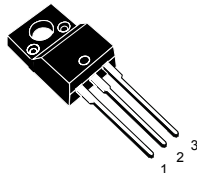
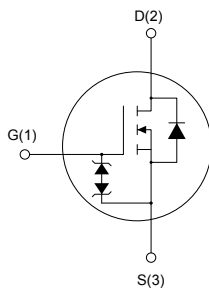


N-channel 600 V, 135 mΩ typ., 22 A MDmesh M2 Power MOSFET in a TO-220FP package



TO-220FP



AM01476v1_noTAB



Product status link

[STF28N60M2](#)

Product summary

Order code	STF28N60M2
Marking	28N60M2
Package	TO-220FP
Packing	Tube

Features

Order code	V _{DS}	R _{DS(on)} max.	I _D
STF28N60M2	600 V	150 mΩ	22 A

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

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET developed using MDmesh M2 technology. Thanks to its strip layout and an improved vertical structure, the device exhibits low on-resistance and optimized switching characteristics, rendering it suitable for the most demanding high efficiency converters.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	600	V
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$	22	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	14	A
$I_{DM}^{(1)}$	Drain current (pulsed)	88	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
$dv/dt^{(3)}$	MOSFET dv/dt ruggedness	50	V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink ($t = 1\text{ s}$; $T_C = 25\text{ }^{\circ}\text{C}$)	2.5	kV
T_{stg}	Storage temperature range	-55 to 150	$^{\circ}\text{C}$
T_J	Maximum operating junction temperature		

1. Pulse width limited by safe operating area.
2. $I_{SD} \leq 22\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DS}(\text{peak}) < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$.
3. $V_{DD} = 480\text{ V}$.

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	$^{\circ}\text{C}/\text{W}$

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_J max.)	3.6	A
E_{AS}	Single pulse avalanche energy (starting $T_J = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	350	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	$I_D = 1\text{ mA}$, $V_{GS} = 0\text{ V}$	600	-	-	V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 600\text{ V}$	-	-	1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 600\text{ V}$, $T_C = 125\text{ }^{\circ}\text{C}^{(1)}$	-	-	100	μA
I_{GSS}	Gate body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 25\text{ V}$	-	-	± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 11\text{ A}$	-	135	150	$\text{m}\Omega$

1. Specified by design, not tested in production.

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	1440	-	pF
C_{oss}	Output capacitance		-	70	-	pF
C_{rss}	Reverse transfer capacitance		-	2	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }480\text{ V}$, $V_{GS} = 0\text{ V}$	-	104	-	pF
Q_g	Total gate charge	$V_{DD} = 480\text{ V}$, $I_D = 22\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (see the Figure 14. Test circuit for gate charge behavior)	-	36	-	nC
Q_{gs}	Gate-source charge		-	7.2	-	nC
Q_{gd}	Gate-drain charge		-	16	-	nC
R_g	Intrinsic gate resistance	$f = 1\text{ MHz}$, $I_D = 0\text{ A}$	-	5.5	-	Ω

1. $C_{oss\text{ eq.}}$ 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	$V_{DD} = 300\text{ V}$, $I_D = 11\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$	-	14.5	-	ns
t_r	Rise time		-	7.2	-	ns
$t_{d(off)}$	Turn-off delay time	(see the Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	100	-	ns
t_f	Fall time		-	8	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-	-	22	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-	-	88	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 22\text{ A}$, $V_{GS} = 0\text{ V}$	-	-	1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 22\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$ (see the Figure 15. Test circuit for inductive load switching and diode recovery times)	-	350	-	ns
Q_{rr}	Reverse recovery charge		-	4.7	-	μC
I_{RRM}	Reverse recovery current		-	27	-	A
t_{rr}	Reverse recovery time	$I_{SD} = 22\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$ (see the Figure 15. Test circuit for inductive load switching and diode recovery times)	-	451	-	ns
Q_{rr}	Reverse recovery charge		-	6.5	-	μC
I_{RRM}	Reverse recovery current		-	29	-	A

