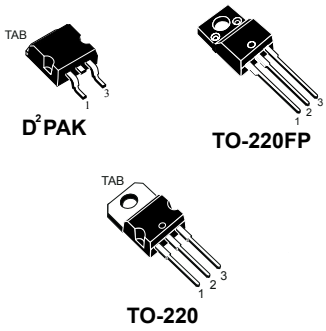
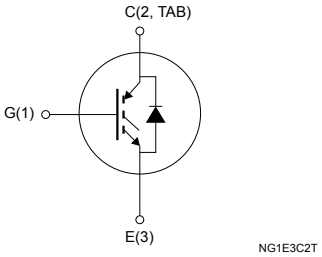
STGB3NC120HDT4, STGF3NC120HD, STGP3NC120HD

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
		D²PAK, 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:* $I_C(T_C) = \frac{T_{J(\max)} - T_C}{R_{thJC} \times V_{CE(sat)(\max)}\left(T_{J(\max)}, I_C(T_C)\right)}$
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
		D²PAK, 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 °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 = 1 mA	1200	-	-	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 3 A	-	2.3	2.8	V
		V_{GE} = 15 V, I_C = 3 A, T_J = 125 °C	-	2.2	-	
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 250 µA	2	-	5	V
I_{CES}	Collector cut-off current	V_{GE} = 0 V, V_{CE} = 1200 V	-	-	0.05	mA
		V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 125 °C(1)	-	-	1	
I_{GES}	Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = ±20 V	-	-	±100	nA
g_{fs}(2)	Forward transconductance	V_{CE} = 15 V, I_C = 3 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 V, f = 1 MHz, V_{GE} = 0 V	-	470	-	pF
C_{oes}	Output capacitance		-	45	-	pF
C_{res}	Reverse transfer capacitance		-	6	-	pF
Q_g	Total gate charge	V_{CC} = 960 V, I_C = 3 A, V_{GE} = 0 to 15 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 V, I_C = 3 A, R_G = 10 Ω, V_{GE} = 15 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 V, I_C = 3 A, R_G = 10 Ω, V_{GE} = 15 V, T_J = 125 °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 V, I_C = 3 A, R_G = 10 Ω, V_{GE} = 15 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 V, I_C = 3 A, R_G = 10 Ω, V_{GE} = 15 V, T_J = 125 °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 V, I_C = 3 A,	-	236	-	µJ
E_{off} (2)	Turn-off switching energy	R_G = 10 Ω, V_{GE} = 15 V	-	290	-	µJ
E_{ts}	Total switching energy	(see the Figure 22. Switching waveform)	-	526	-	µJ
E_{on} (1)	Turn-on switching energy	V_{CE} = 800 V, I_C = 3 A,	-	360	-	µJ
E_{off} (2)	Turn-off switching energy	R_G = 10 Ω, V_{GE} = 15 V, T_J = 125 °C	-	620	-	µJ
E_{ts}	Total switching energy	(see the Figure 22. Switching waveform)	-	980	-	µJ

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

Table 7. Diode switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_F	Forward on-voltage	I_F = 1.5 A	-	1.6	2.0	V
		I_F = 1.5 A, T_J = 125 °C	-	1.3	-	
t_{rr}	Reverse recovery time	I_F = 3 A, V_R = 40 V, di/dt = 100 A/µs	-	51	-	ns
Q_{rr}	Reverse recovery charge	(see the Figure 20. Diode reverse recovery waveform)	-	85	-	nC
I_{rrm}	Reverse recovery current		-	3.3	-	A
t_{rr}	Reverse recovery time	I_F = 3 A, V_R = 40 V, di/dt = 100 A/µs,	-	64	-	ns
Q_{rr}	Reverse recovery charge	T_J = 125 °C	-	133	-	nC
I_{rr}	Reverse recovery current	(see the Figure 20. Diode reverse recovery waveform)	-	4.2	-	A

