INTRODUCTION

Microwave remote sensing satellites are being developed for civilian use and planetary missions under Indian remote sensing program, which is built, launched and maintained by Indian Space Research Organization (ISRO). Space-grade Temperature Compensated Crystal Oscillators (TCXOs) are required for development of RF systems for these microwave remote sensing satellites at Space Applications Centre (SAC/ISRO) under Department of Space (DOS), Government of India.

This document consists of two Annexures as listed below.

**Annexure-I:** Gives the scope of work, electrical and mechanical specifications, guidelines to vendor, delivery schedules and warranty.

**Annexure-II:** Gives the Reliability and Quality Assurance requirements.
Annexure-I

1. Scope of Work

Space-grade Temperature Compensated Crystal Oscillators (TCXOs) are required for development of RF systems at Space Applications Centre (SAC) for ISRO’s Temperature & Humidity Sounding Unit. These TCXOs are required to be fabricated, and tested as per the requirements given in Annexure-I and Annexure-II.

2. Technical Specifications

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>PARAMETER</th>
<th>SPECIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Output Frequency (Sine Wave)</td>
<td>50 MHz</td>
</tr>
<tr>
<td>2</td>
<td>O/P Power at 25°C (Sine wave output in 50Ω load)</td>
<td>≥±7dBm</td>
</tr>
<tr>
<td>3</td>
<td>Output power variation over operating temperature -15°C to +60°C</td>
<td>≤±1.0dB</td>
</tr>
<tr>
<td>4</td>
<td>Frequency stability</td>
<td></td>
</tr>
<tr>
<td>a. In temp. range of -15°C to +60°C</td>
<td>≤ ±1ppm</td>
<td></td>
</tr>
<tr>
<td>b. With ± 5% supply voltage</td>
<td>≤ ±0.1ppm</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Aging</td>
<td></td>
</tr>
<tr>
<td>a. Per year</td>
<td>≤ ±1ppm</td>
<td></td>
</tr>
<tr>
<td>b. Per week at 25°C</td>
<td>≤ ±0.1ppm</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Frequency adjustment range (With reference to initial setting of specified output frequency at 25°C)</td>
<td>±3ppm</td>
</tr>
<tr>
<td>b. Provision of frequency adjustment &amp; details</td>
<td>By external resistor(0-10KΩ)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Output frequency setting accuracy at 25°C at the time of delivery of units</td>
<td>≤ ±0.3ppm</td>
</tr>
<tr>
<td>8</td>
<td>Supply Voltage</td>
<td>15V DC ± 5%</td>
</tr>
<tr>
<td>9</td>
<td>Current drain</td>
<td>25mA (max.)</td>
</tr>
<tr>
<td>10</td>
<td>Harmonic/Sub-harmonic Suppression</td>
<td>≥ 45dBc</td>
</tr>
<tr>
<td>11</td>
<td>Phase Noise</td>
<td>Offset</td>
</tr>
<tr>
<td></td>
<td>@100Hz</td>
<td>≤-70dBc/Hz</td>
</tr>
<tr>
<td></td>
<td>@1KHz</td>
<td>≤-110dBc/Hz</td>
</tr>
<tr>
<td></td>
<td>@10KHz</td>
<td>≤ -130 dBc/Hz</td>
</tr>
<tr>
<td></td>
<td>@100KHz</td>
<td>≤ -145 dBc/Hz</td>
</tr>
<tr>
<td>12</td>
<td>Temperature Range</td>
<td></td>
</tr>
<tr>
<td>a. Operating temperature range over which all specification to be met</td>
<td>-15°C to +60°C</td>
<td></td>
</tr>
<tr>
<td>b. Storage temperature</td>
<td>-40°C to +70°C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pressure</td>
<td>Ambient to 1x10^{-6} torr or better</td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>14</td>
<td>Package type</td>
<td>Hermetically Sealed HMC</td>
</tr>
<tr>
<td>15</td>
<td>RF and DC interface</td>
<td>Compatible with PCB mounting</td>
</tr>
<tr>
<td>16</td>
<td>Package Dimensions</td>
<td>38.3mm x 25.6mm x 7mm</td>
</tr>
<tr>
<td>17</td>
<td>Package Configuration</td>
<td>24 PIN DIP as per figure-1</td>
</tr>
<tr>
<td>18</td>
<td>Weight</td>
<td>&lt;30grams</td>
</tr>
<tr>
<td>19</td>
<td>Spurious</td>
<td>Better than -70dBc</td>
</tr>
</tbody>
</table>

