



5 Method for the manufacture of through-hole plating on a
printed circuit board

State of the art

10 The invention is based upon a method for the manufacture of
through-hole plating on a printed circuit board or a printed
circuit board according to the claims 1 and 9. When
manufacturing through-hole plating on a multilayer printed
15 circuit board, it is a known method to first drill the copper
clad printed circuit board in the specified positions for
through-hole plating and then to plate the internal wall area
of the bore hole with copper deposits by means of a galvanic
process. During this process, the copper is not only deposited
20 on the wall of the bore hole, but also on the entire copper
surface. The plated bore holes and the areas which will later
form the conductive tracks, are subsequently covered with an
etch protection layer or resisting film. The copper surfaces
that are not covered are etched away and as a result, the
25 desired conductive tracks and plated through connections
remain after the removal of the etch protection lacquer. It is
therefore inevitable that additional copper is deposited on
the copper surfaces of the printed circuit board during the
plating process of the wall areas. This additional amount of
copper, however, must be removed later during etching, thus
30 making the manufacturing process of the printed circuit board
more expensive. It is, furthermore, known to apply a
conductive paste by means of the screen-printing method onto a
printed circuit board that is not copper clad. The said
conductive paste also fills the bore holes and forms a through
connection. Nevertheless, this method has the disadvantage,
35 that the through connection can no longer be used for the
reception of a connection wire of an electric component when
using the insertion mounting method, since the bore holes are
blocked by the conductive paste. Hence additional bore holes
must be provided to receive the connection wires of the



THIS SHEET HAS BEEN
REPLACED

components. The said additional bore holes, however, require
5 additional room which is not always available on printed
circuit boards, particularly in multilayer circuit
arrangements.

10 Advantages of the invention

In contrast to the above, the method according to the
invention, or the printed circuit board with the
characteristic features of the claims 1 and 9, has the
15 advantage that no additional metal is deposited on the copper
clad printed circuit board, which has to be etched away again.
A further advantage is, that the through connections can be
utilised for insertion mounting of the component wires, hence
making additional bore holes obsolete and conserving space on
20 the printed circuit board. Furthermore, the manufacturing
process of such a printed circuit board is simplified, which
lowers the costs.

By means of the measures stated in the dependent claims,
25 advantageous further developments and improvements of the
method according to the invention or the printed circuit board
are possible. Of particular advantage is that the catalyst is
applied either after drilling or after the structuring of the
printed circuit board. This makes it possible that the metal
30 in the subsequent electrochemical plating process is applied
directly onto the catalyst without the necessity of
reactivating the catalyst.

It is of particular advantage, that the electrochemical
35 plating is applied at such a reduced wall thickness, that the
remaining bore hole is still large enough to accept the
component connection wires.

A further advantage is, that nickel or nickel compounds are

5 used for the electrochemical plating process. Nickel plating
is corrosion resistant and hence it is not necessary to
protect the surface of the printed circuit board by an
additional passivating coating.

10 A further advantage is, that not only the solder eyelets
around the bore holes are covered by the plating, but also
parts of the tracks. Thus also those parts are largely
protected against corrosive influences.

15 To improve the soldering process or the bonding of the printed
circuit board, the tracks may preferably be covered with
palladium or the connection lands with a layer of gold. This
has the advantage, that also thin bonding wires can be used
with the commonly used bonding methods such as "nail head" or
"thermo compression". Such bonding wires can then be bonded
20 directly onto the respective lands of an integrated circuit,
which is installed in form of a chip.

Drawing

25 Two exemplary configurations of the invention are illustrated
in the drawing and are explained in greater detail in the
following description. The Figures 1a to 1g show sections of
exemplary configuration one, the Figures 2a to 2c show
30 sections of exemplary configuration two, and Figure 3 shows a
partial view of a printed circuit board with components.

Description of the exemplary configurations

35 The Figures 1a to 1g show in cross-sectional view different
progressive steps in the manufacture of the printed circuit
board according to the invention of exemplary configuration
one. The Figures are a diagrammatic representation only and

are, particularly with respect to plating thicknesses or bore
5 holes, not to scale. Figure 1a illustrates a section from a
printed circuit board 1, which contains a vertical bore hole
3. The printed circuit board is clad with a layer of copper 2
top and bottom. The bore holes 3 are drilled into the copper
clad printed circuit board 1 in specified locations with a
10 certain diameter. After the holes 3 are drilled, the wall area
of hole 3 is coated with an adhesion promoter as shown in
Figure 1b. The adhesion promoter is a chemically or
galvanically applied thin copper layer of approximately 3 to
10 micrometers in thickness. In an alternative configuration
15 of the invention, the wall area of the bore hole 3 is coated
with a catalyst 4, which causes the subsequent metallisation
of the printed circuit board and the bore hole. The catalyst
is stabilised by means of a tempering process. The catalyst
used is preferably palladium. According to Figure 1c, an etch
20 protection coating 5 is applied with a suitable masking
process, for example through printing or lithographic masking,
so that a partial area around the bore hole, preferably a
ring-shaped area, is covered. The etch protection coating or
the etch protection lacquer 5 on printed circuit board 1
25 covers simultaneously the bore holes 3 as well as all the
areas which are later to form the tracks 2b. After the etch
protection lacquer 5 has been applied, the remaining free
copper surfaces are etched away as shown in Figure 1d, and the
etch protection lacquer 5 is subsequently removed.
30 Consequently, the thus formed solder eyelets 2a, the catalyst
4 in bore hole 3 as well as the tracks 2b remain. By means of
a further mask 6, those particular sections of the printed
circuit board 1, which are not to be wetted by the subsequent
plating process, are covered as shown in Figure 1e. In
35 particular, the solder eyelets 2a and the tracks 2b, which are
to be coated, are kept free. Nevertheless, tracks for example
on the bottom, as shown in Figure 1e, can be covered fully so
that they are not plated.

