User manual

DECT Module
User Manual

Abstract

*This document provides user guide lines for the DECT Module reference design:
HW description, schematic and PCB details, testability.*

Contents

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Tables

1   Terms and definitions

BoM	Bill of Materials
CODEC	COder / DECoder
GPIO	General Purpose Input / Output (pin)
GND	Ground
HDI	High Density Interconnect
I2C	Inter-IC (serial communication interface)
I2S	Inter-IC sound; in the context of this document it is in relation to the digital audio interface on the module that is the scope in this document
JTAG	Joint Test Action Group (specification of debug interface)
LED	Light Emitting Diode
Lx	Layer x
PCB	Printed Circuit Board
RF	Radio Frequency
SMD	Surface Mount Device
UART	Universal Asynchronous Receiver / Transmitter
USB	Universal Serial Bus

2   References

[1]   Dialog SmartBeat Wireless Audio brochure

[2]   SC14492_493, Datasheet: "Single Chip ZBS DECT Audio Transceiver with USB", Dialog Semiconductor

3   Introduction

This document aims to serve as a guide line in regard to the DECT Module and its use on application level.

The DECT Module is an example HW implementation of the SC14492 chip on a module, to support the development of wireless speaker systems. The air interface is based on the DECT standard, meaning that the system can coexist with regular DECT systems such as DECT phones.

The audio CODEC that is used for audio compression is CELT (sample rate: 48kHz).

The DECT Module is meant to serve as a reference design only. The design files can be made available upon request.

4   General description, block diagram

The DECT Module is a reference design for a SC14492-based module/product. It is a self-contained unit, including the required supporting components such as crystal, FLASH, DC supply and RF circuitry.

The module enables a platform-based product development, in which the RF development is leveraged over multiple products. To further support this platform-based approach, the module is suited to run the Hansong firmware that is fully configurable and enables easy customization without requiring full SW development.

The module supports all required standard interfacing, such as I2S, I2C, USB and GPIO.

The following figure shows the basic module's block diagram and its interfacing to the application PCB:
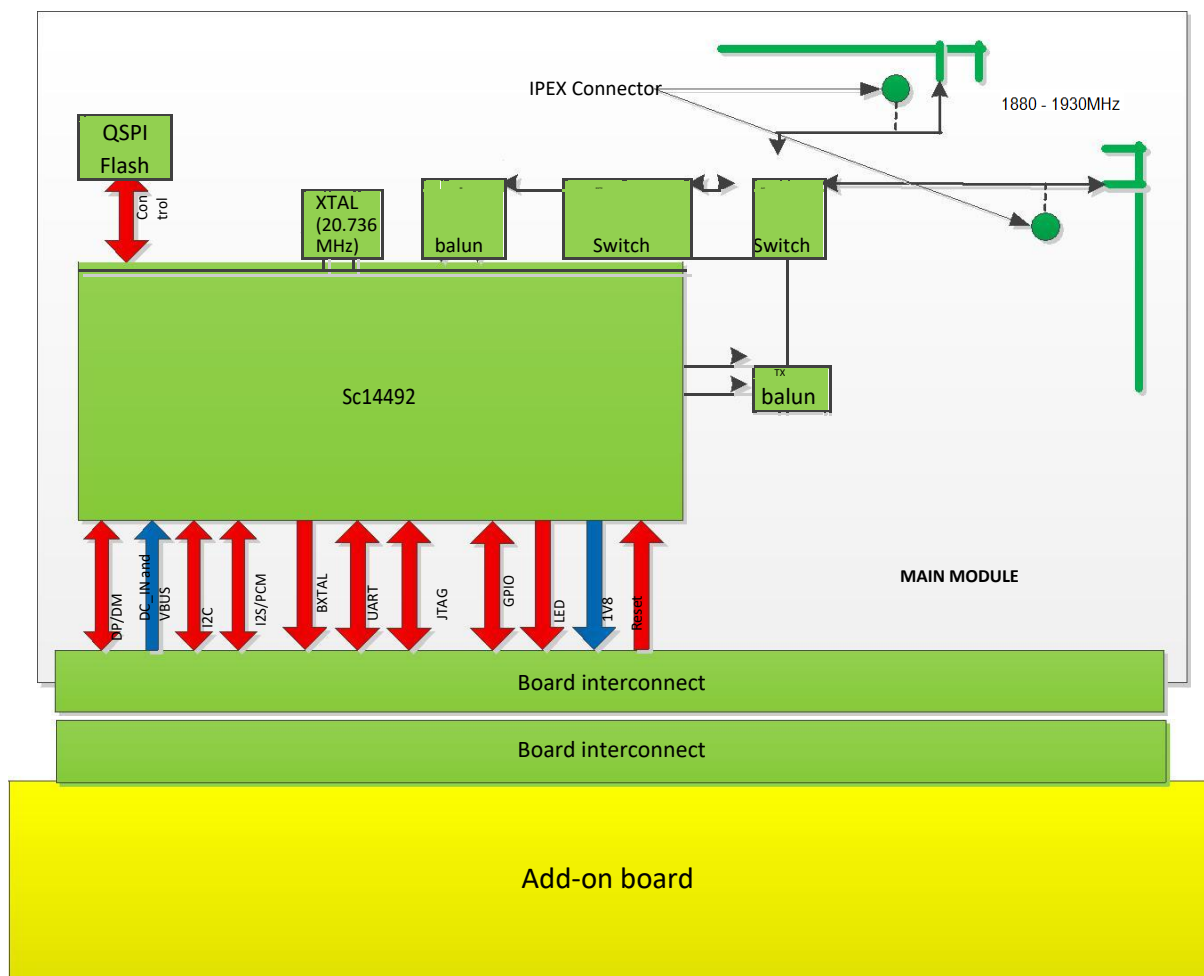

