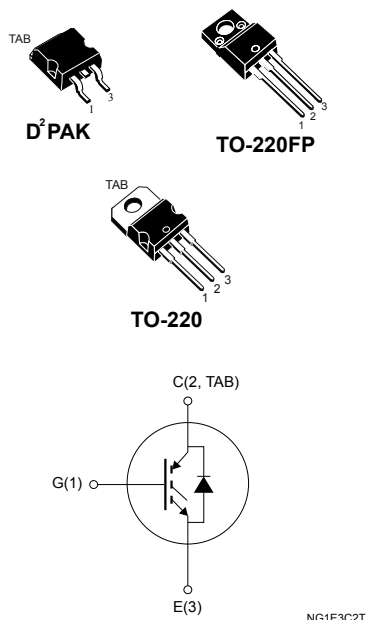




STGB3NC120HDT4, STGF3NC120HD, STGP3NC120HD

Datasheet

7 A, 1200 V, very fast IGBT with ultra-fast diode



Features

- Low on voltage drop ($V_{CE(sat)}$)
- Very soft ultra-fast recovery antiparallel diode

Applications

- Home appliance
- Lighting

Description

These devices are very fast IGBTs developed using advanced PowerMESH technology. This process guarantees an excellent trade-off between switching performance and low on-state behavior.



Product status links

[STGB3NC120HDT4](#)

[STGF3NC120HD](#)

[STGP3NC120HD](#)

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)	1200		V
I _C ⁽¹⁾	Continuous collector current at T _C = 25 °C	14	6	A
	Continuous collector current at T _C = 100 °C	7	3	
I _{CL} ⁽²⁾	Turn-off latching current	14		A
I _{CP} ⁽³⁾	Pulsed collector current	20		A
V _{GE}	Gate-emitter voltage	±20		V
I _F	Diode RMS forward current at T _C = 25 °C	3		A
I _{FSM}	Surge non repetitive forward current t _p = 10 ms sinusoidal	12		A
P _{TOT}	Total power dissipation at T _C = 25 °C	75	25	W
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink	-	2500	V
T _{stg}	Storage temperature range	-55 to 150		°C
T _J	Operating junction temperature range			°C

1. Calculated according to the iterative formula: $I_C(T_C) = \frac{T_{J(max)} - T_C}{R_{thJC} \times V_{CE(sat)(max)}(T_{J(max)}, I_C(T_C))}$
2. V_{clamp} = 80% V_{CES}, T_J = 150 °C, R_G = 10 Ω, V_{GE} = 15 V.
3. Pulse width limited by maximum junction temperature and turn-off within RBSOA.

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		D ² PAK, TO-220	TO-220FP	
R _{thJC}	Thermal resistance, junction-to-case IGBT	1.65	5	°C/W
	Thermal resistance, junction-to-case diode	3.5		
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	$V_{GE} = 0\text{ V}$, $I_C = 1\text{ mA}$	1200	-	-	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 3\text{ A}$	-	2.3	2.8	V
		$V_{GE} = 15\text{ V}$, $I_C = 3\text{ A}$, $T_J = 125\text{ °C}$	-	2.2	-	
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$	2	-	5	V
I_{CES}	Collector cut-off current	$V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$	-	-	0.05	mA
		$V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$, $T_J = 125\text{ °C}^{(1)}$	-	-	1	
I_{GES}	Gate-emitter leakage current	$V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$	-	-	± 100	nA
$g_{fs}^{(2)}$	Forward transconductance	$V_{CE} = 15\text{ V}$, $I_C = 3\text{ A}$	-	4	-	S

1. Specified by design, not tested in production.

2. Pulsed: pulse duration = 300 μs , duty cycle 1.5%.

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$	-	470	-	pF
C_{oes}	Output capacitance		-	45	-	pF
C_{res}	Reverse transfer capacitance		-	6	-	pF
Q_g	Total gate charge	$V_{CC} = 960\text{ V}$, $I_C = 3\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (see the Figure 21. Gate charge test circuit)	-	24	-	nC
Q_{ge}	Gate-emitter charge		-	3	-	nC
Q_{gc}	Gate-collector charge		-	10	-	nC

Table 5. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 800\text{ V}$, $I_C = 3\text{ A}$, $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$ (see the Figure 22. Switching waveform)	-	15	-	ns
t_r	Current rise time		-	3.5	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	880	-	A/ μs
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 800\text{ V}$, $I_C = 3\text{ A}$, $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ °C}$ (see the Figure 22. Switching waveform)	-	14.5	-	ns
t_r	Current rise time		-	4	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	770	-	A/ μs
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 800\text{ V}$, $I_C = 3\text{ A}$, $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$ (see the Figure 22. Switching waveform)	-	72	-	ns
$t_{d(off)}$	Turn-off delay time		-	118	-	ns
t_f	Current fall time		-	250	-	ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 800\text{ V}$, $I_C = 3\text{ A}$, $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ °C}$ (see the Figure 22. Switching waveform)	-	132	-	ns
$t_{d(off)}$	Turn-off delay time		-	210	-	ns
t_f	Current fall time		-	470	-	ns

