

## N-Channel Super Junction Power MOSFET II

### General Description

The series of devices use advanced super junction technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. This super junction MOSFET fits the industry's AC-DC SMPS requirements for PFC, AC/DC power conversion, and industrial power applications.

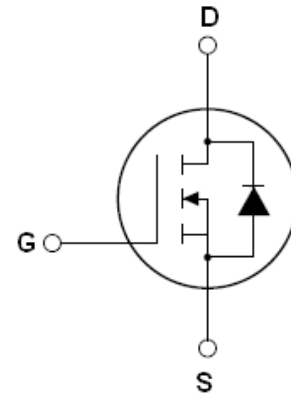
### Features

- New technology for high voltage device
- Low on-resistance and low conduction losses
- small package
- Ultra Low Gate Charge cause lower driving requirements
- 100% Avalanche Tested
- ROHS compliant

### Application

- Power factor correction (PFC)
- Switched mode power supplies(SMPS)
- Uninterruptible Power Supply (UPS)

$V_{DS@T_{jmax}}$	650	V
$R_{DS(ON)MAX}$	360	mΩ
$I_D$	11	A



Schematic diagram

### Package Marking And Ordering Information

Device	Device Package	Marking
NCE60R360K	TO-252	NCE60R360K



TO-252

Table 1. Absolute Maximum Ratings ( $T_C=25^\circ\text{C}$ )

Parameter	Symbol	Value	Unit
Drain-Source Voltage ( $V_{GS}=0V$ )	$V_{DS}$	600	V
Gate-Source Voltage ( $V_{DS}=0V$ )	$V_{GS}$	$\pm 30$	V
Continuous Drain Current at $T_C=25^\circ\text{C}$	$I_{D(DC)}$	11	A
Continuous Drain Current at $T_C=100^\circ\text{C}$	$I_{D(DC)}$	7	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	33	A
Maximum Power Dissipation( $T_C=25^\circ\text{C}$ )	$P_D$	121	W
Derate above $25^\circ\text{C}$		0.97	W/ $^\circ\text{C}$
Single pulse avalanche energy (Note2)	$E_{AS}$	280	mJ
Avalanche current (Note 1)	$I_{AR}$	5.5	A
Repetitive Avalanche energy , $t_{AR}$ limited by $T_{jmax}$ (Note 1)	$E_{AR}$	0.5	mJ

Parameter	Symbol	Value		Unit
Drain Source voltage slope, $V_{DS} \leq 480V$ ,	dv/dt	50	V/ns	
Reverse diode dv/dt, $V_{DS} \leq 480V, I_{SD} < I_D$	dv/dt	15	V/ns	
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55...+150		°C

\* limited by maximum junction temperature

**Table 2. Thermal Characteristic**

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Maximum)	$R_{thJC}$	1.03	°C / W
Thermal Resistance, Junction-to-Ambient (Maximum)	$R_{thJA}$	62	°C / W

