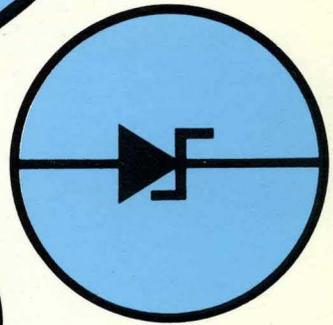
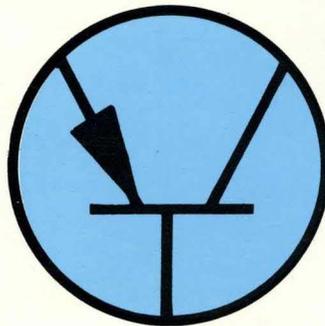
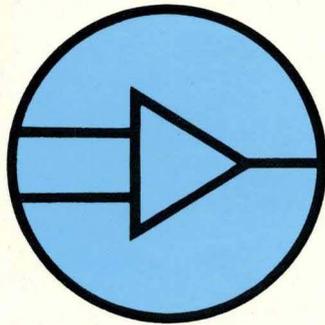
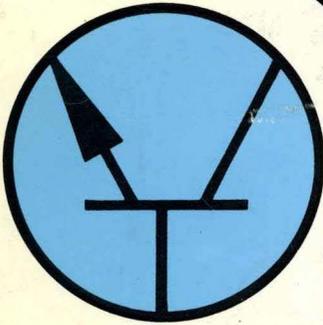


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# SPRAGUE<sup>®</sup> SEMICONDUCTORS



● INTEGRATED CIRCUITS ● ZENER DIODES ● TRANSISTORS



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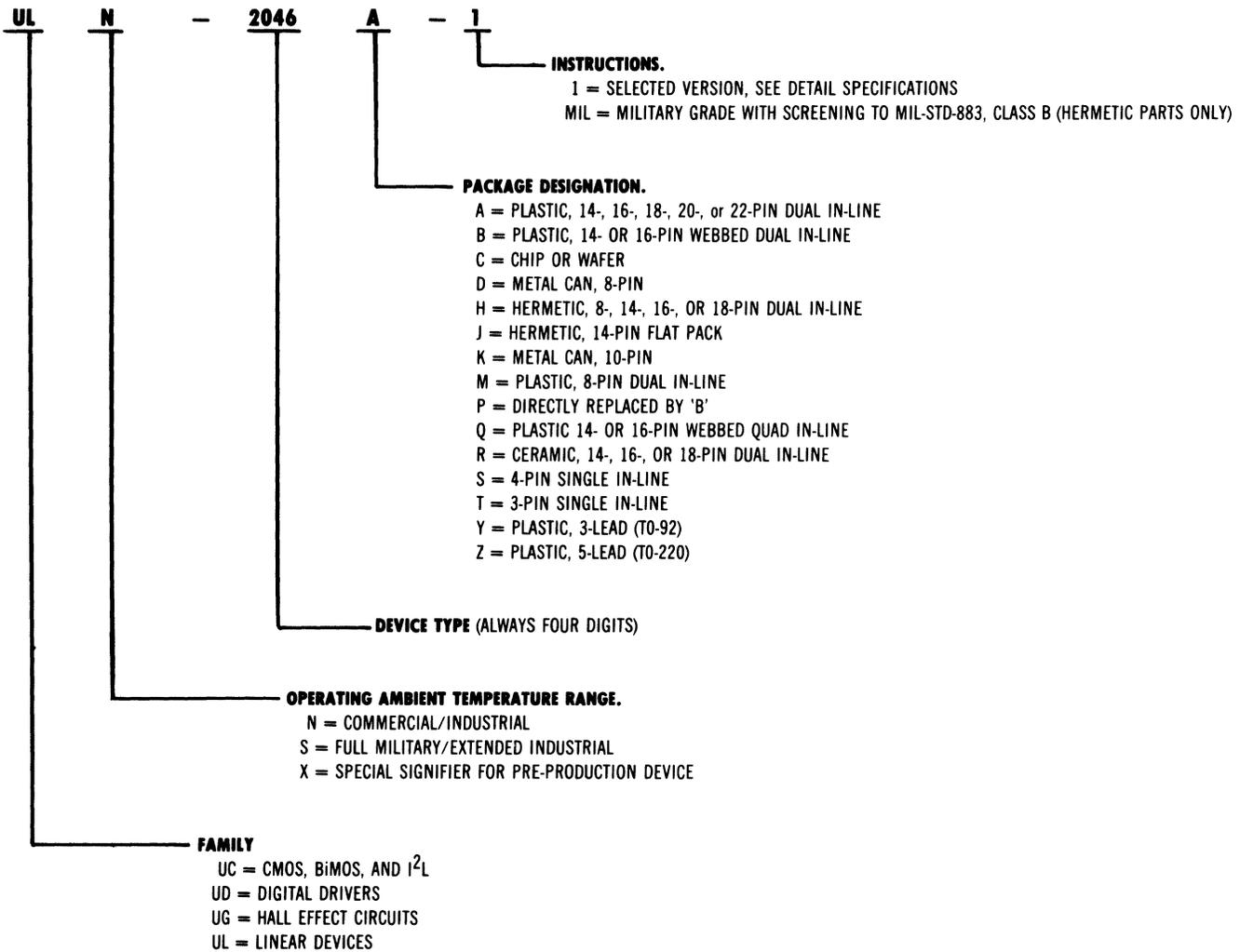
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\*Indicates exact device not available from Sprague. See Page 34 for suggested substitute.

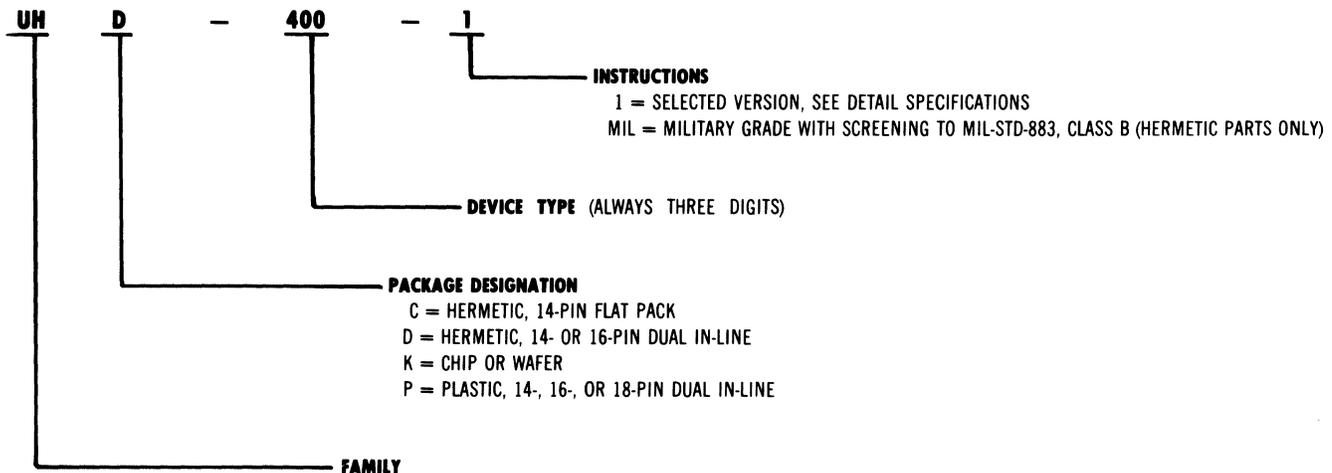
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MPS6514	38	TD242	50	TP3059	47	TPS86	46	UDN-6118A-2	10	UGN-3220S	30	UHD-433-1	4	ULN-2061M	13	ULN-2811R	11	ULS-2076H	13
MPS6515	38	TD243	50	TP3060	47	TPS87	46	UDN-6118R	10	UGN-3501M	30	UHD-433-1MIL	4	ULN-2062M	13	ULN-2812A	11	ULS-2076HMIL	13
MPS6516	38	TD244	52	TP3061	47	TPS90	46	UDN-6118R-2	10	UGN-3501T	30	UHD-480	8	ULN-2064B	13	ULN-2812R	11	ULS-2077H	13
MPS6517	38	TD245	52	TP3115	47	TPS90M	46	UDN-6126A	10	UGN-3600M	30	UHD-481	8	ULN-2065B	13	ULN-2813A	11	ULS-2077HMIL	13
MPS6518	38	TD246	52	TP3116	47	TPS91	46	UDN-6126A-2	10	UGN-3601M	30	UHD-482	8	ULN-2066B	13	ULN-2813R	11	ULS-2083H	21
MPS6519	38	TD247	52	TP3135	47	TPS91M	46	UDN-6126R	10	UGS-3019T	30	UHD-490	8	ULN-2067B	13	ULN-2814A	11	ULS-2083HMIL	21
MPS6520	38	TD248	52	TP3136	47	TPS92	46	UDN-6126R-2	10	UGS-3020T	30	UHD-491	8	ULN-2068B	13	ULN-2814R	11	ULS-2083H-1	21
MPS6521	38	TD250	50	TP3217	47	TPS92M	46	UDN-6128A	10	UGS-3030T	30	UHD-495	8	ULN-2069B	13	ULN-2815A	11	ULS-2083H-1MIL	21
MPS6522	38	TD400	49	TP3218	47	TPS93	46	UDN-6128A-2	10	UHC-400	4	UHD-500	4	ULN-2070B	13	ULN-2815R	11	ULS-2140H	31
MPS6523	38	TD401	49	TP3219	47	TPS93M	46	UDN-6128R	10	UHC-400MIL	4	UHD-500MIL	4	ULN-2071B	13	ULN-2815R	11	ULS-2801H	11
MPS6530	38	TD402	51	TP3304	47	TPS94	46	UDN-6128R-2	10	UHC-400-1	4	UHD-502	4	ULN-2074B	13	ULN-2821A	11	ULS-2801HMIL	11
MPS6531	39	TD500	49	TP3451	47	TPS97	46	UDN-6138A	10	UHC-400-1MIL	4	UHD-502MIL	4	ULN-2075B	13	ULN-2822A	11	ULS-2801R	11
MPS6532	39	TD501	49	TP3566	39	TPS98	46	UDN-6138A-2	10	UHC-402	4	UHD-503	4	ULN-2076B	13	ULN-2823A	11	ULS-2801R	11
MPS6533	39	TD502	51	TP3567	39	TPS99	46	UDN-6144A	9	UHC-402MIL	4	UHD-503MIL	4	ULN-2077B	13	ULN-2824A	11	ULS-2802H	11
MPS6534	39	TD509	49	TP3568	39	TPS100	46	UDN-6148A	10	UHC-402-1	4	UHD-506	4	ULN-2078A	13	ULN-2825A	11	ULS-2802HMIL	11
MPS6535	39	TD510	49	TP3569	39	TPS101	46	UDN-6148A-2	10	UHC-402-1MIL	4	UHD-506MIL	4	ULN-2082A	21	ULN-3303M	33	ULS-2802H	11
MPS6560	39	TD511	51	TP3638	40	TPS108	46	UDN-6164A	9	UHC-403	4	UHD-507	4	ULN-2083A	21	ULN-3304M	33	ULS-2803H	11
MPS6561	39	TD512	49	TP3638A	40	TPS110	46	UDN-6184A	9	UHC-403MIL	4	UHD-507MIL	4	ULN-2083A-1	21	ULN-3305M	33	ULS-2803HMIL	11
MPS6562	39	TD513	49	TP3644	36	TPS111	46	UDN-7180A	9	UHC-403-1	4	UHD-508	4	ULN-2086A	20	ULN-3306M	33	ULS-2803R	11
MPS6563	39	TD514	51	TP3645	36	TPS112	46	UDN-7183A	9	UHC-403-1MIL	4	UHD-508MIL	4	ULN-2101A	22	ULN-3330Y	33	ULS-2804H	11
MPS6565	39	TD517	49	TP3677	37	TPS133	46	UDN-7184A	9	UHC-406	4	UHD-532	4	ULN-2111A	22	ULN-3330Y-2	33	ULS-2804HMIL	11
MPS6566	39	TD518	49	TP3840	47	TPS134	46	UDN-7186A	9	UHC-406MIL	4	UHD-532MIL	4	ULN-2113A	22	ULN-3701Z	28	ULS-2804R	11
MPS6571	41	TD519	51	TP3977	47	TPS135	46	UDS-2580H	12	UHC-406-1	4	UHD-533	4	ULN-2124A	22	ULN-3701ZH	28	ULS-2805H	11
MPS8098	39	TD520	51	TP3978	47	TPS136	46	UDS-2580HMIL	12	UHC-406-1MIL	4	UHD-533MIL	4	ULN-2125A	29	ULN-3701ZV	28	ULS-2805HMIL	11
MPS8099	39	TD521	51	TP3979	47	TSD6100	55	UDS-2580R	12	UHC-407	4	UHP-400	4	ULN-2127A	29	ULN-3804A	28	ULS-2805R	11
MPS-A05	37	TD522	51	TP4007	47	TSD7100	55	UDS-2981H	12	UHC-407MIL	4	UHP-400-1	4	ULN-2136A	22	ULS-2001H	11	ULS-2811H	11
MPS-A06	37	TD523	51	TP4008	47	TZ81	41	UDS-2981HMIL	12	UHC-407-1	4	UHP-402	4	ULN-2140A	31	ULS-2001HMIL	11	ULS-2811HMIL	11
MPS-A09	41	TD524	51	TP4208	47	TZ82	41	UDS-2981R	12	UHC-407-1MIL	4	UHP-402-1	4	ULN-2204A	23	ULS-2001R	11	ULS-2811R	11
MPS-A10	37	TD525	49	TP4384	43	TZ551	40	UDS-2982H	12	UHC-408	4	UHP-403	4	ULN-2209M	23	ULS-2002H	11	ULS-2812H	11
MPS-A12	44	TD526	49	TP4386	43	TZ552	40	UDS-2982HMIL	12	UHC-408MIL	4	UHP-403-1	4	ULN-2211B	29	ULS-2			

## How to Place an Order



## Special Catalog Numbering System for Series 400, 400-1, and 500 Devices Only



# SPRAGUE INTEGRATED CIRCUITS

## MIL-STD-883 HIGH-RELIABILITY SCREENING

All hermetic packaged integrated circuit devices are supplied with high-reliability screening in accordance with Tables I and III. Devices supplied to Tables I, II, and III are specified by the suffix 'MIL' to the part number. For example: UHD-400MIL.

**Table I — 100% Production Screen Tests (All Hermetic Parts)  
MIL-STD-883, Method 5004, Class B, Paragraphs 3.1.1 thru 3.1.6**

Screen	MIL-STD-883 Test Method	Conditions
Internal Visual	2010, Cond. B	—
Stabilization Bake	1008, Cond. C	150°C, 24 Hours
Thermal Shock	1011, Cond. A	0 to 100°C, 15 Cycles
Constant Acceleration	2001, Cond. E	30,000 G's, Y1 Plane
Fine Seal	1014, Cond. A	5 x 10 <sup>-7</sup> Maximum
Gross Seal	1014, Cond. C	—
Electrical	—	Per Eng. Bull.
Marking	—	Sprague or customer part number, date code, lot identification, index point

**Table II — 100% High-Reliability Screening ("MIL" Suffix Parts Only)  
MIL-STD-883, Method 5004, Class B, Paragraphs 3.1.8, 3.1.9, 3.1.12 & 3.1.14**

Screen	MIL-STD-883 Test Method	Conditions
Interim Electrical	5005, Gp A, Subgp 1	25°C per Eng. Bull.
Burn-In	1015, Cond. A	125°C, 160 Hours
Static Electrical	5005, Gp A, Subgp 1	25°C per Eng. Bull.
	5005, Gp A, Subgp 2 & 3	—55° & +125°C per Eng. Bull.
Dynamic & Functional Electrical	5005, Gp A, Subgp 4, 7 & 9	25°C per Eng. Bull.
Fine Seal	1014, Cond. A	5 x 10 <sup>-7</sup> Maximum
Gross Seal	1014, Cond. C	—
External Visual	2009	—

**Table III — High-Reliability Qualification and Quality Conformance Inspection  
MIL-STD-883, Method 5004, Class B, Paragraph 3.1.17**

Test	MIL-STD-883 Test Method	Description
Group A Subgp. 1-4, 7 & 9	5005, Table I	Each production lot
Group B	5005, Table II	Each production lot
Group C	5005, Table III	End points, Gp. A, Subgp. 1, every 90 days
Group D	5005, Table IV	End points, Gp. A, Subgp. 1, every 6 months

## PART NUMBERS OF DEVICES WITH HIGH RELIABILITY SCREENING

UDS-2580HMIL	UDS-5733HMIL	UHC-432-1MIL	UHD-403-1MIL	UHD-508MIL	ULS-2024HMIL	ULS-2801HMIL
UDS-2981HMIL	UDS-5790HMIL	UHC-433MIL	UHD-406MIL	UHD-532MIL	ULS-2025HMIL	ULS-2802HMIL
UDS-2982HMIL	UDS-5791HMIL	UHC-433-1-MIL	UHD-406-1MIL	UHD-533MIL	ULS-2064HMIL	ULS-2803HMIL
UDS-2983HMIL	UHC-400MIL	UHC-500MIL	UHD-407MIL	ULS-2001HMIL	ULS-2065HMIL	ULS-2804HMIL
UDS-2984HMIL	UHC-400-1MIL	UHC-502MIL	UHD-407-1MIL	ULS-2002HMIL	ULS-2066HMIL	ULS-2805HMIL
UDS-3611HMIL	UHC-402MIL	UHC-503MIL	UHD-408MIL	ULS-2003HMIL	ULS-2067HMIL	ULS-2811HMIL
UDS-3612HMIL	UHC-402-1MIL	UHC-506MIL	UHD-408-1MIL	ULS-2004HMIL	ULS-2068HMIL	ULS-2812HMIL
UDS-3613HMIL	UHC-403MIL	UHC-507MIL	UHD-432MIL	ULS-2005HMIL	ULS-2069HMIL	ULS-2813HMIL
UDS-3614HMIL	UHC-403-1MIL	UHC-508MIL	UHD-432-1MIL	ULS-2011HMIL	ULS-2070HMIL	ULS-2814HMIL
UDS-5703HMIL	UHC-406MIL	UHC-532MIL	UHD-433MIL	ULS-2012HMIL	ULS-2071HMIL	ULS-2815HMIL
UDS-5706HMIL	UHC-406-1MIL	UHC-533MIL	UHD-433-1MIL	ULS-2013HMIL	ULS-2074HMIL	ULS-2821HMIL
UDS-5707HMIL	UHC-407MIL	UHD-400MIL	UHD-500MIL	ULS-2014HMIL	ULS-2075HMIL	ULS-2822HMIL
UDS-5711HMIL	UHC-407-1MIL	UHD-400-1MIL	UHD-502MIL	ULS-2015HMIL	ULS-2076HMIL	ULS-2823HMIL
UDS-5712HMIL	UHC-408MIL	UHD-402MIL	UHD-503MIL	ULS-2021HMIL	ULS-2077HMIL	ULS-2824HMIL
UDS-5713HMIL	UHC-408-1MIL	UHD-402-1MIL	UHD-506MIL	ULS-2022HMIL	ULS-2083HMIL	ULS-2825HMIL
UDS-5714HMIL	UHC-432MIL	UHD-403MIL	UHD-507MIL	ULS-2023HMIL	ULS-2083H-1MIL	

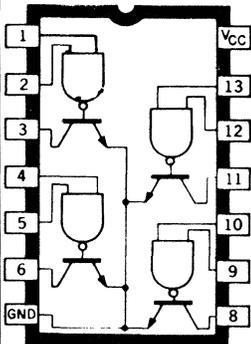
# SPRAGUE POWER/PERIPHERAL DRIVER INTEGRATED CIRCUITS

## SERIES 400 AND 500 POWER DRIVERS

- Monolithic interface circuits incorporating logic gates and high-current switching transistors on the same chip.
- Ideally suited for driving incandescent lamps, relays, solenoids, and other interface devices up to 1A output current per package.
- Inputs compatible with DTL/TTL
- Pinning compatible with 54/74 networks
- 500 mA output sink current capability
- High sustaining voltage output capability per driver
  - Series 400: 40 Volts min.
  - Series 400-1: 70 Volts min.
  - Series 500: 100 Volts min.