Figure 1: Block diagram of DECT Module

5   Specifications

Table 1: Specifications table

Parameter	Value	Note
Module size	40.8mm x 36.5mm x 1.6mm	Fully embedded module, including RF, FLASH, crystal
Mating connector	R6850-36TR-SMT	Or equivalent
Operating temperature range	0…+50°C	Ambient
Interfacing	I2S (input and output) I2C USB JTAG UART GPIOs	FP = I2S Slave, PP = I2S Master For LEDs and buttons
Antennas	2 printed PIFA Antenna diversity support	Optional up to 2 external antennas (U.FL Hirose / IPEX)
Antenna radiation pattern	Dipole, 2dBi	
Operating frequency range	1880 - 1930MHz	EU DECT, US DECT
Current consumption	160 / 95 mA	FP / PP
Input power supply voltage	3.6V~5.0V	±150 mV
GPIO I/O levels	1.8 V	
Type approval	ETSI/FCC	Pre-test only. Full certification will need to be performed by the customer. Changes to the reference design may invalidate the pre-test results.l
Range	50 m indoor, 300 m outdoor	

6   Schematics
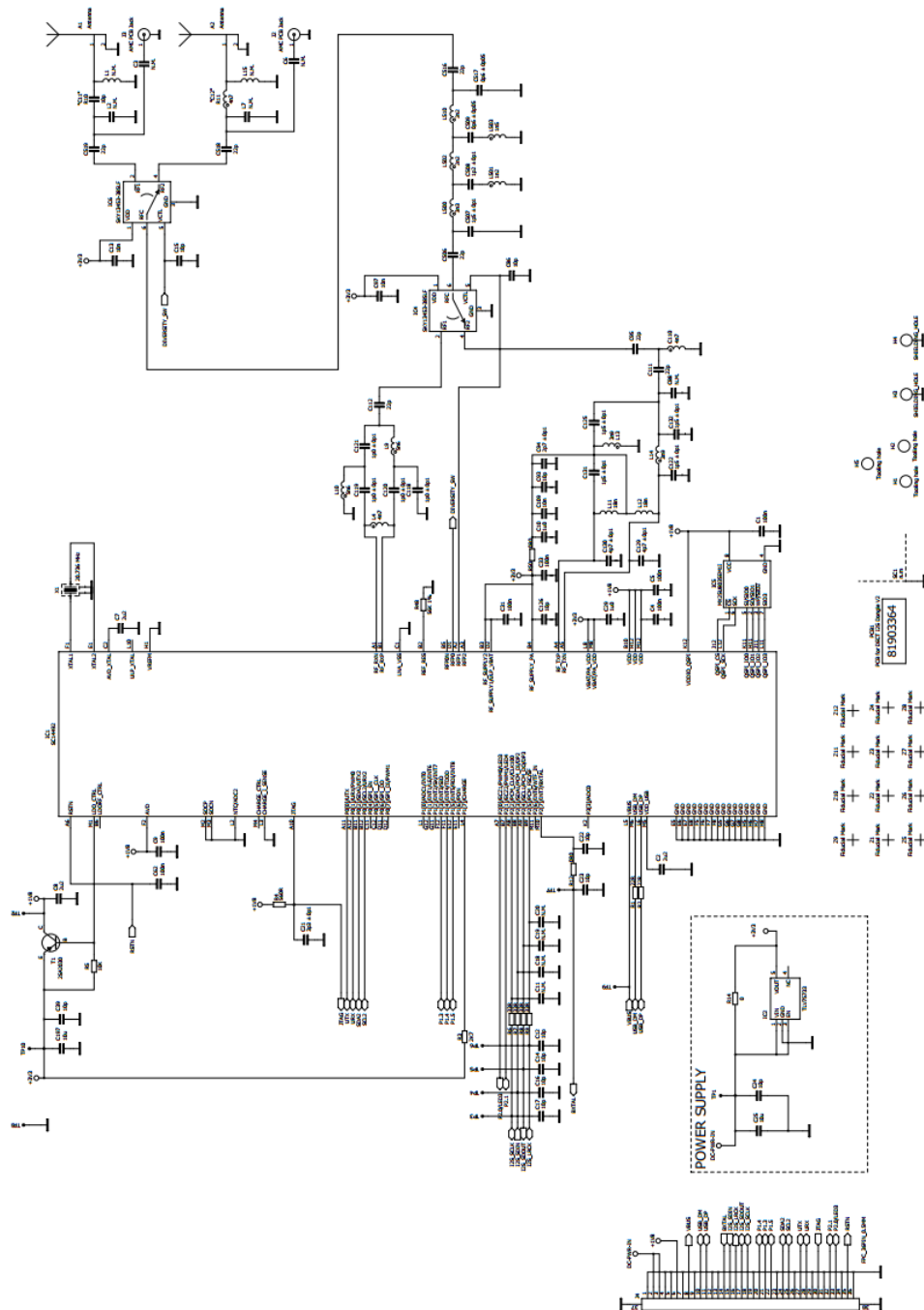
Figure 2: DECT Module Schematics

FCC Frequency

UPCS CHANNEL	FREQUENCY (MHz)
Upper Band Edge	1930.000
0 (Highest)	1928.448
1	1926.720
2	1924.992
3	1923.264
4 (Lowest)	1921.536
