

# NP36P04SDG

-40V – -36A – P-channel Power MOS FET

R07DS1519EJ0100

Application : Automotive

Rev.1.00

Jun. 17, 2022

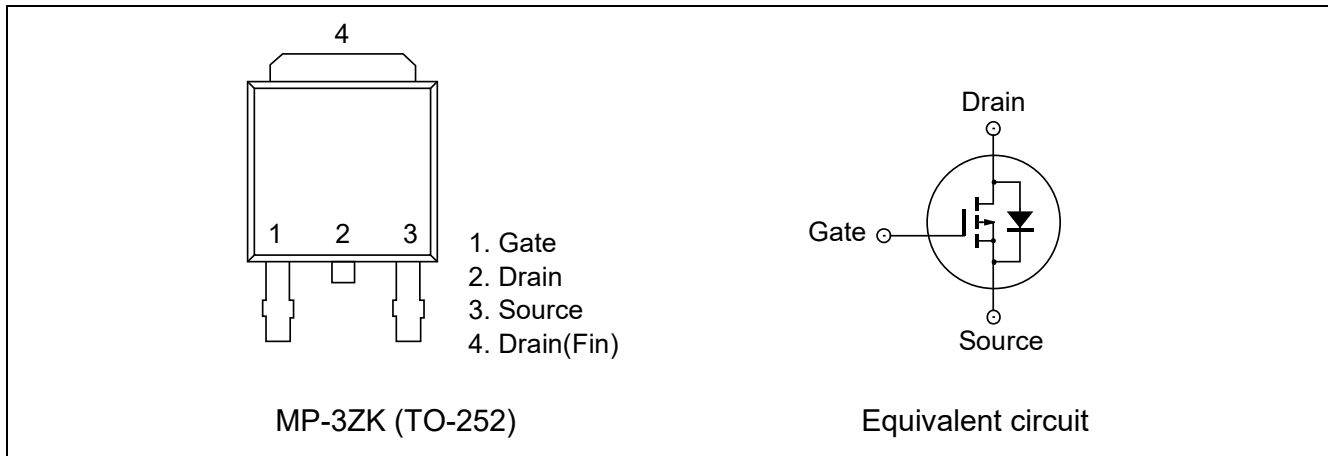
## Description

This product is P-channel MOS Field Effect Transistor designed for high current switching applications.

## Features

- Super low on-state resistance :  $R_{DS(on)} = 17.0 \text{ m}\Omega \text{ Max. ( } V_{GS} = -10 \text{ V, } I_D = -18 \text{ A )}$   
 $R_{DS(on)} = 23.5 \text{ m}\Omega \text{ Max. ( } V_{GS} = -4.5 \text{ V, } I_D = -18 \text{ A )}$
- Low input capacitance :  $C_{iss} = 2800 \text{ pF Typ.}$
- Designed for automotive application and AEC-Q101 qualified.
- Pb-free (This product does not contain Pb in the external electrode)

## Outline



## Absolute Maximum Ratings

( $T_a=25^\circ\text{C}$ )

Item	Symbol	Ratings	Unit
Drain to Source Voltage ( $V_{GS} = 0 \text{ V}$ )	$V_{DSS}$	-40	V
Gate to Source Voltage ( $V_{DS} = 0 \text{ V}$ )	$V_{GSS}$	$\mp 20$	V
Drain Current (DC) ( $T_c = 25^\circ\text{C}$ )	$I_{D(DC)}$	$\mp 36$	A
Drain Current (pulse)	$I_{D(pulse)}$ <sup>Notes1</sup>	$\mp 108$	A
Total Power Dissipation ( $T_c = 25^\circ\text{C}$ )	$P_{T1}$	56	W
Total Power Dissipation ( $T_a = 25^\circ\text{C}$ )	$P_{T2}$	1.2	W
Channel Temperature	$T_{ch}$	175	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	-55 to 175	$^\circ\text{C}$
Single Avalanche Current	$I_{AS}$ <sup>Notes2</sup>	26	A
Single Avalanche Energy	$E_{AS}$ <sup>Notes2</sup>	67	mJ

