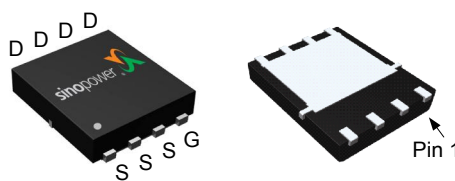


N-Channel Enhancement Mode MOSFET

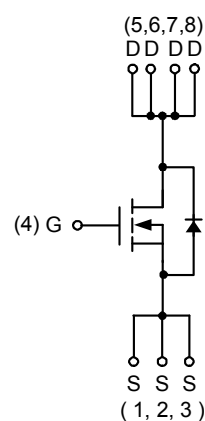
Features

- 40V/60A,
 $R_{DS(ON)} = 9m\Omega$ (max.) @ $V_{GS}=10V$
 $R_{DS(ON)} = 16m\Omega$ (max.) @ $V_{GS}=4.5V$
- Reliable and Rugged
- Lead Free and Green Devices Available
 (RoHS Compliant)

Pin Description



DFN5x6-8



N-Channel MOSFET

Applications

- SMPS Synchronous Rectification
- Load Switch
- DC-DC Conversion

Ordering and Marking Information

SM4028NS □□□-□□□ Assembly Material Handling Code Temperature Range Package Code	Package Code KP : DFN5x6-8 Operating Junction Temperature Range C : -55 to 150 °C Handling Code TR : Tape & Reel (2500ea/reel) Assembly Material G : Halogen and Lead Free Device
SM4028NS KP :	XXXXX - Lot Code

Note : SINOPOWER lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS. SINOPOWER lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J-STD-020D for MSL classification at lead-free peak reflow temperature. SINOPOWER defines "Green" to mean lead-free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

SINOPOWER reserves the right to make changes to improve reliability or manufacturability without notice, and advise customers to obtain the latest version of relevant information to verify before placing orders.

Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
Common Ratings ($T_A=25^{\circ}\text{C}$ Unless Otherwise Noted)			
V_{DSS}	Drain-Source Voltage	40	V
V_{GSS}	Gate-Source Voltage	± 20	
T_J	Maximum Junction Temperature	150	$^{\circ}\text{C}$
T_{STG}	Storage Temperature Range	-55 to 150	
I_S	Diode Continuous Forward Current	20	A
I_{DP}	300 μs Pulse Drain Current Tested	$T_C=25^{\circ}\text{C}$	120
		$T_C=100^{\circ}\text{C}$	80
I_D^a	Continuous Drain Current	$T_C=25^{\circ}\text{C}$	60*
		$T_C=100^{\circ}\text{C}$	38
P_D	Maximum Power Dissipation	$T_C=25^{\circ}\text{C}$	50
		$T_C=100^{\circ}\text{C}$	20
$R_{\theta\text{JC}}$	Thermal Resistance-Junction to Case	Steady State	2.5
$R_{\theta\text{JA}}$	Thermal Resistance-Junction to Ambient	$t \leq 10\text{s}$	30
		Steady State	50
I_{AS}^b	Avalanche Current, Single pulse ($L=0.1\text{mH}$)	20	A
E_{AS}^b	Avalanche Energy, Single pulse ($L=0.1\text{mH}$)	20	mJ

Note a : * Current limited by bond wire.

Note b : UIS tested and pulse width limited by maximum junction temperature 150°C (initial temperature $T_J=25^{\circ}\text{C}$).

Electrical Characteristics ($T_A = 25^{\circ}\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Static Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{\text{GS}}=0\text{V}$, $I_{\text{DS}}=250\mu\text{A}$	40	-	-	V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{\text{DS}}=32\text{V}$, $V_{\text{GS}}=0\text{V}$	-	-	1	μA
		$T_J=85^{\circ}\text{C}$	-	-	30	
$V_{\text{GS(th)}}$	Gate Threshold Voltage	$V_{\text{DS}}=V_{\text{GS}}$, $I_{\text{DS}}=250\mu\text{A}$	1.5	1.9	2.5	V
I_{GSS}	Gate Leakage Current	$V_{\text{GS}}=\pm 20\text{V}$, $V_{\text{DS}}=0\text{V}$	-	-	± 100	nA
$R_{\text{DS(ON)}}^c$	Drain-Source On-state Resistance	$V_{\text{GS}}=10\text{V}$, $I_{\text{DS}}=20\text{A}$	-	7.5	9	m Ω
		$T_J=125^{\circ}\text{C}$	-	12	-	
		$V_{\text{GS}}=4.5\text{V}$, $I_{\text{DS}}=10\text{A}$	-	13.5	16	
Gfs	Forward Transconductance	$V_{\text{DS}}=5\text{V}$, $I_{\text{DS}}=15\text{A}$	-	60	-	S

