60 V, 100 A, 3.8 mΩ Low $R_{DS(ON)}$
N ch Trench Power MOSFET

2SK4161D

Features

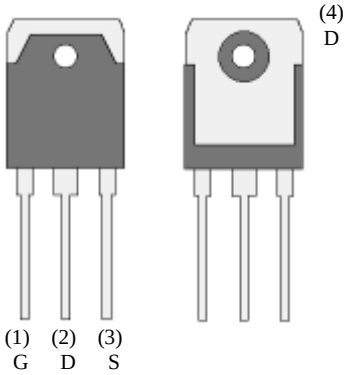
- $V_{(BR)DSS}$ ----------60 V (ID = 100 µA)
- I_D ---------- 100 A
- $R_{DS(ON)}$ ----------4.8 mΩ max. (ID = 35 A, VGS = 10 V)
-
- AEC-Q101 Qualified
- 175°C Capability
- Low On Resistance
- ESD Protection Zener on Gate
- 100% Avalanche Tested
- Compliant with RoHS directive

Applications

- Electric power Steering (EPS)
- Motor
- DC/DC Converter
- Other Switching Mode Power Supply, SMPS

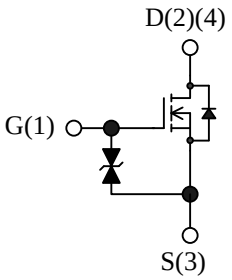
Package

TO3P-3L



Not to scale

Equivalent circuit



Absolute Maximum Ratings

Unless otherwise specified, T_A = 25 °C

Parameter	Symbol	Test conditions	Rating	Unit
Drain to Source Voltage	V_{DS}		60	V
Gate to Source Voltage	V_{GS}		± 20	V
Continuous Drain Current	I_D	T_C = 25 °C	100	A
Pulsed Drain Current	I_{DM}	PW ≤ 100µs Duty cycle ≤ 1 %	200	A
Continuous Source Current (Body Diode)	I_S	T_C = 25 °C	100	A
Pulsed Source Current (Body Diode)	I_{SM}	PW ≤ 100µs Duty cycle ≤ 1 %	200	A
Single Pulse Avalanche Energy	E_{AS}	V_{DD} = 20 V, L = 1 mH, I_{AS} =20 A, unclamped, Refer to Figure 1	400	mJ
Power Dissipation	P_D	T_C = 25 °C	132	W
Operating Junction Temperature	T_J		175	°C
Storage Temperature Range	T_{STG}		− 55 to 175	°C

Thermal Characteristics

Unless otherwise specified, T_A = 25 °C

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Thermal Resistance (Junction to Case)	$R_{\theta JC}$		−	−	1.13	°C/W
Thermal Resistance (Junction to Ambient)	$R_{\theta JA}$		−	−	35.7	°C/W

