

N-channel 800 V, 0.37 Ω typ., 12 A MDmesh™ K5 Power MOSFET in a TO-220FP ultra narrow leads package

Datasheet - production data

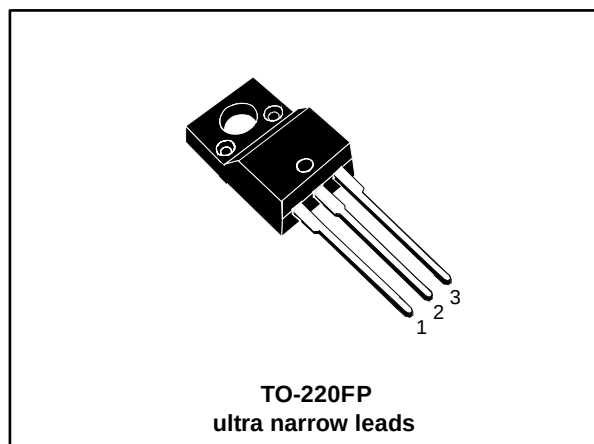
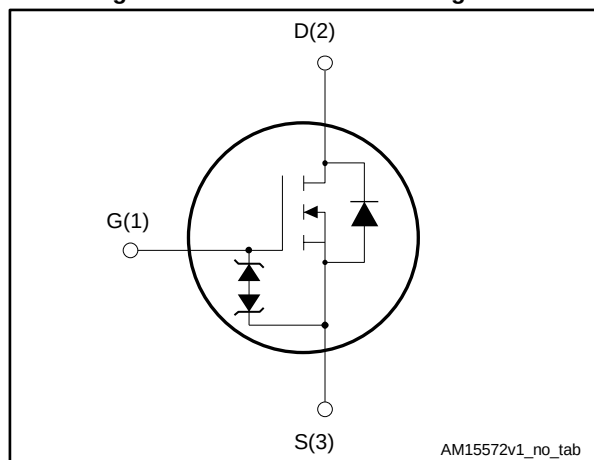


Figure 1: Internal schematic diagram



Features

Order code	V _{DS}	R _{DS(on)} max	I _D	P _{TOT}
STFU13N80K5	800 V	0.45 Ω	12 A	35 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.

Table 1: Device summary

Order code	Marking	Package	Packing
STFU13N80K5	13N80K5	TO-220FP ultra narrow leads	Tube

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1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate source voltage	± 30	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	12	A
$I_D^{(1)}$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	7.6	A
$I_{DM}^{(2)}$	Drain current (pulsed)	48	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	35	W
I_{AS}	Max current during repetitive or single pulse avalanche (pulse width limited by T_{jmax})	4	A
E_{AS}	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$, $I_D = I_{AS}$, $V_{DD} = 50\text{ V}$)	148	mJ
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink ($t = 1\text{ s}$; $T_C = 25\text{ }^\circ\text{C}$)	2500	V
$dv/dt^{(3)}$	Peak diode recovery voltage slope	4.5	V/ns
$dv/dt^{(4)}$	MOSFET dv/dt ruggedness	50	V/ns
T_{stg}	Storage temperature range	-55 to 150	$^\circ\text{C}$
T_J	Operating junction temperature range		

Notes:

⁽¹⁾Limited by package.

⁽²⁾Pulse width limited by safe operating area.

⁽³⁾ $I_{SD} \leq 12\text{ A}$, $di/dt \leq 100\text{ A}/\mu\text{s}$, $V_{DS(peak)} \leq V_{(BR)DSS}$.

⁽⁴⁾ $V_{SD} \leq 640\text{ V}$.

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	3.57	$^\circ\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction-ambient	62.5	

2 Electrical characteristics

(T_C = 25 °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 V, I _D = 1 mA	800			V
I _{DSS}	Zero gate voltage drain current	V _{GS} = 0 V, V _{DS} = 800 V			1	μA
		V _{GS} = 0 V, V _{DS} = 800 V, T _C = 125 °C ⁽¹⁾			50	μA
I _{GSS}	Gate-body leakage current	V _{DS} = 0 V, V _{GS} = ±20 V			±10	μA
V _{GS(th)}	Gate threshold voltage	V _{DS} = V _{GS} , I _D = 100 μA	3	4	5	V
R _{DS(on)}	Static drain-source on-resistance	V _{GS} = 10 V, I _D = 6 A		0.37	0.45	Ω

