SCREENING
MIL-PRF-55310 vs. MIL-PRF-38534 vs. 401-0298-001

MIL-PRF-55310 Product level B	MIL-PRF-55310 Product level S	MIL-PRF-38534 Class K (Space level)	401-0298-001 Space level, Fre-Tech
		Nondestructive Bond Pull	Nondestructive Bond Pull
	Thermal Shock, cond A	Internal visual	Internal visual
Temperature Cycling, cond B	Temperature Cycling, cond B	Temperature Cycling, cond C	Temperature Cycling, cond C
Constant Acceleration, 5000g	Constant Acceleration, 5000g	Mechanical shock or Constant acceleration 3000g	Constant Acceleration, 5000g
	P.I.N.D., cond B	P.I.N.D., cond A	P.I.N.D., cond B
Pre Burn-in electrical	Pre Burn-in electrical	Pre Burn-in electrical	Pre Burn-in electrical
Burn-in (160 hours)	Burn-In (240 hours)	Burn-in (1st 160 hours)	Burn-in (1st 160 hours)
		Interim electrical	Interim electrical
		Burn-in (2nd 160 hours)	Burn-in (2nd 160 hours)
Final Electrical	Final electrical	Final Electrical	Final Electrical
Leak test (Fine & Gross)	Leak test (Fine & Gross)	Leak test (Fine & Gross)	Leak test (Fine & Gross)
	Radiographic inspection	Radiographic inspection	Radiographic inspection
			Frequency Aging (30 days)
		External visual	External visual

Quality Conformance Inspection - GROUP C INSPECTION

MIL-PRF-55310 Product level S

SUBGROUP	TEST DESCRIPTION	QUANTITY/ (ACCEPT)
1	Conducted interference (when specified)	8
	Vibration	8
	Acoustic noise (when specified)	8
	Shock	8
	Acceleration (when specified)	8
	Explosion (when specified)	8
2	Magnetic field (operating) (when specified)	4
	Thermal shock	4
	Ambient pressure	4
	Storage temperature	4
	Radiation hardness (operating) (when specified)	4
3	Resistance to soldering heat	2
	Moisture resistance	2
	Salt atmosphere 2/	2
4	Terminal strength (lead integrity)	2
	Resistance to solvents	2
	Fungus (when specified)	2

401-0298-001

SUBGROUP	TEST DESCRIPTION	MIL-STD-883 METHOD	MIL-STD-883 CONDITION	QUANTITY/ (ACCEPT)
1	External visual	2009		5 (0)
	Temperature cycling	1010	C, 20 cycles	5 (0)
	Constant acceleration	2001	A, Y1 axis	5 (0)
	Seal (fine & gross leak)	1014	A & C	5 (0)
	Radiographic inspection	2012		5 (0)
	Visual examination			5 (0)
	End point electricals			5 (0)
2	End point electricals			5 (0)
	Steady state life	1005	1000 hours at 125 °C	5 (0)
	End point electricals			5 (0)
3	Internal water vapor content			3 (0) or 5 (1)

ENGINEERING PRACTICE STUDY

Crystal Oscillator Testing:
A comparison between MIL-PRF-55310 (Oscillator,Crystal Controlled) and MIL-PRF-38534 (Hybrid Microcircuits).

FINAL REPORT

13 NOVEMBER 2008

PROJECT NUMBER: 5955-2009-002

Study conducted by:

William E. Sindelar, Electronics Component Team, DSCC-VAT
Greg Cecil, Microelectronics Team, DSCC-VAS
Electronics Engineers

Prepared by:

William E. Sindelar

ATTCH 2

I. OBJECTIVE: The objective of this study was to take an in-depth look at both MIL-PRF-55310 (Oscillator, Crystal Controlled) and MIL-PRF-38534 (Hybrid Microcircuits) and compare the mandatory tests each document prescribes in order for a manufacturer to produce, qualify, and deliver to the Government a typical Federal Stock Class 5955 crystal oscillator.

II. BACKGROUND: The idea of testing and qualifying crystal oscillators to MIL-PRF-38534 as opposed to testing and qualifying these same oscillators to MIL-PRF-55310 was discussed on several occasions between DSCC-VA and a small number of members of the Government Electronics and Information Association (GEIA). Certain contractors were interested in knowing if MIL-PRF-38534 might provide more thorough testing and be a more appropriate document than MIL-PRF-55310 for testing crystal oscillators, and if so, should the testing and qualifying of crystal oscillators be transferred from the crystal oscillator specification MIL-PRF-55310 to the hybrid microcircuit specification MIL-PRF-38534.

