

### Features

- High frequency operation up to 50 kHz
- Lower  $C_{RES} / C_{IES}$  ratio (no cross-conduction susceptibility)
- High current capability

### Applications

- High frequency inverters
- UPS, motor drivers
- HF, SMPS and PFC in both hard switch and resonant topologies

### Description

This device is a very fast IGBT developed using advanced PowerMESH™ technology. This process guarantees an excellent trade-off between switching performance and low on-state behavior. This device is well-suited for resonant or soft-switching applications.

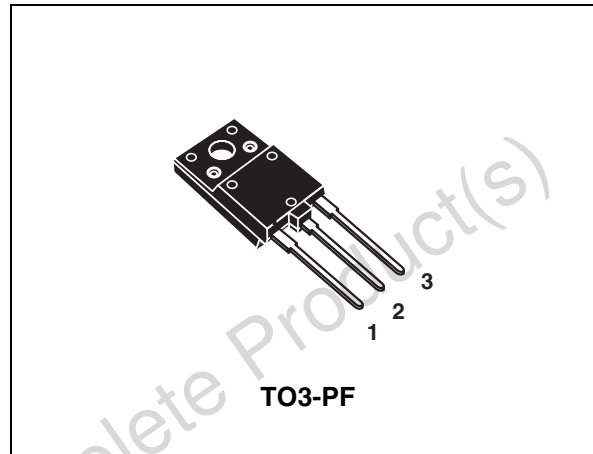


Figure 1. Internal schematic diagram

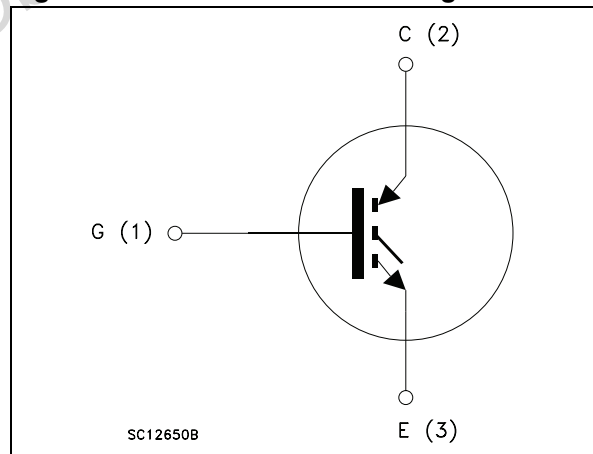


Table 1. Device summary

Order codes	Marking	Package	Packaging
STGFW30NC60V	GFW30NC60V	TO3-PF	Tube

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{GE} = 0$ )	600	V
$I_C$	Collector current (continuous) at 25 °C	36	A
$I_C$	Collector current (continuous) at 100 °C	18	A
$I_{CL}^{(1)}$	Turn-off latching current	100	A
$I_{CP}^{(2)}$	Pulsed collector current	100	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	80	W
$T_J$	Operating junction temperature	– 55 to 150	°C

1.  $V_{clamp} = 80\%(V_{CES})$ ,  $T_J = 150$  °C,  $R_G = 10$  Ω,  $V_{GE} = 15$  V

2. Pulse width limited by max junction temperature allowed

**Table 3. Thermal resistance**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	1.56	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient max	50	°C/W

## 2 Electrical characteristics

$T_{CASE} = 25\text{ °C}$  unless otherwise specified.

