

N-Channel Super-junction MOSFET Gen I

MOSFET

Metal Oixde Semiconductor Field Effect Transistor

650V Super-junction Gen I

650V Super-junction Gen I Power Transistor

HRM65R380D,HRM65R380F Data Sheet

Rev. 2020 V1.0



650V Super-junction Power MOSFET Gen I

Description

650V Super-junction MOSFET Gen I

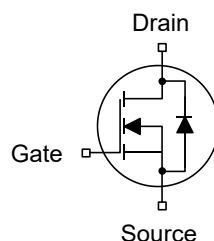
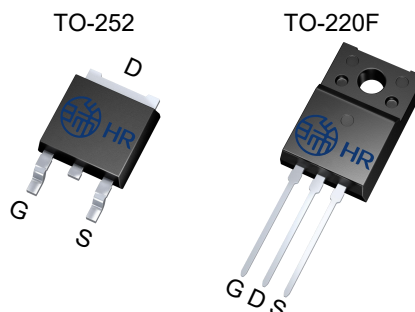
Super-junction MOSFET Gen I is designed by HR-Micro Semiconductor Company, according to the SJ principle. This device provides an excellent Gate charge and $R_{DS(on)}$, which leads to extremely low communication and conduction losses. So it is very suitable for AC/DC power conversion, Laptop adapter, Lighting, and industrial power applications.

Features

- Very low FOM $R_{DS(on)} \times Q_g$
- 100% avalanche tested
- Easy to use/drive
- RoHS compliant

Applications

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC)
- Charger



Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	700	V
$R_{DS(on),max}$	0.38	Ω
$Q_{g,typ}$	23.1	nC
I_D	11	A
$I_{D,pulse}$	33	A
$E_{OSS} @ 400V$	2.29	μJ
Body Diode di_f/dt	500	A/ μs

Device Marking and Package Information

Device	Package	Marking
HRM65R380D	TO-252	65R380D
HRM65R380F	TO-220F	65R380F

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 ¹⁾	$T_C = 25^{\circ}\text{C}$	I_D	11	A
	$T_C = 100^{\circ}\text{C}$		6.6	
Pulsed Drain Current ²⁾		$I_{D,pulse}$	33	A
Gate-Source Voltage		V_{GS}	± 30	V
Single Pulse Avalanche Energy		E_{AS}	215	mJ
Repetitive Avalanche Energy		E_{AR}	0.32	mJ
Avalanche Current		I_{AR}	1.8	A
MOSFET dv/dt Ruggedness, $V_{DS} = 0...480V$		dv/dt	50	V/ns
Power Dissipation For TO-252		P_D	83	W
Power Dissipation For TO-220F			31	
Continuous Diode Forward Current		I_S	9.35	A
Diode Pulsed Current ²⁾		$I_{S,pulse}$	33	
Reverse Diode dv/dt ³⁾		dv/dt	15	V/ns
Maximum Diode Commutation Speed		di_f/dt	500	A/ μs
Operating Junction and Storage Temperature Range		T_J, T_{stg}	-55~+150	$^{\circ}\text{C}$

Thermal Resistance For TO-252			
Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	R_{thJC}	1.5	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient	R_{thJA}	62	

Thermal Resistance For TO-220F			
Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	R_{thJC}	4	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient	R_{thJA}	80	

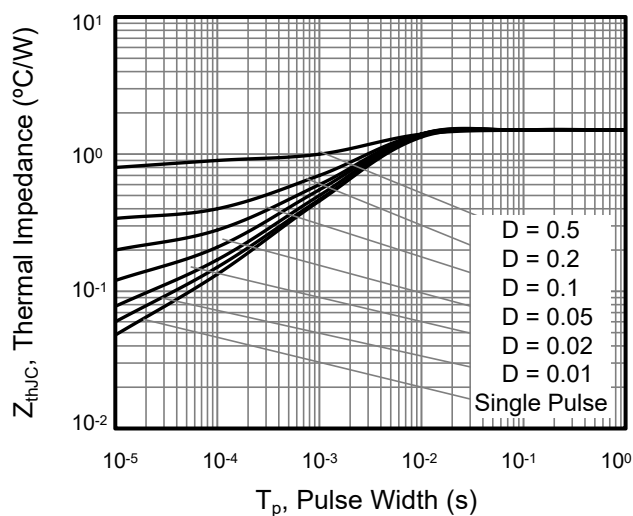
Notes

- 1) Limited by maximum junction temperature.
- 2) Repetitive Rating: Pulse width limited by maximum junction temperature.
- 3) Identical low side and high side switch with identical R_G .

