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P

Packing density; (Constructional element density)

In micro-electronic technology, the number of constructional elements per unit volume.

Parabola method

For the monitoring of peak-position and - height, amongst others the position and the numerical value of the highest spectral value lying in the frequency range of interest are consulted. Thereby the resolution is limited by the frequency resolution, i.e. the frequency spacing of the neighbouring spectral values. For very narrow deterministic points, whose width is comparable with the spectral resolution, the resolution can be refined. This is done by laying a downward open parabola through the highest point and the neighbouring points on either side with a symmetrical axis parallel to the ordinate axis and takes the peak- position and peak value as a peak-position and height.

Parallel

Describing the circumstances with multiple processes, so that the processes run off next to each other, whereby all process intervals overlap one another in one time interval.

Note: If parallel-running processes use operating resources together, then one can speak also of concurrent processes. One can also speak of „one-time-interval parallel“, if the overlap takes place in this time interval.

Parallel measurement means the simultaneous measurement of the measured variables from several measuring points. The converse is serial.

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P

Parallel-filter analyser; Parallel analyser

P. possess a multiplicity of bandpass filters joined in parallel (filter banks) with pass bands and centre frequencies which are different in each case. The centre frequencies are usually graduated in such a way that the pass bands border directly on one another. Downstream measuring instruments indicate the spectrum of the input signal in this case. The required resolution of such analysers determines the number of necessary filters. The frequency spacing of the individual filters usually amounts to 1/3 octave or 1 octave. One therefore also calls these analysers third and/or octave analysers.

Parallel interface

Interface through which data is exchanged in parallel

Parallel offset

Parallel deviation of the shaft axis from the ideal vertical and horizontal alignment condition.

See also Alignment error

Parallel operation

A mode of operation, in which several functional units complete orders in such a way that the processes running off are thereby parallel.

Note: This presupposes that the orders are independent of one another. The converse is serial operation.

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Parallel processing

Simultaneous processing of several data in a computer or a computer system. In a computer P. can thereby be made possible by having several processing units available, e.g. several adding devices. In a computer system P. becomes possible through so-called multiprocessor systems, where the processing of a program is divided over several processors.

Parallel-Serial Converter

A converter, in which parallel represented digital data is examined in a temporal sequence.
Circuit for the conversion of a group of simultaneously available (parallel-running) signal elements into an appropriate series of temporally sequential signal elements, whereby the series represents the same information.

Parity

In digital technology the equivalence of the number of set bits “1“. One differentiates between even parity (in this case the number of all set bits must produce an even number) and odd parity (in this case the number of all set bits must produce an odd number). For the purpose of an error check (parity check) the binary word, which is to be transferred, has a further parity bit (perhaps also several) added, so that even or odd P. develops (depending upon agreement). With the parity test then, e.g. after transmission, the agreed upon P. is examined. From this fact, the transmission can be judged normal or incorrect by whether the number of set bits is even or odd after transmission.

Passband

The frequency range of a system (e.g. an electrical filter), within which oscillations are transferred (let through). The converse is the restricted area.

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P

Password

A secret word for access authorization.

By the use of passwords the entrance to the computer and/or access to files can be controlled. Before a user can utilise the functions of a computer and/or access stored data he must enter an assigned P. in relation to the operating system. The permission (access authorization) to access data can furthermore be individually regulated by the assignment of different passwords. (read password, write password, execution password, etc.)

PCMCIA

Abbr. for <**PC M**emory **C**ard **I**nternational **A**ssociation>

International Organisation for the standardization of memory cards for PCs, especially notebooks.

PCMCIA board

A plug-in board for PCs, especially notebooks, which fulfils the requirements of the PCMCIA guidelines.

Peak-hold

The P. is a function, which is to be found in many digital spectrum analyzers under the generic term averaging. For each frequency line of the entire frequency range the respective maximum values of the amplitudes from an adjustable number of individual analyses are brought to the display. The P. is necessary, if the maximum values in temporally strongly varying signals, which are lost through averaging, are to be acquired.

An application is e.g. the determination of the magnitude of temporally limited, self-excited vibrations which arise.

