Low-cost high-speed handling of Micro/Nano-size components

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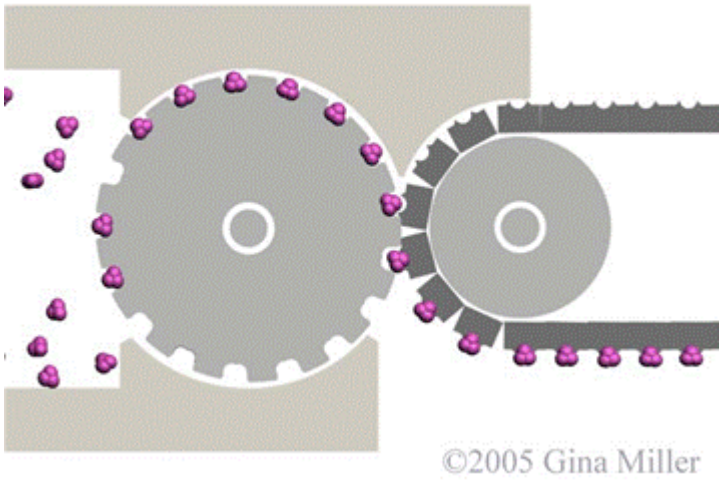
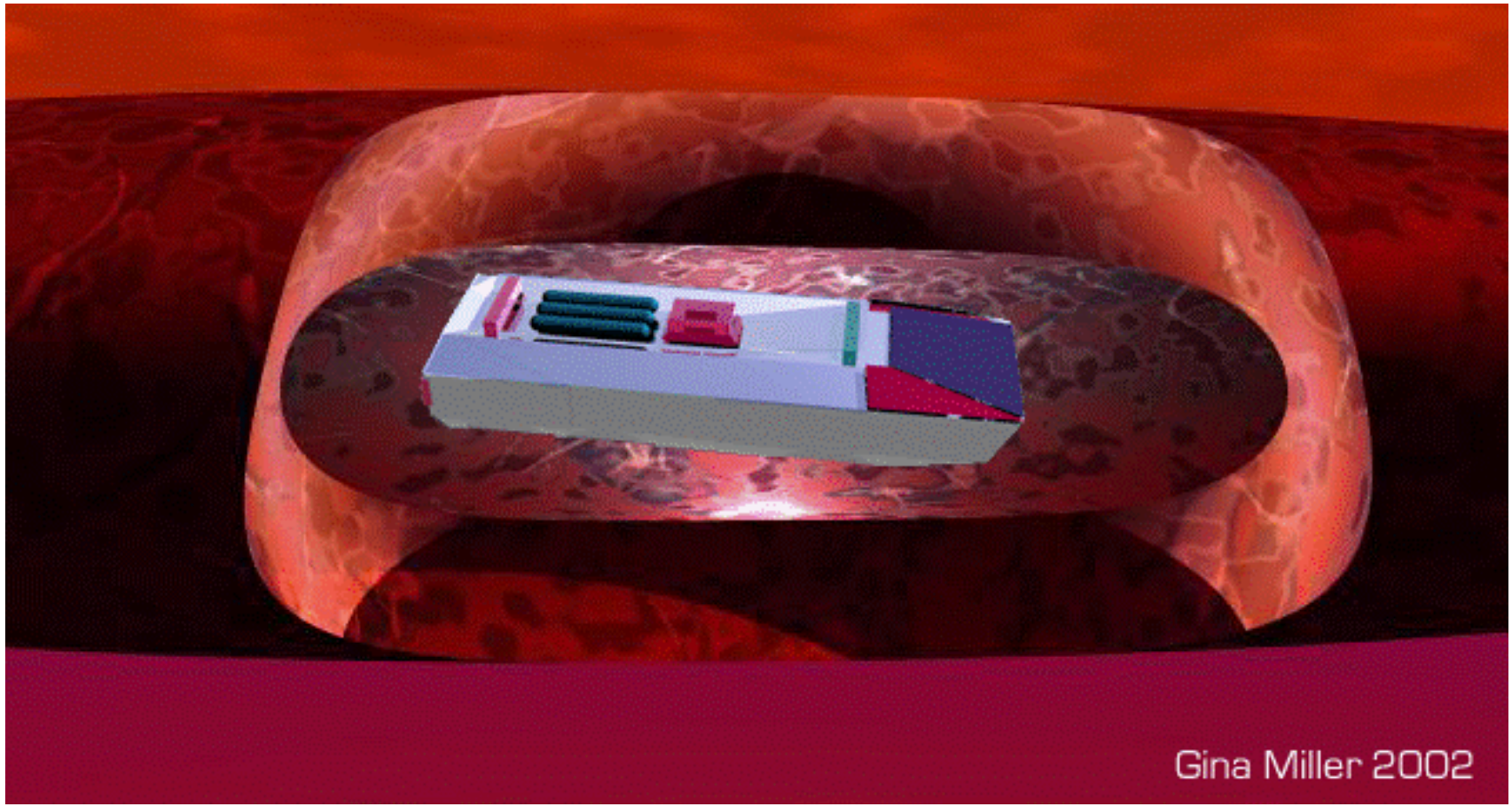