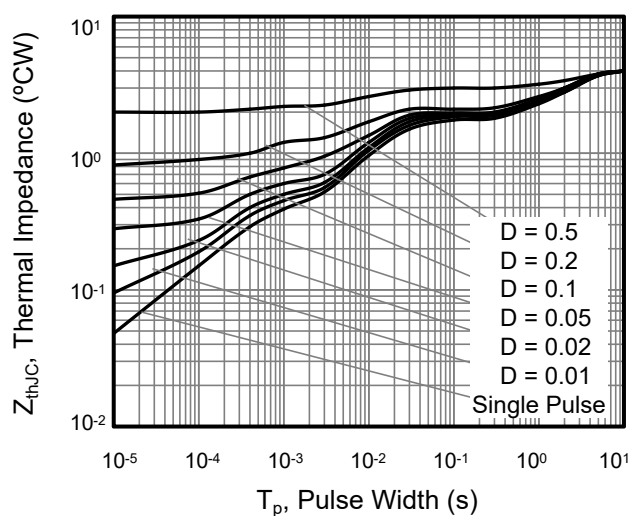
Electrical Characteristics T _J = 25°C, unless otherwise noted						
Parameter	Symbol	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
Static Characteristics						
Drain-Source Breakdown Voltage	V _{(BR)DSS}	V _{GS} = 0V, I _D = 250μA	650	--	--	V
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 650V V _{GS} = 0V, T _J = 25°C	--	--	1	μA
		V _{DS} = 650V, V _{GS} = 0V, T _J = 150°C	--	--	100	
Gate-Source Leakage Current	I _{GSS}	V _{GS} = ±30V	--	--	±100	nA
Gate-Source Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 250μA	3	3.5	4	V
Drain-Source On-State-Resistance	R _{DS(on)}	V _{GS} = 10V, I _D = 5.5A	--	0.34	0.38	Ω
Gate Resistance	R _G	f = 1.0MHz open drain	--	4.8	--	Ω
Dynamic Characteristics						
Input Capacitance	C _{iss}	V _{GS} = 0V, V _{DS} = 100V f = 1.0MHz	--	811	--	pF
Output Capacitance	C _{oss}		--	29	--	
Reverse Transfer Capacitance	C _{rss}		--	2.1	--	
Total Gate Charge	Q _g	V _{DD} = 520V , I _D = 11A V _{GS} = 10V	--	23.1	--	nC
Gate-Source Charge	Q _{gs}		--	6.6	--	
Gate-Drain Charge	Q _{gd}		--	9.0	--	
Gate Plateau Voltage	V _{Plateau}		--	6.0	--	V
Turn-on Delay Time	t _{d(on)}	V _{DD} = 400V,I _D = 11A R _G = 15Ω,V _{GS} = 10V	--	15	--	ns
Turn-on Rise Time	t _r		--	25	--	
Turn-off Delay Time	t _{d(off)}		--	80	--	
Turn-off Fall Time	t _f		--	35	--	
Drain-Source Body Diode Characteristics						
Body Diode Forward Voltage	V _{SD}	T _J = 25°C, I _{SD} = 5.5A, V _{GS} = 0V	--	0.9	1.2	V
Reverse Recovery Time	t _{rr}	V _R = 400V I _F = 5.5A, di _F /dt = 100A/μs	--	330	--	ns
Reverse Recovery Charge	Q _{rr}		--	2.8	--	μC
Peak Reverse Recovery Current	I _{rrm}		--	17	--	A

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

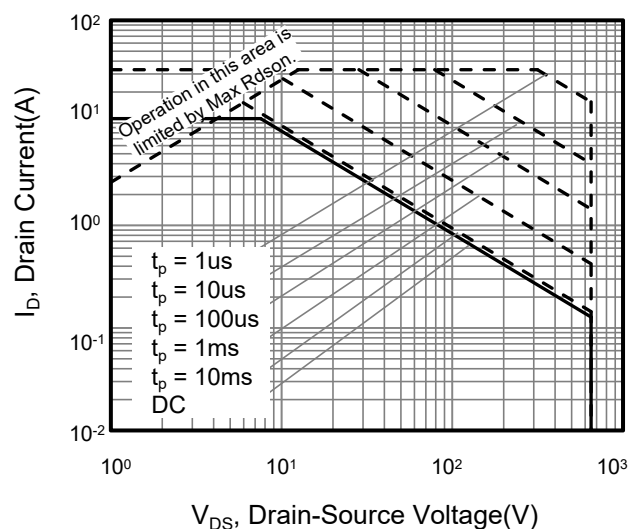
**Figure 1. Transient Thermal Impedance
For TO-252**



