## SWITCHING

## N-CHANNEL POWER MOS FET INDUSTRIAL USE

## DESCRIPTION

The 2SK2355, 2SK2355-Z/2SK2356, 2SK2356-Z is N-Channel MOS Field Effect Transistor designed for high voltage switching applications.

## FEATURES

- Low On-Resistance 2SK2355: RDS(on) $=1.4 \Omega(\mathrm{VGS}=10 \mathrm{~V}, \mathrm{ID}=2.5 \mathrm{~A})$
2SK2356: Rds(on) $=1.5 \Omega(\mathrm{VGS}=10 \mathrm{~V}, \mathrm{ID}=2.5 \mathrm{~A})$
- Low Ciss Ciss = 670 pF TYP.
- High Avalanche Capability Ratings


## QUALITY GRADE

Standard

Please refer to "Quality grade on NEC Semiconductor Devices" (Document number IEI-1209) published by NEC Corporation to know the specification of quality grade on the devices and its recommended applications.

| ABSOLUTE MAXIMUM RATINGS ( $\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}$ ) |  |  |  |
| :---: | :---: | :---: | :---: |
| Drain to Source Voltage (2SK2355/2356) | Voss | 450/500 | V |
| Gate to Source Voltage | Vass | $\pm 30$ | V |
| Drain Current (DC) | $\mathrm{Id}(\mathrm{DC})$ | $\pm 5.0$ | A |
| Drain Current (pulse)* | ID(pulse) | ) $\pm 20$ | A |
| Total Power Dissipation ( $\mathrm{T}_{\mathrm{c}}=25^{\circ} \mathrm{C}$ ) | PT1 | 50 | W |
| Total Power Dissipation ( $\mathrm{Ta}_{\mathrm{a}}=25^{\circ} \mathrm{C}$ ) | PT2 | 1.5 | W |
| Channel Temperature | Tch | 150 | C |
| Storage Temperature | Tstg | -55 to +150 | ${ }^{\circ} \mathrm{C}$ |
| Single Avalanche Current** | IAS | 5.0 | A |
| Single Avalanche Energy** | Eas | 17.4 | mJ |

* $\mathrm{PW} \leq 10 \mu \mathrm{~s}$, Duty Cycle $\leq 1 \%$
** Starting $\mathrm{T}_{\mathrm{ch}}=25^{\circ} \mathrm{C}, \mathrm{Rg}_{\mathrm{g}}=25 \Omega$, Vgs $=20 \mathrm{~V} \rightarrow 0$


## PACKAGE DIMENSIONS

(in millimeter)


MP-25 (TO-220)


MP-25Z (TO-220 SURFACE MOUNT TYPE)


ELECTRICAL CHARACTERISTICS ( $\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}$ )

| CHARACTERISTIC | SYMBOL | MIN. | TYP. | MAX. | UNIT | TEST CONDITIONS |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Drain to Source On-Resistance | Ros(on) |  | 0.9 | 1.4 | $m \Omega$ | $\begin{aligned} & V_{G S}=10 \mathrm{~V} \\ & \mathrm{ID}=2.5 \mathrm{~A} \end{aligned}$ | 2SK2355 |
|  |  |  | 1.0 | 1.5 |  |  | 2SK2356 |
| Gate to Source Cutoff Voltage | VGS(off) | 2.5 |  | 3.5 | V | $\mathrm{V}_{\mathrm{DS}}=10 \mathrm{~V}, \mathrm{ld}=1 \mathrm{~mA}$ |  |
| Forward Transfer Admittance | $\mid \mathrm{yfs}$ \| | 1.0 |  |  | S | $\mathrm{V} \mathrm{DS}=10 \mathrm{~V}, \mathrm{ID}=2.5 \mathrm{~A}$ |  |
| Drain Leakage Current | Idss |  |  | 100 | $\mu \mathrm{A}$ | $\mathrm{V}_{\text {ds }}=\mathrm{V}_{\text {dSS }}, \mathrm{V}_{\text {GS }}=0$ |  |
| Gate to Source Leakage Current | Igss |  |  | $\pm 100$ | nA | $\mathrm{V}_{\mathrm{GS}}= \pm 30 \mathrm{~V}, \mathrm{~V}_{\text {ds }}=0$ |  |
| Input Capacitance | Ciss |  | 670 |  | pF | $\begin{aligned} & V_{D S}=10 \mathrm{~V} \\ & V_{G S}=0 \\ & f=1 \mathrm{MHz} \end{aligned}$ |  |
| Output Capacitance | Coss |  | 140 |  | pF |  |  |
| Reverse Transfer Capacitance | Crss |  | 18 |  | pF |  |  |
| Turn-On Delay Time | tdon) |  | 11 |  | ns | $\begin{aligned} & \mathrm{ID}=2.5 \mathrm{~A} \\ & \mathrm{~V}_{\mathrm{GS}}=10 \mathrm{~V} \\ & \mathrm{~V}_{\mathrm{DD}}=150 \mathrm{~V} \\ & \mathrm{R}_{\mathrm{G}}=10 \Omega \mathrm{R}_{\mathrm{L}}=60 \Omega \end{aligned}$ |  |
| Rise Time | $\mathrm{tr}_{r}$ |  | 8 |  | ns |  |  |
| Turn-Off Delay Time | $\mathrm{t}_{\mathrm{d} \text { (off) }}$ |  | 40 |  | ns |  |  |
| Fall Time | tf |  | 8 |  | ns |  |  |
| Total Gate Charge | $\mathrm{Q}_{\mathrm{g}}$ |  | 20 |  | nC | $\begin{aligned} & \mathrm{ID}=5.0 \mathrm{~A} \\ & \mathrm{VDD}=400 \mathrm{~V} \\ & \mathrm{~V}_{\mathrm{GS}}=10 \mathrm{~V} \end{aligned}$ |  |
| Gate to Source Charge | Qgs |  | 4.5 |  | nC |  |  |
| Gate to Drain Charge | QGD |  | 9 |  | nC |  |  |
| Body Diode Forward Voltage | $V_{\text {FIS-D }}$ |  | 1.0 |  | V | $\mathrm{If}_{\mathrm{F}}=5.0 \mathrm{~A}, \mathrm{~V}_{\mathrm{Gs}}=0$ |  |
| Reverse Recovery Time | trr |  | 270 |  | ns | $\begin{aligned} & \mathrm{I}_{F}=5.0 \mathrm{~A}, \mathrm{~V}_{\mathrm{GS}}=0 \\ & \mathrm{di} / \mathrm{dt}=50 \mathrm{~A} / \mu \mathrm{s} \end{aligned}$ |  |
| Reverse Recovery Charge | Qrr |  | 1.0 |  | nC |  |  |