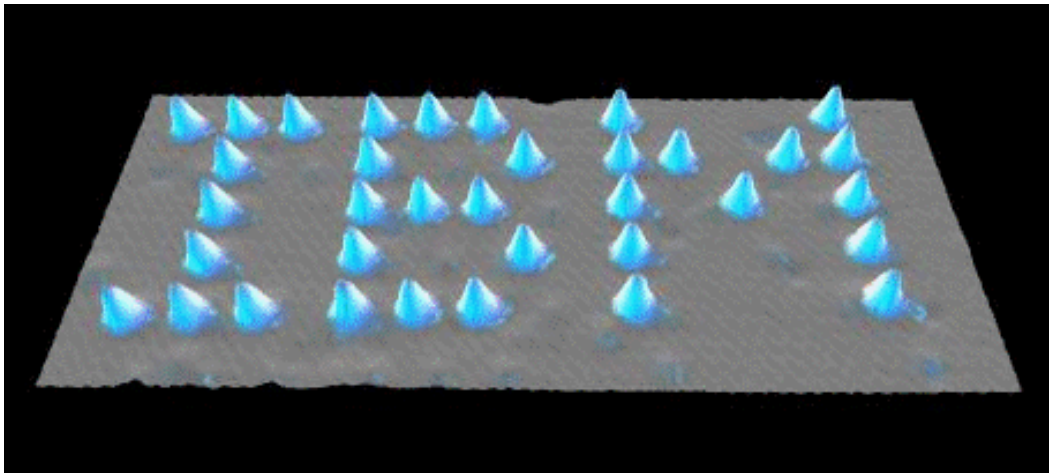
The next big thing is really small



Nanoscout- Microscopic submarines, fitted with a diverse array of molecular sensors, explore the intricate labyrinth of blood vessels within a human organ looking for problems to fix.

IBM logo spelled out with xenon atoms

- On Nov. 9, 1989 IBM scientists purposely manipulated 35 individual atoms to build an IBM logo.
- Ushered in the nano technology age.