**Figure 2. Transient Thermal Impedance
For TO-220F**



**Figure 3. Safe Operation Area
For TO-252**



**Figure 4. Safe Operation Area
For TO-220F**

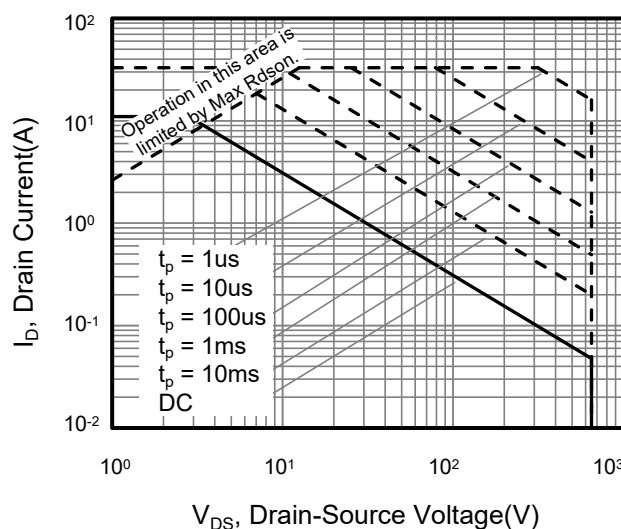


Figure 5. Output Characteristics

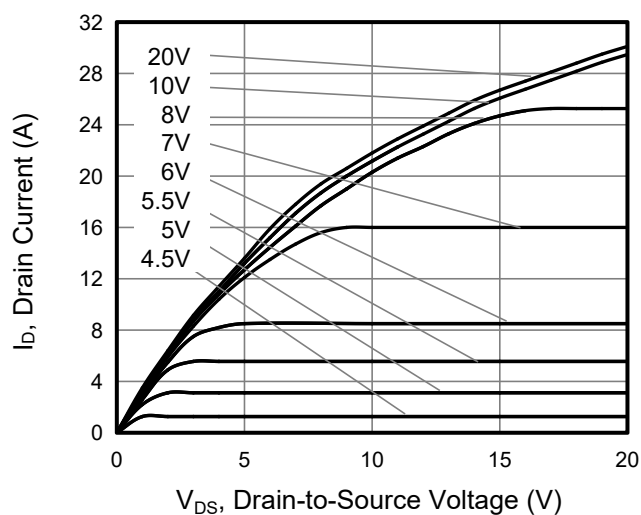
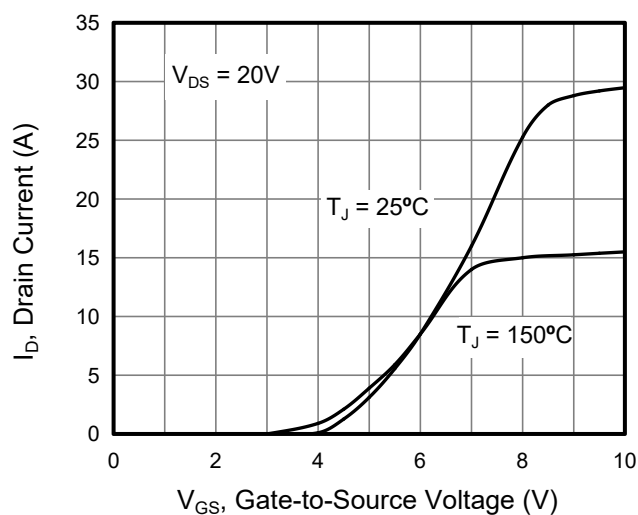


