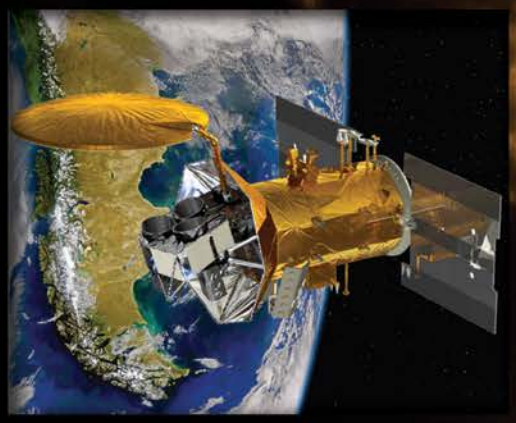
PRODUCTS FOR SPACEBORNE APPLICATIONS

narda MITEQ



Narda-MITEQ

PRODUCTS FOR SPACEBORNE APPLICATIONS

INTRODUCTION

Narda-MITEQ has supplied hardware for space-flight missions for over 33 years. Our emphasis is predominantly in technically challenging requirements, particularly in the area of:

- Custom-designed assemblies
- Frequency synthesizers
- High-performance up/downconverters
- Logarithmic amplifiers
- Low-noise amplifiers
- Microwave mixers
- Oscillators
- Receivers

For many years, Narda-MITEQ's primary area of expertise for space products was in low-noise amplifiers. However, Narda-MITEQ has been able to provide a wide spectrum of products and designs by utilizing mature technology delivered on other high-reliability programs. With our extensive space experience, we have been able to use qualification data from our existing designs while delivering custom-engineered units, thereby offering reduced cost and shorter delivery times to our customers.

CONFORMANCE TO CUSTOMER QUALITY REQUIREMENTS

Narda-MITEQ's involvement in various high-reliability space programs represents a spectrum of programmatic and quality requirements, ranging from a process and test flow similar to that of MIL-PRF-38534 Class H or K to NASA EEE-INST-002.

All open-die, thin-film products are manufactured and tested within Narda-MITEQ's clean rooms (FED-STD-209, Class 100,000 and Class 10,000) according to program requirements.

In addition to compliance to stringent manufacturing controls, Narda-MITEQ possesses the capabilities to support the **program management** and extensive **documentation requirements** of your space contracts, including:

- Configuration Control
- Design Analysis
- Design Reviews
- Dynamic Stress
- EMI/EMC
- FMECA
- MTBF
- Parts Derating
- Parts, Materials and Processes
- Process Documentation
- Radiation Susceptibility
- Thermal Analysis
- Traceability
- WCA

All analysis and support provided is based upon individual custom requirements as set forth in the customer's Statement of Work and/or specifications. Narda-MITEQ has established controls, procedures and a philosophy with the customer in mind. Delivering products that meet requirements has been paramount in all the programs we have supported throughout our history. Our track record of performance and our philosophy have secured our successes in the past, and will guarantee our success in the future.

