BS EN 60546-2:2010

BSI Standards Publication

Controllers with analogue signals for use in industrial-process control systems

Part 2: Guidance for inspection and routine testing

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National foreword

This British Standard is the UK implementation of EN 60546-2:2010. It is identical to IEC 60546-2:2010. It supersedes BS EN 60546-2:1993, which will be withdrawn on 1 September 2013.

The UK participation in its preparation was entrusted by Technical Committee GEL/65, Measurement and control, to Subcommittee GEL/65/2, Elements of systems.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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English version

Controllers with analogue signals for use in industrial-process control systems - Part 2: Guidance for inspection and routine testing

(IEC 60546-2:2010)

Régulateurs à signaux analogiques utilisés pour les systèmes de conduite des processus industriels - Partie 2: Recommandations pour les essais d'inspection et les essais individuels de série (CEI 60546-2:2010)

Regler mit analogen Signalen für die Anwendung in Systemen der industriellen Prozesstechnik - Teil 2: Anleitung für die Abnahme- und Betriebsuntersuchung (IEC 60546-2:2010)

CENELEC

European Committee for Electrotechnical Standardization
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Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 65B/660/CDV, future edition 2 of IEC 60546-2, prepared by SC 65B, Devices & process analysis, of IEC TC 65, Industrial-process measurement, control and automation, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60546-2 on 2010-09-01.

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Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2011-06-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2013-09-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60546-2:2010 was approved by CENELEC as a European Standard without any modification.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60546-1	2010	Controllers with analogue signals for use in industrial-process control systems - Part 1: Methods of evaluating the performance	EN 60546-1	201X[1)]

[1)] At draft stage.

CONTENTS

CONTROLLERS WITH ANALOGUE SIGNALS FOR USE IN INDUSTRIAL-PROCESS CONTROL SYSTEMS –

Part 2: Guidance for inspection and routine testing

1 Scope

This International Standard applies to pneumatic and electrical industrial-process controllers using analogue signals which are in accordance with IEC 60381-1 and IEC 60381-2. The provisions of this standard are applicable in principle to controllers having different, but continuous signals.

This standard is intended to provide technical guidance for inspection and routine testing of controllers, for instance, as acceptance tests or after repair. For a full evaluation, IEC 60546-1 should be used. Quantitative criteria for acceptable performance are established by agreement between manufacturer and user. The requirements of this standard are effective when agreed upon by the manufacturer and the user.

2 Normative references

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

IEC 60546-1:___, *Controllers with analogue signals for use in industrial-process control systems – Part 1: Methods of evaluating the performance*[1]

3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions given in IEC 60546-1 apply.

3.1 Symbols used in this standard

t time

y output signal (see Figure 1)

y_0 output signal at time $t = 0$

x measured value (see Figure 1)

w set point value (see Figure 1)

X_P proportional band

T_I reset time

T_D rate time

K_P proportional action factor

K_I integral action factor

K_D derivative action factor

[1] To be published.

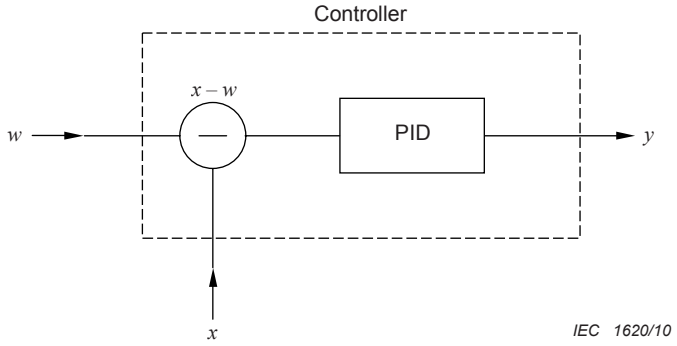


Figure 1 – Basic signals to/from an idealized controller

4 Sampling for test

If, by agreement between manufacturer and user, tests are to be performed on a sample lot, it is recommended that a sampling method such as presented in IEC 60410 be selected. When sampling is used, controllers to be tested may be chosen by the user's inspector.

5 Performance tests

5.1 General

Environmental conditions at the location of testing shall be recorded. Recommended conditions can be found in 5.1.1 of IEC 60546-1.

The following tests shall be performed.