Table 6. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching energy	$V_{CE} = 800\text{ V}$, $I_C = 3\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$ (see the Figure 22. Switching waveform)	-	236	-	μJ
$E_{off}^{(2)}$	Turn-off switching energy		-	290	-	μJ
E_{ts}	Total switching energy		-	526	-	μJ
$E_{on}^{(1)}$	Turn-on switching energy	$V_{CE} = 800\text{ V}$, $I_C = 3\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ (see the Figure 22. Switching waveform)	-	360	-	μJ
$E_{off}^{(2)}$	Turn-off switching energy		-	620	-	μJ
E_{ts}	Total switching energy		-	980	-	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	$I_F = 1.5\text{ A}$	-	1.6	2.0	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 the Figure 20. Diode reverse recovery waveform)	-	51	-	ns
Q_{rr}	Reverse recovery charge		-	85	-	nC
I_{rrm}	Reverse recovery current		-	3.3	-	A
t_{rr}	Reverse recovery time	$I_F = 3\text{ A}$, $V_R = 40\text{ V}$, $di/dt = 100\text{ A}/\mu\text{s}$, $T_J = 125\text{ }^\circ\text{C}$ (see the Figure 20. Diode reverse recovery waveform)	-	64	-	ns
Q_{rr}	Reverse recovery charge		-	133	-	nC
I_{rr}	Reverse recovery current		-	4.2	-	A

2.1 Electrical characteristics (curves)

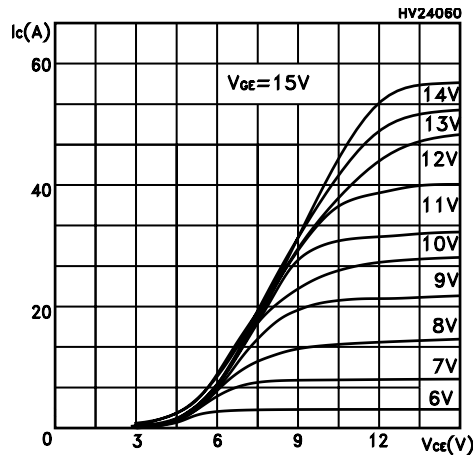
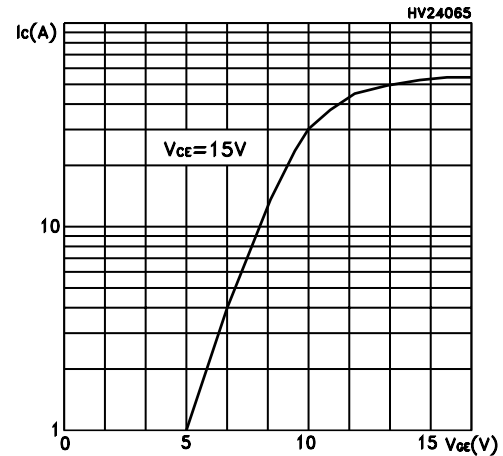
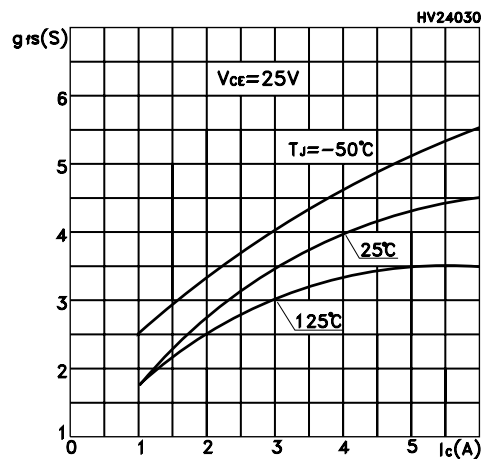
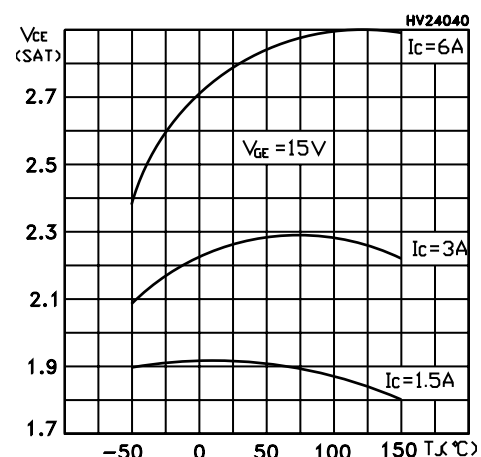
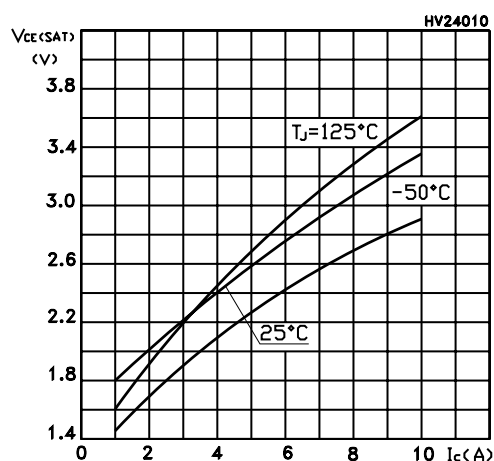
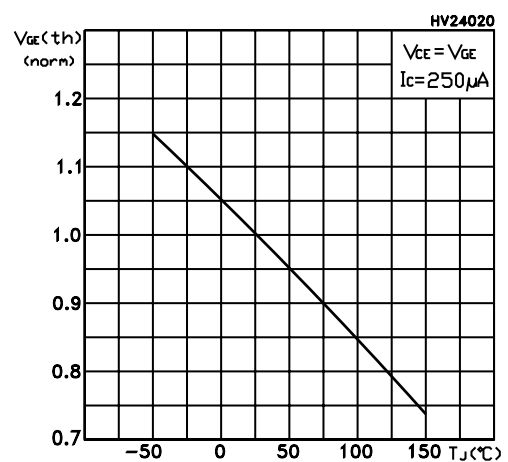
Figure 1. Typical output characteristics

