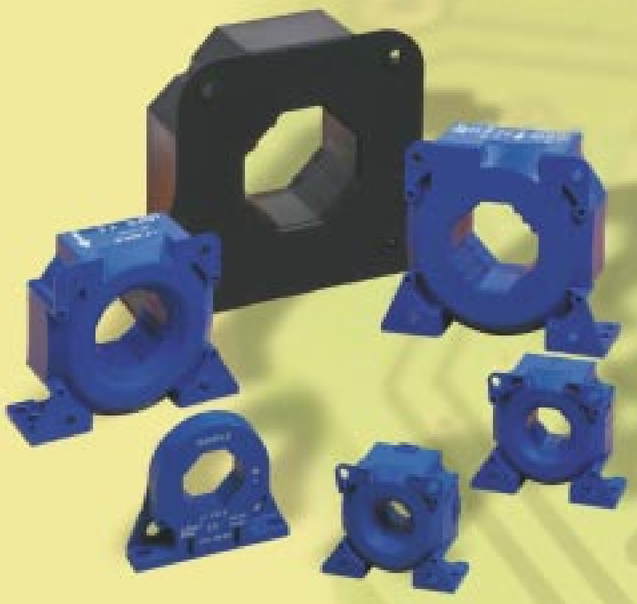


Process & Quality Control
Productivity Gain

Quality improvement & Time Savings thanks to Current Measurement

Applications

• DC current stabilized Power Supply in Electrolysis process
Control the steady state DC current flow

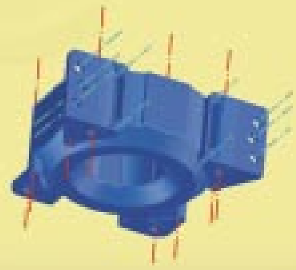
• Square, Positive & Reverse DC current Pulse Rectifier for Printed Circuit Board Manufacturing
Control the current amplitude, the polarity, the pulse width, the duration & duty cycle

Features

- *Bipolar AC & DC current measurement of 100 up to 2000 Arms nominal*
- *Multiple mounting options (Horizontal or vertical)*
- *Compact size*
- *+/- 0.3 % typical accuracy @ + 25°C @ nominal current*
- *Bipolar +/- 12 to 24 Volt DC power supply*
- *Response time @ 90 % of Ipn : <1µs*
- *Current output signal*
- *Galvanic Isolation*
- *EN 50178 Compliance*
- *CE Marking*
- *5 years warranty*

Printed Circuits Boards utilise an Electroplating process during manufacturing, by depositing copper on PCB during an electrochemical process. To improve and guarantee the integrity of the process, current control through modular transducers becomes necessary.

Printed Circuits Boards are commonly used in the Power Electronic world and are produced with thanks to the Electroplating process.
Current measurement plays an important part in this process to ensure quality of the finished PCBs, e.g. the structure, thickness of the tracks, but also saves time in production.
Power supplies or special rectifiers involved in the Electroplating process are purpose built in most cases to ensure a certain level of flexibility with regards to the current provided for the electrolysis process.
With this in mind, the standardisation of the designs is desirable. Indeed, the creation of few standard power modules facilitates the ability to produce multiple rating power units, just by connecting some of these initial standard modules in parallel. For example, to create a 3000 A generator, 6 power modules of 500 A each will be connected.
Different standard power modules are then designed. For practical reasons, each module tries to keep the same dimensions for any power level.
Physical limitation is the primary concern and it is here that the benefits of multimounting configuration become obvious.
The LF Series offers mounting flexibility, as all the models can be fixed either vertically or horizontally. The LF models cover the nominal measuring range of 100, 200, 300, 500, 1000 & 2000 Arms, each offering a similar shape, with different sizes rated to their dedicated nominal current measuring capacity.
The series is offered with an industrial connector for the secondary connection (either a Molex or JST connector) but can also be provided with a more “secured” connector (Molex Minifit 5566) for a better locking. Some special models are also available for PCB mounting (LF 205-P, LF 306-S/SP10) to answer to most of the mounting requirements.



