

## Quality Information

### Vishay Telefunken's Continuous Improvement Activities

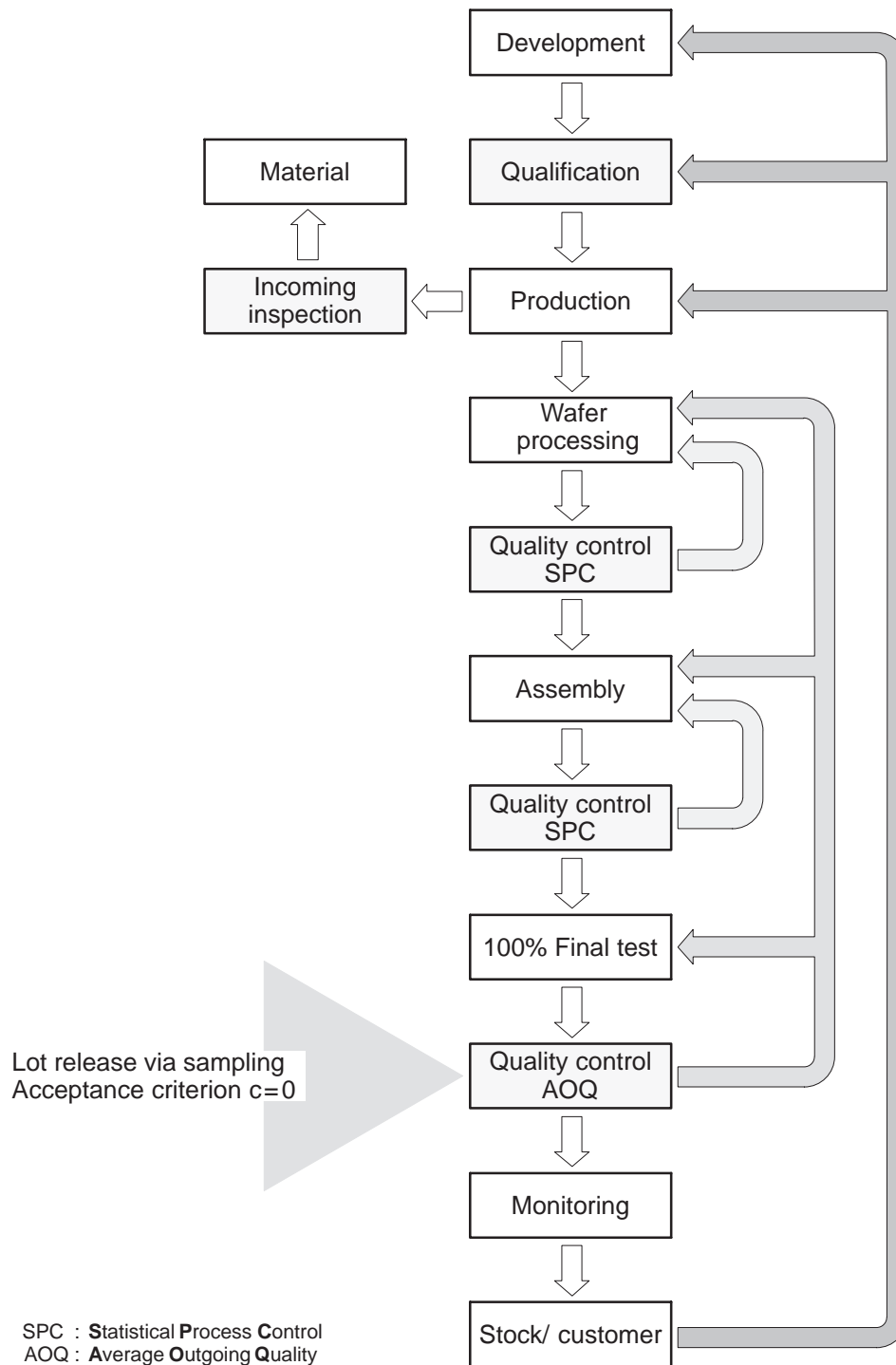
- Quality training for ALL personnel including production, development, marketing and sales departments
- Zero defect mindset
- Permanent quality improvement process
- Total Quality Management (TQM)
- Vishay Telefunken's Quality Policy established by the Management Board
- Quality system certified per ISO 9001 on July 12, 1993 (Commercial Quality System)
- QS9000 / VDA6.1 (1999)

