

TLC59213x 8-Bit Parallel In and Out Darlington Source Driver With Latch

1 Features

- Output Current on Each Channel ($I_{OUT\ Max} = -500\text{ mA}$)
- $V_{CE(sus)} = 13.2\text{ V}$
- Input Compatible With TTL/5-V CMOS
- Clear (\overline{CLR}) and Clock (CLK) TTL/CMOS Control Inputs
- CLR Control Input to Off the Output
- Darlington Source Driver
- Clock Input Up to 1 MHz
- Enhanced Hold Time (t_h) on TLC59213A
- Temperature Range: -40°C to 85°C

2 Applications

- Lamp and Display (LED)
- Hammer
- Relay

3 Description

The TLC59213 and TLC59213A are 8-bit source drivers with input latch with CLK input and \overline{CLR} to set the output OFF. The TLC59213 and TLC59213A have large output source currents up to 500 mA with Darlington transistor and collectors tied to V_{CC} . These features make the device optimum level of driving the matrix of ink jet printer head, LEDs, and the scan-side of resistor's matrix. The TLC59213 and TLC59213A differ only in the Data Hold Time Specification (t_h).

The clamp diode is between output and ground for switching inductive load.

All inputs are TTL/CMOS, which enable to any logic-level inputs such as MCU, CPU or SN74LV594 (serial to parallel) and the output enable LED matrix display. It can also be used with another device sink driver such as TLC59210, TLC59211 and TLC59212.

Device Information⁽¹⁾

| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|-------------|------------|--------------------|
| TLC59213 | PDIP (20) | 24.33 mm × 6.35 mm |
| TLC59213A | TSSOP (20) | 6.50 mm × 4.40 mm |

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Typical Application Diagram:-

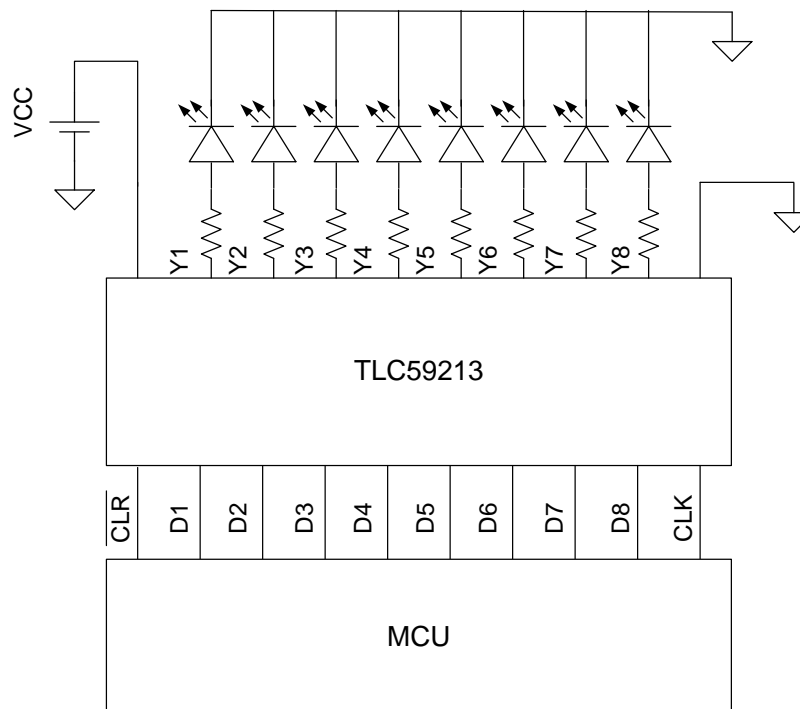


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4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

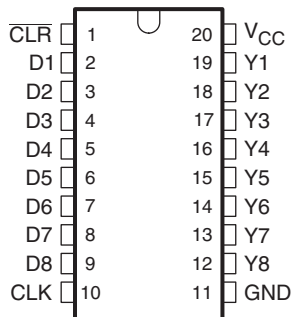
Changes from Revision A (March 2010) to Revision B

Page

- | | |
|---|----------|
| <ul style="list-style-type: none"> • Added <i>Pin Configuration and Functions</i> section, <i>ESD Ratings</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i>, <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section | 1 |
|---|----------|

