

JEDEC STANDARD

Statistical Process Control Systems

JESD557D

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JEDEC SOLID STATE TECHNOLOGY ASSOCIATION



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STATISTICAL PROCESS CONTROL SYSTEMS

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Introduction

Continuous quality improvement and the achievement of operational and manufacturing excellence are the essence of the total quality philosophy. One of the major vehicles used for achieving the excellence objective is the application of Statistical Process Control (SPC) techniques.

SPC embraces a management philosophy of continuous process improvement that has a primary focus on prevention of outliers or maverick products to be shipped to customers. After a process has been characterized using statistical techniques (i.e., design of experiments (DOE), capability studies), SPC is a tool that can be applied to control and optimize the process and reduce variability. An acceptable approach toward an SPC system involves the use of "end-of-process" data to control the process through the application of SPC techniques. However, the intent of this standard is to emphasize the use of in-process data in order to better control and forecast product quality. This proactive use of SPC in conjunction with other techniques and the appropriate responsiveness to out-of-control situations serves to make SPC techniques critical in continuous process improvement and achieving excellence.

It is well recognized that the implementation of an effective and measurable continuous improvement program, which includes SPC, is an ongoing process. In order for techniques such as SPC to be firmly established throughout all facets of an organization, a strong management commitment must exist. In addition, personnel must be trained, involved, and held accountable in this statistical analysis, control and improvement process. The exact nature and sophistication of these techniques may vary from manufacturer to manufacturer, depending on the management concepts involved. In recognition of this tendency, this standard provides the general requirements of SPC, including definitions and terminology to promote standardization of best practices.

STATISTICAL PROCESS CONTROL SYSTEMS

From JEDEC Board ballot JCB-23-20, formulated under the cognizance of the JC-14 Committee on Quality and Reliability of Solid State Products.

1 Scope

This standard specifies the general requirements of a statistical process control (SPC) system.

2 References

The following normative documents contain provisions that, through reference in this text, constitute provisions for this standard. For undated references, the latest edition of the normative document referred to applies.

JEDEC JEP132, Process Characterization Guideline

ISO 10012, Measurement Management Systems - Requirements for Measurement Processes and Measuring Equipment

AIAG Measurement Systems Analysis (MSA) Reference Manual

3 Terms and Definitions

EIA-557-B defined many terms used in the field of SPC. Many were not actually used in EIA-557-B. In this standard, JESD557C, the terms necessary to understand the text are defined in 3.1, other terms are defined in Annex F.

3.1 Terms and definitions used in this document

audit: The periodic review of procedures and observation of performed activities to evaluate compliance with requirements.

average: The sum of the sample values divided by the number of sample values. A measure of location used to estimate the population mean.

capability: The ability to meet a specification.

capability index: A measure of the relationship between the specification limits and the capability.

characteristic: A distinguishing feature of a process or its output on which variables or attributes data can be collected.

characterization: A description of the characteristics of a product or process by mathematical modeling, design of experiments, or statistical data evaluation.

NOTE Methods of statistical data evaluation are described in JESD557 and JEP132.

3.1 Terms and definitions used in this document (cont'd)

common cause: A source of natural variation that affects all the individual values of the process output being studied.

NOTE In control chart analysis common causes appear as part of the random process variation.

control chart: A graphic representation of a process characteristic showing plotted values of some statistic gathered from that characteristic, a central line and one or two statistically derived control limits.

control limits: The maximum allowable variation of a process characteristic due to common causes alone.

NOTE 1 Variation beyond a control limit may be evidence that special causes are affecting the process.

NOTE 2 Control limits are calculated from process data and are usually represented as a line (or lines) on a control chart. They are not to be confused with engineering specification limits.

Cpk: See “process capability index (Cpk)”.

critical (process) node: A node in the process flow whose output has a significant impact on the process.

data point: A value that is either observed or calculated.

individual: A single unit or a single measurement of a characteristic.

mean: The sum of the population values divided by the number of values in the population—a measure of location (central tendency) equal to the center of gravity of the population.

median: The middle value in a group of measurements when arranged from lowest to highest—a measure of location.

NOTE When the number of measurements is an even number, the average of the two middle values is used as the median.

node: A definable point in the process at which form, fit, or function of the product or service is altered.

normal distribution; Gaussian distribution: A continuous, symmetrical, bell-shaped frequency distribution for variables data.

NOTE When measurements have a normal distribution, about 68.26% of all individuals lie within plus or minus one standard deviation unit of the mean; about 95.44% lie within plus or minus two standard deviation units of the mean; and about 99.73% of all individuals lie within plus or minus three standard deviation units of the mean.

out-of-control: A set of data with the mean value or sigma of a sample violating the control limit

out-of-spec: A set of data with at least one value violating the spec limit.

parameter: A measurable characteristic.

population: The collection of all possible values of a given characteristic.

3.1 Terms and definitions used in this document (cont'd)

probability: The relative frequency with which an outcome takes place over a very large number of trials in each of which the outcome could have occurred.

process:

- 1) A combination of people, procedures, methods, machines, materials, measurement equipment, and/or environment for specific work activities to produce a given product or service.
- 2) A repeatable sequence of activities with measurable inputs and outputs.

process capability: The capability of a process to meet its specification.

process capability index (C_{pk}): A measure of the relationship between the process specification limits and its capability.

process capability study: A study that quantifies natural process variability.

run: A number of consecutive points, usually seven or eight, above or below the centerline.

sample: A set of individuals taken from a population.

special cause; assignable cause: A source of variation that is intermittent, unpredictable, or unstable and affects only some of the individual values of the process output being studied.

specification limits: The boundaries for judging acceptability of a particular characteristic.

standard deviation: A measure of the spread or variation in a probability distribution (population standard deviation) or in a sample of values measured on the output from a process (sample standard deviation).

statistic: A value calculated from or based upon sample data used to make inferences about a parameter of the population from which the sample came.

statistical control: The conditions describing a process from which all special causes of variation have been eliminated and only common causes remain.

statistical process control (SPC): A method of quality control that uses statistical methods in order to monitor and control a process.

statistical quality control (SQC): Statistical methods and procedures used to document and ensure compliance with requirements.

target: The desired value for a statistic of a characteristic or parameter of a process node.

trend: The movement of a process in a consistently increasing or decreasing direction.

variation: The difference among individual outputs of a process.

NOTE The sources of variation can be grouped into two major classes: common causes and special causes.

3.2 Other terms related to SPC/SQC

For other terms and definitions related to SPC but not used in the text, see Annex F.