



GE Multilin technical note

Power system device function numbers

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This document provides a list of power system device function numbers used in GE Multilin publications and products.

This document consists of three parts:

1. Device function numbers.
2. Device function acronyms.
3. Device number suffixes.

The device number list has been updated to reflect changes to the IEEE PC37.2-2008 standard.

Device function numbers

Device function numbers 1 through 94 are described below. Devices 95 to 99 are used only for specific applications in individual installations where none of the assigned numbered functions from 1 to 94 are suitable.

Letters and numbers may be used as suffixes to device function numbers to provide a more specific definition of the function. Suffixes should, however, be used only when they accomplish a useful purpose.

1

Master element

A master element is the initiating device, such as a control switch, voltage relay, float switch, etc., which serves either directly or through such permissive devices as protective and time-delay relays to place an equipment in or out of operation.

2

Time delay starting or closing relay

A time delay starting or closing relay 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, and 79.

3

Checking or interlocking relay

A checking or interlocking relay operates in response to the position of a number of other devices (or to a number of predetermined conditions) in an equipment, to allow an operating sequence to proceed, or to stop, or to provide a check of the position of these devices or of these conditions for any purpose.

4

Master contactor

A master contactor is 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 an equipment into operation under the desired conditions and to take it out of operation under other or abnormal conditions.

5

Stopping device

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

6

Starting circuit breaker

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

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 63.

8

Control power disconnecting device

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

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

9

Reversing device

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

10

Unit sequence switch

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

11

Multifunction device

A multifunction 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. Refer to PC37.2 2008 for details on describing device 11 via the list box method.

12

Overspeed device

An overspeed device is usually a direct-connected speed switch which functions on machine over-speed.

13

Synchronous-speed device

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

14

Underspeed device

An underspeed device functions when the speed of a machine falls below a predetermined value.

15

Speed or frequency matching device

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

16

Communication networking device

A communication networking device supports the serial and/or network communications that are a part of the substation control and protection system.

It has a dedicated suffix structure as follows.

- First suffix letter S (serial device) or E (Ethernet device).
- Subsequent suffix letters:
 - C: Security processing function (VPN, encryption, etc.).
 - F: Firewall or message filter function.
 - M: Network managed function (for example, configured via SNMP).
 - R: Router.
 - S: Switch (for example, a port switch on a dial up connection is 16SS, and an Ethernet switch is 16ES).
 - T: Telephone component (for example, auto-answer modem).

The suffix letters can be combined. For example, 16ERFCM is a network-managed Ethernet router with firewall and VPN.

17

Shunting or discharge switch

A shunting or discharge switch serves to open or to 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. 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.

18

Accelerating or decelerating device

An accelerating or decelerating device is used to close or to cause the closing of circuits which are used to increase or decrease the speed of a machine.

19

Starting-to-running transition contactor

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

20

Electrically-operated valve

A valve used in a vacuum, air gas, oil, or similar line, when it is electrically operated or has electrical accessories such as auxiliary switches.

21

Distance relay

A distance relay functions when the circuit admittance, impedance, or reactance increases or decreases beyond predetermined limits.

22

Equalizer circuit breaker

An equalizer circuit breaker serves to control or to make and break the equalizer or the current-balancing connections for a machine field, or for regulating equipment, in a multiple-unit installation.

23

Temperature control device

A temperature control device raises or lowers the temperature of a machine or other apparatus, or of any medium, when its temperature falls below, or rises above, a predetermined value. An example is a thermostat that switches on a space heater in a switchgear assembly when the temperature falls to a desired value as distinguished from a device that is used to provide automatic temperature regulation between close limits and would be designated as device 90T.

24

Volts-per-hertz relay

A volts-per-hertz relay 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.

25

Synchronizing or synchronism-check device

A synchronizing or synchronism-check device operates when two AC circuits are within the desired limits of frequency, phase angle, or voltage, to permit or to cause the paralleling of these two circuits.