Figure 6. Transfer Characteristics



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

Figure 7. On-Resistance vs. Drain Current

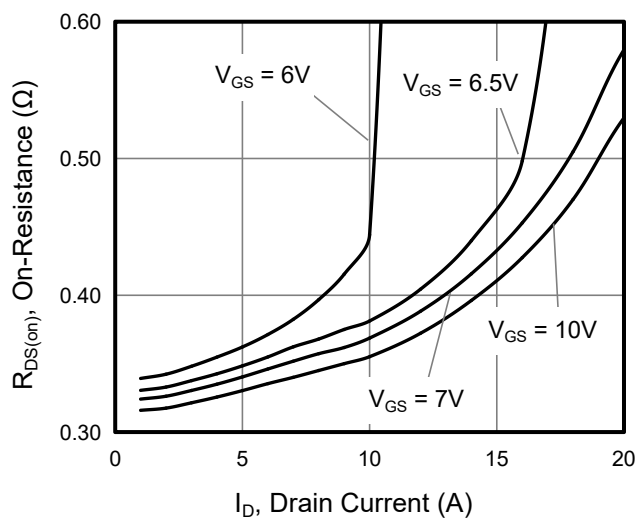


Figure 8. Capacitance

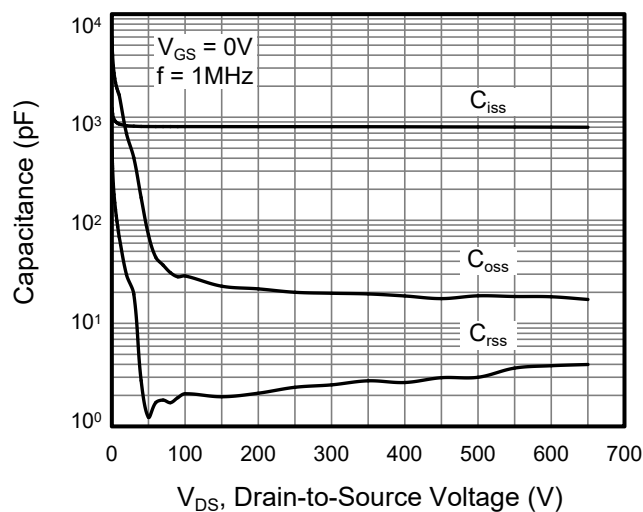


