TLC6C5816-Q1EVM User's Guide

This document is the user's guide for TLC6C5816EVM and TLC6C5816EVM GUI. TLC6C5816EVM is designed to be controlled by TLC6C5816EVM GUI via a USB2ANY communication tool. The TLC6C5816EVM can be powered by a Micro-USB supply, users can use a USB port to power the board easily. The TLC6C5816EVM GUI is designed to demonstrate TLC6C5816-Q1 features which can support both a single device and two cascading devices.

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1 Introduction

The TLC6C5816-Q1 device is a 16-bit shift register LED driver designed to support automotive LED applications. A built-in LED-open and LED-short diagnostic mechanism provides enhanced safety protection. The device contains 16-channel power DMOS transistor outputs. Eight channels support LED fault diagnostics by configuring corresponding registers. The diagnostics channels DIAGn must connect to DRAINn to use the LED diagnostics. A command error fault implies that when a channel is configured for LED diagnostics, a register write command turns on the channel at the same time. The device provides a cyclic redundancy check to verify register values in the shift registers. In read-back mode, the device provides 6 bits of the CRC remainder. The MCU can read back the CRC remainder and check if the remainder is correct. This can check whether the communication loop between MCU and device is good.

1.1 Features

- Qualified for Automotive Applications
  - Device Temperature Grade 1: –40°C to 125ºC Ambient Operating Temperature Range
  - Device HBM ESD Classification Level H3A
  - Device CDM ESD Classification Level C6
- 16-Channel Power DMOS Transistor Outputs
  - Open-Drain Output up to 50 mA per Channel
  - Output Turn-On Resistance: 6.2 Ω (Typ.)
  - Output Voltage Maximum Rating: 45 V
  - Fixed Slew Rate for Optimized EMI Performance
- Serial Interface and PWM Inputs
  - Shift Register Compatible With TPIC6C596, TLC6C598-Q1, TLC6C5912-Q1
  - LED Status Read-back
  - 2 PWM Inputs for Group Dimming
- Diagnostics and Protection
  - Overtemperature Protection
  - Configurable LED Open and Short Diagnostics
  - Serial-Interface Communication Error Detection
  - Open-Drain Error Feedback
- Package
  - 28-Pin HTSSOP

1.2 Applications

- Automotive Instrumentation Clusters
- Automotive HVAC Control Panels
- Automotive Center Stacks
- Automotive E-Shifter Indicators

1.3 Description

1.3.1 Kit Contents

The TLC6C516EVM kit contains a USB2ANY and TLC6C5816EVM, as showed in Figure 1.

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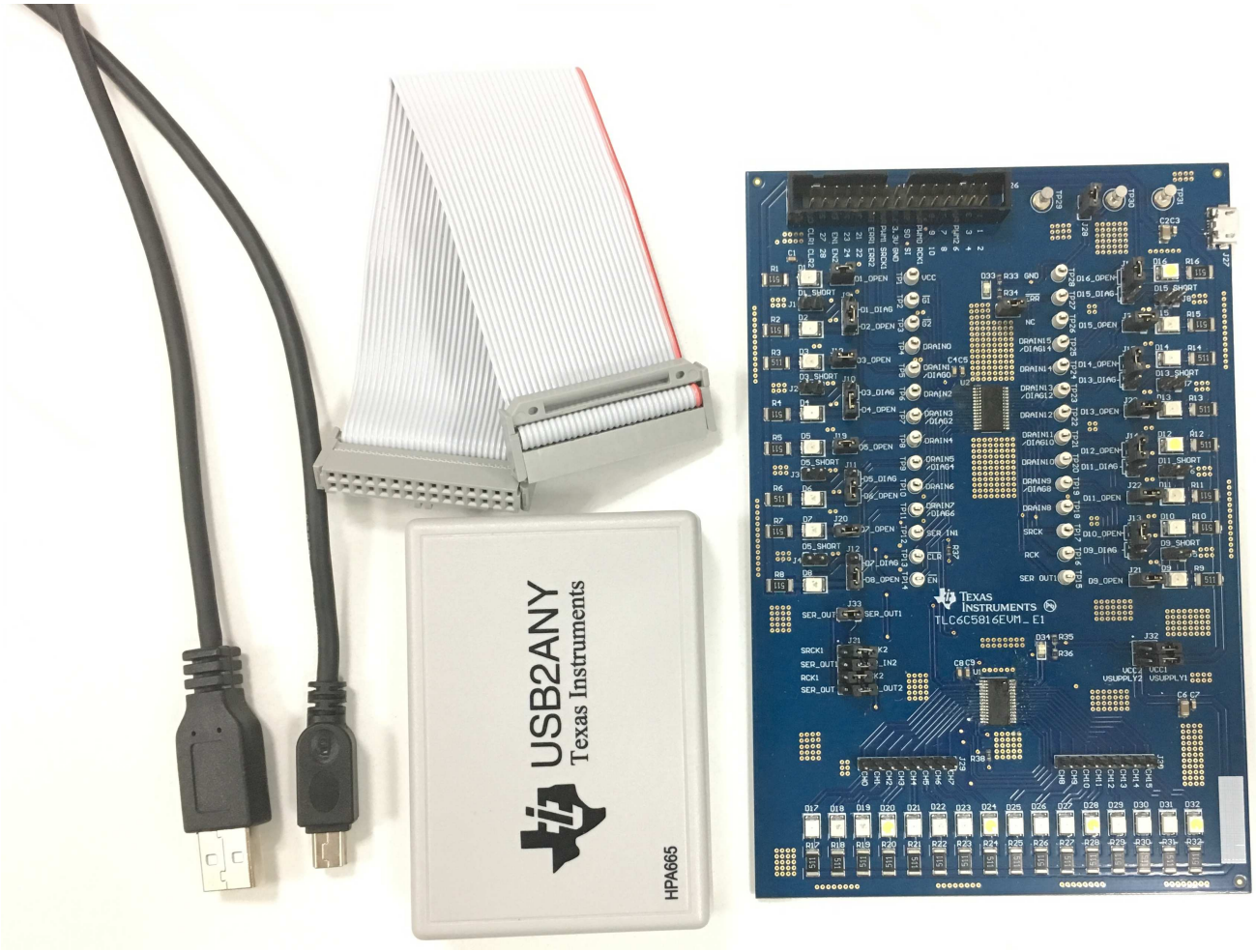


Figure 1. TLC6C5816EVM Kit

1.3.2 Additional Items Required

- PC on which to install the TLC6C5816EVM GUI
- DC supply or USB port for LED supply

1.3.3 EVM Parameters

Table 1 shows the typical parameters of TLC6C5816EVM.

