AM437x IDK Evaluation Hardware

This document describes the hardware architecture of the AM437x industrial development kit (IDK), part number TMDSIDK437x, which is based on the AM437x processor from TI.

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Trademarks

Code Composer Studio is a trademark of Texas Instruments.

1 Introduction

The AM437x IDK is a standalone test, development, and evaluation module (EVM) system that lets developers write software and develop hardware for industrial communication-type applications. The EVM is equipped with a AM437x processor, from TI, and a defined set of features, to allow the user to experience industrial communication solutions using serial or Ethernet-based interfaces. Using standard interfaces, the IDK can interface to other processors or systems, and act as a communication gateway in this case. In addition the IDK can directly operate as a standard remote I/O system or simple sensor connected to an industrial communication network. The embedded emulation logic allows for emulation and debugging using standard development tools such as Code Composer Studio™, from TI, by using the supplied USB cable.

The following sections give more details regarding the EVM.

1.1 System View

The system view of the AM437x industrial EVM consists of the main board and camera board. Figure 1 shows the top and bottom views of the Industrial EVM.

Figure 1. AM437x Industrial EVM

1.2 Schematics, Design, and Errata Files

Hardware Documentation – Schematics, design files, and other related hardware documentation.

2   Functional Block Description

The complete AM437x industrial EVM is mostly contained within a single board. Figure 2 shows the functional block diagram of the AM437x industrial EVM.
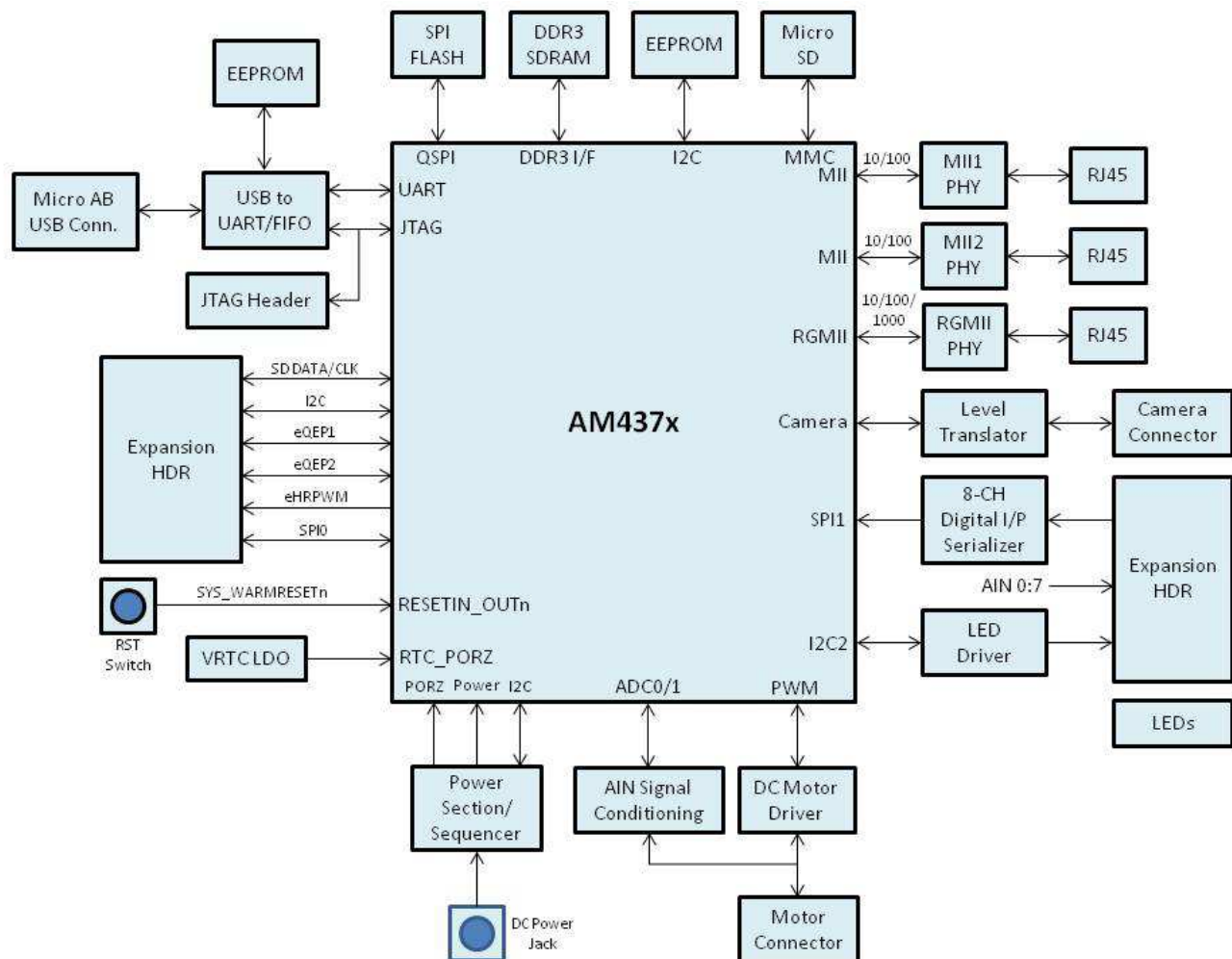

