

ULS-2064H THROUGH ULS-2077H 1.25 A QUAD DARLINGTON SWITCHES

MIL-STD-883 Compliant

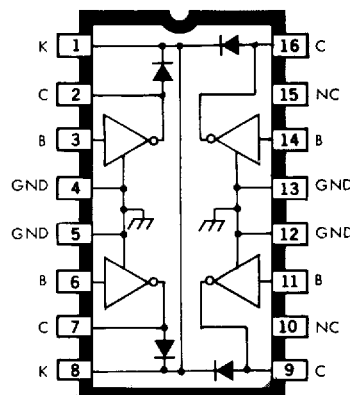
FEATURES

- TTL, DTL, PMOS, or CMOS Compatible Units
- Transient-Protected Outputs
- Hermetically Sealed Packages
- High-Reliability Screening to MIL-STD-883, Class B

IN TENDED FOR MILITARY, aerospace, and related applications, ULS-2064H through ULS-2077H quad Darlington switches interface between low-level logic and a variety of peripheral power loads such as relays, solenoids, dc and stepping motors, multiplexed LED and incandescent displays, heaters, and similar loads of up to 400 watts (1.25 A per output, 80 V, 12.5% duty cycle, +50°C). The devices are specified with a minimum output breakdown of 50 volts (35 volts sustaining at 100 mA) or 80 volts (50 volts sustaining), and a saturated output current specification of 1.25 A.

The ULS-2064/65/68/69H switches are designed for use with TTL, DTL, Schottky TTL, and 5 V CMOS logic. The ULS-2066/67/70/77H are intended for use with 6 V to 15 V CMOS and PMOS logic. These devices include integral transient-suppression diodes for use with inductive loads.

Types ULS-2068H and ULS-2069H incorporate a pre-driver stage operating from a low-current, 5 V



Dwg. No. A-11,025

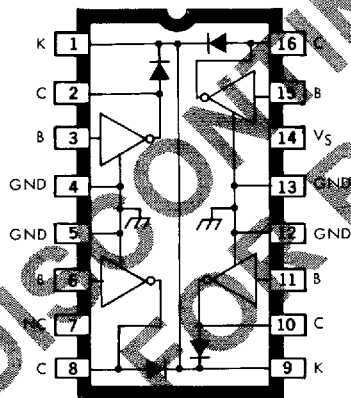
ULS-2064H—ULS-2067H

supply. The pre-driver for the ULS-2070H and ULS-2071H operates from a low-current, 12 V supply. The input drive requirements for these devices are reduced while still allowing the outputs to switch currents up to 1.5 A.

The ULS-2074H through ULS-2077H switches are intended for use in emitter-follower applications. These circuits are identical with the ULS-2064H through ULS-2067H except for the uncommitted emitters and the omission of the suppression diodes.

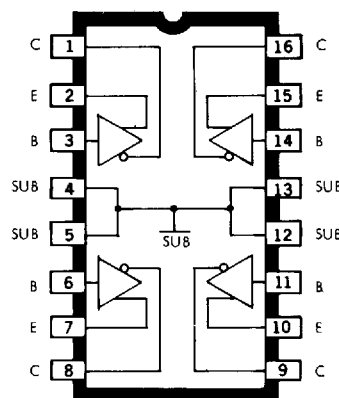
Reverse-bias burn-in and 100% high-reliability screening are standard for all side-brazed hermetic

Continued next page



Dwg. No. A-11,026

ULS-2068H—ULS-2071H



Dwg. No. A-11,027

ULS-2074H—ULS-2077H

ULS-2064H THROUGH ULS-2077H **1.25 A QUAD DARLINGTON SWITCHES**

integrated circuits from Sprague Electric Company. Those devices previously manufactured as the ULS-2064H through ULS-2077H are now screened to the additional requirements of MIL-STD-883, Class B, and are so marked.

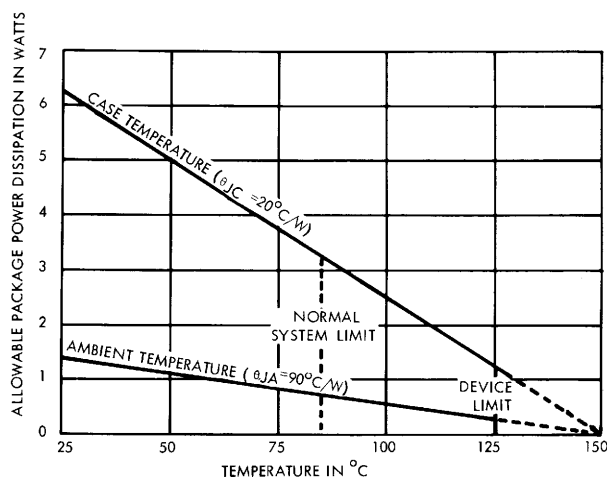
These quad Darlington switches are supplied in 16-pin glass/metal side-brazed hermetic packages.

