

# **DS100KR401EVK User's Guide: 4 Channels SMA Evaluation Kit**

## **User's Guide**



Literature Number: SNLU153

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## ***DS100KR401EVK User's Guide: 4 Channels SMA Evaluation Kit***

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The DS100KR401EVK is a 4 channel SMA evaluation kit. It provides a complete high bandwidth platform to evaluate the signal integrity and signal conditioning features of the Texas instruments DS100KR401SQ – 10.3125 Gbps 8 Channel Repeater with Equalization and De-Emphasis.

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## 1 Features

- 8 Channel Repeater up to 10.3125 Gbps
- 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 = 3.3 V $\pm$ 10% or VDD = 2.5 V  $\pm$ 5%
- -40°C to +85°C Operation
- > 6 kV HBM ESD Rating
- High Speed Signal Flow-Thru Pin-Out Package - SQA54A: 54-pin LLP (10 mm x 5.5 mm, 0.5 mm pitch)

## 2 Applications

FR-4 Backplane Traces and High Speed Cable for 10G - KR

## 3 DS100KR401EVK Demo Kit Contents

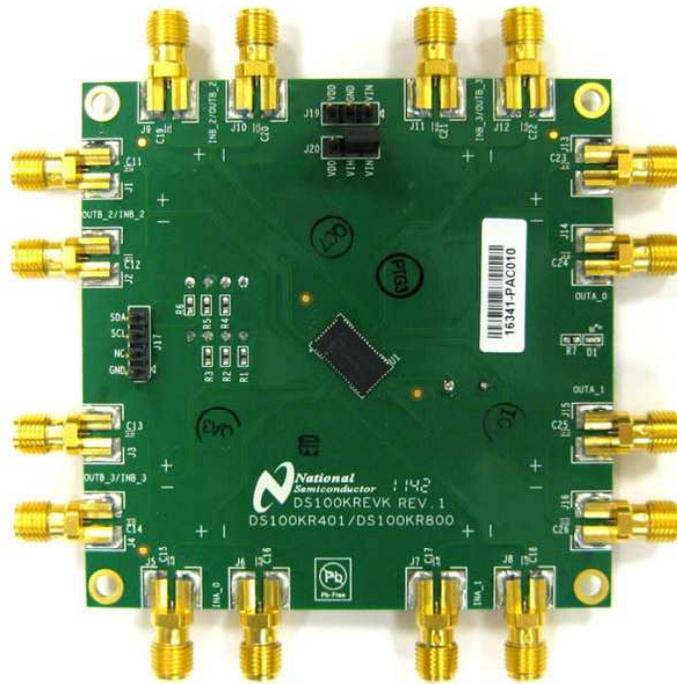
- End User License Agreement
- DS100KR401EVK User Guide
- DS100KR401EVK Board

