Integration Manual

HW 86050

WLAN IEEE 802.11b
Embedded Radio Module

Version 0.95

DATA UNWIRED

HÖFT & WESSEL

Contents

1. Preface

Dear customer, thank you for choosing the HW 86050 Wireless LAN radio module. You have made a good choice, since HW 86050 is a powerful and very versatile product that easily adds WLAN communication to your application.

This document will help you in getting the optimum integration result. This covers mechanical, electrical and RF aspects as well as software and configuration.

Höft & Wessel aims for best customer satisfaction. In case of any problems with this manual or with our products please do not hesitate to contact us. Your feedback will enable our specialists to solve your problems and continually improve our products and documentation.

1.1 About this document

This manual contains the full technical specification of the HW 86050 as well as all necessary information for a successful integration and configuration.

HW 86050 is a future-proof product which offers a number of flexible interfaces and features. It is delivered together with Höft & Wessel WLAN firmware.

However, not all of the versatile features described in the hardware section are supported by the standard firmware but some will require a customised firmware.

1.2 Contact Höft & Wessel AG

For immediate assistance please address yourself to the Höft & Wessel service line:

Telephone: +49-1803-232829
Telefax: +49-511-6102-411
Email: info@hoeft-wessel.de

If you have general questions concerning Höft & Wessel Data-Unwired products you may directly contact the Data-Unwired team:

Telephone: +49-511-6102-226
Telefax: +49-511-6102-437
Email: tol@hoeft-wessel.de

Latest revisions of all publicly available documentation and firmware downloads are available from our web-site www.data-unwired.com. If you are interested in Höft & Wessel Group in general, visit www.hoeft-wessel.de.

Adress:

Höft & Wessel AG
Rotenburger Strasse 20
D-30659 Hannover
Germany

2. Important user information

NOTE:

This equipment makes use of radio spectrum and emits radio frequency energy. Care should be taken when the device is integrated in systems. Make sure that all specification within this document are followed, especially concerning operating temperature and supply voltage range. Operate the device according to the local regulations.

The frequency spectrum used with this device is shared with other users. Any interference may not not be excluded.

2.1 Special note for users in the USA

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.**

The rated RF power (conducted) of the device is 0.072 W. Though this is a low power level a minimum separation distance of 20 cm from the device's antenna to all persons must be kept. The antenna must not be co-located and operated in conjunction with any other antenna or transmitter.

The radio module is designed for professional use and must be integrated into a host system by qualified personel only.

The outside of the device into which the module is installed must display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: PGM860505" or "Contains FCC ID: PGM860505."

On the host application a label shall show the following wording:

„This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation."

Refer to Part 2 and Part 15 of FCC Rules for details.

3. Intoduction

The WLAN radio module HW 86050 is a highly versatile and powerful engine for industrial WLAN applications. It provides a complete radio according to IEEE 802.11b standard together with a frontend application processor interfacing the host system.

3.1 General description

Built around a 16-bit high-speed low-power RISC microcontroller and a highly integrated state-of-the-art Wireless LAN chipset the architecture of the HW 86050 features a full set of useful interfaces for support of data services in various environments and even voice services.

These include RS-232 and SPI for data transmission. Additional general purpose I/Os, I2C plus an accessible bus interface make the HW 86050 ideally suited for industrial automation and control applications with specific I/O requirements.

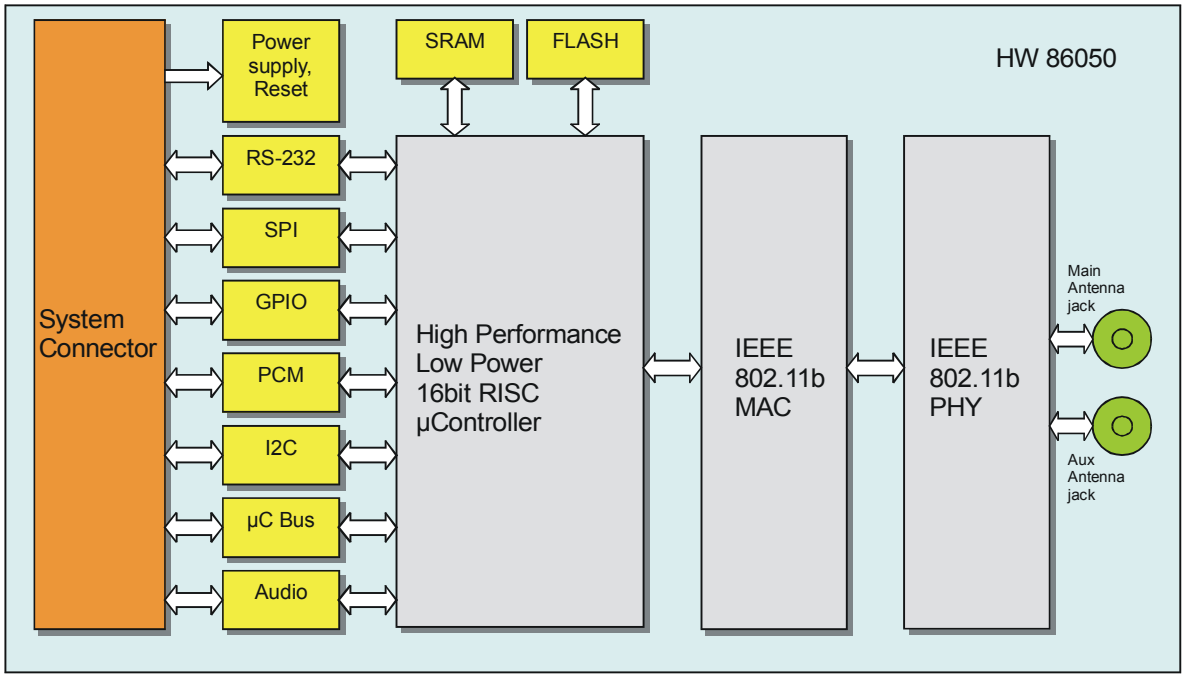
A PCM interface allows for connection to digital voice systems and an analogue frontend supports direct connection of voice equipment such as headsets.

The RF section complies with IEEE 802.11b standard for operation on the worldwide available 2.4 GHz ISM band. Two antenna ports allow for the use of diversity antennas to improve radio performance in difficult environments.

WLAN protocol stack and application software is integrated in the HW 86050 firmware and can be upgraded in the field.

The ultra-compact and low-power design make the HW 86050 optimally suited for battery powered devices.

3.2 System diagram



Hardware Description

3.3 Mechanical Characteristics

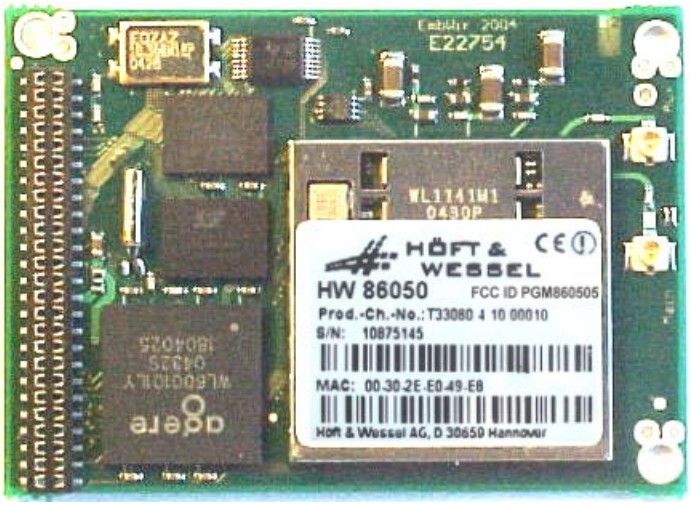
3.3.1 Dimensions

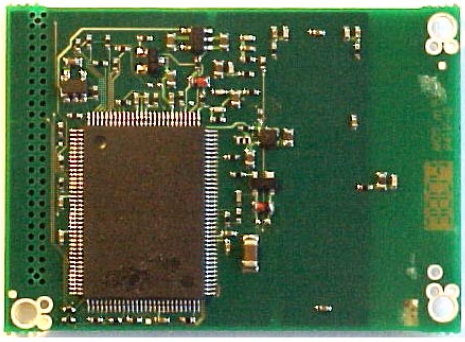
Parameter	Typ.	unit
Length	53.0	mm
Width	37.0	mm
Height	5.0	mm

3.3.2 Weight

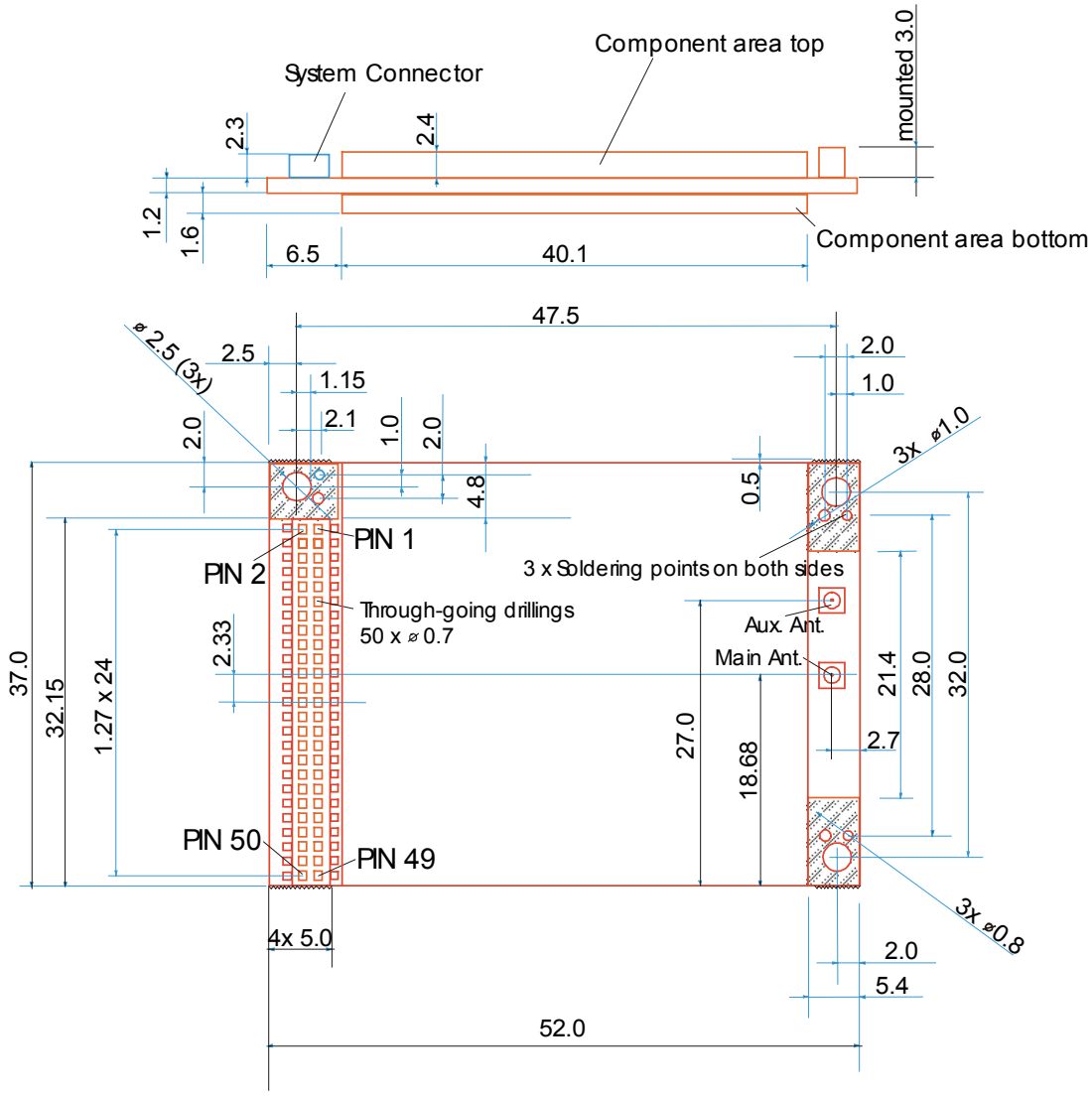
Parameter	Typ.	unit
Weight	10 +/- 2	g

3.3.3 Image





3.3.4 Mechanical Drawing



Both sides without tippings and without strip conductors

					Freimaße +/- 0.1 mm Freie Winkelmaße +/- 0.1 °		Scale:	A4
							Material:	
						Datum	Name	Designation: HW 86050
					Bearb.	03.05.04	SWI	
					Gepr.		LUE	Part number: E22753
					Norm			Drawing number: E22753
					Höft & Wessel AG Rotenburger Str. 20, 30659 Hannover Tel.: (0511) 6102- 0, FAX: -411			File name: E22753.cdr
Grund d. Änder.	Zeichnungsrev.	Artikelrev.	Datum	Name				Blatt 1 von 1

