A2003, A2004, A2023, and A2024

High Voltage High Current Darlington Arrays

Discontinued Product

These parts are no longer in production The device should not be purchased for new design applications. Samples are no longer available.

Date of status change: October 31, 2005

Recommended Substitutions:

NOTE: For detailed information on purchasing options, contact your local Allegro field applications engineer or sales representative.

Allegro MicroSystems, Inc. reserves the right to make, from time to time, revisions to the anticipated product life cycle plan for a product to accommodate changes in production capabilities, alternative product availabilities, or market demand. The information included herein is believed to be accurate and reliable. However, Allegro MicroSystems, Inc. assumes no responsibility for its use; nor for any infringements of patents or other rights of third parties which may result from its use.



HIGH-VOLTAGE, HIGH-CURRENT DARLINGTON ARRAYS

Ideally suited for interfacing between low-level logic circuitry and multiple peripheral power loads, the Series ULN20xxA/L high-voltage, high-current Darlington arrays feature continuous load current ratings to 500 mA for each of the seven drivers. At an appropriate duty cycle depending on ambient temperature and number of drivers turned ON simultaneously, typical power loads totaling over 230 W (350 mA x 7, 95 V) can be controlled. 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 ULN2003A/L and ULN2023A/L 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 ULN2004A/L and ULN2024A/L have series input resistors for operation directly from 6 to 15 V CMOS or PMOS logic outputs.

The ULN2003A/L and ULN2004A/L 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 ULN2023A/L and ULN2024A/L will withstand 95 V in the OFF state.

These Darlington arrays are furnished in 16-pin dual in-line plastic packages (suffix "A") and 16-lead surface-mountable SOICs (suffix "L"). All devices are pinned with outputs opposite inputs to facilitate ease of circuit board layout. All devices are rated for operation over the temperature range of -20°C to +85°C. Most (see matrix, next page) are also available for operation to -40°C; to order, change the prefix from "ULN" to "ULO".

1 16 15 15 15 14 14 13 15 10 10 10 8 777 9

Dwg. No. A-9594

Note that the ULN20xxA series (dual in-line package) and ULN20xxL series (small-outline IC package) are electrically identical and share a common terminal number assignment.

ABSOLUTE MAXIMUM RATINGS

Output Voltage, V _{CE}
(ULN200xA and ULN200xL) 50 V
(ULN202xA and ULN202xL) 95 V
Input Voltage, V _{IN}
Continuous Output Current,
I _C 500 mA
Continuous Input Current, I _{IN} 25 mA
Power Dissipation, P _D
(one Darlington pair) 1.0 W
(total package) See Graph
Operating Temperature Range,
T_A 20°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 Plastic Package or Small-Outline IC Package

x = digit to identify specific device. Characteristic shown applies to family of devices with remaining digits as shown. See matrix on next page.

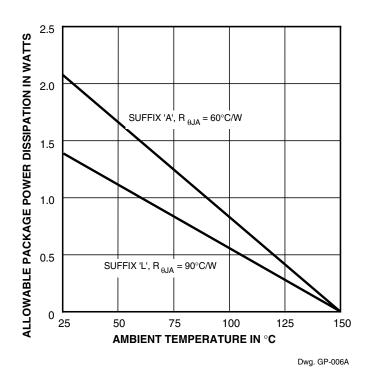


DEVICE PART NUMBER DESIGNATION

V _{CE(MAX)}	50 V	95 V				
I _{C(MAX)}	500 mA	500 mA				
Logic	Part Number					
5V TTL, CMOS	ULN2003A* ULN2003L*	ULN2023A* ULN2023L				
6-15 V CMOS, PMOS	ULN2004A* ULN2004L*	ULN2024A ULN2024L				

^{*}Also available for operation between -40°C and +85°C. To order, change prefix from "ULN" to "ULQ".

Dwg. No. A-9898A PARTIAL SCHEMATICS ULN20x3A/L (Each Driver) Dwg. No. A-9898A



X = Digit to identify specific device. Specification shown applies to family of devices with remaining digits as shown. See matrix above.



Types ULN2003A, ULN2003L, ULN2004A, and ULN2004L ELECTRICAL CHARACTERISTICS at +25°C (unless otherwise noted).

