DS80PCI102EVK User's Guide

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1. Introduction

The DS80PCI102EVK – SMA evaluation kit provides a complete high band-width platform to evaluate the signal integrity and signal conditioning features of the Texas Instruments signal conditioning products – with Equalization and De-emphasis.

SMA edge launch connectors are used as the input and the output connections for this evaluation board. Commercially available adaptor boards can be purchased to facilitate connection to cables or backplane interconnects.

Table 1: Device and Package Configurations

DEVICE	IC	PACKAGE
U1	DS80PCI102SQE	QFN-24

Features:

- 1 lane PCIe repeater up to 8 Gbps (GEN 3)
- Low power consumption, with option to power down unused channels
- Adjustable receive equalization
- Adjustable transmit VOD and De-emphasis
- IDLE detection — squelch function auto mutes the output
- Programmable via pin selection or SMBus interface
- Single supply operation: VIN = 3.3V±10% or VDD = 2.5V ±5%
- -40°C to +85°C Operation
- >5 kV HBM ESD Rating
- High speed signal flow–thru pin-out package – SQA24A: 24-pin LLP (10 mm x 5.5 mm, 0.5 mm pitch)

Applications:

- FR-4 Backplane Traces and High Speed Cable for PCIe GEN 3

Demo Kit Contents:

- End User License Agreement
- DS80PCI102EVK User Guide
- DS80PCI102EVK PCB

Ordering Information:

DEVICE: DS80PCI102SQ – QTY = 2000, DS80PIC102SQE – QTY = 250

SMA Evaluation Kit: DS80PCI102EVK

2. Setup

This section describes the jumpers and connectors on the EVM as well and how to properly connect, set up and use the DS80PCI102EVK.