**Figure 1. Mechanical package drawing & pin description**
3. Guidelines to Vendor

3.1 Guidelines for Preparing Technical Details

3.1.1 The proposal submitted should be in conformity with the specifications / requirements laid down in this document.

3.1.2 The vendor is requested to examine the RFP thoroughly and offer compliance/ non-compliance point by point against each specification in tabular format. In case of non-compliance, the deviation from the specified parameter shall be furnished and for complied parameters the vendor specification (better or same) shall be provided.

3.1.3 The vendor should submit compliance/non-compliance against all requirements specified in the document.

3.1.4 It is necessary for the vendor to furnish complete information as required in Annexure-I and Annexure-II of this RFP for proper evaluation and assessment of the proposal.

3.1.5 Vendor shall provide specific part number with manufacturer name.

3.1.6 The vendor can attach additional information, if any, which may provide more information on these components.

3.2 Guidelines for Preparing Quotations

3.2.1 The quotation shall include, in addition to unit cost and screening charges, charges towards lot-acceptance testing.

3.2.2 The vendor must ensure that the quotation along with all the required details reaches SAC/ISRO before the due date.

3.2.3 Vendor shall provide quotation in slabs of 25-35, 36-45, 46-60.

3.2.4 Vendor should clearly indicate ordering information (order to be placed in favor of, component’s part no. & other relevant information).

4. Delivery Schedule

To meet the project requirements, the following delivery schedule is to be adhered to.

1.1 Order placement - \( T_0 \)

1.2 Delivery of FM units – \( T_0 + 52 \) weeks

1.3 Delivery of LAT units – \( T_0 + 64 \) weeks

Maximum 3 part shipments are allowed. Vendor may please specify the quantity and delivery schedule as minimum as possible) for first shipment.
5. Warranty

The vendor shall provide warranty as given below:

a. "The units supplied here upon shall be free from any defects in material or workmanship and in accordance with the applicable specifications and drawings".

b. This warranty shall run for a period of one year from the date of final acceptance by SAC/ISRO and shall be in addition to any other rights available to SAC/ISRO.
Annexure-II

R & QA Annexure for Space Qualified TCXO (HMC VERSION)

1.0 SCOPE:

This document describes the procurement specifications of space qualified indigenous HMC based Temperature Controlled Crystal Oscillators (TCXO) along with screening and lot acceptance test requirements. It also discusses the crystal & TCXO level aging requirements. This document shall be followed for the procurement of space qualified TCXOs (HMC version) manufactured by Indian Vendor.

2.0 APPLICABILITY OF PROCUREMENT SPECIFICATIONS:

Qualification tests were performed on Indigenous TCXOs having output frequency 139.0625 MHz and 122 MHz. (Ref. certificate no.: SRA/IIPAC/VOQ-TCXO/01/2014, dt.: 24-3-2014) and subsequently on 250MHz (Ref PO No. AHMR 20100009420101/LO DT. 11-7-2011) Based on this qualification, this specification is applicable to all TCXOs (HMC version) having similar electrical design and same mechanical package configuration. Ordered TCXO shall be space qualified including crystal as per ISRO test plan.

3.0 SPECIFICATIONS REQUIREMENTS:

Detailed Electrical and Mechanical specifications of TCXOs are described in Annexure-1 given in RFP.

3.1 Environmental Specifications:

(a) Non-Operating Environment:

The unit shall be capable of withstanding following environmental conditions.
1. Temperature range : -55°C to + 85°C (storage)
2. Pressure : Ambient to 10^{-6} torr or better
3. Relative humidity : 95% (non condensing) at 40 °C (max),

(b) Operating Environment

1. Temperature range : -15°C to +60°C (Base plate temperature)
2. Pressure : Ambient to 10^{-6} torr or better
3. Relative humidity : 95 % (non condensing) at 40 °C (max.)
c) **EMI / EMC**

The TCXOs shall be designed and fabricated to be compliant to EMI performance requirement (RS-103, CS-101 and RE-102 of MIL-STD-461E) as defined in qualification plan.

