

# 650V N-Channel Planar MOSFET

## MOSFET

Metal Oxide Semiconductor Field Effect Transistor

## 650V N-Channel Planar MOSFET

650V N-Channel Planar MOSFET Power Transistor

## DD65N04Ax Data Sheet

Rev. 2024 V1.0



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### Description

#### 650V N-Channel Planar MOSFET

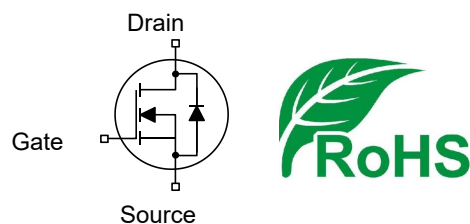
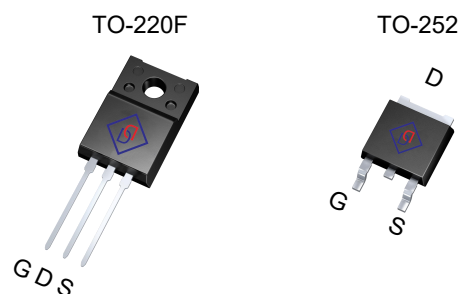
DD65N04Ax is HRM high voltage MOSFET family based on advanced planar stripe DMOS technology. This advanced MOSFET family has optimized on-state resistance, and also provides superior switching performance and higher avalanche energy strength. This device family is suitable for high efficiency switch mode power supplies.

### Features

- $R_{DS(on)}=2.7\Omega$  @ $V_{gs}=10V$ ,  $I_d=2A$
- Low gate Charge(typical 12.6nC)
- Low  $C_{rss}$  (typical 1.3pF)
- Fast switching capability
- 100% avalanche tested
- Improved dv/dt capability
- RoHS compliant

### Applications

- Switch Mode Power Supply
- Uninterruptible Power Supply (UPS)
- TV Power
- A dapter/Charger



### Key Performance Parameters

Parameter	Value	Unit
$V_{DS}$	650	V
$R_{DS(on),typ}$	2.7	$\Omega$
$Q_{g,typ}$	12.6	nC
$I_D$	4	A
$I_{D,pulse}$	16	A

### Device Marking and Package Information

Device	Package	Marking
DD65N04AFT	TO-220F	65N04AFT
DD65N04AD	TO-252	65N04AD

Absolute Maximum Ratings $T_C = 25^{\circ}\text{C}$ , unless otherwise noted				
Parameter		Symbol	Value	Unit
Drain-Source Voltage( $V_{GS}=0V$ )		$V_{DS}$	650	V
Continuous Drain Current <sup>1)</sup>	$T_C = 25^{\circ}\text{C}$	$I_D$	4	A
	$T_C = 100^{\circ}\text{C}$		2.4	
Pulsed Drain Current <sup>2)</sup>		$I_{D,pulse}$	16	A
Gate-Source Voltage		$V_{GS}$	$\pm 30$	V
Single Pulse Avalanche Energy <sup>3)</sup>		$E_{AS}$	208	mJ
Peak Diode Recovery $dv/dt$ <sup>4)</sup>		$dv/dt$	5	V/ns
Power Dissipation For TO-220F		$P_D$	26.7	W
Power Dissipation For    TO-252			34.4	
Continuous Diode Forward Current		$I_S$	4	A
Diode Pulsed Current <sup>2)</sup>		$I_{S,pulse}$	16	
Operating Junction and Storage Temperature Range		$T_J, T_{stg}$	-55~+150	$^{\circ}\text{C}$

Thermal Resistance For TO-220F			
Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	$R_{thJC}$	4.69	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient	$R_{thJA}$	80	

