

Description
HA87
Terminal Software HA209

Application Note 1901

Revision: 2.0
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0 History

Date	Revision	Author	Comments
1.10.2011	1.0	RN	First Release
18.02.2019	2.0	CS	New CD; added Introduction

Table 1: History

0.1 Related Documents

No.	Name	Remarks
1	AN1900: Description HA87 Terminal Software HA400	

Table 2: Related Documents

1 Introduction

The handset HA87 is a classic. For this reason, we decided to republish the software documentation. Please find an overview about currently available variations of the HA87 including software versions and assembly variants in table 3 below.

No.	Article Number	Article Description	Buttons	Software Version	Assembly Variant
1	01 6508 00500051	HA87/21T/PTT/V6011/C6259-5/RJ50/A8	21	HA209	V6011
2	01 6508 00500551	HA87/21T/PTT/V6011-1/C6259-3/RJ50/A8	21	HA400	V6011-1
3	01 6508 00500851	HA87/PTT/V6011-1/C6259-3/RJ50/A8 flame protection	20	HA209	V6011-1

V6011	<ul style="list-style-type: none"> • PTT hardware output (PIN 1 of the RJ50 plug) • ON/OFF software output (no PIN-out)
V6011-1	<ul style="list-style-type: none"> • PTT software output (no PIN-out) • ON/OFF hardware output (PIN 1 of the RJ50 plug)

Table 3: Article overview of the HA87 (Revision: January 2019)

2 Preface

The Terminal-Software is a special firmware running on the processor of a Handset HA87 which allows you to use the Handset as a "Terminal" for **input** and/or **output**. Furthermore, there is also an audio-interface on the connector available.

For example, you could send a text to be displayed in the Handset via a serial connection. A pressed key is analysed in the Handset and then a key-code is sent via the serial link to the host-application where it can be further processed. The handset is hereafter considered as a client and your application is the host-system. For the communication between the host and the client there is a special protocol defined, which will be described in this document.

The simplest host-system could be Putty, for example.

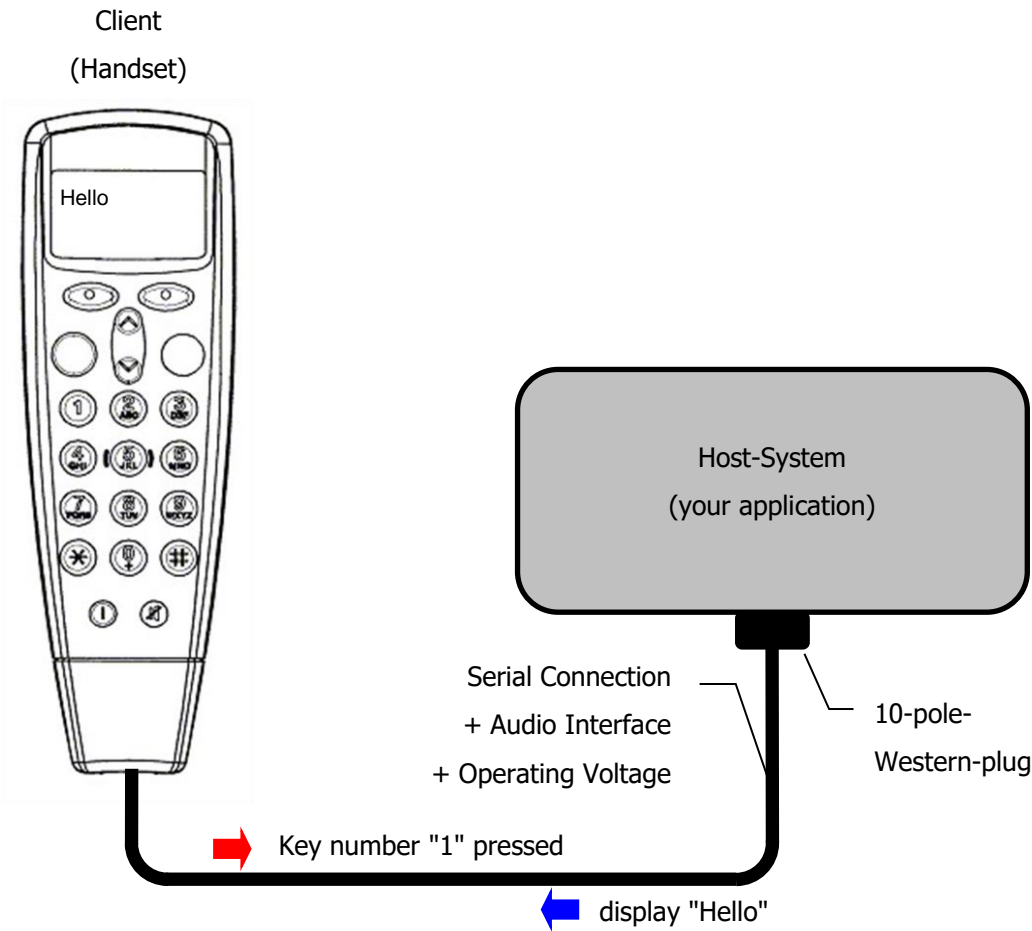


Figure 1: Communication between client and host system



Figure 2: Handset HA87

The Handset consists of the following main parts:

- Microphone
- Loudspeaker (earpiece)
- 21-key keyboard
- PTT button
- 96x54 dot matrix LCD-Display
- Backlight
- Spiral cable with 10-pole-Western-plug
- RS232 Serial Interface
- Hook

2.1 Hardware Definitions

The block diagram of the Handset is as followed:

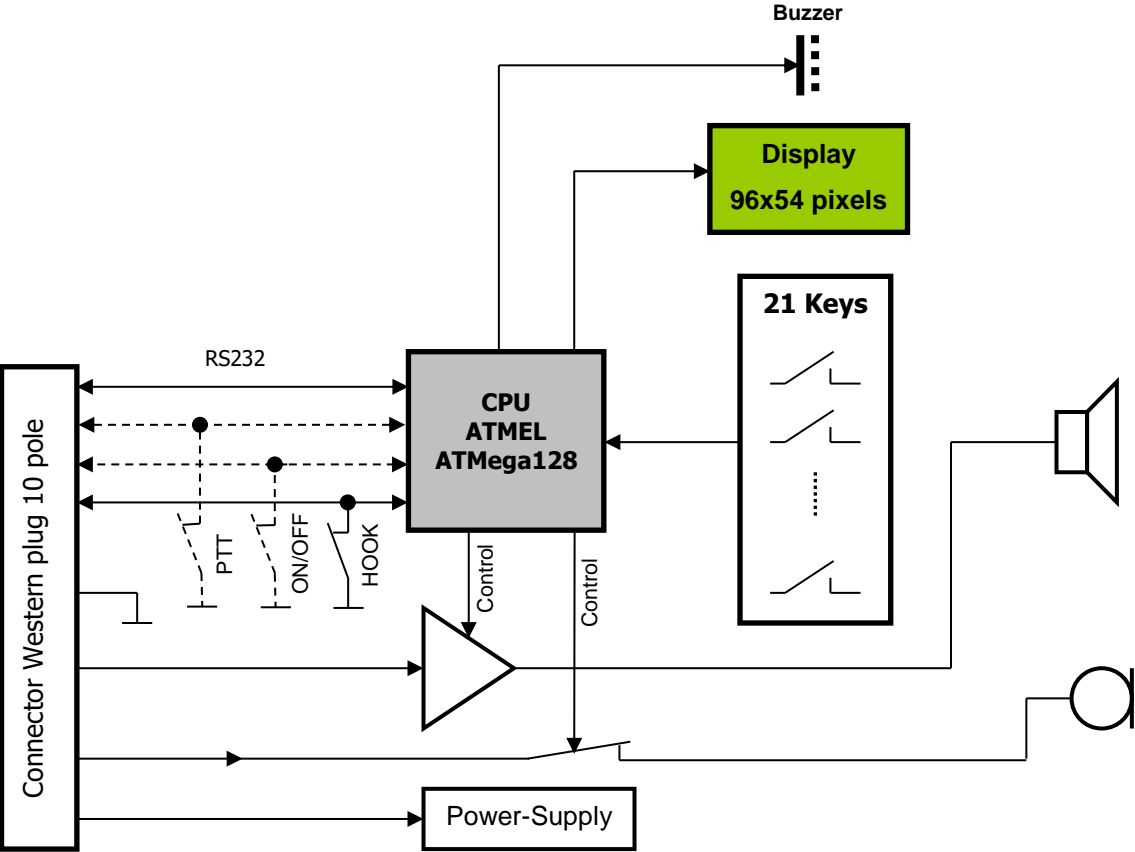


Figure 3: Block diagram

Depending on the model, PTT or ON/OFF are on PIN 1, see also [table 3](#).

The 10-pole-Western-Plug has the following Pin-Out and forms the interface to your host-system:

PIN	Wire Description
1	PTT or ON/OFF
2	MIC -
3	MIC +
4	LS -
5	LS +
6	Hook (low active)
7	TxD
8	RxD
9	GND
10	VBATT (+9 ... +15V)

Table 4: Wire description of the western plug

The settings for the serial connection are as shown below:

Baudrate:	115200 Baud
Parity:	None
Databits:	8
Stoppbits:	1
Handshake:	None

3 Terminal Protocol

As mentioned earlier there is a special protocol used for the communication between the client and the host. This byte-oriented protocol consists of the two parts

- **Handset as Output**
The Handset sends "unsolicited" messages to the host after a key-event has occurred.
- **Handset as Input**
The host can control the Handset via defined commands.

which are described in detail in this document.

3.1 Presentation Rules

In the following, the commands are presented with as much precision as possible. First there is a general description of the command providing information about the command behaviour. A "Syntax" paragraph describes the way to use the command. A "Parameter(s)" paragraph describes the required parameter value(s) where applicable. A "Returned Value(s)" paragraph provides possible responses of a command, where applicable. Finally, an "Example" paragraph provides an example of the command. Schemas are provided where necessary.

3.2 Command line

The byte-oriented protocol uses some sort of a frame. Commands always start with the <ESC>-Character (0x1B_h) and end with <CR> (0x0D_h) **or** <CR><LF> (0x0D_h followed by 0x0A_h). In this document both <CR> and <LF> are used.

