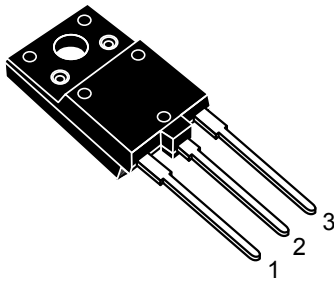
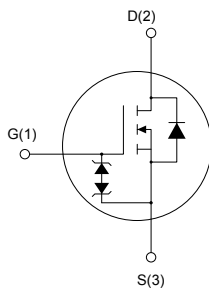


N-channel 1200 V, 1.65 Ω typ., 6 A, MDmesh K5 Power MOSFET in a TO-3PF package


TO-3PF


AM01476v1_No_tab

Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D	P_{TOT}
STFW8N120K5	1200 V	2.00 Ω	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

Order code	STFW8N120K5
Marking	8N120K5
Package	TO-3PF
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 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	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 1200\text{ V}$ $T_C = 125\text{ °C}$ ⁽¹⁾			50	μA
I_{GSS}	Gate body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 20\text{ V}$			± 10	μA
$V_{GS(th)}$	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	Ω

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	-	Ω
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

- $C_{o(tr)}$ 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} .
- $C_{o(er)}$ 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		μC
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		μC
I_{RRM}	Reverse recovery current		-	16		A

1. Pulse width limited by safe operating area.
2. Pulsed: pulse duration = 300 μs , 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	$I_{GS} = \pm 1\text{ mA}$, $I_D = 0\text{ A}$	± 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

