

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

**MIL-STD-883 Compliant**

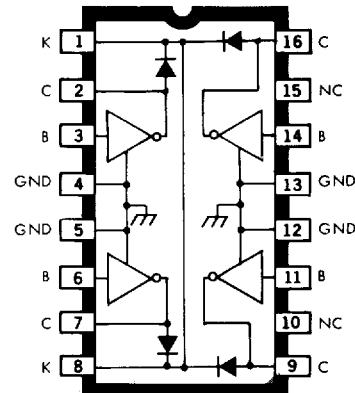
**FEATURES**

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

**I**NTENDED 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

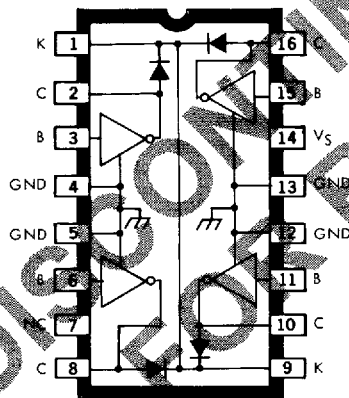
**ULS-2064H—ULS-2067H**

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.

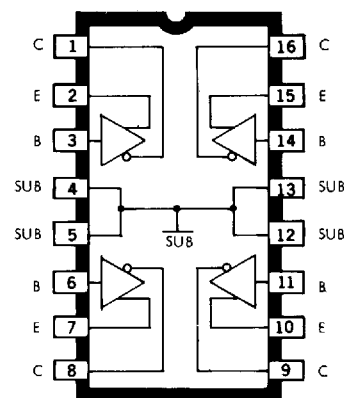
Reverse-bias burn-in and 100% high-reliability screening are standard for all side-brazed hermetic

*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.

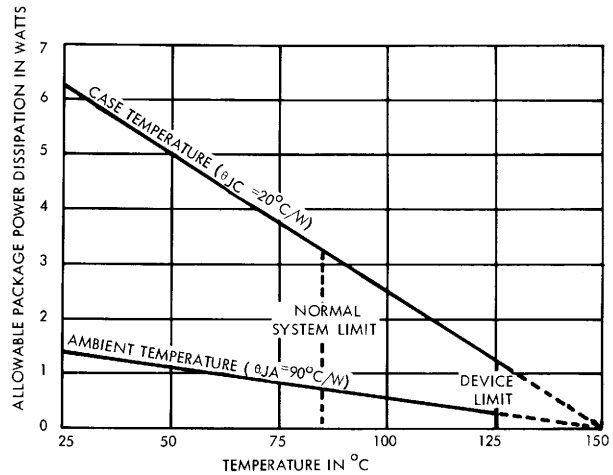
These quad Darlington switches are supplied in 16-pin glass/metal side-brazed hermetic packages.

## 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

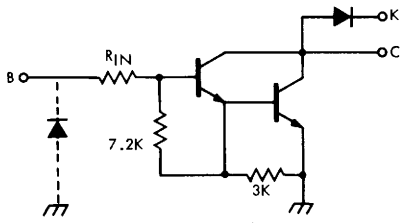
Type Number	$V_{CEX}$ (Max.)	$V_{CE(SUS)}$ (Min.)	$V_{IN}$ (Max.)	Application
ULS-2064H	50 V	35 V	15 V	TTL, DTL, Schottky TTL, and 5 V CMOS
ULS-2065H	80 V	50 V	15 V	
ULS-2066H	50 V	35 V	30 V	6 to 15 V CMOS and PMOS
ULS-2067H	80 V	50 V	30 V	
ULS-2068H	50 V	35 V	15 V	TTL, DTL, Schottky TTL, and 5 V CMOS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

**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.

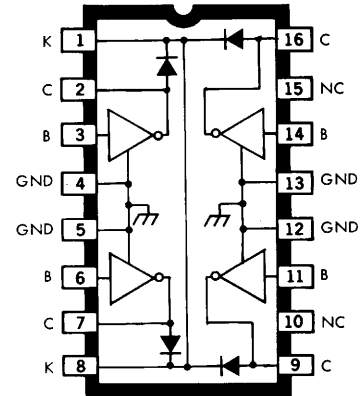
## ULS-2064H THROUGH ULS-2067H

### PARTIAL SCHEMATIC



Dwg. No. A-10,353

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

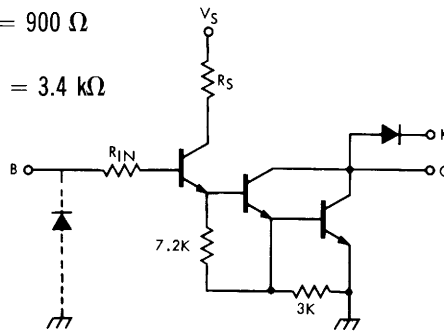


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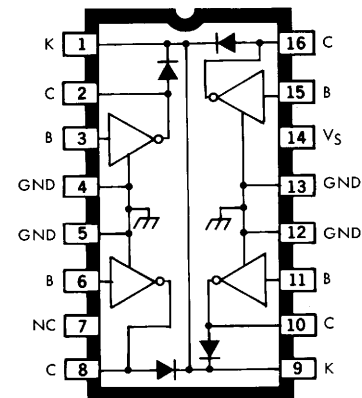
## ULS-2068H THROUGH ULS-2071H

