isola

Challenges and Opportunities for Halogen-free Flame Retardants in Anisotropic Composite Dielectric Materials for RF and Microwave Applications

May 2015

Introductions

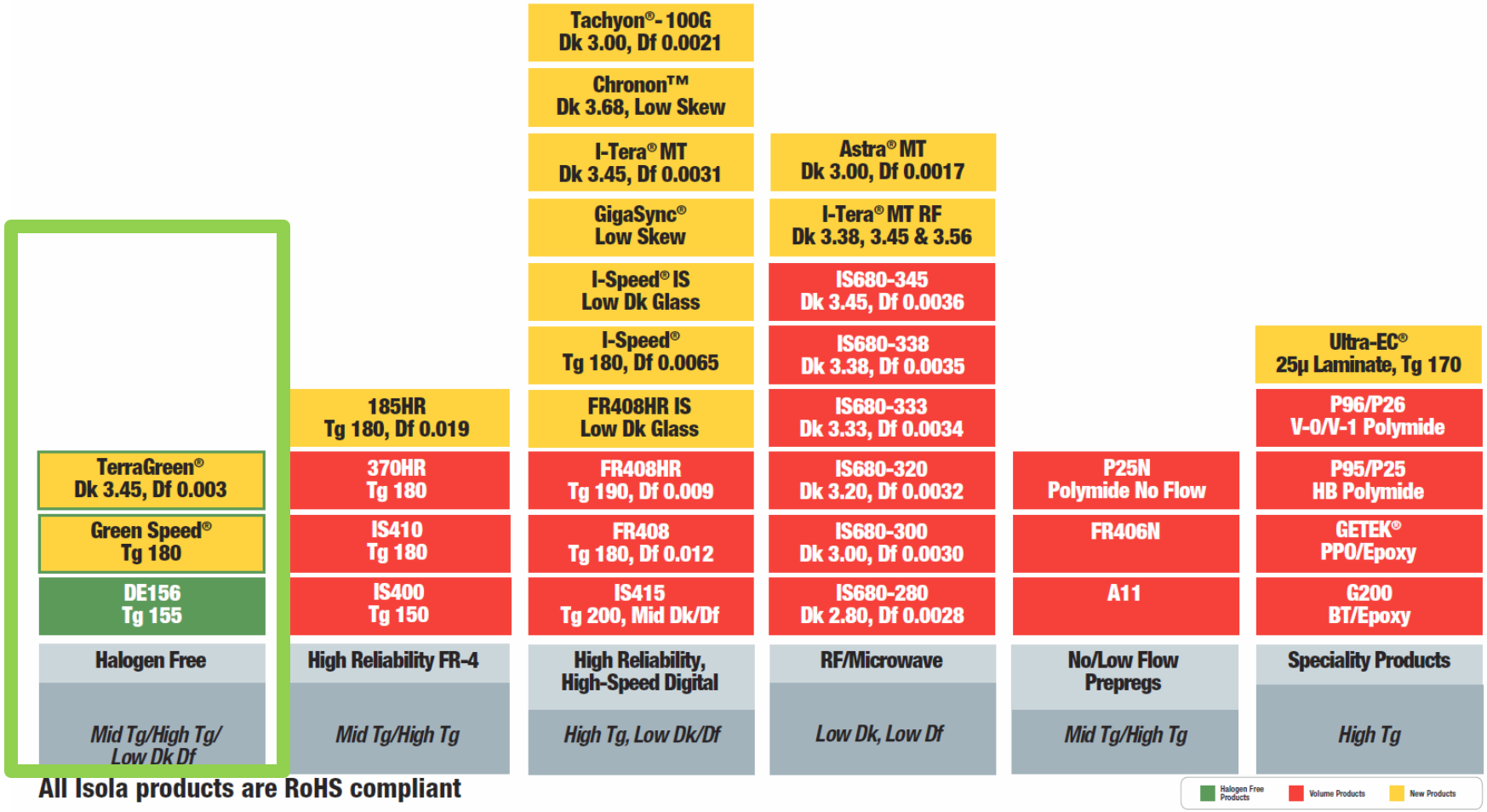
- **David Bedner, Principal Scientist, Isola Group**
- **Isola supplies both halogen and non-halogen materials for PWBs**

