EVM User's Guide: TPLD2001-RJY-EVM

TPLD2001-RJY-EVM Evaluation Module

Description

The TPLD2001RJY 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 TPLD2001RJY 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

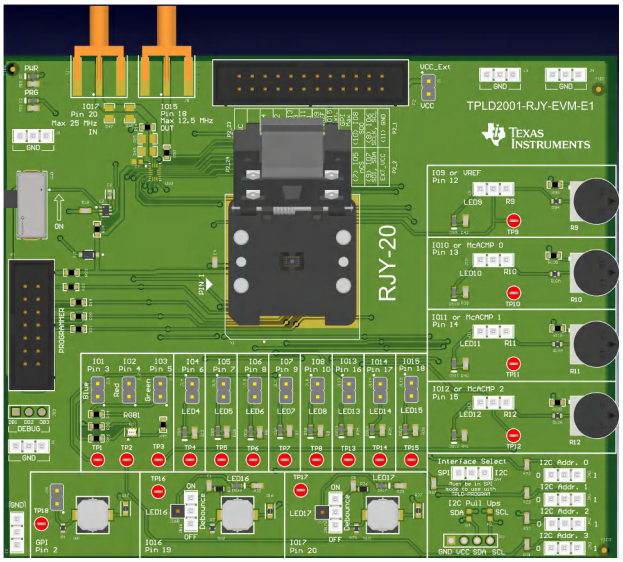
1. Order the TPLD2001-RJY-EVM and TPLD-PROGRAM
2. Download the latest version of InterConnect Studio (ICS)
3. Use the cables included the TPLD-PROGRAM kit to connect the system
4. Place an unprogrammed TPLD2001RJY into the socket and configure using ICS

Features

- RJY socket for easy programming and evaluation of TPLD2001RJY
- 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 TPLD2001RJY 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-RJY-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-RJY-EVM Kit Contents

Item	Description	Quantity
TPLD2001-RJY-EVM	PCB	1
TPLD2001RJY	20-pin TI Programmable Logic Device	5
Quick start guide	Guide to setup system	1

1.3 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-RJY-EVM.

2.1.1 Test Points

Each GPIO and GPI pin of an socketed TPLD2001RJY 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-RJY-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-RJY-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-RJY-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.

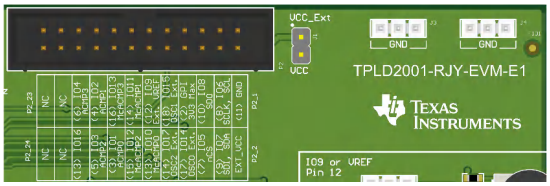


Figure 2-1. P2 and J1 Headers

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.

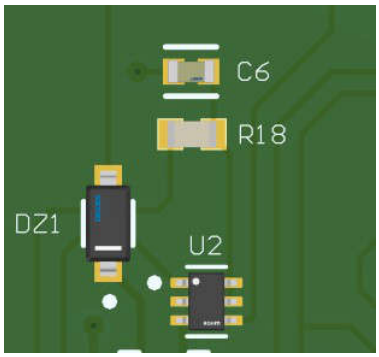


Figure 2-2. GPI Protection Block

2.1.5 RJY Socket

The RJY 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 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.

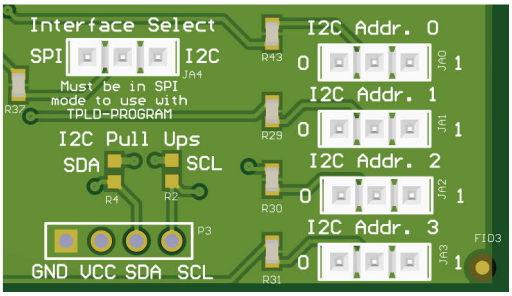


Figure 2-3. I2C Address and Interface Select Blocks

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 disconect the high-frequency input trace from the rest of the board, decreasing parasitics. Then, solder 200 Ohm resistors in soldering points R47, R48, R49, and R15. This is equivalent to a 50 Ohm 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.

