

# RELIABILITY PREDICTION

## REPORT for the

### **MX8M Plus (SRMP8QDWB1D03GE008V12C0)**

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**Prepared For SolidRun Ltd.**

**by RAM CRAFT Ltd.**

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## 1. GENERAL

### 1.1. Scope

This document presents the reliability prediction of the module MX8M Plus (SRMP8QDWB1D03GE008V12C0) – hereafter MX8M Plus.

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
$\lambda$ /FR	-	Failure Rate [Fit]
NHA	-	Next Higher Assy
G <sub>B</sub>	-	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. OVERVIEW

Based on Arm Cortex A53 technology and manufacturing process utilizing 14LPC FinFET process, the NXP i.MX 8M Plus SoC provides high performance and processing speed, while keeping the power consumption to a minimum.

The built-in NPU (up to 2.3TOPs) provides customers the option to perform machine learning inference directly on the edge, reducing cloud dependency, latency and is able to perform highly complex neural network functions like face and emotion detection, object detection and surveillance, which are key to applications such as smart and safe cities, retail, smart home and much more.

Featuring additional high-speed interfaces such as 2 x Gigabit Ethernet, TSN, PCIe Gen 3, USB 3.0, and CAN-FD capabilities, offering industrial temperature grade and NXP's longevity program, the i.MX8M Plus SOM is perfect for industrial IoT and HMI applications.

## 4. RELIABILITY PREDICTION TECHNIQUE

### 4.1. 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 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

### 4.2. Environment & Temperature

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

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

### 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 of any component causes an assembly failure.
- Software failures are not applicable to the Module

### 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 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%

## 5. SUMMARY OF RESULTS AND RECOMMENDATIONS

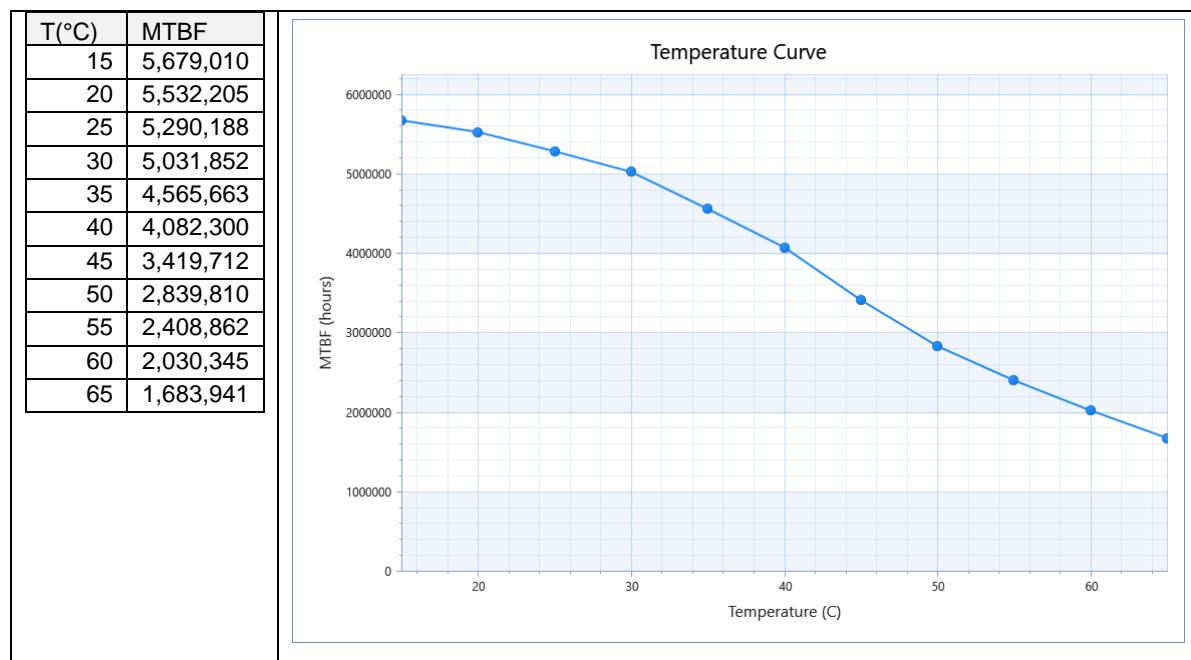
### 5.1. Module Level Reliability Prediction Results

The following are the results of the reliability prediction for the MX8M Plus Module at 55°C Ambient temperature and G<sub>B</sub> Environmental condition.

$$\lambda = 415.1 \text{ FIT}$$

$$\text{MTBF} = 2,408,862 \text{ hours}$$

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



**Figure 1: - MX8M Plus Module Temperature Curve**

### 5.2. Conclusions

Table 2 depicts the main MX8M Plus 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
MIMX8ML8DVNLZAB	i.MX8M-Plus A1 Quad consumer	1	122.756	29.570%	29.570%
KLM8G1GETF-B041	8GB eMMC	1	68.133	16.412%	45.983%
LBEE5HY1MW-230	Bluetooth, WiFi 802	1	67.333	16.220%	62.202%

## 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

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 Plus, ID: 1.2, Description: .

