INTERNATIONAL STANDARD

ISO 16844-3

First edition
2004-11-01

Road vehicles — Tachograph systems —

Part 3:
Motion sensor interface

Véhicules routiers — Systèmes tachygraphes —

Partie 3: Interface de capteur de mouvement

Reference number
ISO 16844-3:2004(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 16844-3 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 16844 consists of the following parts, under the general title *Road vehicles — Tachograph systems*:

— *Part 1: Electrical connectors*

— *Part 2: Recording unit, electrical interface*

— *Part 3: Motion sensor interface*

— *Part 4: CAN interface*

— *Part 5: Secured CAN interface*

— *Part 6: Diagnostics*

— *Part 7: Parameters*

Introduction

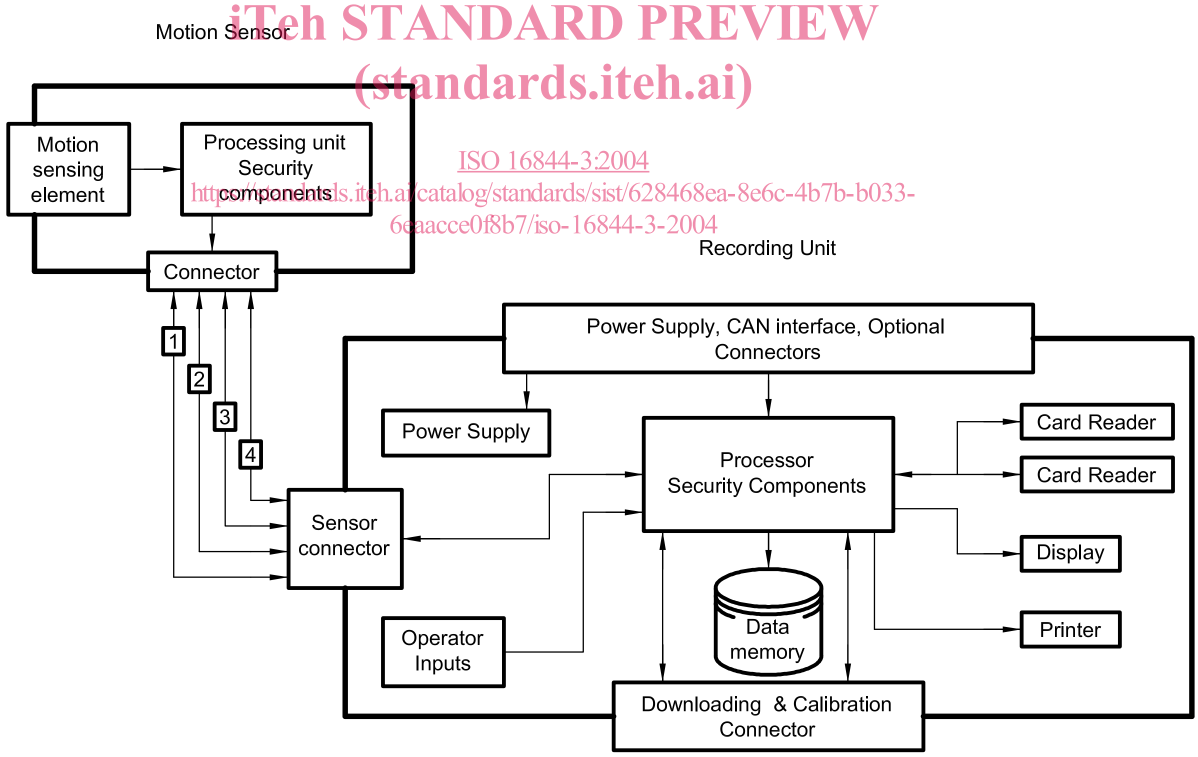
ISO 16844 supports and facilitates the communication between electronic units and a tachograph; the tachograph being based upon Council Regulations (EEC) No. 3820/85 [1] and (EEC) No. 3821/85 [2] and their amendments Council Regulation (EEC) No. 2135/98 [3] and Commission Regulation (EC) No. 1360/2002 [4].