26

Apparatus thermal device

An apparatus thermal device functions when the temperature of the shunt field or the amortisseur winding of a machine, or that of a load limiting or load shifting resistor or of a liquid or other medium, exceeds a predetermined value; or if the temperature of the protected apparatus, such as a power rectifier, or of any medium decreases below a predetermined value.

27

Undervoltage relay

An undervoltage relay functions on a given value of undervoltage.

28

Flame detector

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

29

Isolating contactor

An isolating contactor is a device that is used expressly for disconnecting one circuit from another for the purposes of emergency operation, maintenance, or test.

30

Annunciator relay

An annunciator relay is a non-automatically reset device that gives a number of separate visual indications upon the functioning of protective devices, and which may also be arranged to perform a lockout function.

31

Separate excitation device

A separate excitation device connects a circuit, such as the shunt field of a synchronous converter, to a source of separate excitation during the starting sequence; or one that energizes the excitation and ignition circuits of a power rectifier.

32

Directional power relay

A directional power relay functions on a desired value of power flow in a given direction or upon reverse power resulting from an arc-back in the anode or cathode circuits of a power rectifier.

33

Position switch

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

34

Master sequence device

A master sequence device is a motor-operated multi-contact switch, or the equivalent, or a programming device, such as a computer, that establishes or determines the operating sequence of the major device in an equipment during starting and stopping or during other sequential switching operations.

35

Brush-operating or slip-ring short circuiting device

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

36

Polarity or polarizing voltage device

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

37

Undercurrent or underpower relay

An undercurrent or underpower relay functions when the current or power flow decreases below a predetermined value.

38

Bearing protective device

A bearing protective device functions on excessive bearing temperature, or on other abnormal mechanical conditions associated with the bearing, such as undue wear, which may eventually result in excessive bearing temperature or failure.

39

Mechanical condition monitor

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

40

Field relay

A field relay functions on a given or abnormally 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 low field excitation.

41

Field circuit breaker

A field circuit breaker functions to apply or remove the field excitation or machine.

42

Running circuit breaker

A running circuit breaker is a device whose principal 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 or closing of the circuit.

43

Manual transfer or selector device

A manual transfer or selector device is a manually operated device that transfers the control circuits in order to modify the plan of operation of the switching equipment or some of the devices.

44

Unit sequence starting relay

A unit sequence starting relay functions to start the next available unit in a multiple-unit equipment upon the failure or non-availability of the normally preceding unit.

45

Atmospheric condition monitor

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

46

Reverse-phase or phase balance current relay

A reverse-phase or phase balance current relay functions when the polyphase currents are of reverse-phase sequence, or when the polyphase currents are unbalanced or contain negative phase-sequence components above a given amount.

47

Phase-sequence or phase balance voltage relay

A phase-sequence voltage relay functions upon a predetermined value of polyphase voltage in the desired phase sequence.

48

Incomplete sequence relay

An incomplete sequence relay generally returns the equipment to normal, or off, position and locks it out if the normal starting, operating, or stopping sequence is not properly completed within a predetermined time. If the device is used for alarm purposes only, it should preferably be designated as 48A (alarm).

49

Machine or transformer thermal relay

A machine or transformer thermal relay functions when the temperature of a machine armature or other load-carrying winding or element of a machine or the temperature of a power rectifier or power transformer (including a power rectifier transformer) exceeds a predetermined value.

50

Instantaneous overcurrent relay

An instantaneous overcurrent relay functions instantaneously on an excessive value of current, thus indicating a fault in the apparatus or circuit being protected.

51

AC time overcurrent relay

An AC time overcurrent relay has a definite time characteristic or inverse time characteristic that functions when the current in the AC circuit exceeds a predetermined value.

52

AC circuit breaker

An AC circuit breaker is 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.

53

Exciter or DC generator relay

An exciter or DC generator relay forces the DC machine field excitation to build up during starting or which functions when the machine voltage has been built up to a given value.

54

Turning gear engaging device

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

55

Power factor relay

A power factor relay operates when the power factor in an AC circuit rises above or falls below a predetermined value.

