



# SHORT FORM SPECIFICATION

|                |  |          |                           |        |
|----------------|--|----------|---------------------------|--------|
| <b>Level 2</b> | <b>TRAX INTERCONNECT (Pty.) Ltd.</b>                 |          | <b>Document No: 8.4.1</b> |        |
|                | <b>Short Form Specification for Standard Product</b> |          |                           |        |
| Responsibility | Quality Manager                                      | Initial: | Page 1 of 15              | Rev: 8 |
| Approved by    | Managing Director                                    | Initial: | Date: 10 March 2020       |        |

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## 1. INTRODUCTION

This short form specification defines standard and preferred manufacturing limits and tolerances at TraX Interconnect. It also provides limits and tolerances for designers wishing to have products made in the TraX Interconnect printed circuit facility.

Deviations from this specification are possible but require negotiation before acceptance for manufacture.

The specifications in this document are based on the internationally used IPC-6012 and are applied to professional single sided, double sided, through hole plated and multilayer printed circuit boards (PCBs), made by TraX Interconnect. Default acceptance criteria are based on IPC-TM-650 and IPC-A-600 Class 2. Should it be required, additional processes exist in order for TraX to achieve Class 3 PCBs, special attention is given to certain IPC Class 3 requirements such as additional minimum plating thickness, registration and cosmetics.

The TraX Interconnect Documented Quality System has been certified to comply with ISO 9001:2015. The TraX Interconnect ISO Registration Number is SA1632.

TraX Interconnect is entitled to use the Underwriters laboratory Inc. (UL) mark on specific products. The UL file number applicable to TraX Interconnect is E100180. Board type designations are F/S and MLB and the flame class is UL94V-0

When necessary, these specifications will be revised to consider new, changed or upgraded processes. References & specifications made may be specific to TraX and may not comply with IPC-6012 specifications. Users should make certain that they are in possession of the latest issue by referring to our web site or by contacting the TraX Interconnect factory by telephone, fax or e-mail.

Contact details are as follows:

Telephone: (27) 21 712 5011  
 Fax (27) 21 712 5798  
 Email [sales@trax.co.za](mailto:sales@trax.co.za)  
 Web Site [www.trax.co.za](http://www.trax.co.za)

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## 2. Customer supplied information

The procurement documentation should specify the following:

- Part name, part number, issue, revision number/ letter and date / issue number of latest applicable master drawing.
- Specific exceptions, variations, additions, or conditions, to this specification that are required by the user, this change will be 'As agreed between customer and factory' in writing.
- Part identifications and markings
- Information for packaging, handling and delivery.
- Additional tests required and frequency.

## 3. ARTWORK and DRILLING REQUIREMENTS

The artwork must be Gerber format and drill files in Excellon CNC drill format.

We also accept ODB++.

These files can be transferred to us via our website [www.trax.co.za](http://www.trax.co.za) or e-mailed to [sales@trax.co.za](mailto:sales@trax.co.za)

## 4. GENERAL MECHANICAL FACTS AND REQUIREMENTS

### 4.1 Base Material (laminated) Standard Thicknesses and Tolerances (See IPC-4101B)

These tolerances apply to multilayer panels as well as to standard laminate.

| Nominal Thickness | Tolerance (Class A/K) |
|-------------------|-----------------------|
| 0.5mm             | +/- 0.075mm           |
| 0.8mm             | +/- 0.165mm           |
| 1.55mm            | +/- 0.190mm           |
| 2.4mm             | +/- 0.230mm           |
| 3.2mm             | +/- 0.300mm           |

Note: For Class A materials, the given thickness is measured without copper cladding. This applies mostly to multilayer core laminates.

For Class K materials, the given thickness measurement includes copper cladding. This applies mostly to double-sided PTH and single layered boards.

