

RELIABILITY PREDICTION

REPORT for the

MX8M Mini (SRMM8QDWB1D02GE008V12C0)

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Prepared For SolidRun Ltd.

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1. GENERAL

1.1. Scope

This document presents the reliability prediction of the module MX8M Mini (SRMM8QDWB1D02GE008V12C0) – hereafter MX8M Mini.

The reliability prediction was performed according to TELCORDIA SR-332, Issue 4, Reliability Prediction Procedure for Electronic Equipment [Ref. 1], using dedicated software – RAM Commander™, Version 8.7.

1.2. Abbreviations and Acronyms

FIT	-	Failures/10 ⁹ hours
λ /FR	-	Failure Rate [Fit]
NHA	-	Next Higher Assy
G _B	-	Ground, Fixed, Controlled
MTBF	-	Mean Time Between Failures

2. APPLICABLE DOCUMENTS

[Ref. 1]	TELCORDIA SR332, Issue 4	Reliability Prediction Procedure for Electronic Equipment
[Ref. 2]	RiAC-CPE	Reliability Toolkit: Commercial Practices Edition

3. RELIABILITY PREDICTION TECHNIQUE

3.1. Reliability Prediction Method and Data Sources

The reliability prediction was performed in accordance with:

- Telcordia SR-332 [Ref. 1] for electronic components.
- For chosen components (usually highest contributors to overall failure rate) Telcordia SR-332 [Ref. 1] procedure is substituted by the manufacturer reliability data after adequate adjustment to current temperature and environment environment using Reliability toolkit [Ref. 2].

Table 1 depicts manufacturer’s reliability data.

Table 1 - Manufacturer's Reliability Data

Part Number	Type	Env/Temp	Manufacturer	Reliability Parameter	Link to source
LBEE5HY1MW-230	Bluetooth, WiFi 802	GB @ 30C	Murata	50.5 FIT	By Similarity To Mediatech MT7663BSD

3.2. Environment & Temperature

The reliability prediction of the MX8M Mini Module was performed according to the Telcordia SR-332 [Ref. 1] for following environment and temperatures:

- Environmental condition: G_B (Ground, Benign)
- Ambient temperature (T_A): 25°C
- Temperature rise of component above ambient temperature is 30°C

3.3. General Assumptions

The following are the general assumptions for the reliability prediction:

- Components failure rate is constant during equipment life period.
- The failures of different components are considered statistically independent.
- The assembly reliability model is a series one - failure of any component causes an assembly failure.
- Software failures are not applicable to the Module

3.4. Calculations Methods

The formula for module/card MTBF calculation is:

$$MTBF = \frac{1}{\sum_{i=1}^n \lambda(i)}$$

where:

$\lambda(i)$ = Failure rate of i^{th} item

n = Number of items

3.5. Component's Quality Levels

The assumed quality level for electronic components is Quality Level II according to the definitions of SR-332 [Ref. 1].

3.6. Component electrical stresses

The following electrical stress were applied for reliability prediction:

- For transistors power and voltage stress was defined as 50% of rated value in accordance with related component specification.
- For resistor Film Chip the PSR=20%
- For resistor Power Chip the PSR=50%
- For Ceramic Chip capacitor the VSR=20%
- For Aluminium capacitor the VSR=50%

4. SUMMARY OF RESULTS AND RECOMMENDATIONS

4.1. Module Level Reliability Prediction Results

The following are the results of the reliability prediction for the MX8M Mini Module at 55°C Ambient temperature and G_B Environmental condition.

$$\lambda = 386.5 \text{ FIT}$$

$$\text{MTBF} = 2,587,026 \text{ hours}$$

Figure 1 represents MX8M Mini Module MTBF vs. Ambient Temperature.