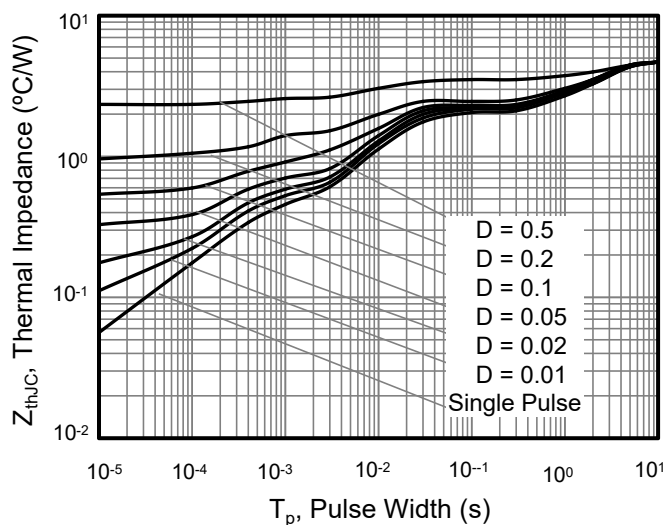
Thermal Resistance For TO-252			
Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	$R_{thJC}$	3.63	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient	$R_{thJA}$	62	

#### Notes

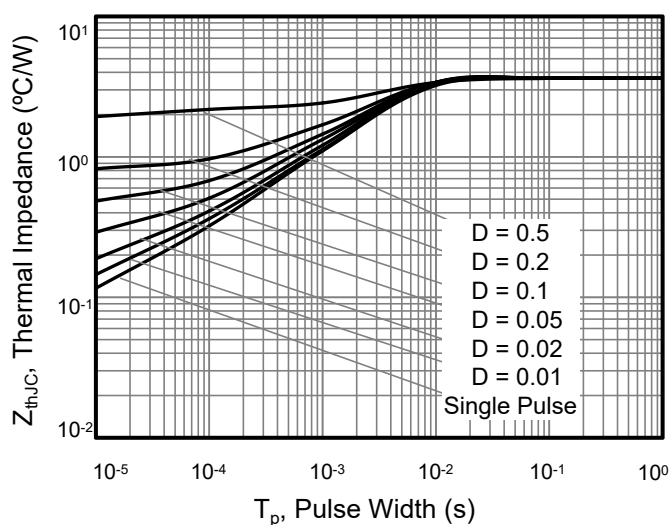
- 1) Limited by maximum junction temperature.
- 2) Repetitive Rating: Pulse width limited by maximum junction temperature.
- 3)  $L=26\text{mH}$ ,  $I_{AS}=4\text{A}$ ,  $R_G=25\Omega$ ,  $V_{DD}=80\text{V}$ , Start  $T_J=25^\circ\text{C}$ .
- 4)  $I_{SD} \leq 4\text{A}$ ,  $di/dt \leq 100\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Start  $T_J=25^\circ\text{C}$ .

Electrical Characteristics T <sub>J</sub> = 25°C, unless otherwise noted						
Parameter	Symbol	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
Static Characteristics						
Drain-Source Breakdown Voltage	V <sub>(BR)DSS</sub>	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA	650	--	--	V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 650V V <sub>GS</sub> = 0V, T <sub>J</sub> = 25°C	--	--	1	μA
		V <sub>DS</sub> = 650V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 150°C	--	--	100	
Gate-Source Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> = ±30V	--	--	±100	nA
Gate-Source Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA	2	--	4	V
Drain-Source On-State-Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10V, I <sub>D</sub> = 2A	--	2.7	3.1	Ω
Gate Resistance	R <sub>G</sub>	f = 1.0MHz open drain	--	1.4	--	Ω
Dynamic Characteristics						
Input Capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 25V f = 1.0MHz	--	537	--	pF
Output Capacitance	C <sub>oss</sub>		--	42	--	
Reverse Transfer Capacitance	C <sub>rss</sub>		--	1.3	--	
Total Gate Charge	Q <sub>g</sub>	V <sub>DD</sub> = 520V, I <sub>D</sub> = 4A V <sub>GS</sub> = 10V	--	12.6	--	nC
Gate-Source Charge	Q <sub>gs</sub>		--	4.2	--	
Gate-Drain Charge	Q <sub>gd</sub>		--	2.6	--	
Gate Plateau Voltage	V <sub>Plateau</sub>		--	4.9	--	V
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 325V, I <sub>D</sub> = 4A R <sub>G</sub> = 12Ω, V <sub>GS</sub> = 10V	--	14	--	ns
Turn-on Rise Time	t <sub>r</sub>		--	16	--	
Turn-off Delay Time	t <sub>d(off)</sub>		--	32	--	
Turn-off Fall Time	t <sub>f</sub>		--	11	--	
Drain-Source Body Diode Characteristics						
Body Diode Forward Voltage	V <sub>SD</sub>	T <sub>J</sub> = 25°C, I <sub>SD</sub> = 4A V <sub>GS</sub> = 0V	--	--	1.2	V
Reverse Recovery Time	t <sub>rr</sub>	V <sub>R</sub> = 520V I <sub>F</sub> = 4A, di <sub>F</sub> /dt = 100A/μs	--	256	--	ns
Reverse Recovery Charge	Q <sub>rr</sub>		--	1.2	--	μC