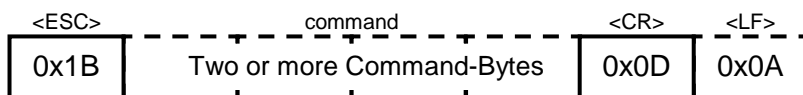


Table 5: Schematic command

If a command is not correct or not understood, then a question mark ('?') is returned. That means if a command was *formally* correct there is no response. But be aware that it does not mean the command was correct!

The following basic rules are applied:

- Control-Characters (not printable characters) are placed within <>-brackets and are marked blue. For example, <ESC> equals the ESC-character which is 0x1B_h. It is just one character! It is not 'E"S"C'!
- Variable values are placed within ()-brackets.
- Do not use spaces in commands unless it is quoted!
- <CR> represents "Carriage Return". The value of <CR> is 0x0D_h.
- <LF> represents "Line Feed". The value of <LF> is 0x0A_h.

Example:

<ESC>[(Row);(Column)H<CR><LF>

This Example consists of the following parts:

<ESC>	ESCAPE-Character 0x1B
[Character '['
(Row)	Variable Value
;	Character ';'
(Column)	Variable Value
H	Character 'H'
<CR>	Carriage Return
<LF>	Line Feed

The real byte stream for this example is:

<ESC>	[Row	;	Column	H	<CR>	<LF>
0x1B	0x5B	Row	0x3B	Column	0x48	0x0D	0x0A

Table 6: Example byte stream

3.3 Handset as Output

The Handset acts as output to notify the host-system about key-events when a key was pressed. Furthermore, some commands return a response.

3.3.1 The Keypad

The Handset (client) acts as output to notify the host-system about key-events (pressed keys). Depending on the Handset there are 20 or 21 Keys available. The optional key is the REC/SOS-Key.

For the keys of the Handset the following definitions are used:

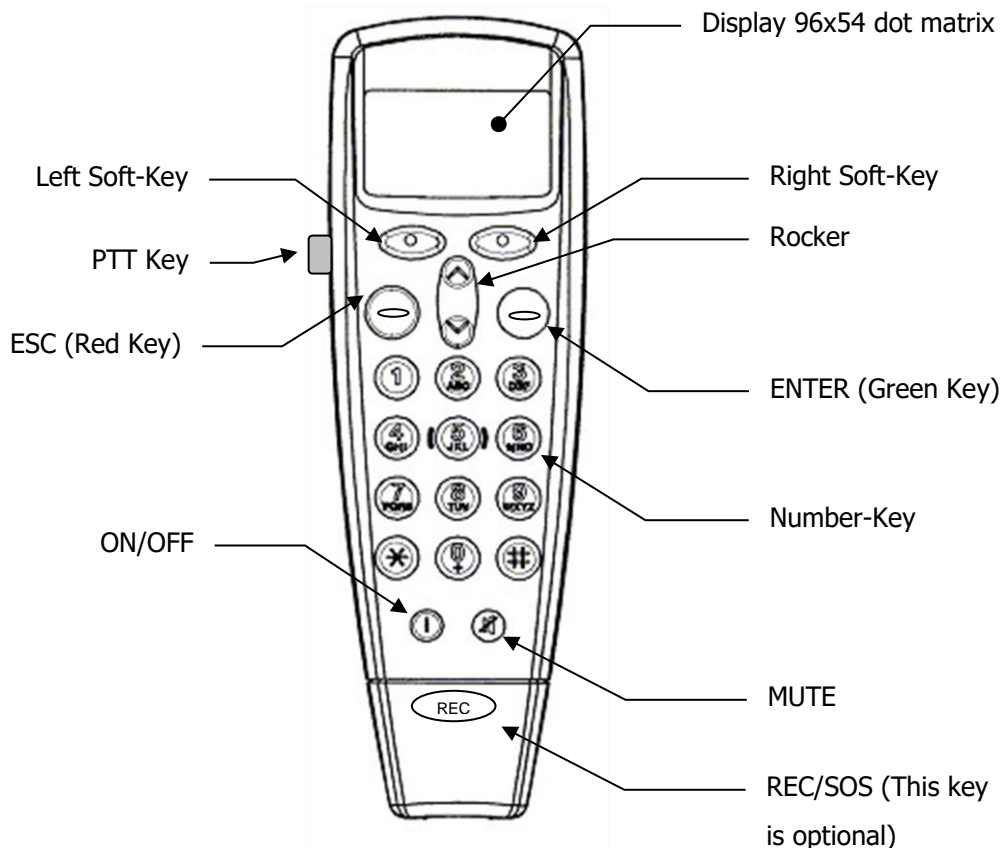


Figure 4: Keypad

The Hook-Switch is placed on the backside in the hole.

Remark:

- The printing of the key-pad can differ, but the definitions stay the same!
- Some buttons/keys might be missing on some handsets!

There are 3 different Key-Press-Modes possible:

- **Short-Key-Press-Mode (SKPM)**
The key is pressed only for a "short" period of time. The change of a key is only evaluated as the key is released. This will result in a keycode with the 8th Bit set to 0.
- **Long-Key-Press-Mode (LKPM)**
After an adjustable period of time (*Time1*) the still pressed key will result in a keycode with the 8th Bit set to 1.
- **Autorepeat-Key-Press-Mode (AKPM)**
After an also adjustable period of time (*Time2*) a still pressed key will result in a "virtually" pressed key with a 3rd keycode.

For the setting of the two adjustable times *Time1* and *Time2* there is a special command (**<ESC>IT(Time1);(Time2)<CR><LF>**) available. Please refer also to [section 3.5.16](#) for more information about this command.

- **Syntax**
The corresponding keycode of the key will be sent via the serial link to the host-system. Just one character (Byte) will be sent.

- **Parameter(s)**

The following table shows the keycode for the keys in the 3 modes (for the keycodes >127 only the hexadecimal value is shown):

Key	SKPM		LKPM	AKPM
	ASCII	Hex	Hex	Hex
Left-Soft-Key	L	0x4C	0xCC	0xEC
Right-Soft-Key	R	0x52	0xD2	0xE2
ESC (red key)	E	0x45	0xC5	n.a.
ENTER (green key)	A	0x41	0xC1	n.a.
Rocker UP	U	0x55	0xD5	0xE5
Rocker DOWN	D	0x44	0xC4	0xE4
Key "1"	1	0x31	0xB1	0xF1
Key "2"	2	0x32	0xB2	0xF2
Key "3"	3	0x33	0xB3	0xF3
Key "4"	4	0x34	0xB4	0xF4
Key "5"	5	0x35	0xB5	0xF5
Key "6"	6	0x36	0xB6	0xF6
Key "7"	7	0x37	0xB7	0xF7
Key "8"	8	0x38	0xB8	0xF8
Key "9"	9	0x39	0xB9	0xF9
Key "0"	0	0x30	0xB0	0xF0
Key "*"	*	0x2A	0xAA	0xEA
Key "#"	#	0x23	0xA3	0xEB
Key "ON/OFF"	O	0x4F	0xCF	0xEF
Key "MUTE"	M	0x4D	0xCD	n.a.
Key "REC/SOS"	N	0x4E	0xCE	0xEE
Switch "HOOK OFF"	h	0x68	n.a.	n.a.
Switch "HOOK ON"	H	0x48	n.a.	n.a.
PTT (pressed)	Z	0x5A	n.a.	n.a.
PTT (released)	z	0x7A	n.a.	n.a.

Table 7: Keycodes

- **Example(s)**

The following timing-diagram shows the keycodes which are sent for the "**Left-Soft-Key**". If the key is released within *Time1* the keycode 0x4C will be sent. If the key is kept pressed, the keycode 0xCC will be sent after the time *Time1*. If the key is still kept pressed, keycode 0xEC will be sent after the time *Time1 + Time2*. From now on there will be always the keycode 0xEC sent after the time *Time2* has expired.

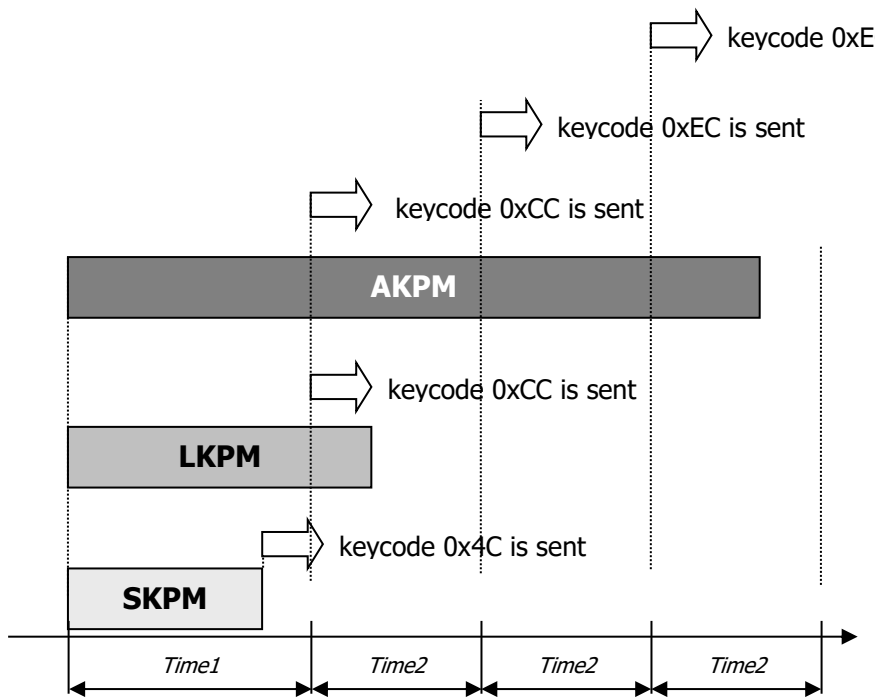


Figure 5: Timing diagram keycode "Left-Soft-Key"

SKPM: Short-Key-Press-Mode
 LKPM: Long-Key-Press-Mode
 AKPM: Auto-Key-Press-Mode

3.3.2 Power-On

When the Handset is connected to the Power-Supply, the sequence

<ESC>INIT<CR><CR><LF>

is sent via the serial link. This sequence can be used to detect the moment, when the Handset is connected to the host-system.

3.4 Display

Before the control-commands are described there is some background about the structure of the display necessary. The following sections will provide these basics.

