INTERNATIONAL STANDARD

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Second edition
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Freight thermal containers — Remote condition monitoring

Conteneurs à caractéristiques thermiques — Système de pilotage à distance des groupes frigorifiques

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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

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Foreword

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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 10368 was prepared by Technical Committee ISO/TC 104, *Freight containers*, Subcommittee SC 2, *Specific purpose containers*.

This second edition cancels and replaces the first edition (ISO 10368:1992), which has been technically revised.

Introduction

In revising this International Standard, material relating to the RCD/Controller interface has been deleted as it is not relevant to the powerline interface, and the section on data logging formats has been deleted as it is not used in the industry. Where necessary, other smaller additions, deletions and corrections have been applied.

The International Organization for Standardization (ISO) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning the low and high data rate systems given in 5.4 and 5.5 respectively. ISO takes no position concerning the evidence, validity and scope of this patent right.

The holder of this patent right has assured ISO that he/she is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with ISO. (The declarations have not yet been received by ISO.) For the low data rate system, information may be obtained from:

Thermo King Corporation,
314 W 90th Street
Minneapolis, Minnesota 55420
USA

For the high data rate system, information may be obtained from:

Adaptive Networks Incorporated
1505 Commonwealth Ave.
Suite 30
Brighton, Massachusetts 02135
USA

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

Freight thermal containers — Remote condition monitoring

1 Scope

This International Standard establishes the information and interfaces required to permit complying central monitoring and control systems employed by one carrier or terminal to interface and communicate with complying remote communication devices of differing manufacture and configuration used by other carriers and terminals.

The data-logging formats and message protocols outlined in this International Standard apply to all currently available data rate transmission techniques. These formats and protocols also apply to all future techniques designed to be an ISO International Standard-compatible system.

The performance requirements for the monitoring, communication and control system are given in Clause 4. The system compatibility requirements are given in Clause 5. All sections of this International Standard apply to all implementations, except where specified.

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 1496-2:1996, *Series 1 freight containers — Specification and testing — Part 2: Thermal containers*

ISO 9711-2, *Freight containers — Information related to containers on board vessels — Part 2: Telex data transmission*

3 Terms and definitions

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

3.1
remote communications device
RCD
device which is physically a part of the refrigeration machinery and which communicates with any complying **CMCS** using the refrigeration machinery power distribution system as the data transmission medium

NOTE 1 See Figures 1 and 2.

NOTE 2 There are two distinct types of RCD:

— an **sRCD** (see 3.9); and

— an **iRCD** (see 3.10).

3.2
central monitoring and control system
CMCS
system consisting of hardware and software which monitors and controls one or more **RCDs**

NOTE A typical system consists of at least:

a) operator interface devices;

b) an **MMU**; and

c) power line data link equipment, such as an **MDCU**.

3.3
master monitoring unit
MMU
central processing unit such as a computer which contains specific hardware and software to control the entire remote condition monitoring system

NOTE It is the interface between the human operator and the network.

3.4
multiple data rate central control unit
MDCU
device which forms the link between the **MMU** and the three-phase power line bus which contains the individual **RCDs**

NOTE An **MDCU** consists of two components as follows:

— a central control unit capable of receiving and transmitting at the data rates which meet the requirements of this International Standard; and

— a central control interface.

3.5
high data rate remote communications device
HRCD
RCD which transmits data at a high data rate, e.g. 19,200 baud

3.6
low data rate remote communications device
LRCD
RCD which communicates data at a low data rate, e.g. 1 200 baud

3.7
high data rate central control unit
HDCU
device which links the **MMU** and the power line network, communicating with the **HRCDs**

3.8
low data rate central control unit
LDCU
device which links the **MMU** and the power line network, communicating with the **LRCDs**

3.9
stand-alone remote communications device
sRCD
slave remote communications device **RCD** which, with limited capabilities, merely monitors a container refrigeration unit

NOTE An sRCD can be either high or low data rate.

3.10
integrated remote communications device
iRCD
slave remote **RCD** which interfaces to a refrigeration unit controller via an EIA R5232-C serial interface and can control the refrigeration machinery

NOTE An **iRCD** can be either high or low data rate.

