

Bluetooth™ Starter Kit from IAR Systems

Hardware Guide

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CONTENTS

Preface	v
Who should read this guide	v
What this guide contains	v
Conventions	v
Product overview	1
Prototyping environment	1
Key features	1
Block diagram	1
Package contents	3
Hardware features	4
Software features	5
USB driver	5
Configuring the Bluetooth Starter Kit hardware	5
Hardware design	7
Block overview	7
Motherboard	7
Power supply	9
Power filters	9
Power regulator	9
Start-up sequence	9
Hardware reset	9
RS232 level shift	9
Serial port connection and USB	10
PCM CODEC	11
Daughterboard	12
Antenna board	12
RF switch	12
External hardware interfaces	13
I2C	14

UART interface	14
PCM interface	14
3.3V and GND pins	15
Additional links	15
Bill of materials	17
Schematics	
Daughterboard	21
Power supply	22
Motherboard	23

Preface

Welcome to the Bluetooth™ Starter Kit from IAR Systems Hardware Guide. The purpose of this guide is to describe how you install and use the Bluetooth Starter Kit from IAR Systems.

Who should read this guide

This guide provides user and reference information about the Bluetooth Starter Kit hardware. Anyone interested in understanding or modifying the hardware design should read this guide.

What this guide contains

This guide consists of the following chapters:

- *Product overview* introduces the Bluetooth Starter Kit hardware design.
- *Hardware design* gives a detailed description of the Bluetooth Starter Kit hardware.
- *Bill of materials* summarizes the materials.
- *Schematics* shows an overview of the Bluetooth Starter Kit hardware.

Conventions

This guide uses the following typographic conventions:

Style	Used for
computer	Text that you type in, or that appears on the screen.
parameter	A label representing the actual value you should type as part of a statement.
reference	Cross-references to another part of this guide.

Table 1: Typographic conventions used in this guide

Product overview

The Bluetooth Starter Kit allows you to develop product prototypes with Bluetooth capabilities, using the Bluetooth Starter Kit as a development platform. This chapter provides detailed description of the hardware design. Coupled with the data sheets on the accompanying Bluetooth Starter Kit CD-ROM, this provides an accelerated jump-start to all Bluetooth product developers.

Prototyping environment

The Bluetooth Starter Kit enables rapid evaluation of the Bluetooth wireless technology, and allows enhancements to be made to both hardware and host software, without having to worry about the Bluetooth system issues. This reduces the time to market and many risks associated in early prototype software and hardware.

The Bluetooth Starter Kit is a highly integrated design, development, and prototyping platform for both Bluetooth hardware and host software applications.

The Bluetooth Starter Kit is a platform which primarily allows a user to become familiar with the Bluetooth wireless technology and its capabilities. Thereafter, it may be used for both host software and hardware development.

KEY FEATURES

- Uses the Bluetooth module from Ericsson Microelectronics
- Communicates with the host computer via UART or USB
- Host software demonstrates data, voice, and data/voice connections and communication
- Hardware can be extended using the interface connectors
- Host software can be enhanced using Microsoft Visual Studio 6.0
- PCM voice CODEC interface for handset or headset.

BLOCK DIAGRAM

The Bluetooth Starter Kit is a 2-tier mechanical assembly, allowing users of the Bluetooth Starter Kit to upgrade and protect their investment and develop new boards without impacting the design of the other parts of the system.

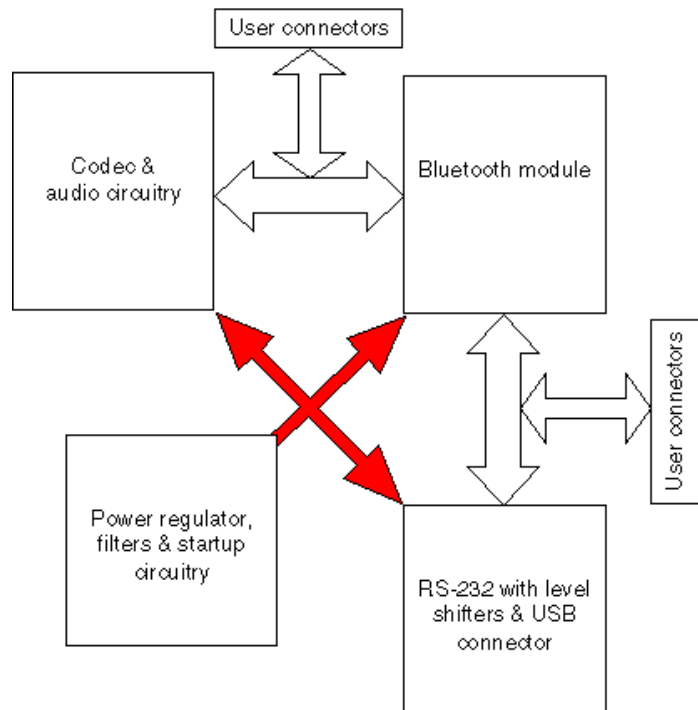


Figure 1: Bluetooth Starter Kit hardware architecture

The Bluetooth Starter Kit host software that runs on the Windows 98, 2000, or NT4 PC will connect to the Bluetooth Starter Kit hardware via a serial or USB cable.

