



# H01N60S Series

N-Channel Power Field Effect Transistor

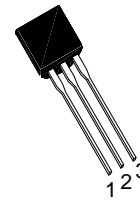
## Description

This high voltage MOSFET uses an advanced termination scheme to provide enhanced voltage-blocking capability without degrading performance over time. In addition, this advanced MOSFET is designed to withstand high energy in avalanche and commutation modes. The new energy efficient design also offers a drain-to-source diode with a fast recovery time. Designed for high voltage, high speed switching applications in power supplies, converters and PWM motor controls, these devices are particularly well suited for bridge circuits where diode speed and commutating safe operating areas are critical and offer additional and safety margin against unexpected voltage transients.

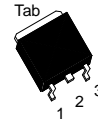
## Features

- 1A, 600V,  $R_{DS(on)}=12\Omega@V_{GS}=10V$
- Low Gate Charge 15nC(Typ.)
- Low  $C_{rss}$  4pF(Typ.)
- Fast Switching
- Improved  $d_v/d_t$  Capability

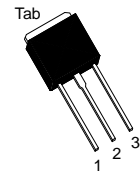
### H01N60S Series Pin Assignment



3-Lead Plastic **TO-92**  
Package Code: A  
Pin 1: Gate  
Pin 2: Drain  
Pin 3: Source

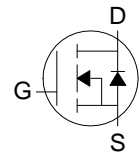


3-Lead Plastic **TO-252**  
Package Code: J  
Pin 1: Gate  
Pin 2 & Tab: Drain  
Pin 3: Source



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

H01N60S Series  
Symbol:



## Absolute Maximum Ratings

Symbol	Parameter	H01N60SA	H01N60SI / H01N60SJ	Units
$V_{DSS}$	Drain-Source Voltage	600		V
$I_D$	Drain Current (Continuous $T_C=25^\circ C$ )	1		A
	Drain Current (Continuous $T_C=100^\circ C$ )	0.6		A
$I_{DM}$	Drain Current (Pulsed) *1	4		A
$V_{GS}$	Gate-Source Voltage	$\pm 30$		V
$E_{AS}$	Single Pulse Avalanche Energy ( $L=59mH$ , $I_{AS}=1.1A$ , $V_{DD}=50V$ , $R_G=25\Omega$ , Starting $T_J=25^\circ C$ )	50		mJ
$I_{AR}$	Avalanche Current *1	1		A
$E_{AR}$	Repetitive Avalanche Energy	2.8		mJ
dv/dt	Peak Diode Recovery dv/dt *2	4.5		V/nS
$P_D$	Total Power Dissipation ( $T_A=25^\circ C$ )	1	2.5	W
	Total Power Dissipation ( $T_C=25^\circ C$ )	3	28	W
	Derate above $25^\circ C$	0.22		W/ $^\circ C$
$T_j, T_{stg}$	Operating and Storage Temperature Range	-55 to +150		$^\circ C$
$T_L$	Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 5 seconds	300		$^\circ C$

\*1: Repetitive Rating : Pulse width limited by maximum junction temperature

\*2:  $I_{SD} \leq 1.1A$ ,  $di/dt \leq 200A/us$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J=25^\circ C$



### Thermal Characteristics

Symbol	Parameter	Value		Units
$R_{\theta JC}$	Thermal Resistance Junction to Case Max.		4.5	°C/W
$R_{\theta JA}$	Thermal Resistance Junction to Ambient Max.	120	110	°C/W

### Electrical Characteristics ( $T_J=25^\circ\text{C}$ , unless otherwise specified)

Symbol	Characteristic	Min.	Typ.	Max.	Unit
--------	----------------	------	------	------	------

#### • Off Characteristics

$V_{DSS}$	Drain-Source Breakdown Voltage ( $V_{GS}=0V$ , $I_D=250\mu A$ )	600	-	-	V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient ( $I_D=250\mu A$ , Referenced to $25^\circ\text{C}$ )	-	0.6	-	V/°C
$I_{DSS}$	Zero Gate Voltage Drain Current ( $V_{DS}=600V$ , $V_{GS}=0V$ )	-	-	1	$\mu A$
	Zero Gate Voltage Drain Current ( $V_{DS}=480V$ , $T_J=125^\circ\text{C}$ )	-	-	50	$\mu A$
$I_{GSSF}$	Gate-Body Leakage Current-Forward ( $V_{GS}=30V$ , $V_{DS}=0V$ )	-	-	100	nA
$I_{GSSR}$	Gate-Body Leakage Current-Reverse ( $V_{GS}=-30V$ , $V_{DS}=0V$ )	-	-	-100	nA