5 Pin Configuration and Functions

**N or PW Package
20-Pin PDIP or TSSOP
Top View**



Pin Functions

| PIN | | I/O | DESCRIPTION |
|-------------------------|-----|-----|--|
| NAME | NO. | | |
| $\overline{\text{CLR}}$ | 1 | I | Direct clear of output |
| D1 | 2 | I | Input control to the current source driver |
| D2 | 3 | I | Input control to the current source driver |
| D3 | 4 | I | Input control to the current source driver |
| D4 | 5 | I | Input control to the current source driver |
| D5 | 6 | I | Input control to the current source driver |
| D6 | 7 | I | Input control to the current source driver |
| D7 | 8 | I | Input control to the current source driver |
| D8 | 9 | I | Input control to the current source driver |
| CLK | 10 | I | Clock to positive edge triggered D flipflops |
| GND | 11 | — | Ground |
| Y8 | 12 | O | Output to load |
| Y7 | 13 | O | Output to load |
| Y6 | 14 | O | Output to load |
| Y5 | 15 | O | Output to load |
| Y4 | 16 | O | Output to load |
| Y3 | 17 | O | Output to load |
| Y2 | 18 | O | Output to load |
| Y1 | 19 | O | Output to load |
| V _{cc} | 20 | I | Supply voltage |

6 Specifications

6.1 Absolute Maximum Ratings⁽¹⁾

over operating free-air temperature range (unless otherwise noted)

| | | MIN | MAX | UNIT |
|------------------|---------------------------|----------------------|-----------------------|------|
| V _{DD} | Supply voltage | -0.5 | 15 | V |
| V _I | Input voltage | -0.5 | V _{CC} + 0.5 | V |
| | Collector-emitter voltage | -0.5 | 15 | V |
| I _O | Peak output current | | -500 | mA |
| I _{IK} | Input clamp current | V _I < 0 V | -20 | mA |
| I _{OK} | Output clamp current | V _O < 0 V | -500 | mA |
| T _{stg} | Storage temperature | -65 | 150 | °C |

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

6.2 ESD Ratings

| | | VALUE | UNIT |
|--------------------|-------------------------|--|------|
| V _(ESD) | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾ | V |
| | | Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾ | |
| | | ±2000 | |
| | | ±1000 | |

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

| | | MIN | MAX | UNIT | |
|-----------------|--------------------------------|------------|------------------|------|----|
| V _{CC} | Supply voltage | 4.5 | 13.2 | V | |
| V _{IH} | High-level input voltage | 2 | | V | |
| V _{IL} | Low-level input voltage | | 0.8 | V | |
| I _O | Output current (8 channel) | N package | Duty cycle < 10% | 400 | mA |
| | | | Duty cycle < 50% | 200 | |
| | | PW package | Duty cycle < 10% | 350 | |
| | | | Duty cycle < 50% | 170 | |
| T _A | Operating free-air temperature | -40 | 85 | °C | |

6.4 Electrical Characteristics

over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT | | |
|----------------------|---------------------------|--|-----|-----------------|------|----|----|
| I _{CEX} | Output leakage current | V _{CC} = 13.2 V, Outputs off | | | 2 | μA | |
| V _{CE(sus)} | Output saturation voltage | I _{OUT} = -350 mA | | | 2.35 | V | |
| | | I _{OUT} = -225 mA | | | 2.15 | | |
| | | I _{OUT} = -100 mA | | | 1.96 | | |
| I _I | Input current | V _{CC} = 13.2 V, V _I = 0 or 13.2 V | | | 1 | μA | |
| V _f | Clamp forward voltage | I _f = -350 mA | | | -2 | V | |
| I _{CC} | Supply current | V _{CC} = 13.2 V, V _I = 0 or 13.2 V | | All outputs OFF | 4.6 | 13 | mA |
| | | | | All outputs ON | 4.8 | 13 | |
| C _I | Input capacitance | | | | 10 | pF | |

6.5 Timing Requirements

over recommended operating free-air temperature range (unless otherwise noted), see Figure 3

| | | | | MIN | MAX | UNIT | |
|----------|-------------|---|---------------------|---|-----|------|----|
| t_{su} | Setup time | D before CLK \uparrow | | 50 | | ns | |
| | | \overline{CLR} high before CLK \uparrow | | 50 | | ns | |
| t_h | Hold time | D after CLK \uparrow | TLC59213, TLC59213A | $T_A = -40^\circ\text{C}$ to 85°C | | 50 | ns |
| | | | TLC59213 | $T_A = 0^\circ\text{C}$ to 70°C | | 25 | |
| | | | TLC59213A | $T_A = 0^\circ\text{C}$ to 70°C , $V_{CC} = 4.5\text{ V}$ to 5.5 V | | 15 | |
| | | | | $T_A = 0^\circ\text{C}$ to 70°C , $V_{CC} = 10.8\text{ V}$ to 13.2 V | | 19 | |
| t_w | Pulse width | CLK, \overline{CLR} | | 100 | | ns | |

