FMOSCPW54N120-Q1-H

List

FMOSCPW54N120-Q1-H

54A 1200V N-Channel Silicon Carbide Enhancement Mode Power MOSFET

Features

- V_{DS}=1200V, I_D=54A.
- $R_{DS(ON)}$≤ 56mΩ, @ V_{GS}=18V, I_D=20A.
- Optimized on-resistance with rapid switching behavior.
- Compatible with standard gate drivers.
- High avalanche endurance capability.
- Qualified to AEC-Q101 standards for high reliability.
- Lead-free parts meet RoHS requirements.
- Halogen-free (IEC61249-2-21).

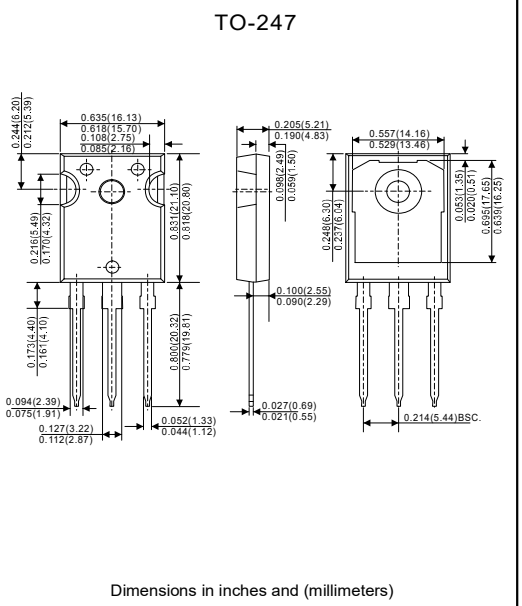
Applications

- Switching mode power supply, PFC and DC/DC converter.
- EV charging station, UPS and renewable energy.
- Power inverter and motor driver.

Mechanical data

- Epoxy : UL94-V0 rated flame retardant.
- Case : Molded plastic, TO-247.
- Terminals : Solder plated, solderable per MIL-STD-750, Method 2026.
- Weight : Approximated 6.15g.

Package outline



Dimensions in inches and (millimeters)

Maximum ratings (At T_J=25°C unless otherwise specified)

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Minimum drain to source voltage	V_{GS}=0V, I_D=5mA	V_{DS}	1200			V
Operate gate to source voltage (Recommended operating values)		$V_{GS\_Op.}$	-8~0		15~18	V
Transient gate to source voltage (Transient operating limit)	AC f >1Hz, pulse width< 100ns	$V_{GS\_Tran.}$	-10		22	V
Continuous drain current	V_{GS}=18V, T_C=25ºC	I_D			54	A
	V_{GS}=18V, T_C=100ºC				40	
Pulsed drain current	per fig.13	I_{DM}			152	A
Continuous body diode current	V_{GS}=0V, T_C=25ºC	I_S			45	A
Avalanche energy, single pulse	L=25mH	E_{AS}			800	mJ
Power dissipation	T_C=25ºC	P_D			278	W
Thermal resistance, junction to ambient	Device on PCB, with 6cm² of cooling area	$R_{\theta JA}$		40		°C/W
Thermal resistance, junction to case		$R_{\theta JC}$		0.54		°C/W
Soldering temperature		T_L			260	°C
Junction temperature range		T_J	-55		+175	°C
Storage temperature range		T_{STG}	-55		+175	°C

