

INTEGRATED POWER SEMICONDUCTORS, LTD.

Darlington Transistor Arrays

Description

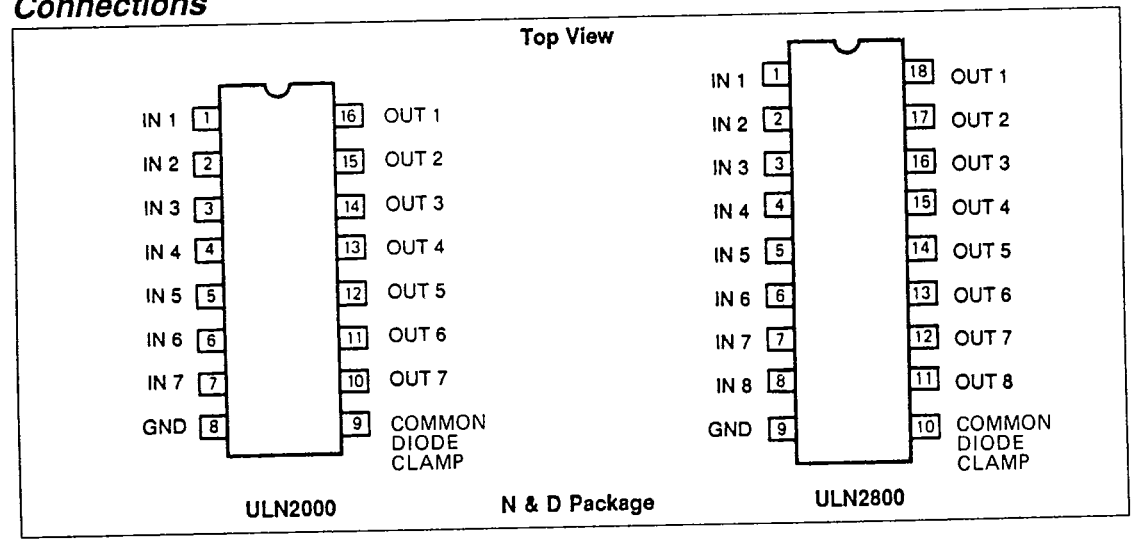
These power driver arrays are an arrangement of either seven (2000 series) or eight (2800 series) darlington transistors with independent inputs and outputs. They are designed to provide a high voltage, medium current interface between low voltage control logic and peripheral loads. The range of inputs 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



Absolute Maximum Ratings (T_A = 25°C)

Output Voltage, V_{CE}		Continuous Base Current, I_B	25mA
ULN2000, 2010, 2800, 2810 Series	50V	Power Dissipation, P_D	
ULN2020, 2820 Series	95V	(Single Darlington Drive)	1.0W
Input Voltage, V_{IN}		*Total Package ULN2000N	2.0W
ULN2002, 2003, 2004, 2802, 2803, 2804	30V	ULN2000D	0.96W
ULN2005, 2805	15V	ULN2800N	2.25W
Continuous Collector Current, I_C		ULN2800D	1.08W
ULN2000, 2020, 2800, 2820 Series	500mA	Operating Temperature Range, T_A	-20°C to +85°C
ULN2010, 2810 Series	600mA	Storage Temperature Range, T_S	-55°C to +150°C

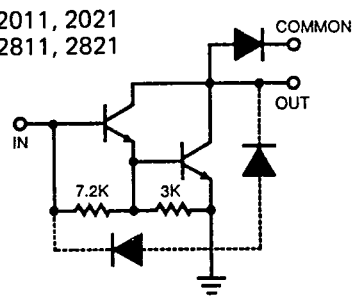
Absolute maximum ratings are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The electrical characteristics provide conditions for actual device operation.

*Deratings above 25°C —

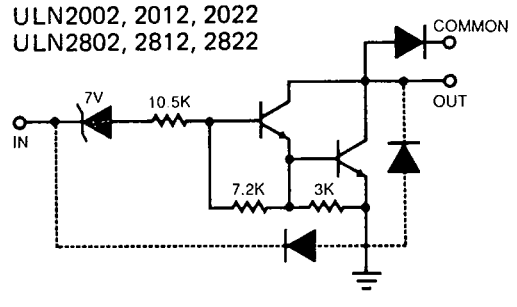
ULN2000N	16.7mW/°C
ULN2000D	7.7mW/°C
ULN2800N	18.2mW/°C
ULN2800D	8.4mW/°C

Schematic Diagrams (Single Darlington Shown)

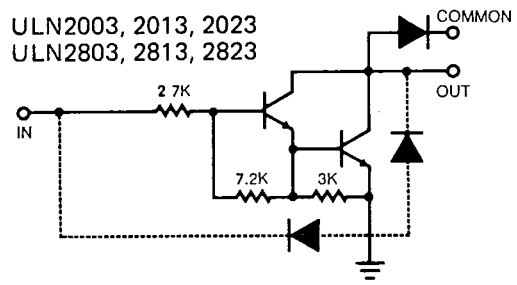
ULN2001, 2011, 2021
ULN2801, 2811, 2821



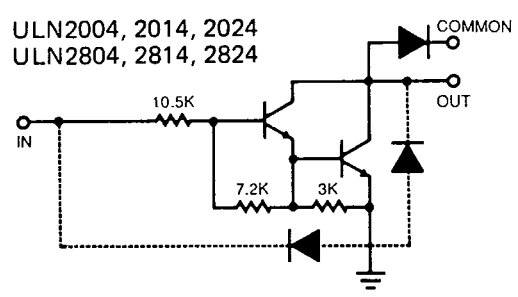
ULN2002, 2012, 2022
ULN2802, 2812, 2822



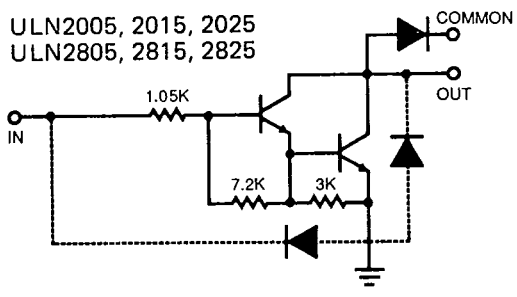
ULN2003, 2013, 2023
ULN2803, 2813, 2823



ULN2004, 2014, 2024
ULN2804, 2814, 2824



ULN2005, 2015, 2025
ULN2805, 2815, 2825



Section 4 - Power Drivers
ULN2000 Series, ULN2800 Series



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
			All	50	65	μA
Input Current, I_{IN} (OFF)	$I_C = 500\mu\text{A}, T_A = 70^\circ\text{C}$	All				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
	$V_{CE} = 2.0\text{V}, I_C = 350\text{mA}$	2001, 2801	1000			
DC Forward Current						
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
	$V_R = 50\text{V}, T_A = 70^\circ\text{C}$					
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



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
DC Forward Current	$V_{CE} = 2.0\text{V}, I_C = 350\text{mA}$	2011, 2811	1000			
	$V_{CE} = 2.0\text{V}, I_C = 500\text{mA}$		900			
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				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



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
	$V_{CE} = 2.0\text{V}, I_C = 350\text{mA}$	2021, 2821	1000			
DC Forward Current	$V_{CE} = 2.0\text{V}, I_C = 350\text{mA}$					
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		0.25	1.0	μs
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



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

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