# DWAM83

## Wireless audio module
## Technical Product Specification

**Order Number(s):**

**DWAM83 MODULE**
**(DARR83 based module with on board antennas operating in 2.4GHz/5.2GHz/5.8GHzbands)**

**This product meets the halogen maximum concentration values per IEC61249-2-21**
**For RoHS compliance and environmental information, please visit www.smsc.com/rohs**

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# 1. DWAM83 Module

## 1.1. Product Description

The DWAM83 Module is an OEM module (35x35mm) based on the SMSC DARR83. It is an uncompressed wireless digital audio transceiver operating in the 2.4GHz, 5.2GHz and 5.8GHz bands. The wireless audio link supports up to 4 stereo audio streams and comes together with additional features such as: data encryption, pairing functionality, bi-directional control data messages, low power audio snooze mode, WLAN detection, Automatic Frequency Allocation and support KleerNet. The DARR83 chip itself provides the basic functions of Audio Processing and buffering, Data Link Layer and Physical Layer. The module integrates all functionality for a wireless digital audio connection, comprising:

- DARR83 Wireless Audio Processor
- 2.4GHz/ 5.2GHz/ 5.8 GHz RF Transceiver
- Embedded Antennas
- Digital audio interfaces ($I^2S$ and/or S/PDIF)
- $I^2C$ control interface
- 26 pins interface connector (FFC) for power, digital audio and control interface and GPIOs
- Built-in 1MB SPI interface Flash 3V 4KB uniform sector

## 1.2. Basic Features

### 1.2.1. High Quality Audio

• Up to four stereo audio channels, fully bidirectional, up to 24-bit/96 ksps uncompressed audio
• Low latency <20ms for real-time audio and lip sync
• Low latency compression algorithm - optimized for voice applications, headphones
• Inter-speaker synchronization; Low-jitter audio clock sync
• Programmable digital audio gain

### 1.2.2. Networking and Connectivity

• 22Mbps Bandwidth in 2.4GHz, 5.2GHz and 5.8 GHz Bands
• In-room or multi-room network topology
• Point-to-Point and Point-to-Multipoint
• Bidirectional data channel (100 kbps)
• Simple Pairing and Association Function
• 4 $I^2S$ Data pins, each provided with their own pair of BCK/LRCK signals or stereo S/PDIF input/output
• Master and Slave I2C bus for external control functions

### 1.2.3. Coexistence and Robustness

• Enhanced robustness against both in- and out of band interferers like: WiFi and cordless phones
• Coexistence with 802.11a, b, g and n
• Automatic receiver antenna diversity minimizes fading and multi-path effects
• Link quality monitoring
• Soft audio muting under poor link circumstances

### 1.2.4. Power Management

• Low power consumption
• Automatic RF output power control
• Power Down Duty Cycle mode: If no link is established, modules (both TX and RX) will enter a power down mode

### 1.2.5. Integrated 8052 MCU

The DARR83 integrates an 8052 MCU. This includes the following features:
• 45 kByte Code RAM
• 8 kByte Data RAM
• 4 Timer/Counters
• UART

### 1.2.6. Digital Audio Clock Synchronization

The digital audio clock synchronization is an additional more cost effective method for synchronization of audio samples on the receiving side with respect to the transmitted audio samples. The digital clock synchronization feature works for output audio sample rates of 96 and 48 ksps.

### 1.2.7. Sample Rate Converter (SRC) + Sample Rate Detector

The SRC can handle the following input sample rates [ksps]:

- 44.1
- 48
- 96
- 192 (using $I^2S$ in slave mode)

### 1.2.8. KleerNet

KleerNet is SMSC's open wireless audio ecosystem, connecting CE, PC and mobile applications. It offers seamless audio connectivity for a wide range of wireless audio needs, from simple headphones and headsets up to multi-zone and 5.1 audio applications.

