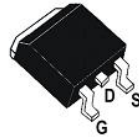
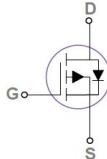


# MOSFET Metal-Oxide-Semiconductor Field-Effect Transistor

## 60V N-Channel MOSFET

General Description			
The SK35N06D uses advanced Trench technology and designs to provide excellent $R_{DS(ON)}$ with low gate charge. This device is suitable for use in PWM, load switching and general purpose applications.			
Product Summary			TO-252-2L
$BV_{DSS}$	60	V	
$R_{DS(ON)} @ V_{GS}=10V$	20(Max.)	m $\Omega$	
$R_{DS(ON)} @ V_{GS}=4.5V$	24(Max.)	m $\Omega$	
$I_D$	35	A	
Features	Applications		Graphic Symbol
<ul style="list-style-type: none"> <li>• Low On-Resistance</li> <li>• Low Input Capacitance</li> <li>• Low Miller Charge</li> <li>• Low Input / Output Leakage</li> </ul>	<ul style="list-style-type: none"> <li>• Lithium-Ion Secondary Batteries</li> <li>• Load Switch</li> <li>• DC-DC converters and Off-line UPS</li> </ul>		

### Maximum Ratings ( $T_A=25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	60V	V
Gate-Source Voltage	$V_{GSS}$	$\pm 20V$	V
Drain Current-Continuous	$I_D$	$T_C=25^\circ\text{C}^1$	35
		$T_C=100^\circ\text{C}^1$	22
Drain Current-Pulsed <sup>2</sup>	$I_{DM}$	80	A
Avalanche Current, $L=0.1\text{mH}$	$I_{AS}$	28	A
Avalanche Energy, $L=0.1\text{mH}^3$	$E_{AS}$	39.2	mJ
TOTAL Power Dissipation @ $T_C=25^\circ\text{C}^4$	$P_D$	45	W
TOTAL Power Dissipation @ $T_A=25^\circ\text{C}^4$		2	W
Storage Temperature Range	$T_{STG}$	-55 to 150°C	°C
Operating Junction Temperature Range	$T_J$	-55 to 150°C	°C

Parameter	Symbol	Conditions	Min.	Typ	Max	Unit
Maximum Junction-to-Ambient <sup>1</sup>	$R_{\theta JA}$	Steady State	-	-	62	°C/W
Maximum Junction-to-Case <sup>1</sup>	$R_{\theta JC}$	Steady State	-	-	2.8	°C/W

**Electrical Characteristics (T<sub>A</sub>=25°C unless otherwise noted)**

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V, I <sub>DS</sub> =250μA	60	-	-	V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> =48V, V <sub>GS</sub> =0V	-	-	1	μA
Gate-Source Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V	-	-	±100	nA
<b>ON CHARACTERISTICS</b>						
Gate Threshold Voltage	V <sub>GS(TH)</sub>	V <sub>GS</sub> =V <sub>DS</sub> , I <sub>DS</sub> =250μA	1.2	-	2.5	V
Drain-Source On-Resistance <sup>2</sup>	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>DS</sub> =20A	-	-	20	mΩ
		V <sub>GS</sub> =4.5V, I <sub>DS</sub> =10A	-	-	24	
Forward Transconductance	g <sub>fs</sub>	V <sub>DS</sub> =5V, I <sub>D</sub> =15A	-	45	-	S
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	C <sub>ISS</sub>	V <sub>DS</sub> =15V, V <sub>GS</sub> =0V, f=1MHz	-	2430	-	pF
Output Capacitance	C <sub>OSS</sub>		-	148	-	
Reverse Transfer Capacitance	C <sub>rss</sub>		-	100	-	
Gate resistance	R <sub>g</sub>	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz	-	1.8	-	Ω
<b>SWITCHING CHARACTERISTICS</b>						
Turn-On Delay Time	T <sub>d(on)</sub>	V <sub>DS</sub> =30V, V <sub>GS</sub> =10V, I <sub>D</sub> =15A, R <sub>GEM</sub> =3.3 Ω	-	7.8	-	ns
Rise Time	t <sub>r</sub>		-	52	-	
Turn-Off Delay Time	T <sub>d(off)</sub>		-	37	-	
Fall Time	t <sub>f</sub>		-	7.2	-	
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =48V, I <sub>DS</sub> =15A, V <sub>GS</sub> =4.5V	-	19.8	-	nC
Gate to Source Gate Charge	Q <sub>gs</sub>		-	7.5	-	
Gate to Drain Charge	Q <sub>gd</sub>		-	8.0	-	
<b>SWITCHING CHARACTERISTICS</b>						
Continuous Source Current <sup>1,5</sup>	I <sub>S</sub>	V <sub>G</sub> =V <sub>D</sub> =0V, Force Current	-	-	35	A
Pulsed Source Current <sup>2,5</sup>	I <sub>SM</sub>		-	-	80	A
Drain-Source Diode Forward Voltage <sup>2</sup>	V <sub>SD</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =1A	-	-	1.2	V