**Table 3. Electrical Characteristics (TA=25°C unless otherwise noted)**

Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>On/off states</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	600			V
Zero Gate Voltage Drain Current( $T_c=25^\circ C$ )	$I_{DSS}$	$V_{DS}=600V, V_{GS}=0V$		0.05	1	$\mu A$
Zero Gate Voltage Drain Current( $T_c=125^\circ C$ )	$I_{DSS}$	$V_{DS}=600V, V_{GS}=0V$			100	$\mu A$
Gate-Body Leakage Current	$I_{GSS}$	$V_{GS}=\pm 30V, V_{DS}=0V$			$\pm 100$	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	2.5	3	3.5	V
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=7A$		300	360	m $\Omega$
<b>Dynamic Characteristics</b>						
Forward Transconductance	$g_{FS}$	$V_{DS} = 20V, I_D = 7A$		8		S
Input Capacitance	$C_{iss}$	$V_{DS}=50V, V_{GS}=0V,$ $F=1.0MHz$		1030		pF
Output Capacitance	$C_{oss}$			87		pF
Reverse Transfer Capacitance	$C_{riss}$			4.5		pF
Total Gate Charge	$Q_g$	$V_{DS}=480V, I_D=11A,$ $V_{GS}=10V$		23	40	nC
Gate-Source Charge	$Q_{gs}$			5.7		nC
Gate-Drain Charge	$Q_{gd}$			8		nC
Intrinsic gate resistance	$R_G$	$f = 1 MHz$ open drain		2		$\Omega$
<b>Switching times</b>						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=5.5A,$ $R_G=6.8\Omega, V_{GS}=10V$		9		nS
Turn-on Rise Time	$t_r$			4		nS
Turn-Off Delay Time	$t_{d(off)}$			40	65	nS
Turn-Off Fall Time	$t_f$			4.5	8	nS
<b>Source- Drain Diode Characteristics</b>						
Source-drain current(Body Diode)	$I_{SD}$	$T_c=25^\circ C$			11	A
Pulsed Source-drain current(Body Diode)	$I_{SDM}$				33	A
Forward on voltage	$V_{SD}$	$T_j=25^\circ C, I_{SD}=11A, V_{GS}=0V$		0.9	1.2	V
Reverse Recovery Time	$t_{rr}$	$T_j=25^\circ C, I_F=11A, di/dt=100A/\mu s$		245		nS
Reverse Recovery Charge	$Q_{rr}$			2.4		$\mu C$
Peak Reverse Recovery Current	$I_{rrm}$			20		A

