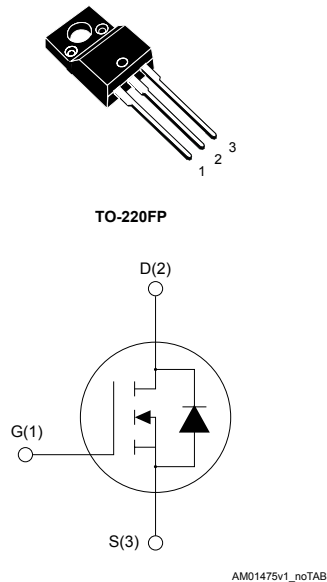


N-channel 650 V, 160 mΩ typ., 18 A MDmesh M5 Power MOSFET in a TO-220FP package



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STF20N65M5	650 V	190 mΩ	18 A

- Higher V_{DSS} rating
- Higher dv/dt capability
- Excellent switching performance
- Extremely low $R_{DS(on)}$
- 100% avalanche tested

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET based on the MDmesh M5 innovative vertical process technology combined with the well-known PowerMESH horizontal layout. The resulting product offers extremely low on-resistance, making it particularly suitable for applications requiring high power and superior efficiency.



Product status link

[STF20N65M5](#)

Product summary

Order code	STF20N65M5
Marking	20N65M5
Package	TO-220FP
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$	18	A
	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	11.3	
$I_{DM}^{(1)}$	Drain current (pulsed)	36	A
P_{TOT}	Total power dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	30	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
$V_{ISO}^{(3)}$	Insulation withstand voltage (RMS) from all three leads to external heat sink ($t = 1\text{ s}$; $T_C = 25\text{ }^{\circ}\text{C}$)	2.5	kV
T_{stg}	Storage temperature range	-55 to 150	$^{\circ}\text{C}$
T_J	Operating junction temperature range		

1. Pulse width is limited by safe operating area.
2. $I_{SD} \leq 18\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$; $V_{DS}(\text{peak}) < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$.
3. $V_{DD} \leq 520\text{ V}$.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	4.17	$^{\circ}\text{C}/\text{W}$
R_{thJA}	Thermal resistance, junction-to-ambient	62.5	

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_J max.)	4	A
E_{AS}	Single pulse avalanche energy (starting $T_J = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	270	mJ

2 Electrical characteristics

$T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Table 4. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$	650	-	-	V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$	-	-	1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$, $T_C = 125\text{ }^{\circ}\text{C}^{(1)}$	-	-	100	
I_{GSS}	Gate-body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 25\text{ V}$	-	-	± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 9\text{ A}$	-	160	190	m Ω

1. Specified by design, not tested in production.

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	1434	-	pF
C_{oss}	Output capacitance		-	38	-	pF
C_{rss}	Reverse transfer capacitance		-	3.7	-	pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }520\text{ V}$, $V_{GS} = 0\text{ V}$	-	118	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related		-	35	-	pF
R_g	Intrinsic gate resistance	$f = 1\text{ MHz}$, $I_D = 0\text{ A}$	-	3.5	-	Ω
Q_g	Total gate charge	$V_{DD} = 520\text{ V}$, $I_D = 9\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (see the Figure 15. Test circuit for gate charge behavior)	-	36	-	nC
Q_{gs}	Gate-source charge		-	7.5	-	nC
Q_{gd}	Gate-drain charge		-	18	-	nC

- $C_{o(tr)}$ is an equivalent capacitance that provides the same charging time as C_{oss} while V_{DS} is rising from 0 V to the stated value.
- $C_{o(er)}$ is an equivalent capacitance that provides the same stored energy as C_{oss} while V_{DS} is rising from 0 V to the stated value.

