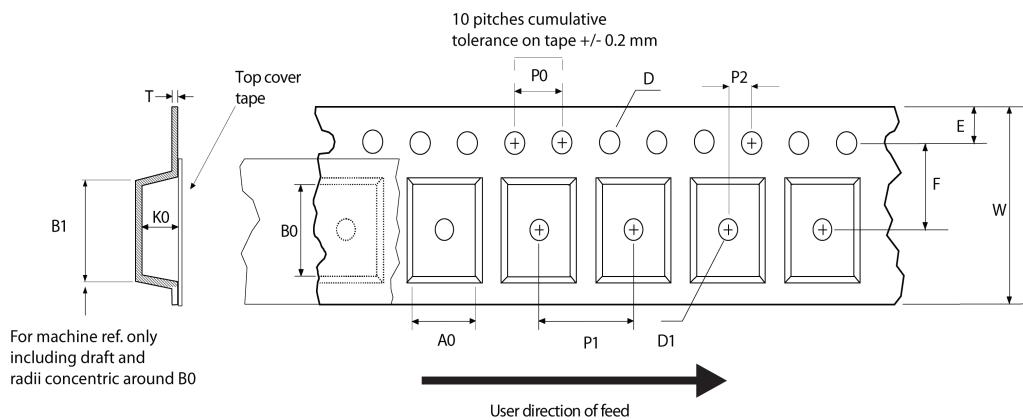
Figure 37. D²PAK (TO-263) recommended footprint (dimensions are in mm)



