

AMC7823 Evaluation Module

This user's guide describes the characteristics, operation, and the use of the AMC7823 evaluation module. It covers all pertinent areas involved to properly use this EVM board along with the devices that it supports. The physical PCB layout, schematic diagram, and circuit descriptions are included.

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1 EVM Overview

This chapter gives a general overview of the AMC7823 evaluation module (EVM) and describes some of the factors that must be considered in using this module.

1.1 Features

This EVM features the AMC7823 analog monitoring and control circuit device. The AMC7823 EVM is a simple evaluation module designed for a quick and easy way to evaluate the functionality and performance of the 12-bit resolution AMC device. The built-in ADC features an eight-channel analog input with 200 ksp/s sample rate. The AMC7823 also consists of eight independent 12-bit resolution DACs with 2- μ s settling times. Although the AMC7823 has a built-in internal band-gap reference that is software selectable between 1.25 V and 2.5 V, an external reference source is provided. The internal 1.25-V reference voltage is the default reference on power up, so the reference voltage should be set to the desired source and level, if necessary.

SPI is a trademark of Motorola, Inc..

The SPI™ serial interface of the AMC7823 can communicate with any host microprocessor capable of the SPI protocol and most TI DSP based systems.

A socket (Samtec, P/N SS-101-T-1C) for a through-hole resistor, R14, is also provided so that the load current can be precisely set to the desired value required to bias any external component connected to pin 5 (THERM_I_OUTPUT) of the AMC7823.

1.2 Power Requirements

The following sections describe the power requirements of this EVM.

1.2.1 Supply Voltage

The dc analog power supply requirement for the AMC7823 EVM (AV_{DD}) is selectable between +3.3 VA and +5 VA via jumper headers, W3. The +3.3 VA comes from J6-8 or J11-1 (if installed), and the +5 VA comes from the J6-3 or J11-3 (if installed) terminals. These power supply voltages are referenced to ground through the J6-6 or J11-2 (if installed) terminals. All of the analog power supplies are referenced to analog ground through the J11-2 and J6-6 terminals.

On the other hand, the dc digital power supply requirement for DV_{DD} and IOV_{DD} are also selectable between +3.3 VD and +5 VD via jumper headers, W4 and W2, respectively. The +3.3 VD comes from the J6-9 or J12-3 (if installed) terminals, and the +5 VD comes from the J6-10 or J12-1 (if installed) terminals. All of the digital power supplies are referenced to digital ground through the J6-5 and J12-2 terminals.

Green LED indicators, D1 and D5 for AV_{DD} and DV_{DD} respectively, are included to show that power is applied on the EVM board.

CAUTION

To avoid potential damage to the EVM board, make sure that the correct cables are connected to their respective terminals as labeled on the EVM board. Stresses above the maximum listed voltage ratings may cause permanent damage to the device.

1.2.2 Reference Voltage

The AMC7823 comes with an internal bandgap reference that is software selectable between 1.25 V and 2.5 V, where the default on power up is 1.25 V. Although the internal reference is included on the DUT, an external reference circuit is still provided onboard the EVM, as well as the option of providing the user supplied reference voltage via terminal pin, TP1.

The REF3125 (REF2) and REF3112 (REF1) precision voltage references are provided to supply the onboard external voltage reference and set the voltage output range of the ADC and DAC of the AMC7823 device. The 1.25-V or 2.5-V reference voltage can be selected via the W7 jumper. The onboard external reference or the user supplied reference can also be selected via W1 jumper. The user supplied reference can be applied to the TP1 test point or J1-20 terminal pins, which are also provided to allow the user to connect to another external reference source if the onboard reference circuit is not desired. The external voltage reference should not exceed the specified voltages listed in the data sheet.

The REF3125 and REF3112 precision references are powered by +5 VA or +3.3 VA, selectable through the W3 jumper.

CAUTION

When applying an external voltage reference through TP1 or J1-20, make sure that it does not exceed the maximum specified voltage listed in the data sheet. Otherwise, this can permanently damage the AMC7823, U1, device under test.

1.3 EVM Basic Functions

The AMC7823 EVM is designed primarily as a functional evaluation platform to test certain functional characteristics of the AMC7823 (analog monitoring and control circuit) converter. Functional evaluation of the AMC7823 device can be accomplished with the use of any microprocessor or TI DSP with SPI interface capability.

The headers J2 (top side) and P2 (bottom side) are pass through connectors provided for the control signals and data required to interface a host processor to the AMC7823 EVM using a custom built cable. The GPIO and alarm pins of the AMC7823 are also mapped to the J2 and J4 headers.

An adapter interface card (5-6k adapter interface) is also available to fit and mate with the TI C5000 and C6000 DSP starter kit (DSK). This alleviates the troubles involved in building a custom cable. In addition, there is also an MSP430 based platform (HPA449) that uses the MSP430F449 microprocessor, which this EVM can connect to and interface with as well. For more details or information regarding the 5-6k adapter interface card or the HPA449 platform, call Texas Instruments Inc. or email us at dataconvapps@list.ti.com.

