



## ABSTRACT

This user's guide describes the characteristics, operation, and use of the TMUX1575 Evaluation Module (EVM). A complete schematic diagram, printed-circuit board layouts, and bill of materials are included in this document

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## Trademarks

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## 1 Information About Cautions and Warnings

The information in the warning statement is provided for personal protection and the information in the caution statement is provided to protect the equipment from damage. Read each caution and warning statement carefully.



### 1.1 Introduction

The TMUX1575 is a low-voltage 4 channel 2:1 multiplexer. The device operates off of a supply voltage of 1.08 V to 3.6 V. The signal pathways can accept either  $2 \times V_{DD}$  or 3.6 V whichever is lower. It has high bandwidth at a nominal rating of 1.5 GHz allowing for high-speed applications to be utilized with this device. The device also features powered off protection, in which the switch will be high impedance when  $V_{DD} = 0$  V. Fail-safe logic is also integrated into the integrated (IC) allowing for a voltage to be applied to the logic pins before power is applied to the device. The device is featured in a very small WSCP package with dimensions of 1.34 mm  $\times$  1.34 mm.

### 1.2 Description

The TMUX1575EVM allows for quick DC testing of the TMUX1575 device with easily configurable loads and SMA connectors for a variety of different tests.

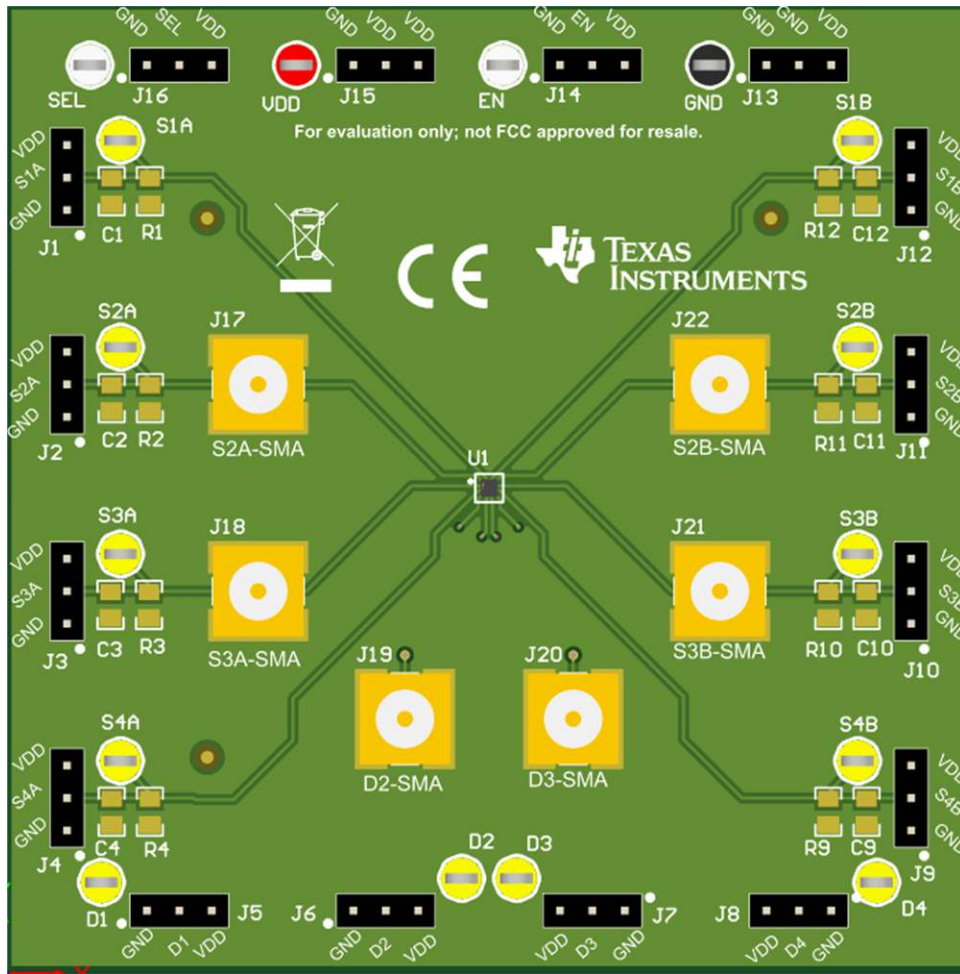
### 1.3 Features

The EVM has the following features:

- A TMUX1575 device in a small WSCP (YKB) package
- Two power-supply decoupling capacitors (1  $\mu$ F and 0.1  $\mu$ F)
- Quick prototyping and testing of the 16-pin TMUX1575 in the WSCP (YKB) package
- All 16 signal paths have test point and jumper access
- All 12 source and drain pins have two 0805 pads each for an easily-configurable test setup
- SMA Connectors on channels 2 and 3 of the device for high-speed evaluation of the TMUX1575

## 2 EVM Setup

Figure 2-1 shows the topside view of the TMUX1575EVM.



