

ULN-2435A, ULN-2445A, AND ULN-2455A AUTOMOTIVE LAMP MONITORS

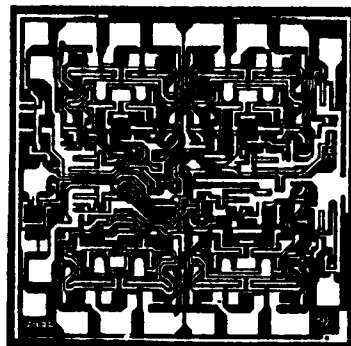
FEATURES

- No Standby Power
- Integral to Wiring Assembly
- Fail-Safe
- Reverse Voltage Protected
- Internal Transient Protection
- Dual In-Line Plastic Packages

CAPABLE of monitoring all types of automotive lamps, Type ULN-2435A, ULN-2445A, and ULN-2455A lamp monitors provide multiple LED outputs to pinpoint the area in which a lamp has failed. Types ULN-2435A and ULN-2445A feature an additional output that triggers an alarm if any of the comparators detects a lamp failure. This output can be used to drive an audible signaling device or centrally located warning indicator.

The Type ULN-2435A lamp monitor has interconnected comparator outputs and logic to monitor the ignition circuit and fuses, making it uniquely applicable to automotive applications. Type ULN-2445A is similar, but has no interconnected comparators. Type ULN-2455A is a general-purpose quad comparator that can be used to monitor automotive lamps, multiple low-voltage power supplies, or, with appropriate sensors, industrial processes.

Installation and operation of these quad lamp monitors has no effect on normal lamp operation. Comparators sense the normal voltage drop in the lamp wiring (approximately 20 mV) for each of the monitored lamp circuits. Little additional wiring is necessary for installation because the system can be completely integral to the wiring assembly. No standby power is required: The operating voltage is obtained from the sense leads; the system is energized only when the lamps are turned ON.



All three integrated circuits are designed for use in the severe automotive environment. Lateral PNP transistors provide high-frequency noise immunity and differential transient-voltage protection. Reverse voltage protection, internal regulators, and temperature compensation are all embodied in the circuit design. A failure within the device will not affect lamp operation.

Types ULN-2435A and ULN-2445A are supplied in 18-pin dual in-line plastic packages. The Type ULN-2455A lamp monitor is supplied in a 14-pin dual in-line plastic package.

ABSOLUTE MAXIMUM RATINGS at +25°C Free-Air Temperature

Supply Voltage, V_{CC}	30 V
Peak Supply Voltage, V_{CC} (0.1 s)	80 V
Peak Reverse Voltage, V_R	30 V
Output Current, I_{OUT}	35 mA
Package Power Dissipation, P_D (ULN-2435/45A)	2.3 W*
(ULN-2455A)	2.0 W**
Operating Temperature Range, T_A	-40°C to +85°C
Storage Temperature Range, T_S	-65°C to +150°C

*Derate at the rate of 18.18 mW/°C above $T_A = +25^\circ\text{C}$.

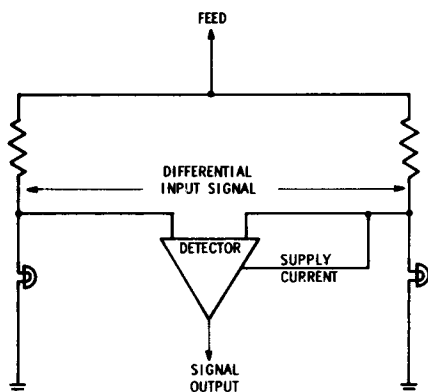
**Derate at the rate of 16.67 mW/°C above $T_A = +25^\circ\text{C}$.

PRINCIPLE OF OPERATION

Operation of these lamp monitors is similar to that of a simple bridge circuit in which the top two legs of the bridge are formed by the wiring assembly resistance or discrete low-value resistors. The bottom legs of the bridge are the monitored lamps. Four differential amplifier circuits sense the voltage drops in the wiring assemblies (approximately 20 mV) for each of the lamp circuits. When the system detects a difference in voltage due to an open filament, the appropriate output driver is turned ON.

