

EVM User's Guide: TPLD2001-DGS-EVM

TPLD2001-DGS-EVM Evaluation Module



Description

The TPLD2001DGS evaluation module (EVM) is part of the TI Programmable Logic Device (TPLD) family of devices that feature versatile programmable logic ICs with combinational logic, sequential logic and mixed-signal functions to provide an integrated, compact, low power design to implement common system functions, such as timing delays, voltage monitors, system resets, power sequencers, and I/O expanders.

The TPLD2001 helps users to configure TPLD2001DGS devices without requiring the soldering of the devices to the board. Users can utilize InterConnect Studio (ICS) for fast evaluation, development, simulation, and programming. Once programmed, TPLD devices can be removed from the socket and placed in a user's system.

Get Started

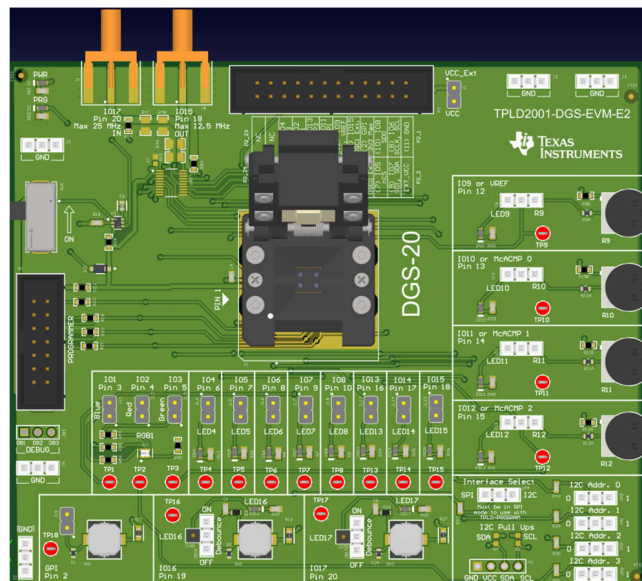
1. Order the TPLD2001-DGS-EVM and TPLD-PROGRAM
2. Download the latest version of [InterConnect Studio \(ICS\)](#)
3. Use the cables included the TPLD-PROGRAM kit to connect the system
4. Place an unprogrammed TPLD2001DGS into the socket and configure using ICS

Features

- DGS socket for easy programming and evaluation of TPLD2001DGS
- Input buttons, potentiometers, and output LEDs for quick evaluation
- Header pins and test points for interfacing with custom systems
- Interfaces with TPLD-PROGRAM using a standard keyed 14-pin cable

Applications

- [Factory automation and control](#)
- [Communications equipment](#)
- [Retail automation and payment](#)
- [Test and measurement](#)
- [Pro audio, video and signage](#)
- [Personal electronics](#)



1 Evaluation Module Overview

1.1 Introduction

This user's guide contains support documentation for the TPLD2001DGS evaluation module (EVM). Included is a description of how to set up and configure the EVM, how to use the EVM in conjunction with a TPLD-PROGRAM board, and how to use InterConnect Studio to configure the TPLD2001. Also included are the printed circuit board (PCB) layout, the schematic, and the bill of materials (BOM) of the TPLD2001-DGS-EVM.

Note

To program devices, the TPLD-PROGRAM board and InterConnect Studio are required.

TI only supports the use of the cables provided in the TPLD-PROGRAM kit to interface between the EVM and the programmer board.

1.2 Kit Contents

Table 1-1. TPLD2001-DGS-EVM Kit Contents

Item	Description	Quantity
TPLD2001-DGS-EVM	PCB	1
TPLD2001DGS	20-pin TI Programmable Logic Device	5
Quick start guide	Guide to setup system	1

1.3 Specification

Table 1-2. TPLD2001-DGS-EVM Specification

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Vcc	Powered by programmer		3.3		V
Vcc	External Power	1.71		5.5	V
Vi	Per pin input	0		Vcc	V
Vo	Per pin output	0		Vcc	V
GPI	Input	0		Vcc	V

1.4 Device Information

The TPLD2001 is part of the TI programmable logic device (TPLD) family of devices that features configurable I/O structures that extends compatibility within mixed-signal environments, reducing the number of discrete components required. System designers can create circuits and configure the macro-cells, I/O pins, and interconnections by temporarily emulating the non-volatile memory or by permanently programming the one-time programmable (OTP) through InterConnect Studio.

2 Hardware

2.1 Functional Blocks

This section covers the different functional blocks of the TPLD2001-DGS-EVM.

2.1.1 Test Points

Each GPIO and GPI pin of an socketed TPLD2001DGS part is connected directly to a test point to allow a user to access each pin of the device for probing and testing. The pins are connected to test points as follows:

Pin Number	IO name	Test Point
2	GPI	TP18
3	IO1	TP1
4	IO2	TP2
5	IO3	TP3
6	IO4	TP4
7	IO5	TP5
8	IO6	TP6
9	IO7	TP7
10	IO8	TP8
12	IO9	TP9
13	IO10	TP10
14	IO11	TP11
15	IO12	TP12
16	IO13	TP13
17	IO14	TP14
18	IO15	TP15
19	IO16	TP16
20	IO17	TP17

Each test point is connected directly to the corresponding pin, so any disconnected header pins do not disconnect the test points from the pins.

2.1.2 Programmer Header Block (P1)

The programmer header block accepts the 14-position cable used to connect the TPLD2001-DGS-EVM to the TPLD-PROGRAM. TI recommends using this header to connect only to the TPLD-PROGRAM using the cables included in the TPLD-PROGRAM kit. The header is keyed, so the 14-position cable can only be inserted to the case with the key facing the correct direction. To connect the TPLD2001-DGS-EVM to a TPLD-PROGRAM, follow the steps in [Section 3.2](#).

SW3 connects the 3V3 line of the programmer header to the VCC line of the EVM. When powering the EVM from the TPLD-PROGRAM, the 3V3 line must be in the ON position.