6.6 Switching Characteristics

over operating free-air temperature range (unless otherwise noted), see Figure 3

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | $T_A = 25^\circ\text{C}$ | | | $T_A = -40^\circ\text{C}$ to 85°C | | UNIT |
|------------|--|------------------|-----------------|-------------------------------|-----|-----|---|-----|------|
| | | | | MIN | TYP | MAX | MIN | MAX | |
| t_{PLH} | Propagation delay time, low-to-high level output | CLK | Y | RL = 25 Ω , CL = 15 pF | | | 250 | | ns |
| t_{PHL} | Propagation delay time, high-to-low level output | CLK | Y | RL = 25 Ω , CL = 15 pF | | | 250 | | ns |
| t_{PHLR} | Propagation delay time, high-to-low level output | \overline{CLR} | Y | RL = 25 Ω , CL = 15 pF | | | 250 | | ns |

6.7 Typical Characteristics

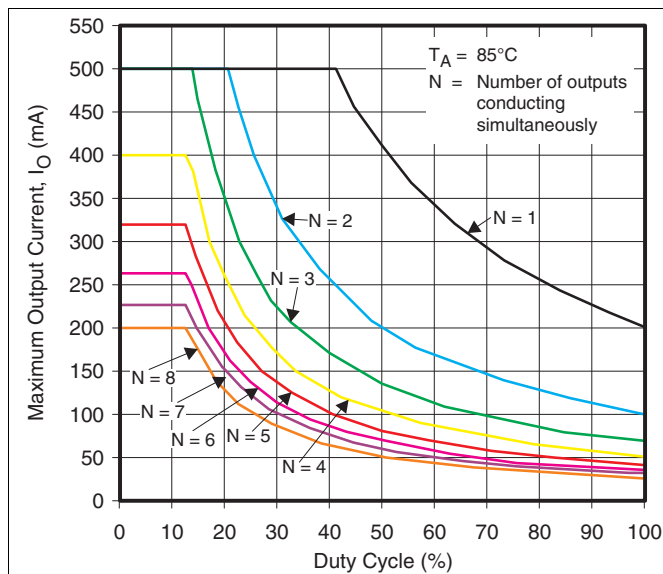


Figure 1. Maximum Output Current vs Duty Cycle (TSSOP (PW) Package)

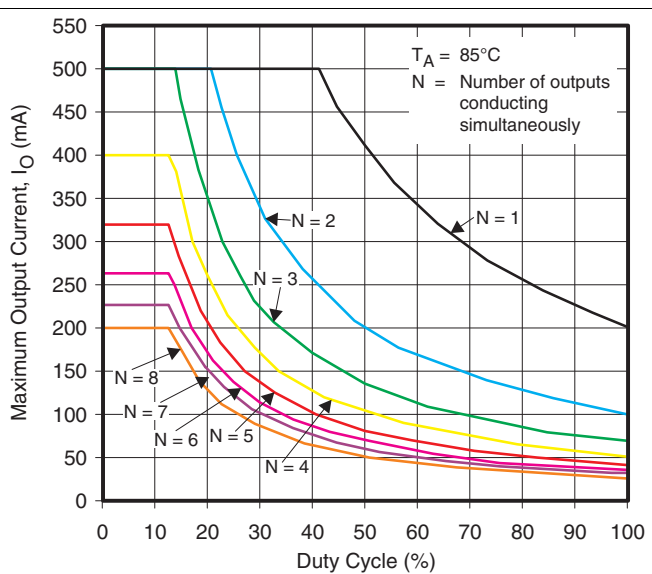
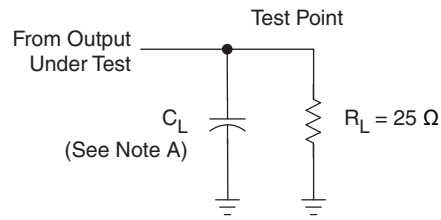
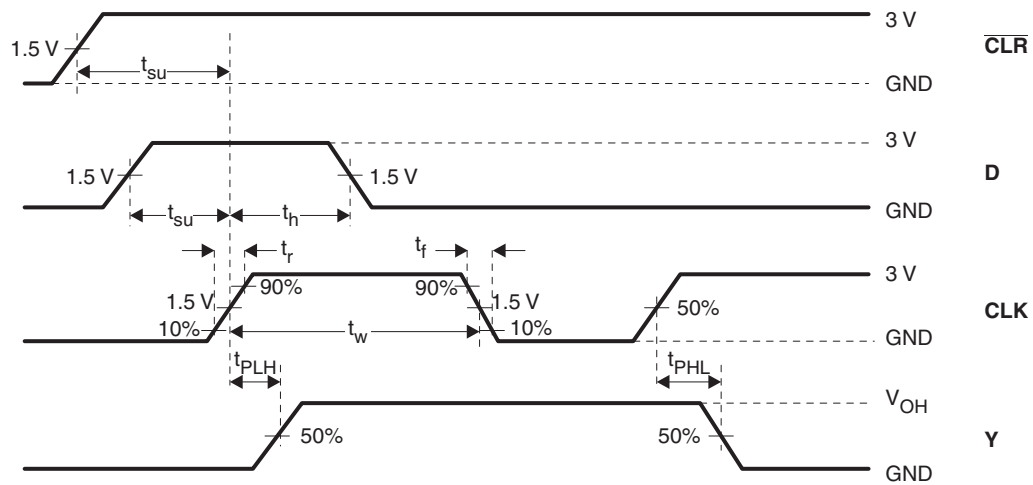