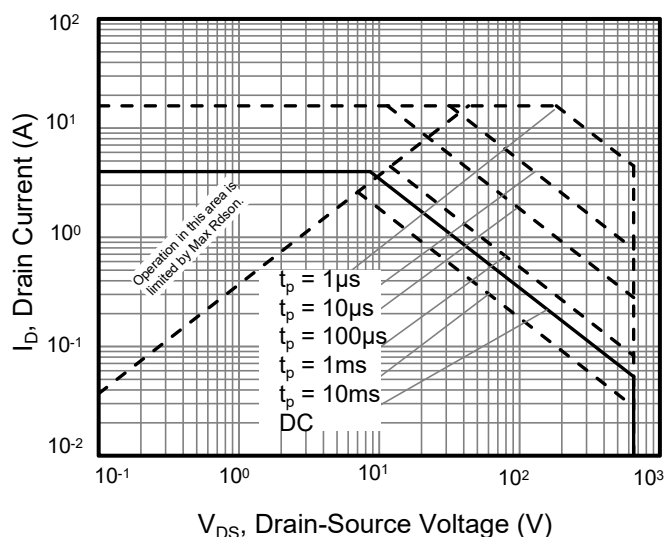
**Typical Characteristics**  $T_J = 25^\circ\text{C}$ , unless otherwise noted



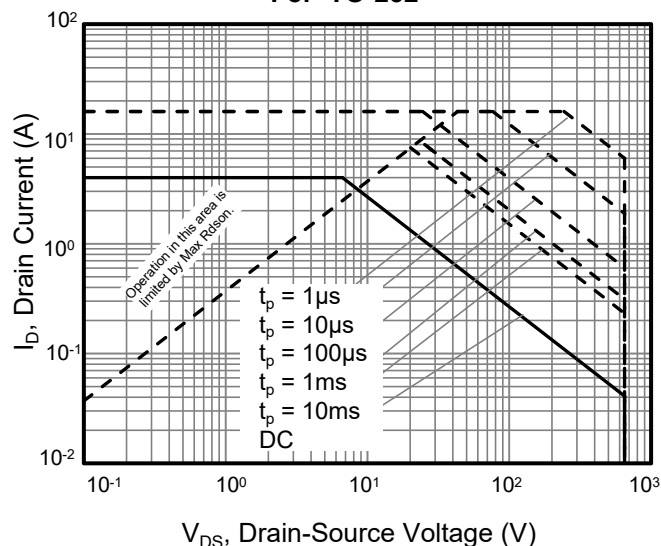
**Figure 1. Transient Thermal Impedance For TO-220F**



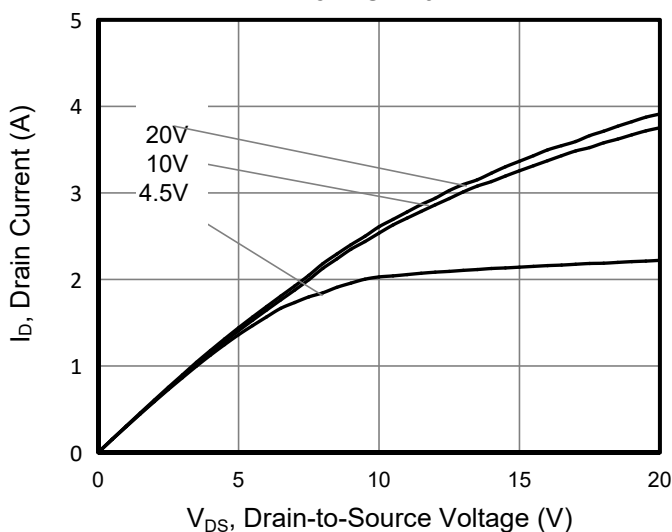
**Figure 2. Transient Thermal Impedance For TO-252**



