This user’s guide describes the characteristics, operation, and use of the AMC13xxEVM (AMC1303EVM, AMC1306EVM, and AMC1336EVM). A complete circuit description as well as schematic diagram and bill of materials are included.

The following related documents are available through the Texas Instruments web site at www.ti.com.

Table 1. Related Documentation

<table>
<thead>
<tr>
<th>Device</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMC1303</td>
<td>Small, High-Precision, Reinforced Isolated Modulator with Internal Clock</td>
</tr>
<tr>
<td>AMC1306</td>
<td>AMC1306x Small-Size, Reinforced Isolated Delta-Sigma Modulators</td>
</tr>
<tr>
<td>AMC1336</td>
<td>AMC1336 Small, High-Precision, Reinforced Isolated Delta-Sigma Modulator for Voltage Sensing Applications</td>
</tr>
</tbody>
</table>

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1 EVM Overview

1.1 Features

This EVM supports the following features:
- Full-featured evaluation board for the AMC1303, AMC1306, or AMC1336 single-channel delta-sigma modulator
- Configurable AVDD and DVDD power supplies
- Screw terminals for easy access to analog inputs and outputs

1.2 Introduction

The AMC1303, AMC1306, and AMC1336 devices are 1-bit modulators with an output buffer separated from the input interface circuitry by a silicon dioxide (SiO2) isolation barrier. The isolation barrier provides galvanic isolation of up to 8000 V<sub>PEAK</sub>. When used in combination with the AMC1210 or other digital filter, the AMC1303, AMC1306, and AMC1336 can be used to achieve 16-bit analog-to-digital (A/D) conversion with no missing codes.

For use in high-resolution measurement applications, an effective accuracy of 14-bits can be obtained with a digital filter bandwidth of 20 kHz at a modulator rate of 10 MHz.

Throughout this document, the abbreviation EVM and the term evaluation module are synonymous with the AMC1303EVM, AMC1306EVM, or the AMC1336EVM.

2 Analog Interface

The analog input to the AMC13xxEVM is routed from a two-wire screw terminal screw at J1. This screw terminal gives the user access to the inverting and non-inverting inputs of the AMC1303, AMC1306, or AMC1336 depending on which device is installed on the board.

2.1 Analog Inputs

The analog input to the AMC13xxEVM board is comprised of direct connection to AINP and AINN through 0-Ω resistors R1 and R2. If filtering is required, R/C filter circuit options are possible using the footprints for C4, C5 and C8. The input circuit for the AMC13xxEVM is illustrated in Figure 1.
3 Digital Interface

The AMC13xxEVM digital input/output is a simple three terminal screw connector located at J4. J4 pin 1 is the output data from the modulator installed in location U2. For the AMC1306 and AMC1336, pin 7 is the modulator clock input as shown below. A 5 MHz to 20 MHz modulator clock can be applied to J4.2 referenced to J4.3. For the AMC1303, pin 7 is the modulator clock output which can be monitored at J4.2 relative to J4.3.
4 Power Supplies

The AMC13xxEVM requires two separate power rails, 5 $V_{ISO}$ and DVDD. 5 $V_{ISO}$ is on the high voltage side of the amplifier. DVDD is on the user side of the amplifier.

4.1 AVDD Input

The default configuration of the EVM provides 5 V to 5 $V_{ISO}$ through transformer T1 via U3, an SN6501 push-pull driver. A shunt on jumper JP1 is shorting pins 2-3, which routes the regulated 5 V from U1, a TPS76350, to pin 1 of U2. The screw terminal at J2 allows the user to provide their own AVDD source when the shunt on JP1 is covering pins 1-2. The AVDD supply should be between 3 and 5.5 VDC. The input power scheme is shown in Figure 3.

![Figure 3. AVDD Input](image-url)
The screw terminal at J3 allows the user to provide the DVDD source. The DVDD supply should be between 3 and 5.5 V\textsubscript{DC}.

