工业型号	公司型号	通俗命名	H	封装标识	TO-251	TO-252	包装规格	每管数量	每盒数量	每箱数量
FQU4N60 FQD4N60	H4N60I H4N60S	4N60	HAOHAI		I	S	TO-251管装 TO-252盘装	80Pcs 每卷2.5K	4000Pcs 5000Pcs	40000Pcs 50000Pcs

Description

This advanced high voltage MOSFET is designed to withstand high energy in the avalanche mode and switch efficiently.

This new high energy device also offers a drain-to-source diode with fast recovery time.

Designed for high voltage, high speed switching applications such as power suplies, converters, power motor controls and bridge circuits.

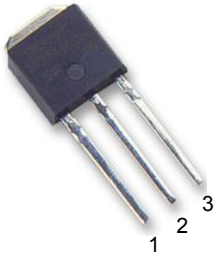
Features

■Higher Current Rating
■Lower RDS(on)
■Lower Capacitances
■Lower Total Gate Charge
■Tighter VSD Specifications
■Avalanche Energy Specified

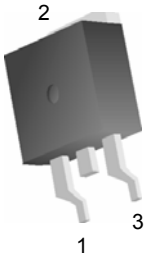
产品特点及应用范围：4N60型硅N沟道VDMOS功率晶体管，主要用于开关电源、LCD电源、LED驱动电源、机箱电源、UPS电源、各种充电器、整流器、逆变器、控制器、转换器、风扇控制板、以及电源适配器、汽车稳压器等线性放大和功率开关电路。其特点如下：

● 开关速度快 ● 驱动简单
● 可并联使用 ● 通态电阻低
● 封装形式：TO-251（IPAK）；TO-252（DPAK）

4N60 Series Pin Assignment

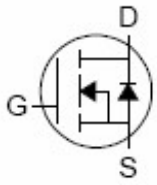


3-Lead Plastic TO-251
Package Code: I
Pin 1: Gate
Pin 2: Drain
Pin 3: Source



3-Lead Plastic TO-252
Package Code: S
Pin 1: Gate
Pin 2: Drain
Pin 3: Source

4N60 Series Symbol:



■Absolute Maximum Ratings

Symbol	Parameter	Value	Units
I_D	Drain to Current (Continuous)(T_C=25°C)	4	A
I_{DM}	Drain to Current (Pulsed)	15	
V_{GSS}	Gate-to-Source Voltage (Continue)	±30	V
P_D	Power Dissipation (T_A=25°C) *	3.13	W
	Power Dissipation (T_C=25°C) *	130	
	Power Dissipation - Derate above 25°C	1.04	W/°C
T_j, T_{stg}	Operating and Storage Temperature Range	-55～+150	°C
E_{AS}	Single Pulse Drain-to-Source Avalanche Enrgy-T_j=25°C (V_{DD}=100V, V_{GS}=10V, I_L=2A, L=10mH, R_G=25Ω)	460	mJ
T_L	Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds	300	°C

■Thermal Characteristics

Symbol	Parameter	Typ	Max	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	--	0.96	W/°C
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	40	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	--	62.5	

ELectrical Characteristics (T_j=25°C, unless otherwise specified)

■Off Characteristics

Symbol	Characteristic	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage (V_{GS}=0V, I_D=250uA)	600	--	--	V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient (I_D=250μA, Referenced to 25°C)	--	0.95	--	V/°C
I_{DSS}	Drain-Source Leakage Current (V_{DS}=600V, V_{GS}=0V)	--	--	10	μA
	Drain-Source Leakage Current (V_{DS}=480V, V_{GS}=0V, T_j=125°C)	--	--	100	
I_{GSSF}	Gate-Source Leakage Current-Forward (V_{gsf}=30V, V_{DS}=0V)	--	--	100	nA
I_{GSSR}	Gate-Source Leakage Current-Reverse (V_{GS}=-±30V, V_{DS}=0V)	--	--	±100	

■On Characteristics

Symbol	Characteristic	Min.	Typ.	Max.	Unit
$V_{GS(th)}$	Gate Threshold Voltage (V_{DS}=V_{GS}, I_D=250uA)	3.0	--	5.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance (V_{GS}=10V, I_D=1.95A)	--	2.8	3.6	Ω
g_{FS}	Forward Transconductance (V_{DS}=50V, I_D=1.95A)	--	3.8	--	S

