650V 180mohm Super-Junction Power MOSFET
AK3S65N1K8FAMF

Description:

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

Features:

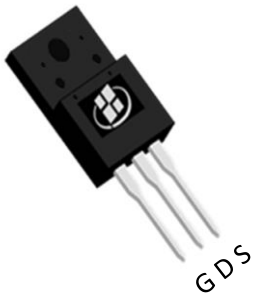
- EMI-Friendly
- RoHS compliant
- Halogen-free

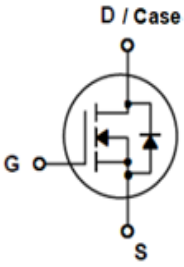
Applications:

- High Frequency Switching
- Quick Charging and Adapter

Key Performance Parameters:

Parameter	Value	Unit
V_{DS}	650	V
$R_{DSON,\ max}$ @V_{GS} = 10 V	180	mΩ
I_D	20	A





Ordering Information:

Ordering Code	Package Type	Marking Code	Form	Packing
AK3S65N1K8FAMF	TO-220NF	3S65N1K8FAMF	Tube	See the detail package information

Maximum Ratings (T_A = 25°C unless otherwise noted)

Symbol	Parameter	Value	Units
V_{DS}	Drain - Source Voltage	650	V
I_D	Drain Current - Continuous (T_C = 25°C) (Note 1)	20	A
	Drain Current - Continuous (T_C = 100°C)	12.5	A
I_{DM}	Drain Current - Pulsed (Note 2)	60	A
V_{GS}	Gate - Source Voltage	± 30	V
E_{AS}	Single Pulsed Avalanche Energy (L = 10.8mH) (Note 3)	194	mJ
	Single Pulsed Avalanche Energy (L = 80mH) (Note 4)	384	mJ
P_D	Power Dissipation (T_C = 25°C)	50	W
dV/dT	MOSFET dv/dt ruggedness, V_{DS} = 0...400 V	70	V/ns
	Reverse diode dv/dt, V_{DS} = 0...400 V	27	V/ns
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150	°C

Thermal Characteristics

Symbol	Parameter	Value	Units
$R_{\theta JC}$	Thermal Resistance, Junction - to - Case, Steady State	2.5	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction - to - Ambient, Steady State (Note 5)	55	°C/W

Notes:

1. The max drain current rating limited by maximum junction temperature
2. Repetitive Rating: Pulse width limited by maximum junction temperature
3. L = 10.8 mH, V_{DD} = 150 V, I_{AS} = 6 A, R_G = 25 Ω, Starting T_J = 25 °C
4. L = 80 mH, V_{DD} = 150 V, I_{AS} = 3.1 A, R_G = 25 Ω, Starting T_J = 25 °C
5. Mount on minimum PCB layout

Electrical Characteristics (T_J = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Static Characteristics						
$V_{(BR)DSS}$	Drain - Source Breakdown Voltage	V_{GS} = 0 V, I_D = 250 μA	650			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 650 V, V_{GS} = 0 V			10	μA
I_{GSS}	Gate Leakage Current	V_{GS} = ± 30 V, V_{DS} = 0 V			±100	nA
$V_{GS(th)}$	Gate Threshold voltage	V_{DS} = V_{GS}, I_D = 250 μA	2	4	5	V
$R_{DS(ON)}$	Drain - Source on - state resistance	V_{GS} = 10 V, I_D = 6 A		150	180	mΩ
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 400 V, V_{GS} = 0 V, f = 1 MHz		1287		pF
C_{oss}	Output Capacitance			26		pF
C_{rss}	Reverse Transfer Capacitance			3		pF
$C_{o(er)}$	Effective output capacitance, energy related	V_{DS} = 0...400 V, V_{GS} = 0 V		48		pF
$C_{o(tr)}$	Effective output capacitance, time related	V_{DS} = 0...400 V, V_{GS} = 0 V, I_D=constant		368		pF
R_g	Gate Resistance	f = 1 MHz		19		Ω
Switching Characteristics						
$t_{d(on)}$	Turn On Delay Time	V_{DD} = 400 V , I_D = 8 A, V_{GS} = 13 V, R_G = 3 Ω		44		ns
t_r	Rise Time			39		ns
$t_{d(off)}$	Turn Off Delay Time			61		ns
t_f	Fall Time			12		ns
Q_g	Total Gate Charge	V_{DD} = 400 V , I_D = 6 A, V_{GS} = 10 V		32		nC
Q_{gs}	Gate - Source Charge			8		nC
Q_{gd}	Gate - Drain Charge			16		nC
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Body - Diode Forward Current				20	A
I_{SM}	Maximum Pulsed Body - Diode Forward Current				60	A
V_{SD}	Diode Forward Voltage	V_{GS} = 0 V, I_S = 6 A		0.9		V
t_{rr}	Reverse recovery time	V_{DD} = 400 V, I_D = 8 A, di/dt = 100 A/μs		89		ns
Q_{rr}	Reverse recovery charge			0.3		μC
I_{rrm}	Peak Reverse Recovery Current			8		A

