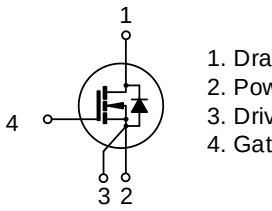
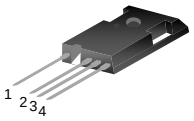
13.5mΩ, 1200V SiC MOS POWER TRANSISTOR

DESCRIPTION

SCDP120R013N2P4B is an N-channel enhancement mode high voltage power MOSFET produced using Silan's Silicon Carbide 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 switching power supplies, inverters, and DC-DC converters.



1. Drain
2. Power Source
3. Driver Source
4. Gate



TO-247B-4L

FEATURES

- 138A, 1200V, $R_{DS(on)(typ.)}$= 13.5mΩ@V_{GS}=15V
- Silicon Carbide technology
- Low switching loss
- Low reverse recovery charge
- Reduced requirement for heat dissipation
- 100% avalanche tested
- Pb-free lead plating
- RoHS compliant

KEY PERFORMANCE PARAMETERS

Characteristics	Ratings	Unit
V_{DS}	1200	V
$V_{GS(th)}$	1.8~3.6	V
$R_{DS(on),max.}$	17	mΩ
$I_{D.pulse}$	276	A
$Q_{g.typ.}$	226	nC

ORDERING INFORMATION

Part No.	Package	Marking	Hazardous Substance Control	Packing Type
SCDP120R013N2P4B	TO-247B-4L	P120R013N2	Halogen free	Tube

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

Characteristics	Symbol	Test conditions	Ratings			Unit
			Min.	Typ.	Max.	
Drain-source Voltage	V_{DS}	--	--	--	1200	V
Gate-source Voltage (Static)	V_{GS}	--	-4	--	15	V
Gate-source Voltage (Dynamic)	V_{GS}	AC(f>1Hz)	-8	--	19	V
Drain Current (Note 1)	I_D	V_{GS}=15V, T_C=25°C	--	--	138	A
		V_{GS}=15V, T_C=100°C	--	--	97	A
Pulsed Drain Current (Note 2)	I_{DM}	T_C=25°C	--	--	276	A
Power Dissipation (Note 3)	P_D	T_C=25°C	--	--	469	W
Single Pulsed Avalanche Energy	E_{AS}	L=5mH, V_{DD}=100V, R_G=25Ω, starting temperature T_J=25°C	--	--	1562	mJ
Single Pulsed Current	I_{AS}	--	--	--	25	A
Operation Junction Temperature Range	T_J	--	-55	--	175	°C
Storage Temperature Range	T_{stg}	--	-55	--	175	°C
Continuous Diode Forward Current	I_S	T_C=25°C, integral reverse P-N junction diode in the MOSFET	--	--	138	A
Diode Pulse Current	$I_{S,pulse}$		--	--	276	A

THERMAL CHARACTERISTICS

Characteristics	Symbol	Test conditions	Ratings			Unit
			Min.	Typ.	Max.	
Thermal Resistance, Junction-case, Bottom	$R_{\theta JC}$	--	--	--	0.32	°C/W
Thermal Resistance, Junction-ambient	$R_{\theta JA}$	--	--	--	40	°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	1200	--	--	V
Drain-source Leakage Current	I_{DSS}	V_{DS}=1200V, V_{GS}=0V, T_J=25°C	--	--	50	μA
		V_{DS}=1200V, V_{GS}=0V, T_J=150°C	--	1.0	--	μA
Gate-source Leakage Current	I_{GSS}	V_{GS}=15V, V_{DS}=0V	--	--	1.0	μA
		V_{GS}=-4V, V_{DS}=0V	--	--	-1.0	μA
Gate Threshold Voltage	$V_{GS(th)}$	V_{GS}=V_{DS}, I_D=20mA, T_J=25°C	1.8	--	3.6	V
		V_{GS}=V_{DS}, I_D=20mA, T_J=175°C	--	1.6	--	
Static Drain-source On State Resistance	$R_{DS(on)}$	V_{GS}=15V, I_D=75A	--	13.5	17.0	mΩ
Transconductance	Gfs	V_{DS}=20V, I_D=75A, T_J=25°C	--	85	--	S
		V_{DS}=20V, I_D=75A, T_J=175°C	--	63	--	
Gate Resistance	R_G	f=1MHz	--	2.9	--	Ω