**Figure 2-1. TMUX1575EVM Topside View**

Use the information in [Table 2-1](#) to power up the board. VDD is indicated by the only red test point on the board with an overlay stating "VDD" next to it; it is closest to the J15 jumper on the topside of the PCB. This is where the positive (+) terminal of the power source is connected. The negative (–) terminal is connected to the only black test point on the PCB labeled ground; it is closest to the J13 jumper on the upper right side of the board. To test DC characteristics, adjust the input voltage between 1.08 V to 3.6 V.

**Table 2-1. Power Supplies Connection Points**

Connector	Connector Color	Adjacent Jumper	Operating Voltage (VDD With Regard to GND)
VDD	Red	J15	1.08 V–3.6 V
GND	Black	J13	

The IC is controlled through the two white test points at the top of the board. Using [Table 2-2](#), external signals can be applied to the white test points to meet the logic thresholds as [Table 2-3](#) shows. [Table 2-3](#) shows the truth table for the TMUX1575 device.

**Table 2-2. Control Lines Connection Points**

Connector	Connector Color	Adjacent Jumper	Logic Low Voltage Range	Logic High Voltage Range
EN	White	J14	0 V–0.45 V	0.8 V–3.6 V
SEL	White	J16		

**Table 2-3. TMUX1575EVM Truth Table**

EN	SEL	Channels Selected
0	x	Device Disabled
1	0	SxA <-> Dx Connected
		SxB <-> Disconnected
1	1	SxB <-> Dx Connected
		SxA <-> Dx Disconnected

[Table 2-4](#) describes the component pads of the TMUX1575EVM 0805 and which pin of the TMUX1575 IC is connected to those pads. This is to allow for configuring different loading conditons depending on the end user's application.

**Table 2-4. TMUX1575 Pins to Component Pads**

Pin Name	0805 Capacitor Pad ID	0805 Resistor Pad ID	Pad Location	Adjacent Jumper
S1A	C1	R1	Top Layer	J1
S1B	C12	R12	Top Layer	J12
D1	C5	R5	Bottom Layer	J5
S2A	C2	R2	Top Layer	J2
S2B	C11	R11	Top Layer	J11
D2	C6	R6	Bottom Layer	J6
S3A	C3	R3	Top Layer	J3
S3B	C10	R10	Top Layer	J10
D3	C7	R7	Bottom Layer	J7
S4A	C4	R4	Top Layer	J4
S4B	C9	R9	Top Layer	J9
D4	C8	R8	Bottom Layer	J8

### 3 EVM Connectors and Test Points

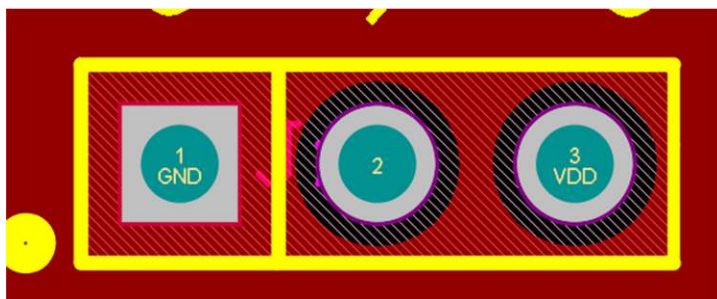
Before using the EVM, make sure to connect an external power supply to the following points on the board. The power supply provides VDD at every jumper that can be further configured by the user.

**Table 3-1. Required External Connections**

Signal	Voltage with Regard to Ground	Signal Input Point
VDD (Power Supply)	1.08 V to 3.6 V - Operating 0 V - Powered Off Protection	Red Test Point Labeled VDD
Ground (Power Supply)	0 V	Black Test Point Labeled GND

The user controls the board using the 16 configurable jumpers laid along the perimeter of the board. [Table 3-2](#) shows the generic jumper position definitions as well as the different configurations that can be utilized with these 16 jumpers.