The analog input signals for the ADC can be applied to the J1 and P1 pass through terminals differentially. The analog inputs are decoupled to ground to eliminate the high frequency noise component that may be present. In similar fashion, the DAC outputs can be monitored through the even pins of the J5 and P5 pass through header connectors.

The terminal connector, J3, is used for connecting an external component, such as a thermistor that can be driven via the THERM_I_OUT pin. The current load can be precisely set by selecting the correct value for R14. Refer to the data sheet for establishing the correct value for R14.

A block diagram of the EVM is shown in [Figure 1](#).

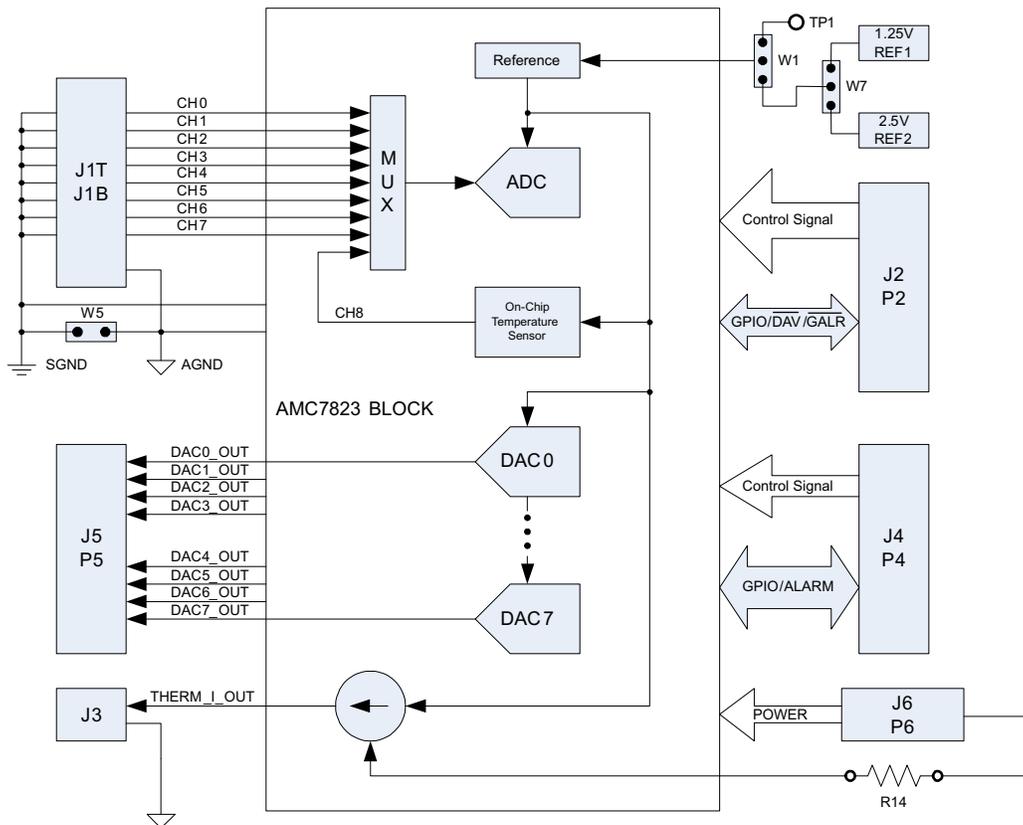


Figure 1. EVM Block Diagram

2 PCB Design

This chapter presents the layout design of the PCB thereby describing the physical and mechanical characteristics of the EVM. The list of components used on the module is also included in this section.

2.1 PCB Layout

The AMC7823 EVM was designed using the double-wide modular EVM form factor developed by Texas Instruments. This EVM form factor allows direct evaluation of the AMC7823 operating characteristics and speeds up software development and other prototyping needs.

The AMC7823 EVM board is constructed on a four-layer printed circuit board using a copper-clad FR-4 laminate material. The printed circuit board has dimensions of 93,9800 mm (3.7000 inch) × 81,2800 mm (3.200 inch), and the board thickness is 1,5748 mm (0.0620 inch). [Figure 2](#) through [Figure 8](#) show the individual artwork layers.

