RELIABILITY PREDICTION

of the

SOM AzurWave

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Prepared by RAM CRAFT Ltd.

for Solid-Run

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FIGURES

1. GENERAL

1.1. Scope

This document presents the reliability prediction of the SOM (System On Module) based on AzurWave card

The reliability prediction was performed according to TELCORDIA SR-332, Issue 3, Reliability Prediction Procedure for Electronic Equipment [Ref. 1], using dedicated software – RAM Commander™, Version 8.5.

1.2. Abbreviations and Acronyms

SOM	-	System On Module
FIT	-	Failures In Time (failures/10^9 operating hours)
FR	-	Failure Rate
GB	-	Ground, Benign
HT	-	High Temperature
MTBF	-	Mean Time Between Failures
λ	-	Failure rate in FIT

2. APPLICABLE DOCUMENTS

[Ref. 1]	TELCORDIA SR332, Issue 3	Reliability Prediction Procedure for Electronic Equipment
[Ref. 2]	RIAC-CPE	Reliability Toolkit: Commercial Practices Edition
[Ref. 3]	NPRD2011	Nonelectronic Parts Reliability Data

3. SYSTEM DESCRIPTION

SolidRun's Micro-System on a Module (MicroSoM™) family.

NXP-Freescale i.MX6 SoC (System-on-Chip), memory subsystem, power management subsystem, networking and system interconnectivity packed into a single ultra-compact system on module ARM board.

The iMX6 series of energy-efficient processors is a scalable multicore platform that includes single, dual and quad-core families based on the ARM® Cortex® architecture. The Family targets consumer, industrial and automotive applications.

Figure 1: SOM View

4. RELIABILITY PREDICTION TECHNIQUE

4.1. Reliability Prediction Method and Data Sources

The reliability prediction was performed in accordance with:

- SR-332 [Ref. 1]. Reliability Prediction Procedure for Electronic Equipment
- NPRD2011 [Ref. 3] for nonelectronic components
- Manufacturer data

4.2. Environment & Temperature

The reliability prediction of the SOM was performed for following environment and temperatures:

- Environmental condition: GB (Ground, Benign).
- Ambient temperature: 40°C.

- Temperature rise above ambient temperature of 25°C was assumed for all components.

4.3. 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 in any component causes an assembly failure.
- The analysis does not take in account software failures

4.4. 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

4.5. Component's Quality Levels

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

4.6. Component electrical stresses

The following default values for electrical stresses were applied for reliability prediction:

- For active components the power stress was defined as 50% of rated value IAW 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 Tantalum Chip capacitor the VSR=50%
- For Aluminium capacitor the VSR=70%

5. SUMMARY OF RESULTS AND RECOMMENDATIONS

The following are the results of the reliability prediction for the SOM at 40°C Ambient temperature and GB Environmental condition.

λ = 354 FIT

MTBF = 2,825,824 hours

Figure 2 presents the SOM MTBF change vs. ambient temperature.

T [°C]	MTBF [hrs]
15	8,905,865
20	7,096,725
25	5,639,544
30	4,476,622
35	3,554,370
40	2,825,824
45	2,251,430
50	1,798,770
55	1,441,775
60	1,159,763

