International Standard 6548

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Data processing — Description of interface between process computing system and technical process

Traitement de l'information — Description de systèmes d'interface entre système informatique de contrôle de processus et processus technique

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been authorized has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 6548 was developed by Technical Committee ISO/TC 97, *Information processing systems*, and was circulated to the member bodies in February 1982.

It has been approved by the member bodies of the following countries :

Belgium	Hungary	Romania
Canada	Ireland	South Africa, Rep. of
China	Italy	Spain
Czechoslovakia	Japan	Sweden
Egypt, Arab Rep. of	Netherlands	USA
Germany, F.R.	Poland	

No member body expressed disapproval of the document.

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Data processing — Description of interface between process computing system and technical process

1 Scope

This International Standard specifies a method of description of the interface between a process computing system and a technical process

This International Standard comprises five forms :

Form 1 : General

Form 2 : Digital inputs

Form 3 : Digital outputs

Form 4 : Analogue inputs

Form 5 : Analogue outputs.

Each form contains a list of parameters. This International Standard describes the parameters, explains the use of the forms, and gives preferred layouts of the forms.

2 Field of application

This International Standard is intended to be used for the specification of process interfaces by all concerned in the design, production, marketing and application of these interfaces. It includes lists of parameters required for the specification of these interfaces with explanations of their use so that the parameters will have the same meaning for all concerned.

3 Terminology

A process control computer system — hereafter called the system — has three major parts (see the figure) :

a) process control equipment :

such as actuators, transducers etc;

b) process computer system :

most systems include a computer but this International Standard may be used for specifying systems which do not contain a computer;

c) interface system :

an interface enables transfer of information between a technical process and a process computer system. An interface may consist of any combination of the following subsystems

— digital inputs

— digital outputs

— analogue inputs

— analogue outputs

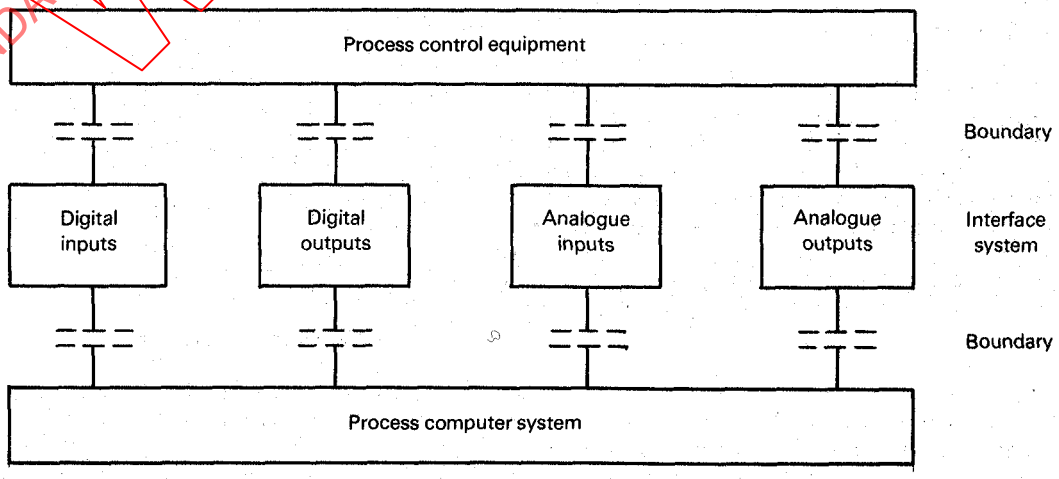

Figure — Process control computer system

Each sub-system has two boundaries one with the technical process and the other with the process computer system. At each boundary, two sets of parameters can be specified, one set looking inwards at the sub-system and the second set looking outwards at the technical process or the process computer system.

In addition to the parameters of the boundaries the parameters of the performance and design of the sub-system have to be specified.

4 Structure of the forms

The general form, Form 1, lists the parameters that are common to all sub-systems in an interface. Forms 2 to 5 contain the following parameters :

a) process boundary : parameters looking inwards at sub-system parameters looking outwards at technical process;

b) computer boundary : parameters looking inwards at sub-system parameters looking outwards at process computer system;

c) sub-system : all parameters, excluding those of the boundaries, of the performance and design of the sub-system;

d) security : all parameters of security, checking and testing of the sub-system and system;

e) remarks : any remarks or parameters not included in the above sections.

5 Use of forms

The forms can be used by a purchaser of interfaces to state his requirements and by a vendor of interfaces to state the parameters of the equipment offered. Although the layout of the form is not obligatory, if the purchaser's specifications and the vendor's specifications are on the same layout of form, comparison will be facilitated. A list of parameters is not a complete specification of an interface, the purchaser has to describe the application, and the vendors have to give a detailed description and diagrams of the interface and other equipment offered.

Each interface requires a general form, Form 1, and those relevant of Forms 2 to 5. Each type of sub-system will require at least one form. Some sub-systems may require more than one form; for instance a digital input sub-system may require one form for logic inputs and another for contact inputs. If the interface contains sub-systems which cannot be described using the forms in this International Standard, further lists of parameters relevant to the sub-systems should be compiled using the same structure as those of the forms in this International Standard.

The reference in the left hand column of the forms refers to clause 6. It is expected that in a specification of an interface, this numbering system will be replaced by one relevant to the specification.

6 Description of forms

6.1 Form 1 — General

A general description of the process interface shall be provided, describing the general characteristics and pertinent design features of the relevant sub-systems. The information shall be clearly presented so that the reader can understand all aspects of the process interface. The general description should include a block diagram indicating the function of each part of the interface.

6.1.1 Compatibility of process computing systems

State the types, manufacturers and models of process computing systems compatible with the sub-systems.

6.1.2 Environmental conditions

State the environmental conditions under which the interface may be subjected without damage or failure.

6.1.3 Operating conditions

State the conditions under which the interface will operate with guarantee of accuracy and performance :

a) temperature;

b) humidity;

c) vibration;

d) shock;

e) dust;

f) supply voltage;

g) frequency of voltage supply;

h) other conditions.

