

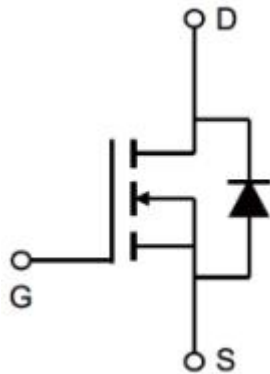


#### Features

- Uses CRM(CQ) advanced Trench technology
- Extremely low on-resistance  $R_{DS(on)}$
- Excellent  $Q_g \times R_{DS(on)}$  product(FOM)
- Qualified according to JEDEC criteria

#### Applications

- Motor control and drive
- Battery management
- UPS (Uninterruptible Power Supplies)



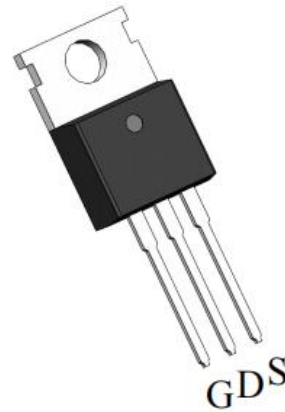
N-Channel MOSFET

#### Product Summary

$V_{DS}$	40V
$R_{DS(on)}$ typ.	2.8mΩ
$I_D$	140A

**100% DVDS Tested**

**100% Avalanche Tested**



TO-220



TO-263

#### Package Marking and Ordering Information

Part #	Marking	Package	Packing	Reel Size	Tape Width	Qty
4004A	4004A	TO-220	Tube	N/A	N/A	50pcs
4004D	4004D	TO-263	Tube	N/A	N/A	50pcs

#### Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Drain-source voltage	$V_{DS}$	40	V
Continuous drain current $T_C$ = 25°C $T_C$ = 100°C	$I_D$	140 92	A
Pulsed drain current ( $T_C$ = 25°C, $t_p$ limited by $T_{jmax}$ )	$I_{D\ pulse}$	320	A
Avalanche energy, single pulse (L=0.5mH, VD=30V)	$E_{AS}$	810	mJ
Gate-Source voltage	$V_{GS}$	±20	V
Power dissipation ( $T_C$ = 25°C)	$P_{tot}$	175	W



Operating junction and storage temperature	$T_j, T_{stg}$	-55...+150	°C
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#### Thermal Resistance

Parameter	Symbol	Max	Unit
Thermal resistance, junction – case.	$R_{thJC}$	<sup>j</sup> 0.72	°C/W
Thermal resistance, junction – ambient(min. footprint)	$R_{thJA}$	132	

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

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

#### Static Characteristic

Drain-source breakdown voltage	$BV_{DSS}$	40	-	-	V	$V_{GS}=0V, I_D=250\mu A$
Gate threshold voltage	$V_{GS(th)}$	1.3	2	2.7	V	$V_{DS}=V_{GS}, I_D=250\mu A$
Zero gate voltage drain current	$I_{DSS}$	-	0.05	1	$\mu A$	$V_{DS}=40V, V_{GS}=0V$ $T_j=25\text{ °C}$
		-	-	10		$T_j=150\text{ °C}$
Gate-source leakage current	$I_{GSS}$	-	10	100	nA	$V_{GS}=20V, V_{DS}=0V$
Drain-source on-state resistance	$R_{DS(on)}$	-	2.8	3.5	m $\Omega$	$V_{GS}=10V, I_D=50A,$ $T_j=25\text{ °C}$
		-	4.7	5.6		$T_j=150\text{ °C}$
Transconductance	$g_{fs}$	-	173	-	S	$V_{DS}=5V, I_D=50A$