- Enabling simple headphone/headset applications up to multi-zone and 5.1 audio network configurations
- Inter-brand connectivity
- Consistent and simple user experience
- KleerNet brand and logo offering end-user recognition
- Adopted by major PC and CE brands
- KleerNet SDK for fast design-in, running on internal MCU

# 2. DWAM83 Module Specifications

| System Specifications | | | | |
|---|---|---|---|---|
| **ID** | **Parameter** | **Value** | **Unit** | **Remarks** |
| **RF Characteristics** | | | | |
| | RF frequency range | 2400 – 2483.5<br>5150 - 5250<br>5725 - 5875 | MHz<br>MHz<br>MHz | |
| | Number of RF channels | 3 | | In each Frequency band. |
| **Air framing** | | | | |
| | Addressing | 24 | Bit | |
| | Data message size | 32 | Byte | Application dependent |
| | CRC | 16, 24 and 32 | Bit | Hybrid |
| **Control** | | | | |
| | Control interface | $I^2C$ | | Compliant with the $I^2C$ protocol (slave), 0…400kbps. Base address 0x80. |
| **Data** | | | | |
| | Data Bandwidth | 100 | Kbps | Bi-directional wireless data channel |
| | Data latency | 5 | ms | Minimum under good RF link conditions for applications that support the 100kbps data rate. |
| **Interference Robustness** | | | | |
| | Fixed frequency devices (e.g. WLAN, microwave oven) | | | Fully coexistent[1] |
| | Frequency hopping devices (e.g. 5.8GHz cordless phones) | | | Fully coexistent[1] |

[1] Laboratory tests have verified coexistence with interference sources collocated. Exact ranges are scenario dependent (function of latency, output power, audio compression, etc.). A mix of interference sources is allowed. Interference of fixed frequency devices may result in the loss of one useable RF channel.

| | | | | |
|---|---|---|---|---|
| **Audio Interface** | | | | |
| | Available Interface Types | $I^2S$ S/PDIF | | Can be used simultaneously Incl. S/PDIF detection. |
| | Number of stereo audio output channels on Mobile Unit | 1, 2, 3 or 4 | | Bidirectional, incl. audio loop |
| | Number of stereo audio input channels on Central Unit | 1, 2, 3 or 4 | | Bidirectional, incl. audio loop |
| **Audio Quality** | | | | |
| | Sample rate | 44.1, 48 or 96 | ksps | |
| | Sample width | 16 or 24 | bit | |
| | Latency | 20 | ms | Configurable from 10 to 23.6ms, depending on the application. |
| | Dynamic Range | 98<br>146 | dB<br>dB | 16 bit 48ksps, A-weighted<br>24 bit 48ksps, A-weighted |
| | THD+N | -96<br>-143 | dB<br>dB | 16 bit 48ksps<br>24 bit 48ksps |
| | Frequency response | 0 | dB | 20Hz…22kHz [2] |
| **Dimensions** | | | | |
| | Module dimensions | 35 x 35 x 4.3 | mm | |

[2] In applications where Digital Clock Sync is not used.

## 2.1. Absolute Maximum Rating

| Symbol | Parameter | Min. | Typ | Max | Unit |
|---|---|---|---|---|---|
| VCC | Supply Voltage | | | 3.8 | V |
| Tstorage | Storage Temperature | -25 | – | 85 | ℃ |
| VESD | ESD Contact Discharge | -2 | – | +2 | kV |

## 2.2. Recommended Operating Conditions

| Symbol | Parameter | Min. | Typ | Max | Unit |
|---|---|---|---|---|---|
| VCC | Supply Voltage | 3.1 | 3.3 | 3.5 | V |
| VCC Ripple | Peak to Peak Ripple (in circuit) | – | 0 | 100 | mV |
| Tamb | Operating Temperature | -10 | 25 | 60 | ℃ |

## 2.3. DC Characteristics

All digital IO levels are 3.3V CMOS. The digital IO ports are not 5V compliant.
Please refer to datasheet of DARR83 for more information.

## 2.5. Power Consumption

(Vcc=3.3V, 25℃, Audio Clock:12.288MHz).

| Application* | 2.4GHz | | 5.2GHz | | 5.8GHz | |
|---|---|---|---|---|---|---|
| | MU (in mA) | CU (in mA) | MU (in mA) | CU (in mA) | MU (in mA) | CU (in mA) |
| Standby mode* | 21 | 21 | 21 | 21 | 21 | 21 |
| 1 Stereo NACK | 31 | 98 | 36 | 96 | 36 | 96 |
| 2-1 Stereo NACK BiDir | 81 | 155 | 82 | 145 | 82 | 146 |
| 2 ACK | 60 | 140 | 65 | 124 | 65 | 127 |
| TX Continuous mode (peak current) | - | 390 | - | 300 | - | 300 |