Lowest Band Edge	1920.000

CE Frequency

Channel	Frequency	Channel	Frequency	Channel	Frequency
09	1881.792 MHz	08	1883.520 MHz	07	1885.248 MHz
06	1886.976 MHz	05	1888.704 MHz	04	1890.432 MHz
03	1892.160 MHz	02	1893.888 MHz	01	1895.616 MHz
00	1897.344 MHz	---	---	---	---

7   Interface Pinning

Table 2: Interface connector pinning

Connector pinning			
Pin	Description	Pin	Description
1	GND	19	GND
2	DC-PWR-IN	20	GPIO_P1.4
3	DC-PWR-IN	21	GPIO_P1.3
4	GND	22	GPIO_P1.5
5	GND	23	GND
6	1V8	24	I2C_SDA2
7	GND	25	I2C_SCL2
8	VBUS	26	GND
9	GND	27	UART_TX
10	USB_DM	28	UART_RX
11	USB_DP	29	GND
12	GND	30	JTAG
13	GND	31	GND
14	BXTAL	32	GPIO_P2.1(LED)
15	I2S_SDIN	33	GPIO_P2.0(LED)
16	I2S_LRCK	34	GND
17	I2S_SDOUT	35	RSTN
18	I2S_SCLK	36	GND

The interface connector pins are also available on test pins (see also section 11.3).

Next to the connector pinning described here above, the DECT Module also holds two RF connectors that can be used to connect one or two external antenna(s). These are standard U.FL Hirose (IPEX) connectors.
Note that using these will require changing some components on the PCB. Please contact Hansong support for further details.

