

Dual N-Channel Enhancement Mode MOSFET

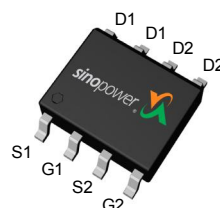
Features

- 40V/7.8A,
 $R_{DS(ON)} = 14.5m\Omega$ (max.) @ $V_{GS} = 10V$
 $R_{DS(ON)} = 18m\Omega$ (max.) @ $V_{GS} = 4.5V$
- 100% UIS + R_g Tested
- Reliable and Rugged
- Lead Free and Green Devices Available
(RoHS Compliant)

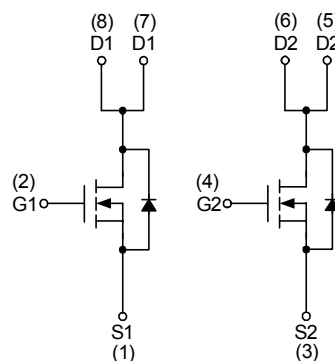
Applications

- Car charger.
- Power Management in Note book.
- Battery Powered System.
- DC/DC Converter.
- Load Switch.

Pin Description



Top View of SOP-8



N-Channel MOSFET

Ordering and Marking Information

SM4041DS □□-□□ □ Assembly Material Handling Code Temperature Range Package Code	Package Code K : SOP-8 Operating Junction Temperature Range C : -55 to 150 °C Handling Code TR : Tape & Reel Assembly Material G : Halogen and Lead Free Device
SM4041DS K :	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 ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter		Rating	Unit
Common Ratings				
V _{DSS}	Drain-Source Voltage		40	V
V _{GSS}	Gate-Source Voltage		±20	
T _J	Maximum Junction Temperature		150	°C
T _{STG}	Storage Temperature Range		-55 to 150	
I _S	Diode Continuous Forward Current	T _A =25°C	2	A
I _{DM} ^a	Pulsed Drain Current	T _A =25°C	19	
I _D ^b	Continuous Drain Current	T _A =25°C	7.8	
		T _A =70°C	6.2	
P _D ^b	Power Dissipation	T _A =25°C	1.31	W
		T _A =70°C	0.84	
R _{θJA} ^b	Thermal Resistance-Junction to Ambient	t ≤ 10s	54	°C/W
		Steady State	95	
R _{θJL}	Thermal Resistance-Junction to Lead	Steady State	32	
I _{AS} ^c	Avalanche Current, Single pulse	L=0.1mH	20	A
E _{AS} ^c	Avalanche Energy, Single pulse	L=0.1mH	20	mJ

Note a : Max. current is limited by bonding wire.

Note b : $R_{\theta\text{JA}}$ steady state $t=999\text{s}$. $R_{\theta\text{JA}}$ is measured with the device mounted on 1in2, FR-4 board with 2oz. Copper.