**Table 4. Static electrical characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ( $V_{GE} = 0$ )	$I_C = 1\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE}=15\text{ V}, I_C=20\text{ A}$ $V_{GE}=15\text{ V}, I_C=20\text{ A}, T_C=125\text{ °C}$		1.8 1.7	2.5	V V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE}=V_{GE}, I_C=250\text{ }\mu\text{A}$	3.75		5.75	V
$I_{CES}$	Collector-emitter cut-off current ( $V_{GE} = 0$ )	$V_{CE} = 600\text{ V}$ $V_{CE} = 600\text{ V}, T_C=125\text{ °C}$			10 1	$\mu\text{A}$ mA
$I_{GES}$	Gate-emitter cut-off current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\text{ V}$			$\pm 100$	nA
$g_{fs}^{(1)}$	Forward transconductance	$V_{CE} = 15\text{ V}, I_C = 20\text{ A}$		15		S

1. Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

**Table 5. Dynamic electrical characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz},$ $V_{GE}=0$		2200		pF
$C_{oes}$	Output capacitance			225		pF
$C_{res}$	Reverse transfer capacitance			50		pF
$Q_g$	Total gate charge	$V_{CE} = 390\text{ V}, I_C = 20\text{ A},$		100		nC
$Q_{ge}$	Gate-emitter charge	$V_{GE} = 15\text{ V},$		16		nC
$Q_{gc}$	Gate-collector charge	(see Figure 17)		45		nC

**Table 6. Switching on/off (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390\text{ V}, I_C = 20\text{ A}$		31		ns
$t_r$	Current rise time	$R_G = 3.3\ \Omega, V_{GE} = 15\text{ V},$ (see Figure 16)		11		ns
$(di/dt)_{on}$	Turn-on current slope			1600		A/ $\mu$ s
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390\text{ V}, I_C = 20\text{ A}$		31		ns
$t_r$	Current rise time	$R_G = 3.3\ \Omega, V_{GE} = 15\text{ V},$ $T_C = 125\text{ }^\circ\text{C}$ (see Figure 16)		11.5		ns
$(di/dt)_{on}$	Turn-on current slope			1500		A/ $\mu$ s
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 390\text{ V}, I_C = 20\text{ A},$ $R_G = 3.3\ \Omega, V_{GE} = 15\text{ V}$ (see Figure 18)		28		ns
$t_{d(off)}$	Turn-off delay time			100		ns
$t_f$	Current fall time			75		ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 390\text{ V}, I_C = 20\text{ A},$ $R_G = 3.3\ \Omega, V_{GE} = 15\text{ V},$ $T_C = 125\text{ }^\circ\text{C}$ (see Figure 18)		66		ns
$t_{d(off)}$	Turn-off delay time			150		ns
$t_f$	Current fall time			130		ns

**Table 7. Switching energy (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}$	Turn-on switching losses	$V_{CC} = 390\text{ V}, I_C = 20\text{ A}$		220		$\mu$ J
$E_{off}^{(1)}$	Turn-off switching losses	$R_G = 3.3\ \Omega, V_{GE} = 15\text{ V},$ (see Figure 18)		330		$\mu$ J
$E_{ts}$	Total switching losses			550		$\mu$ J
$E_{on}$	Turn-on switching losses	$V_{CC} = 390\text{ V}, I_C = 20\text{ A}$		450		$\mu$ J
$E_{off}^{(1)}$	Turn-off switching losses	$R_G = 3.3\ \Omega, V_{GE} = 15\text{ V},$ $T_C = 125\text{ }^\circ\text{C}$ (see Figure 18)		770		$\mu$ J
$E_{ts}$	Total switching losses			1220		$\mu$ J

