

## 24-CHANNEL, 12-BIT PWM LED DRIVER WITH 7-BIT DOT CORRECTION AND 3-GROUP, 8-BIT GLOBAL BRIGHTNESS CONTROL

### FEATURES

- 24-Channel Constant-Current Sink Output
- Current Capability
- Selectable Grayscale (GS) Control With PWM: 12-Bit (4096 Step), 10-Bit (1024 Step), 8-Bit (256 Step)
- Three Independent Grayscale Clocks for Three Color Groups
- Dot Correction (DC): 7-Bit (128 Step)
- Global Brightness Control (BC) for Each Color Group: 8-Bit (256 Step)
- Auto Display Repeat Function
- Independent Data Port for GS, BC and DC Data
- Communication Path Between Each Data Port
- LED Power-Supply Voltage
- $V_{CC} = 3.0\text{ V to }5.5\text{ V}$
- Constant-Current Accuracy:
  - Channel-to-Channel
  - Device-to-Device
- CMOS Logic Level I/O
- Data Transfer Rate
- Grayscale Control Clock
- Continuous Base LED Open Detection (LOD)
- Continuous Base LED Short Detection (LSD)
- Thermal Shutdown (TSD) With Auto Restart
- Grouped Delay to Prevent Inrush Current

### APPLICATIONS

- Full-Color LED Displays
- LED Signboards

### DESCRIPTION

The TLC5951 is a 24-channel, constant-current sink driver. Each channel has an individually-adjustable, 4096-step, pulse width modulation (PWM) grayscale (GS) brightness control and 128 step constant-current dot correction (DC). The dot correction adjusts brightness deviation between channels and other LED drivers. The output channels are grouped into three groups of eight channels. Each channel group has a 256-step global brightness control (BC) function and an individual grayscale clock input.

GS, DC, and BC data are accessible via a serial interface port. DC and BC can be programmed via a dedicated serial interface port.

The TLC5951 has three error detection circuits for LED open detection (LOD), LED short detection (LSD), and thermal error flag (TEF). LOD detects a broken or disconnected LED while LSD detects a shorted LED. TEF indicates an over-temperature condition.

### ORDERING INFORMATION<sup>(1)</sup>

| PRODUCT | PACKAGE DESIGNATOR | PACKAGE                                | ORDERABLE PART NUMBER | PACKAGE QUANTITY |
|---------|--------------------|--|-----------------------|------------------|
| TLC5951 | TD                 | Bare die in waffle pack <sup>(2)</sup> | TLC5951TDA2           | 10               |
|         |                    |  | TLC5951TDA3           | 96               |

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at [www.ti.com](http://www.ti.com).

(2) Processing is per the Texas Instruments commercial production baseline and is in compliance with the Texas Instruments Quality Control System in effect at the time of manufacture. Electrical screening consists of DC parametric and functional testing at room temperature only. Unless otherwise specified by Texas Instruments AC performance and performance over temperature is not warranted. Visual Inspection is performed in accordance with MIL-STD-883 Test Method 2010 Condition B at 75X minimum.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