Figure 2. AM437x Industrial EVM Block Diagram

2.1   Processor

The AM437x processor is the central processor for this EVM. All the resources on the board surround the AM437x processor to provide development capabilities for hardware and software. See the AM437x data sheet and TRM for details about the processor. There are system configuration signals (SYSBOOT0 to SYSBOOT18), that can be set on the EVM using resistors to define some startup parameters on the AM437x processor. See Section 2.5 for more details.

2.2   Clocks

The main clock for the processor is derived from a 24-MHz crystal. An onboard oscillator in the AM437x generates the base clock and subsequent module clocks as needed within the AM437x processor. A 32-kHz clock for the RTC on the AM437x is derived from a 32.768-kHz crystal on the board.

2.3 Reset Signals

SYS_RESETn is a reset signal running to several peripherals and the AM437x which performs a reset on those peripherals. SYS_WARMRESETn is asserted by the push button and used to force a reset of the AM437x and the other peripherals. The AM437x can also pulldown on the RESET_INOUTn signal to cause the SYS_RESETn line to go active. The power on reset to the processor is driven from the power good signal of the power manager.

2.4 Power Supplies

This section describes how the power supplies required for the design are generated.

2.4.1 Power Source

The AM437x Industrial EVM uses an external 24-V power supply. The 24-V power input is converted into different voltage levels using buck converters, to provide power input to the AM437x and other peripherals. The power requirements of the processor are handled by the Quad Power Supervisor IC TPS386000. The power on LED, D2, is on if the 3.3-V power is available. The power sequencing requirements of the AM437X processor (see the AM437x data sheet) are handled automatically by the TPS386000 Power Supervisor chip.

2.4.2 Power Management

The AM437x Industrial EVM uses the buck converters and power supervisor IC for power management. The I2C0 on the AM437x is used to control the TPS62362 buck converter. For the AM437x Industrial EVM, Table 1 lists the buck regulators that are used.