2.1 Electrical characteristics (curves)

Figure 1. Typical output characteristics

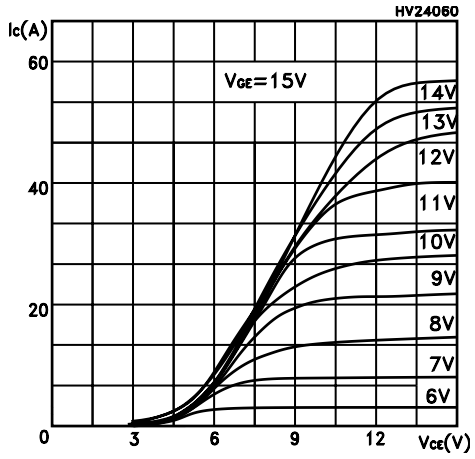


Figure 2. Typical transfer characteristics

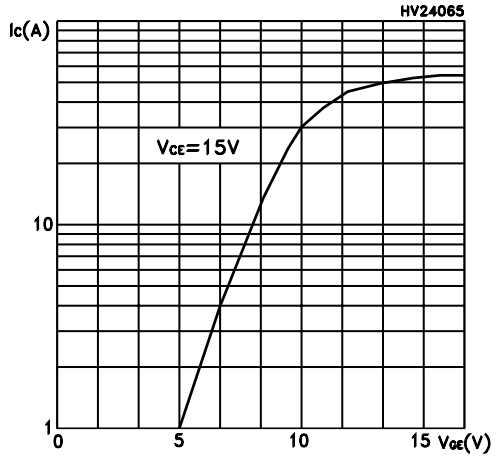


Figure 3. Typical transconductance characteristics

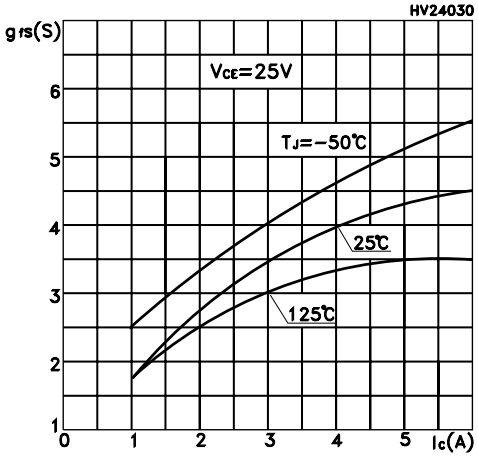


Figure 4. Typical collector-emitter on voltage vs temperature

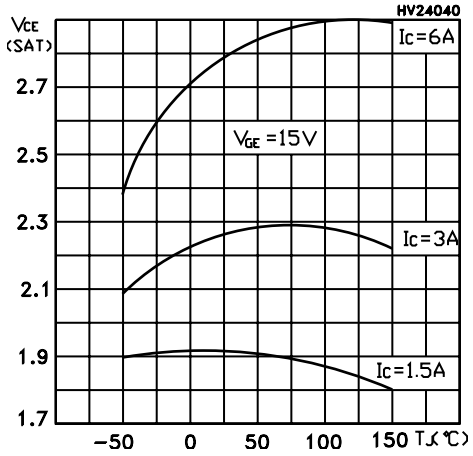


Figure 5. Typical collector-emitter on voltage vs collector current

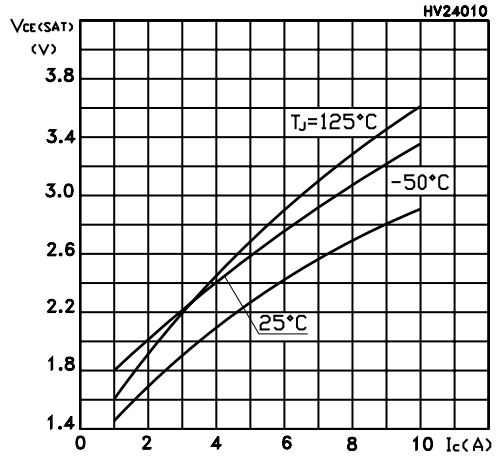


Figure 6. Normalized gate threshold vs temperature