2.1.3 External Connection Header Block

The P2 header block is intended to be used to interface the TPLD2001-DGS-EVM with an external system. Using the guide printed on the EVM silkscreen, the TPLD pins can be interfaced with an external system to allow for prototyping and testing in customer systems. When supplying power to the TPLD using the P2 header block, SW3 needs to be in the OFF position and a shunt placed on J1, connecting the external VCC supply from P2 (VCC_EXT) to the VCC net of the EVM. TI recommends not connecting the board to an external system and to the TPLD-PROGRAM at the same time to avoid the risk of damage to the TPLD-PROGRAM and the external system.

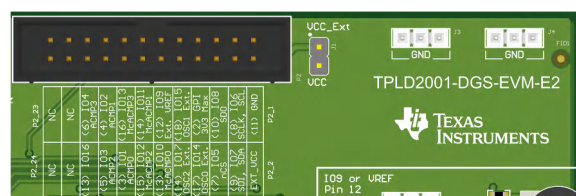


Figure 2-1. P2 and J1 Headers

2.1.4 GPI Protection Block

During the permanent programming process, 8V is applied to the GPI pin of the TPLD. This circuit prevents the voltage at P2 from exceeding 3.3V.

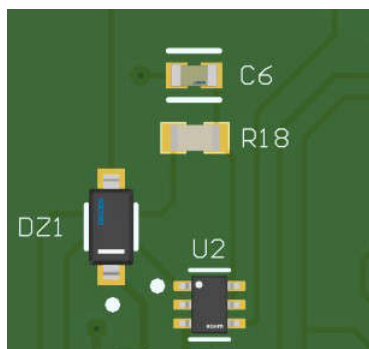


Figure 2-2. GPI Protection Block

2.1.5 DGS Socket

The DGS socket for testing and programming TPLD devices without soldering a device to the EVM.

To place a device in the socket, follow the steps in [Section 3.2](#).

2.1.6 I2C Address Block

The TPLD2001 has an optional I2C address hardware configuration feature that allows the TPLD2001's I2C address to be set via the state of certain pins on device start-up. This block contains pull-up and pull-down resistors that can be used to set the I2C address of the TPLD2001. To set the device's I2C address, use shunts to set each bit of the address as either 1 or 0. To set a bit as 1, place a shunt between the middle pin of the address bit and the pin labeled 1. To set a bit as 0, place a shunt between the middle pin of the address bit and the pin labeled 0.

I2C Address Bit	Pin Number	IO Name
0	7	IO5
1	6	IO4
2	5	IO3
3	4	IO2

2.1.7 Interface Select Block

The TPLD2001 can be programmed with either I2C or SPI. During device start up, an unprogrammed TPLD selects either SPI or I2C by which to be programmable. This selection is made by the voltage on IO1 during start up. If the voltage is high, the device starts up in SPI mode. If the voltage is low, the device starts up in I2C mode. The device has an internal pull down on that pin, so it defaults to I2C mode.

The Interface Select block consists of a 3-state switch select either SPI mode (pull up) or I2C mode (pull down).

To prevent conflicts when programming a TPLD whose address has been pre-configured, the TPLD-PROGRAM uses SPI to communicate with the device in the socket. This means that the Interface Select block must be set to SPI mode to program the device with a TPLD-PROGRAM.

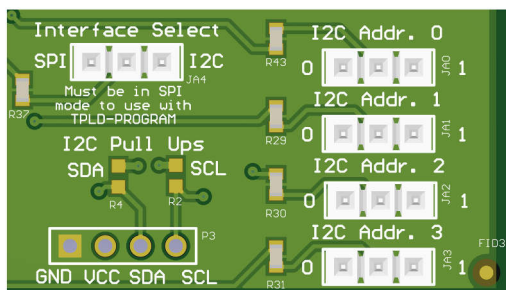


Figure 2-3. I2C Address and Interface Select Blocks

2.1.8 High-Frequency Input and Output

The TPLD2001 can support up to 25MHz, but for frequencies that high, the parasitics on long, non-impedance matched traces can disrupt the signal. The TPLD2001 EVM has a pair of SMB connectors for high frequency input and outputs.

To use the high-frequency input, first, disconnect R14. This will disconnect the high-frequency input trace from the rest of the board, decreasing parasitics. Then, solder 200Ω resistors in soldering points R47, R48, R49, and R15. This is equivalent to a 50Ω pull down resistor on the line for impedance matching. The high-frequency input has a limit of 25MHz and connects to IO17.

To use the high-frequency output, ensure a 50Ω resistor is soldered to R50 for impedance matching. The high-frequency output is output from IO15 and has a limit of 12.5MHz.

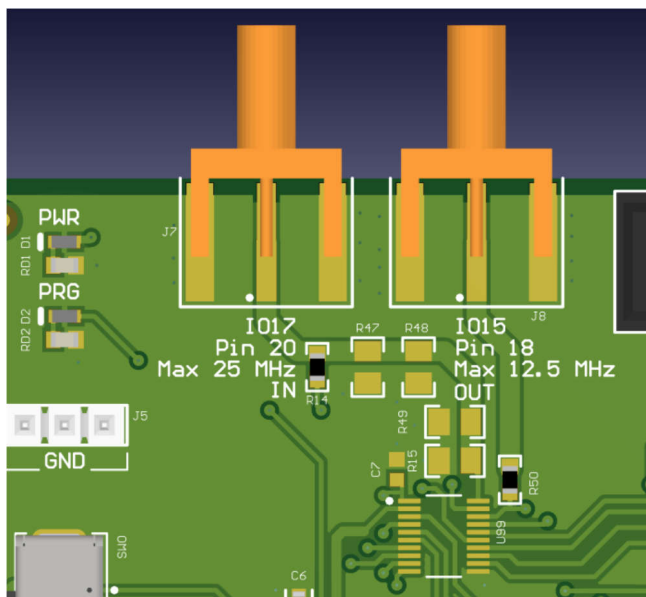


Figure 2-4. High-Frequency IOs

2.2 GPIO Testing Blocks

The 18 GPIO pins on the device are connected to various testing blocks to allow for prototyping. These connections are indicated by the table below.