Figure 2. Typical transfer characteristics

Figure 3. Typical transconductance characteristics

Figure 4. Typical collector-emitter on voltage vs temperature

Figure 5. Typical collector-emitter on voltage vs collector current

Figure 6. Normalized gate threshold vs temperature


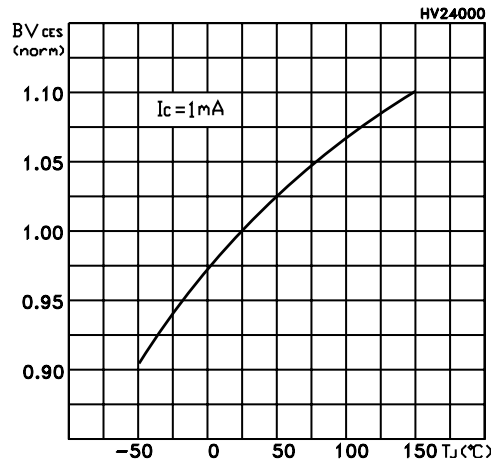
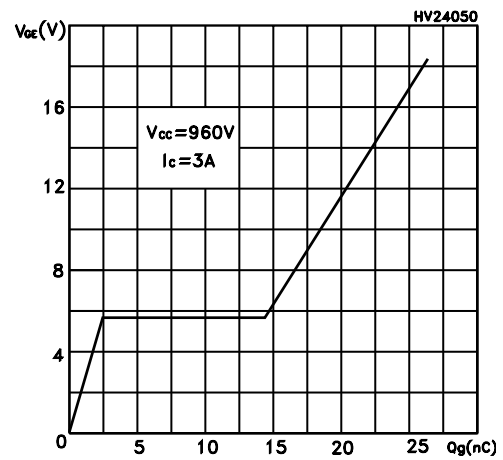
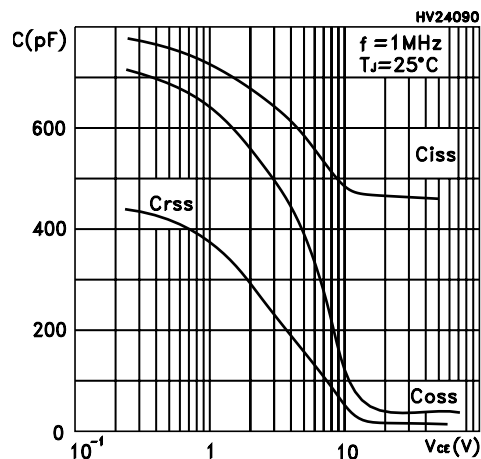
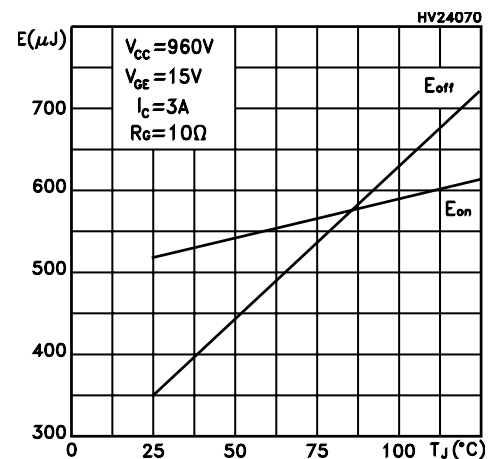
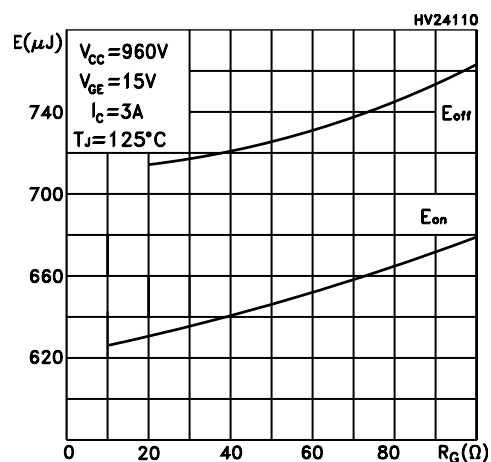