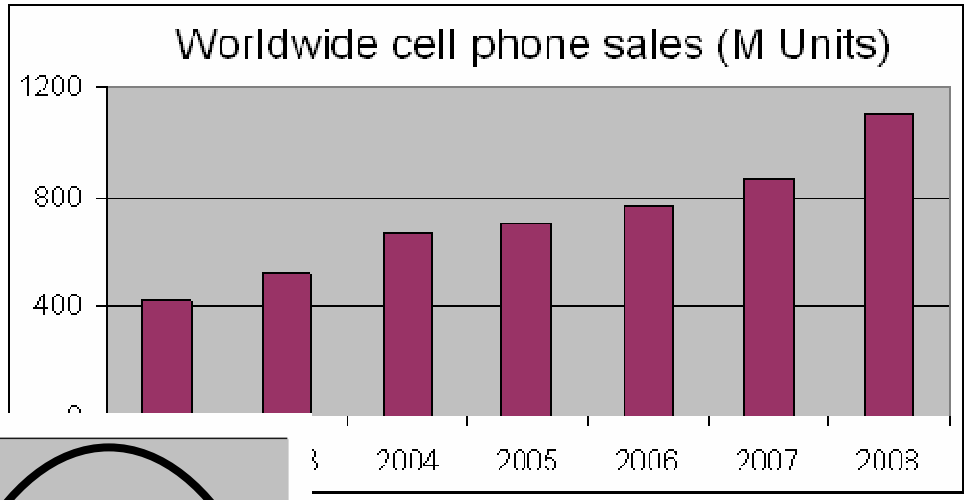


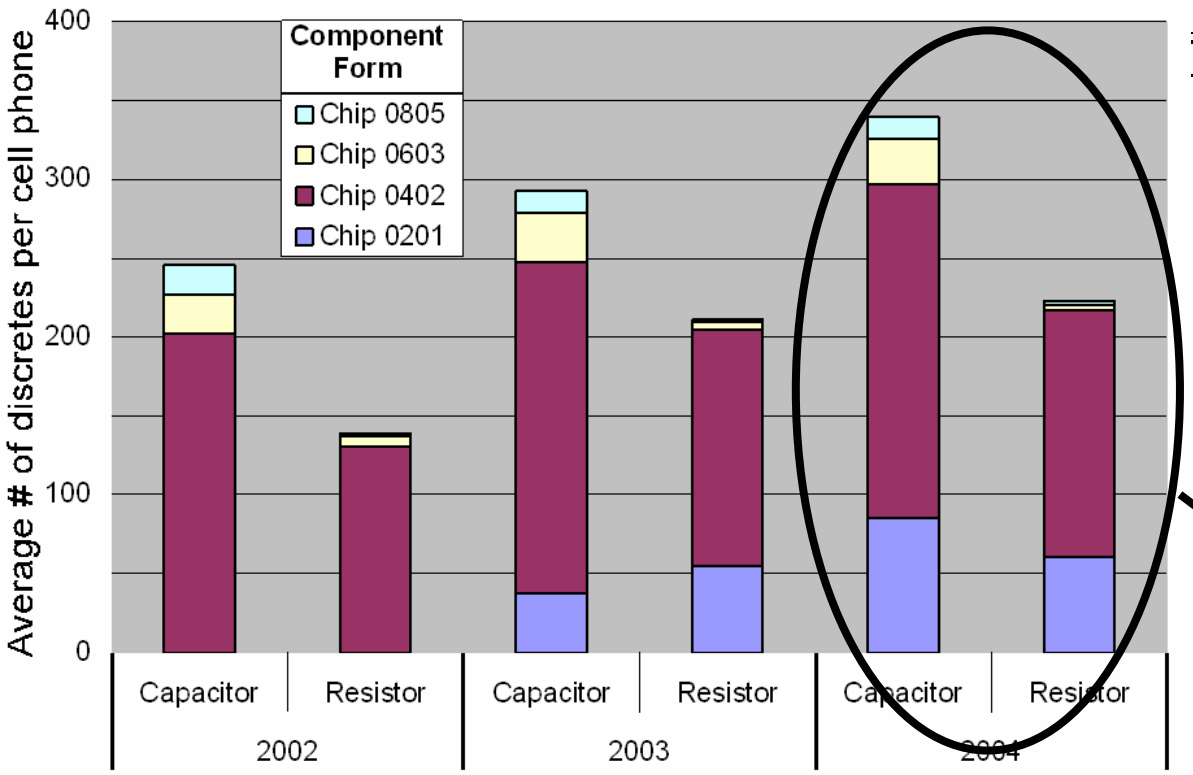
350,000,000 of these logos fit in the period at the end of this sentence

MACRO -> micro -> nano

- Today's technology is on the threshold of the nano-world
- Cellular phone technologies are the driving force for reductions in size of microelectronics products today
- This trend will continue to challenge manufacturing equipment, materials and tooling.