#### Dynamic Characteristic

Input Capacitance	$C_{iss}$	-	5734	-	pF	$V_{GS}=0V, V_{DS}=20V,$ $f=1MHz$
Output Capacitance	$C_{oss}$	-	686	-		
Reverse Transfer Capacitance	$C_{rss}$	-	338	-		
Gate Total Charge	$Q_G$	-	131	-	nC	$V_{GS}=10V, V_{DS}=20V,$ $I_D=50A, f=1MHz$
Gate-Source charge	$Q_{gs}$	-	24	-		
Gate-Drain charge	$Q_{gd}$	-	35	-		
Turn-on delay time	$t_{d(on)}$	-	16	-	ns	$V_{GS}=10V, V_{DD}=20V,$ $R_{G\_ext}=2.7\Omega$
Rise time	$t_r$	-	111	-		
Turn-off delay time	$t_{d(off)}$	-	73	-		
Fall time	$t_f$	-	110	-		



**4004A/D** (文件编号: S&CIC1767)

**N-channel enhancement mode MOSFET**

Gate resistance	$R_G$	-	0.8	-	$\Omega$	$V_{GS}=0V, V_{DS}=0V,$ $f=1MHz$
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### Body Diode Characteristic

Parameter	Symbol	Value			Unit	Test Condition
		min.	typ.	max.		
Body Diode Forward Voltage	$V_{SD}$	-	0.9	1.3	V	$V_{GS}=0V, I_{SD}=50A$
Body Diode Reverse Recovery Time	$t_{rr}$	-	31	-	ns	$I_F=50A, dI/dt=100A/\mu$ $s$
Body Diode Reverse Recovery Charge	$Q_{rr}$	-	30	-	nC	