The Bluetooth Starter Kit aims to satisfy many different types of users, for example users that are:

- Interested in the Bluetooth wireless technology and want to learn more about it.
- Interested in developing software applications, treating the Bluetooth Starter Kit and Bluetooth wireless technology as a new capability.

The Bluetooth Starter Kit is packaged with key components, schematics, software, documentation, and reference material, so you can start working right away.

The pluggable architecture of the Bluetooth Starter Kit facilitates upgrading of future enhancements.

The Bluetooth Starter Kit consists of two boards:

- A motherboard, with power supply conversion, physical interfaces, and associated support circuitry.
- A daughterboard, with the Bluetooth module from Ericsson Microelectronics, an external antenna adapter, and a local antenna, with a jumper to select which antenna to use. This will cater for future variants of the Bluetooth module.

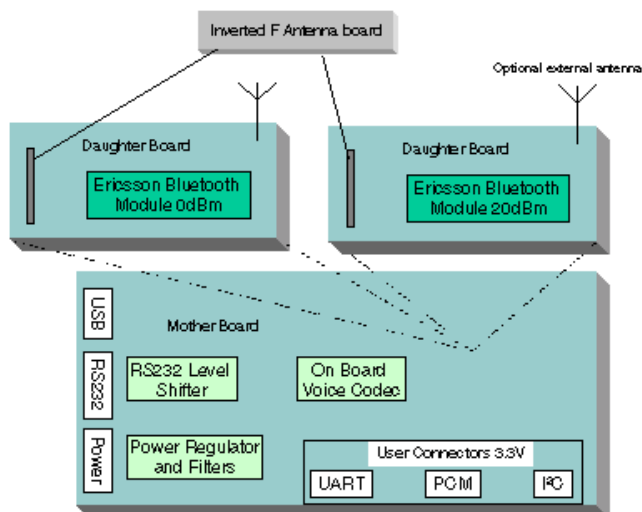


Figure 2: Bluetooth Starter Kit with two types of daughter boards

PACKAGE CONTENTS

The Bluetooth Starter Kit is packaged in a box that contains the following:

- Bluetooth Starter Kit boards with RS232 and USB connectors
- 9-way female to male serial cable, straight connection
- Type A/Type B USB cable
- Mains cable with power supply 110V and/or 220V
- Power supply adapter kit
- External stub antenna
- Bluetooth PC-card
- Handset (optional)
- CD-ROM with software and documentation.

HARDWARE FEATURES

Daughterboard

- A 0dBm Bluetooth module with selectable internal PCB antenna or an SMA connector for an external antenna

Motherboard

- Voice CODEC, power circuits, and interface circuits

Serial ports

- One RS-232 with a 9-pin 90-degree D-type female connector, capable of handling speeds up to 1 Mbit/s

Audio

- One 2.5 mm phone jack

USB

- One series B (SLAVE) receptable

I²C

- One 2-way pin connector and a GND connector

External hardware interfaces

- UART, I²C, USB, and PCM on the Bluetooth module's 3.3V feeding levels

Fault management/supervision

- Power-on LED
- H/W reset button

Accessories

- Serial cable with 9-pin plugs (female/male)
- USB cable (Type A/Type B)
- Bluetooth PC-card
- External stub antenna
- Handset (optional)

Power

- Two power supplies with 110V or 220V input, respectively, 6V DC output at 300mA, with adapter plugs

Mechanical

- Motherboard: 82 mm (W) x 55 mm (L)
- Daughterboard: 55 mm (W) x 35 mm (L)
- Board thickness: 2 mm
- Construction: Industry-standard 4-layer FR4 fibreglass

SOFTWARE FEATURES

The software consists of host software, that runs on the host PC, and target firmware, that runs on the Bluetooth module.

USB driver

USB communication is implemented in this Bluetooth Starter Kit software as an alternative to the UART communication.

CONFIGURING THE BLUETOOTH STARTER KIT HARDWARE

To make the USB functionality work you need to connect the DETACH pin on the module to ground. This is done by putting a jumper between pin 2 and 3 on JP5, see the partial picture of the motherboard in *Figure 3*, page 6.

Since the USB connector on the PC also provides power to the connected USB device the external power supply is not needed. To be able to use the power from the computer the "Power Select" jumper has to be moved from pin 1 and 2 to pin 2 and 3, on JP7, see *Figure 3*, page 6. This jumper must be moved back when returning to UART control.

