CHECKLIST FOR HYBRID MICROCIRCUIT MANUFACTURER AND LINE SURVEY

ESCC Basic Specification No. 2026000

Manufacturer :

Location :

Survey Team Leader :

Hybrid Type :

Issue 1	June 2014

Document Custodian: European Space Agency – see https://escies.org

LEGAL DISCLAIMER AND COPYRIGHT

DOCUMENTATION CHANGE NOTICE

(Refer to https://escies.org for ESCC DCR content)

DCR No.	CHANGE DESCRIPTION

TABLE OF CONTENTS

1 INTRODUCTION

This checklist is intended for use during the initial survey of a Manufacturer's ability to produce high quality articles, his management organisation, production facilities, test facilities and technical know-how. When completed, this checklist should enable the party interested in procurement of the subject components to assess the ability of the Manufacturer concerned to successfully execute a contract for the supply of high reliability space hardware.

2 RELATED DOCUMENTS

The following documents form part of this specification and shall be read in conjunction with it. The relevant issues shall be those in effect on date of starting evaluation.

Reference Documents:

(a) ESCC No. 20600, Preservation Packaging and Despatch of ESCC Electronic Components
(b) ESCC No. 21300, Terms, Definitions, Abbreviations, Symbols and Units
(c) ESCC No. 21500, Calibration System Requirements.
(d) ESCC No. 24600, Minimum Quality System Requirements
(e) ESA PSS-01-606, The Capability Approval Programme For Hermetic Thick Film Hybrid Microcircuits
(f) ESA PSS-01-610, Design Guidelines for Capability Approval of Film Hybrid Microcircuits and Micro-Wave Hybrid Integrated Circuits (MHICs)
(g) ECSS-Q-ST-30-11, Derating - EEE Components
(h) ECSS-Q-ST-60-05, Generic Procurement Requirements For Hybrids
(i) ECSS-Q-ST-60, Electrical, Electronic And Electromechanical (EEE) Components
(j) ECSS-Q-ST-70, Materials, Mechanical Parts And Processes
(k) ISO 9000, Quality Management System
(l) JEP95, JEDEC Registered And Standard Outlines For Solid State And Related Products
(m) JESD9, JEDEC Inspection Criteria For Microelectronic Packages And Covers
(n) MIL-HDBK-217, Military Handbook. Reliability Prediction of Electronic Equipment
(o) MIL-STD-883, Test Method Standard, Microcircuits
(p) MIL-PRF-38534, Hybrid Microcircuits, General Specification for

3 TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

For the purpose of this specification, the terms, definitions, abbreviations, symbols and units specified in ESCC No. 21300, ESCC No. 20200 and ISO 8402 shall apply. In addition the following shall apply:

HM: Hybrid Manufacturer

HTIF: Hybrid circuit technology identification form

4 SURVEY CHECKLIST

4.1 HYBRID MANUFACTURER AND SURVEY TEAM INFORMATION

Para.	Topic	Comments
	Hybrid Manufacturer and Survey Team Information	
4.1a	HM's Name: Address : Telephone: web-site:	
4.1b	Survey requested by : Survey Team Leader : Team Members : • • •	
4.1c	Key personnel of HM interviewed: (Name/Function/Contact Details) • • •	
4.1d	Type of Company (Private company, limited company, etc.)	

Para.	Topic	Comments
	Hybrid Manufacturer and Survey Team Information	
4.1e	Affiliated with any other companies? If so, which:	
4.1f	No. of employees: • total number : • Production : • Quality Assurance : • QA Inspection : • Prod. Engineering : • Design Engineering : • Reliability Control : • Other :	
4.1g	Number of shifts:	

Para.	Topic	Comments
Hybrid Manufacturer and Survey Team Information		
4.1h	General Production line : • Device types manufactured • Statistics of the production line (quantities) • Will flow diagrams of steps to produce hybrid microcircuits be available to survey team?	
4.1i	Are specifications, if any, referenced in the flow diagram?	
4.1j	Principal Government and industrial customers: • • •	

Para.	Topic	Comments
Hybrid Manufacturer and Survey Team Information		
4.1k	Is the HM' s production: • Continuous • Pilot Production • Advanced R&D, limited	
4.1l	What percentage of hybrid microcircuit sales consists of aerospace or other high reliability products?	

4.2 MANAGEMENT ORGANISATION

Para.	Topic	Comments
	Management Organisation	
4.2a	Is the management organisation and responsibilities defined in official HM documentation?	
4.2b	Has the quality policy been documented by management, and is it known and followed at all levels of the organisation?	
4.2c	Which level of management participates actively in orientating policy towards space component production?	
4.2d	Is the management representative for quality management reporting on the performance of the quality system to the HM's management? Does this system lead to (corrective) actions being taken in respect of the production line?	

Para.	Topic	Comments
	Management Organisation	
4.2e	Is the executive management reviewing the quality system at defined intervals to ensure its continuing suitability and effectiveness in satisfying ISO 9000 and ESCC No. 24600?	
4.2f	Do current and future business plans include the continuing supply of space components and where is this stated and by whom?	
4.2g	Is there a policy declaration concerning proprietary rights and confidentiality concerning manufacturing processes and will this inhibit the audit?	
4.2h	What is management commitment to supplying space components, developing further space business and increasing the hybrid microcircuit technological scope in respect of space components?	

Para.	Topic	Comments
	Management Organisation	
4.2i	Is space component business/production integrated with other business sectors or is it segregated by the use of special space production/flow lines?	
4.2j	Do senior management understand special needs of space component business and space requirements and is this disseminated to key areas of the organisation?	
4.2k	Has the 'reliability' department the same authority from management as the 'engineering' and 'production' departments? Does this mean direct responsibility for reliability of products in the line?	
4.2l	How would contract for space components be organised?	
4.2m	How can original requirements from Orderer (Space Agency or end-user) be assumed to be correctly translated into internal instructions?	

Para.	Topic	Comments
	Management Organisation	
4.2n	How can information necessary to the Orderer (corrective actions, deviations, notification of inspection, and/or problem areas) be assumed to be issued and channelled to the Orderer?	
4.2o	Is there a described procedure for alerting suppliers of document and drawing changes?	

4.3 QUALITY ASSURANCE SYSTEM AND ORGANISATION

Para.	Topic	Comments
	Quality Assurance System and Organisation	
4.3a	Is this system in compliance with ESCC No. 24600? Is this system in compliance with other quality system standards? In case of YES, which standards are these?	
4.3b	Is there an appointed quality representative/quality manager/chief inspector? And to whom does he/she report?	
4.3c	Does the HM have a quality manual?	
4.3d	Is there a description in the quality manual of quality policy, quality organisation, and supporting quality documentation system, procedures and work instructions?	

Para.	Topic	Comments
Quality Assurance System and Organisation		
4.3e	Has the quality assurance group sufficient authority in relation to its position within the company's Organisation (see organigram)?	
4.3f	Are areas of responsibility within the quality assurance group clearly defined?	
4.3g	Are quality plans developed to meet the project requirements of specific market sectors? Is such a quality plan available for space grade semiconductor components?	
4.3h	Are corrective actions to which QA management is committed delegated to responsible staff or does QA management have direct authority regarding the line?	
4.3i	Is there a periodic quality data reporting system covering all operational and manufacturing operations?	

Para.	Topic	Comments
Quality Assurance System and Organisation		
4.3j	What is the relationship between the quality organisation and the reliability organisation?	
4.3k	Is a QA Manual or equivalent document supplied to all levels of appropriate supervisory personnel? Is such document updated?	
4.3l	Are written procedure available for identification, segregation, control and disposal of accepted/rejected materials?	
4.3m	Is there an inspection system in place and is it performed by quality assurance personnel and/or other departmental personnel?	

Para.	Topic	Comments
Quality Assurance System and Organisation		
4.3n	Is this inspection system used throughout the HM's organisation and specially in the following areas: • Incoming Inspection • In-process Inspection • Manufacturing Process • Final Inspection and testing • Packaging and delivery	
4.3o	Does QA maintain a system of written procedures for statistic controls (control chart, lot plot, etc.) in any of the following areas: • Receiving Inspection • Manufacturing process • In-process inspection • Final inspection	

Para.	Topic	Comments
Quality Assurance System and Organisation		
4.3p	Is QA responsible for determination of need for, and the conducting of, quality training?	
4.3q	Are training programmes in place for all quality and production processes and are personnel attending these training programmes tested for competency at: • the conclusion of training courses • periodically	
4.3r	Is there an internal quality audit policy established and does it maintain an internal quality audit system and define the responsibilities for conducting internal audits?	
4.3s	Is the internal quality audit system fully documented and are there associated planned programmes and procedures?	

