ULN2002A

NPN Plastic-Encapsulate Darlington Transistors

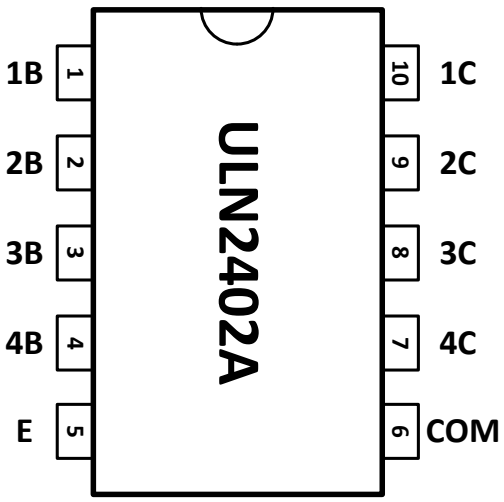
1 简介

ULN2402A 是单片集成高耐压、大电流达林顿管阵列，电路内部包含四个独立的达林顿管驱动单路。电路内部设计有续流二极管，可用于驱动继电器、步进电机等电感性负载。单个达林顿管集电极可输出 500mA 电流。将达林顿管并联可实现更高的输出电流能力。该电路可广泛应用于继电器驱动、照明驱动、显示屏驱动(LED)、步进电机驱动和逻辑缓冲器。

ULN2402A 的每一路达林顿管串联一个 2.7K 的基极电阻，在 5V 的工作电压下可直接与 TTL/CMOS 电路连接，可直接处理原先需要标准逻辑缓冲器来处理的数据。

特别提示:SOP10 脚间距为 1.0mm，和 SOP8/SOP16 脚间距 1.27mm 不同。

引脚排列



SOP10/MSOP10 封装

特点

1、500mA 集电极输出电流(单路)；
2、耐高压(50V)；
3、输入兼容 TTL/CMOS 逻辑信号；
4、广泛应用于继电器驱动；
5、静电能力：4000V（HBM）
6、提供 SOP10、MSOP10 封装

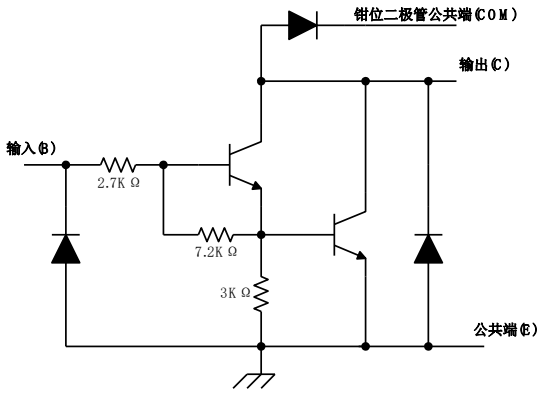
典型应用

1、 继电器驱动；
2、 指示灯驱动；
3、 显示屏驱动。

订购信息

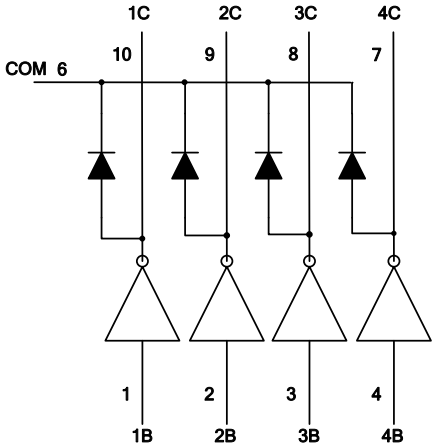
型号	封装类型		温度范围
ULN2402A	SOP10	Pb-Free	-40℃ ~ +85℃
ULN2402A	MSOP10	Pb-Free	-40℃ ~ +85℃

电路原理图(单路达林顿)