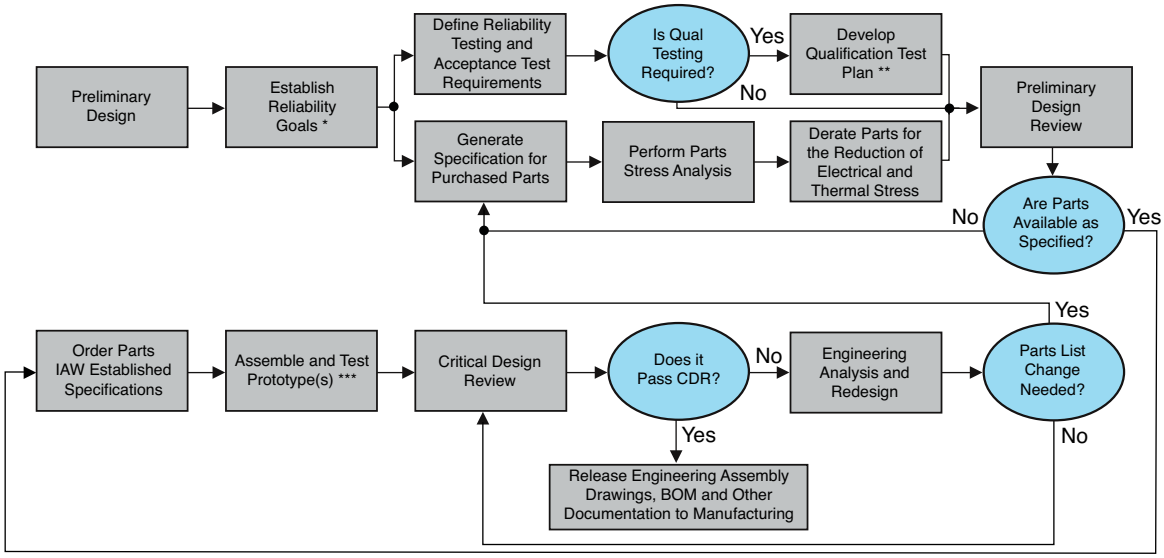
MANUFACTURING FLOW

Narda-MITEQ has established in-house standards in manufacturing processes and product flow, however, our experience has proven that almost every program has its own set of unique requirements. Thanks to the flexibility of our organization, we have been successful in adapting our existing procedures to meet specific customer requirements where "special" issues need to be addressed.

Traceability of all parts, materials and processes is available through our controlled parts lists and manufacturing, process and flow documents. The extent of traceability can be dictated by the customer, or if required, it can be tailored to support cost-reduction needs.

MANUFACTURING FLOW (CONTINUED)

Narda-MITEQ TYPICAL RELIABILITY PLAN FOR SPACE APPLICATIONS (ENGINEERING PROCESS)

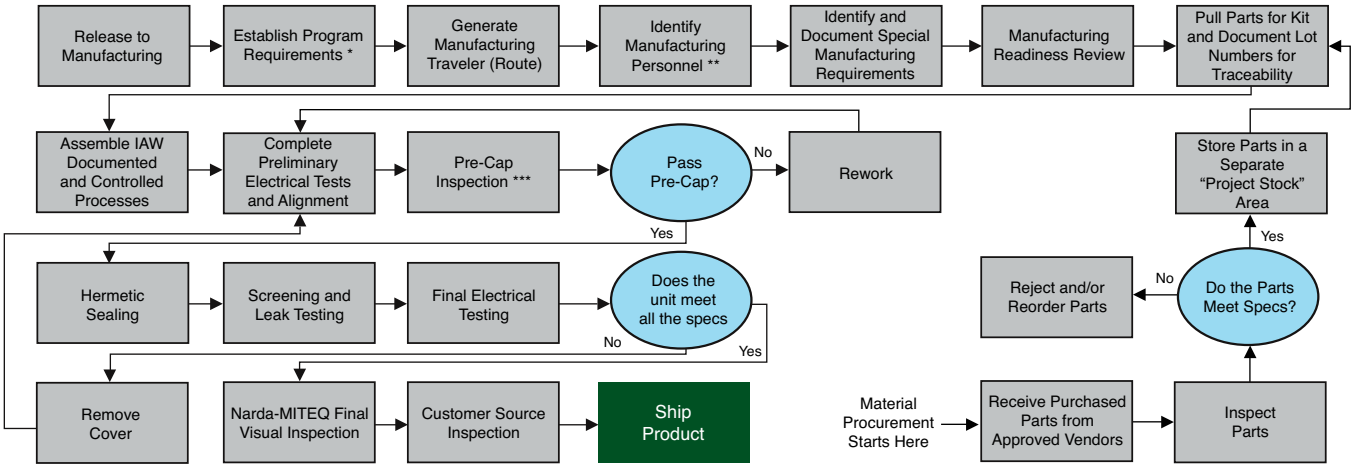


* Establish Reliability Goals: Testing may include:
- Reliability Demonstration Test (RDT)
- Accelerated Life Test (ALT)
- Highly Accelerated Life Test (HALT)

** Develop Qualification Test:
Qualification Testing consists of mechanical, electrical and/or environmental inspections as required to verify specification compliance.

