

# N1M065060PD2

## Silicon Carbide Power MOSFET

N-Channel Enhancement Mode

$V_{DS}$	650V
$I_D @ 25^\circ\text{C}$	29A
$R_{DS(ON)}$	60m $\Omega$

### Features

- High Blocking Voltage with Low On-Resistance
- High Speed Switching with Low Capacitance
- Fast Intrinsic Diode with Low Reverse Recovery

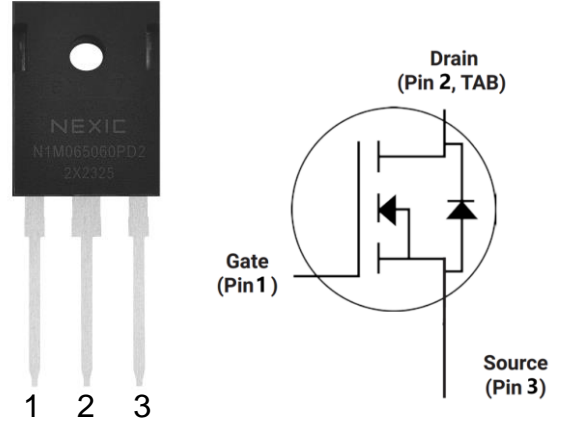
### Benefits

- Higher System Efficiency
- Reduced Cooling Requirements
- Increased Power Density
- Increased System Switching Frequency
- Easy to Parallel and Simple to Drive

### Applications

- EV Charging
- Server Power Supplies
- Solar PV Inverters
- UPS
- DC/DC Converters

### Package



Part Number	Package
N1M065060PD2	TO-247-3

Maximum Ratings ( $T_C = 25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions	Note
$V_{DSmax}$	Drain - Source Voltage	650	V	$V_{GS} = 0\text{ V}, I_D = 100\ \mu\text{A}$	
$V_{GSmax}$	Gate - Source Voltage	-8/+22	V	Absolute maximum values	
$V_{GSop}$	Gate - Source Voltage	-4/+18	V	Recommended operational values	
$I_D$	Continuous Drain Current	29	A	$V_{GS} = 18\text{ V}, T_C = 25^\circ\text{C}$	
		20		$V_{GS} = 18\text{ V}, T_C = 100^\circ\text{C}$	
$I_{D(pulse)}$	Pulsed Drain Current	99	A	Pulse width $t_p$ limited by $T_{jmax}$	
$P_D$	Power Dissipation	150	W	$T_C=25^\circ\text{C}, T_J=175^\circ\text{C}$	
$T_J, T_{stg}$	Operating Junction and Storage Temperature	-40 to + 175	$^\circ\text{C}$		
$T_L$	Solder Temperature	260	$^\circ\text{C}$		

**Electrical Characteristics** ( $T_C=25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	650			V	$V_{GS}=0V, I_D=100\mu A$	
$V_{GS(th)}$	Gate Threshold Voltage	1.8	2.7	4.0	V	$V_{DS}=V_{GS}, I_D=5mA$	Fig. 11
			1.8			$V_{DS}=V_{GS}, I_D=5mA, T_J=175^\circ\text{C}$	
$I_{DSS}$	Zero Gate Voltage Drain Current		0.01	50	$\mu A$	$V_{DS}=650V, V_{GS}=0V$	
$I_{GSS}$	Gate-Source Leakage Current		10	250	nA	$V_{GS}=18V, V_{DS}=0V$	
$R_{DS(on)}$	Drain-Source On-State Resistance	42	60	79	m $\Omega$	$V_{GS}=18V, I_D=13.2A$	Fig. 4, 5, 6
			73			$V_{GS}=18V, I_D=13.2A, T_J=175^\circ\text{C}$	
$C_{iss}$	Input Capacitance		1040		pF	$V_{GS}=0V, V_{DS}=600V,$ $f=1MHz, V_{AC}=25mV$	Fig. 15, 16
$C_{oss}$	Output Capacitance		97				
$C_{riss}$	Reverse Transfer Capacitance		11				
$E_{ON}$	Turn-On Switching Energy		87		$\mu J$	$V_{DS}=400V, V_{GS}=-4/18V, I_D=13.2A,$ $R_{G(ext)}=2.5\Omega, L=200\mu H$	
$E_{OFF}$	Turn-Off Switching Energy		14				
$t_{d(on)}$	Turn-On Delay Time		11		ns	$V_{DS}=400V, V_{GS}=-4/18V, I_D=13.2A,$ $R_{G(ext)}=2.5\Omega, R_L=30\Omega$	
$t_r$	Rise Time		12				
$t_{d(off)}$	Turn-Off Delay Time		24				
$t_f$	Fall Time		10				
$R_{G(int)}$	Internal Gate Resistance		9		$\Omega$	$f=1MHz, V_{AC}=25mV$	
$Q_{gs}$	Gate to Source Charge		13		nC	$V_{DS}=400V, V_{GS}=-4/18V,$ $I_D=13.2A$	Fig. 12
$Q_{gd}$	Gate to Drain Charge		18				
$Q_g$	Total Gate Charge		47				