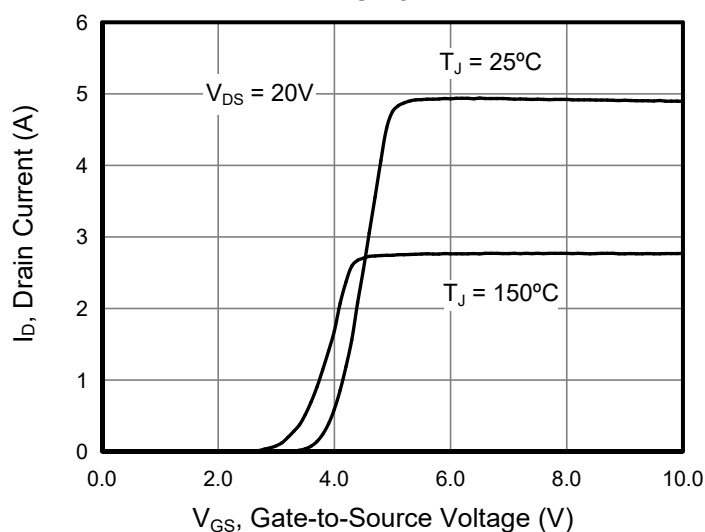
**Figure 3. Safe Operation Area For TO-220F**