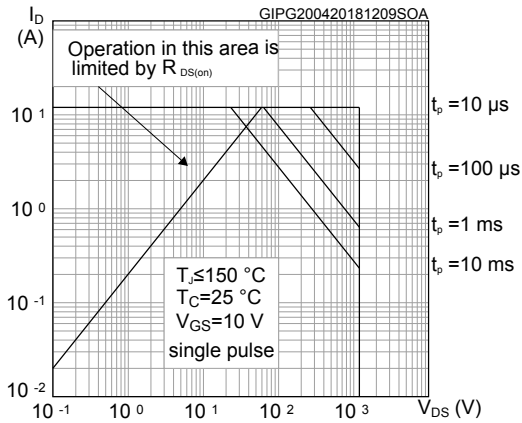


Figure 2. Thermal impedance

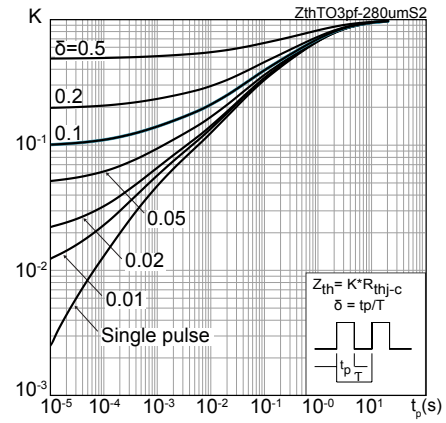


Figure 3. Output characteristics

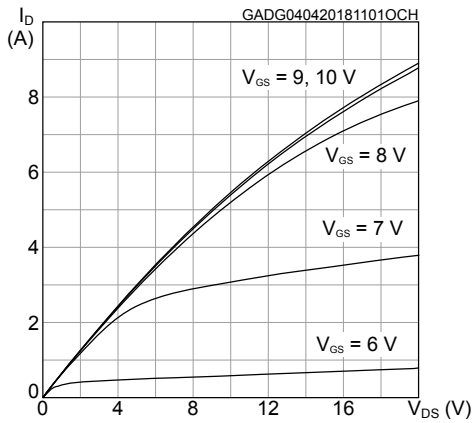


Figure 4. Transfer characteristics

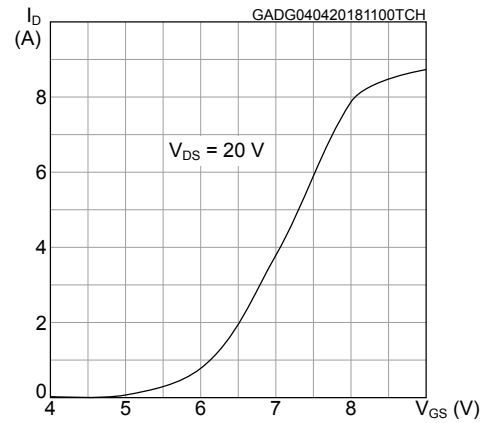


Figure 5. Gate charge vs gate-source voltage

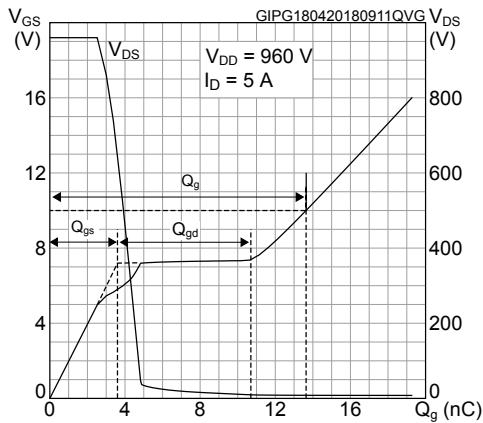


Figure 6. Static drain-source on-resistance

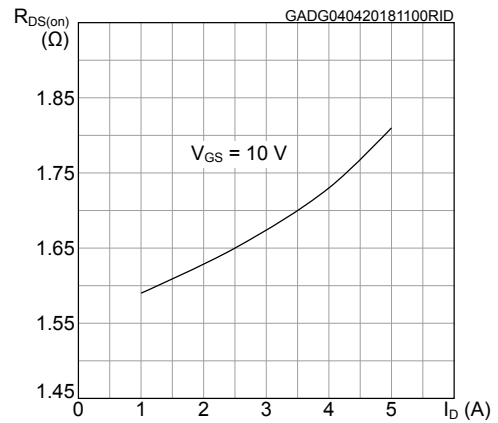


Figure 7. Capacitance variations

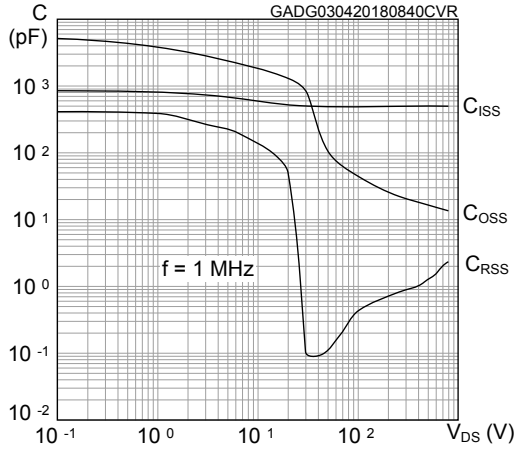


Figure 8. Normalized gate threshold voltage vs temperature

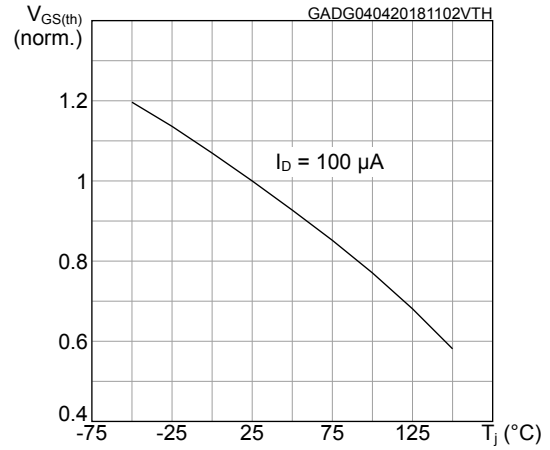


Figure 9. Normalized on-resistance vs temperature

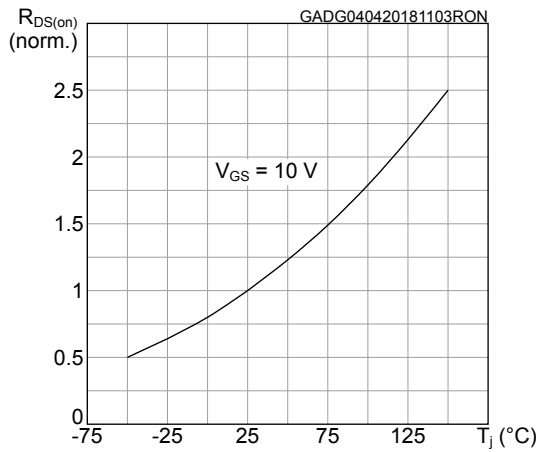


Figure 10. Normalized $V_{(BR)DSS}$ vs temperature

