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Information technology — Future keyboards and other input devices and entry methods

Technologies de l'information — Claviers futurs, autres dispositifs d'entrée associés et méthodes d'entrée liées

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Foreword

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The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, Subcommittee SC 35, *User interfaces*.

This fourth edition cancels and replaces the third edition (ISO/IEC TR 15440:2005), which has been technically revised.

This corrected version of ISO 15440:2016 incorporates the following corrections.

Korean and Chinese characters used throughout Annex A have been replaced with the correct symbols.

Introduction

This Technical Report, supported by the history of information technology keyboards during the last three decades, lists current and anticipated problem areas as seen by users and tries to pave the way to foreseen work items in JTC 1 for solving issues of the user interface with keyboards, other input devices and input methods.

Information technology — Future keyboards and other input devices and entry methods

1 Scope

This Technical Report (TR) covers the following:

— different input requirements catering for national and international practices and support of cultural and linguistic diversity;

— recognition of requirements regarding comfort of use (for any user, including children, elderly and disabled people) and improved user productivity related to inputting data;

— enhancements of keyboards and related input devices and methods required for new emerging phenomena such as Internet, multimedia, virtual reality;

— virtual input requirements;

— labelling issues (soft [LCD] and hard, permanent and temporary labels), function symbols and icons.

This Technical Report does not cover implications of biometric input (fingerprint-based, iris-pattern-based, face-shape-based, etc.) devices for access and security.

This Technical Report is aimed at both the users and manufacturers and intends to present the user requirements regarding keyboards and associated devices and methods, at the time of publication of this technical report.

2 Terms and definitions

For the purposes of this document, the terms and definitions in ISO/IEC 9995-1 apply.

3 Benefits and disadvantages of current keyboards and data entry devices on the market

— Most existing desktop and laptop keyboards on the market are following ISO/IEC 9995-1 and ISO/IEC 9995-2. This helps for education and training.

— The situation on portable computers is less clear, as confusion very often exists between function and alphanumeric keys; some dedicated keys like the portable Fn key are either not "seen" by software or are used in different fashions between different manufacturers' equipment. Different cursor and editing functions are interfering with character data entry. Because of the reduced size of the keyboard, row A in particular is really confusing, function keys varying locations from model to model and not being really well-thought out (for example, the Insert key is sometimes placed immediately next to the Delete key, which is extremely error-prone for the user); blind or visually impaired persons have specific problems, particularly with portable computers: the variation in the placement of the different keys due to the lack of strictly defined international standards for common functions. Because of this, no clues exist to help them finding the location of these functions. Even if the functions are not universal, a survey of the different functions should be made among the devices available on the market and reserving a relative location to each one in an international standard would be desirable.

— Most keyboards misinterpret some parts of ISO/IEC 9995. For example, the decimal separator is not used as a function but rather as an alphanumeric key [this creates problems in countries in which the decimal separator is multiple (this function should not depend from output representation)];

another case in point is the function terminology that is multiple and does not always respect ISO/IEC 9995-7.

— New, much more programmable keyboard interfaces are now becoming available, such as programmed keyboards displayed on a touch screen or displayed on some surface and recognized via a camera. Standards for layouting such keyboards, including code assignment to each key, are now available in ISO/IEC 24757, but actual use is limited. Guidance on using such mechanisms should be produced.

4 Comfort of use and productivity considerations

4.1 General comfort of use and productivity

— No major improvement in the comfort of use has been done since 1995 except some innovative, albeit sometimes very specific platform-oriented tools for multimedia and Internet usage working with very specific drivers.

— Standardisation of placement and functionality of common functions would appear to be possible as technology is stabilising.

EXAMPLE Print Screen function could be selectable at the platform-level as either an application-dependent function or as a "hard-wired" feature that prints the screen independently of the application running under a given operating system.

— Placement and functionality of functions such as Select Level 3 and Group Select remain to be fixed (American keyboards typically do not have a Level 3 select function, for example, and Group Select, when available, is done in different fashions due to lack of guidance in the first edition of ISO/IEC 9995).

— One important drawback of current keyboards is that no software can be made "aware" of the actual geometric layout as it is seen by the user, nor of the actual engraving seen by the user; if standard (de-facto or de-jure, even OEM) keyboards were registered and assigned a worldwide-fixed number, then the keyboard could identify itself (i.e. the actual engraving and geometry) to the software on request and then the software could better display actual mapping to other character sets than those engraved on the keyboard in addition to these. This is of particular importance in a more and more global, multilingual environment. Such a scheme would not necessitate a change in the actual "scan-code" technology used today. The use of ISO/IEC 24757 allows negotiating information on actual engraving of the keyboard.

— Comfort of use is highly dependent of the actual work done by a specific user; reassigning keys allows improvement of user productivity; this is possible only if the software is aware of the actual placement of keys of which it "sees" the "scan codes"; keyboards should ideally be designed according to human ergonomics and this is rarely the case. As an example, the common square keyboard is not ergonomically designed according to the function of normal hands/arms.

— Reassignment of actual "scan codes" of the physical keyboard by software would be desirable (so far, such reassignment is very difficult at the keyboard-driver level if at all possible) for example, to allow the use of a 7-8-9 layout on a 1-2-3 numeric keypad. Currently, hard-wired "scan codes" can be interpreted differently by software but that advantage becomes, at the same time, a problem if all "keyboard-scan-code-aware" programs do not all use the same interpretation of these "scan codes". Such a reassignment would greatly improve software compatibility while serving the end-user and innovative application needs.

— an NP is desirable to standardise the minimum set of keyboard software-driven functions that should be made available by an operating system (and optionally, by an application), standardising placement of the involved function keys at the same time. Functionality could include email, web access, and turning audio on and off.

— ISO/IEC/TR 30109 has been approved to facilitate, among other things, a better match between the user's needs for functionality including national characters and input methods and the available keyboard hardware, e.g. at an Internet café or a hotel in a foreign country.

— Function of the "Capitals Lock"/"Shift Lock" key.

While ISO/IEC 9995-2 expresses that a key providing one of the functions Capitals lock (usually called "Caps Lock"), Level 2 lock (i.e. "Shift lock"), or Generalized lock (which is not specified further) needs to be present, the exact function of this key is not standardized in the ISO/IEC 9995 series. Common implementations show the inheritance from the mechanical typewriter, where such keys in fact were acting by mechanical engagement and mechanical release by pressing of either the lock key again or the Shift key. As, unlike on mechanical typewriters, the actuation of the lock key provides no special tactile or audible feedback for the touch typist (like the spring force or the special sound of the engaging mechanism), it is likely to be recognized only after long sequences of subsequent keys have been entered and misinterpreted.