### 4.2 Finished Board Dimensions

#### 4.2.1 Table of TraX Standard Panels Showing Area Available for Customer Use

| TraX Standard Panel                                     | A: 9" x 12"<br>(229 x 305) | B: 12" x 16"<br>(305 x 406) | C: 16" x 18"<br>(305 x 457) | D: 12" x 18"<br>(305 x 457) |
|---|----------------------------|-----------------------------|-----------------------------|-----------------------------|
| Area Available to Customers for Double Sided pth Boards | 199 x 275 mm               | 275 x 376 mm                | 376 x 427 mm                | 275 x 427 mm                |
| Area Available to Customers for 4- layer Boards         | 179 x 255 mm               | 255 x 356 mm                | 356 x 407 mm                | 255 x 407 mm                |
| Area Available to Customers for 6 to16- layer Boards    | 169x245 mm                 | 245x346 mm                  | 346x397 mm                  | 245 x 397 mm                |

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### 4.3 Tolerances on Finished Board Dimensions

|   |           |
|---|-----------|
| CNC Routed Boards                           | +/- 0.1mm |
| Boards in V-Scored panels – before snapping | +/- 0.1mm |
| Boards in scored panels – after snapping    | +/- 0.2mm |

### **4.4**

#### Other Machining Tolerances

|                                  |           |
|----------------------------------|-----------|
| Preferred internal corner radius | 1.5mm     |
| Minimum internal corner radius   | 0.5mm     |
| BC routed cut-outs               | +/- 0.1mm |

### 4.5 CNC Drilled Holes

See Section 6 of this specification.

### 4.6 Bow and Twist (IPC-6012 Section 3.4)

Bow and twist is measured using IPC-TM-650. Method 2.4.22

|  |       |
|--|-------|
| Maximum bow and twist for SMT panels     | 0.75% |
| Maximum bow and twist for non-SMT panels | 1.5%  |

## **5. MATERIALS USED BY TraX INTERCONNECT**

### 5.1 Base Laminates used at TraX Interconnect

Copper clad epoxy glass-fibre laminate (NEMA FR-4) to IPC-4101/21. Copper thickness stated below is that supplied by laminate manufacturers and applies at the start of the manufacturing process or after pressing in the case of multilayer panels. For final copper thickness, see Section 8 of this specification.

#### **FR4 Laminates**

TraX carry a range of different FR4 laminates from Standard TG to High TG laminates

**See Appendix A for FR4 laminates (Tg140/Tg150)**

**See Appendix B for FR4 laminates (Tg185)**

#### **High Frequency/Low Loss Laminates – (Rogers / Nelco / Taconic)**

TraX carry a modest inventory on selected materials, also in various dielectric thicknesses and copper claddings.

**See Appendix C for RF laminates**

**See Appendix D for PTFE laminates**

**See Appendix E for High Speed Digital / Low Loss Laminates**

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TraX processes many alternative material types which are not kept in stock but supplied by our customers, namely:  
RT Duroid, Arlon, non-stock item PTFE's, Copper substrate and Ceramic's like TMM6 and TMM10

## **5.2 Surface Finishes**

### **5.2.1**

#### **Tin-Lead**

Tin lead, selectively applied over bare copper by "Hot Air Solder Levelling".

### **5.2.2**

#### **Electroless Nickel / Immersion Gold (ENIG)**

The DOW process is used. This is also offered as a finish for very flat requirements such as BGA pads. Deposit thickness are to IPC-4552: Nickel 3.5 to 6.3µM and Gold 0.05 to 0.12µM.

### **5.2.3**

#### **Autocatalytic Silver Immersion Gold (ASIG)**

Silver is 0.15µM minimum and Gold is 0.03µM minimum.

### **5.2.4**

#### **Electroplated Gold over Nickel (for edge connectors)**

1 micron of electroplated hard gold alloy over 3 microns of electroplated nickel.

