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FMOSCPE24N120-Q1-H

24A 1200V N-Channel Enhancement Mode Silicon Carbide Power MOSFET

Features

- $V_{DS} = 1200V$, $I_D = 24A$.
- $R_{DS(ON)} \leq 160m\Omega$, @ $V_{GS} = 20V$, $I_D = 10A$.
- Low on-resistance and high current density.
- Low capacitance for high frequency operation.
- Low impedance Kelvin source pin-out.
- Ultra-high avalanche ruggedness.
- Positive temperature coefficient device.
- Qualified to AEC-Q101 standards for high reliability.
- Lead-free parts meet RoHS requirements.
- Halogen-free (IEC61249-2-21).

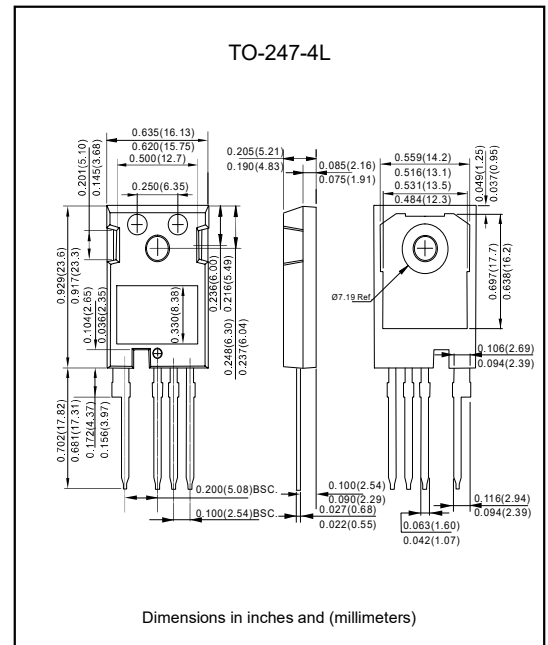
Applications

- Solar/ wind renewable energy, and power inverters.
- DC/DC converters, UPS, and PFC.
- Switching mode power supply, EV charging station, and motor drives.

Mechanical data

- Epoxy:UL94-V0 rated flame retardant.
- Case : Molded plastic, TO-247-4L.
- Terminals : Solder plated, solderable per MIL-STD-750, Method 2026.
- Mounting Position : Any.

Package outline

Maximum ratings (At $T_c=25^\circ C$ unless otherwise specified)

Parameter	Symbol	Ratings	Unit
Maximum drain to source voltage ($V_{GS}=0V$, $I_D=100\mu A$)	V_{DS}	1200	V
Recommend Gate-source voltage Static, recommended DC operating values	$V_{GS(OP)}$	-5 to +20	V
Maximum Gate-source voltage Transient operating limit (AC f > 1Hz, duty cycle < 1%)	$V_{GS(Max)}$	-10 to +25	V
Continuous drain current, @ $V_{GS}=20V$	I_D	($T_c=25^\circ C$) 24	A
		($T_c=110^\circ C$) 16.5	
Pulsed drain current, t_{PW} limitation per Fig.15	$I_{D(pulse)}$	65	A
Avalanche energy, single pulse ($V_{DD}=100V$, $I_D=7A$)	E_{AS}	625	mJ
Power dissipation ($T_c=25^\circ C$)	P_D	166	W
Mounting torque (M3 or 6-32 screw)	M_d	1	Nm
Typical thermal resistance, junction to case	$R_{\theta JC}$	0.9 (Typ.)	$^\circ C/W$
Soldering temperature	T_L	260	$^\circ C$
Junction temperature	T_J	+175	$^\circ C$
Storage temperature range	T_{STG}	-55 to +175	$^\circ C$

