After Sales Technical Documentation
RAE/RAK–1N Series

Chapter 1

Overview

Original, 08/96

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List of abbreviations

AC	Alternating Current
AFC	Automatic Frequency Correction
AGC	Automatic Gain Control
ASIC	Application Specific Integrated Circuit
BB	BaseBand
CMT	Cellular Mobile Telephone
COB	Chip On Board
CODEC	COder/DECoder
CRC	Cyclic Redundancy Check
CTRLU	ConTRoL Unit
DAI	Digital Audio Interface
DBUS	Data BUS (NMP's internal name)
DC	Direct Current
DSP	Digital Signal Processor
DSPU	Digital Signal Processing Unit
DTMF	Dual Tone Multiple Frequency
DTX	Discontinuous Transmission
EEPROM	Electrically Erasable Read Only Memory
FAX	Facsimile
GSM	Global System for Mobile communications
HF	Hands–Free
HFJ	Hands–Free Junction box
HS	HandSet
HW	HardWare
IC	Integrated Circuit
IF	Intermediate Frequency
JTAG	Joint Test Action Group
LCD	Liquid Crystal Display
LNA	Low Noise Amplifier
MBUS	Message BUS
MCM	Multi Chip Module
MCU	MicroController Unit

NMI	Non–Maskable Interrupt
NTC	Negative Temperature Coefficient
PC	Personal Computer
PCB	Printed Circuit Board
PCN	Personal Communication Network
PDA	Personal Digital Assistant
PHF	Personal Hands–Free
PIO	Parallel Input/Output
PLL	Phase Locked Loop
PWM	Pulse Width Modulation
PWRU	PoWeR Unit
RAM	Random Access Memory
RBUS	Responder BUS
RF	Radio Frequency
RFI	Radio Frequency Interface
RLP	Radio Link Protocol
ROM	Read Only Memory
RPE–LTP–LPC	Regular Pulse Excitation–Long Term Prediction–Linear Predictive Coding
RX	Receiver
SCL	Small Custom Logic
SIM	Subscriber Identification Module
SIO	Serial Input/Output
SMD	Surface Mount Device
SRAM	Static Random Access Memory
TDMA	Time Division Multiple Access
TX	Transmitter
UHF	Ultra High Frequency (300MHz – 3GHz)
UIF	User InterFace
VAD	Voice Activity Detection
VCXO	Voltage Controlled Crystal (”Xtal”) Oscillator
VHF	Very High Frequency (30 MHz – 300 MHz)

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Introduction

The NOKIA 9000 communicator is a functional *Cellular Mobile Telephone (CMT)* extended to incorporate a *Personal Digital Assistant (PDA).* The unit is of a modular design incorporating the following:

– A CMT providing access to the GSM / PCN networks.

– A PDA providing a User interface that supports personal handsfree audio, graphical high resolution display, control keys and a QWERTY keyboard for text input.

The two parts are combined with a hinge and all data transfer between these two physical modules is performed over an asynchronous, 2–wire, serial bus called RBUS.

Summary of product features

The 9000 provides an extented UI with appropriate new applications and access to both voice and data services over the GSM network. The following table lists the main features on both categories.

Table 1. List of NOKIA 9000 applications

Application	Features
Phone	* call initiating using contact manager app., using call stack, or keypad dialling * speakerphone control, DTMF, multiple calls conference calls, calling/called party ID, call timer counters * settings
FAX	*sending/receiving/forwarding * sending/forwarding based on a new document or an existing one * manual, call stack, or contact manager based recipient selection * viewing tools * settings on fax call divert & cover page
SMS	* sending/receiving * sending based on a new or an existing document * business card exchange via SMS * DTMF service cards * settings
Contact manager	* communication contact data handling * default + user customisable * keeps track of recent communication
Memos	* document editing & viewing * viewer for FAX, WWW (World Wide Web), and JPEG * printing and sending (SMS, FAX, E–mail)
E–mail & VAS Access	* Internet apps using TCP/IP: WWW, Telnet, SMTP/IMAP * VT100 terminal emulator
System	* user profile data applied by SMS business card sending & FAX cover page * security: PIN, lock code, network password, code control, contact manager information visibility control