Its purpose is to ensure the compatibility of tachographs from various tachograph manufacturers.

The basis of the digital tachograph concept is a recording unit (RU) that stores data related to the activities of the drivers of a vehicle on which it is installed. When the RU is in normal operational status, the data stored in its memory are made accessible to various entities such as drivers, authorities, workshops and transport companies in a variety of ways: they may be displayed on a screen, printed by a printing device or downloaded to an external device. Access to stored data is controlled by a smart card inserted in the tachograph.

In order to prevent manipulation of the tachograph system, the speed signal sender (motion sensor) is provided with an encrypted data link.

A typical tachograph system is shown in Figure 1.



Key

1 positive supply

2 battery minus

3 speed signal, real time

4 data signal in/out

Figure 1 — Typical tachograph system

Road vehicles — Tachograph systems —

Part 3:
Motion sensor interface

1 Scope

This part of ISO 16844 specifies the physical and data link layers of the electrical interface connecting a motion sensor to a vehicle unit, used in tachograph systems in road vehicles to perform speed signal transmission and data interchange.

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.

ISO 15170-1, *Road vehicles — Four-pole electrical connectors with pins and twist lock — Part 1: Dimensions and classes of application*

ISO/IEC 10116, *Information technology — Security techniques — Modes of operation for an n-bit block cipher*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
check sum
sum (two byte value) of the bytes pointed out at the corresponding location

3.2
direction of movement
bit 6 of byte MF showing whether the vehicle moving direction is forward or reverse

3.3
direction of movement ON
bit 7 of Byte MF showing whether the additional direction information is available or not

3.4
identification key
key necessary for Initialization of a motion sensor, not stored in the sensor memory

NOTE The identification key is derived by adding a constant control vector of the value 48 21 5F 00 03 41 32 8A$_{I}$‖ 00 68 4D 00 CB 21 70 1D hexadecimal on the master key (K_{ID}=K XOR CV).

3.5
inter byte timing
possible pause between two bytes of a message

3.6
header
first four bytes of a message containing sync-byte, target, STX and length of the message

3.7
key
master key
key necessary for Initialization of a motion sensor, not stored in the sensor memory

3.8
pairing key
key only used during the pairing sequence

NOTE Every pairing key is unique to the motion sensor to which it belongs.

3.9
reset
restart of the motion sensor processing unit program

3.10
RxD_in
signal within the motion sensor to the RxD input of the processing unit

3.11
sensor signal
frequency signal proportional to the speed within the motion sensor

3.12
session key
key used for messages to be encrypted

NOTE Every session key is unique to a special motion sensor and the vehicle unit to which it belongs.

3.13
tail
last two bytes of a message containing ETX and LRC

3.14
triple DES
multiple encryption or decryption of plain text or cipher text with different keys

NOTE 1 Encryption: first, the plain text is encrypted using a first key, then it is decrypted using a second key, and then it is encrypted again using a third key.

NOTE 2 Decryption: first, the cipher text is decrypted using the third key, then it is encrypted using the second key, and then it is decrypted again using the first key.

3.15
two-key triple DES
encryption algorithm similar to triple DES where the third key used is equal to the first one

3.16
TxD_out
signal within the motion sensor from the TxD output of the processing unit

3.17
vehicle unit
recording equipment excluding the motion sensor and its connecting cables

NOTE The vehicle unit can either be a single unit or several units distributed in the vehicle, as long as it complies with the security requirements of [1], [2] and [3].

