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Input/output protocols and electronic interfaces for water meters — Requirements

Protocoles d'entrée/sortie et interfaces électroniques pour compteurs d'eau — Exigences

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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 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 22158 was prepared by Technical Committee ISO/TC 30, *Measurement of fluid flow in closed conduits*, Subcommittee SC 7, *Volume methods including water meters*.

Introduction

The need to be able to communicate with metered systems has become apparent. This International Standard seeks to address the issues associated with water meters, but can be used in conjunction with other metered systems such as gas and electricity supply that utilize common interfaces and protocols.

During recent years, an increasing number of electronic devices have been introduced into water meters, e.g.:

— pulse output systems;

— absolute encoded systems;

— bidirectional addressable bus systems.

Currently, there is no clear definition of either hardware interfaces or the protocols of such systems and this International Standard attempts to solve the problems arising from this.

Existing technology for water meter communications can be split into three distinct groups, which are defined as follows:

— pulse output water meters — referred to in this International Standard as type A;

— non-addressable water meters — referred to in this International Standard as type B;

— addressable water meters — referred to in this International Standard as type C.

This International Standard describes the general requirements of the protocols and electronic interfaces for water meters. It is intended to provide the necessary guidance for designers of meter registers and reading equipment.

The provisions have been determined by analysing applications currently in use and by consultation within the water industry. However, the list of applications is not exhaustive.

Input/output protocols and electronic interfaces for water meters — Requirements

1 Scope

This International Standard specifies the minimum communication requirements for water meters which have the capability to exchange or provide data by means of an electronic interface.

This International Standard only specifies the interface conditions present at the electrical and electronic connections of water meters and does not prescribe any specific equipment such as transponders and inductive pads, which might be connected to the water meter for automatic meter reading or remote meter reading purposes.

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 1155, *Information processing — Use of longitudinal parity to detect errors in information messages*

IEC 60870-5-1, *Telecontrol equipment and systems — Part 5: Transmission protocols — Section One: Transmission frame formats*

IEC 60870-5-2, *Telecontrol equipment and systems — Part 5: Transmission protocols — Section 2: Link transmission procedures*

IEC 60947-5-6, *Low-voltage switchgear and controlgear — Part 5-6: Control circuit devices and switching elements — DC interface for proximity sensors and switching amplifiers* (*NAMUR*)

EN 13757 (all parts), *Communication systems for meters and remote reading of meters*

JIS X 5001:1982, *Character structure on the transmission circuits and horizontal parity method*

NABS[1)], *Communication system by addressable 8-bit electronic water meters — Specifications, ver. 1.0*, 2008. Available [2011-04-27] from: http://www.keikoren.or.jp/eng/pub.html

M-bus[2)], *The M-bus*: *A documentation Rev. 4.8*, 1997. Available [2011-04-27] at http://www.m-bus.com

1) Published by the Japan Water Meter Manufacturers' Association.

2) Published by the M-bus User Group.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13757 (all parts) and the following apply.

3.1
interface
⟨water meters⟩ point or means of interaction between two systems

3.2
pulse
⟨water meters⟩ electronic output (generated or passive) from the interface, with pulses at increments equal to a specific defined volume

3.3
non-addressable interface device
interface device that cannot be addressed individually in a reading bus

3.4
addressable interface device
interface device that can be addressed individually in a reading bus

3.5
automatic meter reading
AMR
meter reading normally involving a central computer

3.6
remote meter reading
RMR
meter reading remote from the meter, not necessarily involving a central computer

3.7
switching current
current that can be carried by the switch during switching

3.8
switch closure
device providing a digital pulse (reed switch, transistor, etc.)

3.9
omnidirectional pulse data set
pulse data set where the pulses do not signify flow direction

3.10
unidirectional pulse data set
pulse data set where the pulses signify flow in one direction only

3.11
bidirectional pulse data set
pulse data set where the pulses signify flow direction

3.12
passive output
⟨water meters⟩ non-powered switching device

3.13
active output
⟨water meters⟩ powered switching device (internal or external to interface)

3.14
tamper detection
⟨water meters⟩ facility to detect attempts to corrupt the metering equipment or the data stored in it

3.15
output mode
⟨water meters⟩ electronic characteristics of a pulse

3.16
data set type
electronic characteristics of a group of pulses providing flow information

3.17
V-frame
data sets including variable length fields

4 Pulse output water meters — type A

NOTE The primary function of this output type is to provide real-time metering pulses that represent a specific unit of water passing through the meter.

