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definition, specification, and analysis of
systems used for supervisory control,
data acquisition, and automatic control

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An American National Standard

**IEEE Standard Definition, Specification, and
Analysis of Systems Used for
Supervisory Control, Data Acquisition, and
Automatic Control**

Sponsor

**Substations Committee of the
IEEE Power Engineering Society**

Secretariat

**Institute of Electrical and Electronics Engineers
National Electrical Manufacturers Association**

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Foreword

(This Foreword is not a part of ANSI/IEEE C37.1 1987, IEEE Standard Definition, Specification, and Analysis of Systems Used for Supervisory Control, Data Acquisition, and Automatic Control.)

This standard applies to systems used for monitoring, switching, and controlling electric apparatus in unattended or attended substations, generating stations, and power utilization and conversion facilities. It does not apply to equipment designed for the automatic protection of power system apparatus or for switching of communication circuits. The requirements of this standard are in addition to those contained in standards relating to the individual devices.

This significantly revised standard was originally a section of ANSI C37.2-1970 which also contained device function numbers. ANSI C37.2-1970 was revised into two standards: ANSI/IEEE C37.1-1979, Standard Definition, Specification, and Analysis of Manual, Automatic, and Supervisory Station Control and Data Acquisition, and ANSI/IEEE C37.2-1979, Electrical Power System Device Function Numbers. Previous editions were approved by the Standards Institute in 1962, 1956, 1945, and 1937. The original work on this subject was done by the American Institute of Electrical Engineers (now the Institute of Electrical and Electronics Engineers) and published in 1928 as AIEE No 26.

The standard applies to a rapidly changing technology. It is anticipated therefore that frequent revision may be desirable. Electrical Power System Device Function Numbers on the other hand have changed very little over the years. This revision, prepared by the Automatic and Supervisory System Subcommittee of the IEEE Substation Committee, was an attempt to bring the standard up to date and further broaden its applicability with respect to control, supervisory, and telemetering, for greater use in many industries.

IEEE Tutorial Course Text 81 EHO 188-3-PWR¹ is recommended for those not familiar with Supervisory Control Systems.

The Standards Committee on Power Switchgear, C37, which reviewed and approved this standard, had the following personnel at the time of approval:

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¹ This publication is available from the Institute of Electrical and Electronics Engineers Service Center, 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855-1331.

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An American National Standard

IEEE Standard Definition, Specification, and Analysis of Systems Used for Supervisory Control, Data Acquisition, and Automatic Control

1. Scope

This standard applies to, and provides the basis for, the definition, specification, performance analysis, and application of systems used for supervisory control, data acquisition or automatic control, or both,² in attended or unattended electric substations, including those associated with generating stations, and power utilization and conversion facilities.

This standard does not apply to electromechanical or static, protective-relaying equipment. (See ANSI/IEEE C37.90-1978 (R 1982) [11],³ ANSI/IEEE C37.90.1-1974 (R 1979) [12], ANSI/IEEE C37.91-1985 [13], ANSI/IEEE C37.93-1976 [14], ANSI/IEEE C37.95-1973, (R 1980) [15], ANSI/IEEE C37.96-1976 (R 1981) [16], and ANSI/IEEE C37.97-1979 (R 1984) [17].

2. References

When the American National Standards referred to in this standard are superseded by a revision approved by the American National Standards Institute, the revision shall apply.

[1] ANSI X3 TR-1-1983, American National Standard Dictionary for Information Processing.⁴

²Systems covered by this standard typically use computers in the master station and at times in the remote stations. Such computers provide facilities for incorporating automatic control functions either by the supplier or by the user after the system is installed.

³The numbers in brackets correspond to those of the references listed in Section 2 of this standard.

⁴ANSI publications are available from the Sales Department, American National Standards Institute, 1430 Broadway, New York, NY 10018.

[2] ANSI X3.1-1976, American National Standard Synchronous Signaling Rates for Data Transmission.

[3] ANSI X3.4-1977, American National Standard Code for Information Interchange.

[4] ANSI X3.5-1970, American National Standard Flowchart Symbols and Their Usage in Information Processing.

[5] ANSI Y14.15-1966 (R 1973), American National Standard Electrical and Electronics Diagrams (Including Supplements ANSI Y14-15a-1970 and ANSI Y14.15b-1973).

[6] ANSI Z24.21-1957 (R 1971), American National Standard Method for Measurement Specifying the Characteristics of Pickups for Shock and Vibration.