1. Turn-off losses include also the tail of the collector current

## 2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

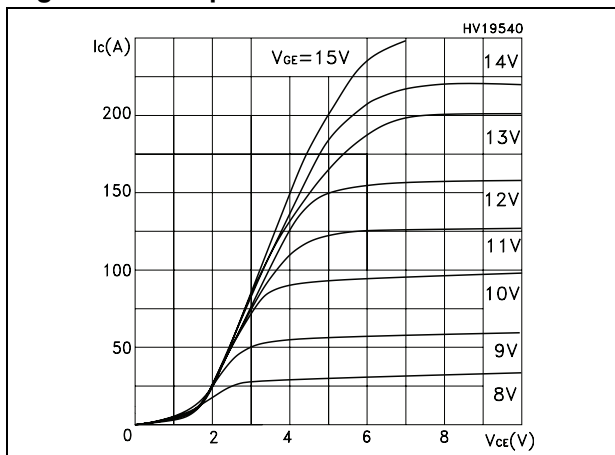


Figure 3. Transfer characteristics

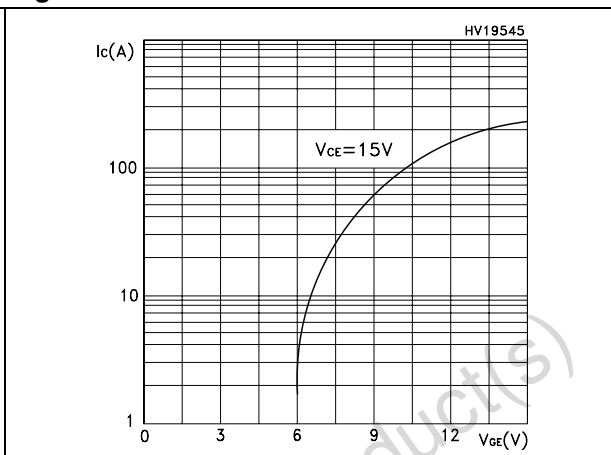


Figure 4. Transconductance

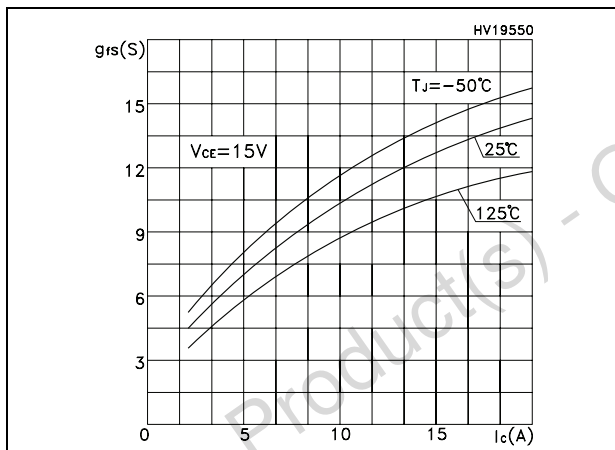


Figure 5. Collector-emitter on voltage vs temperature

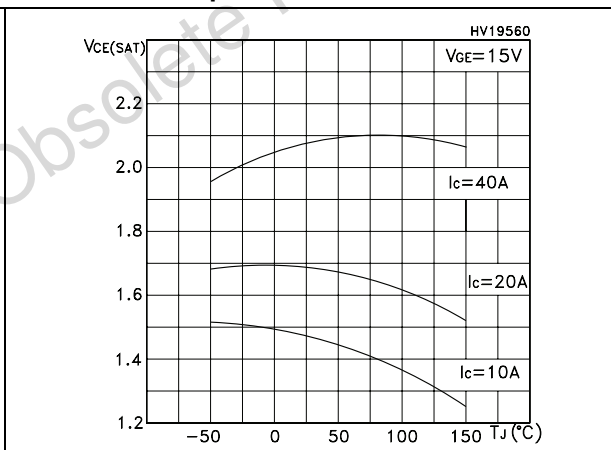