A solution could be standardized which, in addition to avoid the effect of an inadvertent hitting of the lock key, has the advantage that the actuation has a unique function independent of any state (unlike a solution where the lock key switches between lock-on and lock-off, thus being dependent from the current lock state). This is the following:

— Shift + Lock (simultaneously pressed) switch to the state "Shift Lock";

— "Level 3 Select" (i.e. AltGr) + Lock (simultaneously pressed) switch to the state "Caps Lock";

— Lock pressed alone switches off any "Shift Lock" or "Caps Lock" state.

Thus, any inadvertent pressing of the lock key, while neither "Shift Lock" nor "Caps Lock" is on, has no effect.

The function of the "Num Lock" key can be standardized analogously.

4.2 Ergonomic keytop labelling for keyboards with a secondary group

The current ISO/IEC 9995-1 requires for layouts with more than one group that on the keytops, the characters of the (up to) three levels of each group are displayed in a column. While this is a clean solution from a systematic view, it has the ergonomic disadvantage that the height on every character, including the whitespace separating it from other characters or the keytop border, can be a third of the total keytop height at maximum. This applies even for layouts where only four characters are to be displayed, which is the case if the second group does not employ the third level, and employs the second level only for capital letters with the paired lowercase letters at the first level, thus the second level does not need to be displayed on the keytop also.

The T2 layout in the new German keyboard standard DIN 2137-01:2012-06 was designed deliberately to accommodate these requirements.

If there is a way to display in two rows and two columns, the characters could be displayed considerably larger. This is a real advantage especially for elderly people with age-related long-sightedness who are not touch-typists.

In consequence, when there are only two groups displayed and support for only one level of group 2 is required, a future standard should allow the labelling as follows, provided that all levels of group 1 use the same colour or the same shade of gray in column 2 and column 1, and that the level of group 2 displayed uses a different colour or shade of gray:

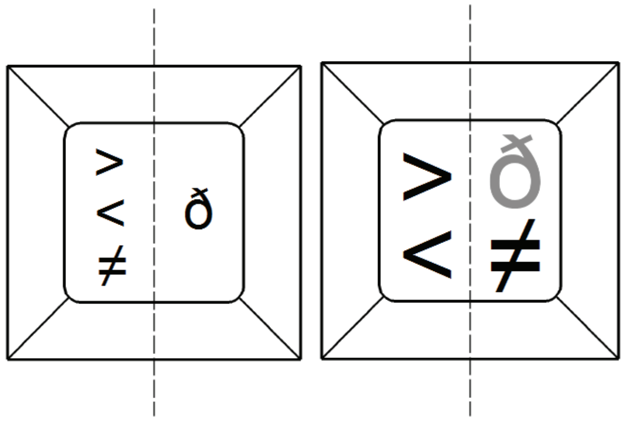
— Group 1, Level 1: lower left corner of the keytop (colour A or shade of gray A);

— Group 1, Level 2: upper left corner of the keytop (colour A or shade of gray A);

— Group 1, Level 3: lower right corner of the keytop (colour A or shade of gray A);

— Group 2, Level 1: upper right corner of the keytop (colour B or shade of gray B).

As the current ISO/IEC 9995-1 already allows an according labelling for keyboards which employ only a Group 1, this is a straightforward extension.



ISO/IEC 9995-1:2009 Possible future extension

Figure 1 — Comparison of possible allocation when support for only one level of group 2 is required

5 Keyboard classification [including linear keyboards, segmented keyboards, mono-handed keyboards, keyboards and input devices for disabled persons, specific keyboards for general (fixed and mobile telephones) and/or specific applications (banking, health care, trade, etc.), virtual keyboards]

Disabled and elderly persons can have many different problems with using a keyboard. These problems may be split up in, for example, problems with recognizing the wanted key, problems with controlling the movement of the arms and fingers, difficulties with the mouse movements without trembling, and possibility of using only one hand. This can result in different types of equipment to solve the problem.

Tactile identifiers are mentioned in ISO 9241-400 but not exactly specified. ETSI has produced a standard on specifying in detail the conventional “touch-type” marking on alphanumeric keys F and J and on the numerical keyboard part key 5. One problem with the numerical keyboard is that the tactile identifier on key 5 does not tell the difference between the “1-2-3” or “7-8-9” layout. It has been mentioned that the keyboard itself, instead of the keys, could be marked to tell which it is. Austria has proposed to instead have different marks.

6 Data entry methods for graphic character sets (including numerical or non-numerical use of numeric keypads, pen-based movements, alphabetic data entry using telephone keypads, alphabetic data entry using telephone keypads)

Some mobile telephones systems (e.g. GSM) give the possibility to send text with help of the telephone keypads (numeric keyboard). ISO/IEC 9995-8 assigns the letters A to Z to the digit keys. Additional characters are generally implemented and accessible through repeated pressing of the keys. The characters are then displayed on the window of the phone. A better and standardized way of doing it would be wanted to improve the usability of text input on small keyboards and to replace the variety of proprietary techniques in use in the industry.

Some of the improved industry technology includes just typing the key that represents multiple letters or characters once and then for a whole character sequence, e.g. limited by a space, to see what is the best probability for a properly spelled word in the respective language. Another idea is to use letter assignments tailored to a specific language fitted by typical letter usage in that language.

A specification method for Input Methods would improve portability of these methods among platforms for the benefit of users. A description of some Input Methods is contained in Annex A.

7 Logical interface with the central unit, methods of recognition of keys (including hardware or software recognized keys, use of scan codes, self-identifying keys, software-hidden keys, etc.)

Nowadays, most, if not all, keyboards on the market have integrated microprocessors which determine by themselves which keys of the keyboard are being typed and which send indications to a central computer (typically a PC) or a terminal controller whenever a key is depressed and when it is released, possibly with a repetitive indication at every given time interval if the key is kept depressed for a long enough time. Each one of such indications is called a “scan code” (from the fact that the microprocessor is scanning the keyboard all the time to see if an electrical contact is made on the intersection of a row and column of the keyboard matrix circuitry).

The only thing that is sent to the computer is hence a code which is used to theoretically identify the coordinates of the keys depressed (for PC, these coordinates correspond indeed to the original 1981 PC keyboard, a geometry that is no longer used) and this allows reprogramming the keyboard in the computer according to, for example, the language of the user or for any other customized purpose. This method of operation is, on one hand, very flexible from a programming point of view. But on the other hand, due to the numerous geometric reconfigurations of keyboards year after year and the necessity to be backward compatible, the software in the computer can no longer “know” for sure the actual location of a key depressed on the keyboard, which can be an annoyance if the keyboard is to be presented on the screen for help or actual operation purposes.