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Electrical characteristics (At T_J=25°C unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Off characteristics						
Drain-source breakdown voltage	BV_{DSS}	I_D=5mA, V_{GS}=0V, T_J=25ºC	1200			V
		I_D=5mA, V_{GS}=0V, T_J=175ºC		1200		
Drain-source leakage current	I_{DSS}	V_{DS}=1200V, V_{GS}=0V		2	500	μA
Gate-source leakage current	I_{GSS}	V_{GS}=18V, V_{DS}=0V			100	nA
On characteristics						
Gate threshold voltage	$V_{GS(TH)}$	V_{DS}=V_{GS}, I_D=40mA		2.2		V
Static drain-source on-state resistance	$R_{DS(ON)}$	V_{GS}=18V, I_D=20A, T_J=25ºC		40	56	mΩ
		V_{GS}=18V, I_D=20A, T_J=175ºC		68		
Dynamic parameters						
Input capacitance	C_{iss}	V_{GS}=0V, V_{DS}=800V, f=250kHz,V_{AC}=25mV		3129		pF
Out capacitance	C_{oss}			95		
Reverse capacitance	C_{rss}			13		
Effective output capacitance, energy related (Note1)	$C_{o(er)}$			123		
Effective output capacitance, time related (Note2)	$C_{o(tr)}$			175		
C_{OSS} Stored energy	E_{OSS}	V_{GS}=0V, V_{DS}=800V, f=250kHz,V_{AC}=25mV		39		μJ
Output capacitive charge	Q_{oss}	V_{GS}=0V, V_{DS}=800V, f=250kHz,V_{AC}=25mV		140		nC
Gate-source charge	Q_{GS}	V_{GS}=0V/15V, V_{DS}=800V, I_D=40A		22		nC
Gate-drain charge	Q_{GD}			52		
Total gate charge	Q_G			117		
Internal gate resistance	$R_{G\_int.}$	f=1.0MHz,V_{AC}=25mV		2.4		Ω
Inductive load						
Turn on delay time	$t_{d(on)}$	V_{GS}=-3/+15V, V_{DS}=800V, I_D=35A, $R_{G(ext.)}$=2.7Ω, External SiC diode as an FWD		47		ns
Rise time	t_r			52		
Turn off delay time	$t_{d(off)}$			28		
Fall time	t_f			11		
Turn on switching erergy	E_{on}			739		μJ
Turn off switching energy	E_{off}			61		

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Electrical characteristics (At T_J=25°C unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Resistive load						
Turn on delay time	$t_{d(on)}$	V_{GS}=-3/+15V, V_{DS}=800V, I_D=26A, $R_{G\_on(ext.)}$=2.7Ω, $R_{G\_off(ext.)}$=1Ω, R_L=30Ω		22		nS
Rise time	t_r			29		
Turn off delay time	$t_{d(off)}$			32		
Fall time	t_f			11		
Body diode characteristics						
Diode forward voltage	V_{SD}	I_S=15A, V_{GS}=0V, T_J=25ºC		3.1		V
		I_S=15A, V_{GS}=0V, T_J=175ºC		3.0		
Peak reverse recovery current	I_{rrm}	I_S=30A, V_{GS}=0V, V_{DS}=400V, di/dt=300A/μs, *Q_{rr} herein excluded the Q_{oss} value.		3.0		A
Reverse recovery charge	Q_{rr}			98		nC
Reverse recovery time	t_{rr}			60		ns

Note: 1.$C_{O(er)}$ is a fixed capacitance that gives the same stored energy as C_{OSS} while V_{DS} is rising from 0 to 800V.

2.$C_{O(tr)}$ is a fixed capacitance that gives the same charging time as C_{OSS} while V_{DS} is rising from 0 to 800V.

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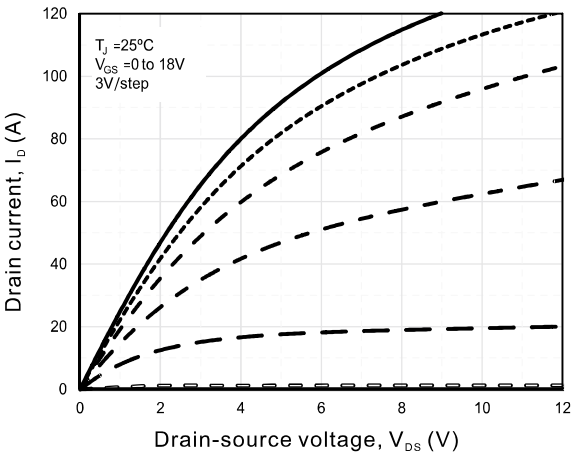
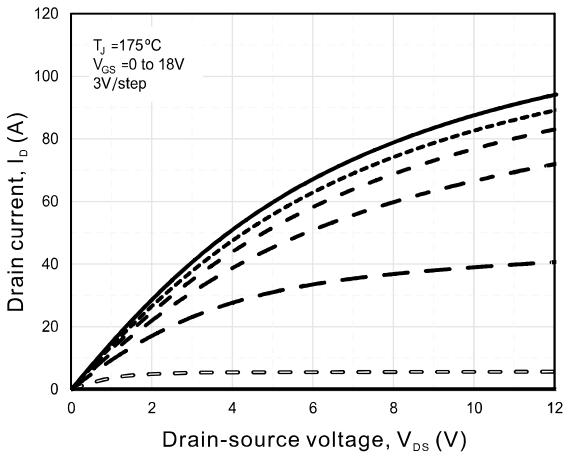
Rating and characteristic curves