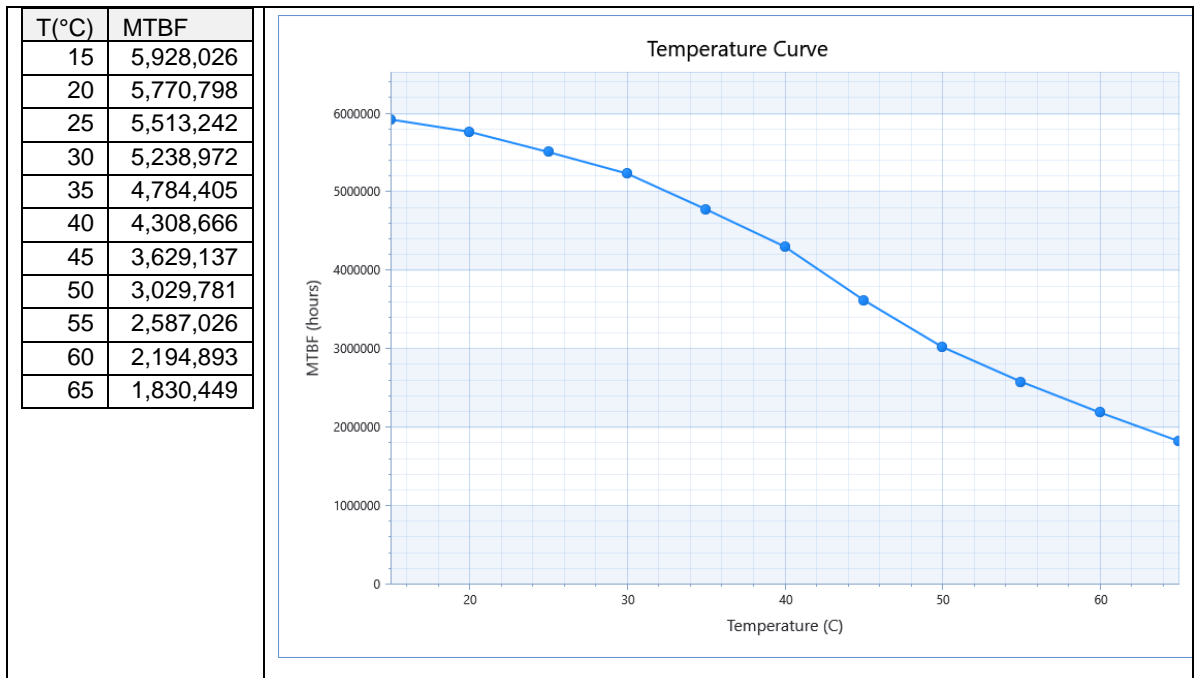


Figure 1: - MX8M Mini Module Temperature Curve

4.2. Conclusions

Table 2 depicts the main MX8M Mini contributors to overall failure rate.

Table 2 – Main Contributors To Overall Failure Rate

PN	Description	Qty	Total Failure rate	Item Failure rate contribution	Cumulative contribution
MIMX8MM6DVTLZAA	i.MX8M-Plus A1 Quad consumer	1	122.756	31.757%	31.757%
KLM8G1GETF-B041	8GB eMMC	1	68.133	17.626%	49.384%
LBEE5HY1MW-230	Bluetooth, WiFi 802	1	67.333	17.419%	66.803%

5. APPENDICES CONTENTS

5.1. Appendix A - Assembly Composite Report

This Appendix describes in detail the results of the reliability prediction at operating state. It provides also the contribution of each component failure rate to the next higher level.

5.2. Appendix B – Pareto Analysis

This appendix provides the list of components sorted by their contribution to total failure rate.

5.3. Appendix C- Applied Values

This appendix provides the list of components parameters that were used for reliability prediction.

APPENDIX A - ASSEMBLY COMPOSITE REPORT

Project name: SR_CARDS_4
 Operating conditions: Environment: GB, Temperature: 25.00 °C
 Current mode: Operating
 FR Units: FIT
 Default prediction Method: Telcordia Issue 4

Assembly Ref.Des.: MX8 Mini, ID: 1.3, Description: .
 Environment: GB, Temperature: 55.00 °C, F.R.(FIT): 386.54 , MTBF(hours): 2587025.8

