

RELIABILITY REPORT FOR DISCRETE DEVICES

Qualification Report No.: R2022A024 Rev.F

Product Details:

Supplier:	Taiwan Semiconductor Co., Ltd.
Test Vehicle/s:	TQM019NH04LCR, TQM070NH04CR & TQM076NH04LDCR
Reason for Rel:	New Product Qualification
Part Description:	SGT40V N-Channel Logic & Standard Level MOSFET Qualification
Package Type:	PDFN56U Single & PDFN56U Dual
General Specification :	AECQ-101

Product Series Covered:

TQM019NH04CR, TQM025NH04LCR, TQM025NH04CR, TQM032NH04LCR, TQM032NH04CR, TQM043NH04LCR, TQM043NH04CR, TQM056NH04LCR, TQM056NH04CR, TQM070NH04LCR, TSM019NH04LCR, TSM019NH04CR, TSM025NH04LCR, TSM025NH04CR, TSM032NH04LCR, TSM032NH04CR, TSM043NH04LCR, TSM043NH04CR, TSM056NH04LCR, TSM056NH04CR, TSM070NH04LCR, TSM070NH04CR, TQM076NH04DCR, TSM076NH04LDCR, TSM076NH04DCR

Reliability Test Results Summary:

Stress Test	Abbrev	Test Methods	Test Conditions	Final Readpoint	Requirements		Results	
					SS	# Lots	Rej/SS	Remarks
Environmental and Lifetime Stress Tests								
Pre- and Post-Stress Electrical Test	TEST	Product Datasheet	Test at room temp	-	634	3	0/1902	Pass
Extrenal Visual	EV	JESD22-B101	per reference standard	-	644	3	0/1932	Pass
Preconditioning	PC	J-STD-020	MSL-1 (3x reflow at 260°C)	-	308	3	0/924	Pass
Temperature Cycle	TC	JESD22-A104	-55°C to +150°C; 15 mins dwell	1000 cyc	77	3	0/231	Pass
Unbiased HAST	UHA	JESD22-A118	130°C/85% RH; unbiased	96 hrs	77	3	0/231	Pass
Highly Accelerated Stress Test	HAST	JESD22-A110	110°C/85% RH; V=80% VR; 42V max	264 hrs	77	3	0/231	Pass
Resistance to Solder Heat	RSH	JESD22-A111	SMD (Pb free); 260°C; 10 sec	10 secs	10	3	0/30	Pass
High Temp Storage Life	HTSL	JESD22-A103	175°C	1000 hrs	77	3	0/231	Pass
High Temp Reverse Bias	HTRB	MIL-STD-750-1	175°C; V=100% rated V	1000 hrs	77	3	0/231	Pass
High Temp Gate Bias	HTGB	JESD22-A108	175°C; V=100% rated Vgs	1000 hrs	77	3	0/231	Pass
Intermittent Operating Life	IOL	MIL-STD-750	Ta=25°C; ΔTj=100°C; 2.0 min on/off	15000 cycs	77	3	0/231	Pass
Package Assembly Integrity Tests								
Destructive Physical Analysis	DPA	AEC-Q101-004	Post-TC 1000	results	2	3	0/6	Pass
Destructive Physical Analysis	DPA	AEC-Q101-004	Post-HAST 264	results	2	3	0/6	Pass
Wire Bond Pull	WBP	MIL-STD-750-2	per assembly spec	results	10	3	0/30	Pass
Wire Bond Shear	WBS	AEC Q101-003	per assembly spec	results	10	3	0/30	Pass
Solderability	SD	J-STD-002	245°C	results	10	3	0/30	Pass
Thermal Resistance	TR	JESD24	per product datasheet	results	10	3	0/30	Pass
Physical Dimension	PD	JESD22-B100	per assembly spec	results	30	1	0/30	Pass
Die Shear	DS	MIL-STD-750-2	per assembly spec	results	16	3	0/48	Pass
Electrical Verification Tests								
Parametric Verification	PV	TSC Datasheet	per product datasheet	results	25	3	0/75	Pass
ESD - Human Body Model	ESD - HBM	AEC-Q101-001	per product spec	results	30	1	0/30 ¹	±500V (H1A)
					30	1	0/30 ²	±250V (H0)
					30	1	0/30 ³	±1kV (H1B)
ESD - Charged Device Model	ESD - CDM	AEC-Q101-005	per product spec	results	30	3	0/90	±1KV (C3)

Note:

- (1) TQM076NH04LDCR & passed ±500V (H1A)
- (2) TQM070NH04CR passed ±250V (H0)
- (3) TQM019NH04LCR passed ±1kV (H1B)

Conclusion:

TQM019NH04LCR, TQM070NH04CR & TQM076NH04LDCR successfully passed Automotive-grade qualification per AEC-Q101.

QUALITY & RELIABILITY ENGINEERING

FIT and MTTF Calculation Report

PN Family Series	TQM019NH04LCR, TQM070NH04CR, TQM076NH04LDCR, TQM019NH04CR, TQM025NH04LCR, TQM025NH04CR, TQM032NH04LCR, TQM032NH04CR, TQM043NH04LCR, TQM043NH04CR, TQM056NH04LCR, TQM056NH04CR, TQM070NH04LCR, TSM019NH04LCR, TSM019NH04CR, TSM025NH04LCR, TSM025NH04CR, TSM032NH04LCR, TSM032NH04CR, TSM043NH04LCR, TSM043NH04CR, TSM056NH04LCR, TSM056NH04CR, TSM070NH04LCR, TSM070NH04CR, TQM076NH04DCR, TSM076NH04LDCR, TSM076NH04DCR
Part Description	N-Channel Automotive MOSFET
Package Type	PDFN56U Single & PDFN56U Dual

Test Variables:

Stress Test	=	HTRB	
No. of failures	=	0	units
Sample Size	=	231	units
Test Duration	=	1000	hours
Total device hours	=	231000	hours
Accelerated Temp (Ta)	=	175	° C
Operating Temp (Tu)	=	55	° C
Activation Energy (Ea)	=	0.7	eV
Confidence Level	=	90	%
Boltzman's Constant (k)	=	8.617E-05	eV / °K

Calculations:

Chi squared value	=	4.60517019	@ 90% Confidence Level
Failure Rate (@accelerated condition)	=	$\frac{(\text{Chi squared value})}{2 * (\text{Sample Size}) * (\text{Test Duration})}$	
	=	9967.90	FIT
Acceleration Factor, AF	=	$e^{(Ea/k)(1/Tu - 1/Ta)}$	
	=	760.4701686	

Results:

Failure Rate (@operating condition)	=	(Failure Rate @accelerated condition) / (AF)	
	=	13	FIT
Mean Time to Failure (MTTF)	=	76291907.5	hours
	=	8709	years