STANDARD

ISA–5.3–1983

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Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems

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ISA–The Instrumentation, Systems, and Automation Society

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Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems

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Preface

This preface is included for informational purposes and is not part of ISA-5.3-1983.

This Standard has been prepared as a part of the service of ISA toward a goal of uniformity in the field of instrumentation. To be of real value, this document should not be static but should be subject to periodic review. Towards this end, the Society welcomes all comments and criticisms and asks that they be addressed to the Secretary, Standards and Practices Board, ISA, 67 Alexander Drive, P.O. Box 12277, Research Triangle Park, North Carolina 27709, telephone 919-549-8411, e-mail: standards@isa.org.

The ISA Standards and Practices Department is aware of the growing need for attention to the metric system of units in general, and the International System of Units (SI) in particular, in the preparation of instrumentation standards. The Department is further aware of the benefits to USA users of ISA Standards of incorporating suitable references to the SI (and the metric system) in their business and professional dealings with other countries. Towards this end this Department will endeavor to introduce SI and SI-acceptable metric units in all new and revised standards to the greatest extent possible. *The Metric Practice Guide,* which has been published by the American Society for Testing and Materials as ANSI designation Z210.1 (ASTM E380-76. IEEE Std. 268-1975), and future revisions, will be the reference guide for definitions, symbols, abbreviations, and conversion factors.

The systems referenced in this Standard are based on advances in control systems technology since the publication of ISA-5.1, "Instrumentation Symbols and Identification." During recent years, technology has evolved in terms of microprocessor-based systems presently manufactured by many companies as "Distributed Control Systems."

These systems may include components identified as "computers" as distinct from the integral processor, which derives the various functions of the system. The computer component may be integrated into the overall system, via the communication link, or it may be a stand-alone computer.

In attempting to implement these systems, the need for supplementary symbolism has become apparent.

The symbols defined in ISA-5.3 are intended to complement those of ISA-5.1, "Instrumentation Symbols and Identification," for use on flow diagrams. In this way, the integration of distributed controllers and process computers into the more traditional instrument systems — analog, binary, and digital — can be depicted clearly on flow diagrams and other documents to give an overall and comprehensive picture of how process variables are measured and controlled.

Distributed control systems appear to be similar to each other; however, they are so diverse in philosophy that there must be a generic way to document their application.

The second printing of ISA-5.3, dated April 1983, was published to correct errors in the original 1982 edition. The definition for communication link, Section 3, has been corrected and an omitted abbreviation, C.R.T., added. Minor clarifications were also made to the Appendix A artwork.

The ISA Standards Committee on Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic, and Computer Systems, SP5.3, operates within the ISA Standards and Practices Department, Dr. Thomas J. Harrison, Vice President. The persons listed below served as members of the SP5.3 Committee.

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This Standard was approved for publication by the ISA Standards and Practices Board in June 1982.

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Contents

1 Purpose

The purpose of this standard is to establish documentation for that class of instrumentation consisting of computers, programmable controllers, minicomputers and micro-processor based systems that have shared control, shared display or other interface features. Symbols are provided for interfacing field instrumentation, control room instrumentation and other hardware to the above. Terminology is defined in the broadest generic form to describe the various categories of these devices.

It is not the intent of this standard to mandate the use of each type symbol for each occurrence of a generic device within the overall control system. Such usage could result in undue complexity in the case of a Piping and Instrument Drawing (P&ID). If, for example, a computer component is an integral part of a distributed control system, the use of the computer symbol would normally be an undesirable redundancy. If, however, a separate general purpose computer is interfaced with the system, the inclusion of the computer symbol may provide the degree of clarity needed for control system understanding.

This standard attempts to provide the users with defined symbolism and rules for usage, which may be applied as needed to provide sufficient clarity of intent. The extent to which these symbols are applied to various types of drawings remains with the users. The symbols may be as simple or complex as needed to define the process.

2 Scope

This standard satisfies the requirements for symbolically representing the functions of distributed control/shared display instrumentation, logic, and computer systems. The instrumentation is generally composed of field hardware communication networks and control room operator devices. This standard is applicable to all industries using process control and instrumentation systems.