ABSOLUTE MAXIMUM RATINGS **at 25°C Free-Air Temperature** **for any one driver** **(unless otherwise noted)**

Output Voltage, V_{CEX} See Below
Output Sustaining Voltage, $V_{CE(SUS)}$ See Below
Output Current, I_{OUT} (Note 1) 1.5 A
Input Voltage, V_{IN} (Note 2) See Below
Input Current, I_B (Note 3) 25 mA
Supply Voltage, V_S (ULS-2068/69H) 10 V
(ULS-2070/71H) 20 V
Total Package Power Dissipation See Graph
Power Dissipation, P_D /Output 2.2 W
Operating Ambient Temperature Range, T_A : -55°C to +125°C
Storage Temperature Range, T_S -65°C to +150°C

On special order, economical ceramic/glass cer-DIP hermetic packages can be specified by changing the part number suffix from 'H' to 'R'. Both package styles conform to the dimensional requirements of MIL-M-38510 and are rated for operation over the military temperature range of -55°C to +125°C.

ALLOWABLE PACKAGE POWER DISSIPATION **AS A FUNCTION OF TEMPERATURE**



Dwg. No. A-10,198A

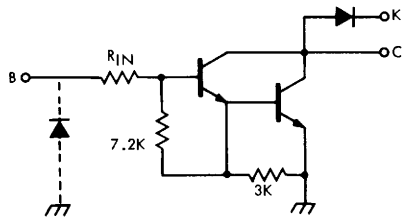
Type Number	V_{CEX} (Max.)	$V_{CE(SUS)}$ (Min.)	V_{IN} (Max.)	Application
ULS-2064H	50 V	35 V	15 V	TTL, DTL, Schottky TTL,
ULS-2065H	80 V	50 V	15 V	and 5 V CMOS
ULS-2066H	50 V	35 V	30 V	6 to 15 V CMOS
ULS-2067H	80 V	50 V	30 V	and PMOS
ULS-2068H	50 V	35 V	15 V	TTL, DTL, Schottky TTL,
ULS-2069H	80 V	50 V	15 V	and 5 V CMOS
ULS-2070H	50 V	35 V	30 V	6 to 15 V CMOS
ULS-2071H	80 V	50 V	30 V	and PMOS
ULS-2074H	50 V	35 V	30 V	General-Purpose
ULS-2075H	80 V	50 V	60 V	
ULS-2076H	50 V	35 V	30 V	6 to 15 V CMOS
ULS-2077H	80 V	50 V	60 V	and PMOS

Notes:

1. Allowable combinations of output current, number of outputs conducting, and duty cycle are shown on following pages.
2. Input voltage is with reference to the substrate (no connection to any other pins) for the ULS-2074/75/76/77H, reference is ground for all other types.
3. Input current may be limited by maximum allowable input voltage.

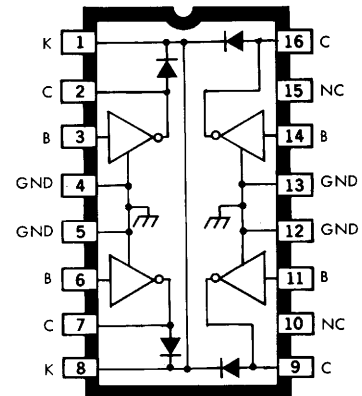
ULS-2064H THROUGH ULS-2067H

PARTIAL SCHEMATIC



Dwg. No. A-10,353

ULS-2064H $R_{IN} = 350 \Omega$
ULS-2065H
ULS-2066H $R_{IN} = 3 k\Omega$
ULS-2067H

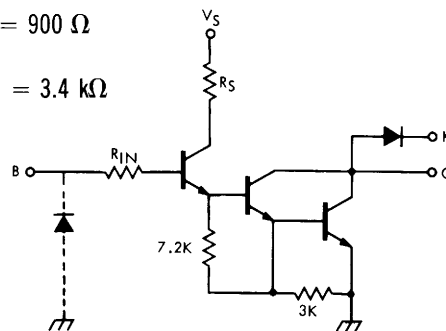


Dwg. No. A-11,025

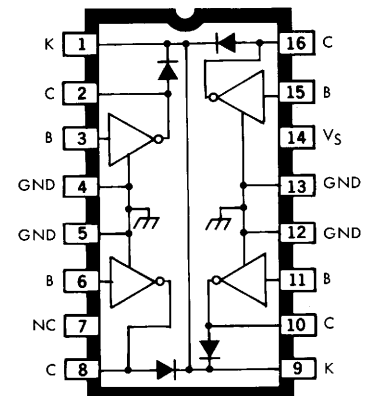
ULS-2068H THROUGH ULS-2071H

PARTIAL SCHEMATIC

ULS-2068H $R_{IN} = 2.5 k\Omega$, $R_S = 900 \Omega$
ULS-2069H
ULS-2070H $R_{IN} = 11.6 k\Omega$, $R_S = 3.4 k\Omega$
ULS-2071H