Notes 1.  $PW \leq 10 \mu\text{s}$ , Duty Cycle  $\leq 1\%$

2. Starting  $T_{ch}=25^\circ\text{C}$ ,  $V_{DD} = -20\text{V}$ ,  $R_G = 25 \Omega$ ,  $V_{GS} = -20 \rightarrow 0\text{V}$ ,  $L = 100\mu\text{H}$

## Thermal Resistance

Channel to Case Thermal Resistance	$R_{th(ch-c)}$ <sup>Notes3</sup>	2.68	°C/W
Channel to Ambient Thermal Resistance	$R_{th(ch-a)}$ <sup>Notes3</sup>	125	°C/W

## Electrical Characteristics

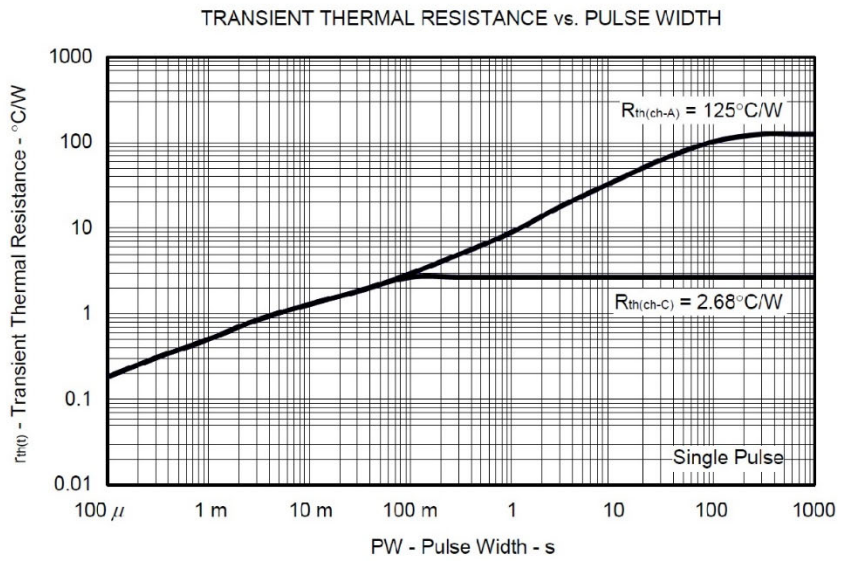
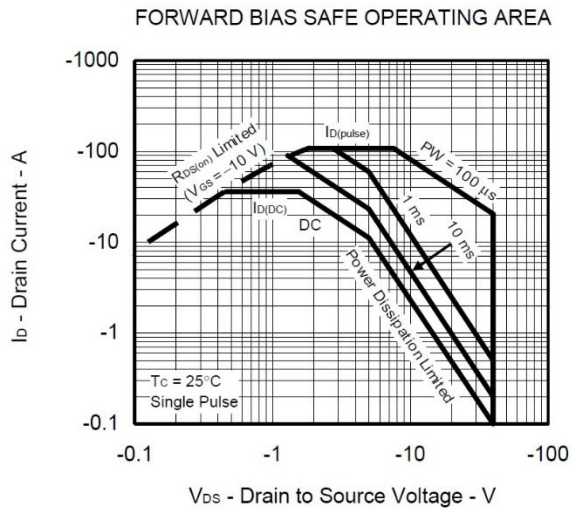
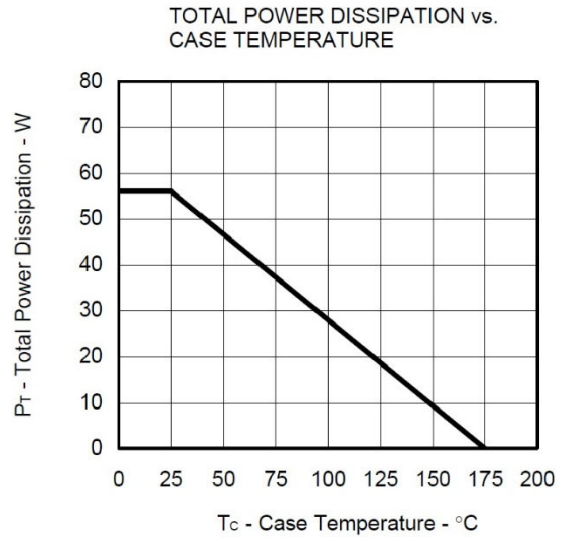
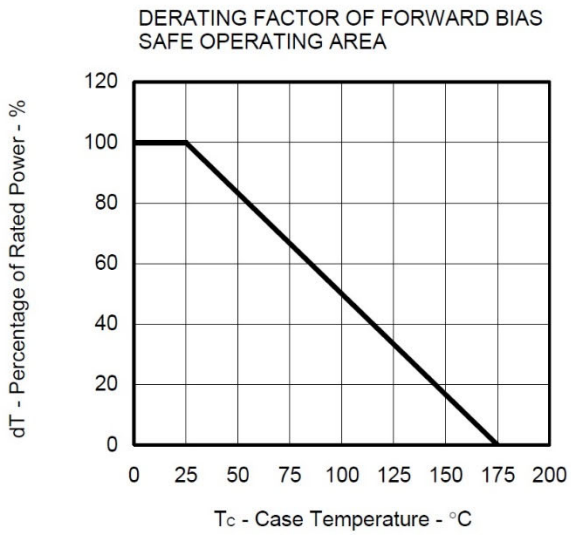
(T<sub>a</sub>=25°C)