3.4 Electrical Characteristics

3.4.1 Pinout

Pin	Name	Description	Pintype	reset state
1	VXN	Speaker out negative	Analog	Oa
2	VXP	Speaker out positive	Analog	Oa
3	VXIN	Microphone in negative	Analog	Ia
4	VXIP	Microphone in positive	Analog	Ia
5	MICN	Microphone bias out reference	Analog	Oa
6	MICP	Microphone bias out positive	Analog	Oa
7	RSTNO	Reset out	Digital	Ipu80k
8	RINGP/SPIDI	Ring out, SPI data in	Digital	I
9	ADC/GPIO12	Analog digital converter in, General purpose I/O	Dig/Analog	I
10	PWM/SPICLK	PWM out, SPI clock in/out, General purpose I/O	Digital	I
11	SDA/PCMFSC1/GPIO11	I2C Data, PCM frame sync 1, General purpose I/O	Digital	Ipu
12	SCL/GPIO10	I2C Clock, General purpose I/O	Digital	O1
13	GPIO1/LED0	General purpose I/O, LED0 control	Digital	O1
14	GPIO2/SPIDO/LED1	General purpose O, SPI data out, LED1 control	Digital	O0
15	GPIO3/PCMFSC0	General purpose I/O, PCM frame sync 0	Digital	Ipu
16	GPIO4/PCMCLK	General purpose I/O, PCM clock in/out	Digital	Ipu
17	GPIO5/PCMDIN	General purpose I/O, PCM data in	Digital	Ipu
18	GPIO6/PCMDOUT	General purpose I/O, PCM data out	Digital	Ipu
19	GPIO7/EXTINT/PIWRDY	General purpose I/O, external interrupt request in, parallel interface write ready	Digital	Ipu
20	GPIO8/EXTCS/PICS	General purpose I/O, external chip select out, parallel interface select	Digital	Ipu
21	RSTBI	Reset in	Digital	Ipu
22	GND	Ground	Ground	
23	RTSI/PIRDREQ/BOOT2	RS232 RST in, parallel interface read request, mode select in	Digital	Ipu
24	DTRI/BOOT3	RS232 DTR in, mode select in	Digital	Ipu
25	RXDO	RS232 RXD out	Digital	Ipu
26	TXDI	RS232 TXD in	Digital	Ipu
27	V3P3	Digital section power supply	Supply	
28	VBATP	RF section power supply	Supply	
29	CTSO/BOOT0	RS232 CTS out, mode select in	Digital	Ipu
30	DSRO/BOOT1	RS232 DSR out, mode select in	Digital	Ipu
31	DCDIO	RS232 DCD in/out, General purpose I/O	Digital	Ohzpu
32	RIIO	RS232 RI in/out, General purpose I/O	Digital	Ohzpu
33	RDn	µC bus read	Digital	O1
34	WRn	µC bus write	Digital	O1
35	D0	µC bus data	Digital	O1
36	D1	µC bus data	Digital	O1
37	D2	µC bus data	Digital	O1
38	D3	µC bus data	Digital	O1
39	D4	µC bus data	Digital	O1
40	D5	µC bus data	Digital	O1
41	D6	µC bus data	Digital	O1
42	D7	µC bus data	Digital	O1
43	A0	µC bus adress	Digital	O1
44	A1	µC bus adress	Digital	O1
45	A2	µC bus adress	Digital	O1
46	A3	µC bus adress	Digital	O1
47	A4	µC bus adress	Digital	O1
48	A5	µC bus adress	Digital	O1
49	GPIO9	General purpose I/O	Digital	Ohz
50	GND	Ground	Ground	

Legend: Oa - analog output, Ia - analog input, Ipu - digital input with internal pull-up, Ipu80k - digital input with 80kOhm pull-up - digital input w/o pull-up, O1 - digital ouput high state, O0 - digital output low state, Ohz - digital ouput high impendance state, Ohzpu - digital output high impedance state with pullup.

3.4.2 Absolute Maximum Ratings

Parameter	Remarks	Conditions	Min	Max	unit
V3P3	Digital supply voltage		-0.3	4.0	V
VBATP	RF supply voltage		-0.3	6.0	V
Iiosum	Current through all IO pins			90	mA
Iio	Current through IO pin			20	mA
Vdigin	Max Voltage on any digital inputs	V3P3>=3.3V V3P3<3,3V	-0.3 -0.3	3.6V V3P3+0.3	V
Vanain	Max voltage on any analog inputs		-0.3	2.0	V
Iioprot	Max current through any pin's protection diodes to V3P3			100	µA
Imicprot	Max current through MIC input pin's protection diodes			2.4	mA

NOTE: Absolute maximum ratings may be applied to the module for a short period of time. Applying values greater than those mentioned will damage the module.

3.4.3 Recommended Operating Conditions

3.4.3.1 Power Supply

Parameter	Remarks	Conditions	Min	Typ.	Max	unit
V3P3	Digital supply voltage		3.1	3.3	3.5	V
VBATP	RF supply voltage		3.1		5.5	V
I3P3	Digital supply current	Operating Power Save		50 30	100	mA
IBATP	RF supply current	Transmit Receive Power Save		250 150 5	400 200	mA

NOTE: Power Save values at no user data. If data are transferred the device will wake up from Power Save Mode for a short period, i.e. actual average current depends on the Power Save Mode configuration and the appearance of user data. Power Save timing parameters may be configured, see section 4.2.6.

NOTE: Maximum IBATP current during transmission may be increased in case of antenna impedance mismatch.

3.4.3.2 Digital I/O

Parameter	Remarks	Conditions	Min	Typ.	Max	unit
Vin_dig_high	Digital in high level		2.0			V
Vin_dig_low	Digital in low level				1.0 (GPIO9:0. 6)	V
Vout_dig_low_ 100µ	Digital out low level	100µA			0.1	V
Vout_dig_low_ 8m	Digital out low level	8mA			0.6	V
Vout_dig_high_ 100µ	Digital out high level	100µA	3.0			V
Vout_dig_high_ 8m	Digital out high level	8mA	2.4			V

3.4.4 Specifications

3.4.4.1 UART interface

Parameter	Remarks	Conditions	Min	Typ.	Max	unit
UART data rates				230.4 115.2 57.6 19.2 9.6		kBd
UART data format				8N1		
UART buffer				DMA, software controlled		

3.4.4.2 SPI interface

SPI interface will be operated in Master mode.

Parameter	Remarks	Conditions	Min	Typ.	Max	unit
SPI Clock Master				1.296 2.592 5.184		MHz
SPI Clock Slave					5.184	MHz
SPI Mode				0, 1, 2, 3		

3.4.4.3 Radio Frequency Interface

Parameter	Remarks	Conditions	Min	Typ.	Max	unit
Frequency range	World mode		2400		2483.5	MHz
Frequency stability			-25		+25	kHz
Transmitter output power			13	15	17	dBm
Antenna ports impedance				50		Ohm
Receiver sensivity	BER < 10e-5	11Mbit/s 5.5 Mbit/s 2 Mbits/s 1 Mbit/s		-84 -87 -90 -93	-82 -85 -88 -91	dBm
Delay spread robustness	FER < 1%	11Mbit/s 5.5 Mbit/s 2 Mbits/s 1 Mbit/s			65 225 400 500	ns

3.4.4.4 Voice interface

3.4.4.4.1 Microphone bias

Parameter	Remarks	Conditions	Min	Typ.	Max	unit
Vref	Differential voltage between MICP and MICN pins			1.5		V
Vrefp_acc	Accuracy of MICP voltage	Trimmed	-1		+1	%
Vrefn_m	Voltage from MICN to GND			0		V
Vrefp_load c	MICP load capacitance				20	pF
Rvrefp	MICP output resistance			10	15	Ohm
Nrefp	MICP peak noise	CCITT weighted		-100	-80	dBV
Srefp	MICP power supply rejection ratio		40			dB
Ivrefp	MICP output current	Minimal load must be applied	100		600	µA

3.4.4.4.2 Microphone input

Parameter	Remarks	Conditions	Min	Typ.	Max	unit
Vmic_0dB	Differential RMS input voltage between VXIP and VXIN for 0dBm0	0dBm0 at codec output = -3.14dB of max PCM value, microphone gain at minimum, @1020Hz		130		mV
Vmic_0dB_acc	Accuracy	Trimmed	-0.5		+0.5	dB
Vmic_cm	VXIP/VXIN commom mode voltage			0.9		V
Vmic_gain	Microphone gain	Software controlled, 16 steps	0		30.1	dB
Vmic_gain_acc	Microphone gain accuracy		-0.75		+0.75	dB
Rmic_diff	Differential input impedance between VXIN and VXIP		150			kOhm
Vmic_offset	Input referred DC-offset	Microphone gain at maximum	-2.6		+2.6	mV

3.4.4.4.3 Speaker output

Parameter	Remarks	Conditions	Min	Typ.	Max	unit
Differential RMS output voltage between VXP and VXN		0dBm0 at codec input = -3.14dB from max PCM value, speaker gain = 0.0dB, load circuit acc. to section 3.6.4.1, @1020Hz		0.69		V
Differential Output Impedance between VXP and VXN				2	5	Ohm
Load resistance			30			Ohm
Load capacitance		RL = 00 Rl < 1kohm			100 30	pF
Speaker gain		Software controlled	-12		2.2	dB
Absolute speaker gain accuracy			-0.75		+0.75	dB

3.5 Environmental Conditions

Parameter	Remarks	Conditions	Min	Typ.	Max	unit
Ta_op	Operational temperature		-20	+25	+70	°C
Ta_st	Storage temperature		-40		+90	°C
H	Humidity	Non condensing	0		95	%

3.6 Interface Description

3.6.1 System connector

The interface to the host system is implemented as a 50 pin 1.27mm grid female connector. The part used on the HW 86050 module is a Plastron SPNBF-50-B-0, which is compatible to Samtec CLP-125-02-G-D-BE.

It is recommended to connect the module with a pin header by bottom entry method, i.e. through the printed board. This allows for best space saving and the RF connectors are accessible in mounted position.

Suitable pin header connectors are available from different manufacturers, such as Plastron, Samtec or others. The pin length determines the module's height above the host circuit board, depending whether components shall be fitted underneath the module.

Find a list of parts below as a suggestion. Contact Höft & Wessel AG for accessories.

Manufacturer	Part No.
Plastron	SPNZ-50...
	SPNB2-50...
Samtech	FTSH125-01...
Others	...

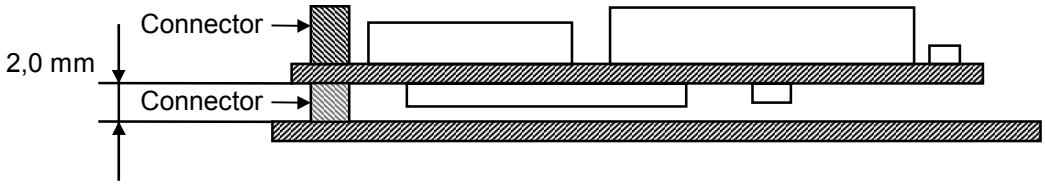


Figure 1: No components fitted on target PCB below HW 86050. Minimum distance between PCBs 2,0 mm

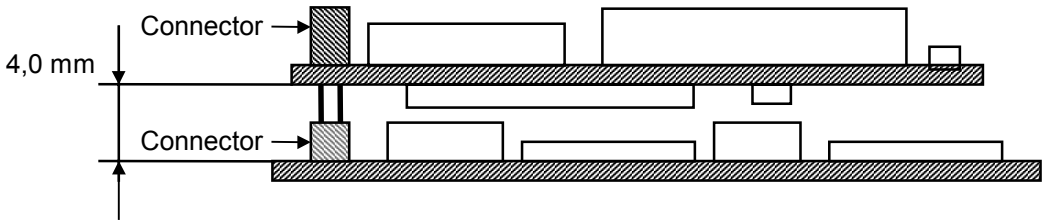


Figure 2: Components fitted on target PCB below HW 86050. Distance between PCBs depend on component heights (here: 4,0 mm)

3.6.2 UART Interface

The HW 86050 module provides a fully featured RS232 serial interface. All interface signals are 3.3V CMOS level and are active at logical low state. A V.24 line driver must be provided in order to connect to a standard V.24 device, e.g. a PC.

NOTE!

Connecting the module to a V.24 line without external line drivers may damage the module.

