

AMC1305x 20-MHz, Isolated Delta-Sigma Modulator for Shunt-Based Current Measurement

1 Features

- Pin-Compatible Family Optimized for Shunt Resistor Based Current Measurements:
 - $\pm 50\text{-mV}$ or $\pm 250\text{-mV}$ Input Voltage Ranges
 - CMOS or LVDS Digital Interface Options
- Excellent DC Performance Supporting High-Precision Sensing on System Level:
 - Offset Error: $\pm 40\ \mu\text{V}$ to $\pm 150\ \mu\text{V}$ (max)
 - Offset Drift: $1\ \mu\text{V}/^\circ\text{C}$ (max)
 - Gain Error: $\pm 0.5\%$ (max)
 - Gain Drift: $\pm 40\ \text{ppm}/^\circ\text{C}$ (max)
- Certified Isolation Barrier:
 - Reinforced Isolation Rating
 - VDE V-0884, IEC60747-5-5, UL1577, and CSA Approved
 - Isolation Voltages: $7000\ V_{\text{PEAK}}$, $12\ \text{kV}_{\text{SURGE}}$
 - Working Voltages: $1500\ V_{\text{DC}}$, $1500\ V_{\text{AC, rms}}$
 - Transient Immunity: $15\ \text{kV}/\mu\text{s}$ (min)
- High Electromagnetic Field Immunity (see Application Note [SLLA181A](#))
- External 5-MHz to 20-MHz Clock Input for Easier System-Level Synchronization
- Fully Specified Over the Extended Industrial Temperature Range

2 Applications

- Shunt Resistor Based Current Sensing:
 - Industrial Motor Drives
 - Photovoltaic Inverters
 - Uninterruptible Power Supplies
- Isolated Voltage Sensing

3 Description

The AMC1305 is a precision, delta-sigma ($\Delta\Sigma$) modulator with the output separated from the input circuitry by a capacitive isolation barrier that is highly resistant to magnetic interference. This barrier is certified to provide reinforced isolation of up to $7000\ V_{\text{PEAK}}$ according to the VDE V-0884, IEC60747-5-5, UL1577, and CSA standards. Used in conjunction with isolated power supplies, the device prevents noise currents on a high common-mode voltage line from entering the local system ground and interfering with or damaging low voltage circuitry.

The AMC1305 is optimized for direct connection to shunt resistors or other low voltage level signal sources while supporting excellent dc and ac performance. Shunt resistors are typically used to sense currents in motor drives, green energy generation systems, or other industrial applications. By using an appropriate digital filter (that is, as integrated on the TMS320F2837x) to decimate the bit stream, the device can achieve 16 bits of resolution with a dynamic range of 80 dB (13 ENOB) at a data rate of 78 kSPS.

On the high-side, the modulator is supplied with a voltage between 3.0 V and 5.5 V (AVDD). The isolated digital interface operates from a 2.7-V to 5.5-V power supply (DVDD).

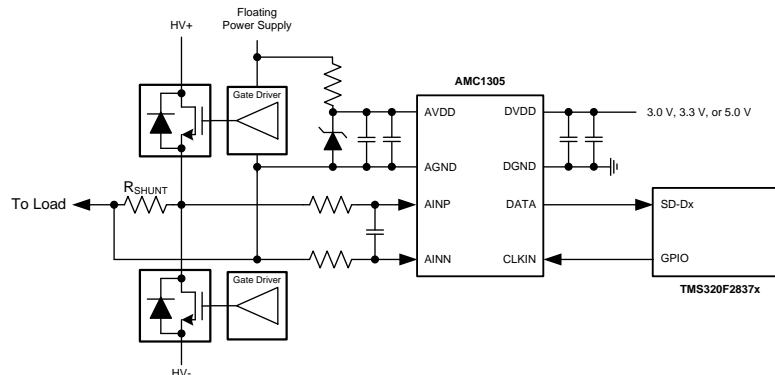
The AMC1305 is available in a wide-body SOIC-16 (DW) package and is specified from -40°C to 125°C .

