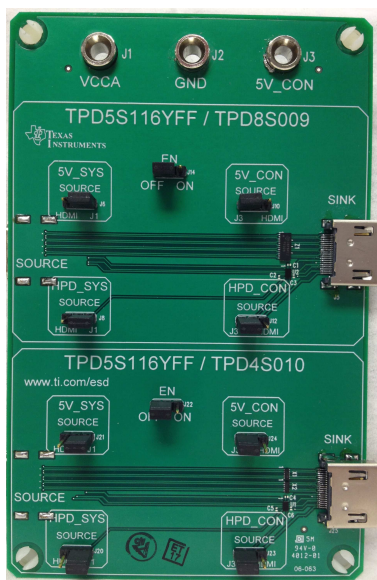


TPD5S116EVM

TPD5S116 is a single-chip HDMI interface device with auto-direction sensing I2C voltage level shift buffers, 5V HDMI compliant current limited load switch, hot-plug-detect, and integrated ESD protection clamps for all HDMI connector side pins. The device pin mapping can be routed to either HDMI Type D or Type C connector. An internal 3.3V node powers the CEC connector side pull-up resistor, eliminating the need for a 3.3V supply on board. TPD5S116 integrates all external termination resistors at the HPD, CEC, SCL, and SDA lines. There are three non-inverting bi-directional translation circuits for the SDA, SCL, and CEC lines. Each has a common power rail (VCCA) on system side from 1.1 V to 3.6V. A 55mA current limiting switch regulates current sent from 5V_SYS to 5V_CON. The SCL and SDA pins meet the I2C specification and can drive up to 750 pF capacitive loads, which exceeds HDMI1.4 specifications. The HPD_CON port has a glitch filter to avoid false detection due to plug bouncing during the HDMI connector insertion. The TPD5S116 offers reverse current blocking at the 5V_CON pin. In fault conditions, such as when two HDMI transmitters are connected to the same HDMI cable, TPD5S116 ensures that the system is safe from powering up through external HDMI transmitter. The SCL_CON, SDA_CON, CEC_CON pins also feature reverse-current blocking, which ensures that the system sees no leakage if an HDMI receiver is connected while the transmitting system is powered off.

The EN pin enables the hot-plug detect and load switch. The level shifters are enabled after a valid HPD signal is detected.



1 Highlighted Features

- Conforms to HDMI Compliance Tests without any External Components
- Supports HDMI 1.4 and HDMI 1.3 Standards
- Match HDMI Connector Pin Mapping
- Internal DC-DC Converter to Generate 5V from a 2.3-5.5V Battery Voltage
- Auto-direction sensing Level Shifting in the CEC, SDA, and SCL paths
- IEC 61000-4-2 (Level 4) System Level ESD Compliance
- Reverse current blocking and short-circuit protection to protect against fault conditions
- Industrial Temperature Range: –40°C to 85°C

2 Applications

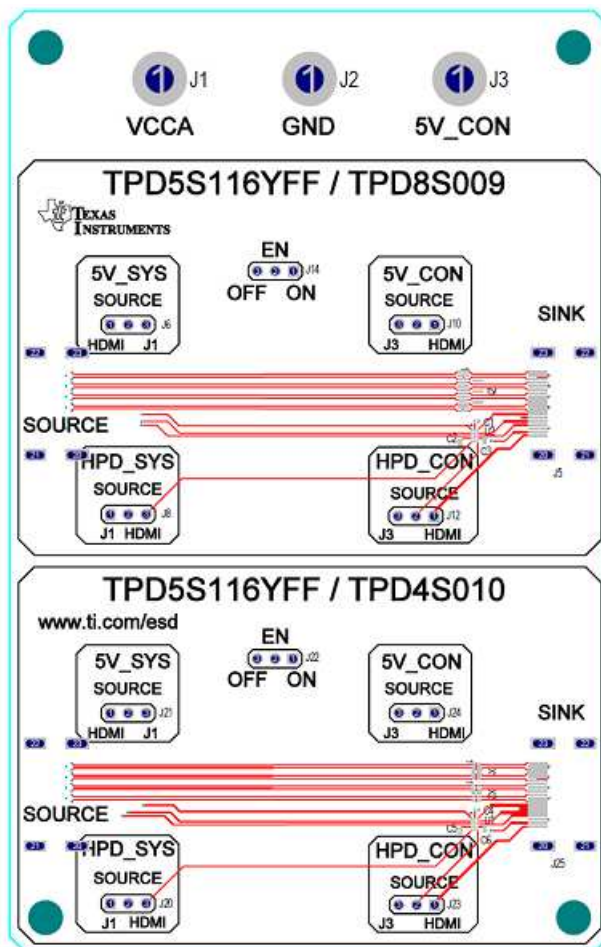
- Smart Phones
- eBook
- Tablet PC
- Digital Camcorders
- Portable Game Console
- Digital Still Cameras

