

4825898 INTEGRATED POWER

82D 00252

DT-43-25

INTEGRATED POWER SEMICONDUCTORS, LTD.

Darlington Transistor Arrays

Description

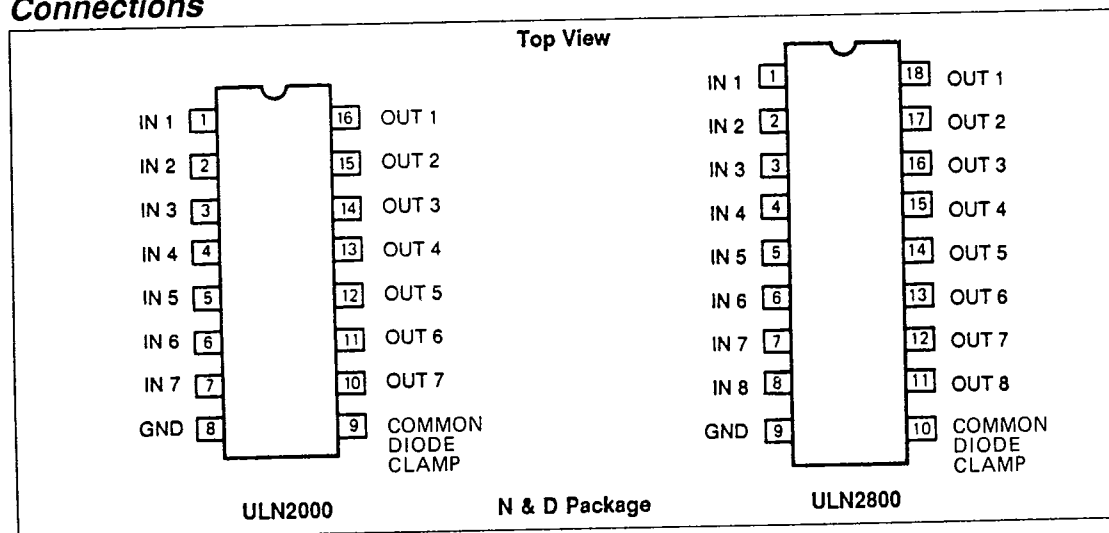
These power driver arrays are an arrangement of either seven (2000 series) or eight (2800 series) darlington transistors with independent inputs and outputs. They are designed to provide a high voltage, medium current interface between low voltage control logic and peripheral loads. The range of inputs available allow specific compatibility with all popular logic families (PMOS, CMOS, TTL, Schottky TTL). Different maximum output current / output voltage combinations allow the customer to select the device closest to the exact needs of the application. Each darlington is configured as an open collector output with internal flyback diode to protect against potentially destructive transient voltages caused by inductive loads.

Features

- 7 or 8 darlington power drives in single package
- 50V or 95V breakdown voltage ratings
- 500mA or 600mA output current capability per driver
- Low saturation voltage
- 5 input options to allow correct interface with all popular logic families
- Internal clamp diodes for driving inductive loads
- Improved cross-talk noise suppression
- Available in plastic DIP and SOIC packages

Section 4 - Power Drivers
ULN2000 Series, ULN2800 Series

Connections



IPS

4825898 INTEGRATED POWER

82D 00253

DT-43-25

Absolute Maximum Ratings ($T_A = 25^\circ\text{C}$)

Output Voltage, V_{CE}

| | |
|----------------------------------|-----|
| ULN2000, 2010, 2800, 2810 Series | 50V |
| ULN2020, 2820 Series | 95V |

Input Voltage, V_{IN}

| | |
|---------------------------------------|-----|
| ULN2002, 2003, 2004, 2802, 2803, 2804 | 30V |
| ULN2005, 2805 | 15V |

Continuous Collector Current, I_C

| | |
|----------------------------------|-------|
| ULN2000, 2020, 2800, 2820 Series | 500mA |
| ULN2010, 2810 Series | 600mA |

Continuous Base Current, I_B

25mA

Power Dissipation, P_D

(Single Darlington Drive)