Discrete passive components dominate the BOM in mobile products

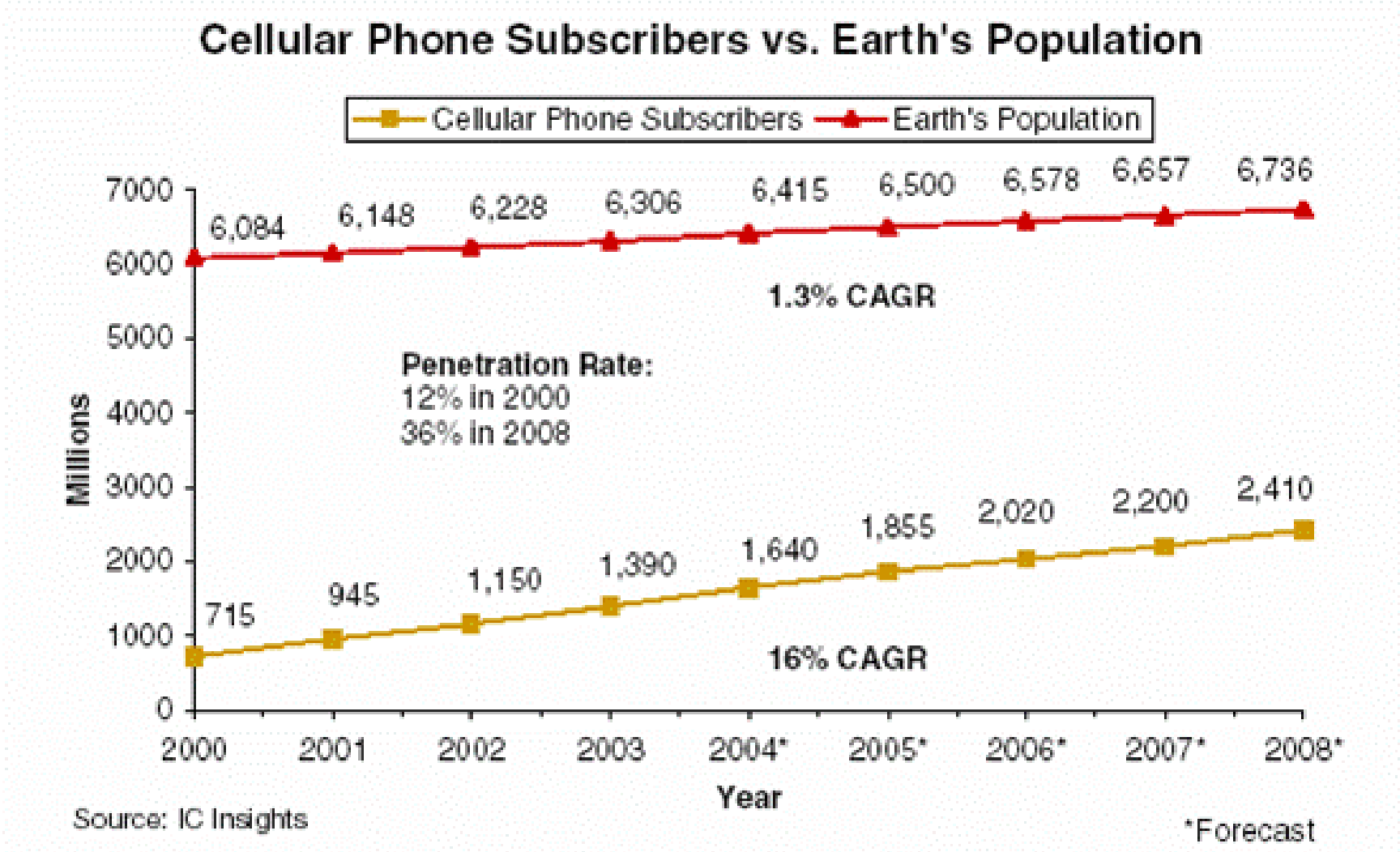




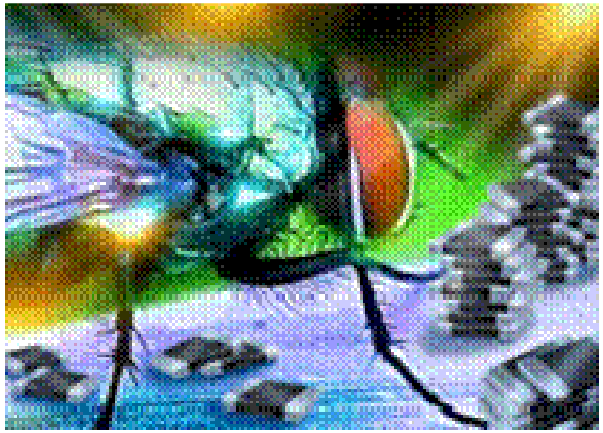
There were more than 600 discrete components in a mobile phone in 2004 – on average

The number of passive components in cell phones continues to increase in number while decreasing in size

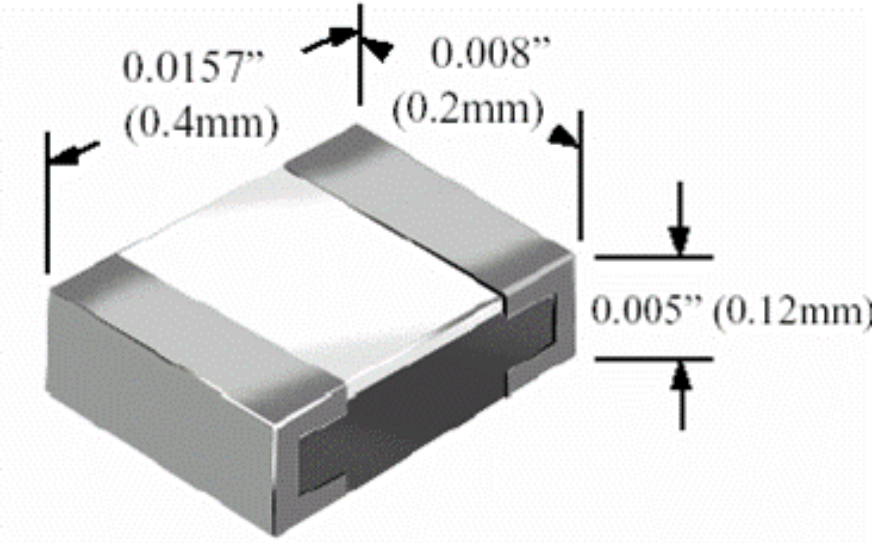
When will everyone on earth have a phone?



01005 Chip Resistor ~ 40µg



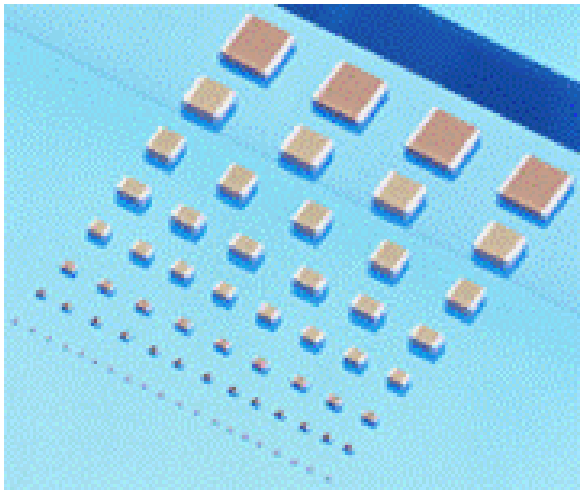
Year of Production	2004	2005	2006	2007	2008	2009	2010
Minimum Component size	0201	0201	01005	01005	01005	01005	01005



The iNEMI 2004 Roadmap as it pertains to passive components for mobile applications envisions a move to the 01005 form factor devices by 2006.