## **5.3 Solder Mask**

Default colour

Dark green matt (photo imageable / air spray)

Optional colours

Yellow-green matt (photo imageable / air spray)

Black matt (photo imageable / air spray)

Blue matt (photo imageable / air spray)

White semi-matt (photo imageable / air spray)

Red Matt (photo imageable / air spray)

Nominal coating thickness 25 microns

Preferred Solder Mask oversize is 0.15mm (150µ)

## **5.4 Component Legends (Silk-screens)**

Standard colour

White (photo imageable / air spray)

Black (on white Solder mask)

Minimum legend line width 0.10 mm

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## 6. CONDUCTOR (TRACK) WIDTHS AND SPACINGS

### 6.1 Conductor Widths - Minimum

| Base Copper | Spacing    |           | Minimum Trace Width |           | Annular Ring |           |
|-------------|------------|-----------|---------------------|-----------|--------------|-----------|
|             | High-tech* | Preferred | High-tech*          | Preferred | High-tech*   | Preferred |
| 12μ         | 0.08mm     | 0.09mm    | 0.075mm             | 0.10mm    | 0.10mm       | 0.10mm    |
| 18μ         | 0.1mm      | 0.13mm    | 0.11mm              | 0.125mm   | 0.10mm       | 0.10mm    |
| 35μ         | 0.14mm     | 0.16mm    | 0.125mm             | 0.15mm    | 0.10mm       | 0.10mm    |
| 70μ         | 0.18mm     | 0.20mm    | 0.20mm              | 0.23mm    | 0.10mm       | 0.10mm    |
| 105μ        | 0.21mm     | 0.24mm    | 0.25mm              | 0.30mm    | 0.10mm       | 0.10mm    |

\*these capabilities are experimental and are possible under certain parameters (design specific!)

### 6.2 Conductor Widths - Inspection Tolerances

Maximum allowable conductor width reduction  
Maximum conductor width reduction from nicks etc.

20% of artwork  
20% of minimum width

### 6.3 Conductor Spacing - Inspection Tolerances

Maximum spacing reduction from roughness, nodules etc.:

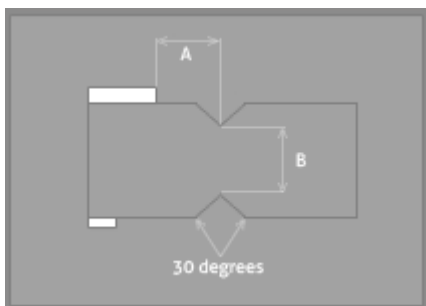
25% of minimum spacing

### 6.4 Distance from Board Edge

Minimum distance from edge to any feature excluding edge connector finger:

| <b>V-Scoring: B = 0.4mm and cutting angle 30°</b> |                      |                                     |
|---|----------------------|-------------------------------------|
|   | <b>PCB thickness</b> | <b>Min clearance from Cu – A mm</b> |
| 1   | 0.80mm               | 0.35mm                              |
| 2   | 1.00mm               | 0.40mm                              |
| 3   | 1.55mm               | 0.50mm                              |
| 4   | 2.00mm               | 0.60mm                              |

We do not V-score boards thinner than 0.8mm and thicker than 2mm.



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| Routing |                        |                                 |
|---------|------------------------|---------------------------------|
| 1       | Router to Cu           | 0.2mm                           |
| 2       | Router size            | 0.70 to 3mm increments of 0.1mm |
| 3       | Preferred Router sizes | 2mm, 2.4mm and 3mm(default)     |
| 4       | Compensation           | Right                           |

Note: Any board that requires the **UL mark** may not have a conductor to edge distance of less than 0.33 mm.

## 7. HOLES

### 7.1 Design Recommendation

It is recommended that the finished hole diameter be the specified pin or lead diameter plus 0.2 mm.

### 7.2 Finished Hole Sizes drill blow up

| Surface Finish   |             |                      |            |                       |            |
|--|-------------|----------------------|------------|-----------------------|------------|
|  | Finish Type | Drill Blow up <2.0mm |            | Drill Blow up ≥ 2.0mm |            |
|  |             | Plated               | Non-plated | Plated                | Non-plated |
| 1  | HASL        | 0.15mm               | 0.05mm     | 0.20mm                | 0.10mm     |
| 2  | ENIG        | 0.10mm               | 0.05mm     | 0.20mm                | 0.10mm     |
| 3  | ASIG        | 0.10mm               | 0.05mm     | 0.20mm                | 0.10mm     |
| <b>Or, as per customer specification – Consult TraX Engineer</b> |             |                      |            |                       |            |