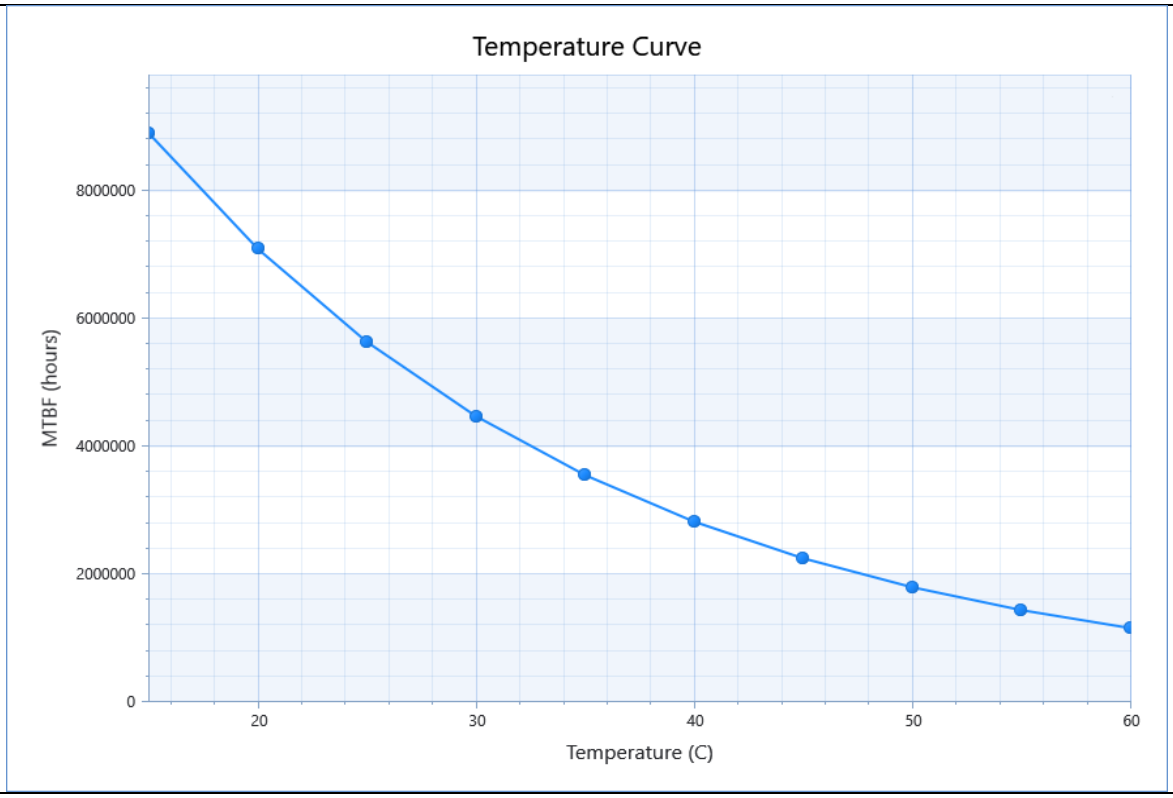

Figure 2: SOM MTBF vs. Ambient Temperature

6. APPENDICES CONTENTS

6.1. 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.

6.2. Appendix B – Pareto Analysis

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

6.3. Appendix C – Applied Values

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

APPENDIX A - ASSEMBLY COMPOSITE REPORT

Assembly Composite Report

Project name: SOM_A
Operating conditions: Environment: GB, Temperature: 40.00 °C
Current mode: Operating
FR Units: FIT
Default prediction Method: Telcordia Issue 3

Assembly Ref.Des.: SOM_A, ID: 1, Description: System On Module.
Environment: GB, Temperature: 40.00 °C,F.R.(FIT): 353.88 , MTBF(hours): 2825824.13

ID	PN	RefDes	Qty	F.R. FIT	F.R.(K) FIT	F.R.(K,Qty) FIT	Contrib. to NHA[%]
1.1	AzurWave	AzurWave	1	353.88	353.88	353.88	100.00

Assembly Ref.Des.: AzurWave, ID: 1.1, Description: .
Environment: GB, Temperature: 65.00 °C,F.R.(FIT): 353.88 , MTBF(hours): 2825824.13

