

INTEGRATED POWER

SEMICONDUCTORS, LTD.

Darlington Transistor Arrays

T-43-25

Description

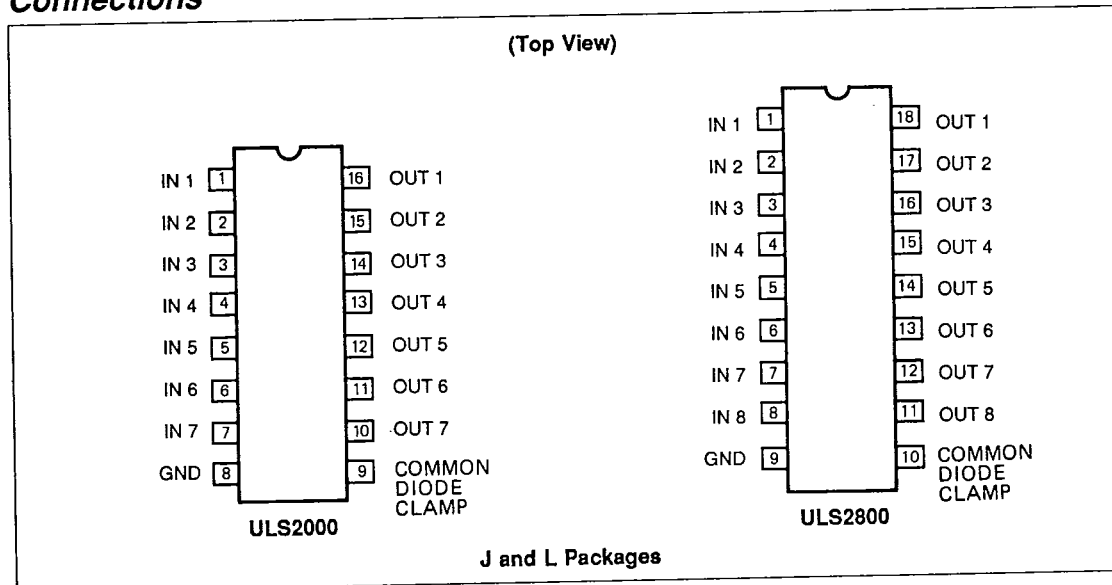
These power driver arrays are an arrangement of either seven (2000 series) or eight (2800 series) darlington transistors with independent inputs and outputs. They are designed to provide high voltage, medium current interface between low voltage control logic and peripheral loads. The range of inputs available allow specific compatibility with all popular logic families (PMOS, CMOS, TTL, Shottky 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
- Hermetically sealed package
- Operating temperature range; -55°C to +125°C

Section 4 - Power Drivers
ULS2000 Series, ULS2800 Series

Connections



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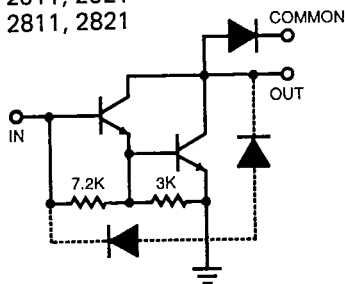
Absolute Maximum Ratings ($T_A = 25^\circ\text{C}$)

| | | | |
|---|-------|--|-----------------|
| Output Voltage, V_{CE} | | Ground Pin Current, I_{GND} | 3.0A |
| ULS2000, 2010, 2800, 2810 Series | 50V | Continuous Base Current, I_B | 25mA |
| ULS2020, 2820 Series | 95V | Power Dissipation, P_D | |
| | | (Single Darlington Drive) | 1.0W |
| | | (Total Package Power Dissipation is Specified on | |
| | | Graphs of Collector Current Versus Duty Cycle) | |
| Input Voltage, V_{IN} | | Operating Temp. Range, T_A | -55°C to +125°C |
| ULS2002, 2003, 2004, 2802, 2803, 2804 | 30V | Storage Temp. Range, T_S | -65°C to +150°C |
| ULS2005, 2805 | 15V | | |
| Continuous Collector Current, I_C | | | |
| ULS2000, 2020, 2800, 2820 Series | 500mA | | |
| ULS2010, 2810 Series | 600mA | | |

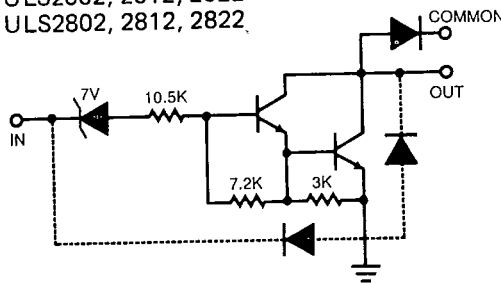
Absolute maximum ratings are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the device should be operated at these limits. The electrical characteristics provide conditions for actual device operation.

