REVISIONS

Letter	ECO No.	Description	Checked	Approved	Date
A	36-403	INITIAL RELEASE	RFG	WFM	12/4/95
B	36-765	CORRECT PINOUTS	BK	[illegible]	9/16/96

NAME	DATE
Drawn: BRIAN KLATT	11/29/95
Checked: R. F . Goeke	125/95
Approved: W. Mayer	12/4/95
Released: D. Gage	12/5/95

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
CENTER FOR SPACE RESEARCH

CRYSTAL OSCILLATOR, HYBRID, 38.4 MHz

Size	Code Identification No.	Drawing No.	Rev.
T	80230	36-02311	B

Scale: NONE

1.0 SCOPE

1.1 Introduction This drawing describes device requirements for radiation hardened, 38.4 MHz crystal Oscillators. These parts will be used in flight hardware for a space experiment on the AXAF CCD Imaging Spectrometer (ACIS) Instrument, in an Earth orbit 10,000 km by 140,000 km.

1.2 Absolute maximum ratings

TA = -55°C to +125°C

2.0 APPLICABLE DRAWINGS

2.1 Government Specifications and Standards Unless otherwise specified, the following specifications and standards, of the latest released issue, form a part of this drawing, to the extent specified herein.

SPECIFICATIONS
MILITARY

MIL-S-19500	Semiconductor Devices, General Specification for
MIL-M-38510	Microcircuits, General Specification for
MIL-H-38534	Hybrid Microcircuits, General Specification for
MIL-O-55310	Crystal Oscillators, General Specification for

STANDARDS

MIL-STD-202	Test Method for Electronic and Electrical Component Parts
MIL-STD-883	Test Methods and Procedures for Microelectronics

2.2 Order of precedence In the event of conflict between the text of this drawing and the references cited herein, the text of this drawing shall govern.

3.0 REQUIREMENTS

3.1 General Requirements

3.1.1 Item Requirements The crystal oscillators described herein shall, in all respects, meet the requirements of this specification. Processes and procedures per MIL-H-38534, level H, option 1, shall be as specified herein. These crystal oscillators shall be fabricated and tested using production and test facilities and a Reliability and Quality Assurance program adequate to assure successful compliance with this specification, and the intent of MIL-O-55310 and MIL-H-38534. Alternate element evaluation per paragraph 4.3.5 of MIL-H-38534 is acceptable.

3.1.2 Procuring Activity For the purposes of this specification and documents referenced herein, the procuring activity is the Massachusetts Institute of Technology (MIT), Center for Space Research (CSR).

3.1.3 Product Changes The supplier(s) shall notify MIT of proposed changes to Crystal oscillators, including changes in design, materials, fabrication methods, or processes, and changes which may affect the quality or intended end use.

3.2 Part marking Crystal oscillator marking shall meet the requirements of paragraph 3.6 of MIL-H-38534, excluding subparagraph "i".

3.2.1 Part Number Crystal oscillators shall be marked with the MIT part number; 36-02311.

3.3 Electrical performance characteristics Unless otherwise specified, the electrical performance characteristics are as specified in table 1 herein, and apply over the full operating temperature range.

3.3.1 Frequency The frequency shall be 38.4 Megahertz (MHz).

3.4 Design and Construction Requirements

3.4.1 Package The package shall be per figure 3 herein.

3.4.2. Lead Finish The lead finish shall be "A" per paragraph 3.6.2.4 of MIL-H-38534.

3.4.3 Terminal connections The terminal connections shall be per figure 1 herein.

3.4.4 Microcircuits Microcircuits elements used in these crystal oscillators shall be radiation hardened HCMOS, and capable of surviving total dose radiation levels of 100 KRads minimum.

3.4.5 Semiconductor Elements Semiconductor elements used in these crystal oscillators shall be capable of surviving total dose radiation levels of 100 KRads minimum.

3.4.6 Radiation Hardness No devices shall be used in these crystal oscillators that latch-up in a single event upset (SEU) environment.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection Unless otherwise specified herein, the manufacturer is responsible for the performance of all examinations and tests as specified herein.