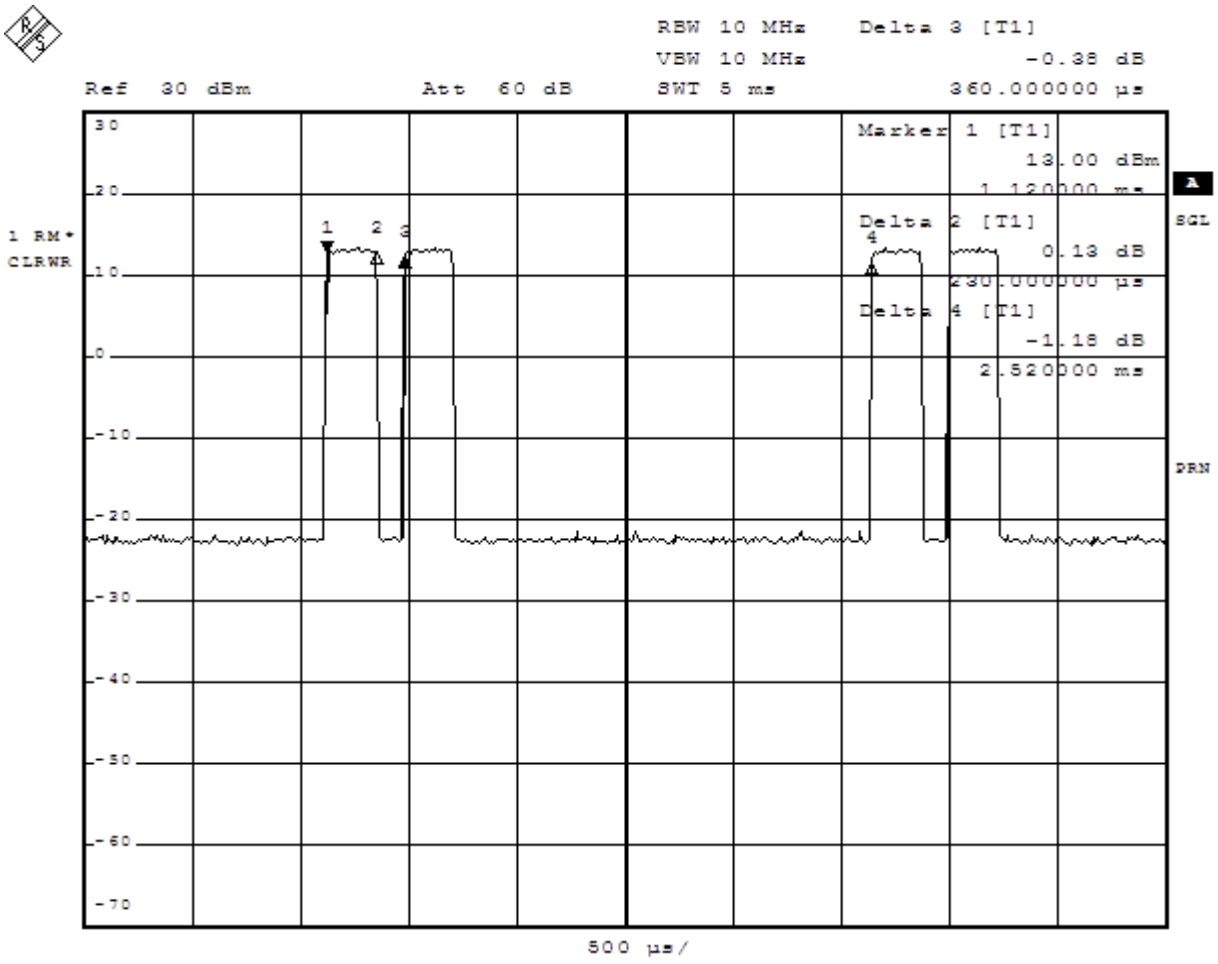
**Current consumption measurements based on External MCU using EVK. Standby mode can be wake up by CU*

For detailed current consumption for other applications mode, please contact our AE.

Note 1: The ACK applications have automatic RF power control therefore these applications will have variable (lower) power consumption depending on wireless link conditions.