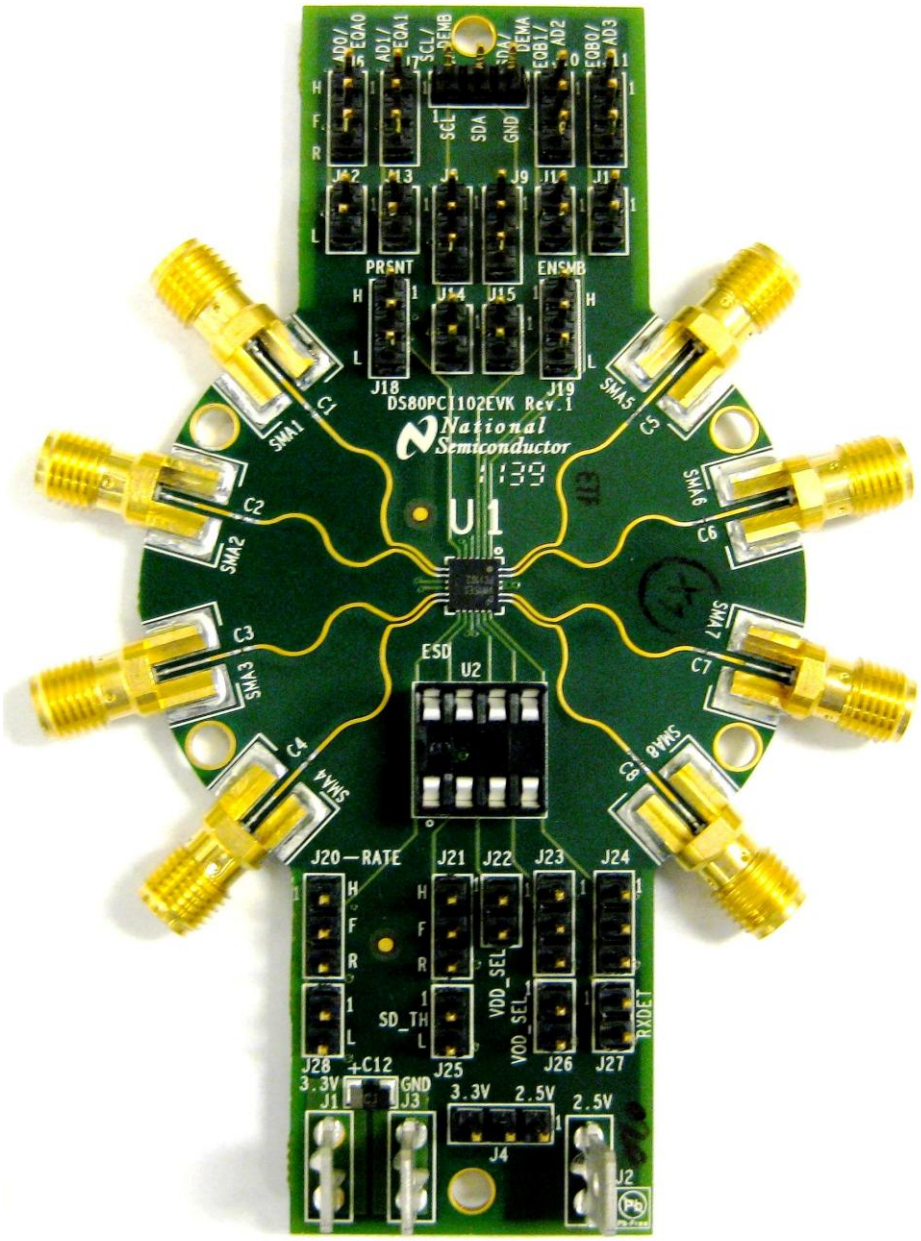

Figure 1: DS80PCI102EVK Evaluation Board

2.1. Mode

The DS80PCI102EVK – SMA evaluation kit can be used in three different modes.

1. Pin Control Mode (provides access to selected signal integrity settings)
2. SMBUS Mode (full access to signal integrity and control settings)
3. EEPROM Mode (full access to signal integrity and control settings)

The EEPROM mode is a convenient method of programming one or more DS80PCI102 devices on system power-up when a SMBus master (microcontroller or similar) is unavailable in the design.

Pin Control with Jumpers:

Uses the external control pins on the DS80PCI102 to configure the signal integrity and control settings of the device. In this mode only a subset of the equalization and de-emphasis levels are available. Due to the limited number of control pins, a limited bandwidth 4-level input scheme has been implemented across the control pin interface. This allows for improved EQ, DE, and VOD control with fewer physical pins.

The 4 levels are defined as:

1. Low - 0 1KΩ to GND
2. Resistor - R 20KΩ to GND
3. Float - F Open
4. High - 1 1KΩ to VDD

The EVK interfaces to this 4-level IO using the setup below. Only one shunt connection is required to access any of the 4 levels. This methodology minimizes the risk of improper connections that could damage the board or board power supply.

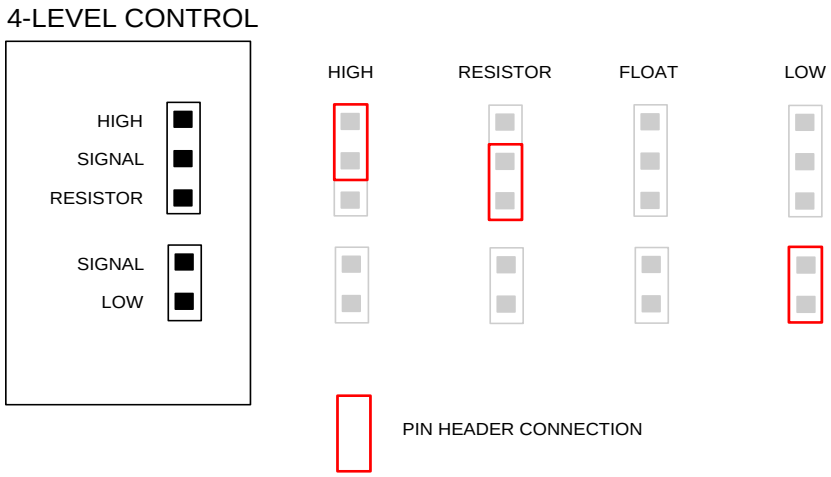

Figure 2: 4-Level IO Control on EVK

PIN CONTROL:

The DS80PCI102EVK are shipped ready to use in pin control configuration. As delivered, the EVK will have the following installed jumpers.