**Figure 4. Safe Operation Area For TO-252**



**Figure 5. Output Characteristics**



**Figure 6. Transfer Characteristics**

Typical Characteristics  $T_J = 25^\circ\text{C}$ , unless otherwise noted

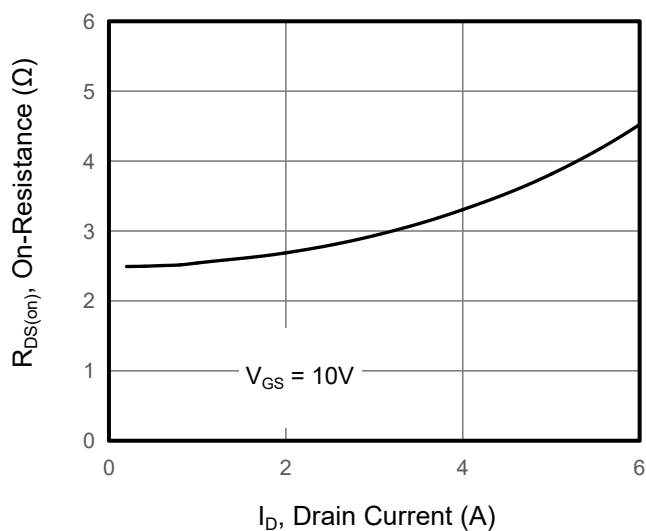


Figure 7. On-Resistance vs Drain Current

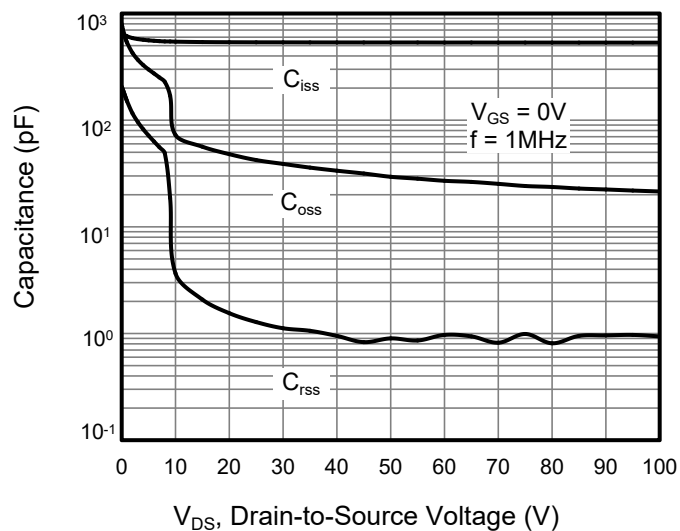