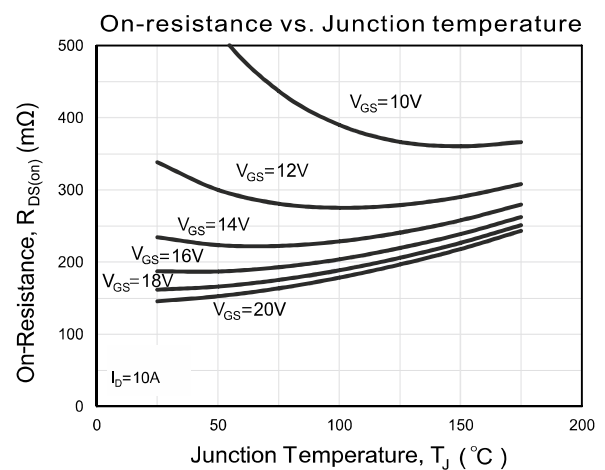
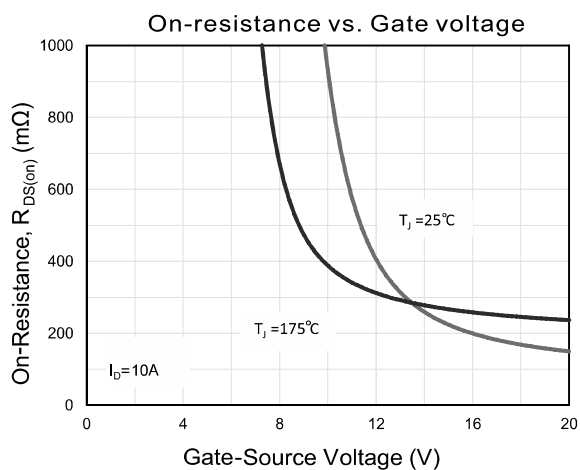
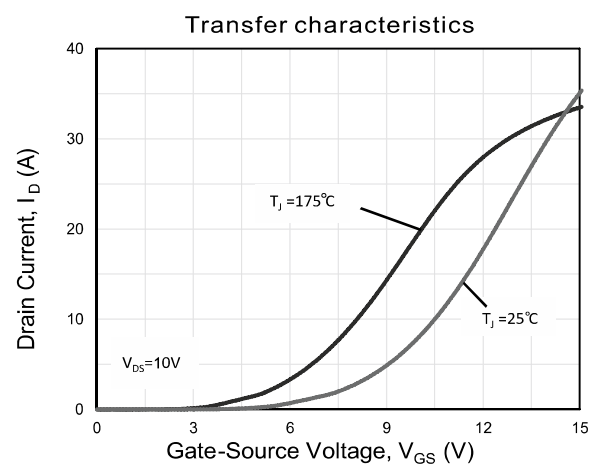
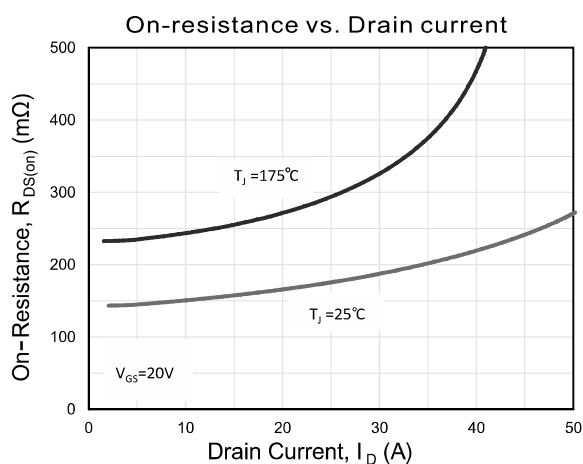
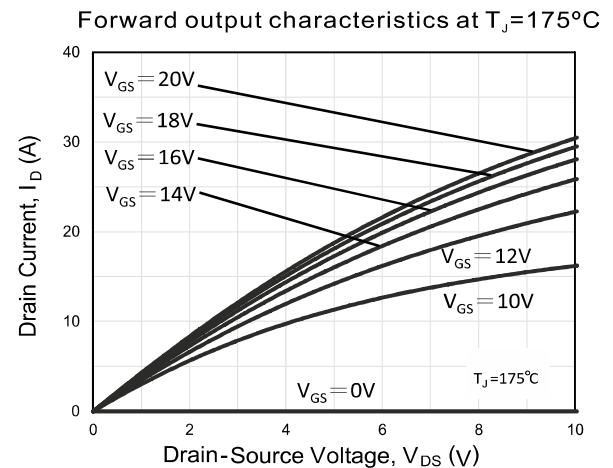
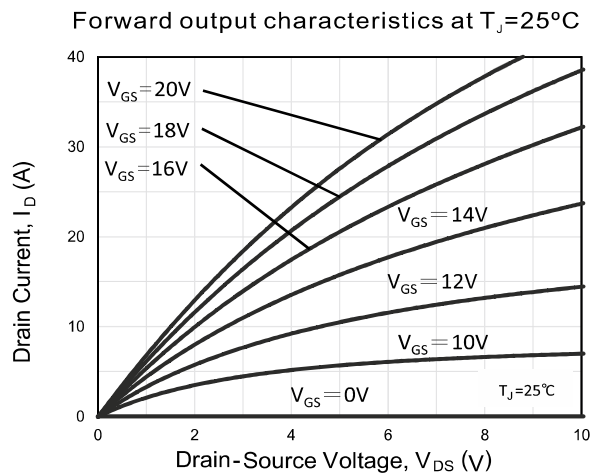
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Electrical characteristics (At $T_c=25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Off characteristics						
Drain-source breakdown voltage	BV _{DSS}	I _D =100μA, V _{GS} =0V	1200			V
Drain-source leakage current	I _{DSS}	V _{DS} =1200V, V _{GS} =0V		<1	50	μA
		V _{DS} =1200V, V _{GS} =0V, T _J =175°C		10	500	
Gate-source leakage current	I _{GSS}	V _{GS} =20V, V _{DS} =0V			250	nA
On characteristics						
Gate threshold voltage	V _{GS(TH)}	V _{DS} =10V, I _{DS} =10mA	1.5	2.95		V
Static drain-source on-state resistance	R _{DS(ON)}	V _{GS} =20V, I _{DS} =10A		120	160	mΩ
		V _{GS} =20V, I _{DS} =10A, T _J =175°C		200		
Transconductance	g _{FS}	V _{DS} =12.5V, I _{DS} =20A		6.2		S
Dynamic parameters						
Input capacitance	C _{iss}	V _{GS} =0V, V _{DS} =800V, f=1.0MHz, V _{AC} =25mV		1083		pF
Out capacitance	C _{oss}			56		
Reverse transfer capacitance	C _{rss}			8		
