

Application Note

External Antenna Design and Leverage Modular Approval for DA14AVDDECT

AN-D-236

Abstract

This document describes the Modular Approval conditions and how to leverage the existing Renesas regulatory certificate when certifying an end-product that includes DA14AVDDECT.

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1 Terms and Definitions

LMA	Limited Modular Approval
EVK	Evaluation Kit
FCC	Federal Communications Commission

2 References

- [1] DA14AVDDECT, Datasheet, Revision 1.7, Renesas Electronics
- [2] SDK, \Documentation\Hardware\Carrier board\V5\Gerber\
- [3] <https://fcc.report/FCC-ID/Y82-DA14AVD>

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3 Introduction

The DA14AVDDECT module is certified with a Limited Modular Approval (LMA). The FCC ID of the module is **Y82-DA14AVD** [3]. Thus, if a customer product meets certain requirements, the LMA can be leveraged on the customer product without radio-specific certification testing. These requirements include:

- In case an external antenna is used: the antenna shall be the same type as the antenna used during the original certification. The antenna gain of the external antenna may not exceed the antenna gain of the antenna used during the original certification
- The +VRF_PA_1 and +VRF_PA_2 connections and external circuitry shall be identical to what was used during the original certification
- No changes should not be made to the radio circuit (hardware) or radio driver (software)

As a background information, below are provided relevant snippets from the FCC documentation in regard to Modular Approval and Limited Modular Approval:

Requirements for Modular Approval:

- 1) Integrated shield; physical components and tuning capacitor(s) may be located external to the shield, but must be on the module assembly;
- 2) Buffered modulation/data inputs
- 3) Power supply regulation on the module
- 4) The module must contain a permanently attached antenna, or contain a unique antenna connector, and be marketed and operated only with specific antenna(s), per §§ 15.203, 15.204(b), 15.204(c), 15.212(a), 2.929(b)
- 5) The module must demonstrate compliance in a stand-alone configuration
- 6) The module must be labeled with its permanently affixed FCC ID label
- 7) The module must comply with all specific rules applicable to the transmitter, including all the conditions provided in the integration instructions by the grantee
- 8) The module must comply with RF exposure requirements

If any of the above isn't met, Limited Modular Approval may apply

A limited single-modular transmitter is a transmitter that does not meet all eight requirements listed in § 15.212(a)(1), and compliance can be demonstrated only for specific host(s) and the applicable operating conditions in which the transmitter will be used. For example, manufacturers have flexibility with respect to requirements such as module shielding, buffered modulation/data inputs, and power supply regulation. If one or more of these functions (shielding, buffered modulation/data inputs, power supply regulation) are provided by a specific host or hosts, then the module can be granted as a limited module that is limited to that specific host or hosts. The responsible party must demonstrate how it will retain control over the final installation of the device such that compliance of the product is ensured; for example, by limiting the installation to a specific host or hosts.

A limited modular approval is based on conditions established in the application such as: the host device(s) into which the module can be installed; documented requirements for professional installation; the antenna separation distance from persons; or, the locations where a device may be used (e.g., outdoor only).

Details of the first two list items are mentioned in the following sections.

3.1 External Antenna for Antenna Diversity Support

The DA14AVDDECT module has an integrated antenna. If antenna diversity is required, an external antenna can be connected. The EVK HW has such an antenna printed on the PCB. To leverage the LMA on a customer product, copy this antenna design onto the customer product.

For more information, see Question 11 of *KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces*.

3.2 Power Supply Configuration

The DA14AVDDECT requires an external supply connection for the RFPA. To leverage the LMA on a customer product, copy the design from the EVK HW. See [Figure 1](#).

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When deviating from this design, the advice is to check with the respective test house how this would affect the LMA.

