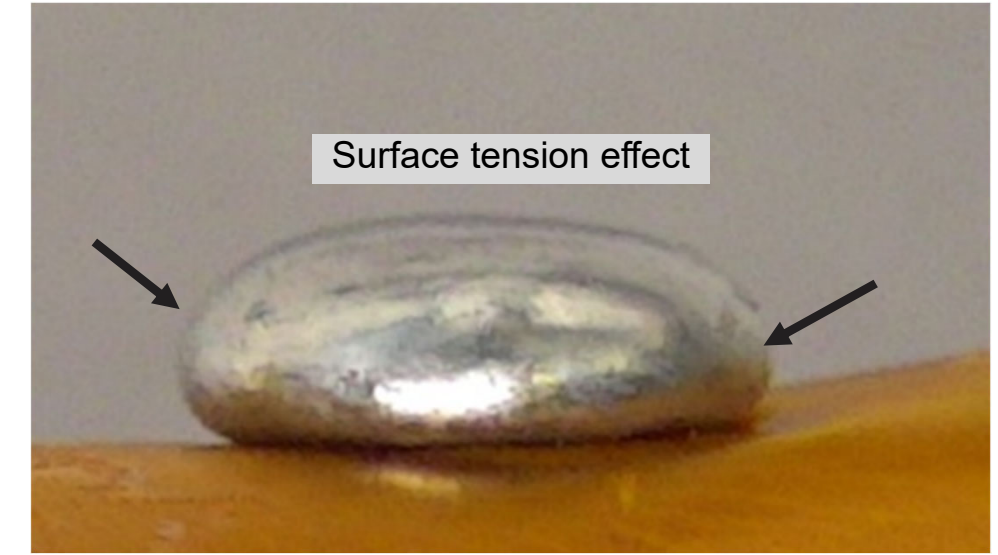




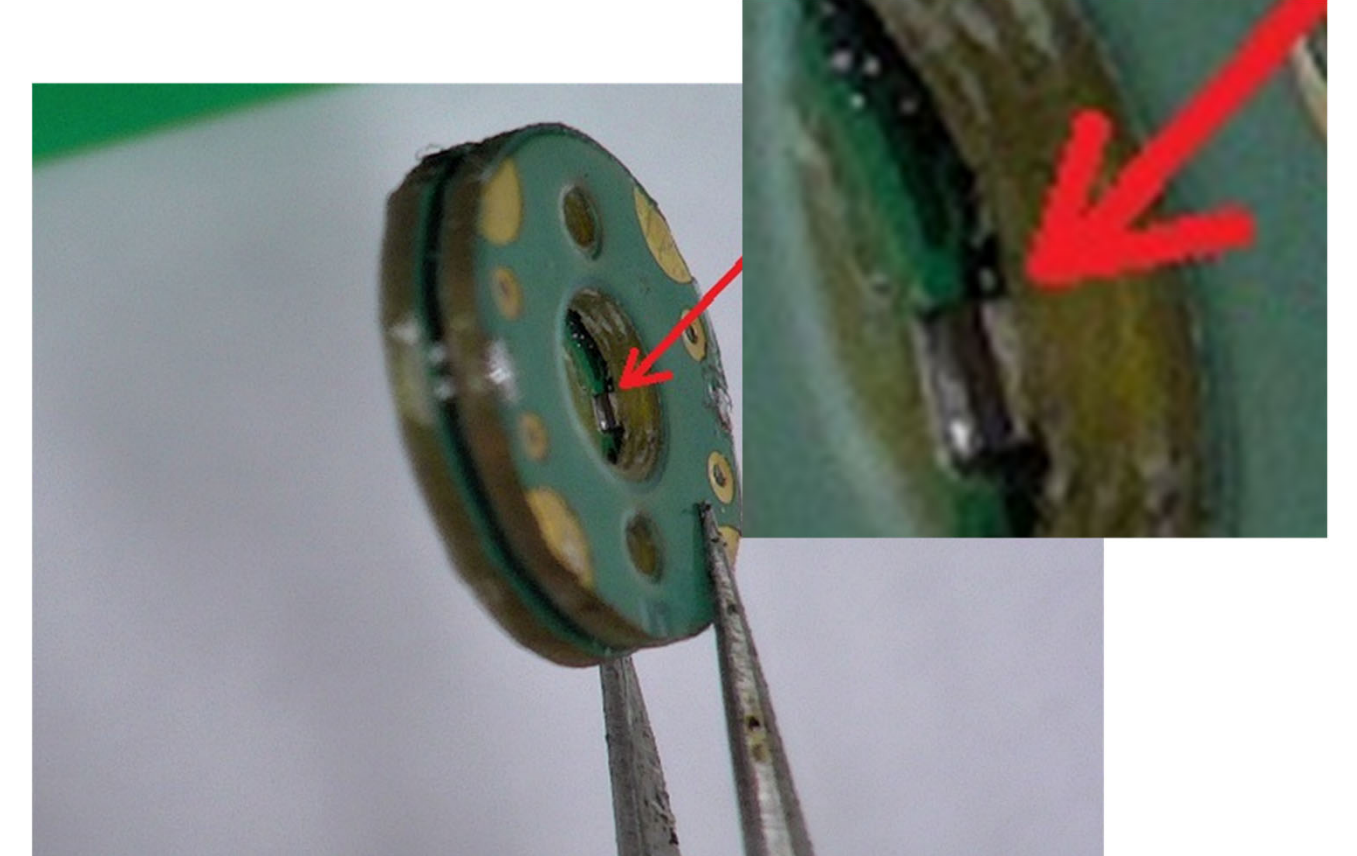
Introducing Vertical Soldering for 3D Circuit Assembly