(d) **Radiation**

The TCXOs shall be capable to withstand total radiation dose of 150 K Rad.

### 4.0 RELIABILITY AND QUALITY ASSURANCE REQUIREMENTS

The vendor is required to ensure that design of TCXOs is such that the manufactured TCXOs shall meet all on-board requirements with a minimum life of 15 years in spacecraft hardware.

The TCXOs shall be capable of meeting all the functional requirements including electrical specification requirements at various stages of spacecraft assembly and storage.

In case of any change in design, specification, fabrication of TCXO with respect to the Qualified TCXO, the changes shall be listed and submitted along with quote. Change in design and fabrication process may call for incremental qualification. In that condition, LAT at TCXO level will be applicable, which is vendor’s responsibility. This shall be decided after review of changes proposed by Vendor.

For any change related to design and specifications, reliability and derating analysis shall be carried by the vendor including revised layout, schematic & BoM shall be submitted to SAC for review and acceptance.

### 4.1 Parts

All parts to be used in TCXO shall be space qualified and shall be selected from either MIL-QPL or ESA-QPL. Following table defines parts quality level requirements.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Description of parts</th>
<th>Quality level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>Active components</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LP2953, Adj. Reg. Die, 2N918, NPN RF Transistor Die</td>
<td>To be procured from QPL vendor with MIL-PRF-38534, Class K element evaluation with SEM Report</td>
</tr>
<tr>
<td></td>
<td>EH76150-500A, VARACTOR Die</td>
<td>ESCC 5010 Level B LAT3</td>
</tr>
<tr>
<td>2.</td>
<td><strong>Crystal</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>XXX MHz 3rd OT</td>
<td>Qualified as per ISAC-SRG-SOW-XO-QUAL-01. with screening</td>
</tr>
<tr>
<td>3.</td>
<td><strong>Resistors</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>XXX K, ±5% 55mw, +/-100ppm</td>
<td>MIL-PRF-55342, failure rate - S</td>
</tr>
<tr>
<td>4.</td>
<td><strong>Capacitors</strong></td>
<td></td>
</tr>
</tbody>
</table>
| CDR-11 | MIL- PRF-55681 / 04  
| CDR-31 (100V) | MIL- PRF-55681 / 07 (BMLT test, if 50V rating)  
| CDR-33 (100V) CWR06, CWR09 | MIL- PRF-55681 / 09 (BMLT test, if 50V rating)  
| MIL- PRF-55365 / 04 |

5. **Inductors**

Chip Inductors  
MIL-PRF-83446, failure rate – R or better

6. **Thermistors**

XX K / M Ω, ±5% NTC, Gold, 0805 Curves Z / T / V  
MIL- PRF-23648, Group A, B & C tests

7. **Package**

24 pin base  
MIL- PRF-38534  
TABLE C-VI  
DIP case  
MIL- PRF-38534  
TABLE C-VI

**Notes :**

(i) Above quality levels of parts to be used in TCXOs are mandatory. If parts with above quality levels are not available, then other quality level of part shall be reviewed and approved by SAC prior to their use.

(ii) **Crystal level aging:** Crystal shall be aged for minimum 30 days at max. non-operating temperature. Drift in the frequency shall be recorded. If required, aging duration may be further extended to achieve required frequency stability. Crystal level aging data shall be supplied as part of TCXO data package.

(iii) **Incoming Inspection and Screening:** All electronic / mechanical parts shall be procured by the vendor in accordance with procurement specifications approved by SAC. These shall be inspected / tested by the vendor. Only screened parts shall be used. Following traceability information shall be maintained by the vendor.

(a) Parts identification details, relevant in-house incoming inspection and test reports.
(b) QC inspection and clearance reports of the vendor.
Above information will be required during QA audit.

4.2 **Materials**

Materials required to be used in TCXOs shall be selected from qualified materials list and through qualified vendor’s / sub vendors normally associated with long life communication satellite hardware.

