



## Features

- 3rd generation SiC MOSFET technology
- Optimized package with separate driver source pin
- High blocking voltage with low on-resistance
- High-speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery ( $Q_{rr}$ )
- Halogen free, RoHS compliant

## Benefits

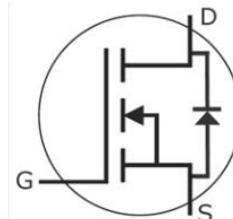
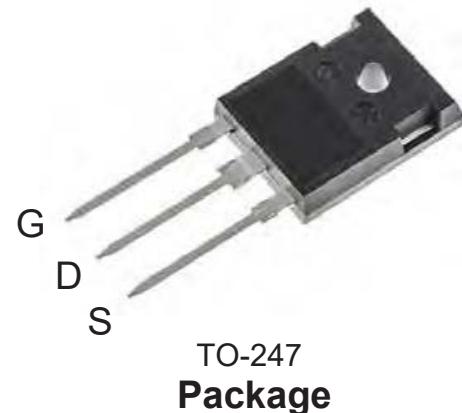
- Reduce switching losses and minimize gate ringing
- Higher system efficiency
- Reduce cooling requirements
- Increase power density
- Increase system switching frequency

## Applications

- Renewable energy
- EV battery chargers
- High voltage DC/DC converters
- Switch Mode Power Supplies



Ordering Part Number	Package	Marking
HC1M40120D	TO-247	HC1M40120D



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

Parameter	Symbol	Value	Unit
Drain-source voltage	$V_{DS}$	1200	V
Continuous drain current $T_c = 25^\circ\text{C}$ , $V_{GS} = 15\text{V}$ $T_c = 100^\circ\text{C}$ , $V_{GS} = 15\text{V}$	$I_D$	68 48	A
Pulsed drain current ( $T_c = 25^\circ\text{C}$ , $t_p$ limited by $T_{j\max}$ )	$I_{D\text{ pulse}}$	120	A
Gate-Source voltage	$V_{GS}$	-4/+18	V
Gate-Source voltage (Absolute maximum values)	$V_{GS\max}$	-8/+22	V
Power dissipation ( $T_c = 25^\circ\text{C}$ )	$P_{\text{tot}}$	357	W
Operating junction and storage temperature	$T_j$ , $T_{\text{stg}}$	-40...+175	°C

• Example of acceptable  $V_{GS}$  waveform





### Thermal Resistance

Parameter	Symbol	Value	Unit
Thermal resistance, junction – case. Max	$R_{thJC}$	0.42	$^{\circ}\text{C}/\text{W}$
Thermal resistance, junction – ambient. Max	$R_{thJA}$	40	

### Electrical Characteristic (at $T_j = 25^{\circ}\text{C}$ , unless otherwise specified)

Parameter	Symbol	Value			Unit	Test Condition
		min.	typ.	max.		

### Static Characteristic

Drain-source breakdown voltage	$\text{BV}_{\text{DSS}}$	1200	-	-	V	$\text{V}_{\text{GS}}=0\text{V}, \text{I}_D=100\text{uA}$
Gate threshold voltage	$\text{V}_{\text{GS(th)}}$	2.2	3	4	V	$\text{V}_{\text{DS}}=\text{V}_{\text{GS}}, \text{I}_D=10\text{mA}$
Zero gate voltage drain current	$\text{I}_{\text{DSS}}$	-	1	20	$\mu\text{A}$	$\text{V}_{\text{DS}}=1200\text{V}, \text{V}_{\text{GS}}=0\text{V}$ $\text{T}_C=25^{\circ}\text{C}$ $\text{T}_C=175^{\circ}\text{C}$
Gate-source leakage current	$\text{I}_{\text{GSS}}$	-		100	nA	$\text{V}_{\text{GS}}=18\text{V}, \text{V}_{\text{DS}}=0\text{V}$
Drain-source on-state resistance	$\text{R}_{\text{DS(on)}}$	-	40	52	$\text{m}\Omega$	$\text{V}_{\text{GS}}=15\text{V}, \text{I}_D=33.3\text{A},$ $\text{T}_J=25^{\circ}\text{C}$ $\text{T}_J=175^{\circ}\text{C}$
Drain-source on-state resistance	$\text{R}_{\text{DS(on)}}$	-	32	40	$\text{m}\Omega$	$\text{V}_{\text{GS}}=18\text{V}, \text{I}_D=33.3\text{A},$ $\text{T}_J=25^{\circ}\text{C}$ $\text{T}_J=175^{\circ}\text{C}$
Transconductance	$\text{g}_{\text{fs}}$	-	20	-	S	$\text{V}_{\text{DS}}=20\text{V}, \text{I}_D=33.3\text{A}$



