PRELIMINARY TECHNICAL REPORT

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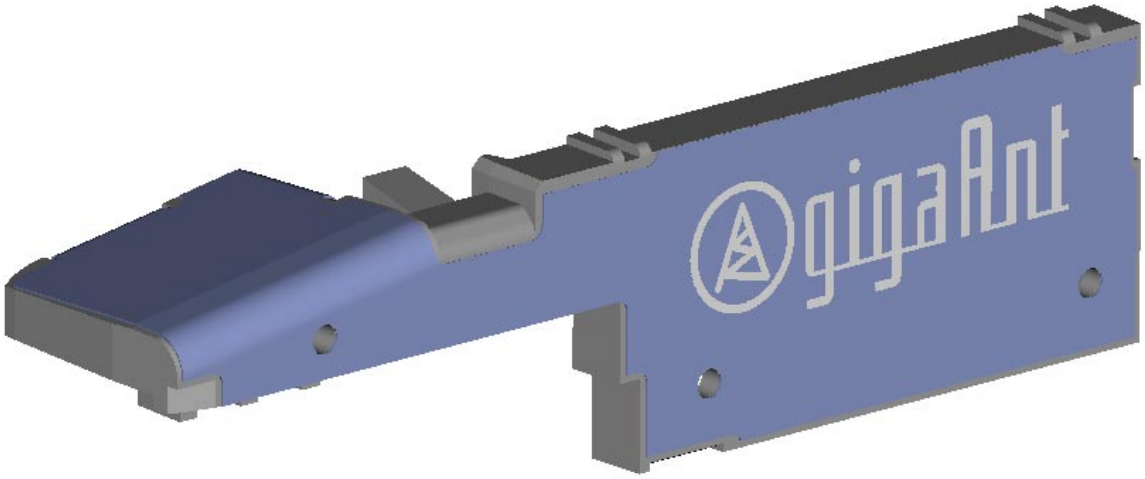
|---|---|---|---|
| **Prepared by:** Ola Carmonius & Elisabeth Wieslander | **File name:** Specifications of iPAQX BT/WLAN Antenna | **Creation date:** 2004-01-13 | **Page:** 1 |
| **Approved by:** Rune Nilsson | **Document number:** AA040002 | **Last rev. date:** 2004-04-21 | **Revision:** PA4 |
| **Distribution:** | EA | | |

# Specification
# Of iPAQX BT/WLAN Antenna



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## Contents

| | | | |
|---|---|---|---|
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# 1 Overview

This is the specification for a gigaAnt dual-band antenna. The antenna is to be used in an iPAQ Personal Digital Assistant (PDA) for the BT and WLAN band.

## 1.1 Definitions

| | |
|---|---|
| dBi | Decibel relative isotropic antenna |
| Tx | Transmit frequency |
| Rx | Receive frequency |
| R.L. | Return Loss |
| PCB | Printed Circuit Board |
| TBD | To Be Defined |
| TBA | To Be Advised |
| TBF | To Be Finalized |
| ASD | Acceleration Spectral Density |
| CW | Continuous Wave |
| PDA | Personal Digital Assistant |
| BT | Bluetooth |
| WLAN | Wireless Local Area Network |

# 2 Interfaces

## 2.1 Electrical

Nominal antenna impedance: 50Ω

## 2.2 Mechanical

### 2.2.1 Dimensions

gigaAnt interface drawing B5969 defines the mechanical interface of the antenna. The drawing can be seen in Enclosure 1. Encircled dimensions represent critical parameters and will be measured.

### 2.2.2 Connector

The antenna is connected via an external separate connector, manufactured by Acon. A specification of this connector can be seen in Enclosure 2. The nominal stroke length of the connector legs is 1.5mm.

### 2.2.3 PDA Frame

The antenna will be mounted in the PDA frame. Three snap hooks are used for fastening the antenna.

## 2.3 Hardware platform

The chassis used for the development and verification of this antenna is an iPAQ (PDA) that consists of the customer handset reference number (TBA).

# 3 Electrical Specification

The electrical performance is dependent on the proper fixation of the antenna in order to ensure stable electrical characteristics.

## 3.1 Electrical measurement methods

### 3.1.1 General

All measurements are performed at room temperature, 20°C ± 3,0°C.

### 3.1.2 Output Power

The power is measured during a period of 10 minutes. The frequency is the middle frequency of the BT/WLAN band. The test signal is a CW signal.

### 3.1.3 Return Loss

The Return Loss is measured with a Network Analyser. The Return Loss is measured in free space.

### 3.1.4 Efficiency

The efficiency is measured in a calibrated 3D anechoic chamber. The efficiency is the total radiated power divided by the total power sent to the antenna, which in some literature is referred to as total efficiency.

### 3.1.5 Gain and Radiation Patterns

The pictures in Figure 3 to Figure 4 show the polar plots of the measured cuts. The vertical and horizontal polarisation are measured and summed up to the total polarisation, which is used to calculate the efficiency. The coaxial feed cable is not electrically interfering with the antenna.

## 3.2 Electrical Requirements

### 3.2.1 Frequency

Both the WLAN and Bluetooth antennas operate in the frequency band: 2,4 – 2,5 GHz

### 3.2.2 Output Power

The maximum output power for the WLAN and Bluetooth antennas is: 5W CW

### 3.2.3 Return Loss

Loss graphs for typical values across the entire bandwidth are listed in Table 1 below. The typical Return Loss the two antennas are showed in Figure 1 and Figure 2.

| **Frequency** / [GHz] | **2,40** | **2,45** | **2,50** |
|---|---|---|---|
| WLAN Return Loss [dB] No cards | 15 | 14 | 9 |
| WLAN Return Loss [dB] With cards, worst case | 13 | 12 | 8 |
| Bluetooth Return Loss [dB] No cards | 5 | 4 | 3 |
| Bluetooth Return Loss [dB] With cards, worst case | 5 | 3 | 3 |

**Table 1**. *Return Loss values for the WLAN and Bluetooth antennas in the IPAQX.*

The Return Loss plot in Figure1 shows the WLAN resonance frequency without the memory cards inserted.


