



# **NASA Electronic Parts and Packaging (NEPP) Program: CubeSat Parts Lists and Supply Chain**

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# Overview

- **Objective**
- **CubeSat Supplier Boards/Kits**
- **CubeSat Supply Chain and Part Usage**
- **NASA CubeSats**
- **NASA CubeSat Parts Database**
- **Conclusion**



# Objective

- 1. Understand the CubeSat supply chain and part usage by CubeSat board and kit manufacturers**
- 2. Obtain, characterize, and quantify EEE parts information for NASA CubeSat missions**



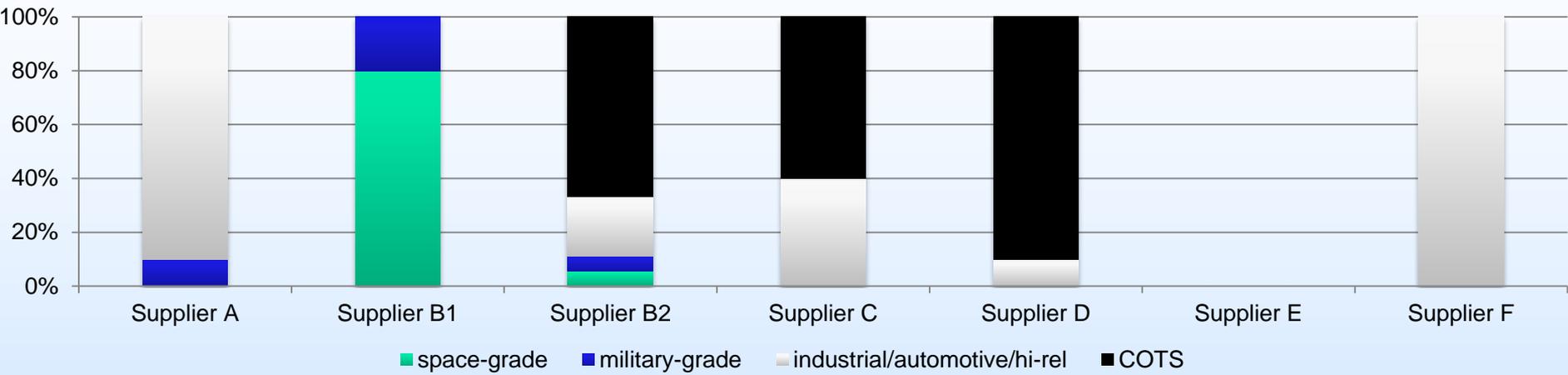
# CubeSat Supplier Boards/Kits

- **Projects are purchasing a variety of board and kit types:**
  - Transmit/receive modules
  - Motherboards
  - Processor modules
  - Computer board
  - Power board
  - ADCS
  - C&DH
  
- **...And they're purchasing them from a variety of suppliers:**
  - Pumpkin
  - Andrews Space
  - Blue Canyon Technologies
  - AAC Microtec
  - Tyvak Nano-Satellite Systems
  - GomSpace
  - Maryland Aerospace
  - ISIS
  - Clyde Space



# Supply Chain

Q: What percentage of parts procured are space, military, industrial/auto/hi-rel, COTS?



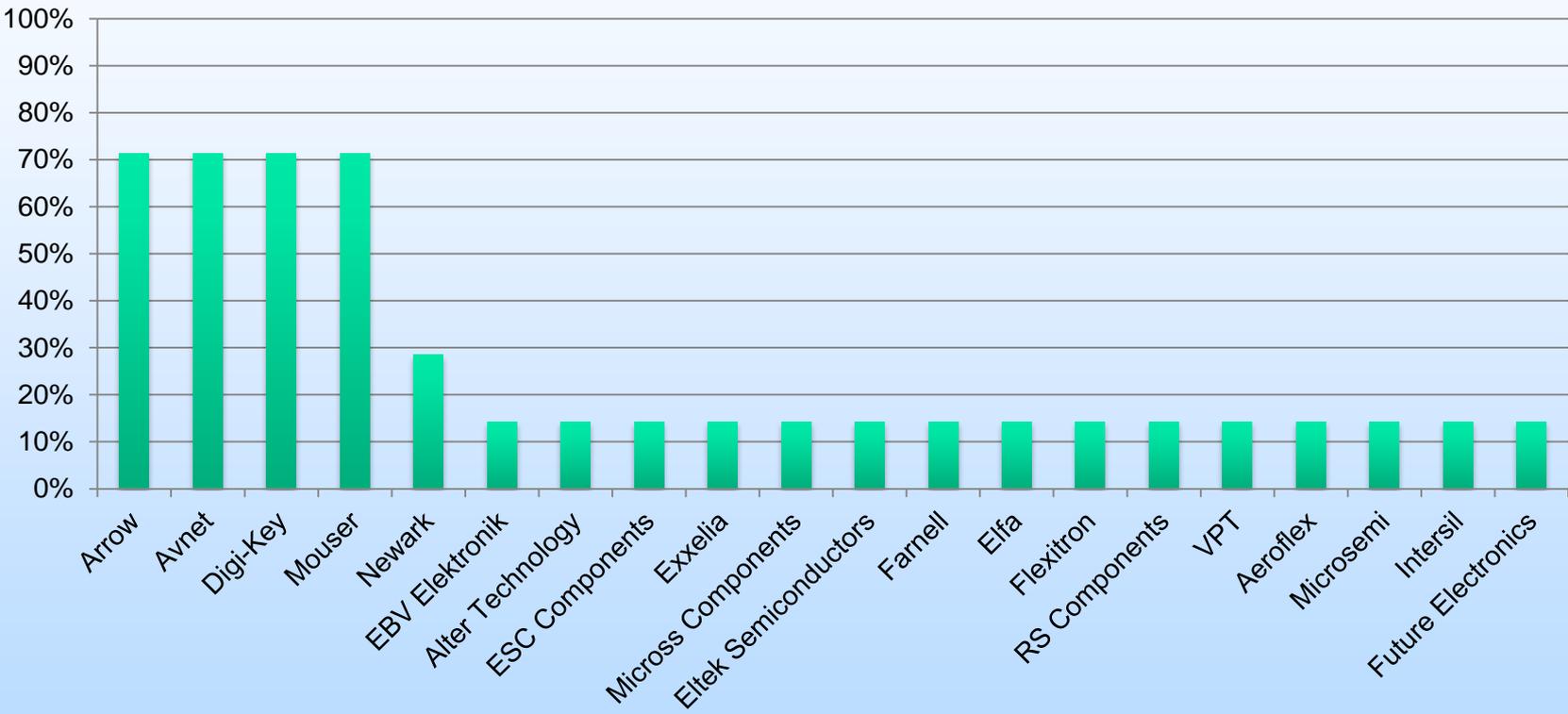
Q: What percentage of parts procured are RoHS?