All jumpers on the TMUX1575EVM use the same numbering system: 1 = Ground, 2 = Signal Pathway, and 3 = VDD.



**Figure 3-1. TMUX1575EVM Jumper Position Definition**

**Table 3-2. TMUX1575EVM Jumper Position Definition**

Test Point Name	Test Point Function	Test Point Color	Associated Connectors
S1A	External Signal I/O or Test Point	Yellow	J1
S2A	External Signal I/O or Test Point	Yellow	J2 and J17
S3A	External Signal I/O or Test Point	Yellow	J3 and J18
S4A	External Signal I/O or Test Point	Yellow	J4
D1	External Signal I/O or Test Point	Yellow	J5
D2	External Signal I/O or Test Point	Yellow	J6
D3	External Signal I/O or Test Point	Yellow	J7
D4	External Signal I/O or Test Point	Yellow	J8
S4B	External Signal I/O or Test Point	Yellow	J9
S3B	External Signal I/O or Test Point	Yellow	J10 and J21
S2B	External Signal I/O or Test Point	Yellow	J11 and J22
S1B	External Signal I/O or Test Point	Yellow	J12
GND	Power Supply Input ( - Terminal )	Black	J13
EN	Control Signal Input or Test Point	White	J14
VDD	Power Supply Input ( + Terminal )	Red	J15
SEL	Control Signal Input or Test Point	White	J16

## 4 Testing Procedures

The TMUX1575EVM was tested against the [TMUX1575 2:1 \(SPDT\) 4-Channel, Powered-Off Protected Switch in WCSP with 1.2 V Logic Data Sheet](#) for charge injection. The voltage supply was set to 3.6 V. For the test, the jumpers and external signals in [Table 4-1](#) are supplied.

**Table 4-1. Jumper Configuration for Charge Injection Test**

Jumper	Connection	Signal, Description	External Signal Input Test Point
J15	J15.3 shorted to J15.2	VDD (3.6 V)	Test Point: VDD Color: Red Voltage: 3.6 V
J13	J13.1 shorted to J13.2	Ground (0 V)	Test Point: GND Color: Black Voltage: 0 V
J14	J14.3 shorted to J14.2	Enable (3.6 V)	N/A
J16	J16.2 left floating	External Signal To Be Applied	Test Point: SEL Color: White Voltage: 0 V–1.8 V
J1	J1.2 left floating	External Signal to Be Applied	Test Point: S1A Color: Yellow Voltage: 1.8V
J5	J5.2 left floating	Output Signal Path	N/A
JX Where X is in Set: {2,3,4,9,10,11, or 12 }	JX.1 shorted to JX.2	All Other Source Pins Grounded (0 V)	N/A
JY Where Y is in Set: {6,7, or 8}	JY.2 left floating	Unused Drain Pins Left Floating	N/A

The load was capacitive with a total output capacitance of about 12 pF. The charge injection was quantified by measuring the voltage transient after switching between 0 V and 1.8 V. Charge injection can be calculated by multiplying the output capacitance by the change in voltage to get charge injection results.

## 5 Test Results

Figure 5-1 shows the charge injection test results. The first picture shows about three cycles of switching; while the second picture details a close up view of the charge injection spike. The test resulted in a voltage transient of 450 mV; when multiplied by 12 pF, the result is 5.4 pC which is right around the typical value of 5 pC expected for this device in typical operating conditions.

The top scope shows the square wave being sent through the device. The bottom scope shows a close up of the charge injection event.