## 4 Ordering Information

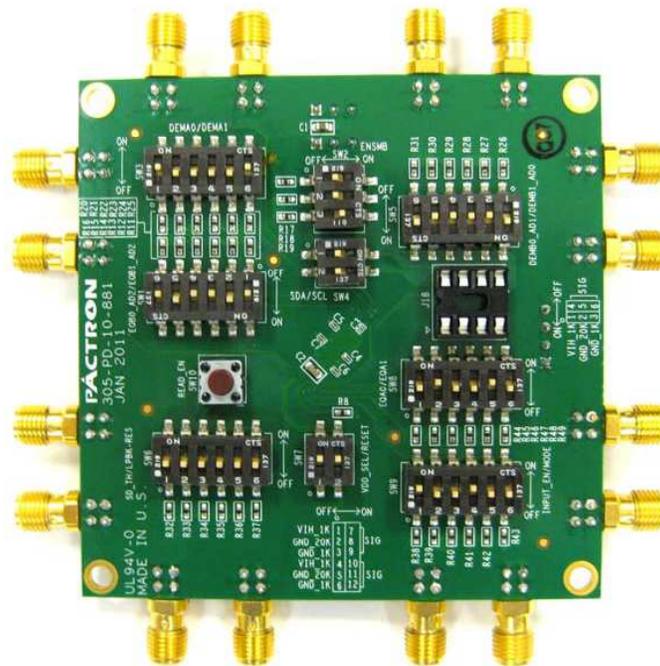
**Table 1.**

DEVICE:	QTY	DEVICE	QTY
DS100KR401SQE/NOPB	250	DS100KR401SQ/NOPB	2000
<b>SMA Evaluation Kit: DS100KR401EVK/NOPB</b>			

**5 DS100KR401EVK Board**



**Figure 1. DS100KR401EVK (Top View)**



**Figure 2. DS100KR401EVK (Bottom View)**

## 6 DS100KR401EVK Setup

**Table 2. Switches to set the 4-Level Input Control Pins**

4 – level Input Settings	Setting for 3 pin switches (3-2-1)
0 – Tie 1k $\Omega$ to GND	<b>ON</b> – OFF – OFF
R – Tie 20k $\Omega$ to GND	OFF – <b>ON</b> – OFF
F – FLOAT (open)	OFF – OFF – OFF
1 – Tie 1k $\Omega$ to VIH	OFF – OFF – <b>ON</b>

The following switches are used to set the input condition for the 4-level inputs: SW1, SW2, SW3, SW5, SW6, SW8, SW9.

There are three switches connected to an input signal pin. Each switch when set to the ON position sets the pin to one of the 4-level setting. The 6 pin switches are assigned similar to the 3 pin switches. The only difference is that two signal pins are connected. Therefore, 6-5-4 is for the one signal pin, and 3-2-1 is for another signal pin. Please note only one switch at the ON position is allowed.

**Table 3. Connection and Control Description**

Component	Name	Function
J9 to J12 J5 to J8	IN_B2+, IN_B2-, IN_B3+, IN_B3-, IN_A0+, IN_A0-, IN_A1+, IN_A1-	High speed differential inputs.
J1 to J4 J13 to J16	OUT_B2+, OUT_B2-, OUT_B3+, OUT_B3-, OUT_A0+, OUT_A0-, OUT_A1+, OUT_A1-	High speed differential outputs.
J19	VIN or VDD	DC Power – VIN or VDD to DS100KR401SQ
J20	VIN or VDD	Jumper – VIN or VDD to VIH power
J17	SDA, SCL	Optional SMBUS access pins. See the datasheet for additional information on SMBUS.
J18	EEPROM	Optional socket for EEPROM
SW1	EQB[1:0] or AD[3:2]	PIN MODE – EQ control for channel B inputs SMBUS MODE – AD[3:2] device address bits
SW2	ENSMB	ENSMB = LOW – PIN MODE ENSMB = HIGH – SMBUS (slave mode) ENSMB = FLOAT – SMBUS (master mode – load configuration from EEPROM)
SW3	DEMA[1:0]	PIN MODE – DE control for channel A outputs
SW4	SDA/SCL	“ON” position connects SDA and SCL lines to the device pin.
SW5	DEMB[1:0] or AD[1:0]	PIN MODE – DE control for channel B outputs SMBUS MODE – AD[1:0] device address bits
SW6	SD_TH and LPBK - RES	SD_TH – Signal detect threshold level (FLOAT = Default level) LPBK = FLOAT = Normal operation
SW7	VDD_SEL and RESET	VDD_SEL – Enable or disable the internal 3.3V to 2.5V regulator. RESET – Enable or disable the device (LOW – enables the device)
SW8	EQA[1:0]	PIN MODE – EQ control for channel A inputs
SW9	INPUT_EN and MODE	INPUT_EN – Enable or disable the internal 50 $\Omega$ to VDD terminations. MODE – set to 1 for 10.3G KR mode, set to 0 for 10G mode
SW10	READ_EN	ENSMB = FLOAT – SMBUS (master mode – load configuration from EEPROM) SW6: SD_TH becomes the READ_EN pin. -To start the loading at power up, set SW6 pin 3 to “ON” position (pull to GND). -To manually control the start, set SW6 pin 1 to “ON” position (pull to VDD) and push the SW10 button for the high to low transition to start the loading. -When the loading is complete the LED – D1 light should turn OFF.

