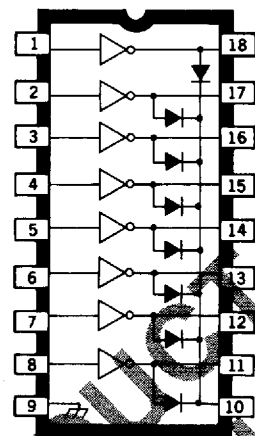
SPRAGUE
THE MARK OF RELIABILITY

SERIES ULS-2800H AND ULS-2800R HIGH-VOLTAGE, HIGH-CURRENT DARLINGTON ARRAYS

MIL-STD-883 Compliant

FEATURES

- TTL, DTL, PMOS, or CMOS Compatible Inputs
- Peak Output Current to 600 mA
- Transient-Protected Outputs
- Side-Brazed Hermetic Package
- Cer-DIP Hermetic Package
- High-Reliability Screening to MIL-STD-883, Class B
- −55°C to +125°C Temperature Range



Dwg. No. A-10,322

DESIGNED TO SERVE as interface between low-level logic circuitry and high-power loads, Series ULS-2800H and ULS-2800R arrays consist of eight silicon NPN Darlington power drivers on a common monolithic substrate. They are ideally suited to driving relays, solenoids, lamps, and other devices in high-reliability military or aerospace applications with up to 3 A output current per package.

These devices are screened to MIL-STD-883, Class B and are supplied in either the popular glass/metal side-brazed 18-pin hermetic package (suffix 'H') or ceramic/glass cer-DIP hermetic package (suffix 'R'). Both package styles conform to the dimensional requirements of MIL-M-38510 and are rated for operation over the full military temperature range of −55°C to +125°C. Reverse-bias burn-in and 100% high-reliability screening are standard.

The 30 integrated circuits described in this bulletin permit the circuit designer to select the optimal device for any application. In addition to the two package styles, there are five input characteristics, two output-voltage ratings, and two output-current ratings. The appropriate part for specific applications can be determined from the Device Part Number Designation chart. All units have open-collector outputs and on-chip diodes for inductive-load transient suppression.

Device Part Number Designation

$V_{CE(MAX)}$	50 V	50 V	95 V
$I_{C(MAX)}$	500 mA	600 mA	500 mA
Logic	Part Number		
General Purpose PMOS, CMOS	ULS-2801*	ULS-2811*	ULS-2821*
14-25 V PMOS	ULS-2802*	ULS-2812*	ULS-2822*
5 V TTL, CMOS	ULS-2803*	ULS-2813*	ULS-2823*
6-15 V CMOS, PMOS	ULS-2804*	ULS-2814*	ULS-2824*
High-Output TTL	ULS-2805*	ULS-2815*	ULS-2825*

*Complete part number includes a final letter to indicate package (H = glass/metal side-brazed, R = ceramic/glass cer-DIP)

ABSOLUTE MAXIMUM RATINGS

Output Voltage, V_{CE}
- (ULS-280X*, ULS-281X*) .... 50 V
- (ULS-282X*) .... 95 V

Input Voltage, V_{IN}
- (ULS-28X2, X3, X4*) .... 30 V
- (ULS-28X5*) .... 15 V

Peak Output Current, I_{OUT}
- (ULS-280X*, ULS-282X*) .... 500 mA
- (ULS-281X*) .... 600 mA

Ground Terminal Current, I_{GND} .... 3.0 A

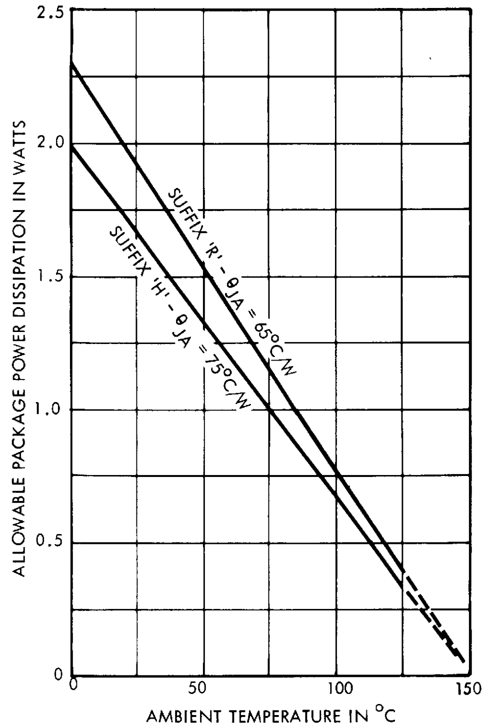
Continuous Input Current, I_{IN} .... 25 mA

Power Dissipation, P_D
- (one Darlington pair) .... 1.0 W
- (total package) .... See Graph

Operating Temperature Range, T_A .... −55°C to +125°C

Storage Temperature Range, T_S .... −65°C to +150°C

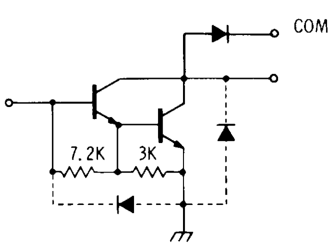
ALLOWABLE PACKAGE POWER DISSIPATION



Dwg. No. A-10,879A

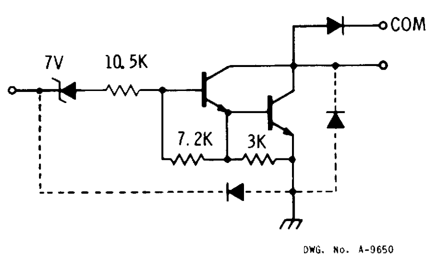
PARTIAL SCHEMATICS

ULS-28X1*
(Each Driver)



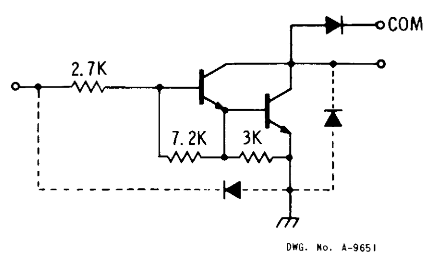
Dwg. No. A-9595

ULS-28X2*
(Each Driver)