Device Information⁽¹⁾

PART NUMBER	PACKAGE	BODY SIZE (NOM)
AMC1305x	SOIC (16)	10.30 mm x 7.50 mm

(1) For all available packages, see the orderable addendum at the end of the datasheet.

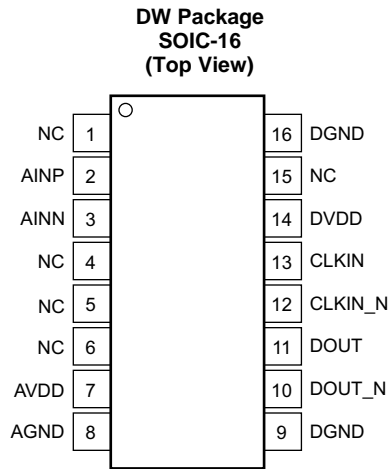
Simplified Schematic



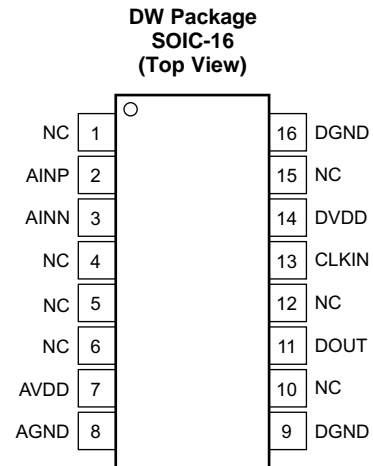
PRODUCT PREVIEW



4 Pin Configurations and Functions



NOTE: LVDS interface versions (AMC1305Lx).



NOTE: CMOS interface versions (AMC1305Mx).

Pin Functions

PIN		FUNCTION	DESCRIPTION
NAME	NO.		
AGND	4	Analog ground	This terminal is internally connected to pin 8 and can be left unconnected or tied to high-side ground
	8	Analog ground	High-side ground reference
AINN	3	Analog Input	Inverting analog input
AINP	2	Analog input	Noninverting analog input
AVDD	7	Analog power	High-side power supply, 3.0 to 5.5 V. See TBD for decoupling recommendations.
CLKIN	13	Digital input	Modulator clock input, 5 MHz to 20.1 MHz
CLKIN_N	12	Digital input	LVDS interface only: inverted modulator clock input
DGND	9, 16	Digital ground	Controller-side ground reference
DOUT	11	Digital output	Modulator data output
DOUT_N	10	Digital output	LVDS interface only: inverted modulator data output
DVDD	14	Digital power	Controller-side power supply, 2.7 to 5.5 V
NC	1	No connection	This terminal can be connected to AVDD or can be left unconnected
	5	No connection	This terminal can be left unconnected or tied to AGND only
	6, 10, 12	No connection	These terminals have no internal connection
	15	No connection	This terminal can be left unconnected or tied to DVDD only

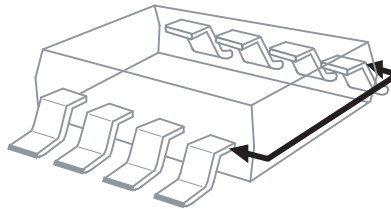
5 Device and Documentation Support

5.1 Device Support

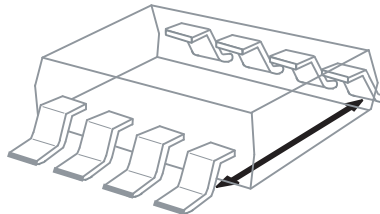
5.1.1 Device Nomenclature

5.1.1.1 Isolation Glossary

Creepage Distance: The shortest path between two conductive input to output leads measured along the surface of the insulation. The shortest distance path is found around the end of the package body.



Clearance: The shortest distance between two conductive input to output leads measured through air (line of sight).



Input-to-Output Barrier Capacitance: The total capacitance between all input terminals connected together, and all output terminals connected together.

