



TELEDYNE
MICROELECTRONIC TECHNOLOGIES
Everywhere you look™

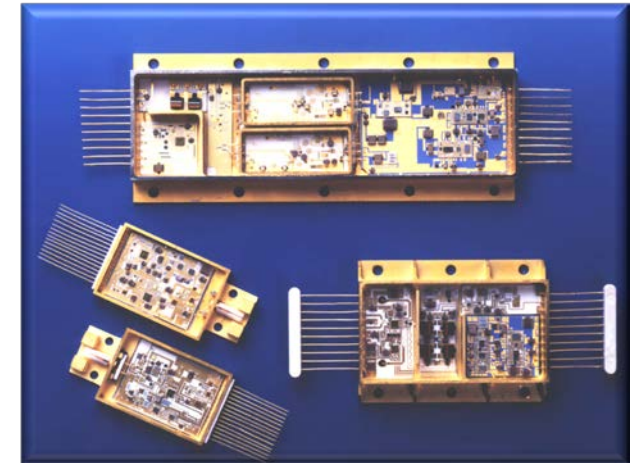
RF & Microwave

Packaging Capabilities & Engineering Services



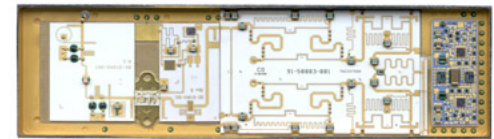
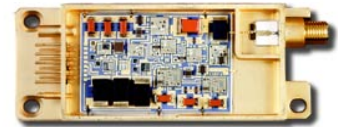
RF & Microwave Applications

- Detector Log Video Amplifier(DLVA)
- Detector Video Compression Amplifier (DVCA)
- Low Noise Amplifiers (LNA)
- Medium Power Amplifiers (MPA)
- Successive Detection Log Amplifier (SDLA)
- Amplifier Controls (Pre, Variable, Gain, Driver, MMIC)
- Converters (Up, Down, High Band, Low Band)
- Detectors (Bit, RF, Log)
- Diplexers
- Filters (Bandpass, Low, High)
- Frequency Discriminators
- Frequency Doubler and Frequency Synthesizer
- GPS RF Processors
- Modulator (PFM)
- Multi-channel Video Module
- Multi-throw Switch Assembly
- Receivers (Wideband, Crystal Video)
- Ripple Counters
- Switch Combiners
- Tracking Converters and Processors
- Transmitters & Receivers



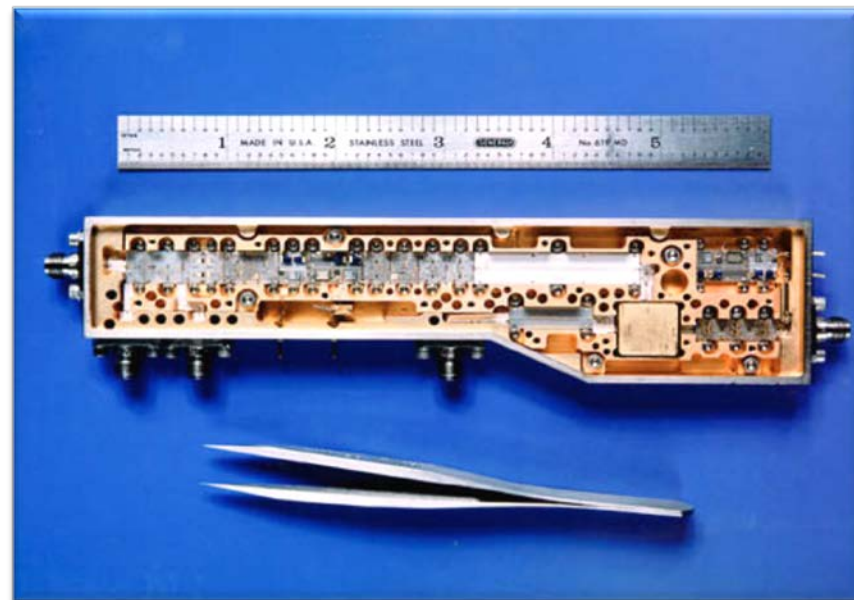
RF & Microwave Technologies

- Surface mount assembly (mixed mode)
- Eutectic and epoxy die attach
- Auto die attach
- Flip chip
- 0.7, 1 mil gold wire bonding
- Manual ribbon bonding
- Testing to 65 GHz
- Active or passive laser trim
- Hermetic construction with replaceable SMA connectors
- -55°C to +125°C electrical
- Burn-in capability
- Thin film microstrip subassemblies
- Multiple substrate construction: thick film substrate with boards
- SPC monitoring