**Notes:**

- The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 2OZ copper.
- The data tested by pulsed, pulse width ≤ 300μs, duty cycle ≤ 2%
- 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>=28A
- The power dissipation is limited by 150°C junction temperature
- 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.

Typical Operating Characteristics

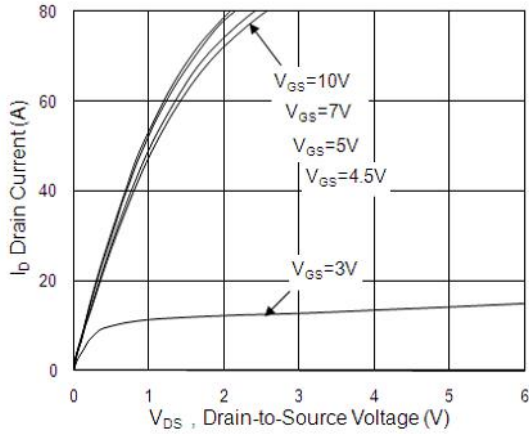


Fig.1 Typical Output Characteristics

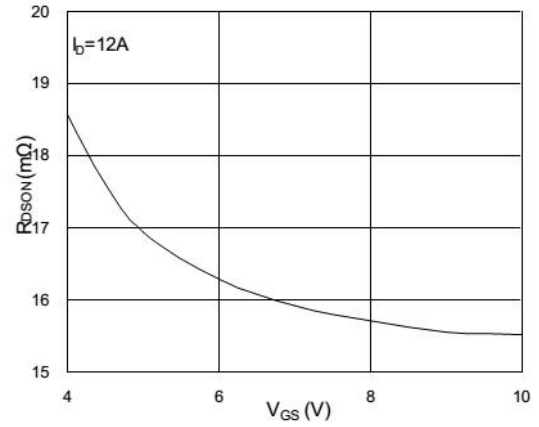


Fig.2 On-Resistance v.s Gate-Source

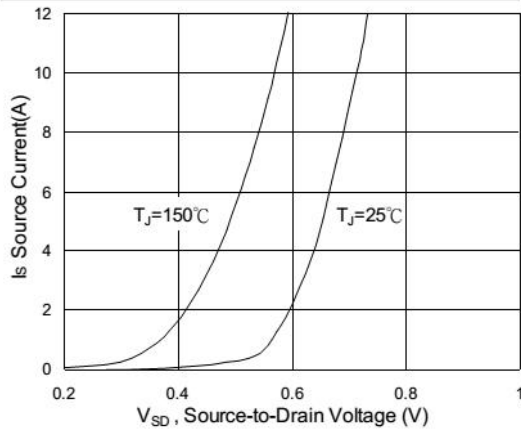


Fig.3 Forward Characteristics of Reverse

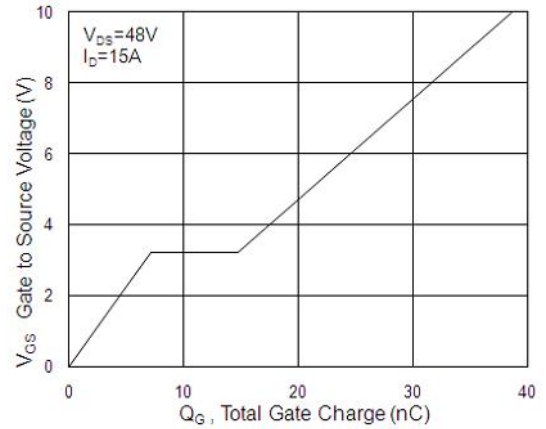


Fig.4 Gate-Charge Characteristics

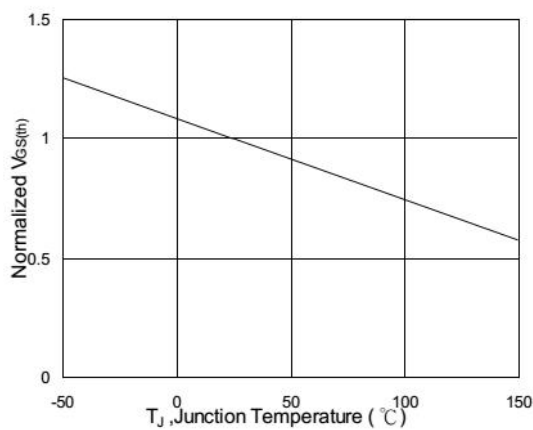


Fig.5 Normalized  $V_{GS(th)}$  v.s  $T_J$

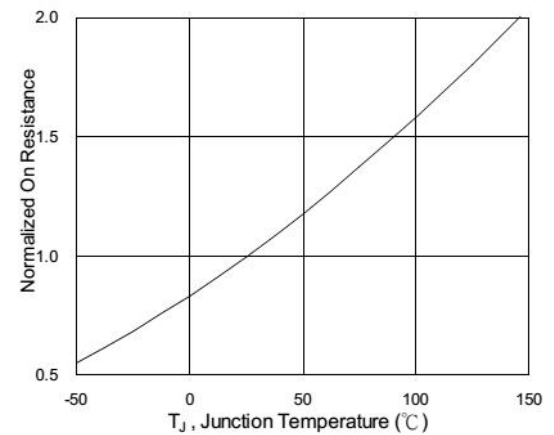


Fig.6 Normalized  $R_{DS(on)}$  v.s  $T_J$

Typical Operating Characteristics (Cont.)

