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Tractors and machinery for agriculture and forestry — Serial control and communications data network —

Part 6:
Virtual terminal

Tracteurs et matériels agricoles et forestiers — Réseaux de commande et de communication de données en série —

Partie 6: Terminal virtuel

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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 11783-6 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 19, *Agricultural electronics*.

This second edition cancels and replaces the first edition (ISO 11783-6:2004), which has been technically revised. It also incorporates the Technical Corrigendum ISO 11783-6:2004/Cor.1:2005. It introduces requirements for Version 4 VTs and Working Sets, while retaining the requirements of the first edition for Version 3 VTs and Working Sets. The specific requirements of Annex G, as well as Annex J and the revised Table L.2, are also applicable to Version 3.

ISO 11783 consists of the following parts, under the general title *Tractors and machinery for agriculture and forestry — Serial control and communications data network*:

— *Part 1: General standard for mobile data communication*

— *Part 2: Physical layer*

— *Part 3: Data link layer*

— *Part 4: Network layer*

— *Part 5: Network management*

— *Part 6: Virtual terminal*

— *Part 7: Implement messages application layer*

— *Part 8: Power train messages*

— *Part 9: Tractor ECU*

— *Part 10: Task controller and management information system data interchange*

— *Part 11: Mobile data element dictionary*

— *Part 12: Diagnostics services*

— *Part 13: File server*

— *Part 14: Sequence control*

Introduction

Parts 1 to 14 of ISO 11783 specify a communications system for agricultural equipment based on the CAN 2.0 B[1] protocol. SAE J 1939[2] documents, on which parts of ISO 11783 are based, were developed jointly for use in truck and bus applications and for construction and agriculture applications. Joint documents were completed to allow electronic units that meet the truck and bus SAE J 1939 specifications to be used by agricultural and forestry equipment with minimal changes. The specifications for virtual terminals given in this part of ISO 11783 are based on DIN 9684-4[3]. General information on ISO 11783 is to be found in ISO 11783-1.

The purpose of ISO 11783 is to provide an open, interconnected system for on-board electronic systems. It is intended to enable electronic control units (ECUs) to communicate with each other, providing a standardized system.

All phrases in this part of ISO 11783 that refer explicitly to a software term for an object or a command have the first letter of each object or command word capitalized (e.g. Linear Bar Graph object, Change Numeric Value command). This aids in the recognition of each of these terms as being a specific item having a specific definition in the document.

The International Organization for Standardization (ISO) draws attention to the fact that it is claimed that compliance with this part of ISO 11783 may involve the use of a patent concerning the controller area network (CAN) protocol referred to throughout the document.

ISO takes no position concerning the evidence, validity and scope of this patent.

The holder of this patent has assured ISO that he 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. Information may be obtained from:

    Robert Bosch GmbH
    Wernerstrasse 51
    Postfach 30 02 20
    D-70442 Stuttgart-Feuerbach
    Germany

Attention is drawn to the possibility that some of the elements of this part of ISO 11783 may be the subject of patent rights other than that those identified above. ISO shall not be held responsible for identifying any or all such patent rights.

Tractors and machinery for agriculture and forestry — Serial control and communications data network —

Part 6:
Virtual terminal

1 Scope

ISO 11783 as a whole specifies a serial data network for control and communications on forestry or agricultural tractors and mounted, semi-mounted, towed or self-propelled implements. Its purpose is to standardize the method and format of transfer of data between sensors, actuators, control elements and information storage and display units, whether mounted on, or part of, the tractor or implement. This part of ISO 11783 describes a universal virtual terminal (VT) that can be used by both tractors and implements.

It is applicable to both Version 3 and Version 4 VTs and Working Sets.

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 11783-1, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 1: General standard for mobile data communication*

ISO 11783-3, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 3: Data link layer*

ISO 11783-5, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 5: Network management*

ISO 11783-7, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 7: Implement messages application layer*

ISO 15077, *Tractors and self-propelled machinery for agriculture — Operator controls — Actuating forces, displacement, location and method of operation*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms, definitions and abbreviated terms given in ISO 11783-1 and the following terms and definitions apply.