1. J4 – VIN to VIH = 3.3V supply operation:
   Use the J1 and J3 connectors to supply VIN = 3.3V and GND.
2. J22 – VDD_SEL = GND: Use internal regulator to convert 3.3V supply to proper internal supply level of 2.5V. Note: The 2.5V level may be observed on J2 (VDD) or the device VDD pins.
3. J19 – ENSMB = 0: PIN CONTROL configuration mode.
4. J18 – PRSNT# = 0: Device is enabled.
5. J20 – RATE = Float: AUTO RATE detection. The auto RATE detect circuit requires the IDLE and ACTIVE signal which occurs during the link training negotiation. If the Beacon signal is not available then the RATE pin needs to be forced.
   RATE = 0 (GEN 1/2), RATE = R (GEN 3)
6. J24 – RXDET = Float: AUTO continuous RX detection.
7. J23 – VOD_SEL = Float : VOD = 1.0 Vp-p output amplitude.
8. J1, J2, J5, J6 – EQA/B[1:0] = R, R: EQ = 14.6 dB at 4 GHz.
9. J3, J4 – DEMA/B = 0: De-emphasis = 0 dB.
10. J21 – SD_TH = Float: Default signal detect threshold levels.

Level	EQA1 EQB1	EQA0 EQB0	EQ – 8 bits [7:0]	dB at 1.25 GHz	dB at 2.5 GHz	dB at 4 GHz	Suggested Use
1	0	0	0000 0000 = 0x00	2.1	3.7	4.9	FR4 < 5 inch trace
2	0	R	0000 0001 = 0x01	3.4	5.8	7.9	FR4 5 inch 5–mil trace
3	0	Float	0000 0010 = 0x02	4.8	7.7	9.9	FR4 5 inch 4–mil trace
4	0	1	0000 0011 = 0x03	5.9	8.9	11	FR4 10 inch 5–mil trace
5	R	0	0000 0111 = 0x07	7.2	11.2	14.3	FR4 10 inch 4–mil trace
6	R	R	0001 0101 = 0x15	6.1	11.4	14.6	FR4 15 inch 4–mil trace
7	R	Float	0000 1011 = 0x0B	8.8	13.5	17	FR4 20 inch 4–mil trace
8	R	1	0000 1111 = 0x0F	10.2	15	18.5	FR4 25 - 30 inch 4–mil trace
9	Float	0	0101 0101 = 0x55	7.5	12.8	18	FR4 30 inch 4–mil trace
10	Float	R	0001 1111 = 0x1F	11.4	17.4	22	FR4 35 inch 4–mil trace
11	Float	Float	0010 1111 = 0x2F	13	19.7	24.4	10m, 30awg cable
12	Float	1	0011 1111 = 0x3F	14.2	21.1	25.8	10m – 12m cable
13	1	0	1010 1010 = 0xAA	13.8	21.7	27.4	
14	1	R	0111 1111 = 0x7F	15.6	23.5	29	
15	1	Float	1011 1111 = 0xBF	17.2	25.8	31.4	
16	1	1	1111 1111 = 0xFF	18.4	27.3	32.7	

Table 2: EQA/B[1:0] Pin Setting Information

Level	VOD_SEL	DEMA/DEMB	VOD (Vp-p)	DEM (dB)	Suggested Use
1	0	0	0.7	0	FR4 <5 inch 4–mil trace
2	0	R	0.7	-6	FR4 12 inch 4–mil trace
3	0	Float	0.7	-3.5	FR4 10 inch 4–mil trace
4	0	1	0.7	-9	FR4 15 inch 4–mil trace
5	R	0	1.2	0	FR4 <5 inch 4–mil trace
6	R	R	1.2	-6	FR4 12 inch 4–mil trace
7	R	Float	1.2	-3.5	FR4 10 inch 4–mil trace
8	R	1	1.2	-9	FR4 15 inch 4–mil trace
9	Float	0	1	0	FR4 <5 inch 4–mil trace
10	Float	R	1	-6	FR4 15 inch 4–mil trace
11	Float	Float	1	-3.5	FR4 10 inch 4–mil trace
12	Float	1	1	-9	FR4 20 inch 4–mil trace
13	1	0	1.1	0	FR4 <5 inch 4–mil trace
14	1	R	1.1	-1.5	FR4 5 inch 4–mil trace
15	1	Float	1.3	-1.5	FR4 5 inch 4–mil trace
16	1	1	1.3	-3.5	FR4 10 inch 4–mil trace