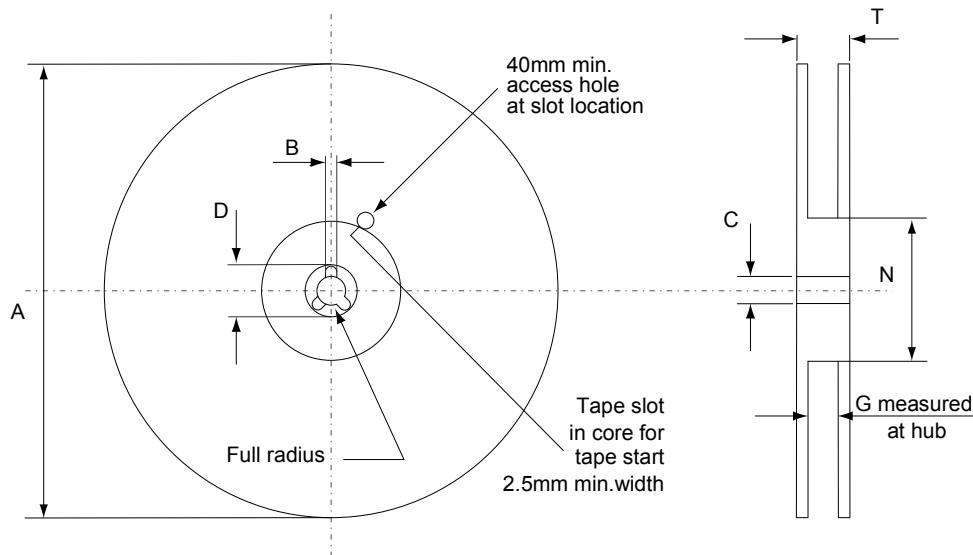
Footprint_26

4.2 D²PAK packing information

Figure 38. D²PAK tape outline



AM08852v1

Figure 39. D²PAK reel outline


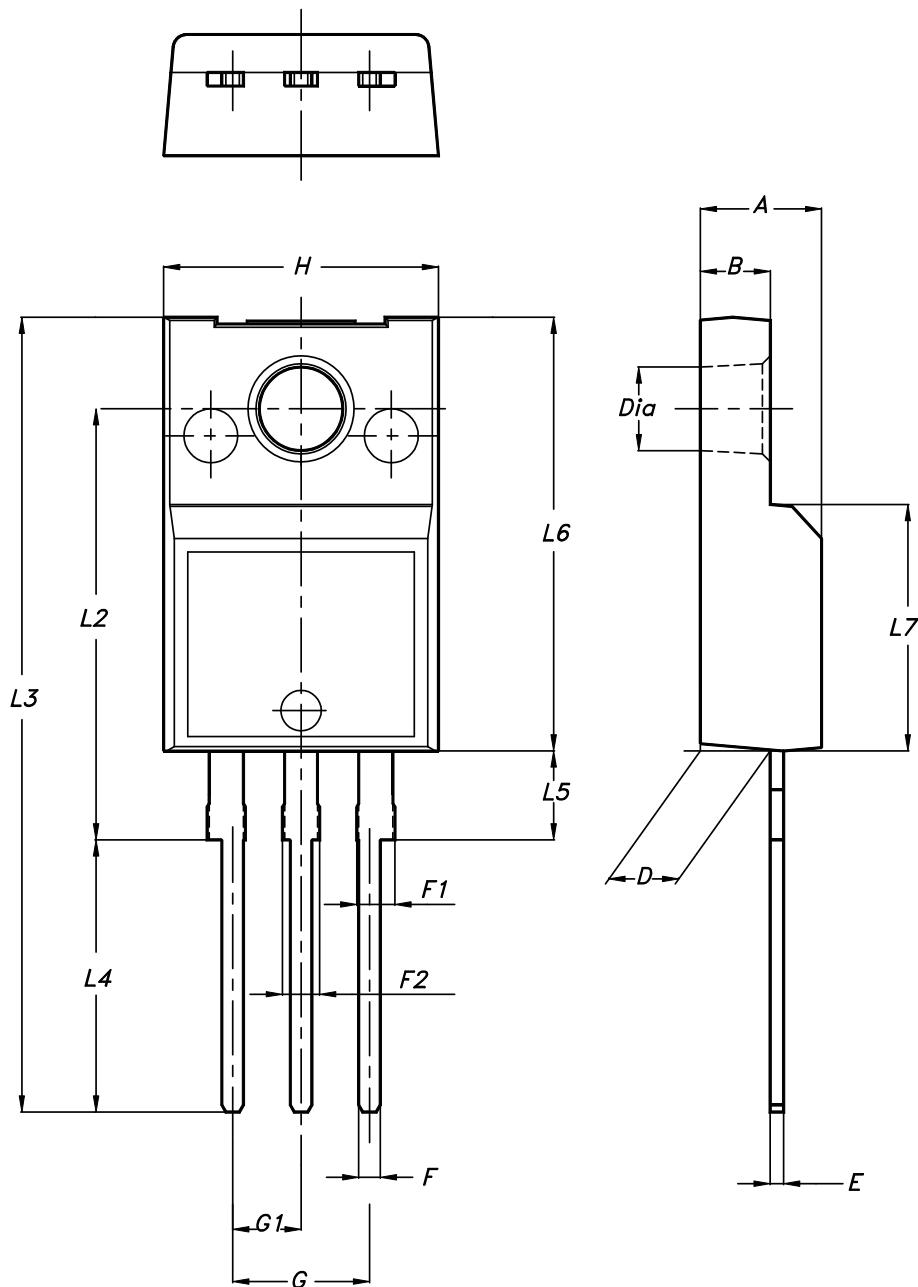
AM06038v1

Table 9. D²PAK tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	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	T		30.4
P0	3.9	4.1			
P1	11.9	12.1		Base quantity	1000
P2	1.9	2.1		Bulk quantity	1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

