

ประกาศกระทรวงอุตสาหกรรม

ฉบับที่ ๓๑๑๕ (พ.ศ. ๒๕๕๕)

ออกตามความในพระราชบัญญัติมาตรฐานผลิตภัณฑ์อุตสาหกรรม

พ.ศ. ๒๕๑๑

เรื่อง กำหนดมาตรฐานผลิตภัณฑ์อุตสาหกรรม

แผ่นวงจรพิมพ์

เล่ม ๑๒ ข้อกำหนดสำหรับมวลแผงที่มีการซ้อนกันหลายชั้น

(แผ่นวงจรพิมพ์หลายชั้นกึ่งการผลิต)

อาศัยอำนาจตามความในมาตรา ๑๕ แห่งพระราชบัญญัติมาตรฐานผลิตภัณฑ์อุตสาหกรรม พ.ศ. ๒๕๑๑ รัฐมนตรีว่าการกระทรวงอุตสาหกรรมออกประกาศกำหนดมาตรฐานผลิตภัณฑ์อุตสาหกรรม แผ่นวงจรพิมพ์ เล่ม ๑๒ ข้อกำหนดสำหรับมวลแผงที่มีการซ้อนกันหลายชั้น (แผ่นวงจรพิมพ์หลายชั้นกึ่งการผลิต) มาตรฐานเลขที่ มอก. ๒๑๐๕ - ๒๕๕๕ ไว้ ดังมีรายการละเอียดต่อท้ายประกาศนี้

ประกาศ ณ วันที่ ๒๗ กันยายน พ.ศ. ๒๕๕๕

สุริยะ จึงรุ่งเรืองกิจ

รัฐมนตรีว่าการกระทรวงอุตสาหกรรม

# มาตรฐานผลิตภัณฑ์อุตสาหกรรม แผ่นวงจรพิมพ์

## เล่ม 12 ข้อกำหนดสำหรับมวลแผงที่มีการซ้อนกันหลายชั้น (แผ่นวงจรพิมพ์หลายชั้นกึ่งการผลิต)

มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้กำหนดขึ้นโดยรับ IEC 326-12(1992-07) Printed boards-Part 12 : Specification for mass lamination panels (semi-manufactured multilayer printed boards) มาใช้ในระดับเหมือนกันทุกประการ (identical) โดยใช้ IEC ฉบับภาษาอังกฤษเป็นหลัก

มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้ใช้กับมวลแผงที่มีการซ้อนหลายชั้น ที่กำหนดคุณลักษณะของมวลแผงที่มีการซ้อนกันหลายชั้น โดยไม่คำนึงถึงกรรมวิธีการผลิต มีจุดมุ่งหมายเพื่อเป็นพื้นฐานในการตกลงกันระหว่างผู้ซื้อและผู้ขาย “ข้อกำหนดที่เกี่ยวข้อง” ให้อ้างถึงข้อตกลงดังกล่าว

โดยมีรายละเอียดเกี่ยวกับเรื่อง การตรวจพินิจและมิติ ได้แก่ การเป็นไปตามข้อกำหนดและสิ่ง รูปลักษณะและผลงาน มิติของแผ่น และความหนาแผ่นในบริเวณขอบ การทดสอบทางไฟฟ้า ได้แก่ ความต้านทานของฉนวนแต่ละชั้น (ที่ยอมรับได้) ความต้านทานของฉนวนระหว่างชั้น (ที่ยอมรับได้) และความทนแรงดัน การทดสอบทางกล ได้แก่ ความเรียบ การแยกออกเป็นชั้น การเปลี่ยนแปลงอุณหภูมิอย่างฉับพลัน

รายละเอียดให้เป็นไปตาม IEC 326-12(1992-07)

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

### PRINTED BOARDS

#### Part 12: Specification for mass lamination panels (semi-manufactured multilayer printed boards)

#### FOREWORD

- 1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.
- 2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.
- 3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

This part of IEC 326 has been prepared by IEC Technical Committee No. 52: Printed circuits.

