INTERNATIONAL STANDARD

ISO 10368

First edition
1992-07-01

Freight thermal containers — Remote condition monitoring

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

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Annex

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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.

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.

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International Standard ISO 10368 was prepared by Technical Committee ISO/TC 104, *Freight containers*, Sub-Committee SC 2, *Specific purpose containers*.

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Annex A of this International Standard is for information only.

Introduction

During the preparation of this International Standard, information was gathered on patents upon which application of this standard might depend.

For the low data rate system of 3.5, the relevant patents were identified as belonging to

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

For the high data rate system of 3.6, the relevant patents were identified as belonging to

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

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ISO cannot give authoritative or comprehensive information about the evidence, validity or scope of patent and like rights. The patent holders have stated that licences will be granted under reasonable terms and conditions. Communications on this subject should be addressed to either Thermo King Corporation or Adaptive Networks Incorporated.

Freight thermal containers — Remote condition monitoring

Section 1: General

1.1 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 standard compatible system.

The performance requirements for the monitoring, communication and control system are given in section 2. The system compatibility requirements are given in section 3. All sections of this International Standard apply to all implementations, except where specified.

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1.2 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 indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1496-2:1988, *Series 1 freight containers — Specification and testing — Part 2: Thermal containers.*

ISO 9711-2:1990, *Freight containers — Information related to containers on board vessels — Part 2: Telex data transmission.*

1.3 Definitions

For the purposes of this International Standard, the following definitions apply.

1.3.1 remote communications device (RCD): Device which is physically a part of the refrigeration machinery and which communicates with any complying central monitoring and control systems (CMCSs) using the refrigeration machinery power distribution system as the data transmission medium. See figures 1 and 2.

There are two distinct types of RCD:

— a stand-alone remote communications device (sRCD) (see 1.3.9);

— an integrated remote communications device (iRCD) (see 1.3.10).

An sRCD is defined as a device which cannot implement the hardware write messages defined in 3.4.6.1.

1.3.2 central monitoring and control system (CMCS): System consisting of hardware and software which monitors and controls one or more remote communications devices (RCDs). A typical system consists of at least

a) operator interface devices,

b) a master monitoring unit (MMU), and

c) power line data link equipment, such as a multiple data rate central control unit (MDCU).

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

1.3.4 multiple data rate central control unit (MDCU): Device which forms the link between the master monitoring unit (MMU) and the three-phase power line bus which contains the individual remote communications devices (RCDs). An MDCU consists of two components as follows:

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

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b) a central control interface.

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1.3.5 high data rate remote communications device (HRCD): Remote communications device (RCD) which transmits data at a high data rate, e.g. 19 200 baud.

1.3.6 low data rate remote communications device (LRCD): Remote communications device (RCD) which communicates data at a low data rate, e.g. 1 200 baud.

1.3.7 high data rate central control unit (HDCU): Device which links the master monitoring unit (MMU) and the power line network, communicating with the high data rate remote communications devices (HRCDs).

1.3.8 low data rate central control unit (LDCU): Device which links the master monitoring unit (MMU) and the power line network, communicating with the low data rate remote communications devices (LRCDs).

1.3.9 stand-alone remote communications device (sRCD): Slave remote communications device (RCD) which, with limited capabilities, merely monitors a container refrigeration unit. An sRCD can be either high or low data rate.

1.3.10 integrated remote communications device (iRCD): Slave remote communications device (RCD) which interfaces to a refrigeration unit controller via an EIA RS232-C serial interface and can control the refrigeration machinery. An iRCD can be either high or low data rate.

1.3.11 controller: Device that monitors and controls the refrigeration machinery.

Section 2: Performance requirements

2.1 Scope

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

2.2 Requirements

2.2.1 System components

2.2.1.1 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 a).

2.2.1.2 Multiple data rate central control unit (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 HDCU and LDCU are joined together by a central control unit (CCU) interface, and the three components together form the MDCU.

2.2.1.3 MMU/MDCU interface

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

2.2.1.4 High and low data rate remote communications devices (HRCDs and LRCDs)

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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.

2.2.1.5 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 must be compatible. Refer to 3.2 and 3.3 for the required protocol and data-logging formats.

