

# 650V 190mohm Super-Junction Power MOSFET

## AKS65N1K9FAM

### Description:

This SJ device provides good FOM performance, better EMI for customer application.

### Features:

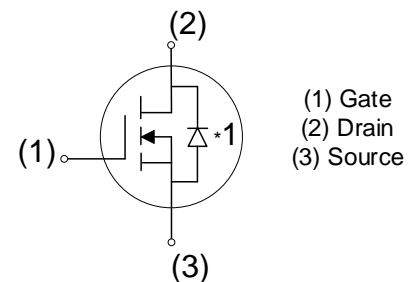
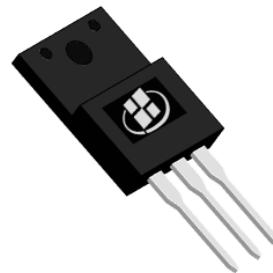
- Low FOM  $R_{DS(ON)} \times Q_G$
- Better EMI
- 100% UIS and Isolation tested
- RoHS compliant (Note 1)
- Halogen-free (Note 1)

### Applications:

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC)

### Key Performance Parameters:

Parameter	Value	Unit
$V_{DS}$	650	V
$R_{DS(ON), max} @ V_{GS}=10V$	190	m $\Omega$
$I_D$	20	A



### Ordering Information:

Ordering Code	Package Type	Marking Code	Form	Packing
AKS65N1K9FAM	TO-220NF	S65N1K9FAM	Tube	1000 per box

### Notes:

1. Contact ALKAIDSEMI sales for detail information

## Maximum Ratings ( $T_A = 25\text{ }^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Value	Units
$V_{DS}$	Drain-Source Voltage	650	V
$I_D$	Drain Current - Continuous ( $T_C = 25\text{ }^\circ\text{C}$ ) <small>(Note 1)</small>	20	A
	Drain Current -Continuous ( $T_C = 100\text{ }^\circ\text{C}$ ) <small>(Note 1)</small>	13	A
$I_{DM}$	Drain Current - Pulsed <small>(Note 1,2)</small>	60	A
$V_{GS}$	Gate-Source Voltage	$\pm 30$	V
$E_{AS}$	Single Pulsed Avalanche Energy <small>(Note 3)</small>	390	mJ
$P_D$	Power Dissipation ( $T_C = 25\text{ }^\circ\text{C}$ )	26.8	W
dV/dT	MOSFET dv/dt ruggedness	50	V/ns
	Reverse diode dv/dt	24	V/ns
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150	$^\circ\text{C}$

## Thermal Characteristics

Symbol	Parameter	Value	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Steady-State	4.6	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient Steady State <small>(Note 4)</small>	50.6	$^\circ\text{C/W}$