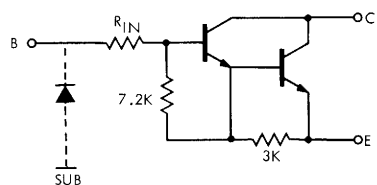
Dwg. No. A-10,354



Dwg. No. A-11,026

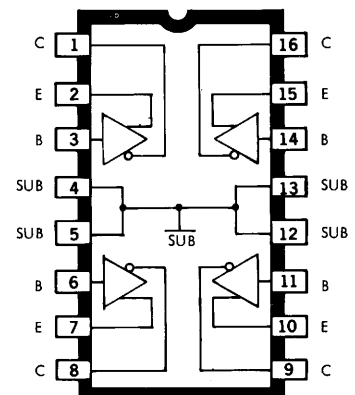
ULS-2074H THROUGH ULS-2077H

PARTIAL SCHEMATIC



Dwg. No. A-10,355

ULS-2074H $R_{IN} = 350 \Omega$
ULS-2075H
ULS-2076H $R_{IN} = 3 k\Omega$
ULS-2077H



Dwg. No. A-11,027

ULS-2064H THROUGH ULS-2067H

ELECTRICAL CHARACTERISTICS over operating temperature range (unless otherwise noted)

Characteristic	Symbol	Applicable Devices	Test Conditions			Limits		
			Temp.	Electrical Conditions	Fig.	Min.	Max.	Units
Output Leakage Current	I_{CEX}	ULS-2064/66H		$V_{CE} = 50\text{ V}$	1	—	500	μA
		ULS-2065/67H		$V_{CE} = 80\text{ V}$	1	—	500	μA
Output Sustaining Voltage	$V_{CE(SUS)}$	ULS-2064/66H		$I_C = 100\text{ mA}$, $V_{IN} = 0.4\text{ V}$	2	35	—	V
		ULS-2065/67H		$I_C = 100\text{ mA}$, $V_{IN} = 0.4\text{ V}$	2	50	—	V
Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	All	− 55°C	$I_C = 500\text{ mA}$, $I_B = 1.1\text{ mA}$	3	—	1.35	V
				$I_C = 750\text{ mA}$, $I_B = 1.7\text{ mA}$	3	—	1.55	V
				$I_C = 1.0\text{ A}$, $I_B = 2.25\text{ mA}$	3	—	1.75	V
				$I_C = 1.25\text{ A}$, $I_B = 3.75\text{ mA}$	3	—	1.95	V
			+ 25°C	$I_C = 500\text{ mA}$, $I_B = 625\text{ }\mu\text{A}$	3	—	1.20	V
				$I_C = 750\text{ mA}$, $I_B = 935\text{ }\mu\text{A}$	3	—	1.35	V
				$I_C = 1.0\text{ A}$, $I_B = 1.25\text{ mA}$	3	—	1.55	V
				$I_C = 1.25\text{ A}$, $I_B = 2.0\text{ mA}$	3	—	1.75	V
			+ 125°C	$I_C = 500\text{ mA}$, $I_B = 625\text{ }\mu\text{A}$	3	—	1.35	V
				$I_C = 750\text{ mA}$, $I_B = 935\text{ }\mu\text{A}$	3	—	1.55	V
				$I_C = 1.0\text{ A}$, $I_B = 1.25\text{ mA}$	3	—	1.75	V
				$I_C = 1.25\text{ A}$, $I_B = 2.0\text{ mA}$	3	—	1.95	V
Input Current	$I_{IN(ON)}$	ULS-2064/65H		$V_{IN} = 2.4\text{ V}$	4	—	4.3	mA
				$V_{IN} = 3.75\text{ V}$	4	—	9.6	mA
		ULS-2066/67H		$V_{IN} = 5.0\text{ V}$	4	—	1.8	mA
				$V_{IN} = 12\text{ V}$	4	—	5.2	mA
Input Voltage	$V_{IN(ON)}$	ULS-2064/65H	− 55°C	$V_{CE} = 2.0\text{ V}$, $I_C = 1.0\text{ A}$	5	—	3.1	V
			+ 25°C	$V_{CE} = 2.0\text{ V}$, $I_C = 1.0\text{ A}$	5	—	2.0	V
		ULS-2066/67H	− 55°C	$V_{CE} = 2.0\text{ V}$, $I_C = 1.0\text{ A}$	5	—	11.5	V
			+ 25°C	$V_{CE} = 2.0\text{ V}$, $I_C = 1.0\text{ A}$	5	—	6.5	V
Turn-On Delay	t_{pHL}	All	+ 25°C		9	—	1.0	μs
Turn-Off Delay	t_{pLH}	All	+ 25°C		9	—	1.5	μs
Clamp Diode Leakage Current	I_R	ULS-2064/66H		$V_R = 50\text{ V}$	6	—	100	μA
		ULS-2065/67H		$V_R = 80\text{ V}$	6	—	100	μA
Clamp Diode Forward Voltage	V_F	All		$I_F = 1.25\text{ A}$	7	—	2.1	V

ULS-2068H THROUGH ULS-2071H

ELECTRICAL CHARACTERISTICS over operating temperature range,
 $V_s = 5.0\text{ V}$ (ULS-2068/69H) or $V_s = 12\text{ V}$ (ULS-2070/71H), (unless otherwise noted)