**Figure 1.** Return loss plot for the WLAN antenna in the IPAQX without any cards inserted.

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|---|---|---|---|
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Since the two antennas are coupling very hard due to being close as well as in the same frequency band, the Bluetooth antenna is matched to be slightly off frequency. In Figure 2 the Bluetooth resonance frequency is shown without cards inserted into the IPAQX. When the cards are inserted the resonance is lowered in frequency and hence a slightly better values are obtained. However, it is important to not make it too good in order not to interfere too much with the WLAN antenna performance.

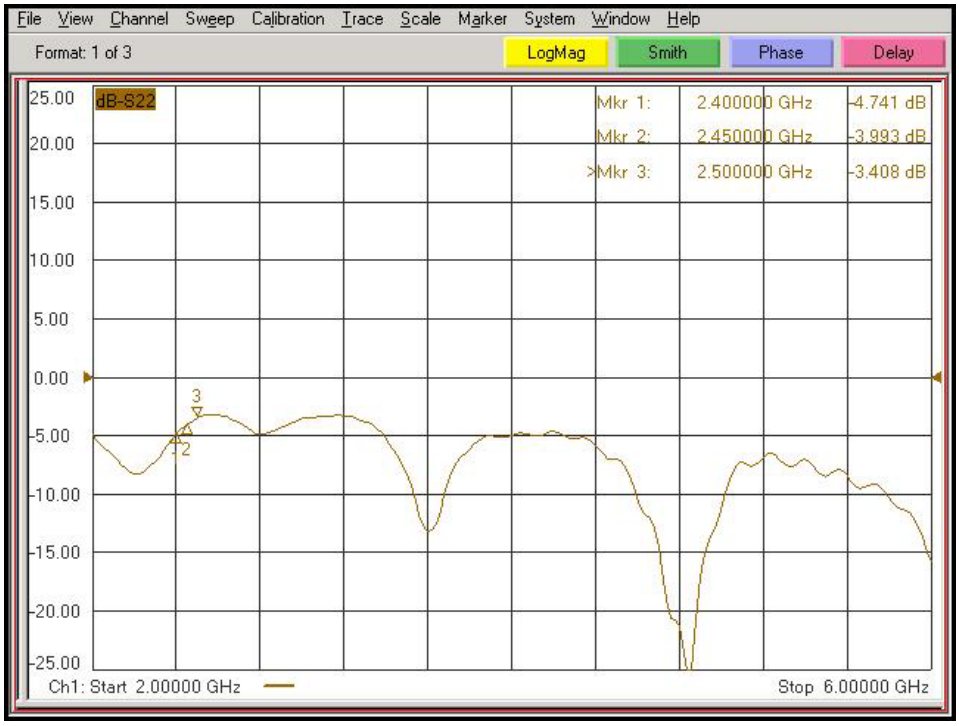


**Figure 2**. *Return loss plot for the Bluetooth antenna in the IPAQX without any cards inserted.*

### 3.2.4 Efficiency

The calculated efficiency values from the gain measurements done in the 3D anechoic chamber are listed in Table 2 below.

| **Frequency** / [GHz] | **2,40** | **2,45** | **2,50** |
|---|---|---|---|
| WLAN Efficiency / [%] No cards | 54 | 54 | 50 |
| WLAN Efficiency / [%] With cards, worst case | 52 | 52 | 45 |
| Bluetooth Efficiency / [%] No cards | 27 | 22 | 21 |
| Bluetooth Efficiency / [%] With cards, worst case | 23 | 18 | 17 |

**Table 2**. *Efficiency values for the WLAN and Bluetooth antennas in the IPAQX.*

### 3.2.5 Gain and Radiation Patterns

Gain values from the measurements in the 3D anechoic chamber are listed in Table 3 below.

| **Frequency** / [GHz] | **2,40** | **2,45** | **2,50** |
|---|---|---|---|
| WLAN Gain / [dBi] No cards | 2.0 | 2.0 | 1,8 |
| WLAN Gain / [dBi] With cards, worst case | 1.9 | 1,9 | 1.0 |
| Bluetooth Gain / [dBi] No cards | 0 | -1.1 | -1.2 |
| Bluetooth Gain / [dBi] With cards, worst case | -1.1 | -1.4 | -1.5 |

**Table 3**. *Gain values for the WLAN and Bluetooth antennas in the IPAQX.*

| | | | |
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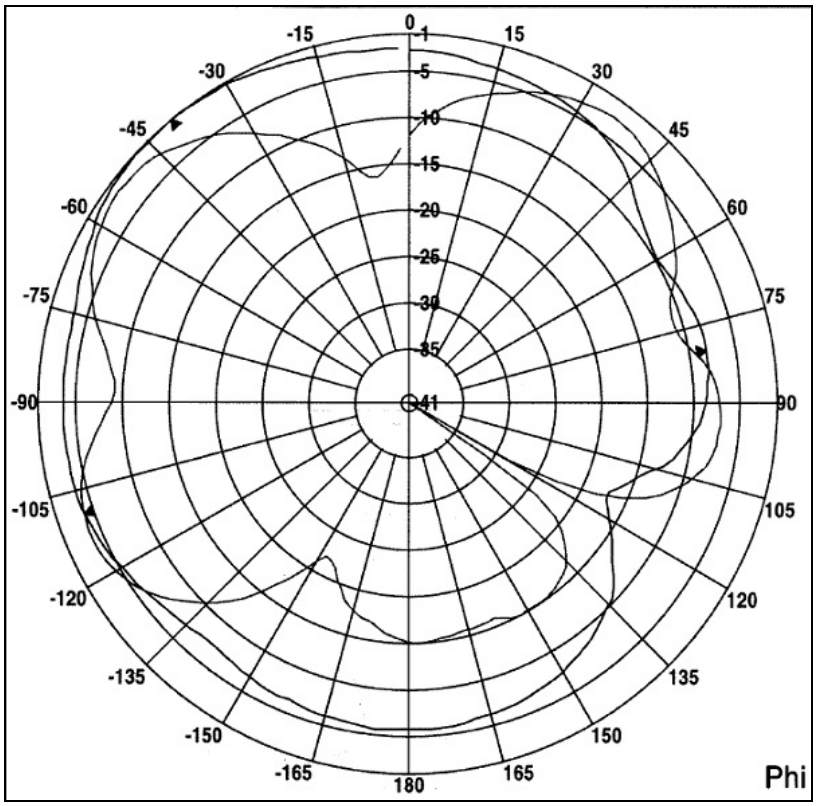