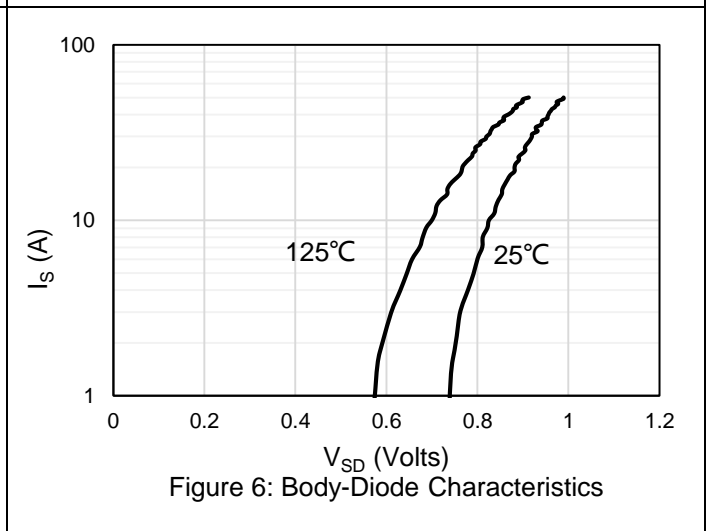
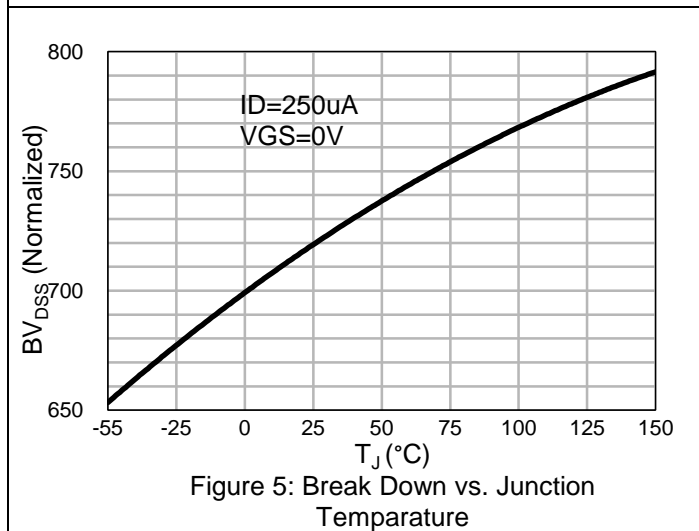
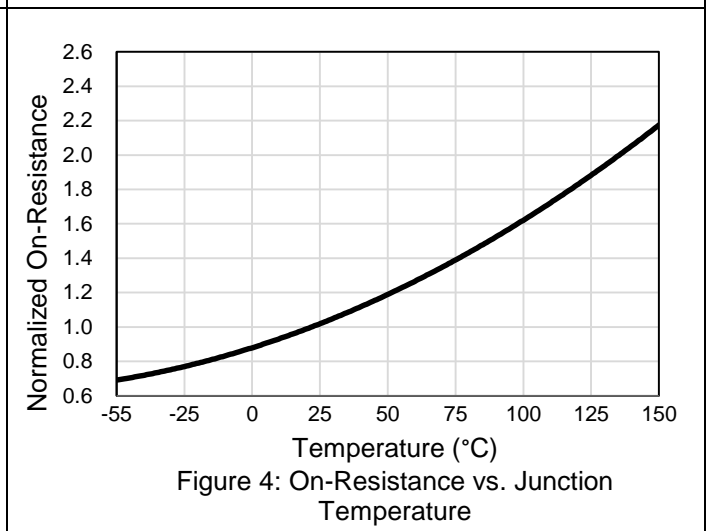
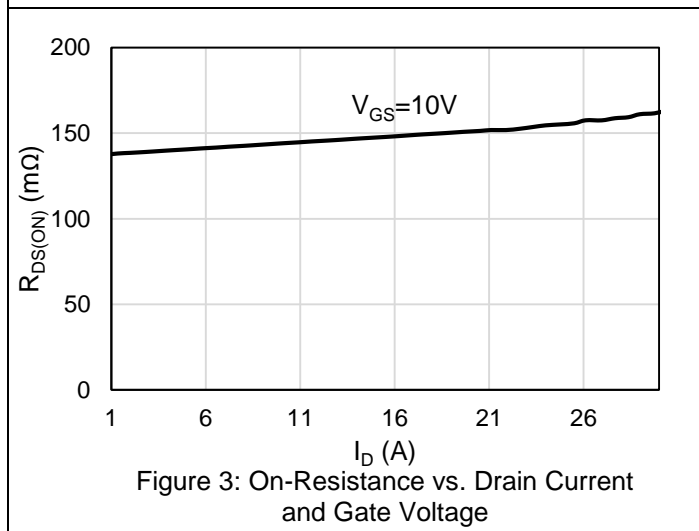
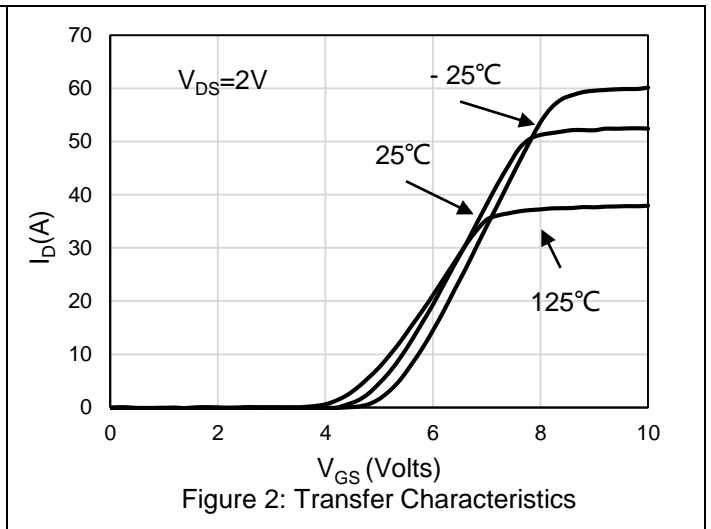
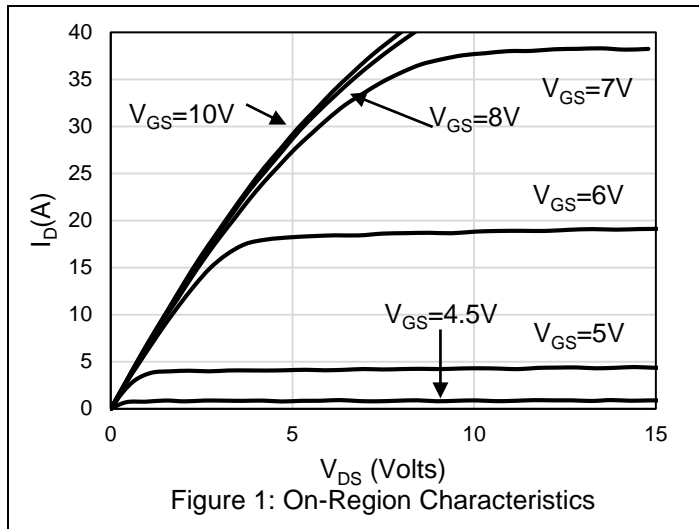
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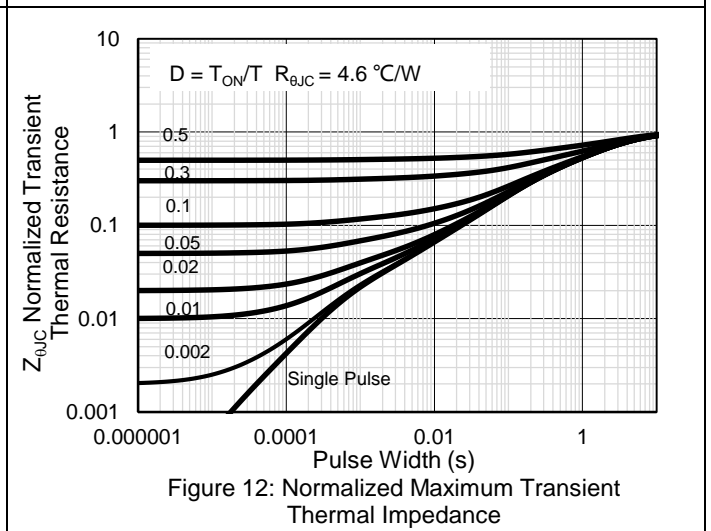