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P

Peak-peak value

The P. describes the maximum deflection of an alternating variable such as alternating voltage or periodic oscillation in positive and negative direction. This is always used if the changes in mechanical distances between machine parts are critical, e.g. with journal-
bearing, bladed rotors. The index designation is pp, e.g. the vibration displacement S_{pp} is derived from the difference between the largest value S_o and the smallest value S_u

$$S_{pp} = S_o - (-S_u) = S_o - S_u$$

Further commonly used designations are: Double amplitude, peak-to peak value and vibration width.

Peak value

P. of a variable dimension, such as the alternating voltage of a periodic oscillation, is the largest instantaneous value during one period.
The P. is characterised by a ^ character above the symbol of the variable (e.g. $\hat{p}$ for the P. of the vibration displacement).

Peak value, calculated; peak value, equivalent

The P. equivalent is used particularly in the USA as a calculated equivalent parameter for the true peak value. The index designation is “equ” or <pk-calculated>. For the determination of the equivalent P. the rms value is measured and multiplied by the factor $\sqrt{2}$. For example for the vibration displacement this gives the value

$$S_{equ} = \sqrt{2} * S_{rms}$$

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P

Perfectly balanced rotor

Rotor, completely balanced

Period

If an event, e.g. the change of a physical property, such as displacement, velocity, acceleration or voltage behaves in such a way that after a certain time or a certain local shift the same value arises again and again, then one says that it has a P. or is periodic, whereby the P. is represented by this specific temporal or local distance.

See also Event, periodic

Period duration (of a sinusoidal vibration)

The time T is the shortest time period after which an oscillation (e.g. a sinusoidal vibration) repeats itself periodically, and is called period duration.

See also Event, periodic

Period frequency

Frequency of a sinusoidal vibration

Periodic phenomenon

A phenomenon whose value at any point, x is a periodic function of time:

$$x(t - nT) = x(t)$$

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P

Here, n is any whole number, T is the duration of the period (shortest period of time according to which the phenomenon will repeat periodically) and $f = 11T$ the (periodic-) frequency.

The periodic phenomenon can be displayed as the sum of an equalisation phenomenon and an exchange phenomenon:

$$x(t) = \underline{X} + \underset{\sim}{x}(t)$$

where $\underline{X}$ is the equalisation part and $\underset{\sim}{x}$ is the exchange part of the hybrid value x. The difference x_0 between the maximum value X_{max} and the minimum value X_{min} is called the vibration width (fluctuation, peak-to-valley height).

Periodic vibration, general

Vibrations, generally periodic in form

Permanent monitoring

See Monitoring, permanent

Permanent monitoring system

A P. examines continuously. i.e. without temporal interruption, certain measured variables, e.g. the vibration level. With multi-channel systems the measurement and evaluation of all channels takes place simultaneously and in parallel, usually supplemented by a recording media such as level strip recorders, magnetic tape or digital data storage. Such systems can react very quickly to sudden changes in the monitored signals and are employed e.g. for monitoring of large turbine-generator sets or other critical machine groups.

See also Monitoring systems, intermittent

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P

Permissible residual unbalance

See Unbalance, permissible

Phase angle (of sinusoidal vibration); short: Phase

The argument of the sine or cosine function is called P. The unit radian is replaced here by 1. The P. goes into action during the representation of a sinus oscillation by projection of the rotation of a vector as an even angle between the vector and projection axis.

Phase-angle measurement; Phase measurement

The measurement of the phase angle of a variable which changes with time. This can be done, e.g. by means of a phase-angle measurement bridge, an oscilloscope or an electrical counter.

Phase-angle modulated sinusoidal phenomenon

Sinusoidal event, phase angle-modulated

Phase-angle spectrum (of sinusoidal vibration); Phase spectrum

The application of the zero-phase angle φ_{0n} of the partial vibrations over its frequency or over its ordinal number is called the P. or the phase-spectrum.
The distribution of the zero-phase angle of the partial oscillations of a signal or a noise as a function of the frequency.

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P

Phase characteristic

The frequency dependence of the phase angle in a complex transfer function.

Phase difference

The difference between the phase angles of two alternating variables of the same frequency (harmonic vibrations).