3 EVM Description

The TPD5S116EVM provides full functionality of TPD5S116. In addition to TPD5S116, protection for the TMDS lines has been added in the form of TPD8S009 and two TPD4S010's. Type-A HDMI connectors provide for breakout boards or HDMI cable connections for both the System side and Sink Side.

The 5V needs to be supplied at VCCA in order to enable TPD5S116 by the EN jumper.

Jumpers are provided for the System Side and Sink Side. For the System Side, 5V_SYS can be supplied by either the SOURCE HDMI port or VCCA at J1. HPD_SYS is similarly supplied. For the Sink Side, 5V_CON can be supplied by either the SINK HDMI port or 5V_CON at J3. HPD_CON is similarly supplied. This allows evaluation of TPD5S116 with only one HDMI breakout board.



Jumper Configurations		
EN	Sets EN pin low	Sets EN pin high in reference to VCCA
5V_SYS	Supply 5V_SYS from SOURCE HDMI	Supply 5V_SYS from VCCA
HPD_SYS	Supply HPD_SYS from SOURCE HDMI	Supply HPD_SYS from VCCA
5V_CON	Supply 5V_CON from SINK HDMI	Supply 5V_CON from 5V_CON / J3
HPD_CON	Supply HPD_CON from SINK HDMI	Supply HPD_CON from 5V_CON / J3

