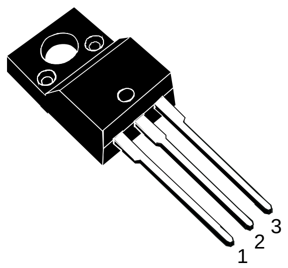
STFU23N80K5

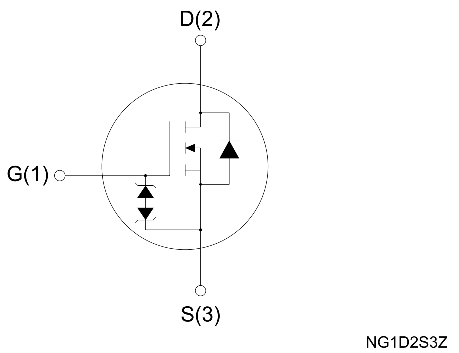
N-channel 800 V, 0.23 Ω typ., 16 A MDmesh™ K5 Power MOSFET in a TO-220FP ultra narrow leads package

Datasheet - production data



TO-220FP
ultra narrow leads

Figure 1: Internal schematic diagram



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D	P_{TOT}
STFU23N80K5	800 V	0.28 Ω	16 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
STFU23N80K5	23N80K5	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	Drain current (continuous) at T_{case} = 25 °C	16	A
	Drain current (continuous) at T_{case} = 100 °C	10	
I_{DM}(1)	Drain current (pulsed)	64	A
P_{TOT}	Total dissipation at T_{case} = 25 °C	35	W
dv/dt(2)	Peak diode recovery voltage slope	4.5	V/ns
dv/dt(3)	MOSFET dv/dt ruggedness	50	
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t= 1 s, T_C= 25 °C)	2500	V
T_{stg}	Storage temperature range	-55 to 150	°C
T_j	Operating junction temperature range		

Notes:

(1)Pulse width is limited by safe operating area.

(2)I_{SD} ≤ 16 A, di/dt=100 A/µs, V_{DS} peak < $V_{(BR)DSS}$, V_{DD} = 80% $V_{(BR)DSS}$

(3)V_{DS} ≤ 640 V

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	3.6	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient	50	

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}(1)	Avalanche current, repetitive or not repetitive	5	A
E_{AS}(2)	Single pulse avalanche energy	400	mJ

Notes:

(1)Pulse width limited by T_{jmax}.

(2)Starting T_j = 25 °C, I_D = I_{AR}, V_{DD} = 50 V.

2 Electrical characteristics

(T_{case} = 25 °C unless otherwise specified)

Table 5: Static

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_{case} = 125 °C(1)			50	
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 = 8 A		0.23	0.28	Ω

Notes:

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

Table 6: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 100 V, f = 1 MHz, V_{GS} = 0 V	-	1000	-	pF
C_{oss}	Output capacitance		-	65	-	
C_{rss}	Reverse transfer capacitance		-	1.5	-	
$C_{O(tr)}$(1)	Equivalent output capacitance	V_{DS} = 0 to 640 V, V_{GS} = 0 V	-	165	-	pF
$C_{O(er)}$(2)	Equivalent output capacitance	V_{DS} = 0 to 640 V, V_{GS} = 0 V	-	59	-	
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	4.7	-	Ω
Q_g	Total gate charge	V_{DD} = 640 V, I_D = 16 A, V_{GS} = 0 to 10 V (see *Figure 14: "Test circuit for gate charge behavior"*)	-	33	-	nC
Q_{gs}	Gate-source charge		-	6	-	
Q_{gd}	Gate-drain charge		-	25	-	

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 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 400 V, I_D = 8 A R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 13: "Test circuit for resistive load switching times"* and *Figure 18: "Switching time waveform"*)	-	14	-	ns
t_r	Rise time		-	9	-	
$t_{d(off)}$	Turn-off delay time		-	48	-	
t_f	Fall time		-	9	-	

Table 8: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		16	A
I_{SDM} [(1)]	Source-drain current (pulsed)		-		64	A
V_{SD} [(2)]	Forward on voltage	V_{GS} = 0 V, I_{SD} = 16 A	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 16 A, di/dt = 100 A/µs, V_{DD} = 60 V (see *Figure 15: "Test circuit for inductive load switching and diode recovery times"*)	-	410		ns
Q_{rr}	Reverse recovery charge		-	7		µC
I_{RRM}	Reverse recovery current		-	34		A
t_{rr}	Reverse recovery time	I_{SD} = 16 A, di/dt = 100 A/µs, V_{DD} = 60 V, T_j = 150 °C (see *Figure 15: "Test circuit for inductive load switching and diode recovery times"*)	-	650		ns
Q_{rr}	Reverse recovery charge		-	10		µC
I_{RRM}	Reverse recovery current		-	32		A

Notes:

[(1)] Pulse width is limited by safe operating area.