5.2 **Tests of controller action** (only functions provided by test specimen need consideration)

5.2.1 **Offset** (full test: see Clause 6 of IEC 60546-1)

This test applies only to controllers with integral action.

a) Initial conditions

Closed loop according to Figure 2, switch position B. Reverse action.

X_p = 100 %, proportional band

T_I = minimum reset time

T_D = witched off, if possible, or at minimum rate time

b) Test procedure

Measure and record the offset, on the differential measuring device, for set point w = 50 %. Note x and w indications, and check corresponding scale indications, if existing. Repeat the measurement with w = 10 % and then w = 90 %.

5.2.2 **Proportional action** (full test: see 7.2 of IEC 60546-1)

The open loop circuit arrangement in Figure 2 is used with the switch in position A.

a) Initial conditions

Open loop according to Figure 2, switch position A.

X_p = 100 %, proportional band

Stabilize output y at 50 %.

T_I = switched off, if possible, or at maximum reset time after stabilization

T_D = switched off, if possible, or at minimum rate time

X = w = 50 %

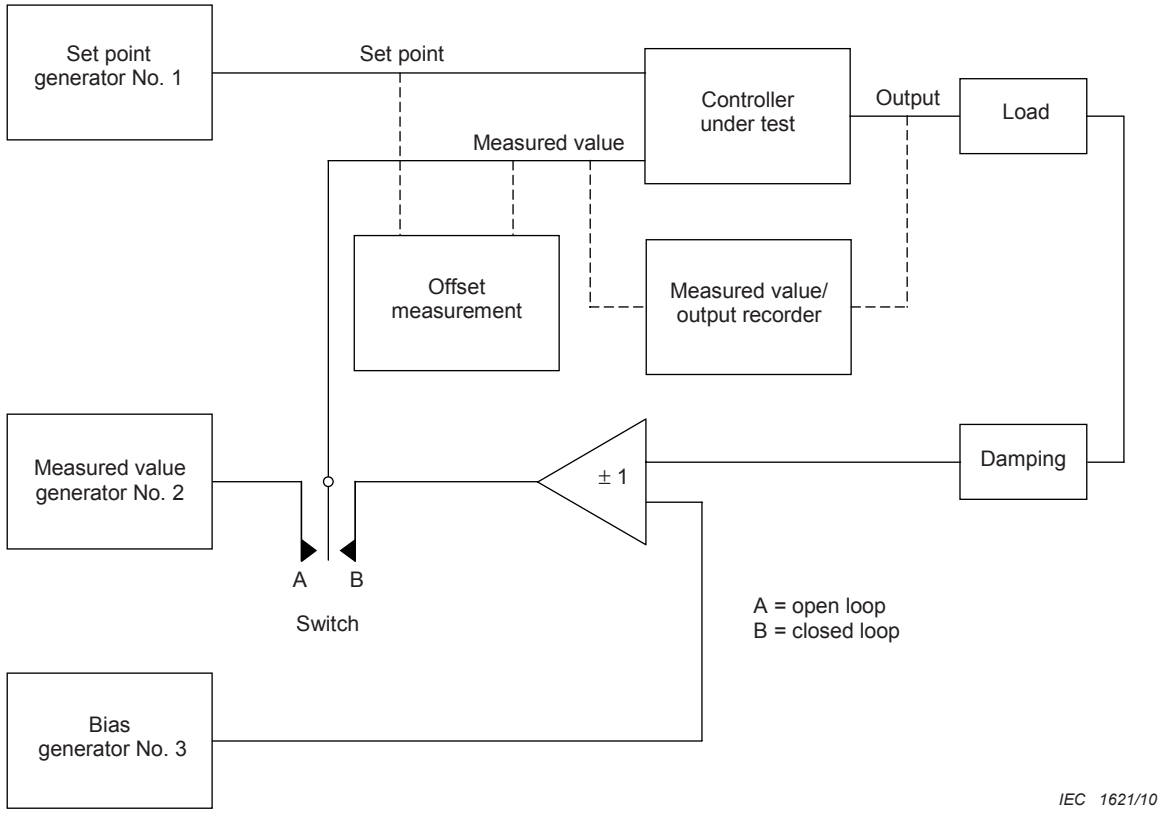
b) Test procedure

Introduce a step change of 20 % of input signal from generator No. 2.