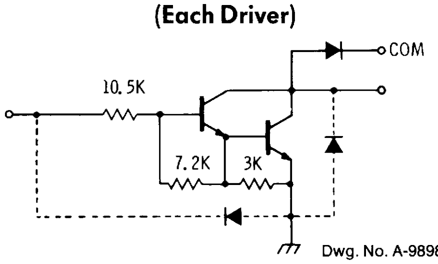
Dwg. No. A-9650

ULS-28X3*
(Each Driver)



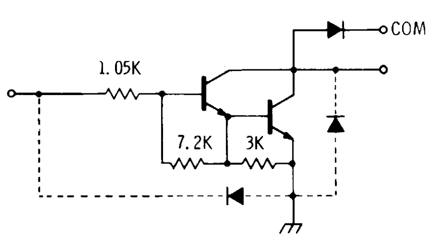
Dwg. No. A-9651

ULS-28X4*
(Each Driver)



Dwg. No. A-9898A

ULS-28X5*
(Each Driver)



Dwg. No. A-10,228

**Complete part number includes a final letter to indicate package (H = glass/metal side-brazed, R = ceramic/glass cer-DIP).*
X = digit to identify specific device. Specification or limit shown applies to family of devices with remaining digits as shown.

SERIES ULS-2800H AND ULS-2800R

ELECTRICAL CHARACTERISTICS over operating temperature range (unless otherwise noted)

Characteristic	Symbol	Applicable Devices	Test Conditions			Limits			
			Temp.	Voltage/Current	Fig.	Min.	Typ.	Max.	Units
Output Leakage Current	I_{CEX}	All		$V_{CE} = 50$ V	1A	—	—	100	µA
		ULS-2802*		$V_{CE} = 50$ V, $V_{IN} = 6$ V	1B	—	—	500	µA
		ULS-2804*		$V_{CE} = 50$ V, $V_{IN} = 1$ V	1B	—	—	500	µA
Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	All	−55°C	$I_C = 350$ mA, $I_B = 850$ µA	2	—	1.6	1.8	V
				$I_C = 200$ mA, $I_B = 550$ µA	2	—	1.3	1.5	V
				$I_C = 100$ mA, $I_B = 350$ µA	2	—	1.1	1.3	V
			+25°C	$I_C = 350$ mA, $I_B = 500$ µA	2	—	1.25	1.6	V
				$I_C = 200$ mA, $I_B = 350$ µA	2	—	1.1	1.3	V
				$I_C = 100$ mA, $I_B = 250$ µA	2	—	0.9	1.1	V
			+125°C	$I_C = 350$ mA†, $I_B = 500$ µA	2	—	1.6	1.8	V
				$I_C = 200$ mA, $I_B = 350$ µA	2	—	1.3	1.5	V
				$I_C = 100$ mA, $I_B = 250$ µA	2	—	1.1	1.3	V
Input Current	$I_{IN(ON)}$	ULS-2802*		$V_{IN} = 17$ V	3	480	850	1300	µA
		ULS-2803*		$V_{IN} = 3.85$ V	3	650	930	1350	µA
		ULS-2804*		$V_{IN} = 5.0$ V	3	240	350	500	µA
				$V_{IN} = 12$ V	3	650	1000	1450	µA
		ULS-2805*		$V_{IN} = 3.0$ V	3	—	1500	2400	µA
	$I_{IN(OFF)}$	All	+125°C	$I_C = 500$ µA	4	25	50	—	µA
Input Voltage	$V_{IN(ON)}$	ULS-2802*	−55°C	$V_{CE} = 2.0$ V, $I_C = 300$ mA	5	—	—	18	V
			+125°C	$V_{CE} = 2.0$ V, $I_C = 300$ mA	5	—	—	13	V
		ULS-2803*	−55°C	$V_{CE} = 2.0$ V, $I_C = 200$ mA	5	—	—	3.3	V
				$V_{CE} = 2.0$ V, $I_C = 250$ mA	5	—	—	3.6	V
				$V_{CE} = 2.0$ V, $I_C = 300$ mA	5	—	—	3.9	V
			+125°C	$V_{CE} = 2.0$ V, $I_C = 200$ mA†	5	—	—	2.4	V
				$V_{CE} = 2.0$ V, $I_C = 250$ mA†	5	—	—	2.7	V
				$V_{CE} = 2.0$ V, $I_C = 300$ mA†	5	—	—	3.0	V
		ULS-2804*	−55°C	$V_{CE} = 2.0$ V, $I_C = 125$ mA	5	—	—	6.0	V
				$V_{CE} = 2.0$ V, $I_C = 200$ mA	5	—	—	8.0	V
				$V_{CE} = 2.0$ V, $I_C = 275$ mA	5	—	—	10	V
				$V_{CE} = 2.0$ V, $I_C = 350$ mA	5	—	—	12	V
			+125°C	$V_{CE} = 2.0$ V, $I_C = 125$ mA	5	—	—	5.0	V
				$V_{CE} = 2.0$ V, $I_C = 200$ mA†	5	—	—	6.0	V
				$V_{CE} = 2.0$ V, $I_C = 275$ mA†	5	—	—	7.0	V
				$V_{CE} = 2.0$ V, $I_C = 350$ mA†	5	—	—	8.0	V
		ULS-2805*	−55°C	$V_{CE} = 2.0$ V, $I_C = 350$ mA	5	—	—	3.0	V
			+125°C	$V_{CE} = 2.0$ V, $I_C = 350$ mA†	5	—	—	2.4	V
D-C Forward Current Transfer Ratio	h_{FE}	ULS2801*	−55°C	$V_{CE} = 2.0$ V, $I_C = 350$ mA	2	500	—	—	—
			+25°C	$V_{CE} = 2.0$ V, $I_C = 350$ mA	2	1000	—	—	—
Turn-On Delay	t_{PLH}	All	+25°C		8	—	250	1000	ns
Turn-Off Delay	t_{PHL}	All	+25°C		8	—	250	1000	ns
Clamp Diode Leakage Current	I_R	All		$V_R = 50$ V	6	—	—	50	µA
Clamp Diode Forward Voltage	V_f	All		$I_F = 350$ mA†	7	—	1.7	2.0	V

*Complete part number includes a final letter to indicate package (H = glass/metal side-brazed, R = ceramic/glass cer-DIP).
Note 1: All limits stated apply to the complete Darlington series except as specified for a single device type.
Note 2: The $I_{IN(OFF)}$ current limit guarantees against partial turn-on of the output.
Note 3: The $V_{IN(ON)}$ voltage limit guarantees a minimum output sink current per the specified test conditions.
†Pulse Test, $t_p \leq 1$ µs, see graph.