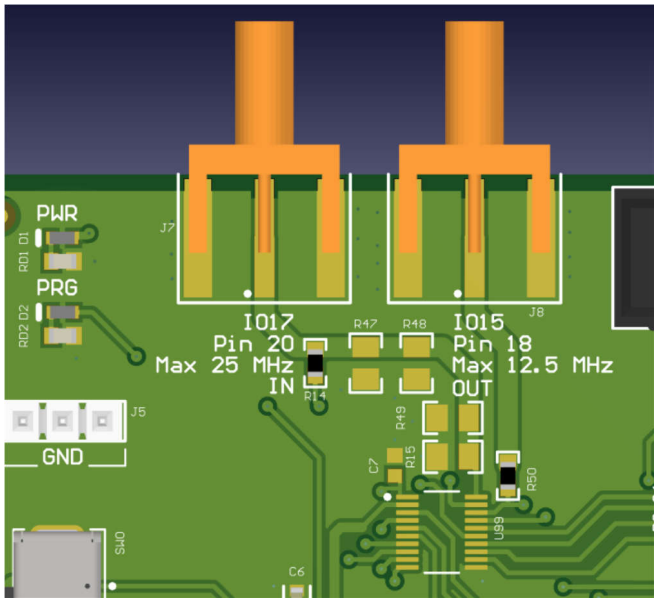


Figure 2-4. High-Frequency IOs

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.

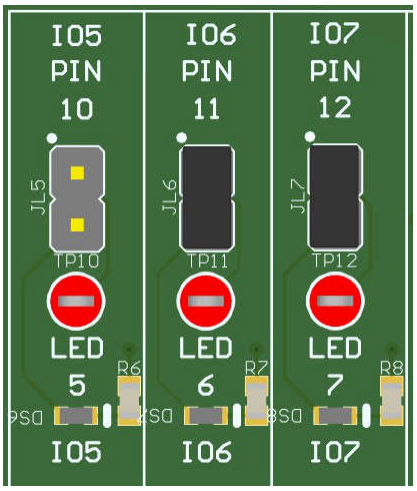


Figure 2-5. LED Blocks

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.

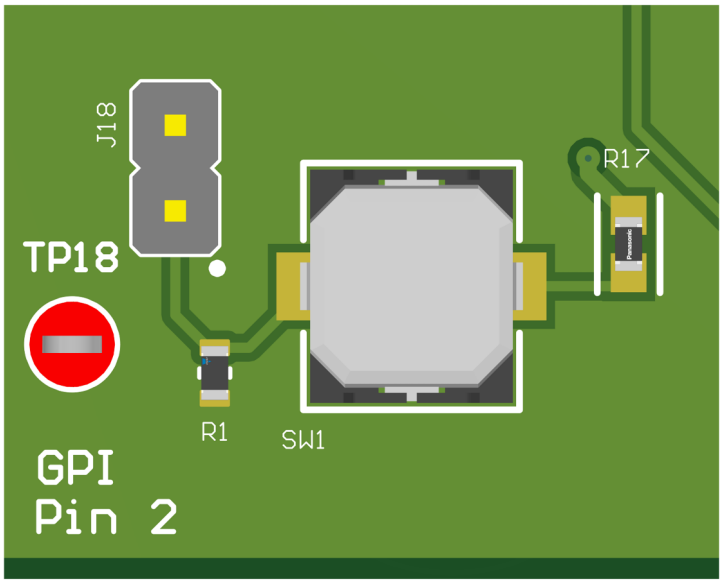


Figure 2-6. Switch Blocks

2.2.3 LED/Potentiometer Blocks

Each LED/POT block consists of a 3-state header pin that can be used the connect the corresponding GPIO pin to either a 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 0.2 V. When the POT is turned fully counterclockwise, the analog voltage source outputs at least VCC - 0.2 V.

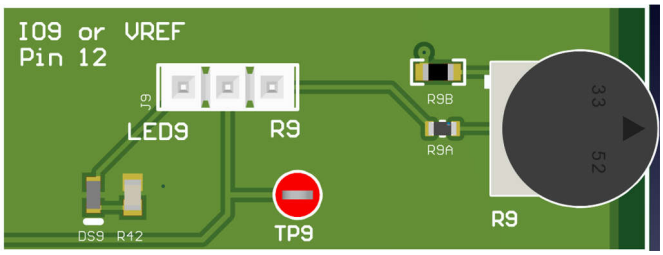


Figure 2-7. LED/POT Blocks

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 OFF 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.