**Reverse Diode Characteristics**

Symbol	Parameter	Typ.	Max.	Unit	Test conditions	Note
$V_{SD}$	Diode Forward Voltage	3.7		V	$V_{GS}=-4V, I_{SD}=6.6A$	Fig. 8, 9, 10
		3.3			$V_{GS}=-4V, I_{SD}=6.6A, T_J=175^\circ\text{C}$	
$I_S$	Continuous Diode Forward Current		23	A	$V_{GS}=-4V, T_C=25^\circ\text{C}$	
$t_{rr}$	Reverse Recovery Time	47		ns	$V_{GS}=-4V, I_{SD}=13.2A, V_R=400V,$ $dif/dt=1000A/\mu s$	
$Q_{rr}$	Reverse Recovery Charge	84		nC		
$I_{rrm}$	Peak Reverse Recovery Current	3		A		

**Thermal Characteristics**

Symbol	Parameter	Typ.	Max.	Unit	Test conditions	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	0.83		$^\circ\text{C/W}$		
$R_{\theta JA}$	Thermal Resistance from Junction to Ambient	33				

## Typical Performance

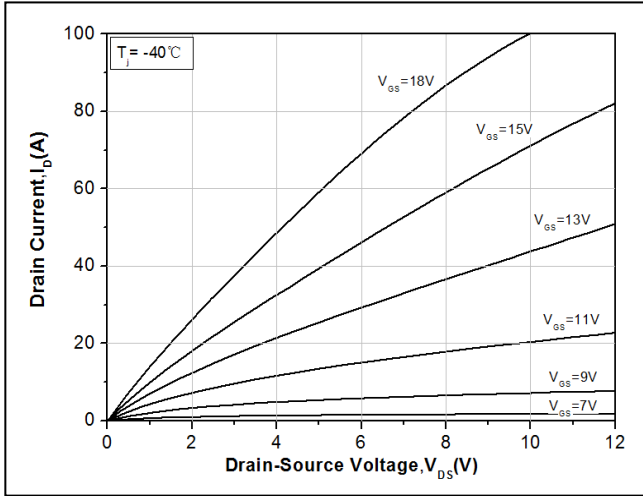


Figure 1. Output Characteristics  $T_j = -40\text{ }^{\circ}\text{C}$

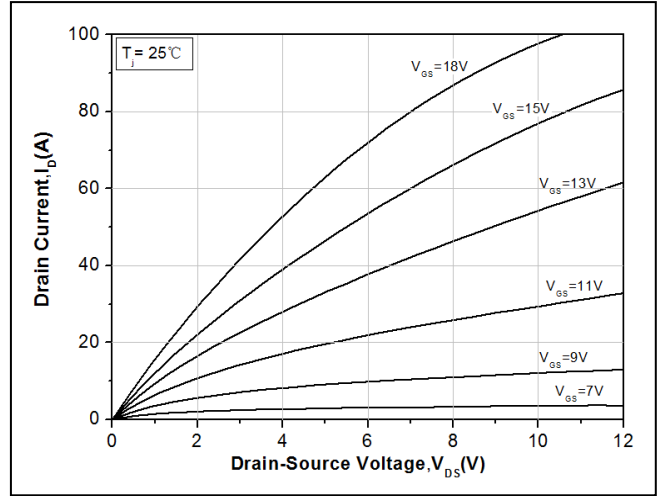


Figure 2. Output Characteristics  $T_j = 25\text{ }^{\circ}\text{C}$