Notes: 1.Repetitive Rating: Pulse width limited by maximum junction temperature

2.  $T_j=25^\circ C, V_{DD}=50V, V_G=10V, R_G=25\Omega$

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

Figure1. Safe operating area

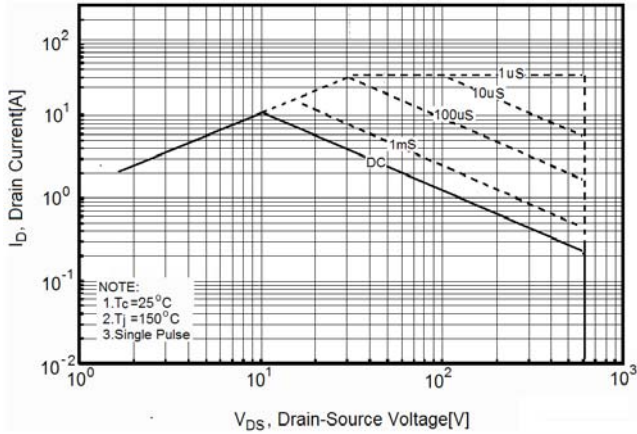


Figure2. Transient Thermal Impedance

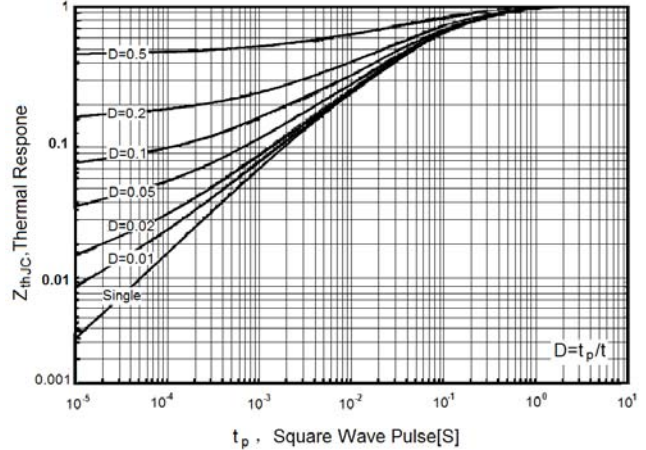


Figure3. Source-Drain Diode Forward Voltage

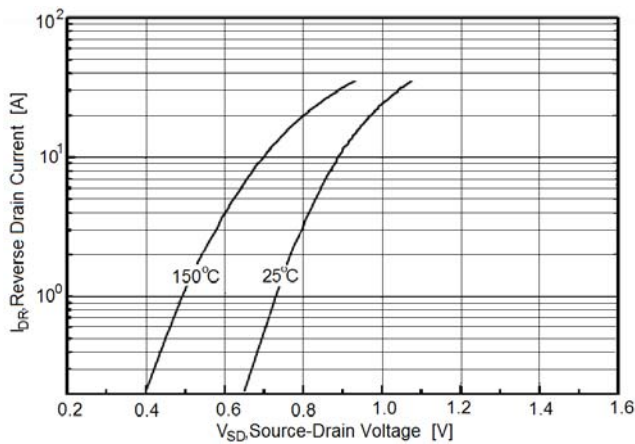


Figure4. Output characteristics

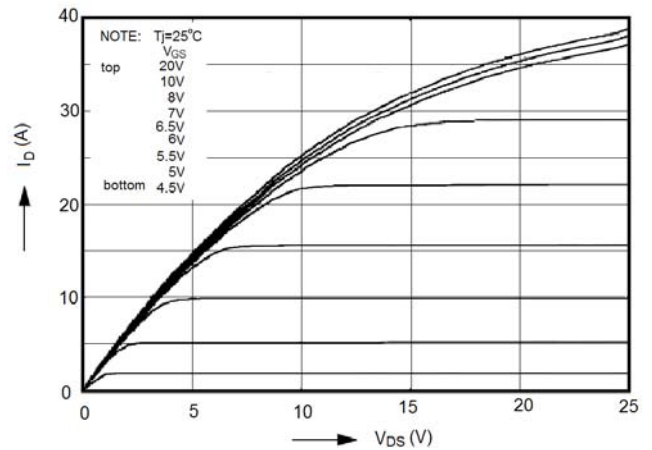


Figure5. Transfer characteristics

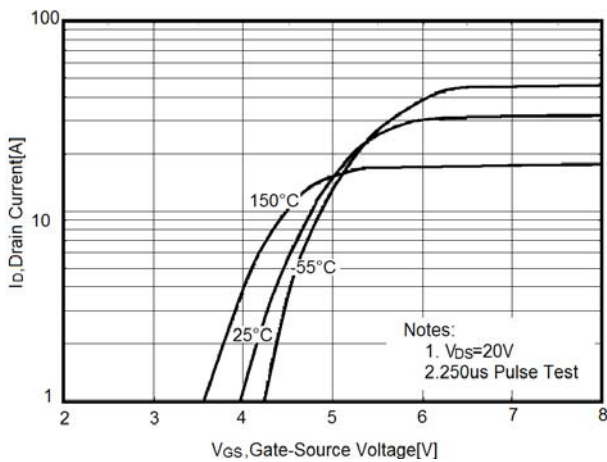
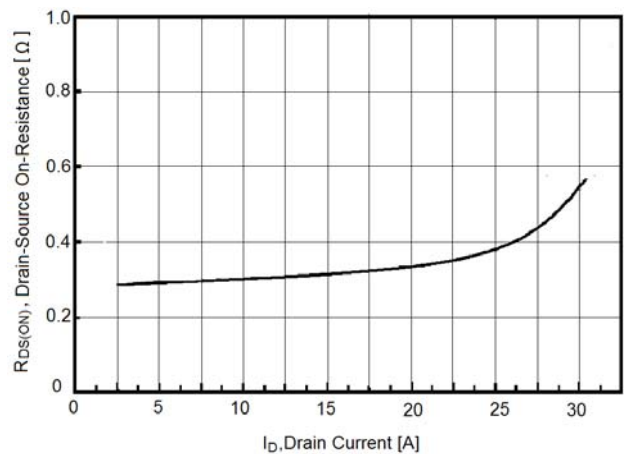
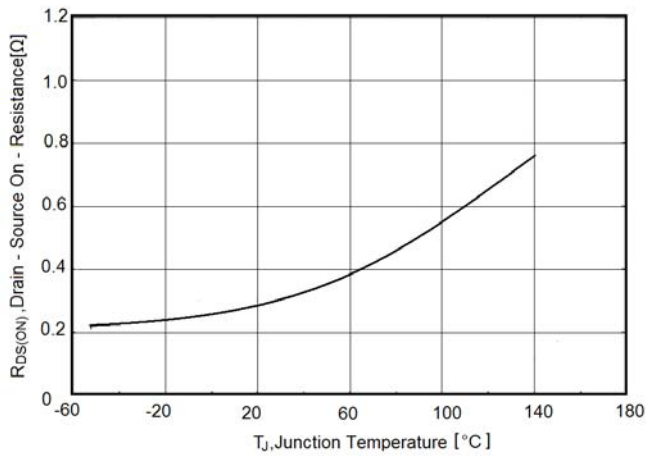


