

# Single N-channel MOSFET

## ELM4N6056FDA-N

<https://www.elm-tech.com>

### ■ General description

ELM4N6056FDA-N uses advanced trench technology to provide excellent  $R_{ds(on)}$ , low gate charge and low gate threshold voltage.

### ■ Features

- $V_{ds}=60V$
- $I_d=58A$  ( $V_{gs}=10V$ )
- $R_{ds(on)} = 8.5m\Omega$  ( $V_{gs}=10V$ )
- $R_{ds(on)} = 12.5m\Omega$  ( $V_{gs}=4.5V$ )

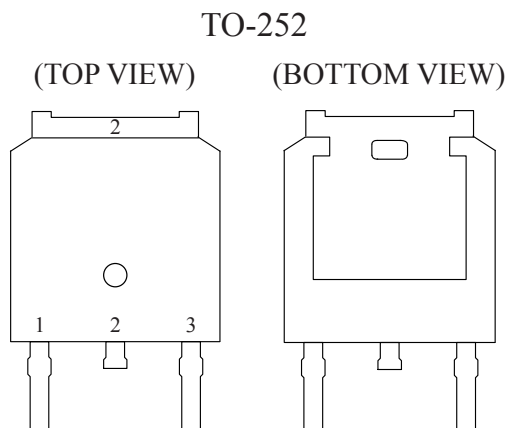
### ■ Maximum absolute ratings

Parameter	Symbol	Limit	Unit	Note	
Drain-source voltage	$V_{ds}$	60	V		
Gate-source voltage	$V_{gs}$	$\pm 20$	V		
Continuous drain current ( $V_{gs}=10V$ )	$I_d$	$T_c=25^\circ C$	58.0	A	1, 6
		$T_c=100^\circ C$	36.6		
Pulsed drain current	$I_{dm}$	125	A	2	
Single pulse avalanche energy	$E_{as}$	26.5	mJ	3	
Avalanche current	$I_{as}$	23	A		
Total power dissipation	$P_d$	$T_c=25^\circ C$	52	W	4
Storage temperature range		$T_{stg}$	-55 to 150	$^\circ C$	
Operating junction temperature range	$T_j$	-55 to 150	$^\circ C$		

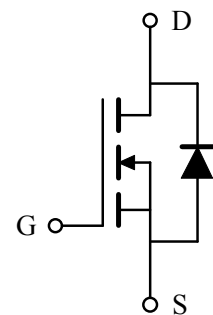
### ■ Thermal characteristics

Parameter	Symbol	Typ.	Max.	Unit	Note
Thermal resistance junction-ambient (Steady state)	$R_{\theta ja}$	--	60.0	$^\circ C/W$	1
Thermal resistance junction-case ambient	$R_{\theta jc}$	--	2.4	$^\circ C/W$	1

### ■ Pin configuration



### ■ Circuit



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### ■Electrical characteristics

T<sub>j</sub>=25°C. Unless otherwise noted.