3.1
auxiliary input unit
autonomous control function (CF) providing auxiliary controls for common use that may also be physically located within an electronic control unit (ECU), or on the virtual terminal (VT)

3.2
object pool
collection of objects that completely define the operator interface for an implement or a single Working Set

NOTE   The complete VT definition will be made up of one or more object pools — one for each Working Set.

3.3
object ID
numeric value which references a specific object within an object pool

3.4
attribute ID
AID
numeric value which references a specific object's attribute

NOTE 1   AID values range from 0 to FE_{16} (254_{10}), with 255 as the NULL_AID.

NOTE 2   This field appears in the attribute and record format tables. AIDs that are explicitly defined with square brackets, [ ], are read-only attributes using the Get Attribute Value message. AIDs that are explicitly defined without square brackets are writable with the Change Attribute command.

3.5
char
single character where the size is 1 byte

NOTE   Commonly used for ISO 8859 characters (e.g. 41_{16} in ISO/IEC 8859-1 represents "A"), see Annex L.

3.6
character
single text grapheme or symbol, as in an alphabet

NOTE   Size is variable, based on the encoding scheme (see char and WideChar).

3.7
code plane
group of 65 536 possible character codes

NOTE   Unicode/ISO 10646 organizes the characters in 17 code planes numbered 0 to 16.

EXAMPLE

Code plane 0 covers characters 000000_{16} to $00FFFF_{16}$.
Code plane 1 covers characters 010000_{16} to $01FFFF_{16}$.
...
Code plane 16 covers characters 100000_{16} to $10FFFF_{16}$.

3.8
open input object
state of an input object where the object has focus and it is open for operator input

NOTE   Open input object is used interchangeably with data input.

3.9
selected input object
state of an input object where the object has focus but it is not open for operator input

NOTE   Selected input object is used interchangeably with "has focus".

3.10
surrogate pair
32 bit code for characters composed of a 16 bit high pair and a 16 bit low pair

NOTE 1   UTF-16 encoding of characters in code plane 1 to 16 (see 4.6.16.6).

NOTE 2   The UTF-16 character encoding scheme is defined by ISO 10646.

3.11
WideChar
single character with a size of 2 bytes encoded in little endian order

EXAMPLE   Byte sequence 41_{16}, 00_{16} represents "A".

NOTE 1   See Annex L.

NOTE 2   Two WideChars can be combined to indicate character codes exceeding 16 bits (see 4.6.16.6).

3.12
WideString
zero or more characters composed of the primitive type "WideChar" always preceded by the byte order mark $FEFF_{16}$

EXAMPLE   Byte sequence FF_{16}, FE_{16}, 41_{16}, 00_{16}, 42_{16}, 00_{16}, 43_{16}, 00_{16} represents "ABC". This WideString has a length of 8 bytes with the number of characters in the presentation equal to 3.

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3.13
8 bit string
zero or more characters composed of the primitive type "char"

NOTE   String length is variable.

3.14
VT number
identification number that is derived from the function instance of the VT

NOTE   VTs can then be referenced as VT Number 1, VT Number 2, etc.

3.15
User-Layout Data Mask
special Data Mask controlled by the VT but laid out by the operator

NOTE   See 4.1 and 4.7.

3.16
window cell
equal-sized cell in a grid on a User-Layout Data Mask

NOTE   See 4.7.

3.17
window mask object
supplied by the Working Set for placement by the operator into the area of one or more window cells but not a partial cell

NOTE   See 4.7.

3.18
User-Layout Soft Key Mask
Soft Key Masks that are controlled by the VT but laid out by the operator

NOTE   See 4.7.

3.19
Key Cell
cell that is the size of a Soft Key designator in a User-Layout Key Mask

NOTE   See 4.7.

3.20
Key Group Object
area of one or more Key Cells and containing a grouping of one or more Key Objects

NOTE   See 4.7.

3.21
non-VT screen
VT-capable display on which no Data Masks are visible

NOTE   See 4.7.

3.22
non-VT area
area outside the normal Data Mask and Soft Key Mask visible at the same time as a Data Mask and Soft Key Mask are displayed

NOTE   See 4.7.