#### • On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage ( $V_{DS}=V_{GS}$ , $I_D=250\mu A$ )	2	-	4	V
$R_{DS(on)}$	Static Drain-Source On-Resistance ( $V_{GS}=10V$ , $I_D=0.6A$ ) <sup>*3</sup>	-	-	12	$\Omega$
$g_{FS}$	Forward Transconductance ( $V_{DS}=40V$ , $I_D=0.5A$ ) <sup>*3</sup>	-	0.75	-	S

#### • Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{GS}=0V$ , $V_{DS}=25V$ , $f=1\text{MHz}$	-	210	250	pF
$C_{oss}$	Output Capacitance		-	19	25	
$C_{riss}$	Reverse Transfer Capacitance		-	4	8	

#### • Switching Characteristics

$t_{d(on)}$	Turn-on Delay Time	$V_{DD}=300V$ , $I_D=1.1A$ $R_G=25\Omega$ <sup>*3</sup>	-	-	30	ns
$t_r$	Turn-on Rise Time		-	-	60	
$t_{d(off)}$	Turn-off Delay Time		-	-	45	
$t_f$	Turn-off Fall Time		-	-	75	
$Q_g$	Total Gate Charge	$V_{DS}=480V$ , $I_D=1.1A$ $V_{GS}=10V$ <sup>*3</sup>	-	15	20	nC
$Q_{gs}$	Gate-Source Charge		-	4	-	
$Q_{gd}$	Gate-Drain Charge		-	3	-	

#### • Drain-Source Diode Characteristics and Maximum Ratings

$I_S$	Maximum Continuous Drain-Source Diode Forward Current	-	-	1	A
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current	-	-	4	A
$V_{SD}$	Drain-Source Diode Forward Voltage ( $V_{GS}=0V$ , $I_S=1A$ )	-	-	1.4	V
$t_{rr}$	Reverse Recovery Time ( $V_{GS}=0V$ , $I_S=1.1A$ , $dI_F/dt=100A/\mu s$ ) <sup>*3</sup>	-	190	-	ns
$Q_{rr}$	Reverse Recovery Charge ( $V_{GS}=0V$ , $I_S=1.1A$ , $dI_F/dt=100A/\mu s$ ) <sup>*3</sup>	-	0.53	-	nC

\*3: Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$



### TO-92 Dimension

**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	4.33	4.83
B	4.33	4.83
C	12.70	-
D	0.36	0.56
E	-	*1.27
F	3.36	3.76
G	0.36	0.56
H	-	*2.54
I	-	*1.27
$\alpha 1$	-	*5°
$\alpha 2$	-	*2°
$\alpha 3$	-	*2°

\*: Typical, Unit: mm

3-Lead TO-92 Plastic Package  
 HSMC Package Code: A

### TO-92 Taping Dimension

DIM	Min.	Max.
A	4.33	4.83
D	3.80	4.20
D1	0.36	0.53
D2	4.33	4.83
F1,F2	2.40	2.90
H	15.50	16.50
H1	8.50	9.50
H2	-	1
H2A	-	1
H3	-	27
H4	-	21
L	-	11
L1	2.50	-
P	12.50	12.90
P1	5.95	6.75
P2	50.30	51.30
T	-	0.55
T1	-	1.42
T2	0.36	0.68
W	17.50	19.00
W1	5.00	7.00

Unit: mm



### TO-252 Dimension

3-Lead TO-252 Plastic  
Surface Mount Package  
HSMC Package Code: J

**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	6.35	6.80
C	4.80	5.50
F	1.30	1.70
G	5.40	6.25
H	2.20	3.00
L	0.40	0.90
M	2.20	2.40
N	0.90	1.50
a1	0.40	0.65
a2	-	*2.30
a5	0.65	1.05

\*: Typical, Unit: mm

3-Lead TO-252 Plastic  
Surface Mount Package  
HSMC Package Code: J

**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	6.40	6.80
B	-	6.00
C	5.04	5.64
D	-	*4.34
E	0.40	0.80
F	0.50	0.90
G	5.90	6.30
H	2.50	2.90
I	9.20	9.80
J	0.60	1.00
K	-	0.96
L	0.66	0.86
M	2.20	2.40
N	0.70	1.10
O	0.82	1.22
a1	0.40	0.60
a2	2.10	2.50
y1	-	5°
y2	-	3°