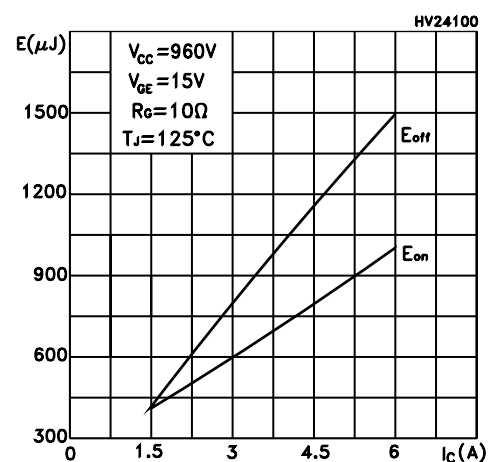
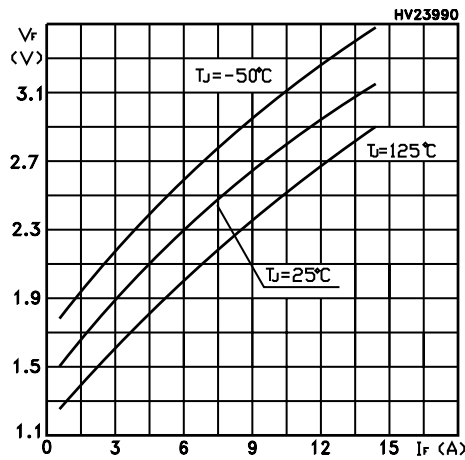
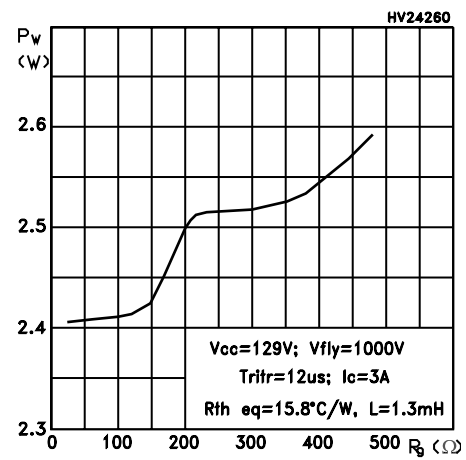
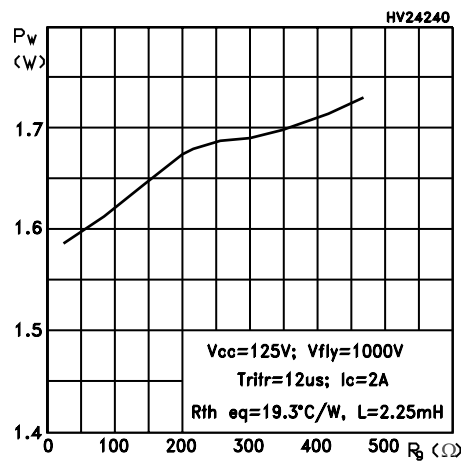
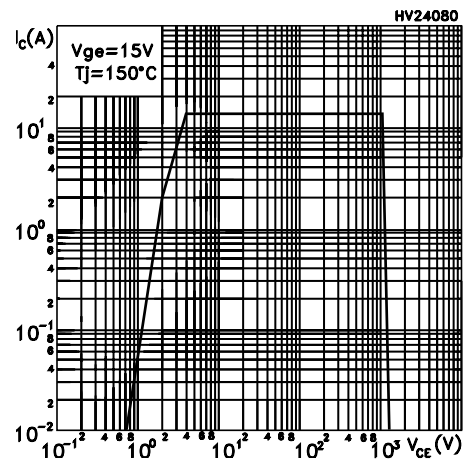
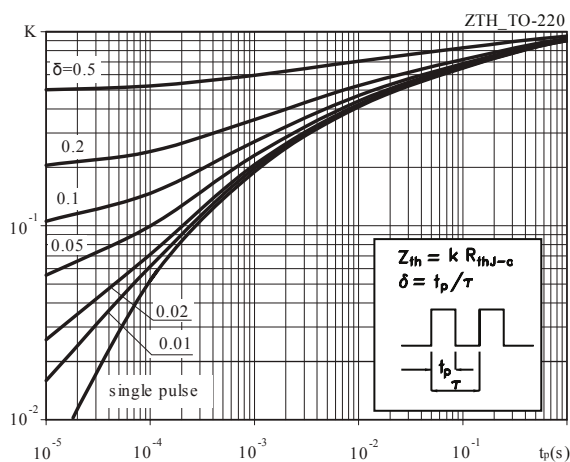
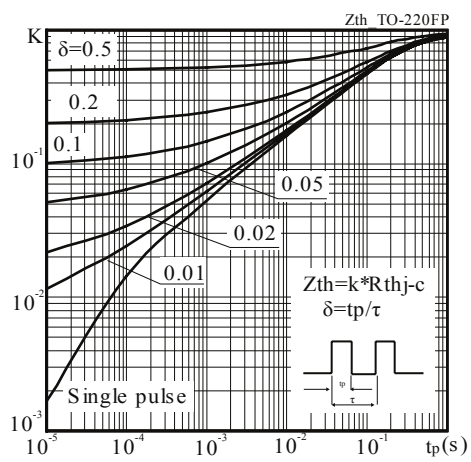
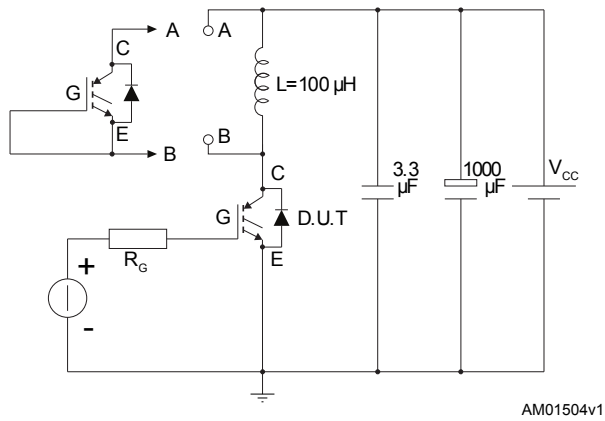
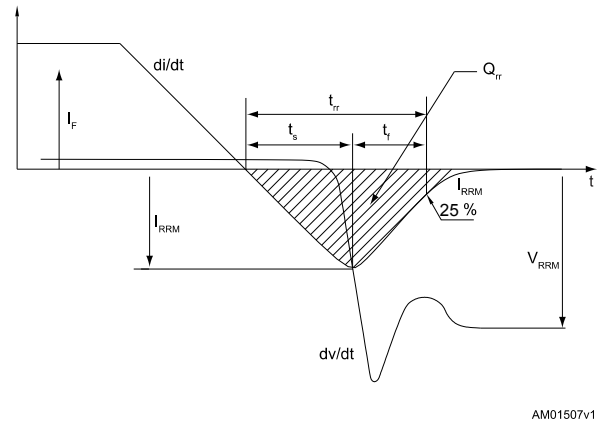
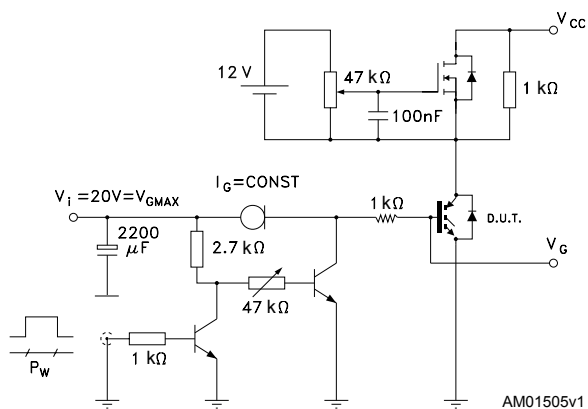
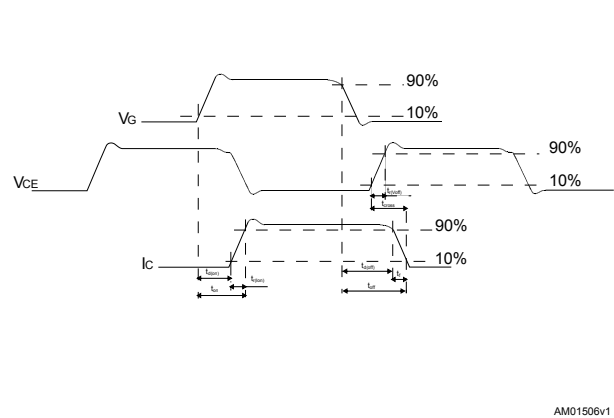
Figure 7. Normalized breakdown voltage vs temperature

