

QUALITY ASSURANCE PROVISIONS (QAP)

The following Quality Assurance Provisions (QAPs) are an integral part of the TTM – Santa Clara Division Purchase Agreements. These provisions supplement the existing Terms and Conditions of the Purchasing Agreement. Each Supplier/Service Provider listed on the Santa Clara Division's *Qualified Supplier List (QSL)*, shall access this document via the TTM website at: www.ttmtech.com/supplier/default.pdf. Suppliers/Service Providers are required to review this document and establish and maintain (as applicable) documented procedures for ensuring control and compliance to the specified provisions listed for their Supplier Classification. A Supplier/Service Provider who is unable to access the TTM website to review the QAPs must contact the TTM-SC Purchasing Department for a copy of this document. Suppliers / Service Providers requesting exceptions to specific provisions must submit a written request to the TTM–SC Purchasing Manager.

Supplier Classification	Applicable Quality Assurance Provisions
Raw Material Suppliers: (Those providing direct materials used in the manufacture of PWBs (i.e.: laminate / prepreg / copper foil / soldermask / legend ink)	Q1, Q2, Q4, Q5, Q6, Q7, Q8, Q9, Q10, Q12, Q13, Q15, Q16, Q18, Q19
Chemical Suppliers: (Those providing chemistry used either directly or indirectly in the Manufacturing process)	Q1, Q2, Q4, Q6, Q8, Q10, Q13, Q19
Outside Service Providers: (Those providing Manufacturing processes performed offsite (i.e.: Immersion Silver, Immersion Tin, Hole fill, OSP)	Q1, Q2, Q4, Q5, Q7-Q14, Q17, Q19
Calibration Service Providers: (Those providing both onsite and offsite calibration services)	Q1, Q2, Q3, Q4, Q5, Q10, Q17
Testing Service Providers: (Those providing testing of coupons)	Q1, Q2, Q4, Q7, Q10, Q11, Q13, Q14, Q17
Manufacturing Support Suppliers: (Those providing tools for the processing of PWBs i.e.: drill bits, router bits, dryfilm resist, packaging materials)	Q1, Q2, Q4, Q5, Q7, Q8, Q10, Q12, Q13, Q16, Q19
Recyclers & other General Services: (Janitorial, Auditors, etc.)	Q1, Q4, Q10, Q17

Q1 General Quality Practices

A. **Prohibited Practices: Changes to Drawings, Specifications, Processes, Materials and Procedures:**

The Supplier's/Service Provider's Quality system shall provide for procedures assuring the latest applicable drawings and specifications are utilized. The Supplier shall remove from use all obsolete drawings and specifications with the receipt of new and/or amended documentation. Special processes, materials and procedures, previously approved, utilized by the Supplier to become a qualified source, shall not be changed without written approval from TTM–SC. Material Review authority is not permitted on this purchase order. Suppliers may submit a written request for deviation. However, formal authorization from the Buyer is required, prior to shipping the material.

1. **Re-submittal of Nonconforming Material:** Material rejected by TTM-SC, which has been returned to conformance and subsequently resubmitted to TTM–SC for evaluation, shall be clearly identified as such on the shipping documents. Reference must be made to the TTM–SC Purchase Order # and objective evidence of root cause and corrective action must be made available.
2. **Unauthorized Repair:** Authority is not granted on this purchase order for the repair of nonconforming material.
3. **Unauthorized Production Submittal:** The Supplier shall not submit material from a production lot without initial acceptance of a "First Article" inspection, when specified by the purchase order.
4. **Notification of Facility Change:** The Supplier shall not utilize or relocate any production, processing and/or manufacturing facility during the performance of this Purchasing Agreement from those which have been previously qualified, without promptly notifying TTM–SC, and affording the opportunity for examination of such facilities to the applicable Quality requirements.
5. **Notice of Subcontracted Services:** In the event a Supplier / Service Provider subcontracts a process originally agreed upon to be provided by said Supplier or Service Provider, TTM-SC Purchasing Management must be alerted prior to processing.