#### Typical Performance Characteristics

Fig 1: Output Characteristics

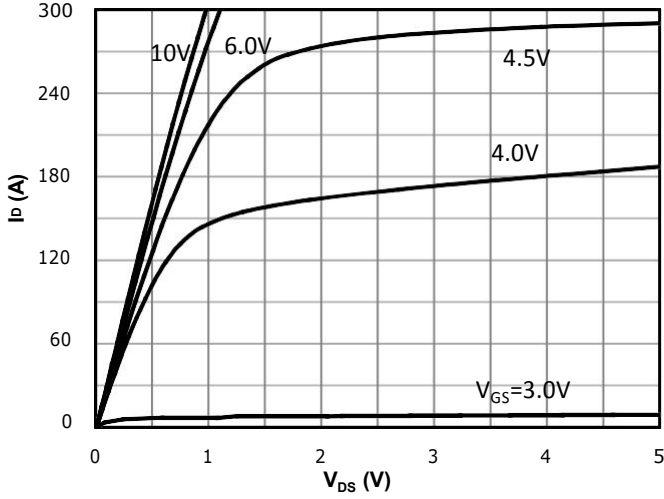


Fig 2: Transfer Characteristics

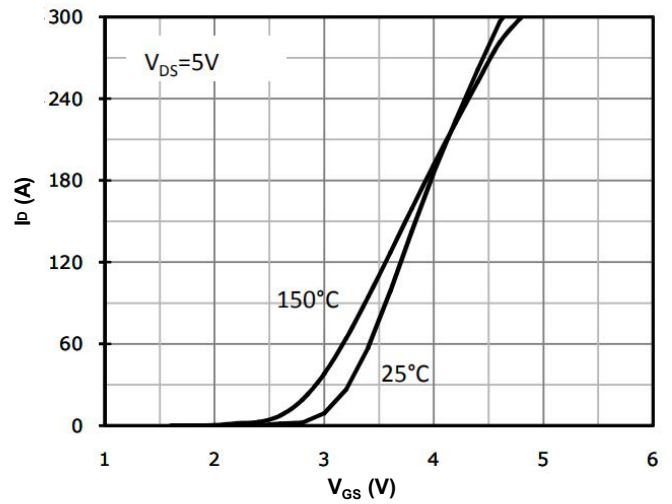


Fig 3:  $R_{DS(on)}$  vs Drain Current and Gate Voltage

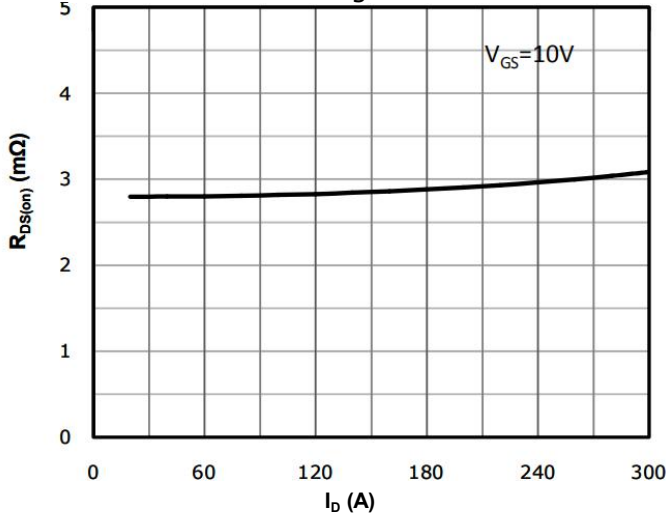


Fig 4:  $R_{DS(on)}$  vs Gate Voltage