ID	PN	RefDes	Qty	F.R. FIT	F.R.(K) FIT	F.R.(K,Qty) FIT	Contrib. to NHA[%]
1.3.1	GRM155R60J224KE01	C248	1	0.03181	0.03181	0.03181	0.00823
1.3.2	GRM155R71C104KA88	C30 C31 C34 C35 C37 C38 C250 C251	8	0.03181	0.03181	0.2545	0.06584
1.3.3	GRM1555C1H180FA01D	C101 C151 C152	3	0.03181	0.03181	0.09544	0.02469
1.3.4	GRM1555C1H220JA01D	C41 C42	2	0.03181	0.03181	0.06363	0.01646
1.3.5	0402X104K250SNT	C103 C104 C164 C165	4	0.03181	0.03181	0.1273	0.03292
1.3.6	GRM155R60J225ME95D	C121 C122 C123	3	0.03181	0.03181	0.09544	0.02469
1.3.7	GRM155C80J106ME11D	C29 C36 C45 C52 C57 C61 C64 C65 C71 C72 C81 C82 C8	26	0.03181	0.03181	0.8272	0.214
1.3.8	CL05B105KQ5NQNC	C32 C33 C126 C128 C149 C150 C240	7	0.03181	0.03181	0.2227	0.05761
1.3.9	04025A120JAT2A	C106 C107	2	0.03181	0.03181	0.06363	0.01646
1.3.10	C0402C222K4REC7411	C76	1	0.03181	0.03181	0.03181	0.00823
1.3.11	C0402C475M9PACTU	C49 C69 C108 C117 C118 C120 C129 C130 C131 C132 C1	19	0.03181	0.03181	0.6045	0.1564
1.3.12	GRM188R60J226MEA0D	C119 C124 C125 C127 C135 C136 C141 C142 C144 C145	12	0.03181	0.03181	0.3818	0.09877
1.3.13	LLL153C80J224ME14E	C39 C40 C44 C46 C47 C48 C50 C51 C55 C56 C60 C62 C6	30	0.03181	0.03181	0.9544	0.2469
1.3.14	LLL153C80G105ME21D	C43 C53 C54 C58 C59 C66 C67 C68 C73 C74 C75 C80 C1	13	0.03181	0.03181	0.4136	0.107
1.3.15	DF40C-80DP-0.4V(51)	J7 J9	2	6.30	6.30	12.61	3.26
1.3.16	DF40C-70DP-0.4V(51)	J5001	1	5.52	5.52	5.52	1.43
1.3.17	U.FL-R-SMT-1(10)	J4	1	0.5713	0.5713	0.5713	0.1478
1.3.18	CAT24AA01TDI-GT3	U17	1	4.34	4.34	4.34	1.12
1.3.19	TXB0304RUTR	U19	1	5.53	5.53	5.53	1.43
1.3.20	AR8031-AL1A	U3	1	9.22	9.22	9.22	2.39
1.3.21	KLM8G1GETF-B041	U6	1	68.13	68.13	68.13	17.63
1.3.22	NTSX2102GD	U9	1	4.94	4.94	4.94	1.28
1.3.23	MT53D512M32D2DS-053 WT:D	U5	1	35.87	35.87	35.87	9.28
1.3.24	MIMX8MM6DVTLZAA	U4	1	122.76	122.76	122.76	31.76
1.3.25	BD71847AMWV-E2	U8	1	13.69	13.69	13.69	3.54
1.3.26	LBEE5HY1MW-230	M1	1	67.33	67.33	67.33	17.42
1.3.27	FPF1504BUCX	U18	1	6.47	6.47	6.47	1.67
1.3.28	PBY160808T-121Y-N	FB4 FB5	2	0.1032	0.1032	0.2063	0.05338

ID	PN	RefDes	Qty	F.R. FIT	F.R.(K) FIT	F.R.(K,Qty) FIT	Contrib. to NHA[%]
1.3.29	LQM2MPN4R7NG0L	L1	1	0.3095	0.3095	0.3095	0.08006
1.3.30	LQM2MPN2R2NG0L	L9	1	0.3095	0.3095	0.3095	0.08006
1.3.31	VLS252012HBX-R47M-1	L2 L3 L4 L5 L6 L7	6	0.3095	0.3095	1.86	0.4804
1.3.32	NX3215SA32.768K-STD-MUA-4	Y4	1	6.11	6.11	6.11	1.58
1.3.33	Q22FA1280026501	Y2	1	6.11	6.11	6.11	1.58
1.3.34	FA-128 24.0000MF10Z-W3	Y3	1	6.11	6.11	6.11	1.58
1.3.36	RC1005J472CS	R21 R35 R36 R37 R38 R39 R40 R41 R42 R66 R67 R104 R	13	0.06984	0.06984	0.908	0.2349
1.3.37	RC1005J000CS	R18 R22 R24 R56 R58 R59 R69 R70 R71 R72 R73 R74 R7	24	0.06984	0.06984	1.68	0.4337
1.3.38	CR-02FL6---10K	R20 R29 R51 R57 R105 R153 R158	7	0.06984	0.06984	0.4889	0.1265
1.3.39	RC1005F152CS	R85	1	0.06984	0.06984	0.06984	0.01807
1.3.40	CR02FL6--200R	R47 R50	2	0.06984	0.06984	0.1397	0.03614
1.3.41	CR0402-FX-2400GLF	R30 R31	2	0.06984	0.06984	0.1397	0.03614
1.3.42	CR0402-FX-2371GLF	R23	1	0.06984	0.06984	0.06984	0.01807
1.3.43	RC1005F303CS	R46 R49	2	0.06984	0.06984	0.1397	0.03614
1.3.44	RC0402FR-07100KL	R52 R53 R54 R60 R75	5	0.06984	0.06984	0.3492	0.09035
1.3.45	RC0402FR-078K2L	R48	1	0.06984	0.06984	0.06984	0.01807
1.3.46	RC0402FR-07150RL	R33 R34	2	0.06984	0.06984	0.1397	0.03614
1.3.47	RC0402FR-0733RL	R13	1	0.06984	0.06984	0.06984	0.01807
1.3.48	RC0402FR-07499KL	R61	1	0.06984	0.06984	0.06984	0.01807
1.3.49	5110	R1	1	0.06984	0.06984	0.06984	0.01807