Signal	I/O	Description
TXDI	I	serial data from host to HW 86050
RXDO	O	serial data from HW 86050 to host
RTSI	I	hardware handshake from host to HW 86050
CTSO	O	hardware handshake from HW 86050 to host
DTRI	I	ready signal from host to HW 86050
DSRO	O	ready signal from HW 86050 to host Transparent mode (SWAP): asserted if SWAP connection is established PPP Mode: tbd TCP/IP Mode: tbd
DCDIO	I/O	carrier detect modem lead signal configured as output Transparent Mode: Indicates WLAN association state, i.e. active if associated to an AP or a peer-to-peer network PPP Mode: Asserted if a PPP connection is established TCP/IP Mode: tbd
RIIO	I/O	ring indicator modem lead signal not used - configured to output, not active

Some of the RS232 signals are used to control mode selection during hardware reset. Refer to section 3.6.6 for details.

NOTE!

The UART interface does not support the transmission of break signals as these have a special purpose function in Höft & Wessel devices. Do not apply break conditions unless specified by Höft & Wessel. Make sure that a break condition is not applied during power-up transient conditions.

3.6.3 SPI Interface

The Serial Programming Interface provides a performant serial interface to control the module and for user data. The module will act as SPI master device and therefore control SPI clock.

Signal	I/O	Description
SPIDO	O	SPI data out
SPIDI	I	SPI data in
SPICLK	I/O	SPI clock

This feature is not supported in all firmware releases.

3.6.4 Voice Interface

Analogue voice interface is provided by hardware. The interface provides differential input and output as well as microphone bias generation and is suitable for connecting differential mode handsets or headsets.

Signal	I/O	Description
VXOP	O	analogue speaker output positive
VXON	O	analogue speaker output negative
VXIP	I	analogue microphone input positive
VXIN	I	analogue microphone input negative
MICBP	O	microphone bias voltage positive
MICBN	O	microphone bias voltage negative

This feature is not supported in all firmware releases.

3.6.4.1 Connection of microphone and speaker

Figure 3 shows a typical circuit to connect a speaker and electret microphone.

The values of the components must be chosen such that

- Together with the input impedance of the pre-amplifier the AC coupling capacitors C1 and C2 form a transfer function with a zero at a frequency low enough to avoid unacceptable ripples in the considered signal bandwidth.
- A very low frequency pole (below 50 Hz) is formed by the capacitor C4 and the series resistors R1 and R2.
- The microphone biasing current is set such that the required sensitivity target is met. This depends on the microphone characteristics.
- System performance may be further enhanced by an additional capacitor C3 that filters out the peak of the cavity resonance. The value depends on the physical characteristics of the microphone housing.

Component values in Figure 1 are typical for a low impedance microphone (less than 3 kΩ).

Note that all signals are dc-coupled to the microcontroller.

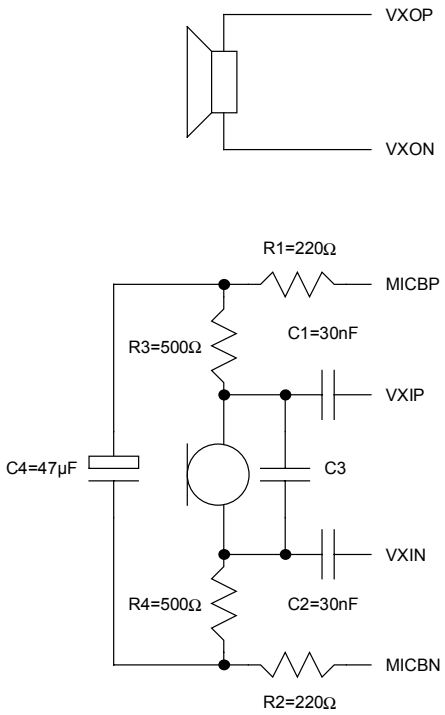


Figure 3: Electrical connection of microphone and speaker

3.6.5 ADC/PWM Interface

This interface is used to capture and reproduce analogue signals with low bandwidth.

Signal	I/O	Description
ADC	I	analogue speaker output positive
PWM	O	analogue speaker output negative

This feature is not supported in all firmware releases.

3.6.6 Reset Interface

The reset interface is used to reset the HW 86050 module and its external peripherals.

Signal	I/O	Description
RSTBI	I	Reset input, ac-coupled, triggers on falling edge
RSTNO	I/O	Reset output, active low
BOOT0	I	download mode selection
BOOT1	I	download mode selection
BOOT2	I	data / configuration mode selection
BOOT3	I	data / configuration mode selection

A reset at the HW 86050 module occurs in the following situations:

- Power on reset
- low voltage detected from internal supervisory circuit
- software reset
- external reset through RSTBI signal
- external reset through RSTNO signal

The HW 86050 module may simply be reset through the reset interface, but additionally certain reset sequences are used to change the module's operational modes:

- Data mode – normal operation with user data transfer

- Configuration mode – allows for configuration commands to be entered in order to change the software settings
- Download mode – a new firmware binary may be downloaded to the module's flash memory.

To support theses modes the module must reliably distinguish an external reset from any other reset (collectively referred to as internal resets). This is achieved through appropriate reset timing. The host, which initiates the external reset must pull the RSTBI signal down. This will physically reset the HW 86050 module as can be observed on the RSTNO output.

After termination of its internal reset cycle, the HW 86050 will raise the RSTNO signal and firmware starts execution. In an early stage of program execution the firmware will test the value of the RSTBI signal. An external reset is indicated by a logical low.

At power-up the HW 86050 is automatically reset by the internal supervisory circuit.

A reset by the host processor (using the RSTBI signal) is needed in order to:
- start **download mode**
- start **configuration mode** (however, a software configuration mode may be entered by applying an escape sequence, see section 4.2.2.
- change from one of the above modes to normal operation (**data mode**), except the software configuration mode entered by an escape sequence.

If none of these functions are required by the application, the RSTBI pin may be left open. In any case, taking provisions for potential firmware downloads is a substantial advantage for the future-proofness of your product. Use the configuration mode reset in your application e.g. if you cannot operate at the initial serial speed or want to avoid the escape sequence to be transferred through the data channel. Also, a few commands may not be available during escape sequence configuration mode.

3.6.6.1 Reset timing (external reset)

In order to make sure that an external reset is detected correctly by the firmware, the host must pull RSTBI down sufficiently long time. The exact timing requirements are indicated in Figure 4.

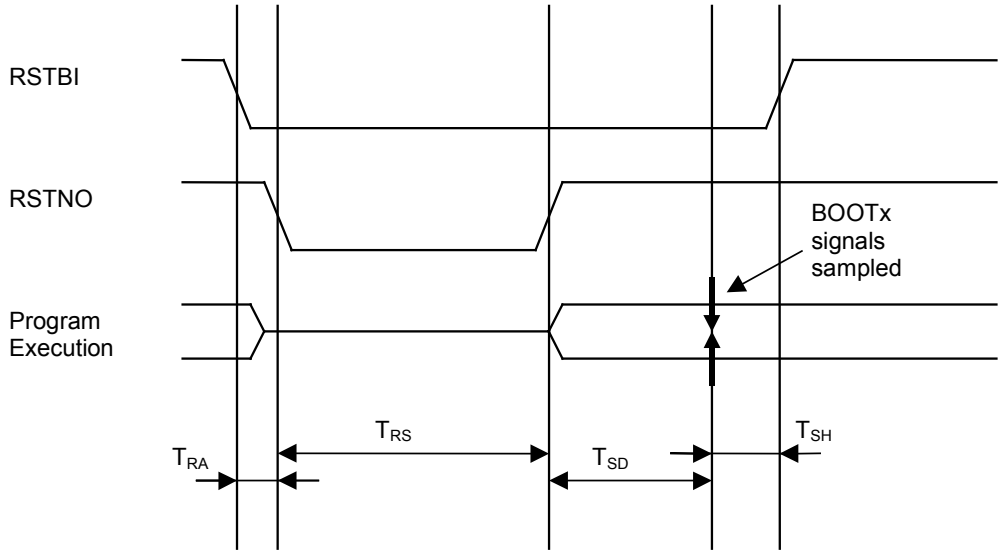


Figure 4: Reset Timing

Parameter	min.	max.
T_{RA}		11 µs
T_{RS}	100 ms	860 ms
T_{SD}	18 µs	100 ms
T_{SH}	100 µs	

The host hardware can be sure to generate external reset pulses of sufficient length, if

- either it observes the RSTNO signal and keeps the RSTBI signal LOW at least 100ms after the rising edge of RSTNO, or
- it applies a RSTBI pulse of at least 960ms.

The latter method is simpler but also slower.

T_{RS} specifies the duration of the reset pulse, it depends on component tolerances, temperature and operating voltage. It may be variable.

T_{SD} specifies the time where the status of BOOTx lines is latched. It depends on the firmware implementation and may vary between different firmware versions.

3.6.6.2 Short Reset

A short reset is a low-active RSTBI pulse that is shorter than the RSTNO pulse.

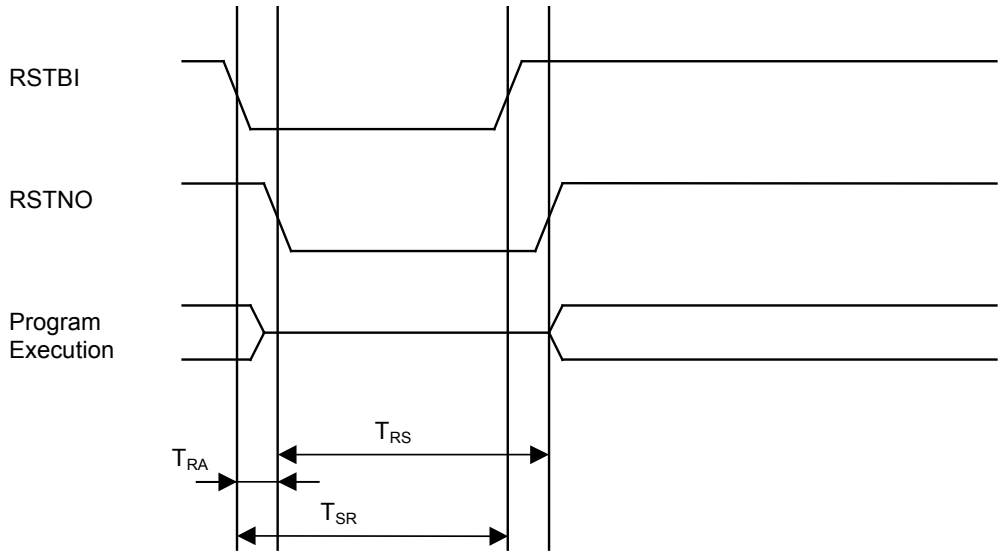


Figure 5: Short Reset

Parameter	min.	max.
T_{SR}	5ms	50ms

Although it is triggered by the RSTBI signal the firmware of the HW 86050 treats a short reset as an internal reset. The host hardware may use this feature to emulate a power-up reset to the HW 86050. A short reset will lead to normal start of firmware unless BOOT0 and BOOT1 pins are pulled low from external circuitry. In this case the download mode is entered.

3.6.6.3 Activation of Download and Configuration Mode

During any reset (internal or external) interface signals BOOT0, BOOT1 overload the normal function of these signals (CTSO, DSRO). They are used to activate download mode if pulled low from external circuitry.

If case of an external reset (RSTBI held low after rising edge of RSTNO) the BOOT2 and BOOT3 signals are evaluated in order to activate configuration mode or normal start of firmware (data mode).

The following table gives an overview on how the modes are selected. Combinations other than specified must not be applied.

RSTBI	**BOOT0 (CTSO)**	**BOOT1 (DSRO)**	**BOOT2 (RTSI)**	**BOOT3 (DTRI)**	**Function**
X	LOW	LOW	X	X	Enable firmware **download mode**
LOW	HIGH	HIGH	HIGH	HIGH	Enable firmware **configuration mode**
LOW	HIGH	HIGH	LOW	HIGH	Normal start of the firmware (**data mode**)
HIGH	HIGH	HIGH	X	X	

X: don't care

RSTBI, BOOT0, BOOT1, BOOT2 and BOOT3 are latched at the rising edge of RSTNO + T_{SD}. All signals have internal pull-ups and may be left unconnected if not used. In order to avoid unwanted switches to firmware download mode, the host device shall take care that BOOT0 and BOOT1 are driven low only together with RSTBI driven low. For normal firmware start RSTBI shall not be held low. In case of external reset BOOT2 and BOOT3 shall be used as normal RS 232 signals after RSTBI is released.

The evaluation kit HW 86956 contains adapter boards that support firmware download and configuration mode reset from a standard PC COM port as well as the required software tools.