*** Assemble and Test Prototype(s):
NOTE: Prototype testing includes those tests defined in the Quality Test Plan.

Narda-MITEQ TYPICAL RELIABILITY PLAN FOR SPACE APPLICATIONS (MANUFACTURING PROCESS)



* Establish Program Requirements:
Key points of consideration are: parts procurement control, program scheduling & reporting, configuration control, process control, manufacturing analysis, inspection requirements (CSI), component screening requirements and traceability requirements.

** Identify Manufacturing Personnel:
Personnel selected based upon acquired certification levels as they compare to program requirements.

*** Pre-cap Inspection:
NOTE: Pre-cap Inspection as per defined standard. Customer Source Inspection may apply.

PRODUCTS FOR SPACEBORNE APPLICATIONS

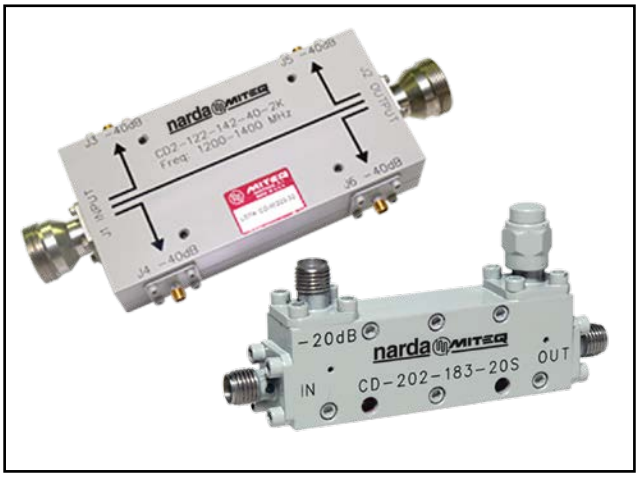
SPACEBORNE PRODUCTS

Narda-MITEQ has the expertise and knowledge to develop for the space field and earth borne stations the products to keep up with today's technology. Through various space programs, Narda-MITEQ has gained the trust of it's customers worldwide. Some of the spaceborne products that Narda-MITEQ is capable of developing are listed below:

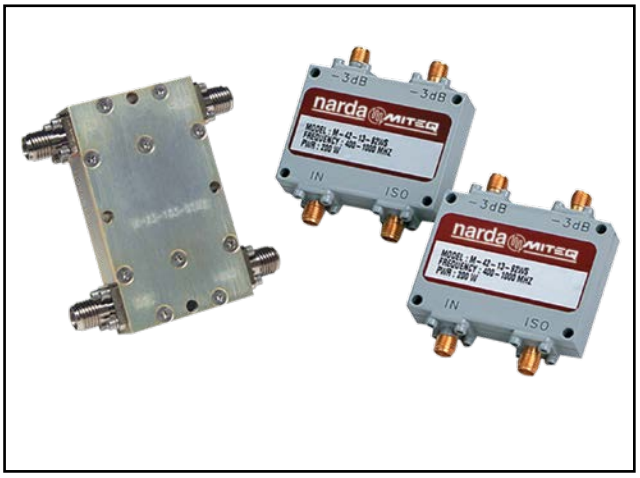
- Amplifiers
- Attenuators – PIN Diode
- Bias Tees
- Diode-Limiters
- Directional Couplers
- Four-Channel Downconverter
- Frequency Discriminators
- Frequency Generation Products
  - – Frequency Synthesizers (VHF thru Ka)
  - – Oscillators
    - - Dual Output Ku-Band Phase-Locked Oscillator
    - - Free-Running Oscillator (DROs)
    - - Ku-Band Phase-Locked Oscillator
- Hybrid Couplers 90 °/180 °
- IF Logarithmic Amplifier
- Microwave & Millimeter-Wave Conversion
  - – Image Rejection Mixers
  - – Mixers
- Modulators
- Multipliers
- PIN Diode Switches
- Power Dividers/Combiners
- Receivers
- RF/Microwave Assemblies