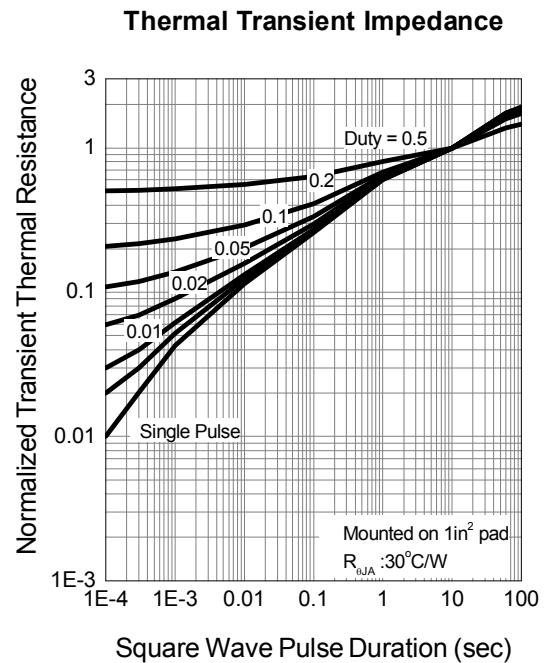
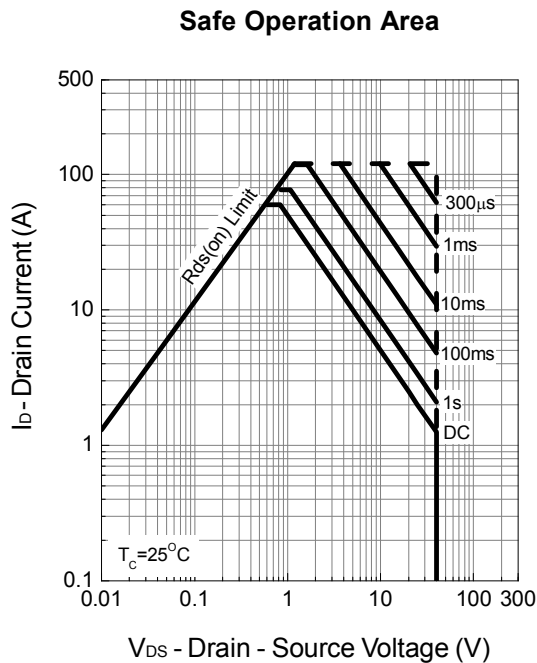
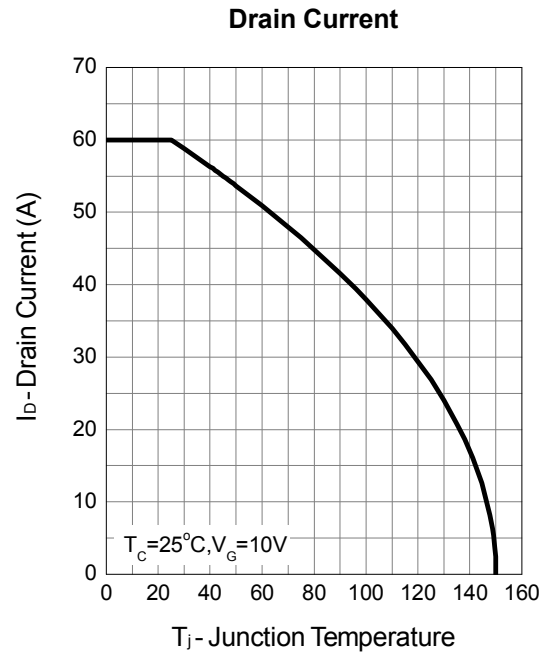
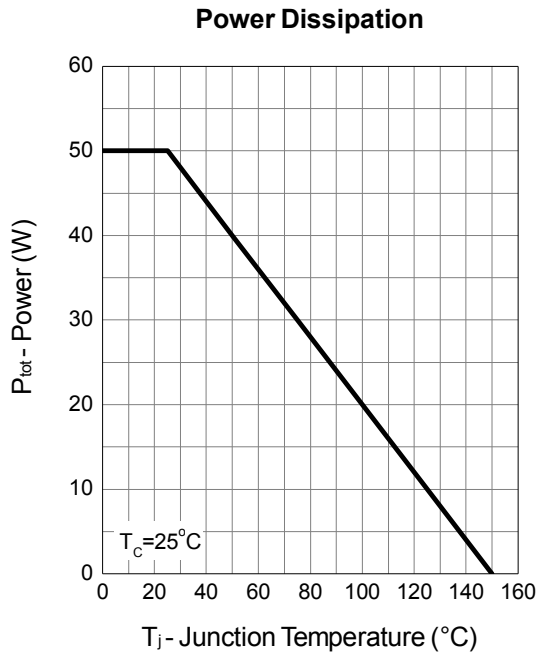
Electrical Characteristics (Cont.) ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Diode Characteristics						
V_{SD}^c	Diode Forward Voltage	$I_{SD}=20A, V_{GS}=0V$	-	0.85	1.1	V
t_{rr}	Reverse Recovery Time	$I_{DS}=20A, dI_{SD}/dt=100A/\mu s$	-	28	-	ns
t_a	Charge Time		-	20	-	
t_b	Discharge Time		-	8	-	
Q_{rr}	Reverse Recovery Charge		-	25	-	nC
Dynamic Characteristics ^d						
R_G	Gate Resistance	$V_{GS}=0V, V_{DS}=0V, F=1MHz$	-	1.3	-	Ω
C_{iss}	Input Capacitance	$V_{GS}=0V, V_{DS}=20V, Frequency=1.0MHz$	-	1460	-	pF
C_{oss}	Output Capacitance		-	155	-	
C_{rss}	Reverse Transfer Capacitance		-	136	-	
$t_{d(ON)}$	Turn-on Delay Time	$V_{DD}=15V, R_L=15\Omega, I_{DS}=1A, V_{GEN}=10V, R_G=6\Omega$	-	11	21	ns
t_r	Turn-on Rise Time		-	13	24	
$t_{d(OFF)}$	Turn-off Delay Time		-	37	67	
t_f	Turn-off Fall Time		-	11	21	
Gate Charge Characteristics ^d						
Q_g	Total Gate Charge	$V_{DS}=15V, V_{GS}=4.5V, I_{DS}=20A$	-	15.4	-	nC
Q_g	Total Gate Charge	$V_{DS}=15V, V_{GS}=10V, I_{DS}=20A$	-	31.2	44	
Q_{gth}	Threshold Gate Charge		-	1.9	-	
Q_{gs}	Gate-Source Charge		-	3.8	-	
Q_{gd}	Gate-Drain Charge		-	9	-	