6.1.4 Storage conditions

State the environmental conditions under which the equipment can be stored or transported :

a) temperature;

b) humidity;

c) vibration;

d) shock;

e) dust;

f) other conditions.

6.1.5 Product safety specifications

State the applicable International Standards and/or national standards that the design meets for electrical safety, personnel safety, fire safety, explosion proof and the equipment locations (class, division of zone and group) for standard or hazardous locations.

6.1.6 Power supply

State the line voltage and frequency of the power source supplying the interface. Also, include the formula for calculating the power consumption of the interface.

6.1.7 Power grounding

Identify the requirements for external grounding for safety purposes.

6.1.8 Surge withstand capability

Describe the protection provided, if any, against transient and steady state overvoltages that may be applied between any two power input terminals and also from any power input terminal to ground.

6.1.9 Physical specifications

6.1.9.1 Size

State the dimensions of the equipment and its enclosure.

6.1.9.2 Weight

State the mass of the equipment and enclosure.

6.1.10 Mounting

Describe the insertion and holding technique of the circuit cards. Also describe the mounting requirements for the sub-system enclosure and orientation limit, if any. Include sketches or drawings if necessary.

6.1.11 Terminations

State the available signal/connection types (i.e. screw, push-on connector, etc.) indicating wire size, connector types and specifications, cable types, grounding facilities, etc. State power connection requirements in terms of connector types, wire size, location, etc. State the maximum distance that the interface can be separated from the terminals and still meet the stated performance specifications.

6.1.12 Access requirements

State the access requirements for cable entry and for maintenance.

6.1.13 Remarks

Use this area of the form to state any pertinent features or parameters not included elsewhere on the form.

6.2 Form 2 — Digital inputs

6.2.1 Technical process boundary — Parameters of technical process

6.2.1.1 Type of signal parameters

Digital input signals present information by two discrete values of the signal parameter which correspond to logic 1 and logic 0. The signal parameter can be a voltage, a current, a resistance, or the opening and closing of a contact. The nominal, minimum and maximum electrical values of the two discrete values shall be given. It shall also be stated whether the input signal is a d.c. or a.c. signal; if a.c., the signal frequency shall also be stated.

6.2.1.2 Type of contact

The type of contact closure, such as mechanical or electronic, shall be stated.

6.2.1.3 Maximum common mode voltage

State the maximum common mode voltage at which the sub-system will operate within the given specification.

6.2.1.4 Maximum normal mode voltage

State the maximum normal mode voltage at which the sub-system will operate within the given specification.

6.2.1.5 Maximum operating common mode voltage

State the maximum operating common mode voltage at which the sub-system will operate at reduced performance.

6.2.1.6 Maximum operating normal mode voltage

State the maximum operating normal mode voltage at which the sub-system will operate at reduced performance.

6.2.1.7 Maximum allowable common mode overvoltage

State the maximum common mode overvoltage which can be applied to the sub-system without circuit damage.

6.2.1.8 Maximum allowable normal mode overvoltage

State the maximum normal mode overvoltage which can be applied to the sub-system without circuit damage.

6.2.2 Technical process boundary — Parameters of sub-system

6.2.2.1 Performance mode

The performance mode of the sub-system shall be stated. For instance :

a) the sub-system may be activated by either the logic state or the transition from one logic state to the other;

b) the sub-system may have a latch;

c) the sub-system may detect if a contact is open or closed;

d) the sub-system may count pulses.

6.2.2.2 Input circuit

The design of the input circuit often influences the digital input source. This influence has to be described by specifying the open circuit voltage and the closed circuit current generated by the digital input circuitry. If necessary, further features shall be illustrated by a circuit diagram.

6.2.2.3 Recognition time of signal logic state

The logic states of digital input signals may not be recognized immediately, mainly due to the settling time of the input circuit. Thus, the digital input signals must have a certain duration in order to be recognized by the subsystem as a logic state.

Nominal, minimum and maximum recognition times of logic 0 and logic 1 signal states shall be stated.

6.2.2.4 Recognition time of signal transition between logic states

The recognition time of a signal transition depends, in general, on the rise time of the input signal during transition between logic states. In some cases, the duration of the logic state reached after transition is of importance. For the recognition time of a sequence of transitions, the recovery time of the input circuit shall be stated.

The minimum nominal and maximum values of the rise time for both 0 to 1 and 1 to 0 transitions shall be stated, as well as the minimum duration of the final logic state and the recovery time.

6.2.2.5 Pulse recognition

If the sub-system includes pulse recognition the minimum values of the following parameters shall be stated :

a) the pulse duration;

b) the leading edge rate;

c) the pulse height;

d) the trailing edge rate;

e) the recovery time.

Furnish additional information on a diagram if further clarification is required.

6.2.2.6 Pulse counting

If the sub-system includes pulse counting, the following shall be stated :

a) the transition or level change required to generate a count;

b) the ability of the counter to be present to a fixed or programmable value;

c) the direction of the counter, increasing, decreasing, or both;

d) the counter content that would generate an interrupt or "look at me" request to the processor;

e) the ability to cascade counters.

6.2.2.7 Pulse duration measurement

If the sub-system includes pulse duration measurement, the following shall be stated :

a) the duration range;

b) the resolution accuracy;

c) the repeatability of measurement.

6.2.2.8 Contact interrogation

If the sub-system includes contact interrogation the following shall be stated :

a) interrogation by d.c., a.c. or a pulse signal;

b) for a.c. or pulse the wave shape parameters;

c) function of any contact bounce suppression circuits;

d) function of any contact protection circuits.

6.2.3 Process computer system boundary — Parameters of sub-system

6.2.3.1 Data string coding

State the organization of the bit string to be exchanged between the subsystem and the process computer system including the string length, the length and the location of address and data part within the string, etc.

State the code used for addressing and data, including the sign.

6.2.4 Process computer system boundary — Parameters of process computer system

6.2.4.1 Highway

State

a) type of highway (i.e. parallel, byteserial, bitserial;

b) organisation of highway :

— address part (number of lines or bits);

— data part (data width);

— control part (i.e. interrupt facilities).