# Supply Chain

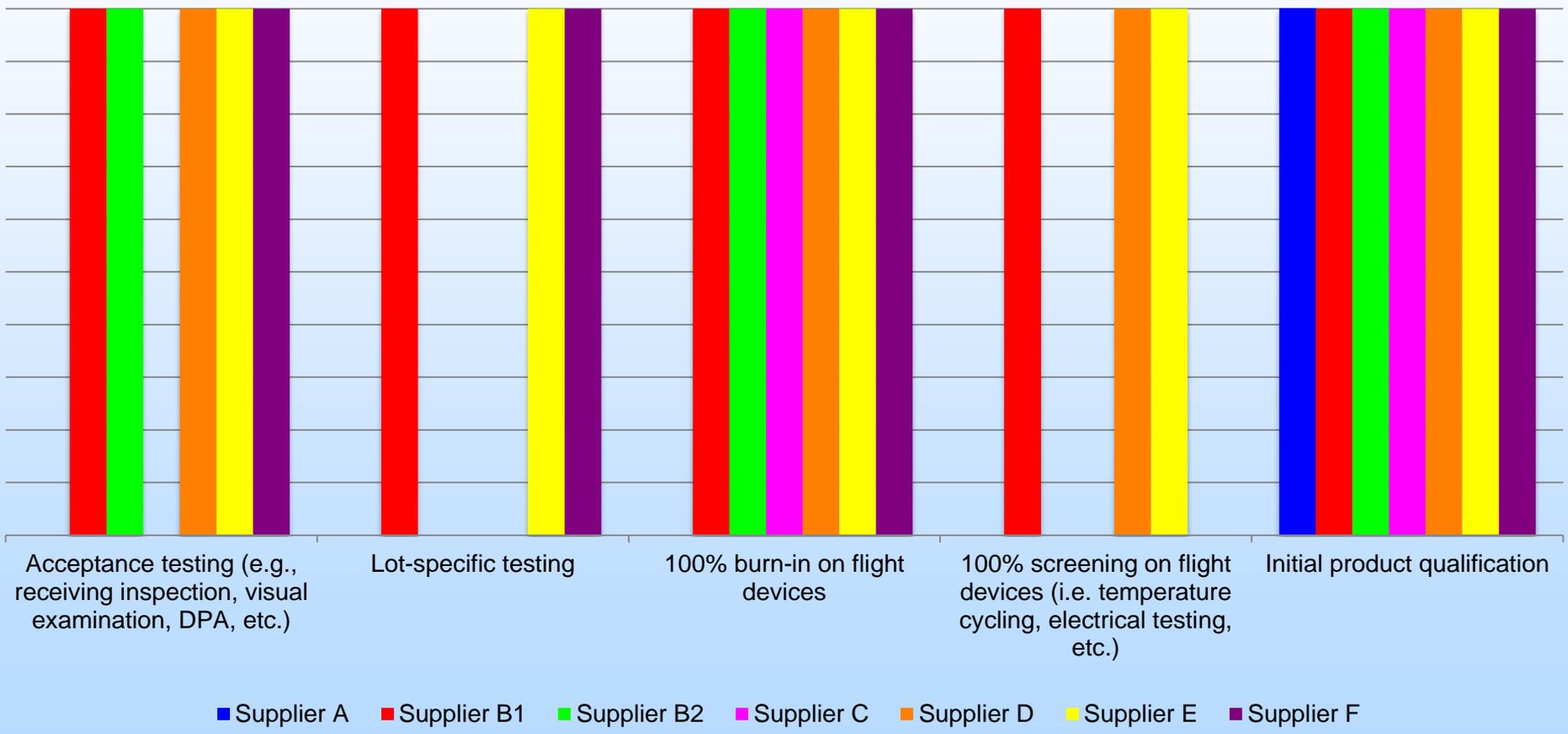
Q: List all EEE part suppliers you procure from.