Note c : Pulse test ; pulse width $\leq 300\mu\text{s}$, duty cycle $\leq 2\%$.

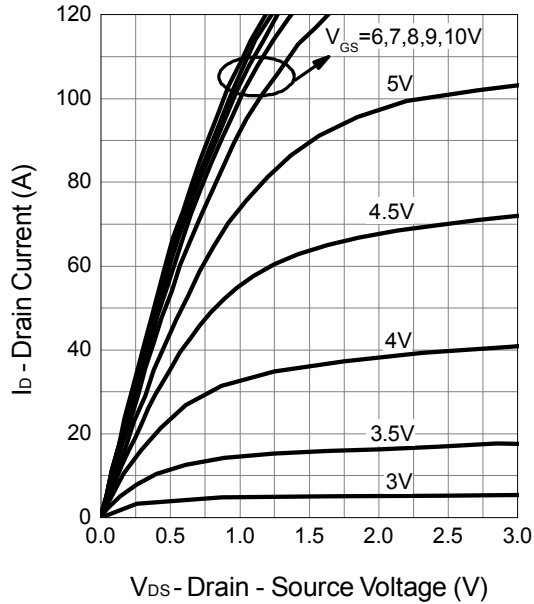
Note d : Guaranteed by design, not subject to production testing.