Phase-Frequency characteristic

Phase angle difference between the fundamental vibration of the output signal of a dual-gate and the associated sinusoidal input signal with a given amplitude as a function of the frequency.
Note: In case of a linear time-invariant dual-gate, the phase-frequency characteristic is represented by the argument of the frequency characteristic.

Phase modulation

Demodulation, applied to a modulated signal which was produced by phase modulation.

Phase modulation

Abbr. PM
Phase modulation with which the phase angle deviation changes the instantaneous value of the modulating signal in agreement with a given, generally linear, function.

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P

Phase-reference impulse

A pulse-type output signal from a phase-reference sensor which is produced with the help of a marking (phase-reference mark) on the shaft.

Phase-reference mark

The location on the shaft circumference at which a groove, key or a drilling is appropriate for the production of the phase-reference impulse. In the case of use of an optical sensor (suitable for temporary mounting) a piece of reflective tape is generally used.

Note: Because of the danger of the reflective tape being compromised by dirt or some other pollution, optical sensors should not be used for a permanent reference mark; a non-contacting displacement sensor is more suitable.

Phase-reference sensor; phase-reference pick-up

A non-contacting displacement sensor, which produces a $1X$ time per revolution voltage pulse from a keyway or key in the shaft: the phase-reference impulse. This serves for determination of the rotational speed and as a point of reference for the measurement of phase angles and harmonic vibrations. The P. is necessary for order analysis, for the measurement of the shaft excursion and the mechanical runout.

Phase-shift angle (of sinusoidal vibration); short: Phase-shift

If two sinusoidal quantities of the same frequency differ by their zero-phase angles, then they are called out of phase; those whose respective phases (e.g. of the highest value) which enter within a half-period duration earlier (later) are called leading (lagging).
The difference $\Delta\varphi$ of the zero-phase angles is called the P.

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P

Phase-shift time (of sinusoidal vibration)

The P. Δt is assigned to the phase-shift angle $\Delta\varphi$ according to

$$\Delta t = \frac{\Delta\varphi}{\omega}$$

Phase shifter

An electronic circuit, which makes it possible to produce from an alternating voltage, a voltage of the same frequency (and amplitude) but whose phase is shifted by an adjustable angle compared to the exciting voltage.

Phase-time (of sinusoidal vibration)

The time $t = \varphi/\omega$, which corresponds to the phase-angle is called the P. Emphasized P. are the zero-phase time and the phase-shift time.

Phasor calculation

The application of the complex calculation to the calculation of sinusoidally fluctuating quantities in linear electrical networks. The vector calculation has, in comparison with the calculation by differential and integral equations, the advantage that the calculation can be carried out with only algebraic equations with complex arguments.

Phon

The unit for sound volume. 1 P. corresponds (approximately) to the auditory threshold of the human ear with the frequency of 1000 cycles per second and a sound intensity of $10 - 16\ Watt/cm^2$. Volume differences are indicated in (dB) decibels: $1\ phon\ =\ 1\ dB$.

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P

Picket-fence effect

The P. exists with the digital scanning of a time function by a continuous spectrum. It is as if the spectrum is observed through the slots of a picket-fence. The peak values in the spectrum are not necessarily visible. In the case of discrete frequency components and known filter characteristics (e.g. a Hanning window) magnitude and frequency instabilities can be determined from the computed discrete spectral lines.

Piezo-electric effect

Different materials - called piezo-electrically active - show the effect, under influence of a mechanical load in a certain direction (polarization direction), of the formation of electrical surface charges which are strictly proportional to the force. If one measures this load through electrodes, one receives at the output an electrical tension which is likewise proportional to the force.

The effect occurs both during pressure load (longitudinal piezoelectric effect) as well as during thrust load (transverse piezoelectric effect). Both variants are used in measuring techniques.

Piezo-electricity

Some crystals are electrically polarized under pressure, an electrical field is formed in their environment (Effect, piezoelectric).

Pink noise

See Noise, pink

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P

Pitch errors

Coupling failure

Pixel

Abbr. for <**P**icture **e**lement>

A digitally stored picture element.

Plausibility check; Plausibility test

The P. serves to determine the validity of acquired process data, i.e. to examine variables lie within the plausibility range or not.

Process data are valid, if their values result from the acquired process variables. Process data are invalid, if their values are excessively falsified by disturbances during the process data acquisition.