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
<b>STATIC PARAMETERS</b>							
Drain-source breakdown voltage	BV <sub>dss</sub>	V <sub>gs</sub> =0V, I <sub>d</sub> =250μA	60	--	--	V	
Static drain-source on-resistance	R <sub>ds(on)</sub>	V <sub>gs</sub> =10V, I <sub>d</sub> =20A	--	7.5	8.5	mΩ	2
		V <sub>gs</sub> =4.5V, I <sub>d</sub> =15A	--	11.0	12.5		
Gate threshold voltage	V <sub>gs(th)</sub>	V <sub>ds</sub> =V <sub>gs</sub> , I <sub>d</sub> =250μA	1.2	--	2.3	V	
Drain-source leakage current	I <sub>dss</sub>	V <sub>ds</sub> =48V, V <sub>gs</sub> =0V	--	--	1	μA	
		V <sub>ds</sub> =48V, V <sub>gs</sub> =0V, T <sub>j</sub> =55°C	--	--	5		
Gate-source leakage current	I <sub>gss</sub>	V <sub>gs</sub> =±20V, V <sub>ds</sub> =0V	--	--	±100	nA	
Continuous source current	I <sub>s</sub>	V <sub>gs</sub> =V <sub>ds</sub> =0V, Force current	--	--	30	A	1,5,6
Diode forward voltage	V <sub>sd</sub>	V <sub>gs</sub> =0V, I <sub>s</sub> =1A	--	--	1.2	V	2
<b>DYNAMIC PARAMETERS</b>							
Input capacitance	C <sub>iss</sub>	V <sub>ds</sub> =30V, V <sub>gs</sub> =0V, f=1MHz	--	1270	--	pF	
Output capacitance	C <sub>oss</sub>		--	479	--	pF	
Reverse transfer capacitance	C <sub>rss</sub>		--	40	--	pF	
Gate resistance	R <sub>g</sub>	V <sub>ds</sub> =0V, V <sub>gs</sub> =0V, f=1MHz	--	1.4	--	Ω	
<b>SWITCHING PARAMETERS</b>							
Total gate charge (10V)	Q <sub>g</sub>	V <sub>ds</sub> =30V, V <sub>gs</sub> =10V, I <sub>d</sub> =15A	--	15.0	--	nC	
Gate-source charge	Q <sub>gs</sub>		--	3.5	--	nC	
Gate-drain charge	Q <sub>gd</sub>		--	4.2	--	nC	
Turn-on delay time	t <sub>d(on)</sub>	V <sub>dd</sub> =30V, V <sub>gs</sub> =10V R <sub>gen</sub> =3.3Ω, I <sub>d</sub> =15A	--	7.0	--	ns	
Turn-on rise time	t <sub>r</sub>		--	4.5	--	ns	
Turn-off delay time	t <sub>d(off)</sub>		--	26.0	--	ns	
Turn-off fall time	t <sub>f</sub>		--	5.0	--	ns	
Reverse recovery time	t <sub>rr</sub>	I <sub>f</sub> =15A, di/dt=100A/μs	--	22	--	nS	
Reverse recovery charge	Q <sub>rr</sub>		--	72	--	nC	

#### NOTE :

1. The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 2OZ copper.
2. Single pulse width limited by junction temperature T<sub>j(max)</sub>=150°C.
3. The Eas data shows Max. rating . The test condition is V<sub>dd</sub>=25V, V<sub>gs</sub>=10V, L=0.1mH, I<sub>as</sub>=23A.
4. The power dissipation is limited by 150°C junction temperature.
5. The data is theoretically the same as I<sub>d</sub> and I<sub>dm</sub>, in real applications, should be limited by total power dissipation.
6. The maximum current rating is package limited.

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## ■ Typical characteristics