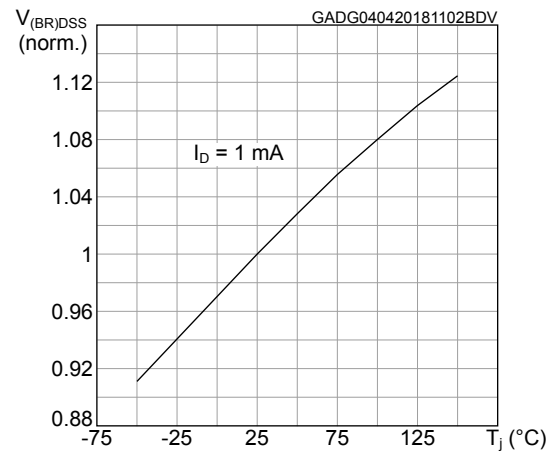


Figure 11. Source-drain diode forward characteristics

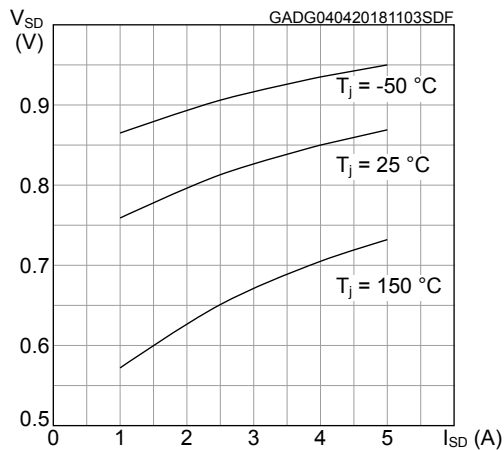
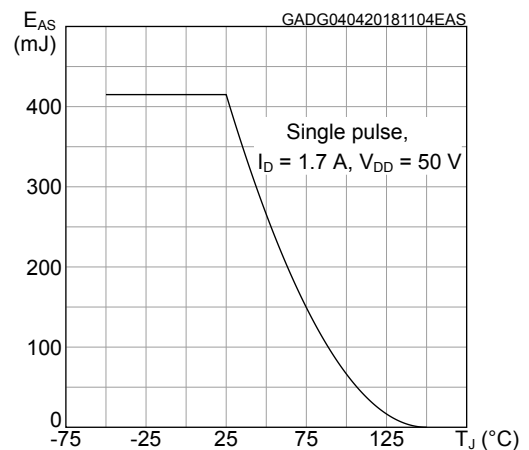
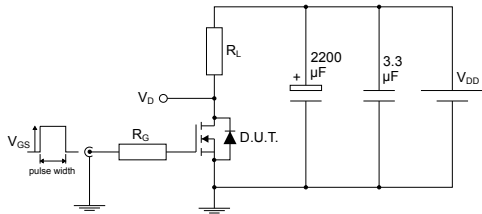


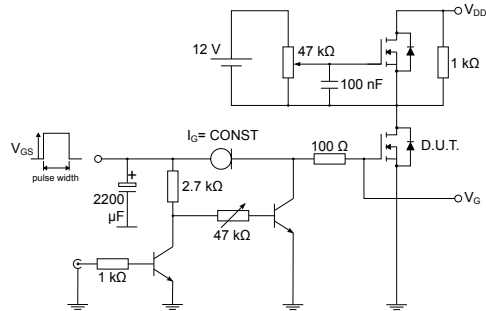
Figure 12. Maximum avalanche energy vs starting T_J



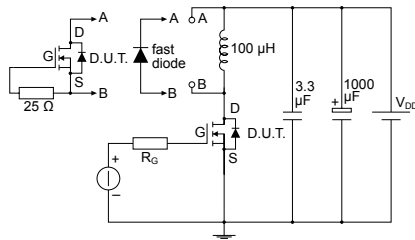
3 Test circuits

Figure 13. Test circuit for resistive load switching times


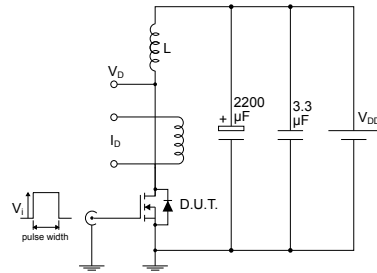
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Figure 14. Test circuit for gate charge behavior


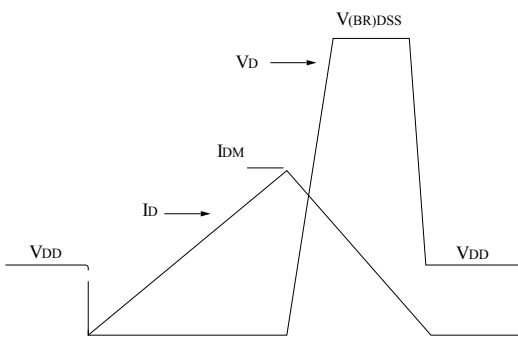
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Figure 15. Test circuit for inductive load switching and diode recovery times