Organic and polymeric materials including dielectric, epoxy etc if used, for manufacturing the components, shall be stable under atmospheric and high vacuum condition. Every batch of these materials shall be tested for outgassing prior to their use. These shall have Total Mass Loss (TML) less than 1% and Collected Volatile Condensable Material (CVCM) of less than 0.1% when subjected to test condition of 10^-6 torr pressure at 125°C for 24 hrs as per ASTM-E-595.

Ferrous and non-ferrous metals used in the TCXO shall be corrosion resistant type or suitably treated to resist corrosion caused by atmospheric conditions during storage or normal operational conditions. Non-magnetic materials shall be
used for all parts except where magnetic materials are essential. Materials, which are nutrient for fungus, shall not be used.

Use of dissimilar materials shall be avoided. Wherever dissimilar materials are used in direct contact, suitable coating / protection against galvanic corrosion shall be provided.

4.3 Process

ISRO qualified processes shall be used for manufacturing of TCXOs and shall have valid qualification status at the time of realization of ordered TCXOs. Components shall be processed as per approved PIDs generated by vendor.

Fabrication and inspection work of TCXOs shall be carried out by ISRO certified fabricators and inspectors and they shall have valid certification status.

4.4 Package

TCXOs shall be hermetically sealed. Package dimensions and Pin configuration shall be as specified. No adhesive or polymeric materials shall be used for package lid attachment (or seal). Flux shall not be used in final sealing process. For final lid seal using a welding process, sufficient distance shall be maintained between the lid and any component to avoid damage during vibration.

4.5 Identification and Marking

TCXOs shall be identified by unique part number marked on exterior surface using suitable method applicable for space use. The marking shall be readable after all qualification tests and it shall not degrade the performance of the unit. Following details shall be marked on each component.

(i) Logo / name of Manufacturer
(ii) Frequency of operation.
(iii) Part number of component
(iv) Pin identification.
(v) Date code

Suggested part No. : TCXO 250MHz PCB24 INDIG

5.0 SCREENING, LOT ACCEPTANCE TESTS (LAT) and RE-SCREENING:

Details of activity to be performed are shown in Figure – 1. Screening tests shall be carried out on all TCXOs as per the flow chart shown in Figure - 2. Electrical performance test shall be carried out after each test indicated in this figure. Test parameters, test methods etc. for screening and LAT are described below.

If, vendor proposes to supply TCXOs from existing screened stock, then re-screening as per para 5.3 shall be applicable and screening & LAT not required for such TCXO. Vendor to provide date code of such TCXO and ensure the availability of screening data. Additionally, vendor should provide details of LAT performed with reference to such existing stock TCXO.
5.1 Screening Tests:

5.1.1 Non-Destructive Bond Pull Test

Non-destructive bond pull test shall be carried out before sealing the package. This test shall be carried out as per MIL-STD-883D, method 2023.

5.1.2 Pre-Cap (Internal) Visual Inspection

Internal visual inspection shall be carried out as per ESA/SCC 20400. After component mounting, these shall be inspected & cleared by vendor’s QC. Polarity of Tantalum capacitor also needs to be verified & recorded. After final assembly and electrical tests, prior to sealing, TCXOs shall be visually inspected (internal) at minimum 10X magnification by Vendor’s QC and cleared for further process. Photographs of both top and bottom populated substrate shall be taken and sent to SAC for review & acceptance.

SAC may carry out audit on pre-cap inspected TCXOs. For this Vendor shall inform schedule minimum two weeks in advance.

5.1.3 Stabilization Bake (Prior To Seal)

All the samples shall be subjected to stabilization bake. This test shall be conducted as per MIL-STD-883, method 1008. The period of test shall be minimum 48 hours and the temperature shall be max. storage temperature of the device. The test can be performed before sealing or after sealing. If the test is performed before sealing, baking shall be done in vacuum and oscillators shall be maintained in dry nitrogen atmosphere until seal (after baking).

Thereafter TCXOs shall be hermetically sealed before subjecting them to the following tests.

5.1.4 External Visual Inspection

After hermetic sealing, TCXOs shall be visually inspected externally at 10X magnification (min) in accordance with EAS/SCC 20500. The units shall be inspected for material, surface finish, metallization, mechanical and workmanship related defects.

