
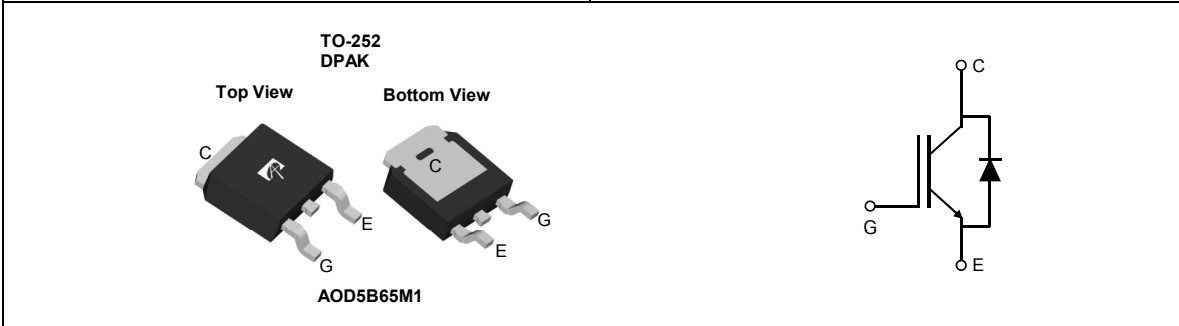


General Description	Product Summary						
<ul style="list-style-type: none"> • Latest AlphaIGBT (α IGBT) technology • 650V breakdown voltage • Very fast and soft recovery freewheeling diode • High efficient turn-on di/dt controllability • Low VCE(SAT) enables high efficiencies • Low turn-off switching loss and softness • Very good EMI behavior • High short-circuit ruggedness <p>Applications</p> <ul style="list-style-type: none"> • Motor Drives • Home appliance applications such as refrigerators and washing machines • Fan, Pumps, Vacuum Cleaner • Other Hard Switching Applications 	<table border="0"> <tr> <td>V_{CE}</td> <td>650V</td> </tr> <tr> <td>I_C ($T_C=100^\circ\text{C}$)</td> <td>5A</td> </tr> <tr> <td>$V_{CE(sat)}$ ($T_J=25^\circ\text{C}$)</td> <td>1.57V</td> </tr> </table> 	V_{CE}	650V	I_C ($T_C=100^\circ\text{C}$)	5A	$V_{CE(sat)}$ ($T_J=25^\circ\text{C}$)	1.57V
V_{CE}	650V						
I_C ($T_C=100^\circ\text{C}$)	5A						
$V_{CE(sat)}$ ($T_J=25^\circ\text{C}$)	1.57V						



Orderable Part Number	Package Type	Form	Minimum Order Quantity
AOD5B65M1	TO252	Tape & Reel	2500

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

Parameter	Symbol	AOD5B65M1	Units
Collector-Emitter Voltage	V_{CE}	650	V
Gate-Emitter Voltage	V_{GE}	± 30	V
Continuous Collector Current	I_C	$T_C=25^\circ\text{C}$	10
		$T_C=100^\circ\text{C}$	5
Pulsed Collector Current, Limited by T_{Jmax}	I_{CM}	15	A
Turn off SOA, $V_{CE} \leq 650\text{V}$, Limited by T_{Jmax}	I_{LM}	15	A
Continuous Diode Forward Current	I_F	$T_C=25^\circ\text{C}$	10
		$T_C=100^\circ\text{C}$	5
Diode Pulsed Current, Limited by T_{Jmax}	I_{FM}	15	A
Short circuit withstanding time ¹⁾ $V_{GE} = 15\text{V}$, $V_{CC} \leq 400\text{V}$, $T_J \leq 150^\circ\text{C}$	t_{SC}	5	μs
Power Dissipation	P_D	$T_C=25^\circ\text{C}$	69
		$T_C=100^\circ\text{C}$	28
Junction and Storage Temperature Range	T_J, T_{STG}	-55 to 150	$^\circ\text{C}$
Maximum lead temperature for soldering purpose, 1/8" from case for 5 seconds	T_L	300	$^\circ\text{C}$

Thermal Characteristics

Parameter	Symbol	AOD5B65M1	Units
Maximum Junction-to-Ambient	$R_{\theta JA}$	55	$^\circ\text{C/W}$
Maximum IGBT Junction-to-Case	$R_{\theta JC}$	1.8	$^\circ\text{C/W}$
Maximum Diode Junction-to-Case	$R_{\theta JC}$	5.5	$^\circ\text{C/W}$

1) Allowed number of short circuits: <1000; time between short circuits: >1s.