Notes:

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

Table 5: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C _{iss}	Input capacitance	V _{DS} = 100 V, f = 1 MHz, V _{GS} = 0 V	-	870	-	pF
C _{oss}	Output capacitance		-	50	-	pF
C _{rss}	Reverse transfer capacitance		-	2	-	pF
C _{o(tr)} ⁽¹⁾	Equivalent output capacitance	V _{GS} = 0 V, V _{DS} = 0 to 640 V	-	110	-	pF
C _{o(er)} ⁽²⁾	Equivalent capacitance energy related			43		pF
R _G	Intrinsic gate resistance	f = 1 MHz, I _D = 0 A	-	5	-	Ω
Q _g	Total gate charge	V _{DD} = 640 V, I _D = 12 A, V _{GS} = 0 to 10 V (see Figure 16: "Test circuit for gate charge behavior")	-	29	-	nC
Q _{gs}	Gate-source charge		-	7	-	nC
Q _{gd}	Gate-drain charge		-	18	-	nC

Notes:

⁽¹⁾Time related is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}.

⁽²⁾Energy related is defined as a constant equivalent capacitance giving the same stored energy as C_{oss} when V_{DS} increases 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	$V_{DD} = 400\text{ V}$, $I_D = 6\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 15: "Test circuit for resistive load switching times" and Figure 20: "Switching time waveform")	-	16	-	ns
t_r	Rise time		-	16	-	ns
$t_{d(off)}$	Turn-off delay time		-	42	-	ns
t_f	Fall time		-	16	-	ns

Table 7: Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		14	A
I_{SDM}	Source-drain current (pulsed)		-		56	A
$V_{SD}^{(1)}$	Forward on voltage	$I_{SD} = 12\text{ A}$, $V_{GS} = 0\text{ V}$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 12\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$ (see Figure 17: "Test circuit for inductive load switching and diode recovery times")	-	406		ns
Q_{rr}	Reverse recovery charge		-	5.7		μC
I_{RRM}	Reverse recovery current		-	28		A
t_{rr}	Reverse recovery time	$I_{SD} = 12\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 17: "Test circuit for inductive load switching and diode recovery times")	-	600		ns
Q_{rr}	Reverse recovery charge		-	7.9		μC
I_{RRM}	Reverse recovery current		-	26		A

Notes:

⁽¹⁾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 2: Safe operating area

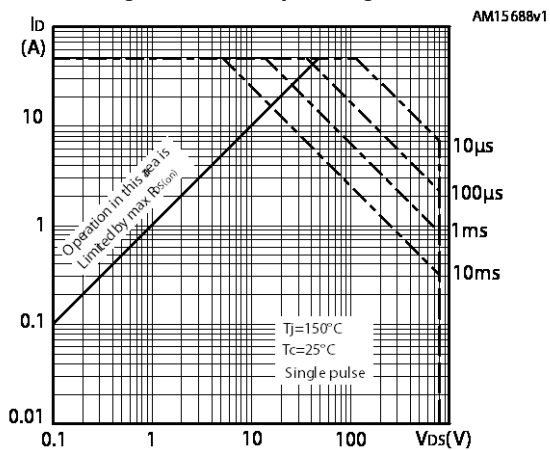


Figure 3: Thermal impedance

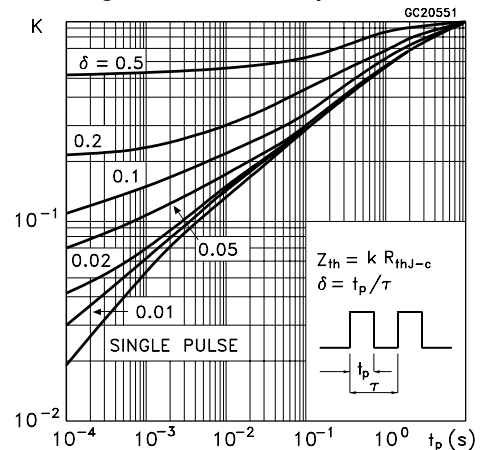


Figure 4: Output characteristics

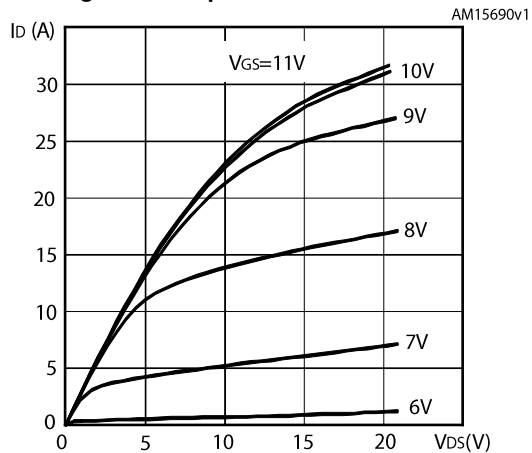


Figure 5: Transfer characteristics

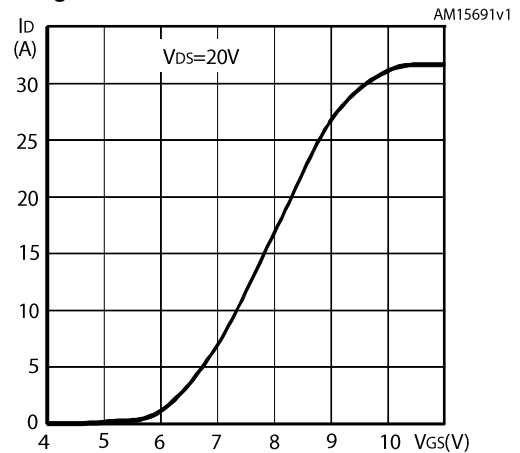


Figure 6: Gate charge vs gate-source voltage

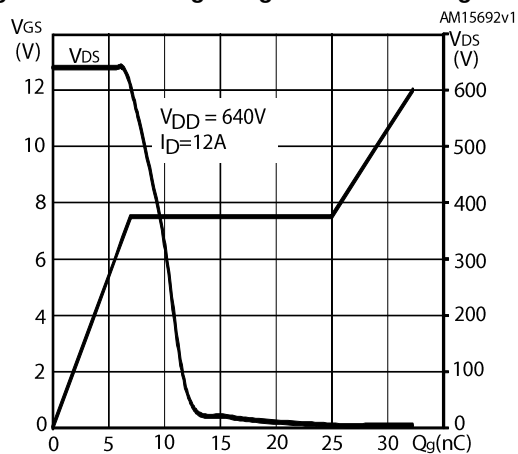


Figure 7: Static drain-source on-resistance

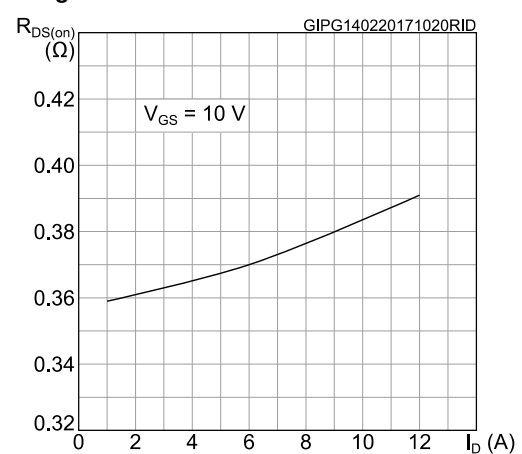


Figure 8: Capacitance variations

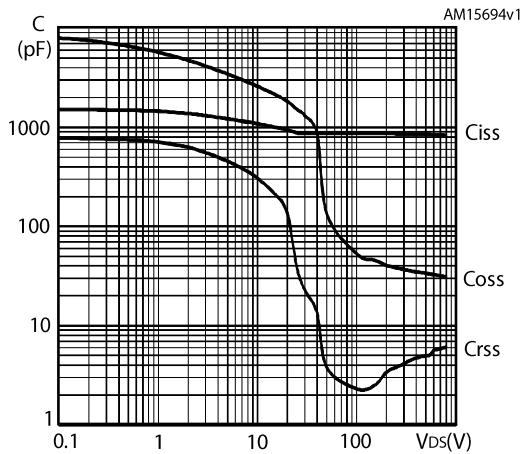


Figure 9: Source-drain diode forward characteristics

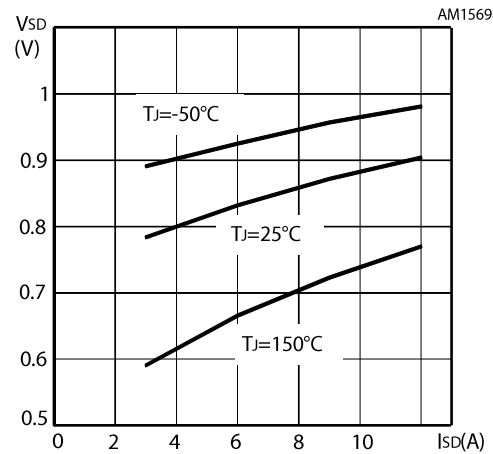