3.4.1 Display Organization

There are currently 3 different splittings of the display implemented. Some of them can have different display-modes. Furthermore, there are also several graphical modes available, which allow to use the display (or parts of it) for graphical purposes.

The display-splittings #1 to #3 are intended for the displaying of ASCII-text, while the graphical modes are intended to display anything you want – which can also include ASCII-Text.

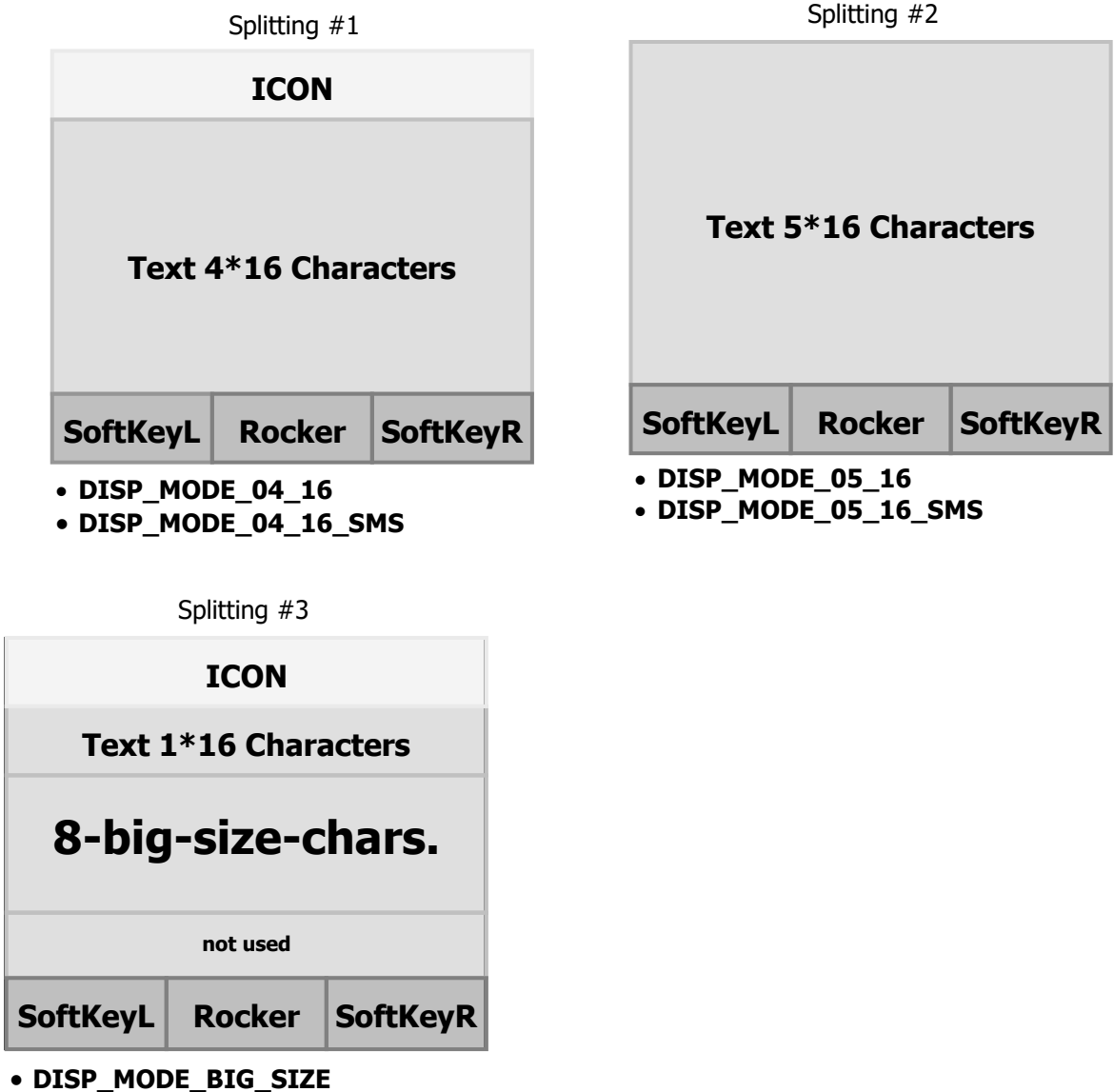


Figure 6: Display organization

Graphic Modes

Row 0
Row 1
Row 2
Row 3
Row 4
Row 5
Row 6

- **DISP_MODE_GR_4ROWS**
- **DISP_MODE_GR_5ROWS**
- **DISP_MODE_GR_6ROWS**
- **DISP_MODE_GR_7**
- **DISP_MODE_GR_8**
- **DISP_MODE_GR_9**
- **DISP_MODE_GR_10**
- **DISP_MODE_GR_11**

Figure 7: Graphic modes

The display can have the following components depending on the Display-Mode selected:

- **Icon-Bar (ICON)**
- **Text-Box (Text)**
- **Soft-Key-Bar (SoftKeyL – Rocker – SoftKeyR)**

When a graphical mode is selected it can be imagined as a transparency which are put on top of the current display. The figure below shows the principle of the graphical modes.

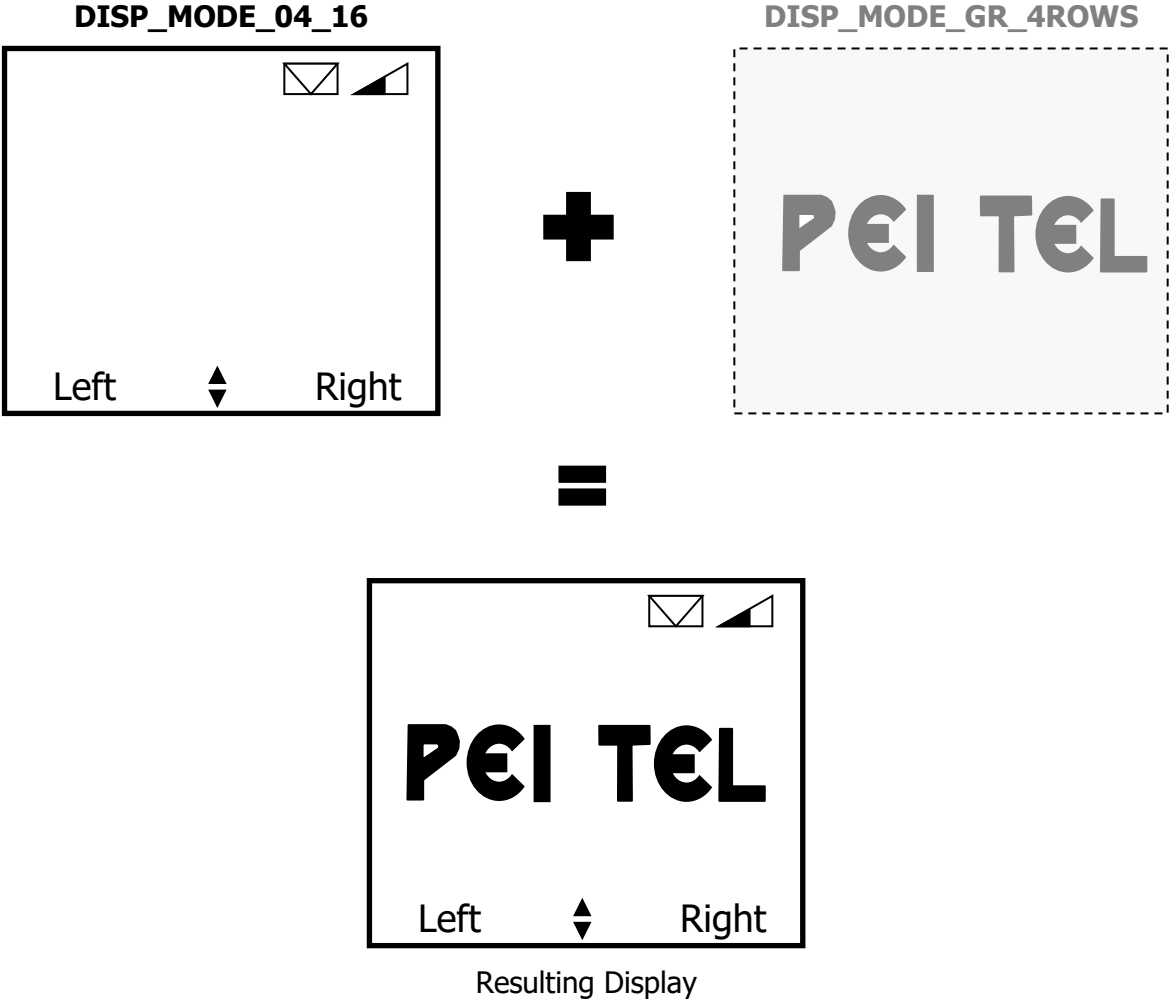


Figure 8: Graphic mode – imagined as transparencies

For example, Arabian characters could be displayed with the graphical modes. Because of the behaviour like a transparency the Icon-Bar and/or Softkey-Bar can still be visible while the Text-Box could show a graphic. The graphical modes are very useful – therefore, an own section deals with these modes.

3.4.2 Character-Sets

For displaying text there are two character-sets implemented:

- **SMS**
- **TB**

A character-set following the recommendation of the GSM-Standard 3.38 is used in SMS-modes. SMS may be processed almost directly due to encoding. In the other modes except the graphical modes the TB-character-set is used. Please see the appendix for detailed tables of the two character-sets.

3.4.3 Icon-Bar

There are already a lot of Icons implemented. To display these Icons the Icon-Bar of the display is divided into 5 Panels, where the Icons will be displayed. An Icon can be displayed in its defined position (Panel) only.

Signal- Strength	Missed- Calls	Roaming	SMS	Volume
---------------------	------------------	---------	-----	--------

Figure 9: Position(s) of certain Icons in the ICON-Bar

The Icons will be displayed in the display-modes DISP_MODE_04_16, DISP_MODE_04_16_SMS and in graphical modes not covering the first row (line) only. Icons may always be set. When switching the display to one of the modes mentioned above, the values last set are displayed.

For example, you have set in Display-Mode DISP_MODE_04_16 the Icon "Signal-Strength". Then you switch to the Display-Mode DISP_MODE_05_16 for displaying another text. When you switch back to DISP_MODE_04_16 the Icon "Signal-Strength" will be displayed again. You don't have to set it again.

The layout of the icons is shown in the sections describing the corresponding command(s).