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

2.1 Electrical characteristics (curves)

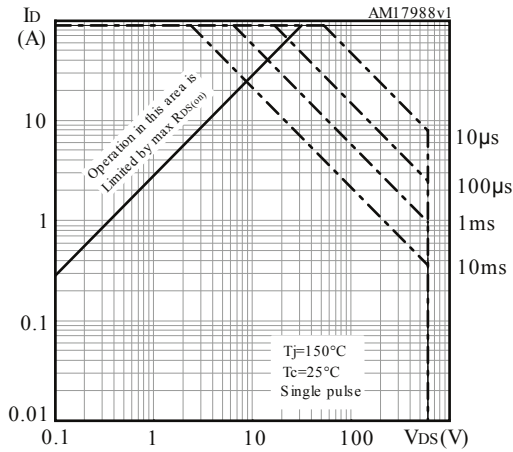
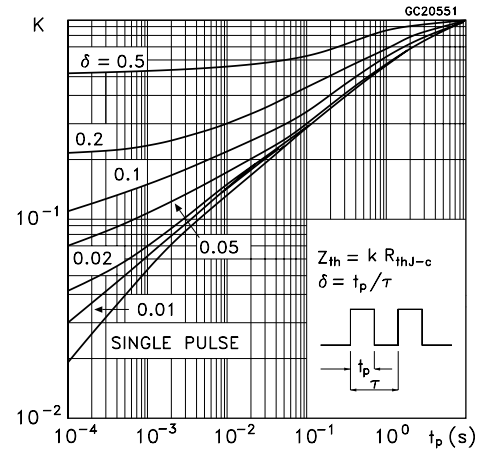
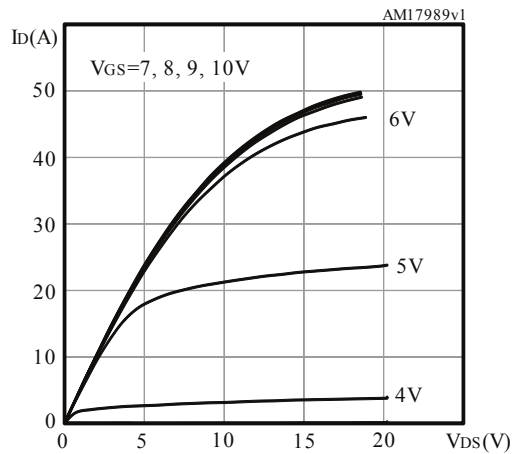
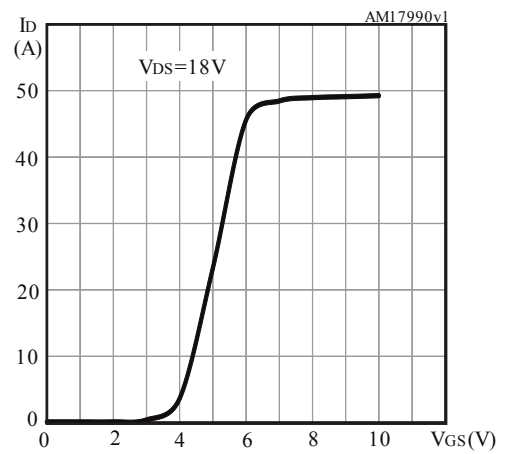
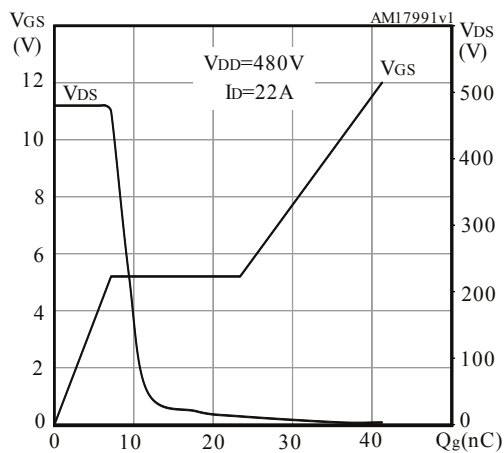