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(v)}$	Voltage delay time	$V_{DD} = 400\text{ V}$, $I_D = 12\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$	-	43	-	ns
$t_{r(v)}$	Voltage rise time		-	7.5	-	ns
$t_{f(i)}$	Current fall time	(see the Figure 16. Test circuit for inductive load switching and diode recovery times and Figure 19. Switching time waveform)	-	7.5	-	ns
$t_{c(off)}$	Crossing time		-	11.5	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-	-	18	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-	-	36	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 18\text{ A}$, $V_{GS} = 0\text{ V}$	-	-	1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 18\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 100\text{ V}$	-	288	-	ns
Q_{rr}	Reverse recovery charge		-	4	-	μC
I_{RRM}	Reverse recovery current	(see the Figure 16. Test circuit for inductive load switching and diode recovery times)	-	27	-	A
t_{rr}	Reverse recovery time	$I_{SD} = 18\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 100\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$	-	342	-	ns
Q_{rr}	Reverse recovery charge		-	4.7	-	μC
I_{RRM}	Reverse recovery current	(see the Figure 16. Test circuit for inductive load switching and diode recovery times)	-	28	-	A

1. Pulse width is limited by safe operating area.
2. Pulsed: pulse duration = 300 μs , duty cycle 1.5%.

2.1 Electrical characteristics curves

Figure 1. Safe operating area

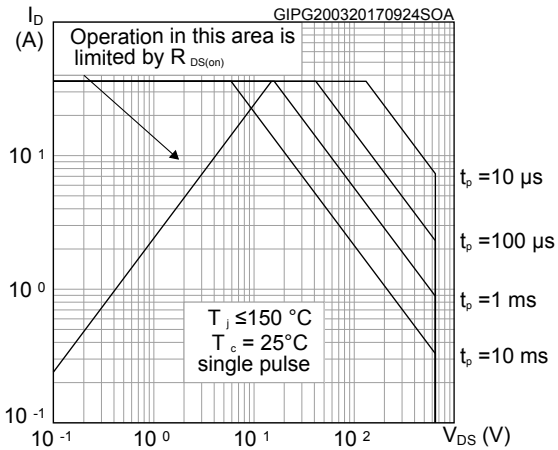


Figure 2. Normalized transient thermal impedance

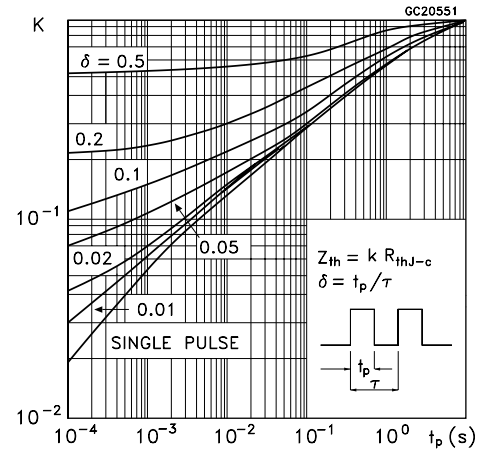


Figure 3. Typical output characteristics

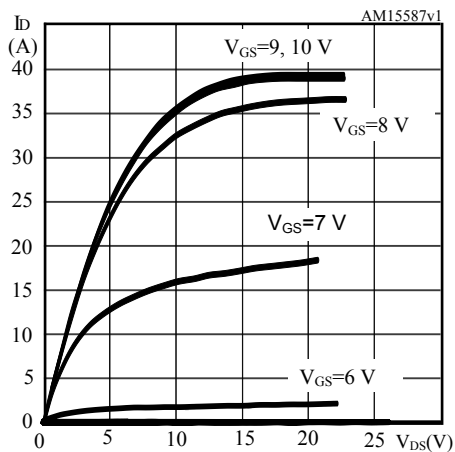


Figure 4. Typical transfer characteristics

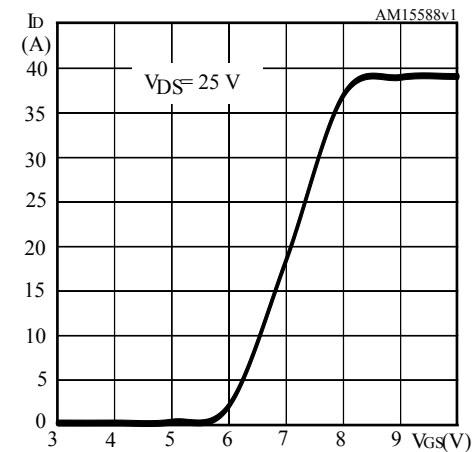


Figure 5. Typical gate charge characteristics