[7] ANSI/EIA RS-310-C-1977 (R 1983), Racks, Panels, and Associated Equipment.

[8] ANSI/EIA RS-334-1968, Signal Quality at Interface Between Data Processing Terminal Equipment and Synchronous Data Communication Equipment for Serial Data Transmission.

[9] ANSI/EIA RS-404-1978, Start-Stop Signal Quality Between Data Terminal Equipment and Non-Synchronous Data Communication Equipment.

[10] ANSI/IEEE C37.2-1979, IEEE Standard Electrical Power System Device Function Numbers.

[11] ANSI/IEEE C37.90-1978 (R 1982), IEEE Standard Relays and Relay Systems Associated with Electric Power Apparatus.

[12] ANSI/IEEE C37.90.1-1974 (R 1979), IEEE Guide for Surge Withstand Capability (SWC) Tests.

- [13] ANSI/IEEE C37.91-1985, IEEE Guide for Protective Relay Applications to Power Transformers.
- [14] ANSI/IEEE C37.93-1976, IEEE Guide for Protective Relay Applications of Audio Tones over Telephone Channels.
- [15] ANSI/IEEE C37.95-1973 (R 1980), IEEE Guide for Protective Relaying of Utility-Consumer Interconnections.
- [16] ANSI/IEEE C37.96-1976 (R 1981), IEEE Guide for AC Motor Protection.
- [17] ANSI/IEEE C37.97-1979 (R 1984), IEEE Guide for Protective Relay Applications to Power System Buses.
- [18] ANSI/IEEE C37.100-1981, IEEE Standard Definitions for Power Switchgear.
- [19] ANSI/IEEE Std 91-1984, IEEE Standard Graphic Symbols for Logic Functions.
- [20] ANSI/IEEE Std 100-1984, IEEE Standard Dictionary for Electrical and Electronics Terms.
- [21] ANSI/IEEE Std 200-1975, IEEE Standard Reference Designations for Electronics Parts and Equipment.
- [22] ANSI/IEEE Std 280-1985, IEEE Standard Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.
- [23] ANSI/IEEE Std 315-1975, IEEE Standard Graphic Symbols for Electrical and Electronics Diagrams.
- [24] ANSI/IEEE Std 344-1975 (R 1980), IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations.
- [25] ANSI/IEEE Std 422-1986, IEEE Guide for the Design and Installation of Cable Systems in Power Generating Stations.
- [26] ANSI/NEMA ICS 6-1978, Enclosures for Industrial Control and Systems.
- [27] EIA EMC B1-1968, Introduction to EMC Designers Guide.⁵
- [28] EIA EMC B2-1968, EMC Specifications, Standards and Bibliography.
- [29] EIA EMC B3-1968, Testing and Measurement Techniques for Electronic Equipment.
- [30] EIA EMC B4-1965, Designers Guide on Electromagnetic System Design of Electric Equipment.
- [31] EIA EMC B5-1964, Bonding of Electronic Equipment.
- [32] EIA EMC B6-1967, Grounding of Electronic Equipment.
- [33] EIA EMC B7-1966, Enclosures of Electronic Equipment.
- [34] EIA EMC B8-1965, Cabling of Electronic Equipment.
- [35] EIA EMC B9-1966, Filtering of Electronic Equipment.
- [36] EIA EMC B10-1967, Electromagnetic Susceptibility.
- [37] EIA IE B12-1977, Application Notes on Interconnection Between Interface Circuits Using EIA RS-449-1980 and EIA RS-232C-1969 (R 1981).
- [38] EIA RS-232-C-1969 (R 1981), Interface Between Data Terminal Equipment Employing Serial Binary Data Interchange.
- [39] EIA RS-363-1969, Standard for Specifying Signal Quality for Transmitting and Receiving Data Processing Terminal Equipments Using Serial Data Transmission at the Interface with Non-Synchronous Data Communication Equipment.
- [40] EIA RS-422-A-1978, Electrical Characteristics of Balanced Voltage Digital Interface Circuits.
- [41] EIA RS-423-A-1978, Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits.
- [42] EIA RS-449-1977, General Purpose 37-Position and 9-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.

⁵EIA publications are available from Electronic Industries Association, 2001 Eye Street, NW, Washington, DC 20006.