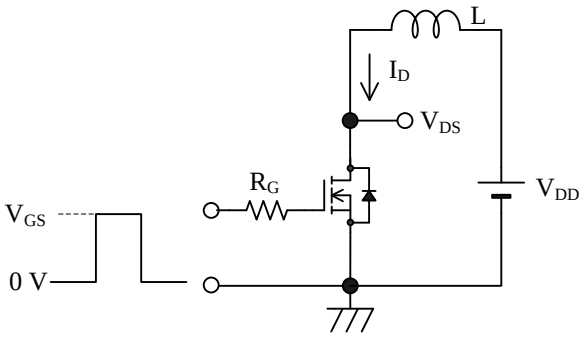
Electrical Characteristics

Unless otherwise specified, T_A = 25 °C

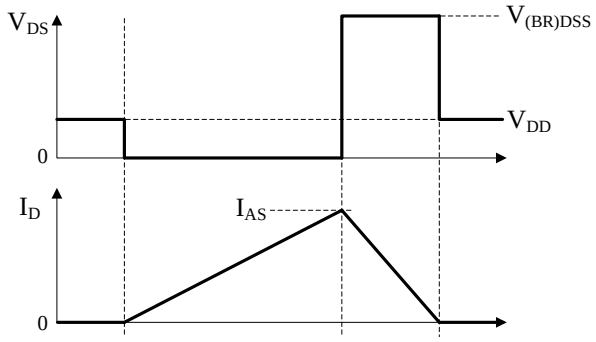
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Drain to Source Breakdown Voltage	$V_{(BR)DSS}$	I_D = 100 µA, V_{GS} = 0 V	60	−	−	V
Drain to Source Leakage Current	I_{DSS}	V_{DS} = 60 V, V_{GS} = 0 V	−	−	100	µA
Gate to Source Leakage Current	I_{GSS}	V_{GS} = ± 15 V	−	−	± 10	µA
Gate Threshold Voltage	$V_{GS(th)}$	V_{DS} = 10 V, I_D = 1 mA	3.0	3.6	4.0	V
Static Drain to Source On-Resistance	$R_{DS(ON)}$	I_D = 35 A, V_{GS} = 10 V	−	3.8	4.8	mΩ
		I_D = 35 A, V_{GS} = 8 V	−	4.2	6.0	mΩ
Input Capacitance	C_{iss}	V_{DS} = 10 V V_{GS} = 0 V f = 1 MHz	−	10000	−	pF
Output Capacitance	C_{oss}		−	1000	−	
Reverse Transfer Capacitance	C_{rss}		−	730	−	
Total Gate Charge (V_{GS} = 10 V)	Q_{g1}	V_{DS} = 40 V I_D = 40 A	−	145	−	nC
Gate to Source Charge	Q_{gs}		−	40	−	
Gate to Drain Charge	Q_{gd}		−	35	−	
Turn-On Delay Time	$t_{d(on)}$	V_{DD} = 20 V I_D = 40 A V_{GS} = 10 V, R_G = 30 Ω Refer to Figure 2	−	160	−	ns
Rise Time	t_r		−	490	−	
Turn-Off Delay Time	$t_{d(off)}$		−	400	−	
Fall Time	t_f		−	200	−	
Source to Drain Diode Forward Voltage	V_{SD}	I_S = 50 A, V_{GS} = 0 V	−	0.9	1.2	V
Source to Drain Diode Reverse Recovery Time	t_{rr}	I_F = 25 A di/dt = 50 A/µs Refer to Figure 3	−	50	−	ns