Schematic Diagrams (Single Darlington Shown)

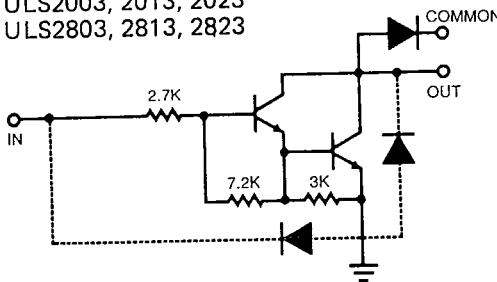
ULS2001, 2011, 2021
ULS2801, 2811, 2821



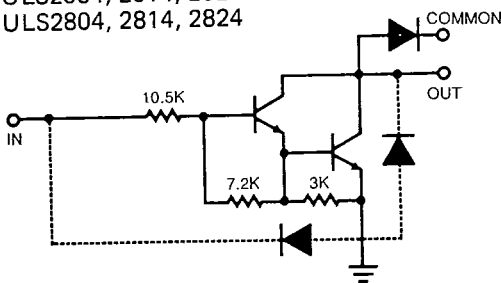
ULS2002, 2012, 2022
ULS2802, 2812, 2822



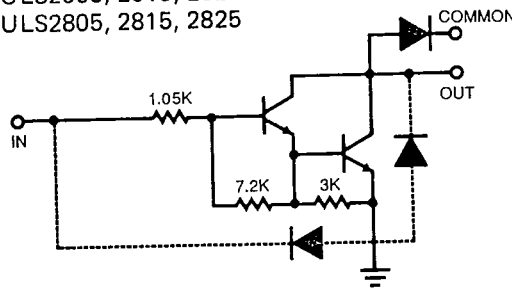
ULS2003, 2013, 2023
ULS2803, 2813, 2823



ULS2004, 2014, 2024
ULS2804, 2814, 2824



ULS2005, 2015, 2025
ULS2805, 2815, 2825



Section 4 - Power Drivers
ULS2000 Series, ULS2800 Series

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Electrical Characteristics

| Characteristic | Conditions | Device | Temp | ULS2000/ULS2800 | | | Units | |
|--|--|--|-----------------------|-----------------|------|------|-------|------|
| | | | | Min | Typ | Max | | |
| Output Leakage Current, I _{CEX} | V _{CE} = 50V | All | • | | | 100 | μA | |
| | V _{CE} = 50V, V _{IN} = 6V | 2002, 2802 | • | | | 500 | μA | |
| | V _{CE} = 50V, V _{IN} = 1V | 2004, 2804 | • | | | 500 | μA | |
| Collector-Emitter Saturation Voltage, V _{CE(SAT)} | I _C = 350mA, I _B = 850μA | All | -55°C | | 1.6 | 1.8 | V | |
| | I _C = 200mA, I _B = 550μA | | -55°C | | 1.3 | 1.5 | V | |
| | I _C = 100mA, I _B = 350μA | | -55°C | | | 1.1 | 1.3 | V |
| | I _C = 350mA, I _B = 500μA | | | | | 1.25 | 1.6 | V |
| | I _C = 200mA, I _B = 350μA | | | | | 1.1 | 1.3 | V |
| | I _C = 100mA, I _B = 250μA | | | | | 0.9 | 1.1 | V |
| | I _C = 350mA, I _B = 500μA | | +125°C | | | 1.6 | 1.8 | V |
| | I _C = 200mA, I _B = 350μA | | +125°C | | | 1.3 | 1.5 | V |
| | I _C = 100mA, I _B = 250μA | | +125°C | | | 1.1 | 1.3 | V |
| | Input Current, I _{IN} (ON) | | V _{IN} = 17V | 2002, 2802 | • | 480 | 850 | 1300 |
| V _{IN} = 3.85V | | 2003, 2803 | • | 650 | 930 | 1350 | μA | |
| V _{IN} = 5V | | 2004, 2804 | • | 240 | 350 | 500 | μA | |
| V _{IN} = 12V | | | • | 650 | 1000 | 1450 | μA | |
| V _{IN} = 3V | | 2005, 2805 | • | 1180 | 1500 | 2400 | μA | |
| Input Current, I _{IN} (OFF) | I _C = 500μA | All | +125°C | 25 | 50 | | μA | |