## 7 Quick Start User Guide

### 1. Connect J19: VIN = 3.3V or VDD = 2.5V and GND.

- **For VIN = 3.3V:**
  - Set SW7 pin1 (VDD\_SEL) to the ON position (enable internal LDO regulator) and float VDD at J19.
- **For VDD = 2.5V:**
  - Set SW7 pin1 (VDD\_SEL) to the OFF positions (disable internal LDO regulator) and float VIN at J19.

### 2. Set jumper – J20 for VIH connection to VIN or VDD.

### 3. Connect 50 Ω SMA cables to the board.

- The input signals J1 to J8 can be connected from a pattern generator.
- The output signals J9 to J16 can be connected to a scope.
- Top 2 – B channel: J9 – IN\_B2+, J10 – IN\_B2- → J1 – OUT\_B2+, J2 – OUT\_B2-  
J11 – IN\_B3+, J12 – IN\_B3- → J3 – OUT\_B3+, J4 – OUT\_B3-
- Bottom 2 – A channel: J5 – IN\_A0+, J6 – IN\_A0- → J13 – OUT\_A0+, J14 – OUT\_A0-  
J7 – IN\_A1+, J8 – IN\_A1- → J15 – OUT\_A1+, J16 – OUT\_A1-
- 

### 4. Set the control pins for normal operation

- SW7 – RESET = 0 (enables the device): set switch pin2 to the ON position.
- SW9 – INPUT\_EN = 1 (50 Ω input termination): set switches (3-2-1) = (OFF-OFF-**ON**).
- SW9 – MODE = 1 (enables 10.3G KR mode): set switches (6-5-4) = (OFF-OFF-**ON**).
- SW6 – SD\_TH = F (default signal detect threshold level): set switches (3-2-1) = (OFF-OFF-OFF).
- SW6 – LPBK - RES = F (normal operation): set switches (6-5-4) = (OFF-OFF-OFF).

5. Set the input equalization level.

- For external pin mode control of the equalization level:
  - Set ENSMB = 0 (1kΩ to GND) by using the SW2 (3-2-1) = **(ON-OFF-OFF)**.
  - SW4 pin1,2 must be set to the OFF positions, so the SMBUS signals are disconnected.
  - Refer to Table 1 for information on the 3 switch settings for the 4 level input.

Example:

- Set EQB[1:0] with SW1 for the B bank of inputs (top 4 inputs of DS100KR401).
- SW1 (6-5-4), (3-2-1) = (OFF-**ON**-OFF), (OFF-**ON**-OFF) = EQB[1:0] = R,R = 16.6 dB at 5 GHz (level 6).
- Set EQA[1:0] with SW8 for the A bank of inputs (bottom 4 inputs of DS100KR401).
- SW8 (6-5-4), (3-2-1) = (OFF-**ON**-OFF), (OFF-**ON**-OFF) = EQA[1:0] = R,R = 16.6 dB at 5 GHz (level 6).

**Table 4. The 16 Possible EQ Settings when in Pin Mode**

Level	EQA/B [1:0]	SW1 - EQB[1:0] SW8 - EQA[1:0]						EQ (dB) at 5 GHz
		6	5	4	3	2	1	
1	0, 0	<b>ON</b>	OFF	OFF	<b>ON</b>	OFF	OFF	5.3
2	0, R	<b>ON</b>	OFF	OFF	OFF	<b>ON</b>	OFF	8.7
3	0, F	<b>ON</b>	OFF	OFF	OFF	OFF	OFF	10.6
4	0, 1	<b>ON</b>	OFF	OFF	OFF	OFF	<b>ON</b>	11.7
5	R, 0	OFF	<b>ON</b>	OFF	<b>ON</b>	OFF	OFF	15.6
6	R, R	OFF	<b>ON</b>	OFF	OFF	<b>ON</b>	OFF	16.6
7	R, F	OFF	<b>ON</b>	OFF	OFF	OFF	OFF	18.3
8	R, 1	OFF	<b>ON</b>	OFF	OFF	OFF	<b>ON</b>	19.7
9	F, 0	OFF	OFF	OFF	<b>ON</b>	OFF	OFF	20.3
10	F, R	OFF	OFF	OFF	OFF	<b>ON</b>	OFF	23.6
11	F, F	OFF	OFF	OFF	OFF	OFF	OFF	25.8
12	F, 1	OFF	OFF	OFF	OFF	OFF	<b>ON</b>	27
13	1, 0	OFF	OFF	<b>ON</b>	<b>ON</b>	OFF	OFF	29.1
14	1, R	OFF	OFF	<b>ON</b>	OFF	<b>ON</b>	OFF	30.7
15	1, F	OFF	OFF	<b>ON</b>	OFF	OFF	OFF	32.7
16	1, 1	OFF	OFF	<b>ON</b>	OFF	OFF	<b>ON</b>	33.8