Table 1. List of NOKIA 9000 applications (continued)

Application	Features
PC connectivity	* AT commands, PC backup, new app. installation, document & file transfer, contact manager contents exchange in ASCII
Calendar	* month/day view, link to notes possible, to–do lists, event based alarms
Extras	* basic calculator * world time clock * ringing tone composer * other small applications loaded from PC

Table 2. Basic GSM services

Group	Feature	Rate (bits/s)	Notes
GSM Speech		13 k	Full rate
GSM Data	Non–transparent	9.6k, 4.8k, 2.4k	Full rate
GSM Teleservices	Facsimile (Grp 3), SMS, Cell Broadcast		Cell broadcast, transparent fax
GSM Supplementary Services	Selected sub–set		

Table 3. Other communication protocols/formats supported

Application	Protocol	Notes
Email	SMTP, IMAP4, MIME1	
All Internet apps	TCP/IP	
WWW	HTTP 1.0, HTML 2.0	JPEG, GIF
Terminal	VT100	
PC Connectivity	RS232, IrDA	
Module interconnection	RBUS	
Ext. serial i/f	MBUS	

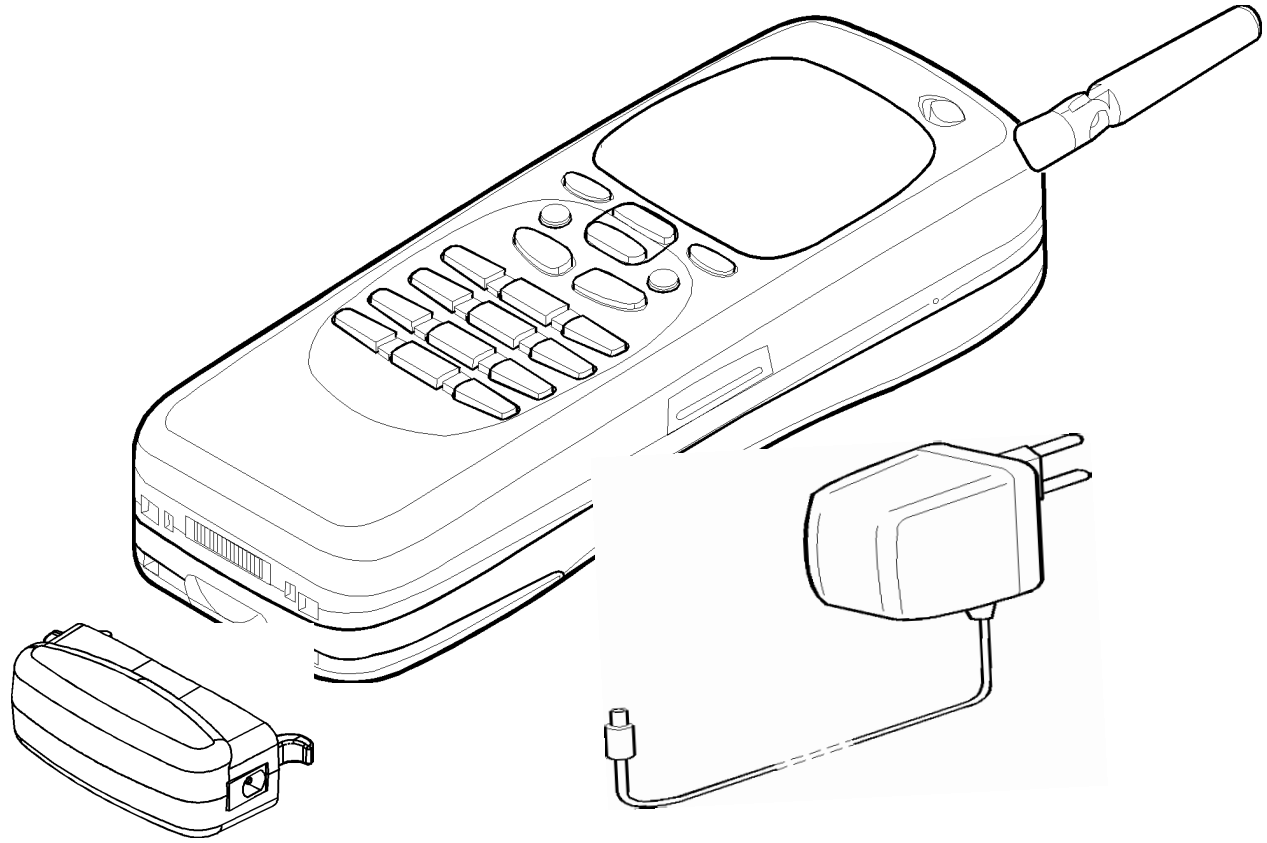


Figure 1. Basic Kit

The NOKIA 9000 communicator integrates the functionality of the Nokia DTP–2 GSM/PCN data adapter card on its modified baseband and adds a second, improved user interface for data applications such as fax, terminal emulator, and graphical Internet browsers, e.g., World Wide Web (WWW).

The transceiver utilises common core electronics (DCT2) which can be easily modified to comply with all digital standards in the world. The HD841 is a GSM / PCN project to develop a series of products for the GSM PCN markets and the 9000's RF block is of this DCT2 generation. The baseband section and accessories are derived from the DCT1 generation (HD740, HD745).

Figure 2. Personal Digital Assistant

GSM/PCN Networks

GSM is originally a pan–European digital cellular network standard, later phrased as the Global System for Mobile Communications. The standard is defined jointly by all related parties in the European Telecommunication Standard Institute (ETSI).