Record corresponding change (Δy %) of output y.

$$X_p = \left(\frac{\Delta x\ \%}{\Delta y\ \%}\right) 100 = \left(\frac{\Delta x}{\text{Measured value span}} / \frac{\Delta y}{\text{Output span}}\right) 100$$

NOTE 1 If integral action cannot be made negligible, Δy should be determined in accordance with Figure 3.



Generator No. 1 – D.C. or pressure for steady-state input

Generator No. 2 – Step for proportional and integral action tests

Generator No. 3 – D.C. or pressure for fixed bias levels for test in closed loop

Figure 2 – Arrangement for open loop or closed loop tests

b) Test procedure

Introduce a step change of 20 % of input signal from generator No. 2.

Record corresponding change (Δy %) of output y.

$$X_p = \left(\frac{\Delta x\ \%}{\Delta y\ \%}\right) 100 = \left(\frac{\Delta x}{\text{Measured value span}} / \frac{\Delta y}{\text{Output span}}\right) 100$$

NOTE 2 If integral action cannot be made negligible, Δy should be determined in accordance with Figure 3.

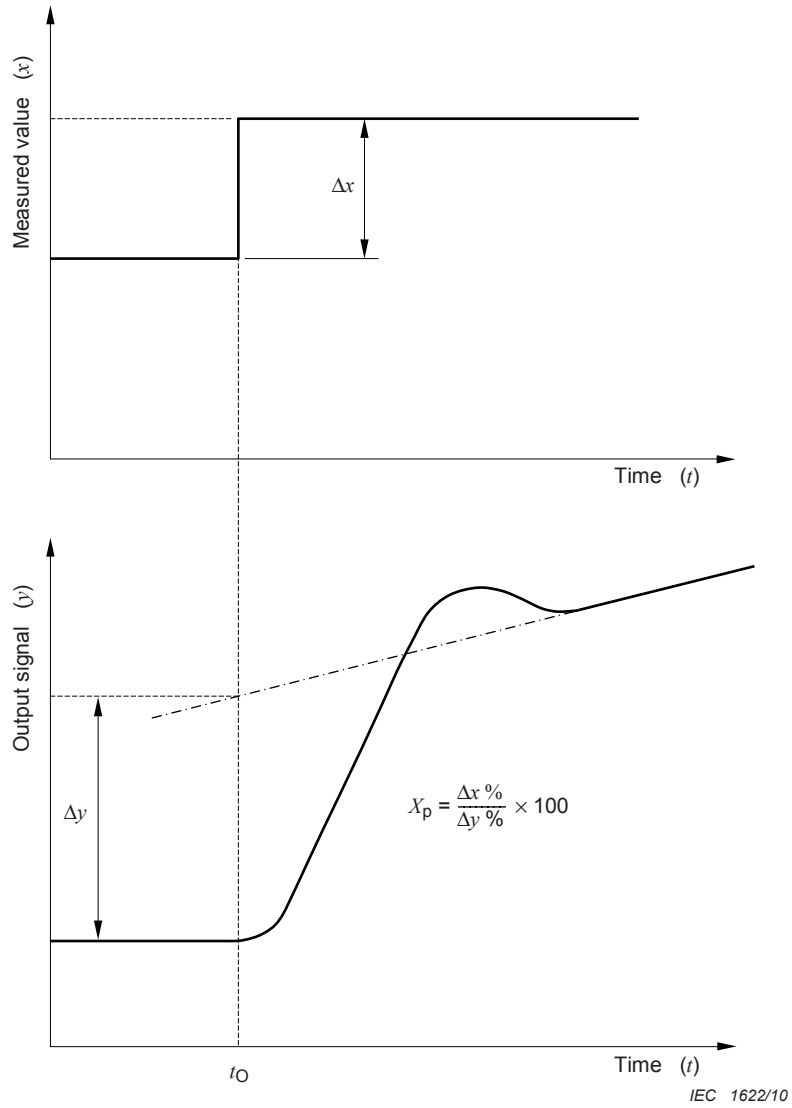


Figure 3 – Recorded characteristics of proportional action

5.2.3 Integral action (full test: see 7.3 of IEC 60546-1)

The open loop circuit arrangement in Figure 2 is used with the switch in position A.

a) Initial conditions

Open loop according to Figure 2, switch position A.