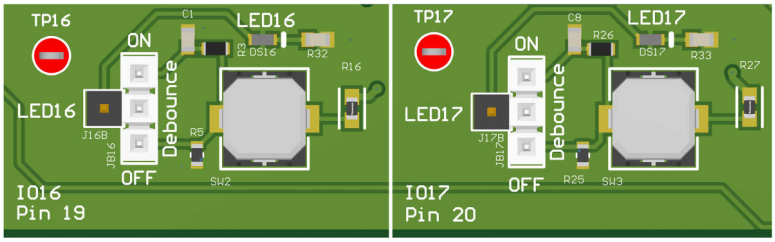


Figure 2-8. LED/Switch Blocks

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.

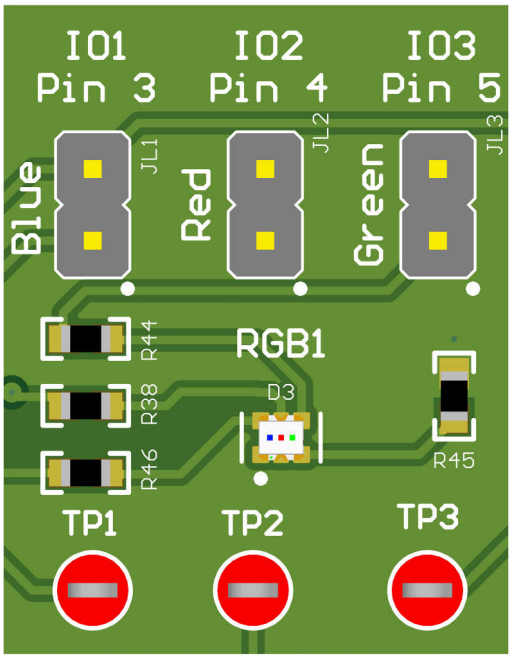


Figure 2-9. RGB LED Block

3 Software

3.1 Using the TPLD2001-RJY-EVM

This section covers using the TPLD2001-RJY-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-RJY-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-RJY-EVM. InterConnect Studio can be downloaded from TI.com by following the instructions in Section 3.1.2.