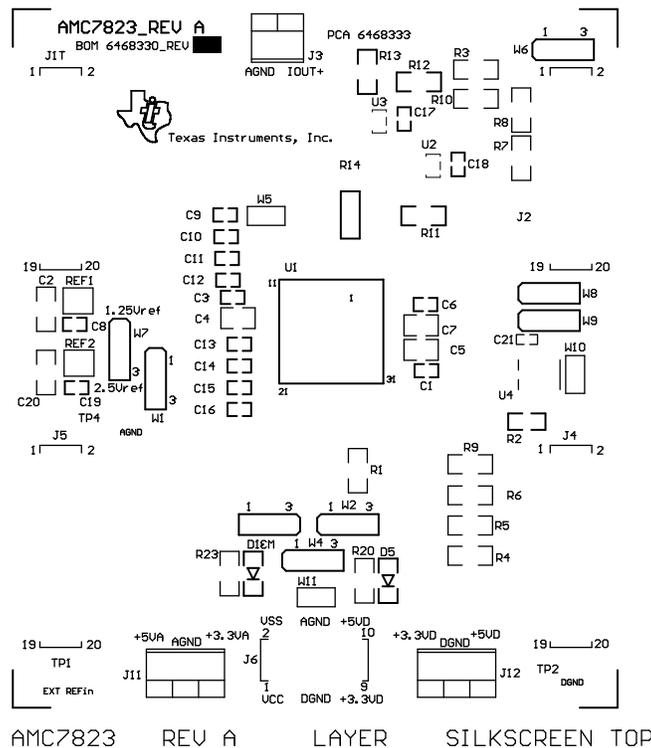


Figure 2. Top Silkscreen

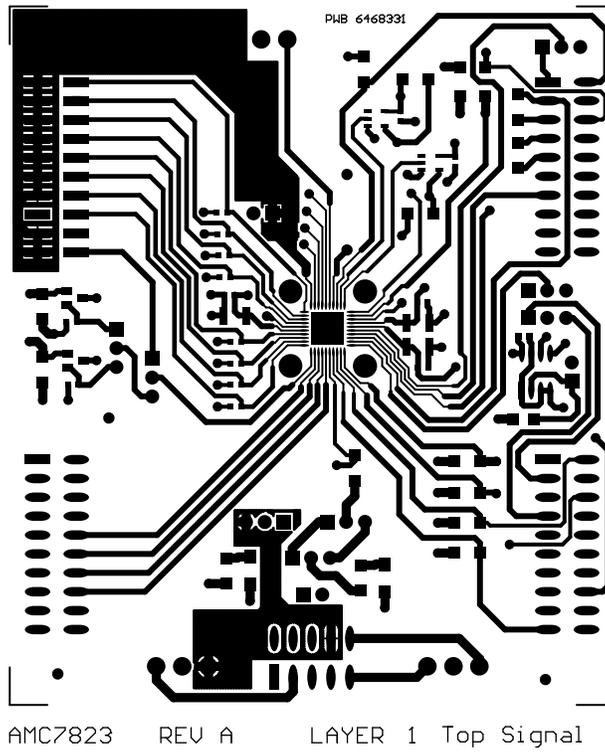


Figure 3. Top Layer (Signal Plane)

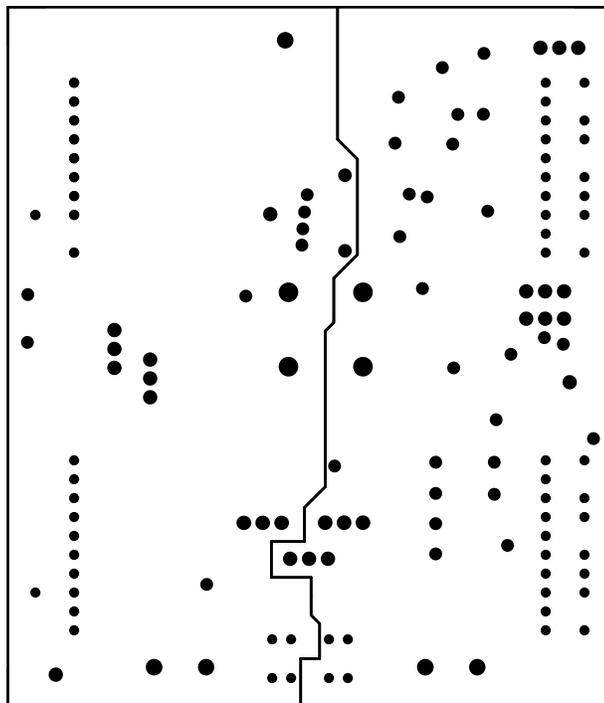
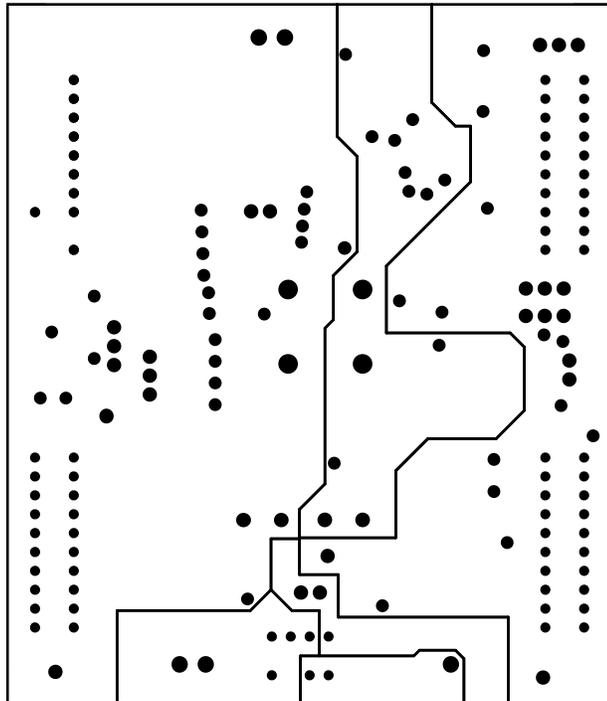
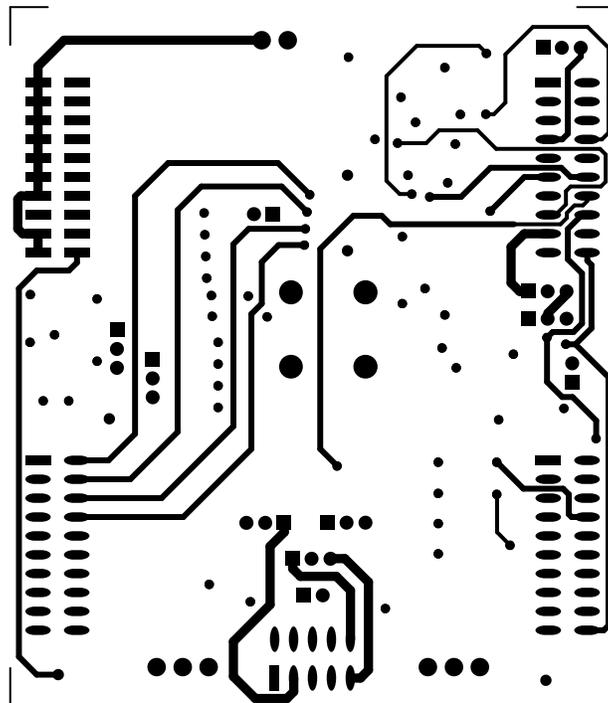


