

## 38A, 600V SUPER JUNCTION MOS POWER TRANSISTOR

### DESCRIPTION

SVSP60R090P7(L)(FJD)(T)(S)HD4 is an N-channel enhancement mode high voltage power MOSFETs produced using Silan's super junction MOS technology. It achieves low conduction loss and switching losses. It leads the design engineers to their power converters with high efficiency, high power density, and superior thermal behavior.

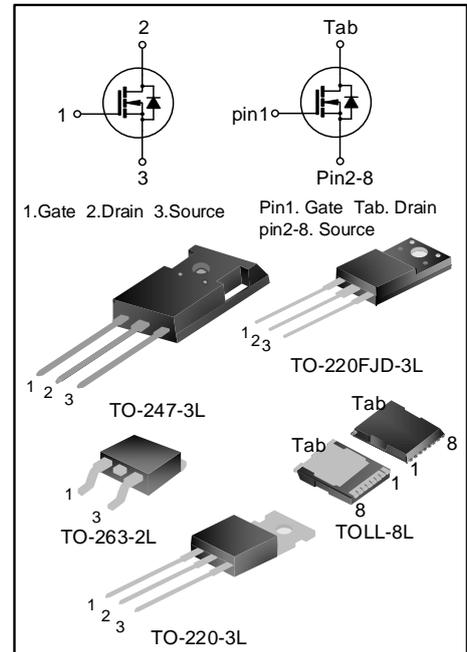
Furthermore, it's universal applicable, i.e., suitable for hard and soft switching topologies.

### FEATURES

- ◆ 38A, 600V,  $R_{DS(on)(typ.)}=75m\Omega@V_{GS}=10V$
- ◆ New revolutionary high voltage technology
- ◆ Ultra low gate charge
- ◆ Periodic avalanche rated
- ◆ Extreme dv/dt rated
- ◆ High peak current capability
- ◆ 100% avalanche tested
- ◆ Pb-free lead plating
- ◆ RoHS compliant

### KEY PERFORMANCE PARAMETERS

Characteristics	Ratings	Unit
$V_{DS@T_{J,max}}$	650	V
$V_{GS(th)}$	3.0~5.0	V
$R_{DS(on),max.}$	90	m $\Omega$
$I_{D,pulse}$	150	A
$Q_{g,typ.}$	87	nC



**ORDERING INFORMATION**

Part No.	Package	Marking	Hazardous Substance Control	Packing Type
SVSP60R090P7HD4	TO-247-3L	P60R090HD4	Halogen free	Tube
SVSP60R090LHD4TR	TOLL-8L	P60R090L	Halogen free	Tape & Reel
SVSP60R090FJDHD4	TO-220FJD-3L	P60R090HD4	Halogen free	Tube
SVSP60R090THD4	TO-220-3L	P60R090HD4	Halogen free	Tube
SVSP60R090SHD4	TO-263-2L	P60R090HD4	Halogen free	Tube
SVSP60R090SHD4TR	TO-263-2L	P60R090HD4	Halogen free	Tape & Reel

**ABSOLUTE MAXIMUM RATINGS (UNLESS OTHERWISE NOTED, T<sub>J</sub>=25°C)**

Characteristics	Symbol	Test conditions	Ratings			Unit
			Min.	Typ.	Max.	
Gate-source Voltage (Static)	V <sub>GS</sub>	--	-20	--	20	V
Gate-source Voltage (Dynamic)	V <sub>GS</sub>	AC(f>1 Hz)	-30	--	30	V
Drain Current	I <sub>D</sub>	T <sub>C</sub> =25°C	--	--	38	A
		T <sub>C</sub> =100°C	--	--	24	A
Drain Current Pulsed (Note 1)	I <sub>DM</sub>	T <sub>C</sub> =25°C	--	--	150	A
Power Dissipation (TO-247-3L) (Note 2)	P <sub>D</sub>	T <sub>C</sub> =25°C	--	--	305	W
Power Dissipation (Note 2) (TOLL-8L)(TO-220-3L) (TO-263-2L)	P <sub>D</sub>	T <sub>C</sub> =25°C	--	--	266	W
Power Dissipation (TO-220FJD-3L) (Note 2)	P <sub>D</sub>	T <sub>C</sub> =25°C	--	--	28	W
Single Pulsed Avalanche Energy	E <sub>AS</sub>	L=79mH, V <sub>DD</sub> =100V, R <sub>G</sub> =25Ω, starting temperature T <sub>J</sub> =25°C	--	--	1152	mJ
Single Pulsed Current	I <sub>AS</sub>	--	--	--	5.0	A
Reverse Diode dv/dt	dv/dt	V <sub>DS</sub> =0~400V, I <sub>SD</sub> ≤ I <sub>S</sub> , T <sub>J</sub> =25°C	--	--	50	V/ns
MOSFET dv/dt Ruggedness	dv/dt	V <sub>DS</sub> =0~400V	--	--	50	V/ns
Operation Junction Temperature Range	T <sub>J</sub>	--	-55	--	150	°C
Storage Temperature Range	T <sub>stg</sub>	--	-55	--	150	°C
Continuous Diode Forward Current	I <sub>S</sub>	T <sub>C</sub> =25°C, integral reverse P-N junction diode in the MOSFET	--	--	38	A
Diode Pulse Current	I <sub>S,pulse</sub>		--	--	150	A
Maximum Diode Commutation Speed	di/dt	V <sub>DS</sub> =0~400V, I <sub>SD</sub> ≤ I <sub>S</sub> , T <sub>J</sub> =25°C	--	--	900	A/μs

**THERMAL CHARACTERISTICS**

Table 1. TO-247-3L (SVSP60R090P7HD4) Thermal characteristics

Characteristics	Symbol	Test conditions	Ratings			Unit
			Min.	Typ.	Max.	
Thermal Resistance, Junction-case, Bottom	$R_{\theta JC}$	--	--	--	0.41	°C/W
Thermal Resistance, Junction-ambient	$R_{\theta JA}$	--	--	--	50	°C/W
Soldering Temperature (in line)	$T_{sold}$	$15_{-0}^{+2}$ sec, 1time	--	--	260	°C

Table 2. TOLL-8L (SVSP60R090L/SHD4) Thermal characteristics

Characteristics	Symbol	Test conditions	Ratings			Unit
			Min.	Typ.	Max.	
Thermal Resistance, Junction-case, Bottom	$R_{\theta JC}$	--	--	--	0.47	°C/W
Thermal Resistance, Junction-ambient	$R_{\theta JA}$	--	--	--	62.0	°C/W
Soldering Temperature (SMD)	$T_{sold}$	Reflow soldering: $10 \pm 1$ sec, 3times	--	--	260	°C

