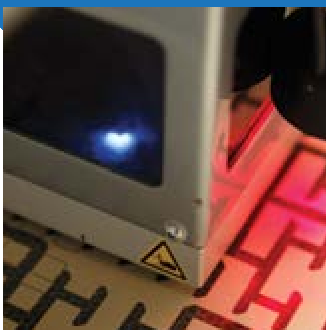
TELEDYNE LABTECH
A Teledyne Technologies Company

# RF/Microwave PCB Manufacturing Capability

## Offering RF & Microwave Value-Added Services for Demanding Applications



# RF/Microwave PCB Manufacturing Capability

## Contents


| | | | |
|---|---|---|---|
| Introduction | 2 | Mechanical Drilling | 5 |
| Materials | 3 | Mechanical Machining | 6 |
| Board Dimensions | 3 | Solder Mask etc. | 7 |
| Circuit Feature Capability | 4 | Surface Finishes | 8 |
| Laser Capability | 5 | | |


# Introduction

Teledyne Labtech is one of the world's leading manufacturers of complex, demanding RF/Microwave PCB printed circuit boards with an established pedigree, which spans more than 30 years. Providing specialist solutions for Military and challenging Commercial markets, Teledyne Labtech offers a wide range of complementary RF/Microwave PCB capabilities. Through comprehensive technical support, our ability to meet prototype-to-volume production requirements, along with state-of-the-art testing facilities, means we've set new standards in the development, manufacturing and testing of RF/Microwave PCB's for demanding and critical applications.

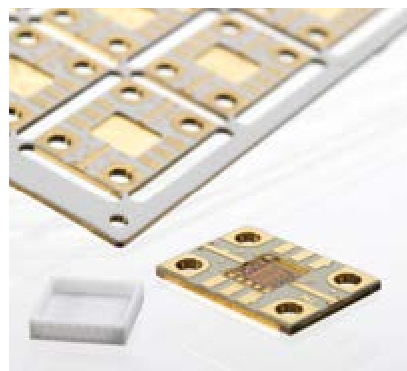
- Dedicated RF/Microwave PCB manufacturer
- Wire bondable surface finishes
- Embedded component capability
- Bonded Wave guide structures & components
- Large format capability
- Laser drilling, profiling and ablation to sub-layers
- Heavy metal machining capability
- Assembly and microwave testing to 40 GHz

### Metal-backed RF/ Microwave PCB's

- Pre-bonded laminates
- Post bonding of finished RF/ Microwave PCB's to discrete carriers
- Conductive and non-conductive adhesives
- Plated thru hole capability to metal backing
- Aluminium, brass & copper
- Copper-invar-copper, copper moly copper and other exotic metal backings

### Precision single sided and double sided RF/ Microwave PCB's

- Thin dielectrics
- MMIC Packages
- High tolerance capability



### Multilayer RF/ Microwave PCB's

- PTFE, LCP and mixed Dielectric constructions including flexible substrates
- Blind, buried and sequential vias
- Metal core and metal backed structures
- Coins and copper filled vias for thermal management
- Ohmega Ply & Ticer Foil – planar resistor technology
- Embedded components
- Vacuum Press and Autoclave bonding capability
- Fusion bonding for PTFE and LCP substrates

# Materials

Teledyne Labtech has extensive experience using the full range of RF/Microwave PCB materials. These materials can be combined with multi-functional epoxy or high temperature laminates to construct multi-layer structures. Teledyne Labtech has full capability to process metal backed laminates and where these are not available from the supplier can be constructed in-house.

| Microwave materials used | Typical Dk's |
|---|---|
| • Random glass | 2.33 |
| • LCP | 2.90 |
| • Thermoset | 3.50 |
| • Woven glass & ceramic fillers | 6.00 |
| • PTFE with ceramic fillers | 10.20 |

**Data submittal**

Email: labtechsales@teledyne.com
Note, Zip files will need to be posted onto Teledyne Liquid files