Figure 4. Internal Layer 1 (Split Ground Plane)



AMC7823 REV A LAYER 3 Internal Plane 2 (Split Power Plane)

Figure 5. Internal Layer 2 (Split Power Plane)



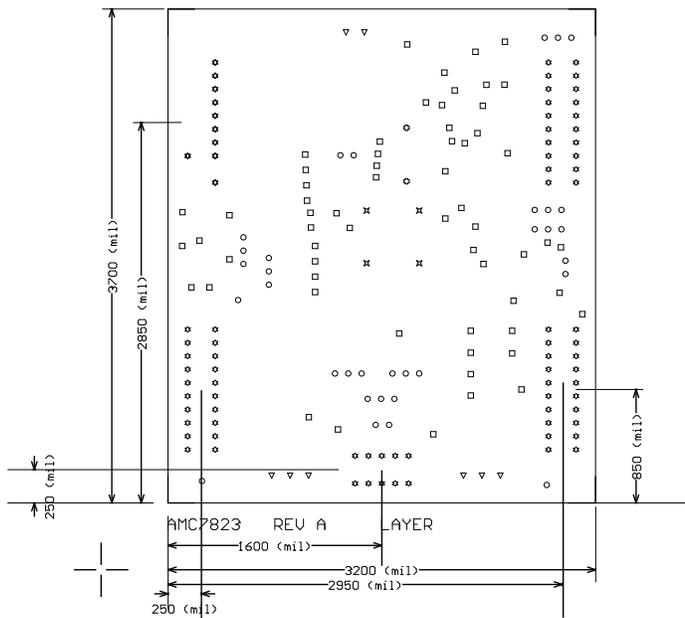
AMC7823 REV A LAYER 4 Bottom Signal

Figure 6. Bottom Layer (Signal Plane)

Texas Instruments, Inc. 12500 TI Boulevard, Dallas, TX 75243		
AMC7823		Drawn By J. PARGUIAN
		Chk'd By J. PARGUIAN
REV: A	SCALE: 1.00	DOCUMENT CONTROL # 6468331
Mechanical Layer 1 19-Aug-2005		

Notes:

1. PWB TO BE FABRICATED TO MEET OR EXCEED IPC-6012, CLASS 3 STANDARDS AND WORKMANSHIP SHALL CONFORM TO IPC-A-600, CLASS 3 - CURRENT REVISIONS
2. BOARD MATERIAL AND CONSTRUCTION TO BE UL APPROVED AND MARKED ON THE FINISHED BOARD.
3. LAMINATE MATERIAL: COPPER-CLAD FR-4
4. COPPER WEIGHT: 1oz FINISHED
5. FINISHED THICKNESS: .062 +/- .010
6. MIN PLATING THICKNESS IN THROUGH HOLES: .001"
7. SMOBC / HASL
8. LPI SOLDERMASK BOTH SIDES USING APPROPRIATE LAYER ARTWORK: COLOR = GREEN
9. LPI SILKSCREEN AS REQUIRED: COLOR - WHITE
10. VENDOR INFORMATION TO BE INCORPORATED ON BACK SIDE WHENEVER POSSIBLE
11. MINIMUM COPPER CONDUCTOR WIDTH IS: 10 MILS
MINIMUM CONDUCTOR SPACING IS: 6 MILS
12. NUMBER OF FINISHED LAYERS: 4



*	4	64.173mil	1.62999mm	PTH
▽	8	47.244mil	1.2mm	PTH
○	33	37mil	0.9398mm	PTH
○	2	32mil	0.8128mm	PTH
◻	61	28mil	0.7112mm	PTH
×	90	15mil	0.381mm	PTH
	198	Total		