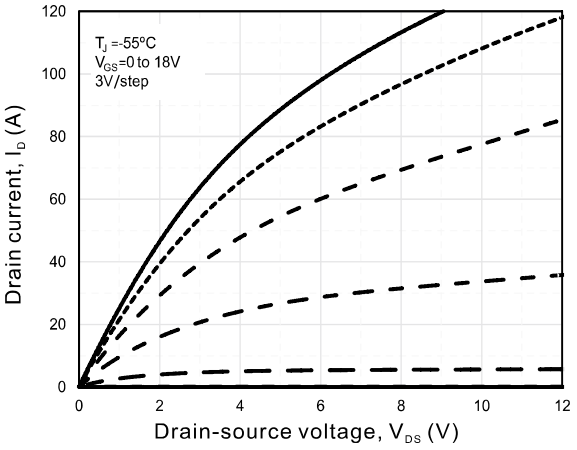
Typical output characteristics at T_J=25ºC



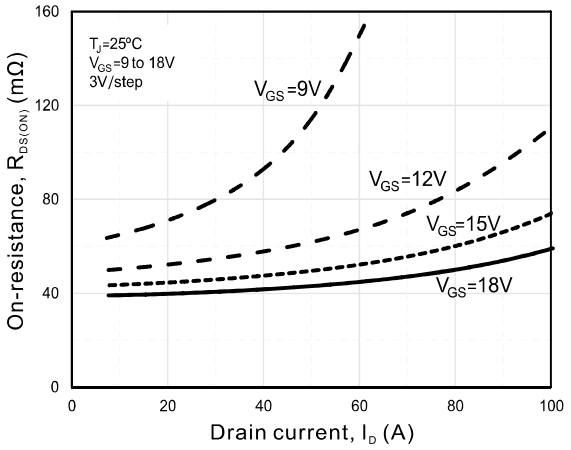
Typical output characteristics at T_J=175ºC



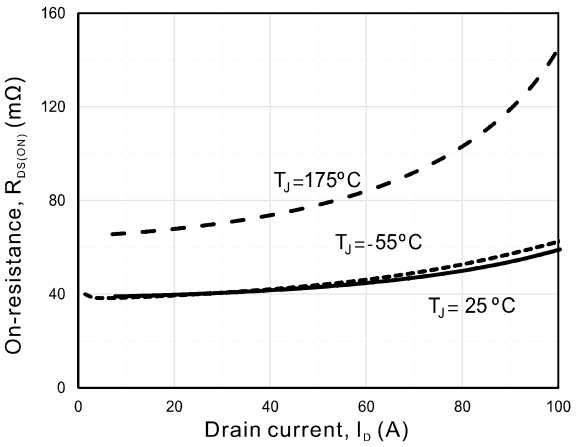
Typical output characteristics at T_J=-55ºC



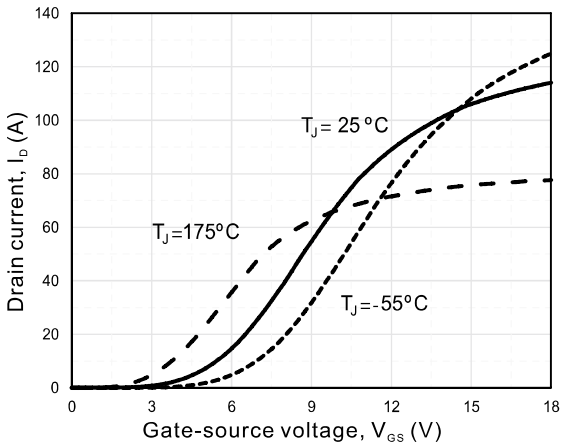
Typical on-resistance vs. Drain current with various V_{GS}