Electrical Characteristics Diagrams

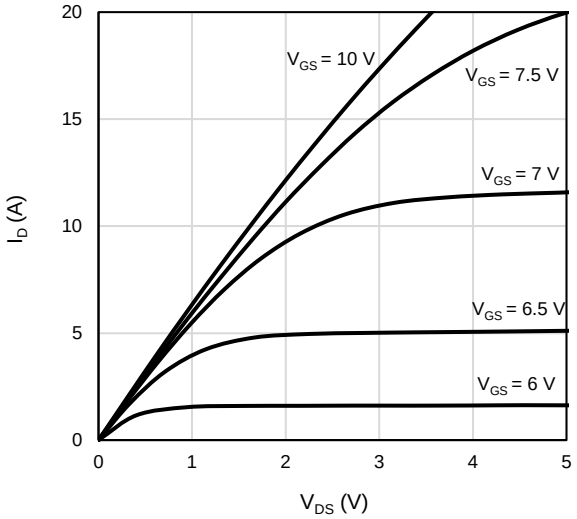


Figure 1: On-Region Characteristics

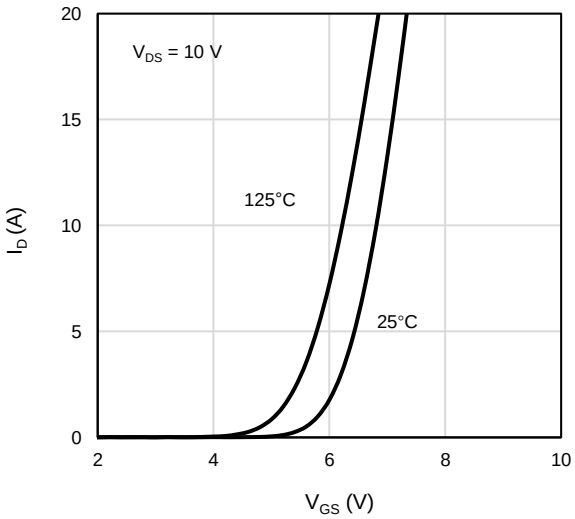


Figure 2: Transfer Characteristics

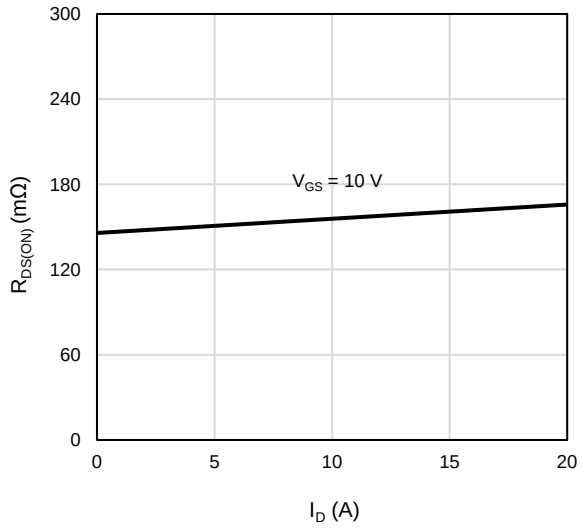


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