Figure 8. Drill Drawing

2.2 Bill of Materials

Table 1. Parts List

Item	Qty.	Designators	Description	Manufacturer	Mfg. Part Number
1	8	C1, C3, C6, C8, C17, C18, C19, C21	0.1 μ F ⁽¹⁾	TDK	C1608X7R1E104KT
2	8	C9, C10, C11, C12, C13, C14, C15, C16	150 pF	TDK	C1608COG1H151J
3	2	C2, C20	0.47 μ F	TDK	C3216X7R1H474KT
4	3	C4, C5, C7	10 μ F	TDK	C3225X7R1E106KT
5	1	R1	10 k Ω	Panasonic	ERJ-8ENF1002V
6	3	R2, R11, R12	2.7 k Ω	BC Components	2312 396 72702
7	2	R20, R23	150 Ω	Panasonic	ERJ-8GEYJ151V
8	2	R7, R8	0 Ω ⁽¹⁾	Panasonic	ERJ-8GEY0R00V
9	1	R13	47 k Ω	Yageo America	RC1206FR-0747KL
10	1	R14	4.99 k Ω ⁽¹⁾	Panasonic	ERO-S2PHF4991
11	6	R3, R4, R5, R6, R9, R10	49.9 k Ω	Panasonic	ERJ-8ENF4992V
12	4	J1T, J2, J4, J5	20-PIN_IDC	Samtec	TSM-110-01-S-DV-M

⁽¹⁾ C1, C3, C6, C8, C19, J11, J12, R7, and R8 are not installed. R14 leads must be cut and bent to fit sockets from Samtec, P/N SS-101-T-1C.

Table 1. Parts List (continued)

Item	Qty.	Designators	Description	Manufacturer	Mfg. Part Number
13	1	J6	10-PIN_IDC	Samtec	TSM-105-01-T-DV
14	2	J11, J12	3-Pin terminal connector ⁽¹⁾	On-Shore Tech.	ED555/3DS
15	4	J1B, P2, P4, P5	20-PIN_IDC ⁽²⁾	Samtec	SSW-110-22-S-D-VS-P
16	1	P6	10-PIN Isolated power socket, 0.100 ⁽²⁾	Samtec	SSW-105-22-F-D-VS-K
17	3	TP1, TP2, TP4	Turret terminal pin	Mill-Max	2348-2-01-00-00-07-0
18	1	U1	QFN-40 (RTA), 12-bit analog monitoring and control circuit	Texas Instruments	AMC7823IRTA
19	2	U2, U3	Single buffer/driver	Texas Instruments	SN74LVC1G07DBVR
20	1	U4	64-Kbit EEPROM	Microchip Technology	24LC64-I/ST
21	1	REF1	1.25-V Reference	Texas Instruments	REF3112AIDBZT
22	1	REF2	2.5-V Reference	Texas Instruments	REF3125AIDBZT
23	1	J3	Terminal block 3,5 mm, 2-pos PCB	On-Shore Tech.	ED555/2DS
24	2	D1, D5	2.2-V, 45 mC LED, green	Lumex	SML-LX1206SUGC-TR
25	3	W5, W10, W11	2 Circuit header, 0.100 straight	Molex	22-03-2021
26	8	W1, W2, W3, W4, W6, W7, W8, W9	3 Circuit header, 0.100 straight	Molex	22-03-2031

⁽²⁾ P2, P4, and P6 parts are not shown in the schematic diagram. All P designated parts are installed in the bottom side of the PC board opposite the J designated counterpart. Example, J2 is installed on the topside while P2 is installed in the bottom side opposite of J2.

3 EVM Operation

This chapter presents in detail the operation of the EVM to provide guidance to the user in evaluating the onboard AMC and how to interface the EVM to a specific host processor.

Refer to the AMC7823 data sheet ([SLAS453](#)) for information about its serial interface and other related topics.

The EVM board is tested and configured to operate from the factory.

3.1 Factory Default Settings

The EVM board is set to its default configuration at the factory as described in [Table 2](#) to operate in unipolar mode. The jumper configuration is shown in [Figure 9](#) for clarity.

Table 2. Factory Default Jumper Settings

Reference	Jumper Position	Function
W1	Open	Internal reference voltage is used.
W2	2-3	Digital logic supply, IOV _{DD} , for the AMC7823 is +3.3 VD.
W3	1-2	Analog supply, AV _{DD} , for the AMC7823 is +5 VA.
W4	1-2	Digital core supply, DV _{DD} , for the AMC7823 is +5 VD.
W5	Closed	Signal ground for ADC analog input is tied to analog ground.
W6	1-2	\overline{CS} signal from J2 is routed through to drive the \overline{SS} signal pin of the AMC7823.
W7	2-3	The external 2.5-V reference is connected as the external reference voltage source through the W1 header.
W8	Open	Convert pin is floated and ADC internal trigger is used.
W9	Open	LRCLK or BCLK not used for convert signal.
W10	Closed	Address of EEPROM is set to 0x00.
W11	Closed	Analog ground and digital ground are tied together.

