

## 4A, 600V N-CHANNEL MOSFET

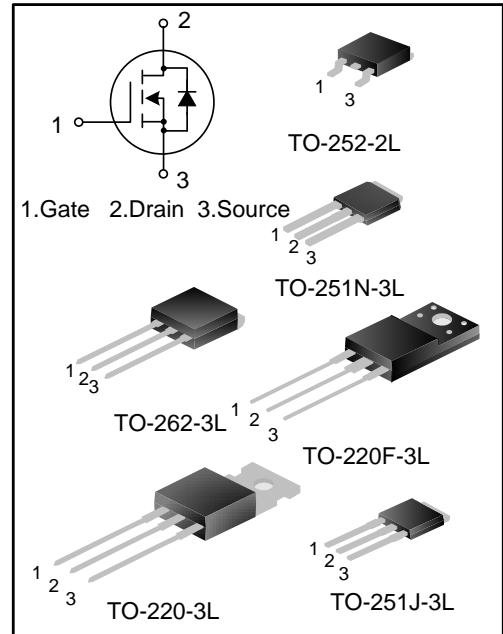
### GENERAL DESCRIPTION

SVF4N60CAF/K/D/T/MN/MJ is an N-channel enhancement mode power MOS field effect transistor which is produced using Silan proprietary F-Cell™ high-voltage planar VDMOS technology. The improved process and cell structure have been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode.

These devices are widely used in AC-DC power supplies, DC-DC converters and H-bridge PWM motor drivers.

### FEATURES

- ◆ 4A, 600V,  $R_{DS(on)(typ.)}=2.0\Omega@V_{GS}=10V$
- ◆ Low gate charge
- ◆ Low Crss
- ◆ Fast switching
- ◆ Improved dv/dt capability



### ORDERING INFORMATION

Part No.	Package	Marking	Hazardous Substance Control	Packing Type
SVF4N60CAF	TO-220F-3L	SVF4N60CAF	Halogen free	Tube
SVF4N60CAK	TO-262-3L	SVF4N60CAK	Halogen free	Tube
SVF4N60CAT	TO-220-3L	SVF4N60CAT	Pb free	Tube
SVF4N60CADTR	TO-252-2L	4N60CAD	Halogen free	Tape & Reel
SVF4N60CAMN	TO-251N-3L	4N60CAMN	Halogen free	Tube
SVF4N60CAMJ	TO-251J-3L	4N60CAMJ	Halogen free	Tube



**ABSOLUTE MAXIMUM RATINGS (TC=25°C UNLESS OTHERWISE NOTED)**

Characteristics	Symbol	Ratings					Unit
		SVF4N 60CAF	SVF4N 60CAK	SVF4N 60CAD	SVF4N60 CAMN/MJ	SVF4N 60CAT	
Drain-Source Voltage	$V_{DS}$	600					V
Gate-Source Voltage	$V_{GS}$	±30					V
Drain Current	$I_D$	$T_C=25^\circ\text{C}$					A
		$T_C=100^\circ\text{C}$					
Drain Current Pulsed	$I_{DM}$	16					A
Power Dissipation( $T_C=25^\circ\text{C}$ ) -Derate above 25°C	$P_D$	33	92	77	86	110	W
		0.26	0.74	0.62	0.69	0.88	W/°C
Single Pulsed Avalanche Energy(Note1)	$E_{AS}$	217					mJ
Operation Junction Temperature Range	$T_J$	-55~+150					°C
Storage Temperature Range	$T_{stg}$	-55~+150					°C

**THERMAL CHARACTERISTICS**

Characteristics	Symbol	Ratings					Unit
		SVF4N 60CAF	SVF4N 60CAK	SVF4N 60CAD	SVF4N60C AMN/MJ	SVF4N 60CAT	
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	3.85	1.36	1.61	1.45	1.14	°C/W
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	62.5	62.5	62.0	62.0	62.5	°C/W

**ELECTRICAL CHARACTERISTICS (T<sub>c</sub>=25°C UNLESS OTHERWISE NOTED)**

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Drain -Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V, I <sub>D</sub> =250μA	600	--	--	V
Drain-Source Leakage Current	I <sub>DSS</sub>	V <sub>DS</sub> =600V, V <sub>GS</sub> =0V	--	--	1.0	μA
Gate-Source Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> =±30V, V <sub>DS</sub> =0V	--	--	±100	nA
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> =250μA	2.0	--	4.0	V
Static Drain- Source On State Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =2.0A	--	2.0	2.4	Ω
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =25V, V <sub>GS</sub> =0V, f=1.0MHz	--	433	--	pF
Output Capacitance	C <sub>oss</sub>		--	55	--	
Reverse Transfer Capacitance	C <sub>rss</sub>		--	4.5	--	
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =300V, I <sub>D</sub> =4A, R <sub>G</sub> =25Ω  (Note2,3)	--	10	--	ns
Turn-on Rise Time	t <sub>r</sub>		--	26	--	
Turn-off Delay Time	t <sub>d(off)</sub>		--	29	--	
Turn-off Fall Time	t <sub>f</sub>		--	26	--	
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =480V, I <sub>D</sub> =4A, V <sub>GS</sub> =10V  (Note 2,3)	--	13	--	nC
Gate-Source Charge	Q <sub>gs</sub>		--	2.8	--	
Gate-Drain Charge	Q <sub>gd</sub>		--	6.2	--	

**SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS**

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Continuous Source Current	I <sub>S</sub>	Integral Reverse P-N Junction Diode in the MOSFET	--	--	4.0	A
Pulsed Source Current	I <sub>SM</sub>		--	--	16	
Diode Forward Voltage	V <sub>SD</sub>	I <sub>S</sub> =4.0A, V <sub>GS</sub> =0V	--	--	1.4	V
Reverse Recovery Time	T <sub>rr</sub>	I <sub>S</sub> =4.0A, V <sub>GS</sub> =0V, dI <sub>F</sub> /dt=100A/μs (Note 2)	--	420	--	ns
Reverse Recovery Charge	Q <sub>rr</sub>		--	1.8	--	μC

**Notes:**

- L=30mH, I<sub>AS</sub>=3.75A, V<sub>DD</sub>=100V, R<sub>G</sub>=25Ω, starting T<sub>B,JB</sub>=25°C;
- Pulse Test: Pulse width ≤300μs, Duty cycle≤2%;
- Essentially independent of operating temperature.



## TYPICAL CHARACTERISTICS

Figure 1. On-Region Characteristics

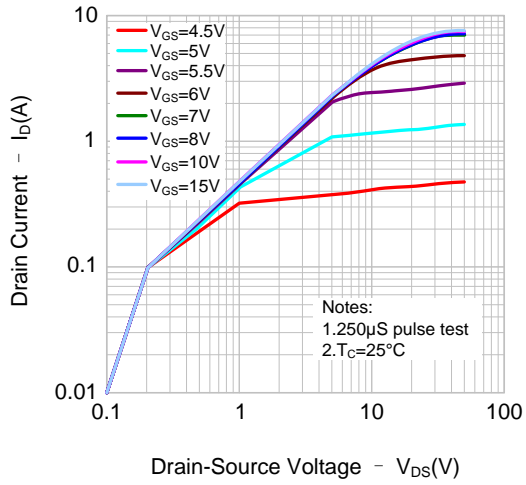


Figure 2. Transfer Characteristics

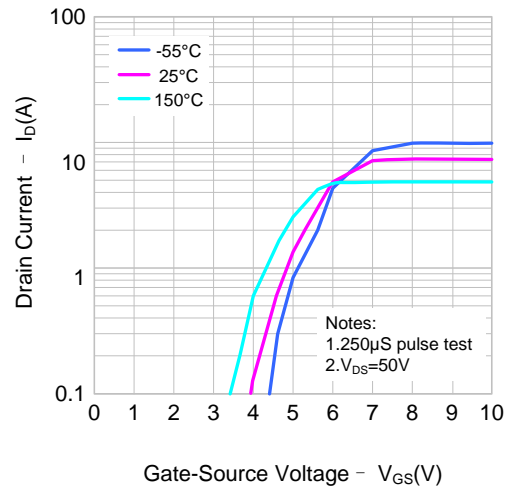


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

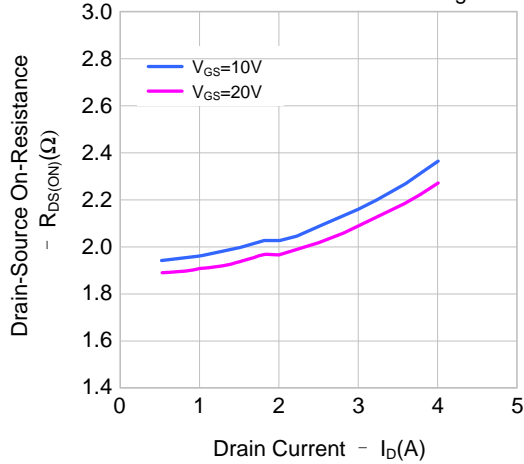
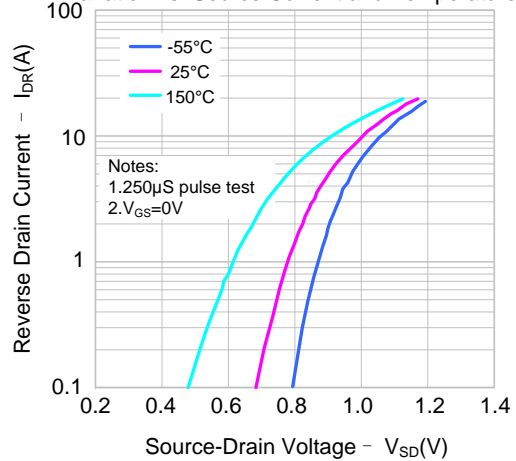