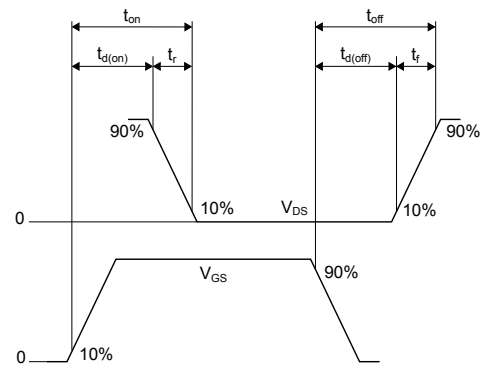
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Figure 16. Unclamped inductive load test circuit


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Figure 17. Unclamped inductive waveform


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Figure 18. Switching time waveform


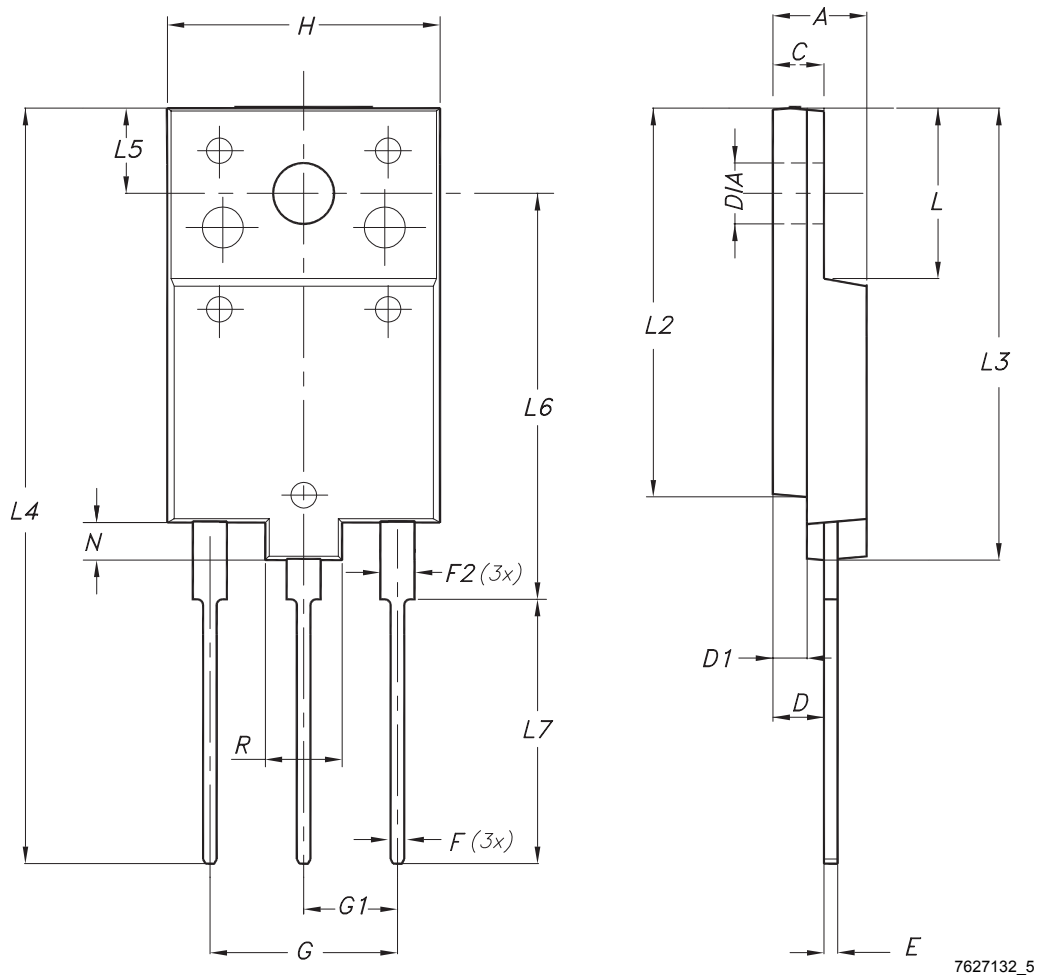
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4 Package information

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. 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 Figure 2. Thermal impedance . Minor text changes

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