

# DHAN-M Module

## DECT-ULE Platform

### *Datasheet*

Version: 3.0

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# TABLE OF CONTENTS

1. INTRODUCTION .....	5
General Description .....	5
Features .....	5
Block Diagram .....	5
2. PIN AND SIGNAL DESCRIPTION .....	6
3. MODULE ELECTRICAL SPECIFICATIONS .....	8
Absolute Maximum Rating .....	8
Recommended Operating Conditions .....	8
Peak Currents and Hibernation Current .....	8
Transmitter .....	9
Receiver .....	9
4. PROTOCOL STACKS .....	10
5. REFERENCE SCHEMATICS .....	11
Interface to Host Processor via UART and 3.3V Logic .....	11
Host to DHAN-M Interface .....	11
Power Supply & (Optional) JTAG .....	11
Interface to the Host Processor via UART and 1.8V Logic .....	12
Host to DHAN-M Interface .....	12
Power Supply .....	12
Interface to the Host Processor via USB and 3.3V Logic .....	13
Host to DHAN-M Interface .....	13
Power Supply & (Optional) JTAG .....	13
JTAG Interface .....	14
RSTN Input .....	14
MIC and Ear Speaker Interfaces .....	14
6. APPLICATION PCB DESIGN RECOMMENDATIONS .....	15
7. DIVERSITY ANTENNA (OPTION) .....	16
8. ASSEMBLY INFORMATION .....	17
Mechanical Drawing .....	17
PCB Metal Land Pattern Recommendation .....	18
PCB Solder Mask Recommendation .....	19
PCB Stencil Pattern Recommendation .....	20
Pick & Place, Reflow .....	20
9. SUPPLEMENTARY INFORMATION .....	21
Labeling (appended to the module shield) .....	21
RF Exposure information and statement .....	21
FCC & IC Interference statement	
RFPI and EMC .....	22
(DoC) Declaration of conformity	
OEM Notes	
IC labeling requirements for the final end product	
Ordering Information .....	23

Change Log..... 24

# 1. Introduction

## General Description

The DSPG DHAN-M module is based on the state-of-the-art DCX81 - a 2<sup>nd</sup> generation DECT SOC. The DHAN-M module is suited for DECT-ULE applications that employ a processor external to the DHAN-M. The DHAN-M can serve as a DECT-ULE Hub (=Base Station) when loaded with a CMBS SW image. This image includes standard DECT-ULE MAC-PHY connectivity as well as CAT-IQ functionality for traditional DECT telephony and HAN-FUN (ie the ULE Alliance Standard) functionality for ULE (low-power packet mode).

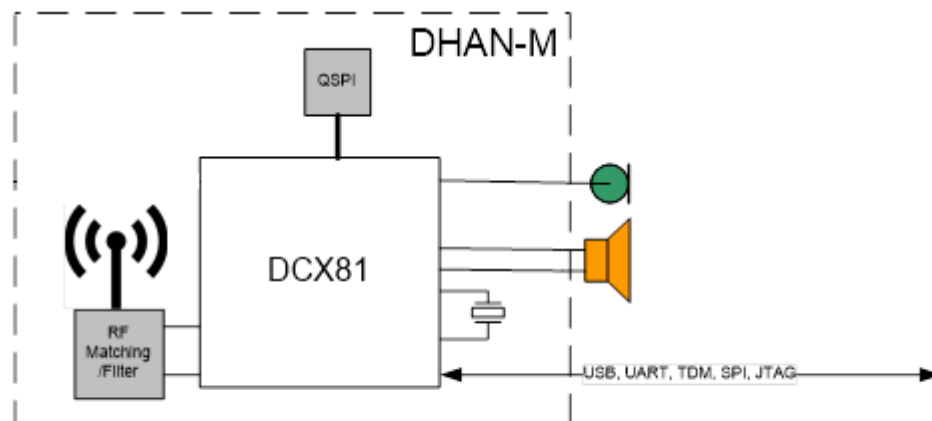
The DHAN-M can also be loaded with a SW image that empowers the module with a DECT “handset” profile (CMHS). As above, both UART and USB interfaces are available for control and, in the case where audio needs to be transferred between the CMHS target and the Host Processor, TDM or USB Audio Class can be utilized.

In either case, the DHAN-M interfaces with the Host Processor via UART or USB. Audio is transferred either via TDM (with control via UART) or via USB (Audio Class).

## Features

- Excellent radio performance, with over 123dB system gain
- A printed antenna is included in the module. A 2<sup>nd</sup> antenna port is provided and can be routed to an optional diversity antenna located elsewhere in the application housing
- Radio covers all regional DECT bands. A simple re-configuration of the EEPROM is required
- Radio is fully compliant with ETSI DECT and ULE standards. Regulatory (EU, FCC) certification is pending
- Compact module footprint of 27.2x15.2x3.3 (including the RF shield height)
- Operating Temperature spanning -40°C to 85°C