2.2.2 Performance function

2.2.2.1 Standard message

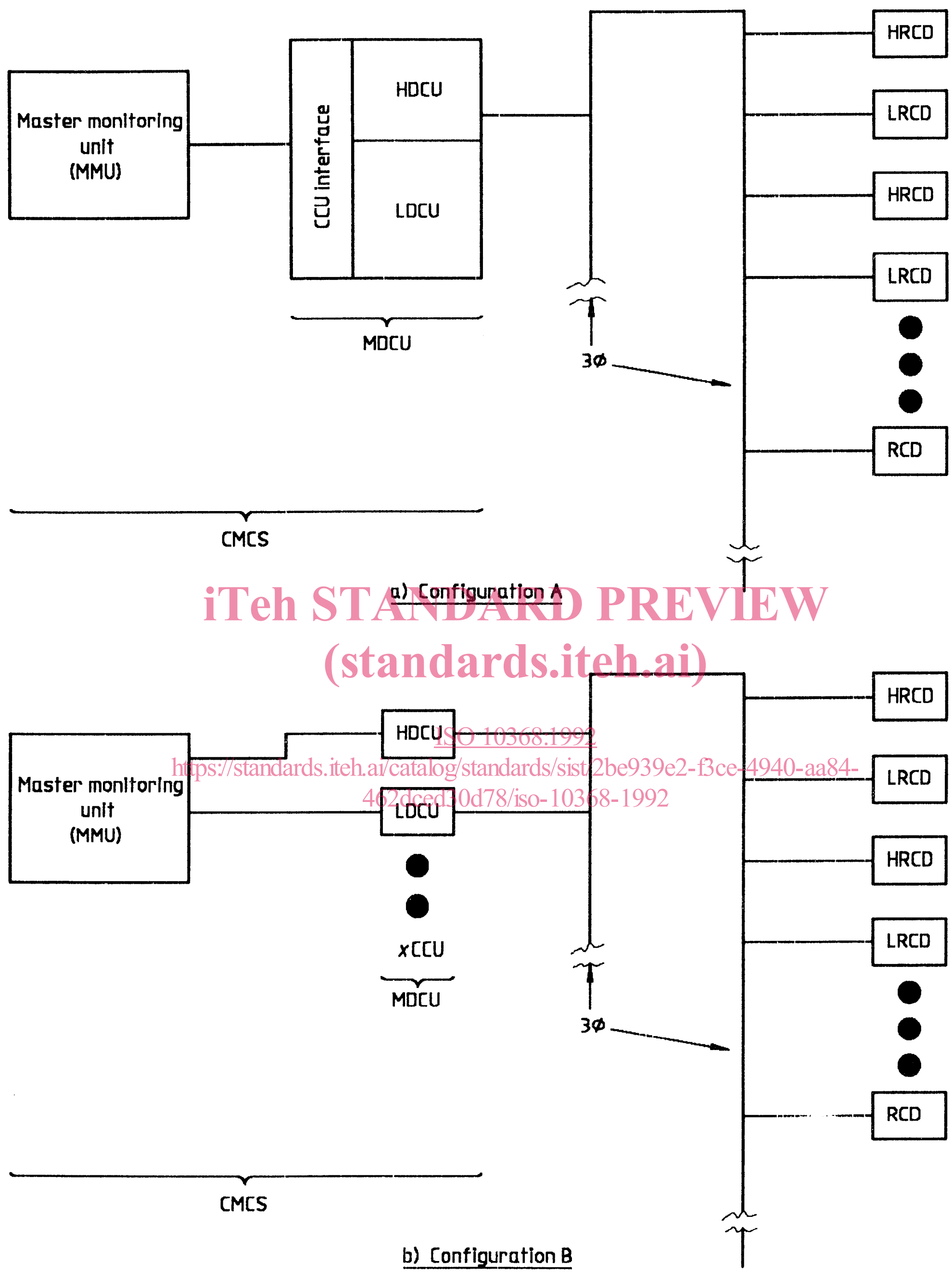
All RCDs shall respond to a minimum list of standardized enquiries (see 2.2.2.4) and commands with a standardized reply or acknowledgement.

2.2.2.2 Acknowledgement message

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

2.2.2.3 "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.



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H = high data rate
L = low data rate
3ϕ = three-phase power mains

Figure 1 — Remote condition monitoring system components layout

2.2.2.4 Required enquiries

All RCDs shall respond to the following required enquiries.

2.2.2.4.1 Identification number: For an integrally refrigerated or thermal container this will 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 (MCOU) is used, the identification number will be the MCOU number in ISO format.

2.2.2.4.2 Porthole container number: This response will be in addition to the identification number for MCOU systems.

2.2.2.4.3 Porthole number change: This is recorded in the RCD memory in alphanumerical format together with the time of the change.

2.2.2.4.4 Return air temperature: 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.

2.2.2.4.5 Supply air temperature: Expressed in the same format as 2.2.2.4.4.

2.2.2.4.6 RCD manufacturer and type: Consisting of a unique identification number registered and controlled by ISO, and for which ISO/TC 104 is the registration authority.