Effective output capacitance, energy related	C _{o(er)}	V _{GS} =0V, V _{DS} =0 to 800V		72		
Effective output capacitance, time related	C _{o(tr)}	I _D =const. , V _{GS} =0V, V _{DS} =0 to 800V		100		
C _{OSS} Stored energy	E _{OSS}	V _{GS} =0V, V _{DS} =800V, f=1.0MHz, V _{AC} =25mV		23		μJ
Turn-on switching energy	E _{ON}	V _{DS} =800V, V _{GS} =0/+20V, I _D =10A, R _{G(ext)} =2.7Ω		60.8		
Turn-off switching energy	E _{OFF}			20.7		
Internal gate resistance	R _{G(int)}	f=1.0MHz, V _{AC} =25mV		1.8		Ω
Gate to source charge	Q _{gs}	V _{DS} =800V, V _{GS} =-5V/+20V, I _D =10A		14.5		nC
Gate to drain charge	Q _{gd}			29		
Total gate charge	Q _g			67		
Gate plateau voltage	V _{pl}			8.2		V
Turn-on delay time	t _{d(on)}	V _{DS} =800V, V _{GS} =0/20V, I _D =8A, R _L =100Ω, R _{G(ext)} =10Ω		24		ns
Rise time	t _r			24		
Turn-off delay time	t _{d(off)}			34		
Fall time	t _f			33		
Built-in SiC diode characteristics						
Diode forward voltage	V _{SD}	I _{SD} =2.5A, V _{GS} =0V		3.4		V
Diode continuous current	I _S	V _{GS} =0V, T _C =25°C		25		A
Peak reverse recovery current	I _{rrm}	V _{GS} =0V, I _{SD} =10A, V _{DS} =400V, di/dt=300A/μs		2.25		A
Reverse recovery time	t _{rr}			53		ns
Reverse recovery charge	Q _{rr}			63		nC