Table 1. TLC6C5816EVM Parameters

V_{CC}	3-5.5 V
LED supply	12 V typical
Channel current	20 mA at 12-V LED supply

NOTE: Channel current is set at 20 mA when the LED supply voltage is 12 V. Although the TLC6C5816-Q1 device can withstand a 40-V maximum LED supply voltage, increased LED supply voltage increases channel output current. Make sure the channel current is within 50 mA when using higher LED supply voltage.

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2 Test Setup and Results

2.1 Hardware Setup

Figure 2 shows the hardware setup of the TLC6C5816EVM.

- Connect a 12-V power supply between TP31 (V_{SENSE}) and TP29 (GND), or connect a 5-V power supply to J27 via a Micro-USB cable.
- Put a shunt on J28 to use the USB2ANY 3.3-V supply to power V_{CC}.
- Connect USB2ANY to the computer.
- Connect the USB2ANY board to the TLC6C5816EVM.

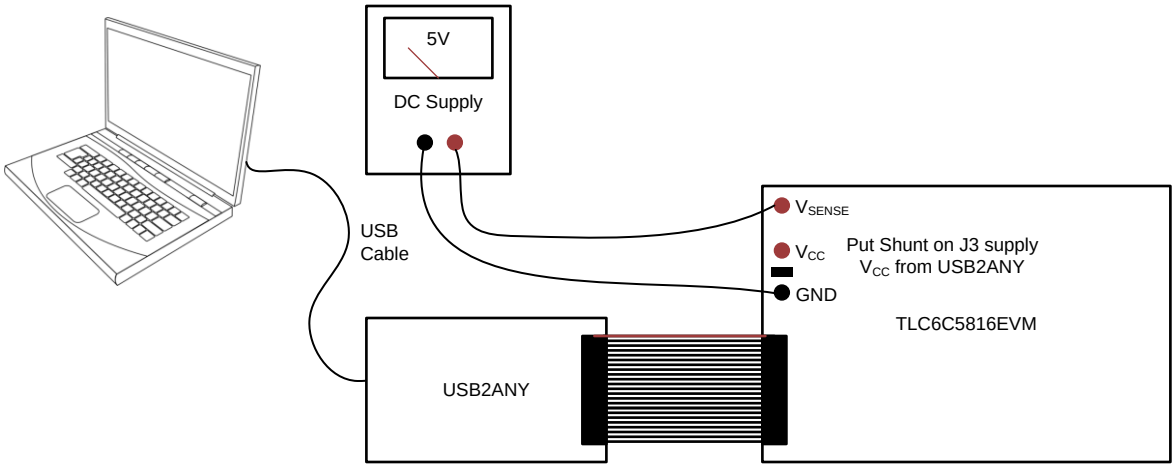


Figure 2. TLC6C5816EVM Hardware Setup

Figure 3 shows the key connectors to launch the TLC6C5816EVM.

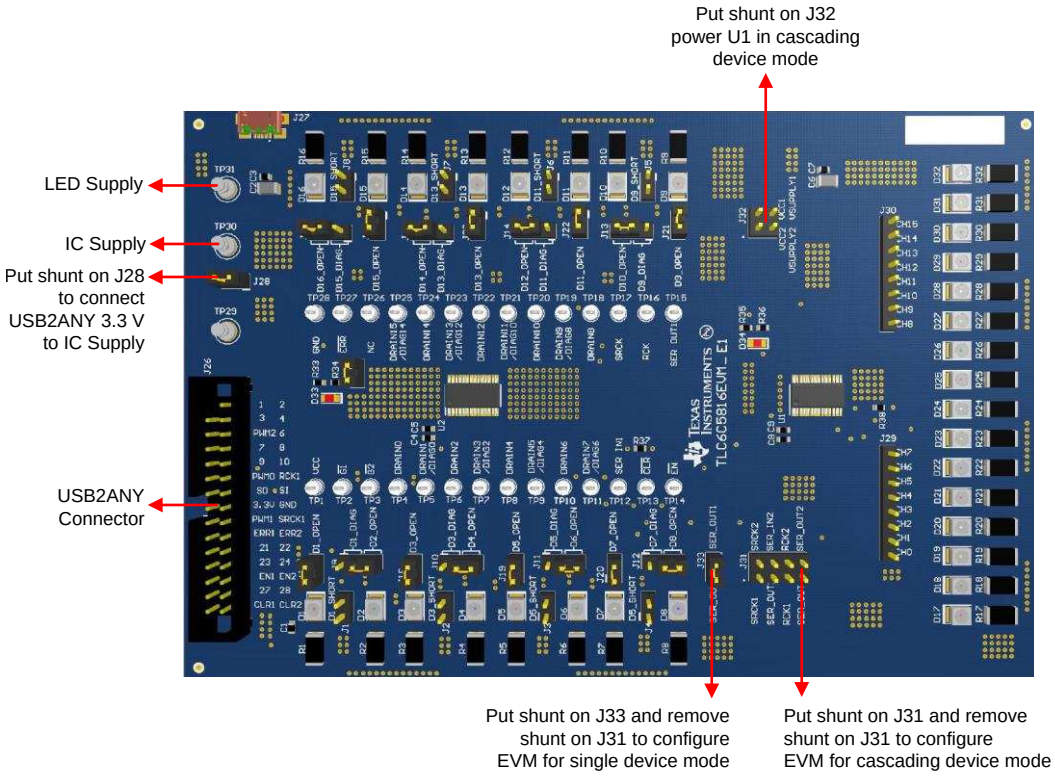


Figure 3. TLC6C5816EVM Key Connectors

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2.2 Software Installation

Download the GUI software from TLC6C5816-Q1 EVM tools folder. After downloading, install the TLC6C5816EVM GUI on the PC. A shortcut to the GUI is found on the desktop. A shortcut can also be found in the start-up menu under the Texas Instruments folder. Figure 4 shows the landing page of TLC6C5816EVM GUI, which contains the TLC6C5816-Q1 introduction information and TLC6C5816EVM information. Click **Menu** to show more information.