| Input Voltage, V _{IN} (ON) | V _{CE} = 2V, I _C = 300mA | 2002, 2802 | -55°C | | | 18 | V | |
| | V _{CE} = 2V, I _C = 300mA | | +125°C | | | 13 | V | |
| | V _{CE} = 2V, I _C = 200mA | 2003, 2803 | -55°C | | | 3.3 | V | |
| | V _{CE} = 2V, I _C = 250mA | | -55°C | | | 3.6 | V | |
| | V _{CE} = 2V, I _C = 300mA | -55°C | | | 3.9 | V | | |
| | V _{CE} = 2V, I _C = 200mA | +125°C | | | 2.4 | V | | |
| | V _{CE} = 2V, I _C = 250mA | +125°C | | | 2.7 | V | | |
| | V _{CE} = 2V, I _C = 300mA | +125°C | | | 3.0 | V | | |
| | V _{CE} = 2V, I _C = 125mA | 2004, 2804 | -55°C | | | 6.0 | V | |
| | V _{CE} = 2V, I _C = 200mA | | -55°C | | | 8.0 | V | |
| | V _{CE} = 2V, I _C = 275mA | -55°C | | | 10 | V | | |
| | V _{CE} = 2V, I _C = 350mA | -55°C | | | 12 | V | | |
| | V _{CE} = 2V, I _C = 125mA | +125°C | | | 5.0 | V | | |
| | V _{CE} = 2V, I _C = 200mA | +125°C | | | 6.0 | V | | |
| | V _{CE} = 2V, I _C = 275mA | +125°C | | | 7.0 | V | | |
| | V _{CE} = 2V, I _C = 350mA | +125°C | | | 8.0 | V | | |
| | V _{CE} = 2V, I _C = 350mA | 2005, 2805 | -55°C | | | 3.0 | V | |
| | V _{CE} = 2V, I _C = 350mA | | +125°C | | | 2.4 | V | |
| | DC Forward Current | V _{CE} = 2V, I _C = 350mA | 2001, 2801 | -55°C | 500 | | | |
| | | V _{CE} = 2V, I _C = 350mA | | | 1000 | | | |
| Transfer Ratio, h _{FE} | | All | | | 15 | 25 | pF | |
| Input Capacitance, C _{IN} | | All | | | 250 | 1000 | ns | |
| Turn-on Delay, t _{PLH} | 0.5 E _{IN} to 0.5 E _{OUT} | All | | | 250 | 1000 | ns | |
| Turn-off Delay, t _{PHL} | 0.5 E _{IN} to 0.5 E _{OUT} | All | | | 250 | 1000 | ns | |
| Clamp Diode Leakage Current, I _R | V _R = 50V | All | • | | | 50 | μA | |
| Clamp Diode Forward Voltage, V _F | I _F = 350mA | All | • | | 1.7 | 2.0 | V | |

The • denotes the specifications which apply over the full operating temperature range, all others apply at T_A = 25°C unless otherwise specified.



Section 4 - Power Drivers
ULS2000 Series, ULS2800 Series

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Electrical Characteristics Continued