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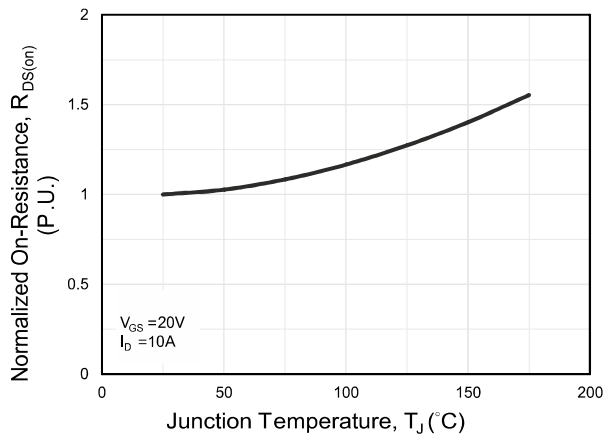
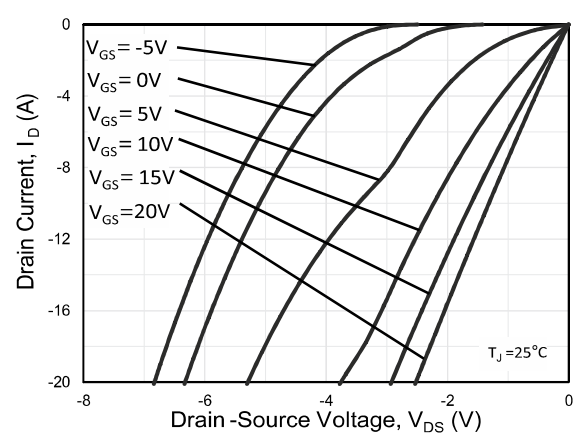
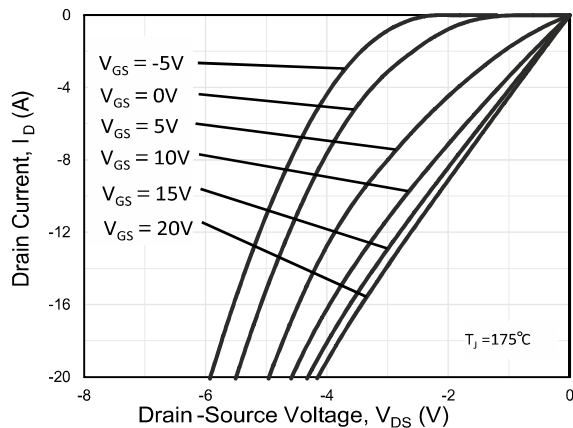
Rating and characteristic curves