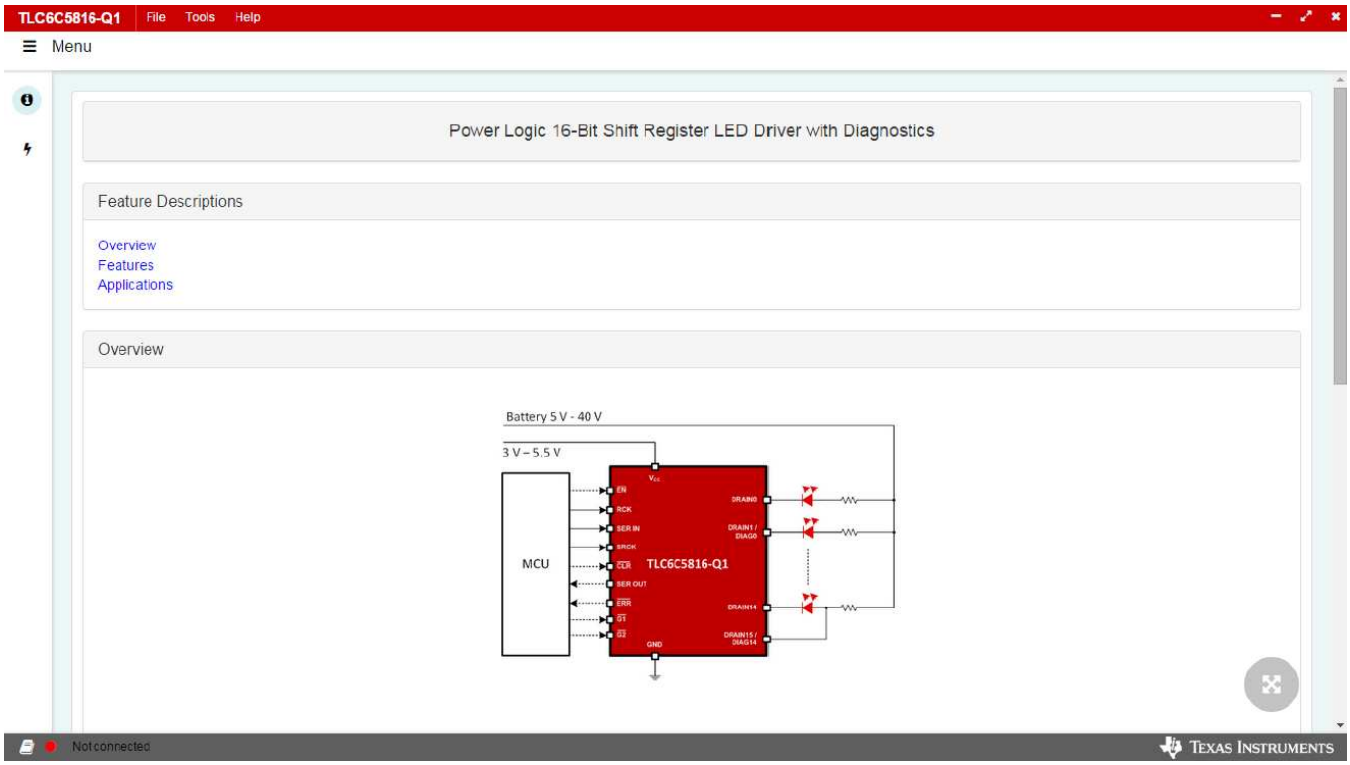


Figure 4. Landing Page of TLCC65916EVM GUI

2.3 GUI Function

Click **LED Control** under **Menu**, and the GUI displays a detailed LED control panel as shown in Figure 5.

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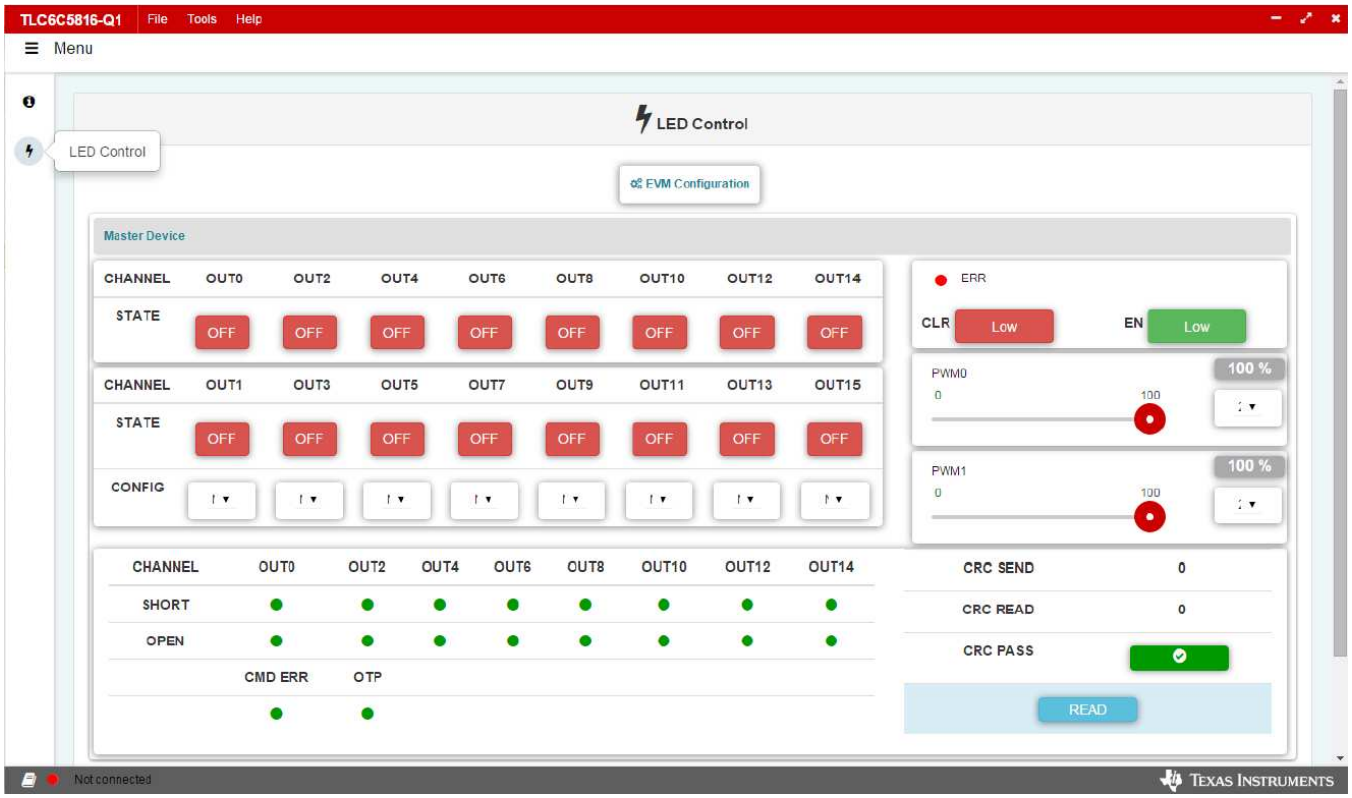


Figure 5. LED Control Panel

2.3.1 Connection Status

Before using the GUI, make sure connection status indicator in the bottom-left corner is in the green state, which means the USB2ANY is connected to computer successfully. If the status indicator is in red state, try to reconnect the USB2ANY cable and restart TLC6C5816EVM GUI.

