

# Original or Fake

*Allocation the root of all evil*

*Recently, the number of incidents users submit complaints to the manufacturer about the power semiconductor failures is steadily increasing. Failure analyses show that these power semiconductors are counterfeits or rejects originally intended for scrapping. How can you protect yourself from such counterfeits and what is the background leading up to such criminal acts?*

*By Werner Bresch, GvA*

It is certainly beyond question, that power semiconductors are key components. Only if they are readily available, power electronic modules and systems can be delivered in time and thus generate added value. If shortages cause these components to be unavailable, unfinished goods of high value idle in the production and cannot be delivered. The same is true for high-quality systems which can no longer be operated because the appropriate spare power semiconductor is not available. Both scenarios can threaten the existence of a company. In any case, extreme pressure will mount on the purchase department responsible. Such shortages often occur during economic boom, or, as just recently, at the tail end of a downswing. Demand cannot be covered because power semiconductor manufacturers already produce at their capacity limit or are unable to quickly ramp up their production capacity.

Allocation is the logical consequence, and affected are mostly, sought-after high-quality power semiconductors, such as IGBT, IGCT, GTO, and high-performance thyristors. The large number of internet-based search action giving an impression of a procurement panic, ultimately paving the way for dubious business practices.

## **Conflict of interest**

Purchasers have a legitimate interest to buy products, among them key components like power semiconductors, at the lowest possible price, and, preferably without any long-term contractual obligations. Formerly appreciated soft facts, like good customer-supplier-relations, supplier expertise, and direct contact to decision-makers at both partners and delivery reliability are no longer crucial for the placement of new orders. The procurement process has become completely impersonal, mutual understanding and appreciation is fading, the differing needs of

business partners are no longer taken into consideration.

However, power semiconductor manufacturers and their distribution channels depend on these soft facts to reliably deliver their customers. This also applies for long-term contractual obligations of both parties.

## **Manufacture of power semiconductors – a tough business**

Few customers are aware that, all delivery deadlines and process cycles taken into account, a time span of up to 18 months is required from silicone order to power semiconductor delivery. It requires that a power semiconductor manufacturer orders silicone of a certain specification to deliver a product his customer may need only 12 to 18 months later, even if no long-term orders are pending. Such long-term planning is tricky, after all, who knows what demand will be next year? The aforementioned alienation of purchaser and supplier makes matters even more difficult.

The fact that power semiconductor manufacturers are not volume customers for silicone producers aggravates this circumstance. They only need about 1-2% of the silicone used worldwide. Furthermore, power semiconductor manufacturers are rather a disturbance in the process flow of large-scale silicone producers because they only need moderate amounts with very special specifications. Therefore, only a limited number of suppliers produces and delivers silicone in a predetermined annual volume.

If the power semiconductor demand was correctly calculated, suitable power semiconductors are available to customers 12-18 months later. If planning turned out to be off-target for the aforementioned reasons, demand grows even more and market shortages can aggravate the situation for all the players involved.

Another minor theater of war is the limited number of molybdenum suppliers or housing suppliers for specific silicone irradiation after-treatment which has become increasingly few and far apart due to changes in the legal regulations. However, this limitation can be responsible for drastic delivery time delays, even if the projected silicone planning was sound. Problems with diffusion process flow, bonding or encapsulations can pose additional risks for delays. Power semiconductor manufacture is a highly complex business which, due to the aforementioned number of circumstances, does not allow to rapidly respond to the ever changing demand.

## **Closing the stable door after the horse has bolted**

It was inevitable: the monster contract was awarded and requires a production conversion with more power semiconductors that was implemented yesterday. Despite extensive procurement efforts suitable power semiconductors can not be delivered within due time. Manufacturing slots for large power semiconductor batches are booked well into the future because other users had ordered extra quantities to be on the safe side. Often, power semiconductor suppliers receive the same order inquiries for one component from different customers, and must turn them all down. The news will spread and shortages of one specific power semiconductor will soon be documented and disseminated on the web.

And then, all of a sudden, and as if like a miracle, these exact component types (usually high-priced large IGBT, GTO, IGCT) are offered in moderate quantities of some 50 pieces and to horrendous prices, but deliverable ex works.

Well, everyone knows that power semiconductors do not grow on trees. So where do they come from?