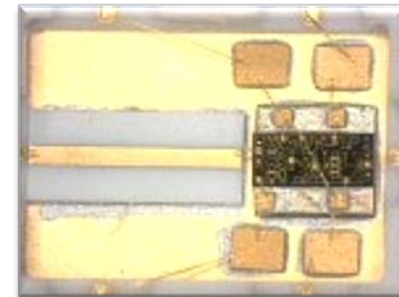
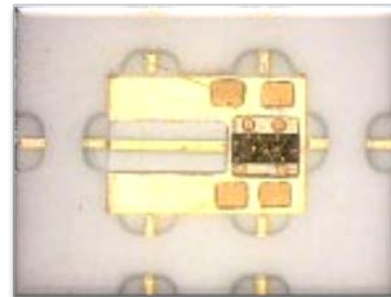
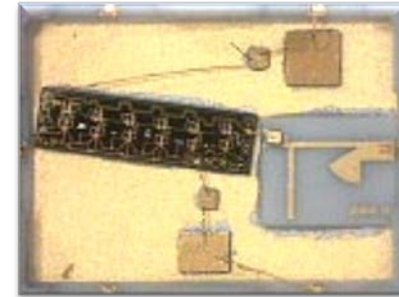
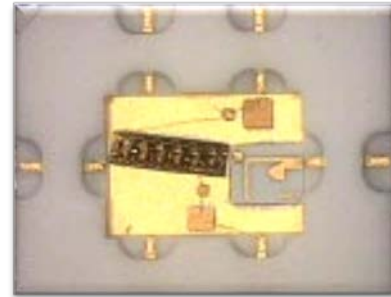
Downconverter

- Airborne Radar System
- Multiple substrate construction
- Broadband
 - RF: 2-8 GHz
 - IF: 650 - 1250 MHz
 - LO: 240 MHz
 - Temperature compensated



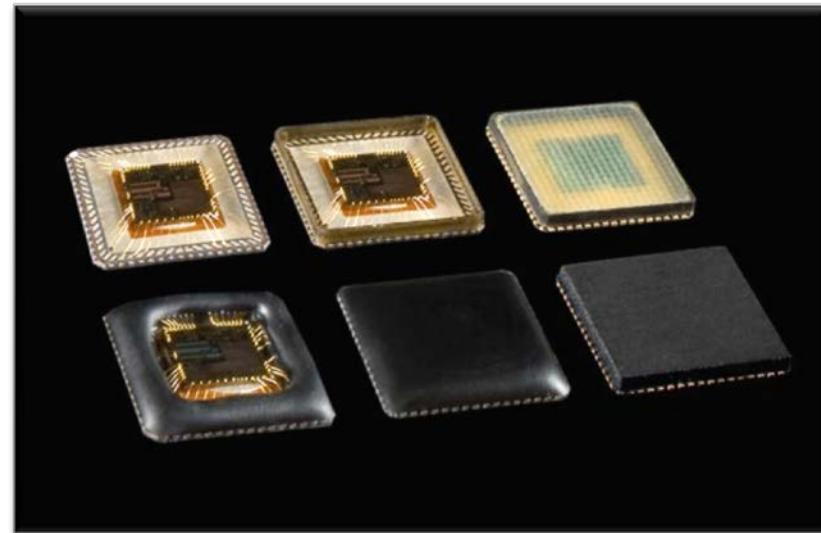
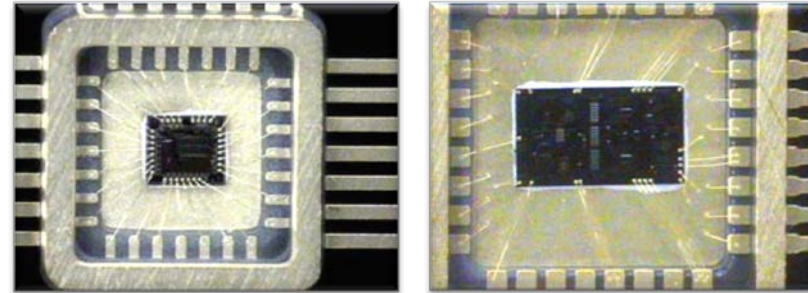
MMIC Chip Evaluation, Packaging & Test