4.1 General

Compatibility is defined by output modes, data set types and signal output types designated as follows.

Pulse output modes	1, 2, 3, 4, 5, 6, 7, 8
Data set types	O, U, B1, B2, N1, N2
Signal output types	N, P, T

NOTE Compatible products may be marked, e.g. ”A1O”, “A2O”, A3U”, “A4UN”, “A5B2P”, “A7N2”.

Requirements for pulse output modes, pulse waveform definitions, pulse data set types and signal output types are given in 4.2 to 4.5.

4.2 Pulse output modes

Pulse output modes shall meet the requirements set out in Table 1.

4.3 Pulse waveform definitions

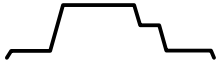
Pulse waveform definitions for pulse output modes A1 to A8 shall meet the requirements set out in Figures 1 to 5.

NOTE In Figures 1 to 5, the timings are illustrative.

4.4 Pulse data set types

Pulse data set types shall conform to the requirements set out in Table 2.

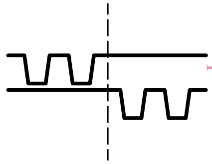
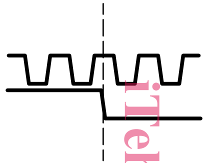
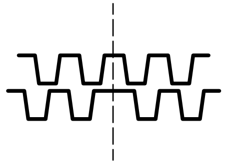
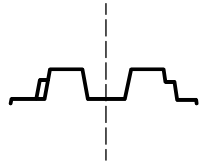
Table 1 — Pulse output modes for pulse output water meters (type A)

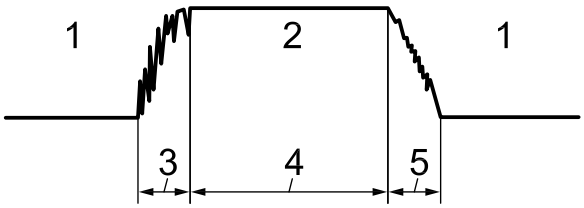
Parameter	Type							
	A1	A2	A3	A4	A5	A6	A7	A8
Character	Passive		Active	Active			Active	
Pulse (see 4.3)	 Volt-free		 Active high	 or 			 Active current loop (see 5.2)	
Engineering	Passive switch closure		Pulse self-powered	Transistor switch self-powered	Transistor switch externally-powered		Current pulse externally-powered	
	signal usage	power usage			sensor usage	buffered usage		
Supply voltage range	—	—	—	—	2 V to 5 V DC	5 V to 15 V DC	IEC 60947-5-6 (8,2 V DC nom. at 1 kΩ source Z)	
Switching current and voltage	3 µA to 20 mA at up to 30 V DC	3 µA to 500 mA at up to 100 V DC	—	⩽20 mA[a] at 20 V DC max.	⩽10 mA[a] at 20 V DC max.	⩽20 mA[a] at 20 V DC max.	—	—
Off-state impedance	>10 MΩ	>10 MΩ	—	—	>10 MΩ		—	—
On-state impedance	<200 Ω	<150 mΩ	—	—	<500 Ω		—	—
Current consumption	—	—	—	—	<20 mA		IEC 60947-5-6 (>2,1 mA)	
Typical data set type (see 4.4)[b]	Omnidirectional		Unidirectional	Omni- uni- or bidirectional			Omni- or bidirectional	
Typical product type[b]	Micro- or reed-switch or solid state		Generator or piezo sensor	Piezo or magnetic sensor	Piezo, magnetic or optical sensor		Micro- or reed-switch magnetic or optical sensor	

[a] In the case of signal output type T, this voltage is replaced by “power supply voltage”.

[b] Other types may also apply.