X_p = 100 %, proportional band

T_D = switched off, if possible, or at minimum rate time

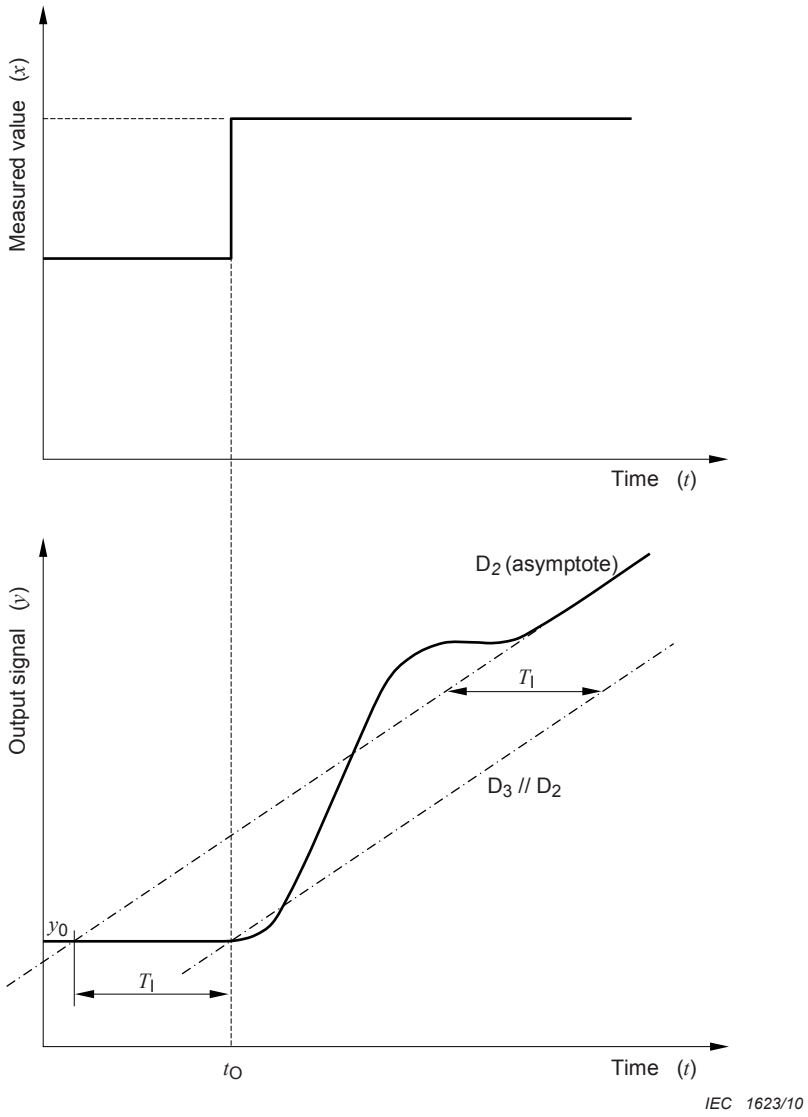
T_I = 1 min or at nearest marking of its scale

X = w = 50 %

b) Test procedure

Stabilize output y at 50 % then introduce ±20 % step of input signal, by generator No. 2.

Record the corresponding output change, Δy. Determine reset time T_I as shown in Figure 4.



T_I = time interval between D_2 and D_3

Figure 4 – Recorded characteristics of integral action

5.2.4 Derivative action (for a more accurate test: see 7.4 of IEC 60546-1)

Applicable to controllers with derivative action on $x - w$ and not on those with derivative action on x only.

a) Initial conditions

Open loop according to Figure 2, switch position B.

X_p = 100 %, proportional band

Stabilize output y at 50 %.

T_I = switched off, if possible, or at maximum reset time after stabilization

T_D = 1 min

w = 50 %

b) Test procedure

Introduce step change of 10 % to 20 % of set point span from generator No. 1. Record corresponding change of output signal y. Determine rate time T_D as shown in Figure 5.