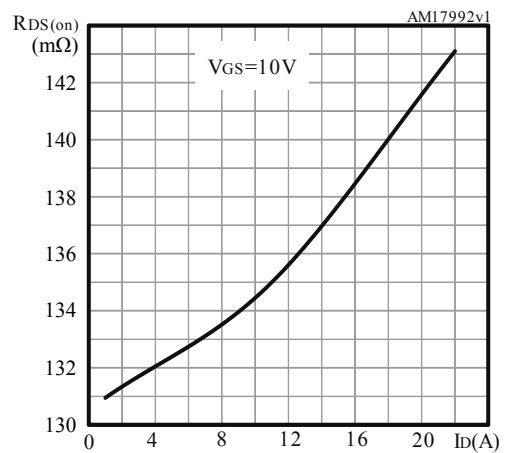
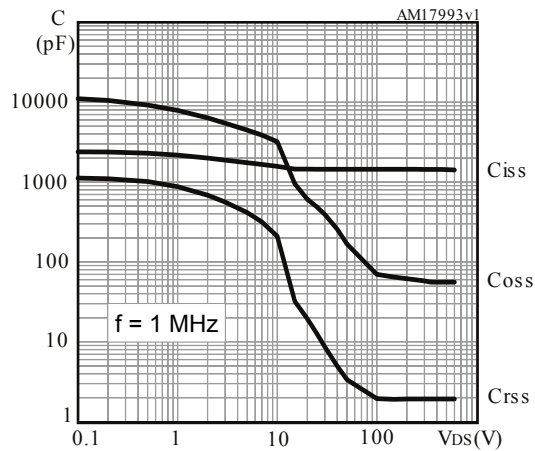
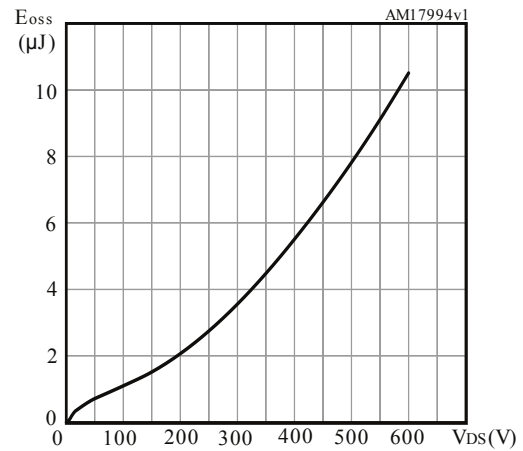
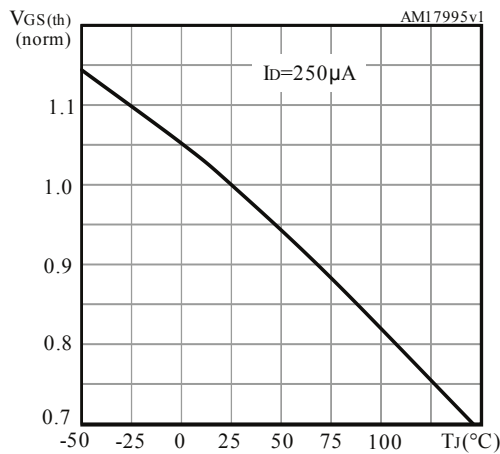
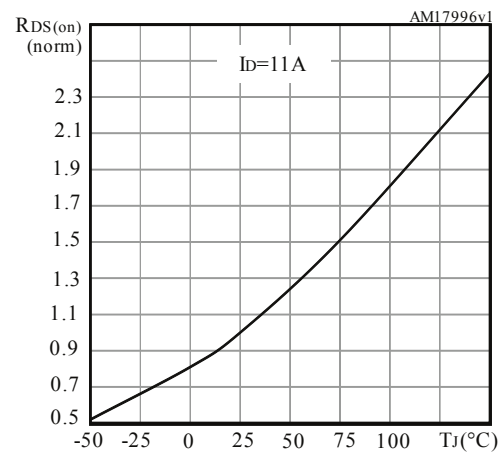
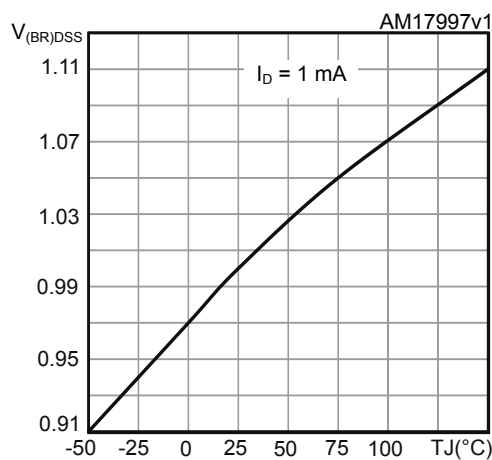
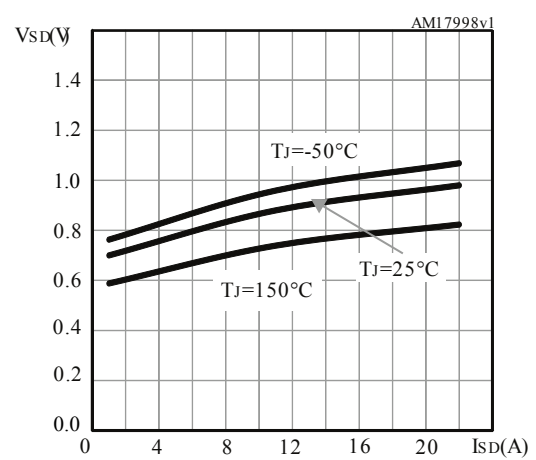
Figure 1. Safe operating area