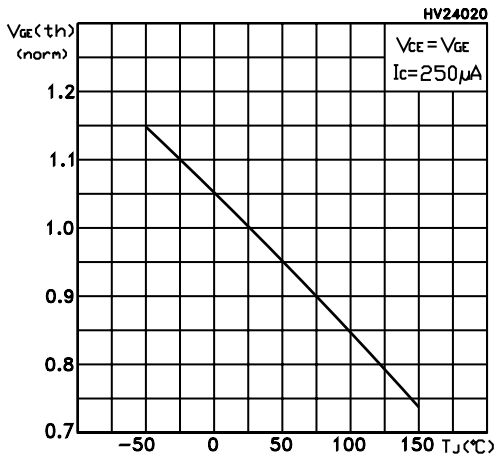


Figure 7. Normalized breakdown voltage vs temperature

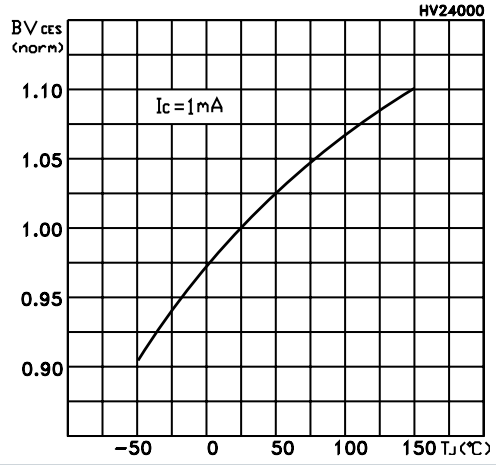


Figure 8. Typical gate charge characteristics

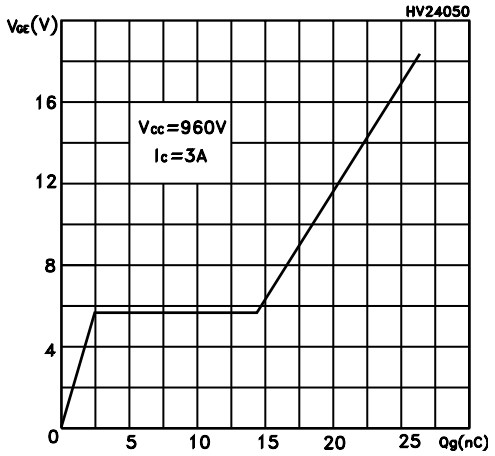


Figure 9. Typical capacitance characteristics

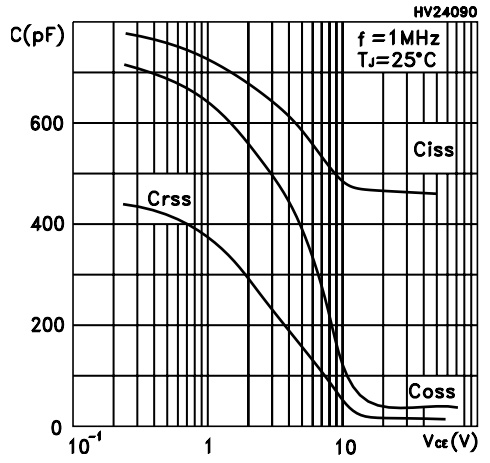


Figure 10. Typical switching energy vs temperature

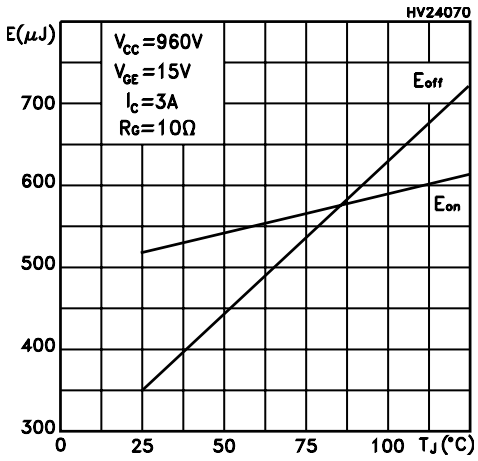


Figure 11. Typical switching energy vs gate resistance

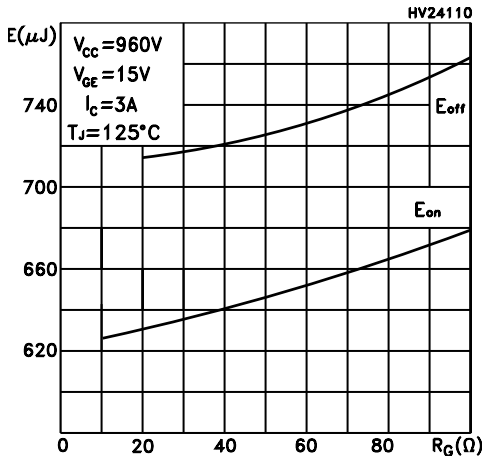


Figure 12. Typical switching energy vs collector current