PCN is a European cellular mobile telephone standard based on the GSM/DCS–1800 standard also defined by the ETSI. The current PCN network licences have been granted to operators in Germany and the UK.

Modular Structure

The transceiver consists of the following modules:

GE8/GE9 – Transceiver modules for PCN and GSM
GP1 – Personal Digital Assistant module
GK2 – Combined User interface module (CMT/PDA)
GEM1 – SIM and audio module (CMT)

In addition, the CMT baseband contains multichip modules (MCM) that are in fact submodules but should be considered as components for the CMT unit.

The LCD module(GK2) consists of a CMT U/I module and a graphic LCD module for the PDA. GK2 contains an insert for an antenna; this Antenna is by default a helix with a joint but can be replaced with a whip type.

The CMT and PDA modules are assembled inside the same covers and connected via a board to board connector. The LCD module and antenna are installed in the lid part which is in turn connected to the main part with a hinge; the LCD module being connected to the PDA module through the hinge with a flexible flat cable. The antenna is connected to the CMT module via coax cable.

The SIM flex module contains the SIM card holder, the buzzer, and the standard handset acoustic components, i.e., microphone and earpiece, on a flex carrier. Handsfree audio components, i.e., microphone and speaker, are assembled in cavities in a magnesium chassis and connected on the PDA via a pair of cables.

In addition the NOKIA 9000 has a dedicated attachable Li Ion battery and contains 2 cells with 730 mAh capacity (1Q/96) plus necessary protection circuitry with external connector.

The CMT module is covered by EMC/EMI shields, i.e., magnesium chassis and metallized plastic shield, of which the chassis is also extended to cover critical parts of the PDA module, e.g., switched mode power supply (SMPS) and infra–red (IR) transceiver circuit. A simplified functional diagram of the modular structure is illustrated below. The figure also includes the unit’s external interfaces.