Input-to-Output Barrier Resistance: The total resistance between all input terminals connected together, and all output terminals connected together.

Primary Circuit: An internal circuit directly connected to an external supply mains or other equivalent source that supplies the primary circuit electric power.

Secondary Circuit: A circuit with no direct connection to primary power that derives its power from a separate isolated source.

Comparative Tracking Index (CTI): CTI is an index used for electrical insulating materials. It is defined as the numerical value of the voltage that causes failure by tracking during standard testing. Tracking is the process that produces a partially conducting path of localized deterioration on or through the surface of an insulating material as a result of the action of electric discharges on or close to an insulation surface. The higher CTI value of the insulating material, the smaller the minimum creepage distance.

Generally, insulation breakdown occurs either through the material, over its surface, or both. Surface failure may arise from flashover or from the progressive degradation of the insulation surface by small localized sparks. Such sparks are the result of the breaking of a surface film of conducting contaminant on the insulation. The resulting break in the leakage current produces an overvoltage at the site of the discontinuity, and an electric spark is generated. These sparks often cause carbonization on insulation material and lead to a carbon track between points of different potential. This process is known as tracking.

Device Support (continued)

5.1.1.1.1 Insulation:

Operational insulation—Insulation needed for the correct operation of the equipment.

Basic insulation—Insulation to provide basic protection against electric shock.

Supplementary insulation—Independent insulation applied in addition to basic insulation in order to ensure protection against electric shock in the event of a failure of the basic insulation.

Double insulation—Insulation comprising both basic and supplementary insulation.

Reinforced insulation—A single insulation system that provides a degree of protection against electric shock equivalent to double insulation.

5.1.1.1.2 Pollution Degree:

Pollution Degree 1—No pollution, or only dry, nonconductive pollution occurs. The pollution has no influence on device performance.

Pollution Degree 2—Normally, only nonconductive pollution occurs. However, a temporary conductivity caused by condensation is to be expected.

Pollution Degree 3—Conductive pollution, or dry nonconductive pollution that becomes conductive because of condensation, occurs. Condensation is to be expected.

Pollution Degree 4—Continuous conductivity occurs as a result of conductive dust, rain, or other wet conditions.

5.1.1.1.3 Installation Category:

Overvoltage Category—This section is directed at insulation coordination by identifying the transient overvoltages that may occur, and by assigning four different levels as indicated in IEC 60664.

1. Signal Level: Special equipment or parts of equipment.
2. Local Level: Portable equipment, etc.
3. Distribution Level: Fixed installation.
4. Primary Supply Level: Overhead lines, cable systems.

Each category should be subject to smaller transients than the previous category.

5.2 Documentation Support

5.2.1 Related Documentation

- Application Report [ISO72x Digital Isolator Magnetic-Field Immunity, SLLA181](#)
- Application Note [Combining ADS1202 with FPGA Digital Filter for Current Measurement in Motor Control Applications, SBAA094](#)

5.2.2 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

Table 1. Related Links

PARTS	PRODUCT FOLDER	SAMPLE & BUY	TECHNICAL DOCUMENTS	TOOLS & SOFTWARE	SUPPORT & COMMUNITY
AMC1305L25	Click here	Click here	Click here	Click here	Click here
AMC1305M05	Click here	Click here	Click here	Click here	Click here
AMC1305M25	Click here	Click here	Click here	Click here	Click here

5.3 Trademarks

All trademarks are the property of their respective owners.

5.4 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

5.5 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

6 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
AMC1305L25DW	PREVIEW	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	-40 to 125	X1305L25HP	
AMC1305L25DWR	PREVIEW	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	-40 to 125	X1305L25HP	
AMC1305M05DW	PREVIEW	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	-40 to 125	X1305M05	
AMC1305M05DWR	PREVIEW	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	-40 to 125	X1305M05	
AMC1305M25DW	PREVIEW	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	-40 to 125	X1305M25	
AMC1305M25DWR	PREVIEW	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	-40 to 125	X1305M25	

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSELETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