ID	PN	RefDes	Qty	F.R. FIT	F.R.(K) FIT	F.R.(K, Qty) FIT	Contrib. to NHA[%]
1.1.1	GNM214R61A105M	CN605,CN606,CN607,CN608,CN6004	5	0.1147	0.3441	1.72	0.49
1.1.2	CL10A475KQ8NNNC	C3005	1	0.1147	0.1147	0.1147	0.03
1.1.3	C1608X5R0J106KT	C614,C7005,C7007,C10000,C10005,C10006,C10008	7	0.1147	0.1147	0.8028	0.23
1.1.4	CL05B333KP5NNNC	C615,C10085,C7000,C7002,C7004,C10014	6	0.1147	0.1147	0.6881	0.19
1.1.5	AMK107BJ226MA-T	C2000,C2019,C2029,C2030,C2042,C2063,C2084,C2014,C2	12	0.1147	0.1147	1.38	0.39
1.1.6	LLL185R70J224MA16F	C2001,C2002,C2003,C2005,C2008,C2009,C2010,C2011,C2	39	0.1147	0.1147	4.47	1.26
1.1.7	JMK063BJ224MP-F	C2051,C2060,C2064,C3016,C2052,C2053,C4000,C4002,C4	10	0.1147	0.1147	1.15	0.32
1.1.8	0402G180F500SNT	C3009,C3010,C3011,C3012	4	0.1147	0.1147	0.4588	0.13
1.1.9	C0402C104K4RAC	C4001,C4004,C7001,C7003,C7006,C7008,C7009,C7010,C7	13	0.1147	0.1147	1.49	0.42
1.1.10	GRM155R71H561KA01D	C10003	1	0.1147	0.1147	0.1147	0.03
1.1.11	GRM033R70J103KA01D	C10004,C10013,C10076	3	0.1147	0.1147	0.3441	0.10
1.1.12	CL21A226MQQNNNE	C10011	1	0.1147	0.1147	0.1147	0.03
1.1.13	GRM155R71H681KA01D	C10012	1	0.1147	0.1147	0.1147	0.03
1.1.14	GRM1555C1H220JA01D	C612,C613,C10081,C10082,C2031	5	0.1147	0.1147	0.5735	0.16
1.1.15	GRM1552C1H8R2CA01	C10078,R10023	2	0.1147	0.1147	0.2294	0.06
1.1.16	DF40C-80DP-0.4V(51)	J5002,J8004	2	7.19	7.19	14.37	4.06
1.1.17	20314-001 E- 01	J8003	1	0.5688	0.5688	0.5688	0.16
1.1.18	BLM18PG121SH1	L3000,L7000,L7002	3	0.1509	0.1509	0.4526	0.13
1.1.19	LQM2MPN4R7NG0L	L7003	1	1.36	1.36	1.36	0.38
1.1.20	SDB0420MT1R5	L10000	1	1.36	1.36	1.36	0.38
1.1.21	SDB0420MTR22	L10001	1	1.36	1.36	1.36	0.38
1.1.22	LQM2MPN2R2NG0L	L10004	1	1.36	1.36	1.36	0.38
1.1.23	NX3215SA32.768K-STD-MUA-4	QZ3000	1	3.20	3.20	3.20	0.90
1.1.24	YC124-JR-074K7L	RN3000,RN3001	2	0.4177	0.4177	0.8353	0.24
1.1.25	YC124-JR-0722RL	RN6002	1	0.4177	0.4177	0.4177	0.12
1.1.26	RK73H1ETTP1601F	R3000,R3013	2	0.1207	0.1207	0.2414	0.07
1.1.27	RC0402FR-076K04L	R3001,R10026	2	0.1207	0.1207	0.2414	0.07
1.1.28	RK73H1ETTP1910F	R3009	1	0.1207	0.1207	0.1207	0.03
1.1.29	CRCW040210K0FKED	R3011,R4004,R4005,R7006,R7010,R10027,R10028	7	0.1207	0.1207	0.8448	0.24
1.1.30	RK73H1ETTP2204F	R3015	1	0.3621	0.3621	0.3621	0.10
1.1.31	CR02FL6--200R	R3016,R4001,R4002,R4003,R4000	5	0.1207	0.1207	0.6035	0.17
1.1.32	RK73H1ETTP2400F	R4006,R4007,R4008,R4009,R4010	5	0.1207	0.1207	0.6035	0.17
1.1.33	RC0402FR-072K37L	R7002	1	0.1207	0.1207	0.1207	0.03