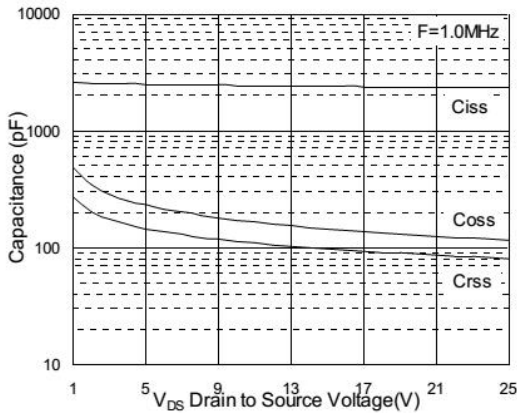


Fig.7 Capacitance

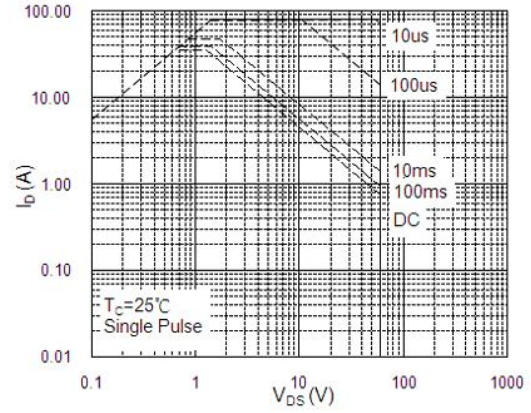


Fig.8 Safe Operating Area

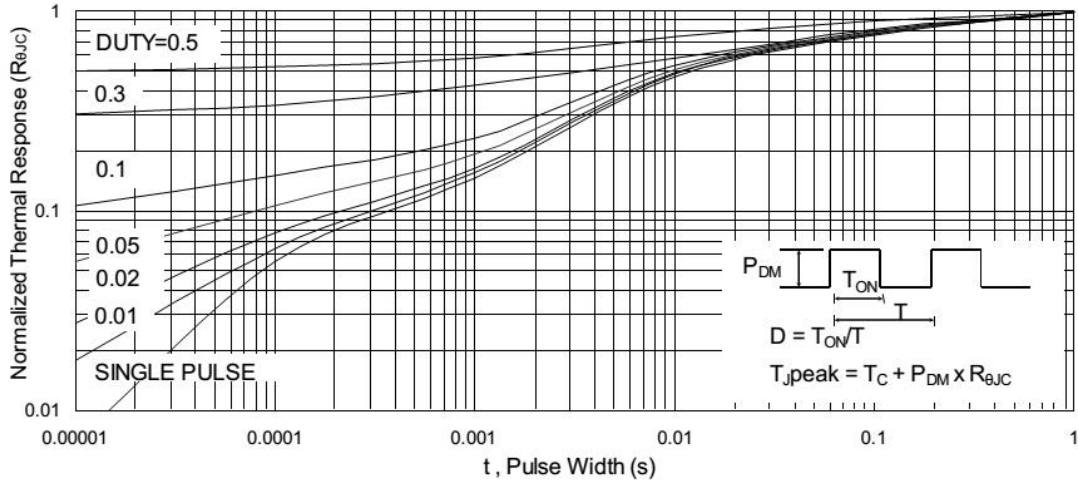