# Part Usage

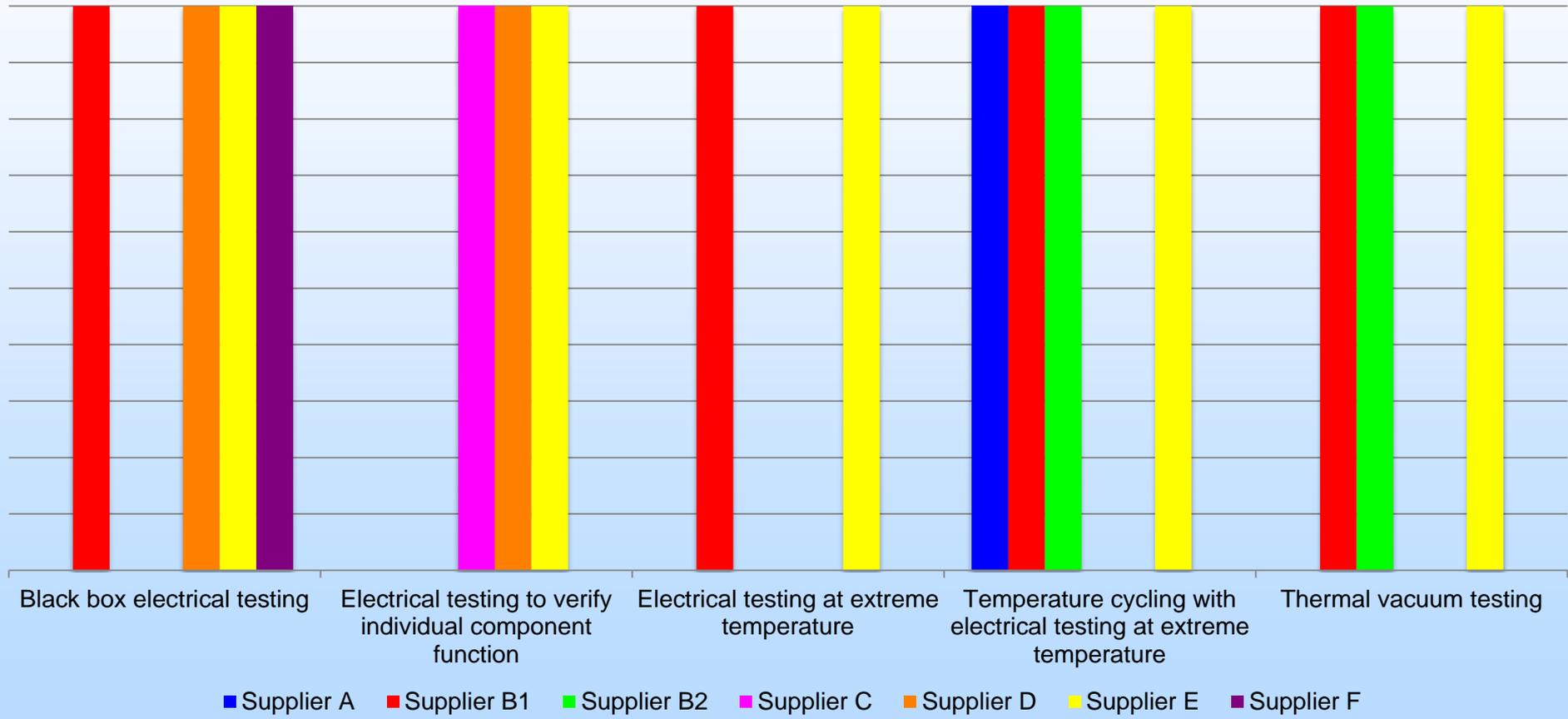
Q: What type of part qualification do you perform?