ULN2402A 单路驱动电路原理图

逻辑图



引脚定义

引脚编号	引脚名称	输入/输出	引脚功能描述
1	1B	I	1 通道输入管脚
2	2B	I	2 通道输入管脚
3	3B	I	3 通道输入管脚
4	4B	I	4 通道输入管脚
5	E	-	接地
6	COM	-	钳位二极管公共端
7	4C	O	4 通道输出管脚
8	3C	O	3 通道输出管脚
9	2C	O	2 通道输出管脚
10	1C	O	1 通道输出管脚

绝对最大额定值

(T_A=25℃，除另有规定外)

参数		符号	值	单位
集电极-发射极电压(7~10 脚)		V_{CE}	-0.5~50	V
COM 端电压（6 脚）		V_{COM}	50	V
输入电压（1~4 脚）		V_I	-0.5~30	V
集电极峰值电流		I_{CP}	500	mA/ch
输出钳位二极管正向峰值电流		I_{OK}	500	mA
总发射极最大峰值电流		I_{ET}	-1.2	A
最高工作结温(2)		T_J	150	℃
焊接温度			260	℃,10s
储存温度范围		T_{stg}	-60 ~ +150	℃
封装热阻(1) (2)	SOP10封装	θ_{JA}	123	℃/W
	MSOP10封装	θ_{JA}	125	℃/W

注：1、最大功耗可按照下述关系计算

$$P_D = (T_j - T_A)/\theta_{JA}$$

2、T_j(max)为 150℃，T_A 表示电路工作的环境温度；

推荐工作条件

(T_A=25℃，除另有规定外)

参数	符号	条件	最小值	最大值	单位
集电极-发射极电压	V_{CE}		0	50	V
控制信号输入电压	V_{IN}		0	24	V
输入电压(输出开启)	$V_{IN(ON)}$	I_{out}=300mA， h_{FE}=800	2.8	24	V
输入电压（输出关断）	$V_{IN(OFF)}$		0	0.7	V
钳位二极管反向电压	V_R			50	V
钳位二极管正向峰值电流	I_F			350	mA
工作温度范围	T_A		-40	+85	℃
功耗	P_D			1.0	W

电参数特性表

(T_A=25℃，除另有规定外)

参数		测试图	测试条件		最小	典型	最大	单位
$V_{I(ON)}$	导通状态输入电压	图 4	V_{CE}=2V	I_C=200mA		1.9	2.4	V
				I_C=250mA		2.0	2.7	
				I_C=300mA		2.1	3	
$V_{CE(SAT)}$	集电极-发射极饱和压降	图 5	V_I=2.4V I_C=30mA			0.78	1.0	V
			V_I=2.4V I_C=60mA			0.82	1.1	
			V_I=2.4V I_C=120mA			0.9	1.2	
			V_I=2.4V I_C=240mA			1.1	1.4	
			V_I=2.4V I_C=350mA			1.25	1.6	
V_F	钳位二极管正向压降	图 8	I_F=350mA			1.6	1.8	V
I_{CEX}	集电极关断漏电流	图 1	V_{CE}=40V I_I=0			-	50	μA
		图 2	V_{CE}=50V T_A=85℃ V_I=0V			-	100	
I_I	输入电流	图 4	V_{IN}=12V	I_C=60mA		4	5.3	mA
			V_{IN}=6V			1.7	2.2	
			V_{IN}=4.5V			1.1	1.6	
			V_{IN}=2.4V			0.35	0.7	
I_R	钳位二极管反向电流	图 7	V_R=40V			-	100	μA
C_{IN}	输入电容					15		pF
t_{PLH}	传输延迟 低-高	图 9	VL=12V RL=45Ω			0.15	1	μs
t_{PHL}	传输延迟 高-低	图 9	VL=12V RL=45Ω			0.15	1	μs