### Dynamic Characteristic

Input Capacitance	$C_{iss}$	-	2766	-	pF	$V_{DS} = 1000V$ $V_{GS} = 0V$ $T_J = 25^\circ C$ $V_{AC} = 25mV$ $f = 1MHz$
Output Capacitance	$C_{oss}$	-	125	-		
Reverse Transfer Capacitance	$C_{rss}$	-	14	-		
Gate Total Charge	$Q_G$	-	112	-	nC	$V_{DS} = 800V$ $V_{GS} = 0/15V$ $I_D = 33.3A$
Gate-Source charge	$Q_{gs}$	-	28	-		
Gate-Drain charge	$Q_{gd}$	-	51	-		
Turn-On Switching Energy	$E_{ON}$	-	701	-	$\mu J$	$V_{DD} = 800V$ $V_{GS} = -4/+15V$ $I_D = 20A$ $R_G = 2.5\Omega$ $L = 120\mu H$
Turn-Off Switching Energy	$E_{OFF}$	-	79	-		
Turn-on delay time	$t_{d(on)}$	-	13.4	-		
Rise time	$t_r$	-	5.4	-	ns	
Turn-off delay time	$t_{d(off)}$	-	32	-		
Fall time	$t_f$	-	19	-		
Gate resistance	$R_G$	-	0.6	-	$\Omega$	$V_{AC} = 25mV, f=1MHz$

### Body Diode Characteristic

Parameter	Symbol	Value			Unit	Test Condition
		min.	typ.	max.		
Body Diode Forward Voltage	$V_{SD}$		5.3		V	$V_{GS}=-4V, I_{SD}=20A, T_J=25^\circ C$
			4.8			$V_{GS}=-4V, I_{SD}=20A, T_J=175^\circ C$
Body Diode Reverse Recovery Time	$t_{rr}$	-	55	-	ns	$V_R = 800V$ $I_D = 33.3A$ $di/dt = 1070A/\mu S$ $T_J = 25^\circ C$
Body Diode Reverse Recovery Charge	$Q_{rr}$	-	288	-	nC	



## Typical Performance Characteristics

Fig 1. Output Characteristic ( $T_j = -55^\circ\text{C}$ )

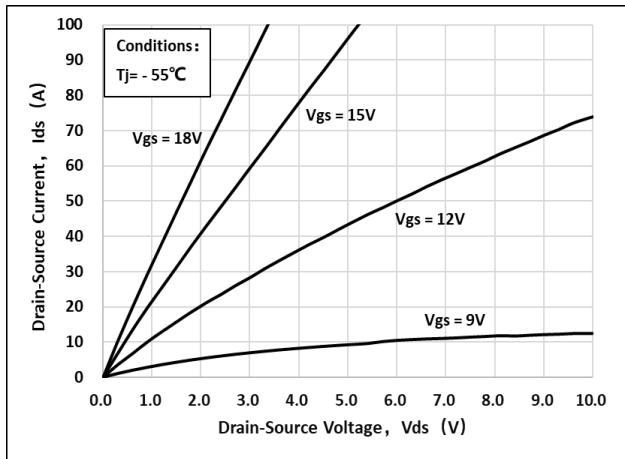


Fig 2. Output Characteristic ( $T_j = 25^\circ\text{C}$ )