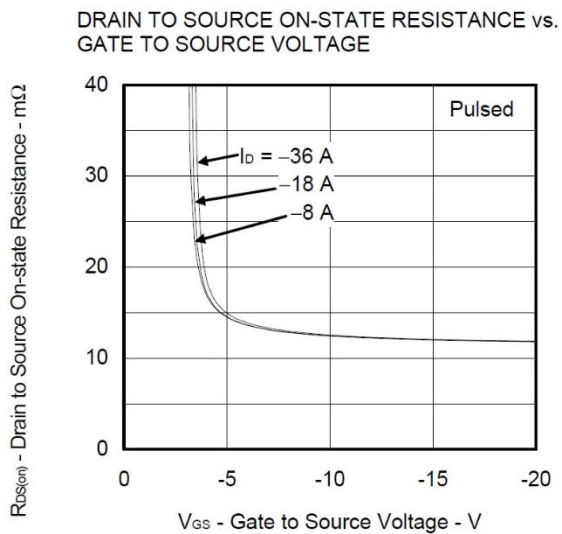
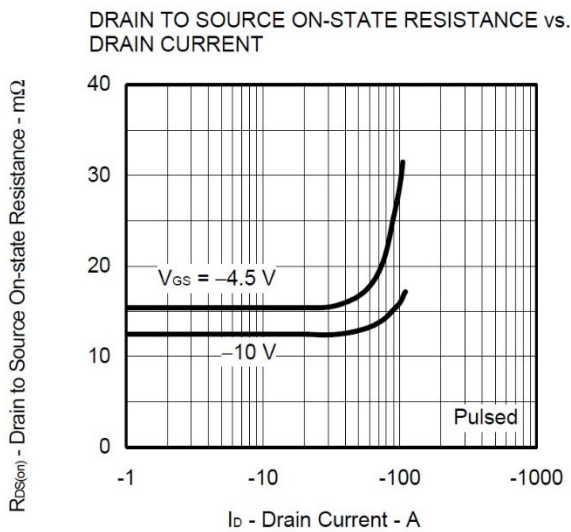
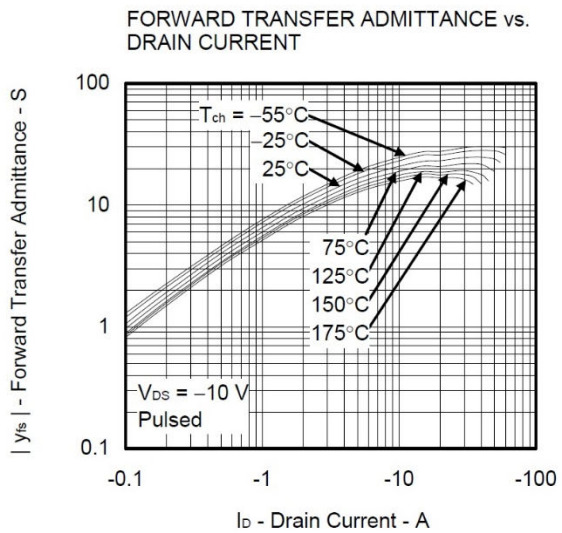
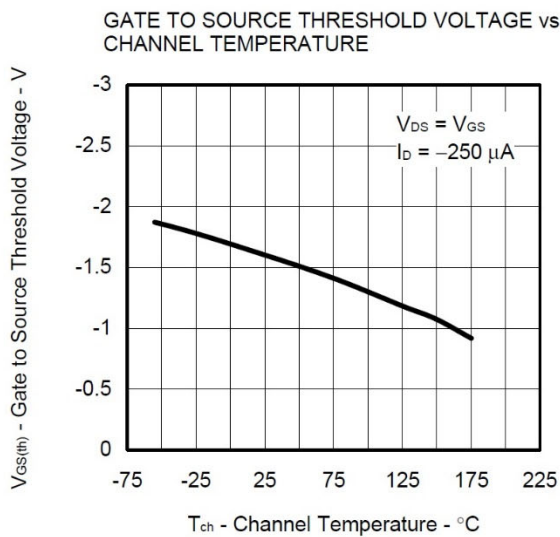
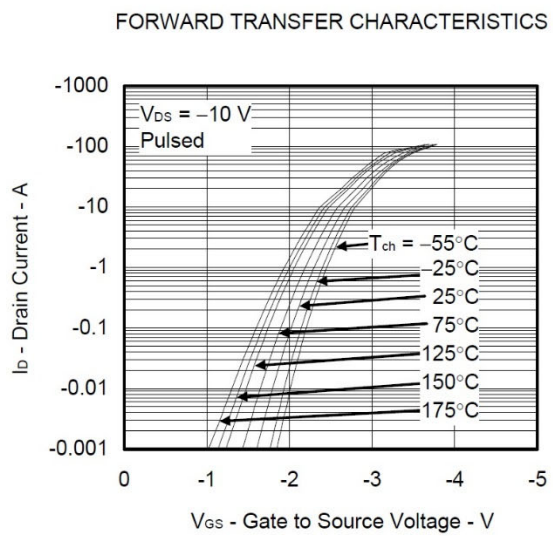
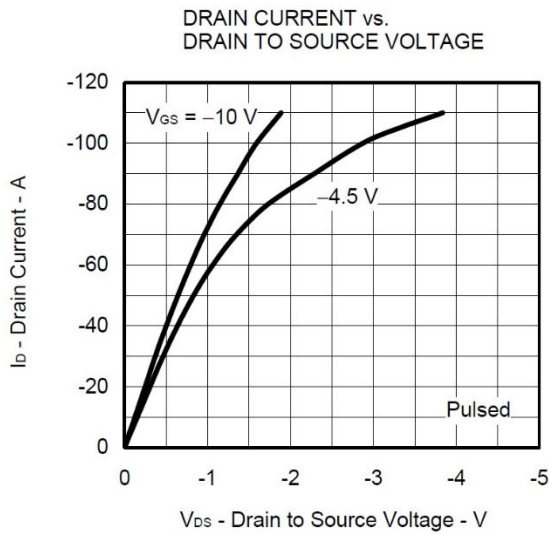
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Zero Gate Voltage Drain Current	$I_{DSS}$	—	—	-10	μA	V <sub>DS</sub> = -40 V, V <sub>GS</sub> = 0 V
Gate Leakage Current	$I_{GSS}$	—	—	±100	nA	V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0 V
Gate to Source Threshold Voltage	V <sub>GS(th)</sub>	-1.0	-1.6	-2.5	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μA
Forward Transfer Admittance	y <sub>fs</sub>   <sup>Notes4</sup>	12	23	—	S	V <sub>DS</sub> = -10 V, I <sub>D</sub> = -18 A
Drain to Source On-state Resistance	$R_{DS(on)1}$ <sup>Notes4</sup>	—	12.5	17.0	mΩ	V <sub>GS</sub> = -10 V, I <sub>D</sub> = -18 A
	$R_{DS(on)2}$ <sup>Notes4</sup>	—	15.4	23.5	mΩ	V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -18 A