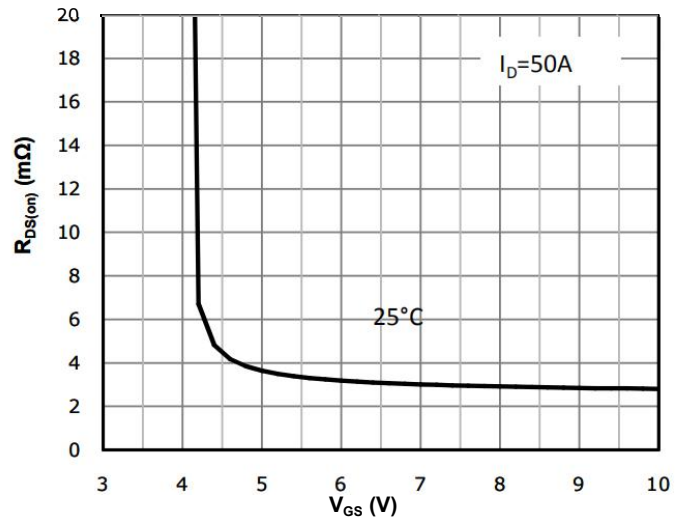


Fig 5:  $R_{DS(on)}$  vs. Temperature

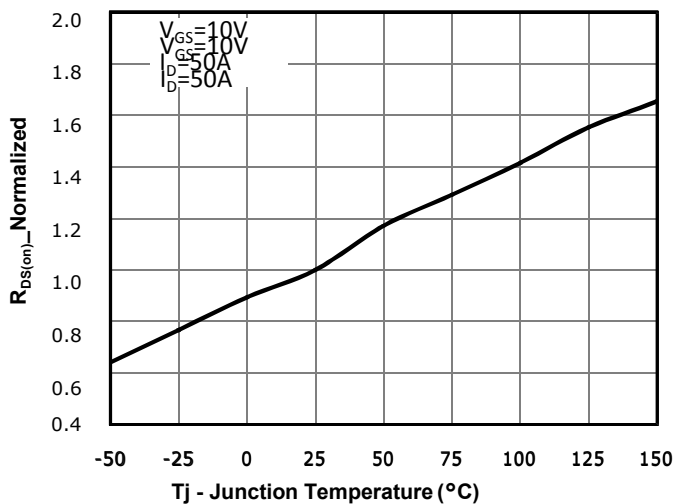


Fig 6: Capacitance Characteristics

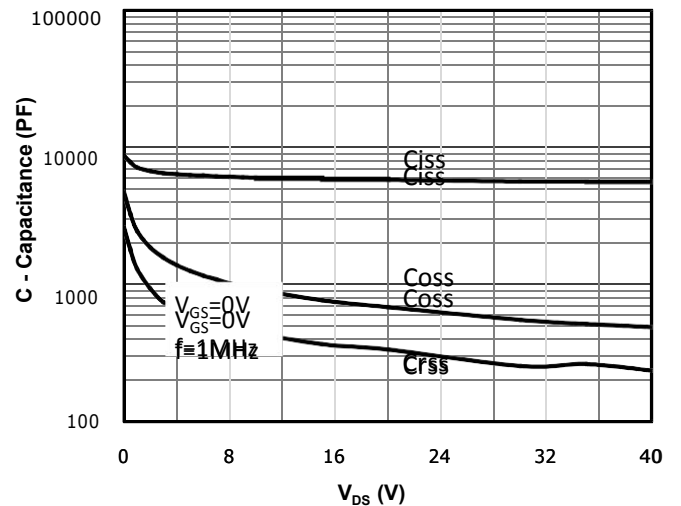




Fig 7: Gate Charge Characteristics

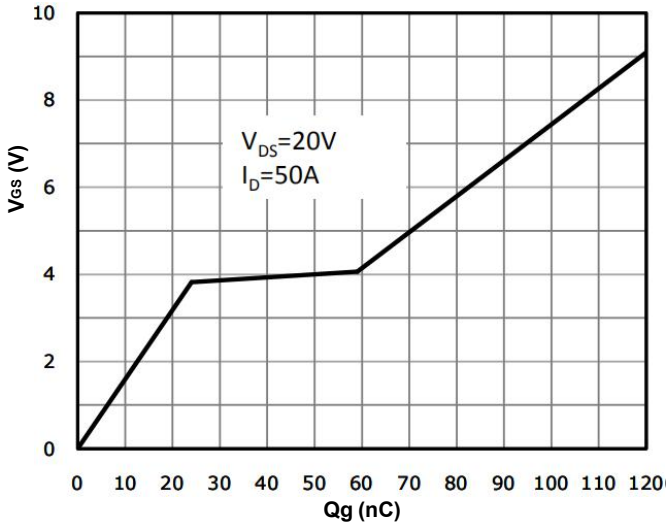


Fig 8: Body-diode Forward Characteristics