5.1.5 Outline Dimensions and Weight Measurement

Dimensional and weight measurement shall be carried out on all TCXOs and shall meet the specifications requirement.

5.1.6 Initial Frequency Aging Test
Initial frequency aging test shall be carried out at 25°C for 10 days, which may be extended till stability specification complied. Measurement shall be started only after 2 days of stabilization. Measured value of frequency and power shall be recorded at least three times a day. Drift in output frequency, if any, shall be within specified limit.

5.1.7 Thermal Shock

This test is conducted for the purpose of determining the resistance of the component to sudden exposures at extremes of high and low temperatures by alternating exposures to these extremes. This test shall be carried out as per MIL-STD-202, method 107, condition A. Number cycles shall be 10. The temperature extremes shall be non-operating temperature as specified in this document.

There shall be no evidence of damage when visually inspected at 10X magnification after the test. Electrical performance tests shall be carried out after the test.

5.1.8 Random Vibration (TBD)

This test shall be carried out as per MIL-STD-202, Method 214. TCXOs shall be fixed on test fixture. This test fixture shall be placed on the platform of the vibration machine. The test condition shall be as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Severity (screening)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 - 50 Hz</td>
<td>0.032 g²/Hz to 0.2 g²/Hz (+ 6 dB/Octave)</td>
</tr>
<tr>
<td>50 - 1200 Hz</td>
<td>0.2 g²/Hz</td>
</tr>
<tr>
<td>1200-2000Hz</td>
<td>0.2 g²/Hz to 0.074 g²/Hz (- 6 dB/Octave)</td>
</tr>
<tr>
<td>Overall g RMS</td>
<td>18.13</td>
</tr>
<tr>
<td>Duration</td>
<td>1 Minute/Axis</td>
</tr>
<tr>
<td>Axis</td>
<td>X, Y, and Z</td>
</tr>
</tbody>
</table>

After the test there shall be no evidence of damage when samples are visually inspected. After random vibration electrical measurements shall be carried out. The samples shall meet electrical specification requirements given in para 3.0

5.1.9 Constant Acceleration

This test is carried out to determine the effects of constant acceleration on microelectronic devices. It is an accelerated test and designed to indicate types of structural and mechanical weaknesses not detected in shock and vibration tests. This test shall be carried out as per MIL-STD-883, method 2001, test condition A (5000g).

5.1.10 Particle Impact Noise Detection (PIND)
The purpose of this test is to detect loose particles inside a device cavity. The test provides a nondestructive means of identifying those devices containing particles of sufficient mass that, upon impact with the case, excite the transducer. This test shall be carried out as per MIL-STD-883, method 2020, condition B. Electrical measurements shall be carried out after the test.

5.1.11 Seal Test

This test is performed to determine the effectiveness of the seal of samples with designed internal cavities.
Fine leak test : This test shall be performed as per MIL-STD-883, Method 1014, condition A1.
Gross leak test : This test shall be performed as per MIL-STD-883, Method 1014, condition C.

5.1.12 Electrical Performance Tests

All TCXOs shall be tested for the following electrical parameters. Measured values shall meet the specification requirements. SAC approved test procedure shall be followed.

a) Frequency output at 25°C and Over Temperature
b) Output Power at 25°C.
c) Output power variation with OTR
d) Frequency stability with OTR and ± 5 % of supply voltage variation.
e) Frequency adjustment range.
f) Current drain (Power dissipation).
g) Harmonics, sub-harmonics and spurious.
h) Phase noise.

5.1.13 Frequency Aging:

Frequency aging test shall be carried out at maximum operating temperature for 30 days. Drift in output frequency, if any, shall be within specified limit.

5.1.14 Final Electrical Bench Test (FBT)

Final electrical measurements shall be carried out for the electrical parameters as specified in Para 5.1.12 of this document. Measured values shall meet the specification requirements.

5.1.15 Radiographic Inspection

The purpose of this examination is to non-destructively detect the defects within the sealed case, especially those resulting from the sealing process, and internal defects such as foreign objects, improper interconnecting wires, and voids in the die attach material or in the glass when seals are used. Radiographic inspection shall be carried out as per MIL-STD-883, method 2012.
5.2 Lot Acceptance Tests (LAT):

After successful completion of screening tests, LAT shall be carried out on 3% or minimum 1 (whichever is higher) screened samples as per flow chart shown in Figure-3. However, vendor shall ensure that minimum one TCXO per year shall have undergone LAT. The LAT samples shall be randomly selected from the lot of screened TCXOs.