参数测试原理图

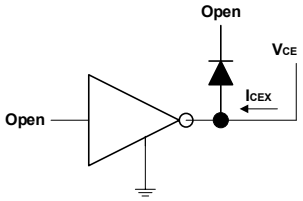


图1 I_{CEX}测试电路

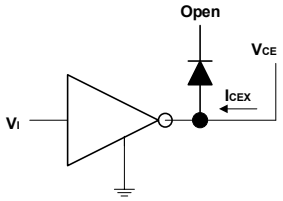


图2 I_{CEX}测试电路

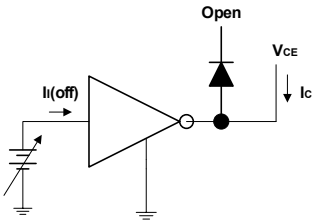


图3 $I_{I\ (off)}$测试电路

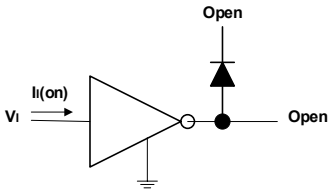


图 4 I_I测试电路

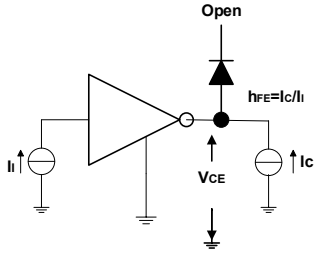


图5 H_{FE},$V_{CE(sat)}$测试电路