Figure 9. Gate Charge

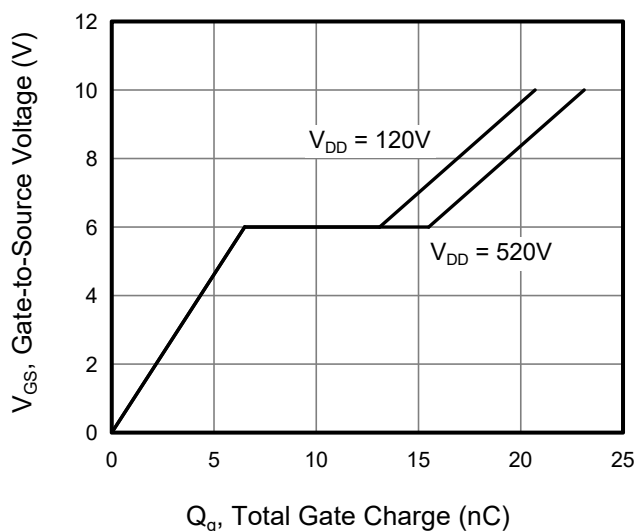


Figure 10. Body Diode Forward Voltage

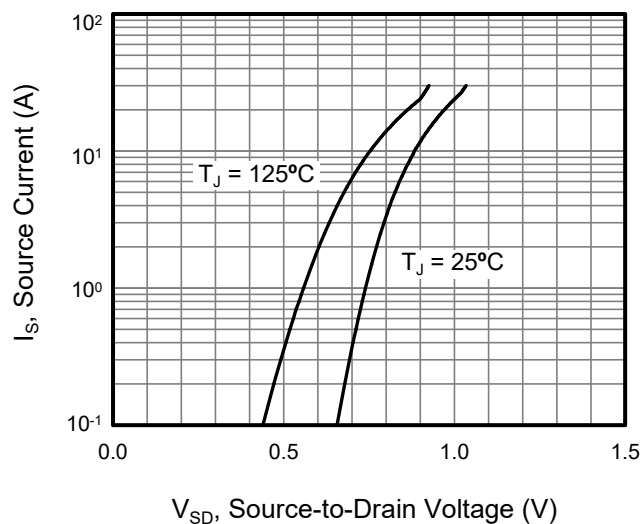


Figure 11. Typ. Coss Stored Energy

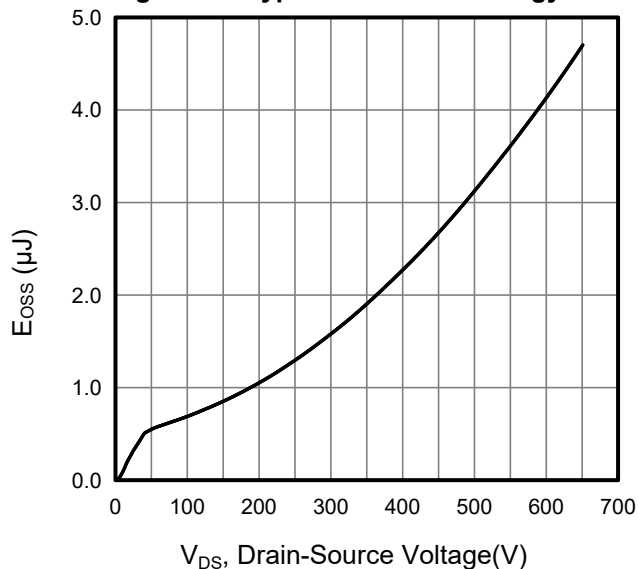
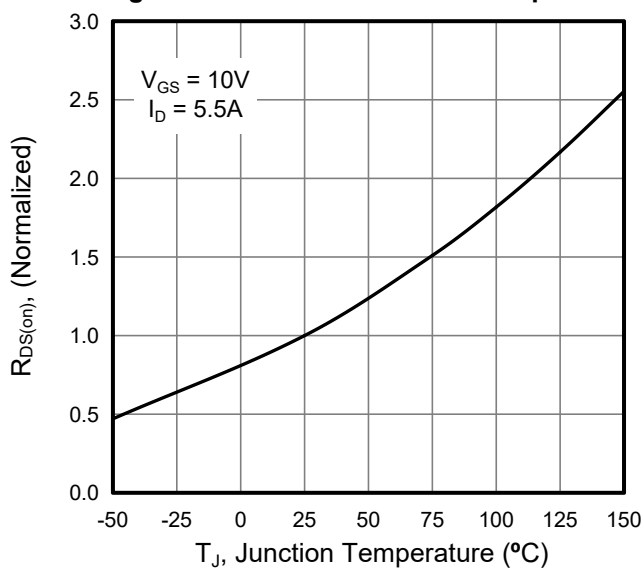


