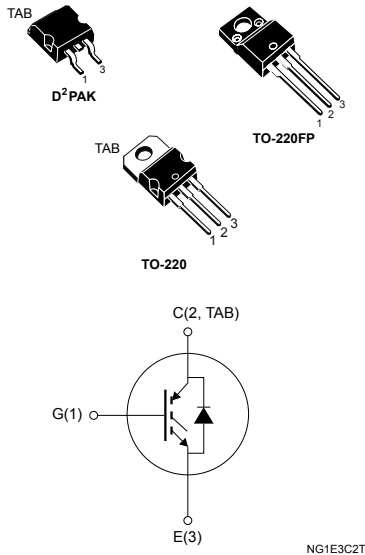




STGB6NC60HDT4, STGF6NC60HD, STGP6NC60HD

Datasheet

N-channel 600 V, 7 A, very fast IGBT



Features

- Low $V_{CE(sat)}$
- Low C_{RES}/C_{IES} ratio (no cross-conduction susceptibility)
- Very soft ultra fast recovery antiparallel diode
- High-frequency operation

Applications

- High frequency inverters
- SMPS and PFC in both hard switch and resonant topologies
- Motor drives

Description

Using the latest high-voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH IGBTs characterized by an outstanding performance. The “H” suffix identifies a family optimized for high-frequency applications which achieve very high switching performances (reduced t_{fall}) while maintaining a low voltage drop.



Product status link

[STGB6NC60HDT4](#)

[STGF6NC60HD](#)

[STGP6NC60HD](#)

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	15	6	A
	Continuous collector current at T _C = 100 °C	7	3	
I _{CM} ⁽¹⁾	Collector current (pulsed)	21		A
V _{GE}	Gate-emitter voltage	±20		V
I _F	Diode RMS forward current at T _C = 25 °C	10		A
P _{TOT}	Total power dissipation at T _C = 25 °C	62.5	25	W
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T _C = 25 °C)		2.5	kV
T _{STG}	Storage temperature range	-55 to 150		°C
T _J	Operating junction temperature range			°C

1. Pulse width is 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	2	5	°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 characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	$V_{GE} = 0\text{ V}$, $I_C = 1\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 3\text{ A}$		1.9	2.5	V
		$V_{GE} = 15\text{ V}$, $I_C = 3\text{ A}$, $T_C = 125\text{ °C}$		1.7		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$	3.75		5.75	V
I_{CES}	Collector cut-off current	$V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$			10	μA
		$V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$, $T_C = 125\text{ °C}$ ⁽¹⁾			1	mA
I_{GES}	Gate-emitter leakage current	$V_{GE} = \pm 20\text{ V}$, $V_{CE} = 0\text{ V}$			± 100	nA

1. Specified by design, not tested in production.

Table 4. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$	-	205	-	pF
C_{oes}	Output capacitance		-	32	-	
C_{res}	Reverse transfer capacitance		-	5.5	-	
Q_g	Total gate charge	$V_{CE} = 390\text{ V}$, $I_C = 3\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 18. Gate charge test circuit)	-	13.6	-	nC
Q_{ge}	Gate-emitter charge		-	3	-	
Q_{gc}	Gate-collector charge		-	6	-	
I_{CL}	Turn-off SOA minimum current	$V_{clamp} = 390\text{ V}$, $T_J = 150\text{ °C}$, $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$	-	19	-	A

Table 5. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390\text{ V}$, $I_C = 3\text{ A}$, $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$ (see Figure 17. Test circuit for inductive load switching)	-	12	-	ns
t_r	Current rise time		-	5	-	
$(di/dt)_{on}$	Turn-on current slope		-	612	-	A/ μs
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390\text{ V}$, $I_C = 3\text{ A}$, $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ °C}$ (see Figure 17. Test circuit for inductive load switching)	-	13	-	ns
t_r	Current rise time		-	4.3	-	
$(di/dt)_{on}$	Turn-on current slope		-	560	-	A/ μs
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 390\text{ V}$, $I_C = 3\text{ A}$, $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$ (see Figure 17. Test circuit for inductive load switching)	-	40	-	ns
$t_{d(off)}$	Turn-off delay time		-	76	-	
t_f	Current fall time		-	100	-	
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 390\text{ V}$, $I_C = 3\text{ A}$, $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ °C}$ (see Figure 17. Test circuit for inductive load switching)	-	60	-	ns
$t_{d(off)}$	Turn-off delay time		-	98	-	
t_f	Current fall time		-	124	-	

Table 6. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching energy	$V_{CC} = 390\text{ V}$, $I_C = 3\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$ (see)Figure 17. Test circuit for inductive load switching	-	20	-	μJ
$E_{off}^{(2)}$	Turn-off switching energy		-	68	-	
E_{ts}	Total switching energy		-	88	-	
$E_{on}^{(1)}$	Turn-on switching energy	$V_{CC} = 390\text{ V}$, $I_C = 3\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ (see)Figure 17. Test circuit for inductive load switching	-	37	-	μJ
$E_{off}^{(2)}$	Turn-off switching energy		-	93	-	
E_{ts}	Total switching energy		-	130	-	