3.6.6.4 Precautions to avoid Reset Problems

The host hardware must assure an appropriate environment that avoids unwanted resets. The reset behaviour is a main source of integration problems and requires specific attention.

Please make sure that the following conditions are fulfilled during operation:

V3P3 must not drop below 2.63 V. This will trigger a low voltage reset.

At power-up of the HW 86050 the RSTBI signal should be either high impedance (not connected) or logic HIGH if data mode is required. A logic LOW during power-up may be interpreted as external reset and may result in unwanted mode selection.

If the host hardware is not able to assure the appropriate RSTBI level during power-up, it may use a short reset afterwards to emulate a power-up reset.

DSRO and CTSO are outputs of the HW 86050. The host hardware must never actively drive these signals for any other purpose than entering the download mode.

The external reset is triggered by the falling edge of the RSTBI signal. Make sure that the fall time (90% down to 10% of V3P3) is less than 50ns.

3.6.7 I2C Interface

I2C Interface is provided by the hardware. This feature is not supported in all firmware releases.

3.6.8 PCM Interface

PCM Interface is provided by the hardware. This feature is not supported in all firmware releases.

3.6.9 General Purpose I/O

HW 86050 provides 12 general purpose I/O pins GPIO1 to GPIO12. They are enabled by firmware. Since most signals are multiplexed with other interface signals, certain resctrictions to the usage of GPIO signals apply.

This feature is not supported in all firmware releases.

3.6.10 LED interface

LED0 and LED1 outputs are provided. They may be used to control two LEDs to display connection and configuration mode and data activity.

Signal	State	Description
LED0	LOW	LED0 off
	HIGH	LED0 on
LED1	LOW	LED1 off
	HIGH	LED1 on

LED0	LED1	Meaning
•	•	Power off condition or firmware download
☼☼••	•	Power on, not connected (slow blink)
☼	•	Connection to base station established, flickers while data is transmitted.
•	☼	Device has entered configuration mode.

Note that current capability is limited so that an external LED driver may be required.

This functionality is deactivated by default and must be activated by software.

3.6.11 Bus Interface

The bus interface allows for external peripherals to be accessed by the module. The 8-bit data bus and 5-bit adress bus, together wih control signals, including chip select, DMA and interrupt signals allows for a variety of external peripherals to be accessed by the module.

Signal	I/O	Description
A0 .. A5	O	Adress bus
D0 .. D7	I/O	Data bus
RDN	O	Read signal, active low
WRN	O	Read signal, active low
EXTCS	O	Chip select signal, active low
EXTINT	I	Interrupt request signal, active low

This feature is not supported in all firmware releases.

3.6.12 RF Interface

RF Interface provides two antenna connections, main antenna jack and aux antenna jack.

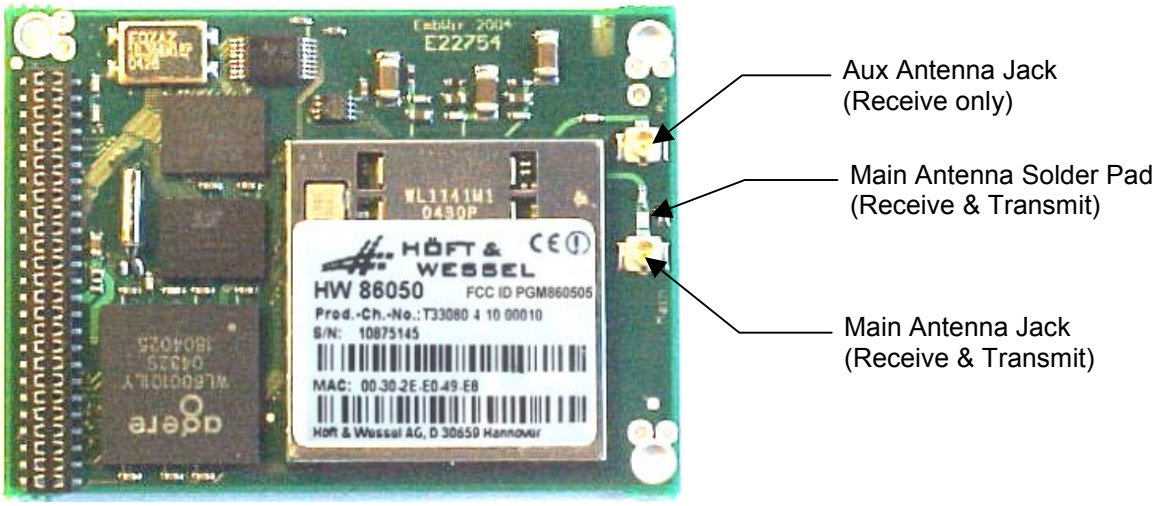
The module supports reception antenna diversity. „Main“ antenna jack is used for both transmit and receive, while „Aux“ antenna jack is used for receive only. During reception of data, the module measures the signal strength on both antennas and activates the antenna with highest level for reception of a data packet. This will significantly improve operation for example in multipath enviroments, utilising the effect that fading is space dependant and one of the two antennas will most propably experience less fading than the other.

In case only one antenna shall be used is must be connected to the main antenna jack.

The part used on the module is a Hirose U.FL series connector, type U.FL-R-SMT, reference no. CL331-0471-0. Refer to www.hirose.com for details.

Adequate cable sets are available with the Hirose connectors already mounted. Contact Höft & Wessel AG for accessories.

Antenna design is the most crucial topic during integration of radio systems. The antenna shall provide good omnidirectional characteristics or a certain directional pattern, depending on the application. Using poor antennas may lead to significant degradation of system performance or influence the reliability. See section 6.4 for recommendations.



4. Firmware Description

4.1 Overview

The module operates in different modes:

- Data Mode allows transfer of user data
- Configuration Mode allows configuration
- Download Mode allows firmware upgrade

The module's operation mode can be selected either by an appropriate reset sequence or by software escape commands. The download mode can only be selected by a reset sequence.

4.2 Configuration Mode

In this mode hard- and software parameters may be set or monitored through the RS-232 port or a wireless link.

4.2.1 Entering the configuration mode

The configuration mode is entered either by a specific reset sequence (see section 3.6.6) or by an appropriate escape command from any of the data sub-modes (see section 4.2.2). When entered by an external reset, the RS-232 port is always operated at 9600 Bd and ignores the baud rate parameter setting.

4.2.2 Escape Sequence to enter Configuration Mode

The configuration mode may be entered by a dedicated escape sequence **+-+** that may be applied to the module on the serial line, using the currently configured line settings (default settings: 115.2 kbps, 8n1). The module must be in normal operation (data mode).

- Before the first + character and after the last + character there must be a pause of at least 500 ms
- Between two characters of the escape sequence the maximum allowed pause is 200 ms
- Note that CR or LF characters must not be applied

4.2.3 Configuration protocol

Configuration mode uses a simple ASCII-based configuration protocol. The controlling unit (host) acts as master while the module acts as slave.

1. The master sends a configuration command. This is a valid command string as described in section 4.2.6. The command is terminated by **<CR><LF>**.

2. Depending on the command given, the module may respond with a response string. This is always terminated by **<CR><LF>**. The response string may contain multiple lines of text. In this case every line is terminated by **<CR><LF>**.

3. The module sends a return code. See section 4.2.4. The return code is terminated by <CR><LF>. This completes the command.

4. The protocol continues at step 1.

By completion of step 3 any modified configuration data has been saved in the non-volatile memory of the HW 86050.

4.2.4 Return Codes

The return codes provided in the configuration mode are given below:

Return Code	**Description**
OK	Command successful
ERROR 1	Command failed
ERROR 2	Command invalid
ERROR 3	Command parameter invalid
ERROR 4	Subscription table full
ERROR 21	Invalid character at command start
ERROR 22	Unexpected argument (Get or Information command)
ERROR 23	Argument missing (Set or Delete command)
ERROR 24	Wrong argument type
ERROR 25	Wrong number of arguments
ERROR 26	Internal conversion error
ERROR 44	Wrong character, where octal digit was expected
ERROR 45	Invalid character in checksum
ERROR 46	Wrong checksum
ERROR 47	Checksum too long
ERROR 53	unsuitable environment
ERROR 60	SPCUST string too long
ERROR 90	command too long
ERROR 91	init data corrupted
ERROR 93	wrong firmware

4.2.5 Leaving the configuration mode

The configuration mode is terminated by a hardware reset sequence or by the EXIT configuration command, respectively.

4.2.6 Command Overview

Those commands starting with „S“ (set) will set parameters while those starting with „G“ (get) will read the actual setting.

Command	Description	Remarks	Default
SPSSID [ssid] GPSSID	configures network name	ssid length 1..32 characters	„“
SPINFRA [„on“/„off“] GPINFRA	selects infrastructure or Peer-to-Peer (Ad-hoc) mode	On = Infrastructure Off = Peer-to-Peer (Ad-hoc)	„on“
SPCH [channel] GPCH	selects RF channel, valid for Peer-to-Peer (Ad-hoc) mode	channel = „1“..“11“	„1“
SPMCR [rate]	configures RF multicast rate	rate = „1“ .. „4“ 1 = 1 Mbps 2 = 2 Mbps 3 = 5,5 Mbps 4 = 11 Mbps	„2“
SPTXR [n] GPTXR	configures RF Tx Rate	n = „1“..“7“ 1 = 1Mbps 2 = 2Mbps 3 = Auto fallback high (11, 5.5, 2, 1 Mbps) 4 = Fixed medium rate (5.5 Mbps) 5 = Fixed high rate (11 Mbps) 6 = Auto fallback standard (2, 1 Mbps) 7 = Auto fallback medium (5.5, 2, 1 Mbps)	„3“
SPWEP [„on“/“off“] GPWEP	enables WEP encryption	WEP encryption strongly recommended	„off“
SPSELKEY [key] GPSELKEY	selects key used for encryption of transmitted data	key = „1“..“4“ any of keys 1..4 used for received data decryption	1
SPKEY [n] [key] GPKEY [n]	40- or 104-bit WEP key	key = 5/13 digits for 40/128 bit Ascii-coded, 10/26 digits for 40/128 bit hex-coded. n=“1“..“4“ return value „1“: key valid return value „0“: key not valid	„“
SPPM [“on“/“off“] GPPM	enables Power Save Mode	„on“ = Power Save Mode enabled (must be enabled at Access Point, data latency may occur) „off“ = Power Save Mode disabled	„off“
SPPMHOD GPPMHOD	configures Power Save Mode Hold Over Duration	n = “1“..“1000“ Time in TU that station remains in awake state after MAC frame transfer if PM on, TU = 1024us	„100“
SPPMMSD [n] GPPMMSD	configures Power Save Mode Maximum Sleep Duration	n = “1“ .. „65535“ Maximum time in TU that the station is allowed to spend consecutive in Doze mode if PM on, TU = 1024us	„100“
SPPMMRX [„on“/“off“] GPPMMRX	enables Multicast Receive when in Power Save Mode	„on“ = Multicast packets will be received „off“ = Multicast packets will not be received	„on“
SPDAP [distance] GPDAP	configures Distance between Aps	distance = „1“ .. „3“, threshold for roaming	„1“
SPMWR [„on“/“off“] GPMWR	enables Microwave Robustness	„on“ = packet length will be reduced by segmentation on air interface to reduce potential interference „off“ = normal operation	„off“
SPCIBSS [„on“/“off“] GPCIBSS	enables creation of Independant Basic Service Set, valid for Peer-to-Peer (Ad-hoc) mode	at least one of the stations in a Peer-to-Peer (Ad-hoc) network must create IBSS	„off“
SPPP GPPP	enables PPP mode		„off“
SPECC GPECC	configures enhanced call control mode	„on“ = DTRI ignored, connection will always be active „off“ = DTRI not ignored, connection activated while DTRI active	„off“
SPCOM [m“,“hs] GPCOM	configures serial port parameters	m = „8,N,1“ hs = “RTSCTS“ enables handshake or hs = „NONE“ disables handshake	„8,N,1, RTSCTS“
GHRSSI	outputs RSSI values	outputs Signal-Noise ration in dB, received signal strength in dBm, received noise level in dBm	
GECHO <num> <p_size> <to_total> <to_packet>	Module sends layer 2 pings to SWAP server, which will echo packets bak to the module	Used for link test if a SWAP server is available. Only available in hardware configuration mode. Num: number of packets send (1..tbd) P_size: packet size (32..1500) To_total: timeout for command in ms (1...tbd)	

		To_packet: packet timeout in ms (1..tbd) Return values: <packets_ok>, <packets_to>, <time_total>, <packets_1_mbit>, <packets_2_mbit>, <packets_5_5_mbit>, <packets_11_mbit>	
GLINKTEST <num_packets> <packet_size> <timeout_total> <timeout_packet>	Modules sends L2 pings to access point, which will echo data packets along with information on signal and noise levels at AP.	Access point must support Wavelan II Management Protocol. Allows for complete link test information. Num: number of packets send (1..tbd) P_size: packet size (32..1500) To_total: timeout for command in ms (1...tbd) To_packet: packet timeout in ms (1..tbd Return values: <packets_ok>, <packets_to>, <time_total>, <rcvd_1_mbit>, <rcvd_2_mbit>, <rcvd_5_5_mbit>, <rcvd_11_mbit>,<last_local_snratio_dbm>, <last_local_signal_dbm>, <last_local_noise_dbm>,<xmit_1_mbit, xmit_2_mbit>, <xmit _5_5_mbit>, <xmit_11_mbit>,<last_remote_snratio_dbm>, <last_remote_signal_dbm>, <last_remote_noise_dbm>	

SPBD GPBD	configures serial port baud rate, data mode	bd = „9600“, „19200“, „57600“, „115200“, „230400“	„115200“
SPTM [tm]	configures SWAP mode	tm =„PT“: module operates as SWAP client, used in infrastruture mode or Ad-hoc (Peer-to-peer) mode tm = „FT“: mode operates as SWAP server, used in Ad-hoc (Peer-to-peer) mode only.	„PT“
GALL	outputs an overview on most important settings and information		
GHETH	outputs device's MAC adress		
GHALL	returns module type and flash type		
GHTY	returns module type		
GSALL	returns important software information		
GSVER	returns software version		
GNSER	outputs device's serial number		
GPALL	outputs important parameter settings		
IPBD	outputs available serial data rate settings		
GOK	returns „OK“	used to test if configuration mode is active	
EXIT	exits configuration mode	only if software configuration mode	

4.3 Data Mode

The data mode is used to actually transfer user data. Several modes of operation are available to fit different applications.