Fig.9 Normalized Maximum Transient Thermal Impedance

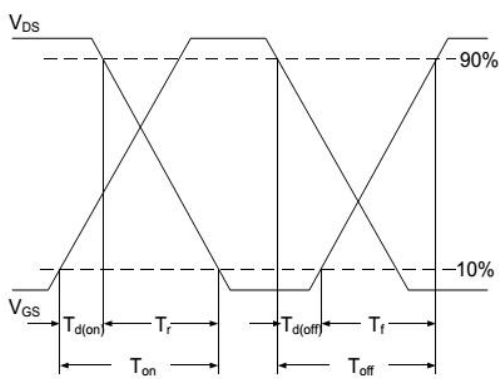


Fig.10 Switching Time Waveform

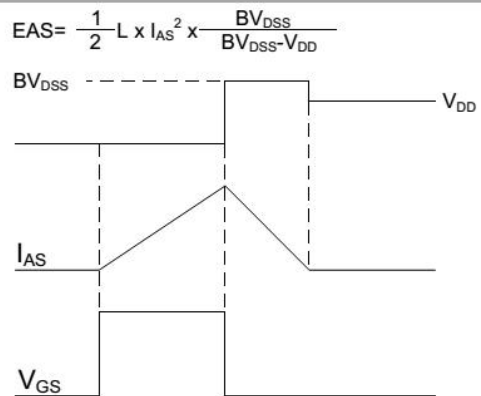
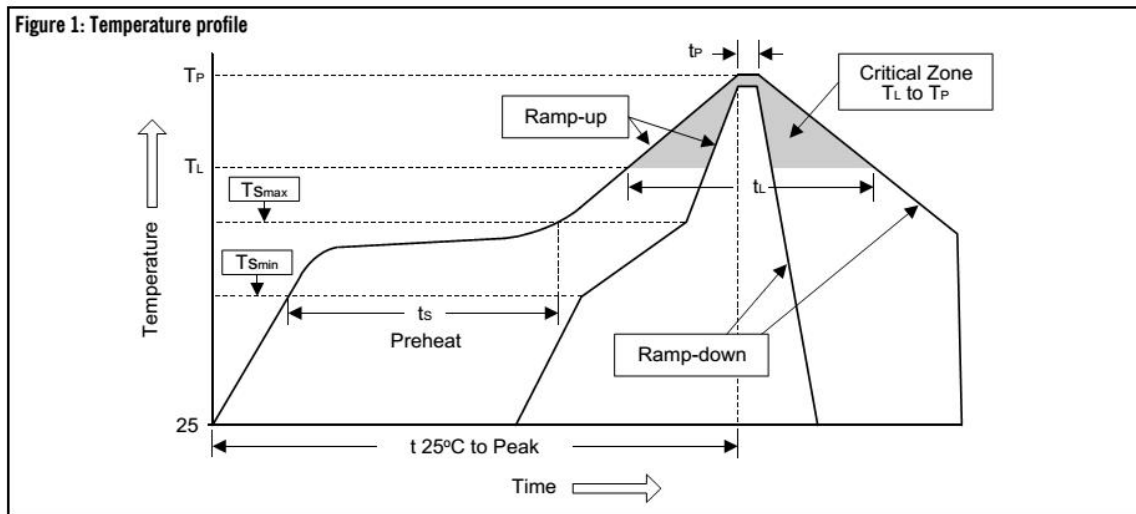