### PARTIAL SCHEMATIC

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



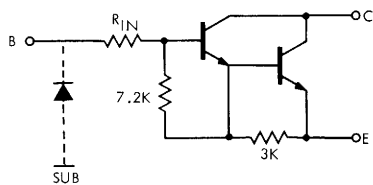
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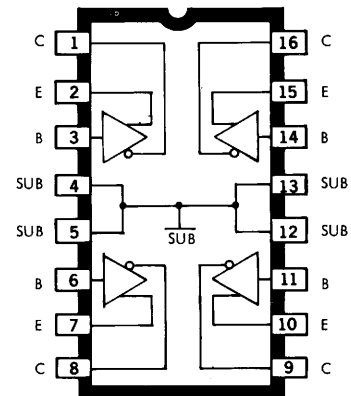
## ULS-2074H THROUGH ULS-2077H

### PARTIAL SCHEMATIC



Dwg. No. A-10,355

ULS-2074H  $R_{IN} = 350 \Omega$   
 ULS-2075H  
 ULS-2076H  $R_{IN} = 3 \text{ k}\Omega$   
 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	$\mu\text{A}$
		ULS-2065/67H		$V_{CE} = 80\text{ V}$	1	—	500	$\mu\text{A}$
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	$\mu\text{s}$
Turn-Off Delay	$t_{pLH}$	All	+25°C		9	—	1.5	$\mu\text{s}$
Clamp Diode Leakage Current	$I_R$	ULS-2064/66H		$V_R = 50\text{ V}$	6	—	100	$\mu\text{A}$
		ULS-2065/67H		$V_R = 80\text{ V}$	6	—	100	$\mu\text{A}$
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)

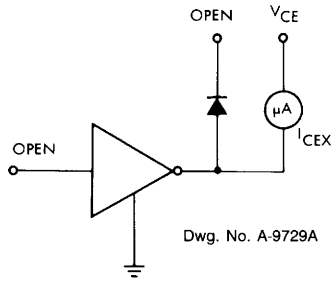
Characteristic	Symbol	Applicable Devices	Test Conditions			Limits					
			Temp.	Electrical Conditions	Fig.	Min.	Max.	Units			
Output Leakage Current	$I_{CEX}$	ULS-2068/70H		$V_{CE} = 50\text{ V}$	1	—	500	$\mu\text{A}$			
		ULS-2069/71H		$V_{CE} = 80\text{ V}$	1	—	500	$\mu\text{A}$			
Output Sustaining 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	$\mu\text{A}$			
			+ 25°C	$V_{IN} = 2.75\text{ V}$	4	—	550	$\mu\text{A}$			
			+ 125°C	$V_{IN} = 2.75\text{ V}$	4	—	850	$\mu\text{A}$			
			+ 125°C	$V_{IN} = 3.75\text{ V}$	4	—	1400	$\mu\text{A}$			
		ULS-2070/71H		$V_{IN} = 5.0\text{ V}$	4	—	400	$\mu\text{A}$			
				$V_{IN} = 12\text{ V}$	4	—	1250	$\mu\text{A}$			
			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	$\mu\text{s}$			
Turn-Off Delay	$t_{PLH}$	All	+ 25°C		9	—	1.5	$\mu\text{s}$			
Clamp Diode Leakage Current	$I_R$	ULS-2068/70H		$V_R = 50\text{ V}$	6	—	100	$\mu\text{A}$			
		ULS-2069/71H		$V_R = 80\text{ V}$	6	—	100	$\mu\text{A}$			
Clamp Diode Forward Voltage	$V_F$	All		$I_F = 1.25\text{ A}$	7	—	2.1	V			

## ULS-2074H THROUGH ULS-2077H

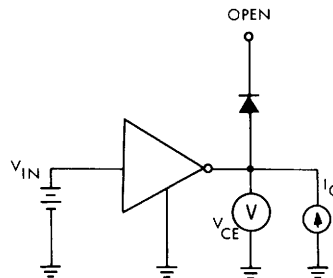
### ELECTRICAL CHARACTERISTICS over operating temperature range (unless otherwise noted)