Input Capacitance	C <sub>iss</sub>	—	2800	—	pF	V <sub>DS</sub> = -10 V
Output Capacitance	C <sub>oss</sub>	—	450	—	pF	V <sub>GS</sub> = 0 V
Reverse Transfer Capacitance	C <sub>rss</sub>	—	280	—	pF	f = 1 MHz
Turn-on Delay Time	t <sub>d(on)</sub>	—	8	—	ns	V <sub>DD</sub> = -20 V
Rise Time	t <sub>r</sub>	—	10	—	ns	I <sub>D</sub> = -18 A
Turn-off Delay Time	t <sub>d(off)</sub>	—	250	—	ns	V <sub>GS</sub> = -10 V
Fall Time	t <sub>f</sub>	—	140	—	ns	R <sub>G</sub> = 0 Ω
Total Gate Charge	Q <sub>g</sub>	—	55	—	nC	V <sub>DD</sub> = -32 V
Gate to Source Charge	Q <sub>gs</sub>	—	7	—	nC	V <sub>GS</sub> = -10 V
Gate to Drain Charge	Q <sub>gd</sub>	—	15	—	nC	I <sub>D</sub> = -36 A
Body Diode Forward Voltage	V <sub>F(S-D)</sub> <sup>Notes4</sup>	—	0.95	1.5	V	I <sub>F</sub> = -36 A, V <sub>GS</sub> = 0 V
Reverse Recovery Time	t <sub>rr</sub>	—	44	—	ns	I <sub>F</sub> = -36 A, V <sub>GS</sub> = 0 V
Reverse Recovery Charge	Q <sub>rr</sub>	—	51	—	nC	di/dt = -100 A/μs

