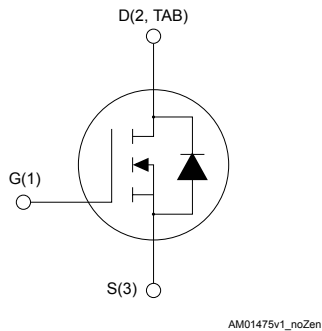
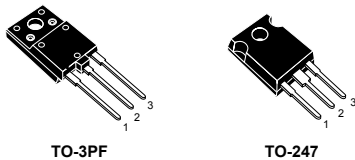




N-channel 650 V, 37 mΩ typ., 58 A MDmesh M5 Power MOSFETs in a TO-3FP and TO-247 packages



Features

Order code	V _{DS}	R _{DS(on)} max.	I _D
STFW69N65M5	650 V	45 mΩ	58 A
STW69N65M5			

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

Applications

- Switching applications

Description

These devices are N-channel Power MOSFETs based on the MDmesh M5 innovative vertical process technology combined with the well-known PowerMESH horizontal layout. The resulting products offer extremely low on-resistance, making them particularly suitable for applications requiring high power and superior efficiency.



Product status links

[STFW69N65M5](#)

[STW69N65M5](#)

Product summary

Order code	STFW69N65M5
Marking	69N65M5
Package	TO-3FP
Packing	Tube
Order code	STW69N65M5
Marking	69N65M5
Package	TO-247
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-3PF	TO-247	
V _{DS}	Drain-source voltage	650		V
V _{GS}	Gate-source voltage	±25		V
I _D	Drain current (continuous) at T _C = 25 °C	58		A
	Drain current (continuous) at T _C = 100 °C	36.5		
I _{DM} ⁽¹⁾	Drain current (pulsed)	232		A
P _{TOT}	Total power dissipation at T _C = 25 °C	79	330	W
dv/dt ⁽²⁾	Peak diode recovery voltage slope	15		V/ns
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s, T _C = 25 °C)	3.5	-	kV
T _{stg}	Storage temperature range	-55 to 150		°C
T _J	Maximum operating junction temperature range	150		°C

1. Pulse width is limited by safe operating area.
2. $I_{SD} \leq 58\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DS}(\text{peak}) < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$.

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		TO-3PF	TO-247	
R_{thJC}	Thermal resistance, junction-to-case	1.58	0.38	$^{\circ}\text{C}/\text{W}$
R_{thJA}	Thermal resistance, junction-to-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_J max.)	12	A
E_{AS}	Single pulse avalanche energy (starting $T_J = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	1410	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	$V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$	650	-	-	V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$	-	-	1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$, $T_C = 125\text{ °C}^{(1)}$	-	-	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	$V_{GS} = 10\text{ V}$, $I_D = 29\text{ A}$	-	37	45	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	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	6420	-	pF
C_{oss}	Output capacitance		-	170	-	pF
C_{rss}	Reverse transfer capacitance		-	11	-	pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }520\text{ V}$, $V_{GS} = 0\text{ V}$	-	536	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related		-	146	-	pF
R_g	Intrinsic gate resistance	$f = 1\text{ MHz}$, $I_D = 0\text{ A}$	-	1.2	-	Ω
Q_g	Total gate charge	$V_{DD} = 520\text{ V}$, $I_D = 29\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (see the Figure 17. Test circuit for gate charge behavior)	-	143	-	nC
Q_{gs}	Gate-source charge		-	38	-	nC
Q_{gd}	Gate-drain charge		-	64	-	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	$V_{DD} = 400\text{ V}$, $I_D = 38\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$	-	102	-	ns
$t_{r(v)}$	Voltage rise time		-	13.5	-	ns
$t_{f(i)}$	Current fall time	(see the Figure 18. Test circuit for inductive load switching and diode recovery times and Figure 21. Switching time waveform)	-	10	-	ns
$t_{c(off)}$	Crossing time		-	19	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-	-	58	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-	-	232	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 58 \text{ A}$, $V_{GS} = 0 \text{ V}$	-	-	1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 58 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 100 \text{ V}$	-	480	-	ns
Q_{rr}	Reverse recovery charge		-	11	-	μC
I_{RRM}	Reverse recovery current	(see the Figure 18. Test circuit for inductive load switching and diode recovery times)	-	46	-	A
t_{rr}	Reverse recovery time	$I_{SD} = 58 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 100 \text{ V}$, $T_J = 150 \text{ }^\circ\text{C}$	-	592	-	ns
Q_{rr}	Reverse recovery charge		-	16	-	μC
I_{RRM}	Reverse recovery current	(see the Figure 18. Test circuit for inductive load switching and diode recovery times)	-	53	-	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 for TO-3PF