56

Field application relay

A field application relay automatically controls the application of the field excitation to an AC motor at some predetermined point in the slip cycle.

57

Short-circuiting or grounding device

A short-circuiting or grounding device is a primary circuit-switching device that functions to short circuit or to ground a circuit in response to automatic or manual means.

58

Rectification failure relay

A rectification failure relay functions if one or more anodes of a power rectifier fail to fire, or to detect an arc-back or a failure of a diode to conduct or block properly.

59

Overvoltage relay

An overvoltage relay functions on a given value of overvoltage.

60

Voltage or current balance relay

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

61

Density switch or sensor

A density switch or sensor operates at a given density value or at a given rate of change of density.

62

Time-delay stopping or opening relay

A time-delay stopping or opening relay is a time-delay relay that serves in conjunction with the device that initiates the shutdown, stopping, or opening operation in an automatic sequence or protective relay system.

63

Pressure switch detector

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

64

Ground protective relay

A ground protective relay functions on failure of the insulation of a machine, transformer, or of other apparatus to ground, or on flashover of a DC machine to ground.

This function is assigned only to a relay that detects the flow of current from the frame of a machine or enclosing case or structure of a piece of apparatus to ground, or detects a ground on a normally ungrounded winding or circuit. It is not applied to a device connected in the secondary circuit of a current transformer, or in the secondary neutral of current transformers, connected in the power circuit of a normally grounded system.

65

Governor

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

66

Notching or jogging device

A notching or jogging device functions to allow only a specified number of operations of a given device, or 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.

67

AC directional overcurrent relay

An AC directional overcurrent relay functions on a desired value of AC overcurrent flowing in a predetermined direction.

68

Blocking relay

A blocking relay 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 to block reclosing on an out-of-step condition or on power savings.

69

Permissive control device

A permissive control device is generally a two-position, manually operated switch that, in one position, permits the closing of a circuit breaker, or the placing of an equipment into operation, and in the other position prevents the circuit breaker or the equipment from being operated.

70

Rheostat

A rheostat is a variable resistance device used in an electric circuit, which is electrically operated or has other electrical accessories, such as auxiliary, position, or limit switches.

71

Liquid switch

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

72

DC circuit breaker

A DC circuit breaker is used to close and interrupt a DC power circuit under normal conditions or to interrupt this circuit under fault or emergency conditions.

73

Load-resistor contactor

A load-resistor contactor is used to shunt or insert a step of load limiting, shifting, or indicating resistance in a power circuit, or to switch a space heater in circuit, or to switch a light or regenerative load resistor of a power rectifier or other machine in and out of circuit.

74

Alarm relay

An alarm relay is a relay other than an annunciator, as covered under device function 30, which is used to operate, or to operate in connection with, a visual or audible alarm.

75

Position changing mechanism

A position changing mechanism is used for moving a main device from one position to another in an equipment; as for example, shifting a removable circuit breaker unit to and from the connected, disconnected, and test positions.

76

DC overcurrent relay

A DC overcurrent relay functions when the current in a DC circuit exceeds a given value.

77

Telemetry device

A transmitting device used to generate and transmit to a remote location an electrical signal representing a measured quantity; or a receiver used to receive the electrical signal from a remote transmitter and convert the signal to represent the original measured quantity.

78

Phase angle measuring or out-of-step protective relay

A phase angle measuring or out-of-step protective relay functions at a predetermined phase angle between two voltages or between two currents or between voltage and current.

79

AC reclosing relay

An AC reclosing relay controls the automatic reclosing and locking out of an AC circuit interrupter.

80

Liquid or gas flow relay

A liquid or gas flow relay operates on given values of liquid or gas flow or on given rates of change of these values.

81

Frequency relay

A frequency relay functions on a predetermined value of frequency (either under or over or on normal system frequency) or rate of change of frequency.

82

DC reclosing relay

A DC reclosing relay controls the automatic closing and reclosing of a DC circuit interrupter, generally in response to load circuit conditions.