- **Transparent Mode**

  The module‘s interface works transparently, user data are are directly transferred, no protocol implementation required.

- **PPP Mode**

  The module's interface works in PPP (point-to-point protocol) mode. The module integrates a PPP server to which the host system‘s PPP client connects. Once established, the PPP link carries TCP/IP traffic. Host application runs TCP/IP stack.

4.3.1 Transparent Data Mode

The transparent data mode is a sub-mode of the data mode. It allows transparent data transmission using the RS-232 interface. All data is treated as a stream, no specific framing is required.

4.3.1.1 Peer-to-Peer Mode

This mode is restricted to a point-to-point connection. Both modules involved operate in transparent data mode. The termination must be different, one must be FT, the other must be PT terminated. Call control is provided by the modem lead lines.

4.3.1.2 Infrastructure mode

This mode is useful for many applications as no protocol is neccessary on the module‘s host system although a networking structure can be realised. Just plain user data are transferred on the interface. As an example, an application that used to be operated directly on a serial line can now easily be transferred to WLAN infrastructure operation, without changing the host system software.

As a couple of HW 86050 WLAN clients need to be multiplexed on the server side, a dedicated protocol is used internally in the modules: SWAP (Secure Wireless Access Protocol) is based on PPPoE (RFC 2516) and LAP and allows for protected data link with adequate performance on the WLAN radio link and further on the wired network. The Data-Unwired embedded module implements the SWAP client - invisible to the user. The SWAP server is located in the network behind the AP and terminates the SWAP connection. The host application may, as shown in figure 1, communicate with the SWAP server in various ways.

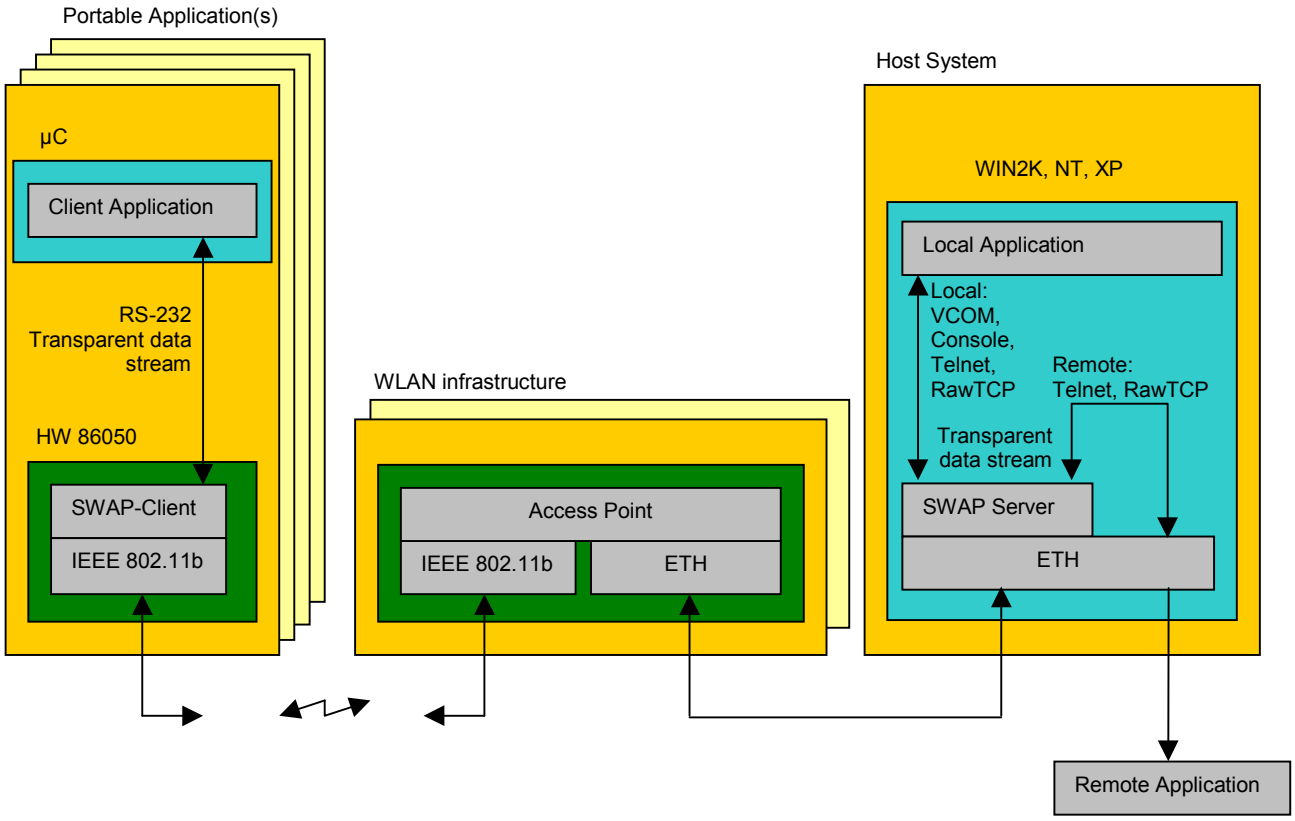


Figure 7: Wireless network using SWAP server, client application working transparently

4.3.2 PPP Data Mode

The module may be configured to operate a PPP server. The host application's PPP client may initiate a PPP connection to the module, having the opportunity to use it's own IP adress or to trigger the module to receive an IP adress from the network using DHCP. DNS and WINS server adresses, net mask and standard gateway may as well be configured automatically.

PPP mode may be used in systems implementing TCP/IP stack and PPP protocol. It allows to connect to the LAN directly through the WLAN infrastructure similar to a modem dial-up connection.

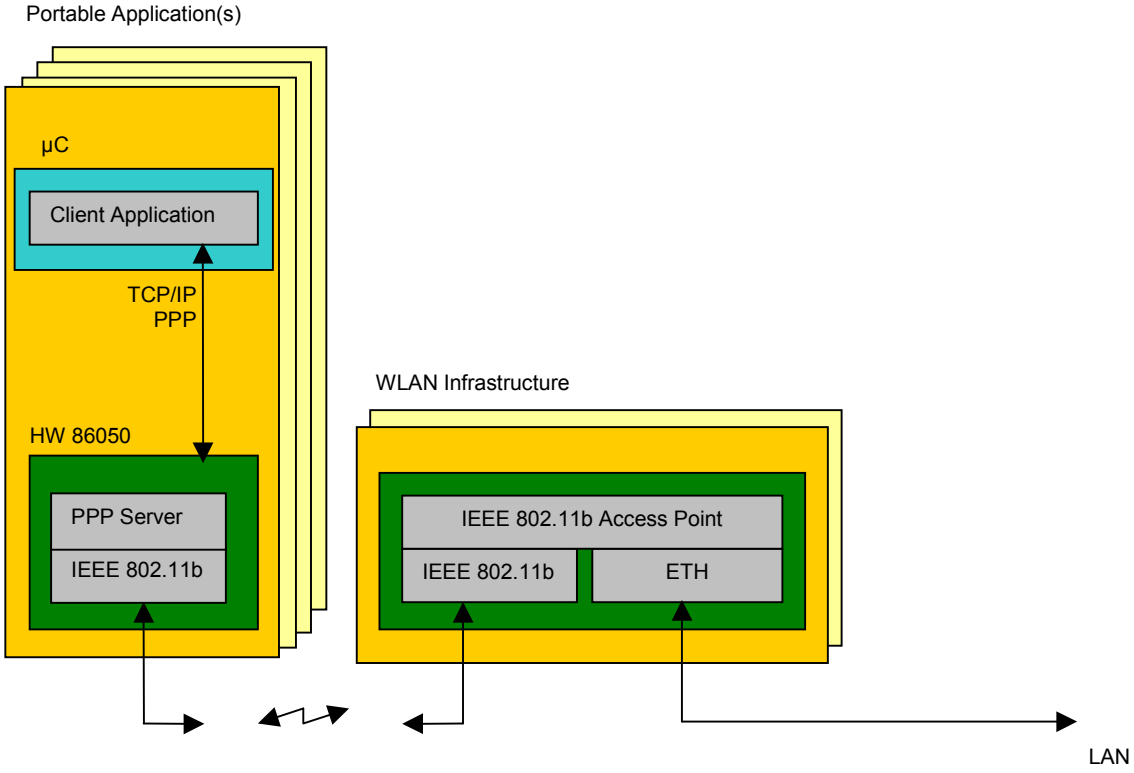


Figure 8: Wireless network in PPP mode

4.4 Firmware Download Mode

This section describes how firmware is downloaded in the HW 86050.

In order to perform firmware download the HW 86050 must be switched into Download Mode.

While in Download Mode the HW 86050 uses a simple download protocol for downloading the firmware via the RS-232 interface.

4.4.1 Entering the Download Mode

The download mode is entered depending on the status of the BOOT0 and BOOT1 signals during reset. See section 3.6.6 for details.

4.4.2 Usage of the RS-232 interface

In download mode only signals TXDI and RXDO are used. No flow control is applied.

When the download mode is started, the baud rate of the RS-232 interface is set to 9.600 Bd. However after the first pass of the download protocol the data rate is increased to 115.200 Bd.

4.4.3 Download procedure

Firmware as it is provided by Höft & Wessel consists in two files:

- A loader file (xxx.ld) that is loaded first into the module and provides the mechanisms for loading the firmware into the Flash memory of the module
- A firmware file (xxx.hp) that contains the firmware to be stored in Flash memory

See section 8.3 for a specification of the download protocol.

5. Getting Started

This section explaines step by step how to configure a HW 86050 module to operate in different scenarios. It is required to enter the module's configuration mode. In configuration mode the modules can be configured using simple text-based commands. The modules can be brought into hardware configuration mode reset (see section 3.6.6) or a reset sequence being entered using a terminal programm.

To start the configuration mode with a terminal program apply a connection to the module's serial port and set the terminal line settings to 115200bps, 8n1. Enter the sequence **+-+** on the terminal program, with the following timing:

- Before the first + character and after the last + character there must be a pause of at least 500 ms
- Between two characters of the escape sequence the maximum allowed pause is 200 ms

In configuration mode the module will respond to commands received via the serial interface. All commands have to be terminated by [↵] (RETURN key).

Try

GOK↵

to verify that the module is in configuration mode. It should answer with „OK".

5.1 Infrastructure Mode

For transparent connections the **Höft & Wessel SWAP Service** must first be installed and configured. See section 8.1.

A Wireless LAN infrastructure consists of one or more Access Points. For the use with the HW 86050 module APs shall support IEEE 802.11b standard.

HW 86050 modules operate as WLAN clients. The following settings are neccessary to connect to the WLAN infrastructure, parameters such as keys and SSID are examples, use those applied on your Access Point(s):

Make sure infrastructure mode is active and module is configured to SWAP client mode (both default settings).

