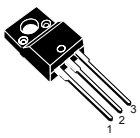
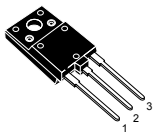
STF40N60M2, STFW40N60M2

Datasheet

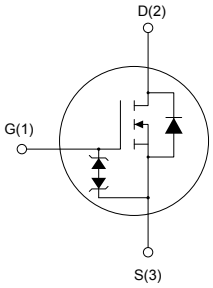
N-channel 600 V, 78 mΩ typ., 34 A MDmesh M2 Power MOSFET in a TO-220FP and TO-3PF packages



TO-220FP



TO-3PF



AM01476v1

Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STF40N60M2	600 V	88 mΩ	34 A
STFW40N60M2			

- Extremely low gate charge
- Excellent output capacitance (C_{oss}) profile
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

These devices are N-channel Power MOSFETs developed using the MDmesh M2 technology. Thanks to their strip layout and improved vertical structure, these devices exhibit low on-resistance and optimized switching characteristics, rendering them suitable for the most demanding high-efficiency converters.

Product status links
STF40N60M2
STFW40N60M2

Product summary	
Order code	**STF40N60M2**
Marking	40N60M2
Package	TO-220FP
Packing	Tube
Order code	**STFW40N60M2**
Marking	40N60M2
Package	TO-3PF
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220FP	TO-3PF	
V_{DS}	Drain-source voltage	600		V
V_{GS}	Gate-source voltage	±25		V
I_D	Drain current (continuous) at T_C = 25 °C	34		A
I_D	Drain current (continuous) at T_C = 100 °C	22		A
I_{DM}(1)	Drain current (pulsed)	136		A
P_{TOT}	Total power dissipation at T_C = 25 °C	40	63	W
dv/dt(2)	Peak diode recovery voltage slope	15		V/ns
dv/dt(3)	MOSFET dv/dt ruggedness	50		V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T_C = 25 °C)	2.5	3.5	kV
T_{stg}	Storage temperature range	-55 to 150		°C
T_J	Operating junction temperature range			

1. *Pulse width limited by safe operating area.*
2. *I_{SD} ≤ 34 A, di/dt ≤ 400 A/µs, V_{DS} (peak) < $V_{(BR)DSS}$, V_{DD} = 400 V.*
3. *V_{DD} = 480 V.*

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		TO-220FP	TO-3PF	
R_{thJC}	Thermal resistance, junction-to-case	3.13	2	°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	62.5	50	°C/W

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_J max.)	6	A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	500	mJ

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	I_D = 1 mA, V_{GS} = 0 V	600	-	-	V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 600 V	-	-	1	µA
		V_{GS} = 0 V, V_{DS} = 600 V, T_C = 125 °C(1)	-	-	100	µA
I_{GSS}	Gate body leakage current	V_{DS} = 0 V, V_{GS} = ±25 V	-	-	±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 17 A	-	78	88	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 V, f = 1 MHz, V_{GS} = 0 V	-	2500	-	pF
C_{oss}	Output capacitance		-	117	-	pF
C_{rss}	Reverse transfer capacitance		-	2.4	-	pF
$C_{oss\ eq.}$(1)	Equivalent capacitance time related	V_{DS} = 0 to 480 V, V_{GS} = 0 V	-	342	-	pF
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 4.5 A, V_{GS} = 0 to 10 V (see the Figure 16. Test circuit for gate charge behavior)	-	57	-	nC
Q_{gs}	Gate-source charge		-	10	-	nC
Q_{gd}	Gate-drain charge		-	25.5	-	nC
R_g	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	4.4	-	Ω