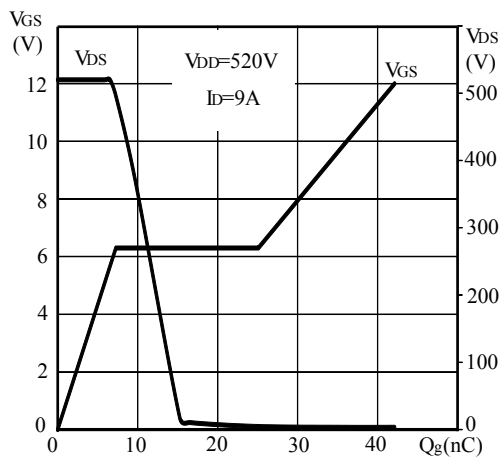


Figure 6. Typical drain-source on-resistance

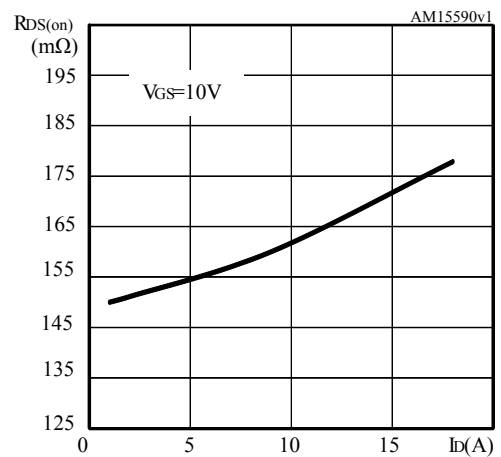


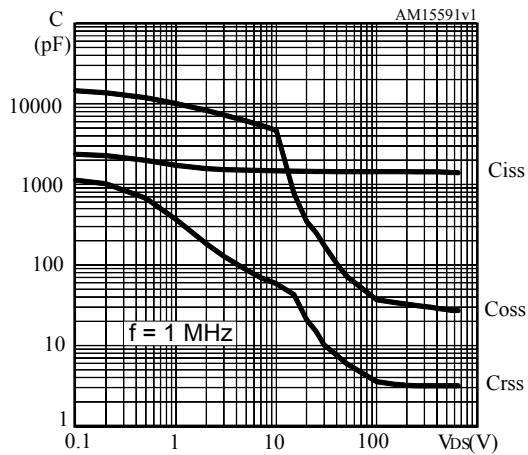
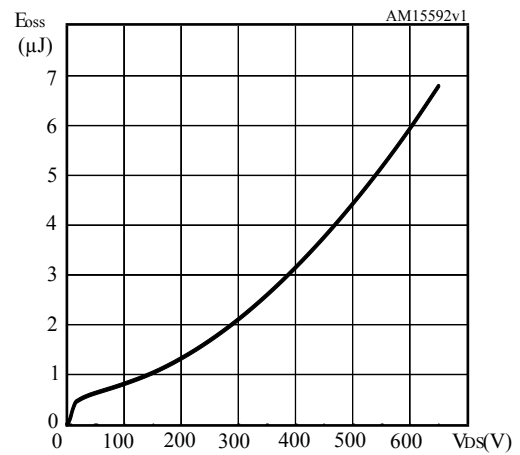
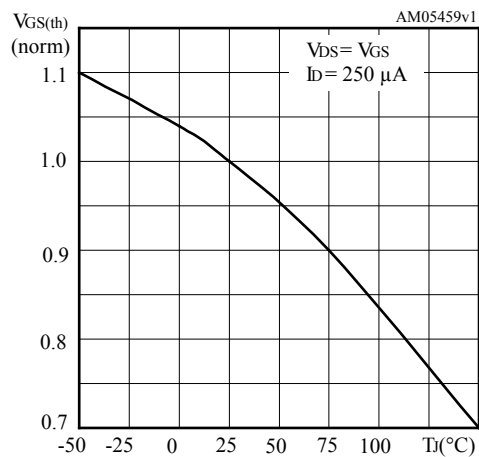
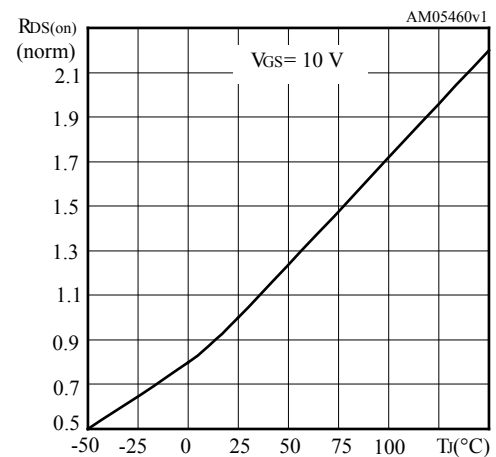
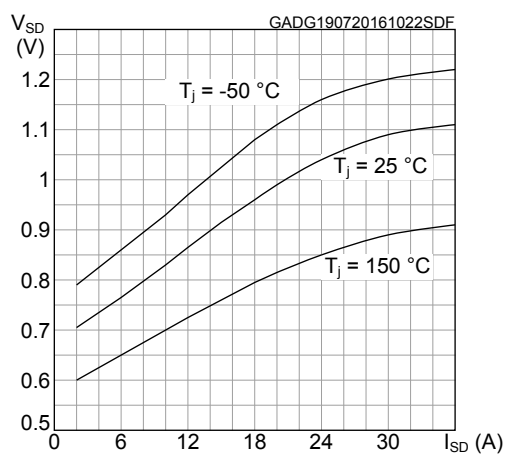
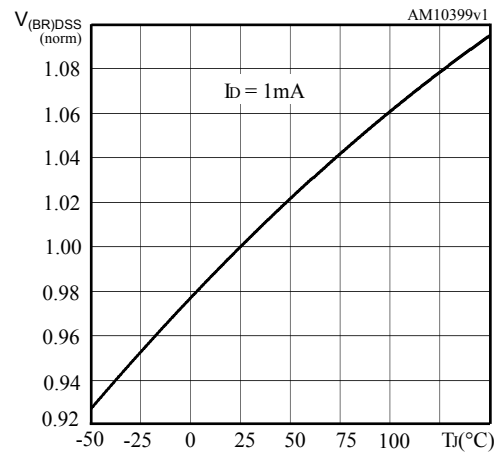
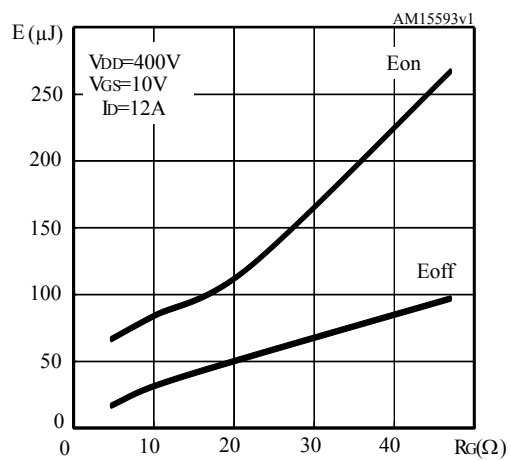
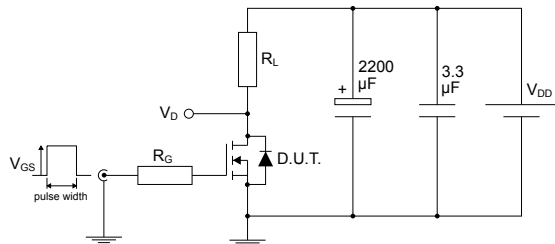
Figure 7. Typical capacitance characteristics

Figure 8. Typical output capacitance stored energy

Figure 9. Normalized gate threshold vs temperature

Figure 10. Normalized on-resistance vs temperature

Figure 11. Typical reverse diode forward characteristics

Figure 12. Normalized breakdown voltage vs temperature


Figure 13. Typical switching energy vs gate resistance

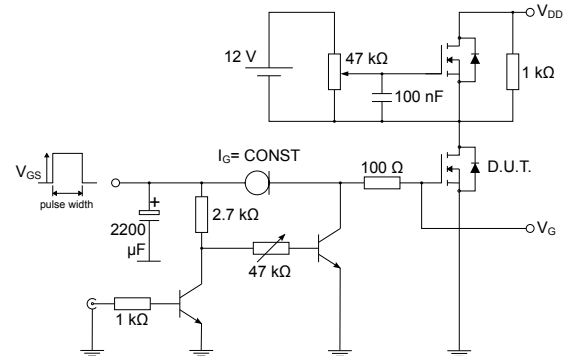


Note: E_{on} including reverse recovery of a SiC diode.

