



TSK20N50M

500V N-Channel MOSFET

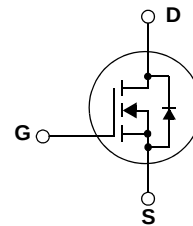
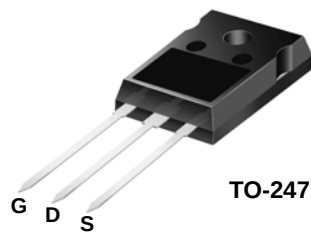
General Description

This Power MOSFET is produced using Truesemi's advanced planar stripe DMOS technology.

This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency switched mode power supplies, active power factor correction based on half bridge topology.

Features

- 20A, 500V, $R_{DS(on)} = 0.26\Omega$ @ $V_{GS} = 10V$
- Low gate charge (typical 70nC)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



Absolute Maximum Ratings

$T_C = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	TSK20N50M	Units
V_{DSS}	Drain-Source Voltage	500	V
I_D	Drain Current - Continuous ($T_C = 25^\circ\text{C}$)	20	A
	- Continuous ($T_C = 100^\circ\text{C}$)	13	A
I_{DM}	Drain Current - Pulsed (Note 1)	80	A
V_{GSS}	Gate-Source Voltage	± 30	V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	1110	mJ
E_{AR}	Repetitive Avalanche Energy (Note 1)	28	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5	V/ns
P_D	Power Dissipation ($T_C = 25^\circ\text{C}$)	280	W
	- Derate above 25°C	2.3	W/ $^\circ\text{C}$
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150	$^\circ\text{C}$
T_L	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300	$^\circ\text{C}$

* Drain current limited by maximum junction temperature.

Thermal Characteristics

Symbol	Parameter	TYP	MAX	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	--	0.44	$^\circ\text{C/W}$
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink Typ.	0.24	--	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	40	$^\circ\text{C/W}$



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Electrical Characteristics

$T_C = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	500	--	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$, Referenced to 25°C	--	0.5	--	$\text{V}/^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$	--	--	1	μA
		$V_{DS} = 400\text{ V}, T_C = 125^\circ\text{C}$	--	--	10	μA
I_{GSSF}	Gate-Body Leakage Current, Forward	$V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	$V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$	--	--	-100	nA

On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	2.0	--	4.5	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 10\text{ A}$	--	0.21	0.26	Ω

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	2700	--	pF
C_{oss}	Output Capacitance		--	400	--	pF
C_{rss}	Reverse Transfer Capacitance		--	40	--	pF

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 250\text{ V}, I_D = 20\text{ A},$ $R_G = 25\text{ }\Omega$ (Note 4, 5)	--	100	--	ns
t_r	Turn-On Rise Time		--	400	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	100	--	ns
t_f	Turn-Off Fall Time		--	100	--	ns
Q_g	Total Gate Charge	$V_{DS} = 400\text{ V}, I_D = 20\text{ A},$ $V_{GS} = 10\text{ V}$ (Note 4, 5)	--	70	-	nC
Q_{gs}	Gate-Source Charge		--	18	--	nC
Q_{gd}	Gate-Drain Charge		--	35	--	nC

Drain-Source Diode Characteristics and Maximum Ratings

I _S	Maximum Continuous Drain-Source Diode Forward Current		--	--	20	A
I _{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	80	A
V _{SD}	Drain-Source Diode Forward Voltage	V _{GS} = 0 V, I _S = 20 A	--	--	1.5	V
t _{rr}	Reverse Recovery Time	V _{GS} = 0 V, I _S = 20 A,	--	500	--	ns
Q _{rr}	Reverse Recovery Charge	di _F / dt = 100 A/μs (Note 4)	--	7.2	--	μC

Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. $L = 5\text{ mH}, I_{AS} = 20\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\text{ }\Omega$, Starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 20\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$
4. Pulse Test : Pulse width $\leq 300\mu\text{s}$, Duty cycle $\leq 2\%$
5. Essentially independent of operating temperature



