IEC 61003-1

Edition 3.0 2016-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Industrial-process control systems – Instruments with analogue inputs and two- or multi-position outputs –
Part 1: Methods for evaluating performance

Systèmes de commande de processus industriels – Instruments avec entrées analogiques et sorties à deux ou plusieurs positions –
Partie 1: Méthodes d'évaluation des performances

IEC 61003-1:2016-06(en-fr)

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Part 1: Methods for evaluating performance

FOREWORD

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International Standard IEC 61003-1 has been prepared by subcommittee SC 65B: Measurement and control devices, of IEC technical committee TC 65: Industrial-process measurement, control and automation.

This third edition cancels and replaces the second edition published in 2004. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) use of the term "two-position output" instead of "two-state instrument" (see 3.2);
b) use of the term "differential gap" instead of "switching differential" (see 3.4);
c) use of "fast transient/burst immunity requirements" instead of "power supply transient overvoltages", and revision of the test method (see 6.2.10);

d) deletion of 6.2.12 “common mode interference” and 6.2.13 “normal mode interference (series mode) ”tests of the previous edition;

e) use of the term “electromagnetic field” instead of “radiated electromagnetic interference”, the test method remained the same (see 6.2.16);

f) use of the term “dielectric strength” instead of “isolation test”, and revision of the reference (see 6.3.4);

g) deletion of Subclauses “8.2 Design features”, “10.1 Routine maintenance and adjustment” and “10.2 Repair” of the previous edition.

The text of this standard is based on the following documents:

FDIS	Report on voting
65B/1040/FDIS	65B/1050/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 61003 series, published under the general title *Industrial-process control systems – Instruments with analogue inputs and two or multi-position outputs*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

The methods of evaluation specified in this part of IEC 61003 are intended for use by manufacturers to determine the performance of their products and by users, or independent testing establishments, to verify the manufacturer's performance specifications.

The test conditions in this standard, for example the range of ambient temperatures and power supply, represent those, which commonly arise in use.

The tests specified in this standard are not necessarily sufficient for instruments specifically designed for unusually arduous duties. Conversely, a restricted series of tests may be suitable for instruments designed to perform within a more limited range of conditions.

It will be appreciated that the closest communication should be maintained between the evaluating body and the manufacturer. Note should be taken of the manufacturer's specifications for the instrument, when the test program is being decided, and the manufacturer should be invited to comment on both the test program and the results. His comments on the results should be included in any report produced by the testing organization.

INDUSTRIAL-PROCESS CONTROL SYSTEMS – INSTRUMENTS WITH ANALOGUE INPUTS AND TWO- OR MULTI-POSITION OUTPUTS –

Part 1: Methods for evaluating performance

1 Scope

This part of IEC 61003 is applicable to pneumatic and electric industrial-process instruments or control device using measured values that are continuous signals either a mechanical (position, force, etc.) or a standard electric signal.

These instruments or process control systems modules may be used as controllers or as switches for alarm and other similar purposes.

Electronic product safety issues may impact only a few products covered by this document. Consequently this document does not address such safety issues.

This standard is intended to specify uniform terminologies and testing methods for performance evaluation of industrial-process instruments or process control systems modules with analogue measured values and two- or multi-position outputs.

Considerations other than the performances are listed in Clause 10.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at <http://www.electropedia.org>)

IEC 60050-300, *International Electrotechnical Vocabulary – Electrical and electronic measurements and measuring instruments* (comprising Parts 311, 312, 313 and 314)

IEC 60050-351, *International Electrotechnical Vocabulary – Part 351: Control technology*

IEC 61298-1:2008, *Process measurement and control devices – General methods and procedures for evaluating performance – Part 1: General considerations*

IEC 61298-2:2008, *Process measurement and control devices – General methods and procedures for evaluating performance – Part 2: Tests under reference conditions*

IEC 61298-3:2008, *Process measurement and control devices – General methods and procedures for evaluating performance – Part 3: Tests for the effects of influence quantities*

IEC 61298-4, *Process measurement and control devices – General methods and procedures for evaluating performance – Part 4: Evaluation report content*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-300, IEC 60050-351, IEC 61298-2 and the following apply.

3.1
switching point
x_i
measured value (with the input moving either upscale or downscale), at which the output (y) changes from one position to another

3.2
two-position output
output variable which may assume one of two discrete values

EXAMPLE

Action illustrated in Figure 1, where x is the value of the input variable and y is the value of the output signal.