Figure 2. Maximum Output Current vs Duty Cycle (DIP (N) Package)

7 Parameter Measurement Information


TEST CIRCUIT

VOLTAGE WAVEFORMS

- C_L includes probe and jig capacitance.
- All input pulses are supplied by generators having the following characteristics: $PRR \leq 1 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 3 \text{ ns}$, and $t_f \leq 3 \text{ ns}$.
- The outputs are measured one at a time with one transition per measurement.

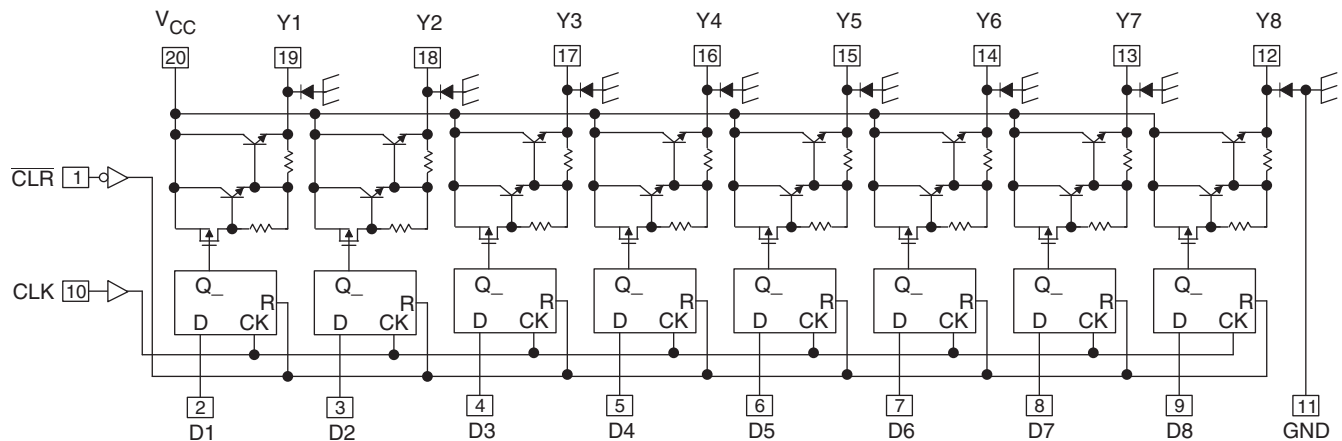
Figure 3. Test Circuit and Voltage Waveforms

8 Detailed Description

8.1 Overview

The TLC59213 device is an 8-bit Darlington source driver with latch for large-output source currents up to 500 mA.

8.2 Functional Block Diagram



(1) This symbol is in accordance with ANSI/IEEE Standard 91-1984 and IEC Publication 617-12.

8.3 Feature Description

Each of the 8 channels is controlled by its input (D_n), a direct clear (\overline{CLR}), and clock (CLK) through a positive-edge-triggered D-type flip-flops. Information at the data (D) input meeting the setup time requirements is transferred to the output (Y) on the positive-going edge of the clock (CLK) pulse. When CLK is at either the high or low level, the D-input has no effect at the output. When \overline{CLR} is at low level, the D-input has no effect at the output.