1. *$C_{oss\ eq.}$ 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}.*

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 300 V, I_D = 34 A, R_G = 4.7 Ω, V_{GS} = 10 V (see the Figure 15. Test circuit for resistive load switching times and Figure 20. Switching time waveform)	-	20.5	-	ns
t_r	Rise time		-	13.5	-	ns
$t_{d(off)}$	Turn-off delay time		-	96	-	ns
t_f	Fall time		-	11	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-	34	-	A
I_{SDM}(1)	Source-drain current (pulsed)		-	136	-	A
V_{SD}(2)	Forward on voltage	I_{SD} = 34 A, V_{GS} = 0 V	-	-	1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 34 A, di/dt = 100 A/µs, V_{DD} = 60 V (see the Figure 17. Test circuit for inductive load switching and diode recovery times)	-	440	-	ns
Q_{rr}	Reverse recovery charge		-	8.2	-	µC
I_{RRM}	Reverse recovery current		-	37	-	A
t_{rr}	Reverse recovery time	I_{SD} = 34 A, di/dt = 100 A/µs, V_{DD} = 60 V, T_J = 150 °C (see the Figure 17. Test circuit for inductive load switching and diode recovery times)	-	568	-	ns
Q_{rr}	Reverse recovery charge		-	11.5	-	µC
I_{RRM}	Reverse recovery current		-	40.5	-	A

1. *Pulse width 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 for TO-220FP

