NASA-STD-8739.11 Tutorial Crystal, Crystal Oscillator

Noman A. Siddiqi

Miller Engineering and Research Corporation (MERC), work performed for NASA GSFC

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Acronyms

AEC	Automotive Electronics Council
COTS	Commercial-Off-The-Shelf
Cpk	Process Capability Index
DLA	Defense Logistics Agency
DoD	Department of Defense
DPPM	Defective Parts Per Million
EEEE	Electrical, Electronic, Electromechanical, Electro-Optical
EOL	End-Of-Line
ETW	Electronics Technology Workshop
FIT	Failure-In-Time
FMEA	Failure Mode and Effects Analysis
GSFC	Goddard Space Flight Center
IL	In-Line
ILPM	Industry Leading Parts Manufacturer
JEDEC	Joint Electron Device Engineering Council

MEAL	Mission Environment, Application, and Lifetime
MIL-SPEC	Military Specification
NASA	National Aeronautics and Space Administration
NEPP	NASA Electronic Parts & Packaging (Program)
NESC	NASA Engineering & Safety Center
NSC	NASA Safety Center
PPAP	Production Part Approval Process
PSW	Part Submission Warrant
QML	Qualified Manufacturers List
QPL	Qualified Product List
RHA	Radiation Hardness Assurance
SMA	Safety and Mission Assurance
SMD	Standard Microcircuit Drawing
SME	Subject Matter Expert
SPC	Statistical Process Control

Crystal

- The most abundant mineral in the earth's crust is natural quartz.
- Natural quartz crystal are hard to manage therefore industry is using synthetic quarts crystals.
- Synthetic quartz crystals shows less frequency shift than natural quartz crystals.



Table 1. CRYSTAL REQUIREMENTS

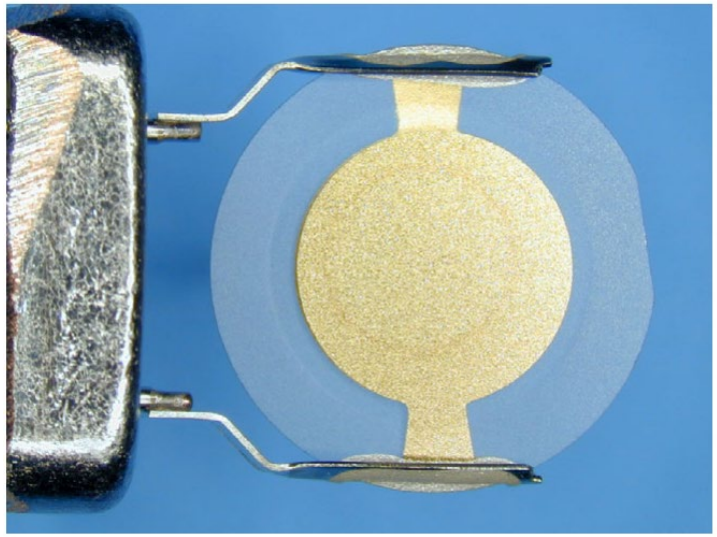
Assurance Level	Specification	Use As Is	Screening	LAT	DPA
Level 1	MIL-PRF-3098		X		X
	SCD		X	X	X
Level 2	MIL-PRF-3098				X
	Automotive, Commercial, SCD		X	X	X
Level 3	MIL-PRF-3098				X
	Automotive, Commercial, SCD		X		X
Level 4	MIL-PRF-3098	X			
	Automotive, Commercial, SCD	X			

Major Changes from EEE-INST-002

- Crystal.
  - Add Introduction to the section
  - The table 1 design changed to include what required specification to be used for each level 1 – 4.
  - Add DPA to the table 1
  - Reduce the number of “Notes”
  - Derating is limited to Power only
  - Screening flow updated to conform space and military specification flows.
  - Changed qualification to Lot Acceptance.

Crystal Design





Crystal Oscillator

- The crystal oscillators are basically hybrid technology that comprise electronic circuit with active and passive discrete device with a piezoelectric crystal.
- There are multiple crystal oscillator classes for different frequencies and environmental conditions.
- There are multiple oscillator types described in MIL-PRF-55310 for various applications such as voltage/temperature/oven control controlled.
- Automotive, Commercial grade oscillators types are designed using similar commercial grade elements for their construction.

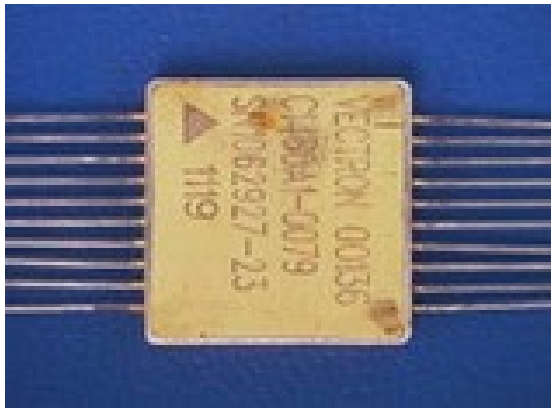
Table 1A. CRYSTAL OSCILLATOR REQUIREMENTS

