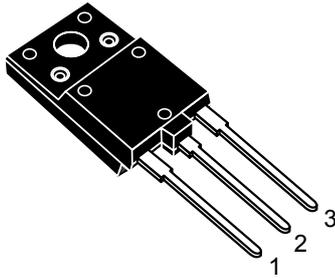
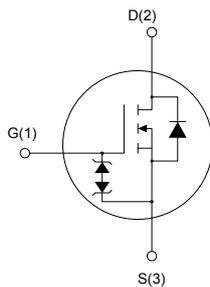


## N-channel 1200 V, 1.65 $\Omega$ typ., 6 A, MDmesh K5 Power MOSFET in a TO-3PF package


**TO-3PF**


AM01476v1\_No\_tab

### Features

Order code	$V_{DS}$	$R_{DS(on)}$ max.	$I_D$	$P_{TOT}$
STFW8N120K5	1200 V	2.00 $\Omega$	6 A	48 W

- Industry's lowest  $R_{DS(on)}$  x area
- Industry's best FoM (figure of merit)
- Ultra-low gate charge
- 100% avalanche tested
- Zener-protected

### Applications

- Switching applications

### Description

This very high voltage N-channel Power MOSFET is designed using MDmesh™ K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.

#### Product status link

[STFW8N120K5](#)

#### Product summary

<b>Order code</b>	STFW8N120K5
<b>Marking</b>	8N120K5
<b>Package</b>	TO-3PF
<b>Packing</b>	Tube

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{GS}$	Gate-source voltage	$\pm 30$	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	6	A
	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	3.5	A
$I_{DM}^{(1)}$	Drain current pulsed	12	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	48	W
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t = 1\text{ s}$ , $T_C = 25\text{ }^\circ\text{C}$ )	3.5	kV
$dv/dt^{(2)}$	Peak diode recovery voltage slope	4.5	V/ns
$dv/dt^{(3)}$	MOSFET $dv/dt$ ruggedness	50	
$T_j$	Operating junction temperature range	-55 to 150	$^\circ\text{C}$
$T_{stg}$	Storage temperature range		

1. Pulse width limited by safe operating area
2.  $I_{SD} \leq 6\text{ A}$ ,  $di/dt \leq 100\text{ A}/\mu\text{s}$ ,  $V_{DS\text{ peak}} \leq V_{(BR)DSS}$
3.  $V_{DS} \leq 960\text{ V}$

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	2.6	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient	50	$^\circ\text{C}/\text{W}$

**Table 3. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not repetitive (pulse width limited by $T_{jmax}$ )	1.7	A
$E_{AS}$	Single-pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ )	415	mJ

## 2 Electrical characteristics

$T_C = 25\text{ °C}$  unless otherwise specified

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	1200			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}, V_{DS} = 1200\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}, V_{DS} = 1200\text{ V}$ $T_C = 125\text{ °C}^{(1)}$			50	$\mu\text{A}$
$I_{GSS}$	Gate body leakage current	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 100\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}, I_D = 2.5\text{ A}$		1.65	2.00	$\Omega$

1. Defined by design, not subject to production test.

**Table 5. Dynamic characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$	-	505	-	pF
$C_{oss}$	Output capacitance		-	44	-	pF
$C_{riss}$	Reverse transfer capacitance		-	0.4	-	pF
$C_{o(tr)}^{(1)}$	Time-related equivalent capacitance	$V_{DS} = 0\text{ to }960\text{ V}, V_{GS} = 0\text{ V}$	-	70	-	pF
$C_{o(er)}^{(2)}$	Energy-related equivalent capacitance		-	24	-	pF
$R_g$	Intrinsic gate resistance	$f = 1\text{ MHz}, I_D = 0\text{ A}$	-	7.7	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 960\text{ V}, I_D = 5\text{ A}$	-	13.7	-	nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 0\text{ to }10\text{ V}$	-	3.6	-	nC
$Q_{gd}$	Gate-drain charge	(see Figure 14. Test circuit for gate charge behavior )	-	7.1	-	nC

1.  $C_{o(tr)}$  is a constant capacitance value that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

2.  $C_{o(er)}$  is a constant capacitance value that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 600\text{ V}, I_D = 2.5\text{ A},$ $R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$	-	15.5	-	ns
$t_r$	Rise time		-	11	-	ns
$t_{d(off)}$	Turn-off delay time	(see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	40	-	ns
$t_f$	Fall time		-	27	-	ns