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	$I_f = 1.5\text{ A}$	-	1.6	2.1	V
		$I_f = 1.5\text{ A}$, $T_J = 125\text{ }^\circ\text{C}$	-	1.3		
t_{rr}	Reverse recovery time	$I_f = 3\text{ A}$, $V_R = 40\text{ V}$, $di/dt = 100\text{ A}/\mu\text{s}$ (see Figure 20. Diode reverse recovery waveform)	-	21		ns
Q_{rr}	Reverse recovery charge		-	14		nC
I_{rrm}	Reverse recovery current		-	1.36		A
t_{rr}	Reverse recovery time	$I_f = 3\text{ A}$, $V_R = 40\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$, $di/dt = 100\text{ A}/\mu\text{s}$ (see Figure 20. Diode reverse recovery waveform)	-	34		ns
Q_{rr}	Reverse recovery charge		-	32		nC
I_{rrm}	Reverse recovery current		-	1.88		A

2.1 Electrical characteristics (curves)

Figure 1. Output characteristics

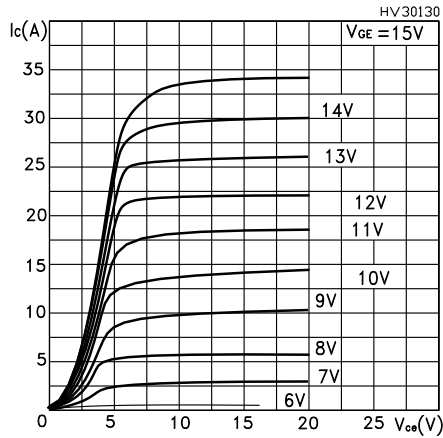


Figure 2. Transfer characteristics

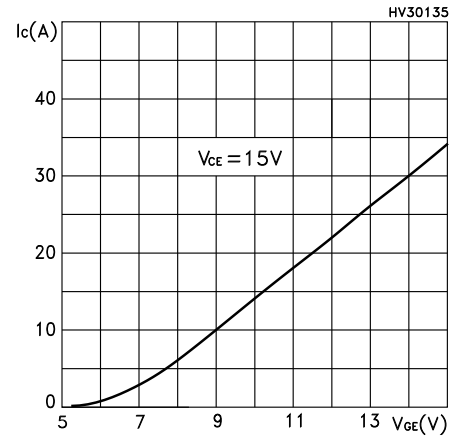


Figure 3. Transconductance

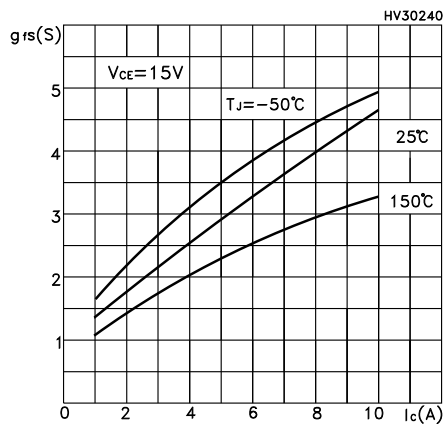


Figure 4. Collector-emitter on-voltage vs temperature

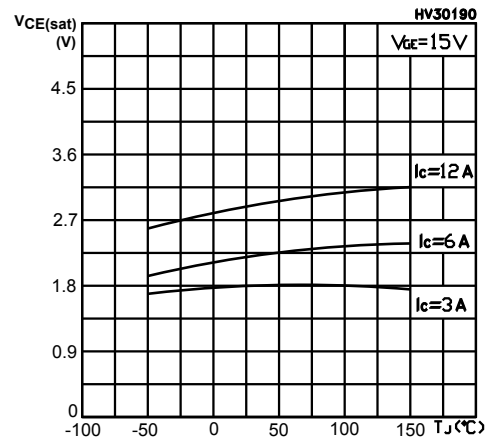


Figure 5. Gate charge vs gate-source voltage

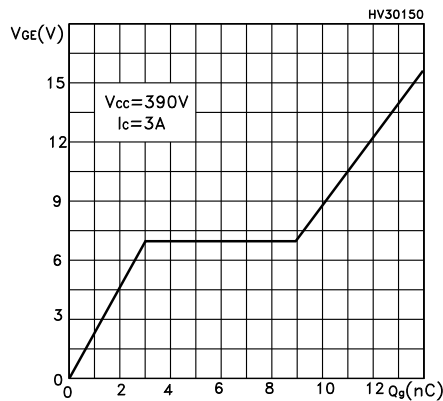


Figure 6. Capacitance variations

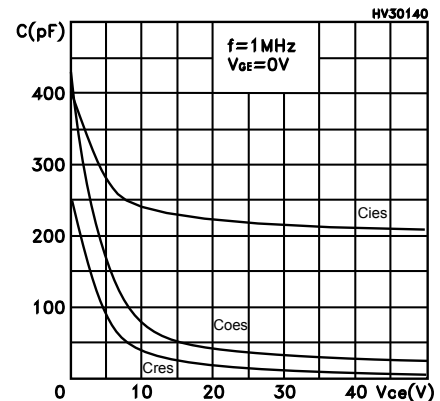