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
STATIC PARAMETERS							
BV_{CES}	Collector-Emitter Breakdown Voltage	$I_C=1mA, V_{GE}=0V, T_J=25^\circ C$	650	-	-	V	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE}=15V, I_C=5A$	$T_J=25^\circ C$	-	1.57	1.98	V
			$T_J=125^\circ C$	-	1.87	-	
			$T_J=150^\circ C$	-	1.95	-	
V_F	Diode Forward Voltage	$V_{GE}=0V, I_C=5A$	$T_J=25^\circ C$	-	1.8	2.25	V
			$T_J=125^\circ C$	-	1.79	-	
			$T_J=150^\circ C$	-	1.75	-	
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$V_{CE}=5V, I_C=1mA$	-	5.1	-	V	
I_{CES}	Zero Gate Voltage Collector Current	$V_{CE}=650V, V_{GE}=0V$	$T_J=25^\circ C$	-	-	10	μA
			$T_J=125^\circ C$	-	-	100	
			$T_J=150^\circ C$	-	-	500	
I_{GES}	Gate-Emitter leakage current	$V_{CE}=0V, V_{GE}=\pm 30V$	-	-	±100	nA	
g_{FS}	Forward Transconductance	$V_{CE}=20V, I_C=5A$	-	4.1	-	S	
DYNAMIC PARAMETERS							
C_{ies}	Input Capacitance	$V_{GE}=0V, V_{CC}=25V, f=1MHz$	-	348	-	pF	
C_{oes}	Output Capacitance		-	36	-	pF	
C_{res}	Reverse Transfer Capacitance		-	13	-	pF	
Q_g	Total Gate Charge	$V_{GE}=15V, V_{CC}=520V, I_C=5A$	-	14	-	nC	
Q_{ge}	Gate to Emitter Charge		-	3	-	nC	
Q_{gc}	Gate to Collector Charge		-	6.5	-	nC	
$I_{C(SC)}$	Short circuit collector current	$V_{GE}=15V, V_{CC}=400V,$ $t_{sc} \leq 5\mu s, T_J \leq 150^\circ C$	-	30	-	A	
R_g	Gate resistance	$V_{GE}=0V, V_{CC}=0V, f=1MHz$	-	6	-	Ω	
SWITCHING PARAMETERS, (Load Inductive, T_J=25°C)							
$t_{D(on)}$	Turn-On Delay Time	$T_J=25^\circ C$ $V_{GE}=15V, V_{CC}=400V, I_C=5A,$ $R_G=60\Omega$	-	8.5	-	ns	
t_r	Turn-On Rise Time		-	13	-	ns	
$t_{D(off)}$	Turn-Off Delay Time		-	106	-	ns	
t_f	Turn-Off Fall Time		-	18	-	ns	
E_{on}	Turn-On Energy		-	0.08	-	mJ	
E_{off}	Turn-Off Energy		-	0.07	-	mJ	
E_{total}	Total Switching Energy		-	0.15	-	mJ	
t_{rr}	Diode Reverse Recovery Time		$T_J=25^\circ C$	-	195	-	ns
Q_{rr}	Diode Reverse Recovery Charge		$I_F=5A, dI/dt=200A/\mu s, V_{CC}=400V$	-	0.24	-	μC
I_{rm}	Diode Peak Reverse Recovery Current			-	2.78	-	A
SWITCHING PARAMETERS, (Load Inductive, T_J=150°C)							
$t_{D(on)}$	Turn-On Delay Time	$T_J=150^\circ C$ $V_{GE}=15V, V_{CC}=400V, I_C=5A,$ $R_G=60\Omega$	-	7	-	ns	
t_r	Turn-On Rise Time		-	14	-	ns	
$t_{D(off)}$	Turn-Off Delay Time		-	127	-	ns	
t_f	Turn-Off Fall Time		-	30	-	ns	
E_{on}	Turn-On Energy		-	0.09	-	mJ	
E_{off}	Turn-Off Energy		-	0.12	-	mJ	
E_{total}	Total Switching Energy		-	0.21	-	mJ	
t_{rr}	Diode Reverse Recovery Time		$T_J=150^\circ C$	-	273	-	ns
Q_{rr}	Diode Reverse Recovery Charge		$I_F=5A, dI/dt=200A/\mu s, V_{CC}=400V$	-	0.38	-	μC
I_{rm}	Diode Peak Reverse Recovery Current			-	3.3	-	A

THIS PRODUCT HAS BEEN DESIGNED AND QUALIFIED FOR THE CONSUMER MARKET. APPLICATIONS OR USES AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS ARE NOT AUTHORIZED. AOS DOES NOT ASSUME ANY LIABILITY ARISING OUT OF SUCH APPLICATIONS OR USES OF ITS PRODUCTS. AOS RESERVES THE RIGHT TO IMPROVE PRODUCT DESIGN, FUNCTIONS AND RELIABILITY WITHOUT NOTICE.

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

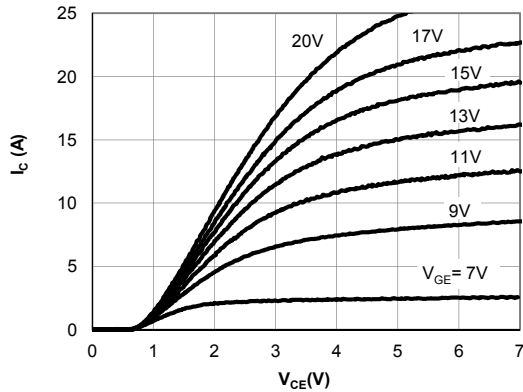


Figure 1: Output Characteristic
($T_j=25^\circ\text{C}$)

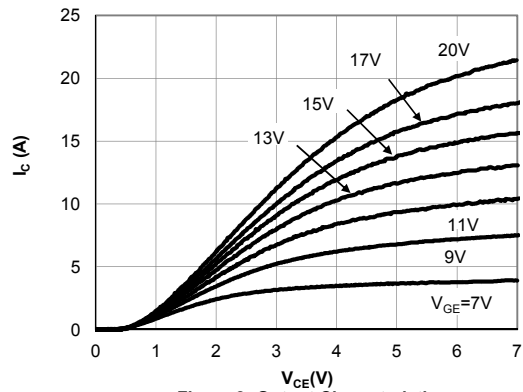


Figure 2: Output Characteristic
($T_j=150^\circ\text{C}$)