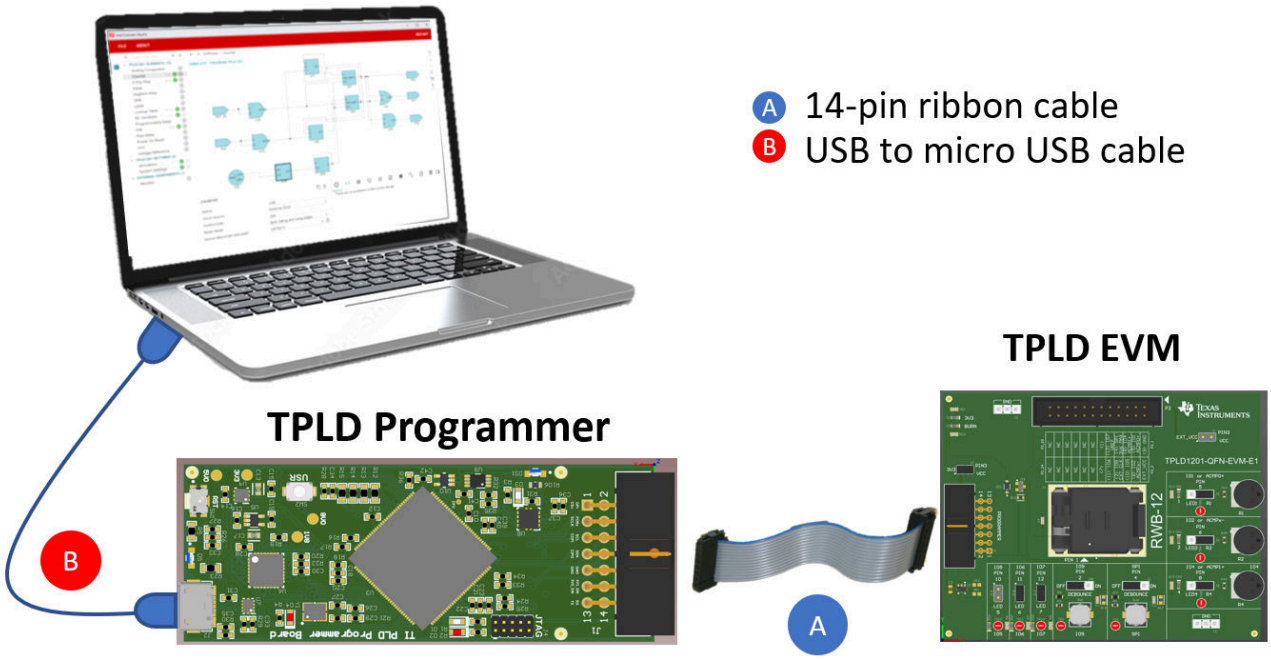


Figure 3-1. Connecting a TPLD EVM and Programmer

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-RJY-EVM and a TPLD-PROGRAM kit to program a TPLD2001RJY.

3.2.1 TPLD2001-RJY-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

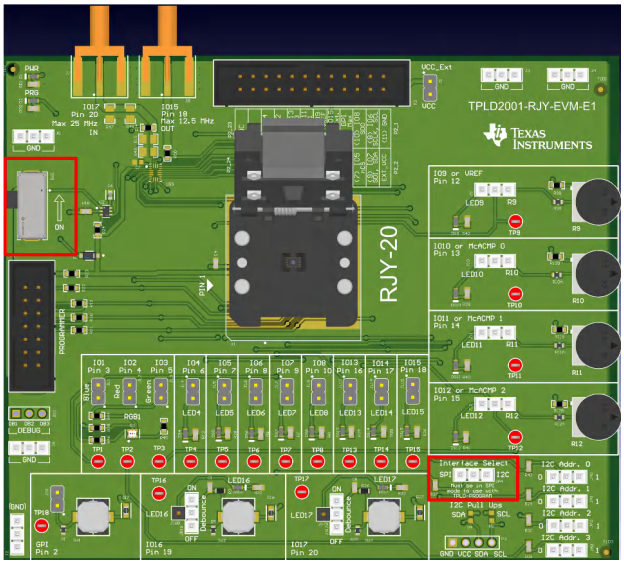


Figure 3-2. Components Considered in Programming Setup

3.2.2 Inserting a TPLD2001RJY into the RJY 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 TPLD2001RJY.

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.

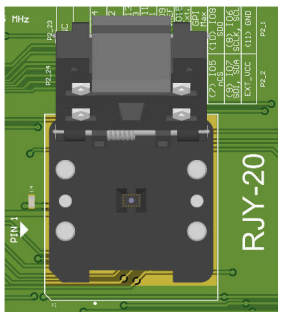


Figure 3-3. RJY Socket

3.2.3 Connecting the TPLD2001-RJY-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-RJY-EVM using the provided 14-position ribbon cable. Make sure that a good connection is made between the TPLD2001-RJY-EVM and the TPLD-PROGRAM, indicated by the 3V3 LED in the top left of the EVM being on.

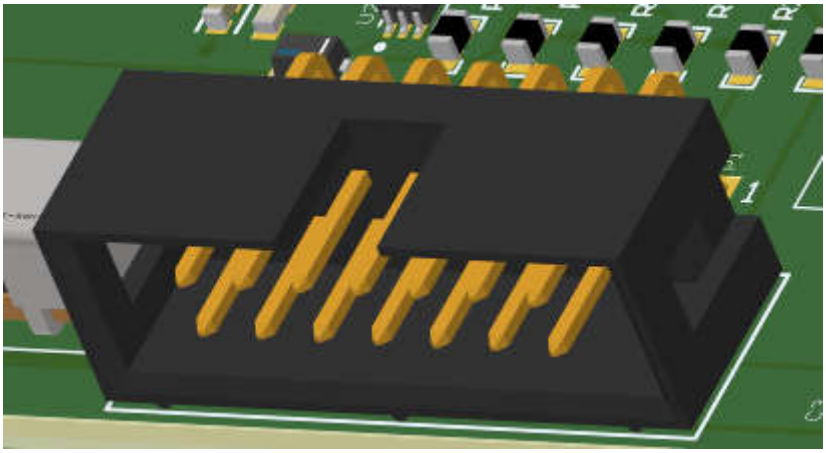


Figure 3-4. Keyed Header Socket

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 *RJY (UQFN, 20)*.
2. Select a demo from the list of pre-designed circuits, or select *Empty Design* to build a custom circuit.