The text of this part is based on the following documents:

Six Months' Rule	Report on Voting
52(CO)367	52(CO)382

Full information on the voting for the approval of this part can be found in the Voting Report indicated in the above table.

Annex A is for information only.

## INTRODUCTION

IEC 326 relates to printed boards irrespective of their method of manufacture.

It is divided into separate parts covering information for the designer, recommendations for the specification writer, test methods and requirements for the various types of printed boards, for example single-sided, double-sided, multilayer and flexible printed boards.

## PRINTED BOARDS

### Part 12: Specification for mass lamination panels (semi-manufactured multilayer printed boards)

#### 1 Scope

This part of IEC 326 relates to mass lamination panels. It specifies the characteristics of mass lamination panels, irrespective of their method of manufacture. It is intended as a basis on which agreements between purchaser and vendor can be made. The term "relevant specification" used herein refers to such agreements.

#### 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 326. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 326 are encouraged to investigate the possibility of applying the most recent editions of the normative documents listed below. Members of IEC and ISO maintain registers of currently valid international standards.

IEC 249-2-5: 1987, *Base materials for printed circuits – Part 2: Specifications – Specification No. 5: Epoxide woven glass fabric copper-clad laminated sheet of defined flammability (vertical burning test)*

IEC 321-3: 1990, *Auxiliary printed board information – Part 3: Guidelines for artwork*

IEC 326-2: 1990, *Printed boards – Part 2: Test methods*

IEC 326-3: 1991, *Printed boards – Part 3: Design and use of printed boards*

IEC 326-6: 1980, *Printed boards – Part 6: Specification for multilayer printed boards*

IEC 326-9: 1991, *Printed boards – Part 9: Specification for flexible multilayer printed boards with through connections*

IEC 326-11: 1991, *Printed boards – Part 11: Specification for flex-rigid multilayer printed boards with through connections*

### 3 General

#### 3.1 Mass lamination panels

The board is the individual printed circuit used by the end purchaser. A panel is made of one or more boards and is the product ordered from the mass laminator. The mass laminator may use manufactured sheets configured with more than one panel to save money. This part refers to the panels.

A mass laminated multilayer panel is a multilayer printed board at an intermediate stage of production, where inner layers have been processed and laminated to produce a panel containing alternate layers of conductive and insulating materials. The two outside conductive layers have not been processed by the mass laminator but are ready for drilling and final processing by the user.

Mass lamination panels are semi-manufactured products which are used to make multilayer printed boards. They:

- are made up of exactly registered internal conductive layers, etched according to the data given by the purchaser, corresponding to one or several boards and of insulating layers and of two external unetched copper-clad layers;
- are made by laminating a stack of thin layers of copper-clad base material etched on one or two sides, of prepregs, and of copper foils;
- include a locating system, which permits the drilling to be done in proper registration with the internal conductive layer;
- may have through connections between conductive internal layers, without connections with the external conductive layer (buried plated-through holes).

#### 3.2 Constituting a mass lamination panel

Generally, the panel, the boards and the conductive patterns have the same reference axes with the same directions; the datum points of the boards and of their conductive patterns are the same. The mass lamination panel is defined, in this case, by:

- the references of the conductive patterns of each etched layer, given in the relevant specification;
- the place of each board on the panel, given by the co-ordinates of its datum points and indicated in the drawing of the relevant specification (see figure A.4).

If the location of one or more boards is different (by rotation or turning over), the drawing of the relevant specification shall give this location, producing the axes of reference of each board and the relationship between the X and Y co-ordinates with respect to the axes of the panel and the X and Y co-ordinates with respect to the axes of a board (see figure A.5).

#### 3.3 Reference of layers

The purchaser identifies the reference side and allocates a number to each conductive layer, corresponding to the place it has in the finished multilayer printed board (see figure A.1).

### 3.4 *Reference side*

The reference side shall be indicated on each panel by an off-centre orientation hole or polarizing slot, specified in the relevant specification.