How do you handle these ?

- At 40 µg ea., you can mail 775,000 of the 01005 form factor resistors anywhere within the USA for 37¢.

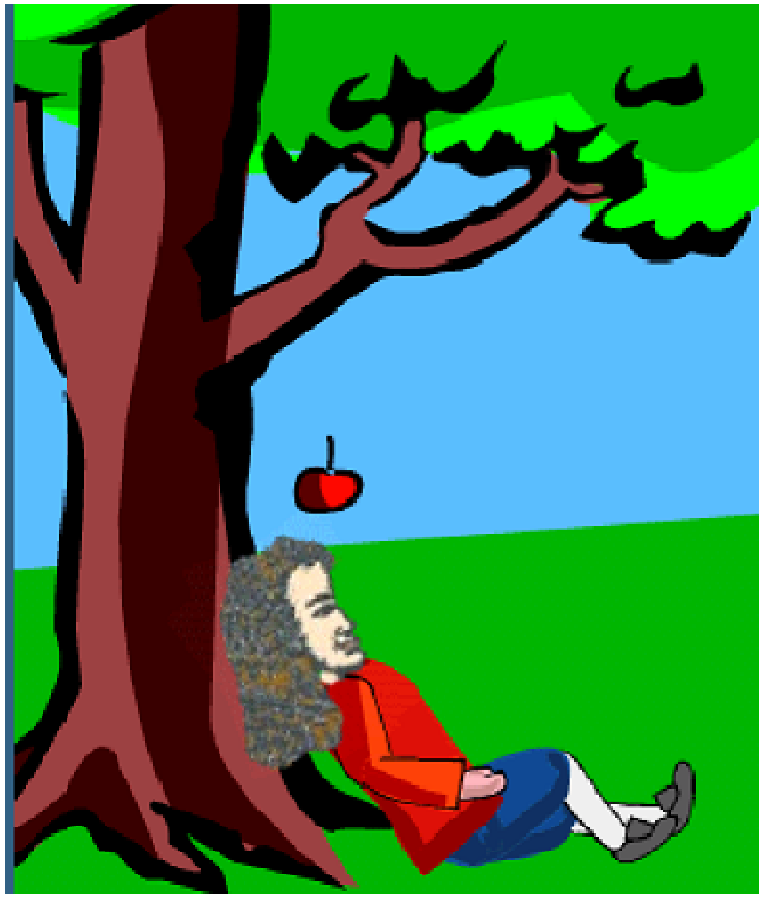


"You can barely see a 0201 capacitor and need a magnifying glass to identify it," according to Bill Glass, director of sales at San Jose-based Samsung EM America, a u.s. subsidiary of Samsung Electro-mechanics.

Chip Resistor	L (mm)	W (mm)	T (mm)	M (mg)
01005	0.4	0.2	0.12	0.04
0201	0.6	0.3	0.23	0.15
0402	1	0.5	0.35	0.8
0603	1.6	0.8	0.45	2
0805	2	1.25	0.6	4
1206	3.2	1.6	0.6	10

A lucky break?

Fortunately, it was an apple* - and not an 01005 - which fell and struck Isaac Newton on the head to initiate his universally-accepted 'Law of Gravity'. 01005's and the avalanche of like-size devices coming to market are exempt from Newton's Law of Gravity.



WHY?

Because they individually lack a key ingredient - MASS,- and can literally, float like particles of dust, unless they are anchored in secure fixed positions providing low cost, high speed handling and assembly in automated factories of tomorrow.

**according to legend*

The Micro/Nano world cannot be effectively implemented with tools and technologies widely employed today!

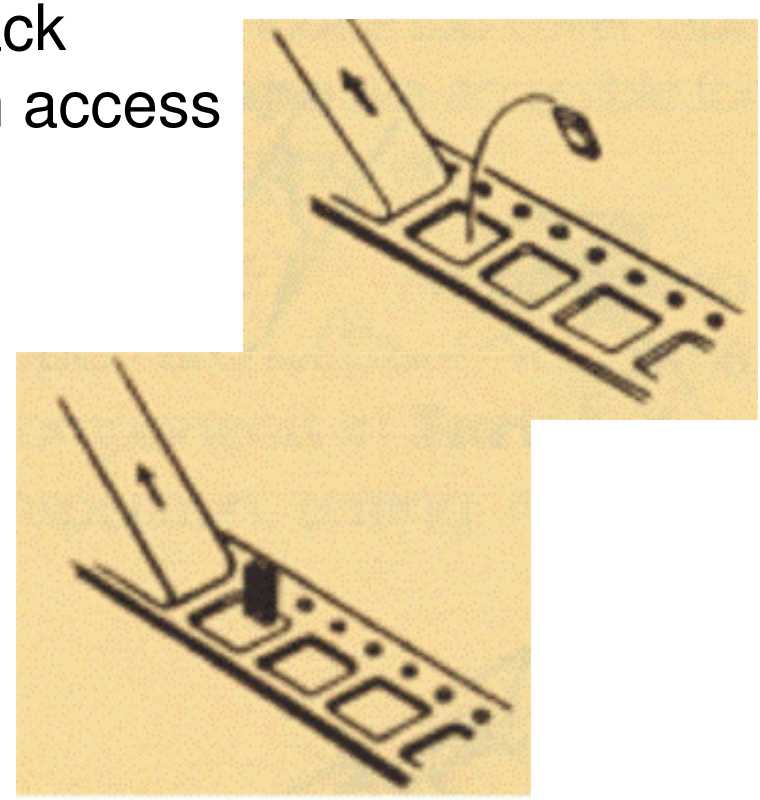
- A 'Sea Change' - - comparable to the transition from Through-Hole to Surface Mount Technology - - - is in the making, New ideas involving specialized enabling technologies must be implemented to achieve cost-effective solutions to these emerging challenges
- Automated factories do not work unless the feedstock components are prepacked in a uniform, industry-standard manner

