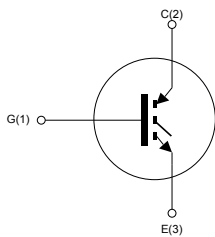

**TO-3PF**


SC12650



### Features

- Optimized performance for medium operating frequencies up to 5 kHz in hard switching
- Low on-voltage drop ( $V_{CE(sat)}$ )
- High current capability

### Applications

- Motor drive

### Description

This device utilizes the advanced PowerMESH process resulting in an excellent trade-off between switching performance and low on-state behavior.

#### Product status link

[STGWF30NC60S](#)

#### Product summary

<b>Order code</b>	STGWF30NC60S
<b>Marking</b>	G30NC60S
<b>Package</b>	TO-3PF
<b>Packing</b>	Tube

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
V <sub>CES</sub>	Collector-emitter voltage (V <sub>GE</sub> = 0 V)	600	V
I <sub>C</sub> <sup>(1)</sup>	Continuous collector current at T <sub>C</sub> = 25 °C	35	A
	Continuous collector current at T <sub>C</sub> = 100 °C	18	
I <sub>CL</sub> <sup>(2)</sup>	Turn-off latching current	150	A
I <sub>CP</sub> <sup>(3)</sup>	Pulsed collector current	150	A
V <sub>GE</sub>	Gate-emitter voltage	±20	V
V <sub>ISO</sub>	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s, T <sub>C</sub> = 25 °C)	2.5	kV
P <sub>TOT</sub>	Total power dissipation at T <sub>C</sub> = 25 °C	79	W
T <sub>J</sub>	Operating junction temperature range	- 55 to 150	°C

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

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
R <sub>thJC</sub>	Thermal resistance junction-case	1.58	°C/W
R <sub>thJA</sub>	Thermal resistance junction-ambient	50	°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	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 20\text{ A}$		1.5	1.9	V
		$V_{GE} = 15\text{ V}, I_C = 20\text{ A}, T_J = 150\text{ °C}$		1.4		
$V_{GE(th)}$	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	$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}$			150	$\mu\text{A}$
		$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}, T_J = 150\text{ °C}$			1	mA
$I_{GES}$	Gate-emitter leakage current	$V_{CE} = 0\text{ V}, V_{GE} = \pm 20\text{ V}$			$\pm 100$	nA
$g_{fs}^{(1)}$	Forward transconductance	$V_{CE} = 15\text{ V}, I_C = 20\text{ A}$		10		S

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

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0\text{ V}$	-	2200	-	pF
$C_{oes}$	Output capacitance		-	185	-	
$C_{res}$	Reverse transfer capacitance		-	48.5	-	
$Q_g$	Total gate charge	$V_{CC} = 480\text{ V}, I_C = 20\text{ A}, V_{GE} = 15\text{ V}$ (see Figure 16. Gate charge test circuit)	-	96	-	nC
$Q_{ge}$	Gate-emitter charge		-	14	-	
$Q_{gc}$	Gate-collector charge		-	44.5	-	

**Table 5. Switching on/off (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 480\text{ V}$ , $I_C = 20\text{ A}$ ,	-	21.5	-	ns
$t_r$	Current rise time	$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$	-	8.5	-	ns
$(di/dt)_{on}$	Turn-on current slope	(see Figure 15. Test circuit for inductive load switching)	-	2280	-	A/ $\mu$ s
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 480\text{ V}$ , $I_C = 20\text{ A}$ ,	-	20.5	-	ns
$t_r$	Current rise time	$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$	-	9.5	-	ns
$(di/dt)_{on}$	Turn-on current slope	(see Figure 15. Test circuit for inductive load switching)	-	2150	-	A/ $\mu$ s
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 480\text{ V}$ , $I_C = 20\text{ A}$ ,	-	85	-	ns
$t_{d(off)}$	Turn-off delay time	$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$	-	180	-	ns
$t_f$	Current fall time	(see Figure 15. Test circuit for inductive load switching)	-	200	-	ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 480\text{ V}$ , $I_C = 20\text{ A}$ ,	-	155	-	ns
$t_{d(off)}$	Turn-off delay time	$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$	-	260	-	ns
$t_f$	Current fall time	(see Figure 15. Test circuit for inductive load switching)	-	295	-	ns