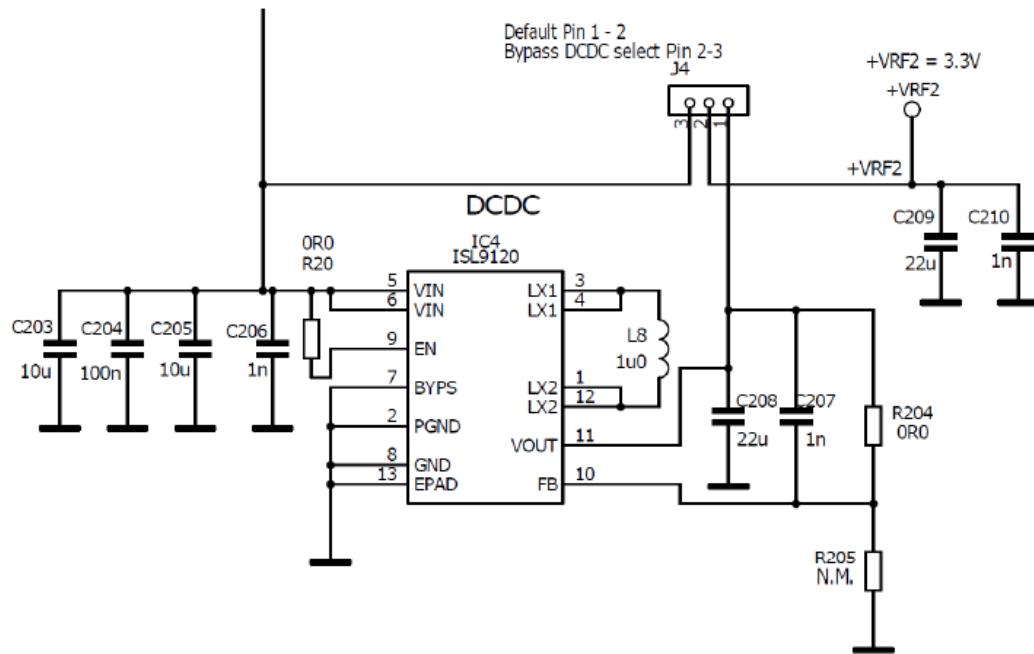


Figure 1: Snapshot of Power Supply Section of AVD EVK

3.3 Layout Guidelines

The module pinout is specifically designed to accommodate easy integration with the customer application PCB, without requiring expensive PCB cost adders due to e.g. blind vias or small line/space dimensions. The PCB Gerbers are included in the SDK [2].

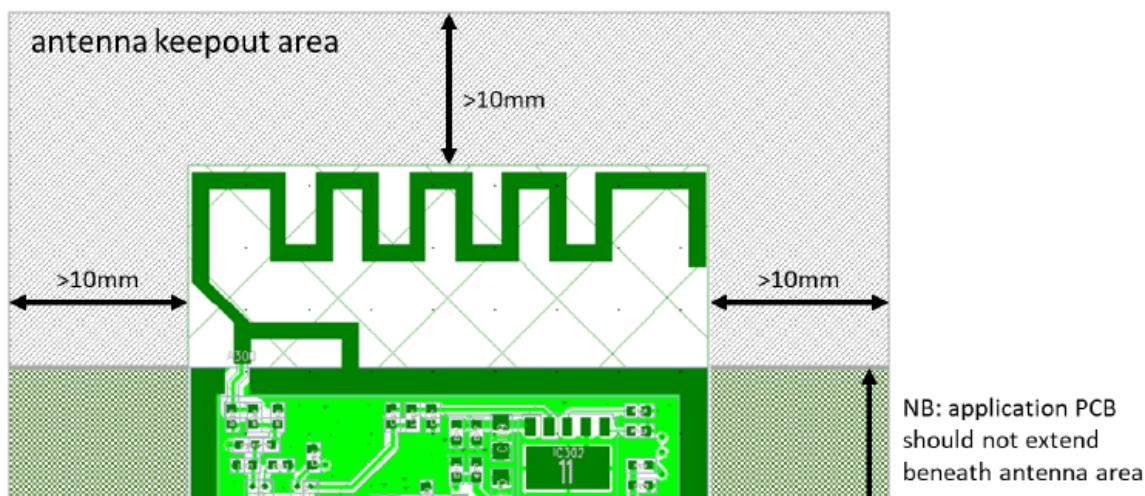


Figure 2: Antenna Layout and Keep-Out Areas

All standard practice layout rules and guidelines apply. Additional special care may be paid to the antenna and USB areas:

- The application PCB may not extend underneath the antenna area (see Figure 2)

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- Any signal from the application PCB containing high harmonic content (e.g. clock signals, memory buses) must be kept away from the antenna
- No metal objects should be placed in the vicinity of the antenna (see [Figure 2](#))
- The USB data lines should be routed 90° hm differential and the line lengths must match
- Appropriate trace width and number of vias should be used for all power supply paths
- A common ground plane should be used, which allows proper electrical and thermal performance
- Noise-sensitive analog signals, such as feedback lines or clock connections, should be kept away from traces carrying pulsed analog or digital signals. This can be achieved by separation (distance) or by shielding with quiet signals or ground traces
- Decoupling capacitors should be X5R ceramics and should be placed as near to the module as possible

3.4 PCB Design Specifications

The PCB design specifications of the development kit are listed below and it is recommended that the customer PCB follows these same specifications since these may affect antenna performance:

- **Board Thickness:** 1.60 mm - thickness measured on finished board
- **Board Thickness Tolerance:** $\pm 10\%$
- **Surface Treatment:** Nickel/Immersion Gold
- **Minimum Trace Width:** 0.1 mm
- **Minimum Spacing – Trace/Via/Pad:** 0.15 mm
- **Minimum Spacing – Copper:** 0.2 mm

Table 1: PCB Layer Stack Up

Layer Name	Layer Number	Layer Type	Components
SM0121	---	Top Layer	Solder Mask
ART01	Layer 1	Top Layer	17 μm Basic CU
---	---	Substrate	2 x PR7628 - Prepreg
ART02	Layer 2	Inner Layer	35 μm Basic CU
---	---	Substrate	0.71 mm - Core
ART03	Layer 3	Inner Layer	35 μm Basic CU
---	----	Substrate	2 x PR7628 - Prepreg
ART04	Layer 4	Bottom Layer	17 μm Basic CU
SM0428	---	Bottom Layer	Solder Mask

4 Antenna Gain and Radiation Pattern

Table 2: Antenna Gain

Ant.	Chan.	Peak Power [dBm]				Integr. Power [dBm]	Conduct. Power [dBm]	Antenna Efficiency [dB]	Peak Antenna Gain [dB]
		0 deg	-45 deg	45 deg	90 Deg				
1	5	24.6	26.7	21.6	23.6	22.27	21.9	0.37	4.84

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Ant.	Chan.	Peak Power [dBm]				Integr. Power [dBm]	Conduct. Power [dBm]	Antenna Efficiency [dB]	Peak Antenna Gain [dB]
		0 deg	-45 deg	45 deg	90 Deg				
2	5	26.1	26.8	23.0	21.8	22.05	22.9	-0.85	3.93