Dynamic characteristics

Characteristics	Symbol	Test conditions	Ratings			Unit
			Min.	Typ.	Max.	
Input Capacitance	C_{iss}	f=1MHz, V_{GS}=0V, V_{DS}=1000V	--	6445	--	pF
Output Capacitance	C_{oss}		--	216	--	
Reverse Transfer Capacitance	C_{rss}		--	15	--	
Output Capacitance Loss	E_{oss}		--	126	--	μJ
Turn-on Switching Loss	E_{on}	V_{DS} =800V, V_{GS} =-4/15V, R_G=2.5Ω, I_D =75A, T_J=175°C	--	1.00	--	mJ
Turn-off Switching Loss	E_{off}		--	1.05	--	
Turn-on Delay Time	$t_{d(on)}$	V_{DD}=800V, V_{GS}=-4/15V, R_G=2.5Ω, I_D=75A, L=50μH (Notes 4,5)	--	21	--	ns
Turn-on Rise Time	t_r		--	14	--	
Turn-off Delay Time	$t_{d(off)}$		--	77	--	
Turn-off Fall Time	t_f		--	39	--	
Total Gate Charge	Q_g	V_{DD}=800V, V_{GS}=-4/15V, I_D=75A (Notes 4,5)	--	224	--	nC
Gate-source Charge	Q_{gs}		--	65	--	
Gate-drain Charge	Q_{gd}		--	99	--	

Reverse diode characteristics

Characteristics	Symbol	Test conditions	Ratings			Unit
			Min.	Typ.	Max.	
Diode Forward Voltage	V_{SD}	I_S=37.5A, V_{GS}=-4.0V	--	--	10	V
Reverse Recovery Time	T_{rr}	I_S=75A, V_{GS}=-4.0V, V_R=800V, dI_F/dt=6500A/μs, T_J=175°C (Note 4)	--	25	--	ns
Reverse Recovery Charge	Q_{rr}		--	1.4	--	μC
Reverse Recovery Peak Current	I_{rrm}		--	85	--	A

Notes:

1. The rated value only refers to the maximum absolute value at the case temperature of 25°C in the specification. If the case temperature is higher than 25°C, it should be derated according to the actual environmental conditions;
2. Pulse time 5μs; pulse width is limited by the maximum junction temperature;
3. The dissipation power will change with temperature, derating above 25°C: 3.13W/°C;
4. Pulse Test: Pulse width ≤300μs, Duty cycle≤2%;
5. Essentially independent of operating temperature.