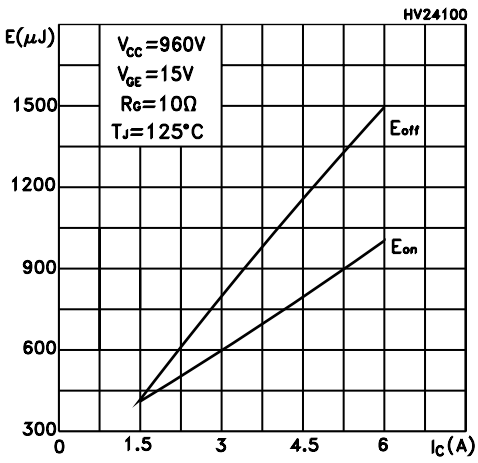


Figure 13. Typical emitter-collector diode characteristics

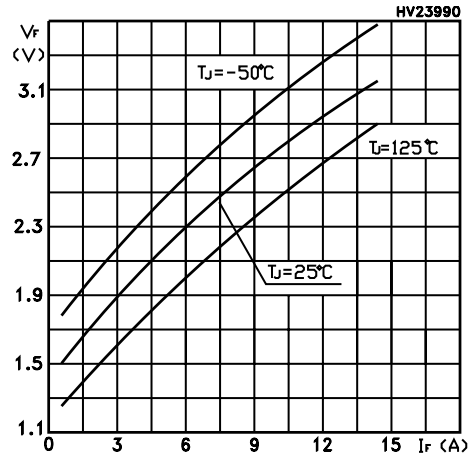


Figure 14. Typical switching energy at I_C = 3 A

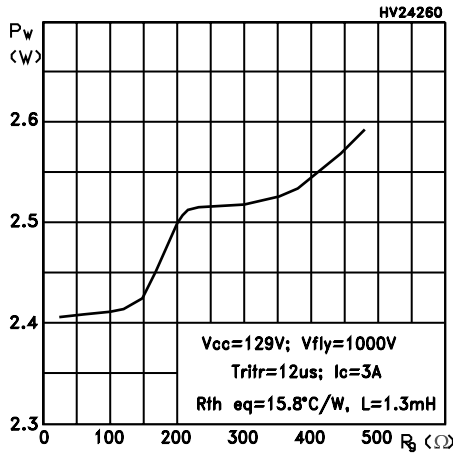


Figure 15. Typical switching energy at I_C = 2 A

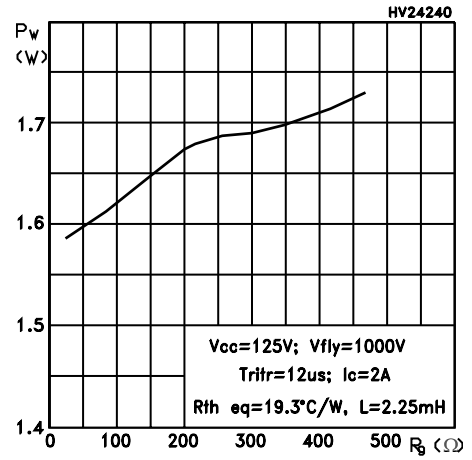


Figure 16. Safe operating area

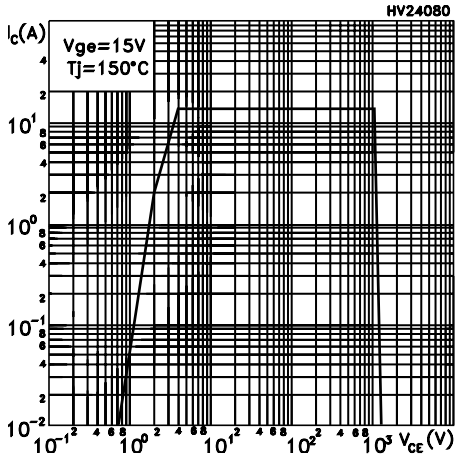


Figure 17. Normalized transient thermal impedance for D²PAK, TO-220

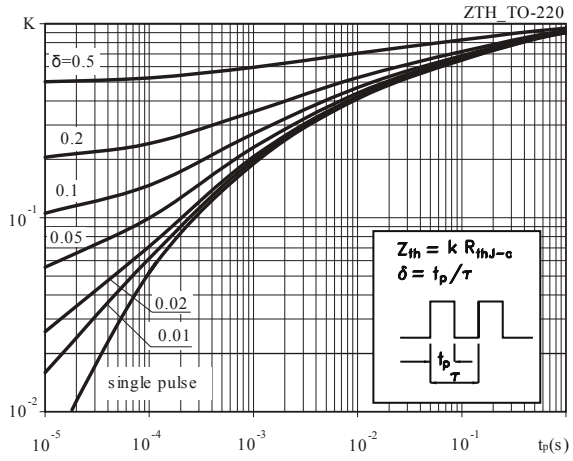
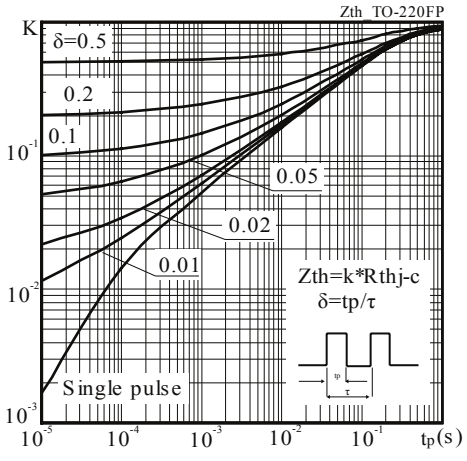