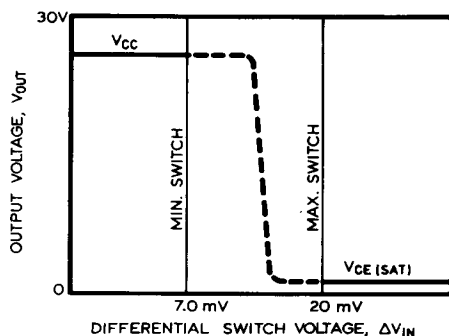
Sprague Electric Technical Paper TP 81-7 discusses the requirements of automotive lamp monitoring systems and presents a more detailed description of the operation of these differential sense amplifiers (page 10-56).

BASIC BRIDGE MONITORING SYSTEM



Des. No. A-11,473A

TYPICAL SWITCH CHARACTERISTICS

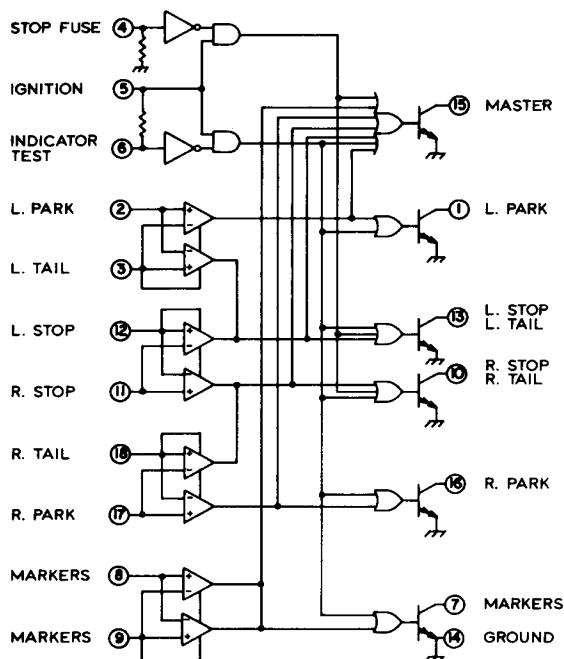


Des. No. A-12,187

ELECTRICAL CHARACTERISTICS at $T_A = +25^\circ\text{C}$, $V_{CC} = V_{IN} = 10$ to 16 V (unless otherwise shown)

Characteristic	Test Pins		Test Conditions	Limits			Units
	ULN-2435/45A	ULN-2455A		Min.	Typ.	Max.	
Output Leakage Current	1, 7, 10, 13, 15, 16	1, 4, 8, 11	$V_{OUT} = 80\text{ V}$, $\Delta V_{IN} < 7\text{ mV}$	—	—	100	μA
Output Saturation Voltage	1, 7, 10, 13, 15, 16	1, 4, 8, 11	$I_{OUT} = 5\text{ mA}$, $\Delta V_{IN} > 20\text{ mV}$	—	0.8	1.0	V
			$I_{OUT} = 30\text{ mA}$, $\Delta V_{IN} > 20\text{ mV}$	—	1.4	2.0	V
Differential Switch Voltage	2-3, 8-9, 11-12, 17-18	2-3, 5-6, 9-10, 12-13	Absolute Value $V_{(2)} - V_{(3)}$	7.0	13	20	mV
Input Current	4	NA	$V_{IN} = V_{CC} = 16\text{ V}$	—	—	500	μA
	5	NA	$V_{IN} = V_{CC} = 16\text{ V}$	—	—	15	mA
	6	NA	$V_{IN} = 0\text{ V}$, $V_{CC} = 16\text{ V}$	—	—	-1.0	mA
	2, 8, 11, 17	2, 5, 9, 12	$\Delta V_{IN} = V_{(2)} - V_{(3)} = +30\text{ mV}$	150	300	800	μA
	3, 9, 12, 18	3, 6, 10, 13	$\Delta V_{IN} = V_{(2)} - V_{(3)} = -30\text{ mV}$	0.5	1.7	3.5	mA