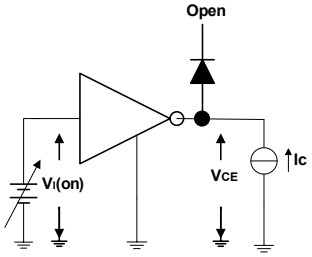


图6 $V_{I\ (on)}$测试电路

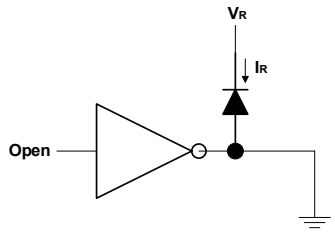


图7 I_R测试电路

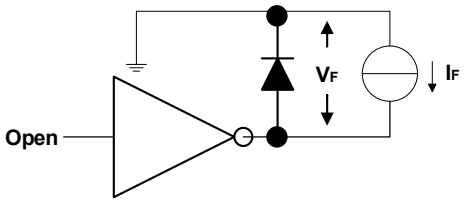


图8 V_R测试电路

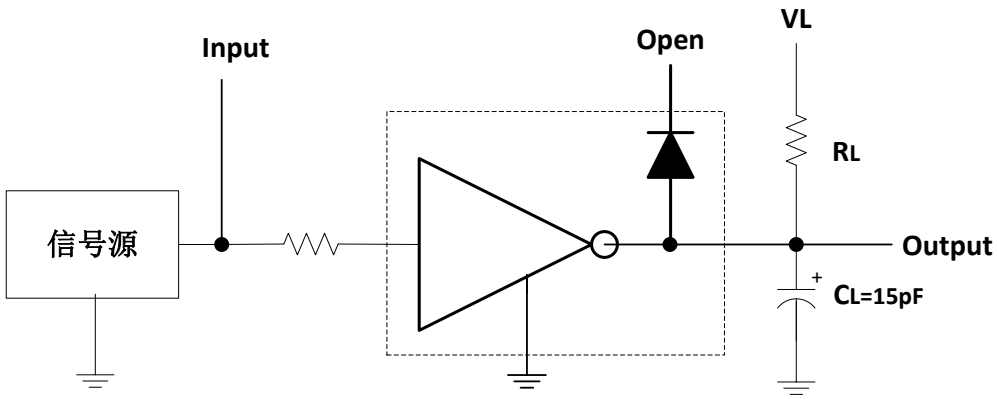


图 9 传输延时波形图

备注：图 9 中电容负载为示波器探头寄生电容

典型应用

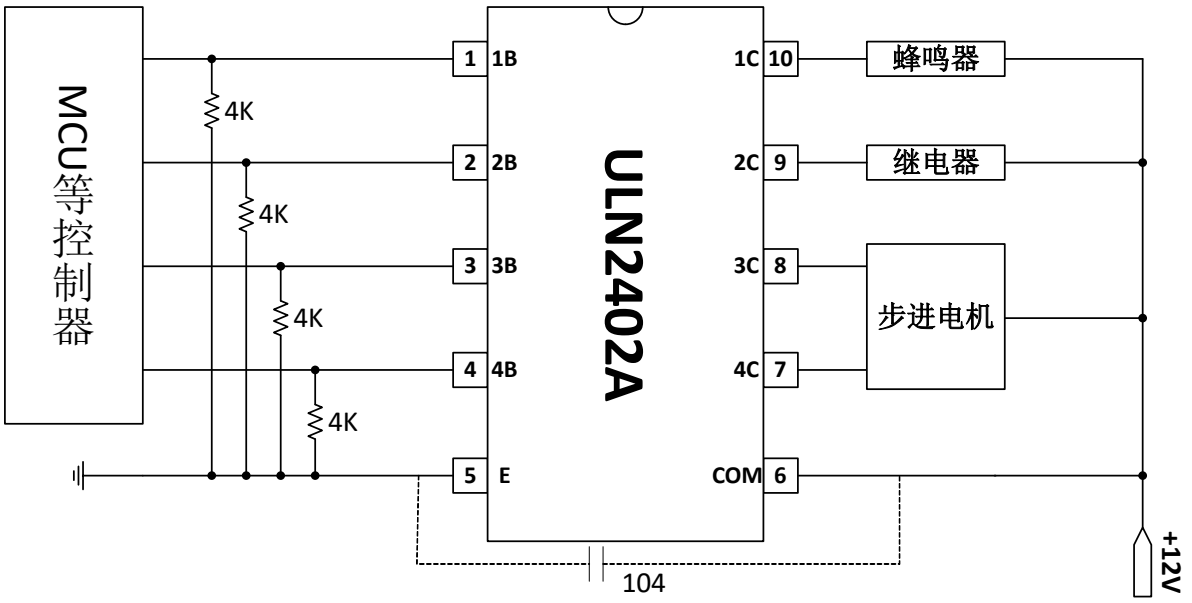
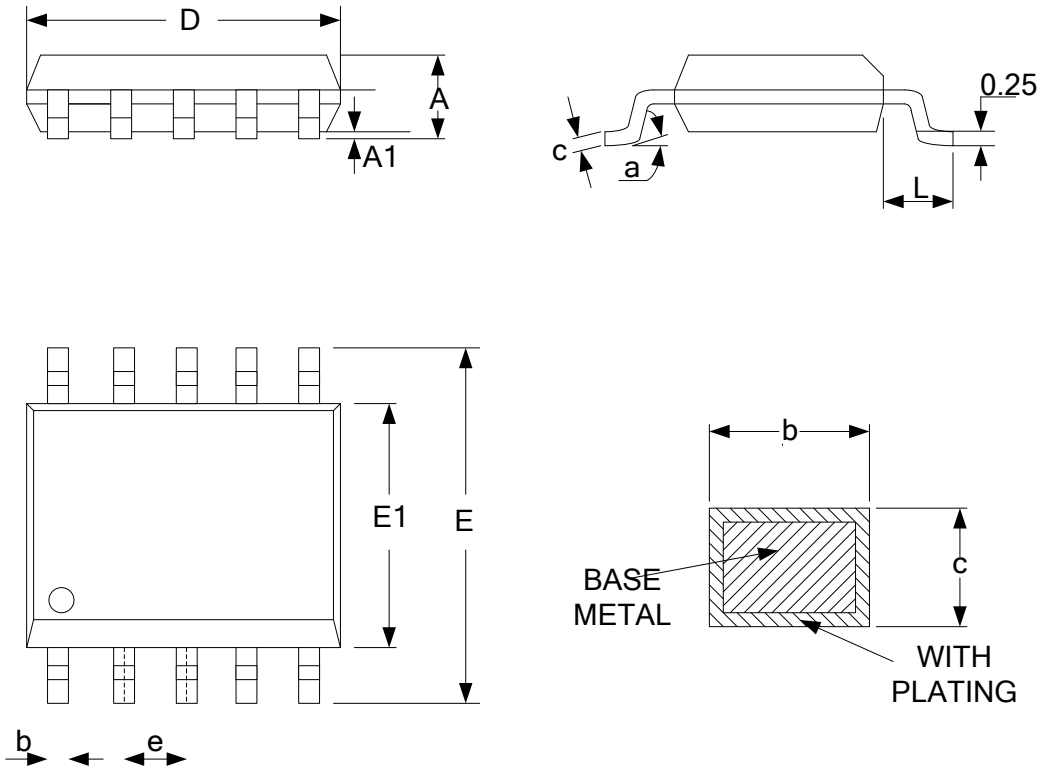