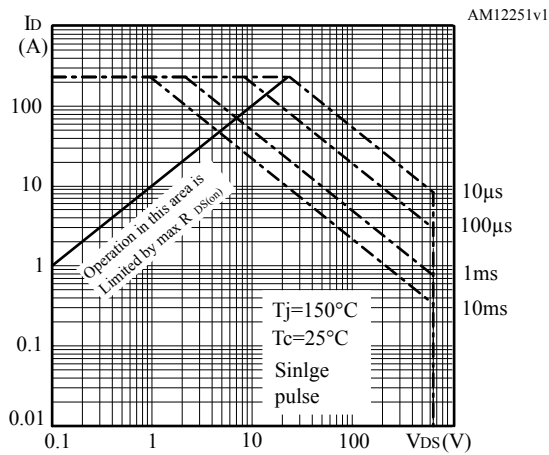


Figure 2. Normalized transient thermal impedance for TO-3PF

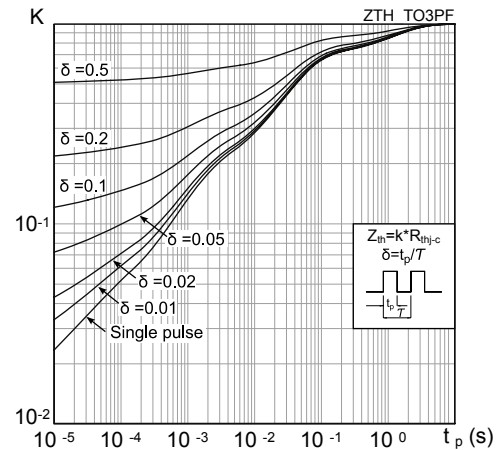


Figure 3. Safe operating area for TO-247

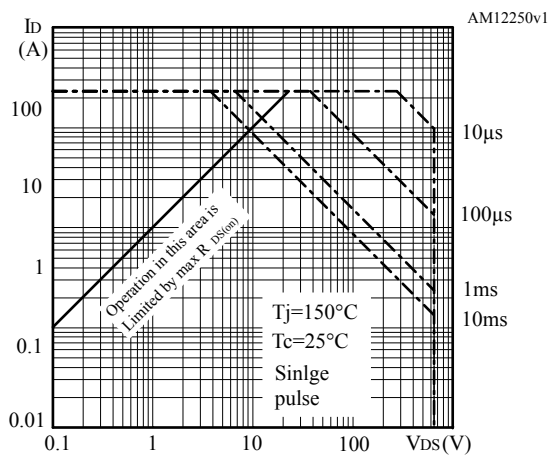


Figure 4. Normalized transient thermal impedance for TO-247

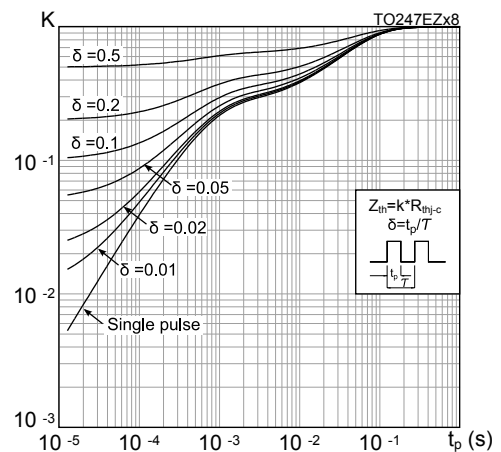


Figure 5. Typical output characteristics

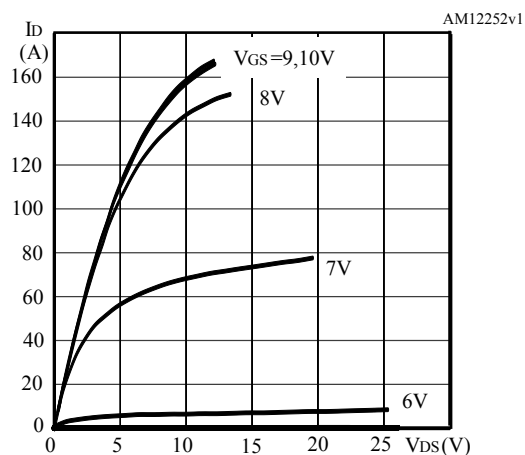


Figure 6. Typical transfer characteristics