QUALITY ASSURANCE PROVISIONS (QAP)

- B. Communication & Documentation:** Changes proposed by the Supplier, both material and process, which may affect form, fit, function, reliability, serviceability, performance, regulatory compliance and safety **must be submitted in writing 60 days in advance of such change**, for TTM-SC approval. This includes, but is not limited to, discontinuance of supply of any materials to this division, changes of sources of material and/or parts, changes in manufacturing processes, test procedures, mfg. locations, relocation or replacement of equipment and any similar changes that are anticipated by Sub-Tier Suppliers. Items affected by such changes may not be delivered to TTM-SC until the Supplier has received written approval for the changes from TTM-SC. At a minimum, the change notice must include the Supplier's affected part number or software revision (if applicable), date of implementation, reason for the change, specific details of the change and, if available, supporting data that demonstrates the change will not negatively affect TTM-SC process compatibility. In addition, TTM-SC reserves the right to request samples for evaluation prior to approval.
1. **Pricing:** TTM-SC requires 30 days written notice prior to any price increases.
 2. **Purchase Orders:** TTM-SC requires purchase order numbers to appear on all packing slips & invoices.
- C. On-Site Survey / Inspection:** TTM-SC reserves the right to conduct on-site survey / inspection(s), for the evaluation of processing capabilities, adequate quality systems, and assurance of continuous compliance to the requirements of the Purchasing Agreement. This survey / inspection may include representatives from TTM-SC Customer base and encompass visiting the Subcontractor's sub-tier Supplier(s).
- D. Conformance to Contractual Requirements:** On-site survey(s) / inspection(s), conducted by TTM-SC or a Customer Representative, as well as First Article and Receiving Inspections, shall not relieve the Subcontractor of the responsibility for furnishing items in compliance to the contractual requirements of the Purchase Order. The Subcontractor is responsible and shall control sub-tier Supplier procurement to the extent necessary for ensuring specified quality requirements are satisfied. Documented evidence shall be maintained as validation of this control.
- E. Retention of Documentation:** The Supplier is required to maintain records of acceptance activities for services performed and/or products and services delivered to TTM-SC. These records may include, as appropriate, test/inspection criteria, revision level of documents/equipment/software used, operating procedures (planning, routing or Traveler sheets), dates of test/inspection, and the results. The records required **shall be retained for a minimum of 7 years** from the close of the contract. These records are subject to TTM-SC review, and must be available at the Subcontractor's facility, upon request.
- F. Corrective Action:** TTM-SC may request corrective action for quality related issues surfacing from received material, deliverable documentation discrepancies and/or problems associated with material detected further in the process which can be attributed to the Subcontractor's manufacturing practices. Upon written request from TTM-SC, the Supplier shall provide documented corrective action plan(s) to prevent future deviations from requirements within **15 days** from receipt of a Supplier Corrective Action Request (SCAR) from TTM-SC. At a minimum, the Subcontractor's response must include: analysis of root cause, action taken to prevent a recurrence, the date of effectiveness, and signature of an authorized company representative. Failure to respond within the allotted time, or evidence of inadequate corrective action, may result in the removal of the Subcontractor from the TTM-SC **Qualified Supplier List (QSL)**.
- G. Continuity or Disaster Preparedness Plan:** The Supplier shall establish a continuity or disaster preparedness plan in the event of a major natural disaster, pandemic, or any unexpected occurrence forcing emergency shutdown of the manufacturing of goods, delivery of materials or provision of services, to minimize the impact on TTM-SC. A copy of the plan must be made available to TTM-SC upon request.
- Q2 Quality Program Requirements:** Suppliers shall establish and maintain a documented Quality System Program in compliance with an International Standard, such as ISO9000. Demonstrated adherence to a Quality System must be evident for the assurance of conformance to specified requirements. In the event a Supplier is not compliant with a known International Standard, at a minimum, the Supplier must have a documented system and be able to demonstrate effective control of materials, processes or services and chemistries that are supplied to TTM-SC.
- Q3 Calibration System Requirements:** The Subcontractor shall establish and maintain a documented calibration program in compliance to the requirements of ANSI NCSL **Z540-3**. The Subcontractor shall submit with each individual calibration, a Certificate of Calibration, stating that the tool/equipment was inspected and calibrated / verified as complying to calibrated standards and traceable to NIST. The Certificate shall state that the Subcontractor has on file all data validating compliance to the specified requirements. Data substantiating compliance must be accessible for examination by TTM-SC and associated Customers. The Service Provider is also required to alert TTM-SC of any inspection equipment found out of specification in the "as received" condition (before calibration).