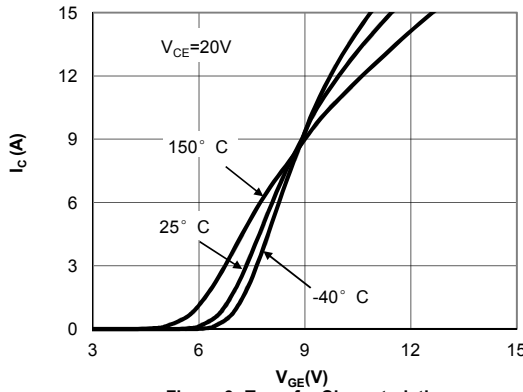


Figure 3: Transfer Characteristic

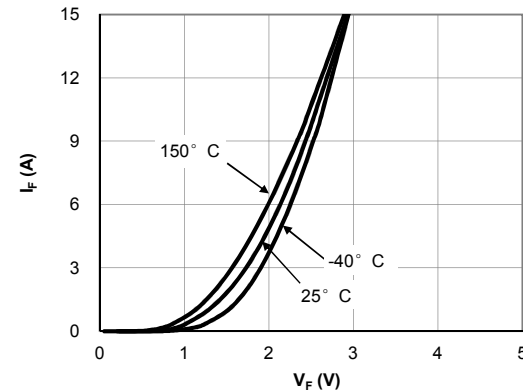


Figure 4: Diode Characteristic

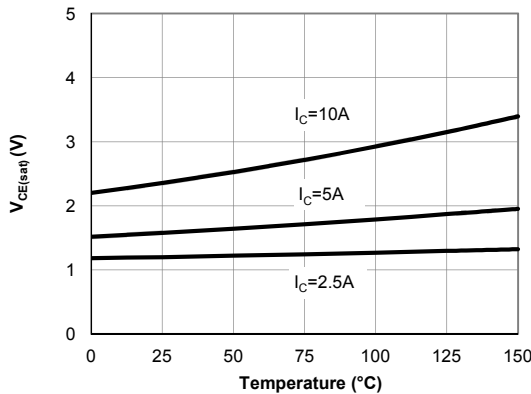


Figure 5: Collector-Emitter Saturation Voltage vs. Junction Temperature

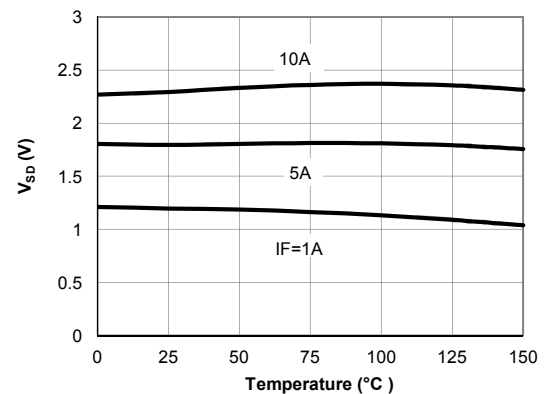


Figure 6: Diode Forward voltage vs. Junction Temperature

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

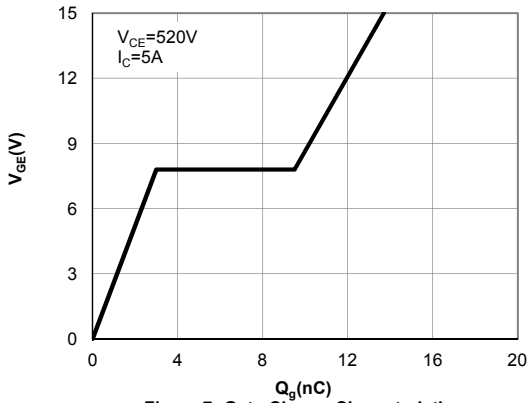


Figure 7: Gate-Charge Characteristics

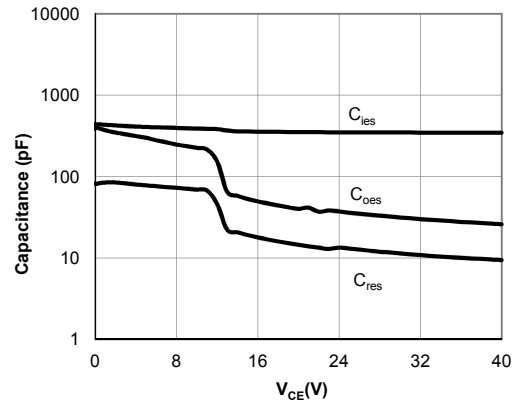


Figure 8: Capacitance Characteristic

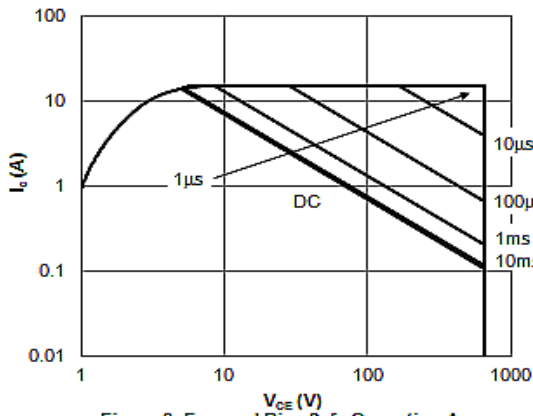


Figure 9: Forward Bias Safe Operating Area
($T_C=25^\circ\text{C}, V_{GE}=15\text{V}$)

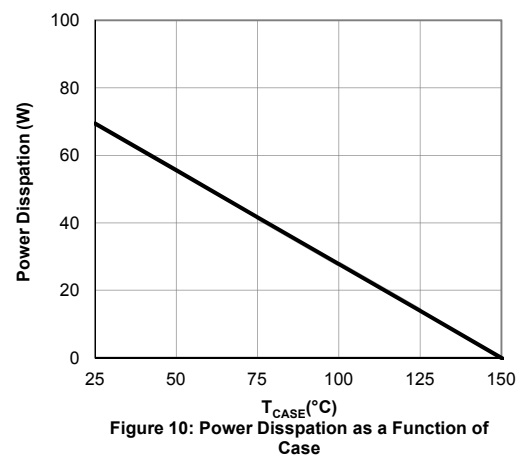


Figure 10: Power Dissipation as a Function of Case

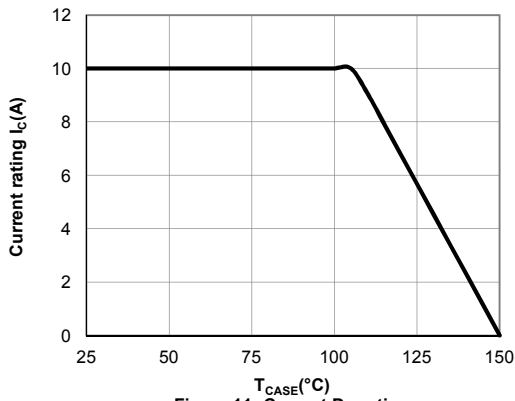


Figure 11: Current De-rating

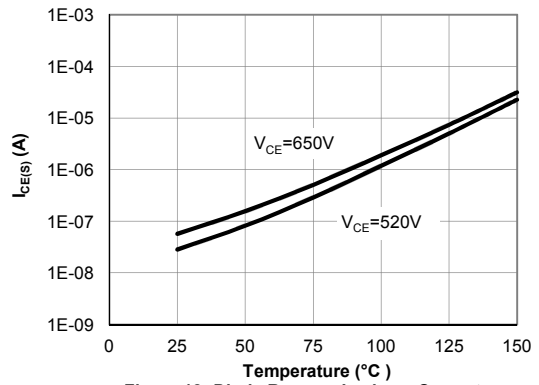


Figure 12: Diode Reverse Leakage Current vs. Junction Temperature

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

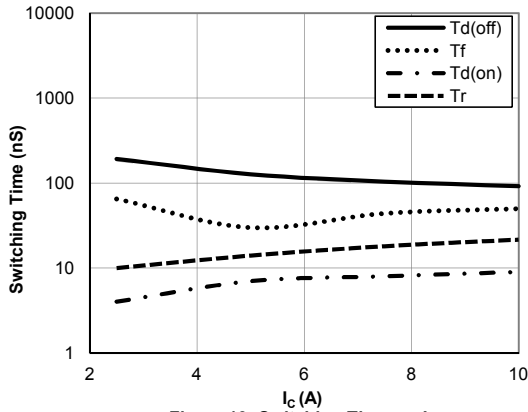


Figure 13: Switching Time vs. I_C
($T_j=150^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, R_g=60\Omega$)