The term lot is defined to be consisting of each frequency of TCXOs manufactured preferably from same batch of raw materials on the same production & assembly line and sealing carried out in single batch having all the provisions for quality assurance. In case, two or more frequencies of TCXOs are processed in single lot, then selection of LAT sample will be decided based on the frequency range. Exact frequency and quantity of the LAT sample will be confirmed by SAC based on information about TCXOs lot from Vendor.

Test parameters, test methods etc. are described below.

5.2.1 Initial Electrical Bench Test (IBT)
Electrical performance tests shall be carried out for the parameters as specified in para 5.1.12 of this document. Measured values shall meet the specification requirements.

5.2.2 Thermal Shock

This test shall be carried out as per para 5.1.7 of this document except number of cycles shall be 25. After the test, samples shall be visually inspected at 10X magnification. There shall be no evidence of damage. There after Electrical performance tests shall be carried out.

5.2.3 Vibration tests

Both sine and random vibration test shall be performed on LAT sample.

(a) Sine Vibration
Sine vibration test shall be carried out as per MIL-STD-202F, method 204.
Severity : 30 g (peak).
Frequency range : 10 to 2000 Hz
Sweep time and duration : The entire freq. range of 10 to 2000 Hz and return to 10Hz shall be traversed at a sweep rate of 2 Oct./min. This cycle shall be performed 4 times in each of three mutually perpendicular directions (total 12 times).

After the test components shall be visually inspected at 10 X magnification. There shall be no evidence of damage or loosening of parts. Also electrical test shall be performed and frequency and output power shall be measured and recorded.
(b) Random Vibration

TCXOs shall be fixed on test fixture. This test fixture shall be placed on a vibration tester. The test condition shall be as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Severity (qualification)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 - 50 Hz</td>
<td>0.072 g²/Hz to 0.45 g²/Hz (+ 6 dB/Octave)</td>
</tr>
<tr>
<td>50 - 1200 Hz</td>
<td>0.45 g²/Hz</td>
</tr>
<tr>
<td>1200-2000Hz</td>
<td>0.45 g²/Hz to 0.16 g²/Hz (- 6 dB/Octave)</td>
</tr>
<tr>
<td>Overall g RMS</td>
<td>27.2</td>
</tr>
<tr>
<td>Duration</td>
<td>2 Minute / axis</td>
</tr>
<tr>
<td>Axis</td>
<td>X, Y, and Z</td>
</tr>
</tbody>
</table>

After the test there shall be no evidence of damage when samples are visually inspected. After random vibration electrical measurements shall be carried out. Samples shall meet electrical specification requirements.

5.2.4 Thermo Vacuum Test

Thermo vacuum test shall be conducted under vacuum condition of 10⁻⁶ torr or better. Thermo vacuum test profile includes two cycles of temperature extremes. The first cycle is for storage and second is for operational temperature test at thermo vacuum condition with respective temperature extremes.

The unit shall be "OFF" during storage temperature cycle. The unit shall be turned ON immediately after achieving the operating temperature. This test shall be carried out as per the test profile shown in Figure -4.

5.2.5 Seal Test

This test shall be performed as para 5.1.11 of this document.

5.2.6 Life Test

Operating Life test (active) shall be carried out at maximum operating temperature for duration of 2000 Hrs. Intermediate electrical performance test shall be carried out at 250, 500, 1000, and 2000 Hrs. Test results shall be within specified tolerance limit. After completion of the life test, results shall be plotted and extrapolated to derive frequency stability at the end of 15 years.

5.2.7 Final Electrical Bench Test (FBT)
Final electrical measurements shall be carried out as per Para 5.1.12 of this document. Measured values shall meet the specification requirements.