3.11
controller
microprocessor device that monitors and controls the refrigeration machinery

4 Performance requirements

4.1 General

This clause specifies the performance requirements of central monitoring and control systems (CMCSs) necessary for them to interface and communicate with complying remote communications devices (RCDs).

4.2 Requirements

4.2.1 System components

4.2.1.1 Remote condition monitoring system components

A single remote condition monitoring system consists of a maximum of one master monitoring unit (MMU) and one multiple data rate central control unit (MDCU). (See Figure 1, Configuration A.)

4.2.1.2 MDCU

An MDCU may include one high data rate central control unit (HDCU) and one low data rate central control unit (LDCU). If an HDCU and an LDCU are both present, the single remote condition monitoring system consists of a maximum of one MMU and one MDCU. (See Figure 1, Configuration A. The HDCU and LDCU are joined together by a central control unit (CCU) interface, and the three components together form the MDCU.

4.2.1.3 MMU/MDCU interface

The preferred method of connecting the MMU to the MDCU complex is through a single port as shown in Figure 1, Configuration A. However, certain expansion paths may require multiple connections as shown in Figure 1, Configuration B.

4.2.1.4 Remote communications devices (HRCDs and LRCDs)

HRCDs and LRCDs shall be able to coexist on the same power line network and not interfere with simultaneous communications with either the HDCU or the LDCU.

4.2.1.5 MDCU components

An MDCU may consist of either a single HDCU (to communicate with the HRCDs on the network) or a single LDCU (to communicate with LRCDs on the network). However, all signalling protocols, data-logging formats, power levels, insertion rates and other physical requirements shall be identical to that which would be used for a combined system and therefore shall be compatible. Refer to 5.2 and 5.3 for the required protocol and data-logging formats.

4.2.2 Performance function

4.2.2.1 Standard message

All RCDs shall respond to a minimum list of standardized enquiries (see 4.2.2.4) and commands with a standardized reply or acknowledgement.

4.2.2.2 Acknowledgement message

The RCD shall send an acknowledgement message for all commands and enquiries that are received and understood.

4.2.2.3 “Not able” message

If the RCD is not capable of executing a command received or of responding to an enquiry because of the configuration of the RCD and the thermal control machinery, it shall respond with a “Not able” message.

4.2.2.4 Required enquiries

4.2.2.4.1 General

All RCDs shall respond to the following required enquiries given in 4.2.2.4.2 to 4.2.2.4.7.

4.2.2.4.2 Identification number

For an integrally refrigerated or thermal container, this shall be the container ISO number comprising a 4-letter alphabetical prefix and a 7-digit suffix (including the check digit). Where a demountable marine clip-on unit is used, the identification number shall be the MDCU number in ISO format.

4.2.2.4.3 Porthole container number

This response shall be in addition to the identification number for MDCU systems.

4.2.2.4.4 Porthole number change

This shall be recorded in the RCD memory in alphanumerical format, together with the time of the change.