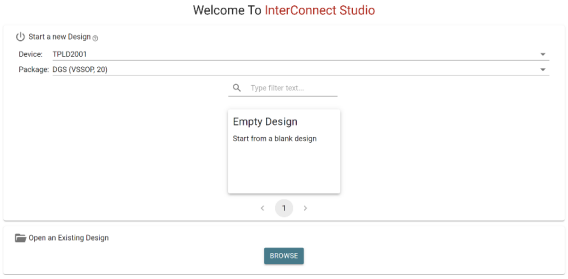


Figure 3-5. Opening a Design in ICS

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*.

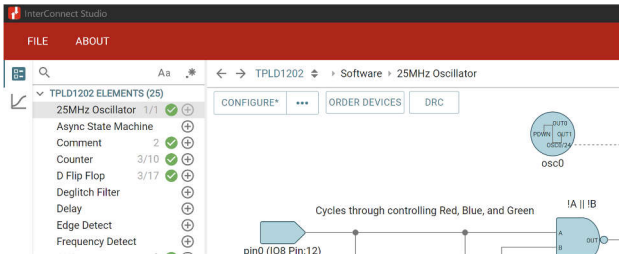


Figure 3-6. Temporarily Configuring in ICS

   a. Some LEDs on the TPLD2001-RJY-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*.

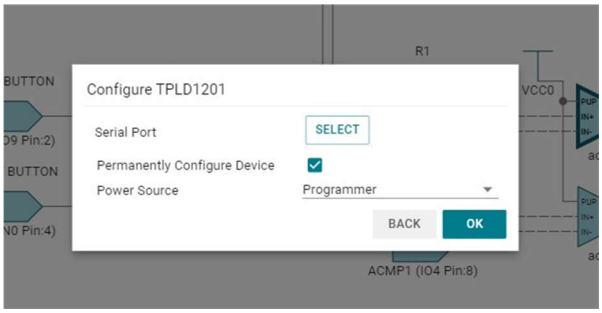


Figure 3-7. Permanent Programming in ICS

4. Select the serial port connected to the TPLD-PROGRAM, then select *OK* again.
   a. Some LEDs on the TPLD2001-RJY-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