### 3.5 *Datum reference - Locating system for the drilling*

To avoid any ambiguity, it is necessary to define the datum references on the mass lamination panels, on the constituent printed boards and on all the documents which define the conductive layers.

The datum references are used to define the exact position of particular points (for example, centre of a land on a conductive pattern, holes on a board, etc.), of a conductive pattern on a board and of a board in a mass lamination panel.

An example of datum reference is given in clause 5 of IEC 321-3.

The datum point of a board in a mass lamination panel is the intersection of the two reference axes of that board. The co-ordinates of the datum point are given on the drawing of the relevant specification.

By agreement between purchaser and vendor, the co-ordinates of the datum points of the boards on a panel may be amended and may be different from the value given in the drawing, but shall be identical for all of the panels of a homogeneous lot. In this case, the applicable co-ordinates shall be given by the vendor for each lot. These differences with the co-ordinates of the drawing are used to balance certain distortions of the conductive patterns and are small (some hundredths of a millimetre). When such an agreement may be used, it shall be given in the drawing of the relevant specification (for instance by a symbol "F" located near the letters X and Y showing the axes, as in figure A.4).

### 3.6 *Dimensional compensation*

By agreement between purchaser and vendor, the artwork used may be dimensionally compensated to allow for material movement.

### 3.7 *Identification*

A mass lamination panel according to this specification shall be identified by:

- the number of the relevant specification;
- the references of the purchaser and those of the vendor;
- the references of the panel in the purchaser's code.

With this identification and marking, the vendor shall warrant the traceability of the panels.



#### 4 Technical definition file

##### 4.1 Contents

The technical definition file shall be made from all the documents (written or computer data) which give the characteristics of the mass lamination panel. With reference to this specification, it shall contain:

- the relevant specification (see 4.2 and annex A);
- the documents giving the conductive patterns (see 4.3);
- the documents giving the mechanical data of the boards: drilling drawings, list of the holes, routing drawings (see 4.4);
- the directions for marking (see 4.5);
- the directions for packaging (see clause 6);
- the special requirements of the purchaser.

This file shall be established by agreement between purchaser and vendor and shall be made in accordance with the technical capability of the vendor. It shall be complete, precise, and identified by the data and/or index.

##### 4.2 Relevant specification

The relevant detailed specification shall give all the stipulations and information needed to manufacture the boards. Annex A enumerates the details that should be specified.

##### 4.3 Documents giving the conductive patterns

A conductive pattern shall be defined by a photographic film or by computer data usable by an automatic plotter. In each case, the documents shall give clearly the reference of the conductive layer and the references of the board in which it is placed. The documents shall also give the axes of reference of this conductive pattern (see 3.5). If it is given by a photographic film, the quality of the document shall be acceptable according to IEC 321-3 or according to an agreement between purchaser and vendor.

##### 4.4 Documents for the subsequent mechanical operations

It is necessary for the vendor to know mechanical operations to be carried out afterwards by the purchaser, for example:

- diameters and positions of the plated through holes;
- routing, tooling holes, etc., to be machined for the finishing of the multilayer printed board.

##### 4.5 Directions for marking the panels

Directions for marking give the composition of the legends, the nature (ink, etching, label) and the place of the marking. Marking of the panels (on one face) shall be done for:

- the polarizing slot or orientation hole;
- the number of the relevant specification;
- the orientation of the glass cloth;
- the date of manufacture (or the reference of the manufacturing lot).

By agreement between purchaser and vendor, the marking of the panels may include a reference which indicates the name of the manufacturer and which remains legible after etching and routing of the boards and also the dimensional compensation lot-to-lot differences.

## 5 Characteristics of mass lamination panels

### 5.1 *Specific characteristics and preferred values*

These characteristics are for a specific mass lamination panel. They are controlled during and evaluated after manufacturing. The values to be found are given in the relevant specification. This part of IEC 326 gives the preferred values for certain characteristics and tolerances in order to standardize and to facilitate the agreements between purchaser and vendor. Different tolerances are given according to the manufacturing methods, the various difficulties for the manufacturing of the specific panels and the needs of the purchaser.