COMPACT AC/DC CURRENT TRANSDUCERS : *LF Series*

LEM

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Application Note
Electroplating & Electrolysis Process Control
Printed Circuit Board Manufacturing

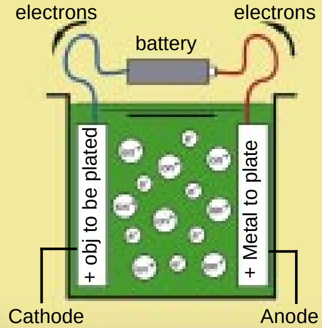
Picture provided by courtesy of DRPP

The production of Printed Circuit Boards goes through the Electroplating process. Electroplating is the electrochemical process of depositing a metallic coating on a material of an object. When it is immersed in a plating solution, a low voltage electric current flows through it, causing the metallic coating to be attracted to the object to be plated.
Different ways to do the plating :

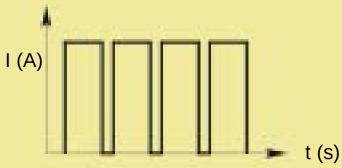
1. The most conventional : With a **DC Plating current**. To summarise briefly the working principle : The object to be plated is located on the cathode linked to the negative pole of the battery. The metal to be deposited on the object is installed on the anode itself linked to the positive pole of the battery. Cathode & anode and their associated objects are immersed into a salt solution of the plating metal. The electrons of the solution are circulating through the battery and accumulating on the cathode, when the positive ions of the metal from the solution are attracted by the cathode (negative load). The object to be plated is then negatively loaded and brings the positive metallic ions on it to produce the wished metallic plating ***(Graph n°1)***.

2. With a **DC Pulse Plating current** : The plating follows the same previous principle, except that the metal deposition is ensured by pulsed electrolysis. An interrupted (square pulse) DC current of equal amplitude and duration with a certain duty cycle is used to facilitate the electroplating process.
Using a pulse DC current causes a higher voltage vs the steady DC plating which directly improves the plating deposit quality ***(Graph n°2) (Chart 1)***.

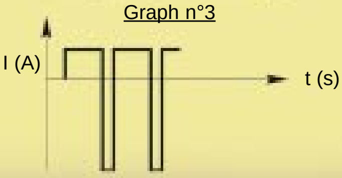
Graph n°1



Graph n°2



Graph n°3



Advantages \ Plating Solution	DC Pulse	Reverse DC Pulse	
Dense fine grained coating	X	XX	Better adhesion Lower porosity
Uniform thickness of the deposit	X	XX	Higher elongation (less stress) Higher conductivity

Chart 1

3. With a **Reverse DC Pulse Plating current** : This is an expanded system of the previous pulse plating process. Amplitudes, frequency, duration and polarity of the DC pulses series can vary under full control.
Typical currents used are 200, 400, 600, 1200 A DC with a 3 times higher in amplitude reverse DC current ***(Graph n°3)***.
This leads to a faster and higher quality production of Printed Circuit Boards ***(Chart 1)***.

When tracks are bigger than through holes on PCBs, it becomes difficult to ensure an efficient and uniform copper deposit. Copper ions are attracted to where the current density is high, like on the edges of the holes. Conversely, they avoid the deep through holes where there is a low current density. This results in more copper on the edges of the holes than in the holes. Using a lower current density is a solution, but leads, however, to a longer process time. Also, a too low current can produce coarse copper in the holes resulting in some cracking. Reverse Pulse Plating completed with an appropriate electrolyte is the answer. The reverse current creates a "shield" on the sensitive areas (edges or through holes). With the positive pulse, the shield disappears progressively on the protected areas when the deposit begins on the unshielded areas. This leads to less deposit on these sensitive areas than on the other ones. By this way, copper deposit of uniform thickness through the holes and at their edges is ensured.

To produce these different plating currents, special rectifiers have been designed. External cabling + electrolytic solution due to their impedances (resistance, inductance and capacitance) directly influence the characteristics of the pulses, resulting in overshoot and/or undershoot if no precautions are taken.

To ensure the best plating process and quality, the pulse current waveform should stay stable and similar to the initial adjusted value regardless of the load. Then, the overshoot or undershoot must be avoided or compensated for. Rise and fall times of the direct & reverse pulse currents are also decisive on the quality of the plating. Thanks to a closed loop control system, the current pulse waveform of the rectifiers can continuously be monitored and adjusted with the help of current transducers such as one of the LF series transducers.

Based on the Closed Loop Hall effect technology, the LF series provides a quick response time (less than 1 µs) at 90 % of the nominal current, allowing a real time control of the rise and fall times of the current pulses of the rectifiers.

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