No effort will be made on the flow diagram to explain the internal construction, configuration, or method of operation of this type of instrumentation, logic and computer systems. Personnel needing to understand flow diagrams must have a basic understanding of the total system in order to correctly interpret the diagram. The type of computation or the use of the process variable within a program is not indicated except in those cases where the process variable is an integral part of the control strategy. In applications where all instrument system data base information is available to the computer via the communication link, the depiction of the computer interconnections is optional in order to conserve space on flow diagrams.

2.1 Application to work activities

This standard is intended for use whenever any reference to an instrument is required. Such references may be required for the following uses as well as others:

Flow diagrams, process and mechanical;

Instrumentation system diagrams;

Specifications, purchase orders, manifests, and other lists;

Construction drawings;

Technical papers, literature, and discussions;

Tagging of instruments; and

Installation, operation, and maintenance instructions, drawings, and records.

2.2 Relationship to other ISA standards

This standard complements ISA-5.1, "Instrumentation Symbols and Identification," for symbols and formats representing functional identification codes. For clarification of examples, a limited amount of ISA-5.1 symbology has been included in this document.

2.3 Relationship to other standards

Where applicable, definitions not included in Section 3 are in accordance with ANSI X3/TR-1-77, "American National Dictionary for Information Processing," and/or ISA-5.1.

3 Definitions and abbreviations

Accessible—A system feature that is viewable by and interactive with the operator, and allows the operator to perform user-permissible control actions, e.g., set point changes, auto-manual transfers, or on-off actions.

Assignable—A system feature that permits an operator to channel (or direct) a signal from one device to another, without the need for changes in wiring, either by means of switches or via keyboard commands to the system.

Communication link—The physical hardware required to interconnect devices for the purpose of transmitting and/or receiving data.

Computer control system—A system in which all control action takes place within the control computer. Single or redundant computers may be used.

Configurable—A system feature that permits selection through entry of keyboard commands of the basic structure and characteristics of a device or system, such as control algorithms, display formats, or input/output terminations.

C.R.T.—Cathode Ray Tube

Distributed control system—That class of instrumentation (input/output devices, control devices and operator interface devices) which in addition to executing the stated control functions also permits transmission of control, measurement, and operating information to and from a single or a plurality of user-specifiable locations, connected by a communication link.

I/O—Input/Output

Shared controller—A control device that contains a plurality of pre-programmed algorithms which are user retrievable, configurable, and connectable, and allows user defined control strategies or functions to be implemented. Control of multiple process variables can be implemented by sharing the capabilities of a single device of this kind.

Shared display—The operator interface device used to display signals and/or data on a time shared basis. The signals and/or data, i.e., alphanumeric and/or graphic, reside in a data base from where selective accessibility for display is at the command of a user.

Software—Digital programs, procedures, rules, and associated documentation required for the operation and/or maintenance of a digital system.

Software link—The interconnection of system components or functions via software or keyboard instruction.

Supervisory set point control system—The generation of set point and/or other control information by a computer control system for use by shared control, shared display or other regulatory control devices.

4 Symbols

4.1 General

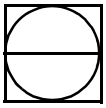
Standard instrumentation symbols as shown in ISA-5.1 are retained as much as possible for flow diagram use, but are supplemented as necessary by the new symbols in Sections 4.2 through 4.6. Symbol size should be consistent with ISA-5.1, Section 3. The symbol descriptions listed to the right of each symbol are intended as guidelines for applications, and are not intended to be all inclusive. The symbol may be used if one or more of the descriptions apply. Shared signal lines can be expressed by the symbol for a system link (See Section 4.6.1.).

4.2 Distributed control/shared display symbols

Advances in control systems brought about by microprocessor based instrumentation permit shared functions such as display, control and signal lines. Therefore, the symbology defined here should be "Shared Instruments," which means shared display and/or shared control. The square portion of this symbol, as shown in paragraphs 4.2.1 through 4.2.3 has the meaning of shared type instrument.

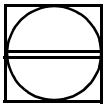
4.2.1 Normally accessible to operator

Indicator/Controller/Recorder or Alarm Points—usually used to indicate video display.



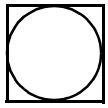
1) Shared display.
2) Shared display and shared control.
3) Access limited to communication link.
4) Operator Interface on communication link.

4.2.2 Auxiliary operator's interface device



1) Panel mounted—normally having an analog faceplate—not normally mounted on main operator console.
2) Can be a backup controller or manual station.
3) Access may be limited to communication link.
4) Operator interface via the communication link.