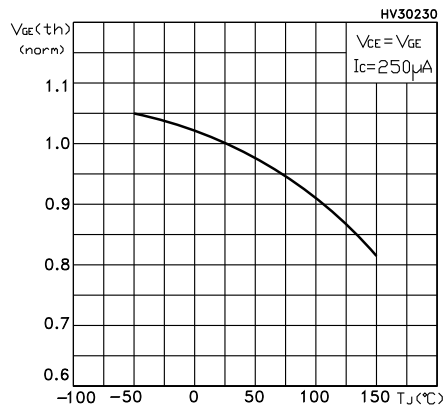
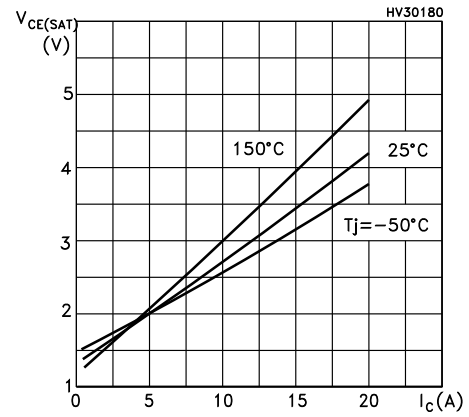
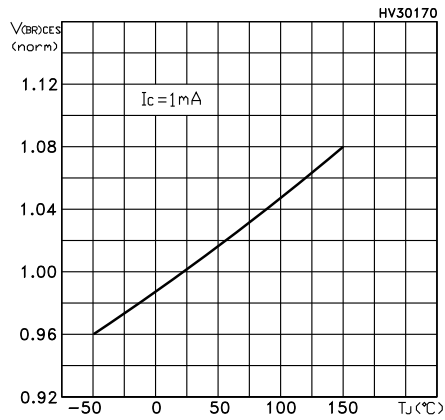
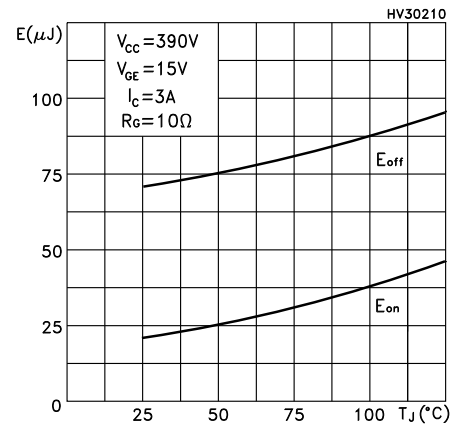
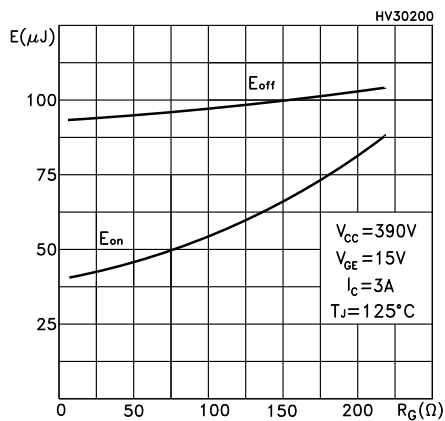
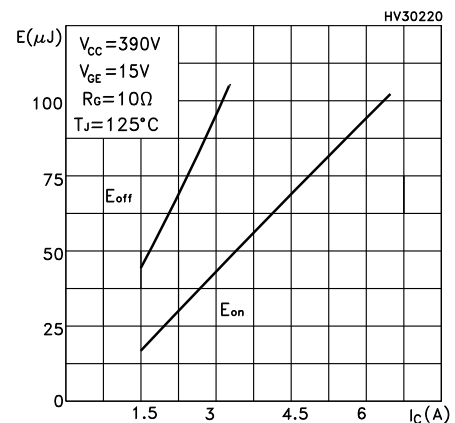
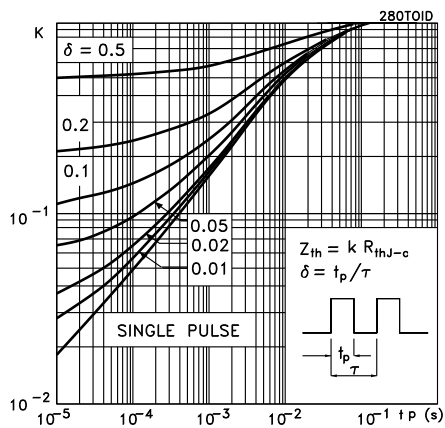
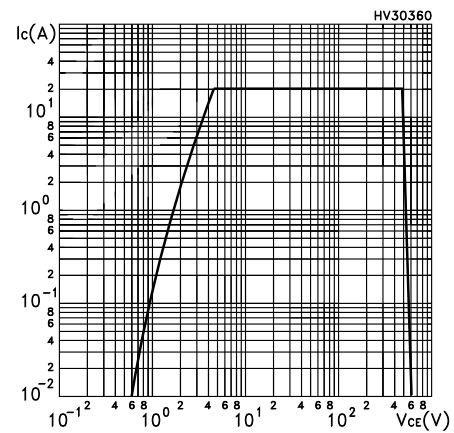
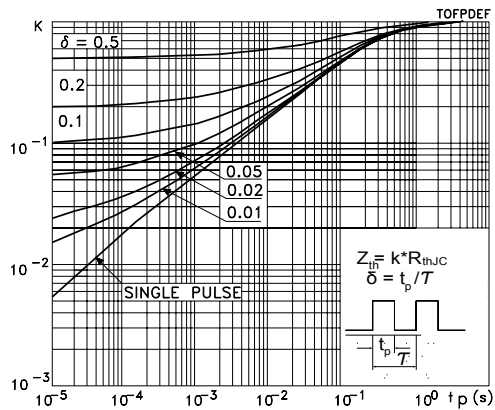
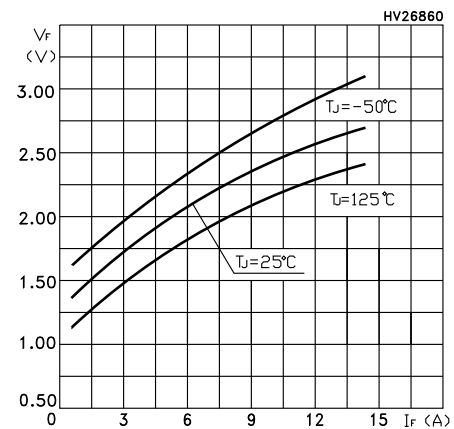
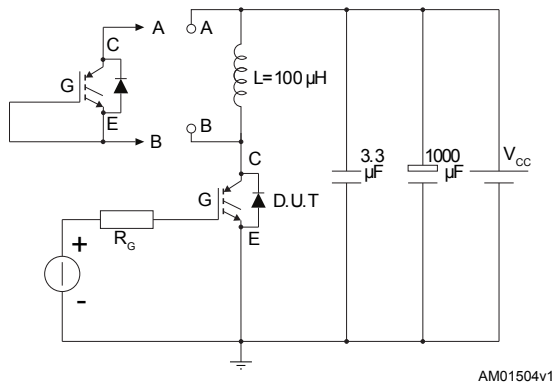
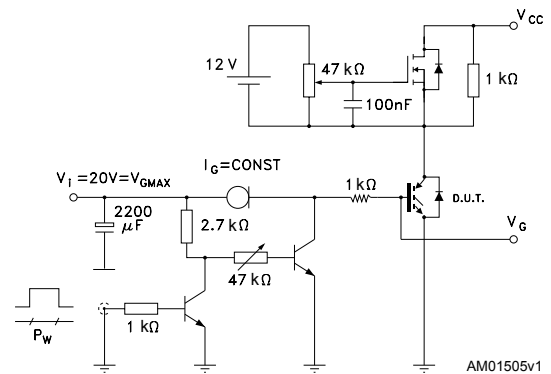
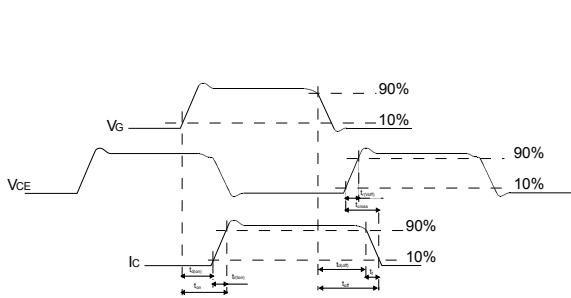
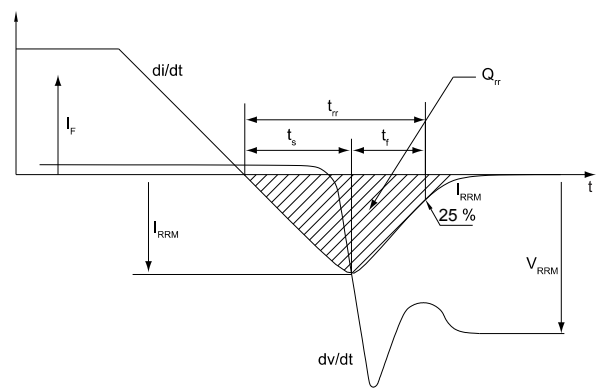
Figure 7. Normalized gate threshold voltage vs temperature