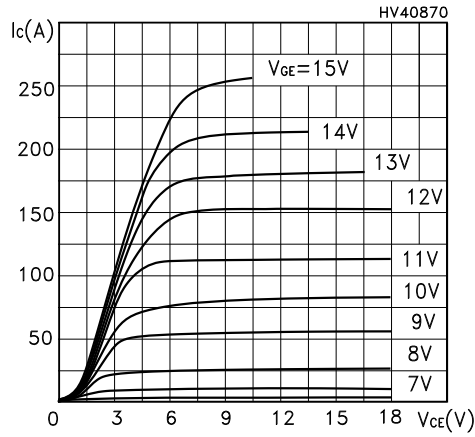
**Table 6. Switching energy (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}$	Turn-on switching energy	$V_{CE} = 480\text{ V}$ , $I_C = 20\text{ A}$ ,	-	300	-	$\mu$ J
$E_{off}$	Turn-off switching energy	$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$	-	1275	-	$\mu$ J
$E_{ts}$	Total switching energy	(see Figure 15. Test circuit for inductive load switching)	-	1575	-	$\mu$ J
$E_{on}$	Turn-on switching energy	$V_{CE} = 480\text{ V}$ , $I_C = 20\text{ A}$ ,	-	430	-	$\mu$ J
$E_{off}$	Turn-off switching energy	$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$	-	1965	-	$\mu$ J
$E_{ts}$	Total switching energy	(see Figure 15. Test circuit for inductive load switching)	-	2395	-	$\mu$ J

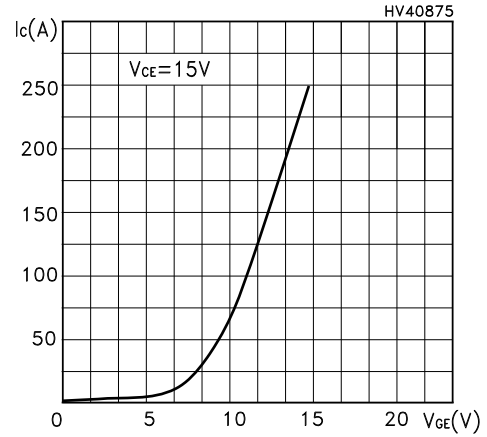
1. Turn-off losses include also the tail of the collector current.