4.2.3 Not normally accessible to operator



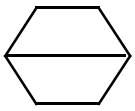
1) Shared blind controller.
2) Shared display installed in field.
3) Computation, signal conditioning in shared controller.
4) May be on communication link.
5) Normally blind operation.
6) May be altered by configuration

4.3 Computer symbols

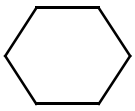
The following symbols should be used where systems include components identified as "computers," as distinct from an integral processor, which drive the various functions of a "distributed control system." The computer component may be integrated with the system via the data link, or it may be a stand-alone computer.

4.3.1 Normally accessible to operator

Indicator/Controller/Recorder or Alarm Point— usually used to indicate video display.



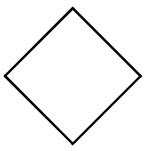
4.3.2 Not normally accessible to operator



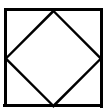
1) Input/Output interface.
2) Computation/Signal conditioning within a computer.
3) May be used as a blind controller or a software calculation module.

4.4 Logic and sequential control symbols

4.4.1 General symbol—For undefined complex interconnecting logic or sequence control. (Also see ISA-5.1).

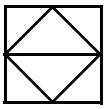


4.4.2 Distributed control interconnecting logic controller with binary or sequential logic functions.



1) Packaged programmable logic controller, or digital logic controls integral to the distributed control equipment.
2) Not normally accessible by the operator.

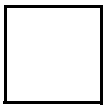
4.4.3 Distributed control interconnecting logic controller with binary or sequential logic functions.



1) Packaged programmable logic controller, or digital logic controls integral to the distributed control equipment.
2) Normally accessible to the operator.

4.5 Internal system function symbols

4.5.1 Computation/Signal conditioning



1) For block identification refer to ISA-5.1, Table 2 "Function Designations for Relays."
2) For extensive computational requirements, use designation "C." Explain on supplementary documentation.
3) Used in conjunction with function relay bubbles per ISA-5.1.

4.6 Common symbols

4.6.1 System link

1) Used to indicate either a software link or manufacturer's system supplied connections between functions.
2) Alternatively, link can be implicitly shown by contiguous symbols.
3) May be used to indicate a communication link at the user's option.

4.7 Recorders and other historical data retention

4.7.1 Conventional hard-wired recording devices such as strip chart recorders shall be shown in accordance with ISA-5.1. (Refer to Appendix A.2.2. of this standard.)

4.7.2 For assignable recording devices use Symbol 4.2.1.

4.7.3 Long term/mass storage of a process variable by digital memory means such as tape, disc, etc., shall be depicted in accordance with 4.2 or 4.3 of this standard, depending on the location of the device.

5 Identification

For purposes of this standard, identification codes shall be consistent with ISA-5.1, with the following additions.

5.1 Software alarms

Software alarms may be identified by placing ISA-5.1, Table 1, letter designators on the input or output signal lines of the controls, or other specific integral system component. See Section 6 Alarms of this standard.

5.2 Contiguity of symbols

Two or more symbols can adjoin to express the following means in addition to those shown in ISA-5.1:

1) Communication among the associated instruments, e. g.,
   - Hard wiring
   - Internal system link
   - Backup
2) Instrument integrated with multiple functions, e.g.,
   - Multipoint recorder
   - Control valve with integrally mounted controller.

The application of contiguous symbols is a user option.

If the intent is not absolutely clear, contiguous symbols should *not* be used.

6 Alarms

6.1 General

All hard-wired standard devices and alarms, as distinct from those devices and alarms specifically covered in this standard, shall be shown in accordance with ISA-5.1, Table 1.

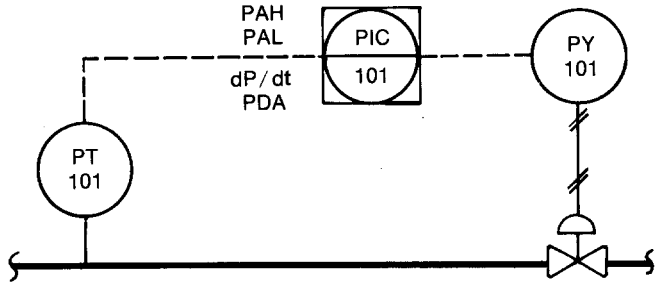
The examples in paragraph 6.2 illustrate principles of the methods of symbolization and identification. Additional applications that adhere to these principles may be devised as required. The location of the alarm identifiers is left to the discretion and convenience of the user.