Typical Operating Characteristics

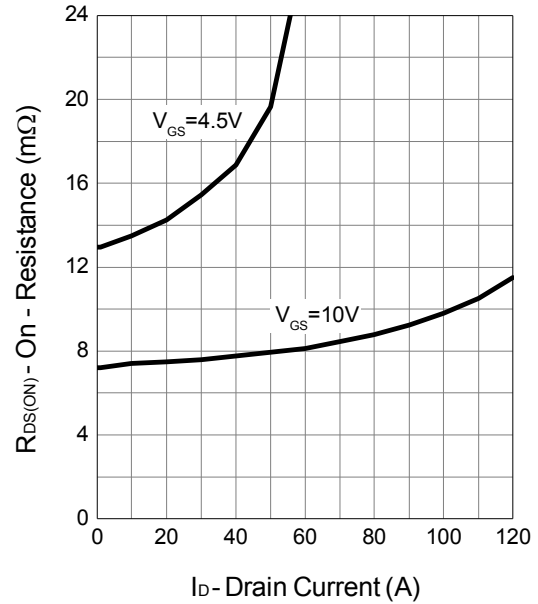


Typical Operating Characteristics (Cont.)

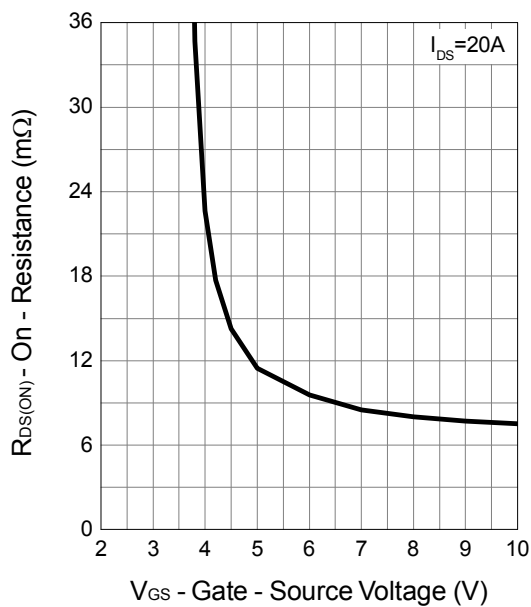
Output Characteristics



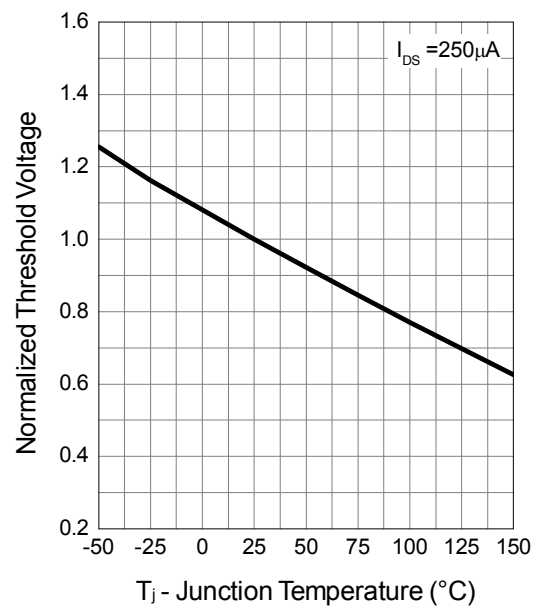
Drain-Source On Resistance



Gate-Source On Resistance

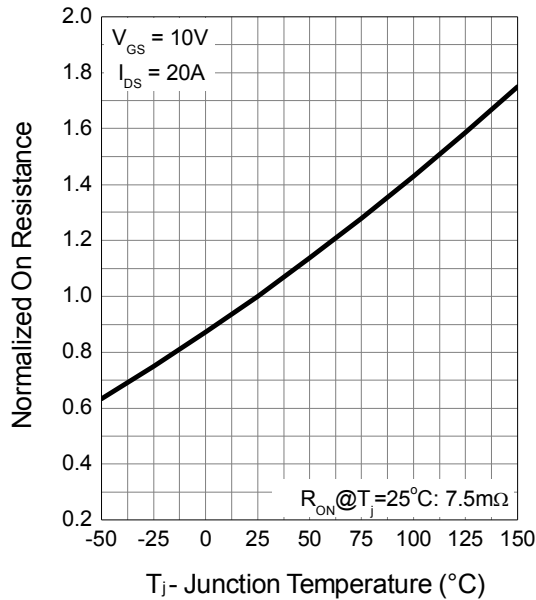


Gate Threshold Voltage

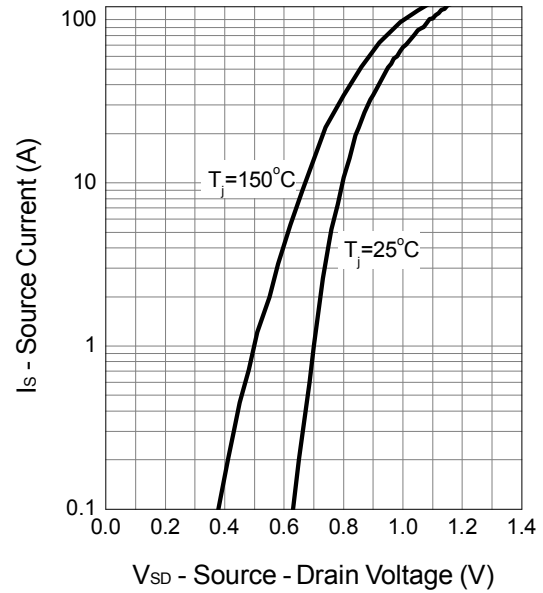


Typical Operating Characteristics (Cont.)