*Total Package ULN2000N

| | |
|----------|-------|
| ULN2000D | 0.96W |
| ULN2800N | 2.25W |
| ULN2800D | 1.08W |

Operating Temperature Range, T_A

 -20°C to $+85^\circ\text{C}$

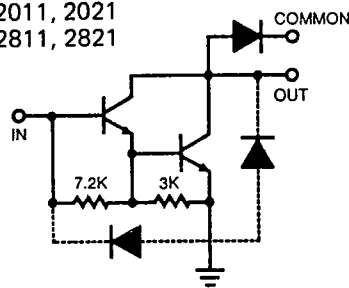
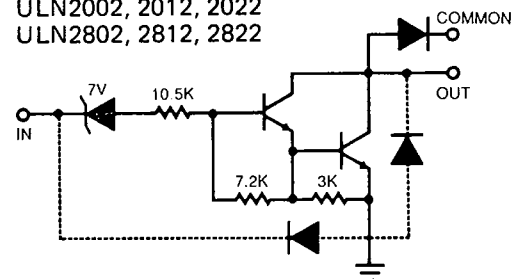
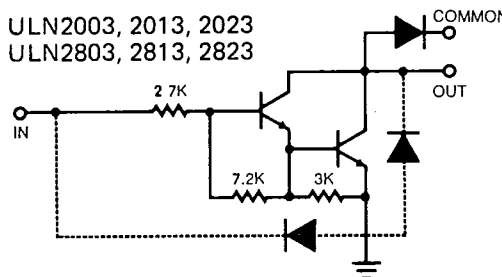
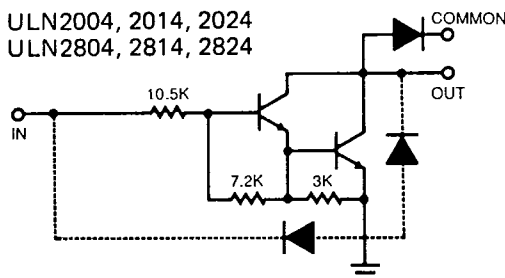
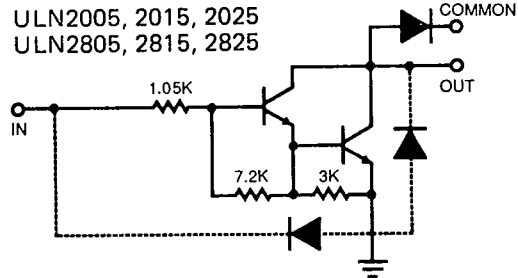
Storage Temperature Range, T_S

 -55°C to $+150^\circ\text{C}$

Absolute maximum ratings are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The electrical characteristics provide conditions for actual device operation.

| | | |
|---------------------------------------|----------|--------------------------|
| *Deratings above 25°C — | ULN2000N | 16.7mW/ $^\circ\text{C}$ |
| | ULN2000D | 7.7mW/ $^\circ\text{C}$ |
| | ULN2800N | 18.2mW/ $^\circ\text{C}$ |
| | ULN2800D | 8.4mW/ $^\circ\text{C}$ |

Schematic Diagrams (Single Darlington Shown)

ULN2001, 2011, 2021
ULN2801, 2811, 2821

ULN2002, 2012, 2022
ULN2802, 2812, 2822

ULN2003, 2013, 2023
ULN2803, 2813, 2823

ULN2004, 2014, 2024
ULN2804, 2814, 2824

ULN2005, 2015, 2025
ULN2805, 2815, 2825


4825898 INTEGRATED POWER

82D 00254

DT-43-25

Electrical Characteristics(Unless otherwise indicated, electrical characteristics apply for $T_A = 25^\circ\text{C}$ only.)