TYPICAL CHARACTERISTICS

Figure 1. Output Characteristics

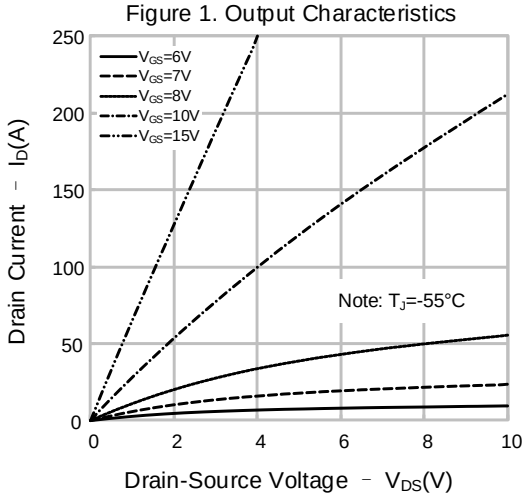


Figure 2. Output Characteristics

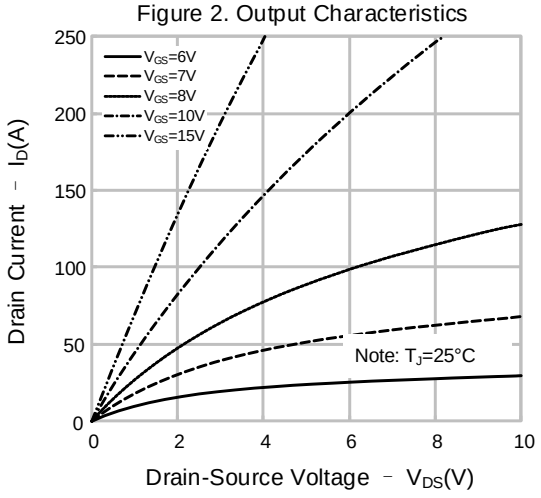


Figure 3. Output Characteristics

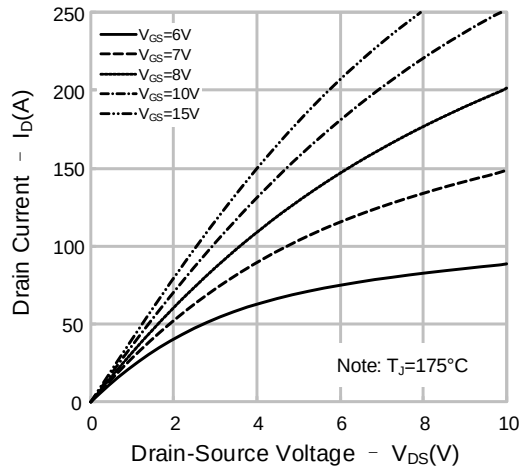


Figure 4. On-resistance Variation vs. Temperature

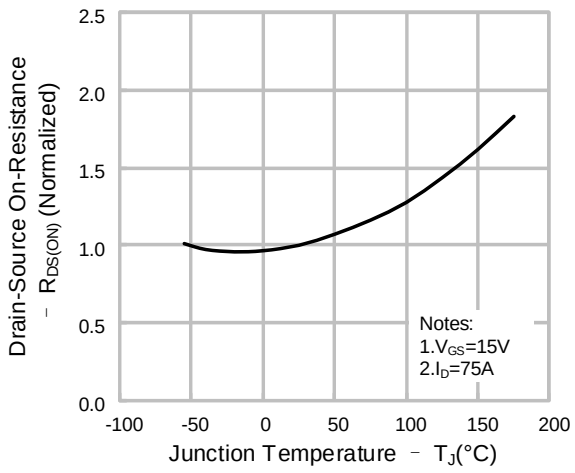


Figure 5. On-resistance vs. Drain Current

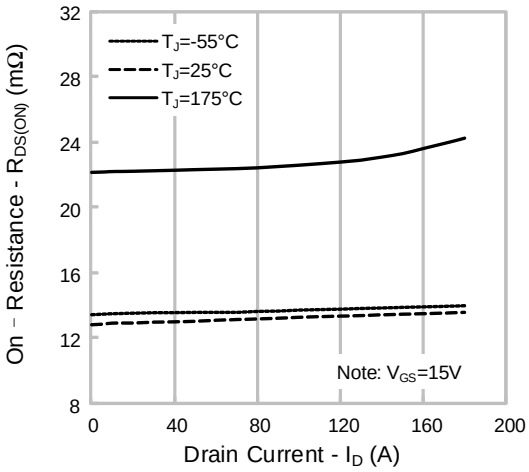
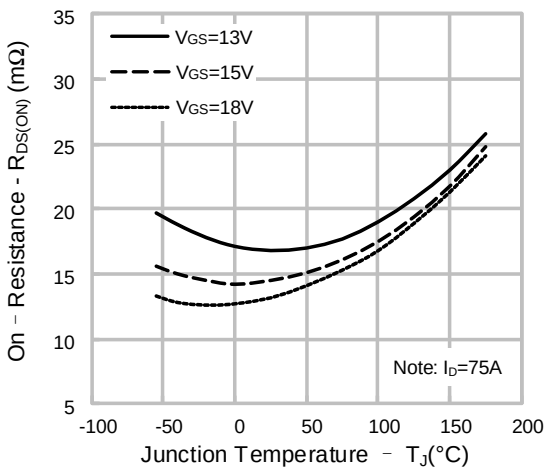


Figure 6. On-resistance vs. Junction Temperature



TYPICAL CHARACTERISTICS (CONTINUED)

