

FMOSCPW123N65-Q1-H

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FMOSCPW123N65-Q1-H

123A 650V N-Channel Enhancement Mode Silicon Carbide Power MOSFET

Features

- $V_{DS} = 650V$, $I_D = 123A$.
- $R_{DS(ON)} \leq 26m\Omega$, @ $V_{GS} = 20V$, $I_D = 50A$.
- Low on-resistance and high current density.
- Low capacitance for high frequency operation.
- 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).

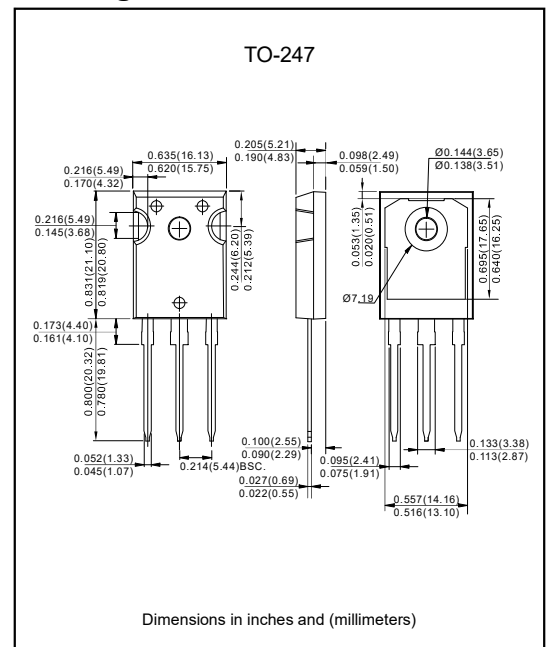
Applications

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

Mechanical data

- Epoxy: UL94-V0 rated flame retardant.
- Case : Molded plastic, TO-247.
- 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 ($V_{GS}=0V$, $I_G=100\mu A$)	V_{DS}	650	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, @ $V_{GS}=20V$ ($T_c=25^\circ C$) ($T_c=110^\circ C$)	I_D	123	A
		83	
Pulsed drain current, t_{PW} limitation per Fig. 15	$I_{D(pulse)}$	281	A
Avalanche energy, single pulse ($V_{DD}=100V$, $I_G=14A$)	E_{AS}	3.2	J
Power dissipation ($T_c=25^\circ C$)	P_D	428	W
Mounting torque (M3 or 6-32 screw)	M_d	1	Nm
Typical thermal resistance, junction to case	$R_{\theta JC}$	0.35 (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	$^\circ C$

