SVENSK STANDARD
SS-ISO 21214:2020

Vägtrafikinformatik – Kommunikations tillgång för mark mobiler (CALM) – Infraröd-system (ISO 21214:2015, IDT)

Intelligent Transport Systems – Communications access for land mobiles (CALM) – Infra-red systems (ISO 21214:2015, IDT)

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Den internationella standarden ISO 21214:2015 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av ISO 21214:2015.

Denna standard ersätter SS-ISO 21214:2006, utgåva 1

The International Standard ISO 21214:2015 has the status of a Swedish Standard. This document contains the official English version of ISO 21214:2015.

This standard supersedes the SS-ISO 21214:2006, edition 1

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 204, *Intelligent Transport Systems*.

This second edition cancels and replaces the first edition (ISO 21214:2006), which has been technically revised with the following changes:

— additional commands have been added in Clause 10;

— a new informative Annex F has been added Compatibility mode for MR-IR protocol and MR-IR protocol specification;

— minor textual clarifications have been made throughout the document.

Introduction

This International Standard determines the air interface using infrared systems operating in the wavelength range at 850 nm.

This International Standard is part of a family of International Standards for communications access for land mobiles (CALM) which specify a common architecture, network protocols, and a set of air interface definitions for wireless communications using a number of mobile (i.e. with horizontal or vertical cell/cell handover) wireless media, including infrared communications, cellular second generation, cellular third generation, 5 GHz, millimetre, and mobile wireless broadband (MWB), over packet-based networks. It is anticipated that other air interfaces will be added in the future. Generally speaking, ISO 21217 is designed to include air interfaces that provide some subset of point-to-point, vehicle-to-vehicle, and vehicle-to-point communications over packet-based networks in the ITS Sector. In particular, this International Standard provides general specifications for air interfaces designed to provide mobile access to packet-based networks.

The requirements for transmission of information over comparatively large distances using wireless technology are functionally very different from the requirements for European 5,8 GHz DSRC. Large volumes of data are required for purposes such as safety, traffic information and management, video downloads to vehicles for tourist information and entertainment, and navigation system updates, etc. In order to support such services, mobile units need to be able to communicate over longer ranges with access points/base stations and the system has to be able to hand over sessions from one access point/base station to another (horizontal or vertical). CALM standards are explicitly designed to enable quasi-continuous data communications, as well as data communications of protracted duration between vehicles and service providers and between vehicles. It is important to note that the CALM architecture is specifically designed to support packet-based communications; support for circuit-switched communications is not included.

The fundamental advantage of the CALM concept over traditional systems is the ability to support media independent handover (MIH), also referred to as heterogeneous handover, between the various media that can be included in a CALM system. Selection policies are supported that include user preferences and media capabilities in making decisions as to which media to use for a particular session and when to handover between media or between service providers on the same medium. These handover mechanisms are defined within ISO 21217, ISO 21210, ISO 21218, and ISO 24102. Handovers between access points using the same technology and service provider use mechanisms that are defined within the particular medium-specific CALM International Standard.

ITS applications that can be enhanced or are enabled by the CALM architecture includes car-to-car and point-to-multipoint safety messaging, collision avoidance, update of roadside telemetry and messaging, probe data collection, general Internet access, image and video transfer, infotainment, multimedia multicast, traffic management, monitoring and enforcement in mobile situations, and route guidance, just to mention a few.

This first revision takes into account and accommodates related CALM International Standards approved since the publication of the original version of this International Standard. Annex G provides a summary of the changes from the first published edition of this International Standard.

Intelligent transport systems — Communications access for land mobiles (CALM) — Infra-red systems

1 Scope

This International Standard determines the air interface using infrared systems at 820 nm to 1 010 nm.

The International Standard provides protocols and parameters for medium range and medium to high speed wireless communications in the ITS sector using infrared systems.

Such links are required for quasi-continuous, prolonged, or short communications between the following:

— vehicles and the roadside;

— between vehicles;

— between mobile equipment and fixed infrastructure points;

— over medium and long ranges.

Vehicles may be moving or stationary.

Wherever practicable, this International Standard has been developed by reference to suitable extant International Standards, adopted by selection. Required regional variations are provided.

Due account is given to, and made use of, any relevant parts of appropriate communications systems such as Global Positioning Systems (GPS), Digital Audio Broadcasting (DAB), Digital Video Broadcasting (DVB), Radio Local Area Networks (RLANs), Digital Data Broadcasting (DDB), TETRA, FM subcarrier, Mobile Broadband Systems (MBS, W-ATM), Internet Protocols, and DSRC.

