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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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Contents

Page

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

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

This fourth edition cancels and replaces the third edition (ISO 11783-6:2014) which has been technically revised. New requirements in this fourth edition are specified as VT version 6. Changes include clarifications to existing VT object and command behaviour, including additional capabilities. One Working Set in collaboration with another Working Set can transfer control of the active mask to the other with the Select Active Working Set command. Additional objects include a Colour Palette object, a Graphic Data object, a Scaled Graphic object, and a Working Set Special Controls object.

A list of all the parts in the ISO 11783 series can be found on the ISO website.

Introduction

ISO 11783-1 to ISO 11783-14 specify a communications system for agricultural equipment based on the ISO 11898[5] protocol. SAE J1939[1] 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 J1939 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[2]. 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 document 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. Output Linear Bar Graph object, Change Numeric Value command). This aides in the recognition of these terms as a specific item which has a specific definition in this document.

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, mounted, semi-mounted, towed or self propelled implements. Its purpose is to standardize the method and format of transfer of data between sensor, actuators, control elements, information storage and display units whether mounted or part of the tractor, or any implements.

This document describes a universal virtual terminal that can be used by both tractors and implements.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 11783-3, *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 and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
auxiliary input unit
autonomous control function (CF) providing Auxiliary Controls for common use that can 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 1 to entry: 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 identifies a specific object within an object pool

Note 1 to entry: Object ID values range from 0 to $FFFF_{16}$ (65535_{10}), with 65535 as the NULL Object ID.

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

Note 1 to entry: AID values range from 0 to FF_{16} (255_{10}), with 255 as the NULL_AID.

3.5
char
single character where the size is 1 byte

Note 1 to entry: Commonly used for ISO 8859 characters (e.g. 41_{16} in ISO 8859-1 represents “A”) (see Annex K).

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

Note 1 to entry: Size is variable based on the encoding scheme [see *char* (3.5) and *WideChar* (3.11)].

3.7
code plane
group of 65536 possible character codes

Note 1 to entry: Unicode/ISO 10464 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 1 to entry: 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 1 to entry: 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 to entry: UTF-16 encoding of characters in code plane 1 to 16 (see 4.6.19.7).

Note 2 to entry: UTF-16 Character encoding scheme 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” (see Annex K).

Note 1 to entry: Two WideChars can be combined to indicate character codes exceeding 16-bit (see 4.6.19.7).

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.

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

Note 1 to entry: String length is variable.

3.14
VT Number
number that is used to uniquely identify each connected VT to the operator

Note 1 to entry: See 4.6.25 and D.18.

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

Note 1 to entry: See 4.1 for information on data mask variations, and 4.7 for User-Layout Data Mask information.

3.16
Window Cell
rectangular presentation cell in a grid on a User-Layout Data Mask

Note 1 to entry: See 4.7.

3.17
Window Mask object
rectangular presentation area composed of one or more adjacent Window Cells

Note 1 to entry: 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 1 to entry: See 4.7.

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

Note 1 to entry: See 4.7.

3.20
Key Group object
area of one or more Key Cells and contains a grouping of one or more Key objects

Note 1 to entry: See 4.7.

3.21
Non-VT Screen
display screen that is not part of the VT application or one in which the layout is controlled by the VT

EXAMPLE A screen that comes from another application within the display (see 4.7).

3.22
Non-VT Area
visible area outside the normal Data Mask and Soft Key Mask areas

EXAMPLE A display of information related to the vehicle operation (see 4.7).

3.23
referenced WS
working set with an object pool containing objects which are shown by another object pool via the External Object Pointer object

Note 1 to entry: See 4.6.11.6.

3.24
referencing WS
working set with an object pool which shows object(s) from another object pool via the External Object Pointer object

Note 1 to entry: See 4.6.11.6.

3.25
Functionally Identical WS
Working Set(s) with a NAME that exactly matches other Working Sets, when the Self Configurable, Instance fields, and Identity Number are excluded in the comparison

3.26
Line End
"cursor" or text positioning control intended to locate the following displayable character "font height" pixels downward and at the left-most position in the containing object

Note 1 to entry: See 4.6.19.6.