Para.	Topic	Comments
	Quality Assurance System and Organisation	
4.3t	Are internal quality audits performed in association with : • ESCC requirement • ISO 9000 requirements	
4.3u	Are the findings and reports of internal quality audits reviewed and analysed? And are these findings and reports followed up in terms of corrective and preventive measures? And is there evidence of this influencing quality policy and management attitude to quality?	
4.3v	Is there an established procedure defining identification, collection, indexing, access, filling, storage, maintenance and disposition of quality records? Are records maintained for a minimum of 5 years?	

4.4 MEASURING, TEST EQUIPMENT AND CALIBRATION

Para.	Topic	Comments
	Measuring, Test Equipment and Calibration	
4.4a	Does the HM maintain documented measuring equipment, standards and software control and calibration system and a time schedule for measurement frequency?	
4.4b	Is calibration of equipment and facilities subcontracted? If so, from whom? What is the name and status of these facilities and is the organisation certified/accredited to International/European/National standard systems and which? And is the subcontracted calibration system fully documented? If not, is the internal calibration system fully documented and described?	

Para.	Topic	Comments
	Measuring, Test Equipment and Calibration	
4.4c	Is the internal calibration system using standards traceable to International/European/National standards?	
4.4d	Are calibration procedures adhered to and up-to date?	
4.4e	Who is responsible for the management of the calibration system and which department maintains the system and takes custody of measuring equipment and calibration standards?	
4.4f	Are decals used for equipment identification to show that the units have been calibrated; when next calibration date is due and calibrator identification? Are decals up-to-date?	
4.4g	Does the calibration system include training of personnel engaged in calibration duties?	

Para.	Topic	Comments
	Measuring, Test Equipment and Calibration	
4.4h	Have calibrating personnel up-to-date certification records reflecting date, traceability to NBS and identification of calibrator	
4.4i	Does the calibration system embodies methods of introducing new equipment and facilities into the calibration system and determine calibration status?	
4.4j	Does the calibration system include methods of reintroduction and re-calibration of repaired or modified equipment and facilities?	
4.4k	Do the calibration procedures provide measures for removal of any equipment not maintained or calibrated according to established schedules?	
4.4l	Are there measures available for making calibrated equipment tamper-proof and for the detection of tampering?	

Para.	Topic	Comments
Measuring, Test Equipment and Calibration		
4.4m	Is measuring equipment stored, handled and transported under controlled conditions?	
4.4n	Is the calibration status of the measuring equipment compatible with record held?	

4.5 CONFIGURATION OF DOCUMENTS AND DRAWINGS

Para.	Topic	Comments
	Configuration of Documents and Drawings	
4.5a	Has the HM adequate written procedures for configuration control of specifications, documents, drawings and contract changes?	
4.5b	Does the configuration control system provide for documented change control guaranteeing availability of required drawing at relevant manufacturing or inspection step? Do flow documents show current revisions?	
4.5c	Does the system cater for the provision of a master list and matters of configuration controlled documents and drawings?	
4.5d	Are all ESCC, European/International/National standards and specification used by the HM up to date and of the correct and latest issue?	

Para.	Topic	Comments
Configuration of Documents and Drawings		
4.5e	Does QA review all drawings and changes therein prior to their becoming effective?	
4.5f	Has the HM established a procedure for involvement of material suppliers and customers in the configuration control process?	
4.5g	Are current specification revisions shown on prints of drawings?	

4.6 RELIABILITY

Para.	Topic	Comments
	Reliability	
4.6a	Does the HM have an established reliability system and is it defined in formal documentation?	
4.6b	Does the HM have a separate reliability organisation or in absence of this is their personnel designated with responsibilities for operating a documented reliability system?	
4.6c	Do staff operating the reliability system have same authority as quality, production and engineering management?	
4.6d	Is there a direct feed-back of information between Reliability, Design Engineering and QA groups to ensure timely notification of all relevant data?	
4.6e	Does the reliability system respond promptly and efficiently to unexpected and/or newly detected failures?	

Para.	Topic	Comments
	Reliability	
4.6f	Are line failures (type and causes) analysed and reported to those responsible for corrective actions?	
4.6g	Are corrective actions resulting from failure analysis agreed with the QA group involved or Reliability if parts or process changes must be made? • QA Group : • Reliability :	
4.6h	Has Reliability right to approve test specifications, data tabulation, parts or process changes?	
4.6i	Is there a system for : • In-process failure analysis: • End-item failure analysis:	

Para.	Topic	Comments
	Reliability	
4.6j	Is reliability of film hybrid microcircuits derived from measured data on manufacturer's hybrids (rather than calculations in accordance with, say, MIL-HDBK-217)?	
4.6k	Are following items submitted to failure analysis as a matter of routine? • Production line rejects • Lots with high rejection rate (Define) • Items returned by Orderer • Items returned by Orderer with special request for failure analysis	
4.6l	Has the HM a failure analysis laboratory or an equivalent facility?	

Para.	Topic	Comments
	Reliability	
4.6m	Is failure analysis equipment: • Available : • In use: • Adequate:	
4.6n	Are there trained personnel dedicated for failure analysis?	
4.6o	Are failure analysis procedures: • Available: • In Use: • Adequate:	
4.6p	Are failure analysis reports: • Available: • In Use: • Adequate:	

Para.	Topic	Comments
	Reliability	
4.6q	Does rating system provide for effectiveness of written corrective actions received from Suppliers?	
4.6r	Do data sheets reflect the results of failure analysis reports?	
4.6s	Give examples of recent failure analysis performed?	
4.6t	Has the HM an evaluation laboratory for determination of product characteristics?	

4.7 DESIGN OF HYBRID MICROCIRCUITS

Para.	Topic	Comments
	Design of Hybrid Microcircuits	
4.7a	Does the HM have a programme plan available to ensure the reliability (FMECA, reliability calculation and worst case analysis) of the Hybrid Microcircuit Component's design?	
4.7b	Have procedures been established and responsibilities assigned for the control of development and verification activities at the product design stage, and are they maintained and fulfilled?	
4.7c	Does the HM maintain procedures for the control of technology selection according to the PID and the HTIF?	
4.7d	Does the HM identify, document, review design changes and modifications and are they approved by authorised personnel before implementation?	

Para.	Topic	Comments
Design of Hybrid Microcircuits		
4.7e	Does the HM maintain procedures for the selection of added-on components and piece parts? Does this selection conform to the requirements specified in the PID?	
4.7f	Is a block diagram of the design process and the selection of materials and added-on components used?	
4.7g	Are methods for the configuration control of designs available?	
4.7h	Does the HM design procedure include a description of the interface between design planning and customer component specification review?	
4.7i	Does the HM have a system for assessment of the impact of design changes?	
4.7j	Does the HM have a system for identification of personnel authorised to make changes in the design?	

Para.	Topic	Comments
Design of Hybrid Microcircuits		
4.7k	Does the HM apply the derating requirements according to ECSS-Q-ST-30-11 for the design of the hybrid microcircuits?	
4.7l	Does the HM implement thermal management criteria in case of power circuits?	
4.7m	Does the HM verify radiation related requirements for the added-on components and the whole hybrid circuit (as applicable)?	
4.7n	Does the HM maintain a procedure for design approval (circuit type approval) assessing e.g. similarity on the basis of the HTIF and the similarity form (Annex C of ECSS-Q-ST-60-05)?	
4.7o	How does the HM assure the use of only the approved combinations and dimensions of materials and components as defined in the PID?	

Para.	Topic	Comments
Design of Hybrid Microcircuits		
4.7p	Is there a formal procedure to give evidence to the QA and Reliability in case of: • need of new materials and/or components • need of new combinations or dimensions	
4.7q	Is there a formalized flow of how to implement the necessary delta evaluation?	