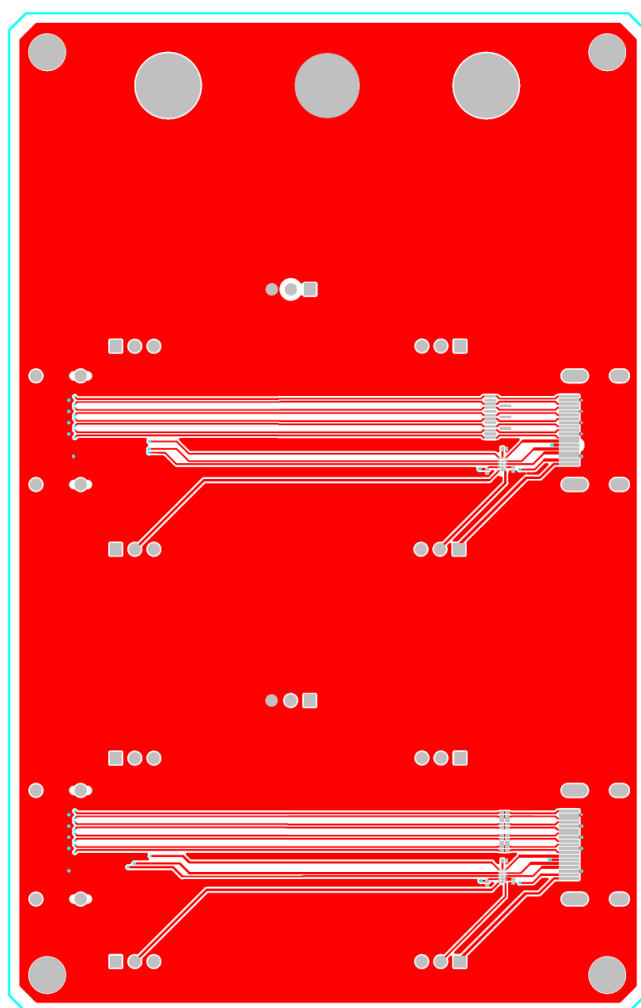


Figure 1. Top Layer of TPD5S116EVM

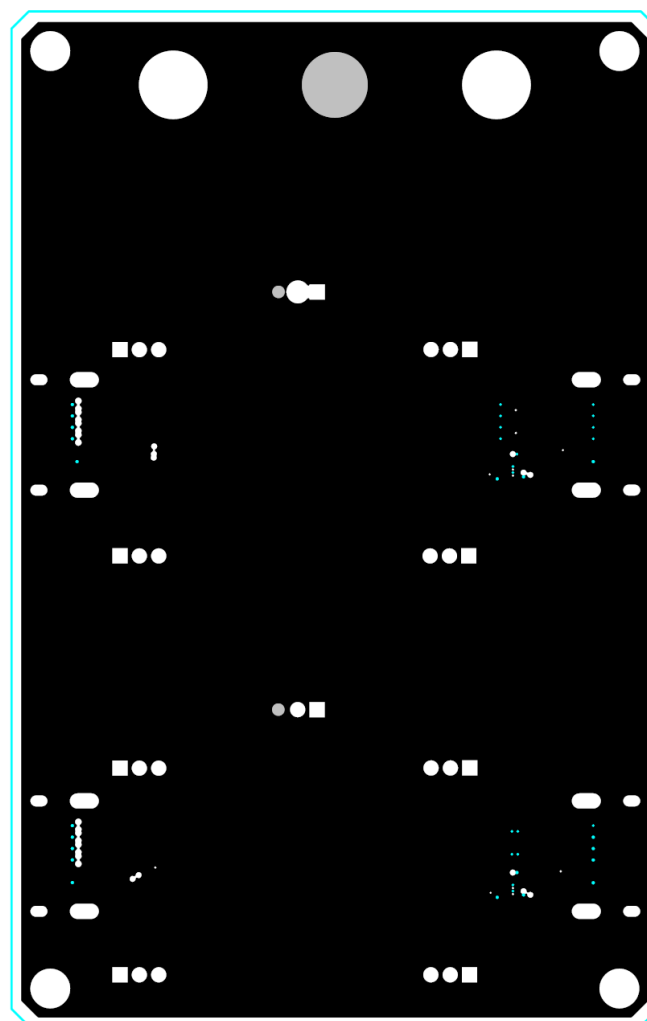


Figure 2. Layer 2 of TPD5S116EVM

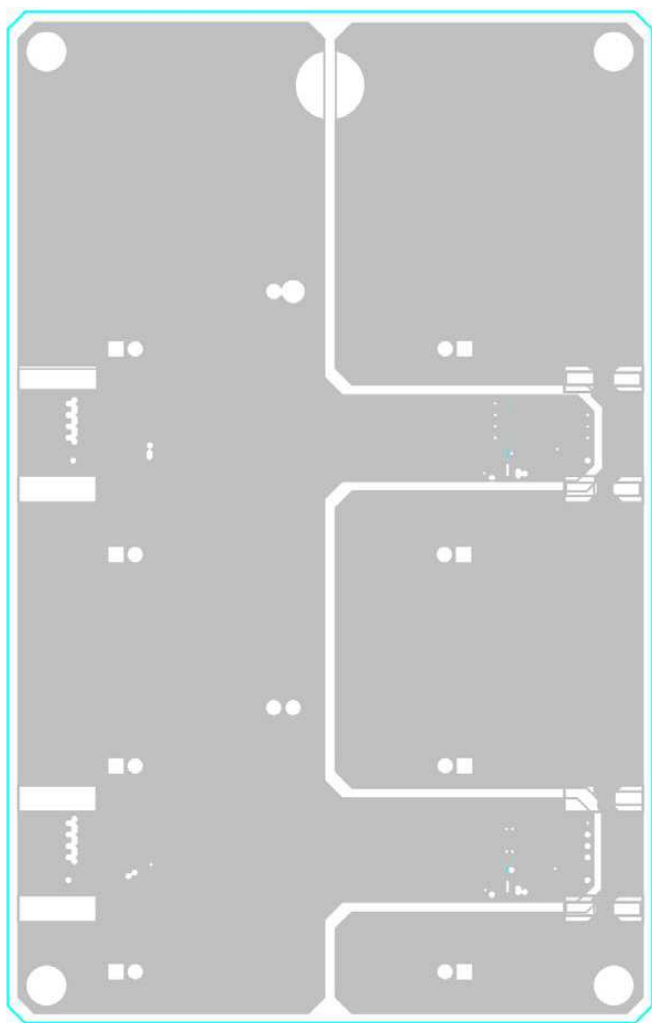


Figure 3. Layer 3 of TPD5S116EVM

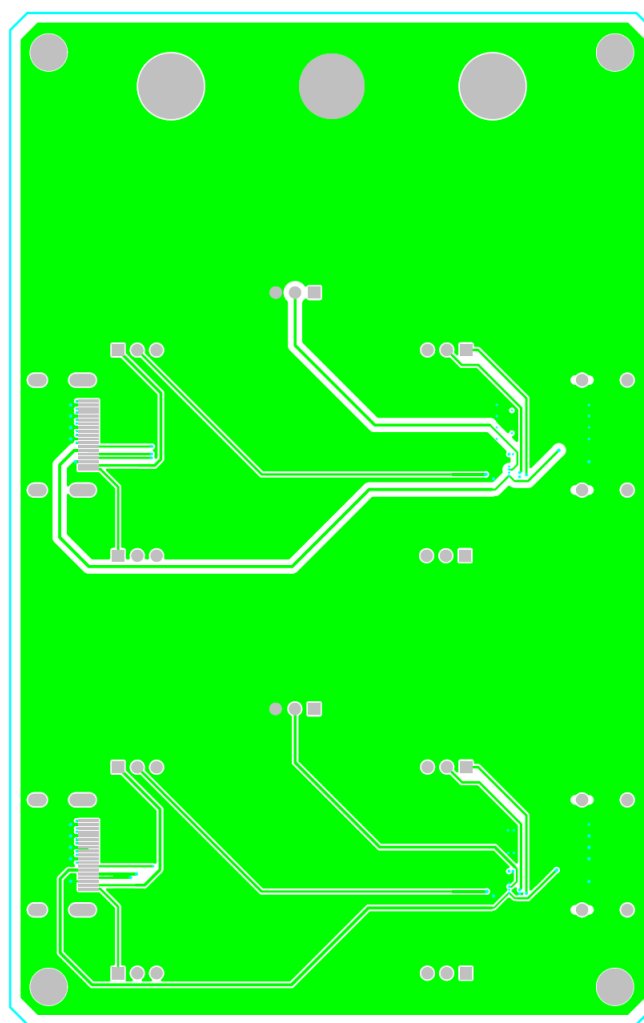


Figure 4. Bottom Layer of TPD5S116EVM

4 Schematics and Bill of Materials

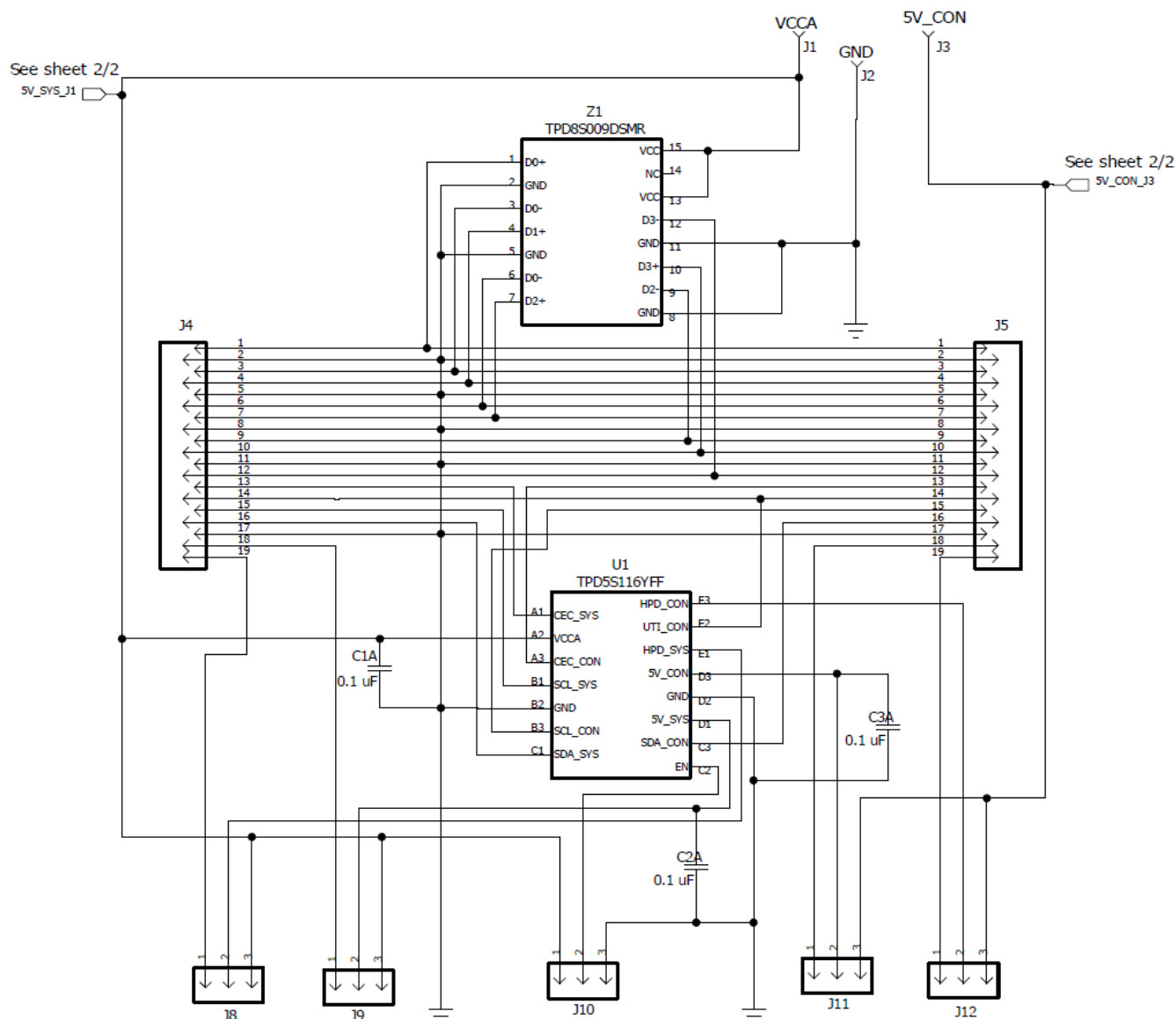


Figure 5. Schematic Drawing: TPD5S116/TPD8S009

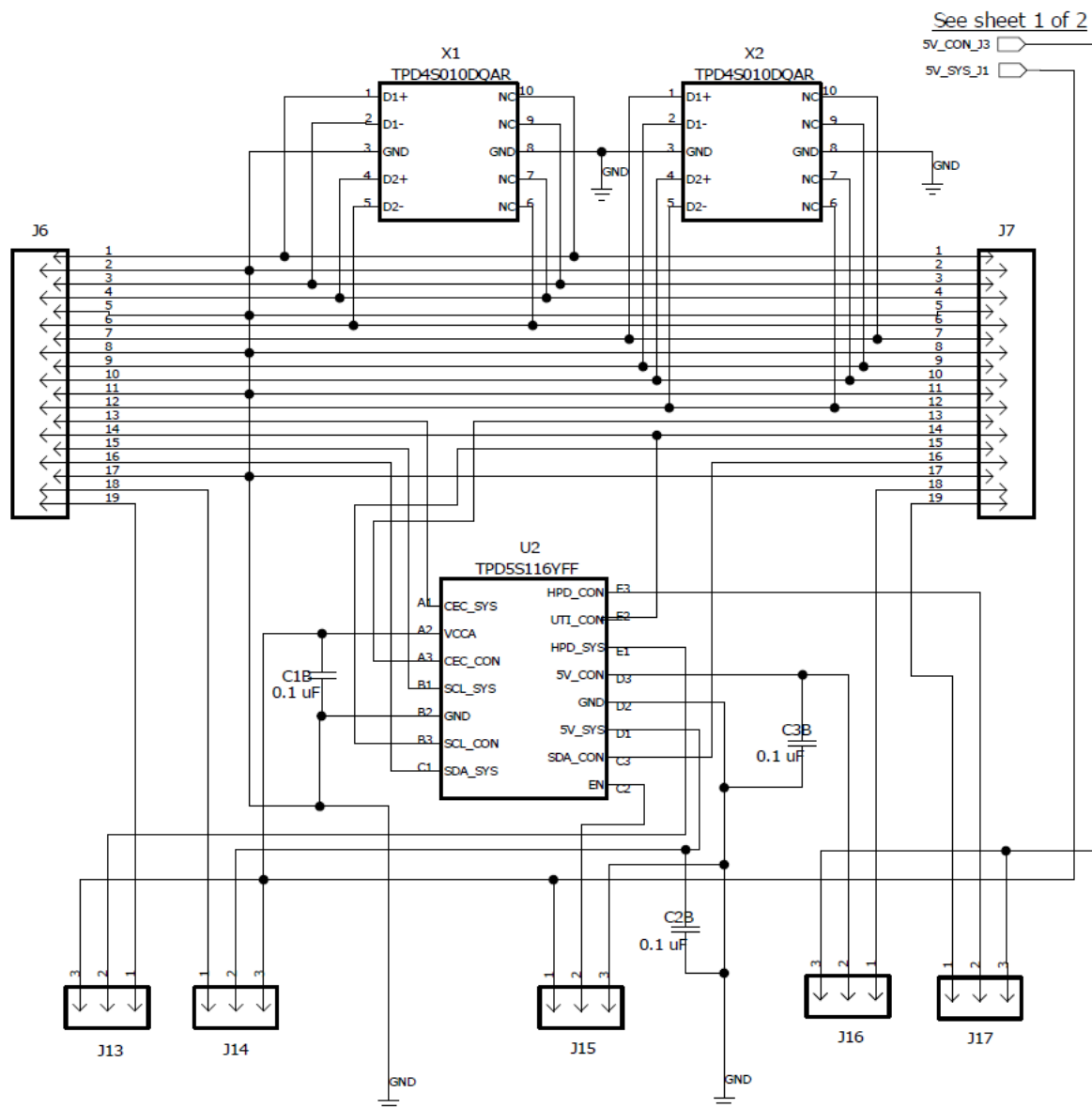