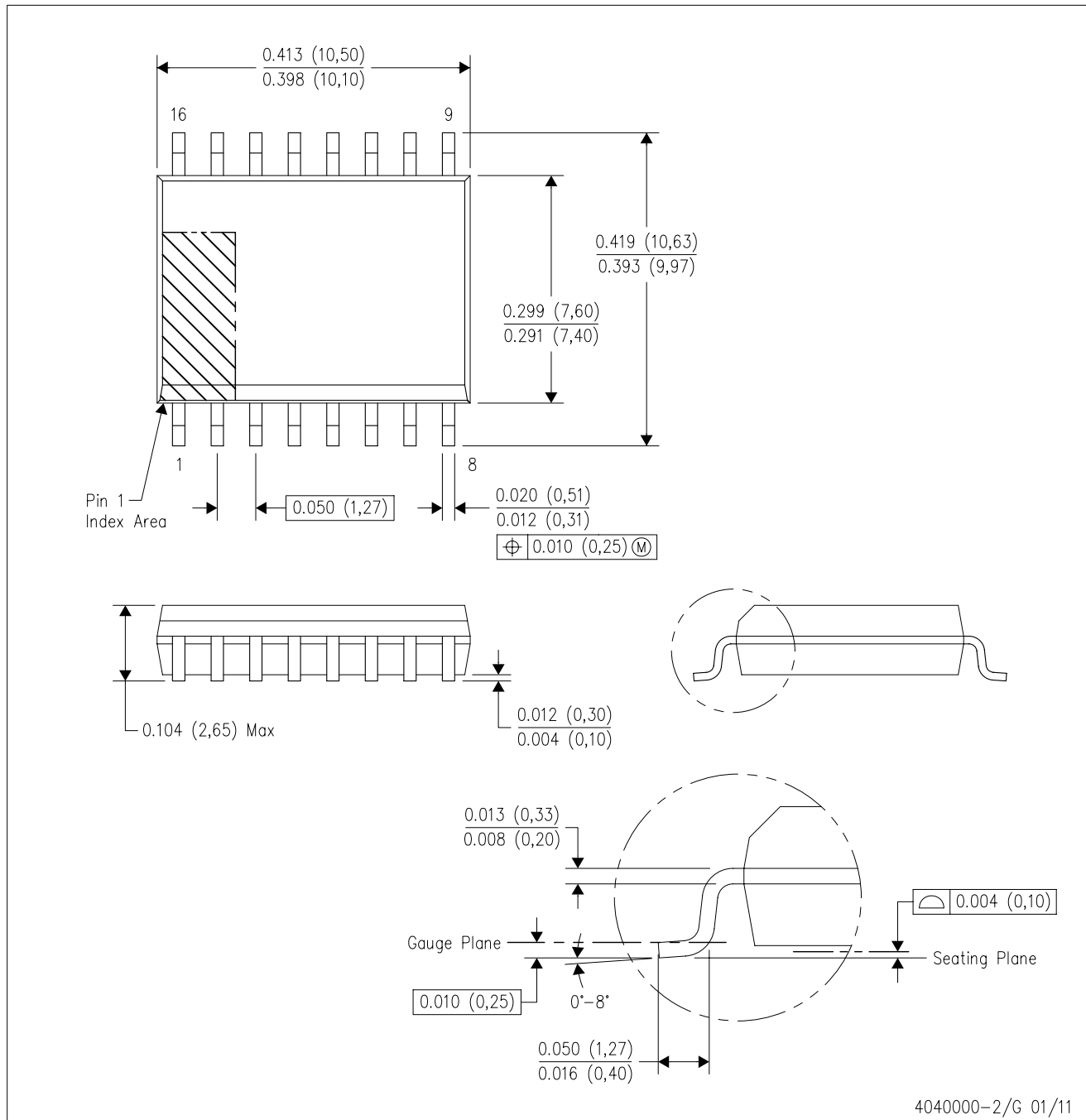
⁽⁶⁾ Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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DW (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - D. Falls within JEDEC MS-013 variation AA.

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