These characteristics shall be taken from IEC 326-3, IEC 326-6, IEC 326-9 or IEC 326-11, for example:

- length and width of the panels  
Preferred tolerances:  $\pm 2$  mm,  $\pm 1$  mm or  $\pm 0,5$  mm;
- deviation from perpendicularity of the edges of the panel  
Preferred tolerances:  $\pm 2,5$  mm/m or  $\pm 1,5$  mm/m;
- thickness of the panel (with the external layer of copper)  
If the thickness of the panel is less than 1,0 mm:  $\pm 15\%$ . If edge board contacts are used, the preferred tolerance in the contact area is  $\pm 10\%$ ;
- flatness (bow and twist)  
Preferred tolerances, for a symmetrical construction and even number of layers:  $+0,5\%$  bow and twist. For asymmetrical construction and/or with an odd number of layers:  $+1\%$  bow and twist;
- misalignment between conductive patterns.  
The misalignment on different layers shall not exceed the following values:
  - in a panel up to 300 mm: 0,10 mm;
  - in a panel over 300 mm: 0,20 mm.The preferred tolerances are: offsetting 0,10 mm;
- surface finish of the surface layers of copper  
The surface finish shall be in accordance with the series IEC 249-2, for example IEC 249-2-5.

### 5.2 *General characteristics*

All the base materials used for manufacturing of the mass lamination panels (for example copper clad thin laminates, prepregs, foils of copper) shall be in accordance with the relevant IEC specification.

As the mass lamination panels are used for the manufacture of multilayer printed boards, they shall have all the characteristics of the multilayer boards, as described in IEC 326-6, IEC 326-9 or IEC 326-11. When it is not possible to put test coupons in the mass lamination panels it shall be agreed between purchaser and vendor.

Mass laminated multilayer panels shall be processed in such a manner as to be uniform in quality and show no visual evidence of dirt, foreign matter, oil, fingerprints and other contaminants that affect life, ability to be assembled and serviceability. Mass laminated multilayer panels shall be free of defects in excess of those allowed in this specification.

The tests given in table 1 shall be applied.

Table 1 - Characteristics

Characteristics	Test number in IEC 326-2	Requirements	Remarks
<i>Visual and dimensional examination</i>			
Conformity and identification	1	See IEC 326-6*	
Appearance and workmanship	1a	See IEC 326-6*	
Board dimensions	2	See IEC 326-6*	See 5.1
Board thickness in the area of edge board contacts	2	See IEC 326-6*	
<i>Electrical tests</i>			
Insulation resistance within a layer (as received)	6b	Preferably $\geq 500$ M $\Omega$	Test coupon
Insulation resistance between layers (as received)	6c	Preferably $\geq 500$ M $\Omega$	Test coupon
Voltage proof (if required)	7a		Test coupon
<i>Mechanical tests</i>			
Flatness	12a	See IEC 326-6*	See 5.1
Delamination, thermal shock	15a		Test coupon
NOTE - A test coupon is under consideration.			
* Or IEC 326-9 or IEC 326-11.			

If the mass lamination panels contain plated-through holes, they shall be in accordance with the requirements for plated-through holes given in IEC 326-6, IEC 326-9 or IEC 326-11.

### **5.3 Other characteristics to be checked**

During or after manufacturing, the manufacturer shall check the following characteristics:

- lack of major defects of the etching on the internal layers;
- continuity and lack of short circuits for the conductive patterns on the internal layers, in accordance with IEC 326-2, Tests 4a and 4b and/or by optical method;
- accuracy of the location and superposition of the conductive patterns;
- specified tolerances for the thicknesses, the dimensions, the rectangularity of the edges;
- specified tolerances for the diameter and the position of the indexation holes (and polarizing slot);
- specified tolerances for bow and twist;
- quality of buried holes, if applicable;
- conformance of marking and packaging.

If agreed between purchaser and vendor, a detailed test report may be joined to each delivery.