Table 3. TO-220FJD-3L (SVSP60R090FJDHD4) Thermal characteristics

Characteristics	Symbol	Test conditions	Ratings			Unit
			Min.	Typ.	Max.	
Thermal Resistance, Junction-case, Bottom	$R_{\theta JC}$	--	--	--	4.5	°C/W
Thermal Resistance, Junction-ambient	$R_{\theta JA}$	--	--	--	62.5	°C/W
Soldering Temperature (in line)	$T_{sold}$	$15_{-0}^{+2}$ sec, 1time	--	--	260	°C

Table 4. TO-220-3L (SVSP60R090THD4) Thermal characteristics

Characteristics	Symbol	Test conditions	Ratings			Unit
			Min.	Typ.	Max.	
Thermal Resistance, Junction-case, Bottom	$R_{\theta JC}$	--	--	--	0.47	°C/W
Thermal Resistance, Junction-ambient	$R_{\theta JA}$	--	--	--	62.0	°C/W
Soldering Temperature (in line)	$T_{sold}$	$15_{-0}^{+2}$ sec, 1time	--	--	260	°C

**ELECTRICAL CHARACTERISTICS (UNLESS OTHERWISE NOTED, T<sub>J</sub>=25°C)**
**Static characteristics**

Characteristics	Symbol	Test conditions	Ratings			Unit
			Min.	Typ.	Max.	
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, T <sub>J</sub> =25°C	--	--	1.0	μA
		V <sub>DS</sub> =600V, V <sub>GS</sub> =0V, T <sub>J</sub> =125°C	--	8.0	--	
Gate-source Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> =±20V, 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	3.0	--	5.0	V
Static Drain-source On State Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =20A, T <sub>J</sub> =25°C	--	75	90	mΩ
		V <sub>GS</sub> =10V, I <sub>D</sub> =20A, T <sub>J</sub> =150°C	--	149	--	
Gate Resistance	R <sub>G</sub>	f=1MHz	--	1.4	--	Ω

**Dynamic characteristics**

Characteristics	Symbol	Test conditions	Ratings			Unit
			Min.	Typ.	Max.	
Input Capacitance	C <sub>iss</sub>	f=1MHz, V <sub>GS</sub> =0V, V <sub>DS</sub> =200V	--	2762	--	pF
Output Capacitance	C <sub>oss</sub>		--	88	--	
Reverse Transfer Capacitance	C <sub>rss</sub>		--	8.5	--	
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =400V, V <sub>GS</sub> =13V, R <sub>G</sub> =5.3Ω, I <sub>D</sub> =20A (Notes 3, 4)	--	22	--	ns
Turn-on Rise Time	t <sub>r</sub>		--	31	--	
Turn-off Delay Time	t <sub>d(off)</sub>		--	89	--	
Turn-off Fall Time	t <sub>f</sub>		--	27	--	
Total Gate Charge	Q <sub>g</sub>	V <sub>DD</sub> =400V, V <sub>GS</sub> =10V, I <sub>D</sub> =20A (Notes 3, 4)	--	87	--	nC
Gate-source Charge	Q <sub>gs</sub>		--	22	--	
Gate-drain Charge	Q <sub>gd</sub>		--	47	--	
Gate-plateau Voltage	V <sub>plateau</sub>		--	7.3	--	V

