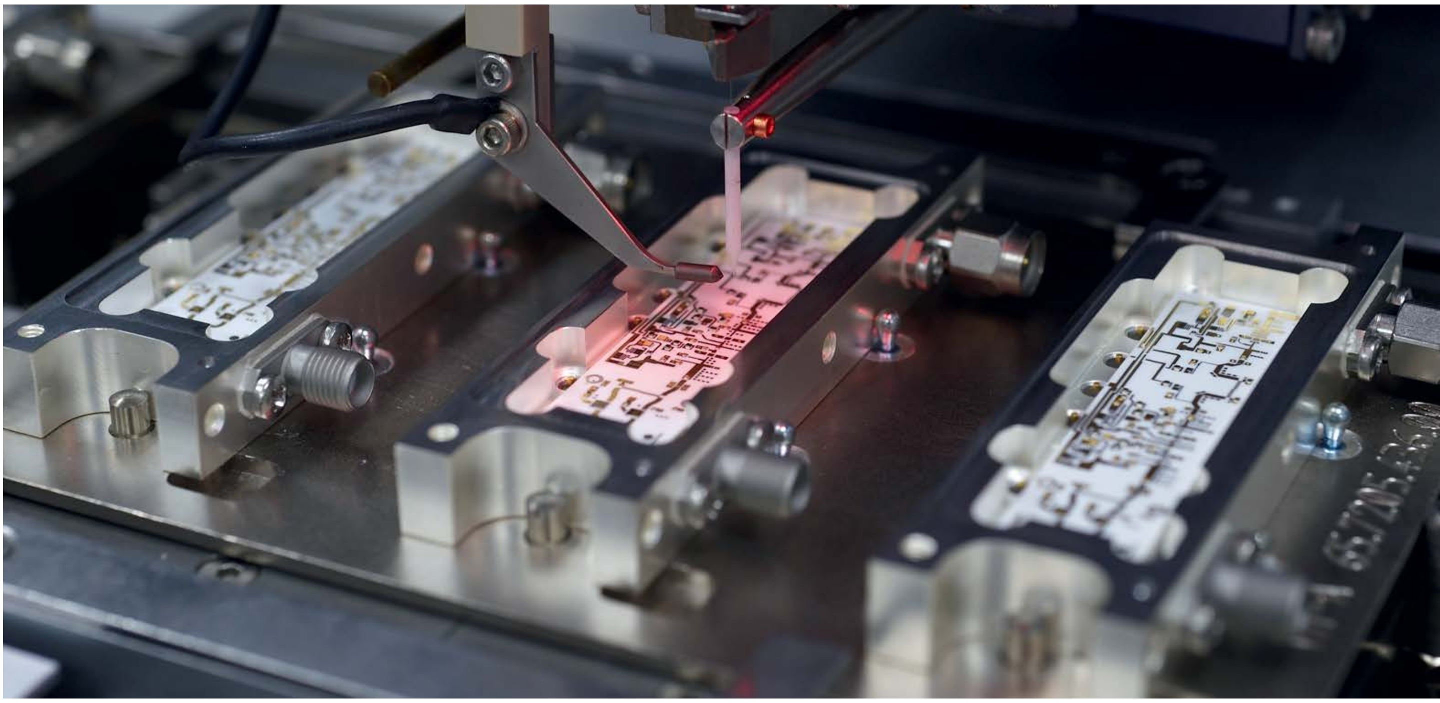


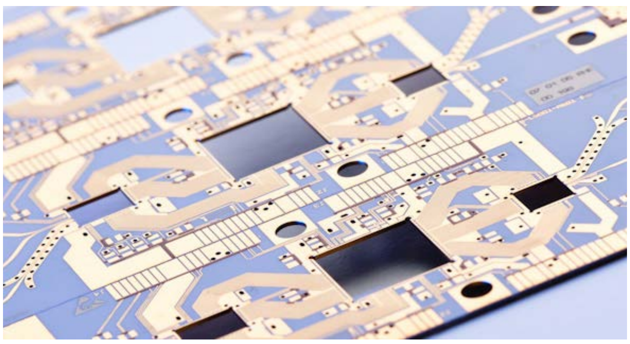
Substrates and hybrid circuits

Thin- and thick-film

Thin-film substrates are used where conventional PCB technology cannot provide adequate technical solutions. Rigid and flexible multilayer circuits with highest resolution (up to 10 µm or less) are possible. Thin-film technology uses processes from semiconductor and microsystem technology to produce circuit structures based on ceramic or organic materials. In contrast, the conductor tracks in thick-film technology are applied by screen printing and subsequent firing for stabilization.

The use of ceramics as substrate provides highest reliability under the harshest environmental conditions. Thick-film and thin-film circuits are clearly superior to the standard PCBs in terms of temperature resistance and service life.

Both substrate types can be populated with active and passive components, like a traditional PCB board. Thus, the finished components hold electrical functions on top of the board, and also in the metal stack itself. Hybrid circuit is a common term for such a configuration, in contrary to the monolithically integrated circuits (MIC) which are fabricated in semiconductor facilities.



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Portfolio

Thin-film substrates

- Rigid thin-film substrates: For decades, thin-film substrates based on rigid substrate materials have been produced and used for applications such as space missions, radar technology and sensor systems. In addition to the standard material aluminium oxide (Al_2O_3), which is available in various grades, aluminium nitride (AlN) is also becoming more common, particularly in applications which require increased thermal conductivity. Circuits are also produced on ferrites or (quartz) glass materials, which are gaining more and more attention due to the benefits in very high bit rate optical communication scenarios.
- Flexible thin-film substrates: For manufacturing of flexible thin-film substrates the same technologies and processes as for the manufacturing of rigid circuits are used. However, the focus is on the use of organic materials, which are either processed from the liquid phase, as insulators or substrates, or which may already be present as film material. Various formulations of polyimide or LCP (liquid crystalline polymer) are typically available as substrate material. The thickness of flexible thin film circuits ranges from a few microns up to several 100µm, depending on the circuit's configuration and metal system used.

Thick-film substrates: Thick-film technology is a highly sophisticated technology for the production of substrates that has been in use for decades. The use of ceramic material as substrate enables highest reliability under the harshest environmental conditions. Thick-film circuitry is clearly superior to PCBs in terms of temperature resistance and service life. The main advantage of this technology lies in the use of ceramic material as base substrate, which provides excellent thermal conductivity and mechanical properties. Printed resistors with a wide spectrum of electrical values (mΩ up to GΩ), can be realized directly on the substrate, with the possibility to achieve tight tolerances by means of laser trimming. Active trimming provides the possibility to adjust the electrical output signals of a circuit during operation in real-life scenario.

Recent advancements include:

- Development of new printing pastes
  - to improve the resolution of lines and via holes
  - to minimize differences in the coefficients of thermal expansion of dielectric pastes vs substrate materials
- Improvement of the printing screens and stencils (finest fabric up to 500 mesh, calendered fabric).
- Improvement of the screen printing equipment (fully automatic with camera alignment) and curing furnaces (improved temperature accuracy, better profile constancy).
- Photolithographic patterning of printed lines or laser structuring of conductor paths in order to extremely minimize line width and spacings (down to approx. 30 µm).

Markets

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