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature





## TYPICAL CHARACTERISTICS(CONTINUED)

Figure 5. Capacitance Characteristics

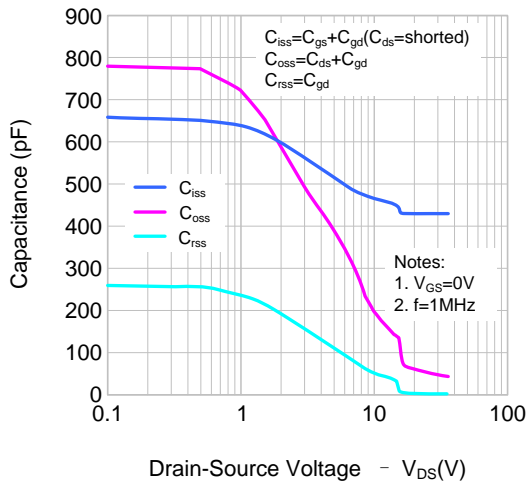


Figure 6. Gate Charge Characteristics

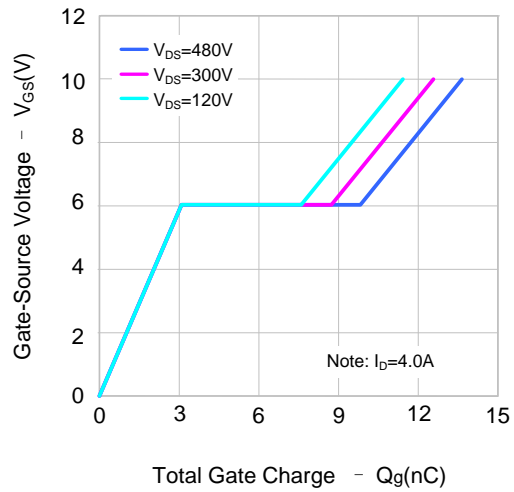


Figure 7. Breakdown Voltage Variation vs. Temperature

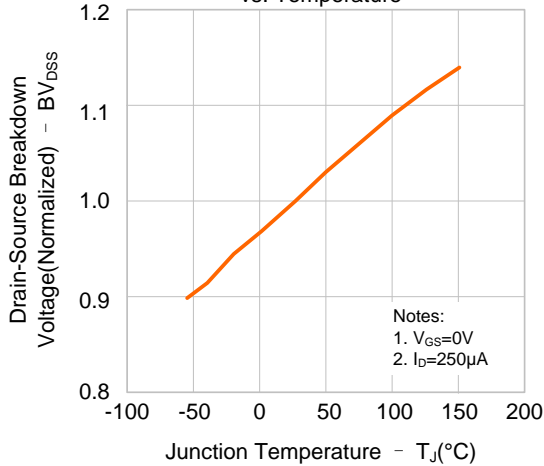


Figure 8. On-resistance Variation vs. Temperature

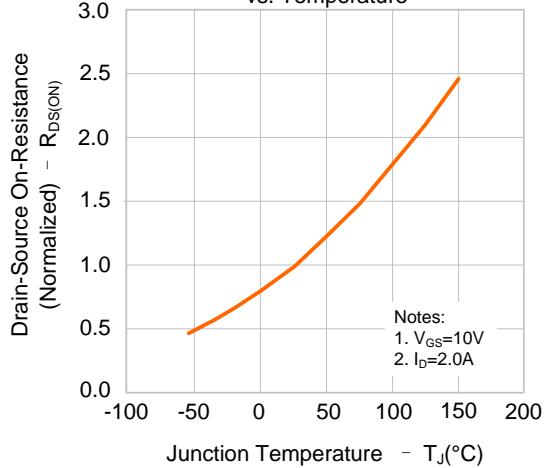


Figure 9-1. Max. Safe Operating Area(SVF4N60CAF)