Figure 7. Transfer Characteristics

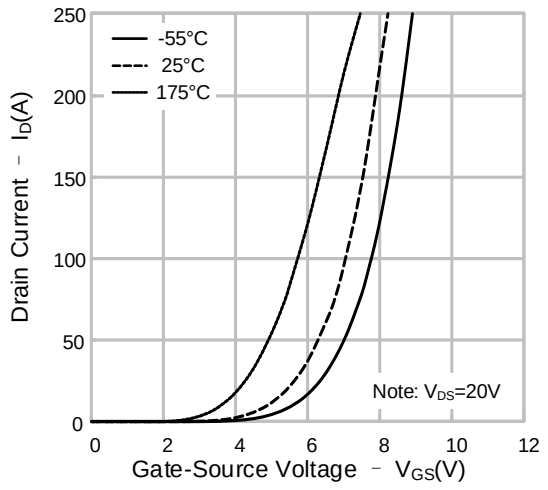


Figure 8. Body Diode Forward Voltage Variation vs. Drain Current

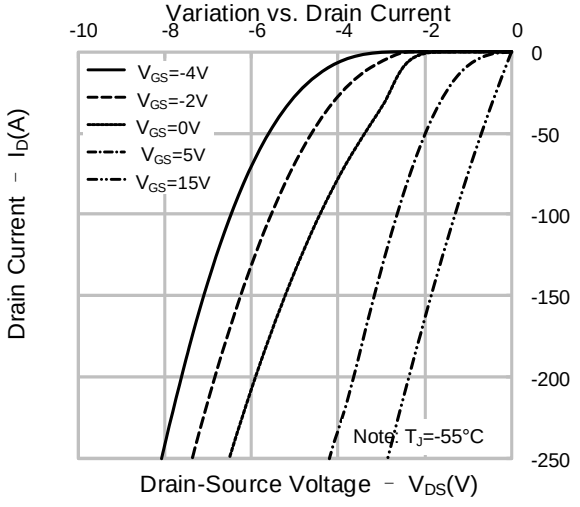


Figure 9. Body Diode Forward Voltage Variation vs. Drain Current

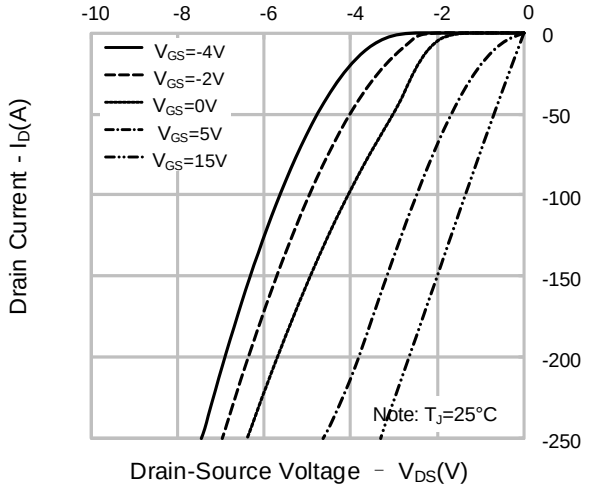


Figure 10. Body Diode Forward Voltage Variation vs. Drain Current

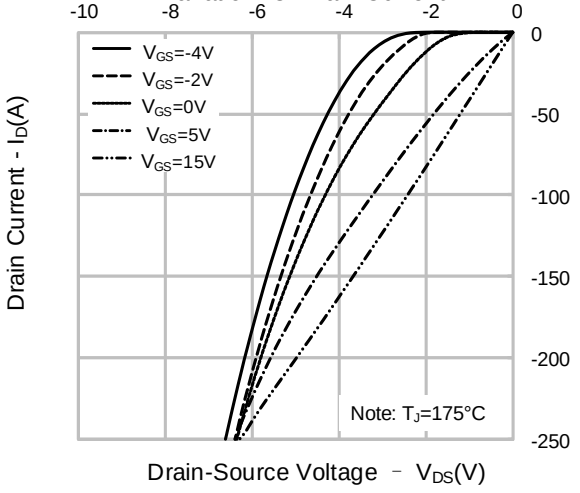


Figure 11. Turn-on Voltage vs. Temperature Characteristics

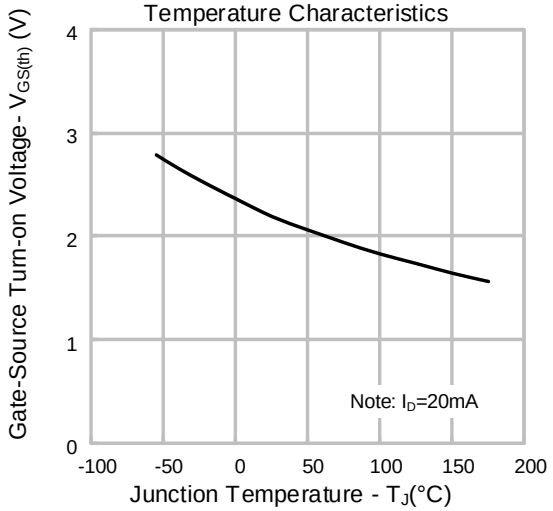
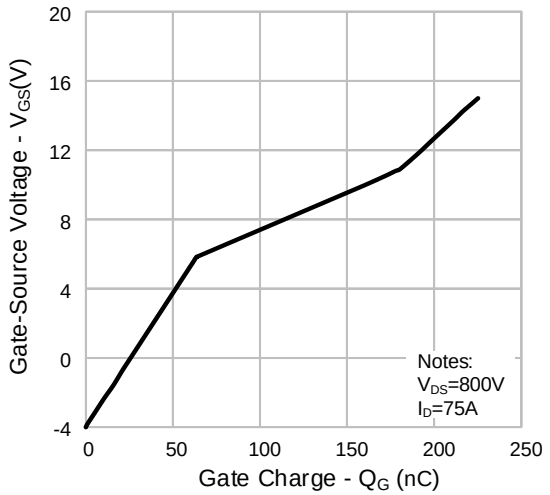


Figure 12. Gate Charge



TYPICAL CHARACTERISTICS (CONTINUED)