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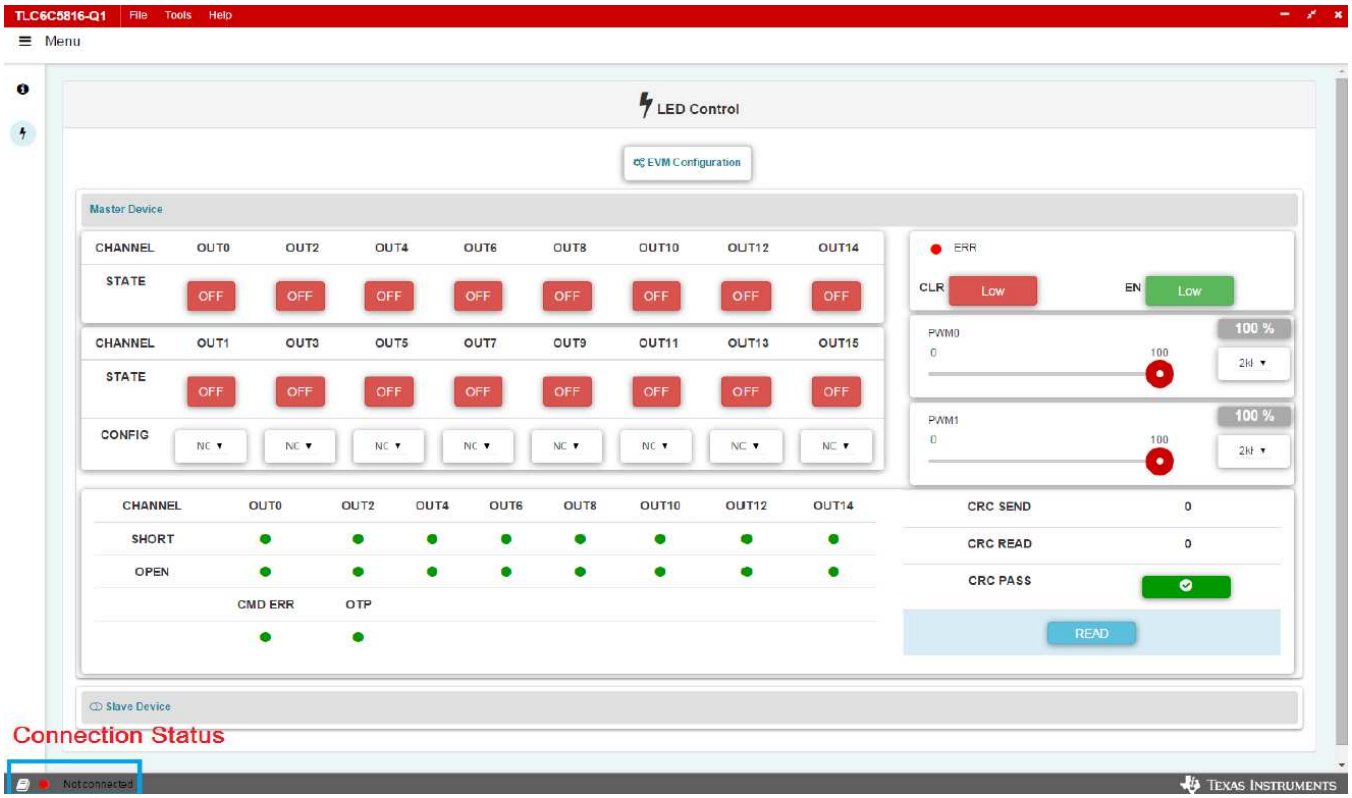


Figure 6. TLC6C5816EVM GUI Connection Status

2.3.2 GUI Function

The following section shows detailed information on how to use the GUI to evaluate the TLC6C5816-Q1 device.

2.3.2.1 Channel On and Off Control

Click the ON and OFF button to turn on or turn off the TLC6C5816-Q1 output channels.



Figure 7. Channel Turn On and Off Control

2.3.2.2 Channel Diagnostics Configuration

The even channels of the TLC6C5816-Q1 device have multiple functions. Normally the GUI can be used for controlling Channel On and Off, but it can also be configured for the LED diagnostics function.

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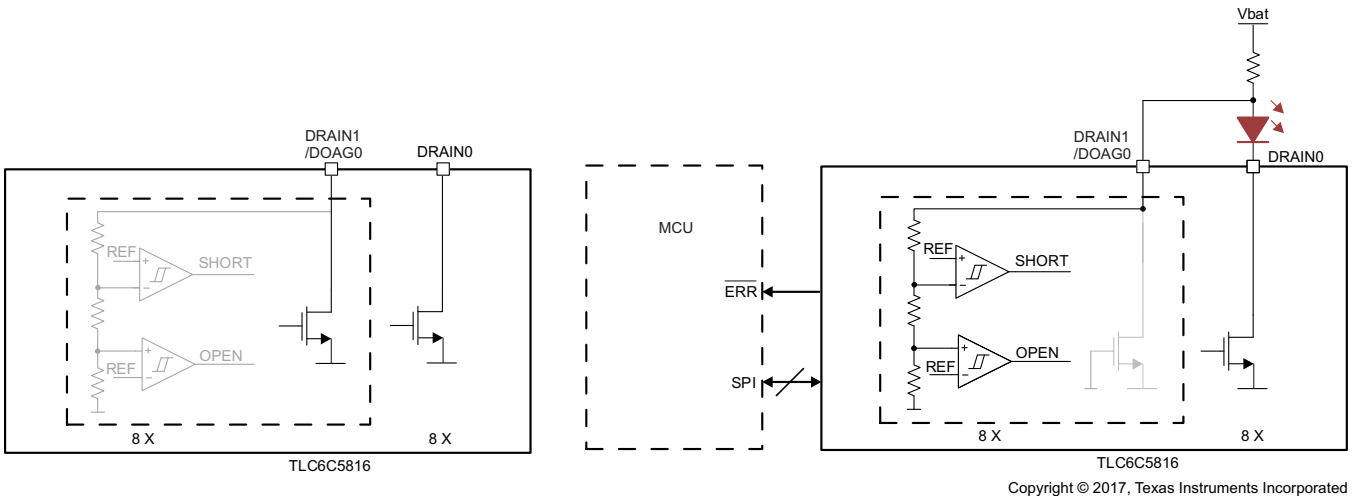


Figure 8. LED Diagnostics Configuration

NOTE: When a channel is configured for LED diagnostics, make sure that the jumpers on the TLC6C5816EVM are configured properly for the LED diagnostics circuit. Remove the Dx-OPEN shunt and put on the Dx-DIAG shunt.