Table 1. AM437x Power Supplies From Buck Regulators

Buck Regulator	AM437x Power Rail	Voltage
TPS5402D (1700 mA)	VDDSHV1, 2, 3, 5, 6, 7, 8, 9, 10, 11, VDDA_3P3V_USB0 and VDDA_3P3V_USB1 (xxxx mA)	3.3 V (rails that are 3.3 V)
TPS5402D (1700 mA)	VDDA_TS_ADC, VDDA_MC_ADC, VDDS_RTC, VDDS_TPM, VDDS_CTM, VDDS_CLKOUT, VDDS_OSC, VDDS_SRAM_CORE_BG, VDDS_SRAM_MPU_BB, VDDS_PLL_CORE_LCD, VDDS_PLL_DDR, VDDS_PLL_MPU, VDDA1P8V_USB0, VDDA1P8V_USB1 (xxxx mA)	1.8 V (rails that are 1.8 V)
TPS5402D (1700 mA)	VDD_DDR and Camera (xxxx mA)	1.5 V
TPS5402D (1700 mA)	VDD_CORE, VDD_TPM (xxxx mA)	1.1 V
TPS62362 (3000 mA)	VDD_MPU (xxxx mA)	1.2 V

2.4.3 Other Power Supplies

Table 2 lists the other power supplies.

Table 2. Other Power Supplies

Regulator	Power Rail	Voltage
TPS5402D (1700 mA)	VCCB for eQEP (xxxx mA)	5.0 V
LM4132	V1_8DADC	1.8 V

2.5   Configuration and Setup

2.5.1   Boot Configuration

Various boot configurations can be set using the pullup and pulldown resistor combinations provided on the SYSBOOT pins (LCD_D0:15, LCD_VSYNC, LCD_HSYNC, and LCD_EN). Boot configuration pins are latched upon deassertion of the PORz pin. The default settings for the AM437x IDK EVM 1.3A are 000_0100_0000_0001_1000b. This corresponds to a boot sequence of the following:

1. MMC0
2. USB_MS (USB1)
3. USB_CL (USB0)
4. QSPI

See the GP EVM schematic for more details. See the AM437x TRM and data sheet for the definitions of each of the sysboot signals.

2.5.2   I^{2}C Address Assignments

In the AM437X Industrial EVM, each separate board has an I^{2}C ID memory that contains the details of the identity of that board such as its configuration. Table 3 provides information on the I^{2}C address assignments.

Table 3. AM437X Industrial EVM I^{2}C Bus Addresses

AM437x Industrial EVM Function	AM437x I2C Port	Address
Baseboard ID memory	I2C0	0x50
TPS62362 (buck regulator)	I2C0	0x60
Clock synthesizer	I2C0	0x65
LED driver	I2C2	0x60

2.5.3   I^{2}C ID Memory

The Industrial EVM has a dedicated I^{2}C EEPROM which contains specific identity and configuration information for that board. In addition, there is available space in each memory for user-specific configuration information. The part number of the memory device is CAT24C256WI-G.

Table 4. AM437x Industrial EVM EEPROM Data

Name	Size (bytes)	Contents
Header	4	MSB 0xEE3355AA LSB
Board Name	8	Name for the board in ASCII "A33515BB" = AM437x Industrial EVM
Version	4	Hardware version code for the board in ASCII "1.2A" = rev. 01.2A
Serial Number	12	Serial number of the board. This is a 12 character string, WWYY4P16nnnn, where: • WW = 2 digit week of the year of production • YY = 2 digit year of production • nnnn = incrementing board number
Configuration	32	Codes to show the configuration setup on this board. For the available EVMs supported, the following codes are used: • ASCII "SKU#01" = base board for gen purpose EVM • ASCII "SKU#02" = base board for industrial motor control EVM Remaining 26 bytes are reserved
Ethernet MAC Address 0	6	MAC Address for AM437x Ethernet MAC 1
Ethernet MAC Address 1	6	MAC Address for AM437x Ethernet MAC 2 or PRU 0
Ethernet MAC Address 2	6	MAC Address for AM437x PRU 1 (if used)
Available	32702	Available space for other nonvolatile codes and data

2.6 JTAG

The AM437x Industrial EVM supports embedded, XDS100V2 USB Emulation through the MicroUSB AB connector. The EVM also has an optional 20-pin, CJTAG connector, from TI, to support the Emulation. This CJTAG connector is not installed by default.