## 2.1 Electrical characteristics (curves)

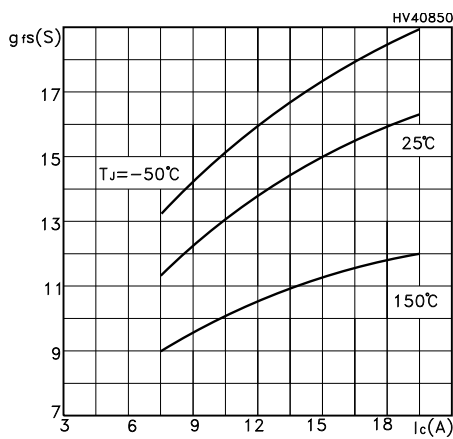
**Figure 1. Output characteristics**



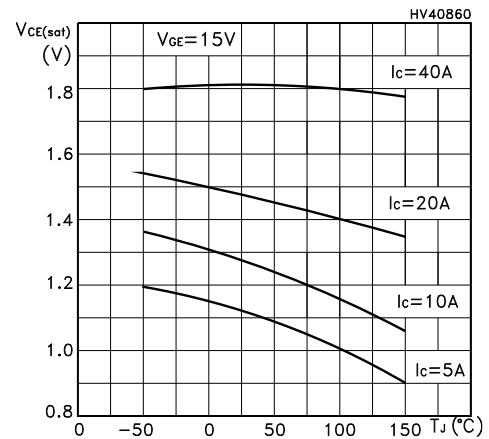
**Figure 2. Transfer characteristics**



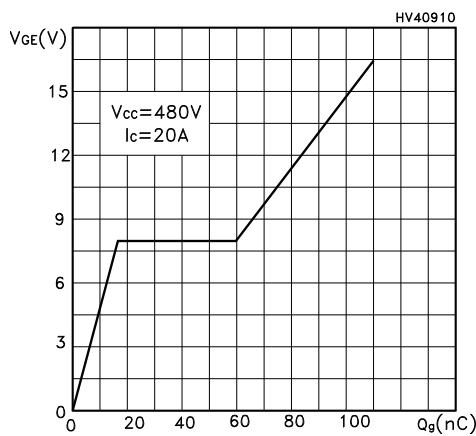
**Figure 3. Transconductance**



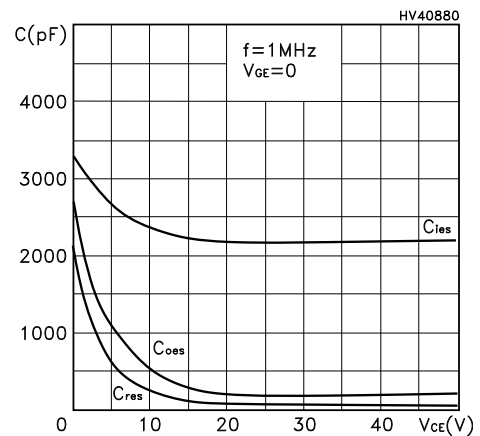
**Figure 4. Collector-emitter on voltage vs temperature**



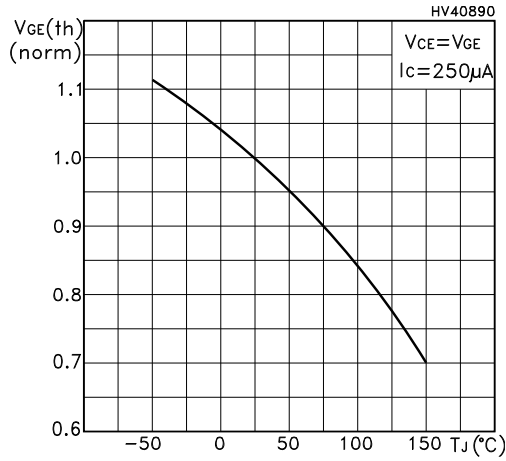
**Figure 5. Gate charge vs gate-source voltage**



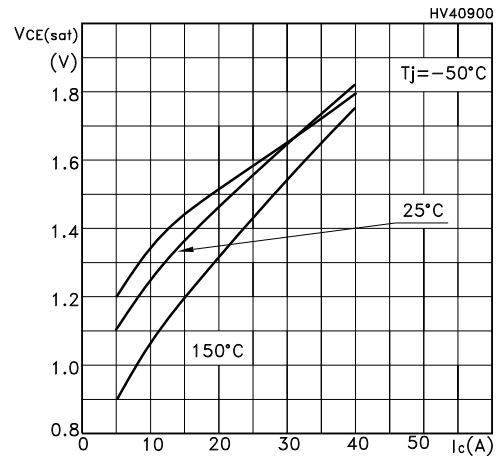
**Figure 6. Capacitance variations**



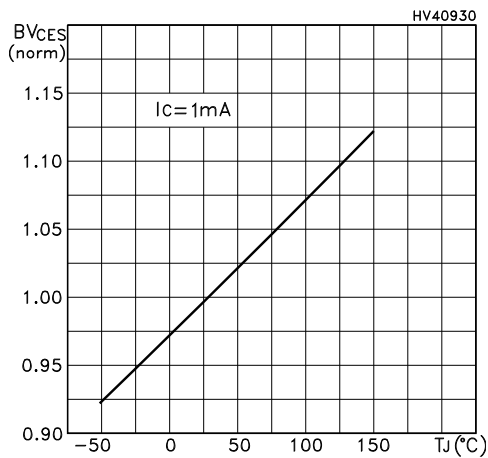
**Figure 7. Normalized gate threshold voltage vs temperature**