4.2.2.4.5 Return air temperature

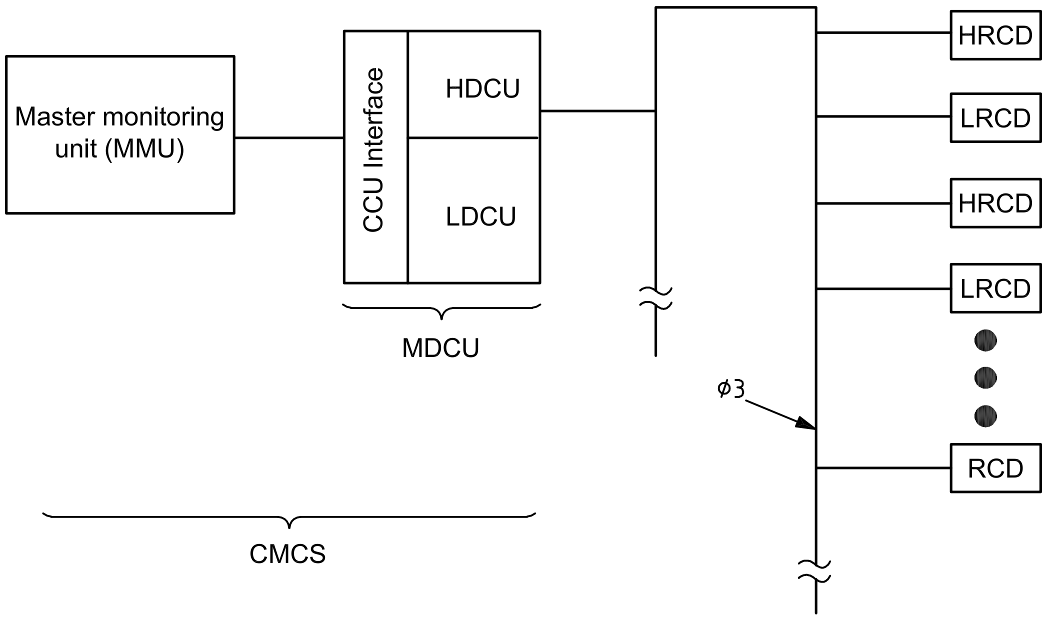
This shall be recorded in the form of a positive or negative value, expressed in degrees Celsius to one decimal place, within the range –30,0 °C to +38,0 °C.

4.2.2.4.6 Supply air temperature

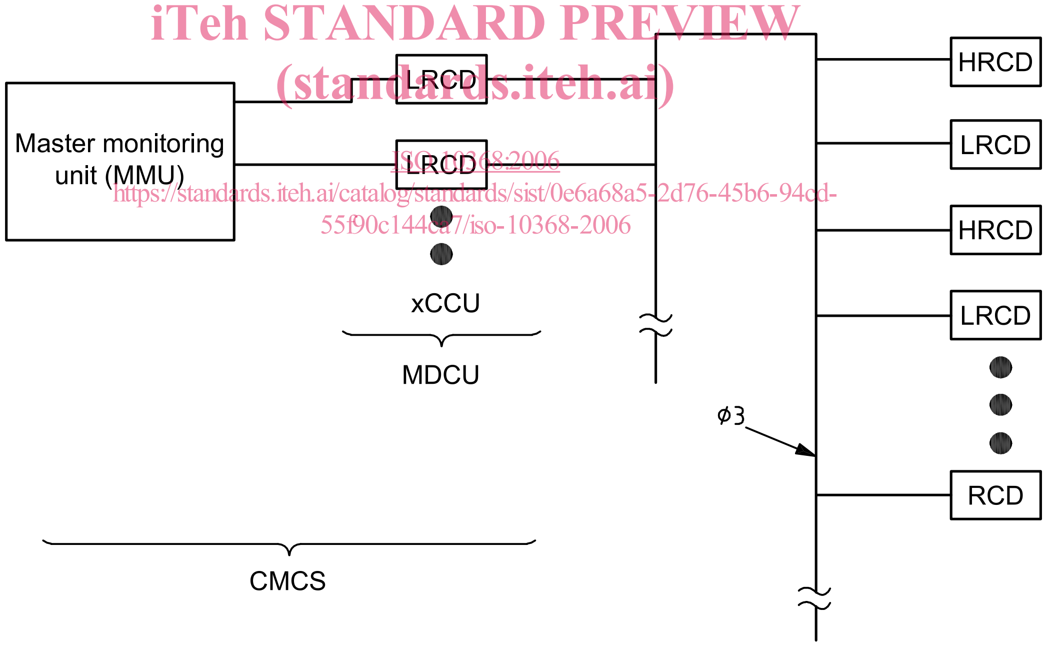
This shall be expressed in the same format as 4.2.2.4.5.

