ARRAYENT

ACM Data Sheet

Version 1.3 Revision 3

November 7, 2013

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1 Overview

The ACM (“Arrayent Connect Module”, “ACM”, or “Module” for short) is a family of surface-mount modules for enabling consumer products to communicate wirelessly to the Arrayent Connect Platform, a global Platform-as-a-Service (PaaS) for connected products.

1.1 Description

The ACM is physically composed of an integrated crystal, internal voltage regulator, matching circuitry, and filtering. The ACM is based on the CC1110 SoC from Texas Instruments. It measures 0.75 by 0.885 inches and is intended for use as a surface-mount module to be soldered on to the PCB of a consumer product.

The ACM's energy-aware algorithms support long battery life. When powered by three AA batteries, the ACM by itself can sustain power for over twelve months.

The ACM has received regulatory approval for modular devices in the United States (FCC), Canada (IC), and Europe (ETSI).

1.2 Benefits

The ACM has been optimized to connect low-cost consumer products to the Arrayent Connect Platform. Benefits include:

- Fast time to market

- Low-power consumption: 2.2uA when sleeping, 165uA when operating normally
- Minimal RF and computer networking experience necessary
- 100% RF-tested in production
- Easy to implement on a two-layer PCB
- Supports whole-house coverage (line of sight range: 150 meters, 10 dBm power output)
- FCC 15.247a2 / 15.249, IC RSS-201 certified
- Compliant with ETSI EN 300 328

1.3 Features

Features of the ACM include:

- 2.3V to 5.5V input
- Three antenna options: external coaxial antenna, wire antenna via through-hole antenna port, and PCB antenna via ACM pin (PCB antenna option will require additional FCC certification testing)
- Efficient UART interface
- Operates in unlicensed ISM bands (915 MHz in United States, 868MHz in European Union)

2 Hardware

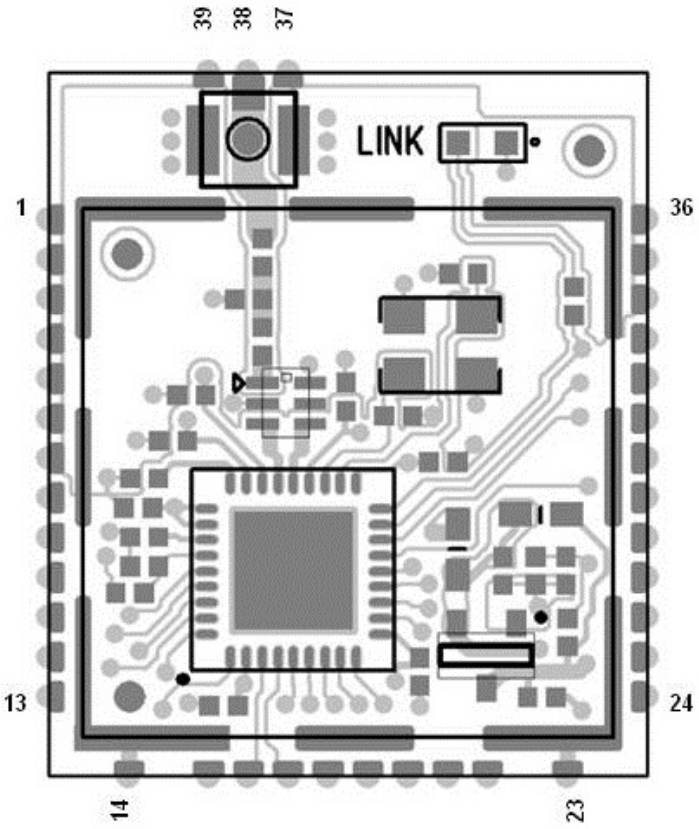
This chapter describes the various hardware requirements and characteristics of the ACM.

2.1 Space Requirements

The ACM is designed to be surface-mounted on a carrier board. The ACM requires 0.75 by 0.855 inches of space on your carrier board.

2.2 Pinout

The main interface between the ACM and the Client MCU are the electrical pins of the ACM.



