STGF35HF60W, STGW35HF60W, STGFW35HF60W

35 A, 600 V Ultrafast IGBT

Datasheet — production data

Features

- Improved E_{off} at elevated temperature
- Minimal tail current
- Low conduction losses

Applications

- Welding
- High frequency converters
- Power factor correction

Description

This Ultrafast IGBT is developed using a new planar technology to yield a device with tighter switching energy variation (E_{off}) versus temperature. The suffix "W" denotes a subset of products designed for high switching frequency operation (over 100 kHz).

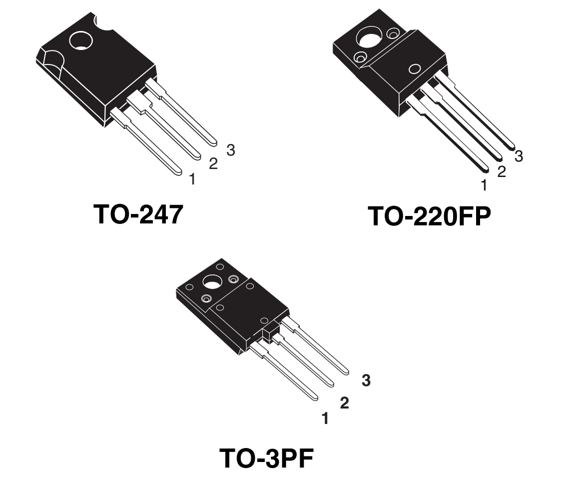


Figure 1. Internal schematic diagram

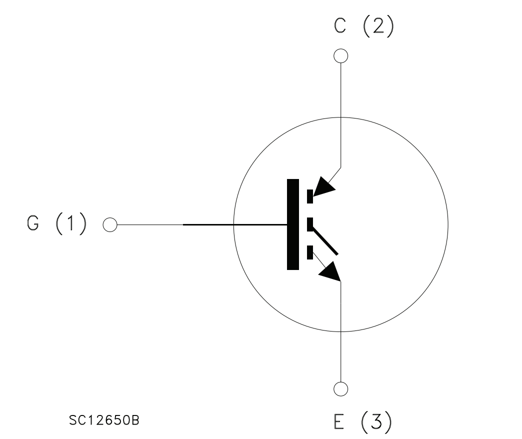


Table 1. Device summary

Order codes	Markings	Packages	Packaging
STGF35HF60W	GF35HF60W	TO-220FP	Tube
STGW35HF60W	GW35HF60W	TO-247	
STGFW35HF60W	GFW35HF60W	TO-3PF	

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		TO-247	TO-220FP	TO-3PF	
V_{CES}	Collector-emitter voltage (V_{GE} = 0)	600			V
I_C	Continuous collector current at T_C = 25 °C	60	19	36	A
I_C	Continuous collector current at T_C = 100 °C	35	12	18	A
I_{CP} (1)	Pulsed collector current	150			A
I_{CL} (2)	Turn-off latching current	80			A
V_{GE}	Gate-emitter voltage	± 20			V
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T_C = 25 °C)		2500		V
P_{TOT}	Total dissipation at T_C = 25 °C	200	40	88	W
T_{stg}	Storage temperature	- 55 to 150			°C
T_j	Operating junction temperature				

1. Pulse width limited by maximum junction temperature and turn-off within RBSOA
2. V_{CLAMP} = 80% (V_{CES}), V_{GE} = 15 V, R_G = 10 Ω, T_J = 150 °C

Table 3. Thermal data

Symbol	Parameter	Value			Unit
		TO-247	TO-220FP	TO-3PF	
$R_{thj\text{-}case}$	Thermal resistance junction-case	0.63	3.1	1.41	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient	50	62.5	50	°C/W

2 Electrical characteristics

(T_J = 25 °C unless otherwise specified)

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage (V_{GE} = 0)	I_C = 1 mA	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C= 20 A		2	2.5	V
		V_{GE} = 15V, I_C = 20 A,T_J= 125 °C		1.65		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 1 mA	3.75		5.75	V
I_{CES}	Collector cut-off current (V_{GE} = 0)	V_{CE} = 600 V V_{CE} = 600 V, T_J = 125 °C			250 1	µA mA
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE} = ±20 V			± 100	nA

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies} C_{oes} C_{res}	Input capacitance Output capacitance Reverse transfer capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0	-	2400 235 50	-	pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	V_{CE} = 400 V, I_C = 20 A, V_{GE} = 15 V, *(see Figure 18)*	-	140 13 52	-	nC nC nC

Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	V_{CC} = 400 V, I_C = 20 A R_G = 10 Ω, V_{GE} = 15 V, *(see Figure 17)*	-	30 15 1650	-	ns ns A/µs
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	V_{CC} = 400 V, I_C = 20 A R_G = 10 Ω, V_{GE} = 15 V, T_J = 125 °C *(see Figure 17)*	-	30 15 1600	-	ns ns A/µs
$t_r(V_{off})$ $t_d(_{off})$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 400 V, I_C = 20 A, R_{GE} = 10 Ω, V_{GE} = 15 V *(see Figure 17)*	-	30 175 40	-	ns ns ns
$t_r(V_{off})$ $t_d(_{off})$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 400 V, I_C = 20 A, R_{GE} = 10 Ω, V_{GE} =15 V, T_J = 125 °C *(see Figure 17)*	-	50 225 70	-	ns ns ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on}(1) E_{off} E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 400 V, I_C = 20 A R_G = 10 Ω, V_{GE} = 15 V, *(see Figure 19)*	-	290 185 475		µJ µJ µJ
E_{on}(1) E_{off} E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 400 V, I_C = 20 A R_G = 10 Ω, V_{GE} = 15 V, T_J = 125 °C *(see Figure 19)*	-	420 350 770	530	µJ µJ µJ

1. Eon is the turn-on losses when a typical diode is used in the test circuit in *Figure 19*. If the IGBT is offered in a package with a co-pak diode, the co-pack diode is used as external diode. IGBTs and diode are at the same temperature (25 °C and 125 °C). Eon includes diode recovery energy.