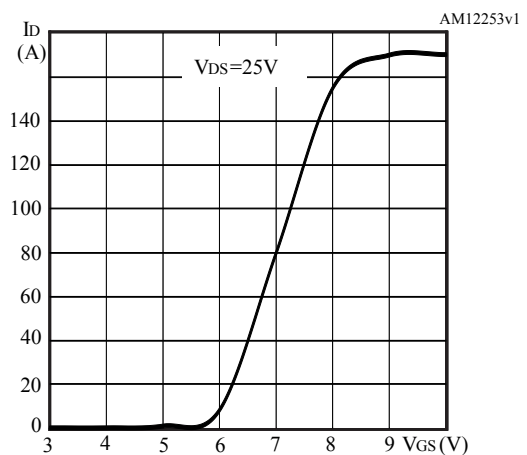


Figure 7. Typical gate charge characteristics

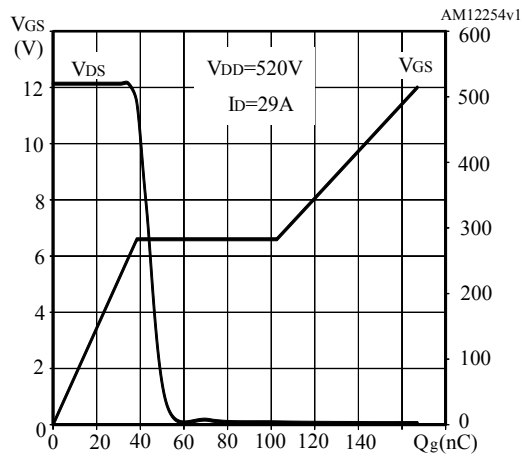


Figure 8. Typical capacitance characteristics

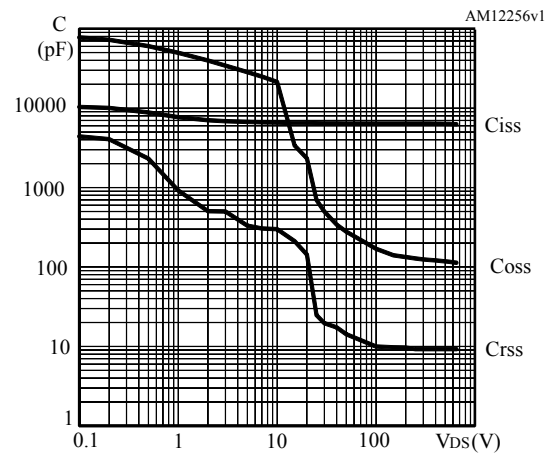


Figure 9. Typical drain-source on-resistance

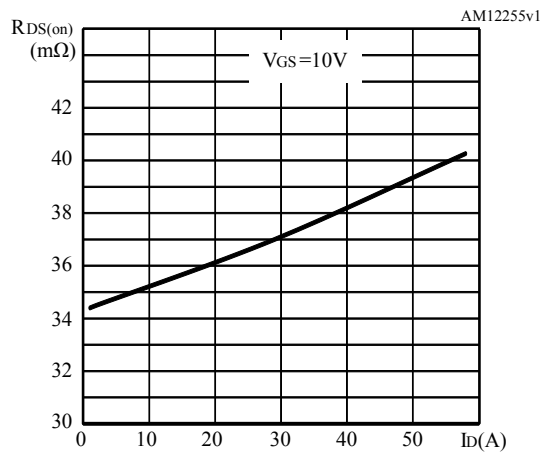


Figure 10. Typical output capacitance stored energy

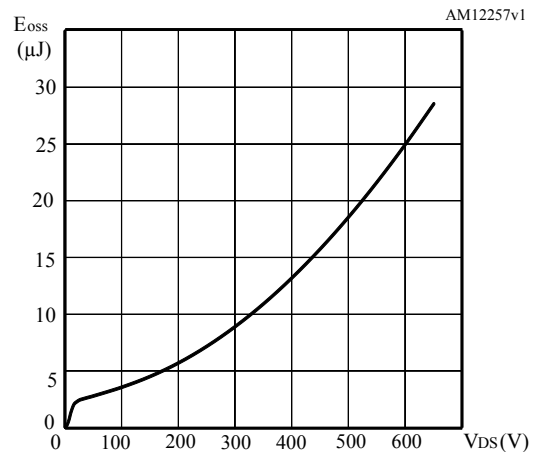