2.7 Memories Supported

The Industrial EVM supports onboard memories like the DDR3 SDRAM and SPI NOR Flash. The EVM also supports a microSD card socket.

2.7.1 DDR3L SDRAM

The Industrial EVM design supports up to 8Gbit (2 × 256M × 16) of DDR3L SDRAM memory. The part number for the DDR3L SDRAM memory used is MT41K256M16HA-125 AIT:E. The package used is a 96-ball TFBGA package. See the AM437x TRM for memory locations of this memory.

2.7.2 SPI NOR Flash

The Industrial EVM supports a 512-Kbit (128K × 4) SPI flash memory from Macronix (MX66L51235FMI-10G) in a 16SOIC package. The SPI port of the AM437X device is used to interface with the flash.

2.7.3 Board Identity Memory

Each board contains a 256KB serial EEPROM which contains board specific data that allows the processor to automatically detect which board is connected and the version of that board. Other hardware-specific data can be stored on this memory device as well. The part number of the memory device is CAT24C256WI-G. See Section 2.5 for details on the data in this memory.

2.7.4 SD/MMC0

The SD/MMC connector on the Industrial EVM is a microSD connector, part number SCHA5B0200. This is a standard SD/MMC Card type of connector. It is connected to the MMC0 port of the AM437x processor. Check the AM437x data sheet and TRM for supported card types/densities.

2.8 10/100 Ethernet PRU Controlled Ports

The Industrial EVM has two 10/100 Ethernet transceivers (TLK105L) interfaced to connectors J6 and J9. These Ethernet transceivers are connected to the PRU0 and PRU1 units within the AM437x device. The reset for the transceivers is driven by the board system reset, SYS_RESETn. A 25-MHz clock drives the clock signal for the TLK105L.

> **NOTE:** The RJ-45 connectors used on the board have integrated magnetics that are configured in a NIC configuration which does not support AutoMDIX. When designing a custom board based on this schematic, be sure to verify whether an AutoMDIX, type RJ-45 connector, is required for your design.

2.9 Gigabit Ethernet Port

The Industrial EVM has a one Gb (10/100/1000) Ethernet transceiver (KSZ9031RN) interfaced to connector J4. This gigabit ethernet transceiver is connected to the RGMII 1 unit within the AM437x device. The reset for the transceiver is driven by the board system reset SYS_RESETn. A 25-MHz clock drives the clock signal for the KSZ9031RN.

> **NOTE:** The RJ-45 connectors used on the board have integrated magnetics that are configured in a NIC configuration which does not support AutoMDIX. When designing a custom board based on this schematic, be sure to verify whether an AutoMDIX, type RJ-45, connector is required for your design.

2.10 USB

The Micro USB-AB connector port is connected to the upstream port of the USB and to the UART converter IC (FT2232HL). This is used for USB-to-JTAG and USB-to-UART conversion applications. This USB port can also be used for XDS100V2 emulation. The ESD device, TPD2E001, is used on the USB signals before they are connected to the AM437X pins.

2.11 ADC

The industrial EVM uses two ADCs. The input to the ADCs is by default connected to the motor sensing circuit. These ADC inputs are terminated to the I/O expansion header and Magnetic swipe assembly for user accessibility.

2.12 Camera

The camera Interface from the AM437x processor is terminated on the 12 × 2 header, J5. The camera interface is supported using the J5 (AXK7L24223G) connector provided. The custom made Camera Module, from TI, shall be interfaced with this header.

3   User Interfaces

3.1   LEDs

Two RGY LEDs, U1 and U2, are used in the EVM and it is driven by the LCD signals mentioned in Table 5.

Table 5. LEDs

Signal Name	LED Color
AM437X_LCD_PCLK	U1 – Red
AM437X_LCD_AC_BIAS_EN	U1 – Green
AM437X_LCD_VSYNC	U1 – Yellow
AM437X_LCD_HSYNC	U2 – Red
AM437X_CAM1_WEN	U2 – Green
AM437X_CAM1_DATA2	U2 – Yellow

3.2   Industrial Inputs

For industrial 24-V digital inputs, a SN65HVS882 serializer is used to accept standard signals (from the I/O Expander header) in and allow the AM437x device to read them. The serialized output from the serializer is fed to the SPI1 port of the processor.