QUALITY ASSURANCE PROVISIONS (QAP)

The Certificate of Calibration must include, as a minimum, the following:

1. Title: "Certificate of Calibration"
2. Identification of the calibration service
3. Certificate identification (unique identification of the C of C)
4. Customer (TTM Technologies Inc., Santa Clara, CA)
5. Identification of the calibration procedure used
6. Description and/or Part name
7. Status of the instrument upon receipt from Customer, to be indicated on the C of C indicating:
 - a) Tool in Tolerance
 - b) Tool out of Tolerance
8. Identification and calibration status of the equipment and standards used in performing the calibration
9. Calibration completion date
10. Calibration interval and next calibration due date
11. Calibration results with units of measurement, where appropriate
12. Calibration results before and after adjustment or repair, if available
13. Calibration actions taken (i.e.: adjusted, repaired, new value assigned, limited, de-rated, modified, etc.), as applicable
14. Limitations of use, if applicable
15. Person authorizing the calibration certificate (report)
16. Statement of measuring traceability
17. Factors and conditions under which the calibration(s) were performed that have an influence on the measurement results
18. Uncertainty of measurement, where appropriate, and/or a statement of conformance

Q4 Order of Precedence: In case conflicts occur between the requirements of the purchase order, drawing, a referenced specification or this document, the Purchase Order will take precedence. Formal changes to the purchase order require written approval from the TTM-SC Buyer. Original purchase order requirements not modified by the change must be met in full, unless otherwise specified.

Q5 Purchase Order Flow Down: The Supplier is responsible for ensuring that TTM-SC and applicable Customer Requirements (i.e. drawings, referenced specifications, artworks, etc.) are flowed-down to all sub-tier Suppliers / Service Providers.

Q6 Raw Material Certification: Chemical and Physical analysis of raw materials furnished under this purchase order is required. Certification substantiating the raw material adherence to the specifications and requirements imposed by the purchase order shall be stated. The certificate of conformance must indicate the key characteristic analysis, specification or drawing requirements, actual measured results and acceptance. Documented reports shall include as a minimum, the following information:

1. Subcontractor/Supplier Name
2. Purchase Order Number (*excluding chemicals*)
3. Part Name and Description
4. Lot Number / Batch Number
5. Manufacturing Specification (IPC/MILSpec, if applicable) (*excluding chemicals*)
6. Manufactured Date (if applicable)
7. Material Expiration Date (if applicable)
8. Quantity – (By Date Code, if applicable) (*excluding chemicals*)
9. Unit of Measure (*excluding chemicals*)
10. Date and Signature of Authorized Company Representative
11. Statement certifying compliance of material, including traceability to applicable specs.
12. When special processes are required by drawing or specifications, specific Certificate of Compliance to applicable military and/or Customer specifications are required, including revision.

The certificate of conformance shall be enclosed with any other required shipping documents.

Q7 Foreign Object Elimination: The Seller shall establish and maintain an effective Foreign Object Damage (FOD) Prevention Program to reduce FOD. The material supplied to TTM-SC shall be manufactured in an environment that is free of foreign objects. Material supplied shall be free of foreign objects. The Seller's program shall utilize effective FOD prevention practices. The program shall be proportional to the sensitivity of the design of the product(s) to FOD, as well as, to the FOD generating potential of the manufacturing methods. The written procedures or policies developed by the Seller shall be subject to review, upon request, by TTM-SC, and disapproval when the Seller's procedures or policies do not accomplish their objectives.

QUALITY ASSURANCE PROVISIONS (QAP)