3.4.4 Soft-Key-Bar

The Soft-Key-Bar is located in in lower part of the display and is divided into the following three Panels:

- **SoftKeyL**
- **SoftKeyR**
- **Rocker**

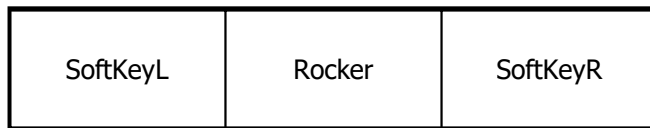


Figure 10: Soft-Key-Bar

While SoftKeyL and SoftkeyR are Text-Panels, the Rocker-Panel is for an Icon in non-graphic modes. The character set of the Soft-Key-Bar is TB. In some graphic modes the SoftKeyL-Panel and Soft-KeyR-Panel can be also used for graphical purposes while the Rocker remains in the display. The Soft-Keys and the Rocker are the Keys right beneath the display.

3.5 Handset as Input (Commands)

There are several commands defined to control the handset. They have to be sent to the Handset via the serial link with the defined communication settings 115200,N,8,1.

3.5.1 Select Display-Mode

This command selects the display-mode and turns on/off the display. In a non-graphical-mode the display-mode has to be selected *prior* dealing with the display (for example writing text to it). In the graphical modes the graphic to be displayed has to be transferred first to the Handset and then the mode has to be selected *afterwards*. The reason for that behaviour is, that it may take some time to transfer a graphic. So the display will be updated when the whole graphic has arrived in the Handset. This avoids seeing just a part of the graphic, then the next part etc.

- **Syntax**

<ESC>ID(Mode)<CR><LF>

- **Parameter(s)**

Mode:	D	Turn off display
	E	Turn on display
	0	DISP_MODE_04_16
	1	DISP_MODE_04_16_SMS
	5	DISP_MODE_05_16
	6	DISP_MODE_05_16_SMS
	10	DISP_MODE_BIG_SIZE
	11	DISP_MODE_GR_4ROWS
	12	DISP_MODE_GR_5ROWS
	13	DISP_MODE_GR_6ROWS
	14	DISP_MODE_GR_7
	15	DISP_MODE_GR_8
	16	DISP_MODE_GR_9
	17	DISP_MODE_GR_10
	18	DISP_MODE_GR_11

- **Example(s)**

<ESC>ID0<CR><LF> Select display-mode DISP_MODE_04_16

<ESC>ID18<CR><LF> Select display-mode DISP_MODE_GR_11

3.5.2 Cursor ON

This command switches the cursor on. The cursor is supported in the display-modes DISP_MODE_04_16, DISP_MODE_04_16_SMS, DISP_MODE_05_16 and DISP_MODE_05_16_SMS only.

- **Syntax**

<ESC>&C<CR><LF>

- **Parameter(s)**

None

- **Example(s)**

<ESC>&C<CR><LF>

3.5.3 Cursor OFF

This command switches the cursor off.

- **Syntax**

<ESC>&D<CR><LF>

- **Parameter(s)**

None

- **Example(s)**

<ESC>&D<CR><LF>

3.5.4 Set Cursor

With this command you can set the cursor to a certain position. Text always starts at the cursor-position. This command does not switch on the cursor! To switch on/off the cursor separate commands are used. When the display-mode is changed in non-graphic modes, the cursor is set to the home-position of the selected display-mode. If the text written to the display is longer than the remaining space, then the text will be cut to fit in the display.

- **Syntax**

<ESC>[(Row);(Column)H<CR><LF>

- **Parameter(s)**

Row: The row the cursor is set to. The range depends on the selected display-mode. For example, if a display-mode with 5 rows (lines) is selected, then the range is from 0 to 4.

Column: The Column the cursor is set to. The range is 0 to 15. A value > 15 results in discarding the entire command. The Parameter is ASCII-coded, that means Column 15 contains of the two Bytes "1" which is 0x31 and "5" which is 0x35!

- **Example(s)**

<ESC>[3;15H<CR><LF>

This example sets the cursor to row 3 (line 3) and column 15.

3.5.5 Clear Display

This command clears the display in non-graphic modes and sets the cursor to the home-position of the selected display-mode.

- **Syntax**

<ESC>&#<CR><LF>

- **Parameter(s)**

None

- **Example(s)**

<ESC>&#<CR><LF>

3.5.6 Clear Line

This command clears the line from the current cursor position to the end of the line. To clear an entire line, the cursor has to be set to the start of the line first.

- **Syntax**

<ESC>[K<CR><LF>

- **Parameter(s)**

None

- **Example(s)**

<ESC>[3;0H<CR><LF> Set Cursor to 3;0 (Line 3, Column 0)

<ESC>[K<CR><LF> Clear line 3

3.5.7 Write Text

Text can be written always to the display in non-graphic modes. It is the only command which does not start with the <ESC>-character. The text starts from the current cursor-position. Text has to be terminated with <CR><LF>. But a <CR><LF> does not cause the text to be written to the next line. To write text to the next line, the cursor has to be set to the start position of that line first!

- **Syntax**

Plain text<CR><LF>

- **Parameter(s)**

None

- **Example(s)**

<ESC>ID5<CR><LF> Select display-mode DISP_MODE_05_16

<ESC>[3;0H<CR><LF> Set Cursor to 3;0 (Line 3, Column 0)

***Hello*<CR><LF>** Writes the text "Hello" to line 3

3.5.8 Text in Invers-Style

A text-line can be displayed invers. Only one line can be shown in invers-style at the time. The text line will look like this:



Figure 11: Inverted text

- **Syntax**

<ESC>IZ(Line)<CR><LF>

- **Parameter(s)**

Line: 0 Switch off invers-style
 1 – 5 Show corresponding line in invers-style (1 corresponds to row 0).

In display-modes

- DISP_MODE_04_16
- DISP_MODE_04_16_SMS

there are 4 lines available, in display-modes

- DISP_MODE_05_16
- DISP_MODE_04_16_SMS

there are 5 lines available.

- **Example(s)**

<ESC>&#<CR><LF> Clear Display/Set cursor to home position
 Hello<CR><LF> Writes "Hello" to the display

<ESC>IZ1<CR><LF> Displays line 1 in invers style

3.5.9 Set Left-Soft-Key

With this command it is possible to write some text in the Panel "SoftKeyL" of the Soft-Key-Bar. The text is limited to 7 characters.

- **Syntax**

<ESC>IK1(Text)<CR><LF>

- **Parameter(s)**

Text: The text to be placed in the SoftKeyL-Panel (0 – 7 characters)

- **Example(s)**

<ESC>IK1Left<CR><LF> Write "Left" to SofKeyL-Panel

3.5.10 Set Right-Soft-Key

With this command it is possible to write some text in the Panel "SoftKeyR" of the Soft-Key-Bar. The text is limited to 7 characters.

- **Syntax**

<ESC>IK2(Text)<CR><LF>

- **Parameter(s)**

Text: The text to be placed in the SoftKeyR-Panel (0 – 7 characters)

- **Example(s)**

<ESC>IK2Right<CR><LF> Write "Right" to SofKeyR-Panel

<ESC>IK2<CR><LF> Clear SoftKeyR-Panel

3.5.11 Clear Soft-Keys

With this command it is possible to clear both SoftKeyL-Panel and SoftKeyR-Panel at once.

- **Syntax**

<ESC>IK0<CR><LF>

- **Parameter(s)**

None

- **Example(s)**

<ESC>IK0<CR><LF> Clear both Soft-Key-Panels

3.5.12 Set Contrast

With this command it is possible to set the contrast of the display.

- **Syntax**

<ESC>IA(Value)<CR><LF>

- **Parameter(s)**

Value: Value for the contrast in the range 1 (bright) to 20 (dark).

- **Example(s)**

<ESC>IA10<CR><LF> Set contrast to a middle value

3.5.13 Get Contrast

This command is used to get the current value of the displays contrast setting.

- **Syntax**

<ESC>IA<CR><LF>

- **Parameter(s)**

None

- **Returned Value(s)**

The current setting of the displays contrast in the format:

<ESC>IA(Value)<CR>

Attention: The returned value of the contrast is ASCII-coded. For values greater than 9 there are two bytes returned for the current setting.

- **Example(s)**

<ESC>IA<CR><LF> Request current contrast setting

Returned response could be (current contrast setting is 10 in this case):

<ESC>IA10<CR>

3.5.14 Get Hook-State

This command is used to get the current state of the hook-switch. With this switch it can be detected whether the Handset is ON-HOOK or OFF-HOOK. The host-system could then perform corresponding actions like switching the audio-paths.

- **Syntax**

<ESC>IH<CR><LF>

- **Parameter(s)**

None

- **Returned Value(s)**

The current state of the hook-switch, which can be:

<ESC>IHh<CR>	Handset is OFF-HOOK
<ESC>IHH<CR>	Handset is ON-HOOK

- **Example(s)**

<ESC>IH<CR><LF> Request state of hook-switch

Returned response could be (Handset is OFF-HOOK in this case):

<ESC>IHh<CR>

3.5.15 Get Version

This command is used to request the string of the SW-version of the Handset.

- **Syntax**

<ESC>&V<CR><LF>

- **Parameter(s)**

None

- **Returned Value(s)**

The current SW-Version in the format:

<ESC>&V (*Version*)<CR><LF>

Currently *Version* is:

HA209 V.01.01 11.07.2006

- **Example(s)**

<ESC>&V<CR><LF> Request version

Returned response would be:

<ESC>&VHA209 V.01.00 11.07.2006<CR><LF>

3.5.16 Set Key-Press-Times

This command is used to set the times *Time1* and *Time2* for the different Key-Press-Modes (SKPM, LKPM and AKPM). The Key-Press-functionality has already been described in [section 3.3.1](#). These times are permanently stored in an EEPROM.

- **Syntax**

<ESC>IT(*Time1*);(*Time2*)<CR><LF>

- **Parameter(s)**

Time1: *Time1* in steps of 100 ms. Valid values are in the range between 4 and 50 which corresponds to 0.4 s and 5.0 s. The default value is 12 (1.2 s).

Time 2: *Time2* in steps of 100 ms. Valid values are in the range between 4 and 50 which corresponds to 0.4 s and 5.0 s. The default value is 12 (1.2 s). If Time2 is set to 0, then the AKPM-Mode is switched off.