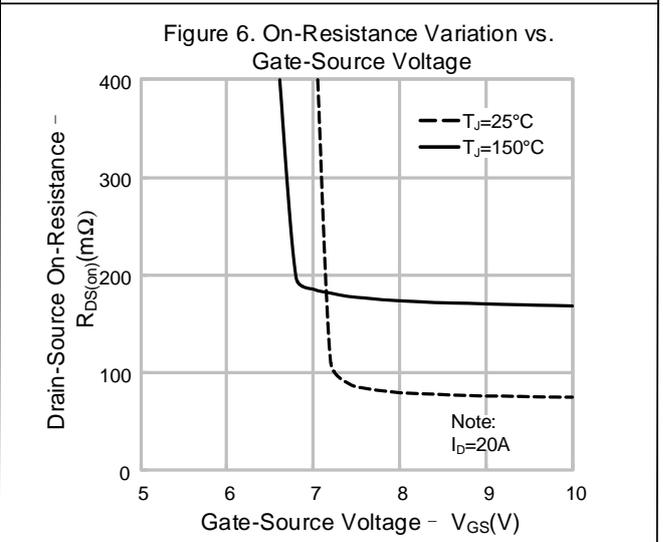
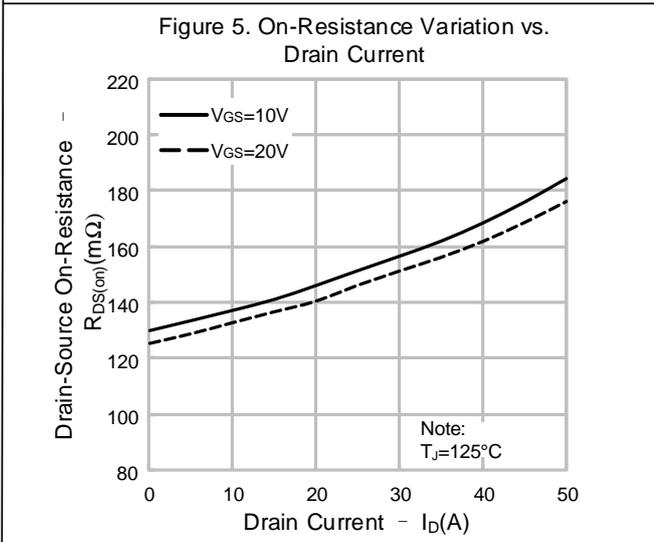
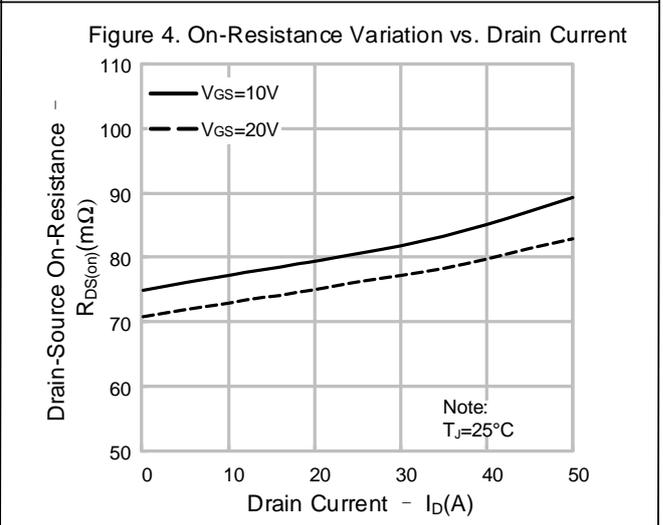
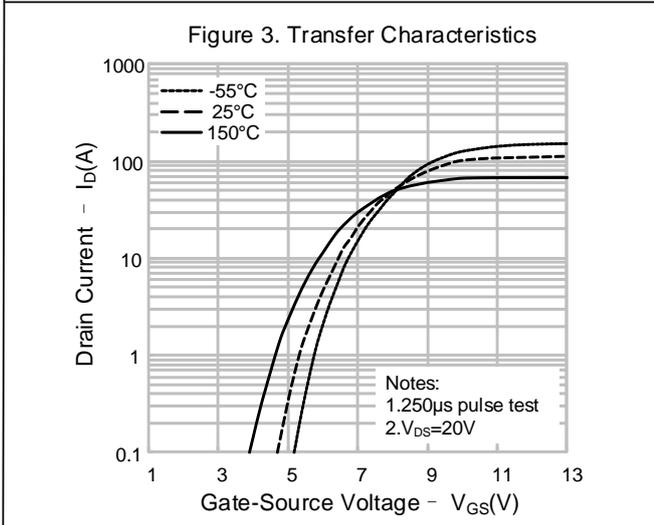
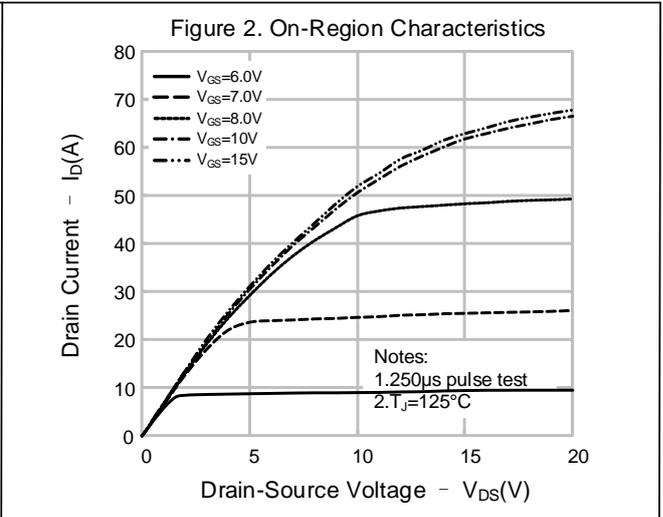
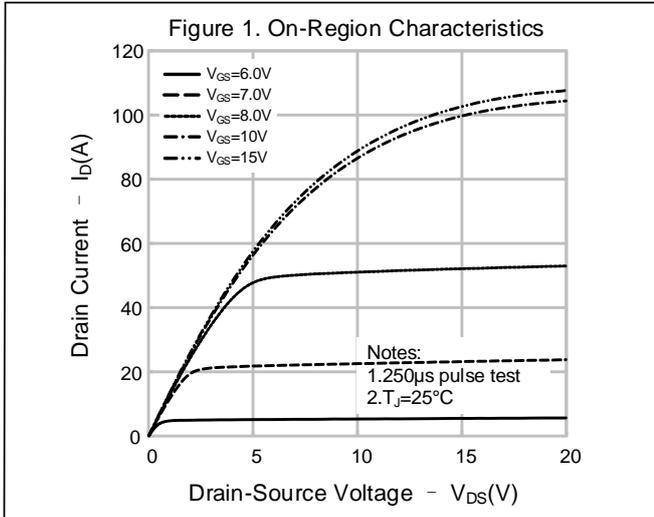
**Reverse diode characteristics**

Characteristics	Symbol	Test conditions	Ratings			Unit
			Min.	Typ.	Max.	
Diode Forward Voltage	V <sub>SD</sub>	I <sub>S</sub> =20A, V <sub>GS</sub> =0V	--	--	1.4	V
Reverse Recovery Time	T <sub>rr</sub>	I <sub>S</sub> =20A, V <sub>GS</sub> =0V, V <sub>DD</sub> =400V, dI <sub>F</sub> /dt=100A/μs (Note 3)	--	123	--	ns
Reverse Recovery Charge	Q <sub>rr</sub>		--	0.75	--	μC
Reverse Recovery Peak Current	I <sub>rrm</sub>		--	11	--	A

