Abracon PTM
Introduction to AMCA Series
Ceramic Multilayer Chip Antennas

Crystals
Oscillators
Filters
Precision Timing
Inductors
AMCA Series
Multilayer Chip Antennas

Purpose
To introduce AMCA Series, Multilayer Chip Antennas.

Objective
Present the advantage, performance and applications of Abracon AMCA Series.

Content
22 pages

Learning Time
25 minutes

Welcome to Abracon’s AMCA Series; Ceramic Multilayer Chip Antenna Training Module. This training session will provide an overview of the key features and benefits; as well as, discuss the applications of this product series.
**Product - AMCA Series**  
**Ceramic Multilayer Chip Antennas**

**Abracon AMCA Series-Part Numbering**

<table>
<thead>
<tr>
<th>AMCA</th>
<th>31</th>
<th>2R450G</th>
<th>S1F</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part Series</td>
<td>Size</td>
<td>Center Frequency</td>
<td>Series Code / Hazardous Substance</td>
<td>Packaging Code</td>
</tr>
<tr>
<td>Multilayer Chip Ant</td>
<td>31, 52, 62 72, 81 &amp; 92</td>
<td>2R450G equals 2.450GHz</td>
<td>Series Code S1, 01, 02 / F = Hazard Free</td>
<td>Blank: Bulk / Cut Tape T: T/R 1000pcs per reel T3/T4: T/R 3K or 4K per reel</td>
</tr>
</tbody>
</table>

The AMCA Series offers a range of Multilayer Chip Antennas as described by their part number code.
# Abracon AMCA Series - Part Numbering & Descriptions

<table>
<thead>
<tr>
<th>Part No</th>
<th>Description / Band</th>
<th>Center Frequency</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Bandwidth (MHz)</td>
<td></td>
</tr>
<tr>
<td>AMCA31-2R450G-S1F-T</td>
<td>Chip Antenna – WLAN / WiFi / Bluetooth</td>
<td>2450MHz 2405 ~ 2495MHz</td>
<td>3.1 x 1.6 x 1.2mm</td>
</tr>
<tr>
<td>AMCA31-2R800G-S1F-T</td>
<td>Chip Antenna WLAN</td>
<td>2800MHz 2750~ 2850MHz</td>
<td>3.1 x 1.6 x 1.2mm</td>
</tr>
<tr>
<td>AMCA52-2R350G-S1F-T</td>
<td>Chip Antenna WLAN</td>
<td>2350MHz 2275 ~ 2425MHz</td>
<td>5.2 x 2.1 x 1.1mm</td>
</tr>
<tr>
<td>AMCA52-2R510G-S1F-T</td>
<td>Chip Antenna WLAN</td>
<td>2510MHz 2410 ~ 2610MHz</td>
<td>5.2 x 2.1 x 1.0mm</td>
</tr>
</tbody>
</table>

The ACMA Series covers a broad range of RF bands including IEEE 802.11b/g & IMT, and WiMax bands. The term IMT (International Mobile Telecommunications) is the root name which encompasses both IMT-2000 and IMTAdvanced (4G) collectively.
## Abracon AMCA Series - Part Numbering & Descriptions

<table>
<thead>
<tr>
<th>Part No</th>
<th>Description / Band</th>
<th>Center Frequency Bandwidth (MHz)</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMCA52-2R540G-S1F-T</td>
<td>Chip Antenna WLAN</td>
<td>2540MHz 2440 ~ 2640MHz</td>
<td>5.2 x 2.1 x 1.0mm</td>
</tr>
<tr>
<td>AMCA52-2R710G-S1F-T</td>
<td>Chip Antenna WLAN</td>
<td>2710MHz 2610 ~ 2810MHz</td>
<td>5.2 x 2.1 x 1.0mm</td>
</tr>
<tr>
<td>AMCA52-2R780G-S1F-T</td>
<td>Chip Antenna WLAN</td>
<td>2780MHz 2680 ~ 2880MHz</td>
<td>5.2 x 2.1 x 1.0mm</td>
</tr>
<tr>
<td>AMCA62-2R640G-01F-T</td>
<td>Chip Antenna WLAN</td>
<td>2640MHz 2540 ~ 2740MHz</td>
<td>6.0 x 2.0 x 1.0mm</td>
</tr>
</tbody>
</table>