Fig.11 Unclamped Inductive Switching Waveform

## Soldering Methods for SK Product

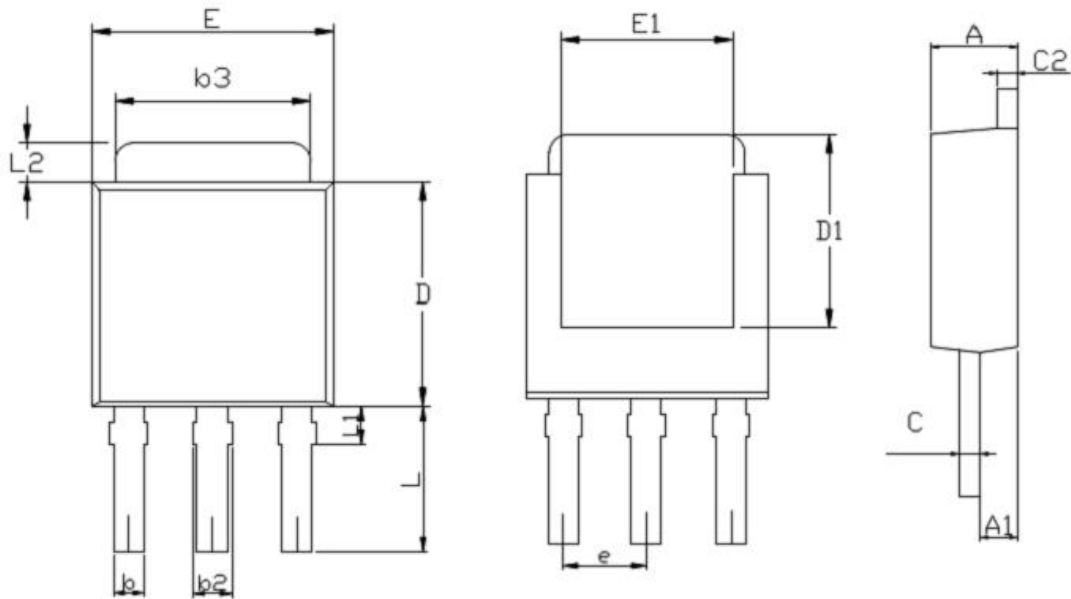
1. Storage environment: Temperature=10°C to 35°C Humidity=65%±15%
2. Reflow soldering of surface-mount devices



Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate ( $T_L$ to $T_P$ )	<3°C/sec	<3°C/sec
Preheat		
- Temperature Min ( $T_{Smin}$ )	100°C	150°C
- Temperature Max ( $T_{Smax}$ )	150°C	200°C
- Time (min to max) ( $t_s$ )	60 to 120 sec	60 to 180 sec
$T_{Smax}$ to $T_L$		
- Ramp-up Rate	<3°C/sec	<3°C/sec
Time maintained above:		
- Temperature ( $T_L$ )	183°C	217°C
- Time ( $t_L$ )	60 to 150 sec	60 to 150 sec
Peak Temperature ( $T_P$ )	240°C +0/-5°C	260°C +0/-5°C
Time within 5°C of actual Peak Temperature ( $t_p$ )	10 to 30 sec	20 to 40 sec
Ramp-down Rate	<6°C/sec	<6°C/sec
Time 25°C to Peak Temperature	<6 minutes	<8 minutes

### 3. Flow (wave) soldering (solder dipping)

Products	Peak Temperature	Dipping Time
Pb devices.	245°C ±5°C	5sec ±1sec
Pb-Free devices.	260°C +0/-5°C	5sec ±1sec

**PACKAGE DIMENSION**


Symbol	TO-252-2L			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	2.184	2.338	0.086	0.094
A1	0.890	1.143	0.035	0.045
b	0.635	0.890	0.025	0.035
b2	0.910	1.143	0.035	0.045
b3	4.953	5.460	0.195	0.215
c	0.457	0.610	0.018	0.024
c1	0.457	0.890	0.018	0.035
D	5.334	6.223	0.210	0.245
D1	5.207		0.205	
E	6.350	6.730	0.250	0.265
E1	4.320		0.170	
e	2.29 BSC		0.090 BSC	
L	3.700	4.400	0.146	0.173
L1	0.850	1.250	0.033	0.049
L2	0.890	1.270	0.035	0.050