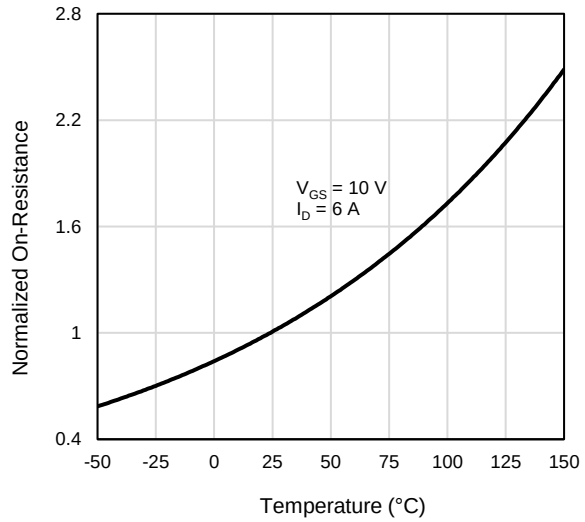


Figure 4: On-Resistance vs. Junction Temperature

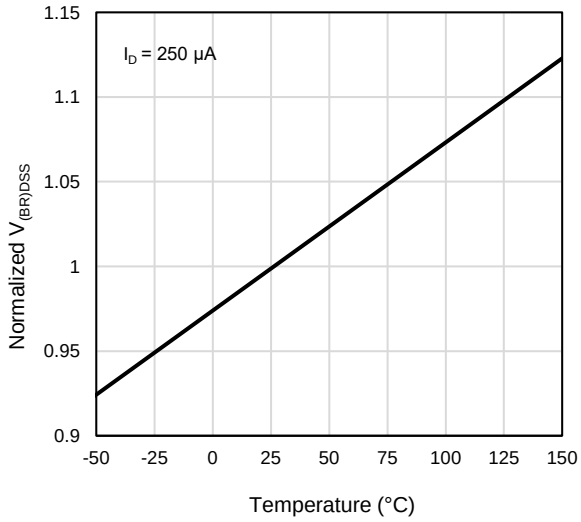


Figure 5: Breakdown Voltage vs. Junction Temperature

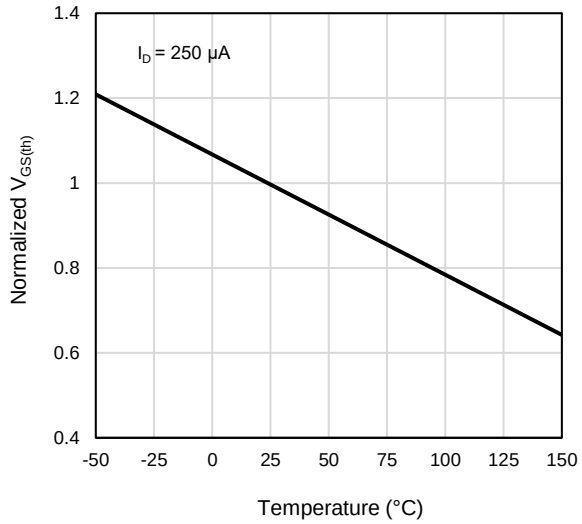


Figure 6: Threshold Voltage vs. Junction Temperature

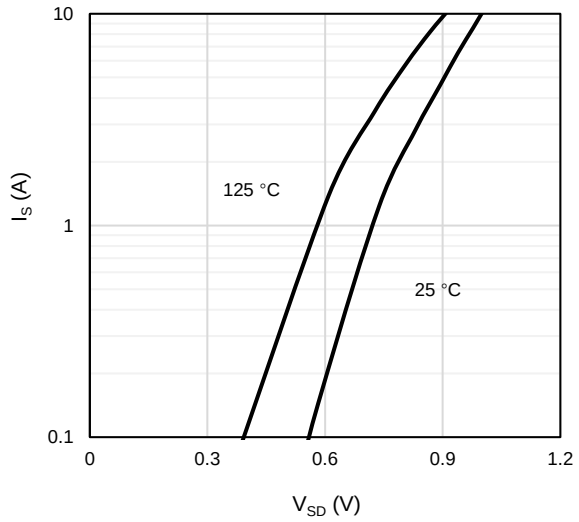