**Figure 3**. *Gain pattern for the WLAN antenna in the phi = 90 degree plane at the frequency 2,45 GHz. Both horizontal and vertical polarization is drawn in the plot.*

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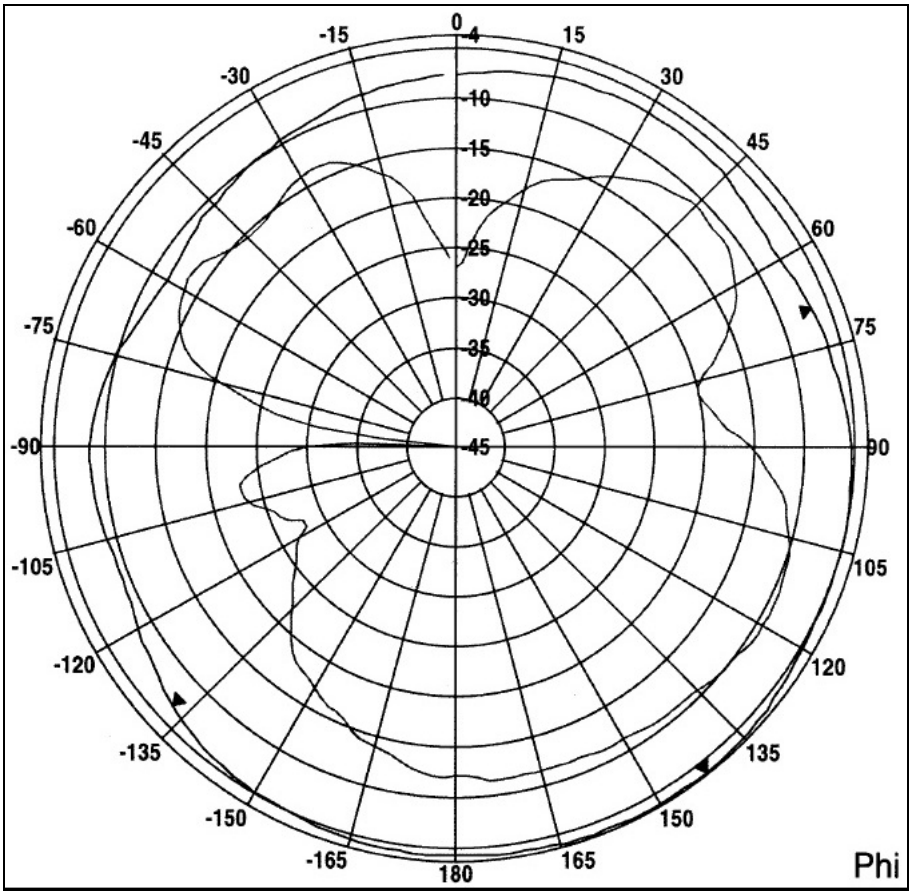



**Figure 4**. *Gain pattern for the Bluetooth antenna in the phi = 90 degree plane at the frequency 2,45 GHz. Both horizontal and vertical polarization is drawn in the plot.*

# 4 Mechanical Specification

## 4.1 Mechanical Performance

## 4.2 Mechanical test methods

### General

All tests shall be performed in room temperature ($T_0$) 20°C±3°C if not otherwise stated. All tests shall be performed with the real PDA framing to the maximum extent that is possible.

### 4.2.1 Drop Test

The antenna shall be mounted in the PDA or a dummy.

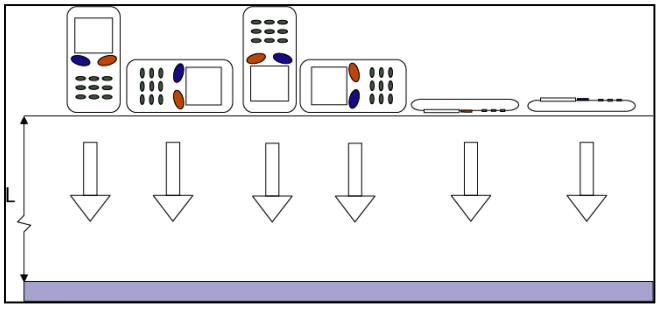
One drop on each side of the PDA

Total number of drops 6.

L=1.2 m, onto concrete floor.

Weight of dummy or PDA: TBA

Number of drops/side: 3



## 4.3 Mechanical requirements

### 4.3.1 Drop Test

The antenna shall meet the electrical specification after the test but can have remaining deformation. The flexible film shall stay attached to the carrier after the test. Visual deterioration or damage of the PDA will not be taken into consideration.

## 4.4 Environmental Performance

**General**

All tests shall be performed with antenna mounted to the PCB placed in the PDA chassis to the maximum. ($T_0$)= 20°C±3°C.