FTP: http://transfereast.teledyne.com

**Data formats**

RF/Microwave PCB design

- ODB++
- Extended Gerber (RS-274x)
- Autocad DWG/DXF

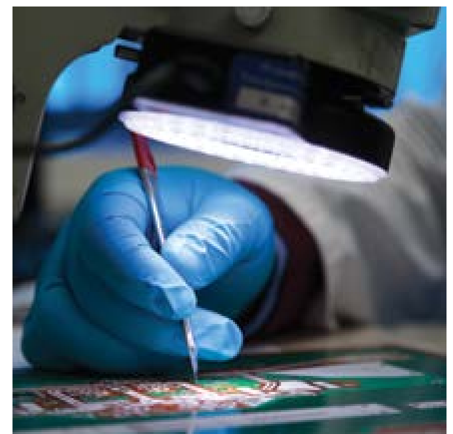
**Mechanical design**

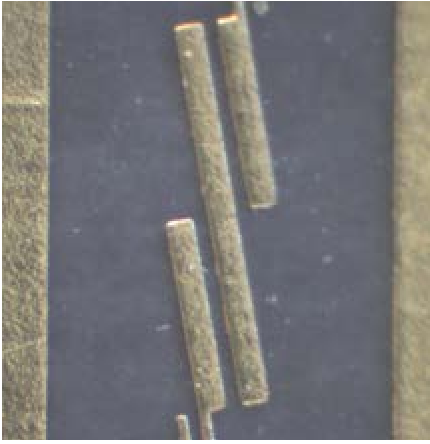
- STP files
- Autocad DWG/DXF

# Board Dimensions

| | | |
|---|---|---|
| Maximum standard panel | 457mm x 610mm | 18" x 24" |
| Large format capability | 100mm x 1800mm | 4" x 70" |
| Bonded Antenna structures | Up to 500mm x 1800mm | 20" x 70" |
| Minimum laminate thickness | 0.025mm | 0.001" |
| Maximum Board thickness | 8mm | 0.315" |

Board thickness above 8mm can be manufactured although certain processes are not compatible with boards above this thickness.





# Circuit Feature Capability

**Imaging**

Base foil thickness

| | 1/4oz 9 micron | 1/2oz 18 micron | 1oz 35 micron | 2oz 70 micron |
|---|---|---|---|---|
| Minimum Track | 50μm* 0.002″ | 75μm 0.003″ | 125μm 0.005″ | 150μm 0.006″ |
| Minimum Gap | 50μm* 0.002″ | 75μm 0.003″ | 125μm 0.005″ | 150μm 0.006″ |
| Etch Tolerance Print & Etch | +/10μm 0.0004″ | +/10μm 0.0004″ | +/25μm 0.001″ | +/40μm 0.0016″ |

* Print & etch only, minimum 65μm 0.0025″ for pattern plate process.

Values quoted are best possible without major yield impact. Wherever possible tolerances should be relaxed and minimum features should only be used where necessary, not globally.

**Pad – drilled hole registration**

| | | |
|---|---|---|
| Standard | +/−50μm | +/–0.002″ |
| Technical | +/−25μm | +/–0.001″ |

**Minimum designed annular ring to avoid drill breakout (Outer Layers)**

| | | |
|---|---|---|
| Standard | 100μm | 0.004″ |
| Technical | 50μm | 0.002″ |

Where required it is possible to plate hole barrels only to avoid pad build up on surface. This is not possible on holes below 0.30mm (0.012″) drilled diameter.

**Image registration side-side**

| | | |
|---|---|---|
| Standard | +/−45μm | +/–0.0018″ |
| Technical | +/−25μm | +/–0.001″ |

PTFE laminates can stretch or shrink during the process cycle.

# Laser Capability

### Positional Accuracy

| | | |
|---|---|---|
| Feature – feature | +/−25µm | +/–0.001″ |

### Laser Via

**Thru**

| | | |
|---|---|---|
| Standard | 200µm | 0.008″ |
| Technical | 50µm | 0.002″ |

**Blind**

| | | |
|---|---|---|
| Standard | 200µm | 0.008″ |
| Technical | 100µm | 0.004″ |

Maximum 1:1 aspect ratio on blind hole processing.

### Hole – Hole Spacing

| | | |
|---|---|---|
| Minimum | 0.05mm | 0.002″ |

### Profiling

| | | |
|---|---|---|
| Internal radii | 10µm | 0.0004″ |
| Dimensional Tolerance | +/−25µm | +/–0.001″ |
| Alignment to circuit image | +/−25µm | +/–0.001″ |

### Ablation

**Dimensional Tolerance**

| | | |
|---|---|---|
| X & Y axis | +/−25µm | +/–0.001″ |
| Z axis | +/−10µm | +/–0.001″ |

Laser ablation can be controlled to ablate material and thus expose buried circuit features, the minimum base copper on these should be 18 micron 1/2oz.