Environment: GB, Temperature: 55.00 °C, F.R.( FIT ): 415.13 , MTBF(hours): 2408861.7

ID	PN	RefDes	Qty	F.R. FIT	F.R.(K) FIT	F.R.(K,Qty) FIT	Contrib. to NHA[%]
1.2.1	0402ZC104KAT2A	C1 C79 C80 C96	4	0.03181	0.03181	0.1273	0.03065
1.2.2	GRM155R61A105KE15D	C120 C122 C123 C128 C130 C131	6	0.03181	0.03181	0.1909	0.04598
1.2.3	GRM155R60J224KE01	C155	1	0.03181	0.03181	0.03181	0.007664
1.2.4	GRM155R60J224KE01D	C127 C129 C132 C133 C134 C135	6	0.03181	0.03181	0.1909	0.04598
1.2.5	GRM1555C1H180FA01D	C83 C84 C124 C125	4	0.03181	0.03181	0.1273	0.03065
1.2.6	GRM1555C1H220JA01D	C136 C137	2	0.03181	0.03181	0.06363	0.01533
1.2.7	GRM155C80J106ME11D	C3 C13 C18 C29 C44 C47 C54 C55 C58 C59 C66 C90 C10	13	0.03181	0.03181	0.4136	0.09963
1.2.8	CL05B105KQ5NQNC	C103 C153	2	0.03181	0.03181	0.06363	0.01533
1.2.9	CL05C160JB5NNNC	C74	1	0.03181	0.03181	0.03181	0.007664
1.2.10	04025A120JAT2A	C85 C86	2	0.03181	0.03181	0.06363	0.01533
1.2.11	C0402C222K4REC7411	C81 C82	2	0.03181	0.03181	0.06363	0.01533
1.2.12	C0402C475M9PACTU	C51 C87 C95 C116 C121 C150 C151 C152 C154	9	0.03181	0.03181	0.2863	0.06897
1.2.13	0402X224K250SNT	C75 C76 C77 C78	4	0.03181	0.03181	0.1273	0.03065
1.2.14	GRM188R60J106KE47D	C104	1	0.03181	0.03181	0.03181	0.007664
1.2.15	GRM188R60J226MEA0D	C100 C101 C106 C111 C112 C114 C118	7	0.03181	0.03181	0.2227	0.05365
1.2.16	GRM188R61C106KAAL	C2 C97 C99 C105 C109 C110 C113 C117 C126	9	0.03181	0.03181	0.2863	0.06897
1.2.17	LLL153C80J224ME14E	C6 C20 C21 C88 C89 C91 C92 C93 C94	9	0.03181	0.03181	0.2863	0.06897
1.2.18	LLL153C80G105ME21D	C4 C5 C7 C8 C9 C10 C11 C12 C14 C15 C16 C17 C19 C22	58	0.03181	0.03181	1.85	0.4445
1.2.19	DF40C-80DP-0.4V(51)	J7 J9	2	6.30	6.30	12.61	3.04
1.2.20	DF40C-70DP-0.4V(51)	J5001	1	5.52	5.52	5.52	1.33
1.2.21	U.FL-R-SMT-1(10)	J4	1	0.5713	0.5713	0.5713	0.1376
1.2.22	FH41-28S-0.5SH(05)	CONN1	1	2.21	2.21	2.21	0.5315
1.2.23	CAT24AA01TDI-GT3	U8	1	4.34	4.34	4.34	1.05
1.2.24	74LVC1G125GW	U5	1	4.69	4.69	4.69	1.13
1.2.25	NCP114AMX090TCG	U10	1	5.53	5.53	5.53	1.33
1.2.26	KLM8G1GETF-B041	U7	1	68.13	68.13	68.13	16.41
1.2.27	MT53E768M32D4DT-053 WT:E	U2	1	38.93	38.93	38.93	9.38
1.2.28	LBEE5HY1MW-230	M1	1	67.33	67.33	67.33	16.22