Amplifiers


Custom Integrated Assemblies

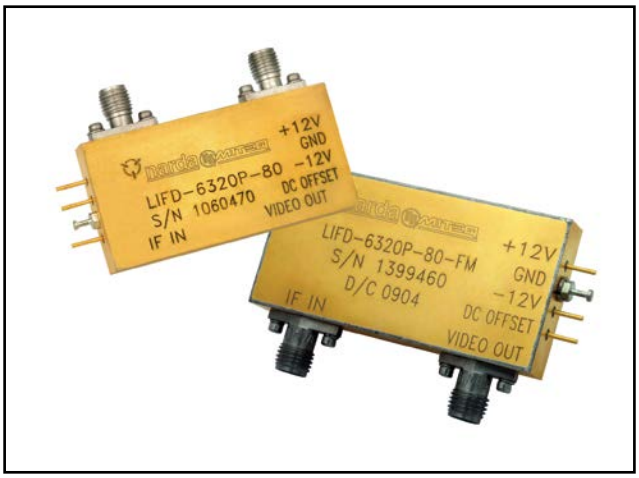


Directional Couplers



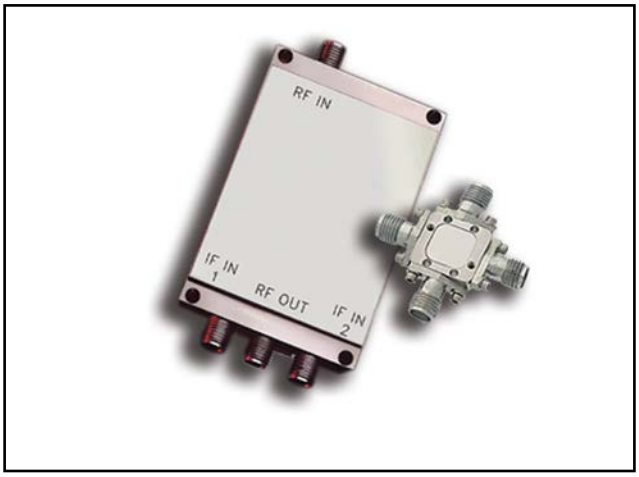
Hybrid Couplers

SPACEBORNE PRODUCTS (CONTINUED)

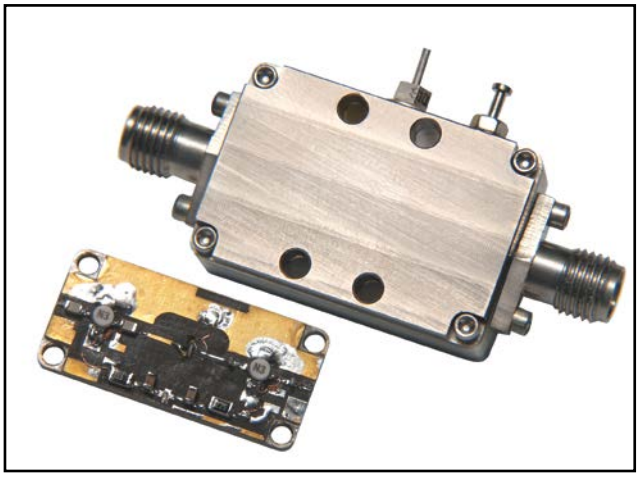


IF Logarithmic Amplifiers

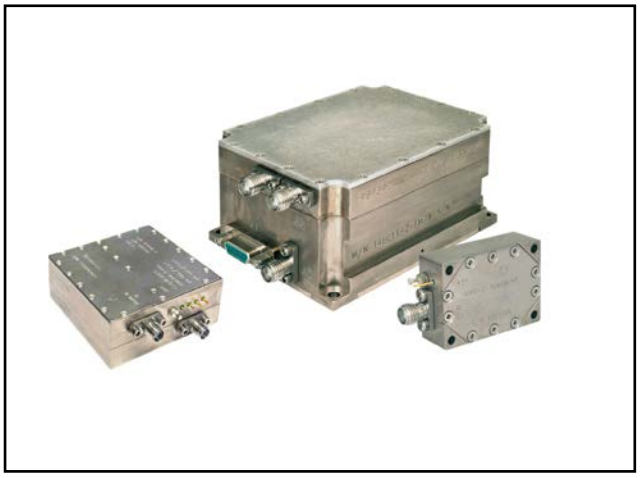
Mixers



Modulators



Multipliers



Oscillators

Power Dividers/Combiners

PRODUCTS FOR SPACEBORNE APPLICATIONS

SPACEBORNE APPLICATIONS

Narda-MITEQ's involvement with spaceborne projects for over 33 years has included: radar imaging, oceanography, atmospheric, land and polar exploration, as well as the study of sea winds.