Figure 8. Collector-emitter on voltage vs collector current

Figure 9. Normalized breakdown voltage vs temperature

Figure 10. Switching energy vs temperature

Figure 11. Switching energy vs gate resistance

Figure 12. Switching energy vs collector current


Figure 13. Thermal impedance for TO-220 / D²PAK

Figure 14. Turn-off SOA

Figure 15. Thermal impedance for TO-220FP

Figure 16. Emitter-collector diode characteristics


3 Test circuits

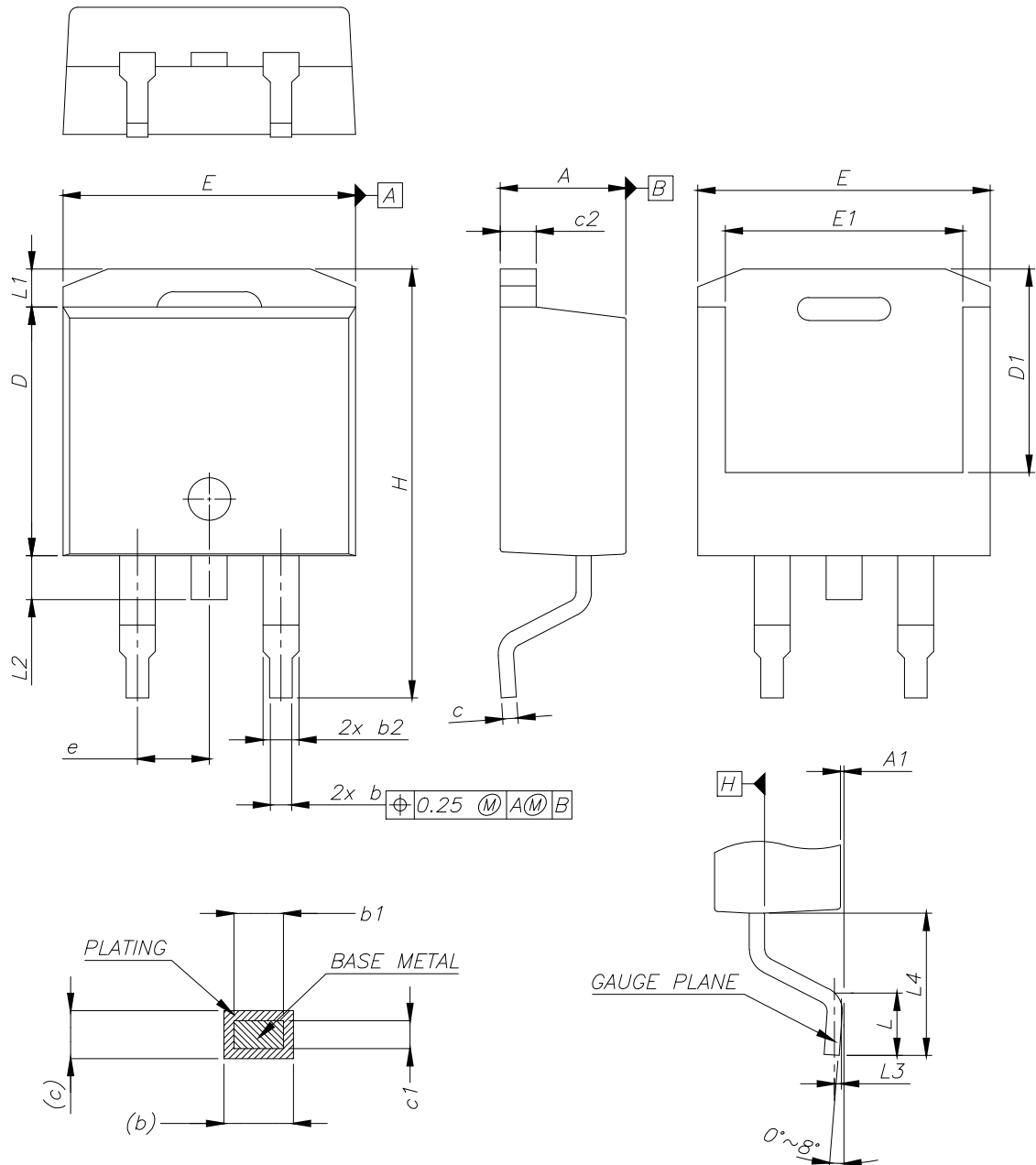
Figure 17. Test circuit for inductive load switching