**6. Set the output VOD and De-emphasis level.**

For external pin mode control for the VOD and De-emphasis level:

- Set ENSMB = 0 (1kΩ to GND) by using the SW2 (3-2-1) = (**ON**-OFF-OFF).
- SW4 pin1,2 must be set to the OFF positions, so the SMBUS signals are disconnected.
- Refer to Table 1 for information on the 3 switch settings for the 4 level input.

Example:

- Set DEMB[1:0] with SW5 for the B bank of outputs (top 4 outputs of DS100KR401).
  - SW5 (6-5-4), (3-2-1) = (**ON**-OFF-OFF), (OFF-OFF-**ON**) = DEMB[1:0] = 0,1 (VOD=1.0V, DE=0 dB).
- Set DEMA[1:0] with SW3 for the A bank of outputs (bottom 4 outputs of DS100KR401).
  - SW3 (6-5-4), (3-2-1) = (**ON**-OFF-OFF), (OFF-OFF-**ON**) = DEMA1:0] = 0,1 (VOD=1.0V, DE=0 dB).

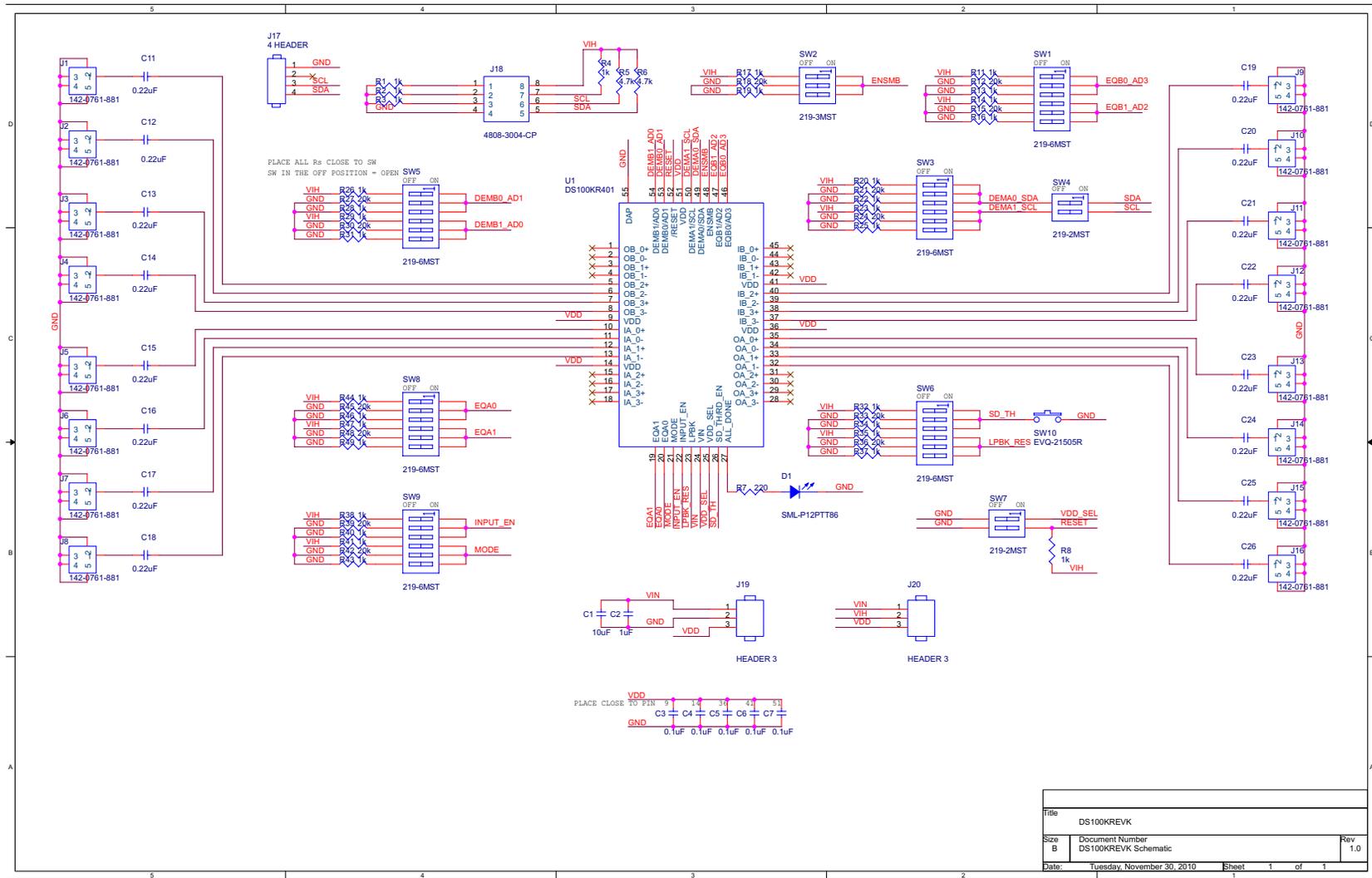
**Table 5. The 16 Possible Settings of VOD and DE when in Pin Mode**