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| Drilling |                  |                               |               |                            |
|----------|------------------|-------------------------------|---------------|----------------------------|
| 1        | Drill Size       | 0.25mm Min.                   |               | 6.2mm Max                  |
| 2        | Drill to Cu      | 0.18mm High Tech.             | Allowed 0.2mm | Preferred 0.25mm           |
| 3        | NPTH to Cu       | 0.18mm High Tech.             | Allowed 0.2mm | Preferred 0.25mm           |
| 4        | Drill sizes      | <2.0mm increments of 0.05mm   |               | ≥2.0mm increments of 0.1mm |
| 5        | Slots            | ≥ 0.5mm increments of 0.1mm   |               |                            |
| 6        | Larger Diameters | >6.2mm routed                 |               |                            |
| 7        | Aspect Ratio     |                               |               | 6.5:1 (Pulse Plating 10:1) |
| 8        | Breakaway Tab    | 0.8mm general                 |               | Customer requirement       |
| 9        | Mousebite Tab    | At least 0.33mm between holes |               | Customer requirement       |

Minimum drilled hole size on 1.55 material (before plating):  
 Minimum plated through holes (1.55 mm material & less):

0.25 mm  
 0.15 mm finished diameter.

### 7.3 Finished Hole Size Inspection Tolerances

|                    |                   |                 |
|--------------------|-------------------|-----------------|
| Plated Through     | <2.00 mm diameter | -0.0mm +0.15mm  |
| Plated Through     | >2.00 mm diameter | -0.0mm +0.20mm  |
| Non-Plated Through | <2.00 mm diameter | -0.05mm +0.10mm |
| Non-Plated Through | >2.00 mm diameter | -0.05mm +0.15mm |

The above table applies unless otherwise stated by the customer specifications

### 7.4 Board Thickness to Hole Diameter Aspect Ratios

|   |  |
|---|--|
| Maximum aspect ratio (board thickness: drilled hole diameter)   | Conventional Plating 6.5:1<br>Pulse Plating 10:1 |
| Maximum aspect ratio for mechanically drilled blind vias (check with TraX engineering and TraX provided stack-up) | 0.8:1  |

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### 7.5 Hole Location and Photo Tool Registration Tolerances

Remaining external annular ring after manufacture will be to IPC-A-600

### 7.6 Plating Voids and Hole Imperfections

As per IPC-A-600

### 7.7 Acceptable Visual Imperfections

As per IPC-A-600

### 7.8 Distance Between Holes and from Hole to Edge

|  |   |
|--|---|
| Minimum wall thickness between holes   | 0.3mm   |
| Minimum distance from hole to board edge or cut-out                                  | 1.0mm   |
| Castellation holes (plated holes routed through the center on the edge of the board) | Allowed (minimum diameter of 0.5mm)<br>Anything less must be discussed with TraX engineer |

### 7.9 Back-drilling

Drill size will be as per 7.2 above. The back-drill tool size will be the drill size + 0.15mm (0.1mm experimental). The target condition will be the customers required depth + 0mm - 0.15mm.

### 7.10 Resin Filling specification:

1. We can resin fill and copper cap through hole and blind vias.
2. The Epoxy Fill will be non-conductive Taiyo THP-100DX1, which is a single component, thermally curable, permanent hole filling material. Technical data sheet is available on our website.
3. The Epoxy Fill is High Tg and low CTE. It is Halogen Free and RoHS Compliant.
4. Aspect Ratio for through holes will be 1:10 and blind vias 1:0.8
5. Board thicknesses to be resin filled will range from 0.2mm to 4.0mm
6. Manufacturing data pack should include a gerber layer, drill file or mechanical drawing which indicate all holes requiring resin filling.
7. Our Copper Cap plating will be in accordance to IPC-6012, section 3.6.2.11.2
8. Our Epoxy fill will be in accordance to IPC-6012, section 3.6.2.18