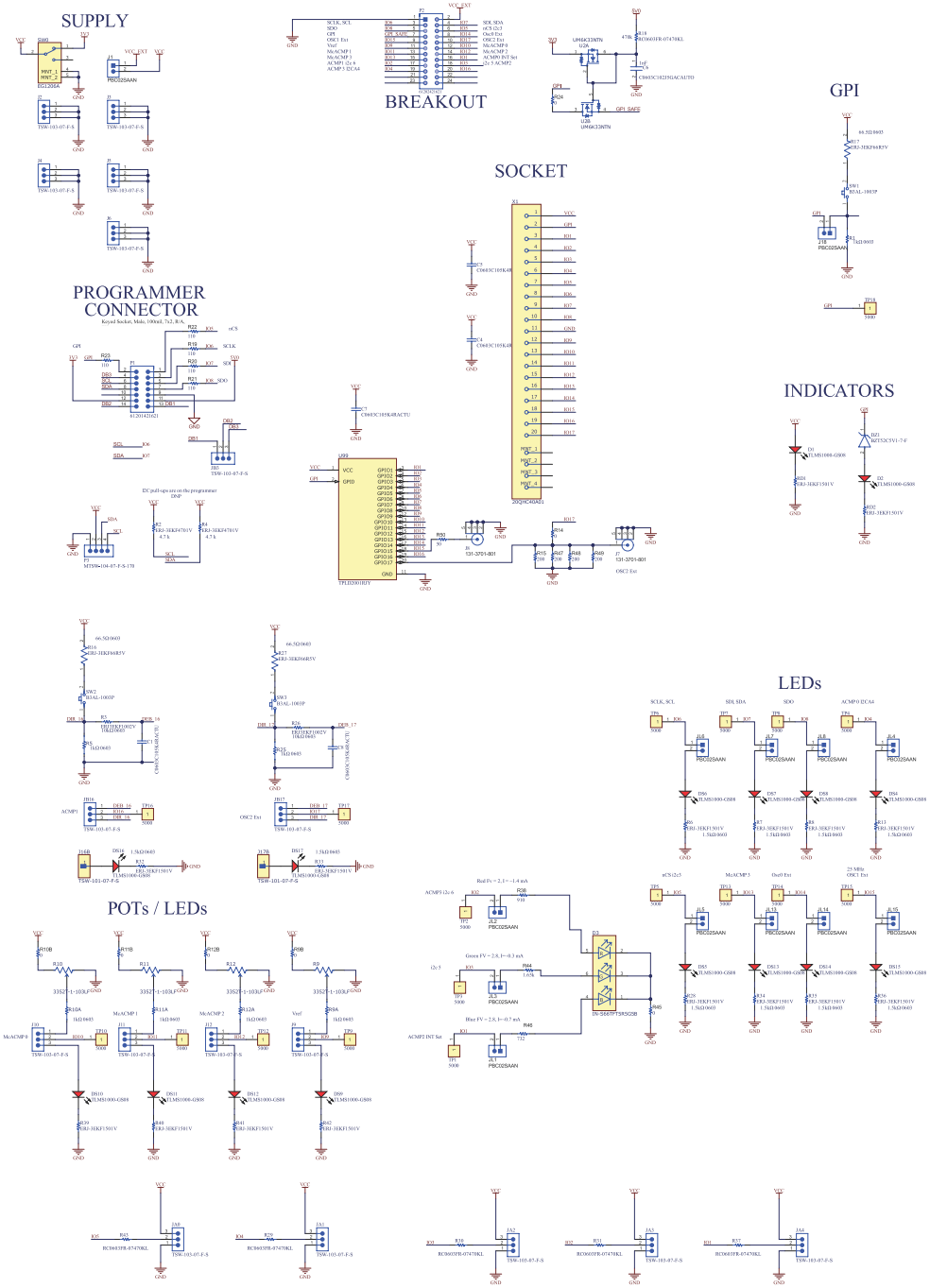


Figure 4-1. TPLD2001-RJY-EVM Schematic

4.2 PCB Layout

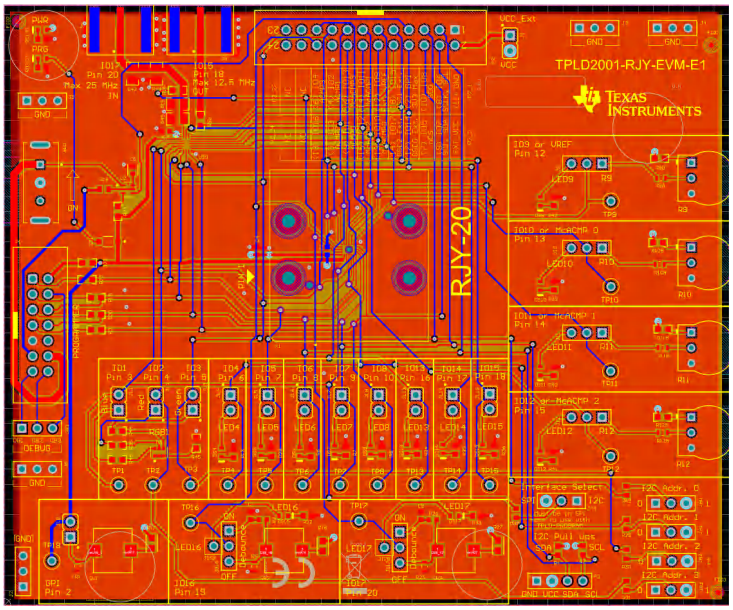


Figure 4-2. TPLD2001-RJY-EVM Layout

4.2.1 PCB Overview

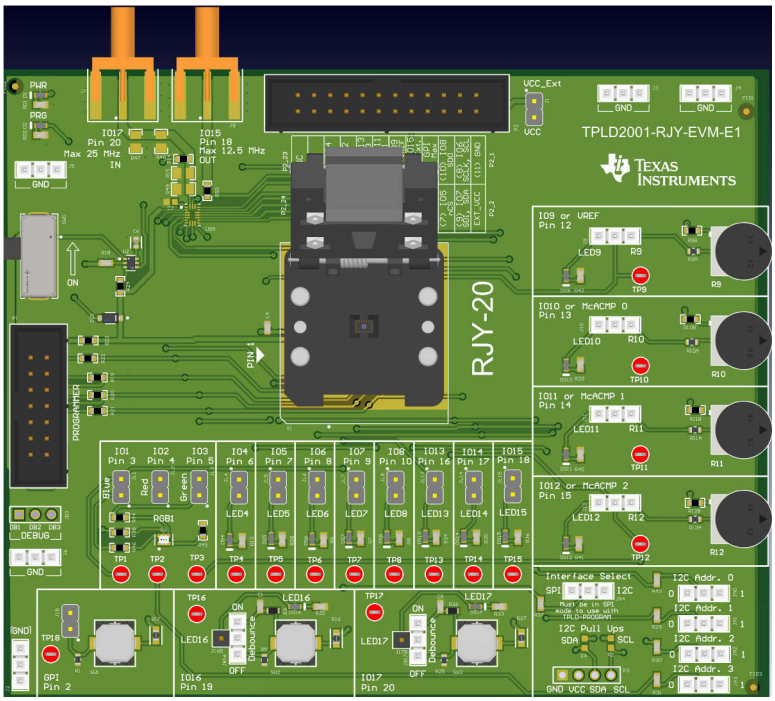


Figure 4-3. TPLD2001-RJY-EVM Board Front

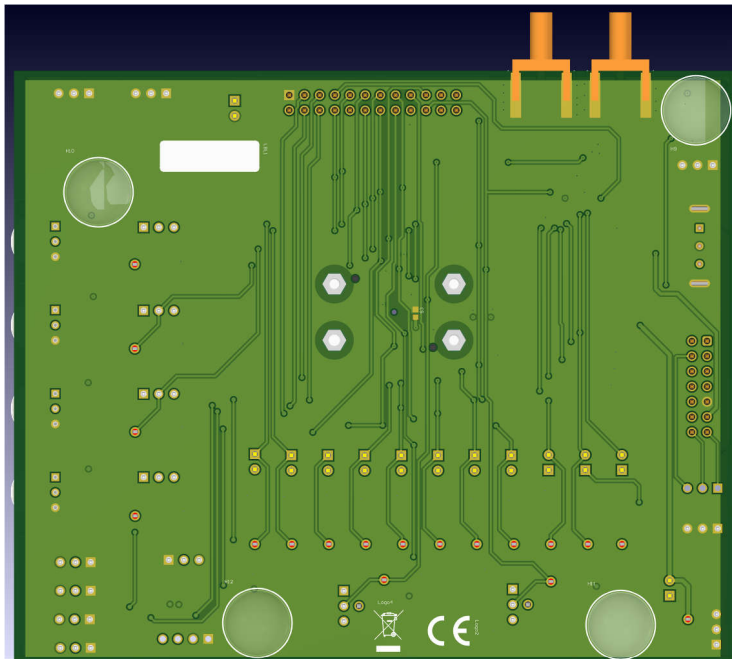


Figure 4-4. TPLD2001-RJY-EVM Board Bottom

4.3 Bill of Materials

REFERENCE DESIGNATOR	QUANTITY	DESCRIPTION	MANUFACTURER	PART NUMBER
C1, C4, C8	3		KEMET	C0603C105K4RACTU
C6	1	CAP CER 1000PF 50V C0G/NP0 0603	KEMET	C0603C102J5GACAUTO
D1, D2, DS4, DS5, DS6, DS7, DS8, DS9, DS10, DS11, DS12, DS13, DS14, DS15, DS16, DS17	16	Low Current LED, 40 mW, 1.8 V, -40 to 100 degC, 2-Pin SMD (0603), RoHS, Tape and Reel	ams-OSRAM USA INC.	LS L29K-G1J2-1-Z
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)	Inolux	IN-S66TFT5R5G5B
DZ1	1	DIODE ZENER 5.1V 500MW SOD123	Diodes Incorporated	BZT52C5V1-7-F
J1, J18, JL1, JL2, JL3, JL4, JL5, JL6, JL7, JL8, JL13, JL14, JL15	13	Header, 100mil, 2x1, Gold, TH	Sullins Connector Solutions	PBC02SAAN
J2, J3, J4, J5, J6, J9, J10, J11, J12, JA0, JA1, JA2, JA3, JA4, JB16, JB17	16	0.025	Samtec Inc.	TSW-103-07-F-S