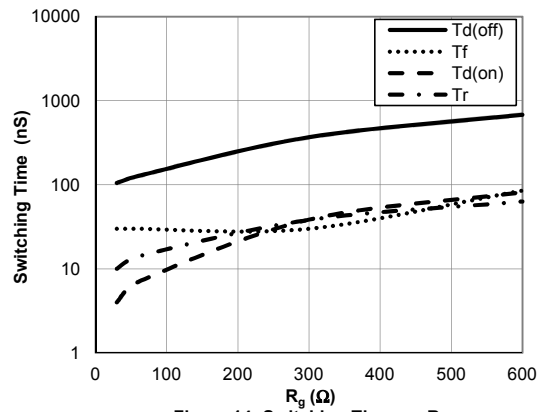


Figure 14: Switching Time vs. R_g
($T_j=150^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=5\text{A}$)

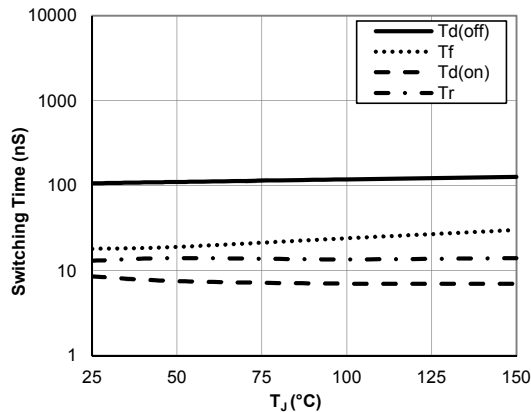


Figure 15: Switching Time vs. T_j
($V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_C=5\text{A}, R_g=60\Omega$)

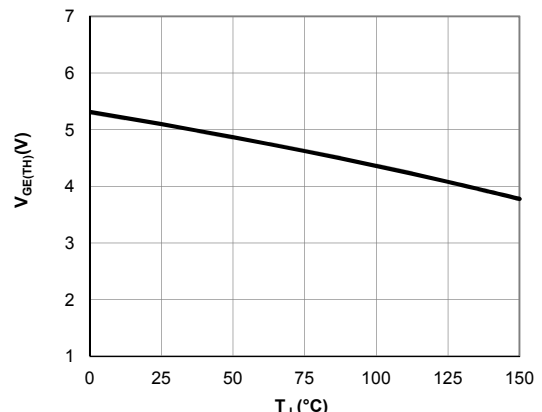


Figure 16: $V_{GE(\text{TH})}$ vs. T_j

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

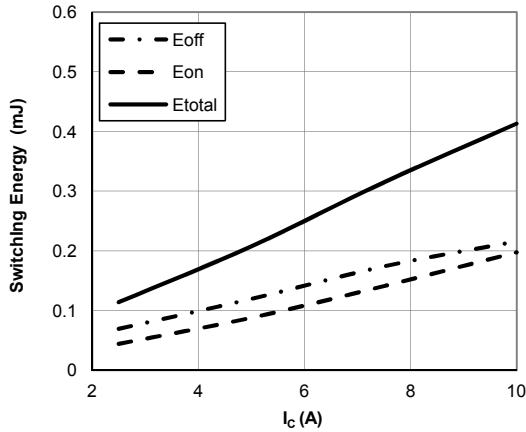


Figure 17: Switching Loss vs. I_c
($T_j=150^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, R_g=60\Omega$)

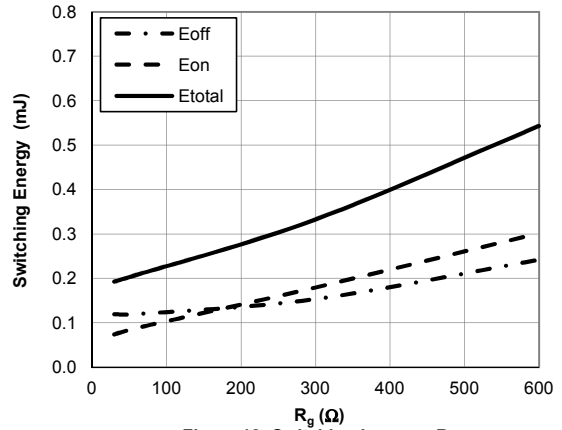


Figure 18: Switching Loss vs. R_g
($T_j=150^\circ\text{C}, V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_c=5\text{A}$)

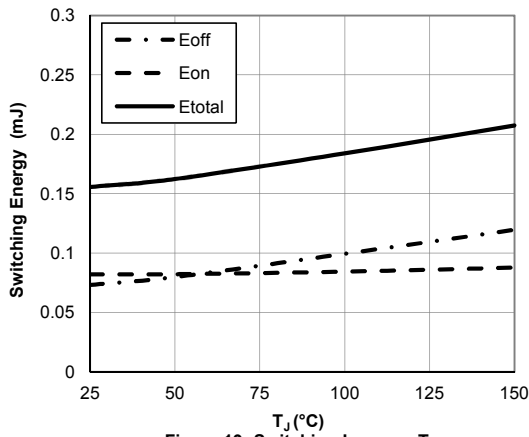


Figure 19: Switching Loss vs. T_j
($V_{GE}=15\text{V}, V_{CE}=400\text{V}, I_c=5\text{A}, R_g=60\Omega$)

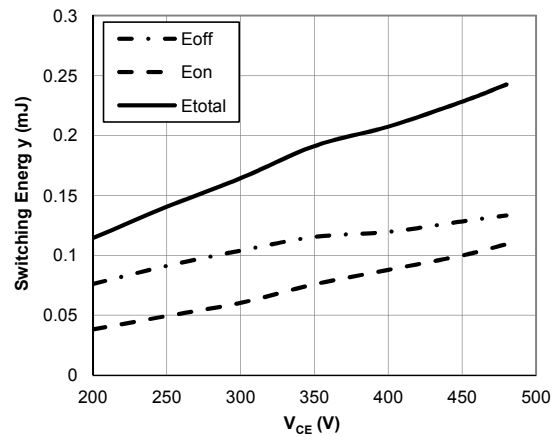


Figure 20: Switching Loss vs. V_{CE}
($T_j=150^\circ\text{C}, V_{GE}=15\text{V}, I_c=5\text{A}, R_g=60\Omega$)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

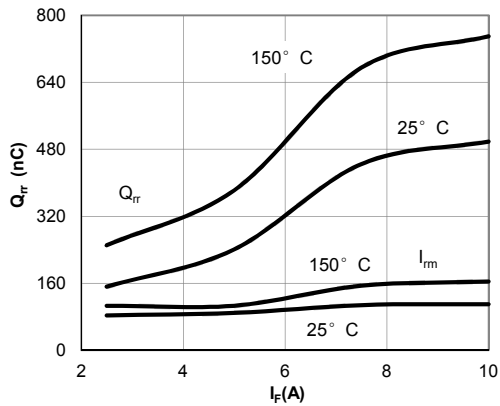


Figure 21: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current
($V_{GE}=15V, V_{CE}=400V, di/dt=200A/\mu s$)