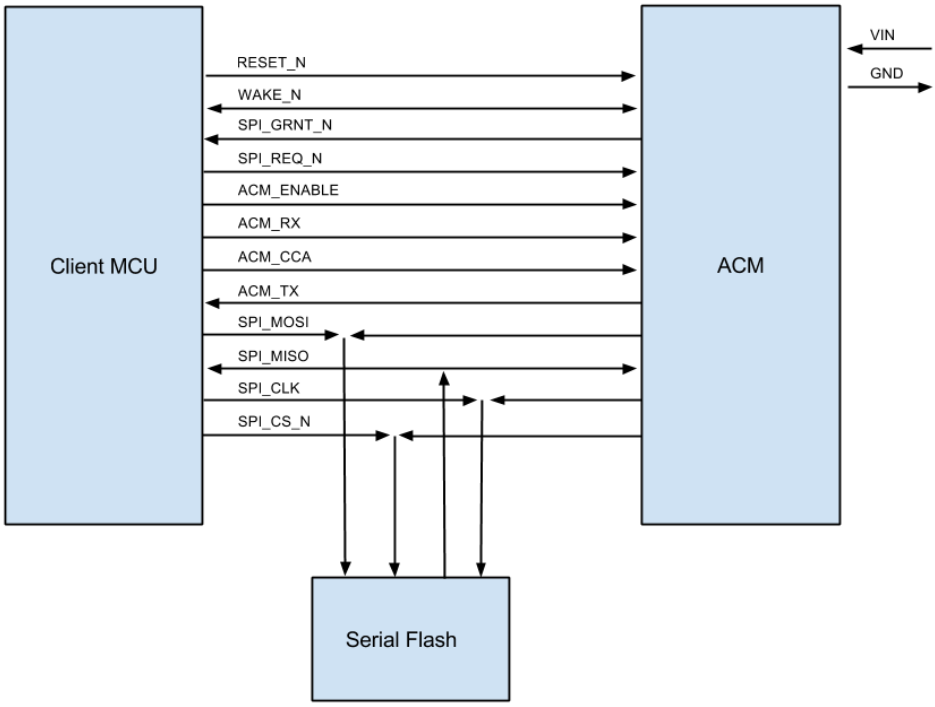
If a pin is not noted in the table below, then it should be considered reserved for internal use and should not be connected to the circuit of the carrier board.

In the table below, direction is from the perspective of the ACM (input = client MCU → ACM, output = ACM → client MCU).

Pin #	Required	Function	Direction	Description
1-7, 14, 23, 34-36, 37,	x	ACM Ground		Connected to carrier board ground. Best practice is to connect all pins to ground. At minimum, customer should connect one ground from each corner to

Pin #	Required	Function	Direction	Description
39				ensure good coupling.
20	x	SPI_CS_N	Output/Hi-Z	SPI Select Line. High impedance when SPI_GNT_N asserted.
21	x	SPI_CLK	Output/Hi-Z	SPI Clock Line. High impedance when SPI_GNT_N asserted.
22	x	SPI_MOSI	Output/Hi-Z	SPI MOSI Line, for writing data to external flash. High impedance when SPI_GNT_N asserted.
26	x	SPI_MISO	Input	SPI MISO Line, for reading data from external flash.
17	x	SPI_GNT_N	Output	SPI Grant Line, for arbitrating between multiple external client MCUs requesting the shared SPI.
16	x	SPI_REQ_N	Input	SPI Request Line, for listening for a request from one of multiple external client MCUs to control the shared SPI.
15	x	WAKE_N	Bidirectional	Active low open collector signal, which is driven low by either the ACM or the client MCU for a preset period of time before sending any data over the UART port. 0 = force awake, 1 = allow sleep.
13		ACM_ENABLE	Input	Active low shutdown line which sends the radio link of the ACM into a completely inactive state when driven low. Useful for conserving power. 0 = disabled, 1 = enabled.
12	x	ACM_RX	Input	UART Rx, for receiving data sent from client MCU.
11	x	ACM_TX	Output	UART Tx, for sending data to client MCU.