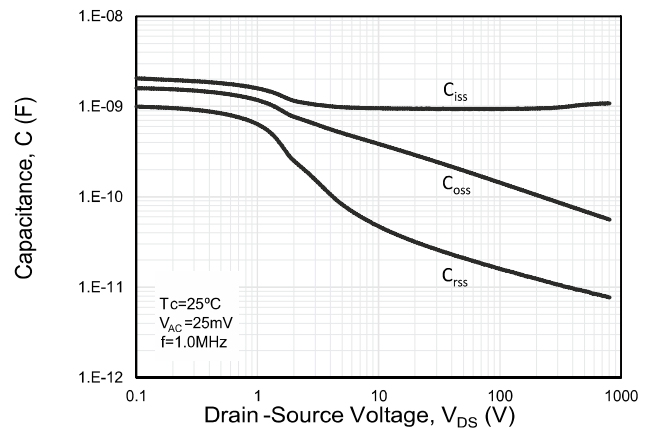
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Rating and characteristic curves

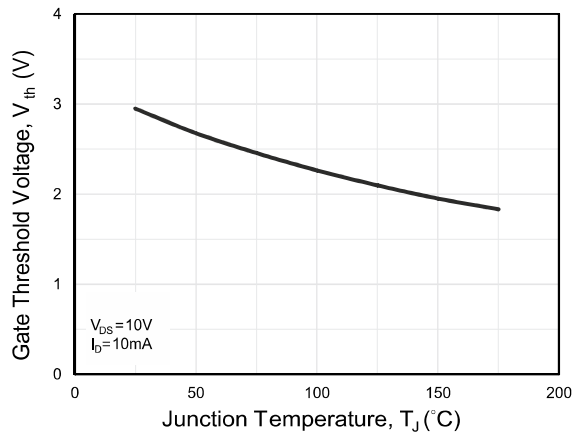
Normalized on-resistance vs. Junction temperature

Reverse output characteristics at $T_J = 25^\circ C$ Reverse output characteristics at $T_J = 175^\circ C$ 