8.4 Device Functional Modes

Table 1 lists the functional modes of the TLC59213.

Table 1. Function Table (Each Latch)⁽¹⁾

| INPUTS | | | OUTPUT Y |
|------------------|-----|---|-------------|
| \overline{CLR} | CLK | D | |
| L | X | X | Z (OFF) |
| H | ↑ | L | Z (OFF) |
| H | ↑ | H | H (ON) |
| H | L | X | Y_0 |
| H | ↓ | X | Y_0 |

(1) L: Low-level
H: High-level
X: Irrelevant
↑: Rising edge
↓: Falling edge
Z: High-impedance (OFF)

9 Application and Implementation

NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

9.1 Application Information

In LED display application, TLC59213 is used to drive the current source for 8 LEDs in parallel. LED display pattern can be created by providing different bit pattern. At every positive clock edge, new bit pattern will be transferred to LED display.

9.2 Typical Application

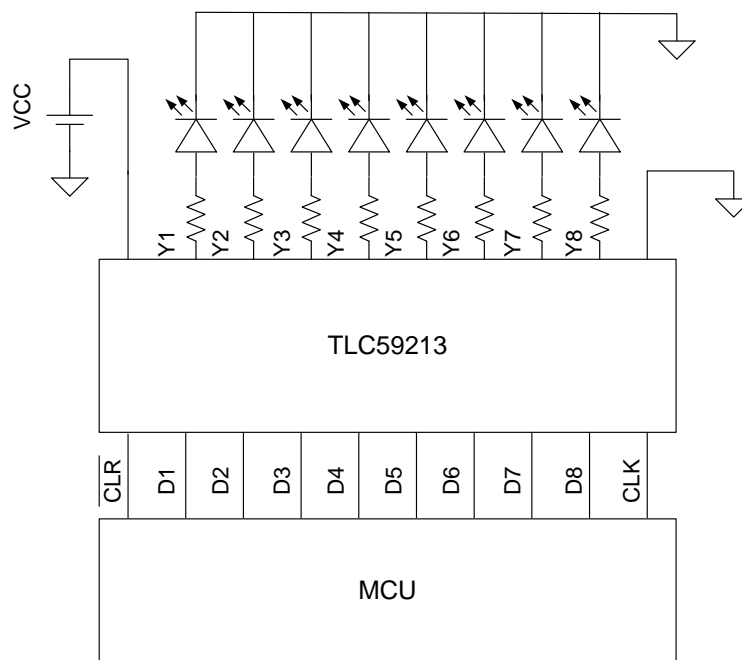


Figure 4. Typical Application Diagram

9.2.1 Design Requirements

For LED display application, LED is selected based on the application. The current level is determined by the required brightness. Given the available supply, the resistor value could be determined. The maximum output current is constrained by the duty cycle. See [Figure 1](#) and [Figure 2](#).

9.2.2 Detailed Design Procedure

The selection of supply voltage (VCC), LED, and resistor sets the current of the LED.

$$V_R + V_L + V_{CE} = V_{CC} \quad (1)$$

$$I = (V_{CC} - V_L - V_{CE}) / R \quad (2)$$

V_R is the voltage drop across the resistor, V_L is the voltage drop across the LED when LED is on, V_{CE} is the collector-to-emitter voltage of the Darlington current source driver, when the driver is enabled. For example, when $V_{CC} = 12\text{ V}$, $V_L = 2.9\text{ V}$, and $V_{CE} = 1.6\text{ V}$, a $75\text{-}\Omega$ resistor is used to obtain output current 100 mA .

Typical Application (continued)

9.2.3 Application Curve

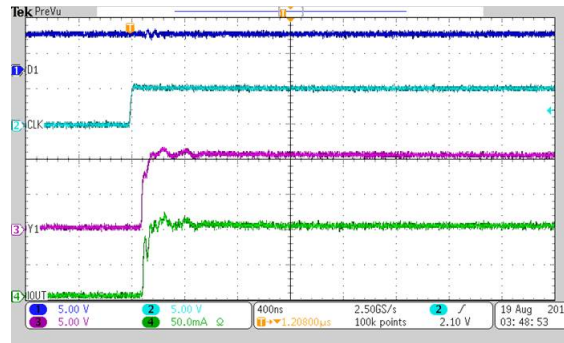


Figure 5. Output Voltage and Current Response

10 Power Supply Recommendations

The supply voltage to TLC59213 is from 4.5 V to 13.2 V.