■Dynamic Characteristics

Symbol	Characteristic		Min.	Typ.	Max.	Unit
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=25V f=1MHz	--	680	880	pF
C_{oss}	Output Capacitance		--	75	100	
C_{rss}	Reverse Transfer Capacitance		--	8.6	12	

■Switching Characteristics

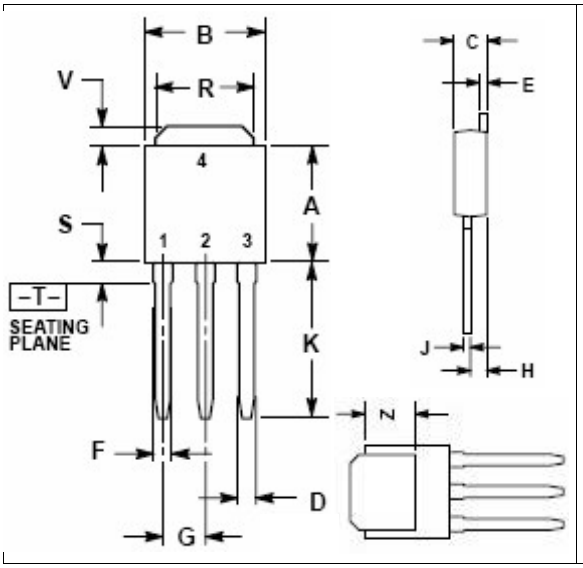
Symbol	Characteristic		Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on Delay Time	V_{DD}=400V, I_D=3.9A R_G=25Ω, V_{GS}=10V	--	16	40	nS
t_r	Turn-On Rise Time		--	45	100	
$t_{d(off)}$	Turn-off Delay Time		--	35	80	
t_f	Turn-Off Fall Time		--	35	80	
Q_g	Total Gate Charge	V_{DS}=640V I_D=3.9A, V_{GS}=10V	--	19	25	nC
Q_{gs}	Gate-Source Charge		--	4.2	--	
Q_{gd}	Gate-Drain Charge		--	9.1	--	

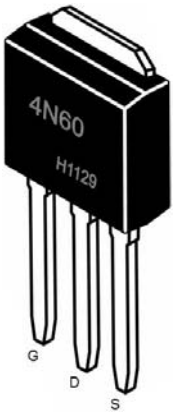
■Drain-Source Diode Characteristics and Maximum Ratings

Symbol	Characteristic		Min.	Typ.	Max.	Unit
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	4	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	15	
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS}=0V, I_S=3.9A	--	--	1.4	V
T_{rr}	Reverse Recovery Time	V_{GS}=0V, I_S=3.9A dI_F/dt=100A/μs	--	575	--	nC
Q_{rr}	Reverse Recovery Charge		--	3.65	--	μC

Pulse Test: Pulse Width ≤300us, Duty Cycle≤2%

■TO-251 Dimension （TO-251 or IPAK 半塑封 封装尺寸数据） 单位: mm





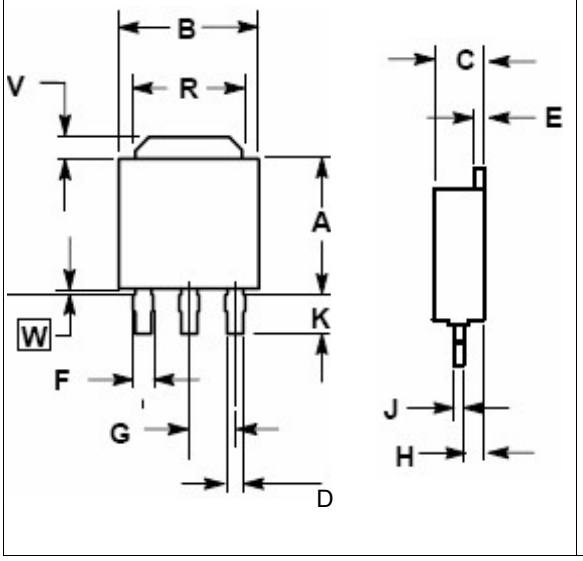
元件打印标识

型号: 4N60
4: 4A
N: N沟道
60: 600V
批号: H1129
H: 浩海电子
11: 2011年
29: 第29周
按实际出厂日期
管脚排列, 从左至右
G-D-S
G: Gate
D: Drain
S: Source

