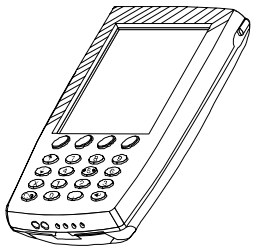
User manual



HW 90196

and components

VECTRON Systems AG

Version 1.0

HÖFT & WESSEL

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1. General

Introduction

The mobile point-of-sale terminal HW 90196 is by its conception a non-intelligent terminal for input/output operations and radio connected with a base station that runs the Vectron POS program.

Purpose of document

This documentation contains informations about function mode of the HW 90196 and its components:

- printer HW 90195
- accu blocks for HW 90196 / HW 90195
- Base Station HW 8660

Survey of content

Firstly the HW 90196 will be illlustrated with graphics and functions of keyboard and technical data will be described. Next the processing of the operating system will be explained and the single system components, technical data and functions will be specified. Finally connecting possibilities of the HW 90196 are shown.

Terminology

mobile point-of-sale terminal	HW 90196
mobile printer	HW 90195
Base Station	HW 8660
charging station	HW 16196
accumulator blocks	HW 19195, HW 19196
power supply unit	HW 1210
Radio module	HW 86020
mobile data registration device	MDE

Target group

This documentation refers to all users of HW 90196 and also to users dealing with operating system levels of HW 90196.

NOTE:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- **Reorient or relocate the receiving antenna.**
- **Increase the separation between the equipment and receiver.**
- **Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.**
- **Consult the dealer or an experienced radio/TV technician for help.**

1.1 Important comments for application!

Initiation

Remove devices from packaging. Keep packaging material for future shipment purposes!

Accu blocks are not inserted in HW 90196 at time of delivery. After unpacking of box accu blocks have to be inserted in HW 90196.

A final functional test of the HW 90196 and its peripheral devices should be performed before delivery to customer.

Application

- Operate device only with contained equipment.
- Keep device from humidity and dust.
- Clean device only with damp cloth and mild detergent.
- Do not insert objects other than applicable into openings of device (risk of destroying electronical system).

Safety

- Do not operate in close range of strong electromagnetic fields.
- Note temperatur ranges under sec. 3.1 (avoid over-heating: e.g. due to storage in direct sun light impact area behind windows [like in a car]).
- Protect against theft and abuse (terminal HW 90196 may contain great financial values
- Pay attention to plug-ins (dealer card)

Storage

A terminal HW 90196 must only be stored ***without*** accu block!
(Accu block should always be stored *seperately* in charged condition.)

Shipment

Device must only be shipped in original or comparable robust packaging. Conventional paded bags do not protect the HW 90196 against shocks and pressure sufficiently. Non-applicable packaging means have to be assesed as *negligent.*

Maintenance

The HW 90196 is – apart from charging of accu block and above mentioned comments- lifetime maintenance-free.

Opening of HW 90196

The HW 90196 does not contain any components which could be maintained, replaced or repaired by the customer or personell other than the H&W service personell. The casing screws of the HW 90196 are sealed to keep from non-authorized opening. Opening of device provokes data loss.

IMPORTANT!

1. **This device must not be changed or modified unless expressly approved by Vectron Systems AG. Any unapproved modification could void the user´s authority to operate the equipment.**
2. **Damages of device due to non-applicable packaging means during shipment or due to non-authorized opening will cause invalidity of warranty!**

1.2 Bring-in service (repair of devices)

In case of a necessary repair the device should always be send in with all equipment in original packaging to Höft & Wessels.
The equipment may faciliate trouble-shooting as sometimes defective peripheral devices can be the cause for malfunctions.

Please enclose a written **malfunction report** or – if possible – fill out **service form** and attach to shipment.
This allows the service section of Höft & Wessels an easier trouble-shooting and helps to return the HW 90196 faster.

1.2.1 Special case plug-in in ID-000 format at initial delivery

The plug-ins will usually inserted by the dealer (network carrier, competence centre) or service technician mounting/delivering the HW 90196 at first initiation.

1.2.2 Special case plug-in in ID-000 format at repair

IMPORTANT!

It is due to the responsibility of the customer to remove any plug-ins (e.g. dealer cards) from the HW 90196 mobile POS terminal before shipment to H & W. Company H & W is not liable for loss of plug-ins or resulting damages.

H & W accepts liability only for expert implementation of service and proper condition of applied materials. Any subsequent responsibility, as e.g. for compensation of missing sales or for the loss of data and programs, is hereby denied.

2. Graphik presentation and keyboard

2.1 HW 90196 frontal view

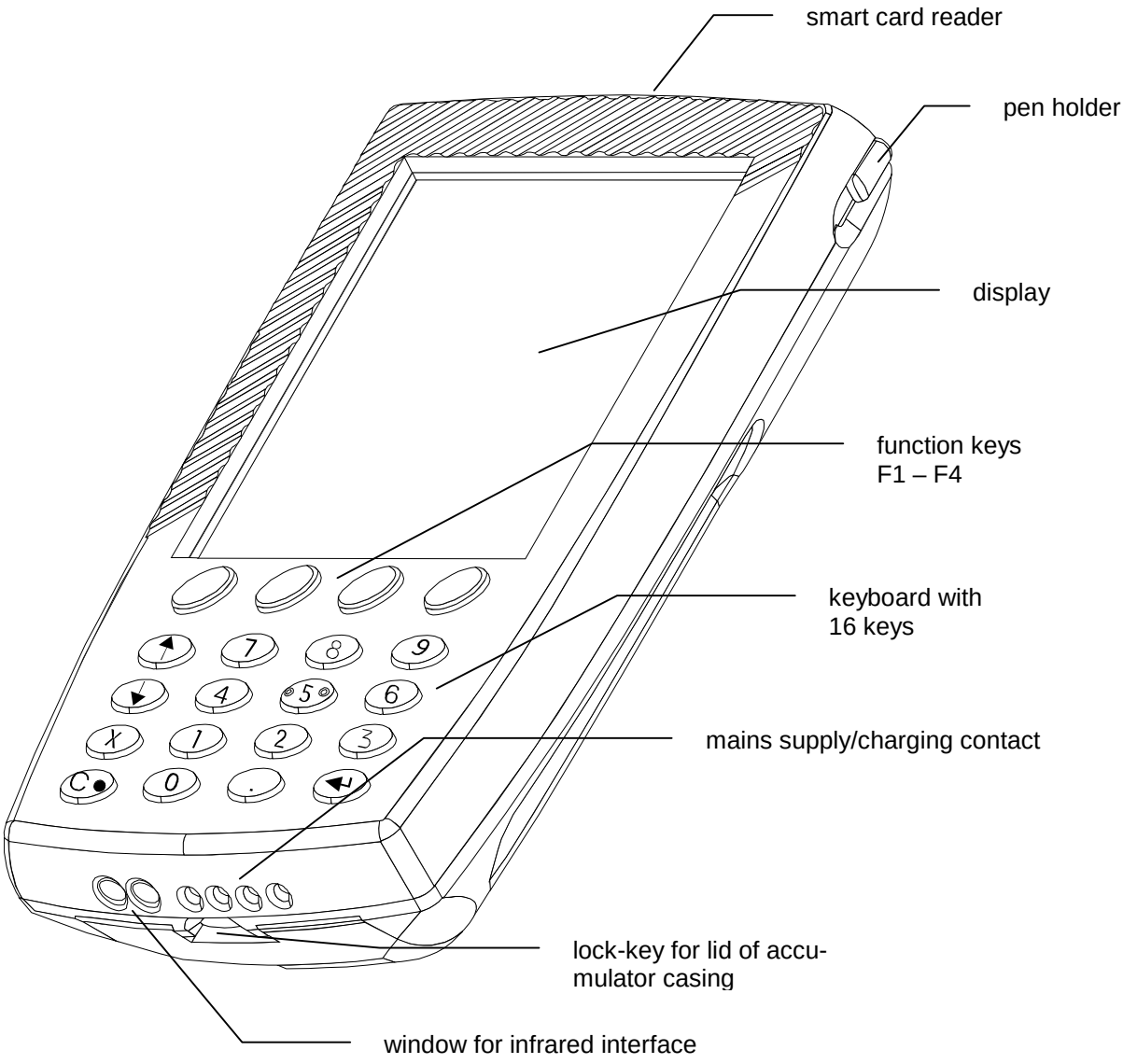


fig. 1: HW 90196, frontal view

2.2 Keyboard functions

Key	*Function*
	Switch on/off device Corrections (delete of last character)
	Numerical keys for numerical inputs.
	Decimal point inputs.
	Scroll key downward.
	Scroll key upward.
	Close data input.

Function keys

Below the display you find – in addition to the key board further down – function keys. Those help in conjunction with relevant display messages to carry out program tasks faster.

Function keys below display, from left to right

Key	*Program part*	*Function*
F1	For operating system:* For application program:**	No Optional assignment
F2	For operating system:* For application program:**	End Optional assignment
F3	For operating system:* For application program:**	Delete Optional assignment
F4	For operating system:* For application program:**	Yes Optional assignment

***Operating system**: The operating system controls assignment and use of hardware resources, e.g. internal memory, processing time, data carrier location and peripheral devices.
****Application program:** The application program supports the user while processing certain tasks.

2.2.1 Switch on/off HW 90196

Switch on/off HW 90196 with this key 

.

After approx. 30 seconds HW 90196 switches off **automatically** (to sleep mode), if processor is not running operations, e.g. data transmissions. Any short key stroke will switch it back on. The program can be continued from any point where it has been interrupted.

To switch off terminal press 

for a while. If not pressed long enough second function will be activated.
The period of time before automatic switch off of HW 90196 kann be changed in the application program.

2.2.2 KEYBOARD-CLICK-function (keyboard beep) during standard mode

Any keyboard stroke will be answered by an acoustic beep signal.
If a key pushed in this program part is permitted you will hear a short soft beep for the keyboard click.
If a key pushed in this program part in not permitted you will hear a long loud beep as a warning signal.
Also a warning signal can be generated as acoustical support of messages and error warnings indicated in the display.

Keyboard click and acoustic warning signals can be modified with the application program.

If charging voltage of accumulator drops below permitted values, no warning signal will be generated.

3. Technical data

3.1 Hardware

Casing:	Robust casing made of 100% reusable ABS-plastic, with integrated ring for shoulder strap.
Dimensions:	L 156 mm, W 83 mm, H 35,5 mm.
Weight:	approx. 337 g (without accu block), less than 400 g (with accu block).
Strengthening:	Lateral grip edges.
Electronic pen for touch function:	pen holder located top right on side of display
Processor:	Motorola MC 68328 „Dragonball“, 16,58 MHz.
Operating system:	HW-DOS.
Programming:	Choice of different languages (Assembler, High Level Languages C and C++, ...).
Memory:	Internal memory 1 MB S-RAM, can be apported into 512 kB TPA and 512 kB RAM-disk. Flash: 1 MB, alternatively equipped with 2 MB.
Display:	Analog-resistive touch sensitive film. Graphics type with 240 x 320 points , ¼ VGA Supertwist. LED-background lighting. Contrast adjustment via software. Dimensions: Module size 70,1 x 92,1 x 9,0 mm LxWxH. Actual displayed size 60,6 x 79,8 mm. Dot Size 0,225 x 0,225 mm. Dot Distance 0,24 x 0,24 mm.
Keyboard:	Elastomer sheeting with 4 x 4 keys. 4 freely programmable function keys below display. Backlighting (soft keys excluded).
Power supply:	Via separate NiCd-accu block HW 19196 (3,6 V). Working time: approx. 1000 re-charging cycles.
Data security:	Data safeguard of current program state (e.g. during change of accu pack) in internal memory for 2 min. with gold-cap capacitor.
radio module:	HW 86020; integrated in casing.

Antenna	Wire antenna λ/4, omnidirectional, integrated in casing.
Frequency range	2.03 – 2.480 GHz
Communication	According to FCC part 15; Uses frequency hopping; Propritary protocol;
Radio data rate	24 kbps.
Range	In obstacle-free open areas upto 300 m, less in buildings, depending on conditions.
Connections	Serial 3,3 V interface, incl. status lines.
Power supply	Via terminal unit.

Read/Write unit for smart cards:	• Plug-in reader in accordance with ISO 7816, FCI 7312 E 0225 S01, SMD (at top of device). • 2 plug-in places for 2 dealer cards in ID-000 format (under accu block).
Interfaces:	Infrared interface,Type S-IR, 115 kBit/s, to base station (lower edge); Internal hidden12-pole contact pads
Temperature range:	Working temperature 0° to +40°C; Storager temperature -20° to +60° C.
Humidity:	Up to 95 % (not condensing).
Auxiliary equipment:	Programmable acoustic beeper. Reset key in accu casing.

3.2 Software

Power management:	For optimal use of power resources with automatic cutoff function, warning indication in case off low charged accumulator and emergency stop trigger in case of slow or abrupt fall of minimum power supply voltage.
Configuration possibilities:	Time to switch to sleep mode for electronical system and radio module. Display lighting time, beepmode keyclick on/off, malfunction beep on/off.
Bootstrap loader:	BIOS via IR interface loadable.

3.3 Block diagram

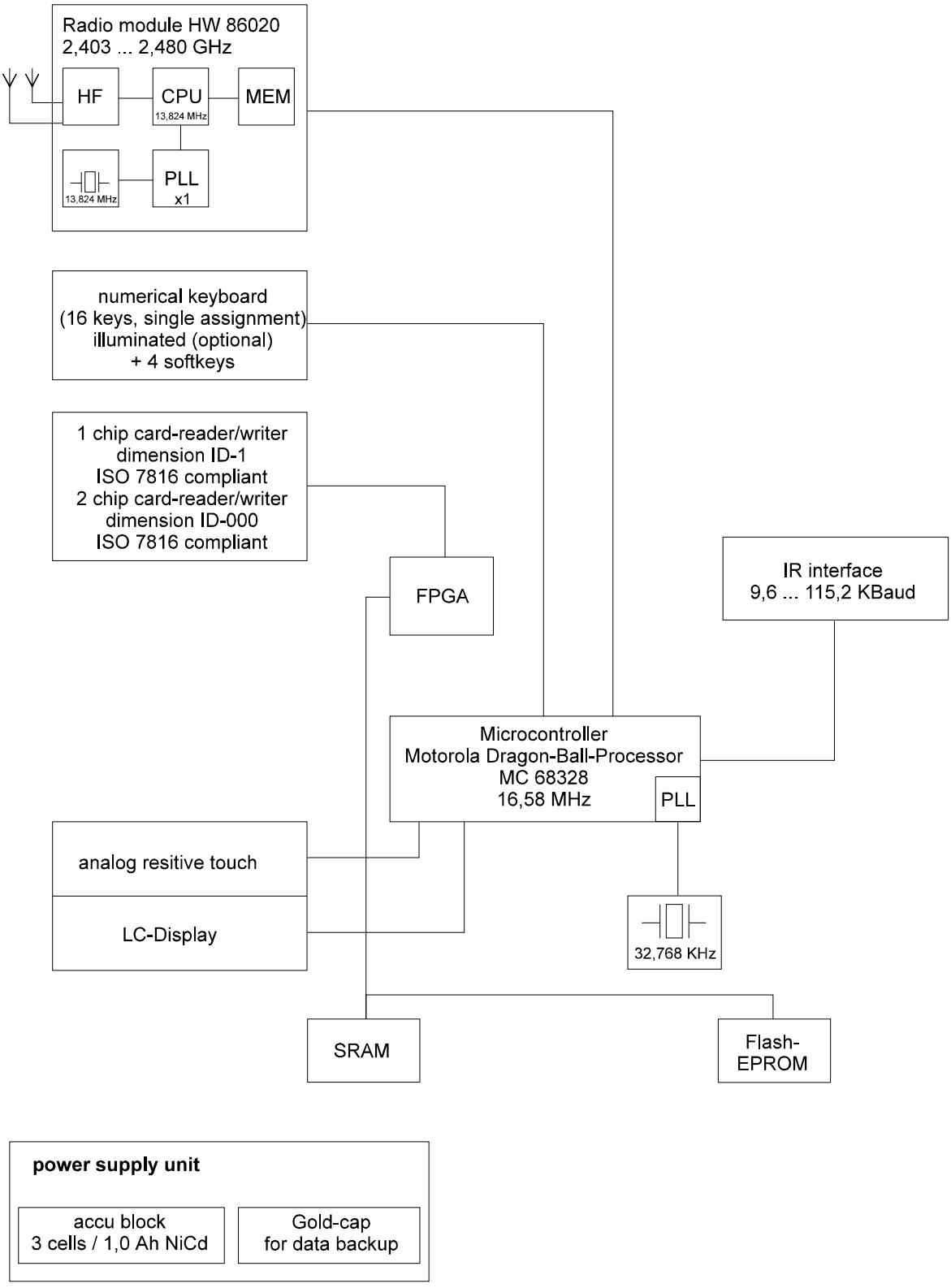


fig. 2: HW 90196, Block diagram

3.4 Power consumption

Following table shows an approximate overview of power consumption of mobile terminal HW 90196 at different operating states (BIOS terminal:‘09905, firmware radio module: #09907). The measured values during operation depend on the current accumulator voltage. The measurement has been taken with an accumulator voltage at 3,8 V while discharged accus provoke higher currents. The operating status of the radio module has a significant influence of the overall power consumption of terminal HW 90196. In particular, if the terminal is switched off or outside radio frequency range (see No. 8, 12, 6, 4, 2), programming should meet these conditions, e.g. by switch off with bios_sleep() (see No. 13) after time out. Also, if no optical warning can be indicated on switched off display of terminal (see No. 11 & 12) and radio connection is still running after a time out, the terminal should be completely switched off by bios_sleep() (see No. 13).