The two-position output, having one pair of switching points x_1 and x_2 (x_2 greater than x_1) has the relationships:

$$y = \begin{cases} y_1, x < x_1 \\ y_2, x > x_2 \end{cases}$$

For $x_1 < x < x_2$, y may be either y_1 or y_2.

It is y_1 if the last switching point crossed by x was x_1.

It is y_2 if the last switching point crossed by x was x_2.

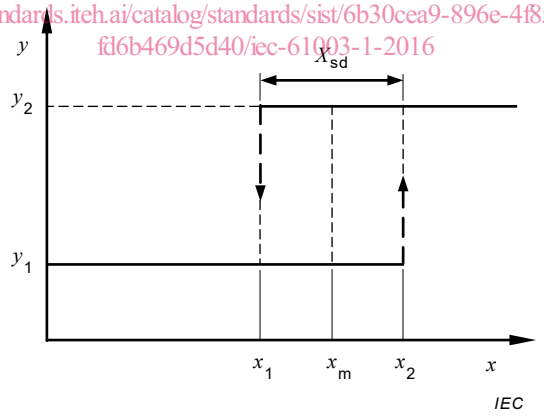

Figure 1 – Action of two-position output

3.3
multi-position output
output variable which may assume any of a set of discrete values

EXAMPLE

A multi-position output has n possible output values and n-1 pairs of switching points, (see Figure 2, a three-position output). Each pair of switching points may be investigated by the procedure given for the two-position output.

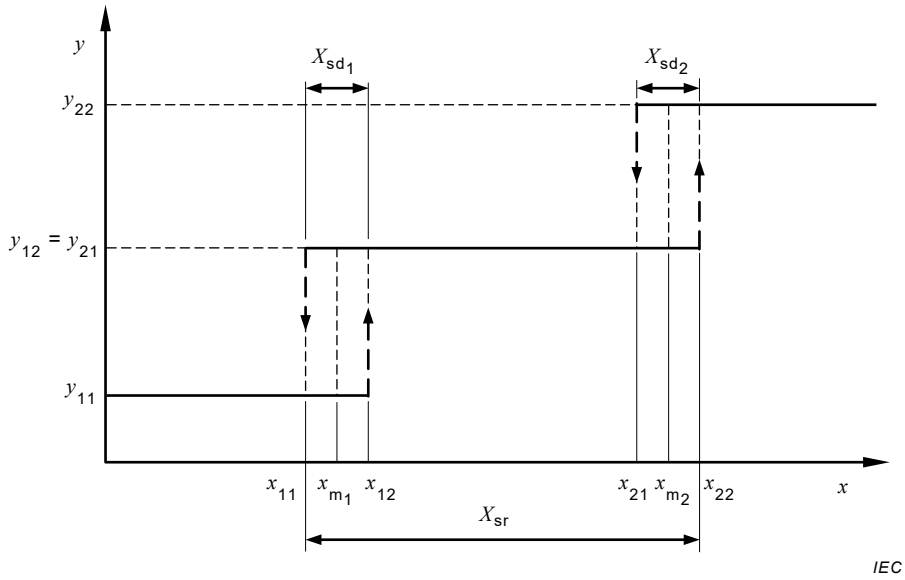

Figure 2 – Action of three-position output

3.4
differential gap
X_{sd}
absolute value of difference between the switching point x_2 with the measured value moving upscale and the switching point x_1 with the measured value moving downscale

SEE: Figure 1 and Figure 2.

3.5
mean switching point
x_m
mean of the values of upscale and downscale switching points

SEE: Figure 1 and Figure 2.

3.6
switching range
X_{sr}
in a multi-position output, range of measured values corresponding to the extreme switching points

SEE: Figure 2.

3.7
set point
w
point value at which it is desired that switching (at x_2 or x_1 as specified) should occur

4 General conditions for tests

4.1 Documentary information

4.1.1 General reference documents

For the purpose of this standard, the general test conditions (e.g. environmental test conditions, supply conditions, load conditions, mounting position, externally induced

vibrations, external mechanical constraints, and delivery of the instrument) specified in Clause 6 of IEC 61298-1:2008 apply, together with Clause 4 of this part of IEC 61003.

The general testing procedures and precautions, specified in Clause 7 of IEC 61298-1:2008, shall be applied, together with Clause 5 of this part of IEC 61003.