### 4.4.1 Temperature, Steady state

Test according to IEC 60068-2-1 Test Ab (Cold) and IEC 60068-2-2 Test Bb (Dry heat)

The antenna is stored in a climatic chamber with the following temperature and time periods:

Low temp/Duration: $T_1$= -40°C / $t_1$=72hr

High temp/Duration: $T_2$= +85°C / $t_2$=72hr

### 4.4.2 Temperature, Cycling

Test according to IEC 60068-2-14 Test Na (Change of temperature)

Low temp ($T_1$): -40°C

High temp ($T_2$): +85°C

Steady state time ($t_1$): 30 min

Transition time ($t_2$): <30 s.

Duration: 5 cycles

### 4.4.3 Salt Mist Resistance

Test according to ASTM B117 with 5% NaCl at 35° C.

Duration: 24h

The antenna shall be mounted in the device during the test.

### 4.4.4 Damp heat, steady state

Test according to EN/IEC 60068-2-1, Test Cb: Damp heat, steady state.

Temperature: +40°C

Relative humidity: 93 % RH

Duration: 24 hours

The antenna shall be mounted in the device during the test.

### 4.4.5 Vibration Test

Test according to IEC 60068-2-6 Test Fc (Sinusoidal)

Frequency 10 - 500 -10 Hz (1 cycle) Sweep rate 1 octave per minute (logarithmic.

10-15.8 Hz Amplitude: 2.0 mm

15.8-1000 Hz Acceleration: 20 $m/s^2$

15-8-10 Hz Amplitude: 2.0 mm

Direction: 3 axes (x,y,z)

Duration: 3 cycles / axes (one cycle is from 10Hz to 1000Hz and back to 10Hz)

## 4.5 Environmental requirements

### 4.5.1 Temperature, Steady state

The antenna shall fulfil mechanical and electrical requirements after recovered to room temperature. No visual deterioration shall occur.

### 4.5.2 Temperature, Cycling

The antenna shall fulfil mechanical and electrical requirements after recovered to room temperature. No visual deterioration shall occur.

### 4.5.3 Salt Mist Resistance

The antenna shall fulfil mechanical and electrical after recovered to room temperature.

### 4.5.4 Damp heat, steady state

The antenna shall fulfil mechanical and electrical after recovered to room temperature.

### 4.5.5 Vibration Test

The antenna shall fulfil mechanical and electrical requirements after recovered to room temperature. No visual deterioration shall occur.

# 5 Verification test sequence

The antenna shall be tested according to above electrical- and environmental tests. To verify the antenna the tests will be performed in a certain sequence, see Table 4. The testing will be performed on hard tool details.

| | | | |
|---|---|---|---|
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| **Approved by:** Rune Nilsson | **Document number:** AA040002 | **Last rev. date:** 2004-04-21 | **Revision:** PA4 |
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| No | Test Paragraph | Test sequence | Test sequence | Test sequence |
|---|---|---|---|---|
| 2.2.1 | Dimensions | Separate test | | |
| 3.1.3 | Return Loss | | 1, 3, 5 | 1, 4 |
| 3.1.5 | Gain and Radiation Patterns | Separate test | | |
| 3.1.4 | Efficiency | Separate test | | |
| 4.2.1 | Drop Test | Separate test | | |
| 4.4.1 | Temperature, Steady state | | | 3 |
| 4.4.2 | Temperature, Cycling | | | 2 |
| 4.4.3 | Salt Mist Resistance | | 4 | |
| 4.4.4 | Damp Heat, Steady State | | 2 | |
| 4.4.5 | Vibration Test | Separate test | | |
| | Number of samples | 3 each test | 3 | 5 |

**Table 4**. *Test Sequence, TBD*

# 6 Material Specification

## 6.1 Antenna Radiator

The material for the antenna radiator is a flexible film. The radiator connecting areas are plated with 1-2µm Ni and 0.1-0.3µm Au.

## 6.2 Antenna Carrier

The material for the antenna holder is a PC/ABS plastic named Cycoloy 6600. A material data sheet for the plastic can be seen in Enclosure 4 (TBD).

# 7 Packaging Specification

The antennas are packaged in trays. The design of the tray can be seen in Enclosure 3. Each tray contains 60 antennas. Five trays are packaged in each box, 4 with antennas and one empty on top. Total numbers of antennas per box equal 240. If the quantity differs from 240, this will be marked on the box.

Each cartoon contains 8 boxes, in total 1920 antennas per cartoon.

# 8 Marking

All individual parts shall have sufficient marking for tracking cavities and other relevant information.

# 9 Design Changes

The design, dimensions and tolerances are defined by gigaAnt interface drawing.

Changes of parameters, which have an influence on design and/or performance, will be communicated in writing to customer. If interface drawing is changed or if the specification is changed, a new revision of this specification will be issued and sent to customer.

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# 10 Enclosures

Enclosure 1; Antenna drawing (TBF)

Enclosure 2; Connector drawing

Enclosure 3; Tray drawing

Enclosure 4; Material data A5968

Enclosure 5; MSDS A5967

Enclosure 6; MSDS A5968 (To be added)