There is a CONFIG option in the GUI for the TLC6C5816-Q1 even channels. Selecting NORM means the channel is in normal ON/OFF operation mode. Selecting DIAG enables the diagnostics function.



Figure 9. Channel Function Selection

2.3.2.3 Status Read-Back

When the LED diagnostics function is used, the TLC6C5816EVM GUI provides a status check function. Pressing READ reads back the TLC6C5816-Q1 status register, including LED open or short status, command error, overtemperature status, and CRC check status. A green indicator means everything is in the normal state. A red indicator means there is a fault.

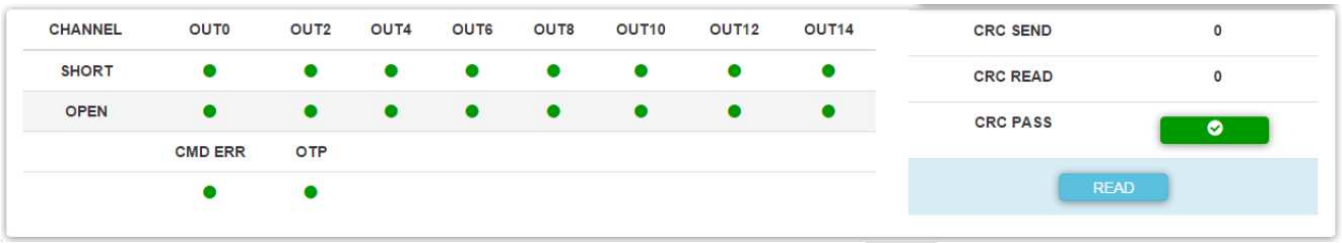


Figure 10. Status Read-Back

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2.3.2.4 ERR Indicator and Device Reset

The TLC6C5816-Q1 device has an ERROR pin which can indicate when an error happens in the device. The TLCC65816EVM GUI integrates an ERR indicator which detects the ERROR pin status simultaneously. Red indicates ERROR pin is pulled down, green means there is no fault on the device.

Both the $\overline{CLR}$ pin and $\overline{EN}$ of TLC6C5816-Q1 are low active pins. $\overline{CLR}$ high means the voltage on $\overline{CLR}$ pin is high, so the register clear function is disabled. $\overline{CLR}$ low means the voltage on the $\overline{CLR}$ pin is low, so the register data is cleared.

$\overline{EN}$ low means the voltage on the $\overline{EN}$ pin is low and the device is enabled. $\overline{EN}$ high means the voltage on the $\overline{EN}$ pin is high, so the device is disabled. $\overline{EN}$ high puts the device in low-power mode and clears all the register data simultaneously.



Figure 11. ERR Indicator and Device Reset

2.3.2.5 PWM Dimming

PWM0 controls the G1 pin to enable the PWM dimming function on CH0–CH7. PWM1 controls the G2 pin to enable the PWM dimming function on CH8–CH15. The PWM frequency has 5 options: 2 kHz, 1 kHz, 400 Hz, 200 Hz, 100 Hz, and the duty cycle can be configured from 0 to 100%.

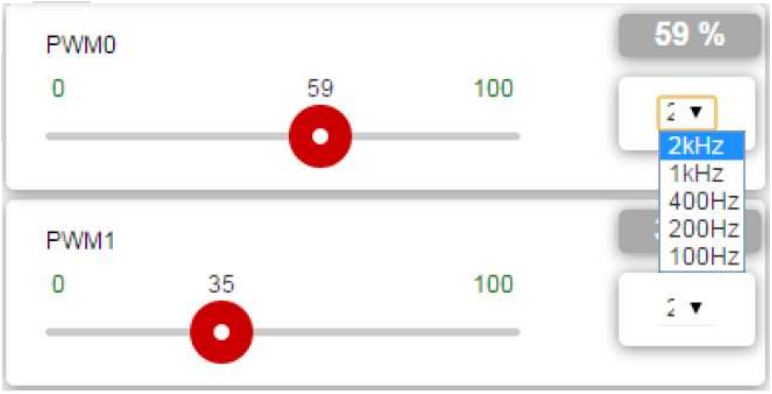


Figure 12. PWM Dimming

2.3.2.6 Cascading Device Mode

The TLC6C5816EVM can be configured as two devices connected in cascade by removing the shunt on J33 and putting shunts on J31 and J32.

NOTE: The GUI only has channel-on and -off functions for devices in cascade. The GUI does not implement the LED diagnostics function for devices in cascade. All channels of the cascaded devices are dimmed by PWM2.

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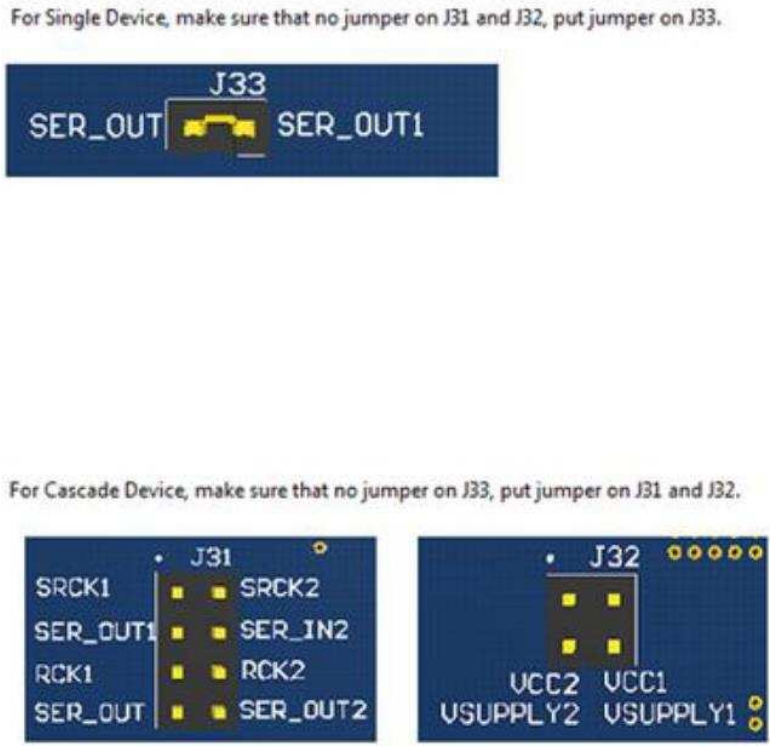


Figure 13. Cascading Device Configuration

Clicking **Slave Device** configures the GUI to the cascading device mode.