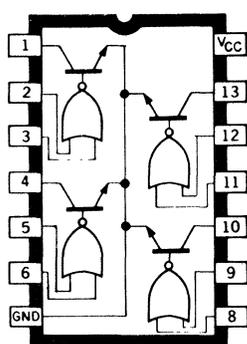
- Circuits 03, 06, 07, and 33 have transient protected outputs
- Operating temperature range: for hermetically-sealed packages,  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ; for plastic package,  $0^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$
- Three package configurations:
  - UHP = Plastic (14-pin) Dual In-Line A
  - UHD = Hermetic (14-pin) Dual In-Line H
  - UHC = Hermetic (14-pin) Flat-Pack J avail. on request
- Hermetically-Sealed Packages to MIL-M-38510
- High-Reliability Screening to MIL-STD-883, Class B

**QUAD 2-INPUT AND**



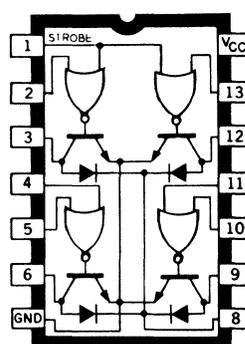
UHD/UHP-400  
UHD/UHP-400-1  
UHD/UHP-500  
UHD-400MIL  
UHD-400-1MIL  
UHD-500MIL

**QUAD 2-INPUT OR**



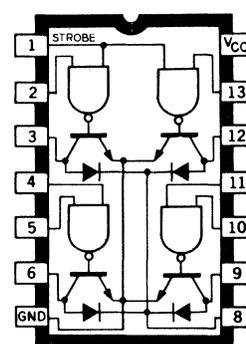
UHD/UHP-402  
UHD/UHP-402-1  
UHD/UHP-502  
UHD-402MIL  
UHD-402-1MIL  
UHD-502MIL

**QUAD OR**



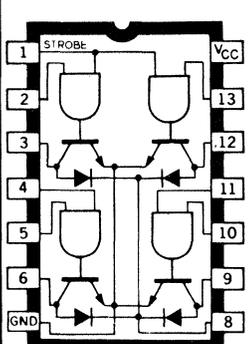
UHD/UHP-403  
UHD/UHP-403-1  
UHD/UHP-503  
UHD-403MIL  
UHD-403-1MIL  
UHD-503MIL

**QUAD AND**



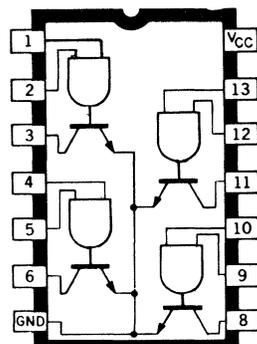
UHD/UHP-406  
UHD/UHP-406-1  
UHD/UHP-506  
UHD-406MIL  
UHD-406-1MIL  
UHD-506MIL

**QUAD NAND**



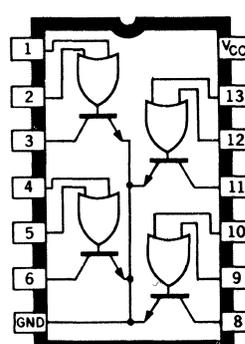
UHD/UHP-407  
UHD/UHP-407-1  
UHD/UHP-507  
UHD-407MIL  
UHD-407-1MIL  
UHD-507MIL

**QUAD 2-INPUT NAND**



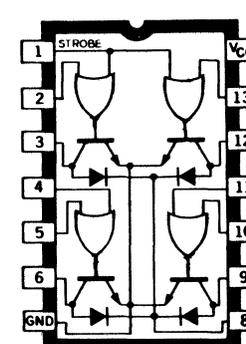
UHD/UHP-408  
UHD/UHP-408-1  
UHD/UHP-508  
UHD-408MIL  
UHD-408-1MIL  
UHD-508MIL

**QUAD 2-INPUT NOR**



UHD/UHP-432  
UHD/UHP-432-1  
UHD/UHP-532  
UHD-432MIL  
UHD-432-1MIL  
UHD-532MIL

**QUAD NOR**



UHD/UHP-433  
UHD/UHP-433-1  
UHD/UHP-533  
UHD-433MIL  
UHD-433-1MIL  
UHD-533MIL

NOTE: Pin-out for the hermetic flat-pack is given in Engineering Bulletin No. 29300.1.

## SERIES 3600 LAMP and POWER DRIVERS

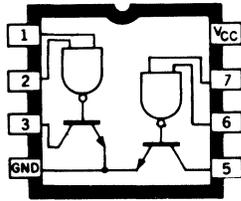
These 'mini-DIP' dual peripheral and power drivers are bipolar monolithic integrated circuits incorporating AND, NAND, OR, or NOR logic gates, high-current switching transistors, and transient suppression diodes on the same chip. The two output transistors are capable of simultaneously sinking 300 mA continuously. In the OFF state, these drivers will sustain at least 80 V.

### FEATURES

- Four Logic Types
- DTL/TTL/PMOS/CMOS Compatible Inputs

- Low Input Current
- 300 mA Continuous Output Current
- Sustaining Voltage of 80 V
- Hermetically-Sealed Package
- High-Reliability Screening to MIL-STD-883, Class B
- Operating Temperature Range:  
0°C to +70°C (UDN series)  
-55°C to +125°C (UDS series)
- Plastic Package (8-pin) Dual In-Line M  
Hermetic Package (8-pin) Dual In-Line H

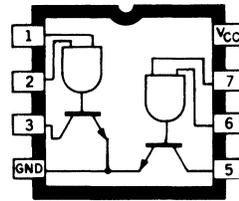
### DUAL AND DRIVER



DWG. NO. A-9792

**UDN-3611M**  
**UDS-3611H**  
**UDS-3611H MIL**

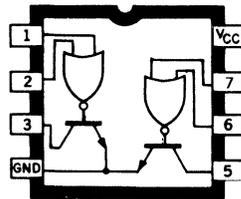
### DUAL NAND DRIVER



DWG. NO. A-9793

**UDN-3612M**  
**UDS-3612H**  
**UDS-3612H MIL**

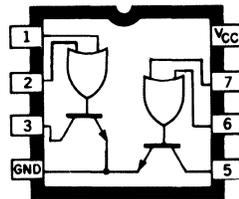
### DUAL OR DRIVER



DWG. NO. A-9795

**UDN-3613M**  
**UDS-3613H**  
**UDS-3613H MIL**

### DUAL NOR DRIVER



DWG. NO. A-9794

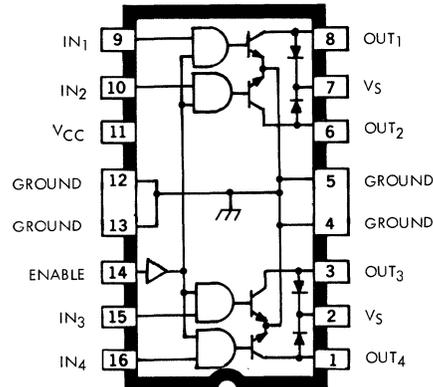
**UDN-3614M**  
**UDS-3614H**  
**UDS-3614H MIL**

## UDN-2540B QUAD NAND POWER DRIVER

Specifically designed for use in extremely harsh electrical environments, the UDN-2540B quad NAND driver interfaces between low-level signal processing circuits and medium-power inductive loads. The inputs are compatible with most TTL, DTL, LS TTL, 5 V to 15 V CMOS, and PMOS. The outputs include integral transient suppression diodes for inductive loads such as relays, solenoids, d-c and stepping motors. These devices can also be used to drive incandescent or heater loads.

### MAXIMUM RATINGS

- Output Voltage,  $V_{OUT}$  ..... 60 V
- Output Sustaining Voltage,  $V_{CE(SUS)}$  ..... 35 V
- Output Current,  $I_{OUT}$  ..... 1.5 A
- Logic Supply Voltage,  $V_{CC}$  ..... 18 V
- Input Voltage,  $V_{IN}$  ..... 30 V
- Power Dissipation,  $P_D$  (each driver) ..... 2.5 W



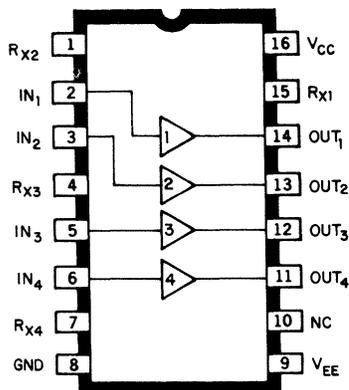
- Operating Temperature Range ..... 0°C to +70°C
- Plastic (16-pin) Dual In-Line Package B

## SERIES 5790 PIN DIODE POWER DRIVERS

Consisting of four high-voltage NPN output stages and associated logic and level shifting, these monolithic, planar integrated circuits offer an easy solution to many PIN diode driving applications. The 5790 driver uses a grounded-base input stage for non-inverting operation while the 5791 driver uses a common-emitter input stage for inverting operation. Both devices are capable of sustaining OFF voltages of 120 V and will switch currents to 500 mA.

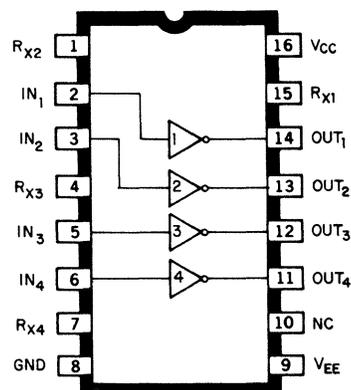
### FEATURES:

- Low Input Current
- TTL, DTL, MOS Compatible
- Operating Temperature:
  - 0°C to +70°C (UDN Series)
  - 55°C to +125°C (UDS Series)
- Two Package Configurations:
  - Plastic (16-pin) Dual In-Line A
  - Hermetic (16-pin) Dual In-Line H
- Hermetically-Sealed Package to MIL-M-38510
- High-Reliability Screening to MIL-STD-883, Class B



DWG. NO. A-10 477

UDN-5790A  
UDS-5790H  
UDS-5790HMIL



DWG. NO. A-10 478

UDN-5791A  
UDS-5791H  
UDS-5791HMIL

## SERIES 5700 LAMP, RELAY and POWER DRIVERS

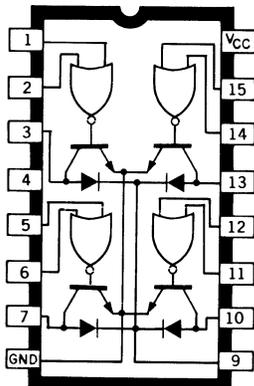
- Reliable monolithic construction
- Ideally suited for driving incandescent lamps, relays, solenoids, and other interface devices
- Inputs compatible with DTL/TTL, PMOS, and CMOS
- 300 mA output sink current capability per gate
- High sustaining voltage: 80 volts
- Hermetically-sealed packages
- High-reliability screening to MIL-STD-883, Class B
- Built-in suppression diodes for transient protection

- Operating temperature range:  
UDN Series = 0°C to +70°C  
UDS Series = -55°C to +125°C

- Package Configurations:  
Plastic: 16-pin Dual In-Line A and 8-pin Dual In-Line M  
Hermetic: 16-pin and 8-pin Dual In-Line H

### QUAD 16-PIN DRIVERS

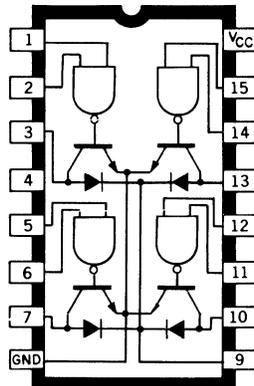
QUAD OR DRIVER



DWG. NO. A-9799

UDN-5703A  
UDS-5703H  
UDS-5703H MIL

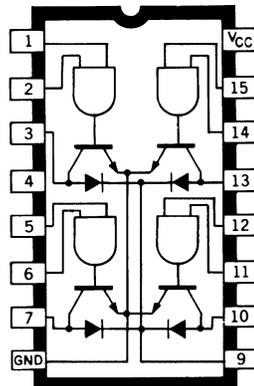
QUAD AND DRIVER



DWG. NO. A-9717

UDN-5706A  
UDS-5706H  
UDS-5706H MIL

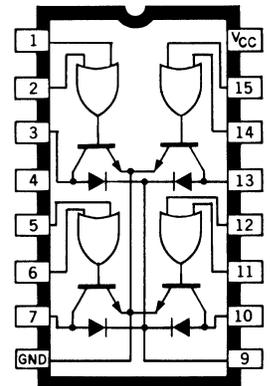
QUAD NAND DRIVER



DWG. NO. A-9796

UDN-5707A  
UDS-5707H  
UDS-5707H MIL

QUAD NOR DRIVER

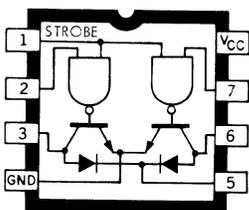


DWG. NO. A-9798

UDN-5733A  
UDS-5733H  
UDS-5733H MIL

### DUAL MINI-DIPs

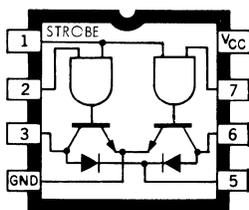
DUAL AND DRIVER



DWG. NO. A-9791

UDN-5711M  
UDS-5711H  
UDS-5711H MIL

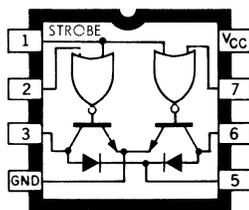
DUAL NAND DRIVER



DWG. NO. A-9790

UDN-5712M  
UDS-5712H  
UDS-5712H MIL

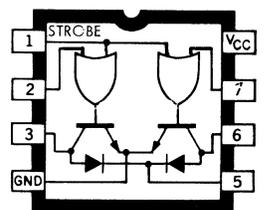
DUAL OR DRIVER



DWG. NO. A-9789

UDN-5713M  
UDS-5713H  
UDS-5713H MIL

DUAL NOR DRIVER



DWG. NO. A-9788

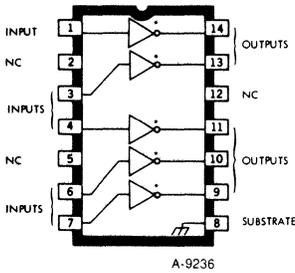
UDN-5714M  
UDS-5714H  
UDS-5714H MIL

## SERIES 480 and 490 GAS-DISCHARGE DISPLAY DRIVERS

The Series 480 and 490 high-voltage display drivers are bipolar monolithic integrated circuits designed for interface between MOS or open collector TTL logic and gas discharge displays such as the Burroughs Panaplex®, the Beckman SP series, Dale, and Pantek. These drivers replace the major portion of discrete components typically required to inter-

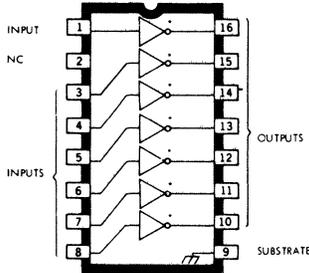
face between an MOS calculator or counter/decoder circuit and the gas discharge display. They are available in the plastic dual in-line A package (UHP series) rated for 0°C to +70°C operation and the hermetic dual in-line package H (UHD series) rated for -55°C to +125°C. The latter meet MIL-M-38510.

**UHP-480  
UHD-480**



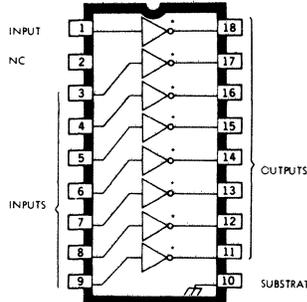
A-9236

**UHP-481  
UHD-481**

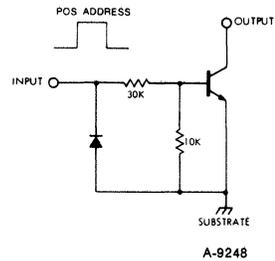


A-9237

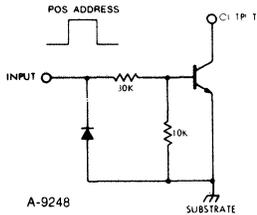
**UHP-482  
UHD-482**



A-9658



A-9248

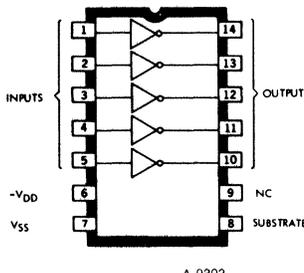


A-9248

High voltage switches for use in the segment side of a gas display panel, available with either 5 (480) or 7 (481) switches per dual in-line package. For applications such as calculators, DVM's, DMM's, DPM's, clocks, etc. Also has bargraph potential.

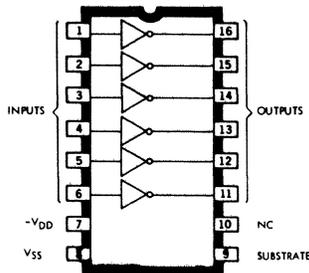
High voltage switch for use in the segment side of a gas display panel, available with 8 switches per dual in-line package. For applications such as calculators, DVM's, DMM's, DPM's, clocks, etc. Also has bargraph potential.

**UHP-490  
UHD-490**



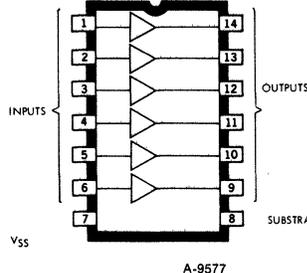
A-9302

**UHP-491  
UHD-491**

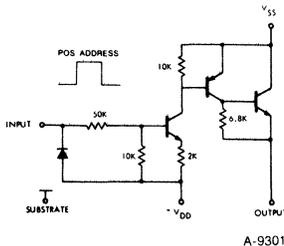
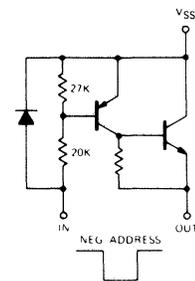


A-9303

**UHP-495  
UHD-495**



A-9577



A-9301

High voltage display drivers for use in the digit side of a gas display panel, available with either 5 (490) or 6 (491) drivers per dual in-line package. For applications such as MOS calculators and digital clocks. Some use with fluorescent displays and level shifting applications.

High voltage display driver for use in the digit side of a gas display panel. Six drivers per dual in-line package for applications such as MOS calculators and digital clocks. Some use with fluorescent displays and level shifting applications.

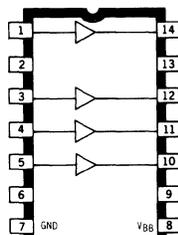
## SERIES 6100 and 7100 GAS-DISCHARGE DISPLAY DRIVERS

These devices are monolithic high-voltage bipolar integrated circuits for interfacing between MOS, or other low-voltage circuitry, and the cathode of gas discharge display panels. These devices dramatically reduce the number of discrete components normally required with panels, such as the Burroughs Panaplex®, in calculator, clock, and instrumentation applications.

### APPLICATIONS

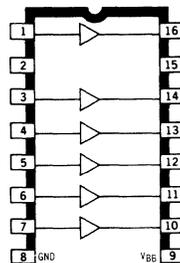
- Point-of-Sale Terminals
- Instruments
- Cash Registers
- Calculators
- Clocks
- Automobile Dash Boards

- FEATURES:**
- Reliable Monolithic Construction
  - High Output Breakdown Voltage:
    - 6100 Series = +110 V
    - 7100 Series = -110 V
  - Input Voltage,  $V_{in} = 4.5 \text{ V to } 15 \text{ V}$
  - Low Power
  - Minimum Size
  - Hermetically-Sealed Packages to MIL-M-38510
  - Operating Temperature Range:
    - 0°C to +70°C (UDN Series)
    - 55°C to +125°C (UDS Series)
  - Two Package Configurations:
    - Plastic (14-, 16-, and 18-pin) Dual In-Line A
    - Hermetic (14-, 16-, and 18-pin) Dual In-Line H



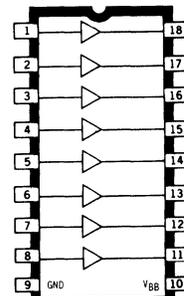
A-9642

UDN-6144A  
UDS-6144H



A-9643

UDN-6164A  
UDS-6164H



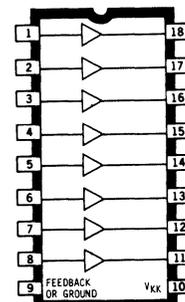
A-9641

UDN-6184A  
UDS-6184H

Gas discharge display digit drivers designed for interfacing between MOS or other low-voltage circuitry. Used with multiplexed gas discharge display panels in calculator, clock or instrumentation applications. The 6144 contains 4 complete drivers, the 6164 contains 6 drivers, and the 6184 contains 8 drivers. Each driver contains appropriate level shifting, signal amplification, off stage voltage bias, and 70 mA maximum output current sourcing for the sequential addressing of display panel anodes.

The Series 7100 high voltage, bipolar integrated circuits are intended for interfacing between MOS, or other low-voltage circuitry, and the cathode of gas discharge display panels. The 7183 is designed for use with 0.7" clock panels and 0.4" calculator panels. The 7186 is intended for use with 0.25" calculator panels.