4.8 PROCUREMENT OF PASSIVE AND ACTIVE CHIPS, MATERIALS AND PIECE PARTS

Para.	Topic	Comments
Procurement of Passive and Active Chips, Materials and Piece Parts		
4.8a	Does the HM identify for all Chips, Materials and Piece parts intended for space applications: • the type of source (e.g. Fabrication plant authorised distributor) • Conformity to ECSS-Q-ST-60 and ESCC specifications or ECSS-Q-ST-70 • Verification that 'qualified chip components' are procured in case of chip components being qualified in an 'encapsulated version' • Procurement as traceable homogeneous lots • Conformity to ESA PSS-01-610 for adhesives, solders, fluxes and other materials	

Para.	Topic	Comments
Procurement of Passive and Active Chips, Materials and Piece Parts		
4.8b	Does the HM identify the procured passive or active chips' technologies and are there contractually binding agreements with the chip manufacturer in respect of: • used technologies and materials	
4.8c	Does the HM describe the space qualification status of the procured passive or active chips (e.g. RHA designator, ESCC and CECC or equivalent MIL class)?	

Para.	Topic	Comments
Procurement of Passive and Active Chips, Materials and Piece Parts		
4.8d	Does the HM have a system, procedures and descriptions of: • Content of procurement specification as e.g.: maximum ratings, specification of electrical, mechanical and environmental performance, screening conditions, life tests and chip mask, when applicable • Identification of procured material • How the procurement specification is reviewed internally and the effect of this for the final specification • How information is handled when specification changes require modifications of current purchase order. • How “incoming inspection” is informed of changes in purchase order.	

Para.	Topic	Comments
Procurement of Passive and Active Chips, Materials and Piece Parts		
4.8e	Does the HM have a vendor rating system?	
4.8f	Does the HM have an agreement/dialogue with the relevant source concerning intended use, assembly, packaging and test methods?	
4.8g	How does the HM demonstrate that the procured chips, piece parts and materials are reliable in the hybrid environment, i.e. the materials and processes used are compatible?	
4.8h	Does the HM have a system, procedures and description of an evaluation and approval programme according to ECSS-Q-ST-60 in case that non-qualified components are procured?	

Para.	Topic	Comments
Procurement of Passive and Active Chips, Materials and Piece Parts		
4.8i	For the procurement of active or passive chip components does the HM have a system, procedures and description of : • Bondability test • Lot acceptance test • User Lot acceptance test • Are the requirements of ECSS-Q-ST-60-05 fulfilled for the above tests?	

4.9 INCOMING INSPECTION OF PASSIVE AND ACTIVE CHIPS, MATERIALS AND PIECE PARTS

Para.	Topic	Comments
Incoming Inspection of Passive and Active Chips, Materials and Piece Parts		
4.9a	Are the HM's written standard inspection procedures adequate for control of incoming materials and services received? Do inspectors know how and when to apply these procedures?	
4.9b	Are chip components and materials received in a controlled area from which removal prior to inspection is impossible and which guaranties segregation of non-conforming material?	
4.9c	Are chip components and materials properly handled and protected during incoming inspection?	

Para.	Topic	Comments
Incoming Inspection of Passive and Active Chips, Materials and Piece Parts		
4.9d	Does Incoming Inspection use drawings and purchase orders assuring lot traceability and homogeneity with proven designs? If so, do these documents show Quality Control review and are they up-to-date?	
4.9e	Are test reports/data documentation from suppliers being reviewed?	
4.9f	Does Incoming Inspection have appropriate facilities, visual aids and measuring equipment?	
4.9g	Does Incoming Inspection have provisions for handling, storage and protection of chip components and other type of material?	
4.9h	Does the Incoming Inspection system provide for feedback and corrective actions with the source concerning non-conforming material?	

Para.	Topic	Comments
Incoming Inspection of Passive and Active Chips, Materials and Piece Parts		
4.9i	Does the Incoming Inspection System provide for inspection, handling, and storage of chip components?	
4.9j	Does Incoming inspection perform 100% visual inspection of chip components?	
4.9k	Does Incoming Inspection perform SEM inspection on sample basis of accepted wafer/dice?	
4.9l	Does Incoming Inspection include scribing/breaking of accepted wafer? If so, is a 100% visual inspection performed afterwards?	
4.9m	Does Incoming Inspection include bondability test, die shear test and lot acceptance test?	
4.9n	Are shelf-life and cure-date materials properly identified and controlled?	

Para.	Topic	Comments
Incoming Inspection of Passive and Active Chips, Materials and Piece Parts		
4.9o	Are suitable inspections and tests, including physical and chemical tests, performed on raw materials?	
4.9p	Are Incoming Inspection tests subcontracted and which are these and to whom?	
4.9q	Are the packages procured with a dedicated specification per each family type? Do the above specifications contain as a minimum the requirements of JEP95 for metal packages and JESD27 for ceramic packages?	
4.9r	Are adhesives, absorbers, particle getters procured with a dedicated procurement specification? Does the above specification contain as minimum the requirements of MIL-STD-883, TM5011?	

Para.	Topic	Comments
Incoming Inspection of Passive and Active Chips, Materials and Piece Parts		
4.9s	Is a recertification of expired materials allowed (e. g. shelf life of organic materials)? Are there specific test procedures for the recertification? What is the rule to define the new shelf life?	

4.10 THIN FILM PROCESSING

4.10.1 Design, Artwork, Screen Fabrication

Para.	Topic	Comments
Thin Film Processing - Design, Artwork, Screen Fabrication		
4.10.1a	Is thin film hybrid microcircuit design performed in-house?	
4.10.1b	Does a formalised set of Design Rules exist? Do these comply with the requirements of ESA PSS-01-610? Do all designs and layouts comply with these Design Rules? If so, do QA verify this?	
4.10.1c	Is artwork for masks performed in-house? Are QA checks made on artwork?	
4.10.1d	Are masks made in-house Are QA checks made on masks?	

Para.	Topic	Comments
Thin Film Processing - Design, Artwork, Screen Fabrication		
4.10.1e	Which type of mask is used (high resolution plates, chrome etc.)?	
4.10.1f	Are rules available controlling the maximum usage of masks?	
4.10.1g	Are masks labelled uniquely (including issue and revision status and serial number)? Are they under controlled conditions: • In a clean area • Limited access • Catalogued	

4.10.2 Substrates

Para.	Topic	Comments
	Thin Film Processing - Substrates	
4.10.2a	What substrates are used? • Manufacturer • Purity Do substrates comply with Section 3.2.5.2 and 3.2.5.3 of ESA PSS-01-610?	
4.10.2b	Is substrate subject to adequate goods receiving checks?	
4.10.2c	Is substrate cleaned before use?	
4.10.2d	Is substrate stored adequately between cleaning and printing?	

4.10.3 Thin Film Deposition

Para.	Topic	Comments
Thin Film Processing - Thin Film Deposition		
4.10.3a	Which methods of deposition are used?	
4.10.3b	What materials are used for deposition? • Material • Type No. • Manufacturer • Resistor/Conductor	
4.10.3c	Do deposition materials comply with the requirements of Section 3.2.5.3 of ESA PSS-01-610?	
4.10.3d	Are written procedures available for the deposition of each material used, including material characteristics?	

Para.	Topic	Comments
Thin Film Processing - Thin Film Deposition		
4.10.3e	Are written procedures available for each deposition technique used, including control of process parameters and monitoring of deposition rates?	
4.10.3f	Do procedures exist that control characteristics and parameters of deposited layers (e.g. Thickness, uniformity, resistivity, adherence, blistering etc.)?	

4.10.4 Thin Film Patterning

Para.	Topic	Comments
Thin Film Processing - Thin Film Patterning		
4.10.4a	Where substrates are bought in with material pre-deposited, are adequate goods receiving checks performed on thickness uniformity, resistivity, adherence, blistering etc.?	
4.10.4b	What patterning methods are used?	
4.10.4c	Do written procedures exist on thin film patterning methods?	
4.10.4d	Do written procedures exist to control: • patterning materials • patterning process parameters	
4.10.4e	Is final inspection/control carried out on patterned layers?	