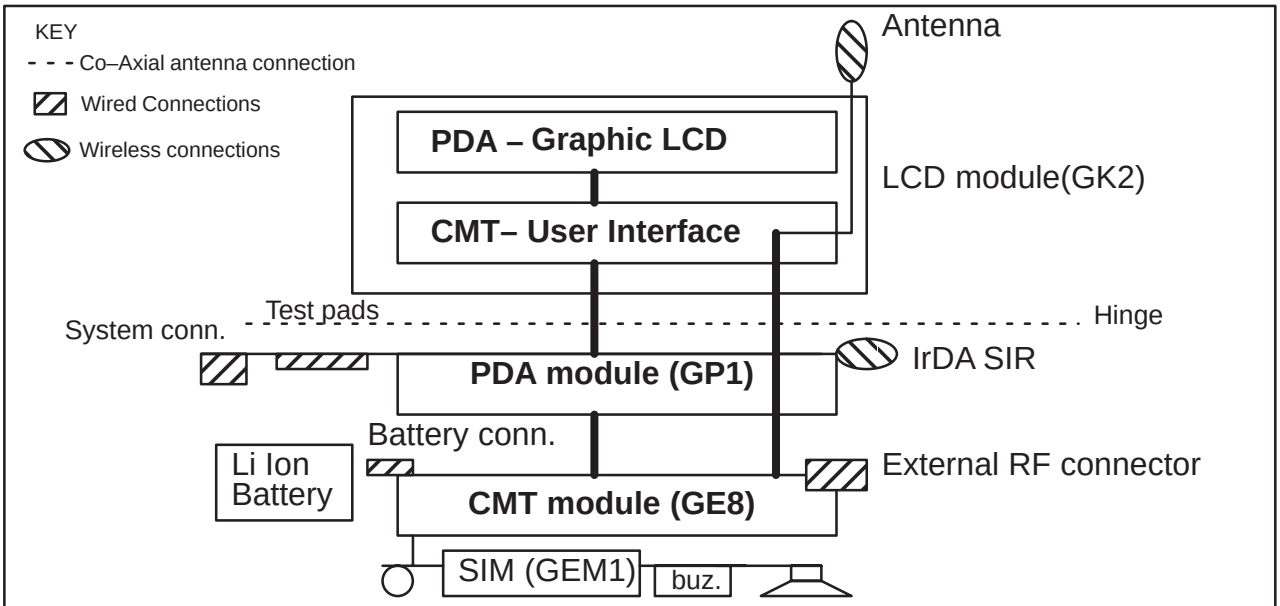


Figure 3. Modular Structure

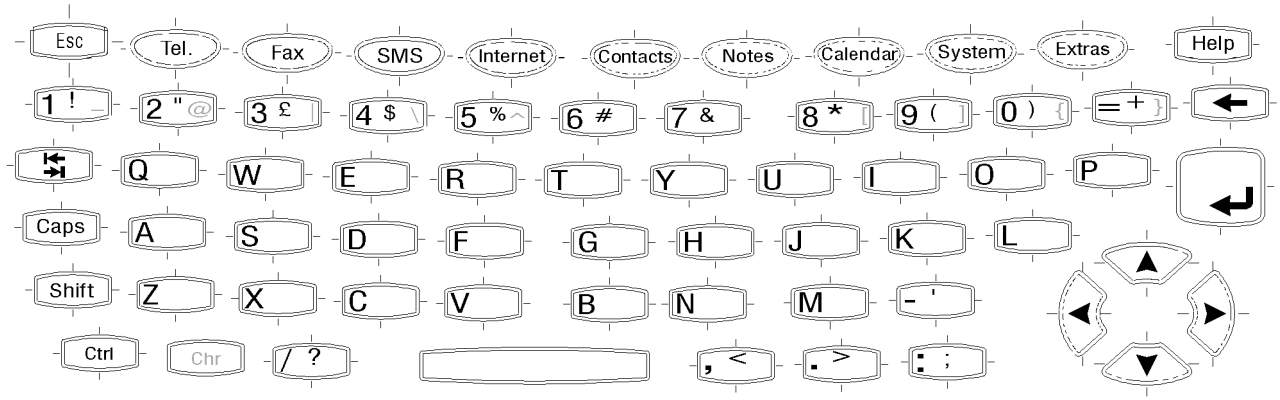
Product Variants

The NOKIA 9000 communicator has the type designator RAE/RAK–1N where RAE refers to the GSM version and RAK ,the PCN version. The table below shows the variants that apply to this product; these variations only affecting the QWERTY keymat layouts, illustrated in Figure 4 overleaf.