Output Current,  $I_{out}$   
 7180A/H = 0-14 mA  
 7183A/H = 1.9 mA  
 7184A/H = 1.2 mA  
 7186A/H = 0.6 mA



A-9640

UDN-7180A, 83A, 84A, 86A  
UDS-7180H, 83H, 84H, 86H

## SERIES 6100 FLUORESCENT DISPLAY DRIVERS

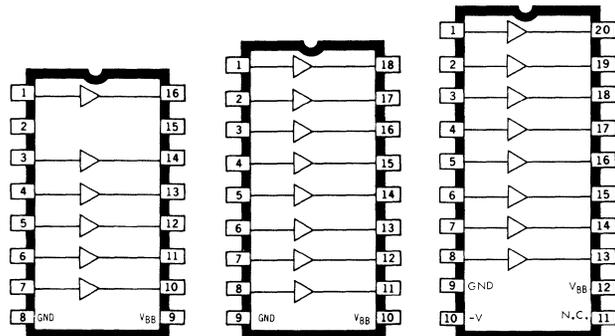
Sprague vacuum fluorescent display drivers are capable of interfacing from TTL, CMOS, NMOS, and PMOS to multiplexed (or d-c) fluorescent display panels such as those furnished by Futaba, Noritake, (ISE), NEC, etc.

Each driver channel contains suitable level shifting, current gain, 40 mA max. output sourcing, high impedance input, and internal output pull-down resistors.

Sprague VF display integrated circuits may be used for both digit and segment switching and are used in either 7- or 9-segment panels, 14/16-segment alpha-numeric, bargraphs, and 5 x 7 dot matrix panels.

### FEATURES:

- Digit or Segment Driver
- Low Power Consumption
- Low Input Current
- Integral Output Pull-Down Resistors
- High Output Breakdown Voltage
- Operating Temperature Range:
  - 0°C to +70°C (UDN Series)
  - 40°C to +85°C (UDS Series)
- Two Package Configurations:
  - Plastic (16-, 18-, and 20-pin) Dual In-Line A
  - Ceramic (16- and 18-pin) Dual In-Line R



6116  
6126

6118  
6128

6138  
6148  
(-V ≤ 40 Volts)

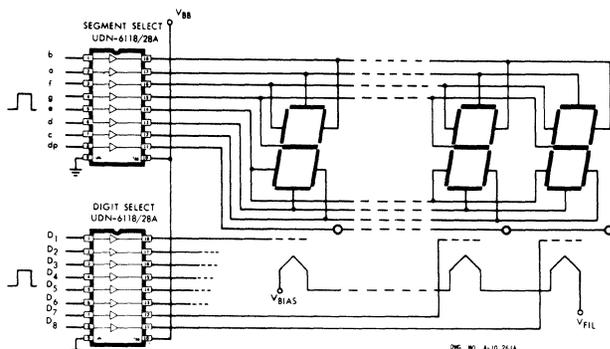
### DEVICE SELECTION GUIDE

Input Compatibility	$V_{CE(max)} = 80V *$ $I_{C(max)} = 40 mA$
5 V TTL, CMOS	6116/6118
6-15 V CMOS, PMOS	6126/6128
5V TTL, CMOS	6138
6-15 V CMOS, PMOS	6148

### PACKAGE SELECTION GUIDE

Plastic Dual In-Line A		Ceramic Dual In-Line R			
0°C to +70°C		0°C to +70°C		-40°C to +85°C	
No. Pins	Device Type *	No. Pins	Device Type *	No. Pins	Device Type *
16	UDN-6116A	16	UDN-6116R	16	UDS-6116R
18	UDN-6118A	18	UDN-6118R	18	UDS-6118R
16	UDN-6126A	16	UDN-6126R	16	UDS-6126R
18	UDN-6128A	18	UDN-6128R	18	UDS-6128R
20	UDN-6138A				
20	UDN-6148A				

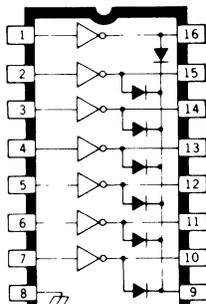
\*Add -1 to part number for  $V_{CE(max)} = 100 V$  or -2 to part number for  $V_{CE(max)} = 60 V$



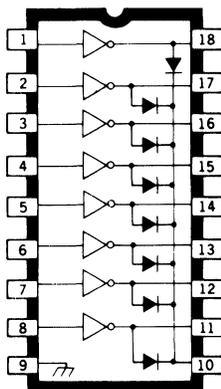
TYPICAL  
MULTIPLEXED  
FLUORESCENT  
DISPLAY

# SPRAGUE HIGH-CURRENT DARLINGTON ARRAY INTEGRATED CIRCUITS

## SERIES 2000 and 2800 DARLINGTON ARRAYS



**2000 SERIES  
PINNING**



**2800 SERIES  
PINNING**

These high-voltage, high-current Darlington arrays are comprised of seven or eight silicon NPN Darlington pairs on a common monolithic substrate. All units feature open collector outputs and integral suppression diodes for inductive loads. Peak inrush currents to 600 mA are allowable, making them ideal for driving tungsten filament lamps as well.

### FEATURES

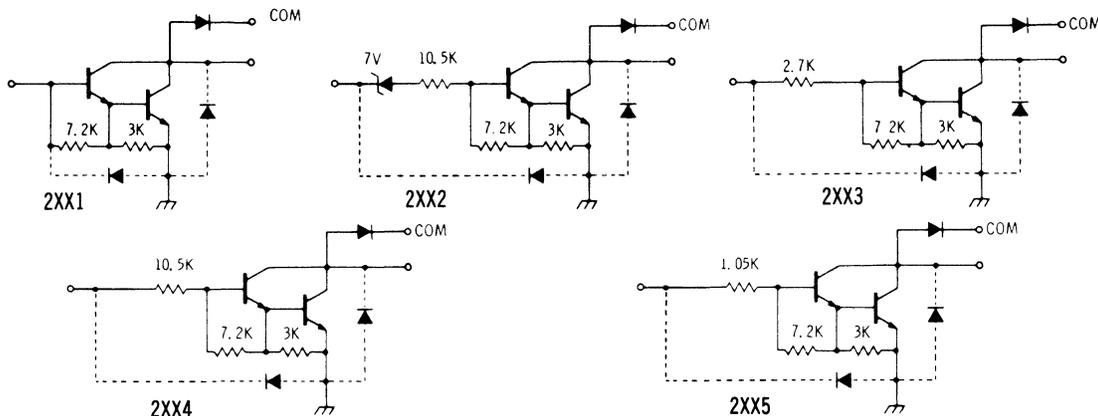
- Output Voltage Up To 95 V
- Output Currents to 600 mA (saturated)
- Integral Suppression Diodes for Inductive Loads
- Inputs Compatible with DTL, TTL, PMOS, CMOS
- Package Power Dissipation to 2.25 W
- Inputs Pinned Opposite Outputs - Lower PC Board Costs
- Able to Switch Loads of 125 W at +70°C
- Hermetically-Sealed Package to MIL-M-38510
- High Reliability Screening to MIL-STD-883
- Operating Temperature Range:
  - 0°C to +70°C (ULN Series A Packaged Devices)
  - -40°C to +85°C (ULS Series R Packaged Devices)
  - -55°C to +125°C (ULS Series H Packaged Devices)
- Three Package Configurations:
  - Plastic Dual In-Line A
  - Hermetic Dual In-Line H
  - Ceramic Dual In-Line R

### DEVICE SELECTION GUIDE

	V <sub>CE</sub> (MAX) = I <sub>C</sub> (MAX) =	50 V 500 mA	50 V 600 mA	95 V* 500 mA
Input Compatibility	Type No.			
General Purpose PMOS, CMOS		2001/2801	2011/2811	2021/2821
15 - 25 V PMOS		2002/2802	2012/2812	2022/2822
5 V TTL, CMOS		2003/2803	2013/2813	2023/2823
6 - 15 V CMOS, PMOS		2004/2804	2014/2814	2024/2824
High Output TTL		2005/2805	2015/2815	2025/2825

\*Ceramic dual in-line R packaged devices are not available in 95 V rating.

### PARTIAL SCHEMATICS (each gate)



### PACKAGE SELECTION GUIDE

Plastic Dual In-Line A		Ceramic Dual In-Line R				Hermetic Dual In-Line H			
0 to +70°C		0 to +70°C		-40°C to +85°C		-55°C & +125°C (Std)		-55°C to +125°C (MIL)	
Series		Series		Series		Series		Series	
2000	2800	2000	2800	2000‡	2800‡	2000	2800	2000	2800
ULN-20X1A	ULN-28X1A	ULN-20X1A	ULN-28X1R	ULS-20X1R	ULS-28X1R	ULS-20X1H	ULS-28X1H	ULS-20X1HMIL	ULS-28X1HMIL
ULN-20X2A	ULN-28X2A	ULN-20X2R	ULN-28X2R	ULS-20X2R	ULS-28X2R	ULS-20X2H	ULS-28X2H	ULS-20X2HMIL	ULS-28X2HMIL
ULN-20X3A	ULN-28X3A	ULN-20X3R	ULN-28X3R	ULS-20X3R	ULS-28X3R	ULS-20X3H	ULS-28X3H	ULS-20X3HMIL	ULS-28X3HMIL
ULN-20X4A	ULN-28X4A	ULN-20X4R	ULN-28X4R	ULS-20X4R	ULS-28X4R	ULS-20X4H	ULS-28X4H	ULS-20X4HMIL	ULS-28X4HMIL
ULN-20X5A	ULN-28X5A	ULN-20X5R	ULN-28X5R	ULS-20X5R	ULS-28X5R	ULS-20X5H	ULS-28X5H	ULS-20X5HMIL	ULS-28X5HMIL

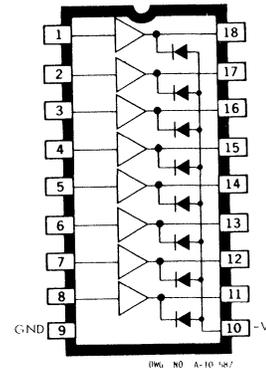
‡Types 2021, 2022, 2023, 2024, 2025, 2821, 2822, 2823, 2824, and 2825 not available in 'R' package.

## SERIES 2580 SOURCE DRIVERS

Designed for high voltage, high current source driving applications.

### FEATURES:

- Output Voltage,  $V_{CE} = -50$  V (Basic part) or  $-80$  V (add -1 after package designator — UDN-2580A-1)
- Input Voltage,  $V_{IN} = -30$  V
- Output Current,  $I_{OUT} = -500$  mA  
Ground Terminal Current,  $I_{GND} = 3$  A
- Hermetically-Sealed Package to MIL-M-38510
- High Reliability Screening to MIL-STD-883
- Operating Temperature Range:
  - 0°C to +70°C (UDN Series)
  - 40°C to +85°C (UDS Series R Packaged Devices)
  - 55°C to +125°C (UDS Series H Packaged Devices)
- Package Configurations:
  - Plastic (18-pin) Dual In-Line A
  - Hermetic (18-pin) Dual In-Line H
  - Ceramic (18-pin) Dual In-Line R



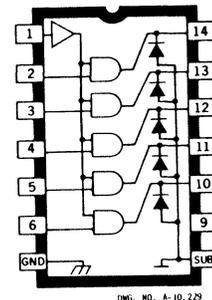
UDN-2580A/R  
UDS-2580H/R  
UDS-2580HMIL

## SERIES 2950 RELAY DRIVERS

These devices are chiefly intended as interface circuits for telecommunication relays and similar loads, but also have additional application potential. The enable pin must be high ( $\geq 5.0$  V for 2956 and  $\geq 2.4$  V for 2957) for operation of the outputs, while a low logic 0 on the enable pin inhibits all the outputs. The 2956 is intended for MOS interface applications, the 2957 for TTL, LSTTL, and 5 V CMOS applications.

### FEATURES:

- Output Breakdown Voltage:  $-80$  V each output
- Output Source Current : 500 mA Max. (each output)
- Operating Temperature Range: 0°C to +70°C
- Two Package Configurations:
  - Plastic Package (14-pin) Dual In-Line A
  - Ceramic Package (14-pin) Dual In-Line R



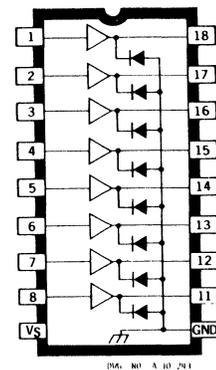
UDN-2956A  
UDN-2956R  
UDN-2957A  
UDN-2957R

## SERIES 2980 SOURCE DRIVERS

The 2980 series are eight channel arrays designed for general purpose high voltage/high current sourcing applications. Output loads range from LEDs, relays, solenoids, stepping motors, lamps, etc. The 2981 and 2983 are intended for TTL, DTL, and 5 V CMOS interface applications while the 2982 and 2984 are intended for 12 V CMOS and PMOS logic interface.

### FEATURES:

- Output Breakdown Voltage: +50 V (2981, 2982), +80 V (2983, 2984)
- Output Source Current (each output):  $-350$  mA nominal,  $-500$  mA max.
- Operating Temperature Range:
  - 0°C to +70°C (UDN Series)
  - 40°C to +85°C (UDS Series R Packaged Devices)
  - 55°C to +125°C (UDS Series H Packaged Devices)
- Package Configurations:
  - Plastic (18-pin) Dual In-Line A
  - Hermetic (18-pin) Dual In-Line H
  - Ceramic (18-pin) Dual In-Line R
- Hermetically-Sealed Package to MIL-M-38510
- High-Reliability Screening to MIL-STD-883



UDN-2981A/R    UDS-2981H/R/HMIL  
UDN-2982A/R    UDS-2982H/R/HMIL  
UDN-2983A/R    UDS-2983H/R/HMIL  
UDN-2984A/R    UDS-2984H/R/HMIL

## SERIES 2060 and 2070 DARLINGTON SWITCHES

These high-voltage, high-current Darlington arrays are monolithic bipolar devices especially designed for switching applications and may control loads of up to 480 watts (1.5 A per output, 80 V, 26% duty cycle).

The 2061 thru 2077 devices are intended for interfacing from low-level logic to peripheral loads such as relays, solenoids, d-c and stepping motors, multiplexed LED and incandescent displays, heaters, and similar high-voltage, high-current loads.

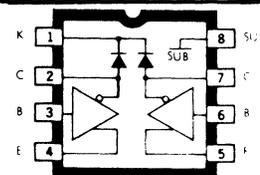
### FEATURES:

- 1.5 A Output Current (each switch)
- Package Power Dissipation to 2 W
- High Current Gains: 800 min. (each switch)
- Hermetically-Sealed Packages to MIL-M-38510
- High-Reliability Screening to MIL-STD-883, Class B
- Operating Temperature Range:
  - 0°C to +70°C (ULN Series)
  - 55°C to +125°C (ULS Series)

Type Number	V <sub>IN</sub> (Max)	V <sub>CEX</sub> (Max)	V <sub>CE(SUS)</sub> (Min)	Application
2061	30 V	50 V	35 V	TTL, DTL, Schottky
2062	60 V	80 V	50 V	TTL, and 5 V CMOS
2064	15 V	50 V	35 V	TTL, DTL, Schottky
2065	15 V	80 V	50 V	TTL, and 5 V CMOS
2066	30 V	50 V	35 V	6 to 15 V CMOS
2067	30 V	80 V	50 V	and PMOS
2068	15 V	50 V	35 V	TTL, DTL, Schottky
2069	15 V	80 V	50 V	TTL, and 5 V CMOS
2070	30 V	50 V	35 V	6 to 15 V CMOS
2071	30 V	80 V	50 V	and PMOS
2074	30 V	50 V	35 V	General Purpose
2075	60 V	80 V	50 V	
2076	30 V	50 V	35 V	6 to 15 V CMOS and PMOS
2077	60 V	80 V	50 V	

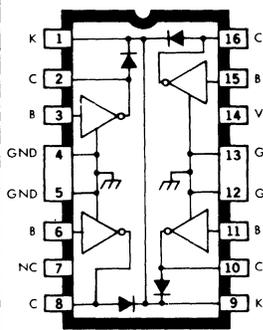
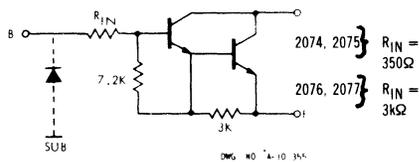
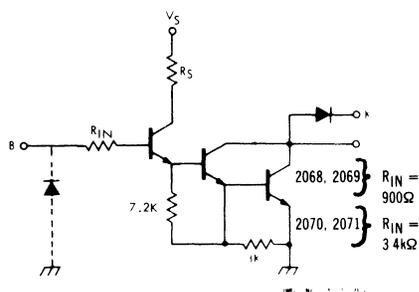
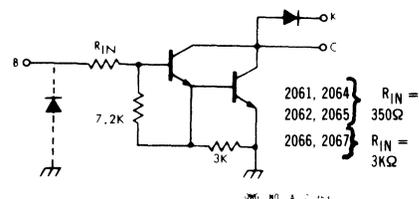
### Package Configurations:

- Plastic (16-pin) Dual In-Line B
- Hermetic (16-pin) Dual In-Line H
- Plastic (8-pin) Dual In-Line M

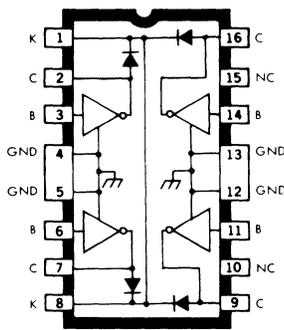


ULN-2061M  
ULN-2062M

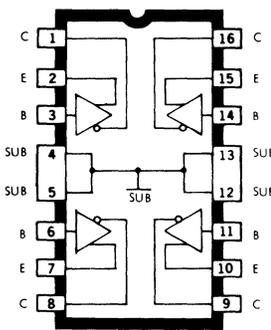
### PARTIAL SCHEMATICS (each driver)



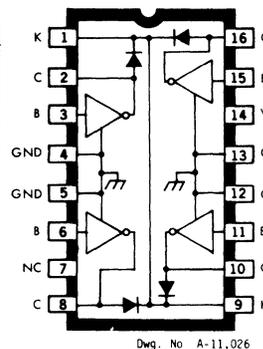
ULN-2064B  
ULN-2065B



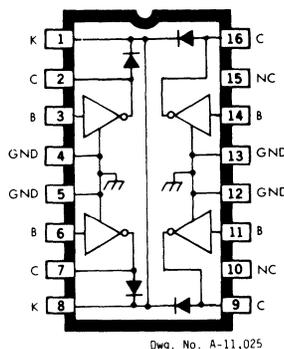
ULN-2068B  
ULN-2069B



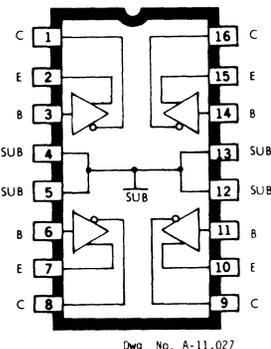
ULN-2074B  
ULN-2075B



ULS-2064H/HMIL  
ULS-2065H/HMIL



ULS-2068H/HMIL  
ULS-2069H/HMIL



ULS-2074H/HMIL  
ULS-2075H/HMIL

### UDN-2841B thru UDN-2846B QUAD 1.5 AMPERE DRIVERS

This series of quad Darlington based switches is especially designed for high-current, high-voltage peripheral driver applications. It is intended to provide solutions to interface problems involving electronic discharge printers, d-c motor drive (bipolar or unipolar), telephone relays, PIN diodes, LEDs, and other high-current loads operating from negative supplies.

Types UDN-2841B and UDN-2842B are intended for sinking applications in which the load is connected to ground and the IC device switches the negative supply. The input PNP transistor in each driver serves as a level translator and the first NPN stage provides sufficient current gain to drive the output Darlington.

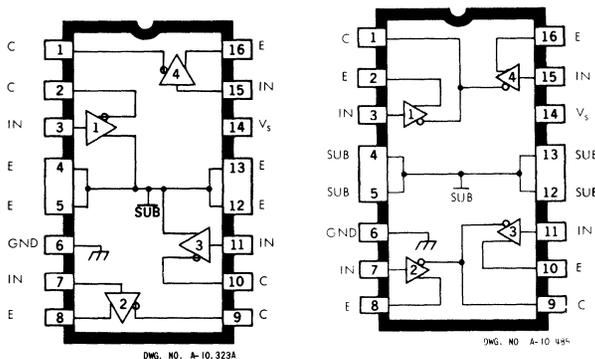
Type UDN-2843B and UDN-2844B quad drivers are primarily intended for switching the ground end of loads which utilize negative supply voltages. The NPN Darlington emitter follower outputs are operated as emitter followers in this application.

Type UDN-2845B and UDN-2846B devices are sink-and-source combinations in a single dual in-line package. Either device can be used for bipolar switching applications in which both ends of the load are floating.