- **Example(s)**

<ESC>IT20;0<CR><LF>

This example sets the Time1 to 20 (2.0 s) and switches off AKPM.

3.5.17 Set Buzzer

With this command it is possible to switch on the buzzer for a certain time in steps of 10 ms.

- **Syntax**

<ESC>IB(Value)<CR><LF>

- **Parameter(s)**

Value: Value for the buzzer-time in the range 0 (short) to 255 (long).

- **Example(s)**

<ESC>IB10<CR><LF> Switch on buzzer for 100 ms

3.5.18 Set Backlight

This command is used to configure the backlight of the display in the Handset. There are 3 basic modes available:

- Permanently ON
- Permanently OFF
- Automatic

In automatic-mode the backlight is switched on when a key is pressed. After an adjustable period of time, the backlight is switched off automatically. With every key-press the backlight-timer is restarted. It is also possible that the backlight of the keypad remains ON all the time and just the display-backlight is turned off after the period of time has expired. This can be achieved by setting a flag.

In the other two modes, a key-press does not influence the backlight – it is either ON or OFF. After power-up the backlight is switched off permanently.

- **Syntax**

<ESC>IE(Mode)<CR><LF>

- **Parameter(s)**

Mode: Backlight-Mode – the following values are supported:

- 0 Backlight is switched off permanently
- E Backlight is switched on permanently
- A selects automatic mode and restarts the timer - that means that when this command was received by the Handset the backlight is switched on for the adjusted period of time. When a key is pressed the backlight is switched on again for the adjusted period of time.
- S selects automatic mode and does not restart the timer. But when a key is pressed the backlight is switched on for the adjusted period of time.
- R Sets the duration-time for the backlight to factory-default value of 30 s
- e Sets the flag for the permanent backlight of the keypad.
- r Clears the flag for the permanent backlight of the keypad
- 1...n Sets the duration-time of the backlight to a user-defined value in steps of 1 s

- **Example(s)**

<ESC>IE0<CR><LF> Switch OFF backlight permanently

<ESC>IE3<CR><LF> Set duration-time to 3 s

<ESC>IEA<CR><LF> Select automatic-mode and restart timer

3.5.20 Set Icon "Unread-SMS"

With this command it is possible to show the icon for "Unread SMS". The icon "Unread SMS" can be displayed in a flashing-mode, too. When the flashing-mode is selected, the icon "Read SMS" should be deactivated first (if it was activated) -otherwise it could mix-up with the icon "Read SMS".

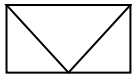


Figure 13: Icon "Unread SMS"

- **Syntax**

<ESC>IU(State)<CR><LF>

- **Parameter(s)**

State:	0	Switch off icon "Unread SMS"
	1	Switch on icon "Unread SMS"
	255	Switch on icon "Unread SMS" in flashing-mode

- **Example(s)**

<ESC>IU255<CR><LF> Switch on icon "Unread SMS" in flashing-mode

3.5.21 Set Icon "Signal-Strength"

With this command it is possible to show the icon for "Signal-Strength". The icon for the Signal strength is located in the Signal-Strength-Panel of the Icon-Bar and looks like shown below.



Figure 14: Icon "Signal Strength"

- **Syntax**

<ESC>IF(State)<CR><LF>

- **Parameter(s)**

State:	0	Switch off icon "Signal-Strength"
	1-6	Switch on icon "Signal-Strength" with corresponding value
	1:	Display icon without signal-bars
	6:	Display icon with 5 signal-bars

- **Example(s)**

<ESC>IF3<CR><LF> Switch on icon "Signal-Strength" with 2 bars

3.5.22 Set Icon "Roaming"

The Icon "Roaming" is located in the middle of the Icon-Bar and looks like shown below.



Figure 15: Icon "Roaming"

- **Syntax**

<ESC>IR(State)<CR><LF>

- **Parameter(s)**

State:	0	Switch off icon "Roaming"
	1	Switch on icon "Roaming"

- **Example(s)**

<ESC>IR1<CR><LF> Switch on icon "Roaming"

3.5.23 Set Icon "Missed Calls"

The Icon "Missed Calls" is located in the Missed-Calls-Panel of the Icon-Bar and is a number.

- **Syntax**

<ESC>IP(Value)<CR><LF>

- **Parameter(s)**

Value:	0	Switch off icon "Missed Calls"
	1-19	Switch on icon "Missed Calls" with corresponding Value

- **Example(s)**

<ESC>IP10<CR><LF> Switch on icon "Missed Calls" with Value 10

3.5.24 Set Icon "Volume Private-Mode"

There are 2 volume-icons plus an icon for muting available. There are the following rules applied:

- Just one can be displayed at the time.
- It will be displayed in the Volume-Panel of the Icon-Bar.
- The icon "Mute" overrules the 2 volume-icons!
- A volume-icon can not be displayed if the icon "Mute" is active. When switching on a volume-icon and icon "Mute" was (or is) active, then icon "Mute" will be displayed. Nevertheless, the value of the icon can be updated.

- When switching off the icon "Mute", the last displayed volume-icon will be displayed again with its current value – if there was previously one displayed.



Figure 16: Volume icons

- **Syntax**

<ESC>IL(Value)<CR><LF>

- **Parameter(s)**

- Value: 0 Switch off all volume-icons (inclusive icon "Mute" – but if icon "Mute" was active it will be displayed again, when a volume-icon is switched on!)
- 1-10 Activate icon "Volume Private Mode" with corresponding value. The icon will be displayed only if icon "Mute" is not active! If icon "Mute" is active, icon "Mute" overrules the volume-icons and will be displayed.
- 1: Display icon with min value (triangle empty)
- 10: Display icon with max value (triangle full)

- **Example(s)**

<ESC>IL5<CR><LF>

Switch on icon "Volume Private-Mode" with a middle value (only if icon "Mute" is not active)
If icon "Mute" is (was) active, then the icon "Mute" will be displayed – but we can update the value anyway.

3.5.25 Set Icon "Volume Handsfree-Mode"

The Icon "Volume Handsfree-Mode" is member of the volume-icons. For general rules see previous section.

- **Syntax**

<ESC>II(Value)<CR><LF>

- **Parameter(s)**

Value: 0 Switch off all volume-icons (inclusive icon "Mute" – but if icon "Mute" was active it will be displayed again, when a volume-icon is switched on!)

1-10 Activate icon "Volume Handsfree-Mode" with corresponding value. The icon will be displayed only if icon "Mute" is not active! If icon "Mute" is active, icon "Mute" overrules the volume-icons and will be displayed.

1: Display icon with min value (triangle empty)

10: Display icon with max value (triangle full)

- **Example(s)**

<ESC>II5<CR><LF>

Switch on icon "Volume Handsfree-Mode" with a middle value (only if icon "Mute" is not active). If icon "Mute" is (was) active, then the icon "Mute" will be displayed – but we can update the value anyway.

3.5.26 Set Icon "Mute"

The Icon "Mute" is member of the volume-icons. For general rules see [section 3.5.24](#). Whether the microphone-path is muted or not depends on the hardware of the Handset.

- **Syntax**

<ESC>IM(State)<CR><LF>

- **Parameter(s)**

State: 0 Switch off icon "Mute" – if a volume-icon was activated previously it will now be shown

1 Activate and display icon "Mute". A volume-icon will not be displayed anymore – but it remains active!

- **Example(s)**

<ESC>IM1<CR><LF>

Switch on icon "Mute".

3.5.27 Set Icon "Rocker"

The icons "Rocker" are located in Rocker-Panel of the Soft-Key-Bar. The icon "Rocker" is intended to represent the Rocker-Key. There are 3 icons available.

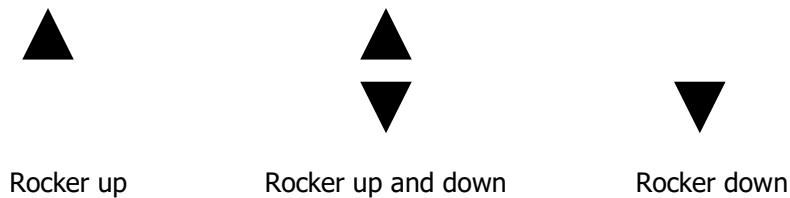


Figure 17: "Rocker" icons

- **Syntax**

<ESC>IW(State)<CR><LF>

- **Parameter(s)**

State:	0	Switch off icon "Rocker"
	1	Switch on icon "Rocker down"
	2	Switch on icon "Rocker up"
	3	Switch on icon "Rocker up and down"

- **Example(s)**

<ESC>IW3<CR><LF> Switch on icon "Rocker up and down"

3.5.28 Set Volume

The internal potentiometer is used to set the attenuation factor of the handset. This only effects the volume of the internal speaker. The value for the volume will be saved permanently in an EEPROM.

The potentiometer has 8 logarithmic steps.

- **Syntax**

<ESC>IV(Value)<CR><LF>

- **Parameter(s)**

Value: Value for the desired attenuation according to the table for potentiometer settings:

Value	Attenuation [dB]
0	35
1	30
2	25
3	20
4	15
5	10
6	5
7	0

Value is limited to 7. The default value is 3.

Table 8: Volume table

- **Example(s)**

<ESC>IV4<CR><LF> Increase Volume of speaker in Handset

3.5.29 DISP_MODE_BIG_SIZE

This mode is a fixed combination of a "normal" display mode and a graphic mode. It uses the rows (lines) 1 to 3. Row 2 and 3 are used for displaying up to 8 big-size-characters (double-sized), Row 1 has normal size. With the 9th character the first character is automatically shifted to line 1 and so forth. So altogether there are 16 (row 1, normal size) plus 8 (row 2 and 3, big-size) characters possible. When there are more than 24 characters to be displayed, then line 1 is not shifted anymore and just one more character is added when it is written to the display.

The Icon-Bar and the Soft-Key-Bar are still available. They can be used - but they don't have to be used.