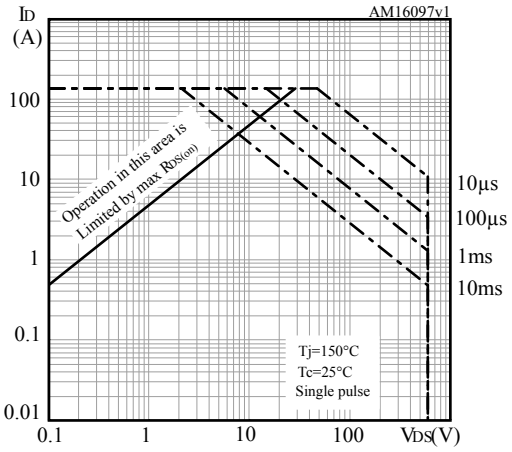


Figure 2. Normalized transient thermal impedance for TO-220FP

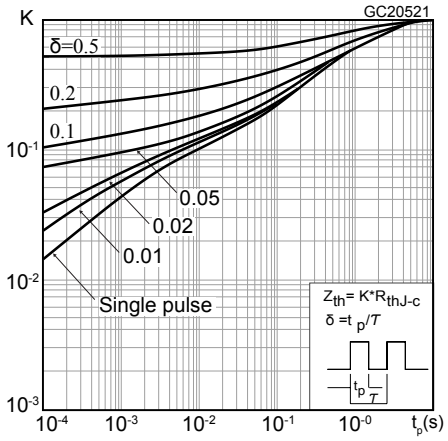


Figure 3. Safe operating area for TO-3PF

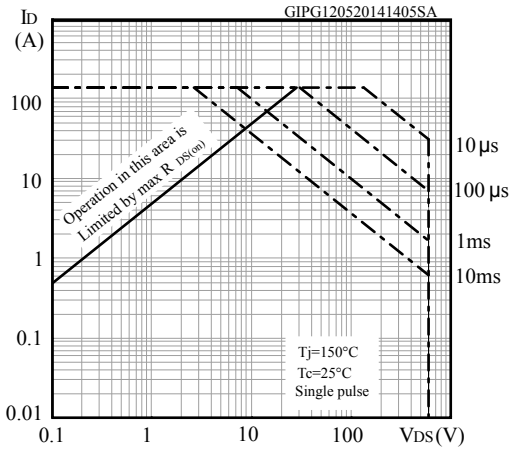


Figure 4. Normalized transient thermal impedance for TO-3PF

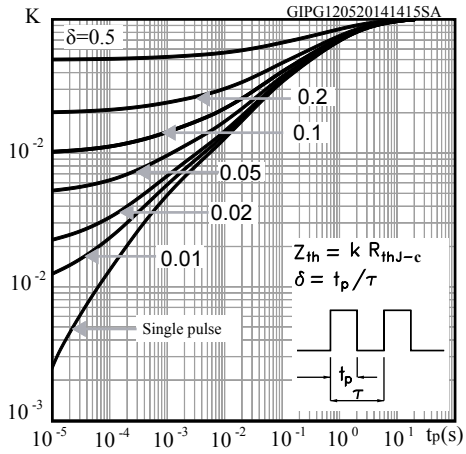


Figure 5. Typical output characteristics

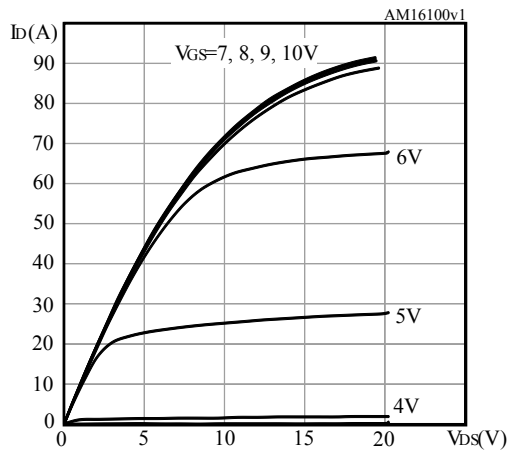


Figure 6. Typical transfer characteristics

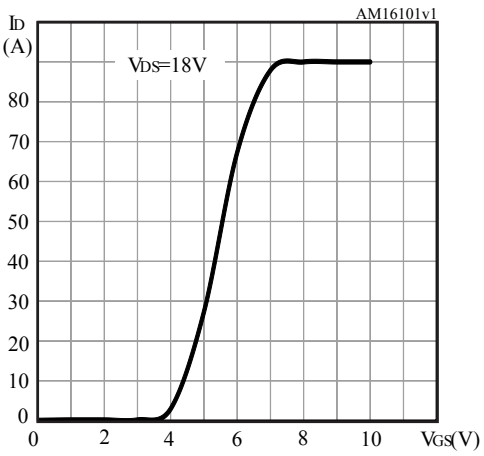


Figure 7. Typical gate charge characteristics

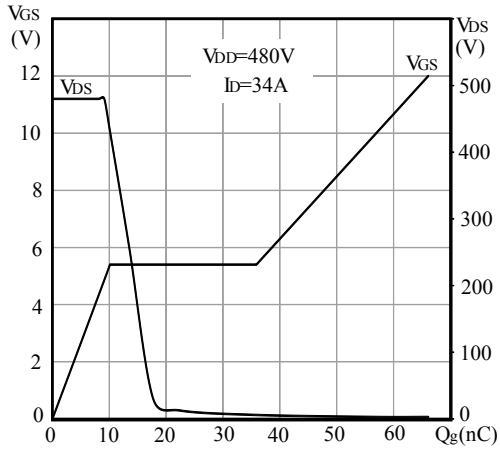


Figure 8. Typical drain-source on-resistance