IMT 5.384A describes the bands, or portions of the bands, 1710 ~ 1885 MHz, 2300 ~ 2400 MHz and 2500 ~ 2690 MHz. These are identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) in accordance resolution 223 (Rev.WRC-07). The AMCA series covers the upper two IMT bands.
The AMCA antennas also covers portions of the WiMax (IEEE-802.16.) bands, that operates globally between 2-11 GHz (3.5 GHz in Europe) for Fixed WiMax and 2-6GHz for Mobile WiMax. They also cover several TDD LTE bands. In both cases the AMCA antenna are applicable for the user equipments.
USA Radio Frequency Allocation from 2GHz to 3GHz

The chart shows the relevant section of US Radio Frequency Allocation between 2GHz and 3GHz. It can be seen that a wide range of Fixed and Mobile bands are available across this frequency bandwidth. The AMCA Series covers many bands used by IMT User Equipment (UE) applications (fixed and mobile).
Example of Block Diagram WiFi / WLAN TCVR

Block diagram shows application of **Chip Antenna** with a RFIC.

In this WiFi or ISM example; the 2.45GHz antenna provides the transmission and reception of signals. In many handheld solution the choice of antenna will be a ceramic chip type. Abracon also provides other BOM elements for example SAW, Balun, BPF, as well as Crystals or Resonators.
Ceramic Multilayer Chip Antenna Technology

What are Chip Antennas?
Chip antennas come in various sizes and are often seen as small ceramic blocks with minimal metal artwork and SM pads into which the signal is launched.

Multilayer Ceramic Technology
The AMCA Series are made from LTCC (Low Temperature Co-fired Ceramic). This technology is the same used in multilayer inductors and capacitors, allowing the devices to be small but especially low profile. The metallization is all within the devices, so only the pads and can be seen at the ends of the package.

Chip Antennas are small ceramic blocks, either solid or multilayer; this type are the latter, and have been manufactured using LTCC technology, so allowing exceptional low profiles. This allows for compact very low profile devices.
Ceramic Multilayer Chip Antenna Technology

Size of Multilayer Chip Antennas

- Antenna size is one of the determining factors to achieve **Gain** and **Bandwidth** requirements that are important for radio system design.
- A reduction of size while maintaining efficiency leads to a reduction in bandwidth; conversely maintaining efficiency and bandwidth leads to a lower gain \(^{(1)}\).

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Code / Size (mm)</th>
<th>Bandwidth (MHz)</th>
<th>Peak Gain (dBi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMCA31-2R450G-S1F-T</td>
<td>(31) 3.2 x 1.6 x 1.2</td>
<td>90MHz</td>
<td>+0.5dBi</td>
</tr>
<tr>
<td>AMCA52-2R350G-S1F-T</td>
<td>(52) 5.2 x 2.1 x 1.0</td>
<td>200MHz</td>
<td>+2.5dBi</td>
</tr>
<tr>
<td>AMCA62-2R640G-01F-T</td>
<td>(62) 6.0 x 2.0 x 1.0</td>
<td>200MHz</td>
<td>+2.6dBi</td>
</tr>
<tr>
<td>AMCA72-2R470G-S1F-T</td>
<td>(72) 7.0 x 2.0 x 1.0</td>
<td>200MHz</td>
<td>+2.7dBi</td>
</tr>
<tr>
<td>AMCA81-3R010G-S1F-T</td>
<td>(81) 8.0 x 1.0 x 1.0</td>
<td>200MHz</td>
<td>+2.0dBi (^{(2)})</td>
</tr>
<tr>
<td>AMCA92-2R660G-S1F-T</td>
<td>(92) 9.0 x 2.0 x 1.0</td>
<td>200MHz</td>
<td>+3.0dBi</td>
</tr>
</tbody>
</table>

(\(Note\) \(^{(1)}\): Subject to similar frequency bands and the same dielectric constant)

(\(Note\) \(^{(2)}\): Lower gain here is subject to higher operating frequency 3.010GHz)

The size of the Chip Antennas is determined by the dielectric constant (Er) of the Ceramic. Designers need to consider trade-offs of board space, gain and bandwidth requirements when picking an antenna.
Key Features of Multilayer Chip Antennas

- Multilayer Chip Antennas offer...
- Use of multilayer technology offers compact design.
- Available across a range of bands, makes these ideal for multi-band applications like Mobile Phone / Tablets / WLAN / WiMax / LTE.
- Multilayer technology provides exception low profile, light weight, range of form factor suitable for compact applications.
- The range of form factors gives designers scope to exploit excellent gain and directivity performance relative to their size.
- Ease of matching during application development.
- Better SAR response than PCB traces.
- Improved isolation allowing multiple antenna applications.
- Omni-directional radiation highly suitable for mobile communications.