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	$\mu\text{A}$
		ULS-2075/77H		$V_{CE} = 80\text{ V}$	1	—	500	$\mu\text{A}$
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	$I_C = 500\text{ mA}, I_B = 625\text{ }\mu\text{A}$	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-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	$\mu\text{s}$
Turn-Off Delay	$t_{PLH}$	All	+ 25°C		9	—	1.5	$\mu\text{s}$

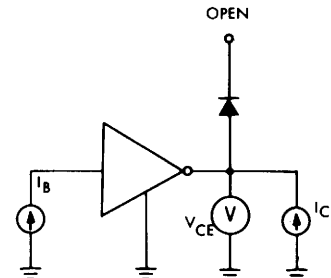
**TEST FIGURES**



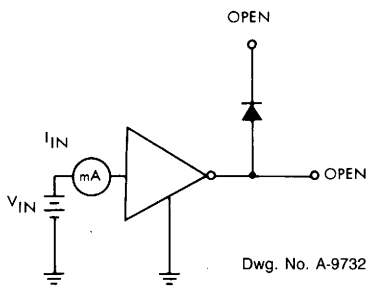
**Figure 1**



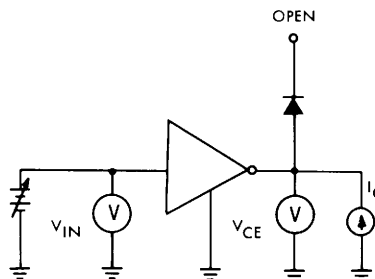
**Figure 2**



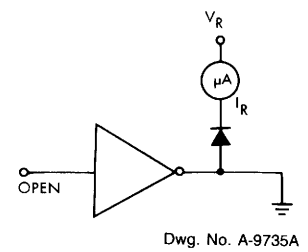
**Figure 3**



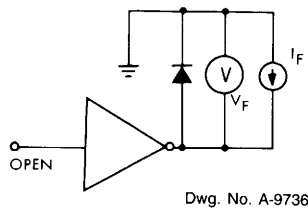
**Figure 4**



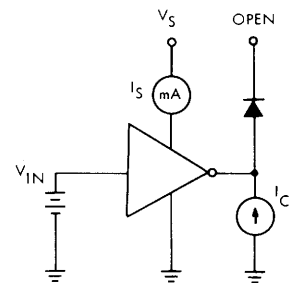
**Figure 5**



**Figure 6**



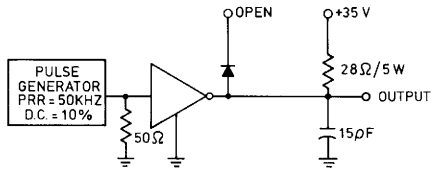
**Figure 7**



**Figure 8**

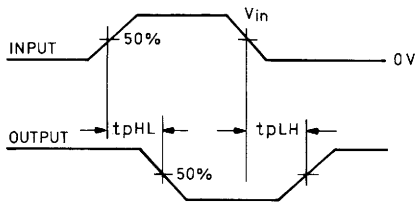
NOTE: Diodes not applicable to Types ULS-2074H through ULS-2077H.

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



Dwg. No. A-13,247

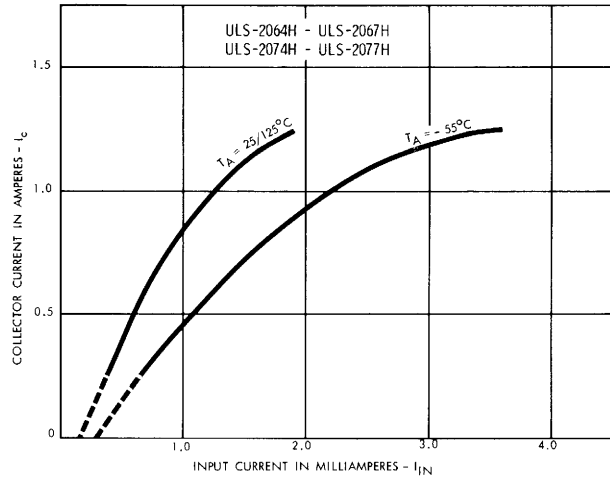
ULS-2064/65/68/69/74/75H  $\frac{V_{in}}{2.4V}$   
 ULS-2066/67/70/71/76/77H  $5.0V$