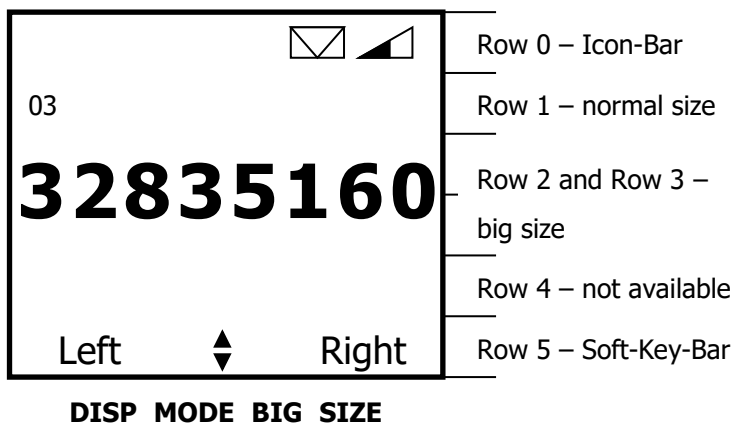


Figure 18: Display mode "DISP_MODE_BIG_SIZE"

The figure above shows an example of the display-mode DISP_MODE_BIG_SIZE. Here the telephone-number 0332835160 is shown in the display.

Example:

The following steps have to be performed to get this screen (it is shown very detailed so that you can get an idea of how the Terminal works):

- Switch to a display mode allowing the Soft-Key-Bar and the Icon-Bar to be displayed, for example DISP_MODE_04_16
<ESC>ID0<CR><LF>
- Set text for SoftKeyL
<ESC>IK1Left<CR><LF>
- Set text for SoftKeyR
<ESC>IK2Right<CR><LF>
- Set icon "Rocker up and down"
<ESC>IW3<CR><LF>

- Set Icon "Read SMS"
<ESC>IU1<CR><LF>
- Set Icon "Volume" with value 4
<ESC>IL4<CR><LF>

The result will be the basic display without the telephone-number. Now we use the display-mode DISP_MODE_BIG_SIZE

- Clear display (just to be save)
<ESC>&#<CR><LF>
- Switch to display-mode DISP_MODE_BIG_SIZE
<ESC>ID10<CR><LF>
- Send telephone-number to the display
0332835160<CR><LF>

Notice:

The steps can sometimes differ, because you have to take in account the point of start. This example shows the steps after power-up.

3.6 Graphic Modes

In this section it will be discussed how the graphic modes work. As mentioned earlier, there are several graphic modes implemented which allow the host-system to use the display or parts of it for graphical purposes.

In general, a graphical mode can be imagined as transparencies which is put on top of the current display. The following figure shows the principle of the graphic-modes.

In the figure on the next page a combination is used. The "main"-display uses the display-mode DISP_MODE_04_16 and with the graphic-mode DISP_MODE_GR_4ROWS the graphic shaded grey (here the pei tel logo) is put on top of the "main"-display, so that the resulting display will look like shown on the right-hand side.

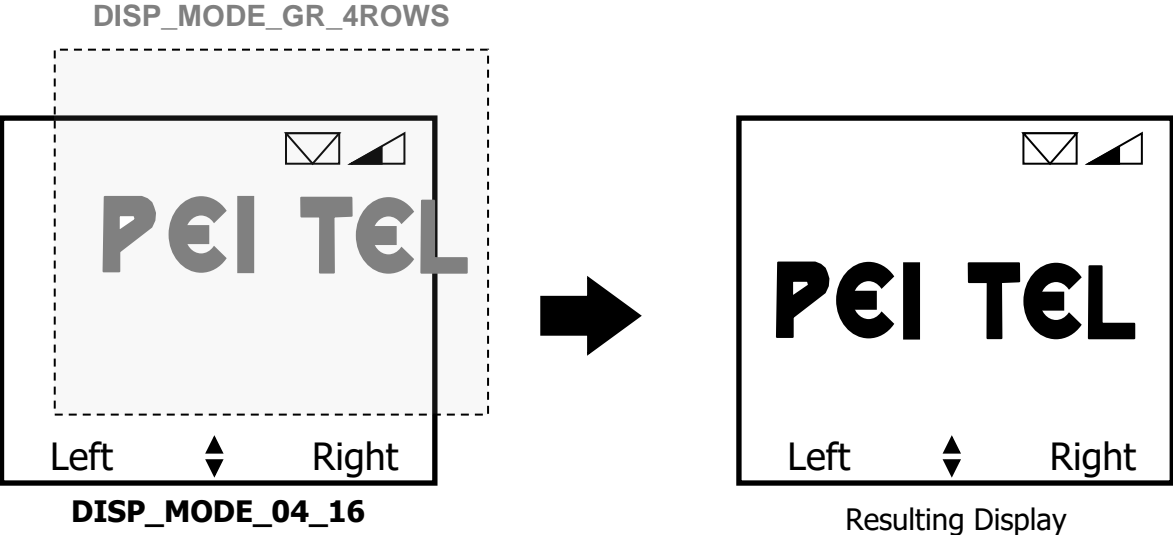


Figure 19: Graphic modes

3.6.1 Display Structure Graphic Mode

Now we have a more detailed look at the display structure. A row consists of 96x8 pixels. Every single pixel can be addressed by the user. Depending on the graphic mode up to 7 rows can be displayed (please see also [3.4.1 Display Organization](#)). For technical reasons the 7th row has just 96x5 pixels. Thus, 96x53 pixels can be displayed altogether (see figure).

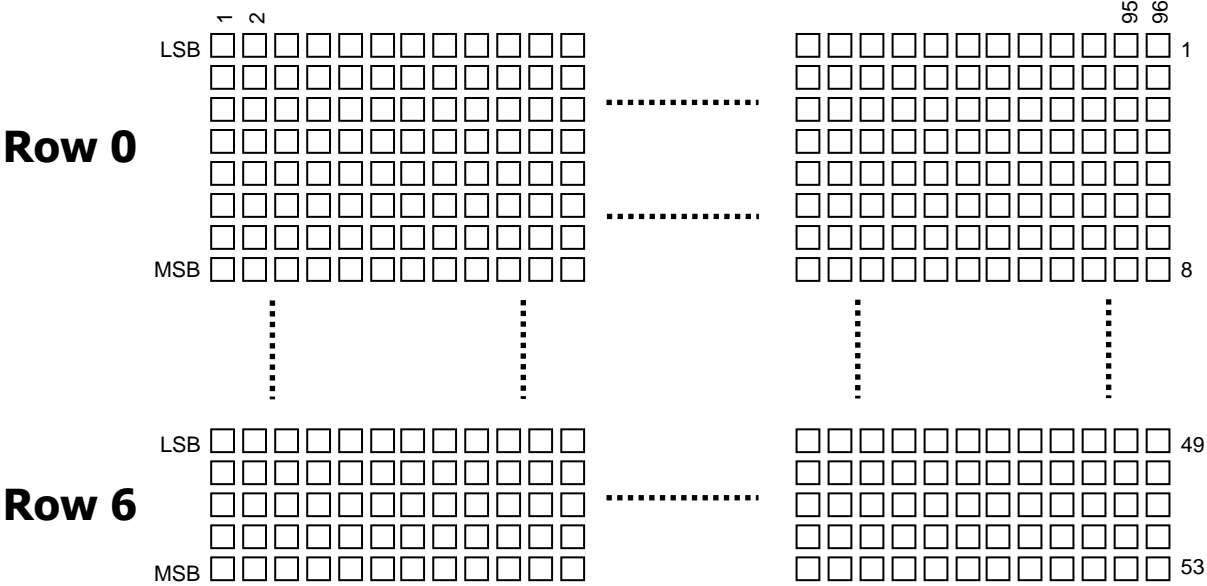


Figure 20: Display structure

3.6.2 Coding Scheme Graphic Mode

Having a look at one row will reveal the general coding scheme for the graphical modes. For each column the LSB (Least Significant Bit) is the top-dot, the MSB (Most Significant Bit) is the lowest dot as shown. If a dot of a column should be displayed, the corresponding bit has to be set to 1:

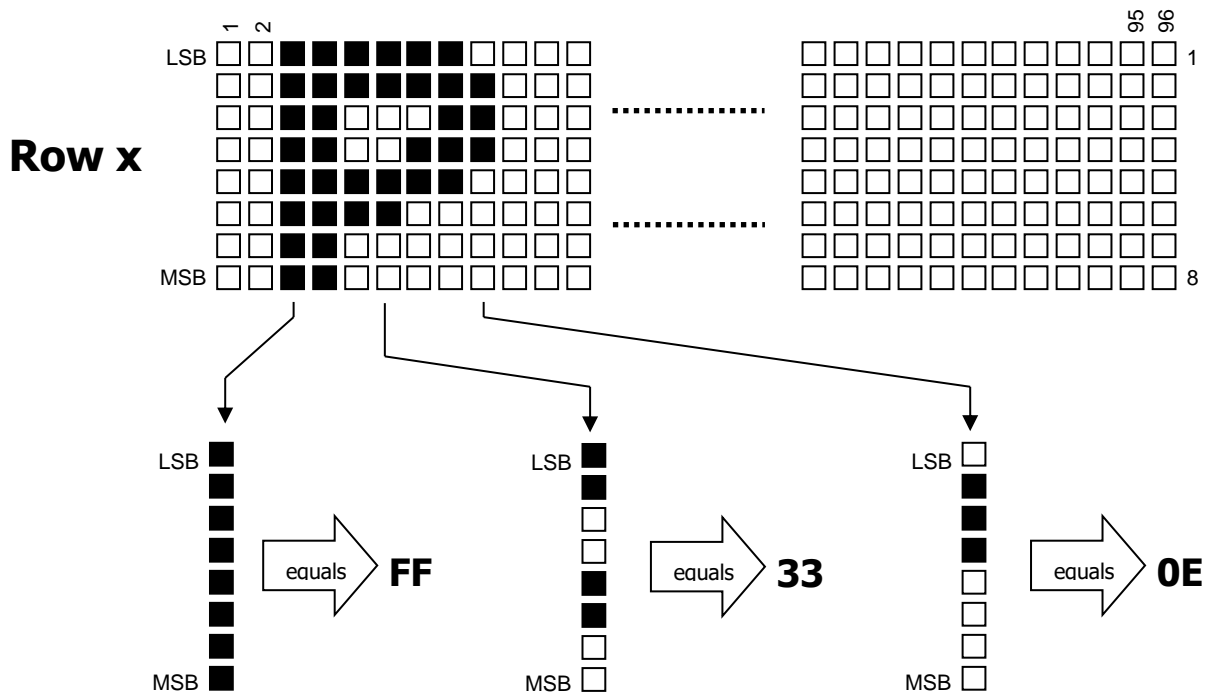


Figure 21: Coding scheme

Therefore, the coding for the first 10 columns would be:

0000FFFF33331B1F0E00

Following points have to be considered:

- A column is coded with a hexadecimal value. Because of the ASCII-oriented protocol the hexadecimal value consists actually of two bytes. For example, FF is 0x46 (F) followed by another 0x46 (F)!
- The values are case sensitive! For example, FF does not equal ff!
- For an entire display of graphic, a lot of bytes would have to be transferred. An entire row would consist of at least 2 x 96 Bytes of data. To speed things up, a compression algorithm can be used as shown in the next section.