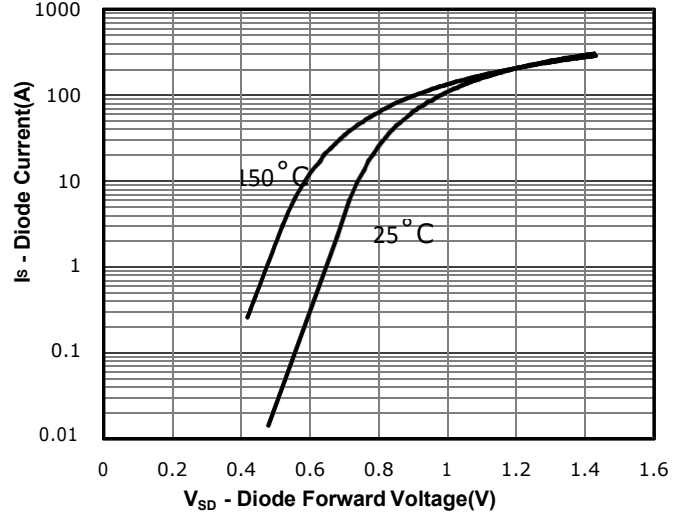


Fig 9: Power Dissipation

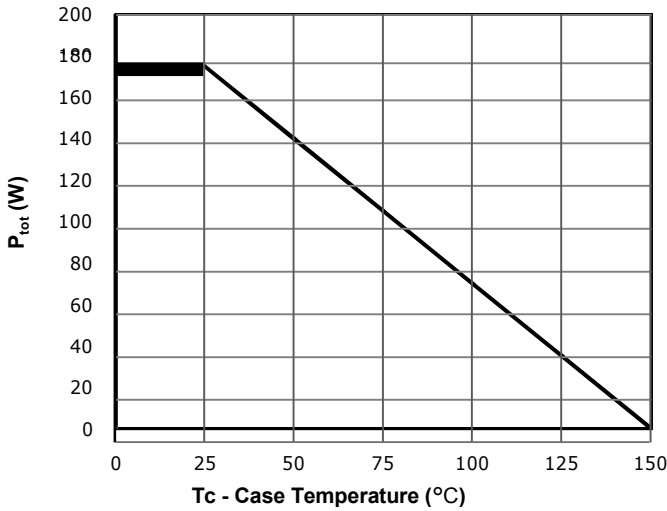


Fig 10: Drain Current Derating

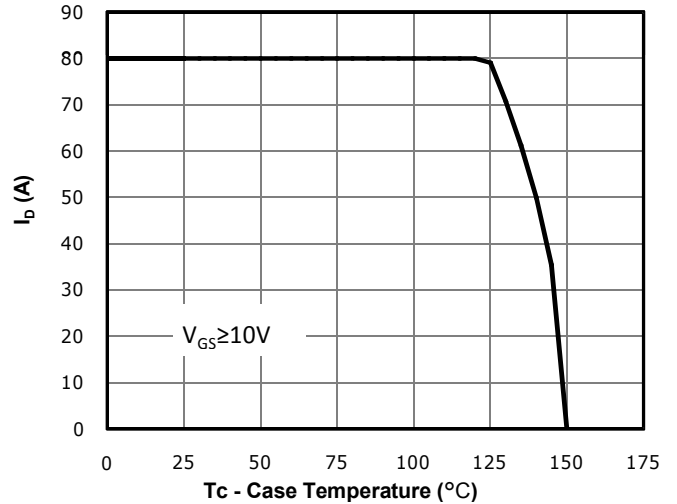


Fig 11: Safe Operating Area

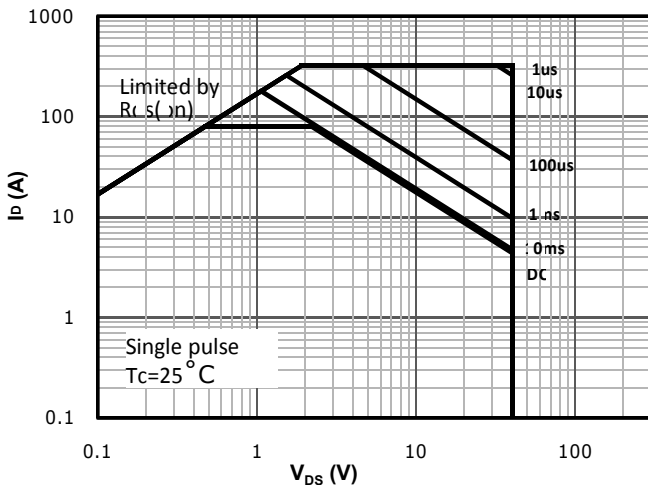
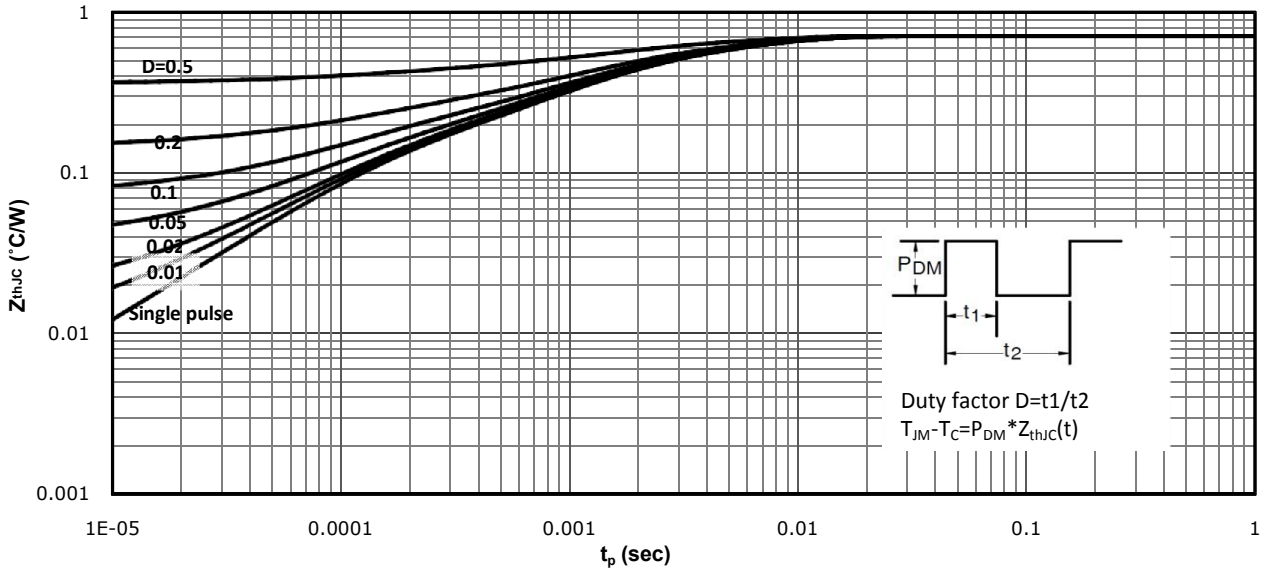