- Amplifiers, Splitters, Filters, Combiners, Mixers, etc.
 - Up to 43 GHz
 - 24 part types
 - Eutectic or Epoxy Die Attachment
 - Au Wire Bonds
 - Low Cost Ceramic SMT Packages (JEDEC)



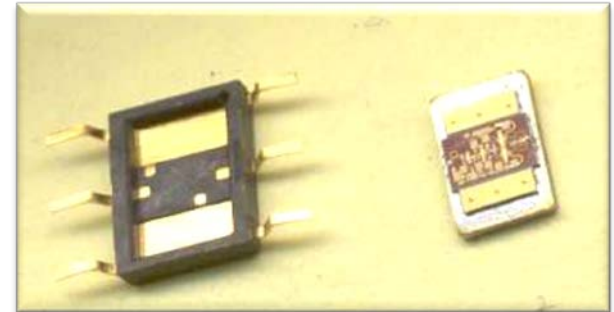
MMIC Chip Evaluation, Packaging & Test

- Amplifiers, Detectors, Switches
 - Up to 3.3 GHz
 - 6 circuits
 - Eutectic or Epoxy Die Attachment
 - Au Wire Bonds
 - Hermetic Ceramic Flat Packs
 - Plastic Encapsulated Leadless Carriers (JEDEC)



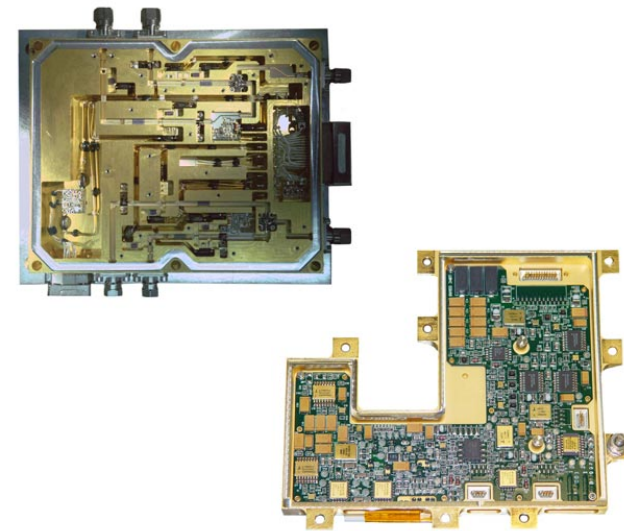
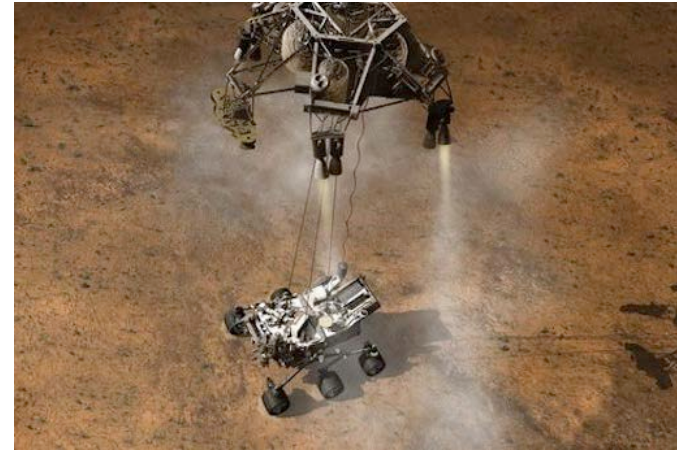
High Frequency Flip Chip

