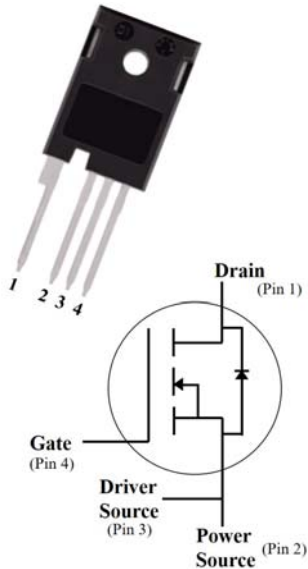


## Silicon Carbide Power MOSFET (N-Channel Enhancement)

$V_{DS}$	1200V
$I_D$ (25°C)	39A
$R_{DS(on)}$	80mΩ



### Features

- High speed switching
- Essentially no switching losses
- Reduction of heat sink requirements
- Maximum working temperature at 175 °C
- High blocking voltage
- Fast Intrinsic diode with low recovery current
- High-frequency operation
- Halogen free, RoHS compliant
- AEC-Q101 qualified

### Typical Applications

Typical applications are in power factor correction(PFC), solar inverter, uninterruptible power supply, motor drives, photovoltaic inverter, electric car and charger.

### Mechanical Data

- **Package:** TO247-4L
- **Terminals:** Tin plated leads
- **Polarity:** As marked

### ■Maximum Ratings ( $T_c=25^\circ\text{C}$ Unless otherwise specified)

PARAMETER	SYMBOL	UNIT	VALUE	TEST CONDITIONS	NOTE
Device marking code				D212080NCFG1Q	
Drain source voltage @ $T_j=25^\circ\text{C}$	$V_{DS,max}$	V	1200	$V_{GS}=0\text{ V}, I_D=100\mu\text{A}$	
Gate source voltage @ $T_j=25^\circ\text{C}$	$V_{GS,max}$	V	-8/+22	Absolute maximum values	Note1
Gate source voltage @ $T_j=25^\circ\text{C}$	$V_{GS,op}$	V	-4/+18	Recommended operational values	Note2
Continuous drain current @ $T_c=25^\circ\text{C}$	$I_D$	A	39	$V_{GS}=18\text{V}, T_c=25^\circ\text{C}$	Fig.18
Continuous drain current @ $T_c=100^\circ\text{C}$			28	$V_{GS}=18\text{V}, T_c=100^\circ\text{C}$	
Pulsed drain current	$I_{D(pulsed)}$	A	80	Pulse width $t_p$ limited by $T_{j,max}$	Fig.23
Power Dissipation	$P_{TOT}$	W	223	$T_c=25^\circ\text{C}, T_j = 175^\circ\text{C}$	Fig.17
Power Dissipation			97	$T_c=110^\circ\text{C}, T_j = 175^\circ\text{C}$	
Operating junction and Storage temperature range	$T_j, T_{stg}$	°C	-55 to +175		
Soldering temperature	$T_L$	°C	260	1.6mm (0.063") from case for 10s	
Mounting torque	$T_M$	Nm	0.6	M3 screw Maximum of mounting process: 3	



# YJD212080NCFG1Q

## ■Static Electrical Characteristics (Tc=25°C unless otherwise specified)

PARAMETER	SYMBOL	UNIT	Min.	Typ.	Max.	Test Conditions	Note
Gate threshold voltage	V <sub>GS(th)</sub>	V	2.3	2.9	3.6	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =5mA	Fig.4, 11
				2.2		V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =5mA, T <sub>j</sub> =175°C	
Drain source breakdown voltage	V <sub>(BR)DSS</sub>	V	1200			V <sub>GS</sub> =0, I <sub>D</sub> =100uA	
Zero gate voltage drain current	I <sub>DSS</sub>	uA		1	10	V <sub>DS</sub> =1200V, V <sub>GS</sub> =0V	Fig.16
Gate source leakage current	I <sub>GSS</sub>	nA			100	V <sub>GS</sub> =18V, V <sub>DS</sub> =0V	
Current drain source on-state resistance	R <sub>DS ON</sub>	mΩ		77	85	V <sub>GS</sub> =18V, I <sub>D</sub> =20A	Fig.5, 6, 7
				122		V <sub>GS</sub> =18V, I <sub>D</sub> =20A, T <sub>j</sub> =175°C	
Internal gate resistance	R <sub>g</sub>	Ω		3.1		f=1MHz	
Diode forward voltage	V <sub>SD</sub>	V		3.9		V <sub>GS</sub> =-4V, I <sub>SD</sub> =10A	Fig.8
				3.2		V <sub>GS</sub> =0V, I <sub>SD</sub> =10A T <sub>j</sub> =175°C	Fig.9
Transconductance	g <sub>f</sub>	S		10		V <sub>DS</sub> =16V, I <sub>D</sub> =20A	Fig.4
				9.2		V <sub>DS</sub> =16V, I <sub>D</sub> =20A, T <sub>j</sub> =175°C	

