Features

- 5V-to-90V Operating Range (VA–B)
- 20 mA ±5% at 45V (VA–B)
- −8.5 µA/°C Typical Temperature Coefficient
- No External Components (Two-Terminal Device)
- Can be Paralleled for Higher Current

Applications

- LED Driver
- Industrial Lamp Indicators
- Signage
- Accent Lighting
- Automotive
- Constant-Current Source
- Constant-Current Sink

General Description

The CL1 is a high-voltage temperature-compensated, constant-current source. The device is trimmed to provide a constant current of 20 mA ±5% at an input voltage of 45V. No external components are required. This device can be used as a two-terminal constant-current source or constant-current sink.

A typical application for the CL1 is to drive LEDs with a constant current of 20 mA. Multiple CL1s can also be used in parallel to provide higher currents, such as 40 mA, 60 mA and 80 mA. The device is available in SOT-89 packages.

Package Type

3-lead SOT-89
(Top view)

See Table 2-1 for pin information.
CL1

Functional Block Diagram

Functional Circuit Diagram

Equivalent Block Diagram

Control Circuit and Temperature Compensation

VA

VB

20mA

5%

VA

VB
Typical Application Circuit

Up to 90V
$+V_{LED(total)}$

CL1

Control Circuit and Temperature Compensation

Functional Circuit Diagram
1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings†

Operating Voltage, \( V_{A-B} \) .......................................................... +100V
Junction Temperature, \( T_J \) ......................................................... −40°C to +135°C
Storage Temperature, \( T_S \) ......................................................... −55°C to +150°C
Power Dissipation (at \( T_A = 25°C \)) .................................................. 1.3W

† Notice: Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only, and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

DC ELECTRICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sym.</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Operating Voltage</td>
<td>( V_{A-B} )</td>
<td>—</td>
<td>—</td>
<td>90</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Current Regulation ( I_{A-B} )</td>
<td></td>
<td>17.1</td>
<td>18</td>
<td>18.9</td>
<td>mA</td>
<td>( V_{A-B} = 5V )</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>mA</td>
<td>( V_{A-B} = 45V )</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19</td>
<td>22</td>
<td>24.2</td>
<td>mA</td>
<td>( V_{A-B} = 90V )</td>
</tr>
<tr>
<td>( I_{A-B} ) Temperature Coefficient</td>
<td>( \Delta I_{A-B}/\Delta T )</td>
<td>—</td>
<td>−8.5</td>
<td>—</td>
<td>µA/°C</td>
<td>( V_{A-B} = 45V, T_J = 0°C ) to 100°C</td>
</tr>
<tr>
<td>Operating Junction Temperature</td>
<td>( T_J )</td>
<td>−40</td>
<td>—</td>
<td>125</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Dynamic Resistance ( R_{A-B} )</td>
<td></td>
<td>—</td>
<td>17</td>
<td>—</td>
<td>kΩ</td>
<td>( V_{A-B} = 5V ) to 90V</td>
</tr>
</tbody>
</table>

TEMPERATURE SPECIFICATIONS

<table>
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<tr>
<th>Parameter</th>
<th>Sym.</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Conditions</th>
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<td>TEMPERATURE RANGE</td>
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<td></td>
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<tr>
<td>Operating Junction Temperature</td>
<td>( T_J )</td>
<td>−40</td>
<td>—</td>
<td>+125</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>( T_J(\text{ABSMAX}) )</td>
<td>—</td>
<td>—</td>
<td>+135</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Storage Temperature ( T_S )</td>
<td></td>
<td>−55</td>
<td>—</td>
<td>+150</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>PACKAGE THERMAL RESISTANCE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-lead SOT-89</td>
<td>( \theta_{JA} )</td>
<td>—</td>
<td>133</td>
<td>—</td>
<td>°C/W</td>
<td>Note 1</td>
</tr>
</tbody>
</table>

Note 1: Mounted on FR4 board; 25 mm x 25 mm x 1.57 mm
2.0 PIN DESCRIPTION

The details on the pins of CL1 are listed in Table 2-1. Refer to Package Type for the location of pins.