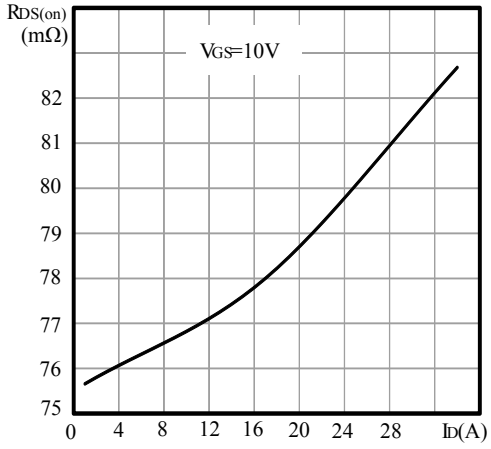


Figure 9. Typical capacitance characteristics

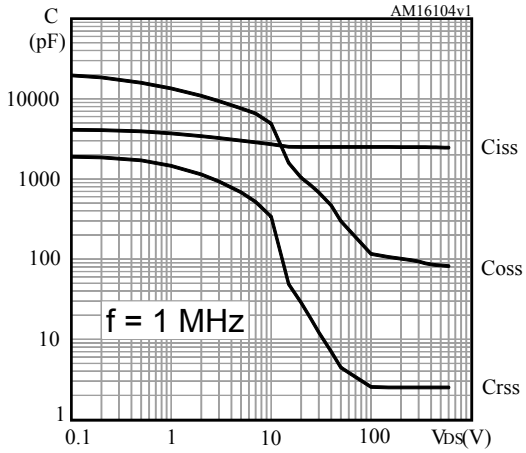


Figure 10. Typical output capacitance stored energy

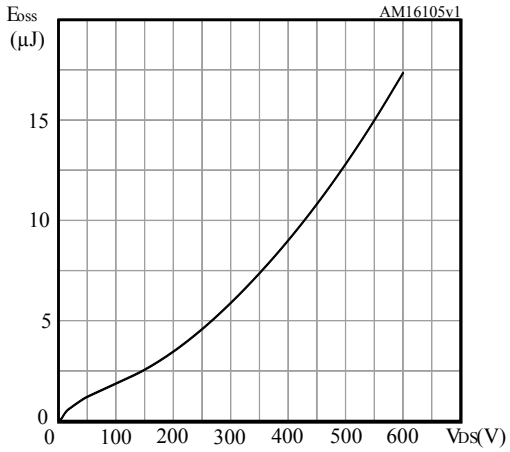


Figure 11. Normalized gate threshold vs temperature

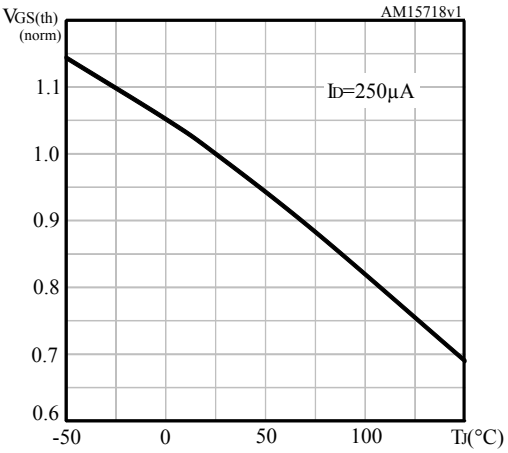


Figure 12. Normalized on-resistance vs temperature

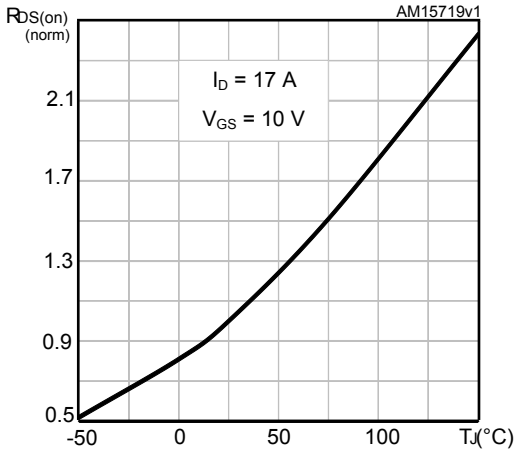


Figure 13. Normalized breakdown voltage vs temperature

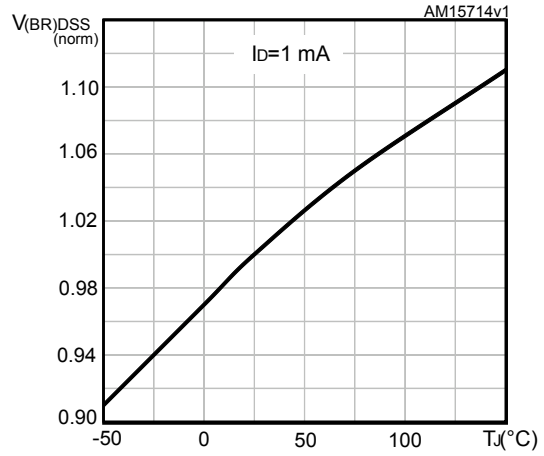
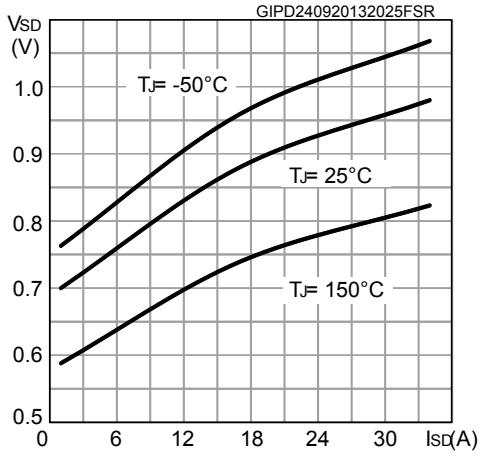
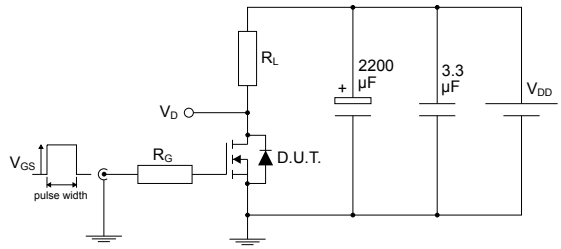