WHAT IS VERTICAL SOLDERING?

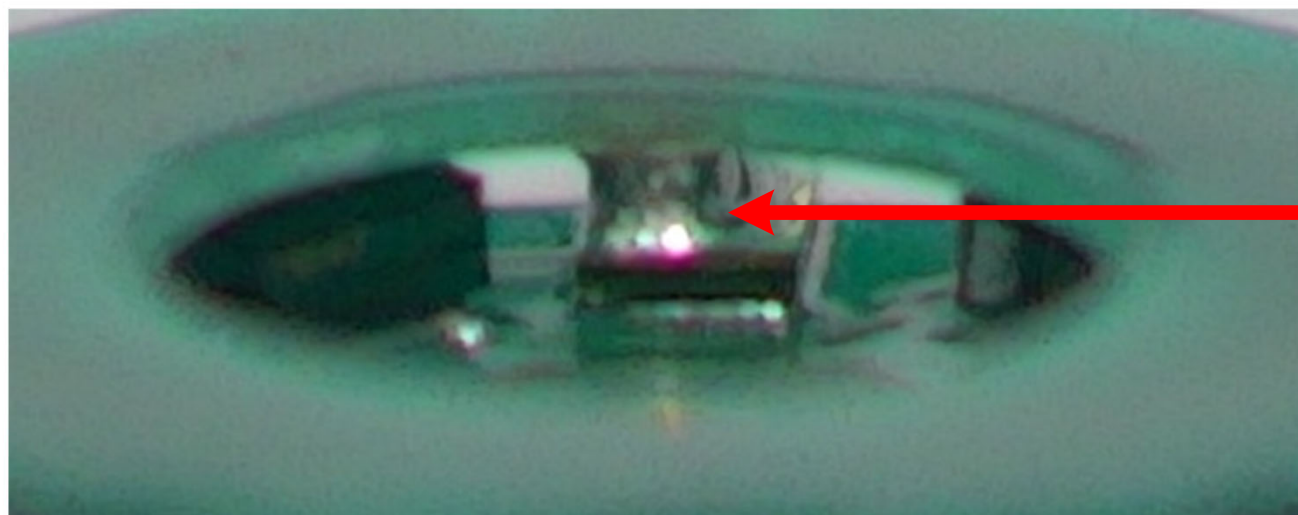
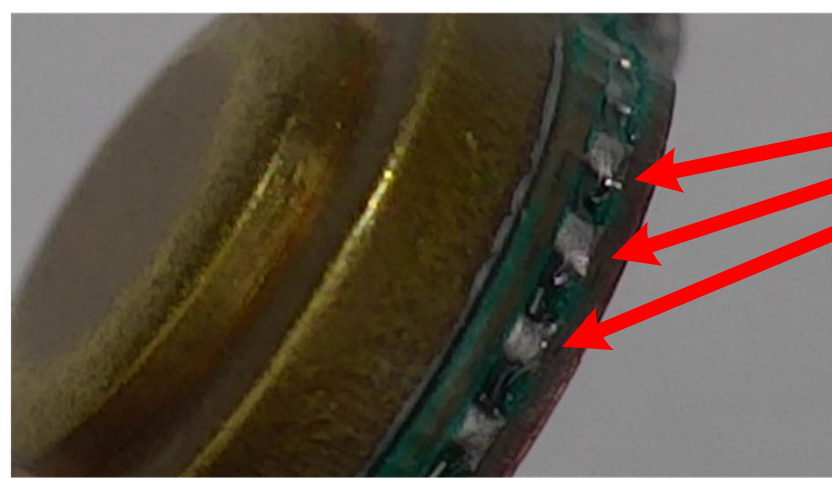
- A method of making soldered connections to PCB's that are stacked vertically using solder paste to form bridges
- A method for guaranteeing the formation of a solder bridge by overprinting solder paste
- A method for creating three-dimensional circuit assemblies with conventional SMT assembly equipment and solder paste
- Patent granted Nov 15, 2022 (Patent # 11,501,982) Entitled: Vertical Soldering for 3D Circuit Assembly
 - Founded on a documented solder study in Jan 2020
 - Defines a generalized 50% volume reduction rule as a basis for practical applications of vertical solder joints
 - Vertical solder joints are created by overprinting solder paste on a solder mask between a controlled air gap