Furthermore, the software is not aware of what is engraved on the keys. At the end of the 1980s, LCD-display key keyboards were manufactured on a small scale which allowed the computer to show, in a programmable way, what were the characters supported by the keyboard driver in use. These keyboards were significantly expensive to produce (typically six times more than the average keyboard) and their production was stopped. This technology will possibly be replaced by less expensive ways of providing the same functionality but it will probably be more expensive than standard keyboards.

One idea to make sure that the computer would be made aware of what is engraved on the computer would be to assign, in addition to the scan code, an identification of the characters engraved on the keys (theoretically up to nine characters per key, for up to three groups of up to three levels each according to ISO/IEC 9995) which could be queried by the computer to the keyboard. This would allow the keyboard to be made aware of the complete physical layout of the actual keyboard (for display or help purposes), including customized one, without affecting the “traditional” mode of keyboard operation, and also inexpensively. The best way a character should be identified would be by using the canonical 4-octet encoding assigned to each character in the Universal character set (ISO/IEC 10646), which assigns a coding element to each one of the characters used by all known written languages on earth and much beyond. To complete the solution to the physical placement of the keys on the keyboard, each key should be identified in such a system by its location using the grid system of coordinates of ISO/IEC 9995. A standard for describing the physical layout of a keyboard with key assignment to ISO/IEC 10646 is now accomplished in ISO/IEC 24757.

An issue that would remain would be, for help purposes, to make known to the computer all the keys of the keyboard which depression is never indicated to the computer (keys such as Fn key on portable keyboards), and their location, by some private text identification and also in using the grid system of coordinates of ISO/IEC 9995. As the number of keys affected by those hidden keys may be everything from this hidden key itself to all the other keys of the computer (which depression is then not indicated to the computer), an easy way out of this would be that the keyboard make the computer aware of its generic model identification.

8 Principles of adaptation related especially to linguistic and cultural characteristics

8.1 Current situation and perspectives

Today, the ISO/IEC 9995 series specifies the possibility to have many groups with three levels each. Hopefully in the future, many keyboards will have the possibility to use this for, e.g. writing in different languages or for different applications. If there are many versions, it would also be preferable if the keyboard or connected PC had a visual indication at which layout is active at the moment. It would also be helpful if there is an easy way to reset the keyboard to a default layout. This is something which is absolutely required by people with visual defects. New specifications in ISO/IEC 9995 are underway, allowing shifting between more scripts and allowing more characters for a multilingual input to be keyed in in a convenient way.

Except for the possibility to choose between different groups for applications and languages, it would also be possible to, e.g. configure different groups for different diacritics.

Further, it would be desirable if the keyboard could be able to identify for the connected system its different possible groups.

Another similar possibility is a way of toggling between different characters used in, e.g. Japan called IME (Input Method Editor). After setting the keyboard in the state for IME, a list of the alternatives for characters to select from is displayed on-screen, either the alternatives are shown one-by-one or all at once. By default, i.e. if key-in continues without any action to choose another alternative, the first alternative should be picked. Getting the next or previous alternative could be done by the tab and back-tab, respectively.

8.2 Labelling support for multilingual keyboards

Multilingual-multiscript keyboards are useful for environments like multinational administrations (like the one of the E.U.) or universities. ISO/IEC 9995-9 addresses this. However, the rules for keyboard labeling, as expressed in ISO/IEC 9995-1, are confined to the use of three groups. These rules are to be expanded to employ more groups in an ergonomic manner.

A possible way to employ this is adding a new clause 8.5 “Labelling of multigroup keyboards” to the current (2009) text of ISO/IEC 9995-1 like the following.

When it is required to label more than three groups, this can be done in the following way:

— The first and second group are labelled according to ISO/IEC 9995-1:2009, 8.2.1 “Labeling of all three levels on the key-top”.

— Up to four additional levels of other groups can be labeled on the key face (i.e. the front face of the key). For this purpose, the key face is divided into a row of four roughly equal-sized fields; each of these fields is used, if at all, for the same level of the same group throughout all graphic keys of the layout.

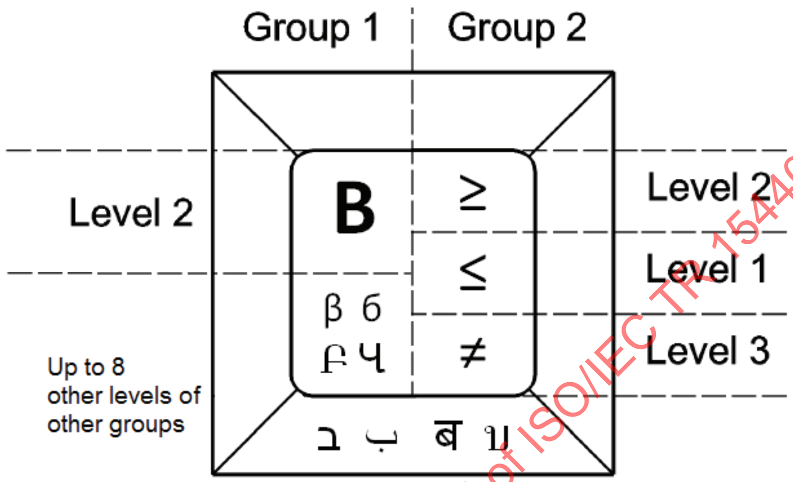
— Up to four other additional levels of other groups can be labeled on the key-top, provided that only such graphic characters of these levels are to be labeled which occupy the keys which are used by capital/small letters pairs of the primary group. For this purpose, the lower left quarter of the key-top (which is unused by the primary group according to ISO/IEC 9995-1:2009, 8.3 “Capital/small letter parts”) is divided into a 2 × 2-grid of four roughly equal-sized fields; each of these fields is used, if at all, for the same level of the same group throughout all graphic keys of the layout.

NOTE 1 This labeling pattern is adequate for keyboards in multilingual environments where the characters of several scripts need in fact to be labeled.

NOTE 2 For groups where one of the levels 1 or 2 is only populated by the respective components of capital/small letter pairs, only the other level needs to be given such a field, in accordance with ISO/IEC 9995-1:2009, 8.3.

If the level 1 or 2 of a specific group uses a field of the keyface or of the key-top in this way, but the other of this level does not but requires only a few members to be shown, this can be done by showing these members in pairs with the according members of the level which uses the field.

NOTE 3 An example is given by a group which contains Greek characters, where the level 1 containing the small characters uses a field, while the level 2 contains the capital letters which do not need to be shown, but at the place where the level 1 contains the final sigma, which has no capital counterpart, the level 2 contains an unrelated graphical character, which may then be shown exceptionally in a pair with the final sigma within the same field.



NOTE 1 The combination of characters used in this figure is for illustration purposes only.