6.2.5 Sub-system

6.2.5.1 Transfer rate

The transfer rate is the rate at which bits, characters, or words are transferred from an input point into the sub-system. The transfer rate shall be stated as :

a) the transfer time interval;

b) the maximum transfer rate for :

— a fixed address of input point;

— a changing address of input point.

Both definitions imply transient behaviour of the input circuit of the sub-system.

6.2.5.1.1 Transfer time interval

The transfer time interval is the time elapsed between the start of the digital input command and the completion of transfer of data into the sub-system.

The digital input command can be started internally or externally.

6.2.5.1.2 Maximum transfer rate

The maximum transfer rate is the maximum rate at which bits, characters, or words can be transferred from an input point into the sub-system.

It is necessary to distinguish between the sequential data transfer from the same input point (fixed address transfer) and from different input points (changing address transfer).

Both rates shall be given in bits per second, character per second, or words per second.

6.2.5.2 Electrical isolation

State the methods employed to electrically isolate the interface logic from both the system power supply voltage and accidentally applied voltages to the terminals.

6.2.5.3 Grouping isolation

Often, terminals are grouped to provide electrical isolation between families of terminals. Points are said to be grouped if they share any common electrical connections between their terminals. Indicate the method of grouping isolation and the number of terminals per group.

6.2.5.4 Filter availability

Indicate the ability of the sub-system to filter or disregard unwanted signals and noise.

6.2.5.5 Contact interrogation power supply

It shall be specified whether the power supply will be provided by the vendor or by the purchaser. If it is provided by the vendor, it shall be further specified how many contact input points can be driven by the digital input power supply.

It shall be stated if the output of the power supply is monitored. If the power supply should be provided by the purchaser, its required characteristics shall be specified.

6.2.5.6 Modularity

Include an indication of the modularity of the sub-system and specify :

a) the capacity of the total unit;

b) the number of channels/card;

c) the number of cards/rack or box;

d) the number of racks or boxes/unit.

6.2.6 Security

6.2.6.1 Internal protection

State the methods used to protect the sub-system from internal failures. Such protective features could be in the form of power supply overvoltage and over-current limiting. It might also take the form of logic error checking and associated fault protection.

6.2.6.2 Validity check

State whether a given input word or words can be used as a validity check. Also state whether this feature is hardware determined or programmable.

6.2.6.3 Diagnostic and self-testing functions

State the capability of the digital input hardware to diagnose internal faults and indicate them as a status. State whether this is possible in an on-line configuration or available only when the hardware is operating in a testing mode. State also if any test features, such as manual switches for data, address, or control functions, have been incorporated.

6.2.6.4 *Monitoring of power supply*

State the ability of the sub-system to detect and/or recover from a power supply loss or malfunction :

a) sub-system power supply;

b) contact interrogation power supply.

6.2.6.5 Other security functions

State further security functions not included in 6.2.6.1 to 6.2.6.4.

6.2.7 Remarks

Use this area of the form to state any pertinent features or comments not included elsewhere on the form.

6.3 Form 3 — Digital outputs

6.3.1 Technical process boundary — Parameters of technical process

6.3.1.1 Output circuit

For proper usage, it is necessary to know what devices may successfully be connected to the digital output sub-system. Therefore, state the electrical limits of the load which may be connected to each type of output circuit. If necessary, illustrate further features by a circuit diagram.

6.3.2 Technical process boundary — Parameters of sub-system

6.3.2.1 Type of digital output

The type of digital output shall be stated :

a) signal state;

b) transition between signal states;

c) a single pulse;

d) a pulse train or pulse duration;

e) a contact open or closed.

6.3.2.2 Performance mode

According to the type of digital outputs, as defined above, three types of activation methods can be distinguished. These are :

a) logic state;

b) transition between logic states;

c) pulse.

The performance mode shall be stated.

6.3.2.3 Logic states of digital output signals

Digital output signals represent information by two discrete values of the signal parameter. These values correspond to the two logic states : logic 1 and logic 0.

The signal parameter could be a voltage, a current, or a resistance.

It shall be stated whether the output signal is an a.c. or d.c. signal. If a.c., the signal frequency shall be given. In either cases, the nominal, minimal, and maximal electrical values corresponding to the two logic states, shall be given.

6.3.2.4 Settling time

Logic of some form is used to send information to the final output element; i.e. a relay driver used to energize a relay coil. The settling time is measured from the instant of receipt of the output command by the sub-system, until the 90 % value is reached. State the maximum, nominal, and minimum time required for the specified logic element.

6.3.2.5 Pulse output

The pulse output technique shall be stated :

a) single pulse;

b) pulse train;

c) pulse duration.

6.3.2.6 Single pulse output

The following pulse parameters shall be stated for a single pulse output :

a) the minimum pulse duration;

b) the rising edge rate;

c) the height;

d) the falling edge rate;

e) the recovery time.

6.3.2.7 Pulse train output

For a pulse train output, the maximum number of output pulses resulting from a single transfer of information from the processor to the sub-system, shall be stated. It shall also be stated whether the pulse is fixed in time duration or variable. In the latter case, state whether the changes are programmable or hardware adjustable.

6.3.2.8 Pulse duration output

State the duration range, the resolution accuracy and the stability of the pulse duration output.

6.3.2.9 Type of contact

For a contact output, state the type of contact, (mechanical or electronic) and the expected maximum number of operations under nominal loading conditions (life time of contact).

6.3.2.10 Contact bounce

State the maximum time required to eliminate contact bounce under nominal loading conditions.

6.3.3 Sub-system

6.3.3.1 Transfer rate

The transfer rate is the rate at which bits, characters, or words are transferred from the sub-system to the output points. State the transfer rate as defined by :

a) the transfer time interval;

b) the maximum transfer rate for :

— a fixed address of output point;

— a changing address of output point.

6.3.3.1.1 Transfer time interval

State the transfer time interval which is the time elapsed in the sub-system between the initiation of an output sequence, and the activation of the final device parameter; i.e. the time a relay is requested to energize.

6.3.3.1.2 Maximum transfer rate

The maximum transfer rate is the maximum rate at which bits, characters, or words can be transferred from the digital output unit to the output points.

It is necessary to distinguish between the sequential data transfer to the same output point (fixed address transfer) and to different output points (changing address transfer).