Plausibility range

The P. is a range, in which a variable is appropriate for all functional units of a process control system and/or trouble-free technical operating processes.

Plausibility test

See Plausibility check

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P

PLL

Abbr. for <**p**hase-**l**ocked **l**oop>

Closed automatic, electronic control loop which serves for production of signals with a certain desired frequency of high accuracy or also for decoding frequency-modulated signals.

Polar coordinate diagram

In the P. concentric circles are arranged with an angular distribution. It serves for the representation of vibration vectors whose length (amount) determines the amplitude and the direction (phase) by the angle from the point of 0° reference.

Polar diagram; polar plot

A representation of harmonic vibrations as vectors in a polar coordinate diagram. A P. has special significance when balancing rotors.

See also Locus curve

Polarity

In connection with vibration sensors one understands the change of output signal (in positive or negative direction) by P. due to the movement in a certain direction (toward or away from the sensor). It is considered as agreed upon that a movement of the item under test toward the sensor is to cause a positive change of the signal.

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P

Power amplifier; output amplifier

The last amplifier stage of an amplifier with comparatively large power output, usually following a driver. There is P. for low frequency, for high frequency and as a microwave power amplifier (microwave amplifier). P. must have particularly small distortion with good rejection, which is reached e.g. by inverse feedback. Important is also a high efficiency (relationship of the delivered AC tension to the received DC current power). A P. is therefore often implemented as a push-pull amplifier. For the maximum power output the usually low-impedance consumer, e.g. the loudspeaker, must be adapted to the output resistance of the final stage, to which e.g. the transformer coupling serves. One calls a P. with low output resistance and without a transformer an ironless final stage.

Power-fail bridging

See power-fail bridging circuit

Power-fail bridging circuit; short-term

In machine monitoring systems short-term power failures could result in normally-energized relays dropping out and also produce power re-engagement transients in the electronics. To avoid this they have sufficient energy storage available to maintain the operating conditions of normally-energized relays in the case of brief power failures and to prevent disturbances by transients on re-engagement of the power.

Power gain

The ratio of output to input power with an electronic constructional element or an amplifier circuit.

$$\upsilon_p = \frac{P_a}{P_e}$$

This is the maximum available power amplification with adapted input and output (adaptation).

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P

Power-level, absolute

Logarithmic power relationship of a signal or noise at a point in a transmission channel, related to a given reference power; this relationship is generally expressed in decibels and displayed in shortened form, e.g. "dBm" for the reference performance of a $mWatt$.

Power-level, relative

Logarithmic power relationship (generally expressed in decibels) of a signal or noise at a point in a transmission channel, related to the performance at a selected point of reference, generally at the beginning of the channel.

Power-on indicator

An indicator to show when the electrical power is ON.

Power spectral density; power density spectrum

Distribution of the performance, referred to a bandwidth, of the partial oscillation of a signal or noise with a continuous spectrum and finite performance average value as a function of the frequency.

Note 1: The instantaneous power of a signal or a noise is according to agreement equal to the square of its instantaneous values. This square is proportional to a physical performance, if the characteristic variable is a field variable.

Note 2: The P. is the Fourier transform of the autocorrelation function of the signal or noise. The autocorrelation function of a deterministic signal exists, if the signal has a finite average power value. The autocorrelation function of a random signal or a noise exists, if it is represented by a stationary coincidental function of the second order.

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P

Power spectral function

The square of the absolute values of the spectral function existing for finite observation times divided by the observation time is called the P.:

$$\Phi(\omega) = \lim_{\Delta t \to \infty} \frac{1}{\Delta t} \left| \underline{x}(\omega) \right|^2$$

The limit violation introduced here means that, calculated in each case, the value for F does not change with further extensions in the context of the given margin of error.

Note: The P. is often also somewhat differently standardized and simply called the power spectrum. The expression ‘power’ refers to the squaring of the spectral function associated with the vibrating variable and its division by the observation time; however F must first be multiplied by the respective variable x of the corresponding coefficient in order to become a variable of the type of power. Also F does not represent the spectral function due to the time progress of the power. The designation “square spectral function“ would circumvent this difficulty, whereby the shortness, on account of the division by the observation time, remains unmentioned.