SERIES ULS-2810H AND ULS-2810R

ELECTRICAL CHARACTERISTICS over operating temperature range (unless otherwise noted)

Characteristic	Symbol	Applicable Devices	Test Conditions			Limits			
			Temp.	Voltage/Current	Fig.	Min.	Typ.	Max.	Units
Output Leakage Current	I_{CEX}	All		$V_{CE} = 50$ V	1A	—	—	100	μA
		ULS-2812*		$V_{CE} = 50$ V, $V_{IN} = 6$ V	1B	—	—	500	μA
		ULS-2814*		$V_{CE} = 50$ V, $V_{IN} = 1$ V	1B	—	—	500	μA
Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	All	−55°C	$I_C = 500$ mA, $I_B = 1100$ μA	2	—	1.8	2.1	V
				$I_C = 350$ mA, $I_B = 850$ μA	2	—	1.6	1.8	V
				$I_C = 200$ mA, $I_B = 550$ μA	2	—	1.3	1.5	V
			+25°C	$I_C = 500$ mA, $I_B = 600$ μA	2	—	1.7	1.9	V
				$I_C = 350$ mA, $I_B = 500$ μA	2	—	1.25	1.6	V
				$I_C = 200$ mA, $I_B = 350$ μA	2	—	1.1	1.3	V
			+125°C	$I_C = 500$ mA†, $I_B = 600$ μA	2	—	1.8	2.1	V
				$I_C = 350$ mA†, $I_B = 500$ μA	2	—	1.6	1.8	V
				$I_C = 200$ mA, $I_B = 350$ μA	2	—	1.3	1.5	V
Input Current	$I_{IN(ON)}$	ULS-2812*		$V_{IN} = 17$ V	3	480	850	1300	μA
		ULS-2813*		$V_{IN} = 3.85$ V	3	650	930	1350	μA
		ULS-2814*		$V_{IN} = 5.0$ V	3	240	350	500	μA
				$V_{IN} = 12$ V	3	650	1000	1450	μA
		ULS-2815*		$V_{IN} = 3.0$ V	3	—	1500	2400	μA
	$I_{IN(OFF)}$	All	+125°C	$I_C = 500$ μA	4	25	50	—	μA
Input Voltage	$V_{IN(ON)}$	ULS-2812*	−55°C	$V_{CE} = 2.0$ V, $I_C = 500$ mA	5	—	—	23.5	V
			+125°C	$V_{CE} = 2.0$ V, $I_C = 500$ mA	5	—	—	17	V
		ULS-2013*	−55°C	$V_{CE} = 2.0$ V, $I_C = 250$ mA	5	—	—	3.6	V
				$V_{CE} = 2.0$ V, $I_C = 300$ mA	5	—	—	3.9	V
				$V_{CE} = 2.0$ V, $I_C = 500$ mA	5	—	—	6.0	V
			+125°C	$V_{CE} = 2.0$ V, $I_C = 250$ mA†	5	—	—	2.7	V
				$V_{CE} = 2.0$ V, $I_C = 300$ mA†	5	—	—	3.0	V
				$V_{CE} = 2.0$ V, $I_C = 500$ mA†	5	—	—	3.5	V
		ULS-2814*	−55°C	$V_{CE} = 2.0$ V, $I_C = 275$ mA	5	—	—	10	V
				$V_{CE} = 2.0$ V, $I_C = 350$ mA	5	—	—	12	V
				$V_{CE} = 2.0$ V, $I_C = 500$ mA	5	—	—	17	V
			+125°C	$V_{CE} = 2.0$ V, $I_C = 275$ mA†	5	—	—	7.0	V
				$V_{CE} = 2.0$ V, $I_C = 350$ mA†	5	—	—	8.0	V
				$V_{CE} = 2.0$ V, $I_C = 500$ mA†	5	—	—	9.5	V
		ULS-2815*	−55°C	$V_{CE} = 2.0$ V, $I_C = 350$ mA	5	—	—	3.0	V
				$V_{CE} = 2.0$ V, $I_C = 500$ mA	5	—	—	3.5	V
			+125°C	$V_{CE} = 2.0$ V, $I_C = 350$ mA†	5	—	—	2.4	V
				$V_{CE} = 2.0$ V, $I_C = 500$ mA†	5	—	—	2.6	V
D-C Forward Current Transfer Ratio	h_{FE}	ULS-2811*	−55°C	$V_{CE} = 2.0$ V, $I_C = 500$ mA	2	450	—	—	—
			+25°C	$V_{CE} = 2.0$ V, $I_C = 500$ mA	2	900	—	—	—
Turn-On Delay	t_{PLH}	All	+25°C		8	—	250	1000	ns
Turn-Off Delay	t_{PHL}	All	+25°C		8	—	250	1000	ns
Clamp Diode Leakage Current	I_R	All		$V_R = 50$ V	6	—	—	50	μA
Clamp Diode Forward Voltage	V_f	All		$I_F = 350$ mA†	7	—	1.7	2.0	V
				$I_F = 500$ mA†	7	—	—	2.5	V

*Complete part number includes a final letter to indicate package (H = glass/metal side-brazed, R = ceramic/glass cer-DIP).
Note 1: All limits stated apply to the complete Darlington series except as specified for a single device type.
Note 2: The $I_{IN(OFF)}$ current limit guarantees against partial turn-on of the output.
Note 3: The $V_{IN(ON)}$ voltage limit guarantees a minimum output sink current per the specified test conditions.
†Pulse Test, $t_p \leq 1$ μs, see graph.