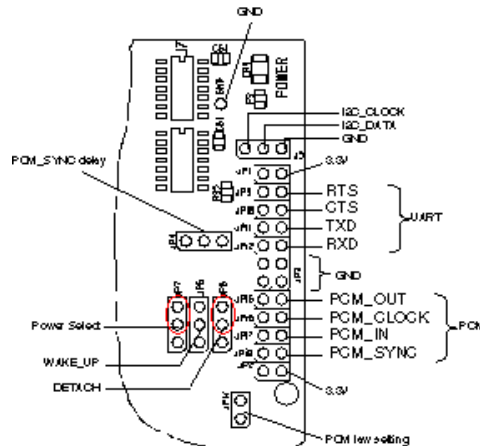


Figure 3: Motherboard (partial picture)

Hardware design

The scope of this chapter is to describe the hardware for the Bluetooth Starter Kit from IAR Systems. There will be no attempt to describe the functionality of the Bluetooth module, apart from where the Bluetooth Starter Kit functionality needs to be explained.

Block overview

The Bluetooth Starter Kit is split into two separate PCBs: motherboard and daughterboard.

The motherboard carries all of the support circuitry for the daughterboard. The circuitry fitted is intended to be as flexible as possible to accommodate the perceived wide usage of the Bluetooth Starter Kit.

The motherboard carries all interfaces, power circuits, and additional circuitry.

The daughterboard carries the Bluetooth module from Ericsson Microelectronics and the antenna.

Motherboard

The motherboard carries power circuits, power filters, start-up circuitry, voice CODEC, and interfaces.

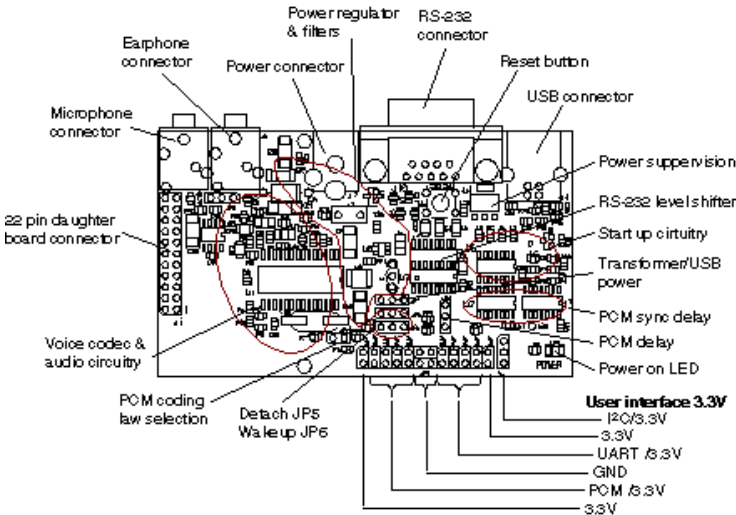


Figure 4: Overview of the motherboard supporting a headset

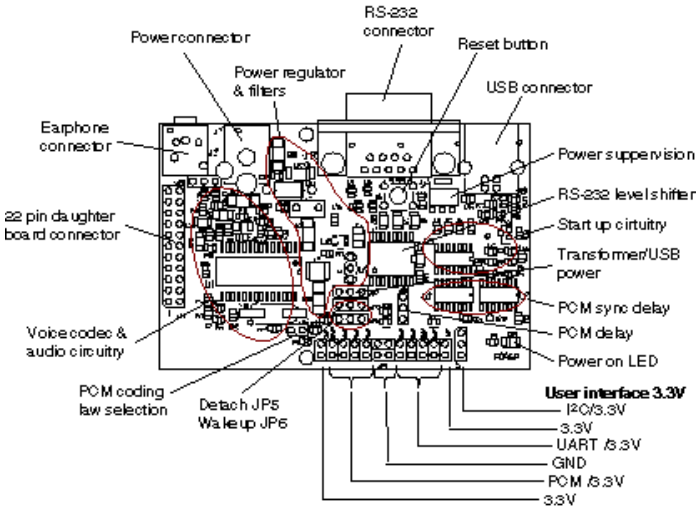


Figure 5: Overview of the motherboard supporting a handset

POWER SUPPLY

The Bluetooth Starter Kit takes 6V DC input from the power supply provided. Should the user wish to use a lab or bench power supply, it should be ensured that it is set to a range of between 5 and 16 V DC. Less than 5V and the regulation of the circuit cannot be guaranteed, greater than 16V and the thermal dissipation of the linear regulators will exceed their recommended operating range. Any auxiliary power supply should be capable of supplying at least 150mA to cope with the switching transients that may be encountered on first power-up (due to charging of decoupling capacitors on the supply rails).

POWER FILTERS

There are two diodes on the motherboard power input, CR1 and CR2, protecting the boards from reverse polarity of the input voltage. The power is filtered through an EMI filter (L1) protecting from high frequency disturbance.