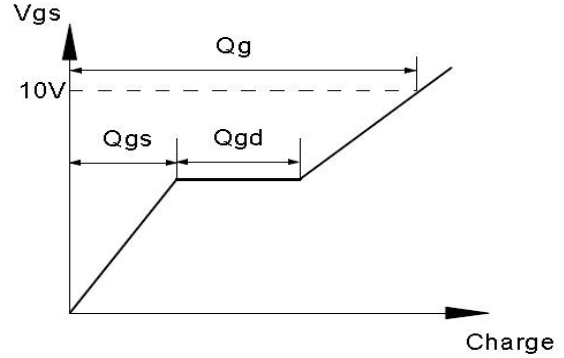
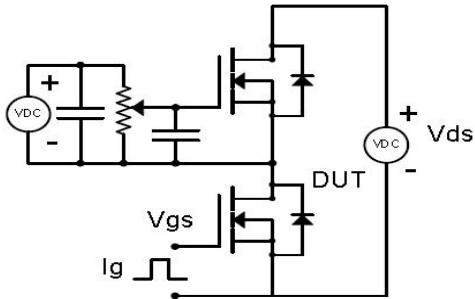
Fig 12: Max. Transient Thermal Impedance



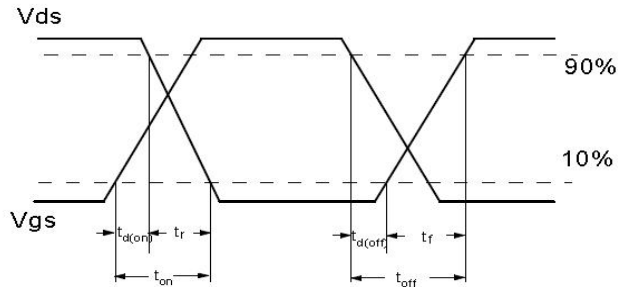
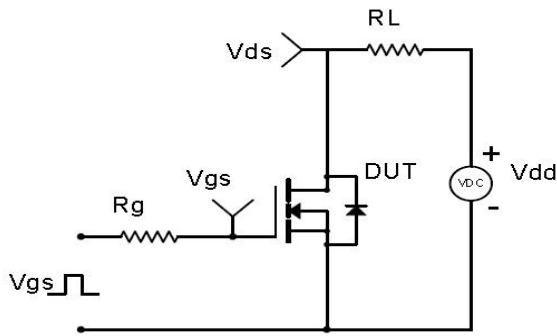


#### Test Circuit & Waveform

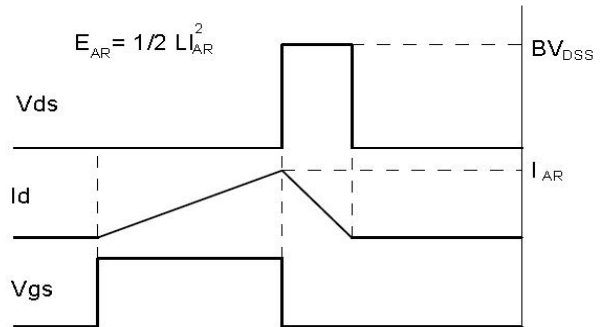
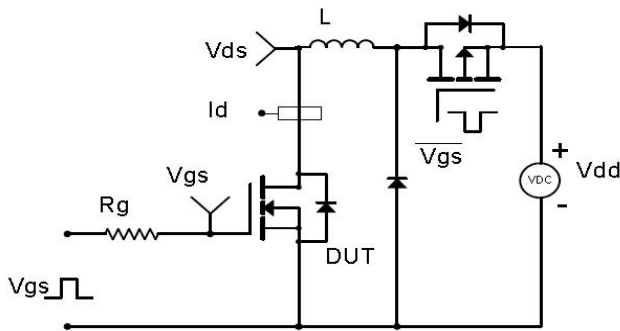
##### Gate Charge Test Circuit & Waveform