This International Standard

— supports data rates of 1 Mbit/s up to 128 Mbit/s (it may also support higher data rates),

— supports vehicle speeds to a minimum of 200 km/h (closing speeds could be double this value),

— defines or reference environmental parameters relevant to link operation,

— supports communication distances to 100 m (it may also support longer communication distances of 300 m to 1 000 m),

— supports latencies and communication delays in the order of milliseconds,

— is compliant to regional/national regulatory parameters, and

— may support other regional/national parameters, as applicable.

Application specific requirements are outside the scope of this International Standard. These requirements will be defined in the CALM management and upper layer standards and in application standards.

Application specific upper layers are not included in this International Standard but will be driven by application standards (which may not be technology specific).

2 Conformance

Systems claiming conformance with this International Standard shall meet the specifications herein.

3 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

For a list of related deliverables under concurrent development, see Bibliography.

ISO/IEC 8802-11:1999, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications*

IEC 60825-1, *Safety of laser products — Part 1: Equipment classification, requirements and user's guide*

4 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21217 and the following apply.

4.1 General terms and definitions

4.1.1
broadcast window
BcW
window (4.1.27) used to broadcast information to slaves, even to those who have not yet performed the "registration process"

4.1.2
chip
smallest information unit communicated over the link

Note 1 to entry: Depending on the chosen coding, one information bit may be represented by one or more consecutive chips.

4.1.3
communications profile
specific set of data rate, modulation, and flow control

4.1.4
communication zone
spatial zone in which two CALM-IR units are able to communicate with acceptable performance

4.1.5
compatibility window
CmpW
window (4.1.27) that enables non-CALM-IR systems that follow certain rules to co-exist with a CALM-IR system without harmful interference

4.1.6
default data rate
data rate used in the *default communications profile* (4.1.7) to determine the data rate if not otherwise specified

4.1.7
default communications profile
communications profile (4.1.3) used except where another communications profile is successfully negotiated

4.1.8
flush byte
8 bit sequence used to denote the end of the main body of the information to be transmitted using the HHH (1,13) coding procedure

4.1.9
forward direction
forward link
forward window
communication flow from master to slave

4.1.10
frame length indicator
FLen
code used to calculate the frame length from the last slot index

4.1.11
frame organisation table
FOT
table that carries all organisational data of the TDMA frame

4.1.12
free air time indicator
FATI
code used to signal that “free air time” follows the current frame

Note 1 to entry: This airtime may be used by units not being a slave of the current master to establish “secondary mastership”.

4.1.13
guard time
TG
time which precedes a 'command alert' CA in certain cases in order to allow the automatic gain control of the receivers to re-settle

4.1.14
HHH (1,13) code
special run length limited code with d=1 and k=13 used in the CALM-IR communications profiles 2 to 6

4.1.15
management window
first window in a CALM-IR frame and carries all organisational information for the current frame

4.1.16
master identifier
code which uniquely identifies a CALM-IR master

4.1.17
multicast window
McW
window (4.1.27) used for communication from master to multiple slaves, forward direction only

4.1.18
private window(s)
window(s) (4.1.27) that carry the information exchange between a master and a specific slave

4.1.19
registration phase
phase where a master identifies devices newly entering his communication zone

4.1.20
slave
device that is under the control of another device

4.1.21
spare window
SpW
window (4.1.27) not allocated to a slave and reserves airtime for slaves eventually registering during the current frame in order to enable the master to instantly allocate them a private window without the need for frame reorganisation

4.1.22
slot index (S)
index used to count the time slots

4.1.23
TDMA frame
time structure based on a train of consecutive time slots (at least one)

4.1.24
Time slot
subunit of a TDMA frame

4.1.25
temporary identifier
TempID
code used for addressing the slave device while it resides in the communication environment of the master

Note 1 to entry: Each time the slave registers in a communication zone, a new TempID is created.

4.1.26
wake-up window
WuW
special case of a broadcast window and is used to “wake-up” sleeping units entering the communication zone of an active master

4.1.27
window
smallest addressable time span of a CALM-IR frame and may consist of one or multiple time slots

4.2 Terms and definitions of the optical parameters

4.2.1
irradiance
E_e
(at a point of a surface) quotient of the radiant flux $d\Phi_e$ incident on an element of the surface containing the point, by the area dA of that element Equivalent definition. Integral, taken over the hemisphere visible from the given point, of the following expression

$$L_e \cdot \cos\theta \cdot d\,\Omega$$

where

L_e is the radiance at the given point in the various directions of the incident elementary beams of solid angle $d\Omega$;

θ is the angle between any of these beams and the normal to the surface at the given point

$$E_e = \frac{d\Phi_e}{dA} = \int_{2\pi\, sr} L_e \cdot \cos\theta \cdot d\Omega$$

Note 1 to entry: It is expressed in W/m^2.