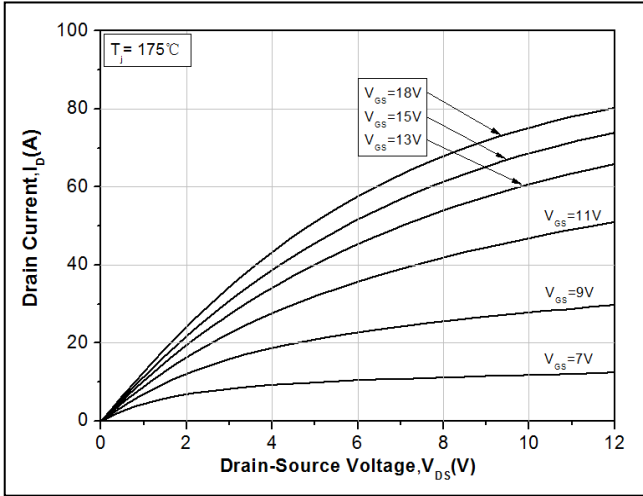


Figure 3. Output Characteristics  $T_j = 175\text{ }^{\circ}\text{C}$

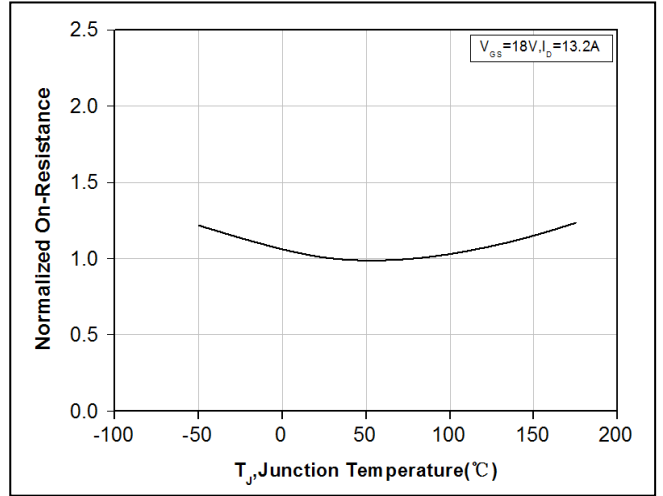


Figure 4. Normalized On-Resistance vs. Temperature

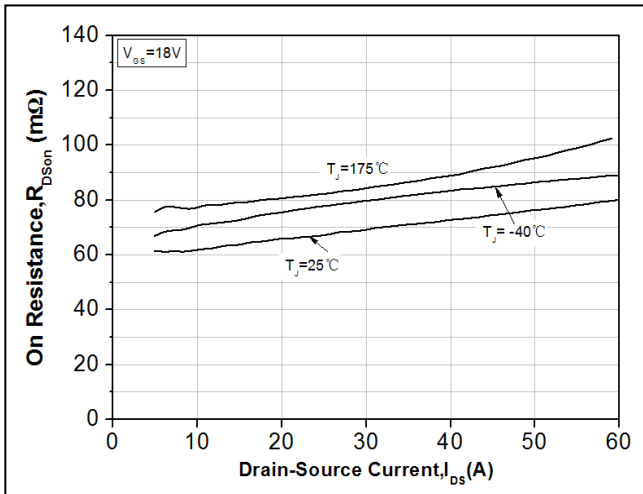


Figure 5. On-Resistance vs. Drain Current for Various Temperatures

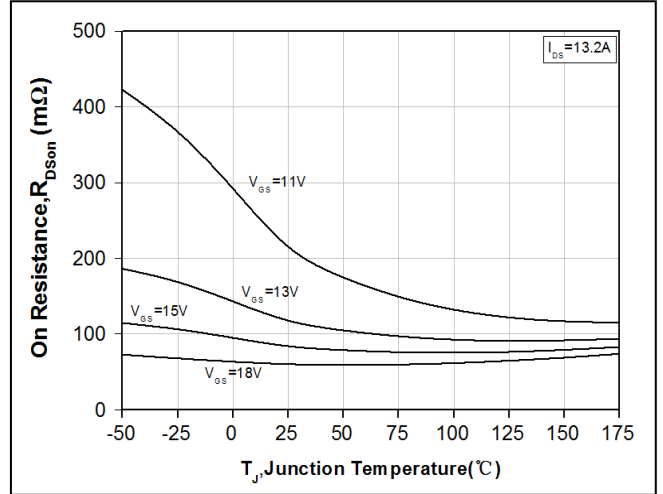
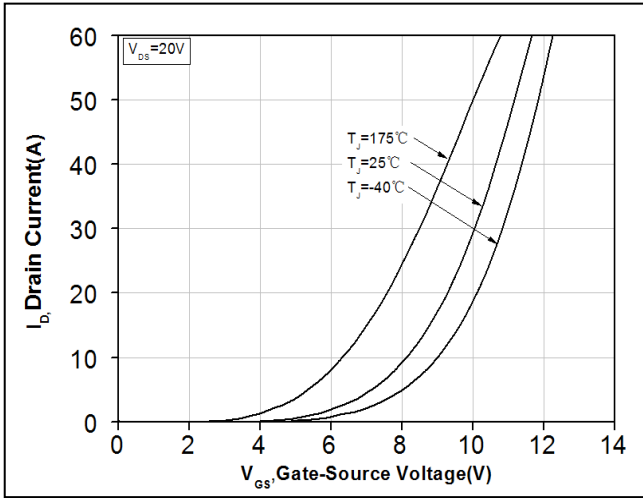
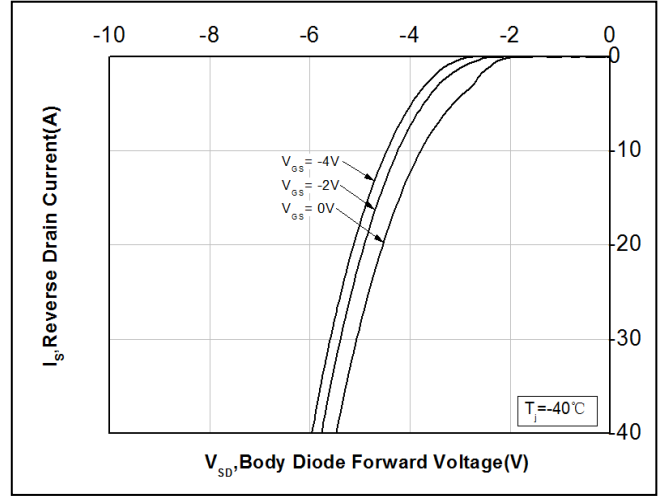