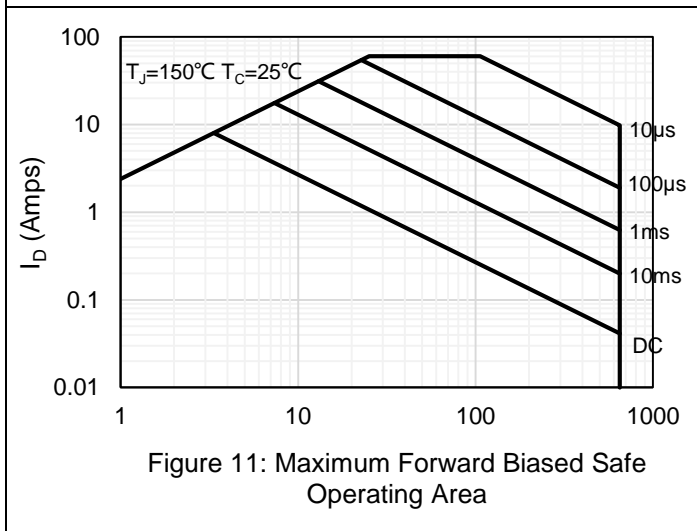
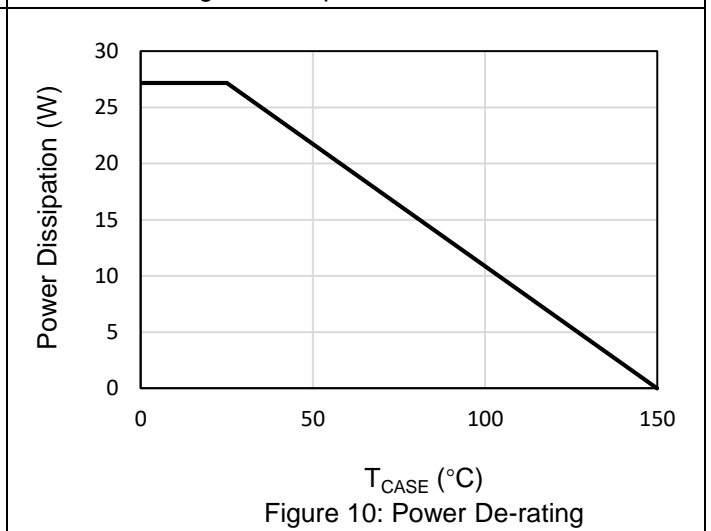
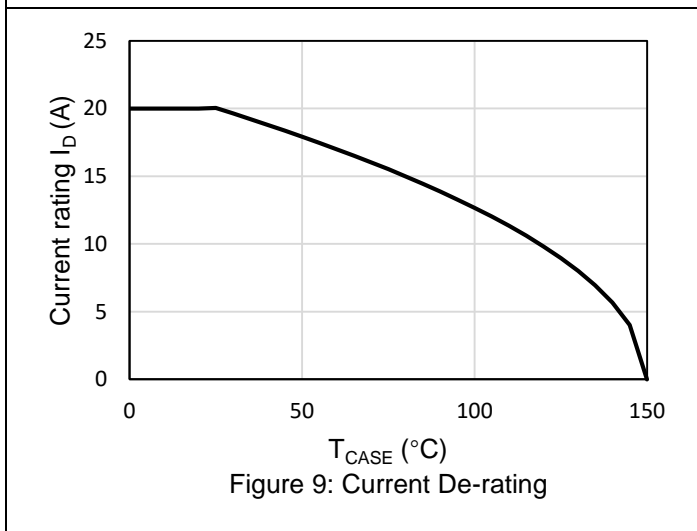
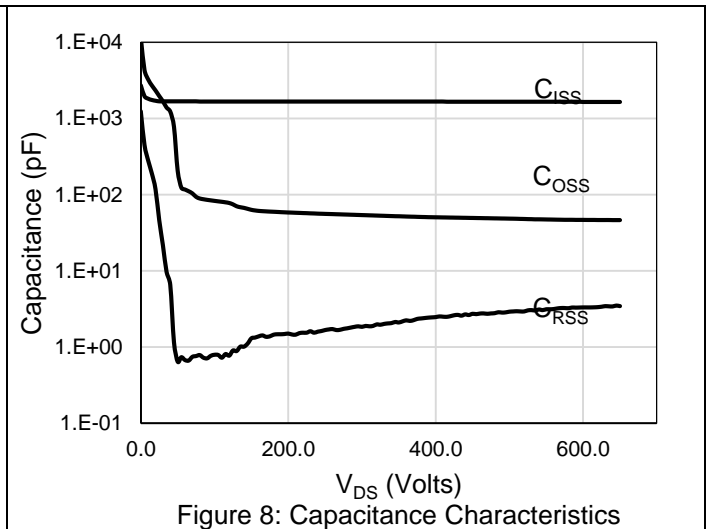
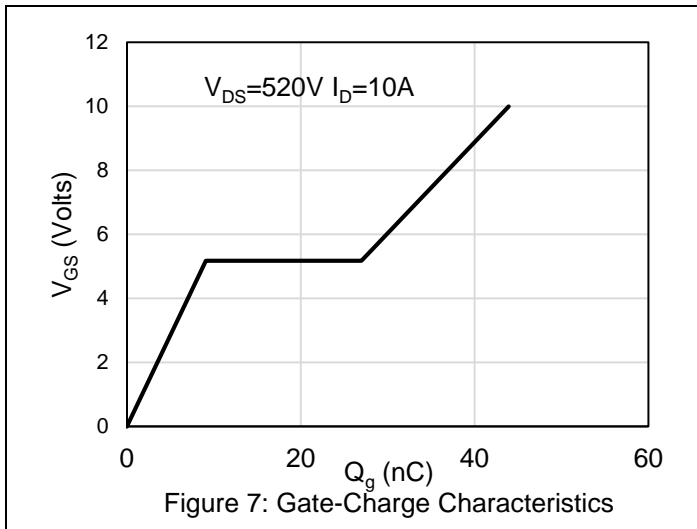
1. The max drain current rating limited by TO220 package and maximum junction temperature
2. Repetitive Rating: Pulse width limited by maximum junction temperature
3.  $L = 10.8\text{ mH}$ ,  $V_{DD} = 150\text{V}$ ,  $I_{AS} = 8.5\text{A}$ ,  $R_G = 25\ \Omega$ , Starting  $T_J = 25\text{ }^\circ\text{C}$ , guarantee by design
4. Mount on minimum PCB layout