Multilayer Chip Antennas offer a range of advantages to designers who have restricted space or cannot afford an external antenna. Key features include low profile compact designs, and choice of form factors giving designers flexibility to trade size, efficiency, & gain to meet system requirements while minimizing antenna profile.
Antenna Radiation Patterns

3D Radiation Pattern

2445.000MHz

3D Radiation Pattern shows Omni-directional Pattern

The diagram shows the omni-directional 3D radiation pattern of a typical Chip Antenna. This provides 360 degree coverage, and is suited to handheld devices.
**Typical Antenna PCB Matching**

Chip antennas should be matched within the environment of the final product. Normally this process can be done with inductors and/or capacitors.

Note: It is recommended to pre-place the $\pi$-type circuit layout that offers full flexibility to match the antenna to 50 Ohms, in the final product layout. Depending on matching, NC may apply to certain components in the matching configurations above.

The diagram shows a typical pcb layout for a chip antenna, with matching components. Typically the antenna will need a no-ground region / keep out area. Matching should be done in final production environment. $\pi$-type circuit layout should be adopted for flexibility.
Comparison between Dielectric & LTCC Multilayer Chip Antennas

• ABRACON offers both Dielectric and LTCC Multilayer Chip antennas from the ACA and AMCA series respectively.

Dielectric Chip Antennas: ACA series
• Made from a solid ceramic block onto which silver is printed or sprayed to make an antenna pattern. This might take the form of a meandering line of silver metallization to create a helical type antenna, (see below).
• Process scalable based on block size, suitable for low to high volumes.
• More costly, approximately 50%
• Higher gain for same size block

LTCC Chip Antennas: AMCA series
• These are made from several layers of dielectric sheets, that are pressed then fired. The multilayer technique allows metallization on each layer that are joined internally with via holes. So in this process the helical pattern would be contained internally across the layers.
• Lower cost
• Lower gain for same size compared to dielectric types.
• Wide range of size formats, all very low profile.
• Process suited to very high volumes
What RF Applications need Chip Antenna

Chip Antennas are useful for mobile wireless systems where a compact solution is required.

- Mobile Phones
- Tablets
- Mobile Gaming
- Bluetooth
- WLAN 802.11b/g
- Zigbee
- 802.15

- IMT and WiMax Bands
- TDD LTE Bands
- And Other Apps

- 2.45GHz / 2.47GHz
  AMCA31-2R450G-S1F-T
  AMCA72-2R470G-S1F-T

- All REMAINING PARTS
Applications for Chip Antennas

- Chip Antennas are used extensively by the mobile phone manufacturers, but these tier 1 customers are not our targets.

- **Bluetooth Applications:**
  - Bluetooth exists in many products, such as telephones, tablets, media players, and gaming like Lego Mindstorms NXT, Playstation 3, PS Vita, Nintenddo Wii, and HD Headsets, Modems and watches:
  - Bluetooth Headsets / Intercoms
  - Bluetooth Audio Headsets
  - Keyboards / Mouse
  - Games Consoles / Controllers
  - Wireless bridge between two Industrial Ethernet (e.g. PROFINET) networks.
  - Short range transmission of health sensor data from medical devices to mobile phone, or dedicated “Telehealth” devices.
  - Personal security applications – tags

The Bluetooth technology offers a wide selection of applications involved with Bluetooth enabled devices.
Applications for Chip Antennas

- WiFi Applications: The “Internet of Things”
  - The number of Internet-connected devices is the world in 2011 was estimated at 20 billion by 2020 this is expected to rise to 50 billion devices.
  - Networking
  - Consumer Electronics
  - Computing and Peripherals
  - Headsets
  - Automotive and Transport
  - Health & Fitness
  - Smart Energy
  - Industrial Communications

The “Internet of Things” offers an increasing wide application of connected or controlled WiFi solutions. A wide selection of WiFi certified product exist, and offer opportunities for Chip Antennas.
Applications for Chip Antennas

IMT Standardization:
IMT-2000 / IMT Advanced:

IMT Applications:
- **Mobile Health**
  - Easy to carry devices
  - Better coverage
  - Backhaul capability for body sensor devices
- **Smart Energy**
  - Smart Appliances
  - Programmable wireless connected thermostats
  - Adoption of smart energy devices in medium to dense residential areas
- **Smart City**
  - Telematics
  - Environmental control
  - Public safety (webcam monitoring)
- **Architecture of Internet of Things**
  - Ubiquitous wireless Connected World

IMT Standards Drives Technology and Telecom Operators to invest in infrastructure.
Applications for Chip Antennas

WiMax - 802.16 - Worldwide Interoperability for Microwave Access

WiMax is short for Worldwide Interoperability for Microwave Access. It is a metropolitan wireless standard ratified by the IEEE (Institute of Electrical and Electronics Engineers) under the name IEEE-802.16.