3.18
voltage monitor
hardware function that detects a drop of the supply voltage below a defined level

3.19
K'_{P}
key derived from the pairing used to encrypt the pairing data

4 Symbols and abbreviated terms

CS	check sum
Cs_{high}	high byte of CS
Cs_{low}	low byte of CS
CV	control vector
CVPI	check value previous instruction
D_{A}	data for authentication
DES	data encryption standard
D_{Fs}	data of file selected
DON	direction of movement On
DM	direction of movement
D_{S}	data of sensor (encrypted, i.e. two-key triple DES)
EXT	end of text marker
K	master key
K_{ID}	identification key
K_{P}	pairing key
K_{S}	sessions key
LSB	least significant byte
LRC	longitudinal redundancy check
MF	multi function byte
MSB	most significant byte

NARA new audit record available

N_S extended serial number

P_D pairing data

STX start of text

VU vehicle unit

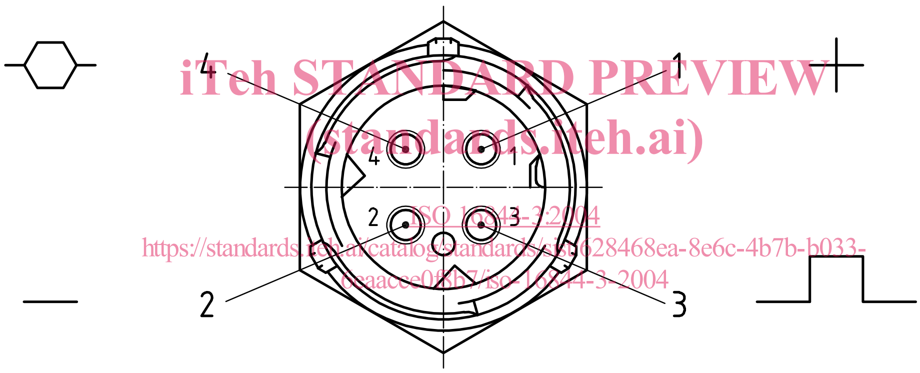
XOR arithmetical exclusive OR

5 Connector

5.1 Dimensions and pin allocation

The connector used (see Figure 2) shall be according to ISO 15170-1, with coding No. 1, application class K3 (contact temperature range –40 °C to +140 °C, max. acceleration of vibrations 300 m/s^2).

The pin allocation shall be in accordance with Table 1.



Key

1 to 4 pin Nos.

Figure 2 — Marking zone at fixed or free connector — Code 1

Table 1 — Pin allocation

Pin No.	Function
1	Positive supply
2	Battery minus
3	Speed signal, real time
4	Data signal, in/out

5.2 Electrical specification

5.2.1 Electrical requirements

The allocated connector function shall be in accordance with Table 2 and valid within the temperature range −40 °C to +135 °C.

Table 2 — Electrical requirements of allocated connector function

Pole No.	Function	Parameter	Electrical requirements			Remark
			min.	typical.	max.	
1	Positive supply	Voltage	6.5 V	—	9 V	Reverse voltage protected[b]
		Current I_S	—	—	15 mA	Total unit current without direction signal current, see Clause 8.
2	Battery minus	—	—	—	—	See ISO 16844-2.
3	Speed signal real time[a]	U_{low}	—	—	0,8 V	I = 250 µA[b]
		U_{high}	$U_{pos\ sply}$ −1,5 V	—	—	I = −150 µA[b]
		Rise time (10 % to 90 %)	—	50 µs	—	Test condition: External pull up resistor 22 kΩ to positive supply ($U_{pos\ sply}$); $U_{pos\ sply}$ = 6,5 V; external capacitor 2 nF to battery minus.
		Fall time (90 % to 10 %)	—	10 µs	—	
		Frequency		—	<1,6 kHz	—
4	Data signal in/out[a]	$U_{low\ in}$	—	—	1,2 V	I = −1 mA[b]
		$U_{high\ in}$	5,2 V	—	—	I = −0,5 mA[b]
		$U_{low\ out}$	—	—	1 V	I = 1 mA[b]
		$U_{high\ out}$	5,4 V	—	—	I = −20 µA[b]
		Rise time (10 % to 90 %)	—	110 µs	—	Test condition: External pull up resistor 10 kΩ to positive supply ($U_{pos\ sply}$); $U_{pos\ sply}$ = 6,5 V; external capacitor 5 nF to battery minus.
		Fall time (90 % to 10 %)	—	10 µs	—	
		Baud rate	—	1200 Baud	—	Accuracy ± 3 %

