



IEEE Standard for Electrical Power System Device Function Numbers, Acronyms, and Contact Designations

STANDARDS

IEEE Power and Energy Society

Developed by the
Power System Relaying and Control Committee

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IEEE Std C37.2-2008)



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Power System Relaying and Control Committee
of the
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Approved 21 September 2022

IEEE SA Standards Board

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Abstract: Abstract: The definition and application of function numbers and acronyms for devices and functions used in electrical substations and generating plants and in installations of power utilization and conversion apparatus are covered. The purpose and use of the numbers and acronyms are discussed, and 95 numbers and 22 acronyms are assigned. Function numbers or function acronyms now exist for arc flash detection, clock or timing source, dynamic disturbance recorder, digital fault recorder, disturbance monitoring equipment, environmental data, fault data concentrator, high impedance fault detector, human machine interface, historian, scheme logic, substation metering, phasor data concentrator, phasor measurement unit, power quality monitor, remedial action scheme, remote input/output device, remote terminal unit/data concentrator, sequence of events recorder, and trip circuit monitor. The use of prefixes and suffixes to provide a more specific definition of a function is defined. Device contact designations are also covered.

Keywords: Keywords: control, designations, device functions, device function acronyms, device function numbers, function numbers, IEC 61850, IEEE C37.2, relay, switchgear

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Introduction

This introduction is not part of IEEE Std C37.2-2022, IEEE Standard for Electrical Power System Device Function Numbers, Acronyms, and Contact Designations.

This standard applies to systems used for the monitoring, protection, switching, and controlling of electric apparatus in unattended and attended substations, generating stations, power utilization and conversion facilities, and equipment designed for automatic protection of power systems. This standard is a revision of IEEE Std C37.2-2008. Several acronyms were added for functions that the working group has seen used in industry:

- FDC for fault data concentrator
- FLOC for fault location
- RAS for remedial action scheme
- IID for instantaneous impulse detection

Acronyms were first added in 2008, rather than utilizing numbers above 99, as those numbers are already in use in some installations. See [3.2](#) for the acronyms.

Definitions of some device functions have been improved for present applications. An annex cross-referencing IEEE Std C37.2 device function numbers to IEC 61850 logical nodes was updated. An annex describing disturbance related acronyms was added based on Strang et al. [\[B14\]](#),⁶ NERC PRC-01801 [\[B13\]](#), and Bhatt et al. [\[B2\]](#).

Previous revisions were approved and published as standards dated 2008, 1996, 1991, 1987, 1979, 1962, 1956, 1945, and 1937. The original work on this subject was approved in 1928 and published by the American Institute of Electrical Engineers (AIEE) as AIEE No. 26.

⁶The numbers in brackets correspond to those of the bibliography in [Annex G](#).

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1. Overview

1.1 Scope

This standard applies to the definition and application of function numbers and acronyms for devices and functions used in electrical substations, ~~and~~ generating plants, and in installations of power utilization and conversion apparatus.

~~NOTE~~—Historically, device function numbers have typically represented individual or component devices. These numbers and acronyms may also be used to represent individual functions within multi-function devices or software programs, and that may contain both protection- and non-protection-oriented functions.¹

~~1 Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.~~

1.2 Purpose

1.3 Word usage

The word *shall* indicates mandatory requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted (*shall* equals *is required to*).^{7,8}

The word *should* indicates that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required (*should* equals *is recommended that*).

The word *may* is used to indicate a course of action permissible within the limits of the standard (*may* equals *is permitted to*).

The word *can* is used for statements of possibility and capability, whether material, physical, or causal (*can* equals *is able to*).

~~A device function number, with an appropriate prefix and appended suffix (or an acronym), is used to identify the function(s) of each device installed in electrical equipment. These numbers and acronyms are to be used in drawings, elementary and connection diagrams, instruction books, publications, and specifications. The device number or acronym may be physically placed on, or adjacent to, each device on the assembled equipment.~~

⁷The use of the word *must* is deprecated and cannot be used when stating mandatory requirements; *must* is used only to describe unavoidable situations.

⁸The use of *will* is deprecated and cannot be used when stating mandatory requirements; *will* is only used in statements of fact.

~~NOTE—Most of these device function designations have been developed as a result of usage over many years, with the first version of this standard having been published in 1928. They may define the actual function the device performs in equipment or they may refer to the electrical or other quantity to which the device is responsive. Hence, in some instances, there may be a choice of the function number or acronym to be used for a given application. The preferable choice should be the function number or acronym that is recognized to have the narrowest interpretation in all cases. The choice should specifically identify a device or function in the minds of all individuals concerned with the design and operation of the equipment.~~

2. Normative references

There are no normative references in this standard.