[(2)] Pulse test: pulse duration = 300 µs, duty cycle 1.5%.

Table 9: Gate-source Zener diode

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

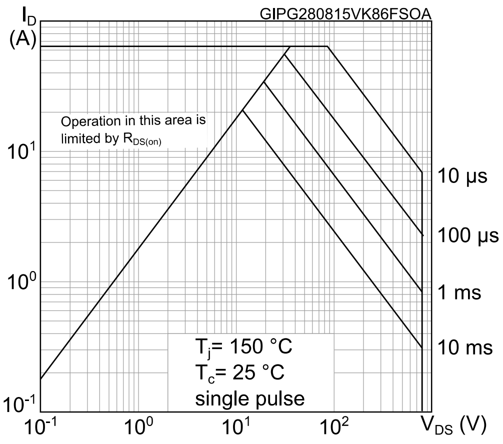


Figure 3: Thermal impedance

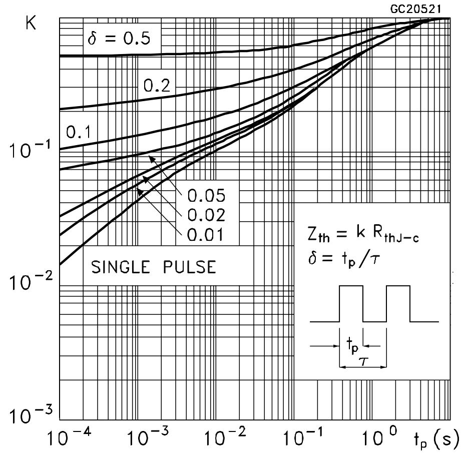


Figure 4: Output characteristics

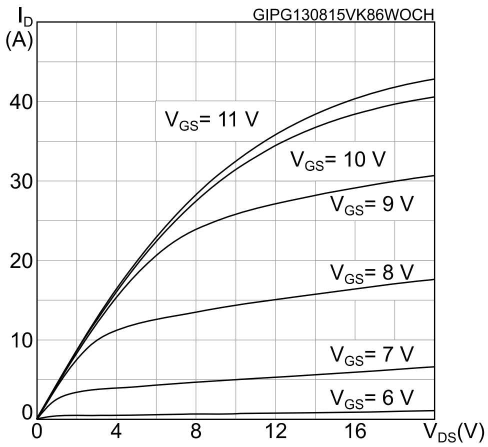


Figure 5: Transfer characteristics

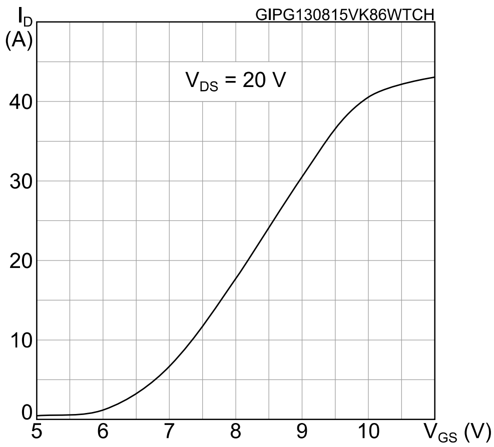


Figure 6: Gate charge vs gate-source voltage

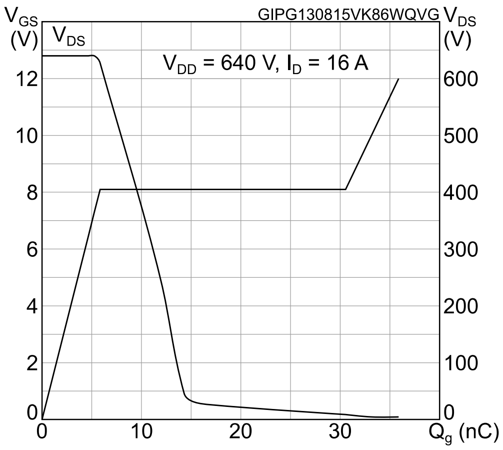


Figure 7: Static drain-source on-resistance