Test Circuits and Waveforms

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

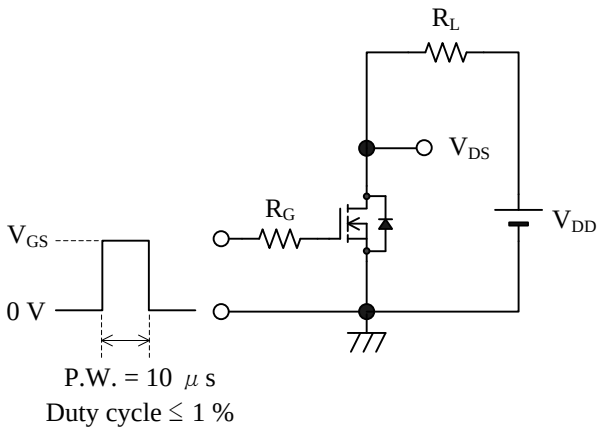


(a) Test Circuit

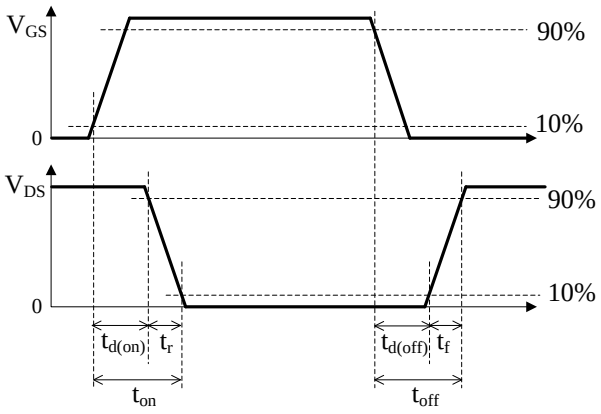


(b) Waveform

Figure 1 Unclamped Inductive Switching

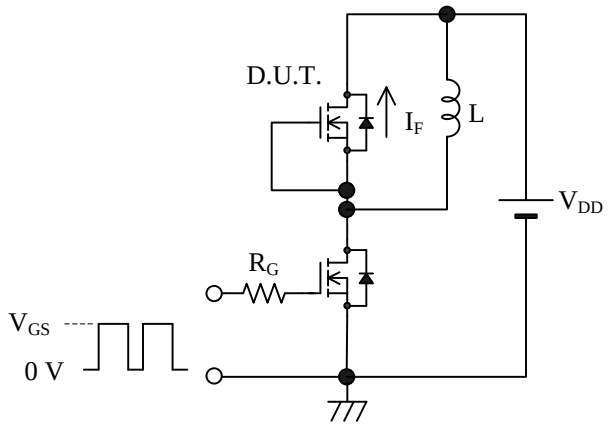


(a) Test Circuit

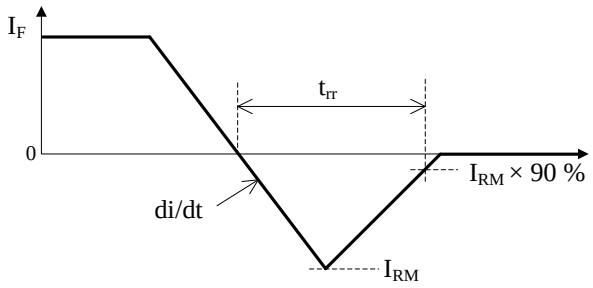


(b) Waveform

Figure 2 Switching Time



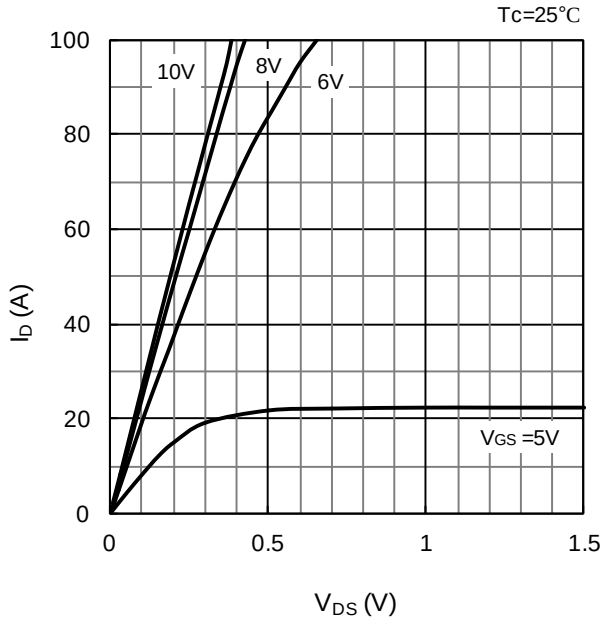
(a) Test Circuit



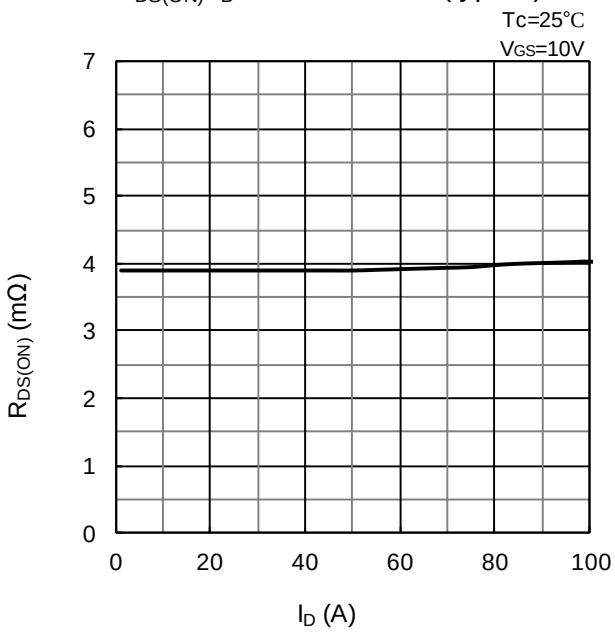
(b) Waveform

Figure 3 Diode Reverse Recovery Time

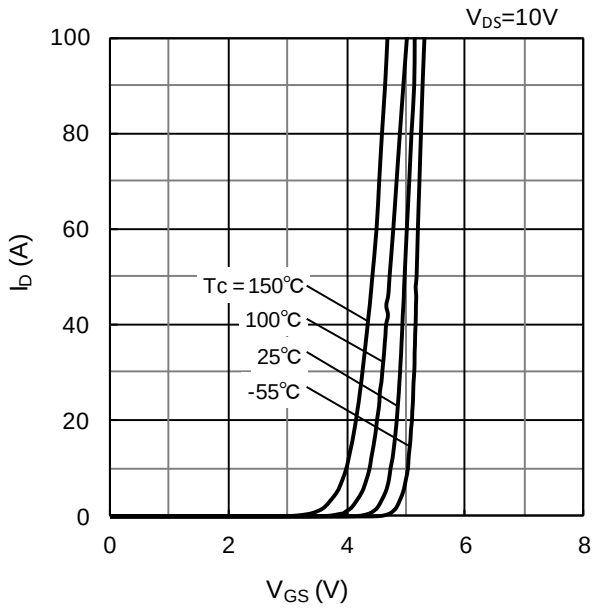
I_D-V_{DS} characteristics(typical)



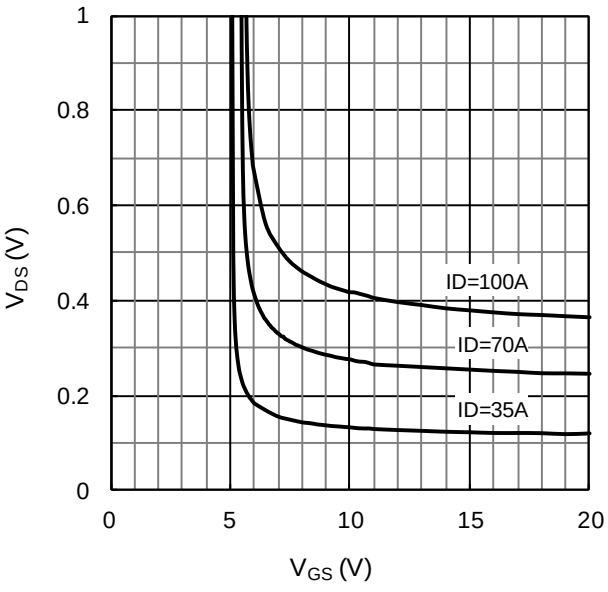
$R_{DS(ON)}$-I_D characteristics (typical)