3. Standard device/ function number and function acronym descriptions

3.1 Standard device/function numbers

Each number, with its corresponding function name and a general description of the function, is listed in the subclauses that follow. Note that a function may be provided by means of a separate freestanding device (a device function), or as one of the functions in a multifunction device. The use of the word “*relay*” in the function names is intended to be generic, and does not necessarily imply a separate freestanding single function device. Additional functions are defined in 3.2. An index of device/function names consisting of the corresponding device/function numbers or acronyms and [clause](#) [page](#) numbers is provided in Annex E.

NOTE—When alternate names and descriptions are included under the function, only the name and description that applies to each specific case should be used. In general, only one name for each device, such as relay, contactor, circuit breaker, switch, or monitor, is included in each function designation. However, when the function is not inherently restricted to any specific type of device, and where the type of device itself is thus merely incidental, any one of the listed alternative names, as applicable, may be substituted. For example, if a device number 6—a contactor—is used to function as a circuit breaker, the function name should be specified as “starting contactor.”⁹

For every application of device/function numbers and acronyms, the originator should provide a brief definition for all device/function numbers used in that application, including all combinations of prefixes, function numbers, and suffixes. Typical definitions are illustrated in the figures in Annex A and Annex B. These definitions should be included in the drawing where the device/function number or acronym is used, or in a separate drawing or list to which the other drawings refer. All instruction books and other documents shall also include the device—~~device~~/function number and acronym definitions.

Numbers from 95 through 99 should be assigned only for those functions in specific cases where none of the assigned standard device function numbers or acronyms are applicable.

3.1.1 Device number 1—master element

A device, such as a control switch, etc., that serves, either directly or through such permissive devices as protective and time-delay relays, to place equipment in or out of operation.

NOTE—This number is normally used for a hand-operated device, although it may also be used for an electrical or mechanical device for which no other function number is suitable.

⁹Notes in text, tables, and figures of a standard are given for information only and do not contain requirements needed to implement this standard.

3.1.2 Device number 2—time-delay starting or closing relay

A device that functions to give a desired amount of time delay before or after any point of operation in a switching sequence or protective relay system, except as specifically provided by device functions 48, 62, 79, and 82.

3.1.3 Device number 3—checking or interlocking relay

A device that operates in response to the position of one or more other devices or predetermined conditions in a piece of equipment or circuit, to allow an operating sequence to proceed, or to stop, or to provide a check of the position of these devices or conditions for any purpose.

3.1.4 Device number 4—master contactor

A device, generally controlled by device function [1](#) or the equivalent and the required permissive and protective devices, that serves to make and break the necessary control circuits to place equipment into operation under the desired conditions and to take it out of operation under abnormal conditions.

3.1.5 Device number 5—stopping device

A control device used primarily to shut down equipment and hold it out of operation. [F](#)This device may be manually or electrically actuated, but it excludes the function of electrical lockout (see device function 86) on abnormal conditions [F](#).

3.1.6 Device number 6—starting circuit breaker

A device whose principal function is to connect a machine to its source of starting voltage.

3.1.7 Device number 7—rate-of-change relay

A device that operates when the rate-of-change of the measured quantity exceeds a threshold value, except as defined by device [61](#), [63](#), [71](#), [80](#), or [83](#).

3.1.8 Device number 8—control power disconnecting device

A device, such as a knife switch, circuit breaker, or pull-out fuse block, used for the purpose of connecting and disconnecting the source of control power to and from the control bus or equipment.

NOTE—Control power is considered to include auxiliary power that supplies such apparatus as small motors and heaters.

3.1.9 Device number 9—reversing device

A device that is used for the purpose of reversing the field of a machine or for performing any other reversing function.

3.1.10 Device number 10—unit sequence switch

A device that is used to change the sequence in which units may be placed in and out of service in multiple-unit equipment.

3.1.11 Device number 11—multifunction device

A device that performs three or more comparatively important functions that could only be designated by combining several device function numbers. All ~~of~~ the functions performed by device 11 shall be defined in the drawing legend, device function definition list, or relay-setting record. See Annex A for further discussion and examples.

NOTE 1—If only two relatively important functions are performed by the device, it is preferred that both function numbers be used, as described in 3.7.