# Part Usage

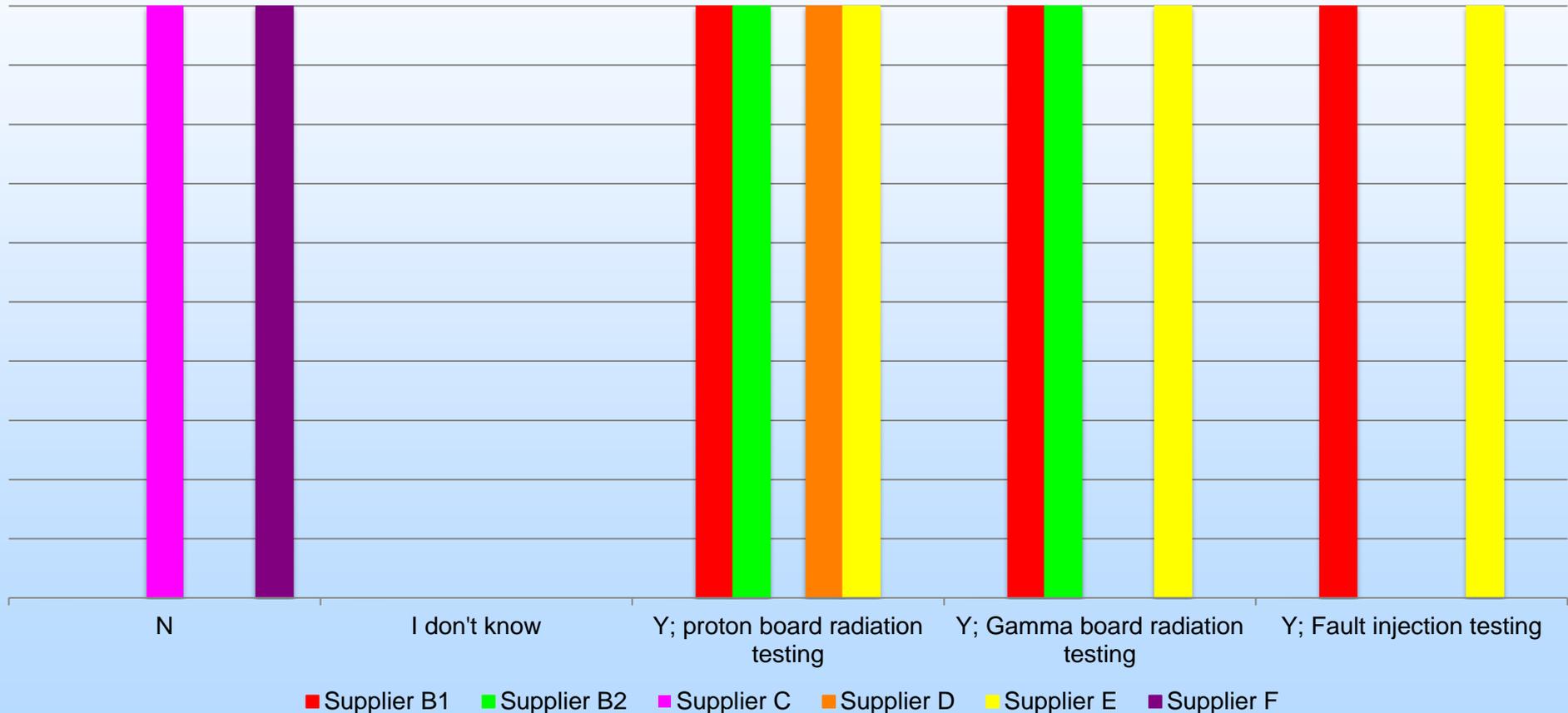
Q: What type of electrical verification of boards do you perform?





# Part Usage

Q: Do you perform board level testing for radiation?





# NASA CubeSats

- **The number of NASA CubeSat missions is growing**
  - Extensive involvement and interest throughout the agency, between its centers, and its industry/university partners
- **In-house designs represent a percentage of the electronics on the CubeSat**
- **A subset of NASA CubeSat projects provided parts lists/BOMs**
  - In-house board designs for various assemblies: ADCS, C&DH, EPS, etc.