图 10　ULN2402A 应用示意图

考虑到目前有些应用采用了带上拉电阻的单片机，在上电时单片机输出状态不定，此时 ULN2402A 输入级会受单片机上拉电阻影响而将负载打开，为了避免负载的误动作建议存在此种应用问题的客户在输入级接 1 个 4K 的对地的下拉电阻，如上图所示。

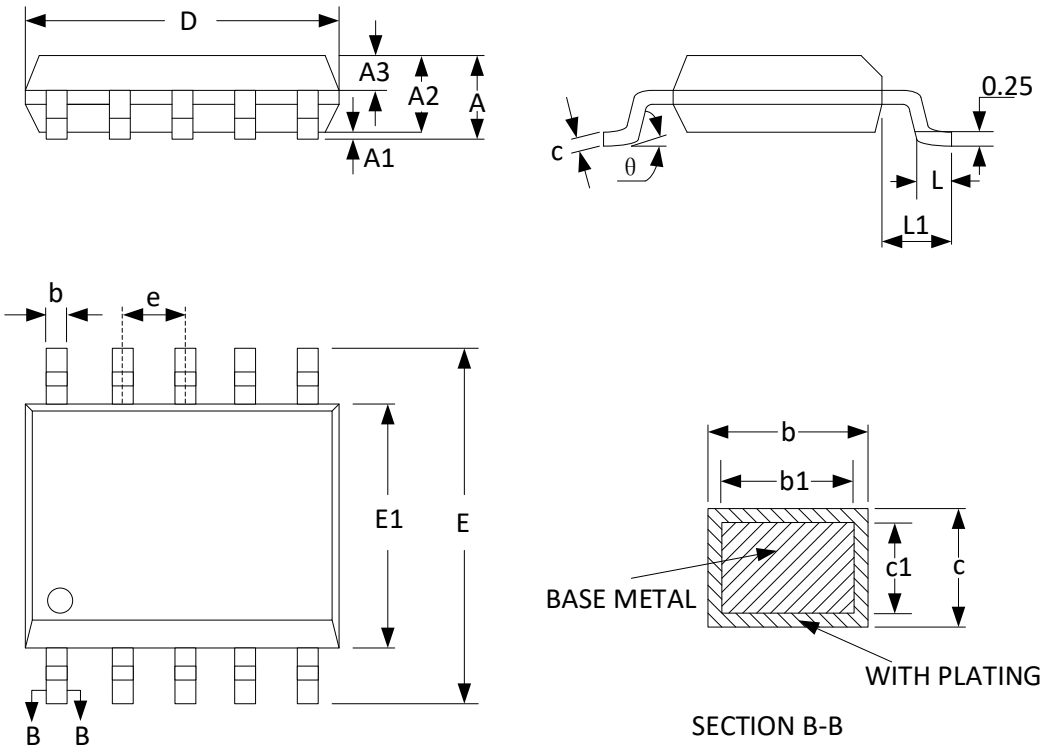
封装外形尺寸图

SOP10：



SYMBOL	MILLMETER		
	MIN	NOM	MAX
A	-	-	1.75
A1	0.10	-	0.23
b	0.30	-	0.40
c	0.19	-	0.25
D	4.70	4.90	5.10
E	5.80	6.00	6.20
E1	3.70	3.90	4.10
e	1.00BSC		
L	0.40	-	0.80
a	0°	-	8°