Typical Characteristics

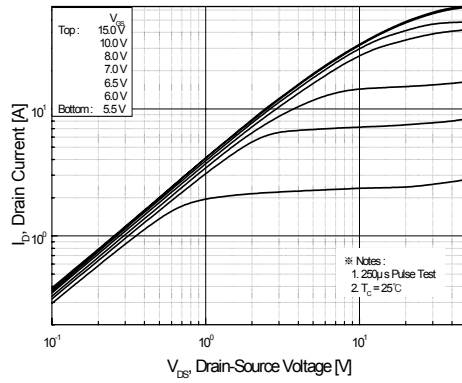


Figure 1. On-Region Characteristics

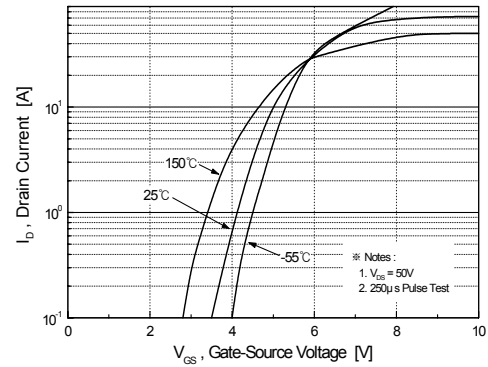


Figure 2. Transfer Characteristics

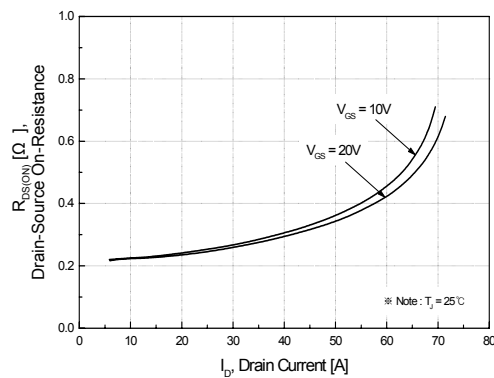


Figure 3. On-Resistance Variation vs

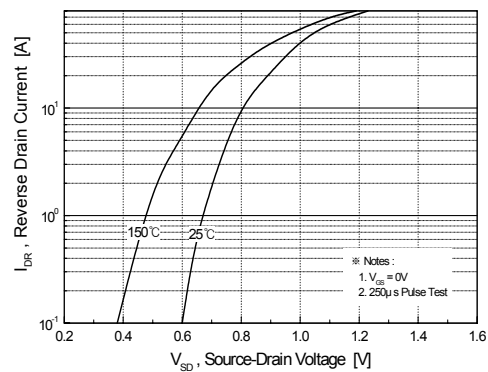


Figure 4. Body Diode Forward Voltage

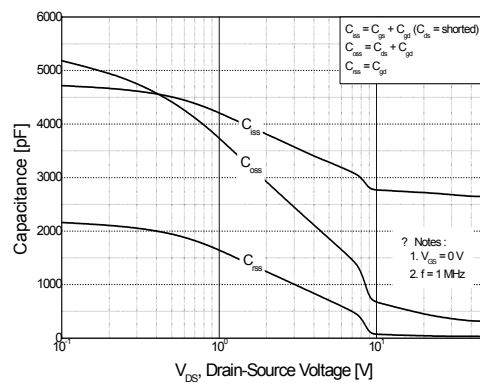


Figure 5. Capacitance Characteristics

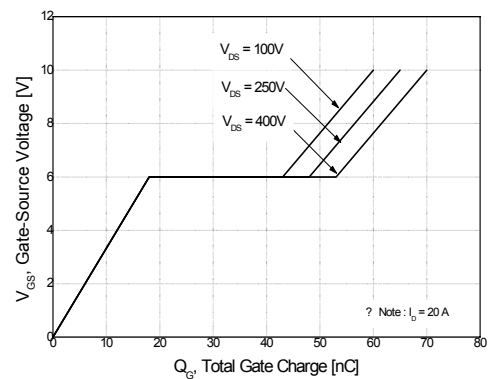


Figure 6. Gate Charge Characteristics



Typical Characteristics (Continued)