Section 4 - Power Drivers
 ULS2000 Series, ULS2800 Series

| Characteristic | Conditions | Device | Temp | ULS2010/ULS2810 | | | Units |
|---|--------------------------------|------------|--------|-----------------|------|------|---------|
| | | | | Min | Typ | Max | |
| Output Leakage Current, I_{CEX} | $V_{CE} = 50V$ | All | • | | | 100 | μA |
| | $V_{CE} = 50V, V_{IN} = 6V$ | 2012, 2812 | • | | | 500 | μA |
| | $V_{CE} = 50V, V_{IN} = 1V$ | 2014, 2814 | • | | | 500 | μA |
| Collector-Emitter Saturation Voltage, $V_{CE(SAT)}$ | $I_C = 500mA, I_B = 1100\mu A$ | All | -55°C | | 1.8 | 2.1 | V |
| | $I_C = 350mA, I_B = 850\mu A$ | | -55°C | | 1.6 | 1.8 | V |
| | $I_C = 200mA, I_B = 550\mu A$ | | -55°C | | 1.3 | 1.5 | V |
| | $I_C = 500mA, I_B = 600\mu A$ | | | | 1.7 | 1.9 | V |
| | $I_C = 350mA, I_B = 500\mu A$ | | | | 1.25 | 1.6 | V |
| | $I_C = 200mA, I_B = 350\mu A$ | | | | 1.1 | 1.3 | V |
| | $I_C = 500mA, I_B = 600\mu A$ | | +125°C | | 1.8 | 2.1 | V |
| | $I_C = 350mA, I_B = 500\mu A$ | | +125°C | | 1.6 | 1.8 | V |
| | $I_C = 200mA, I_B = 350\mu A$ | | +125°C | | 1.3 | 1.5 | V |
| Input Current, $I_{IN(ON)}$ | $V_{IN} = 17V$ | 2012, 2812 | • | 480 | 850 | 1300 | μA |
| | $V_{IN} = 3.85V$ | 2013, 2813 | • | 650 | 930 | 1350 | μA |
| | $V_{IN} = 5V$ | 2014, 2814 | • | 240 | 350 | 500 | μA |
| | $V_{IN} = 12V$ | | • | 650 | 1000 | 1450 | μA |
| | $V_{IN} = 3V$ | 2015, 2815 | • | 1180 | 1500 | 2400 | μA |
| Input Current, $I_{IN(OFF)}$ | $I_C = 500\mu A$ | All | +125°C | 25 | 50 | | μA |
| Input Voltage, $V_{IN(ON)}$ | $V_{CE} = 2V, I_C = 500mA$ | 2012, 2812 | -55°C | | | 23.5 | V |
| | $V_{CE} = 2V, I_C = 500mA$ | | +125°C | | | 17 | V |
| | $V_{CE} = 2V, I_C = 250mA$ | 2013, 2813 | -55°C | | | 3.6 | V |
| | $V_{CE} = 2V, I_C = 300mA$ | | -55°C | | | 3.9 | V |
| | $V_{CE} = 2V, I_C = 500mA$ | | -55°C | | | 6.0 | V |
| | $V_{CE} = 2V, I_C = 250mA$ | | +125°C | | | 2.7 | V |
| | $V_{CE} = 2V, I_C = 300mA$ | | +125°C | | | 3.0 | V |
| | $V_{CE} = 2V, I_C = 500mA$ | | +125°C | | | 3.5 | V |
| | $V_{CE} = 2V, I_C = 275mA$ | 2014, 2814 | -55°C | | | 10 | V |
| | $V_{CE} = 2V, I_C = 350mA$ | | -55°C | | | 12 | V |
| | $V_{CE} = 2V, I_C = 500mA$ | | -55°C | | | 17 | V |
| | $V_{CE} = 2V, I_C = 275mA$ | | +125°C | | | 7.0 | V |
| | $V_{CE} = 2V, I_C = 350mA$ | | +125°C | | | 8.0 | V |
| | $V_{CE} = 2V, I_C = 500mA$ | | +125°C | | | 9.5 | V |
| | $V_{CE} = 2V, I_C = 350mA$ | 2015, 2815 | -55°C | | | 3.0 | V |
| | $V_{CE} = 2V, I_C = 500mA$ | | -55°C | | | 3.5 | V |
| | $V_{CE} = 2V, I_C = 350mA$ | | +125°C | | | 2.4 | V |
| | $V_{CE} = 2V, I_C = 500mA$ | | +125°C | | | 2.6 | V |
| DC Forward Current | $V_{CE} = 2V, I_C = 500mA$ | 2011, 2811 | -55°C | 450 | | | |
| Transfer Ratio, h_{FE} | $V_{CE} = 2V, I_C = 500mA$ | | | | 900 | | |
| Input Capacitance, C_{IN} | | All | | | 15 | 25 | pF |
| Turn-on Delay, t_{PLH} | 0.5 E_{IN} to 0.5 E_{OUT} | All | | | 250 | 1000 | ns |
| Turn-off Delay, t_{PHL} | 0.5 E_{IN} to 0.5 E_{OUT} | All | | | 250 | 1000 | ns |
| Clamp Diode Leakage Current, I_R | $V_R = 50V$ | All | • | | | 50 | μA |
| Clamp Diode Forward Voltage, V_F | $I_F = 350mA$ | All | • | | 1.7 | 2.0 | V |
| | $I_F = 500mA$ | | • | | | 2.5 | V |