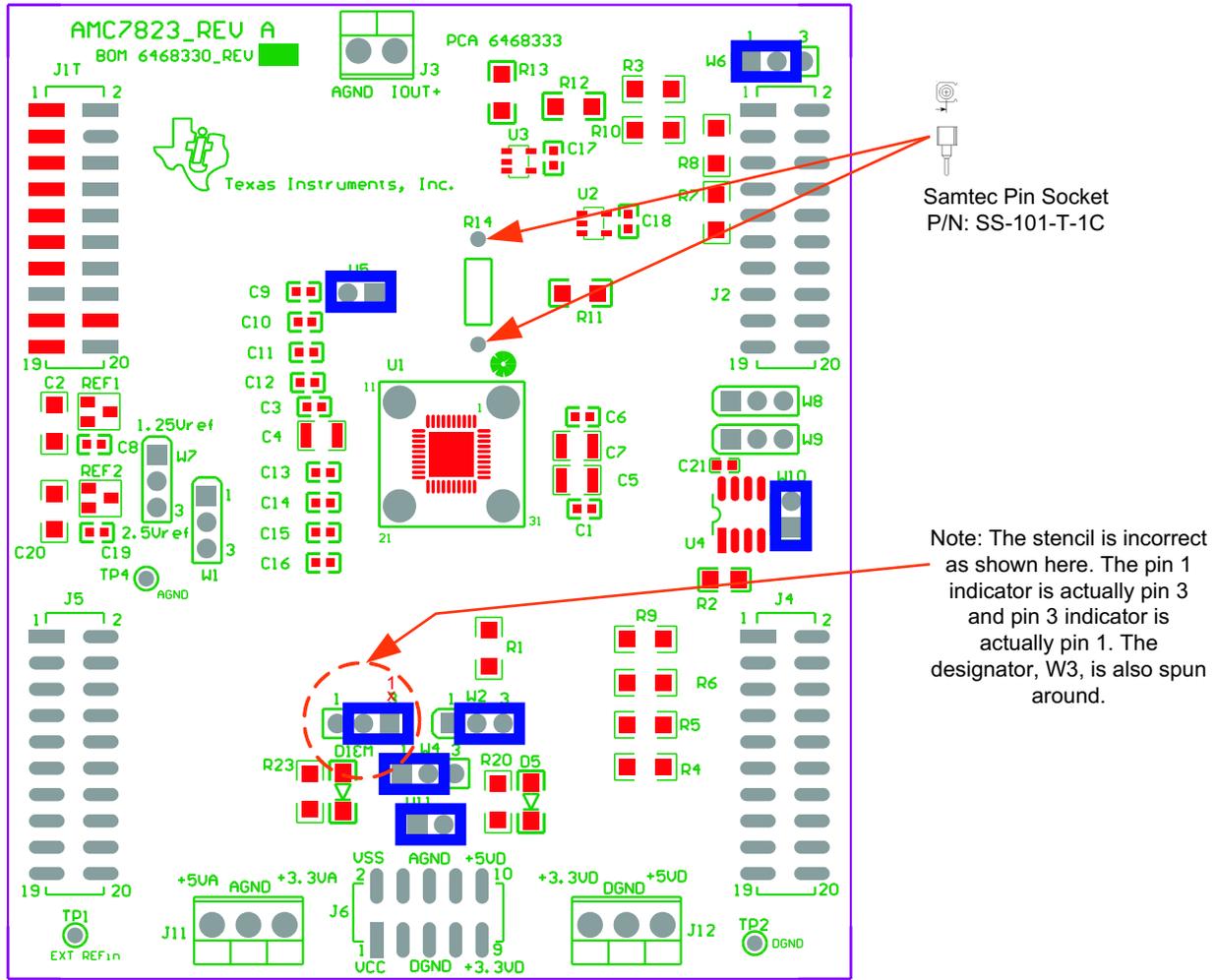


Figure 9. Factory Default Jumper Settings

3.2 Host Processor Interface

As noted in chapter 1 of this manual, the AMC7823 EVM is compatible with the 5-6k interface board ([SLAU104](#)) from Texas Instruments, as well as the HPA449 demonstration board from SoftBaugh, Inc. Using these boards alleviates the tedious task of building custom cables and allows easy configuration of a simple evaluation system.

If another system is used that is not directly compatible with this EVM, a custom cable can be made specific to the host interface platform. The EVM allows interfacing to the host processor through the J2 and J4 header connectors for serial control signals and serial data input. The pinout mapping is shown in [Figure 10](#).