- A prototype built for C-band Power amplifier, including 2 by-pass capacitors
- Preserves microstrip structure
 - Can be applied to virtually all existing dies
 - Placement accuracy is not very critical.
- Heat transfers in the classical way, from the back of the die
 - Well suitable for power devices
- Solid grounding to avoid common problems
 - Eliminates problem of radiation from the flipped die
- Plastic DIP packages



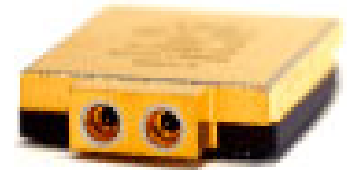
Mars Science Laboratory Curiosity Rover RF Modules

- Two RF modules on the terminal descent and landing unit of the MSL Curiosity Rover
- Transmit /Receive Module (TRM)
 - Combines a channelized portion with a surface mount PWB
 - 35 GHz frequency band
 - 5" square x 1.5" thick
 - Hermetically sealed via laser sealing
- Up/Down Microwave Module (UDMM)
 - Channelized design utilizing a chain of substrates connected by ribbons and wirebonds
 - 35 GHz frequency band
 - 5" square x 1.5" thick
 - Hermetically sealed via laser sealing
- Both modules designed by JPL with extensive manufacturing design inputs from Teledyne
- 7 EDU and 14 flight UDMM's and 12 EDU and 20 flight TRM's were delivered and tested by the customer



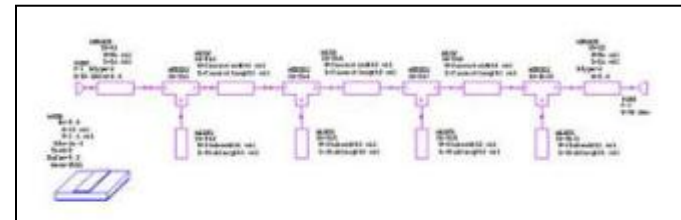
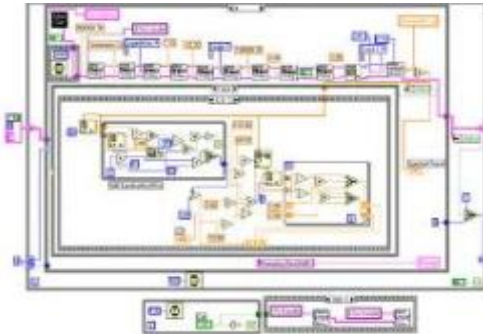
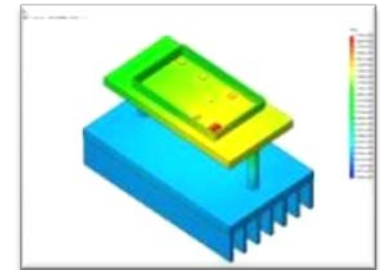
Optical Mux, DeMux, Transponder

- OC768 for Optical Routers & Transponders
- 16 channels, multiple rates to 44 Gbps
- Highly integrated single chip modules
- High frequency and noise isolation
- Solder bump flip chip
- High Temperature Co-fired Ceramic (HTCC) BGA substrate
- Utilizing stripline and microstrip provisions



RF/Microwave & Optoelectronics Design Tools

- 2D Microwave - EEsolf, Microwave Office
- 3D Microwave - Ansoft, HFSS
- Photonic Design and Simulation
 - Zemax – Far Field Optics
 - RSoft – Near Field Optics
- Mentor Graphics MCM Station
 - Schematic Capture
 - Autorouting
 - High Speed/Crosstalk Analysis
 - Idea - Schematic Capture, Digital Simulation
 - Quick Fault - Test Vector Generation
- Pro Engineering, Pro Mechanical, COSMOS, SolidWorks
 - 3D Mechanical Design
 - FEA, Stress Analysis, Thermal Analysis, Dynamic Analysis
- OrCad
 - Schematic Capture
 - Autorouting
- AutoCAD
 - Substrate layout
 - Hybrid packaging design
 - Microelectronic interconnection
- PSPICE
 - Design, Analysis and Simulation