Figure 18. Normalized transient thermal impedance for TO-220FP



3 Test circuits

Figure 19. Test circuit for inductive load switching

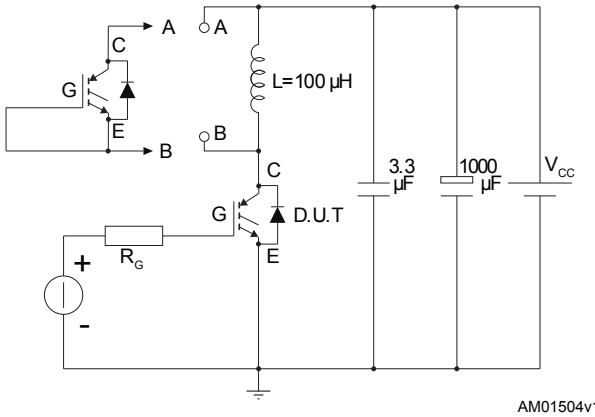


Figure 20. Diode reverse recovery waveform

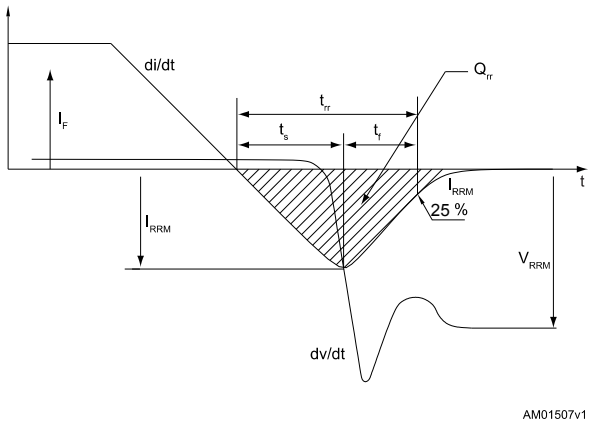


Figure 21. Gate charge test circuit

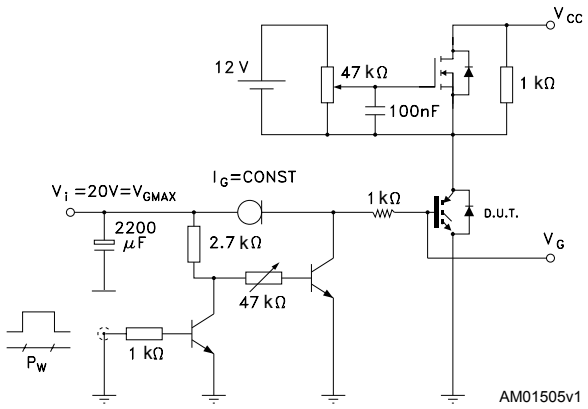
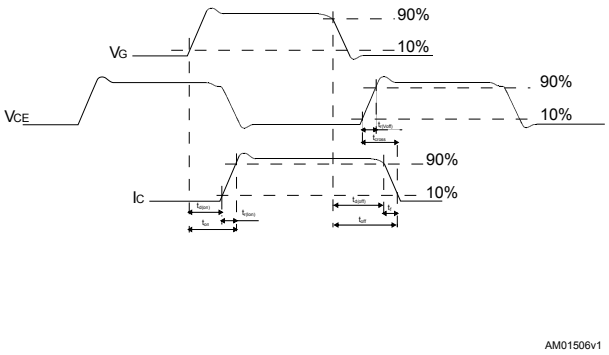