### Vishay Telefunken Tools for Continuous Improvement

- Vishay Telefunken qualifies materials, processes and process changes
- Vishay Telefunken uses Process FMEA (Failure Mode and Effects Analysis) for all processes. Process and machine capability as well as Gage R&R (Repeatability & Reproducibility) are proven
- Vishay Telefunken's internal qualifications correspond to IEC 68-2 and MIL STD 883
- Vishay Telefunken periodically requalifies device types (Short Term Monitoring, Long Term Monitoring).
- Vishay Telefunken uses SPC for significant production parameters. SPC is performed by trained operators.
- Vishay Telefunken's Burn-In of selected device types.
- Vishay Telefunken's 100% testing of final products.
- Vishay Telefunken's lot release is carried out via sampling. Sampling acceptance criterion is always  $c = 0$ .

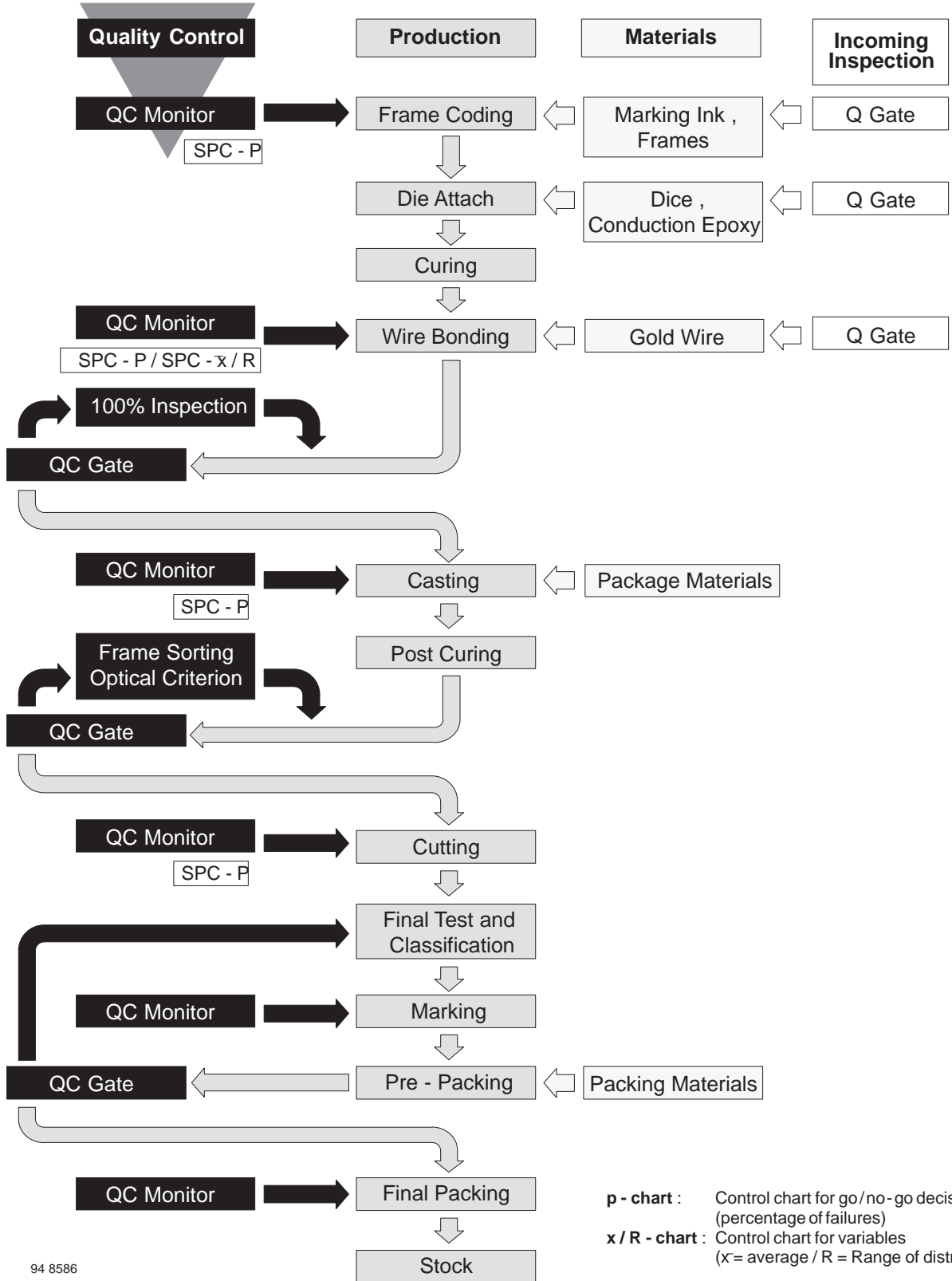


General Quality Flow Chart Diagram



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### Production Flow Chart Diagram



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**p - chart :** Control chart for go/no-go decisions (percentage of failures)  
**x / R - chart :** Control chart for variables (x = average / R = Range of distribution)

## Qualification and Release

New wafer processes, packages and device types are qualified according to the internal Vishay Telefunken specification PB04002.