Test Technologies



VLSI Tester



Multifunction Test Stations



Custom ATE Station



Fiber Optic Test Stations



Fiber Optic Tx/RX Tester



RF Test Bench



High Power Tester



Solid State Power ATE



Cryptologic Tester

Diversified Packaging Technology Portfolio

- Substrates

- Ceramics

- Al₂O₃, BeO, AlN
- Multi-layer thick film
 - Standard
 - Photo-etchable
 - High Frequency
- Single-layer thin film
- Cofired (LTCC, HTCC)

- Laminates

- FR-4
- Polyimide
- Rigid-Flex
- Insulated Metal
- Proprietary High Tg

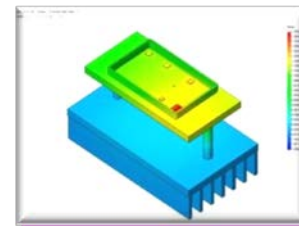


- Assembly

- Chip and wire
- Flip Chip
- SMT
- Mixed Technologies
- Chip Scale Packaging

- Technical Expertise

- Multi-disciplinary product engineering
- Routing and layouts
- Circuit simulation, design, analysis
- Established processes, SPC monitored
- Concurrent Engineering Teams



RF & Microwave Substrates

- Thin Film Ceramic
 - Nickel & Gold Plating
 - Nichrome, TaN, Gold & TiWn Sputtering
 - Fine line capability (0.001" lines w/0.0005" spacing)
 - Nichrome & TaN resistors
- Thick Film Fine Line Ceramic
 - FODEL
 - Photo-Etchable
 - Low-K Dielectric



High Frequency Thick Film

- DuPont Fodel

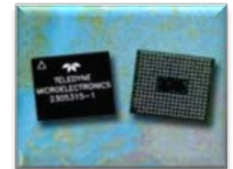
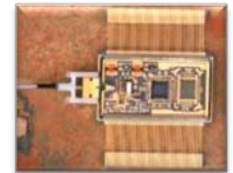
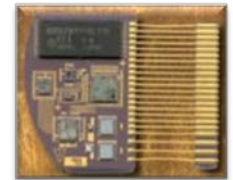
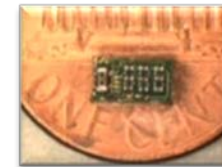
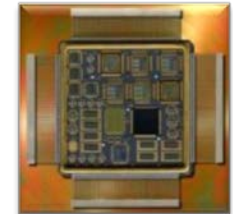
- Characterized to 19 GHz
- Metallization - Au, Ag
- 2 mil lines and spaces, 3 mil vias
- Uses standard thick film manufacturing techniques
- 2" x 2" wafers standard
- Resistors - 20 x 20 mil to 40 x 40 mil

- Etchable

- Characterized to 50+ GHz
- Metallization - Au, Ag
- 1.5 mil lines and spaces, 2 mil vias
- Resistors - 10 x 10 mil

Enabling Packaging Technologies

- Ball Grid Array (BGA & micro BGA)
- Ceramic Quad Flat Pack (CQFP)
- Chip & Wire and Surface Mount Assembly (SMT)
- Chip on Board (COB)
- Chip Scale Packaging (CSP)
- Detachable Fiber Optic (DFO) connector
- Direct Bonded Copper (DBC)
- Flip Chip die attach/interconnect (FC)
- Flip Chip on flex
- Laminate: Flex, Stacked/folded/encapsulated
- Laminate: FR4 Epoxy, PTFE, Polyimide
- Land Grid Array (LGA)
- Multi-Chip Scale Packaging (MCSP)
- Optics: for High Brightness LEDs
- Stud Bumping (Gold & Solder)
- Substrates: Thin & Thick film, LTCC, HTCC



Manufacturing Technologies

Microelectronic Interconnection:



Dispensing



Die Attach



Wire Bonding



Flip Chip

SMT:



Stenciling/Screen Printing



SMT Pick & Place



Solder Reflow

Packaging:



Cover Seal



Encapsulation

Process Validation & Environmental Screening



**Wire Bond Pull
and Shear Tester**



Sonoscan



Pressurizing Helium Chamber



Temp Cycling



Fine Leak Test



Gross Leak Test



Real Time X-Ray



HAST



Centrifuge



Vibration



Mechanical Shock



**X-Ray Fluorescence
Tester**

Test Technologies



VLSI Tester



Multifunction Test Stations



Custom ATE Station



Fiber Optic Test Stations



Fiber Optic Tx/RX Tester



RF Test Bench



High Power Tester



Solid State Power ATE



Cryptologic Tester

Test Capabilities

Manufacturer	Model	Description	Speed/Bandwidth
Agilent	8722ES	Network Analyzer	50 MHz – 40 GHz
	8753C	Network Analyzer	300 KHz – 3 GHz
	4195A	Network / Spectrum Analyzer	10 MHz – 500 MHz
	N8975A	Noise Figure Analyzer with Frequency Conversion Measurement Capabilities	10 MHz – 26.5 GHz
	70820A	Microwave Transition Analyzer	DC – 40 GHz
	70340A	Signal Generator	1 – 20 GHz
	70341A	Frequency Extension Module	0.01 – 1 GHz
	86100A	Digital Communication Analyzer	12 GHz
	8482A	Power Sensor	100 KHz – 4 GHz
	83484A	Dual Channel 50 GHz Electrical Plug-in/Measurement Module	50 GHz
	83485B	30 GHz optical/40 GHz electrical Plug-in/Measurement Module	30 GHz / 40 GHz
	8703B	Optical Spectrum Analyzer	50 MHz – 20 GHz
	8702D	Optical Spectrum Analyzer	3 KHz – 3 GHz
	8703A	Lightwave Component Analyzer	130 MHz – 20 GHz
	86030A	Lightwave Component Analyzer	50 GHz
	83433A	Lightwave Transmitter	10.7 GHz
	86100A	Digital Communication Analyzer	12 GHz
	71612	Error Performance Analyzer	12 GHz
	86140B	Optical Spectrum Analyzer	600 to 1700 nm
	86142B	Optical Spectrum Analyzer	600 to 1700 nm
	71501C	Jitter Analysis System	40 GHz
	8504B	Precision Reflectometer	1300 to 1500 nm
	E4407B	Spectrum Analyzer	9 KHz – 26.5 GHz
	E8362B	Performance Network Analyzer with Frequency Conversion Measurement	10 MHz – 20 GHz
	E8257C	Signal Generator	250 MHz – 20 GHz
	E4418B	Power Meter	18 GHz
	E4412A	Power Sensor	18 GHz
	54845A	4 Channel Oscilloscope	1.5 GHz
	83651B	Synthesized Signal Source / Sweeper	10 MHz – 50 GHz
	83752A	Synthesized Signal Source / Sweeper	10 MHz – 20 GHz
93000	VLSI Tester, 512 pins	400 MHz	
HP82000	VLSI Tester, 480 pins	200 MHz	
Anritsu	MS9710B	Optical Spectrum Analyzer	600 to 1750 nm
	69047B	Synthesized Signal Source / Sweeper	10 MHz – 20 GHz
Takeda Riken	T3340	VLSI Tester, 256 pins	40 MHz
GEN RAD	2225	Static Functional, 192 pins	17 KHz
LTX	MTS-77	Analog, 48 pins	100 KHz

Certifications and Qualifications

- MIL-PRF-38534, General Specification for Hybrid Microcircuits
 - Facility and Manufacturing process certified and qualified by DSCC for Class “H” and “K” devices
 - Laboratory Suitability to MIL-STD-883 for 21 test methods
- ISO 9001:2008, Quality Management System
- SAE AS/EN/JISQ9100:2009 Revision C
- D6-82479 Appendix A, Advanced Quality Systems
 - Facility certification to Boeing D1-9000 updated in June 2002 to include AS 9100
- MIL-STD-790, Product Assurance Program for Electronic and Fiber Optic Parts Specification
- MIL-PRF-28750, Qualified Products List - Solid State Relay
- DOD DMEA (Defense Microelectronics Activity) Microelectronics Trusted Source