Figure 22. Switching waveform



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**

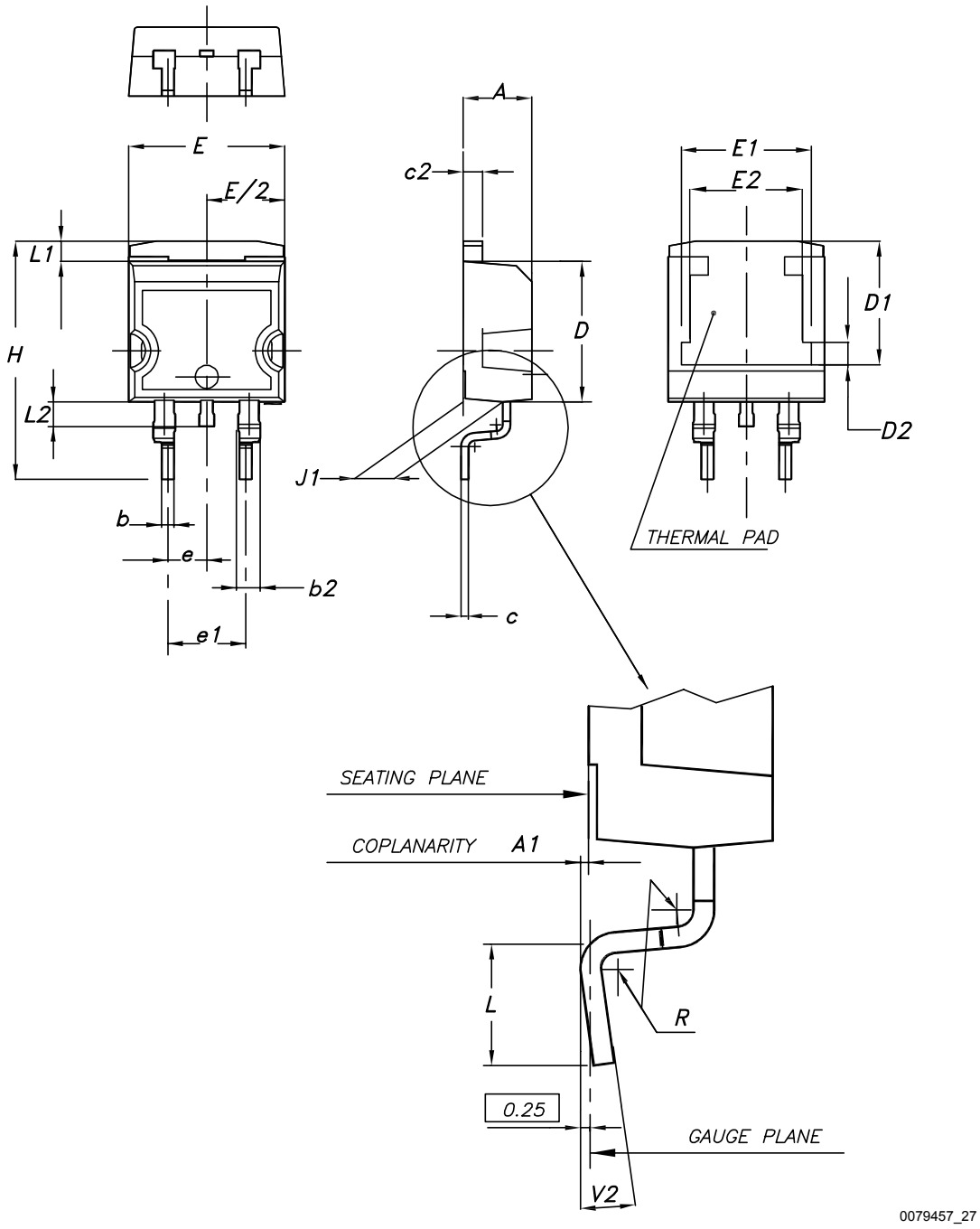
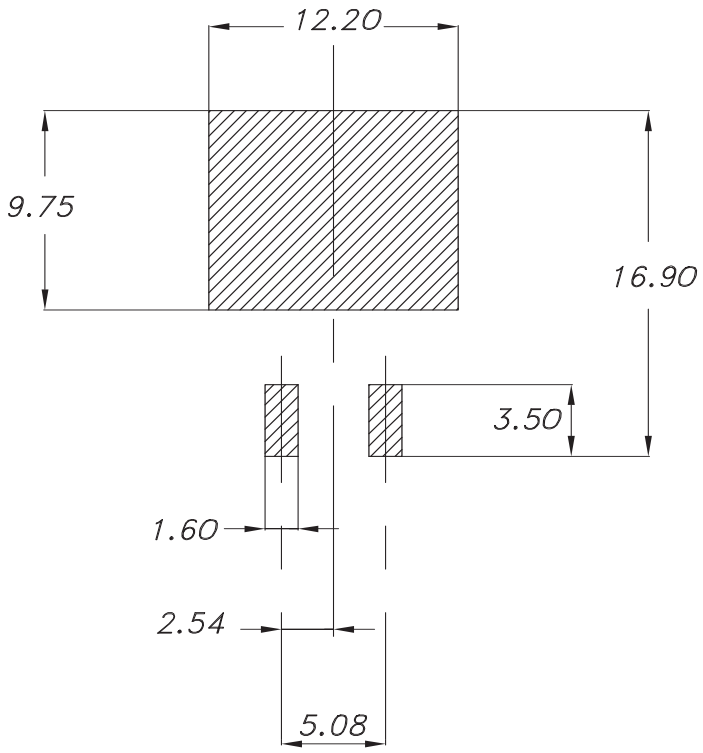