## **8. LAND (PAD) SIZE (See IPC-6012 Section 3.4)**

### 8.1 Land Diameter (or width) - Component Holes

This depends on customer requirements and on accuracy of artworks and drilling information. Accurate tooling reduces the risk of holes breaking out.

|                            |                       |
|----------------------------|-----------------------|
| Nominal minimum land width | Hole diameter + 0.4mm |
|----------------------------|-----------------------|

### 8.2 Land Diameter - Via Holes

This depends on customer requirements and on accuracy of artworks and drilling information. Accurate tooling lessens the chances of holes breaking out.

|                            |                       |
|----------------------------|-----------------------|
| Nominal minimum land width | Hole diameter + 0.3mm |
|----------------------------|-----------------------|

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### **8.3** Land diameter - Inner Layers

|  |                            |
|--|----------------------------|
| Inner Layer copper clearance/land diameter | Finished hole size + 0.4mm |
|--|----------------------------|

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**9. PLATING LIMITS AND TOLERANCES**

**9.1 Plating Thickness**

Average minimum plated copper thickness: 20µM  
 Minimum gold over nickel thickness for edge connectors: 1 over 3µM  
 Surface finishes are covered under Section 4.2

**9.2 Minimum Final Copper Thickness**

**9.2.1 Plated Through Hole and Multilayer Boards – Default Process**

| Base Cu Thickness (micron) | Plated Cu Thickness (micron) | Final Cu Thickness (micron) |
|----------------------------|------------------------------|-----------------------------|
| 17                         | 20                           | 37                          |
| 35                         | 20                           | 55                          |
| 70                         | 20                           | 90                          |

**Note: 1.** Class 3 work is copper plated to minimum average of 25  
**Note: 2.** Non-essential narrow tracks, spacings and small holes increase prices.

**9.2.2 Single Sided Boards**

| Base Cu Thickness (micron) - Nominal | Plated Cu Thickness (micron) - Nominal | Final Cu Thickness (micron) - Nominal |
|--------------------------------------|--|---------------------------------------|
| 35                                   | 0                                      | 35                                    |
| 70                                   | 0                                      | 70                                    |

|                |  |          |                           |        |
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## 10. CONTROLLED IMPEDANCE

Controlled impedance design using Polar Instruments equipment and software.  
 Testing is possible by means of test coupons using Polar Instruments CITS500S2a.  
 Capability is +/- 10%

## 11. Verification and Compliance

The Printed Circuit boards manufactured are inspected and verified to the IPC specified requirements as described in IPC-TM-650 and the IPC-6012 document (latest).

If required a First Article Inspection Report can be generated as supporting documentation for the tests performed. This report comprises of the following:

- Acceptance Test Report Summary
- Hole Size Verification Report
- Dimensional Measurement Report
- PCB Thickness & Layup Measurement Report
- Micro section Report
- Solderability Test Report
- Thermal Test Report
- Ionic Contamination & Surface Finish Report
- Electrical and Impedance Testing Report

## 12. REASON FOR DOCUMENT CHANGE

- Rev 6: General review and update to include latest capabilities
- Rev 7: Section 7.9 added to include back drilling; Added: Appendix E & F– PTFE material.
- Rev 8: Section 5 – Thermal management materials paragraph removed; Section 5.2.5 – removed reference to peelable mask; Section 4.2.1 – removed reference of aluminium boards, Section 7.10 – Resin filling has been added.

## 13. DISTRIBUTION

|                                     |  |
|-------------------------------------|--|
| <b>01 – Managing Director</b>       | <b>12 – Intermediate Inspection</b>  |
| <b>02 – Quality Manager</b>         | <b>13 – ISO File</b>   |
| <b>03 – Production Director</b>     | <b>14 – Sales Manager</b>  |
| <b>05 – Production Control</b>      | <b>17 – Laboratory Manager</b>   |
| <b>06 – CAM Engineering Manager</b> | <b>20 – Sales Office Johannesburg</b>  |
| <b>08 - Drilling</b>                | <b>21 – <a href="http://www.trax.co.za">www.trax.co.za</a> (as pdf file)</b> |
| <b>08 - Routing</b>                 |  |

|                |  |          |                           |        |
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|                | <b>Short Form Specification for Standard Product</b> |          |                           |        |
| Responsibility | Quality Manager                                      | Initial: | Page 13 of 15             | Rev: 8 |
| Approved by    | Managing Director                                    | Initial: | Date: 10 March 2020       |        |