POWER REGULATOR

The U8 power regulator supplies the boards with 3.3V. The LP2985 regulator has a maximum 150mA output current capability. The input voltage should be kept between 5 and 16V. The regulator can be bypassed using a zero ohm resistor at pad R21, making it possible to use an external power supply. If this is done, the input voltage must not be higher than can be handled by the board circuits.

START-UP SEQUENCE

After the boards have been powered on, there is a delay of ~0,68 ms until the ON signal goes high. R4 and C11 provide this delay. The VCC_IO is delayed with ~6.8 ms by R6 and C12. The reset* is delayed with ~136 ms by R1 and C3. For further information, see the Bluetooth module data sheet.

HARDWARE RESET

When the reset button is pressed, the reset* signal to the module goes low. After releasing the button there is a delay of ~136 ms, provided by R1 and C3, until the reset* goes high again.

RS232 LEVEL SHIFT

The RS232 connector signals go to the U3 level shifter. U3 on the motherboard is a Maxim MAX3225E. When the signal has been shifted to 3.3V, the signal goes to the JP9, JP10, JP11, and JP12 links, and then to the Bluetooth module.

SERIAL PORT CONNECTION AND USB

The Bluetooth Starter Kit has one 9-way D-type connector wired as a modem type serial port. There is also one USB Type B connector. Note that a straight cable (pin1-pin1, pin2-pin2, etc.) should be used when connecting to the serial port of a PC. Do not attempt to use a null modem cable (Rx/Tx crossed), as it will not work.

Serial Port

The motherboard serial connector is routed to the RS232 level shifter. From the level shifter, the signals go to the JP9, JP10, JP11, and JP12 links, and are then routed to the Bluetooth module on the daughterboard. The jumpers are mounted as default, but could be removed enabling direct connection to the UART on the Bluetooth module; see *External hardware interfaces*, page 13.

USB port

The Bluetooth Starter Kit provides a USB Type B port, which is linked straight through to the Bluetooth module. There are also options to filter the USB input by using the R22, R23, R34, R35, C26, and C26 pads.

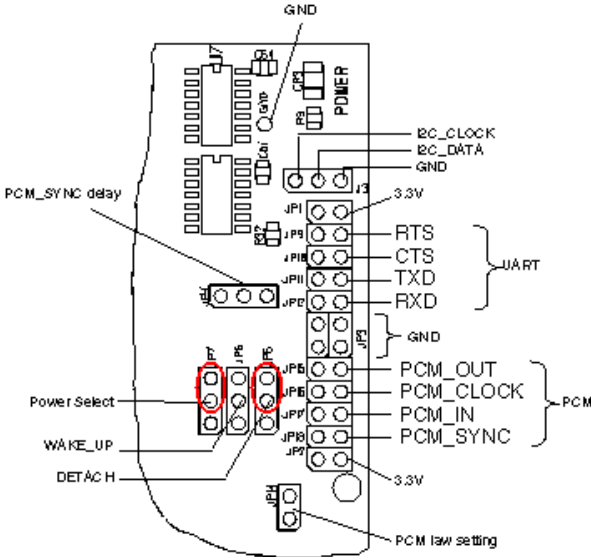


Figure 6: Jumper configuration for using the USB

PCM CODEC

The CODEC chosen for the Bluetooth Starter Kit is an OKI CODEC, MSM7540L. Other CODEC designs could be tested using the user connectors, see later sections.

CODEC interface

The Bluetooth module supports a variety of PCM data structures (μ -law, A-law, or Linear), which are then transmitted as either the μ -law, A-law, or linear PCM, as a CVSD format.

The timing on the interface to the Bluetooth module is fixed, and must comply with the timing constraints specified by Ericsson.

The CODEC fitted to the Bluetooth module has a modified timing requirement, which is shown in detail below:⁷

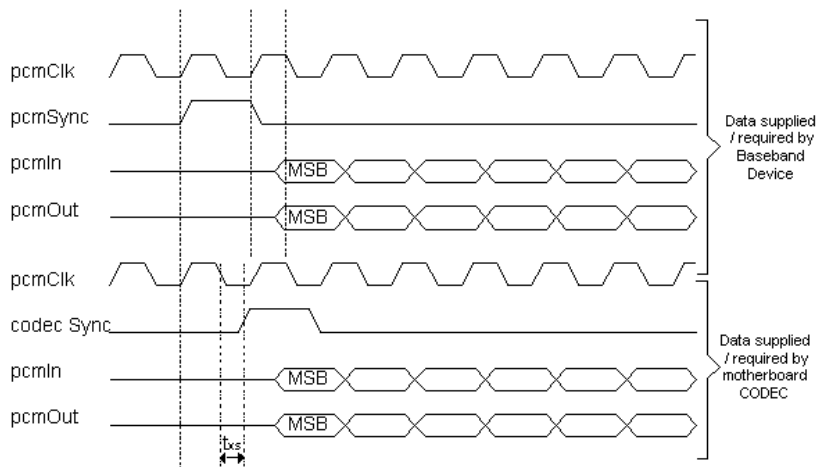


Figure 7: PCM timing for Bluetooth module versus CODEC

As can be seen, the CODEC requires the sync pulse to be shifted relative to the sync from the Bluetooth module. Typically, t_{xs} needs to be at least 100ns. The shift is carried out with the U7E inverter and U2 d-latches, making the data transfer completely transparent. The delay could be set using the JP4 jumper.