Table 8. D²PAK (TO-263) type A package mechanical data

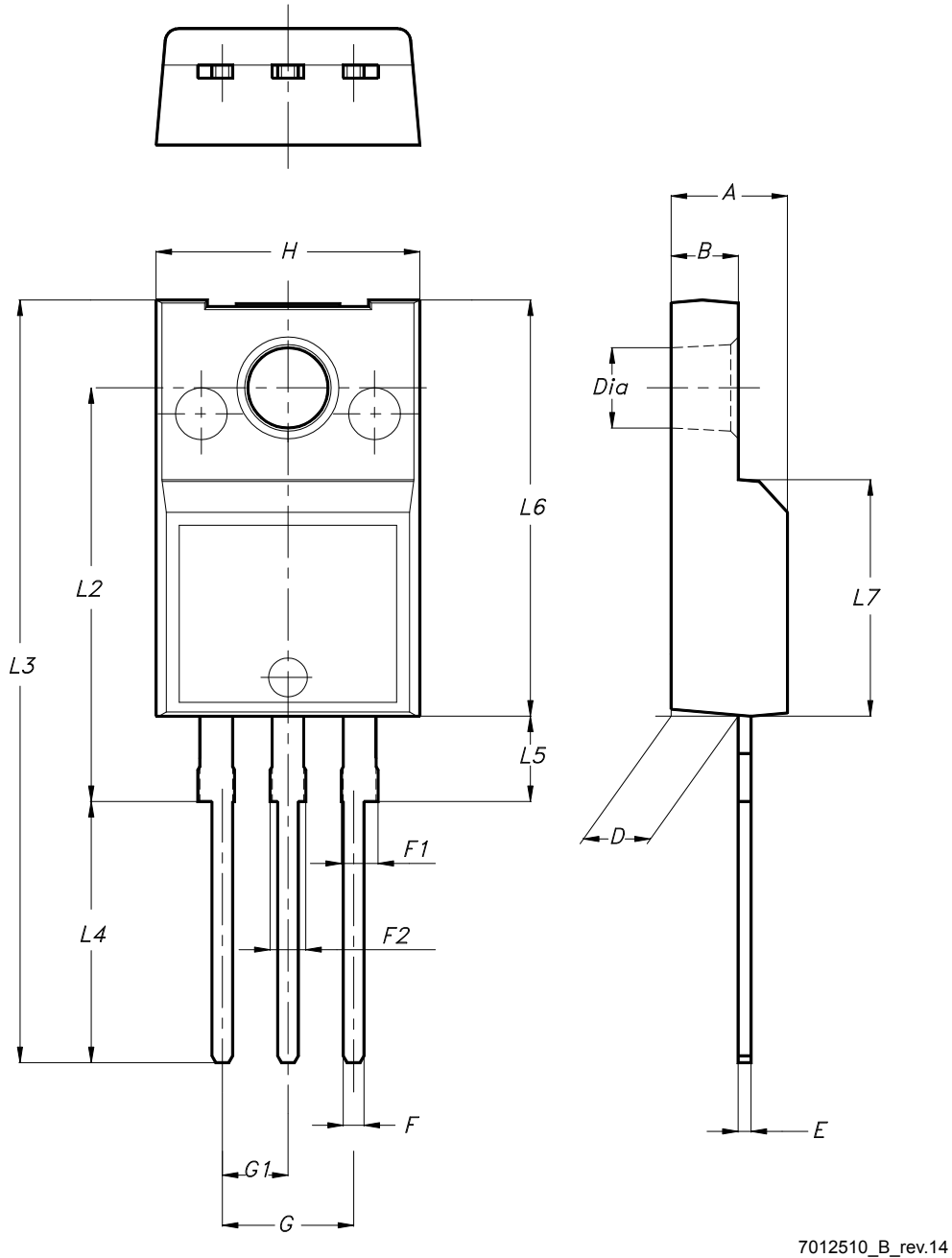
Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50	7.75	8.00
D2	1.10	1.30	1.50
E	10.00		10.40
E1	8.30	8.50	8.70
E2	6.85	7.05	7.25
e		2.54	
e1	4.88		5.28
H	15.00		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R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

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



4.2 TO-220FP type B package information

Figure 25. **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 26. **TO-220 type A package outline**