No.	CPU	Displ.light	Key light	Radio module	Display	Power cons. in mA
1	on	on	on	on/ conn.	on	190
2	on	on	on	on / no conn.	on	225
3	on	on	off	on / conn.	on	135
4	on	on	off	on / no conn.	on	170
5	on	off	off	on / conn.	on	125
6	on	off	off	on / no conn.	on	160
7	doze	off	off	on / conn.	on	95
8	doze	off	off	on / no conn.	on	130
9	doze	off	off	sleep / conn.	on	50
10	doze	off	off	sleep / no conn.	on	130
11	doze	off	off	sleep / conn.	off	25
12	doze	off	off	sleep / no conn.	off	105
13						
13	sleep	off	off	off	off	0,5

4. Power supply of HW 90196 with accu block HW 19196

The power supply of HW 90196 is realised by an accu block which is inserted in the device.

The accu block HW 19196 consists of a module of 3 NiCd-cells with a total capacity of 1000 mAh.

The accu block HW 19196 has been specifically designed for use in the HW 90196. Contacting is realised by two high-current contacts which are sunk in sockets to avoid unintentional short-circuits.

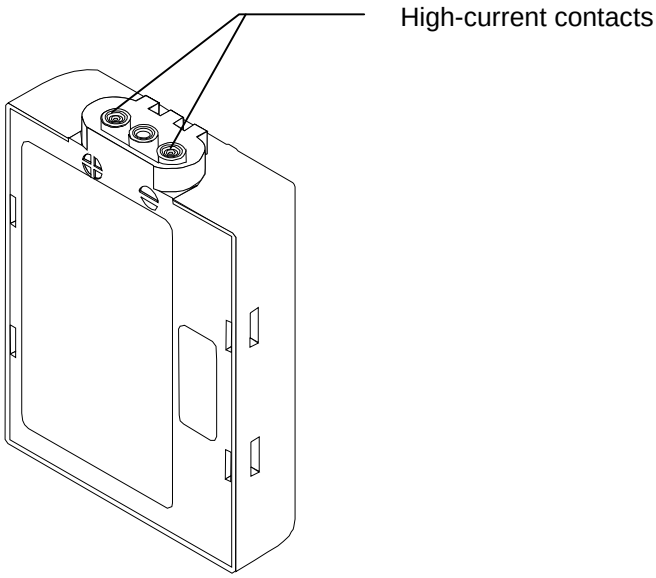


fig. 3: HW 19196, frontal view

4.1 Technical data

Type:	Separate ABS-plastic casing (Snap-In technique) with NiCd-accus; 3 cells, each 1,2 V.
Dimensions:	L approx.64 mm, W approx. 47 mm.
Weight:	Approx. 76 g.
Nominal capacity:	1.000 mAh
Working life:	approx. 1000 re-charging cycles.
Safety features:	Sunk-in contacts against short-circuits.
Contacts:	2 high-current contacts. Optional 3rd contact for charging condition monitoring via HW 90196. Spring mounted design in plastic inset, self-centering form

4.2 Charging condition of accu block

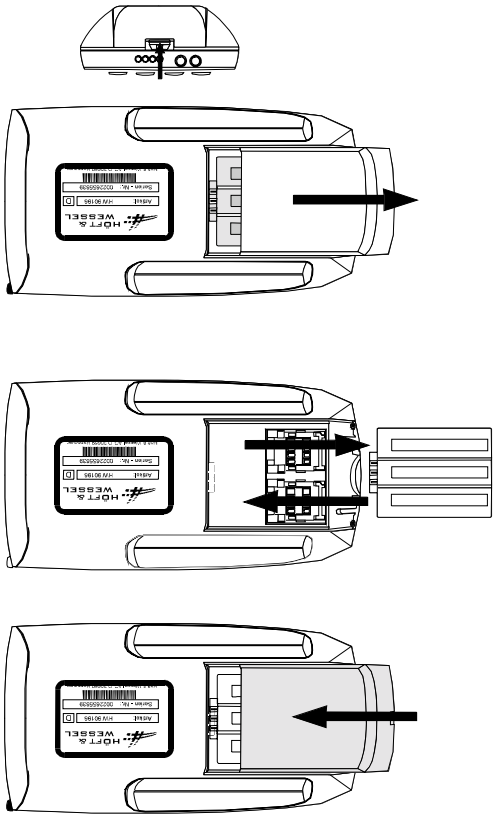
The loading capacity of accu block should always be used to full extend. Keep HW 90196 in operation until the message „attention! Recharge batteries!!!“ is indicated in the display. After this the device can still be used for a while, however only essential inputs should be entered and the accu block be re-charged afterwards.

If the accumulator voltage drops below a permitted value, the device switches off automatically. After switch on display indicates „emergency cutout! check accu!!!“.

Accu block can be recharged in accu charging unit HW 16196 (see sec. **Fehler! Verweisquelle konnte nicht gefunden werden.**) or in communication station HW 50196.

4.3 Replacing the accu block in HW 90196

Following steps are required to change the accu block in HW 90196:



1. **Switch off** HW 90196 with key C and turn device on rear side.
2. Push locking button of accu casing towards top and remove lid of accu casing.

3. Remove accu block.
4. Insert new accu block (reverse battery protection-no vice versa insertion possible),

5. Replace accu casing lid and close.

fig. 4: Replacin accu block of HW 90196

General: It is **not recommended** to pull out accu block while HW 90196 is still switched on. Operating states that lead to a system crash after restart of the device might appear.

IMPORTANT!

Swich off device before taking out accu block!

Taking out the accu block during an accounting operation with the customers smart card inserted might destroy the smart card!

4.4 Maintenance of accu block

If accu blocks are stored, they should be re-charged on a regular basis. After a period of 6-8 weeks, even a new accu block is discharged to such an extent due to self-discharge that it is no longer possible to operate a HW 90196 with it.

About how to store device and accu block see also 1.1 „Important comments for application“.

IMPORTANT!

A stored MDE which is not used, has to be recharged *once per month.*

The maintenance and service of such accus which have not been used for a longer period may be executed by the Höft & Wessels service department. For further information, please contact our service line : Tel. (0049) 01803/ 23 28 29

As for maintenance of the accu block, the following points should be taken into account:

Good:
- Daily use of the accu block
- Total use of capacity (discharge) until display shows "attention! - recharge batteries!!!"
- Re-charging with charging unit HW 16196 or communication station HW 50196

Bad:
- Occasional use of accu block
- Heat impact (increased self-discharging)
- Frost impact

Very bad:
- Total discharging
- Humidity; aggressive gaseous substances, which increase corrosion of contacts
- Storage with temperatures lower than -20°C
- Charging with temperatures lower than 0°C

4.5 Disposal of used accus

"NiCd-accu cells contain between 15 and 20 % highly toxic cadmium."
(Source: test 12/88 p. 1175)

Used accu cells must under no circumstances be disposed with common household waste, as the contained cadmium will result in heavy pollution of environment.

All used accu cells have to be disposed of in an appropriate way. For this purpose, they have to be returned to Höft & Wessels. As a part of its normal service, Höft & Wessels guarantees that all used accu cells are fed to the recycling process.

The return of the accu cells ensures 100% reuse of the chemicals contained. This recycling process avoids any impact to the environment.

See also extract from BattV - 01.10.1998:
"The manufacturers are obliged to take back and reuse toxic containing batteries according to the regulations and dispose of non-reusable batteries that have been handed in by distributors (§5) or public disposal departments (§9).“

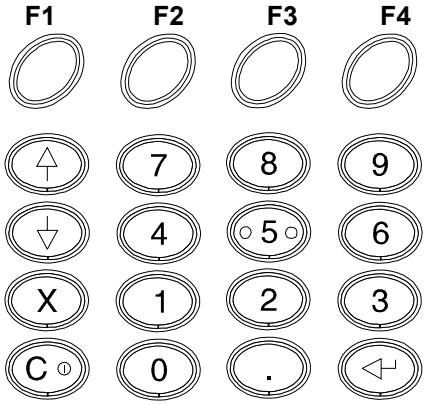
5. Operating system

Preface

Those functions which are explained in this chapter are installed as standard features in the operating system of the HW 90196 and are independent of the type of application program. The user will usually not have to deal with the operating system, as during normal operation only the displays of the application program are presented. These are explained in detail in the corresponding documentation of the application program.
For special purposes it may however be useful that the responsible support person of the HW 90196 uses the functions of the operating system explained in the following. Note that by means of the functions given below, individual data as well as complete programs may be deleted!

Function key layout for operating system level:

Function keys



Funktion:

F1	F2	F3	F4
NO	**END**	**DELETE**	**YES**

```
    - HW 90196 -

12345678901234567890
```

The font used in the operating system presents text in the graphics display in 20 lines with 20 characters each.

Graphics type with 240 x 320 points.

```
    - HW 90196 -
```

The messages of the operating system do not use the complete space of 20 lines. Therefore, in the following, the displays are represented without lower frame, in order to emphasise that the display presentation is actually bigger in reality.

5.1 Operating system-basic menu

300

```
    - HW 90196 -
```

8	→ 320 (system-Info)
9	→ 326 (checking RAM-/FLASH-Disk)
	→ 327 (checking RAM-/FLASH-Disk)
↲ (Entry)	→ 305 (if no application programm is existing)
	→ 310 (if program is already existing)
0	→ 302 (choose language)

additional inputs:

6 0 12 0 52	→	(format Flash-Disk, see 5.4)
3 0 1 4 1 5 9 0	→	(auxiliary program for user, e.g. setting of accu charging condition, radio module configuration and -update, ...)

After having pressed the **9**-key, the system starts to check its disks. If no errors are detected on the disks, the device executes a warm-start. By pressing the **C**-key, the basic menu of the operating system is called again.

326

```
    - HW 90196 -
Checkdisk B: OK
File system B: OK
WBoot -> C
```

C	→ 300 (Operating system-basic menu)

The HW 90196 presents the following display, if an error has been detected on one of its disks:

327

```
    - HW 90196 -

Checkdisk B: Error
F-CBoot ! -> C
```

The application program has to be deleted in order to avoid non-defined program conditions and has to be downloaded again in order to take the HW 90196 back into operation.

302

```
Select Language
1=D  2=GB
```

↵ (Entry) or **F2** (End) → 300
1 → 300 (German language chosen)
2 → 300 (English language chosen)

With language selected „2=GB“ system messages will be presented in english. English will be set as a standard settting after a reset. The language set by the user remains after a warm start. This is also the case after an update with a german language BIOS version as the preset language remains until further reset or change through the current user.

305

```
load program ?
No              Yes
```

Is only presented, if no application program has been downloaded

F4 (Yes) → 400 (PC-connection via infrared syst. interface)
F1 (No) → 315

310

```
start program ?
No              Yes
```

Is only presented, if an application program has been downloaded

F4 (Yes) → Start of application program
F1 (No) → 305

315

```
Fildtransfer
from PDE ?
No              Yes
```

F4 (Yes) → MDE MDE-connection
F1 (No) → 300

5.1.1 System-info-display

320

```
SSSSSSSS----NNNNNNNN
EEEE-XXXX-YYYY-VV.VV
FLASH:nn RRRR DDDD
BOOTLDR:  BBBBB

 TT.MM.JJ    HH:MM
```

8 → 300 (back to system menu)

SSSSSSSS	= Customer-specific start set
NNNNNNNN	= Serial number of the HW 90196 (identical with number indicated on type plate)
EEEE	= Customer-specific EPROM-No. (Höft & Wessel internal).
XXXX	= Size of working storage (hex).
YYYY	= Storage capacity of RAM-Disk (hex).
VV.VV	= Version-No. of the operating system
nn	= Number of Flash-Chips.
RRRR	= Storage capacity (Flash) (hex) for the system
DDDD	= Storage capacity of Flash-Disk (hex).
BBBBB	= Customer-specific Bootloader-No. (Höft & Wessel internal).
TT.MM.JJJJ HH:MM	= Date/time on system watch

If the MDE is inserted in the communication station HW 50196, system-info-display (320) is followed by a presentation of the EPROM-No. of the communication station.

321

```
KOM-Station
H&W EPROMNR=XXXXX
TT.MM.JJJJ
```

5.2 Warm start

A warm start is the complete initialization of hard- and software.
After a warm start (message: `Ws ! -> C`) an application program will be started automatically, if an autostart file with any name and the extension „AST“ has been generated beforehand on the disk. This automatic restart process can be supressed by **not** activating „C“ but the „F1“-key followed by keys „2071828“. After this, the functions of the operating system-basic menu can be used.

450

```
WBoot ! -> C
```

C	→ 300 (System menu)
or	→ Start of application program (if an autostart file has been generated beforehand)
F1, “2.71828“	→ 300 Suppress autostart

5.3 Reset

A reset means the most profound level to process an initialization of hard- and software. The reset provokes an **abandonment** of the running application programm at any given position. To proceed, the reset-key in the accumulator compartment may be activated. Note that the accumulator block should only be removed if the HW 90196 is switched off, as otherwise files could be damaged during running write operations.

If an application program is stored on the Flash-Disk, it will be started automatically after a reset with the stored file and extension „AST“ without needing further instructions of user. The automatic start of the application program after reset can be suppressed by activating a combination of keys as followed: press at same time: „F1+F4+0“. Only in this case the operating system will check the Flash-Disk.
The following message „`Ws ! -> C`“ must *not* be confirmed with the ‚C‘-key as otherwise the application program will be automatically started (see chap. above 5.2).