ID	PN	RefDes	Qty	F.R. FIT	F.R.(K) FIT	F.R.(K,Qty) FIT	Contrib. to NHA[%]
1.2.29	FPF1504BUCX	U14	1	5.53	5.53	5.53	1.33
1.2.30	NTS0302JKZ	U4 U6	2	5.53	5.53	11.06	2.66
1.2.31	PCA9450CHNY	U9	1	6.47	6.47	6.47	1.56
1.2.32	ADIN1300BCPZ	U11	1	16.15	16.15	16.15	3.89
1.2.33	MIMX8ML8DVNLZAB	U1	1	122.76	122.76	122.76	29.57
1.2.34	FXL2TD245L10X	U3	1	5.02	5.02	5.02	1.21
1.2.35	LQM2MPN2R2NG0L	L9	1	0.3095	0.3095	0.3095	0.07455
1.2.36	BKP1005HS121-T	L7	1	0.1032	0.1032	0.1032	0.02485
1.2.37	VLS252012HBX-R47M-1	L1 L2 L3 L4 L5 L6	6	0.3095	0.3095	1.86	0.4473
1.2.38	NX3215SA32.768K-STD-MUA-4	Y1 Y3	2	6.11	6.11	12.21	2.94
1.2.39	Q22FA1280026501	Y4	1	6.11	6.11	6.11	1.47
1.2.40	FA-128 24.0000MF10Z-W3	Y2	1	6.11	6.11	6.11	1.47
1.2.42	RC1005J000CS	R63 R65 R66 R69 R73 R94 R96	7	0.06984	0.06984	0.4889	0.1178
1.2.43	CR-02FL6---10K	R30 R53 R74 R76 R78 R79 R99 R103	8	0.06984	0.06984	0.5588	0.1346
1.2.44	RC1005F152CS	R77	1	0.06984	0.06984	0.06984	0.01682
1.2.45	CR02FL6--200R	R47 R49	2	0.06984	0.06984	0.1397	0.03365
1.2.46	CR0402-FX-2400GLF	R31 R32 R33	3	0.06984	0.06984	0.2095	0.05047
1.2.47	RC1005F153CS	R102	1	0.06984	0.06984	0.06984	0.01682
1.2.48	RC0402FR-07100KL	R56 R57 R68	3	0.06984	0.06984	0.2095	0.05047
1.2.49	RC0402FR-078K2L	R48 R52	2	0.06984	0.06984	0.1397	0.03365
1.2.50	RC0402FR-074K7L	R36 R37 R46 R50 R51 R71 R72	7	0.06984	0.06984	0.4889	0.1178
1.2.51	RC0402FR-0733RL	R93	1	0.06984	0.06984	0.06984	0.01682
1.2.52	RC0402FR-073K01L	R82	1	0.06984	0.06984	0.06984	0.01682
1.2.53	ERJ-2RKF5103X	R59	1	0.06984	0.06984	0.06984	0.01682
1.2.54	741C083472JP	RN1 RN2	2	2.28	2.28	4.56	1.10

## 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 Plus

Limited by: 90.000

PN	Qty	Total Failure rate	Item Failure rate contribution	Cumulative contribution
MIMX8ML8DVNLZAB	1	122.756	29.570%	29.570%
KLM8G1GETF-B041	1	68.133	16.412%	45.983%
LBEE5HY1MW-230	1	67.333	16.220%	62.202%
MT53E768M32D4DT-053 WT:E	1	38.933	9.379%	71.581%
ADIN1300BCPZ	1	16.147	3.890%	75.470%
DF40C-80DP-0.4V(51)	2	12.608	3.037%	78.507%
NX3215SA32.768K-STD-MUA-4	2	12.214	2.942%	81.449%
NTS0302JKZ	2	11.056	2.663%	84.113%
PCA9450CHNY	1	6.468	1.558%	85.671%
FA-128 24.0000MF10Z-W3	1	6.107	1.471%	87.142%
Q22FA1280026501	1	6.107	1.471%	88.613%
FPF1504BUCX	1	5.528	1.332%	89.944%
NCP114AMX090TCG	1	5.528	1.332%	91.276%

## 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 Plus, IC-Memory

ID	Ref.des.	PN	Environment	Temperature
1.2.26	U7	KLM8G1GETF-B041	GB	55.00
1.2.27	U2	MT53E768M32D4DT-053 WT:E	GB	55.00

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

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

Project name: SR\_CARDS\_4 <Telcordia Issue 4>

Assembly Ref.Des.: MX8 Plus, IC-Memory

ID	Ref.des.	PN	Device type	Technology	Number of bits or bits range	Qual
1.2.23	U8	CAT24AA01TDI-GT3	ROM	CMOS	1000	2

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

ID	Ref.des.	PN	# of transistors or range	Qual
1.2.25	U10	NCP114AMX090TCG	33-90	2
1.2.29	U14	FPF1504BUCK	33-90	2
1.2.30	U4 U6	NTS0302JKZ	33-90	2
1.2.31	U9	PCA9450CHNY	100	2
1.2.32	U11	ADIN1300BCPZ	721-860	2

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

ID	Ref.des.	PN	Device type	Technology	# of gates or range	Qual	# of trans. (for PAL)	bus width (for Mkproc)
1.2.24	U5	74LVC1G125GW	Logic	CMOS	21-50	2	---	---
1.2.33	U1	MIMX8ML8DVNLZAB	Mkproc	CMOS	1000	2	---	64