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Pin Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VB</td>
<td>Constant-current source</td>
</tr>
<tr>
<td>2</td>
<td>VA</td>
<td>Supply voltage and constant-current sink</td>
</tr>
<tr>
<td>3</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>4</td>
<td>VA</td>
<td>Supply voltage and constant-current sink</td>
</tr>
</tbody>
</table>
3.0 APPLICATION INFORMATION

**FIGURE 3-1:** Output Current vs. Voltage.

3.1 Application Circuits

**FIGURE 3-2:** CL1 for 120V Offline LED Driver.
Up to 90V
+V_{LED(total)}
(Note)

**FIGURE 3-3:** CL1 for Multiple LED Strings.

Note: At high voltages across the VA pin and VB pin, pulse operation with suitable duty cycle should be used to keep the device power dissipation and junction temperature below the maximum limit.

Up to 90V
+V_{LED(total)}
(Note)

**FIGURE 3-4:** Higher Current with Multiple CL1 Devices.

Note: At high voltages across the VA pin and VB pin, pulse operation with suitable duty cycle should be used to keep the device power dissipation and junction temperature below the maximum limit.
4.0 PACKAGING INFORMATION

4.1 Package Marking Information

Legend:
- **XX...X**  Product Code or Customer-specific information
- **Y**  Year code (last digit of calendar year)
- **YY**  Year code (last 2 digits of calendar year)
- **WW**  Week code (week of January 1 is week ‘01’)
- **NNN**  Alphanumeric traceability code
- **(e3)**  Pb-free JEDEC® designator for Matte Tin (Sn)
- **(*)**  This package is Pb-free. The Pb-free JEDEC designator (e3) can be found on the outer packaging for this package.

**Note:** In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for product code or customer-specific information. Package may or not include the corporate logo.
3-Lead TO-243AA (SOT-89) Package Outline (N8)

Top View

Side View

Note: For the most current package drawings, see the Microchip Packaging Specification at www.microchip.com/packaging.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>A</th>
<th>b</th>
<th>b1</th>
<th>C</th>
<th>D</th>
<th>D1</th>
<th>E</th>
<th>E1</th>
<th>e</th>
<th>e1</th>
<th>H</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions (mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIN</td>
<td>1.40</td>
<td>0.44</td>
<td>0.36</td>
<td>0.35</td>
<td>4.40</td>
<td>1.62</td>
<td>2.29</td>
<td>2.00†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAX</td>
<td>1.60</td>
<td>0.56</td>
<td>0.48</td>
<td>0.44</td>
<td>4.60</td>
<td>1.83</td>
<td>2.60</td>
<td>2.29</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

† This dimension differs from the JEDEC drawing.

Drawings not to scale.
APPENDIX A: REVISION HISTORY

Revision A (December 2018)

- Converted Supertex Doc# DSFP-CL1 to Microchip DS20006072A
- Removed the 3-lead TO-252 K4 and 3-lead TO-92 N3 packages
- Changed the package marking format
- Added new sections to comply with the standard Microchip format
- Made minor text changes throughout the document
**PRODUCT IDENTIFICATION SYSTEM**

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>XX</th>
<th>-</th>
<th>X</th>
<th>-</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device</td>
<td>CL1</td>
<td></td>
<td>90V 20 mA Simple Temperature-Compensated Constant-Current LED Driver IC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Package</td>
<td>N8</td>
<td>= 3-lead SOT-89</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental</td>
<td>G</td>
<td>= Lead (Pb)-free/RoHS-compliant Package</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Media Type</td>
<td>(blank)</td>
<td>= 2000/Reel for an SOT-89 Package</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Example:**

a) CL1N8-G: 90V 20 mA Simple Temperature-Compensated Constant-Current LED Driver IC, 3-lead SOT-89 Package, 2000/Reel
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