### **6 Packaging**

There shall be only one lot in each package. A homogeneous lot shall be made of panels manufactured:

- within the same lamination cycle;
- with the same corrections (if necessary) for the co-ordinates of the datum point of the boards, if there is a floating zero.

The packaging shall be sufficient to protect the panels against twist, moisture penetration or other damage which can occur during transport. The number of panels in each package shall be limited by the weight which is permitted by regulations agreed upon between purchaser and vendor.

The following marking shall be made on the packaging:

- the number of the relevant specification;
- the date of manufacture and the manufacturing lot;
- the name or symbol of the manufacturer;
- the number of panels in the package.

**ANNEX A**  
**(informative)**  
**Relevant detail specification**

The relevant detailed specification:

- shall be identified by a number;
- shall give the name of the purchaser and of the vendor;
- shall describe the constitution of the panel:
  - a) number of boards on a panel;
  - b) number of layers;
  - c) positions of the sub-assemblies;
  - d) thicknesses of the insulating layers and the copper;
  - e) number of each layer (see 3.2);
- shall give the characteristics of the board:
  - a) references of the documents giving the conductive patterns;
  - b) nature of the conductive patterns (ground, mixed, signal, etc.);
  - c) length and width of the board, grid for the drilling, references of the documents for drilling and routing;
- shall give:
  - a) a drawing of the axes of reference and of the locating system for the drilling according to 3.5 (view from the reference side for the drilling, see 3.4);
  - b) the position of the boards (outlines), identified, if necessary by letters or by a reference number with the help of the indications given in 3.2;
- shall give in an inset:
  - a) dimensions of the panel (nominal values with tolerances) (see 5.1);
  - b) admissible deviations (see 5.1) for:
    - perpendicularity of the edge;
    - bow and twist;
    - positions of conductive patterns;
    - superposition of the conductive patterns;
- shall give, if necessary:
  - a) the nature of the polarizing slot or orientation hole;
  - b) the line width of the artwork and of the etched mass laminated internal layer which should be agreed upon to take into account the undercut during etching. This factor would than be used to design a better layout for impedance controlled mass laminate internal layers;
  - c) the directions for marking;
  - d) the directions for packaging;
  - e) the special requirements of the purchaser;
  - f) any other information that may be useful (diameter of drills for routing, number of panels per lot, etc.).

The part of the relevant detail specification specifying the number of layers, the constitution of a panel, etc., may be presented as shown in the example below.

<b>Mass lamination panel</b>	<b>IEC 326-12</b>	<b>Relevant specification No. _____ page ./.</b>
<b>Purchaser</b>  For consulting For manufacturing		<b>Vendor</b>  For proposition For agreement
Simple case below <input type="checkbox"/>		Other cases, see page <input type="checkbox"/>
Number of boards per panel: _____		Number of layers <input type="checkbox"/>
<b>Board No.</b>		<b>Panel No.</b>
<b>Conductive patterns</b>		<b>Thicknesses Copper</b>
Signal	Mixed	Notes
Ground or voltage	References	Reference side
No. of layer		Level
<input type="checkbox"/>	<input type="checkbox"/>	1
<input type="checkbox"/>	<input type="checkbox"/>	2
<input type="checkbox"/>	<input type="checkbox"/>	3
<input type="checkbox"/>	<input type="checkbox"/>	4
<input type="checkbox"/>	<input type="checkbox"/>	5
<input type="checkbox"/>	<input type="checkbox"/>	6
<input type="checkbox"/>	<input type="checkbox"/>	7
<input type="checkbox"/>	<input type="checkbox"/>	8
<input type="checkbox"/>	<input type="checkbox"/>	9
<input type="checkbox"/>	<input type="checkbox"/>	10
Length of the board: ± ... mm Width of the board: ± ... mm Grid: ... mm Drilling reference: Routing reference:		* The thicknesses of the insulating layers are given after lamination.  Total thickness with external copper: (... ± ...) mm

Figure A.1 – Mass lamination panel (example 1)