ID	PN	RefDes	Qty	F.R. FIT	F.R.(K) FIT	F.R.(K, Qty) FIT	Contrib. to NHA[%]
1.1.34	ERJ-2GE0R00X	R7003	1	0.1207	0.1207	0.1207	0.03
1.1.35	CRCW040213K0FKED	R10003	1	0.1207	0.1207	0.1207	0.03
1.1.36	CRCW040224K0FKED	R10004,R10014	2	0.1207	0.1207	0.2414	0.07
1.1.37	CRCW040221K0FKED	R10010	1	0.1207	0.1207	0.1207	0.03
1.1.38	RC0402FR-0714K7L	R10011	1	0.1207	0.1207	0.1207	0.03
1.1.39	CRCW040215K0FKED	R10012	1	0.1207	0.1207	0.1207	0.03
1.1.40	CRCW040228K7FKED	R10013	1	0.1207	0.1207	0.1207	0.03
1.1.41	RC0402FR-07499RL	R10024	1	0.1207	0.1207	0.1207	0.03
1.1.42	RC0402JR-0722RL	R10025	1	0.1207	0.1207	0.1207	0.03
1.1.43	MCIMX6Q5EYM10AD	U1	1	84.48	84.48	84.48	23.87
1.1.44	AP7333-28SRG	U2001	1	8.57	8.57	8.57	2.42
1.1.45	DMN65D8LDW-7	U3000	1	6.29	6.29	6.29	1.78
1.1.46	M74VHC1GT08DFT1G	U3003	1	7.16	7.16	7.16	2.02
1.1.47	K4B4G1646B-HYK0T00	U4001	1	8.90	8.90	8.90	2.52
1.1.48	K4B4G1646B-HYK0T00	U4002	1	8.90	8.90	8.90	2.52
1.1.49	K4B4G1646B-HYK0T00	U4003	1	8.90	8.90	8.90	2.52
1.1.50	K4B4G1646B-HYK0T00	U4004	1	8.90	8.90	8.90	2.52
1.1.51	AW-NH660	U6002	1	84.48	84.48	84.48	23.87
1.1.52	AR8035-AL1A	U7000	1	29.95	29.95	29.95	8.46
1.1.53	RT8070ZQW	U10000	1	25.38	25.38	25.38	7.17
1.1.54	RT8073GQW	U10001	1	25.38	25.38	25.38	7.17
1.1.55	S3225A024000-F10CCCA	Y3000	1	3.20	3.20	3.20	0.90

APPENDIX B – PARETO ANALYSIS

Project name: SOM_A
Operating conditions: Environment: GB, Temperature: 40.00 °C
Current mode: Operating
FR Units: FIT
Default prediction Method: Telcordia Issue 3
Start from: SOM_A
Limited by: 95.000

PN	Qty	Total Failure rate	Item Failure rate contribution	Cumulative contribution
AW-NH660	1	84.484	23.874%	23.874%
MCIMX6Q5EYM10AD	1	84.484	23.874%	47.747%
K4B4G1646B-HYK0T00	4	35.613	10.064%	57.811%
AR8035-AL1A	1	29.951	8.464%	66.274%
RT8070ZQW	1	25.375	7.171%	73.445%
RT8073GQW	1	25.375	7.171%	80.616%
DF40C-80DP-0.4V(51)	2	14.370	4.061%	84.677%
AP7333-28SRG	1	8.566	2.421%	87.097%
M74VHC1GT08DFT1G	1	7.160	2.023%	89.120%
DMN65D8LDW-7	1	6.288	1.777%	90.897%
LLL185R70J224MA16F	39	4.473	1.264%	92.161%
NX3215SA32.768K-STD-MUA-4	1	3.200	0.904%	93.065%
S3225A024000-F10CCCA	1	3.200	0.904%	93.970%
GNM214R61A105M	5	1.720	0.486%	94.456%
C0402C104K4RAC	13	1.491	0.421%	94.877%
AMK107BJ226MA-T	12	1.376	0.389%	95.266%

APPENDIX C – APLLIED VALUES

Project name: SOM_A
Operating conditions: Environment: GB, Temperature: 40.00 °C
Current mode: Operating
FR Units: FIT
Default prediction Method: Telcordia Issue 3
Project name: SOM_A <Telcordia Issue 3>
Assembly Ref.Des.: AzurWave, IC-Memory