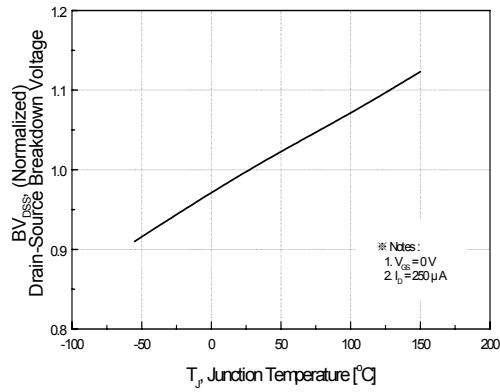


Figure 7. Breakdown Voltage Variation

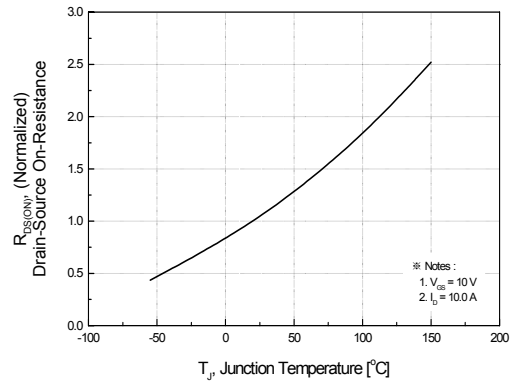


Figure 8. On-Resistance Variation

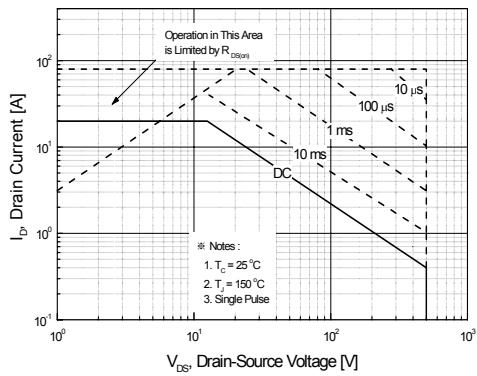


Figure 9. Maximum Safe Operating Area

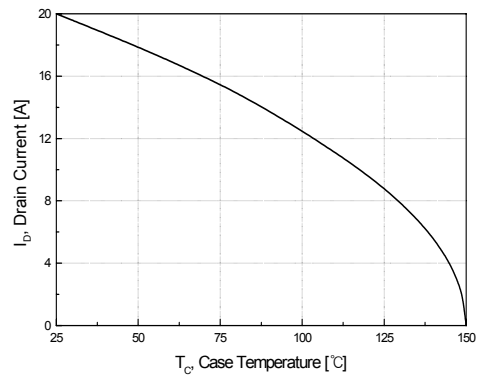


Figure 10. Maximum Drain Current vs Case Temperature

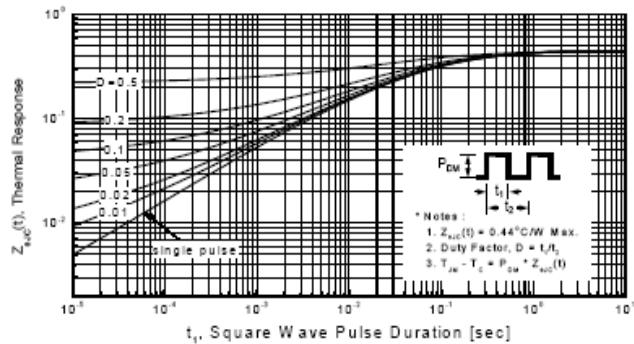
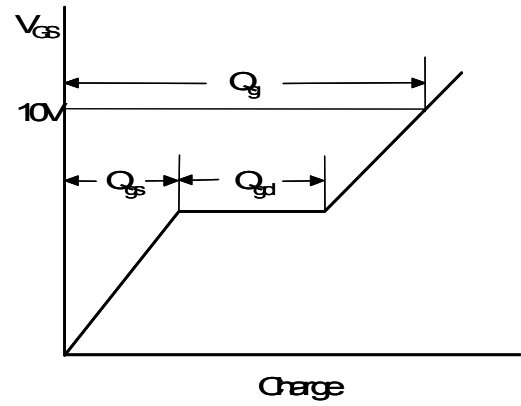
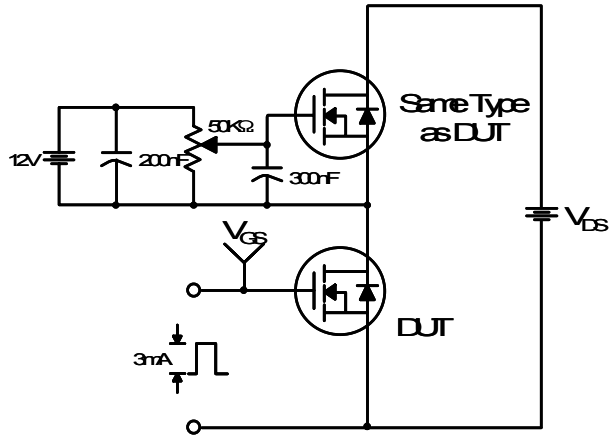