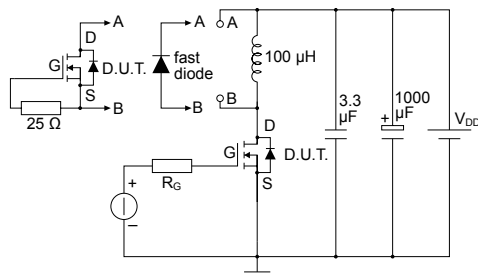
3 Test circuits

Figure 14. Test circuit for resistive load switching times


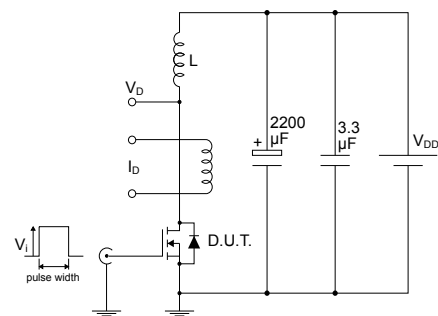
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Figure 15. Test circuit for gate charge behavior


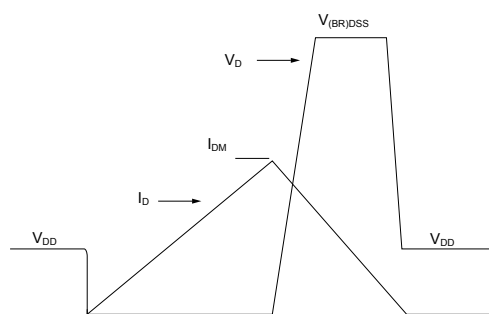
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Figure 16. Test circuit for inductive load switching and diode recovery times


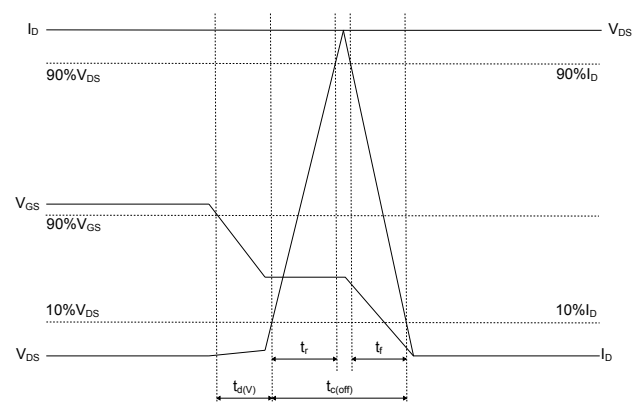
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Figure 17. Unclamped inductive load test circuit


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Figure 18. Unclamped inductive waveform


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Figure 19. Switching time waveform