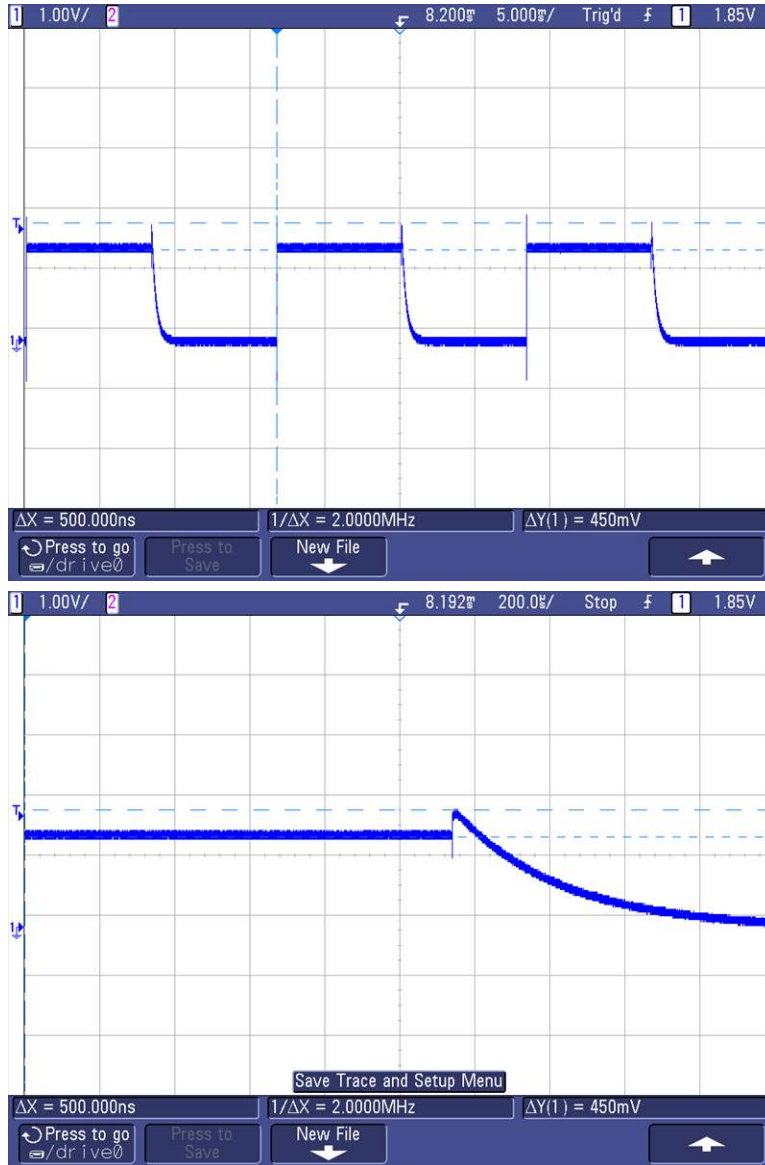


Figure 5-1. Charge Injection

## 6 PCB Layouts

Figure 6-1 and Figure 6-2 show the EVM PCB layout images.

