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 125°C 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.
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>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{CC}$</td>
<td>3-5.5 V</td>
</tr>
<tr>
<td>LED supply</td>
<td>12 V typical</td>
</tr>
<tr>
<td>Channel current</td>
<td>20 mA at 12-V LED supply</td>
</tr>
</tbody>
</table>

**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.
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\text{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\text{CC}.
- Connect USB2ANY to the computer.
- Connect the USB2ANY board to the TLC6C5816EVM.

![Figure 2. TLC6C5816EVM Hardware Setup](image)

Figure 3 shows the key connectors to launch the TLC6C5816EVM.

![Figure 3. TLC6C5816EVM Key Connectors](image)
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.
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.
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.

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.
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.

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

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

![Figure 11. ERR Indicator and Device Reset](image)

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](image)

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.
Figure 13. Cascading Device Configuration

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

Figure 14. GUI for Cascading Device
Figure 15. TLC6C5816EVM Top Layout
4 Schematic and Bill of Materials

The following section contains the EVM schematic and BOM.
4.1 Schematic

Figure 17. Schematic
### 4.2 BOM

<table>
<thead>
<tr>
<th>DESIGNATOR</th>
<th>DESCRIPTION</th>
<th>MANUFACTURER</th>
<th>PART NUMBER</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Capacitor, ceramic, 1000 pF, 100 V, ±5%, X7R, 0603</td>
<td>AVX</td>
<td>06031C102JAT2A</td>
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</tr>
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<td>C2, C6</td>
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<td>TDK</td>
<td>C3216X6S1H475K160</td>
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<td>C3, C7</td>
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<td>AVX</td>
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<td>C4, C8</td>
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<td>C5, C9</td>
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<td>AVX</td>
<td>0603YC104JAT2A</td>
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<tr>
<td>C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25</td>
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<td>AVX</td>
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<td>LED, super red, SMD</td>
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<td>LS T67K-J1L2-1-Z</td>
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<td>OSRAM</td>
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<td>LED, blue, SMD</td>
<td>OSRAM</td>
<td>LB T673-L2P1-25-Z</td>
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<tr>
<td>D12, D16, D20, D24, D28, D32</td>
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<td>OSRAM</td>
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<tr>
<td>D33, D34</td>
<td>LED, red, SMD</td>
<td>Lite-On</td>
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<tr>
<td>J1, J2, J3, J4, J5, J6, J7, J8, J17, J18, J19, J20, J21, J22, J23, J24, J25, J28, J33</td>
<td>Header, 100 mil, 2×1, gold, TH</td>
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<td>J26</td>
<td>Connector, 15 × 2, 3 A, 300 V STRT DIP, TH</td>
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<td>J27</td>
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<td>J32</td>
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<td>Samtec</td>
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<td>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</td>
<td>Resistor, 510 Q, 5%, 0.75 W, AEC-Q200 grade 0, 2010</td>
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<td>R33, R35</td>
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<tr>
<td>R34, R36</td>
<td>Resistor, 3.3 kΩ, 5%, 0.1 W, 0603</td>
<td>Vishay</td>
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<tr>
<td>R37, R38</td>
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<td>Vishay</td>
<td>CRCW060310K0FKEA</td>
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<tr>
<td>DESIGNATOR</td>
<td>DESCRIPTION</td>
<td>MANUFACTURER</td>
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<td>------------</td>
<td>-------------</td>
<td>--------------</td>
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<td>Test point, miniature, white, TH</td>
<td>Keystone</td>
<td>5002</td>
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<td>TP29, TP30, TP31</td>
<td>Terminal, turret, TH, double</td>
<td>Keystone</td>
<td>1502-2</td>
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