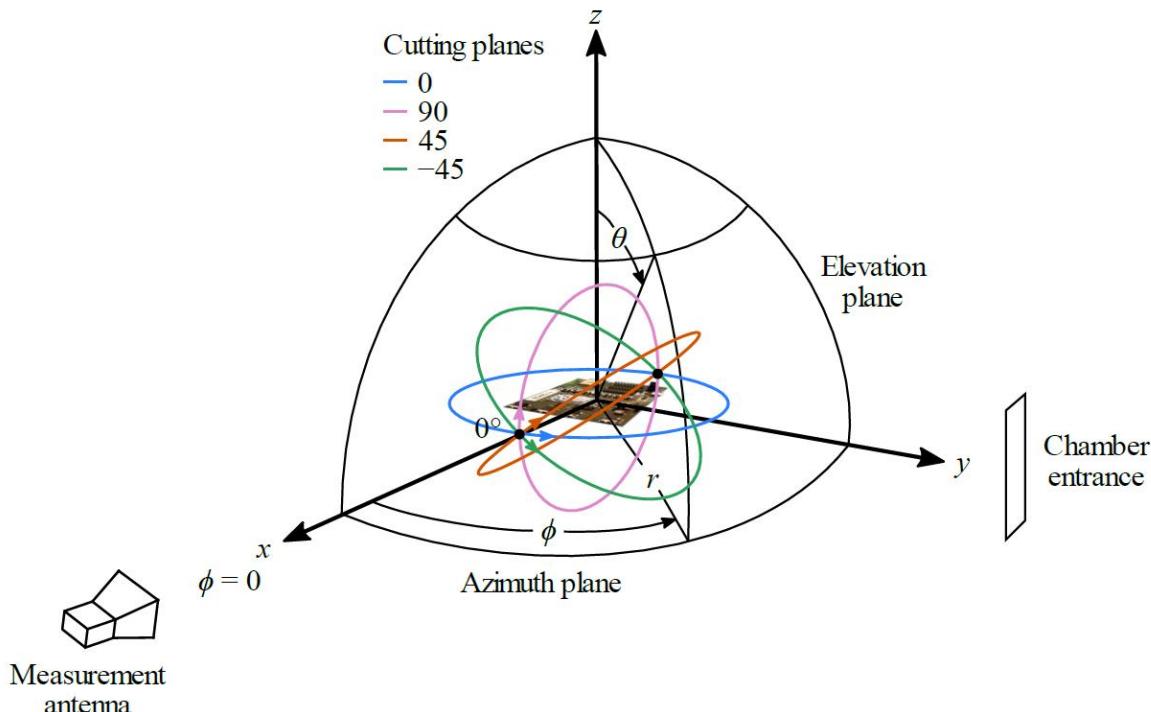
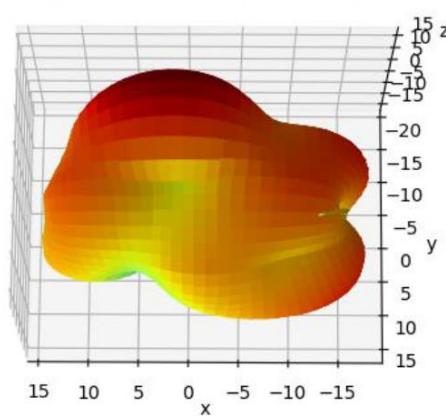