| Characteristic | Test Conditions | Device | ULN2000/ULN2800 | | | Units |
|---|---|------------|-----------------|------|------|---------------|
| | | | Min | Typ | Max | |
| Output Leakage Current, I_{CEX} | $V_{CE} = 50\text{V}$ | All | | | 50 | μA |
| | $V_{CE} = 50\text{V}, T_A = 70^\circ$ | | | | 100 | μA |
| | $V_{CE} = 50\text{V}, V_{IN} = 6.0\text{V}, T_A = 70^\circ\text{C}$ | 2002, 2802 | | | 500 | μA |
| | $V_{CE} = 50\text{V}, V_{IN} = 1.0\text{V}, T_A = 70^\circ\text{C}$ | 2004, 2804 | | | 500 | μA |
| | | | | | | |
| Collector-Emitter Saturation Voltage, $V_{CE(SAT)}$ | $I_C = 100\text{mA}, I_B = 250\mu\text{A}$ | All | | 0.9 | 1.1 | V |
| | $I_C = 200\text{mA}, I_B = 350\mu\text{A}$ | | | 1.1 | 1.3 | V |
| | $I_C = 350\text{mA}, I_B = 500\mu\text{A}$ | | | 1.3 | 1.6 | V |
| | | | | | | |
| Input Current, I_{IN} (ON) | $V_{IN} = 17\text{V}$ | 2002, 2802 | | 0.82 | 1.25 | mA |
| | $V_{IN} = 3.85\text{V}$ | 2003, 2803 | | 0.93 | 1.35 | mA |
| | $V_{IN} = 5.0\text{V}$ | 2004, 2804 | | 0.35 | 0.5 | mA |
| | $V_{IN} = 12\text{V}$ | | | 1.0 | 1.45 | mA |
| | $V_{IN} = 3.0\text{V}$ | 2005, 2805 | | 1.5 | 2.4 | mA |
| | | | | | | |
| Input Current, I_{IN} (OFF) | $I_C = 500\mu\text{A}, T_A = 70^\circ\text{C}$ | All | 50 | 65 | | μA |
| Input Voltage, V_{IN} (ON) | $V_{CE} = 2.0\text{V}, I_C = 300\text{mA}$ | 2002, 2802 | | | 13 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 200\text{mA}$ | 2003, 2803 | | | 2.4 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 250\text{mA}$ | | | | 2.7 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 300\text{mA}$ | | | | 3.0 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 125\text{mA}$ | 2004, 2804 | | | 5.0 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 200\text{mA}$ | | | | 6.0 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 275\text{mA}$ | | | | 7.0 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 350\text{mA}$ | | | | 8.0 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 350\text{mA}$ | 2005, 2805 | | | 2.4 | V |
| | | | | | | |
| | | | | | | |
| DC Forward Current | $V_{CE} = 2.0\text{V}, I_C = 350\text{mA}$ | 2001, 2801 | 1000 | | | |
| Transfer Ratio, h_{FE} | | All | | 15 | 25 | pF |
| Input Capacitance, C_{IN} | | All | | 0.25 | 1.0 | μs |
| Turn-on Delay, t_{PLH} | 0.5 E_{IN} to 0.5 E_{OUT} | All | | 0.25 | 1.0 | μs |
| Turn-off Delay, t_{PHL} | 0.5 E_{IN} to 0.5 E_{OUT} | All | | | 50 | μA |
| Clamp Diode Leakage Current, I_R | $V_R = 50\text{V}$ | All | | | 100 | μA |
| Clamp Diode Forward Voltage, V_F | $V_R = 50\text{V}, T_A = 70^\circ\text{C}$ | | | | | |
| | $I_F = 350\text{mA}$ | All | | 1.7 | 2.0 | V |

 Section 4 - Power Drivers
 ULN2000 Series, ULN2800 Series

4825898 INTEGRATED POWER

82D 00255

DT-43-25

Electrical Characteristics (Cont.)(Unless otherwise indicated, electrical characteristics apply for $T_A = 25^\circ\text{C}$ only.)