## ■Dynamic Electrical Characteristics (Tc=25°C unless otherwise specified)

PARAMETER	SYMBOL	UNIT	Min.	Typ.	Max.	Test Conditions	Note
Input capacitance	C <sub>iss</sub>	pF		890		V <sub>DS</sub> =1000V, V <sub>GS</sub> =0V, T <sub>j</sub> =25°C, f=1MHz, V <sub>AC</sub> =25mV	Fig.13, 14
Output capacitance	C <sub>oss</sub>			58			
Reverse capacitance	C <sub>rss</sub>			4			
Coss stored energy	E <sub>oss</sub>	uJ		34			Fig.15
Gate source charge	Q <sub>gs</sub>	nC		12		V <sub>DS</sub> =800V, V <sub>GS</sub> =-4/18V, I <sub>D</sub> =20A	Fig.12
Gate drain charge	Q <sub>gd</sub>			11			
Gate charge	Q <sub>g</sub>			41			

## ■Switching Characteristics (Tc=25°C unless otherwise specified)

PARAMETER	SYMBOL	UNIT	Min.	Typ.	Max.	Test Conditions	Note
Turn on switching energy	E <sub>on</sub>	uJ		377		V <sub>DD</sub> =800V, V <sub>GS</sub> =-4/+15V, I <sub>D</sub> =20A, R <sub>g</sub> =0Ω, L=16.7uH	Fig.21, 22
Turn off switching energy	E <sub>off</sub>			14			
Turn on delay time	t <sub>d(on)</sub>	ns		21			
Rise time	t <sub>r</sub>			17			
Turn off delay time	t <sub>d(off)</sub>	ns		14		V <sub>DD</sub> =800V, V <sub>GS</sub> =-4/+15V, I <sub>D</sub> =20A, R <sub>g</sub> =0Ω, L=16.7uH	Fig.21, 22
Fall time	t <sub>f</sub>			8			



# YJD212080NCFG1Q

## ■Body diode characteristics (T<sub>c</sub>=25°C unless otherwise specified)

PARAMETER	SYMBOL	UNIT	Min.	Typ.	Max.	Test Conditions	Note
Diode forward voltage	V <sub>SD</sub>	V		3.9		V <sub>GS</sub> =-4V, I <sub>SD</sub> =10A	Fig.8
				3.2		V <sub>GS</sub> =0V, I <sub>SD</sub> =10A, T <sub>j</sub> =175°C	Fig.9
Continuous diode forward current	I <sub>S</sub>	A		39		T <sub>c</sub> =25°C	Note1
Reverse recovery time	trr	nS		28.24		V <sub>R</sub> =800V, V <sub>GS</sub> =-4V, I <sub>D</sub> =20A, di/dt=2095A/uS	
Reverse recovery charge	Qrr	nC		190			
Peak reverse recovery current	Irrm	A		30.08			