Typical on-resistance vs. I_D with various T_J, V_{GS}=18V



Typical drain current vs. V_{GS} with various T_J, V_{GS}=10V



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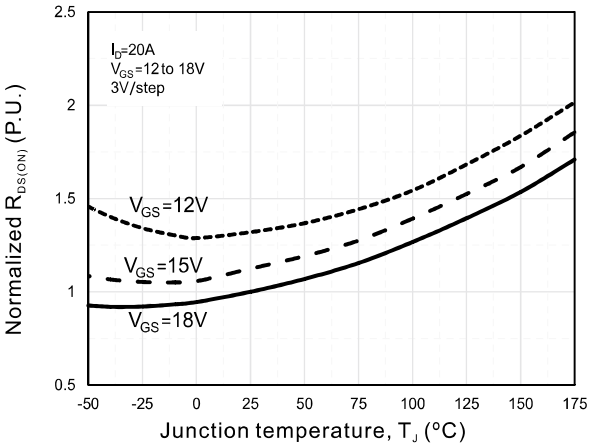
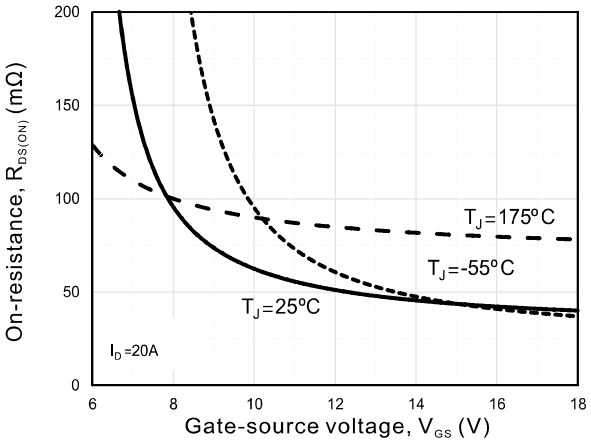
Rating and characteristic curves

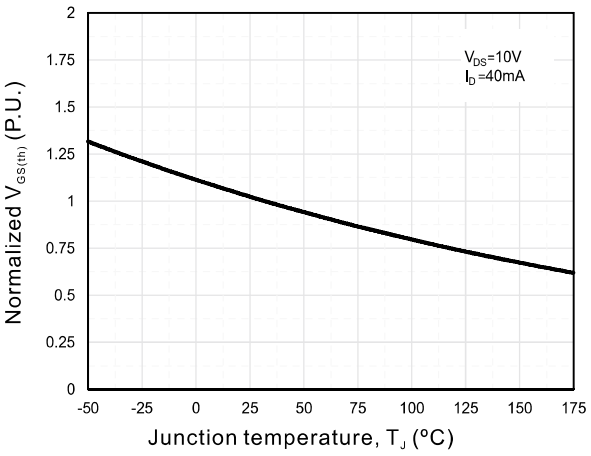
Normalized $R_{DS(ON)}$ vs. T_J with various V_{GS}



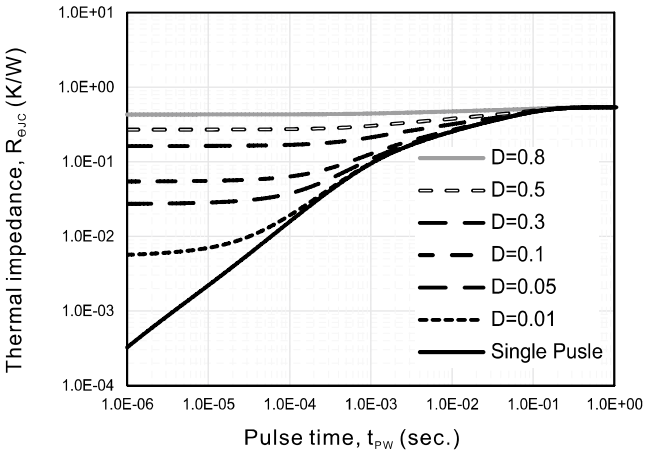
Typical $R_{DS(ON)}$ vs. V_{GS} with various T_J



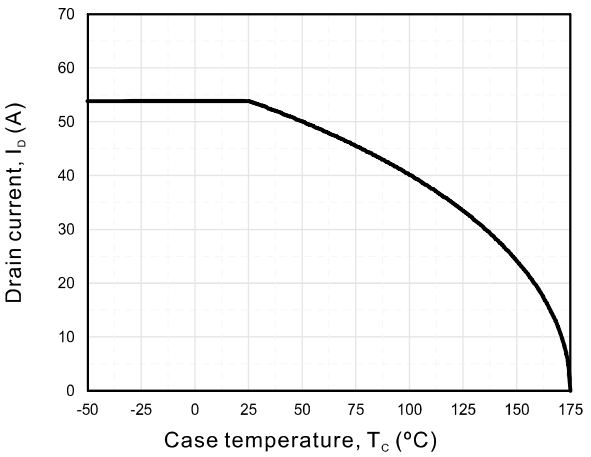
Normalized $V_{GS(th)}$ vs. Junction temperature