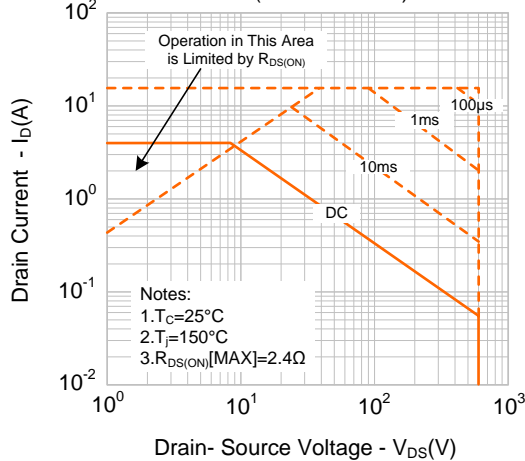
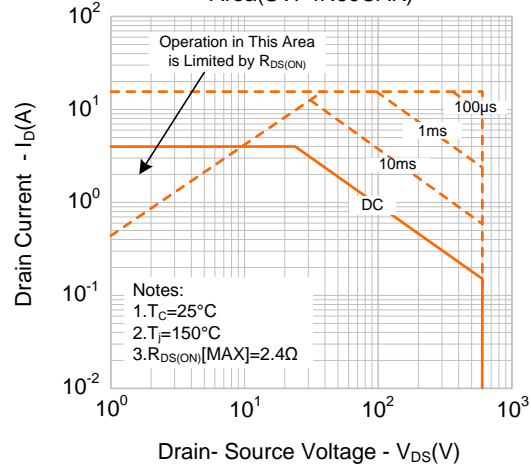


Figure 9-2. Max. Safe Operating Area(SVF4N60CAK)





## TYPICAL CHARACTERISTICS(CONTINUED)

Figure 9-3. Max. Safe Operating Area(SVF4N60CAD)

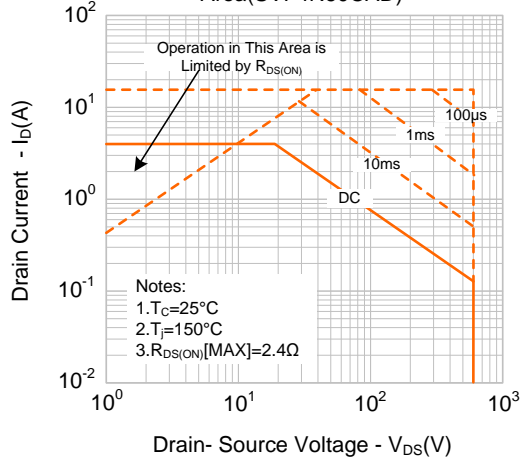


Figure 9-4. Max. Safe Operating Area(SVF4N60CAMN/MJ)

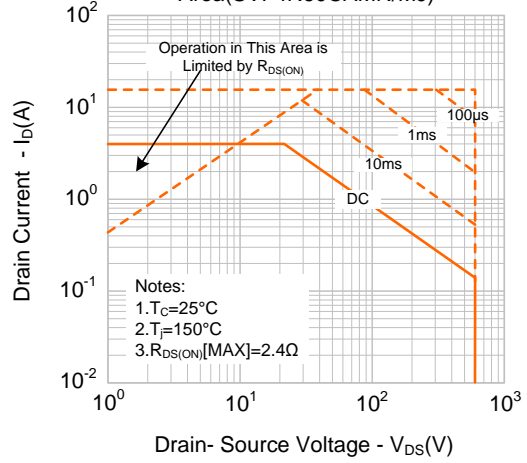


Figure 9-5. Max. Safe Operating Area(SVF4N60CAT)