Both rates shall be stated in bits per second, characters per second or words per second.

6.3.3.2 Contact protection

State if any internal electrical devices are used to provide protection to the output contact logic. Include a diagram, if necessary, to clearly explain their use.

6.3.4 Security

6.3.4.1 Internal protection

State the methods used to protect the sub-system from internal failures. Such protection could be in the form of power supply overvoltage and overcurrent limiting. It might also take the form of logic error checking or preventing accidental output operation caused by external circuits connected to the sub-system.

6.3.4.2 Validity check

State whether a given word or register can be used to verify the operation of the sub-system. Indicate if this feature is programmable or is fixed by the hardware. State also whether it requires additional hardware, such as direct connection to the digital input sub section, to accomplish this check.

6.3.4.3 Diagnostic and self-testing functions

State the capability of the digital output hardware to diagnose internal faults and indicate them as a status signal. State if this is possible in an on-line configuration or available only when the hardware is operating in a testing mode. State also if any test features, such as manual switches for data, addresses, or control functions, have been incorporated.

6.3.4.4 Conditions on power failure and recovery

It shall be stated if, under a power failure condition, the output logic remains in the same state or fails to another condition; i.e. fail safe. The output state upon restoration of power and prior to any change or clear condition issued by the processor or external controlling logic shall be stated.

6.4 Form 4 — Analogue inputs

6.4.1 Technical process boundary — Parameters of technical process

6.4.1.1 Type of input

State the type of signal which can be connected to the sub-system and any necessary features of the source. Examples of process signals are current, voltage, resistance and thermocouple. Where applicable, state :

a) span of signal;

b) reference function compensation;

c) number of lead wires;

d) bridge type input;

e) source impedance.

6.4.1.2 Source impedance

State the maximum source impedance for which the rated performance parameters apply.

6.4.1.3 Signal grounding and shielding

For each type of analogue input channel state the grounding and shielding practice required. Use diagrams where necessary.

6.4.2 Technical process boundary — Parameters of sub-system

6.4.2.1 Input circuit

A reference shall be given to a general diagram of the circuit.

6.4.2.2 Input protection

For each analogue input channel, describe the protection provided, if any, against transient and steady state overvoltages that may be applied between any two input terminals and also from any input terminals to ground.

6.4.2.3 Effective input impedance

State the minimum input impedance of each type of analogue input both when the power is off and when the channel is selected.

6.4.3 Sub-system

6.4.3.1 Performance parameters

The performance parameters are fundamental and application-independent. They are the parameters which are needed to calculate system error for any specific application, or to evaluate the sub-system for general applications.

The performance parameters for the reference operating conditions shall be stated on the form. It is necessary to state these parameters for each type of input. It is also necessary to state the performance parameters for each operating condition at maximum and at minimum value with the other operating conditions at reference value. This can be shown on further copies of this page of the form or in tabular form.

6.4.3.1.1 Transfer rate

The transfer rate is the rate at which analogue signals are transferred from the input points into the sub-system. The transfer includes the addressing of the input points and the analogue signal conversion.

Usually expressed as points per second, the transfer rate is effected by the method of point selection. Therefore, state the system transfer rate for :

a) a random address;

b) a sequential address;

c) a revisited address.

6.4.3.1.2 Accuracy (accuracy rating)

State the accuracy rating of the sub-system, i.e. the limit that errors will not exceed when the subsystem is used, under specified operating conditions.

6.4.3.1.3 Linearity (terminal-based)

State the terminal-based linearity error, as a percentage of span, which each analogue input channel will not exceed.

6.4.3.1.4 Repeatability

State the 3 S.D. (S.D. being the standard deviation) limit on the error (nonrepeatibility) that occurs for a given value of input for repeated conversions under the same operating conditions.

6.4.3.1.5 Warm-up period (turn-on stabilization time)

State the time required after energizing the sub-system before the rated performance characteristics apply.

6.4.3.1.6 Common mode rejection

State, for d.c. and a.c. (sinusoidal) at line and higher frequencies, the ability of the analogue input channels to discriminate against common mode voltage, as a ratio or in decibels at the maximum common mode voltage.

State the effect of changes in source impedance unbalance on common mode rejection.

6.4.3.1.7 Normal mode rejection

State the ability of the analogue input channels to discriminate against a normal mode voltage as a ratio or in decibels, both at line and higher frequencies.

6.4.3.1.8 Crosstalk

a) d.c. crosstalk

State the maximum error for interaction with other input channels;

b) common mode crosstalk

State the maximum error of a given analogue input channel caused by common mode voltage applied to an adjacent channel;

c) gain-change crosstalk

For a sub-system with channel gain changing capability, state the effect on the next sequenced channel, due to a difference in gain of the adjacent channel;

d) input overload crosstalk

State the maximum error of an overloaded input channel on the output reading of subsequent channels. State the over-range (overload) value that causes this error.

6.4.3.1.9 Recovery time from overload

State the recovery time from saturation of a given channel before the rated performance parameters apply.

6.4.3.1.10 Drift

State the maximum drift error that can occur, short term (i.e., percentage per day) and, long term (i.e., percentage per month), when the same input is measured under reference operating conditions after a specified time interval.

6.4.3.1.11 Settling time

State the time period from the step change (10 to 90 %) of input signal to the time when the output settles within a 2 % band about the final steady state value.

6.4.3.2 Input channel amplifier

State the types of input channel amplifier and the type of their inputs :

a) single ended non-isolated;

b) single ended isolated;

c) differential non-isolated;

d) differential isolated;

e) other.

State the configuration of the input channel amplifier in the input circuit. Indicate whether there is a unique amplifier for each analogue input, each group of inputs, or a single amplifier for the sub-system.

State the signal span for each type of input amplifier.

If the input amplifier has multiple ranges, state the signal span for each range. State if the range is determined by a hardware adjustment, is changeable by programming or is automatically changed by the signal level (auto-ranging).

6.4.3.3 Multiplexer

State the type of multiplexer (i.e. relay, FET, static switch) incorporated in the sub-system. Give also the configuration of the multiplexer in the input scheme.