Figure 8. Typical gate charge characteristics

Figure 9. Typical capacitance characteristics

Figure 10. Typical switching energy vs temperature

Figure 11. Typical switching energy vs gate resistance

Figure 12. Typical switching energy vs collector current


Figure 13. Typical emitter-collector diode characteristics

Figure 14. Typical switching energy at $I_C = 3\text{ A}$

Figure 15. Typical switching energy at $I_C = 2\text{ A}$

Figure 16. Safe operating area

Figure 17. Normalized transient thermal impedance for D²PAK, TO-220

Figure 18. Normalized transient thermal impedance for TO-220FP


3 Test circuits

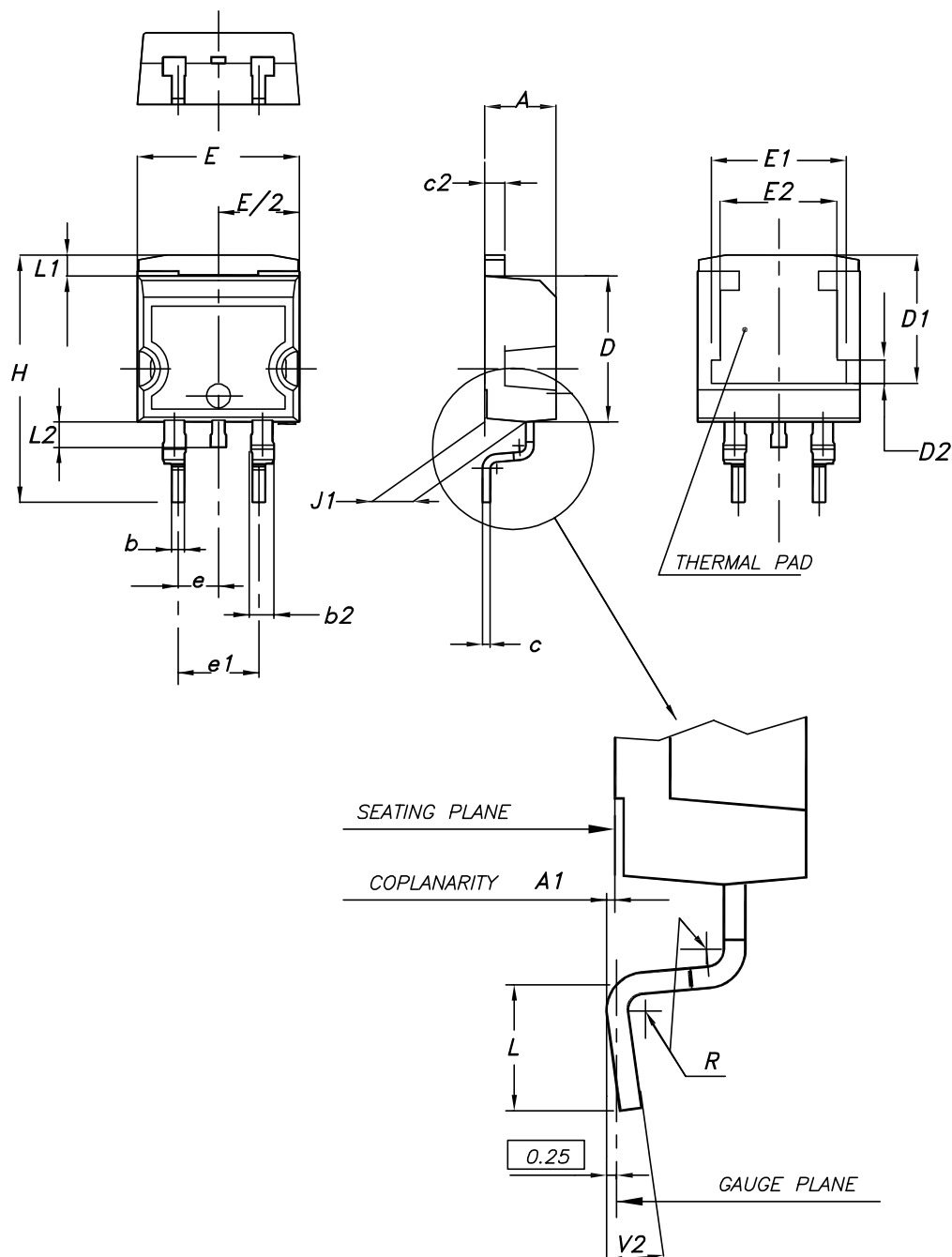
Figure 19. Test circuit for inductive load switching

Figure 20. Diode reverse recovery waveform

Figure 21. Gate charge test circuit

Figure 22. 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 A package information

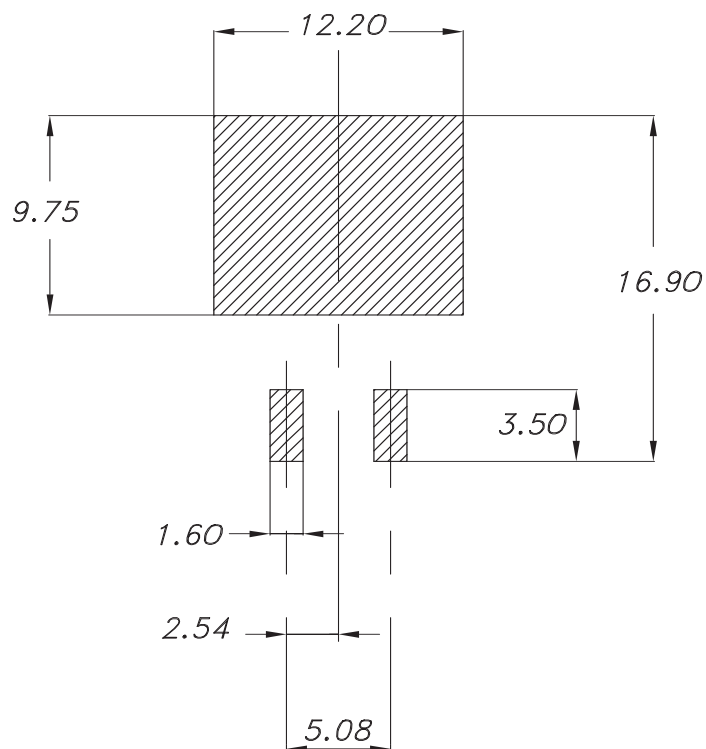
Figure 23. D²PAK (TO-263) type A package outline