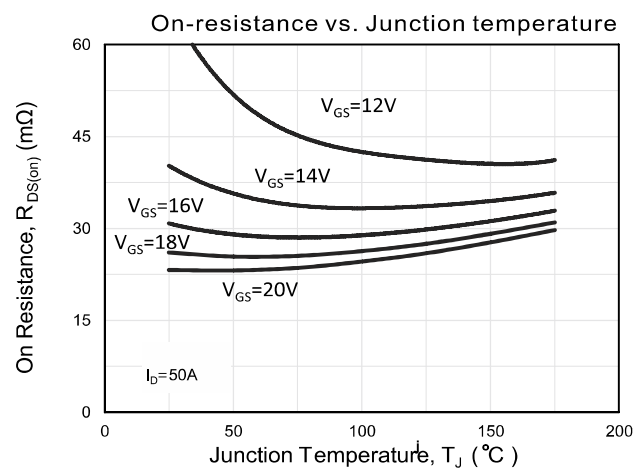
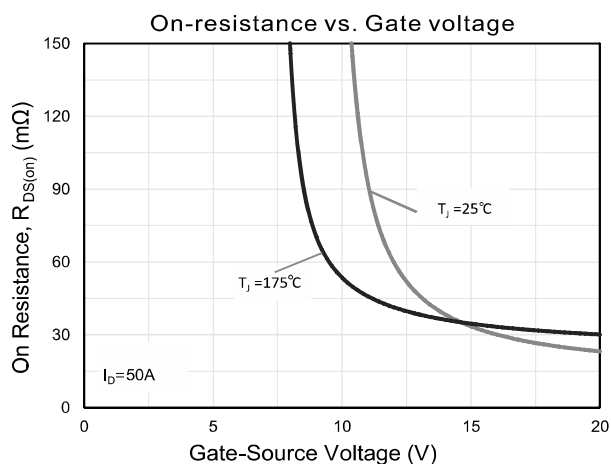
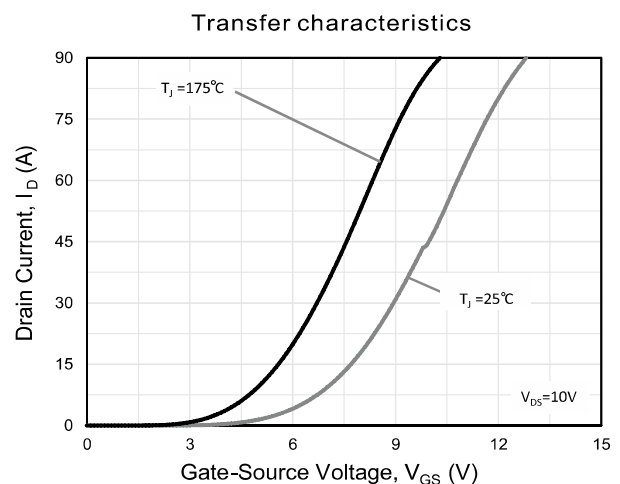
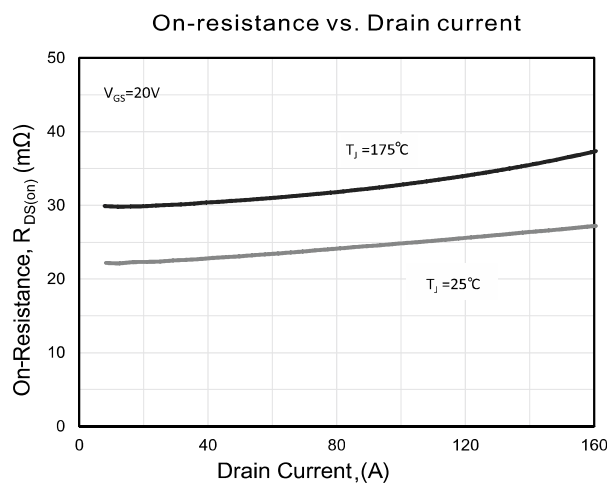
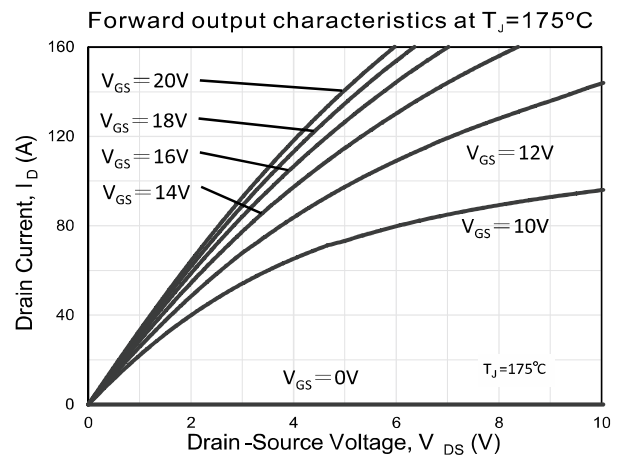
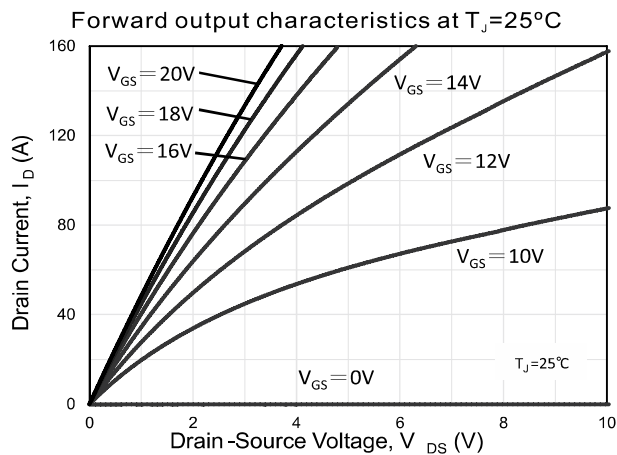
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Electrical characteristics (At $T_c=25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Off characteristics						
Drain-source breakdown voltage	BV _{DSS}	I _D =100μA, V _{GS} =0V	650			V
Drain-source leakage current	I _{DSS}	V _{DS} =650V, V _{GS} =0V		<1	100	μA
		V _{DS} =650V, 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} =50mA		2.2	3.0	V
Static drain-source on-state resistance	R _{DS(ON)}	V _{GS} =20V, I _{DS} =50A		20	26	mΩ
		V _{GS} =20V, I _{DS} =50A, T _J =175°C		30		
Transconductance	g _{FS}	V _{DS} =10V, I _{DS} =60A		18.2		S
Dynamic parameters						
Input capacitance	C _{iss}	V _{GS} =0V, V _{DS} =400V, f=1.0MHz, V _{AC} =25mV		5740		pF
Out capacitance	C _{oss}			359		
Reverse transfer capacitance	C _{rss}			47		
Effective output capacitance, energy related	C _{o(er)}	V _{GS} =0V, V _{DS} =0 to 400V		445		
Effective output capacitance, time related	C _{o(tr)}	I _D =const. , V _{GS} =0V, V _{DS} =0 to 400V		616		
C _{OSS} Stored energy	E _{OSS}	V _{GS} =0V, V _{DS} =400V, f=1.0MHz, V _{AC} =25mV		34		μJ
Turn-on switching energy	E _{ON}	V _{DS} =400V, V _{GS} =0/+20V, I _D =50A, L=100μH		457		
Turn-off switching energy	E _{OFF}	R _{G(ext)} =2.7Ω, FWD=body diode of MOSFET		237		
Internal gate resistance	R _{G(int)}	f=1.0MHz, V _{AC} =25mV		0.6		Ω
Gate to source charge	Q _{gs}	V _{DS} =400V, V _{GS} =-5V/+20V, I _D =50A		80		nC
Gate to drain charge	Q _{gd}			75		
Total gate charge	Q _g			287		
Gate plateau voltage	V _{pl}			7.6		V
Short- circuit withstand time	t _{sc}	V _{GS} =0/15V , V _{DS} =400V, R _G =100Ω		<18		μs
Turn-on delay time	t _{d(on)}	V _{DS} =400V, V _{GS} =-4V/+20V, I _D =35A, R _L =11.4Ω, R _{G(ext)} =2.7Ω		29		ns
Rise time	t _r			51		
Turn-off delay time	t _{d(off)}			30		
Fall time	t _f			16		
Built-in SiC diode characteristics						
Diode forward voltage	V _{SD}	I _{SD} =10A, V _{GS} =0V		2.9		V
Diode continuous current	I _s	V _{GS} =0V, T _c =25°C		62		A
Peak reverse recovery current	I _{rrm}	V _{GS} =0V, I _{SD} =30A, V _{DS} =400V, di/dt=300A/μs		12.8		A
Reverse recovery time	t _{rr}			262		ns
Reverse recovery charge	Q _{rr}			319		nC