ID	Ref.des.	PN	Device type	Technology	# of gates or range	Qual	# of trans. (for PAL)	bus width (for Mkproc)
1.2.34	U3	FXL2TD245L10X	Logic	CMOS	100	2	---	---

## Assembly Ref.Des.: MX8 Plus, Resistor

ID	Ref.des.	PN	Device type	# of resist.	Resistance	PSR	P oper.	P.rated	Qual
1.2.42	R63 R65 R66 R69 R73 R9	RC1005J000CS	Discrete Fixed Film	---	0.00 Ohm	0.200	20.00	0.06	2
1.2.43	R30 R53 R74 R76 R78 R7	CR-02FL6---10K	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.2.44	R77	RC1005F152CS	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.2.45	R47 R49	CR02FL6-200R	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.2.46	R31 R32 R33	CR0402-FX-2400GLF	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.2.47	R102	RC1005F153CS	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.2.48	R56 R57 R68	RC0402FR-07100KL	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.2.49	R48 R52	RC0402FR-078K2L	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.2.50	R36 R37 R46 R50 R51 R7	RC0402FR-074K7L	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.2.51	R93	RC0402FR-0733RL	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.2.52	R82	RC0402FR-073K01L	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	0.06	2
1.2.53	R59	ERJ-2RKF5103X	Discrete Fixed Film	---	1.00 KOhm	0.200	20.00	100.00	2
1.2.54	RN1 RN2	741C083472JP	Discrete Elements Network	9	---	---	---	---	2

## Assembly Ref.Des.: MX8 Plus, Capacitor

ID	Ref.des.	PN	Capacitor type	Capacitance	VSR	V.appl.DC	V.peak AC	V.rated	Qual
1.2.1	C1 C79 C80 C96	0402ZC104KAT2A	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.2.2	C120 C122 C123 C128 C1	GRM155R61A105KE15D	Ceramic	1.00 uF	0.20	20.00	0.00	100.00	2
1.2.3	C155	GRM155R60J224KE01	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.2.4	C127 C129 C132 C133 C1	GRM155R60J224KE01D	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.2.5	C83 C84 C124 C125	GRM1555C1H180FA01D	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.2.6	C136 C137	GRM1555C1H220JA01D	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.2.7	C3 C13 C18 C29 C44 C47	GRM155C80J106ME11D	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.2.8	C103 C153	CL05B105KQ5NQNC	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.2.9	C74	CL05C160JB5NNNC	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
1.2.10	C85 C86	04025A120JAT2A	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.2.11	C81 C82	C0402C222K4REC7411	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.2.12	C51 C87 C95 C116 C121	C0402C475M9PACTU	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.2.13	C75 C76 C77 C78	0402X224K250SNT	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.2.14	C104	GRM188R60J106KE47D	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.2.15	C100 C101 C106 C111 C1	GRM188R60J226MEA0D	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.2.16	C2 C97 C99 C105 C109 C	GRM188R61C106KAAL	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.2.17	C6 C20 C21 C88 C89 C91	LLL153C80J224ME14E	Ceramic	--- --	0.20	20.00	0.00	100.00	2
1.2.18	C4 C5 C7 C8 C9 C10 C11	LLL153C80G105ME21D	Ceramic	--- --	0.20	20.00	0.00	100.00	2

**Assembly Ref.Des.: MX8 Plus, Connector**

ID	Ref.des.	PN	Configuration	# active contacts	Quality
1.2.19	J7 J9	DF40C-80DP-0.4V(51)	Multi-Pin	80	2
1.2.20	J5001	DF40C-70DP-0.4V(51)	Multi-Pin	70	2
1.2.21	J4	U.FL-R-SMT-1(10)	Coaxial, Electric	---	2
1.2.22	CON1	FH41-28S-0.5SH(05)	Multi-Pin	28	2

**Assembly Ref.Des.: MX8 Plus, Inductive**

ID	Ref.des.	PN	Device type	Quality
1.2.35	L9	LQM2MPN2R2NG0L	Coil - Power Filter	2
1.2.36	L7	BKP1005HS121-T	Ferrite Beads	3
1.2.37	L1 L2 L3 L4 L5 L6	VLS252012HBX-R47M-1	Coil - Power Filter	2

**Assembly Ref.Des.: MX8 Plus, Crystal**

ID	Ref.des.	PN	Device type	Quality
1.2.38	Y1 Y3	NX3215SA32.768K-STD-MUA-4	Quartz Crystal	2
1.2.39	Y4	Q22FA1280026501	Quartz Crystal	2
1.2.40	Y2	FA-128 24.0000MF10Z-W3	Quartz Crystal	2