



H04N60 Series

N-Channel Power Field Effect Transistor

Description

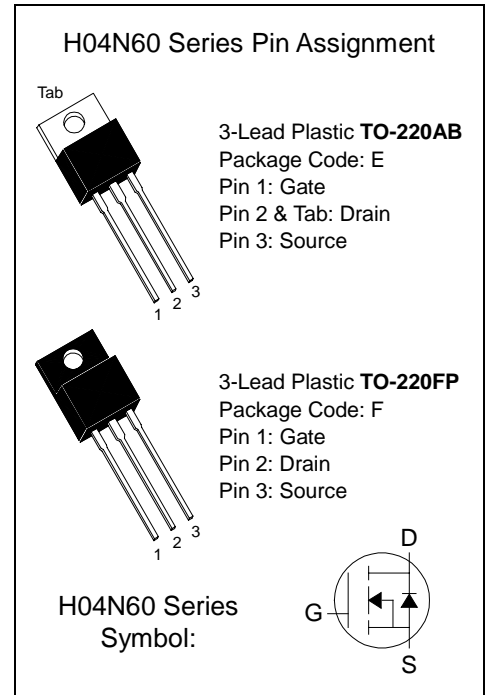
This advanced high voltage MOSFET is designed to withstand high energy in the avalanche mode and switch efficiently. This new high energy device also offers a drain-to-source diode with fast recovery time. Designed for high voltage, high speed switching applications such as power supplies, converters, 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

Absolute Maximum Ratings

Symbol	Parameter	Value	Units
I_D	Drain to Current (Continuous)	4	A
I_{DM}	Drain to Current (Pulsed)	16	A
V_{GS}	Gate-to-Source Voltage (Continue)	± 30	V
P_D	Total Power Dissipation ($T_c=25^\circ\text{C}$)		
	H04N60E (TO-220AB)	70	W
	H04N60F (TO-220FP)	30	
	Derate above 25°C		
	H04N60E (TO-220AB)	0.56	W/ $^\circ\text{C}$
	H04N60F (TO-220FP)	0.2	
T_j, T_{stg}	Operating and Storage Temperature Range	-55 to 150	$^\circ\text{C}$
E_{AS}	Single Pulse Drain-to-Source Avalanche Enrgy- $T_j=25^\circ\text{C}$ ($V_{DD}=100\text{V}, V_{GS}=10\text{V}, I_L=2\text{A}, L=10\text{mH}, R_G=25\Omega$)	250	mJ
T_L	Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds	260	$^\circ\text{C}$





Thermal Characteristics

Symbol	Parameter	Value		Units
R _{θJC}	Thermal Resistance Junction to Case Max.	TO-220AB	1.3	°C/W
		TO-220FP	5	
R _{θJA}	Thermal Resistance Junction to Ambient Max.	62.5		°C/W

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

Symbol	Characteristic	Min.	Typ.	Max.	Unit
V _{(BR)DSS}	Drain-Source Breakdown Voltage (V _{GS} =0V, I _D =250uA)	600	-	-	V
I _{DSS}	Drain-Source Leakage Current (V _{DS} =600V, V _{GS} =0V)	-	-	1	uA
	Drain-Source Leakage Current (V _{DS} =480V, V _{GS} =0V, T _J =125°C)	-	-	50	uA
I _{GSSF}	Gate-Source Leakage Current-Forward (V _{gsf} =30V, V _{DS} =0V)	-	-	100	nA
I _{GSSR}	Gate-Source Leakage Current-Reverse (V _{gsr} =-30V, V _{DS} =0V)	-	-	-100	nA
V _{GS(th)}	Gate Threshold Voltage (V _{DS} =V _{GS} , I _D =250uA)	2	-	4	V
R _{DS(on)}	Static Drain-Source On-Resistance (V _{GS} =10V, I _D =2A)*	-	-	2.2	Ω
g _{FS}	Forward Transconductance (V _{DS} =15V, I _D =2A)*	2	-	-	mhos
C _{iss}	Input Capacitance	-	540	-	pF
C _{oss}	Output Capacitance	-	125	-	
C _{rss}	Reverse Transfer Capacitance	-	8	-	
t _{d(on)}	Turn-on Delay Time	-	12	-	ns
t _r	Rise Time	-	7	-	
t _{d(off)}	Turn-off Delay Time	-	19	-	
t _f	Fall Time	-	10	-	
Q _g	Total Gate Charge	-	5	-	nC
Q _{gs}	Gate-Source Charge	-	2.7	-	
Q _{gd}	Gate-Drain Charge	-	2	-	
L _D	Internal Drain Inductance (Measured from the drain lead 0.25" from package to center of die)	-	4.5	-	nH
L _S	Internal Drain Inductance (Measured from the drain lead 0.25" from package to source bond pad)	-	7.5	-	nH