3.23
range
value
signifying that each object has an attributes and record format table

NOTE   Each parameter has a range or value for the specific attribute. Where there are ranges and values that are explicitly defined with square brackets, [ ], they are applicable to VT Version 3 and prior, whereas the adjacent unbracketed range or value applies to VT Version 4 or later.

4   Technical requirements

4.1   Overview

A virtual terminal (VT) is a control function (CF) within an electronic control unit (ECU), consisting of a graphical display and input functions, connected to an ISO 11783 network that provides the capability for a CF, composing an implement or a group of implements to interact with an operator. The VT provides the capability to display information and to retrieve data from an operator. The CF, as an implement or a group of implements represented by a Working Set Master, acquires storage for objects within the VT and on demand displays this stored information to an operator. In this part of ISO 11783, the term *Working Set* will be used for a CF, as an implement or a group of implements represented either by a single ECU or a group of ECUs acting as a Working Set. Working Sets on the network can also acquire the use of input and control keys of the VT to allow the operator to send signals back to the Working Set.

This part of ISO 11783 describes the VT with the detail and clarity required for VTs built by different manufacturers to be interchangeable with any implement Working Set that uses the VT services. The interface protocol of this part of ISO 11783 also reduces the runtime ISO 11783 communication bus traffic as much as possible. For these reasons, the requirements of this part of ISO 11783 are organized in an object-oriented

manner with specific attributes and behaviour of each object clearly and fully defined. The required behaviour of the VT given certain situations is also detailed.

In general, the functions, not the design, of the user interface of the VT are defined in order to avoid restrictions on possible designs. However, certain limitations are imposed in order to meet the goal of interchangeability between various manufacturers. Specifications regarding physical layout, components, processing power and the number of physical elements comprising a VT have been omitted in order to avoid restricting manufacturers' designs.

The VT shall have a pixel-addressable (graphical) display. Information from connected Working Sets is shown to the operator on the graphical display. This information is shown in display areas that are defined by Data Masks, Alarm Masks and Soft Key Masks. The data for these masks is contained in object definitions that are loaded into a VT via the ISO 11783 CAN bus, or from non-volatile memory. When the information defined by a mask is required on the display, the mask can be made visible by a single Change Active Mask command from the Working Set, and therefore does not require significant additional network traffic.