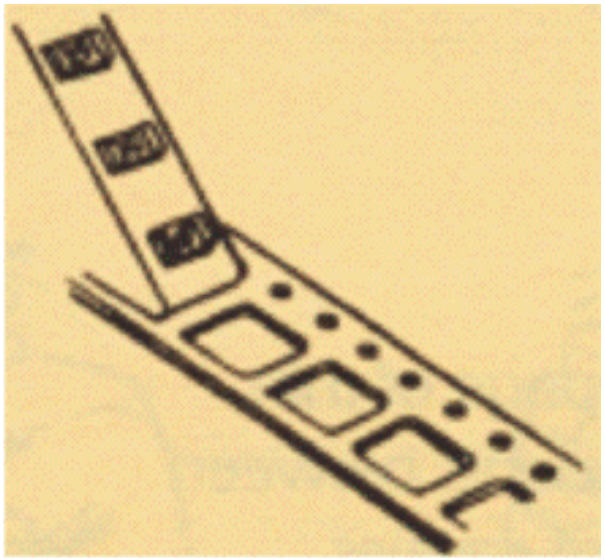
Packing for small, high volume devices in tape and reel format

- An automated factory of tomorrow will rely on a flexible, standardized means of handling all of the constituent sizes of the macro-micro-nano world
- Heretofore, the popular forms of punched and embossed carrier tapes have been adequate, but only for components that have significant mass

Conventional Punched and Embossed Carrier Tapes will not work with virtually weightless devices

- These Carrier Tapes require peel-back removal of the top cover tape to gain access to each device for pick and place
  - Cover tape removal will dislodge Micro/Nano devices
  - Tombstone or flip-out before pick
  - Problems with small devices - <u>Low Mass</u>

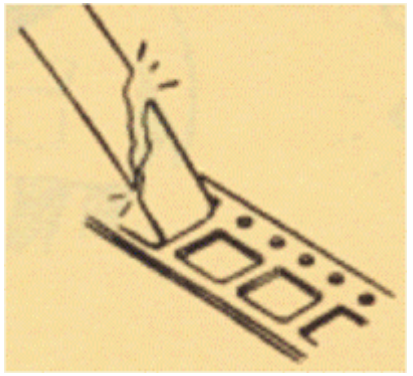


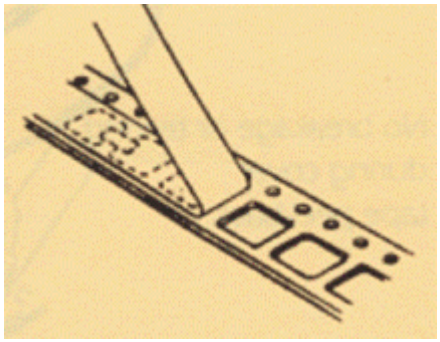


- Small devices cling to cover tape during peel-back removal
  - Cannot retrieve device from carrier tape cavities
- Triboelectric charges are developed
  - Components literally “float” in mid-air

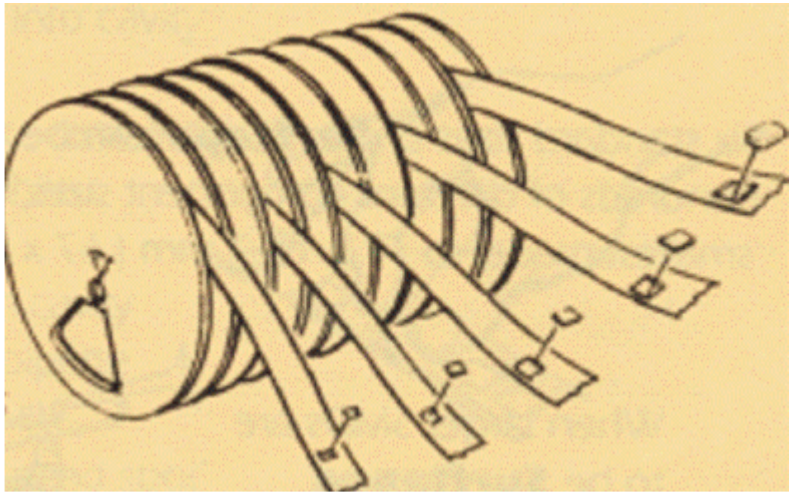
Conventional Carrier Tapes - More Limitations

