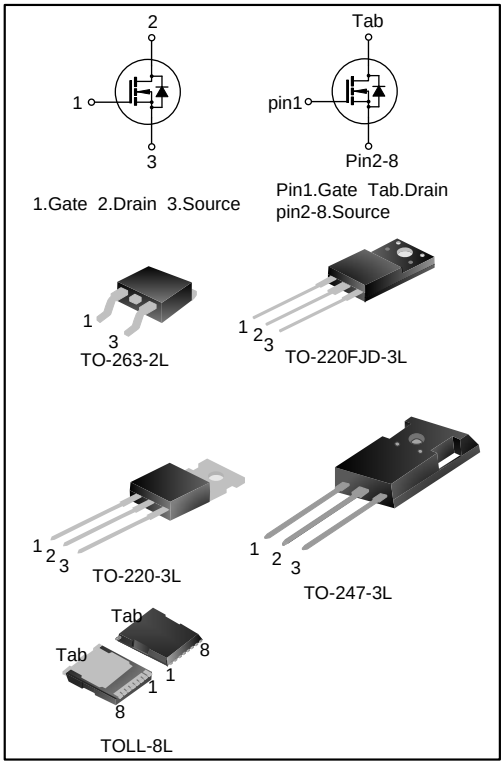
35A, 650V SUPER JUNCTION MOS POWER TRANSISTOR

DESCRIPTION

SVSP65R110P7(T)(S)(FJD)(L)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

- 35A, 650V, $R_{DS(on)(typ.)}$=90mΩ@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}	650	V
$V_{GS(th)}$	3.0~5.0	V
$R_{DS(on),max.}$	110	mΩ
$I_{D.pulse}$	140	A
$Q_{g.typ.}$	80	nC

ORDERING INFORMATION

Part No.	Package	Marking	Hazardous Substance Control	Packing Type
SVSP65R110P7HD4	TO-247-3L	P65R110P7	Halogen free	Tube
SVSP65R110THD4	TO-220-3L	P65R110T	Halogen free	Tube
SVSP65R110SHD4	TO-263-2L	P65R110S	Halogen free	Tube
SVSP65R110SHD4TR	TO-263-2L	P65R110S	Halogen free	Tape & Reel
SVSP65R110FJDHD4	TO-220FJD-3L	P65R110FJD	Halogen free	Tube
SVSP65R110LHD4TR	TOLL-8L	P65R110L	Halogen free	Tape & Reel

ABSOLUTE MAXIMUM RATINGS (UNLESS OTHERWISE NOTED, T_J=25°C)

Characteristics	Symbol	Test conditions	Ratings			Unit
			Min.	Typ.	Max.	
Drain-source Voltage	V_{DS}	--	650	--	--	V
Gate-source Voltage (Static)	V_{GS}	--	-20	--	20	V
Gate-source Voltage (Dynamic)	V_{GS}	AC(f>1 Hz)	-30	--	30	V
Drain Current	I_D	T_C=25°C	--	--	35	A
		T_C=100°C	--	--	22	A
Drain Current Pulsed (Note 1)	I_{DM}	T_C=25°C	--	--	140	A
Power Dissipation (Note 2) (TO-247-3L)	P_D	T_C=25°C	--	--	278	W
Power Dissipation (Note 2) (TO-220-3L) (TO-263-2L) (TOLL-8L)	P_D	T_C=25°C	--	--	245	W
Power Dissipation (Note 2) (TO-220FJD-3L)	P_D	T_C=25°C	--	--	26	W
Single Pulsed Avalanche Energy	E_{AS}	L=79mH, V_{DD}=100V, R_G=25Ω, starting temperature T_J=25°C	--	--	1136	mJ
Single Pulsed Current	I_{AS}	--	--	--	5.0	A
Reverse Diode dv/dt	dv/dt	V_{DS}=0~400V, I_{SD}<= I_S, T_J=25°C	--	--	50	V/ns
MOSFET dv/dt Ruggedness	dv/dt	V_{DS}=0~400V	--	--	50	V/ns
Operation Junction Temperature Range	T_J	--	-55	--	150	°C
Storage Temperature Range	T_{stg}	--	-55	--	150	°C
Continuous Diode Forward Current	I_S	T_C=25°C, integral reverse P-N junction diode in the MOSFET	--	--	35	A
Diode Pulse Current	$I_{S,pulse}$		--	--	140	A
Maximum Diode Commutation Speed	di/dt	V_{DS}=0~400V, I_{SD}<= I_S, T_J=25°C	--	--	900	A/μs

THERMAL CHARACTERISTICS

Table 1. TO-247-3L (SVSP65R110P7HD4) Thermal characteristics

Characteristics	Symbol	Test conditions	Ratings			Unit
			Min.	Typ.	Max.	
Thermal Resistance, Junction-case, Bottom	$R_{\theta JC}$	--	--	--	0.45	°C/W
Thermal Resistance, Junction-ambient	$R_{\theta JA}$	--	--	--	50	°C/W
Soldering Temperature (in line)	T_{sold}	15^{+2}_{-0} sec, 1time	--	--	260	°C

Table 2. TO-220-3L (SVSP65R110THD4) Thermal characteristics

Characteristics	Symbol	Test conditions	Ratings			Unit
			Min.	Typ.	Max.	
Thermal Resistance, Junction-case, Bottom	$R_{\theta JC}$	--	--	--	0.51	°C/W
Thermal Resistance, Junction-ambient	$R_{\theta JA}$	--	--	--	62.5	°C/W
Soldering Temperature (in line)	T_{sold}	15^{+2}_{-0} sec, 1time	--	--	260	°C