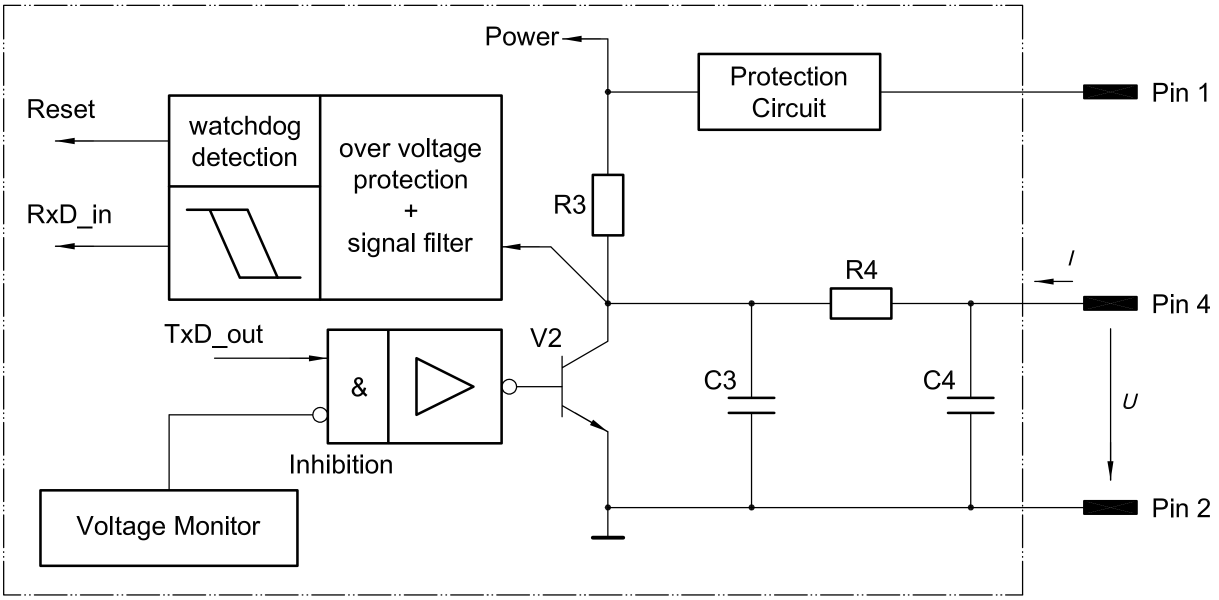
[a] Outputs shall be short circuit protected up to 28V and 1 min.

[b] All values measured relative to pin 2.

5.2.2 Block diagram data signal, in/out

Figure 3 shows a block diagram of the data interface hardware. If no communication takes place, the state of pin 4 shall be high. The incoming signal at pin 4 shall be filtered before it is used as an input signal to the processing unit.

The data TxD_out shall only be transmitted if the voltage monitor shows that the supply voltage is within the specified range. See also 7.5.3.



R3 = 10 kΩ; R4 = 330 Ω; C3 = C4 = 2,2 nF

Figure 3 — Interface data signal — Example

5.2.3 Voltage monitoring and watchdog signal

5.2.3.1 Electrical requirements

The electrical requirements of the voltage monitoring of supply voltage over poles 1 and 2, and the watchdog signal, both submitted via pole 4, shall be in accordance with Table 3.

Table 3 — Requirements of the watchdog signal voltage monitor

Parameter		Electrical requirements			Remark
		Min.	Typical	Max.	
Voltage monitor [a]		5,0 V	—	$U_{pos\ sply}$ 6,5 V	If the supply voltage is below 6,5 V, the sensor may not reply to any request, but if it is below 5,0 V, it does not reply.
Watchdog signal [b]	t_{don}	—	—	1 s	Sensor watchdog reset delay time
	t_{doff}	—	—	1 s	Sensor watchdog recover time
	t_{won}	1 s	—	—	Watchdog on time
	t_{woff}	1 s	—	—	Watchdog off time