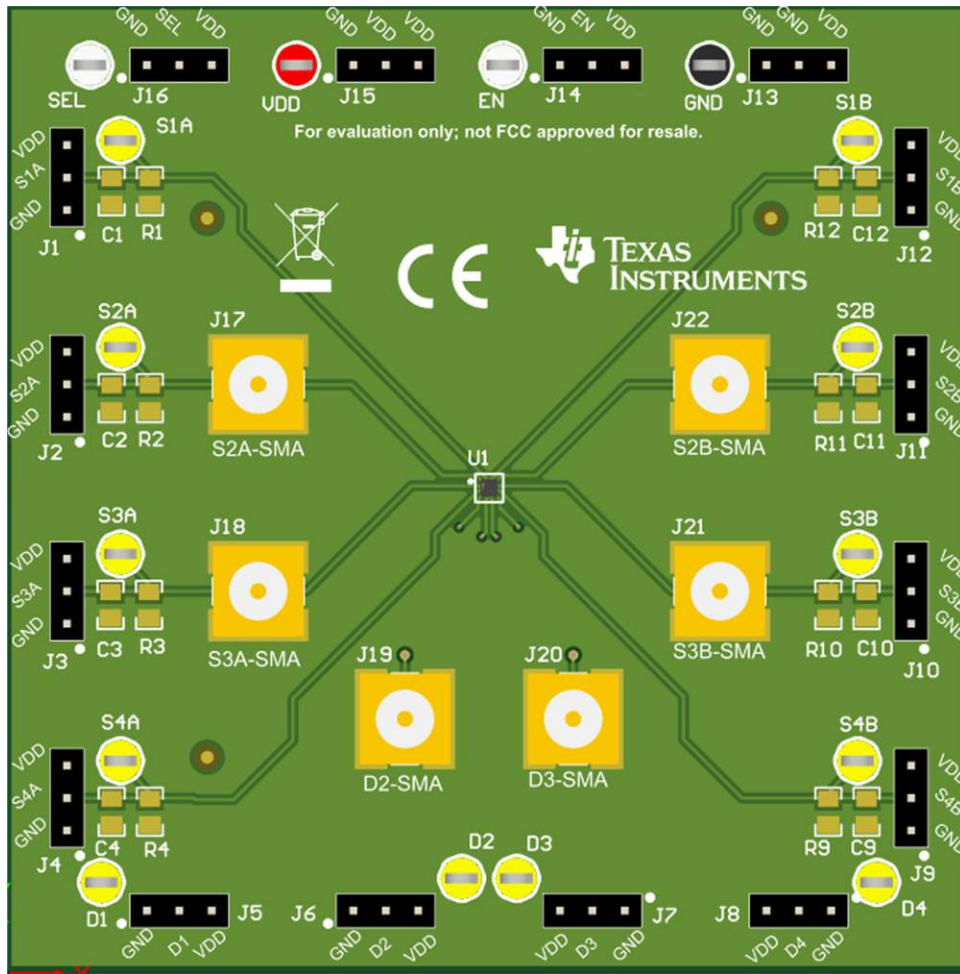
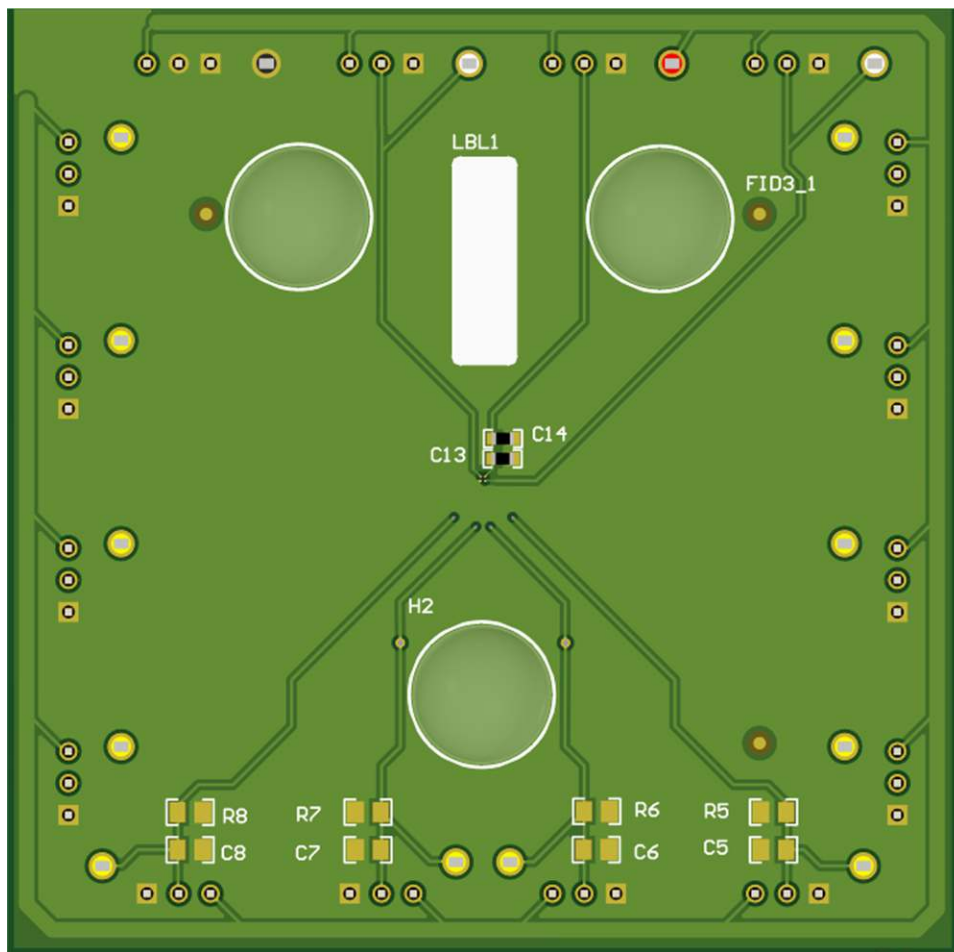


Figure 6-1. TMUX1575EVM Layout (Front)