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

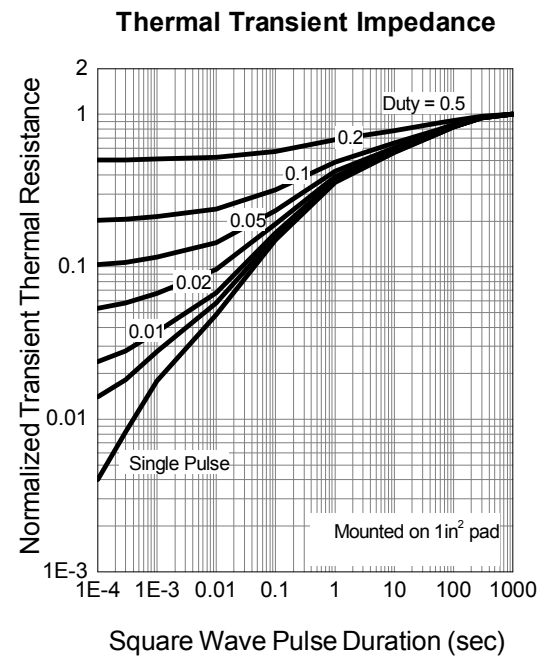
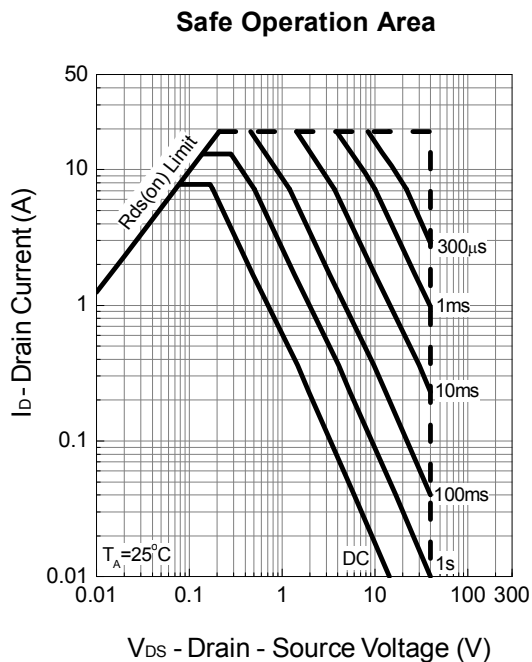
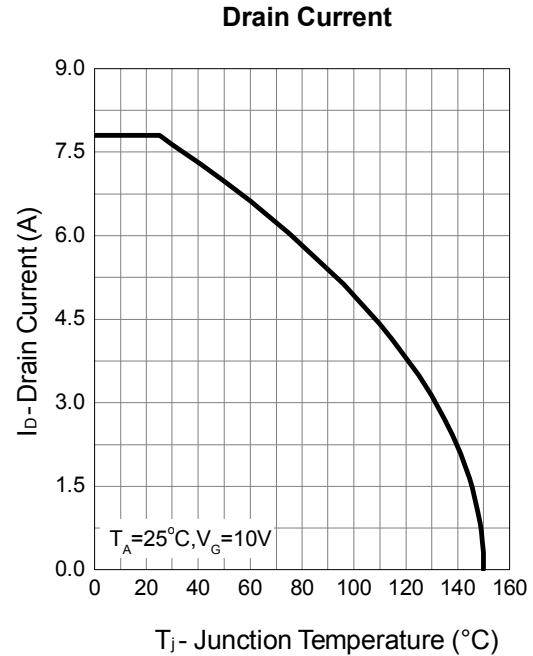
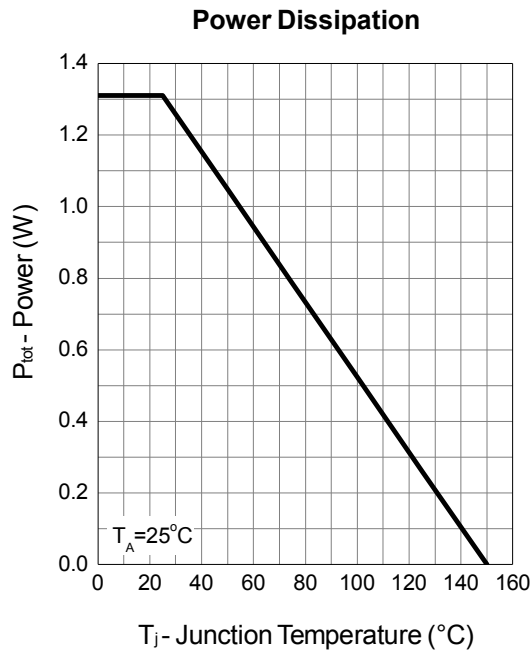
Electrical Characteristics ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Static Characteristics						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} =0V, I _{DS} =250μA	40	-	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} =32V, V _{GS} =0V	-	-	1	μA
		T _J =85°C	-	-	30	
V _{GS(th)}	Gate Threshold Voltage	V _{DS} =V _{GS} , I _{DS} =250μA	1.5	1.8	2.5	V
I _{GSS}	Gate Leakage Current	V _{GS} =±20V, V _{DS} =0V	-	-	±100	nA
R _{DS(ON)} ^d	Drain-Source On-state Resistance	V _{GS} =10V, I _{DS} =12A	-	12	14.5	mΩ
		V _{GS} =4.5V, I _{DS} =10A	-	13.5	18	
Diode Characteristics						
V _{SD} ^d	Diode Forward Voltage	I _{SD} =10A, V _{GS} =0V	-	0.88	1.1	V
t _{rr}	Reverse Recovery Time	I _{DS} =12A, dl _{SD} /dt=100A/μs	-	17	-	ns
Q _{rr}	Reverse Recovery Charge	V _{DS} =20V	-	12	-	nC
Dynamic Characteristics ^e						
R _G	Gate Resistance	V _{GS} =0V,V _{DS} =0V,F=1MHz	-	1.3	2.5	Ω
C _{iss}	Input Capacitance	V _{GS} =0V, V _{DS} =20V, Frequency=1.0MHz	-	1095	1424	pF
C _{oss}	Output Capacitance		-	135	176	
C _{rss}	Reverse Transfer Capacitance		-	74	111	
t _{d(ON)}	Turn-on Delay Time	V _{DD} =30V, R _L =30Ω, I _{DS} =1A, V _G =10V, R _G =6Ω	-	8.2	-	ns
t _r	Turn-on Rise Time		-	6.8	-	
t _{d(OFF)}	Turn-off Delay Time		-	25.2	-	
t _f	Turn-off Fall Time		-	6.4	-	
Gate Charge Characteristics ^e						
Q _g	Total Gate Charge	V _{DS} =20V, V _{GS} =10V, I _{DS} =12A	-	20	30	nC
Q _g	Total Gate Charge	V _{DS} =20V, V _{GS} =4.5V I _{SD} =12A	-	9.6	-	
Q _{gs}	Gate-Source Charge		-	2.5	-	
Q _{gd}	Gate-Drain Charge		-	3.8	-	
Q _{gth}	Threshold Gate Charge		-	1.5	-	