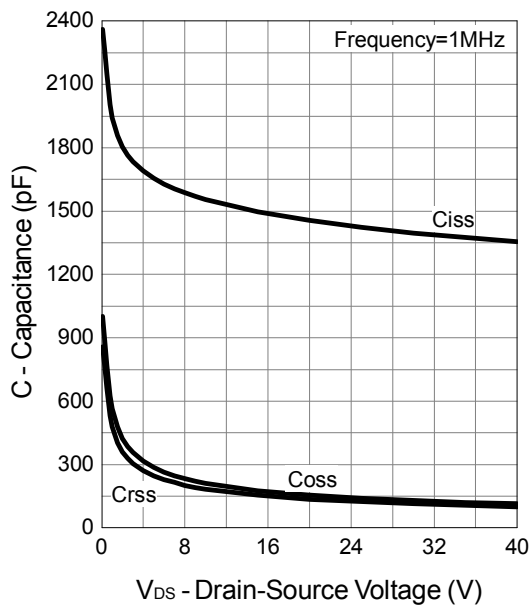
Drain-Source On Resistance



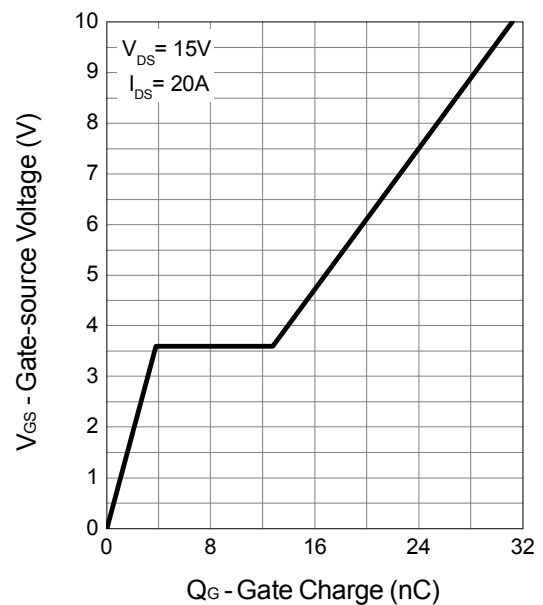
Source-Drain Diode Forward



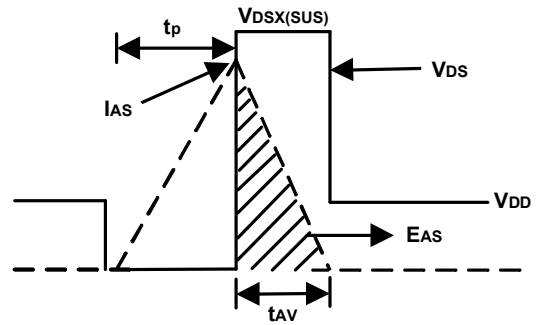
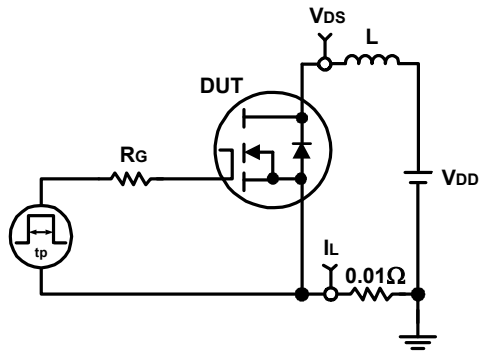
Capacitance



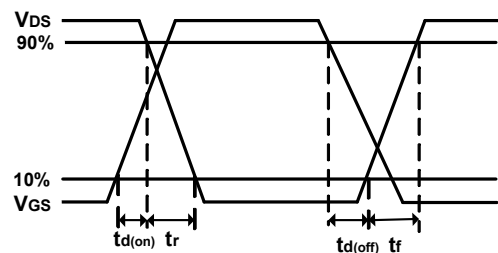
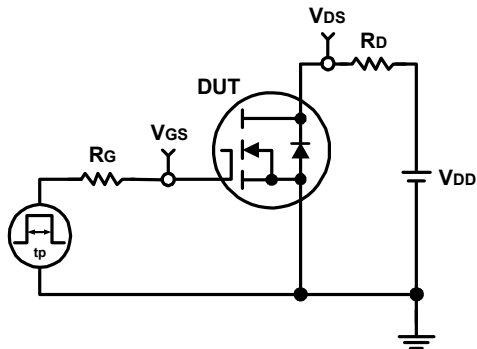
Gate Charge