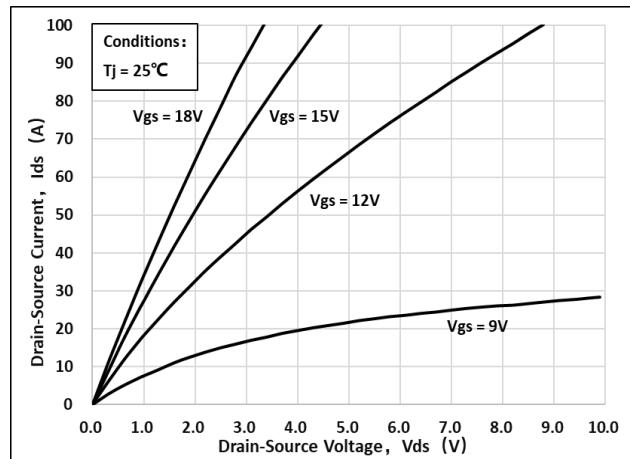


Fig 3. Output Characteristic ( $T_j = 175^\circ\text{C}$ )

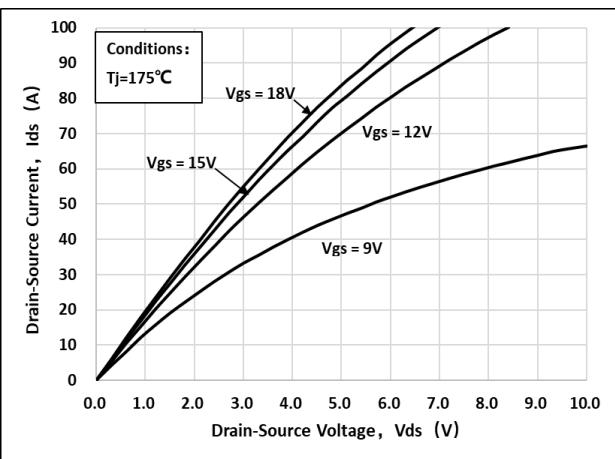


Fig 4:  $R_{dson}$  Vs  $Id_s$  Characteristic

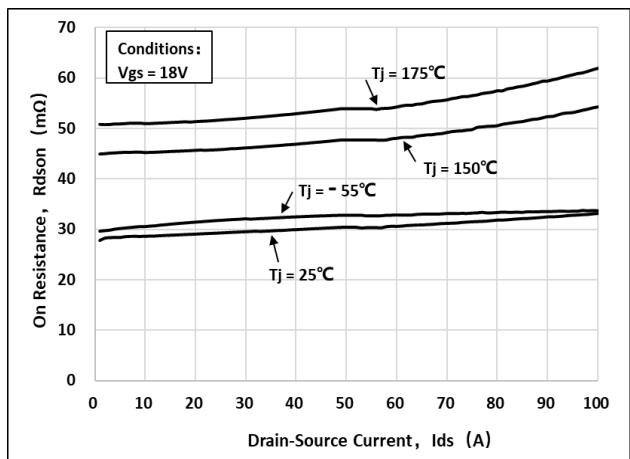


Fig 5:  $R_{ds(on)}$  vs. Temperature

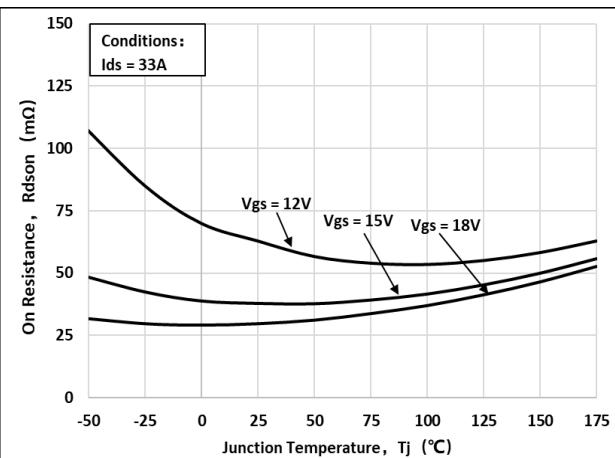


Fig 6: Transfer Characteristic

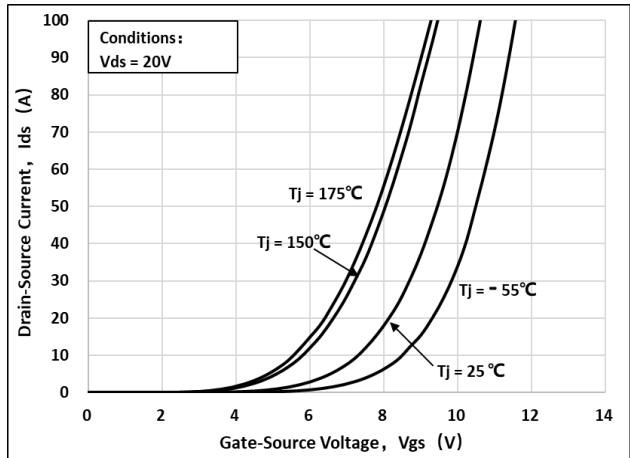




Fig 7: Body-diode Characteristic ( $T_J = -55^\circ\text{C}$ )