- Q8 Age Control:** Materials with defined characteristics may, over time, become susceptible to quality degradation through use or storage, shall be clearly identified on the lowest level of unit packaging. The package shall be marked to indicate the critical date the shelf life was initiated and date of expiration. At a minimum, materials shall be marked with the date of manufacture, expiration date, storage temperature and humidity requirements, special handling conditions, in addition to the standard identification requirements. Materials at the date of receipt by TTM-SC shall have a minimum of seventy-five (75) percent of the usable shelf life remaining.
- Q9 Inspection and Test Plan:** The Subcontractor shall prepare an inspection and test plan for materials processed and delivered against this purchase order. The inspection and test plan shall include the manufacturing/processing sequences, in-process, and final inspection points in relation to procurement, manufacture, and final acceptance, the method of inspection that will be utilized, measuring and test equipment, and system of delivery. All applicable procedures, specifications, and work instructions shall be referenced by number at the appropriate points. TTM Technologies may elect to establish its own inspection points, consistent with the Subcontractor's plan.
- Q10 TTM Technologies Right of Access / Inspection:** TTM-SC reserves the right of access to all applicable Supplier / Service Provider facilities, at any level of the supply chain, to allow their Customers and/or regulatory authorities access to review any applicable records pertaining to an order of purchased goods or services. TTM-SC may audit the Supplier's quality system at periodic intervals, upon written advance notification. TTM-SC reserves the right, should the need present itself, to verify processing methods, with the exception of proprietary processes. This includes those processes of the Subcontractor's sub-tier Supplier. The Subcontractor shall have available all documentation, shop order and/or rout sheet, drawings and specifications, inspection and test results, purchase order, test samples and material for inspection.
- Q11 Special Processing:** The Subcontractor and sub-tier suppliers shall establish and document procedures for the control of all special processes (i.e. plating, heat treat, brazing, welding, bonding, coating, testing, etc.). Special processing utilized in the manufacturing of materials for this purchase order requires prior approval, as well as the methods of verifying compliance. This approval does not relieve the Subcontractor of responsibility for delivering compliant material to the stated requirements. The Subcontractor shall notify TTM Technologies in writing of changes to the process or inspection/test methods. A Certificate of Compliance is required for each shipment in which material was produced / tested utilizing a special process. Stated on this document shall be the special process, applicable military, industry and/or customer specification and associated revision.
- Q12 Packaging Requirements, including Bar Coding of Boxes, Bags and Packing Slips:**
The Subcontractor shall establish and maintain a documented system for the control and monitoring of its packaging and shipping practices. Included will be provisions for handling, preservation, storage, packaging, and final shipment. The system must be designed to ensure the quality of deliverable material through prevention of damage, deterioration and degradation. Packaging requirements are as stated on the purchase order. When not specified, the method used will be "best commercial practices". All Laminate, Prepreg, and Flex materials are to have individual boxes/bags identified with readable bar codes. Information required includes; TTM Part #, Qty of pieces, and Lot #. All Laminate, Prepreg, and Flex materials require packing slips with readable bar codes. Information required includes TTM PO #, TTM Part #, and total Qty of pieces for the specific part #. The order of these bar codes is important as the receiving and issuing programs flow in this order. The use of bar codes for other materials/supplies, although not required, is encouraged for boxes and/or packing slips.
- Q13 Qualification Lot:** Proposed Subcontractor, as an alternative method for placement onto the **Qualified Supplier List (QSL)**, shall manufacture, inspect, and test a qualification lot of material and/or service(s). The qualification lot shall be produced with the processes, materials, and equipment planned for production orders. The requirements of the qualification lot shall be documented and flowed down to the proposed Subcontractor through the purchasing document. An inspection and test plan shall be prepared by the Quality department for verification of the qualification lot upon receipt. Results of this verification will be forwarded to the Subcontractor through the purchasing department.
- Q14 Statistical Process Control / Improvement:** The Subcontractor shall establish and maintain a documented system for the application and implementation of Statistical Techniques for the qualification, measurement, monitoring, control, and continuous improvement of critical processes, where appropriate. The Subcontractor shall identify key process characteristics and as required, provide objective evidence as to the performance of these indicators. Evidence shall include but is not limited to: identification of key characteristic, method of measuring performance, distribution values, CPK level, etc.
- Q15 Dielectric Thickness:** The dielectric thickness minimum requirement of 0.0035" is to be measured peak to peak, measured using 50x, referee using 100x.

QUALITY ASSURANCE PROVISIONS (QAP)

- Q16 Counterfeit Part Prevention:** The Seller shall not deliver counterfeit raw materials and/or products that contain counterfeit electrical and/or mechanical parts/assemblies.
- Q17 ITAR Compliance:** The Supplier must be *ITAR (International Traffic in Arms Regulations)* compliant and provide evidence, upon request, that personnel who are within the facility or supply a service to TTM-Santa Clara product are either U.S. citizens or permanent residents. If the Supplier performs work on ITAR product, or has access to ITAR data/drawings/documentation, that Supplier must also be registered with the DDTC (Directorate of Defense Trade Controls).
- Q18 User/Supplier Agreements:** A documented (User/Supplier) agreement is required between the PWB Supplier and the laminate/prepreg Supplier, assuring that material is certified to IPC-4101. The agreement shall be submitted to the Customer (if required) for concurrence, prior to submittal of a PWB to the Customer (if required). The Customer's Supplier Management shall maintain agreements. The PWB Supplier shall notify the Customer (if required) prior to any change.
- Q19 Conflict Minerals Declaration:** The Supplier shall annually submit the latest version of a completed and accurate conflict minerals reporting template (CMRT) issued by the Conflict Free Sourcing Initiative (CFSI). The CMRT shall be completed in English and submitted in Excel format.
- a) Suppliers to PCB divisions shall utilize source smelters that are validated as Conflict Free Smelters (CFS) by third party organizations such as CFSI, LBMA or RJC.
 - b) Suppliers to EMS divisions shall utilize Conflict Free Smelters (CFS) whenever possible, as Customer BOM specifications permit.
 - c) Suppliers shall notify TTM at least 90 days prior to any change in source smelters and shall confirm such changes in a revised CMRT.