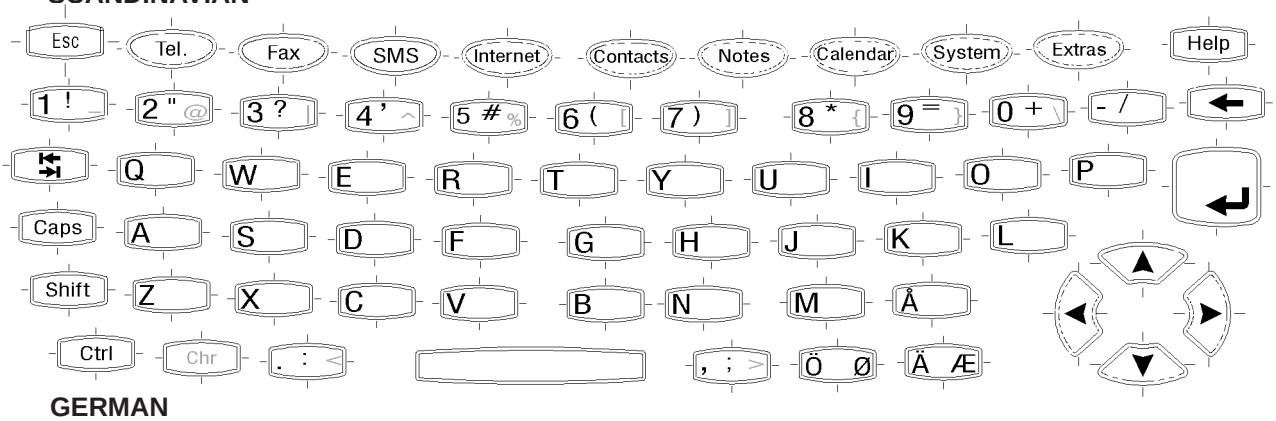
Table 4. NOKIA 9000 communicator Product Variants

Type Designation	Language Version
RAE/RAK–1NA	UK English
RAE/RAK–1NB	German
RAE/RAK–1NC	French
RAE/RAK–1NE	Scandinavian