[SOURCE: IEC 60050 (845-01-37), modified]

4.2.2
luminous flux
Φ_V
quantity derived from radiant flux Φ_e by evaluating the radiation according to its action upon the CIE standard photometric observer. For photopic vision

$$\Phi_V = K_m \int_0^\infty \frac{d\Phi_e(\lambda)}{d\lambda} \cdot V(\lambda) \cdot d\lambda$$

where

$\frac{d\Phi_e(\lambda)}{d\lambda}$ is the spectral distribution of the radiant flux and V(λ) is the spectral luminous efficiency.

Note 1 to entry: For the value K_m (photopic vision) and K'_m (scotopic vision), see IEC 60050 (845–01–56).

[SOURCE: IEC 60050 (845-01-35), modified]

4.2.3
luminous efficacy of radiation
K

quotient of the luminous flux Φ_V by the corresponding radiant flux $K = \frac{\Phi_v}{\Phi_e}$

Note 1 to entry: When applied to monochromatic radiation, the maximum value of $K(\lambda)$ is denoted by the symbol K_m. K_m = 683 lm. W^{-1} for $\nu_m = 540 \times 10^{12}$ Hz (λ_m approximately 555 nm) for photopic vision. K'_m = 1 700 lm. W^{-1} for λ'_m approximately 507 nm for scotopic vision. For other wavelengths: $K(\lambda) = K_m V(\lambda)$ and $K'(\lambda) = K'_m V'(\lambda)$.

[SOURCE: IEC 60050 (845-01-55), modified]

4.2.4
radiance
L_e, L
(in given direction, at a given point of a real or imaginary surface) quantity defined by the following formula:

$$L_e = \frac{d\Phi_e}{dA \cdot \cos\theta \cdot d\Omega}$$

where

$d\Phi_e$ is the radiant flux transmitted by an elementary beam passing through the given point and propagating in the solid angle $d\Omega$ containing the given direction;

dA is the area of a section of that beam containing the given point;

θ is the angle between the normal to that section and the direction of the beam.

Note 1 to entry: It is expressed in $W/sr \cdot m^2$.

[SOURCE: IEC 60050 (845-01-34), modified]

4.2.5
radiant exitance
M_e
quotient of the radiant flux $d\Phi_e$ leaving an element of the surface containing the point, by the area dA of that element
Equivalent definition. Integral, taken over the hemisphere visible from the given point of the following formula:

$$M_e = \frac{d\Phi_e}{dA} = \int_{2\pi sr} L_e \cdot \cos\theta \cdot d\Omega$$

where

$L_e \cdot \cos\theta \cdot d\Omega$	is the radiance at the given point in the various directions of the emitted elementary beams of solid angle $d\Omega$;
θ	is the angle between any of these beams and the normal to the surface at the given point

Note 1 to entry: It is expressed in $W/sr \cdot m^2$.

[SOURCE: IEC 60050 (845-01-47), modified]

4.2.6
radiant flux
alternative expression for radiant power

[SOURCE: IEC 60050 (845-01-24), modified]

4.2.7
radiant intensity
I_e
quotient of the radiant flux, $d\Phi_e$, leaving the source and propagated in the element of solid angle, $d\Omega$, containing the given direction, by the element of solid angle

$$I_e = \frac{d\Phi_e}{d\Omega}$$

Note 1 to entry: It is expressed in W/sr (Watt per steradian).

[SOURCE: IEC 60050 (845-01-30), modified]

4.2.8
radiant power
radiant power ϕ_e is the power emitted, transmitted or received in the form of radiation

Note 1 to entry: It is expressed in W (Watt).

[SOURCE: IEC 60050 (845-01-24), modified]

4.2.9
steradian
sr
dimensionless SI unit of solid angle

Note 1 to entry: Solid angle that, having its vertex at the centre of a sphere, cuts off an area of the surface of the sphere equal to that of a square with sides of length equal to the radius of the sphere. (ISO, 31/1-2.1, 1978)

Note 2 to entry: Usually, the abbreviation "sr" is appended although this is mathematically incorrect.

EXAMPLE The unity solid angle, in terms of geometry, is the angle subtended at the centre of a sphere by an area on its surface numerically equal to the square of the radius (see Figure 1). Other than the figure might suggest, the shape of the area does not matter at all. Any shape on the surface of the sphere that holds the same area will define a solid angle of the same size.