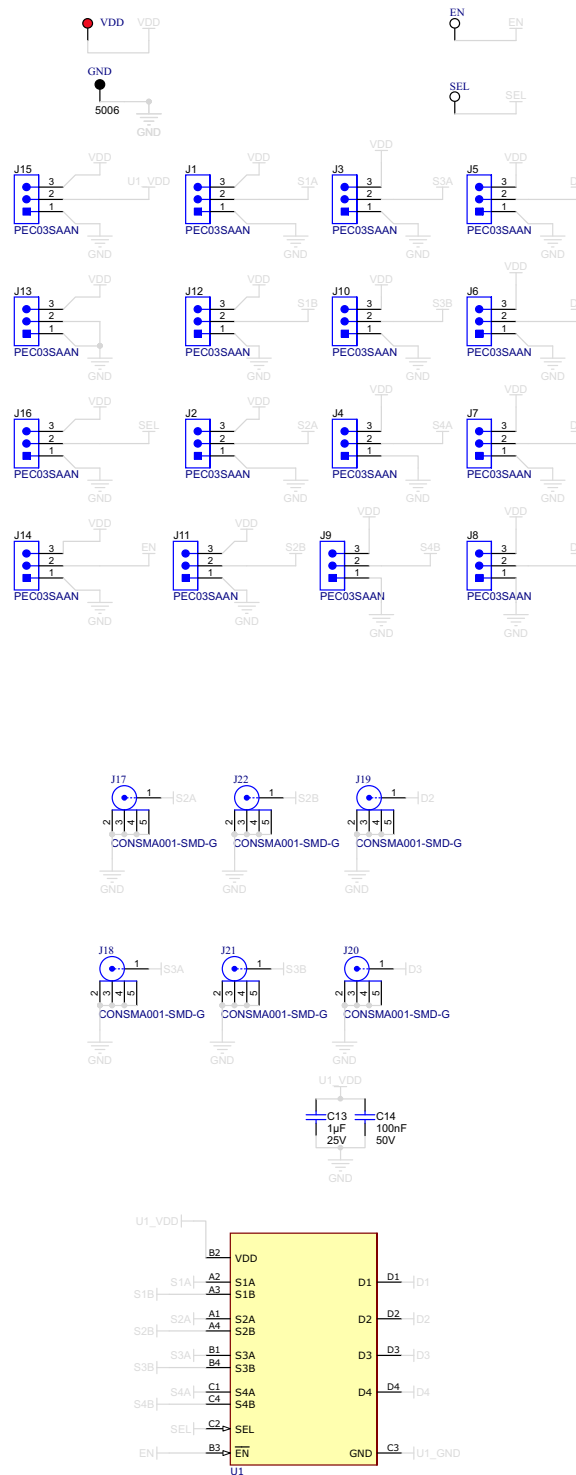




**Figure 6-2. TMUX1575EVM Layout (Back)**

## 7 Schematics

Figure 7-1 illustrates the EVM schematic.





**Figure 7-1. TMUX1575 Schematic Print**

## 8 Bill of Materials

Table 8-1 details the EVM bill of materials.

**Table 8-1. TMUX1575EVM Bill of Materials**

Designator	Part Number	Description	QTY	Manufacturer 1
U1	TMUX1575YCJR	2:1 (SPDT) 4-Channel, Powered-Off Protected Switch in WCSP with 1.8 V Logic	1	Texas Instruments
H1, H2, H3, H4	SJ-5303 (CLEAR)	Bumpon, Hemisphere, 0.44 X 0.20, Clear	4	3M
C2	C0603C104K5RACAUTO	CAP, CERM, 0.1 $\mu$ F, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	1	Murata
C1	GCM188R71E105KA64D	CAP, CERM, 1 $\mu$ F, 25 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	1	Murata
J1, J2, J3, J4, J5, J6, J7, J8, J9, J10, J11, J12, J13, J14, J15, J16	PEC03SAAN	Header, 100mil, 3x1, Tin, TH	16	Sullins
J18, J23, J24, J27, J28, J29	CON SMA001-SMD-G	Jack, SMA, PCB, Gold, SMT	6	Linx Technologies
R10, R12, R14, R15, R16, R18, R19, R20, R22, R24, R26, R30, R31, R34, R35, R36	ERJ-6GEY0R00V	RES, 0, 5%, 0.125 W, AEC-Q200 Grade 0, 0805	16	Panasonic
GND	5006	Test Point, Compact, Black, TH	1	Keystone Electronics
VDD	5005	Test Point, Compact, Red, TH	1	Keystone Electronics
EN, SEL	5007	Test Point, Compact, White, TH	2	Keystone Electronics
D1, D2, D3, D4, S1A, S1B, S2A, S2B, S3A, S3B, S4A, S4B	5009	Test Point, Compact, Yellow, TH	12	Keystone Electronics

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### 3 Regulatory Notices:

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##### 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.

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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.

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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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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:*
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