Table 3. TO-263-2L/TOLL-8L (SVSP65R110S/LHD4) Thermal characteristics

Characteristics	Symbol	Test conditions	Ratings			Unit
			Min.	Typ.	Max.	
Thermal Resistance, Junction-case, Bottom	$R_{\theta JC}$	--	--	--	0.51	°C/W
Thermal Resistance, Junction-ambient	$R_{\theta JA}$	--	--	--	62.5	°C/W
Soldering Temperature (SMD)	T_{sold}	Reflow soldering:: 10±1 sec, 3times	--	--	260	°C

Table 4. TO-220FJD-3L (SVSP65R110FJDHD4) Thermal characteristics

Characteristics	Symbol	Test conditions	Ratings			Unit
			Min.	Typ.	Max.	
Thermal Resistance, Junction-case, Bottom	$R_{\theta JC}$	--	--	--	4.8	°C/W
Thermal Resistance, Junction-ambient	$R_{\theta JA}$	--	--	--	62.5	°C/W
Soldering Temperature (in line)	T_{sold}	15^{+2}_{-0} sec, 1time	--	--	260	°C

ELECTRICAL CHARACTERISTICS (UNLESS OTHERWISE NOTED,T_J=25°C)

Static characteristics

Characteristics	Symbol	Test conditions	Ratings			Unit
			Min.	Typ.	Max.	
Drain-source Breakdown Voltage	BV_{DSS}	V_{GS}=0V, I_D=250μA	650	--	--	V
Drain-source Leakage Current	I_{DSS}	V_{DS}=650V, V_{GS}=0V, T_J=25°C	--	--	1.0	μA
		V_{DS}=650V, V_{GS}=0V, T_J=125°C	--	9.0	--	
Gate-source Leakage Current	I_{GSS}	V_{GS}=±20V, V_{DS}=0V	--	--	±100	nA
Gate Threshold Voltage	$V_{GS(th)}$	V_{GS}=V_{DS}, I_D=250μA	3.0	--	5.0	V
Static Drain-source On State Resistance	$R_{DS(on)}$	V_{GS}=10V, I_D=17.5A, T_J=25°C	--	90	110	mΩ
		V_{GS}=10V, I_D=17.5A, T_J=150°C	--	197	--	mΩ
Gate Resistance	R_G	f=1MHz	--	1.8	--	Ω

Dynamic characteristics

Characteristics	Symbol	Test conditions	Ratings			Unit
			Min.	Typ.	Max.	
Input Capacitance	C_{iss}	f=1MHz, V_{GS}=0V, V_{DS}=200V	--	3010	--	pF
Output Capacitance	C_{oss}		--	83	--	
Reverse Transfer Capacitance	C_{rss}		--	5.4	--	
Turn-on Delay Time	$t_{d(on)}$	V_{DD}=400V, V_{GS}=13V, R_G=1.8Ω, I_D=19.1A (Notes 3, 4)	--	24	--	ns
Turn-on Rise Time	t_r		--	28	--	
Turn-off Delay Time	$t_{d(off)}$		--	60	--	
Turn-off Fall Time	t_f		--	23	--	
Total Gate Charge	Q_g	V_{DD}=480V, V_{GS}=10V, I_D=19.1A (Notes 3, 4)	--	80	--	nC
Gate-source Charge	Q_{gs}		--	28	--	
Gate-drain Charge	Q_{gd}		--	42	--	
Gate-plateau Voltage	$V_{plateau}$		--	8.5	--	V

Reverse diode characteristics

Characteristics	Symbol	Test conditions	Ratings			Unit
			Min.	Typ.	Max.	
Diode Forward Voltage	V_{SD}	I_S=19A, V_{GS}=0V	--	--	1.4	V
Reverse Recovery Time	T_{rr}	I_S=19.1A, V_{GS}=0V, V_R=400V, dI_F/dt=100A/μs (Note 3)	--	103	--	ns
Reverse Recovery Charge	Q_{rr}		--	0.44	--	μC
Reverse Recovery Peak Current	I_{rrm}		--	8.0	--	A

Notes:

1. Pulse time 5μs;
2. The dissipation power will change with temperature, derating above 25°C:
   2.22W/°C(TO-247-3L)/ 1.96W/°C(TO-220-3L)(TO-263-2L)(TOLL-8L)/ 0.21W/°C(TO-220FJD-3L);
3. Pulse Test: Pulse width ≤300μs, Duty cycle≤2%;
4. Essentially independent of operating temperature.