11 Layout

11.1 Layout Guidelines

The traces that carry current from the output pins must be wide enough to support the current.

11.2 Layout Example

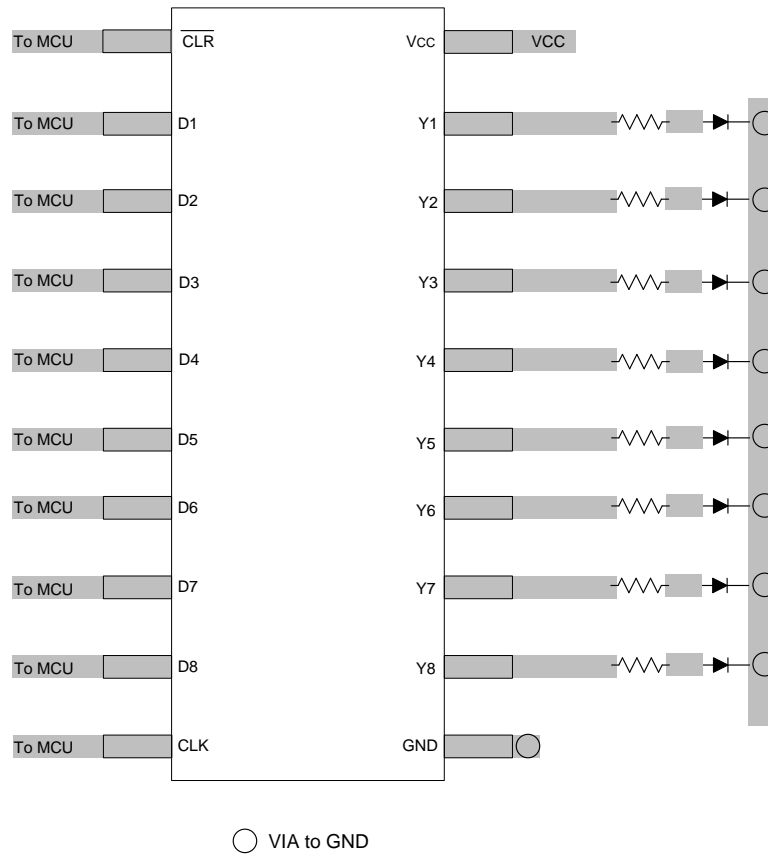


Figure 6. Layout Recommendation

12 Device and Documentation Support

12.1 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

TI E2E™ Online Community *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

12.2 Trademarks

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

12.3 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

12.4 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TLC59213AIN | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | -40 to 85 | TLC59213AIN | Samples |
| TLC59213AIPW | ACTIVE | TSSOP | PW | 20 | 70 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | Y59213A | Samples |
| TLC59213AIPWR | ACTIVE | TSSOP | PW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | Y59213A | Samples |
| TLC59213AIPWT | ACTIVE | TSSOP | PW | 20 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | Y59213A | Samples |
| TLC59213IN | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | -40 to 85 | TLC59213IN | Samples |
| TLC59213IPWR | ACTIVE | TSSOP | PW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | Y59213 | Samples |

(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.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

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.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

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.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

⁽⁶⁾ Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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TAPE AND REEL INFORMATION
REEL DIMENSIONS

TAPE DIMENSIONS


| | |
|----|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

TAPE AND REEL INFORMATION

*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLC59213AIPWR | TSSOP | PW | 20 | 2000 | 330.0 | 16.4 | 6.95 | 7.1 | 1.6 | 8.0 | 16.0 | Q1 |
| TLC59213AIPWT | TSSOP | PW | 20 | 250 | 180.0 | 16.4 | 6.95 | 7.1 | 1.6 | 8.0 | 16.0 | Q1 |
| TLC59213IPWR | TSSOP | PW | 20 | 2000 | 330.0 | 16.4 | 6.95 | 7.1 | 1.6 | 8.0 | 16.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLC59213AIPWR | TSSOP | PW | 20 | 2000 | 367.0 | 367.0 | 38.0 |
| TLC59213AIPWT | TSSOP | PW | 20 | 250 | 210.0 | 185.0 | 35.0 |
| TLC59213IPWR | TSSOP | PW | 20 | 2000 | 367.0 | 367.0 | 38.0 |

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



4040049/E 12/2002

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - (C) Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - (D) The 20 pin end lead shoulder width is a vendor option, either half or full width.

PW (R-PDSO-G20)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
 - E. Falls within JEDEC MO-153

PW (R-PDSO-G20)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate design.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

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