The tests general methods and procedures – if any – specified in IEC 61298-2 and IEC 61298-3 apply, together with Clause 6 of this part of IEC 61003.

4.1.2 Collect data

The manufacturer shall supply to the evaluating body information for installation, commissioning, operation, routine maintenance and repair of the instrument. A spare parts list, together with a recommendation of the spare parts to be held in stock, shall be supplied. The language of written information for installation should be primary or accepted language of the country where implemented.

Installation and use guidelines including diagrams, operation instructions, spare parts requirements, and all specifications should be clearly stated.

Additionally, any certificates indicating the degree of intrinsic safety and flameproofing, etc. of electrically powered instruments should be listed. This information should give details of the certificate numbers and the degree of protection provided.

Procedures for installation, routine maintenance and adjustment, repairs and overhaul should be examined by the actual performance of the required operation. This should be performed in accordance with the manufacturer's instructions, so that an evaluation of the instructions can be carried out concurrently.

4.2 Electrical safety

Electrically powered instruments should be examined to determine the degree to which their design protects them against accidental electric shock.

4.3 Installation

The instrument should be installed and set to work according to the manufacturer's instructions, taking account of the various applications which may be met in practice and which require different procedures.

4.4 Supply conditions

Tolerances on supply conditions for mains supplied equipment are given in 6.2.2 of IEC 61298-1:2008. For instruments with self-contained power supplies (e.g. battery-powered) the tolerances are different and shall be agreed.

5 General testing procedures and precautions

5.1 Checking of calibration made prior to delivery

The input-output characteristic that shall be checked (see 7.6 of IEC 61298-1:2008) is the values of the switching points x_1 and x_2 found during the calibration (if any) made prior to delivery.

5.2 Set point

Except where otherwise specified, the set point shall be set to the midscale value or, where no scale is provided, to the middle of the effective range of adjustment.

5.3 Differential gap

Except where otherwise specified, if the differential gap X_{sd} is adjustable, it shall be set to the midscale value or, where no scale is provided, to the middle of the effective range of adjustment.

6 Test methods and procedures

6.1 Tests under reference conditions

6.1.1 Switching accuracy related factors

6.1.1.1 General

The general test description refers to 4.1.7 of IEC 61298-2:2008.

The input measured value x shall be varied slowly at least five times in each direction through its entire range. By observation of the output, the values of points x_1 and x_2 and their average shall be determined.

For each cycle, the individual differential gap $| x_1 - x_2 |$ shall be noted.

6.1.1.2 Inaccuracy of switching points

The general test description refers to 4.1.7.1 of IEC 61298-2:2008.

Switching point inaccuracy is determined by selecting the greatest positive and negative deviations of any measured value of x_1 and x_2, of any cycle, from the set point w for increasing and decreasing inputs.

This should be reported in percent of nominal span of measured value.

6.1.1.3 Non-repeatability of switching points

The general test description refers to 4.1.7.6 of IEC 61298-2:2008.

Non-repeatability shall be computed observing the range, in percent of nominal span of measured value, among all x_1 values and among all x_2 values.

The maximum value, from either the x_1 range or the x_2 range, is reported as non-repeatability.

6.1.1.4 Inaccuracy of differential gap

The general test description refers to 4.1.7.1 of IEC 61298-2:2008.

The differential gap X_{sd} is calculated by subtracting the average value of x_1 from the average value of x_2 (see 6.1.1).

Differential gap inaccuracy is determined by selecting the greatest positive and negative deviations of any measured value of the individual differential gaps – calculated in each of the five cycles – from the X_{sd}.

Reporting this in percent of the nominal span of measured value.

6.1.1.5 Non-repeatability of differential gap

The general test description refers to 4.1.7.6 of IEC 61298-2:2008.

Non-repeatability shall be computed calculating the differences, in percent of the nominal span of measured value, among all individual differential gap values noted in 6.1.1.

The maximum of those values is reported as non-repeatability of differential gap.

6.1.2 Mean switching point

Mean switching point x_m is calculated as the mean of the average values of x_1 and x_2 (see 6.1.1.1).

6.1.3 Set point

6.1.3.1 Set point adjustable and measurable or indicated

The general test description refers to 4.1.7.1 and 4.1.7.6 of IEC 61298-2:2008.