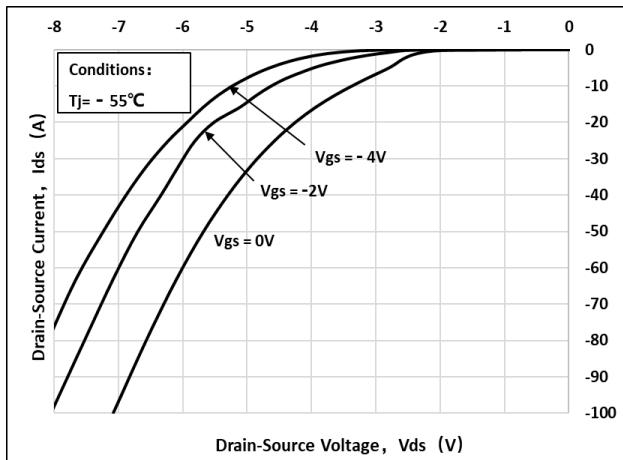


Fig 8: Body-diode Characteristic ( $T_J = 25^\circ\text{C}$ )

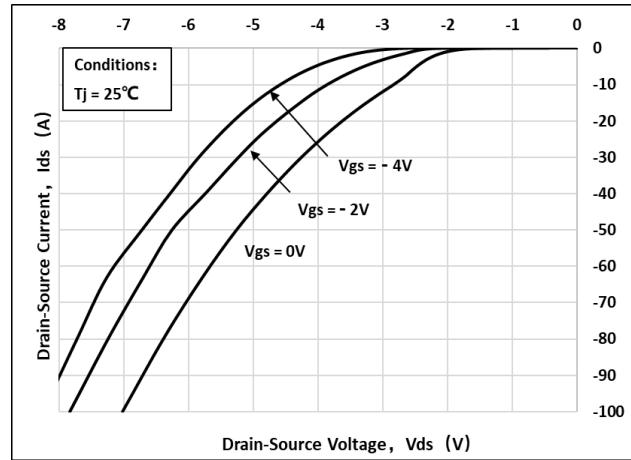


Fig 9: Body-diode Characteristic ( $T_J = 175^\circ\text{C}$ )