Table 2 — Pulse data set types for pulse output water meters

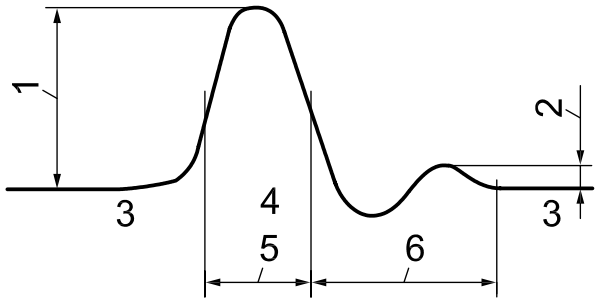
Data-set type	**O**	**U**	**B1**	**B2**	**B3**	**N1**	**N2**
Format	Omnidirectional	Unidirectional	Bidirectional	Bidirectional	Bidirectional	Omnidirectional	Bidirectional
Pulse(s)			Forward  Reverse	Forward  Reverse	Forward  Reverse		Forward  Reverse
Definition	Indistinguishable direction	Specific direction	Both unidirectionals	Omnidirection plus direction signal	Quadrature	IEC 60947-5-6	IEC 60947-5-6 plus “transparent” modifiers



Key

1 switch open
2 switch closed
3 5 ms max. leading noise
4 25 ms min. width
5 5 ms max. trailing noise

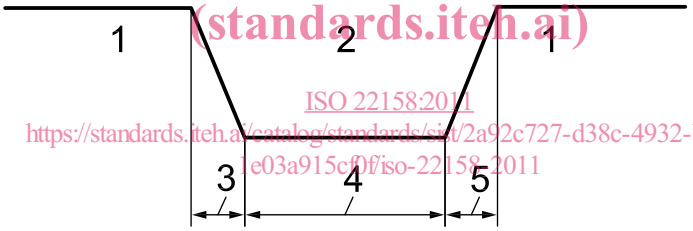
Figure 1 — Types A1 and A2



Key

1 3 V min. primary pulse
2 1 V min. secondary pulse(s)
3 off
4 on
5 1 ms min. width
6 200 ms max. ringing

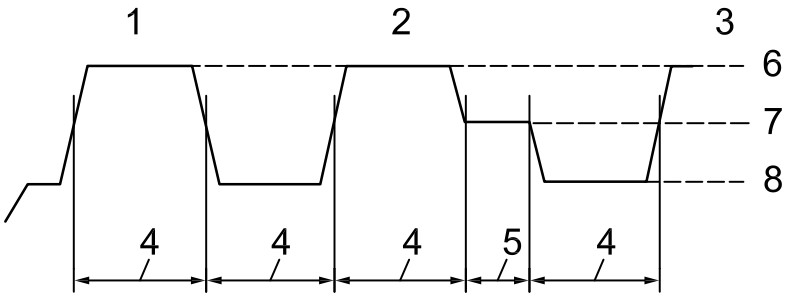
Figure 2 — Type A3



Key

1 off
2 on
3 100 µ max. leading transition
4 2 ms min. width
5 10 ms max. trailing transition

Figure 3 — Types A4, A5 and A6

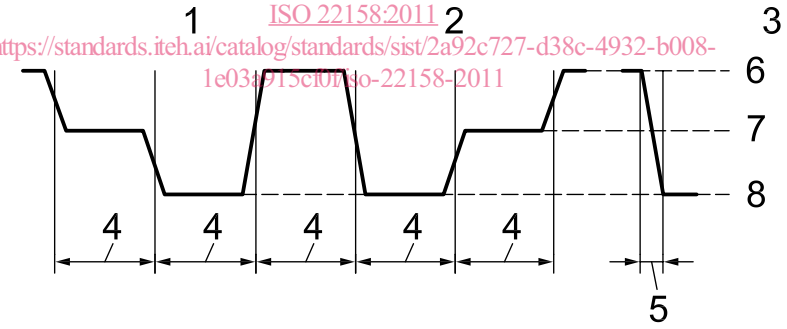


Key

1 forward
2 reverse
3 next pulse
4 1 ms
5 0,5 ms (all minimum widths)
6 2,1 mA min.
7 (1,65 ± 0,165) mA
8 1,2 mA max.

Maximum frequency = 500 Hz forward, 400 Hz reverse

Figure 4 — Type A7



Key

1 forward
2 reverse
3 next pulse
4 1,2 ms (all minimum widths)
5 0,3 ms maximum
6 6,0 mA max., 2,2 mA min.
7 (1,5 ± 0,05) mA
8 1,0 mA max., 0,04 mA min.