# 11 Approval

| | |
|---|---|
| _____ | _____ |
| gigaAnt | Customer |
| Date: | Date: |

# 12 Revision history

| Revision | Reason | Date | Approved |
|---|---|---|---|
| | | | |
| | | | |
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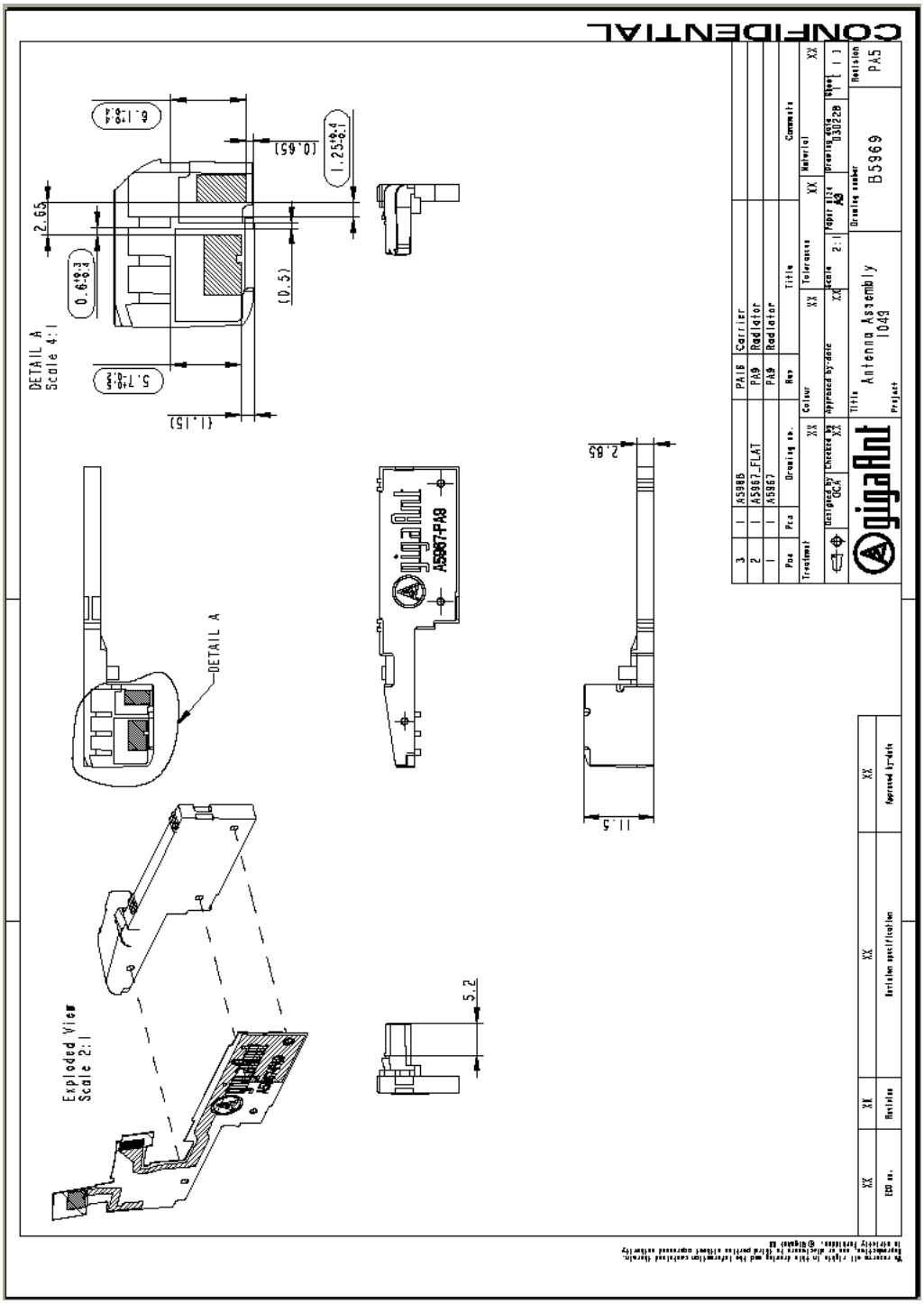
**Enclosure 1; Antenna drawing (TBF)**



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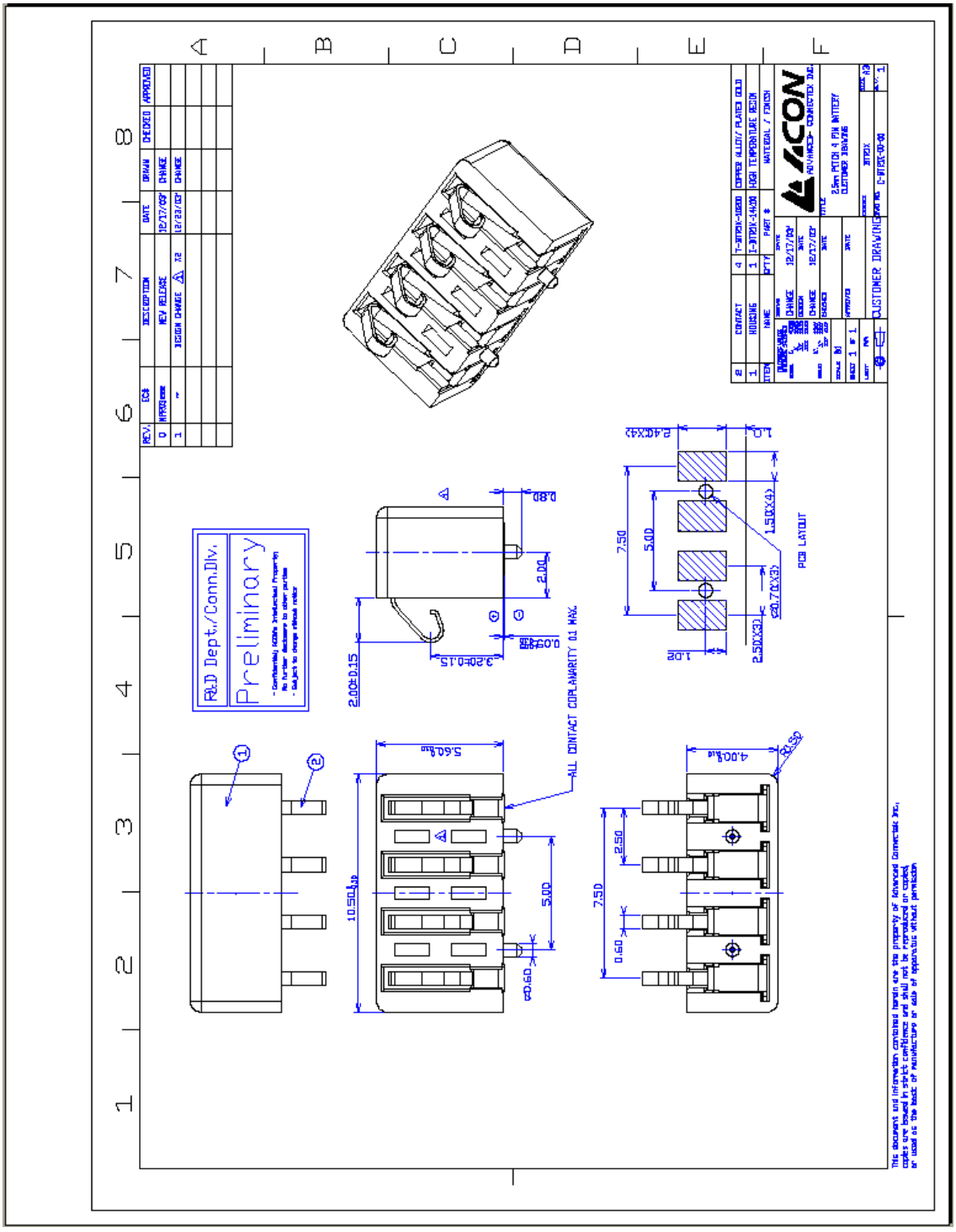
**Enclosure 2; Connector drawing**