Figure 6. Schematic Drawing: TPD5S116/TPD4S010

Table 1. Bill of Materials

Qty	RefDes	Size	Value	Description	Part Number	MFR	Part Name
6	C1-6	201	0.1 u	Capacitor, Ceramic Chip, 10V, ±10%	C0603X5R0J104K	TDK	C0201,0.1 u
3	J1-3	0.203 dia. inch	5V_SUPPLY	Connector, Banana Jack, Un-insulated	575-4	Keystone	CONN_BANANA_PLUG_IN
4	J4-5 J15 J25	12.50 x 15.00 mm	SD-47151-001	Connector, HDMI , RA, 19 pin - A Type	47151-0001	Molex	CONN_HDMI_SD-47151-001
10	J6 J8 J10 J12 J14 J20-24	0.100 inch x 3	PEC03SAAN	Header, Male 3-pin, 100mil spacing,	87224-3	TE Connectivity	HEADER_1X3
10	J6 J8 J10 J12 J14 J20-24	0.100 x 2	NA	SHUNT, ECON, PHBR 5AU, BLACK	382811-8	TE Connectivity	NA
2	X1-2	SON	TPD4S010DQAR	IC, 4-Channel ESD Solution for High-Speed Differential Interface	TPD4S010DQAR	TI	TPD4S010DQAR
2	U1-2	BGA	TPD5S116YFF	IC, HDMI Port Protector and 5V Current Limited Load Switch;	TPD5S116YFF	TI	TPD5S116YFF
1	Z1	SON	TPD8S009DSMR	IC, 8-Chan Display/HDMI Port ESD Protection	TPD8S009DSMR	TI	TPD8S009DSMR

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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.

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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.

Texas Instruments Japan Limited
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<http://www.tij.co.jp>

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

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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.

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