Figure 11. Normalized gate threshold voltage vs temperature

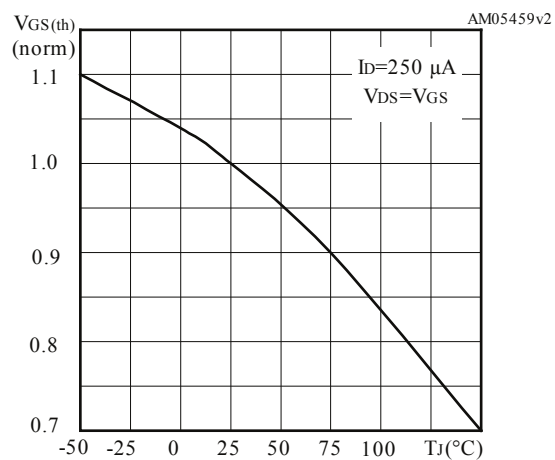


Figure 12. Normalized on-resistance vs temperature

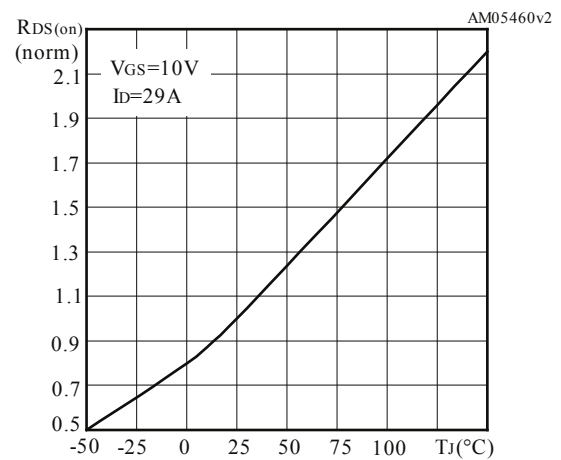


Figure 13. Typical reverse diode forward characteristics

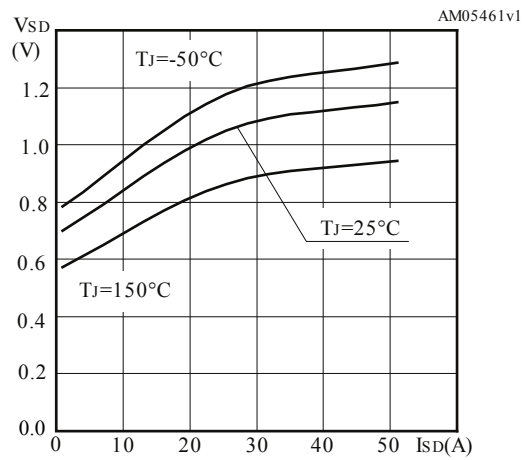


Figure 14. Normalized breakdown voltage vs temperature

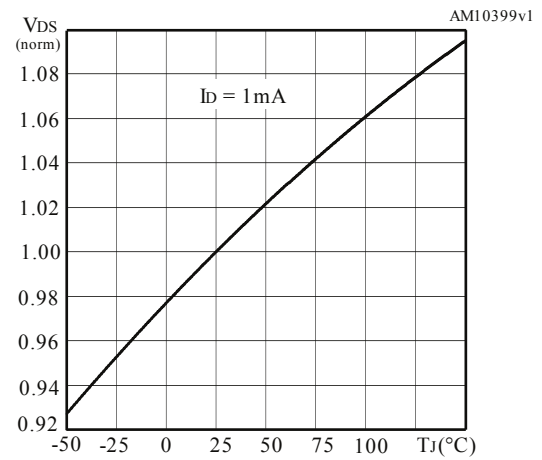
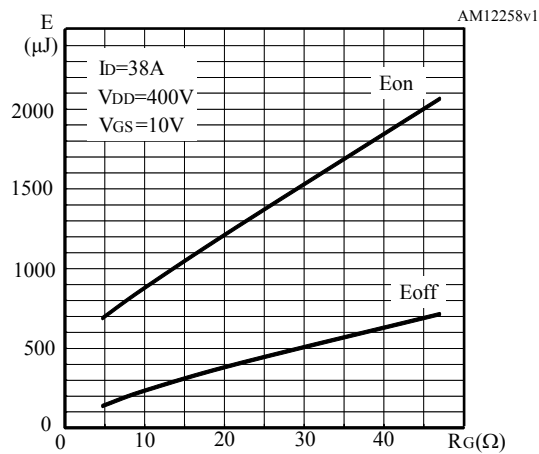
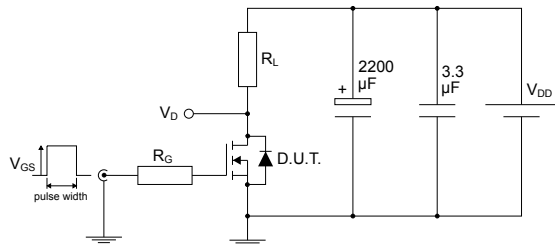