Figure 14. Typical reverse diode forward characteristics



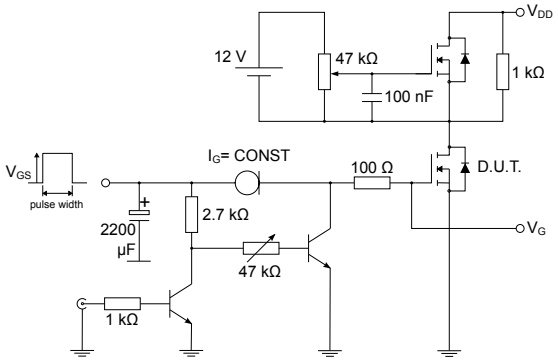
3 Test circuits

Figure 15. Test circuit for resistive load switching times



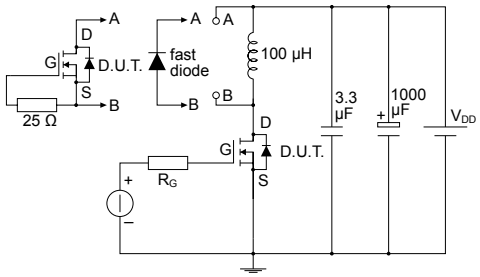
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Figure 16. Test circuit for gate charge behavior



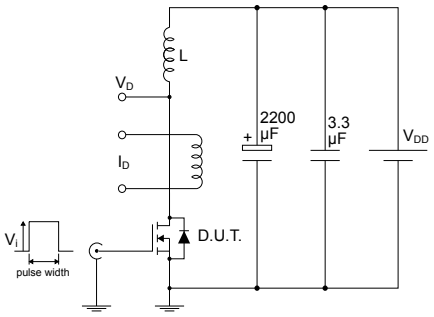
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Figure 17. Test circuit for inductive load switching and diode recovery times



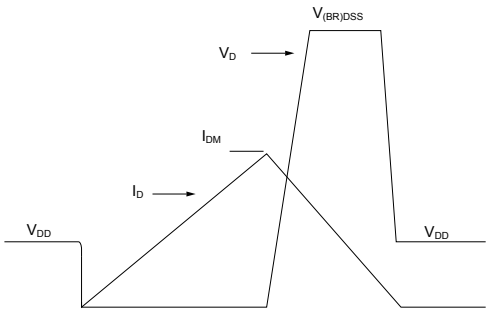
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Figure 18. Unclamped inductive load test circuit



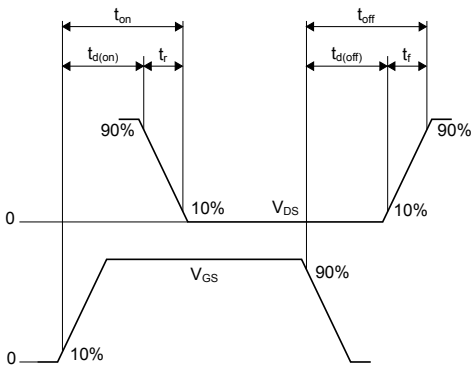
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Figure 19. Unclamped inductive waveform



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Figure 20. Switching time waveform