Overview

- History of Flame Retardants (FRs) in Electronic Materials
- Challenges for Standard Brominated FRs and non-Halogen FRs
- Opportunities for Growth

isola

Isola HF Product Portfolio



All Isola products are RoHS compliant

isola

History of FR in Electronics

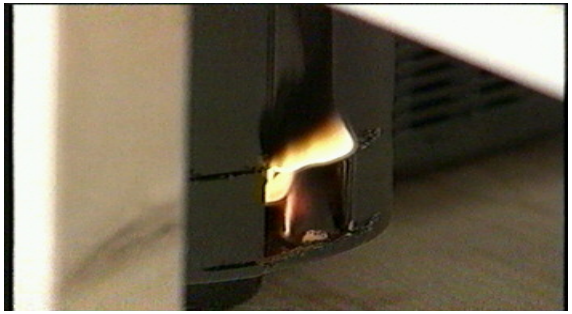
- **Underwriters Laboratory**
  - Established 1894
- **UL94 V0 is the industry standard**
- **Today many compliant companies in all regions**

Underwriters Laboratories

Utilization of FR

TV without Flame Retardant

Time (min/sec)
0:08



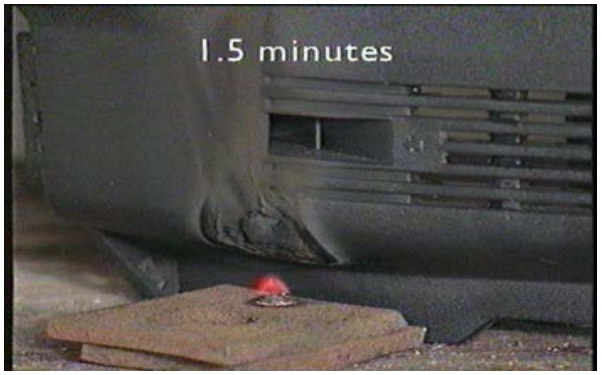
Time (min/sec)
7:23

Time (min/sec)
8.00-9:00

TV with Flame Retardant

Time (min/sec)
0:05

Time (min/sec)
1:30



Time (min/sec)
1.45

isola

Comparison of Flame Retardants

Brominated FRs

- >95% of FR-4 PWB use TBBPA
- Inexpensive
- Well studied
- Easily extracted
- Very efficient
- TBBPA NOT RoHS restricted
- REACh registered as of October 2010

Phosphorous FRs

- Finite supply
- Has to be strip mined
- Not as efficient
- Many phosphorous compounds are explosive & neurotoxic

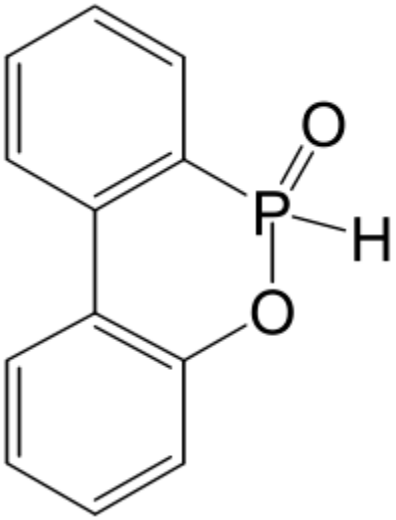
Not All Electronics Require FRs

isola

Brominated FR Under Scrutiny

- **1996 Fire at Dusseldorf Airport**
  - 10x Dioxins Detected after Fire
- **DecaBDEs and PBDEs not in use**
  - TBBPA under attack

DOPO Arrive in the 1990s



And It Worked!

Reacted into Backbone

Can Etch and Plate

Thermally “OK”

Cost “OK”