## Block Diagram

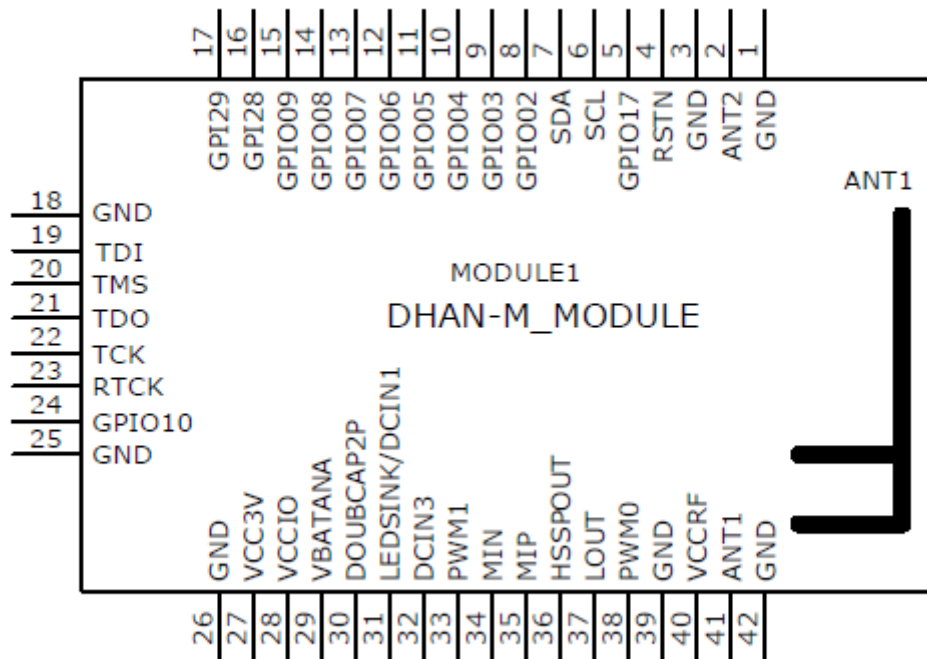


**DHAN-M Module Block Diagram**

## 2. Pin and Signal Description

PIN NO.	NAME	DESCRIPTION/TYPE
1	GND	Place many vias in the vicinity of this pin
2	ANT2	Optional port for connection to a diversity antenna located elsewhere in the housing. Otherwise terminate with a 51-Ohm resistor
3	GND	Place many vias in the vicinity of this pin
4	RSTN	Resets the DCX81 SOC. See reference schematic and comments
5	GPIO17	
6	SCL (GPIO0)	GPIO or I2C Clock. Open Drain, reset value is floating
7	SDA (GPIO1)	GPIO or I2C Data. Open Drain, reset value is floating
8	GPIO2 (PCM_Tx)	TDM Tx Data
9	GPIO3 (PCM_Rx)	TDM Rx Data
10	GPIO4 (PCM_FSYNC)	TDM Frame Sync
11	GPIO5 (PCM_CLK)	TDM SCLK
12	GPIO6 (SPI_MOSI)	SPI Data Input to the DHAN-M
13	GPIO7 (SPI_MISO)	SPI Data Output from the DHAN-M
14	GPIO8 (SPI_CLK)	SPI Clock
15	GPIO9 (RxD or SPI_CS)	UART Rx (most typically) or SPI Chip Select
16	GPIO28 (DM_USB)	USB Positive Pin
17	GPIO29 (DP_USB)	USB Negative Pin
18	GND	
19	TDI	JTAG Data In. Should be connected to TP
20	TMS	JTAG Mode Select. Should be connected to TP
21	TDO	JTAG Data Out. Should be connected to TP
22	TCK	JTAG Clock. Should be connected to TP
23	RTCK	JTAG Reset. Should be connected to TP
24	GPIO10 (TxD)	GPIO or UART Tx
25	GND	
26	GND	

PIN NO.	NAME	DESCRIPTION/TYPE
27	VCC3V	Power Supply Input
28	VCCIO	Powers the IO level shifters. 1.8 or 3.3V. See reference schematics
29	VBATANA	Power Supply Input for the analog portion of the SOC
30	DOUBCAP2P	
31	LEDSINK/DCIN1	
32	DCIN3	ADC. Check of Power. See reference schematic
33	PWM1	
34	MIN	Microphone negative input
35	MIP	Microphone positive input
36	HSSPOT	Handset/Headset positive speaker output
37	LOUT	Line Output or Handset/Headset negative speaker output
38	PWM0	
39	GND	
40	VccRF	Power Supply Input to RF. Add 10pF bypass capacitor adjacent to this pin!
41	ANT1	Test pin. Leave unconnected
42	GND	Place many vias in the vicinity of this pin



### 3. Module Electrical Specifications

All parameters are for 25°C.

#### Absolute Maximum Rating

**Table 3-1: Absolute Maximum Rating**

Minimum Voltage Applied to all pins: -0.3V

Maximum Voltage Applied to all pins: +4.6V

Storage Temperature Range: -45 to 90°C

Note: Functionality at or above these limits is not implied. Exposure to absolute maximum ratings for extended periods may affect device reliability.

#### Recommended Operating Conditions

**Table 3-2: Recommended Operating Conditions**

RATING	CONDITIONS	MIN	TYP	MAX	UNIT
Operating ambient temperature		-40	+25	+85	°C
VccRF, VCC		2	3.0	3.6	V
JTAG, UART	VIL VIH VOL VOH (VCC is at nominal 3V)	2.0		0.8 0.4	V
DCIN3		2	3.0	VCC	V

#### Peak Currents and Hibernation Current

PARAMETER	TEST CONDITIONS	TYP	MAX	UNIT
Tx Current	VccRF=3 V VCC=3 V Band=EU @ 23dBm	400	480	mA
Tx Current	VccRF=3 V VCC=3 V Band=US @ 21 dBm	250	300	mA
Rx Current	VccRF=3 V VCC=3 V	125	135	mA



## Transmitter

**Table 3-3: Tx Characteristics**

CHARACTERISTICS	TEST CONDITIONS	MIN	TYP	MAX	UNIT
NTP	V <sub>ccRF</sub> =3 V VCC=3 V Band=EU	21.5	23	24	dBm
NTP	V <sub>ccRF</sub> =3 V VCC=3 V Band=US	19	20	21	dBm
Harmonics	V <sub>ccRF</sub> =3 V VCC=3 V Band=EU & US		-40	-35	dBm
Transmission Mask	EN 301406 Paragraph 5.3.3		Comply		N/A
Frequency Offset	EN 301406 Paragraph 5.3.1	-50	8	+50	KHz
Frequency Drift	EN 301406 Paragraph 5.3.5	-15	0	+15	KHz/Slot
Emission Due Modulation	EN 301406 Paragraph 5.3.6.2				dBm
	M±1		-20	-8	
	M±2		-42	-30	
	M±3		-47	-40	
	M>±3		-50	-44	