Figure 10: Normalized gate threshold voltage vs temperature

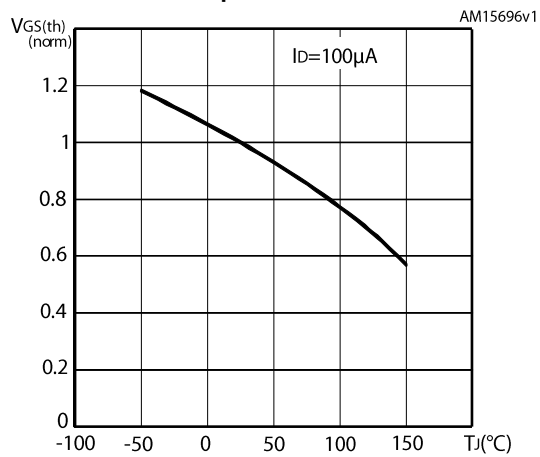


Figure 11: Normalized on-resistance vs temperature

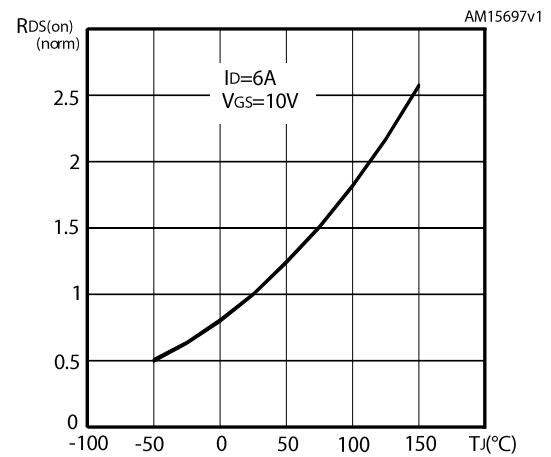


Figure 12: Output capacitance stored energy

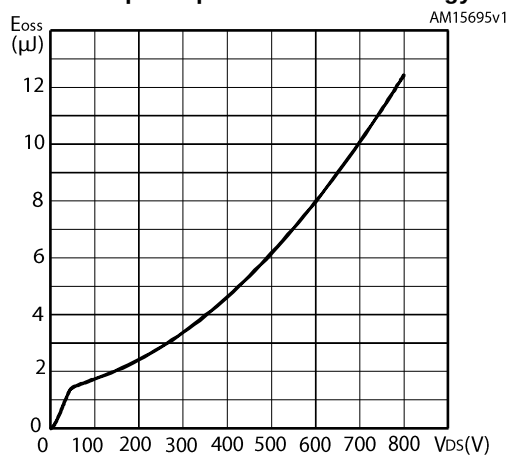


Figure 13: Normalized V(BR)DSS vs temperature

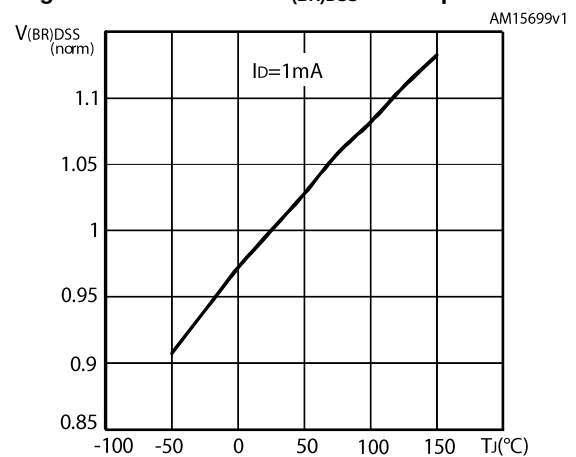
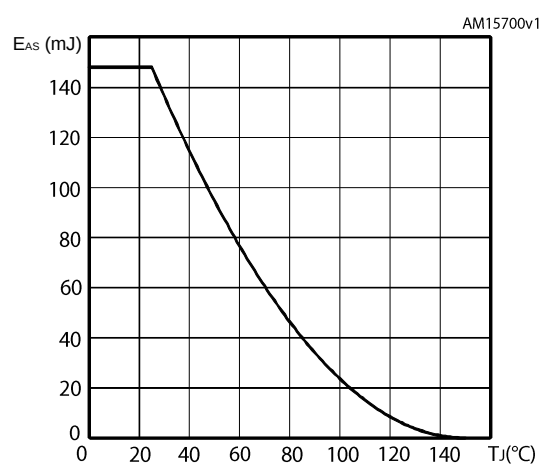
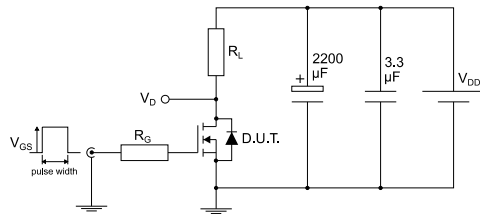


Figure 14: Maximum avalanche energy vs temperature



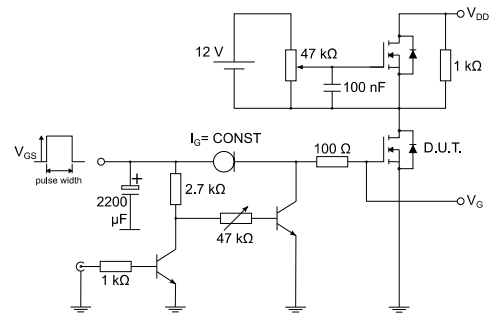
3 Test circuit

Figure 15: Test circuit for resistive load switching times



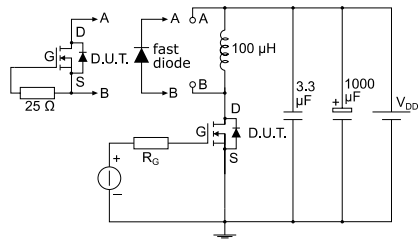