Pin Number	IO Name	Testing Block	Testing Block Name
2	GPI	SW	SW1
3	IO1	RGB LED	RGB1 (Blue)
4	IO2	RGB LED	RGB1 (Red)
5	IO3	RGB LED	RGB1 (Green)
6	IO4	LED	LED4
7	IO5	LED	LED5
8	IO6	LED	LED6
9	IO7	LED	LED7
10	IO8	LED	LED8
12	IO9	LED/POT	LED9/R9
13	IO10	LED/POT	LED10/R10
14	IO11	LED/POT	LED11/R11
15	IO12	LED/POT	LED12/R12
16	IO13	LED	LED13
17	IO14	LED	LED14
18	IO15	LED	LED15
19	IO16	LED/SW	LED16/SW2
20	IO17	LED/SW	LED17/SW3

2.2.1 LED Blocks

Each LED block consists of an LED that can be connected or disconnected from the TPLD pin via a header. To connect the LED to the corresponding pin, place a shunt on the corresponding header between the two header pins.

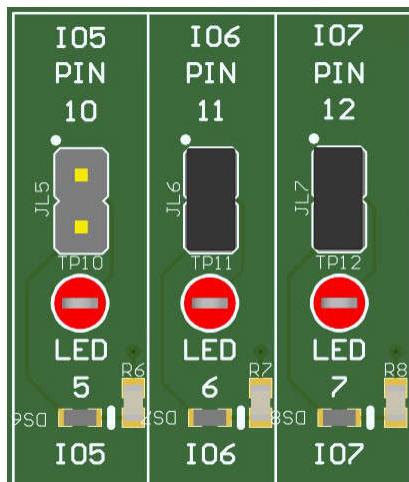


Figure 2-5. LED Blocks

2.2.2 Switch Blocks

Each SW block consists of a tactile switch and an optional debounce circuit. The switch can be connected to the corresponding TPLD pin via a 3-position header. One side of the 3-position header, labeled OFF, connects directly to the switch output, and the other side of the 3-position header, labeled ON, connects to a debounce circuit leading to the switch output. The middle pin of the header connects to the corresponding TPLD pin. To connect directly to the switch output, place a shunt between the middle pin of the header and the OFF pin. To connect to the debounce circuit, place a shunt between the middle pin of the header and the OFF pin. If no shunt is placed between either set of pins, the switch is not connected to the TPLD pin.

Note

The debounce circuit must not be connected on the GPI pin during programming.

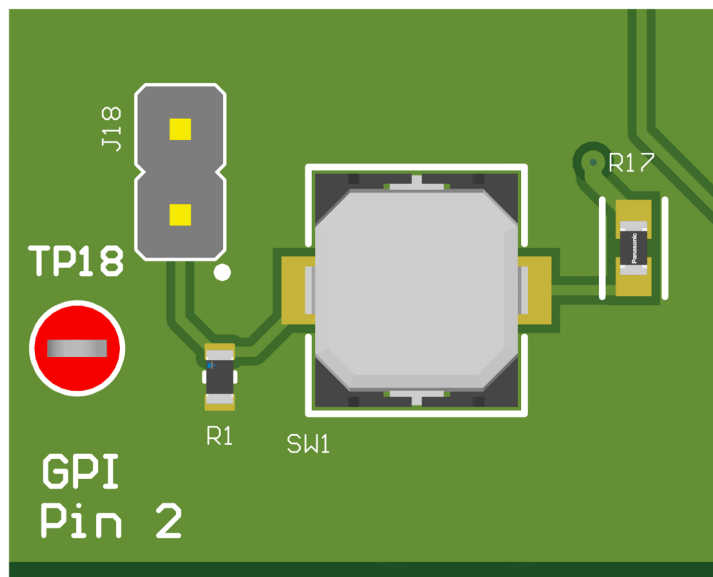


Figure 2-6. Switch Blocks

2.2.3 LED/Potentiometer Blocks

Each LED/POT block consists of a 3-state header pin that can be used to connect the corresponding GPIO pin to either an analog voltage source or an LED. The middle pin of the header connects to the corresponding GPIO pin of the TPLD. The left side of the header pin, marked LED, connects to the LED. The right side of the header pin, marked R, leads to the analog voltage source. To connect the corresponding GPIO to the LED, place a shunt between the middle pin and the LED pin. To connect the GPIO to the analog voltage source, place a shunt between the middle pin and the R pin.

The analog voltage source consists of a voltage divider using a POT. When the POT is turned fully clockwise, the analog voltage source outputs at most 0.2V. When the POT is turned fully counterclockwise, the analog voltage source outputs at least $V_{CC} - 0.2V$.

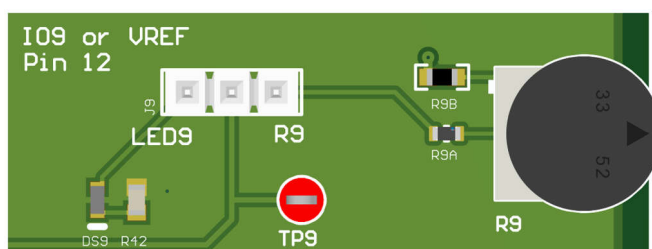


Figure 2-7. LED/POT Blocks

2.2.4 LED/Switch Blocks

Each LED/switch block consists of a 4-position header that can be connected to a tactile switch with an optional debounce circuit, or to an LED. One side of the 4-position header, labeled OFF, connects directly to the switch output, and the other side of the 4-position header, labeled ON, connects to a debounce circuit leading to the switch output. The pin labeled LED connects to an LED. The middle pin of the header connects to the corresponding TPLD pin. To connect directly to the switch output, place a shunt between the middle pin of the header and the OFF pin. To connect to the debounce circuit, place a shunt between the middle pin of the header and the ON pin. To connect to the LED, place a shunt between the middle pin of the header and the LED pin. If no shunt is placed between any set of pins, then the TPLD pin is floating.

