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Information technology — Galvanic isolation of balanced interchange circuits

Systèmes de traitement de l'information — Isolation galvanique des circuits d'échange équilibrés

Reference number
ISO/IEC 9549:1990(E)

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 9549 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*.

Annex A of this International Standard is for information only.

Introduction

This International Standard specifies a method of galvanically isolating signal exchanges on balanced interchange circuits using optocoupler integrated circuit technology. It may be applied for data transmission in a two-condition code (e.g. NRZ).

Galvanic isolation of interchange circuits is required whenever the intercommunicating devices are connected to different mains supplies. In this case, the ground potential difference between the earthing systems frequently is higher than the common mode voltage specified for the interchange circuit receiver. Transmission errors and even damage to the receiver may be the result.

The optocoupler type of galvanic isolation may also be used when high external signal interferences have to be minimized. This situation may exist with long interchange circuits and operation at higher data signalling rates.

The specifications of this International Standard are compatible with both ISO 8482 (multipoint connection) and CCITT Recommendation V.11 (point-to-point connection) because of application flexibility and the fact that there is not much difference in the parameters for the component design.

Bidirectional data transmission is provided and requires the implementation of an isolated generator and an isolated receiver. Their unbalanced interfaces are not specified in order to provide flexibility for implementations and device manufacturers.

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Information technology — Galvanic isolation of balanced interchange circuits

1 Scope

1.1 This International Standard specifies galvanic isolation of balanced interchange circuits using optocoupler integrated circuit technology and is provided for data transmission in the two-condition code (e.g. NRZ).

The electrical characteristics are compatible with both ISO 8482 and CCITT Recommendation V.11.

NOTE — Compatible means to allow interoperation with devices having interchange circuits conforming to the electrical characteristics specified in the referenced standards.

Annex A shows interoperation with CCITT Recommendation V.11 interchange circuits in a point-to-point environment.

1.2 The specifications are given in terms of parameters and measurements for an isolated generator and an isolated receiver. These components may be used in twisted pair 2-wire or 4-wire point-to-point connections up to 1 000 m or multipoint connections up to 500 m for speeds up to 2 Mbit/s for point-to-point connections and 1 Mbit/s for multipoint connections. For data signalling rates up to 20 kbit/s, device manufacturers may optimize their component design.

1.3 Options are provided to meet special application requirements, such as

- isolated generator high impedance control;
- isolated receiver circuit failure detection capability;
- line termination in point-to-point configuration.

1.4 This International Standard does not describe a complete equipment interface in terms of mechanical, electrical and functional /procedural specifications.

2 Normative references

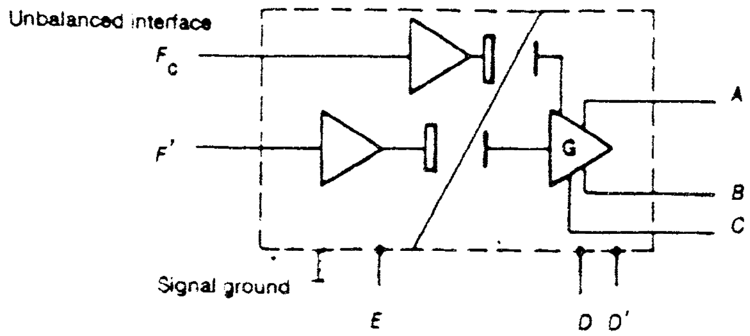
The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 8482 : 1987, *Information processing systems - Data communication - Twisted pair multipoint interconnections.*

CCITT Recommendation V.11 : 1988, *Electrical characteristics for balanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications.*

3 Symbolic representation of optocoupler components

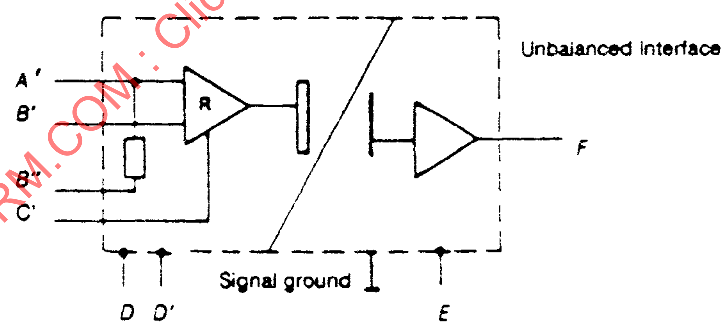
3.1 Isolated generator



A,B	Balanced signal output
C	Zero volt reference interchange point
D,D'	Floating power supply
E	Unbalanced station power supply
F'	Unbalanced signal input
F_c	Unbalanced high impedance control
G	Isolated generator

Figure 1 - Symbolic representation of isolated generator

3.2 Isolated receiver



A',B'	Balanced signal input
A',B'+B''	Balanced terminated signal input option
C'	Zero volt reference interchange point
D,D'	Floating power supply
E	Unbalanced station power supply
F	Unbalanced signal output
R	Isolated receiver

Figure 2 - Symbolic representation of isolated receiver

4 Polarities and significant levels

4.1 Balanced signal output / input

The generator polarities and receiver differential significant levels correspond to those of subclause 7 of ISO 8482 and clause 4 of CCITT Recommendation V.11.