Note 2: The above measurements are under un-interfered circumstances. When retransmissions are required, current consumption will change (e.g. ACK and CU NACK at 30 % and only MU NACK when there is interference)

Note 3: The duration of the peak current is depending on the application. For example, a 2 Stereo ACK CU has a peak power duration of two time slots of 230us in a 2.52ms frame period as depicted here below:


RBW 10 MHz
VBW 10 MHz
SWT 5 ms
Delta 3 [T1]
-0.38 dB
360.000000 µs
Ref 30 dBm
Att 60 dB
Marker 1 [T1]
13.00 dBm
1.120000 ms
Delta 2 [T1]
0.13 dB
230.000000 µs
Delta 4 [T1]
-1.18 dB
2.520000 ms
1 RM
CLRWR
SGL
PRN
500 µs/

## 2.6. RF Performance

Vcc=3.3V, 25℃)

| Parameter | | Condition | Min. | Typ. | Max | Units |
|---|---|---|---|---|---|---|
| RF Frequency Range | | | 2400 | – | 2483.5 | MHz |
| Number of RF-channels | | Carriers in the spectrum | – | 3 | – | |
| Transmission Power[3] | | | | 14 | | dBm |
| Channel Frequency (dynamic or fixed allocation) | CH1<br>CH2<br>CH3 | | – | 2412<br>2438<br>2464 | – | MHz |
| Channel Spacing | | | – | 26 | – | MHz |
| RF Bandwidth | | Null-to-null | – | 22 | – | MHz |
| Rx sensitivity | | | – | -83 | – | dBm |
| Antenna Diversity | | TX/RX | – | ON | – | |

For 5.2GHz application (Vcc=3.3V, 25℃)

| Parameter | | Condition | Min. | Typ. | Max | Units |
|---|---|---|---|---|---|---|
| RF Frequency Range | | | 5150 | – | 5250 | MHz |
| Number of RF-channels | | Carriers in the spectrum | – | 3 | – | |
| Transmission Power[3] | | Depending on antenna design | | 9 | | dBm |
| Channel Frequency (dynamic or fixed allocation) | CH1<br>CH2<br>CH3 | | – | 5180<br>5210<br>5240 | – | MHz |
| Channel Spacing | | | – | 30 | – | MHz |
| RF Bandwidth | | Null-to-null | – | 22 | – | MHz |
| Rx sensitivity | | | – | -81 | – | dBm |
| Antenna Diversity | | TX/RX | – | ON | – | |

For 5.8GHz application (Vcc=3.3V, 25℃)

| Parameter | | Condition | Min. | Typ. | Max | Units |
|---|---|---|---|---|---|---|
| RF Frequency Range | | | 5725 | – | 5875 | MHz |
| Number of RF-channels | | Carriers in the spectrum | – | 3 | – | |
| Transmission Power[3] | | Depending on antenna design | | 9 | | dBm |
| Channel Frequency (dynamic or fixed allocation) | CH1<br>CH2<br>CH3 | | – | 5736<br>5762<br>5814 | – | MHz |
| Channel Spacing | | | – | 26 | – | MHz |
| RF Bandwidth | | Null-to-null | – | 22 | – | MHz |
| Rx sensitivity | | | – | -81 | – | dBm |
| Antenna Diversity | | TX/RX | – | ON | – | . |

[3] With DARR83-ADC based Power Control Loop. Output power country/region dependent.

## 2.7. Pin out of 26pin FFC Interface Connector

Specs of FFC connector: 0.5mm pitch FPC/FFC Connector, 26 ways, Right Angle Type (Double-Face Contact), LIF SMT type, Tin/Nickel (Lead Free), Halogen Free

| Pin Number | Pin Name | I/O | Description |
|---|---|---|---|
| 1 | VDD | Power | Regulated 3.3V input |
| 2 | GND | Ground | Ground |
| 3 | MCLK | In | 12.288MHz audio clock In |
| 4 | DARR83_GPIO_2 | I/O | Configurable.<br>Please refer to the DARR83 datasheet |
| 5 | DARR83_GPIO_7 | I/O | Configurable.<br>Please refer to the DARR83 datasheet |
| 6 | DARR83_GPIO_4 | I/O | Configurable.<br>Please refer to the DARR83 datasheet |
| 7 | DARR83_GPIO_23 | I/O | Configurable.<br>Please refer to the DARR83 datasheet |
| 8 | DARR83_GPIO_13 | I/O | Configurable.<br>Please refer to the DARR83 datasheet |
| 9 | DARR83_GPIO_3 | I/O | Configurable.<br>Please refer to the DARR83 datasheet |
| 10 | DARR83_GPIO_15 | I/O | Configurable.<br>Please refer to the DARR83 datasheet |
| 11 | NC | | NOT CONNECTED |
| 12 | NC | | NOT CONNECTED |
| 13 | DARR83_GPIO_24 | I/O | Configure as MON_TXD |
| 14 | DARR83_GPIO_14 | I/O | Configure as IRQ |
| 15 | DARR83_GPIO_1 | I/O | Configure as WP |
| 16 | NC | | NOT CONNECTED |
| 17 | DARR_RST | | DARR RESET (external pull up required) |
| 18 | I2C_SCL_SLV | | I2C SLAVE (SCLK) |
| 19 | I2C_SDA_SLV | | I2C SLAVE (SDA) |
| 20 | DARR83_GPIO_12 | I/O | Configure as SDIO Z |
| 21 | DARR83_GPIO_11 | I/O | Configure as SDIO X |
| 22 | DARR83_GPIO_10 | I/O | Configure as LRCK W |
| 23 | GND | Ground | Ground |
| 24 | DARR83_GPIO_8 | I/O | Configure as BCK W |
| 25 | DARR83_GPIO_6 | I/O | Configure as SDIO Y |
| 26 | DARR83_GPIO_5 | I/O | Configure as SDIO W |