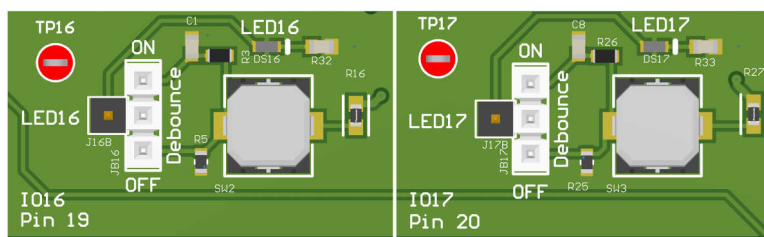


Figure 2-8. LED/Switch Blocks

2.2.5 RGB LED Block

The RGB LED block consists of a 3-input RGB LED with independent red, green, and blue inputs. Each input is controlled by a different TPLD output. To connect the LED to the corresponding pin, place a shunt on the corresponding header between the two header pins.

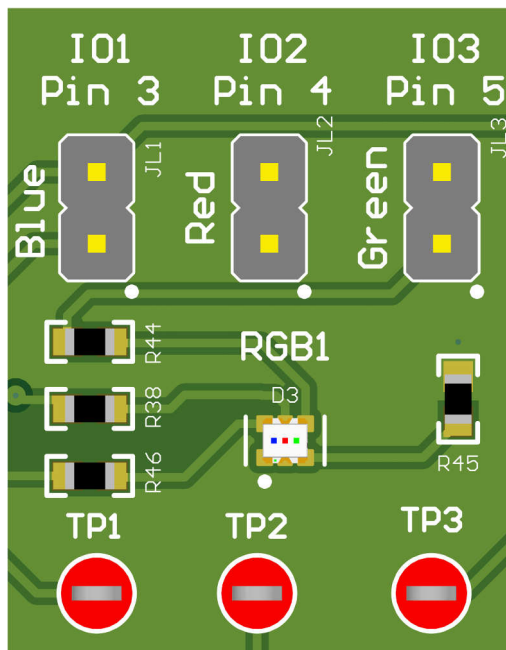


Figure 2-9. RGB LED Block

3 Software

3.1 Using the TPLD2001-DGS-EVM

This section covers using the TPLD2001-DGS-EVM to demo and program TPLD2001. For more help using InterConnect Studio (ICS) to create your own circuit, see the InterConnect Studio User's Guide.

3.1.1 Equipment Needed for Programming

To program a TPLD device with the TPLD2001-DGS-EVM, a TPLD-PROGRAM kit and a computer running InterConnect Studio are needed. The TPLD-PROGRAM kit includes everything required to interface a computer to the TPLD2001-DGS-EVM. InterConnect Studio can be downloaded from TI.com by following the instructions in [Section 3.1.2](#).

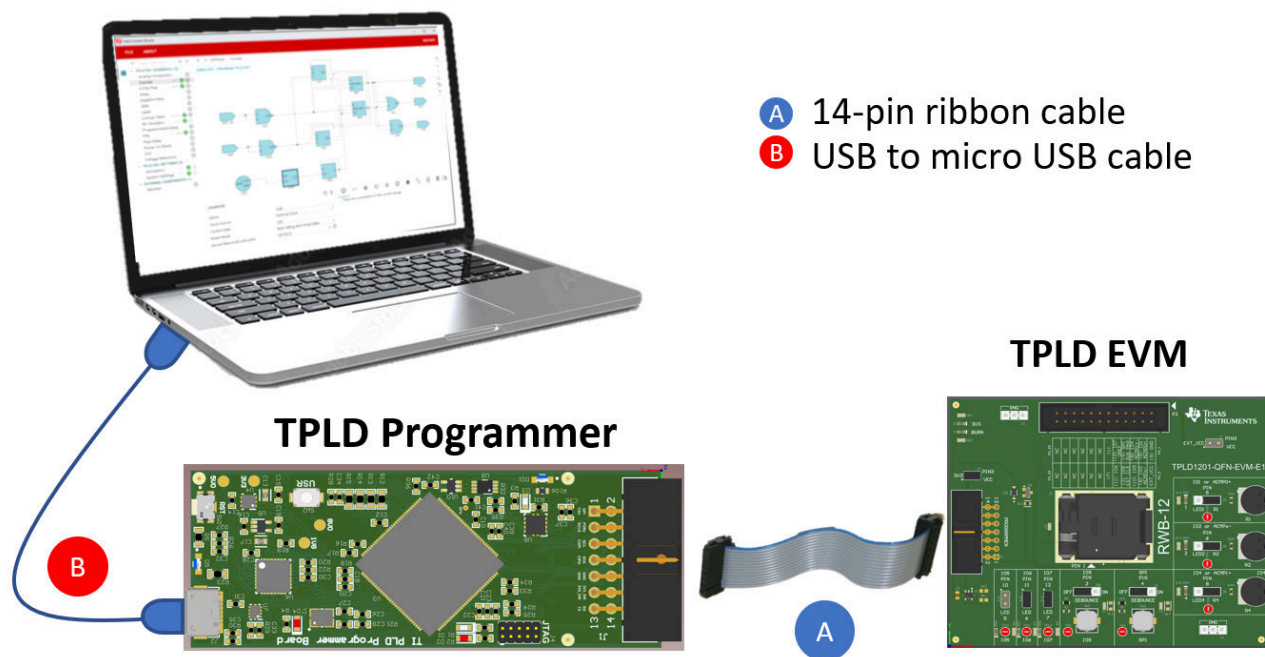


Figure 3-1. Connecting a TPLD EVM and Programmer

3.1.2 Installing Software

InterConnect Studio (ICS) is available free of charge at interconnect_studio.itg.ti.com

For more information on using InterConnect Studio (ICS), reference the InterConnect Studio User's Guide.

3.2 Configuring a TPLD Device

This section covers the steps to use the TPLD2001-DGS-EVM and a TPLD-PROGRAM kit to program a TPLD2001DGS.