Figure 3: Test Setup for Radiation Pattern Measurement

Antenna = 1, Polarization = Sum
Integrated power = 22.269461 dBm



Antenna = 2, Polarization = Sum
Integrated power = 22.052961 dBm

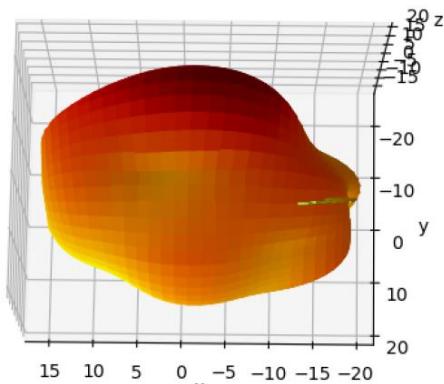


Figure 4: Radiation 3D Patterns, the View from Above

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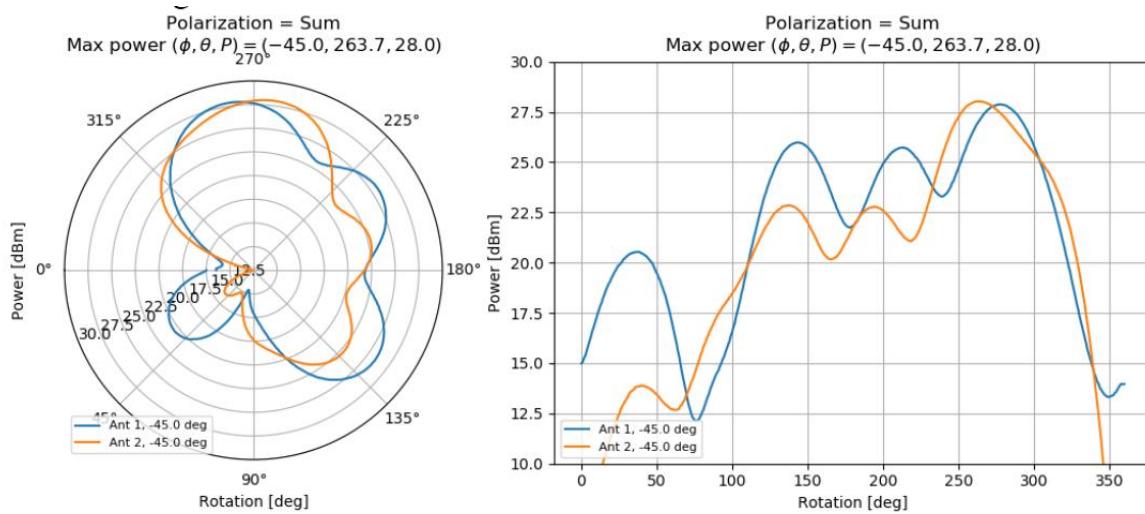