ULN-2435A
FUNCTIONAL BLOCK DIAGRAM



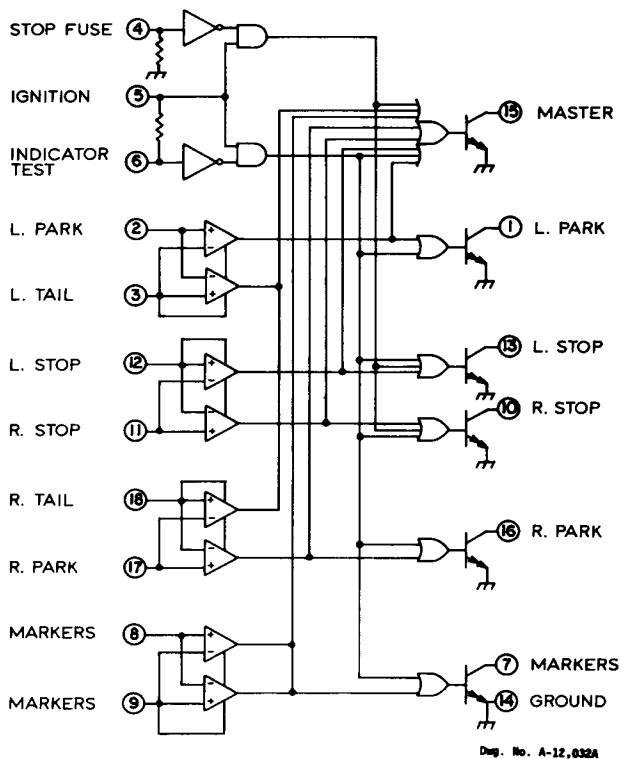
Doc. No. A-12,031A

ULN-2435A and ULN-2445A TRUTH TABLES

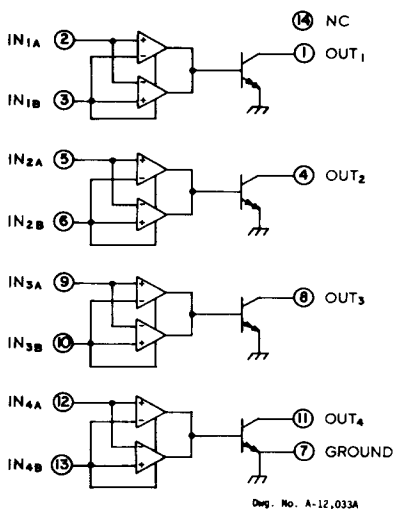
CONDITIONS	INPUT PINS							OUTPUT PINS											
								ULN-2435A						ULN-2445A					
	2/3	8/9	11/12	17/18	6	4	5	1	7	10	13	15	16	1	7	10	13	15	16
Normal	=	=	=	=	0	H	X	H	H	H	H	H	H	H	H	H	H	H	H
L. Park Lamp Failure	>	=	=	=	0	H	X	L	H	H	H	L	H	L	H	H	H	L	H
L. Tail Lamp Failure	<	=	=	=	0	H	X	H	H	H	L	L	H	H	H	H	H	L	H
Marker Lamp Failure	=	>	=	=	0	H	X	H	L	H	H	L	H	H	L	H	H	L	H
Marker Lamp Failure	=	<	=	=	0	H	X	H	L	H	H	L	H	H	L	H	H	L	H
R. Stop Lamp Failure	=	=	>	=	0	H	X	H	H	L	H	L	H	H	L	H	L	H	H
L. Stop Lamp Failure	=	=	<	=	0	H	X	H	H	H	L	L	H	H	H	H	L	L	H
R. Park Lamp Failure	=	=	=	>	0	H	X	H	H	H	H	L	L	H	H	H	H	L	L
R. Tail Lamp Failure	=	=	=	<	0	H	X	H	H	L	H	L	H	H	H	H	H	L	H
Stop Lamp Fuse Failure	=	=	=	=	0	L	H	H	H	L	L	L	H	H	H	L	L	L	H
Indicator Lamp Test	X	X	X	X	L	X	H	L	L	L	L	L	L	L	L	L	L	L	L

= — Less than 7 mV offset between a pair of input pins
 > — Greater than + 20 mV differential between a pair of input pins [$V_{(2)} - V_{(3)}$]
 < — Greater than - 20 mV differential between a pair of input pins [$V_{(2)} - V_{(3)}$]
 H — V_{CC}
 L — V_{SAT} (outputs) or GROUND (inputs)
 0 — Open or V_{CC}
 X — Irrelevant