3.2.1 TPLD2001-DGS-EVM Setup for Programming

To program with a TPLD-PROGRAM, make sure that the following conditions are met:

1. Set SW0 to the ON position
2. Remove the EXT_VCC (J1) jumper
3. Disconnect P2 from any external system
4. Set the Interface Select (JA4) jumper to select SPI

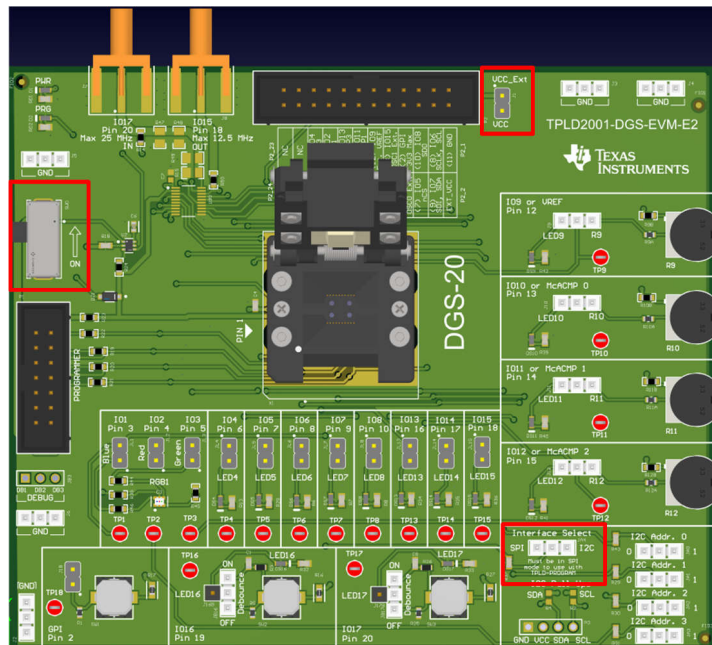


Figure 3-2. Components Considered in Programming Setup

3.2.2 Inserting a TPLD2001DGS into the DGS Socket

Do not remove, replace, or add a TPLD device to or from a powered board. Do not place fingers inside the socket or touch the contacts on the bottom of the socket. TI recommends following typical ESD protection procedures while handling the TPLD2001DGS.

1. Open the socket by gently pulling the latch until the lid snaps open.
2. Make sure that the socket is clean by blowing off socket contacts and device pads with clean compressed air.
3. Use a vacuum pen or antistatic tweezers to guide the part into the socket, aligning pin 1 of the part to pin 1 of the socket as shown below.
4. Close the socket lid until the latch snaps and holds the lid in place.

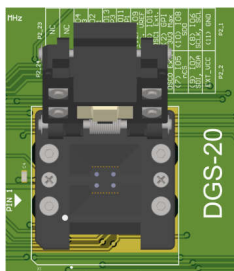


Figure 3-3. DGS Socket

3.2.3 Connecting the TPLD2001-DGS-EVM to a TPLD-PROGRAM Board

All cables included are keyed and can only be plugged in when facing the correct direction. If a cable cannot be inserted with the application of a gentle amount of force, try swapping the orientation of the cable and making sure that the header housings are unobstructed before trying again. Forcing the connections can cause damage to the cables and boards.

1. Connect the programmer board to a computer running InterConnect Studio using the provided USB cable. Make sure that a good connection is made between the TPLD-PROGRAM and the computer, indicated by the two blue LEDs on the TPLD-PROGRAM both being on. An example of a fully connected EVM can be seen in [Figure 3-1](#).
2. Connect the TPLD-PROGRAM to the TPLD2001-DGS-EVM using the provided 14-position ribbon cable. Make sure that a good connection is made between the TPLD2001-DGS-EVM and the TPLD-PROGRAM, indicated by the 3V3 LED in the top left of the EVM being on.

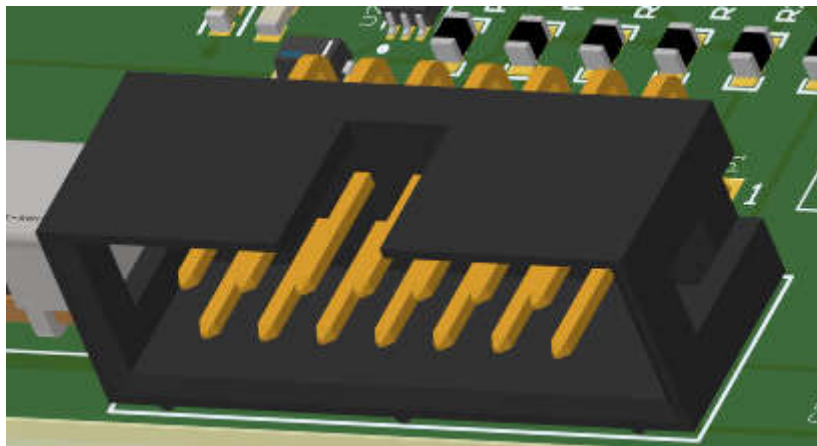


Figure 3-4. Keyed Header Socket

3.2.4 Temporarily Configuring a TPLD Device

When the TPLD is temporarily configured, removing power from the device causes the TPLD to reset and the configured circuit to be erased. The TPLD can be reconfigured multiple times without needing to be reset between configurations.

1. Open InterConnect Studio on the computer to which the TPLD-PROGRAM is connected. Under *Design*, select *TPLD2001*. Under *Package*:, select *DGS (VSSOP, 20)*.
2. Select a demo from the list of pre-designed circuits, or select *Empty Design* to build a custom circuit.

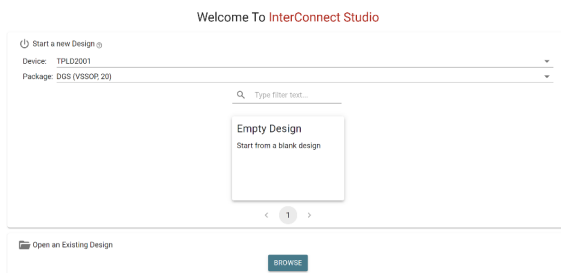


Figure 3-5. Opening a Design in ICS

3. InterConnect Studio opens the chosen circuit.
4. Select *CONFIGURE* in the top left corner of InterConnect Studio to configure the TPLD in the socket of the EVM with the circuit shown by InterConnect Studio. Select the serial port connected to the TPLD-PROGRAM, then select *OK*.