Notes 3. Designed target value on Renesas measurement condition. Not subject to production test.

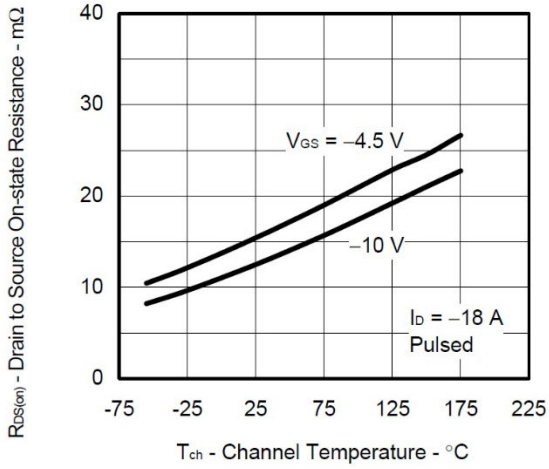
4. Pulse test.

### Typical Characteristics

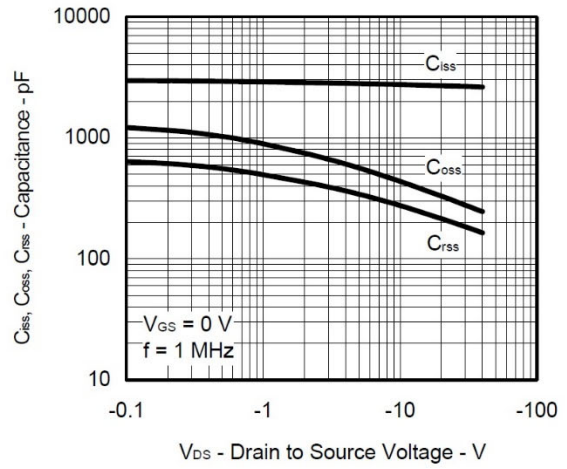




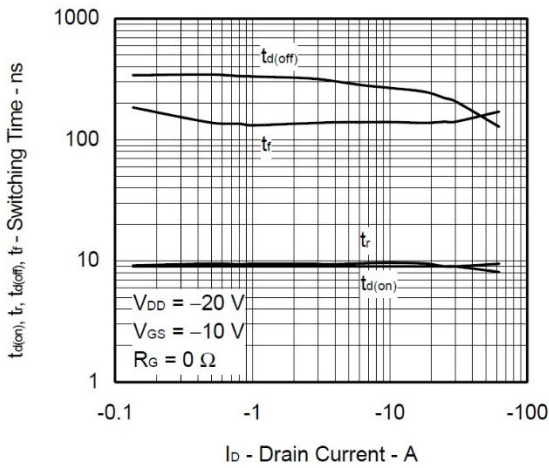