SERIES ULS-2820H AND ULS-2820R

ELECTRICAL CHARACTERISTICS over operating temperature range (unless otherwise noted)

Characteristic	Symbol	Applicable Devices	Test Conditions: Temp.	Test Conditions: Voltage/Current	Fig.	Limits: Min.	Limits: Typ.	Limits: Max.	Units
Output Leakage Current	I_{CEX}	All		V_{CE} = 95 V	1A	—	—	100	μA
		ULS-2822*		V_{CE} = 95 V, V_{IN} = 6 V	1B	—	—	500	μA
		ULS-2824*	25°C	V_{CE} = 95 V, V_{IN} = 1 V	1B	—	—	500	μA
			+125°C	V_{CE} = 95 V, V_{IN} = 0.5 V	1B	—	—	500	μA
Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	All	−55°C	I_C = 350 mA, I_B = 850 μA	2	—	1.6	1.8	V
				I_C = 200 mA, I_B = 550 μA	2	—	1.3	1.5	V
				I_C = 100 mA, I_B = 350 μA	2	—	1.1	1.3	V
			+25°C	I_C = 350 mA, I_B = 500 μA	2	—	1.25	1.6	V
				I_C = 200 mA, I_B = 350 μA	2	—	1.1	1.3	V
				I_C = 100 mA, I_B = 250 μA	2	—	0.9	1.1	V
			+125°C	I_C = 350 mA†, I_B = 500 μA	2	—	1.6	1.8	V
				I_C = 200 mA, I_B = 350 μA	2	—	1.3	1.5	V
				I_C = 100 mA, I_B = 250 μA	2	—	1.1	1.3	V
Input Current	$I_{IN(ON)}$	ULS-2822*		V_{IN} = 17 V	3	480	850	1300	μA
		ULS-2823*		V_{IN} = 3.85 V	3	650	930	1350	μA
		ULS-2824*		V_{IN} = 5.0 V	3	240	350	500	μA
				V_{IN} = 12 V	3	650	1000	1450	μA
		ULS-2825*		V_{IN} = 3.0 V	3	—	1500	2400	μA
	$I_{IN(OFF)}$	All	+125°C	I_C = 500 μA	4	20	50	—	μA
Input Voltage	$V_{IN(ON)}$	ULS-2822*	−55°C	V_{CE} = 2.0 V, I_C = 300 mA	5	—	—	18	V
			+125°C	V_{CE} = 2.0 V, I_C = 300 mA	5	—	—	13	V
		ULS-2823*	−55°C	V_{CE} = 2.0 V, I_C = 200 mA	5	—	—	3.3	V
				V_{CE} = 2.0 V, I_C = 250 mA	5	—	—	3.6	V
				V_{CE} = 2.0 V, I_C = 300 mA	5	—	—	3.9	V
			+125°C	V_{CE} = 2.0 V, I_C = 200 mA†	5	—	—	2.4	V
				V_{CE} = 2.0 V, I_C = 250 mA†	5	—	—	2.7	V
				V_{CE} = 2.0 V, I_C = 300 mA†	5	—	—	3.0	V
		ULS-2824*	−55°C	V_{CE} = 2.0 V, I_C = 125 mA	5	—	—	6.0	V
				V_{CE} = 2.0 V, I_C = 200 mA	5	—	—	8.0	V
				V_{CE} = 2.0 V, I_C = 275 mA	5	—	—	10	V
				V_{CE} = 2.0 V, I_C = 350 mA	5	—	—	12	V
			+125°C	V_{CE} = 2.0 V, I_C = 125 mA	5	—	—	5.0	V
				V_{CE} = 2.0 V, I_C = 200 mA†	5	—	—	6.0	V
				V_{CE} = 2.0 V, I_C = 275 mA†	5	—	—	7.0	V
				V_{CE} = 2.0 V, I_C = 350 mA†	5	—	—	8.0	V
		ULS-2825*	−55°C	V_{CE} = 2.0 V, I_C = 350 mA	5	—	—	3.0	V
			+125°C	V_{CE} = 2.0 V, I_C = 350 mA†	5	—	—	2.4	V
D-C Forward Current Transfer Ratio	h_{FE}	ULS2821*	−55°C	V_{CE} = 2.0 V, I_C = 350 mA	2	500	—	—	—
			+25°C	V_{CE} = 2.0 V, I_C = 350 mA	2	1000	—	—	—
Turn-On Delay	t_{PLH}	All	+25°C		8	—	250	1000	ns
Turn-Off Delay	t_{PHL}	All	+25°C		8	—	250	1000	ns
Clamp Diode Leakage Current	I_R	All		V_R = 95 V	6	—	—	50	μA
Clamp Diode Forward Voltage	V_f	All		I_F = 350 mA†	7	—	1.7	2.0	V

*Complete part number includes a final letter to indicate package (H = glass/metal side-brazed, R = ceramic/glass cer-DIP).

Note 1: All limits stated apply to the complete Darlington series except as specified for a single device type.

Note 2: The $I_{IN(OFF)}$ current limit guarantees against partial turn-on of the output.

Note 3: The $V_{IN(ON)}$ voltage limit guarantees a minimum output sink current per the specified test conditions.

†Pulse Test, $t_p \leq 1$ μs, see graph.