		Test	Applicable		Limits			
Characteristic	Symbol	Fig.	Devices	Test Conditions	Min.	Тур.	Max.	Units
Output Leakage Current	I _{CEX}	1A	All	V _{CE} = 50 V, T _A = 25°C	_	< 1	50	μΑ
				V _{CE} = 50 V, T _A = 70°C	_	< 1	100	μΑ
		1B	ULN2004A/L	V _{CE} = 50 V, T _A = 70°C, V _{IN} = 1.0 V	_	< 5	500	μΑ
Collector-Emitter	V _{CE(SAT)}	2	All	I _C = 100 mA, I _B = 250 μA	_	0.9	1.1	V
Saturation Voltage				I _C = 200 mA, I _B = 350 μA	_	1.1	1.3	V
				I _C = 350 mA, I _B = 500 μA	_	1.3	1.6	V
Input Current	I _{IN(ON)}	3	ULN2003A/L	V _{IN} = 3.85 V	_	0.93	1.35	mA
			ULN2004A/L	V _{IN} = 5.0 V	_	0.35	0.5	mA
				V _{IN} = 12 V	_	1.0	1.45	mA
	I _{IN(OFF)}	4	All	I _C = 500 μA, T _A = 70°C	50	65	_	μΑ
Input Voltage	V _{IN(ON)}	_{N)} 5	ULN2003A/L	V _{CE} = 2.0 V, I _C = 200 mA	_	_	2.4	V
				V _{CE} = 2.0 V, I _C = 250 mA	_	_	2.7	V
				V _{CE} = 2.0 V, I _C = 300 mA	_	_	3.0	V
			ULN2004A/L	V _{CE} = 2.0 V, I _C = 125 mA	_	_	5.0	V
				V _{CE} = 2.0 V, I _C = 200 mA	_	_	6.0	V
				V _{CE} = 2.0 V, I _C = 275 mA	_	_	7.0	V
				V _{CE} = 2.0 V, I _C = 350 mA	_	_	8.0	>
Input Capacitance	C _{IN}	_	All		_	15	25	pF
Turn-On Delay	t _{PLH}	8	All	0.5 E _{IN} to 0.5 E _{OUT}	_	0.25	1.0	μs
Turn-Off Delay	t _{PHL}	8	All	0.5 E _{IN} to 0.5 E _{OUT}		0.25	1.0	μs
Clamp Diode	I _R	6	All	V _R = 50 V, T _A = 25°C	_	_	50	μΑ
Leakage Current				V _R = 50 V, T _A = 70°C	_	_	100	μΑ
Clamp Diode Forward Voltage	V _F	7	All	I _F = 350 mA	_	1.7	2.0	V

Complete part number includes suffix to identify package style: A = DIP, L = SOIC.

2003 THRU 2024 HIGH-VOLTAGE, HIGH-CURRENT DARLINGTON ARRAYS

Types ULN2023A, ULN2023L, ULN2024A, and ULN2024L ELECTRICAL CHARACTERISTICS at +25°C (unless otherwise noted).

		Test	Applicable		Limits			
Characteristic	Symbol	Fig.	Devices	Test Conditions	Min.	Тур.	Max.	Units
Output Leakage Current	I _{CEX}	1A	All	V _{CE} = 95 V, T _A = 25°C	_	< 1	50	μΑ
				V _{CE} = 95 V, T _A = 70°C	_	< 1	100	μΑ
		1B	ULN2024A/L	V _{CE} = 95 V, T _A = 70°C, V _{IN} = 1.0 V		< 5	500	μΑ
Collector-Emitter Saturation Voltage	V _{CE(SAT)}	2	All	I _C = 100 mA, I _B = 250 μA		0.9	1.1	V
				I _C = 200 mA, I _B = 350 μA		1.1	1.3	V
				I _C = 350 mA, I _B = 500 μA	-	1.3	1.6	V
Input Current	I _{IN(ON)}	3	ULN2023A/L	V _{IN} = 3.85 V		0.93	1.35	mA
			ULN2024A/L	V _{IN} = 5.0 V	_	0.35	0.5	mA
				V _{IN} = 12 V	_	1.0	1.45	mA
	I _{IN(OFF)}	4	All	I _C = 500 μA, T _A = 70°C	50	65	_	μΑ
Input Voltage	V _{IN(ON)}	5	ULN2023A/L	V _{CE} = 2.0 V, I _C = 200 mA	_	_	2.4	V
				V _{CE} = 2.0 V, I _C = 250 mA	_	_	2.7	V
				V _{CE} = 2.0 V, I _C = 300 mA	_	_	3.0	V
			ULN2024A/L	V _{CE} = 2.0 V, I _C = 125 mA	_	_	5.0	V
				V _{CE} = 2.0 V, I _C = 200 mA	_	_	6.0	V
				V _{CE} = 2.0 V, I _C = 275 mA	_	_	7.0	V
				V _{CE} = 2.0 V, I _C = 350 mA	l	_	8.0	V
Input Capacitance	C _{IN}	_	All			15	25	pF
Turn-On Delay	t _{PLH}	8	All	0.5 E _{IN} to 0.5 E _{OUT}		0.25	1.0	μs
Turn-Off Delay	t _{PHL}	8	All	0.5 E _{IN} to 0.5 E _{OUT}	_	0.25	1.0	μs
Clamp Diode	I _R	6	All	V _R = 95 V, T _A = 25°C	_	_	50	μΑ
Leakage Current				V _R = 95 V, T _A = 70°C	_	_	100	μΑ
Clamp Diode Forward Voltage	V _F	7	All	I _F = 350 mA		1.7	2.0	V