In order to initiate a reset, proceed as follows:

1. Take out the accu block **(with switched off HW 90196)**.
2. Press the reset-key which is located under the accu block and above the sticker (see also fig 17, p. 52).

   Do press the reset-key carefully, with low expenditure of force. You may want to use a bend up paper clip, e.g..

3. Insert the accu block. The HW 90196 is automatically switched on again.

5.4 Format FLASH-Disk

Note!

The procedures described in this chapter will delete all data and programs on the HW 90196 and should thus be executed only in emergency cases!

The FLASH-disk in the HW 90196 is administered as a virtual hard disk. In order to delete all files on a disk, it has to be formated anew just as a floppy or a HD.

The process starts with the following display:

300

```
    - HW 90196 -
```

For a correctly entered code → 375
(do not press the enter-key)

The following code has to be entered:
" **6 0 12 0 52** "
The procedure may be repeated starting from display 300, if necessary.

375

```
format flashdisk?
```

For a correctly entered code → 380
any key → 300 system menu

The following code has to be entered:
" **3 0 1 4 1 5 9 0** "
Any other key will cancel the process while the system goes back to menu 300.

380

```
formatting
disk B:
```

automatically
→ 385

The progress of the action is indicated by a rotating bar (*).

385

```
formatting
completed -> C
```

C → 300 system menu

After confirmation with the **C**-key in display 385 the FLASH-disk has been formatted succesfully.

5.5 Radio module configuration menu (DECT-menu)

5.5.1 Terminal

```
    - HW 90196 -
```

Enter the code "30141590" from the basic state of the operating system.

```
->DECT menu
  Printer menu
  END
```

Select „DECT-menu“ with arrow keys.

Enter (↵) for confirmation.

```
->DECT serial no.
  Offline Sub. SK
  Oflline Sub SMK
  Air Subscription
  Defaults
  Firmware
  Download
  END
```

Menu levels of DECT -menu

Select with arrow keys and enter (↵) for confirmation.

5.5.2 Functions

All avaible functions, their expressions, display indications and commands that will be transmitted to the radio module within the configuration mode, will be explained in the following. These functions are also selected by the enter- and arrow-keys. Due to the changed format of the commands all functions are classified as new and old firmware. The radio module firmware version will be determinded before transmission of a command.
These functions prove to be advantageous as they enable a configuration of the radiio module without having loaded an application program beforehand and thus an application program can later be duplicated onto the Flash-disk via radio connection. Even in the case of an unintentional delete of the application program at the customers place, the terminal does not need to be sent to the service department.

Radion module serial number

Determination and indication of radio module no. of PT-radio-modules.

Sent commands	Display	Possible error message	Remarks
GNDNR	N-number: <NO>	radio module does not respond	
			End with any key

Offline-Subscribtion SK

Proceeds offline-subscribing, requires entering of radio module no., PIN and PAK of radio terminal

Sent commands	Display	Possible error messages	Remarks
	Enter N-number of remote station:		Stop with F2-key, delete with C-key
	Enter PIN:		Stop with F2-key, delete with C-key
	Enter PAK:		Stop with F2-key, delete with C-key
DISUB ALL			
SISUB322, <NO>, <PIN>, <PAK>	Subscription executed	Subscription failed	
			End with any key

Offline-Subscription with SubscriptionMasterKey / SMK:

Proceeds offline-subcription, requires entering of radio module no., PIN and SMK of FT.

Sent commands	Display	Possible error messages	Remarks
	Enter radio module serial number of re-mote station:		Stop with F2-key, delete with C-key
	Enter PIN:		Stop with F2-key, delete with C-key
	Enter SMK:		Stop with F2-key, delete with C-key
DISUB ALL			
SISUM322, <NO>, <PIN>, <SMK>	Subscription executed	Subscription failed	
			End with any key

On-Air-Subscription:

Logs PT on FT, requires entering of PARK and PIN, entries can be deleted with F2-key, FT must be in online-subscription mode.

Sent commands	Display	Possible error messages	Remarks
	Enter PARK:		Stop with F2-key, delete with C-key
	Enter PIN:		Stop with F2-key, delete with C-key
DISUB ALL			
SISUA <PARK>, <PIN>	Subscription executed	Subscription failed	
			End with any key

Standard settings

Resets radio module to standard settings.

Sent commands	Display	Possible error messages	Remarks
SPBD115200			
SPTM PT			
SPPR OFF			
SPCTR OFF			
SPCCN 1			
SPINI 0	Setting of standard settings successful!	Setting of standard settings failed!	

Firmware:

Displays of radio module firmware. The user test menu contains DECT in a submenu with the function „firmware“ and a notice about the version number and the manufacturer date of the radio module firmware.

Download:

Download of the radio modules with new firmware, the files root.pp and root.bin have to be generated on the Flash-disk beforehand.
This function does not refer to the mobile printer HW 90195.

5.5.3 Printer

```
    - HW 90196 -
```

Enter the code "30141590" from the basic state of the operating system.

```
  DECT menu
->Printer menu
  END
```

Select „Printer menu“ with arrrow keys.

Enter (↵) for confirmation.

```
->DECT serial no
  Offline Sub. SK
  Oflline Sub SMK
  Air Subscription
  Defaults
  Firmware
  END
```

Menu levels DECT-menu Printer

Select with arrow keys and enter (↵) for confirmation.

The DECT-menu for the printer is, concerning its functions, equal to the one for the HW 90196. The DECT-menu for the terminal additionally contains the menu level „download“.

To configure the radio module in the printer the terminal and the printer have to be aligned with their infrared interfaces on the bottom sides of the devices towards each other. The printer must be in IR mode (see also chapt. 6.6). Stray light influences, e.g. by fluorescent lamps, should be avoided, if possible.

5.6 Connection to a PC

The HW 90196 is able to communicate with a PC via the infrared-system interface or the integrated radio module.
A communcation station HW 50196 is employed for communication via the infrared-system interface. It can be connected directly with a PC (H&W-cable 63) or contact can be established via a modem connection. The modem can alternatively to cable 63 be connected to the communication station.

The connection between HW 90196 and PC (display 400) is established starting from the operating system (display 304, „load program“?).

400

```
load program
via modem ?

No              Yes
```

F4 (Yes) → 405
F1 (No) → 420

If the connection has once been established, it is possible to send or recieve data. This process is monitored and controlled by the PC.The HW 90196 operates in the server mode, i.e. it reacts only to commands of the PC and the F2 (End)-key.

The connection to the PC is only terminated by a command of the PC, by pressing the F2(End)-key on the HW 90196 or because of a time-out, if it was not possible to establish the connection or if the connection hab been interrupted.

405

```
Phone-Nr./Receiver:
```

↵ (Entry) → 410 (Blank entry; MDE switches to call-off mode)
F2 (End) → 300 (system menu)
Entry of a phone number terminated by
↵ (Entry) → 410 (call MDE)

410

```
dial up...
```

F2 (End) → 450 (Warm start)
after 60 s time-out → 450 (- “ -)
Connect established → 415

415

```
PC-connection
PDE is waiting
```

F2 (End)
or controlled by the PC → 450
Cancel by time-out → 450

The display 415 is only presented, if the HW 90196 has been inserted in the communication station. Else the communication program is aborted.

420

```
load program
from PC via IrDA ?

No               Yes
```

F1 (No) → 425
F4 (Yes) → 415

425

```
load program
from PC via DECT ?

No               Yes
```

F1 (No) → 315 (p. 22)
F4 (Yes) → 415

450

```
WBoot ! -> C
```

C → 300 (system menu)
or → Start of the application program (if an autostart-file is existing.)

A warm start is executed on the HW 90196 after having terminated the connection. By pressing the **C**-key the operating system opens up again. The application program is automatically started up again, if an auto-start file and an application program is existing.

If the connection to the PC has been established manually starting from the operating system (display 300), it is necessary to confirm display 415 by pressing the **C**-key.

Cancel the connection
The HW 90196 executes a warm start (display 450), if the communication has been interrupted by pressing the **F2** (End)-key.

5.7 Error messages of the operating system

Major messages of the operating system, which are given out as a result of exceptional situations, may only be deleted by pressing the **C**-key. Thus, these messages contain the additional information:

"-> **C**"

All other messages, which are presented in the display, may be deleted by pressing any key. It is however recommended to write down the presented message in order to be able to inform the Höft&Wessel service line. These data may faciliate trouble-shooting and error elimination tremendously.

Power supply

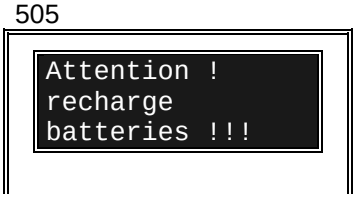
500

Empty display, device has been switched off.

The device has to be switched on by pressing the C -key. If the display is still not presented, then the voltage of the accu is lower than necessary for operating the device. Switch off HW 90196 and change the accu block or insert HW 90196 in the communication station or in the accu charging station 16196.

If the HW 90196 still does not react, the error may have different causes. These have to be detected by the Höft&Wessel-service. For this reason, the device has to be sent to Höft&Wessel.

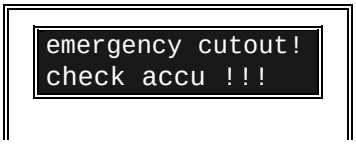
505



The chargemeter detected a too low accu voltage. The voltage of the accu is checked with every key stroke. If a certain value is exceeded, this message is given out for app. 2 seconds.

It is recommended to insert a re-charged accu block immediately or to insert the HW 90196 in the communication station HW 50196 or in the accu charging station HW 16196.
It is however possible to suppress this message by the application program.

515



The message in display 515 is presented for several seconds after a forced switch-off, initiated by a too far discharged accu block.
It is however possible to suppress this message by the application program.

6. Printer HW 90195

The mobile printer HW 90195 has been specifically designed for use with POS terminal HW 90196. The connection to the terminal is established via radio transmission. The printer is powered by an individual high-performance power supply. Also a belt fastening facility is provided. The Easy Paper Load Technology for fast changing of the paper reel has been applied.

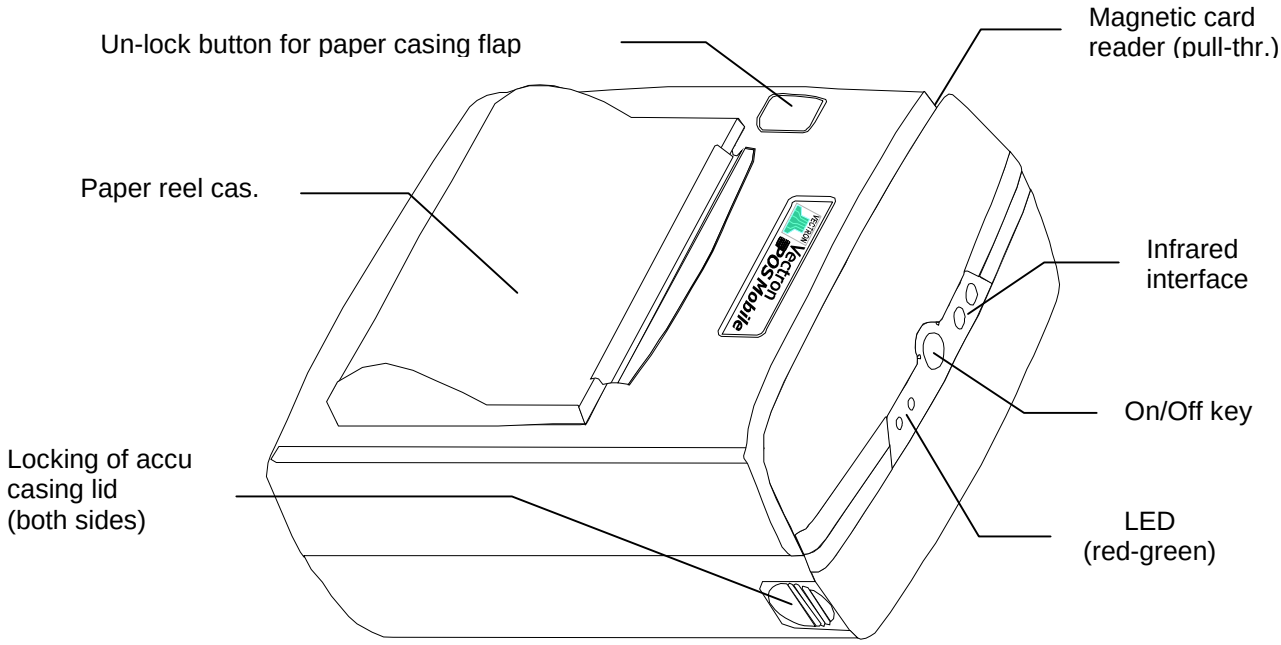


fig. 5: HW 90195, frontal view

6.1 Technical data

6.1.1 Hardware

Casing:	Robust ABS-plastic casing with fastening facilities for belt	
Dimensions:	L 133 mm, W 98 mm, H 64 mm.	
Weight:	Ca. 446 g incl. rechargable battery, ca. 280 g without battery.	
On/Off switch:	Key design.	
Printing unit:	High-speed thermal printer, fixed thermal head, Easy Paper Load Technology, Loosening of fricitional drum with lever mechanism.	
Printing speed:	Up to 27 mm/s.	
Width of paper:	58 mm +0 / -1 mm.	
Actual width of print:	48 mm.	
Paper cutting:	Stainless blade with saw tooth.	
Paper control:	Detects end of paper.	
Optical indication:	1 red LED and 1 green LED on operational frontside.	
Power supply:	With NiCd battery block HW 19195 Separate battery block with 5 x 1,2 V cells, 1100 mAh each	
Working time:	At full operation: ca. 8 h. Switch off after operation.	
Interface IR:	1 infrared interface, 56,7 kBit/s (top side).	
Radio module:	HW 86020 , integrated in casing.	
	Antenna	Wire antenna λ/4, omnidirectional, integrated in casing.
	Frequency range	2.03 – 2.480 GHz
	Communication	According to FCC part 15; Uses frequency hopping; Propritary protocol;
	Radio data rate	24 kbps.
	Range	In obstacle-free open areas upto 300 m, less in buildings, depending on conditions.
	Connections	Serial 3,3 V interface, incl. status lines.
	Power supply	Via terminal unit.
Magnetic card reader:	Integrated in casing. 3 tracks readable, according to ISO 7811. Type: American Magnetics Type 45D, TRK3, art.no. T17645. Read data of magnetic card are transmitted to terminal via radio transmission.	
Standard paper reel:	30 mm outer diameter. 9 m Length at paper weight < 60 g / m².	

Paper type:	TF50KS-E2C	65 µm (Nippon Paper Industries)
	TP50KJ-R	65 µm
	AP50KS-E	65 µm
	HP220-AB1	65 µm (Mitsubishi Paper)
	PD160R-N	75 µm (Oji Paper)

6.1.2 Software

Instruction set:	Epson Escape-sequencies for POS-printer (subset).
Character set:	Line print, any font type, special characters printable.
	Automatic line break after 24 characters/line at standard font.
Infrared:	IR-protocol, Initialization of radio module via IR-interface.
Radio module features:	Sleep-mode programmable;
	Sleep-mode indication via LED;
	Akku-low indication via LED.