4.2.2.4.7 RCD manufacturer and type

This shall consist of a unique identification number registered and controlled by ISO, and for which ISO/TC 104 is the registration authority.



a) Configuration A



b) Configuration B

Components

MMU	master monitoring unit
∅3	three-phase power mains
CCU	central control unit
LDCU	low data rate central control unit
HCDU	high data rate central control unit
RCD	remote communications device
MDCU	multiple data rate central control unit
HRCD	high data rate remote communications device
LRCD	low data rate remote communications device

Figure 1 — Remote condition monitoring system components layout

4.2.2.5 Optional standard enquiries

4.2.2.5.1 General

Other optional enquiries shall be standardized. RCDs and refrigeration machinery so equipped shall respond to the enquiries given in 4.2.2.5.2 to 4.2.2.5.14. RCDs not so equipped shall respond “Not able” (see 4.2.2.3).

4.2.2.5.2 Operating mode

These include Full cool, Partial or Lower capacity cool, Modulated cool, Fans only or Null mode, Defrost, Heat, Off.

4.2.2.5.3 Set-point temperature

This shall be expressed in the same format as 4.2.2.4.5.

4.2.2.5.4 Alarms

These include High refrigeration pressure, Temperature out of range, Low compressor oil pressure, Defrost/Heat/Overheat, Compressor overload, Controller failure, Sensor failure — Return air, Sensor failure — Supply air, Power off, Amperage draw too high, Amperage draw too low, Defrost (out of time). (There is capacity for future development, e.g. controlled atmosphere.)

4.2.2.5.5 All current alarms

These shall be in sequence of occurrence.

4.2.2.5.6 Product temperatures

These include, for example, tank, poultry.

4.2.2.5.7 Data-logger interval

This shall be one digit in half-hour intervals up to a maximum of 12 h.

4.2.2.5.8 Amperage

This shall be 0 to 63,75 A in 0,25 A intervals.

4.2.2.5.9 Destination

This may be up to five alphanumerical digits. If the destination changes, both the old and the current destination may be declared.

4.2.2.5.10 Port of discharge

This may be up to five alphanumerical digits.

4.2.2.5.11 Origin

This may be up to five alphanumerical digits.

4.2.2.5.12 Report results of self-check level 1

These shall be one digit: 0 = Fail, 1 = Pass.

4.2.2.5.13 Report results of self-check level *n*

This shall be in the format of up to 256 ASCII characters, where *n* is a single character between two and nine.

4.2.2.5.14 Vessel and voyage designation

(See ISO 9711-2.)

4.2.2.6 Commands

4.2.2.6.1 General

RCDs and refrigeration machinery if so equipped shall respond to the commands given in 4.2.2.6.2 to 4.2.2.6.9. RCDs not so equipped shall respond "Not able" (see 4.2.2.3).

4.2.2.6.2 Change set-point temperature

This shall be expressed in the same format as 4.2.2.4.5.

4.2.2.6.3 Initiate self-check level 1

The self-check level 1 shall be initiated.

4.2.2.6.4 Initiate self-check level *n*

This shall be expressed in the same format as 4.2.2.5.13, where *n* is in the range two to nine.

4.2.2.6.5 Change identification number

This shall be expressed in the same format as 4.2.2.4.2.

4.2.2.6.6 Change data-logger interval

This shall be expressed in the same format as 4.2.2.5.7.

4.2.2.6.7 Set data-logger time and date

This shall have the date expressed in the format year/month/day.

4.2.2.6.8 Change operating mode

This shall be expressed in the same format as 4.2.2.5.2.

4.2.2.6.9 Change porthole container number

This shall be expressed in the same format as 4.2.2.4.4.

4.2.2.7 Indecipherable or unserviceable messages

Indecipherable or unserviceable messages shall not cause the RCD or CMCS to "crash" or "hang up". Also, failures of an electronic device in any RCD shall not cause the system to "crash" or "hang up".

4.2.2.8 Verification of container identification number

The CMCS, if so equipped, shall verify the container identification number, using the check digit (the seventh digit of the numerical suffix) and an algorithm selected.

4.2.3 Performance constraints

4.2.3.1 Power interference

RCDs and CMCSs shall not interfere with the proper functioning of power supply regulating or controlling devices, such as voltage regulators or protective relaying equipment.

4.2.3.2 Marine device Interference

CMCSs and RCDs, individually or as a system, shall not interfere with standard marine navigation and communication devices.

4.2.3.3 System size

All CMCSs shall be suitable to coordinate and report on a system of 1 024 RCDs active at the same time on one CMCS.