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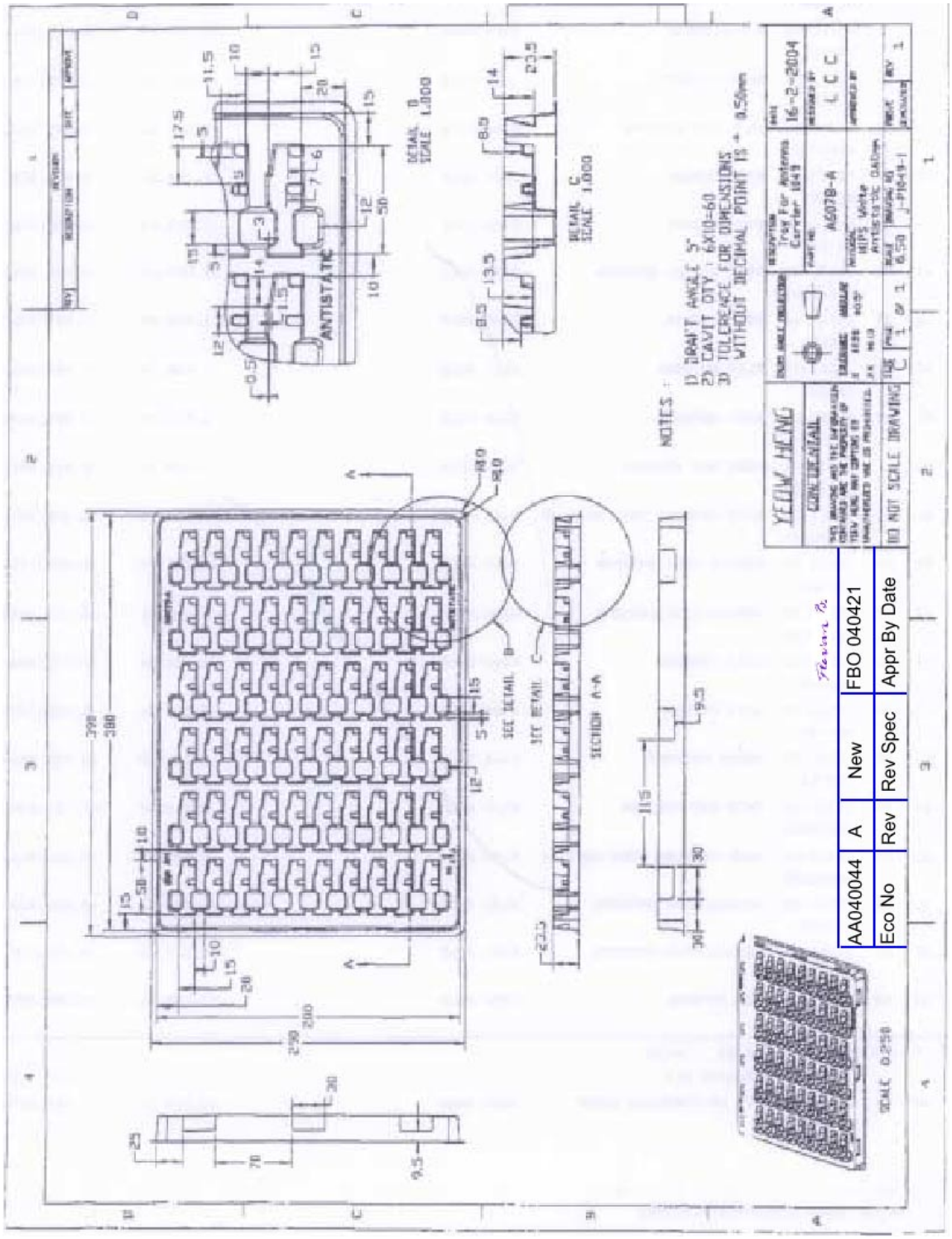
**Enclosure 3; Tray drawing**



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**Enclosure 4; Material data A5968**

GE Plastics

***CYCOLOY*® *C6600***

*Asia Pacific: COMMERCIAL* — *ABS+PC Thermoplastic Alloy*

Nonbrominated, nonchlorinated ABS+PC. Eco-label conforming nonhalogenated flame retardant. Business equipment, monitors, enclosures, etc.