Characteristic	Symbol	Applicable Devices	Test Conditions			Limits		
			Temp.	Electrical Conditions	Fig.	Min.	Max.	Units
Output Leakage Current	I_{CEX}	ULS-2068/70H		$V_{CE} = 50\text{ V}$	1	—	500	μA
		ULS-2069/71H		$V_{CE} = 80\text{ V}$	1	—	500	μA
Output Sustaining Voltage	$V_{CE(SUS)}$	ULS-2068/70H		$I_C = 100\text{ mA}$, $V_{IN} = 0.4\text{ V}$	2	35	—	V
		ULS-2069/71H		$I_C = 100\text{ mA}$, $V_{IN} = 0.4\text{ V}$	2	50	—	V
Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	ULS-2068/69H	− 55°C	$I_C = 500\text{ mA}$, $V_{IN} = 3.2\text{ V}$	3	—	1.35	V
				$I_C = 750\text{ mA}$, $V_{IN} = 3.2\text{ V}$	3	—	1.55	V
				$I_C = 1.0\text{ A}$, $V_{IN} = 3.2\text{ V}$	3	—	1.75	V
				$I_C = 1.25\text{ A}$, $V_{IN} = 3.2\text{ V}$	3	—	1.95	V
			+ 25°C	$I_C = 500\text{ mA}$, $V_{IN} = 2.9\text{ V}$	3	—	1.20	V
				$I_C = 750\text{ mA}$, $V_{IN} = 2.9\text{ V}$	3	—	1.35	V
				$I_C = 1.0\text{ A}$, $V_{IN} = 2.9\text{ V}$	3	—	1.55	V
				$I_C = 1.25\text{ A}$, $V_{IN} = 2.9\text{ V}$	3	—	1.75	V
			+ 125°C	$I_C = 500\text{ mA}$, $V_{IN} = 2.8\text{ V}$	3	—	1.35	V
				$I_C = 750\text{ mA}$, $V_{IN} = 2.8\text{ V}$	3	—	1.55	V
				$I_C = 1.0\text{ A}$, $V_{IN} = 2.8\text{ V}$	3	—	1.75	V
				$I_C = 1.25\text{ A}$, $V_{IN} = 2.8\text{ V}$	3	—	1.95	V
		ULS-2070/71H	− 55°C	$I_C = 500\text{ mA}$, $V_{IN} = 5.5\text{ V}$	3	—	1.35	V
				$I_C = 750\text{ mA}$, $V_{IN} = 5.5\text{ V}$	3	—	1.55	V
				$I_C = 1.0\text{ A}$, $V_{IN} = 5.5\text{ V}$	3	—	1.75	V
				$I_C = 1.25\text{ A}$, $V_{IN} = 5.5\text{ V}$	3	—	1.95	V
			+ 25°C	$I_C = 500\text{ mA}$, $V_{IN} = 5.1\text{ V}$	3	—	1.20	V
				$I_C = 750\text{ mA}$, $V_{IN} = 5.1\text{ V}$	3	—	1.35	V
				$I_C = 1.0\text{ A}$, $V_{IN} = 5.1\text{ V}$	3	—	1.55	V
				$I_C = 1.25\text{ A}$, $V_{IN} = 5.1\text{ V}$	3	—	1.75	V
			+ 125°C	$I_C = 500\text{ mA}$, $V_{IN} = 5.0\text{ V}$	3	—	1.35	V
				$I_C = 750\text{ mA}$, $V_{IN} = 5.0\text{ V}$	3	—	1.55	V
				$I_C = 1.0\text{ A}$, $V_{IN} = 5.0\text{ V}$	3	—	1.75	V
				$I_C = 1.25\text{ A}$, $V_{IN} = 5.0\text{ V}$	3	—	1.95	V
Input Current	$I_{IN(ON)}$	ULS-2068/69H	− 55°C	$V_{IN} = 3.2\text{ V}$	4	—	600	μA
			+ 25°C	$V_{IN} = 2.75\text{ V}$	4	—	550	μA
			+ 125°C	$V_{IN} = 2.75\text{ V}$	4	—	850	μA
			+ 125°C	$V_{IN} = 3.75\text{ V}$	4	—	1400	μA
		ULS-2070/71H		$V_{IN} = 5.0\text{ V}$	4	—	400	μA
				$V_{IN} = 12\text{ V}$	4	—	1250	μA
Input Voltage	$V_{IN(ON)}$	ULS-2068/69H	− 55°C	$V_{CE} = 2.0\text{ V}$, $I_C = 1.0\text{ A}$	5	—	3.2	V
			+ 25°C	$V_{CE} = 2.0\text{ V}$, $I_C = 1.0\text{ A}$	5	—	2.75	V
		ULS-2070/71H	− 55°C	$V_{CE} = 2.0\text{ V}$, $I_C = 1.0\text{ A}$	5	—	5.0	V
			+ 25°C	$V_{CE} = 2.0\text{ V}$, $I_C = 1.0\text{ A}$	5	—	5.0	V
Supply Current	I_S	ULS-2068/69H		$I_C = 500\text{ mA}$, $V_{IN} = 3.2\text{ V}$	8	—	6.0	mA
		ULS-2070/71H		$I_C = 500\text{ mA}$, $V_{IN} = 5.0\text{ V}$	8	—	4.5	mA
Turn-On Delay	t_{PHL}	All	+ 25°C		9	—	1.0	μs
Turn-Off Delay	t_{PLH}	All	+ 25°C		9	—	1.5	μs
Clamp Diode Leakage Current	I_R	ULS-2068/70H		$V_R = 50\text{ V}$	6	—	100	μA
		ULS-2069/71H		$V_R = 80\text{ V}$	6	—	100	μA
Clamp Diode Forward Voltage	V_F	All		$I_F = 1.25\text{ A}$	7	—	2.1	V