Solderphobic Response



Vertically Soldered PCB's

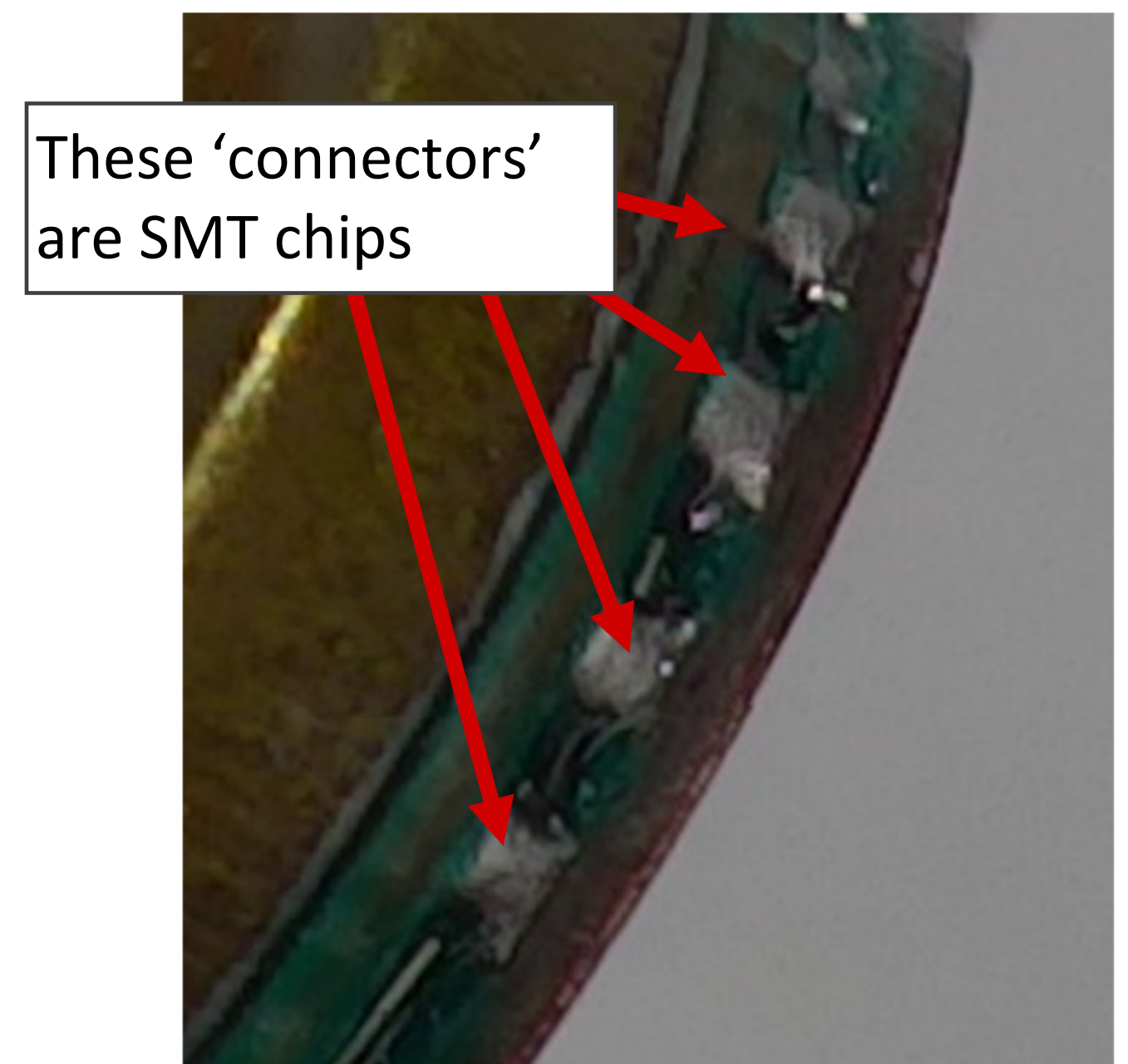


TYPES OF VERTICAL SOLDER JOINTS

- **Type 1: Self Supported**
 - Zero Ohm joint formed with solder alone
 - Comparable to a BGA solder joint but solder is printed
- **Type 2: Mechanically Supported**
 - Zero Ohm joint is formed with circuit components between layers
 - Electrical current path is shared between circuit layers with a common end of a components metallic conductor
 - Can be used solely for obtaining a physical gap or structural support (electrical current may be irrelevant)
- **Type 3: Functionally Supported**
 - Bridge is formed with a component between layers as a functional circuit element