4.2 Screening All Crystal oscillators (100%) shall be subjected to and pass the screen tests and examinations defined in Table 2 herein

4.2.1 Burn-in The Load circuit of figure 2 applies. Delta limits are detailed in table 4.

4.2.2 Xray All Crystal oscillators (100%) shall be subjected to and pass radiographic examination per MIL-STD-883, method 2012.

4.2.3 Particle Impact Noise Detection (PIND) All Crystal oscillators (100%) shall be subjected to and pass PIND examination per MIL-STD-883, method 2020, condition B.

4.3 Quality Conformance Inspection (QCI) Quality conformance inspection shall be in accordance with groups A, B, C, and D, Tables 4, 5, 6, and 7 respectively. The life test of Group C shall be per the load circuit detailed in Figure 2.

4.4 Destructive Physical Analysis (DPA) An internal destructive examination shall be performed in accordance with paragraph 3.5, of MIL-STD-883, method 5009. Sample size shall be one (1). An electrical reject shall be used for DPA.

4.5 Inspection and Test Records The supplier shall maintain inspection and test records for 36 months after hardware delivery to MIT. Test data for all electrical tests, screening, DPA, and QCI inspections shall be submitted to MIT with the delivery of flight parts.

4.6 Source Inspection

4.6.1 Government Source Inspection (GSI) The government has the right to inspect any or all of the work included in this order at the supplier's facility.

4.6.2 MIT Source Inspection MIT Performance Assurance will impose mandatory inspection points (MIPs) at wire bonding (precap visual examination) and final test, and must be notified 2 weeks before parts are ready for MIT Inspection. (call area code 617, phone 253-7555).

5.0 PACKAGING

5.1 Packaging requirements Packaging shall be in accordance with paragraph 5.1 of MIL-O-55310

6.0 NOTES

6.1 Approved Source of Supply

Q-Tech Corporation
10150 W. Jefferson Blvd.
Culver City, CA 90232

Cage Code: 51774

Table 1: ELECTRICAL PERFORMANCE CHARACTERISTICS

ELECTRICAL PARAMETER	TEST CONDITIONS	LIMITS				
		MIN.	NOM.	MAX	UNITS	NOTES
FREQUENCY/TEMPERATURE STABILITY	T_A =-55°C TO +125°C			65	ppm	1, 4, 7
SUPPLY VOLTAGE		4.5	5	5.5	Vdc	
INPUT CURRENT	Measured without load at 5.5 Vdc			15	mA	
OUTPUT VOLTAGE - LOGIC "0"				Vcc X .1	Vdc	
OUTPUT VOLTAGE - LOGIC "1"		Vcc X .9			Vdc	
OUTPUT WAVEFORM			Squarewave		N/A	
RISE TIME (Measured between 10% and 90%)			5	8	nsec	
FALL TIME (Measured between 90% and 10%)			5	8	nsec	
DUTY CYCLE (Measured at 50% level)			60/40 or better		%	
FREQUENCY AGING (After 30 days)	T_A = 70°C + 2°C			1.5	ppm	
FREQUENCY AGING (After 1 year)	T_A = 70°C + 2°C			10	ppm	
STARTUP TIME			5	18	msec	
OUTPUT FREQUENCY	T_A =-55°C TO +125°C		38.4±1%		MHz	

NOTES

1) If the limit for "initial accuracy at reference temperature" is specified, all frequency/temperature stability measurements are referenced to the initial accuracy measurement at the reference temperature specified. If the limit for "initial accuracy at reference temperature" is not specified, the limit for frequency/temperature stability shall be referenced to the specified nominal output frequency.

2) Unless otherwise specified, the limits are over the full operating temperature range and under specified load conditions.

3) Although not required to meet the frequency/temperature stability limits, the oscillator(s) shall meet the output logic and waveform requirements from -55°C to 125°C.

4) Unless otherwise specified, all measurements are in accordance with MIL-O-55310.