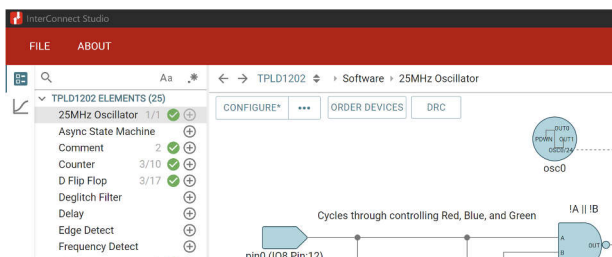


Figure 3-6. Temporarily Configuring in ICS

- a. Some LEDs on the TPLD2001-DGS-EVM flash during the programming sequence, which is normal.
- b. If the configuration fails, check the connections between the EVM and the computer, make sure SW0 is ON, check the connection between the TPLD device and the socket contacts, and retry.

Once the programming sequence is completed, the TPLD device on the board is temporarily configured with the circuit built in InterConnect Studio. The configured circuit can be tested using the buttons, potentiometers and LEDs provided on the EVM.

3.2.5 Permanently Programming a TPLD Device

This section covers using InterConnect Studio to permanently program a TPLD2001. Permanently programmed devices retain the configuration the devices are programmed with after power is reset.

Permanently programmed devices must not be permanently programmed again to avoid damaging the device.

1. Open the desired configuration to be permanently programmed in the TPLD2001 in InterConnect Studio.
2. Open the Configure Settings by selecting the three dots icon beside the **CONFIGURE** button.
3. Select **Permanently Configure Device**. If using a TPLD-PROGRAM to power the EVM, then leave the Power Source as **Programmer**. Select **OK**.

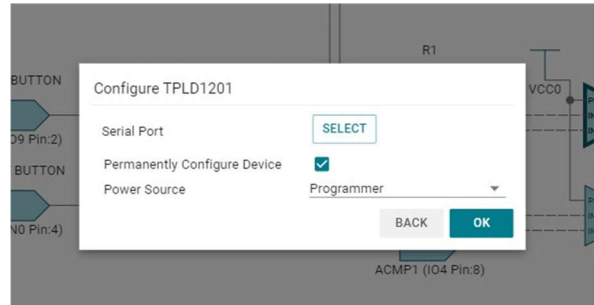
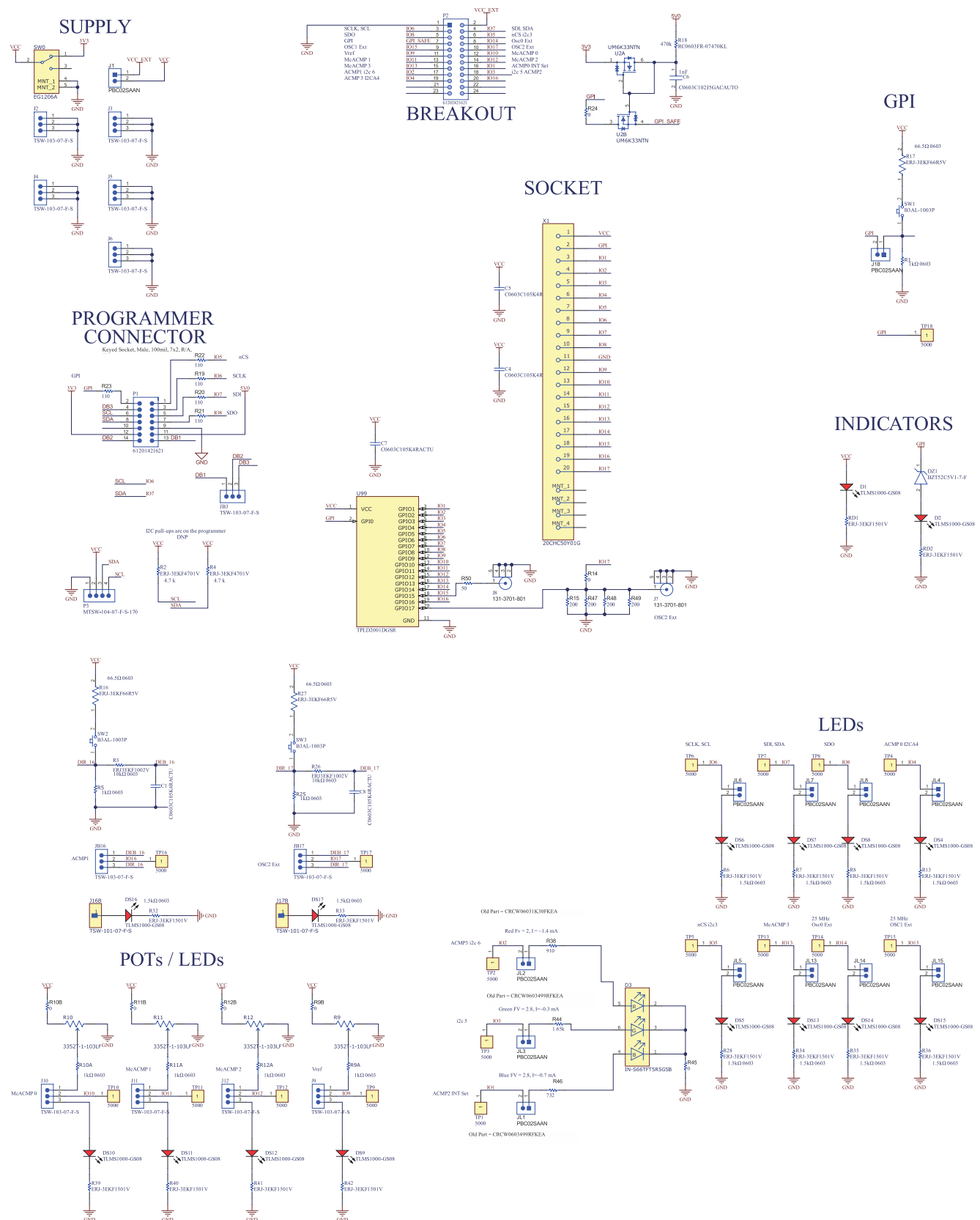


Figure 3-7. Permanent Programming in ICS

4. Select the serial port connected to the TPLD-PROGRAM, then select **OK** again.
 - a. Some LEDs on the TPLD2001-DGS-EVM may flash during the programming sequence, which is normal.
 - b. If the configuration fails, then check the connections between the EVM and the computer, make sure SW3 is ON, check the connection between the TPLD device and the socket contacts, and retry.
5. Remove power from the EVM before removing the permanently programmed TPLD2001.