PB04002 consists of four parts (see figure 1).

**Wafer process release:** The wafer process release is the fundamental release/qualification for the various technologies used by Vishay Telefunken. Leading device types are defined for various technologies. Three wafer lots of these types are subjected to an extensive qualification procedure and are used to represent this technology. A positive result will release the technology.

**Package release:** The package release is the fundamental release/qualification for the different

packages used. Package groups are defined (see figure 1).

Critical packages are selected: two assembly lots are subjected to the qualification procedure representing that package group. A positive result will release all similar packages.

**Device type release:** The device type released is the release of individual designs.

**Product or process changes** are released via ECN (Engineering Change Note). This includes proving process capability and meeting the quality requirements.

Test procedures utilized are IEC 68-2-... and MIL-STD-883 D respectively.

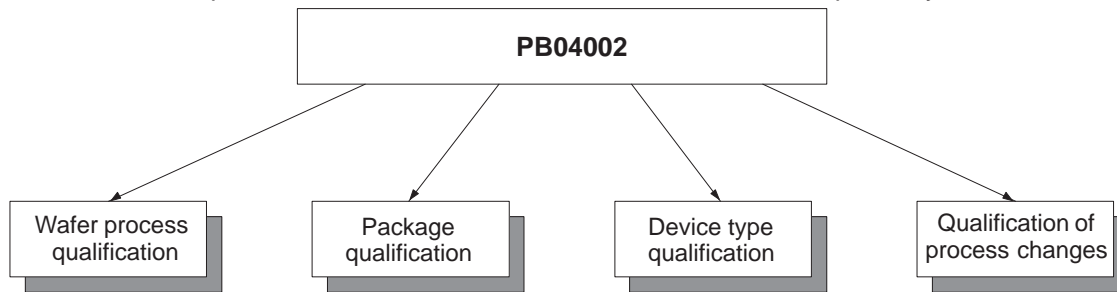


Figure 1. Structure of PB04002

## Statistical Methods for Prevention

To manufacture high-quality products, it is not sufficient controlling the product at the end of the production process.

Quality has to be 'designed-in' during process- and product development. In addition to that, the 'designing-in' must also be ensured during production flow. Both will be achieved by means of appropriate measurements and tools.

- Statistical Process Control (SPC)
- R&R- (Repeatability and Reproducibility) tests
- Up-Time Control (UTC)
- Failure Mode and Effect Analysis (FMEA)
- Design Of Experiments (DOE)
- Quality Function Deployment (QFD)

Vishay Telefunken has been using SPC as a tool in production since 1990/91.

By using SPC, deviations from the process control goals are quickly established. This allows control of the

processes before the process parameters run out of specified limits. To assure control of the processes, each process step is observed and supervised by trained personnel. Results are documented.

Process capabilities are measured and expressed by the process capability index ( $C_{pk}$ ).

Validation of the process capability is required for new processes before they are released for production.

Before using new equipment and new gauges in production, machine capability ( $C_{mk}$  = machine capability index) or R&R (Repeatability & Reproducibility) is used to validate the equipment's fitness for use.

Up-Time is recorded by an Up-Time Control (UTC) system. This data determines the intervals for preventive maintenance, which is the basis for the maintenance plan.

A process-FMEA is performed for all processes (FMEA = Failure Mode and Effect Analysis). In addition, a design- or product- FMEA is used for critical products or to meet agreed customer requirements.

Design of Experiments (DOE) is a tool for the statistical design of experiments and is used for optimization of processes. Systems (processes, products and procedures) are analyzed and optimized

by using designed experiments.

A significant advantage compared to conventional methods is the efficient performance of experiments with minimum effort by determining the most important inputs for optimizing the system.

As a part of the continuous improvement process, all Vishay Telefunken's employees are trained in using new statistical methods and procedures.