3.3   Industrial Output LEDs

An I2C-to-8-bit LED driver, TPIC2810, is used to drive the eight industrial output LEDs D3 to D10. The I2C interface is connected to the I2C2 port of the AM437x processor. The eight LED driver outputs are also driven to the I/O Expansion header. All the LEDs are green in color.

3.4   DC Motor Drive

Three phase brushless DC motor driver DRV8313 is used to drive the DC motor. The motor driver is controlled by AM437x through PWM interface. The power to the motor is derived from the internal 24VDC or through external power using separate power connector J14. Connector J17 is used for motor connection.

4 Pin Use Description

4.1 Functional Interface Mapping

Some signals of the AM437x device are connected to a fixed device on the EVM that cannot be changed. Some of the signals of the AM437x device, however, are connected to devices on the EVM based on the profile setting. See the additional columns in the pinmux document, because there are preset profiles which define what peripherals are connected and able to be used at a given time on the hardware boards.

Pin Use Assignment – Assignment list of pin functions.

4.2 GPIO Definitions

See the updated pinmux documents, which list use-case columns for the GPIOs. Developers can select and enable pins, based on the selective peripheral pins, as output or input.

5 Board Connectors

These sections list the board connectors.

5.1 Host Expansion Header – J16

Table 6 lists the Host Expansion header, J16, pin descriptions.

Table 6. AM437x EXP0 Host Connector – J16

Pin No.	Signal	Description
1	V3_3D	3.3-V power
2	V5_0D	5.0-V power
3	SD_CLKOUT	SD clock out
4	AM437X_eHRPWM0B	PWM 0B signal
5	SD_CLKIN	SD clock in
6	AM437X_eHRPWM0_SYNCI	PWM sync input
7	SD_DATA_IN0	SD data input 0
8	AM437X_eHRPWM012_TRPZONE	PWM trip zone
9	SD_DATA_IN1	SD data input 1
10	AM437X_eHRPWM0_SYNCO	PWM sync output
11	SD_DATA_IN2	SD data input 2
12	AM437X_eHRPWM1B	PWM 1B signal
13	SD_DATA_IN3	SD data input 3
14	AM437X_eHRPWM2A	PWM 2A signal
15	SD_DATA_IN4	SD data input 4
16	AM437X_eHRPWM2B	PWM 2B signal
17	SD_DATA_IN5	SD data input 5
18	PR1_EDC_SYNC0_OUT	EDC sync 0 out
19	SD_DATA_IN6	SD data input 6
20	PR1_EDC_SYNC1_OUT	EDC sync 1 out
21	SD_DATA_IN7	SD data input 7
22	GND	Ground
23	SD_DATA_IN8	SD data input 8
24	eHRPWM0A	PWM 0A signal
25	SYS_RESETn	System reset
26	SPI0_DIN	SPI0 data input
27	AM437X_I2C_SCL	I2C clock
28	SPI0_DOUT	SPI0 data output

Table 6. AM437x EXP0 Host Connector – J16 (continued)