4.3 TO-220FP package information

Figure 40. TO-220FP package outline



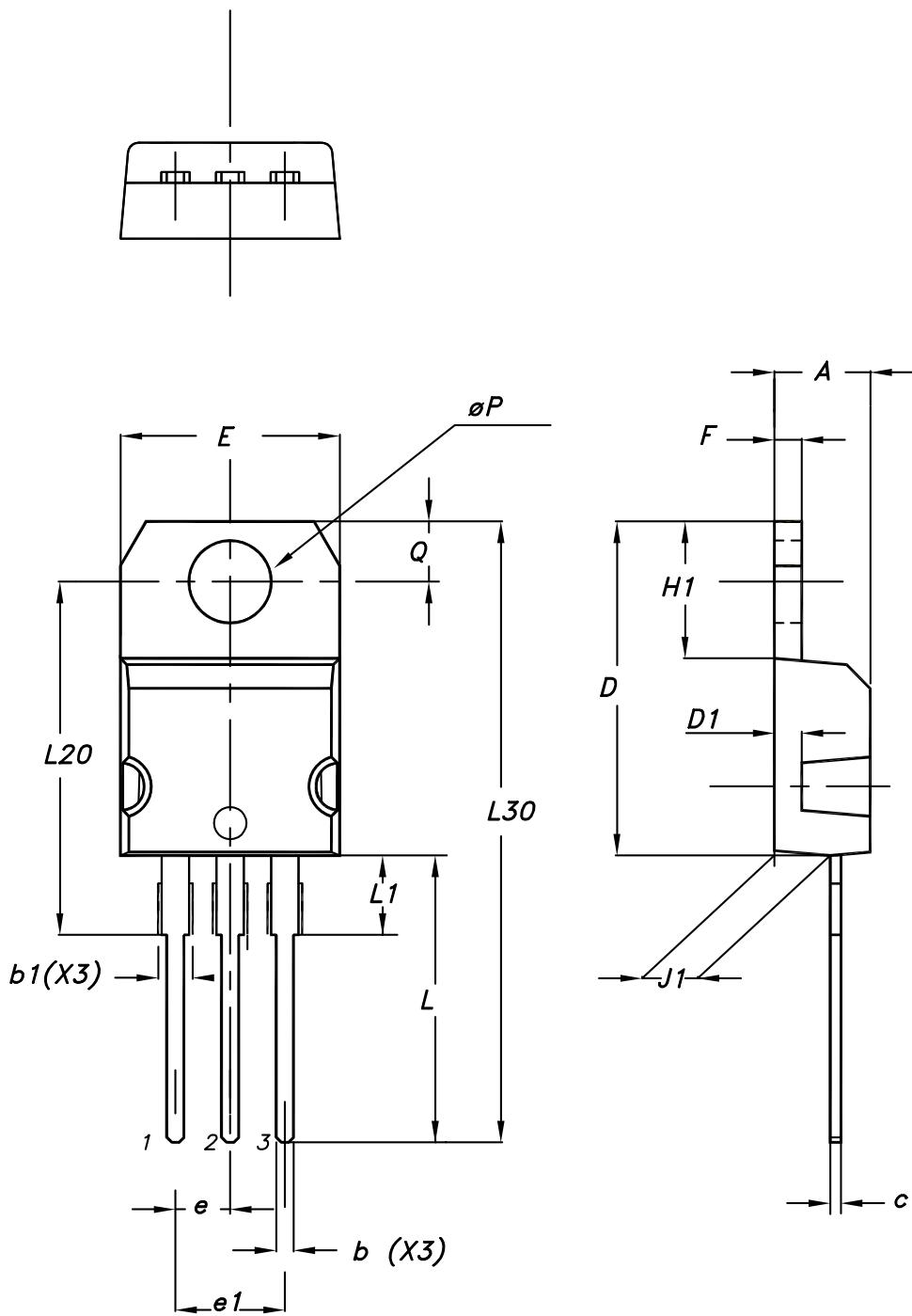
7012510_Rev_13_B

Table 10. TO-220FP 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 41. TO-220 type A package outline



0015988_typeA_Rev_22

Table 11. 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

5 Ordering information

Table 12. Order codes

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

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.

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ООО "ЛайфЭлектроникс"

"LifeElectronics" LLC

ИНН 7805602321 КПП 780501001 Р/С 40702810122510004610 ФАКБ "АБСОЛЮТ БАНК" (ЗАО) в г.Санкт-Петербурге К/С 30101810900000000703 БИК 044030703

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- Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.
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- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.



Тел: +7 (812) 336 43 04 (многоканальный)
Email: org@lifeelectronics.ru