TEST FIGURES

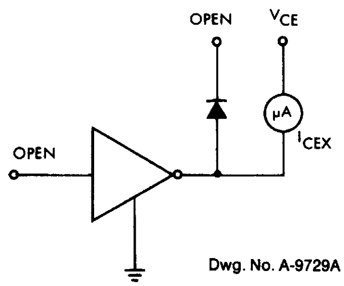


FIGURE 1A

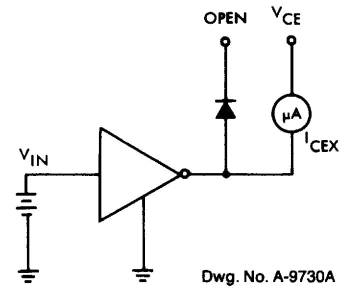


FIGURE 1B

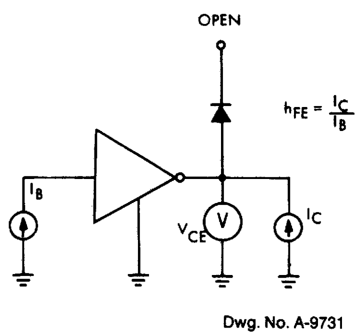


FIGURE 2

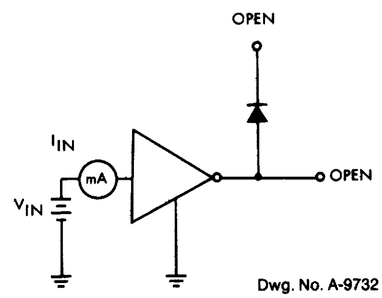


FIGURE 3

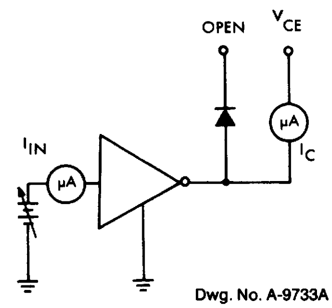


FIGURE 4

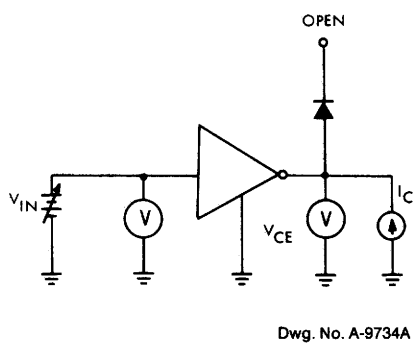


FIGURE 5

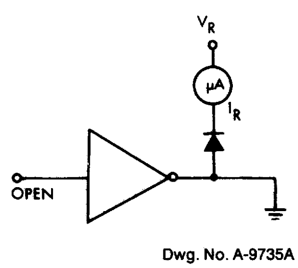


FIGURE 6

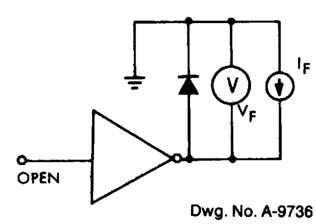
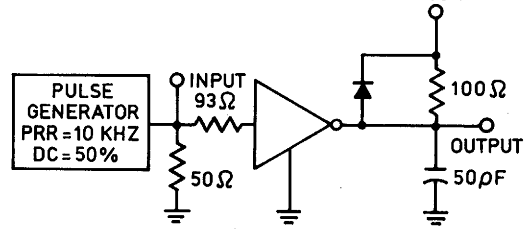
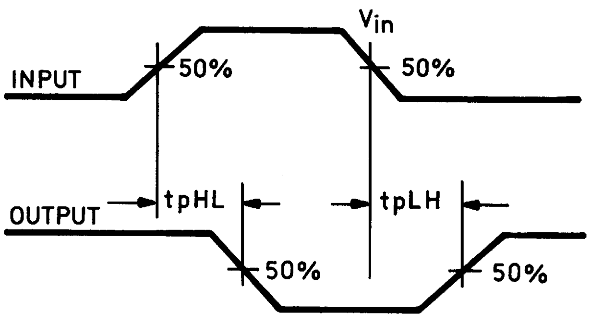


FIGURE 7

	V_{in}
ULS-28X1*	3.5 V
ULS-28X2*	13 V
ULS-28X3*	3.5 V
ULS-28X4*	12 V
ULS-28X5*	3.5 V



Dwg. No. A-13,273

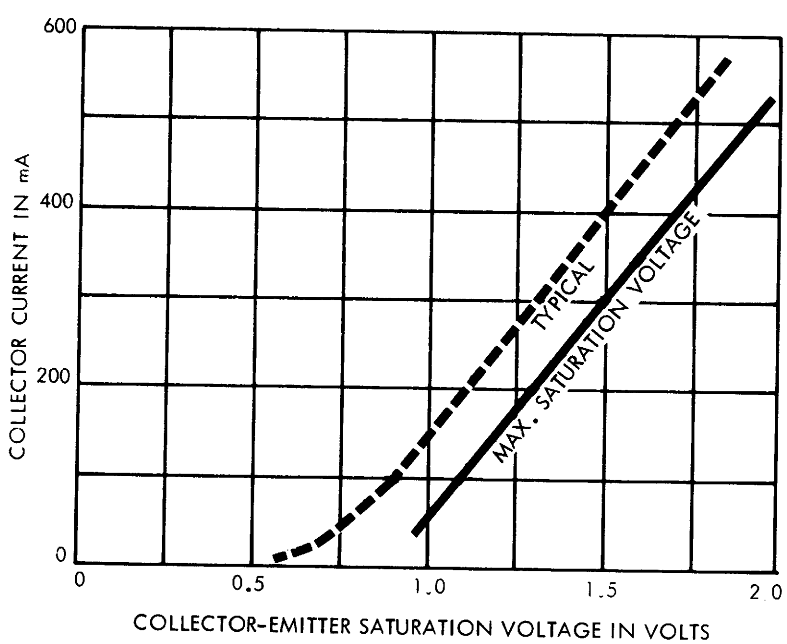


Dwg. No. A-13,272

* 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.