Note 1: When using SiC Body Diode the maximum recommended V<sub>GS</sub> = -4V

Note 2: MOSFET can also safely operate at 0/18 V

## ■Thermal Characteristics (T<sub>a</sub>=25°C Unless otherwise specified)

PARAMETER	SYMBOL	UNIT	Value
Thermal resistance	R <sub>θJ-C</sub>	°C/W	0.67

## ■Typical Characteristics

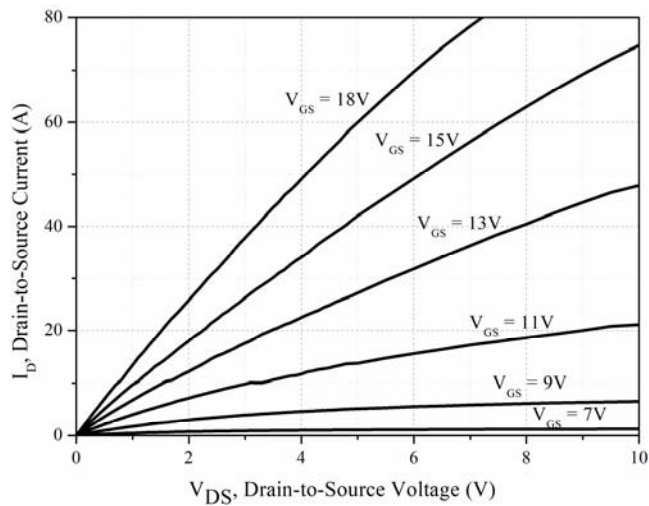


Figure 1. Output Characteristics T<sub>j</sub> = -40°C

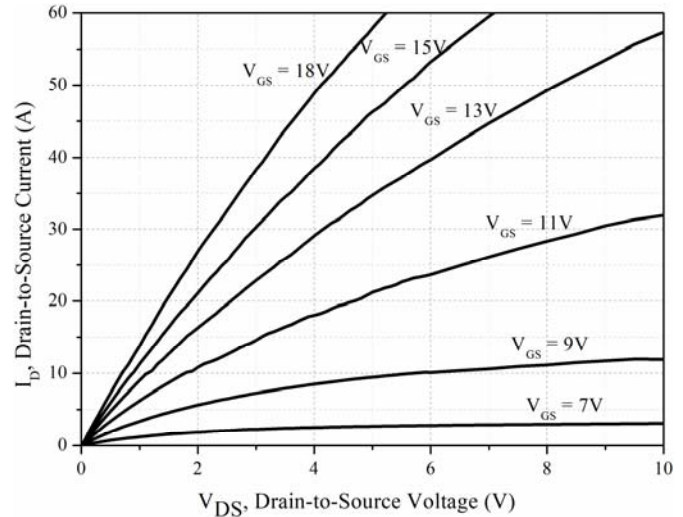


Figure2. Output Characteristics T<sub>j</sub> = 25°C



# YJD212080NCFG1Q

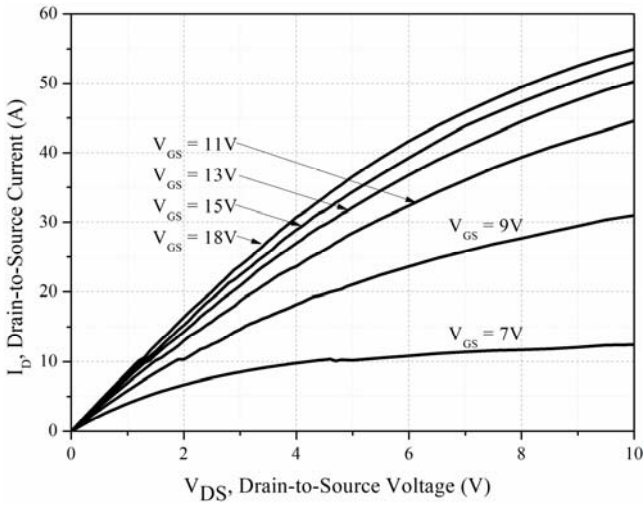