The UDN-2841B, UDN-2843B, and UDN-2845B ICs are intended for use with 5 V TTL, Schottky TTL, DTL, and CMOS logic. The UDN-2842B, UDN-2844B, UDN-2845B, and UDN-2846B feature a higher input impedance and are intended for use with 12 V to 20 V PMOS and CMOS logic.

#### FEATURES:

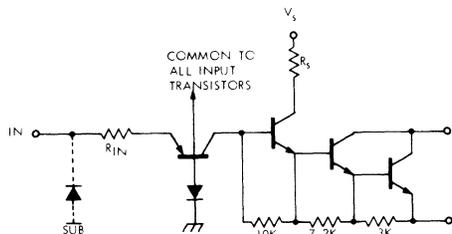
- Inputs Compatible with DTL/TTL/LS TTL/CMOS/PMOS
- High Voltage Output: -50 V
- High Current Gain
- Sink from Negative Supply: UDN-2841B/UDN-2842B
- Source to Negative Supply: UDN-2843B/UDN-2844B
- Sink & Source Combination: UDN-2845B/UDN-2846B
- Operating Temperature Range: 0°C to +70°C
- Plastic Package (16-pin) Dual In-Line B



**UDN-2841B, UDN-2842B,  
UDN-2845B, UDN-2846B**

**UDN-2843B, UDN-2844B**

#### SCHEMATIC (each driver)

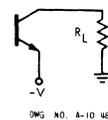


Type Number	Resistor Values in k $\Omega$			
	Amplifier 1 & 3		Amplifier 2 & 4	
	R <sub>IN</sub>	R <sub>S</sub>	R <sub>IN</sub>	R <sub>S</sub>
UDN-2841B	2.6	12	2.6	12
UDN-2842B	8.4	12	8.4	12
UDN-2843B	2.6	0.8	2.6	0.8
UDN-2844B	8.4	0.8	8.4	0.8
UDN-2845B	2.6	12	2.6	0.8
UDN-2846B	8.4	12	8.4	0.8

NOTE: The substrate terminals must be tied to the most negative point in the external circuit to maintain isolation between transistors and to provide for normal device operation.

#### DEVICE SELECTION GUIDE

Type Number	V <sub>S</sub>	V <sub>IN</sub>	Application
UDN-2841B	10 V	10 V	TTL, DTL, 5 V CMOS; current sink
UDN-2842B	15 V	15 V	12-20 V PMOS & CMOS; current sink
UDN-2843B	10 V	10 V	TTL, DTL, 5 V CMOS; current source
UDN-2844B	15 V	15 V	12-20 V PMOS & CMOS; current source
UDN-2845B	10 V	10 V	TTL, DTL, 5 V CMOS; source & sink
UDN-2846B	10 V	15 V	12-20 V PMOS & CMOS; source & sink



DMG. NO. A-10 489

Current Sink



DMG. NO. A-10 490

Current Source

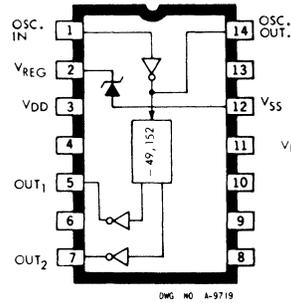
## UCN-4103A/23M OSCILLATOR/FREQUENCY DIVIDERS

Specifically designed for use in automotive applications, the UCN-4103A/23M CMOS circuits consist of an oscillator inverter, a frequency divider, and buffer amplifiers. Only a minimum number of external components are needed for a complete clock.

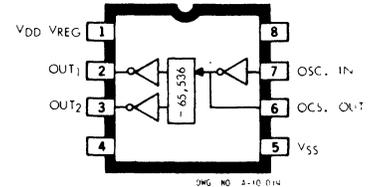
The UCN-4103A Oscillator/Frequency Divider is furnished in a standard 14-pin dual in-line plastic 'A' package. The UCN-4123M is furnished in a standard 8-pin dual in-line plastic 'M' package.

### FEATURES:

- Metal Gate Ion-Implanted CMOS
- Internal 12 V Regulator
- Buffered Outputs
- Operating Temperature Range:  $-30^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$



UCN-4103A



UCN-4123M

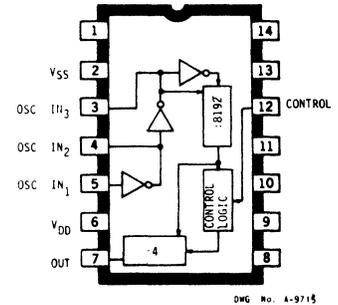
## UCN-4105A OSCILLATOR/FREQUENCY DIVIDER

The UCN-4105A is a low-threshold CMOS circuit consisting of 3 oscillator inverters, a 15-stage ripple counter, and associated control logic. In normal operation, the 18.2 Hz oscillator frequency is divided by  $2^{14}$  or  $2^{15}$  to provide an output pulse every 15 or 30 minutes. By adjustment of the three external components, other timing periods may be obtained.

This device is available in a 14-pin dual in-line plastic 'A' package.

### FEATURES:

- Low Threshold, Metal Gate, Ion-Implanted CMOS
- 2 V to 5 V Operation
- Buffered Outputs
- Static Charge Protection
- Operating Temperature Range:  $-30^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$



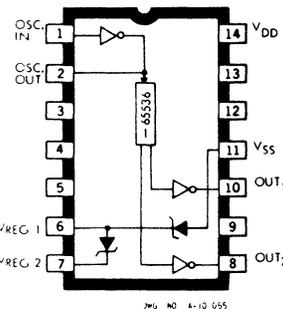
## UCN-4112 OSCILLATOR/FREQUENCY DIVIDER

Consisting of an oscillator inverter, a frequency divider, buffer amplifiers, and two Zener diode regulators, the Series UCN-4112 low-threshold CMOS circuits are designed for synchronous motor applications. These devices are operable over a wide temperature range, over a wide supply voltage range, and feature very low power consumption.

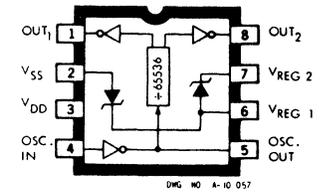
The UCN-4112A Oscillator/Frequency Divider is furnished in a standard 14-pin dual in-line plastic 'A' package. The UCN-4112M is furnished in a standard 8-pin dual in-line 'M' package.

### FEATURES:

- Metal Gate Ion-Implanted CMOS
- Internal Zener Diode Regulator
- Buffered Outputs
- Operating Temperature Range:  $-30^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$



UCN-4112A



UCN-4112M

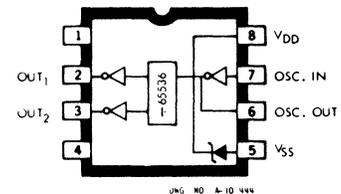
## UCN-4116M OSCILLATOR/FREQUENCY DIVIDER

Specifically designed for use in automotive applications, the UCN-4116M oscillator/frequency divider will drive synchronous clock motors in a push-pull configuration. The Zener diode regulator serves the dual function of voltage regulation and protection from automotive electrical system transients, spikes, and noise.

The UCN-4116M oscillator/frequency divider is supplied in a standard 8-pin "mini-DIP" dual in-line plastic 'M' package.

### FEATURES:

- Metal Gate Ion-Implanted CMOS
- Internal Zener Diode Regulator
- Buffered Outputs
- Operating Temperature Range:  $-30^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$



Sprague BiMOS technology (combination of CMOS logic with bipolar buffers) has been used to provide new state-of-the-art interface between microprocessors and vacuum fluorescent displays, relays, and other high-current loads.

## UCN-4401A and UCN-4801A BiMOS LATCH/DRIVERS

### FEATURES

- 500 mA Output Sink Current Capability
- 50 Volt Output
- Output Transient Protection
- CMOS, PMOS, NMOS, TTL Compatible Inputs
- Internal Pull-Down Resistors
- Low-Power CMOS Latches
- Operating Temperature Range: 0°C to +70°C

These high-voltage, high-current latch/drivers are comprised of four or eight CMOS data latches, a bipolar Darlington transistor driver for each latch, and CMOS control circuitry for the common CLEAR, STROBE, and DUTY CYCLE CONTROL functions. The bipolar/MOS combination provides an extremely low-power latch with maximum interface flexibility.

Information present at an input is transferred to its latch when the STROBE is high. A high CLEAR input will set all latches to the output OFF condition regardless of the data or STROBE input levels. A high DUTY CYCLE CONTROL will set all outputs to the OFF condition regardless of any other input conditions. When the DUTY CYCLE CONTROL is low, the output depend on the state of their respective latches.

### TRUTH TABLE

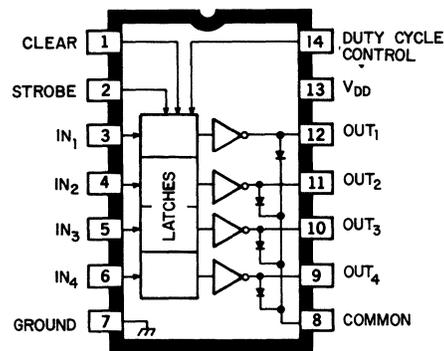
IN <sub>N</sub>	STROBE	CLEAR	DUTY CYCLE CONTROL	OUT <sub>N</sub>	
				t-1	t
0	1	0	0	X	OFF
1	1	0	0	X	ON
X	X	1	X	X	OFF
X	X	X	1	X	OFF
X	0	0	0	ON	ON
X	0	0	0	OFF	OFF

X = irrelevant

t-1 = previous output state

t = present output state

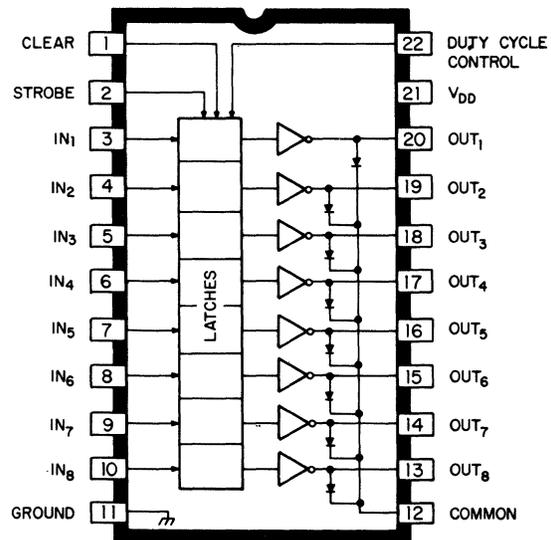
The UCN-4401A 4-latch device is furnished in a standard 14-pin dual in-line plastic package. The UCN-4801A 8-latch device is furnished in a 22-pin dual in-line plastic package with lead centers on 0.400" (10.16 mm) spacing. All outputs are pinned opposite their respective inputs to simplify circuit board layout.



DWG. NO. A-10,499

14-pin dual in-line plastic 'A' package

TYPE UCN-4401A



DWG. NO. A-10,498

22-pin dual in-line plastic 'A' package

TYPE UCN-4801A

## UCN-4805A and UCN-4806A LATCHED DECODER/DRIVERS

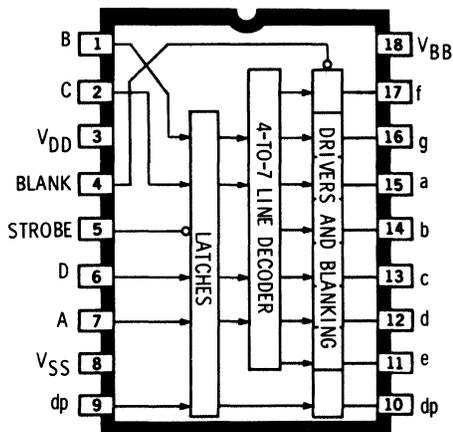
### FEATURES

- High-Voltage Source Outputs
- CMOS, PMOS, NMOS, TTL Compatible Inputs
- Low-Power CMOS Latches
- Hexadecimal Decoding
- Internal Pull-Up/Pull-Down Resistors
- Wide Supply Voltage Range
- Operating Temperature Range: 0°C to +70°C

Designed for use in high-voltage vacuum fluorescent display driver applications, the UCN-4805A and UCN-4806A latched decoder/drivers combine CMOS logic with bipolar source outputs. Both devices consist of eight high-voltage bipolar sourcing outputs with internal pull-down resistors and CMOS input latches, hexadecimal decoder, and control circuitry (strobe and blanking).

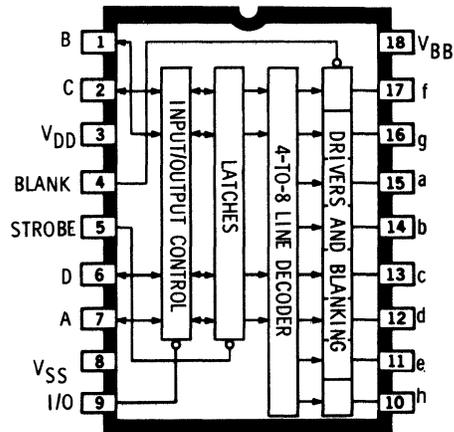
The UCN-4805A BiMOS latched decoder/driver is intended to serve as the segment driver with standard 7-segment displays incorporating a colon or decimal point. The UCN-4806A modification is designed for use with centered "1" (9-segment) displays. It has an I/O input to permit interrogating the input latches for error-checking purposes. Both ICs use hexadecimal decoding to display 0 - 9, A, b, C, d, E, and F.

Inputs				Character	
D	C	B	A		
0	0	0	0	Zero	
0	0	0	1	One	
0	0	1	0	Two	
0	0	1	1	Three	
0	1	0	0	Four	
0	1	0	1	Five	
0	1	1	0	Six	
0	1	1	1	Seven	
1	0	0	0	Eight	
1	0	0	1	Nine	
1	0	1	0	A	
1	0	1	1	b	
1	1	0	0	C	
1	1	0	1	d	
1	1	1	0	E	
1	1	1	1	F	



Dwg. No. A-10,984

**TYPE UCN-4805A**



Dwg. No. A-10,983

**TYPE UCN-4806A**

**18-pin dual in-line 'A' package**

## 8- AND 10-BIT DISPLAY DRIVERS

### FEATURES

- High-Voltage Source Outputs
- CMOS, PMOS, NMOS, TTL Compatible Inputs
- Low-Power CMOS Latches
- Internal Pull-Down Resistors
- Wide Supply Voltage Range
- Operating Temperature Range: 0°C to +70°C

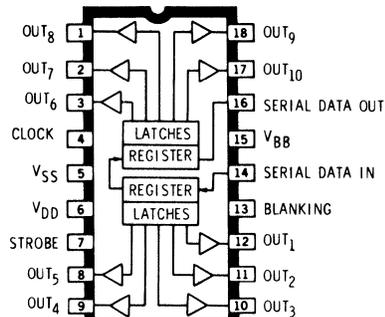
Combining low-power CMOS Logic with bipolar source drivers, the UCN-4810A (serial input) and UCN-4815A (parallel input) BiMOS 8- and 10-bit latched drivers will simplify many display systems. Although primarily designed for use with vacuum fluores-

cent displays, these devices can also be used with LED and incandescent displays within their output limitations of 60 V and 40 mA per driver.

Both devices have CMOS inputs which provide for minimum loading and are compatible with standard CMOS, PMOS, and NMOS logic. The use of CMOS also allows operation over a supply voltage range of 5 V to 15 V.

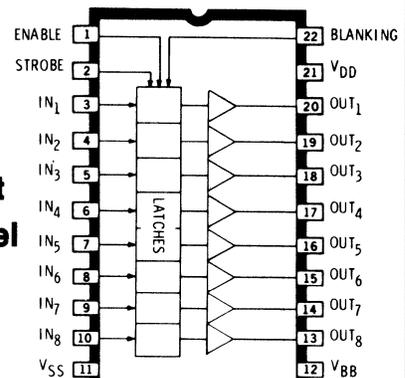
When combined with each other, or with the UCN-4805A or UCN-4806A latched hexadecimal decoder/drivers, the UCN-4810A and UCN-4815A latched drivers may be used to implement a minimum component display sub-system requiring few or no discrete components.

**UCN-4810A 10-Bit  
Serial-to-Parallel  
Display Driver**



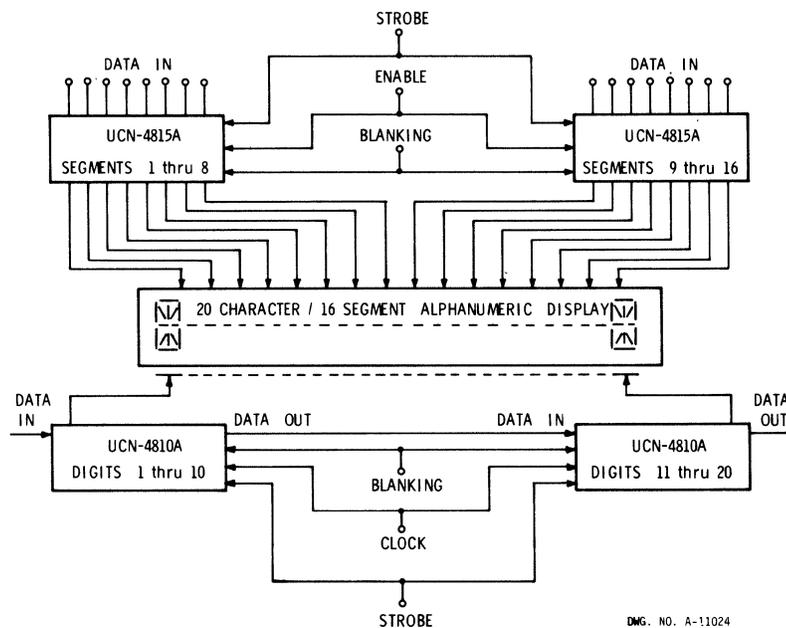
**18-pin plastic  
dual in-line 'A' package**

**UCN-4815A 8-Bit  
Parallel-to-Parallel  
Display Driver**



**22-pin plastic  
dual in-line 'A' package**

### TYPICAL APPLICATION



DWG. NO. A-11024

## SERIES TPQ QUAD TRANSISTOR ARRAYS

The Sprague Series TPQ quad transistor arrays are general-purpose silicon transistor arrays consisting of four independent transistors. Shown are eight NPN types, Five PNP types, and nine NPN/PNP dual complementary pairs.

All of these devices are furnished in a 14-lead dual in-line plastic A package. The molded package is identical to that used in most consumer integrated circuits and offers superior mechanical protection during insertion into printed wiring boards.

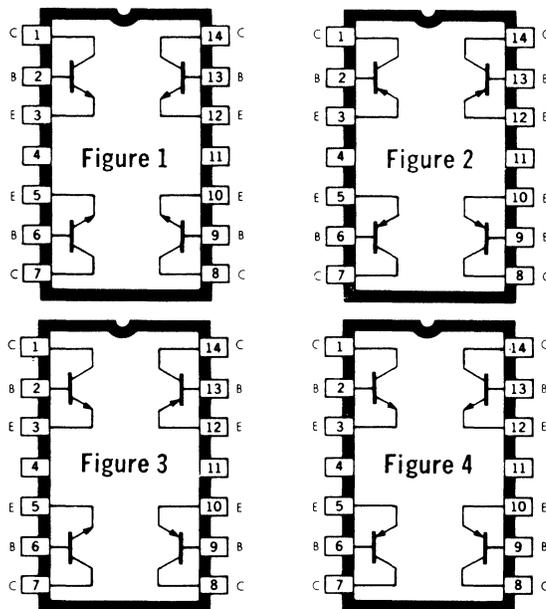
### TYPICAL RATINGS (Max.)