The nearby photos and illustrations depict some of the space platforms that Narda-MITEQ supports. Listed below are some products and applications.

Frequency Generation Products
- Study the make-up of a comet
- Communication and tracking data in the network
- Navigate spacecraft (Mars Science Laboratory)
- Health telemetry
- Calibration synthesizer covering the 100 MHz to 1700 MHz Band
- Phase-locked oscillator modules covering 0.9 GHz to 19.0 GHz

IF Signal Processor Products
- Telemetry
- Range measurements

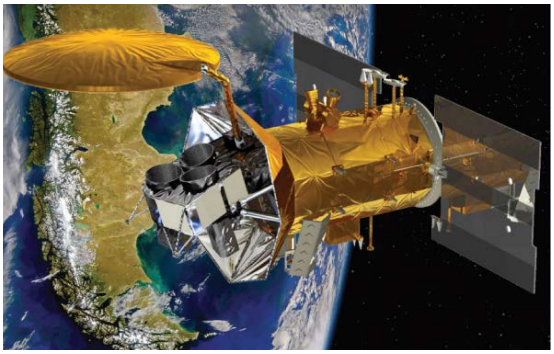
Microwave and Millimeter–Wave Conversion Products
- Low orbit-based Millimeter-Wave Radiometer
- Mix RF signals in C-Band for transmitting and receiving purposes

Space & High-Reliability Oscillators/Synthesizers
- Collect Long-Wavelength Infrared Radiation
- Cover spectral range from a far-infrared to Sub-Millimeter Wavelengths

High-Reliability/Space Amplifiers
- Communications with Earth Stations and between satellites
- Radiometry

Passive Power Components
- Communication with Earth Stations and tracking data
- Spectral processing
- Study in radioastronomy

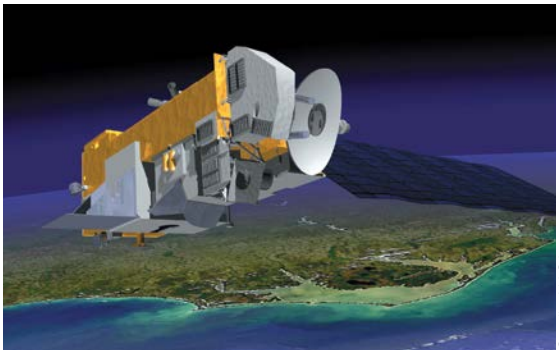
Custom Integrated Assemblies
- Measure microwave radiation emitted by ozone, chlorine compounds and other trace gases
- Wideband downconverter
- High resolution downconverter



Credit: NASA

AQUARIUS

Sea surface salinity



Credit: NASA

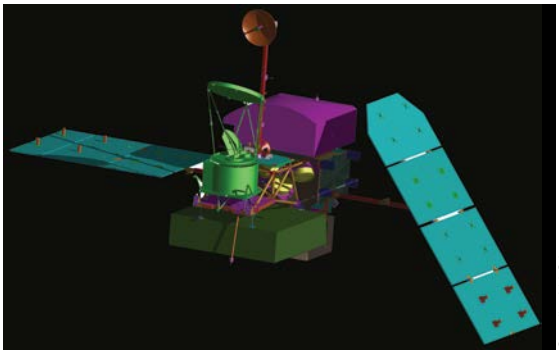
AURA

Measure microwave radiation emitted by ozone, chlorine compounds and other trace gases

Credit: NASA/JPL

CLOUDSAT & CALIPSO

Relationships between clouds and climate



Credit: NASA

GPM

Sea surface salinity

Image Disclaimer: As Narda-MITEQ's products vary on different space programs, the space program images depicted in this brochure are for illustration purposes only. These space program images do not endorse nor depict any particular Narda-MITEQ product being utilized on these missions.