5.3 **RE-SCREENING TEST: (if applicable)**
Following test are to be conducted:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Test</th>
<th>Test condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aging</td>
<td>9 days at 25°C</td>
</tr>
<tr>
<td>2</td>
<td>Temperature cycling</td>
<td>Frequency stability measurement over -10°C to +60°C as per test profile shown below</td>
</tr>
<tr>
<td>3</td>
<td>Frequency stability with power supply variation</td>
<td>For 5% supply voltage variation</td>
</tr>
<tr>
<td>4</td>
<td>Visual inspection</td>
<td>At 10X magnification</td>
</tr>
</tbody>
</table>

During the stability measurement tests, O/P power and frequency shall be recorded.

**Acceptance Criteria:** TCXO shall comply the design specifications and shall meet visual inspection requirements.

6.0 **AUDIT REQUIREMENTS**
Following records shall be maintained and made available for each lot as a minimum for audit as and when required by concerned ISRO centre. Audit will be performed sample basis on vendor’s QC cleared TCXOs (substrate as well as package level).

6.1 Incoming inspection and QA/QC clearance reports / batch acceptance report / CoC for all parts and materials used in deliverable units.

6.2 Inspection and clearance of mechanical fabrication / assembly records.

6.3 Logbook for chemical process parameters like temperature, bath concentration, pH, in-process & final inspection records etc.

6.4 Records for Final production, Screening and LAT tests results.
6.5 Lab environment records during testing.

6.6 Calibration records for all for all tests and measuring instruments used during fabrication and testing.

7.0 TERMS AND CONDITION

7.1 Vendor shall carry out reliability & derating analysis in case of design and / or specification change with respect to qualified design.

7.2 It is mandatory that vendor shall follow SAC approved test procedure. Any revision in the test procedure will be reviewed & approved by SAC.

7.3 Vendor shall ensure that once the frequency adjustment is carried out (before start of Screening/rescreening test), no further re-adjustment in the frequency shall be done at any stage of testing (screening or LAT). External POT / resistance value shall be recorded at each electrical test step.

7.4 Vendor shall provide screening, rescreening and LAT test reports (complete report in soft copy & electrical test results in Hard copy) along with deliverables including LAT samples. Non-conformance, if any, observed during manufacturing & testing including their disposition shall also be addressed in above report.

Above report shall also contain CoC stating that TCXOs have been processed as per approved PID No. CTMRAKON/FCP_FAB/ISAC/TCXO-PID and comply requirements given in this Procurement Specification. Non-conformance, if any, observed during manufacturing & testing including their disposition shall also be addressed in above report.

7.5 LAT sample shall be properly marked so that it can be easily distinguished from FM unit and shall be delivered in separate packing.

7.6 All the tests for screening and LAT are to be carried out by the vendor at their facility or other govt. approved labs as per above plan.

7.7 Calibrated test and measuring instrument shall be used for testing of ordered TCXOs.

7.8 Vendor is required to send screening and Lot acceptance test schedule in advance to the procurement agency for witnessing during testing, if required.

7.9 Vendor to provide point by point compliance of this document along with necessary relevant certificate / document.
TCXO Lot

Screening Tests 100%

LAT on 3% of lot or 1 unit (Whichever greater)

Is LAT test result acceptable?

Y

FM delivery (of remaining screened samples except LAT sample)

N

Reject the Lot

FIGURE – 1 : ACTIVITY FLOW CHART
Note: 1. Electrical performance test shall be carried out after each above test.  
2. Once 10K pot value set at the beginning of the test, its value shall not be changed after subsequent tests.

Figure 2: FLOW CHART FOR SCREENING TESTS FOR FM – TCXO
Screened sample(s)

→ IBT

→ Thermal shock

→ Vibration (sine and random)

→ Thermo- vacuum (Pre, hot, cold and post electrical measurements)

→ Seal test

→ Life test at maximum operating temp. for 2000 hrs. (Electrical performance test at 250, 500, 1000 and 2000 hrs.)

→ FBT

→ Review of test results

**Note**: 1. Electrical performance test shall be carried out after each above test.  
2. Once 10K pot value set at the beginning of the test, its value shall not be changed after subsequent tests.

**FIGURE –3 : FLOW CHART FOR LOT ACCEPTANCE TEST**
FIGURE – 4: TEST PROFILE FOR THERMO VACUUM TEST

Switch ON at max. op. temp.

Max. op. temp.

ELECTRICAL MEASUREMENTS