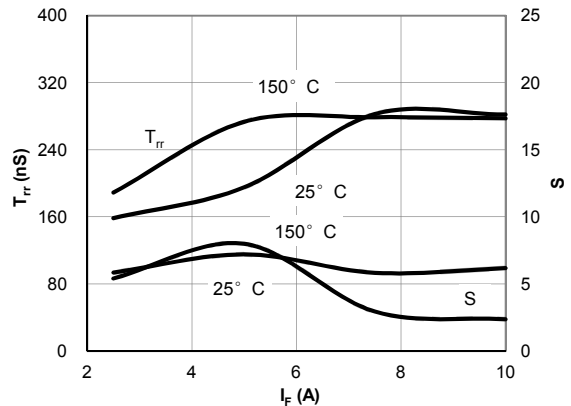


Figure 22: Diode Reverse Recovery Time and Softness Factor vs. Conduction Current
($V_{GE}=15V, V_{CE}=400V, di/dt=200A/\mu s$)

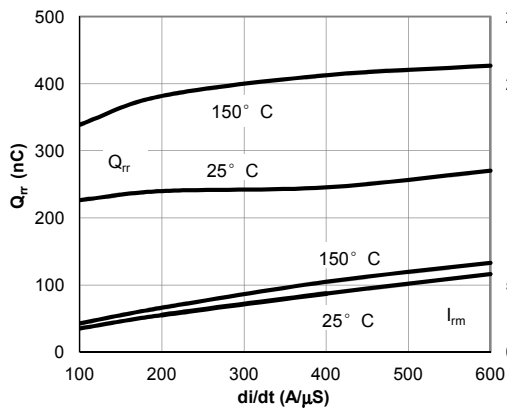


Figure 23: Diode Reverse Recovery Charge and Peak Current vs. di/dt
($V_{GE}=15V, V_{CE}=400V, I_F=5A$)

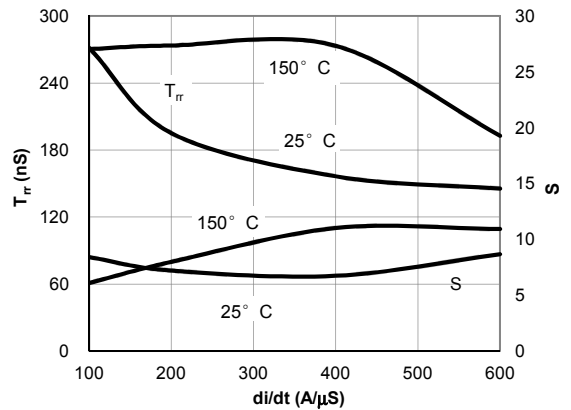


Figure 24: Diode Reverse Recovery Time and Softness Factor vs. di/dt
($V_{GE}=15V, V_{CE}=400V, I_F=5A$)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

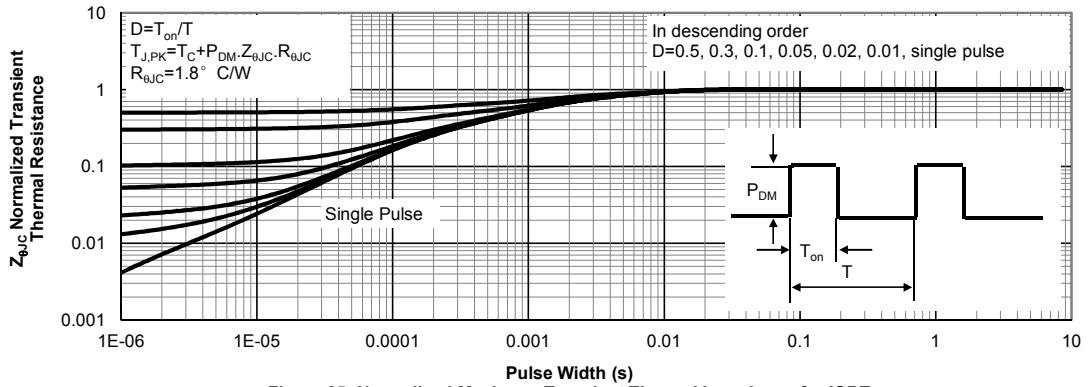


Figure 25: Normalized Maximum Transient Thermal Impedance for IGBT

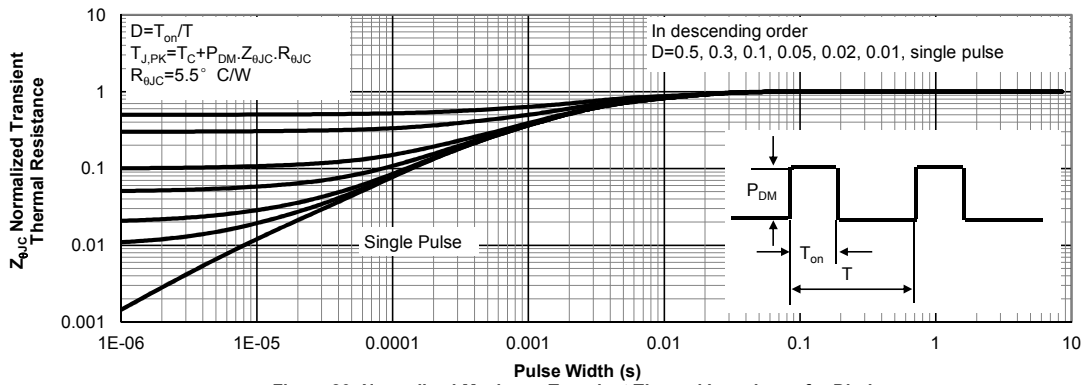


Figure 26: Normalized Maximum Transient Thermal Impedance for Diode

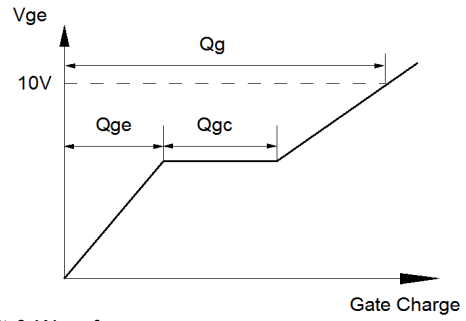
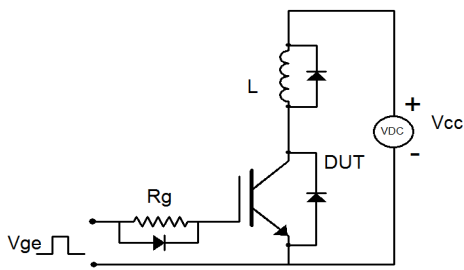