Figure 7: Body-Diode Characteristics

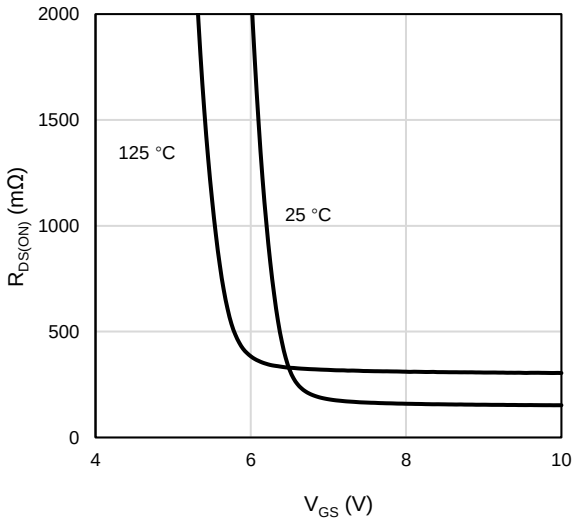


Figure 8: On-Resistance vs. Gate-Source Voltage

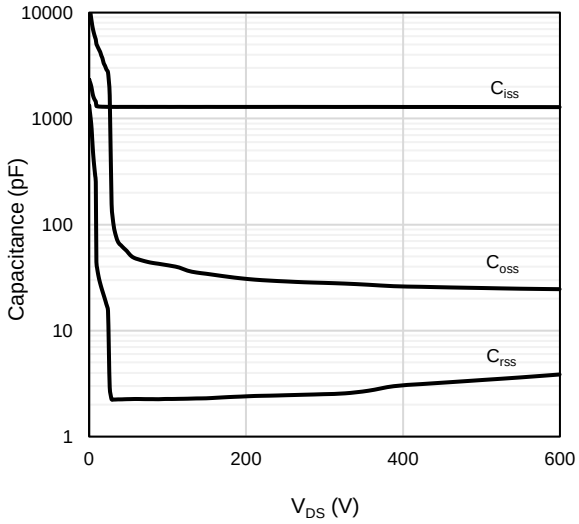


Figure 9: Capacitance Characteristics

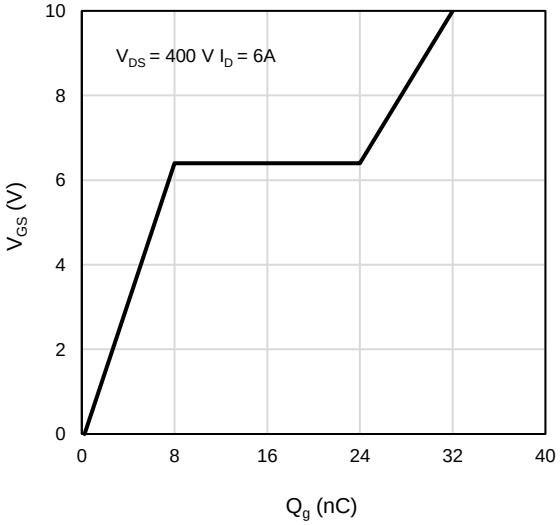


Figure 10: Gate-Charge Characteristics