NOTE 2 Not drawn to scale; all lines are only indicative.

Figure 2 — Allocation for more than three groups

Keyboard layouts employing this labeling may look like the tentative "Five Scripts Keyboard" described in the CEN Workshop Agreement "Functional Multilingual Extensions to European Keyboard Layouts" (CWA 16108, March 2010) which looks as in Figure 3, if the Hebrew characters are shown on the key face. As the labeling rules described above allow for two more characters, such a layout can be expanded to a "Six scripts keyboard", e.g. showing also Arabic characters.

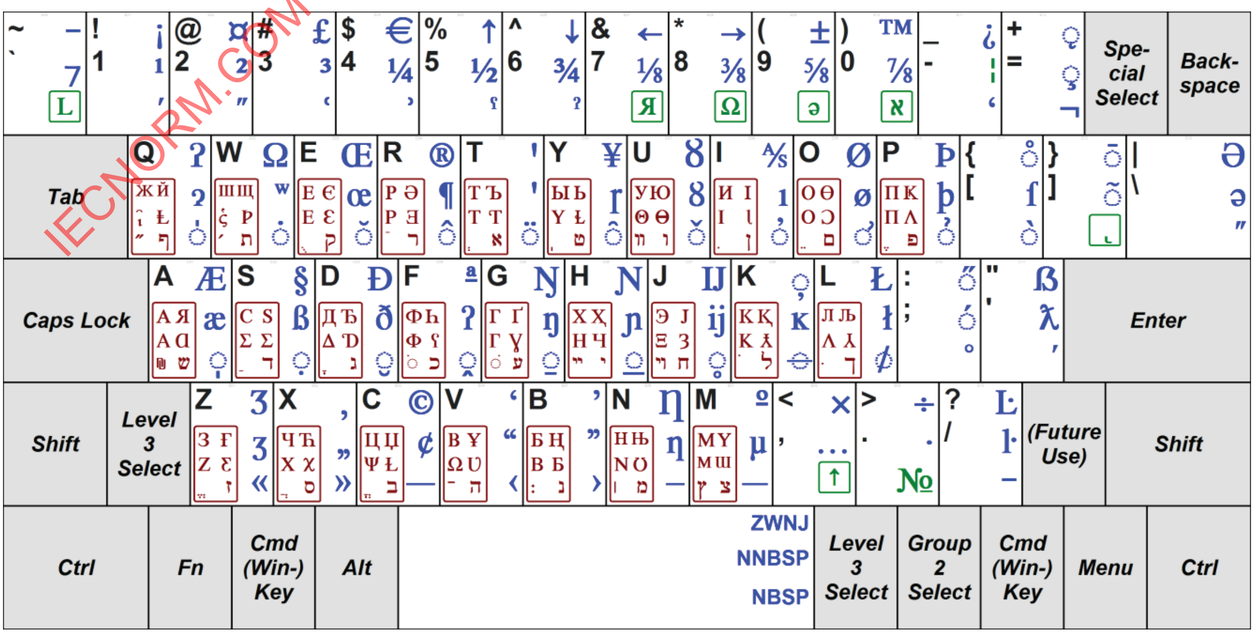


Figure 3 — Tentative "Five Scripts Layout" (from CEN CWA 16108) as a multigroup layout example

9 Portability and interchangeability of keyboards and related input devices [drivers, physical (plugs) and electrical connectivity]

People who change cultural or linguistic environment or people who use special keyboards often do not currently have the ability to plug their own keyboard to a different software or hardware platform. When their keyboard uses a standard layout, it is possible that, currently, a software driver be provided but this does not solve the labeling problem of the unadapted keyboard. Furthermore, there will always be a need for special keyboards for people with special needs. There is a requirement so that a given user can attach his keyboard or entry device to different environments (different computers with different operating systems, ATMs, etc.).

A number of systems do however provide support for many different keyboard layouts and input methods, so if this is available, the job is merely to change the keyboard layout and/or input method. When using equipment compliant to ISO/IEC 24757, this should be done automatically when the keyboard is connected.

There are many technical approaches to improve the portability and interchangeability of keyboards and related input devices. One approach is through the use of a Universal Remote Console (or a virtual input interface), where a standard is defined for devices to provide a socket to their user interface in a modality-independent method. Any compliant device can connect to this socket through standard networking techniques and create a virtual interface between the input device and the target hardware or software platform. This approach will provide for maximum flexibility between input devices and hardware or software platforms and will provide a simple method for interfacing input device for persons with special needs to standard computing devices. The use of standardized network connections between the input devices and hardware devices will eliminate the problem of physical plug incompatibilities.

10 Consistency of use between desktop and portable keyboards

A problem that has showed up with the mass-marketing of portable computers and multimedia-function-aware keyboards is the increased inconsistency of operation between the different models of keyboards. This can go to a simple difficulty of adaptation of the user to different keyboards not offering the same functionality to situations where productivity can be significantly affected to the point where normal operation cannot proceed.

For example, typical portable computer keyboards use a special key position to switch display from the LCD device to an external display, and on many occasions, such a portable computer's cover is shut over the keyboard so that the PC can be inserted in a docking station. In many instances, when the user forgot to switch its computer to the right display position, controlled by the portable computer hardware, it is not possible to even have any display through the docking station, and the computer then has to be de-docked, or the workstation has to be physically reconfigured on the desk space (with the external display removed from its support base over the portable computer), so that the portable keyboard be accessed, as the function to switch on the external display is typically not provided on an external keyboard.

Some proprietary computer systems have their keyboards controlling the sound of external speakers, which preclude replacing the keyboard with another one to support ergonomic functions or extra languages, or even extra functionality normally associated to keyboards for persons with disabilities.

In a general way, for a good keyboard user interface, special functions which do not belong to a keyboard per se should always be backed up by software-controlled key combinations on standard external keyboards and by software drivers which would give the appropriate orders to the computer whose keyboard is not accessible by the normal functions provided on its regular keyboard.

Generally speaking, a keyboard maker should avoid providing functions on the keyboard that cannot be easily and intuitively backed up by any normal keyboard. Generally speaking too, it should go without saying, but unfortunately this has to be said as it is an actual problem on the market, any portable computer manufacturer should provide keyboards whose software drivers are compatible with standard external keyboards.

11 Related input devices and especially pointing, dragging and tracing devices and free hand-input devices: mouse, track ball, stick, joystick, pen, tablet, stylus, light pen, eye-movement-driven data entry, etc.

At time of preparation of this Technical Report, no International Standard relative to those user interfaces existed from a user system interface perspective. Nevertheless, there is still a need for International Standards project to harmonize the different integration practices of the market with the user interface taken as a whole.