4.10.5 Trimming

Para.	Topic	Comments
Thin Film Processing - Trimming		
4.10.5a	What method of trimming is used?	
4.10.5b	Are trimming rules available in compliance with Section 3.1.4 of ESA PSS-01-610?	
4.10.5c	Does trimming equipment automatically control resistor adjustment within trimming rules?	
4.10.5d	Are separate checks performed by QA to verify that resistors are accurately adjusted within trimming rules?	
4.10.5e	Are short and long term stability tests carried out to ensure adjusted resistor stability? Is data available?	

4.10.6 Passivation

Para.	Topic	Comments
Thin Film Processing - Passivation		
4.10.6a	What passivation layer is used?	
4.10.6b	Does the passivation layer comply with Section 3.2.5.4 of ESA PSS-01-610?	
4.10.6c	Is final inspection/control carried out for the passivation layer?	

4.10.7 Film Stabilisation

Para.	Topic	Comments
Thin Film Processing - Film Stabilisation		
4.10.7a	Is a procedure used for film stabilisation?	
4.10.7b	Is the effectiveness of this procedure verified by long term stability tests?	

4.10.8 Substrate, Saw or Scribe and Break and Substrate Hole Drilling

Para.	Topic	Comments
Thin Film Processing - Substrate, Saw or Scribe And Break and Substrate Hole Drilling		
4.10.8a	What method of substrate sawing or scribing and breaking is used?	
4.10.8b	Is this documented with respect to method and parameter control?	
4.10.8c	Is inspection carried out on separated substrates?	
4.10.8d	Are holes checked for positional tolerance and hole profile?	

4.10.9 Final Acceptance Test for Thin Film Processing

Para.	Topic	Comments
Thin Film Processing - Final Acceptance Test For Thin Film Processing		
4.10.9a	Are checks carried out on dimensions?	
4.10.9b	Are electrical tests carried out on all circuits?	
4.10.9c	Are visual inspections carried out on all circuits?	
4.10.9d	Is this compatible with the relevant sections of the current edition of MIL-STD-883, TM 2017 for Class S devices?	
4.10.9e	Are thin film processing results recorded and filed for a specified period?	
4.10.9f	Is bondability test performed on Al microwires? Is it performed with a bake test at 300°C for 1hour? If different, state time and temperature	

4.11 THICK FILM PROCESSING

4.11.1 Design, Artwork, Screen Fabrication

Para.	Topic	Comments
Thick Film Processing - Design, Artwork, Screen Fabrication		
4.11.1a	Is thick film hybrid microcircuit design performed in -house?	
4.11.1b	Does a formalised set of Design Rules exist? Do these comply with the requirements of ESA PSS-01-610? Do all designs and layouts comply with these Design Rules? If so, do QA verify this?	
4.11.1c	Is artwork for screens performed in-house? Are QA checks made on artwork?	
4.11.1d	Are screens made in-house? Are QA checks made on screens before first use?	

Para.	Topic	Comments
Thick Film Processing - Design, Artwork, Screen Fabrication		
4.11.1e	Which types of screens are used (polyester, stainless steel, direct/indirect, mesh number etc.)?	
4.11.1f	Are rules available controlling the maximum number of prints to be made with screen or wear of screens?	
4.11.1g	Are screens labelled uniquely (including issue and revision status and serial number)? Are they under controlled conditions? • In a clean area • Limited access • Catalogued	

4.11.2 Substrates

Para.	Topic	Comments
Thick Film Processing - Substrates		
4.11.2a	What substrates are used? • Manufacturer • Purity Do substrates comply with Section 3.2.5.I of ESA PSS-01-610?	
4.11.2b	Is substrate subject to adequate goods receiving checks?	
4.11.2c	Is substrate cleaned before use?	
4.11.2d	Is substrate stored adequately between cleaning and printing?	

4.11.3 Thick Film Pastes

Para.	Topic	Comments
	Thick Film Processing - Thick Film Pastes	
4.11.3a	Which makes of paste are used? • Manufacturer • Type	
4.11.3b	Do pastes comply with Section 3.2.5.4 of ESA PSS-01-610?	
4.11.3c	Are pastes from different manufacturers used on the same substrates?	
4.11.3d	Are written procedures available for use of each paste type (firing, temperature etc.)?	
4.11.3e	Are pastes stored adequately (temperature, location, shelf life)?	
4.11.3f	Is paste viscosity controlled?	
4.11.3g	Is blending of pastes controlled?	

4.11.4 Printing

Para.	Topic	Comments
Thick Film Processing - Printing		
4.11.4a	Is wear on squeegees controlled?	
4.11.4b	Is printed layer thickness controlled?	
4.11.4c	Do environmental conditions comply with Table 1 of ESA PSS-01-606 and Para. 4.15 of this document?	

4.11.5 Firing

Para.	Topic	Comments
	Thick Film Processing - Firing	
4.11.5a	What makes of furnace are used? • Manufacturer • Type • No. of zones • Belt • Atmospheres • Used for	
4.11.5b	Is temperature in individual zones controlled and profiled regularly and logged?	
4.11.5c	Is atmosphere in non-air firing furnaces controlled and logged?	
4.11.5d	Do firing profiles correspond with paste manufacturer's recommendations?	

4.11.6 Printed Substrate In-Process Control

Para.	Topic	Comments
	Thick Film Processing - Printed Substrate In-Process Control	
4.11.6a	Does a special test pattern/test procedure exist for control of each deposition batch before release to production?	
4.11.6b	Are parameters/characteristics of resistor conductor test pattern controlled? • Parameters/Characteristics • Control/Inspection Method	
4.11.6c	Are checks on multi-layer prints made between layers to ensure registration, isolation etc.?	
4.11.6d	Are checks made on vias between layers to ensure registration and prevent underfilling of overfilling?	
4.11.6e	Are acceptance/rejection criteria available and in use?	
4.11.6f	Who is responsible for batch acceptance decisions?	

4.11.7 Trimming

Para.	Topic	Comments
	Thick Film Processing - Trimming	
4.11.7a	What method of trimming is used?	
4.11.7b	Are trimming rules available in compliance with Section 3.1.4 of ESA PSS-01-610?	
4.11.7c	Does trimming equipment automatically control resistor adjustment within trimming rules?	
4.11.7d	Are separate checks performed by QA to verify that resistors are accurately adjusted within trimming rules etc.?	
4.11.7e	Is air abrasive trimming controlled so as to prevent contamination of surrounding areas?	
4.11.7f	Is it demonstrated that the laser trimming used does not introduce thermal microcracks?	

Para.	Topic	Comments
Thick Film Processing - Trimming		
4.11.7g	Are short and long term stability tests carried out to ensure adjusted resistor stability? Is data available?	

4.11.8 Passivation

Para.	Topic	Comments
Thick Film Processing - Passivation		
4.11.8a	What passivation layer is used?	
4.11.8b	Does the passivation layer comply with Section 3.2.5.4 of ESA PSS-01-610?	
4.11.8c	Is final inspection/control carried out for the passivation layer?	

4.11.9 Film Stabilisation

Para.	Topic	Comments
Thick Film Processing - Film Stabilisation		
4.11.9a	Is a procedure used for film stabilisation?	
4.11.9b	Is the effectiveness of this procedure verified by long term stability tests?	

4.11.10 Substrate, Saw or Scribe and Break and Substrate Hole Drilling

Para.	Topic	Comments
Thick Film Processing - Substrate, Saw or Scribe and Break and Substrate Hole Drilling		
4.11.10a	What method of substrate sawing or scribing and breaking is used? What method of hole drilling is used?	
4.11.10b	Is this documented with respect to method and parameter control?	
4.11.10c	Is inspection carried out on separated substrates?	
4.11.10d	Are holes checked for positional tolerance and hole profile?	