Pin #	Required	Function	Direction	Description
9	x	ACM_CCA	Input	Input to the ACM that allows or disallows the ACM from transmitting on its radio channel. When asserted by the Client MCU, the ACM will delay data transmission until the Client MCU releases the signal. Useful in a multi-radio environment for avoiding traffic collisions. 1 = RF busy, 0 = OK for ACM to transmit.
33		STATUS_LED	Output	Active high output pin which controls the ACM's LED.
8		RESET_N	Input	Active low output pin which forces a hard reboot of the ACM.
25	x	ACM Power In		Input voltage to ACM. 2.3 to 5V DC.
24		ACM Power Output		Output voltage from ACM. Customers may use VOUT as an external power source for SPI flash.



2.3 Electrical Characteristics

The ACM includes an internal voltage regulator supplied through one of the module pins. Power is sourced from the customer carrier board and must comply with the following characteristics:

Net	Min	Typ	Max	Description
V_{input}	2.3	3.6V	5.5	Internal voltage, regulated to 3.3V maximum.
V_{output}			3.3V	ACM output voltage. Follows VIN up to a maximum of 3.3V. Maximum current is 50mA.
I_{pm2}		2.2uA		Sleep.
I_{idle}		4.1mA		Idle.
I_{rx}		22mA		Receive.

Net	Min	Typ	Max	Description
I_{tx}		35mA		Transmit at 10dBm.
$I_{average}$		165uA		Average total when ACM is operating in a normal connected state.

$I_{average}$ is the average value during connected operation assuming that the ACM receives one message every ten minutes. In this state, the ACM is online and is available to send and receive messages in both directions (from the Client MCU to the Arrayent Cloud, and vice versa).

2.4 UART Configuration

The following table represents the default UART configuration of the ACM.

Parameter	Default Value	Configurable
Baud Rate	38400. All standard rates from 2400 to 115200 are supported.	Yes
Data Bits	8	No
Parity	None	No
Stop Bits	1	No
Flow Control	None	No
Wake Delay	1. Range of supported values is 1 ms to 255 ms.	Yes

Wake Delay refers to the number of milliseconds the ACM will wait after it drives the wake pin low before sending data to the Client MCU.

The baud rate of the ACM can be adjusted to meet the needs of your product.

2.5 Antenna

The ACM supports three antenna options:

1. Coaxial external antenna connected to optional U.FL connector
2. Low-cost wire antenna, soldered to the ACM's through-hole antenna port
3. PCB or chip antennas attached to carrier board, connected to RF pin on ACM. Note that this option will require additionall FCC certification testing.

Antenna requirements are dictated by the System-on-Chip driving the ACM, the Texas Instruments CC1110. Read more about antenna recommendations for the CC1110 at:

http://www.ti.com/lit/an/swra367a/swra367a.pdf

3 External Flash and SPI - Usage and Requirements

The ACM requires access to an external flash memory chip via a shared SPI bus. The shared SPI bus and external flash are used for two purposes:

1. Storing ACM firmware images
2. Storing Client MCU firmware images and data when the ACM performs over-the-air downloads

The flash chip must be segmented into a series of contiguous address ranges, called “slots”. The minimum size for each slot is 64KB. The external flash memory chip must support partial page programming. Compatible models include (but are not limited to):

- Macronix
- Winbond
- Spansion

4 SKU Nomenclature

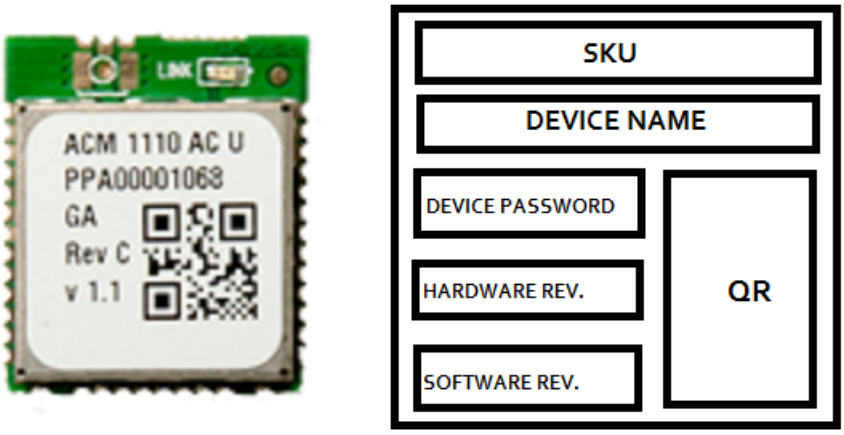
ACM-110-900 (Arrayent Connect Module, TI CC1110, 915MHz without coax)