## 2.8. Antenna

The module uses embedded PCB track Tri-Band antennas. RX and TX diversity antennas are used to avoid dropouts due to multipath fading.

- Antenna A (ANT A) fixed track antenna on the module
- Antenna B (ANT B) fixed track antenna on the module

Only 'one' antenna is selected for use at any one time, through the on-board Transmit-Receive/ Diversity RF switch.

# 3. Hardware Development

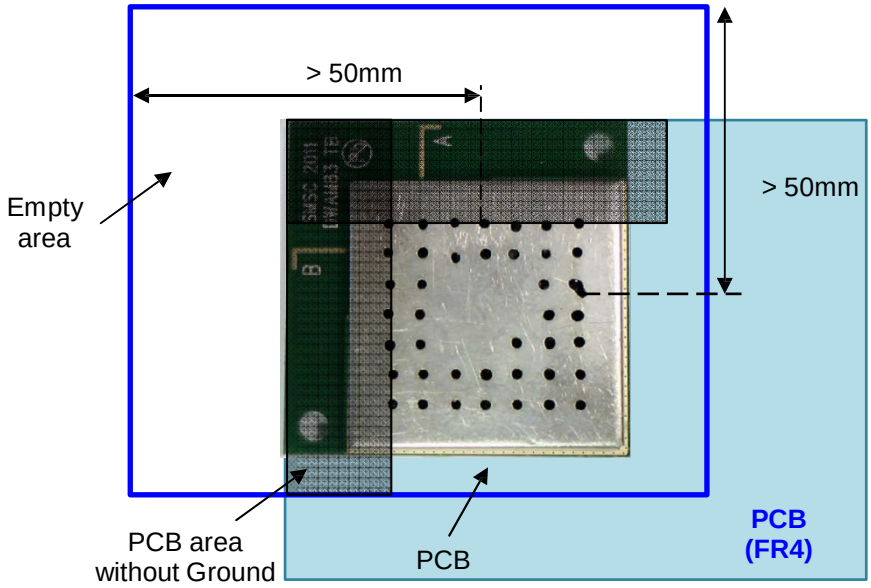
## 3.1. Module Placement

The module outputs typically RF Power of 14dBm @ 2.4GHz and 9dBm @ 5.2GHz and 5.8GHz band. This holds both for the CU and the MU (in NACK mode, the MU transmits when a packet is lost and in ACK the MU acknowledges receipt of each message by RF transmission). This RF energy may be received by the application controller board and rectified by analog non-linear components (e.g. coupling capacitors) and this may eventually result in audible artifacts if not proper care is taken (especially since the air frame rate is in the audible range). It is therefore important that the RF module (especially the antennae) is separated from the analog circuitry as much as possible.

### 3.1.1. Potential Antenna Issues

This section goes for the embedded antennae only

- No ground plane of tracks must be placed on the application board underneath the DWAM83 module
- Antennas must not be placed close to metallic objects
- Antennas should not be placed in direct contact or close proximity to Plastic Casings/ objects to avoid Antenna detuning.
- Be careful not to place the wiring inside the finalized product close to the antennas.
- Please note that final antenna tuning may be required of the final product for optimal antenna performance (due to antenna detuning by the enclosure and/or surrounding components)
- Do not use a metallic enclosure or metalized plastic if the antennas are internal
- Ensure that the enclosure is tested for low RF losses when the antennas are placed internally (an easy test is to measure the heating of the enclosure when put by itself in a microwave oven)




**Typical Module (RF) Placement:** >30mm separation (all directions) from antennae is recommended.

## 3.2. General Power Supply Decoupling

The RF frame rate is in the audio frequency band. So the switching between TX and RX will cause a power supply ripple (because of the change in current between TX and RX mode) that is also in the audio frequency band. Therefore, it is important that the module power supply is isolated from the audio circuitry power supply.