TYPICAL CHARACTERISTICS

Figure 1. On-Region Characteristics

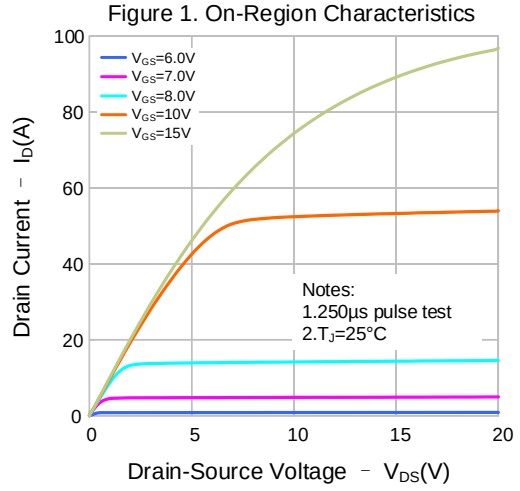


Figure 2. On-Region Characteristics

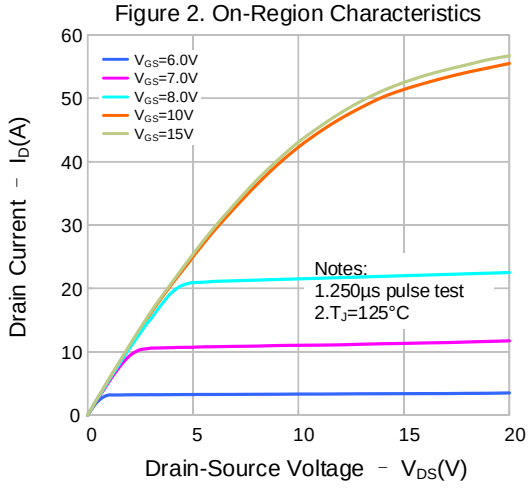


Figure 3. Transfer Characteristics

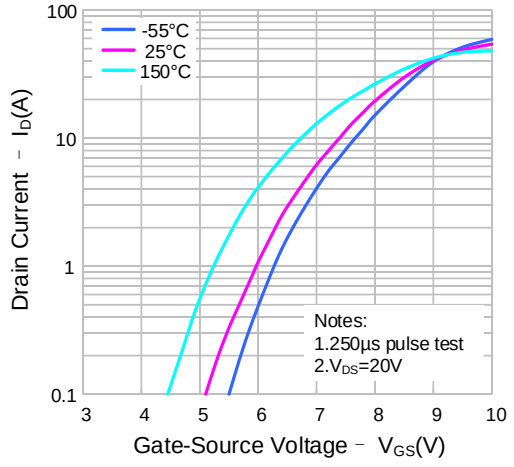


Figure 4. On-Resistance Variation vs. Drain Current

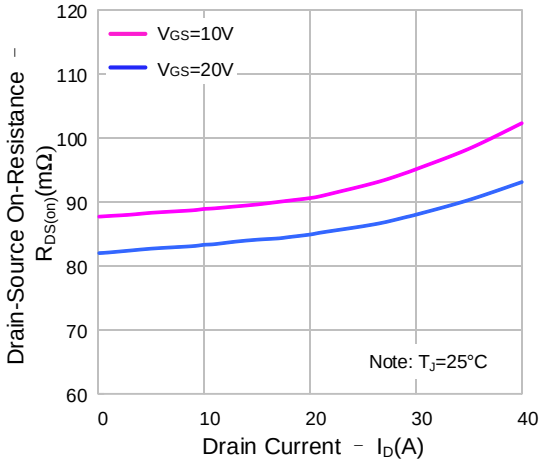


Figure 5. On-Resistance Variation vs. Drain Current

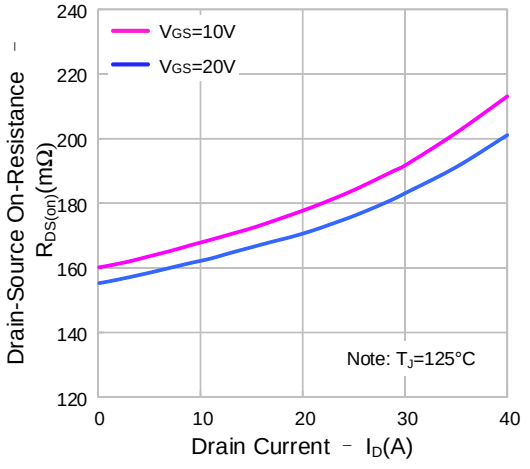
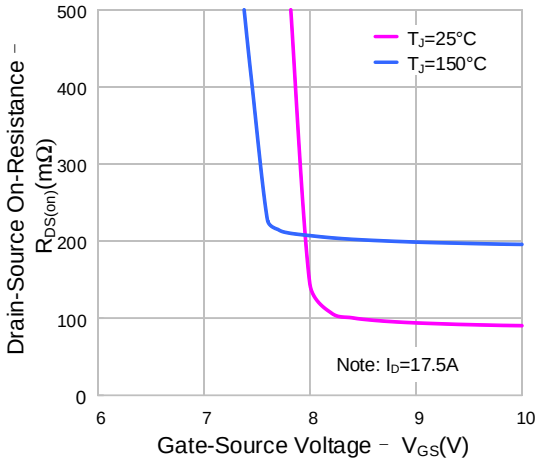


Figure 6. On-Resistance Variation vs. Gate-Source Voltage



TYPICAL CHARACTERISTICS (CONTINUED)

Figure 7. Gate-source Threshold Voltage vs. Temperature

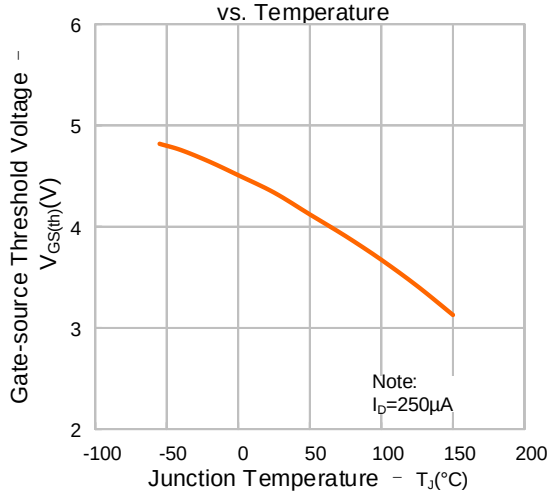


Figure 8. Body Diode Forward Voltage Variation vs. Source Current and Temperature