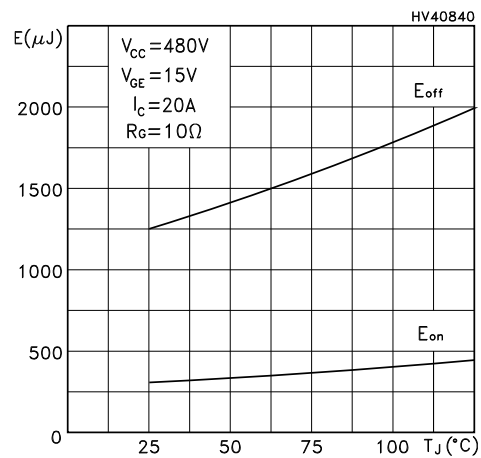
**Figure 8. Collector-emitter on voltage vs collector current**



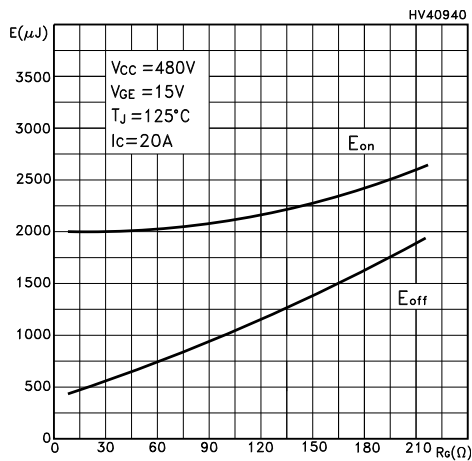
**Figure 9. Normalized breakdown voltage vs temperature**



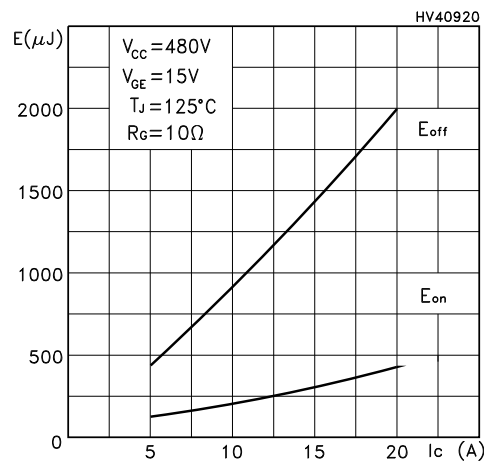
**Figure 10. Switching losses vs temperature**



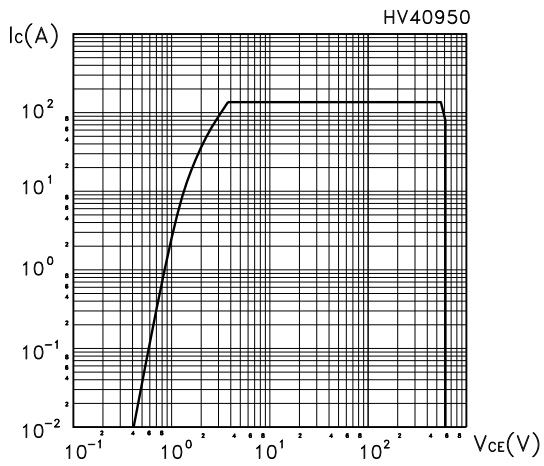
**Figure 11. Switching losses vs gate resistance**



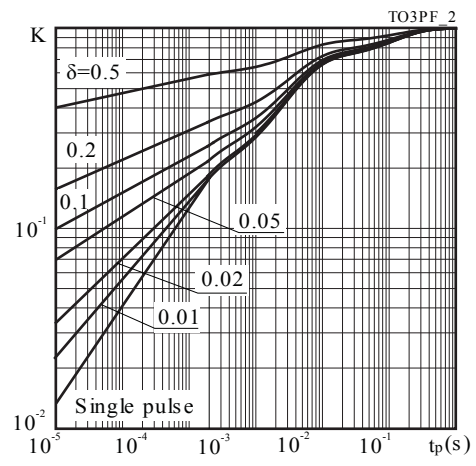
**Figure 12. Switching losses vs collector current**