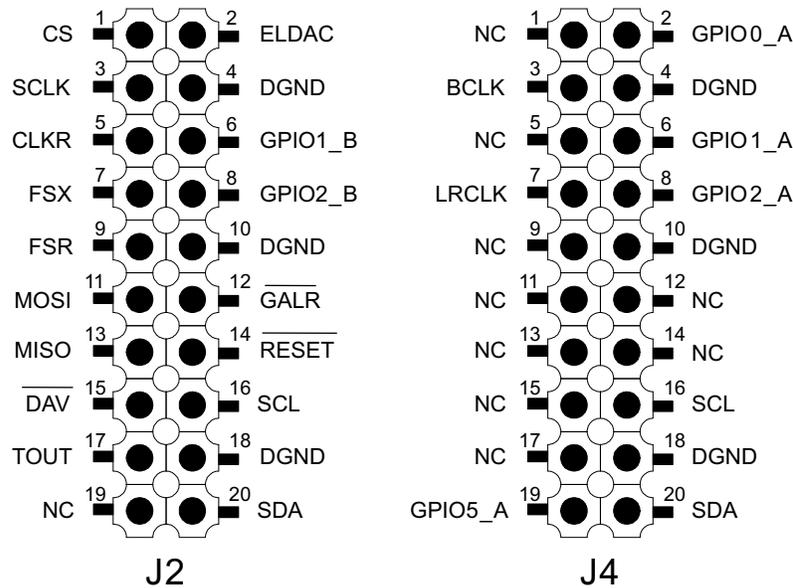


Figure 10. Digital Serial Interface Pinout

The analog signals can be applied directly to the J1T header connector, either single-ended or differentially. To apply a differential signal into the AMC7823, make sure to disconnect the jumper from W5 so that the AMC7823 can accommodate the signals correctly. For single-ended signal input, make sure that W5 is shorted so that the signal ground is connected back to the analog ground.

The DAC outputs can be monitored from the J5 header connector directly. See the schematic and printed circuit board silkscreen for details.

3.3 Serial EEPROM

This EVM includes a 64-kbit I²C serial EEPROM, U4, to store firmware data. It is intended particularly for future use with PC graphical user interface applications using a USB–MODEVM interface board or other similar board.

The serial EEPROM is not used by the EVM itself, so it is not discussed further in this user's guide.

3.4 Jumper Settings

Table 3 lists the function of each specific EVM jumper setting.

Table 3. Jumper Settings and Functions

Reference	Jumper Setting	Function
W1		External reference input voltage via TP1 is selected to set the range of the ADC and the DAC.
		Internal reference voltage is used to set the range of the ADC and the DAC.
		External reference input voltage via REF1 or REF2, as selected by W7, is routed to the reference input pin of the AMC7823 to set the range of the ADC and the DAC.

Table 3. Jumper Settings and Functions (continued)

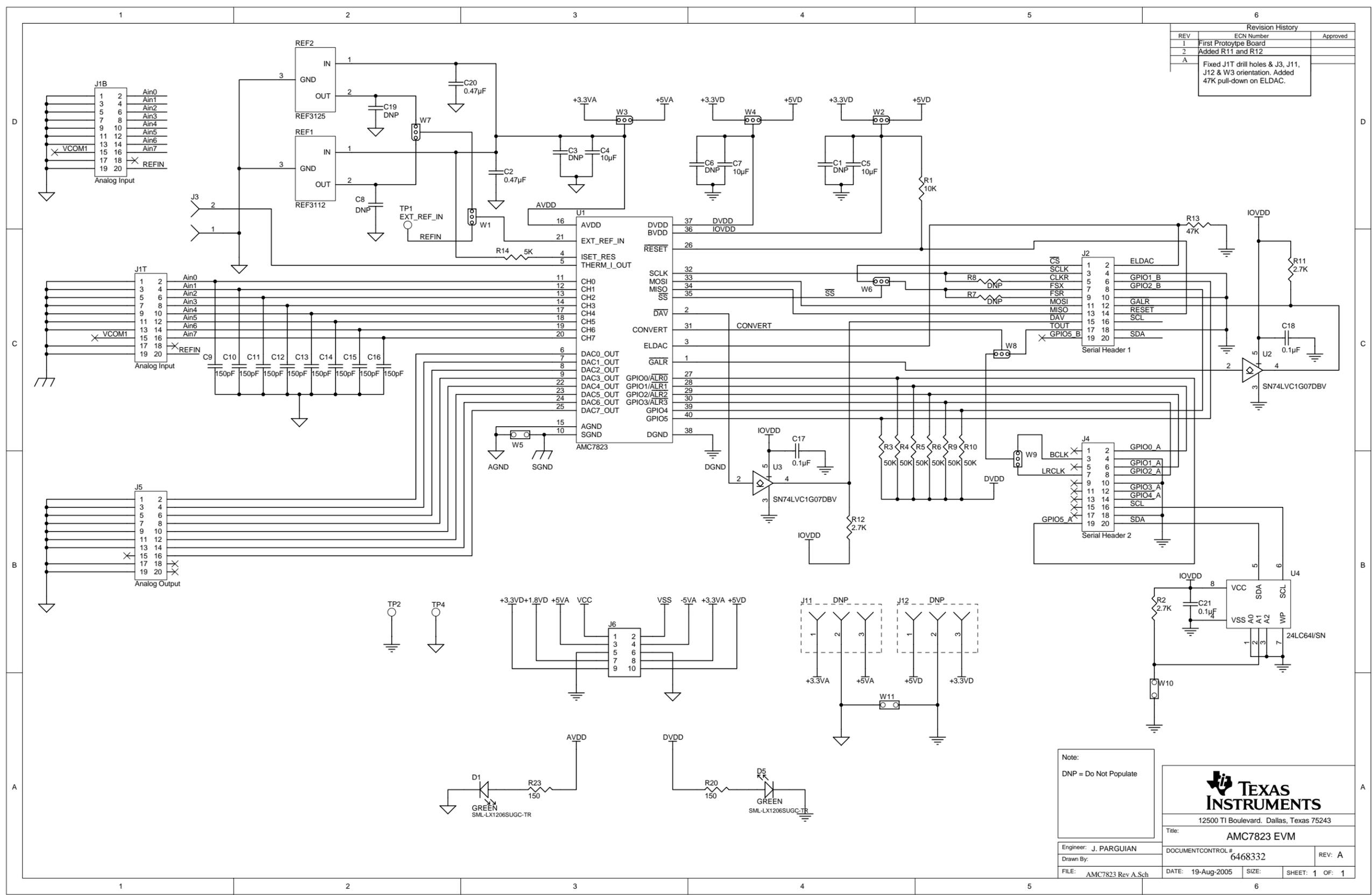
Reference	Jumper Setting	Function
W2		+5-V analog supply is selected for DUT IOV _{DD} .
		+3.3-V analog supply is selected for DUT IOV _{DD} .
W3		+5-V analog supply is selected for DUT AV _{DD} .
		+3.3-V analog supply is selected for DUT AV _{DD} .
W4		+5-V digital supply is selected for DUT DV _{DD} .
		+3.3-V digital supply is selected for DUT DV _{DD} .
W5		Signal ground is not connected to analog ground. Use this for differential input signal application.
		Signal ground is connected to analog ground. Use this for single-ended input signal application.
W6		\overline{CS} signal from J2-1 is routed through to control the SS function of the AMC7823. Normally used for μ C operation.
		FSX signal from J2-7 is routed through to control the SS function of the AMC7823. Normally used for DSP operation.
W7		External reference input voltage via REF1 is routed to W1 pin 3.
		External reference input voltage via REF2 is routed to W1 pin 3.
W8		TOUT signal is used to generate the external trigger for ADC conversion.
		Internal trigger for conversion is used.
		BCLK or LRCLK signal, as selected by W9, is used to generate the external trigger for ADC conversion.
W9		BCLK signal from J4-3 is routed through to generate the external trigger for ADC conversion. Normally used for μ C operation.
		LRCLK signal from J4-7 is routed through to generate the external trigger for ADC conversion. Normally used for μ C operation.