ULS-2074H THROUGH ULS-2077H

ELECTRICAL CHARACTERISTICS over operating temperature range (unless otherwise noted)

Characteristic	Symbol	Applicable Devices	Test Conditions			Limits		
			Temp.	Electrical Conditions	Fig.	Min.	Max.	Units
Output Leakage Current	I_{CEX}	ULS-2074/76H		$V_{CE} = 50 \text{ V}$	1	—	500	μA
		ULS-2075/77H		$V_{CE} = 80 \text{ V}$	1	—	500	μA
Output Sustaining Voltage	$V_{CE(SUS)}$	ULS-2074/76H		$I_C = 100 \text{ mA}, V_{IN} = 0.4 \text{ V}$	2	35	—	V
		ULS-2075/77H		$I_C = 100 \text{ mA}, V_{IN} = 0.4 \text{ V}$	2	50	—	V
Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	All	− 55°C	$I_C = 500 \text{ mA}, I_B = 1.1 \text{ mA}$	3	—	1.35	V
				$I_C = 750 \text{ mA}, I_B = 1.7 \text{ mA}$	3	—	1.55	V
				$I_C = 1.0 \text{ A}, I_B = 2.25 \text{ mA}$	3	—	1.75	V
				$I_C = 1.25 \text{ A}, I_B = 3.75 \text{ mA}$	3	—	1.95	V
			+ 25°C	$I_C = 500 \text{ mA}, I_B = 625 \mu\text{A}$	3	—	1.20	V
				$I_C = 750 \text{ mA}, I_B = 935 \mu\text{A}$	3	—	1.35	V
				$I_C = 1.0 \text{ A}, I_B = 1.25 \text{ mA}$	3	—	1.55	V
				$I_C = 1.25 \text{ A}, I_B = 2.0 \text{ mA}$	3	—	1.75	V
			+ 125°C	$I_C = 500 \text{ mA}, I_B = 625 \mu\text{A}$	3	—	1.35	V
				$I_C = 750 \text{ mA}, I_B = 935 \mu\text{A}$	3	—	1.55	V
				$I_C = 1.0 \text{ A}, I_B = 1.25 \text{ mA}$	3	—	1.75	V
				$I_C = 1.25 \text{ A}, I_B = 2.0 \text{ mA}$	3	—	1.95	V
Input Current	$I_{IN(ON)}$	ULS-2074/75H		$V_{IN} = 2.4 \text{ V}$	4	—	4.3	mA
				$V_{IN} = 3.75 \text{ V}$	4	—	9.6	mA
		ULS-2076/77H		$V_{IN} = 5.0 \text{ V}$	4	—	1.8	mA
				$V_{IN} = 12 \text{ V}$	4	—	5.2	mA
Input Voltage	$V_{IN(ON)}$	ULS-2074/75H	− 55°C	$V_{CE} = 2.0 \text{ V}, I_C = 1.0 \text{ A}$	5	—	3.1	V
			+ 25°C	$V_{CE} = 2.0 \text{ V}, I_C = 1.0 \text{ A}$	5	—	2.0	V
		ULS-2076/77H	− 55°C	$V_{CE} = 2.0 \text{ V}, I_C = 1.0 \text{ A}$	5	—	11.5	V
			+ 25°C	$V_{CE} = 2.0 \text{ V}, I_C = 1.0 \text{ A}$	5	—	6.5	V
Turn-On Delay	t_{PHL}	All	+ 25°C		9	—	1.0	μs
Turn-Off Delay	t_{PLH}	All	+ 25°C		9	—	1.5	μs