- Cover tape may break during peel-back removal from carrier tape



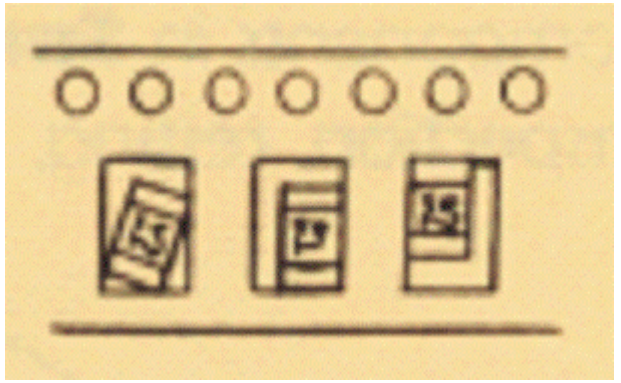


- Component movement to adjacent pockets: (aka “Shingling”)
  - Major problem with very thin, small devices
  - Cover tape does not prevent such movement



- Conventional Carrier tape cavity sizes are “component specific”
  - Cavity are custom-sized for each component in X, Y, and Z dimensions
  - Multiple component sizes require many different carrier tape sizes
    - One for each size
    - Inventory and availability issues

Conventional Carrier Tapes - More Limitations



- Very small components are hard to find for automated high speed pickup
  - Free movement within cavity – random repeatability at pick point
  - May require vision at pick point
- Delicate components may be damaged during shipment and handling
- Cover tape precludes inspection or test of components

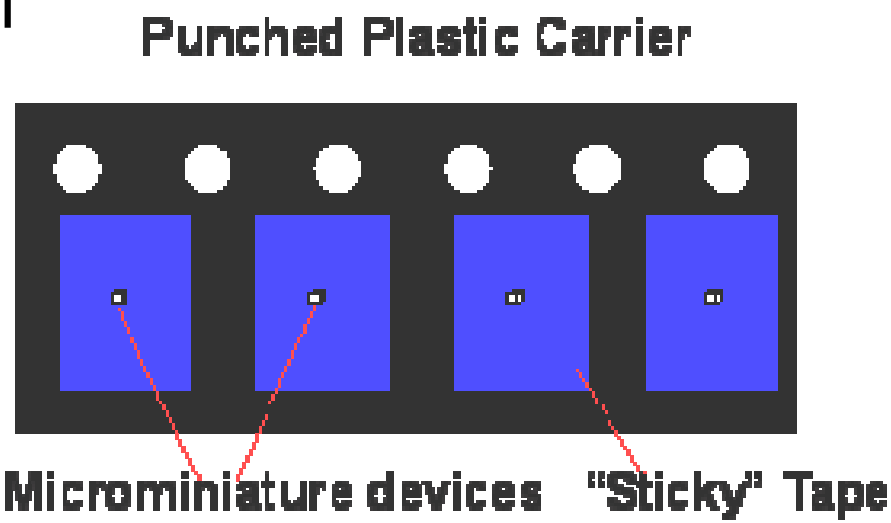
"In-situ"

  - No final inspection of die in carrier by supplier
  - No incoming inspection of die can be accomplished by customer

SURFTAPE® is THE proven solution for reliable handling today's ultra miniature SMD components.

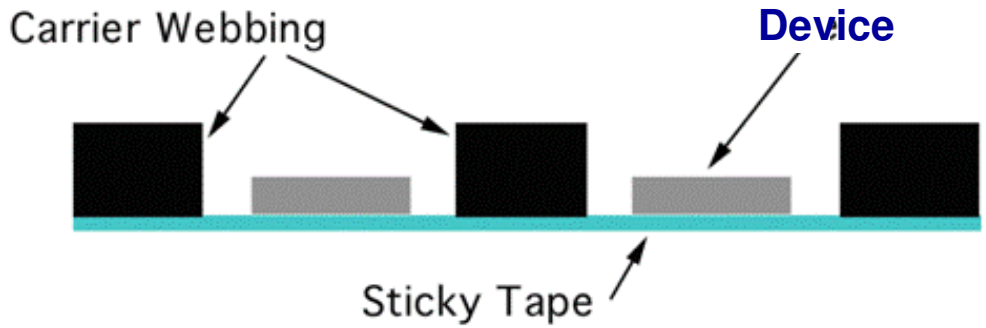
Designed specifically for packing and handling ultra-small form-factor products

- **Sticky tape** base retains each device in a repeatable, fixed location
  - Independent of "gravity" or "mass" of device to maintain location
- No cover tape required