Figure A: Gate Charge Test Circuit & Waveforms

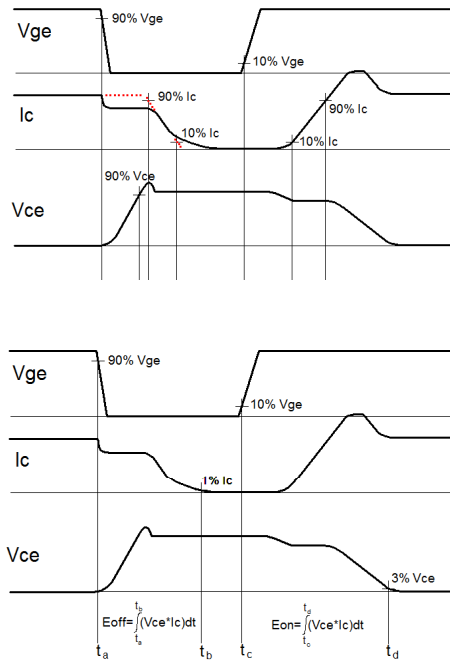
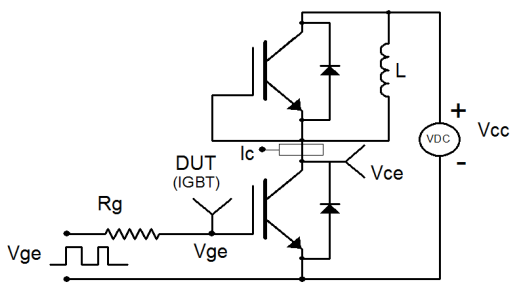


Figure B: Inductive Switching Test Circuit & Waveforms

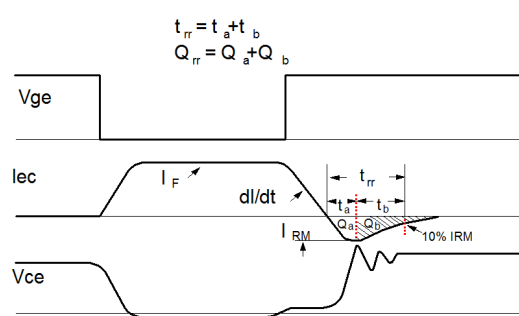
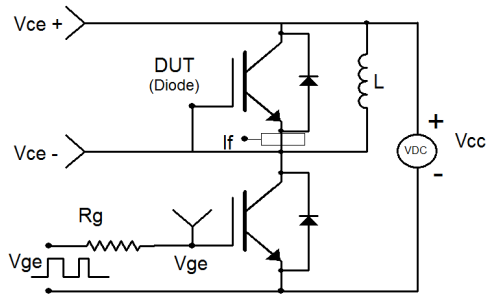


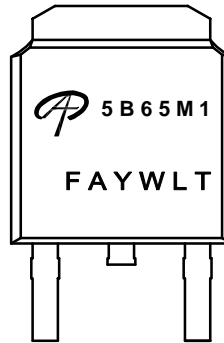
Figure C: Diode Recovery Test Circuit & Waveforms



ALPHA & OMEGA
SEMICONDUCTOR

Document No.	PD-02300
Version	A
Title	AOD5B65M1 Marking Description

TO252(DPAK) PACKAGE MARKING DESCRIPTION



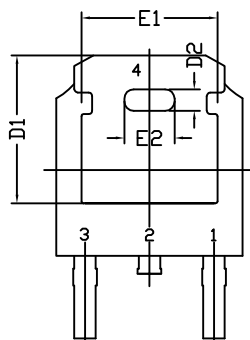
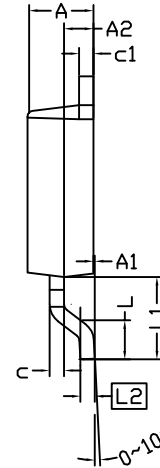
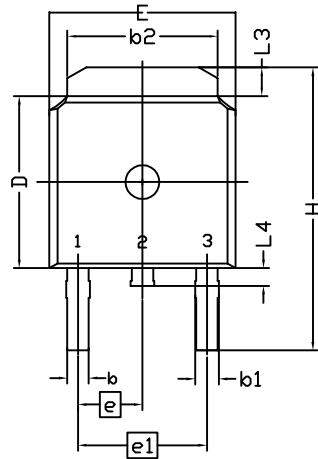
Green product

NOTE:
LOGO - AOS Logo
5B65M1 - Part number code
F - Fab code
A - Assembly location code
Y - Year code
W - Week code
L&T - Assembly lot code

PART NO.	DESCRIPTION	CODE
AOD5B65M1	Green product	5B65M1

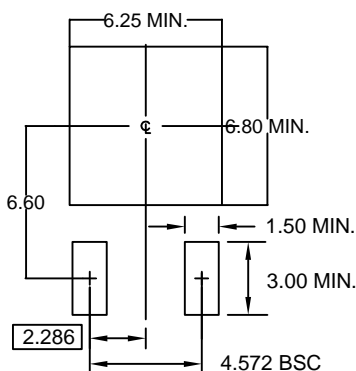


TO252(DPAK) PACKAGE OUTLINE



SYMBOL	DIMENSION IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	2.184	2.286	2.388	0.086	0.090	0.094
A1	0.000	-----	0.127	0.000	-----	0.005
A2	0.889	1.041	1.143	0.035	0.041	0.045
b	0.635	0.762	0.889	0.025	0.030	0.035
b1	0.762	0.840	1.143	0.030	0.033	0.045
b2	4.953	5.340	5.461	0.195	0.210	0.215
c	0.450	0.508	0.610	0.018	0.020	0.024
c1	0.450	0.508	0.610	0.018	0.020	0.024
D	5.969	6.096	6.223	0.235	0.240	0.245
D1	5.210	5.249	5.380	0.205	0.207	0.212
D2	0.662	0.762	0.862	0.026	0.030	0.034
E	6.350	6.604	6.731	0.250	0.260	0.265
E1	4.318	4.826	4.901	0.170	0.190	0.193
E2	1.678	1.778	1.878	0.066	0.070	0.074
e	2.286 BSC			0.090 BSC		
e1	4.572 BSC			0.180 BSC		
H	9.398	10.033	10.414	0.370	0.395	0.410
L	1.270	1.520	2.032	0.050	0.060	0.080
L1	2.921 REF.			0.115REF.		
L2	0.408	0.508	0.608	0.016	0.020	0.024
L3	0.889	1.016	1.270	0.035	0.040	0.050
L4	0.635	-----	1.016	0.025	-----	0.040