![Figure 4. DVDD Input](image)

### 4.2 Isolated Power and Analog Inputs: J1 and J2

The isolated power input to the AMC13xxEVM printed circuit board (PCB) can be applied directly to J2 pins 1 and 2.

Table 2 lists the details of J2.

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Signal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J2.1</td>
<td>AGND</td>
<td>Connection to the AMC1303, AMC1306, or AMC1336 AGND terminal (pin 4)</td>
</tr>
<tr>
<td>J2.2</td>
<td>AVDD</td>
<td>Connection to the AMC1303, AMC1306, or AMC1336 AVDD terminal (pin 1)</td>
</tr>
</tbody>
</table>

The analog input to the AMC13xxEVM printed circuit board (PCB) can be applied directly to J1 pins 1 and 2.

**CAUTION**

Carefully review the AMC1303, AMC1306, and AMC1336 product data sheets for the limitations of the analog input range, and ensure that the appropriate analog/digital voltages are applied prior to connecting any analog input to the EVM. The EVM uses the ±250 mV versions of the devices for the AMC1303 and AMC1306. The EVM uses ±1 V for the AMC1336.

Table 3 lists the details of J1.

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Signal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1.1</td>
<td>AINP</td>
<td>Noninverting analog input to the AMC1303, AMC1306, or AMC1336</td>
</tr>
<tr>
<td>J1.2</td>
<td>AINN</td>
<td>Inverting input to the AMC1303, AMC1306, or AMC1336</td>
</tr>
</tbody>
</table>
4.3 Device Operation

Once the analog and isolated power is applied to the AMC13xxEVM, the digital outputs become active. If the AMC1303 is installed at location U2, the device uses its own internal modulator clock. Screw terminal J4 has the connections as shown in Table 4.

Table 4. J4: AMC1303EVM Digital Output

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Signal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J4.1</td>
<td>DOUT</td>
<td>AMC1303 bit stream data output</td>
</tr>
<tr>
<td>J4.2</td>
<td>CLOCK</td>
<td>AMC1303 modulator clock output</td>
</tr>
<tr>
<td>J4.3</td>
<td>DGND</td>
<td>Digital ground reference</td>
</tr>
</tbody>
</table>

If the AMC1306 is installed at location U2, the device requires an external modulator clock between 5 and 20 MHz. Screw terminal J4 has the connections as shown in Table 5.

Table 5. J4: AMC1306EVM, AMC1336EVM Digital Output

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Signal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J4.1</td>
<td>DOUT</td>
<td>AMC1306, AMC1336 bit stream data output</td>
</tr>
<tr>
<td>J4.2</td>
<td>CLOCK</td>
<td>AMC1306, AMC1336 modulator clock input</td>
</tr>
<tr>
<td>J4.3</td>
<td>DGND</td>
<td>Digital ground reference</td>
</tr>
</tbody>
</table>

An analog input signal may be applied directly at screw terminal J1. Refer to Figure 1 and Table 3 for details. The linear analog input range, \((V_{IN^+}) - (V_{IN^-})\), is ±250 mV for the AMC1303 and AMC1306. The linear analog input range, \((V_{IN^+}) - (V_{IN^-})\), is ±1 V for the AMC1336.

For the AMC1303 and AMC1306, as the input voltage approaches the maximum input level of +250 mV, the 1s density of the modulator output will approach 92%. Likewise, when the input voltage approaches the lower limit of -250 mV the 1s density will be approximately 8%.

For the AMC1336, as the input voltage approaches the maximum input level of +1 V, the 1s density of the modulator output approaches 92%. Likewise, when the input voltage approaches the lower limit of -1 V the 1s density is approximately 8%.
5  Layout, BOM, and Schematic

This section contains the complete bill of materials, schematic diagram and printed circuit board (PCB) layout of the AMC1303/06EVM.

NOTE: Board layouts are not to scale. These are intended to show how the board is laid out; they are not intended to be used for manufacturing AMC13xxEVM PCBs.