<table>
<thead>
<tr>
<th>Standard</th>
<th>Frequency</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed WiMax (802.16-2004)</td>
<td>2-11 GHz (3.5 GHz in Europe)</td>
<td>75Mbps</td>
</tr>
<tr>
<td>Mobile WiMax (802.16e)</td>
<td>2-6 GHz</td>
<td>30Mbps</td>
</tr>
</tbody>
</table>

The AMCA antenna can be used in WiMax User Equipment (UE) devices, like dongles, laptops, mobile wireless.

WiMax standard is a metropolitan wireless standard. The AMCA chip antennas cover global bands for WiMax user equipments. They can be used in dongles, mobiles and wireless devices to connect to the internet.
Applications for Chip Antennas

E-UTRA and LTE-Advanced
The range of AMCA antenna cover certain E-UTRA TDD bands (LTE), between 2.3GHz to 3.6GHz

<table>
<thead>
<tr>
<th>LTE Band</th>
<th>Frequency (MHZ)</th>
<th>Duplex</th>
<th>Common Name</th>
<th>Antenna PN</th>
<th>Antenna B/W (MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>2570 - 2620</td>
<td>TDD</td>
<td>IMT-E / 2600</td>
<td>AMCA92-2R660G-S1F-T</td>
<td>1660 - 3660</td>
</tr>
<tr>
<td>40</td>
<td>2300 - 2400</td>
<td>TDD</td>
<td>2300</td>
<td>AMCA52-2R350G-S1F-T</td>
<td>2275 - 2425</td>
</tr>
<tr>
<td>42</td>
<td>3400 - 3600</td>
<td>TDD</td>
<td>3500</td>
<td>AMCA81-3R010G-S1F-T</td>
<td>2010 - 4010</td>
</tr>
</tbody>
</table>

The AMCA antenna can be used in WiMax User Equipment (UE) devices, like dongles, laptops, mobile wireless.

The AMCA chip antennas cover several of the E-UTRA and LTE-Advanced bands, and can be used in user equipments like dongles, or other LTE equipments covering these bands.
## Cross Reference Guide

<table>
<thead>
<tr>
<th>ABRACON</th>
<th>MURATA</th>
<th>YAGEO (PHYCOMP)</th>
<th>TAIYO YUDEN</th>
<th>JOHANSON TECHNOLOGY Inc</th>
<th>ANTENOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMCA31-2R450G-S1F-T</td>
<td>ANCV12G44SAA127</td>
<td>CAN4311712002451K</td>
<td>AH316M245001-T</td>
<td>2450AT42A100</td>
<td>A10192-L</td>
</tr>
<tr>
<td>AMCA31-2R800G-S1F-T</td>
<td>LDA212G8610K-285</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMCA52-2R350G-S1F-T</td>
<td></td>
<td>AH104F2350S1-T</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMCA52-2R510G-S1F-T</td>
<td></td>
<td>AH104F2550S1-T</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMCA52-2R540G-S1F-T</td>
<td></td>
<td></td>
<td>2500AT43A0100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMCA52-2R710G-S1F-T</td>
<td>2500AT43A0100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMCA52-2R780G-S1F-T</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMCA62-2R640G-01F-T</td>
<td>LDA212G4410K-283</td>
<td>AH104F2650S1-T</td>
<td>2600AT44A0600E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMCA72-2R470G-S1F-T</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMCA72-2R860G-02F-T</td>
<td>LDA212G8610K-285</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMCA81-3R010G-S1F-T</td>
<td>LDA313G0313F-240</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMCA92-2R660G-S1F-T</td>
<td></td>
<td></td>
<td></td>
<td>2650AT43A0100E</td>
<td></td>
</tr>
</tbody>
</table>

The table summarizes the best matches offered by the ACA series to other antenna company products. Products are alternatives and may not be a drop-in solution, so please refer to the specifications.
The table summarizes the suggested technology advantages of size, efficiency and gain offered by the AMCA Series.
Thank You for your Kind Attention

Abracon Multilayer Chip Antennas