| TYPICAL PROPERTIES [1] | TYPICAL VALUE | UNIT | STANDARD |
|---|---|---|---|
| **MECHANICAL** | | | |
| Tensile Str, yld, Type I, 50 mm/min | 63 | MPa | ASTM D 638 |
| Tensile Str, brk, Type I, 50 mm/min | 49 | MPa | ASTM D 638 |
| Tensile Elong, yld, Type I, 50 mm/min | 4 | % | ASTM D 638 |
| Tensile Elong, brk, Type I, 50 mm/min | 80 | % | ASTM D 638 |
| Tensile Modulus, 50 mm/min | 3000 | MPa | ASTM D 638 |
| Flex Stress, yld, 1.3 mm/min, 50 mm span | 94 | MPa | ASTM D 790 |
| Flex Mod, 1.3 mm/min, 50 mm span | 2620 | MPa | ASTM D 790 |
| **IMPACT** | | | |
| Izod Impact, notched, 23°C | 587 | J/m | ASTM D 256 |
| Instrumented Impact Total Energy, 23°C | 51 | J | ASTM D 3763 |
| Instrumented Impact Total Energy, -30°C | 51 | J | ASTM D 3763 |
| **THERMAL** | | | |
| Vicat Softening Temp, Rate B | 99 | °C | ASTM D 1525 |
| HDT, 0.45 MPa, 3.2 mm, unannealed | 98 | °C | ASTM D 648 |
| HDT, 1.84 MPa, 3.2mm, unannealed | 90 | °C | ASTM D 648 |
| Relative Temp Index, Elec | 80 | °C | UL 746B |
| Relative Temp Index, Mech w/impact | 70 | °C | UL 746B |
| Relative Temp Index, Mech w/o impact | 80 | °C | UL 746B |
| **PHYSICAL** | | | |
| Specific Gravity | 1.19 | - | ASTM D 792 |
| Water Absorption, 24 hours | 0.11 | % | ASTM D 570 |
| Mold Shrinkage, flow, 3.2 mm | 0.4 - 0.6 | % | ASTM D 955 |
| Melt Flow Rate, 260°C/2.16 kgf | 21.5 | g/10 min | ASTM D 1238 |
| **ELECTRICAL** | | | |
| Volume Resistivity | >1.E+15 | Ohm-cm | IEC 60093 |
| Surface Resistivity, ROA | >1.E+15 | Ohm | IEC 60093 |
| Dielectric Strength, in oil, 3.2 mm | 17 | kV/mm | IEC 60243-1 |
| Relative Permittivity, 50/60 Hz | 2.7 | - | IEC 60250 |
| Relative Permittivity, 1 MHz | 2.7 | - | IEC 60250 |
| Dissipation Factor, 50/60 Hz | 0.004 | - | IEC 60250 |

1) Typical values only. Variations within normal tolerances are possible for various colours. All values are measured at least after 48 hours storage at 23°C/50% relative humidity.
All properties, except the melt volume rate are measured on injection moulded samples.
All samples are prepared according to ISO 294.

2) Only typical data for material selection purpose. Not to be used for part or tool design.
3) This rating is not intended to reflect hazards presented by this or any other material under actual fire conditions.
4) Own measurement according to UL.

Source, GMD, Last Update 09/12/2002 Page 1

| | | | |
|---|---|---|---|
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GE Plastics

***CYCOLOY*® *C6600***

*Asia Pacific: COMMERCIAL*

*ABS+PC Thermoplastic Alloy*

| TYPICAL PROPERTIES [1] | TYPICAL VALUE | UNIT | STANDARD |
|---|---|---|---|
| Dissipation Factor, 1 MHz | 0.006 | - | IEC 60250 |
| Comparative Tracking Index | 600 | V | IEC 60112 |
| **FLAME CHARACTERISTICS** | | | |
| UL Recognized, 94V-2 Flame Class Rating (3) | 0.8 | mm | UL 94 |
| UL Recognized, 94V-0 Flame Class Rating (3) | 1.5 | mm | UL 94 |
| UL Recognized, 94-5VB Rating (3) | 2 | mm | UL 94 |

1) Typical values only. Variations within normal tolerances are possible for various colours. All values are measured at least after 48 hours storage at 23°C/50% relative humidity.
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Source, GMD, Last Update 09/12/2002 Page 2

| | | | |
|---|---|---|---|
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**Enclosure 5; MSDS A5967**

JIU JIANG Flex Co., Ltd

1210 Qianjin Road(E), Jiujiang Jiangxi, China 332006
Tel: 86-792-8355813, Fax: 86-792-8355803

## MATERIAL SAFETY DATA SHEET

Product name: Copper-Polyester Laminates Product code: LPET#&/@

### SECTION 1 - PRODUCT AND COMPANY IDENTIFICATION

1.1 Material Name: Copper-Polyester Laminates
1.2 Material Code: LPET#&/@
1.3 Chemical name: NA
1.4 Chemical family: Modified Epoxy
1.5 Company Identification: Jiujiang Flex Co., Ltd.
1210Qianjin Road (E) Jiujiang, Jiangxi, China 332006
1.6 Emergency Telephone Number: 86-792-8355813
1.7 Telephone number for information: 86-792-8355813

**Notes:**
#-Thickness of PET film: 1 mil, 2mil, 3mil, 4mil and 5mil(0.125mm);
&-Copper Type: RA and EDHD Copper
Copper Thickness: 0.5Oz/SF(0.018mm),1.0Oz/SF(0.035mm), and 2Oz/SF(0.070mm).
@-S: single side; D: double sides

### SECTION 2 – HAZARDOUS INGREDIENTS

| Chemical Name | OSHA PEL | ACGIH TLV | % |
|---|---|---|---|
| Copper | 1mg/m$^3$ | 1mg/m$^3$ | <60% |
| Methyl ethyl ketone | 200ppm | 200ppm | <1% |
| Formaldehyde | 0.75ppm | 0.3ppm | <0.1% |
| Methylene bisphenyl isocyanate | 0.02ppm | 0.005ppm | <0.1% |

Components not listed above are either non-hazardous or proprietary as defined in the OSHA Hazard.