[43] IEC TC 65-1976, Safety Requirements for Mains Operated and Related Apparatus for Household and Similar General Use.⁶

[44] IEEE Std 525-1978, IEEE Guide for Selection and Installation of Control and Low-Voltage Cable Systems in Substations.⁷

[45] MIL-HDBK 217D-1982, Reliability Prediction of Electronic Equipment.⁸

[46] MIL-STD 471A-1973, Maintainability Demonstration.

[47] MIL-STD 1472C-1981, Human Engineering Design Criteria for Military System Equipment and Facilities.

[48] GAUSHELL, D. J., FRISBIE, W. L., and KUCHEFSKI, M. H. *Analysis of Analog Data Dynamics for Supervisory Control and Data Acquisition System*, IEEE Paper 82 SM 304-4.

[49] LLOYD AND LIPOW. *Reliability, Management, Methods, and Mathematics*. Englewood Cliffs, NJ: Prentice-Hall, 1962.

3. Definitions

The definitions of terms contained in this standard, or in other American National Standards referred to in this standard, are not intended to embrace all legitimate meanings of the terms. They are applicable only to the subject treated in this American National Standard.

Supervisory control and data acquisition systems may use computers. For standard definition of computer terms refer to ANSI X3 TR-1-1983 [1].

⁶IEC publications are available from American National Standards Institute, 1430 Broadway, New York, NY 10018.

⁷IEEE publications are available from the Institute of Electrical and Electronics Engineers Service Center, 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855-1331.

⁸MIL publications are available from the Director, US Navy Publications and Printing Service, Eastern Division, 700 Robbins Avenue, Philadelphia, PA 19111.

Definitions in this standard may also be listed in ANSI/IEEE C37.100-1981 [18].

Definitions in ANSI/IEEE Std 100-1984 [20] are used whenever possible; however, sometimes such definitions do not include the meaning associated with the equipment governed by this standard.

alarm condition. A predefined change in the condition of equipment or the failure of equipment to respond correctly. Indication may be audible or visual, or both.

analog device. A device that operates with variables represented by continuously measured quantities such as voltages, resistances, rotations, and pressures.

analog-to-digital (a/d) conversion. Production of a digital output corresponding to the value of an analog input quantity.

analog quantity. A continuous variable that is typically digitized and represented as a scalar value.

automatic. Pertaining to a process or device that, under specified conditions, functions without intervention by a human operator.

automatic circuit recloser. A self-controlled device for automatically interrupting and reclosing an alternating-current circuit, with a predetermined sequence of opening and reclosing followed by resetting, hold-closed, or lockout operation.

automatic control. *See:* control, (1) automatic.

automatic line sectionalizer. A self-contained circuit-opening device that automatically opens the main electrical circuit through it after sensing and responding to a predetermined number of successive main current impulses equal to or greater than a predetermined magnitude. It opens while the main electrical circuit is deenergized. It may also have provision to be manually operated to interrupt loads.

automatic load throwover equipment (transfer or switchover). An equipment that automatically transfers a load to another source of power when the original source to which it has been connected fails, and that automatically restores the load to the original source under desired conditions.

NOTE: The restoration of the load to the preferred source from the emergency source upon re-energization of the preferred source after an outage may be of the continuous circuit restoration type or interrupted circuit restoration type.

(1) *Equipment of the Nonpreferential Type.* Equipment that automatically restores the load to the original source only when the other source, to which it has been connected, fails.

(2) *Fixed Preferential Type.* Equipment in which the original source always serves as the preferred source and other source as the emergency source. The automatic transfer equipment will restore the load to the preferred source upon its re-energization.

(3) *Selective Preferential Type.* Equipment in which either source may serve as the preferred or the emergency source of preselection as desired, and which will restore the load to the preferred source upon its re-energization.

(4) *Semiautomatic Load Throwover Equipment.* An equipment that automatically transfers a load to another (emergency) source of power when the original (preferred) source to which it has been connected fails, but requires manual restoration of the load to the original source.

automatic reclosing equipment. Equipment which initiates automatic closing of a switching device under predetermined conditions without operator intervention.

automatic opening (tripping). The opening of a switching device under predetermined conditions without operator intervention.

availability. The ratio of uptime and uptime plus downtime. (See: 7.3, Availability.)

backup. Provision for an alternate means of operation if the primary system is not available.

backup, degraded. A backup capability that does not perform all of the functions of the primary system.

baud. The term *baud* defines the signaling speed, that is, keying rate of the modem.