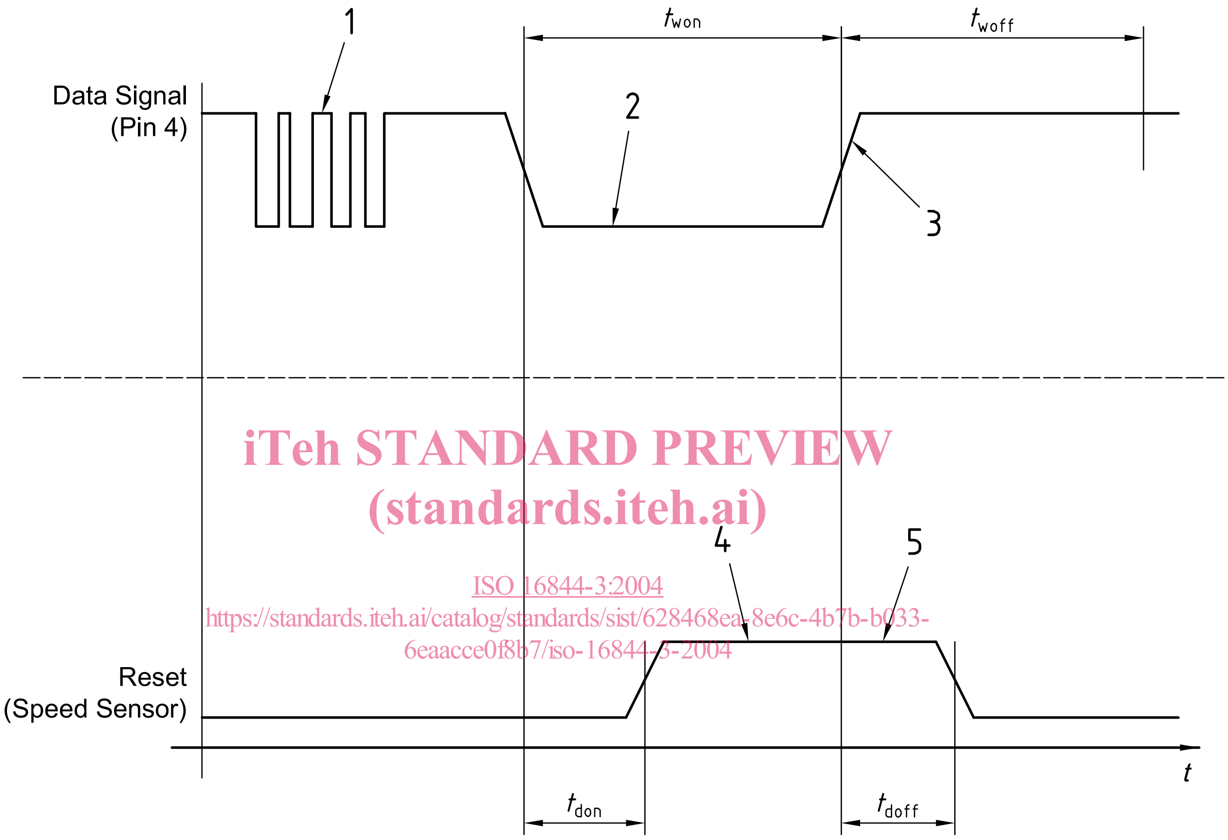
[a] See block diagram of data signal in Figure 3.

[b] See data signal (in) U_{low}, see 5.2.3.2.

5.2.3.2 Timing diagram watchdog signal

If the vehicle unit discovers a time-out of an expected response, it shall be possible to start another attempt or send a watchdog signal to the motion sensor in accordance with Figure 4 and, for voltage levels and timing, in accordance with Table 3. If the motion sensor detects a watchdog signal at pin 4, it shall restart its program (see 7.5.3)

The reset shall not effect the speed real time signal of pin 3.



Key

1 normal data signal

2 tachograph sends watchdog signal

3 requirement

4 watchdog detection

5 example

Figure 4 — Timing of watchdog signal