Power Dissipation,  $P_D$   
 (each transistor) ..... 500 mW  
 (total package) ..... 1700 mW\*

Operating Temperature  
 Range,  $T_A$  ..... 0°C to +85°C

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

\*Derate at the rate of 1.79 mW/°C above  $T_A = +55^\circ\text{C}$



### STANDARD RATINGS

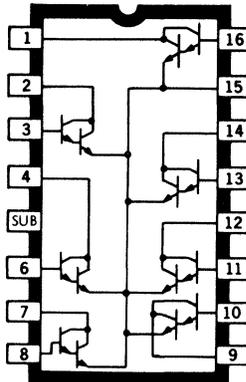
Type No.	$BV_{CBO}$	$BV_{CEO}$	$BV_{EBO}$	$I_{CBO}$	D-C Current Gain, $h_{FE}$		$I_C$ & $V_{CE}$	$f_T$	$C_{ob}$	$V_{CE(SAT)}$		Similar Discrete Devices	
	V Min.	V Min.	V Min.	nA Max.	Limits @	mA				V	MHz Min.		pF Max.
<b>Four NPN Devices - Figure 1</b>													
TPQ2221	60	40	5	50	40	—	150	10	200	8.0	400	150	2N2221
TPQ2222	60	40	5	50	100	—	150	10	200	8.0	400	10	2N2222
TPQ2369	40	15	4.5	400	40	120	10	10	500	4.0	250	10	2N2369
TPQ2483	60	40	6	20	100	—	0.1	5	50	6.0	350	1.0	2N2483
TPQ2484	60	40	6	20	200	—	0.1	5	50	6.0	350	1.0	2N2484
TPQ3724	50	30	5	500	35	—	100	1	250	8.0	450	500	2N3724
TPQ3725	60	40	5	500	35	200	100	1	250	10.0	450	500	2N3725
TPQ3725A	70	50	5	500	40	—	100	1	200	10.0	450	500	2N3725A
TPQ3904	60	40	6	50	75	—	10	1	250	4.0	200	10	2N3904
TPQ5550	160	140	6	100	60	—	10	5	100	6.0	250	50	2N5550
TPQ5551	180	160	6	50	80	—	10	5	100	6.0	200	50	2N5551
TPQA05	60	60	4	100	50	—	10	1	100	10.0	250	100	MPSA05
TPQA06	80	80	4	100	50	—	10	1	100	10.0	250	100	MPSA06
<b>Four PNP Devices - Figure 2</b>													
TPQ2906	60	40	5	50	40	—	150	10	200	8.0	400	150	2N2906
TPQ2907	60	40	5	50	100	—	150	10	200	8.0	400	150	2N2907
TPQ2907A	60	40	5	20	75	—	10	10	200	8.0	400	150	2N2907A
TPQ3798	60	40	5	10	150	—	0.1	5	60	4.0	250	1.0	2N3798
TPQ3799	60	60	5	10	300	—	0.1	5	60	4.0	250	1.0	2N3799
TPQ3906	40	40	5	50	75	—	10	1	200	4.5	250	10	2N3906
TPQ4258	12	12	4.5	10	30	120	10	.3	700	3.0	150	10	2N4258
TPQ4354	60	60	5	50	50	—	10	10	100	30.0	150	15	2N4354
TPQ5400	130	120	5	100	40	180	10	5	100	6.0	200	10	2N5400
TPQ5401	160	150	5	50	60	240	10	5	100	6.0	200	10	2N5401
TPQA56	80	80	4	100	50	—	10	5	100	15.0	250	100	MPSA56
<b>Two NPN/Two PNP Devices - Figure 3</b>													
TPQ6001	60	30	5	30	40	—	150	10	200	8.0	400	150	2N2221/2N2906
TPQ6002	60	30	5	30	100	—	150	10	200	8.0	400	150	2N2222/2N2907
TPQ6100	60	40	5	10	75	—	1.0	5	50	4.0	250	1.0	2N2483/2N3798
TPQ6100A	60	45	5	10	150	—	1.0	5	50	4.0	250	1.0	2N2484/2N3799
<b>Two NPN/Two PNP Devices - Figure 4</b>													
TPQ6501	60	30	5	30	40	—	150	10	200	8.0	400	150	2N2221/2N2906
TPQ6502	60	30	5	30	100	—	150	10	200	8.0	400	150	2N2222/2N2907
TPQ6600	60	40	5	10	75	—	1.0	5	50	4.0	250	1.0	2N2483/2N3798
TPQ6600A	60	45	5	10	150	—	1.0	5	50	4.0	250	1.0	2N2484/2N3799
TPQ6700	40	40	5	50	70	—	10	1	200	4.5	250	10	2N3904/2N3906

## ULN-2031A, ULN-2032A, and ULN-2033A

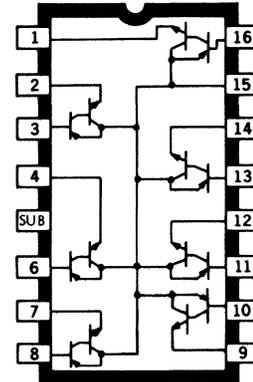
Type ULN-2031A, ULN-2032A, and ULN-2033A high-current Darlington transistor arrays are comprised of seven Darlington pairs on a common monolithic substrate. The ULN-2031A consists of 14 NPN transistors connected to form seven Darlington pairs with NPN action. The ULN-2032A ( $h_{FE} = 500$  min.) and the ULN-2033A ( $h_{FE} = 50$  min.) consists of seven NPN and seven PNP transistors connected to form seven Darlington pairs with PNP action. All devices feature a common emitter configuration.

These devices are especially suited for interfacing between MOS, TTL, or DTL outputs and 7-segment LED or tungsten filament indicators. Peak inrush currents to 100 mA are allowable. They are also ideal for a variety of other driver applications such as relay control and thyristor firing.

These arrays are housed in a plastic 16-pin dual in-line A package and are designed for 0°C to +85°C operation.



ULN-2031A



ULN-2032A  
ULN-2033A

## ULS-2045H, ULN-2046A, ULN-2046A-1, and ULN-2086A

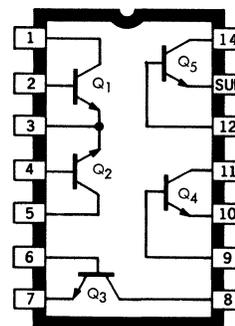
Each device is a general-purpose transistor array consisting of five NPN transistors on a single monolithic chip. Two transistors are internally connected to form a differential pair. Integrated circuit construction provides close electrical and thermal matching between each transistor.

This array is well-suited for a wide range of applications such as D-C to VHF signal processing systems; temperature-compensated amplifiers; custom designed differential amplifiers and discrete transistors in conventional circuits.

Two package configurations are available. Type ULN-2046A, ULN-2046A-1 and ULN-2086A are housed in a 14-pin plastic dual in-line A package and Type ULS-2045H is housed in a 14-pin hermetic dual in-line H package.

### FEATURES:

- Operation from D-C to 120 MHz
- Wide Operating Current Range
- Two matched pairs of transistors (ULS-2045H, ULN-2046A, and ULN-2046A-1):  $V_{BE}$  matched  $\pm 5$  mV; Input Offset Current = 2  $\mu$ A max. at  $I_C = 1$  mA
- Low Noise Figure: 3.2 dB at 1 kHz
- Operating Temperature Range: ULS-2045H = -55°C to +125°C; ULN-2046A, ULN-2046A-1, and ULN-2086A = 0°C to +85°C



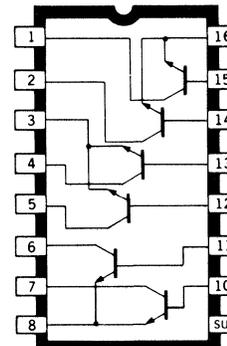
DWG. NO. A-10034

## ULN-2047A THREE DIFFERENTIAL AMPLIFIERS

The ULN-2047A is a monolithic NPN multiple transistor array comprising three independent differential amplifiers. It is specifically intended for use in switching applications such as electronic organ keyboards. All base leads are brought out on one side of the 16-lead plastic dual in-line package to simplify printed wiring board layout. A separate substrate connection permits maximum circuit design flexibility.

### FEATURES:

- 5 mV Differential Input Offset Voltage
- High Gain: 75 min. at 10 mA
- Plastic Package (16-pin) Dual In-Line A
- Operating Temperature Range: 0°C to +85°C

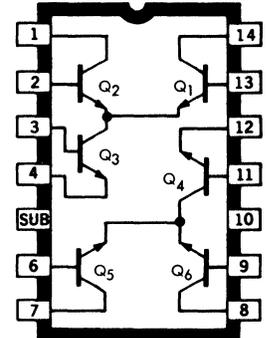


## ULN-2054A DUAL INDEPENDENT DIFFERENTIAL AMPLIFIER

The ULN-2054A is a transistor array consisting of six NPN transistors on a single monolithic chip. The transistors are internally interconnected to form two independent differential amplifiers.

The ULN-2054A is intended for a wide range of applications requiring extremely close electrical and thermal matching characteristics. Some applications are: cascade limiter circuits; balanced mixer circuits; balanced quadrature/synchronous detector circuits; balanced (push-pull) cascade/sense/IF amplifier circuits; or in almost any multifunction system requiring RF/Mixer/Oscillator, converter/IF functions.

- FEATURES:**
- Independently accessible inputs and outputs
  - Maximum input offset voltage:  $\pm 5\text{mV}$
  - Plastic Package (14-pin) Dual In-Line A
  - Operating Temperature Range:  $0^\circ\text{C}$  to  $+85^\circ\text{C}$



DWG. NO. A-8035A

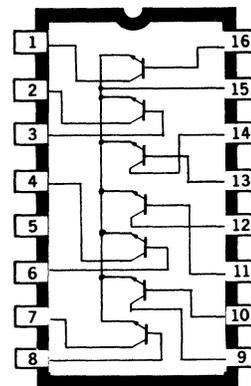
## ULN-2081A and ULN-2082A TRANSISTOR ARRAYS

Type ULN-2081A and ULN-2082A Transistor Arrays are comprised of seven high-current NPN transistors on a common monolithic substrate. The Type ULN-2081A is connected in a common-emitter configuration and the Type ULN-2082A is connected in a common-collector configuration.

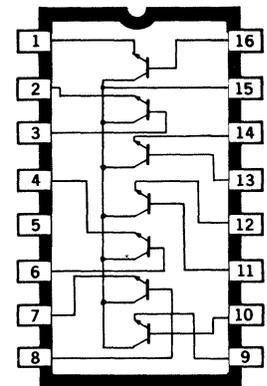
Both arrays are capable of directly driving seven segment displays and LED displays. They are ideal for a variety of other driver applications such as relay control and thyristor firing.

**FEATURES:**

- High  $I_C$ : 100 mA max.
- Low  $V_{CE(SAT)}$ : 400 mV typ. at 50 mA
- Plastic Package (16-pin) Dual In-Line A
- Operating Temperature Range:  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$



ULN-2081A



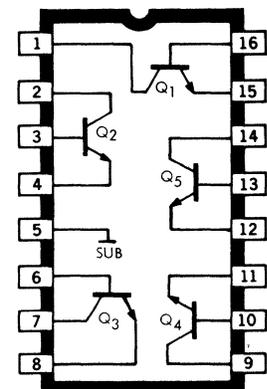
ULN-2082A

## ULN-2083A, ULN-2083A-1, ULS-2083H, ULS-2083H-1, ULS-2083HMIL, and ULS-2083H-1MIL 5-TRANSISTOR ARRAYS

Designed for use in general-purpose, medium-current (to 100 mA) switching and differential amplifier applications, the ULN-2083A, ULN-2083A-1, ULS-2083H, and ULS-2083H-1 transistor arrays each consist of five NPN transistors on a single monolithic chip. Two transistors are matched at low currents (1 mA) making them ideal for use in balanced mixer circuits, push-pull amplifiers, and other circuit functions requiring close thermal and offset matching.

**FEATURES:**

- Matched Pair ( $Q_1$  and  $Q_2$ ):  $V_{10}$  ( $V_{BE}$  matched) =  $\pm 5$  MV max.;  $I_{10}$  (at 1 mA) =  $2.5 \mu\text{A}$  max
- Low  $V_{CE(SAT)}$  = 0.7 V max. at 50 mA
- High  $I_C$  = 100 mA max.
- Package Configurations:
  - Plastic 16-pin Dual In-Line A
  - Hermetic 16-pin Dual In-Line H
- Hermetically-Sealed Packages to MIL-M-38510
- High-Reliability Screening to MIL-STD-883, Class B
- Operating Temperature Range:
  - $0^\circ\text{C}$  to  $+70^\circ\text{C}$  (ULN Series)
  - $-55^\circ\text{C}$  to  $+125^\circ\text{C}$  (ULS Series)



DWG. NO. A-10,232

Sprague Electric's Semiconductor Division has taken the advantages of Sprague-pioneered ion-implantation and directed them toward the design and manufacture of consumer entertainment products. With 'state-of-the-art' design and process capability, many new consumer entertainment integrated circuits are now available. Each of these provides performance advantages not

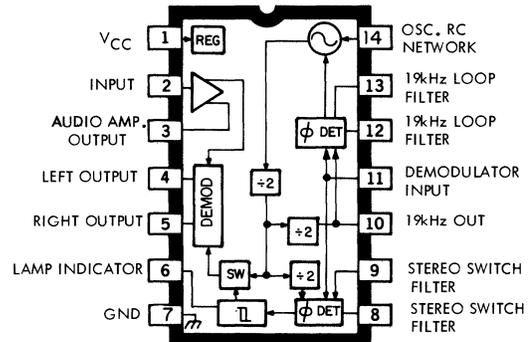
previously available with discrete fabrication techniques, while simultaneously reducing component count. With their proven reliability, Sprague ion-implanted integrated circuits not only save space in electronic equipment, but also provide enormous time and cost savings to consumer entertainment equipment manufacturers.

## ULN-2110A PHASE-LOCKED LOOP STEREO DECODER

The Type ULN-2110 monolithic Phase-Locked Loop FM Stereo Multiplex Decoder is used for decoding FM stereo multiplex signals into right and left audio channels while inherently suppressing SCA information when it is contained in the composite input signal. Internal functions include automatic mono/stereo mode switching and drive for an external stereo mode operation.

### FEATURES

- Low Number of External Parts - No Coils
- 75 mA Lamp Driving Capability
- 40 dB Channel Separation
- 8 to 14V Supply Voltage Range
- 75 dB SCA Rejection
- Operating Temperature Range:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Automatic Stereo/Mono Switching
- Stereo Indicator Lamp Driver with Current Limiting
- Plastic Package (14-pin) Dual In-Line A



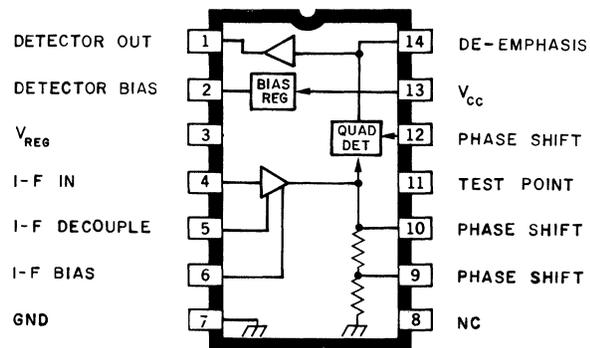
DWG. NO. A-9443A

## ULN-2111A and ULN-2113A \* F-M DETECTOR and LIMITERS

These devices are comprised of a three-stage limiter and a balanced product detector. The ULN-2111A finds wide application in 12-volt TV sound channels, F-M receivers, automatic frequency control systems and communication receivers, radar, etc. The ULN-2113A is designed for use in 8-volt portable or mobile systems.

### FEATURES:

- 55 dB min. High Voltage Gain at 4.5 MHz
- 400  $\mu\text{V}$  Threshold at 10.7 MHz
- Zener Diode Power Supply Regulation
- 12 Volt Nom. Supply Voltage
- 500 mVrms Recovered Audio at 10.7 MHz
- Operating Temperature Range:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Plastic Package (14-pin) Dual In-Line A

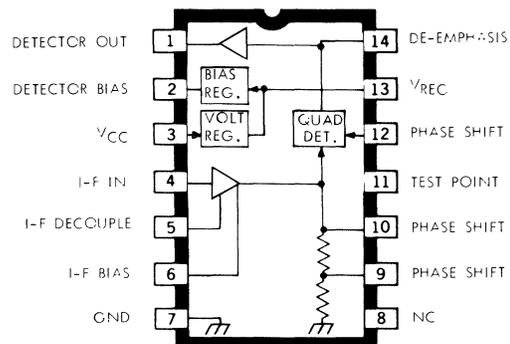


## ULN-2136A F-M, I-F AMPLIFIER/LIMITER AND QUADRATURE DETECTOR

The ULN-2136A combines a limiting amplifier, quadrature discriminator and a voltage regulator in a single monolithic IC. Although primarily for F-M receivers, the device is quite versatile for use in any F-M demodulator application.

### FEATURES

- Improved AFC Stability
- Low Harmonic Distortion
- No Detector Unbalance
- Single Coil Tuning
- Line and Load Regulation
- Operating Temperature Range:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Plastic Package (14-pin) Dual In-Line A



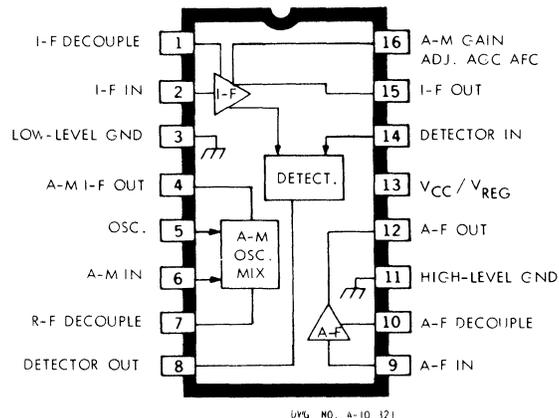
DWG. NO. A-9443A

## ULN-2204A/TDA1083 A-M/F-M RADIO SYSTEM

The ULN-2204A is a monolithic integrated circuit designed primarily for use in A-M/F-M radios and similar applications. It will perform such functions as A-M R-F amplifier, A-M local oscillator, A-M/F-M I-F amplifier, A-M/F-M detectors, A-M AGC, F-M AFC control voltage, audio preamplifier, audio driver, and audio power output.

### FEATURES:

- Good Sensitivity
- Low Harmonic Distortion
- Wide Operating Voltage Range
- Operating Temperature Range:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Plastic Package (16 pin) Dual In-Line A
- Minimum System Parts Count
- Low Power Drain
- Class 'B' Power Amplifier
- D-C A-M/F-M Switching
- $40\ \mu\text{V}$  Limiting Threshold
- Excellent A-M Rejection

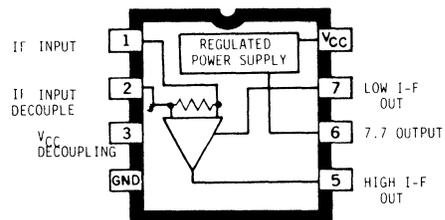


## ULN-2209M I-F GAIN BLOCK with VOLTAGE REGULATOR\*

The Type ULN-2209M four-stage limiting amplifier provides the function of an I-F gain block and is designed for use in communications and F-M receivers.

### FEATURES

- Gain at 10.7 MHz: 50 dB Typical
- Operating Voltage Range: 10 V — 20 V
- Excellent Temperature Stability
- Power Supply Rejection Ratio: 40 dB Typical
- Operating Temperature Range:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Plastic Package (8-pin) Dual In-Line M



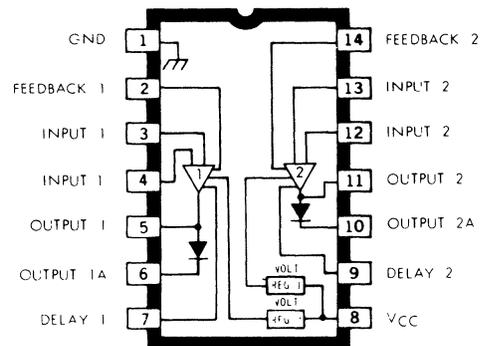
## ULN-2231A DUAL PREAMPLIFIER

The Type ULN-2231A Dual Preamplifier is a linear monolithic integrated circuit designed for use with low-level signals in low-noise applications. It offers outstanding value, performance, and reliability in both consumer and industrial products such as stereo tape players, microphone amplifiers, F-M stereo receivers, and phonograph amplifiers.

An integral voltage regulator eliminates the need for audio or r-f coupling. Internal feedback resistors are provided for NAB equalization.

### FEATURES

- Single Power Supply Operation
- High Input Impedance
- Wide Power Supply Range
- Matched Open Loop Voltage Gain
- Turn-On Delay
- Low External Parts Count



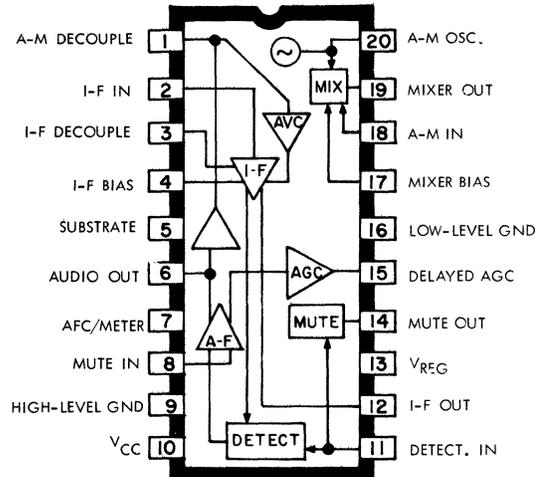
- Internal Schottky Diodes to Prevent Tape Marking During Turn-Off
- Internal Transient Protection
- Operating Temperature Range:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Plastic Package (14-pin) Dual In-Line A

## ULN-2240A A-M/F-M SIGNAL PROCESSING SYSTEM

Providing many bonus features such as delayed AGC for the R-F stage, an AFC drive circuit, inter-station (signal level) muting, and off-channel (deviation) muting, the ULN-2240A A-M/F-M signal processing system combines receiver F-M I-F functions and all A-M functions in a single monolithic integrated circuit.