Figure 6. Gate charge vs. gate-source voltage

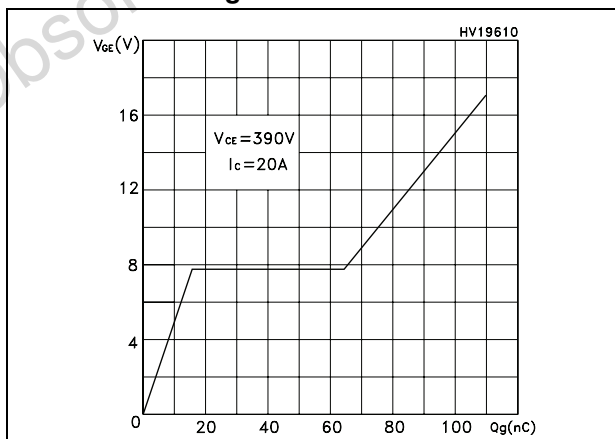


Figure 7. Capacitance variations

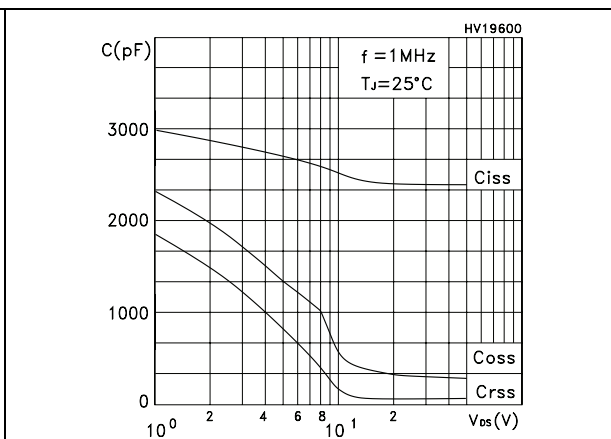


Figure 8. Normalized gate threshold voltage vs. temperature

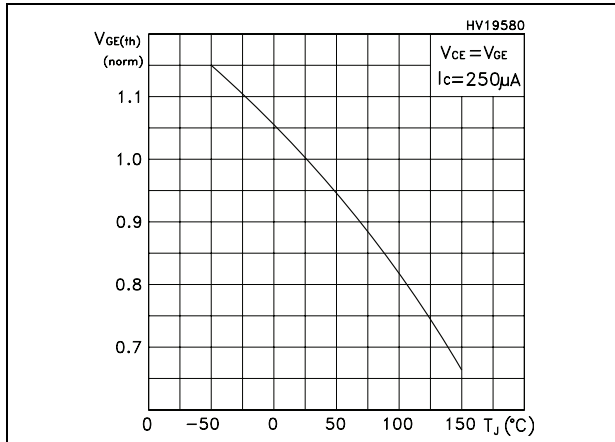


Figure 9. Collector-emitter on voltage vs. collector current

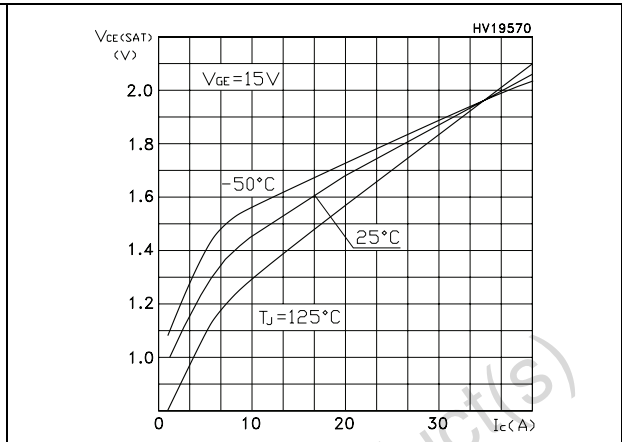


Figure 10. Normalized breakdown voltage vs. temperature