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Electrical Characteristics Continued

Section 4 - Power Drivers
ULS2000 Series, ULS2800 Series

| Characteristic | Conditions | Device | Temp | ULS2020 / ULS2820 | | | Units | |
|--|--|--|-----------------------|-------------------|------|------|-------|------|
| | | | | Min | Typ | Max | | |
| Output Leakage Current, I _{CEX} | V _{CE} = 95V | All | • | | | 100 | μA | |
| | V _{CE} = 95V, V _{IN} = 6V | 2022, 2822 | • | | | 500 | μA | |
| | V _{CE} = 95V, V _{IN} = 1V | 2024, 2824 | • | | | 500 | μA | |
| Collector-Emitter Saturation Voltage, V _{CE(SAT)} | I _C = 350mA, I _B = 850μA | All | -55°C | | 1.6 | 1.8 | V | |
| | I _C = 200mA, I _B = 550μA | | -55°C | | 1.3 | 1.5 | V | |
| | I _C = 100mA, I _B = 350μA | | -55°C | | 1.1 | 1.3 | V | |
| | I _C = 350mA, I _B = 500μA | | | | 1.25 | 1.6 | V | |
| | I _C = 200mA, I _B = 350μA | | | | 1.1 | 1.3 | V | |
| | I _C = 100mA, I _B = 250μA | | | | 0.9 | 1.1 | V | |
| | I _C = 350mA, I _B = 500μA | | +125°C | | 1.6 | 1.8 | V | |
| | I _C = 200mA, I _B = 350μA | | +125°C | | 1.3 | 1.5 | V | |
| | I _C = 100mA, I _B = 250μA | | +125°C | | 1.1 | 1.3 | V | |
| | Input Current, I _{IN} (ON) | | V _{IN} = 17V | 2022, 2822 | • | 480 | 850 | 1300 |
| V _{IN} = 3.85V | | 2023, 2823 | • | 650 | 930 | 1350 | μA | |
| V _{IN} = 5V | | 2024, 2824 | • | 240 | 350 | 500 | μA | |
| V _{IN} = 12V | | | • | 650 | 1000 | 1450 | μA | |
| V _{IN} = 3V | | 2025, 2825 | • | 1180 | 1500 | 2400 | μA | |
| Input Current, I _{IN} (OFF) | I _C = 500μA | All | +125°C | 25 | 50 | | μA | |
| Input Voltage, V _{IN} (ON) | V _{CE} = 2V, I _C = 300mA | 2022, 2822 | -55°C | | | 18 | V | |
| | V _{CE} = 2V, I _C = 300mA | | +125°C | | | 13 | V | |
| | V _{CE} = 2V, I _C = 200mA | 2023, 2823 | -55°C | | | 3.3 | V | |
| | V _{CE} = 2V, I _C = 250mA | | -55°C | | | 3.6 | V | |
| | V _{CE} = 2V, I _C = 300mA | | -55°C | | | 3.9 | V | |
| | V _{CE} = 2V, I _C = 200mA | | +125°C | | | 2.4 | V | |
| | V _{CE} = 2V, I _C = 250mA | | +125°C | | | 2.7 | V | |
| | V _{CE} = 2V, I _C = 300mA | | +125°C | | | 3.0 | V | |
| | V _{CE} = 2V, I _C = 125mA | | 2024, 2824 | -55°C | | | 6.0 | V |
| | V _{CE} = 2V, I _C = 200mA | | | -55°C | | | 8.0 | V |
| | V _{CE} = 2V, I _C = 275mA | | | -55°C | | | 10 | V |
| | V _{CE} = 2V, I _C = 350mA | | | -55°C | | | 12 | V |
| | V _{CE} = 2V, I _C = 125mA | +125°C | | | | 5.0 | V | |
| | V _{CE} = 2V, I _C = 200mA | +125°C | | | | 6.0 | V | |
| | V _{CE} = 2V, I _C = 275mA | +125°C | | | 7.0 | V | | |
| | V _{CE} = 2V, I _C = 350mA | +125°C | | | 8.0 | V | | |
| | V _{CE} = 2V, I _C = 350mA | 2025, 2825 | -55°C | | | 3.0 | V | |
| | V _{CE} = 2V, I _C = 350mA | | +125°C | | | 2.4 | V | |
| | DC Forward Current | V _{CE} = 2V, I _C = 350mA | 2021, 2821 | -55°C | 500 | | | |
| | Transfer Ratio, h _{FE} | V _{CE} = 2V, I _C = 350mA | | | | 1000 | | |
| Input Capacitance, C _{IN} | | All | | | 15 | 25 | pF | |
| Turn-on Delay, t _{PLH} | 0.5 E _{IN} to 0.5 E _{OUT} | All | | | 250 | 1000 | ns | |
| Turn-off Delay, t _{PHL} | 0.5 E _{IN} to 0.5 E _{OUT} | All | | | 250 | 1000 | ns | |
| Clamp Diode Leakage Current, I _R | V _R = 95V | All | • | | | 50 | μA | |
| Clamp Diode Forward Voltage, V _F | I _F = 350mA | All | • | | 1.7 | 2.0 | V | |