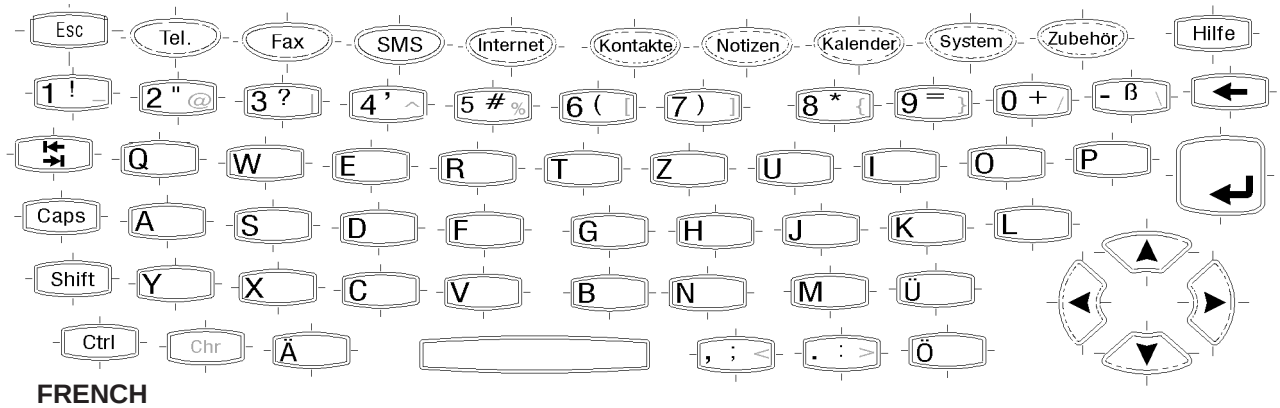
U.K



SCANDINAVIAN



GERMAN



FRENCH

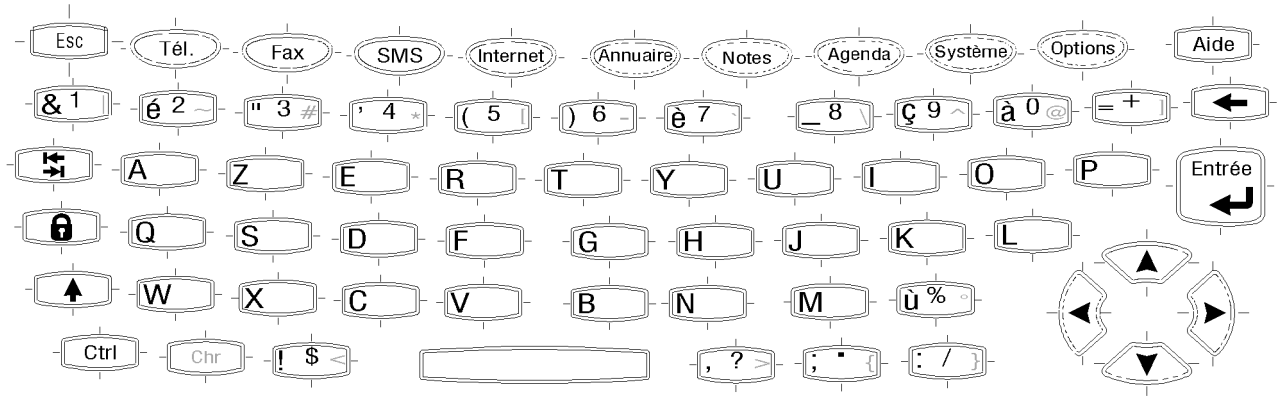


Figure 4. PDA QWERTY keypads

Sales Packages

The NOKIA 9000 product family is a first generation GSM / PCN handportable. The family contains a basic sales package for portable use and optional accessories for office and mobile use. There is only one Nokia design version of the transceiver. However, product variation is done by changing the QWERTY keymat according to the target country.

The basic sales package consists of the following products:

- NOKIA 9000 communicator transceiver (RAE–1Nx/RAK–1Nx)
- Standard Battery Pack (BLK–4S)
- Fast Travel Charger (ACH–3)
- Power Adapter Module (PAR–1)
- PC Diskette (connection software – Windows)
- User's Manual & Quick Guide
- Packaging materials
- Security Code Envelope

Accessories

The following tables outline accessory part numbers and specifications:

Table 5. Batteries

Name of battery	Type code	Material code	Notes
Battery	BLK–4S	0670153	730 mAh Li–Ion

Table 6. Chargers

Name of charger	Type code	Material code	Notes	
Fast Travel Charger	ACH–4E	0675008	Euro	Mains voltage 200...240 V
Fast Travel Charger	ACH–4X	0675009	UK	Mains voltage 200...240 V
Fast Travel Charger	ACH–4A	0675036	Australian	Mains voltage 200...240 V
Fast Travel Charger	ACH–4P	0675065	Philippines	Mains voltage 200...240 V

Table 7. HF Car Installation

Name of accessory	Type code	Material code	Notes
HF Junction Box	HFJ–3	0694009	
Hands Free Speaker	HFS–6	0692005	
Hands Free Microphone	HFM–10	0690009	

Table 7. HF Car Installation

Name of accessory	Type code	Material code	Notes
Power Cable	PCH–4	0730009	
External Audio Handset	HSU–1	0640047	
Swivel Kit	MKR–1	0620033	
Mounting Plate	MKE–1	0650007	
Installation Guide, HF Car kit	CARK 60	9385069	

Table 8. Data and office accessories

Name of accessory	Type code	Material code	Notes
RS232 cable	DLR–1	0730077	
Spare battery charger	DCH–4	0675107	To be used with ACH–4x

Technical Summary

The transceiver electronics consist of the following modules:

– PDA (PIM & extended UI control),
– Radio System (RF + System blocks),
– UIF
– SIM and audio submodule.