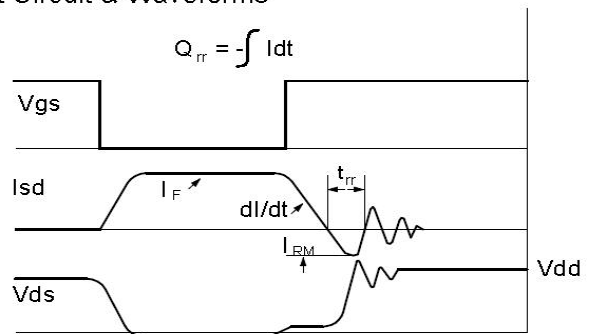
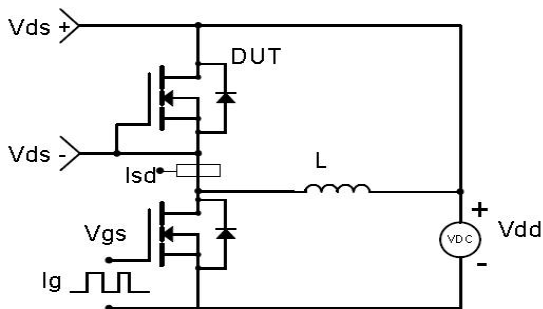
##### Resistive Switching Test Circuit & Waveforms