isola

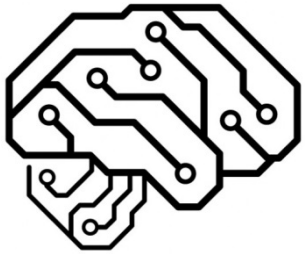
Non-DOPO Developments 1995-Today

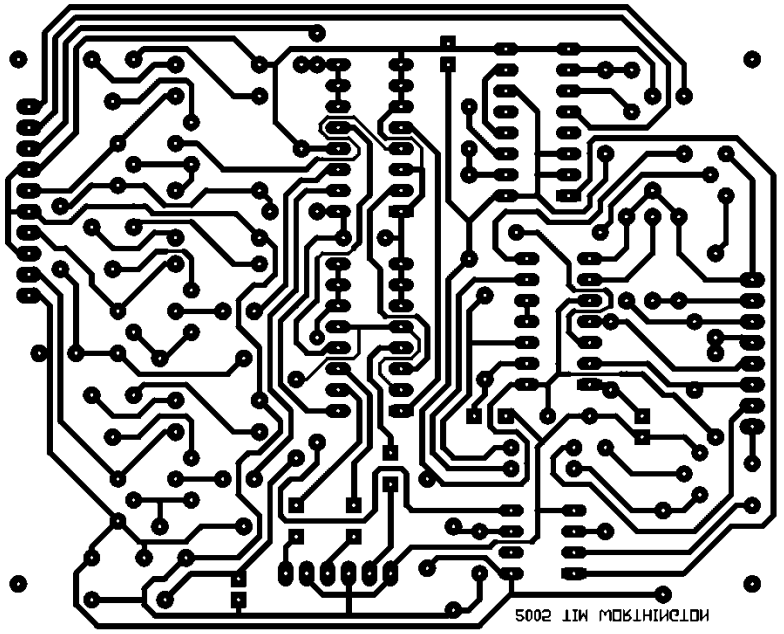
- **Additive**
  - >15 tested, I used today
  - 3 new materials, 0 work
- **Reactive**
  - 3 DOPO-based used today
  - Many knock-offs
  - 4 new materials, 0 work

isola

2015 DOPO Products

- **Still exist in commodity products**
- **Many drawbacks as technology advances**
  - Electrical
  - Mechanical
  - Thermal





Challenges
How to make a PWB
Critical Properties

Meets UL-94 Flammability Test

- **Needs to extinguish a flame**
- **Needs to resist ignition**
- **Most PWBs require a V-0 rating**
  - Total Burn <50s
  - Longest Burn <10s

isola

ISOLA Processing

- **Attributes**
  - Health and Safety
  - Compatibility
  - Shelf Life
  - Cost

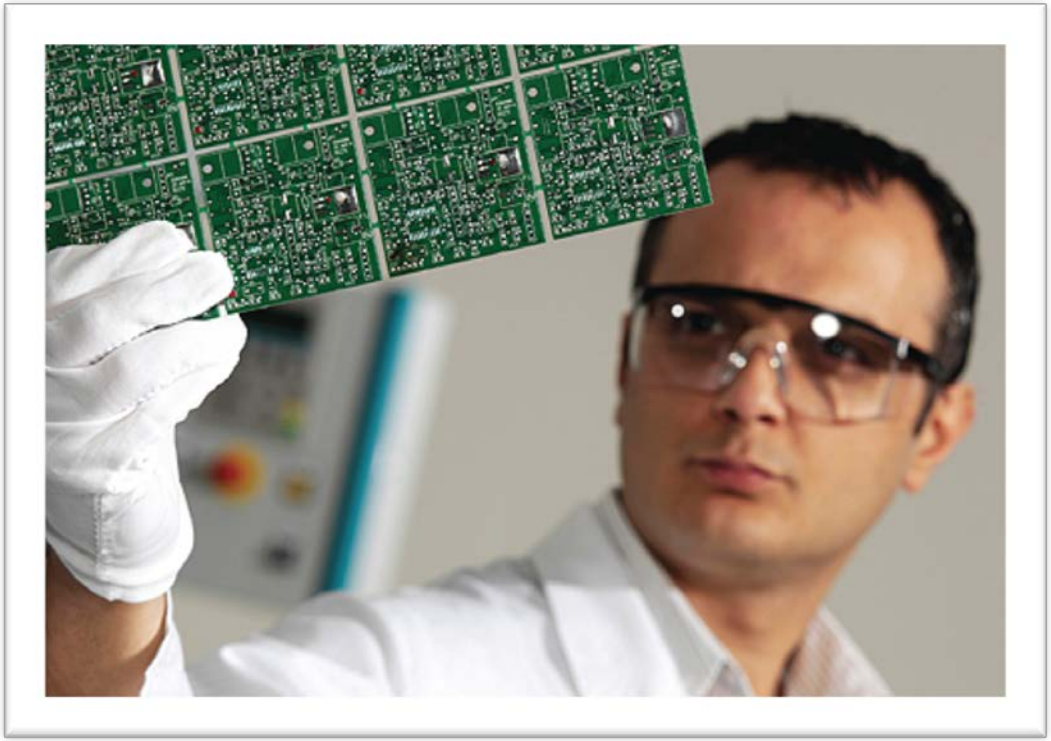
PWB Fabrication

- Print
- Develop
- Etch
- Layup / press
- Drill
- Desmear
- Electroless Copper Cu Plate/Sn Plate
- Print
- Develop
- Etch/Sn-Strip
- Apply Solder mask
- Solder (Many Varieties)
- Test