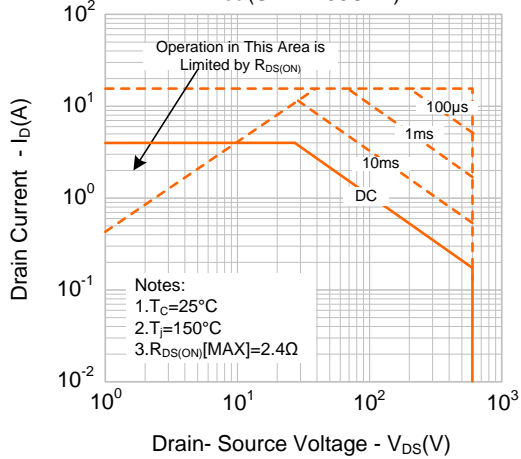
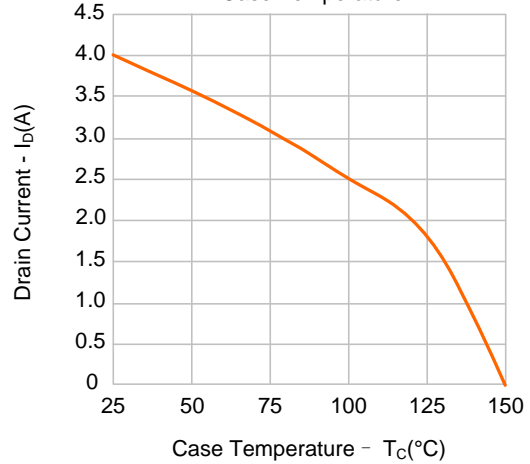
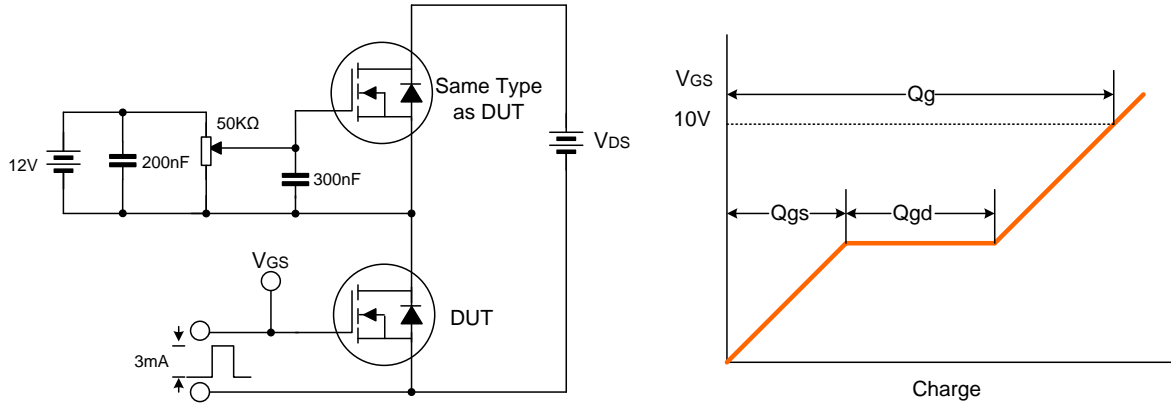


Figure 10. Maximum Drain Current vs. Case Temperature

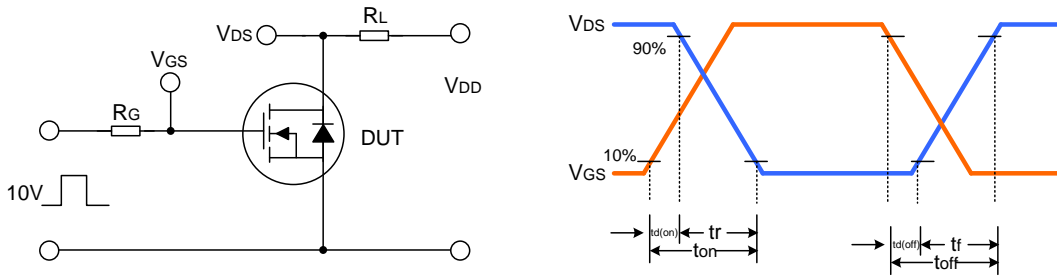


**TYPICAL TEST CIRCUIT**

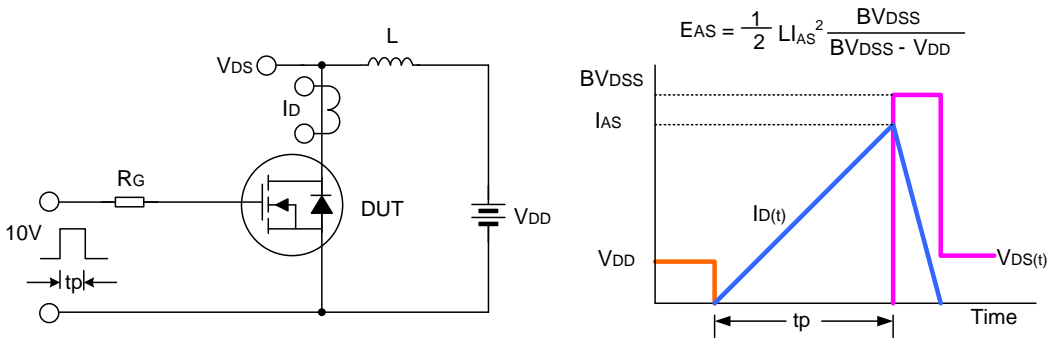
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveform



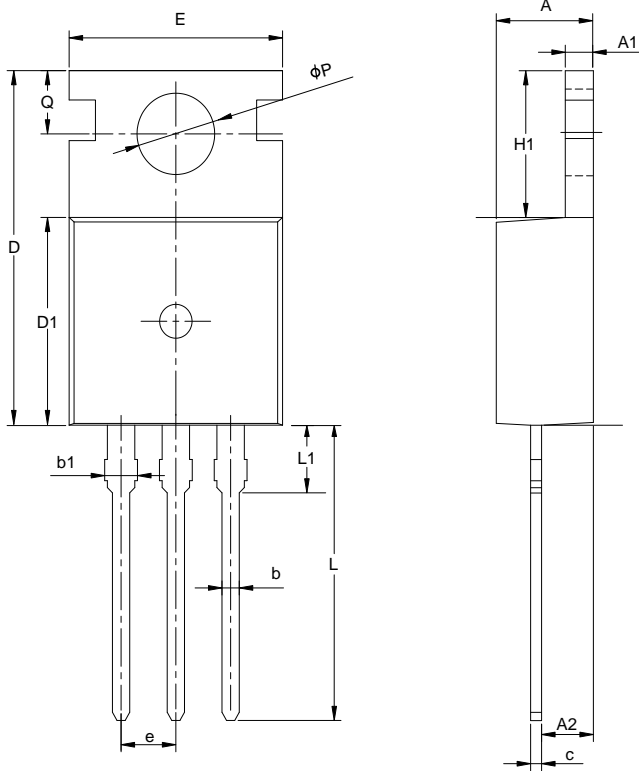
Unclamped Inductive Switching Test Circuit & Waveform



**PACKAGE OUTLINE**

**TO-220-3L**

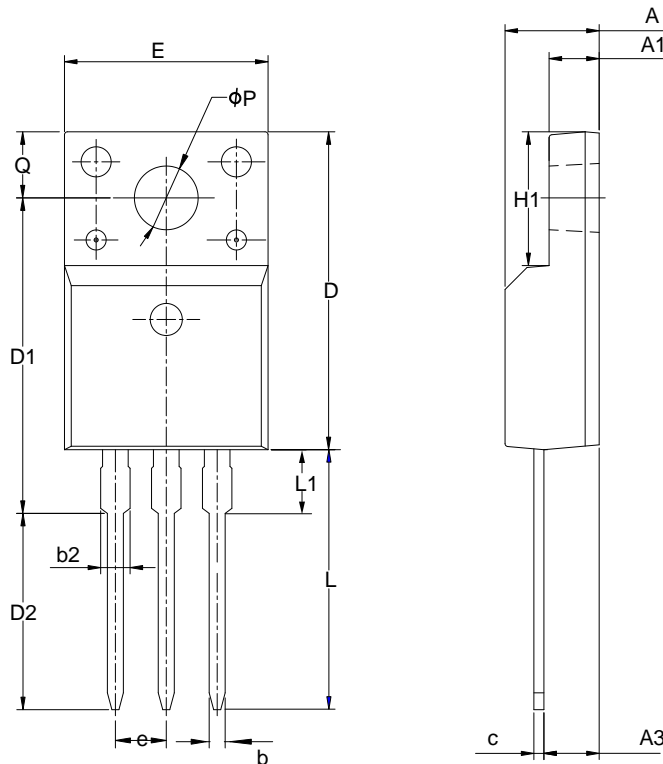
**UNIT: mm**



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	4.30	4.50	4.70
A1	1.00	1.30	1.50
A2	1.80	2.40	2.80
b	0.60	0.80	1.00
b1	1.00	—	1.60
c	0.30	—	0.70
D	15.10	15.70	16.10
D1	8.10	9.20	10.00
E	9.60	9.90	10.40
e	2.54BSC		
H1	6.10	6.50	7.00
L	12.60	13.08	13.60
L1	—	—	3.95
$\phi P$	3.40	3.70	3.90
Q	2.60	—	3.20

**TO-220F-3L**

**UNIT: mm**



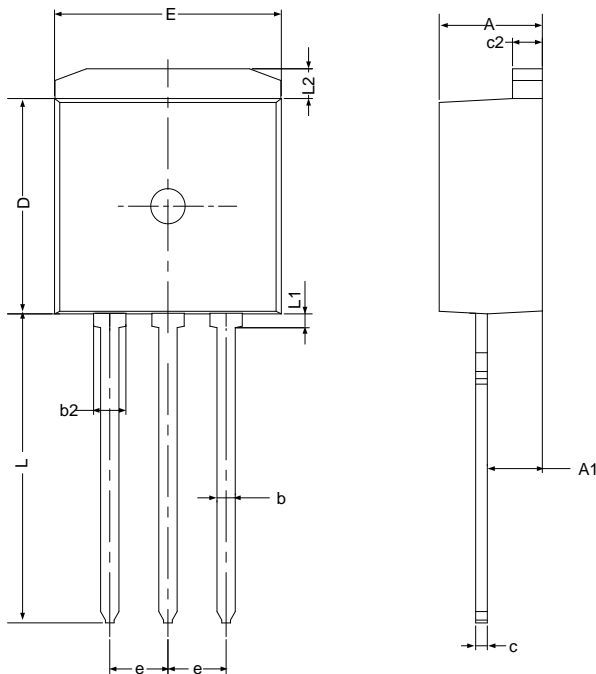
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	4.42	4.70	5.02
A1	2.30	2.54	2.80
A3	2.50	2.76	3.10
b	0.70	0.80	0.90
b2	—	—	1.47
c	0.35	0.50	0.65
D	15.25	15.87	16.25
D1	15.30	15.75	16.30
D2	9.30	9.80	10.30
E	9.73	10.16	10.36
e	2.54BSC		
H1	6.40	6.68	7.00
L	12.48	12.98	13.48
L1	—	—	3.50
$\phi P$	3.00	3.18	3.40
Q	3.05	3.30	3.55