Power spectrum

Distribution of the squares of the amplitudes of the partial oscillations of a signal or noise as a function of the frequency.
The spectral density distribution through the Fourier transform of an autocorrelation function of a given variable with a stationary coincidental process, e.g. with noise.

Power supply

A power supply unit, that takes the energy exclusively from the public low-voltage system or e.g. electrical systems of ships or missiles. Most P. contain one or more supply transformers apart from electric rectifiers, filter devices and building groups for stabilization of one or more mains transformers for voltage conversion and for the galvanic separation of the outputs from the mains.

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P

Power switch

Main electrical power switch

Power-up error protection circuit

In machine monitoring systems, after a power failure the P blocks the signaling of alarms for a short time (typically 15 seconds) after power has returned to the monitoring system. Thus false alarms, which may be caused by the transient behaviour of the electronics after a power return, are prevented.

Preamplifier

An amplifier for potentials or currents with a low signal level. Because of the low power level, the signal-to-noise ratio is important whereas distortions can mostly be ignored. For example, preamplifiers for microphones usually offer only low amplification and small dimensions. They are supposed to pass the low power of a mostly high impedance source on to the connecting cable at low impedance; that is why there is very often an impedance converter at the output with a high impedance input and low impedance output.

Predictive maintenance; predictive service

Predictive maintenance is today still the best known and in the industrial field, probably the most widely used method. In order to protect oneself from unexpected breakdowns, maintenance is carried out at fixed intervals. In accordance with experience, one has to assume a somewhat higher probability of outage caused by errors in material or installation. The probability of outage will very quickly fall to a low level during the initial phase; it will remain constant or climb just slightly during the regular intervals between maintenance efforts. After correspondingly long operation, the outage probability will finally begin to rise steeply due to wear and tear and material fatigue.

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P

If predictive maintenance is to be applied effectively, the inspection interval has to be set during the period of low outage probability and at a safe distance from the moment of outage expected on the basis of statistics. From that, we learn the disadvantages of such a system:

- The inspection interval must, when seen from a technical and economic standpoint, be set too short in every case.

- As a result of the maintenance, the probability of an outage immediately afterwards first increases in many cases.

- It should be noted here that the model that serves as the basis for this, the so-called bathtub curve, is regarded as not being appropriate for all types of machines which is what causes the increased probability of outage at the beginning.

Predictive monitoring

Predictive monitoring means detailed analytical monitoring in order to insure early warning in the event of small changes in the condition of the machine. Predictive monitoring includes trend prediction and the thorough inspection of components in complex spectra and cepstra to identify changes. Process variables and other parameters like thermodynamic efficiency can be included in order to evaluate the overall condition comprehensively. Predictive monitoring is advisable for machines like transmissions and components such as bearings where early symptoms before damage occurs are hidden behind complex vibration characteristics and therefore require detailed analytical methods for early detection.

Preventive maintenance

Maintenance, preventive

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P

Printed-circuit board

Synthetic board with conducting strips and holes for mounting of constructional components. One differentiates between two-layered and multi-layered P. The multiplication of the layers makes for simple cross-over of conducting strips.

Probability

A statement about the frequency to be expected for a random event. The probability can be calculated (e.g. by means of combinatorics) or by measuring the relative frequency according to the law of large numbers. The determination will become more accurate, the more results that are observed.

Probability calculating

Probability theory, probability

Probability density

The probability $w(x)$ for the occurrence of event x in the range of $x \ldots x + dx$, with reference to the interval dx

$$w(x) = \frac{dW(x)}{dx}$$

where $w(x)$ is the probability.

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P

Probability distribution

A mathematical function defined within a model based on probability theory that can specify the probability of occurrence of every possible event.

Probability theory

A mathematical theory that proceeds from the axiomisation (axiom) of the concept of probability.

Processing

A totality of operations, arranged as a convenient and dedicated whole.

PROFIBUS
Abbr. for <**pro**cess **fi**eld **bus**>

A field bus system: PROFIBUS is laid out for the middle capacity range (coupling e.g. under SPS) and conditionally for the lower field range (sensor/actuator level). The definition of the specification for PROFIBUS is given in DIN 19245 standard. The distribution of PROFIBUS is definitively supported by the company Siemens, where it is offered under the product designation SINEC L2.