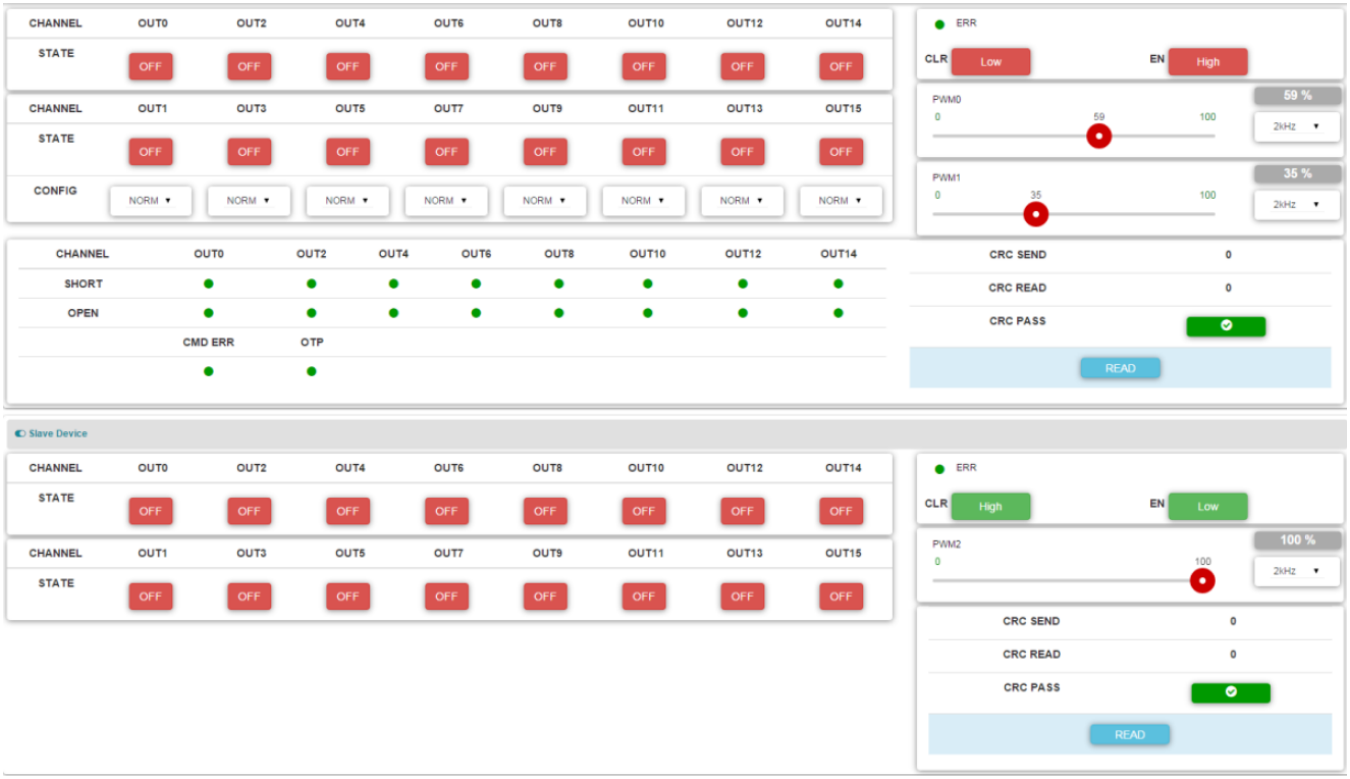


Figure 14. GUI for Cascading Device

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3 Board Layout

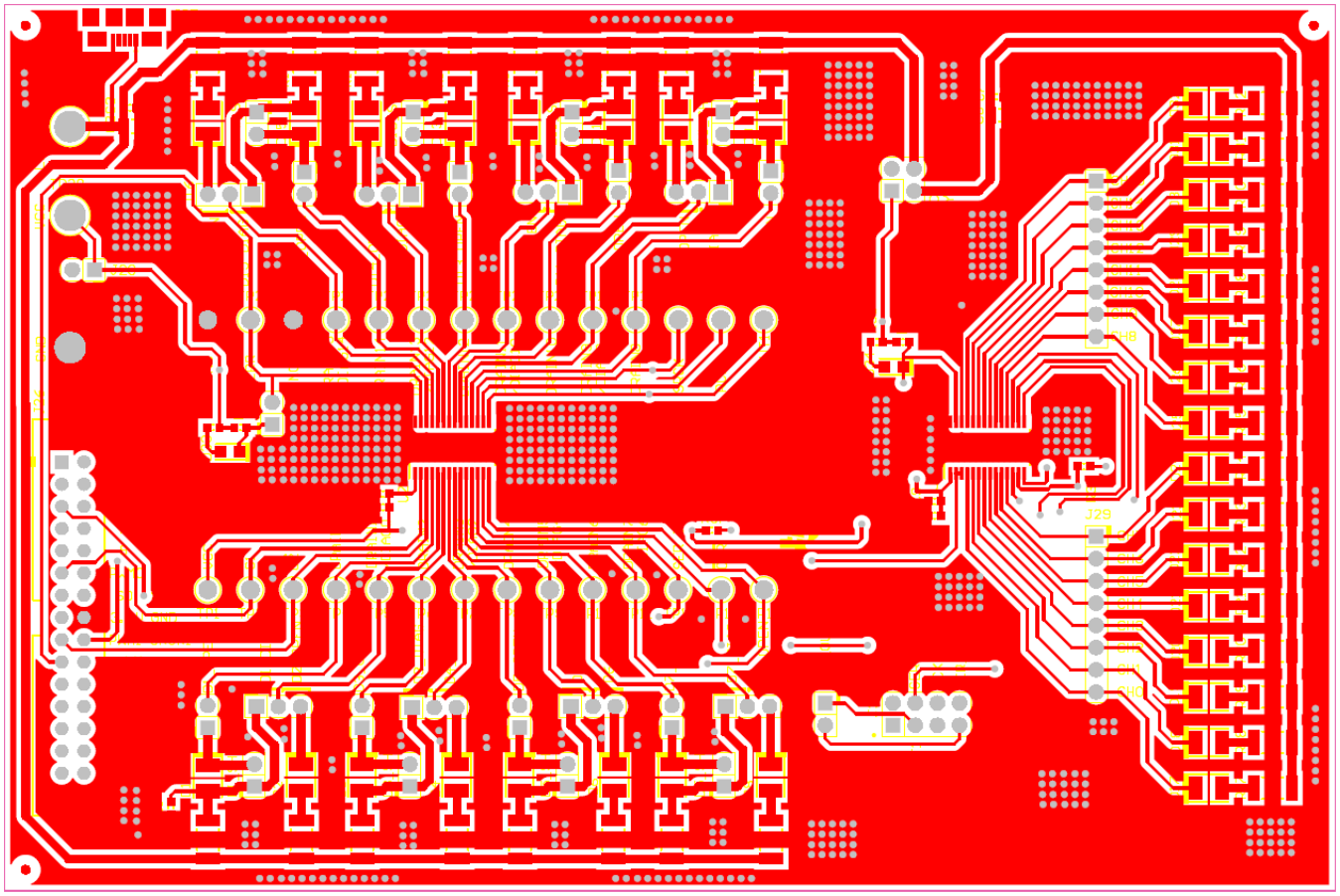


Figure 15. TLC6C5816EVM Top Layout