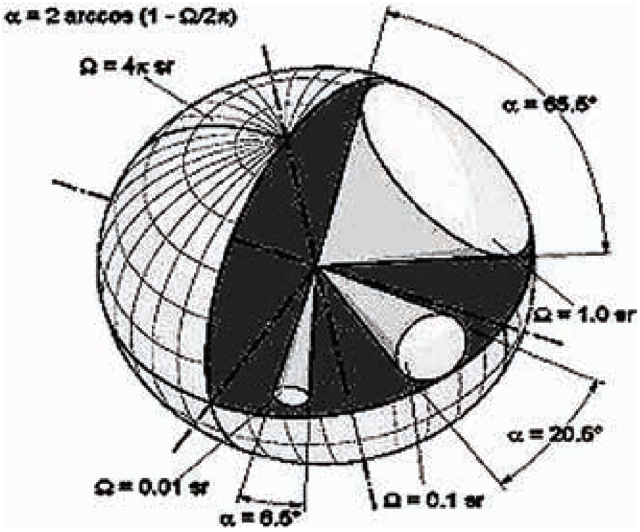

Figure 1 — Solid angle

Relation between distance *r*, irradiance E_e, and intensity I_e. Using a single radiation point source, we get the following formula:

$$E_e = \frac{d\Phi_e}{dA} = \frac{I_e \cdot d\Omega}{dA} = \frac{I_e}{r^2}; \left[\frac{W}{m^2}\right]$$

[SOURCE: IEC 60050 (845-01-24), modified]

5 Symbols (and abbreviated terms)

Symbols and abbreviated terms used in this International Standard are listed below. Reference should also be made to ISO 21217.

Φ_e	radiant power, radiant flux
Φ_v	luminous power or luminous flux
BcW	broadcast window
BER	bit error ratio
CA	command alert
CALM	communications access for land mobiles
CCI	control channel indicator
CFA	CALM fast application
Cmd	command
CmpW	compatibility window

$\boldsymbol{\phi}_\mathbf{e}$	radiant power, radiant flux
CRC	cyclic redundancy check
D	beam axis, “bore-sight direction”
DSRC	dedicated short range communication
$\boldsymbol{E}_\mathbf{e}$	irradiance
$\boldsymbol{E}_\mathbf{v}$	illuminance
FATI	free air time indicator
FB	flush byte
FCIR	fast CALM infrared packet format
FLen	frame length indicator
FOT	frame organization table
F-Sync	frame synchronisation pattern
HHH	Hirt, Hassner, Heise (inventors of the HHH(1,13) code)
$\boldsymbol{I}_\mathbf{e}$	radiant intensity
IR	infrared
IR-CAL	IR communication adaptation layer
IR-MAE	IR management adaptation entity
IR-ME	IR management entity
$\boldsymbol{I}_\mathbf{v}$	luminous intensity
K	luminous efficacy of radiation
$\boldsymbol{L}_\mathbf{e}$	radiance
$\boldsymbol{L}_\mathbf{v}$	luminance
MAC	medium access control. Sometimes used synonym to MAC layer.
McW	multicast window
$\boldsymbol{M}_\mathbf{e}$	radiant exitance
MID	master identifier
MnW	management window
Mv	luminous exitance
Nframe	number of time slots in a CALM-IR frame
Nmaxframe	maximum number of time slots in a CALM-IR frame
Nminframe	minimum number of timeslots in a CALM-IR frame

ϕ_{e} radiant power, radiant flux

OBU on board unit

PA preamble

PL payload

PP preamble period

PrW private window

RLL run length limited code

RSU road side unit

s slot index

SAP service access point

SpW spare window

sr steradian

STA start flag

STO stop flag

Tbit bit time (duration of one bit)

Tchip chip time (duration of one chip)

TCWAIT waiting time of the slave for a reply to a proposed TempID

TDMA time division multiple access

TDREG registration time-out

TempID temporary ID

TF-Sync duration of the F-Sync signal

TG guard time

TL lead time - time from the rising edge of the last pulse of a synchronisation signal (F-Sync, W-Sync, CA) to the rising edge of the first pulse of the following command, etc

TPfall optical pulse fall time

TPon optical pulse on time

TPrise optical pulse rise time

TREG delay time before slave replies to an MC-RRQ or MC-REN

TRT waiting time of the master for a reply to its MC-IDP

TRW receiver window – time span around the allocated time slot when the receiver circuit shall be ready to detect a W-Sync signal

TRWAIT waiting time of the master for a reply to an MC-RRQ or MC-REN