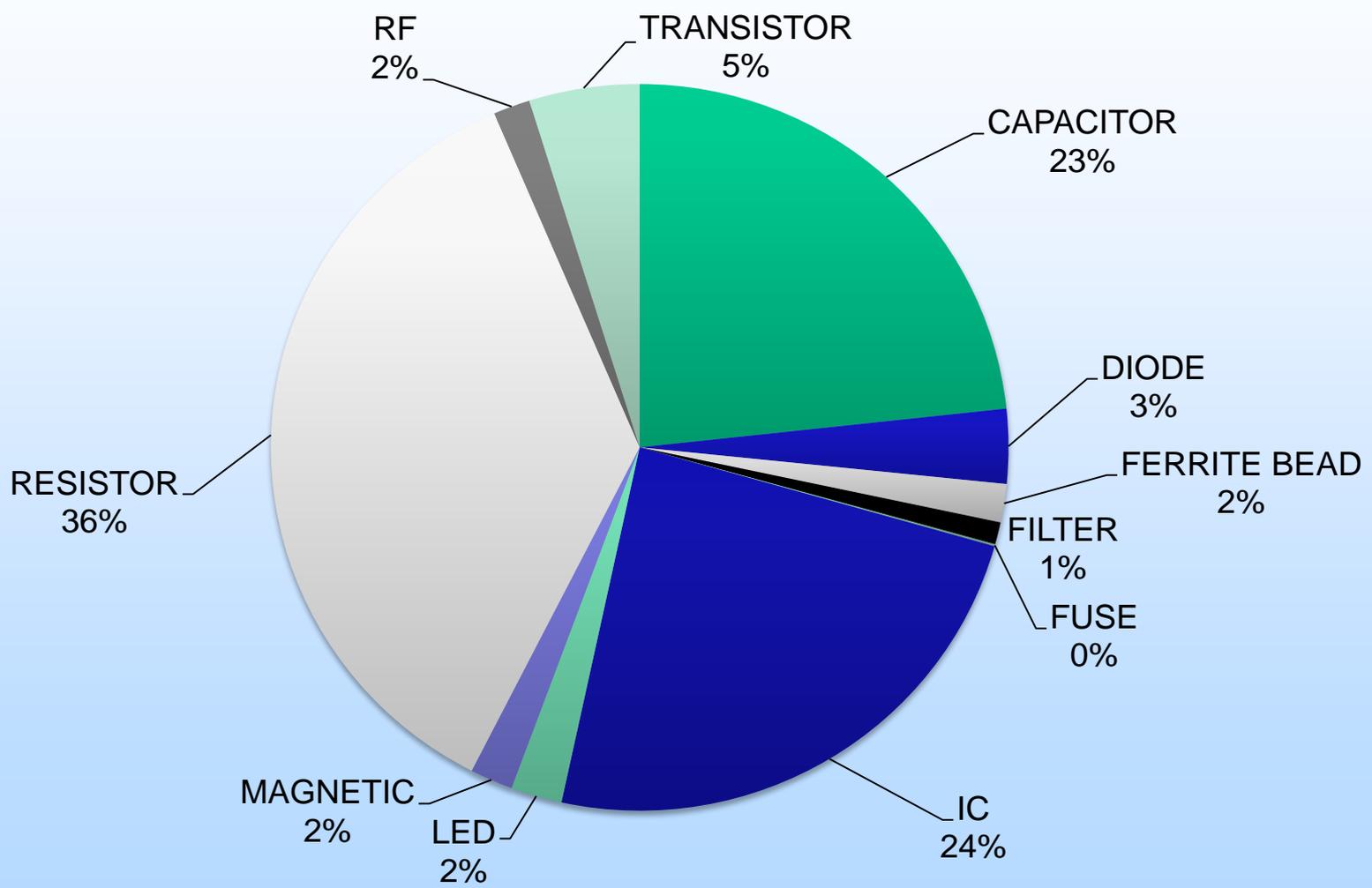


# NASA CubeSat Parts Database

- **Database represents >1100 individual lines of data**
  - **Line = Part and corresponding part number**
- **Approx. two-thirds of total parts have unique part numbers**