# Mechanical Drilling

### Maximum Aspect ratio

**(Board Thickness : Hole Diameter)**

| | |
|---|---|
| Standard | 10:1 |
| Technical | 11:1 |
| Metal Backed | 10:1 |
| Blind Holes | 1:1 |

Aspect ratios in excess of the above could cause plating deposition issues. Note, limitations on drill sizes may impact the above ratios

### Minimum drill diameter

**Softboard & Multilayer**

| | | |
|---|---|---|
| Standard | 0.20mm | 0.008″ |
| Technical | 0.10mm | 0.004″ |

**Metal backed**

| | | |
|---|---|---|
| Standard | 0.50mm | 0.002″ |
| Technical | 0.30mm | 0.012″ |

### Hole – Hole Spacing

| | | |
|---|---|---|
| Minimum | 0.20mm | 0.008″ |

### Z axis control

| | | |
|---|---|---|
| Standard | +/–0.50mm | +/–0.002″ |
| Technical | +/–0.025mm | +/–0.001″ |

### Hole size Tolerance

**Plated**

| | | |
|---|---|---|
| Standard | +/–0.10mm | +/- 0.004″ |
| Technical | +/–0.05mm | +/- 0.002″ |

**Non-plated**

| | | |
|---|---|---|
| Standard | +/–0.05mm | +/- 0.002″ |
| Technical | +/–0.02mm | +/- 0.0008″ |

# Mechanical Machining

**Profile feature tolerance**

| | | |
|---|---|---|
| Standard | +/–0.050mm | +/–0.002″ |
| Technical | +/–0.030mm | +/–0.0012″ |

**Minimum Internal radii**

Metal Backed

| | | |
|---|---|---|
| Standard | 1.000mm | 0.040″ |
| Technical | 0.500mm | 0.020″ |

Soft-board/Multilayer

| | | |
|---|---|---|
| Standard | 0.500mm | 0.020″ |
| Technical | 0.200mm | 0.008″ |

Where required by the use of tool overshoot in corners a pocket without radii in corners can be achieved. Note, minimum radii will be dependent upon material thickness

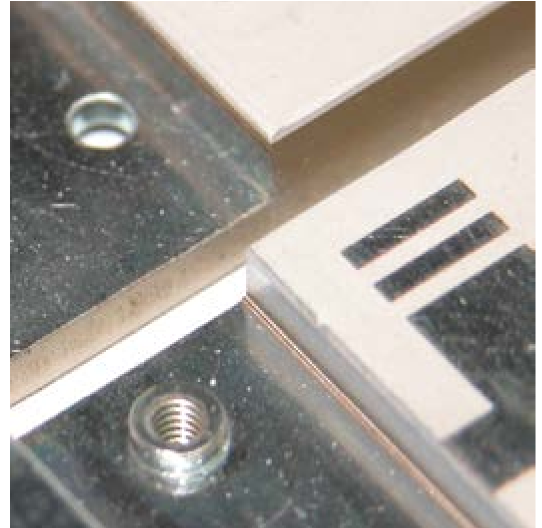
**Alignment to circuit image**

| | | |
|---|---|---|
| Standard | +/–0.50mm | +/–0.002″ |
| Technical | +/–0.25mm | +/–0.001″ |

**"Z" axis depth control**

| | | |
|---|---|---|
| Standard | +/–0.05mm | +/–0.002″ |
| Technical | +/–0.25mm | +/–0.001″ |

Critical waveguide features designed on thin dielectrics can be formed using a combination of mechanical and chemical processing techniques.



# Solder Mask etc.

### Solder mask

| | |
|---|---|
| Type: | Peters SD2467SG DG |
| Thickness: | 20 – 70µm/0.0008″ – 0.0028″ |
| Colour: | Green (Red or blue also available) |
| Hardness: | 6 H |

### Circuit feature – mask clearance on design

| | | |
|---|---|---|
| Standard | 0.100mm | 0.004″ |
| Technical | 0.075mm | 0.003″ |

### Minimum solder mask web (Isolation)

| | | |
|---|---|---|
| Standard | 0.150mm | 0.006″ |
| Technical | 0.100mm | 0.004″ |

### Solder resist dams (Line thickness)

| | | |
|---|---|---|
| Standard | 0.200mm | 0.008″ |
| Technical | 0.100mm | 0.004″ |

Due to the nature of some PTFE laminates it is not possible to achieve fine solder-mask features when positioned over bare laminate.