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

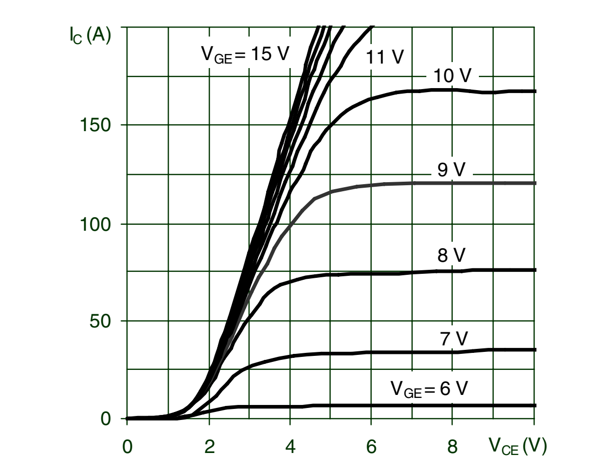


Figure 3. Transfer characteristics

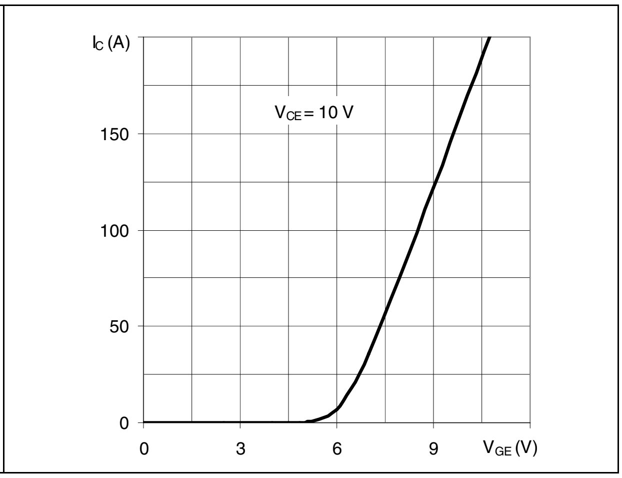


Figure 4. Normalized $V_{CE(sat)}$ vs. I_C

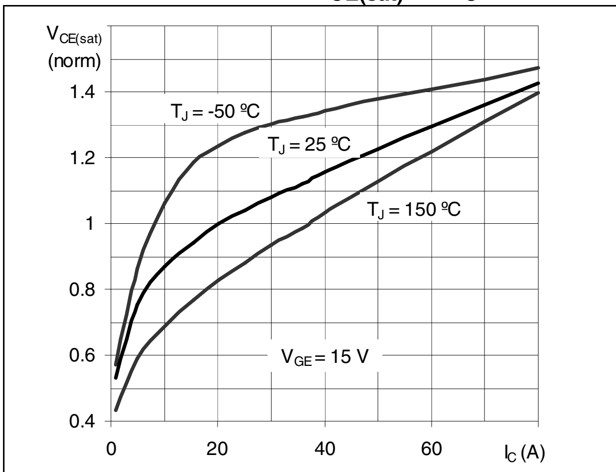


Figure 5. Normalized $V_{CE(sat)}$ vs. temperature

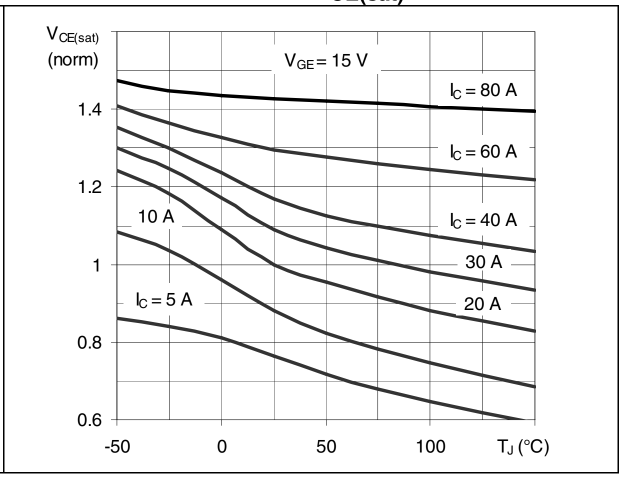


Figure 6. Normalized breakdown voltage vs. temperature