6.2 Instrument system alarms

6.2.1 Multiple alarm capability is provided in most systems. Alarms covered by this standard should be identified as shown by the examples in 6.2.2 and 6.2.3.

6.2.2 Alarms on measured variables shall include the variable identifiers, i.e.:

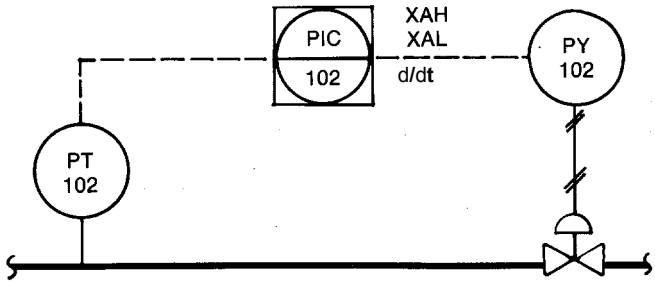
Pressure:	PAH	(High)
	PAL	(Low)
	dP/dt	(Rate of change)
	PDA	(Deviation from set point)



Example 6.2.2

6.2.3 Alarms on controller output shall use the undefined variable identifier X, i.e.:

XAH	(High)
XAL	(Low)
d/dt	(Rate of change)



Example 6.2.3

Appendix A — Examples

A.1 Examples of use

A.1.1 The following figures illustrate some of the various combinations of symbols presented in this standard and ISA-5.1. These symbols may be combined as necessary to fulfill the needs of the user.

A.1.2 Controllers located in the diagram main information line are to be considered the primary controllers. All devices outside the main line provide a backup or secondary function.

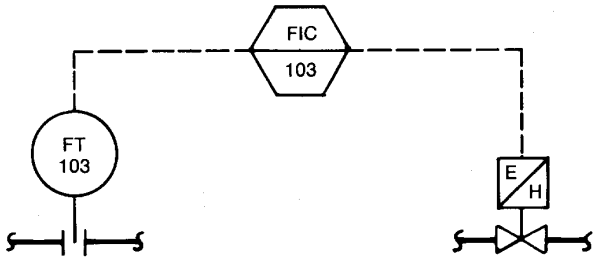


Figure A1. Computer Control—No Backup - Shared Display

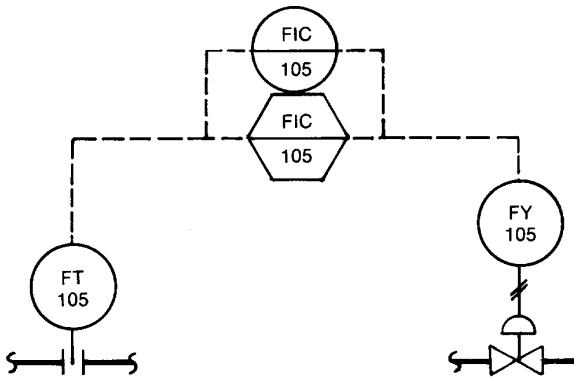


Figure A2. Computer Control—With Analog Backup

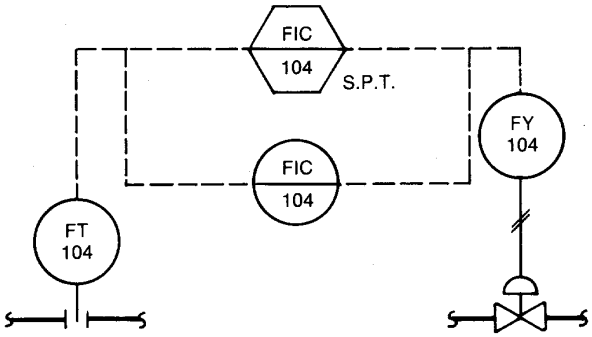


Figure A3. Computer Control—Full Analog Backup Through Set Point Tracking (SPT)