4 Hardware Design Files

4.1 Schematics



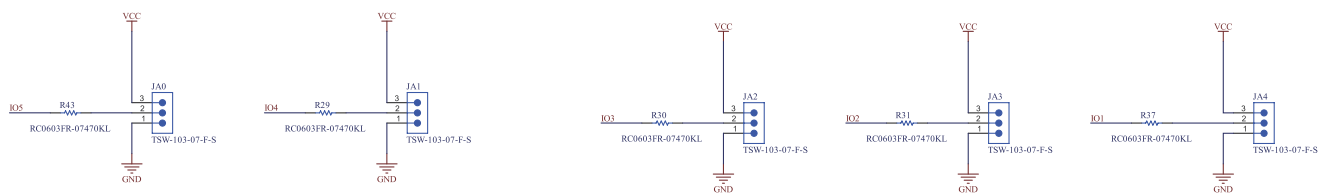


Figure 4-1. TPLD2001-DGS-EVM Schematic

4.2 PCB Layout

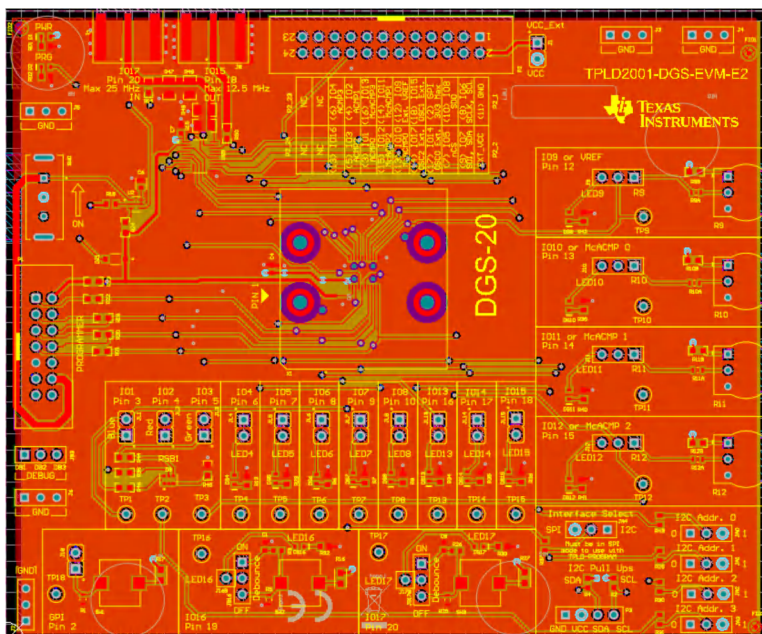


Figure 4-2. TPLD2001-DGS-EVM Layout

4.2.1 PCB Overview

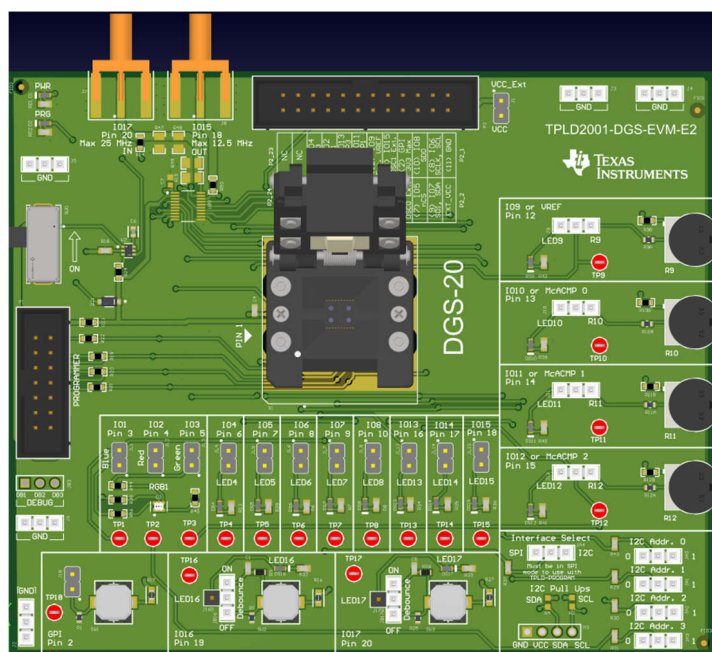


Figure 4-3. TPLD2001-DGS-EVM Board Front

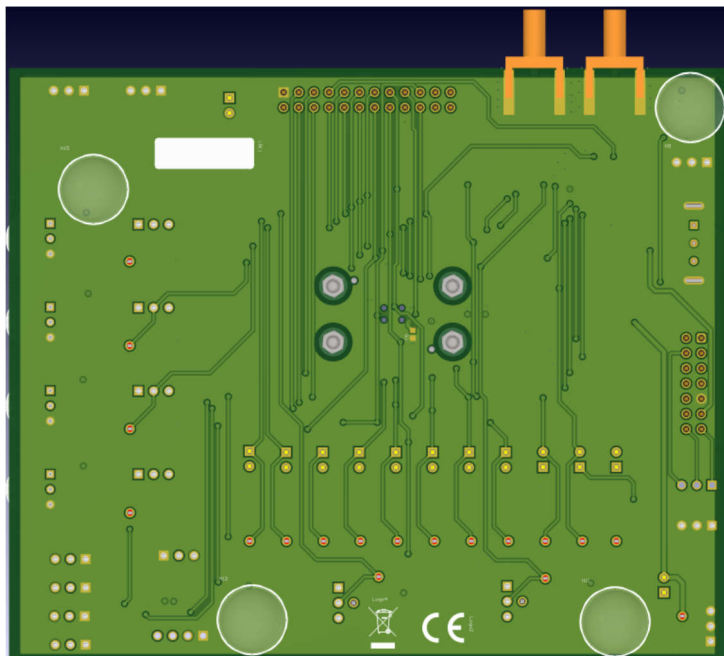


Figure 4-4. TPLD2001-DGS-EVM Board Bottom

4.3 Bill of Materials

REFERENCE DESIGNATOR	QUANTITY	DESCRIPTION	PART NUMBER	MANUFACTURER
C1, C4, C8	3		C0603C105K4RACTU	KEMET
C6	1	Capacitor, ceramic, 1000PF 50V C0G/NP0 0603	C0603C102J5GACAUTO	KEMET
D1, D2, DS4, DS5, DS6, DS7, DS8, DS9, DS10, DS11, DS12, DS13, DS14, DS15, DS16, DS17	16	Low current LED, 40mW, 1.8V, -40 to 100°C, 2-Pin SMD (0603), RoHS, tape and reel	LS L29K-G1J2-1-Z	ams-OSRAM USA INC.
D3	1	Red, green, blue (RGB) 620nm red, 525nm green, 470nm blue LED indication - discrete 2V red, 2.8V green, 2.8V blue 0606 (1616 Metric)	IN-S66TFT5R5G5B	Inolux
DZ1	1	DIODE ZENER 5.1V 500MW SOD123	BZT52C5V1-7-F	Diodes Incorporated
J1, J18, JL1, JL2, JL3, JL4, JL5, JL6, JL7, JL8, JL13, JL14, JL15	13	Header, 100mil, 2x1, gold, TH	PBC02SAAN	Sullins Connector Solutions
J2, J3, J4, J5, J6, J9, J10, J11, J12, JA0, JA1, JA2, JA3, JA4, JB16, JB17	16	0.025	TSW-103-07-F-S	Samtec Inc.
J7, J8	2	Connector, SMB jack, end launch, SMT	131-3701-801	Cinch Connectivity Solutions Johnson
J16B, J17B	2	Connector header through hole 1 position	TSW-101-07-F-S	Samtec Inc.
P1	1		61201421621	Würth Elektronik
P2	1	Male box header WR-BHD, THT, vertical, pitch 2.54mm, 24 pins	61202421621	Würth Elektronik
R1, R5, R9A, R10A, R11A, R12A, R25	7	Resistor, chip, 1 kΩ ±1% 0.1W, 1/10W chip 0603 (1608 Metric) thick film	CRCW06031K00FKEAC	Vishay Dale

R3, R26	2	Resistor, chip, 10K Ω , \pm 1%, 0.1W, -55 to 155 °C, 0603 (1608 metric), RoHS, tape and reel	ERJ3EKF1002V	Panasonic Electronic Components
R6, R7, R8, R13, R28, R32, R33, R34, R35, R36, R39, R40, R41, R42, RD1, RD2	16		ERJ-3EKF1501V	Panasonic Electronic Components
R9, R10, R11, R12	4	Resistor, 10 k Ω 0.5W, 1/2W through hole thumbwheel potentiometer Top adjustment	3352T-1-203LF	Bourns Inc.
R9B, R10B, R11B, R12B, R14, R24, R45	7	Resistor, 0, 1%, 0.1W, AEC-Q200 Grade 0, 0603	RMCF0603ZT0R00	Stackpole Electronics Inc
R16, R17, R27	3	Resistor, SMD 66.5 Ω 1% 1/10W 0603	ERJ-3EKF66R5V	Panasonic Electronic Components
R18, R29, R30, R31, R37, R43	6	Resistor. chip, 470K Ω , \pm 1%, 0.1W, -55 to 155 °C, 0603 (1608 metric), RoHS, tape and reel	RC0603FR-07470KL	YAGEO
R19, R20, R21, R22, R23	5	Resistor, 110, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW0603110RJNEA	Vishay Dale