Figure 6. On-Resistance vs. Temperature for Various Gate Voltages

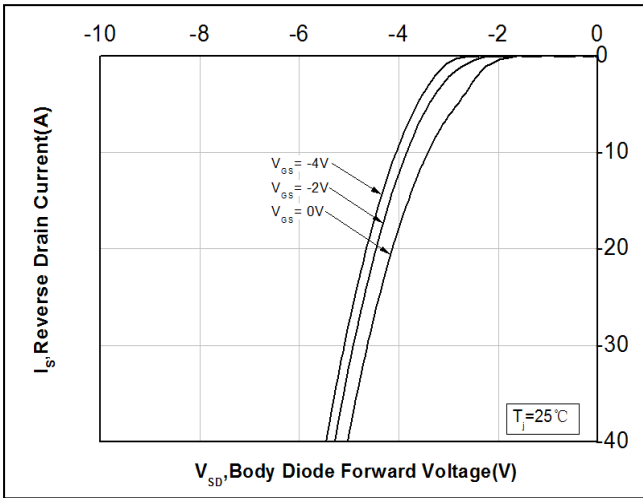
## Typical Performance



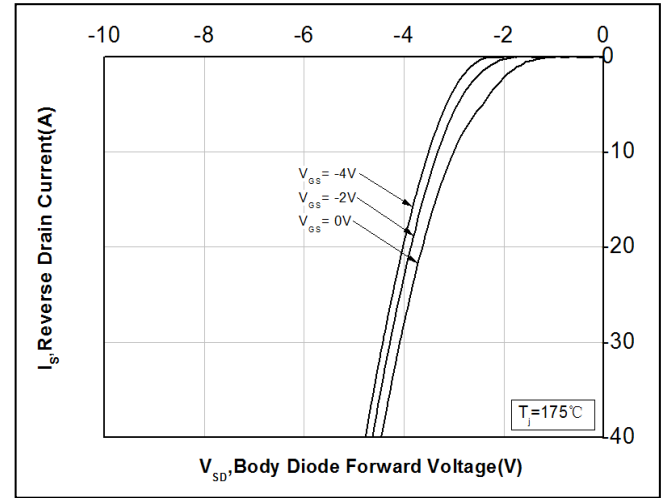
**Figure 7. Transfer Characteristics for Various Junction Temperatures**



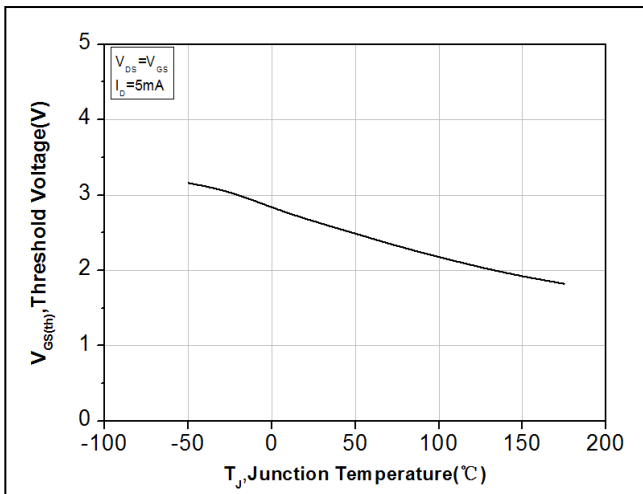
**Figure 8. Body Diode Characteristics at -40 °C**



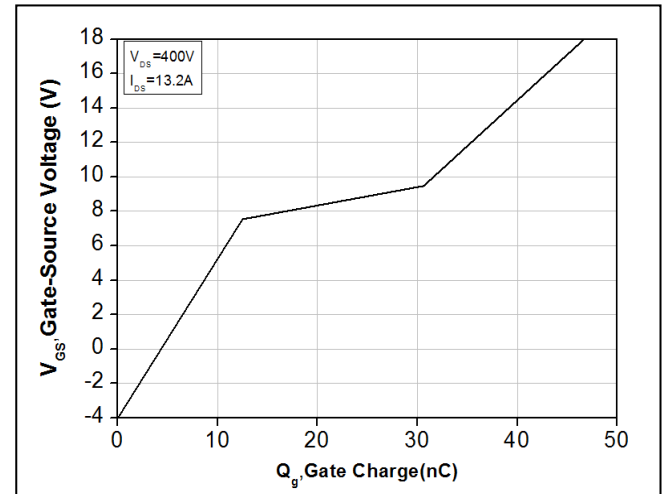
**Figure 9. Body Diode Characteristics at 25 °C**