RECOMMENDED LAND PATTERN



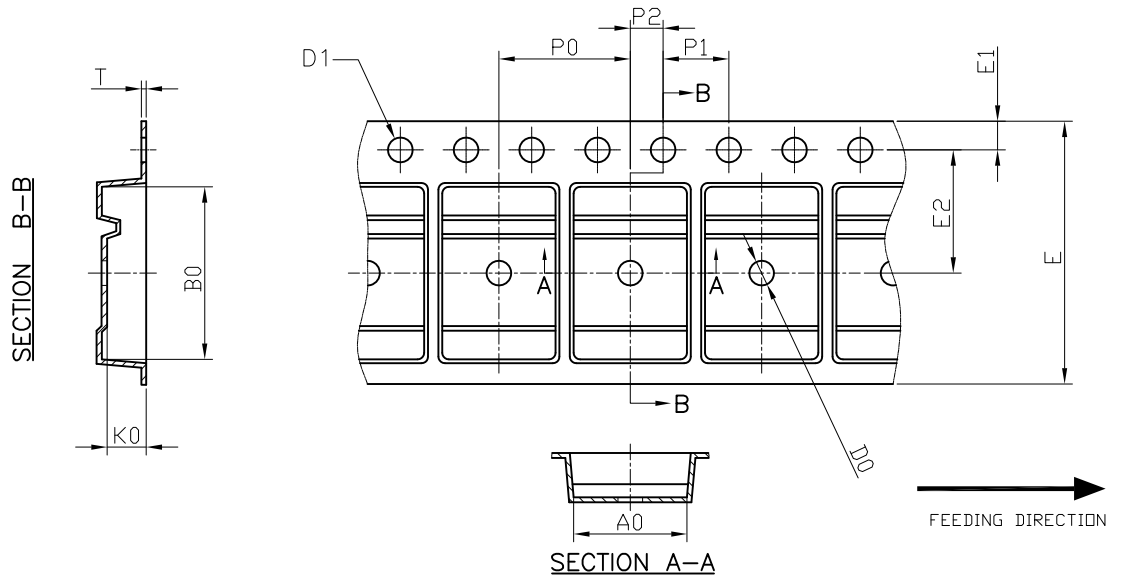
UNIT: mm

NOTE

1. PACKAGE BODY SIZES EXCLUDE MOLD FLASH AND GATE BURRS. MOLD FLASH SHOULD BE LESS THAN 6 MILS.
2. DIMENSION L IS MEASURED IN GAUGE PLANE
3. TOLERANCE 0.10 mm UNLESS OTHERWISE SPECIFIED
4. CONTROLLING DIMENSION IS MILLIMETER. CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.
5. REFER TO JEDEC TO-252 (AA)



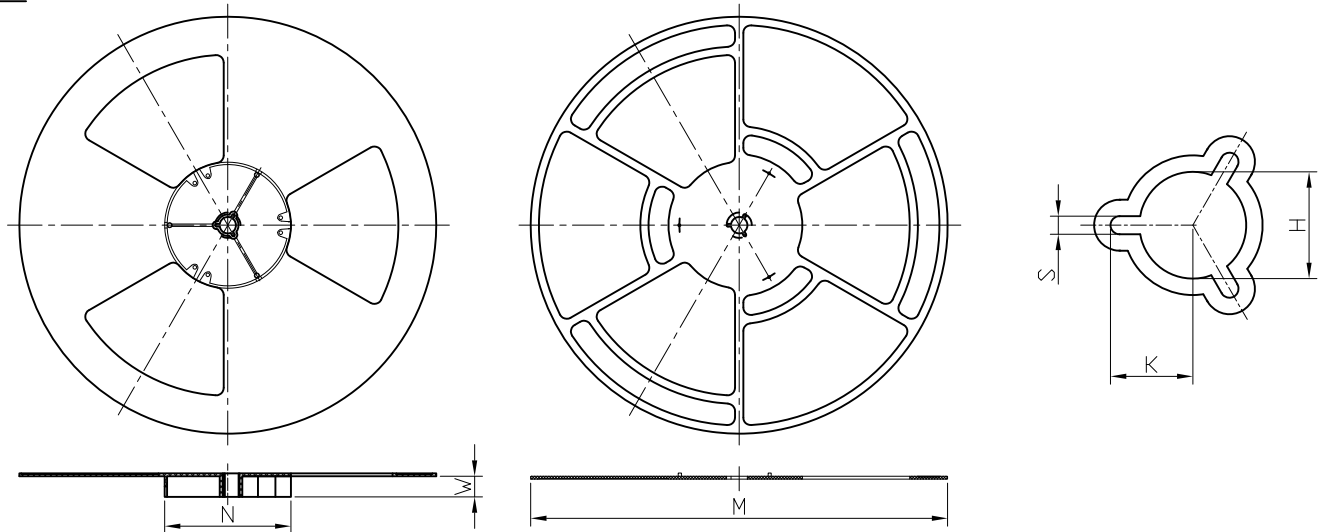
DPAK Carrier Tape



UNIT: MM

PACKAGE	A0	B0	K0	D0	D1	E	E1	E2	P0	P1	P2	T
DPAK (16 mm)	6.90 ±0.10	10.50 ±0.10	2.50 ±0.10	1.50 +0.1 -0	1.50 +0.1 -0	16.00 ±0.30	1.75 ±0.10	7.50 ±0.10	8.00 ±0.10	4.00 ±0.10	2.00 ±0.10	0.30 ±0.05

DPAK Reel



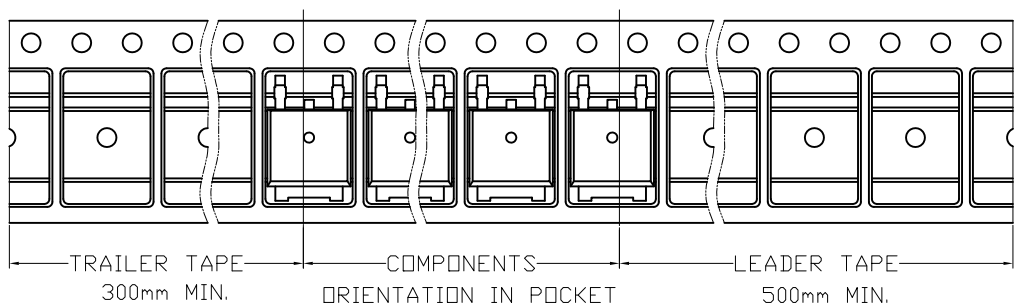
UNIT: MM

TAPE SIZE	REEL SIZE	M	N	W	H	K	S
16 mm	ø330	ø330.00 +0.25 -4.00	ø100.00 ±0.2	16.4 +2.0 -0.0	ø13.00 +0.50 -0.20	10.5 ±0.25	2.2 ±0.25