4.11.11 Final Acceptance Test for Thick Film Processing

Para.	Topic	Comments
Thick Film Processing - Final Acceptance Test For Thick Film Processing		
4.11.11a	Are checks carried out on dimensions?	
4.11.11b	Are electrical tests carried out on all circuits?	
4.11.11c	Are visual inspections carried out on all circuits?	
4.11.11d	Is this compatible with the relevant sections of the current edition of MIL-STD-883, TM 2017 for Class S devices?	
4.11.11e	Are thin film processing results recorded and filed for a specified period?	
4.11.11f	Is bondability test performed on Al microwires? Is it performed with a bake test at 300°C for 1hour? If different, state time and temperature	

4.12 LTCC PROCESSING

4.12.1 Design, Artwork, Screen Fabrication

Para.	Topic	Comments
LTCC Processing - Design, Artwork, Screen Fabrication		
4.12.1a	Is stencils design performed in - house?	
4.12.1b	Does a formalised set of Design Rules exist? Do these comply with the requirements of ESA PSS-01-610? Do all designs and layouts comply with these Design Rules? If so, do QA verify this?	
4.12.1c	Is artwork for screens/stencils performed in-house? Are QA checks made on artwork?	
4.12.1d	Are screens/stencils made in-house? Are QA checks made on screens?	

Para.	Topic	Comments
LTCC Processing - Design, Artwork, Screen Fabrication		
4.12.1e	What types of screens/stencils are used (mylar, stainless steel, direct/indirect, mesh number, etc.)?	
4.12.1f	Are rules available controlling the maximum number of prints to be made with screen/stencil or wear of screen /stencil?	
4.12.1g	Are screens /stencils labelled uniquely (including issue and revision status and serial number)? Are they under controlled conditions? • In a clean area • Limited access • Catalogued	

4.12.2 Substrates (Green Tapes)

Para.	Topic	Comments
LTCC Processing - Substrates (Green Tapes)		
4.12.2a	What tapes are used? • Manufacturer	
4.12.2b	Is substrate subject to adequate goods receiving checks?	
4.12.2c	Is substrate stored adequately before blanking?	

4.12.3 LTCC Film Pastes

Para.	Topic	Comments
LTCC Processing - LTCC Film Pastes		
4.12.3a	Which makes of paste are used? • Manufacturer • Type	
4.12.3b	Do pastes comply with Section 3.2.5.4 of ESA PSS-01-610?	
4.12.3c	Are pastes from different manufacturers used on the same substrates?	
4.12.3d	Are written procedures available for use of each paste type (firing, temperature etc.)?	
4.12.3e	Are pastes stored adequately (temperature, location, shelf time)?	
4.12.3f	Is paste viscosity controlled?	
4.12.3g	Is blending of pastes controlled?	

4.12.4 Printing

Para.	Topic	Comments
LTCC Processing - Printing		
4.12.4a	Is wear on squeegees controlled?	
4.12.4b	Is printed layer thickness controlled? Are filled vias controlled?	
4.12.4c	Do environmental conditions comply with Table 1 of ESA PSS-01-606 and Para. 4.15 of this document?	

4.12.5 Pressing

Para.	Topic	Comments
	LTCC Processing - Pressing	
4.12.5a	What type of press is used? • Manufacturer • Type	
4.12.5b	Is temperature and pressure profile programmable? Is it verified and logged regularly?	

4.12.6 Burn-Out

Para.	Topic	Comments
LTCC Processing - Burn-Out		
4.12.6a	What type of furnace is used? • Manufacturer • Type	
4.12.6b	Is temperature profile programmable? Is it verified and logged regularly?	

4.12.7 Firing

Para.	Topic	Comments
	LTCC Processing - Firing	
4.12.7a	What makes of furnaces are used? • Manufacturer • Type • No of Zones • Belt • Atmosphere • Used for	
4.12.7b	Is temperature in individual zones controlled and profiled regularly and logged?	
4.12.7c	Do firing profiles correspond with paste manufacturer's recommendations?	

4.12.8 Printed Substrate In-Process Control

Para.	Topic	Comments
LTCC Processing - Printed Substrate In-Process Control		
4.12.8a	Does a special test pattern/test procedure exist for control of each deposition batch before release to production?	
4.12.8b	Are parameters/characteristics of resistors conductor test pattern controlled? If yes which? • Parameter/Characteristic • Control/Inspection Method	
4.12.8c	Are checks on multi-layer prints made between layers to ensure registration, isolation etc.?	
4.12.8d	Are checks made on vias between layers to ensure registration and prevent underfilling or overfilling?	
4.12.8e	Are acceptance/rejection criteria available and in use?	
4.12.8f	Who is responsible for batch acceptance decisions?	

4.12.9 Trimming

Para.	Topic	Comments
LTCC Processing - Trimming		
4.12.9	What method of trimming is used?	
4.12.9	Are trimming rules available in compliance with Section 3.1.4 of ESA PSS-01-610?	
4.12.9	Does trimming equipment automatically control resistor adjustment within trimming rules?	
4.12.9	Are separate checks performed by QA to verify that resistors are accurately adjusted within trimming rules?	
4.12.9	Is air abrasive trimming controlled so as to prevent contamination of surrounding areas?	
4.12.9	Is it demonstrated that the laser trimming used does not introduce thermal microcracks?	

Para.	Topic	Comments
LTCC Processing - Trimming		
4.12.9	Are short and long term stability tests carried out to ensure adjusted resistor stability? Is data available?	

4.12.10 Passivation

Para.	Topic	Comments
LTCC Processing - Passivation		
4.12.10a	What passivation layer is used?	
4.12.10b	Does the passivation layer comply with Section 3.2.5.4 of ESA PSS-01-610?	
4.12.10c	Is final inspection/control carried out for the passivation layer?	

4.12.11 Film Stabilisation

Para.	Topic	Comments
LTCC Processing - Film Stabilisation		
4.12.11a	Is a procedure used for film stabilisation?	
4.12.11b	Is the effectiveness of this procedure verified by long term stability tests?	

4.12.12 Substrate, Saw or Scribe and Break and Substrate Hole Drilling

Para.	Topic	Comments
LTCC Processing - Substrate, Saw or Scribe and Break and Substrate Hole Drilling		
4.12.12a	What method of substrate sawing or scribing and breaking is used? What method for hole drilling is used?	
4.12.12b	Is this documented with respect to method and parameter control?	
4.12.12c	Is inspection carried out on separated substrates?	
4.12.12d	Are holes checked for positional tolerance and hole profile?	

4.12.13 Final Acceptance Test for LTCC Processing

Para.	Topic	Comments
LTCC Processing - Final Acceptance Test for LTCC Processing		
4.12.13a	Are checks carried out on dimensions?	
4.12.13b	Are electrical tests carried out on all circuits?	
4.12.13c	Are visual inspections carried out on all circuits?	
4.12.13d	Is this compatible with the relevant sections of the current edition of MIL-STD-883, TM 2017 for Class S devices?	
4.12.13e	Are LTCC processing results recorded and filed for a specified period?	
4.12.13f	Is bondability test performed on Al microwires? Is it performed with a bake test at 300°C for 1hour? If different, state time and temperature	

4.13 PACKAGE MANUFACTURING

Para.	Topic	Comments
	Package Manufacturing	
4.13a	Which types of package are manufactured in house?	
4.13b	Are process controls in place for brazing and laser welding employing representative test procedures?	
4.13c	Are screening tests applied on packages before using them in the assembly line?	
4.13d	Are the screening test requirements, as minimum the package element evaluation per MIL-PRF-38534 except subgroup 5 and 6, performed?	

4.14 HYBRID ASSEMBLY

4.14.1 Use of Chip Carriers

Para.	Topic	Comments
Hybrid Assembly - Use Of Chip Carriers		
4.14.1a	Does the HM mount components into chip carriers?	
4.14.1b	Do chip carriers conform to JEP95?	
4.14.1c	Are adhesives, solder, fluxes and other interconnection materials used for chip mounting in chip carriers in accordance with ESA PSS-01-610?	
4.14.1d	Are components mounted in chip carriers fully characterised, tested, screened and burn-in before attachment to hybrid substrates?	

4.14.2 Parts Mounting - Adhesives

Para.	Topic	Comments
	Hybrid Assembly - Parts Mounting - Adhesives	
4.14.2a	State adhesives used and for which interconnection it is used? • Name/Type • Manufacturer • Description of interconnection	
4.14.2b	Is adequate data available (either from HM or of the adhesive manufacturer) on the following: • Corrosivity • Joint strength • Service temperature • Storage conditions • Shelf life	
4.14.2c	Are details available on adhesive application, equipment used, control of amount, and component alignment?	
4.14.2d	Do adhesives comply with Section 3.2.5.11 of ESA PSS-01-610?	