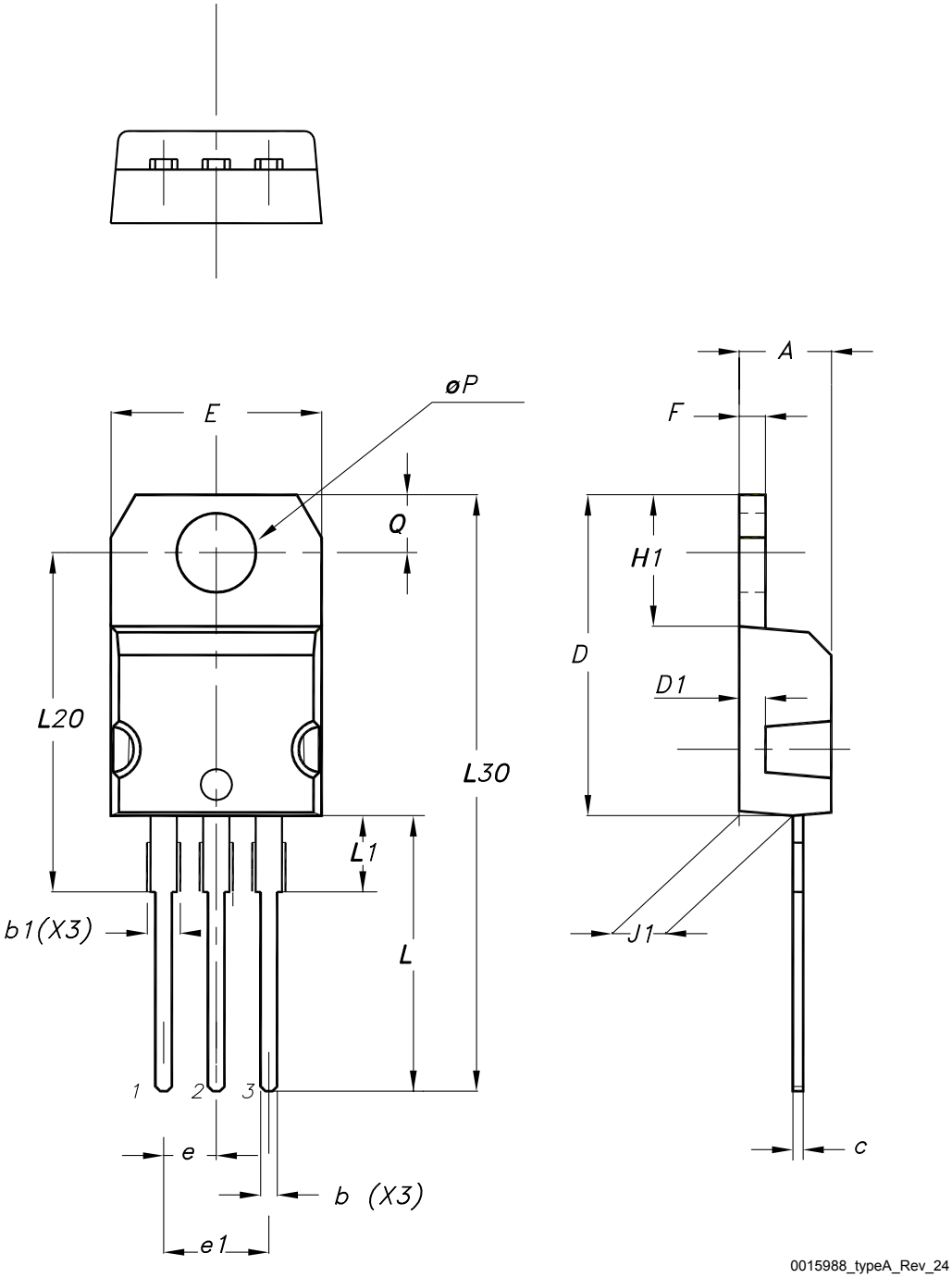
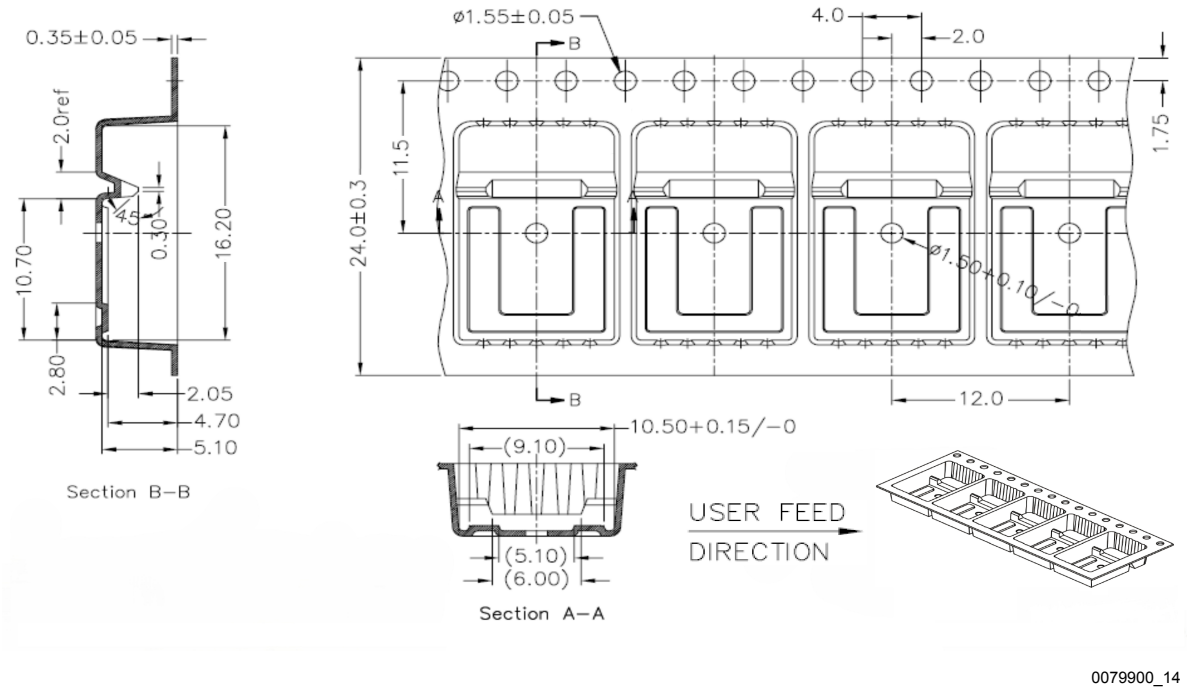


Table 10. **TO-220 type A package mechanical data**

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 27. **D²PAK tape drawing (dimensions are in mm)**



5 Ordering information

Table 11. **Order codes**

Order codes	Marking	Package	Packing
STGB3NC120HDT4	GB3NC120HD	D²PAK	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 *Figure 18: Turn-off SOA*.
03-May-2010	3	Added new package, mechanical data: TO-220.
25-Jan-2011	4	Added new package, mechanical data: D²PAK.
09-Jun-2025	5	Updated Section 4: Package information.

Contents