Figure 13. Eoss vs. Drain-Source Voltage

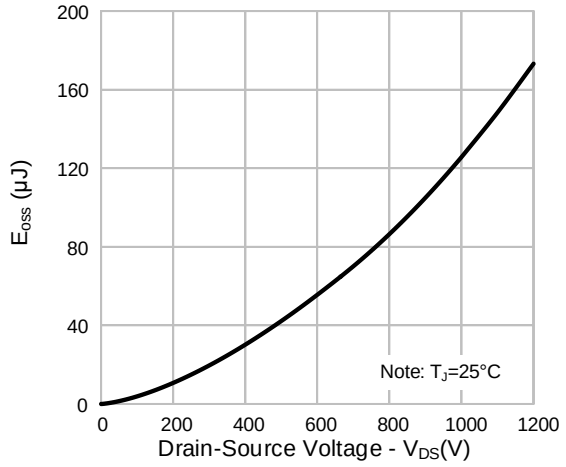


Figure 14. Capacitance Characteristics

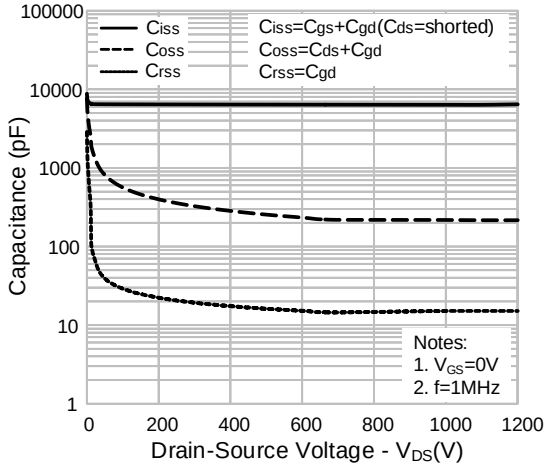


Figure 15. Capacitance Characteristics

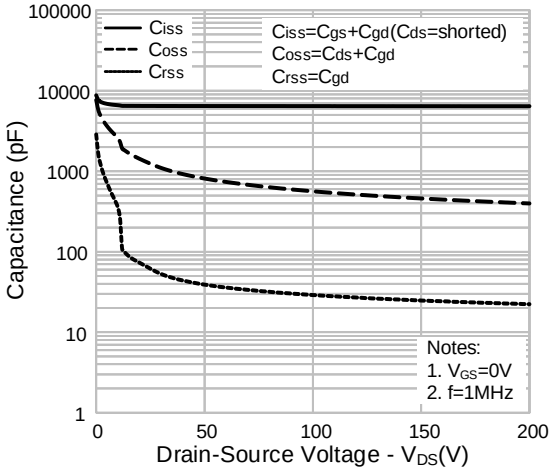


Figure 16. Drain Current vs. Case Temperature

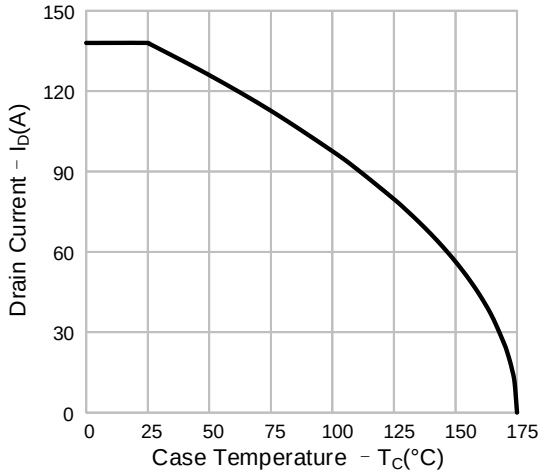


Figure 17. Power Dissipation vs. Temperature

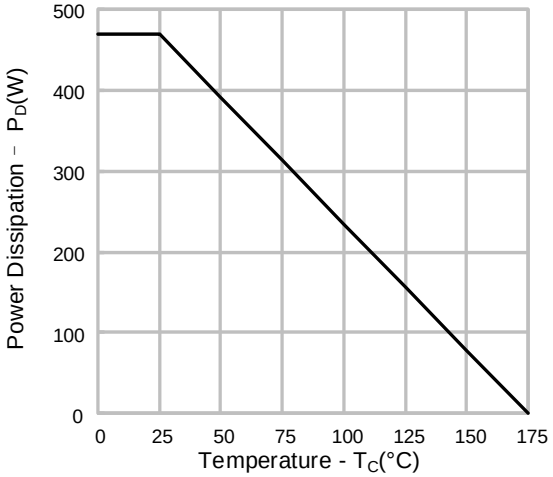
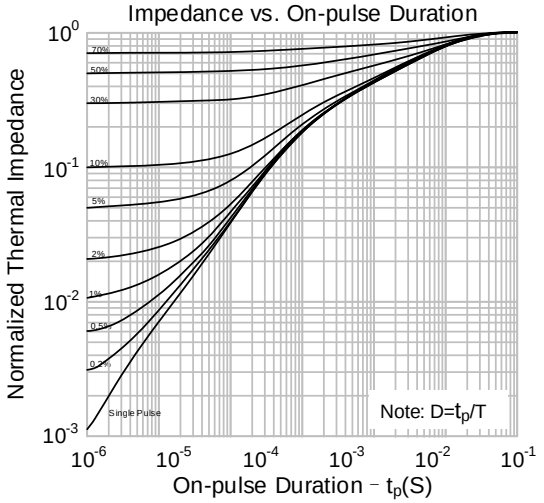


Figure 18. Transient Thermal Impedance vs. On-pulse Duration



TYPICAL CHARACTERISTICS (CONTINUED)