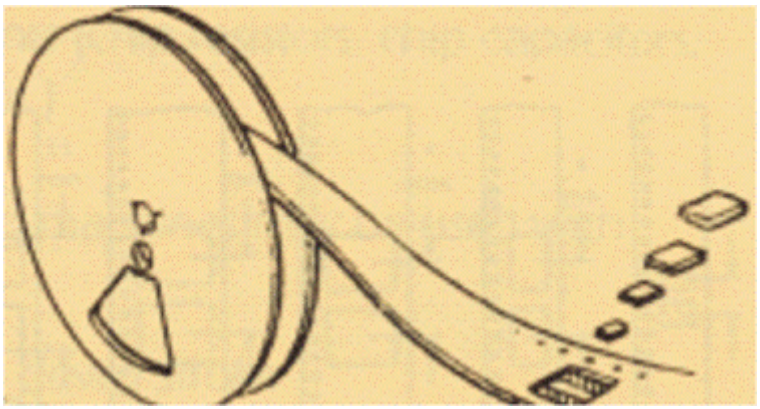
Surftape® FAQ's

- Pierced carrier tape frame is conductive plastic
  - Dimensions are compatible with conventional punched and embossed carrier tapes
  - Same tape transport mechanisms and feeders can be used
- Open architecture - no cover tape
  - Can inspect and test all devices "in-situ"
  - Recessed devices will not contact adjacent windings of Surftape when spooled



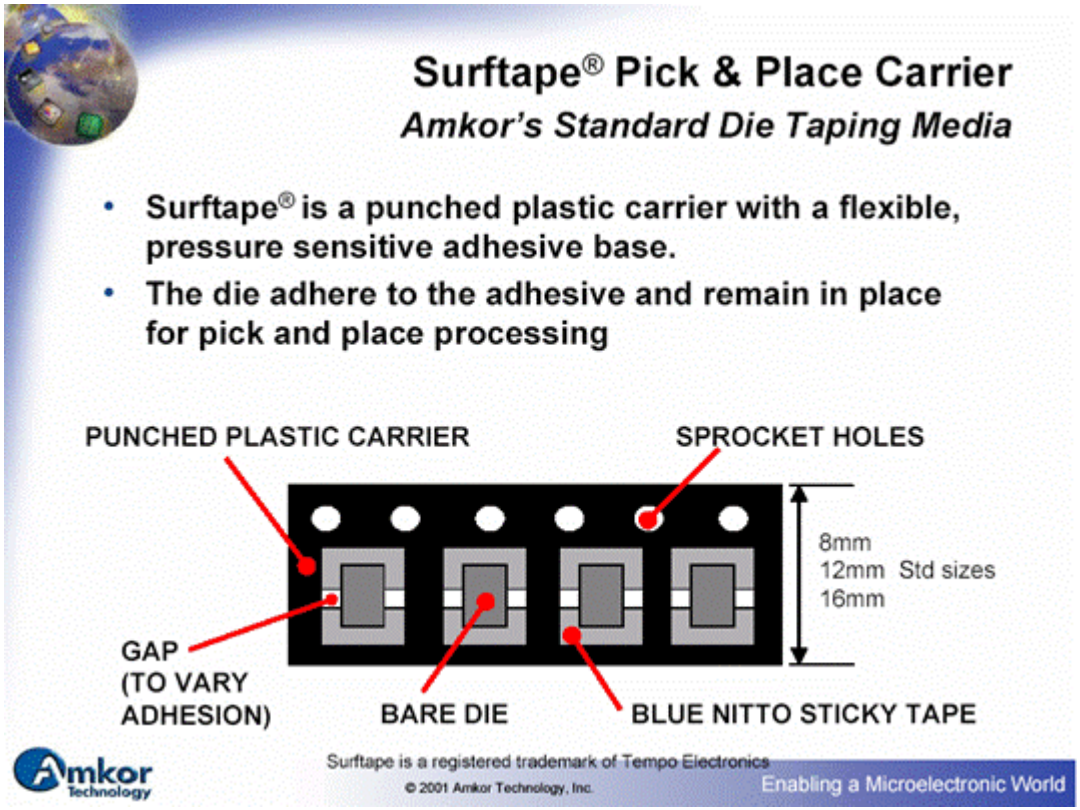
Surftape® Compartments for micro-miniature devices

- One standard compartment of maximum size
  - For each tape width and compartment pitch
- Compartments constitute virtual boundaries rather than cavities, custom-sized for each device
  - **Multiple** device sizes can be accommodated by **One** Surftape compartment size
  - Centroid of each device is placed with respect to the carrier tape drive holes which serve as the datum for device positioning
  - Device taping machines for Surftape are commercially available



SURFTAPE® - the de facto industry standard!

- SURFTAPE® enhances customer satisfaction
- High throughput means lower cost of ownership
- ESD protection maintains die quality
- Six standard sizes accommodate thousands of low profile component sizes



In Summary

- The “future” nano-world is upon us - - -

NOW!

– High volume, low cost, consumer products are the drivers

– Today’s factories must be adapted to tomorrow’s nano-scale technologies.

– Gravity will not be there to help you with this transition.