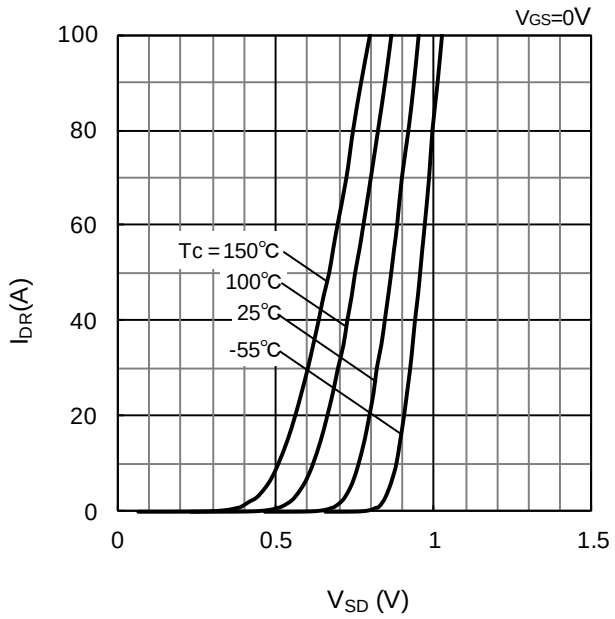
I_D-V_{GS} characteristics (typical)



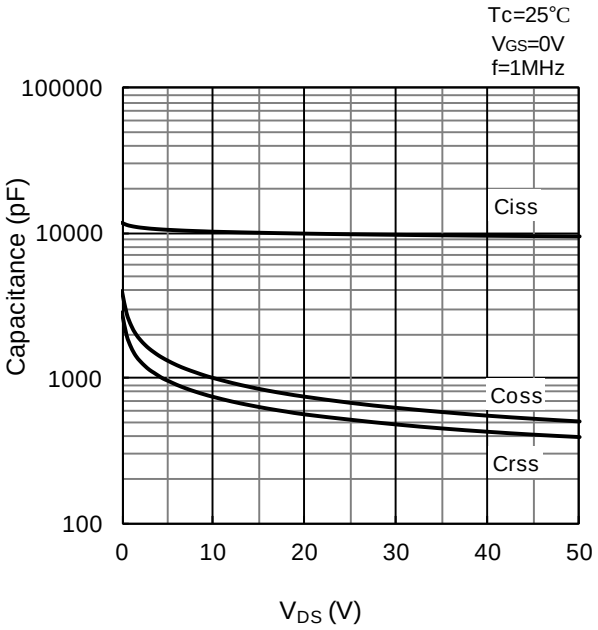
V_{DS} - V_{GS} characteristics (typical)



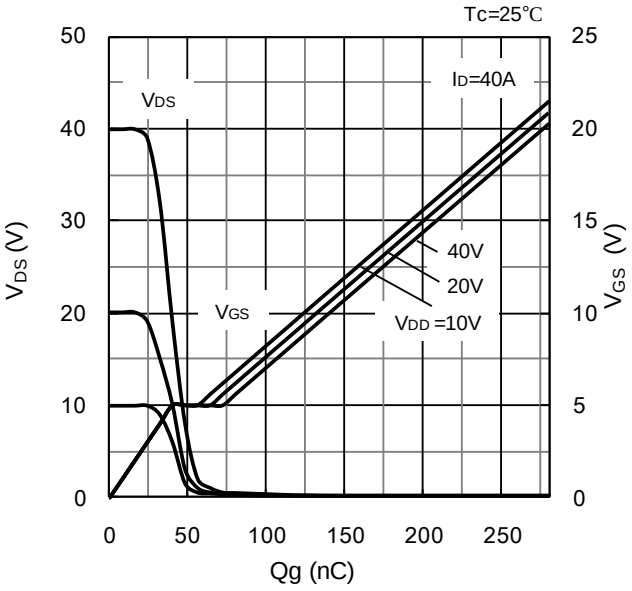
I_{DR}-V_{SD} characteristics (typical)



