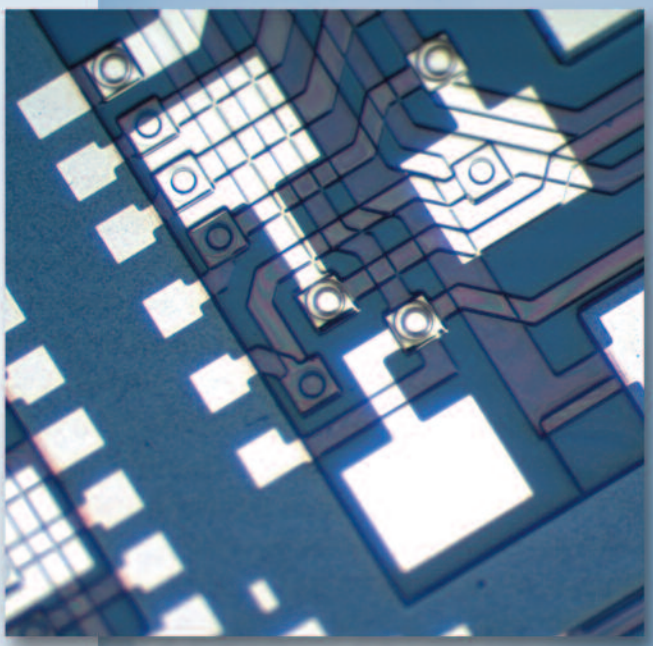
Multilayer

TECHNOLOGY OVERVIEW

The constant evolution of RF/microwave communications systems requires designers to strive for means of reaching new levels of electrical performance, miniaturization, and lower total system costs. A production proven thin film multilayer technology platform, which was originally developed for the interconnection of high speed digital circuits, has been developed by UltraSource® for use in the construction of multilevel DC, RF, and microwave circuits containing integrated passive components. The high accuracy and repeatability of this platform allows the technology to be a viable choice for packaging high frequency miniaturized electronics.

The multilayer solution provides a 5 layer system that includes 3 layers of custom patterned gold conductors separated by 2 layers of polyimide dielectric. The gold layers are pure sputtered gold which provide a low loss conductor system and can be patterned with 20 micron lines and spaces. The polyimide is a well characterized production dielectric and can be custom patterned to any shape including contact windows as small as 40 micron lines and spaces.



The construction of the thin film multilayer system is as follows:

Layer 1 = 4.5 µm thick gold conductor layer is applied and patterned as layer 1. Tantalum-nitride sheet resistors may also be applied to this first layer so that stable 50 ohm terminations and custom resistors may be realized.

Layer 2 = 7.5 µm layer of polyimide is applied, patterned, and cured on top of conductor layer 1.

Layer 3 = 4.5 µm thick gold conductor layer, applied and patterned over layer 2.

Layer 4 = 7.5 µm layer of polyimide is applied, patterned, and cured on top of conductor layer 3.

Layer 5 = 4.5 µm thick gold conductor layer, applied and patterned over layer 4.

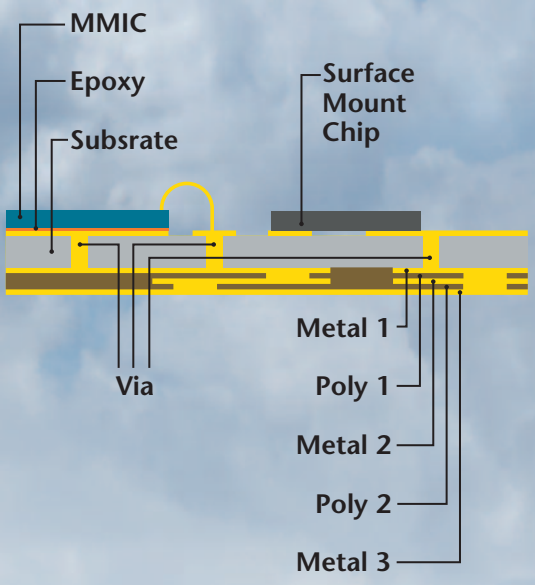
THE APPROACH

Using multiple polyimide and gold conductor layers, the thin film multilayer solution was created to provide designers with a custom, flexible, accurate, and reproducible technology that enables the realization of three dimensional DC, RF, and microwave structures. This technology can provide competitive advantages for designers looking to reach new levels of functional density, performance, and miniaturization.

THE POSSIBILITIES

UltraSource's thin film multilayer solution, utilizing alternating layers of low loss gold and production proven polyimide, provides designers with the opportunity to pursue ideas for gaining competitive advantage. These include:

- ***Miniaturization:*** More functionality fits into a small space and enables new methods of reducing circuit and overall package size.
- ***Speed:*** Designs can be compacted, which means that connections become shorter so overall signal speed increases.
- ***Power:*** The compact designs possible with the multilayer platform mean that power consumption is reduced.
- ***Design:*** The platform opens a world of new design possibilities.
- ***Bandwidth:*** Multilevel integration enables the construction of wide bandwidth connections between the functional blocks of different layers.
- ***Part Count:*** Less piece parts result in lower costs for purchasing, storage, assembly, and test.