### Notation

| | |
|---|---|
| Type: | Peters SD2513UV |
| Thickness: | 10 – 20µm/0.0004″ – 0.0008″ |
| Colour: | White, yellow & black (Others also available) |
| Hardness: | 4 H |

### Minimum character size

| | | |
|---|---|---|
| Standard | 1.500mm | 0.060″ |
| Technical | 1.000mm | 0.040″ |

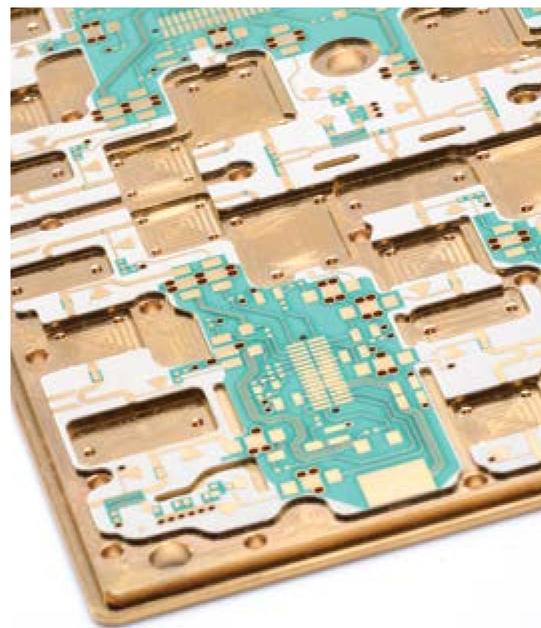
### Minimum line thickness

| | | |
|---|---|---|
| Standard | 0.254mm | 0.010″ |
| Technical | 0.150mm | 0.006″ |

### Peelable solder masks (Temporary)

| | |
|---|---|
| Type: | Elektra EM55 |
| Minimum thickness: | 0.200mm 0.008″ |
| Colour: | Green/Red |

| | |
|---|---|
| Type: | Peters DD 2954 |
| Minimum thickness: | 0.300mm 0.012″ |
| Colour: | Blue |



# Surface Finishes

### Profile feature tolerance

| | |
|---|---|
| Tin/Lead (60/40 ratio)<br>(As plated or brushed) | Min thickness 2.00um |
| Bright acid Tin | Min thickness 2.00µm |
| Tin (as plated or brushed) | Min thickness 2.00µm |
| Immersion Tin | 0.10µm |
| Electroless Tin | 0.50 – 1.5 µm |
| Electroless Nickel/Immersion Gold | Ni 3.50 – 8.00µm<br>Au 0.05 – 0.15µm |
| Electroless Nickel/Immersion Gold<br>(Higher build Gold for wire bonding) | Ni 3.50 – 8.00µm<br>Au 0.10 – 0.20µm |
| Electroless Nickel/Palladium/Gold<br>(Universal plating for wire bonding) | Ni 3.50 – 8.00µm<br>Pd 0.20 – 0.50µm<br>Au 0.05 – 0.15µm |
| Electrolytic pure soft Gold plating<br>(Suitable for wire bonding) | Au 0.50 – 5.00µm |
| Optional Nickel under-layer | Ni 1.00 – 10.00µm |

Alternative finishes are available through our network of fully approved sub-contractors.

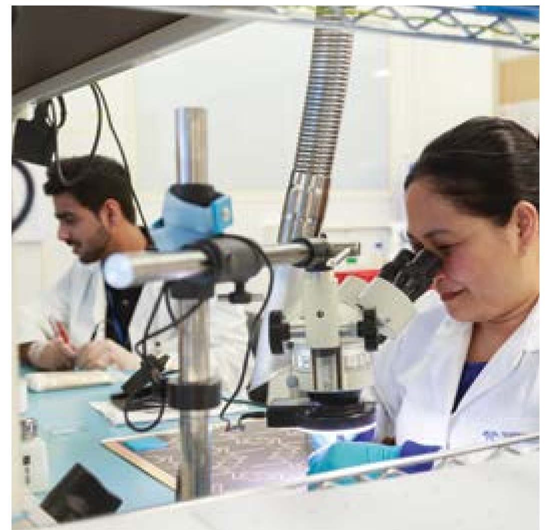
### Planar resistor technology

Ohmega-Ply clad laminates or foils

Ticer Foil

25, 50 & 100 ohm/square material

10% capability tolerance



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