5.1 Printed Circuit Board Layout

Figure 5. AMC13xxEVM Silkscreen
## 5.2 Bill of Material

### Table 6. AMC13xxEVM Bill of Materials

<table>
<thead>
<tr>
<th>Designators</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Mfg. Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1, C6, C11</td>
<td>CAP, CERM, 10 uF, 10 V, +/- 10%, X5R, 0805</td>
<td>Kemet</td>
<td>C0805C106K8PACTU</td>
</tr>
<tr>
<td>C3, C9</td>
<td>CAP, CERM, 0.1 uF, 25 V, +/- 10%, X7R, 0603</td>
<td>AVX</td>
<td>06033C104KAT2A</td>
</tr>
<tr>
<td>C7</td>
<td>CAP, CERM, 0.1 uF, 50 V, +/- 10%, X7R, 1206</td>
<td>Yageo America</td>
<td>CC1206KRX7R9B104</td>
</tr>
<tr>
<td>C10</td>
<td>CAP, CERM, 1 uF, 10 V, +/- 10%, X5R, 0603</td>
<td>Kemet</td>
<td>C0603C106K8PACTU</td>
</tr>
<tr>
<td>C12, C13</td>
<td>CAP, CERM, 33 pF, 50 V, +/- 5%, C0G/NP0, AEC-Q200 Grade 0, 0603</td>
<td>TDK</td>
<td>CGA3E2NP01H330J080AA</td>
</tr>
<tr>
<td>D1, D2</td>
<td>Diode, Schottky, 20 V, 0.5 A, SOD-123</td>
<td>ON Semiconductor</td>
<td>MBR0520LT1G</td>
</tr>
<tr>
<td>J1, J2, J3</td>
<td>Terminal Block, 3.5mm Pitch, 2x1, TH</td>
<td>On-Shore Technology</td>
<td>ED555/2DS</td>
</tr>
<tr>
<td>J4</td>
<td>Terminal Block, 3.5mm Pitch, 3x1, TH</td>
<td>On-Shore Technology</td>
<td>ED555/3DS</td>
</tr>
<tr>
<td>JP1</td>
<td>Header, 2mm, 3x1, Tin, TH</td>
<td>Samtec</td>
<td>TMM-103-01-T-S</td>
</tr>
<tr>
<td>JP2</td>
<td>Header, 2mm, 2x1, Tin, TH</td>
<td>Samtec</td>
<td>TMM-102-01-T-S</td>
</tr>
<tr>
<td>LBL1</td>
<td>Thermal Transfer Printable Labels, 0.650&quot; W x 0.200&quot; H - 10,000 per roll</td>
<td>Brady</td>
<td>THT-14-423-10</td>
</tr>
<tr>
<td>R1, R2, R3</td>
<td>RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603</td>
<td>Panasonic</td>
<td>ERJ-3GEY0R00V</td>
</tr>
<tr>
<td>R7, R8</td>
<td>RES, 100, 5%, 0.1 W, AEC-Q200 Grade 0, 0603</td>
<td>Vishay-Dale</td>
<td>CRCW0603100RJNEA</td>
</tr>
<tr>
<td>SH-J1, SH-J2</td>
<td>Shunt, 2mm, Gold plated, Black</td>
<td>Samtec</td>
<td>2SN-BK-G</td>
</tr>
<tr>
<td>T1</td>
<td>Transformer, 45.6 uH SMT</td>
<td>Coilcraft</td>
<td>DA2303-ALB</td>
</tr>
<tr>
<td>TP1, TP3</td>
<td>Terminal, Turret, TH, Double</td>
<td>Keystone</td>
<td>1573-2</td>
</tr>
<tr>
<td>U1</td>
<td>Single Output LDO, 150 mA, Fixed 5 V Output, 2.7 to 10 V Input, with Low IQ, 5-pin SOT-23 (DBV), -40 to 125 degC, Green (RoHS &amp; no Sb/Br)</td>
<td>Texas Instruments</td>
<td>TPS76350DBVR</td>
</tr>
<tr>
<td>U2</td>
<td>Small Reinforced Isolated Modulator With +/-250mV Input and CMOS Interface, DWV00008A (SOIC-8)</td>
<td>Texas Instruments</td>
<td>AMC1306M25DWVR or AMC1303M2510DWVR AMC1336MDWVR</td>
</tr>
<tr>
<td>U3</td>
<td>Low-Noise 350 mA, 410 kHz Transformer Driver, DBV00005A (SOT-23-5)</td>
<td>Texas Instruments</td>
<td>SN6501DBVR</td>
</tr>
<tr>
<td>TP1</td>
<td>Terminal, Turret, TH, Double</td>
<td>Not Installed</td>
<td></td>
</tr>
<tr>
<td>R4, R5, R6</td>
<td>RES, 10.2 k, 1%, 0.25 W, 1206</td>
<td>Not Installed</td>
<td></td>
</tr>
<tr>
<td>C4, C5, C8</td>
<td>CAP, CERM, 10 pF, 50 V, +/- 5%, C0G/NP0, 0603</td>
<td>Not Installed</td>
<td></td>
</tr>
</tbody>
</table>
5.3 Schematic