Figure 3. Output Characteristics Tj = 175°C

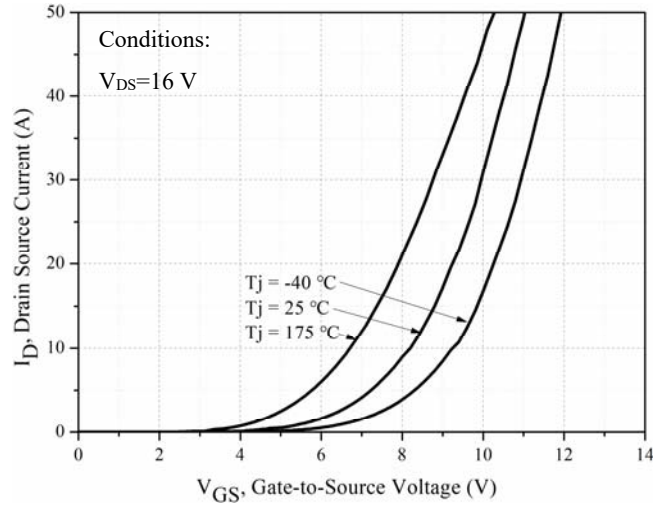


Figure 4. Transfer Characteristics for various junction temperature

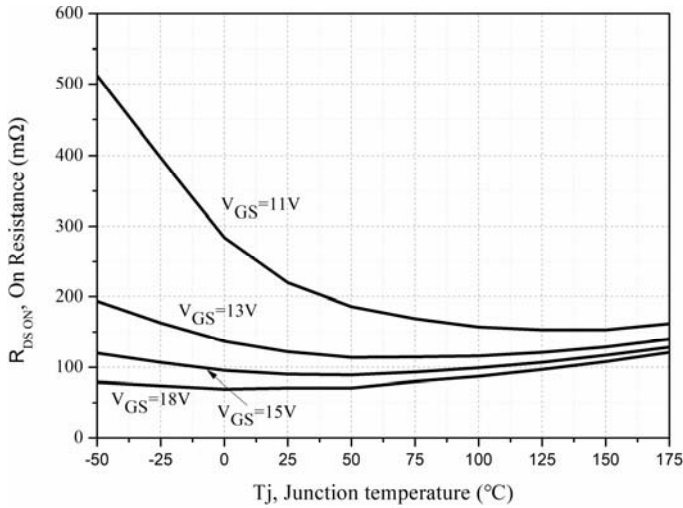


Figure 5. On-resistance vs. temperature for various gate voltage

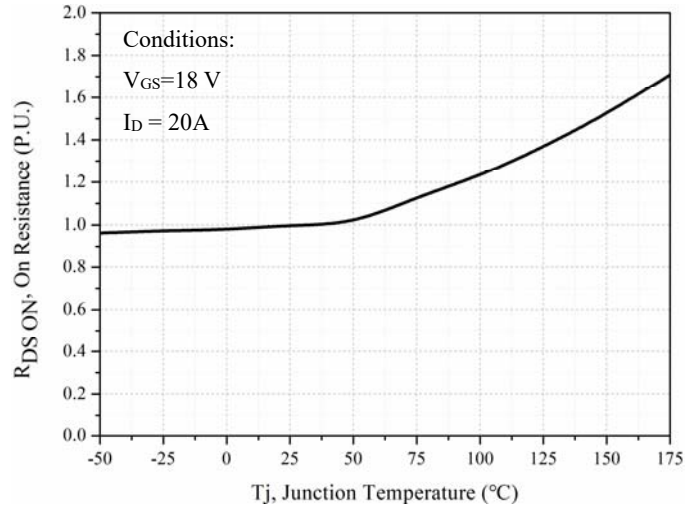


Figure 6. Normalized on-resistance vs. temperature

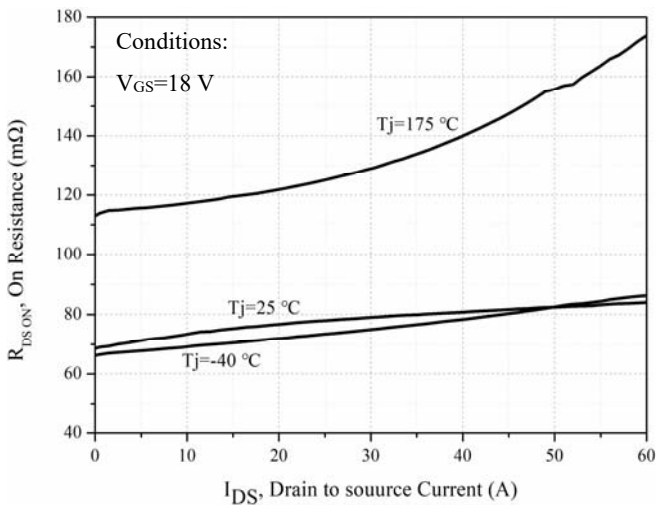


Figure 7. On-resistance vs. drain current

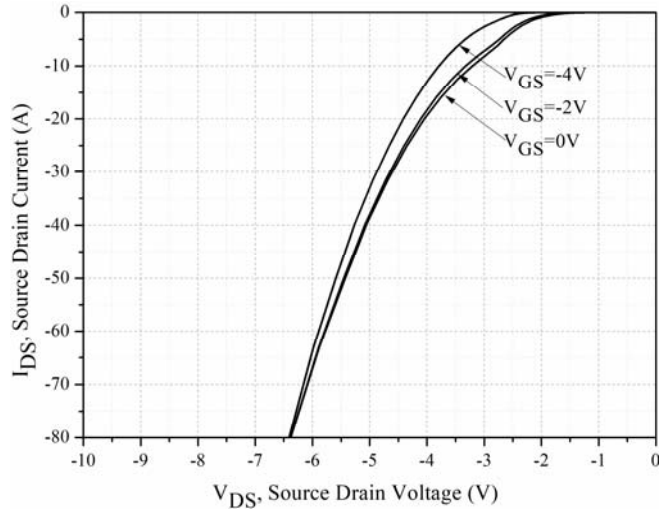


Figure 8. Body diode characteristic at Tj = 25°C