2.2.2.5 Optional standard enquiries

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Other optional enquiries are standardized. RCDs and refrigeration machinery so equipped shall respond to the following enquiries. RCDs not so equipped shall respond "Not able" (see 2.2.2.3).

2.2.2.5.1 Operating mode: Full cool, Partial or Lower capacity cool, Modulated cool, Fans only or Null mode, Defrost, Heat, Off.

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2.2.2.5.2 Set-point temperature: Expressed in the same format as 2.2.2.4.4.

2.2.2.5.3 Alarms: 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).

(Capacity for future development, e.g. controlled atmosphere.)

2.2.2.5.4 All current alarms: In sequence of occurrence.

2.2.2.5.5 Product temperatures: For example, tank, poultry.

2.2.2.5.6 Data-logger interval: One digit in half-hour intervals up to a maximum of 12 h.

2.2.2.5.7 Amperage: 0 to 63,75 A in 0,25 A intervals.

2.2.2.5.8 Destination: Three alphanumerical digits. If the destination changes, both the old and the current destination may be declared.

2.2.2.5.9 Port of discharge: Three alphanumerical digits.

2.2.2.5.10 Origin: Three alphanumerical digits.

2.2.2.5.11 Report results of self-check level 1: One digit, 0 = Fail, 1 = Pass.

2.2.2.5.12 Report results of self-check level *n*: In the format of up to 256 ASCII characters, where *n* is a single character between two and nine.

2.2.2.5.13 Vessel and voyage designation: (See ISO 9711-2.)

2.2.2.6 Commands

RCDs and refrigeration machinery if so equipped shall respond to the following commands. RCDs not so equipped shall respond "Not able" (see 2.2.2.3).

2.2.2.6.1 Change set-point temperature: Expressed in the same format as 2.2.2.4.4.

2.2.2.6.2 Initiate self-check level 1.

2.2.2.6.3 Initiate self-check level *n*: In the same format as 2.2.2.5.12, where *n* is in the range two to nine.

2.2.2.6.4 Change identification number: Expressed in the same format as 2.2.2.4.1.

2.2.2.6.5 Change data-logger interval: Expressed in the same format as 2.2.2.5.6.

2.2.2.6.6 Set data-logger time and date: With the date expressed in the format year/month/day.

2.2.2.6.7 Change operating mode: Expressed in the same format as 2.2.2.5.1.

2.2.2.6.8 Download data-logger record to central monitor.

2.2.2.6.9 Change porthole container number: Expressed in the same format as 2.2.2.4.3.

2.2.2.6.10 Change destination: Expressed in the same format as 2.2.2.5.8.

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2.2.2.7 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".

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2.2.2.8 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.

2.2.3 Performance constraints

2.2.3.1 Power interference

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

2.2.3.2 Marine device interference

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

2.2.3.3 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.

2.2.3.4 Status update

The MMU/MDCU system shall generate RCD updated status per 2.2.2.4 at least once per hour per container for a system of up to 1 024 containers active at the same time on one CMCS.

2.2.3.5 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.

2.2.3.6 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.

2.2.3.7 Voltage and frequency requirements

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

2.2.3.8 Dual voltage requirements

No special handling shall be required for RCDs to operate on the three voltage types of refrigeration machinery. (See ISO 1496-2:1988, subclause 7.2.)

2.2.3.9 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.

2.2.3.10 Error rates

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2.2.3.10.1 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.

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2.2.3.10.2 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.

2.2.3.10.3 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.

Section 3: System compatibility requirements

3.1 Scope

This section 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).

3.2 Communications protocol

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.

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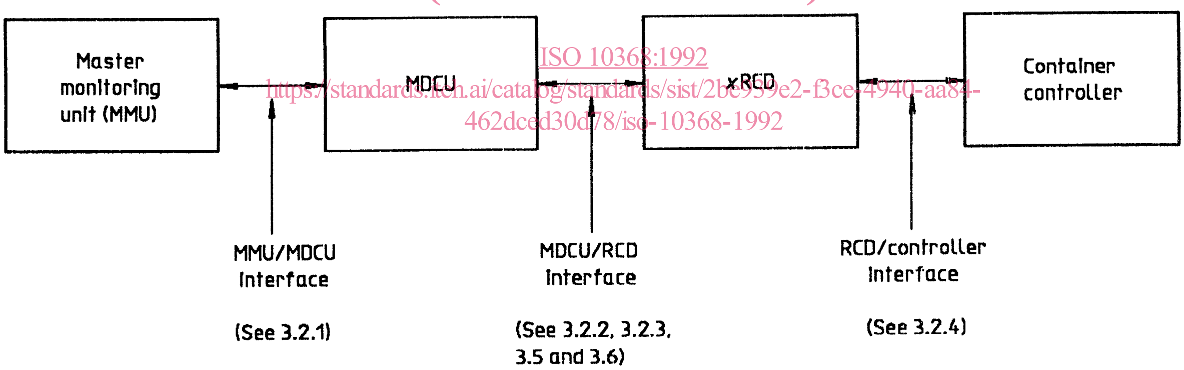