6.4.3.4 Input filter

Describe the type of input filter used and the frequency ranges which may be rejected by the filter. Describe the technique(s) used to eliminate power line frequencies. Include a diagram if necessary.

6.4.3.5 A/D converter

State the type of A/D converter used in the sub-system and resolution available. Indicate if bipolar capabilities are available.

State the conversion time and the conversion rate of the A/D converter used.

If there is more than one A/D converter, state the number and describe their function in the system.

State also whether an interrupt signal will be created after the A/D conversion is completed.

6.4.3.6 Sample and hold

State whether a sample and hold technique is used.

6.4.4 Security

6.4.4.1 Open circuit detection

State if sub-system has open circuit detection of input and the type or reference to diagram.

6.4.4.2 Internal protection

State the methods used to protect the sub-system from internal failures. Such a protective feature could be in the form of power supply overvoltage and overcurrent limiting. It might also take the form of logic error checking as a verification of point (address) selection or A/D conversion time.

6.4.4.3 Validity check

State whether input channels can be used for verification of the proper operation of the sub-system. This could take the form of reference voltages connected to designated channels and frequently checked to ensure that the converted values fall within the prescribed operating limits.

If a validity check feature is incorporated within the design, state whether this feature is hardware designated, may be altered by program, or requires any additional wiring and equipment.

6.4.4.4 Diagnostic and self-testing functions

State the capability of the analogue input sub-system to diagnose internal faults and indicate them by a status signal. State whether this is possible in an on-line configuration or available only when the hardware is operating in a testing mode. State also if any test features, such as manual switches for data, address, or control functions, have been incorporated.

6.5 Form 5 — Analogue outputs

6.5.1 Technical process boundary — Parameters of technical process

6.5.1.1 Load impedance

State the impedance of the technical process at the terminals of an output and any special features of the technical process that may be required.

6.5.1.2 Signal grounding and shielding

For each type of analogue output channel state the grounding and shielding practice required. Use diagrams where necessary.

6.5.2 Technical process boundary — Parameters of sub-system

6.5.2.1 Type of analogue output

State the type of analogue output :

a) voltage;

b) current;

c) other outputs.

6.5.2.2 Output circuit

State a reference to a general diagram of the analogue output circuit.

6.5.2.3 Output impedance

State the minimum and maximum value of output impedance for each analogue output channel both when the power is on, and when the power is off, during the period when the channel is selected.

6.5.2.4 Output signal

a) Direct output

State maximum and minimum values of output signal range;

b) Incremental output

State the minimum and maximum increment of output signal.

6.5.2.5 Output noise

State the output noise level as a percentage of span of output signal for the stated frequency values or band (d.c. to .... Hz).

6.5.3 Sub-system

6.5.3.1 *Performance parameters*

The performance parameters are fundamental and application-independent. They are the parameters which are needed to calculate system error for any specific application, or to evaluate the sub-system for general application.

The performance parameters for the reference operating conditions shall be stated on the form. It is also necessary to state the performance parameters for each operating condition at maximum, and at minimum value with the other operating conditions at reference value. This can be shown on further copies of this page of the form or in tabular form.

6.5.3.1.1 Transfer rate

The transfer rate is the rate at which analogue signals are transferred from the sub-system to the output points. The transfer includes the addressing of the output points and the A/D signal conversion. This rate includes the transient behaviour of the output amplifier. Usually expressed as points per second, the transfer rate is affected by the method of output point selection. Therefore state the system transfer rate for :

a) a random address;

b) a sequential address;

c) a revisit address.

6.5.3.1.2 Accuracy (accuracy rating)

State the accuracy rating of the sub-system i.e. the limit that errors will not exceed when the subsystem is used, under specified operation conditions.

6.5.3.1.3 Linearity (terminal-based)

State the terminal-based linearity error as a percentage of span, which each analogue output channel will not exceed.

6.5.3.1.4 Repeatability

State the 3 S.D. (S.D. being the standard deviation) limit on the error (non-repeatability) that occurs for a given value of input for repeated conversions under the same operating conditions.

6.5.3.1.5 Warm-up period (turn-on stabilization time)

State the time required after energizing the device before the rated performance characteristics apply. Give the corresponding error as a percentage.

6.5.3.1.6 Common mode rejection

State for d.c. and a.c. (sinusoidal) at line and higher frequencies, the ability of the analogue output channels to discriminate against common mode voltage, as a ratio or in decibels at the maximum common mode voltage.

State the effect of changes in load impedance unbalance on common mode rejection.

6.5.3.1.7 Normal mode rejection

State the ability of the analogue output channels to descriminate against a normal mode voltage, as a ratio or in decibels, both at line and higher frequencies. Also state the maximum allowable a.c. normal mode voltage (peak to peak).

6.5.3.1.8 Crosstalk

a) D.C. crosstalk

State the maximum error for interaction with other output channels;

b) common mode crosstalk

Indicate the maximum error of a given analogue output channel caused by common mode voltage applied to an adjacent channel;

c) A.C. crosstalk

State the steady-state value of the a.c. crosstalk for each channel with a resistive load when the other channels output a zero value voltage.

State the value of a.c. crosstalk for each channel with resistive load, when other channels are switched between the extreme values of the output signal at the maximum rate.

6.5.3.1.9 Recovery time from overload

State the recovery time from saturation of a given channel before the rated performance parameters apply.

6.5.3.1.10 Drift

State the maximum drift error that can occur, short term (i.e., percentage per day), and long term (i.e., percentage per month), when the same output is measured under reference operating conditions after a specified time interval.

6.5.3.1.11 Output voltage droop rate

This rate is a measure of the time dependency of the analogue output signal when the final output element is a sample-and-hold (analogue-memory).

State the output voltage droop rate as a percentage of span per second. If necessary state the short and long-time droop rate.

6.5.3.1.12 Settling time

The settling time is measured from the instance of receipt of the output command by the sub-system, until 90 % of output signal value is reached. State the maximum, nominal and minimum time required for the specified output circuit.

6.5.3.2 Output channel amplifier

State the types of amplifiers and their type of output :

a) single ended non-isolated;

b) single ended isolated;

c) differential non-isolated;

d) differential isolated;

e) other.