Note d : Pulse test ; pulse width $\leq 300\mu s$, duty cycle $\leq 2\%$.

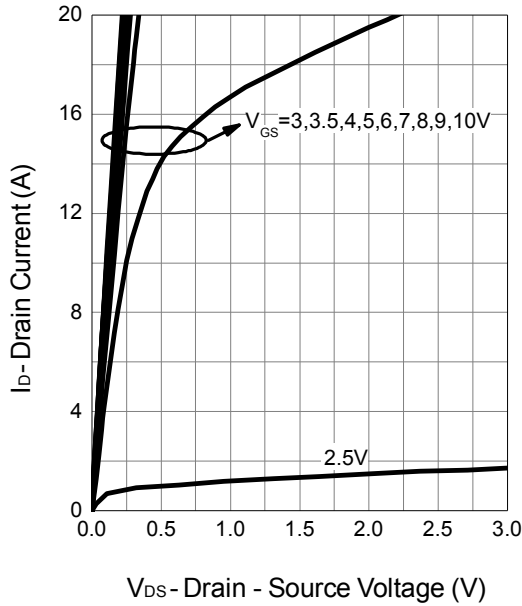
Note e : Guaranteed by design, not subject to production testing.

Typical Operating Characteristics

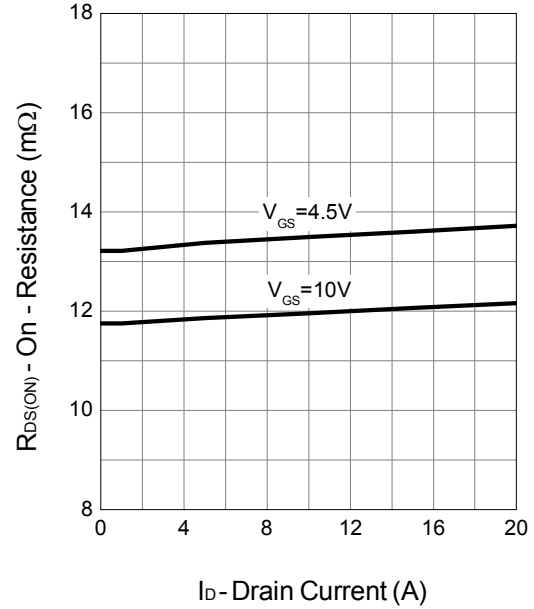


Typical Operating Characteristics (Cont.)