Figure 12. On-Resistance vs. Temperature



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

Figure 13. Breakdown Voltage vs. Junction Temperature

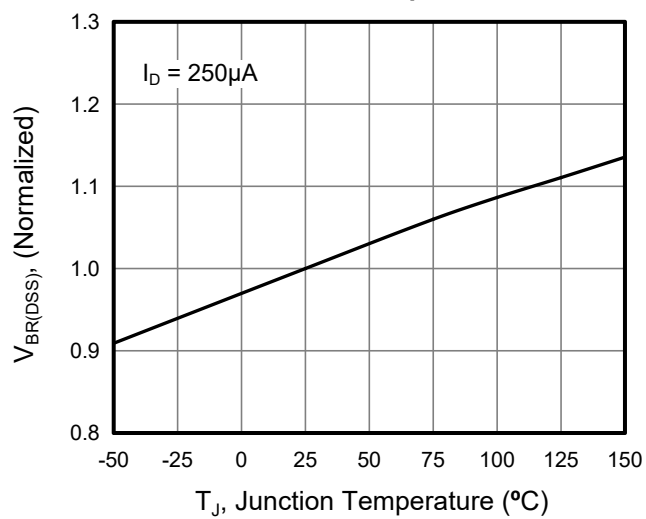


Figure A: Gate Charge Test Circuit and Waveform