**Notes:**

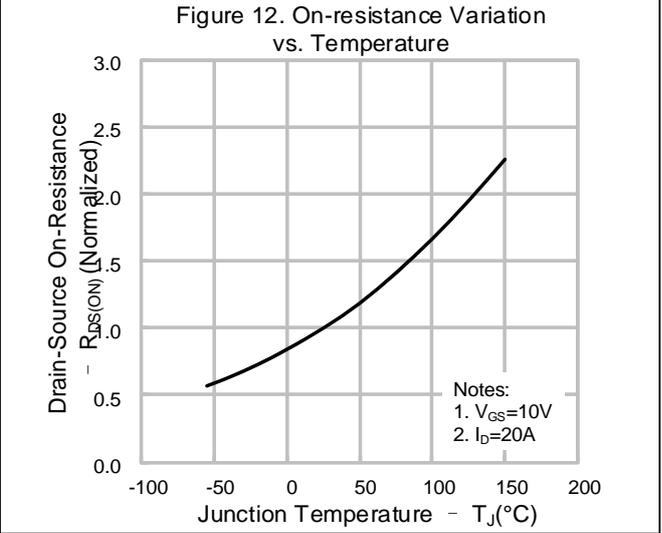
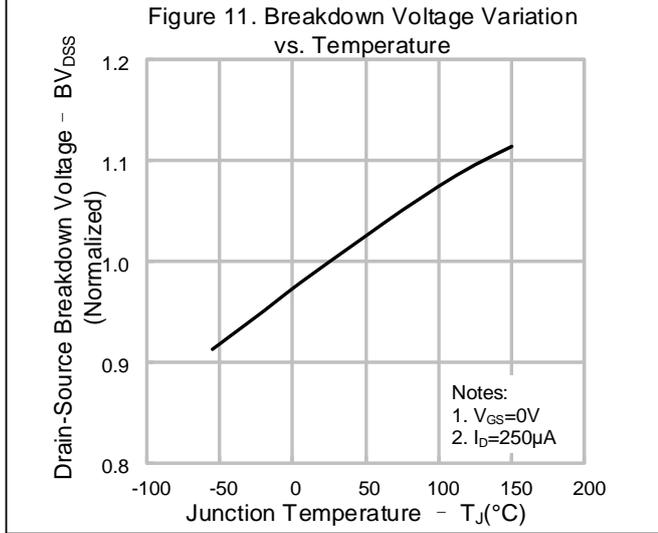
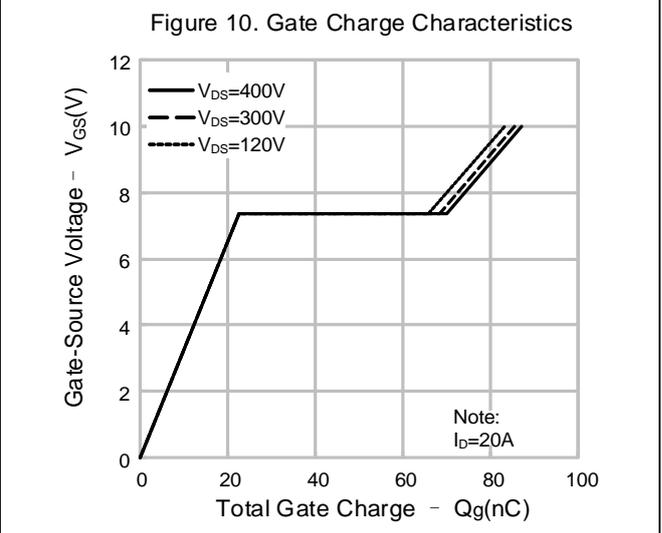
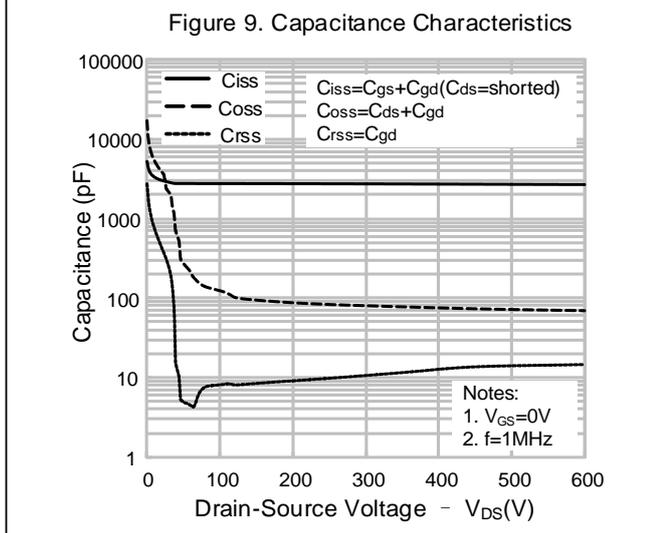
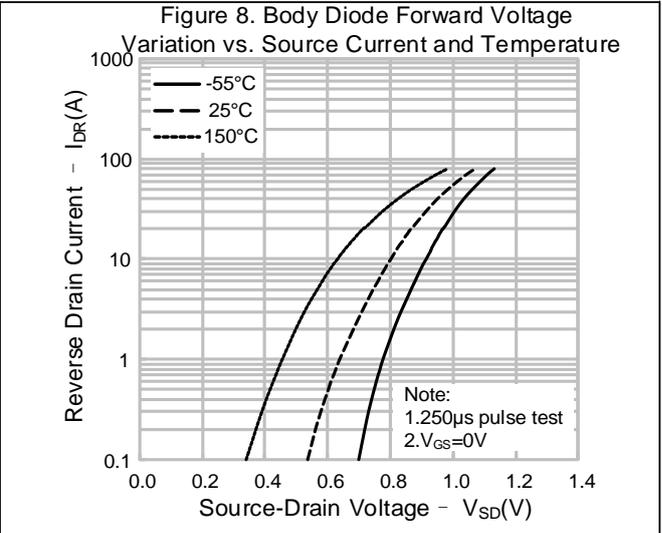
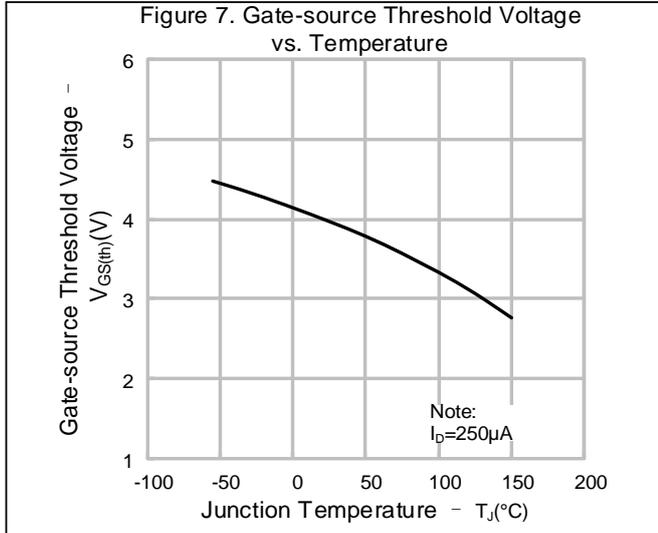
- Pulse time 5μs;
- The dissipation power will change with temperature, derating above 25°C:  
2.44W/°C(TO-247-3L)/ 2.13W/°C(TOLL-8L)(TO-220-3L)(TO-263-2L)/ 0.22W/°C(TO-220FJD-3L);
- Pulse Test: Pulse width ≤300μs, Duty cycle≤2%;
- Essentially independent of operating temperature.