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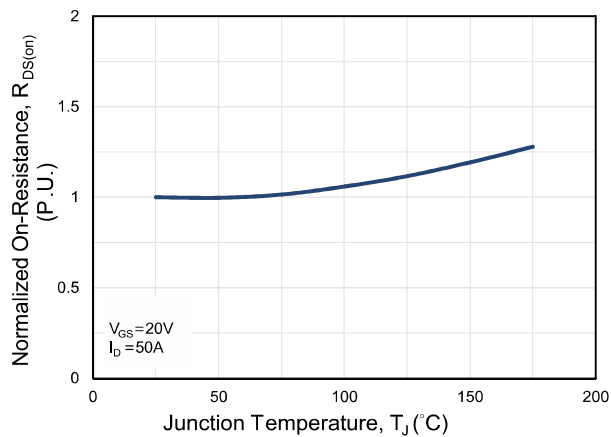
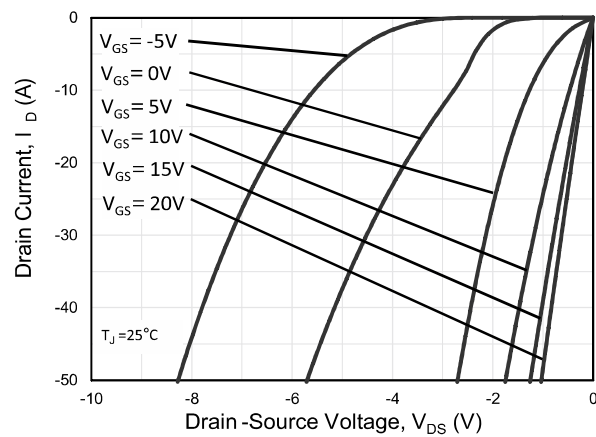
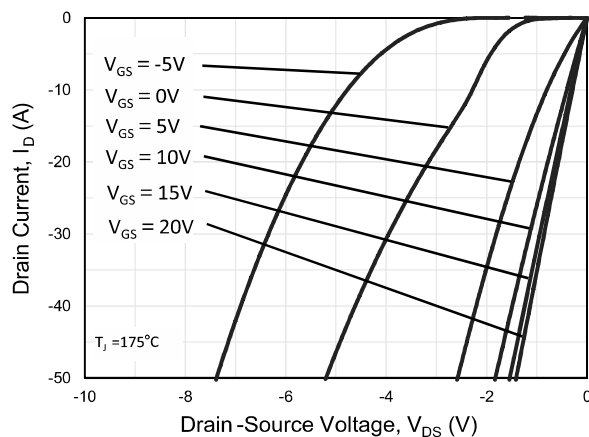
Rating and characteristic curves