83

Automatic selective control or transfer relay

An automatic selective control or transfer relay operates to select automatically between certain sources or conditions in an equipment, or performs a transfer operation automatically.

84

Operating mechanism

An operating mechanism is the complete electrical mechanism or servomechanism, including the operating motor, solenoids, position switches, etc., for a tap changer, induction regulator, or any similar piece of apparatus which otherwise has no device function number.

85

Carrier or pilot-wire receiver relay

A carrier or pilot-wire receiver relay is operated or restrained by a signal used in connection with carrier-current or DC pilot-wire fault directional relaying.

86

Locking-out relay

A locking-out relay is an electrically operated hand, or electrically, reset relay or device that functions to shut down or hold an equipment out of service, or both, upon the occurrence of abnormal conditions.

87

Differential protective relay

A differential protective relay functions on a percentage of phase angle or other quantitative difference of two currents or some other electrical quantities.

88

Auxiliary motor or motor generator

An auxiliary motor or motor generator is one used for operating auxiliary equipment, such as pumps, blowers, exciters, or rotating magnetic amplifiers.

89

Line switch

A line switch is used as a disconnecting, load interrupter, or isolating switch in an AC or DC power circuit, when this device is electrically operated or has electrical accessories, such as an auxiliary switch or magnetic lock.

90

Regulating device

A regulating device functions to regulate a quantity, or quantities, such as voltage, current, power, speed, frequency, temperature, and load, at a certain value or between certain (generally close) limits for machines, tie lines, or other apparatus.

91

Voltage directional relay

A voltage directional relay operates when the voltage across an open circuit breaker or contactor exceeds a given value in a given direction.

92

Voltage and power directional relay

A voltage and power directional relay permits or causes the connection of two circuits when the voltage difference between them exceeds a given value in a predetermined direction and causes these two circuits to be disconnected from each other when the power flowing between them exceeds a given value in the opposite direction.

93

Field-changing contactor

A field-changing contactor functions to increase or decrease, in one step, the value of field excitation on a machine.

94

Tripping or trip-free relay

A tripping or trip-free relay functions to trip a circuit breaker, contactor, or equipment, or to permit immediate tripping by other devices; or to prevent immediate reclosure of a circuit interrupter if it should open automatically even though its closing circuit is maintained closed.

Device acronyms

Additional device acronyms are described below for functions not defined by function numbers.

AFD

Arc flash detector

An arc flash detector is a device or function that detects an unintentional electrical arc in air.

CLK

Clock or timing source

A clock or timing source is a device or function that receives an accurate timing signal input and distributes an accurate timing signal output to other devices.

An example of an accurate timing signal input is a signal received from a GPS (Global Positioning System) satellite clock. An example of an accurate timing output signal is IRIG-B (Inter-Range Instrumentation Group Type B).

DDR

Dynamic disturbance recorder

A dynamic disturbance recorder is a device or function that records incidents that portray power system behavior during low frequency (0.1 to 3 Hz) oscillations, and abnormal frequency or voltage excursions.

DFR

Digital fault recorder

A digital fault recorder is a device or function that records, for analysis purposes, events on the power system. It records voltage and/or current waveforms replicating the primary power system voltages and currents when triggered by a sudden change in the waveforms or by an external event.

ENV

Environmental data

Environmental data is a device or function that measures and stores variables relating to the environment, such as weather data, ice buildup conditions, geomagnetic disturbances, earthquakes, and other similar phenomena.

HIZ

High impedance fault detector

A high impedance fault detector is a device or function that detects high impedance faults on grounded or ungrounded systems.

HMI

Human machine interface

A human machine interface is a device or function that displays information to and allows control of a system by an operator. An HMI may also be local to a specific device for operator interaction specific to that device.

HST

Historian

A historian is a device or function that continuously gathers states and values from a data concentrator or directly from protection and control IEDs (Intelligent Electronic Devices), and may also act as a recorder of data from which trends may be determined.