Pin No.	Signal	Description
29	AM437X_I2C_SDA	I2C data
30	SPI0_CS0n	SPI0 chip select
31	AM437X_PRU0_ENDAT0_CLK	PRU0 Data0 clock
32	PRU0_ENDAT1_CLK	PRU0 Data1 clock
33	AM437X_PRU0_ENDAT0_OUT	PRU0 Data0 out
34	PRU0_ENDAT1_OUT	PRU0 Data1 out
35	AM437X_PRU0_ENDAT0_OUTEN	PRU0 Data0 out enable
36	PRU0_ENDAT1_OUTEN	PRU0 Data1 out enable
37	AM437X_PRU0_ENDAT0_IN	PRU0 Data0 in
38	PRU0_ENDAT1_IN	PRU0 Data1 in
39	GND	Ground
40	GND	Ground
41	AM437X_CAM0_DATA6	Cam0 Data6
42	eQEP2_STROBE	eQEP2 strobe
43	MTR_FAULT	MTR fault
44	eQEP2_INDEX	eQEP2 index
45	AM437X_PROFI_TXD	Profibus transmit
46	eQEP2A_IN	eQEP2A in
47	AM437X_PROFI_RXD	Profibus receive
48	eQEP2B_IN	eQEP2B in
49	PROF_TXENABLE	Profibus transmit enable
50	HDQ	HDQ
51	eQEP1_STROBE	eQEP1 strobe
52	eQEP0_STROBE	eQEP0 strobe
53	eQEP1_INDEX	eQEP1 index
54	eQEP0_INDEX	eQEP0 index
55	eQEP1B_IN	eQEP1B in
56	PRU0_ENDAT2_OUTEN	PRU0 Data2 out enable
57	eQEP1A_IN	eQEP1A in
58	PRU0_ENDAT2_IN	PRU0 Data2 in
59	GND	Ground
60	GND	Ground

5.2 I/O Expansion Header – J1

Table 7 lists the I/O Expansion header, J1, pin descriptions.

Table 7. AM437x EXP1 I/O Connector – J1

Pin No.	Signal	Description
1	INDUS INPUT0	Digital input 0
2	V24_0D	24-V power
3	INDUS INPUT1	Digital input 1
4	V24_0D	24-V power
5	INDUS INPUT2	Digital input 2
6	V24_0D	24-V power
7	INDUS INPUT3	Digital input 3
8	V24_0D	24-V power

Table 7. AM437x EXP1 I/O Connector – J1 (continued)

Pin No.	Signal	Description
9	INDUS INPUT4	Digital input 4
10	V24_0D	24-V power
11	INDUS INPUT5	Digital input 5
12	V24_0D	24-V power
13	INDUS INPUT6	Digital input 6
14	V24_0D	24-V power
15	INDUS INPUT7	Digital input 7
16	V24_0D	24-V power
17	DGND	Ground
18	NC	Not connected
19	DRAIN0	Digital output 0
20	DRAIN1	Digital output 1
21	DRAIN2	Digital output 2
22	DRAIN3	Digital output 3
23	DRAIN4	Digital output 4
24	DRAIN5	Digital output 5
25	DRAIN6	Digital output 6
26	DRAIN7	Digital output 7
27	V5_0D	5-V power
28	V5_0D	5-V power
29	DGND	Ground
30	DGND	Ground
31	AM437X_AIN0	Analog input 0
32	AM437X_AIN4	Analog input 4
33	AM437X_AIN1	Analog input 1
34	AM437X_AIN5	Analog input 5
35	AM437X_AIN2	Analog input 2
36	AM437X_AIN6	Analog input 6
37	AM437X_AIN3	Analog input 3
38	AM437X_AIN7	Analog input 7
39	GNDA_ADC	Analog ground
40	GNDA_ADC	Analog ground

5.3   SDMMC0 – J19

Table 8 lists the SDMMC0, J19, pin descriptions.

Table 8. Micro SD Connector Pin Details

Pin No.	Memory Card PIN No.
uSD#1	DAT2
uSD#2	CD/DAT3
uSD #3	CMD
uSD #4	VDD
uSD #5	CLK
uSD #6	VSS
uSD #7	DAT0
uSD #8	DAT1

Table 8. Micro SD Connector Pin Details (continued)

Pin No.	Memory Card PIN No.
uSD #9	GND
uSD #10	CD
uSD #11	GND_SD
uSD #12	GND_SD
uSD #13	GND_SD
uSD #14	GND_SD
uSD #15	GND_SD
uSD #16	GND_SD

5.4 10/100 Ethernet PRU Controlled Ports, J6 and J9

Table 9 lists the 10/100 Ethernet PRU controlled ports, J6 and J9, pin descriptions.