Figure 19. Max. Safe Operating Area

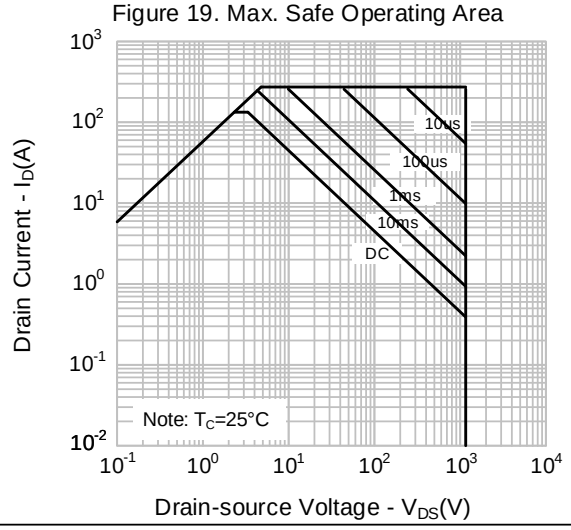


Figure 20. Switch Loss vs. Drain Current

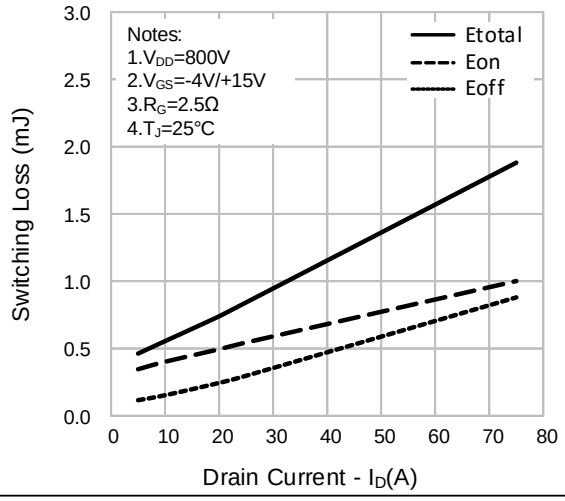


Figure 21. Switching Loss vs. Gate Resistance