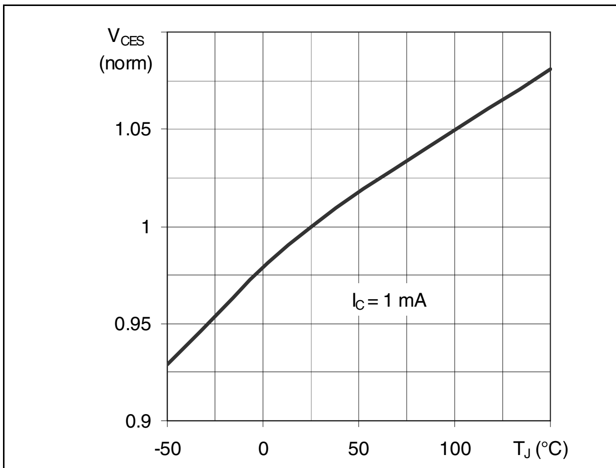


Figure 7. Normalized gate threshold voltage vs. temperature

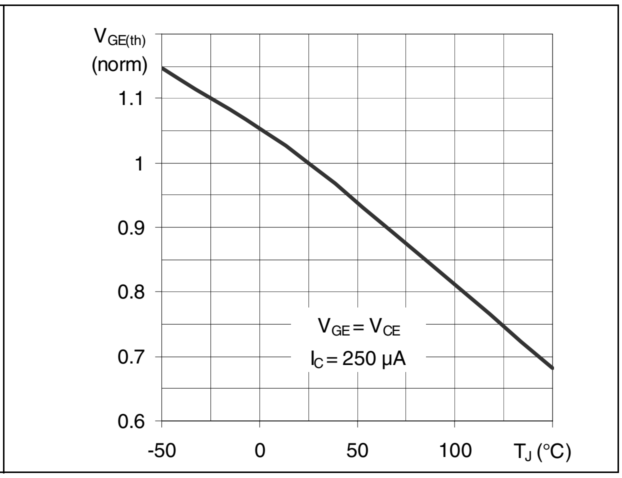


Figure 8. Gate charge vs. gate-emitter voltage

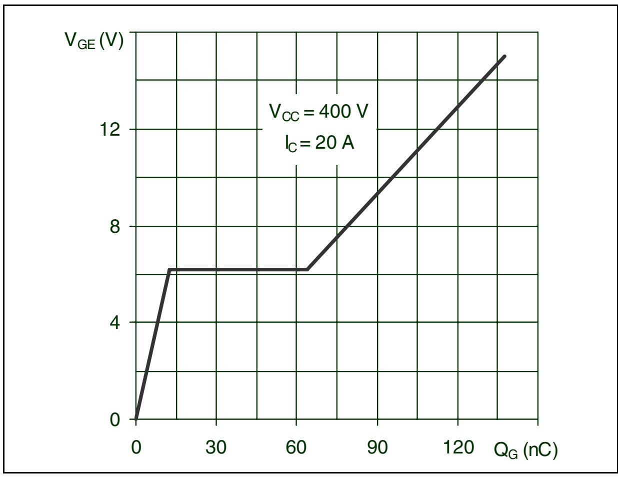


Figure 9. Capacitance variations

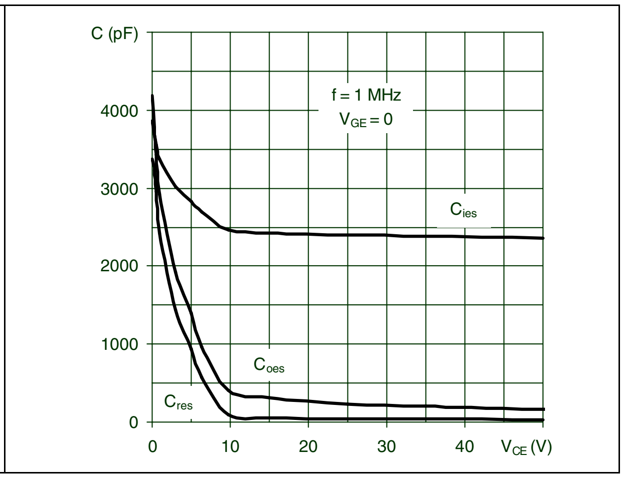


Figure 10. Switching losses vs. temperature

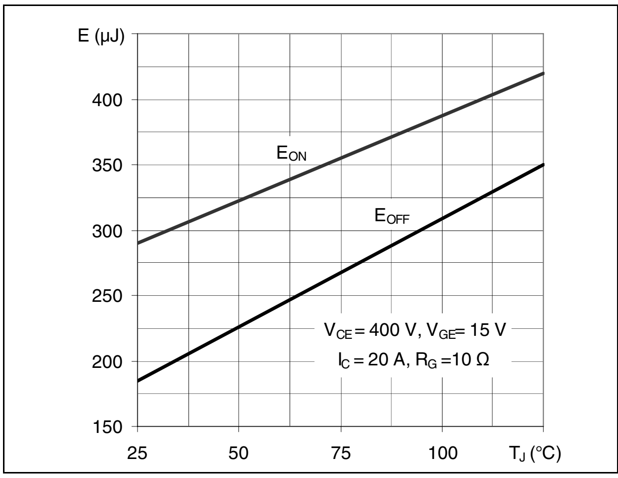


Figure 11. Switching losses vs. gate resistance