**PACKAGE OUTLINE(CONTINUED)**

**TO-262-3L**

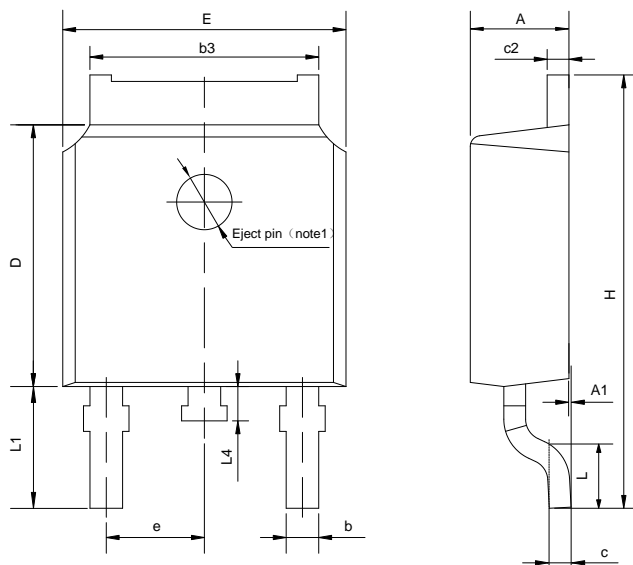
**UNIT: mm**



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	4.30	4.50	4.70
A1	2.20	—	2.92
b	0.71	0.80	0.90
b2	1.20	—	1.50
c	0.34	—	0.65
c2	1.22	1.30	1.35
D	8.38	—	9.30
E	9.80	10.16	10.54
e	2.54 BSC		
L	12.80	—	14.10
L1	—	—	0.75
L2	1.12	—	1.42

**TO-252-2L**

**UNIT: mm**

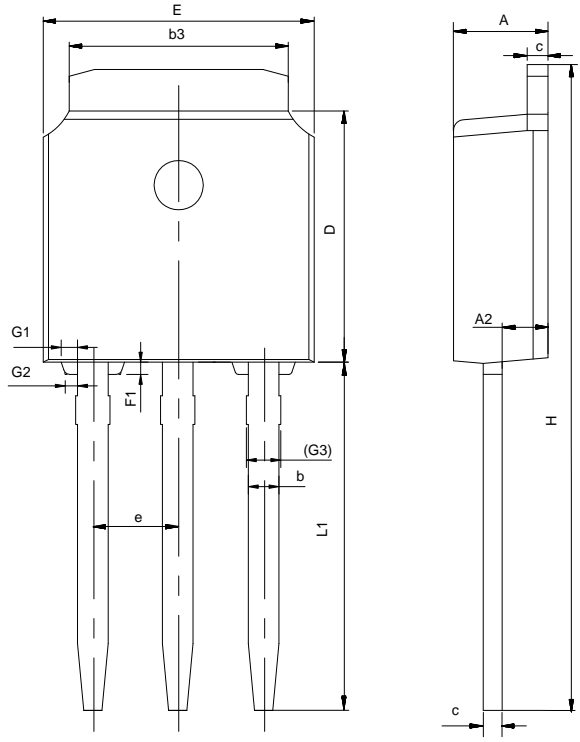


SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	2.10	2.30	2.50
A1	0	—	0.127
b	0.66	0.76	0.89
b3	5.10	5.33	5.46
c	0.45	—	0.65
c2	0.45	—	0.65
D	5.80	6.10	6.40
E	6.30	6.60	6.90
e	2.30TYP		
H	9.60	10.10	10.60
L	1.40	1.50	1.70
L1	2.90REF		
L4	0.60	0.80	1.00