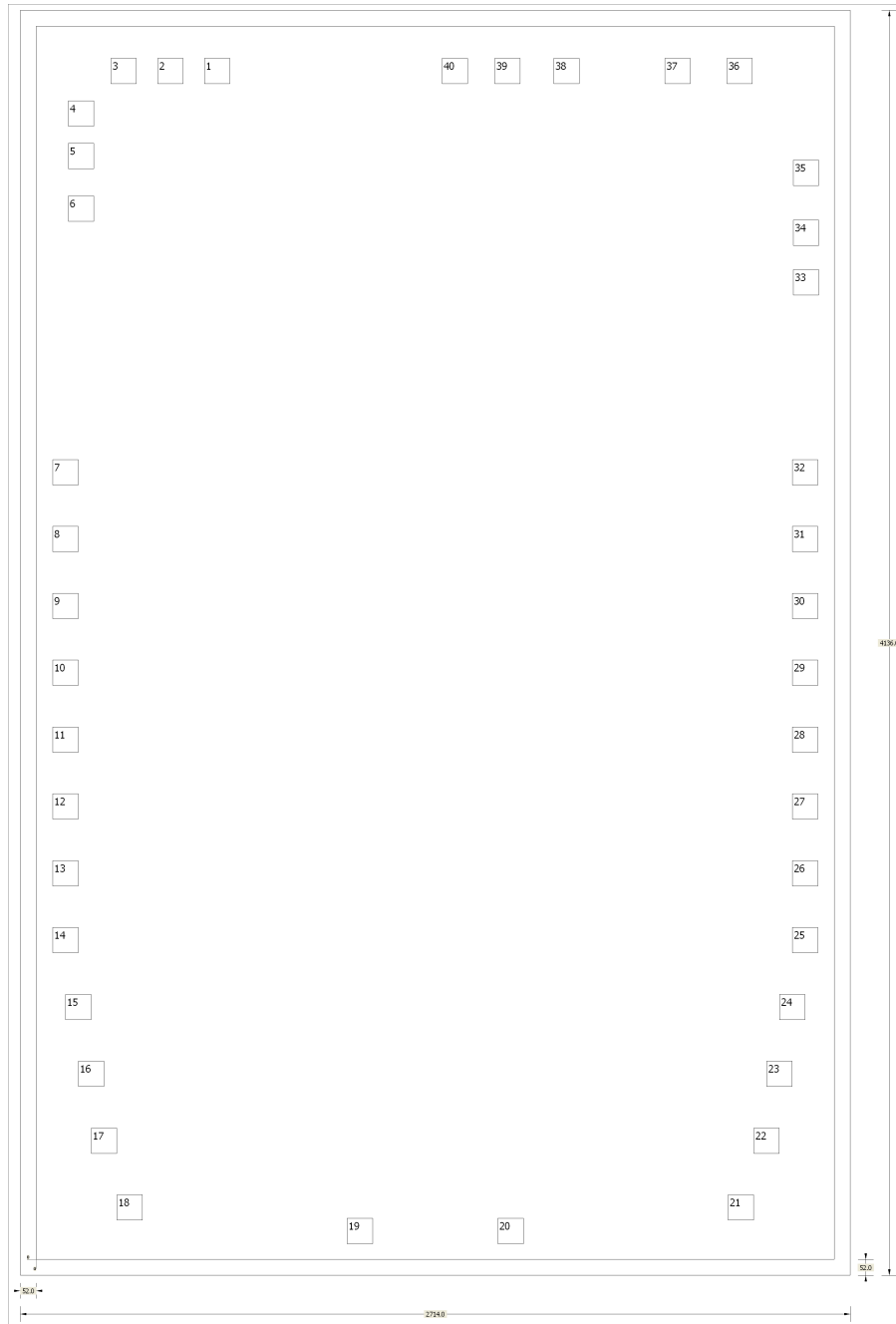


This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### BARE DIE INFORMATION

| DIE THICKNESS | BACKSIDE FINISH        | BACKSIDE POTENTIAL | BOND PAD METALLIZATION COMPOSITION | BOND PAD THICKNESS |
|---------------|------------------------|--------------------|------------------------------------|--------------------|
| 11 mils.      | Silicon with backgrind | Floating           | TiW-AlCu (0.5%)                    | 900 nm             |