Figure 6 illustrates the AMC1306EVM schematic.

![AMC1306EVM Schematic](image)

5.4 Trademarks

All trademarks are the property of their respective owners.
**Revision History**

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

<table>
<thead>
<tr>
<th>Changes from A Revision (July 2019) to B Revision</th>
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<tr>
<td>• Changed AMC1336 description in Related Documentation table</td>
<td>1</td>
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<tr>
<td>• Changed AMC13xxEVM Silkscreen figure</td>
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<table>
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<tr>
<th>Changes from Original (January 2017) to A Revision</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Added AMC1336EVM to document</td>
<td>1</td>
</tr>
<tr>
<td>• Changed VDD1 to AVDD and VDD2 to DVDD in Power Supplies section</td>
<td>4</td>
</tr>
<tr>
<td>• Changed Signal column in J2: Analog Inputs table</td>
<td>5</td>
</tr>
<tr>
<td>• Changed clock output to clock input in CLOCK row of J4: AMC1306EVM, AMC1336EVM Digital Output table</td>
<td>6</td>
</tr>
<tr>
<td>• Changed AMC13xxEVM Bill of Materials table</td>
<td>8</td>
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</table>
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NOTE:
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3.1.2 For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:

**CAUTION**

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 not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

**FCC Interference Statement for Class A EVM devices**

*NOTE:* This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

**FCC Interference Statement for Class B EVM devices**

*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.

3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247

**Concerning EVMs Including Radio Transmitters:**

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

**Concernant les EVMs avec appareils radio:**

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.

**Concerning EVMs Including Detachable Antennas:**

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.
Concernant les EVMs avec antennes détachables
Conformément à la réglementation d’Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d’un type et
d’un gain maximal (ou inférieur) approuvé pour l’émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage
radioélectrique à l’intention des autres utilisateurs, il faut choisir le type d’antenne et son gain de sorte que la puissance isotope
rayonnée équivalente (p.i.r.e.) ne dépasse pas l’intensité nécessaire à l’établissement d’une communication satisfaisante. Le
présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d’antenne énumérés dans le
manuel d’usage et ayant un gain admissible maximal et l’impédance requise pour chaque type d’antenne. Les types d’antenne
non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l’exploitation de
l’émetteur.

3.3 Japan

3.3.1 Notice for EVMs delivered in Japan: Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内
輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

3.3.2 Notice for Users of EVMs Considered “Radio Frequency Products” in Japan: EVMs entering Japan may not be certified
by TI as conforming to Technical Regulations of Radio Law of Japan.
If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the
instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs
(which for the avoidance of doubt are stated strictly for convenience and should be verified by User):
1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal
Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry’s Rule for
Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to
EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan
with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note
that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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3.3.3 Notice for EVMs for Power Line Communication: Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page
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3.4 European Union

3.4.1 For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive):
This is a class A product intended for use in environments other than domestic environments that are connected to a
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4 EVM Use Restrictions and Warnings:

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4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 Safety-Related Warnings and Restrictions:

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4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User’s handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

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