### Appendix A – FR4 Laminates (Tg140/Tg150)

| Mid-TG Multilayer Substrate - FR4 (TG150) |                       |       |       | Single Sided / Double Sided / PTH Substrate - FR4 (TG140) |                       |         |         |        |         |         |
|---|-----------------------|-------|-------|---|-----------------------|---------|---------|--------|---------|---------|
| Dielectric Constant - 4.2                 |                       |       |       | Dielectric Constant - 4.2                                 |                       |         |         |        |         |         |
| This refers to dielectric thickness ONLY  | Cu Thickness in $\mu$ |       |       | Thickness includes dielectric and Cu                      | Cu Thickness in $\mu$ |         |         |        |         |         |
| 0.1mm                                     | 17/17                 | 35/35 |       | 0.41mm  | 17/17                 |         |         |        |         |         |
| 0.15mm                                    | 17/17                 |       |       | 0.8mm   | 17/17                 |         |         |        |         |         |
| 0.2mm                                     | 17/17                 | 35/35 | 70/70 | 1.00mm  | 17/17                 |         |         |        |         |         |
| 0.35mm                                    | 17/17                 | 35/35 | 70/70 | 1.55mm  | 17/17                 | 35/35   | 35/0    | 70/70  | 70/0    | 105/105 |
| 0.51mm                                    | 17/17                 | 35/35 |       | 2.0mm   | 17/17                 |         |         |        |         |         |
| 0.71mm                                    | 17/17                 | 35/35 | 70/70 | 2.40mm  |                       | 35/35   |         | 70/70  |         |         |
| 0.93mm                                    | 17/17                 | 35/35 |       | 3.20mm  |                       | 35/35   |         |        |         |         |
| 1.2mm                                     | 17/17                 | 35/35 |       |   |                       |         |         |        |         |         |
| 1.55mm                                    |                       | 35/35 |       |   |                       |         |         |        |         |         |
| 2.4mm                                     |                       | 35/35 |       |   |                       |         |         |        |         |         |
| Pre Preg - FR4(TG150)                     | Base Thickness in mm  |       |       |   |                       |         |         |        |         |         |
| 1080                                      | 0.070mm               |       |       |   |                       |         |         |        |         |         |
| 2116                                      | 0.120mm               |       |       | Copper Foil used in Multilayer Builds                     |                       |         |         |        |         |         |
| 7628                                      | 0.187mm               |       |       | Thickness   | 0.012mm               | 0.018mm | 0.035mm | 0.07mm | 0.105mm |         |

### Appendix B – FR4 Laminates (Tg185)

| <b>Nelco n4000-29 (TG185)</b> |                       |       |       |                   |                |
|-------------------------------|-----------------------|-------|-------|-------------------|----------------|
| Dielectric Constant - 4.2     |                       |       |       |                   |                |
| Thickness                     | Cu Thickness in $\mu$ |       |       | n4000-29 Pre Preg | Base Thickness |
| 0.0508mm(capacitance)         |                       | 35/35 |       | 106               | 0.060mm        |
| 0.089mm                       | 17/35                 |       |       | 1080              | 0.075mm        |
| 0.1016mm                      | 17/17                 | 35/35 |       | 2113              | 0.100mm        |
| 0.127mm                       | 17/17                 |       |       | 2116              | 0.135mm        |
| 0.1524mm                      | 17/17                 | 35/35 |       |                   |                |
| 0.2032mm                      | 17/17                 | 35/35 | 70/70 |                   |                |
| 0.254mm                       | 17/17                 | 35/35 |       |                   |                |
| 0.3556mm                      | 17/17                 | 35/35 | 70/70 |                   |                |
| 0.381mm                       | 17/17                 |       |       |                   |                |
| 0.508mm                       | 17/17                 | 35/35 |       |                   |                |

|                |  |          |                           |        |
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| Approved by    | Managing Director                                    | Initial: | Date: 10 March 2020       |        |