Complete part number includes suffix to identify package style: A = DIP, L = SOIC.



TEST FIGURES

OPEN VCE | LAA | | CEX | Dwg. No. A-9729A

FIGURE 1A

FIGURE 1B

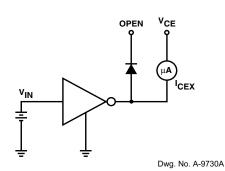
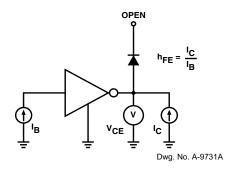


FIGURE 2





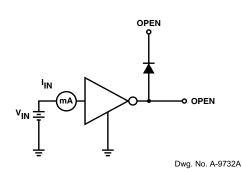


FIGURE 4

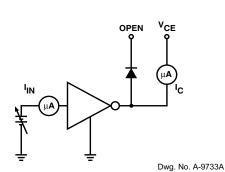


FIGURE 5

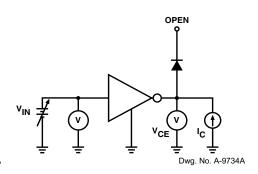


FIGURE 6

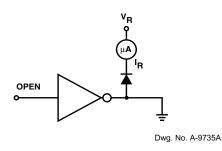


FIGURE 7

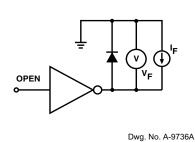
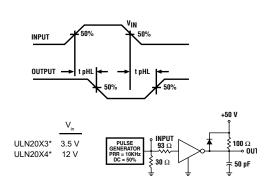


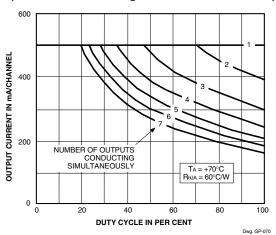
FIGURE 8



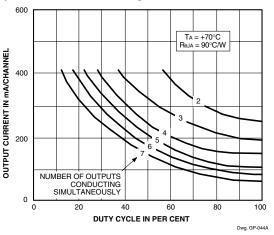
- * Complete part number includes a final letter to indicate package.
- X = Digit to identify specific device. Specification shown applies to family of devices with remaining digits as shown.

2003 THRU 2024 HIGH-VOLTAGE, **HIGH-CURRENT DARLINGTON ARRAYS**

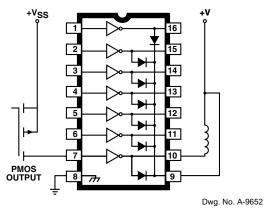
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE (Dual In-line-Packaged Devices, Suffix 'A')

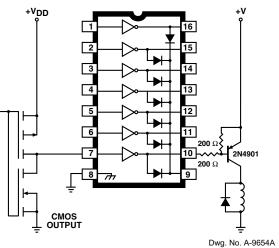


(Small-Outline-Packaged Devices, Suffix 'L')