3.27
Model Identification Code
proprietary code defined by the manufacturer that defines a unique model and version of an Auxiliary Input Unit that does not change at runtime, and is revised by the manufacturer when a new and incompatible Auxiliary Input Unit is created

4 Technical requirements

4.1 Overview

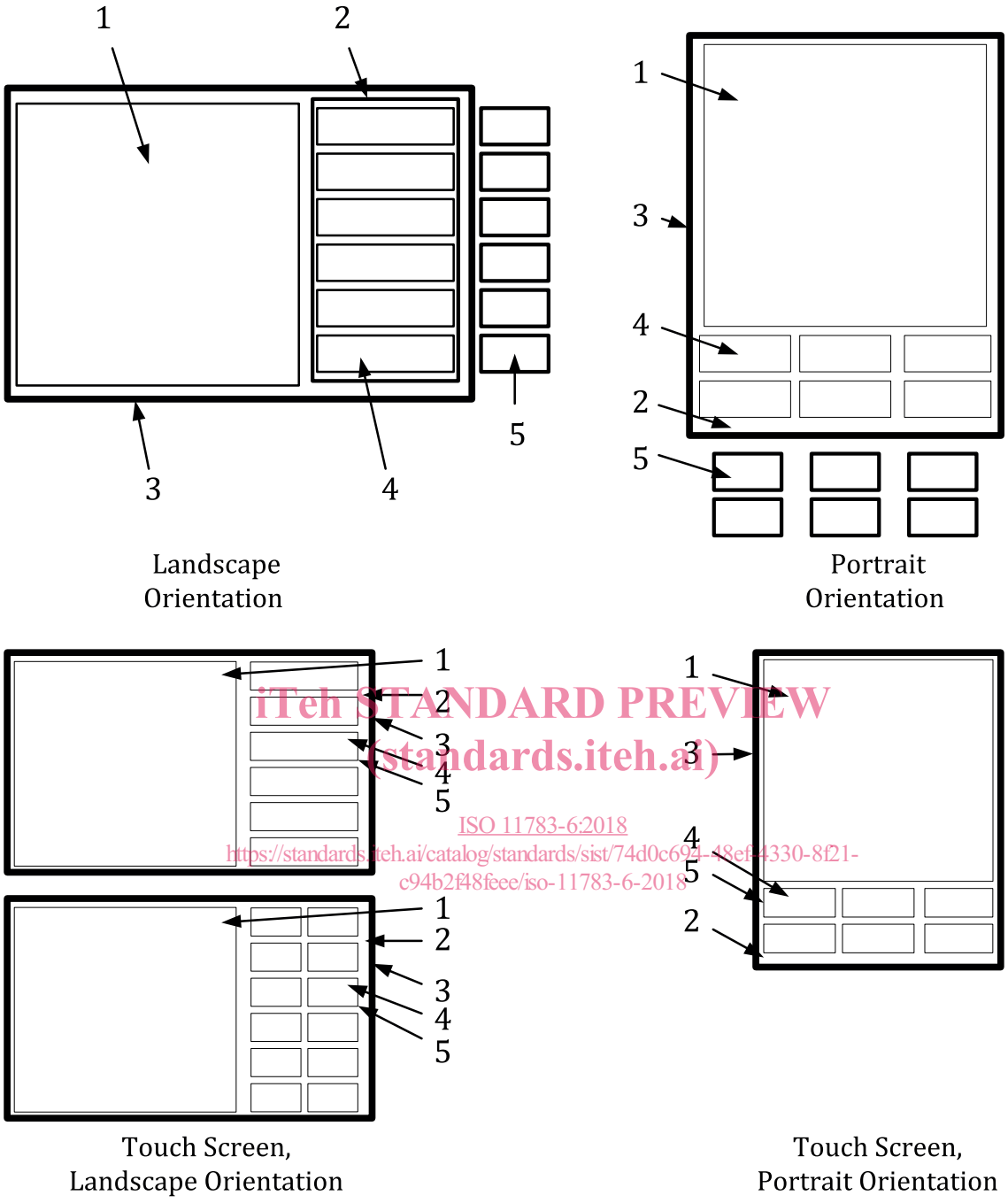
A virtual terminal (VT) is a control function (CF) within an electronic control unit (ECU), consisting of a graphical display and input functions, connected to an ISO 11783 network that provides the capability for a CF, composing an implement or a group of implements to interact with an operator. The 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 document, the term *Working Set* will be used for a CF, as an implement or a group of implements either represented 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 methods of the VT to allow the operator to send signals back to the Working Set.

This document 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 its services. The interface protocol of this document also reduces the run-time ISO 11783 communication bus traffic as much as possible. For these reasons, the requirements of this document 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 manufacturer's 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

4.1.1 Technical requirements of VT versions

Essential characteristics and attributes of a VT can be identified using the Technical data messages as defined in Annex D.

VT version 6 imposed requirements are as follows.

Feature	Detailed requirements and recommendations	Clause(s)
Physical Soft Keys	Minimum 60 × 60 pixels (recommended to be square)	D.5
Text Fonts	All small font sizes, all large font sizes, all font styles.	D.7
Graphic Type	Minimum 256 colours, recommended 16-bit or greater colour capability to support Colour Palette object and Graphic Data object. The VT can downscale the presentation to match the hardware capability (e.g. 24-bit PNG downscaled to 16-bit VT hardware).	D.9
Data Mask Size	Minimum 480 × 480 pixels	4.5.2, D.9
Window Mask object	Fully parsed, presentation is optional.	4.7.3
Key Group object	Fully parsed, presentation is optional.	4.7.9
Graphics Context object	Full presentation support is required	B.18

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 — 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 — 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 — 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.