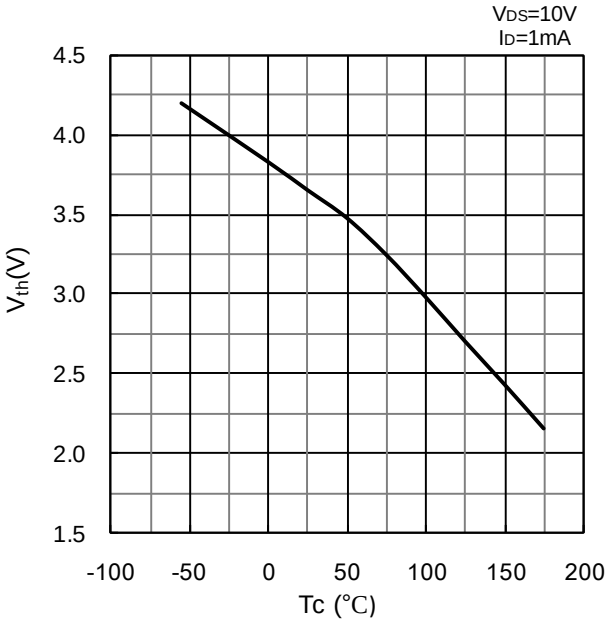
Capacitance-V_{DS} characteristics (typical)



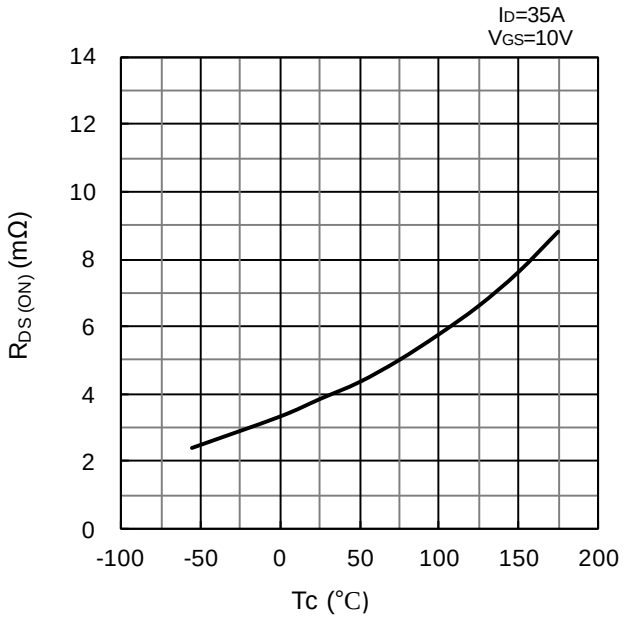
V_{GS} - Q_g characteristics (typical)



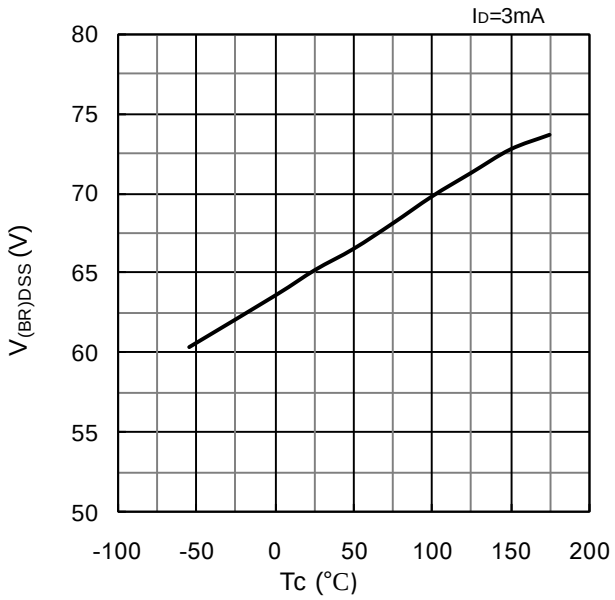
V_{th} - T_C characteristics (typical)



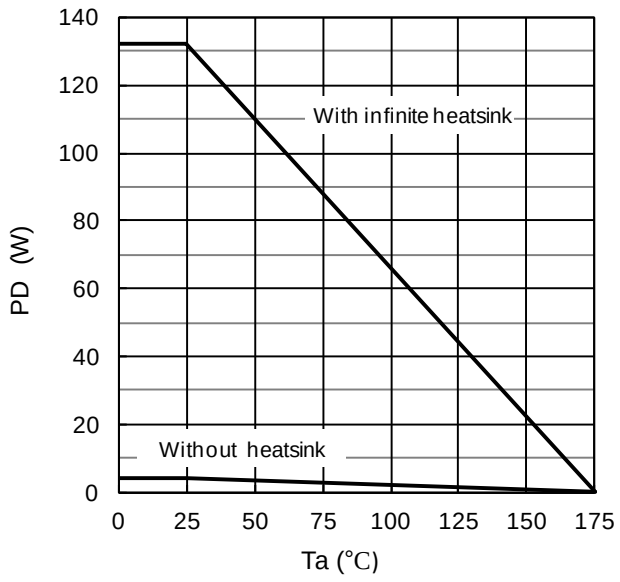
$R_{DS(ON)}$-T_C characteristics (typical)