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

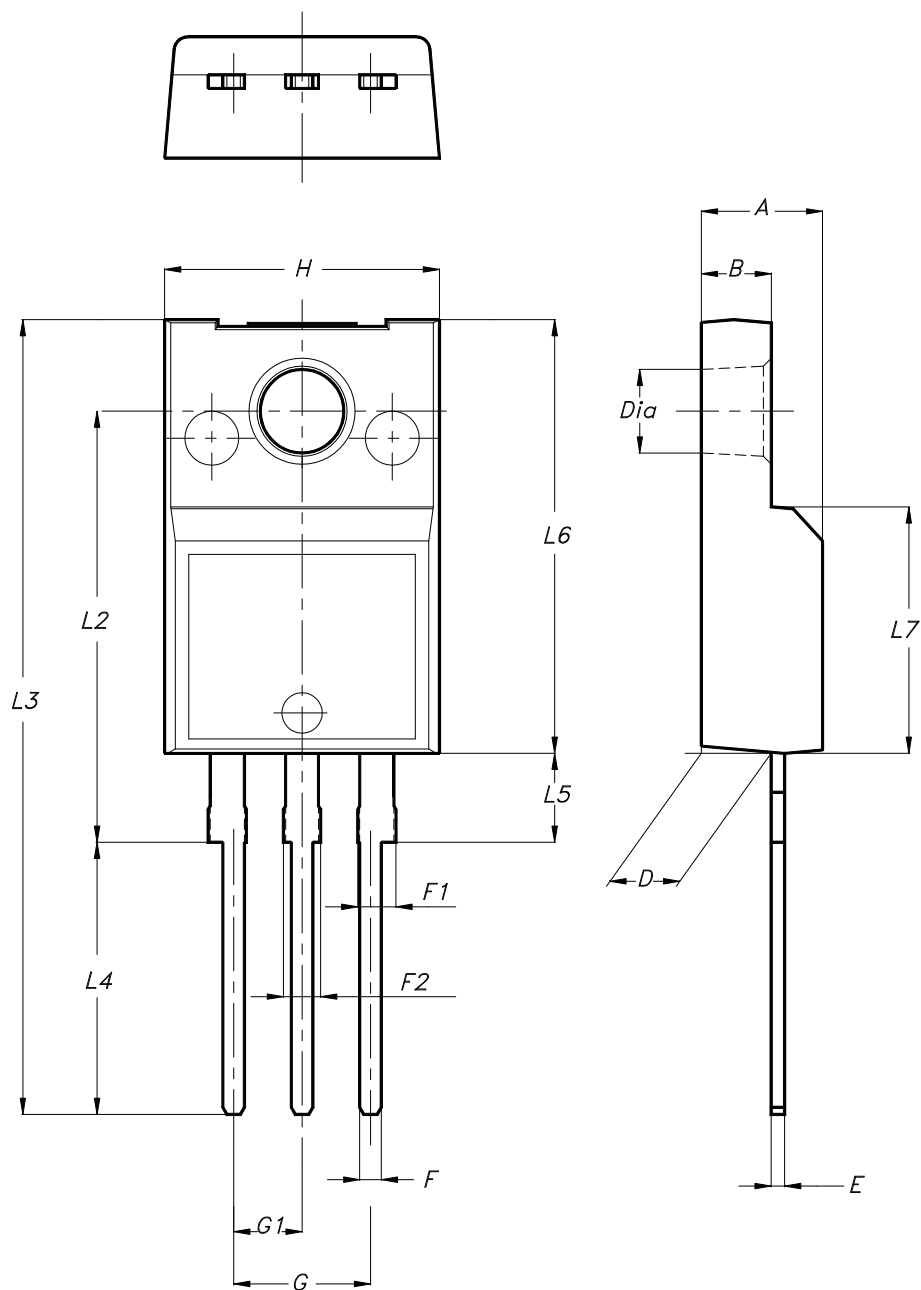
Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50	7.75	8.00
D2	1.10	1.30	1.50
E	10.00		10.40
E1	8.30	8.50	8.70
E2	6.85	7.05	7.25
e		2.54	
e1	4.88		5.28
H	15.00		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.40	
V2	0°		8°