NOTE 2—If one of the many functions performed by the device can be identified as most significant, it is acceptable to identify the device by that function number in place of device 11 while identifying all the other functions performed as in Annex A.

3.1.12 Device number 12—overspeed device

A device, usually direct-connected, that operates on machine overspeed.

3.1.13 Device number 13—synchronous-speed device

A device such as a centrifugal-speed switch, a slip-frequency relay, a voltage relay, an undercurrent relay, or any other type of device that operates at approximately the synchronous speed of a machine.

3.1.14 Device number 14—underspeed device

A device that functions when the speed of a machine falls below a predetermined value.

3.1.15 Device number 15—speed or frequency matching device

A device that functions to match and hold the speed or frequency of a machine or a system equal to, or approximately equal to, that of another machine, source, or system.

3.1.16 Device number 16—data communications device

A device that supports ~~the~~ serial and/or network communications, used for power system protection, automation, and control ~~that are a part of the substation control and protection system. This clause establishes the assignment of IEEE C37.2™ device number 16 for a data communications device handling protective relaying or other substation communication traffic.~~

The following suffix list identifies specific functions of a component identified as device 16. The first suffix letter shall be either S (serial devices for RS-232, 422, or 485 communications) or E (for Ethernet components). The second and subsequent suffix letters shall be one or more of the following letters to further define the device:

- C Security processing function ~~{~~(virtual private network [VPN] ~~}, encryption, etc.)~~}~~~~
- F Firewall or message filter function

- G Protocol gateway (including RedBoxes, or redundancy boxes)
- M Network managed function (~~f~~e.g., configured via Simple Network Management Protocol [~~f~~(SNMP)]~~f~~)
- R Router
- S Switch (examples: port switch on a dial up connection is 16SS, and an Ethernet switch is 16ES)
- T Telephone component (example: auto-answer modem)
- U Media converter (example: Ethernet fiber to copper media converter is 16EU)
- P Serial device server (example: an Ethernet to serial port server is 16EP)

See Annex B for a complete description of this function number and example usage of its unique suffix letters.

A device 16 may be a single function or a multifunction device.

3.1.17 Device number 17—shunting or discharge switch

A device that serves to open or close a shunting circuit around any piece of apparatus (except a resistor), such as a machine field, a machine armature, a capacitor, or a reactor.

NOTE—This excludes devices that perform such shunting operations as may be necessary in the process of starting a machine by devices 6 or 42 (or their equivalent), and ~~also~~ excludes device function 73 that serves for the switching of resistors.

3.1.18 Device number 18—accelerating or decelerating device

A device that is used to close or cause the closing of circuits that are used to increase or decrease the speed of a machine.

3.1.19 Device number 19 — starting-to-running transition contactor

A device that operates to initiate or cause the automatic transfer of a machine from the starting to the running power connection.

3.1.20 Device number 20 — electrically-operated valve

An electrically-operated or -controlled device used in a fluid, air, gas, or vacuum line.

NOTE—The function of the valve may be more completely indicated using ~~by the use of~~ suffixes as discussed in 3.3.

3.1.21 Device number 21 — distance (impedance) relay

A device that functions when the circuit admittance ~~or~~ impedance crosses a boundary defined by a characteristic in the admittance ~~or reactance increases~~ or impedance plane ~~decreases beyond a predetermined value~~.

3.1.22 Device number 22 — equalizer circuit breaker

A device that serves to control or make and break the equalizer or the current balancing connections for a machine field, or for regulating equipment, in a multi-unit installation.

3.1.23 Device number 23 — temperature control device

A device that functions to control the temperature of a machine or other apparatus, or of any medium, when its temperature falls below or rises above a predetermined value.

NOTE—An example is a thermostat that switches on a space heater in a switchgear assembly when the temperature falls to a predetermined value. This should be distinguished from a device that is used to provide automatic temperature regulation between close limits, which would be designated as device function 90T.

3.1.24 Device number 24 —volts per Hertz relay

A device that operates when the ratio of voltage to frequency is above a preset value or is below a different preset value. The relay may have any combination of instantaneous or time-delayed characteristics.

3.1.25 Device number 25 —synchronizing or synchronism-check relay

A synchronizing device that produces an output that permits or blocks ~~causes~~ closure of a circuit breaker between two circuits whose voltages are within prescribed limits of magnitude, phase angle, and frequency. It may or may not include voltage or speed control. A synchronism-check relay permits the paralleling of two circuits that are within prescribed (usually wider) limits of voltage magnitude, phase angle, and frequency.