LGC

Scheme logic

Scheme logic is a device or function that provides the programmed logic for a multi-device control or protective relay scheme, such as a Remedial Action Scheme (RAS) or an interlocking scheme



Substation metering

Substation metering is a device or function that is connected to CTs and VTs, and may calculate and store one or several of the following quantities - watts, VARs, amps, volts, power factor, demand, energy.



Phasor data concentrator

A phasor data concentrator is a device or function that collects phasor and discrete event data from PMUs (and from other PDCs) and transmits the data to other destinations. PDCs may buffer data for a short time period, but do not store the data.



Phasor measurement unit

A phasor measurement unit is a device or function that samples voltage and current with very accurate time stamps and calculates phase angles vs. a GPS time reference (synchrophasors).



Power quality monitor

A power quality monitor is a device or function that monitors electrical parameters used in power quality measurements. Parameters include (but are not limited to) RMS variations, frequency variations, unbalance, transients, harmonics, and inter-harmonics. The storage of historical values of these measurements may also be performed.



Remote input/output device

A remote input/output device is a device/function interfacing between the power system process (analog or digital) and the substation automation system that serves as a substation data repository of control and protection system information, but without connection to a SCADA master station.



Resistance temperature detector

A resistance temperature detector is a protection and control device whose resistivity is a known function of temperature.



Remote terminal unit / data concentrator

A remote terminal unit / data concentrator is a device or function that serves as the primary interface (the data concentrator function) between a protection and control system and a SCADA system to provide operational data visibility to, and perform command operations from the SCADA control center.



Sequence of events recorder

A sequence of events recorder is a device or function that records events (changes of state of equipment or functions) with a time reference (commonly from a GPS or IRIG-B receiver).



Trip circuit monitor

A trip circuit monitor is a device or function that monitors an associated circuit breaker's trip circuit for continuity and for the presence of tripping voltage, and sets an externally readable alarm when continuity or tripping voltage is lost (a surrogate for the traditional red light on relay and control panels).

Device suffixes

Device suffixes for the device numbers and acronyms are shown below. These suffixes should only be used to accomplish a useful purpose. For example, when all devices in a system are associated with only one type of apparatus, it is common practice not to include that apparatus suffix to retain simplicity.

- **_0**: zero-sequence
- **_1**: positive-sequence
- **_2**: Negative-sequence
- **A**: alarm, auxiliary power
- **AC**: alternating current
- **AN**: anode
- **B**: bus, battery, or blower
- **BF**: breaker failure
- **BK**: brake
- **BL**: block (valve)
- **BP**: bypass
- **BT**: bus tie
- **BU**: backup
- **C**: capacitor, condenser, compensator, carrier current, case, or compressor
- **CA**: cathode
- **CH**: check (valve)
- **D**: discharge (valve)
- **DC**: direct current
- **DCB**: directional comparison blocking
- **DCUB**: directional comparison unblocking
- **DD**: disturbance detector
- **DUTT**: direct underreaching transfer trip
- **E**: exciter
- **F**: feeder, field, filament, filter, or fan
- **G**: ground or generator
- **GC**: ground check
- **H**: heater or housing
- **L**: line or logic
- **M**: motor or metering
- **MOC**: mechanism operated contact
- **N**: neutral or network
- **O**: over
- **P**: phase or pump
- **PC**: phase comparison
- **POTT**: permissive overreaching transfer trip
- **PUTT**: permissive underreaching transfer trip
- **R**: reactor, rectifier, or room
- **S**: synchronizing, secondary, strainer, sump, or suction (valve)
- **SOTF**: switch on to fault

- **T**: transformer or thyatron
- **TD**: time delay
- **TDC**: time-delay closing contact
- **TDDO**: time delayed relay coil drop-out
- **TDO**: time-delay opening contact
- **TDPU**: time delayed relay coil pickup
- **THD**: total harmonic distortion
- **TH**: transformer (high-voltage side)
- **TL**: transformer (low-voltage side)
- **TM**: telemeter
- **TT**: transformer (tertiary-voltage side)
- **U**: under or unit
- **X**: auxiliary
- **Z**: impedance