Figure 15. Typical switching energy vs gate resistance

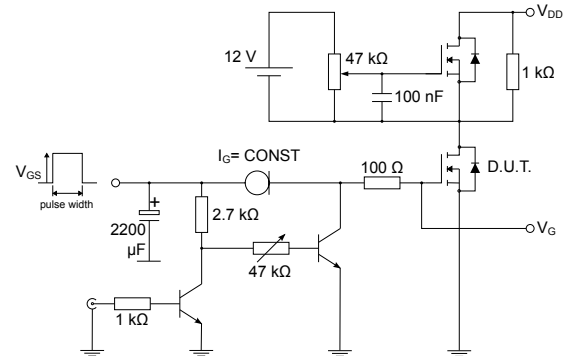


Note: E_{on} including reverse recovery of a SiC diode.

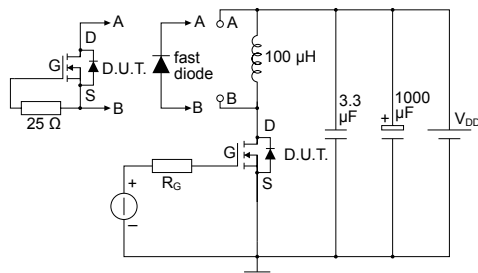
3 Test circuits

Figure 16. Test circuit for resistive load switching times


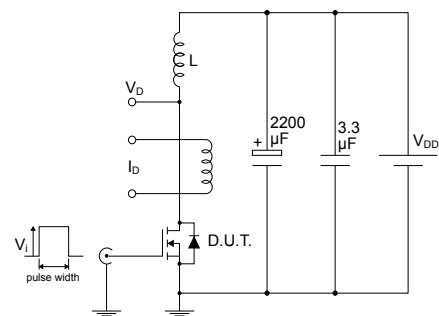
AM01468v1

Figure 17. Test circuit for gate charge behavior


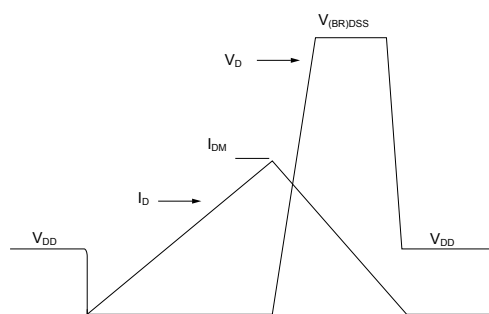
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Figure 18. Test circuit for inductive load switching and diode recovery times