Table 3: VOD_SEL and DEMA/B Pin Setting Information

PRSNT#	RXDET	Input Termination	Termination sensed on output pins	Comments
0	0	High Impedance	X	Manual force RX-Detect, input is high impedance mode.
0	R	High Impedance 50 ohm	High Z until receiver is detected	Auto RX-Detect, outputs test every 12 msec for 600 msec then stops; termination is high-z until detection; once detected input termination is 50 ohm. Reset function by pulsing PRSNT# high for 5 usec then low again.
0	Float	High Impedance 50 ohm	High Z until receiver is detected	Auto RX-Detect, outputs test every 12 msec until detection occurs; termination is high-z until detection; once detected input termination is 50 ohm.
0	1	50 ohm	X	Manual force RX-Detect, input is 50 ohm.
1	X	High Impedance	X	Power down mode, input is high impedance, output drivers are disabled.

Table 4: PRSNT# and RXDET Pin Setting Information

SMBUS MODE CONTROL:

The SMBus can also be used to control the DS80PCI102 devices. This method has the advantage of independent control and finer signal conditioning granularity.

1. Set the AD[3:0] pins for the device slave address bytes: AD[3:0] = 0000 = B0'h
2. J19 – ENSMB = 1: SMBUS slave mode.
3. Connect SDA, SCL and GND to J5. If 1kohm pull-up is needed then place jumper on 1-2 on J8, J9.

Typical DS80PIC102 Register Writes:

Register Address	Function	Description
Register 0x06	CRC DIS	Write bit [3] = 1'b send register updates directly to channel without any CRC check.
Register 0x0F	CHA EQ	Write EQ setting for bits [7:0]; see table 1.
Register 0x11	CHA DEM	Write DE setting for bits [2:0] = 000'b (0 dB)
Register 0x23	CHA VOD	Write VOD setting for bits [4:2] = 011'b (1.0Vp-p)
Register 0x16	CHB EQ	Write EQ setting for bits [7:0]; see table 1.
Register 0x18	CHB DEM	Write DE setting for bits [2:0] = 000'b (0 dB)
Register 0x2D	CHB VOD	Write VOD setting for bits [4:2] = 011'b (1.0Vp-p)

EEPROM MODE:

A serial EEPROM may also be used to configure one or more DS80PCI102 devices. This configuration mode is accessed by setting the ENSMB = FLOAT. For additional information please see the device datasheet.

3. Board Layout

Figure 3 and Figure 4 show the board layout for the DS80PCI102EVK PWB. The EVM offers resistors, capacitors and jumpers to control the signal integrity functions

The DS80PCI102 are very compact and low power. The QFN package offers an exposed thermal pad to enhance electrical and thermal performance. This must be soldered to the copper landing on the PWB.