TEST FIGURES

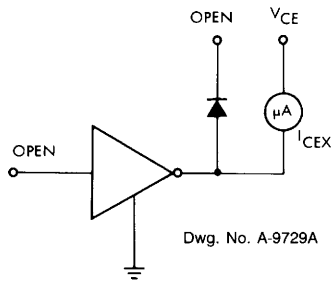


Figure 1

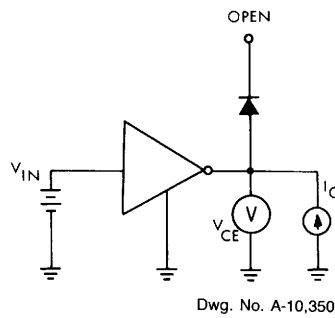


Figure 2

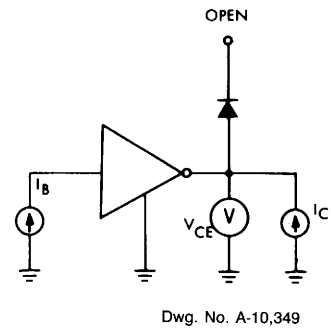


Figure 3

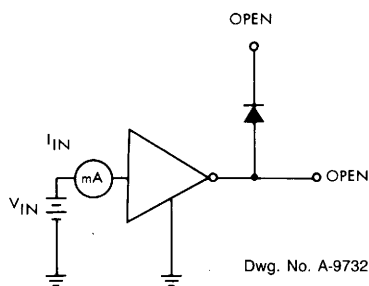


Figure 4

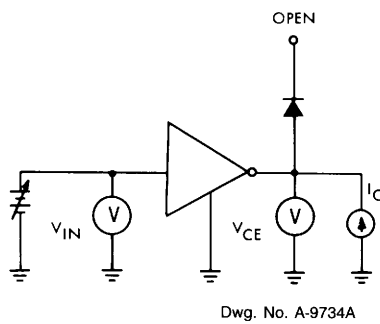


Figure 5

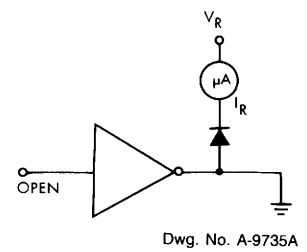


Figure 6

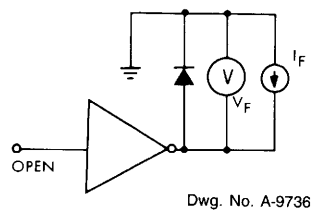


Figure 7

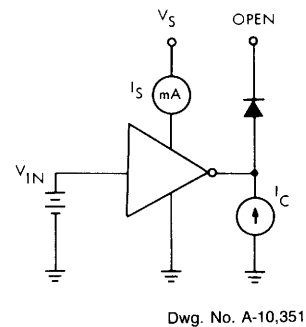
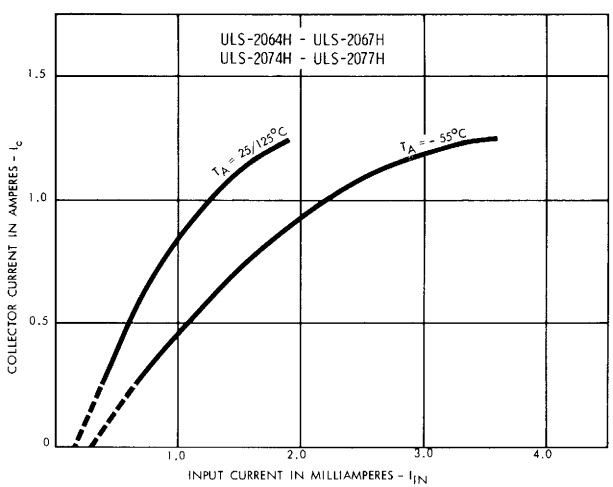


Figure 8

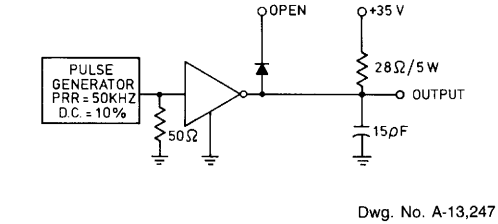
NOTE: Diodes not applicable to Types ULS-2074H through ULS-2077H.

ULS-2064H THROUGH ULS-2077H
 1.25 A QUAD DARLINGTON SWITCHES

COLLECTOR CURRENT
 AS A FUNCTION OF INPUT CURRENT

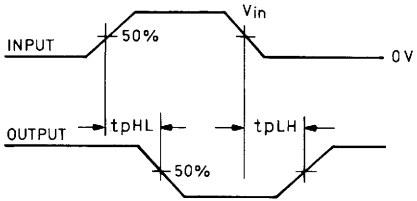


Dwg. No. A-11,030



Dwg. No. A-13,247

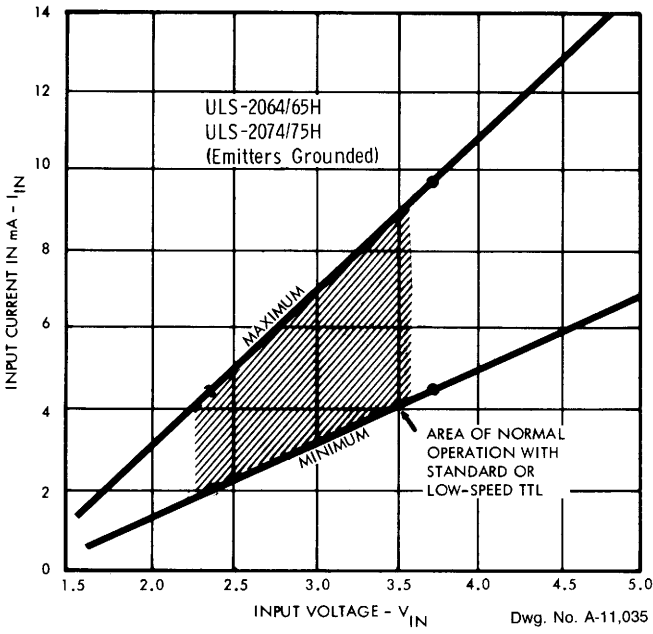
ULS-2064/65/68/69/74/75H $\frac{V_{in}}{2.4V}$
 ULS-2066/67/70/71/76/77H 5.0V