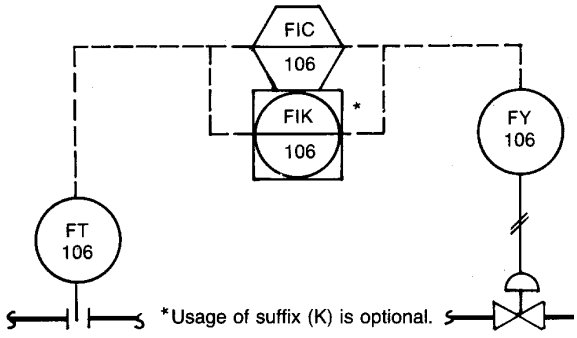


Figure A4. Computer Control-Full Backup from Distribute Control Instrumentation. Computer Uses Instru ment System Communication Link

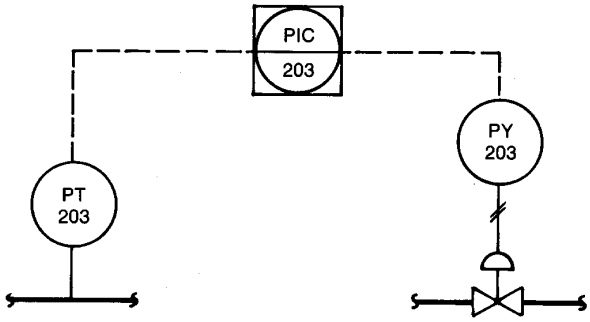


Figure A5. Shared Display/Shared Control—No Backup

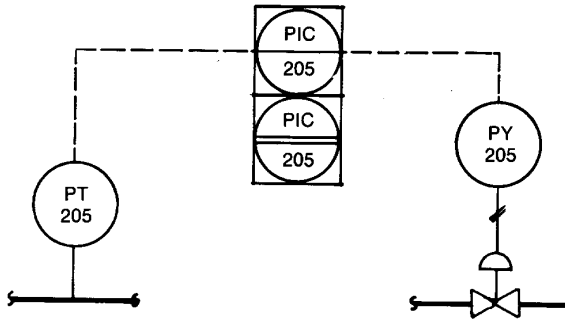


Figure A6. Shared Display/Shared Control—With Auxilia Operator's Interface Device