ACM-110-910 (Arrayent Connect Module, TI CC1110, 915MHz with coax)

ACM-110-800 (Arrayent Connect Module, TI CC1110, 868MHz without coax)

ACM-110-810 (Arrayent Connect Module, TI CC1110, 868MHz with coax)

5 Label Nomenclature



The QR Code evaluates to the following string (excluding quotes): “<Device Name>-<Device Password>”.

6 ACM Development Kits and Additional Documentation

Contact info@arrayent.com to purchase an ACM Development Kit (“DevKit”). The DevKit will give you access to the ACM Developer Guide, which is the definitive guide for learning how to implement a connected product that interfaces with the ACM.

7 FCC NOTICE

FCC ID: Y4B-ACM1110

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.

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

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by Arrayent, Inc., may void the user's authority to operate the equipment.

To comply with FCC RF exposure compliance requirements, the antenna used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

This equipment is sold only to OEM integrators and must be installed by the OEM or OEM integrators under the following conditions:

- The antennas used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons, and
- The transmitter must not be co-located with any other antenna or transmitter.

8 IC NOTICE

IC ID: 10122A-ACM1110

English

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

- this device may not cause interference, and

- this device must accept any interference, including interference that may cause undesired operation of the device.

This product meets the applicable Industry Canada technical specifications.

The Class [B] digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulation.

French

Cet appareil est conforme à Industrie Canada une licence standard RSS exonérés (s). Son fonctionnement est soumis aux deux conditions suivantes:

- Cet appareil ne doit pas provoquer d'interférences
- Cet appareil doit accepter toute interférence reçue, y compris les interférences pouvant provoquer un fonctionnement indésirable de l'appareil.

Ce produit est conforme aux spécifications d'Industrie Canada.

La classe [B] appareil numérique est conforme à toutes les exigences du règlement équipement brouilleur du Canada.

9 Document Information

This chapter contains information about the data sheet document itself.

9.1 Document Versioning

The title page and header of this document contains versioning information in the form of “Version X.x Revision X”.

“Version” represents the version of the ACM product which this document corresponds to. Make sure that the “Version” corresponds to the version of the ACM which you are developing upon, as newer versions of the ACM may contain features not supported in older versions of the ACM.

“Revision” represents the number of revisions made to this document for this version of the ACM. The document with the highest revision number for each respective ACM version is the most up to date.

9.2 Revision History

Date	Revision	Description
7 November 2013	3	Updated FCC and IC notices. Added note that using ACM with PCB antenna requires additional FCC certification testing.
21 October 2013	2	Expanded description of $I_{average}$ in Section 2.3 “Electrical Characteristics“ to define “normal operating state”.
17 October 2013	1	Note that the ACM Data Sheet has been in circulation but was not properly revisioned. Revisions below are changes made from the most recent, un-revisioned Data Sheet. Removed ACM software block diagram from Section 1.1 “Description“. Changed the pinout numbering scheme in the diagram and table of Section 2.2 “Pinout“. Previously, pins were labeled according to their CC1110 mapping. Now, pins are linearly labeled from 1 to 39, counterclockwise from top left. Added information about range of supported Baud rates and wake delay in Section 2.4 “UART Configuration“. Added description of VOUT to Section 2.2 “Pinout“ and Section 2.3 “Electrical Characteristics“. Reduced font size of FCC and IC Chapters. Added Chapter 5 “Label Nomenclature“. Updated Chapter 4 “SKU Nomenclature“ to reflect new naming scheme.