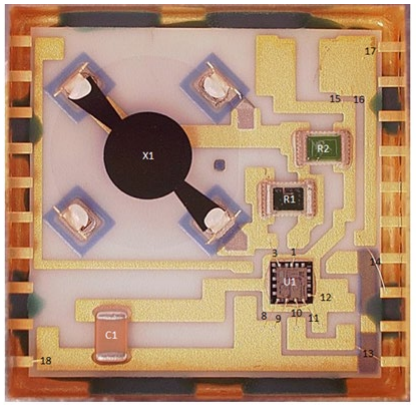
Assurance Level	Crystal Oscillator Class	Specification	Temperature Range /5	Use as Is	Element Evaluation /4	Screening	LAT	DPA
Level 1	QPL Class 1, 2 or 3 (Product Level S) 2/	MIL-PRF-55310	A, B					X
	SCD	VICD, SCD			X	X 3/	X	X
Level 2	QPL Class 1, 2 or 3 (Product Level S, B)	MIL-PRF-55310	A, B, D					X
	Commercial, Automotive, SCD	VICD, SCD, AEC-Q200				X	X	X
Level 3	QPL Class 1, 2 or 3 (Product Level S, B, C)	MIL-PRF-55310	A, B, C, D, E	X				
	Commercial, Automotive, SCD	VICD, SCD, AEC-Q200				X		X
Level 4	QPL Class 1, 2 or 3 (Product Level S, B, C)	MIL-PRF-55310	A, B, C, D, E	X				
	Commercial, Automotive, SCD	VICD, SCD, AEC-Q200		X				

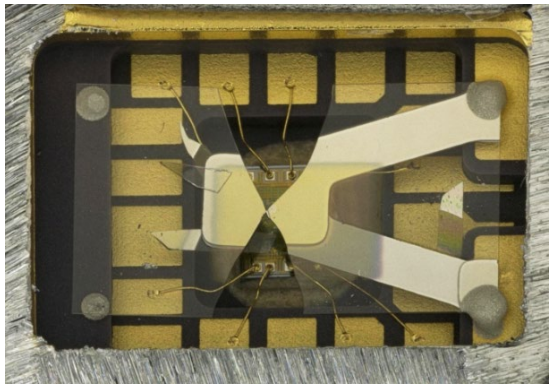
Major Changes from EEE-INST-002

- Crystal Oscillator.
  - Add Introduction to the section
  - The table 1A design changed to include what required specification to be used for each level 1 – 4.
  - Add DPA to the table 1A
  - Add Surface Acoustic Wave Oscillators to Table 1B
  - Reduce the number of “Notes”
  - Table 4 derating factor is for digital microcircuit only. Because oscillators are hybrid added Black Box derating method.
  - Screening flow updated to conform space and military specification flows.
  - Changed qualification to Lot Acceptance.

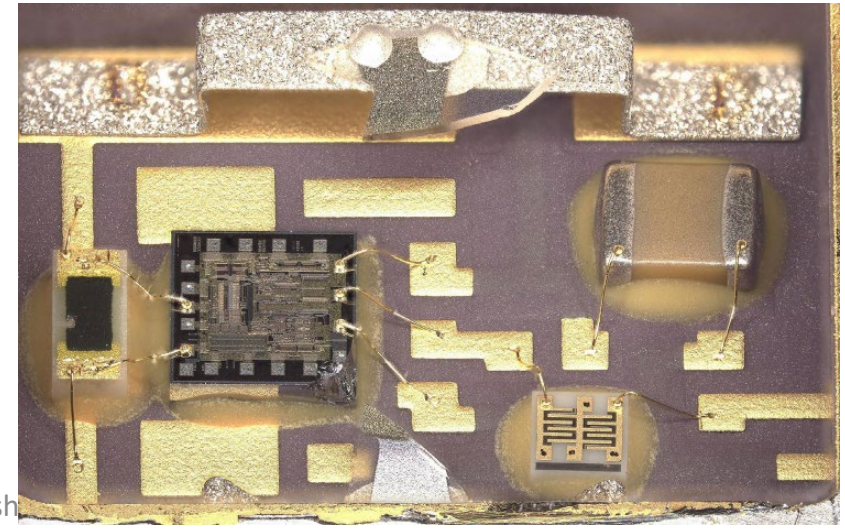
Crystal Oscillator





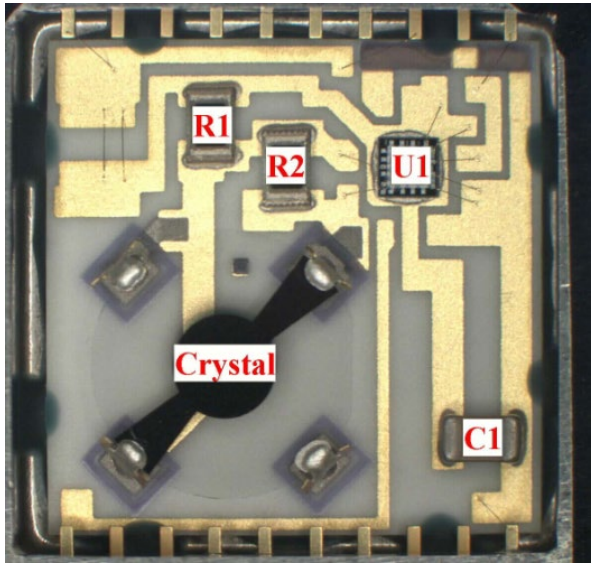






Crystal Oscillator





Send email to address below for questions

Noman.a.siddiqi@nasa.gov

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