III. RESULTS: DSCC-VA decided to conduct a study in an effort to answer the idea posed by the contractors concerned with the testing of crystal oscillators. Together, DSCC-VAT and DSCC-VAS conducted a study to compare the testing of a typical crystal oscillator as mandated by MIL-PRF-55310 and MIL-PRF-38534.

We started by constructing tables of the various tests in each military specification. It soon became apparent that our original tables were too cumbersome for an effective briefing (see attachment 1 for a typical detailed test table), so it was necessary to scale back some of the detailed information. From these multiple and reduced tables, we constructed new tables that showed a side-by-side comparison of the two specification's main test sequences; screening, qualification testing, conformance inspection (Group A and Group B), and period inspection (Group C). Element analysis was also reviewed but not included in the presentation since element analysis is similar in both documents. The condensed results of this study were presented at the September 2008 meeting of the GEIA G11 and G12 committees (see attachment 2). It should be noted that little interest and no discussion was generated as a result of the presentation.

IV. CONCLUSIONS: These two military specifications differ significantly in their test flow. MIL-PRF-55310 qualifies to MIL-STD-790 while MIL-PRF-38534 qualifies to its own quality management program in appendix A of the document. MIL-PRF-55310 adheres to the Qualified Products List program while MIL-PRF-38534 adheres to the Qualified Manufacturers List program. It was difficult to assess the merits of one document over the other since the same or similar tests are performed at different times during each specification's test flow. For example, Thermal Shock is performed during every main test sequence in MIL-PRF-55310 and is not performed in MIL-PRF-38534. Conversely, PIND is performed during every main test sequence in MIL-PRF-38534 and is only performed during screening for space level product in MIL-PRF-55310. These tests are but two of the many tests done at differing stages of the test flow for the respective specifications.

Further comparison of the two documents shows that MIL-PRF-55310 requires Group C testing every two years while MIL-PRF-38534 requires Group C testing only at initial qualification and for design changes. MIL-PRF-55310 addresses crystal evaluation requirements while MIL-PRF-38534 has no requirements in this area. MIL-PRF-38534 has an inline option for testing while MIL-PRF-55310 does not. One of the few commonalities of the two specifications is that MIL-PRF-55310 utilizes element evaluation tables similar to tables found in MIL-PRF-38534.

Finally, MIL-PRF-55310 has very detailed interface and physical dimension criteria and allows for specific frequency selection within the part numbering system whereas MIL-PRF-38534 has no such provision and is designed for a more custom product.

MIL-PRF-55310 and MIL-PRF-38534 are fundamentally different documents, and to date, there has been nothing presented to show that crystal oscillators should come under the purview of MIL-PRF-38534.

V. RECOMMENDATIONS: The testing and qualification of crystal oscillators should remain under the purview of MIL-PRF-55310 and the Qualified Products List program.

NOTE: I want to thank Mr. Greg Cecil for his input and insight in gathering the MIL-PRF-38534 test information to make the comparison of the two specifications a less daunting task. Additionally, thanks goes to Mr. Rob Heber and Mr. Mike Radecki for their help in arranging the information in the most meaningful way for presentation purposes.

ATTACHMENT 1

COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310 WITH HYBRID SPECIFICATION MIL-PRF-38534

SCREENING

TEST 100%	REQUIREMENTS			
	MIL-PRF-55310 (table III)	MIL-PRF-38534	MIL-PRF-55310 (table III)	MIL-PRF-38534
	CLASS B	CLASS H	CLASS S	CLASS K
Preseal burn-in		Optional MIL-PRF-883, method 1030 (C.5.3)		Optional MIL-PRF-883, method 1030 (C.5.3)
Nondestructive bond pull	N/A	N/A	MIL-STD-883, method 2023. PDA 2% of total wires (4.4.1).	MIL-STD-883, method 2023 (C.5.4)
Internal visual	MIL-STD-883, method 2017, 2032, plus manufacturer's data on crystal attachment. Between final internal visual and seal prep, osc stored in dry nitrogen or vacuum bake oven. First internal visual prior to crystal element install. Final internal after crystal element install and prior to cover seal. (4.4.2)	MIL-STD-883, method 2017 (C.5.5)	Same as Class B	MIL-STD-883, method 2017 (C.5.5)
Stabilization bake (prior to seal). Vacuum Bake & maintain in dry nitrogen until sealed.	MIL-STD-883, method 1008: +150ºC, 24 hours minimum	N/A	MIL-STD-883, method 1008: +150ºC, 48 hours minimum	N/A
Thermal shock	N/A	N/A	MIL-STD-883, method 1011: Water, step 1: 100 +10-2 ºC, step 2: 0+2-10 ºC, 15 cycles	N/A
Temperature cycling	MIL-STD-883, method 1010: cold: -55+0-10 ºC, hot: +125+15-0 ºC, 10 min dwell, 10 cycles	MIL-STD-883, method 1010 (C.5.6)	MIL-STD-883, method 1010: cold: -55+0-10 ºC, hot: +125+15-0 ºC, 10 cycles	MIL-STD-883, method 1010 (C.5.6)
Constant acceleration	MIL-STD-883, method 2001: 5000 g's Y_1 only.	MIL-STD-883, method 2001 or mechanical shock MIL-STD-883, method 2002 (C.5.6).	MIL-STD-883, method 2001: 5000 g's Y_1 only.	MIL-STD-883, method 2001 or mechanical shock MIL-STD-883, method 2002 (C.5.6).