**TYPICAL CHARACTERISTICS**

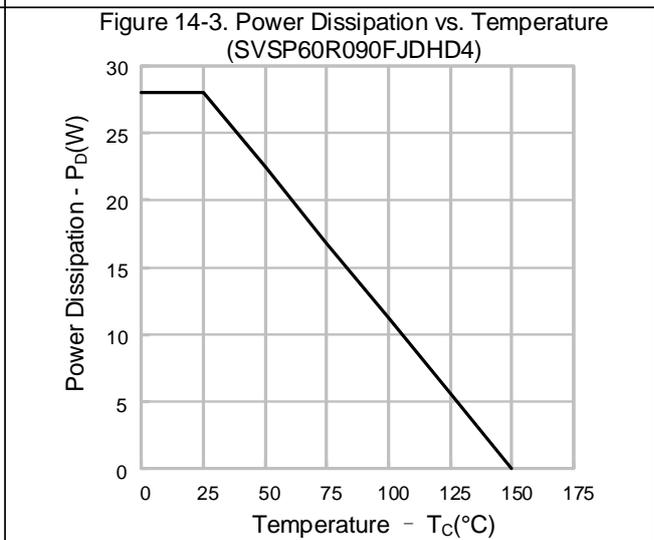
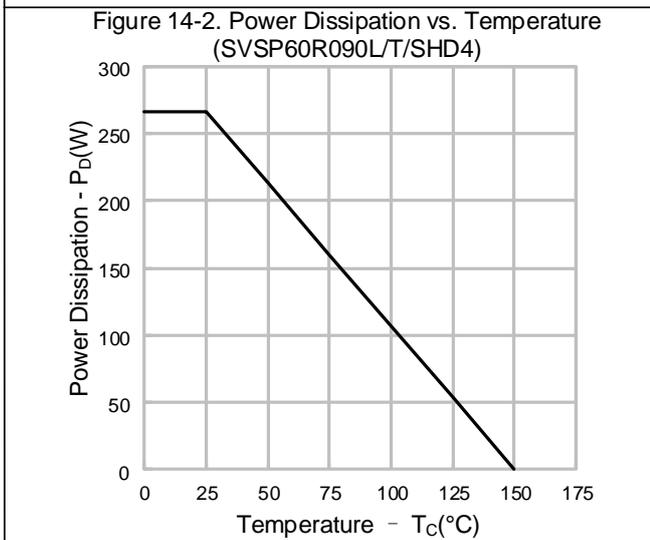
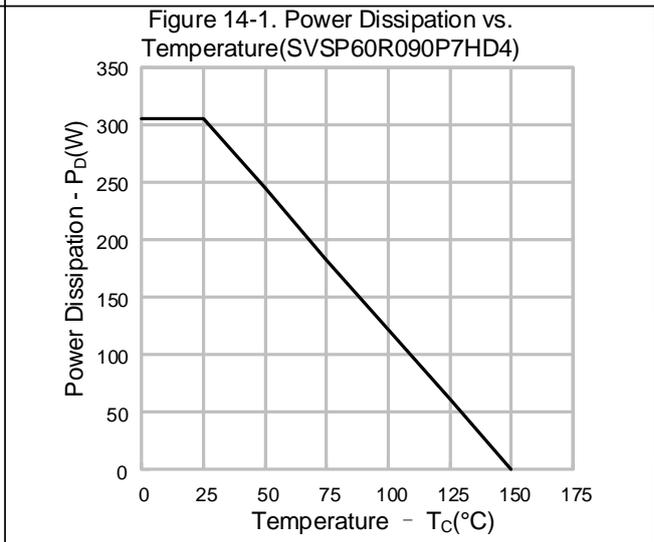
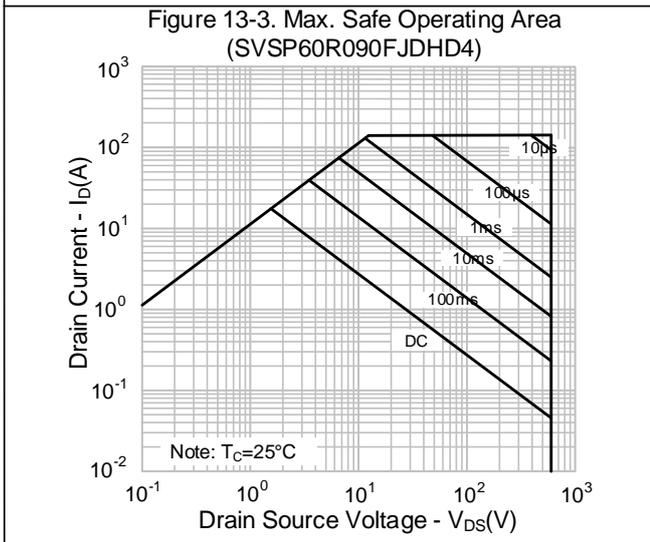
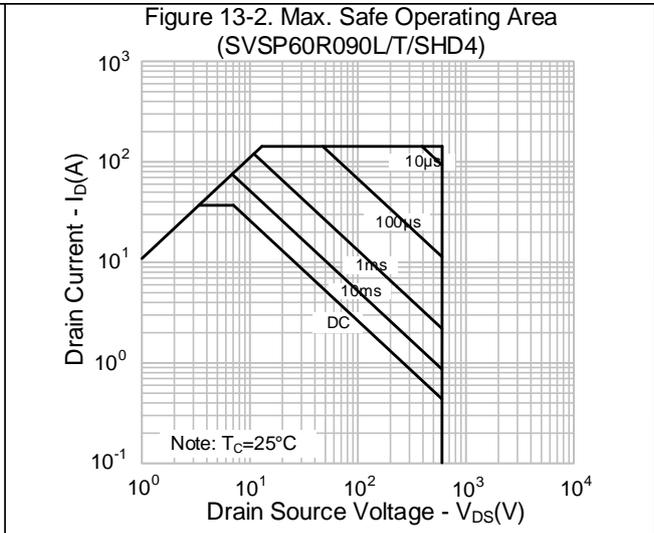
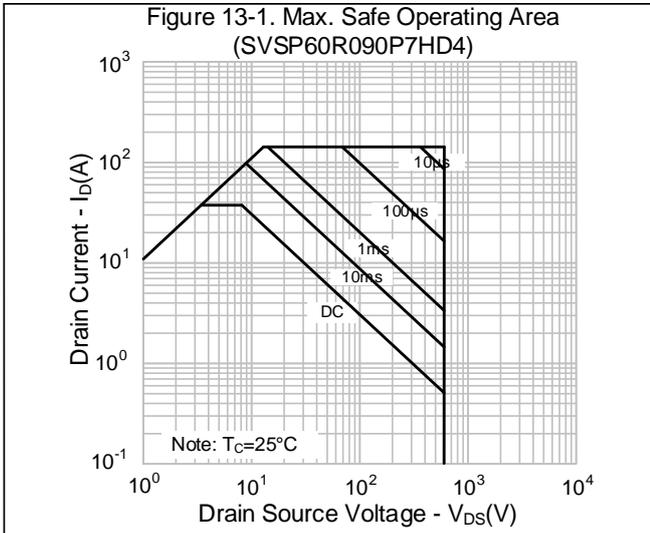