MSOP10：



SYMBOL	MILLMETER		
	MIN	NOM	MAX
A	-	-	1.10
A1	0.05	-	0.15
A2	0.75	0.85	0.95
A3	0.30	0.35	0.40
b	0.18	-	0.26
b1	0.17	0.20	0.23
c	0.15	-	0.19
c1	0.14	0.15	0.16
D	2.90	3.00	3.10
E	4.70	4.90	5.10
E1	2.90	3.00	3.10
e	0.50BSC		
L	0.40	-	0.70
L1	0.95REF		
θ	0°	-	8°

Contact Information

TANI website: **http://www.tanisemi.com** Email:tani@tanisemi.com

For additional information, please contact your local Sales Representative.

Product Specification Statement

The product specification aims to provide users with a reference regarding various product parameters, performance, and usage. It presents certain aspects of the product's performance in graphical form and is intended solely for users to select product and make product comparisons, enabling users to better understand and evaluate the characteristics and advantages of the product. It does not constitute any commitment, warranty, or guarantee.

The product parameters described in the product specification are numerical values, characteristics, and functions obtained through actual testing or theoretical calculations of the product in an independent or ideal state. Due to the complexity of product applications and variations in test conditions and equipment, there may be slight fluctuations in parameter test values. TANI shall not guarantee that the actual performance of the product when installed in the customer's system or equipment will be entirely consistent with the product specification, especially concerning dynamic parameters. It is recommended that users consult with professionals for product selection and system design. Users should also thoroughly validate and assess whether the actual parameters and performance when installed in their respective systems or equipment meet their requirements or expectations. Additionally, users should exercise caution in verifying product compatibility issues, and TANI assumes no responsibility for the application of the product. TANI strives to provide accurate and up -to-date information to the best of our ability. However, due to technical, human, or other reasons, TANI cannot guarantee that the information provided in the product specification is entirely accurate and error-free. TANI shall not be held responsible for any losses or damages resulting from the use or reliance on any information in these product specifications.

TANI reserves the right to revise or update the product specification and the products at any time without prior notice, and the user's continued use of the product specification is considered an acceptance of these revisions and updates. Prior to purchasing and using the product, users should verify the above information with TANI to ensure that the prod uct specification is the most current, effective, and complete. If users are particularly concerned about product parameters, please consult TANI in detail or request relevant product test reports. Any data not explicitly mentioned in the product specification shall be subject to separate agreement.

Users are advised to pay attention to the parameter limit values specified in the product specification and maintain a certain margin in design or application to ensure that the product does not exceed the parameter limit values defined in the product specification. This precaution should be taken to avoid exceeding one or more of the limit values, which may result in permanent irreversible damage to the product, ultimately affecting the quality and reliability of the system or equipment.

The design of the product is intended to meet civilian needs and is not guaranteed for use in harsh environments or precision equipment. It is not recommended for use in systems or equipment such as medical devices, aircraft, nuclear power, and similar systems, where failures in these systems or equipment could reasonably be expected to result in personal injury. TANI shall assume no responsibility for any consequences resulting from such usage.

Users should also comply with relevant laws, regulations, policies, and standards when using the product specification. Users are responsible for the risks and liabilities arising from the use of the product specification and must ensure that it is not used for illegal purposes. Additionally, users should respect the intellectual property rights related to the product specification and refrain from infringing upon any third- party legal rights. TANI shall assume no responsibility for any disputes or controv ersies arising from the above-mentioned issues in any form.