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P

Prognosis system

P. have the goal, on the basis of practical experiences or theoretical knowledge-based statements and under consideration of well-known or presumed boundary conditions, of providing information about the anticipated arrival of future events in a finite time interval. Such a statement is derived with the help of logical laws and represents a passive preview (without the influence of active arguments).
P. can avail itself of three procedural classes:

- Mathematical-statistic procedures, which derive prognostic statements from past data (e.g. Time series calculation)
- Procedure on the basis of causal connections (e.g. Involution and correlation calculation and
- Intuitive procedures (e.g. Brainstorming, Delphi method), which serve a forecast which is not so well formalised.

Depending upon the setting of tasks, combinations of these procedures are also meaningful. P. on the one hand are called programmed method packages, and on the other hand this term is applied also to man-machine systems, which are embedded frequently as data suppliers in more comprehensive information and planning systems.

Protection class

A defining concept for protective measures against excessively high contact voltages. Four protection classes can be distinguished.
With P. 0 only operating insulation is present; With P. 1 a connection for a protective cable is present in addition to the operating insulation; with P. II a protective insulation is present; with P. III operation takes place only with harmlessly low voltages.

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P

Protective cable

A cable that makes an electrical connection between plant parts which are to be secured and a protective ground. The P. must be particularly corrosion resistant.

Protective circuits

Machine monitoring can be only as reliable as the monitoring equipment itself.
Therefore particularly high demands are made on the monitoring equipment. The following special protective circuits are necessary in order to avoid false alarms and shutdowns as a result of external disturbances:

- Self- or system-monitoring circuit
- Limit value blocking circuit
- Power failure bridging circuit
- Power-up protection circuit

Protective grounding

A preventive measure against the existence of excessively high contact voltages. With the P. (contrary to protective grounding) a short-circuit current can flow over a protective cable and the ground back to the operationally grounded neutral point or outer conductor of a supply network and activate over-current protection mechanisms.

Protective measure

In electro-technology and electronics, a measure for the protection of humans and goods against harmful effects of electrical voltages and currents. In particular P. are directed against arising or continued existence of excessively high contact voltages. One differentiates between the following P.:

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P

- Measures for protection against contacting live parts. The protection is ensured by suitable covers or insulation of live parts.
- Measures for protection against the occurrence of inadmissible contact voltages. In addition all contactable, prominent parts with non-operating voltage are grounded i.e. are connected with the general mass potential. Thus at the same time an effective potential equalization is produced between the parts of the electrical systems, building construction parts and other metallic parts which do not belong to an operating electric circuit, i.e. are not directly connected with the actual function of the plant.

- Measures for protection of humans, animals and objects of value against inadmissibly high electrical field strengths.

- Measures against unintentional or inconsistent on- and/or off-switching processes, against endangering overstress and against overloading.

- Measures for protection of humans, animals and objects of value against the effects of atmospheric discharges (lightning protection).

By suitable dimensioning of the grounding system according to high frequency and lightning-protection technical criteria and by appropriate connection of all conductive, prominent parts with non-operating voltage to the grounding system, contact and pace voltages can be reduced to permissible values.

Protective monitoring

Protective monitoring means immediate recognition and reaction to changes in those conditions of the machine that could be dangerous to personnel and/or other important machines.

It calls for permanent monitoring systems that constantly compare easily measurable values such as broad-band oscillation values with fixed limits.

Exceeding those limits activates relays to warn or automatically shut down the machine. In order to insure maximum operational reliability, the choice of a shutdown logic whereby two or more values must exceed their limits is customary. See also Boundary values for operation.

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P

Pulse duty factor

Relationship of the average pulse duration to the reciprocal of the impulse rate for a series of impulses.

Pulse repetition rate; Pulse repetition frequency

The number of impulses of a pulse rate, divide by the duration of the pulse rate.

Note: In German the term “pulse frequency" is used only if the pulse intervals are equal.

Pulse vibration; Pulse

A periodic procedure, whose instantaneous value *x* takes different values within a period duration T only during one time period $\tau < T$ of zero, is called P. or pulse (See DIN 5483 [6], where there are also further designations).

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