R38	1	Resistor, 910, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW0603910RJNEA	Vishay Dale
R44	1	Resistor, SMD 1.65K OHM 1% 1/10W 0603	CRCW06031K65FKEA	Vishay Dale
R46	1	Resistor, SMD 732 OHM 1% 1/10W 0603	CRCW0603732RFKEA	Vishay Dale
R50	1	Resistor, 50, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW060350R0FKEA	Vishay Dale

SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8, SH-J9, SH-J10, SH-J11, SH- J12, SH-J13, SH-J14, SH- J15, SH-J16, SH-J17, SH- J18, SH-J19, SH-J20, SH- J21, SH-J22, SH-J23, SH- J24, SH-J25, SH-J26	26	Shunt, 100mil, flash gold, black	SPC02SYAN	Sullins Connector Solutions
SW0	1	Slide Switch SPDT through hole, right angle	EG1206A	E-Switch
SW1, SW2, SW3	3	SWITCH TACTILE SPST-NO 0.05A 16V	B3AL-1003P	Omron Electronics Inc-EMC Div
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP18	18	PC TEST POINT MINIATURE RED	5000	Keystone Electronics
U2	1	Transistor MOSFET array dual N-CH 50V 200mA 6-Pin SOT-363 emboss T/R	UM6K33NTN	Rohm Semiconductor
H9, H10, H11, H12	4	Bumpon, hemisphere, 0.44 X 0.20, clear	SJ-5303 (CLEAR)	3M
LBL1	1	LABEL 0.2	THT-14-423-10	Brady Corporation
X1	1	20 pin DGS socket	20CHC50Y01G	Plastronics

5 Additional Information

Trademarks

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STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.
 - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software
 - 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.
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.

WARNING

Evaluation Kits 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 shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGRADATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

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/sds/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。

<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html>

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.

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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。

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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/sds/ti_ja/general/eStore/notice_02.page

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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.

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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.

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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.

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