6.1.3 Block diagram

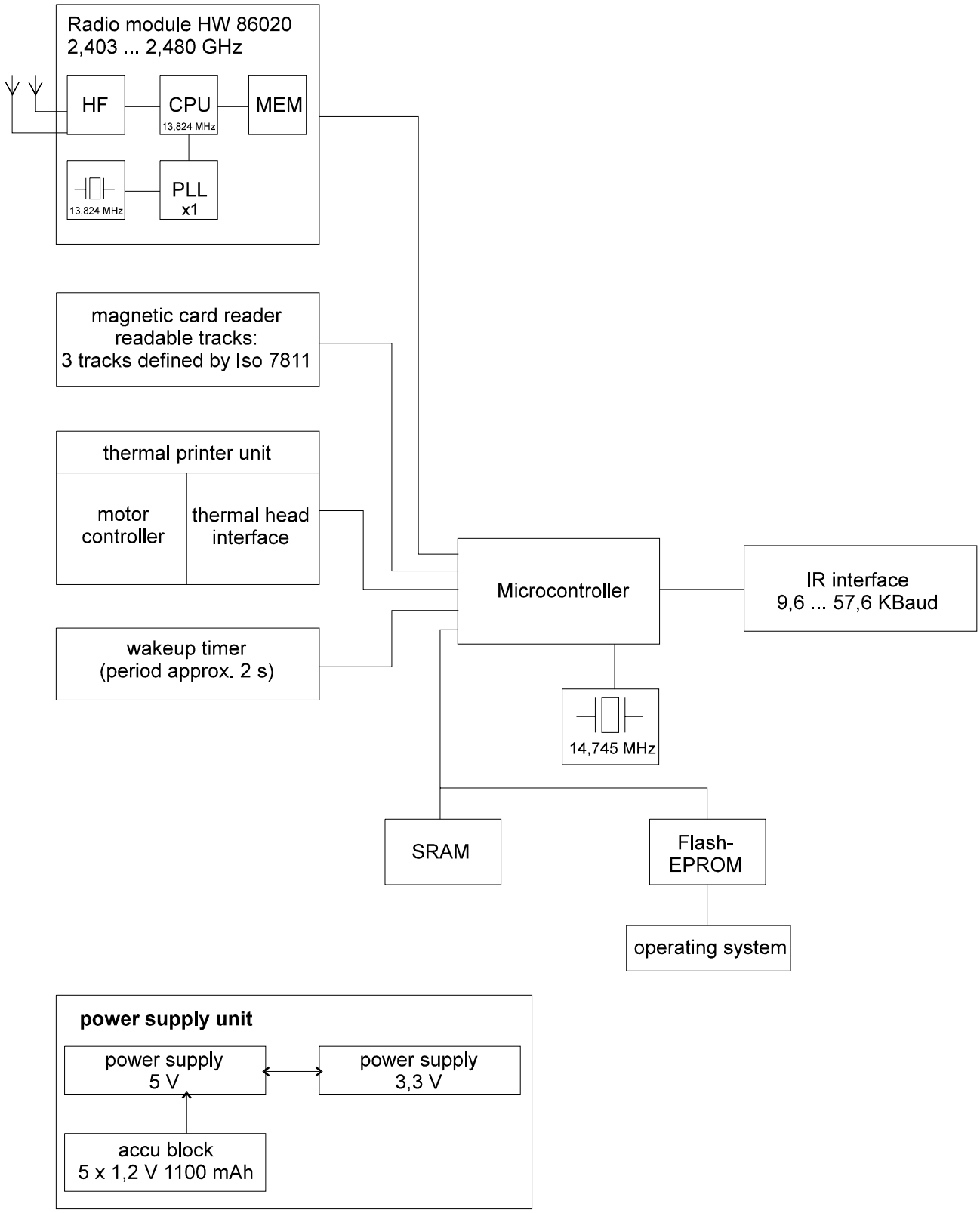


fig. 6: Drucker HW 90196, Block diagram

6.1.4 Power consumption

Following table shows an approximate overview of power consumption of mobile printer HW 90195 at different operating states (BIOS printer #09906, firmware radio module: #09907). The power consumption during printing depends much on the print image. The pulse motor will be supplied with power for 15 seconds after each printout (see 2), holding the printout tight for easy tear off. During this period of time the mobile printer can turn to operating state 5 as a result of a canceled radio connection. If the mobile terminal is switched off or out of radio range, the power consumption will be significantly increased (see 6&4).

No.	CPU	Radio module	Stepping motor	Print line	Power consumption in mA
1	on	on / conn.	Paper forward feed	on	500 ... 3000
2	on	on / conn.	Holding paper	off	300
3	on	on / conn.	off	off	110
4	on	on / no conn.	off	off	150
5	doze	sleep / conn.	off	off	20
6	doze	sleep / no conn.	off	off	100
7	off	off	off	off	0,3

6.2 Functions

6.2.1 Operating modes

On The green LED of the printer is switched on or flashing (depending on charging condition of accu). Printer can be switched off with on/off-key.

Off All LEDs of the printer are switched off. Printer can be switched on with on/off-key. Printer turns to sleep mode immediately after switch on.

Sleep mode The printer turns immediately after switch on from off-mode, resp. after a period of 30 seconds with no radio connection, to sleep mode (green LED flashes every 2 seconds).
The printer can be activated with the on/off-key or via radio by the Base Station. Now the printer is switched on. To activate the printer via radio a signal will be sent to the printer to establish a connection. If the printer turns to the sleep mode because of the 30s-time-out function, the connection will still remain for further activation processing.

Note!

The printer should always be switched off after operation (do not let the printer remain at sleep mode).

If the printer will not be used for a long period of time (> 1 day) , take out accu block.

6.2.2 Function indication LEDs

A list of all LED-combinations will be shown in the following.

The green LED usually indicates the accu charging condition:

- on = „ok“,
- flashing = „low“ oder „discharged“.

The red LED indicates several error conditions:

- off = „ok“,
- on = „no paper“ resp. „open casing flap“,
- flashing = „no radio connection“.

Additionally, the green LED flashes every 2 seconds, if the printer is at sleep mode. Update processes and the inital switch on from „off-mode“ are the exceptions.

Printer mode	**accu charg-ing cond.**	**Status paper/ casing flap**	**Status radio connection**	**green LED**	**red LED**
OFF	-	-	-	aus	off
SLEEP	-	-	-	flash (ca. 0,5Hz)	off
ON	ok	ok	ok	on	off
ON	ok	Error	-	on	on
ON	ok	ok	Error	on	flash (ca. 2Hz)
ON	low / discharg.	ok	ok	flash (ca. 2Hz)	off
ON	low / discharg.	Error	-	flash (ca. 2Hz)	on
ON	low / discharg.	ok	Error	flash (ca. 2Hz)	flash (ca. 2Hz)
Update / trans-mission	-	-	ok	flash (ca. 0,5Hz at block size of 1kByte)	off
Update / pro-gramming	-	-	ok	off	on

Tab. 1: optical indication of printer mode

6.2.3 Acoustic signals

The printer generates acoustic signals during certain operations.

Operation	acoustic signal
Switch on of printer with on/off-key.	Double whistle sound.
Printer turns to sleep mode.	Whistle sound after app. 5 s (radio connection has been interrupted).
radio connection is interrupted.	Whistle sound as error indication.
Printer recieved command to read magnetic card.	Beep sound as request to pull magnetic card through slot of reading unit.
Magnetic card has been pulled through slot of reader unit.	Beep sound after having pulled a magnetic card through slot of reader unit.

6.3 Fonts

6.3.1 Standard font 1

Following table shows an overview of provided font 1 of mobile printer .

HEX	Dez.	ASCII	HEX	Dez.	ASCII	HEX	Dez.	ASCII	HEX	Dez.	ASCII
00	0		20	32	SP	40	64	**@**	60	96	**`**
01	1		21	33	**!**	41	65	**A**	61	97	**a**
02	2		22	34	**“**	42	66	**B**	62	98	**b**
03	3		23	35	**#**	43	67	**C**	63	99	**c**
04	4		24	36	**$**	44	68	**D**	64	100	**d**
05	5		25	37	**%**	45	69	**E**	65	101	**e**
06	6		26	38	**&**	46	70	**F**	66	102	**f**
07	7		27	39	**’**	47	71	**G**	67	103	**g**
08	8		28	40	**(**	48	72	**H**	68	104	**h**
09	9	HT	29	41	**)**	49	73	**I**	69	105	**i**
0A	10	LF	2A	42	*****	4A	74	**J**	6A	106	**j**
0B	11		2B	43	**+**	4B	75	**K**	6B	107	**k**
0C	12		2C	44	**,**	4C	76	**L**	6C	108	**l**
0D	13	CR	2D	45	**-**	4D	77	**M**	6D	109	**m**
0E	14		2E	46	**.**	4E	78	**N**	6E	110	**n**
0F	15		2F	47	**/**	4F	79	**O**	6F	111	**o**
10	16	DLE	30	48	**0**	50	80	**P**	70	112	**p**
11	17	DC1	31	49	**1**	51	81	**Q**	71	113	**q**
12	18	DC2	32	50	**2**	52	82	**R**	72	114	**r**
13	19		33	51	**3**	53	83	**S**	73	115	**s**
14	20		34	52	**4**	54	84	**T**	74	116	**t**
15	21		35	53	**5**	55	85	**U**	75	117	**u**
16	22		36	54	**6**	56	86	**V**	76	118	**v**
17	23		37	55	**7**	57	87	**W**	77	119	**w**
18	24		38	56	**8**	58	88	**X**	78	120	**x**
19	25		39	57	**9**	59	89	**Y**	79	121	**y**
1A	26		3A	58	**:**	5A	90	**Z**	7A	122	**z**
1B	27	ESC	3B	59	**;**	5B	91	**[**	7B	123	**{**
1C	28		3C	60	**<**	5C	92	****	7C	124	
1D	29	GS	3D	61	**=**	5D	93	**]**	7D	125	**}**
1E	30		3E	62	**>**	5E	94	**^**	7E	126	**~**
1F	31		3F	63	**?**	5F	95	**_**	7F	127	

HEX	Dez.	ASCII	HEX	Dez.	ASCII	HEX	Dez.	ASCII	HEX	Dez.	ASCII
80	128		A0	160		C0	192		E0	224	
81	129		A1	161		C1	193	’	E1	225	
82	130		A2	162		C2	194	___	E2	226	
83	131		A3	163	**£**	C3	195	**^**	E3	227	
84	132		A4	164	**¤**	C4	196	**Ä**	E4	228	
85	133		A5	165	**¥**	C5	197	**Å**	E5	229	**å**
86	134		A6	166		C6	198	**Æ**	E6	230	**æ**
87	135		A7	167	**§**	C7	199		E7	231	
88	136		A8	168	”	C8	200		E8	232	
89	137		A9	169	’	C9	201		E9	233	
8A	138		AA	170	”	CA	202	**(SP)**	EA	234	
8B	139		AB	171		CB	203	**,**	EB	235	
8C	140		AC	172		CC	204		EC	236	
8D	141		AD	173		CD	205		ED	237	
8E	142		AE	174		CE	206	**IJ**	EE	238	
8F	143		AF	175		CF	207	**ij**	EF	239	
90	144		B0	176		D0	208		F0	240	
91	145		B1	177		D1	209	**Ň**	F1	241	
92	146		B2	178	**†**	D2	210	**|**	F2	242	
93	147		B3	179		D3	211	**▉**	F3	243	
94	148		B4	180	’	D4	212	**_**	F4	244	
95	149		B5	181	**m**	D5	213		F5	245	
96	150		B6	182		D6	214	**Ö**	F6	246	
97	151		B7	183	**.**	D7	215		F7	247	
98	152		B8	184		D8	216	**Ø**	F8	248	**ø**
99	153		B9	185		D9	217		F9	249	
9A	154		BA	186	”	DA	218		FA	250	
9B	155		BB	187		DB	219		FB	251	
9C	156		BC	188		DC	220	**Ü**	FC	252	
9D	157		BD	189		DD	221		FD	253	
9E	158		BE	190		DE	222		FE	254	
9F	159		BF	191		DF	223	**ß**	FF	255	

6.3.2 Standard font 2

Following table shows an overview of font 2 of mobile printer.

HEX	Dez.	ASCII	HEX	Dez.	ASCII	HEX	Dez.	ASCII	HEX	Dez.	ASCII
00	0		20	32	SP	40	64	**@**	60	96	**`**
01	1		21	33	**!**	41	65	**A**	61	97	**a**
02	2		22	34	**u**	42	66	**B**	62	98	**b**
03	3		23	35	**#**	43	67	**C**	63	99	**c**
04	4		24	36	**$**	44	68	**D**	64	100	**d**
05	5		25	37	**%**	45	69	**E**	65	101	**e**
06	6		26	38	**&**	46	70	**F**	66	102	**f**
07	7		27	39		47	71	**G**	67	103	**g**
08	8		28	40	**(**	48	72	**H**	68	104	**h**
09	9	HT	29	41	**)**	49	73	**I**	69	105	**i**
0A	10	LF	2A	42	*****	4A	74	**J**	6A	106	**j**
0B	11		2B	43	**+**	4B	75	**K**	6B	107	**k**
0C	12		2C	44	**,**	4C	76	**L**	6C	108	**l**
0D	13	CR	2D	45	**-**	4D	77	**M**	6D	109	**m**
0E	14		2E	46	**.**	4E	78	**N**	6E	110	**n**
0F	15		2F	47	**/**	4F	79	**O**	6F	111	**o**
10	16	DLE	30	48	**0**	50	80	**P**	70	112	**p**
11	17	DC1	31	49	**1**	51	81	**Q**	71	113	**q**
12	18	DC2	32	50	**2**	52	82	**R**	72	114	**r**
13	19		33	51	**3**	53	83	**S**	73	115	**s**
14	20		34	52	**4**	54	84	**T**	74	116	**t**
15	21		35	53	**5**	55	85	**U**	75	117	**u**
16	22		36	54	**6**	56	86	**V**	76	118	**v**
17	23		37	55	**7**	57	87	**W**	77	119	**w**
18	24		38	56	**8**	58	88	**X**	78	120	**x**
19	25		39	57	**9**	59	89	**Y**	79	121	**y**
1A	26		3A	58	**:**	5A	90	**Z**	7A	122	**z**
1B	27	ESC	3B	59	**;**	5B	91	**[**	7B	123	**{**
1C	28		3C	60	**<**	5C	92	\	7C	124	
1D	29	GS	3D	61	**=**	5D	93	**]**	7D	125	**}**
1E	30		3E	62	**>**	5E	94	**^**	7E	126	**~**
1F	31		3F	63	**?**	5F	95	**_**	7F	127	

HEX	Dez.	ASCII	HEX	Dez.	ASCII	HEX	Dez.	ASCII	HEX	Dez.	ASCII
80	128		A0	160		C0	192	**À**	E0	224	**à**
81	129		A1	161	**¡**	C1	193	**Á**	E1	225	**á**
82	130		A2	162	**¢**	C2	194	**Â**	E2	226	**â**
83	131		A3	163	**£**	C3	195	**Ã**	E3	227	**ã**
84	132	„	A4	164	**¤**	C4	196	**Ä**	E4	228	**ä**
85	133	**…**	A5	165		C5	197	**Å**	E5	229	**å**
86	134	**†**	A6	166		C6	198	**Æ**	E6	230	**æ**
87	135	**‡**	A7	167	**§**	C7	199	**Ç**	E7	231	**ç**
88	136	**ˆ**	A8	168	**¨**	C8	200	**È**	E8	232	**è**
89	137	**‰**	A9	169	**©**	C9	201	**É**	E9	233	**é**
8A	138		AA	170		CA	202	**Ê**	EA	234	**ê**
8B	139		AB	171	**«**	CB	203	**Ë**	EB	235	**ë**
8C	140	**€**	AC	172	**¬**	CC	204	**Ì**	EC	236	**ì**
8D	141		AD	173	**-**	CD	205	**Í**	ED	237	**í**
8E	142		AE	174	**®**	CE	206	**Î**	EE	238	**î**
8F	143		AF	175	**¯**	CF	207	**Ï**	EF	239	**ï**
90	144		B0	176	**°**	D0	208		F0	240	
91	145	**`**	B1	177	**±**	D1	209	**Ñ**	F1	241	**ñ**
92	146	**'**	B2	178		D2	210	**Ò**	F2	242	**ò**
93	147	**“**	B3	179		D3	211	**Ó**	F3	243	**ó**
94	148	**”**	B4	180		D4	212	**Ô**	F4	244	**ô**
95	149	**•**	B5	181		D5	213	**Õ**	F5	245	**õ**
96	150	**-**	B6	182	**¶**	D6	214	**Ö**	F6	246	**ö**
97	151	**–**	B7	183	**·**	D7	215		F7	247	**÷**
98	152	**~**	B8	184		D8	216	**Ø**	F8	248	**ø**
99	153	**™**	B9	185		D9	217	**Ù**	F9	249	**ù**
9A	154		BA	186		DA	218	**Ú**	FA	250	**ú**
9B	155		BB	187	**»**	DB	219	**Û**	FB	251	**û**
9C	156	**œ**	BC	188		DC	220	**Ü**	FC	252	**ü**
9D	157		BD	189		DD	221		FD	253	
9E	158		BE	190		DE	222		FE	254	
9F	159	**Ÿ**	BF	191	**¿**	DF	223	**ß**	FF	255	**ÿ**

6.4 Test printout

To process a test printout:

1. Switch on printer with on/off-key.
2. Open casing flap.
3. Press on/off-key and continue pressing it .
4. Close casing flap.
5. Release on/off-key.