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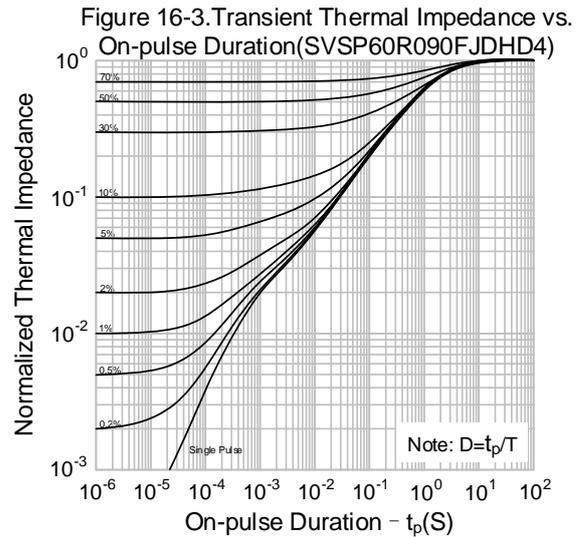
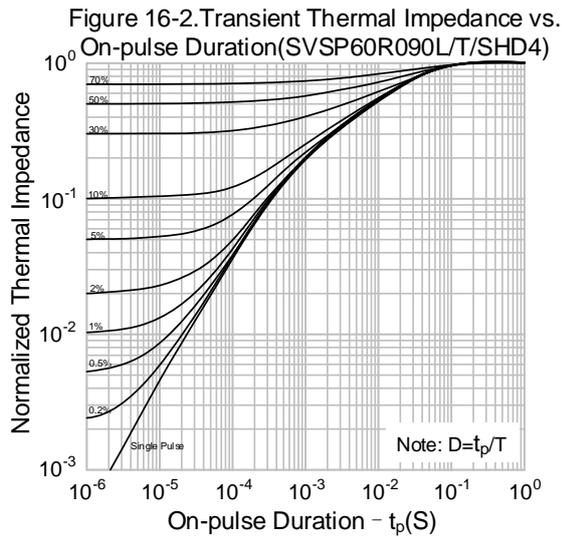
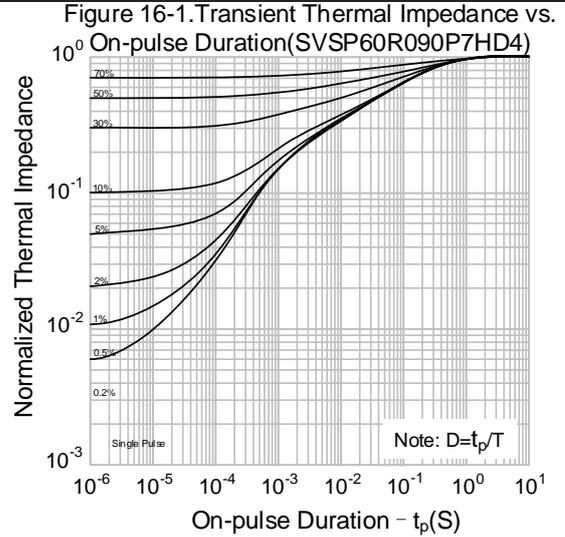
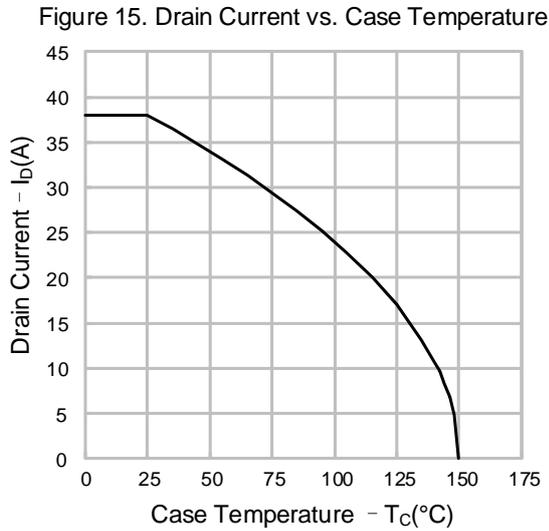


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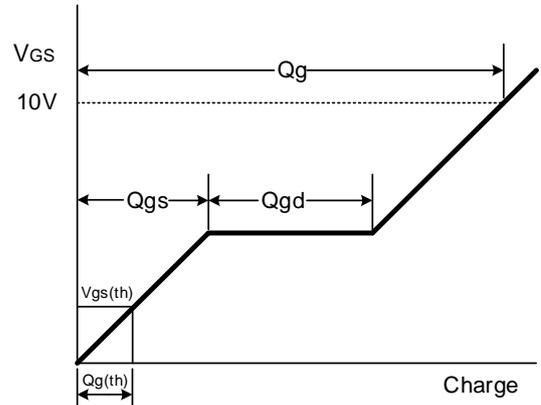
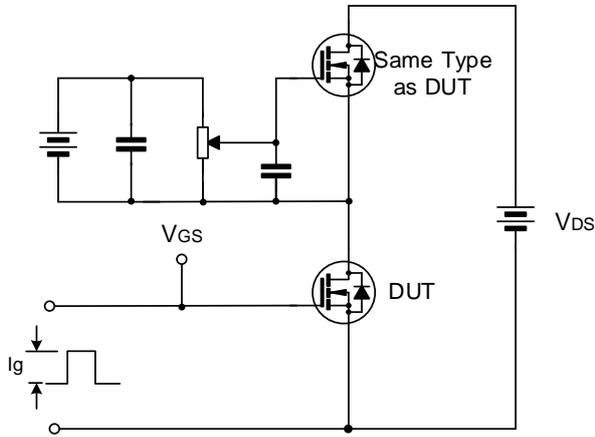


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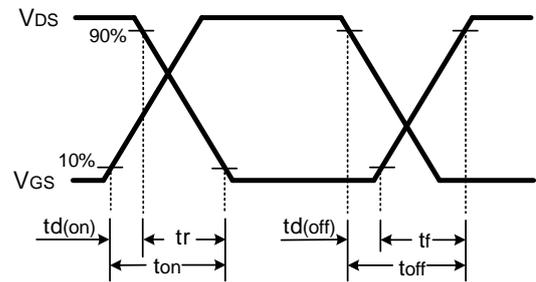
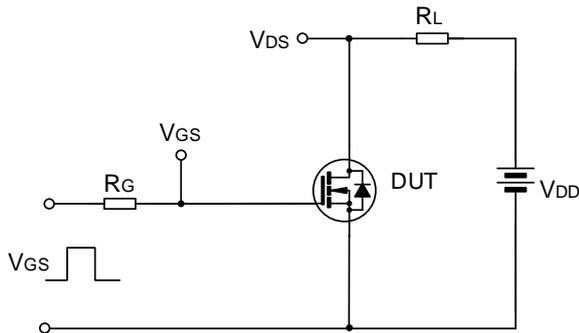