The Bluetooth Starter Kit provides access to the CODEC serial port on the user connectors. For further information, see *External hardware interfaces*, page 13. This requires any external CODEC design to be compliant with the Bluetooth module timing specifications.

Daughterboard

The daughterboard carries the Bluetooth module. There is also an RF switch for selecting either the onboard antenna or an external antenna connected to the SMA connector. The daughterboard is replaceable, making it possible to upgrade the kit with new versions of the Bluetooth module.

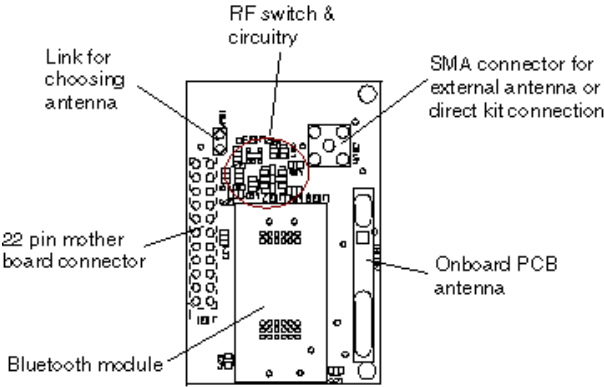


Figure 8: Overview of the daughterboard

ANTENNA BOARD

The antenna board is permanently attached to the daughterboard (see picture). The board is a single matched track, and is fitted perpendicularly to the radio board.

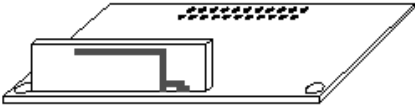


Figure 9: Location of PCB antenna on the daughterboard

RF SWITCH

The daughterboard has a Murata RF switch controlled by JP101. If the jumper is not set, the RF from the radio device is channelled to the SMA connector fitted to the board. In normal operation the jumper should be set to use the onboard PCB antenna.

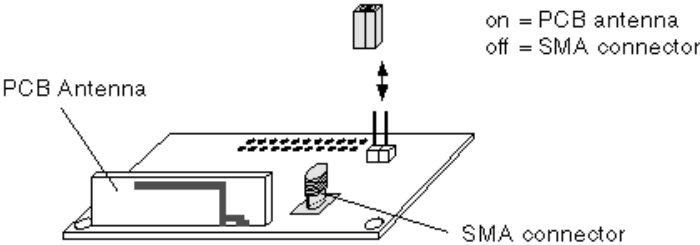
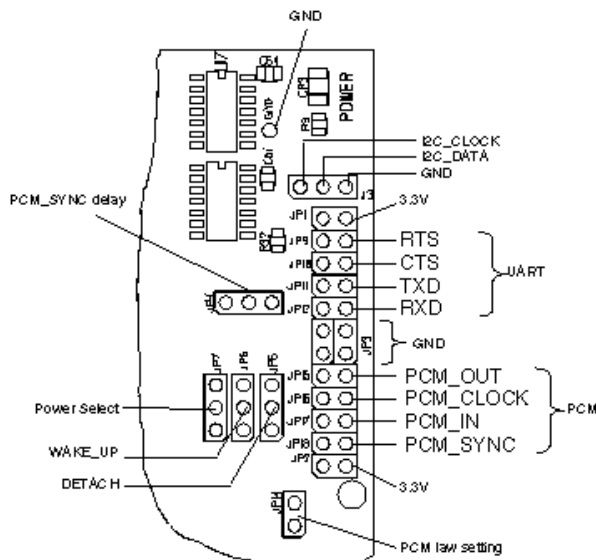


Figure 10: Link operation to choose antenna

The SMA connector can be used to test your own antenna design, or to connect an external antenna.

External hardware interfaces

The interface connectors are located on the edge of the motherboard (see *Figure 11*, page 14). The purpose of the connectors is to enable the user to try different CODEC applications, control the boards using an external microprocessor, or using the I²C to control external circuits. In addition to the interface connectors, there are GND and power pins for powering an external design.



UART INTERFACE

By removing the JP9, JP10, JP11, and JP12 links, the module is disconnected from the RS232 level shifter. The pins closest to the edge of the board are connected directly to the Bluetooth module, and can be used as input/output for an external microprocessor to control the Bluetooth module through the UART interface.