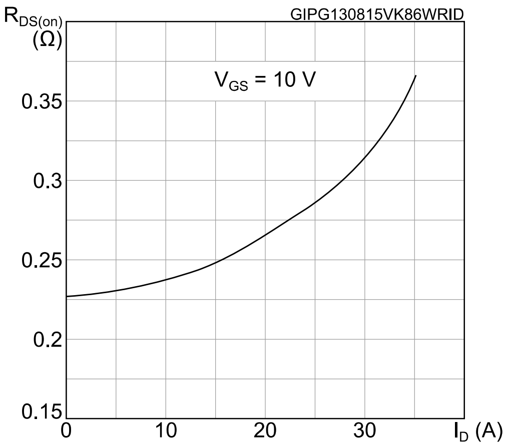


Figure 8: Capacitance variations

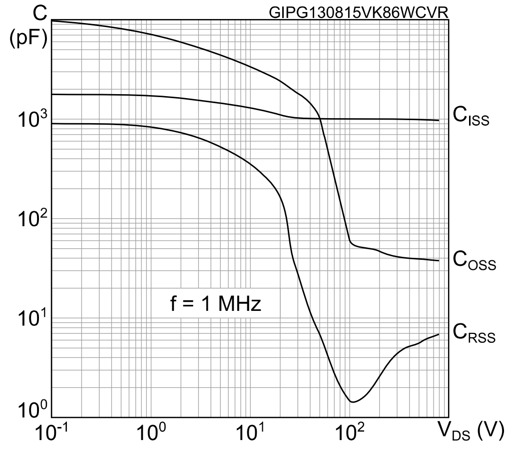


Figure 9: Normalized gate threshold voltage vs temperature

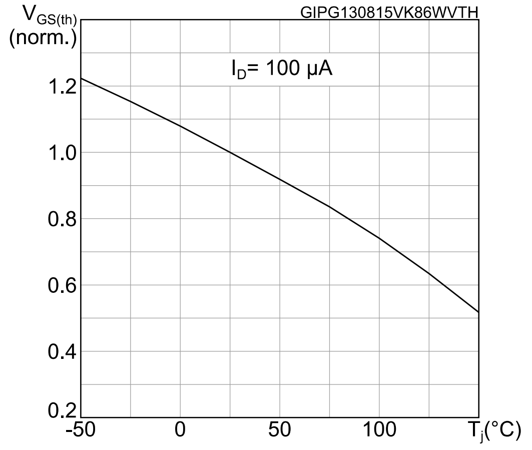


Figure 10: Normalized on-resistance vs temperature

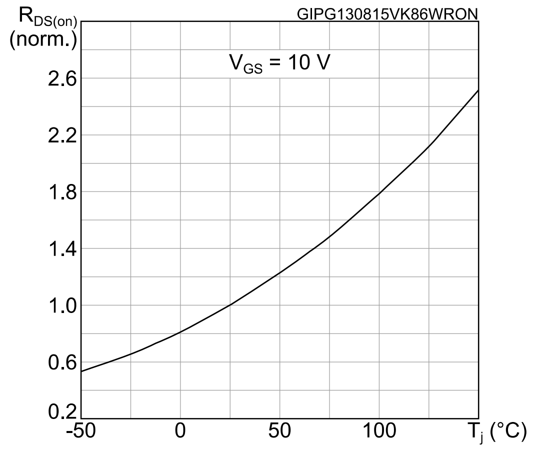


Figure 11: Normalized $V_{(BR)DSS}$ vs temperature

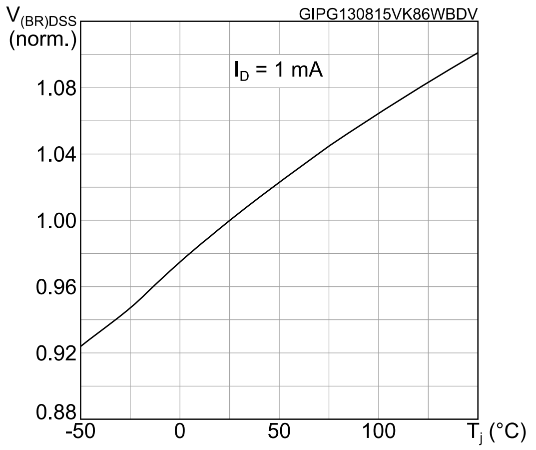
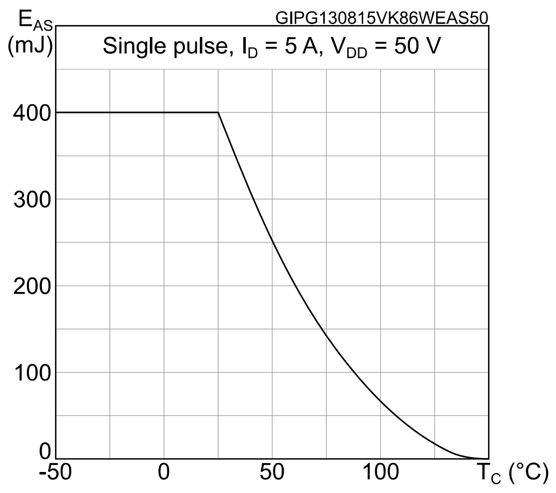


Figure 12: Maximum avalanche energy vs temperature



3 Test circuits