**Table 1. Bond Pad Coordinates in Microns<sup>(1)</sup>**

| DESCRIPTION | PAD NUMBER | X MIN   | Y MIN   | X MAX   | Y MAX   |
|-------------|------------|---------|---------|---------|---------|
| GSSIN       | 1          | 550.35  | 3842.64 | 634.41  | 3926.7  |
| GSSCK       | 2          | 396.99  | 3842.64 | 481.05  | 3926.7  |
| GSLAT       | 3          | 243.63  | 3842.64 | 327.69  | 3926.7  |
| GSCKG       | 4          | 105.3   | 3704.31 | 189.36  | 3788.37 |
| GSCKR       | 5          | 105.3   | 3565.17 | 189.36  | 3649.23 |
| GSCKB       | 6          | 105.3   | 3392.55 | 189.36  | 3476.61 |
| OUTG0       | 7          | 54      | 2531.43 | 138.06  | 2615.49 |
| OUTR0       | 8          | 54      | 2312.91 | 138.06  | 2396.97 |
| OUTB0       | 9          | 54      | 2094.39 | 138.06  | 2178.45 |
| OUTG1       | 10         | 54      | 1875.87 | 138.06  | 1959.93 |
| OUTR1       | 11         | 54      | 1657.35 | 138.06  | 1741.41 |
| OUTB1       | 12         | 54      | 1438.83 | 138.06  | 1522.89 |
| OUTG2       | 13         | 54      | 1220.31 | 138.06  | 1304.37 |
| OUTR2       | 14         | 54      | 1001.79 | 138.06  | 1085.85 |
| OUTB2       | 15         | 96.03   | 783.27  | 180.09  | 867.33  |
| OUTG3       | 16         | 138.06  | 564.75  | 222.12  | 648.81  |
| OUTR3       | 17         | 180.09  | 346.23  | 264.15  | 430.29  |
| OUTB3       | 18         | 264.15  | 127.71  | 348.21  | 211.77  |
| GSSOUT      | 19         | 1016.46 | 51.3    | 1100.52 | 135.36  |
| DCSOUT      | 20         | 1509.48 | 51.3    | 1593.54 | 135.36  |
| OUTB4       | 21         | 2261.79 | 127.71  | 2345.85 | 211.77  |
| OUTR4       | 22         | 2345.85 | 346.23  | 2429.91 | 430.29  |
| OUTG4       | 23         | 2387.88 | 564.75  | 2471.94 | 648.81  |
| OUTB5       | 24         | 2429.91 | 783.27  | 2513.97 | 867.33  |
| OUTR5       | 25         | 2471.94 | 1001.79 | 2556    | 1085.85 |
| OUTG5       | 26         | 2471.94 | 1220.31 | 2556    | 1304.37 |
| OUTB6       | 27         | 2471.94 | 1438.83 | 2556    | 1522.89 |
| OUTR6       | 28         | 2471.94 | 1657.35 | 2556    | 1741.41 |
| OUTG6       | 29         | 2471.94 | 1875.87 | 2556    | 1959.93 |
| OUTB7       | 30         | 2471.94 | 2094.39 | 2556    | 2178.45 |
| OUTR7       | 31         | 2471.94 | 2312.91 | 2556    | 2396.97 |
| OUTG7       | 32         | 2471.94 | 2531.43 | 2556    | 2615.49 |
| GND         | 33         | 2474.64 | 3152.43 | 2558.7  | 3236.49 |
| GND         | 34         | 2474.64 | 3314.34 | 2558.7  | 3398.4  |
| GND         | 35         | 2474.64 | 3510    | 2558.7  | 3594.06 |
| IREF        | 36         | 2258.37 | 3842.64 | 2342.43 | 3926.7  |
| VCC         | 37         | 2055.42 | 3842.64 | 2139.48 | 3926.7  |
| XBLNK       | 38         | 1692    | 3842.64 | 1776.06 | 3926.7  |
| DCSCK       | 39         | 1499.31 | 3842.64 | 1583.37 | 3926.7  |
| DCSIN       | 40         | 1326.69 | 3842.64 | 1410.75 | 3926.7  |

 (1) Substrate  $V_{DD}$ .

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead/Ball Finish | MSL Peak Temp<br>(3) | Samples<br>(Requires Login) |
|------------------|---------------|--------------|--------------------|------|-------------|-----------------|------------------|----------------------|-----------------------------|
| TLC5951TDA2      | ACTIVE        |              |                    | 0    | 10          | TBD             | Call TI          | N / A for Pkg Type   |                             |
| TLC5951TDA3      | ACTIVE        |              |                    | 0    | 96          | TBD             | Call TI          | N / A for Pkg Type   |                             |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

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**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSELETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

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**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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|                               |  |
|-------------------------------|--|
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