Table 9. 10/100 PRU Ethernet1 Pin Details

Pin No.	Signal Name	Description
1	PRUETHER0_RDP	Ethernet data RX positive
2	PRUETHER0_RDN	Ethernet data RX negative
3	V3_3D_PRUETH0JCK	Power
4	V3_3D_PRUETH0JCK	Power
5	PRUETHER0_TDP	Ethernet data TX positive
6	PRUETHER0_TDN	Ethernet data TX negative
7	NC	Not connected
8	GND	Ground
9	V3_3D	Active LED power
10	ACTLED	Active LED signal
11	V3_3D	Link LED power
12	LINKLED	Link LED signal

5.5 Gigabit Ethernet Port – J4

Table 10 lists the Gigabit Ethernet port, J4, pin descriptions.

Table 10. 10/100/1000 Gb Ethernet Pin Details

Pin No.	Signal Name	Description
1	GND	Ground
2	NC	Not connected
3	ETHER1_D3P	Ethernet Data3 positive
4	ETHER1_D3N	Ethernet Data3 negative
5	ETHER1_D2P	Ethernet Data2 positive
6	ETHER1_D2N	Ethernet Data2 negative
7	ETHER1_D1P	Ethernet Data1 positive
8	ETHER1_D1N	Ethernet Data1 negative
9	ETHER1_D0P	Ethernet Data0 positive
10	ETHER1_D0N	Ethernet Data1 negative
11	ACTLED	ACT LED signal
12	GND	Ground
13	GND	Ground

Table 10. 10/100/1000 Gb Ethernet Pin Details (continued)

Pin No.	Signal Name	Description
14	LINKLED	Link LED signal

5.6 USB Connector – J18

Table 11 lists the USB Connector, J18, pin descriptions.

Table 11. USB Micro AB Connector

Pin No.	Signal Name	Description
1	USB_DC	USB bus voltage
2	USB_DM	USB data minus
3	USB_DP	USB data plus
4	USB_ID	USB identification
5	DGND	Ground

5.7 ADC1 Input Connector – J2

Table 12 lists the ADC1 Input Connector, J2, pin descriptions.

Table 12. AM437x Analog Input Connector

Pin No.	Signal	Description
1	AIN6	Analog input 6
2	AIN7	Analog input 7
3	AGND	Analog ground

5.8 Camera Connector – J5

Table 13 lists the Camera Connector, J5, pin descriptions.

Table 13. AM437x Camera Connector

Pin No.	Signal	Description
1	AGND	Analog ground
2	SENSOR_SIO_D	Sensor serial IO D
3	V2_8A	Power supply, 2.8 V
4	SENSOR_SIO_C	Sensor serial IO C
5	DGND	Digital ground
6	SENSOR_VSYNC	Sensor vertical sync
7	DGND	Digital ground
8	SENSOR_HREF	Sensor HREF
9	V1_5D	Power supply, 1.5 V
10	SENSOR_XCLK	Sensor X clock
11	SENSOR_PWRDN	Sensor power down
12	V2_8D	Power supply, 2.8 V
13	SENSOR_PCLK	Sensor P clock
14	NC	Not connected
15	SENSOR_RESET	Sensor reset
16	NC	Not connected
17	SENSOR_Y9	Sensor DATA9

Table 13. AM437x Camera Connector (continued)

Pin No.	Signal	Description
18	SENSOR_Y8	Sensor DATA8
19	SENSOR_Y7	Sensor DATA7
20	SENSOR_Y6	Sensor DATA6
21	SENSOR_Y5	Sensor DATA5
22	SENSOR_Y4	Sensor DATA4
23	SENSOR_Y3	Sensor DATA3
24	SENSOR_Y2	Sensor DATA2

5.9   eQEP Interface Connector – J15

The eQEP0 signals are level translated and terminated in a 6-pin header, J15, for external interface. Table 14 lists the connector pin details.