J7, J8	2	Connector, SMB Jack, End launch, SMT	Cinch Connectivity Solutions Johnson	131-3701-801
J16B, J17B	2	Connector Header Through Hole 1 position	Samtec Inc.	TSW-101-07-F-S
P1	1		Würth Elektronik	61201421621
P2	1	Male Box Header WR-BHD, THT, Vertical, pitch 2.54 mm, 24 pins	Würth Elektronik	61202421621
R1, R5, R9A, R10A, R11A, R12A, R25	7	1 kOhms ±1% 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) Thick Film	Vishay Dale	CRCW06031K00FKEAC
R3, R26	2	Chip Resistor, 10 KOhm, +/- 1%, 0.1 W, -55 to 155 degC, 0603 (1608 Metric), RoHS, Tape and Reel	Panasonic Electronic Components	ERJ3EKF1002V
R6, R7, R8, R13, R28, R32, R33, R34, R35, R36, R39, R40, R41, R42, RD1, RD2	16		Panasonic Electronic Components	ERJ-3EKF1501V
R9, R10, R11, R12	4	10 kOhms 0.5W, 1/2W Through Hole Thumbwheel Potentiometer Top Adjustment	Bourns Inc.	3352T-1-203LF
R9B, R10B, R11B, R12B, R14, R24, R45	7	RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Stackpole Electronics Inc	RMCF0603ZT0R00
R16, R17, R27	3	RES SMD 66.5 OHM 1% 1/10W 0603	Panasonic Electronic Components	ERJ-3EKF66R5V

R18, R29, R30, R31, R37, R43	6	Chip Resistor, 470 KOhm, +/- 1%, 0.1 W, -55 to 155 degC, 0603 (1608 Metric), RoHS, Tape and Reel	YAGEO	RC0603FR-07470KL