A test printout with an extract of supported fonts und printable charactes will be printed. Also informations about serial number and BIOS- and bootloader number will be given.

6.5 Printer malfunction

Malfunction	Elimination
Printout is not ejected poperly.	Check, if paper reel has just been inserted. If so, take reel out and insert again.
The HW 90195 stops during printing and shows no more reaction.	The accu block is almost completely discharged and HW 90196 stopped printing. Recharge accu block or insert a recharged accu block.
Printing does not start.	Read messages in display of terminal.
No message about end of paper reel, printing can be continued.	Open flap of paper reel casing. Clean sensor for „paper end“ by blowing out printing unit.
All recieved but not yet printed characters are deleted after interruption of connection, resp. connection establishing, by the radio terminal because of impossible feedback to radio terminal without radio connection.	After establishing a new connection the printout can be repeated.

6.6 Special features of printer

Paper hold:

After printing the last line the printer holds on tight of the printout for 15 seconds by motor power to facilitate the tear off. After this period, resp. if the accu is low, discharged or taken out, the printout needs to be torn off more carefully. It is also programmable that the radio connection is canceled after the printout. The printer then turns to sleep mode.

Establish/Cancel the radio connection:

The printer is activated from sleep mode by a RING-signal of the integrated radio module. The printer awaits the establishing of a connection to the Base Station for the following 30 seconds. If no connection will be established, the printer turns back to sleep mode. After a succesfully established connection the printer awaits either print data or the intentional cancellation of the connection by the Base Station. There is no time-out after the printer has turned to sleep mode.

Infrared-command-mode

The printer turns from sleep mode to infrared-command-mode by pressing the on/off-key. Now the printer can be configured by the terminal and the IR-interfaces of both devices. The IR-mode will be abandoned after a time-out of 30 seconds. By pressing the switch on/off-key during IR-mode the printer is switched off.

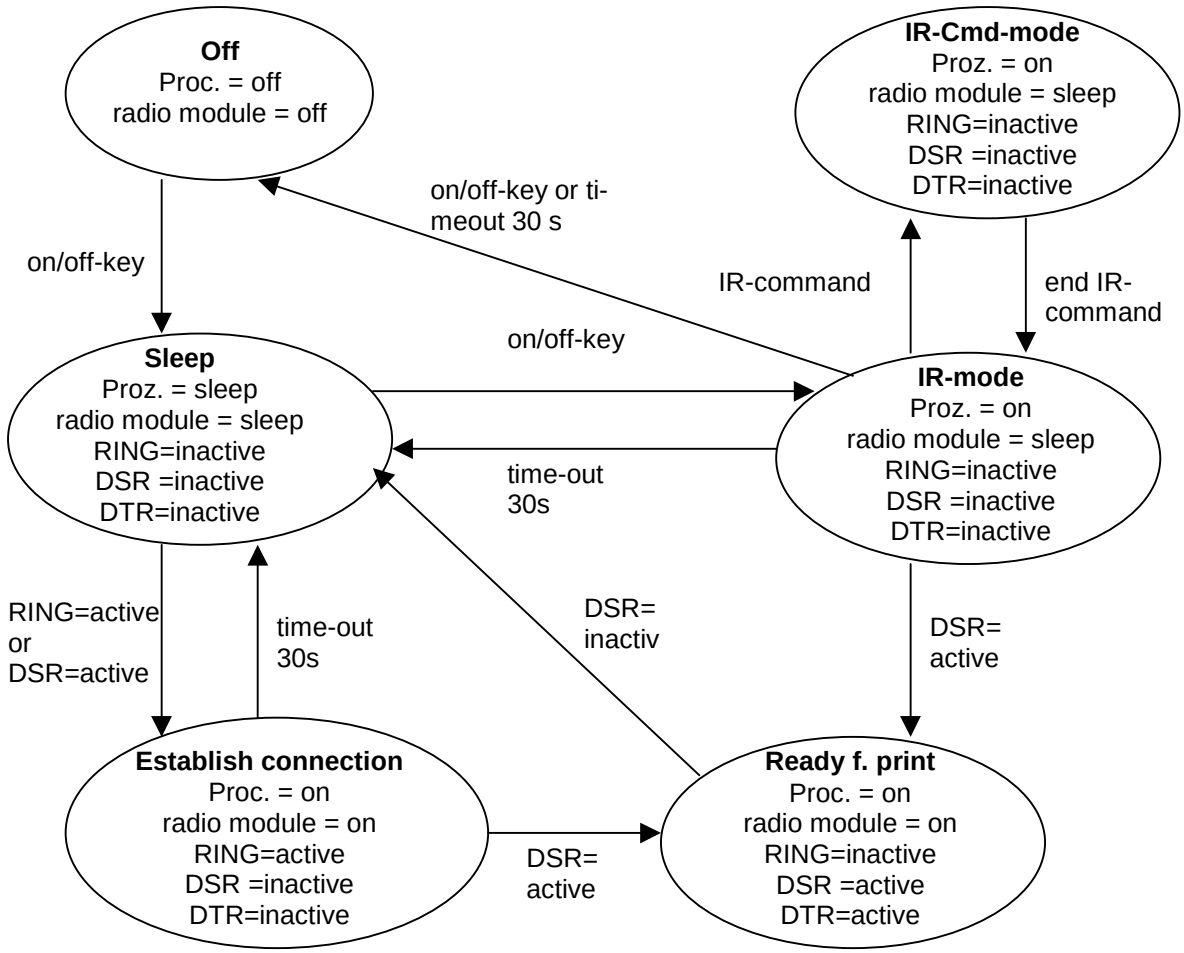
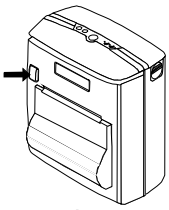
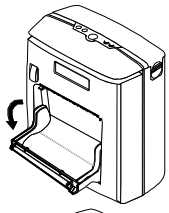


fig. 7: simplified mode diagram of mobile printer

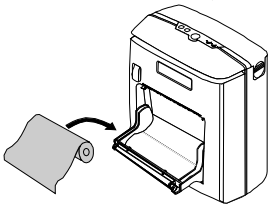
6.7 Changing paper reel of printer



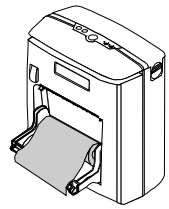
1. Press green key to open casing of paper reel.



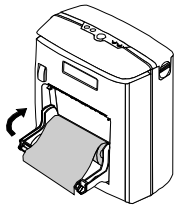
2. Open flap completely.



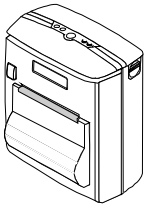
3. Insert paper reel in trough-shaped position.



4. Insert paper reel with ending lapping over flap.



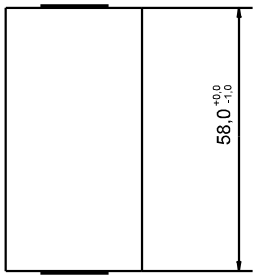
5. Close flap.

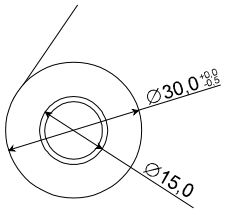


6. Paper reel is inserted properly.

fig. 8: HW 90195, change of paper reel

6.7.1 Comments about the thermopaper





Recommended thermopaper:

TF50KS-E2C	65 µm (Nippon Paper Industries)
TP50KJ-R	65 µm
AP50KS-E	65 µm
HP220-AB1	65 µm (Mitsubishi Paper)
PD160R-N	75 µm (Oji Paper)

fig. 9: Specification of thermopaper

Temperature range:
up to +50 °C

Humidity:
max. 80 % at up to 40 °C

Good:
- Store paper dry and cool.

Bad:
- Long-time exposure to high temperatures (discolouration).
- Sun light impact.
- Chemical impact.
- Humidity.

6.8 Power supply with accu block HW 19195

The power supply for the mobile thermal printer HW 90195 is realised by the accu block HW 19195. Contacting is realised by two high-current contacts which are sunk in sockets to avoid unintentional short-circuits.

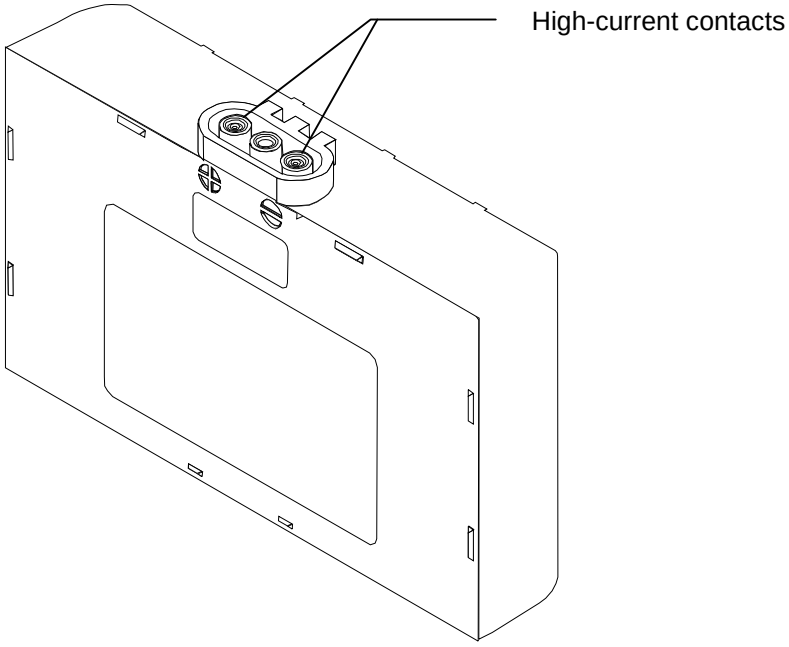
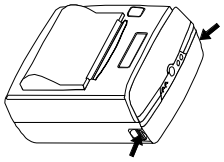


fig. 10: HW 19195, frontal view

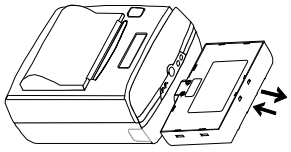
6.8.1 Technical data

Type:	Separate ABS-plastic casing (Snap-In technique) with NiCd-accus; 5 cells, 1,2 V.each.
Dimensions:	L app.88 mm, W app. 56 mm.
Weight:	App. 162 g.
Nominal capacity:	1.100 mAh
Working life:	app. 1000 re-charging cycles.
Safety features:	Sunk-in contacts.
Contacts:	2 high-current contacts. Optional 3rd contact for charging condition monitoring via HW 90196.
	Spring mounted design in plastic inset, self-centering form

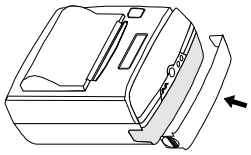
6.8.2 Replacing accu block of printer HW 90195



1. Open lid of accu casing by pressing both locking bottoms of accu casing lid.



2. Remove accu block.
3. Insert new accu block (reverse battery protection- no vice versa insertion possible).



4. Close lid of accu casing.

6.8.3 Recharging the accu blocks

The accu blocks can be recharged in the accu charging unit HW 16196 (s. chap. **Fehler! Verweisquelle konnte nicht gefunden werden.**) or in the communication station HW 50196.

6.8.4 Maintenance and disposal

See chapter 4.4 and 4.5.

7. Base Station HW 8660

The HW 8660 is the base station for radio data transmission. It is suitable for communication with devices containing Radiomodules of Höft & Wessel.
Peripheral devices like modem, printer etc. can be connected via serial interfaces.
The radio base station is network-compatible, applied protocol is TCP/IP via ethernet.

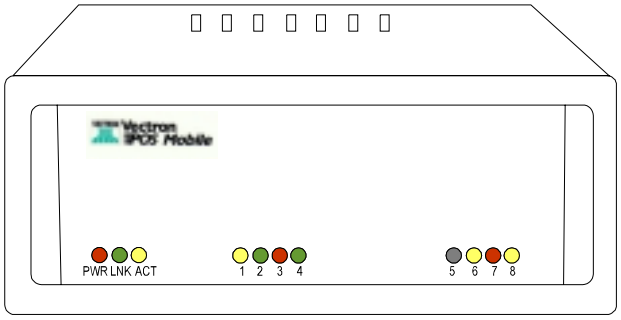
It is the main task of the Base Station, to relieve the receiving PC from data transmission tasks with critical time conditions. The Base Station is capable to perform data telecommunication with MDEs via ISDN terminal adapters, modem or interfaces automatically.

The Base Station HW 8660 is connected directly with a local network via ethernet allowing easy scaling of the central system setup. Any number of MDEs can be applied for the network depending only on the number of desired communication lines. One Base Station can serve up to four lines at the same time.

NOTE!

1. **Use connections only as specified in operating manual (note on rear side).**
2. **Do not connect with any telecommunication means, like e.g. ISDN-components.**

frontal view



rear view

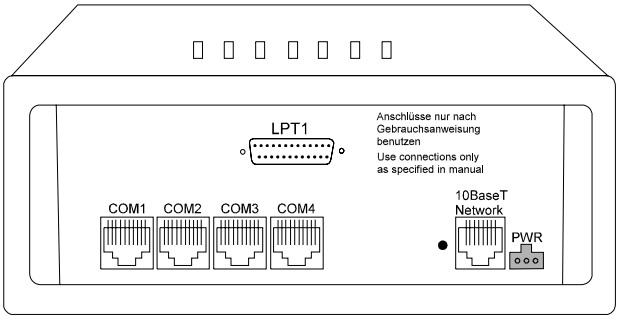


fig. 11: HW 8660, frontal and rear view

IMPORTANT!