Table 1 - Receiver differential significant levels

	$V_{A'} - V_{B'} \leq -0{,}3$ V	$V_{A'} - V_{B'} \geq +0{,}3$ V
Data circuits	Mark, 1	Space, 0
Control and timing circuits	OFF	ON

4.2 Unbalanced signal output / input

The generator polarities and receiver differential significant levels are in accordance with the technology used on the unbalanced interface.

5 Isolated generator characteristics

5.1 Balanced signal output

A generator component is measured in the active, low impedance state in accordance with the measurement arrangements in ISO 8482. The generator component may be supplied for the measurements by an appropriate single-rail power supply for the unbalanced input side and the balanced output side. Alternatively a floating power supply may be used for the balanced output side. The tests are made for either binary state. For these states the symbols used in ISO 8482 are $|V|$ and $|\overline{V}|$, respectively.

5.1.1 Open circuit voltage, V_o

As in subclause 8.1 of ISO 8482

5.1.2 Terminated output voltage, V_t

As in subclause 8.3 of ISO 8482

5.1.3 Offset voltage, V_{os}

As in subclause 8.2 of ISO 8482

5.1.4 Rise time, t_r, and imbalance voltage, V_e

As in subclause 8.4 of ISO 8482

5.2 Inactive high impedance state measurements option

5.2.1 Static measurements

When in the high impedance state and with test loads of 50 Ω connected between each generator output point and point C, the magnitude of the voltage V_h measured between points A and B shall not exceed 4 mV whatever the logical condition of the generator input data lead. When the generator is in the high impedance state, with voltages ranging between -6 V and +6 V applied between each output point and point C, the magnitude of the output leakage currents I_{xa} and I_{xb} shall not exceed 150 µA. The same situation applies in the power-off condition.

5.2.2 Dynamic measurements

During transitions of the generator output between the low impedance state and the high impedance state, the differential signal measured across a 100 Ω test load connected between the generator points A and B shall be such that the amplitude changes from 10% to 90% of the steady state voltage in less than 10 µs.

5.3 Unbalanced signal input

Reference measurements for verification of the parameters at the unbalanced input side should be made in accordance with the technology used and are not specified in this International Standard.

6 Isolated receiver characteristics

6.1 Balanced signal input

A receiver component is measured in accordance with the measurement arrangements shown in subclause 9 of ISO 8482 (without termination). The receiver component may be supplied for the measurements by an appropriate single-rail power supply for the unbalanced output side and the balanced input side. Alternatively, a floating power supply may be used for the balanced input side. The tests are made for either binary state.

6.1.1 Input sensitivity

As in subclause 9.1 of ISO 8482

6.1.2 Input balance

As in subclause 9.2 of ISO 8482

6.2 Cable termination option

The cable termination resistance shall not be less than 120 Ω.

6.3 Circuit failure detection option

The interpretation of a fault condition by an isolated receiver depends on its application. The following two types, as specified in clause 9 of CCITT Recommendation V.11, shall be selectable:

- Type 1: Data circuits assume a binary 1 state. Control and timing circuits assume an OFF condition.

- Type 2: Data circuits assume a binary 0 state. Control and timing circuits assume an ON condition.

6.4 Unbalanced signal output

Reference measurements for verification of the parameters at the unbalanced output side should be made in accordance with the technology used and are not specified in this International Standard.

7 Fault condition tests

The components are tested according to the measurement arrangements shown in subclause 10 of ISO 8482. No damage shall occur due to a single fault condition.

7.1. Generator short circuit

As in subclause 10.1 of ISO 8482

7.2 Generator contention

As in subclause 10.2 of ISO 8482

7.3 Generator current limitation

As in subclause 10.3 of ISO 8482

7.4 Transient over-voltage

As in subclause 10.4 of ISO 8482

8 Interconnection configuration

Shielded twisted pair cables with wires 0,4 mm to 0,6 mm in diameter are recommended to be used in all configurations. Examples of configurations are illustrated in CCITT Recommendation V.11, figure 3, for point-to-point applications and in ISO 8482, figures 2 and 3, for multipoint applications, respectively.

9 Optocoupler component isolation

The resistance between the unbalanced input side and the balanced output side of an isolated generator, and between the balanced input side and the unbalanced output side of an isolated receiver shall be > $10^6 \Omega$ at 500 V (a.c.) under operational conditions. The optocoupler components, when connected to their associated power supplies, as shown in figure 3, shall withstand without breakdown a voltage of 2,5 kV(rms) for a minimum of 1 min.

NOTE - Higher voltage may apply where safety is under consideration. (e.g. IEC 950)