3.6.3 Compression Algorithm

To fill an entire display with a graphic would require to transfer a lot of bytes. Even at a baudrate of 115200 Baud this would take quite a while. Therefore, a compression algorithm has been defined.

With the compression algorithm consecutive, equal values can be written as *n times the value*. To differentiate between "normal" data and "compressed" data, small letters are used. The small letter "a" means 2 times the value followed, the letter "b" means 3 times the value followed and so forth. The "highest" compression small letter is "y", which means 26 times the value followed. That is also the reason, why the data values are case sensitive.

Compression table:

2	3	4	5	6	7	8	9	10	11	12	13	14
a	b	c	d	e	f	g	h	i	j	k	l	m

15	16	17	18	19	20	21	22	23	24	25	26
n	o	p	q	r	s	t	u	v	w	x	y

Table 9: Compression table

Example:

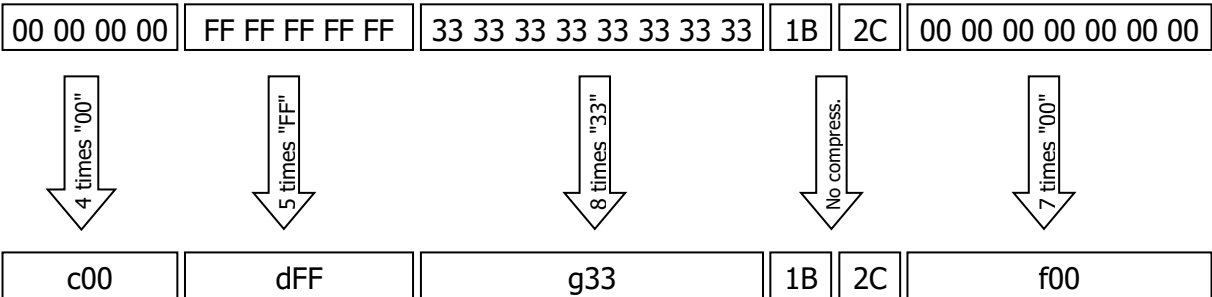
The data stream with 52 bytes

00 00 00 00 FF FF FF FF FF 33 33 33 33 33 33 33 33 33 1B 2C 00 00 00 00 00 00 00

can be compressed to

c00 dFF g33 1B 2C f00

which has only 16 bytes.



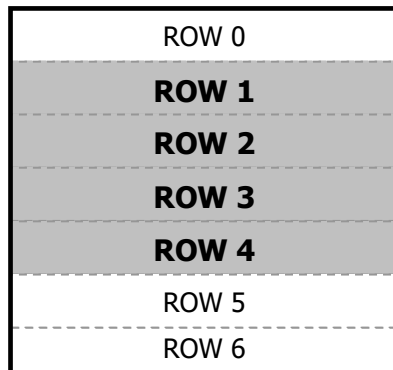
The spaces between the values are just for visual reasons. The real data stream does not have these spaces!

The real data stream would be:

c	0	0	d	F	F	g	3	3	1	B	2	C	f	0	0
0x63	0x30	0x30	0x64	0x46	0x46	0x67	0x33	0x33	0x31	0x42	0x32	0x43	0x66	0x30	0x30

3.6.4 Graphic Display Modes

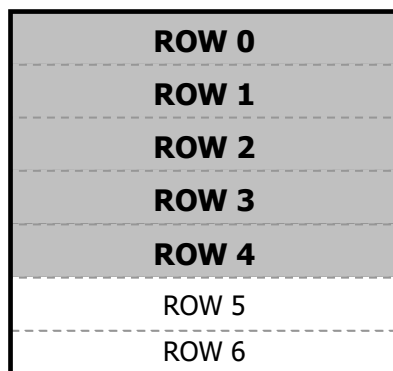
A short description of the 8 graphical modes is provided in this section.



DISP_MODE_GR_4ROWS:

Row 1 to Row 4 can be used for graphics. Icon-Bar (Row 0) and Soft-Key-Bar (Row 5) remain visible.

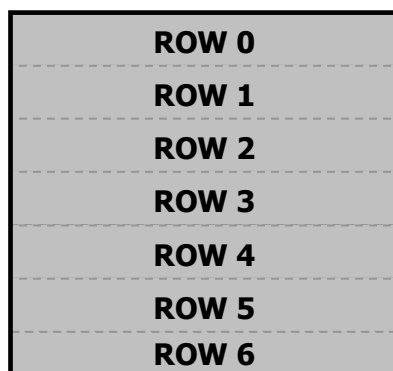
Command: <ESC>ID11<CR><LF>



DISP_MODE_GR_5ROWS:

Row 0 to Row 4 can be used for graphics. Soft-Key-Bar (Row 5) is still visible. Icon-Bar is not visible in this mode.

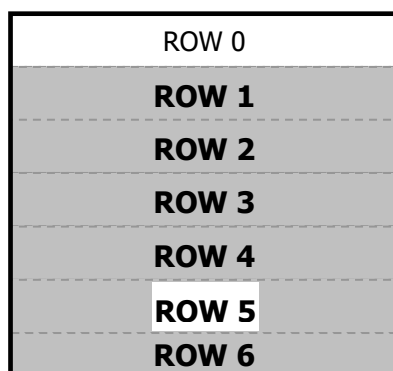
Command: <ESC>ID12<CR><LF>



DISP_MODE_GR_6ROWS:

Entire display can be used for graphics. Neither Soft-Key-Bar nor Icon-Bar are visible in this mode.

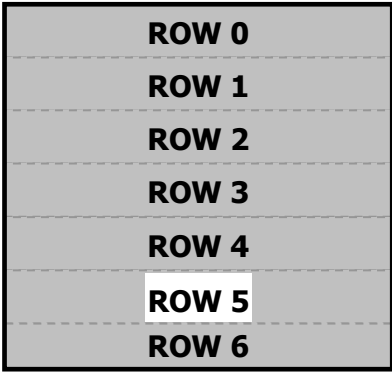
Command: <ESC>ID13<CR><LF>



DISP_MODE_GR_7:

Row 1 to Row 6 can be used for graphics. Icon-Bar (Row 0) is visible. The Rocker-Panel of the Soft-Key-Bar (Row 5) is visible.

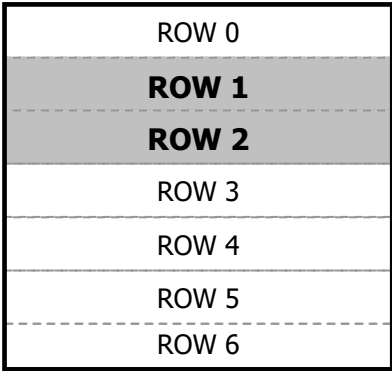
Command: <ESC>ID14<CR><LF>



DISP_MODE_GR_8:

Row 0 to Row 6 can be used for graphics. Icon-Bar (Row 0) is not visible. The Rocker-Panel of the Soft-Key-Bar (Row 5) is visible.

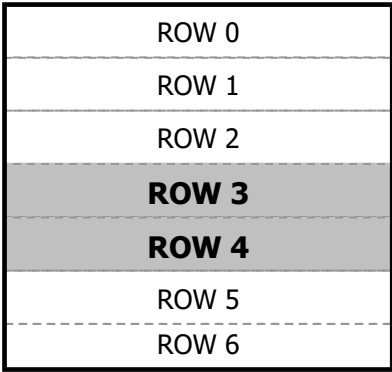
Command: <ESC>ID15<CR><LF>



DISP_MODE_GR_9:

Row 1 and Row 2 can be used for graphics.

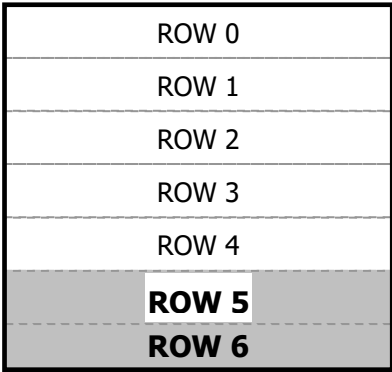
Command: <ESC>ID16<CR><LF>



DISP_MODE_GR_10:

Row 3 and Row 4 can be used for graphics.

Command: <ESC>ID17<CR><LF>



DISP_MODE_GR_11:

Row 5 and Row 6 can be used for graphics. The Rocker-Panel of the Soft-Key-Bar (Row 5) is visible.

Command: <ESC>ID18<CR><LF>

Figure 22: Graphic display modes

Attention:

When data is written to a row, this data is buffered. The next time that row is displayed, the buffered data will be displayed. This can cause unwanted effects, when display-modes with many rows are selected.

Now that we have knowledge about the principles of the graphic mode, the command for using the graphical modes can be introduced.

3.6.5 Send Graphic Data

With this command the uncompressed or compressed data can be sent to the Handset. Please remember to select the corresponding graphical mode afterwards to update the display! The command "Clear Display" does not work for graphic modes.

- **Syntax**

<ESC>G(Row),(Data)z<CR><LF>

- **Parameter(s)**

Row:	r0-r6	The row where the data shall be displayed.
Data:	xxx	The uncompressed or compressed data ASCII-coded.
	00	To clear an entire row.

- **Example(s)**

Example 1:

<ESC>Gr0,00z<CR><LF> Clear row 0

<ESC>ID13<CR><LF> Select display-mode to update display

Example 2:

<ESC>Gr0,a00aFFa331B1F0Ez<CR><LF>

<ESC>ID15<CR><LF> Select display-mode to update display

Example 2 displays the previously defined graphic (special character "P", [section 3.6.2](#)) at row 0 of the display.

Hints:

It is recommended to transfer all rows of the graphic first, then update the display. So, the whole graphic will be visible at once. Otherwise, there is the possibility of seeing the graphic "growing"! Select only the graphic mode(s) you need. For example, if you would like to put a graphic in row 1 and row 2, then select DISP_MODE_GR_9 and not one of the other.