5) Up to 30 days after shipment.

6) Voltage values are with respect to network ground terminal.

7) 100 ppm @ end of life.

TABLE 2: SCREENING TESTS

TEST DESCRIPTION	STANDARD	METHOD	CONDITION	COMMENTS
Internal visual	883	2017	B	Class B
Stabilization bake	883	1008	C	48 hours at 150°C
Temperature cycling	883	1010	C	
Constant acceleration	883	2001	E	Y1 direction only
Particle impact noise detection (PIND)	883	2020	B	5 passes minimum (Note 2)
Pre burn-in electrical	Refer to Table 1 and Table VIII			
Burn-in	883	1015	125°C for 160 hours	Note 3
Final electrical	Refer to Tables 1 and Table VIII			
Seal; Fine leak	883	1014	A1	
Seal; Gross Leak	883	1014	C	
Radiographic inspection	883	2012	Class B	
Frequency aging	MIL-O-55310	-	70°C	Note 4
External visual	883	2009		

NOTES:

1) PIND testing shall be performed using five (5) independent passes and all failures found at the end of each pass are rejected. The survivors of the last pass are acceptable.

2) Burn-in shall be under the specified load and nominal voltage conditions.

3) Percent defective allowable (PDA) of selected critical parameters is accountable from interim to final electrical testing.

4) Normally, frequency aging tests are for 30 days. However, the frequency aging test may be ceased if after 15 days the measured aging rate is less than half of the specified aging rate.

TABLE 3 Delta Limits at 25°C

Test	Parameter	Symbol	Delta Limits
Burn-in	Supply Current	I_{CC}	±10% of initial reading
Frequency aging after 30 days at =70°C	Output Frequency	F_O	Refer to Table I
Life test after 1000 hours at 125°C	Supply Current	I_{CC}(Life)	± 10% of initial reading

TABLE 4. GROUP A INSPECTION

TEST DESCRIPTION	CONDITION
Supply current	25°C and temperature extremes
Initial accuracy at reference temperature	25°C and temperature extremes
Frequency - temperature stability	Over specified operating temperature range, measure output frequency at ten equispaced points of the temperature extremes
Frequency - voltage tolerance	25°C and temperature extremes
Output voltages	
Duty cycle (output waveform symmetry)	
Output rise and fall times	
Start-up time	

TABLE 5. GROUP B INSPECTION (NOTE 1)				
SUBGROUP	**TEST DESCRIPTION**	**MIL-STD-883**		**QUANTITY/ (ACCEPT NO.)**
		METHOD	**CONDITION**	
1	Physical dimensions	2016	-	2 (0)
2	Particle impact noise detection (Note 2)	2020	B	15 (0)
3	Resistance to solvents	2015	-	4 (0)
4	Internal visual and mechanical	2014	-	1 (0)
5	Bond strength (note 3)	2011	C or D	2 (0)
6	Die shear strength (note 4)	2019	-	2 (0)
7	Solderability (note 5)	2003	Solder temperature 245 ±5 °C	

1) Screening test rejects may be used for Group B provided they have been processed through burn-in testing.
2) To be omitted. Being done during screening. See Table 1.
3) Subgroup 5 is performed in accordance with paragraph 3.5.3.3 of MIL-STD-883, method 5008. This test is typically performed in-process (refer to the screening test table herein).
4) Die shear test samples shall not be the same units as subjected to bond pull. Die sheer specimens shall not be exposed to the 300o C preconditioning used for the bond strength test.
5) Solder temperature shall be 245 + 5C.

TABLE 6 GROUP C INSPECTION (NOTE 1)				
SUBGROUP	**TEST DESCRIPTION**	**MIL-STD-883**		**QUANTITY/ (ACCEPT NO.)**
		METHOD	**CONDITION**	
1	End point electricals Steady state life End point electricals	1005	1000 hours at 125°C	5 (0)
2	Internal water vapor content	1018		3 (0) or 5 (1)

1) End point electricals shall be as specified in the Table VIII.
2) Subgroup 1 specimens shall be used for subgroup 2 testing.