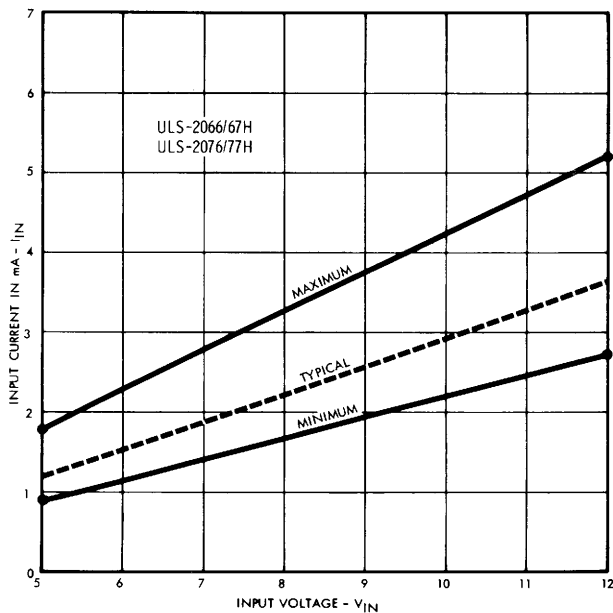
Dwg. No. A-13,248

Figure 9

INPUT CURRENT AS A FUNCTION OF INPUT VOLTAGE

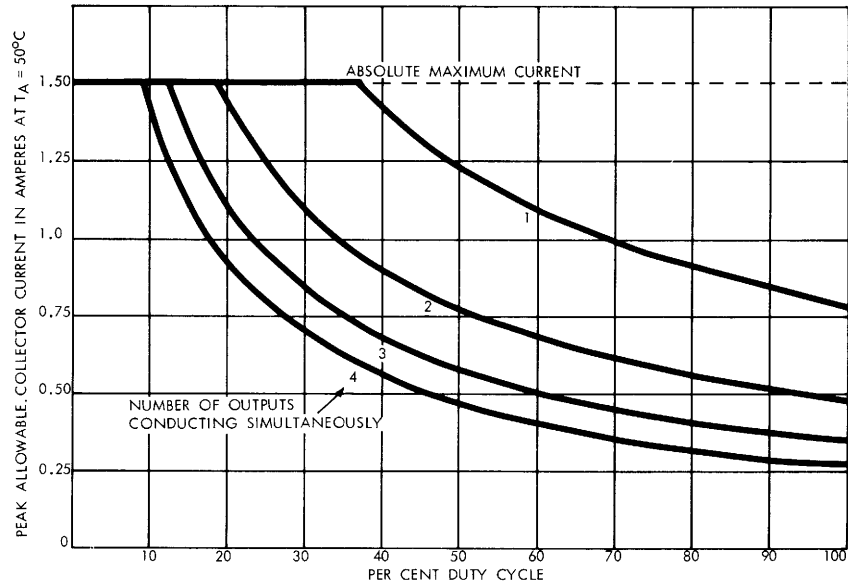


Dwg. No. A-11,035



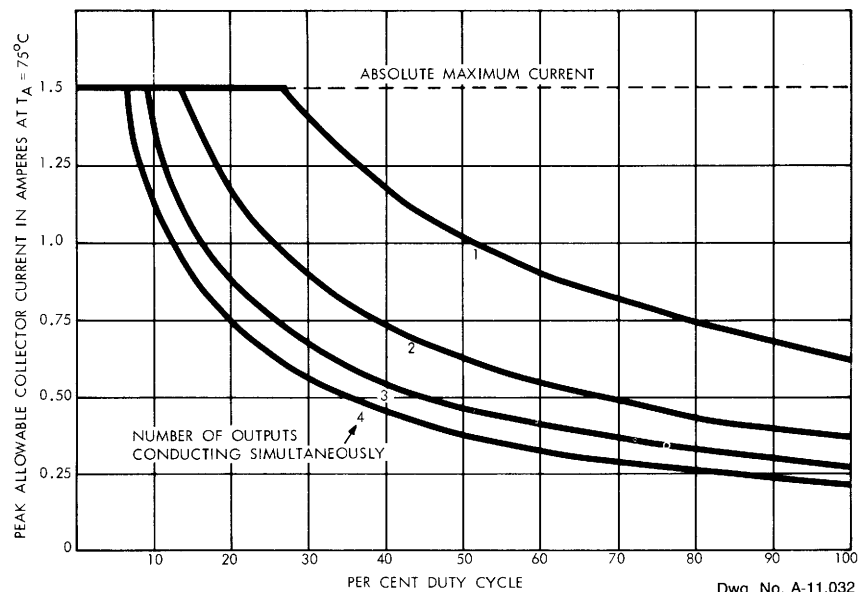
ALLOWABLE PEAK COLLECTOR CURRENT
AS A FUNCTION OF DUTY CYCLE

AT $T_A = +50^\circ\text{C}$



Dwg. No. A-11,031

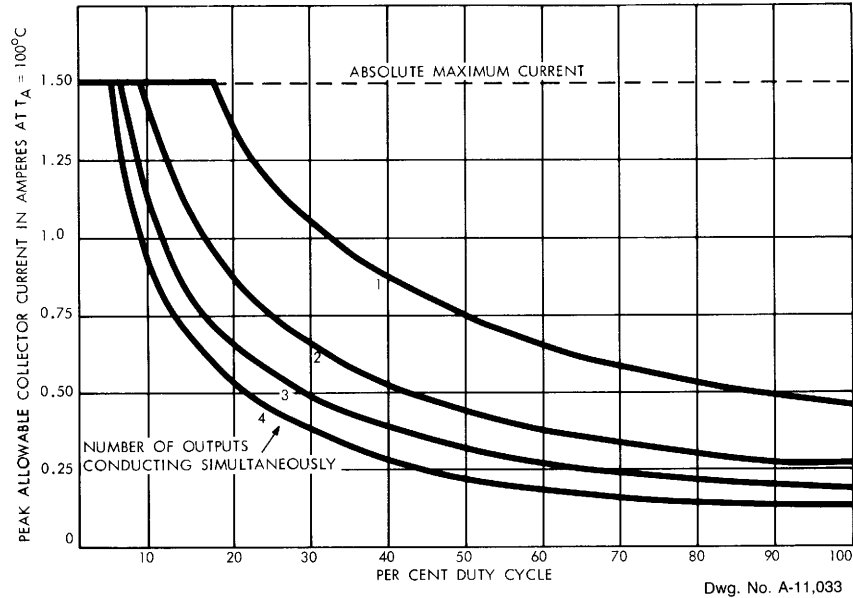
AT $T_A = +75^\circ\text{C}$



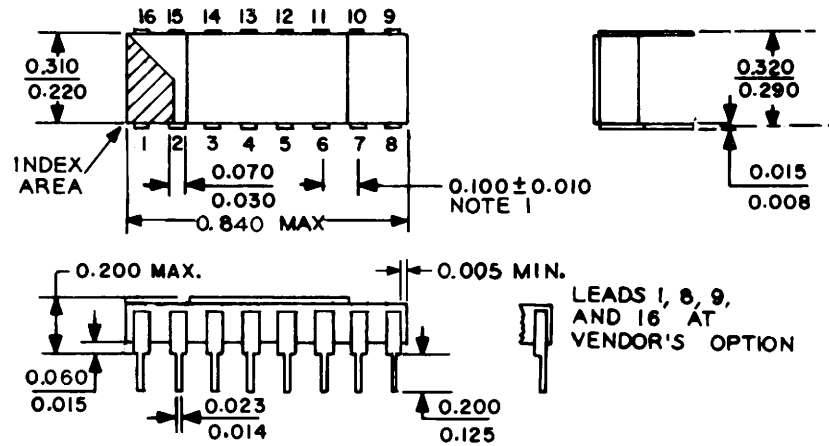
Dwg. No. A-11,032

ALLOWABLE PEAK COLLECTOR CURRENT
AS A FUNCTION OF DUTY CYCLE