# YJD212080NCFG1Q

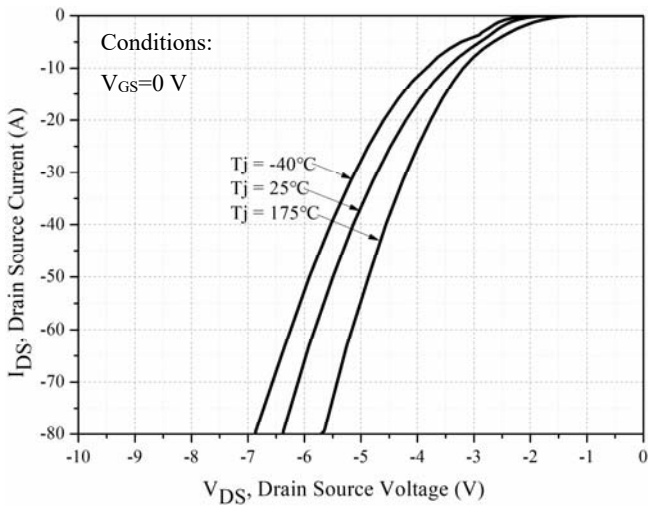


Figure 9. Body diode characteristic

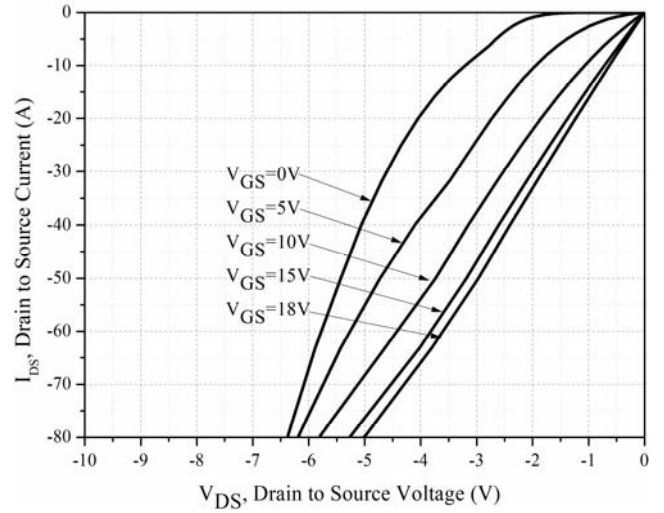


Figure 10. 3<sup>rd</sup> quadrant characteristic at  $T_j = 25^\circ\text{C}$

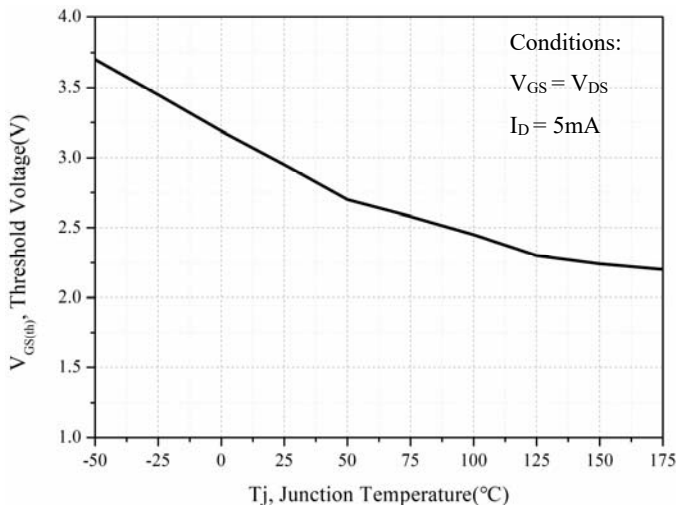


Figure 11. Threshold voltage vs.temperature

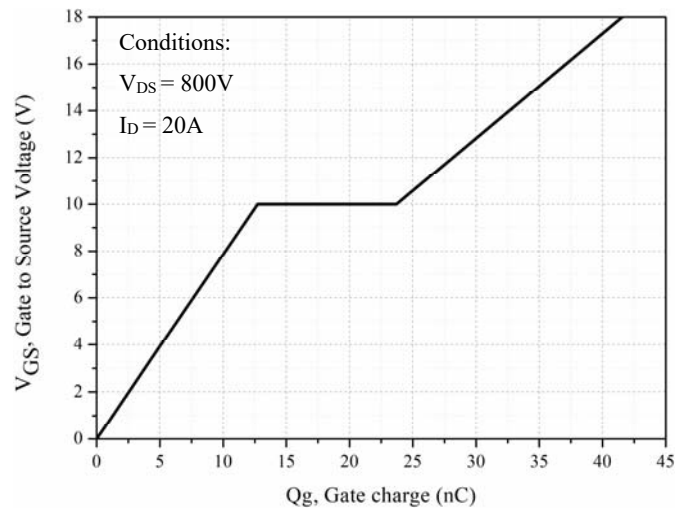


Figure 12. Gate charge characteristic

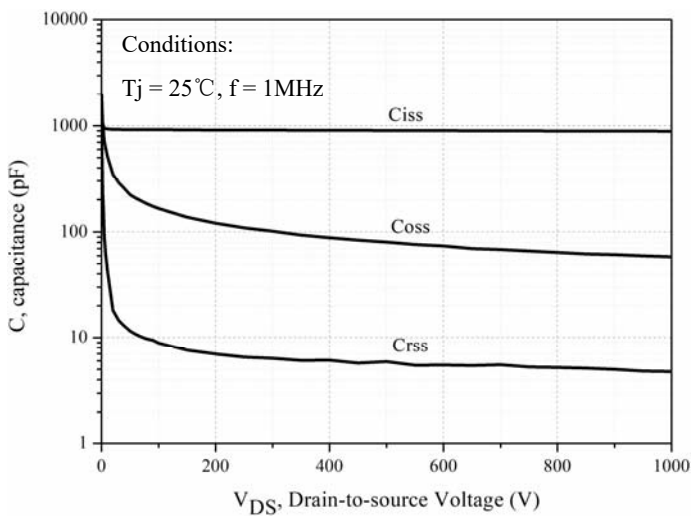


Figure 13. Capacitances vs.drain source voltage (0-1000V)

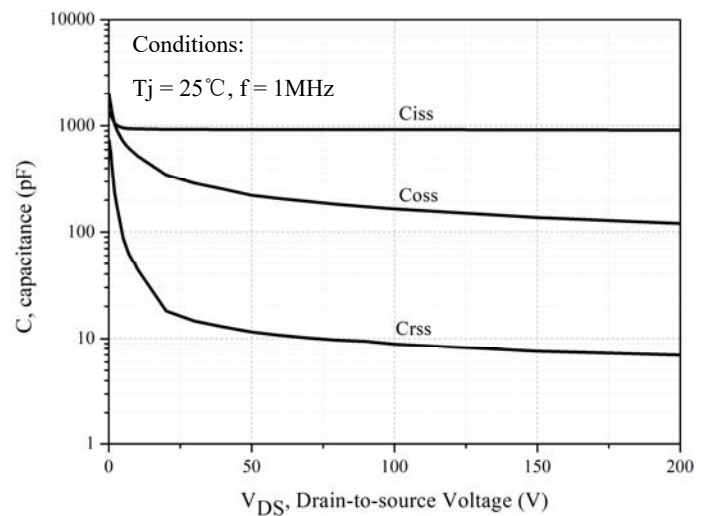


Figure 14. Capacitances vs.drain source voltage (0-200V)