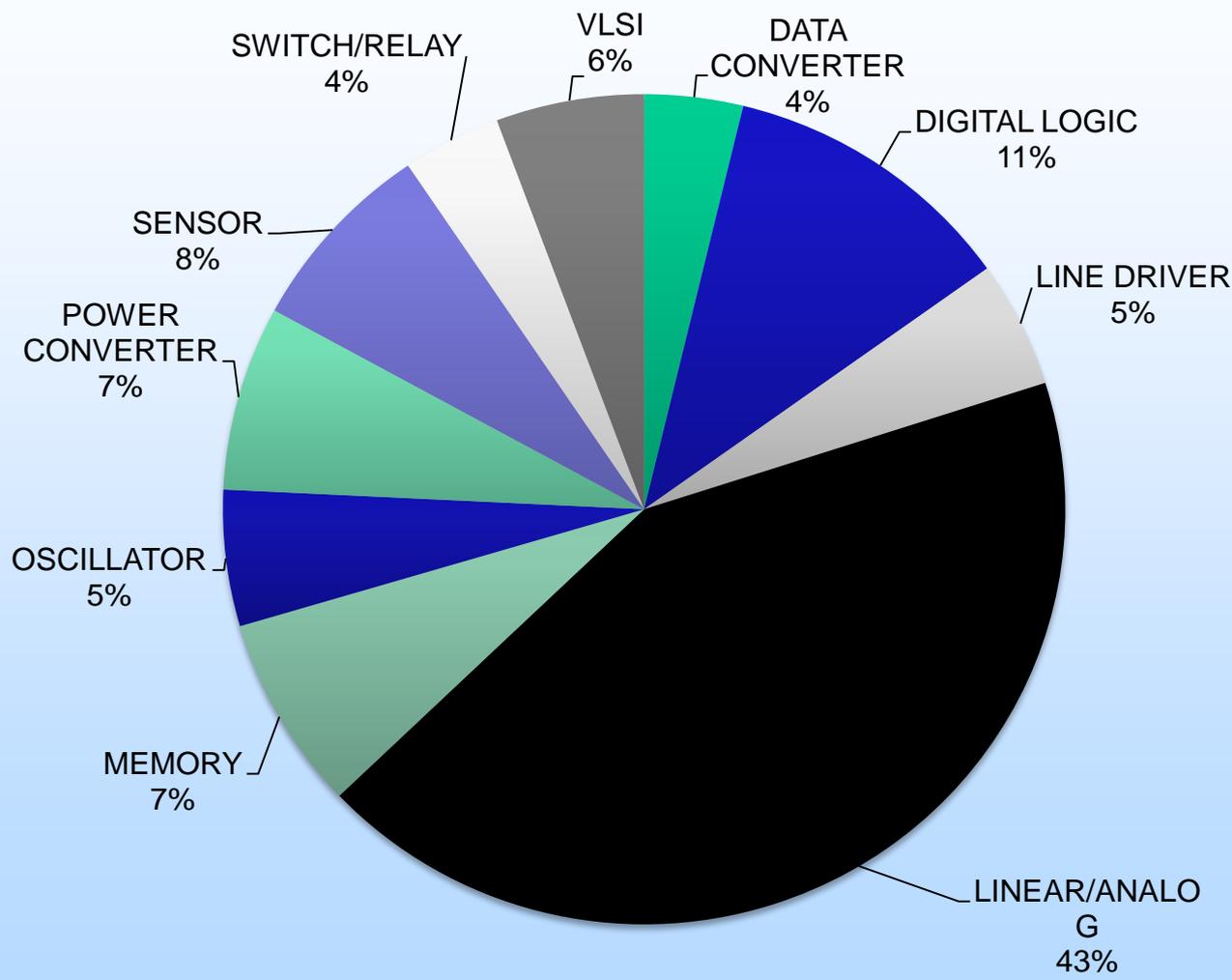


# Breakdown of Total Parts





# Breakdown of ICs

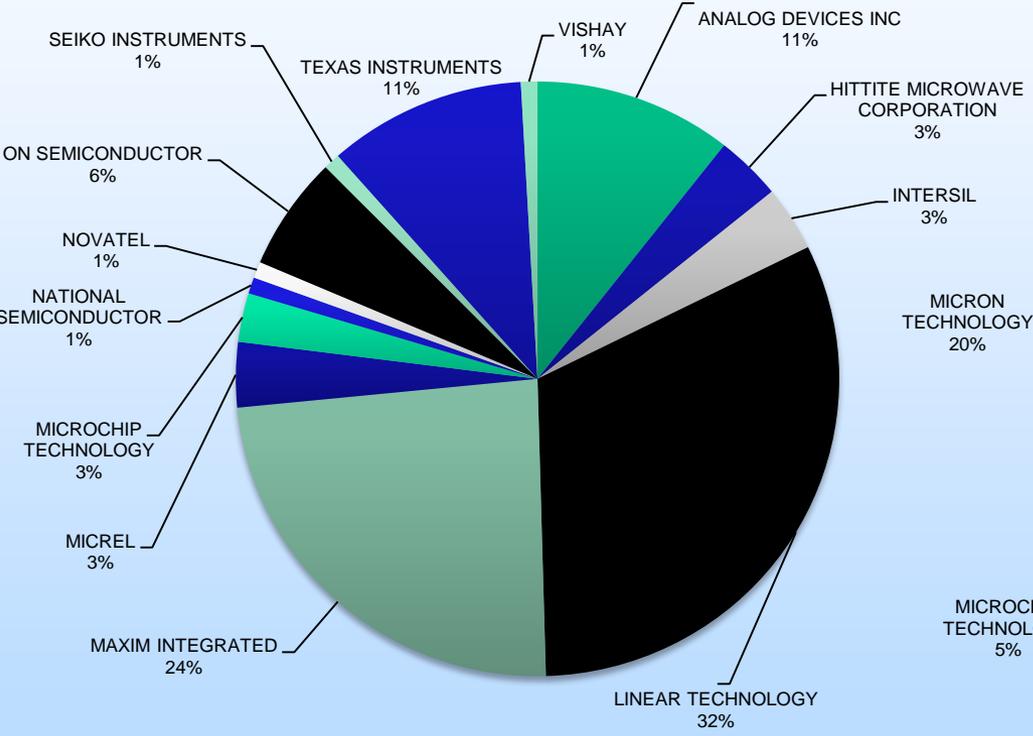


SUBCATEGORIES		
DIGITAL LOGIC		
Flip-Flop MUX/DEMUX Shift Register	Serializer/Deserialzer Logic Inverter Inverter	Gate Timekeeper/Timer Counter
LINEAR/ANALOG		
Amplifier Charge Pump Current Monitor Driver	Multivibrator Receiver Supervisor	Voltage Regulator Reference Opamp/Comparator
MEMORY		
MRAM PCM Flash	PROM EPROM/EEPROM SRAM	SDRAM MicroSD
VLSI		
FPGA ASIC	Complex Logic Processor	Microprocessor MCU
OSCILLATOR		
Crystal	Oscillator	VCO
LINE DRIVER		
Buffer	Transceiver	GPIO
DATA CONVERTER		
ADC/DAC		
POWER CONVERTER		
DC/DC		
PULSE WIDTH MODULATOR		
HYBRID		
SWITCH/RELAY		
SENSOR		