Currently, this phenomenon will have the following reasons:

Components made of an identical or similar looking new material and manufactured by a competitor are neutralized by an unknown third party and labeled with all the relevant data that is actually needed on the market.

Power semiconductors contain precious resources which are recycled into the economic cycle. When power semiconductors have reached the end of their life cycle, they are preventively replaced to make sure high-tech systems using them can be operated for many more years. There are incidents where such components have not been disassembled and recycled but visually rehashed and offered as new, often simply relabeled as previously described.

Nobody is perfect! Every once in while it happens that power semiconductors do not pass the manufacturer functional test. Usually, such components are recycled as scrap. But sometimes it happens that they find their way mysteriously back from the scrap yard to the warehouse of some mysterious distributors.

One can imagine what such rehashed power semiconductors will do to their intended application ...

#### **An ounce of prevention is worth a pound of cure**

Every supplier will understand, if a customer in jeopardy searches for alternative sources of supply. But once such a source is found, the customer should demand an approved authentication that the offered product is really genuine merchandise.

Every manufacturer has a specific system to designate components. Such designations usually consist of data codes, bar codes and

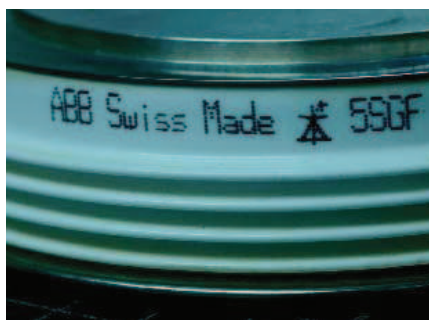


Figure 1: Labeling of the fake

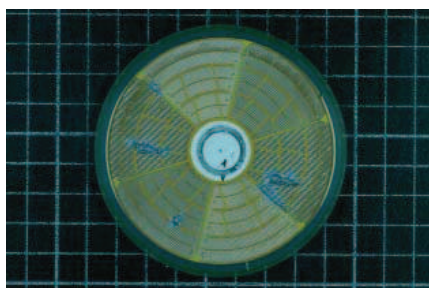


Figure 2: Wafer of the GTO fake

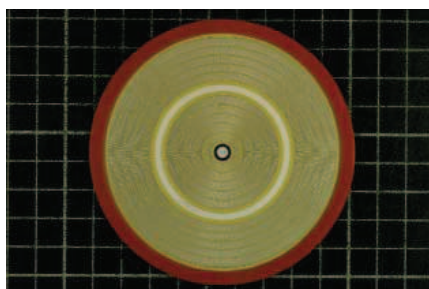


Figure 3: Original ABB wafer  
Pictures from an analysis report for the investigation of fake ABB GTOs  
(Courtesy of ABB Switzerland Ltd.).

numbers embossed, labeled, printed or lasered on the power semiconductor casing. Prior to the purchase, the customer should request all numbers, codes and designations and check them for plausibility. Most likely, the manufacturer has records, which prove when each power semiconductor was manufactured and where it was delivered. Of course, this only helps, if the component has a designation that roots back to its manufacturer.

If power semiconductors cannot provide such information, they are at least suspect and potential purchasers should be most careful.

Eventually, users can take precautionary measures so that these situations never occur!

#### **Avoid delivery bottlenecks**

Today, reliable supply with key components power semiconductor provides an enormous competitive edge because the number of competent manufacturer of power semiconductors capable of delivering large quantities is relatively small.

It is a proven fact that a good customer-supplier relationship helps to detect and tackle supply shortages with power semiconductors early. Long-term contractual agreements offer both partners planning certainty and allow to satisfy the basic demand. Possible bottlenecks can be opened by a framework contract flexibly responding to changing demands. If the customer communicates with the supplier by allowing access to their ERP-system, increased demand can be recognized early and allows the supplier to flexibly respond. Ideally, the planning horizons of both partners are identical or at least meeting on one level.

At any rate, it is much more sensible to place an order, and, if need be, postpone it, rather than not process the order and not be allocated in a production slot.

Even project business can be smartly planned by devising a flexible agreement and creating a buffer warehouse to cover initial demand. This requires more understanding and active contribution of both partners than a regular customer-supplier relationship.

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