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

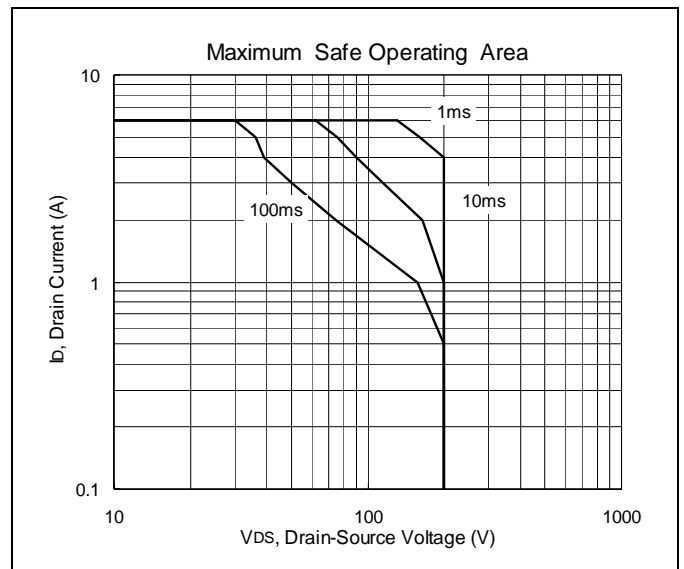
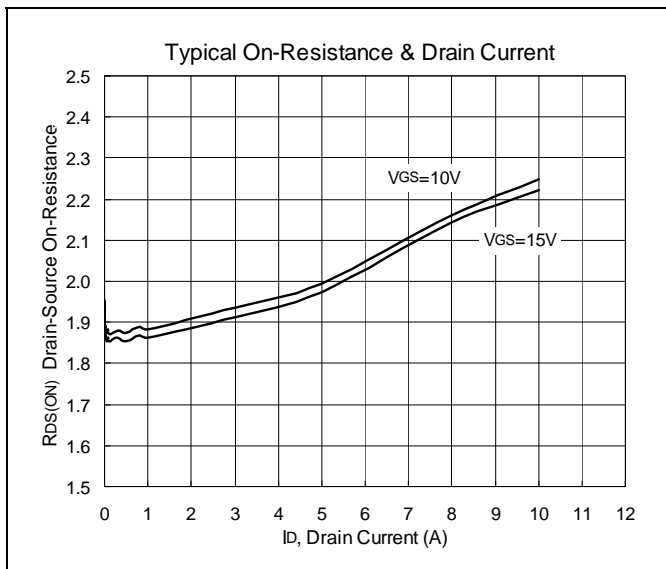
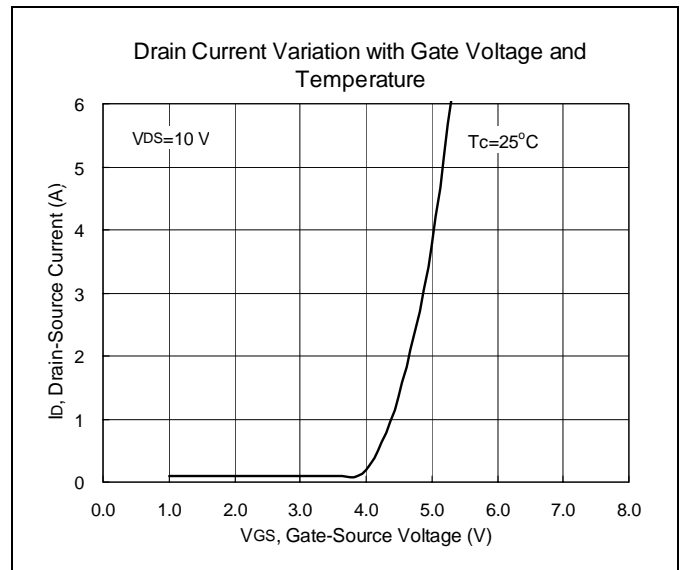