TEST 100%	REQUIREMENTS			
	MIL-PRF-55310 (table III)	MIL-PRF-38534	MIL-PRF-55310 (table III)	MIL-PRF-38534
	CLASS B	CLASS H	CLASS S	CLASS K
Seal (fine and gross leak)	MIL-STD-883, method 1014: Fine Leak: A_1, A_2, or B (A_1, A_2: tracer gas helium, flexible method. B: Radioisotope) or MIL-STD-202, method 112 test condition C (tracer gas, nominal leak value 10^{-8} atm. cm^3/s, proc 3: force gas in, or proc 4: backfill). Gross Leak: perfluorocarbon or MIL-STD-202, method 112, test condition D or E (D: fluorocarbon liquid at 125°C±5°C, bubble detect, E: (bubble test - two fluorocarbon liquids - one at pressure followed by immersion in a second liquid at 125°C ±5°C - when a nominal sensitivity of 10^{-5} atm. cm^3/s is sufficient). Performed in any sequence between constant accel. & ext. visual and after all shearing & forming (4.8.2.2.2).	MIL-STD-883, method 1014 after final electrical (C.5.11).	Same as Class B except: Performed in any sequence between final elec & ext. visual and after all shearing & forming.	MIL-STD-883, method 1014 after final electrical (C.5.11).
Particle impact noise detection (PIND)	N/A	N/A	MIL-STD-883, method 2020: vibration shaker 10 g peak at 60 Hz minimum, shock pulse of 1,000 ±200 g peak, Sequence: a. 3 pre-test shocks. b. Vibration 3 ±1 seconds. c. 3 co-test shocks. d. Vibration 3 ±1 seconds. e. 3 co-test shocks. f. Vibration 3 ±1 seconds. g. 3 co-test shocks. h. Vibration 3 ±1 seconds. i. Accept or reject.	MIL-STD-883, method 2020, condition A (C.5.7)
Electrical test:	N/A	Optional pre-burn-in electrical in accordance with applicable device specification (C.5.8).		Pre-burn-in in accordance with applicable device specification (C.5.8).
Input current-power	N/A		4.8.5	
Output waveform	N/A		4.8.20	
Output voltage-power	N/A		4.8.21	
As specified	Supply voltage, overvoltage, Input current-power, Init-freq accuracy, freq-volt tolerance, output waveform, output voltage-power, rise & fall times, duty cycle, freq-aging (4.8.3-4.8.5, 4.8.10, 4.8.14, 4.8.20-4.8.23, 4.8.35).		Supply voltage, overvoltage, Init-freq accuracy, freq-volt tolerance, rise & fall times, duty cycle, freq-aging (4.8.3-4.8.5, 4.8.10, 4.8.14, 4.8.20-4.8.23, 4.8.35).	

TEST 100%	REQUIREMENTS			
	MIL-PRF-55310 (table III)	MIL-PRF-38534	MIL-PRF-55310 (table III)	MIL-PRF-38534
	CLASS B	CLASS H	CLASS S	CLASS K
Burn-in (load)	+125ºC, nominal supply voltage and burn-in load, 160 hours minimum	N/A	+125ºC, nominal supply voltage and burn-in load, 240 hours minimum	N/A
Electrical test:	Nominal supply voltage, specified load, +23ºC and verify frequency at the temperature extremes.	Final electrical in accordance with applicable device specification (C.5.10).	Nominal and extreme supply voltages, specified load, +23ºC and temperature extremes, record all test parameters by serial number.	Final electrical in accordance with applicable device specification (C.5.10).
Input current-power	4.8.5		4.8.5	
Output waveform	4.8.20		4.8.20	
Output voltage-power	4.8.21		4.8.21	
As specified	Supply voltage, overvoltage, Input current-power, Init-freq accuracy, freq-volt tolerance, output waveform, output voltage-power, rise & fall times, duty cycle, freq-aging (4.8.3-4.8.5, 4.8.10, 4.8.14, 4.8.20-4.8.23, 4.8.35).		Same as Class B	
Radiographic: radiographic inspection may be performed following PIND test to expedite screening test completion	N/A	N/A	MIL-STD-883, method 2012: NOTE: Radiographic inspection may be performed following PIND test to expedite screening test completion.	MIL-STD-883, method 2012 (C5.12).
External Visual	N/A	MIL-STD-883, method 2009 (C.5.13).	N/A	MIL-STD-883, method 2009 (C.5.13).