### SECTION 3 -PHYSICAL AND CHEMICAL PROPERTIES

3.1 Physical/Chemical characteristics

| | |
|---|---|
| State | Solid |
| Boiling Point | Not Applicable |
| Vapor Pressure | Not Applicable |
| Solubility in Water: | Nil |
| Appearance: | Adhesive coated Polyester film clad with copper |
| Evaporation Rate: | Not Applicable |

| | | | |
|---|---|---|---|
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JIU JIANG Flex Co., Ltd
1210 Qianjin Road(E), Jiujiang Jiangxi, China 332006
Tel: 86-792-8355813, Fax: 86-792-8355803

**MATERIAL SAFETY DATA SHEET**

Product name: Copper-Polyester Laminates Product code: LPET#&/@

| | |
|---|---|
| PH: | Not Applicable |
| Odor: | None |
| Vapor Density(air=1) | Not Applicable |
| Flash Point: | Not Applicable |
| Melting Point | No Data |

3.2 Main Property to be tested and test method

| Testing Method | | Standard Value |
|---|---|---|
| Peel Strength, minimum, lb./in-width, IPC-TM-650-2.4.9 | | (1) (2) |
| As received | Method B | 6.0 7.0 |
| After sold float | Method D | 6.0 7.0 |
| After temperature cycling | Method F | 6.0 7.0 |
| Dimensional, Stability, maximum percentage, IPC-TM-650-2.2.4 | | |
| | Method B | +/-0.20 |
| | Method C | +/-0.40 |
| Solder Float, IPC-TM-650-2.4.13 | Method A | 400$^0$F/5sec. Pass |
| | Method B | |
| Flammability, IPC-TM-650-2.3.8 | | U.L.94V-0 |
| Chemical Resistance percentage, IPC-TM-650-2.3.2 | Method A | 80 |
| Moisture and insulation resistance, minimum, megohms, IPC-TM-650-2.6.3.2 | | $10^5$ |
| Moisture Absorption, maximum, percent, IPC-TM-650-2.6.2 | | 1.0 |

Note: (1) The data is applied to 1mil PET film clad 1Oz/SF EDHD copper structure.
(2) The data is applied to 3mil PET film clad 1Oz/SF EDHD copper structure.

**SECTION 4- FIRE AND EXPLOSION HAZARD DATA**

4.1 Auto-ignition Temperature Not Applicable
Lower Explosive Limit Not Applicable
Upper Explosive Limit Not Applicable

4.2 Extinguishing Agents
Use the following extinguishing media when fighting involving this material:
-carbon dioxide-dry chemical-water spray-foam

4.3 Unusual Fire and Explosion Hazards
Material will generate toxic fumes in extreme heat or fire.

4.4 Personal Protective Equipment

| | | | |
|---|---|---|---|
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As in any fire, wear self-contained breathing apparatus and full protective gear.

4.5 Hazardous Decomposition Products

CO, $CO_2$, formaldehyde, aliphatic and aromatic hydrocarbons.

**SECTION 5 - STABILITY AND REACTIVITY**

5.1 Stability: Stable

5.2 Conditions to Avoid: Not Applicable

5.3 Hazardous Polymerization: Does Not Occur

5.4 Incompatibility: There are no known incompatible with this product.

**SECTION 6-HEATH HAZARD DATA**

6.1 Effects of Overexposure: Heating and lasing operations may produce toxic vapors which be controlled by local exhaust. Excessive skin contact may cause irritation, or rash in sensitive individuals.

6.2 First Aid Procedures

Inhalation: Remove to fresh air and seek medical attention.

Eye Contact: Flush thoroughly with water and seek medical attention.

Skin Contact: Wash contacted area thoroughly with soap and water. Seek medical attention if irritation persists or rash is present.

Ingestion: Not a likely route of exposure-treat symptomatically.

**SECTION 7-PRECAUTIONS FOR SAFE HANDLING AND USE**

7.1 Respiratory Protection

Not generally required. If machining, lasting, or processing generates dust, vapors, or fumes are an irritant to employees, use NIOSH/MSHA approved respirator protection. Engineering controls should preclude need for respiratory protection.

7.2 Local Exhaust

Required where exposure limits are exceeded or fumes/dust/vapors are noticeable. Local exhaust is recommended with all heating operations.

7.3 Mechanical (General)

Optimize whenever possible following good industrial practice.

7.4 Eye Protection

Safety glasses are recommended for all industrial operations.

7.5 Protective Clothing

| | | | |
|---|---|---|---|
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Impermeable gloves as needed to avoid unnecessary skin contact and irritation. (Suggest butyl rubber, nitrile, or neoprene)

7.6 This product may contain the following substances
Copper
Formaldehyde
Methyl ethyl ketone
Methylene bisphenyl isocyanate

7.7 Other: NA

**SECTION 8-ECOLOGICAL INFORMATION**

8.1 No ecological testing has been conducted on this product.
8.2 Waste Disposal Method
Dispose of in accordance with national, province, and local regulations.
8.3 Container Disposal: NA

**SECTION9-TRANSPORTATION INFORMATION**

9.1 This product is NOT REGULATED for domestic and international transportation.

**SECTION10- SPETLL OR LEAK PROCEDURES**

10.1 Response to Spills: Not Applicable
10.2 Reportable Quantity: Not Applicable

**SECTION11-STORAGE**

11.1 Storage conditions
The material can be stored for 24 months at dry, ambient temperature wrapped with PE film.
11.2 Keep away from heat, ignition sources, and direct sunlight.
11.3 Keep cartons tightly closed when not in use.

**SECTION12-OTHER INFORMATION**

**12.1 Legend:**
PET film: Polyester Film

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Product name: Copper-Polyester Laminates Product code: LPET#&/@

NA: Not Applicable
RA: Rolled anneal
EDHD: Electro-deposited high-ductility

**12.2 Users Responsibility/Disclaimer of Liability**

AS the conditions or methods of use are beyond our control, we do not assume any responsibility and expressly disclaim any liability for any use of this material. Information contained herein is believed to be true and accurate but all statements or suggestions are made without warranty, expressed or implied, regarding accuracy of the information, the hazards connected with the use of the material or the result to be obtained from the use thereof.

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