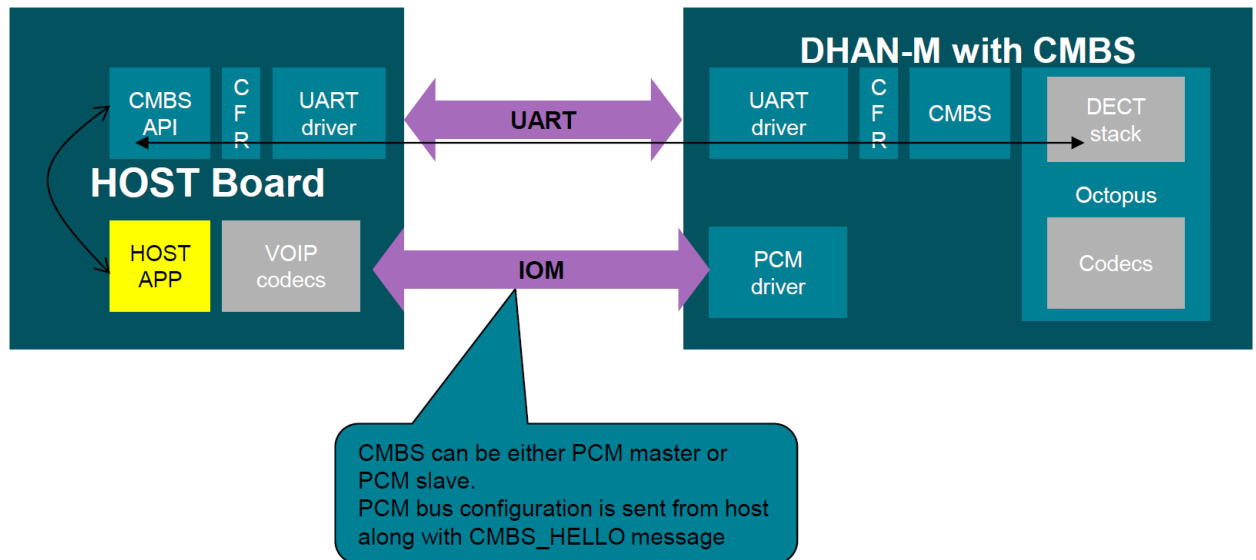
## Receiver

**Table 3-4: Rx Characteristics**

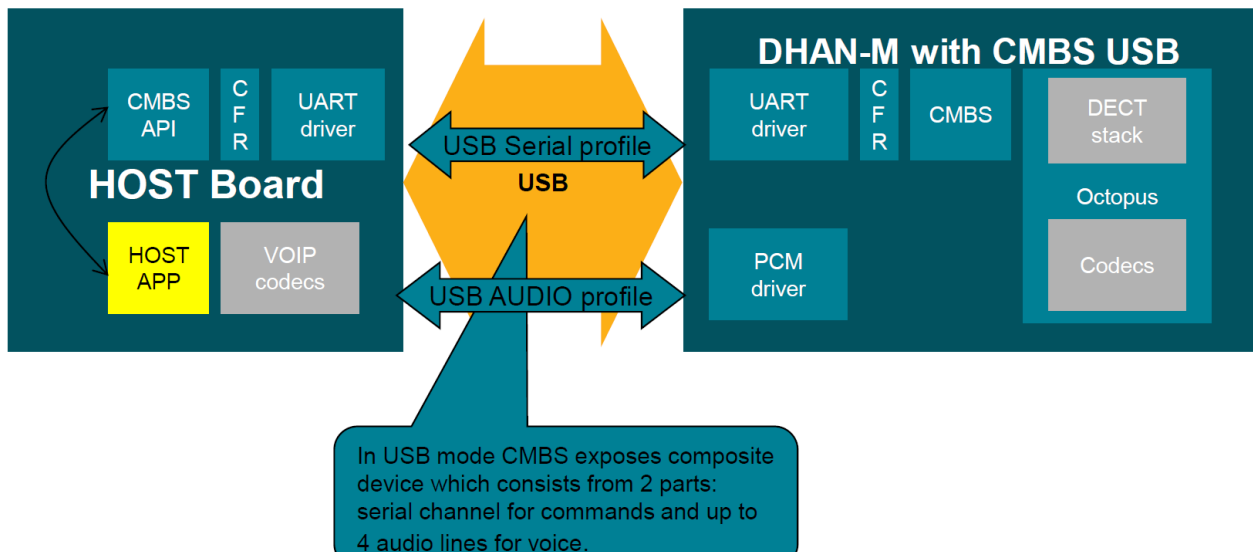
CHARACTERISTICS	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Sensitivity, BER < 1000ppm	V <sub>ccRF</sub> =3 V VCC=3 V		-96	-93	dBm
Maximum input power	V <sub>ccRF</sub> =3 V VCC=3 V			15	dBm

## 4. Protocol Stacks

The module comes configured for the role of a DECT-ULE Hub (=Base Station) with control via the 2-pin UART interface according to the CMBS API. This API supports both traditional telephony functionality (per the CAT-IQ standard as well as ULE HAN-FUN functionality). Concurrent audio paths are supported at the TDM (IOM) interface running between the Host Processor and the DHAN-M. The “division of labor” and interface between the Host Application and the standard CMBS protocol stack is depicted below:



Alternatively, the customer can request to download an image which uses the USB interface for both control and audio – as depicted below:



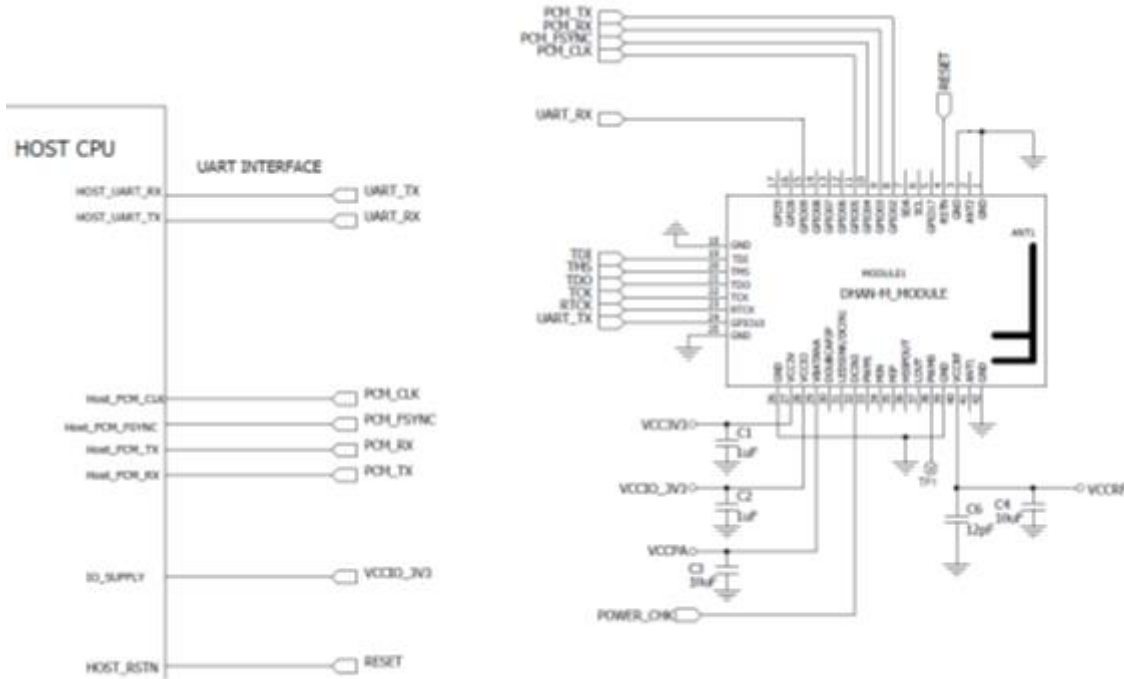
Similarly, customers wanting to implement a high-end DECT-ULE Device (=end point or PP), can request a CMHS image, with either UART or USB interface options. Reference Schematics for both USB and UART options are supplied in the following Section.

## 5. Reference Schematics

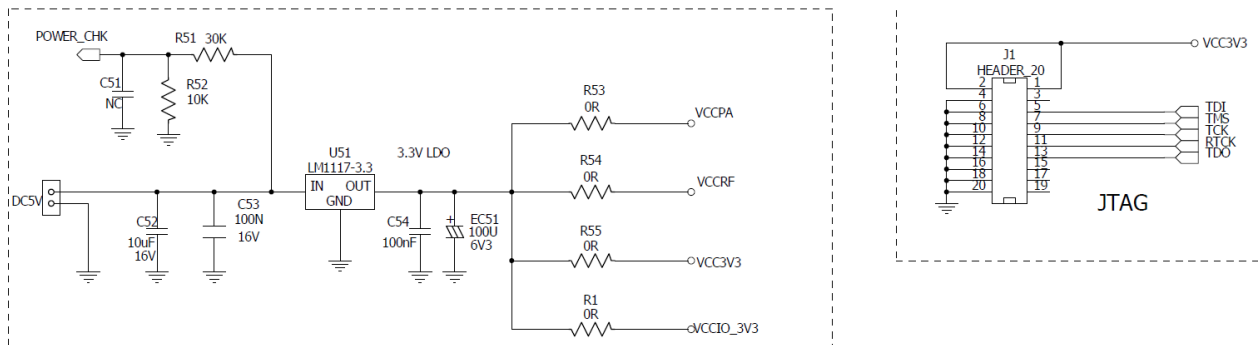
General Note: The 3.3V regulator should be capable of regulating the output with the module drawing 450mA for 0.5mS during the Tx burst!