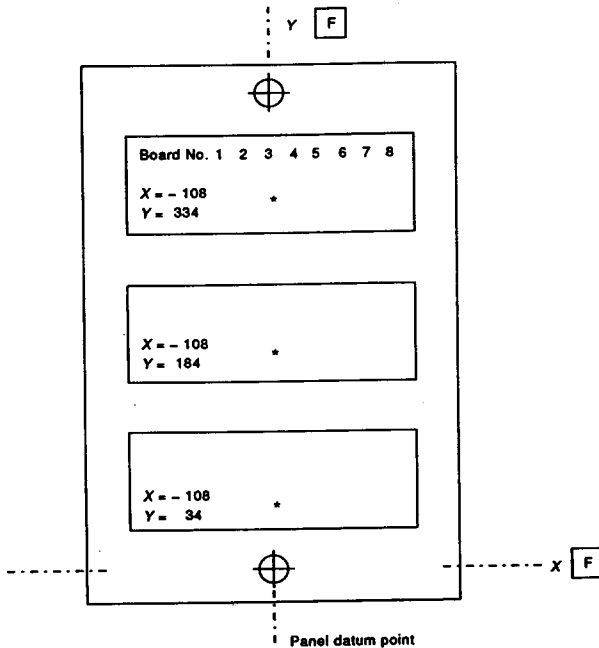
Drawing of the panel View from the drilling reference side	IEC 326-12	Relevant specification No. <span style="float: right;">page ./.</span>
Length of the panel      ± ... mm Width of the board        ± ... mm Perpendicularity         ± ... mm/m Bow and twist             ± ... % Tolerance of position     ± ... mm Tolerance of superposition: ± ... mm	Observations	

Figure A.2 - Drawing of the panel

Mass lamination panel				IEC 326-12				Relevant specification No. _____ page . _____	
Number of boards per panel:								Number of layers <input type="text"/>	
Board No.				Board No.				Panel No.	
Conductive patterns				Conductive patterns				Thickness Copper <span style="float: right;">Notes</span>	
Signal	Mixed	Ground or voltage	No. of layers	Signal	Mixed	Ground or voltage	No. of layers	Level	Reference side
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	1	↓
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	2	↓
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<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	4	↓
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	5	↓
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	6	↓
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	7	↓
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	8	↓
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<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	14	↓
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	15	↓
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	16	↓

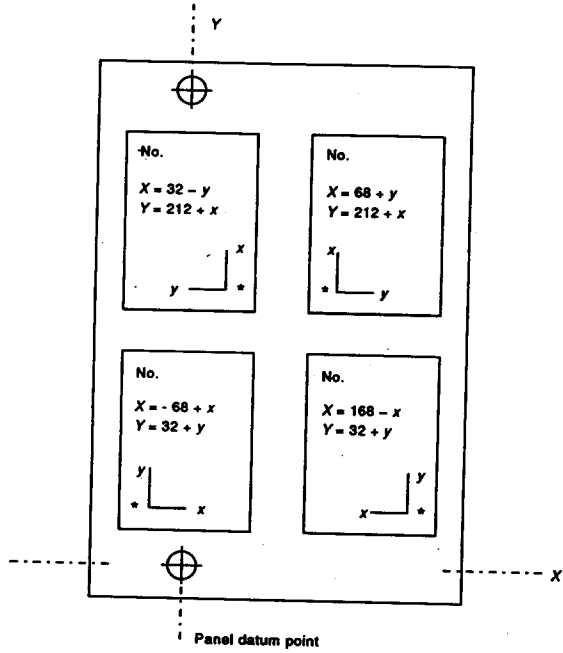
Figure A.3 - Mass lamination panel (example 2)





\* Board datum point

Figure A.4 - Drawing of a mass lamination panel;  
principle of the artwork scheme;  
case of identical boards; floating zero is possible



\* Board datum point

Figure A.5 - Drawing of a mass lamination panel;  
principle of the artwork scheme;  
case of different boards, in valid positions