Listed here below are some general guide lines:

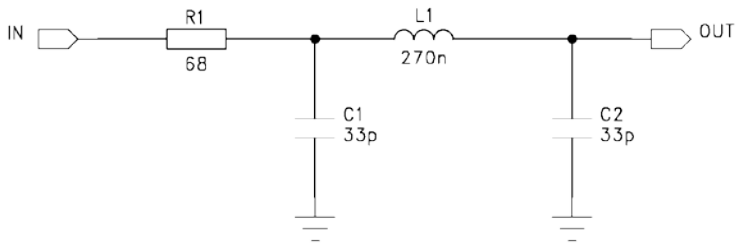
- Use a dedicated power supply for the module.
- Consider the Pi-network for power supply decoupling from the regulator to the module (large capacitor to ground, series bead inductor, large capacitor to ground).
- Isolate the control loop of the application board regulator from this 3.3V power supply domain
- Use a very short and solid ground connection from the star point of the power supply to the module.
- Isolate the module's ground from the analog ground.
- Use low ESR capacitors (e.g. Nichicon HDM)

With the above guide lines, it should be possible to suppress the switching peaks to well over 110dB below the full scale output.

## 3.3. Digital IO filtering

### 3.3.1. MCLK filtering

The audio clock signal runs over the flat foil cable to the module. The harmonics can easily radiate and exceed the regulatory limits if the drive strength is too strong and/or cable and/or PCB trace lengths are too long. To overcome this, the audio clock signal can be filtered at the source (i.e. at the crystal oscillator itself) by a simple filtering circuit such as depicted here below:

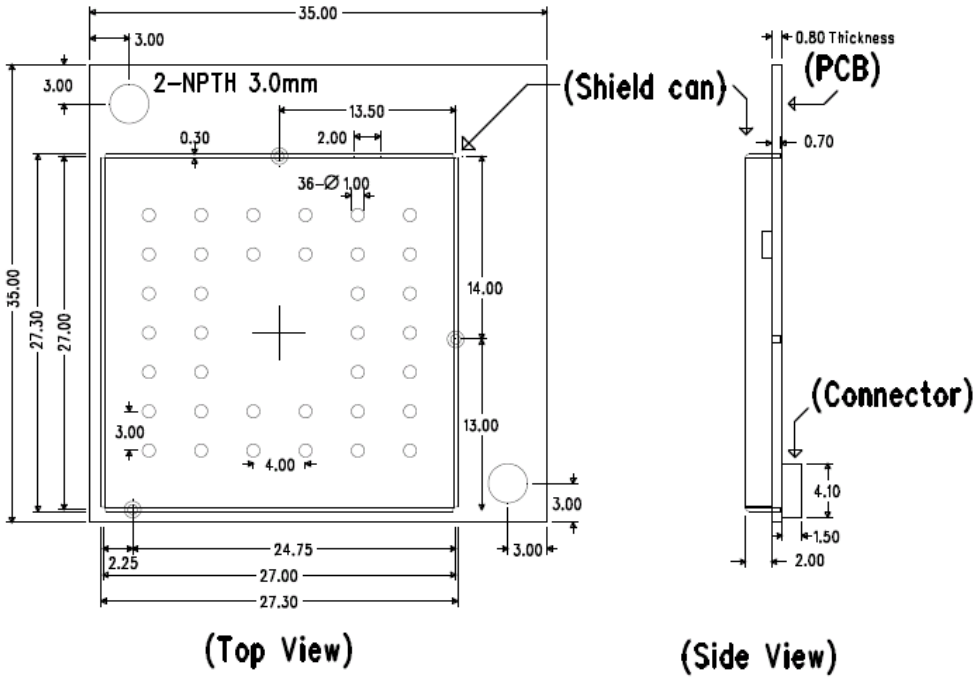



### 3.3.2. $I^2S$ Bus

The $I^2S$ bus signals are transported over the FFC. To overcome potential radiation problems, it is advised that the bus is filtered on the application board with a resistor array (e.g. 33…68Ohm) and small valued (e.g.10pF) capacitors.