\*: Typical, Unit: mm



### TO-251 Dimension

**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	6.35	6.80
C	4.80	5.50
F	1.30	1.70
G	5.40	6.25
H1	6.75	8.00
K	0.50	0.90
K1	0.40	0.90
L	0.90	1.50
M	2.20	2.40
a1	0.40	0.65
a2	-	*2.30

\*: Typical, Unit: mm

**3-Lead TO-251  
 Plastic Package  
 HSMC Package Code: I**

**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	6.40	6.80
B	-	6.00
C	5.04	5.64
D	-	*4.34
E	0.40	0.80
F	0.50	0.90
G	5.90	6.30
H	-	*1.80
H1	-	*9.30
I	-	*16.10
J	-	*0.80
K	-	0.96
K1	-	*0.76
M	2.20	2.40
a1	0.40	0.60
a2	2.10	2.50
y1	-	5°
y2	-	3°

\*: Typical, Unit: mm

**3-Lead TO-251  
 Plastic Package  
 HSMC Package Code: I**

#### Important Notice:

- All rights are reserved. Reproduction in whole or in part is prohibited without the prior written approval of HSMC.
- HSMC reserves the right to make changes to its products without notice.
- **HSMC semiconductor products are not warranted to be suitable for use in Life-Support Applications, or systems.**
- HSMC assumes no liability for any consequence of customer product design, infringement of patents, or application assistance.

#### Head Office And Factory:

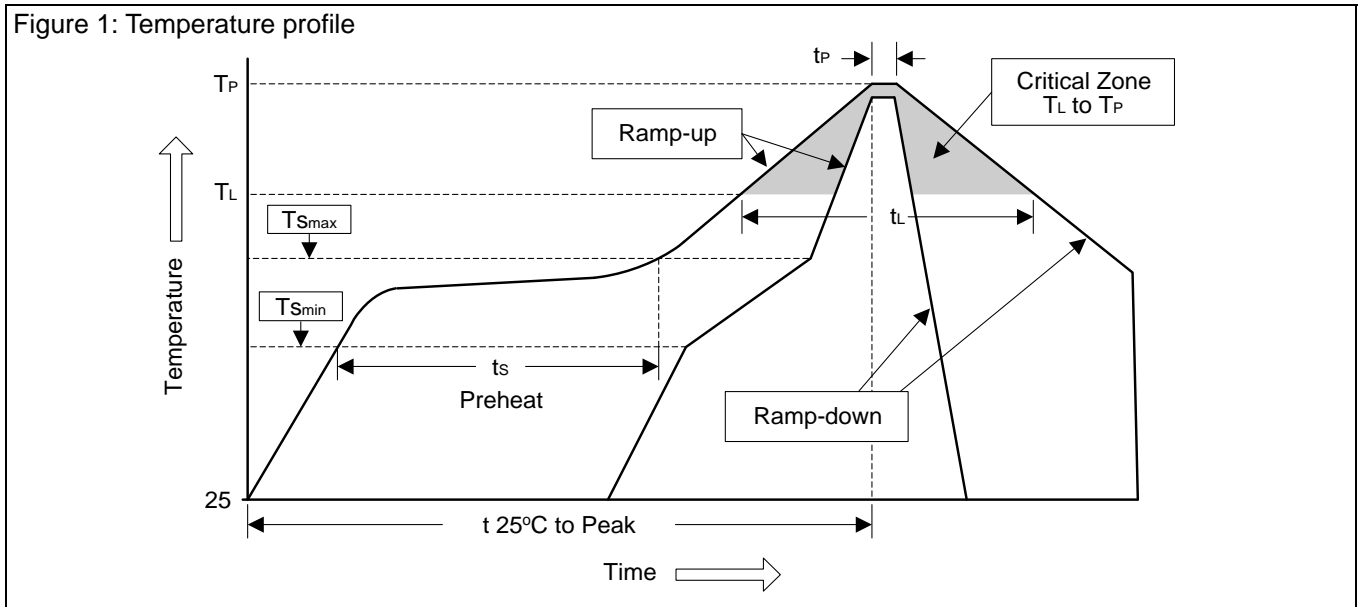
• **Head Office** (Hi-Sincerity Microelectronics Corp.): 5/F., Golden Harvest Building 15 Wang Chiu Road, Kowloon Bay, Hong Kong  
 Tel: +852-2755-7162 Fax: +852-2755- 7795  
 AVANTICS : Shanghai Address: No.399, Cai Lum Rd. Zhangjiang Technology Industrial Park Pudong, Shanghai 201210, China  
 Tel: +86(21) 61637118 Fax: +86(21)61637006



### 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	10sec ±1sec
Pb-Free devices.	260°C ±5°C	10sec ±1sec