SPINFRA on↵
SPTM PT↵

Set the network name that is applied in the Access Point(s). The encryption should be enabled and the encryption key must be entered and selected.

SPSSID MyWLANNetWork↵
SPWEP on↵
SPSELKEY 1↵
SPKEY 1 13DGTASCIIKEY↵

Now enter

EXIT↵

(software configuration mode) or **reset the module** (hardware configuration mode) in order to apply changed settings.

The HW 86050 will now associate to the specified infrastructure. Change to hardware configuration mode and check the received signals strength using the

GHRSSI↵

command (not available in software configuration mode). If other than 0,0,0 is responded than association was successful.

Now **reset the module** (hardware configuration mode) and change to data mode.

Once the module is associated to the WLAN infrastructure it will connect to a SWAP server. Make sure **DTRI is active** or enter

SPCC 1↵

to configure the module to ignore DTRI and always connect immediately to a SWAP server.

A SWAP server is found if DSRO is active.

5.2 Peer-to-Peer Mode

Two modules may set-up a point-to-point connection without the need of an Access Point.

One module needs to be the SWAP client and the other will be SWAP server.

Module 1	Module 2
SPTM FT↵	**SPTM PT↵**

Disable infrastructure mode on both modules.

SPINFRA off↵	**SPINFRA off↵**

Enable IBSSID creation on one module and make sure power save mode is off on the other.

SPCBISS on↵	**SPPM off↵**

Choose the same channel on both modules.

SPCH 6↵	**SPCH 6↵**

Enter network name and encryption data on both modules.

SPSSID MyWLANNetwork↵	**SPSSID MyWLANNetwork↵**
SPWEP on↵	**SPWEP on↵**
SPSELKEY 1↵	**SPSELKEY 1↵**
SPKEY 1 13DGTASCIIKEY↵	**SPKEY 1 13DGTASCIIKEY↵**

Now enter

EXIT↵

(software configuration mode) or **reset the module** (hardware configuration mode) in order to apply changed settings and change to data mode.

A transparent link between the modules is now available.

6. Specific Integration Topics

6.1 Power supply

The power supply must be chosen so that the maximum current during transmit pulses can be delivered. Keep in mind that an antenna which is not sufficiently matched to the tranmitter impedance will signicicantly increase the transmitter current draw.

Both power supply rails are designed to work at 3.3V nominal. The higher voltages specified for VBATP will enable compatibility to HW 86010 and HW 86020 modules. As a LDO regulator is used to generate the onboard voltage of 3.3V it is recommended to use a voltage close to 3.3V if effiency is a matter.

6.2 Worldwide Usage of Radio Spectrum

The HW 86050 operates on the license-free 2.4GHz ISM band. This band may be used in most parts of the world. However, regional restrictions may apply.

NOTE!

Refer to national regulations of the region where the HW 86050 module shall be operated and make sure the national requirements are fulfilled.

The HW 86050 operates the so-called world mode, which includes operation on IEEE 802.11b channels 1 to 11. It may therefore be used in most parts of europe and in the United States of America and Canada, for example. Other regions may require a different channel set.

6.3 Type approvals

6.3.1 Europe

The HW 86050 has been tested towards ETSI EN 300328[1] in a reference design. After design-in it is required to perform EMC test according to ETSI EN 300 489-3[2] with the host application. It will usually not be required to perform another radio test during certicifaction testing as the module test can be applied. Once approved and CE marked, the system may be applied in the different countries without the need to have country-specific approval test. However, a notification procedure must be performed in the countrys of the European Union, which has been performed by Höft & Wessel for this module. Note that restrictions in the operation of IEEE 802.11b applications apply in some European countries. Contact Höft & Wessel to assist you in conformance testing, approval and notification procedures.

[1] Electromagnetic compatibility and Radio spectrum Matters (ERM); Wideband Transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using spread spectrum modulation techniques; Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive.

[2] Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 40 GHz.

6.3.1.1 EU Declaration of Conformity

HÖFT & WESSEL

CE

EU – Konformitätserklärung
EC - Declaration of Conformity

gemäß dem Gesetz über Funkanlagen und Telekommunikationsendeinrichtungen (FTEG) und der Richtlinie 1999/5/EG (R&TTE)
in accordance with the Radio and Telecommunications Terminal Equipment Act (FTEG) and Directive 1999/5/EC (R&TTE Directive)

Hersteller / Manufacturer:	Höft & Wessel AG
Anschrift / Address:	Rotenburger Straße 20, D-30659 Hannover, Germany
Produkt / Product:	Embedded WLAN-Modul
Typ / Type:	**HW 86050**

Höft & Wessel AG erklärt, dass das bezeichnete Produkt bei bestimmungsgemäßer Verwendung den grundlegenden Anforderungen des § 3 und den übrigen einschlägigen Bestimmungen des FTEG (Artikel 3 der R&TTE-Richtlinie) entspricht.
Höft & Wessel AG declares that the product complies with the essential requirements of §3 and the other relevant provisions of the FTEG (Article 3 of the R&TTE Directive) when used for its intended purpose

Angewendete harmonisierte Normen / Harmonised standards applied:

Luftschnittstelle bei Funkanlagen gemäß § 3 (2) (Artikel 3 (2))
Air interface of the radio systems pursuant to article 3 (2)

EN 300328 V 1.4.1

Schutzanforderungen in Bezug auf die elektromagnetische Verträglichkeit § 3 (1) 2 (Artikel 3 (1) b))
Protection requirements concerning electromagnetic compatibility according to article 3 (1) b

EN 301489-1 : 2002 EN 61000-4-3 : 1999
EN 301489-17 : 2002

Hannover, den 04.01.05
Place and date

Rechtsverbindliche Unterschrift
Name and signature

Dr. Werner Andexser
Höft & Wessel AG

6.3.1.2 EU Notification

The HW 86050 has been notified in the following list of EU countries and can be used without further actions. Paticulars towards local variations may change and can not be not guaranteed. Please refer to local authorities.

Country	Remarks
Austria	Special restrictions apply for outdoor usage.
Belgium	
Denmark	
Finland	
France	Restrictions apply in some departements.
Germany	Special restrictions apply for outdoor usage.
Greece	
Ireland	
Italy	Special restrictions apply for outdoor usage.
Luxemburg	
Netherlands	Special restrictions apply for outdoor usage.
Norway	
Portugal	
Poland	
Spain	
Sweden	
United Kingdom	

6.3.2 US

The HW 86050 has been tested towards FCC part 15 rules in a reference design and has achieved a FCC module certification. The system that integrates the module does not need to be retested towards FCC part 15 rules if all relevant specifications in this document are fulfilled. The complete system can be approved by a declaration of conformity (DOC) or by verification as appropriate. It must carry a label referring to the enclosed module. This exterior label can use wording such as the following: „Contains Transmitter Module FCC ID PGM860505" or "Contains FCC ID PGM860505".

The existing approval is limited to mobile devices. Portable devices need their own FCC authorization and an additional SAR evaluation according to §2.1093 of the FCC rules.

Please refer to the FCC rules for further details.

6.3.3 Other countries

Please contact Höft & Wessel to assist you in conformance testing or certification procedures.

6.4 Antennas

6.4.1 General Considerations

The antenna is the element that is resonsible of radiating the radio frequency energy generated by the transmitter and has to capture the energy emitted by other transmitters to feed it to the receiver of the HW 86050 module. Antenna design is among the most important topics of a module integration. It has big influence on the coverage range of your product. With a poor antenna design your product will not have the full coverage range of typical WLAN equipment. Many insufficiencies observed at radio systems can be solved with changing a poor antenna with a good one.

Höft & Wessel provides a set of antennas and accessories that can be used in many applications. Depending on the physical constraints of your application it may require special antennas, such as internal or miniature antennas. In depth RF experience is required in many cases. Contact Höft & Wessel if you need assistance with this topic. RF experts will be able to suggest antenna systems suitable for your application or develop application specific antennas. Most important parameters of antenna systems such as return loss and radiation diagrams can be measured to ensure antenna performance.

Basically, antennas shall be placed under the following considerations:

Internal antennas
- may only be used with plastic housings
- take care as some plastics are conductive and will attenuate RF signals
- avoid shielding the antennas with metal objects or PCBs
- keep the antennas far from electronic signals and components
- be particularly careful with fast signals (like µC bus signals), if they come close to the antennas there is a risk of receiver sensivity degradation by processor noise
- mismatching may occur if antenna comes too close to plastic materials, this situation must be considered when matching the antenna.

All antennas be placed
- so that few obstacle will be in the direct line of signals propagation
- away from large metal objects
- away from any electronic equipment.

Care must be taken when choosing an antenna for a specific application, as national regulations limit the maximum antenna gain. Refer to the appropriate national or regional regulations.

For information, the most important regulations are

6.4.1.1 European Regulations (ETSI)

In Europe (ETSI) the maximum radiated power is limited to 20 dBm, which equals 100 mW. If the HW 86050 module has a maximum power output of 17 dBm the antenna system must not provide more than 3 dBi gain. The antenna system consist of cable, connectors and the radiator itself. Assuming a cable loss of 2 dB, the antenna may have a gain of 5 dBi maximum. A 10 dBi antenna may be used if cable losses are at least 7 dB.

With these regulations long range systems are difficult to establish without reducing the transmitter output power. A solution would be to use the Main Antenna port with a low gain transmit antenna while the Aux Antenna port may be connected to a high gain receive antenna on both sides of a link. The effective gain is the addition of both antenna gains and may be increased without limits at the receiver path.

6.4.1.2 US Regulations (FCC)

If external antenna connectors shall be applied in the host application, FCC rules require the usage of non-standard antenna connectors in order to prevent users to misuse the system attaching equipment that may increase the output power above the specified limits. Using the HW 86050 module based on the existing FCC modular approval the antenna with part number E29776 must be used in combination with cable adaptor E29777.

6.5 Coverage range

A wireless system's range depends on quite a lot of physical parameters. Even for a well-defined system as IEEE 802.11b a global prediction on the actual radio coverage cannot be given, as the influencing factors from the surroundings are still most decisive.

For example, a dry mortarless construction may easily be penetrated by the WLAN radio signals, a concrete, steel armed wall however may absorb or reflect most of the radio energy. Also human bodies will significantly attenuate the radio signal if located in the path between transmitter and receiver.

In addition, reflections from objects of many kinds will effect multi path propagation. The signal on the direct path and multiple reflected signals, which differ in phase and amplitude will be combined and superimposed at the receiver. This so called fading effect results in interference and a potentially significant loss in signal strength.

A line-of-sight condition is desirable for best radio connections, however this is not a practical demand in most cases. As few obstacles as possible should be in the direct path between transmitter and receiver.

Using low gain antennas will typically provide a range of some 20..60m inside buildings and up to 300m outside buildings, depending on the environment.

Using high gain antennas will increase the range by a maximum of 100% for each 6dB of gain. This is valid for free space environment and will significantly decrease in complex environments such as inside buildings.

7. WLAN Basics

Wireless LAN according to IEEE 802.11b operate on the 2.4 GHz ISM band (2.400 .. 2.483,5 MHz). The applied modulation technique is Direct Sequnce Spread Spectrum (DSSS) with Complementary Code Keying (CCK). A static channel selection is used, whereas channels 1..13 may be used in Europe and channels 1..11 in the US. The signal occupies a bandwidth of about 22 Mhz (-30 dBr), whereas the channel spacing is only 5 MHz. In a multiple cell network topology, overlapping and/or adjacent cells using different channels can operate simultaneously without interference if the distance between the center frequencies is at least 25 MHz. Thus only three non-overlapping channels are avaiable.

The frequency channel that is used will be defined by the station creating a service set. In infrastructure mode scenarios this usually is the Access Point. In Peer-to-Peer networks it is one of the involved stations that shall create the service set. IEEE 802.11b recommends the operation on channels 1, 6, 11 or 1,7,13 respectively if non-overlapping channels are requeired. The HW 86050 module currently supports world mode channel set 1 to 11.

The HW 86050 client (not creating a service set) will scan the band for a beacon (passive scanning) and will then send a probe request to the station sending the beacon. This will respond with a probe response. In case the service set matches the client will continue sending an association request which will than be answered with an association response. If successful, the client is associated to the Access Point or to the Peer-to-Peer station resp. and is ready for data communication.

Air data rates of 1, 2, 5.5 and 11 Mbit/s are supported and will be continously negotiated by the involved radios according to the observed quality of the radio link, unless the auto-fallback feature is disabled.