ID	Ref.des.	PN	Device type	Technology	Number of bits or bits range	Qual
1.1.47	U4001	K4B4G1646B-HYK0T00	DRAM	CMOS	1024	2
1.1.48	U4002	K4B4G1646B-HYK0T00	DRAM	CMOS	1024	2
1.1.49	U4003	K4B4G1646B-HYK0T00	DRAM	CMOS	1024	2
1.1.50	U4004	K4B4G1646B-HYK0T00	DRAM	CMOS	1024	2

Assembly Ref.Des.: AzurWave, IC-Analog

ID	Ref.des.	PN	# of transistors or range	Qual
1.1.44	U2001	AP7333-28SRG	50	2
1.1.52	U7000	AR8035-AL1A	860	2
1.1.53	U10000	RT8070ZQW	590	2
1.1.54	U10001	RT8073GQW	590	2

Assembly Ref.Des.: AzurWave, IC-Digital

ID	Ref.des.	PN	Device type	Technology	# of gates or range	Qual	# of trans. (for PAL)	bus width (for Mkproc)
1.1.43	U1	MCIMX6Q5EYM10AD	Mkproc	CMOS	1000	2	---	32
1.1.46	U3003	M74VHC1GT08DFT1G	Logic	CMOS	20	2	---	---
1.1.51	U6002	AW-NH660	Mkproc	CMOS	1000	2	---	32

Assembly Ref.Des.: AzurWave, Resistor

ID	Ref.des.	PN	Device type	# of resist.	Resistance	PSR	P.oper.	P.rated	Qual
1.1.24	RN3000,RN3001	YC124-JR-074K7L	Thick/Thin Film Network	4	--- --	---	---	---	2
1.1.25	RN6002	YC124-JR-0722RL	Thick/Thin Film Network	4	--- --	---	---	---	2
1.1.26	R3000,R3013	RK73H1ETTP1601F	Discrete Fixed Film	---	1.00 KOhm	0.50	50.00	100.00	2
1.1.27	R3001,R10026	RC0402FR-076K04L	Discrete Fixed Film	---	6.04 KOhm	0.50	50.00	100.00	2
1.1.28	R3009	RK73H1ETTP1910F	Discrete Fixed Film	---	1.00 KOhm	0.50	50.00	100.00	2
1.1.29	R3011,R4004,R4005,R700	CRCW040210K0FKED	Discrete Fixed Film	---	1.00 KOhm	0.50	50.00	100.00	2
1.1.30	R3015	RK73H1ETTP2204F	Discrete Fixed Film	---	2.20 MOhm	0.50	50.00	100.00	2

ID	Ref.des.	PN	Device type	# of resist.	Resistance	PSR	P.oper.	P.rated	Qual
1.1.31	R3016,R4001,R4002,R400	CR02FL6--200R	Discrete Fixed Film	---	1.00 KOhm	0.50	50.00	100.00	2
1.1.32	R4006,R4007,R4008,R400	RK73H1ETTP2400F	Discrete Fixed Film	---	1.00 KOhm	0.50	50.00	100.00	2
1.1.33	R7002	RC0402FR-072K37L	Discrete Fixed Film	---	1.00 KOhm	0.50	50.00	100.00	2
1.1.34	R7003	ERJ-2GE0R00X	Discrete Fixed Film	---	1.00 KOhm	0.50	50.00	100.00	2
1.1.35	R10003	CRCW040213K0FKED	Discrete Fixed Film	---	1.00 KOhm	0.50	50.00	100.00	2
1.1.36	R10004,R10014	CRCW040224K0FKED	Discrete Fixed Film	---	1.00 KOhm	0.50	50.00	100.00	2
1.1.37	R10010	CRCW040221K0FKED	Discrete Fixed Film	---	1.00 KOhm	0.50	50.00	100.00	2
1.1.38	R10011	RC0402FR-0714K7L	Discrete Fixed Film	---	1.00 KOhm	0.50	50.00	100.00	2
1.1.39	R10012	CRCW040215K0FKED	Discrete Fixed Film	---	1.00 KOhm	0.50	50.00	100.00	2
1.1.40	R10013	CRCW040228K7FKED	Discrete Fixed Film	---	1.00 KOhm	0.50	50.00	100.00	2
1.1.41	R10024	RC0402FR-07499RL	Discrete Fixed Film	---	1.00 KOhm	0.50	50.00	100.00	2
1.1.42	R10025	RC0402JR-0722RL	Discrete Fixed Film	---	1.00 KOhm	0.50	50.00	100.00	2