AT $T_A = +100^\circ\text{C}$



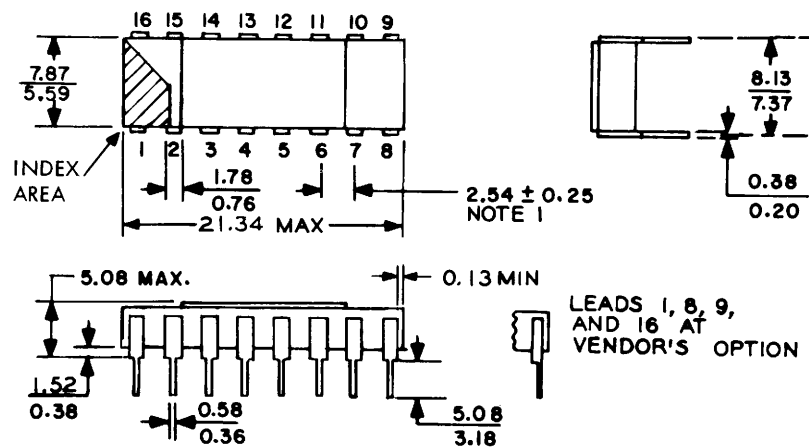
DIMENSIONS IN INCHES



Dwg. No. A-10,210C IN

DIMENSIONS IN MILLIMETERS

(Based on 1" = 25.4 mm)



Dwg. No. A-10,211B MM

This package conforms to military specification MIL-M-38510, case outline D-2, Configuration 3.

NOTES:

1. Lead spacing tolerances is non-cumulative.
2. Exact body and lead configuration at vendor's option within limits shown.
3. Lead gauge plane is 0.030" (0.76 mm), maximum below seating plane.

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