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Figure 16: Test circuit for gate charge behavior



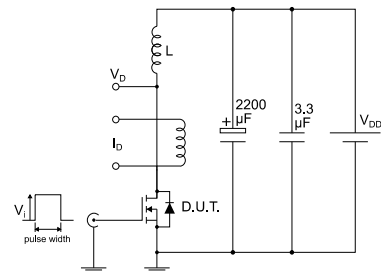
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Figure 17: Test circuit for inductive load switching and diode recovery times



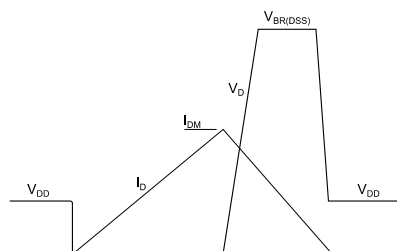
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Figure 18: Unclamped inductive load test circuit



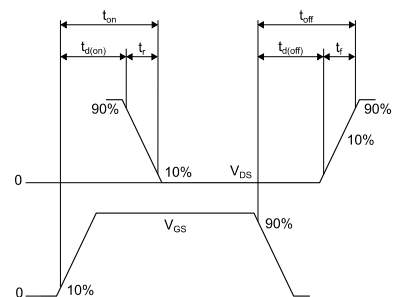
AM01471v1

Figure 19: Unclamped inductive waveform



AM01472v1

Figure 20: Switching time waveform



AM01473v1

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-220FP ultra narrow leads package information