PCM INTERFACE

By removing the JP15, JP16, JP17, and JP18 links, the Bluetooth module is disconnected from the onboard CODEC. The pins closest to the edge of the board are connected directly to the PCM interface on the Bluetooth module. Other CODEC designs can be tested using these pins. This requires that the CODEC design is compliant with the Bluetooth module timing specification.

3.3V AND GND PINS

The JP3 pin is connected to GND on the motherboard, and can be used for signal and power reference for external microprocessor and CODEC designs. The 3.3V JP1 and JP2 pins can be used to power external designs. It is not recommended to use more than 50 mA to external designs from the motherboard power regulator.

ADDITIONAL LINKS

Power select

JP7 makes it possible to use either the external power supply or the power from the USB connector. The default setting is a link between pin 1 and 2, which selects the external power supply.

WAKE_UP and DETACH

The WAKE_UP signal from the Bluetooth module is present on pin 2 at JP6. The DETACH input to the module is present on pin 2 at JP5. Pin 1 on both JP5 and JP6 are connected to +3.3V, and pin 3 on both connectors are connected to GND.

PCM law coding

The onboard CODEC can be set to use different coding laws. By default, there is no link inserted on connector JP14. Since there is a pull-up resistor connected to the law selecting pin (pin 8 LPS) on the CODEC, the law is set to linear. By putting a link on connector JP14, the law selecting pin is pulled low and A-law is selected. For further information regarding the CODEC, see the data sheet.

PCM_SYNC delay

The onboard CODEC has a slightly different PCM interface than the Bluetooth module. This is adjusted by using d-latches as delay circuits. The delay could be set to either 1.5 or 2.5 PCM_CLOCK cycles. For information on PCM timing, see *PCM CODEC*, page 11.

Bill of materials

The following table summarizes the materials:

Item	Quantity	Reference	Part	Package	Manufacturer
1	1	ANT101	Slinke Antenna	Custom	
2	1	ANT102	SMA Antenna connector	SMA Antenna connector(Antenna in center)	
3	1	CR1	BZW06-11	DO15	GI BZW06-11
4	1	CR2	SM4004		Liteon SM4004
5	1	CR3	SM-LED Green	I206	Citizen CLI50GCD
6	1	CR4	BAT54A	SOT23	
7	1	C1	1uF	RTANB	
8	4	C2,C21,C30,C56	22uF	RTANC	
9	17	C3,C8,C11,C12,C28,C29,C50,C51,C52,C53,C54,C55,C121,C122,C123,C124,C125	68nF	R0805C	
10	4	C4,C5,C6,C7	100nF	R1206C	
11	4	C9,C10,C31,C32	NFM39R02C470	0805+GND	Murata NFM39R02C470
12	3	C16,C18,C33	100pF	R0805C	
13	2	C17,C37	4.7uF	RTANB	
14	1	C19	10nF	R0805C	
15	1	C20	220nF	R1206C	
16	2	C23,C22	NFM39R12C102	0805+GND	Murata NFM39R12C102
17	2	C25,C26	47pF	R0805C	Not mounted
18	1	C34	47pF	R0805C	
19	1	C36	10 nF	R0805C	
20	2	C101,C102	1nF	R0805C	
21	3	C103,C104,C105	27 pF	R0805C	
22	12	JP1,JP2,JP3,JP9,JP10,	—	CO2X1	