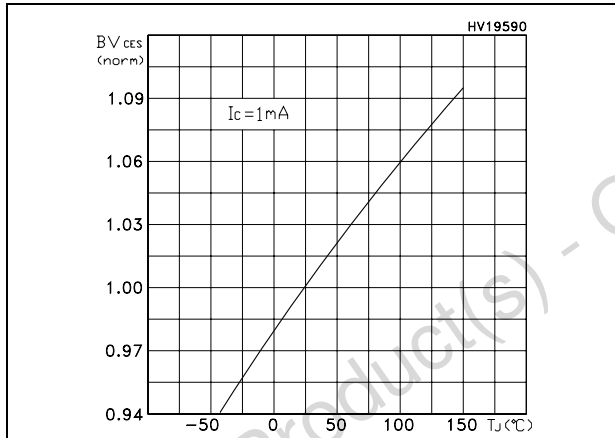


Figure 11. Switching losses vs. temperature

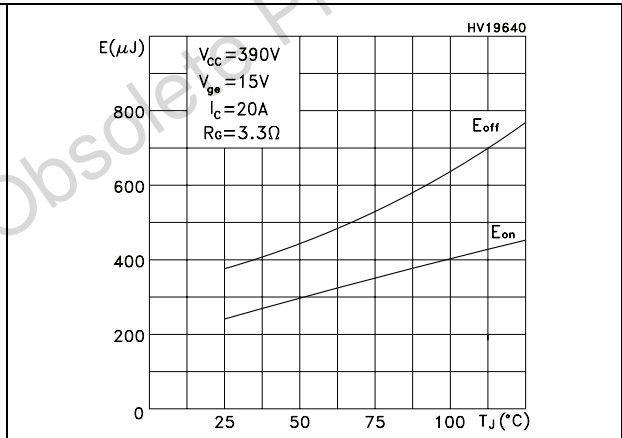


Figure 12. Switching losses vs. gate resistance

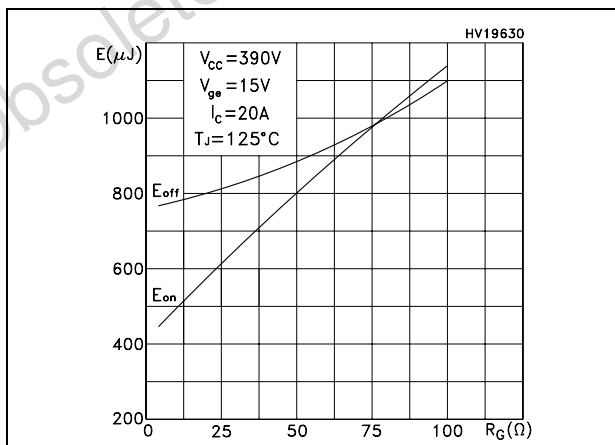


Figure 13. Switching losses vs. collector current

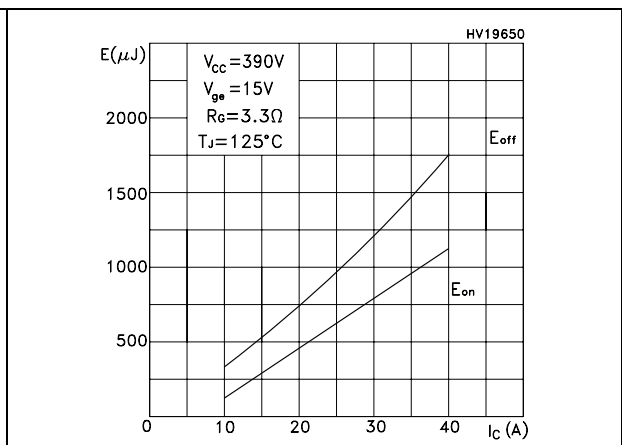


Figure 14. Thermal impedance

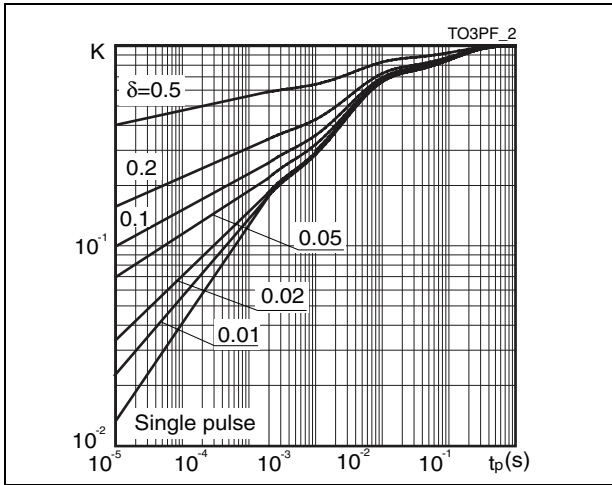
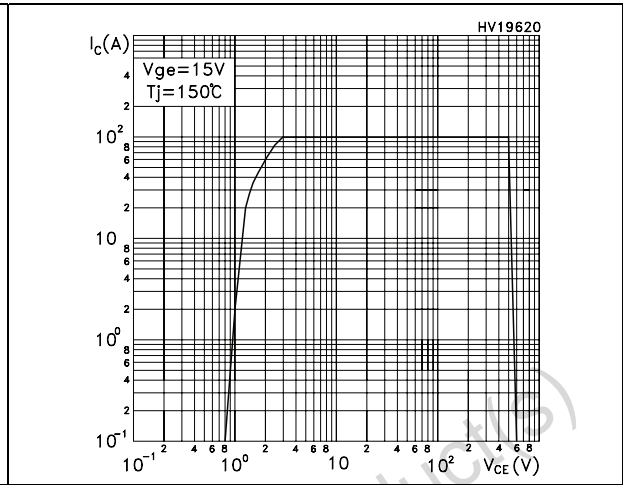