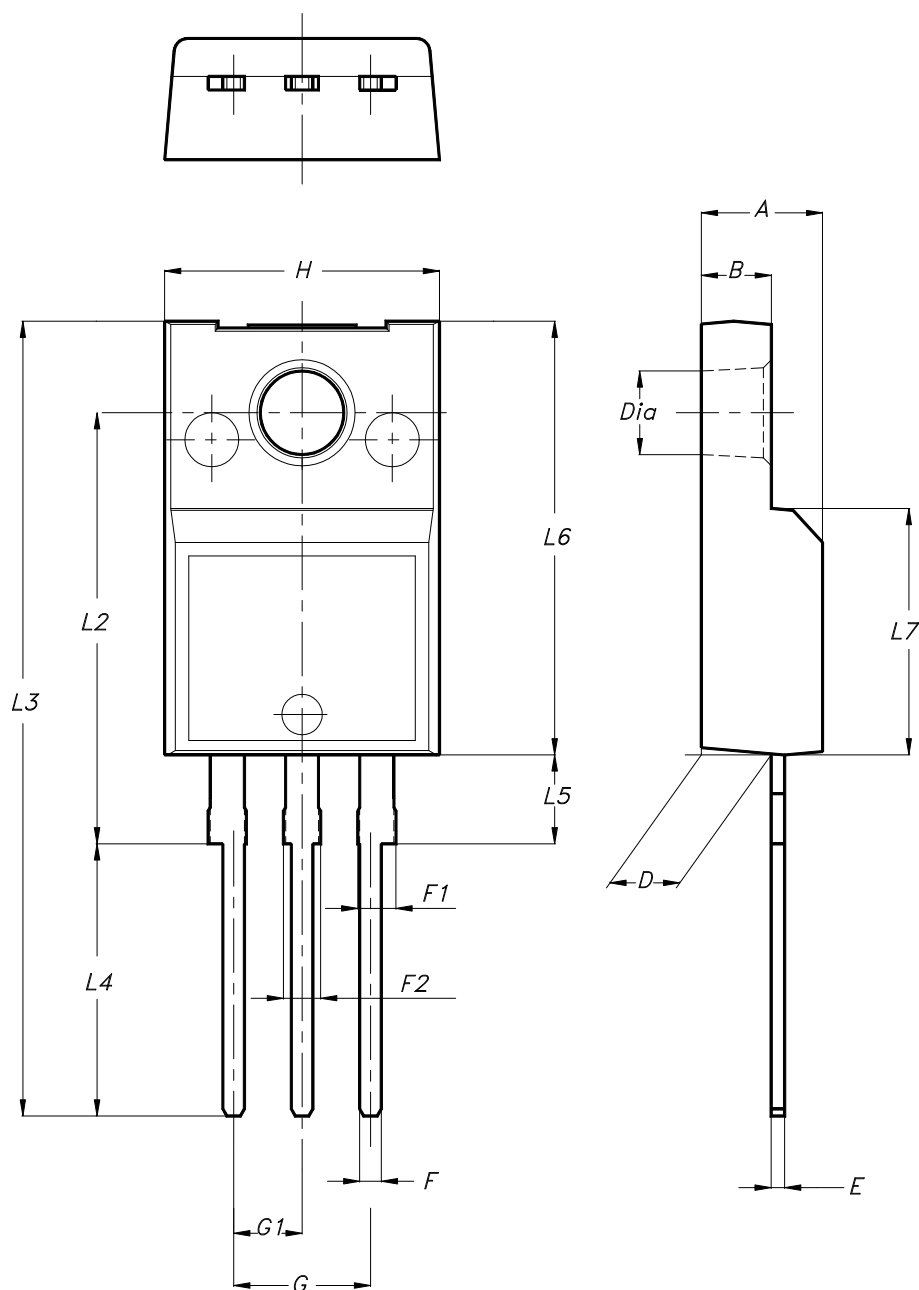
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4 Package information

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 type B package information

Figure 20. TO-220FP type B package outline



7012510_B_rev.14

Table 8. TO-220FP type B package 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		0.70
F	0.75		1.00
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.20
G1	2.40		2.70
H	10.00		10.40
L2		16.00	
L3	28.60		30.60
L4	9.80		10.60
L5	2.90		3.60
L6	15.90		16.40
L7	9.00		9.30
Dia	3.00		3.20

Revision history

Table 9. Document revision history

Date	Revision	Changes
01-Feb-2013	1	First release. Part numbers previously included in datasheet DM00049308.
21-Jul-2016	2	Added device in TO-3PF. Modified: <i>Table 2: "Absolute maximum ratings", Table 5: "On /off states"</i> . Modified: <i>Figure 2: "Safe operating area for TO-220FP and I²PAKFP", Figure 4: "Safe operating area for TO-3PF", Figure 5: "Thermal impedance for TO-3PF"</i> . Minor text changes.
22-Mar-2017	3	Modified <i>Table 2: "Absolute maximum ratings", Table 8: "Source drain diode"</i> . Modified <i>Figure 2: "Safe operating area for TO-220FP and I²PAKFP", Figure 4: "Safe operating area for TO-3PF", Figure 12: "Normalized gate threshold voltage vs temperature ", Figure 13: "Normalized onresistance vs temperature" and Figure 14: "Source-drain diode forward characteristics "</i> . Minor text changes.
01-Dec-2025	4	Removed order code STFI20N65M5 and STFW20N65M5. Updated Section 4: Package information . Minor text changes.

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