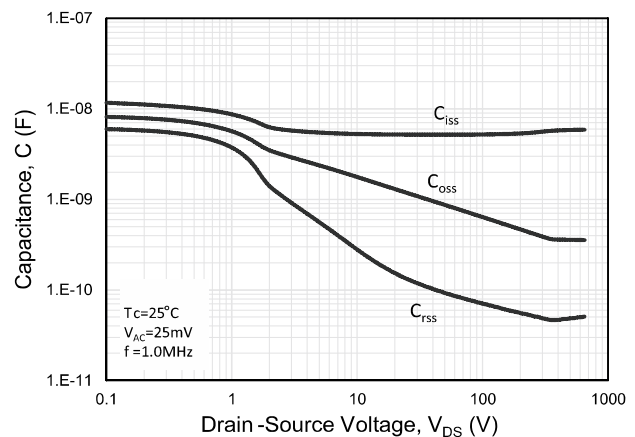
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Rating and characteristic curves

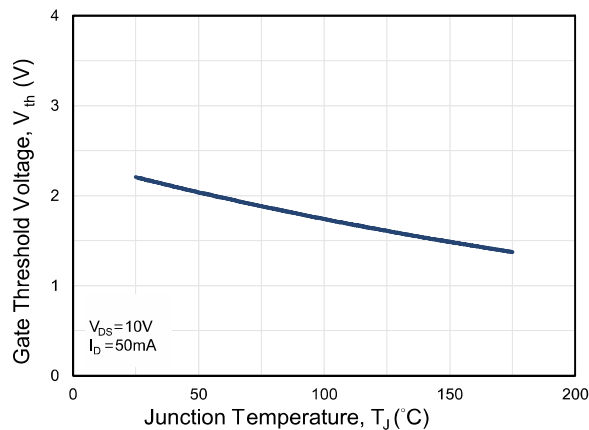
Normalized on-resistance vs. Junction temperature