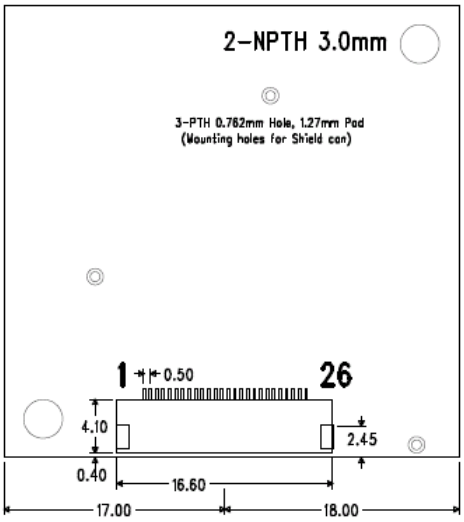
## 3.4. Transceiver Dimension

- Module -size: 35 x 35 x 4.3 mm (±0.15), including 2-Printed Tri-Band antennas.
- Diameter mounting holes: 3.0 mm (±0.05).




(Top View)

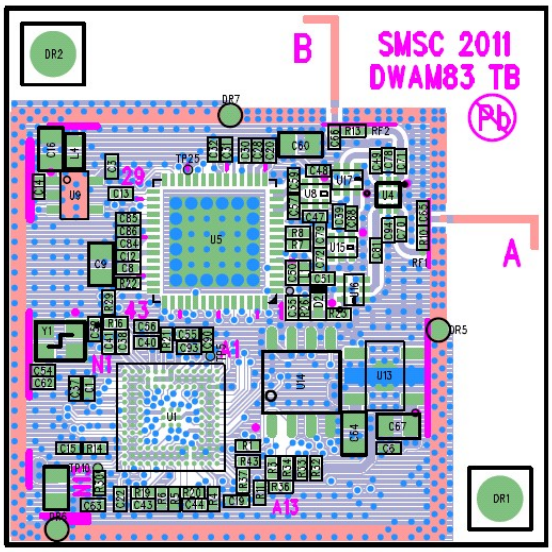
(Side View)



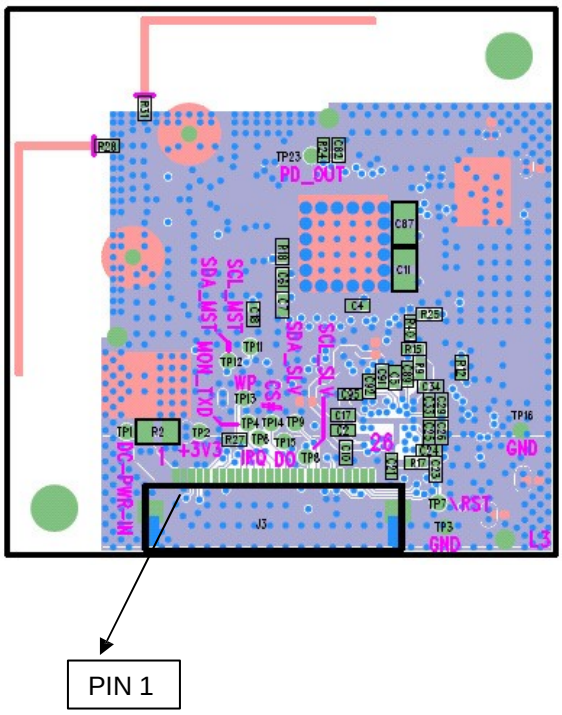

(Bottom View)

## 3.5. DWAM83 Module Picture

TOP-SIDE




BOTTOM-SIDE



# 4. APPENDIX

FCC Statements

(OEM) Integrator has to assure compliance of the entire end-product incl. the integrated RF Module. For 15 B (§15.107 and if applicable §15.109) compliance, the host manufacturer is required to show compliance with 15 while the module is installed and operating.

Furthermore the module should be transmitting and the evaluation should confirm that the module's intentional emissions (15C) are compliant (fundamental / out-of-band). Finally the integrator has to apply the appropriate equipment authorization (e.g. Verification) for the new host device per definition in §15.101.

Integrator is reminded to assure that these installation instructions will not be made available to the end-user of the final host device.

The final host device, into which this RF Module is integrated" has to be labeled with an auxiliary label stating the FCC ID of the RF Module, such as "Contains FCC ID: 2ADKJ-DWAM83

"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."

"Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment."

the Integrator will be responsible to satisfy SAR/ RF Exposure requirements, when the module integrated into the host device.

RF Exposure Warning Statements:

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

Module statement

The single-modular transmitter is a self-contained, physically delineated, component for which compliance can be demonstrated independent of the host operating conditions, and which complies with all eight requirements of § 15.212(a)(1) as summarized below.

1) The radio elements have the radio frequency circuitry shielded.

2) The module has buffered modulation/data inputs to ensure that the device will comply with Part 15 requirements with any type of input signal.

3) The module contains power supply regulation on the module.

4) The module contains a permanently attached antenna.

5) The module demonstrates compliance in a stand-alone configuration.

6) The module is labeled with its permanently affixed FCC ID label.

7) The module complies with all specific rules applicable to the transmitter, including all the conditions provided in the integration instructions by the grantee.

8) The module complies with RF exposure requirements.

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 equipment could not be co-located or operating in conjunction with any other antenna or transmitter except in accordance with the FCC multi-transmitter product procedures.

Operation of this device is restricted to indoor use only.(5GWIFI)

# 5. Revision History

| Revision | Author | Date | Detail |
|---|---|---|---|
| **0.0** | **SM/ET** | **27/1/2011** | **Preliminary** |
| **0.1** | **ET** | **18/7/2011** | **Added KleerNet logo and update specs** |
| **0.2** | **MC** | **29/7/2011** | **Updated comment at ADC Power Control** |
| **1.0** | **ET** | **18/8/2011** | **MP version release** |

# Regulatory notice to host manufacturer according to KDB 996369 D03 OEM Manual

**2.2 List of applicable FCC rules**
This module has been granted modular approval as below listed FCC rule parts.

- FCC Rule parts 15C(15.247) and 15E(15.407)

**2.3 Summarize the specific operational use conditions**
- The OEM integrator should use equivalent antennas which is the same type and equal or less gain then an antenna listed in 2.7 in this instruction manual.

**2.4 Limited module procedures**
- N/A

**2.5 Trace antenna designs**
- N/A

**2.6 RF exposure considerations**
The module has been certified for integration into products only by OEM integrators under the following condition:

- The antenna(s) must be installed such that a minimum separation distance of at least 20 cm is maintained between the radiator (antenna) and all persons at all times.

- The transmitter module must not be co-located or operating in conjunction with any other antenna or transmitter except in accordance with FCC multi-transmitter product procedures.

- Mobile use

As long as the three conditions above are met, further transmitter testing will not be required.

OEM integrators should provide the minimum separation distance to end users in their end-product manuals.

**2.7 Antennas**
This module is certified with the following integrated antenna.
- Type: PCB antenna (Peak gain (dBi): 2 (Ant1) / 3 (Ant2))

Any new antenna type, higher gain than listed antenna should be met the requirements of FCC rule 15.203 and 2.1043 as permissive change procedure.

## 2.8 Label and compliance information

End Product Labeling
The module is labeled with its own FCC ID and IC Certification Number. If the FCC ID and IC Certification Number are not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. In that case, the final end product must be labeled in a visible area with the following:
“Contains FCC ID: 2ADKJ-DWAM83”
“Contains IC: 12493A-DWAM83”

## 2.9 Information on test modes and additional testing requirements

- OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, additional transmitter in the host, etc.).

## 2.10 Additional testing, Part 15 Subpart B disclaimer

- The final host product also requires Part 15 subpart B compliance testing with the modular transmitter installed to be properly authorized for operation as a Part 15 digital device.

IC Statements

This device is acting as slave and operating in the 2.4 GHz (2412 ~2462 MHz) band.

The final host device, into which this RF Module is integrated" has to be labeled with an auxiliary label stating the IC of the RF Module, such as" Contains transmitter module IC: 12493A-DWAM83

Le périphérique hôte final, dans lequel ce module RF est intégré "doit être étiqueté avec une étiquette auxiliaire indiquant le CI du module RF, tel que" Contient le module émetteur IC: 12493A-DWAM83

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada’s licence-exempt RSS(s). Operation is subject to the following two conditions:
(1) This device may not cause interference.
(2) This device must accept any interference, including interference that may cause undesired operation of the device.

L’émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d’Innovation, Sciences et Développement économique 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;
(2) L' appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d' en compromettre le fonctionnement.