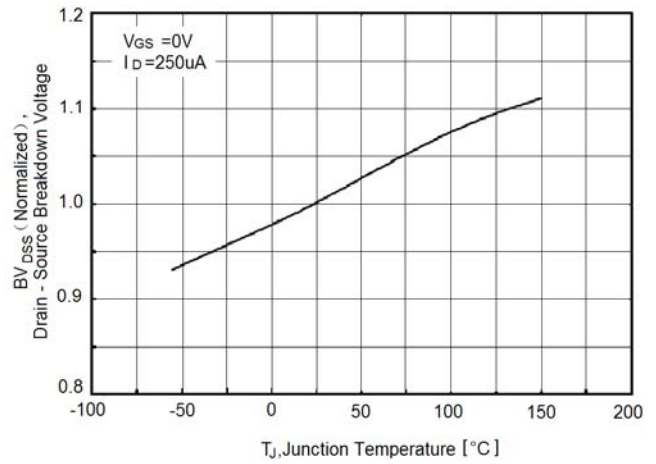
Figure6. Static drain-source on resistance



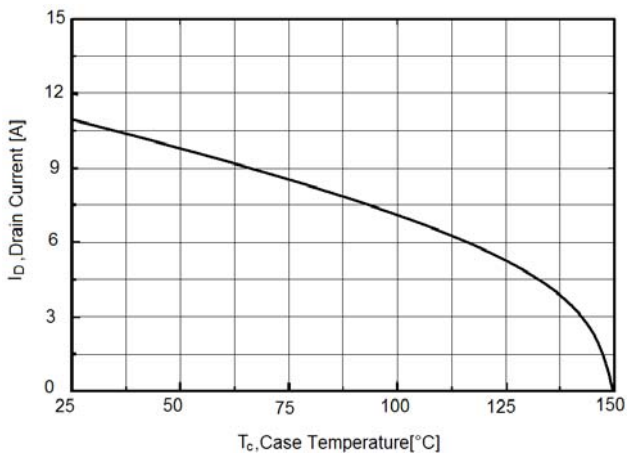
**Figure7.  $R_{DS(ON)}$  vs Junction Temperature**



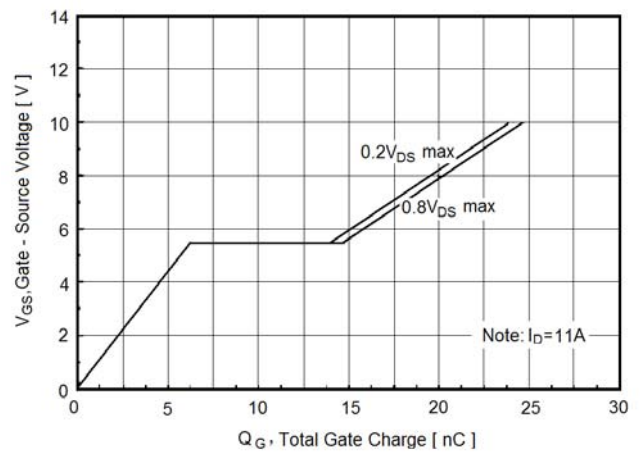
**Figure8.  $BV_{DSS}$  vs Junction Temperature**



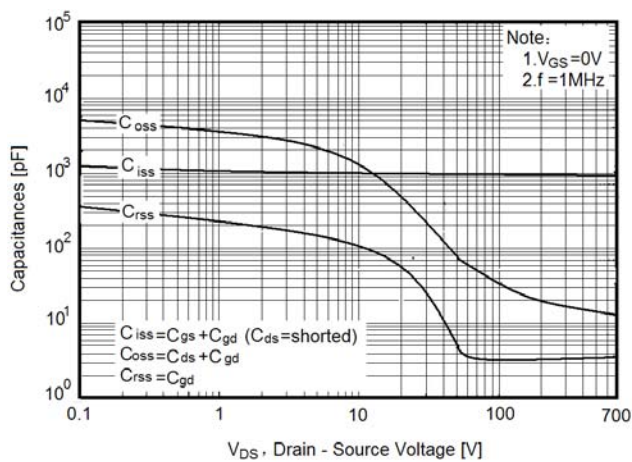
**Figure9. Maximum  $I_D$  vs Junction Temperature**