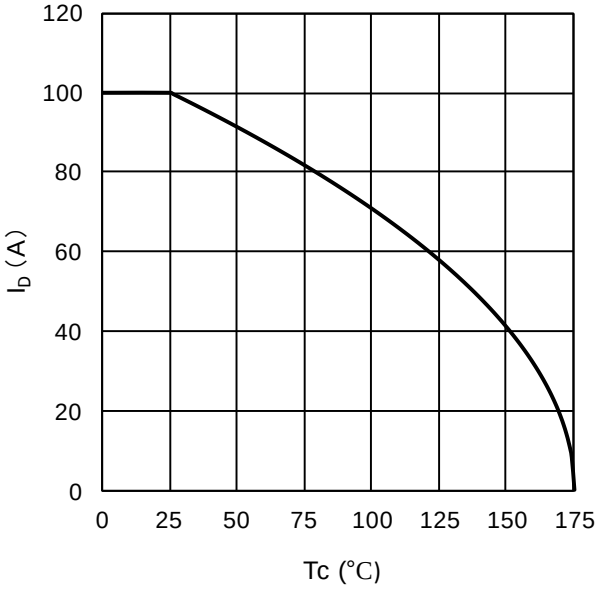
$V_{(BR)DSS}$ - T_C characteristics (typical)