Test Circuit 1 Avalanche Capability
Test Circuit 2 Switching Time



The application circuits and their parameters are for references only and are not intended for use in actual design-in's.

## TYPICAL CHARACTERISTICS (TA $=25^{\circ} \mathrm{C}$ )




VDs - Drain to Source Voltage - V

DRAIN CURRENT vs.
gate to source voltage


TOTAL POWER DISSIPATION vs. CASE TEMPERATURE


DRAIN CURRENT vs
drain to source voltage


Vos - Drain to Source Voltage - V



DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT
RdS(on) - Drain to Source On-State Resistance - $\Omega$
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT


DRAIN TO SOURCE ON-STATE RESISTANCE vs.


VGs - Gate to Source Voltage - V

GATE TO SOURCE CUTOFF VOLTAGE vs. CHANNEL TEMPERATURE



CAPACITANCE vs. DRAIN TO
SOURCE VOLTAGE


VDS - Drain to Source Voltage - V

REVERSE RECOVERY TIME vs. DRAIN CURRENT




ID - Drain Current - A


SINGLE AVALANCHE CURRENT vs INDUCTIVE LOAD


## REFERENCE

| Document Name | Document No. |
| :--- | :---: |
| NEC semiconductor device reliability/quality control system. | TEI-1202 |
| Quality grade on NEC semiconductor devices. | IEI-1209 |
| Semiconductor device mounting technology manual. | IEI-1207 |
| Semiconductor device package manual. | IEI-1213 |
| Guide to quality assurance for semiconductor devices. | MEI-1202 |
| Semiconductor selection guide. | MF-1134 |
| Power MOS FET features and application switching power supply. | TEA-1034 |
| Application circuits using Power MOS FET. | TEA-1035 |
| Safe operating area of Power MOS FET. | TEA-1037 |

The diode connected between the gate and source of the transistor serves as a protector against ESD. When this device is actually used, an additional protection circuit is externally required if a voltage exceeding the rated voltage may be applied to this device.
[MEMO]

No part of this document may be copied or reproduced in any form or by any means without the prior written consent of NEC Corporation. NEC Corporation assumes no responsibility for any errors which may appear in this document.
NEC Corporation does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from use of a device described herein or any other liability arising from use of such device. No license, either express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC Corporation or others.
The devices listed in this document are not suitable for use in aerospace equipment, submarine cables, nuclear reactor control systems and life support systems. If customers intend to use NEC devices for above applications or they intend to use "Standard" quality grade NEC devices for applications not intended by NEC, please contact our sales people in advance.
Application examples recommended by NEC Corporation
Standard: Computer, Office equipment, Communication equipment, Test and Measurement equipment, Machine tools, Industrial robots, Audio and Visual equipment, Other consumer products, etc.
Special: Automotive and Transportation equipment, Traffic control systems, Antidisaster systems, Anticrime systems, etc.