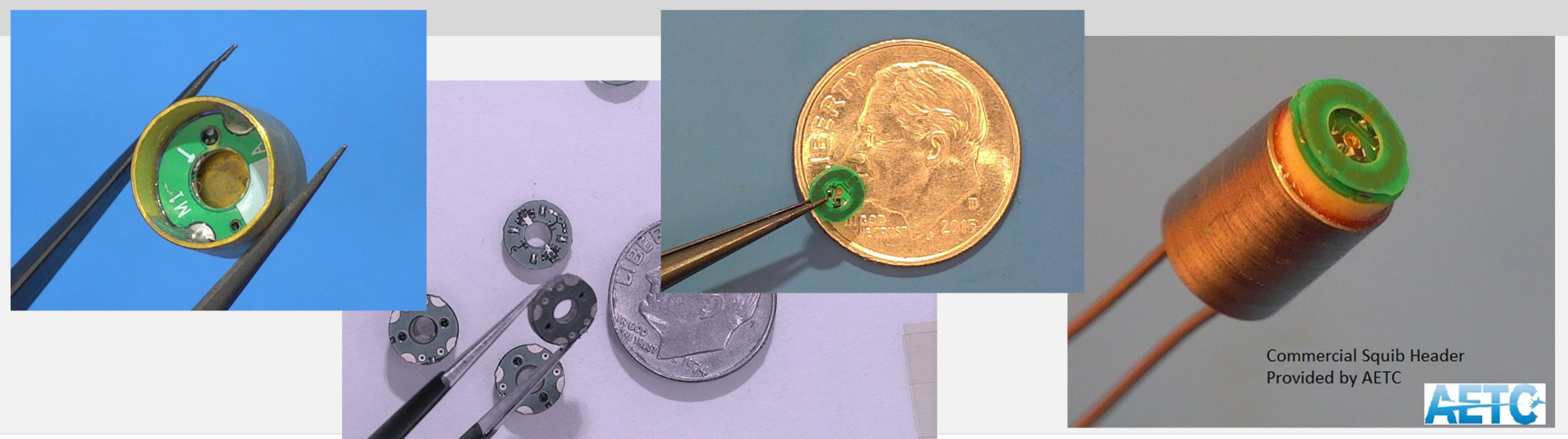
WHEN AND WHERE IS IT PRACTICAL

- Air gaps less than 20 mil
- Automated assembly / mass production desirable
- A lot of functionality in a very small space
- All Components all have a relatively low height
- Real estate is at a premium and volume is confined
 - Type 1 joints can be placed on demand
 - Discrete chips make very cheap vertical connectors



SOME EXAMPLES

Practical assemblies made possible by utilizing vertical soldering



Commercial Squib Header
Provided by AETC

FOR FURTHER INFORMATION:

U.S. ARMY COMBAT CAPABILITIES
DEVELOPMENT COMMAND
ARMAMENTS CENTER:
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