SPACEBORNE APPLICATIONS (CONTINUED)

Credit: ESA

HERSCHEL

Infrared Space Telescope observing planets

Credit: NASA/JPL

JASON 2

Monitor global ocean circulation

Credit: NASA/JPL- Caltech

MARS SCIENCE LABORATORY

Collect Martian soil and rock samples

Credit: NASA

NPOESS

Monitor Global environmental conditions

Credit: ESA

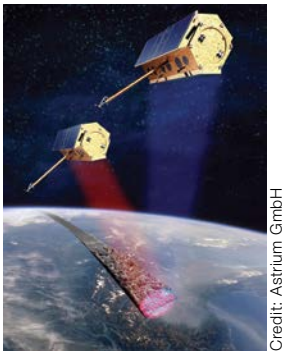
ROSETTA & LANDER

Study make-up of comet

Credit: NASA

SEAWINDS

Microwave radar that measures near-surface wind velocity



Credit: Astrium GmbH

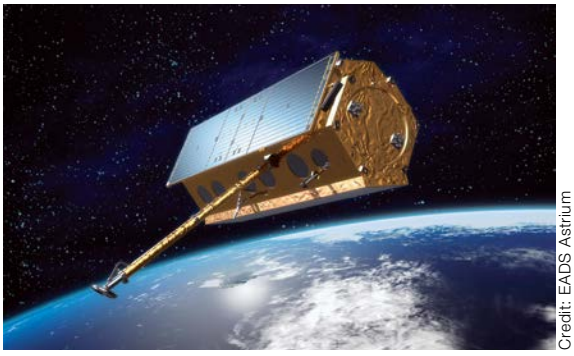
TANDEM X

Satellite laser ranging data

Credit: NASA

TOPEX

Observing and understanding the ocean circulation



Credit: EADS Astrium

TERRASAR-X

Satellite laser ranging data

PRODUCTS FOR SPACEBORNE APPLICATIONS

SPACE HERITAGE

Narda-MITEQ's continued advancements combining state-of-the-art components and unique capabilities have led to a wide acceptance by the microwave community as a leader in spaceborne technology. Our space-qualified components include mixers, oscillators, amplifiers, synthesizers and super-components.

Narda-MITEQ's Space-Qualified Quality Assurance Plan establishes the actions necessary to provide confidence that the end item will meet the quality, reliability and electrical performance required for space-qualified applications.

Below is a list of space programs which Narda-MITEQ has supported:

NARDA-MITEQ CUSTOMER	END USER	PROGRAM
Northrop Grumman	NASA	NPOESS
Northrop Grumman	-	Corvair
NT-Space	JAXA	Global Precipitation Measurement
Jet Propulsion Labs	NASA	Mars Science Lab
Comdev	JPL	Cloudsat
NASA	NASA	Aquarius
Applied Physics Lab	NASA	New Horizons
ASTRIUM GmbH	DLR	TanDEM X
ASTRIUM SAS	ISRO	Megatropics
MacDonald Dettwiler	CSA	Radarsat II
ALCATEL Space	German DOD	SAR-Lupe
ALCATEL Space	JPL	Jason-2
Lockheed Martin	USAF	Alpha Extension
University of Bordeaux	ESA	Herschel
SRON	ESA	Herschel
Technologica	CSA	Herschel
Max Plank Institute	ESA	Herschel
Dornier	DLR	TerraSAR-X
Jet Propulsion Labs	NASA	Miro, EOS-MLS
Assurance Technology	U.S. Navy	Windsat
ITT	USAF	Alpha I-IV
Motorola/GD	USAF	P-94-99, 02
E-Systems	JPL	SEAWINDS
Matra Marconi	EUMESAT	MHS
E-Systems	JPL	GEOSAT
Aerojet	USAF	SSMIS, AMSU-B
Millitech	USAF	SSMIS
Lockheed	USAF	STS-54
Applied Physics Lab	U.S. Navy	Seasat, Spinsat, Topex, Extended Test Bed
Millitech	Ball Aerospace	Global Microwave Imager
Harris	USAF	Alpha Extension
Jet Propulsion Labs	NASA	AURA
Jet Propulsion Labs	ESA	Rosetta and Lander
CONAE	CONAE	Aquarius/SAC-D
Northrop Grumman	NOAA	JPSS
Jet Propulsion Labs	NOAA	COSMIC
Jet Propulsion Labs	NASA	GRAIL
JHU/APL	NASA	Radiation Belt Storm Probe (RBSP)