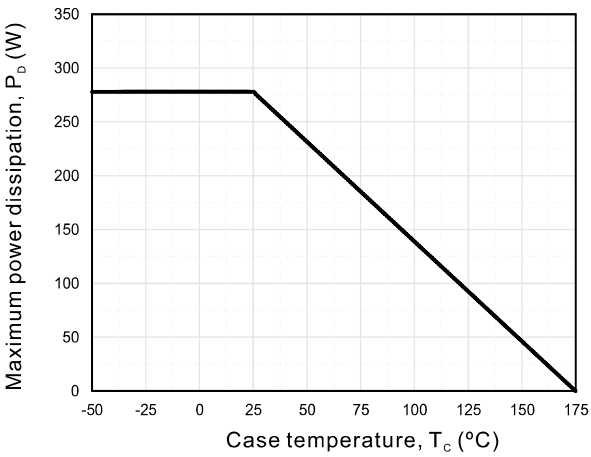
Typical transient thermal impedance $R_{\theta JC}$



Continuous I_D de-rating at V_{GS}=18V, T_J≤175°C



Power dissipation at V_{GS}=18V, T_J≤175°C



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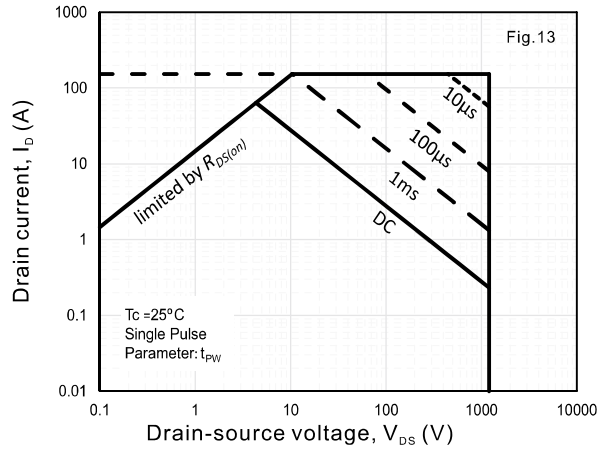
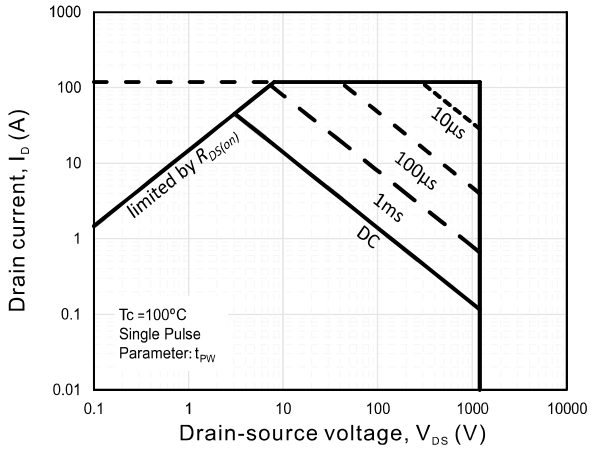
Rating and characteristic curves