# YJD212080NCFG1Q

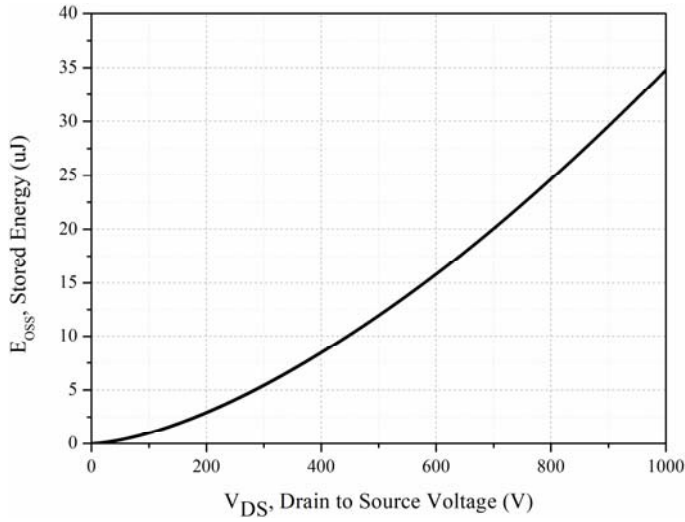


Figure 15. Output capacitor stored energy

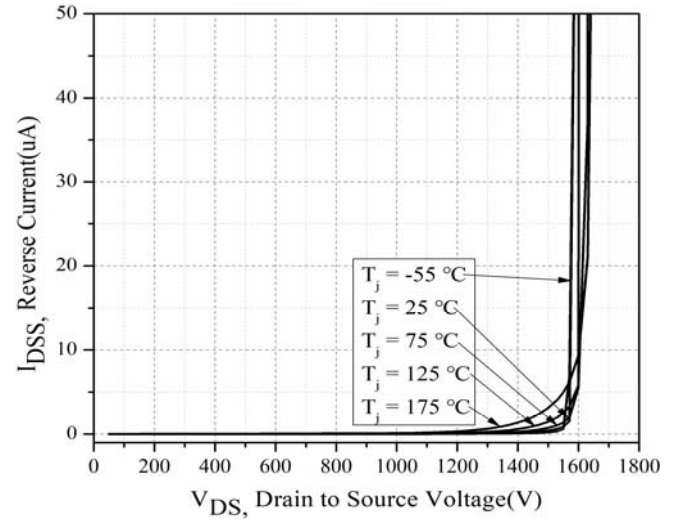


Figure 16. Reverse characteristics vs. Tj

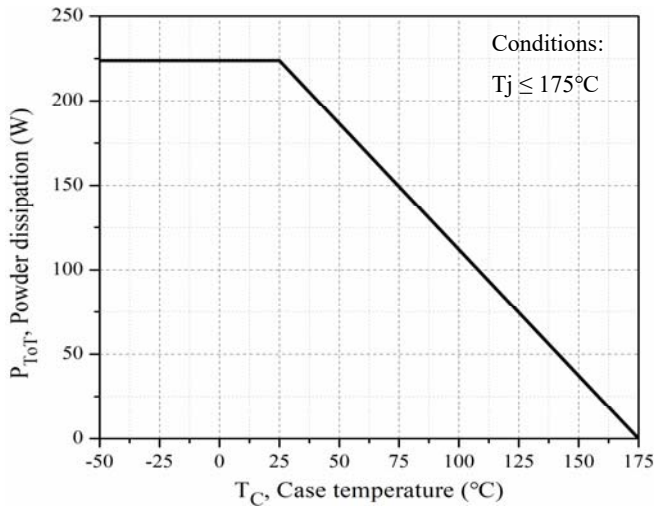


Figure 17. Maximum power dissipation derating vs. case temperature

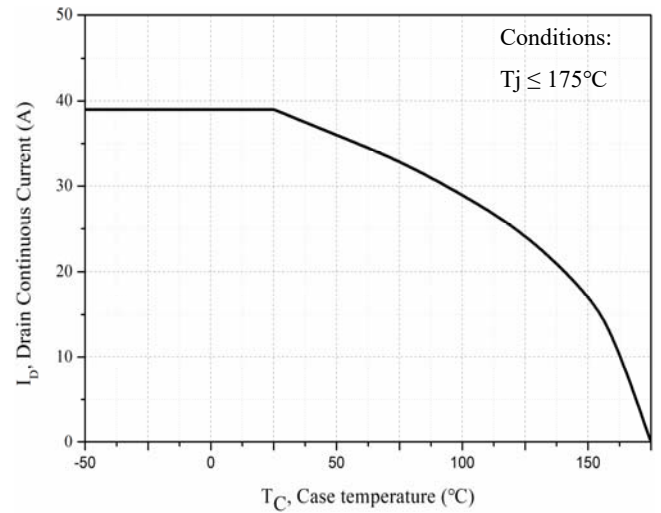


Figure 18. Continuous drain current derating vs. case temperature

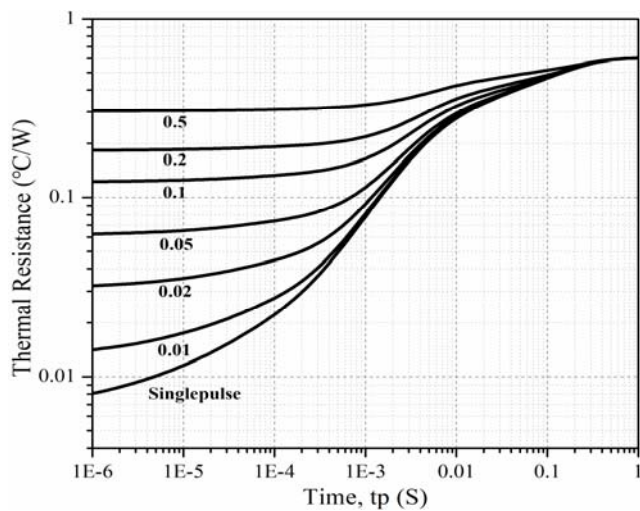


Figure 19. Transient thermal impedance (junction - case)