Figure 18. Gate charge test circuit

Figure 19. Switching waveform

Figure 20. 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 B package information

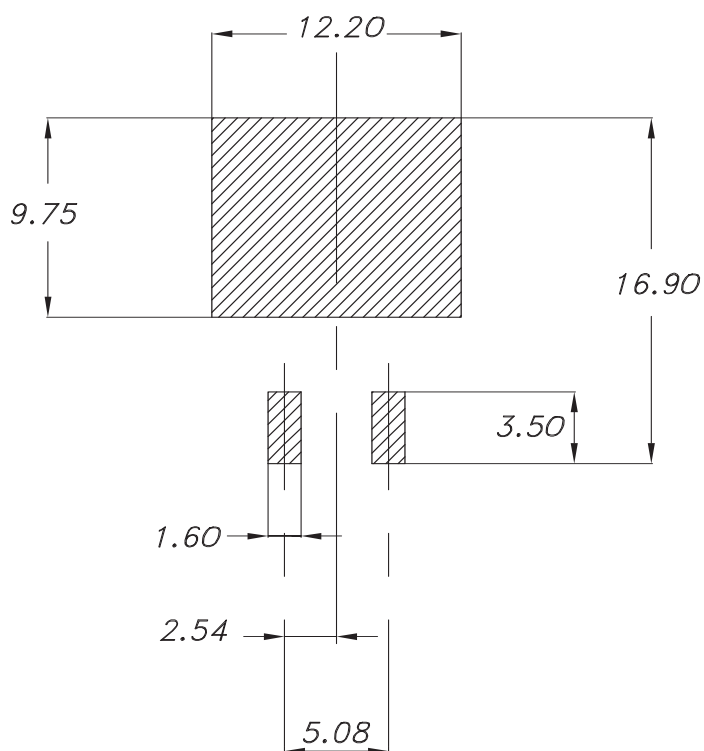
Figure 21. D²PAK (TO-263) type B package outline



0079457_27_B

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

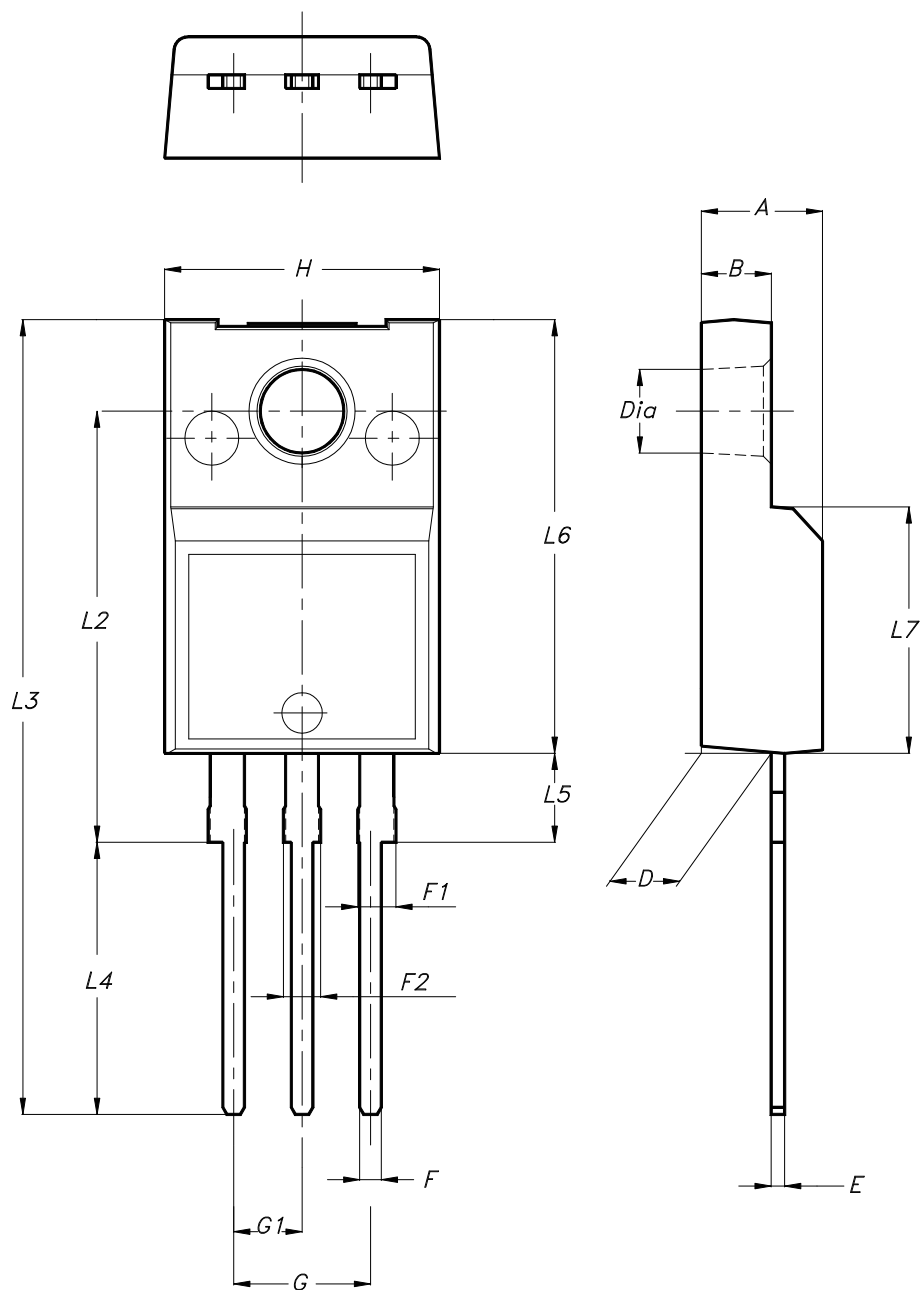
Dim.	mm		
	Min.	Typ.	Max.
A	4.36		4.56
A1	0.00		0.25
b	0.70		0.90
b1	0.51		0.89
b2	1.17		1.37
c	0.38		0.694
c1	0.38		0.534
c2	1.19		1.34
D	8.60		9.00
D1	6.90		7.50
E	10.15		10.55
E1	8.10		8.70
e	2.54 BSC		
H	15.00		15.60
L	1.90		2.50
L1			1.65
L2			1.78
L3		0.25	
L4	4.78		5.28