The physical size, resolution, orientation and methods of implementing the graphical display are at the discretion of the designer of the VT. Figure 1 shows examples of some possible VT designs and orientations.
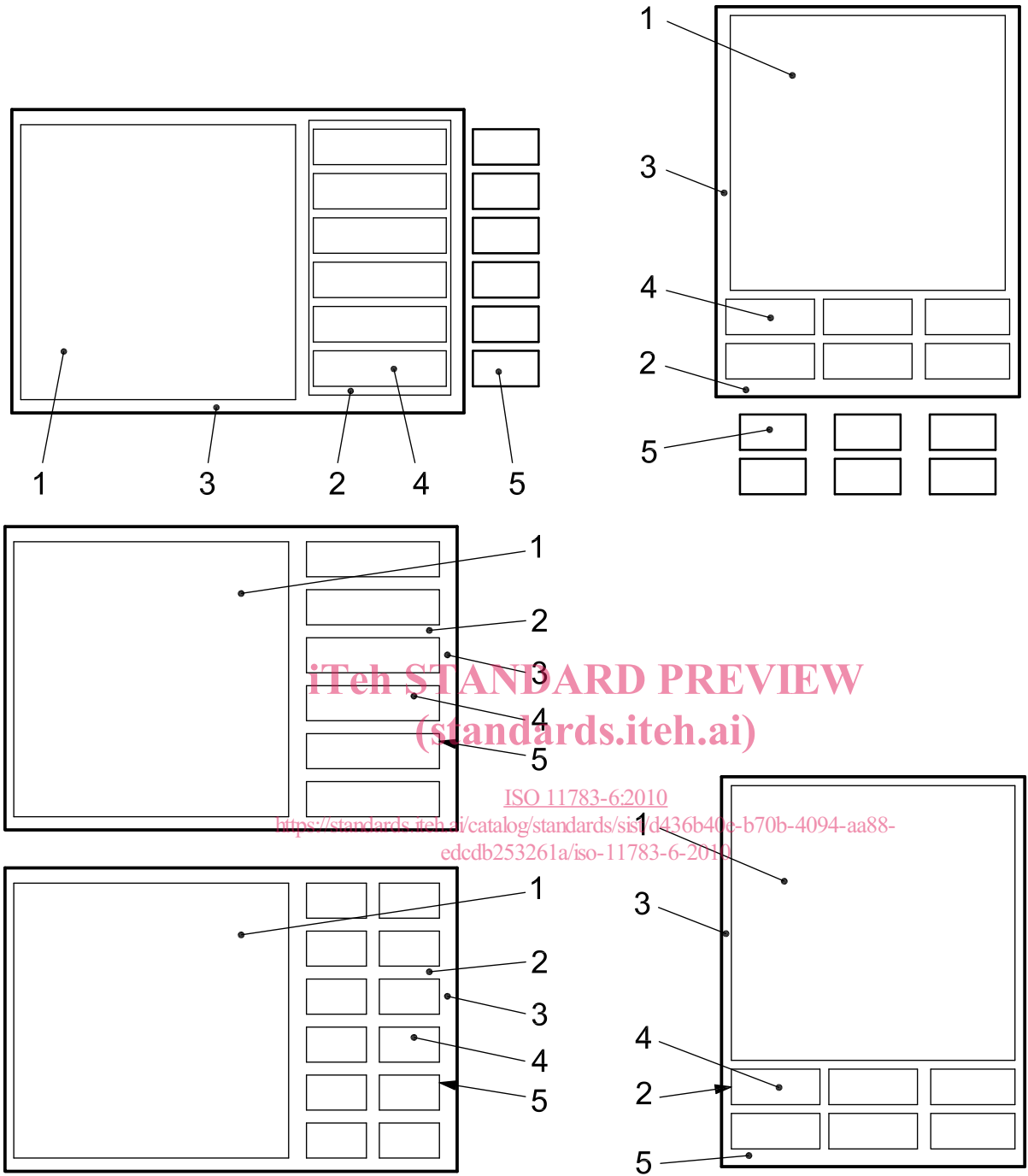
Key

1   Data Mask Area

2   Soft Key Mask area

3   physical screen

4   Soft Key designator

5   physical Soft Key

Figure 1 — Virtual terminal — Examples

4.2 Operator input and control

The VT shall provide the operator with means for control and input. There are five means associated with a VT that can be used for the input of data, selection of display data, and the control of connected Working Sets.

See Figure 2.

a) **Soft**

This is a means, most likely keys on the VT, using software-changeable designators (labels). "Soft Keys" have their identity changed depending on which Soft Key Mask is visible. The VT shall make the association between a Soft Key and its designator clearly evident to the operator.

b) **Navigation**

This is a means of selecting an input field or Button within the active Data Mask. If keys are used for "Navigation", they do not send key activation information to the Working Set and are proprietary to the VT.

c) **Data Input**

This is a means of entering/editing information in an input field within the active Data Mask. If keys are used for "Data Input", they do not send key activation information to the Working Set and are proprietary to the VT. A means shall be provided for entering any number or character sequence that is valid for the input field.

During the data input operation, the VT Status message will continue to indicate the active Working Set and active mask which contains the input object for which the data input operation applies. Data input operation that originates on a User-Layout Data Mask does not affect the VT Status message.

There are two types of Data Input: "editing" and "real time editing".

1) **Editing**

This is a means of data input where the new value being entered is composed by the operator using a proprietary means within the VT. During the composition of the new value, changes to the original value are not communicated to the Working Set. A means shall also be provided for ESC from, or ENTER of, information into a data field.

The ENTER means shall be provided to indicate to the Working Set the completion of data entry and communication of the new value, and the ESC means shall be provided to indicate that the data entry was aborted. The ESC means either may be a permanent key or may only be available during data entry (see Table 4). The VT shall send a VT ESC message to a Working Set for an operator-activated ESC means or an ESC response as a response to receiving an ESC command from a Working Set.