##### Unclamped Inductive Switching (UIS) Test Circuit & Waveforms

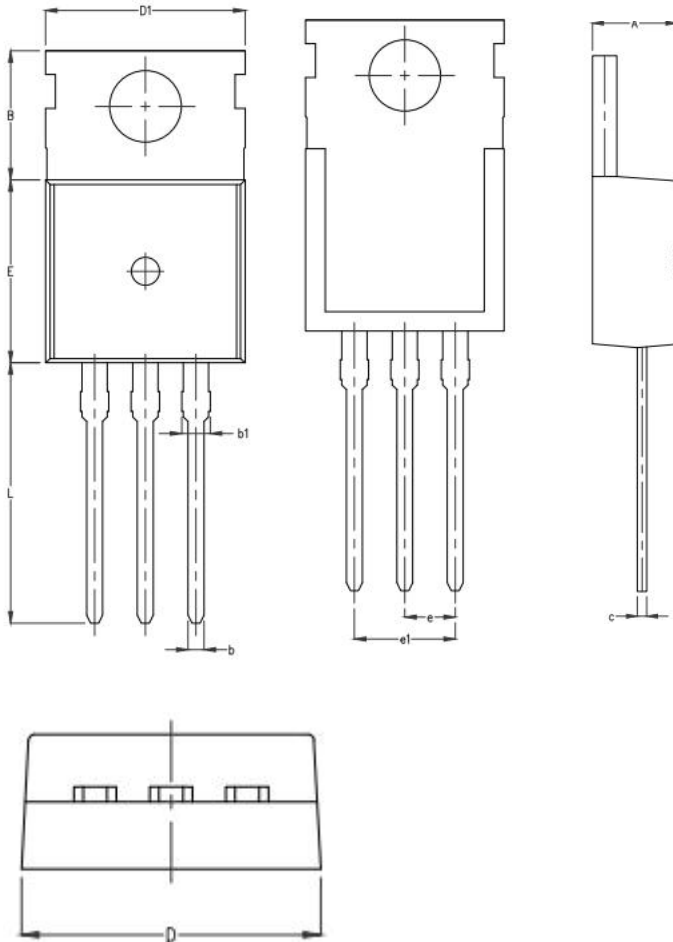


##### Diode Recovery Test Circuit & Waveforms





## TO-220 Package Information

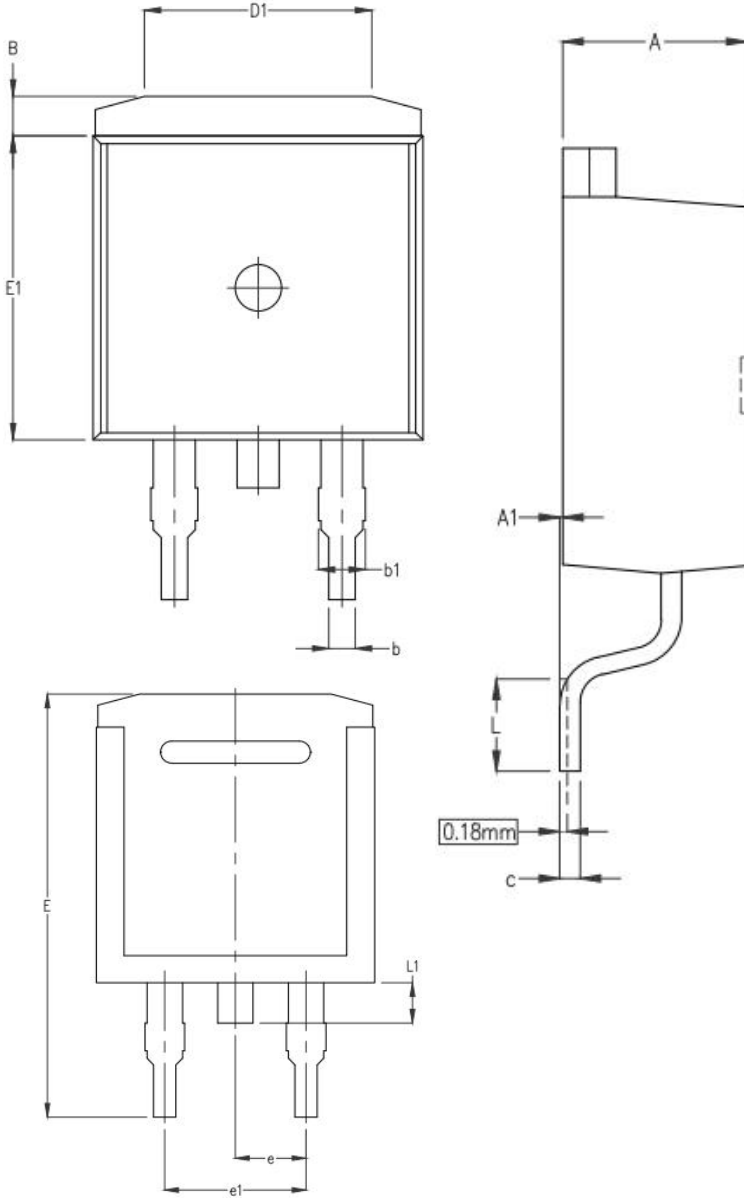


SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	4.45	4.50	4.55
B	6.40	6.50	6.60
b	0.80TYP.		
b1	1.24	1.27	1.30
c	0.48	0.50	0.52
D	9.95	10.00	10.05
D1	9.80	10.00	10.20
E	9.15	9.20	9.25
e	2.51	2.54	2.57
e1	5.05	5.08	5.11
L	12.95	13.10	13.25





TO-263 Package Information



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	4.45	4.50	4.55
A1	0	0.07	0.15
B	1.08	1.20	1.32
b	0.80TYP.		
b1	1.24	1.27	1.30
c	0.48	0.50	0.52
D	9.95	10.00	10.05
D1	6.89REF.		
E	15.09	15.24	15.39
E1	9.15	9.20	9.25
e	2.51	2.54	2.57
e1	5.05	5.08	5.11
L	2.29	2.54	2.79