### Interface to Host Processor via UART and 3.3V Logic

#### Host to DHAN-M Interface



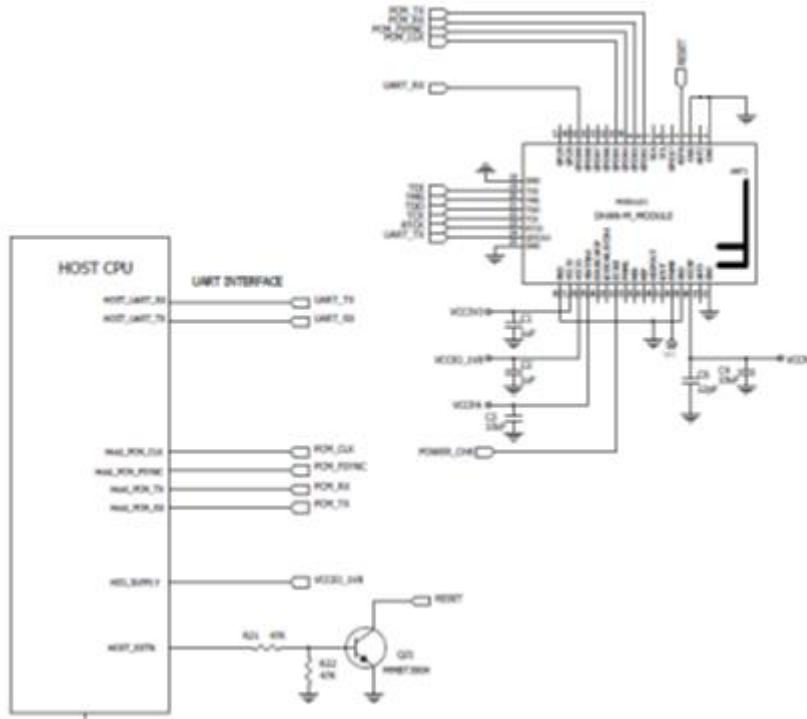
#### Power Supply & (Optional) JTAG



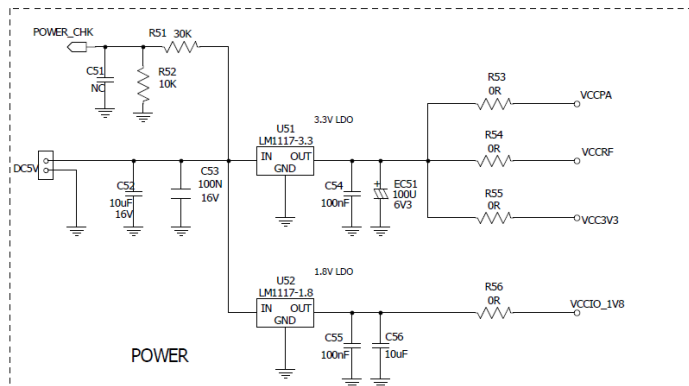
Note: The PCM (=TDM = I<sup>2</sup>S) Interface is required only in applications where audio must be exchanged between the DHAN-M and the Host Processor.