**TYPICAL TEST CIRCUIT**

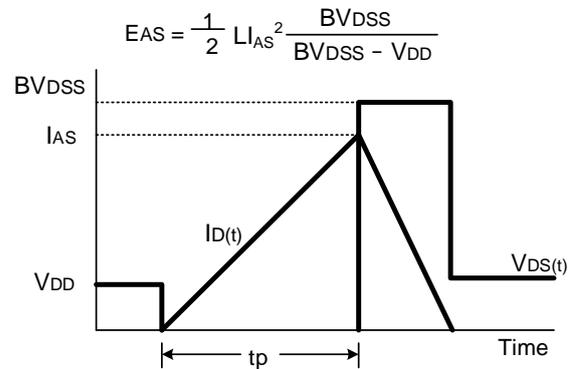
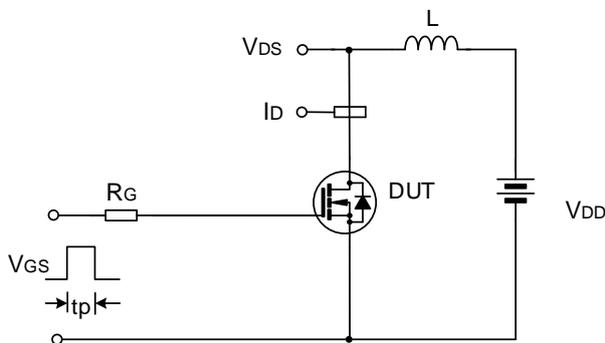
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveform



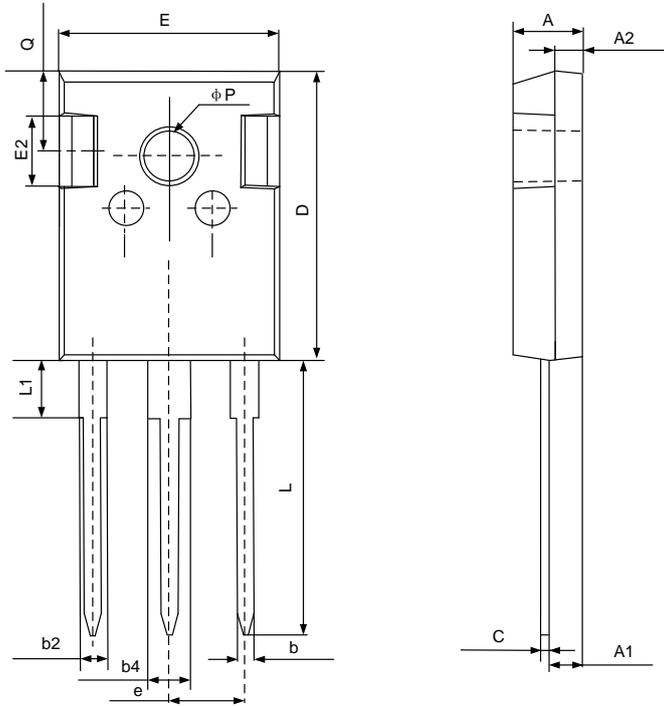
Unclamped Inductive Switching Test Circuit & Waveform



**PACKAGE OUTLINE**

**TO-247-3L**

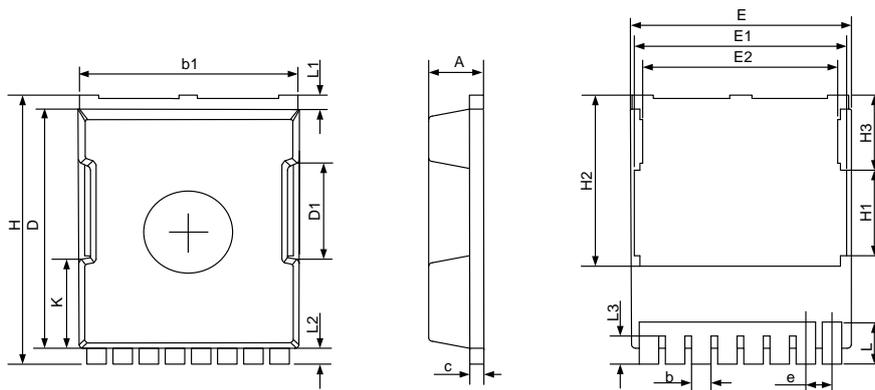
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SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.21	2.41	2.59
A2	1.85	2.00	2.15
b	1.11	-	1.36
b2	1.91	-	2.25
b4	2.91	-	3.25
c	0.51	-	0.75
D	20.80	21.00	21.30
E	15.50	15.80	16.10
E2	4.40	5.00	5.20
e	5.44 BSC		
L	19.72	19.92	20.22
L1	-	-	4.30
Q	5.60	5.80	6.00
P	3.40	-	3.80

**TOLL-8L**

**UNIT: mm**

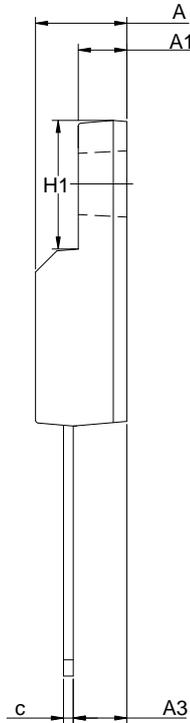
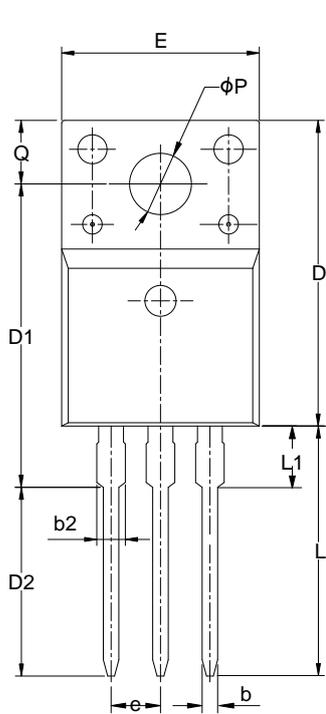


SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	2.20	2.30	2.40
b	0.70	0.80	0.90
b1	9.70	9.80	9.90
c	0.40	0.50	0.60
D	10.28	10.38	10.48
D1	3.15	3.30	3.45
E	9.70	9.90	10.10
E1	9.30	9.50	9.70
E2	8.35	8.50	8.65
e	1.20 BSC		
H	11.48	11.73	11.88
H1	3.16	3.26	3.36
H2	7.20	7.35	7.50
K	4.03	4.18	4.33
L	1.60	1.85	2.10
L1	0.55	0.70	0.85
L2	0.45	0.60	0.75
L3	1.00	1.20	1.30