isola

PWB Fabrication & OEM Requirements

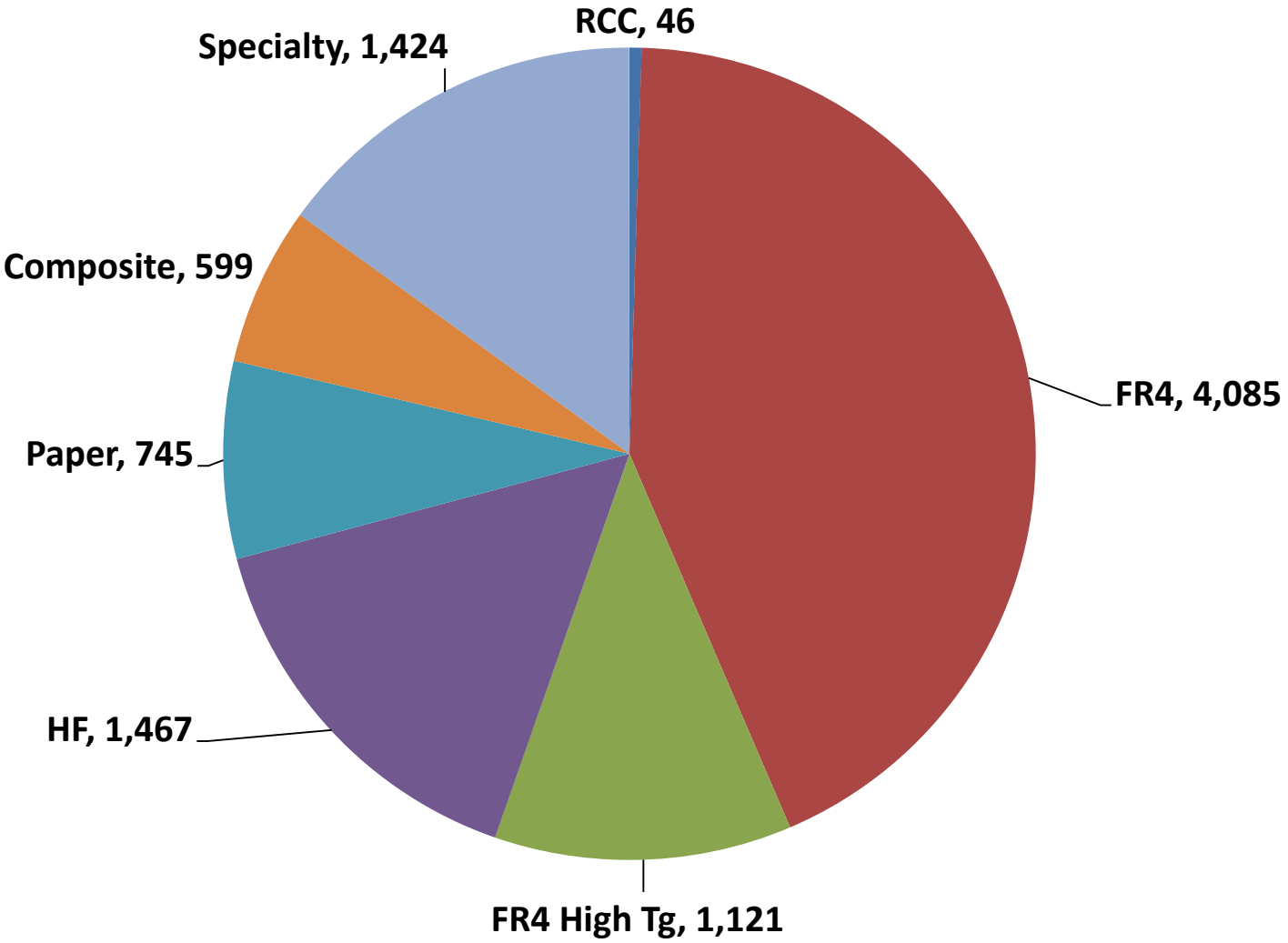
- **Key Attributes**
  - Homogeneous
  - Low/no moisture pick up
  - Chemically stable
  - Thermally stable