| Characteristic | Test Conditions | Device | ULN2010/ULN2810 | | | Units |
|---|---|------------|-----------------|------|------|---------------|
| | | | Min | Typ | Max | |
| Output Leakage Current, I_{CEX} | $V_{CE} = 50\text{V}$ | All | | | 50 | μA |
| | $V_{CE} = 50\text{V}, T_A = 70^\circ\text{C}$ | | | | 100 | μA |
| | $V_{CE} = 50\text{V}, V_{IN} = 6.0\text{V}, T_A = 70^\circ\text{C}$ | 2012, 2812 | | | 500 | μA |
| | $V_{CE} = 50\text{V}, V_{IN} = 1.0\text{V}, T_A = 70^\circ\text{C}$ | 2014, 2814 | | | 500 | μA |
| Collector-Emitter Saturation Voltage, $V_{CE(SAT)}$ | $I_C = 200\text{mA}, I_B = 350\mu\text{A}$ | All | | 1.1 | 1.3 | V |
| | $I_C = 350\text{mA}, I_B = 500\mu\text{A}$ | | | 1.3 | 1.6 | V |
| | $I_C = 500\text{mA}, I_B = 600\mu\text{A}$ | | | 1.7 | 1.9 | V |
| Input Current, I_{IN} (ON) | $V_{IN} = 17\text{V}$ | 2012, 2812 | | 0.82 | 1.25 | mA |
| | $V_{IN} = 3.85\text{V}$ | 2013, 2813 | | 0.93 | 1.35 | mA |
| | $V_{IN} = 5.0\text{V}$ | 2014, 2814 | | 0.35 | 0.5 | mA |
| | $V_{IN} = 12\text{V}$ | | | 1.0 | 1.45 | mA |
| | $V_{IN} = 3.0\text{V}$ | 2015, 2815 | | 1.5 | 2.4 | mA |
| Input Current, I_{IN} (OFF) | $I_C = 500\mu\text{A}, T_A = 70^\circ\text{C}$ | All | 50 | 65 | | μA |
| Input Voltage, V_{IN} (ON) | $V_{CE} = 2.0\text{V}, I_C = 500\text{mA}$ | 2012, 2812 | | | 17 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 250\text{mA}$ | 2013, 2813 | | | 2.7 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 300\text{mA}$ | | | | 3.0 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 500\text{mA}$ | | | | 3.5 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 275\text{mA}$ | 2014, 2814 | | | 7.0 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 350\text{mA}$ | | | | 8.0 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 500\text{mA}$ | | | | 9.5 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 500\text{mA}$ | 2015, 2815 | | | 2.6 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 350\text{mA}$ | 2011, 2811 | 1000 | | | |
| Transfer Ratio, h_{FE} | $V_{CE} = 2.0\text{V}, I_C = 500\text{mA}$ | | 900 | | | |
| Input Capacitance, C_{IN} | | All | | 15 | 25 | pF |
| Turn-on Delay, t_{PLH} | $0.5 E_{IN}$ to $0.5 E_{OUT}$ | All | | 0.25 | 1.0 | μs |
| Turn-off Delay, t_{PHL} | $0.5 E_{IN}$ to $0.5 E_{OUT}$ | All | | 0.25 | 1.0 | μs |
| Clamp Diode Leakage Current, I_R | $V_R = 50\text{V}$ | All | | | 50 | μA |
| | $V_R = 50\text{V}, T_A = 70^\circ\text{C}$ | | | | 100 | μA |
| Clamp Diode Forward Voltage, V_F | $I_F = 350\text{mA}$ | All | | 1.7 | 2.0 | V |
| | $I_F = 500\text{mA}$ | | | 2.1 | 2.5 | V |

Section 4 - Power Drivers
ULN2000 Series, ULN2800 Series

4825898 INTEGRATED POWER

82D 00256

DT-43-25

Electrical Characteristics (Cont.)(Unless otherwise indicated, electrical characteristics apply for $T_A = 25^\circ\text{C}$ only.)

| Characteristic | Test Condition | Device | ULN2020/ULN2820 | | | Units |
|---|---|------------|-----------------|------|------|---------------|
| | | | Min | Typ | Max | |
| Output Leakage Current, I_{CEX} | $V_{CE} = 95\text{V}$ | All | | | 50 | μA |
| | $V_{CE} = 95\text{V}, T_A = 70^\circ\text{C}$ | | | | 100 | μA |
| | $V_{CE} = 95\text{V}, V_{IN} = 6.0\text{V}, T_A = 70^\circ\text{C}$ | 2022, 2822 | | | 500 | μA |
| | $V_{CE} = 95\text{V}, V_{IN} = 1.0\text{V}, T_A = 70^\circ\text{C}$ | 2024, 2824 | | | 500 | μA |
| Collector-Emitter Saturation Voltage, $V_{CE(SAT)}$ | $I_C = 100\text{mA}, I_B = 250\mu\text{A}$ | All | | 0.9 | 1.1 | V |
| | $I_C = 200\text{mA}, I_B = 350\mu\text{A}$ | | | 1.1 | 1.3 | V |
| | $I_C = 350\text{mA}, I_B = 500\mu\text{A}$ | | | 1.3 | 1.6 | V |
| Input Current, I_{IN} (ON) | $V_{IN} = 17\text{V}$ | 2022, 2822 | | 0.82 | 1.25 | mA |
| | $V_{IN} = 3.85\text{V}$ | 2023, 2823 | | 0.93 | 1.35 | mA |
| | $V_{IN} = 5.0\text{V}$ | 2024, 2824 | | 0.35 | 0.5 | mA |
| | $V_{IN} = 12\text{V}$ | | | 1.0 | 1.45 | mA |
| | $V_{IN} = 3.0\text{V}$ | 2025, 2825 | | 1.5 | 2.4 | mA |
| Input Current, I_{IN} (OFF) | $I_C = 500\mu\text{A}, T_A = 70^\circ\text{C}$ | All | 50 | 65 | | μA |
| Input Voltage, V_{IN} (ON) | $V_{CE} = 2.0\text{V}, I_C = 300\text{mA}$ | 2022, 2822 | | | 13 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 200\text{mA}$ | 2023, 2823 | | | 2.4 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 250\text{mA}$ | | | | 2.7 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 300\text{mA}$ | | | | 3.0 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 125\text{mA}$ | 2024, 2824 | | | 5.0 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 200\text{mA}$ | | | | 6.0 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 275\text{mA}$ | | | | 7.0 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 350\text{mA}$ | | | | 8.0 | V |
| | $V_{CE} = 2.0\text{V}, I_C = 350\text{mA}$ | 2025, 2825 | | | 2.4 | V |
| DC Forward Current | $V_{CE} = 2.0\text{V}, I_C = 350\text{mA}$ | 2021, 2821 | 1000 | | | |
| Transfer Ratio, h_{FE} | | All | | 15 | 25 | pF |
| Input Capacitance, C_{IN} | | All | | 0.25 | 1.0 | μs |
| Turn-on Delay, t_{PLH} | $0.5 E_{IN}$ to $0.5 E_{OUT}$ | All | | 0.25 | 1.0 | μs |
| Turn-off Delay, t_{PHL} | $0.5 E_{IN}$ to $0.5 E_{OUT}$ | All | | | | |
| Clamp Diode Leakage Current, I_R | $V_R = 95\text{V}$ | All | | | 50 | μA |
| | $V_R = 95\text{V}, T_A = 70^\circ\text{C}$ | | | | 100 | μA |
| Clamp Diode Forward Voltage, V_F | $I_F = 350\text{mA}$ | All | | 1.7 | 2.0 | V |