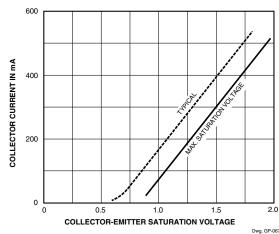


TYPICAL APPLICATIONS

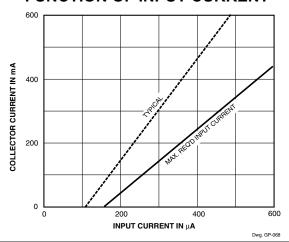




SATURATION VOLTAGE AS A FUNCTION OF COLLECTOR CURRENT



COLLECTOR CURRENT AS A FUNCTION OF INPUT CURRENT

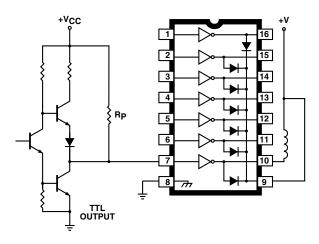




TYPICAL APPLICATIONS

+VCC 1 2 15 14 13 4 11 10 11 OUTPUT

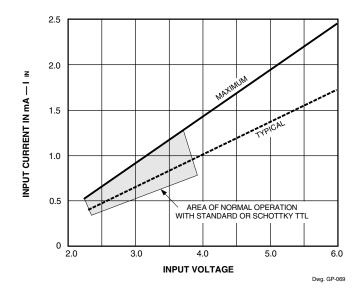
Dwg. No. A-9653A



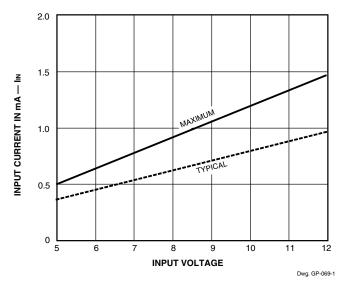
Dwg. No. A-10,175

INPUT CURRENT AS A FUNCTION OF INPUT VOLTAGE

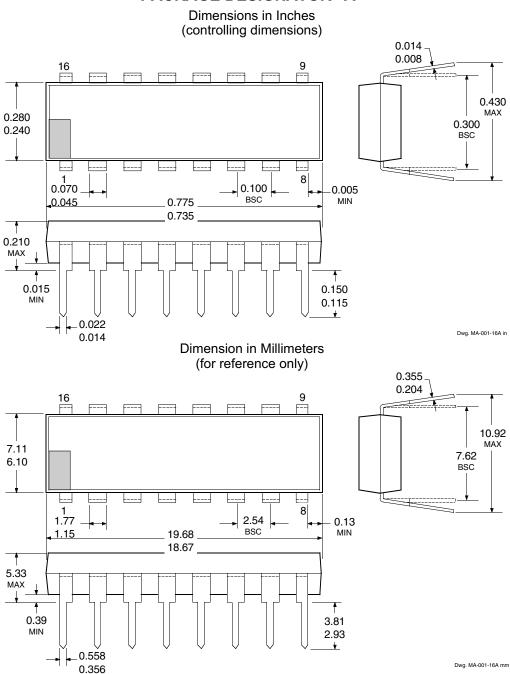
Types ULN2003A, ULN2003L, ULN2023A, and ULN2023L



Types ULN2004A, ULN2004L, ULN2024A, and ULN2024L



PACKAGE DESIGNATOR "A"

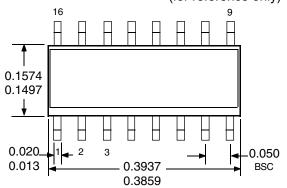


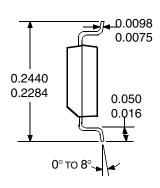
- NOTES: 1. Leads 1, 8, 9, and 16 may be half leads at vendor's option.
 - 2. Lead thickness is measured at seating plane or below.
 - 3. Lead spacing tolerance is non-cumulative.
 - 4. Exact body and lead configuration at vendor's option within limits shown.

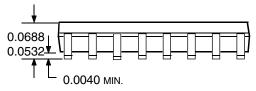


PACKAGE DESIGNATOR "L"

Dimensions in Inches (for reference only)

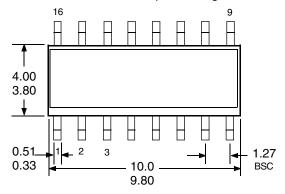


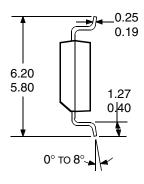


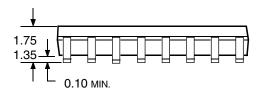


Dwg. MA-007-16 in

Dimension in Millimeters (controlling dimensions)







Dwg. MA-007-16A mm

NOTES: 1. Lead spacing tolerance is non-cumulative.

2. Exact body and lead configuration at vendor's option within limits shown.

2003 THRU 2024 HIGH-VOLTAGE, HIGH-CURRENT DARLINGTON ARRAYS

The products described here are manufactured under one or more U.S. patents or U.S. patents pending.

Allegro MicroSystems, Inc. reserves the right to make, from time to time, such departures from the detail specifications as may be required to permit improvements in the performance, reliability, or manufacturability of its products. Before placing an order, the user is cautioned to verify that the information being relied upon is current.

Allegro products are not authorized for use as critical components in life-support devices or systems without express written approval.

The information included herein is believed to be accurate and reliable. However, Allegro MicroSystems, Inc. assumes no responsibility for its use; nor for any infringement of patents or other rights of third parties which may result from its use.