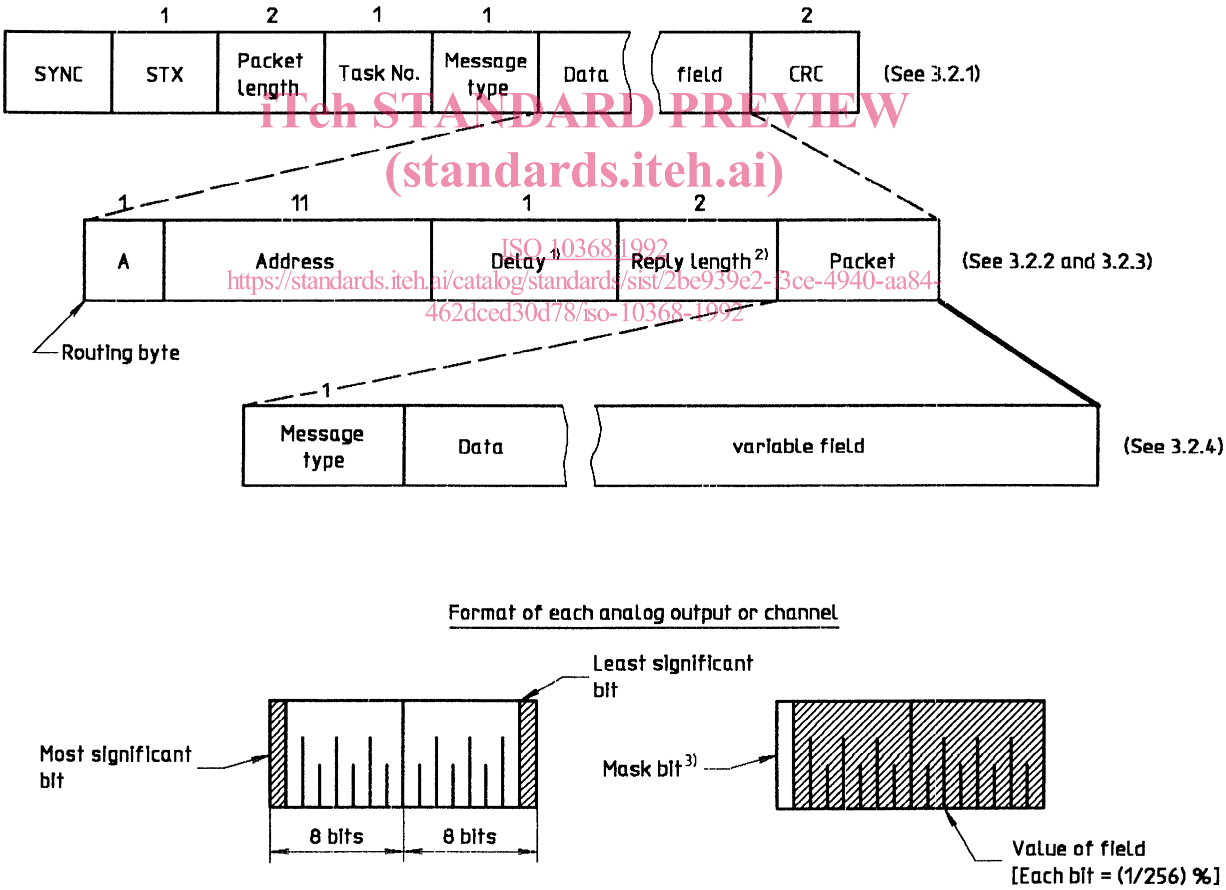
Figure 2 — Remote condition monitoring — Communications interfaces

3.2.1 MMU to MDCU communications

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 RS232-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 two times 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.

The messages for succeeding interfaces are embedded in the formats of earlier stages (see figure 3). These messages may be intended for action by the MDCU only. These messages are described fully in 3.2.1.1. If the message contains embedded data intended for an RCD, the format is as described in 3.2.1.3. Similarly, embedded data intended for the refrigeration machinery is described in 3.2.1.5 and 3.2.4. Note that the field length, in bytes, is also defined in figure 3.



1) Interactive 1 and 2 commands only.
2) Device commands only.
3) Mask bit equals 1 if there is a change in the field or 0 if there is no change.

Figure 3 — Message format overview

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