Level	DEMA/B [1:0]	SW5 - DEMB[1:0] SW3 - DEMA[1:0]						10G-KR, 10G Mode	
		6	5	4	3	2	1	VOD (V <sub>p-p</sub> )	DE (dB)
1	0, 0	<b>ON</b>	OFF	OFF	<b>ON</b>	OFF	OFF	0.8	0
2	0, R	<b>ON</b>	OFF	OFF	OFF	<b>ON</b>	OFF	0.9	0
3	0, F	<b>ON</b>	OFF	OFF	OFF	OFF	OFF	0.9	-3.5
4	0, 1	<b>ON</b>	OFF	OFF	OFF	OFF	<b>ON</b>	1	0
5	R, 0	OFF	<b>ON</b>	OFF	<b>ON</b>	OFF	OFF	1	-3.5
6	R, R	OFF	<b>ON</b>	OFF	OFF	<b>ON</b>	OFF	1	-6
7	R, F	OFF	<b>ON</b>	OFF	OFF	OFF	OFF	1.1	0
8	R, 1	OFF	<b>ON</b>	OFF	OFF	OFF	<b>ON</b>	1.1	-3.5
9	F, 0	OFF	OFF	OFF	<b>ON</b>	OFF	OFF	1.1	-6
10	F, R	OFF	OFF	OFF	OFF	<b>ON</b>	OFF	1.2	0
11	F, F	OFF	OFF	OFF	OFF	OFF	OFF	1.2	-3.5
12	F, 1	OFF	OFF	OFF	OFF	OFF	<b>ON</b>	1.2	-6
13	1, 0	OFF	OFF	<b>ON</b>	<b>ON</b>	OFF	OFF	1.3	0
14	1, R	OFF	OFF	<b>ON</b>	OFF	<b>ON</b>	OFF	1.3	-3.5
15	1, F	OFF	OFF	<b>ON</b>	OFF	OFF	OFF	1.3	-6
16	1, 1	OFF	OFF	<b>ON</b>	OFF	OFF	<b>ON</b>	1.3	-9