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

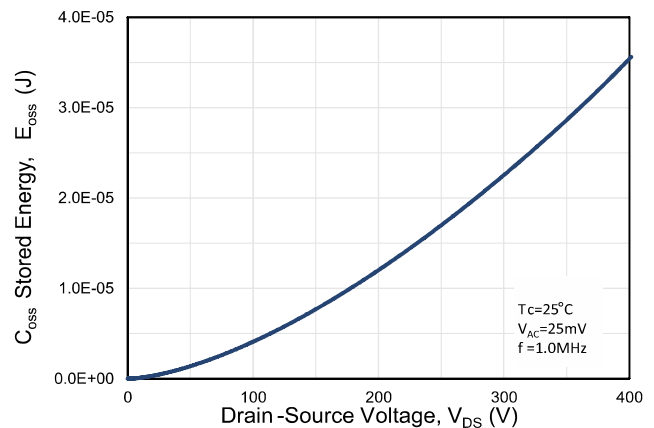
Capacitances vs. Drain-source voltage



Threshold voltage vs. Junction temperature

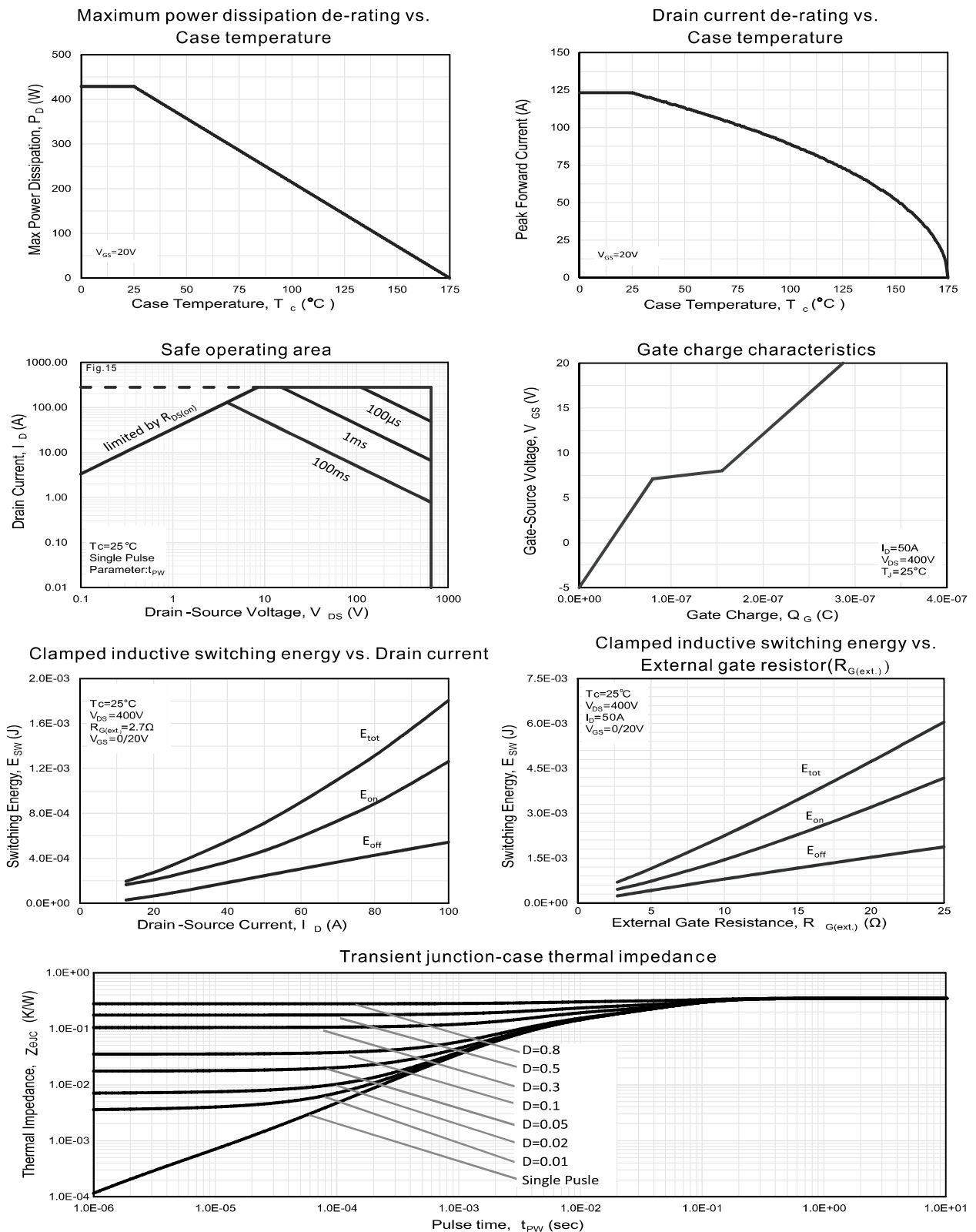


Output capacitor stored energy



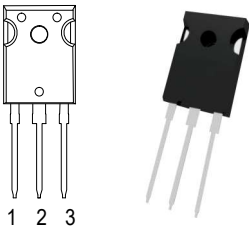
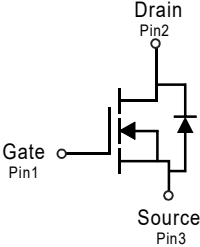
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Rating and characteristic curves