Overvoltage may damage base station.

7.1 Technical data

7.1.1 Hardware

Casing:	Plastic injection moulded casing, suitable for mounting on wall and ceiling; casing rear side: aluminium plate.
Dimensions:	L 157 mm, W 200 mm, H 61 mm.
Weight:	Ca. 835 g.
Connection network:	1 Twisted Pair Ethernet (10base-T).
Processor:	486, 386-compatible for PC-104-Board, 66 MHz.
Storage:	• Working storage: 8 MB DRAM; • Data storage: 1 MB SRAM as Plug-on-Board, optional 2 MB, 3 MB, 4 MB (component layouts).
Interfaces:	• 1 LPT interface (parallel), SUB-D 25-pole; • 4 connections with RJ-45-sockets(10-pole, serial); optional 6 connections with RJ-45-sockets; • 1 serial terminal-port interface, connection with RJ-45 (8-pole); • 1 3-pole connection socket for power supply with power supply unit HW 1210.
Interfaces internal:	1 internal interfaces for radio module
LED indication:	LED1: indication ready for operation; LED2: active network link; LED3: active communication; 8 additional free programmable LEDs.
Radio module:	Radio module HW 86020: integrated in casing.
Antenna	Wire antenna λ/4, omnidirectional, integrated in casing.
Frequency range	2.03 – 2.480 GHz
Communication	According to FCC part 15; Uses frequency hopping; Propritary protocol; channels: max. 4 per each Radio module, 3 for the terminal and 1 for printer.
Radio data rate	24 kbps.
Range	In obstacle-free open areas upto 300 m, less in buildings, depending on conditions.
Connections	Serial 3,3 V interface, incl. status lines.
Power supply	Via terminal unit.
Power failure safety:	Battery-buffered SRAM-board for data storage during power failure
Power supply:	With power supply unit HW 1204 (see chap. 7.2). Available for 120 V.

7.1.2 Software

Operating system:	Linux
Programming:	In C oder C++.
Protocol ethernet:	TCP/IP.
Protocol to radio module:	LAP-Protokoll.

7.1.3 Block diagram

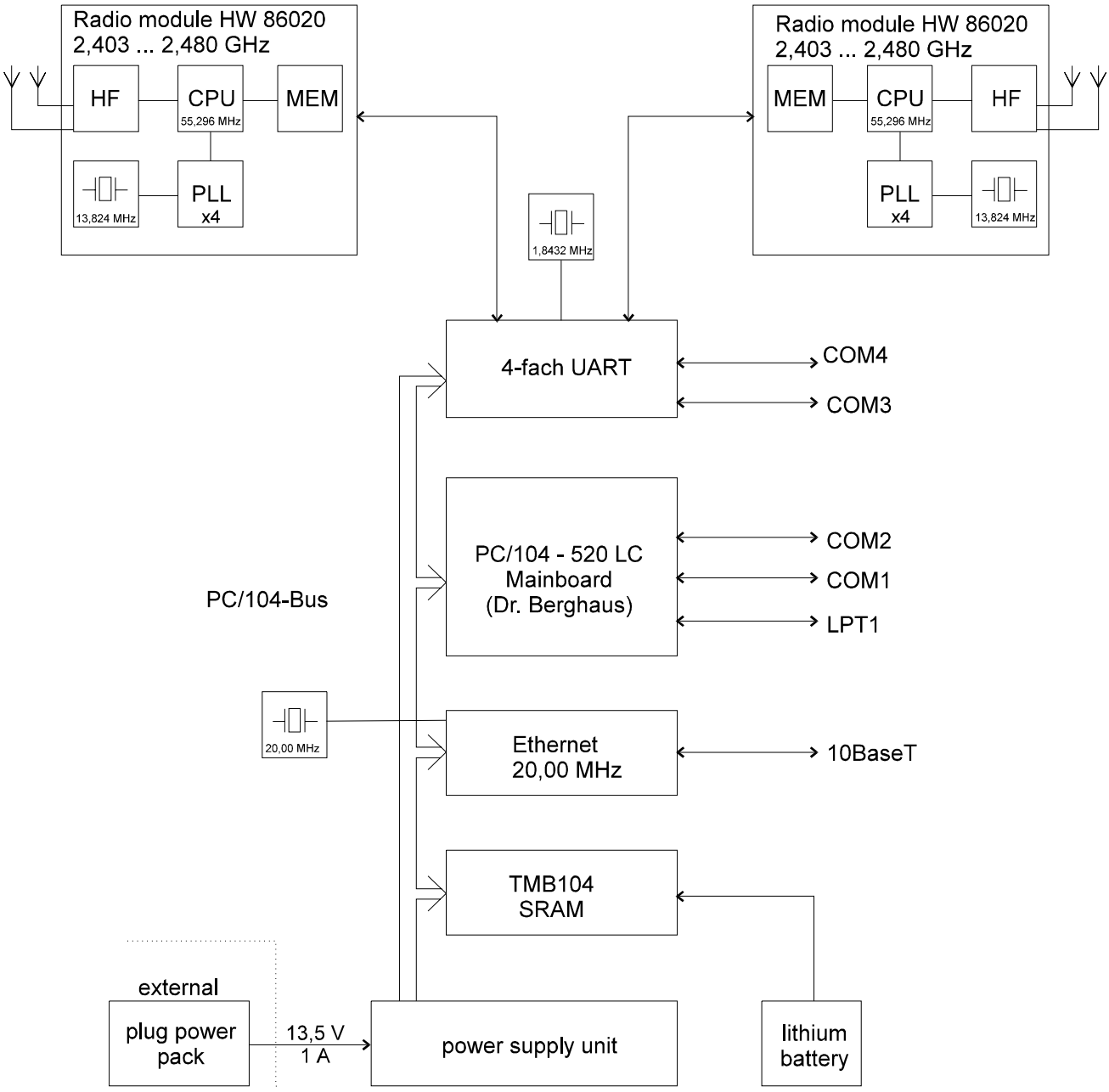


fig. 12: HW 8660, Block diagram

7.2 Power supply unit

The Base Station HW 8660 is connected to the mains by means of various power supply units.

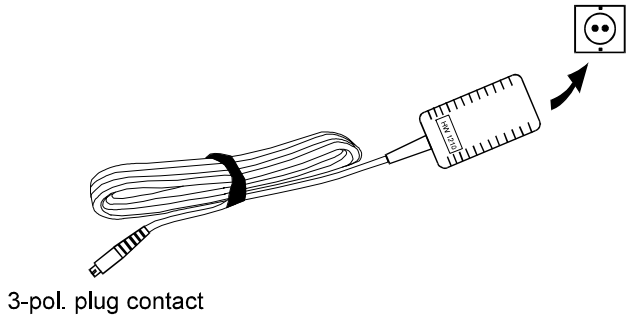


fig. 13: HW 1204, frontal view

7.2.1 Technical data

Type:	Power supply unit with mains lead (2 m length) and 3-pole plug contact.
Manufacturer:	ONTOP CO., LTD.: part no. A41410
	FRIWO Gerätebau GmbH: part no. HW1204
	Motor Electric Manufacturing Co., Ltd.: part no. MEC-B5665
Weight:	Approx. 500 g.
Connection:	Primary voltage: 120 V~ / 60 Hz / 100 mA / 23 VA;
	Secondary voltage: 13,5 V⎓ / 1000 mA / 13,5 VA.
Certifications:	UL1310 / CSAC22.2 NO. 223.

Do only use in dry rooms!

8. Plug-in in ID-000-format

8.1 Description

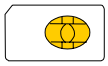


fig. 14: Plug-in

The Plug-in in ID-000-format (e.g. dealer card) contains the key to withdraw money from customer smart cards of corresponding payment systems. That for, if the HW 90196 is intended to accept smart cards etc., a relevant plug-in for the payment system has to be inserted in the corresponding slot.

If the dealer card is sent in „oversize format“, take out the punched card part (plug-in) carefully.

The HW 90196 can take in 2 plug-ins. The corresponding slots are on the bottom side of the HW 90196 on the board which you will see after having removed the accu block.

Plug-in	Payment system
←	Smart card
↑	Reserved

fig. 2: Assignment of plug-ins

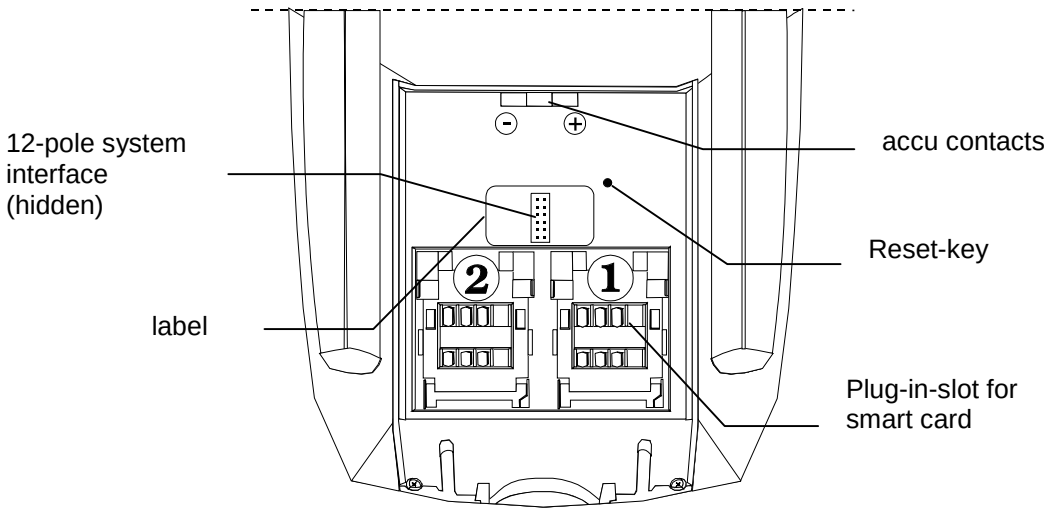
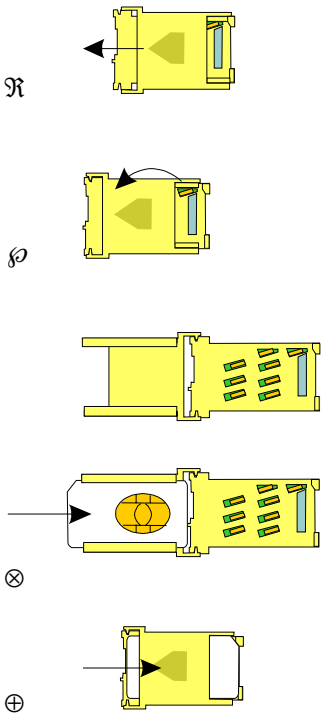


fig. 15: HW 90196 with plug-ins

8.2 Inserting the plug-in



1. Switch off the HW 90196.
2. Take out accu block.
3. Push lid of casing ① (see fig. 17) to the back.
4. Open lid topwise.
5. Insert plug-in in lid.
6. Close lid and push to the front .
7. Insert accu block.
8. Switch on the HW 90196.

fig. 16: Inserting the plug-in

9. Connection of the HW 90196 and HW 90195 via radio transmission

9.1 General

The digital radio data transmission allows the application of mobile devices as online-terminals. The location independent online-access and/or –transmission of relevant data faciliates timing and coordination of complex schemes in areas as mobile data registration or catering. The interaction of components in a local radio communication network will be explained in the following.

The radio base station HW 8660 operates as a crossover for multiple serial interfaces and provides a network gate for radio connections with TCP/IP. The principle works out as followed:

Program-in/output-data from the server is transmitted via the Base Station to the mobile terminals. The Base Station serves hereby as a converter translating the relevant data reciprocally into a format that is readable for serial resp. radio network accesses.

Another function is Roaming. Mobile terminals can be used location independently in a networked environment with several Base Stations. The radio connection to a mobile terminal is taken over by the Base Station with the strongest radio signal. Every communication operation, independend of the range, is transmitted to the virtual control panel.

This allows many different application possibilities:

The MDE can operate as a mobile terminal with the server running the program and the mobile terminal presenting the program surface. This way the whole range of standard-TCP/IP-applications can be presented on a mobile terminal.

Also the mobile terminals can run their own applications. In this case the Base Station can be used to read master data or sales data for analysis and transmit these to the server. This eliminates the need for physical temporary storage devices or wired connection of the terminal with the network.

9.2 Technical architecture

Following hardware is required for the data radio solution:

- A mobile terminal HW 90196 with integrated radio module HW 86020;
- A mobile printer HW 90195 with integrated radio module HW 86020;
- A radio base station HW 8660 with integrated radio module HW 86020 and power supply unit;
- A host computer with Telnet-Daemon and application programm;
- A network cable (RJ45 ⇔ RJ45).

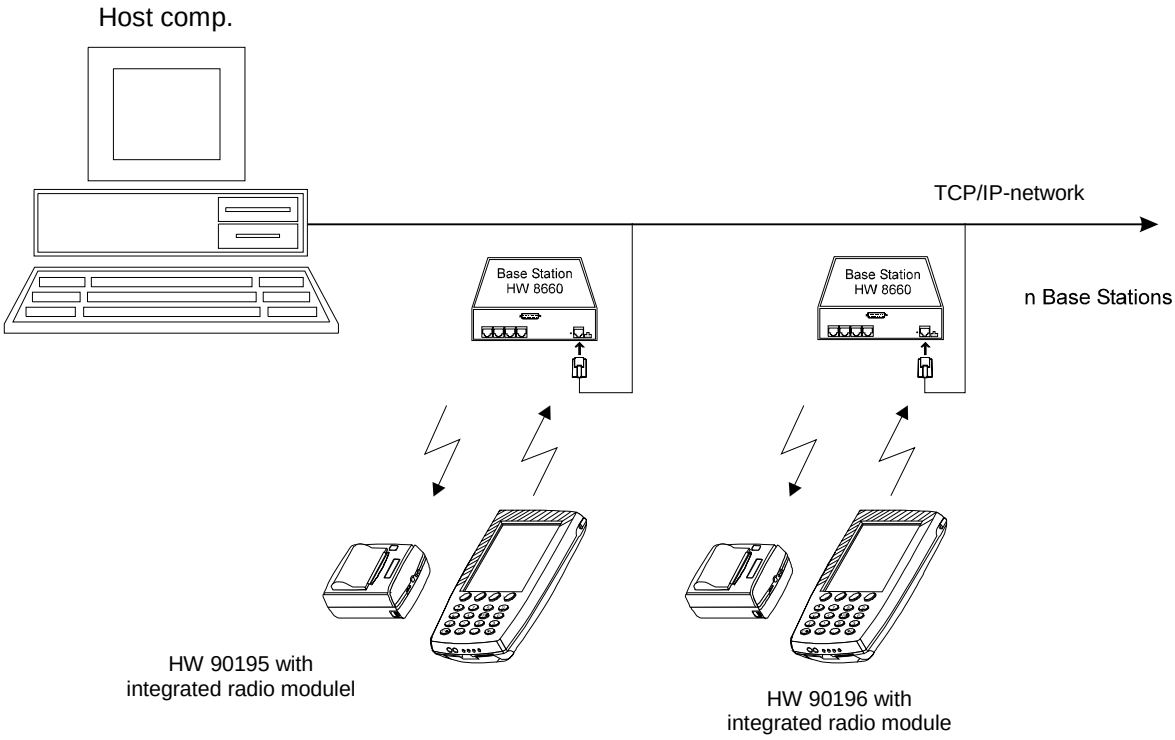
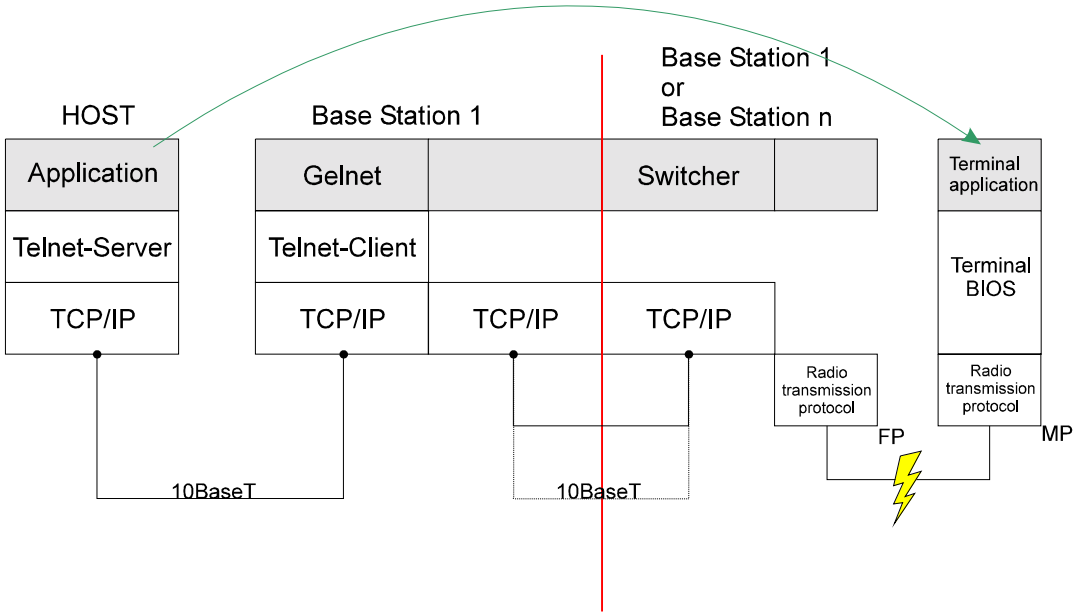