APPENDIX B - PARETO ANALYSIS

Project name: SR_CARDS_4
 Operating conditions: Environment: GB, Temperature: 25.00 °C
 Current mode: Operating
 FR Units: FIT
 Default prediction Method: Telcordia Issue 4

Start from: MX8 Mini
 Limited by: 90.000

PN	Qty	Total Failure rate	Item Failure rate contribution	Cumulative contribution
MIMX8MM6DVTLZAA	1	122.756	31.757%	31.757%
KLM8G1GETF-B041	1	68.133	17.626%	49.384%
LBEE5HY1MW-230	1	67.333	17.419%	66.803%
MT53D512M32D2DS-053 WT:D	1	35.867	9.279%	76.082%
BD71847AMWV-E2	1	13.693	3.542%	79.624%
DF40C-80DP-0.4V(51)	2	12.608	3.262%	82.886%
AR8031-AL1A	1	9.225	2.386%	85.272%
FPF1504BUCX	1	6.468	1.673%	86.945%
FA-128 24.0000MF10Z-W3	1	6.107	1.580%	88.525%
NX3215SA32.768K-STD-MUA-4	1	6.107	1.580%	90.105%

APPENDIX C - APPLIED VALUES

Project name: SR_CARDS_4
 Operating conditions: Environment: GB, Temperature: 25.00 °C
 Current mode: Operating
 FR Units: FIT
 Default prediction Method: Telcordia Issue 4

Project name: SR_CARDS_4 <GPRD>
 Assembly Ref.Des.: MX8 Mini, IC-Memory

ID	Ref.des.	PN	Environment	Temperature
1.3.21	U6	KLM8G1GETF-B041	GB	55.00
1.3.23	U5	MT53D512M32D2DS-053 WT:D	GB	55.00

Assembly Ref.Des.: MX8 Mini, IC-Digital

ID	Ref.des.	PN	Environment	Temperature
1.3.26	M1	LBEE5HY1MW-230	GB	55.00

Project name: SR_CARDS_4 <Telcordia Issue 4>
 Assembly Ref.Des.: MX8 Mini, IC-Memory

ID	Ref.des.	PN	Device type	Technology	Number of bits or bits range	Qual
1.3.18	U17	CAT24AA01TDI-GT3	ROM	CMOS	1000	2

Assembly Ref.Des.: MX8 Mini, IC-Analog

ID	Ref.des.	PN	# of transistors or range	Qual
1.3.19	U19	TXB0304RUTR	33-90	2
1.3.25	U8	BD71847AMWV-E2	471-590	2
1.3.27	U18	FPF1504BUCX	100	2

Assembly Ref.Des.: MX8 Mini, IC-Digital

ID	Ref.des.	PN	Device type	Technology	# of gates or range	Qual	# of trans. (for PAL)	bus width (for Mkproc)
1.3.20	U3	AR8031-AL1A	Logic	CMOS	100001-1000000	2	---	---
1.3.22	U9	NTSX2102GD	Logic	CMOS	51-100	2	---	---

ID	Ref.des.	PN	Device type	Technology	# of gates or range	Qual	# of trans. (for PAL)	bus width (for Mkproc)
1.3.24	U4	MIMX8MM6DVTLZAA	Mkproc	CMOS	1000	2	---	64