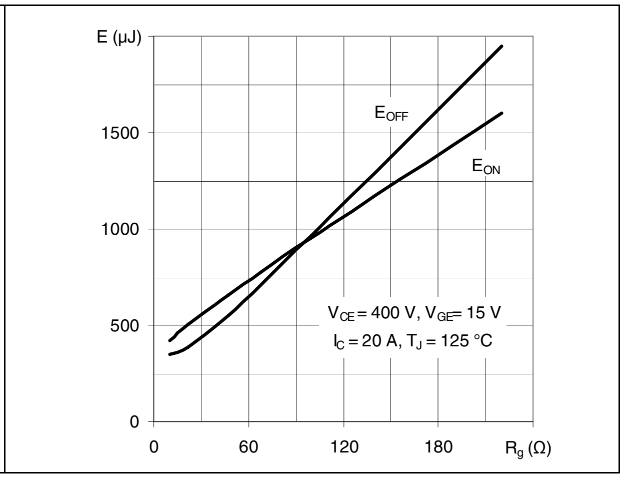


Figure 12. Switching losses vs. collector current

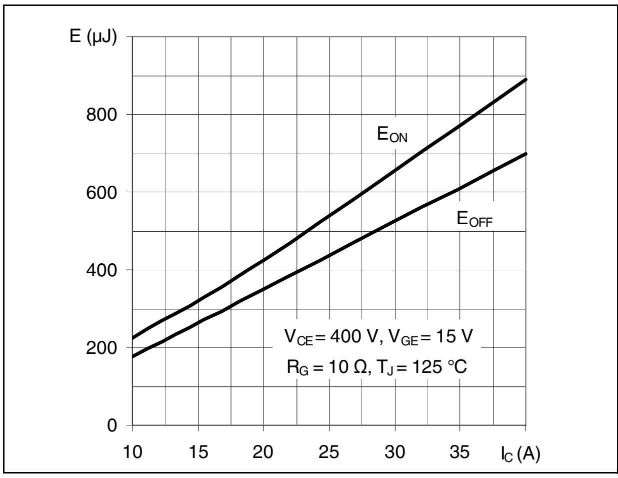


Figure 13. Turn-off SOA

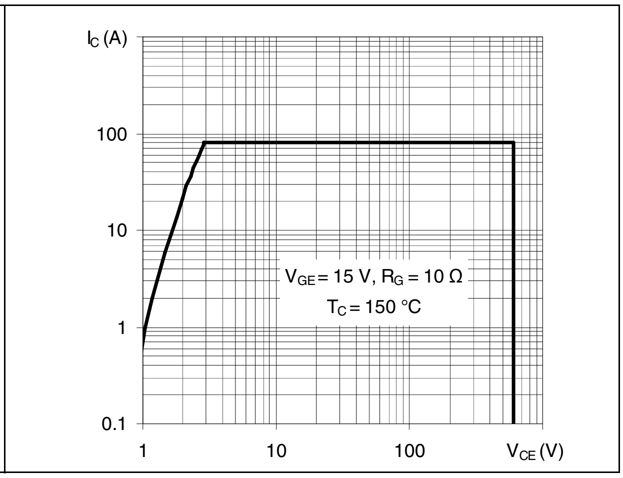


Figure 14. Thermal impedance for TO-247

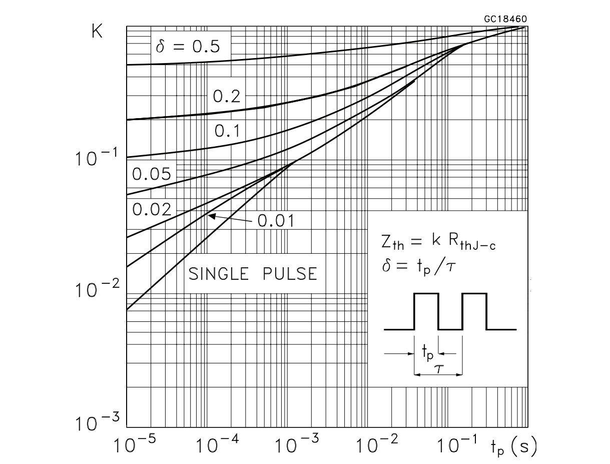


Figure 15. Thermal impedance for TO-220FP

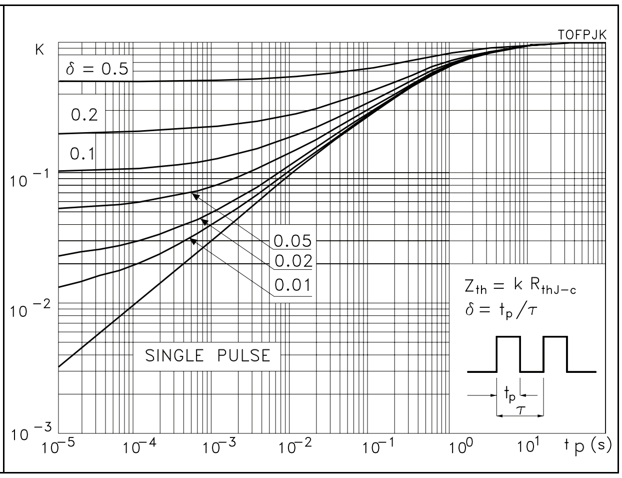
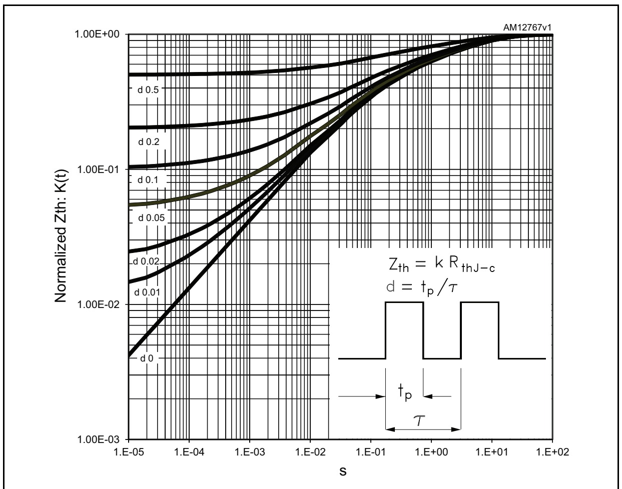