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. Output capacitance stored energy

Figure 9. Normalized gate threshold vs temperature

Figure 10. Normalized on-resistance vs temperature

Figure 11. Normalized breakdown voltage vs temperature

Figure 12. Typical reverse diode forward characteristics


3 Test circuits

Figure 13. Test circuit for resistive load switching times


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Figure 14. Test circuit for gate charge behavior


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


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Figure 16. Unclamped inductive load test circuit


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Figure 17. Unclamped inductive waveform


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Figure 18. Switching time waveform

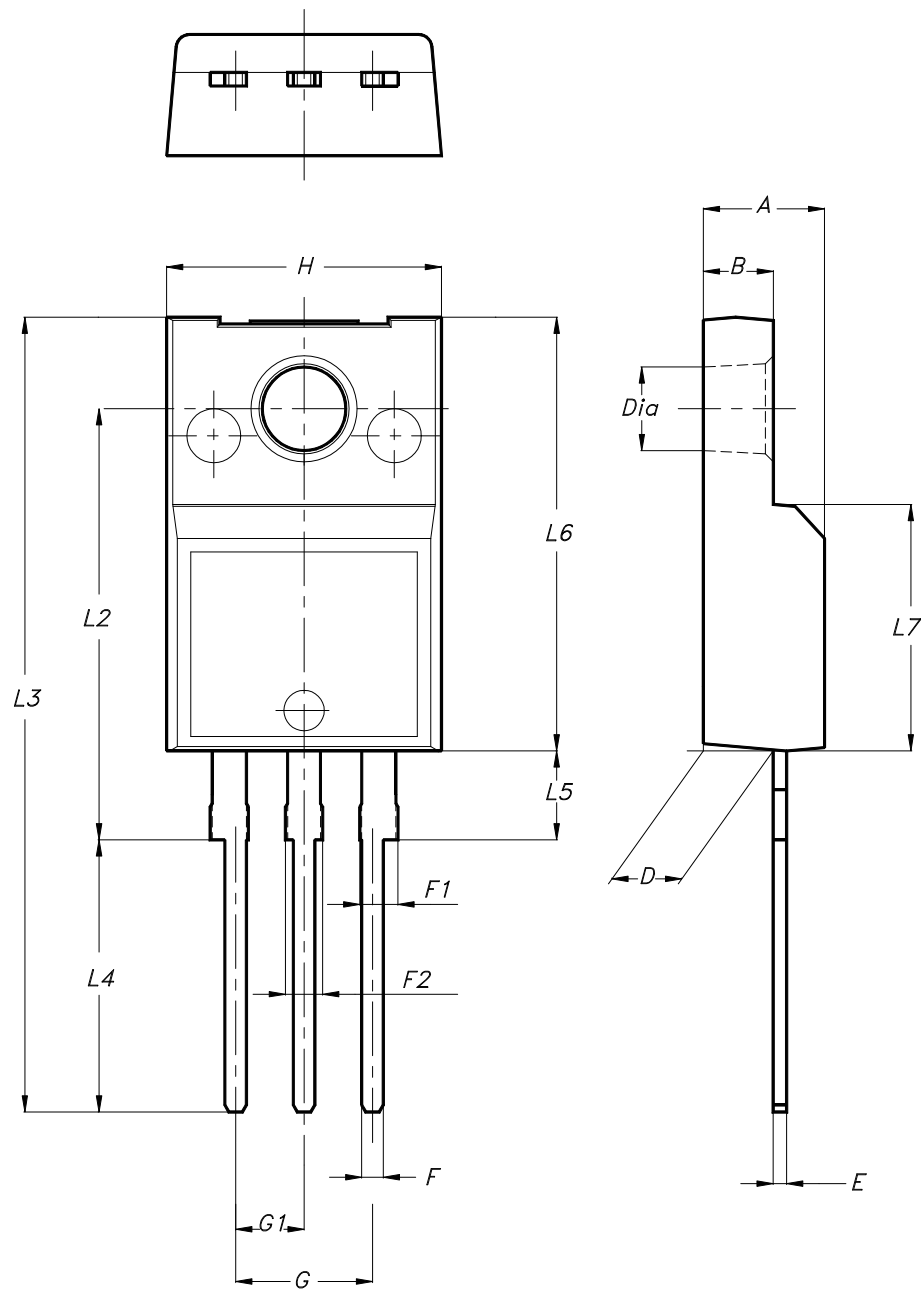

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4 Package information

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 19. 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
13-Sep-2013	1	First release.