For additional technical information on our space product capabilities, please contact our Sales Department at (631) 439-9220 or email satcomsalesnm@nardamiteq.com.

FACILITIES

Narda-MITEQ owns and occupies a building located in Hauppauge on Long Island, New York, a total of 150,000 square feet which include the following facilities:

- Clean Rooms:
  Six Class 100K clean rooms
  Two Class 10K clean rooms (operation to 1K)
- Manufacturing:
  160,000 sq. feet of manufacturing space
- Test Equipment:
  Vector network analyzers, spectrum analyzers and phase noise test sets
- Machine Shop:
  15 CNC machines supporting kovar, copper tungsten, aluminum and other metals
- Two Glass Sealing Furnaces
- Hermetic Sealing:
  Seam-welding and projection welding
- Environmental Labs:
  Temperature cycle/shock, mechanical shock and vibration
  Temperature/humidity, fine and gross leak testing and PIND testing
- Chemical Facilities:
- Chemical plating and etching capability of microwave circuits, including plated-through-hole technology (PTH) and tight tolerance printed filters, immersion silver (Ag) and electroless nickel/immersion gold (ENIG) plating over copper for PCB finish, Trivalent Chromate conversion process for aluminum parts, powder coating process for SATCOM outdoor products and paint systems for Narda-MITEQ products
- PCB and Thin-Film Lab
- In-house automated assembly which includes: two SMT pick and place machines (Mydata 12 with vision and Mydata 9 with vision) and three MRSI 505 automated pick and place machines for chip and wire assembly, test equipment, X-ray, bond pull/die shear equipment

FACILITIES (CONTINUED)

Class 100K Clean Rooms

Class 10K Clean Rooms

Machine Shop

Supporting kovar, copper tungsten, aluminum & other metals

Glass Sealing Furnace

For glass seal feedthroughs

Automated Epoxy And Die Placement

Hermetic Sealing

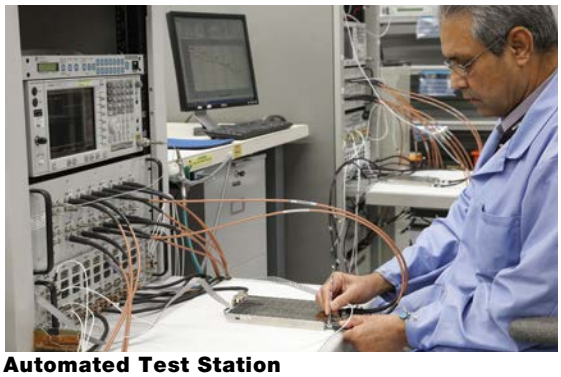
Seam welding and projection welding

Automated Wire Bonding

Bonding Pull And Die Shear

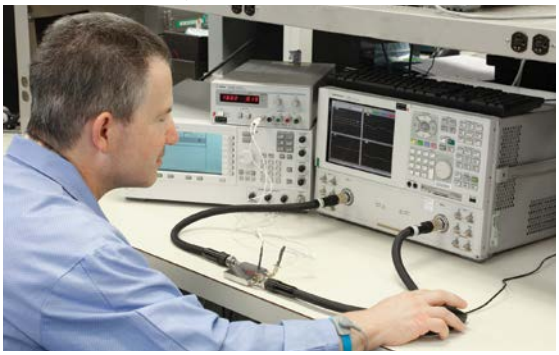
FACILITIES (CONTINUED)