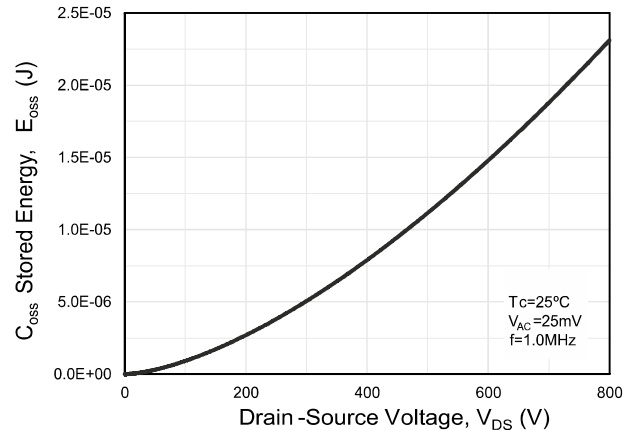
Capacitances vs. Drain-source voltage



Threshold voltage vs. Junction temperature

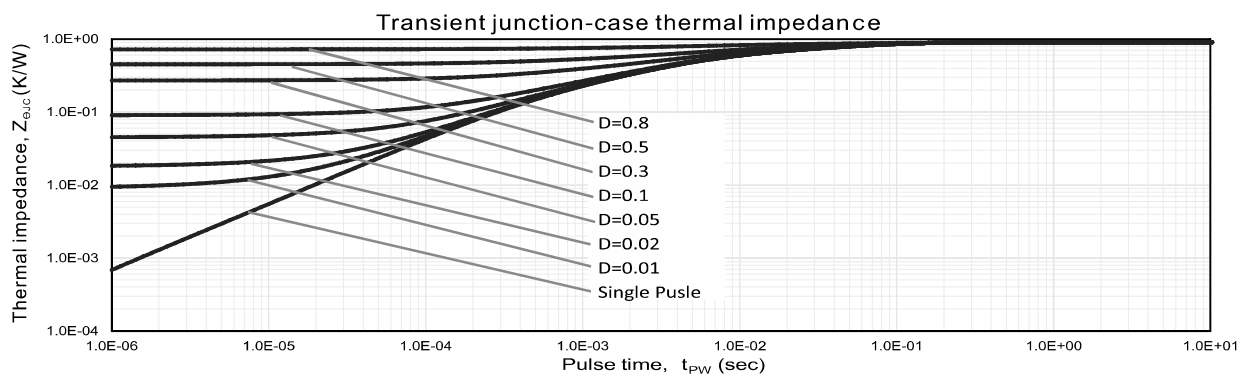
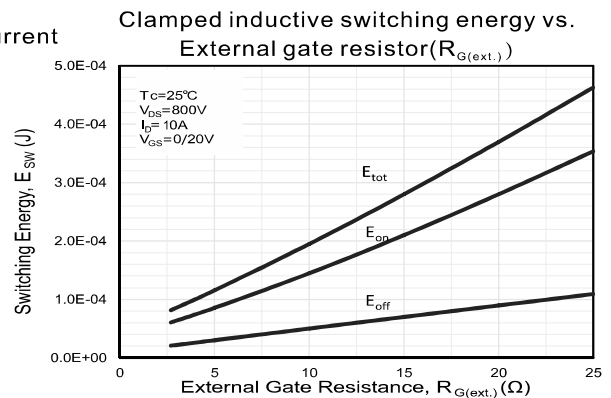
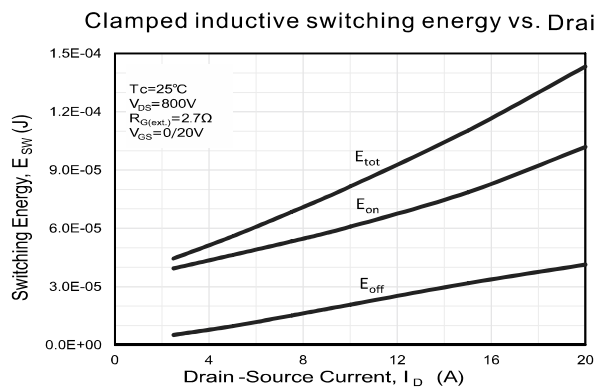
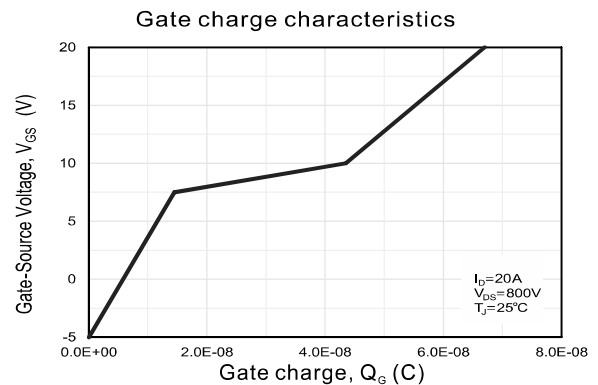
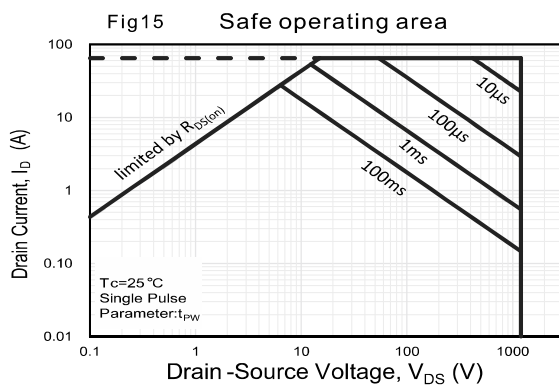
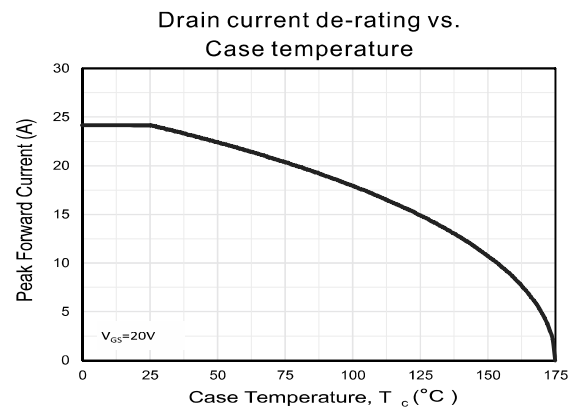
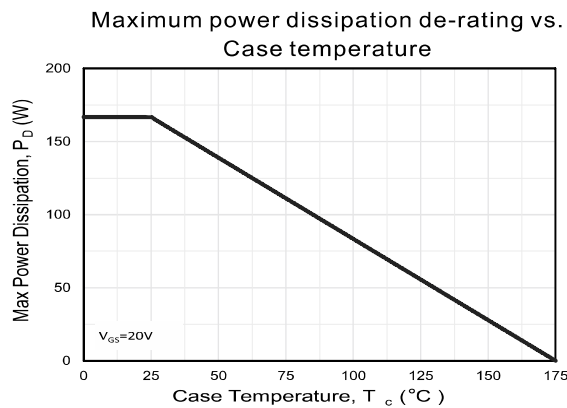