The signaling speed in baud is equal to the reciprocal of the shortest element duration in seconds to be transmitted.

For example, in the following table, the signaling speed is calculated from the signaling element duration. In addition, the distinction between bit rate and baud for two different types of modems is illustrated.

Signaling Technique		
	Modem One	Modem Two
Signaling element duration	0.833 ms	
Signaling speed	1200 Bd	
Information transmitted per element duration	1 bit	2 bits
Bit rate	1200 bits per second	2400 bits per second

The bit rate and baud are not synonymous and shall not be interchanged in usage. Preferred usage is bit rate, with baud used only when the details of a communication modem or channel are specified.

bit. (1) **least significant.** In an n bit binary word its contribution is (0 or 1) toward the maximum word value of $(2^n - 1)$.

(2) **most significant.** In an n bit binary word its contribution is (0 or 1 times $2^{(n-1)}$) toward the maximum word value of $(2^n - 1)$.

bit rate. The number of bits transferred in a given time interval. Bits per second is a measure of the rate at which bits are transmitted.

buffer (buffer storage).

(1) A device in which data are stored temporarily, in the course of transmission from one point to another; used to compensate for a difference in the flow of data, or time of occurrence of events, when transmitting data from one device to another.

(2) An isolating circuit used to prevent a driven circuit from influencing a driving circuit.

burn in. A period, usually prior to on-line operation, during which equipment is continuously energized for the purpose of forcing infant mortality failures.

calibration. Adjustment of a device so that the output is within a specific range for particular values of the input.

cathode ray tube (crt). A display device in which controlled electron beams are used to

present alphanumeric or graphical data on an electroluminescent screen.

channel load factor. *See:* 5.4.4

channel, scada. The communication path between master and remote stations. (*See:* Section 4, Fig 1.)

checkback message. The response from the receiving end to the initiating end of a coded signal or message.

(1) *Partial.* Message from the initiating end is mirrored by the receiving end back to the initiating end to verify error-free transmission of the message.

(2) *Complete.* Message from the initiating end is interpreted by the receiving end. A new message is sent to the initiating end to verify error-free transmission and proper interpretation of the message. (*See:* 7.4, System Security.)

common equipment. That complement of either the master or remote station supervisory equipment that interfaces with the interconnecting channel and is otherwise basic to the operation of the supervisory system, but is exclusive of those elements that are peculiar to and required for the particular applications and uses of the equipment.

console. That component of the system which provides facilities for control and observation of the system. Examples include operator's console, maintenance console. (*See:* panel, control)

contention. An operational condition on a data communication channel in which no station is designated a master station. In contention, each station on the channel shall monitor the signals on the channel and wait for a quiescent condition before initiating a bid for circuit control.

control. The execution of a system change by manual means, remote means, automatic means, or partially automatic means.

(1) *automatic.* An arrangement of electrical controls that provides for switching or controlling, or both, of equipment in an automatic sequence and under predetermined conditions.

(2) *closed loop.* A type of automatic control in which control actions are based on signals fed back from the controlled equipment or sys-

tem. For example, remote stations can manage local voltage conditions by control of load tap changers and volt amperes reactive (VAR) control compensation equipment.

(3) *open loop.* A form of control without feedback.

(4) *manual.* Control in which the system or main device, whether direct or power-aided in operation, is directly controlled by an attendant.

(5) *partial automatic.* Control which is a combination of manual and automatic control. For example, to cause a voltage reduction the local automatic load tap changing closed-loop control may be biased by way of a supervisory control command.

(6) *remote.* Control of a device from a distant point.

data. Any representation of a digital or analog quantity to which meaning has been assigned.

data acquisition. The collection of data.

data acquisition system. A centralized system which receives data from one or more remote points. A telemetering system. Data may be transported by either analog or digital telemetering. (*See:* telemetering.)

data rate. The rate at which a data path (for example, channel) carries data, measured in bits per second (b/s).

data logging. The recording of selected data on suitable media.

dead band. The range through which an input can be varied without initiating response.

device (electrical equipment). An operating element such as a relay, contactor, circuit breaker, switch, valve, or governor used to perform a given function in the operation of electrical equipment.

digital quantity. A variable represented by a number of discrete units.

digital-to-analog (d/a) conversion. Production of an analog signal whose magnitude is proportional to the value of a digital input.

disable. A command or condition which prohibits some specific event from proceeding.

display, graphic. A hardware device (crt, plasma panel, arrays of lamps, or light emitting diodes) used to present pictorial information.