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



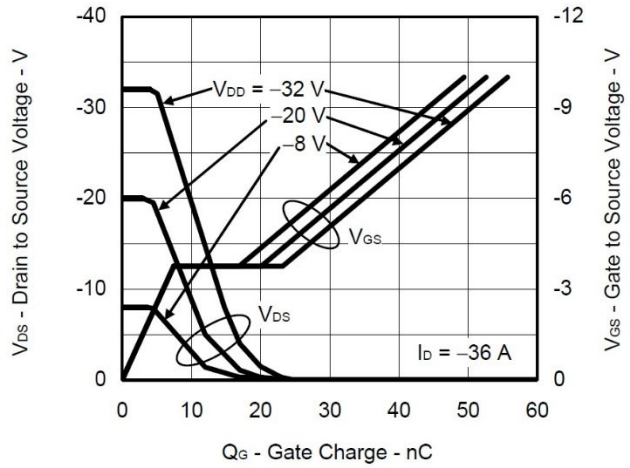
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



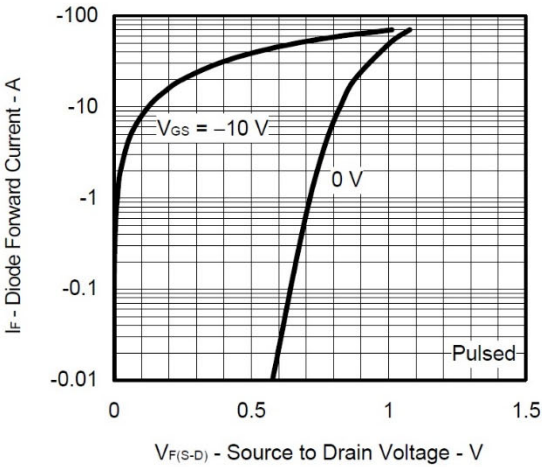
SWITCHING CHARACTERISTICS



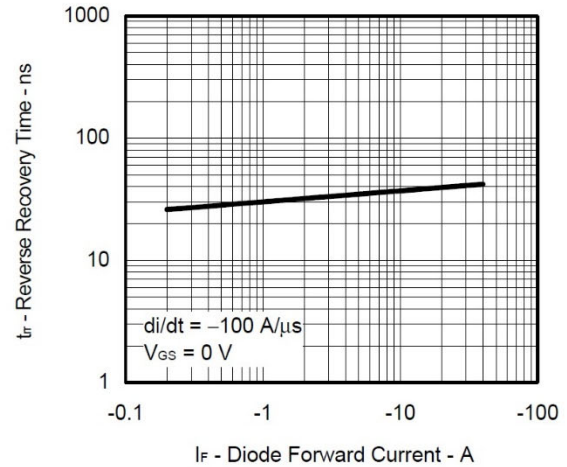
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