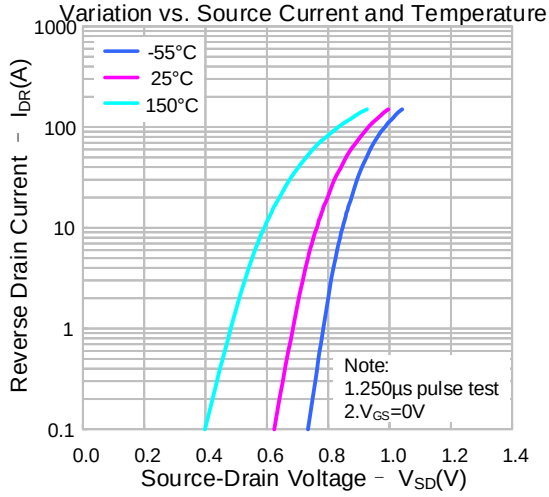


Figure 9. Capacitance Characteristics

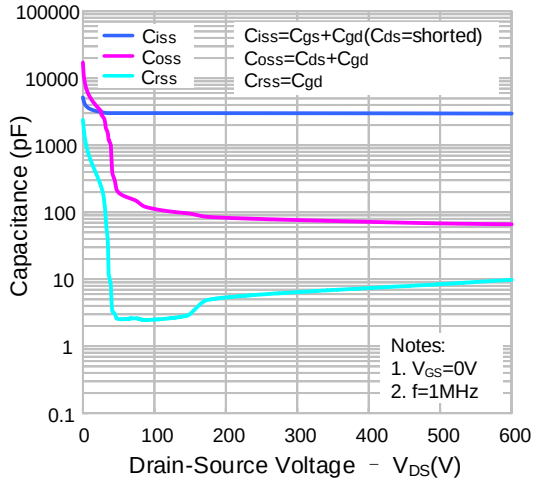


Figure 10. Gate Charge Characteristics

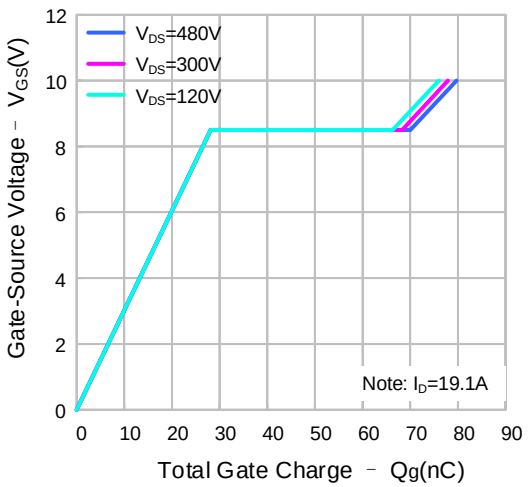


Figure 11. Breakdown Voltage Variation vs. Temperature

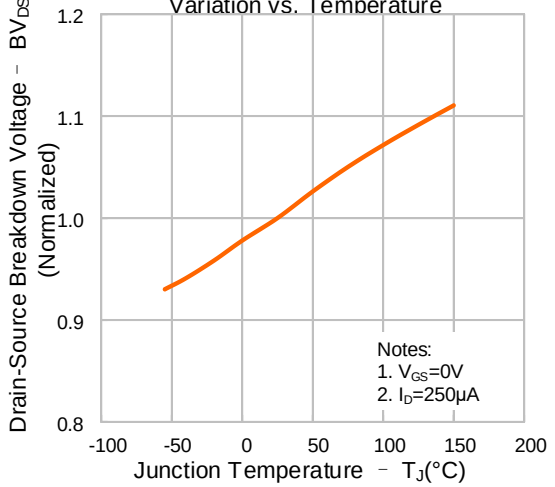
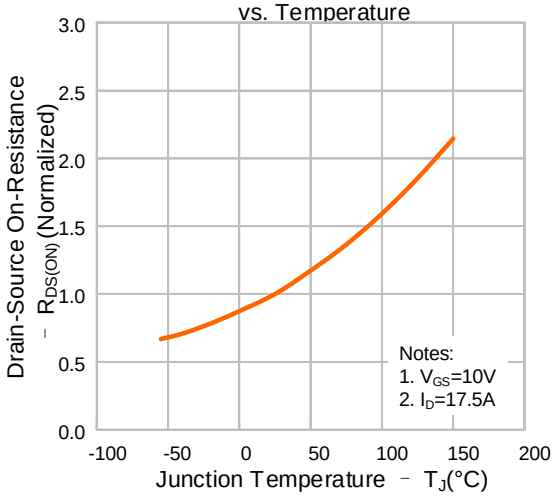


Figure 12. On-resistance Variation vs. Temperature



TYPICAL CHARACTERISTICS (CONTINUED)

Figure 13-1. Max. Safe Operating Area(SVSP65R110P7HD4)

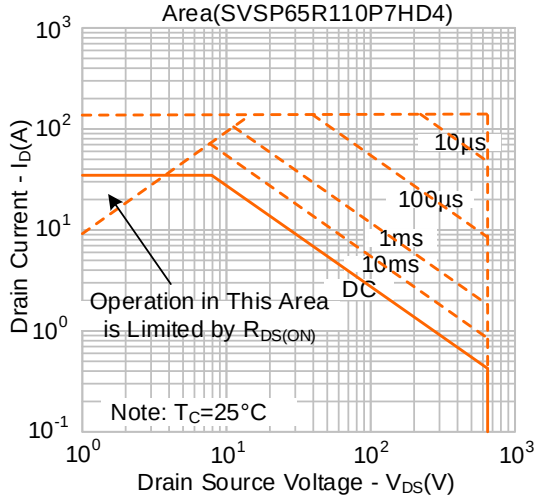


Figure 13-2. Max. Safe Operating Area(SVSP65R110T/L/SHD4)

