High-Voltage, High-Current Darlington Arrays

Featuring continuous load current ratings to 500 mA for each of the drivers, the Series ULN28xxA/LW and ULQ28xxA/LW high-voltage, high-current Darlington arrays are ideally suited for interfacing between low-level logic circuitry and multiple peripheral power loads. Typical power loads totaling over 260 W (350 mA x 8, 95 V) can be controlled at an appropriate duty cycle depending on ambient temperature and number of drivers turned on simultaneously. Typical loads include relays, solenoids, stepping motors, magnetic print hammers, multiplexed LED and incandescent displays, and heaters. All devices feature open-collector outputs with integral clamp diodes.

The ULx2803A, ULx2803LW, ULx2823A, and ULN2823LW have series input resistors selected for operation directly with 5 V TTL or CMOS. These devices will handle numerous interface needs — particularly those beyond the capabilities of standard logic buffers. The ULx2804A, ULx2804LW, ULx2824A, and ULN2824LW have series input resistors for operation directly from 6 V to 15 V CMOS or PMOS logic outputs.

The ULx2803A/LW and ULx2804A/LW are the standard Darlington arrays. The outputs are capable of sinking 500 mA and will withstand at least 50 V in the off state. Outputs may be paralleled for higher load current capability. The ULx2823A/LW and ULx2824A/LW will withstand 95 V in the off state.

These Darlington arrays are furnished in 18-pin dual in-line plastic packages (suffix ‘A’) or 18-lead small-outline plastic packages (suffix ‘LW’). All devices are pinned with outputs opposite inputs to facilitate ease of circuit board layout. Prefix ‘ULN’ devices are rated for operation over the temperature range of -20°C to +85°C; prefix ‘ULQ’ devices are rated for operation to -40°C.

ABSOLUTE MAXIMUM RATINGS

| Output Voltage, \(V_{CE}\)       | 50 V       |
|Input Voltage, \(V_{IN}\)        | 30 V       |
|Continuous Output Current, \(I_C\) | 500 mA     |
|Continuous Input Current, \(I_{IN}\) | 25 mA     |
|Power Dissipation, \(P_D\)       | 1.0 W      |

(See Graph)

Operating Temperature Range, \(T_A\)
- Prefix ‘ULN’ : -20°C to +85°C
- Prefix ‘ULQ’ : -40°C to +85°C

Storage Temperature Range, \(T_S\)
- -55°C to +150°C

FEATURES
- TTL, DTL, PMOS, or CMOS Compatible Inputs
- Output Current to 500 mA
- Output Voltage to 95 V
- Transient-Protected Outputs
- Dual In-Line Package or Wide-Body Small-Outline Package

The ULx2804, ULx2823, & ULx2824 are last-time buy. Orders accepted until October 19, 2001.

x = Character to identify specific device. Characteristic shown applies to family of devices with remaining digits as shown. See matrix on next page.
### DEVICE PART NUMBER DESIGNATION

<table>
<thead>
<tr>
<th>Logic</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 V TTL, CMOS</td>
<td>ULN2803A*</td>
</tr>
<tr>
<td></td>
<td>ULN2803LW*</td>
</tr>
<tr>
<td>6-15 V CMOS, PMOS</td>
<td>ULN2804A*</td>
</tr>
<tr>
<td></td>
<td>ULN2804LW*</td>
</tr>
<tr>
<td></td>
<td>ULN2823A*</td>
</tr>
<tr>
<td></td>
<td>ULN2823LW</td>
</tr>
<tr>
<td></td>
<td>ULN2824A*</td>
</tr>
<tr>
<td></td>
<td>ULN2824LW</td>
</tr>
</tbody>
</table>

* Also available for operation between -40°C and +85°C. To order, change prefix from ‘ULN’ to ‘ULQ’.