ULN-2445A FUNCTIONAL BLOCK DIAGRAM

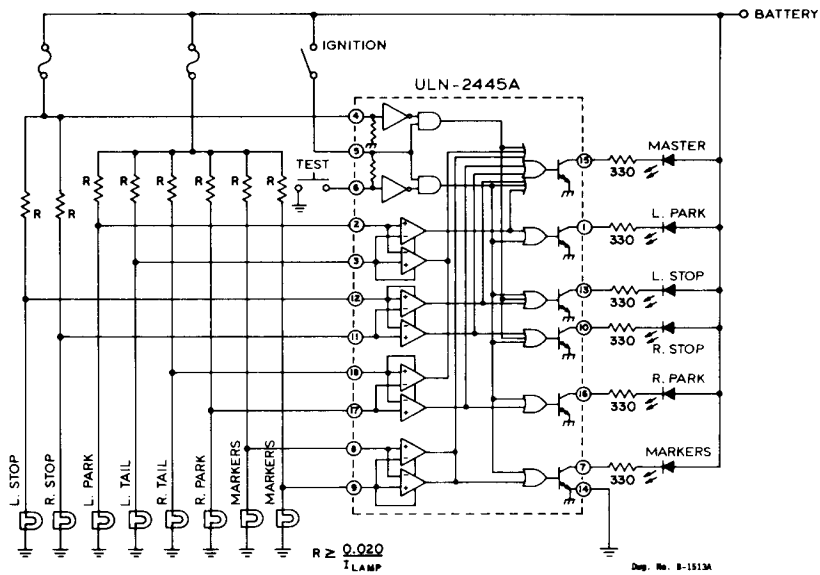


ULN-2455A
FUNCTIONAL BLOCK DIAGRAM

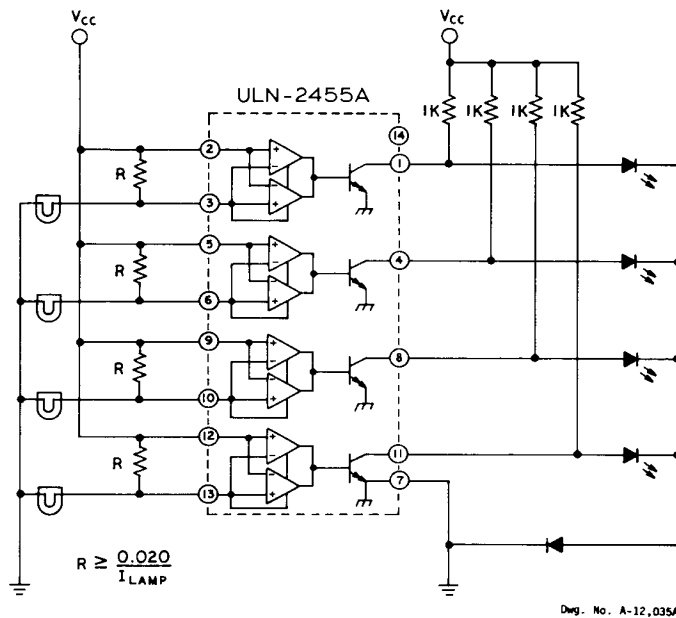


TYPICAL APPLICATIONS

AUTOMOTIVE LAMP MONITOR

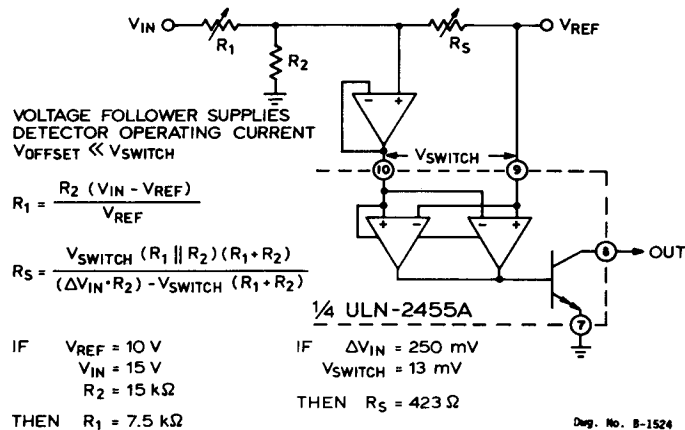


QUAD LAMP MONITOR



TYPICAL APPLICATIONS (Continued)

POWER SUPPLY SUPERVISORY CIRCUIT



SIMPLIFIED SCHEMATIC

(One of 4 differential
sense amplifiers)