Table 14. AM437x eQEP Interface Connector

Pin No.	Signal	Description
1	V5_0D	Power supply, 5 V
2	EQEP0A_IN	EQEP0A input
3	EQEP0B_IN	EQEP0B input
4	EQEP0_INDEX	EQEP0 index
5	EQEP0_STROBE	EQEP0 strobe
6	DGND	Digital ground

5.10   EN DAT Interface Connector – J10

The EN DAT signals are converted as RS485 signals and terminated in a 8-pin, female socket, J10 43K1A231. Table 15 lists the connector pin details.

Table 15. AM437x EN DAT Interface Connector

Pin No.	Signal	Description
1	MTRA_GND	Ground
2	VENDAT	Supply voltage
3	RS485_2_A	Differential data signal
4	RS485_2_B	Differential data signal
5	MTRA_GND	Ground
6	RS485_1_A	Differential clock signal
7	RS485_1_B	Differential clock signal
8	VENDAT	Supply voltage

6 PCB Guideline Deviations

Table 16 lists the PCB guidelines deviation, with respect to the data sheet.

Table 16. PCB Guidelines Deviations

Serial.No.	PCB Design Guidelines	Data Sheet Reference	Deviation	Reason For Deviation
1	Full VDDS_DDR power reference layers under the DDR3 routing region	Table 5-35	Signals other than DDR in layer 4 are also referenced with the VDDS_DDR power plane.	Due to space constraints
2	Placement X2 (DDR device 1 to DDR device 2 distance) – 600 mils (maximum)	Table 5-36	740 mils	To enable ease of routing
3	VDDS_DDR bulk bypass capacitor, 2-count devices (minimum)	Table 5-37	Only one bulk capacitor used	Due to space constraints
4	VDDS_DDR bulk bypass total capacitance 20 μF (minimum)	Table 5-37	Two, 10 µF capacitors required, but only one 10 µF capacitor used	Due to space constraints
5	DDR3 bulk bypass capacitor, 2-count devices (minimum)	Table 5-37	One device (22 µF) capacitor used	Due to space constraints
6	DDR3 bulk bypass total capacitance 20 μF (minimum)	Table 5-37	One, 22 µF capacitor used	Due to space constraints
7	VDDS_DDR HS bypass capacitor, 20-count devices (minimum)	Table 5-38	Six bypass capacitors used	Due to space constraints
8	VDDS_DDR HS bypass capacitor total capacitance 1 μF (minimum)	Table 5-38	Six, 0.01 µF capacitors used	Due to space constraints
9	DDR device 1 to DDR device 2: DDR3 device HS bypass capacitor total capacitance – 0.85 μF (minimum)	Table 5-38	14, 0.01 µF capacitors used	Due to space constraints
10	CK and ADDR_CTRL nominal trace length – 100 mils (maximum)	Table 5-41	More than 200 mils difference	Due to space and routing constraints
11	Split plane crossing	5.6.2.1.3.3	Found across the board	Due to space and routing constraints

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2 *Limited Warranty and Related Remedies/Disclaimers*:

    2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

    2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

    2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

3 *Regulatory Notices:*

    3.1 *United States*

        3.1.1 *Notice applicable to EVMs not FCC-Approved:*

    FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

        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 isotrope 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 日本国内に
  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.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けて
いないものがあります。 技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの
措置を取っていただく必要がありますのでご注意ください。
1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用
いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。
上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・イ
ンスツルメンツ株式会社
東京都新宿区西新宿６丁目２４番１号
西新宿三井ビル

   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

       電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

  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 low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

  4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

  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:*

   4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user 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. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

   4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

  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.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*

   6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

   6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

   8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMNITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.