TABLE 7. GROUP D INSPECTION				
SUBGROUP	**TEST DESCRIPTION**	**MIL-STD-883**		**QUANTITY/ (ACCEPT NO.)**
		METHOD	**CONDITION**	
1	Thermal shock	1011	C	5 (0)
	Stabilization bake	1008	1 hour at 150°C	5 (0)
	Lead integrity	2004	B2 (lead fatigue)	1 (0)
	Seal (fine and gross leak)		A & C	5 (0)

TABLE 8. ELECTRICAL TEST - MEASUREMENT REQUIREMENTS

ELECTRICAL PARAMETERS	TEST STEP AND ENVIRONMENTAL CONDITION									
	pre burn-in @ 25°C	pre burn-in @ -55°C	pre burn-in @ 125°C	post burn-in @ 25°c	post burn-in @ -55°C	post burn-in @ 125°C	group A @25°C	group A @-55°C	group A @125°C	group C interim
Output Frequency	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Frequency/ Temperature stability							See Note 1/			
Frequency/voltage stability	✓			✓			✓	✓	✓	✓
Input Current	✓			✓	✓	✓	✓	✓	✓	✓
Output Voltage	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Waveform	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Duty Cycle (symmetry)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Rise and Fall Time	✓			✓	✓	✓	✓	✓	✓	✓
Start up Time	✓			✓			✓	✓	✓	✓

√ = Required measurement

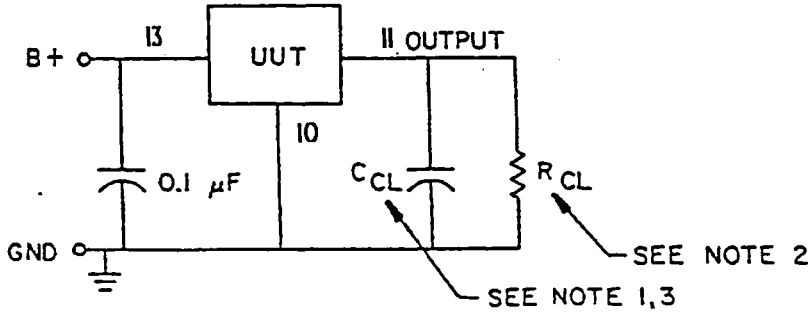
Note 1/ Measure the output frequency at ten (10) equispaced points, minimum, of the specified operating temperature range

FIGURE 1 TERMINAL CONNECTIONS

PIN NUMBER	DESCRIPTION
1 through 9, 12, and 14 through 20	internal tie points (Do not connect these to pins)
10	GND
11	OUTPUT
13	V_{CC}

Figure 2

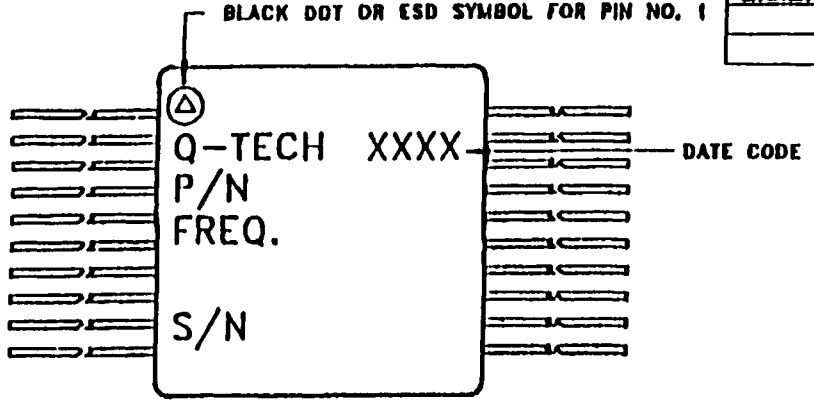
LOAD CIRCUIT



NOTES:
1. For HCMOS: C_{CL} = 15 pF ±5 percent.
2. For HCMOS: R_{CL} = 10 kΩ ±5 percent.
3. C_{CL} includes scope capacitance.