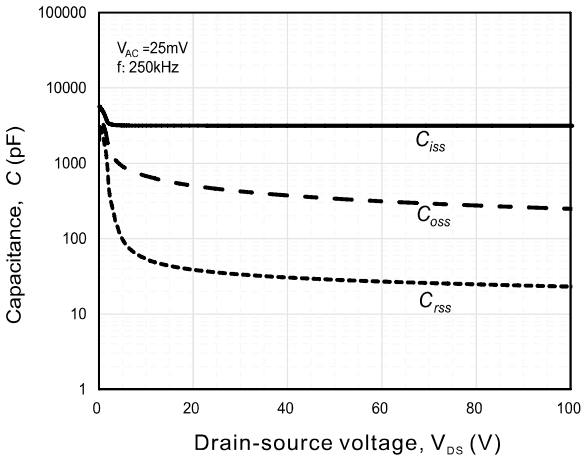
Safe operating area at T_C=25ºC



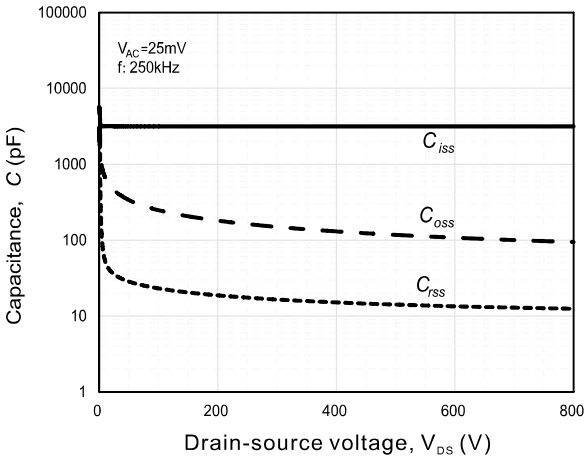
Safe operating area at T_C=100ºC



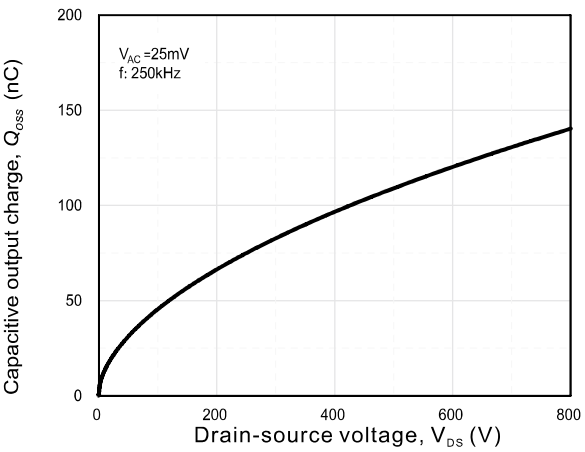
Typical capacitance vs.V_{DS} at f_{sw}=250kHz, V_{DS} ≤100V



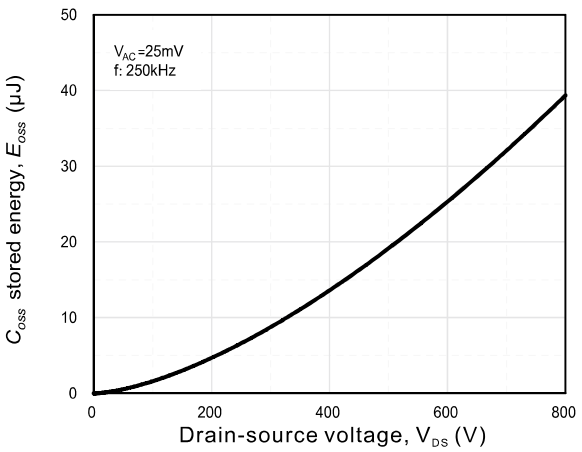
Typical capacitance vs.V_{DS} at f_{sw}=250kHz, V_{DS} ≤800V



Typical capacitance output charge at f_{sw}=250kHz



Typical C_{oss} stored energy at f_{sw}=250kHz



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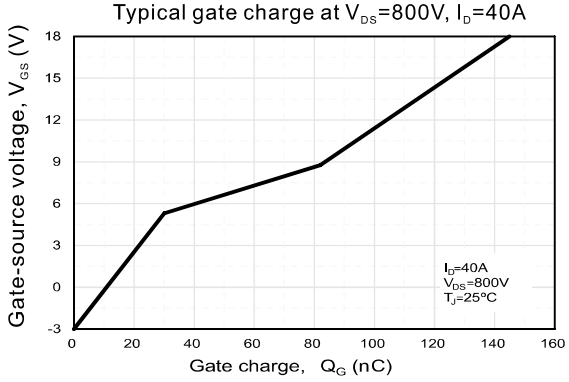
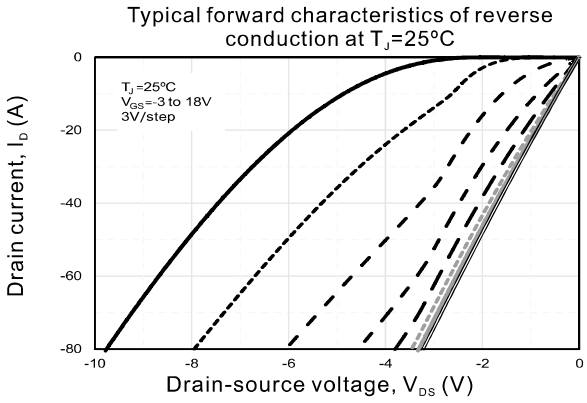
Rating and characteristic curves