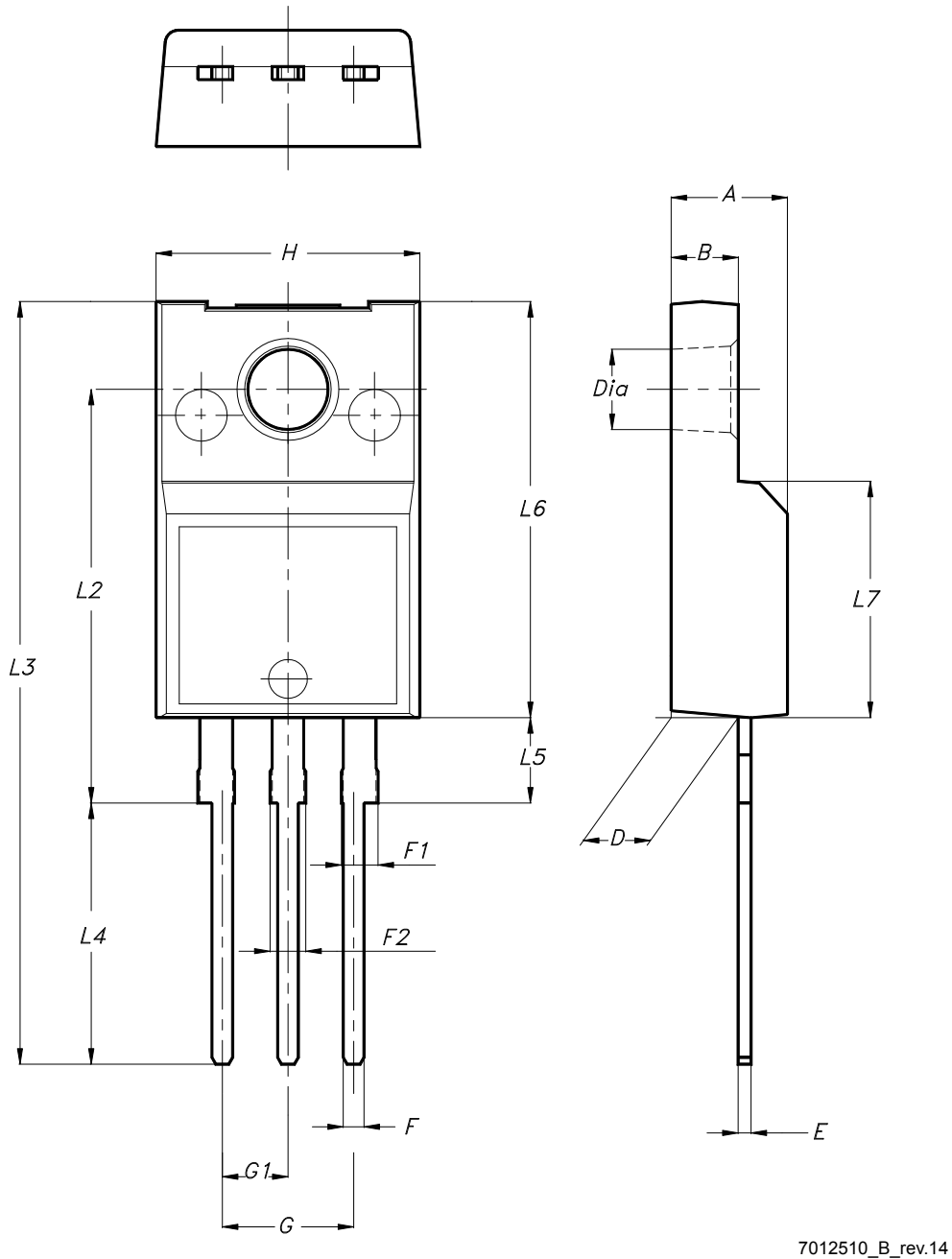
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4 Package information

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 21. 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