State the configuration of the output channel amplifier in the output circuit. Indicate whether there is an amplifier for each analogue output point, each group of output points, or a single amplifier for the sub-system (analogue memory).

State the signal span that is available with each type of output amplifier.

If the output amplifier has multiple range capabilities, give the signal span of each range. State if the range is determined by a hardware adjustment or is changeable by programming.

6.5.3.3 Demultiplexer

State the type of the demultiplexer incorporated in the analogue output unit. Give also the configuration of the demultiplexer in the output scheme.

6.5.3.4 Output filter

Describe the type of output filter used to suppress the output noise and the frequency ranges which may be rejected by the filter. Describe the technique(s) used to eliminate power line frequencies. Include a diagram if necessary.

6.5.3.5 D/A converter

State the type of D/A converter used in the system and the resolution available. Indicate if bipolar capabilities are available.

If more than one D/A converter is present in the sub-system, state the number and describe their function in the system.

6.5.3.6 Output buffer

State whether the output buffer is digital or analogue.

6.5.4 Security

6.5.4.1 Internal protection

State the method used to protect the analogue output system from internal failures. Such a protective feature could be in the form of power supply overvoltage and overcurrent limiting. It might also take the form of logic error checking as a verification of point (address) selection.

6.5.4.2 Validity check

State whether a given point(s) can be used for verification of the proper operation of the analogue output system. This could take the form of feedbacking an analogue output point to an analogue input point.

If validity check feature is incorporated within the design, state whether this feature is hardware designated, may be altered by program or requires any additional wiring and equipment.

6.5.4.3 Diagnostic and self-testing functions

State the capability of the analogue output hardware to diagnose internal faults and indicate these faults by a status signal. State whether this is possible in an on-line configuration or available only when the hardware is operating in a testing mode.

State also if any test features such as manual switches for data, addresses or control functions, have been incorporated.

6.5.4.4 Conditions on power failure and recovery

State whether, under a power failure condition, the value of the output signal persists or fails safe. Also state the conditions upon restoration of power and prior to any change or clear condition issued by the process computer system or external controlling logic.

7 Forms

7.1 Form 1 — General

Clause	Parameter	Specification	Notes
6.1	Block diagram reference		
6.1.1	Compatibility of process computer systems		
6.1.2	Environmental conditions		
	a) temperature	..... to ..... °C	
	b) humidity	..... to ..... % RH	
	e) vibration	..... mm, ... to ..... Hz	
	d) shock	..... g, ... to ..... Hz	
6.1.3	Operating conditions		
	a) temperature	..... to ..... °C	
	b) humidity	..... to ..... % RH	
	c) vibration	..... mm, ... to ..... Hz	
	d) shock	..... g, ... to ..... Hz	
	e) dust	..... g, ... ms	
	f) supply voltage	..... to V	
	g) frequency of voltage supply	..... to ..... Hz	
	h) other conditions	.....	
6.1.4	Storage conditions		
	a) temperature	..... to ..... °C	
	b) humidity	..... to ..... % RH	
	c) vibration	..... mm, ... to ..... Hz	
	d) shock	..... g, ... to ..... Hz	
	e) dust	..... g, ... ms	
	f) other conditions	....	
6.1.5	Product safety specifications		
6.1.6	Power supply		
	a) voltage range	..... to V	
	b) frequency range	..... to ..... Hz	
	c) power consumption	.... W	
6.1.7	Power grounding		
6.1.8	Surge withstand capability		
6.1.9	Physical Specifications		
6.1.9.1	Size		
6.1.9.2	Weight		
6.1.10	Mounting		

NOTE — Form 1, page 1.

Form 1 (*concluded*)

Clause	Parameter	Specification	Notes
6.1.11	Terminations a) signal connection types wire size connector types and specifications cable types grounding facilities b) power connection types wire size location c) maximum distance between process interface sub-system and terminals		
6.1.12	Access requirements (For cable entry and for maintenance)		
6.1.13	Remarks		

NOTE — Form 1, page 2.

7.2 Form 2 — Digital inputs

Clause	Parameter	Specification	Notes
6.2.1	Technical process boundary — Parameters of technical process		
6.2.1.1	Type of signal parameters		
	Logic 1 — signal at steady state : a.c./d.c.	a.c. ..... Hz, d.c. ( )	
		min. nom. max.	
	a) voltage	..... V ..... V V	
	b) current	..... mA ..... mA ..... mA	
	c) resistance	..... Ω ..... Ω ..... Ω	
	Logic 0 — signal at steady state : a.c./d.c.	a.c. ..... Hz, d.c. ( )	
		min. nom. max.	
	a) voltage	..... V ..... V V	
	b) current	..... mA ..... mA ..... mA	
	c) resistance	..... Ω ..... Ω ..... Ω	
6.2.1.2	Type of contact	mechanical ( ) electronic ( )	
6.2.1.3	Maximum common mode voltage	 V	
6.2.1.4	Maximum normal mode voltage	 V	
6.2.1.5	Maximum operating common mode voltage	 V	
6.2.1.6	Maximum operating normal mode voltage	 V	
6.2.1.7	Maximum allowable common mode overvoltage	 V	
6.2.1.8	Maximum allowable normal mode overvoltage	 V	
6.2.2	Technical process boundary — Parameters of sub-system		
6.2.2.1	Performance mode	Logic state ( ) Transition ( ) Latch ( ) Pulse duration ( ) Pulse count ( )	
6.2.2.2	Input circuit diagram	....	
6.2.2.3	Recognition time of signal logic state	min. nom. max.	
	a) logic 0	..... μs ..... μs ..... μs	
	b) logic 1	..... μs ..... μs ..... μs	

NOTE — Form 2, page 1.