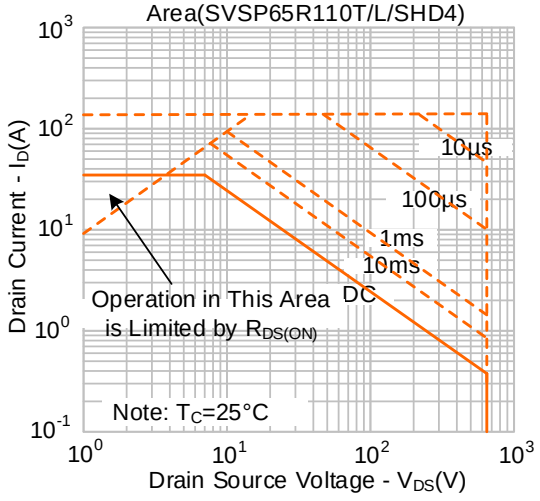


Figure 13-3. Max. Safe Operating Area(SVSP65R110FJDHD4)

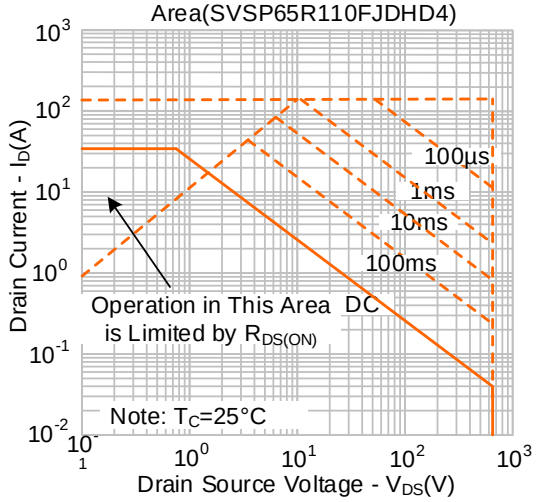


Figure 14-1. Power Dissipation vs. Temperature(SVSP65R110P7HD4)

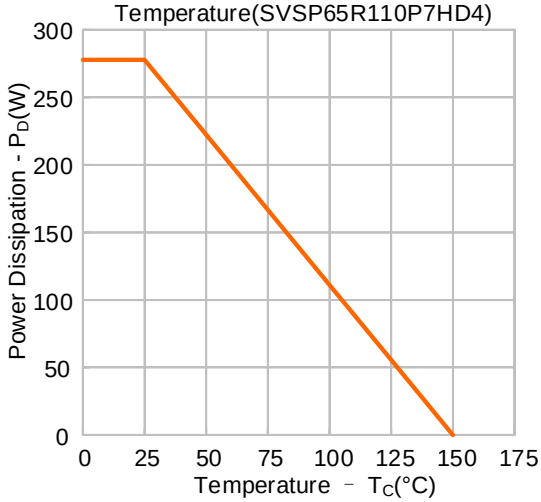


Figure 14-2. Power Dissipation vs. Temperature(SVSP65R110T/L/SHD4)

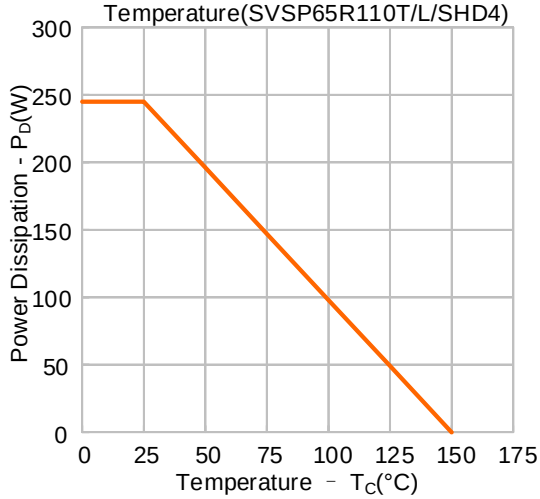
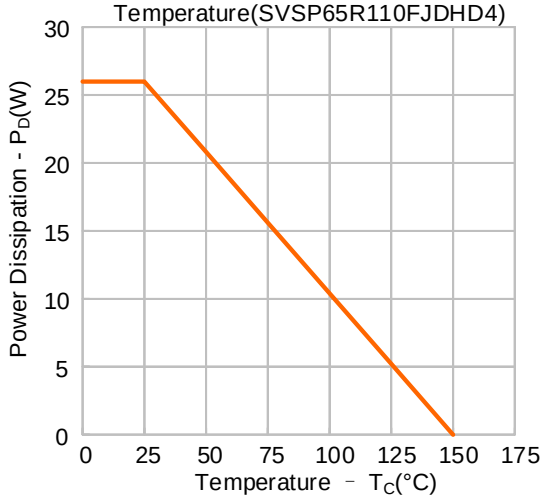


Figure 14-3. Power Dissipation vs. Temperature(SVSP65R110FJDHD4)



TYPICAL CHARACTERISTICS (CONTINUED)