Figure 24. D²PAK (TO-263) recommended footprint (dimensions are in mm)


0079457_Rev27_footprint

4.2 TO-220FP type B package information

Figure 25. TO-220FP type B package outline



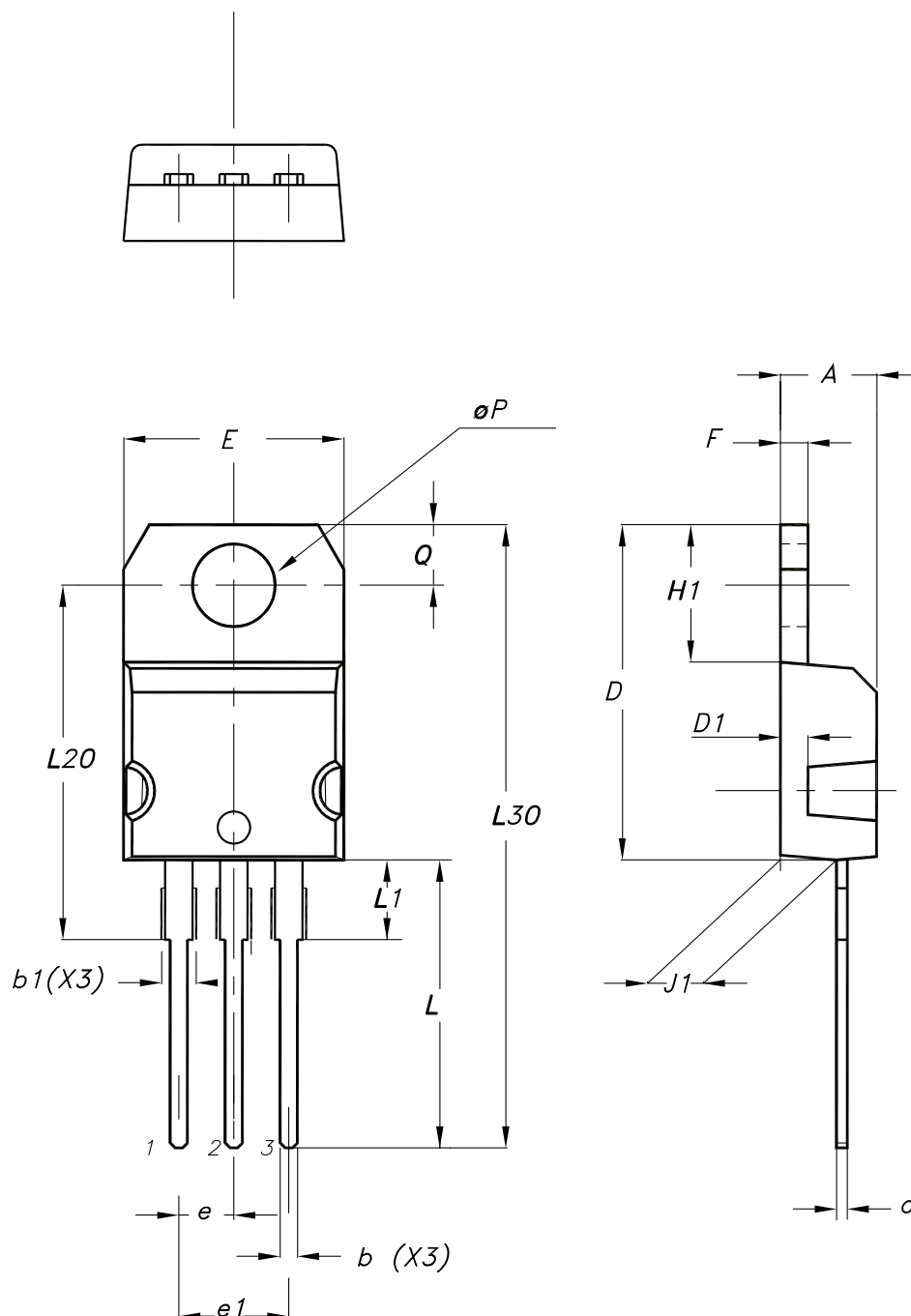
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Table 9. TO-220FP type B package mechanical data