The UIF Module is connected to the PDA module with a flex cable and a connector. The PDA module is connected to the Radio System Module using a 44 pin board–to–board connector.

The System block (Baseband and RF modules) are interconnected with PCB wiring and the transceiver is connected to accessories via a bottom system connector plus an RF connector in the other end of the device. An IR eye for wireless data exchange locates to the same end as the external RF connector.

The PDA module provides the hardware platform for the extended UI with an integrated CPU and peripheral control IC (E3G), memories (DRAM, Flash), power circuitry (SMPS), IR electronics and external RS buffering.

The PDA power supply generates power for;
– Graphical LCD (22V)
– Basic PDA logic (3.3 V)
– Flash programming (dynamic) (5V)

The System block contains the MCU and DSP environments, System BB IC (D2CA), memories, audio processing and RF interface hardware (RFI). On board power supply circuitry delivers operating voltages for both System and RF blocks.

The general purpose microcontroller, Hitachi H8, communicates with the DSP, memories and Logic control IC (D2CA) with an 8–bit data bus.

The purpose of the RF block is to receive and demodulate the radio frequency signal from the base station and to transmit a modulated RF signal to the base station.

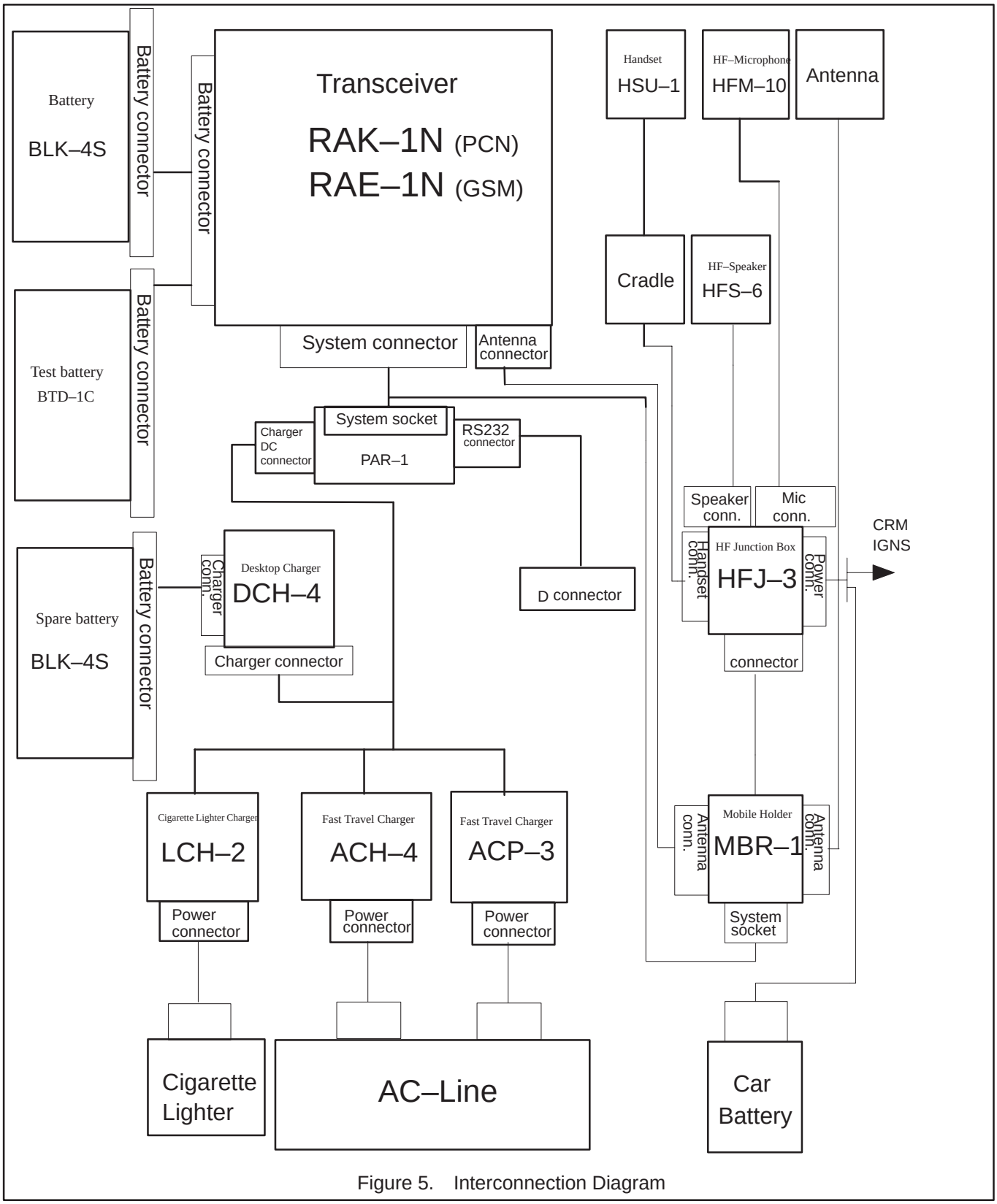


Figure 5. Interconnection Diagram

Mechanical Characteristics

Table 9. Mechanical Characteristics

RAE–1	Dimensions (WxLxH) / mm	Weight / g	Volume/ cm^3	Notes
Transceiver with standard battery pack	65*176*39	397	400	If antenna is included, length is 189
Transceiver w/o battery pack	same	315	300	
Radio module (inc. chassis + shield)	57*170*16	73	–	
UIF module	57*170*11	87	–	
Mechanics		155	–	
Battery pack BLK–4S	52*61*19	83		

Environmental Conditions

Temperature Conditions

Table 10. Allowed Ambient Temperatures