Figure 13: Test circuit for resistive load switching times

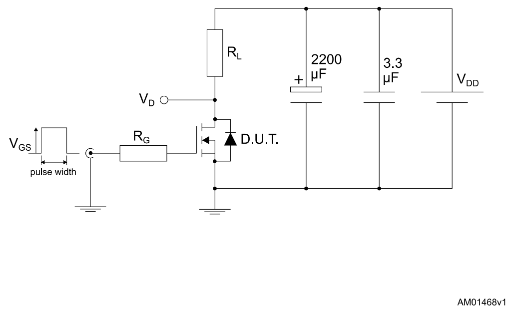


Figure 14: Test circuit for gate charge behavior

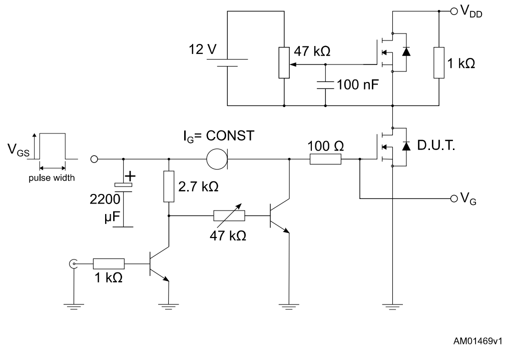


Figure 15: Test circuit for inductive load switching and diode recovery times

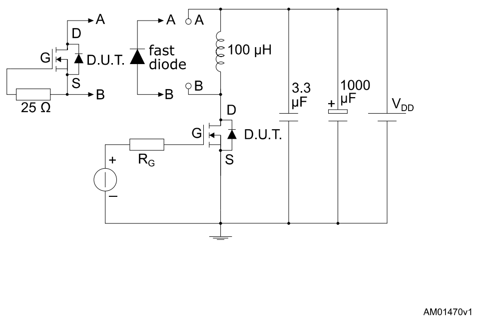


Figure 16: Unclamped inductive load test circuit

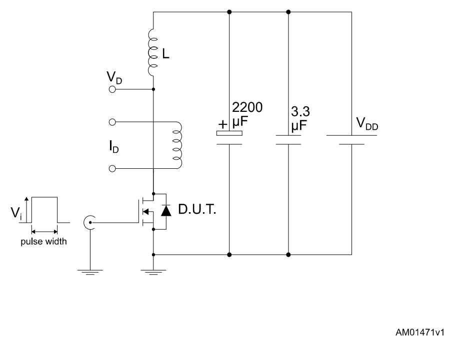


Figure 17: Unclamped inductive waveform

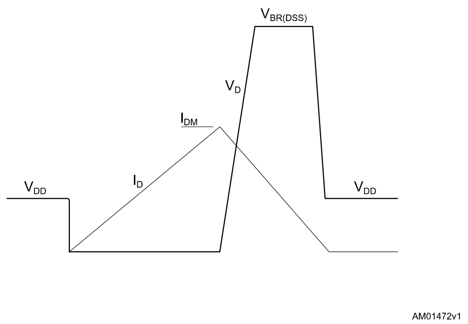
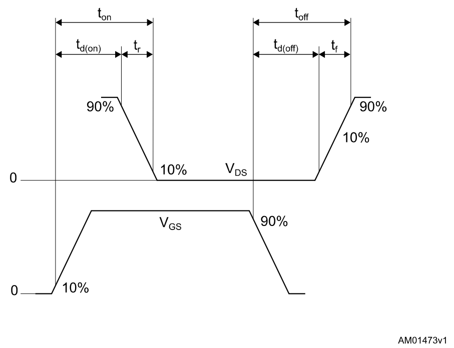