4 Appendix

4.1 Character-Set SMS

Character-Set SMS 0-127

Dez	Hex	Char
0	00	1)
1	01	£
2	02	\$
3	03	¥
4	04	È
5	05	É
6	06	Ù
7	07	Ì
8	08	Ò
9	09	Ç
10	0A	LF
11	0B	Ø
12	0C	Ø
13	0D	CR
14	0E	Á
15	0F	á
16	10	Δ
17	11	_
18	12	.
19	13	.
20	14	.
21	15	.
22	16	.
23	17	.
24	18	.
25	19	.
26	1A	.
27	1B	2)
28	1C	Æ
29	1D	Æ
30	1E	ß
31	1F	É

Dez	Hex	Char
32	20	SP
33	21	!
34	22	"
35	23	#
36	24	¤
37	25	%
38	26	&
39	27	'
40	28	(
41	29)
42	2A	*
43	2B	+
44	2C	,
45	2D	-
46	2E	.
47	2F	/
48	30	0
49	31	1
50	32	2
51	33	3
52	34	4
53	35	5
54	36	6
55	37	7
56	38	8
57	39	9
58	3A	:
59	3B	;
60	3C	<
61	3D	=
62	3E	>
63	3F	?

Dez	Hex	Char
64	40	i
65	41	A
66	42	B
67	43	C
68	44	D
69	45	E
70	46	F
71	47	G
72	48	H
73	49	I
74	4A	J
75	4B	K
76	4C	L
77	4D	M
78	4E	N
79	4F	O
80	50	P
81	51	Q
82	52	R
83	53	S
84	54	T
85	55	U
86	56	V
87	57	W
88	58	X
89	59	Y
90	5A	Z
91	5B	Ä
92	5C	Ö
93	5D	Ñ
94	5E	Ü
95	5F	Ş

Dez	Hex	Char
96	60	ı
97	61	a
98	62	b
99	63	c
100	64	d
101	65	e
102	66	f
103	67	g
104	68	h
105	69	i
106	6A	j
107	6B	k
108	6C	l
109	6D	m
110	6E	n
111	6F	o
112	70	p
113	71	q
114	72	r
115	73	s
116	74	t
117	75	u
118	76	v
119	77	w
120	78	x
121	79	y
122	7A	z
123	7B	ä
124	7C	ö
125	7D	ñ
126	7E	ü
127	7F	à

1) The character '@' was moved to 128; this allows the use of strings terminated by zero.)

2) This code value is reserved for the extension to another extension table. On receipt of this code, a receiving entity shall display a space until another extension table is defined.

Character-Set SMS 128-255

Dez	Hex	Char
128	80	@
129	81	1)
130	82	1)
131	83	1)
132	84	1)
133	85	1)
134	86	1)
135	87	1)
136	88	1)
137	89	1)
138	8A	1)
139	8B	1)
140	8C	1)
141	8D	1)
142	8E	1)
143	8F	Ä
144	90	1)
145	91	1)
146	92	1)
147	93	1)
148	94	1)
149	95	1)
150	96	1)
151	97	1)
152	98	1)
153	99	1)
154	9A	Ö
155	9B	Ü
156	9C	1)
157	9D	1)
158	9E	1)
159	9F	1)

Dez	Hex	Char
160	A0	1)
161	A1	1)
162	A2	1)
163	A3	1)
164	A4	1)
165	A5	1)
166	A6	1)
167	A7	1)
168	A8	1)
169	A9	1)
170	AA	1)
171	AB	1)
172	AC	1)
173	AD	1)
174	AE	1)
175	AF	1)
176	B0	1)
177	B1	1)
178	B2	1)
179	B3	1)
180	B4	1)
181	B5	1)
182	B6	1)
183	B7	1)
184	B8	1)
185	B9	1)
186	BA	1)
187	BB	1)
188	BC	1)
189	BD	1)
190	BE	1)
191	BF	1)

Dez	Hex	Char
192	C0	1)
193	C1	1)
194	C2	1)
195	C3	1)
196	C4	1)
197	C5	Ä
198	C6	1)
199	C7	1)
200	C8	1)
201	C9	1)
202	CA	1)
203	CB	1)
204	CC	1)
205	CD	1)
206	CE	1)
207	CF	1)
208	D0	1)
209	D1	1)
210	D2	1)
211	D3	1)
212	D4	1)
213	D5	1)
214	D6	1)
215	D7	Ö
216	D8	1)
217	D9	1)
218	DA	1)
219	DB	1)
220	DC	1)
221	DD	Ü
222	DE	1)
223	DF	1)

Dez	Hex	Char
224	E0	1)
225	E1	1)
226	E2	1)
227	E3	1)
228	E4	1)
229	E5	ä
230	E6	1)
231	E7	1)
232	E8	1)
233	E9	1)
234	EA	1)
235	EB	1)
236	EC	1)
237	ED	1)
238	EE	1)
239	EF	1)
240	F0	1)
241	F1	1)
242	F2	1)
243	F3	1)
244	F4	1)
245	F5	1)
246	F6	1)
247	F7	ö
248	F8	1)
249	F9	1)
250	FA	1)
251	FB	1)
252	FC	1)
253	FD	ü
254	FE	1)
255	FF	1)

1) This value will be displayed as a " \ ".

4.2 Character-Set TB

Character-Set "TB" 0-127

Dez	Hex	Char
0	00	1)
1	01	1)
2	02	1)
3	03	1)
4	04	1)
5	05	1)
6	06	1)
7	07	1)
8	08	1)
9	09	1)
10	0A	LF
11	0B	1)
12	0C	1)
13	0D	CR
14	0E	1)
15	0F	1)
16	10	1)
17	11	1)
18	12	1)
19	13	1)
20	14	1)
21	15	1)
22	16	1)
23	17	1)
24	18	1)
25	19	1)
26	1A	1)
27	1B	1)
28	1C	1)
29	1D	1)
30	1E	1)
31	1F	1)

Dez	Hex	Char
32	20	SP
33	21	!
34	22	"
35	23	#
36	24	¤
37	25	%
38	26	&
39	27	'
40	28	(
41	29)
42	2A	*
43	2B	+
44	2C	,
45	2D	-
46	2E	.
47	2F	/
48	30	0
49	31	1
50	32	2
51	33	3
52	34	4
53	35	5
54	36	6
55	37	7
56	38	8
57	39	9
58	3A	:
59	3B	;
60	3C	<
61	3D	=
62	3E	>
63	3F	?

Dez	Hex	Char
64	40	@
65	41	A
66	42	B
67	43	C
68	44	D
69	45	E
70	46	F
71	47	G
72	48	H
73	49	I
74	4A	J
75	4B	K
76	4C	L
77	4D	M
78	4E	N
79	4F	O
80	50	P
81	51	Q
82	52	R
83	53	S
84	54	T
85	55	U
86	56	V
87	57	W
88	58	X
89	59	Y
90	5A	Z
91	5B	[
92	5C	\
93	5D]
94	5E	^
95	5F	_

Dez	Hex	Char
96	60	
97	61	a
98	62	b
99	63	c
100	64	d
101	65	e
102	66	f
103	67	g
104	68	h
105	69	i
106	6A	j
107	6B	k
108	6C	l
109	6D	m
110	6E	n
111	6F	o
112	70	p
113	71	q
114	72	r
115	73	s
116	74	t
117	75	u
118	76	v
119	77	w
120	78	x
121	79	y
122	7A	z
123	7B	{
124	7C	
125	7D	}
126	7E	~
127	7F	1)

1) This not printable character will be displayed as a SPACE.

2) This value will be displayed as " \ ".

Character-Set "TB" 128-255

Dez	Hex	Char
128	80	2)
129	81	2)
130	82	2)
131	83	2)
132	84	2)
133	85	2)
134	86	2)
135	87	2)
136	88	2)
137	89	2)
138	8A	2)
139	8B	2)
140	8C	2)
141	8D	2)
142	8E	Ä
143	8F	2)
144	90	2)
145	91	2)
146	92	`
147	93	2)
148	94	2)
149	95	2)
150	96	2)
151	97	2)
152	98	2)
153	99	Ö
154	9A	Ü
155	9B	2)
156	9C	2)
157	9D	2)
158	9E	2)
159	9F	2)

Dez	Hex	Char
160	A0	2)
161	A1	2)
162	A2	2)
163	A3	£
164	A4	2)
165	A5	2)
166	A6	2)
167	A7	2)
168	A8	€
169	A9	2)
170	AA	2)
171	AB	2)
172	AC	2)
173	AD	2)
174	AE	2)
175	AF	2)
176	B0	2)
177	B1	2)
178	B2	2)
179	B3	2)
180	B4	2)
181	B5	2)
182	B6	2)
183	B7	2)
184	B8	2)
185	B9	2)
186	BA	2)
187	BB	2)
188	BC	2)
189	BD	2)
190	BE	2)
191	BF	€

Dez	Hex	Char
192	C0	À
193	C1	Á
194	C2	Â
195	C3	Ã
196	C4	Ä
197	C5	Å
198	C6	Æ
199	C7	Ç
200	C8	È
201	C9	É
202	CA	Ê
203	CB	Ë
204	CC	Ì
205	CD	Í
206	CE	Î
207	CF	Ï
208	D0	2)
209	D1	Ñ
210	D2	Ò
211	D3	Ó
212	D4	Ô
213	D5	Õ
214	D6	Ö
215	D7	2)
216	D8	Ø
217	D9	Ù
218	DA	Ú
219	DB	Û
220	DC	Ü
221	DD	2)
222	DE	2)
223	DF	2)

Dez	Hex	Char
224	E0	2)
225	E1	2)
226	E2	2)
227	E3	2)
228	E4	ä
229	E5	2)
230	E6	2)
231	E7	2)
232	E8	2)
233	E9	2)
234	EA	2)
235	EB	2)
236	EC	2)
237	ED	2)
238	EE	2)
239	EF	2)
240	F0	2)
241	F1	2)
242	F2	2)
243	F3	2)
244	F4	2)
245	F5	2)
246	F6	ö
247	F7	2)
248	F8	2)
249	F9	2)
250	FA	2)
251	FB	2)
252	FC	ü
253	FD	2)
254	FE	2)
255	FF	2)

2) This value will be displayed as " \ " "

END OF DOCUMENT