**Table 7. Source-drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		6	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		12	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 5\text{ A}$ , $V_{GS} = 0\text{ V}$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 5\text{ A}$ , $V_{DD} = 60\text{ V}$ , $di/dt = 100\text{ A}/\mu\text{s}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	327		ns
$Q_{rr}$	Reverse recovery charge		-	3		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	$I_{SD} = 5\text{ A}$ , $V_{DD} = 60\text{ V}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $T_j = 150\text{ }^\circ\text{C}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	18.4		A
$t_{rr}$	Reverse recovery time		-	485		ns
$Q_{rr}$	Reverse recovery charge		-	3.9		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	16		A

1. Pulse width limited by safe operating area.
2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

**Table 8. Gate-source Zener diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)GSO}$	Gate-source breakdown voltage	$I_{GS} = \pm 1\text{ mA}$ , $I_D = 0\text{ A}$	$\pm 30$	-	-	V

The built-in back-to-back Zener diodes are specifically designed to enhance the ESD performance of the device. The Zener voltage facilitates efficient and cost-effective device integrity protection, thus eliminating the need for additional external componentry.

## 2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

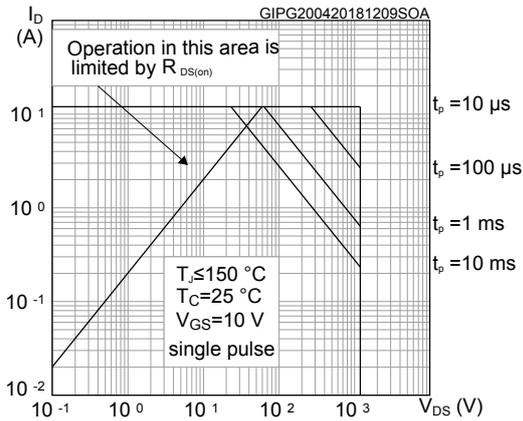


Figure 2. Thermal impedance

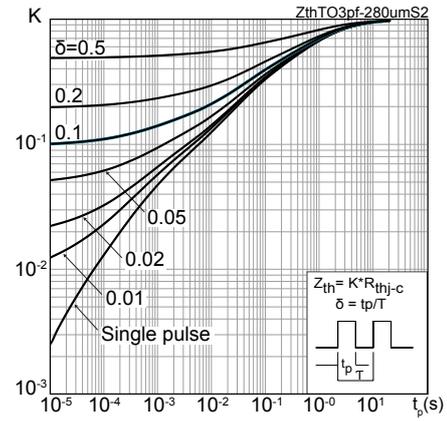


Figure 3. Output characteristics

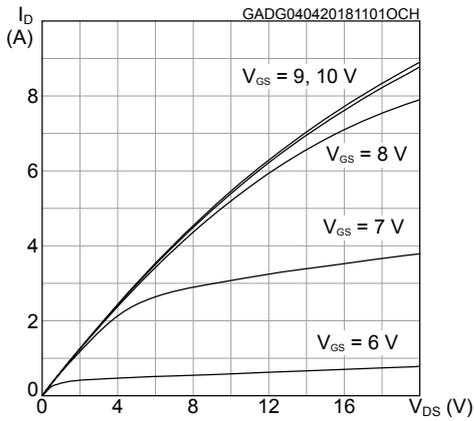


Figure 4. Transfer characteristics

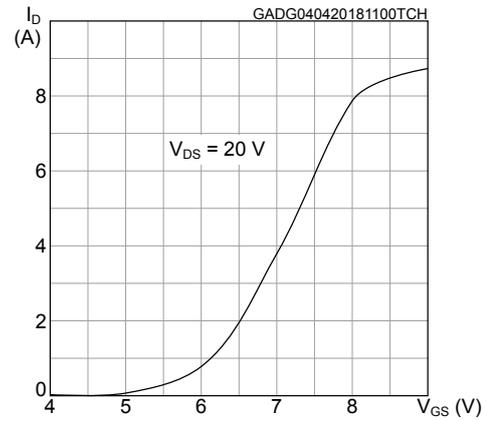


Figure 5. Gate charge vs gate-source voltage

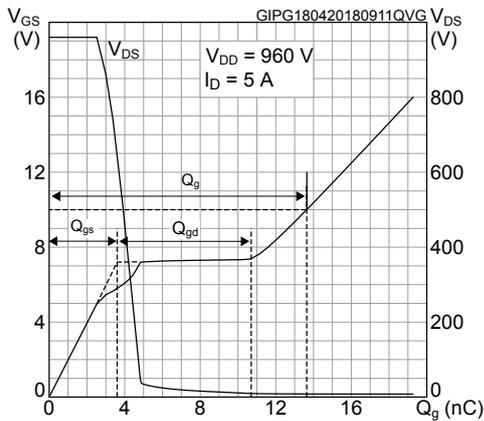


Figure 6. Static drain-source on-resistance

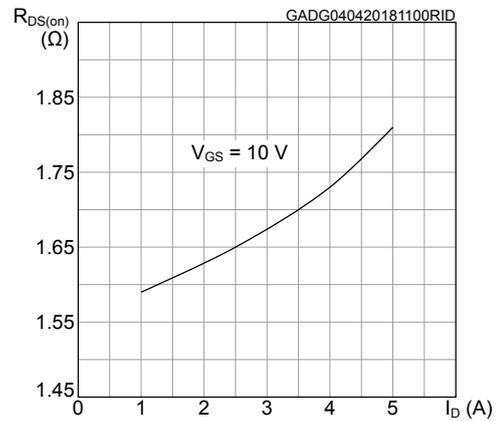


Figure 7. Capacitance variations

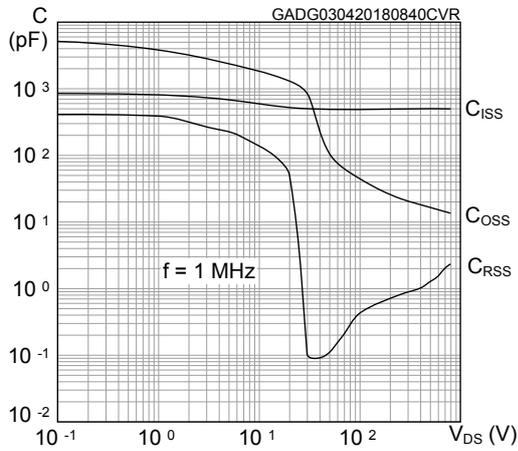