Dwg. No. A-13,248

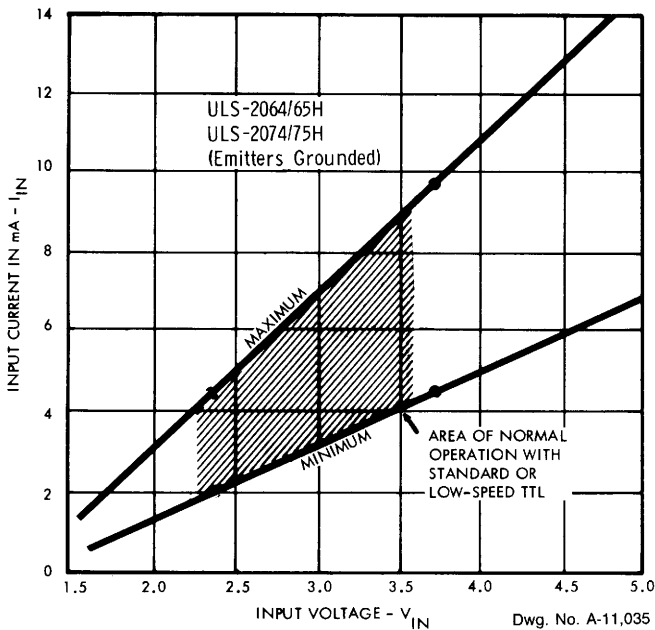
Figure 9

**COLLECTOR CURRENT**  
**AS A FUNCTION OF INPUT CURRENT**

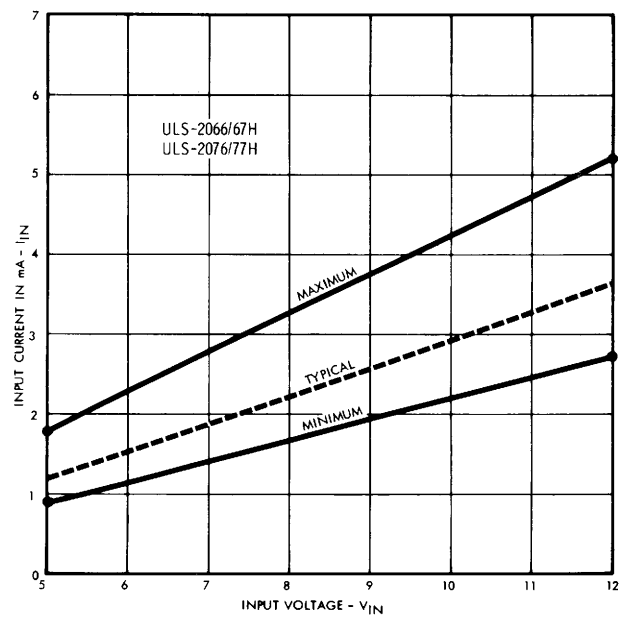


Dwg. No. A-11,030

**INPUT CURRENT AS A FUNCTION OF INPUT VOLTAGE**



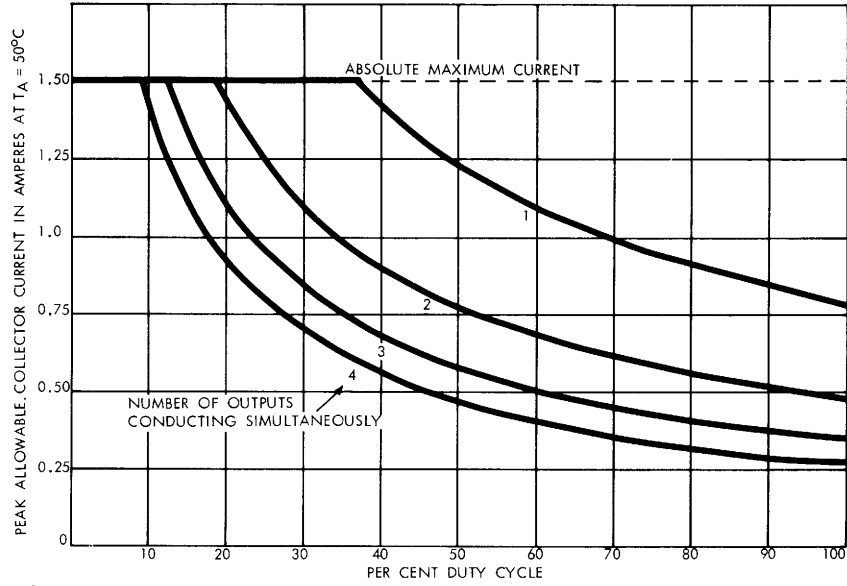
Dwg. No. A-11,035





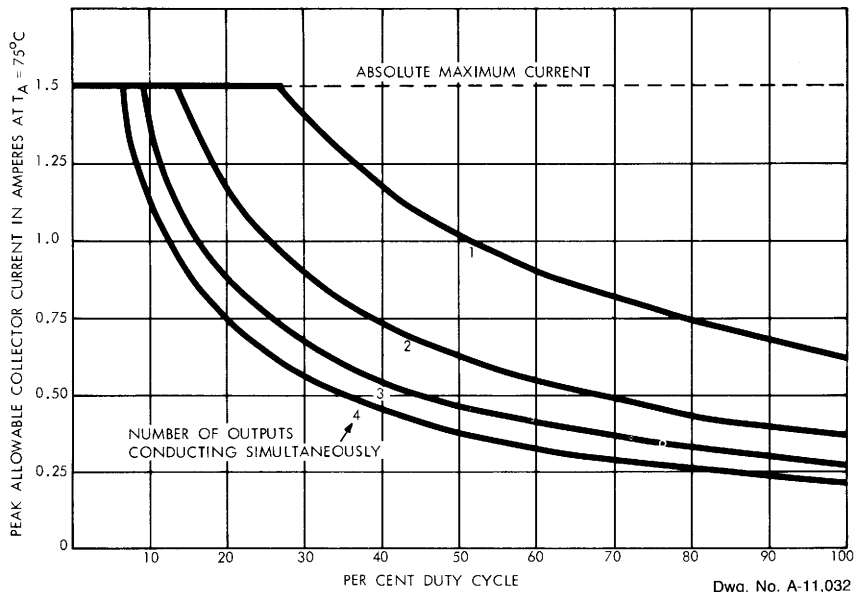
**ALLOWABLE PEAK COLLECTOR CURRENT  
AS A FUNCTION OF DUTY CYCLE**

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



Dwg. No. A-11,031

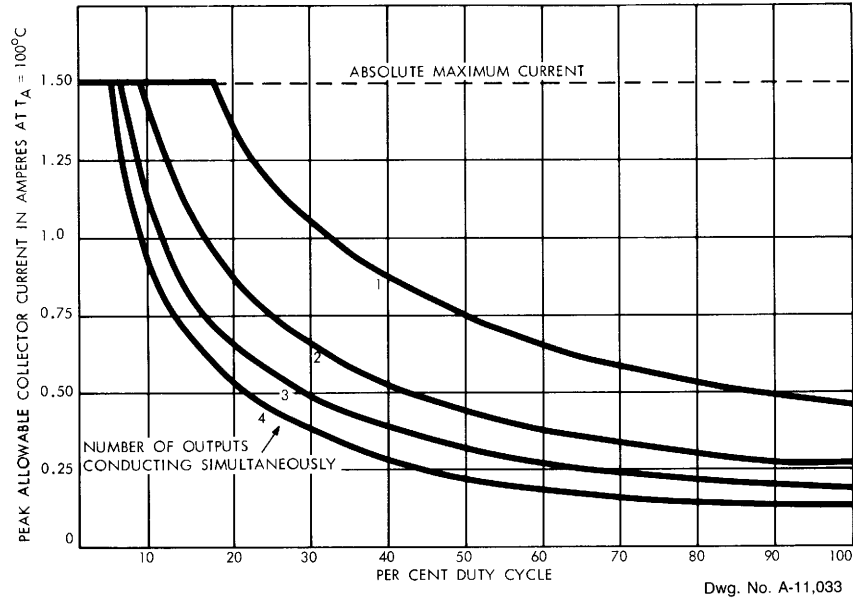
**AT  $T_A = +75^\circ\text{C}$**



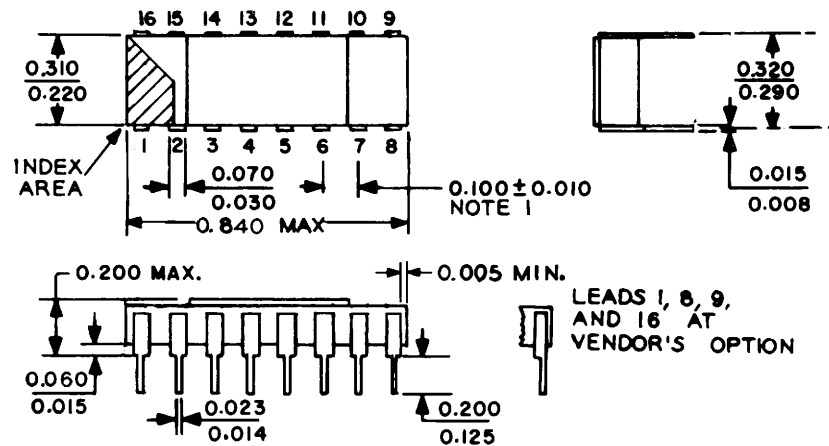
Dwg. No. A-11,032

ALLOWABLE PEAK COLLECTOR CURRENT  
AS A FUNCTION OF DUTY CYCLE

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



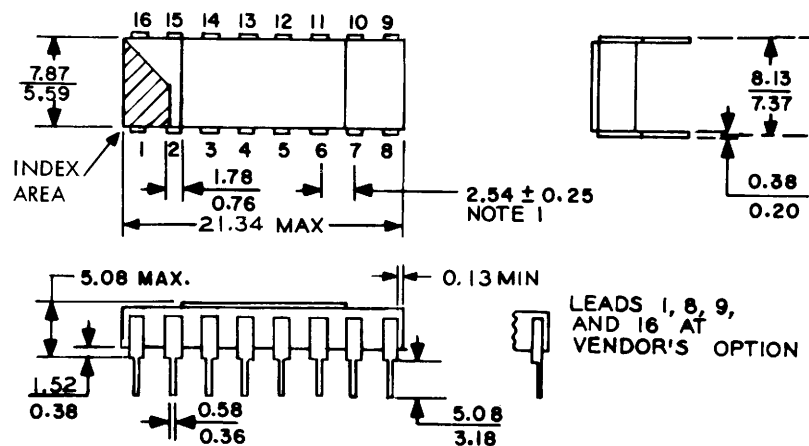
DIMENSIONS IN INCHES



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.

**SALES OFFICES**

**UNITED STATES**

**ALABAMA**

**EPI Inc.**  
Suite 13 — 9694 Hwy. 20 W  
Madison 35758  
Tel. 205/461-7000

**Electramark Inc.**

Suite 21  
3322 South Memorial Parkway  
Huntsville 35801  