**Figure10. Gate charge waveforms**

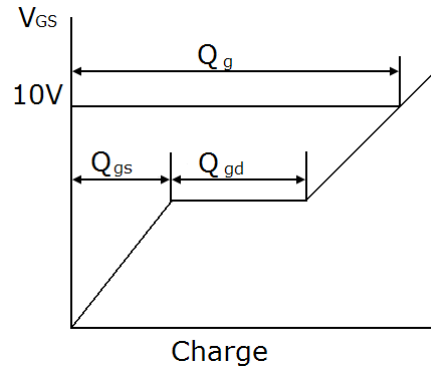
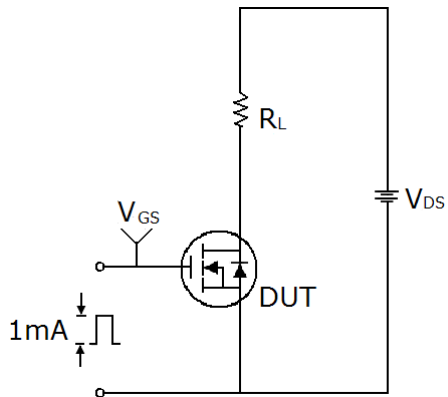


**Figure11. Capacitance**

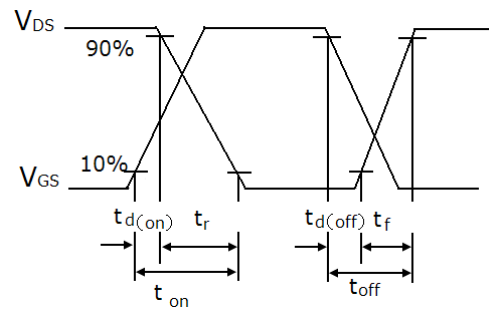
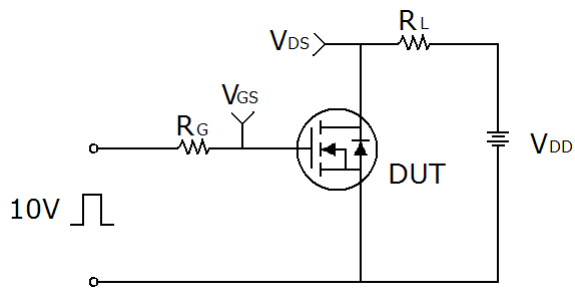


## Test circuit

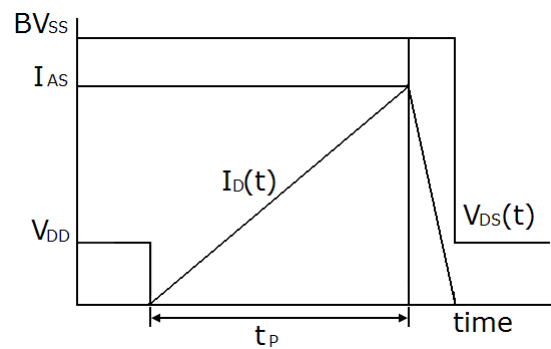
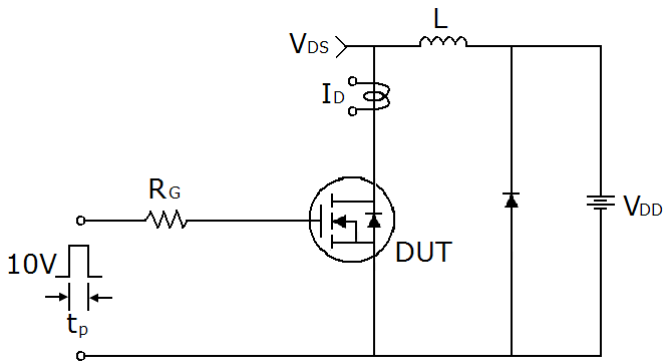
### 1) Gate charge test circuit & Waveform