Figure 15. Turn-off SOA



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### 3 Test circuit

Figure 16. Test circuit for inductive load switching

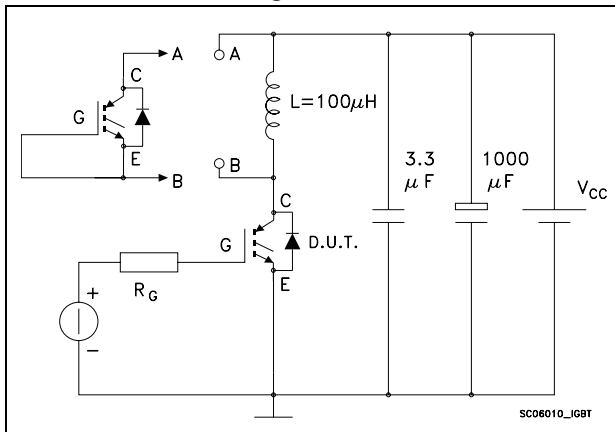


Figure 17. Gate charge test circuit

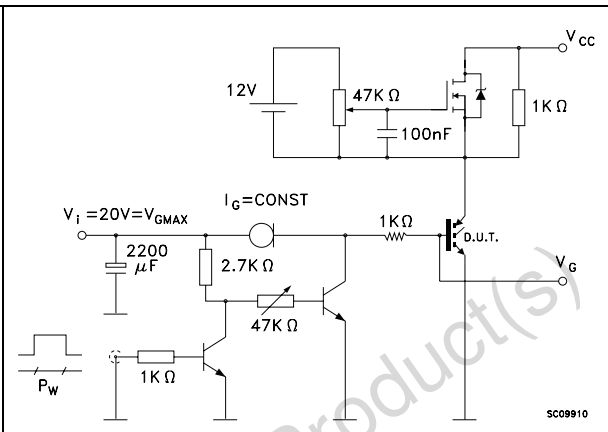
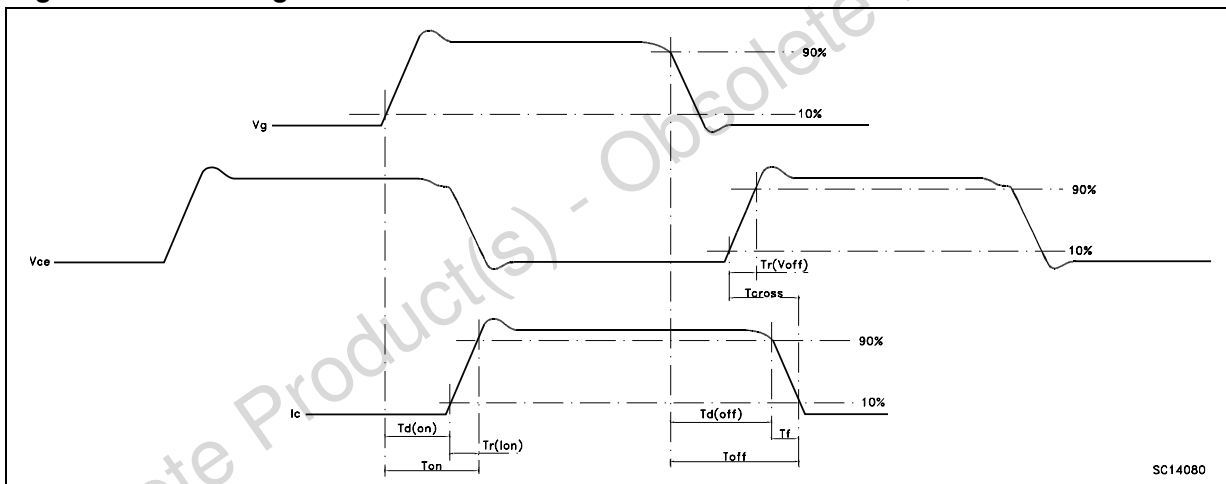