Figure 21: TO-220FP ultra narrow leads package outline

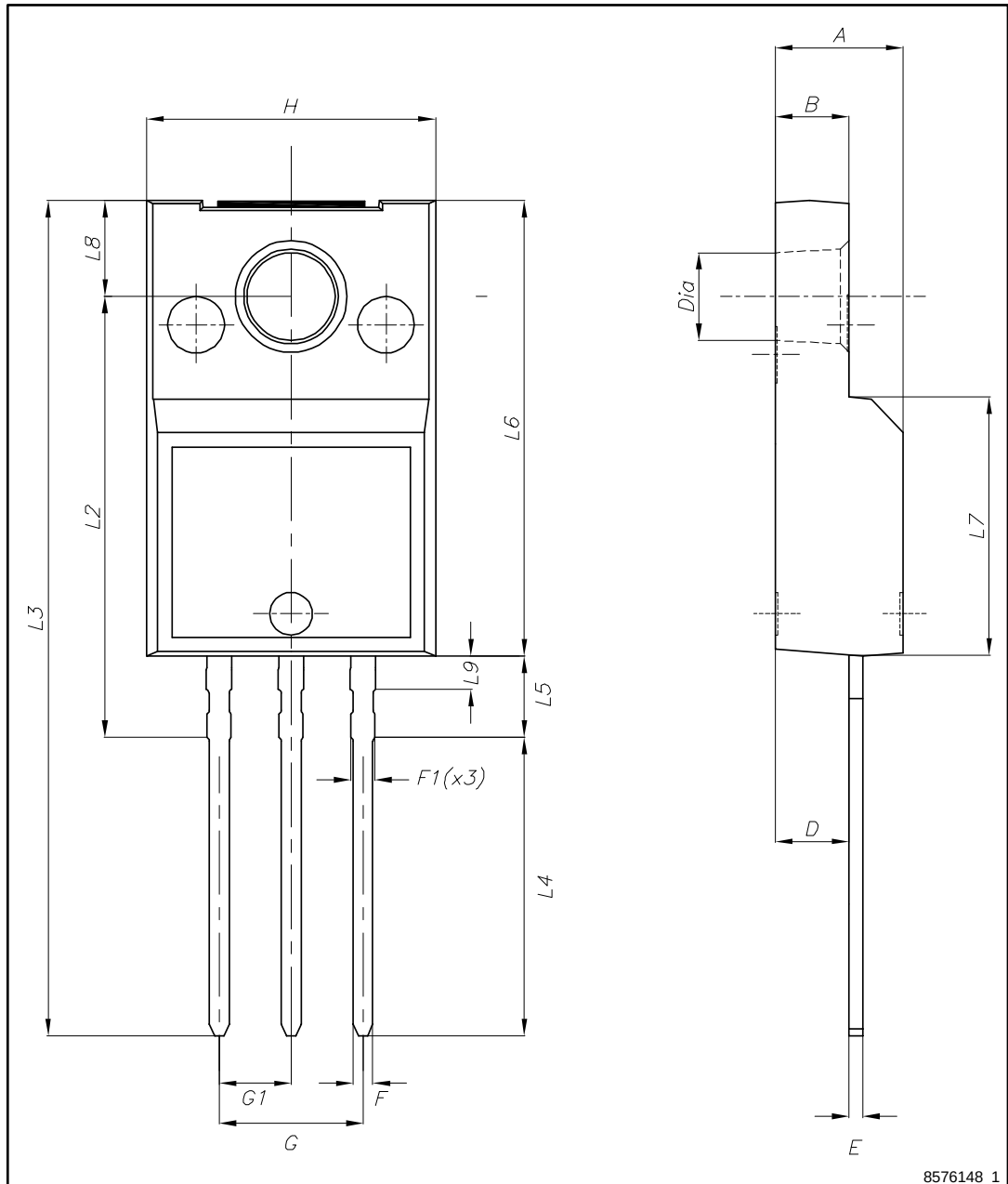


Table 9: TO-220FP ultra narrow leads mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
B	2.50		2.70
D	2.50		2.75
E	0.45		0.60
F	0.65		0.75
F1	-		0.90
G	4.95		5.20
G1	2.40	2.54	2.70
H	10.00		10.40
L2	15.10		15.90
L3	28.50		30.50
L4	10.20		11.00
L5	2.50		3.10
L6	15.60		16.40
L7	9.00		9.30
L8	3.20		3.60
L9	-		1.30
Dia.	3.00		3.20

5 Revision history

Table 10: Document revision history

Date	Revision	Changes
08-Oct-2015	1	Initial release
14-Jul-2017	2	Modified Figure 7: "Static drain-source on-resistance " . Minor text changes.

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