3.1.26 Device number 26 —apparatus thermal device

A device that functions when the temperature of the protected apparatus (other than the load-carrying windings of machines and transformers as covered by device function number 49), or that of a liquid or other medium, exceeds a predetermined value; or when the temperature of the protected apparatus, or that of a liquid or other medium, exceeds a predetermined value or decreases below a predetermined value.

3.1.27 Device number 27 —undervoltage relay

A device that operates when its input voltage is less than a predetermined value.

3.1.28 Device number 28 —flame detector

A device that monitors the presence of the pilot or main flame in such apparatus as a gas turbine or a steam boiler.

3.1.29 Device number 29 — isolating contactor or switch

A device that is used expressly for disconnecting one circuit from another for the purposes of emergency operation, maintenance, or testing.

3.1.30 Device number 30 — annunciator relay

A nonautomatically reset device that gives [several](#) ~~a number of~~ separate visual indications upon the functioning of protective devices and that may also be arranged to perform a lockout function.

3.1.31 Device number 31 — separate excitation device

A device that connects a circuit, such as the shunt field of a synchronous converter, to a source of separate excitation during the starting sequence.

3.1.32 Device number 32 — directional power relay

A device that operates on a predetermined value of power flow in a given direction, such as reverse power flow resulting from the motoring of a generator upon loss of its prime mover.

3.1.33 Device number 33 — position switch

A device that makes or breaks contact when the main device or piece of apparatus that has no device function number reaches a given position.

3.1.34 Device number 34 — master sequence device

A device such as a motor-operated multi-contact switch (or the equivalent), or a programmable device, that establishes or determines the operating sequence of the major devices in equipment during starting and stopping, or during sequential switching operations.

3.1.35 Device number 35 —brush-operating or slip-ring short-circuiting device

A device for raising, lowering, or shifting the brushes of a machine; short-circuiting its slip rings; or engaging or disengaging the contacts of a mechanical rectifier.

3.1.36 Device number 36 —polarity or polarizing voltage device

A device that operates, or permits the operation of, another device on a predetermined polarity only, or that verifies the presence of a polarizing voltage in equipment.

3.1.37 Device number 37 —undercurrent or underpower relay

A device that functions when the current or power flow decreases below a predetermined value.

3.1.38 Device number 38 —bearing protective device

A device that activates upon excessive bearing temperature or on other abnormal mechanical conditions associated with bearings, such as undue wear, which may eventually result in excessive bearing temperature or failure.

3.1.39 Device number 39 —mechanical condition monitor

A device that activates upon the occurrence of an abnormal mechanical condition (except conditions associated with bearings as covered under device function 38), such as excessive vibration, eccentricity, expansion, shock, tilting, or seal failure.

3.1.40 Device number 40 —field (over/under excitation) relay

A device that activates upon a given or abnormally high or low value or failure of machine field current, or on an excessive value of the reactive component of armature current in an ac machine indicating abnormally high or low field excitation.

3.1.41 Device number 41 — field circuit breaker

A device that functions to apply or remove the field excitation of a machine.

3.1.42 Device number 42 — running circuit breaker

A device whose function is to connect a machine to its source of running or operating voltage. This function may also be used for a device, such as a contactor, that is used in series with a circuit breaker or other fault-protecting means, primarily for frequent opening and closing of the circuit.

3.1.43 Device number 43 — manual transfer or selector device

A manually-operated device that transfers control or potential circuits in order to modify the plan of operation of the associated equipment or of some of the associated devices.

3.1.44 Device number 44 — unit sequence starting relay

A device that functions to start the next available unit in multiple-unit equipment upon the failure or non-availability of the normally preceding unit.

3.1.45 Device number 45 — abnormal atmospheric condition monitor

A device that functions upon the occurrence of an abnormal atmospheric condition, such as damaging fumes, explosive mixtures, smoke, or fire.

3.1.46 Device number 46 — reverse-phase or phase-balance current relay

A device in a polyphase circuit that operates when the polyphase currents are of reverse-phase sequence, or when the polyphase currents are unbalanced, or when the negative phase-sequence current exceeds a preset value.

3.1.47 Device number 47—phase-sequence or phase-balance voltage relay

A device in a polyphase circuit that functions upon a predetermined value of polyphase voltage in the desired phase sequence when the polyphase voltages are unbalanced, or when the negative phase-sequence voltage exceeds a preset value.