Usually a WLAN radio will have its receiver enabled all the time which will consume a significant amount of current. IEEE 802.11b specifies a Power Save Mode. The WLAN client may disable its receiver and wake up after a specified time, just to observe the APs beacon. The AP will buffer data that are to be send to clients operated in power save mode and will notifiy the client in the beacon transmission if data are pending. Now, the client may wake up in order to request its data and will fall back to sleep mode afterwards. Power Save Mode must be implemented and enabled at both the client and the AP. Operation in power save mode will reduce effective data rate and increase latency times. Power save mode parameters may be configured according to the application’s demands on the client and the AP respectively.

WLAN traffic may be traced if appropiate equipment is at hand. Therefore it is strongly recommended to enable security features such as WEP or WPA encryption. Refer to the AP documentation to find out more about your AP’s security features such as hiding the SSID transmission or MAC filtering, for example.

8. Appendix

8.1 Data-Unwired SWAP Service

Data-Unwired SWAP Service is a service for Windows operating systems. It is capable of linking incoming radio connections to a couple of interfaces, such as TELNET or TCP server, virtual COM ports or WIN32 console applications. This allows for a transparent data link on applications hosting the HW 86050 module, see section 4.3.1.

Supported operating systems are **Windows NT4.0, Windows 2000, Windows XP**.

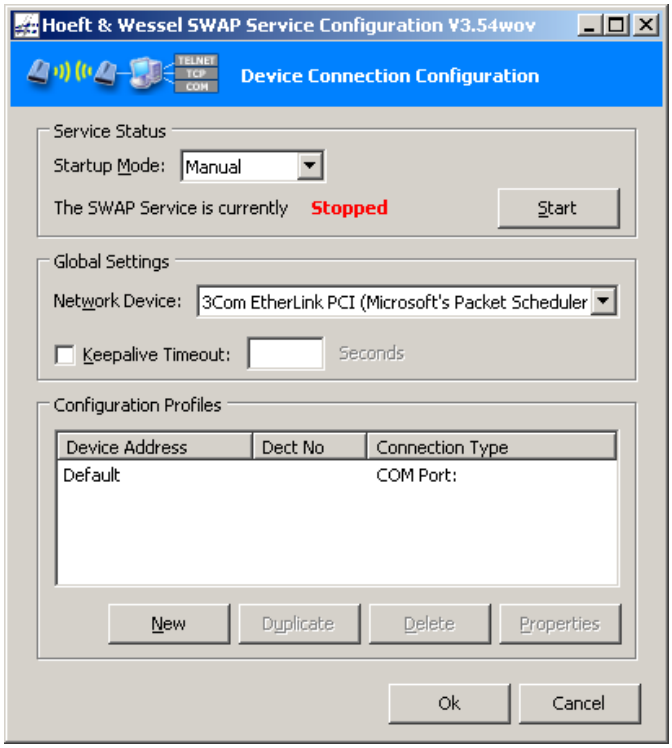
8.1.1 Installation

Run **setup.exe** from the directory **Data-Unwired SWAP Service** on the Data-Unwired CD-ROM and follow the instructions from the setup program.

8.1.2 Configuration

The Data-Unwired SWAP service can be configured through a control applet which can be launched from Start->Settings->System Control->Hoeft Wessel SWAP Service.

8.1.2.1 Main menu Device Connection Configuration



Startup Mode

The startup mode can be configured here. Choose between the following options: „manual“ means the service is started manually, select „automatic“ for startup after system boot or „deactivated“ to completet deactivate the service.

Start / Stop

This button allows to start and stop the service manually.

Network Device

Selects the network device that shall provide connection to the SWAP Service.

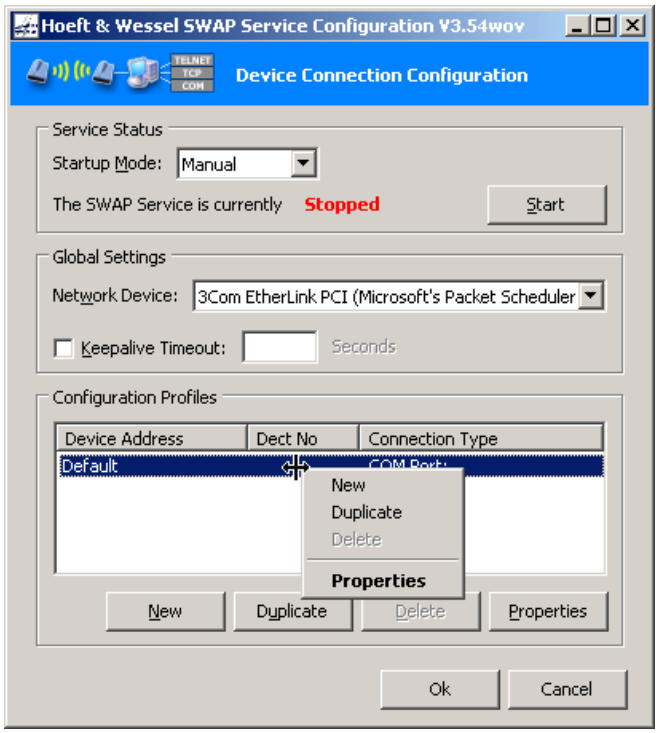
Keepalive Timeout

Configures and activates the keepalive timeout. In case no keepalive message is received from the PT after this time the SWAP connection will be disconnected and will then be ready for a connection restart. Activate this feature only if the corresponding timeout setting is configured on the HW 86050. Configure the timeout on the module using configuration command „sptimeout 5 <ms_timeout>“, where ms is the specified timeout in milliseconds. Recommended values are 10..20s (i.e. 10000...20000ms on the module).

Configuration Profiles

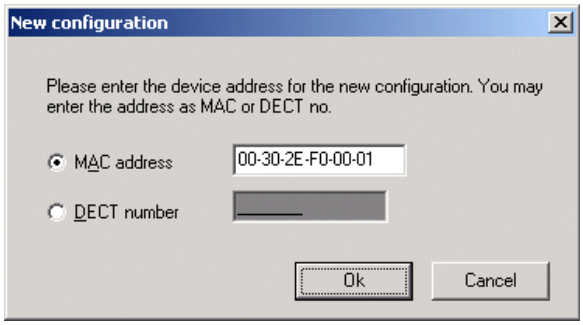
List of configuration profiles for configured devices. After software installation only the „Default“ entry exists. For specified devices additional configuration profiles may be generated. On incoming radio connections the SWAP service will look for a device specific entry. In case this does not exist for the connected HW 86050 a default entry will be used.

8.1.2.1.1 Context Menu



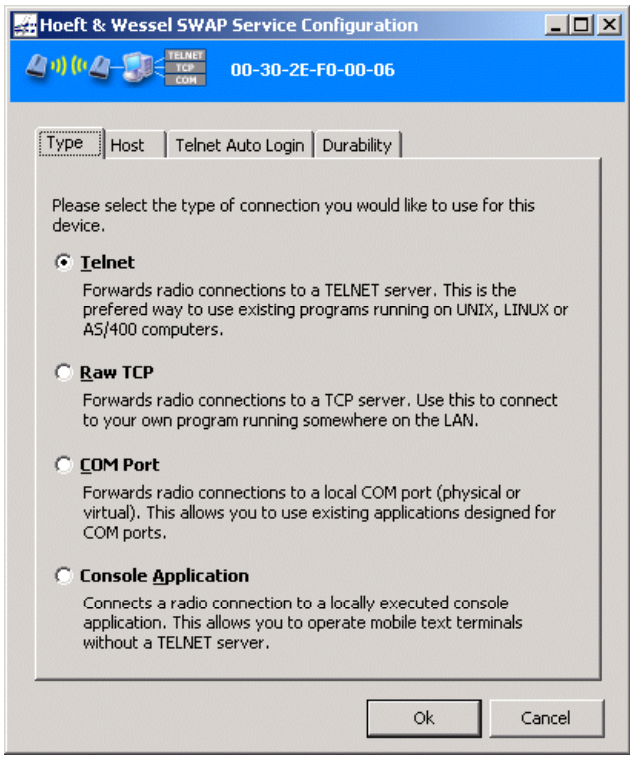
The context specific menu (right click) in the configuration profiles list allows for generating, duplicating and deleting profile entries.

8.1.2.1.2 Generation of new Profiles



A new device specific profile can be generated by identifying the device through the MAC address.

8.1.2.1.3 Profile Properties: Connection Type



The way the radio connection will be forwarded may be configured here.

Telnet

Used to forward data from a radio connection to a Telnet server.

Raw TCP

A remote HW 86050 will be connected to a TCP port. This allows communication to a network application.

COM Port

This connection type may be used if existing software is able to communicate to COM ports. Virtual COM ports can be generated for individual HW 86050 modules or the data may be forwarded to a physical COM port.

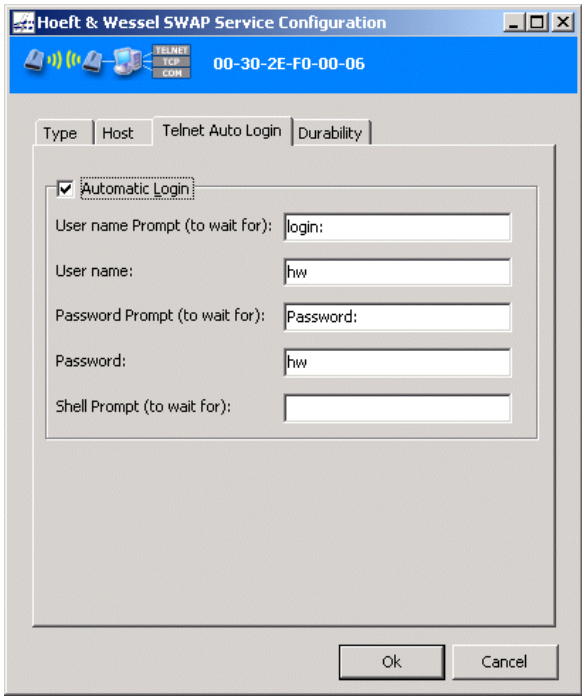
Console Application

The standard I/O of a specified application is redirected to the remote PT. Application may very easily be developed without the need of network programming.

8.1.2.1.4 Profile Properties: Host

Only for **Telnet** und **Raw TCP** connection types the host's IP address and the port are configured.

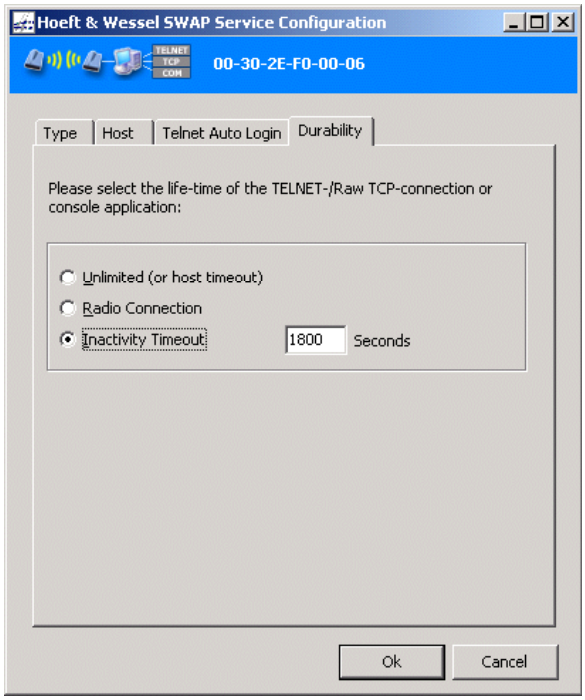
8.1.2.1.5 Profile Properties: Telnet Auto Login



For the **Telnet** connection type the auto login feature is configured:

- Prompt for user name entry, which triggers the user name transmission.
- User name
- Prompt for password entry, which triggers the password transmission.
- Shell prompt, which is waited for to detect successful login (optionally, rarely used).

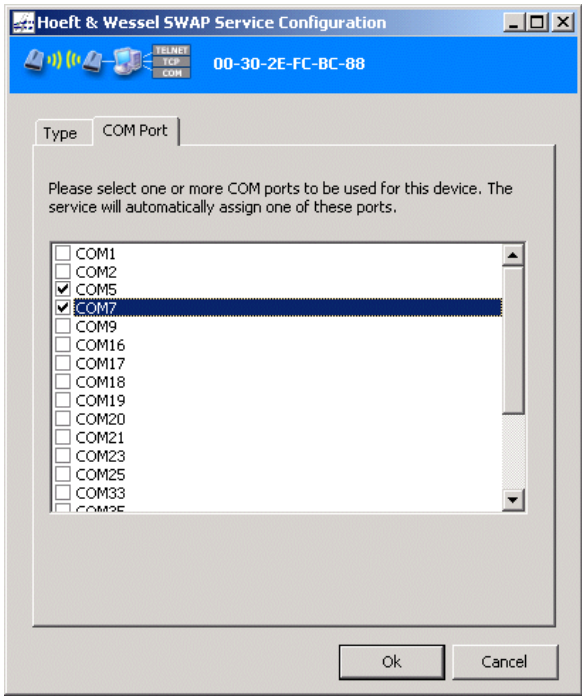
8.1.2.1.6 Profile Properties: Durability



Configures a connection's lifetime, valid only for **Telnet**, **Raw TCP** und **Console Application**.