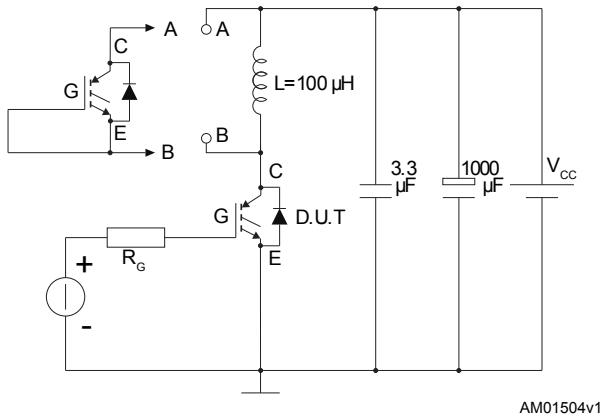
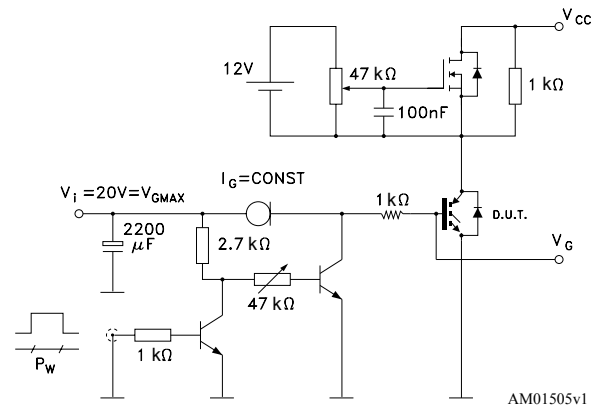
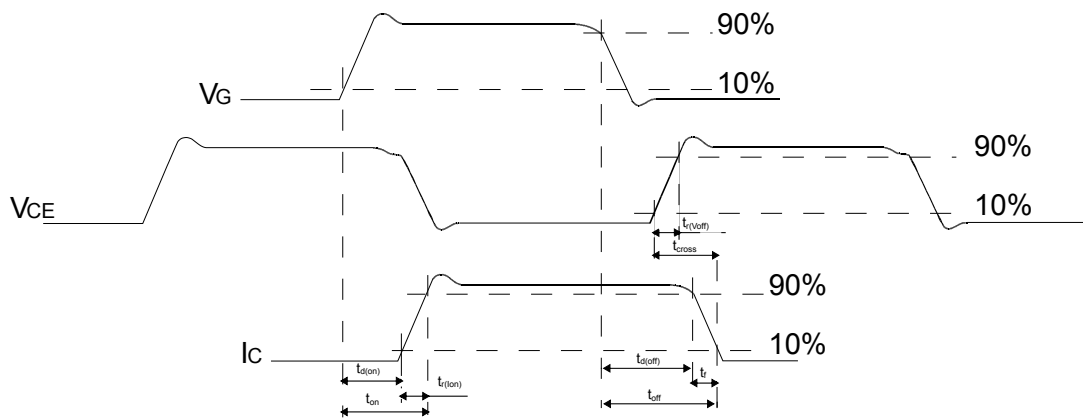
**Figure 13. Turn-off SOA**