2) **Real time input**

This is a means of data input for an Input Number object and Input List object where the object has focus and is open for operator input, and changes by the operator to the value are periodically transmitted to the Working Set while the object is being changed. The VT Change Numeric Value message is limited to a 5 Hz update rate. Each value change sent to the Working Set is considered a complete transaction and cannot be reverted by the ESC means. The VT is not required to provide steps in uniform increments; however, it shall be possible to set any value (e.g. fast scrolling is allowed to span a wide range of values, with fine adjustment for final setting). If the ESC means is activated during real time data input, the VT shall ensure that the on-screen value is equal to the value last sent to the Working Set. The VT may send a final value to the Working Set prior to sending the VT ESC message or ESC response message to ensure this synchronization. Real time data input shall meet the operator controls requirement specified in ISO 15077.
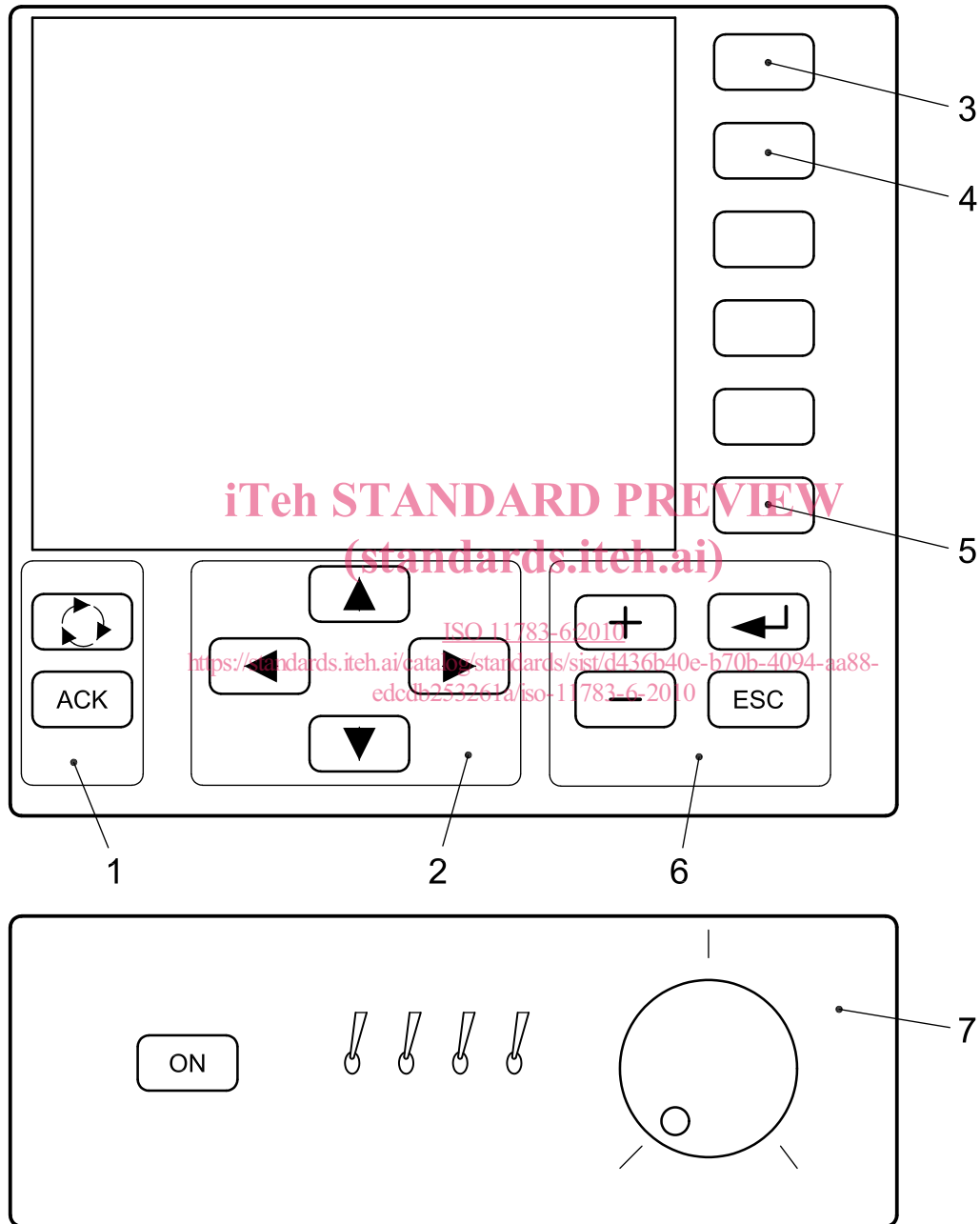
d) **Control**