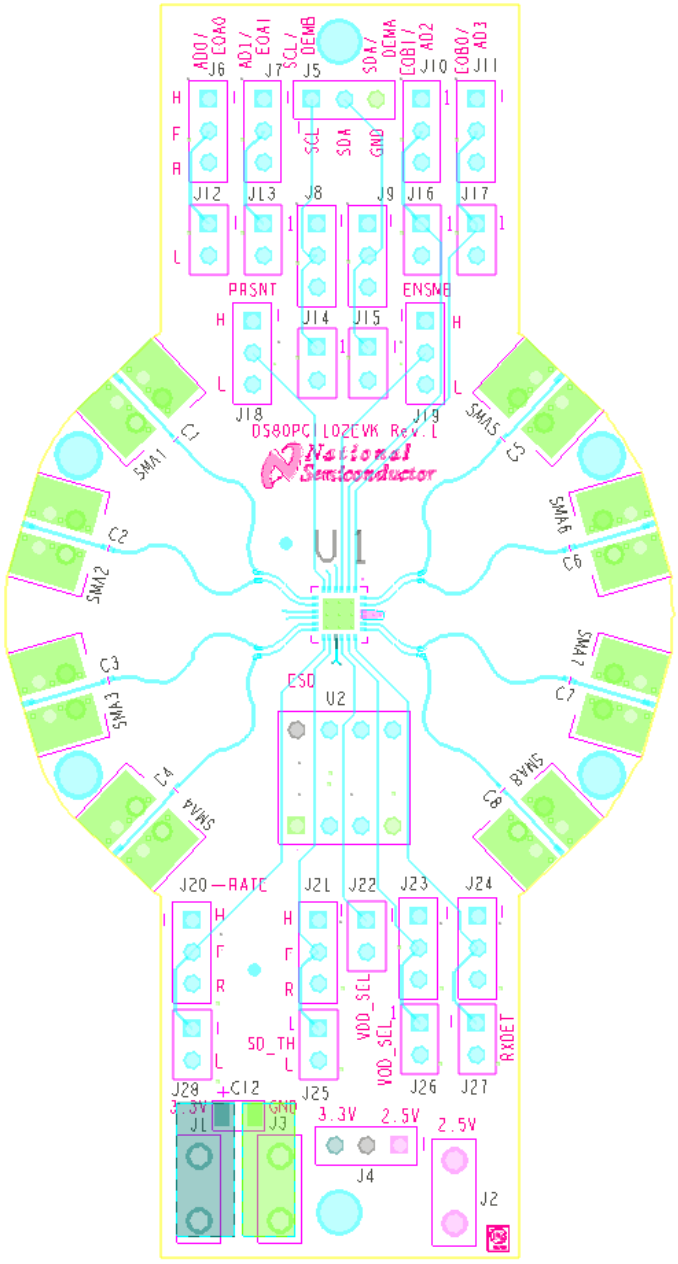

Figure 3: Top Assembly Layer

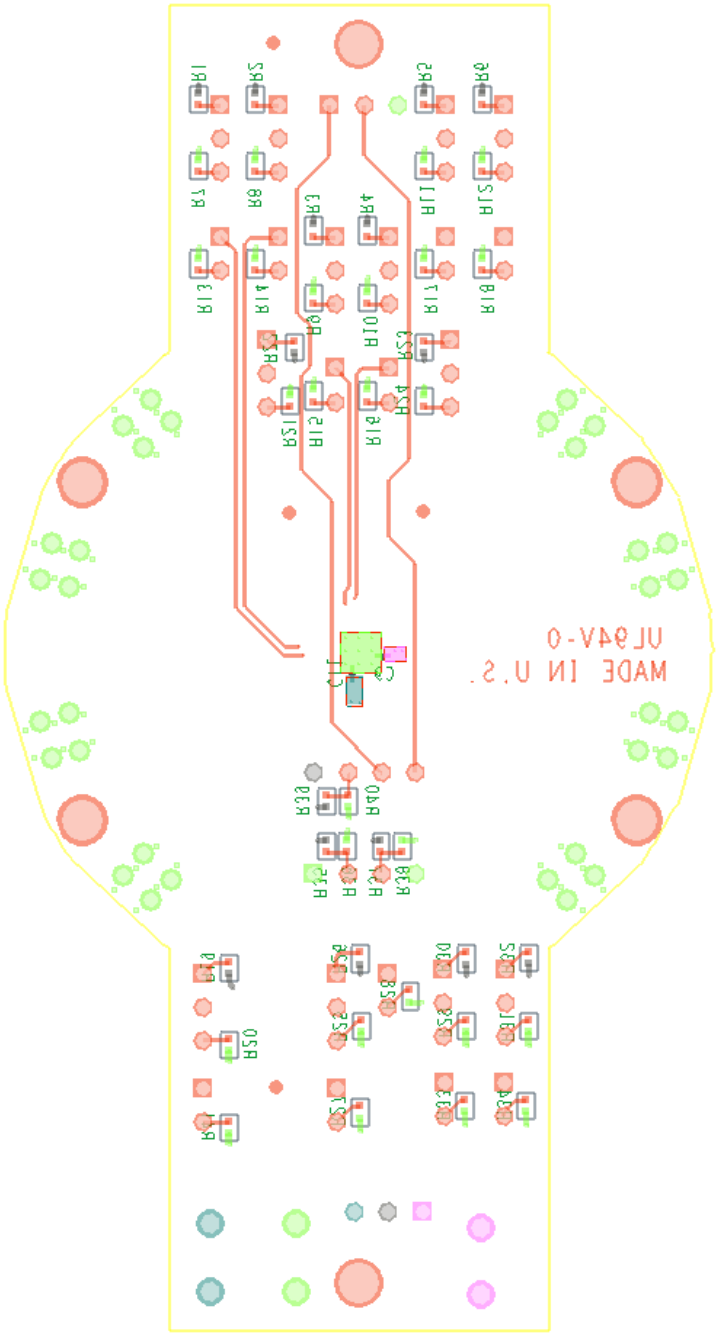

Figure 4: Bottom Assembly Layer

4. Schematic

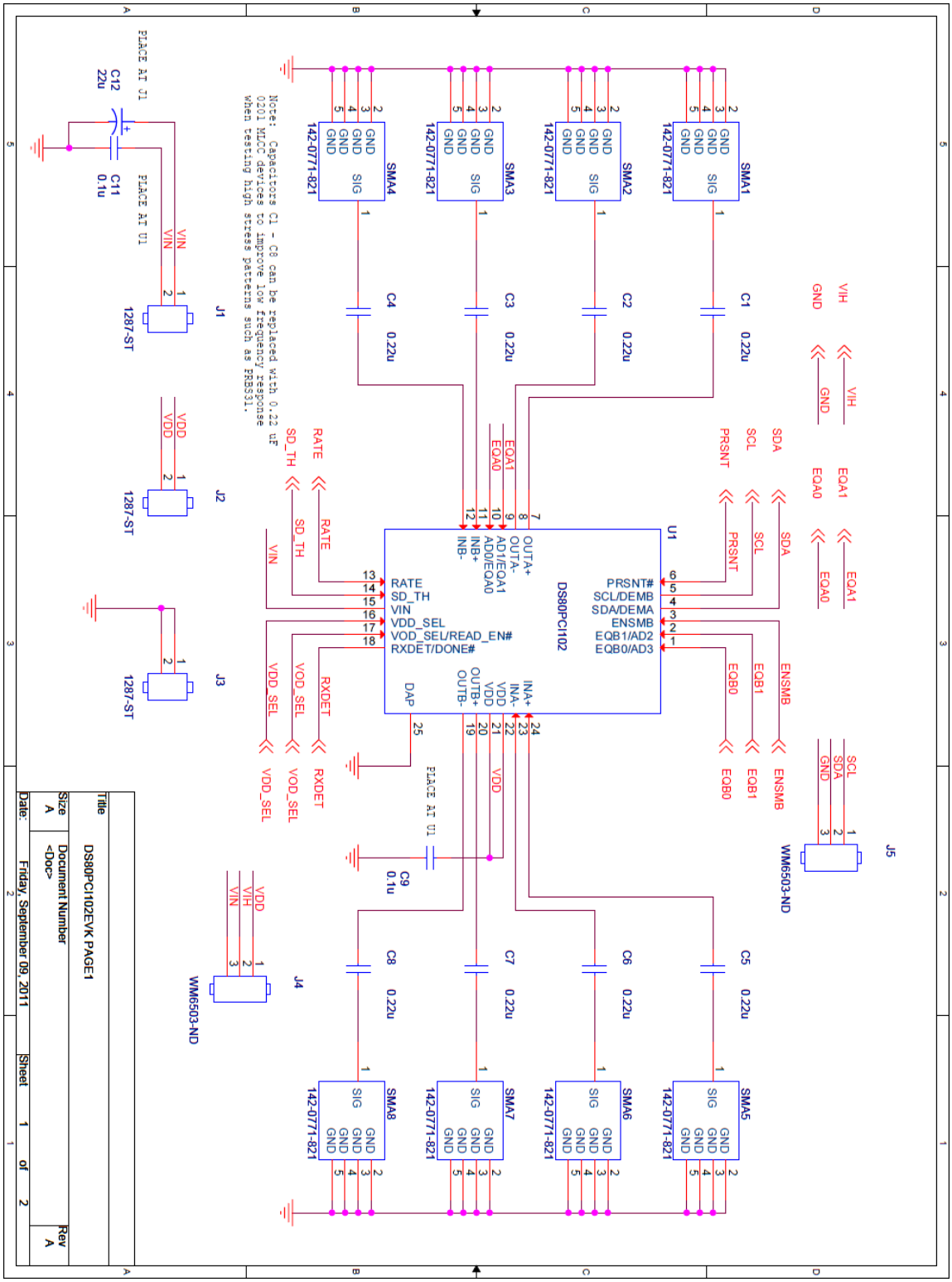

Figure 5: DS80PCI102EVK Schematic

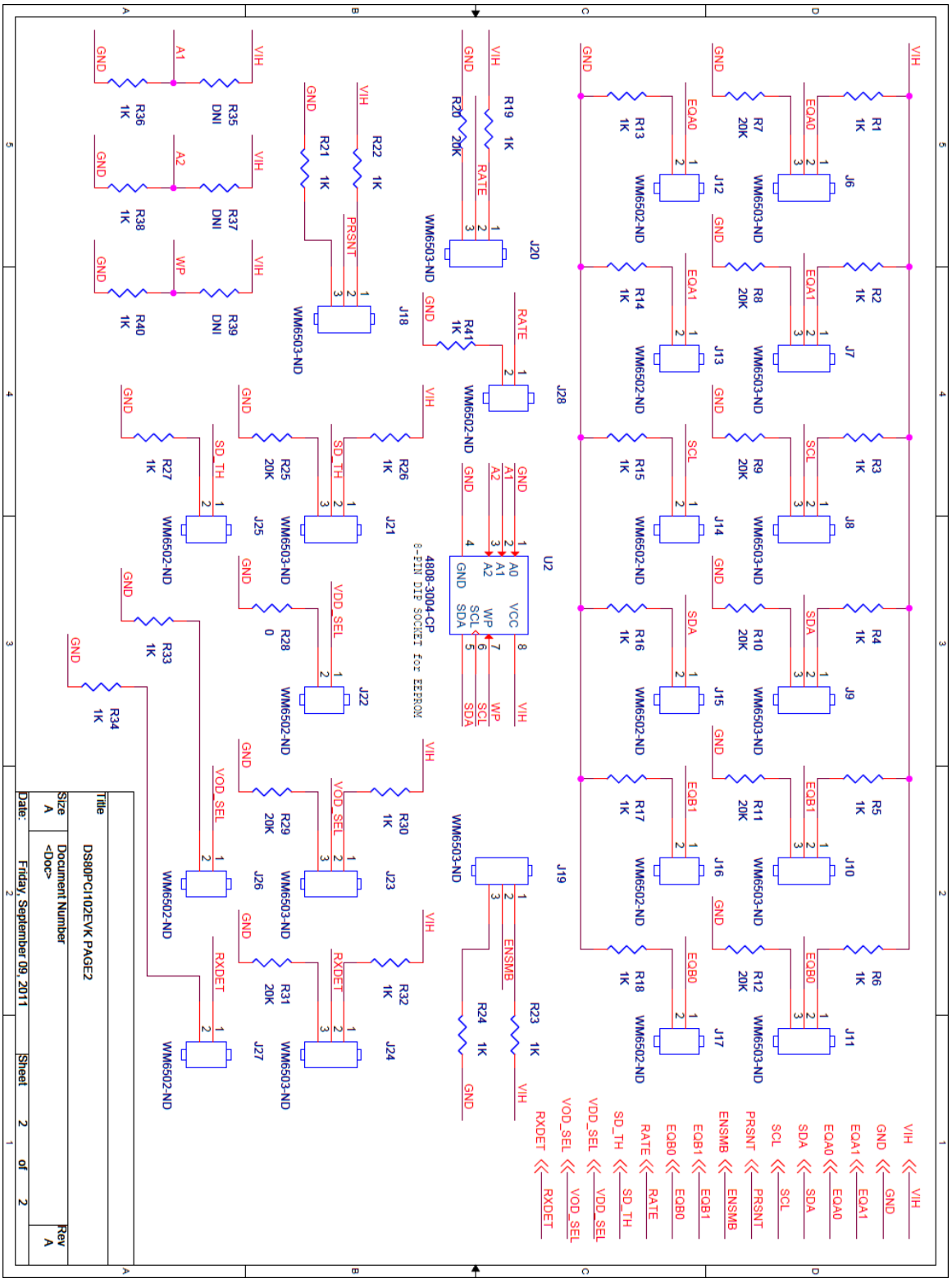

Figure 6: DS80PCI102EVK Schematic

Table 5: DS80PCI102 Bill of Materials

COUNT	REF DES	DESCRIPTION	SIZE	MFR	PART NUMBER
8	C1,C2,C3, C4,C5,C6, C7,C8	CAP CERAMIC .22UF 6.3V X5R	0201	Taiyo Yuden	LMK063BJ224MP-F
2	C9,C11	CAP CERAMIC .1UF 6.3V X5R	0201	TDK	C0603X5R0J104K
1	C12	CAP TANTALUM 22UF 16V 20%	1206	Rohm	TCTAL1C226M8R
8	SMA1,SMA2, SMA3,SMA4, SMA5,SMA6, SMA7,SMA8	CONN JACK SMA 50 OHMS PC MOUNT	0603	Emerson	142-0771-821
3	J1, J2, J3	TERM QF .052"DIA .250" STURDY MT		Keystone	1287-ST
14	J4, J5, J6, J7, J8, J9, J10,J11,J18, J19,J20,J21, J23,J24	CONN HEADER 3-POS 0.100 VERT GOLD		Molex	22-28-4033