29-Jan-2014	2	Added: I2PAKFP package. Modified: title, I_D value and features in cover page. Modified: I_D, I_{DM} and P_{TOT} values in <i>Table 2</i>. Modified: <i>note 3</i>. Modified: $R_{thj-case}$ value in <i>Table 3</i>. Modified: the entire typical values in <i>Table 4</i>, 6, 7 and 8. Modified: $R_{DS(on)}$ typical value. Modified: <i>Figure 7</i> and 8. Updated: <i>Table 9</i> and <i>Figure 14</i>. Added: <i>Section 4: Package information</i>. Minor text changes.
13-Feb-2015	3	Updated title, description and features in cover page. Updated <i>Table 2</i>: <i>Absolute maximum ratings</i> and <i>Table 4</i>: <i>Avalanche characteristics</i>. Updated <i>Figure 12</i>: <i>Normalized $V(BR)_{DSS}$ vs temperature</i>. Updated <i>4: Package information</i>. Minor text changes.
01-Dec-2025	4	Removed order code STF128N60M2. Updated <i>Section 4: Package information</i>. Minor text changes.

Contents

1	Electrical ratings	2
2	Electrical characteristics.....	3
2.1	Electrical characteristics (curves)	5
3	Test circuits	7
4	Package information.....	8
4.1	TO-220FP type B package information	8
	Revision history	10

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