4.2.3.4 Status update

The MMU/MDCU system shall generate RCD updated status in accordance with 4.2.2.4 at least once per hour per container for a system of up to 1 024 containers active at the same time on one CMCS.

4.2.3.5 Automatic RCD system list

The population or database of RCDs on the CMCS shall be self-generating. No input to the MMU, whether from an operator or from another computer, shall be necessary to determine the RCDs connected to that system.

4.2.3.6 Identification of new RCDs

The MMU/MDCU system shall be designed to identify an average of at least one new container every 10 s, or 6 per minute.

4.2.3.7 Voltage and frequency requirements

RCDs shall be suitable for operating on the voltage systems specified in ISO 1496-2.

4.2.3.8 RCD connection

The RCD shall be connected on the line side of the refrigeration machinery disconnect or circuit breaker, if any, so that communication is possible when the refrigeration machinery is switched off. The RCD may have its own disconnect switch for servicing.

4.2.3.9 Error rates

4.2.3.9.1 All CMCSs and RCDs shall be designed to meet the following error rate criteria.

The RCD/MDCU communication system may have two different types of “undetected and uncorrected” communication errors. An “undetected and uncorrected” communication error is one which is not detected and corrected within 5 min after occurrence.

4.2.3.9.2 An error whereby an RCD executes a command which was not commanded by the MMU shall not occur more often than one time in 25×10^6 messages (i.e. any power line disturbance which the receiver interprets as a message), or more often than once in 10 years for each CMCS, whichever is greater.

4.2.3.9.3 An error whereby a CMCS misinterprets a message (i.e. any power line disturbance which the receiver interprets as a message) shall not occur more often than one time in 25×10^5 messages.

5 System compatibility requirements

5.1 General

This clause specifies the interface requirements for communications protocol, data-logging formats, message definitions, and physical requirements for low data rate and high data rate (CU and CD) systems.

5.2 Communications protocol

5.2.1 General

Each remote condition monitoring system has three interface areas as follows (see Figure 2):

— MMU to MDCU interface;

— MDCU to RCD interface;

— RCD to refrigeration machinery controller interface.

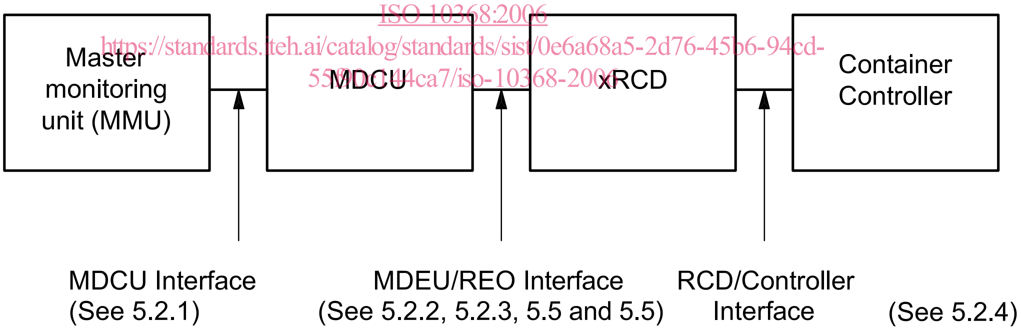


Figure 2 — Remote condition monitoring — Communications interfaces

5.2.2 MMU to MDCU communications

5.2.2.1 General

This subclause, in part, defines the communications protocol to be used when the MDCU is implemented as a discrete system component which is separate from the MMU architecture. The requirements given in this subclause do not preclude the use of bus-based open architecture MDCU applications where the EIA R5232-C is not appropriate.

The MMU communicates with the MDCU via a full duplex EIA RS232-C serial interface. The baud rate shall be at least twice the baud rate of the fastest RCD in the system. A typical communications baud rate is 4 800 baud. Each character transferred requires 1 start bit (low logic level), 8 data bits, and 1 stop bit (high logic level). The minimum time delay required between packets is one character time. This, therefore, restricts deadtime between any 2 bytes in a packet to less than one character delay.