- Unlimited oder host timeout: The connection will only be disconnected by a host timeout.
- Radio Connection: The connection only exists during a valid radio connection to the client HW 86050.
- Inactivity Timeout: The connection will be terminated if a radio connection did not exist in the specified time.

8.1.2.1.7 Profile Properties: COM Port

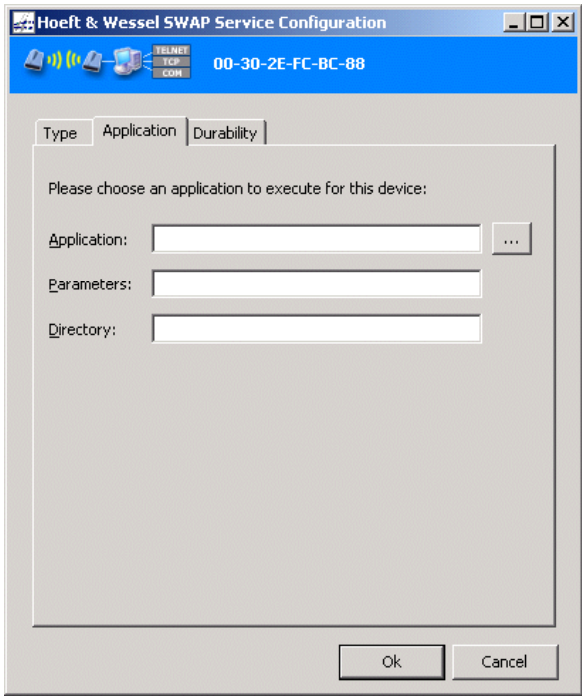


Selects the COM port to which the remote HW 86050 is connected when connection type **COM Port** is configured. Both physical and virtual COM ports are supported. More than one ports may be selected, in this case a free port will automatically be chosen.

Configuration of a physical COM port is useful if for example a modem is to be connected to the SWAP service PC.

A virtual COM port is useful in case a legacy software or a RAS connection shall be applied, e.g. for WinCE devices.

8.1.2.1.8 Profile properties: Application



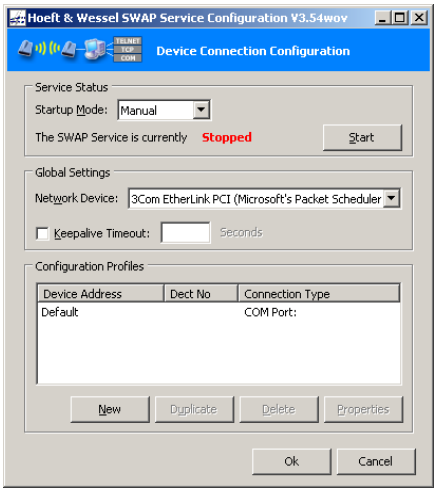
For the connection type **Console Application** an application must be configured which shall be launched with an incoming radio connection.

- Application: Configures the application to be launched.
- Parameters: Configures command line parameters which shall be provided to the application.
- Directory: Configures the application's working directory (will automatically be adjusted when selecting the application)

8.1.3 Quick Start - Configuration of virtual COM Ports

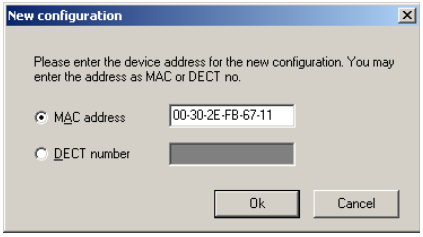
Open the SWAP Service configuration using **Start→Settings→System control→ Hoeft Wessel SWAP Service**. In case this entry is not available, install SWAP Service (see section 8.1.1)

The SWAP configuration may also be launched from the Data-Unwired Manangement Console using **Tools→SWAP Service Configuration.**



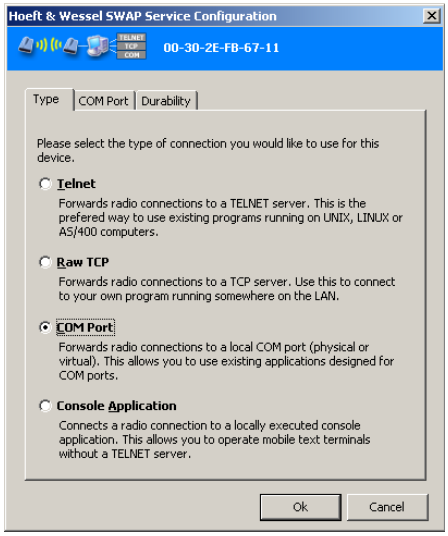
Start the profile entry dialog with the **[New]** button.

The „Default“ entry should not be changed.

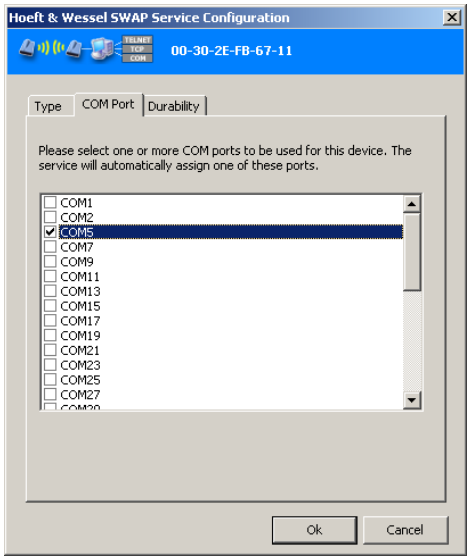


Enter the MAC adress or the DECT number of the PT you wish to confugre and confirm using **[Ok]**.

Enter the MAC adress of the desired HW 86050 device.



Select the **COM Port** and open **Index card COM Port**.



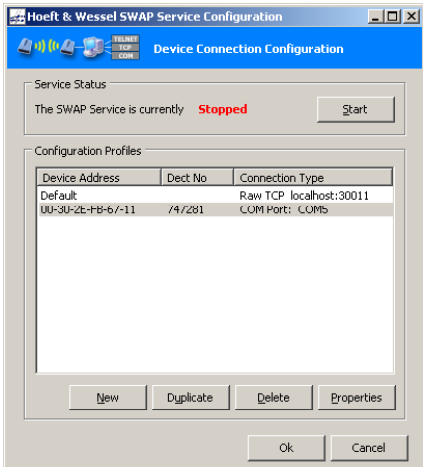
Choose the desired COM port and press **[Ok]**.

Both physical and virtual COM ports appear in the list. In case a physical port is selected, the data traffic will be lead to the COM port.

Due to technical reasons, only even numbered virtual COM ports are available.

Those settings displayed on the index card **Durability** are not relevant for COM ports.

Repeat the four last steps to configure further HW 86050 modules.



Press **[Start]** to start the SWAP service.

Use the Data-Unwired Management Console Text-Terminal **Tools→Text terminal** or another terminal software to test virtual COM port connections.

8.2 Configuration of PPP connections

A PPP implementation is required on the device hosting the HW 86050.

8.2.1 Dial-up Options

The PPP dial-up procedure may applied using AT commands or Microsoft Direct Link protocol.

8.2.1.1 AT Commands

The portable device implements an AT command handler, responding „OK“ on all incoming AT commands. Dial-up may be started with „ATD <any number>“. The PT immediately responds with „CONNECT“ and activates the DCD.

8.2.1.2 Microsoft Direct Link

Client sends „CLIENT“, the PC responds with "CLIENTSERVER" and sets DCD. This option can not be used if DHCP is not available and gateway and netmask settings must be configured manually.

8.2.2 PPP Options

After successful dial-up the PPP options will be negotiated.

8.2.3 DHCP available

Through DHCP the PT derives the following configurations:
1. IP adress for PPP client
2. IP-adress DNS server 1
3. IP-adress DNS server 2
4. IP-adress WINS server 1
5. IP-adress WINS server 2
6. IP-adress gateway
7. Netmask

1. to 5. are transferre to the client during PPP connection establishment.
6. and 7. are only required by the PT for internal usage.

8.2.4 DHCP not available

In case a DHCP server is not available parameters 1. to 5. will be configured by the client's PPP access software. It is possible to configure the gateway adress and netmask through PPP options. In case the network consists of several sub-networks those parameters must be set through the following AT commands:

AT+GW=a.b.c.d configures gateway adress.
AT+NM=a.b.c.d configures netmask.

8.3 Download Protocol

The download protocol consists in two passes. The first pass loads the loader file, the second pass loads the firmware file.

8.3.1.1 Pass one

Step	Action	Note
1	Enter Download Mode	see section 3.6.6
2	Initialise RS-232 port	9.600 Bd, 8 data bits, no parity, 1 stop bit
3	Transmit byte 0xAA	StartRequest token
4	Receive byte 0xA1	StartConfirm token
5	Transmit 2 bytes LenLd	Length in bytes of file xxx.ld expressed as 2-byte unsigned. Low byte transmitted first.
6	Receive 2 bytes LenLd	Compare with LenLd from step 5. Only continue if equal. Otherwise stop with error.
7	Transmit byte 0x00	Acknowledgement token
8	Transmit file xxx.ld	Binary transfer of LenLd bytes. In parallel compute a CRC (see section 8.3.1.3)
9	Receive 2 bytes CRC	Low byte transmitted first. Compare with computed CRC from step 8. Only continue if equal. Otherwise stop with error.
10	Transmit byte 0x00	Acknowledgement token
11	continue with pass two	

Any transmit must not pause more than 1 second. Otherwise the HW 86050 may timeout.

If not otherwise noted, any receive must tolerate a pause of 2 seconds before the host timeouts.

If during pass 1 the download procedure stops with error or is interrupted by the host, the previous firmware remains intact in the Flash memory.

8.3.1.2 Pass two

Step	Action	Remark
1	Change baud rate	115.200 Bd, 8 data bits, no parity, 1 stop bit
2	Wait 10 ms	Allow HW 86050 to change baud rate
3	Transmit byte 0xAA	StartRequest token
4	Receive byte 0xA1	StartConfirm token
5	Transmit 4 bytes LenHp	Length in bytes of file xxx.hp expressed as 4-byte unsigned. Low byte transmitted first.
6	Receive 4 bytes LenHp	Compare with LenHp from step 5. Only continue if equal. Otherwise stop with error.
7	Transmit byte 0x00	Acknowledgement token
8	Receive byte 0x00	This confirms that the Flash memory was successfully erased. Step 8 includes erasing the Flash and may take up to 15 seconds. Any return value other than 0 signals an error.
9	Transmit block of file xxx.hp	Binary transfer. The block length is 1024 bytes. If less than 1024 bytes are left to be transmitted, the size of the block is reduced accordingly. Compute a CRC for the block (see section 8.3.1.3)
10	Receive 2 bytes CRC	Low byte transmitted first. Compare with computed CRC from step 9. Only continue if equal. Otherwise stop with error.
11	Transmit byte 0x00	Acknowledgement token
12	Repeat steps 9 to 11 until end of file xxx.hp	
13	Start new firmware	Through reset of module

Any transmit must not pause more than 1 second. Otherwise the HW 86050 may timeout.

If not otherwise noted, any receive must tolerate a pause of 2 seconds before the host timeouts.

If during pass 2 the download procedure stops with error or is interrupted by the host, no valid firmware resides in the module. It my become neccessary repeat the download procedure, however a firmware download is still possible.

8.3.1.3 Computation of CRC

The following short piece of C-code describes the computation of a CRC for a block of bytes to be applied for firmware download:

```
unsigned short CalculateCRC (
   unsigned char *Block,   /* array of bytes */
   unsigned int BlockLen   /* length of Block in bytes */
)
{
   unsigned short crc = 0; /* CRC initialised with zero */
   unsigned char BitPos;   /* counter for bit level loop */

   while (BlockLen != 0)   /* main loop over all bytes */
   {
      crc ^= ( (unsigned short) *Block++ << 8)
                           /* modulo-2 add a byte */
      for (BitPos=0; BitPos<8; BitPos++)
                           /* loop over all bits of byte */
      {
         if (crc & 0x8000)
           crc = (crc << 1) ^ 0x1021
         else
           crc <<= 1;
                           /* apply generator polynomial */
      }
      BlockLen--;          /* decrement loop counter */
   }
   return crc
}
```

9. Table of figures