Figure 8. Capacitance

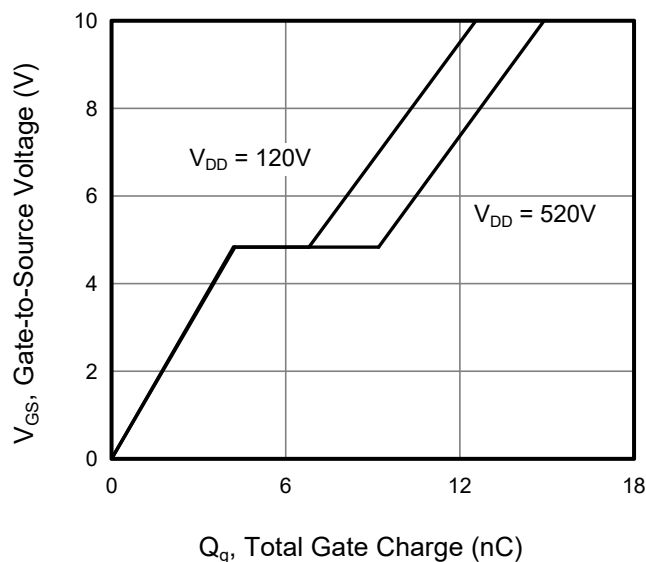


Figure 9. Gate Charge

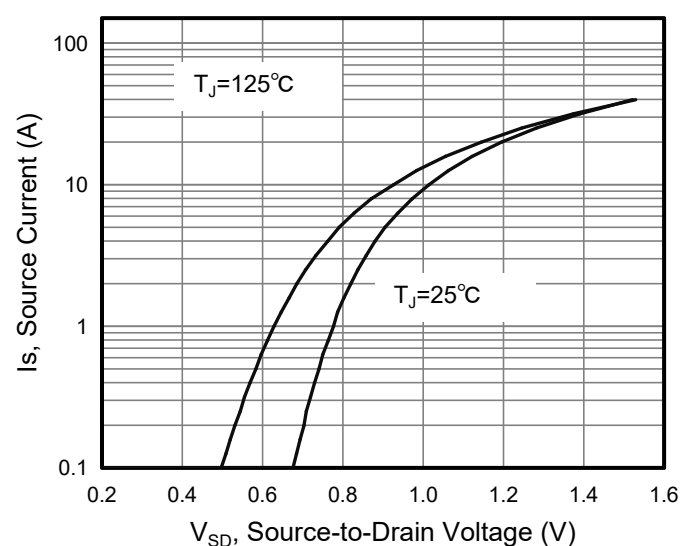


Figure 10. Body Diode Forward Voltage

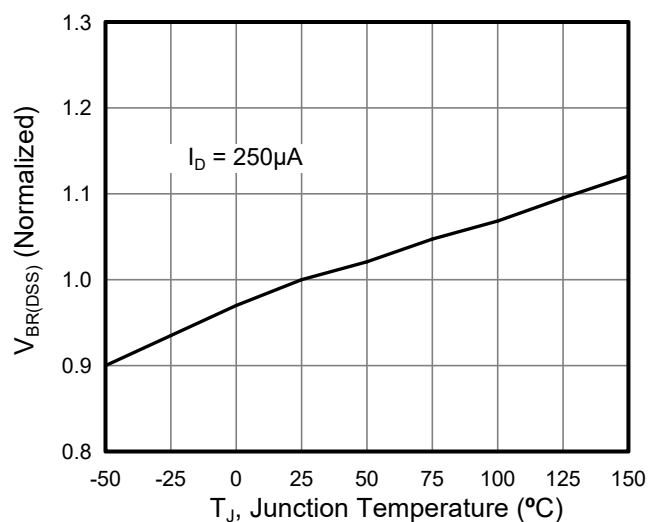


Figure 11. Breakdown Voltage vs Junction Temperature

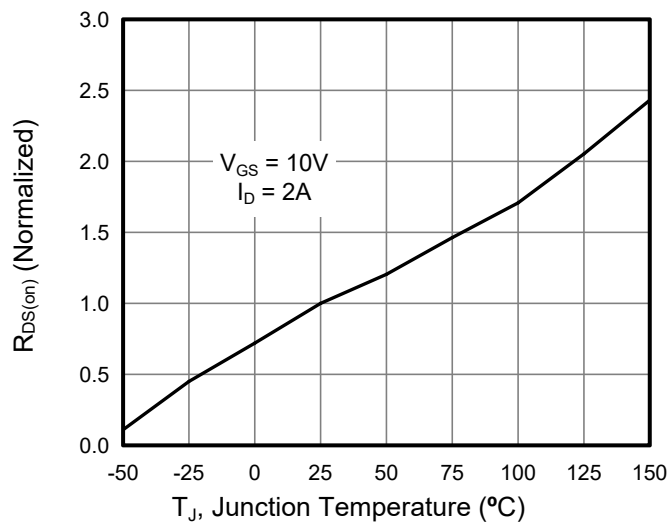


Figure 12. On-Resistance vs Temperature