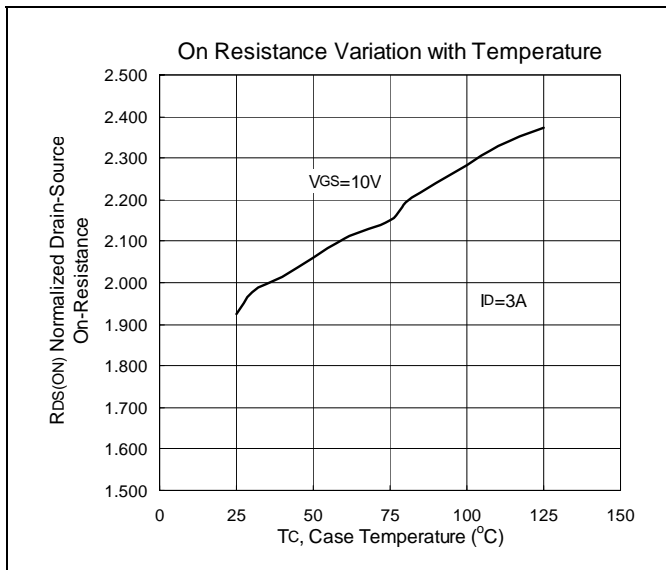
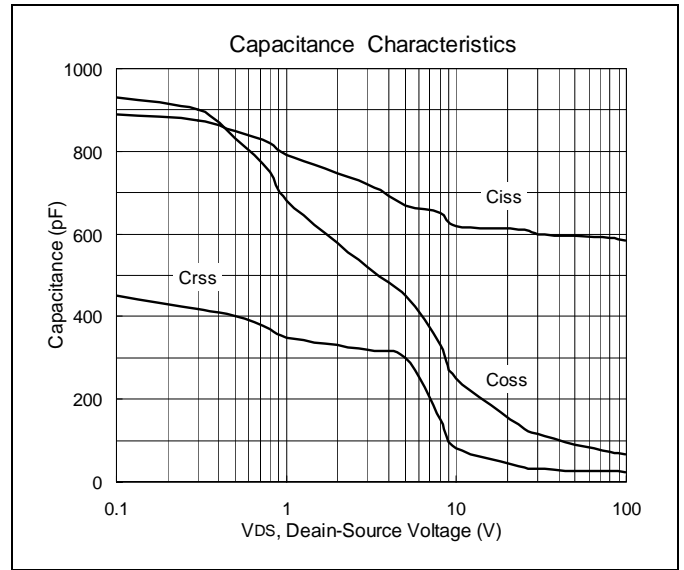
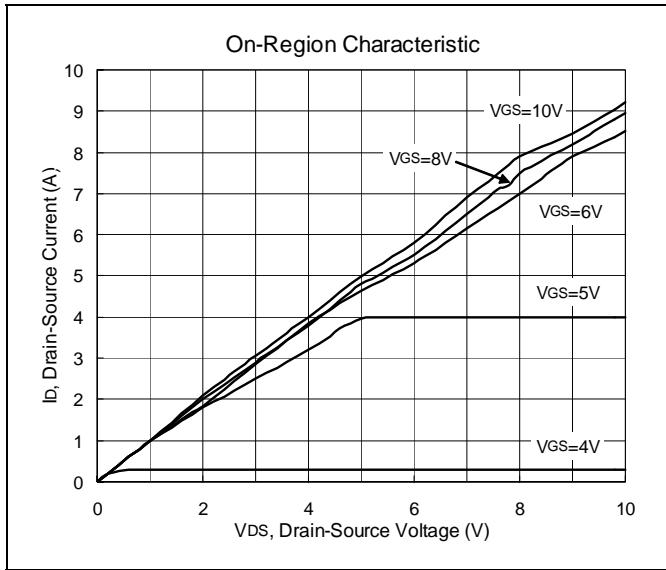
Source-Drain Diode