Name/	Description
Power	Power supply input pin of I2S module.
GND	Connect to application PCB GND plane
JTAG	JTAG debug pin of SC14492 (pin A10)
UART_TX	UART TX, P0[0] of SC14492, connect to application PCB UART RX pin if UART support is required
UART_RX	UART RX, P0[1] of SC14492, connect to application PCB UART TX pin if UART support is required
LED 1/2	Can be used to drive external LED 1/2
GPIO1/2/3	GPIO pin used to connect to external switch, LED or other digital IO device
I2C_SDA	I2C interface serial data pin, P0[2] of SC14492; requires external pull up resistor
I2C_SCL	I2C interface serial clock pin, P0[3] of SC14492; requires external pull up resistor
I2S data in	I2S interface data input of SC14492 on I2S module (connect to external audio ADC/DAC I2S output)
I2S data out	I2S interface data output of SC14492 on I2S module (connect to external audio ADC/DAC I2S input)
BCLK	I2S interface bit clock
LRCK	I2S interface left/right clock
USB _DM	USB interface data "-"
USB_DP	USB interface data "+"
RF ANT 1/2	RF antenna 1/2: printed antenna with optional U.FL/IPEX connector for external antenna support
VBUS	USB supply voltage (input to module)
1V8	1V8 power supply output of I2S module that can be used to supply e.g. external audio ADC/DAC
BXTAL	Optional I2S master clock output: **note that this is a 10.368MHz signal. In case e.g. 12.288MHz is required, an external PLL may be required.**
Reset	Active low reset signal to reset SC14492 of I2S module

Note that the digital IO levels (except I2C) are 1.8V.
Please also refer to the SC14492 datasheet [2] for further pinning details.

8   Layout

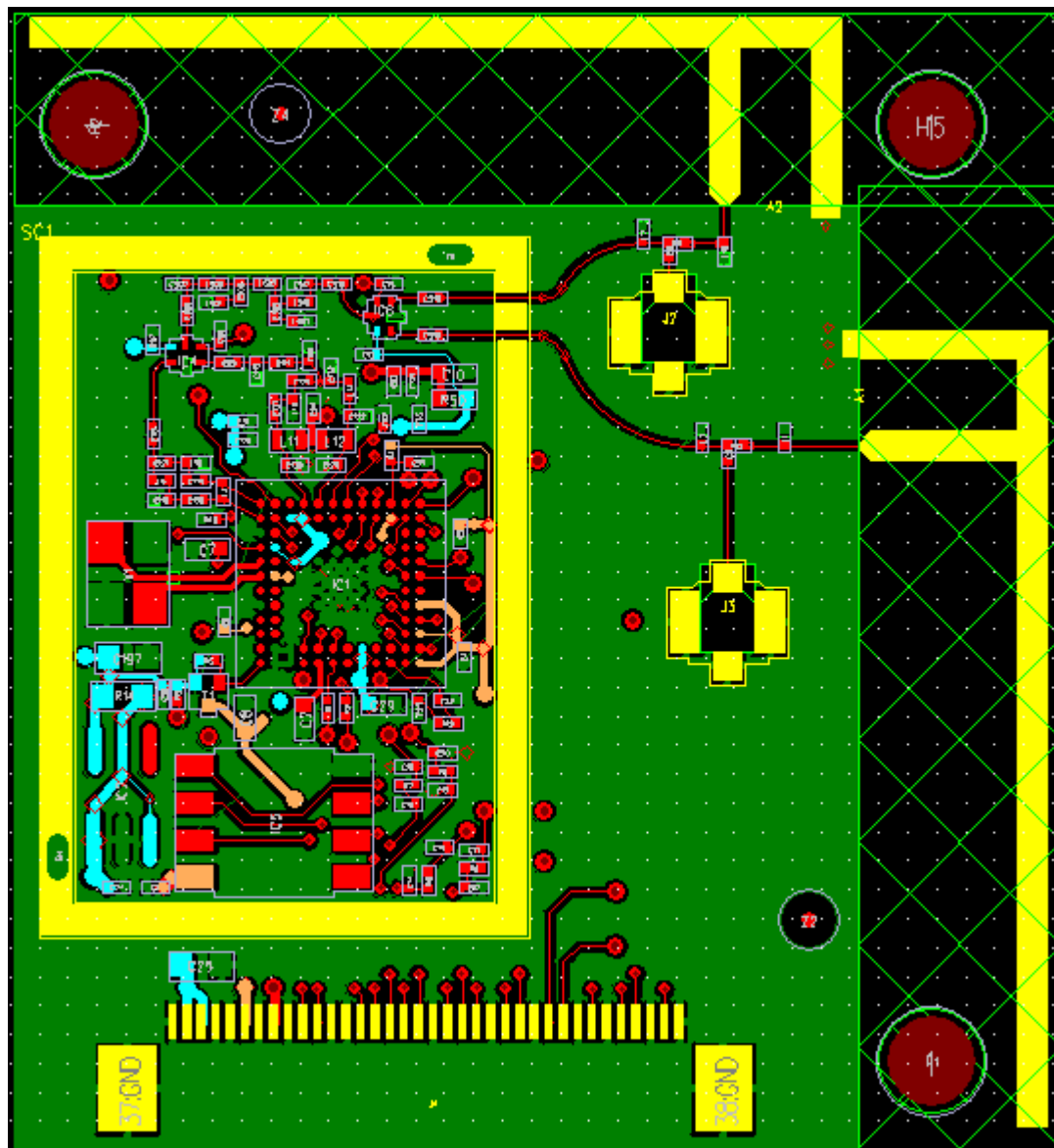Here below a layout plot is depicted of the DECT Module:

Figure 3: Layout plot of DECT Module

9   BoM

Table 3: Bill of Materials List

ID	Description	Manufacturer	Order number	Count
1	MX25U8035EM1I-10G	MXIC	MX25U8035EM1I-10G	1
2	SC14492,ZBS DECT Transceiver with USB	Dialog Semiconductor	SC14492A76R101ULC	1
3	SKY13453-385LF	SKYWORKS	SKY13453-385LF	2
4	AP2112K-3.3TRG1	Diodes(BCD)	MMBT4403M3T5G	1
5	MMBT4403M3T5G	ON	MMBT4403M3T5G	1
6	0Ω,0201,1/20W,±5%,RC0201JR-070RL	YAGEO	RC0201JR-070RL	1
7	0Ω,0201,1/20W,±5%,RC0201JR-070RL	YAGEO	RC0201JR-070RL	pcb antenna：2
8	0Ω,0201,1/20W,±5%,RC0201JR-070RL	YAGEO	RC0201JR-070RL	external antenna：2
9	0Ω,0402,1/16W,±5%,RC0402JR-070RL	Yageo/Phicomp	RC0402JR-070RL	1
10	10KΩ,0201,1/20W,±5%,RC0201JR-0710KL	Yageo	RC0201JR-0710KL	1
11	22R±5%,0201	YAGEO		2
12	2K7±5%,0201	YAGEO		1
13	33Ω,0201,1/20W,5%, RC0201JR-0733RL	Yageo	RC0201JR-0733RL	4
14	560R±5%,0201	YAGEO		1
15	56k 1% 0201	YAGEO		1
16	0.6p +/- 0.05 NP0,0201			2
17	1uK,16V,0402,X5R,C1005X5R1C105K	TDK/Phicomp	C1005X5R1C105K	2
18	100nF,10V,±10%,X5R,C0201KRX5R6BB104	TDK / YAGEO	C0201KRX5R6BB104	7
19	10nK,10V,0201,X7R,C0603X7R1A103KT00NN	Yageo/Phicomp	C0603X7R1A103KT00NN	3
20	10pF 25V ±5% 0201NPO,GRM0335C1E100JD01D	Murata	GRM0335C1E100JD01D	12
21	10uK,10V,0603,X5R,CL10A106KP8NNNC	Samsung	CL10A106KP8NNNC	1
22	CAP,0201,C0G,1.0pF,+/-0.1pF,25V	Murata		4
23	1.2pC,25V,0201,NPO,C0603C0G1E1R2C	TDK/Yageo	C0603C0G1E1R2C	1
24	1p5 ,+/-0.1pF NP0 25V	Murata		5
25	22pF 50V ±5% 0201 NPO, CC0201JRNPO9BN220	Murata	CC0201JRNPO9BN220	7
26	CAP,0201,C0G,2.7pF,+/-0.25pF,25V	MURATA		1
27	2.2uM,6.3V,0402,X5R	Yageo		3
28	3p3 ,+/-0.1pF NP0 25V,0201	Murata		1
29	4.7pF,+/-0.1pF,25V,0201,NPO	TDK/Yageo/和伸堂		2
30	Coil, chip 18nH Wirewound ±3%,LQW15AN18NH00x,0402	Murata	LQW15AN18NH00x	2
31	Inductor Chip 1n2,±0.1nH,LQP03TN1N2B02,0201	Murata	LQP03TN1N2B02	1
32	Inductor Chip 1n5'±0.1nH,LQP03TN1N5B02,0201	Murata	LQP03TN1N5B02	1
33	HK0603 2N2S-T,2.2 ±0.3nH,LQP03TN2N2B02#,0201	TAIYO YUDEN	LQP03TN2N2B02#	2
34	Inductor Chip 3n3,±0.1nH,LQP03TN3N3B02,0201	Murata	LQP03TN3N3B02	1
35	Inductor Chip 3n9'±0.1nH,LQP03TN3N9B02#,0201	TDK	LQP03TN3N9B02#	2
36	4.7nH ±0.3nH,LQP03TN4N7H02,0201	WE	LQP03TN4N7H02	2
37	5n6 '±3%,LQP03TN5N6H02,0201	Murata	LQP03TN5N6H02	2
38	KFM110Z-1002-7F	FOXCONN		external antenna：2
39	36PIN,0.5mm, R6850-36TR-SMT	晋宇	R6850-36TR-SMT	1
40	SHIELDING COVER FRAM-2			1
41	SHIELDING COVER			1
42	TZ1284B, 20.736 MHz	TAI-SAW Technology	TZ1284B	1