Assembly Ref.Des.: MX8 Mini, Resistor

ID	Ref.des.	PN	Device type	# of resist.	Resistance	PSR	P oper.	P.rated	Qual
1.3.36	R21 R35 R36 R37 R38 R3	RC1005J472CS	Discrete Fixed Film	---	4700.00 Ohm	0.200	20.00	0.06	2
1.3.37	R18 R22 R24 R56 R58 R5	RC1005J000CS	Discrete Fixed Film	---	0.00 Ohm	0.200	20.00	0.06	2
1.3.38	R20 R29 R51 R57 R105 R	CR-02FL6---10K	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.3.39	R85	RC1005F152CS	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.3.40	R47 R50	CR02FL6--200R	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.3.41	R30 R31	CR0402-FX-2400GLF	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.3.42	R23	CR0402-FX-2371GLF	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.3.43	R46 R49	RC1005F303CS	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.3.44	R52 R53 R54 R60 R75	RC0402FR-07100KL	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.3.45	R48	RC0402FR-078K2L	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.3.46	R33 R34	RC0402FR-07150RL	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.3.47	R13	RC0402FR-0733RL	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.3.48	R61	RC0402FR-07499KL	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.3.49	R1	5110	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2

Assembly Ref.Des.: MX8 Mini, Capacitor

ID	Ref.des.	PN	Capacitor type	Capacitance	VSR	V.appl.DC	V.peak AC	V.rated	Qual
1.3.1	C248	GRM155R60J224KE01	Ceramic	---	0.20	20.00	0.00	100.00	2
1.3.2	C30 C31 C34 C35 C37 C3	GRM155R71C104KA88	Ceramic	---	0.20	20.00	0.00	100.00	2
1.3.3	C101 C151 C152	GRM1555C1H180FA01D	Ceramic	---	0.20	20.00	0.00	100.00	2
1.3.4	C41 C42	GRM1555C1H220JA01D	Ceramic	---	0.20	20.00	0.00	100.00	2
1.3.5	C103 C104 C164 C165	0402X104K250SNT	Ceramic	100.00 nF	0.20	20.00	0.00	25.00	2
1.3.6	C121 C122 C123	GRM155R60J225ME95D	Ceramic	---	0.20	20.00	0.00	100.00	2
1.3.7	C29 C36 C45 C52 C57 C6	GRM155C80J106ME11D	Ceramic	---	0.20	20.00	0.00	100.00	2

ID	Ref.des.	PN	Capacitor type	Capacitance	VSR	V.appl.DC	V.peak AC	V.rated	Qual
1.3.8	C32 C33 C126 C128 C149	CL05B105KQ5NQNC	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.3.9	C106 C107	04025A120JAT2A	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.3.10	C76	C0402C222K4REC7411	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.3.11	C49 C69 C108 C117 C118	C0402C475M9PACTU	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.3.12	C119 C124 C125 C127 C1	GRM188R60J226MEA0D	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.3.13	C39 C40 C44 C46 C47 C4	LLL153C80J224ME14E	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.3.14	C43 C53 C54 C58 C59 C6	LLL153C80G105ME21D	Ceramic	--- --	0.20	20.00	0.00	100.00	2

Assembly Ref.Des.: MX8 Mini, Connector

ID	Ref.des.	PN	Configuration	# active contacts	Quality
1.3.15	J7 J9	DF40C-80DP-0.4V(51)	Multi-Pin	80	2
1.3.16	J5001	DF40C-70DP-0.4V(51)	Multi-Pin	70	2
1.3.17	J4	U.FL-R-SMT-1(10)	Coaxial, Electric	---	2

Assembly Ref.Des.: MX8 Mini, Inductive

ID	Ref.des.	PN	Device type	Quality
1.3.28	FB4 FB5	PBY160808T-121Y-N	Ferrite Beads	3
1.3.29	L1	LQM2MPN4R7NG0L	Coil - Power Filter	2
1.3.30	L9	LQM2MPN2R2NG0L	Coil - Power Filter	2
1.3.31	L2 L3 L4 L5 L6 L7	VLS252012HBX-R47M-1	Coil - Power Filter	2

Assembly Ref.Des.: MX8 Mini, Crystal

ID	Ref.des.	PN	Device type	Quality
1.3.32	Y4	NX3215SA32.768K-STD-MUA-4	Quartz Crystal	2
1.3.33	Y2	Q22FA1280026501	Quartz Crystal	2
1.3.34	Y3	FA-128 24.0000MF10Z-W3	Quartz Crystal	2