4.2 TO-3PF type A package information

Figure 22. **TO-3PF type A package outline**

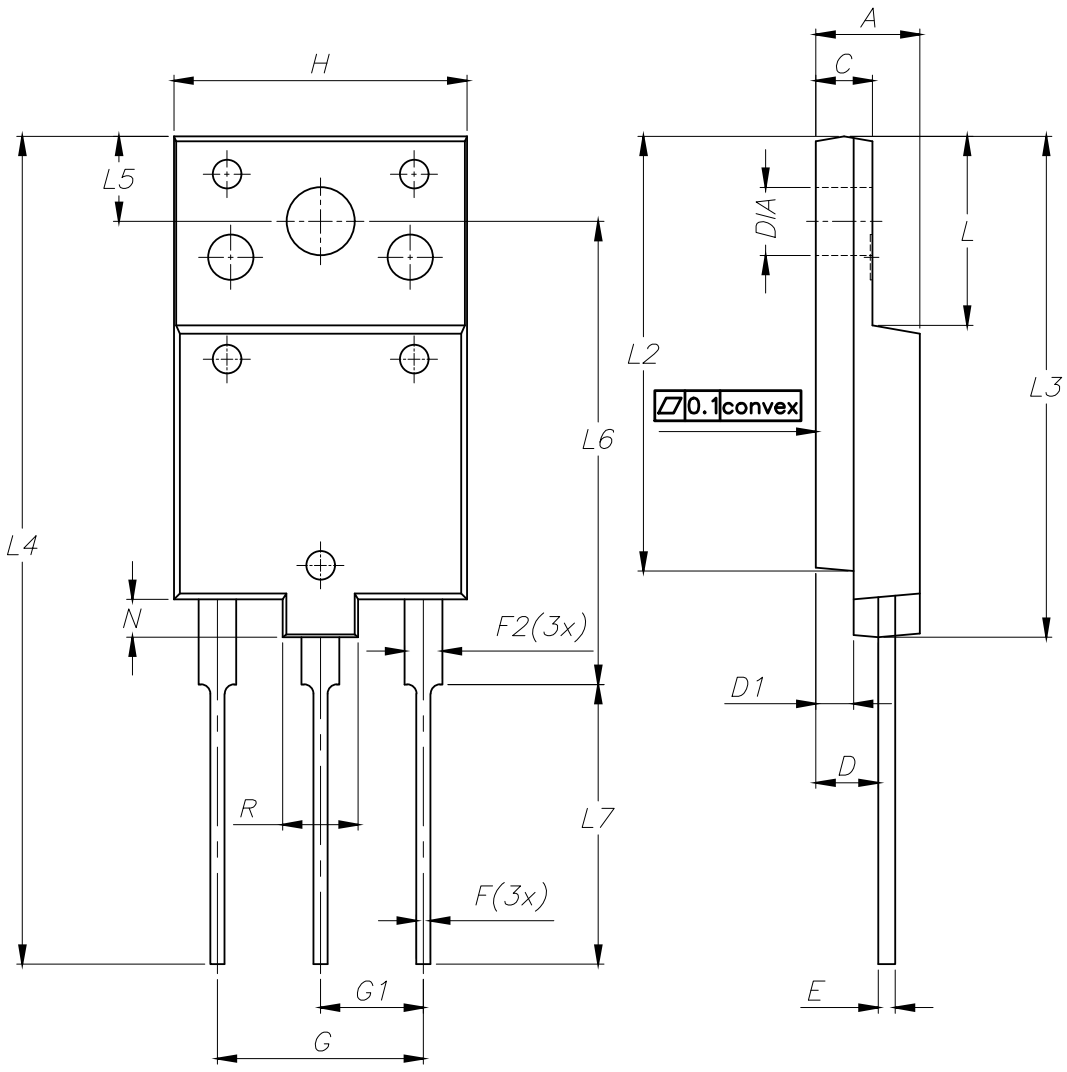


Table 9. **TO-3PF type A mechanical data**

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		1.00
F	0.65		0.85
F2	1.80		2.20
G	10.80		11.00
G1	5.35	5.45	5.55
H	15.30		15.70
L	9.80	10.00	10.20
L2	22.80		23.20
L3	26.30		26.70
L4	43.60		44.00
L5	4.30		4.70
L6	24.30		24.70
L7	14.60		15.00
N	1.80		2.20
R	3.80		4.20
Dia	3.40		3.80

Revision history

Table 10. **Document revision history**

Date	Revision	Changes
15-May-2014	1	First release. Part numbers STF40N60M2 and STFI40N60M2 previously included in datasheet DocID024932.
28-Sep-2016	2	Updated title in cover page. Updated *Table 2: Absolute maximum ratings*, *Table 5: On /off states*, *Table 6: Dynamic* and *Table 8: Source drain diode*. Minor text changes.
03-Dec-2025	3	Removed order code STFI40N60M2. Updated Section 4: Package information. Minor text changes.

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