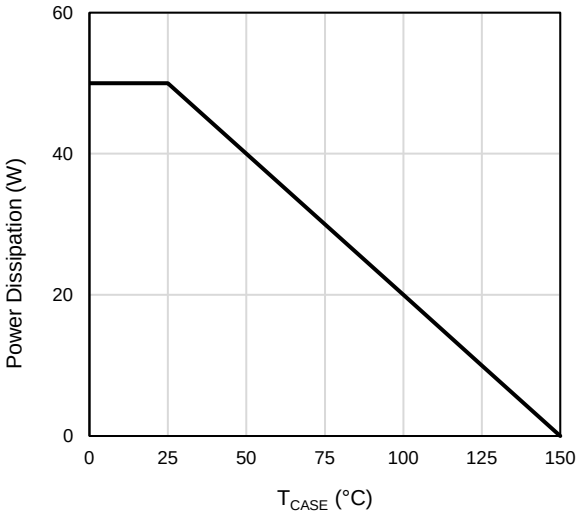


Figure 11: Power De-rating

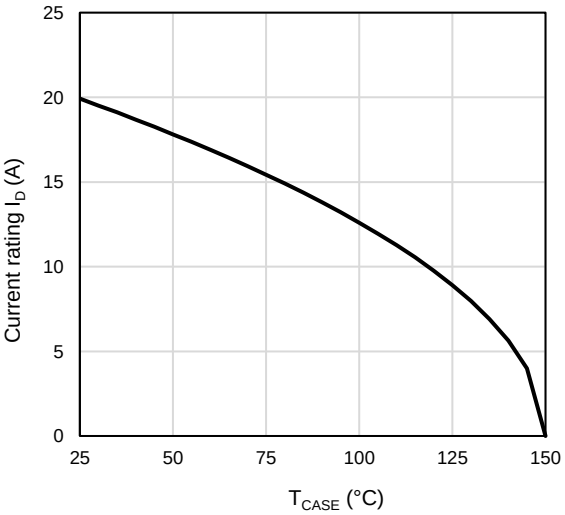


Figure 12: Current De-rating

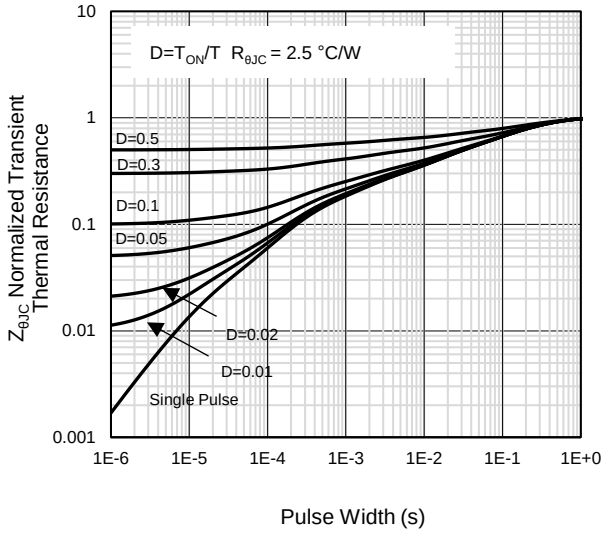


Figure 13: Normalized Maximum Transient Thermal Impedance

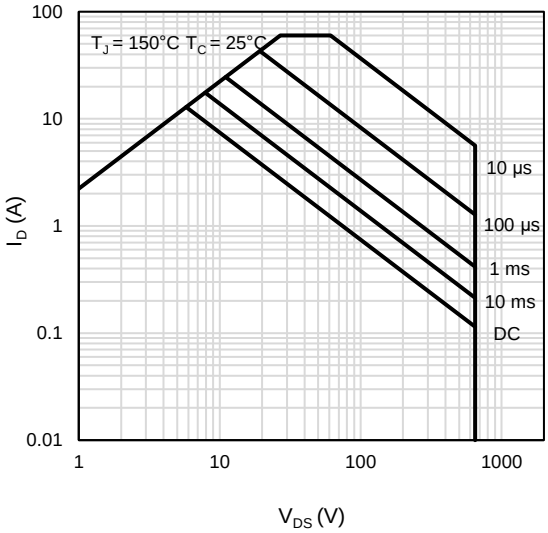
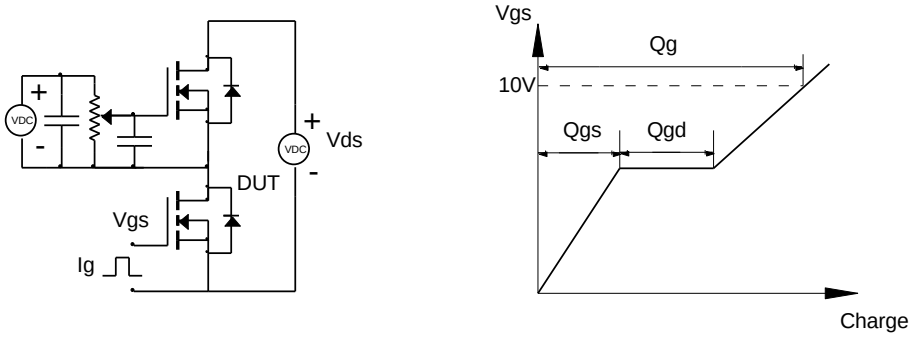