MILLIMETERS		
DIM	Min.	Max.
A	5.97	6.35
B	6.35	6.73
C	2.19	2.38
D	0.69	0.88
E	0.46	0.58
F	0.94	1.14
G	2.29 BSC	
H	0.87	1.01
J	0.46	0.58
K	8.89	9.65
R	4.45	5.45
S	0.63	1.01
V	0.89	1.27
Z	3.93	---

装箱规格：管装，每管80只，每盒4000只，每箱40000只

■TO-252 (DPAK) Dimension（TO-252 or DPAK 片式表面贴 封装尺寸数据） 单位: mm



元件打印标识

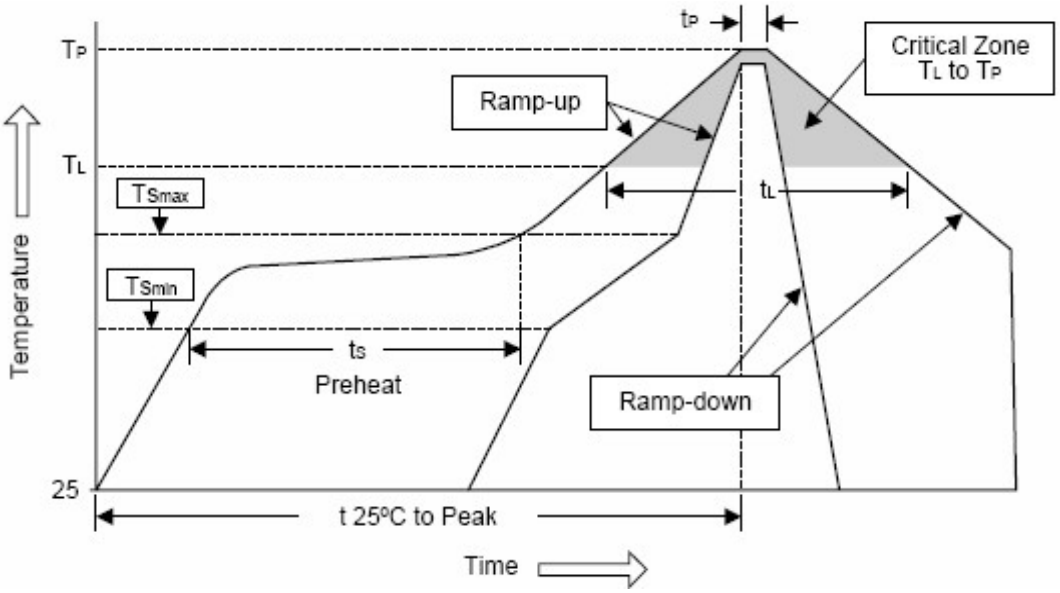
型号: 4N60
4: 4A
N: N沟道
60: 600V
批号: H1135
H: 浩海电子
11: 2011年
35: 第35周
按实际出厂日期
管脚排列, 从左至右
G-D-S
G: Gate
D: Drain
S: Source

MILLIMETERS		
DIM	Min.	Max.
A	5.97	6.22
B	6.35	6.73
C	2.19	2.38
D	0.69	0.88
E	0.46	0.58
F	0.94	1.09
G	2.29 BSC	
H	0.87	1.01
J	0.46	0.58
K	2.10	2.41
R	4.57	5.46
V	0.89	1.27
W	0.00	0.25

装箱规格：载带卷盘装，每卷2500只，每盒5000只，每箱50000只

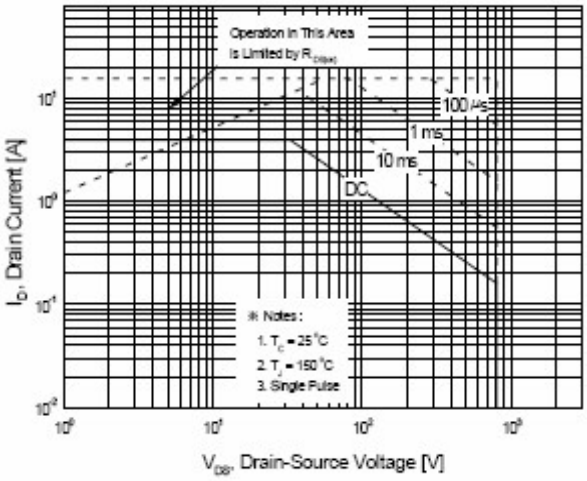
■Soldering Methods for HAOHAI ELECTRONICS Products