Determine values of x_1, x_2 and X_{sd}, and their accuracy-related factors, in accordance with the test procedures in 6.1.1.1, at least for values of w of 10 %, 50 % and 90 %, the 50 % value being taken last.

Determine values of x_m, in accordance with the test procedures in 6.1.2.

The inaccuracy of set point setting is determined by selecting the greatest positive and negative deviations of any measured value of x_m from the ideal set-point value for each cycle and for each set point.

6.1.3.2 Set point adjustable but not indicated

The general test description refers to 4.1.7.1 and 4.1.7.6 of IEC 61298-2:2008.

Determine values of x_1, x_2 and X_{sd}, and their accuracy-related factors, in accordance with the test procedures in 6.1.1.1, and values of x_m, in accordance with the test procedures in 6.1.2.

Make this test, for at least three values of w, approximately evenly spaced over the effective range of adjustment, the approximately mid-value being taken last.

It is not necessary to determine $x_m - w$ in this case.

6.1.3.3 Set point not adjustable

The general test description refers to 4.1.7.1 and 4.1.7.6 of IEC 61298-2:2008.

Determine values of x_1, x_2 and X_{sd}, and their accuracy-related factors, in accordance with the test procedures in 6.1.1.1, and values of x_m, in accordance with the test procedures in 6.1.2.

The inaccuracy of set point setting is determined by selecting the greatest positive and negative deviations of any measured value of x_m from the value of w declared by the manufacturer. Reporting that in percent of the nominal span of measured value.

For two-position output with non-symmetrically adjustable differential gap (e.g. instruments where x_1 or x_2 instead of x_m is intended to be equal to w), the value of $x_1 - w$ or $x_2 - w$ instead of $x_m - w$ should be taken into account.

6.2 Tests for the effects of influence quantities

6.2.1 Ambient temperature

The general test description refers to Clause 5 of IEC 61298-3:2008.

The change in switching points shall be determined at each test temperature specified in 5.2 of IEC 61298-3:2008. For example: +20 °C (reference), +40 °C, +55 °C, +20 °C, 0 °C, –20 °C, +20 °C. After the first cycle, a second temperature cycle, identical to the first, shall be performed without readjustment of the instrument.

For instruments with a pneumatic output the air supply temperature shall be the same as the instrument temperature.

6.2.2 Humidity

The test shall be performed for electrical instruments only.

This test shall be performed according to the methods and procedures stated in Clause 6 of IEC 61298-3:2008, together with what is stated below.

After the stabilization at the reference relative humidity and temperature, a set of reference measurements shall be taken.

The power supply to the instrument shall be switched off and the relative humidity shall be increased as specified in Clause 6 of IEC 61298-3:2008.

The instrument shall be switched on for the final 4 h of the period in stable conditions and the change in switching points shall be measured immediately after this period.

As specified in Clause 6 of IEC 61298-3:2008, the relative humidity shall be reduced to the original reference value and, after stabilization, the effect of this test on the switching points shall be determined.

After this test, a visual inspection shall be conducted to check for effects of flashover, accumulation of condensation, deterioration of components.

6.2.3 Vibrations

The general test description refers to Clause 7 of IEC 61298-3:2008, together with the following additional requirements.

a) During the frequency sweeping, frequencies shall be noted, which cause significant changes in the switching points or spurious operation such as contact bounce.

   In order to measure the effect of vibrations on the switching behaviour, the sweeping shall be performed with the measured variable input set above the switching point x_2, or below the switching point x_1 to a distance that is twice the value of the differential gap X_{sd}, but not less than 1 % of nominal span of measured value.

   If, during the sweeping, switching occurs, the test shall be repeated with a larger difference between measured value input and switching point (at 0 Hz) until no switching is induced by vibration.

   The largest difference and the frequency, at which the last switching occurred, are to be noted.

b) Endurance conditioning by sweeping.

   The instrument shall be subjected to vibration for 30 min in each of three mutually perpendicular planes, one of which shall be the vertical direction. In each plane, the test shall be run at that frequency which resulted in the largest mechanical resonance during the initial resonance search, or if a resonance was not detected, the vibration frequency shall be swept continuously through the whole frequency range being considered.

c) Final resonance search 7.4 of IEC 61298-3:2008.

   The resonance frequencies, and the frequencies, which cause significant changes in the switching points, found in the initial resonance search and the final resonance search shall