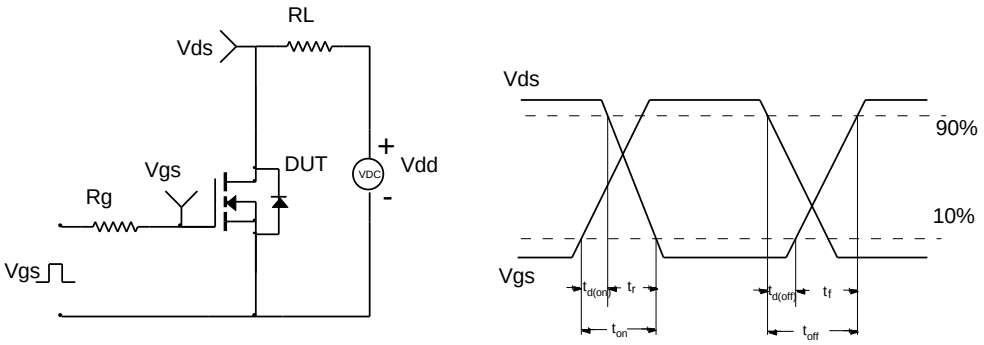
Figure 14: Maximum Forward Biased Safe Operating Area

Test Circuit and Waveform

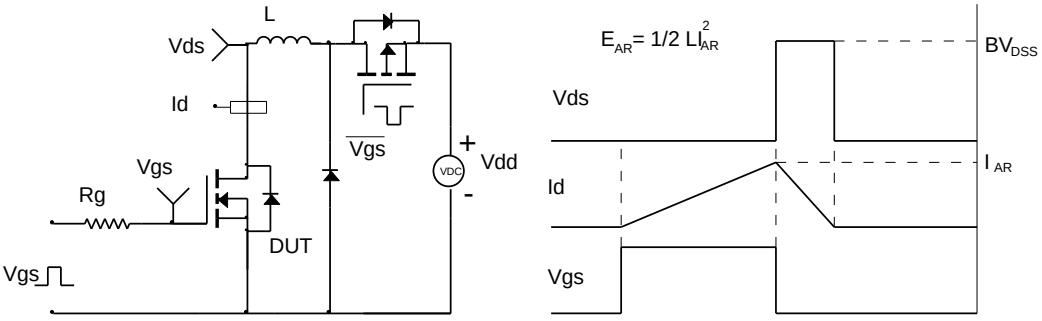
Gate Charge Test Circuit & Waveform



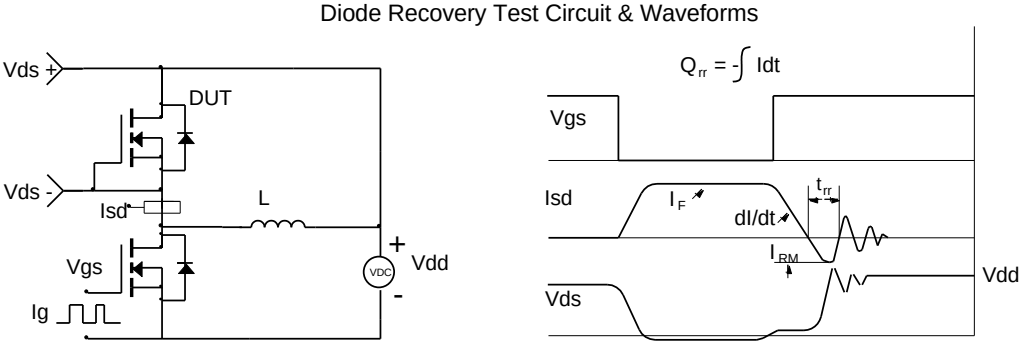
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms



Revision History

Revision	Released	Remark
Rev.1.0	2024	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.