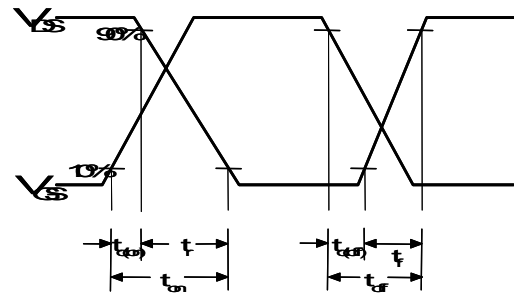
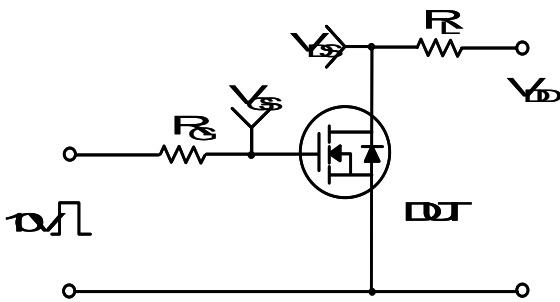
Figure 11. Transient Thermal Response Curve



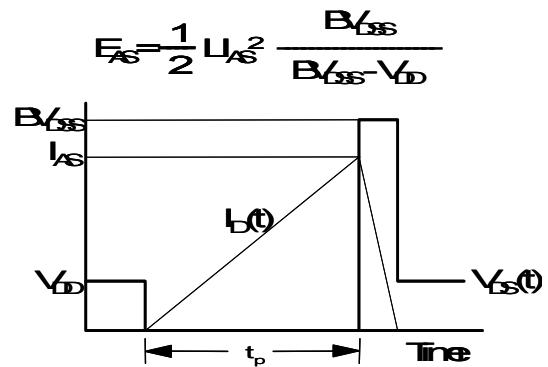
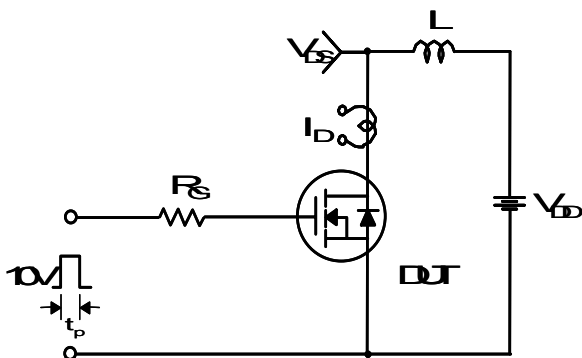
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms



Peak Diode Recovery dv/dt Test Circuit & Waveforms

The diagram illustrates a test circuit and its corresponding waveforms for measuring the peak diode recovery dv/dt of a MOSFET's body diode.

Test Circuit:

- A MOSFET (DUT) is connected in a common-source configuration.
- The gate is driven by a pulse generator V_{GS} through a gate resistor R_G .
- The drain is connected to a load inductor L and a supply voltage V_{DD} .
- The source is connected to ground through a current source I_{SD} .
- The drain-source voltage V_{DS} is measured across the MOSFET.
- The MOSFET is labeled "Same Type as DUT".
- Notes:
 - dv/dt controlled by R_G
 - I_{SD} controlled by pulse period

Waveforms:

- V_{GS} (Driver):** A square wave pulse. The duty cycle is defined as $D = \frac{\text{Gate Pulse Width}}{\text{Gate Pulse Period}}$. The pulse height is 10 V.
- I_{SD} (DUT):** The source current. It shows a forward current I_{FW} (Body Diode Forward Current) during the gate pulse, followed by a reverse current I_{RM} (Body Diode Reverse Current) during the recovery phase. The recovery phase is labeled di/dt .
- V_{DS} (DUT):** The drain-source voltage. It shows a forward voltage drop V_{SD} (Body Diode Forward Voltage Drop) during the forward current, followed by a recovery phase labeled "Body Diode Recovery dv/dt" where the voltage rises sharply to V_{DD} .