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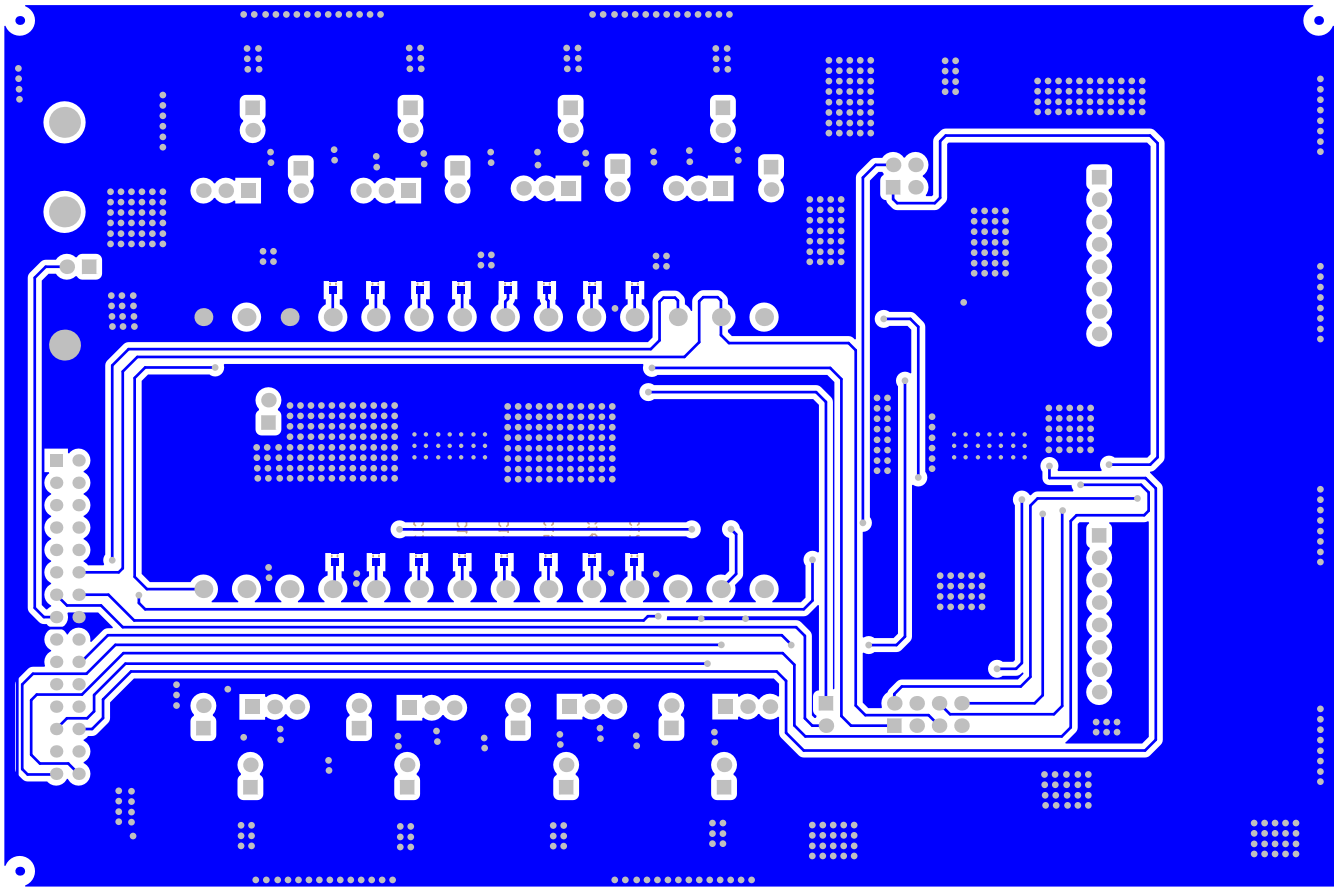


Figure 16. TLC6C5816EVM Bottom Layout

4 Schematic and Bill of Materials

The following section contains the EVM schematic and BOM.