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

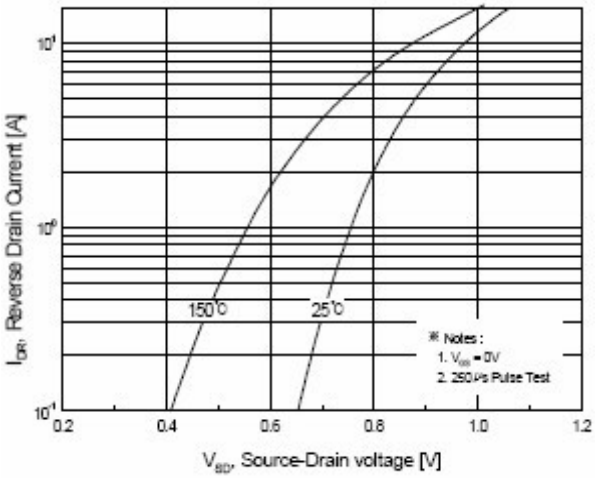


特性曲线

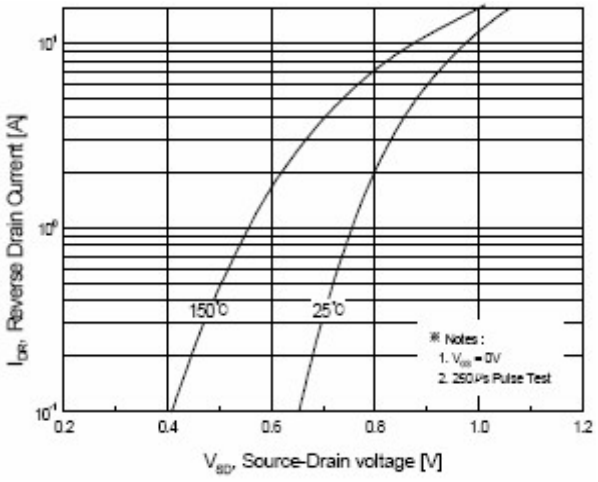
安全工作 区 (TC=25℃)



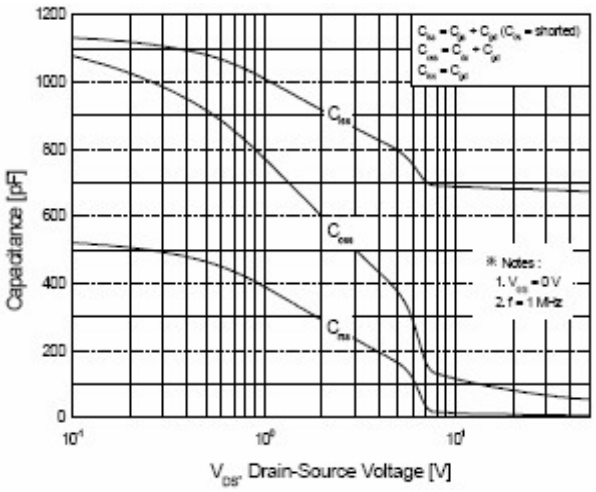
P_{tot}-T 关系曲线



典型传输 特性曲线



通态电阻—温度曲线



器件封装相关环保指标 有害物质或元素

部件名称	铅(Pb)	汞(Hg)	镉(Cd)	六价铬[Cr(VI)]	多溴联苯(PBB)	多溴苯醚（PBDE）
引线框	○	○	○	○	○	○
塑封树脂	○	○	○	○	○	○
管 芯	○	○	○	○	○	○
内引线	○	○	○	○	○	○
焊 料	╳	○	○	○	○	○
说 明	○：表示该有毒有害物质的含量在 SJ/T11363-2006 标准的限量要求以下。 ╳：表示该有毒有害物质的含量超出 SJ/T11363-2006 标准的限量要求。 目前产品的焊料中含有铅（Pb）成分，但属于欧盟 ROHS 指令豁免范围。					

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 (Ts_{min}) - Temperature Max (Ts_{max}) - Time (min to max) (t_s)	 100°C 150°C 60~120 sec	 150°C 200°C 60~180 sec
Tsmax to T_L - Ramp-up Rate	<3°C/sec	<3°C/sec
Time maintained above: - Temperature (T_L) - Time (t_L)	 183°C 60~150 sec	 217°C 60~150 sec
Peak Temperature (T_P)	240°C +0/-5°C	260°C +0/-5°C
Time within 5oC of actual Peak Temperature (t_P)	10~30 sec	20~40 sec
Ramp-down Rate	<6℃/sec	<6°C/sec
Time 25℃ 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