Tel. 205/883-9948

**ARIZONA**

**Sprague Electric Company**  
Suite 209 — 1819 S. Dobson Rd.  
Mesa 85202 — 0590  
Tel. 602/244-0154  
Tel. 602/831-6762

**Sprague Electric Company**

Suite 601  
1150 E. Pennsylvania Street  
Tucson 85714 — 1640  
Tel. 602/746-0955

**CALIFORNIA (Metro. L.A.)**

**Sprague Electric Company**  
Suite 150 — 3100 S. Harbor Blvd.  
Santa Ana 92704  
Tel. 714/549-9913

**Sprague Electric Company**

Suite 459  
15350 Sherman Way  
Van Nuys 91406  
Tel. 818/994-6500

**Sprague Electric Company**

Suite 126  
4300 Stevens Creek Boulevard  
San Jose 95129 — 1249  
Tel. 408/241-7111

**(Northern)**

**William J. Purdy Company**  
770 Airport Blvd.  
Burlingame 94010 — 1927  
Tel. 415/347-7701

**(San Diego)**

**Miner Associates, Inc.**  
Suite 117 — 10721 Treena Street  
San Diego 92131 — 1009  
Tel. 619/566-9891

**COLORADO**

**William J. Purdy Company**  
5570 E. Yale Ave.  
Denver 80222 — 6907  
Tel. 303/753-6800

**Todd & Fry Associates**

P.O. Box 1689  
Longmont 80502 — 1689  
Tel. 303/776-7331

**CONNECTICUT**

**Sprague Electric Company**  
88 Main Street South  