12 Control of multimedia actions, mechanical functions (screen reversal, sound and clicker volume, etc.) and new additional functions (Internet integration, telephone, tv-tuner, fax, etc.)

In the years since the release of ISO/IEC 9995, the IT industry has developed many new technologies that might be accessed through the keyboard, including multimedia control (sound volume, Audio CD control, etc.), screen controls, Internet functionality, and many more. These functions have been implemented in proprietary ways such that keyboard interoperability is not possible with these functions. As a part of good design, any non-standard commands available on keyboards should be available through other methods on the IT device. It would be desirable to survey all of the new functions available on keyboards and also study adding some of these functions to future versions of ISO/IEC 9995.

13 Test methods for evaluation and optimization

At time of preparation of this Technical Report, no International Standard relative to those user interfaces existed from a user system interface perspective. Nevertheless, there is still a need for International Standards project to harmonize the different integration practices of the market with the user interface taken as a whole.

14 Function symbols, design and disposition of symbols on keys, consistency between icons and symbols

A problem that has been raised a few years after the publishing of ISO/IEC 9995-7 (keyboard function symbols) is the discrepancy between current icons implemented by different software makers and some functions whose symbols have been standardized internationally in 1994 (first publication of ISO/IEC 9995-7) or before (some keyboard function symbols were standardised in ISO 7000 before).

There is a need for a technical report that would make a complete survey of issues and document inter-relationship between symbols, icons and even coded characters (ISO/IEC 9995-7 symbols are encoded as workable coded characters in the Universal character set, ISO/IEC 10646, like many other industrial symbols). Note that a character-glyph model technical report, ISO/IEC/TR 15285, was already produced by ISO/IEC JTC 1 SC 2. This could be taken into account, too.

Another need is to attempt to eliminate differences between keyboards. Keys are often been remembered by users in a very fundamental way, it lies in the spine so to say. This is exemplified by the ten finger writing system, and also the position of other keys, like the control, function, backspace, delete and escape keys are often on the spine. A standard to place functional keys is thus desirable.

15 National keyboard layouts database

AFNOR maintains a registry of keyboard layouts, the access of each one currently being accessible by password to ISO and IEC national bodies. There is also a possibility to register keyboard layouts with the Cultural registry of ISO/IEC 15897 and other registry services could be available through the Internet, e.g. in conjunction with the 30109 project on Worldwide available personal computer environment.

Annex A
(informative)

Input methods

A.1 General

For input to an Input Method specification standard, this Appendix contains descriptions of various types of Input Methods.

A.2 Korean input methods

A.2.1 General Korean input method

In Korea, Hangul (한글: their own Korean characters), Hanja (한자: Korean name for Chinese characters), and English characters are frequently used in their documents. The three characters can be presented in a same document. On their keyboard, Hangul and English alphabets are engraved.

NOTE 1 The transliteration of "한글" is "Hangeul" according to the revised Romanisation of Korean; however, "Hangul" (McCune-Reischauer) is more widely used.

NOTE 2 Hanja refers to Chinese characters borrowed from Chinese and incorporated into the Korean language with Korean pronunciation.

In order to select a character set from the option of Hangul or English, a 'toggling' operation is used. In the Microsoft Windows environment, a function key is defined for the option. It is located next to the 'space' key. In the Apple environment, the keyboard layout is same except for the function key. Since there is no function key for the option in Apple keyboards, a user should press the 'command' key and the 'space' key at the same time to change the character set. The selection of the character set changes by 'toggling' the two keys.

As for Hanja input, a user should type Korean characters first. Then, he should convert the Korean characters into their corresponding Hanja. In the Microsoft Windows environment, another function key is defined. It is commonly located at the left of the 'space' key. Then, a list of the corresponding Hanja characters of the same pronunciation pops up. The user has to select one Hanja character form the list in order to convert the Korean character into its corresponding Hanja. In the Apple environment, no function key is defined for the Hanja conversion. So the user has to press the 'option' key and the 'return' key at the same time to have the list of the corresponding Hanja. As the list pops up, the user has to select a corresponding Hanja character from the list.

A.2.2 Korean keyboard layout

The layout of Korean keyboard with 103 keys was standardized in KS X 5003. The layout is based on the 101-key layout of U.S. of Figure A.1. In the alphanumeric section of the Korean keyboard, there are two additional keys to the left and the right of the space bar. The one is for switching between Hangul and English. The key is '한/영' key (Hangul-English selection key) and it is located at the right of the space key. By pressing the 한/영 key once, keyboard layout is switched between Hangul and English. The other key is '한자' (Hanja) key for inputting Hanja. It is located at the left of the space key (see Figure A.2, Figure A.3 and Figure A.4.)

The shape of the return key in the standard of KS X 5003 differs from the one of U.S. 101-key keyboard. The position D13 in the Korean keyboard is included for the return key. And the key of D13 in U.S. keyboard is moved to the position of E13 in Korean keyboard. Therefore, the size of backspace key in Korean keyboard is smaller than the one in U.S. keyboard.

In the current market, Korean keyboard with 106 keys is commonly used for users of Microsoft Windows. The layout of alphanumeric section in Korean keyboard with 106 keys is shown in Figure A.3. Two Windows keys and Menu key are added to the 103-key layout.

There is another 106-key layout of Korean keyboard as shown in Figure A.4. It is also available in the current market. The layout is based on the 104-key layout of U.S. The 한/영 key and the 한자 key are added to the 104-key layout of U.S.

When U.S. keyboard with 104-key layout for inputting Hangul is used, the right Alt key is commonly used as the 한/영 key, while the right Ctrl key is used as the 한자 key.

The Korean keyboard layout for users of Apple Macintosh computers is shown in Figure A.5. There is no separated 한/영 key and 한자 key in the keyboard. Combination of the command key and the space key acts as the 한/영 key, while combination of the option key and the return key acts as the 한자 key.

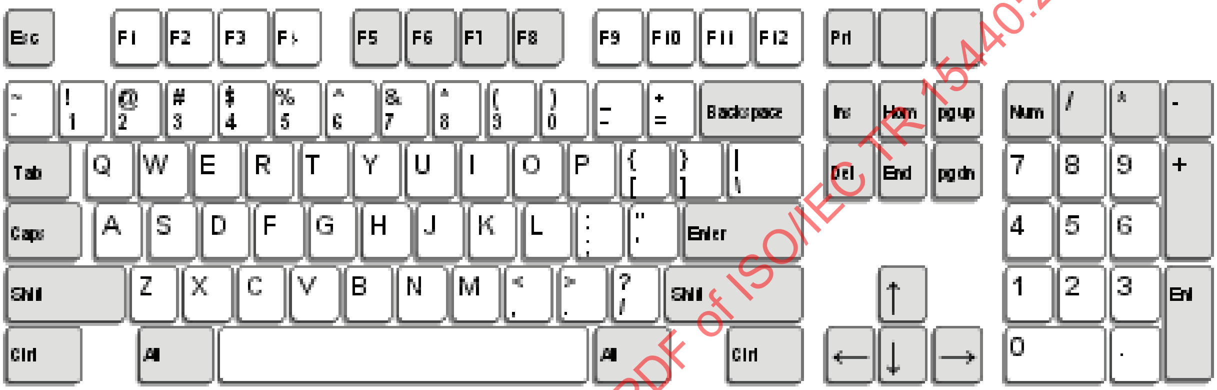


Figure A.1 — 101-key layout (U.S.)