**Appendix C – RF Laminates**

| <b>Mercury Wave 9350 (TG200)</b> |   |         | <b>Rogers 4003C (TG280)</b>        |   |       |
|----------------------------------|---|---------|------------------------------------|---|-------|
| Dielectric Constant - 3.5        |   |         | Dielectric Constant - 3.38         |   |       |
| <u>Thickness</u>                 | <u>Cu Thickness in <math>\mu</math></u> |         | <u>Thickness</u>                   | <u>Cu Thickness in <math>\mu</math></u> |       |
| 0.1016mm                         | 17/17                                   | 35/35   | 0.2mm                              | 17/17                                   | 35/35 |
| 0.211mm                          | 17/17                                   | 35/35   | 0.5mm                              | 17/17                                   | 35/35 |
| 0.508mm                          | 17/17                                   | 35/35   | 0.8mm                              | 17/17                                   | 35/35 |
| 0.812mm                          | 17/17                                   | 35/35   | 1.52mm                             | 17/17                                   | 35/35 |
| 0.254mm                          | 17/17                                   |         | Rogers 3001 Bonding Film   0.038mm |   |       |
| 1.524mm                          | 17/17                                   | 35/35   |                                    |   |       |
| <u>Pre Preg</u>                  | <u>Base Thickness in mm</u>             |         |                                    |   |       |
| 106                              | 0.043mm                                 |         |                                    |   |       |
|                                  | 1080                                    | 0.082mm |                                    |   |       |
|                                  | 2116                                    | 0.105mm |                                    |   |       |

**Appendix D – PTFE Laminates (limited stocks)**

| <b>Nelco NX9250ST</b>     |   | <b>Nelco NY9220ST</b>     |   | <b>Taconic TLX</b>        |   |
|---------------------------|---|---------------------------|---|---------------------------|---|
| Dielectric Constant - 2.5 |   | Dielectric Constant - 2.0 |   | Dielectric Constant - 2.5 |   |
| <u>Thickness</u>          | <u>Cu Thickness in <math>\mu</math></u> | <u>Thickness</u>          | <u>Cu Thickness in <math>\mu</math></u> | <u>Thickness</u>          | <u>Cu Thickness in <math>\mu</math></u> |
| 0.5mm                     | 35/35                                   | 0.254mm                   | 17/17                                   | 0.5mm                     | 35/35                                   |
| 1.1mm                     | 35/35                                   |                           |   | 1.1mm                     | 35/35                                   |

**Appendix E – High Speed Digital / Low Loss Laminates**

| <b>Meteorwave 4000 (TG200)</b> |   |  | <b>Nelco N4800-20/20 si (TG200)</b> |   |       |
|--------------------------------|---|--|-------------------------------------|---|-------|
| Dielectric Constant - 3.4      |   |  | Dielectric Constant - (various)     |   |       |
| <u>Thickness</u>               | <u>Cu Thickness in <math>\mu</math></u> |  | <u>Thickness</u>                    | <u>Cu Thickness in <math>\mu</math></u> |       |
| 0.101mm                        | 17/17                                   |  | 0.051mm (20si)                      |   | 70/70 |
| 0.787mm                        | 17/17                                   |  | 0.127mm (20si)                      | 17/17                                   |       |
| <u>Pre Preg</u>                | <u>Base Thickness in mm</u>             |  | 0.1mm (20)                          | 17/17                                   |       |
| 1080                           | 0.074mm                                 |  | <u>Pre Preg</u>                     | <u>Base Thickness</u>                   |       |
|                                |   |  | 1080 (20si)                         | 0.079mm                                 |       |
|                                |   |  | 2116 (20si)                         | 0.147mm                                 |       |
|                                |   |  | 2116 (20)                           | 0.122mm                                 |       |