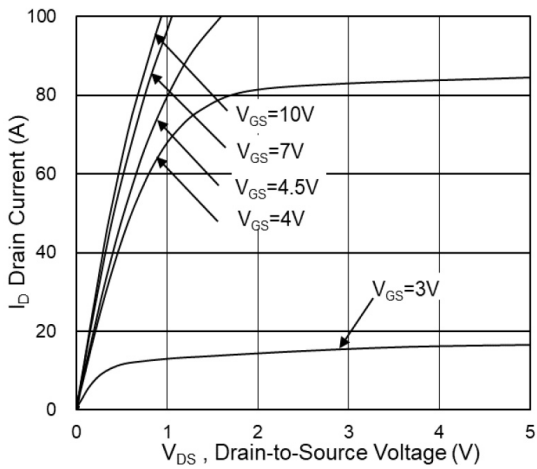


Fig.1 Typical Output Characteristics

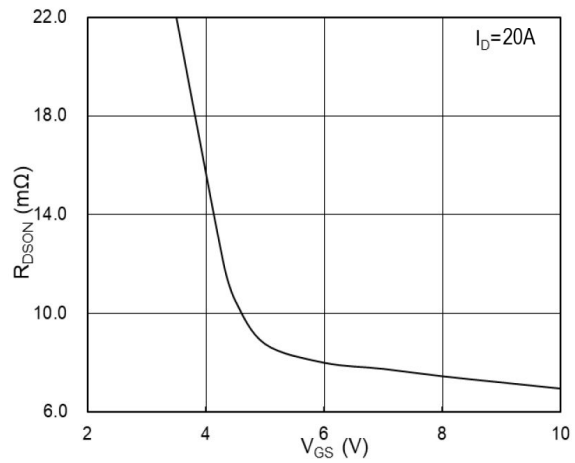


Fig.2 On-Resistance vs G-S Voltage

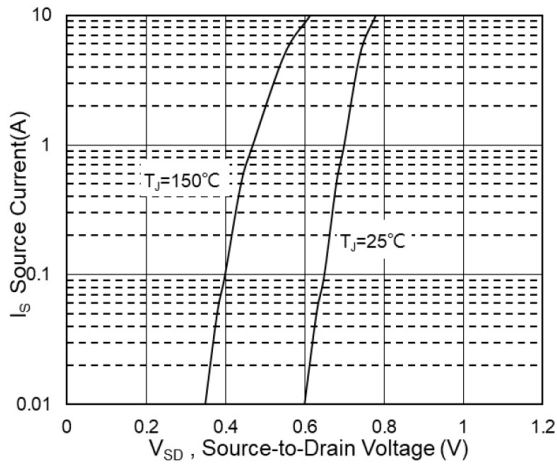


Fig.3 Source Drain Forward Characteristics

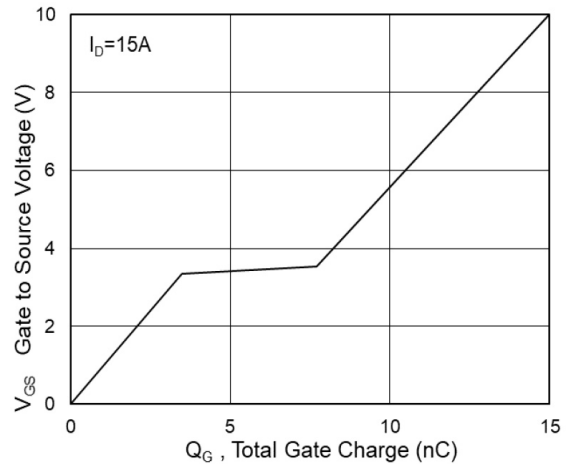


Fig.4 Gate-Charge Characteristics

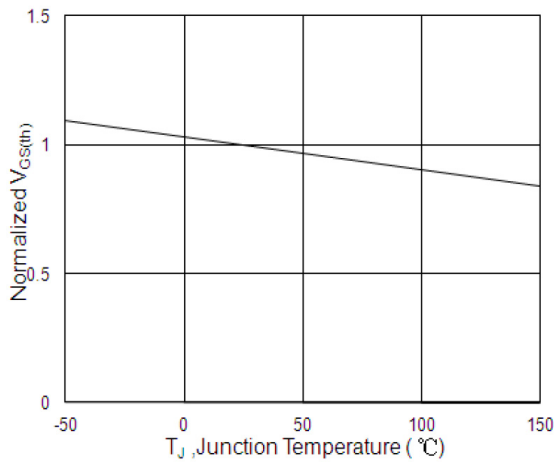


Fig.5 Normalized  $V_{GS(th)}$  vs  $T_J$

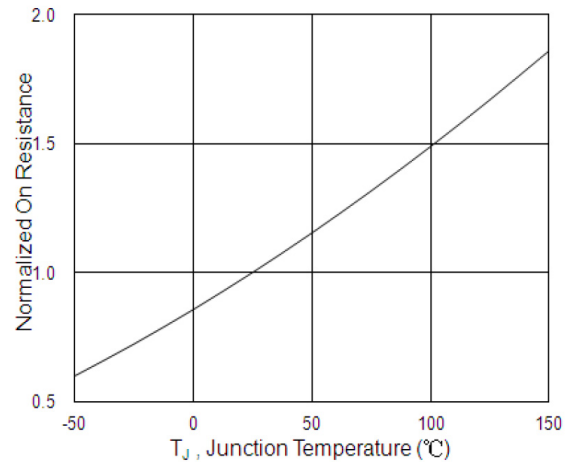


Fig.6 Normalized  $R_{DS(on)}$  vs  $T_J$

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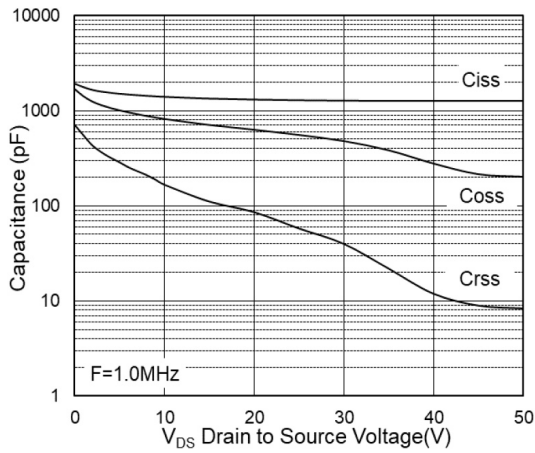