Figure 8. Normalized gate threshold voltage vs temperature

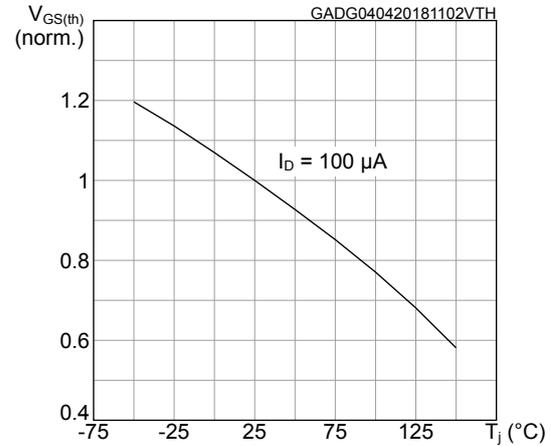


Figure 9. Normalized on-resistance vs temperature

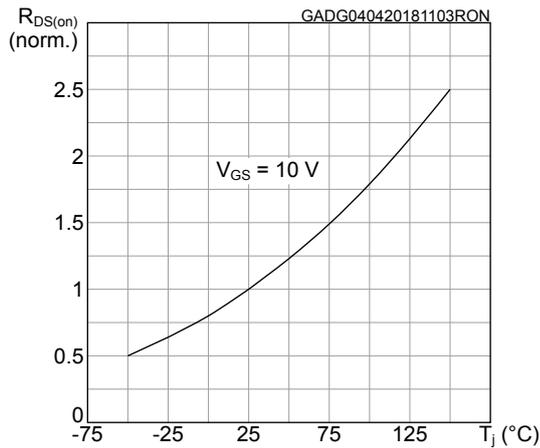


Figure 10. Normalized  $V_{(BR)DSS}$  vs temperature

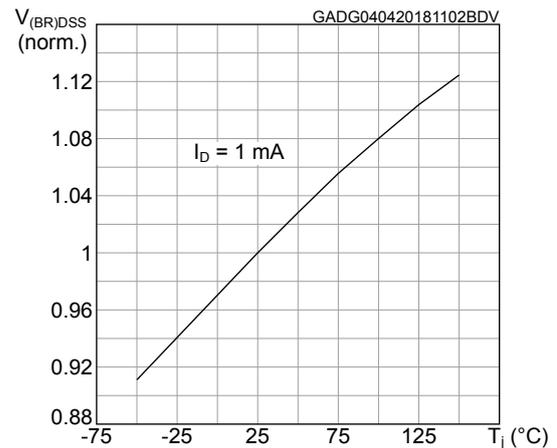


Figure 11. Source-drain diode forward characteristics

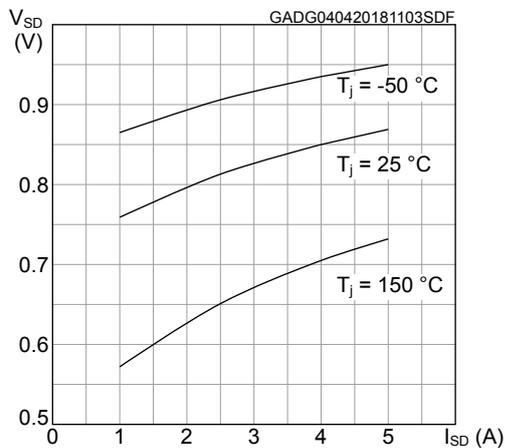
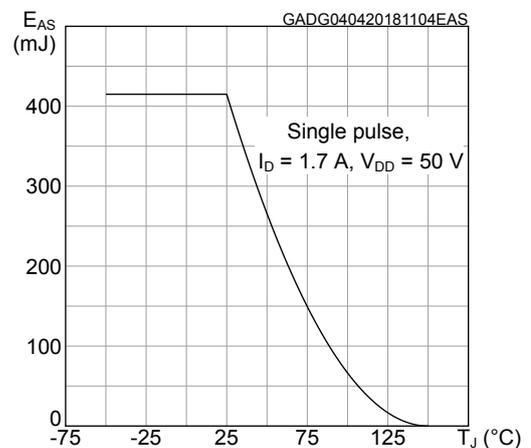
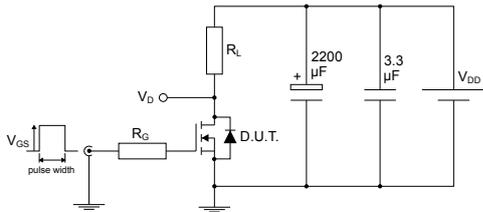


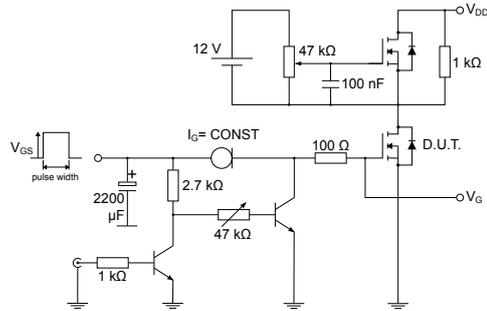
Figure 12. Maximum avalanche energy vs starting  $T_J$



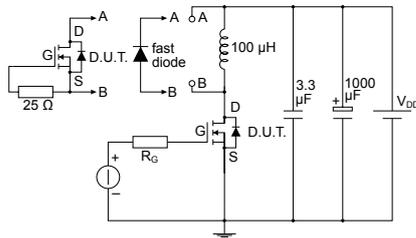
### 3 Test circuits

**Figure 13. Test circuit for resistive load switching times**


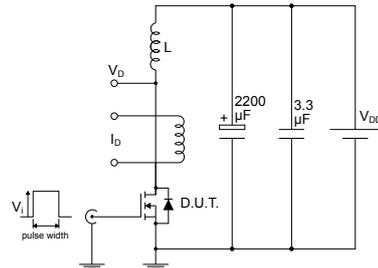
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**Figure 14. Test circuit for gate charge behavior**


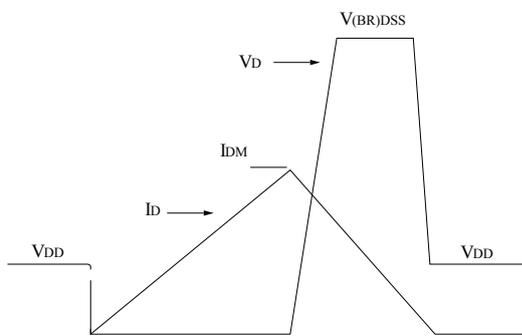
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**Figure 15. Test circuit for inductive load switching and diode recovery times**