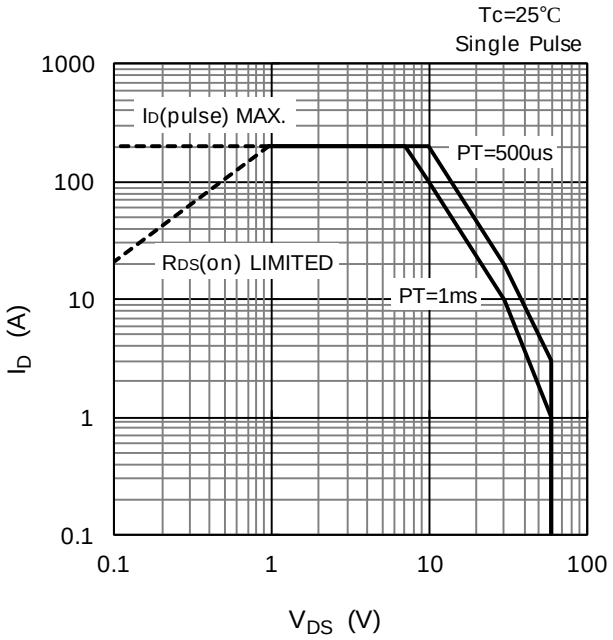
P_D-T_a Derating



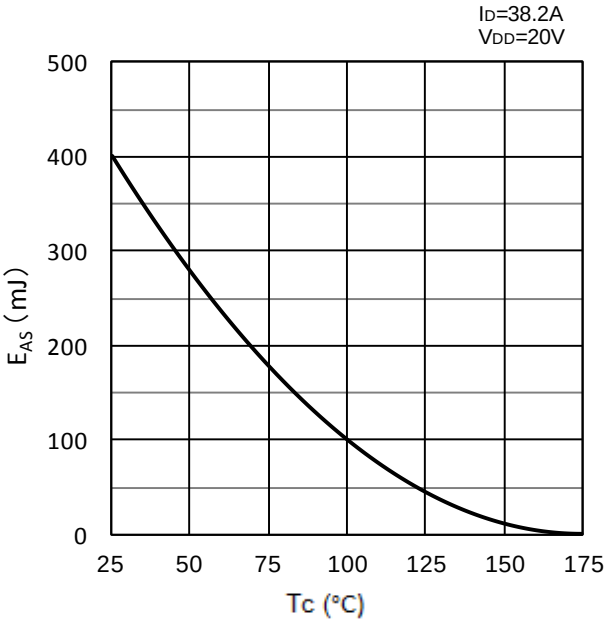
I_D-T_C characteristics



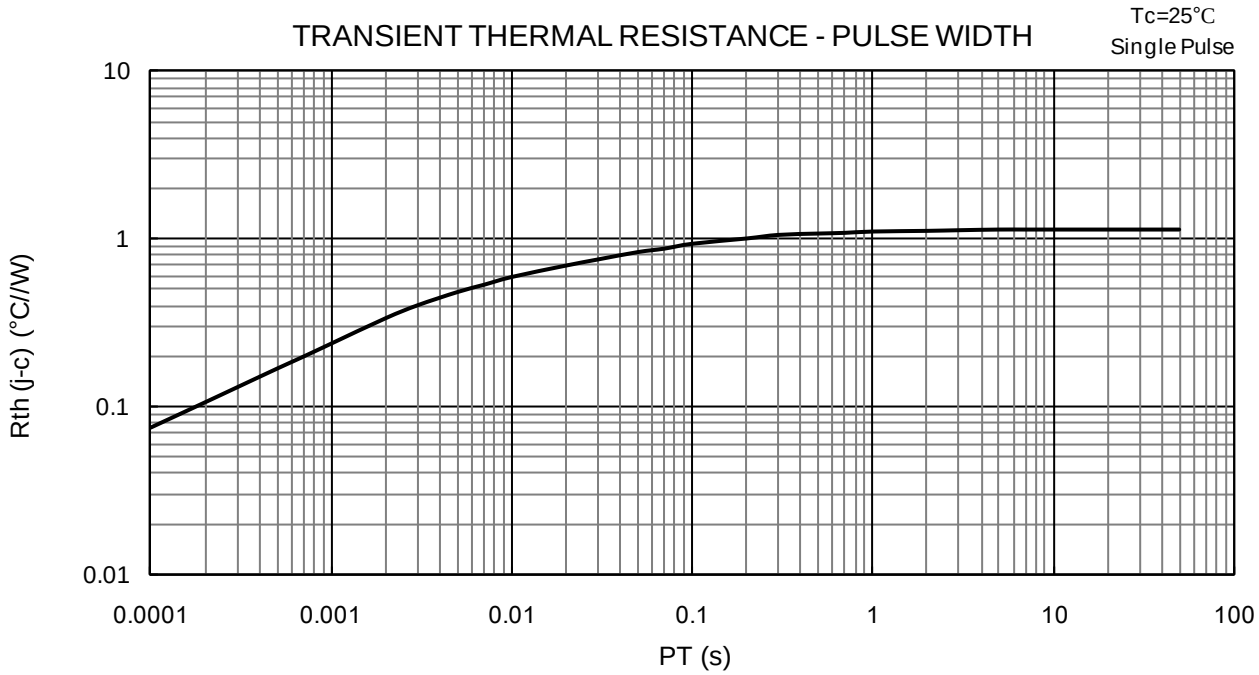
SAFE OPARATING AREA



E_{AS}-Tc characteristics

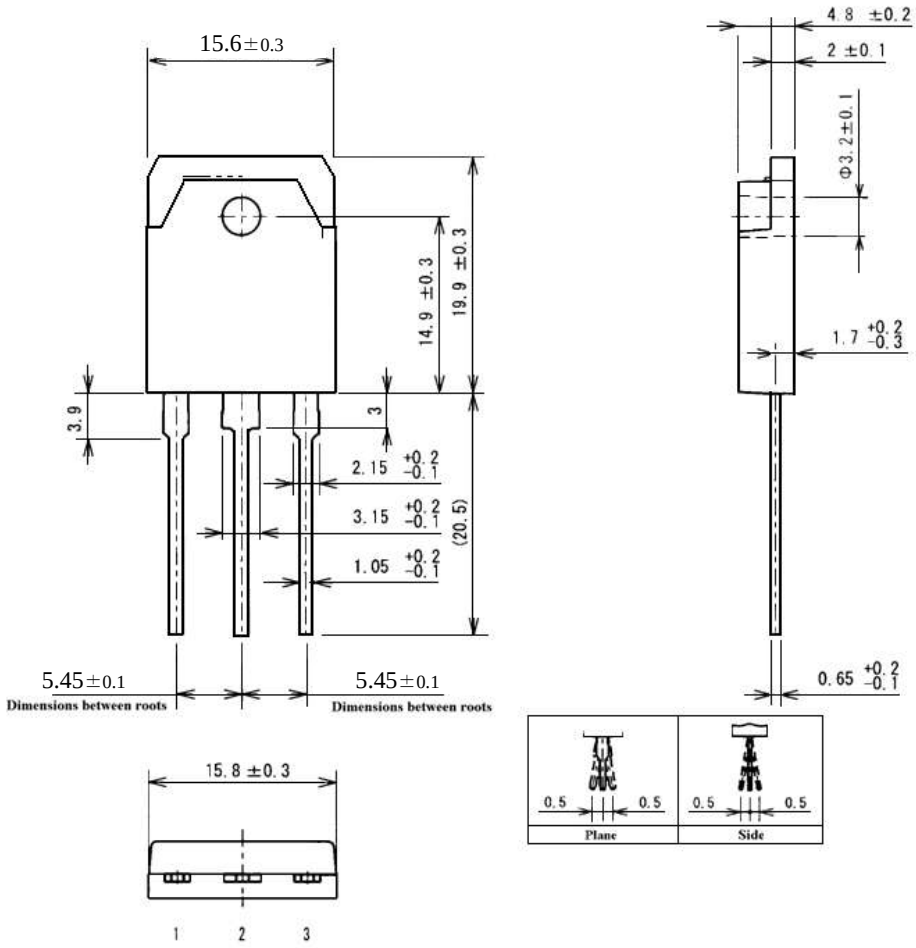


TRANSIENT THERMAL RESISTANCE - PULSE WIDTH



Package Outline

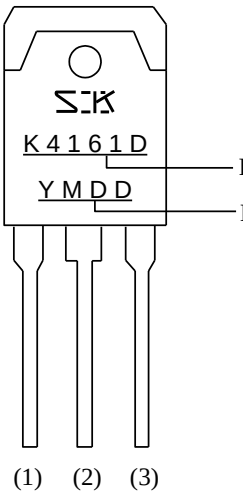
TO3P-3L



NOTES:

- Dimension is in millimeters
- Pin treatment Pb-free. Device composition compliant with the RoHS directive.