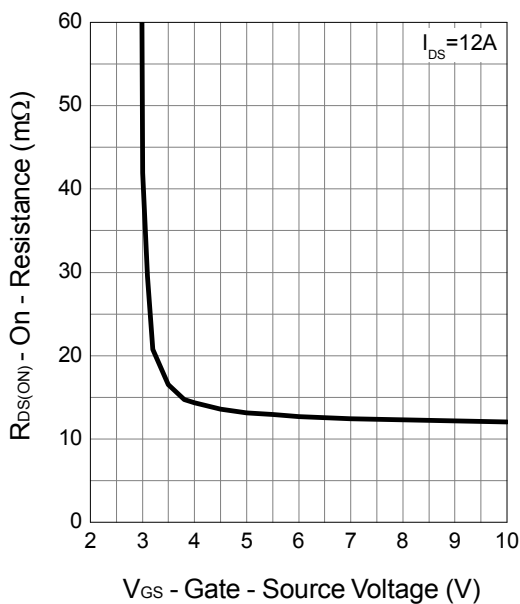
Output Characteristics



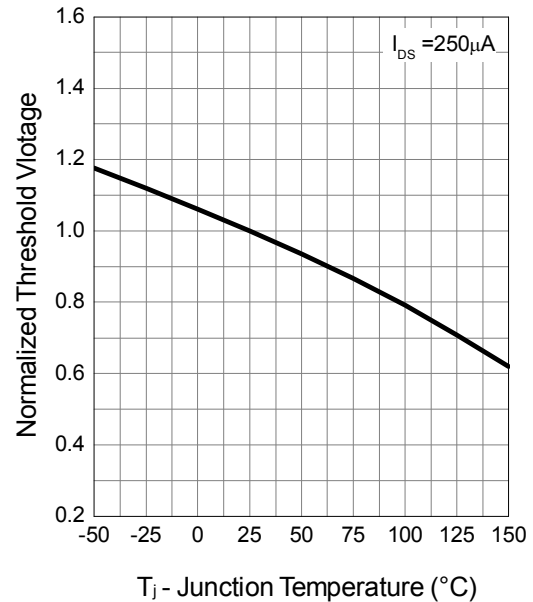
Drain-Source On Resistance



Gate-Source On Resistance

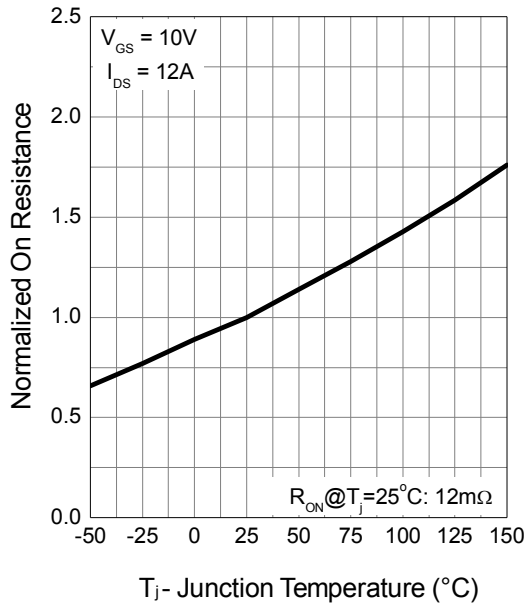


Gate Threshold Voltage

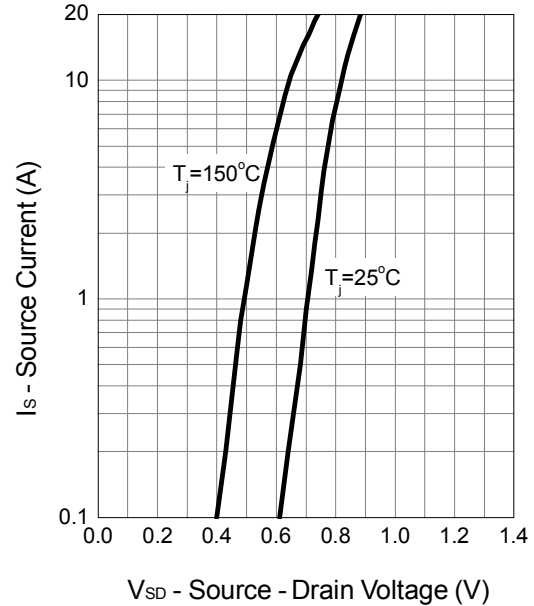


Typical Operating Characteristics (Cont.)