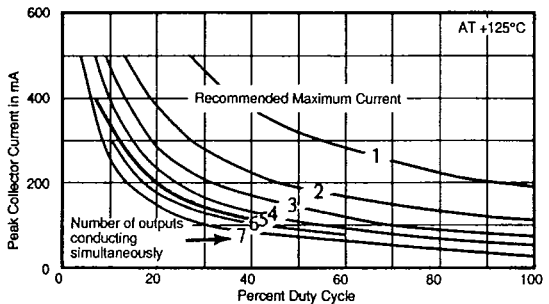
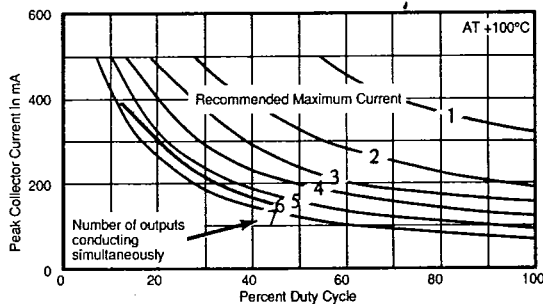
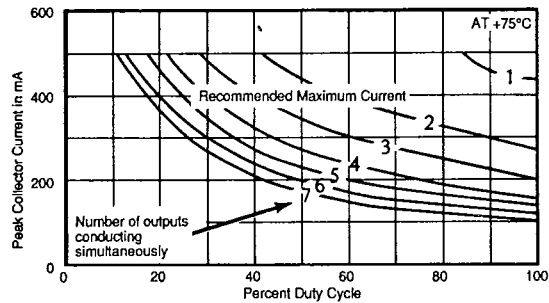
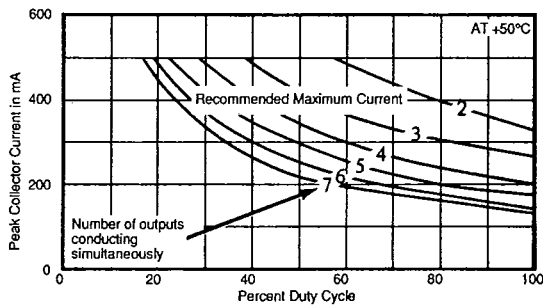
The • denotes the specifications which apply over the full operating temperature range, all others apply at T_A = 25°C unless otherwise specified.



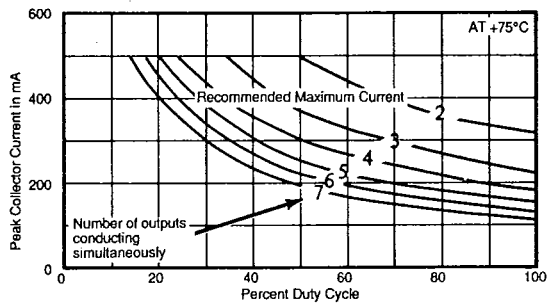
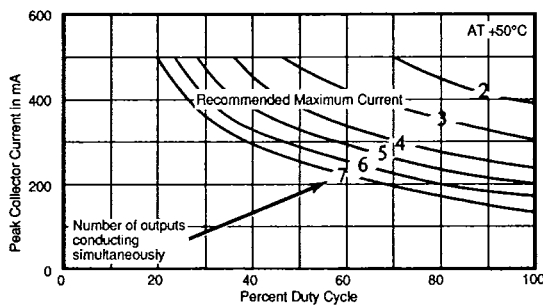
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Operating Conditions