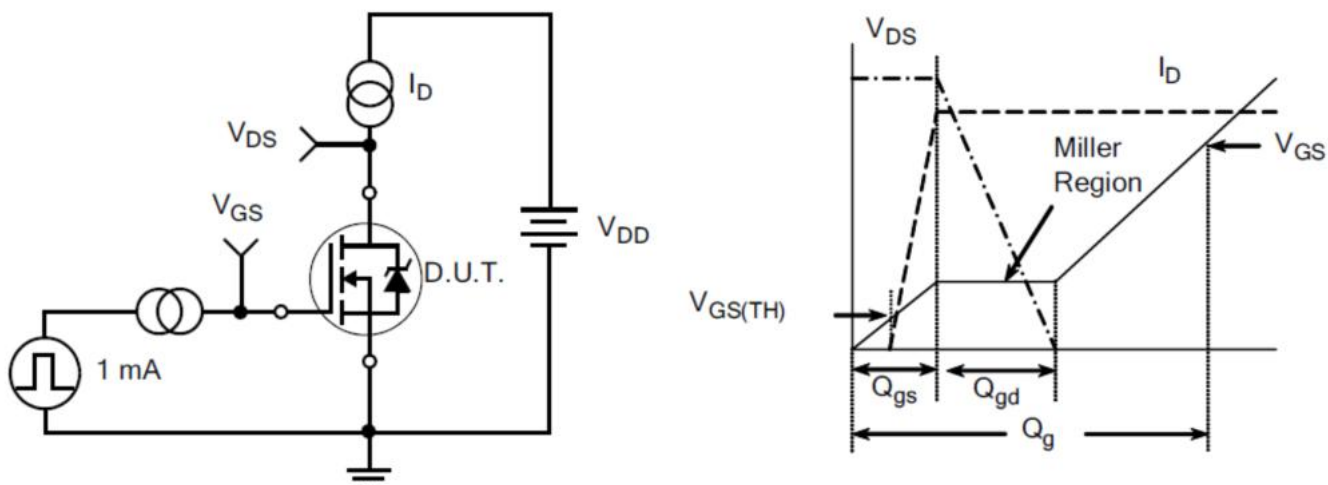


Figure B: Resistive Switching Test Circuit and Waveform

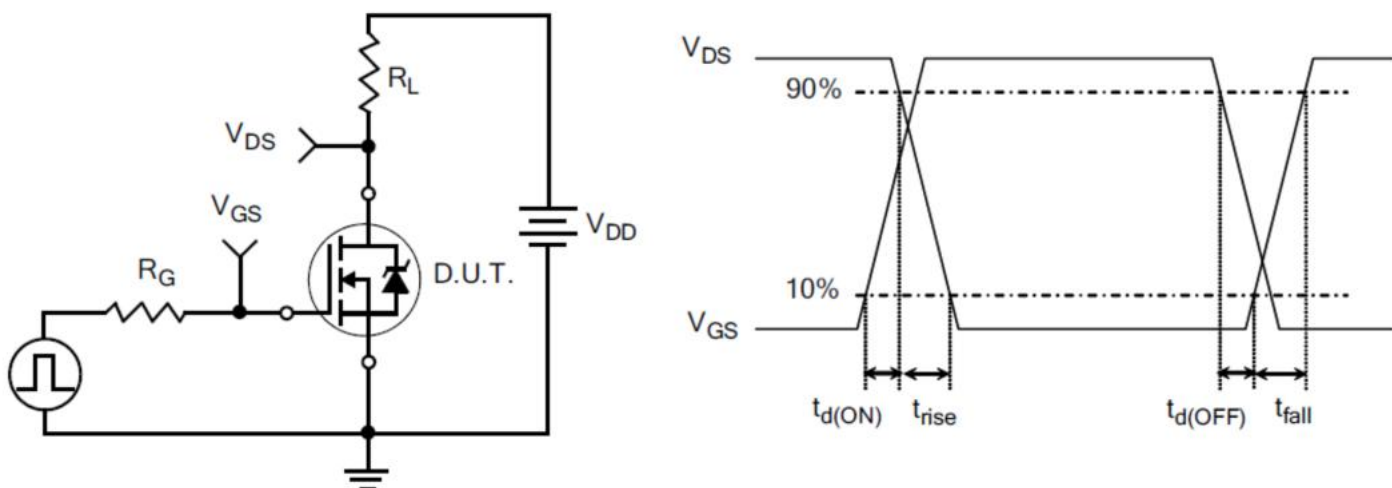
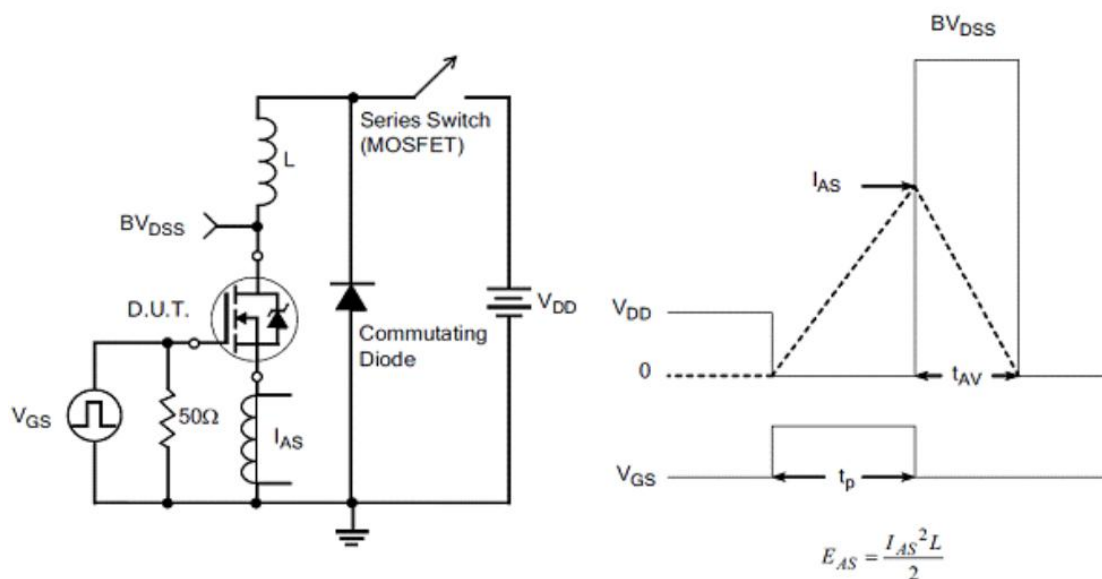
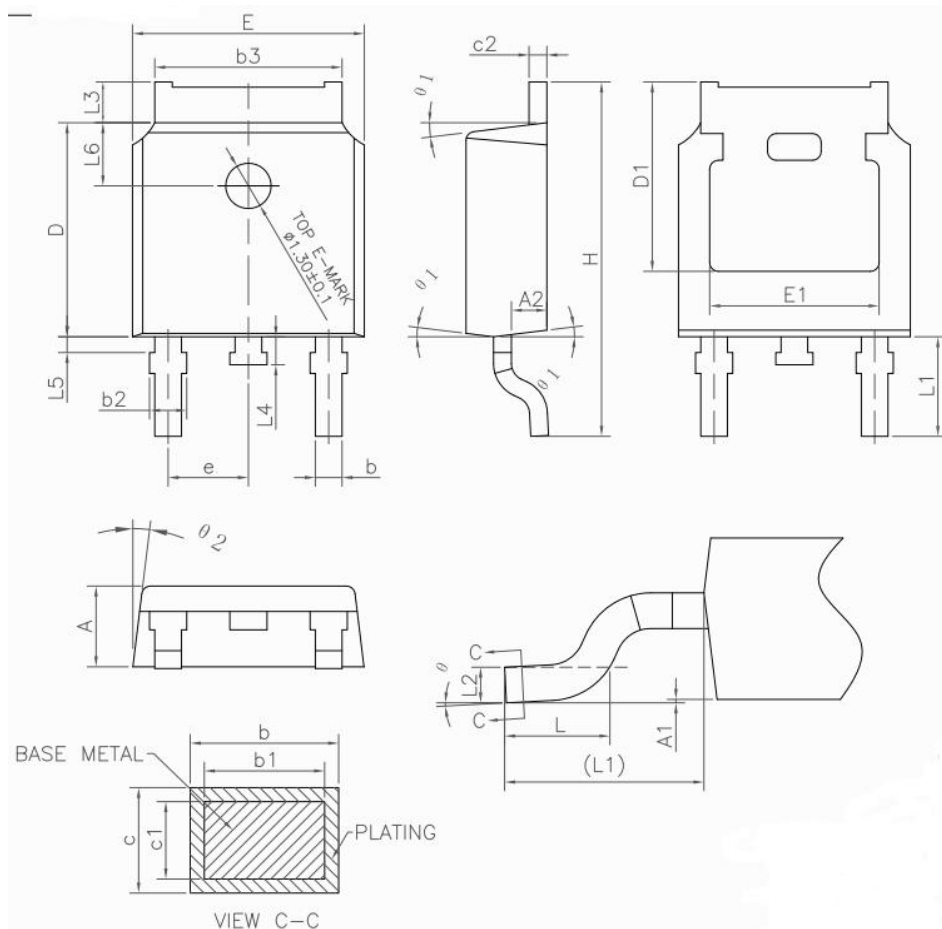