### FEATURES

- 12 $\mu$ V Limiting Threshold
- Deviation/Level Muting
- Meter Drive
- Balanced A-M Mixer
- 5  $\mu$ V A-M Sensitivity
- D-C Mode Switching
- Internal Voltage Regulator
- Meets Dolby Noise Requirements
- Plastic Package 20-Pin Dual In-Line A

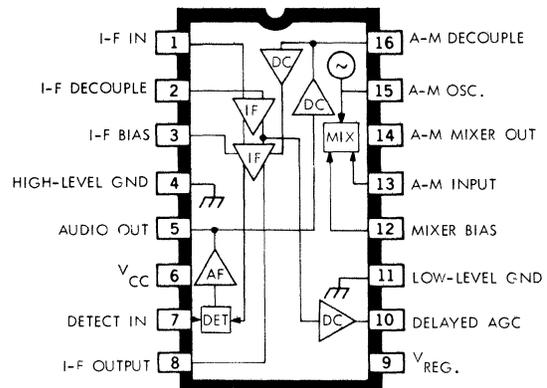


## ULN-2241A A-M/F-M SIGNAL PROCESSING SYSTEM

The ULN-2241A Signal Processing System was designed with carefull attention to the total system costs and performance requirements of modern automotive and high-quality home entertainment boradcast receivers. All F-M I-F functions and all A-M functions are provided on this "one-chip" receiver with minimum external parts count.

### FEATURES

- Low External Parts Count
- D-C A-M/F-M Switching
- 12  $\mu$ V Limiting Threshold
- 5  $\mu$ V A-M Sensitivity
- Low Harmonic Distortion
- Balanced A-M Mixer
- Internal Regulator
- Plastic Package 16-Pin Dual In-Line A



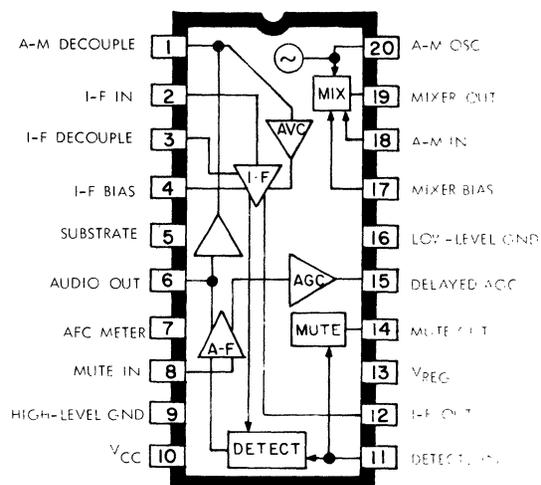
Rev. No. A-11,126

## ULN-2242A/TDA1090 A-M/F-M SIGNAL PROCESSING SYSTEM

Substantial simplification of A-M/F-M receiver design is possible with the ULN-2242A signal processing system with improved system performance and minimum external parts count. All F-M I-F functions and all A-M functions are provided in this monolithic integrated circuit.

### FEATURES:

- Low External Parts Count
- D-C A-M/F-M Switching
- 12 $\mu$ V Limiting Threshold
- 5  $\mu$ V A-M Sensitivity
- Low Harmonic Distortion
- Balanced A-M Mixer
- Meter Drive
- Internal Regulator
- Self-Contained Muting (Squelch)
- Operating Temperature Range: -40°C to +85°C
- Plastic Package (20-pin) Dual In-Line A

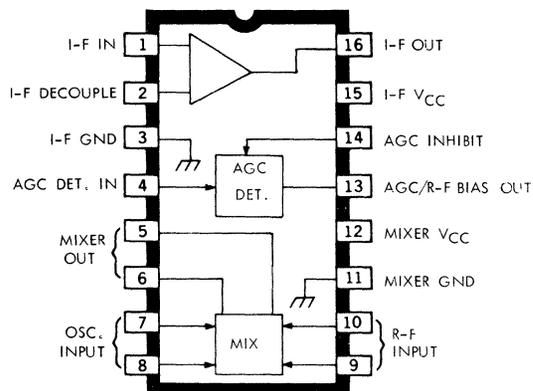


## ULN-2243A MIXER/I-F FOR F-M RADIO APPLICATIONS

Providing an important basic building block for use in F-M radio applications, the ULN-2243A mixer/I-F minimizes spurious responses from strong off-channel signals while providing an excellent noise figure, maximum desired signal gain and very-high I-F rejection.

### FEATURES:

- Doubly-Balanced Linear Mixer
- Very-High I-F Rejection
- 32 mmho Conversion Gain at 100 MHz
- 330  $\Omega$  I-F Input/Output Impedance
- 46 dB I-F Gain at 10.7 MHz
- AGC Detector for MOSFET R-F Stage
- Low External Component Count
- Plastic Package 16-Pin Dual In-Line



Draw. No. A-11,125

### ULN-2244A and ULN-2245A PHASE-LOCKED LOOP STEREO DECODERS

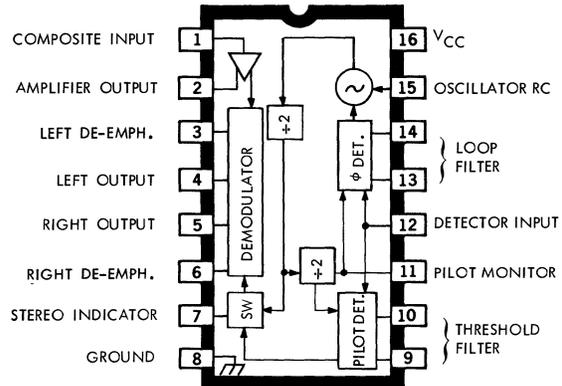
These monolithic integrated circuits are used for decoding stereo multiplexed signals in F-M receivers, while eliminating the tuning coils required to operate previous design stereo processors. The circuit creates a signal which is in phase with and of exactly double the 19 kHz pilot signal provided during stereo transmission. This 38 kHz subcarrier signal is used to demodulate the stereo information.

The stereo switch portion of the circuit is disabled during weak stereo signals or monaural broadcasts.

The 2244 has a high impedance output while the 2245 is designed for low impedance applications.

#### FEATURES:

- High Channel Separation
- Low T.H.D.
- High Power Supply Decoupling
- 100 mA Lamp Driver Capability
- High VCO Frequency Stability
- High Processing Gain



Dwg. No. A-9407B

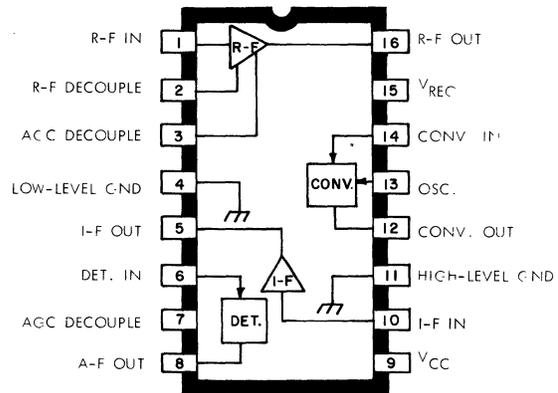
- Operating Voltage: 10.5 to 16 V
- Operating Temperature Range: -40°C to +85°C
- Plastic Package (16-pin) Dual In-Line A

### ULN-2249A A-M RADIO SYSTEM

The ULN-2249A A-M radio system consists of an R-F amplifier, converter, I-F amplifier, A-M detector, AGC amplifier, and bias voltage regulator. The low-level audio output can be used to drive a standard audio power amplifier such as the Sprague ULN-3701.

#### FEATURES:

- Low External Parts Count
- Internal Bias Regulator
- High AGC Ratio
- Low Distortion
- Good Sensitivity
- Operating Temperature Range: -40°C to +85°C
- Plastic Package (16-pin) Dual In-Line A



DWG. NO. A-10 435

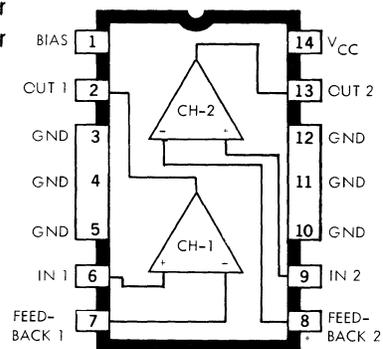
### ULN-2274B, ULN-2274B-1, ULN-2278B and ULN-2278B-1 DUAL AUDIO POWER AMPLIFIERS

These dual audio amplifiers are linear monolithic integrated circuits designed primarily for low-cost audio amplifiers in phonograph and radio applications. They are also ideally suited for industrial applications requiring high power output and reliable performance.

#### FEATURES:

- Low Distortion
- Low Quiescent Current
- Self Centering Bias
- High Input Impedance
- High Open Loop Gain
- High Peak Output Current
- Internal Current Limiting
- Thermal Shutdown
- High Channel Separation
- Internal Compensation Network
- Minimum External Components
- Operating Temp: -40°C to +85°C
- Plastic Package (14-Pin) Dual In-Line B

Type No.	Power Rating per Channel (Watts) RMS	V <sub>CC</sub> (Volts)		R <sub>L</sub> (ohms)
		Nom.	Max.	
ULN-2274B	1.0	9	22	8-16
ULN-2274B-1	1.5	9	22	8-16
ULN-2278B	2.0	9	26	8-16
ULN-2278B-1	2.5	9	26	8-16



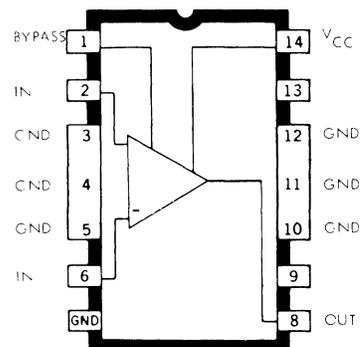
DWG. NO. A-9049B

## ULN-2280B and ULN-2281B AUDIO POWER AMPLIFIERS

These monolithic integrated circuits are designed for minimum external component requirements. They are ideally suited for applications in consumer, automotive, and communications designs. The ULN-2280B is rated for 2 watt max. applications; the ULN-2281B for 4 watt max. applications.

### FEATURES

- Low Distortion
- Low Quiescent Current
- 34 dB Internally Fixed Gain
- High Input Impedance
- Thermal Overload Protection
- Output Short Circuit Current Limiting
- Minimum External Components
- Supply Voltage Range: ULN-2280B, 9-26V; ULN-2281B, 9-32V



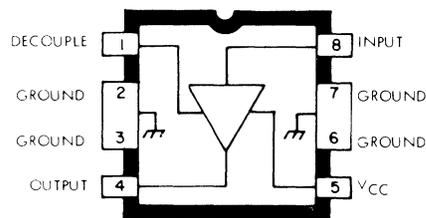
- Operating Temperature Range:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- ULN-2280B is replacement for LM380N, ULN-2281B for LM384N
- Webbed Plastic Package (14-pin) Dual In-Line B

## ULN-2283B, and ULN-2283B-1 LOW POWER AUDIO AMPLIFIERS

Designed primarily for use in low-cost phonographs and radio receivers, the ULN-2283B audio power amplifier is well-suited for use in battery-operated portable equipment.

### FEATURES:

- Wide Operating Voltage Range:
  - ULN-2283B ..... 3-15V
  - ULN-2283B-1 ..... 3-18V
- Low Quiescent Current Drain
- Short Circuit Protected
- Low External Parts Count
- Low Distortion
- 43 dB Voltage Gain
- Operating Temperature Range:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Plastic Package (8-pin) Dual In-Line B

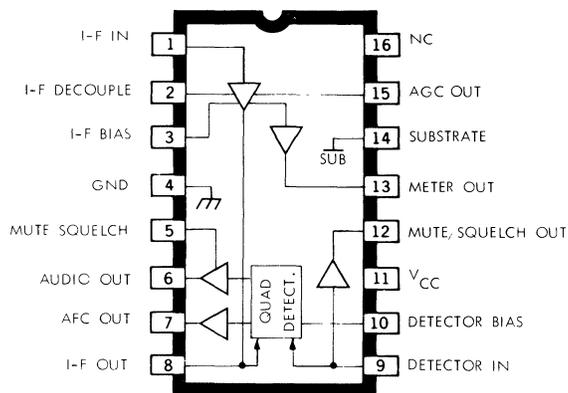


## ULN-2289A/TCA3089 I-F SYSTEM FOR F-M RECEIVER APPLICATIONS

Designed for use with low-output level tuners, each I-F system features a delayed AGC characteristic which will improve the performance of most F-M radio tuners.

### FEATURES:

- Wide Operating Voltage Range (8.5 to 16 V)
- Self-Contained Mute/Squelch
- Internal Voltage Regulator
- Low Distortion
- Single-Coil Tuning
- High Sensitivity (15  $\mu\text{V}$ )
- High Recovered Audio (425 mV)
- Direct Tuning Meter Drive
- Delayed AGC Output



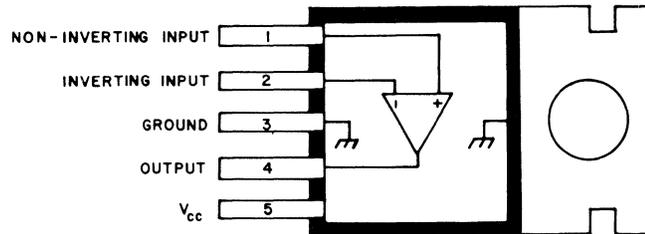
- Isolated AFC Output
- Operating Temperature Range:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Plastic Package (16-pin) Dual In-Line A

## ULN-3701Z/TDA2002, ULN-3701ZH, and ULN-3701ZV AUDIO POWER AMPLIFIERS

Designed specifically for driving low-impedance loads down to  $1.6 \Omega$ , the 3701 audio power amplifier is ideal for automotive radio, tape player, and CB applications and can deliver 15 W of audio in the bridge configuration or 5 W to 10 W single-ended.

### FEATURES:

- Low External Parts Count
- Low Distortion
- Class-B Operation
- Short Circuit Protected
- Thermal Overload Protected
- Low Noise
- High Output Voltage Swing
- Operating Temperature Range:  $-25^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$



### ● TO-220 Style Package:

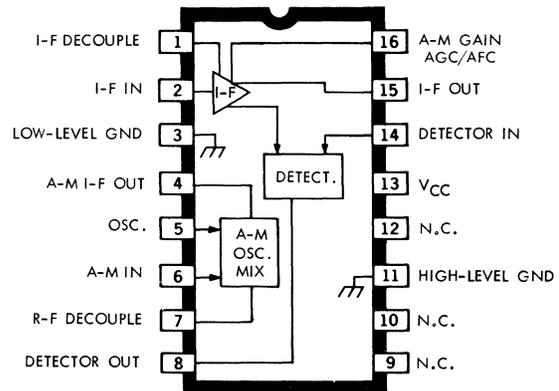
- ULN-3701Z Standard Leads
- ULN-3701ZH Horizontal Mounting
- ULN-3701ZV Vertical Mounting

## ULN-3804A A-M/F-M SIGNAL PROCESSOR

Designed for use in battery-operated portable radios or line-driven table radios, the ULN-3804A A-M/F-M signal processor is well-suited for low-cost applications requiring a low parts count and high performance standards.

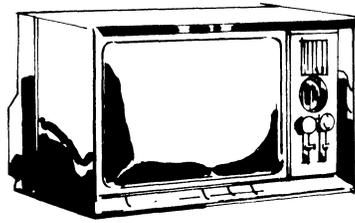
### FEATURES:

- Good Sensitivity
- Low Harmonic Distortion
- Wide Operating Voltage Range
- Excellent A-M Rejection
- Low Power Drain
- D-C A-M/F-M Switching
- $40 \mu\text{V}$  Limiting Threshold



Dwg. No. A-11,124

**GET MORE WITH SPRAGUE . . .**  
**MORE TYPES • MORE RATINGS**  
**MORE QUALITY • MORE VALUE**



Sprague also makes available additional consumer linear integrated circuits designed for TV applications. These devices are listed below. More specific information on these integrated circuits is available upon request.

Device Type	No. Pins	Description	Function					Engineering Bulletin No.*
			Chroma	Luma	AFT	Sound	Sync.	
ULN-2124A★	16	Chroma Oscillator	X	—	—	—	—	27113
ULN-2125A★	16	Video Signal Processor	—	—	—	—	X	27119
ULN-2127A★	14	Chroma Amplifier	X	—	—	—	—	27114
ULN-2211B	†	TV Sound System — 2 W	—	—	—	X	—	27110.30
ULN-2212B	†	TV Sound System — 1 W	—	—	—	X	—	27110.29
ULN-2216★	16	Luminance Processor	—	X	—	—	—	27104
ULN-2217A/TDA1327	14	Chroma Demodulator	X	—	—	—	—	27103.14
ULN-2219A/TBA396	14	Luma/Chroma Control	X	X	—	—	—	27104.20
ULN-2220A/TDA3950A	14	Chroma Processor	X	—	—	—	—	27113.21
ULN-2224A	14	Chroma Demodulator	X	—	—	—	—	27103.12
ULN-2227A★	16	Chroma Oscillator	X	—	—	—	—	27113.2
ULN-2228A★	14	Chroma Demodulator	X	—	—	—	—	27103.11
ULN-2229A★	14	Chroma Demodulator	X	—	—	—	—	27103.13
ULN-2260A	16	AGC, Sync., & Scan	—	—	—	—	X	27119.2
ULN-2261A	16	Luminance Amplifier	—	X	—	—	—	27104.10
ULN-2263A★	16	Chroma Amp./Demod.	X	—	—	—	—	27103.102
ULN-2264A★	14	Automatic Fine Tuner	—	—	X	—	—	27122.10
ULN-2268A★	16	Chroma Oscillator	X	—	—	—	—	27113.1
ULN-2269A★	16	Chroma Amp./Demod.	X	—	—	—	—	27103.100
ULN-2270Q/TDA1170	‡	Vert. Deflection	—	—	—	—	X	27124.10
ULN-2290B/TDA3190	16	TV Sound System — 1.5 W	—	—	—	X	—	27110.31
ULN-2290Q/TDA1190Z	‡	TV Sound System — 4 W	—	—	—	X	—	27110.31
ULN-2293A★	16	Chroma Amp./Demod.	X	—	—	—	—	27103.101
ULN-2294M★	8	Horiz. Processor	—	—	—	—	X	27106
ULN-2298A★	14	Chroma Processor	X	—	—	—	—	27113.10

\*Detailed data is given in the latest issue of the applicable Sprague Engineering Bulletin.

†Package B: Webbed Plastic 16-Pin

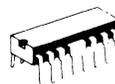
‡Package Q: 12-Pins and 2 Tabs



PACKAGE A  
14 PINS



PACKAGE A  
16 PINS



PACKAGE B  
16 PINS



PACKAGE M  
8 PINS



PACKAGE Q

★ Available until present stock is exhausted.

## SERIES 3000 MAGNETICALLY-ACTIVATED 'HALL EFFECT' SWITCHES

**UGN-3013T, UGN/UGS-3019T, UGN/UGS-3020T, UGN/UGS-3030T  
UGN-3201M, UGN-3203M and UGN-3220S DIGITAL SWITCHES**

These devices are magnetically-activated electronic switches utilizing the Hall Effect for sensing a magnetic field. Each circuit consists of a silicon Hall generator, amplifier, trigger, and output stage integrated with its own voltage regulator onto a monolithic silicon chip.

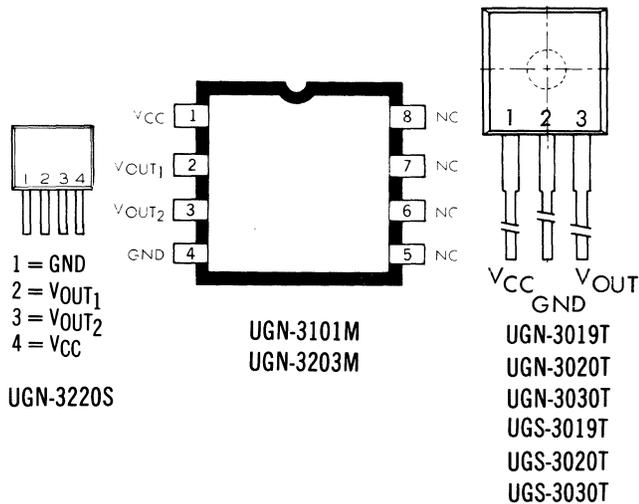
Circuit outputs can be interfaced directly with bipolar or MOS logic circuits.