This is a means of selecting between Working Sets whenever a Data Mask is visible, and a means of acknowledging alarms. Both means are required. Since more than one Working Set can use the services

of the VT, the VT shall provide a means for the operator of selecting between connected Working Sets. The Working Set selection means should be indicated by three circular arrows or a similar graphic. Only the ACK means sends key activation information to the Working Set.

e) Auxiliary input

This is a means available to the operator for communicating input commands to the Working Set(s) using Auxiliary Controls which are assigned to Auxiliary Functions. (See Annex J.)

Key

1	control	5	Soft Key 6
2	navigation	6	data input
3	Soft Key 1	7	auxiliary input
4	Soft Key 2		

Figure 2 — Operator input and control means — Example

4.3   Acoustic alarm

The VT shall provide an acoustic alarm. The alarm may be a simple on/off type buzzer or an acoustic component capable of variable frequency and audio level.

4.4   Coordinate system

Positions and sizes in this part of ISO 11783 are always given in physical pixels unless otherwise stated. A two-dimensional coordinate plane (x, y) is used, where x is the number of units wide (x increases from left to right) and y is the number of units high (y increases from top to bottom). The coordinates are signed values. The origin $(0, 0)$ for any object's coordinate system is located at the top left corner of the parent object.

4.5   Display areas

The following defines standard Data Mask and Soft Key Mask areas of the display. Alternative usage of these areas supports displaying data from multiple working sets (see 4.7).

4.5.1   Data Mask

The VT shall reserve an area of the display for displaying Data Masks and Alarm Masks. This area is called the Data Mask area (see Figure 1). Recognizing that the physical orientation of the VT display could be different, depending on the manufacturer of the VT, a square Data Mask aspect ratio is chosen to ensure correct display in either landscape or portrait orientation. The minimum Data Mask area shall be 200 pixels × 200 pixels. This requirement does not limit the physical resolution or size of the display, only the usable Data Mask area. Higher resolution mask areas are permitted, but the square aspect ratio shall be strictly enforced. Examples of Data Mask areas that would meet this requirement are

— 200 × 200,

— 240 × 240,

— 320 × 320, and

— 480 × 480.

Any other square dimensions would be acceptable.

It is suggested that unused areas of the physical display be used for proprietary information such as vehicle data, VT statistics or other data.

4.5.2   Soft Key Mask area and Soft Key designators

The VT shall reserve an area of the display for Soft Key labels, separate from the Data Mask Area. This area is called the Soft Key Mask area (see Figure 1). Each Soft Key shall have a reserved display area, called a Soft Key designator, for displaying a label (see Figure 1). The minimum size of the designator field is 60 pixels wide × 32 pixels high, regardless of screen orientation. The Soft Key designators may contain text, graphics or both. The Soft Key Mask area may be adjacent to, or physically separate from, the Data Mask area, but shall not be part of the Data Mask area.

The VT shall provide a clearly visible separation between the individual Soft Key designators (for example, by drawing a one-pixel line). It is recommended that this visible separation be drawn outside the Soft Key designator area.

The presentation of the Soft Keys can be further described in three groups, with a defined relationship: Navigation Soft Keys < Number of Physical Soft Keys ⩽ Number of Virtual Soft Keys.

a)   VT Version 3 and prior VTs have no requirement on the number of physical Soft Keys.

b)   VT Version 4 and later VTs shall provide at least six Physical Soft Keys.