fig. 17: Radio transmission with HW 90196 / HW 90195

To mount explained components:

HOST-computer	The host computer must be integrated in a TCP/IP-network.
Base Station HW 8660	Plug in western connector of mains lead in Base Station HW 8660. Plug other end in mains supply socket.
HW 90196	The HW 90196 with integrated radio module must be logged on to host via Telnet.
HW 90195	The mobile printer communicates with Base Station via radio transmission and prints relevant documents.

9.3 Function diagram



9.3.1 Initial logon of MDE

- The radio *fixed part* (in *Base Station*) sends program *Switcher* signal information about established connection to *Mobile Part* (=radio module in MDE).
- *Switcher* determines serial number of MDE.
- By network broadcasting *Switcher* checks, if there already is a *Base Station* which has operated this MDE. It will recieve no response as this is the initial logon.
- *Switcher* starts a local *Gelnet*.
- *Gelnet* starts a *Telnet* and logs on to host with user name and password.
- The application on host is started.
- *Switcher* transmits all data from/of the serial interface to local *Gelnet* and vice versa.
- The communication line between MDE and host can be described as followed:
  MDE – Radio MP – Radio FP (Base Station 1) – Switcher (Base Station 1) – Gelnet (Base Station 1) – Telnet (Base Station 1) - host

9.3.2 Repeated logon of MDE

- The Radio *fixed part* (in *Base Station*) sends program *Switcher* signal information about established connection to *Mobile Part* (= Radio module in MDE).
- *Switcher* determines serial number of MDE.
- By network broadcasting *Switcher* checks, if there already is a *Base Station* which has operated this MDE.
- As the MDE has already communicated with a *Base Station* the *Gelnet* of this *Base Station* sends a message. This can – but does not have to be – identical with the current *Base Station*; to explain this more clearly, it is suggested that the MDE has now a connection with Base Station 2.
- *Switcher* transmitts all data from/of the serial interface to remote *Gelnet* and vice versa.
- The communication line between MDE and host can be described as followed:
  MDE – Radio MP – Radio FP (Base Station 2) – Switcher (Base Station 2) – Gelnet (Base Station 1) – Telnet (Base Station 1) – host

10. Radio frequency transmission system according to FCC part 15

10.1 Purpose of the chapter

This chapter describes the radio frequency transmission system HW 90196/US, HW 90195/US, and HW 8660/US in the light of the requirements according FCC part 15. It is intended to provide information to the test house and to FCC authorities.

10.2 Abbreviations

RSSI Received Signal Strength Indication

10.3 Overview

10.3.1 Product HW 90196/US

The product HW 90196/US is a mobile terminal using low power radio communication in the 2400 – 2483.5 MHz band.

Radio frequency is used for transmission of digital information between the product and other devices supporting the same radio standard. The radio frequency transmission and reception is provided by an encapsulated transceiver module HW 86020.

The product is battery-powered and not connected to the AC power lines.

The antennas are permanently attached to the transceiver module inside the housing of the product. There is no provision for connecting external antennas or amplifiers.

10.3.2 Product HW 90195/US

The product HW 90196/US is a mobile printer using low power radio communication in the 2400 – 2483.5 MHz band.

Radio frequency is used for transmission of digital information between the product and other devices supporting the same radio standard. The radio frequency transmission and reception is provided by an encapsulated transceiver module HW 86020.

The product is battery-powered and not connected to the AC power lines.

The antennas are permanently attached to the transceiver module inside the housing of the product. There is no provision for connecting external antennas or amplifiers.

10.3.3 Product HW 8660/US

The product HW 8660/US is a radio base station operating in the 2400 – 2483.5 MHz band. It includes a general purpose microcomputer which serves external interfaces such as Ethernet, RS-232 and Centronics.

The product is connected to the AC power lines through an external AC adaptor.

Radio frequency is used for transmission of digital information between the product and other devices supporting the same radio standard. The radio frequency transmission and reception is provided by an encapsulated transceiver module HW 86020.

The product either contains one or two of these modules depending on the required number of simultaneous radio connections.

The antennas are permanently attached to the transceiver modules inside the housing of the product. There is no provision for connecting external antennas or amplifiers.

10.4 Radio frequency transmission

The entire radio function is encapsulated in a module of type HW 86020, in the following referred to as transceiver. It comprises RF as well as baseband signal processing.

10.4.1 Frequency channels

The transceiver uses the frequency band 2400 – 2483.5 MHz. Within this band it operates on 48 frequency channels. Table 1 lists the center frequencies. The channel spacing equals 1.626353 MHz, the channel bandwidth equals 1.6 MHz, i.e. the frequency channels are not overlapping.

Ch #	Frequency [MHz]		CH#	Frequency [MHz]
0	2403,749647		24	2442,782118
1	2405,376000		25	2444,408471
2	2407,002353		26	2446,034824
3	2408,628706		27	2447,661176
4	2410,255059		28	2449,287529
5	2411,881412		29	2450,913882
6	2413,507765		30	2452,540235
7	2415,134118		31	2454,166588
8	2416,760471		32	2455,792941
9	2418,386824		33	2457,419294
10	2420,013176		34	2459,045647
11	2421,639529		35	2460,672000
12	2423,265882		36	2462,298353
13	2424,892235		37	2463,924706
14	2426,518588		38	2465,551059
15	2428,144941		39	2467,177412
16	2429,771294		40	2468,803765
17	2431,397647		41	2470,430118
18	2433,024000		42	2472,056471
19	2434,650353		43	2473,682824
20	2436,276706		44	2475,309176
21	2437,903059		45	2476,935529
22	2439,529412		46	2478,561882
23	2441,155765		47	2480,188235

Table 1: Center frequencies of the used frequency channels

The frequency stability of the radio frequency carriers at the transceiver shall be better than +/- 50 kHz under extreme temperature conditions.

10.4.2 Carrier modulation

For transmission of binary data on a frequency channel, GFSK modulation is used. The nominal modulation equals 400 kHz. The modulation is performed on binary symbols (1 symbol = 1 bit). The symbol clock equals 1.152 Mbit/s.

10.5 Multiplexing

A transceiver may operate either as Basestation or as Endpoint of a radio network. A basic network comprises a single Basestation and multiple Endpoints. Communication happens always between an Endpoint and a Basestation, i.e. there is no direct Endpoint-to-Endpoint communication.

Communication is based on connections. Establishing a connection means in fact the allocation of radio spectrum resources for a specific link between an Endpoint and a Basestation. Multiple connections may be active at the same time.

Moreover there is the requirement of sharing the radio spectrum with other low power devices operating in the same band.

The radio spectrum is shared through a combination of time and frequency multiplexing.

10.5.1 Multiplexing in the Time Domain

The system used TDMA based on a 10ms time frame containing 11520 bit. The frame is divided into K=24 time slots numbered k=0 to 23 in the order of transmission. Each time slot contains 480 bit. This corresponds to a slot time of about 416,7 µs.

A connection is built by one or multiple bearers. A bearer is a sequence of transmissions occupying the same time slot in a number of consecutive frames. Each transmission is a burst, starting with a preamble followed by a synchronization word and payload data.

So a bearer is a sequence of burst transmissions. The duty cycle of a bearer is 1/24.

For the internal administration of the system a multiframe consisting of 16 frames and a superframe consisting of 3 multiframes (i.e. N=48 frames) are defined. Each frame is numbered according to its position in the superframe. Frame numbers range from n=0 to 47.

10.5.2 Multiplexing in the Frequency Domain

The system uses fast frequency hopping for multiplexing in the Frequency Domain. The hopping time, i.e. the period between two consecutive hops, equals 10ms and is synchronized to the TDMA frame clock.

This frequency hopping scheme implies that consecutive transmissions for the same bearer always use different frequency channels. The actual sequence of frequencies is defined by a so-called hopping pattern.

A hopping pattern is a mapping of the frame number onto a corresponding frequency channel number. Since the frame number is periodic with period N=48, also the hopping pattern is periodic with N=48.

10.5.3 Generic frequency hopping patterns

I=46 generic hopping patterns are defined. Each generic hopping pattern uses all 48 frequency channels. Over a period of the hopping pattern, each frequency channel is used during a single frame. Therefore the signal power is distributed uniformly over all frequency channels.

All 46 generic hopping patterns are listed in table 2. Each sequence f(i)[n] occupies two rows in the table, the first row containing f(i)[0] to f(i)[23], and the second row f(i)[24] to f(i)[47].

n / i	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
0	33	34	35	47	37	38	39	40	41	42	43	44	45	46	4	1	2	3	0	5	6	7	8	9
	10	11	12	13	14	15	36	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	19	21	23	25	27	29	31	33	35	37	39	41	43	45	4	2	0	6	8	10	12	14	16	18
	20	22	24	26	28	30	32	34	47	38	40	42	44	46	1	3	5	7	9	11	13	15	36	17
2	5	8	11	14	17	20	23	26	29	32	35	38	41	44	4	3	6	9	12	15	18	21	24	27
	30	33	47	39	42	45	36	1	0	7	10	13	16	19	22	25	28	31	34	37	40	43	46	2
3	38	42	46	3	7	11	15	19	23	27	31	35	39	43	4	0	8	12	16	20	24	28	32	47
	40	44	1	5	9	13	17	21	25	29	33	37	41	45	2	6	10	14	18	22	26	30	36	34
4	24	29	34	39	44	2	7	12	17	22	27	32	37	42	4	5	10	15	20	25	30	35	40	45
	3	8	13	18	23	28	36	33	38	43	1	6	11	16	21	26	31	47	41	46	0	9	14	19
5	10	16	22	28	34	40	46	5	11	17	23	29	35	41	4	6	12	18	24	30	47	42	1	7
	13	19	25	31	37	43	2	8	14	20	26	32	38	44	3	9	15	21	27	33	39	45	36	0
6	43	3	10	17	24	31	38	45	5	12	19	26	33	40	4	7	14	21	28	35	42	2	9	16
	23	30	37	44	0	11	36	18	25	32	39	46	6	13	20	27	34	41	1	8	15	22	29	47
7	29	37	45	6	14	22	30	38	46	7	15	23	31	39	4	8	16	24	32	40	1	9	17	25
	33	41	2	10	18	26	34	42	3	11	19	27	35	43	0	12	20	28	47	44	5	13	36	21
8	15	24	33	42	0	13	22	31	40	2	11	20	29	38	4	9	18	27	47	45	7	16	25	34
	43	5	14	23	32	41	36	3	12	21	30	39	1	10	19	28	37	46	8	17	26	35	44	6
9	1	11	21	31	41	0	14	24	34	44	7	17	27	37	4	10	20	30	40	3	13	23	33	43
	6	16	26	47	46	9	19	29	39	2	12	22	32	42	5	15	25	35	45	8	18	28	36	38
10	34	45	9	20	31	42	6	17	28	39	3	14	25	47	4	11	22	33	44	8	19	30	41	5
	16	27	38	2	13	24	36	35	46	10	21	32	43	7	18	29	40	0	15	26	37	1	12	23
11	20	32	44	9	21	33	45	10	22	34	46	11	23	35	4	12	24	47	1	13	25	37	2	14
	26	38	3	15	27	39	0	16	28	40	5	17	29	41	6	18	30	42	7	19	31	43	36	8
12	6	19	32	45	11	24	37	3	16	29	42	8	21	34	4	13	26	39	5	18	31	44	10	23
	47	2	15	28	41	7	36	20	33	46	12	25	38	0	17	30	43	9	22	35	1	14	27	40
13	39	6	20	34	1	15	29	43	10	24	38	5	19	33	4	14	28	42	9	23	37	0	18	32
	46	13	27	41	8	22	47	3	17	31	45	12	26	40	7	21	35	2	16	30	44	11	36	25
14	25	40	8	23	38	6	21	47	0	19	34	2	17	32	4	15	30	45	13	28	43	11	26	41
	9	24	39	7	22	37	36	5	20	35	3	18	33	1	16	31	46	14	29	44	12	27	42	10
15	11	27	43	12	28	44	13	29	45	14	30	46	15	31	4	16	32	1	17	33	2	18	34	3
	19	35	0	20	47	5	21	37	6	22	38	7	23	39	8	24	40	9	25	41	10	26	36	42
16	44	14	31	1	18	35	5	22	39	9	26	43	13	30	4	17	34	0	21	38	8	25	42	12
	29	46	16	33	3	20	36	37	7	24	41	11	28	45	15	32	2	19	47	6	23	40	10	27
17	30	1	19	37	8	26	44	15	33	0	22	40	11	29	4	18	47	7	25	43	14	32	3	21
	39	10	28	46	17	35	6	24	42	13	31	2	20	38	9	27	45	16	34	5	23	41	36	12
18	16	35	7	26	45	17	47	8	27	46	18	37	9	28	4	19	38	10	29	1	20	39	11	30
	2	21	40	12	31	3	36	22	41	13	32	0	23	42	14	33	5	24	43	15	34	6	25	44
19	2	22	42	15	35	8	28	1	21	41	14	34	7	27	4	20	40	13	33	6	26	46	19	39
	12	32	5	25	45	18	38	11	31	0	24	44	17	37	10	30	3	23	43	16	47	9	36	29
20	35	9	30	0	25	46	20	41	15	47	10	31	5	26	4	21	42	16	37	11	32	6	27	1
	22	43	17	38	12	33	36	7	28	2	23	44	18	39	13	34	8	29	3	24	45	19	40	14
21	21	43	18	40	15	37	12	34	9	31	6	28	3	25	4	22	44	19	41	16	38	13	35	10
	32	7	29	0	26	1	23	45	20	42	17	39	14	47	11	33	8	30	5	27	2	24	36	46
22	7	30	6	29	5	28	0	27	3	26	2	25	1	24	4	23	46	22	45	21	44	20	43	19
	42	18	41	17	40	16	36	39	15	38	14	37	13	47	12	35	11	34	10	33	9	32	8	31