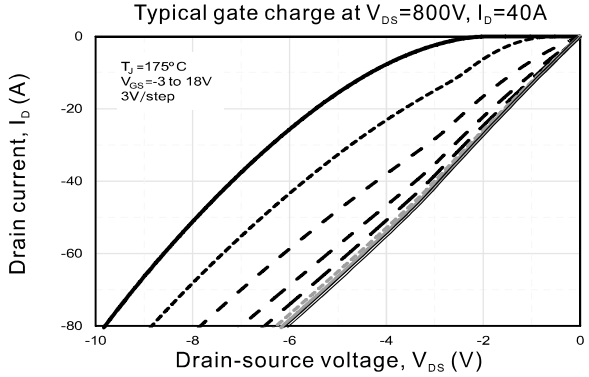
Typical gate charge at V_{DS}=800V, I_D=40A



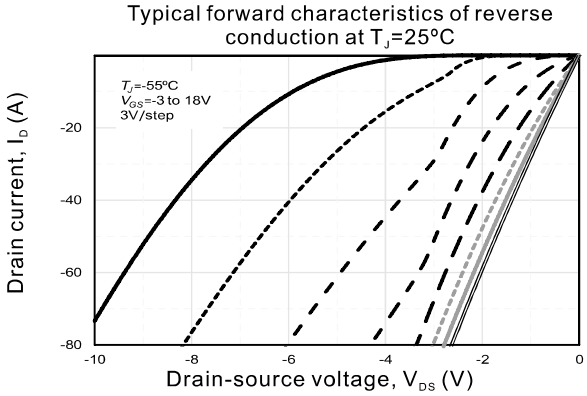
Typical forward characteristics of reverse conduction at T_J=25°C



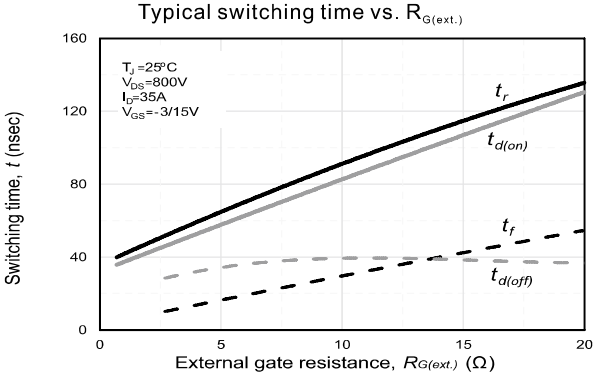
Typical gate charge at V_{DS}=800V, I_D=40A



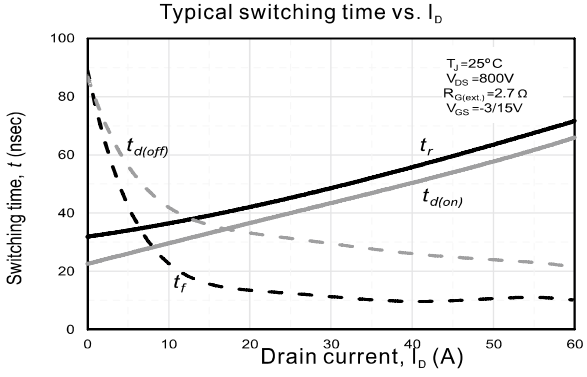
Typical forward characteristics of reverse conduction at T_J=25°C



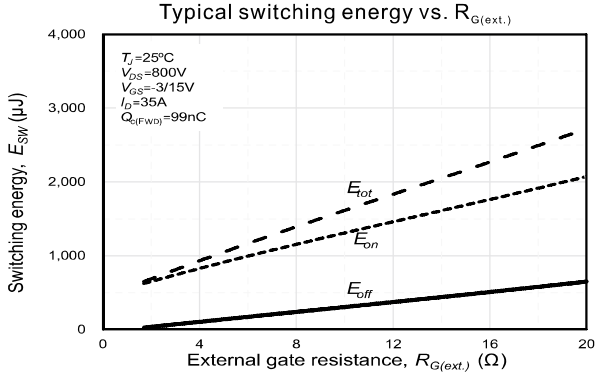
Typical switching time vs. $R_{G(ext.)}$