Table 3. Jumper Settings and Functions (continued)

Reference	Jumper Setting	Function
W10		The EEPROM, U4, address is set to 010b. This is only used with a PC graphical user interface application program. See section 3.3.
		The EEPROM, U4, address is set to 000b. This is only used with a PC graphical user interface application program. See section 3.3.
W11		Digital ground is not connected to analog ground.
		Digital ground is connected to analog ground.
Legend:  indicates the corresponding pins that are shorted or closed.		

3.5 Schematic

Revision History		
REV	ECN Number	Approved
1	First Prototype Board	
2	Added R11 and R12	
A	Fixed J1T drill holes & J3, J11, J12 & W3 orientation. Added 47K pull-down on ELDAC.	



Note:
DNP = Do Not Populate

TEXAS INSTRUMENTS
 12500 TI Boulevard, Dallas, Texas 75243
 Title: **AMC7823 EVM**
 DOCUMENT CONTROL # **6468332** REV: **A**
 Engineer: **J. PARGUIAN**
 Drawn By:
 FILE: **AMC7823 Rev A.Sch** DATE: **19-Aug-2005** SIZE: SHEET: **1** OF: **1**

4 Related Documentation From Texas Instruments

To obtain a copy of any of the following TI documents, call the Texas Instruments Literature Response Center at (800) 477-8924 or the Product Information Center (PIC) at (972) 644-5580. When ordering, identify this manual by its title and literature number. Updated documents can also be obtained through our website at www.ti.com.

Data Sheets:	Literature Number:
AMC7823	SLAS453
REF3125	SBVS046
REF3112	SBVS046
SN74LVC1G07	SCES296

4.1 *Questions about this or other Data Converter EVMs?*

If you have questions about this or other Texas Instruments Data Converter evaluation modules, feel free to e-mail the Data Converter Application Team at dataconvapps@list.ti.com. Include in the subject heading the product you have questions or concerns with.

FCC Warnings

This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

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Should this EVM not meet the specifications indicated in the EVM User's Guide, it may be returned within 30 days from the date of delivery for a full refund of any amount paid by user for the EVM, which user agrees shall be user's sole and exclusive remedy. **THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY TI TO USER, AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE OR NON-INFRINGEMENT.**

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TI assumes **no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.**

User agrees to read the EVM User's Guide and, specifically, the EVM warnings and Restrictions notice in the EVM User's Guide prior to handling the EVM and the product. This notice contains important safety information about temperatures and voltages.

It is user's responsibility to ensure that persons handling the EVM and the product have electronics training and observe good laboratory practice standards.

By providing user with this EVM, product and services, TI is NOT granting user any license in any patent or other intellectual property right.

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 0 V to 5 V and the output voltage range of 0 V to 5 V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

EVM WARNINGS AND RESTRICTIONS (continued)

During normal operation, some circuit components may have case temperatures greater than 30°C. The EVM is designed to operate properly with certain components above 85°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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