## Interface to the Host Processor via UART and 1.8V Logic

### Host to DHAN-M Interface

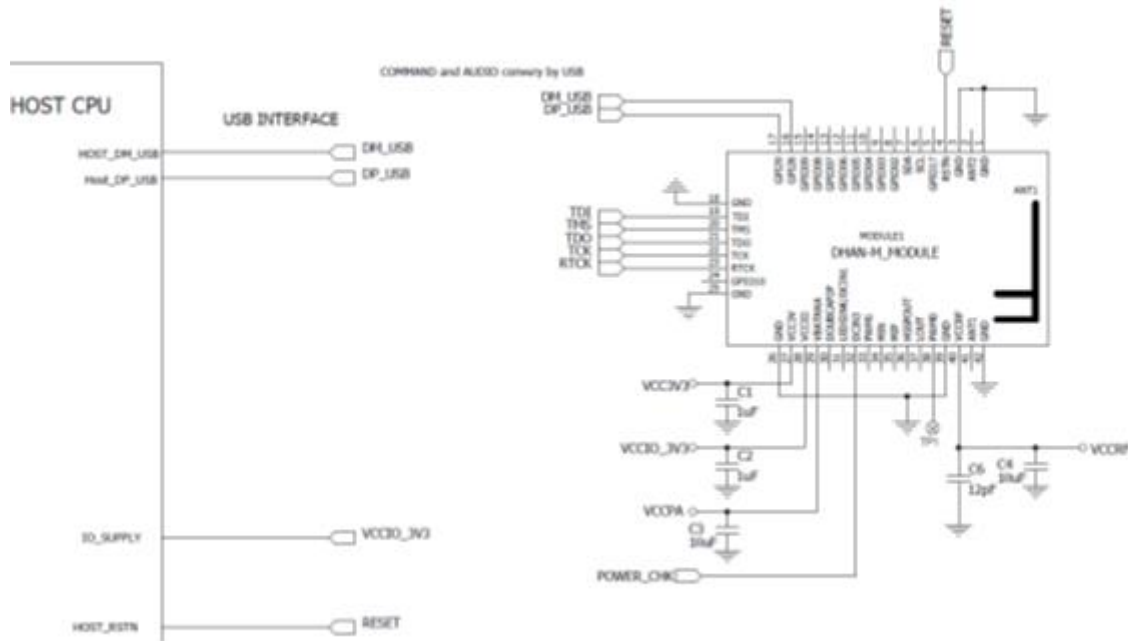


### Power Supply

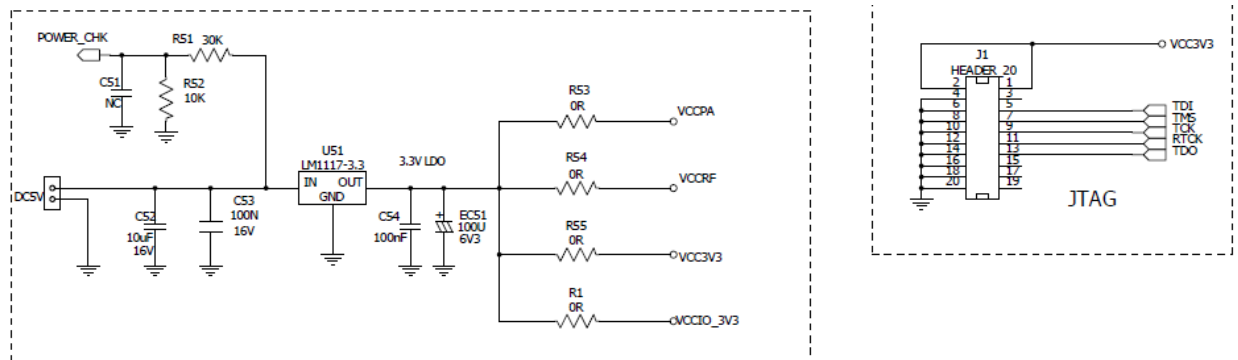


## Interface to the Host Processor via USB and 3.3V Logic

### Host to DHAN-M Interface



### Power Supply & (Optional) JTAG



## JTAG Interface

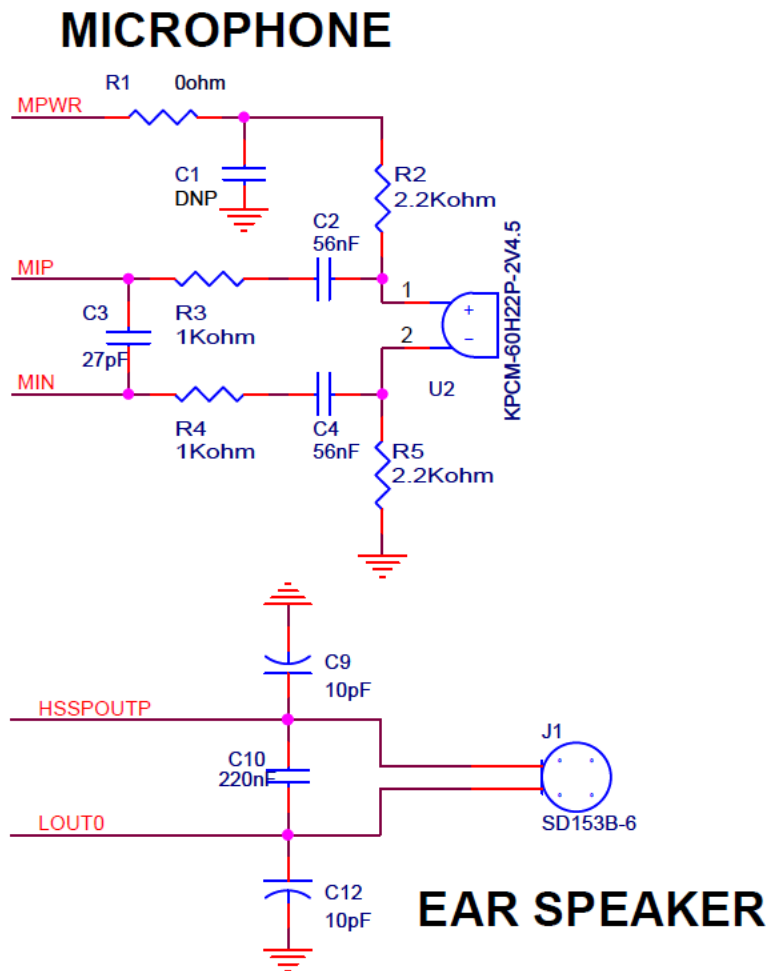
Easy access to the JTAG interface is a MUST for customers requiring a SW image other than the CMBS UART stack which is standard on the DHAN-M. The standard 20-pin connector shown in the reference schematic is convenient if the application board can accommodate it. Alternatively, test pins should be added which can be accessed both during prototyping and production.

## RSTN Input

At power-up, the Application Host should hold this pin at logic Low until it is ready to establish communication (via UART) with the DHAN-M. When ready, the MCU should apply Logic High and wait for the “Hello” indication from the DHAN-M. If at some point later on the MCU cannot communicate with the DHAN-M, it can apply a low going pulse of >100uS to reset the DCX81 on the DHAN-M.

## MIC and Ear Speaker Interfaces

Some CMHS applications will need to route to/from the DHAN-M MIC and Speaker interfaces – reference schematics for these connections are shown below:



## 6. Application PCB Design Recommendations

It is recommended that unused pads on the Application PCB not be left as isolated islands of copper but rather be anchored with via to inner layers of the PCB. It is also recommend that GND vias be applied liberally in the vicinity of GND pins 1,3 and 42.

The following layout recommendations need to be apply on Main Board:

1. Implement a solid ground under the DHAN-M module.
2. Do not route signal traces under the module. Use the bottom layer for signal routing.
3. Locate the on-board printed antenna on the edge of the PCB – as pictured below
4. Locate the antenna in the housing in such a way that minimizes obstruction of the radiation pattern by metallic objects



## 7. Diversity Antenna (OPTION)

If no diversity antenna is planned, a 51-Ohm chip resistor should be placed as close as possible from Pin2 to GND. Alternatively, Pin2 can be routed to a Diversity antenna. There are several options for a diversity antenna:

- a) Route a 50-ohm line to an RF connector on the Application Board and RF cable to a connectorized commercial antenna mounted in elsewhere in the device housing
- b) Route the 50-ohm line to the antenna feed point located ~8cm from the on-board antenna feed-point. This antenna can be a ¼ wave monopole wire antenna, chip or printed antenna (similar to the on-board antenna). Guidelines for such antennas are given below:

- A wire antenna can be inserted through a via at the feed-point. It should extend vertically with respect to the face of the PCB. The total length of the wire antenna should be ¼ Lambda (~40.0 mm). It is important to ensure an adequate ground plane near the feed point in order to obtain maximal antenna gain and efficiency
- Off the shelf chip antennas:

P/N	Manufacturer
H2U74W1H1M0100	Unictron
ANT8868LL00R1880A	Yageo
CAN4311112001881K	Yageo
W3022	Pulse Elect

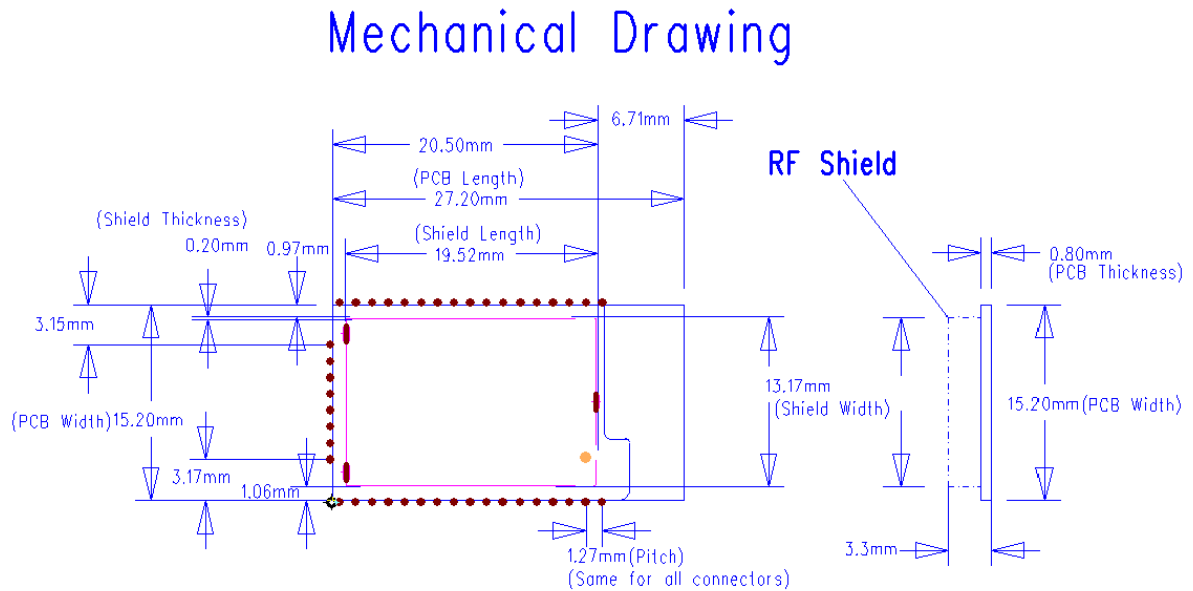
- Inverted-F printed antenna – See [www.dspg.com](http://www.dspg.com) for analysis and database for such an antenna. In this case, the orientation of the antenna should be rotated 90° with respect to the DHAN-M antenna