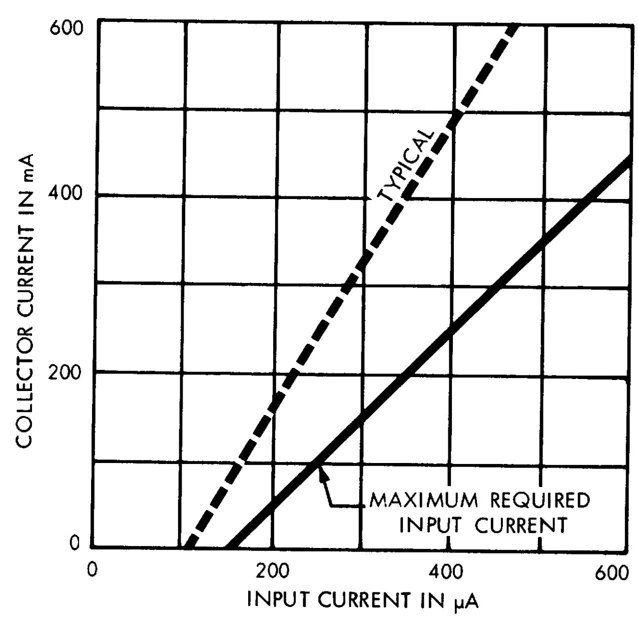
FIGURE 8

COLLECTOR CURRENT AS A FUNCTION OF SATURATION VOLTAGE



Dwg. No. A-9754C

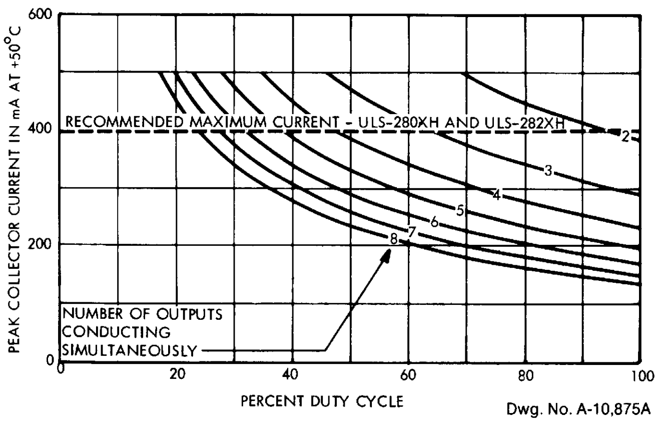
COLLECTOR CURRENT AS A FUNCTION OF INPUT CURRENT



Dwg. No. A-10,872B

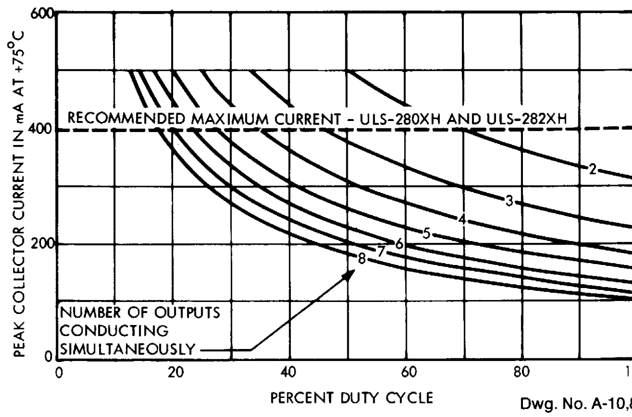
SERIES ULS-2800H

PEAK COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE AT +50°C



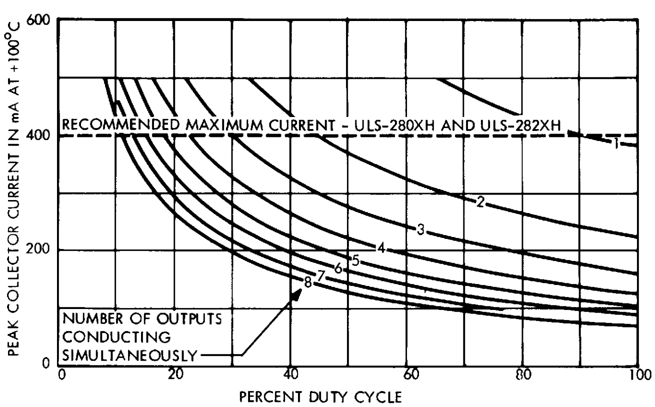
Dwg. No. A-10,875A

PEAK COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE AT +75°C



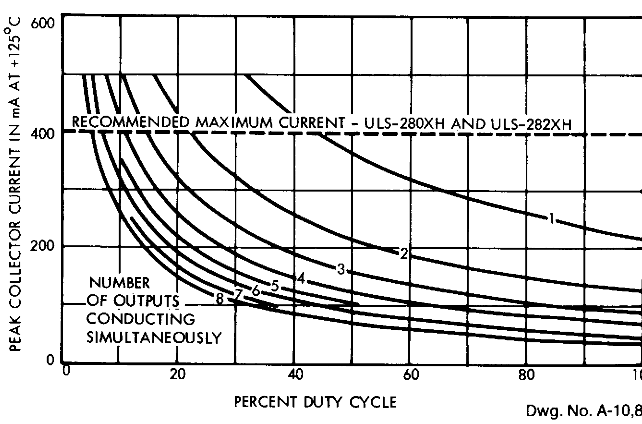
Dwg. No. A-10,876A

PEAK COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE AT +100°C



Dwg. No. A-10,877A

PEAK COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE AT +125°C

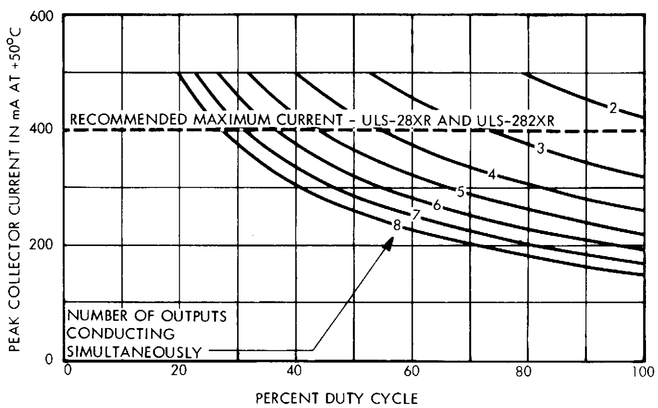


Dwg. No. A-10,878A

X = digit to identify specific device. Specification or limit shown applies to family of devices with remaining digits as shown.