Figure 22. D²PAK (TO-263) recommended footprint (dimensions are in mm)


0079457_Rev27_footprint

4.2 TO-220FP type B package information

Figure 23. TO-220FP type B package outline



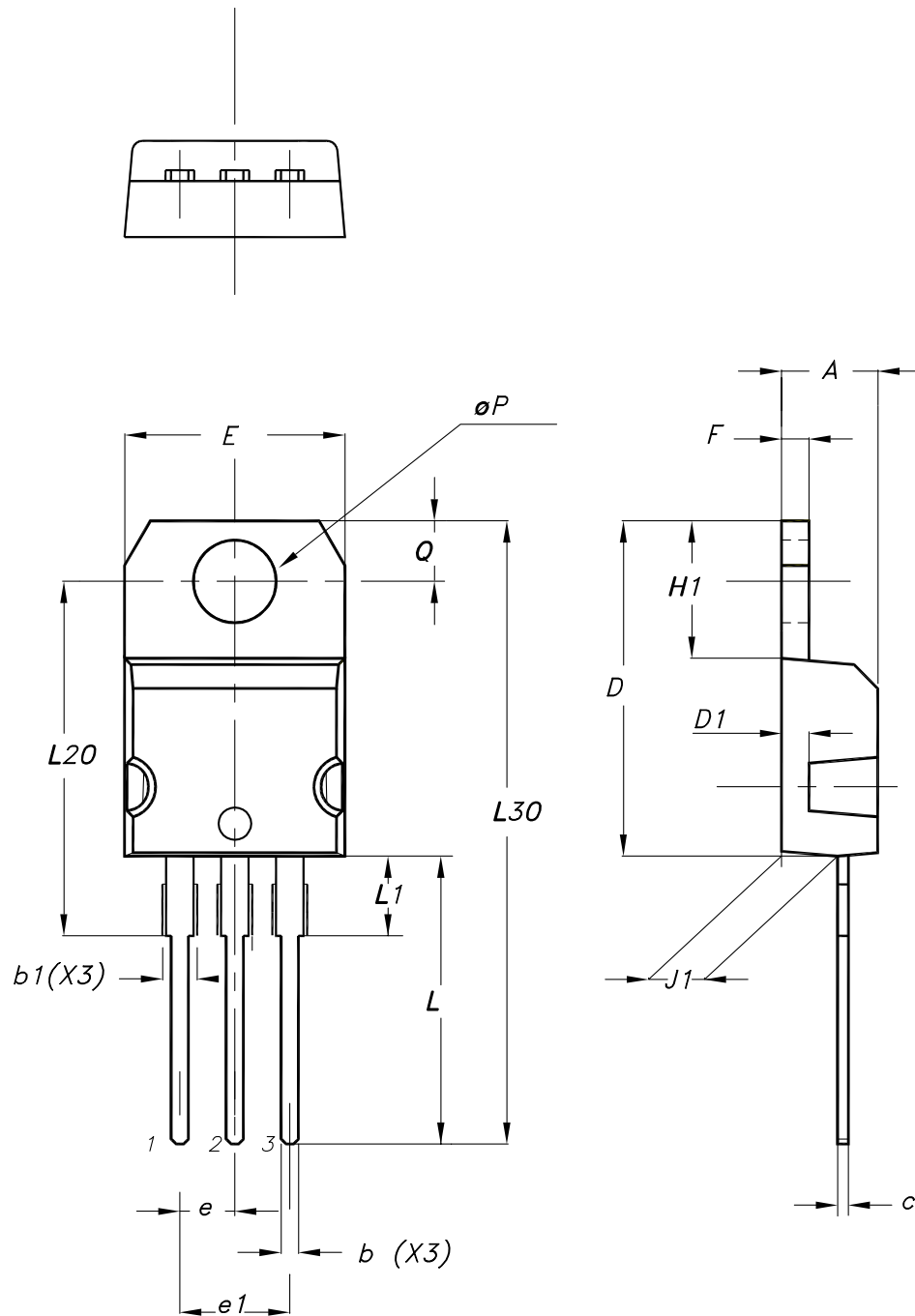
7012510_B_rev.14

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

4.3 TO-220 type A package information

Figure 24. TO-220 type A package outline



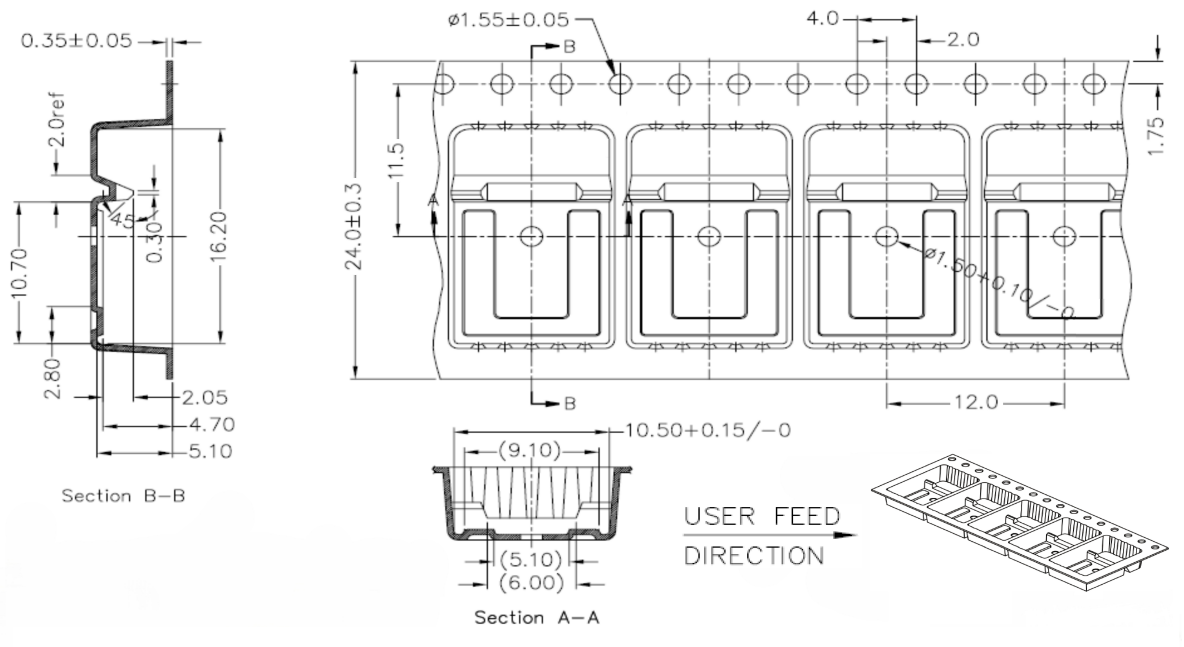
0015988_typeA_Rev_24

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

4.4 D²PAK packing information

Figure 25. D²PAK tape drawing (dimensions are in mm)



DM01095771_1



5 Ordering information

Table 11. Ordering information

Order code	Marking	Package	Packing
STGB6NC60HDT4	GB6NC60HD	D ² PAK	Tape and reel
STGF6NC60HD	GF6NC60HD	TO-220FP	Tube
STGP6NC60HD	GP6NC60HD	TO-220	Tube

Revision history

Table 12. Document revision history

Date	Revision	Changes
28-Nov-2005	1	First release
07-Mar-2006	2	Complete version
31-Jul-2006	3	Modified <i>Figure 10</i> .
26-Apr-2007	4	Inserted package I ² PAK
20-Nov-2017	5	Part number STGB6NC60HD-1 has been moved to a separate datasheet. Updated information on cover page. Updated <i>Table 2: "Absolute maximum ratings"</i> and <i>Table 4: "Static characteristics"</i> . Updated <i>Section 2.1: "Electrical characteristics (curves)"</i> . Updated <i>Section 4: "Package information"</i> . Minor text changes
23-Oct-2018	6	Updated title in coverpage, and <i>Table 4. Dynamic characteristics</i> . Minor text changes.
16-May-2025	7	Updated Section 4: Package information .



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