Figure A.2 — Arrangement and location of keys in the alphanumeric section of KS X 5003:2001, A.1.1)

Figure A.3 — Arrangement and location of keys in the alphanumeric section of Korean keyboard with 106 keys

Figure A.4 — Another 106-key layout of Korean keyboard

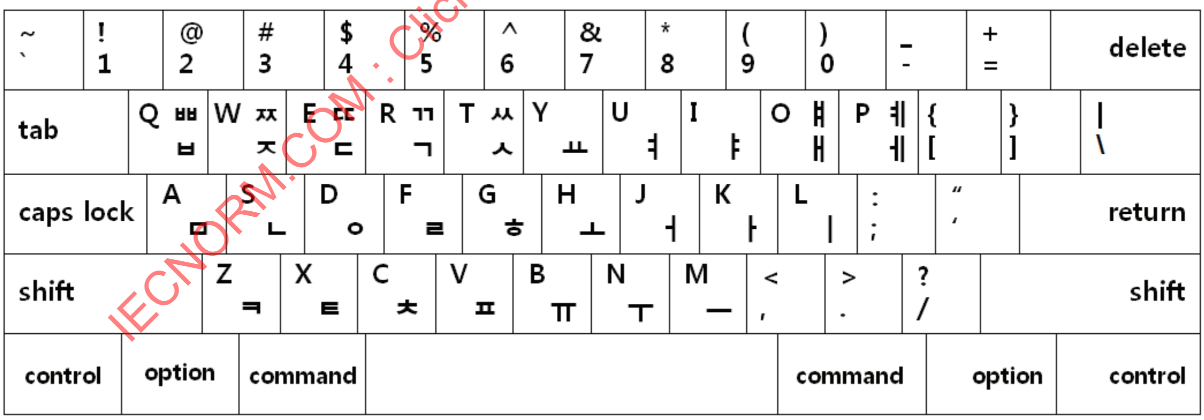


Figure A.5 — Apple layout of Korean keyboard

A.2.3 Allocation of Hangul letters to the keys of a numeric keypad

ISO/IEC 9995-8 defines allocation of 26 basic Latin letters to the keys of a numeric keypad. The allocation is commonly and typically used in traditional mobile phones and feature phones. For Hangul, Republic of Korea has established a national standard KS X 5020 which allocates Hangul letters to the keys of a numeric keypad and mobile information devices. Hangul is the name of Korean alphabet or

Korean script. In the official revised Romanisation of Korean, there are two methods for consonant letters; Method II proposed by Republic of Korea is used in this part of ISO/IEC TR 15440.

Modern Hangul has 24 simple letters: 14 consonant simple letters which can be used either as a syllable-initial or as a syllable-final and 10 vowel (syllable-peak) simple letters. The 14 consonant simple letters are ㄱ (g), ㄴ (n), ㄷ (d), ㄹ (l/r), ㅁ (m), ㅂ (b), ㅅ (s), ㅇ (-/ng), ㅈ (j), ㅊ (ch), ㅋ (k), ㅌ (t), ㅍ (p) and ㅎ (h). The transliteration of '한글' is 'Hangeul' according to the official revised Romanisation of Korean; however, 'Hangul' (McCune-Reischauer romanisations) is more widely used. The ten vowel simple letters are ㅏ (a), ㅑ (ya), ㅓ (eo), ㅕ (yeo), ㅗ (o), ㅛ (yo), ㅜ (u), ㅠ (yu), ㅡ (eu) and ㅣ (i). In Modern Hangul, 14 consonant simple letters can be combined to produce five syllable-initial complex letters and 13 syllable-final complex letters. Since two consonant complex letters [ㄲ(gg) and ㅆ(ss)] can be used either as a syllable-initial or as a syllable-final, the total number of consonant complex letters is 16 (= 5 + 13 – 2), not 18. 10 vowel (syllable-peak) simple letters can be combined to produce 11 vowel (syllable-peak) complex letters.

In rendering, a sequence of the Hangul letters is displayed as a series of syllable blocks. A complete syllable block is composed of a syllable-initial and a syllable-peak, and optionally a syllable-final letter. Each of a syllable-initial, a syllable-peak, and a syllable-final letter can be either simple or complex. An incomplete syllable is a string of one or more letters which does not constitute a complete syllable block (for example, a syllable-initial alone, a syllable-peak alone, a syllable-final alone, or a syllable-peak followed by a syllable-final letter).

In modern Hangul, there are 14 syllable-initial simple letters and five syllable-initial complex letters [ㄲ (kk), ㄸ (tt), ㅃ (pp), ㅆ (ss) and ㅉ (jj)]; there are 14 syllable-final simple letters and 13 syllable-final complex letters [ㄲ (gg), ㄳ (gs), ㄵ (nj), ㄶ (nh), ㄺ (lg), ㄻ (lm), ㄼ (lb), ㄽ (ls), ㄾ (lt), ㄿ (lp), ㅀ (lh), ㅄ (bs) and ㅆ (ss)].

In modern Hangul, there are 10 syllable-peak (vowel) simple letters [ㅏ (a), ㅑ (ya), ㅓ (eo), ㅕ (yeo), ㅗ (o), ㅛ (yo), ㅜ (u), ㅠ (yu), ㅡ (eu), ㅣ (i)] and 11 syllable-peak (vowel) complex letters [ㅐ (ae), ㅒ (yae), ㅔ (e), ㅖ (ye), ㅘ (wa), ㅙ (wae), ㅚ (oe), ㅝ (weo), ㅞ (we), ㅟ (wi), and ㅢ (yi)]. There are three basic elements for vowel (syllable-peak) letters: •, ㅡ, and ㅣ each of which represents "sky/heaven" (•), "earth" (ㅡ), and "human/man" (ㅣ), respectively. These three basic elements are used alone or combined together to produce syllable-peak simple or complex letters.

The 14 consonant simple letters (which can be used either as a syllable-initial or as a syllable-final) and the five consonant complex letters are allocated to a numeric keypad as shown in Table A.1 The other 11 consonant complex letters can be composed by entering a sequence of two consonant simple letters. The three basic elements for vowel letters are allocated to a numeric keypad as shown in Table A.1.