Figure 15. Drain Current vs. Case Temperature

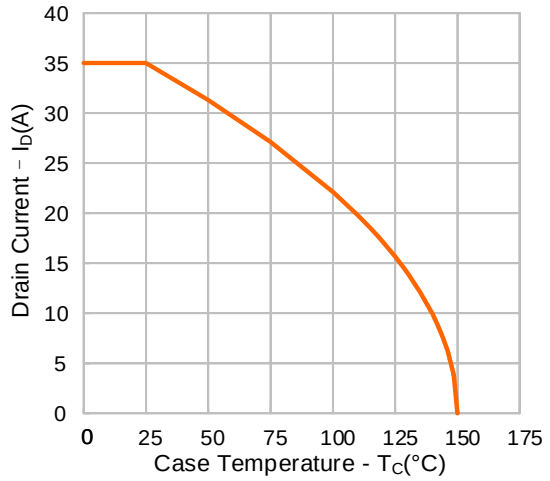


Figure 16-1. Transient Thermal Impedance vs. On-pulse Duration (SVSP65R110P7HD4)

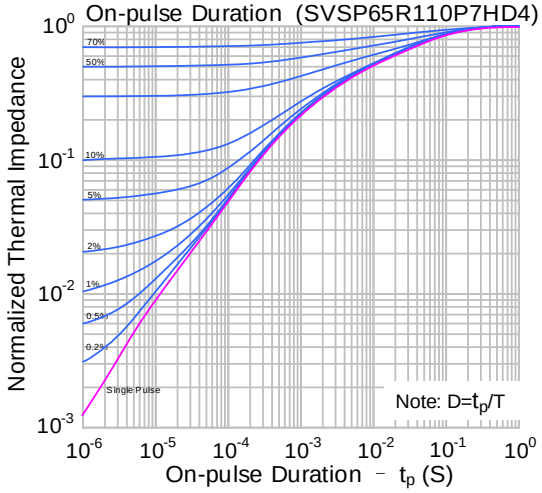


Figure 16-2. Transient Thermal Impedance vs. On-pulse Duration (SVSP65R110T/L/SHD4)

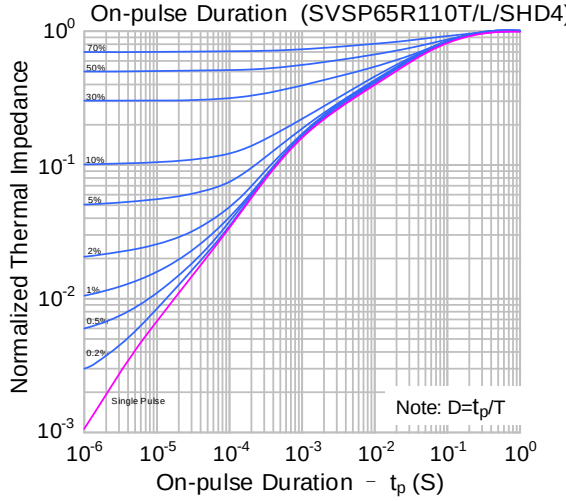
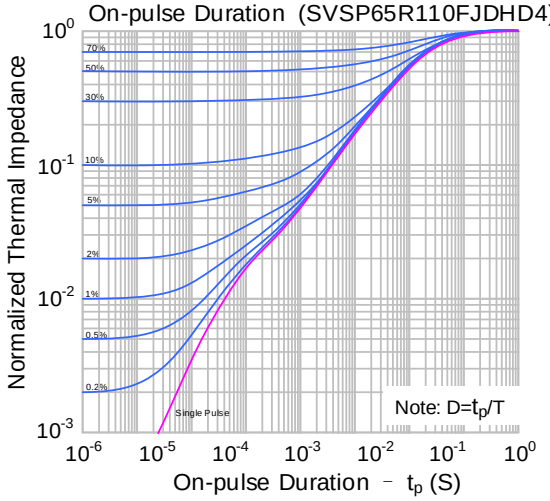
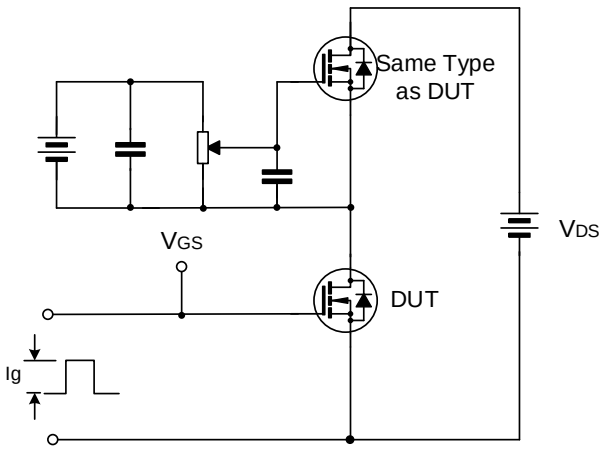


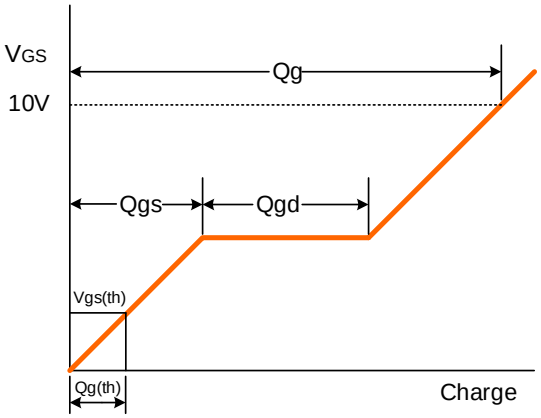
Figure 16-3. Transient Thermal Impedance vs. On-pulse Duration (SVSP65R110FJDHD4)