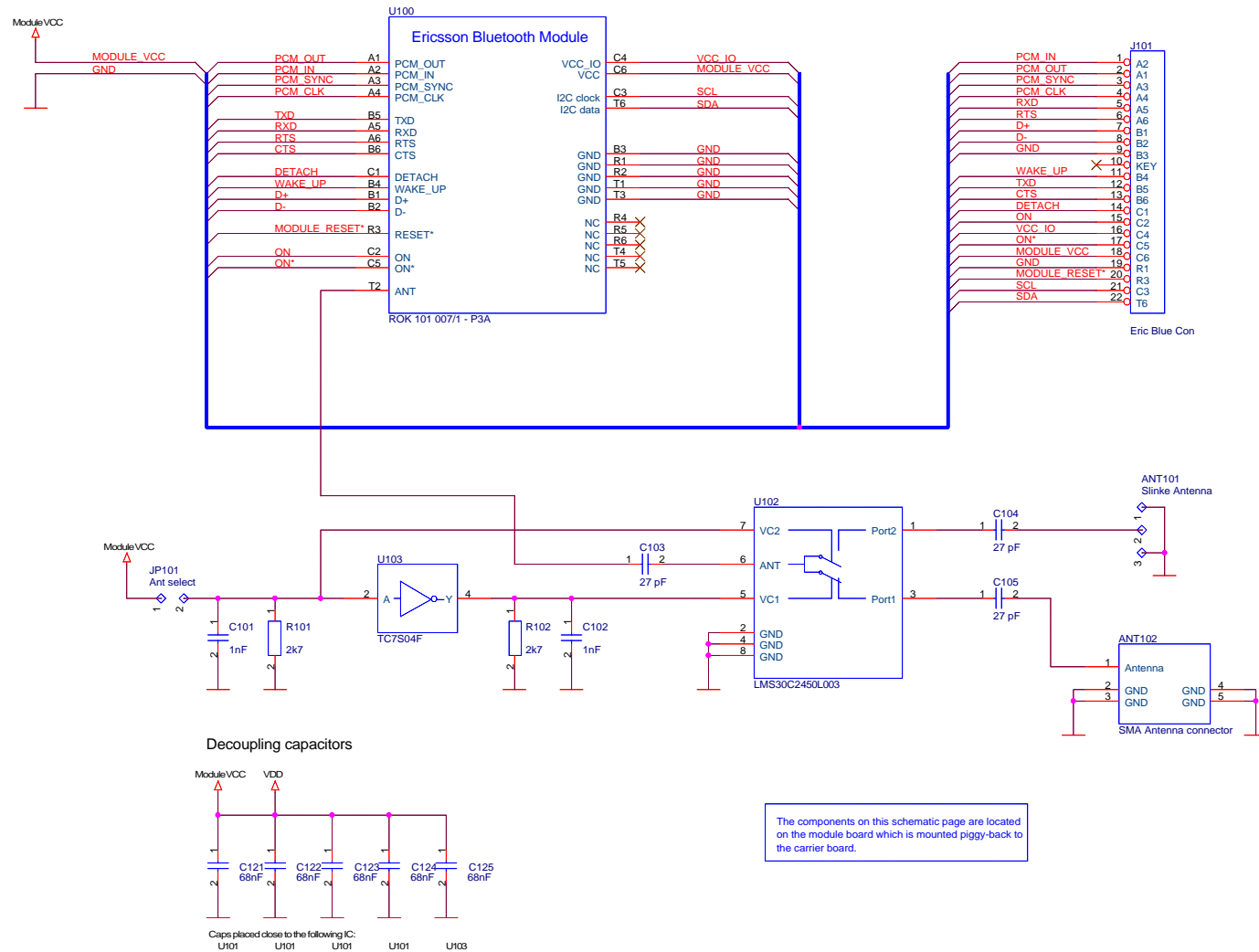
Table 2: Bill of materials

Item	Quantity	Reference	Part	Package	Manufacturer
		JP11,JP12,JP14,JP15,JP16, JP17,JP18			
23	1	JP4	PCM CLK Sel	CO3X1	
24	1	JP5	Detach	CO3X1	
25	1	JP6	Wake Up	CO3X1	
26	1	JP7	Power select	CO3X1	
27	1	JP8	Audio select	CO3X1	
28	1	JP101	Ant select	CO2X1	
29	1	J1	Eric Blue Con	2x11 pin 2,54 mm pitch, socket	
30	1	J2	Head set interface	2,5 mm dia telephone socket	
31	1	J3	I2C-interface	CO3X1	
32	1	J4	USB series B	USB 4 pos right angle receptacle series B	
33	1	J7	Power		
34	1	J10	RS-232-9 socket connector	DSUB9S-angled, socket	
35	1	J101	Eric Blue Con	2x11 pin 2,54 mm pitch, pins	
36	1	L1	DSS306	DSS306	Murata DSS306-FZ103N100
37	1	L2	BL02	BL02	Murata BL02RN2-R62
38	1	L3	10uH	1812	Murata LQH4N100(J/K)04
39	1	Q1	MOSFET P	SOT23	Fairchild FDV304P
40	2	R2,R1	2M	R0805R	
41	1	R3	500	R0805R	
42	9	R4,R9,R10,R11,R14,R24, R25,R27,R104	10K	R0805R	
43	10	R5,R6,R13,R26,R28,R29, R30,R31,R32,R33	100k	R0805R	

Table 2: Bill of materials (Continued)

Item	Quantity	Reference	Part	Package	Manufacturer
44	1	R7	1M	R0805R	
45	1	R8	470K	R0805R	
46	1	R12	4,7K	R0805R	
47	2	R16,R15	1K	R0805R	
48	2	R51,R17	470	R0805R	
49	1	R18	15K	R0805R	
50	2	R20,R21,R103	0	R0805R	Not mounted
51	4	R22,R23,R50	0	R0805R	
52	2	R35,R34	15k	R0805R	Not mounted
53	2	R101,R102	2k7	R0805R	
54	1	SW1	RESET		
55	1	U1	MSM7540L	28-pin SOP	OKI MSM7540L
56	1	U2	74AC74	RSO14	
57	1	U3	MAX3225	SSOP20	
58	1	U4	ZSM330	SOT223	Zetex ZSM330
59	1	U5	74AC132	RSO14	
60	1	U7	74AC14	RSO14	
61	1	U8	LP2985	SOT-23 MA05B	National LP2985
62	1	U100	ROK 101 008/1	Custom	Ericsson Bluetooth Module
63	1	U102	LMS30C2450L003	Custom	Murata
64	1	U103	TC7S04F	SSOP5-P-0.95	Toshiba
65	1	Y101	10.368 MHz	HC49/U4H low, SM	Jauch SSxxxxx U4H
66	1	GND-Pin			