Figure 16. Thermal impedance for TO-3PF



3 Test circuits

Figure 17. Test circuit for inductive load switching

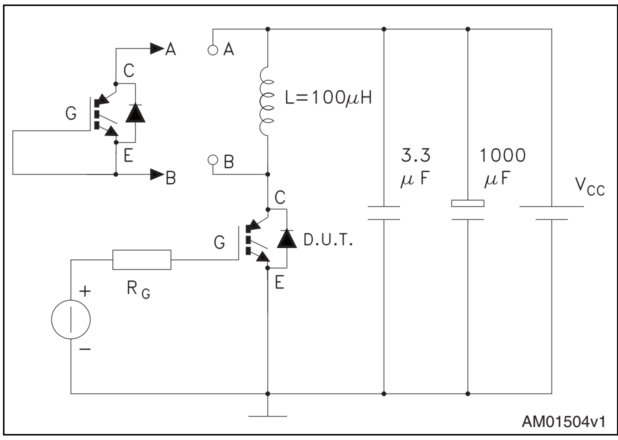


Figure 18. Gate charge test circuit

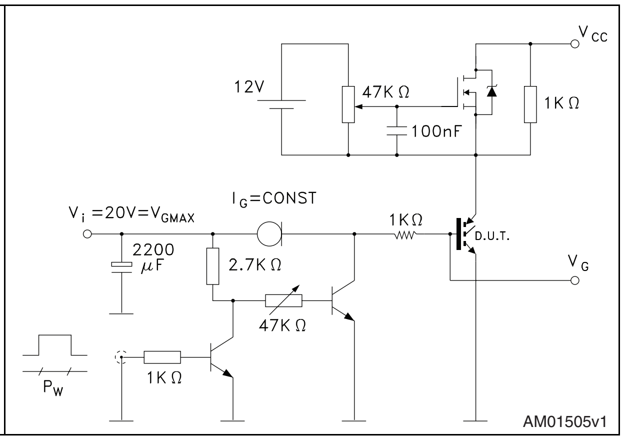
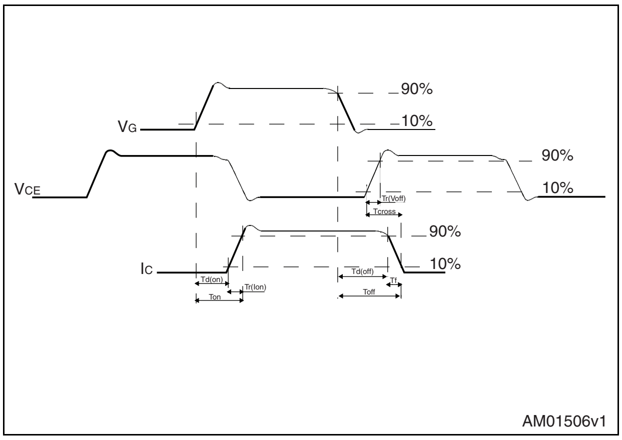


Figure 19. Switching waveform



4 Package mechanical data

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.