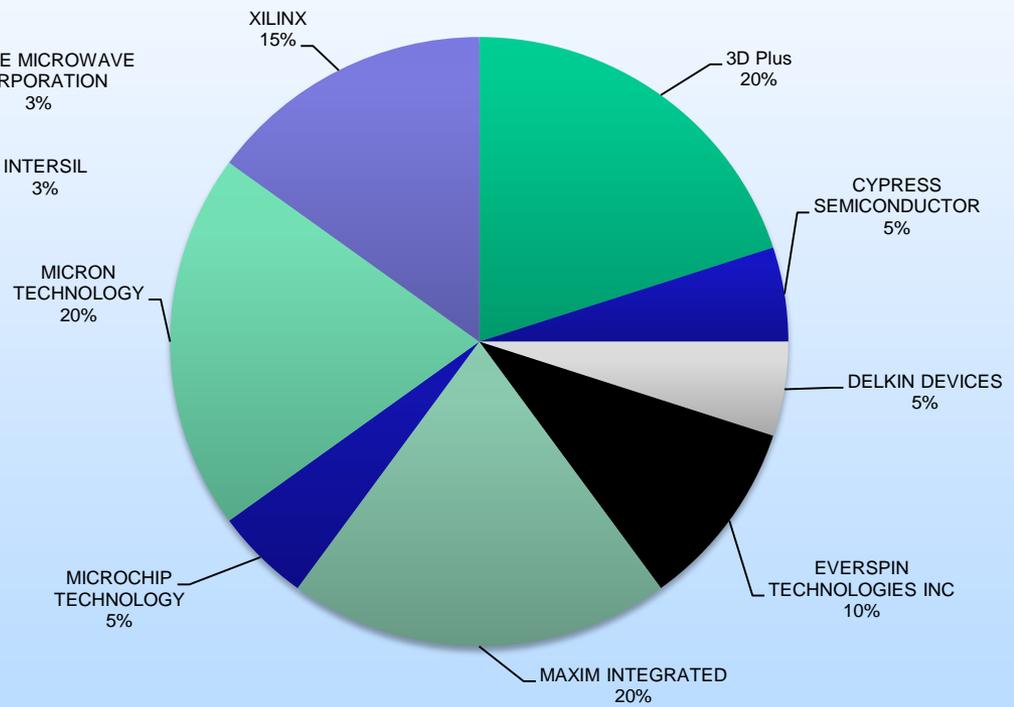


# IC Manufacturer Distribution

### LINEAR/ANALOG



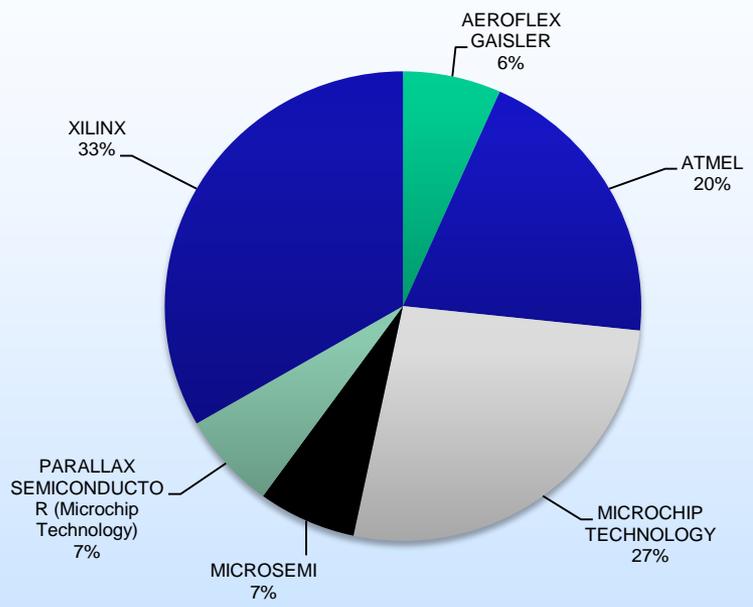
### MEMORY



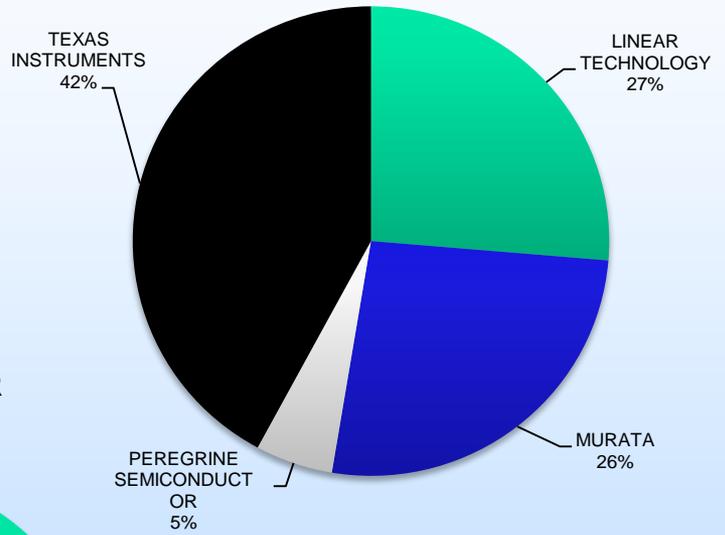


# IC Manufacturer Distribution

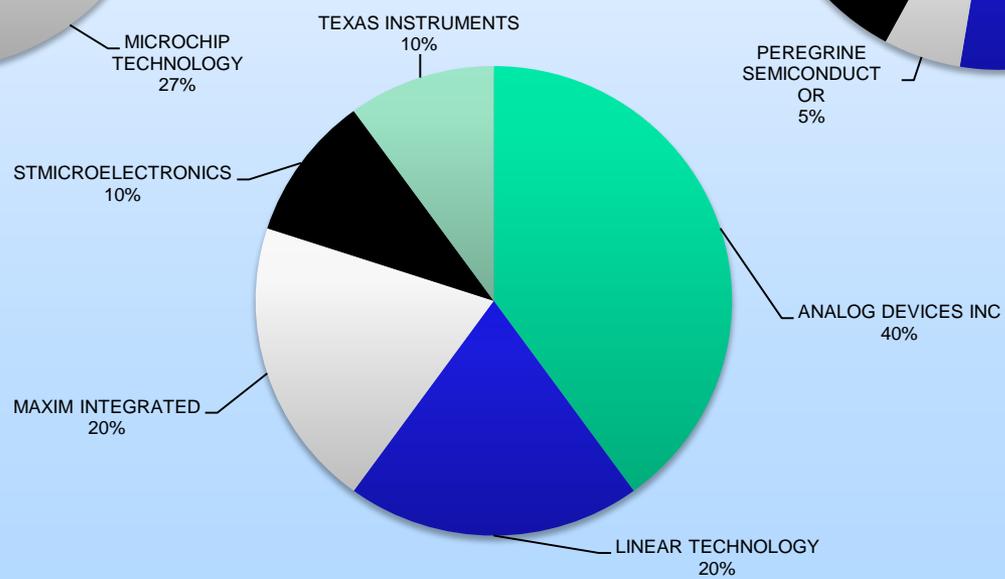
### VLSI



### POWER CONVERTER



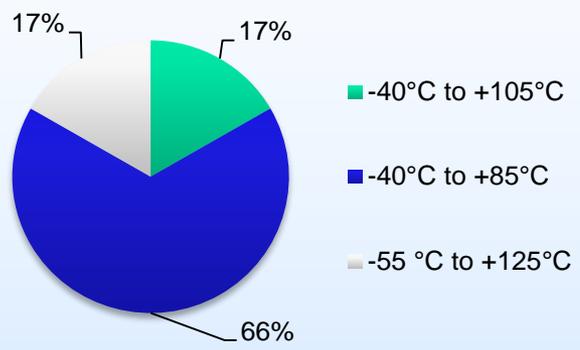
### DATA CONVERTER



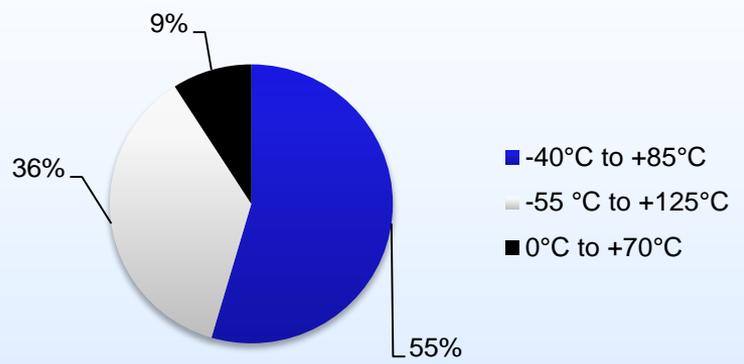


# Temperature Distribution

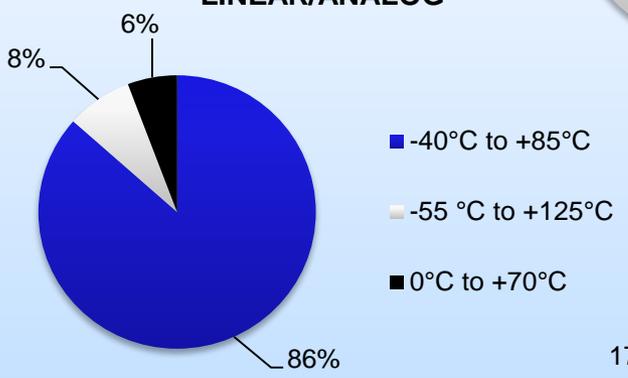
### DATA CONVERTER



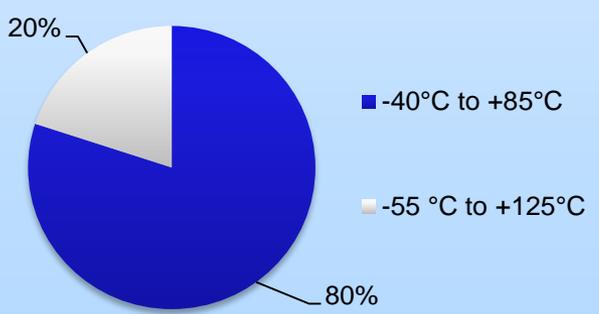
### VLSI



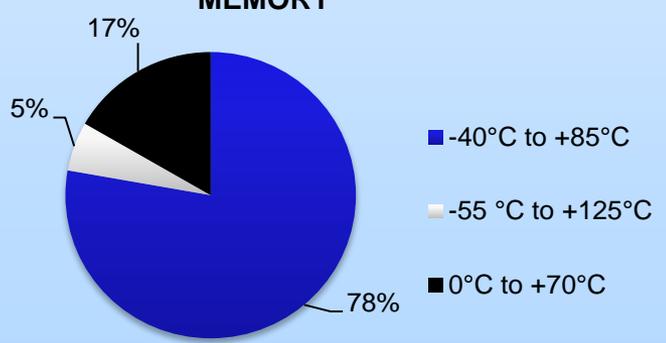
### LINEAR/ANALOG



### POWER CONVERTER



### MEMORY





# Conclusion

- 1. CubeSat supplier responses revealed that almost all parts procured are industrial or commercial-grade; a small percentage are space-grade**
- 2. A large percentage of parts that CubeSat suppliers procure are through distributors**
- 3. Some suppliers implement more qualification and testing practices than others**
- 4. Passive components represent ~60% of total parts and ICs represent ~25% of total parts**
- 5. Small number of manufacturers provide a large number of ICs (linear/analog, VLSI, power converter, data converter, etc.)**



# Acknowledgments

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# Thank You!

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