**The ULx2804, ULx2823, & ULx2824 are last-time buy. Orders accepted until October 19, 2001.**

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**PARTIAL SCHEMATICS**

**ULx28x3A/LW (Each Driver)**

![Schematic](Dwg.FP-052-2)

**ULx28x4A/LW (Each Driver)**

![Schematic](Dwg.FP-052-3)

x = Character to identify specific device. Specification shown applies to family of devices with remaining digits as shown. See matrix above.
Types ULx2803A, ULx2803LW, ULx2804A, and ULx2804LW
ELECTRICAL CHARACTERISTICS at +25°C (unless otherwise noted).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Test Fig.</th>
<th>Applicable Devices</th>
<th>Test Conditions</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Min.</td>
</tr>
<tr>
<td>Output Leakage Current</td>
<td>ICEX</td>
<td>1A</td>
<td>All</td>
<td>V_{CE} = 50 V, T_A = 25°C</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>V_{CE} = 50 V, T_A = 70°C</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1B</td>
<td>ULx2804x</td>
<td>V_{CE} = 50 V, T_A = 70°C, V_{IN} = 1.0 V</td>
<td>—</td>
</tr>
<tr>
<td>Collector-Emitter Saturation Voltage</td>
<td>V_{CE(SAT)}</td>
<td>2</td>
<td>All</td>
<td>I_C = 100 mA, I_B = 250 µA</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>I_C = 200 mA, I_B = 350 µA</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>I_C = 350 mA, I_B = 500 µA</td>
<td>—</td>
</tr>
<tr>
<td>Input Current</td>
<td>I_{IN(ON)}</td>
<td>3</td>
<td>ULx2803x</td>
<td>V_{IN} = 3.85 V</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ULx2804x</td>
<td>V_{IN} = 5.0 V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>V_{IN} = 12 V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Voltage</td>
<td>V_{IN(ON)}</td>
<td>5</td>
<td>ULx2803x</td>
<td>V_{CE} = 2.0 V, I_C = 200 mA</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>V_{CE} = 2.0 V, I_C = 250 mA</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>V_{CE} = 2.0 V, I_C = 300 mA</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ULx2804x</td>
<td>V_{CE} = 2.0 V, I_C = 125 mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>V_{CE} = 2.0 V, I_C = 200 mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>V_{CE} = 2.0 V, I_C = 275 mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>V_{CE} = 2.0 V, I_C = 350 mA</td>
</tr>
<tr>
<td>Input Capacitance</td>
<td>C_{IN}</td>
<td>—</td>
<td>All</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Turn-On Delay</td>
<td>t_{PLH}</td>
<td>8</td>
<td>All</td>
<td>0.5 E_{IN} to 0.5 E_{OUT}</td>
<td>—</td>
</tr>
<tr>
<td>Turn-Off Delay</td>
<td>t_{PHL}</td>
<td>8</td>
<td>All</td>
<td>0.5 E_{IN} to 0.5 E_{OUT}</td>
<td>—</td>
</tr>
<tr>
<td>Clamp Diode Leakage Current</td>
<td>I_{R}</td>
<td>6</td>
<td>All</td>
<td>V_R = 50 V, T_A = 25°C</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>V_R = 50 V, T_A = 70°C</td>
<td>—</td>
</tr>
<tr>
<td>Clamp Diode Forward Voltage</td>
<td>V_{F}</td>
<td>7</td>
<td>All</td>
<td>I_{F} = 350 mA</td>
<td>—</td>
</tr>
</tbody>
</table>

Complete part number includes prefix to operating temperature range: ULN = -20°C to +85°C, ULQ = -40°C to +85°C and a suffix to identify package style: A = DIP, LW = SOIC.

The ULx2804 is last-time buy.
Orders accepted until October 19, 2001.
### Types ULx2823A, ULN2823LW, ULx2824A, and ULN2824LW