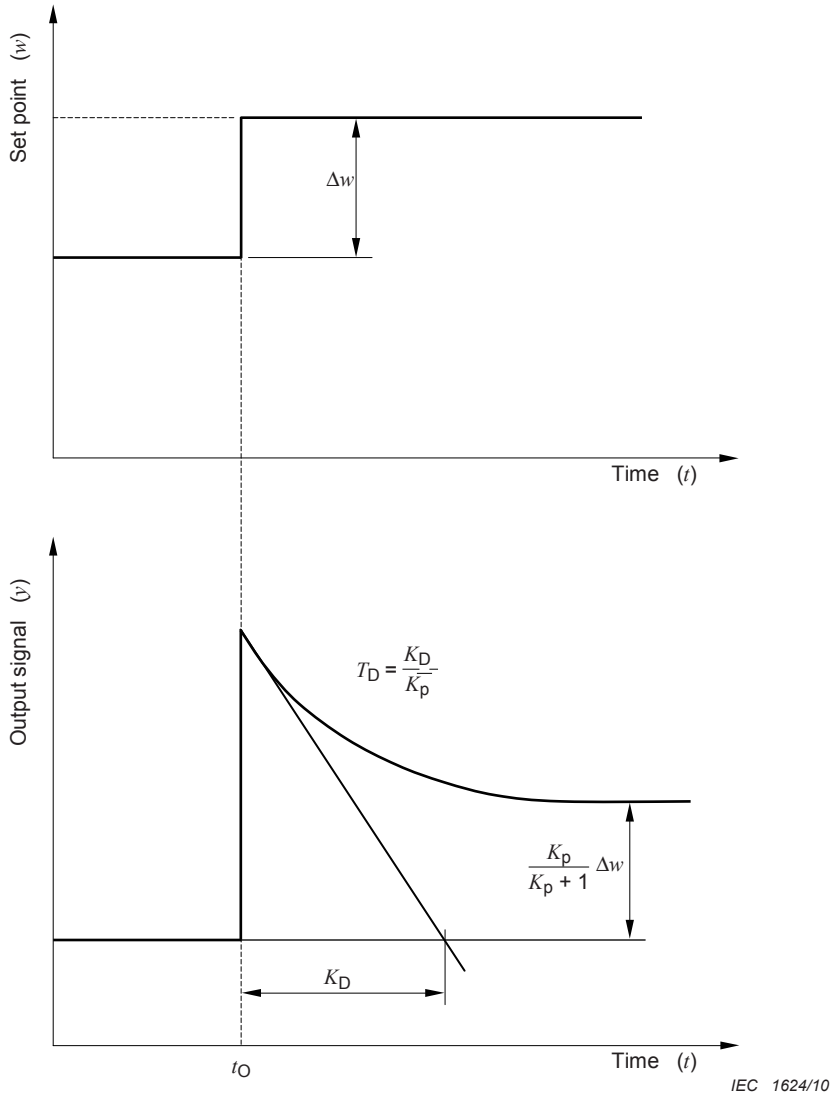


Figure 5 – Recorded characteristics of derivative action

5.3 Power supply variations (full test: see 8.5.1 of IEC 60546-1)

Routine testing of power supply variations can be made under the following.

a) Initial conditions

See 5.1.1 of IEC 60546-1 and with controller connected to maximum rated load.

b) Test procedure

Measure the effect on offset of the following variations in power supply or the manufacturer's stated limits, if smaller.

Voltage variation: $^{+10}_{-15}$ % of nominal a.c. or d.c. voltage.

Air pressure variation: ±10 % of nominal pressure.

5.4 Transfer between manual and automatic

The method of assessment of the performance of the automatic/manual transfer facility shall be agreed between manufacturer and user.

5.5 Set point generator

NOTE For controllers with no accessible set point connections, suitable test procedures should be agreed between manufacturer and user.

Test procedure

Determine that w is able to reach at least 0 % and 100 % and compare its value with scale indication if possible.

5.6 Manual loading transmitter

Test manual loading transmitter to determine that y is able to reach at least 0 % and 100 %. Check the corresponding scale indication, if existing.

NOTE If these tests of the manual loading function are not applicable, equivalent tests should be agreed between manufacturer and user.

Bibliography

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

IEC 60381-1, *Analogue signals for process control systems – Part 1: Direct current signals*

IEC 60381-2, *Analogue signals for process control systems – Part 2: Direct voltage signals*

IEC 60410, *Sampling plans and procedures for inspection by attributes*

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