### FEATURES

- Operable with a small permanent magnet
- High Reliability - eliminates contact wear, contact bounce; no moving parts
- Small size
- Constant amplitude output - independent of frequency
- Operating Temperature Range: 0°C to +70°C (UGN Series), -40°C to +150°C (UGS Series)
- Three Plastic Package Configurations:
  - Suffix 'M' = 8-pin Dual In-Line M
  - Suffix 'S' = 4-pin Single-Ended S
  - Suffix 'T' = 3-pin Single-Ended T

### CHARACTERISTICS

Type	Supply Voltage VCC (VDC)	Magnetic Flux Density in Gauss				Typical Hysteresis (Gauss)
		Operate		Release		
		Max.	Typ.	Typ.	Min.	
UGN-3013T	4.5-16	450	300	90	25	210
UGN/UGS-3019T	4.5-16	500	420	300	100	120
UGN/UGS-3020T	4.5-24	350	220	160	50	90
UGN/UGS-3030T	4.5-24	—	200	150	—	25
UGN-3201M	5-16	750	450	300	100	150
UGN-3203M	5-16	350	235	100	25	135
UGN-3220S	4.5-24	350	220	165	50	90

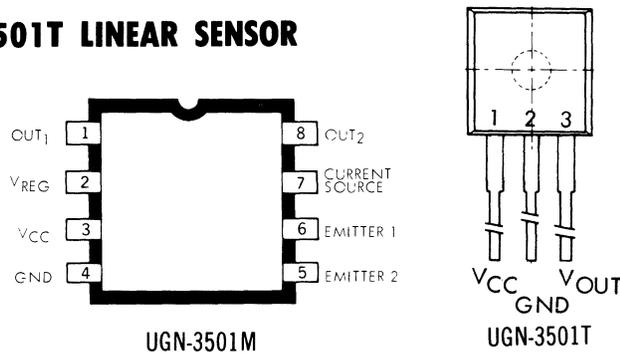


## UGN-3501M and UGN-3501T LINEAR SENSOR

The UGN-3501M and UGN-3501T are used principally to sense relatively small changes in a magnetic field. Type UGN-3501M has provisions for gain and output adjustment of the built-in differential amplifier.

### FEATURES:

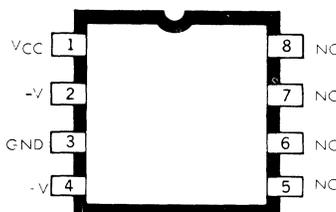
- Internal Voltage Regulation: VCC 8-12 VDC
- Flat Response to 25 kHz



## UGN-3600M and UGN-3601M HALL CELL ELEMENTS

The UGN-3600M and UGN-3601M are intended for use as an empirical design aid or as a production test vehicle. Each device consists of the Hall generator only with connections brought out on pins 2 and 4. Type UGN-3600M is supplied with a calibration chart for monitoring magnetic field intensity without the use of a gauss meter. Type UGN-3601M is supplied without the calibration chart.

**Supply Voltage: 5 V.**

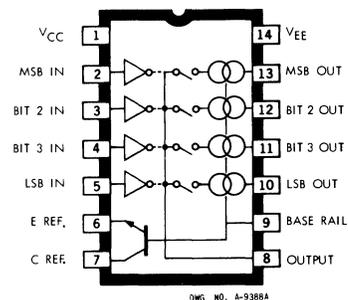


### ULN-2140 and ULS-2140 HIGH PERFORMANCE MONOLITHIC QUAD CURRENT SWITCHES

Series 2140 Quad Current Switches are high precision monolithic integrated circuits for use in digital-to-analog converters. Each package contains four logic controlled current switches and a reference transistor. Continuously running current sources and superior thermal layout maximize speed and accuracy by reducing transitional anomalies. Series 2140 Switches accept a wide range of d-c references or an a-c reference for two quadrant multiplying D/A applications. Inputs may be driven from TTL, RTL, DTL, or similar sources and are independent of reference voltage level. The continuously ON current sources optimize operation with R-2R and wirewound resistor networks as well as binary weighted thin-film networks.

#### FEATURES:

- Variable Reference: -3 to -10 Volts
- Low Temperature Coefficient: 5 ppm/°C



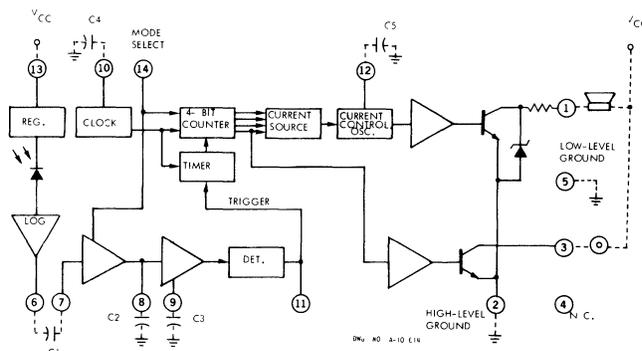
- Fast Settling: 300 ns to 0.01% TTL Compatible Inputs
- Non-Linearity 0.5%
- Operating Temperature Range:
  - ULS-2140H: -55°C to +125°C
  - ULN-2140A: -25°C to +70°C
- Package Configurations:
  - ULN-2140A: 14-Pin Plastic Dual In-Line
  - ULS-2140H: 14-pin Hermetic Dual In-Line

### ULN-2232A MOTION DETECTOR\*

Combining I<sup>2</sup>L and Bipolar circuitry, the ULN-2232A motion detector is a complex optilinear integrated circuit which includes an on-chip photodiode, high-gain logarithmic and linear amplifiers, extensive digital circuitry for sound generation and timing, and high-current output drivers. With the addition of only five small capacitors, a speaker, and a power source, this state-of-the-art device makes a complete motion detector which is sensitive to small changes in light level as a function of time.

#### FEATURES:

- Automatic Timed Reset
- 120 Hz Rejection
- Two Sound Patterns
- Long Range Operation
- 100 mW Audio Output
- Visible or Infra-Red Response
- Clear Plastic Package 14-Pin Dual In-Line 'A'



### ULN-2300M AMPLIFIER SCR FIRING CIRCUIT\*

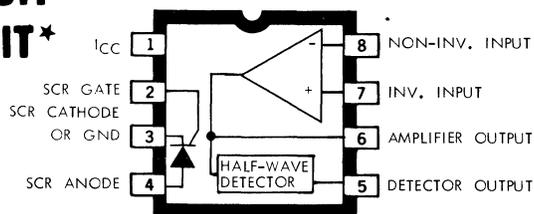
### ULN-2301M AMPLIFIER-DETECTOR CIRCUIT\*

Drive SCRs directly from the detector output of the ULN-2301M. Or use the ULN-2300M, complete with a 60 V SCR right on the same chip. Both feature high input impedance, 12 V Zener diode regulation, an internal bias network, and temperature-compensated triggering level. External connections allow sensitivity adjustment, making them ideal for control systems design. Available in an 8-pin dual in-line package M.

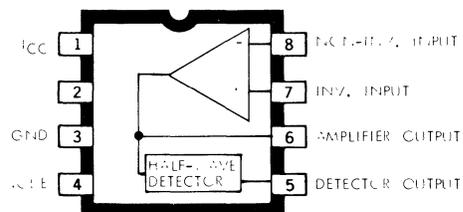
#### CHARACTERISTICS:

Voltage Gain:

ULN-2300M.....	35 dB
ULN-2301M.....	37 dB
Frequency Response.....	150 kHz
Bandwidth.....	15 kHz
Input Impedance.....	80 kΩ
Common-Mode Rejection Ratio.....	80 dB



ULN-2300M



ULN-2301M

\* Available until present stock is exhausted.

## ULN-2401A ELECTRONIC LAMP MONITOR

Offering several advantages for a lamp monitoring system, the ULN-2401A monolithic integrated circuit is versatile, easily connected, and does not affect normal lamp operation. Little additional wiring is required for installation since the system is completely integral to the wiring assembly.

### FEATURES:

- No Standby Power
- Completely Integral to Wiring Assembly
- Monitor 1 to 8 Lamps per Channel
- Fail-Safe
- Reverse Voltage Protected
- Plastic Package 14-Pin Dual In-Line 'A'

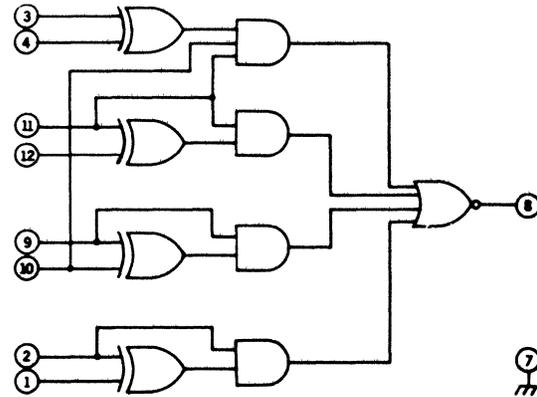


FIG. NO. A-10,712

## ULN-2429A and ULN-2429A-1 FLUID DETECTORS

Primarily designed for use as an automotive low coolant detector, the ULN-2429A monolithic bipolar integrated circuit is ideal for detecting the presence or absence of many different types of liquids in automotive, home, or industrial applications. Especially useful in harsh environments, reverse voltage protection, internal voltage regulation, temperature compensation, and high-frequency noise immunity are all incorporated in the design.

Type ULN-2429A output voltage is rated for +30V, while Type ULN-2429A-1 is rated for +50V.

### FEATURES:

- High Output Current
- A-C or D-C Output
- Single-Wire Probe
- Low External Parts Count
- Internal Voltage Regulator
- Reverse Voltage Protection
- Plastic Package 14-Pin Dual In-line 'A'

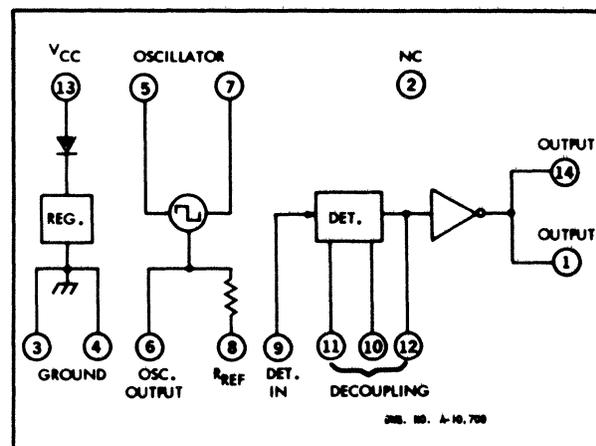


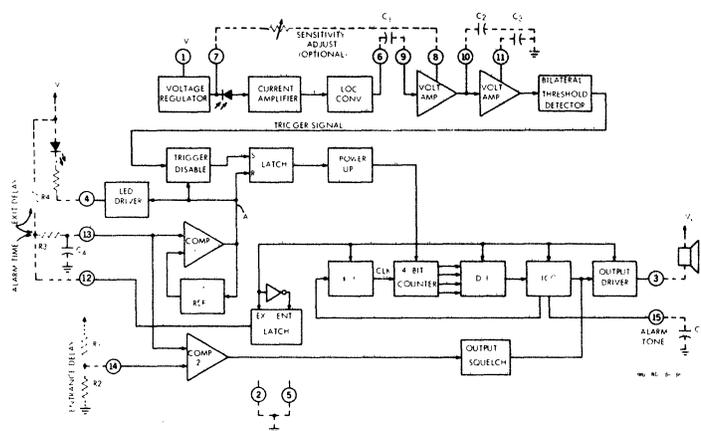
FIG. NO. A-10,709

## ULN-2601A OPTOELECTRONIC INTRUSION ALARM\*

Providing many of the features of expensive discrete intrusion alarm systems, the ULN-2601A monolithic integrated circuit features adjustable timed exit, timed entrance, and timed alarm with a minimum number of components. It is a complete alarm including optoelectronic sensor, logarithmic and linear amplifiers, rate of change detector, extensive 1<sup>2</sup>L timing and tone generating circuitry, and a class-D alarm output stage with up to 500 mA drive capability.

### FEATURES:

- 9 Volt Operation
- Low Quiescent Current Drain
- Variable Timed Exit
- Variable Timed Entrance
- Variable Alarm Time
- Class-D Alarm Output
- Clear Plastic Package 16-Pin Dual In-line 'A'



\*These devices are presently engineering prototype design. Salient specifications listed are subject to change without notice.

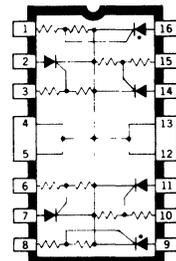
## UTN-2886B and UTN-2888A SCR ARRAYS \*

These common cathode SCR arrays are bipolar monolithic integrated circuits incorporating both input (gate) limiting resistors and gate-to-cathode resistors within a single dual in-line package.

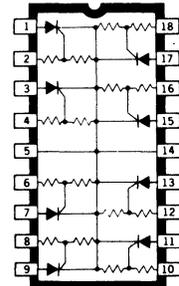
The UTN-2886B contains six SCRs — four are capable of continuous operation at 250 mA each and two of 500 mA each. The UTN-2888A contains eight SCRs all capable of simultaneous, continuous operation at 200 mA.

### FEATURES:

- Inrush Currents (surges) to 2 A
- 35 V Blocking Voltage



UTN-2886B  
\* Two Parallel SCRs  
Dwg. No. A-11,092



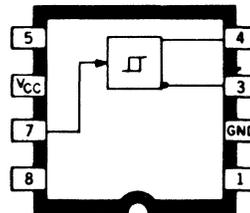
UTN-2888A  
Dwg. No. A-11,092

## ULN-3303M, ULN-3304M, ULN-3305M, and ULN-3306M SCHMITT TRIGGERS ☆

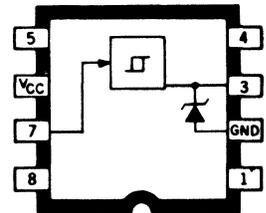
These Schmitt Triggers are capable of operation over a supply voltage range of +2.2 to +8.0 volts and a temperature of -40°C to +100°C. They are intended for low-cost applications such as camera shutter controls, temperature-sensitive alarms, touch operated switches, timers, etc. These devices are especially useful in battery operated equipment and will sustain battery reversal indefinitely without damage.

### FEATURES:

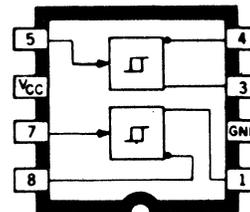
- Small Size
- Long Life
- High Output Breakdown Voltage
- Stable Predictable Switching Levels
- 10% Hysteresis
- Plastic Package (8-pin) Dual In-Line M



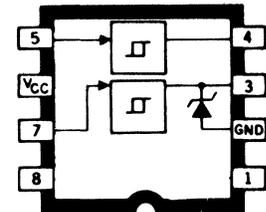
ULN-3303M  
COMPLEMENTARY OUTPUTS



ULN-3304M  
ZENER CLAMPED OUTPUT



ULN-3305M  
COMPLEMENTARY OUTPUTS



ULN-3306M  
ONE ZENER CLAMPED OUTPUT

## ULN-3330Y, and ULN-3330Y-2 OPTOELECTRONIC SWITCHES

Providing all of the necessary circuitry in a single 3-lead clear plastic package, the ULN-3330 Optoelectronic Switch is a monolithic integrated circuit containing a photodiode, low-level amplifier, level detector, output power driver, and voltage regulator. It can be used as a low-cost photo-detector in consumer or industrial applications and requires only the absolute minimum in external components for operation.

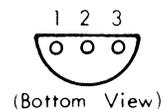
### FEATURES:

- On-Chip Photodiode
- On-Chip Amplifier
- On-Chip Trigger
- On-Chip Power Driver
- On-Chip Regulator
- Operation to 1 MHz
- T0-92 Clear Plastic Package

The standard ULN3330Y Opto-electronic Switch is specified for operation within a  $\pm 15\%$  light level "window" and is recommended for applications requiring a light threshold sensor. Low-cost devices for use in ON-OFF light applications are available as the ULN-3330Y-2.



T0-92  
Package



(Bottom View)

- 1 = Output
- 2 = Ground
- 3 =  $V_{CC}$

\*These devices are presently engineering prototype design. Salient specifications listed are subject to change without notice.

☆ Available until present stock is exhausted.

# SPRAGUE

# TRANSISTOR CROSS-REFERENCE INFORMATION

Sprague manufactures many popular small-signal '2N' registered transistors, and in addition, many 'in-house' device types suitable as replacements for registered '2N' types which employ package configurations not available from Sprague. In most cases, these 'in-house' types have identical major electrical specifications and are direct pin-for-pin replacements.

Industry Type Number	Sprague Suggested Replacement	Page No.	Industry Type Number	Sprague Suggested Replacement	Page No.	Industry Type Number	Sprague Suggested Replacement	Page No.	Industry Type Number	Sprague Suggested Replacement	Page No.
2N706	MPS706	41	2N3135	TP3135	47	2N4250	MPS4250	41	MD2904	TD519	51
2N706A	MPS706A	41	2N3136	TP3136	47	2N4257	MPS4257	41	MD2904A	TD520	51
2N2218	TP2221	47	2N3217	TP3217	47	2N4258	MPS4258	41	MD2905	TD521	51
2N2218A	TP2221A	47	2N3218	TP3218	47	2N4274	MPS4274	41	MD2905A	TD522	51
2N2219	TP2222	47	2N3219	TP3219	47	2N4275	MPS4275	41	MD3251A	TD518	49
2N2219A	TP2222A	47	2N3304	TP3304	47	2N4354	MPS4354	38	MD3250A	TD517	49
2N2221	TP2221	47	2N3390	MPS3390	36	2N4355	MPS4355	38	MD6001	TD709	53
2N2221A	TP2221A	47	2N3391	MPS3391	41	2N4356	MPS4356	38	MD6002	TD710	53
2N2222	TP2222	47	2N3391A	MPS3391A	41	2N4383	TP4384	43	MD6003	TD711	53
2N2222A	TP2222A	47	2N3392	MPS3392	37	2N4384	TP4384	43	MPS2222	TP2222	47
2N2369	MPS2369	47	2N3393	MPS3393	37	2N4385	TP4386	43	MPS2222A	TP2222A	47
2N2369A	MPS2369A	47	2N3394	MPS3394	37	2N4386	TP4386	43	MPS2907	TP2907	47
2N2483	TP2483	43	2N3395	MPS3395	38	2N4412	TP4413	43	MPS2907A	TP2907A	47
2N2484	TP2484	43	2N3396	MPS3396	38	2N4412A	TP4413A	43	SE5036	TPE5036	46
2N2639	TD234	50	2N3397	MPS3397	38	2N4413	TP4413	43	SE5050	TPE5050	46
2N2640	TD235	50	2N3398	MPS3398	38	2N4413A	TP4413A	43	SE5051	TPE5051	46
2N2641	TD236	52	2N3414	MPS3414	38	2N4414	TP4415A	43	SE6020	TPE6020	46
2N2642	TD237	50	2N3415	MPS3415	38	2N4414A	TP4415A	43	SE6021	TPE6021	46
2N2643	TD238	50	2N3416	MPS3416	38	2N4415	TP4415	43	TIS62A	TPS62A	46
2N2644	TD239	52	2N3417	MPS3417	38	2N4415A	TP4415A	43	TIS63A	TPS63A	46
2N2711	MPS2711	37	2N3440	TP3440	43	2N4854	TD712	53	TIS64A	TPS64A	46
2N2712	MPS2712	37	2N3451	TP3451	47	2N4855	TD713	53	TIS84	TPS84	46
2N2713	MPS2713	36	2N3563	MPS3563	43	2N5127	MPS5127	38	TIS86	TPS86	46
2N2714	MPS2714	36	2N3566	TP3566	39	2N5131	MPS5131	38	TIS87	TPS87	46
2N2802	TD509	49	2N3567	TP3567	39	2N5132	MPS5132	38	TIS90	TPS90	46
2N2803	TD510	49	2N3568	TP3568	39	2N5133	MPS5133	41	TIS90M	TPS90M	46
2N2804	TD511	51	2N3569	TP3569	39	2N5134	MPS5134	41	TIS91	TPS91	46
2N2805	TD512	49	2N3638	TP3638	40	2N5135	TP5135	39	TIS91M	TPS91M	46
2N2806	TD513	49	2N3638A	TP3638A	40	2N5136	TP5136	39	TIS92	TPS92	46
2N2807	TD514	51	2N3639	MPS3639	41	2N5137	MPS5137	38	TIS92M	TPS92M	46
2N2904	TP2906	47	2N3640	MPS3640	41	2N5140	TP5140	41	TIS93	TPS93	46
2N2904A	TP2906A	47	2N3644	TP3644	36	2N5142	TP5142	36	TIS93M	TPS93M	46
2N2905	TP2907	47	2N3645	TP3645	36	2N5172	MPS5172	38	TIS94	TPS94	46
2N2905A	TP2907A	47	2N3677	TP3677	47	2N5305	MPS5305	44	TIS97	TPS97	46
2N2906	TP2906	47	2N3680	TD240	50	2N5306	MPS5306	44	TIS98	TPS98	46
2N2906A	TP2906A	47	2N3693	MPS3693	38	2N5306A	MPS5306A	44	TIS99	TPS99	46
2N2907	TP2907	47	2N3694	MPS3694	38	2N5307	MPS5307	44	TIS100	TPS100	46
2N2907A	TP2907A	47	2N3702	MPS3702	38	2N5308	MPS5308	44	TIS101	TPS101	46
2N2913	TD228	52	2N3703	MPS3703	38	2N5308A	MPS5308A	44	TIS108	TPS108	46
2N2914	TD229	52	2N3704	MPS3704	38	BC107A	TP107A	45	TIS110	TPS110	46
2N2915	TD230	50	2N3705	MPS3705	38	BC107B	TP107B	45	TIS111	TPS111	46
2N2915A	TD242	50	2N3706	MPS3706	38	BC108A	TP108A	45	TIS112	TPS112	46
2N2916	TD231	50	2N3707	MPS3707	38	BC108B	TP108B	45	TIS133	TPS133	46
2N2916A	TD243	50	2N3708	MPS3708	38	BC108C	TP108C	45	TIS134	TPS134	46
2N2917	TD232	50	2N3709	MPS3709	38	BC109B	TP109B	45	TIS135	TPS135	46
2N2918	TD233	50	2N3710	MPS3710	38	BC109C	TP109C	45	TIS136	TPS136	46
2N2923	MPS2923	37	2N3711	MPS3711	38	BC110	TP110	45	TN53	CT1454	45
2N2924	MPS2924	37	2N3721	MPS3721	38	BC177A	TP177A	45	TN54	CT1454	46
2N2925	MPS2925	37	2N3806	TD523	51	BC177B	TP177B	45	TN59	CT1460	46
2N2926	MPS2926	37	2N3807	TD524	51	BC178A	TP178A	45	TN60	CT1460	46
2N2944	TP2944	47	2N3808	TD525	49	BC178B	TP178B	45	TN61	CT1462	46
2N2945	TP2945	47	2N3809	TD526	49	BC178C	TP178C	45	TN62	CT1462	46
2N2946	TP2946	47	2N3810	TD527	49	BC179B	TP179B	45	TN63	CT1464	46
2N2958	TP3115	47	2N3811	TD528	49	BC179C	TP179C	45	TN64	CT1464	46
2N2959	TP3116	47	2N3840	TP3840	47	MD1120	TD224	50	TQ59	CT760	46
2N3058	TP3058	47	2N3977	TP3977	47	MD1121	TD225	50	TQ60	CT760	46
2N3059	TP3059	47	2N3978	TP3978	47	MD1122	TD226	50	TQ61	CT762	46
2N3060	TP3060	47	2N3979	TP3979	47	MD1129	TD227	50	TQ62	CT762	46
2N3061	TP3061	47	2N4007	TP4007	47	MD2218	TD244	52	TQ63	CT764	46
2N3115	TP3115	47	2N4008	TP4008	47	MD2218A	TD245	52	TQ64	CT764	46
2N3116	TP3116	47	2N4208	TP4208	47	MD2219	TD246	52			
2N3133	TP3135	47	2N4248	MPS4248	41	MD2219A	TD247	52			
2N3134	TP3136	47	2N4249	MPS4249	41	MD2369	TD248	52			