**Figure 10. Body Diode Characteristics at 175 °C**



**Figure 11. Threshold Voltage vs. Temperature**



**Figure 12. Gate Charge Characteristics**

## Typical Performance

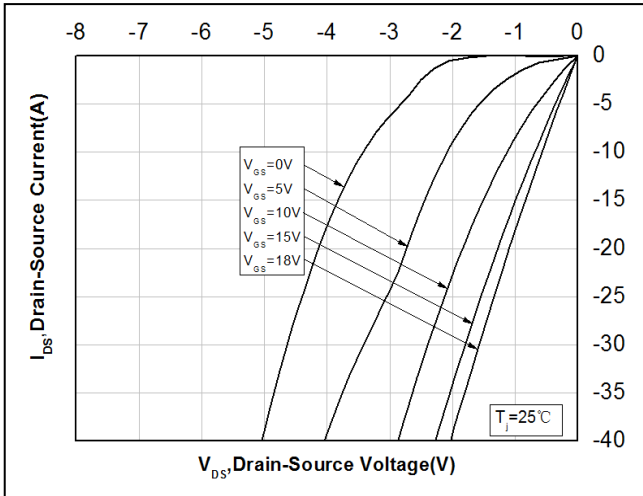


Figure 13. 3rd Quadrant Characteristics at 25 °C

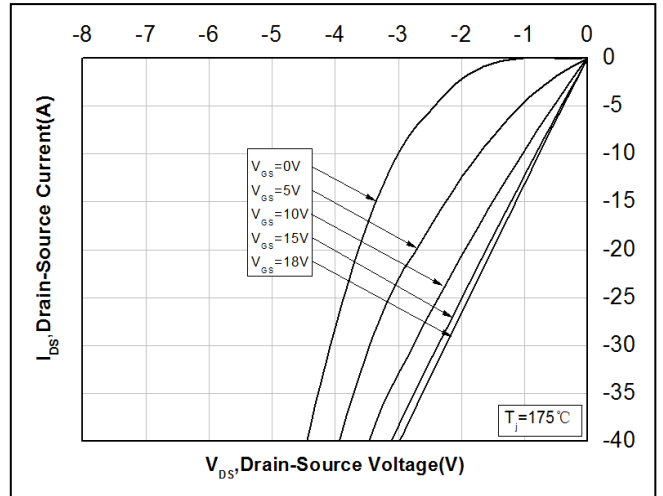


Figure 14. 3rd Quadrant Characteristics at 175 °C

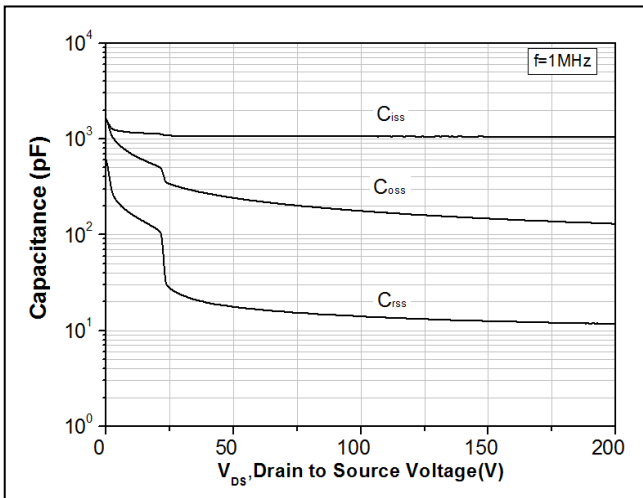


Figure 15. Capacitances vs. Drain-Source Voltage (0 - 200V)