Figure 18. Switching waveform



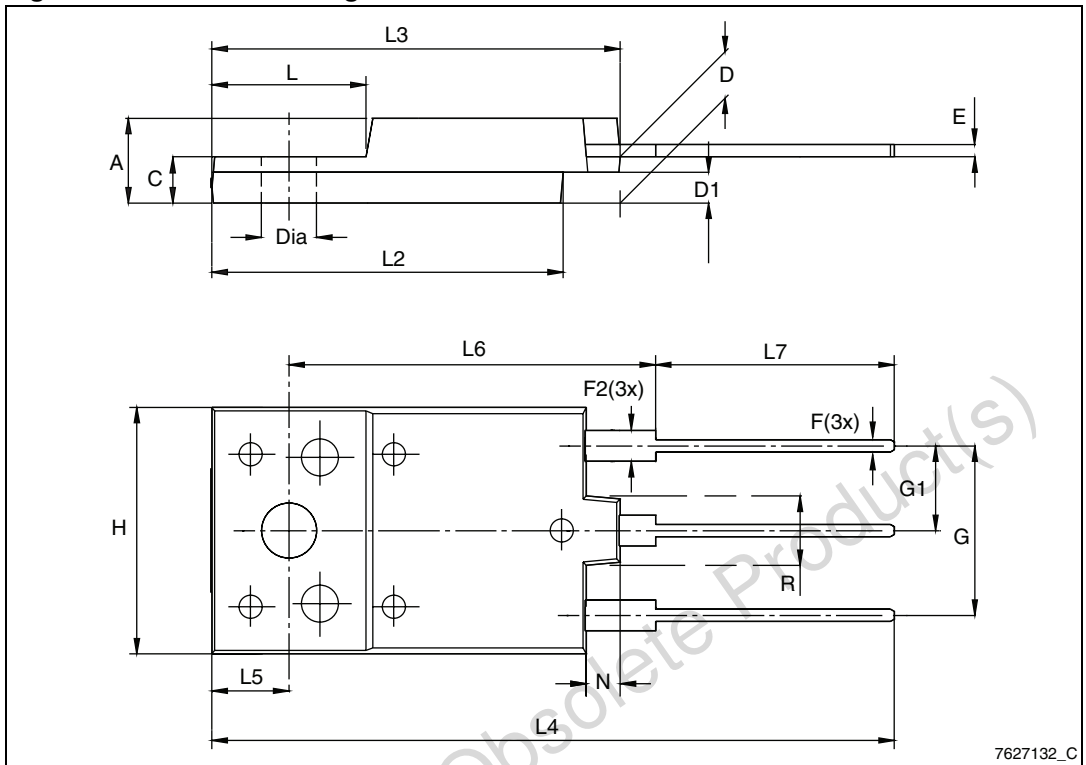
## 4 Package mechanical data

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](http://www.st.com). ECOPACK® is an ST trademark.

**Table 8. 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 19. TO-3PF drawing



## 5 Revision history

Table 9. Document revision history

Date	Revision	Changes
16-Apr-2012	1	Initial release.

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