distributed processing. A design in which all data is not processed in one processor. Multiple processors in the master station or in the remote stations, or both, share the functions.

downtime. The time during which a device or system is not capable of meeting performance requirements.

echo. A communication technique assuring that a word received at the termination point in a system is the same as the word originally transmitted. The received word is retransmitted to the sending device and matched to ensure that the original message was received properly.

electromagnetic compatibility (emc). A measure of equipment tolerance to external electromagnetic fields.

electromagnetic interference (emi). A measure of electromagnetic radiation from equipment.

enable. A command or condition which permits some specific event to proceed.

engineering units. A unit of measure for use by operating/maintenance personnel usually provided by scaling the input quantity for display (meter, stripchart, or crt).

expandability. The capability of a system to be increased in capacity or provided with additional functions. (See: 7.5.)

event. A discrete change of state (status) of a system or device.

failure. An event that may limit the capability of an equipment or system to perform its function(s).

(1) *Critical.* Causes a false or undesired operation of apparatus under control.

(2) *Major.* Loss of control or apparatus which does not involve a false operation.

(3) *Minor.* Loss of data relative to power flow or equipment status.

failure distribution. The manner in which failures occur as a function of time; generally expressed in the form of a curve with the abscissa being time.

failures. (1) *infant mortality.* A characteristic pattern of failure, sometimes experienced with new equipment which may contain marginal components, wherein the number of failures per unit of time decrease rapidly as the number of operating hours increase. A burn-in period may be utilized to age (or mature) an equipment to reduce the number of marginal components.

(2) *random.* The pattern of failures for equipment that has passed out of its infant mortality period and has not reached the wear-out phase of its operating lifetime. The reliability of an equipment in this period may be computed by the equation

$$R = e^{-\lambda t}$$

where

λ = failure rate

t = time period of interest

(3) *wear out.* The pattern of failures experienced when equipment reaches its period of deterioration. Wear-out failure profiles may be approximated by a Gaussian (bell curve) distribution centered on the nominal life of the equipment.

firmware. Hardware used for the nonvolatile storage of instructions or data that can be read only by the computer. Stored information is not alterable by any computer program. (See: station, remote.)

function check. A check of master and remote station equipment by exercising a predefined component or capability.

(1) *Analog.* Monitor a reference quantity

(2) *Control.* Control and indication from a control-check relay

(3) *Scan.* Accomplished when control function check has been performed with all remotes

(4) *Poll.* Accomplished when analog function is performed with all remotes

(5) *Logging.* Accomplished when results of the control function check are logged

hard copy. A permanent record of information in readable form for human use, for example, reports, listings, displays, logs, and charts.

hardwired. The implementation of processing steps within a device by way of the placement of conductors between components within the device. The processing steps are not alterable except by modifying the conducting paths between components.

indication. A light or other signal (audio or visual) provided by the man/machine interface that signifies a particular condition.

inhibit. To prevent a specific event from occurring.

log. A printed record of data.

master terminal unit (MTU). Refers to the master station of a supervisory control system (See: station, master).

mean time between failure (MTBF). The time interval (hours) that may be expected between failures of an operating equipment.

mean time to repair (MTTR). The time interval (hours) that may be expected to return a failed equipment to proper operation.

modem. A MODulator/DEModulator device which converts serial binary digital data to and from the signal form appropriate for the respective communication channel.

multiplexer. (1) A device that allows the interleaving of two or more signals to a single line or terminal.

(2) A device for selecting one of a number of inputs and switching its information to the output.

offset. A predetermined value modifying the actual value so as to improve the integrity of the system, for example, the use of a 4 mA signal to represent zero in a 4 mA to 20 mA system.

panel, control. An assembly of man machine interface devices. (See: 5.5.)

point equipment (point). Elements of a supervisory system, exclusive of the basic common equipment, which are peculiar to and required for the performance of a discrete supervisory function. (See: supervisory control functions.)

(1) *Alarm Point.* Station (remote or master, or both) equipment(s) that inputs a signal to the alarm function.

(2) *Accumulator Point.* Station (remote or master, or both) equipment(s) that accepts a pulsing digital input signal to accumulate a total of pulse counts.

(3) *Analog Point.* Station (remote or master, or both) equipment(s) that inputs an analog quantity to the analog function.

(4) *Control Point.* Station (remote or master, or both) equipment(s) that operates to perform the control function.