Figure 18: Switching time waveform



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 19: TO-220FP ultra narrow leads package outline

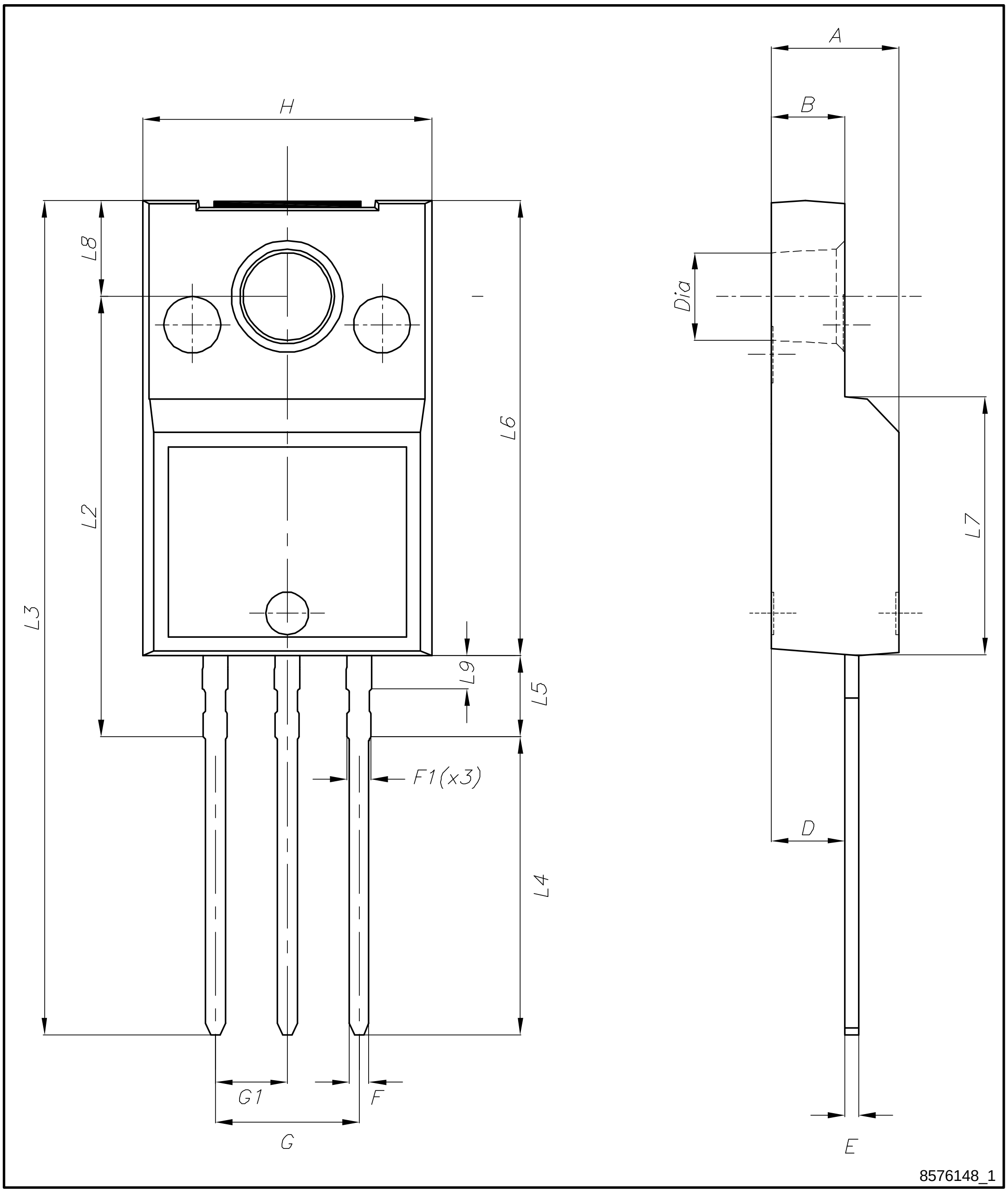


Table 10: TO-220FP ultra narrow leads mechanical data

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 11: Document revision history

Date	Revision	Changes
21-Feb-2017	1	First release