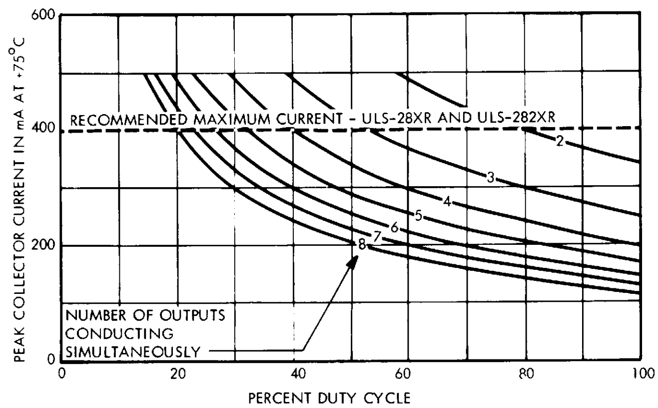
SERIES ULS-2800R

PEAK COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE AT +50°C



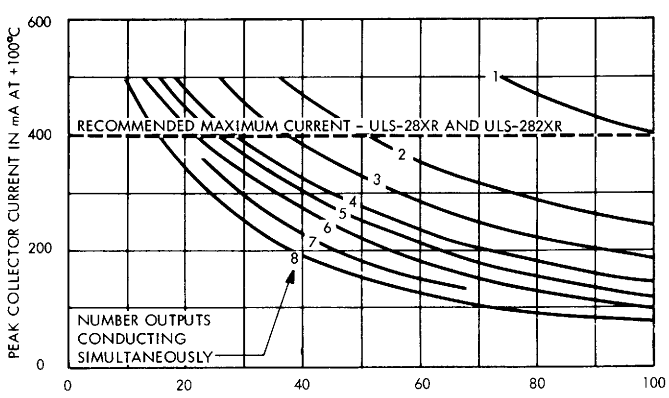
Dwg. No. A-10,870A

PEAK COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE AT +75°C



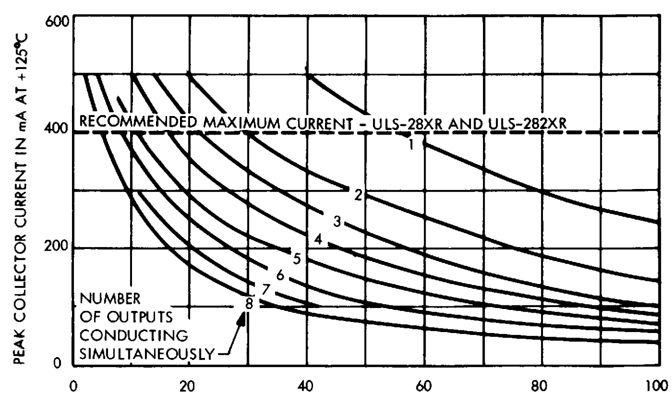
Dwg. No. A-10,871A

PEAK COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE AT +100°C



Dwg. No. A-12,466

PEAK COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE AT +125°C

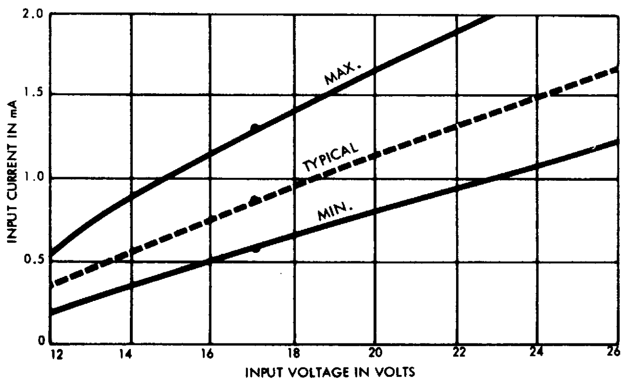


Dwg. No. A-12,467

X = digit to identify specific device. Specification or limit shown applies to family of devices with remaining digits as shown.

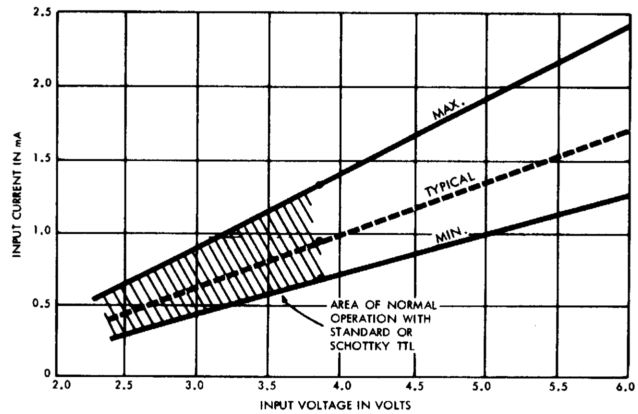
INPUT CURRENT AS A FUNCTION OF INPUT VOLTAGE

ULS-28X2



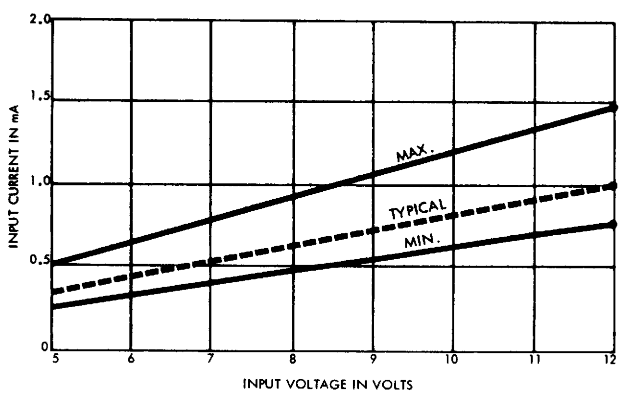
Dwg. No. A-10,225A

ULS-28X3



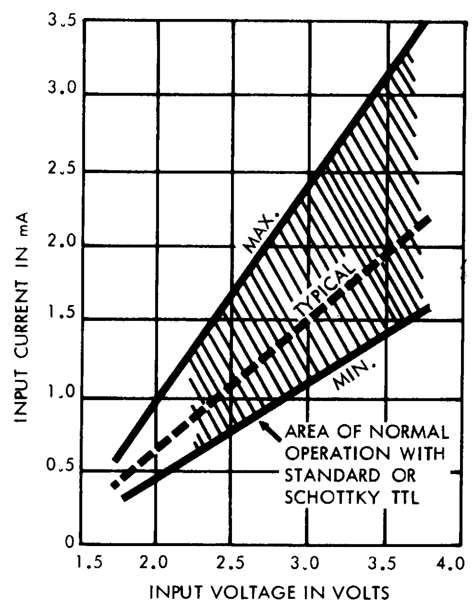
Dwg. No. A-10,224A

ULS-28X4



Dwg. No. A-10,226A

ULS-28X5

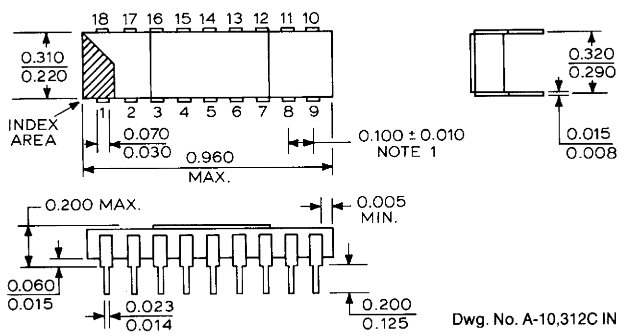


Dwg. No. A-10,874A

X = digit to identify specific device. Specification or limit shown applies to family of devices with remaining digits as shown.