DPAK Tape

Leader / Trailer
& Orientation

Unit Per Reel:
2500pcs





AOS Semiconductor Product Reliability Report

AOD5B65M1, rev A

Plastic Encapsulated Device

ALPHA & OMEGA Semiconductor, Inc

www.aosmd.com



This AOS product reliability report summarizes the qualification result for AOD5B65M1. Accelerated environmental tests are performed on a specific sample size, and then followed by electrical test at end point. Review of final electrical test result confirms that AOD5B65M1 passes AOS quality and reliability requirements. The released product will be categorized by the process family and be routine monitored for continuously improving the product quality.

Table of Contents:

- I. Product Description
- II. Package and Die information
- III. Reliability Stress Test Summary and Results
- IV. Reliability Evaluation

I. Product Description:

- Latest AlphaIGBT (α IGBT) technology
- 650V breakdown voltage
- Very fast and soft recovery freewheeling diode
- High efficient turn-on di/dt controllability
- Low $V_{CE(SAT)}$ enables high efficiencies
- Low turn-off switching loss and softness
- Very good EMI behavior
- High short-circuit ruggedness

Details refer to the datasheet.

II. Die / Package Information:

	AOD5B65M1
Process	Standard sub-micron 650V Alpha IGBT™ with Diode
Package Type	TO-252
Lead Frame	Bare Cu
Die Attach	Solder Paste
Bond	Al wire
Mold Material	Epoxy resin with silica filler
Moisture Level	Level 1

III. Reliability Stress Test Summary and Results

Test Item	Test Condition	Time Point	Total Sample Size	Number of Failures	Reference Standard
HTGB	Temp = 150°C , Vge=100% of Vgemax	168 / 500 / 1000 hours	924 pcs	0	JESD22-A108
HTRB	Temp = 150°C , Vce=80% of Vcemax	168 / 500 / 1000 hours	924 pcs	0	JESD22-A108
MSL Precondition	168hr 85°C / 85%RH + 3 cycle reflow @260°C (MSL 1)	-	5313 pcs	0	JESD22-A113
HAST	130°C , 85%RH, 33.3 psia, Vce = 80% of Vcemax up to 42V	96 hours	924 pcs	0	JESD22-A110
H3TRB	85°C , 85%RH, Vce = 80% of Vcemax up to 100V	1000 hours	924 pcs	0	JESD22-A101
Autoclave	121°C , 29.7psia, RH=100%	96 hours	924 pcs	0	JESD22-A102
Temperature Cycle	-65°C to 150°C , air to air,	1000 cycles	924 pcs	0	JESD22-A104
HTSL	Temp = 150°C	1000 hours	924 pcs	0	JESD22-A103
Power Cycling	Δ Tj = 100°C	15000 cycles	693 pcs	0	AEC Q101

Note: The reliability data presents total of available generic data up to the published date.

IV. Reliability Evaluation

FIT rate (per billion): 1.91

MTTF = 59839 years

The presentation of FIT rate for the individual product reliability is restricted by the actual burn-in sample size. Failure Rate Determination is based on JEDEC Standard JESD 85. FIT means one failure per billion hours.

Failure Rate = $\text{Chi}^2 \times 10^9 / [2 (N) (H) (Af)] = 1.91$

MTTF = $10^9 / \text{FIT} = 59839$ years

Chi² = Chi Squared Distribution, determined by the number of failures and confidence interval

N = Total Number of units from burn-in tests

H = Duration of burn-in testing

Af = Acceleration Factor from Test to Use Conditions (Ea = 0.7eV and Tuse = 55°C)

Acceleration Factor **[Af]** = $\text{Exp} [Ea / k (1/Tj u - 1/Tj s)]$

Acceleration Factor ratio list:

	55 deg C	70 deg C	85 deg C	100 deg C	115 deg C	130 deg C	150 deg C
Af	259	87	32	13	5.64	2.59	1

Tj s = Stressed junction temperature in degree (Kelvin), K = C+273.16

Tj u = The use junction temperature in degree (Kelvin), K = C+273.16

k = Boltzmann's constant, $8.617164 \times 10^{-5} \text{eV} / \text{K}$

X-ON Electronics

Largest Supplier of Electrical and Electronic Components

Click to view similar products for [IGBT Transistors category](#):

Click to view products by [Alpha & Omega manufacturer](#):

Other Similar products are found below :

[748152A](#) [FGH60T65SHD_F155](#) [APT100GT60B2RG](#) [APT13GP120BG](#) [APT20GN60BG](#) [APT20GT60BRDQ1G](#) [APT25GN120B2DQ2G](#)
[APT35GA90BD15](#) [APT36GA60BD15](#) [APT40GP60B2DQ2G](#) [APT40GP90B2DQ2G](#) [APT50GN120B2G](#) [APT50GT60BRG](#)
[APT64GA90B2D30](#) [APT70GR120J](#) [NGTB10N60FG](#) [NGTB30N60L2WG](#) [IGP30N60H3XKSA1](#) [STGB15H60DF](#) [STGFW20V60DF](#)
[STGFW30V60DF](#) [STGFW40V60F](#) [STGWA25H120DF2](#) [FGB3236_F085](#) [APT25GN120BG](#) [APT25GR120S](#) [APT30GN60BDQ2G](#)
[APT30GN60BG](#) [APT30GP60BG](#) [APT30GS60BRDQ2G](#) [APT30N60BC6](#) [APT35GP120JDQ2](#) [APT36GA60B](#) [APT45GR65B2DU30](#)
[APT50GP60B2DQ2G](#) [APT68GA60B](#) [APT70GR65B](#) [APT70GR65B2SCD30](#) [GT50JR22\(STA1ES\)](#) [TIG058E8-TL-H](#) [IDW40E65D2](#)
[NGTB50N60L2WG](#) [STGB10H60DF](#) [STGB20V60F](#) [STGB40V60F](#) [STGFW80V60F](#) [IGW40N120H3FKSA1](#) [RJH60D7BDPQ-E0#T2](#)
[APT40GR120B](#) [APT33GF120B2RDQ2G](#)