4.14.3 Parts Mounting - Eutectic

Para.	Topic	Comments
	Hybrid Assembly - Parts Mounting - Eutectic	
4.14.3a	State eutectic materials used and for which interconnection it is used • Name/Type • Manufacturer • Description of interconnection	
4.14.3b	Is adequate data available (either from HM or eutectic supplier) on the following: • Stability of electrical parameters • Operating temperature • Environmental stability	
4.14.3c	Are details available on eutectic mounting procedures, equipment used and control of parameters during bonding?	
4.14.3d	Do eutectics comply with Section 3.2.5.7 of ESA PSS-01-610?	

4.14.4 Parts Mounting - Soldering

Para.	Topic	Comments
Hybrid Assembly - Parts Mounting - Soldering		
4.14.4a	State solder materials and fluxes used and for which interconnection they are used? • Name/Type • Manufacturer • Description of interconnection	

Para.	Topic	Comments
Hybrid Assembly - Parts Mounting - Soldering		
4.14.4b	Is adequate data available (either from HM or solder/flux supplier) on the following: • Compatibility with metallisation system on component or substrate • Corrosivity (for fluxes) • Outgassing (for solder pastes and fluxes) • Shelf life (for solder pastes) • Stability of electrical parameters • Operating temperature • Environmental stability	
4.14.4c	Are details available on solder attachment procedures, equipment used and control of parameters during reflow process (including curing for solder pastes)?	
4.14.4d	Do solder and fluxes comply with Section 3.2.5.7 to 3.2.5.9 of ESA PSS-01-610?	

Para.	Topic	Comments
Hybrid Assembly - Parts Mounting - Soldering		
4.14.4e	Are there adequate procedures for cleaning off solder fluxes?	
4.14.4f	In the case of chip carriers and other surface mount components, are adequate procedures used to ensure there is no entrapment of flux residues and solder balls underneath the surface mounted component?	
4.14.4g	In case of chip carriers and other surface mount components, is inspection carried out to ensure an adequate stand-off between component and substrate?	

4.14.5 Parts Mounting - Control

Para.	Topic	Comments
Hybrid Assembly - Parts Mounting - Control		
4.14.5a	Is the attachment cycle controlled and does it follow that laid down by the attachment medium supplier?	
4.14.5b	Are inspection procedures compatible with the current edition of Method 2017 of MIL-STD-883 in use?	
4.14.5c	Are test carried out to ensure the adhesion strength of attached components (shear strength, torque strength etc.)?	
4.14.5d	In case of failure at adherence test what action is taken?	
4.14.5e	Does data exist to prove the long term strength of adhesive systems?	

4.14.6 Cleaning

Para.	Topic	Comments
	Hybrid Assembly - Cleaning	
4.14.6a	Is cleaning carried out in accordance with Section 3.2.5.10 of ESA PSS-01-610? (i.e. Ultrasonic cleaning of circuits with wire or beam lead connections is not permitted)	
4.14.6b	Are cleaning steps included during the fabrication process at all relevant stages and clearly identified in the flow chart?	
4.14.6c	Are the following parameters of the cleaning process controlled and documented? • Time • Temperature • Solutions concentration • Solution purity • Ultrasonic frequency range • Ultrasonic power	

Para.	Topic	Comments
	Hybrid Assembly - Cleaning	
4.14.6d	Are tests carried out to ensure that cleaning processes: • Are effective • Do not damage circuits (electrically, chemically etc.)?	

4.14.7 Wire and Ribbon Bonding

Para.	Topic	Comments
	Hybrid Assembly - Wire and Ribbon Bonding	
4.14.7a	State wire and ribbon bond materials used and for which bonding interconnection they are used • Wire/Ribbon type and material • Manufacturer • Manufacturer's part no. • Used for	

Para.	Topic	Comments
Hybrid Assembly - Wire and Ribbon Bonding		
4.14.7b	Are controls in operation for these properties/parameters? • Composition • Dimensions • Cross-section (imperfections) • Elongation • Breaking strength • Surface properties • Manner of spooling • manner of packaging • Storage conditions Has an evaluation been carried out on bonding materials? If so, are the results available?	
4.14.7c	Do bonding wires meet the requirements of Section 3.2.5.12 of ESA PSS-01-610?	

Para.	Topic	Comments
Hybrid Assembly - Wire and Ribbon Bonding		
4.14.7d	State equipment make, method (ultrasonic, thermo-compression, thermasonic) used for wire/ribbon bonding, type (manual, automatic or semi-automatic) and which process it is used for (active devices to substrates, passive devices to substrates, cross-overs to substrates, within chip carriers or others (specify) • Equipment • Method • Type • Used for • Documents	

Para.	Topic	Comments
Hybrid Assembly - Wire and Ribbon Bonding		
4.14.7e	Are the following bonding process factors/parameters controlled? • Temperature • Ultrasonic power • Time • Bonding tool force • Condition of capillary • Cleanliness Was an optimisation program carried out on these parameters for each machine? If so, are the results available?	
4.14.7f	How often are these bonding process factors/parameters controlled?	
4.14.7g	Are these bonding process factors/parameters subject to calibration?	

Para.	Topic	Comments
Hybrid Assembly - Wire and Ribbon Bonding		
4.14.7h	Does a sampling schedule exist to test consistency of bonding strength? Give details of bonds pulled at setting up, how often setting up is performed (hourly, daily, per shift etc.) and what pulling is performed on product?	
4.14.7i	In the case of failure at bond strength test, does a formalised procedure exist?	
4.14.7j	Are control/inspection methods applied to bonded devices/parts?	
4.14.7k	Is a 100% visual inspection carried out?	

4.14.8 Other Interconnections Techniques

Para.	Topic	Comments
Hybrid Assembly - Other Interconnections Techniques		
4.14.8a	In the case of other interconnection techniques (e.g. Beamlead, Tab etc.) full details shall be given of the techniques and the kind of devices bonded. Then, each of the questions of Para. 4.14.7 above shall be answered.	

4.14.9 Package Sealing

Para.	Topic	Comments
	Hybrid Assembly - Package Sealing	
4.14.9a	Are pre-seal acceptance tests (including accept/reject criteria) specified with respect to: • Electrical parameters • Visual Inspections	
4.14.9b	Is a 100% pre-seal acceptance carried out?	
4.14.9c	Are devices cleaned prior to sealing? If so, are they inspected 100% after the cleaning?	
4.14.9d	Do packages, package materials, sealing methods and sealing materials comply with the requirements of Section 3.2.5.13 of ESA PSS-01-610?	
4.14.9e	Are precautions taken to avoid the entrapment of corrosive solder flux vapours in the package during the sealing process?	
4.14.9f	Are precautions taken to avoid the overheating of circuit components during the sealing process?	

Para.	Topic	Comments
Hybrid Assembly - Package Sealing		
4.14.9g	Are the following controlled, where applicable, and documented? • Pre-seal bake • Heat (or power) used to produce seal • Humidity during sealing • Flow rate of gases • Welding controls (pressure, power, time)	
4.14.9h	Are controls in existence to ensure an inert gas atmosphere within the package?	
4.14.9i	Do control and inspection procedures exist for the seal quality?	
4.14.9j	Is the hermeticity of the package measured in accordance with the requirements of ECSS-Q-ST-60-05?	

Para.	Topic	Comments
Hybrid Assembly - Package Sealing		
4.14.9k	Has an evaluation been carried out on the compatibility of the package and sealing method with other materials, parts and processes and the anticipated usage with respect to: • Stability of electrical parameters? • Type and geometry of devices • Chemical stability • Environmental stability	
4.14.9l	Has a hydrogen sensitivity analysis for MHIC containing sensitive GaAs components been performed?	