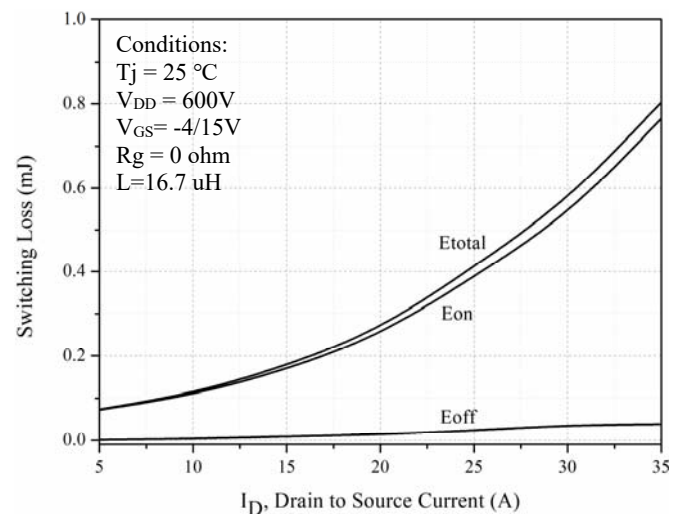


Figure 20. Clamped Inductive switching energy vs. drain current



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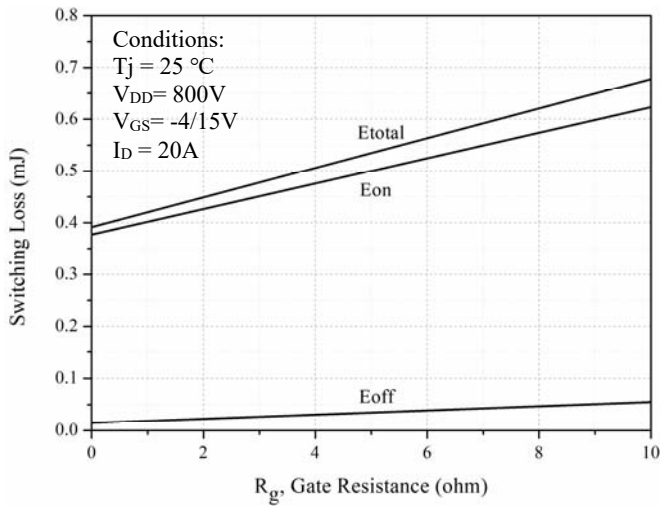