11	J12,J13,J14, J15,J16,J17, J22,J25,J26, J27,J28	CONN HEADER 2-POS 0.100 VERT GOLD		Molex	22-28-4023
27	R1, R2, R3, R4, R5, R6, R13, R14, R15, R16, R17, R18, R19, R21, R22, R23, R24, R26, R27, R30, R32, R33, R34, R36, R38, R40, R41	RES 1.0K OHM 1/16W 5%	0402	Rohm	MCR01MZPJ102
10	R7, R8, R9, R10, R11, R12, R20, R25, R29, R31	RES 20.0K OHM 1/16W 1%	0402	Murata	GCM1885C1H221JA16B
1	R28	RES 0.0 OHM 1/16W 5%	0402	Rohm	MCR01MZPJ472
1	U1	DS80PIC102SQ (24-QFN - 4x4mm, 0.5mm pitch)		TI	DS80PIC102SQ
1	U2	SOCKET IC OPEN FRAME 8-POS 0.3"		3M	4808-3004-CP
3	R35,R37,R39	Do Not Populate			
	-	PCB, 0.062 inch		Any	DS80PCI102EVK, REV 1

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Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions: The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

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As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment 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.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

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

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
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.

For EVMs annotated as IC – INDUSTRY CANADA Compliant
This Class A or B digital apparatus complies with Canadian ICES-003.

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

Concerning EVMs including radio transmitters
This device complies with Industry Canada licence-exempt RSS standard(s). 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.

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.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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.

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.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product 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 this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure 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.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please 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 result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. 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. During normal operation, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to 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 use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

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