**For SMBUS mode control of the EQ, VOD and De-emphasis level:**

- Set ENSMB = 1 (1kΩ to VIH) by using the SW2 (3-2-1) = (OFF-OFF-**ON**).
- Set SW4 pin1,2 to the ON position so the SMBUS signals are connected.
- Set SW3 pin1 thru pin6 switches to the OFF position so they do not connect to the SDA and SCL line.
- Set the SW1 and SW5 for the AD[3:0] pins. AD[3:0]=0000 sets device slave address = B0'hex.
- Connect SDA, SCL and GND to J17. Please refer to datasheet for register map for EQ, VOD and DEM.

8 Schematic



**9 Bill of Materials**
**Table 6. DS100KR401EVK Bill of Materials**

Item	Qty	Reference	Digikey PN	Manufacture PN	Descriptions
1	1	C1	445-3448-1-ND	C1608Y5V0J106Z	CAP CER 10UF 6.3 V Y5V 0603
2	1	C2	445-1322-1-ND	C1608X5R0J105K	CAP CER 1.0UF 6.3 V X5R 10% 0603
3	1	C3,C4,C5,C6,C7	445-4711-1-ND	C0603X5R0J104M	CAP CER .10UF 6.3 V X5R 0201
4	16	C11,C12,C13,C14,C15, C16, C17,C18,C19,C20,C21, C22, C23,C24,C25,C26	587-2483-1-ND	LMK063BJ224MP-F	CAP CER .22UF 10 V X5R 20% 0201
5	1	D1	511-1592-1-ND	SML-P12PTT86	LED GREEN 0.2MM 13MCD 0402 SMD
6	16	J1,J2,J3,J4,J5,J6,J7,J8, J9,J10,J11,J12,J13,J14, J15,J16	J801-ND	142-0761-881	CONN JACK SMA 50 Ω PC MOUNT
7	1	J17	WM6504-ND	22-28-4043	CONN HEADER 4POS .100 VERT GOLD
8	2	J19,J20	WM6503-ND	22-28-4033	CONN HEADER 3POS .100 VERT GOLD
9	1	J18	3M5473-ND	4808-3004-CP	SOCKET IC OPEN FRAME 8POS .3"
10	31	R1,R2,R3,R4,R8,R11,R1 3, R14,R16,R17,R19,R20, R22, R23,R25,R26,R28,R29, R31, R32,R34,R35,R37,R38, R40, R41,R43,R44,R46,R47, R49	P1.00KLCT-ND	ERJ-2RKF1001X	RES 1.00K Ω 1/10W 1% 0402 SMD
11	1	R7	P220LCT-ND	ERJ-2RKF2200X	RES 220 Ω 1/10W 1% 0402 SMD
12	13	R12,R15,R18,R21,R24, R27, R30,R33,R36,R39,R42, R45, R48	P20.0KLCT-ND	ERJ-2RKF2002X	RES 20.0K Ω 1/10W 1% 0402 SMD
13	2	R5,R6	P4.70KLCT-ND	ERJ-2RKF4701X	RES 4.70K Ω 1/10W 1% 0402 SMD
14	6	SW1,SW3,SW5,SW6,S W8, SW9	CT2196MST-ND	219-6MST	SWITCH TAPE SEAL 6 POS SMD
15	1	SW2	CT2193MST-ND	219-3MST	SWITCH TAPE SEAL 3 POS SMD
16	2	SW4,SW7	CT2192MST-ND	219-2MST	SWITCH TAPE SEAL 2 POS SMD
17	1	SW10	P12225SCT-ND	EVQ-21505R	SWITCH LT 6MM 160GF 5MM HEIGHT
18	1	U1	296-36213-6-ND	DS100KR401SQ/NO PB	IC REPEATER 10.3GBPS 8CH 54WQFN

## STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, or documentation (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.
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  - 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.
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  - 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 any defects that are 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. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.
  - 2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, 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:*

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

##### **Concerning EVMs Including Radio Transmitters:**

This device complies with Industry Canada license-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.

##### **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/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/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/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/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 by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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