Symbol	Characteristic		Min.	Typ.	Max.	Units
V _{SD}	Forward On Voltage(1)	I _S =4A, V _{GS} =0V, T _J =25°C	-	-	1.6	V
t _{on}	Forward Turn-On Time	I _S =2A, V _{GS} =0V, d _{iS} /d _t =100A/us	-	**	-	ns
t _{rr}	Reverse Recovery Time		-	302	-	ns

** : Negligible, Dominated by circuit inductance



Characteristics Curve





TO-220AB Dimension

3-Lead TO-220AB
Plastic Package
HSMC Package Code: E

Marking:

Pb Free Mark
Pb-Free: "●" (Note)
Normal: None

Date Code Control Code

Note: Green label is used for pb-free packing

Pin Style: 1.Gate 2 & Tab.Drain 3.Source

Material:

- Lead solder plating: Sn60/Pb40 (Normal), Sn/3.0Ag/0.5Cu or Pure-Tin (Pb-free)
- Mold Compound: Epoxy resin family, flammability solid burning class: UL94V-0

DIM	Min.	Max.
A	5.58	7.49
B	8.38	8.90
C	4.40	4.70
D	1.15	1.39
E	0.35	0.60
F	2.03	2.92
G	9.66	10.28
H	-	*16.25
I	-	*3.83
J	3.00	4.00
K	0.75	0.95
L	2.54	3.42
M	1.14	1.40
N	-	*2.54
O	12.70	14.27
P	14.48	15.87

*: Typical, Unit: mm

TO-220FP Dimension

3-Lead TO-220FP
Plastic Package
HSMC Package Code: F

Marking:

Pb Free Mark
Pb-Free: "●" (Note)
Normal: None

Date Code Control Code

Note: Green label is used for pb-free packing

Pin Style: 1.Gate 2.Drain 3.Source

Material:

- Lead solder plating: Sn60/Pb40 (Normal), Sn/3.0Ag/0.5Cu or Pure-Tin (Pb-free)
- Mold Compound: Epoxy resin family, flammability solid burning class: UL94V-0

DIM	Min.	Max.
A	6.48	7.40
C	4.40	4.90
D	2.34	3.00
E	0.45	0.80
F	9.80	10.36
G	3.10	3.60
I	2.70	3.43
J	0.60	1.00
K	2.34	2.74
L	12.48	13.60
M	15.67	16.20
N	0.90	1.47
O	2.00	2.96
$\alpha 1/2/4/5$	-	*5°
$\alpha 3$	-	*27°

*: Typical, Unit: mm

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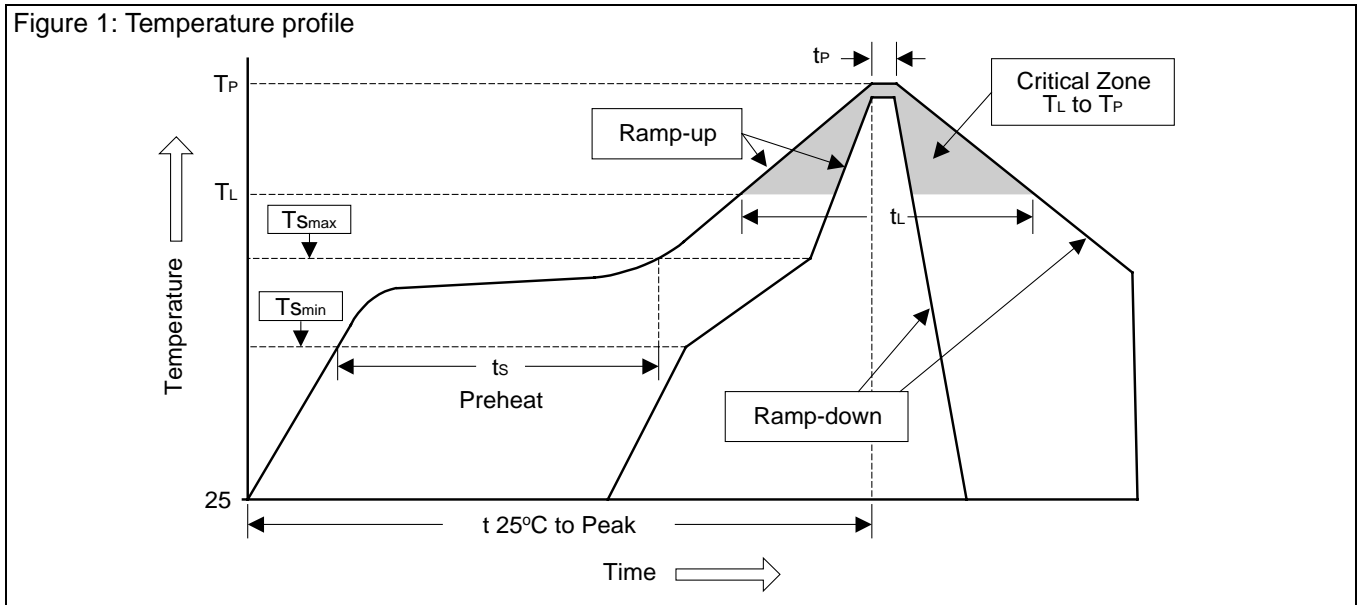
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Soldering Methods for HSMC's Products

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

Figure 1: Temperature profile



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)	60~120 sec	60~180 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)	60~150 sec	60~150 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)	10~30 sec	20~40 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