R19, R20, R21, R22, R23	5	RES, 110, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay Dale	CRCW0603110RJNEA
R38	1	RES, 910, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay Dale	CRCW0603910RJNEA
R44	1	RES SMD 1.65K OHM 1% 1/10W 0603	Vishay Dale	CRCW06031K65FKEA
R46	1	RES SMD 732 OHM 1% 1/10W 0603	Vishay Dale	CRCW0603732RFKEA
R50	1	RES, 50, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay Dale	CRCW060350R0FKEA
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	Sullins Connector Solutions	SPC02SYAN
SW0	1	Slide Switch SPDT Through Hole, Right Angle	E-Switch	EG1206A
SW1, SW2, SW3	3	SWITCH TACTILE SPST-NO 0.05A 16V	Omron Electronics Inc-EMC Div	B3AL-1003P
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP18	18	PC TEST POINT MINIATURE RED	Keystone Electronics	5000
U2	1	Transistor MOSFET Array Dual N-CH 50V 200mA 6-Pin SOT-363 Emboss T/R	Rohm Semiconductor	UM6K33NTN
H9, H10, H11, H12	4	Bumpon, Hemisphere, 0.44 X 0.20, Clear	3M	SJ-5303 (CLEAR)
LBL1	1	LABEL 0.2	Brady Corporation	THT-14-423-10
X1	1	20 pin RJY Socket	Plastronics	20QHC40A01

5 Additional Information

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6 References

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