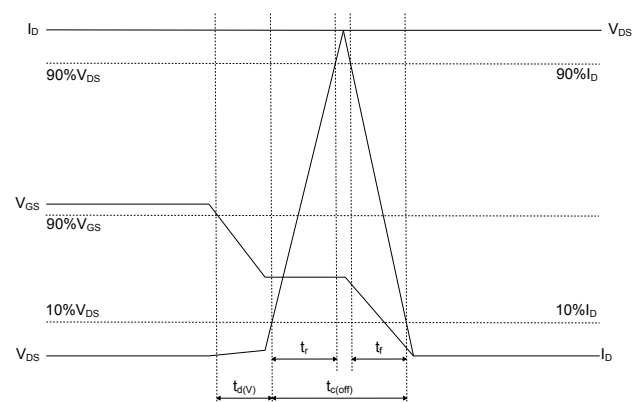
AM01470v1

Figure 19. Unclamped inductive load test circuit


AM01471v1

Figure 20. Unclamped inductive waveform


AM01472v1

Figure 21. Switching time waveform


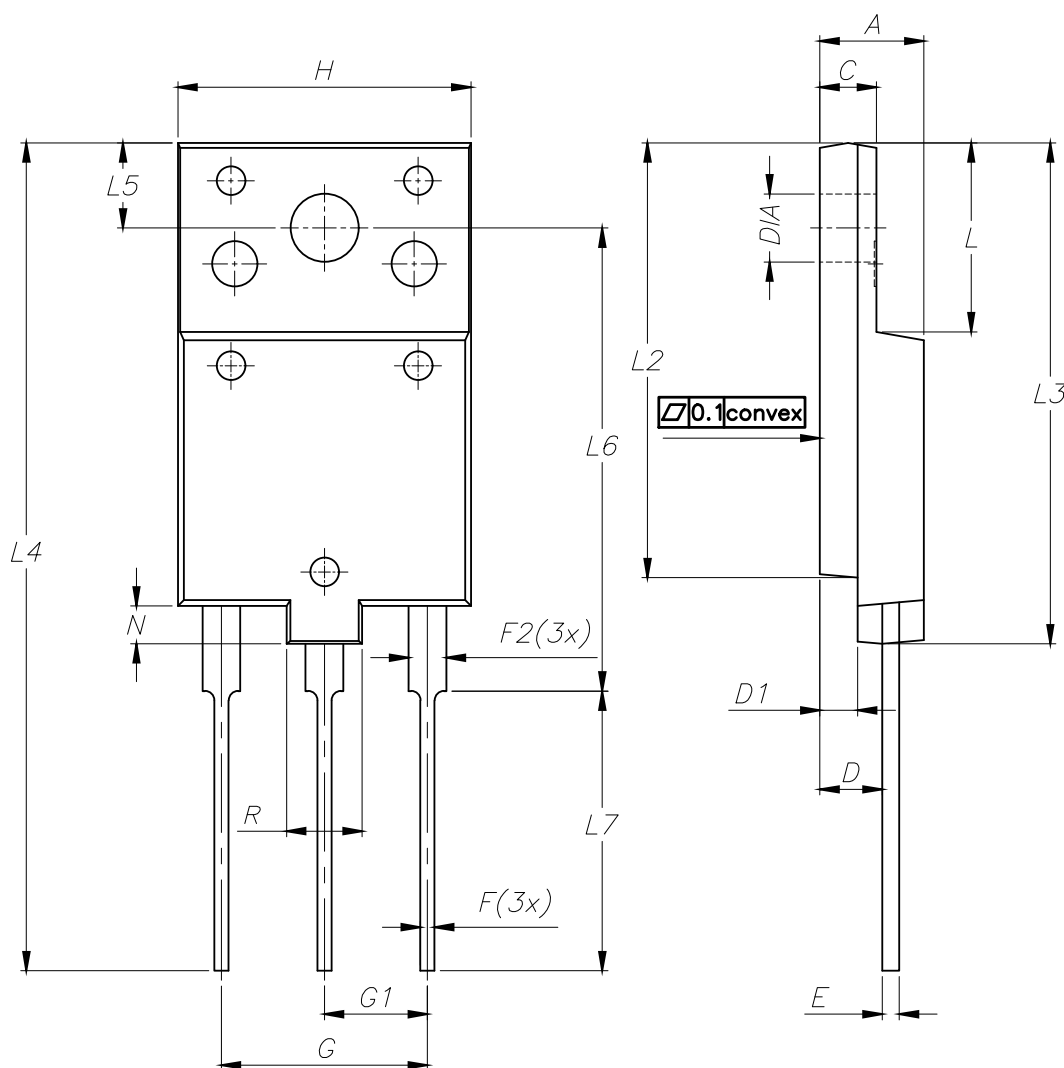
AM05540v2

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-3PF type A package information