Table A.1 — Allocation of 19 consonant letters and three basic elements for vowel letters of Hangul to the keys of a numeric keypad

1 ㅣ	2 •	3 ㅡ
4 ㄱㅋㄲ	5 ㄴㄹ	6 ㄷㅌㄸ
7 ㅂㅍㅃ	8 ㅅㅎㅆ	9 ㅈㅊㅉ
*	0 ㅇㅁ	#

Table A.2 shows the method to compose 21 vowel letters by using the three basic elements for vowel letters.

Table A.2 — Method to compose 21 vowel letters by using three basic elements of "sky/heaven", "earth" and "human/man"

syllable-peak (vowel) letter	Composition method
ㅏ	ㅣ+ ·
ㅐ	ㅣ+ · +ㅣ
ㅑ	ㅣ+ · + ·

syllable-peak (vowel) letter	Composition method
ㅒ	ㅣ+ㆍ+ㆍ+ㅣ
ㅓ	ㆍ+ㅣ
ㅔ	ㆍ+ㅣ+ㅣ
ㅕ	ㆍ+ㆍ+ㅣ
ㅖ	ㆍ+ㆍ+ㅣ+ㅣ
ㅗ	ㆍ+ㅡ
ㅘ	ㆍ+ㅡ+ㅣ+ㆍ
ㅙ	ㆍ+ㅡ+ㅣ+ㆍ+ㅣ
ㅚ	ㆍ+ㅡ+ㅣ
ㅛ	ㆍ+ㆍ+ㅡ
ㅜ	ㅡ+ㆍ
ㅝ	ㅡ+ㆍ+ㆍ+ㅣ
ㅞ	ㅡ+ㆍ+ㆍ+ㅣ+ㅣ
ㅟ	ㅡ+ㆍ+ㅣ
ㅠ	ㅡ+ㆍ+ㆍ
ㅡ	ㅡ
ㅢ	ㅡ+ㅣ
ㅣ	ㅣ

Table A.3, Table A.4 and Table A.5 show Hangul syllable-initial, syllable-peak and syllable-final letters, respectively, together with their corresponding UCS code positions.

Table A.3 — Hangul syllable-initial letters and their corresponding UCS code positions

syllable-initial letter	UCS code position
ㄱ	1100
ㄲ	1101
ㄴ	1102
ㄷ	1103
ㄸ	1104
ㄹ	1105
ㅁ	1106
ㅂ	1107
ㅃ	1108
ㅅ	1109
ㅆ	110A
ㅇ	110B
ㅈ	110C
ㅉ	110D
ㅊ	110E
ㅋ	110F
ㅌ	1110
ㅍ	1111
ㅎ	1112

Table A.2 *(continued)*

Table A.4 — Hangul syllable-peak (vowel) letters and their corresponding UCS code positions

syllable-peak (vowel) letter	UCS code position
ㅏ	1161
ㅐ	1162
ㅑ	1163
ㅒ	1164
ㅓ	1165
ㅔ	1166
ㅕ	1167
ㅖ	1168
ㅗ	1169
ㅘ	116A
ㅙ	116B
ㅚ	116C
ㅛ	116D
ㅜ	116E
ㅝ	116F
ㅞ	1170
ㅟ	1171
ㅠ	1172
ㅡ	1173
ㅢ	1174
ㅣ	1175

Table A.5 — Hangul syllable-final letters and their corresponding UCS code positions

Syllable-final letter	UCS code position
ㄱ	11A8
ㄲ	11A9
ㄳ	11AA
ㄴ	11AB
ㄵ	11AC
ㄶ	11AD
ㄷ	11AE
ㄹ	11AF
ㄺ	11B0
ㄻ	11B1
ㄼ	11B2
ㄽ	11B3
ㄾ	11B4
ㄿ	11B5
ㅀ	11B6
ㅁ	11B7

Syllable-final letter	UCS code position
ㅂ	11B8
ㅄ	11B9
ㅅ	11BA
ㅆ	11BB
ㅇ	11BC
ㅈ	11BD
ㅊ	11BE
ㅋ	11BF
ㅌ	11C0
ㅍ	11C1
ㅎ	1102

A.3 Japanese input methods

Japanese sentences may include hiragana letters, katakana letters, Chinese characters, half size katakanas, alphanumeric characters, half size alphanumeric characters, symbols, and foreign system fonts. How to input Japanese sentences depends on the Japanese input system. The following explanation is the basic key functions among the popular Japanese input systems using Japanese keyboards.

The Japanese keyboard layout is decided by the Japanese Industrial Standard. It keeps the Roman letters in the English qwerty layout, with numbers above them. Many of the non-alphanumeric symbols are the same as on English-language keyboards. The hiragana letters are also ordered in a consistent way across different keyboards. For example, the Q, W, E, R, T, Y keys correspond to た, て, い, す, か, ん, respectively (the English sounds for the previous hiragana letters are: ta, te, i, su, ka, and n, respectively) when the computer is used for the direct hiragana letter input.

《 half size/full size, Chinese character key 》

The status of the Japanese input system is changed from on to off, or from off to on while pushing the [Alt] key by pushing the [half size/full size, Chinese character key] key.

《 enter key/return key 》

When a Japanese input system is on, the input character is decided by pushing the (enter key/return key) key.

If after the character confirmation and a Japanese input system are off, it becomes “the line feed”.

《 shift key 》

While pushing the [shift] key, a character, symbol or capital letter drawn at the upper part on the key is input.

《 katakana, hiragana letter, Roman character key 》

Change the input mode from hiragana letter to Roman character, or from Roman character to hiragana letter, by pushing the [katakana, hiragana letter, Roman character] key while pushing the [alt] key. In addition, it changes to katakana letter input mode by pushing the [katakana, hiragana letter, Roman character] key while pushing the [shift] key. To return to hiragana letter input mode, push only the [katakana, hiragana letter, Roman character] key.

《 conversion key 》

When a Japanese input system is on, convert the input characters to appropriate Japanese words by pushing the [conversion] key.

Table A.5 *(continued)*

By pushing the [conversion] once again, the list of another appropriate Japanese words is displayed.

《 no conversion key 》

When a Japanese input system is on, convert the input character into a katakana or a numeric character of the full size/half size of character.

Figure A.6 — Japanese keyboard

A.4 Chinese input methods

There is no need to have specific input method for English as it has only 26 letters, corresponding to the 26 keys in the keyboard. But Chinese has so many words, more than 100,000 characters, that it cannot form a one-on-one relationship with keys in the keyboard. So we have to encode Chinese characters to associate them with keys.