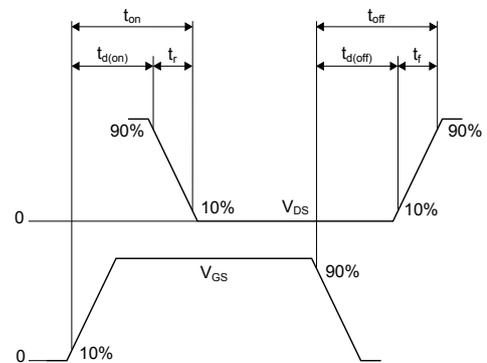
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**Figure 16. Unclamped inductive load test circuit**


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**Figure 17. Unclamped inductive waveform**


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**Figure 18. Switching time waveform**


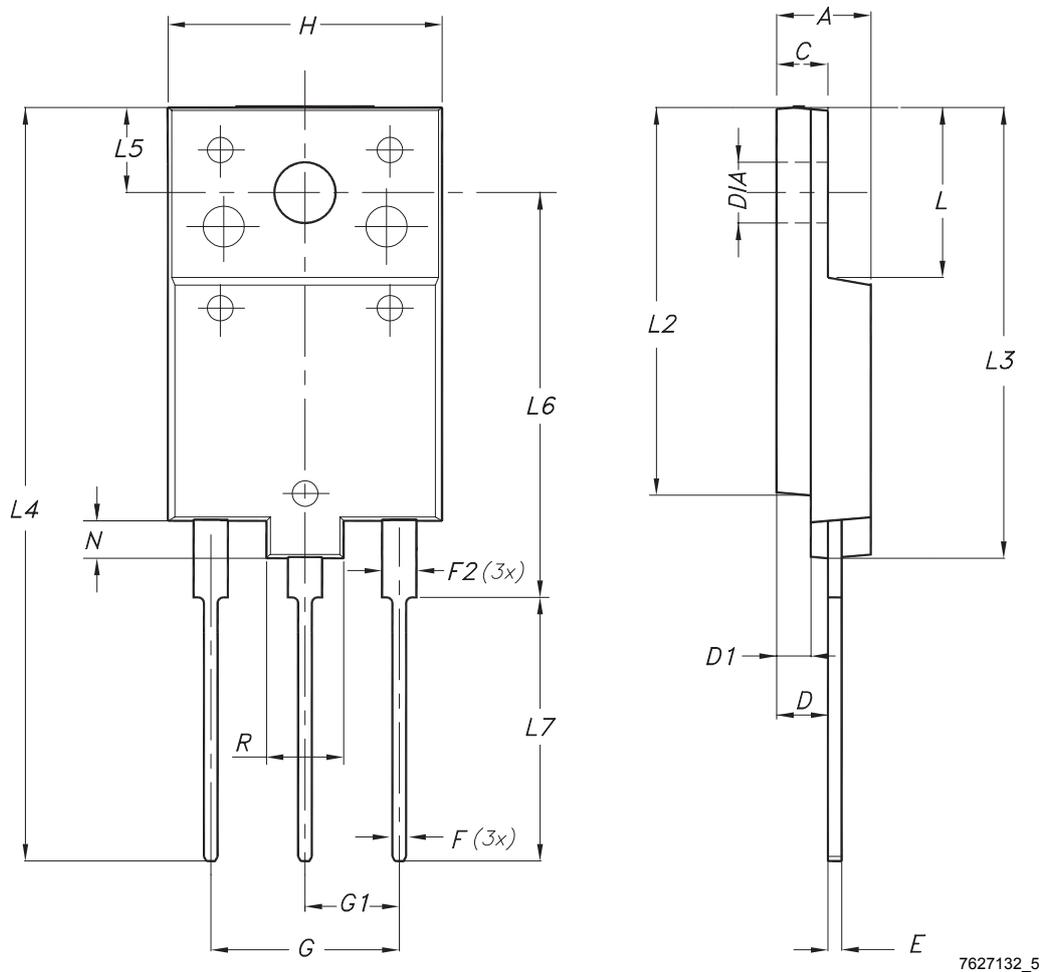
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## 4 Package information

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 19. TO-3PF package outline



7627132\_5

**Table 9. 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

## Revision history

**Table 10. Document revision history**

Date	Version	Changes
20-Apr-2018	1	Initial release.
02-Jul-2018	2	Document status promoted from preliminary to production data. Updated <a href="#">Figure 2. Thermal impedance</a> . Minor text changes

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