Figure 21. Clamped inductive switching energy vs.  $R_g$

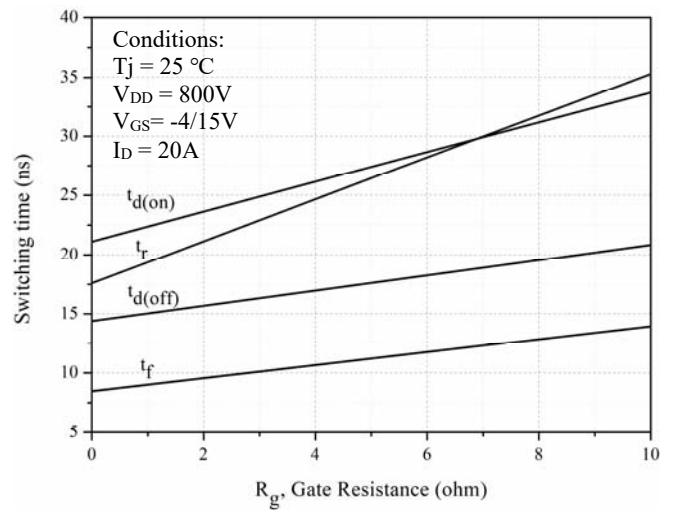


Figure 22. Switching times vs.  $R_g$

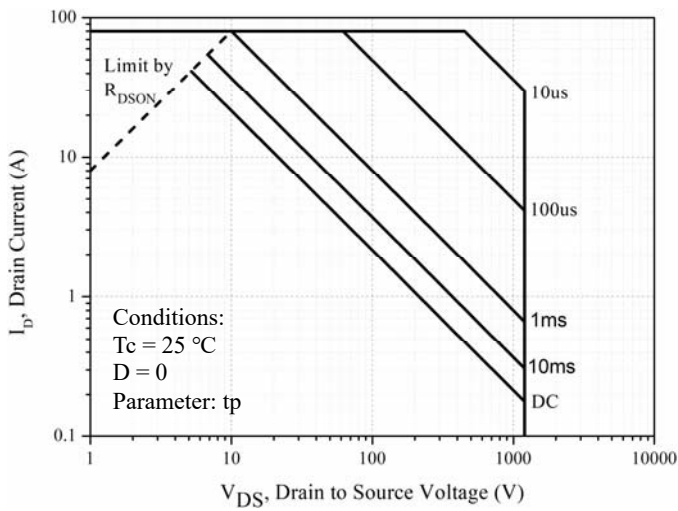


Figure 23. Safe operating area

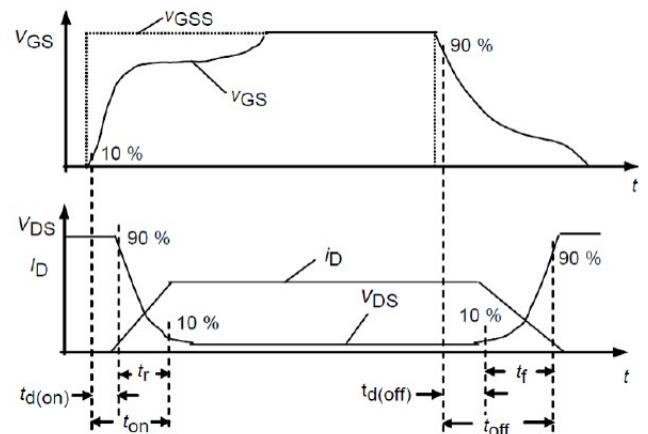


Figure 24. Switching Times Definition

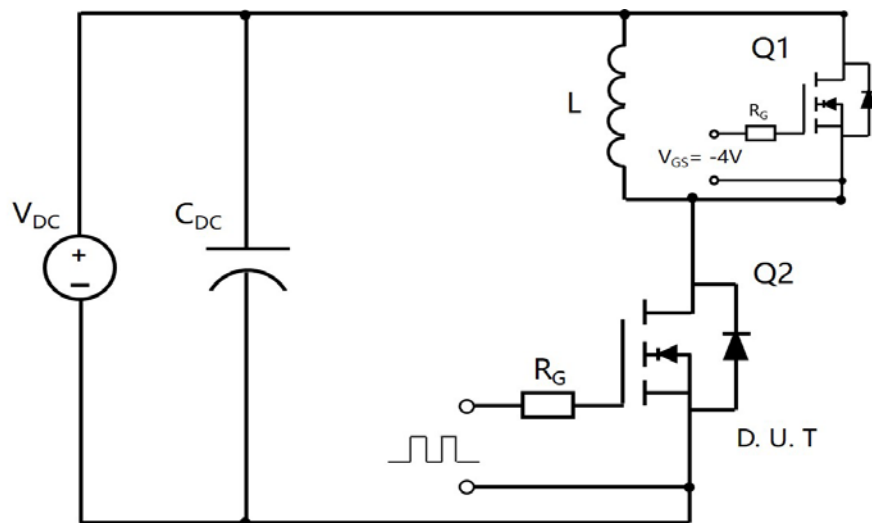
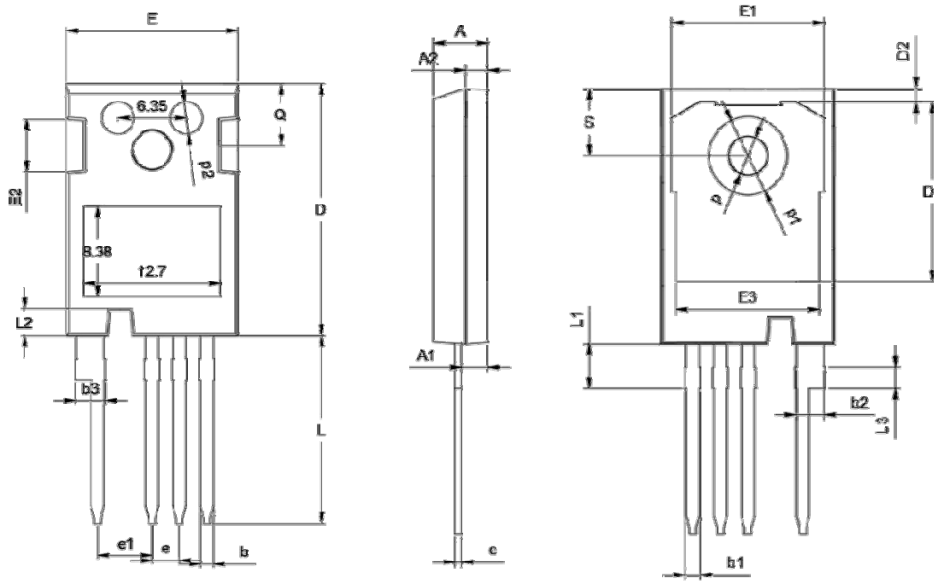


Figure 25. Clamped Inductive Switching Waveform Test Circuit



# YJD212080NCFG1Q

## ■Outline Dimensions



TO247-4L			
Dim	Min	Norm	Max
A	4.80	5.00	5.20
A1	2.30	2.40	2.50
A2	1.88	1.98	2.08
b	1.10	1.20	1.30
b1	1.20	/	1.50
b2	2.35	2.55	2.75
b3	2.45	/	2.85
c	0.55	0.60	0.65
D	23.3	23.45	23.6
D1	16.25	16.55	16.85
D2	1.00	/	1.30
e	TYP2.54		
e1	TYP5.06		
E	15.75	15.90	16.05
E1	13.80	/	14.20
E2	4.40	4.75	5.10
E3	13.00	/	13.45
L	17.34	17.49	17.64
L1	4.00	/	4.30
L2	2.35	/	2.65
L3	TYP1.98		
Q	5.60	5.80	6.00
S	6.05	/	6.30
p	TYP3.58		
p1	TYP7.18		
p2	TYP3.00		





## YJD212080NCFG1Q

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