Cross-Sectional view of advanced multilayer design

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MULTILAYER QUICK REFERENCE GUIDE

Multilayer Physical Characteristics

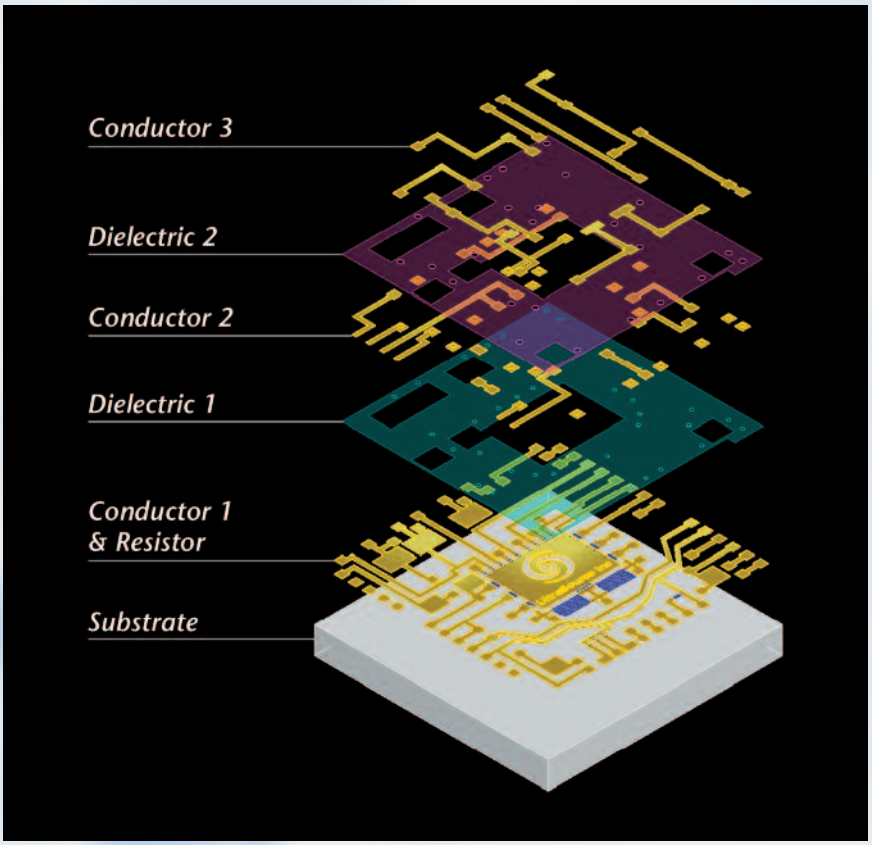
Layer	Name	Material	Thickness	Minimum Lines/Spaces	Minimum Contact Via Size	Pattern Tolerance	Alignment Tolerance
1	Substrate	AIN, Alumina	10 to 30 mils	–	–	–	–
2	Resistor	Tantalum Nitride	50 to 100 Ω/sq.	25 µm (.001")	–	±5 µm (.0002")	±5 µm (.0002")
3	Conductor 1	WTi/Au	4.5 µm	40 µm (.0016")	–	±10 µm (.0004")	±5 µm (.0002")
4	Dielectric 1	Polyimide	7.5 µm	40 µm (.0016")	75 µm (.003")	±10 µm (.0004")	±5 µm (.0002")
5	Conductor 2	WTi/Au	4.5 µm	40 µm (.0016")	–	±10 µm (.0004")	±5 µm (.0002")
6	Dielectric 2	Polyimide	7.5 µm	40 µm (.0016")	75 µm (.003")	±10 µm (.0004")	±5 µm (.0002")
7	Conductor 3	WTi/Au	4.5 µm	40 µm (.0016")	–	±10 µm (.0004")	±5 µm (.0002")

Properties of the Dielectric Material

Property	Value	Unit
Tensile Strength	200	MPa
Elongation (Max.)	45	%
Young's Modulus	3.5	GPa
Water Absorption	1.3	%
Tg Value (TMA)	325	°C
CTE	35	ppm
Dielectric Constant	3.3	–
Dissipation Factor	.001	–
Dielectric Strength	250	kV/mm
Volume Resistivity	$2.4x10^{16}$	Ohm cm

Layer Names & Descriptions

Layer	Name	Description
1	Substrate	AIN or Alumina
2	Resistors	Selective TaN traces
3	Conductor 1	Gold Layer 1
4	Dielectric 1	Polyimide insulating layer
5	Conductor 2	Gold Layer 2
6	Dielectric 2	Polyimide insulating layer
7	Conductor 3	Gold Layer 3



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UltraSource, Inc. 22 Clinton Drive, Hollis, NH 03049 • 603.881.7799 • www.UltraSource.com

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