Assembly Ref.Des.: AzurWave, Capacitor

ID	Ref.des.	PN	Capacitor type	Capacitance	VSR	V.appl.DC	V.peak AC	V.rated	Qual
1.1.1	CN605,CN606,CN607,CN60	GNM214R61A105M	Ceramic	--- --	0.50	50.00	0.00	100.00	2
1.1.2	C3005	CL10A475KQ8NNNC	Ceramic	--- --	0.50	50.00	0.00	100.00	2
1.1.3	C614,C7005,C7007,C1000	C1608X5R0J106KT	Ceramic	--- --	0.50	50.00	0.00	100.00	2
1.1.4	C615,C10085,C7000,C700	CL05B333KP5NNNC	Ceramic	--- --	0.50	50.00	0.00	100.00	2
1.1.5	C2000,C2019,C2029,C203	AMK107BJ226MA-T	Ceramic	--- --	0.50	50.00	0.00	100.00	2
1.1.6	C2001,C2002,C2003,C200	LLL185R70J224MA16F	Ceramic	--- --	0.50	50.00	0.00	100.00	2
1.1.7	C2051,C2060,C2064,C301	JMK063BJ224MP-F	Ceramic	--- --	0.50	50.00	0.00	100.00	2
1.1.8	C3009,C3010,C3011,C301	0402G180F500SNT	Ceramic	--- --	0.50	50.00	0.00	100.00	2
1.1.9	C4001,C4004,C7001,C700	C0402C104K4RAC	Ceramic	100.00 nF	0.50	50.00	0.00	16.00	2
1.1.10	C10003	GRM155R71H561KA01D	Ceramic	--- --	0.50	50.00	0.00	100.00	2
1.1.11	C10004,C10013,C10076	GRM033R70J103KA01D	Ceramic	--- --	0.50	50.00	0.00	100.00	2
1.1.12	C10011	CL21A226MQQNNNE	Ceramic	--- --	0.50	50.00	0.00	100.00	2
1.1.13	C10012	GRM155R71H681KA01D	Ceramic	--- --	0.50	50.00	0.00	100.00	2
1.1.14	C612,C613,C10081,C1008	GRM1555C1H220JA01D	Ceramic	--- --	0.50	50.00	0.00	100.00	2
1.1.15	C10078,R10023	GRM1552C1H8R2CA01	Ceramic	--- --	0.50	50.00	0.00	100.00	2

Assembly Ref.Des.: AzurWave, Connector

ID	Ref.des.	PN	Configuration	# active contacts	Quality
1.1.16	J5002,J8004	DF40C-80DP-0.4V(51)	Multi-Pin	80	2
1.1.17	J8003	20314-001 E- 01	Coaxial, Electric	---	2

Assembly Ref.Des.: AzurWave, LF Transistor

ID	Ref.des.	PN	Type	Application	PSR	VSR	P oper.	P rat.	V oper.	V rat.	Qual
1.1.45	U3000	DMN65D8LDW-7	FIELD EFFECT	Switch	0.50	--	1.000	2.000	---	---	2

Assembly Ref.Des.: AzurWave, Inductive

ID	Ref.des.	PN	Device type	Quality
1.1.18	L3000,L7000,L7002	BLM18PG121SH1	Ferrite Beads	2
1.1.19	L7003	LQM2MPN4R7NG0L	Coil - Load	2
1.1.20	L10000	SDB0420MT1R5	Coil - Load	2
1.1.21	L10001	SDB0420MTR22	Coil - Load	2
1.1.22	L10004	LQM2MPN2R2NG0L	Coil - Load	2

Assembly Ref.Des.: AzurWave, Crystal

ID	Ref.des.	PN	Device type	Quality
1.1.23	QZ3000	NX3215SA32.768K-STD-MUA-4	Quartz Crystal	2
1.1.55	Y3000	S3225A024000-F10CCCA	Quartz Crystal	2