Maximum frequency = 150 Hz

Figure 5 — Type A8

4.5 Signal output types

With the exception of data sets N1 and N2, the output signal shall be referenced to either supply rail.

The type of output shall be indicated by a suffix, as follows.

N	signal referenced to 0 volts
P	signal referenced to positive supply volts
T	totem-pole, push-pull output signal
W	floating output without polarity, not referenced signal

The suffix is used in conjunction with the data set type, e.g. ON, UP, B1T.

4.6 Pulse configuration

The signal “set” outputs shall be inherently without reference to measurement values.

EXAMPLE Devices can have more than one “set” of outputs and thus be marked with each compatible output type, which might or might not be different. For example, “A1O + A1O” indicates a single passive volt-free output device providing two signal “sets” meeting the requirements of this International Standard. “A6B1 + A6B2” indicates an active externally powered output device providing two different bidirectional signal “sets” meeting the requirements of this International Standard.

Where a pulse output is polarity conscious, the “most negative” terminal should be so marked, or if it is a wire then a brown core should be used.

Tamper detection or tamper checking facilities can also be provided as a secondary function(s), using one of: cable loop-back, cable impedance-change or magnetic interference signal. These extra connections may optionally utilize the common line, but it is essential that any such use does not compromise the primary pulse function(s).

NOTE Due to the multiplicity of the conceivable pulse, power and tamper connections, it is not practical to allocate all possible core colours to functions.

5 Non-addressable water meters — type B

NOTE The primary function of this output type is to provide a data stream that identifies and reports the registered units of water passed through the meter when exclusively coupled to a reading device.

5.1 General

Compatibility is defined by output modes and data set types (using a common data protocol) designated as follows.

Output modes	1, 2, 3
Data set types	A, S1, S2

Compatible products may be compliance marked, e.g. “B1S1”, “B2A”, “B3A”.

5.2 Non-addressable output modes

Output modes for non-addressable water meters shall meet the requirements set out in Table 3.

Table 3 — Output modes for non-addressable water meters (type B)

Parameter	Type		
	B1	B2	B3
Engineering	Two-wire encoded register	Three-wire encoded register	Two-wire encoded register
Signal	Unidirectional ASCII data frame protocol		Bidirectional ISO data frame protocol
Data set type (see 5.3)	Asynchronous or synchronous		Asynchronous
Supply voltage (if externally powered)	7 to 17 Vp-p AC	2,9 V to 6 V DC (asynchronous) 5 V to 12 V AC (synchronous)	—
AC supply frequency (if externally powered)	10 kHz to 30 kHz		—
Two-wire modulation depth	>10 % inductively	—	Optically isolated — not applicable
Three-wire output low voltage	—	<0,9 V with regard to “COMMON” pseudo-open collector/ open drain external pull-up resistor required	—
Current consumption	<3 mA (asynchronous) <15 mA (synchronous)		—

5.3 Non-addressable data set types

Data set types for non-addressable water meters shall meet the requirements set out in Table 4.

Table 4 — Data set types for non-addressable water meters (type B)

Parameter	Data set type		
	A	S1	S2
Communications	Asynchronous	Externally clocked synchronous	
Data rate	⩾(300 ± 2,25) bit/s	1 clock per bit, from 0 bit/s to 2 000 bit/s	1 clock per bit or 16 clocks per bit at 1 200 bit/s
Character format	1 start, 7 data (LSB first), even parity, 1 stop		
Two-wire data sense	logic 0 = carrier collapsed logic 1 = NO action	logic 0 = impulse burst logic 1 = NO action	logic 0 = biphase change logic 1 = NO biphase change
Three-wire data polarity	logic 0 = output LOW		logic 1 = output HIGH
Inter-character gap	⩽6 bit times	—	—
Data frames	⩾4 identical frames	as clocked, each frame “real-time”	
Inter-frame gap	<2 s	<200 ms	8 “stop” bits
Clock “low” definition	—	250 µs min., 1 000 µs max., stability ±25 %	
Clock “high” definition	—	>1 000 µs	
Power down conditions	>500 ms	>200 ms	