X-Ray Inspection

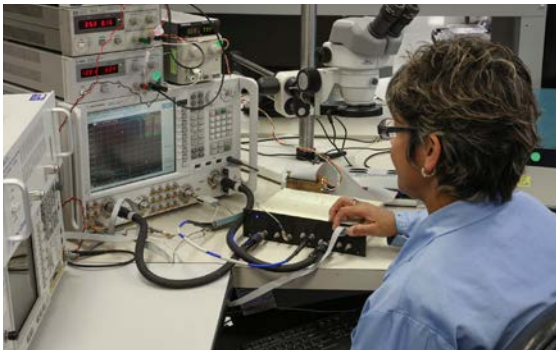


Automated Test Station
Vector network analyzers

Production Test

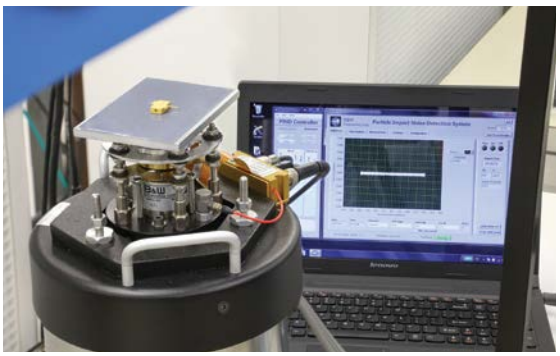


Microwave Engineering
Vector network analyzers



Fiber-optic Test

Thermal Shock
Temperature cycle/shock



Environmental Testing
Mechanical shock and PIND testing

Environmental Testing
Fine and gross leak testing

PRODUCTS FOR SPACEBORNE APPLICATIONS

HIGH-RELIABILITY PROGRAM CHECKLIST

Process Control Requirements
- ☐ Process control drawings
- ☐ Assembly travelers
- ☐ Test plans
- ☐ Test procedures

Parts Procurement Control
- ☐ Source control drawings for die and packaged parts only, or including substrates, passive parts, housings, etc.; should also include definition of element evaluation profile (100% and lot basis)
- ☐ Traceability logs
- ☐ Parts storage requirements
- ☐ Age limitations
- ☐ Customer parts approval

Reports
- ☐ Status reports (_____ interval)
- ☐ Customer interface meetings (_____ interval)
- ☐ Design reviews (_____ number)

Configuration Control

Reports and Analysis
- ☐ Thermal analysis
- ☐ Mean time between failure (MTBF)
- ☐ Failure analysis
- ☐ Failure mode effects analysis (FMECA)
- ☐ Worst case analysis (electrical performance)
- ☐ Stability analysis
- ☐ Parts derating
- ☐ Radiation susceptibility analysis/test
- ☐ EMI/EMC analysis/test

Customer Source Inspections
- ☐ Production documentation review
- ☐ Precap visual
- ☐ Final source inspection (testing and documentation review)

Purchased Elements/Components
- ☐ Narda-MITEQ Screening
- ☐ Narda-Military Grade (QPL, JAN, ER)
- ☐ Narda-MITEQ Element Evaluation similar to MIL-PRF-38534 Class H
- ☐ Narda-MITEQ Element Evaluation similar to MIL-PRF-38534 Class K
- ☐ Customer-defined

100% Unit Screening
- ☐ Narda-MITEQ Screening
- ☐ MIL-STD-883, Class _____ Similar Test Flow
- ☐ MIL-PRF-38534, Class _____ Similar Test Flow
- ☐ Customer-defined

Unit Quality Control Inspection (QCI) Testing
- ☐ MIL-STD-883 Group B testing
- ☐ Additional testing
- ☐ Customer-defined

Qualification Testing
- ☐ MIL-STD-883 Group C and D testing
- ☐ Additional testing
- ☐ Customer-defined

Process Qualification
- ☐ Process verification testing, (e.g., extended life tests, extended temperature cycles, destructive physical analysis, etc.)

Lot Requirements
- ☐ Manufactured timing constraints (homogeneous lot restrictions)
- ☐ Build vs. pass percentage for lot acceptance

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