**PACKAGE OUTLINE(CONTINUED)**

**TO-220FJD-3L**

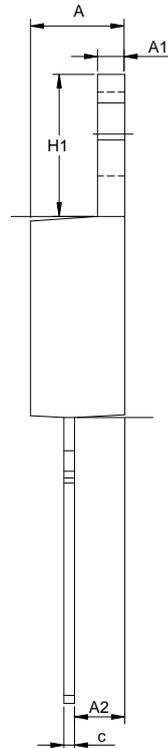
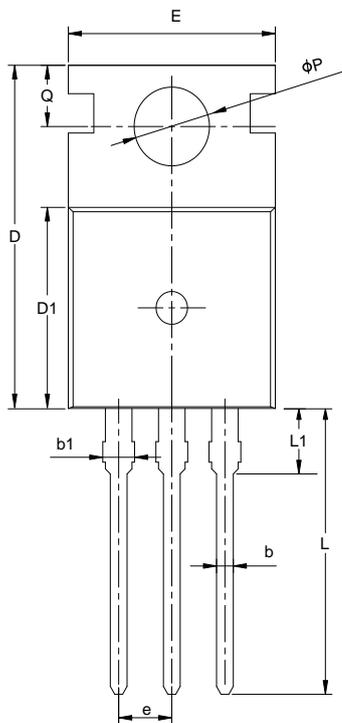
**UNIT: mm**



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	0.55	0.70	0.85
b2	—	—	1.29
c	0.35	0.50	0.65
D	15.25	15.87	16.25
D1	13.97	14.47	14.97
D2	10.58	11.08	11.58
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	—	—	2.00
$\phi P$	3.00	3.18	3.40
Q	3.05	3.30	3.55

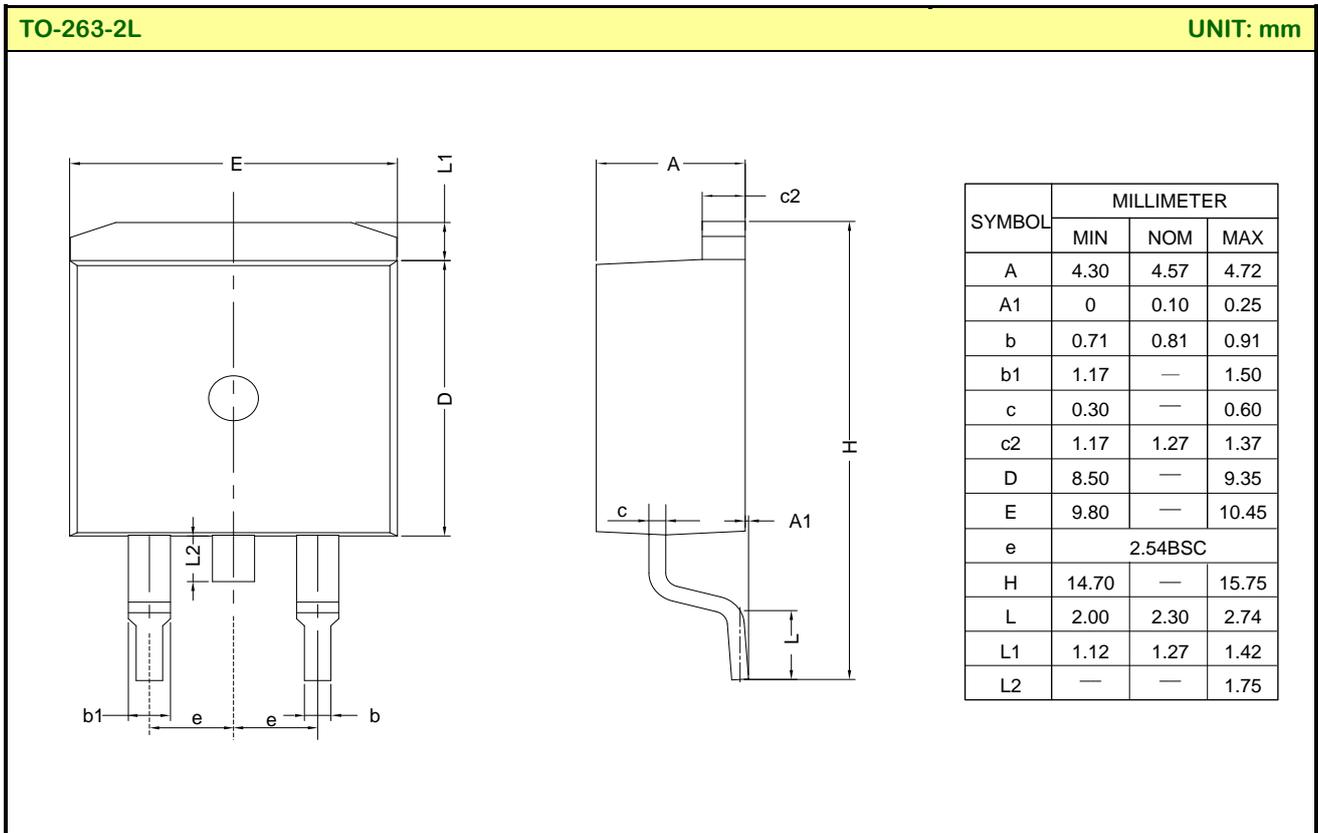
**TO-220-3L**

**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

**PACKAGE OUTLINE(CONTINUED)**



**MOS DEVICES OPERATE NOTES:**

Electrostatic charges may exist in many things. Please take following preventive measures to prevent effectively the MOS electric circuit as a result of the damage which is caused by discharge:

- The operator must put on wrist strap which should be earthed to against electrostatic.
- Equipment cases should be earthed.
- All tools used during assembly, including soldering tools and solder baths, must be earthed.
- MOS devices should be packed in antistatic/conductive containers for transportation.

**Important notice :**

1. Silan reserves the right to make changes of this instruction without notice.
2. Customers should obtain the latest relevant information when purchasing and should verify whether such information is latest and complete. Please read this instruction and application manual and related materials carefully before using products, including the circuit operation precautions, etc.
3. It is neither tested nor verified in accordance with AEC-Q series standards testing or application requirements. Silan does not give any warranties as to the suitability of the Silan's product for any specific use. The design intent, design definition and design of the product are not intended for application (the application stated in this instruction includes use, etc.) in transportation equipment, medical equipment, life-saving equipment, aerospace equipment, non-civil equipment or non-civil use, etc. (the equipment stated in this instruction includes systems, devices, etc., all referred to as equipment). The product should not be used in any equipment or system whose manufacture, use or sale is prohibited under any applicable laws or regulations ("unintended use"). If the product is used for unintended use, therefore the full risks of such products application are borne by the customer and Silan assumes no liability for the product used for the unintended use. If the customer intends to use the Silan's product in a application where malfunction or failure can be reasonably be expected to result in personal injury, or serious property, or environment damage, the customer shall make adequate assessment, testing and verification, and Silan shall not be liable for such applications.
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Rev: 1.2

Revision History:

1. Add TO-220-3L、TO-263-2L package
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Rev: 1.1

Revision History:

1. Add TO-220FJD-3L package
  2. Update typical characteristics
  3. Update important notice
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Rev: 1.0

Revision History:

1. First release
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