Table 2: Generic frequency hopping patterns f(i)[n]

n / i	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
23	40	17	41	18	42	19	43	20	44	21	45	22	46	23	4	24	1	25	2	26	3	27	0	28
	5	29	6	30	7	31	8	32	9	33	10	34	11	35	12	47	13	37	14	38	15	39	36	16
24	26	0	29	7	32	10	35	13	38	16	41	19	44	22	4	25	3	28	6	31	9	34	12	37
	15	40	18	43	21	46	36	24	2	27	5	30	8	33	11	47	14	39	17	42	20	45	23	1
25	12	38	17	43	22	1	27	6	32	11	37	16	42	21	4	26	5	31	10	47	15	41	20	46
	25	0	30	9	35	14	40	19	45	24	3	29	8	34	13	39	18	44	23	2	28	7	36	33
26	45	25	5	32	12	39	19	46	26	6	33	13	40	20	4	27	7	34	14	41	21	1	28	8
	35	15	42	22	2	29	36	9	47	16	43	23	3	30	10	37	17	44	24	0	31	11	38	18
27	31	12	40	21	2	30	11	39	20	1	29	10	38	19	4	28	9	37	18	46	27	8	47	17
	45	26	7	35	16	44	25	6	34	15	43	24	5	33	14	42	23	0	32	13	41	22	36	3
28	17	46	28	10	39	21	3	32	14	43	25	7	47	18	4	29	11	40	22	0	33	15	44	26
	8	37	19	1	30	12	36	41	23	5	34	16	45	27	9	38	20	2	31	13	42	24	6	35
29	3	33	16	46	29	12	42	25	8	38	21	0	34	17	4	30	13	43	26	9	39	22	5	35
	18	1	31	14	44	27	10	40	23	6	47	19	2	32	15	45	28	11	41	24	7	37	36	20
30	47	20	0	35	19	3	34	18	2	33	17	1	32	16	4	31	15	46	30	14	45	29	13	44
	28	12	43	27	11	42	36	26	10	41	25	9	40	24	8	39	23	7	38	22	6	37	21	5
31	22	7	39	24	9	41	26	11	43	28	13	45	30	15	4	32	17	2	34	19	0	47	21	6
	38	23	8	40	25	10	42	27	12	44	29	14	46	31	16	1	33	18	3	35	20	5	36	37
32	8	41	27	13	46	32	18	0	37	23	9	42	28	14	4	33	19	5	38	24	10	43	29	15
	1	34	20	6	39	25	36	11	44	30	16	2	35	21	7	40	26	12	45	31	17	3	47	22
33	41	28	15	2	47	23	10	44	31	18	5	39	26	13	4	34	21	8	42	29	16	3	37	24
	11	45	32	19	6	40	27	14	1	35	22	9	43	30	17	0	38	25	12	46	33	20	36	7
34	27	15	3	38	26	14	2	37	25	13	1	47	24	12	4	35	23	11	46	34	22	10	45	33
	21	9	44	32	20	8	36	43	31	19	7	42	30	18	6	41	29	17	5	40	28	16	0	39
35	13	2	38	27	16	5	41	30	19	8	44	33	22	11	4	47	25	14	3	39	28	17	6	42
	31	20	9	45	34	23	12	1	37	26	15	0	40	29	18	7	43	32	21	10	46	35	36	24
36	46	47	26	16	6	43	33	23	13	3	40	30	20	10	4	37	27	17	7	44	34	24	14	0
	41	31	21	11	1	38	36	28	18	8	45	35	25	15	5	42	32	22	12	2	39	29	19	9
37	32	23	14	5	43	34	25	16	7	45	47	27	18	9	4	38	29	20	11	2	40	31	22	13
	0	42	33	24	15	6	44	35	26	17	8	46	37	28	19	10	1	39	30	21	12	3	36	41
38	18	10	2	41	33	25	17	9	1	40	32	24	16	8	4	39	31	23	15	7	46	38	30	22
	14	6	45	37	29	21	36	13	5	44	47	28	20	12	0	43	35	27	19	11	3	42	34	26
39	0	44	37	30	23	16	9	2	42	35	28	21	14	7	4	40	33	26	19	12	5	45	38	31
	24	17	10	3	43	47	29	22	15	8	1	41	34	27	20	13	6	46	39	32	25	18	36	11
40	37	31	25	19	13	7	1	42	47	30	24	18	12	6	4	41	35	29	23	17	11	5	46	40
	34	28	22	16	10	0	36	45	39	33	27	21	15	9	3	44	38	32	26	20	14	8	2	43
41	23	18	13	8	3	45	40	35	30	25	20	15	10	5	4	42	37	32	27	22	17	12	7	2
	44	39	34	29	24	19	14	9	0	46	41	47	31	26	21	16	11	6	1	43	38	33	36	28
42	9	5	1	44	40	47	32	28	24	20	16	12	8	0	4	43	39	35	31	27	23	19	15	11
	7	3	46	42	38	34	36	30	26	22	18	14	10	6	2	45	41	37	33	29	25	21	17	13
43	42	39	47	33	30	27	24	21	18	15	12	9	6	3	4	44	41	38	35	32	29	26	23	20
	17	14	11	8	5	2	46	43	40	37	34	31	28	25	22	19	16	13	10	7	0	1	36	45
44	28	26	24	22	20	18	16	14	12	10	8	6	0	2	4	45	43	41	39	37	35	33	31	29
	27	25	23	21	19	17	36	15	13	11	9	7	5	3	1	46	44	42	40	38	47	34	32	30
45	14	13	12	11	10	9	8	7	6	5	0	3	2	1	4	46	45	44	43	42	41	40	39	38
	37	47	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	36	15

Table 2 (continued): Generic frequency hopping patterns f(i)[n]

Each basestation has assigned a fixed generic hopping pattern. Co-located basestations may use the same generic hopping pattern or different generic hopping patterns without restriction.

Endpoints support the whole set of generic hopping patterns. When an endpoint establishes a connection to a basestation it detects, during the synchronization procedure, the generic hopping pattern to be used.

10.5.4 Hopping channels

Hopping channels are derived by shifting a generic frequency hopping pattern along the time axis. For each generic hopping pattern f(i)[n] a set of L=12 hopping channels h(i,l)[n] is generated through the following equation: h(i,l)[n] = f(i)[n-8l]

10.5.5 Bearer position

The position of a bearer in the combined time / frequency multiplex is marked as b(i,l,k), where
i denotes the generic frequency hopping pattern
l denotes the hopping channel
k denotes the time slot

10.6 Medium Access Procedures

10.6.1 Synchronization

Two transceivers are synchronized, if their bit clock, frame clock, multiframe and superframe clocks are in phase alignment and they use the same generic hopping pattern.

In a basic network the basestation is the synchronization master and the endpoints are synchronization slaves, i.e. the endpoints synchronize their clocks to the basestation.

Even when no connection is active, any basestation sends a dummy bearer. On that bearer all information is contained which is needed by an endpoint in order to establish synchronization to the basestation.

The dummy bearer is sent using the generic hopping pattern f(i)[n] on an arbitrary bearer b(i,l,k). Before setting up the dummy bearer, the basestation performs RSSI (Received Signal Strength Indication) scan on all available bearer positions and selects the quietest bearer position.

During dummy bearer operation the basestation observes adjacent timeslots in order to detect sliding collisions. In this situation it will move the dummy bearer to another bearer position.

Information contained in the dummy bearer contains the identification of the generic hopping pattern used by the base station.

An endpoint obtains synchronization by continuously scanning a single frequency channel. In the course of its hopping pattern the dummy bearer of the basestation will hit this channel every 480ms. In this event, the receiver obtains bit synchronization from the synchronization word and it retrieves the generic hopping pattern f(i)[n] from the information contained in the dummy bearer.

Although at this stage of synchronization the actual hopping channel and time slot are still unknown to the endpoint, it is already able to set the correct frequency channel for the next transmission burst of the dummy bearer. By monitoring the dummy bearer over a several frames, the endpoint retrieves all required information to establish and maintain synchronization of frame, multiframe and superframe clocks, including the values of l and k for the dummy bearer.

An endpoint will not transmit any radio signal before it is synchronized to a base station.

10.6.2 Monitoring of the environment

Both sides, basestation and endpoint regularly and independently perform RSSI scans of all accessible hopping channels and time slots. The basestation broadcasts on its dummy bearer a list of allowed hopping channels and time slots. Any endpoint maintain a list of quietest channels, i.e. preferred values (l,k) for setting up a connection.

10.6.3 Setting up a connection

Connection setup is always initiated by the endpoint. It selects values (l,k) depending on its RSSI measurements and the information received through the dummy bearer from the basestation. It then starts transmission on the selected traffic bearer b(i,l,k).

The basestation regularly scans through all accessible bearer positions. This is referred to the Primary Scan function of the basestation. Information about the primary scan is broadcast on the dummy bearer, so when the endpoint establishes a traffic bearer this is done exactly at the time when the basestation scans the respective bearer position. This allows the basestation to answer the bearer establishment procedure and set up a connection.

10.6.4 Connection maintenance

As long as the connection is required (by higher layer protocols) it remains on the selected traffic bearer b(i,l,k) unless a bearer handover procedure is invoked.

During the connection both transceivers monitor the quality of service on the traffic bearer. This is done through RSSI measurements in adjacent time slots and bit error measurements. In case the quality of service falls below a certain threshold, a handover procedure is started. It is always initiated by the endpoint.

During handover a new bearer b(i,l_new,k_new) is established and the old bearer is closed down. Selection of the new bearer happens according to the same rules as for a new connection, i.e. involve RSSI measurements.

10.7 Interference avoidance strategies

10.7.1 Interference within the system

The medium access procedures provide sufficient mechanisms so that there is no relevant interference within a system.

Only endpoints send out a signal that are synchronized to the basestation.

In a synchronized system only signals interfere that use the same bearer b(i,l,k). Due to the fact that the basestation broadcasts a list of free channels and each endpoint performs RSSI measurements, the only potential interference situation is a collision of two endpoints during connection setup. Such a collision is detected at both endpoints which then re-attempt to establish the connection after a variable timeout. So the probability is very low that the two endpoints collide again .

10.7.2 Interference between two systems of the same type

In case two systems of the described type are operated in the same location, they may interfere with each other. There are two possible situations:

1. Both system use different generic hopping patterns. In this case connections belonging to different systems may hit the same frequency at the same time. Due to the bursty transmission a collision occurs only, if the connections use the same time slot and the same frequency channel. So the total collision probability is (1/24)(1/48) < 0,09%. The system is tolerant to a certain amount of interference. Packet loss is detected and corrected through re-transmission. Only if a significant amount of packets is lost (say 10%) this will reduce performance.

2. Both system use the same generic hopping pattern. This case is further studied below

Each of two systems using the same generic hopping sequence recognizes (through RSSI measurement) the bearer positions used by connections of the other system. So it avoids these bearer positions.

Since the two systems are mutually not synchronized, they drift against each other. The maximum relative drift is given by the oscillator accuracy of 10ppm. For drifting one slot position at least 2 seconds are needed.

In this case slow sliding collisions occur. The system invokes bearer handover to solve sliding collisions.

10.7.3 Interference from other sources

Other frequency hopping systems may cause occasional packet loss which is solved through packet re-transmission.

The same applies to CW interferers.

In case the interference pattern of a specific interferer tends to disturb specific time slots or hopping channels, the system will avoid these channels.

Since the hopping is fast and is spread over the whole band it may stand even interference from micro-wave ovens.

The presence of direct sequence spread spectrum systems will cause an increased noise floor and re-duce the coverage range. However, GFSK modulation has a strong noise immunity.

10.7.4 Interference to other systems

In case the system detects other transmissions during a number of consecutive frames it will perform bearer handover to a quieter channel.

The low duty cycle and the fast frequency hopping are helpful in reducing the amount of interference to other systems.

10.8 Specific requirements from FCC chapter 15

10.8.1 15.203 Antenna requirement

An intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section.

The antennas of the product are permanently attached.

10.8.2 15.204 External radio frequency power amplifiers and antenna modifications

a) Except as otherwise described in paragraph (b) of this section, no person shall use, manufacture etc. any external radio frequency power amplifier or amplifier kit intended for use with a Part 15 intentional radiator.

The product offers no means for connection of an external RF power amplifier.

b) A transmission system consisting of an intentional radiator, an external radio frequency power amplifier, and an antenna, may be authorized, marketed and used under this part.

Does not apply. The product has no external RF amplifier. The product has no external antenna.

c) Only the antenna with which an intentional radiator is authorized may be used with the intentional radiator.

The antenna is permanently attached inside the housing of the product

10.8.3 15.205 Restricted bands of operation

The product operates in the frequency band 2400 – 2483.5 MHz. See test house report for spurious emissions.

10.8.4 15.207 Conducted limit

See test house report

10.8.5 15.209 Radiated emission limits

See test house report

10.8.6 15.247 Operation within the bands ... 2400 – 2483.5 MHz ...

(a) Operation under provisions of this section is limited to frequency hopping and direct sequence spread spectrum intentional radiators that comply with the following provisions:

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel whichever is greater.

The product uses a channel spacing of 1.626353 MHz which is greater than the 20 dB bandwidth of 1.5 MHz.

The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudorandomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter.

The product uses a pseudorandomly ordered list of hopping frequencies, see table 2. Each frequency is used equally in this list.

(i) does not apply
(ii) does not apply
(iii) Frequency hopping systems in the 2400 – 2483.5 MHz band may utilize hopping channels whose 20 dB bandwidth is greater than 1 MHz provided the systems use at least 15 non-overlapping channels.

The product uses 48 non-overlapping channels

The total span of hopping channels shall be at least 75 MHz

The total span of hopping channels used by the product is about 78 MHz

The average time of occupancy on any frequency shall not be greater than 0,4 seconds within a 30 second period

The average time of occupancy on any frequency is 416 µs within 480 ms which corresponds to 26 ms within a 30 seconds period per for a single transmit bearer.

(2) does not apply
(b) The maximum peak output power of the intentional radiator shall not exceed the following:
(1) For frequency hopping systems in the 2400 – 2483.5 MHz band employing at least 75 hopping channels ...: 1 watt. For all other frequency hopping systems in the 2400 – 2483.5 MHz band 0,125 watts.

The maximum output power of the product does not exceed 0,125 watts.

(2) does not apply
(3) does not apply
(4) See test house report

(g) *Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However the system, consisting of both the transmitter and receiver must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.*

The product employs all available hopping channel for each transmission lasting longer than 480 ms. In particular this is true for a continuous data stream.

The product uses short transmission bursts which are distributed over all available hopping channels as described above.

(h) *The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently choses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.*

As described above the product uses RSSI measurement to recognize other users and individually and independently choses and adapts its hopsets. There is no coordination of frequency hopping systems.

10.8.7 15.249 Operation within the bands ... 2400 – 2483.5 MHz

See test house report

11. List of figures

12. Index