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4.1 Schematic

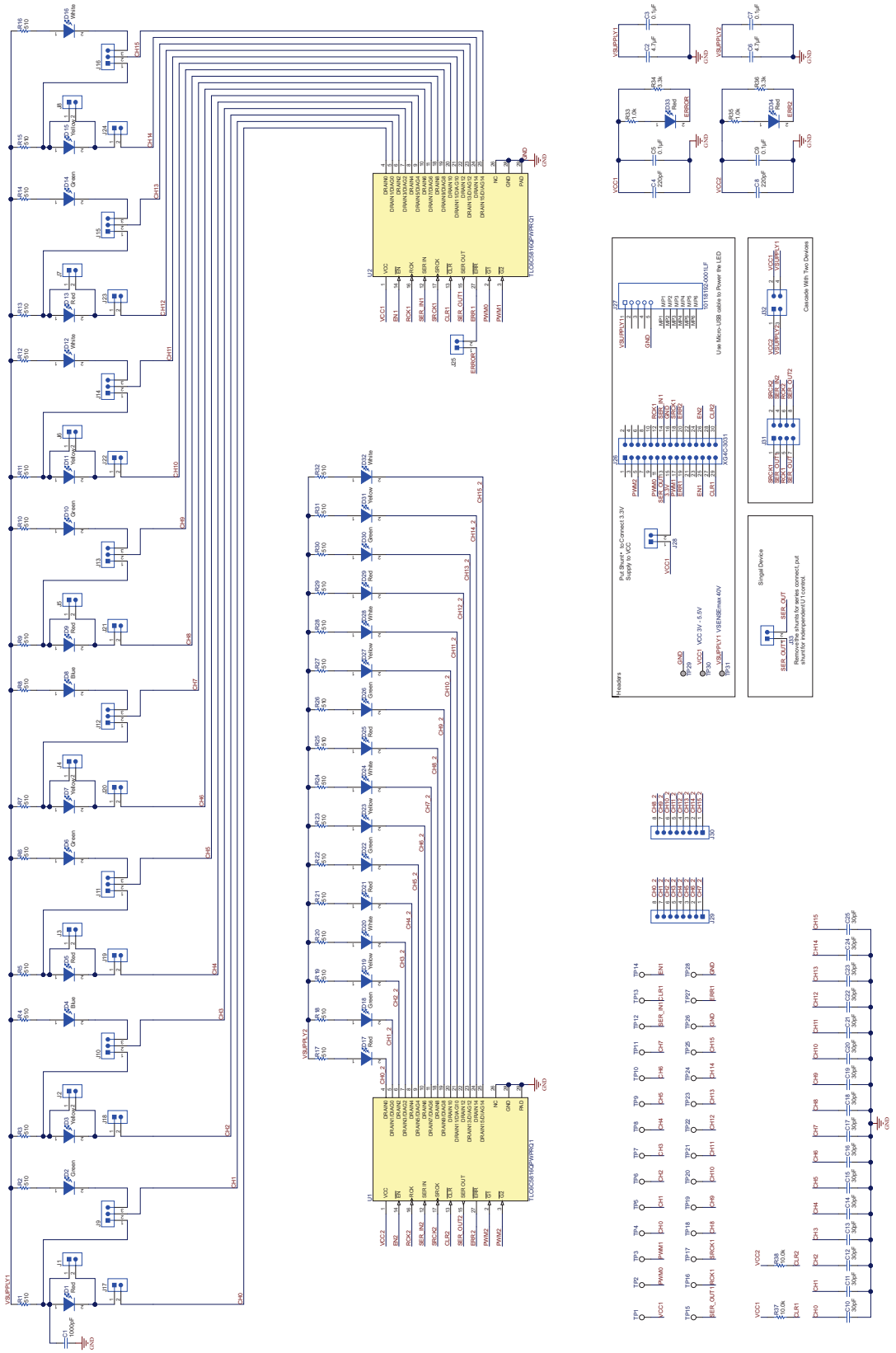


Figure 17. Schematic

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4.2 BOM

DESIGNATOR	DESCRIPTION	MANUFACTURER	PART NUMBER	QUANTITY
C1	Capacitor, ceramic, 1000 pF, 100 V, ±5%, X7R, 0603	AVX	06031C102JAT2A	1
C2, C6	Capacitor, ceramic, 4.7 µF, 50 V, ±10%, X6S, 1206	TDK	C3216X6S1H475K160 AB	2
C3, C7	Capacitor, ceramic, 0.1 µF, 50 V, ±10%, X7R, 0603	AVX	06035C104KAT2A	2
C4, C8	Capacitor, ceramic, 220 pF, 100 V, ±10%, X7R, 0603	AVX	06031C221KAT2A	2
C5, C9	Capacitor, ceramic, 0.1 µF, 16 V, ±5%, X7R, 0603	AVX	0603YC104JAT2A	2
C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25	Capacitor, ceramic, 30 pF, 50 V, ±5%, C0G/NP0, 0603	AVX	06035A300JAT2A	16
D1, D5, D9, D13, D17, D21, D25, D29	LED, super red, SMD	OSRAM	LS T67K-J1L2-1-Z	8
D2, D6, D10, D14, D18, D22, D26, D30	LED, green, SMD	OSRAM	LG T67K-G2K1-24-Z	8
D3, D7, D11, D15, D19, D23, D27, D31	LED, yellow, SMD	OSRAM	LY T67K-J2M1-26-Z	8
D4, D8	LED, blue, SMD	OSRAM	LB T673-L2P1-25-Z	2
D12, D16, D20, D24, D28, D32	LED, white, SMD	OSRAM	LW T67C-S2V1-5K8L-Z	6
D33, D34	LED, red, SMD	Lite-On	LTST-C170KRKT	2
J1, J2, J3, J4, J5, J6, J7, J8, J17, J18, J19, J20, J21, J22, J23, J24, J25, J28, J33	Header, 100 mil, 2×1, gold, TH	Samtec	TSW-102-07-G-S	19
J9, J10, J11, J12, J13, J14, J15, J16	Header, 100mil, 3×1, gold, TH	Samtec	TSW-103-07-G-S	8
J26	Connector, 15 × 2, 3 A, 300 V STRT DIP, TH	Omron	XG4C-3031	1
J27	Receptacle, 0.65 mm, 5×1, gold, R/A, SMT	FCI	10118192-0001LF	1
J29, J30	Header, 100 mil, 8×1, gold, TH	Samtec	TSW-108-07-G-S	2
J31	Header, 100 mil, 4×2, gold, TH	Samtec	TSW-104-07-G-D	1
J32	Header, 100 mil, 2×2, gold, TH	Samtec	TSW-102-07-G-D	1
R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, R12, R13, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, R24, R25, R26, R27, R28, R29, R30, R31, R32	Resistor, 510 Ω, 5%, 0.75 W, AEC-Q200 grade 0, 2010	Vishay	CRCW2010510RJNEF	32
R33, R35	Resistor, 1.0 kΩ, 5%, 0.1 W, 0603	Vishay	CRCW06031K00JNEA	2
R34, R36	Resistor, 3.3 kΩ, 5%, 0.1 W, 0603	Vishay	CRCW06033K30JNEA	2
R37, R38	Resistor, 10.0 kΩ, 1%, 0.1 W, 0603	Vishay	CRCW060310K0FKEA	2

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DESIGNATOR	DESCRIPTION	MANUFACTURER	PART NUMBER	QUANTITY
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	Shunt, 100 mil, gold plated, black	3M	969102-0000-DA	19
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP18, TP19, TP20, TP21, TP22, TP23, TP24, TP25, TP26, TP27, TP28	Test point, miniature, white, TH	Keystone	5002	28
TP29, TP30, TP31	Terminal, turret, TH, double	Keystone	1502-2	3

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