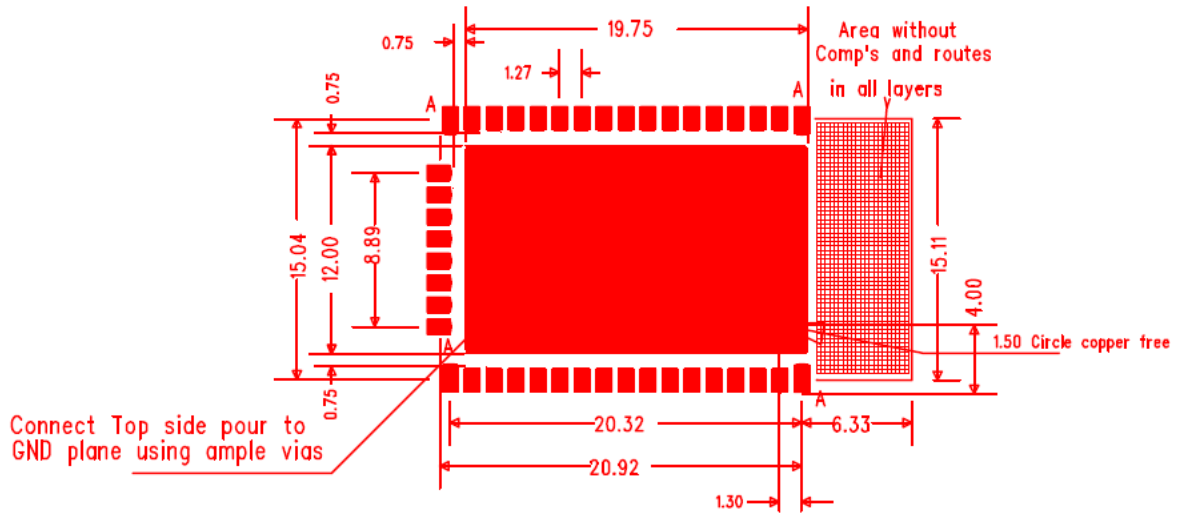
## 8. Assembly Information

An electronic version of the information in this Section can be downloaded from the DSP Group website, in the [HW Developer's Collateral](#) section. The files

### Mechanical Drawing

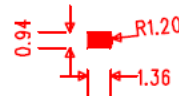
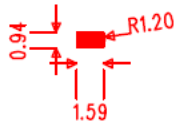


### PCB Metal Land Pattern Recommendation



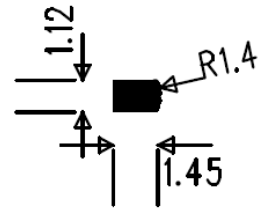
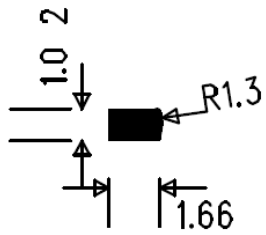
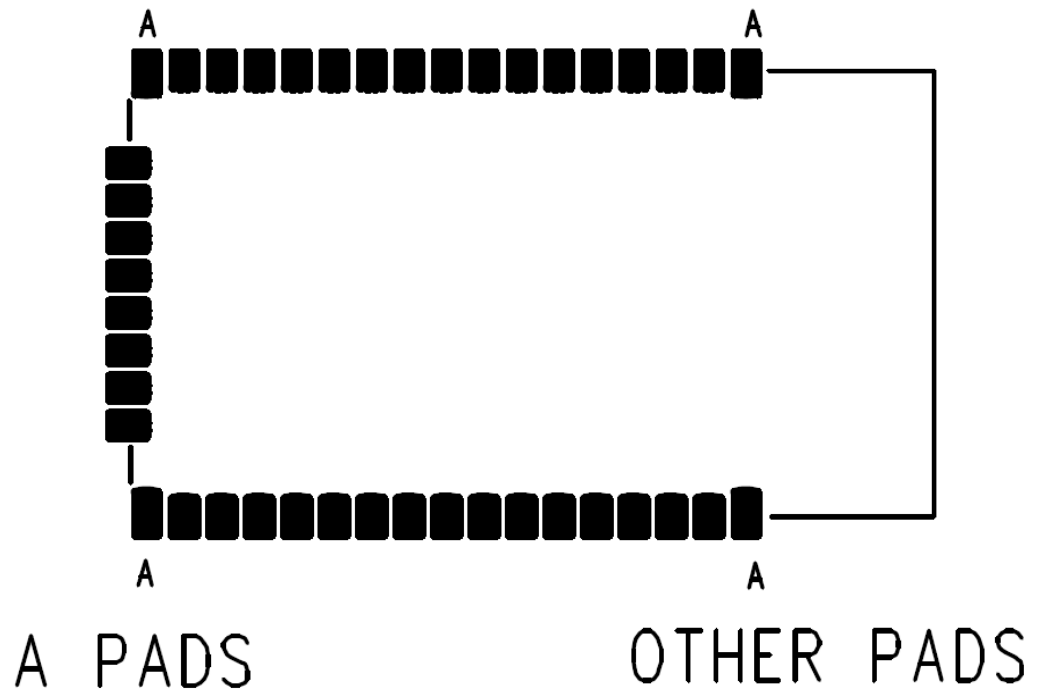
A PADS