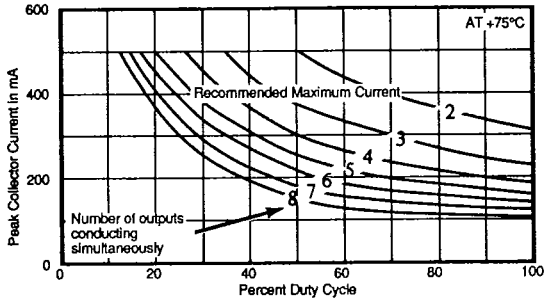
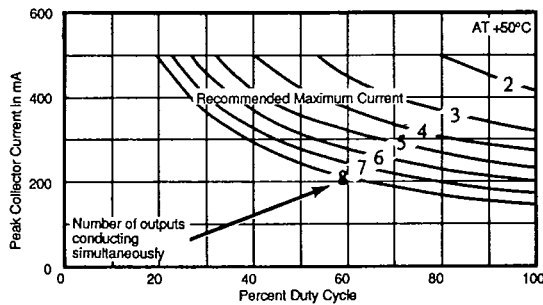
ULS2000L — Peak Collector Current as a Function of Duty Cycle (See Note)



ULS2000J — Peak Collector Current as a Function of Duty Cycle (See Note)



ULS2800J — Peak Collector Current as a Function of Duty Cycle (See Note)



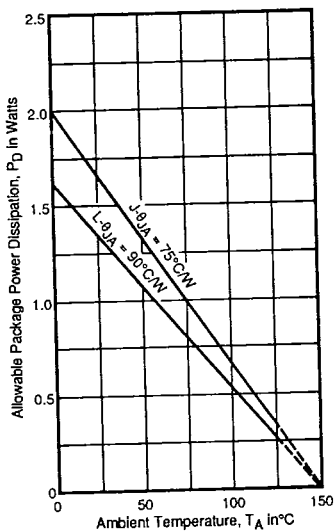
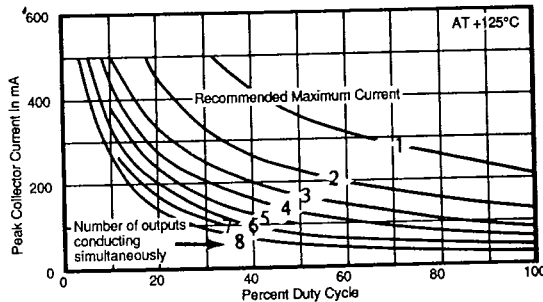
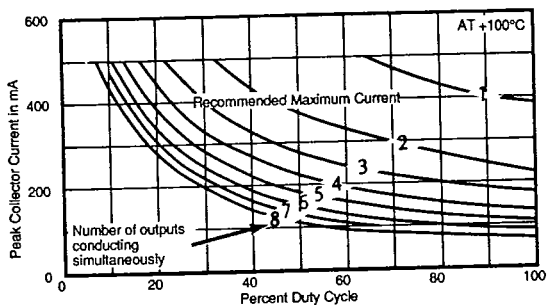
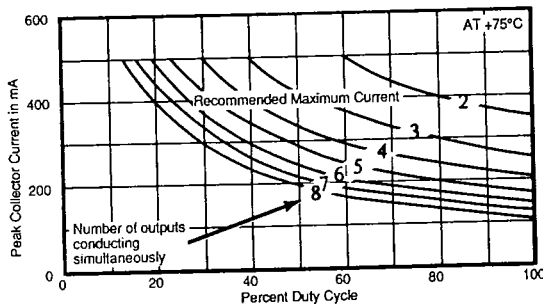
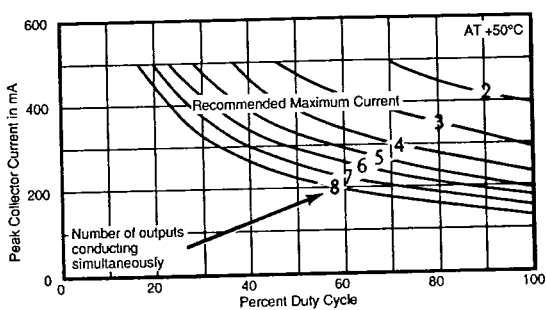
Note: The recommended maximum currents apply to the 2000, 2800, 2020, and 2820 series.