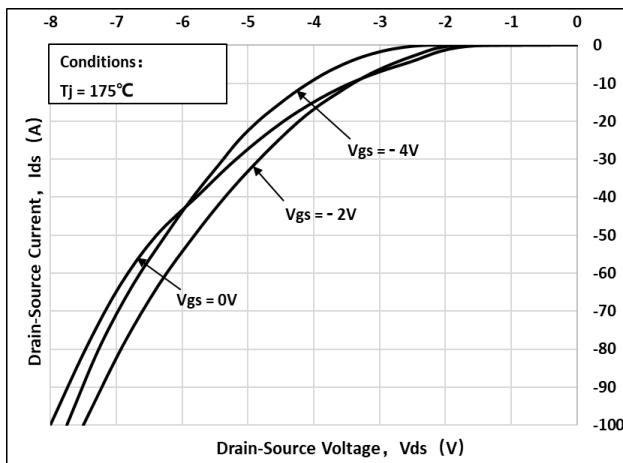


Fig 10:  $V_{th}$  Vs  $T_J$  Temperature Characteristic

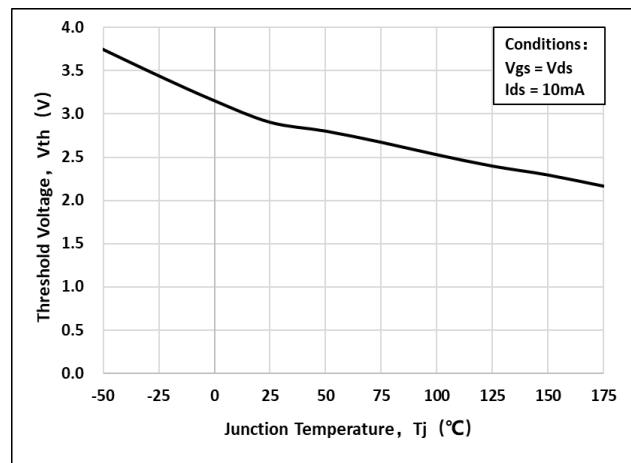


Fig 11: Gate Charge Characteristics

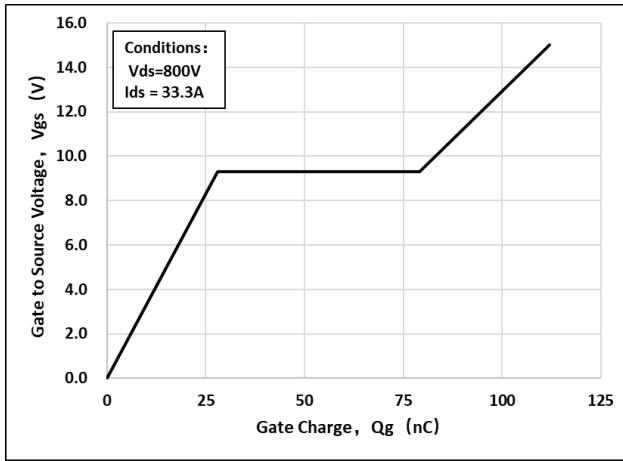


Fig 12: 3rd Quadrant Characteristic ( $T_J = -55^\circ\text{C}$ )

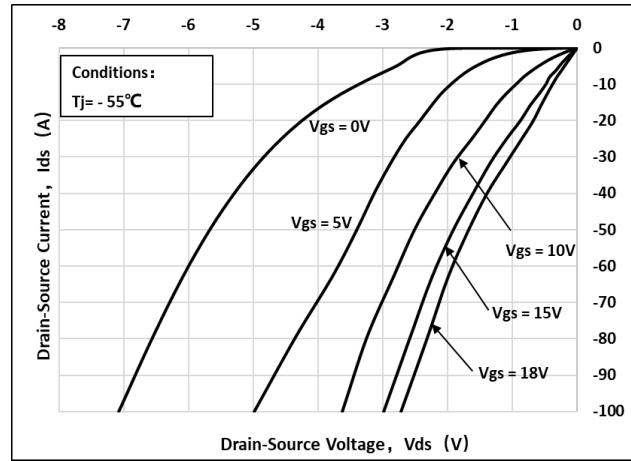




Fig 13: 3rd Quadrant Characteristic( $T_j=25^\circ\text{C}$ )

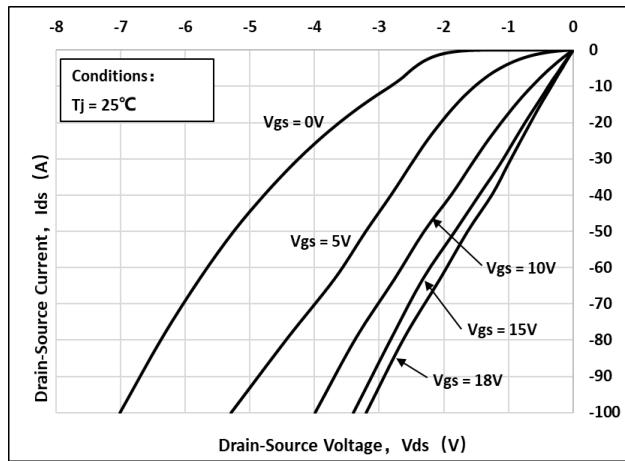


Fig 14: 3rd Quadrant Characteristic( $T_j=175^\circ\text{C}$ )