 Section 4 - Power Drivers
 ULN2000 Series, ULN2800 Series

4825898 INTEGRATED POWER

82D 00257

07-43-25

Order Information

| Input Conditions | Maximum Output Conditions | | | | | |
|-------------------------------|---|---|---|---|---|---|
| | 7 Segment Drive | | | 8 Segment Drive | | |
| | V _{CE} = 50V I _C = 500mA | V _{CE} = 50V I _C = 600mA | V _{CE} = 95V I _C = 500mA | V _{CE} = 50V I _C = 500mA | V _{CE} = 50V I _C = 600mA | V _{CE} = 95V I _C = 500mA |
| General Purpose CMOS, PMOS | ULN2001N ULN2001D | ULN2011N ULN2011D | ULN2021N ULN2021D | ULN2801N ULN2801D | ULN2811N ULN2811D | ULN2821N ULN2821D |
| 14 - 25V PMOS | ULN2002N ULN2002D | ULN2012N ULN2012D | ULN2022N ULN2022D | ULN2802N ULN2802D | ULN2812N ULN2812D | ULN2822N ULN2822D |
| 5V TTL, CMOS | ULN2003N ULN2003D | ULN2013N ULN2013D | ULN2023N ULN2023D | ULN2803N ULN2803D | ULN2813N ULN2813D | ULN2823N ULN2823D |
| 6 - 15V CMOS, PMOS | ULN2004N ULN2004D | ULN2014N ULN2014D | ULN2024N ULN2024D | ULN2804N ULN2804D | ULN2814N ULN2814D | ULN2824N ULN2824D |
| High Output TTL | ULN2005N ULN2005D | ULN2015N ULN2015D | ULN2025N ULN2025D | ULN2805N ULN2805D | ULN2815N ULN2815D | ULN2825N ULN2825D |

Note : N — 16 or 18 pin plastic DIP
D — 16 or 18 pin SOIC

Section 4 - Power Drivers
ULN2000 Series, ULN2800 Series

Integrated Power Semiconductors, Ltd. cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in an Integrated Power product. No circuit patent licenses are implied. Integrated Power reserves the right to change the circuitry and specifications without notice at any time.

Integrated Power Semiconductors, Ltd.

2727 Walsh Avenue, Suite 201, Santa Clara, CA 95051 • Telephone : 408-727-2772 • Telex: 350073 (IPS SNTA) • FAX: 408-988-6185
8 Quaker Drive, West Warwick, RI 02893 • Telephone: 401-821-4260 • Telex: 332948 (IPS RI) • FAX: 401-823-7260
2081 Business Center Drive, Suite 140, Irvine, CA 92715 • Telephone: 714-752-0188 • FAX: 714-752-5019
789 Turnpike Street, North Andover, MA 01845 • Telephone: 617-683-9042 • FAX: 617-975-0193