Form 2 (*continued*)

Clause	Parameter	Specification	Notes
6.2.2.4	Recognition time of signal transition between logic states :	min. nom. max.	
	a) with 0 → 1 transition	..... µs ..... µs ..... µs	
	b) with 1 → 0 transition	..... µs ..... µs ..... µs	
	c) duration	..... µs min.	
	d) recovery time	..... µs max.	
6.2.2.5	Pulse recognition		
	a) pulse duration	..... µs min.	
	b) leading edge	..... V/s min.	
	c) pulse height	..... V min.	
	d) trailing edge rate	..... V/s min.	
	e) recovery time	..... µs max.	
6.2.2.6	Pulse counting		
	a) counter activation	0 →1 ( ) 1 →0 ( )	
	b) counter presetting	Yes ( ) No ( )	
	c) counting direction	increasing ( ) decreasing ( )	
	d) content of counter which causes interruption	.....	
	e) counter cascading possibility	Yes ( ) No ( )	
6.2.2.7	Pulse duration measurement	Yes ( ) No ( )	
	a) duration range	..... to ..... µs	
	b) resolution accuracy	.....	
	c) repeatability	.....	
6.2.2.8	Contact interrogation		
	a) signal	a.c. ( ) d.c. ( ) pulse ( )	
	b) shape parameter	.....	
	c) contact-bounce suppression at short settling times	.....	
	d) function of contact protection	.....	
6.2.3	Process computer system boundary — Parameters of sub-system		
6.2.3.1	Data string coding		
	a) bit string organization		
	b) address coding		
	c) data coding		

NOTE — Form 2, page 2.

Form 2 (*continued*)

Clause	Parameter	Specification	Notes
6.2.4	Process computer system boundary — Parameters of process computer system		
6.2.4.1	Highway a) type b) organization — address part — data part — control part		
6.2.5	Sub-system		
6.2.5.1	Transfer rate		
6.2.5.1.1	Transfer time interval	..... µs	
6.2.5.1.2	Maximum transfer rate a) fixed transfer address b) changing transfer address	 ..... /s ..... /s	
6.2.5.2	Electrical isolation method	Yes ( ) No ( )	
6.2.5.3	Grouping isolation a) method b) grouping	Yes ( ) No ( ) individual ( ) grouped ( ) ..... inputs/group	
6.2.5.4	Filter availability time constant	Yes ( ) No ( )	
6.2.5.5	Contact interrogation power supply a) provided by b) number of input points c) monitoring	 vendor ( ) purchaser ( ) .... Yes ( ) No ( )	
6.2.5.6	Modularity a) capacity : inputs b) number of inputs/card c) number of cards/box d) number of boxes/input unit	 ..... max. ..... max. ..... max. ..... max.	
6.2.6	**Security**		
6.2.6.1	Internal protection method	Yes ( ) No ( )	
6.2.6.2	Validity check input word usable	Yes ( ) No ( ) Yes ( ) No ( ) fixed ( ) programmable ( )	

NOTE — Form 2, page 3.

Form 2 (*concluded*)

Clause	Parameter	Specification	Notes
6.2.6.3	Diagnostic and self-testing functions	Yes ( ) No ( )	
	a) method	on-line ( ) in testing mode ( )	
	b) test features	....	
6.2.6.4	Monitoring of power supply		
	a) sub-system power supply		
	— detection of malfunction	Yes ( ) No ( )	
	— recovery from malfunction	Yes ( ) No ( )	
	b) interrogation power supply		
	— detection of malfunction	Yes ( ) No ( )	
6.2.6.5	Other security functions	....	
6.2.7	Remarks		

NOTE — Form 2, page 4.

7.3 Form 3 — Digital outputs

Clause	Parameter	Specification	Notes
6.3.1	Technical process boundary — Parameters of technical process		
6.3.1.1	Output circuit	min. max.	
	a) load current	..... mA ..... mA	
	b) load voltage	..... V V	
	c) apparent power	..... V·A	
	d) maximum capacity load	..... µF	
	e) maximum inductive load	..... mH	
	f) diagram	....	
6.3.2	Technical process boundary — Parameters of sub-system		
6.2.1.3	Maximum common mode voltage	 V	
6.2.1.4	Maximum normal mode voltage	 V	
6.2.1.5	Maximum operating common mode voltage	 V	
6.2.1.6	Maximum operating normal mode voltage	 V	
6.2.1.7	Maximum allowable common mode overvoltage	 V	
6.2.1.8	Maximum allowable normal mode overvoltage	 V	
6.3.2.1	Type of digital output		
6.3.2.2	Performance mode	logic state ( ) state transition ( )	
6.3.2.3	Logic states of digital output signals	pulse ( ) pulse train ( )	
	Logic 1 — signal at steady state : a.c./d.c.	a.c. ..... Hz, d.c. ( )	
		min. nom. max.	
	a) voltage	..... V ..... V V	
	b) current	..... mA ..... mA ..... mA	
	c) resistance	..... Ω ..... Ω ..... Ω	
	Logic 0 — signal at steady state : a.c./d.c.	a.c. ..... Hz, d.c. ( )	
		min. nom. max.	
	a) voltage	..... V ..... V V	
	b) current	..... mA ..... mA ..... mA	
	c) resistance	..... Ω ..... Ω ..... Ω	

NOTE — Form 3, page 1.

Form 3 (*continued*)

Clause	Parameter	Specification	Notes
6.3.2.4	Settling time	min. nom. max.	
	a) with 0 → 1 transition	..... µs ..... µs ..... µs	
	b) with 1 → 0 transition	..... µs ..... µs ..... µs	
6.3.2.5	Pulse output		
	type of output	single pulse ( ) pulse train ( ) pulse duration ( )	
6.3.2.6	Single pulse output		
	a) pulse duration	..... µs min.	
	b) rising edge	..... V/µs	
	c) height	 V	
	d) falling edge rate	..... V/µs	
	e) recovery time	..... µs	
6.3.2.7	Pulse train output		
	a) number of pulses per transfer	..... max.	
	b) period of unit pulse	..... to ..... ms	
	c) selection of unit pulse period	fixed ( ) variable ( ) programmable ( ) hardware adjustable ( )	
6.3.2.8	Pulse duration output		
	a) duration range	..... to ..... ms	
	b) resolution accuracy		
	c) stability		
6.3.2.9	Type of contact	mechanical ( ) electronic ( )	
	life time	..... operations	
6.3.2.10	Contact bounce	..... ms max.	
6.2.3	Process computer system boundary — Parameters of sub-system		
6.2.3.1	Data string coding		
	a) bit string organization		
	b) address coding		
	c) data coding		
6.2.4	Process computer system boundary — Parameters of process computer system		
6.2.4.1	Highway		
	a) type		
	b) organization		
	— address part		
	— data part		
	— control part		

NOTE — Form 3, page 2.