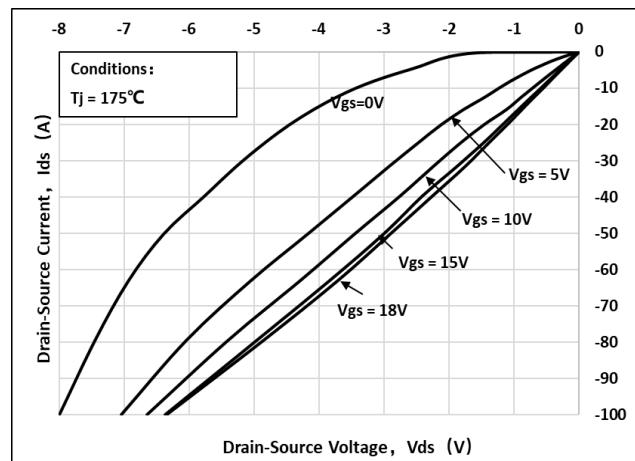


Fig 15: Capacitance Characteristic

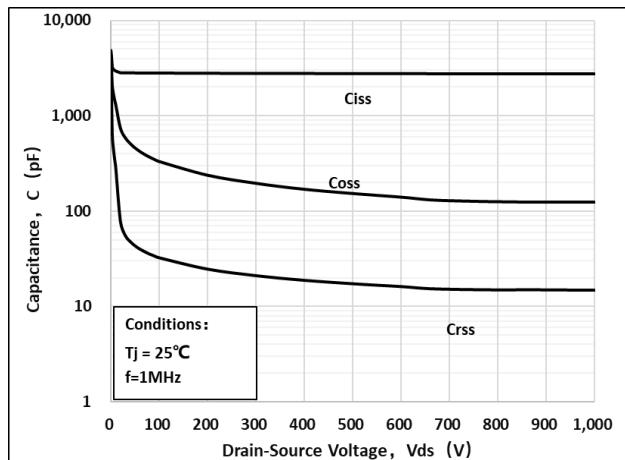
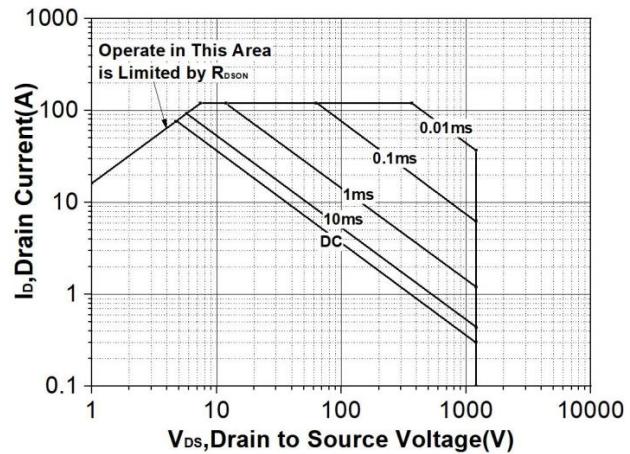