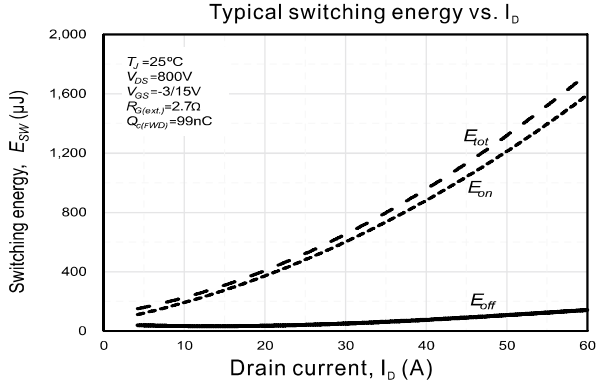
Typical switching time vs. I_D



Typical switching energy vs. $R_{G(ext.)}$



Typical switching energy vs. I_D



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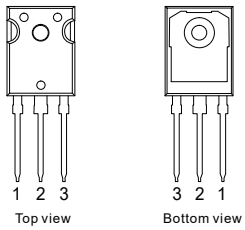
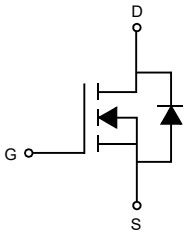
Pinning information

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

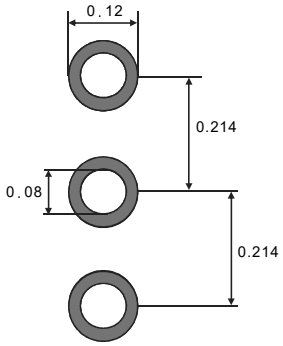
Marking

Type number	Marking code
FMOSCPW54N120-Q1-H	FMS CPW54N120 XXXYYWW

*XXX: Lot ID or other information.
YYWW: Wafer lot code.
YY: Year
WW: Week

Suggested solder pad layout

TO-247

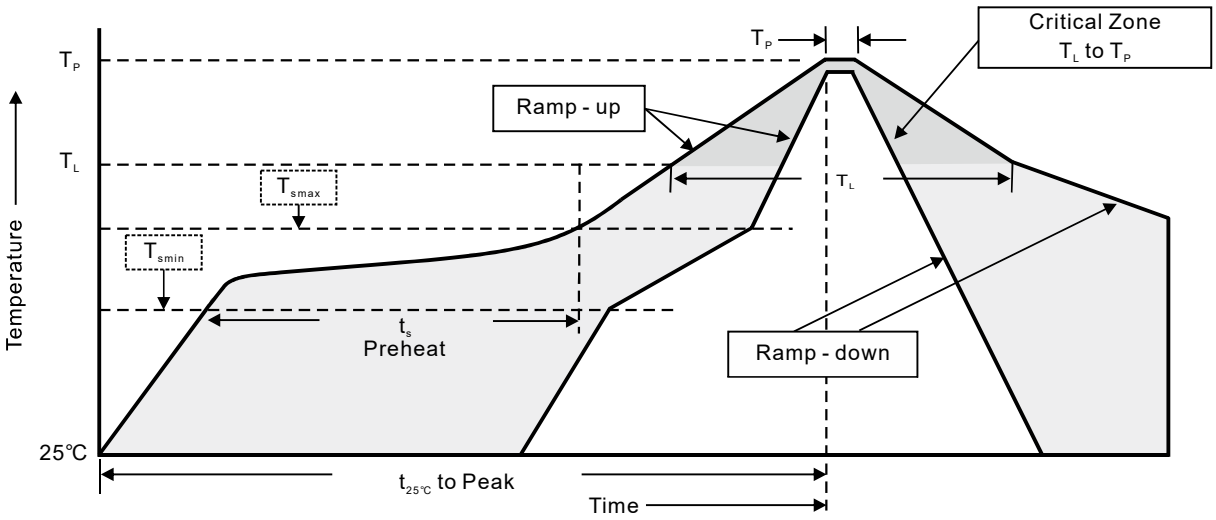


Dimensions in millimeters

FMOSCPW54N120-Q1-H

Suggested thermal profiles for soldering processes

1. Storage environment : Temperature = 5℃ ~ 40℃, 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 ℃/sec
Preheat - Temperature Min (T_{smin}) - Temperature Max (T_{smax}) - Time (Min to Max) (t_s)	 150℃ 200℃ 60 ~ 120 sec
T_{smax} to T_L - Ramp-up rate	 < 3 ℃ / sec
Time maintained above : - Temperature (T_L) - Time (T_L)	 217℃ 60 ~ 260 sec
Peak temperature (T_P)	255 ℃ -0 / +5℃
Time with 5℃ of actual peak temperature (T_P)	10 ~ 30 sec
Ramp-down rate	< 6℃ / sec
Time 25℃ to peak temperature	< 6 minutes