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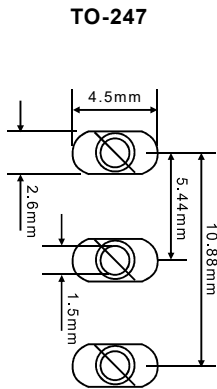
Pinning information

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

Marking

Type number	Marking code
FMOSCPW123N65-Q1-H	CPW123N65

Suggested solder pad layout



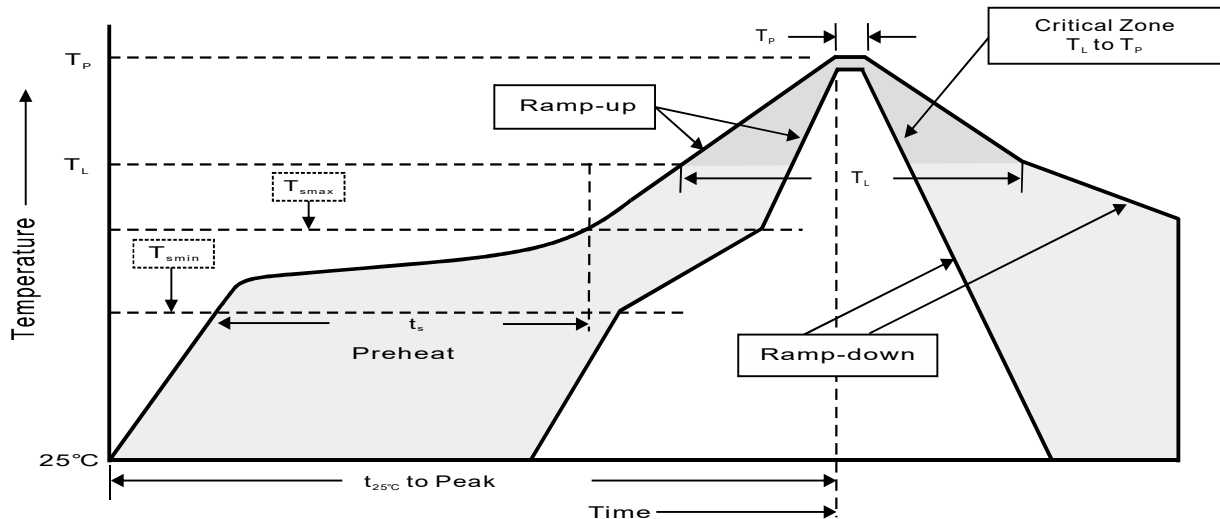
Dimensions in millimeters

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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	Conditions	Reference
1. MSL Preconditioning	24hr bake @125°C+168hrs @85°C / 85%RH + 3 x I _{DSS} @260°C + 1flux Immersion + Alcohol + DI H2O rinse	JESD22-A113
2. High Temperature Reverse Bias	V _{DS} = V _{DS} x 80% (T _J = T _J max.) Test Duration : 1000hrs	JESD22-A108
3. High Temperature Storage Life	T _A = 150°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 = 2Atm T _A = 121°C RH = 100% Test Duration : 96hrs	JESD22 A-102
6. Solder ability	245 ± 5°C for 5sec	J-STD-002
7. Moisture Resistance	T _A = 85°C / 85% Relative Humidity Test Duration : 1000hrs	MIL-STD-750E METHOD 1021.2
8. Resistance To Solder Heat	260±5°C for 10sec	JESD22 B-106
9. High Temperature High Humidity Reverse Bias	T _A = 85°C, 85% RH, V _{DS} = 80% rated V _{DS} Test Duration : 1000hrs	JESD22-A101