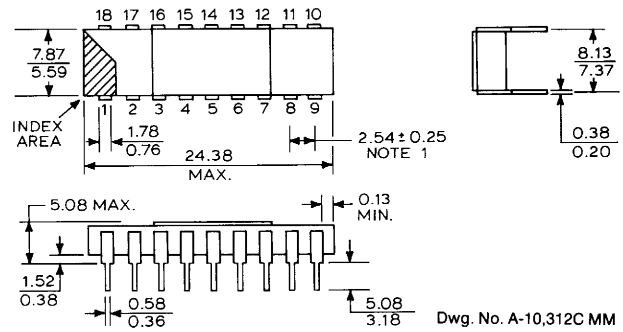
HERMETIC GLASS/METAL 'H' PACKAGE

DIMENSIONS IN INCHES



Dwg. No. A-10,312C IN

DIMENSIONS IN MILLIMETERS
Based on 1" = 25.4 mm

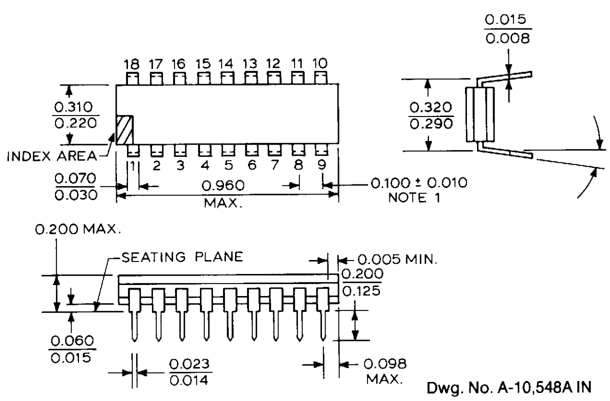


Dwg. No. A-10,312C MM

This package conforms to military specification MIL-M-38510, case outline D-6, configuration 3. Devices using this package are marked to indicate compliance to the latest issue of MIL-STD-883. For example: ULS2801H-883.

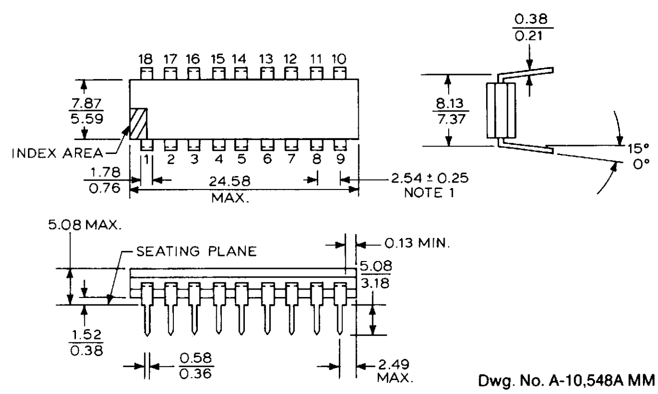
HERMETIC CERAMIC/GLASS 'R' PACKAGE

DIMENSIONS IN INCHES



Dwg. No. A-10,548A IN

DIMENSIONS IN MILLIMETERS
Based on 1" = 25.4 mm



Dwg. No. A-10,548A MM

This package conforms to military specification MIL-M-38510, case outline D-6, configuration 1. Devices using this package are marked to indicate compliance to the latest issue of MIL-STD-883. For example: ULS2803R-883.

NOTES:
1. Lead spacing tolerance is non-cumulative.
2. Exact body and lead configuration at vendor's option within limits shown.
3. Lead gauge plane is 0.030 in. (0.76 mm) max. below seating plane.

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Huntsville 35801
Tel. 205/883-9948

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Indianapolis 46240
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St. Louis, MO 63119 — 2915
Tel. 314/962-1411

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821 Corporate Drive
Unit #16, Suite 200
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Laurel 20708 — 1130
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Tel. 314/962-1411

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Tel. 919/847-8800

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Tel. 614/761-1881

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Vancouver, WA 98664 — 9025
Tel. 503/225-0493
Tel. 206/892-0361

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Beaverton 97005 — 5945
Tel. 503/641-9373

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Cherry Hill, NJ 08034 — 0460
Tel. Phila. 215/922-2080

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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
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Dallas 75243 — 3403
Tel. 214/235-1256

Sprague Electric Company
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Austin 78723 — 1033
Tel. 512/458-2514

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Laurel, MD 20708 — 1130
Tel. 301/953-1717

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Cherry Hill, NJ 08034 — 0460
Tel. 609/795-4200

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Seattle 98103 — 7996
Tel. 206/632-7761

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Ottawa, Ont. K1P 6A4
Tel. 613/238-2542

Lenbrook Electronics
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Surrey, B.C. V3T1W4
Tel. 604/585-9599

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Switzerland
Tel. 98-4021
TLX 845-23469

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Bus 3
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Crawley West Sussex RH 102 YQ
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9430 Cachan
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Shinjuku-ku, Tokyo 160
Japan
Tel. (03) 348-5221
TLX J23328

Tecnomil Ltd.
Sprague Korea Branch
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44-1, Yoido-Dong
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Tel. (2) 783-9784
TLX 78726186

Sprague World Trade Corp.
Singapore Office
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Alexandra Road
Singapore 0511
Tel. 475-1826
TLX RS 26384

Sprague Taiwan Branch/
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Chung Hsiao East Road
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