Output capacitor stored energy



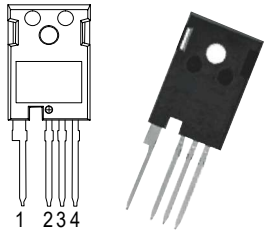
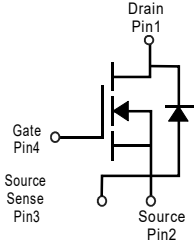
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Rating and characteristic curves



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Pinning information

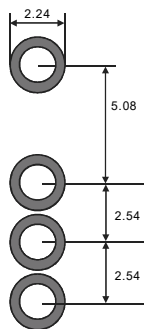
Pin	Simplified outline	Symbol
Pin 1 Drain Pin 2 Source Pin 3 Source sense Pin 4 Gate		

Marking

Type number	Marking code
FMOSCPE24N120-Q1-H	CPE24N120

Suggested solder pad layout

TO-247-4L

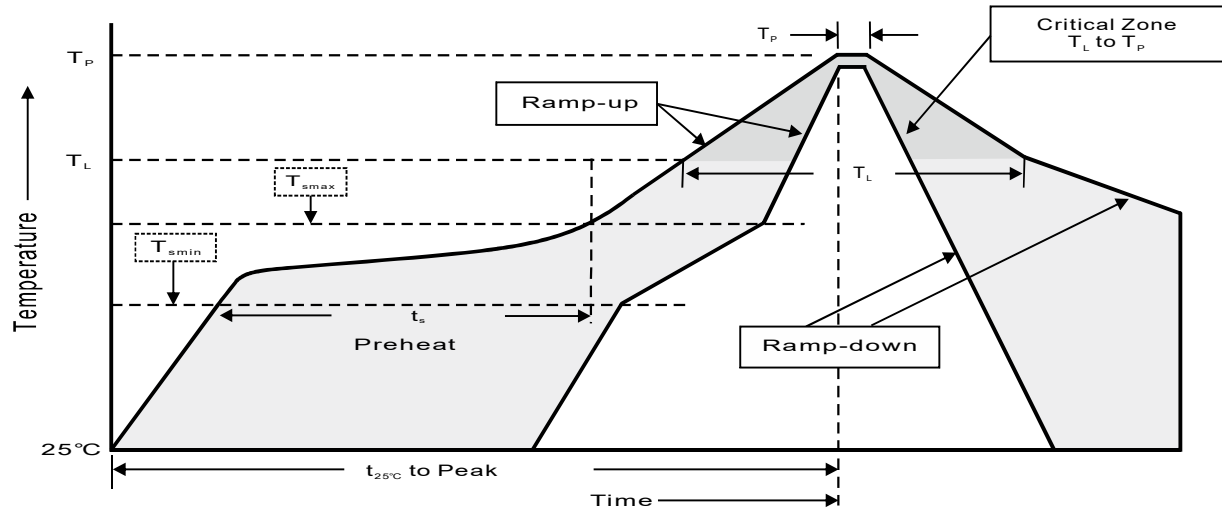


Dimensions in millimeters

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Suggested thermal profiles for soldering processes

- 1.Storage environment: Temperature = 5°C ~ 40°C Humidity = 55%, ±25%
- 2.Reflow soldering of surface-mount devices



3.Reflow soldering

Profile feature	Soldering condition
Average ramp-up rate (T_L to T_P)	< 3 °C/sec
Preheat - Temperature Min (T_{smin}) - Temperature Max (T_{smax}) - Time (Min to Max) (t_s)	150°C 200°C 60 ~ 120 sec
T_{smax} to T_L - Ramp-up rate	< 3 °C/sec
Time maintained above : - Temperature (T_L) - Time (T_L)	217°C 60 ~ 260 sec
Peak temperature (T_P)	255 °C -0/+5°C
Time with 5°C of actual peak temperature (T_P)	10 ~30 sec
Ramp-down rate	< 6 °C/sec
Time 25°C to peak temperature	< 6 minutes

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High reliability test capabilities

Item Test	Conditions	Reference
1. MSL Preconditioning	24hr bake@125°C+168hrs@85°C /85%RH+3xIR@260°C+1flux immersion+alcohol+DI H2O rinse	JESD22-A113
2. High Temperature Reverse Bias	$V_{DS}=V_{DS}^{*}80\%$ ($T_J=T_J^{max.}$)Test Duration:1000hrs	JESD22-A108
3. High Temperature Storage Life	$T_a=150^{\circ}\text{C}$ Test Duration:1000hrs	JESD22 A-103
4. Temperature Cycle	-55°C (15min) to 150°C (15min)Test Cycles:1000cycles	JESD22 A-104
5. Autoclave	$P=2\text{atm}$ $T_a=121^{\circ}\text{C}$ RH=100% Test Duration:96hrs	JESD22 A-102
6. Solderability	$245\pm 5^{\circ}\text{C}$ for 5sec	J-STD-002
7. Moisture Resistance	$T_a=85^{\circ}\text{C}$ /85% Relative humidity Test Duration:1000hrs	MIL-STD-750E METHOD 1021.2
8. Resistance To Solder Heat	$260\pm 5^{\circ}\text{C}$ for 10sec	JESD22 B-106
9. High Temperature High Humidity Reverse Bias	$T_a=85^{\circ}\text{C}$, 85%RH, $V_{DS}=80\%$ rated V_{DS} Test Duration: 1000hrs	JESD22-A101