Table 2: Bill of materials (Continued)



Ericsson Microelectronics		
Title	Bluetooth Starter Kit from Ericsson	
Size	Document Number	Rev
A3	EBSK_MH_1999	D
Date:	Friday, March 23, 2001	Sheet 2 of 4

Polarity protection

Transient protection

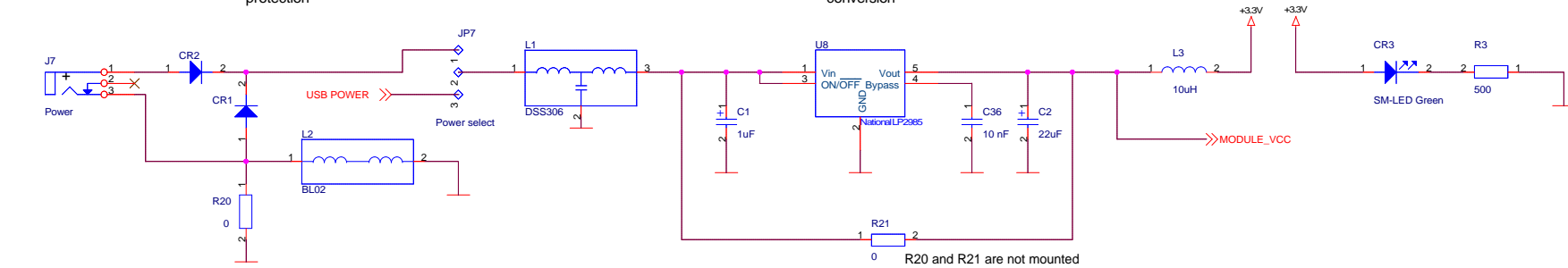
Power supply

EMI-filter

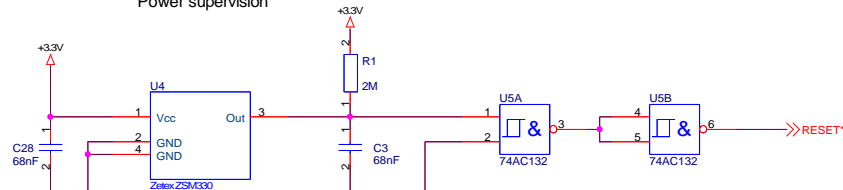
6 VDC to 3.3 VDC conversion

Filter

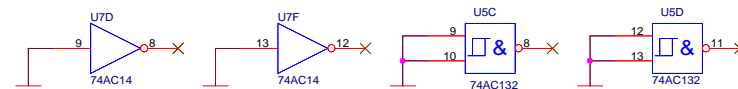
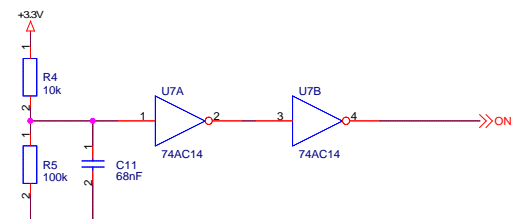
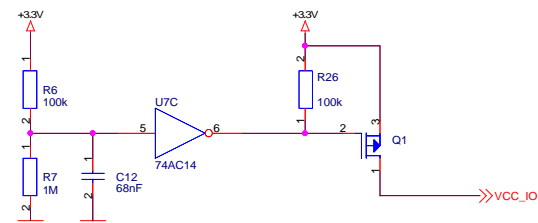
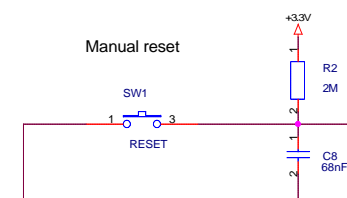
Power on LED



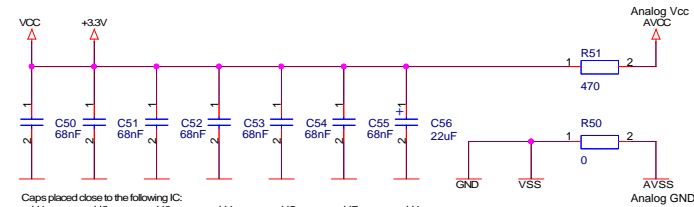
Power supervision



Manual reset



Decoupling capacitors



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Title			
Bluetooth Starter Kit from Ericsson			
Size	Document Number	Rev	
A3	EBSK_MH_1999	D	
Date:	Friday, March 23, 2001	Sheet	3 of 4