Form 3 (*concluded*)

Clause	Parameter	Specification	Notes
6.3.3	Sub-system		
6.3.3.1	Transfer rate		
6.3.3.1.1	Transfer time interval	..... µs	
6.3.3.1.2	Maximum transfer rate		
	fixed transfer address	..... /s	
	changing transfer address	..... /s	
6.3.3.2	Contact protection	Yes ( ) No ( )	
6.2.5.2	Electrical isolation	Yes ( ) No ( )	
	method	....	
6.2.5.3	Grouping isolation	Yes ( ) No ( )	
	a) method	individual ( ) grouped ( )	
	b) grouping	..... outputs/group	
6.2.5.4	Filter available	Yes ( ) No ( )	
6.2.5.6	Modularity		
	a) capacity : outputs	..... max.	
	b) number of outputs/card	..... max.	
	c) number of cards/box	..... max.	
	d) number of boxes/output unit	..... max.	
6.3.4	Security		
6.3.4.1	Internal protection	Yes ( ) No ( )	
	method	....	
6.3.4.2	Validity check	Yes ( ) No ( ) fixed ( ) programmable ( )	
6.3.4.3	Diagnostic and self-testing functions	Yes ( ) No ( )	
	a) method	on-line ( ) in testing mode ( )	
	b) test features	....	
6.3.4.4	Conditions on power failure and recovery	volatile ( ) non-volatile ( ) state "1" ( ) state "0" ( ) undefined ( )	
6.2.7	Remarks		

NOTE — Form 3, page 3.

7.4 Form 4 — Analogue input

Clause	Parameter	Specification	Notes
6.4.1	Technical process boundary — Parameters of technical process		
6.4.1.1	Type of input	Voltage ( ) Current ( ) Thermocouple ( ) Resistance ( )	
	Span of signal	..... to	
	Reference function compensation	Yes ( ) No ( )	
	Number of lead wires	....	
	Bridge type input	Yes ( ) No ( )	
	Source impedance		
	a) resistance	..... Ω	
	b) inductance	..... mH	
	c) capacitance	..... μF	
6.4.1.2	Maximum source impedance	....	
6.4.1.3	Signal grounding and shielding diagram	....	
6.2.1.3	Maximum common mode voltage	 V	
6.2.1.4	Maximum normal mode voltage	 V	
6.2.1.5	Maximum operating common mode voltage	 V	
6.2.1.6	Maximum operating normal mode voltage	 V	
6.2.1.7	Maximum allowable common mode overvoltage	 V	
6.2.1.8	Maximum allowable normal mode overvoltage	 V	
6.4.2	Technical process boundary — Parameters of sub-system		
6.4.2.1	Input circuit diagram		
6.4.2.2	Input protection	Yes ( ) No ( )	
6.4.2.3	Effective input impedance		
	a) Power ON	....	
	b) Power OFF	....	
6.2.3	Process computer system boundary — Parameters of sub-system		
6.2.3.1	Data string coding		
	a) bit string organization		
	b) address coding		
	c) data coding		

NOTE — Form 4, page 1.

Form 4 (*continued*)

Clause	Parameter	Specification	Notes
6.2.4	Process computer system boundary — Parameters of process computer system		
6.2.4.1	Highway a) type b) organization — address part — data part — control part		
6.4.3	Sub-system		
6.4.3.1	Performance parameters		
6.4.3.1.1	Transfer rate a) at random address b) at sequential address c) at revisited address	 ...../s ...../s ...../s	
6.4.3.1.2	Accuracy (accuracy rating)	.....	
6.4.3.1.3	Linearity (terminal-based)	..... %	
6.4.3.1.4	Repeatability	..... %	
6.4.3.1.5	Warm-up period	..... s	
6.4.3.1.6	Common mode rejection a) d.c. b) a.c. (line frequency) c) a.c. (higher frequency)	 ..... dB ..... dB ..... dB ..... Hz	
6.4.3.1.7	Normal mode rejection a) a.c. (line frequency) b) a.c. (higher frequency)	 ..... dB ..... dB ..... Hz	
6.4.3.1.8	Crosstalk a) d.c. crosstalk b) common mode crosstalk c) gain-change crosstalk d) input overload crosstalk	 ..... % ..... % ..... % ..... %	
6.4.3.1.9	Recovery time from overload	..... s	

NOTE — Form 4, page 2.

Form 4 (*continued*)

Clause	Parameter	Specification	Notes
6.4.3.1.10	Drift		
	a) short term	..... %/day	
	b) long term	..... %/month	
6.4.3.1.11	Settling time	..... µs	
6.4.3.2	Input channel amplifier		
	a) type of input and span	single ended non-isolated ( ) single ended isolated ( ) differential non-isolated ( ) differential isolated ( )	
	b) ranges and spans available for multiple-range amplifier		
	c) change of range	programmable ( ) fixed gain ( ) auto-ranging ( )	
6.4.3.3	Multiplexer		
	a) type	....	
	b) configuration	.....	
6.4.3.4	Input filter		
	a) type	....	
	b) frequency range	..... Hz	
	c) technique to eliminate power line frequencies	....	
6.4.3.5	A/D converter		
	a) type	....	
	b) resolution	..... bit	
	c) bipolar capability	Yes ( ) No ( )	
	d) conversion time	..... µs	
	e) conversion rate	...../s	
	f) number of A/D's	....	
	g) interrupt signal after completion of conversion	Yes ( ) No ( )	
6.4.3.6	Sample and hold	Yes ( ) No ( )	
6.2.5.2	Electrical isolation	Yes ( ) No ( )	
	method	....	
6.2.5.3	Grouping isolation	Yes ( ) No ( )	
	a) method	individual ( ) grouped ( )	
	b) grouping	..... inputs/group	

NOTE — Form 4, page 3.