Chinese characters, as pictograph, is represented by its pronunciations, shape and meaning. Now there are all different kinds of input methods of Chinese characters, each has its own features and advantages, while new input methods are still constantly emerging. The current input methods can be divided into the following.

a) Corresponding code (flow code): Corresponding code uses all kinds of coding schemes as the basis for input. Because every character has only one code, it has advantages (such as, almost zero coincident codes, high efficiency, allowing for high-speed blind play) and disadvantages (such as heavy burden of memorization with few rules). The most common flow codes are zone bit code, telegraph code, internal code and so on, one code to one character.

b) Phonetic code: Phonetic code inputs characters according to the rules of Chinese phonetic alphabet, so it needs no specific memorization, matches the thinking habits of customers. As long as you know the pronunciations, you can input characters. But it also has short comings: first, with so many characters sharing the same pronunciation, it has high rate of coincident code and low input efficiency; second, the customers need to know the right pronunciation; third, it would be very difficult to deal with the new words that you do not recognize. Pinyin input method can be divided into full spell, simple spell and double spell. For particular examples, see A.3.1.1.

c) Configurational code: Configurational code encodes according to the configures of Chinese characters (strokes, radicals, shapes). Chinese characters are composed by many relatively separate basic parts. Examples like the Chinese character “好” is composed by “女” and “子”,”助” is composed by “且” and “力”, the “女””子””且””力” is called word root or char in Chinese encoding. Configurational code defines word roots or strokes as the basic input codes and combines these together to form the input method of Chinese characters. Configurational code is mainly divided into stroke input, block input and so on. For particular examples, see A.3.1.2.

d) Phonetic and configurational code: It combines both the advantages of phonetic code and configurational code, using the two codes at the same time. This kind of input methods has relatively fast speed and needs only a little specific training. But less people use it compared to phonetic code and configurational code.

e) Other input methods: In order to improve the efficiency of input, some Chinese systems have used some of the intelligent functions, input through different ways include pronunciation, shape and meaning at the same time. And many intelligent input methods combine Pinyin input methods and some kind of configurational code together, so that one input method includes many different kinds of input ways.

China has released two national standards, separately determine the input methods products of digital keyboards and standard keyboards: GB/T 19246-2003 "*Information technology — The universal requirements for input Chinese characters in standard keyboards*" and GB/T 18031-2000 "*Information technology — The universal requirements for input Chinese characters in digital keyboards*". Here, the fourth chapter of each of the two standards are included.

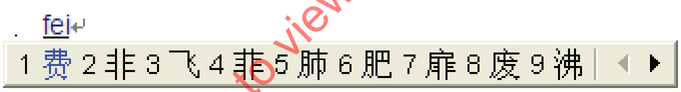
A.4.1 Examples of Chinese input methods

A.4.1.1 Phonetic alphabet input method

Chinese phonetic alphabet input method is one of the Chinese input methods that use the pronunciations of Chinese characters (Chinese phonetic alphabet) to input. It has several input schemes: full spell, double spell and simple spell. Now, much input software are designed based on Chinese phonetic alphabet.

a) Input of single Chinese character

To input a single character, you need to input every letter of its pronunciation. For example, to input "飞", you need to input "fei", and the hint will give a list of characters whose pronunciations are "fei", like this:

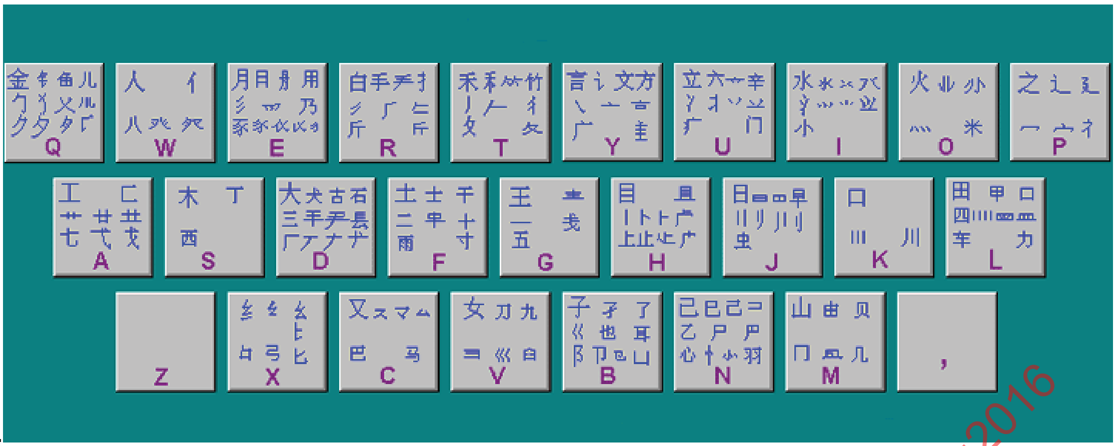


b) Input of words

For example, to input "可以", a word with two characters, you can input phonetic alphabet "keyi", then the hint will give a list of words, you can type space to choose "可以", like this:

A.4.1.2 Glyph input method

Glyph input method encodes Chinese characters according to strokes and glyphs; it is a one word configurational code. The feature is to distribute word roots or charcaters to 25 letter keys (standard QWERTY keyboard, without Z) according to a certain rule.



A.4.2 Chinese input method with numeric/digital keys

A.4.2.1 Requirements

A.4.2.1.1 Setting of the range of keys

The encoding elements for the input Chinese characters are set between numeric keys 0 to 9.

The encoding elements which use phonetic alphabet to input Chinese characters in mobile phones can also be set between numeric keys 2 to 9.

A.4.2.1.2 Function keys

The function keys should at least be able to realize separation, turning pages when encountered with coincident code, the select for different words and characters when encountered with coincident code.

A.4.2.2 Encoding character set

The Chinese characters that can be input by numeric keyboards through encoding should include all the Chinese characters defined in GB 2312 or GB 13000.1 or GB 18030.

A.4.2.3 Encoding specification

A.4.2.3.1 The digital encoding related strokes and the order of strokes of Chinese characters should follow "The Specification of The Order of Strokes of The Universal Characters of Modern Chinese".

A.4.2.3.2 The digital encoding related units of Chinese characters should follow "GB 13000.1 The Specification of The Units of Chinese Characters in Character Set for The Use of Information Processing".

A.4.2.3.3 The digital encoding related Chinese characters' pronunciation should follow "The Scheme for the Chinese Phonetic Alphabet" and "The Authorized Table of Mandarin Words with Variant Pronunciations" .

A.4.2.4 Setting of keys

A.4.2.4.1 Setting of keys for basic strokes

The setting of keys for five basic strokes is in Figure A.7.