**NOTE1** : There are two conditions for this position:has an eject pin or has no eject pin.

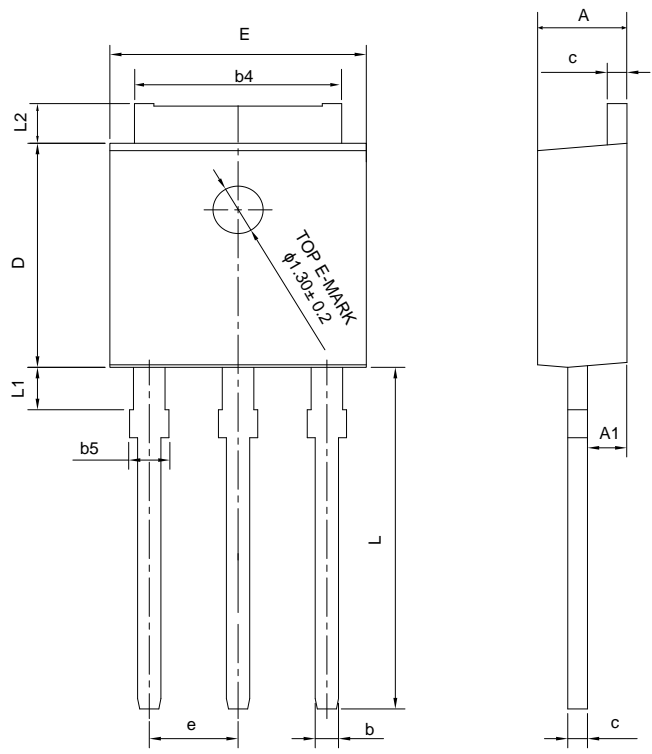
**PACKAGE OUTLINE(CONTINUED)**

**TO-251N-3L** UNIT: mm



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	2.20	2.30	2.40
A2	0.97	1.07	1.17
b	0.58	0.68	0.80
b3	5.20	5.33	5.50
c	0.43	0.53	0.63
D	5.80	6.10	6.40
E	6.30	6.60	6.90
e	2.286 BSC		
F1	0.20	0.30	0.40
G1	0.30	0.40	0.50
G2	0.20	0.30	0.40
G3	0.60	0.74	0.88
H	16.02	16.52	17.02
L1	9.10	9.40	9.70

**TO-251J-3L** UNIT: mm



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	2.18	2.30	2.39
A1	0.89	1.00	1.14
b	0.56	—	0.89
b4	4.95	5.33	5.46
b5	—	—	1.05
c	0.46	—	0.61
D	5.97	6.10	6.27
E	6.35	6.60	6.73
e	2.29 BCS		
L	8.89	9.30	9.65
L1	0.95	—	1.50
L2	0.89	—	1.27



## Important notice :

- The instructions are subject to change without notice! Customers should obtain the latest relevant information before placing orders and should verify that such information is complete and current.
- Our products are consumer electronic products, and / or civil electronic products.
- When using our products, please do not exceed the maximum rating of the products, otherwise the reliability of the whole machine will be affected. There is a certain possibility of failure or malfunction of any semiconductor product under specific conditions. The buyer is responsible for complying with safety standards and taking safety measures when using our products for system design, sample and whole machine manufacturing, so as to avoid potential failure risk that may cause personal injury or property loss.
- It is strongly recommended to identify the trademark when buying our products. Please contact us if there is any question.
- When exporting, using and reselling our products, buyer must comply with the international export control laws and regulations of China, the United States, the United Kingdom, the European Union and other countries & regions.
- Product promotion is endless, our company will wholeheartedly provide customers with better products!
- Website: <http://www.silan.com.cn>

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Rev.: 2.2

### Revision History:

1. Deleted NOMENCLATURE
2. Modify Important notice

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Rev.: 2.1

### Revision History:

1. Add the package outline of TO-251J-3L
2. Modify package outline of TO-220/262/251N

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Rev.: 2.0

### Revision History:

1. Delete the package outline of TO-251J-3L
2. Add another solid figure of TO-220-3L
3. Update the package outline of TO-262-3L

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Rev.: 1.9

### Revision History:

1. Delete the package outline of TO-262L-3L

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Rev.: 1.8

### Revision History:

1. Update the package outline of TO-262-3L

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Rev.: 1.7

### Revision History:

1. Update the package outline of TO-251J-3L
2. Delete the package outline of TO-220F-3L(2)

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Rev.: 1.6

### Revision History:

1. Add information of TO-220-3L and TO-262L-3L package

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Rev.: 1.5

### Revision History:

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1. Modify the Typical Characteristics

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Rev.: 1.4

Revision History:

1. Modify the package information of TO-220F-3L
  2. Modify the package information of TO-252-2L
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Rev.: 1.3

Revision History:

1. Modify the electrical characteristics
  2. Modify the typical characteristics
- 

Rev.: 1.2

Revision History:

1. Add the package of TO-251N-3L
- 

Rev.: 1.1

Revision History:

1. Modify the thermal characteristics
- 

Rev.: 1.0

Revision History:

1. First release
- 
-