Figure A: Gate Charge Test Circuit and Waveform

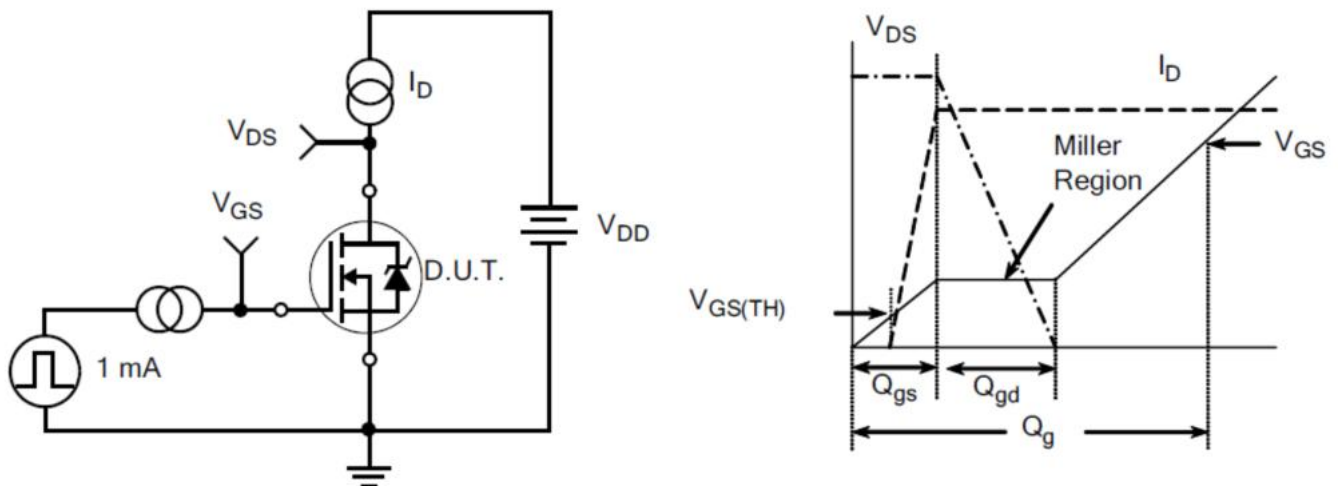


Figure B: Resistive Switching Test Circuit and Waveform

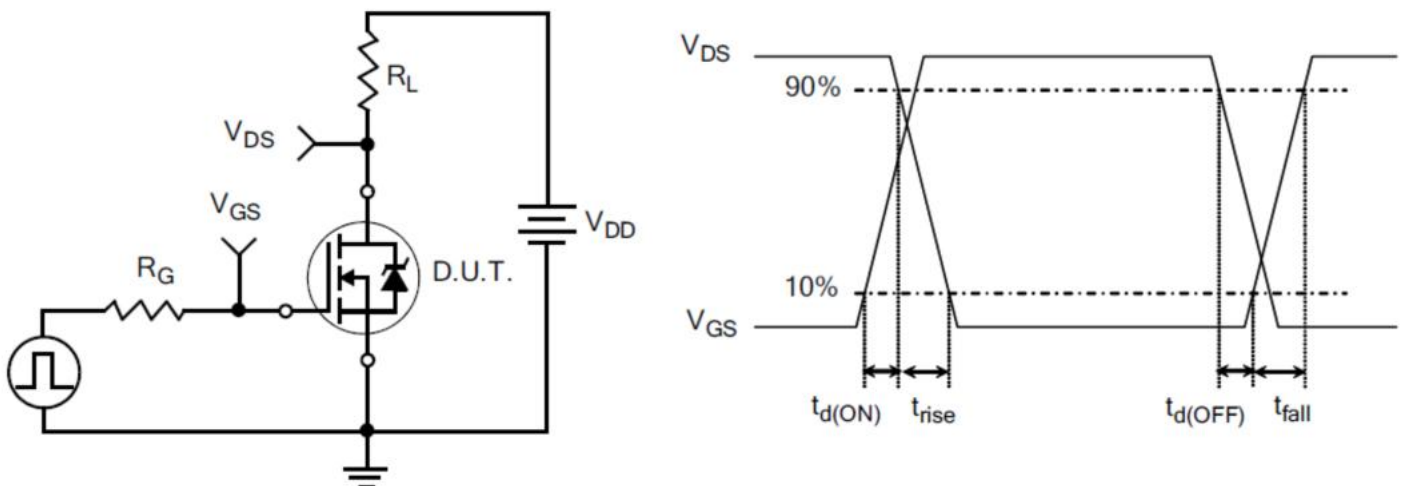
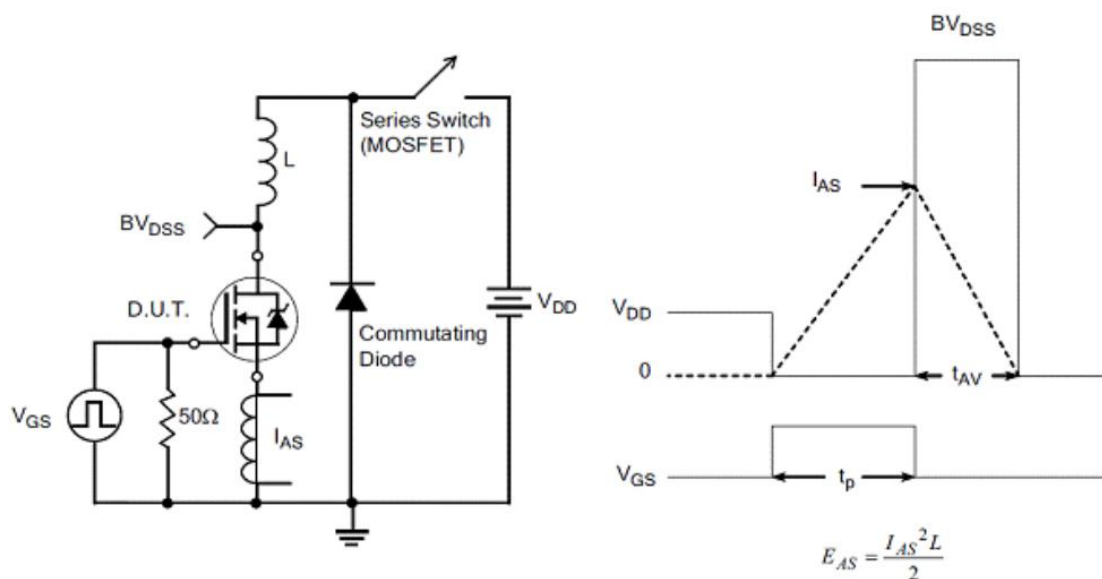
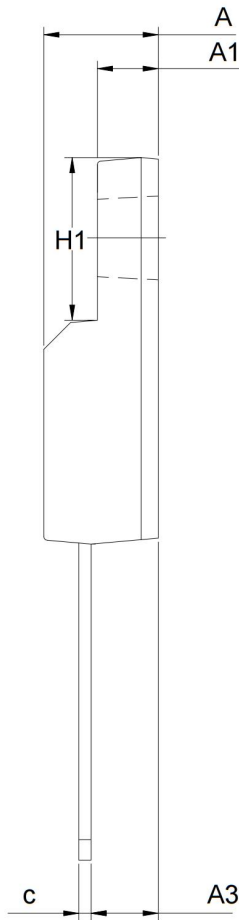
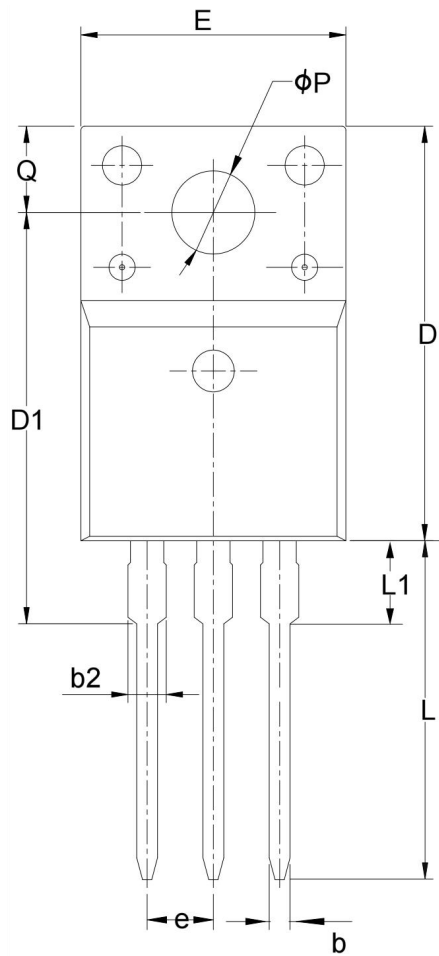