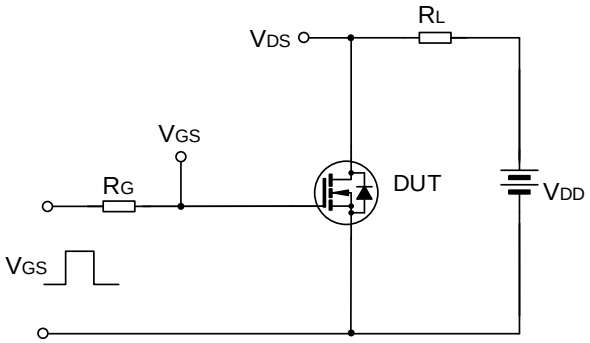
TYPICAL TEST CIRCUIT

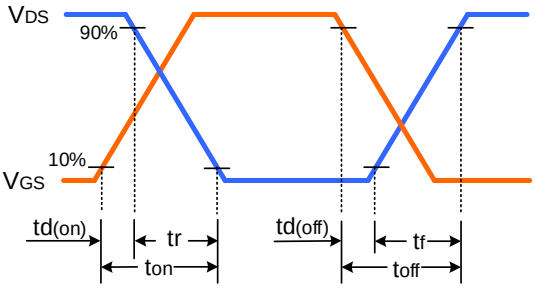
Gate Charge Test Circuit & Waveform



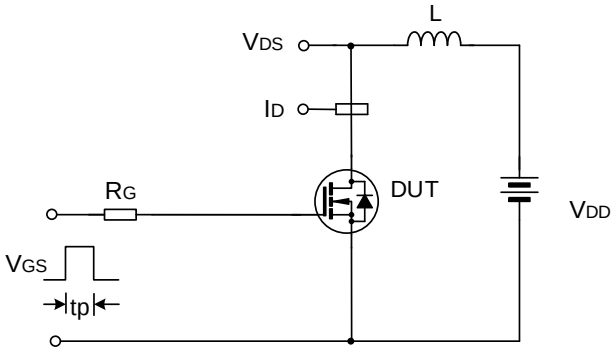


Resistive Switching Test Circuit & Waveform

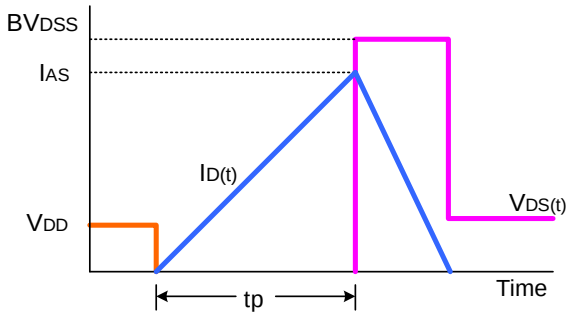




Unclamped Inductive Switching Test Circuit & Waveform

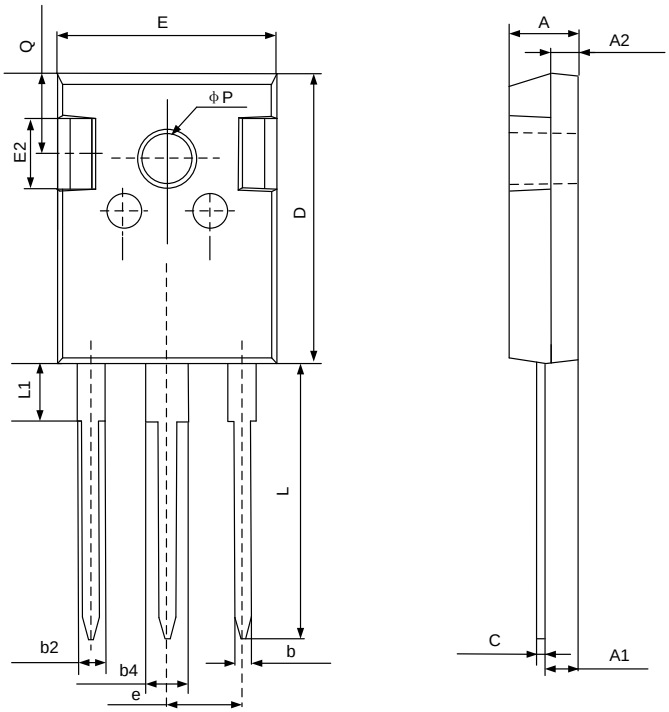


$$E_{AS} = \frac{1}{2} LI_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$



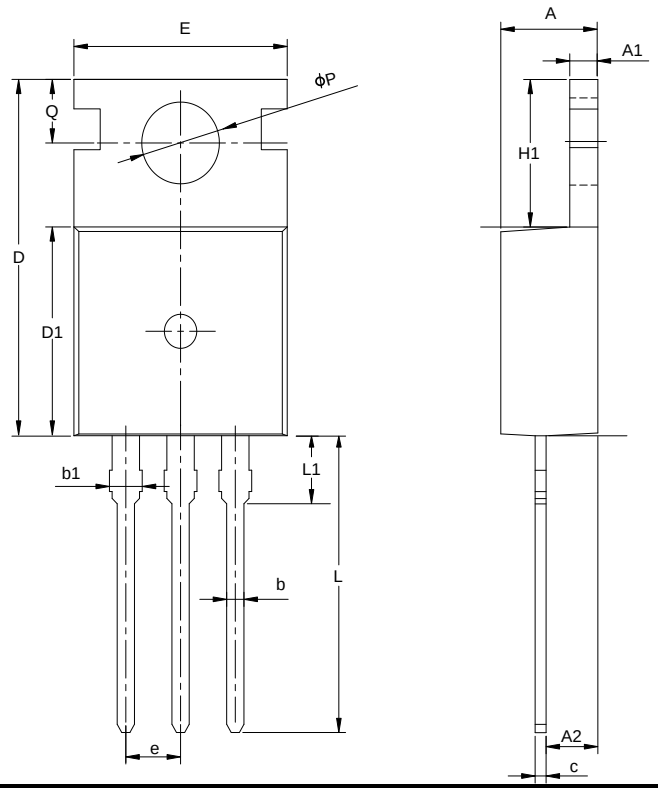
PACKAGE OUTLINE

TO-247-3L **UNIT: mm**



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

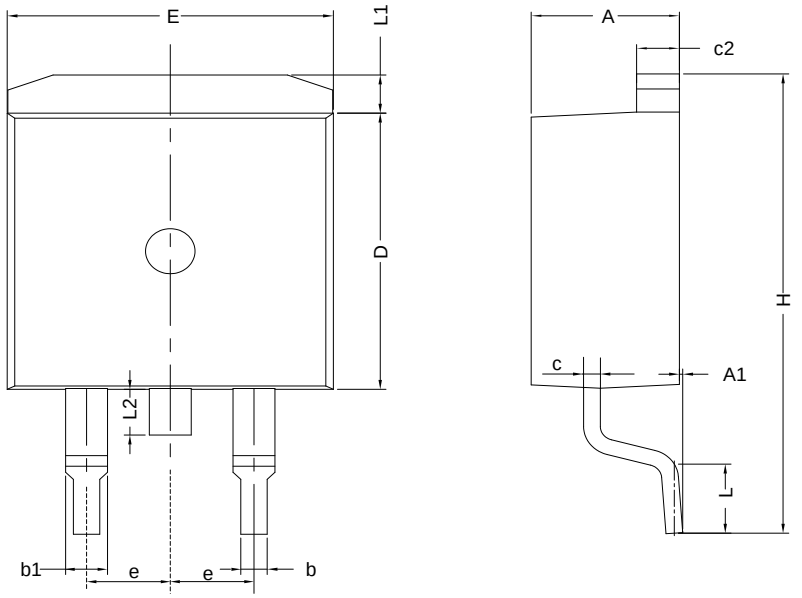
TO-220-3L **UNIT: mm**



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
ϕP	3.40	3.70	3.90
Q	2.60	—	3.20

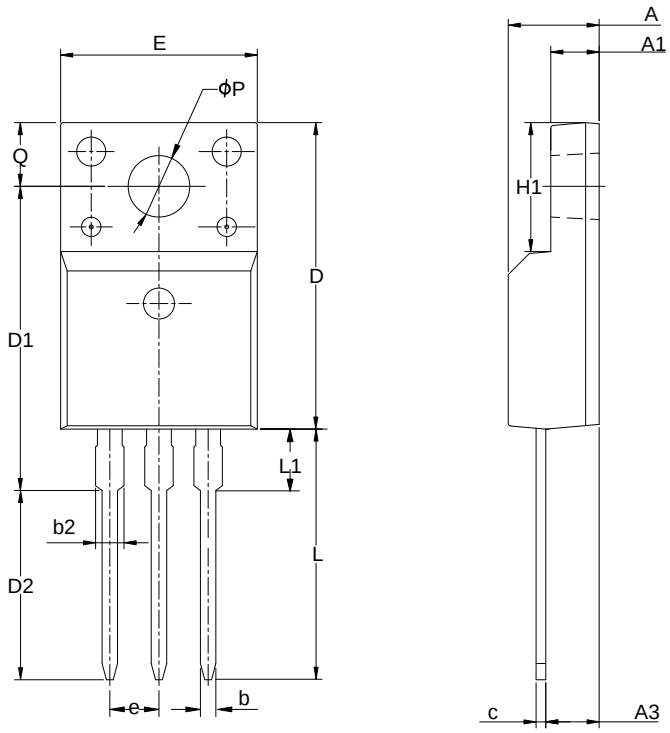
PACKAGE OUTLINE (CONTINUED)

TO-263-2L **UNIT: mm**



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	4.30	4.57	4.72