Table 8. TO-220FP mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2

Figure 20. TO-220FP drawing

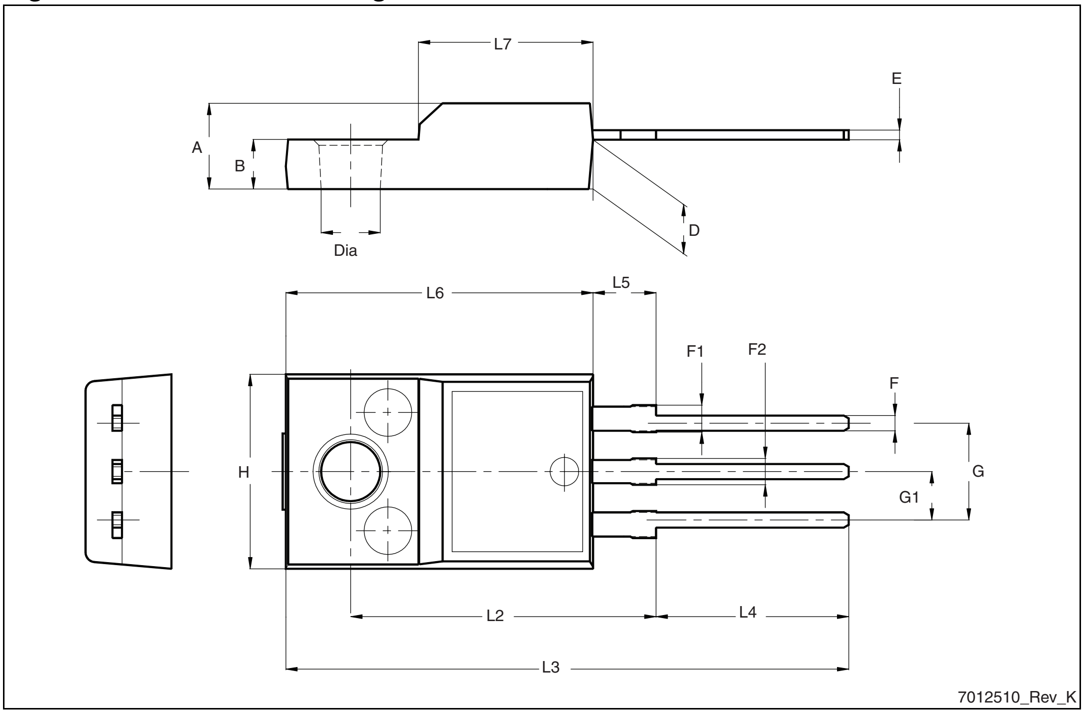


Table 9. TO-247 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e		5.45	
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
∅P	3.55		3.65
∅R	4.50		5.50
S		5.50	