**Electrical Characteristics** ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<b>Static Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$ $T_J = 25^\circ\text{C}$	650			V
		$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$ $T_J = 150^\circ\text{C}$	750			
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V},$ $T_J = 25^\circ\text{C}$			1	$\mu\text{A}$
		$V_{DS} = 100\text{ V}, V_{GS} = 0\text{ V},$ $T_J = 150^\circ\text{C}$			100	
$I_{GSS}$	Gate Leakage Current	$V_{GS} = \pm 30\text{ V}, V_{DS} = 0\text{ V}$			$\pm 100$	nA
$V_{GS(TH)}$	Gate Threshold voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	2.6	3.3	4	V
$R_{DS(ON)}$	Drain-Source on-state resistance	$V_{GS} = 10\text{ V}, I_D = 4\text{ A}$		140	190	m $\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 10\text{ V}, I_D = 4\text{ A}$		9		S
<b>Dynamic Characteristics</b>						
$C_{ISS}$	Input capacitance	$V_{DS} = 100\text{ V}, V_{GS} = 0\text{ V},$ $F = 100\text{ kHz}$		1670		pF
$C_{OSS}$	Output capacitance			83.1		pF
$C_{RSS}$	Reverse transfer capacitance			0.8		pF
$R_G$	Gate resistance	$F = 1\text{ MHz}$		20		$\Omega$
<b>Switching Characteristics</b>						
$T_{D(ON)}$	Turn On Delay Time	$V_{DS} = 520\text{ V}, I_D = 20\text{ A},$ $V_{GS} = 10\text{ V}, R_{GEN} = 25\ \Omega$		49.8		ns
$T_R$	Rise Time			61.4		ns
$T_{D(OFF)}$	Turn Off Delay Time			195.8		ns
$T_F$	Fall Time			55.8		ns
$Q_G$	Total Gate Charge	$V_{DS} = 520\text{ V}, I_D = 10\text{ A},$ $V_{GS} = 10\text{ V}$		44		nC
$Q_{GS}$	Gate-Source Charge			9		nC
$Q_{GD}$	Gate-Drain Charge			18		nC
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
$I_S$	Maximum Continuous Body-Diode Forward Current				20	A
$I_{SM}$	Maximum Pulsed Body-Diode Forward Current (NOTE 1)				60	A
$V_{SD}$	Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 8\text{ A}$		0.81		V
$T_{RR}$	Reverse recovery time	$I_F = 20\text{ A}, dI/dT = 100\text{ A}/\mu\text{S}$		350		ns
$Q_{RR}$	Reverse recovery charge			6.2		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			-36		A