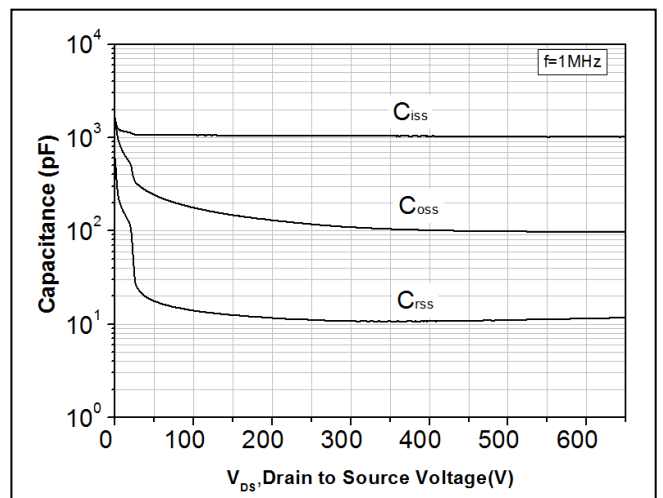
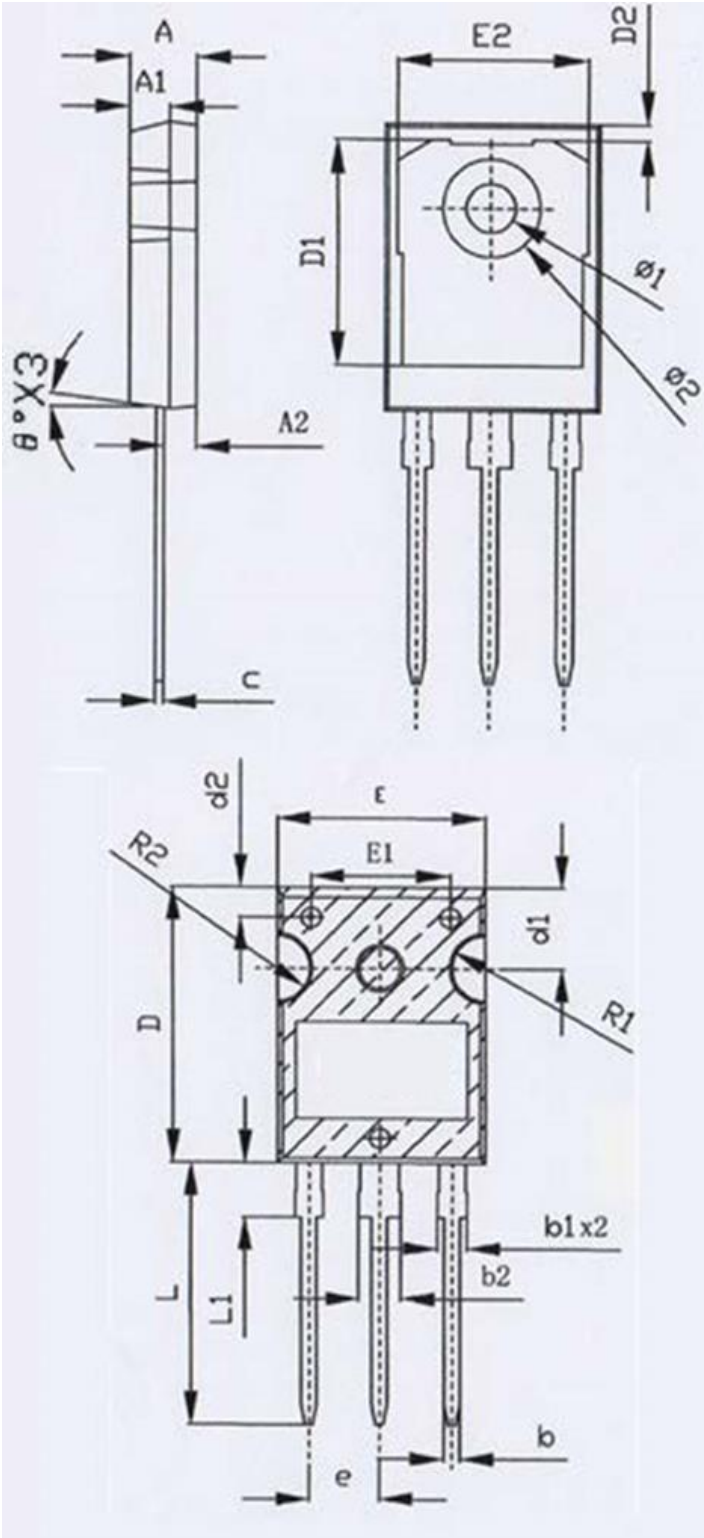


Figure 16. Capacitances vs. Drain-Source Voltage (0 - 650V)

## Package TO-247-3



	mm		
	MIN	NOM	MAX
A	4.9	5.0	5.1
A1	2.9	3.0	3.1
A2	2.31	2.36	2.41
b	1.16	1.20	1.26
b1	2.05	/	2.20
b2	3.05	/	3.20
c	0.58	0.60	0.66
D	20.9	21.0	21.1
D1	16.46	16.56	16.76
D2	/	1.17	/
d1	6.05	6.15	6.25
E	15.7	15.8	15.9
E2	/	14.02	/
e	/	5.44	/
L	19.82	19.92	20.02
L1	1.88	1.98	2.08
$\phi 1$	/	3.6	/
$\phi 2$	/	7.19	/