Para.	Topic	Comments
Hybrid Assembly - Package Sealing		
4.14.9m	Are microwave absorbers used? • Type Are they attached to the lid to be sealed? If not state where it is attached Is it submitted to pre-cap inspection? Is it submitted to vacuum bake-out together with the populated hybrid package? If not give reference	

Para.	Topic	Comments
Hybrid Assembly - Package Sealing		
4.14.9n	Are particle getter used? • Type Are they attached to the lid to be sealed? If not state where it is attached Is it submitted to pre-cap inspection? Is it submitted to vacuum bake-out together with the populated hybrid package? If not give reference	

Para.	Topic	Comments
	Hybrid Assembly - Package Sealing	
4.14.9o	Is hydrogen getter needed and used? • Type Is it attached to the lid to be sealed? If not state where it is attached Is it submitted to pre-cap inspection? Is it submitted to vacuum bake-out together with the populated hybrid package? If not, give reference or explain alternative solutions (if needed)	

Para.	Topic	Comments
	Hybrid Assembly - Package Sealing	
4.14.9p	Are RF gasket used? • Type Are they attached to the lid to be sealed? If not state where it is attached Is there a procedure to verify that the operation of closure and opening of RF cover do not generate particles from the RF gasket? Is it submitted to pre-cap inspection? Is it submitted to vacuum bake-out together with the populated hybrid package? If not give reference	

4.15 FACILITIES AND EQUIPMENT

Para.	Topic	Comments
	Facilities and Equipment	
4.15a	Are hybrid microcircuit components intended for space use manufactured on: • the standard manufacturing line • a special line • a part standard/part special line	
4.15b	Are cleanrooms and/or clean workstations used?	
4.15c	Are all manufacturing operations to be performed in house or are some subcontracted and if so, what steps and to whom?	
4.15d	Are subcontractors for outside processing and testing evaluated and assessed?	
4.15e	Does the HM have specialised jigs, fixtures and facilities to manufacture space hybrid microcircuit components?	

Para.	Topic	Comments
	Facilities and Equipment	
4.15f	Does QA have written in-process procedures to control acceptance of products?	
4.15g	Does the HM identify specific personnel for the manufacture, inspection and test of space components and is this personnel included in a dedicated training programme? Are records maintained of training and competence of operators for key wafer/die processing, assembly, packaging and testing?	
4.15h	Are certified operators identifiable by means of a card or badge on their clothing?	
4.15i	What recent manufacturing line audits (internal or external) have been performed and with what results?	

Para.	Topic	Comments
	Facilities and Equipment	
4.15j	Are requests for corrective actions issued in writing? Are such requests answered? Do corrective actions result in corrective measures being implemented?	
4.15k	Does QA Organisation maintain any statistical controls (X&R, etc.) in manufacturing and processing and are these controls up-to-date and at individual process stations?	
4.15l	Are calibrations evidenced and up-to-date?	
4.15m	Are there specific standards for handling, cleanliness and care of materials, parts and equipment available?	

Para.	Topic	Comments
	Facilities and Equipment	
4.15n	Do the equipment and facilities provide for and maintain the following: • Cleanliness of manufacturing conditions and environment • Clean room conditions and to what processes do they apply: o Production control and Screening tests o Internal Visual Inspection o Cleaning o Sealing o List others	

Para.	Topic	Comments
	Facilities and Equipment	
4.15o	Do the equipment and facilities provide for and maintain the following: • Definition of and documentation how often: o air filters are checked and changed o how often particle counts are taken in: • class 100 area • class 10000 area • class 100000 area Controls and recording of humidity and temperature	

Para.	Topic	Comments
	Facilities and Equipment	
4.15p	Do the equipment and facilities provide for and maintain the following: • Is authority granted to cease production when contamination level is exceeded? • Ensure that personnel in a clean room environment are provided with adequate protective clothing and which? • Provide clean room procedures and discipline in respect of clothing, access food consumption, allowable materials, cosmetics, etc.? • System for cleaning of components and tools?	
4.15q	Are part-finished products stored in inert atmosphere?	
4.15r	Are finished products stored in inert atmosphere?	
4.15s	Is there an ESD control program in place?	

Para.	Topic	Comments
Facilities and Equipment		
4.15t	Does the ESD control program foresee the training and certification of all the hybrid line personnel?	
4.15u	Does the ESD control program foresee the records and checks of the personnel grounding devices?	
4.15v	Does the ESD control program foresee ESD Periodic Internal Audits?	
4.15w	Does the ESD control program foresee the approval by ESD committee of any new packaging and handling material?	

4.16 PRODUCTION CONTROL AND SCREENING

Para.	Topic	Comments
	Production Control and Screening	
4.16a	Does the HM maintain an established system that provides for description of the basic technologies used for the assembly, packaging, testing and screening of hybrid microcircuit components dedicated for space use?	
4.16b	Does the HM have an established product control and screening system and is it defined in a process identification document (PID)?	

Para.	Topic	Comments
	Production Control and Screening	
4.16c	Are the following controls documented and maintained on the mounting process of chips, substrates or encapsulated components: • Temperature • Time • Pressure • Ultrasonic power • Cleanliness • Ambient conditions • Substrate pull test results • Documentation of die shear test results	

Para.	Topic	Comments
	Production Control and Screening	
4.16d	Are the following controls documented on the wire, ribbon, beam lead and lead bonding process: • Type of bonding • Temperature • Pressure • Time • Condition of capillary or electrode control • Ultrasonic power • Ambient conditions • Documentation of bond strength test	

Para.	Topic	Comments
	Production Control and Screening	
4.16e	Are devices cleaned prior to sealing? Is 100% inspection performed on clean? Are cleaning solutions changed periodically? Are filters changed periodically? Are controls of cleaning solutions in place?	
4.16f	Are devices stored and transported in protective carriers following cleaning operation?	
4.16g	Do inspectors have adequate visual aids to establish reject criteria prior to encapsulation?	

Para.	Topic	Comments
	Production Control and Screening	
4.16h	What type of internal visual inspection is performed and are rejected parts: • stored in containers for rejected parts • identified as rejected parts and how • disposed of and how	
4.16i	What type of package sealing is used? Are the following controls documented on the sealing operation? • Pre-seal bake (time temperature, ambient) • Heat (or power) used • Humidity during sealing (moisture content in ppm) • Flow rate of gases • Welding controls (pressure, power, time)	

Para.	Topic	Comments
Production Control and Screening		
4.16j	Does the HM maintain and document their in-process inspection and test system?	
4.16k	Does the HM use inspection and/or operation travellers sequential to performance and control of all operations and processes?	
4.16l	Do travellers: • refer to inspection procedures and are inspectors trained to use them and when to use them • refer to controlled specifications and do specifications issue show current revision status	
4.16m	Are there documents describing in-process manufacturing procedures and controls and are inspectors trained in when and how to use them?	

Para.	Topic	Comments
	Production Control and Screening	
4.16n	Do in-process QA Inspectors: • summarise quality experience on the basis of specific process stages? • issue quality reports on a regular basis? • do these reports result in appropriate remedial actions or improvements in the relevant processes?	
4.16o	Has QA authority to stop production flow in the case of out-of-control conditions?	
4.16p	Does the HM provide regular summary inspection and test reports to the QA management (lot acceptance, percentage of defects, types of failures)? Do these summary reports result in actions to decrease problem areas?	

Para.	Topic	Comments
	Production Control and Screening	
4.16q	Is a testing laboratory or equivalent facility available for QA purposes? Which of the following tests are performed in this laboratory or facility: • Electrical Tests o is there automatic test equipment available and are tests performed on GoNoGo or recorded basis o are DC and AC tests performed • Mechanical tests • Chemical tests	

Para.	Topic	Comments
	Production Control and Screening	
4.16r	Is an environmental test facility available in-house? If not, state where: Are the following tests performed at this facility: • Temperature • Shock (mechanical, thermal) • Acceleration • Vibration • Moisture Resistance • Altitude • Radiographic • Hermeticity (Gross and fine leak) • Lead Fatigue • Life Tests, Burn-Ins	

Para.	Topic	Comments
	Production Control and Screening	
4.16r (cont.)	• how many Burn-in positions are available • does Burn-In , Life test require soldering of leads • what precautions are taken to maintain solderability of leads after burn-in • Are charts provided for the monitoring of environmental test equipment?	
4.16s	Is final visual inspection performed on 100%?	
4.16t	State how failed components are: • separated and segregated from processed lots and how it is ensured that these components are prevented from being unintentionally reinserted with accepted components • stored for failure analysis and other investigations	

4.17 INSPECTION AND TEST FACILITIES

Para.	Topic	Comments
	Inspection and Test Facilities	
4.17a	Are in-house test facilities and measuring equipment identified, documented and brought under calibration control?	
4.17b	Are subcontracted test facilities fully identified together with their accreditation status or other recognised approval?	
4.17c	Are charts provided for the monitoring of environmental test equipment?	
4.17d	Is in-house test equipment and facilities exclusively for inspection, test and screening purposes or is it also used and/or located in other departments and if so, which departments?	