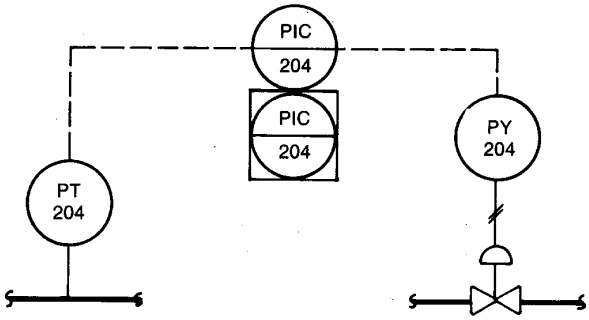


Figure A7. Analog Control—Interfaced with Shared Display. Shared Control Backup

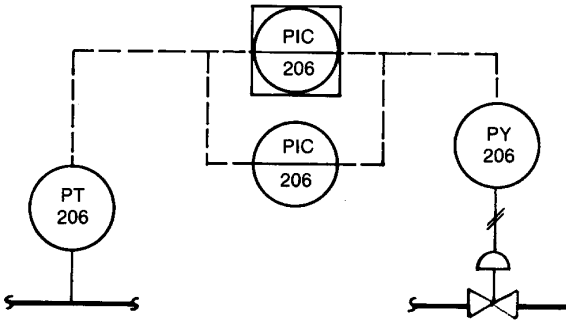


Figure A8. Shared Display/Shared Control—With Analc Controller Backup

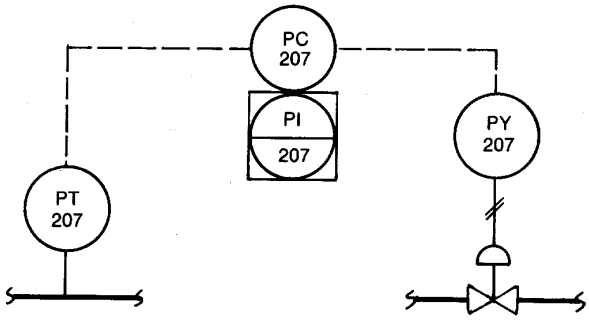


Figure A9. Analog Control—Blind Controller. Shared Display

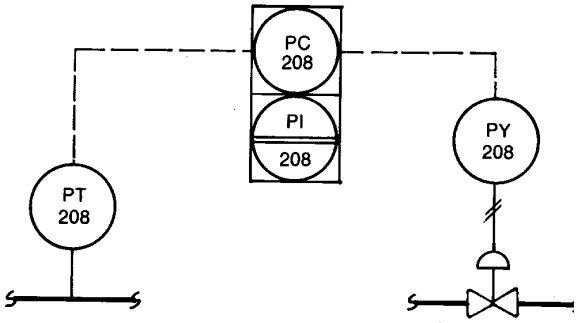


Figure A10. Blind Shared Control—With Auxiliary Operator Interface Backup

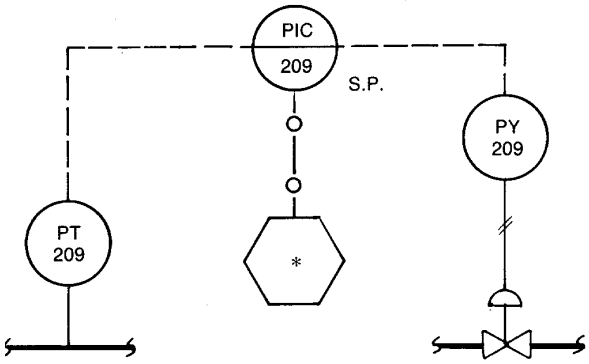


Figure A11. Supervisory Set Point Control—Analog Controller with Conventional Faceplate. Computer Supervisory Set Point via Communication Link

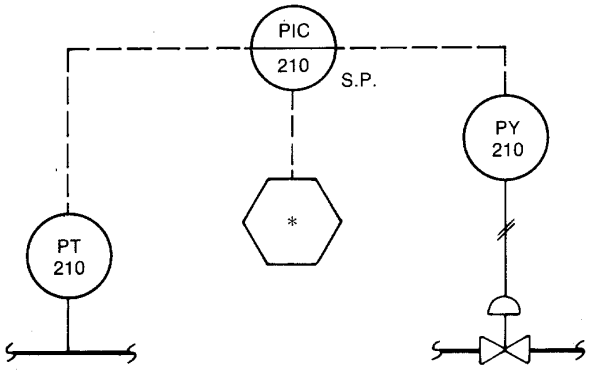


Figure A12. Supervisory Set Point Control—Analog Controller Complete with Conventional Faceplate. Computer Supervisory Set Point Hardwired.

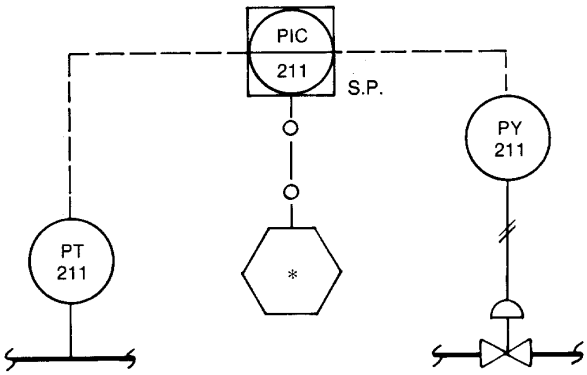


Figure A13. Supervisory Set Point Control—Shared Display Shared Control with Full Computer Access via the Communication Link

*User identification is optional

A.2 Typical Flow Diagrams

A.2.1 Figure A.14 combines the basic symbols of this standard in a simplified drawing. It is intended to provide a hypothetical example and to stimulate the user's imagination in the application of symbolism to this equipment. Figure A.14 is arranged in the following manner:

1) Volumetric fuel and air flows provide inputs for combustion system firing rate and fuel air ratio via distributed control instrumentation. Set points for both rate and ratio can be computer generated.

2) Combustion air and gas pressures are monitored by pressure switches which control the gas safety shutoff valve via UC-600 "distributed control interconnecting logic."

3) Material moisture content is measured, dry weight of the input material is calculated, and feed rate is controlled by MT-300 and WC-301. Discharged material moisture content is read by MT-302. At this point, firing rate and/or feed rate could be controlled by the Distributed Control System (DCS) instrumentation or by the computer taking other process variables into consideration.