Inches	mm
.002	0.05
.003	0.08
.010	0.25
.015	0.38
.045	1.14
.050	1.27
.060	1.52
.0875	2.223
.150	3.81
.450	11.43
.500	12.70
.625	15.88

REVISIONS				
E.C.O.	LTR	DESCRIPTION	DATE	APPROVED
	-	INITIAL RELEASE.	2/11/91	



PIN NO.	FUNCTION	PIN NO.	FUNCTION
1	NC	11	OUTPUT
2	NC	12	NC
3	NC	13	Vcc
4	NC	14	NC
5	NC	15	NC
6	NC	16	NC
7	NC	17	NC
8	NC	18	NC
9	NC	19	NC
10	GND/CASE	20	NC

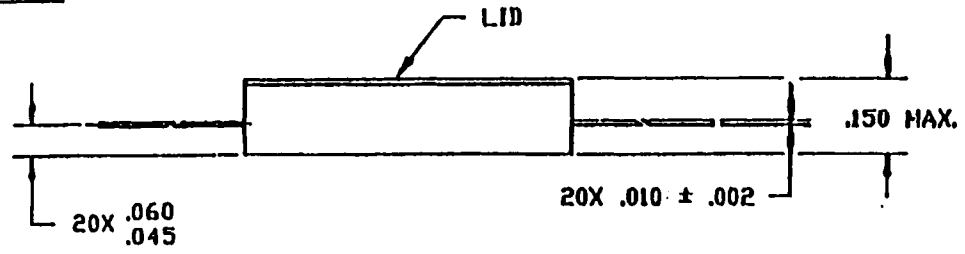
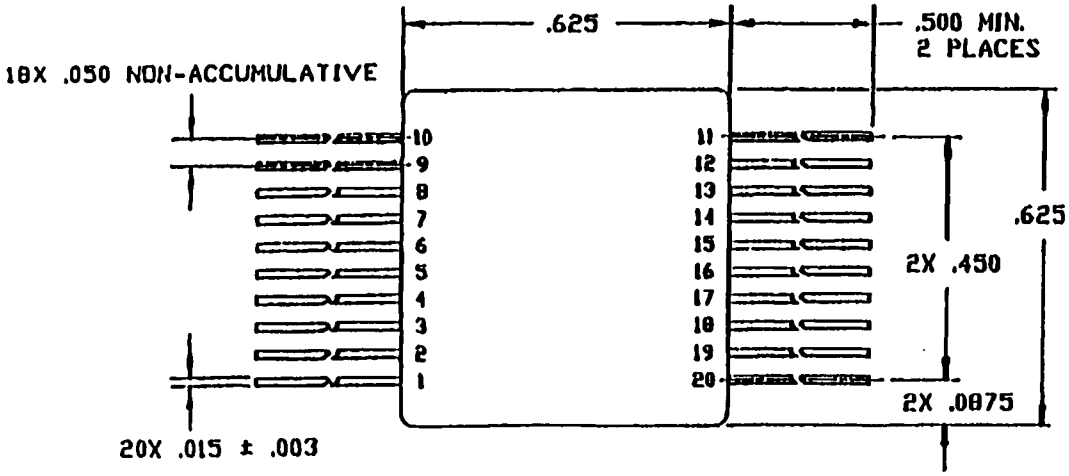


figure 3



NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only and are based upon 1.00 inch = 25.4 mm.
3. All pins with FUNCTION NC and ITP may be connected internally and are not to be used as external tie points or connections.
4. Lead numbers are for reference only and are not marked on unit.

APP.	DATE	Q-TECH CORPORATION
DRAWN STEVEN	FEB 6 91	14150 W. JEFFERSON BLVD. CULVER CITY, CA 90232-3518
CHECK	2/11/91	QT25 TOP ASSY. DWG.
K.G.	2/11/91	DWG. # 195-3025-001 SHEET 1 OF 1