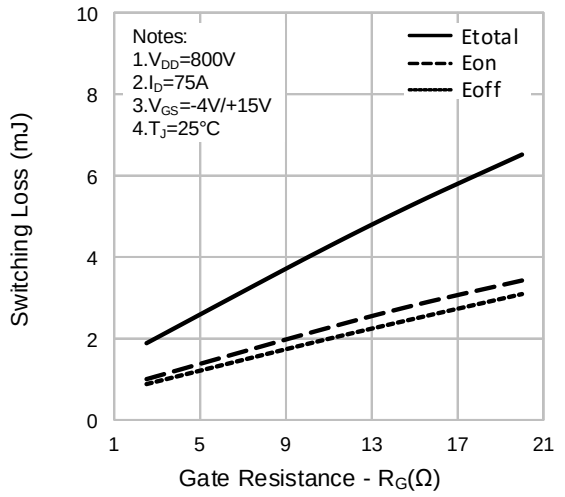


Figure 22. Switching Loss vs. Temperature

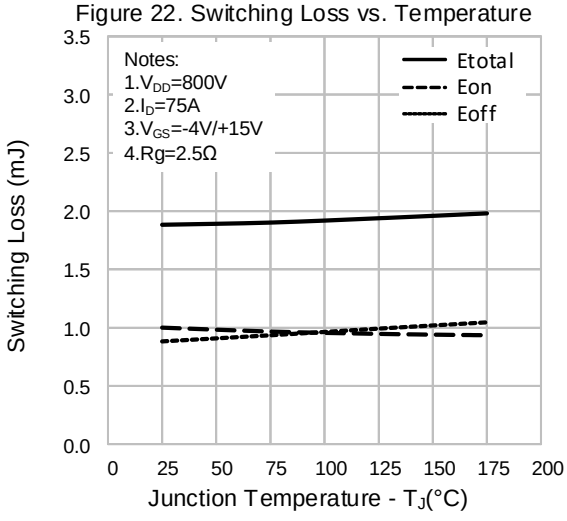
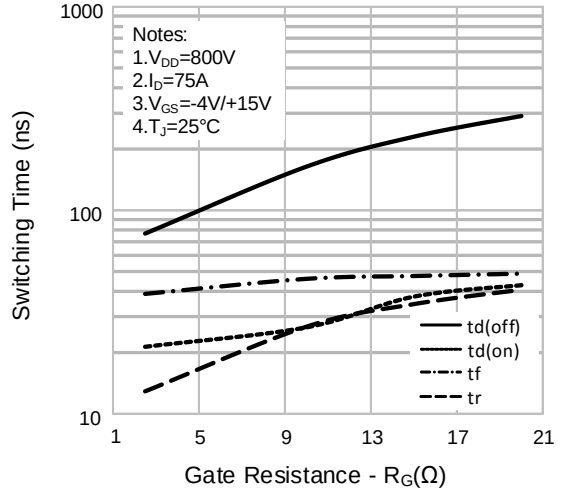
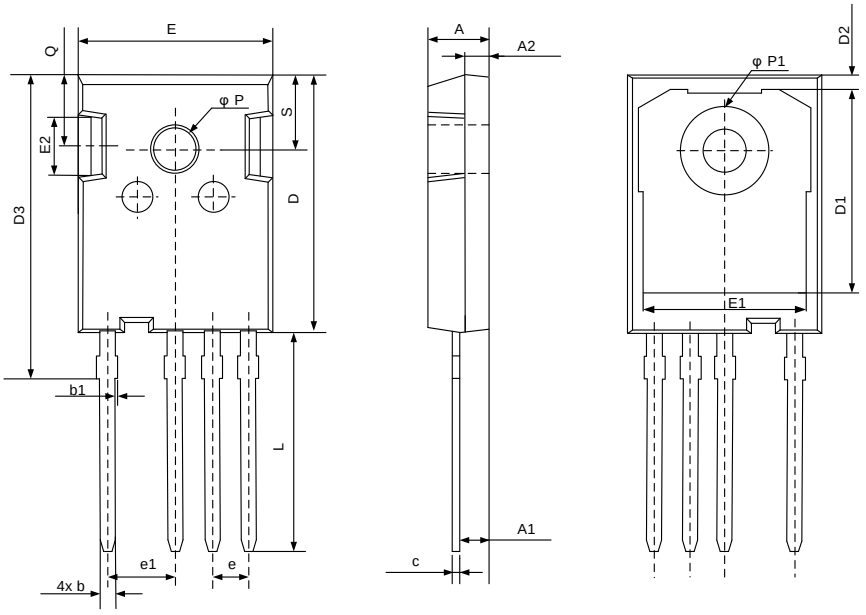