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 26. TO-220 type A package outline



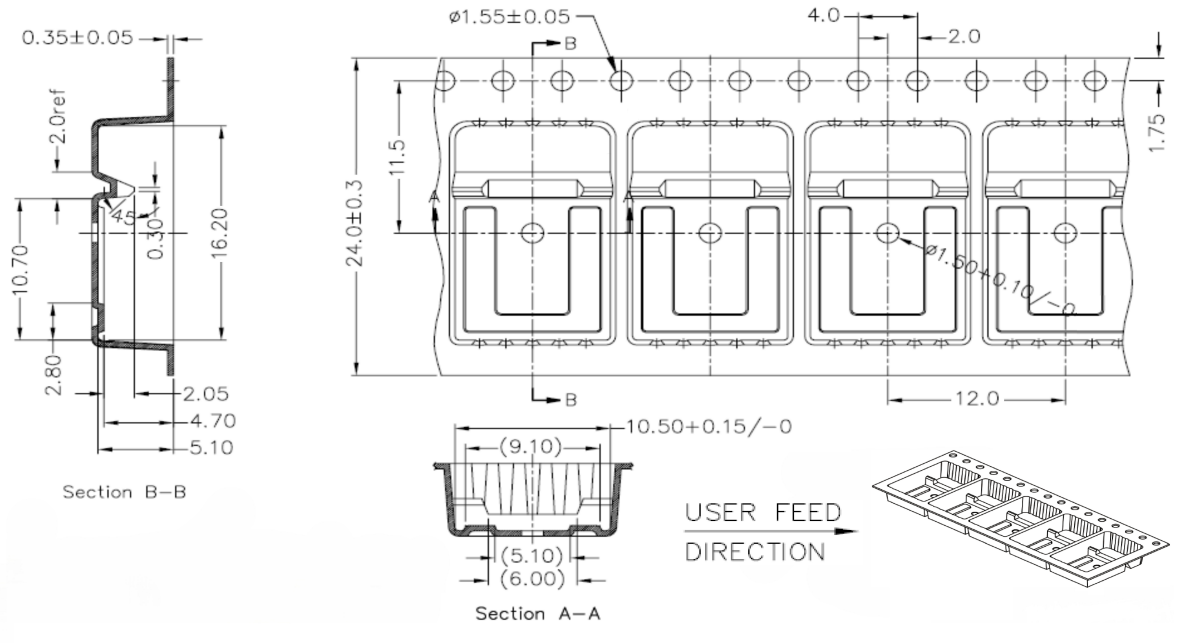
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Table 10. TO-220 type A package mechanical data

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 27. D²PAK tape drawing (dimensions are in mm)



0079900_14



5 Ordering information

Table 11. Order codes

Order codes	Marking	Package	Packing
STGB3NC120HDT4	GB3NC120HD	D ² PAK	Tape and reel
STGF3NC120HD	GF3NC120HD	TO-220FP	Tube
STGP3NC120HD	GP3NC120HD	TO-220	

Revision history

Table 12. Document revision history

Date	Revision	Changes
13-Dec-2004	1	First release.
21-Jan-2005	2	Modified <i>Figure 18: Turn-off SOA</i> .
03-May-2010	3	Added new package, mechanical data: TO-220.
25-Jan-2011	4	Added new package, mechanical data: D ² PAK.
09-Jun-2025	5	Updated Section 4: Package information .



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