Fig 17: Transient Thermal Impedance

Fig 16: Safe Operating Area





## Test Circuit & Waveform

Figure A. Definition of switching times

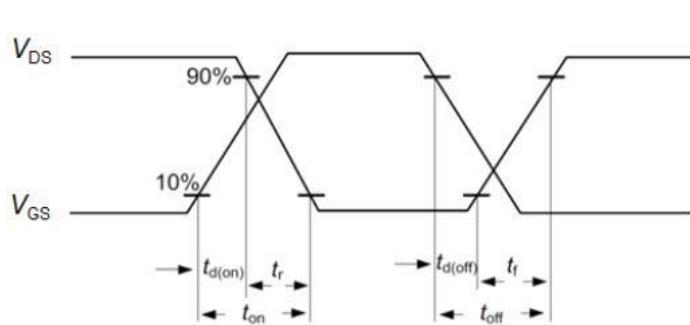


Figure B. Dynamic test circuit

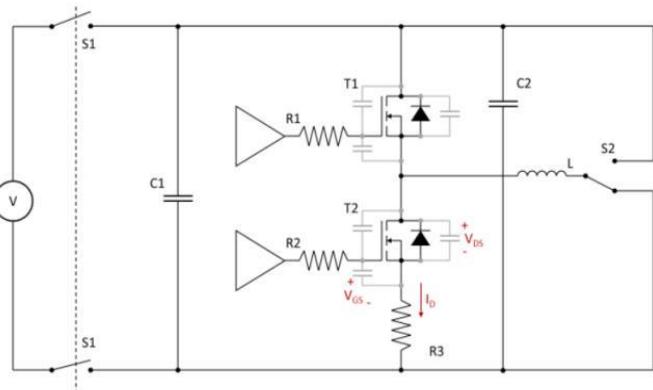


Figure C. Definition of body diode switching characteristics

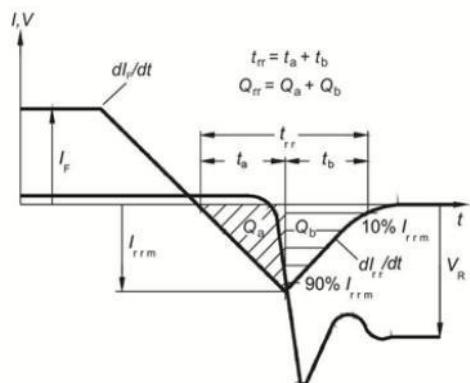
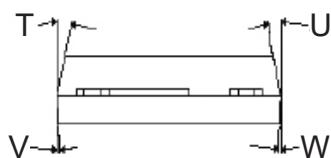
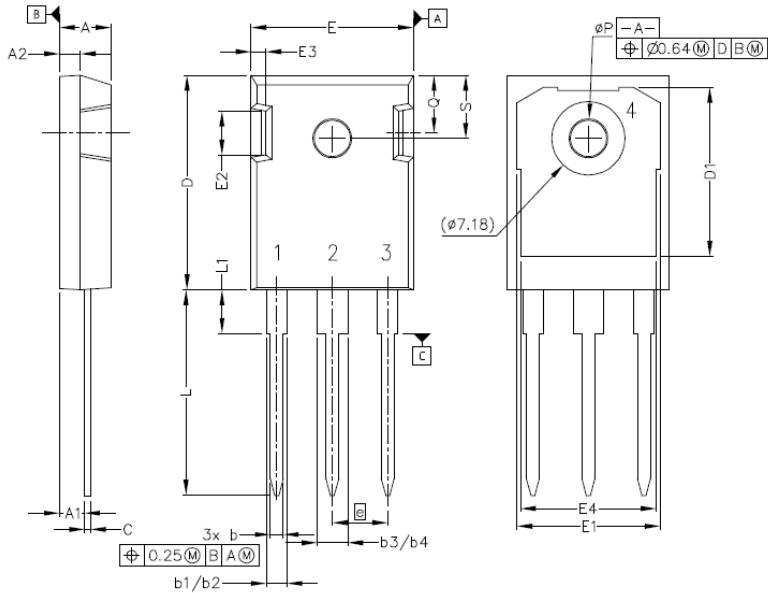


Figure C. Definition of diode switching characteristics



## Package Dimensions

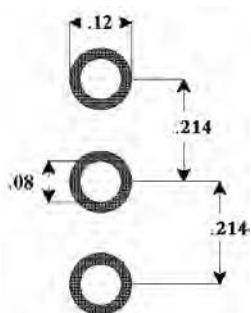
Package TO-247



### Pinout Information:

- Pin 1 = Gate
- Pin 2, 4 = Drain
- Pin 3 = Source

### Recommended Solder Pad Layout



TO-247

POS	Inches		Millimeters	
	Min	Max	Min	Max
A	.190	.205	4.83	5.21
A1	.090	.100	2.29	2.54
A2	.075	.085	1.91	2.16
b	.042	.052	1.07	1.33
b1	.075	.095	1.91	2.41
b2	.075	.085	1.91	2.16
b3	.113	.133	2.87	3.38
b4	.113	.123	2.87	3.13
c	.022	.027	0.55	0.68
D	.819	.831	20.80	21.10
D1	.640	.695	16.25	17.65
D2	.037	.049	0.95	1.25
E	.620	.635	15.75	16.13
E1	.516	.557	13.10	14.15
E2	.145	.201	3.68	5.10
E3	.039	.075	1.00	1.90
E4	.487	.529	12.38	13.43
e	.214 BSC		5.44 BSC	
N	3		3	
L	.780	.800	19.81	20.32
L1	.161	.173	4.10	4.40
ØP	.138	.144	3.51	3.65
Q	.216	.236	5.49	6.00
S	.238	.248	6.04	6.30
T	9°	11°	9°	11°
U	9°	11°	9°	11°
V	2°	8°	2°	8°
W	2°	8°	2°	8°



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