THIS SHEET HAS BEEN
REPLACED

As illustrated in Figure 1f, the electrochemical plating of
5 the free areas takes place now. During this process, the metal
connects up fully through the bore holes and around the solder
eyelets 2a via the catalyst 4. The plated bore hole 8 is
sleeve-shaped so that connection wires of components to be
10 mounted can still be inserted into the opening. Nickel or
nickel compounds are preferably used for plating 7 to ensure
that the plated surfaces are preferably protected against
corrosion. As depicted in Figure 1g, a further masking step
can now be undertaken, in which the non-plated track or parts
of track 2b in position 9 can be covered, for example, with a
15 protective coating of palladium or gold.

Onto these areas can then be bonded a thin bonding wire, in
particular in accordance with known bonding methods. In this
bonding process, the second end of the bonding wire is bonded
20 to a corresponding land on chip 23 of the integrated circuit.

To preserve clarity, certain operating stages such as
degreasing of the printed circuit board surface, reactivating
of the catalyst, passivating or application of a solder resist
25 coating or a printed component layout for assembly have been
left out.

The Figures 2a to 2c illustrate modified processing stages of
the manufacturing method according to the invention in
30 exemplary configuration two. Same as Figure 1a, Figure 2a is
based upon a double sided printed circuit board 1 into which
one or more bore holes 3 are drilled. As shown in Figure 2b,
and similar to Figure 1c, the bore hole 3 is covered by the
etch protection lacquer 5. Figure 2c illustrates that after
35 the etching process the solder eyelets 2a at the bore holes 3
and the tracks 2c remain. In the following processing step the
catalyst 4 is applied to the inner wall area of bore hole 3.
The remaining processing steps take place in the same way as

This Sheet Has Been Replaced



in exemplary configuration one as shown in Figures 1e, 1f and
5 1g.

The exemplary configuration two differs therefore mainly in
that, that the catalyst 4 is only applied to the bore holes 3
after the fabrication of solder eyelets and tracks. This
10 results in the advantage that the catalyst 4 does not have to
be reactivated, since the remaining processing steps can be
applied without great time delay and the catalyst 4 is
therefore still active.

15 Figure 3 illustrates a partial view of the printed circuit
board 1 according to the invention in which a component 20 is
inserted with both its connection wires 21 into the plated
bore hole 8. The connection wires 21 are wetted with solder 22
in a soldering process in such a way, that they form a
20 connection with plating 7. A chip 23 with an integrated
circuit is, furthermore, mounted on part of a track 2b (i.e. a
land) on printed circuit board 1. A bonding wire 24 is applied
from a connection point of chip 23 to a further track 2b,
which has been covered prior to that with a protective coating
25 19, for example a gold coating. The bonding wire 24 can be
bonded to this gold coating by means of known production
processes.

The individual processing stages to carry out bonding are
30 known per se and do not require further explanation.



THIS SHEET HAS BEEN
REPLACED

CLAIMS

- 5 1. Method for the manufacture of through-hole plating on a printed circuit board, in which the printed circuit board is clad with at least two layers of copper, containing bore holes in certain positions for the through-hole plating and in which the wall area of the bore holes is plated by an electrochemical depositing process, thereby characterised,
- 10 a) that an adhesion promoter or catalyst (4) is applied to the wall area of the bore holes (3),
- 15 b) that an etch protection lacquer (5) is applied to the copper (2) in a ring shape around the bore holes (3) and that the etch protection lacquer (5) may also cover the bore holes (3) and the printed tracks (2b),
- 20 c) that the copper surfaces, that are not covered, are etched away and that the etch protection lacquer (5) is subsequently removed at least from the ring-shaped copper surfaces (solder eyelets) and the bore holes (3) and
- 25 d) that the solder eyelets (2a) are connected electrically conductive through electrochemical plating (7) with the wall area of the bore holes (3) via the catalyst (4).
- 30 2. Method according to claim 1, thereby characterised, that the catalyst (4) is only applied to the wall area of the bore holes (3) after the solder eyelets (2a) are etched free.
- 35 3. Method according to claim 1, thereby characterised, that the adhesion promoter (4) is a chemical, galvanically applied layer of copper of $< 10 \mu\text{m}$.

This Sheet Has Been Replaced





THIS SHEET HAS BEEN
REPLACED

4. Method according to one of the claims 1 to 3, thereby
5 characterised, that the electrochemical plating (7) is applied
as a thin, sleeve-shaped layer to the wall areas of the bore
holes (3).

5. Method according to one of the above claims, thereby
10 characterised, that the electrochemical plating (7) contains
preferably nickel or nickel compounds.

6. Method according to one of the above claims, thereby
characterised, that specified sections of the tracks (2b)
15 are covered with the electrochemical plating (7).

7. Method according to one of the claims 1 to 5, thereby
characterised, that the specified sections (2b) are covered
with a protective layer (19) consisting of palladium or gold.
20

8. Method according to claim 7, thereby characterised, that
bonding wires (24) are fixed to the protective layer (19) to
form the electrical connections to a semiconductor chip (23).

9. Multilayer printed circuit board, manufactured in
25 accordance with the method according to one of the previous
claims, thereby characterised, that on the printed circuit
board (1) a component (20) is arranged, of which at least one
connection wire (21) is inserted into the plated bore hole (8)
30 and is soldered to the plating (7).

10. Multilayer printed circuit board according to claim 9,
thereby characterised, that the printed circuit board is
fitted with at least one chip-type component (23), which is
35 connected with at least one bonding wire (24) to the plated
protective layer (19).