(5) *Indication (Status) Point.* Station (remote or master, or both) equipment(s) that accepts a digital input signal for the function of indication.

(6) *Sequence of Events Point.* Station (remote or master, or both) equipment(s) that accepts a digital input signal to perform the function of registering sequence of events.

(7) *Telemetry Selection Point.* Station (remote or master, or both) equipment(s) for the selective connection of telemetry transmitting equipment to appropriate telemetry receiving equipment over an interconnecting communication channel. This type of point is more commonly used in electromechanical or stand-alone type of supervisory control.

(8) *Spare Point.* Point equipment that is not being utilized but is fully wired and equipped.

(9) *Wired Point.* Point for which all common equipment, wiring, and space are provided. To activate the point requires only the addition of plug-in hardware.

(10) *Space Only Point.* Point for which cabinet space only is provided for future addition or wiring and other necessary plug-in equipment.

NOTE: A point may serve for one or more of the purposes described above, for example, when a supervisory system is used for combined control and supervision of remotely operated equipment, a point for supervisory control and point for supervisory indication may be combined into a single control and indication point.

polling (data request). The process by which a data acquisition system selectively requests data from one or more of its remote terminals. A remote terminal may be requested to respond with all, or a selected portion of, the data available.

primary. An equipment or subsystem which normally contributes to system operation. See: backup.

programmable equipment. A remote or master station having one or more of its operations specified by a program contained in a memory device.

protocol. A strict procedure required to initiate and maintain communication.

quantization error. The amount that the digital

quantity differs from the analog quantity. (*See: analog-to-digital (a/d) conversion.*)

quiescent supervisory system. (*See: supervisory system, quiescent.*)

refresh rate. The number of times in each second that the information displayed on a nonpermanent display, for example, a crt, is rewritten or re-energized.

relay, interposing. A device which enables the energy in a high-power circuit to be switched by a low-power control signal.

remote terminal unit (RTU). Refers to a remote station equipment of a supervisory system. (*See: station, remote.*)

repeatability. The measure of agreement among multiple readings of an output for the same value of input, made under the same operating conditions, approaching from the same direction, using full-range traverses.

reproducibility. The measure of agreement among multiple readings of the output for the same value of input, made under the same operating conditions, approaching from either direction, using full-range traverses.

resolution. The least value of the measured quantity which can be distinguished.

scan (interrogation). The process by which a data acquisition system interrogates remote stations of points for data.

scan cycle. The time in seconds required to obtain a collection of data (for example, all data from one remote, all data from all remotes, and all data of a particular type from all remotes).

serial communication. A method of transmitting information between devices by sending all bits serially over a single communication channel.

station, automatic. A station that operates in automatic control mode.

NOTE: An automatic station may go in and out of operation in response to predetermined voltage, load, time, or other conditions, or in response to a remote or locally manually operated control device.

station check (supervisory check, status update). The automatic selection, in a definite order, of all the supervisory alarm and indi-

cation points associated with one remote station or all remote stations of a system, and the transmission of all the indications to the master station.

station identification. A sequence of signal elements used to identify a station.

station. (1) master (of a supervisory system). The entire complement of devices, functional modules, and assemblies which are electrically interconnected to effect the master station supervisory functions. The equipment includes the interface with the communication channel but does not include the interconnecting channel.

During communication with one or more remote stations the master station is the superior in the communication hierarchy.

(2) remote (of a supervisory system). The entire complement of devices, functional modules, and assemblies which are electrically interconnected to effect the remote station supervisory functions. The equipment includes the interface with the communication channel but does not include the interconnecting channel.

During communication with a master station the remote station is the subordinate in the communication hierarchy.

NOTES: Examples of station equipments include

(1) *Hardwired.* Station supervisory equipment which is comprised entirely of wired-logic elements.

(2) *Firmware.* Station supervisory equipment which uses hardware logic programmed routines in a manner similar to a computer. The routines can only be modified by physically exchanging logic memory elements.

(3) *Programmable.* Station supervisory equipment which uses software routines.

(3) semiautomatic. A station that requires both automatic and manual modes to maintain the required character of service.

(4) submaster. A station that can perform as a master station on one message transaction and as a remote station on another message transaction.

status. Information describing a logical state of a point or equipment.

supervisory control. An arrangement for operator control and supervision of remotely located apparatus using multiplexing techniques over a relatively small number of interconnecting channels.

supervisory control data acquisition system. A