**ELECTRICAL CHARACTERISTICS at +25°C (unless otherwise noted).**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Test Fig.</th>
<th>Applicable Devices</th>
<th>Test Conditions</th>
<th>Limits</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Leakage Current</td>
<td>$I_{CEX}$</td>
<td>1A</td>
<td>All</td>
<td>$V_{CE} = 95 \text{ V, } T_A = 25^\circ C$</td>
<td>—</td>
<td>$&lt; 1$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1B</td>
<td>ULx2824x</td>
<td>$V_{CE} = 95 \text{ V, } T_A = 70^\circ C, V_{IN} = 1.0 \text{ V}$</td>
<td>—</td>
<td>$&lt; 5$</td>
</tr>
<tr>
<td>Collector-Emitter Saturation Voltage</td>
<td>$V_{CE(SAT)}$</td>
<td>2</td>
<td>All</td>
<td>$I_C = 100 \text{ mA, } I_B = 250 \mu\text{A}$</td>
<td>—</td>
<td>$0.9$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$I_C = 200 \text{ mA, } I_B = 350 \mu\text{A}$</td>
<td>—</td>
<td>$1.1$</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$I_C = 350 \text{ mA, } I_B = 500 \mu\text{A}$</td>
<td>—</td>
<td>$1.3$</td>
</tr>
<tr>
<td>Input Current</td>
<td>$I_{IN(ON)}$</td>
<td>3</td>
<td>ULx2823x</td>
<td>$V_{IN} = 3.85 \text{ V}$</td>
<td>—</td>
<td>$0.93$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$V_{IN} = 5.0 \text{ V}$</td>
<td>—</td>
<td>$0.35$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ULx2824x</td>
<td>$V_{IN} = 12 \text{ V}$</td>
<td>—</td>
<td>$1.0$</td>
</tr>
<tr>
<td></td>
<td>$I_{IN(OFF)}$</td>
<td>4</td>
<td>All</td>
<td>$I_C = 500 \mu\text{A, } T_A = 70^\circ C$</td>
<td>50</td>
<td>$65$</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>$V_{IN(ON)}$</td>
<td>5</td>
<td>ULx2823x</td>
<td>$V_{CE} = 2.0 \text{ V, } I_C = 200 \text{ mA}$</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$V_{CE} = 2.0 \text{ V, } I_C = 250 \text{ mA}$</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$V_{CE} = 2.0 \text{ V, } I_C = 300 \text{ mA}$</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ULx2824x</td>
<td>$V_{CE} = 2.0 \text{ V, } I_C = 125 \text{ mA}$</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$V_{CE} = 2.0 \text{ V, } I_C = 200 \text{ mA}$</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$V_{CE} = 2.0 \text{ V, } I_C = 275 \text{ mA}$</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$V_{CE} = 2.0 \text{ V, } I_C = 350 \text{ mA}$</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Input Capacitance</td>
<td>$C_{IN}$</td>
<td>—</td>
<td>All</td>
<td></td>
<td>—</td>
<td>$15$</td>
</tr>
<tr>
<td>Turn-On Delay</td>
<td>$t_{PLH}$</td>
<td>8</td>
<td>All</td>
<td>$0.5 E_{IN} \text{ to } 0.5 E_{OUT}$</td>
<td>—</td>
<td>$0.25$</td>
</tr>
<tr>
<td>Turn-Off Delay</td>
<td>$t_{PHL}$</td>
<td>8</td>
<td>All</td>
<td>$0.5 E_{IN} \text{ to } 0.5 E_{OUT}$</td>
<td>—</td>
<td>$0.25$</td>
</tr>
<tr>
<td>Clamp Diode Leakage Current</td>
<td>$I_R$</td>
<td>6</td>
<td>All</td>
<td>$V_R = 95 \text{ V, } T_A = 25^\circ C$</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$V_R = 95 \text{ V, } T_A = 70^\circ C$</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Clamp Diode Forward Voltage</td>
<td>$V_F$</td>
<td>7</td>
<td>All</td>
<td>$I_F = 350 \text{ mA}$</td>
<td>—</td>
<td>$1.7$</td>
</tr>
</tbody>
</table>

Complete part number includes prefix to operating temperature range: ULN = -20°C to +85°C, ULQ = -40°C to +85°C and a suffix to identify package style: A = DIP, LW = SOIC. Note that the ULQ2823LW and ULQ2824LW are not presently available.

The ULx2823 & ULx2824 are last-time buy.
Orders accepted until October 19, 2001.
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE
ULx28xxA

ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE
ULx28xxLW

T_A = +50°C
R_ΘJA = 60°C/W

T_A = +70°C
R_ΘJA = 80°C/W

x = Characters to identify specific device. Specification shown applies to family of devices with remaining digits as shown.
INPUT CURRENT AS A FUNCTION OF INPUT VOLTAGE
ULx28x3x

SATURATION VOLTAGE AS A FUNCTION OF COLLECTOR CURRENT

COLLECTOR CURRENT AS A FUNCTION OF INPUT CURRENT
ULx28x4x

x = Characters to identify specific device. Characteristic shown applies to family of devices with remaining digits as shown.

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NOTES: 1. Exact body and lead configuration at vendor’s option within limits shown.
2. Lead spacing tolerance is non-cumulative.
3. Lead thickness is measured at seating plane or below.
PACKAGE DESIGNATOR “LW” DIMENSIONS

Dimensions in Inches
(for reference only)

Dimensions in Millimeters
(controlling dimensions)

NOTES: 1. Exact body and lead configuration at vendor’s option within limits shown.
2. Lead spacing tolerance is non-cumulative.
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