Southbury 06488  
Tel. 203/264-9595

**Sprague Electric Company**

120 Hartford Turnpike South  
P.O. Box 578  
Wallingford 06492 — 0578  
Tel. 203/284-8300

**Data Mark Inc.**

47 Clapboard Hill Road  
Guilford 06437 — 2261  
Tel. 203/453-0575

**DIST. OF COLUMBIA**

**Sprague Electric Company**  
Suite 311  
14333 Laurel-Bowie Road  
Laurel, MD 20708 — 1130  
Tel. 301/953-1717

**Trinkle Sales Inc.**  
P.O. Box 5320  
Cherry Hill, NJ 08034 — 0460  
Tel. 609/795-4200

**FLORIDA**

**Sprague Electric Company**  
P.O. Box 1410  
Altamonte Springs 32715 — 1410  
Tel. 305/831-3636

**Sprague Electric Company**  
Suite 419 — 1500 N.W. 62nd Street  
Ft. Lauderdale 33309 — 1802  
Tel. 305/491-7411

**Sprague Electric Company**  
Suite T, Building 501  
8001 North Dale Mabry  
Tampa 33614 — 3265  
Tel. 813/935-8203

**GEORGIA**

**Electramark Inc.**  
6030 — I Unity Drive  
Norcross 30071 — 3583  
Tel. 404/446-7915

**Electronic Marketing Associates**  
Suite 101  
6695 Peachtree Industrial Blvd.  
Atlanta 30360 — 2116  
Tel. 404/448-1215