Figure 22. TO-3PF type A package outline



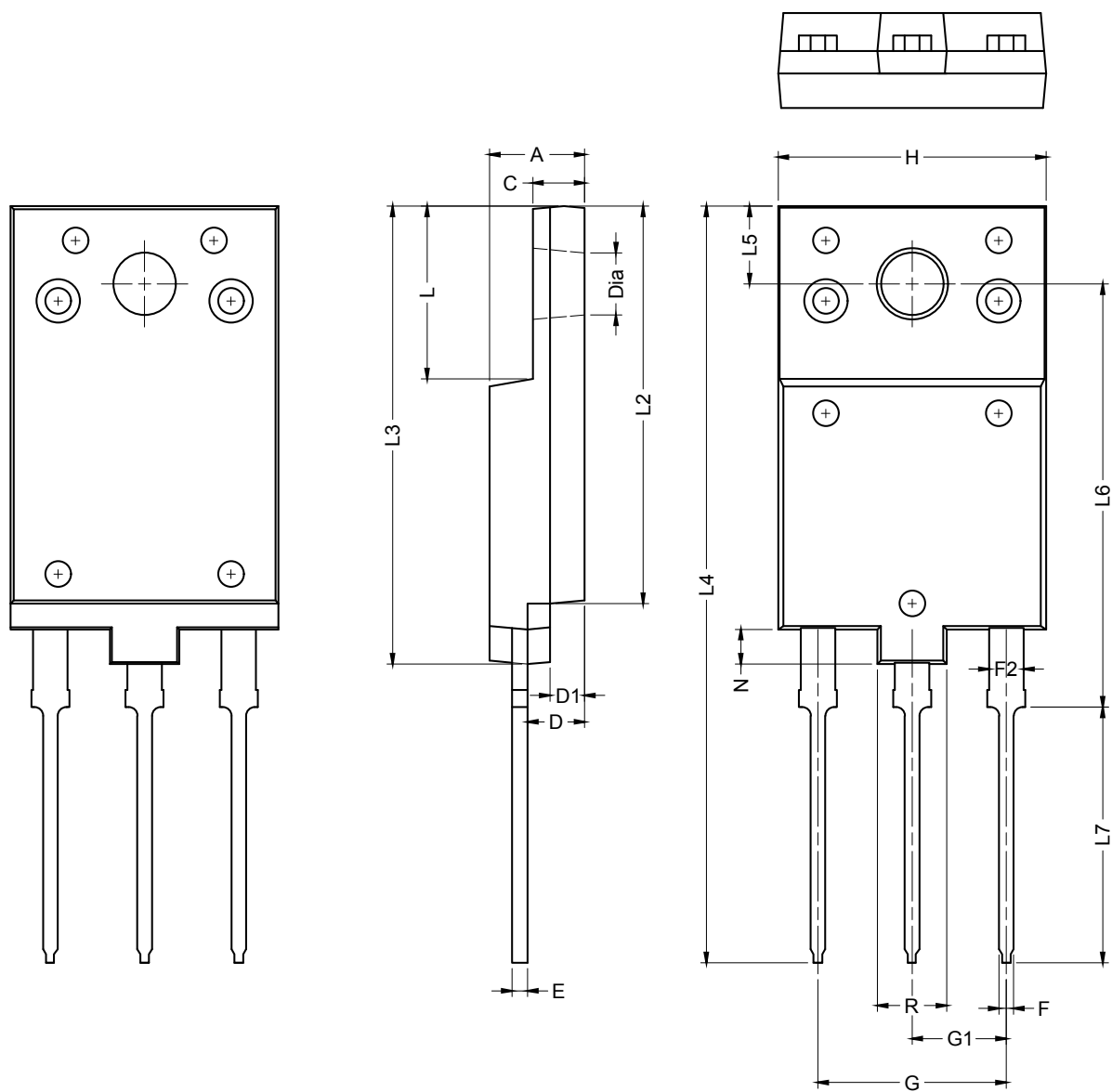
7627132_type_A_9

Table 8. 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

4.2 TO-3PF type B package information

Figure 23. TO-3PF type B package outline



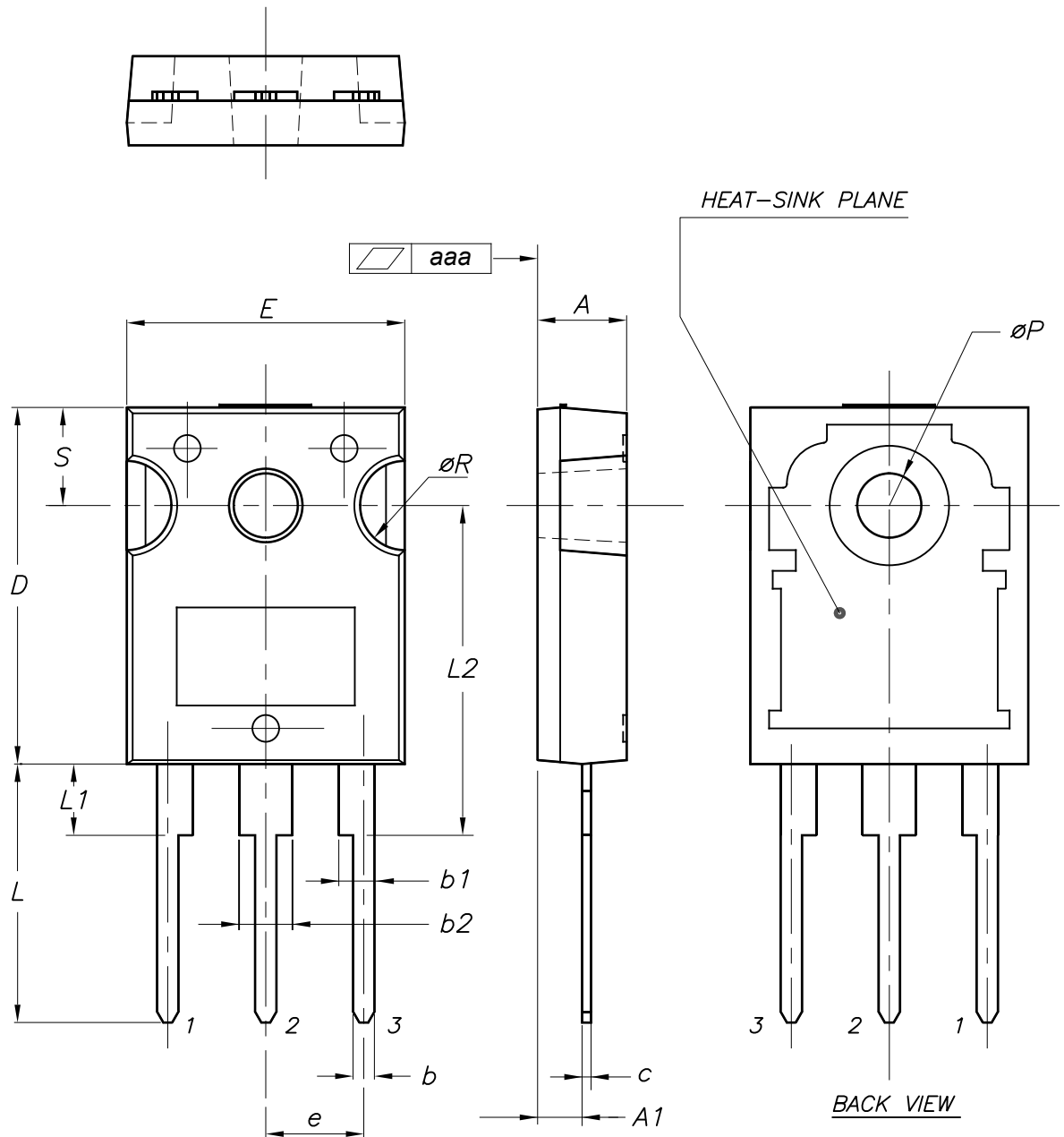
7627132_type_B_9

Table 9. TO-3PF type B mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	5.30	5.50	5.70
C	2.80	3.00	3.20
D	3.10	3.30	3.50
D1	1.80	2.00	2.20
E	0.80	0.95	1.10
F	0.65	0.80	0.95
F2	1.80	2.00	2.20
G	10.30	10.90	11.50
G1		5.45	
H	15.30	15.50	15.70
L	9.80	10.00	10.20
L2	22.80	23.00	23.20
L3	26.30	26.50	26.70
L4	43.20	43.80	44.40
L5	4.30	4.50	4.70
L6	24.30	24.50	24.70
L7	14.60	14.80	15.00
N	1.80	2.00	2.20
R	3.80	4.00	4.20
Dia	3.40	3.60	3.80

4.3 TO-247 package information

Figure 24. TO-247 package outline



0075325_10

Table 10. TO-247 package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70
aaa		0.04	0.10

Revision history

Table 11. Document revision history

Date	Revision	Changes
27-Feb-2012	1	First release.
28-Sep-2012	2	Modified: <i>note 3</i> of <i>Table 2</i> , values in <i>Table 4</i> , typ. values in <i>Table 6</i> , 7 and 8. Curves inserted. Minor text changes.
12-Aug-2025	3	Updated Section 4: Package information . Minor text changes.

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