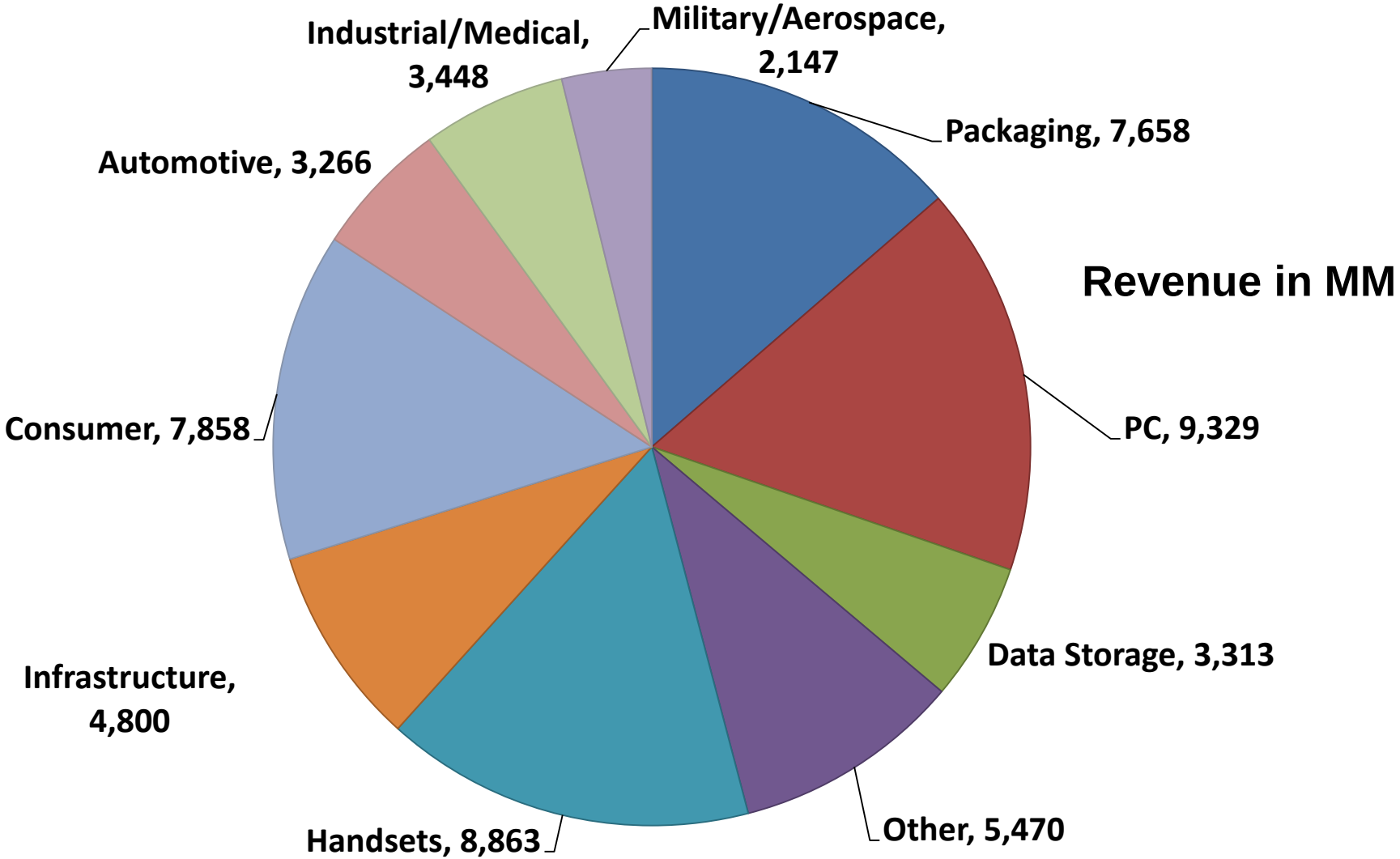
isola

Opportunities for FR in Electronics

PWB Materials by Type



PWB Materials by Application



isola

Growth Areas for HF PWBs

- **Computing and Office Equipment (~30%)**
  - PC, Tablets and Data Storage
- **Communication Electronics (~24%)**
  - Smart Phones, RF and Backplanes
- **Automotive (>7%?)**
  - Entertainment, Telematics, Hybrid Vehicles