OTHER PADS

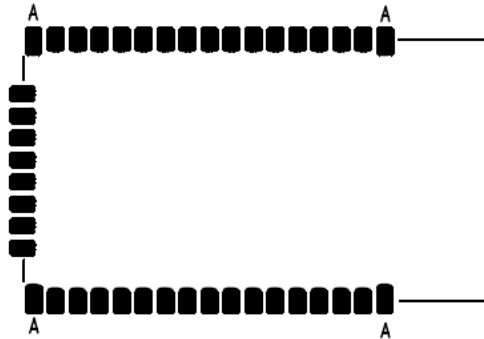


ALL DIMENSIONS in MM

### PCB Solder Mask Recommendation

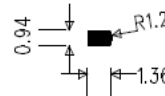
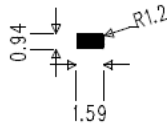


## PCB Stencil Pattern Recommendation



A PADS

OTHER PADS



ALL DIMENSIONS in MM

## Pick & Place, Reflow

The DHAN-M module uses a flat shield cover to facilitate a fully automatic assembly process. For backing and reflow recommendations, use MSL 3 in the JEDEC/IPC standard J-STD-20b. The temperature classification (TC) for the module is 245° C.

## 9. Supplementary Information

Labeling (appended to the module shield)



- 1) Year
- 2) Week
- 3) 6-digit serial#
- 4) HW Version
- 5) SW Version

### Handling Guidance

This module includes highly sensitive electronic circuitry. Handling without proper ESD protection may damage the module permanently.

### RF Exposure Information and Statement

This equipment complies with FCC and IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

**Cet équipement est conforme aux limites d'exposition aux rayonnements de la IC établies pour un environnement non contrôlé. Cet équipement doit être installé et fonctionner à au moins 20 cm de distance d'un radiateur ou de votre corps.**

### FCC & IC Interference Statement

This device complies with part 15 of the FCC rules and RSS-213 of Industry Canada. 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.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

**NOTE:** The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

**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
- This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter

## Declaration of Conformance (DOC)

Hereby, DSP Group Ltd declares that the radio equipment type DHAN-M is in compliance with Directive 2014/53/EU.

The full text of the EU Declaration of Conformity is available at the following internet address:

[www.dspg.com.hk](http://www.dspg.com.hk)

## ORIGINAL EQUIPMENT MANUFACTURER (OEM) NOTES:

The OEM must certify the final end product to comply with unintentional radiators (FCC Sections 15.107 and

15.109) before declaring compliance of the final product to Part 15 of the FCC rules and regulations. Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change.

The OEM must comply with the FCC labeling requirements. If the module's label is not visible when installed, then an additional permanent label must be applied on the outside of the finished product which states: "Contains transmitter module FCC ID: 2AOUK-DHANM

Additionally, the following statement should be included on the label and in the final product's user manual: "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 interferences, and (2) this device must accept any interference received including interference that may cause undesired operation."

The module is limited to installation in mobile or fixed applications. Separate approval is required for all other operating configurations, including portable configuration with respect to Part 2.1093 and different antenna configurations

A module or modules can only be used without additional authorizations if they have been tested and granted under same intended end-use operational conditions, including simultaneous transmission operations.

When they have not been tested and granted in this manner, additional testing and/or FCC application filing may be required. The most straightforward approach to address additional testing conditions is to have

The grantee responsible for the certification of at least one of the modules submit a permissive change application.

When having a module grantee file a permissive change is not practical or feasible, the following guidance provides some additional options for host manufacturers. Integrations using modules where additional testing and/or FCC application filing(s) may be required are: (A) a module used in devices requiring additional RF exposure compliance information (e.g., MPE evaluation or SAR testing); (B) limited and/or split modules not meeting all of the module requirements; and (C) simultaneous transmissions for independent collocated transmitters not previously granted together.

This Module is full modular approval, it is limited to OEM installation ONLY. Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change. (OEM) Integrator has to assure compliance of the entire end product including the integrated Module. Additional measurements (15B) and/or equipment authorizations (e.g. Verification) may need to be addressed depending on co-location or simultaneous transmission issues if applicable. (OEM) Integrator is reminded to assure that these installation instructions will not be made available to the end user of the final host device.

## IC labeling requirement for the final end product

The final end product must be labeled in a visible area with the following “Contains IC:23573-DHANM”

The Host Marketing Name (HMN) must be 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.

## RFPI and EMC

Each DHAN-M Module is shipped to the customer with a unique RFPI – its DECT identity.

DHAN-M will ship with an “EMC” of 0xFEB. This is the DSP Group “generic” EMC. The EMC setting identifies a Device as belonging to a specific group of ULE Devices/Hubs that utilize some proprietary signaling.

In either case, the customer is free to re-program these parameters.

## Ordering Information

Part #: DCX81MD0CFAE5AMI

## Change Log

**Table 9-1: List of Changes**

REVISION	DATE	DESCRIPTION
1.0	May 24, 2017	Baseline release
2.0	September 13, 2017	<ul style="list-style-type: none"> <li>*Add PCB metal, mask and stencil information</li> <li>*Modify Pinout and Pinout Numbering</li> <li>*Modify App Schematics to match new pinout</li> <li>*Modify Vmin from 1.95 to 2V</li> <li>*Add SW Stack description with options for CMHS, CMBS &amp; UART/USB</li> <li>*Add detail regarding antenna layout and options for Diversity</li> <li>*Add reference schematic for MIC and Ear SPK</li> </ul>
3.0	In progress	*Need to add USB and CMHS Parts
4.0	May 5 2018	*Add OEM Notes
5.0	May 5 2018	*IC Labeling requirements for the final end product