Figure 23. Switching Time vs. Gate Resistance



PACKAGE OUTLINE

TO-247B-4L **UNIT: mm**



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
b	1.16	—	1.29
b1	0	—	0.20
c	0.59	—	0.66
D	20.90	21.00	21.10
D1	16.25	16.55	16.85
D2	1.05	1.20	1.35
D3	24.97	25.12	25.27
E	15.70	15.80	15.90
E1	13.10	13.30	13.50
E2	4.90	5.00	5.10
e	2.44	2.54	2.64
e1	4.98	5.08	5.18
L	19.80	19.92	20.10
P	3.50	3.60	3.70
P1	—	—	7.40
Q	5.60	—	6.00
S	6.15 BSC		

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.
4. The application of the product described in this instruction, the application manual of the product and related materials is for illustrative purposes only, and Silan makes no warranty that such application can be used directly without further testing, verification or modification. Silan is not responsible for any assistance in product application or customers' product design. Customer shall be responsible for the application of Silan's products and the design, manufacture and use of customers' products using Silan's products (in this document, "use products", "apply Silan's products", "product application" and "customers' products using Silan's products" are synonymous). It is the sole responsibility of the customer to take the following actions: 1) Verify and determine whether Silan's products are suitable for the customers' applications and customers' products; 2) All applicable standards of the customers' industry shall be complied with and fully tested and verified when applying Silan's product or using Silan's product to develop and design customers' products; 3) Although Silan is constantly committed to improve product's quality and reliability, semiconductor products have possibility to malfunction or fail in various application environments. Customers are responsible for complying with safety standards and for providing adequate designs and safeguards for customers' products using Silan's product to minimize risks and avoid situations in which a malfunction or failure could cause bodily injury or damage to property; 4) When using the products, please do not exceed the maximum rating of the products, Stress above one or more limiting values will cause damage to the product and the equipment or affect the reliability to the equipment (customers' product); 5) Ensure customers' product using Silan's product are designed, manufactured and used in full compliance with all applicable standards, safety standards and other requirements of the customers' industry. The parameters stated in this instruction may and do vary in different applications, actual performance may vary over time. Customers must use the products within their effective static storage period, please contact Silan sales or Silan customer service support and sales management department if there is any questions about the effective static storage period, Silan does not assume any responsibility if the product has exceeded the static storage period when it is used.
5. Do not disassemble, reverse-engineer, alter, modify, decompile or copy product, without Silan's prior written consent.
6. Please identify Silan's trademark when purchasing our product. Please contact us if there is any question. Our products are not sold through TAOBAO or any other third-party e-commerce platforms. If customers purchase from such platforms, please contact us in writing before purchasing to confirm whether the product is authentic and original from Silan.
7. Please use and apply product in compliance with all applicable laws and regulations, including but not limited to trade control regulations etc. The product is civil electronic product, please do not use it in non-civil fields.
8. Product promotion is endless, our company will wholeheartedly provide customers with better products!
9. Website: http: //www.silan.com.cn

Part No.:	SCDP120R013N2P4B	Document Type:	Datasheet
Copyright:	HANGZHOU SILAN MICROELECTRONICS CO.,LTD	Website:	http: //www.silan.com.cn

Rev.: 1.1

Revision History:

1. Update dynamic characteristics and curves

Rev.: 1.0

Revision History:

1. First release