10 PCB Stackup

Table 4: PCB Layer Stackup

Parameter	Value	Note
Board Definition	PCB	Rigid
Stack-up	1-2-1	
SMD	Single-sided	
Via-type	Through, microvia	
Layer Definition	Multilayer – 4L	
Laminate	FR-4	
Board size	36.5mm x 40.0mm	+/-0.2mm
Board thickness	1.6mm	+/-10%
Surface finish	Immersion Gold	

11 Application PCB guidelines

This section describes some guidelines in relation to the use of the DECT Module with the application (host) PCB.

11.1 RF considerations

To ensure optimum wireless performance of the DECT Module, special attention should be paid to the antenna selection and placement. In case the internal/embedded printed antennas are used, the module location would be best selected by focusing on the following:

● Ensure that the antennas are uninhibited as much as possible (e.g. by placing the module at the corner of the application PCB

● Ensure that no components , traces or ground/power planes are close to the module; they should preferably be spaced >>2cm away

● The module location with respect to the product's enclosure should be such that the antennas are not close to conductive parts (e.g. metallic paint, metal parts, wiring, …)

○ Should this be insufficiently feasible, it can be considered to use external antennas instead, to have optimum design freedom with respect to the antenna placement for optimum performance

● The antennas may radiate significant RF power. Care should be taken to ensure that e.g. an analog audio ADC/DAC is not affected by this (i.e. rectifying the RF energy inside the ADC/DAC and causing audible artefacts). This can be accomplished by any of the following:

○ Ensure sufficient physical separation between the antennas

○ Use a C-R-C filtering pi-network at the analog audio IO (e.g. R=33Ohm, C=10pF)

● The module has a provision for an optional RF shield that can be used to minimize EMC/EMI in case this is required on the application level

11.2 Routing

High speed signals, such as the I2S bus (most notably the BLCK) and/or other digital/clock signals should be routed with great care, to ensure that their harmonics aren't received by the module's antennas, limiting its receiver sensitivity. To this effect, the following can be considered:

● Use C-R-C filtering pi-networks on signal lines that are high speed

● Route high speed signals on inner layers, while ensuring that they are sandwiched between power/GND planes for optimum shielding/isolation

Other general audio/RF design guidelines would apply, such as the use of a good (uninterrupted) system ground plane, sufficiently thick traces for the power supply routing, etc.

Also, to minimize current switching noise from the module to the application PCB, it may be advisable to use solid, wide frequency[1] decoupling close to the connector.

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[1] E.g. at least a large valued capacitor, e.g. 100uF, to buffer the larger LF current peaks and 10pF to decouple the RF content.

11.3 Testability

BAT files can be made available that configure the module in specific test modes that can be used for production level testing.

The interface pins are also available on test pins, located on the bottom side of the PCB, suitable for a bed-of-nails (pogo-pins) test bed (pin-to-pin spacing >100 mil).

11.4 Debug interface

On the application / host PCB, in order to support application programming debugging, there needs to be a provision for the debug connector. For connecting the Unity box the standard (white) connector has to be used.