Fig.7 Capacitance

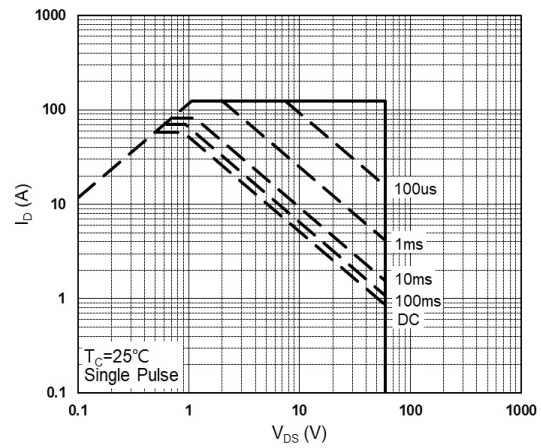


Fig.8 Safe Operating Area

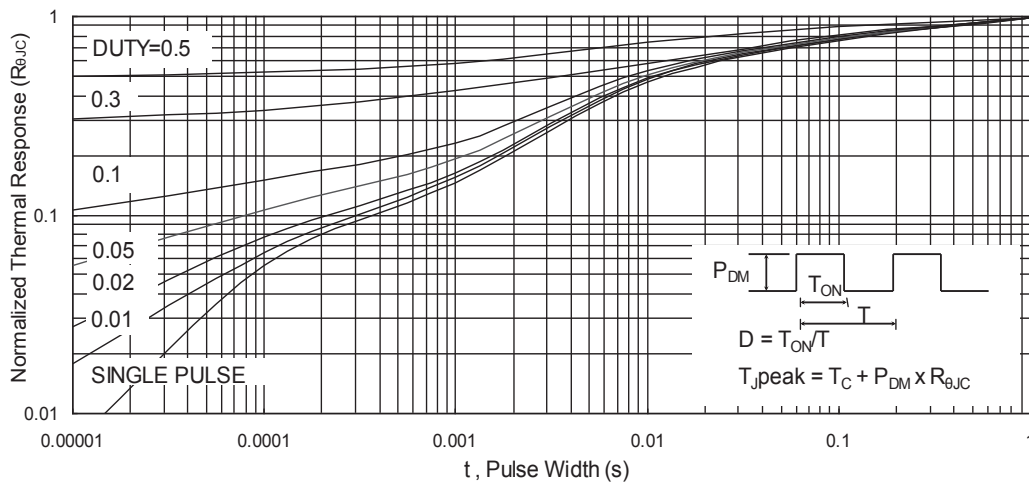


Fig.9 Normalized Maximum Transient Thermal Impedance

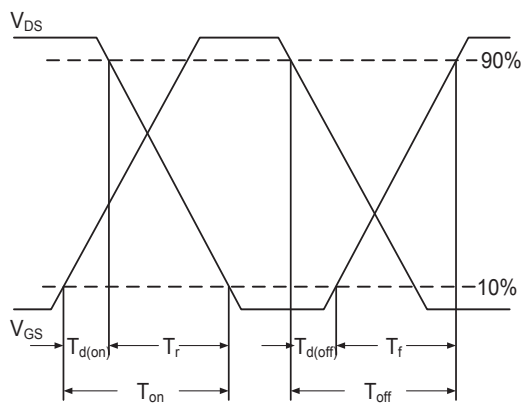


Fig.10 Switching Time Waveform

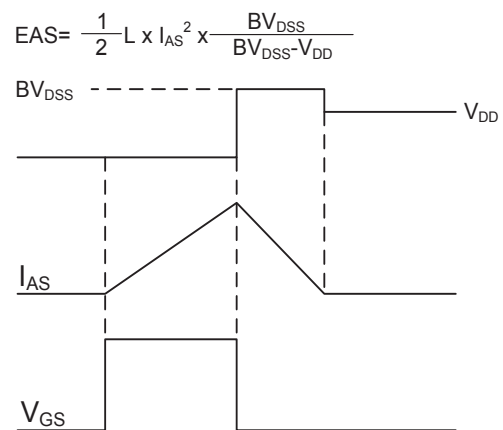


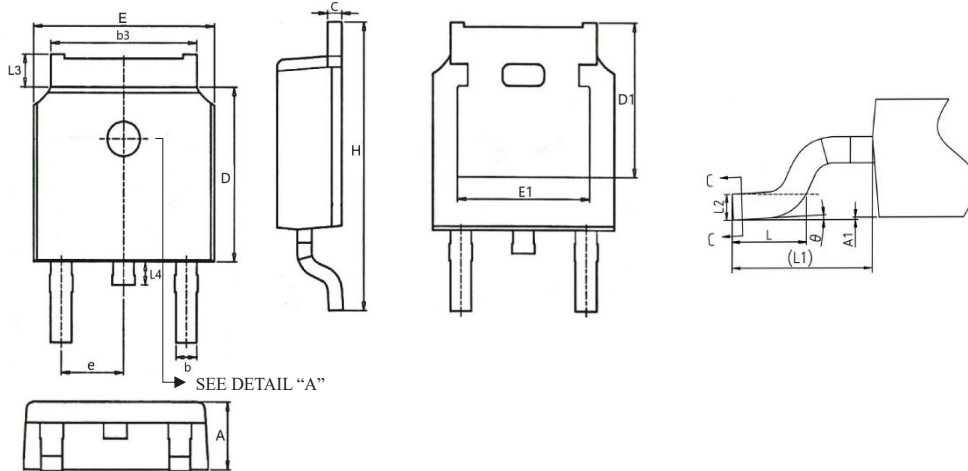
Fig.11 Unclamped Inductive Switching Waveform

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## TO-252 dimension (2,500pcs/reel)

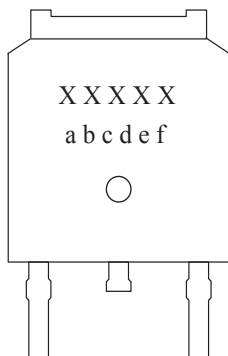


Detail "A"

	Top	Bottom		Top	Bottom
Option 1			Option 3		
Option 2			Option 4		

Symbols	Millimeters		Inches		Symbols	Millimeters		Inches	
	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.
A	2.18	2.40	0.086	0.094	e	2.29 BSC		0.090 BSC	
A1	0.00	0.20	0.000	0.008	H	9.40	10.50	0.370	0.413
b	0.64	0.90	0.025	0.035	L	1.27	2.03	0.050	0.080
b3	4.95	5.50	0.195	0.217	L1	2.90 REF		0.114 REF	
c	0.43	0.61	0.017	0.024	L2	0.51 BSC		0.020 BSC	
D	5.90	6.30	0.232	0.248	L3	0.88	1.28	0.035	0.050
D1	5.30 REF		0.209 REF		L4	0.50	1.02	0.020	0.040
E	6.35	6.80	0.250	0.268	θ	0°	10°	0°	10°
E1	4.32	4.95	0.170	0.195					

## Marking



Symbols	Content
xxxxxx	Product code
a	Yearly code: 2019=K, 2020=L, 2021=M...
b, c	Weekly code: 01 to 53
d, e	Sequence: 01 to 99 or 0A to 0Z
f	Assembly code: A to Z (I, O excepted)