Figure 5: Radiation Patterns on Polar and Linear Axes Elevation = -45 Degrees

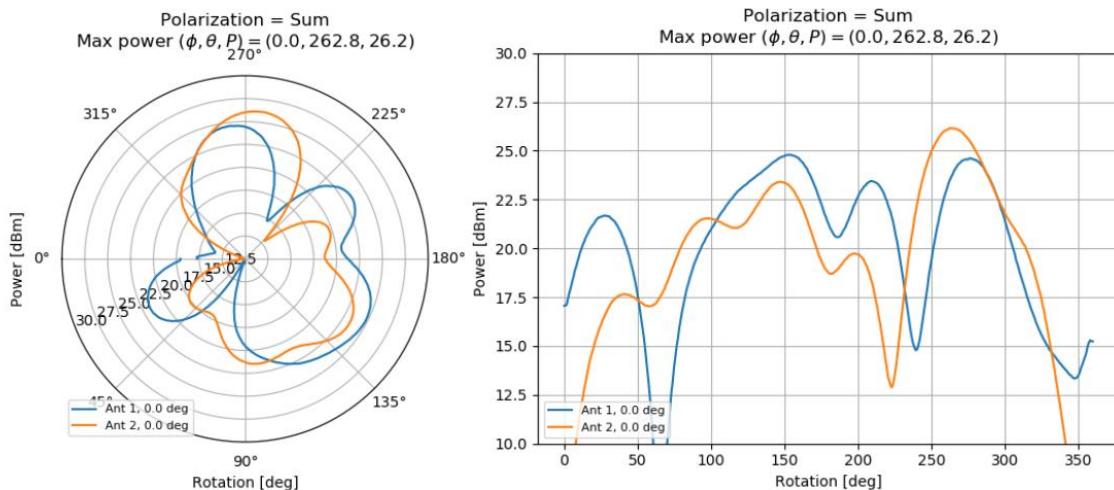


Figure 6: Radiation Patterns on Polar and Linear Axes Elevation = 0 Degrees

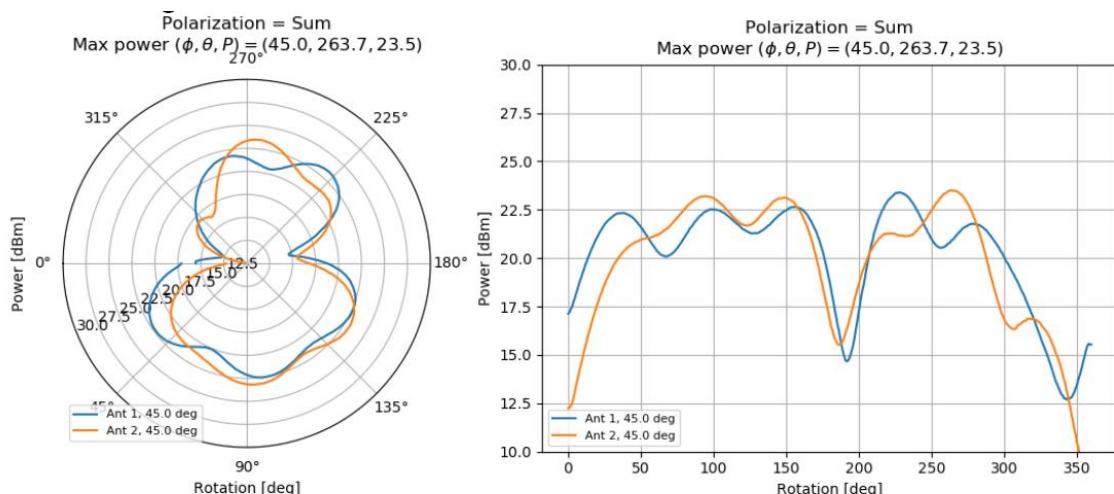


Figure 7: Radiation Patterns on Polar and Linear Axes Elevation = 45 Degrees

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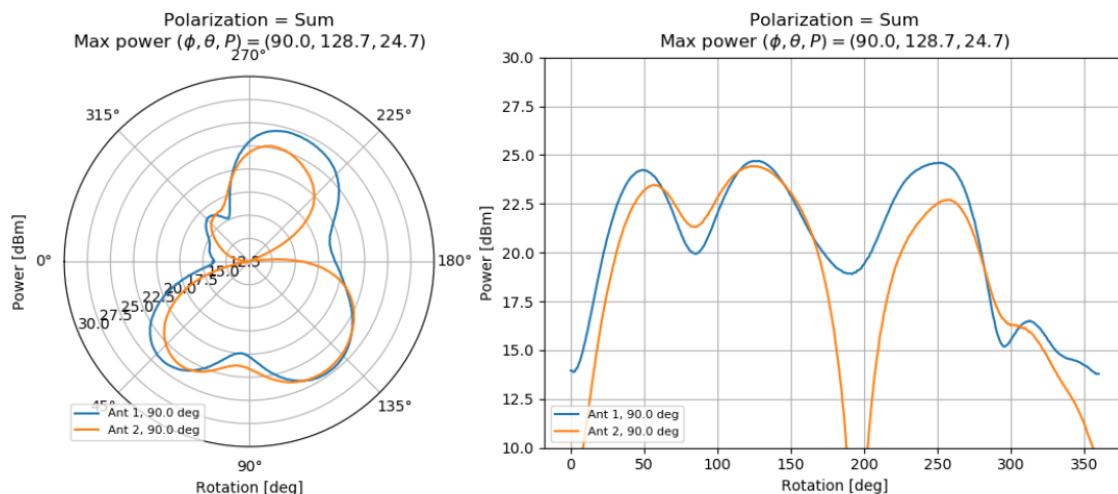


Figure 8: Radiation Patterns on Polar and Linear Axes Elevation = 90 Degrees

5 Other FCC References

Other references to FCC documentation that might be useful:

- 996369 D01 Module Equip Auth Guide v02
- 996369 D03 OEM Manual v01
- 996369 D04 Module Integration Guide v01
- TCB09-FCC-Limited-Modular-Approval-Checklist
- <https://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?id=44637&switch=P>

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Revision History

Revision	Date	Description
1.1	20-Oct-2022	Updated logo, disclaimer, copyright.
1.0	23-Oct-2020	Initial version.

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Status Definitions

Status	Definition
DRAFT	The content of this document is under review and subject to formal approval, which may result in modifications or additions.
APPROVED or unmarked	The content of this document has been approved for publication.

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Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu

Koto-ku, Tokyo 135-0061, Japan

www.renesas.com

Contact Information

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