SOURCE TO DRAIN DIODE FORWARD VOLTAGE



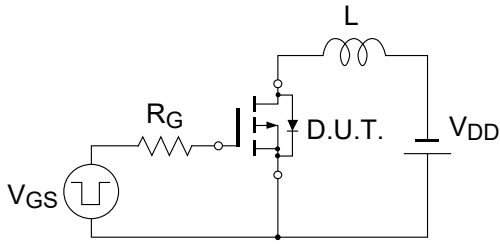
REVERSE RECOVERY TIME vs. DIODE FORWARD CURRENT



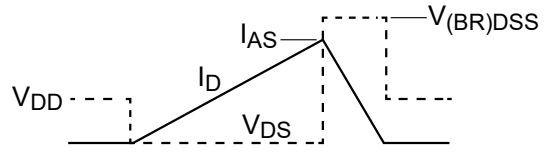
**Test Circuit**

**Avalanche**

Test Circuit



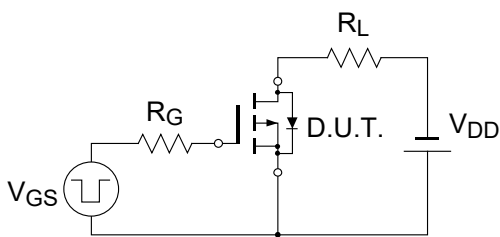
Waveform



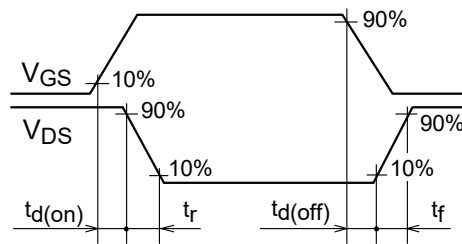
$$E_{AS} = \frac{1}{2} \cdot L \cdot I_{AS}^2 \cdot \frac{V_{(BR)DSS}}{V_{(BR)DSS} - V_{DD}}$$

**Switching Time**

Test Circuit

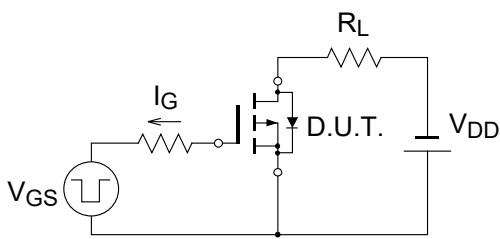


Waveform

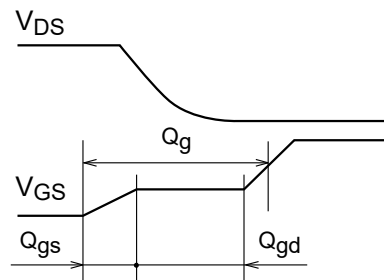


**Gate Charge**

Test Circuit

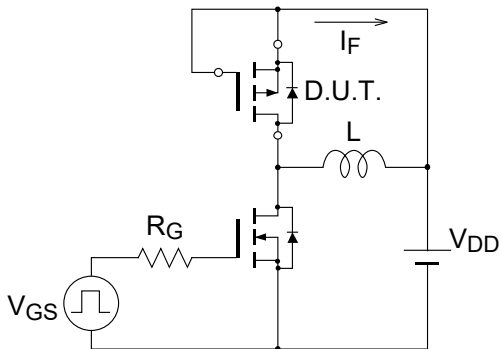


Waveform

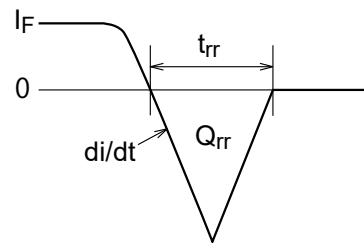


**Reverse Recovery**

Test Circuit



Waveform







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TOYOSU FORESIA, 3-2-24 Toyosu,  
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