Figure C: Unclamped Inductive Switching Test Circuit and Waveform



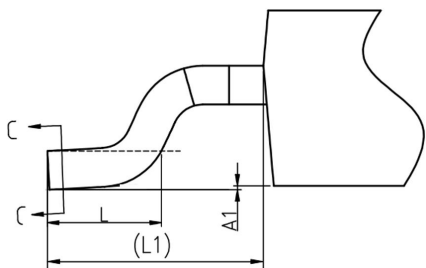
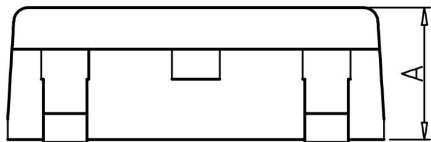
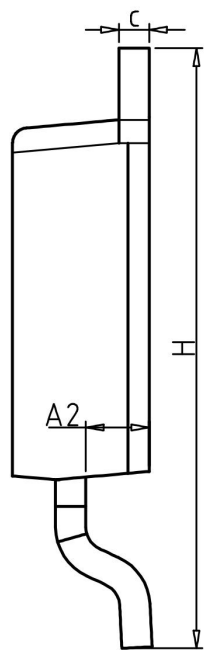
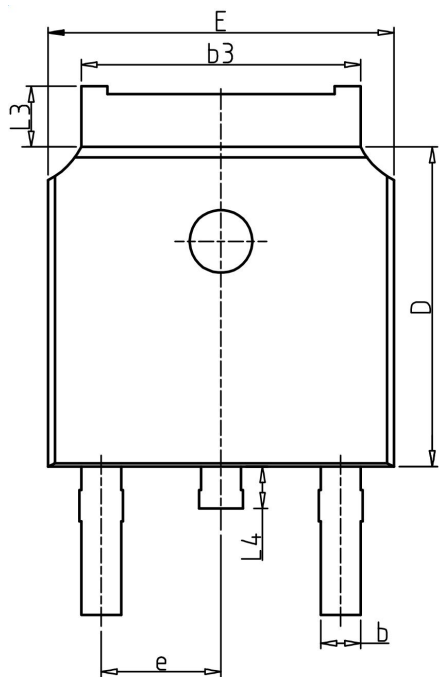
Outlines TO-220F Package



SYMBOL	Unit: mm	
	MIN	MAX
A	4.45	4.9
A1	2.3	2.8
A3	2.5	3.03
b	0.65	0.95
b2	1.28	1.56
c	0.4	0.65
D	15.5	16.24
D1	15.27	16.07
E	9.91	10.36
e	2.54BSC	
H1	6.48	6.88
L	12.5	13.6
L1	2.6	3.5
$\phi P$	3.03	3.48
Q	3.1	3.5



Outlines TO-252 Package



SYMBOL	Unit: mm	
	MIN	MAX
A	2.1	2.5
A1	0	0.2
A2	0.88	1.17
b	0.5	0.9
b3	5.1	5.53
c	0.4	0.62
D	5.4	6.4
E	6.3	6.9
e	2.286BSC	
H	9.25	10.5
L	1.35	1.8
L1	2.4	3.4
L3	0.82	1.412
L4	0.5	1



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