Para.	Topic	Comments
	Inspection and Test Facilities	
4.17e	Is the test facility suitably: • Illuminated • Ventilated • temperature and humidity controlled • Dust-controlled	
4.17f	Is availability of relevant inspection and test procedures at working level in the following areas ensured: • Incoming inspections • In-process inspections • Pre-cap inspections • Production control • Screening tests • Burn-in and electrical testing • Lot acceptance testing • Visual Inspections	

4.18 NON-CONFORMING AND CORRECTIVE ACTION

Para.	Topic	Comments
	Non-Conforming and Corrective Action	
4.18a	Have provisions been made for: • the identification of non-conforming product • the documentation of non-conformities • the segregation of non-conforming products • the notification of relevant functions	
4.18b	Are responsibility and authority for the disposition of non-conforming product specified, documented and maintained?	
4.18c	Are non-conforming products re-processed or reworked and is there a clearly defined reprocess and rework policy?	
4.18d	Are quality records, such as non-conformance reports, used to actively determine where corrective actions may be necessary?	

Para.	Topic	Comments
Non-Conforming and Corrective Action		
4.18e	Has the HM established an appropriate failure analysis capability?	
4.18f	Is a failure analysis procedure available and maintained?	
4.18g	Is there a maintained procedure for implementing corrective and preventive actions?	

4.19 HANDLING, STORAGE, PACKAGING AND DELIVERY

Para.	Topic	Comments
Handling, Storage, Packaging and Delivery		
4.19a	Do written procedures exist for handling, storage, packaging and delivery?	
4.19b	Are they maintaining the quality of the product, materials, piece parts, wafer/dice?	
4.19c	Do QA personnel perform audits of outgoing lots?	
4.19d	Do shipment documents reflect inspection status or evidence of inspection, identification and similar shipping requirements?	
4.19e	Are devices and invoices verified against the purchase order?	
4.19f	Are packaging and despatch methods in accordance with ESCC No. 20600?	

4.20 TRAINING OF PERSONNEL

Para.	Topic	Comments
	Training of Personnel	
4.20a	Are procedures maintained for identifying training needs and provide for the training of all personnel performing activities affecting quality?	
4.20b	Are personnel assigned to manufacture, test and inspection of dedicated space parts qualified and assessed on the basis of appropriate education, training and experience as required?	

4.21 CONTROL OF SOFTWARE

Para.	Topic	Comments
	Control of Software	
4.21a	Is there a documented software control system covering all relevant aspects of hybrid microcircuit design, manufacture and test?	
4.21b	Do procedures exist for software configuration management?	
4.21c	Are software standards and codes of practice used in programmes during design and development?	
4.21d	Is software formally accepted and verified prior to general use?	
4.21e	Do controlled, security back-up systems and copies exist for software?	

APPENDIX A
GUIDELINES FOR CHECKLIST FOR HYBRID MICROCIRCUITS MANUFACTURER AND LINE SURVEY

A summary of the general range and intent of each item of the checklist is described in the following paragraphs.

HYBRID MANUFACTURER AND SURVEY TEAM INFORMATION
See Checklist Para. 4.1.

A structured approach to the interaction between the HM and the Audit Team is an essential factor in the performance of the survey. The organisation and preparation of the survey, and the execution of the opening meeting, require an open, positive and productive relationship between the HM and the Audit Team. For this purpose a comprehensive picture of the HM and his organisation as well as the information about the appointed audit team shall be determined.

MANAGEMENT ORGANISATION
See Checklist Para. 4.2.

The structure of the Manufacturer's management organisation and responsibilities shall be determined. Particular emphasis shall be placed on the Manufacturer's management commitment to supplying space grade hybrids. The status and support given to the Manufacturer's Quality and Reliability Organisation shall also be determined.

QUALITY ASSURANCE SYSTEM AND ORGANISATION
See Checklist Para. 4.3

The effectiveness and functionality of the Manufacturer's Quality Assurance System and Organisation shall be determined.

Specific quality system requirements are given in ESCC No. 24600.

MEASURING, TEST EQUIPMENT AND CALIBRATION
See Checklist Para. 4.4.

The maintenance by the Manufacturer of a functioning and effective control and calibration system for measuring equipment, standards and test software shall be determined. Specific ESCC calibration requirements are given in ESCC No. 21500.

CONFIGURATION OF DOCUMENTS AND DRAWINGS
See Checklist Para. 4.5.

The measures established by the Manufacturer to identify documents and drawings used in the specification, contract, design, manufacture, inspection, test, packaging and release for delivery of space grade components shall be determined.

RELIABILITY
See Checklist Para. 4.6.

It shall be determined if the Manufacturer has a functioning reliability system with the necessary independence and authority to monitor reliability, investigate component reliability problems, and impose necessary corrective actions.

DESIGN OF HYBRID MICROCIRCUITS
See Checklist Para. 4.7.

The physical design of a hybrid microcircuit component is defined by a set of technology specific rules and parameters. The acquisition of data or the traceability to data verifying the geometrical layout rule set and allowing the electrical or optical evaluation of hybrid microcircuit shall ensure that the procured hybrids are suitable for space use.

PROCURMENT OF PASSIVE AND ACTIVE CHIPS, MATERIALS AND PIECE PARTS
See Checklist Para. 4.8.

The established system for procurement of passive and active chips, materials, and piece parts used in the assembly, packaging, test and delivery of hybrid microcircuits shall be determined. The procurement specifications, methods, materials, and tests for assurance of compatibility between the chip and the assembly methods and materials used by the HM, shall be considered.

INCOMING INSPECTION OF PASSIVE AND ACTIVE CHIPS, MATERIALS AND PIECE PARTS
See Checklist Para. 4.9.

The HM's established system for assessment, evaluation, and rating of suppliers, the maintenance of procurement specifications and the means for ensuring that received passive and active chips, materials, and piece parts meet the requirements of the purchase order and the procurement specification, shall be determined. The detection and handling of non-conforming materials shall also be determined.

THIN FILM PROCESSING
See Checklist Para. 4.10.

The HM's established system for thin film processing shall be determined.

THICK FILM PROCESSING
See Survey Checklist Para. 4.11.

The HM's established system for thick film processing shall be determined.

LTCC PROCESSING
See Checklist Para. 4.12.

The HM's established system for LTCC processing shall be determined.

PACKAGE MANUFACTURING
See Checklist Para. 4.13.

The HM's established system for package manufacturing shall be determined.

HYBRID ASSEMBLY
See Checklist Para. 4.14.

The HM’s established hybrid assembly technology and methods shall be determined.

FACILITES AND EQUIPMENT
See Checklist Para. 4.15.

The HM's established manufacturing, processing, testing, inspection, wafer cutting (if applicable) facilities and equipment shall be determined.

PRODUCTION CONTROL AND SCREENING
See Checklist Para. 4.16.

The HM's established system for production control, screening and rework of the hybrid microcircuits shall be determined.

INSPECTION AND TEST FACILITIES
See Checklist Para. 4.17.

The link between inspection and test results, their analysis and review, and any corrective actions, shall be determined for the HM's inspection and test system, together with the references to standards, specifications and test methods used in the inspection and test programmes. This ranges from incoming inspection testing, through in process testing, to final inspection and test.

NON-CONFORMING AND CORRECTIVE ACTION
See Checklist Para. 4.18.

The HM's established system for identification, documentation, review, segregation, disposition and notification of relevant functions for non-conforming products and processes shall be determined.

HANDLING, STORAGE, PACKAGING, DELIVERY
See Checklist Para. 4.19.

The HM's established system ensuring adequate handling, storage, packaging and delivery of wafer/dice for space use shall be determined.

Specific ESCC calibration requirements are given in ESCC No. 20600.

TRAINING OF PERSONNEL
See Checklist Para. 4.20.

The HM's established system for training of personnel shall be determined.

CONTROL OF SOFTWARE
See Checklist Para. 4.21.

The HM's established system for control of software shall be determined.