Table 5: Pin out of connector , the debug interface of the DECT module

Pin	Label	Connect to	Function
1	GND		GND
2	URX	See picture, pin 4	UART
3	UTX	See picture, pin 3	UART
4	JTAG	See picture, pin 2	1wire JTAG
5	1v8	See picture, pin 1, including resistor	Power

Figure 4: Debug connector

11.5 USB interface

Here below the USB interface to/from the DECT module is depicted.

Note that D1 should become part of the application / host PCB.

Figure 5. USB interface

11.6 Buttons and LEDs

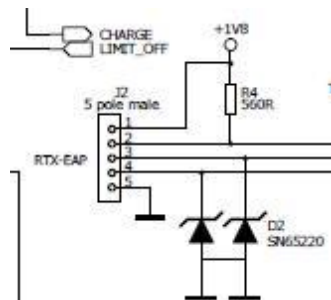Here below a possible implementation of buttons/LEDs is depicted for the application / host PCB:

Figure 6. Buttons and LEDs on the application / host PCB

Federal Communications Commission (FCC) Interference Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference in a residentiallinstallation. This equipment generate, 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 doescause harmful interference to radio or television reception, which can be determined by turning the equipmentoff and on, the user is encouraged to try to correct the interference by one 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.

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.
FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

RF exposure warning

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment must be installed and operated in accordance with provided instructions and the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be collocated or operating in conjunction with any other antenna or transmitter.

Industry Canada (IC)

CAN ICES-3 (B)/NMB-3(B)

This device complies with Industry Canada's licence-exempt RSSs. 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.

Cetappareilestconforme à la norme RSS d'Industrie Canada. Son fonctionnementestsujet aux deux conditions suivantes:

(1) ledispositif ne doit pas produire de brouillagepréjudiciable, et

(2) cedispositifdoit accepter tout brouillagereçu, y compris un brouillage susceptible de provoquer un fonctionnementindésirable.

IMPORTANT NOTE:

Radiation Exposure Statement:

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

Déclarationd'exposition aux radiations:

Cetéquipementestconforme aux limitesd'exposition aux rayonnements IC établies pour unenvironnement non contrôlé. Cetéquipementdoitêtreinstalléetutilisé avec un minimum de 20cm de distance entre la source de rayonnement et votre corps.

OEM Integration Instructions：

This device is intended only for OEM integrators under the following conditions：

The module can be used to installation in other host. The antenna must be installed such that 20 cm is maintained between the antenna and users, and the transmitter module may not be co-located with any other transmit or antenna. The module shall be only used with the integral antenna(s) that has been originally tested and certified with this module. As long as 3 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirement with this module installed (for example, digital device emission, PC peripheral requirements, etc.)

IMPORTANT NOTE：

In the event that these conditions cannot be met (for example certain laptop configuration or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module cannot be used on the final product. In these and circumstance, the OEM integrator will be responsible for re-evaluating. The end product (including the transmitter) and obtaining a separate FCC authorization. The final end product must be labeled in a visible area with the following: "**Contains Transmitter Module FCC ID: XCO-DECT** or **Contains FCC ID: XCO-DECT**".

Antenna Specification:

Antenna Type	Part No.	Peak Antenna Gain
Dipole Antenna	N/A	2dBi
Monopole Antenna	45-2-000272	2dBi
PCB Antenna	RC12WFI0283A1	2dBi

IMPORTANT NOTE :

This DECT Module (IC: 7756A-DECT) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

The Host Marketing Name(HMN) must be displayed (according to e-labelling requirements) or indicated at any location on the exterior of the host product or product packaging or product literature, which shall be available with the host product or online.

The host product shall be properly labelled to identify the modules within the host product. The Innovation, Science and Economic Development Canada certification label of a module shall be clearly visible at all times when installed in the host product; otherwise, the host product must be labelled to display the Innovation, Science and Economic Development Canada certification number for the module, preceded by the word "Contains" or similar wording expressing the same meaning, as follows: Contains IC: 7756A-DECT.

Antenna Specification:

Antenna Type	Part No.	Peak Antenna Gain
Dipole Antenna	N/A	2dBi
Monopole Antenna	45-2-000272	2dBi
PCB Antenna	RC12WFI0283A1	2dBi

Revision history

Revision	Date	Description
1.0	13-Dec-2017	Initial version.