Environmental condition	Ambient temperature (degrees Celcius)	Notes
Normal operation conditions	+15°C...+35°C	Office environment
Extreme operation conditions	–20°C...+55°C	GSM Specifications fullfilled
Reduced performance conditions	–30°C...–20°C	Operation possible after warm–up, LCD's might operate slowly or cessate operating.
	+55°C...+65°C	Connection can be established
	+65°C...+75°C	Operational only for a short period
Intermittent operation condidions	–40°C... –30°C	Operation not possible but attempt to operate will not damage the device
	+75°C ...+85°C	
Cessation of operation	< –40°C or > +85°C	No storage or operation possible without permanent damage
Storage conditions	–40°C ... +70°C	
Charging	0°C ... +45°C	Li–Ion charging recommendation by the vendor; exceeding these limits will result in reduced capacity and longer charging times

Vibration and Free Fall

The transceiver meets the module phase error requirements which equates to a total RMS vibration in the range 10 Hz to 150 Hz of 0.5 g. The transceiver has been drop tested to withstand an 80cm drop onto a solid floor.

Humidity and Water Resistance

Relative humidity range in normal operation conditions : 20 ... 75 %.

Relative humidity range allowed : 5 ... 95 %

The transceiver is not waterproof and care should be taken if used in damp conditions.

Maximum Ratings

Table 11. Maximum Ratings

Pin / Conn	Line Symbol	Minimum	Typical / Nominal	Maxi-mum	Unit / Notes
1 / Battery	VBATT	5.0	7.2	9.0	V / Phone off in min . extreme, PDA on
1 / 3 / Char	VCHAR	10.0	12.0	13.0	V (unloaded)

Operating Instructions

Operating instructions are given in the QUICK GUIDE in the Appendix of this manual and the USER‘S GUIDE that comes with the product. The transceiver is provided with a HELP system via both keypads (lid open/closed). Also, ‘on line’ help will be available on the Internet via the Nokia–club service.

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