Avalanche Test Circuit and Waveforms

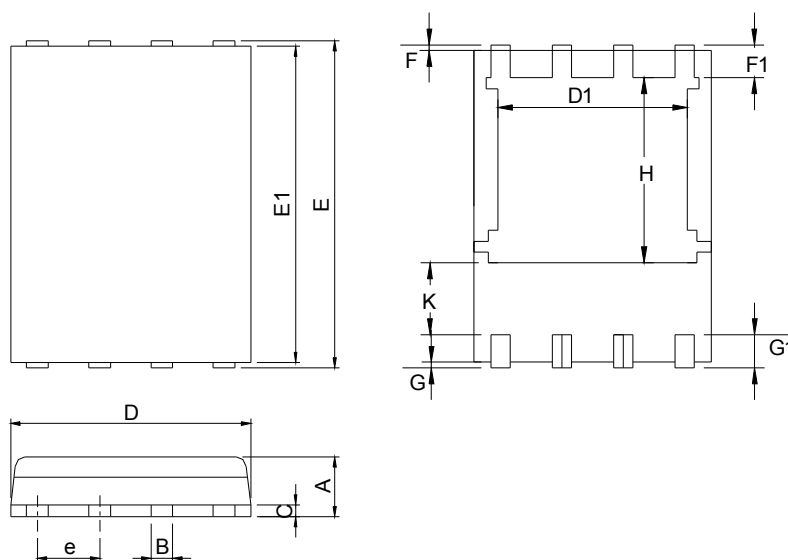


Switching Time Test Circuit and Waveforms



Package Information

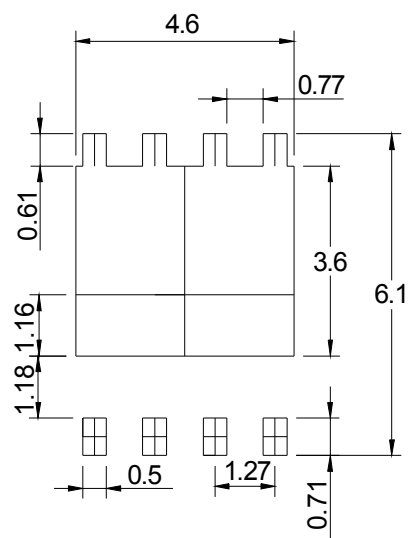
DFN5x6-8



SYMBOL	DFN5x6-8			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	0.90	1.20	0.035	0.047
B	0.3	0.51	0.012	0.020
C	0.19	0.25	0.007	0.010
D	4.80	5.30	0.189	0.209
D1	4.00	4.40	0.157	0.173
E	5.90	6.20	0.232	0.244
E1	5.50	5.80	0.217	0.228
e	1.27 BSC		0.050 BSC	
F	0.05	0.30	0.002	0.012
F1	0.35	0.75	0.014	0.030
G	0.05	0.30	0.002	0.012
G1	0.35	0.75	0.014	0.030
H	3.34	3.9	0.131	0.154
K	0.762	-	0.03	-

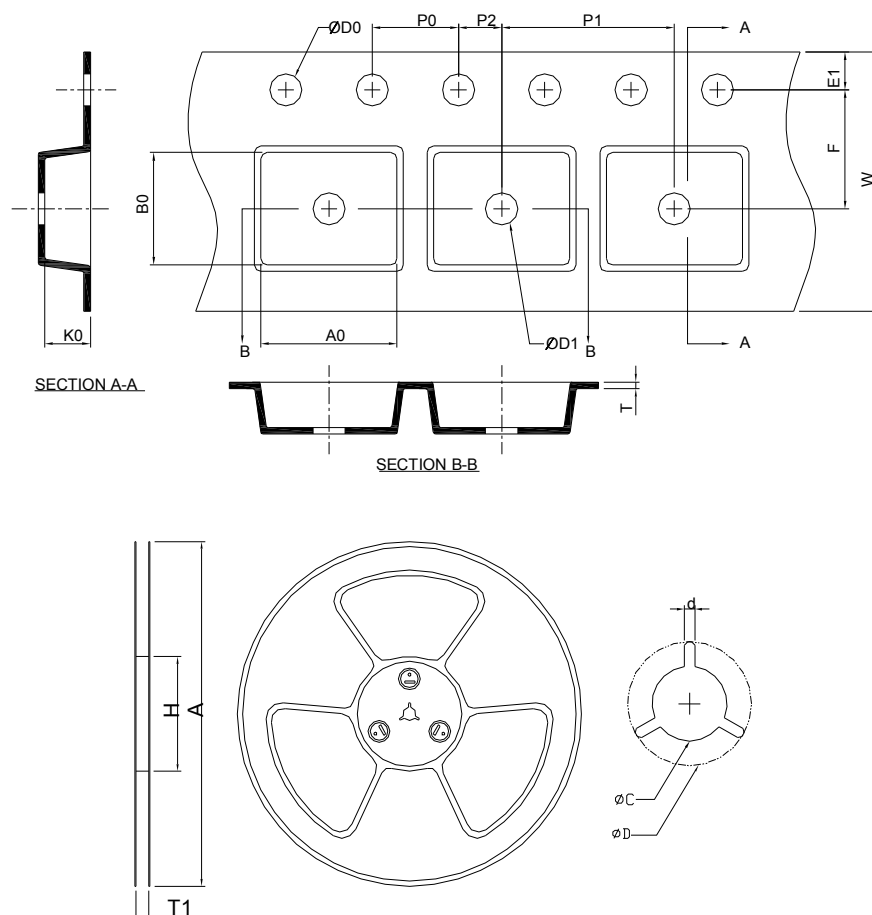
Note : 1.Dimension D, D1,D2 and E1 do not include mold flash or protrusions.
Mold flash or protrusions shall not exceed 10 mil.

RECOMMENDED LAND PATTERN



UNIT: mm

Carrier Tape & Reel Dimensions



Application	A	H	T1	C	d	D	W	E1	F
DFN5x6-8	330.0±2.00	50 MIN.	12.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	12.0±0.30	1.75±0.10	5.5±0.10
	P0	P1	P2	D0	D1	T	A0	B0	K0
	4.0±0.10	8.0±0.10	2.0±0.10	1.5+0.10 -0.00	1.5 MIN.	0.3±0.05	6.5±0.10	5.3±0.10	1.4±0.10

(mm)