## Electrical Characteristics Diagrams



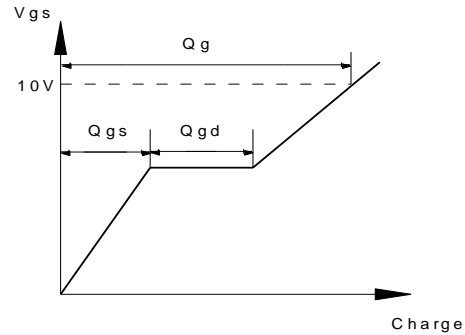
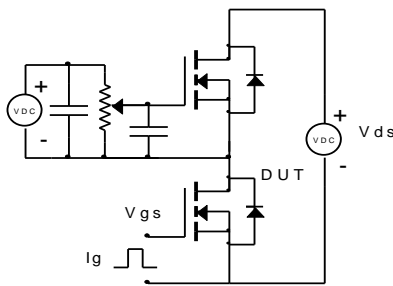


**Notes:**

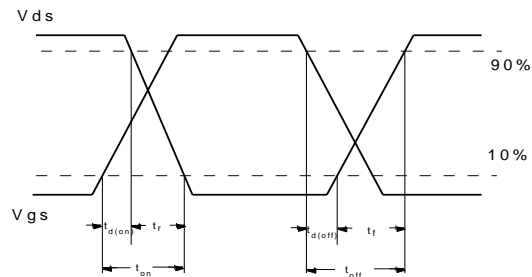
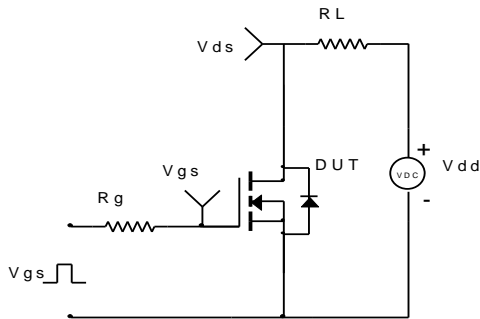
1. Pulse Test: Pulse width ≤ 300 us, Duty cycle ≤ 2%
2. Essentially independent of operating temperature

# Test Circuit and Waveform

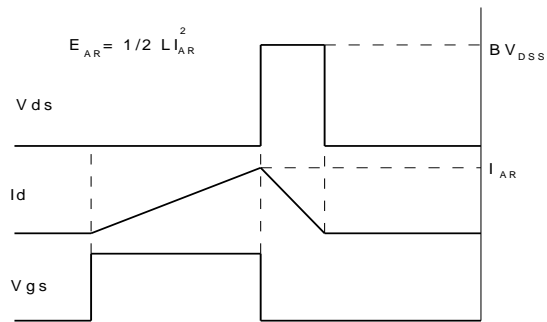
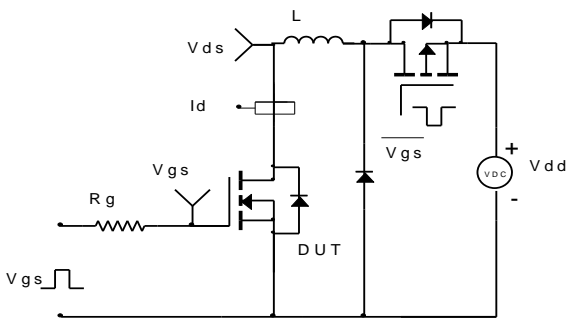
Gate Charge Test Circuit & Waveform



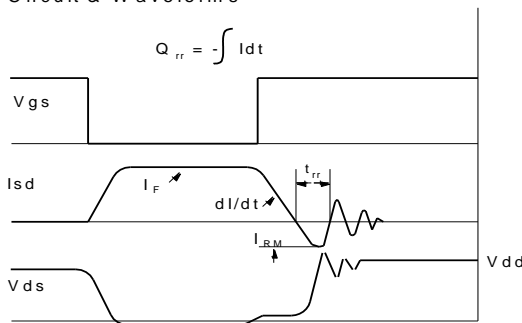
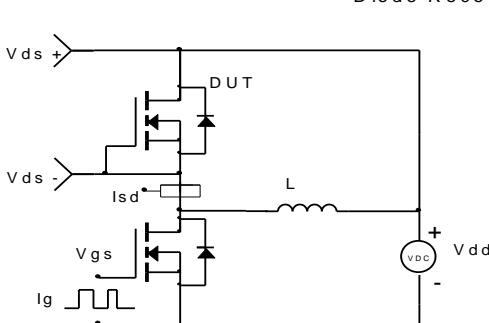
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms

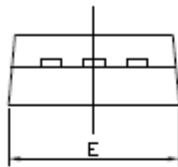
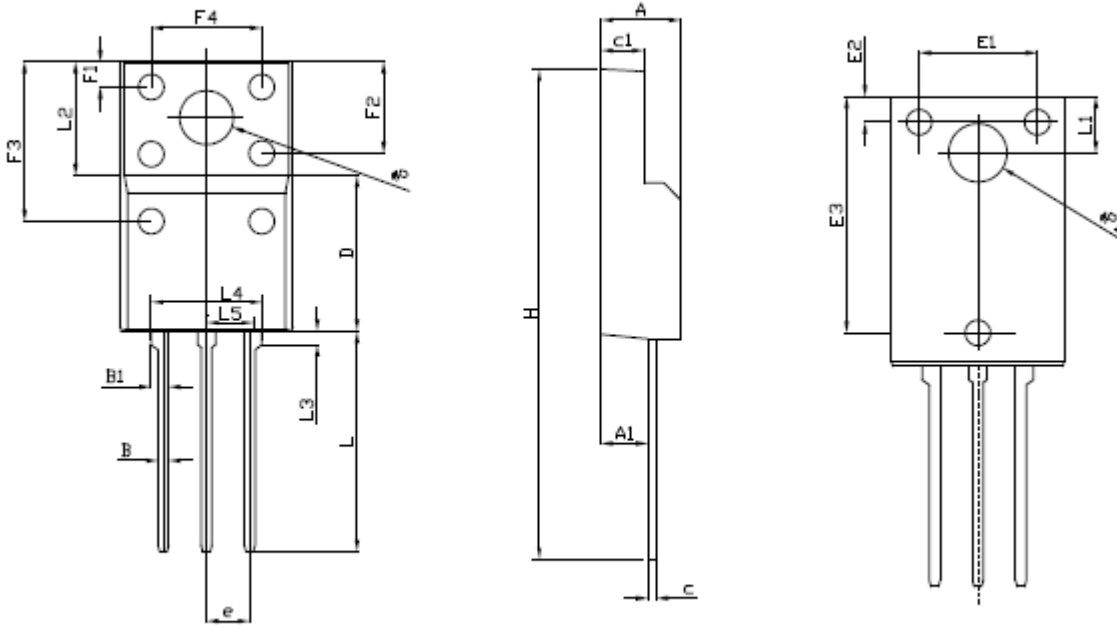


Diode Recovery Test Circuit & Waveforms

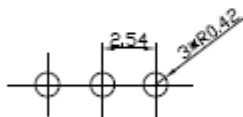


Package Outlines

TO-220NF-3L PACKAGE OUTLINE



RECOMMENDED LAND PATTERN



UNIT: mm

	MIN	NOM	MAX
A	4.50	4.70	4.90
A1	2.63	2.76	2.89
B	0.50	0.60	0.75
B1	0.90	1.05	1.20
c	0.40	0.50	0.60
c1	2.34	2.54	2.74
D	8.87	9.17	9.47
e	2.34	2.54	2.74
E	9.86	10.16	10.46
E1	6.86	6.96	7.06
E2	1.40	1.50	1.60
E3	13.80	13.90	14.00
F1	1.40	1.50	1.60
F2	5.15	5.40	5.65
F3	9.10	9.40	9.70
F4	6.70	7.00	7.30
H	28.50	29.00	29.50
L	12.58	12.98	13.38
L1	3.15	3.30	3.45
L2		6.7REP	
L3	0.70	0.80	0.85
L4	6.38	6.58	6.78
L5	2.63	2.83	3.03
ΦP	2.90	3.18	3.48
ΦP1	3.15	3.45	3.75

## Marking Information



Note:

S65N1K9FAM = Product Name Code

XXXXXXX = Date code

Contact ALKAIDSEMI sales for detail information

## Revision History

Revision	Release Date	Remark
Rev.1.0	2022-04-10	Initial release

## Disclaimer

The information given in this document describes the independent performance of the product, but similar performance is not guaranteed under other working conditions, and cannot be guaranteed when installed with other products or equipment. To achieve the required performance of the product in actual scenarios, the customer should conduct a complete application test to assess the functionality of the product.

Alkaidsemi assumes no responsibility for equipment failures result from using products at values that exceed the ratings, operating conditions, or other parameters listed in the product specifications.

The product described in this specification is not applicable for aerospace or other applications which requires high reliability. Customers using or selling these products for use in medical, life-saving, or life-sustaining applications do so at their own risk and agree to fully indemnify.

Due to product or technical improvements, the information described or contained herein may be changed without prior notice.