**ILLINOIS (Northern)**

**Sprague Electric Company**  
Suite 410 — 1480 Renaissance Dr.  
Park Ridge 60068 — 1386  
Tel. 312/296-6620

**(Southern)**

**EPI Inc.**  
Suite 201 — 103 W. Lockwood  
St. Louis, MO 63119 — 2915  
Tel. 314/962-1411

**INDIANA**

**Sprague Electric Company**  
Suite 290 — 8200 Haverstick Road  
Indianapolis 46240  
Tel. 317/253-4247

**IOWA**

**J. R. Sales Engineering, Inc.**  
1930 St. Andrews, N. E.  
Cedar Rapids 52402  
Tel. 319/393-2232

**KANSAS**

**EPI Inc.**  
Suite 201 — 103 W. Lockwood  
St. Louis, MO 63119 — 2915  
Tel. 314/962-1411

**MARYLAND**

**Sprague Electric Company**  
Suite 311  
14333 Laurel-Bowie Road  
Laurel 20708 — 1130  
Tel. 301/792-4890

**Trinkle Sales Inc.**  
P.O. Box 5320  
Cherry Hill, NJ 08034 — 0460  
Tel. 609/795-4200

**MASSACHUSETTS**

**Sprague Electric Company**  
10 Burr St.  
Framingham 01701 — 4617  
Tel. 617/875-3200

**Ray Perron & Co., Inc.**  
P.O. Box 389  
Needham 02192 — 0009  
Tel. 617/449-6162

**MICHIGAN**

**Sprague Electric Company**  
Suite 301 — 2155 Jackson Road  
Ann Arbor 48103 — 3917  
Tel. 313/761-2014

**MINNESOTA**

**HMR, Inc.**  
9065 Lyndale Ave. South  
Minneapolis 55420 — 3520  
Tel. 612/888-2122

**MISSISSIPPI**

**EPI Inc.**  
Suite 64  
3322 South Memorial Pkwy  
Huntsville, AL 35801 — 5335  
Tel. 205/883-0520

**MISSOURI**

**EPI Inc.**  
Suite 201 — 103 W. Lockwood  
St. Louis 63119 — 2915  
Tel. 314/962-1411

**NEBRASKA**

**J. R. Sales Engineering, Inc.**  
1930 St. Andrews, N. E.  
Cedar Rapids, Iowa 52402  
Tel. 319/393-2232

**NEW HAMPSHIRE**

**Ray Perron & Co., Inc.**  
1 Elm St.  
Dover 03820 — 3910  
Tel. 603/742-2321

**NEW JERSEY (Northern)**

**Sprague Electric Company**  
P.O. Box 1612  
Wayne 07470 — 0701  
Tel. 201/696-8200

**(Southern)**

**Trinkle Sales Inc.**  
P.O. Box 5320  
Cherry Hill 08034 — 0460  
Tel. 609/795-4200

**NEW MEXICO**

**William J. Purdy Company**  
120 LaVeta Drive NE  
Albuquerque 87108 — 1613  
Tel. 505/266-7959

**NEW YORK (Downstate)**

**Sprague Electric Company**  
2001 Palmer Ave.  
Larchmont 10538 — 2420  
Tel. 914/834-4439

**(Long Island)**

**Sprague Electric Company**  
P.O. Box 541  
Central Islip 11722 — 0541  
Tel. 516/234-8700

**(Upstate)**

**Sprague Electric Company**  
2002 Teal Ave.  
Syracuse 13206 — 1542  
Tel. 315/437-7311

**Paston-Hunter Co., Inc.**

2002 Teal Ave.  
Syracuse 13206 — 1596  
Tel. 315/437-2843

**NORTH CAROLINA**

**Sprague Electric Company**  
9741-M Southern Pine Blvd.  
Charlotte 28210 — 5560  
Tel. 704/527-1306

**Electronic Marketing Associates**

9225 Honeycutt Creek Rd.  
Raleigh 27609 — 1523  
Tel. 919/847-8800

**OHIO**

**Sprague Electric Company**  
Suite 330 — 555 Metro Place North  
Dublin 43017 — 1375  
Tel. 614/761-1881

**OREGON**

**Sprague Electric Company**  
Suite H  
16111 S.E. McGillivray Boulevard  
Vancouver, WA 98664 — 9025  
Tel. 503/225-0493  
Tel. 206/892-0361