3.1.48 Device number 48—incomplete sequence relay

A device that returns the equipment to the normal or off position and locks it out if the normal starting, operating, or stopping sequence is not properly completed within a predetermined time.

3.1.49 Device number 49—machine or transformer thermal relay

A device that functions when the temperature of a machine armature winding or other load-carrying winding or element of a machine or power transformer exceeds a predetermined value.

3.1.50 Device number 50—instantaneous overcurrent relay

A device that operates with no intentional time delay when the current exceeds a preset value. The suffix TD should be used (e.g., 50TD) to describe [an a-definite time-overcurrent function with intentional definite time delay](#). The suffix BF shall be used (e.g., ~~Use~~ 50BF) [to describe for](#) a currentmonitored breaker failure function.

3.1.51 Device number 51—ac inverse time overcurrent relay

A device that functions when the ac input current exceeds a predetermined value, and in which the input current and operating time are inversely related through a substantial portion of the performance range.

3.1.52 Device number 52—ac circuit breaker

A device that is used to close and interrupt an ac power circuit under normal conditions or to interrupt this circuit under fault or emergency conditions.

3.1.53 Device number 53 — field excitation relay

A device that forces the dc machine field excitation to build up during starting or that functions when the machine voltage has built up to a given value.

3.1.54 Device number 54 — turning gear engaging device

A device either electrically-operated, controlled, or monitored that functions to cause the turning gear to engage (or disengage) the machine shaft.

3.1.55 Device number 55 — power factor relay

A device that operates when the power factor in an ac circuit rises above or falls below a predetermined value.

3.1.56 Device number 56 — field application relay

A device that automatically controls the application of the field excitation to a synchronous ac motor at some predetermined point in the slip cycle.

3.1.57 Device number 57 — short-circuiting or grounding device

A device that functions to short-circuit or ground a circuit in response to automatic or manual means.

3.1.58 Device number 58 — rectification failure relay

A device that functions if a power rectifier (diode) fails to conduct or block properly.

3.1.59 Device number 59 — overvoltage relay

A device that operates when its input voltage exceeds a predetermined value.

3.1.60 Device number 60—voltage or current balance relay

A device that operates on a given difference in voltage, or current input or output, of two circuits.

3.1.61 Device number 61—density switch or sensor

A device that operates at a given density value or at a given rate of change of density.

3.1.62 Device number 62—time-delay stopping or opening relay

A device that imposes a time delay in conjunction with the device that initiates the shutdown, stopping, or opening operation in an automatic sequence. Example: 62BF = breaker failure function (with no current monitoring).

3.1.63 Device number 63—pressure switch

A device that operates at a given pressure value or at a given rate of change of pressure.

3.1.64 Device number 64—ground detector relay

A device that operates upon the insulation failure of a machine or other apparatus to ground.

NOTE—This function is not applied to a device connected in the secondary circuit of current transformers in a normally grounded power system where other overcurrent device numbers with the suffix G or N should be used; for example, 51N for an ac time overcurrent relay connected in the secondary neutral of the current transformers.

3.1.65 Device number 65—governor

A device consisting of an assembly of fluid, electrical, or mechanical control equipment used for regulating the flow of water, steam, or other media to the prime mover for such purposes as starting, holding speed or load, or stopping.

3.1.66 Device number 66 —notching or jogging device

A device that functions to allow only a specified number of operations of a given device or piece of equipment, or a specified number of successive operations within a given time of each other. It is also a device that functions to energize a circuit periodically or for fractions of specified time intervals, or that is used to permit intermittent acceleration or jogging of a machine at low speeds for mechanical positioning.

3.1.67 Device number 67 —ac directional overcurrent relay

A device that functions at a desired value of ac overcurrent flowing in a predetermined direction.

3.1.68 Device number 68 —blocking ~~or “out-of-step”~~ relay

A device that initiates a pilot signal for blocking of tripping on external faults in a transmission line or in other apparatus under predetermined conditions, or cooperates with other devices to block tripping or reclosing on an out-of-step condition or on power swings.

3.1.69 Device number 69 —permissive control device

A device with two positions that, in one position permits the closing of a circuit breaker, or the placing of a piece of equipment into operation, and in the other position, prevents the circuit breaker or the equipment from being operated.

3.1.70 Device number 70 —rheostat

A device used to vary the resistance in an electric circuit when the device is electrically operated or has other electrical accessories, such as auxiliary, position, or limit switches.

3.1.71 Device number 71 —liquid level switch

A device that operates at a given level value, or on a given rate of change of level of a liquid.