Figure 21. TO-247 drawing

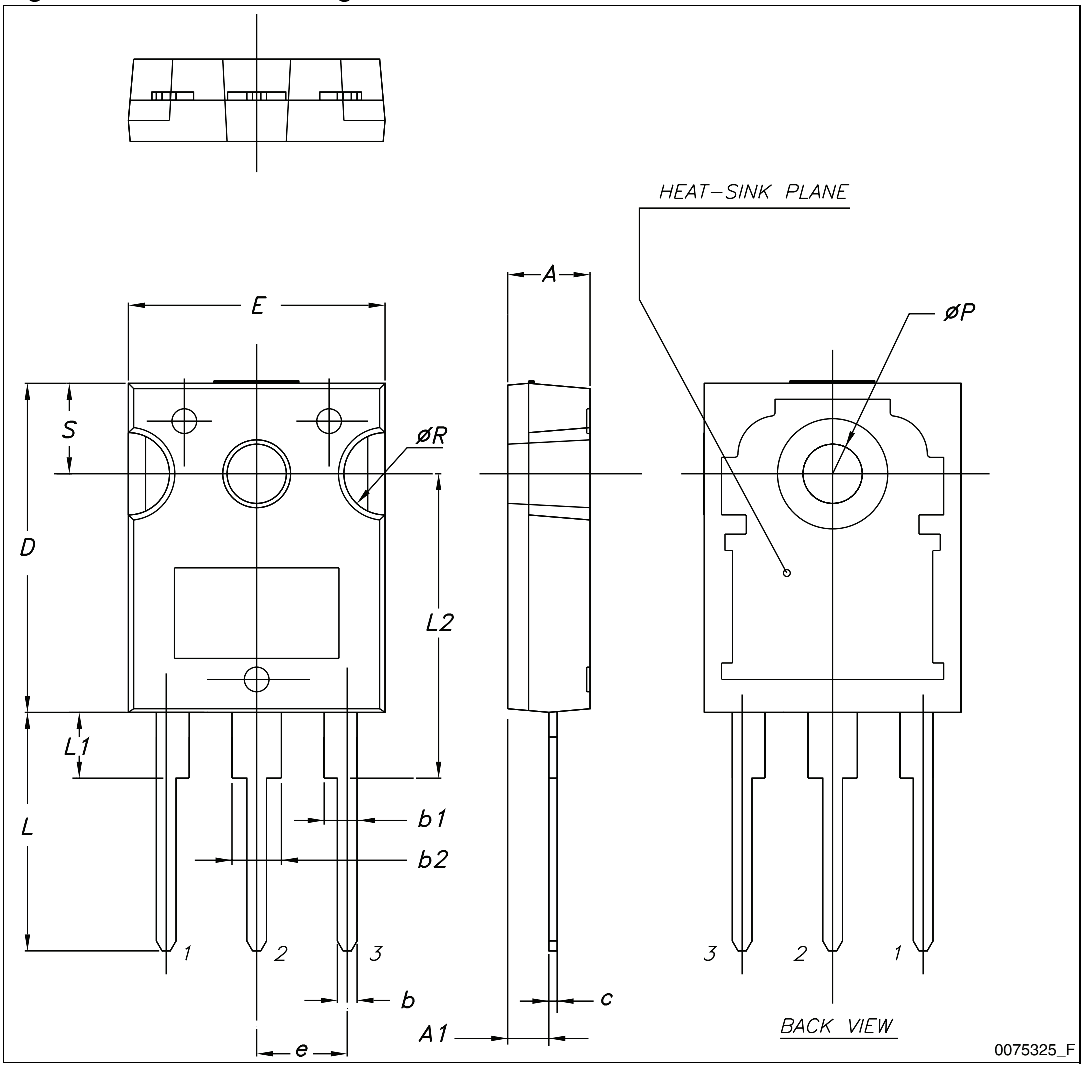
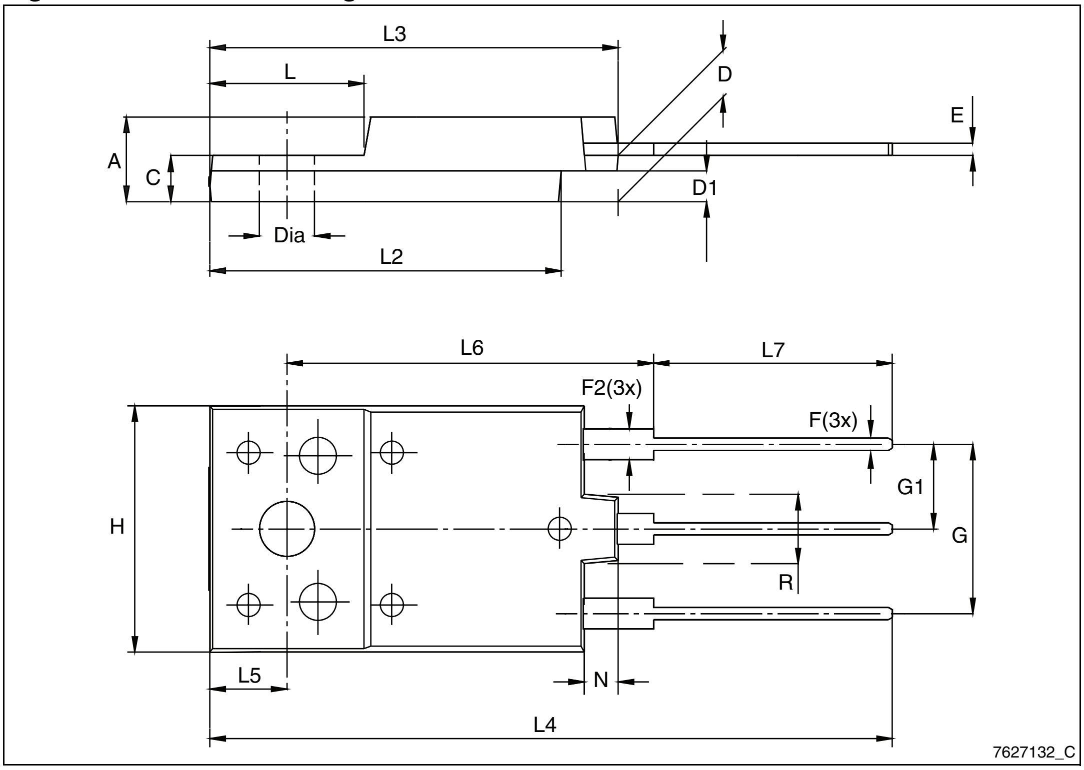


Table 10. TO-3PF mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	5.30		5.70
C	2.80		3.20
D	3.10		3.50
D1	1.80		2.20
E	0.80		1.10
F	0.65		0.95
F2	1.80		2.20
G	10.30		11.50
G1		5.45	
H	15.30		15.70
L	9.80	10	10.20
L2	22.80		23.20
L3	26.30		26.70
L4	43.20		44.40
L5	4.30		4.70
L6	24.30		24.70
L7	14.60		15
N	1.80		2.20
R	3.80		4.20
Dia	3.40		3.80

Figure 22. TO-3PF drawing



5 Revision history

Table 11. Document revision history

Date	Revision	Changes
17-May-2010	1	Initial release.
14-Dec-2010	2	Document status promoted from preliminary data to datasheet. Inserted new order code STGF35HF60W in TO-220FP package.
24-Jul-2012	3	Inserted new order code STGFW35HF60W in TO-3PF package.

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