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

   1) **Editing** — 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.

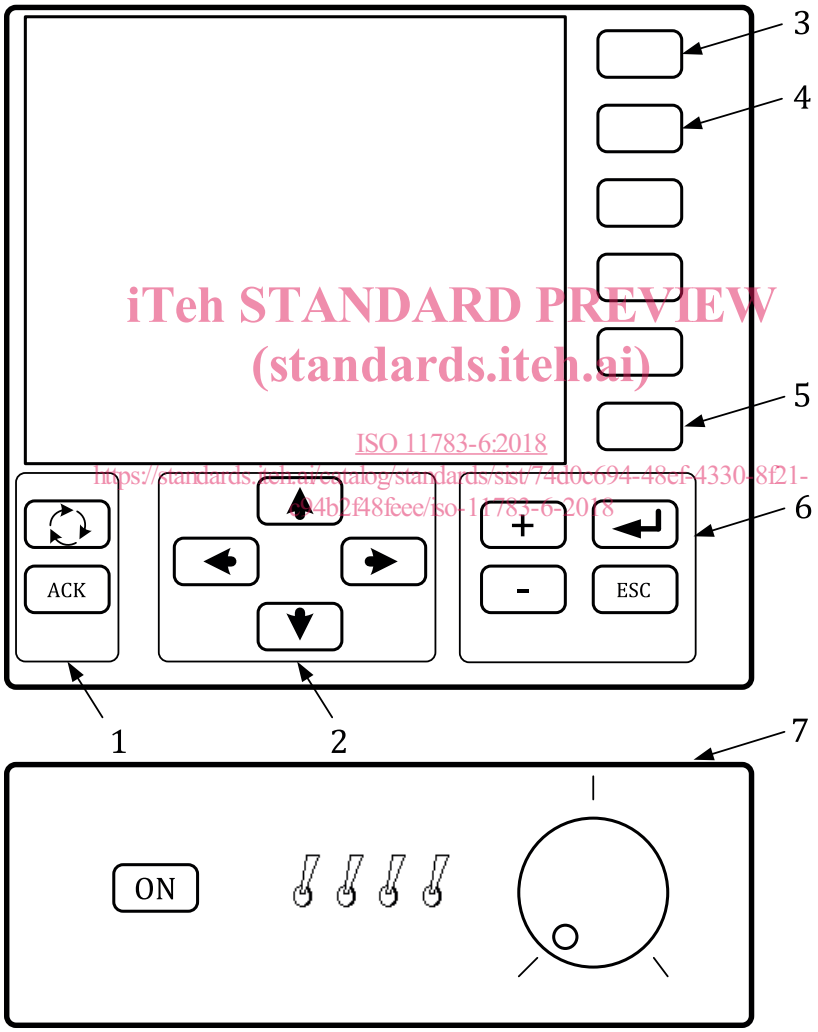
      The ENTER means shall be provided to indicate to the Working Set the completion of data entry and communication of the new value, and the ESC means shall be provided to indicate that the data entry was aborted. The ENTER and ESC means can either be a permanent key or can only be available during data entry (see Table 5) 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 editing** — is a means of data input for an Input Number object and Input List object where the object has focus and it 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, as if the ENTER means was activated, 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 editing, the VT shall ensure that the on-screen value is equal to the value last sent to the Working Set. The VT can 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 editing shall meet the operator controls requirement specified in ISO 15077.

d) Control — is a means of selecting between Working Sets whenever a Data Mask is available and for 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 — 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
2 navigation
3 soft key 1
4 soft key 2
5 soft key 6
6 data input
7 auxiliary input

Figure 2 — Operator input and control means — Example

4.3 Acoustic alarm

The VT shall provide an acoustic alarm. The alarm can be a simple on/off type buzzer or an acoustic component capable of either/or variable frequency and audio level (see D.9).

4.4 Coordinate system

Positions and sizes in this document 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-hand corner of the parent object.

4.5 Display areas

4.5.1 General

This section defines standard Data Mask and Soft Key Mask areas of the display. Alternate usage of this area supports displaying data from multiple working sets (see 4.7).

4.5.2 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 (480 × 480 for VT version 6 and later). This requirement does not limit the physical resolution or size of the display, only the useable 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;

— 480 × 480;

— 600 × 600;

— 800 × 800;

— 1 024 × 1 024.

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.

4.5.3 Soft Key Mask area and Soft Key designators

4.5.3.1 Soft Key variants and navigation

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 (60 × 60 for VT version 6 and