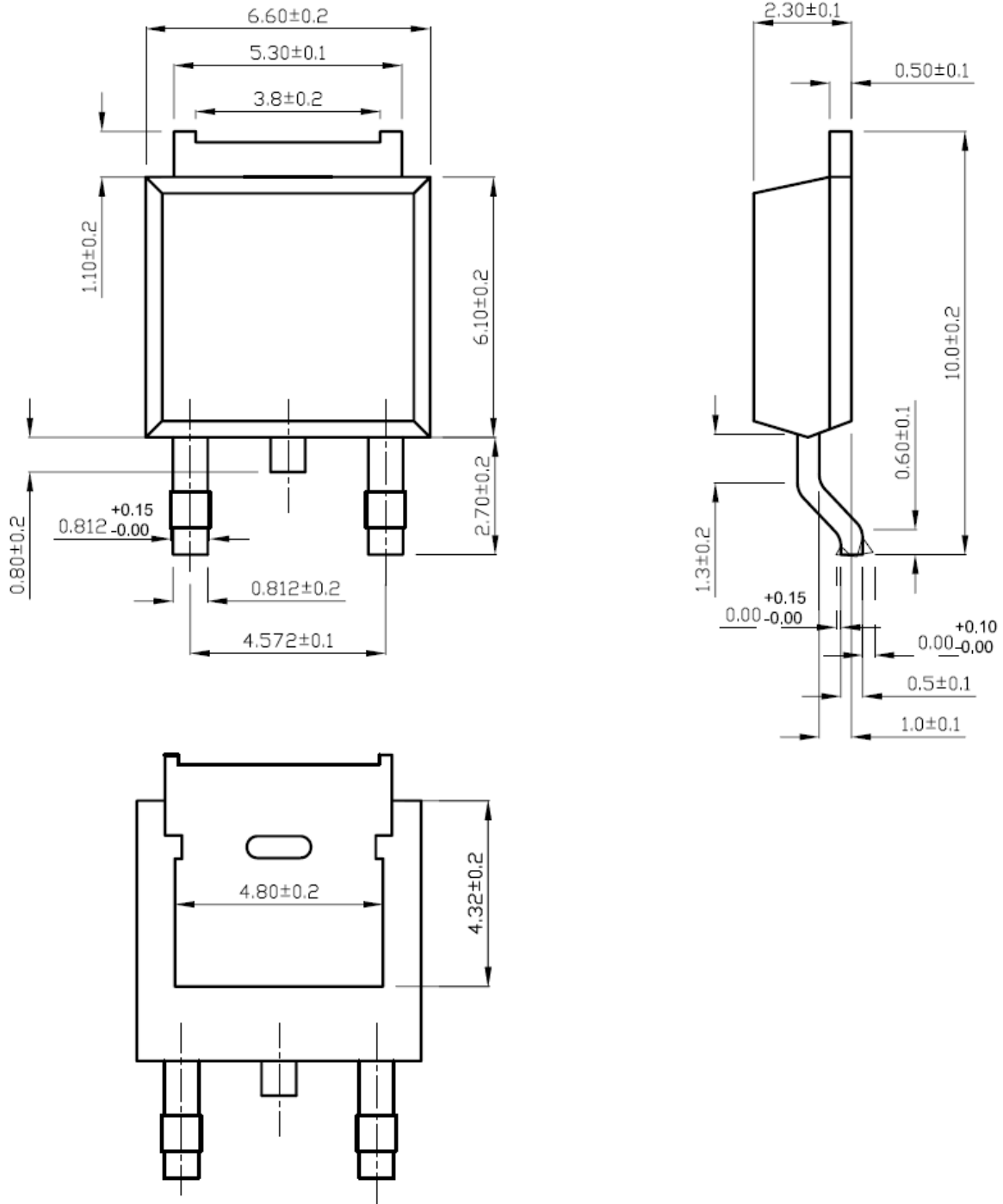
### 2) Switch Time Test Circuit:



### 3) Unclamped Inductive Switching Test Circuit & Waveforms



## TO-252 Package Information



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