**Figure 14. Thermal Impedance**



### 3 Test circuits

**Figure 15. Test circuit for inductive load switching**

**Figure 16. Gate charge test circuit**

**Figure 17. Switching waveform**


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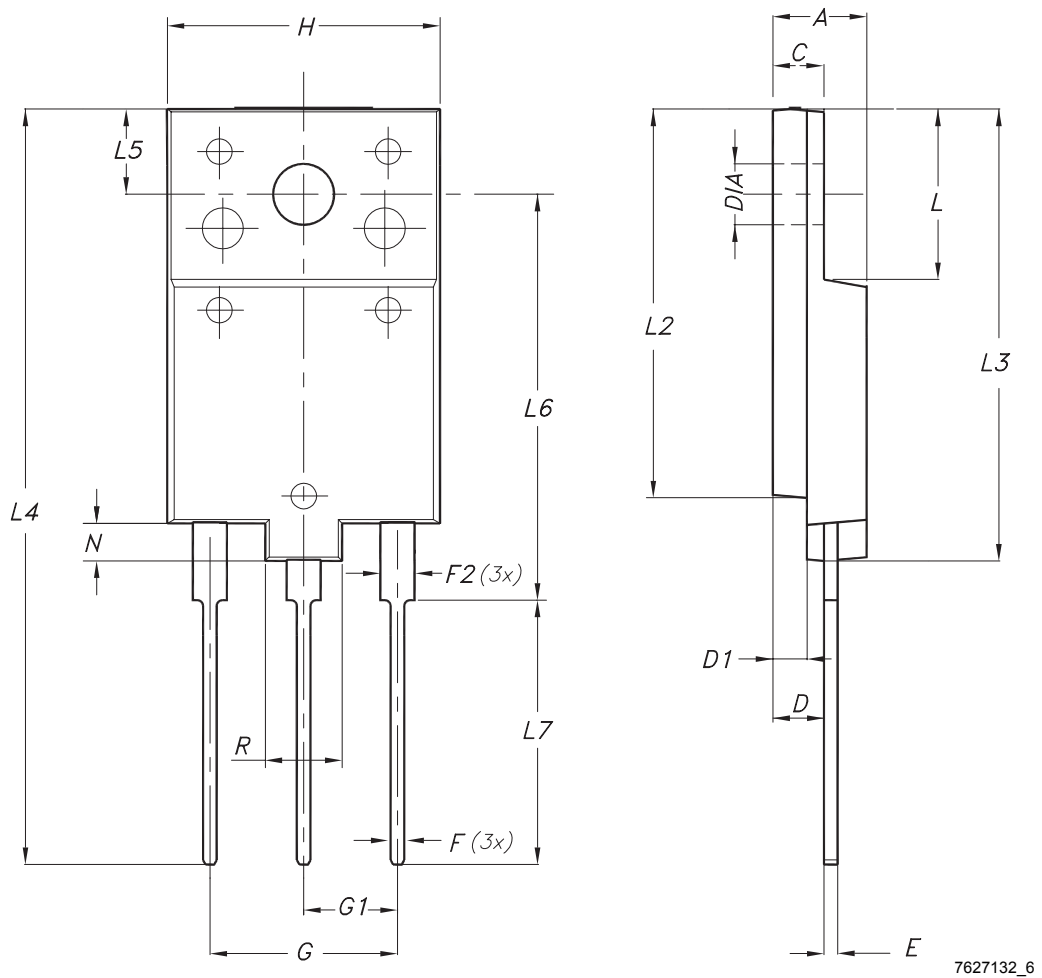


## 4 Package information

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.

### 4.1 TO-3PF package information

Figure 18. TO-3PF package outline



**Table 7. 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	10.00	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		15.00
N	1.80		2.20
R	3.80		4.20
Dia	3.40		3.80

## Revision history

**Table 8. Document revision history**

Date	Revision	Changes
02-Jul-2007	1	Initial release
20-Nov-2007	2	Document status promoted from preliminary data to datasheet
04-May-2009	3	Added new package, mechanical data: TO-220FP
30-Jun-2010	4	Added new package, mechanical data: TO-3PF
11-Nov-2010	5	<ul style="list-style-type: none"> <li>– Updated data for TO-3PF in <i>Table 2</i> and <i>Table 3</i></li> <li>– Modified <i>Figure 17</i></li> </ul>
04-May-2020	6	<p>The part numbers STGF30NC60S and STGP30NC60S have been moved to a separate datasheet and the document has been updated accordingly.</p> <p>Updated <a href="#">Device summary</a>.</p>

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