ATTACHMENT 2

HYBRID OSCILLATORS

DOCUMENT STANDARDIZATION

DSCC-VA

HYBRID OSCILLATOR REQUIREMENTS COMPARISON

- MIL-PRF-55310 (CLASS 2)
- MIL-PRF-38534
  - Qualification testing
  - Screening
  - Quality conformance testing (Groups A,B,C)

COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310 WITH HYBRID SPECIFICATION MIL-PRF-38534
QUALIFICATION

TEST	REQUIREMENTS			
	MIL-PRF-55310	MIL-PRF-38534	MIL-PRF-55310	MIL-PRF-38534
	CLASS B	CLASS H	CLASS S	CLASS K
External Visual	X	X	X	X
PIND	N/A	X	N/A	X
Temperature cycling	N/A	X	N/A	X
Mechanical shock and/or Constant acceleration	N/A	X	N/A	X
Seal (fine and gross)	X	X	X	X
PIND	N/A	X	N/A	X
Visual examination	N/A	X	N/A	X
Electricals	X	X	X	X
Steady-state life test	N/A	X	N/A	X
Electricals	N/A	X	N/A	X
Internal water vapor content	X	X	X	X

COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310 WITH HYBRID SPECIFICATION MIL-PRF-38534
QUALIFICATION - continued

TEST	REQUIREMENTS			
	MIL-PRF-55310	MIL-PRF-38534	MIL-PRF-55310	MIL-PRF-38534
	CLASS B	CLASS H	CLASS S	CLASS K
Internal visual and mechanical	N/A	X	N/A	X
Bond Strength	N/A	X	N/A	X
Element Shear	N/A	X	N/A	X
ESD	N/A	X	N/A	X
Frequency aging	X	N/A	X	N/A
Conducted interference (when specified)	X	N/A	X	N/A
Vibration	X	N/A	X	N/A
Acoustic noise (when specified)	X	N/A	X	N/A
Shock	X	N/A	X	N/A
Acceleration (when specified)	X	N/A	X	N/A

COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310 WITH HYBRID SPECIFICATION MIL-PRF-38534
QUALIFICATION - continued

TEST	REQUIREMENTS			
	MIL-PRF-55310	MIL-PRF-38534	MIL-PRF-55310	MIL-PRF-38534
	CLASS B	CLASS H	CLASS S	CLASS K
Explosion (when specified)	X	N/A	X	N/A
Magnetic field (operating) (when specified)	X	N/A	X	N/A
Thermal shock	X	N/A	X	N/A
Ambient pressure	X	N/A	X	N/A
Storage temperature	X	N/A	X	N/A
Radiation hardness (operating) (when specified)	X	N/A	X	N/A
Resistance to soldering heat	X	N/A	X	N/A
Moisture resistance	X	N/A	X	N/A

COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310 WITH HYBRID SPECIFICATION MIL-PRF-38534
QUALIFICATION - continued

TEST	REQUIREMENTS			
	MIL-PRF-55310	MIL-PRF-38534	MIL-PRF-55310	MIL-PRF-38534
	CLASS B	CLASS H	CLASS S	CLASS K
Salt atmosphere	X	N/A	X	N/A
Terminal strength (lead integrity)	X	N/A	X	N/A
Solderability	X	N/A	X	N/A
Resistance to solvents	X	N/A	X	N/A
Fungus	X	N/A	X	N/A

COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310 WITH HYBRID SPECIFICATION MIL-PRF-38534.
SCREENING

	REQUIREMENTS			
TEST	MIL-PRF-55310 (table III)	MIL-PRF-38534	MIL-PRF-55310 (table III)	MIL-PRF-38534
100%	CLASS B	CLASS H	CLASS S	CLASS K
Preseal burn-in	N/A	X Optional	N/A	X Optional
Nondestructive bond pull	N/A	N/A	X	X
Internal visual	X	X	X	X
Stabilization bake (prior to seal). Vacuum Bake & maintain in dry nitrogen until sealed.	X	N/A	X	N/A
Thermal shock	N/A	N/A	X	N/A
Temperature cycling	X	X	X	X
Constant acceleration	X	X	X	X
Seal (fine and gross leak)	X	X	X	X
Particle impact noise detection (PIND)	N/A	N/A	X	X

COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310 WITH HYBRID SPECIFICATION MIL-PRF-38534.
SCREENING - continued

	REQUIREMENTS			
TEST	MIL-PRF-55310 (table III)	MIL-PRF-38534	MIL-PRF-55310 (table III)	MIL-PRF-38534
100%	CLASS B	CLASS H	CLASS S	CLASS K
Electrical test:	N/A	X	N/A	X
Burn-in	X	N/A	X	N/A
Electrical test:	X	X	X	X
Radiographic:	N/A	N/A	X	X
External Visual	N/A	X	N/A	X

COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310 WITH HYBRID SPECIFICATION MIL-PRF-38534
Groups A, B, and C.

TEST	REQUIREMENTS			
	MIL-PRF-55310	MIL-PRF-38534	MIL-PRF-55310	MIL-PRF-38534
	CLASS B	CLASS H	CLASS S	CLASS K
Electrical	X	X	X	X
Physical Dimensions	N/A	X	N/A	X
Resistance to solvents	X	X	X	X
Internal visual and mechanical	X	X	X	X
Bond Strength	N/A	X	N/A	X
Die shear strength	N/A	X	N/A	X
Solderability	X	X	X	X
Seal (fine and gross)	N/A	X	N/A	X
External Visual	N/A	X	N/A	X
Particle impact noise detection (PIND)	N/A	N/A	N/A	X
Temperature cycling	N/A	X	N/A	X

COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310 WITH HYBRID SPECIFICATION MIL-PRF-38534
Groups A, B, and C. - continued

TEST	REQUIREMENTS			
	MIL-PRF-55310	MIL-PRF-38534	MIL-PRF-55310	MIL-PRF-38534
	CLASS B	CLASS H	CLASS S	CLASS K
Mechanical shock and/or Constant acceleration	N/A	X	N/A	X
Visual examination	N/A	X	N/A	X
Steady-state life test	N/A	X	N/A	X
Internal water vapor content	N/A	X	N/A	X
Element Shear	N/A	X	N/A	X
ESD	N/A	X	N/A	X
Conducted interference (when specified)	X	N/A	X	N/A
Vibration	X	N/A	X	N/A
Acoustic noise (when specified)	X	N/A	X	N/A
Shock	X	N/A	X	N/A

COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310 WITH HYBRID SPECIFICATION MIL-PRF-38534
Groups A, B, and C. - continued

TEST	REQUIREMENTS			
	MIL-PRF-55310	MIL-PRF-38534	MIL-PRF-55310	MIL-PRF-38534
	CLASS B	CLASS H	CLASS S	CLASS K
Acceleration (when specified)	X	N/A	X	N/A
Explosion (when specified)	X	N/A	X	N/A
Magnetic field (operating) (when specified)	X	N/A	X	N/A
Thermal shock	X	N/A	X	N/A
Ambient pressure	X	N/A	X	N/A
Storage temperature	X	N/A	X	N/A
Radiation hardness (operating) (when specified)	X	N/A	X	N/A
Resistance to soldering heat	X	N/A	X	N/A
Moisture resistance	X	N/A	X	N/A

COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310 WITH HYBRID SPECIFICATION MIL-PRF-38534
Groups A, B, and C. - continued

TEST	REQUIREMENTS			
	MIL-PRF-55310	MIL-PRF-38534	MIL-PRF-55310	MIL-PRF-38534
	CLASS B	CLASS H	CLASS S	CLASS K
Salt atmosphere	X	N/A	X	N/A
Terminal strength (lead integrity)	X	N/A	X	N/A
Fungus (when specified)	X	N/A	X	N/A
Frequency Aging	X	N/A	X	N/A

MIL-PRF-55310 vs. MIL-PRF-38534

- MIL-PRF-55310
  - Qualifies to MIL-STD-790
  - Does Group C every two years
  - Addresses crystal evaluation requirements
  - Uses element evaluation tables similar to the tables in MIL-PRF-38534
  - Associate slash sheets for listing on QPL
  - Part number allows for specific frequency

- MIL-PRF-38534
  - Qualifies to MIL-PRF-38534 Appendix A (Quality Management Program)
  - Does group C only at initial qualification and for design changes
  - Does not have any requirements for crystals
  - Has an inline option for testing
  - Allows for custom product

CONCLUSION