Marking Diagram



Part Number

Lot Number

Y is the Last digit of the year (0 to 9)

M is the Month (1 to 9, O, N or D)

DD is the Date (two digit of 01 to 31)

A is the suffix No.

IMPORTANT NOTES

- All data, illustrations, graphs, tables and any other information included in this document as to Sanken's products listed herein (the "Sanken Products") are current as of the date this document is issued. All contents in this document are subject to any change without notice due to improvement, etc. Please make sure that the contents set forth in this document reflect the latest revisions before use.
- The Sanken Products are intended for use as components of electronic equipment or apparatus (transportation equipment and its control systems, home appliances, office equipment, telecommunication equipment, measuring equipment, etc.). Prior to use of the Sanken Products, please put your signature, or affix your name and seal, on the specification documents of the Sanken Products and return them to Sanken. If considering use of the Sanken Products for any applications that require higher reliability (traffic signal control systems or equipment, disaster/crime alarm systems, etc.), you must contact a Sanken sales representative to discuss the suitability of such use and put your signature, or affix your name and seal, on the specification documents of the Sanken Products and return them to Sanken, prior to the use of the Sanken Products. Any use of the Sanken Products without the prior written consent of Sanken in any applications where extremely high reliability is required (aerospace equipment, nuclear power control systems, life support systems, etc.) is strictly prohibited.
- In the event of using the Sanken Products by either (i) combining other products or materials therewith or (ii) physically, chemically or otherwise processing or treating the same, you must duly consider all possible risks that may result from all such uses in advance and proceed therewith at your own responsibility.
- Although Sanken is making efforts to enhance the quality and reliability of its products, it is impossible to completely avoid the occurrence of any failure or defect in semiconductor products at a certain rate. You must take, at your own responsibility, preventative measures including using a sufficient safety design and confirming safety of any equipment or systems in/for which the Sanken Products are used, upon due consideration of a failure occurrence rate or derating, etc., in order not to cause any human injury or death, fire accident or social harm which may result from any failure or malfunction of the Sanken Products. Please refer to the relevant specification documents and Sanken's official website in relation to derating.
- No anti-radioactive ray design has been adopted for the Sanken Products.
- No contents in this document can be transcribed or copied without Sanken's prior written consent.
- The circuit constant, operation examples, circuit examples, pattern layout examples, design examples, recommended examples and evaluation results based thereon, etc., described in this document are presented for the sole purpose of reference of use of the Sanken Products and Sanken assumes no responsibility whatsoever for any and all damages and losses that may be suffered by you, users or any third party, or any possible infringement of any and all property rights including intellectual property rights and any other rights of you, users or any third party, resulting from the foregoing.
- All technical information described in this document (the "Technical Information") is presented for the sole purpose of reference of use of the Sanken Products and no license, express, implied or otherwise, is granted hereby under any intellectual property rights or any other rights of Sanken.
- Unless otherwise agreed in writing between Sanken and you, Sanken makes no warranty of any kind, whether express or implied, as to the quality of the Sanken Products (including the merchantability, or fitness for a particular purpose or a special environment thereof), and any information contained in this document (including its accuracy, usefulness, or reliability).
- In the event of using the Sanken Products, you must use the same after carefully examining all applicable environmental laws and regulations that regulate the inclusion or use of any particular controlled substances, including, but not limited to, the EU RoHS Directive, so as to be in strict compliance with such applicable laws and regulations.
- You must not use the Sanken Products or the Technical Information for the purpose of any military applications or use, including but not limited to the development of weapons of mass destruction. In the event of exporting the Sanken Products or the Technical Information, or providing them for non-residents, you must comply with all applicable export control laws and regulations in each country including the U.S. Export Administration Regulations (EAR) and the Foreign Exchange and Foreign Trade Act of Japan, and follow the procedures required by such applicable laws and regulations.
- Sanken assumes no responsibility for any troubles, which may occur during the transportation of the Sanken Products including the falling thereof, out of Sanken's distribution network.
- Although Sanken has prepared this document with its due care to pursue the accuracy thereof, Sanken does not warrant that it is error free and Sanken assumes no liability whatsoever for any and all damages and losses which may be suffered by you resulting from any possible errors or omissions in connection with the contents included herein.
- Please refer to the relevant specification documents in relation to particular precautions when using the Sanken Products, and refer to our official website in relation to general instructions and directions for using the Sanken Products.