**OREGON (continued)**

**William J. Purdy Company**  
7799 Southwest Cirrus Drive  
Beaverton 97005 — 5945  
Tel. 503/641-9373

**PENNSYLVANIA**

**Trinkle Sales Inc.**  
P.O. Box 5320  
Cherry Hill, NJ 08034 — 0460  
Tel. Phila. 215/922-2080

**SOUTH CAROLINA**

**Electronic Marketing Associates**  
210 W. Stone Ave.  
Greenville 29609 — 5499  
Tel. 803/233-4637

**TENNESSEE (Eastern)**

**Electronic Marketing Associates**  
9225 Honeycutt Creek Road  
Raleigh, NC 27609 — 1523  
Tel. 919/847-8800

**(Western)**

**EPI Inc.**  
Suite 13 — 9694 Hwy. 20 W  
Madison, AL 35758  
Tel. 205/461-7000

**TEXAS**

**Sprague Electric Company**  
Suite 220  
9319 LBJ Freeway  
Dallas 75243 — 3403  
Tel. 214/235-1256

**Sprague Electric Company**  
Suite 350W — 1106 Clayton Lane  
Austin 78723 — 1033  
Tel. 512/458-2514

**UTAH**

**William J. Purdy Company**  
5570 E. Yale Avenue  
Denver, CO 80222 — 6907  
Tel. 303/753-6800

**VIRGINIA**

**Sprague Electric Company**  
1 East Preston St.  
Lexington 24450 — 2324  
Tel. 703/463-9161

**Sprague Electric Company**

Suite 311  
14333 Laurel-Bowie Road  
Laurel, MD 20708 — 1130  
Tel. 301/953-1717

**Trinkle Sales Inc.**

P.O. Box 5320  
Cherry Hill, NJ 08034 — 0460  
Tel. 609/795-4200

**WASHINGTON**

**Sprague Electric Company**  
3826 Woodland Park, North  
Seattle 98103 — 7996  
Tel. 206/632-7761

**Sprague Electric Company**

Suite H  
16111 S.E. McGillivray Blvd.  
Vancouver 98664  
Tel. 206/892-0361  
Tel. 503/225-0493

**William J. Purdy Company**

4082-148th Ave. N.E.  
Redmond 98052 — 5165  
Tel. 206/882-3144

**WISCONSIN**

**D. Dolin Sales**  
131 West Layton Ave.  
Milwaukee 53207 — 5991  
Tel. 414/482-1111

**CANADA**

**Sprague Electric of Canada, Ltd.**

Suite 220  
2375 Steeles Avenue, W  
Downsview, Ontario M3J 3A8  
Tel. 416/665-6066

**CANADA (continued)**

**Sprague Electric of Canada, Ltd.**  
Suite 1610 — 85 Albert St.  
Ottawa, Ont. K1P 6A4  
Tel. 613/238-2542

**Lenbrook Electronics**

Suite No. 2  
13696 104th Ave  
Surrey, B.C. V3T1W4  
Tel. 604/585-9599

**EUROPE**

**Sprague World Trade Corp.**  
18 Avenue Louis Casar  
1209 Geneva  
Switzerland  
Tel. 98-4021  
TLX 845-23469

**Sprague Benelux**

Excelsiorlaan 21  
Bus 3  
1930 Zaventem  
Belgium  
Tel. 02/721 48 60  
TLX 62897

**Sprague Electric (U.K.) Ltd.**

Airtech No. 2  
Fleming Way  
Crawley West Sussex RH 102 YQ  
England  
Tel. 293-51-78-78  
TLX 877813

**Sprague France S.A.R.L.**

3 Rue Camille Desmoulins  
9430 Cachan  
France  
Tel. (1) 547-6600  
TLX 250697

**Sprague Elektronik GmbH**

Postfach 700 848  
D 6 Frankfurt/M  
West Germany  
Tel. 069-60551  
TLX 414008

**Sprague Italiana S.p.A.**

Via G. DeCastro 4  
20144 Milano  
Italy  
Tel. 02-498-7891  
TLX 332321

**Sprague Scandinavia AB**

Box 54  
S-182 71 Stocksund  
Sweden  
Tel. (04) 08-8502 20  
TLX 854 15239

**FAR EAST**

**Sprague World Trade Corp.**

Eastern Branch  
G.P.O. Box 4289  
Hong Kong  
Tel. 0-283188  
TLX 43395

**Sprague Japan K.K.**

Shinjuku KB Bldg.  
11-3, Nishi-Shinjuku 6-Chome  
Shinjuku-ku, Tokyo 160  
Japan  
Tel. (03) 348-5221  
TLX J23328

**Tecnomic Ltd.**

Sprague Korea Branch  
4th Fl., Daiyong Bldg.,  
44-1, Yoido-Dong  
Youngdungpo-Ku, Seoul, Korea  
Tel. (2) 783-9784  
TLX 78726186

**Sprague World Trade Corp.**

Singapore Office  
11th Floor, 450/452 Inchoape House  
Alexandra Road  
Singapore 0511  
Tel. 475-1826  
TLX RS 26384

**Sprague Taiwan Branch/  
Tecnomic, Ltd.**

8/F, 142, Sec. 4  
Chung Hsiao East Road  
Taipei, Taiwan, R.O.C.  
Tel. 771-9582  
TLX 21422

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