4) British thermal unit (Btu) analysis (AT-97) is input to the computer system to generate feed forward control adjusting firing rate, in Btu/hr. The set point is calculated by the computer, based on feed rate, weight, and moisture content.

5) Internal system links are shown for selected computer input/output, while the firing rate and ratio set points are implied. Shown in the same manner, the links between the calculation modules and the controllers are implied by contiguous symbols, while the wild flow to the ratio control is shown in the system link symbol.

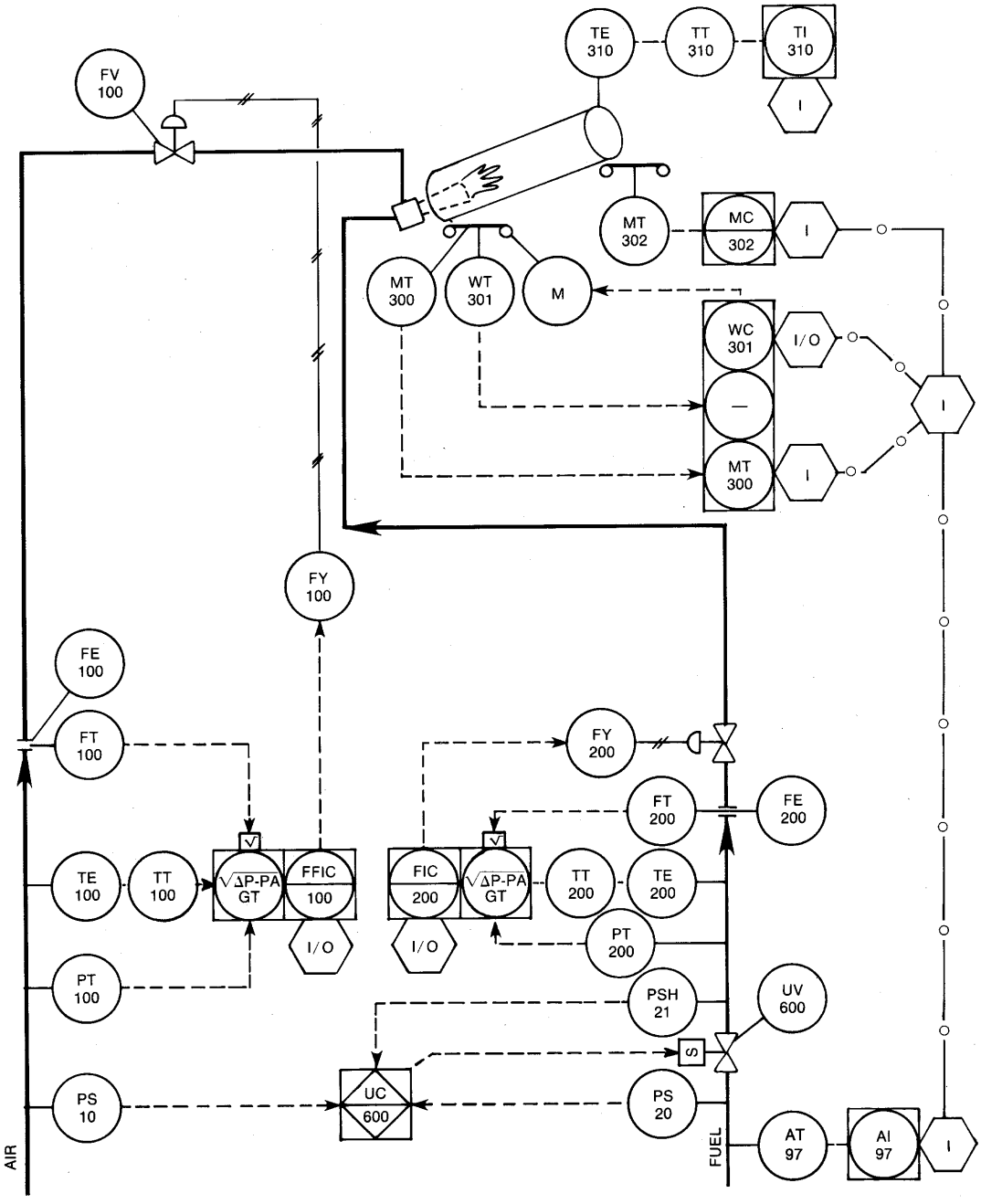
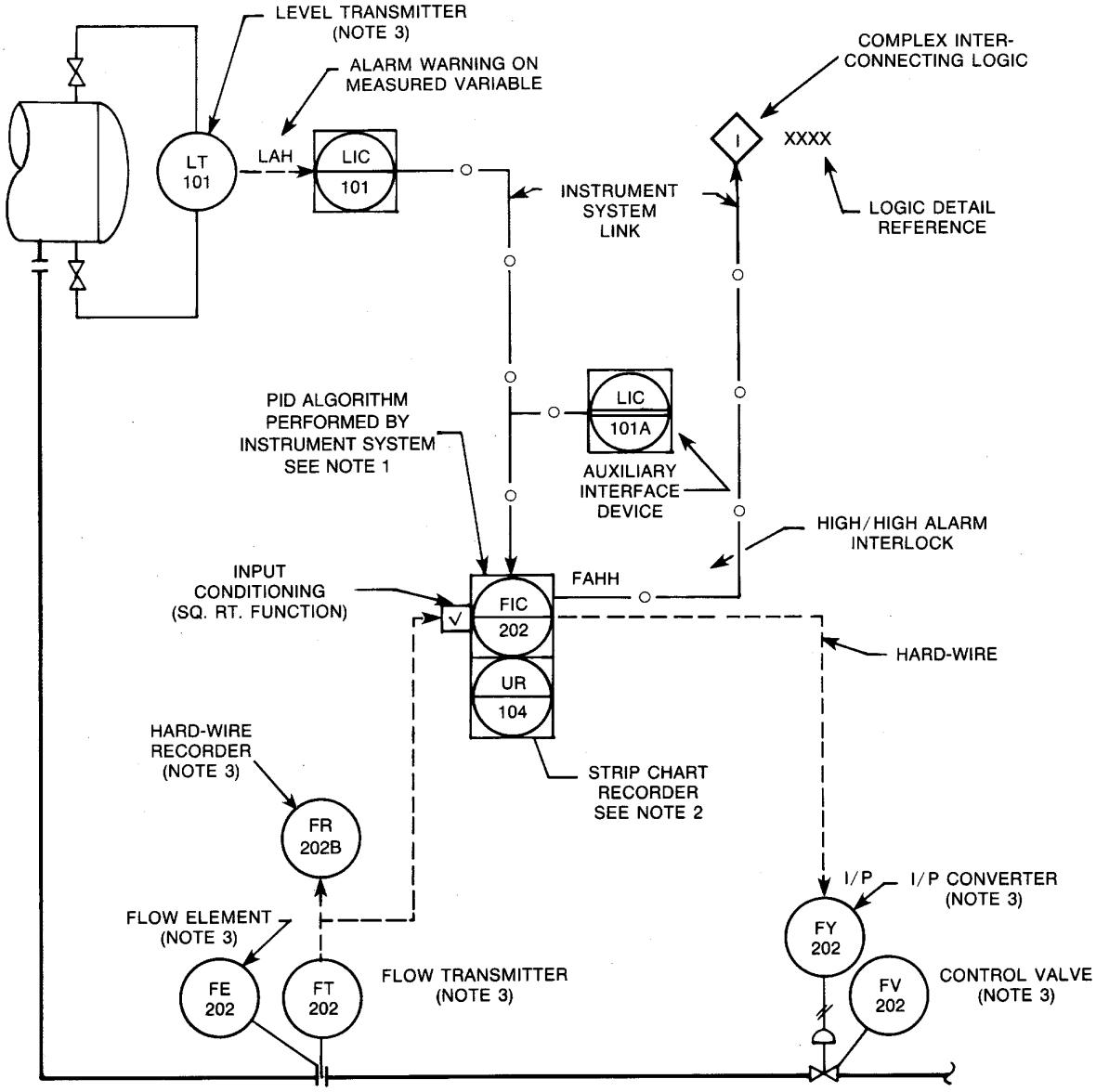


Figure A.14 — Example — simplified drawing

A.2.2 Figure A.15 combines the symbols to depict a cascade loop with alarms. Notes are added on the diagram itself for clarification purposes only.



Notes: Shared Display
1. Display/adjustments on console. Communication via data link.
2. Located in console. Signal selected from instrument system data base.
3. Field mounted.

Figure A.15 — Typical flow diagram—cascade control loop

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