DFN5x6-8

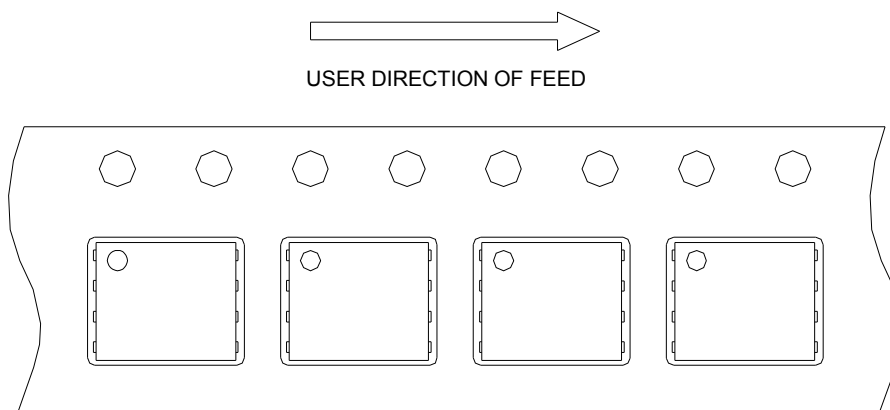


Figure 1 illustrates the thermal profile of a power MOSFET, showing Temperature (°C) versus Time (s). The main graph displays the temperature curve during a switching event, starting from 25°C, ramping up at 3°C/s to T_{smax} , then entering a "Preheat Area" where the temperature levels off. The temperature then ramps down at 6°C/s to T_L . Key parameters include the peak temperature T_p , the case temperature T_c , and the temperature difference $T_c - 5^\circ\text{C}$. The time intervals shown are t_s (switching time), t (pulse width), and t_p (pulse period).

Two inset graphs provide a detailed view of the thermal profile near the peak temperature T_p . The left inset shows the "Supplier $T_p \geq T_c$ " condition, where the peak temperature is above the case temperature. The right inset shows the "User $T_p \leq T_c$ " condition, where the peak temperature is below the case temperature. Both insets highlight the difference in pulse width t_p and the temperature difference $T_c - 5^\circ\text{C}$.

Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat & Soak		
Temperature min (T_{smin})	100 °C	150 °C
Temperature max (T_{smax})	150 °C	200 °C
Time (T_{smin} to T_{smax}) (t_s)	60-120 seconds	60-120 seconds
Average ramp-up rate (T_{smax} to T_p)	3 °C/second max.	3°C/second max.
Liquidous temperature (T_L)	183 °C	217 °C
Time at liquidous (t_L)	60-150 seconds	60-150 seconds
Peak package body Temperature (T_p)*	See Classification Temp in table 1	See Classification Temp in table 2
Time (t_p)** within 5°C of the specified classification temperature (T_c)	20** seconds	30** seconds
Average ramp-down rate (T_p to T_{smax})	6 °C/second max.	6 °C/second max.
Time 25°C to peak temperature	6 minutes max.	8 minutes max.
* Tolerance for peak profile Temperature (T_p) is defined as a supplier minimum and a user maximum.		
** Tolerance for time at peak profile temperature (t_p) is defined as a supplier minimum and a user maximum.		

Table 1. SnPb Eutectic Process – Classification Temperatures (T_c)

Package Thickness	Volume mm ³ <350	Volume mm ³ ≥350
<2.5 mm	235 °C	220 °C
≥2.5 mm	220 °C	220 °C

Table 2. Pb-free Process – Classification Temperatures (T_c)

Package Thickness	Volume mm ³ <350	Volume mm ³ 350-2000	Volume mm ³ >2000
<1.6 mm	260 °C	260 °C	260 °C
1.6 mm – 2.5 mm	260 °C	250 °C	245 °C
≥2.5 mm	250 °C	245 °C	245 °C

Reliability Test Program

Test item	Method	Description
SOLDERABILITY	JESD-22, B102	5 Sec, 245°C
HTRB	JESD-22, A108	1000 Hrs, 80% of VDS max @ T_{jmax}
HTGB	JESD-22, A108	1000 Hrs, 100% of VGS max @ T_{jmax}
PCT	JESD-22, A102	168 Hrs, 100%RH, 2atm, 121°C
TCT	JESD-22, A104	500 Cycles, -65°C~150°C

Customer Service

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