A1	0	0.10	0.25
b	0.71	0.81	0.91
b1	1.17	—	1.50
c	0.30	—	0.60
c2	1.17	1.27	1.37
D	8.50	—	9.35
E	9.80	—	10.45
e	2.54BSC		
H	14.70	—	15.75
L	2.00	2.30	2.74
L1	1.12	1.27	1.42
L2	—	—	1.75

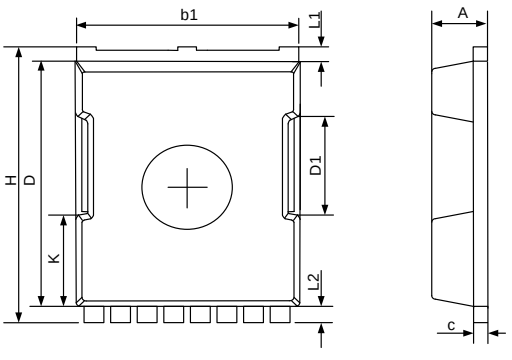
TO-220FJD-3L **UNIT: mm**



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
ϕP	3.00	3.18	3.40
Q	3.05	3.30	3.55

PACKAGE OUTLINE (CONTINUED)

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	1.05	1.20	1.30

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.
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Rev.: 1.2

Revision History:

1. Add TOLL-8L package
2. Update some parameters and typical characteristics
3. Update important notice

Rev.: 1.1

Revision History:

1. Add SVSP65R110THD4(TO-220-3L)、SVSP65R110SHD4(TO-263-2L)、SVSP65R110FJDHD4(TO-220FJD-3J) package
2. Add curve 13-2、13-3、14-2、14-3、16-2、16-3

Rev.: 1.0

Revision History:

1. First release