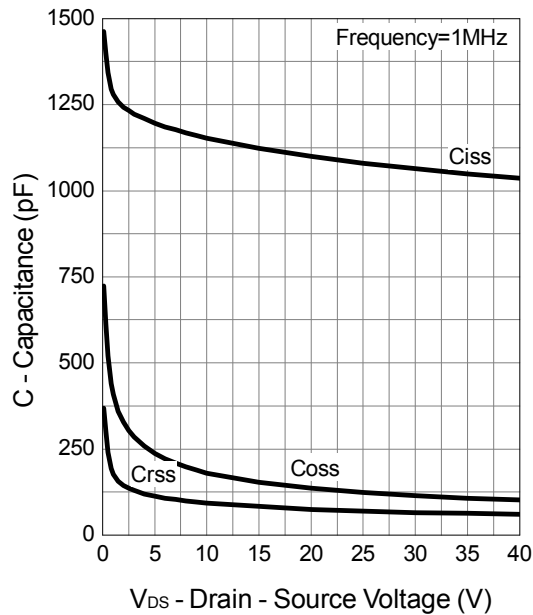
Drain-Source On Resistance



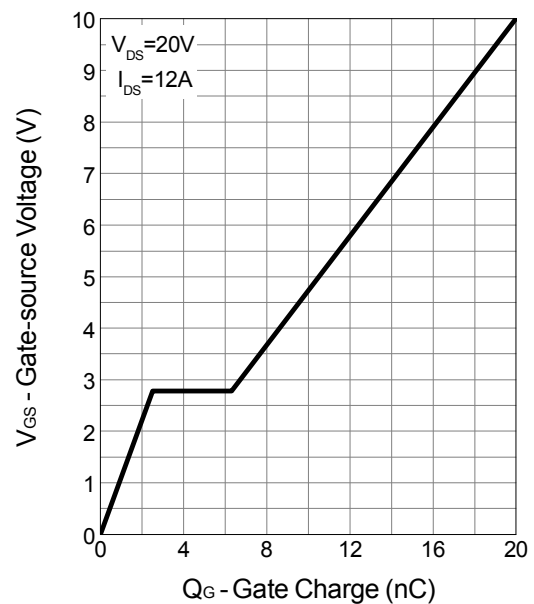
Source-Drain Diode Forward



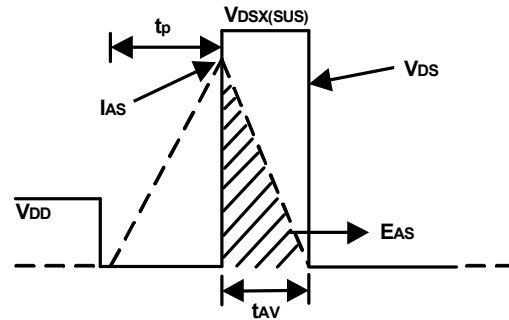
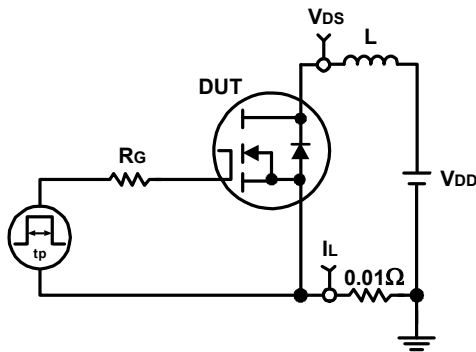
Capacitance



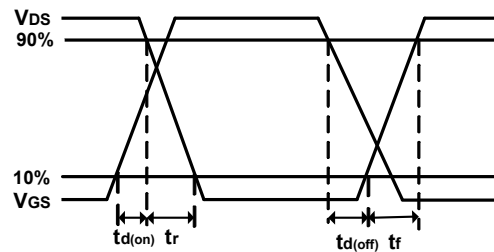
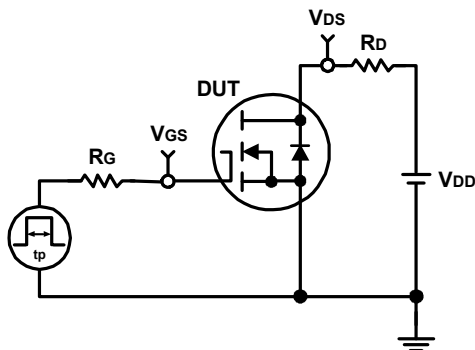
Gate Charge



Avalanche Test Circuit and Waveforms



Switching Time Test Circuit and Waveforms



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Figure 1 illustrates the temperature profile of a typical heat pump. The main graph plots Temperature (Y-axis) against Time (X-axis). The temperature starts at 25°C, rises to a peak T_p , and then falls. Key parameters and regions are labeled:

- T_L : Lower limit temperature.
- T_{smax} and T_{smin} : Supply temperature limits.
- Preheat Area**: The region between T_{smin} and T_{smax} .
- t_s : Time interval from the start of the preheat area to the peak.
- t : Total time interval from the start of the preheat area to the end of the peak.
- t_p : Time interval from the start of the peak to the end of the peak.
- Time 25°C to Peak**: The total time from 25°C to the peak.
- T_c : Critical temperature.
- $T_c - 5^\circ\text{C}$: Temperature at the peak.

Two inset graphs show the temperature profile at the Supplier and User conditions:

- Supplier**: $T_p \geq T_c$. The temperature profile shows a peak at T_p and a minimum at $T_c - 5^\circ\text{C}$. The time interval from the start of the preheat area to the peak is labeled t_p .
- User**: $T_p \leq T_c$. The temperature profile shows a peak at T_p and a minimum at $T_c - 5^\circ\text{C}$. The time interval from the start of the preheat area to the peak is labeled t_p .

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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