Section 4 - Power Drivers
ULS2000 Series, ULS2800 Series

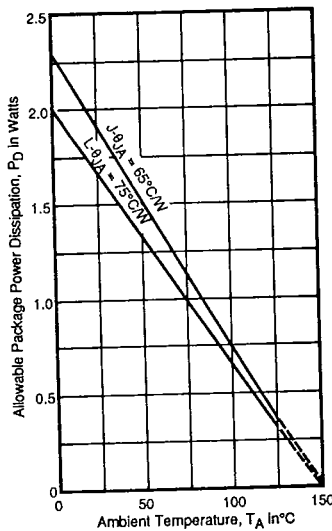


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ULS2800L — Peak Collector Current as a Function of Duty Cycle (See Note)



Allowable Package Power Dissipation
ULS-2000J and ULS-2000L



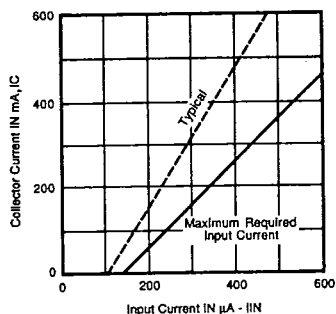
Allowable Package Power Dissipation
ULS-2800J and ULS-2800L

Note: The recommended maximum currents apply to 2000, 2800, 2020, and 2820 series.

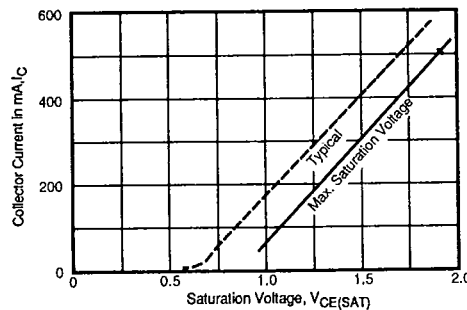
Section 4 - Power Drivers
ULS2000 Series, ULS2800 Series

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Saturation Voltage Characteristics



Collector Current as a Function of Input Current



Collector Current as a Function of Saturation Voltage

Section 4 - Power Drivers
ULS2000 Series, ULS2800 Series

Order Information

| Input Conditions | Maximum Output Conditions | | | | | |
|-------------------------------|---------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| | 7 Segment Drive | | | 8 Segment Drive | | |
| | VCE = 50V IC = 500mA | VCE = 50V IC = 600mA | VCE = 95V IC = 500mA | VCE = 50V IC = 500mA | VCE = 50V IC = 600mA | VCE = 95V IC = 500mA |
| General Purpose CMOS, PMOS | ULS2001J ULS2001L | ULS2011J ULS2011L | ULS2021J ULS2021L | ULS2801J ULS2801L | ULS2811J ULS2811L | ULS2821J ULS2821L |
| 14 - 25V PMOS | ULS2002J ULS2002L | ULS2012J ULS2012L | ULS2022J ULS2022L | ULS2802J ULS2802L | ULS2812J ULS2812L | ULS2822J ULS2822L |
| 5V TTL, CMOS | ULS2003J ULS2003L | ULS2013J ULS2013L | ULS2023J ULS2023L | ULS2803J ULS2803L | ULS2813J ULS2813L | ULS2823J ULS2823L |
| 6 - 15V CMOS, PMOS | ULS2004J ULS2004L | ULS2014J ULS2014L | ULS2024J ULS2024L | ULS2804J ULS2804L | ULS2814J ULS2814L | ULS2824J ULS2824L |
| High Output TTL | ULS2005J ULS2005L | ULS2015J ULS2015L | ULS2025J ULS2025L | ULS2805J ULS2805L | ULS2815J ULS2815L | ULS2825J ULS2825L |

Note: J — 16 or 18 pin Cerdip
L — 16 or 18 pin side braised ceramic

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