Figure C: Unclamped Inductive Switching Test Circuit and Waveform



TO-252



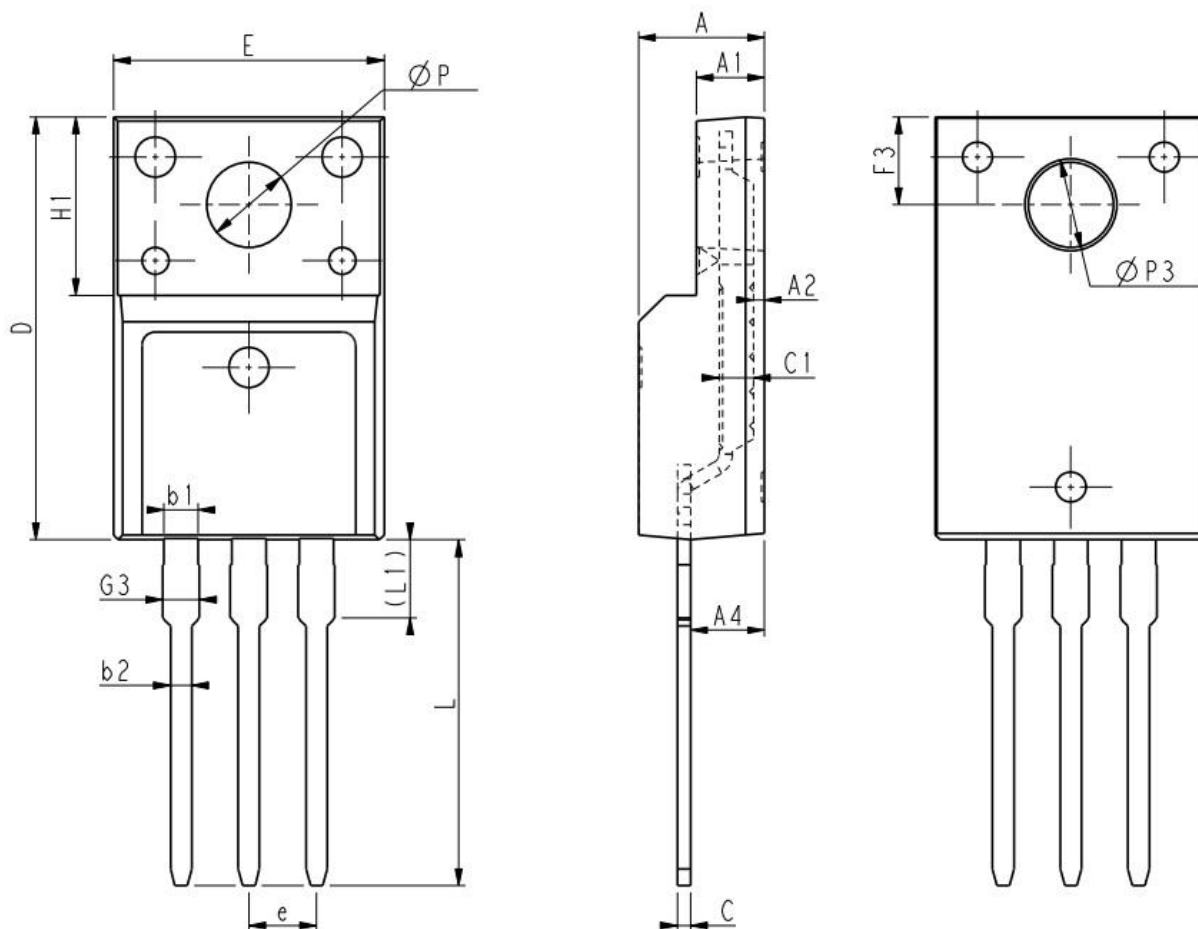
Unit:mm			
Symbol	Min.	Nom	Max.
A	2.20	2.30	2.38
A1	0.00	-	0.20
A2	0.90	1.01	1.10
b	0.72	--	0.85
b1	0.71	0.76	0.81
b2	0.72	--	0.90
b3	5.13	5.33	5.46
c	0.47	--	0.60
c1	0.46	0.51	0.56
c2	0.47	--	0.60
D	6.00	6.10	6.20
D1	5.25	--	--
E	6.50	6.60	6.70

Unit:mm			
Symbol	Min.	Nom	Max.
E1	4.70	--	--
e	2.186	2.286	2.386
H	9.80	10.10	10.40
L	1.40	1.50	1.70
L1	2.90 REF		
L2	0.508 BSC		
L3	0.90	--	1.25
L4	0.60	0.80	1.00
L5	0.15	--	0.75
L6	1.80 REF		
θ	0°	-	8°
θ_1	5°	7°	9°
θ_2	5°	7°	9°

Ordering information For TO-252

Package	Units/Tape	Tapes/ Inner Box	Units/Inner Box	Inner Box/Carton Box	Units/Carton Box
TO-252	2500	2	5000	5	25000

TO-220F



Unit:mm			
Symbol	Min.	Nom	Max.
E	9.70	10.16	10.30
A	4.40	4.70	4.80
A1	2.50	2.54	2.90
A2	0.55	0.65	0.75
A4	2.25	2.35	2.45
c	0.40	0.50	0.60
c1	1.20	1.30	1.35
D	15.50	15.87	16.10

Unit:mm			
Symbol	Min.	Nom	Max.
H1	6.70REF		
e	2.34	2.54	2.74
L	12.60	12.98	13.60
L3	3.40	3.49	3.80
ΦP	3.00	3.18	3.30
ΦP3	3.45REF		
F3	3.20	3.30	3.40
G3	1.12	1.28	1.42
b1	1.23	1.20	1.38
b2	0.70	0.80	0.90

Ordering information For TO-220F

Package	Units/Tube	Tubes/ Inner Box	Units/Inner Box	Inner Box/Carton Box	Units/Carton Box
TO-220F	50	40	2000	4	8000

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