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### GENERAL-PURPOSE SMALL-SIGNAL AMPLIFIERS

Type No.	POLARITY	P <sub>D</sub> T <sub>A</sub> = 25 C (mW)	V <sub>(BR)</sub> CBO Volts	V <sub>(BR)</sub> CEO Volts	V <sub>(BR)</sub> EBO Volts	I <sub>CBO</sub> μA Max.	D-C CURRENT GAIN (h <sub>FE</sub> )				V <sub>CE(SAT)</sub>		f <sub>T</sub> Min. (MHz)	C <sub>cb</sub> Max. (pF)	t <sub>off</sub> Max. (nsec)	N.F. Max. (dB)				
							Conditions		Limits		I <sub>C</sub> (mA)	V <sub>CE</sub> Volts					Min.	Max.	I <sub>C</sub>	Max. Volts
							I <sub>C</sub>	V <sub>CE</sub>	Min.	Max.										
2N2711	NPN	360	18	18	5	0.50	2	4.5	30	90	—	—	—	12.0	—	2.8*				
2N2712	NPN	360	18	18	5	0.50	2	4.5	75	225	—	—	—	12.0	—	2.8*				
2N2923	NPN	360	25	25	5	0.10	2	10	†90	180	—	—	160*	12.0	—	2.8*				
2N2924	NPN	360	25	25	5	0.10	2	10	†150	300	—	—	160*	12.0	—	2.8*				
2N2925	NPN	360	25	25	5	0.10	2	10	†235	470	—	—	160*	12.0	—	2.8*				
2N2926■	NPN	360	25	25	5	0.50	2	10	†35	470	—	—	120*	12.0	—	—				
2N3392	NPN	360	25	25	5	0.10	2	4.5	150	300	—	—	120*	10.0	—	—				
2N3393	NPN	360	25	25	5	0.10	2	4.5	90	180	—	—	120*	10.0	—	—				
2N3394	NPN	360	25	25	5	0.10	2	4.5	55	110	—	—	120*	10.0	—	—				
2N3395▼	NPN	360	25	25	5	0.10	2	4.5	150	500	—	—	—	10.0	—	—				
2N3396▼	NPN	360	25	25	5	0.10	2	4.5	90	500	—	—	—	10.0	—	—				
2N3397▼	NPN	360	25	25	5	0.10	2	4.5	55	500	—	—	—	10.0	—	—				
2N3398▼	NPN	360	25	25	5	0.10	2	4.5	55	800	—	—	—	10.0	—	—				
2N3721	NPN	360	18	18	5	0.50	2	10	†60	660	—	—	120*	10.0	—	—				
2N5172	NPN	360	25	25	5	0.10	10	10	100	500	10	0.25	200*	13.0	—	—				
2N5249	NPN	400	70	50	5	0.3	2	5	400	800	10	0.125	—	4.0	—	—				
2N5249A	NPN	400	70	50	5	0.3	2	5	400	800	10	0.125	—	4.0	—	3.0				
2N5354	PNP	360	25	25	4	0.10	50	1	40	120	50	0.25	250*	8.0	—	—				
2N5355	PNP	360	25	25	4	0.10	50	1	100	300	50	0.25	250*	8.0	—	—				
2N5356	PNP	360	25	25	4	0.10	50	1	250	500	50	0.25	250*	8.0	—	—				
2N5365	PNP	360	40	40	4	0.10	50	1	40	120	50	0.25	250*	8.0	—	—				
2N5366	PNP	360	40	40	4	0.10	50	1	100	300	50	0.25	250*	8.0	—	—				
2N5367	PNP	360	40	40	4	0.10	50	1	250	500	50	0.25	250*	8.0	—	—				
2N5998	NPN	400	35	25	5	0.03	10	2	150	300	50	0.25	140	6.0	—	1.5				
2N5999	PNP	400	35	25	5	0.03	10	2	150	300	50	0.25	140	8.0	—	1.5				
2N6008	NPN	400	35	25	5	0.03	10	2	250	500	50	0.25	140	6.0	—	1.5				
2N6009	PNP	400	35	25	5	0.03	10	2	250	500	50	0.25	140	8.0	—	1.5				
2N6076	PNP	360	25	25	3	0.10	10	10	100	500	10	0.25	200	13.0	—	—				
D29E1	PNP	500	35	25	5	0.10	500	2	45	—	500	0.75	100	15.0	—	—				
D29E2	PNP	500	35	25	5	0.10	500	2	60	—	500	0.75	135	15.0	—	—				
D29E4	PNP	500	50	40	5	0.10	2	2	60	120	500	0.75	80	15.0	—	—				
D29E5	PNP	500	50	40	5	0.10	2	2	100	200	500	0.75	120	15.0	—	—				
D29E6	PNP	500	50	40	5	0.10	2	2	150	300	500	0.75	135	15.0	—	—				
D29E7	PNP	500	50	40	5	0.10	2	2	250	500	500	0.75	150	15.0	—	—				
D29E9	PNP	500	70	60	5	0.10	500	2	20	—	500	0.75	80	15.0	—	—				
D29E10	PNP	500	70	60	5	0.10	500	2	25	—	500	0.75	150	15.0	—	—				
D33D21	NPN	500	35	25	5	0.10	500	2	45	—	500	0.75	100	15.0	—	—				
D33D22	NPN	500	35	25	5	0.10	500	2	60	—	500	0.75	135	15.0	—	—				
D33D24	NPN	500	50	40	5	0.10	2	2	60	120	500	0.75	80	15.0	—	—				
D33D25	NPN	500	50	40	5	0.10	2	2	100	200	500	0.75	120	15.0	—	—				
D33D26	NPN	500	50	40	5	0.10	2	2	150	300	500	0.75	135	15.0	—	—				
D33D27	NPN	500	50	40	5	0.10	2	2	250	500	500	0.75	150	15.0	—	—				
D33D29	NPN	500	70	60	5	0.10	500	2	20	—	500	0.75	80	15.0	—	—				
D33D30	NPN	500	70	60	5	0.10	500	2	25	—	500	0.75	120	15.0	—	—				



\*Typical value

†AC Current Gain, h<sub>FE</sub> @ f = 1kHz

▼Table 1 - GUARANTEED D-C BETA DISTRIBUTION BY GROUP

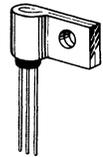
h <sub>FE</sub>	Color Code Group	55-110	90-180	150-300	250-500	400-800
		Red	Orange	Yellow	White	Blue
2N3395	—	—	35-65%	35-65%	—	—
2N3396	—	10-60%	10-60%	5-35%	—	—
2N3397	0-15%	10-50%	10-50%	5-35%	—	—
2N3398	0-15%	10-50%	10-50%	5-35%	0-15%	—

■Table 2 - GUARANTEED A-C BETA DISTRIBUTION BY GROUP

h <sub>fe</sub>	Color Code Group	35-70	55-110	90-180	150-300	235-470
		Brown	Red	Orange	Yellow	Green
2N2926	0-6%	5-10%	20-26%	35-45%	20-30%	—

### GENERAL-PURPOSE SMALL-SIGNAL AMPLIFIERS

Type No.	POLARITY	P <sub>D</sub> T <sub>A</sub> = 25 C (mW)	V <sub>(BR)</sub> CBO Volts	V <sub>(BR)</sub> CEO Volts	V <sub>(BR)</sub> EBO Volts	I <sub>CBO</sub> nA Max.	D-C CURRENT GAIN (h <sub>FE</sub> )				V <sub>CE(SAT)</sub>		f <sub>T</sub> Typ. (MHz)	C <sub>cb</sub> Max. (pF)	t <sub>off</sub> Max. (nsec)	N.F. Max. (dB)		
							Conditions		Limits		I <sub>C</sub> (mA)	Max. Volts					I <sub>C</sub> (mA)	Max. Volts
							I <sub>C</sub> (mA)	V <sub>CE</sub> Volts	Min.	Max.								
D29E1-J1	PNP	700	35	25	5	100	500	2	45	—	500	0.75	100	15.0	—	—		
D29E2-J1	PNP	700	35	25	5	100	500	2	60	—	500	0.75	135	15.0	—	—		
D29E4-J1	PNP	700	50	40	5	100	2	2	60	120	500	0.75	80	15.0	—	—		
D29E5-J1	PNP	700	50	40	5	100	2	2	100	200	500	0.75	120	15.0	—	—		
D29E6-J1	PNP	700	50	40	5	100	2	2	150	300	500	0.75	135	15.0	—	—		
D29E7-J1	PNP	700	50	40	5	100	2	2	250	500	500	0.75	150	15.0	—	—		
D29E9-J1	PNP	700	70	60	5	100	500	2	20	—	500	0.75	80	15.0	—	—		
D29E10-J1	PNP	700	70	60	5	100	500	2	25	—	500	0.75	150	15.0	—	—		
D33D21-J1	NPN	700	35	25	5	100	500	2	45	—	500	0.75	100	15.0	—	—		
D33D22-J1	NPN	700	35	25	5	100	500	2	60	—	500	0.75	135	15.0	—	—		
D33D24-J1	NPN	700	50	40	5	100	2	2	60	120	500	0.75	80	15.0	—	—		
D33D25-J1	NPN	700	50	40	5	100	2	2	100	200	500	0.75	120	15.0	—	—		
D33D26-J1	NPN	700	50	40	5	100	2	2	150	300	500	0.75	135	15.0	—	—		
D33D27-J1	NPN	700	50	40	5	100	2	2	250	500	500	0.75	150	15.0	—	—		
D33D29-J1	NPN	700	70	60	5	100	500	2	20	—	500	0.75	80	15.0	—	—		
D33D30-J1	NPN	700	70	60	5	100	500	2	25	—	500	0.75	120	15.0	—	—		
2N3702	PNP	360	40	25	5	100	50	5	60	300	50	0.25	100	12.0	—	—		
2N3703	PNP	360	50	30	5	100	50	5	30	150	50	0.25	100	12.0	—	—		
2N3704	NPN	360	50	30	5	100	50	2	100	500	100	0.60	100	12.0	—	—		
2N3705	NPN	360	50	30	5	100	50	2	50	150	100	0.80	100	12.0	—	—		
2N3706	NPN	360	40	20	5	100	50	2	30	600	100	1.00	100	12.0	—	—		
2N3707	NPN	360	30	30	6	100	0.1	5	100	400	10	1.00	—	—	—	—		
2N3708	NPN	360	30	30	6	100	1.0	5	45	660	10	1.00	—	—	—	—		
2N3709	NPN	360	30	30	6	100	1.0	5	45	165	10	1.00	—	—	—	—		
2N3710	NPN	360	30	30	6	100	1.0	5	90	330	10	1.00	—	—	—	—		
2N3711	NPN	360	30	30	6	100	1.0	5	180	660	10	1.00	—	—	—	—		
2N3827	NPN	360	60	45	4	10	10	10	100	—	—	—	200	4.0	—	—		
2N3973	NPN	360	60	30	5	500	10	1	35	100	150	0.3	—	—	—	—		
2N3974	NPN	360	60	30	5	500	10	1	55	200	150	0.3	—	—	—	—		
2N4058	PNP	360	30	30	6	100	0.1	5	100	400	10	0.70	—	—	—	5		
2N4059	PNP	360	30	30	6	100	1.0	5	45	660	10	0.70	—	—	—	—		
2N4060	PNP	360	30	30	6	100	1.0	5	45	165	10	0.70	—	—	—	—		
2N4061	PNP	360	30	30	6	100	1.0	5	90	330	10	0.70	—	—	—	—		
2N4062	PNP	360	30	30	6	100	1.0	5	180	660	10	0.70	—	—	—	—		



TO-92HS  
(ECB)  
In-Line  
Pinning



TO-92  
(ECB)  
In-Line  
Pinning

### GENERAL-PURPOSE AMPLIFIER/SWITCHES

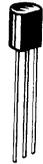
2N3903	NPN	360	60	40	6	50	10	1	50	150	50	0.30	250	4.0	175	6
2N3904	NPN	360	60	40	6	50	10	1	100	300	50	0.30	300	4.0	200	5
2N3905	PNP	360	40	40	5	50	10	1	50	150	50	0.40	200	4.5	200	5
2N3906	PNP	360	40	40	5	50	10	1	100	300	50	0.40	250	4.5	225	4
2N4123	NPN	500	40	30	5	50	2	1	50	150	50	0.40	250	4.0	—	6
2N4124	NPN	500	30	25	5	50	2	1	120	360	50	0.40	300	4.0	—	5
2N4125	PNP	500	30	30	4	50	2	1	50	150	50	0.40	200	4.5	—	5
2N4126	PNP	500	25	25	4	50	2	1	120	360	50	0.40	250	4.5	—	4
2N4400	NPN	350	60	40	6	100	150	1	50	150	150	0.40	200	6.5	—	—
2N4401	NPN	350	60	40	6	100	150	1	100	300	150	0.40	250	6.5	—	—
2N4402	PNP	310	40	40	5	100	150	2	50	150	150	0.40	150	8.5	—	—
2N4403	PNP	310	40	40	5	100	150	2	100	300	150	0.40	200	8.5	—	—
MPS2713	NPN	360	18	18	5	500	2	4.5	30	90	50	0.30	—	—	—	—
MPS2714	NPN	360	18	18	5	500	2	4.5	75	225	50	0.30	—	—	—	—
MPS3390	NPN	360	18	18	5	100	2	4.5	400	800	—	—	10.0	—	—	—
MPS3638	PNP	310	25	25	4	35	50	1	30	—	50	0.25	150	20.0	210	—
MPS3638A	PNP	310	25	25	4	35	50	1	100	—	50	0.25	150	10.0	210	—
TP3644	PNP	625	45	45	5	35	50	1	80	240	150	0.40	200	8.0	100	—
TP3645	PNP	625	60	60	5	35	50	1	80	240	150	0.40	200	8.0	100	—
TP5142	PNP	625	20	20	4	50	50	1	30	—	50	0.50	100	10.0	200	—



TO-92  
(ECB)  
In-Line  
Pinning

### GENERAL-PURPOSE SMALL-SIGNAL AMPLIFIERS

Type No.	POLARITY	P <sub>D</sub> T <sub>A</sub> = 25 C (mW)	V <sub>(BR)</sub> CBO Volts	V <sub>(BR)</sub> CEO Volts	V <sub>(BR)</sub> EBO Volts	I <sub>CBO</sub> nA Max.	D-C CURRENT GAIN (h <sub>FE</sub> )				V <sub>CE(SAT)</sub>		f <sub>T</sub> Min. (MHz)	C <sub>cb</sub> Max. (pF)	t <sub>off</sub> Max. (nsec)	N.F. Max. (dB)		
							Conditions		Limits		I <sub>C</sub> (mA)	V <sub>CE</sub> Volts					I <sub>C</sub> (mA)	Max. Volts
							I <sub>C</sub> (mA)	V <sub>CE</sub> Volts	Min.	Max.								
2N4264	NPN	310	30	15	6	—	10	1	40	160	10	0.22	300	4	35	—		
2N4265	NPN	310	30	12	6	—	10	1	100	400	10	0.22	300	4	35	—		
2N5087	PNP	350	50	50	3	50	0.1	5	250	—	10	0.50	40	—	—	2		
2N5088	NPN	350	35	30	4.5	50	0.1	5	300	900	10	0.50	50	—	—	3		
2N5089	NPN	350	30	25	4.5	50	0.1	5	400	1200	10	0.50	50	—	—	2		
2N5131	NPN	400	20	15	3	50	10	1	30	500	10	1.0	100	6.0	—	—		
2N5132	NPN	400	20	20	3	50	10	10	30	400	10	2.0	200	3.5	—	—		
2N5219	NPN	360	20	15	3	100	2	10	35	500	10	0.40	150	4.0	—	—		
2N5223	NPN	360	25	20	3	100	2	10	50	800	10	0.70	150	4.0	—	—		
2N5225	NPN	360	25	25	4	300	50	10	30	600	100	0.80	50	20.0	—	—		
2N5226	PNP	360	25	25	4	300	50	10	30	600	100	0.80	50	20.0	—	—		
MPS-A05	NPN	360	60	60	4	100	10	1	50	—	100	0.25	100	6.0*	—	—		
MPS-A06	NPN	400	80	80	4	100	10	1	50	—	100	0.25	100	6.0*	—	—		
MPS-A10	NPN	400	40	40	4	100	5	10	40	400	—	—	50*	4.0	—	—		
MPS-A20★	NPN	360	40	30	4	100	5	10	40	400	10	0.25	125	4.0	—	—		
MPS-A55	PNP	400	60	60	4	100	10	1	50	—	100	0.25	100	6.0*	—	—		
MPS-A56	PNP	400	80	80	4	100	10	1	50	—	100	0.25	100	6.0*	—	—		
MPS-A70★	PNP	360	40	30	4	100	5	10	40	400	10	0.25	125	4.0	—	—		
MPS-D05	NPN	350	25	25	4	1000	100	5	80	—	100	0.50	100	—	—	—		
MPS-D06	NPN	350	25	25	4	1000	50	5	50	—	50	0.30	100	—	—	—		
MPS-D55	PNP	625	25	25	4	1000	100	5	80	—	100	0.50	100	—	—	—		
MPS-D56	PNP	625	25	25	4	1000	50	5	50	—	50	0.30	100	—	—	—		
MPS2711	NPN	360	18	18	5	500	2	4.5	30	90	—	—	—	12.0	—	—		
MPS2712	NPN	360	18	18	5	500	2	4.5	75	225	—	—	—	12.0	—	—		
MPS2923	NPN	360	25	25	5	500	2	10	+90	180	—	—	—	12.0	—	—		
MPS2924	NPN	360	25	25	5	500	2	10	+150	300	—	—	—	12.0	—	—		
MPS2925	NPN	360	25	25	5	500	2	10	+235	470	—	—	—	12.0	—	—		
MPS2926■	NPN	360	18	18	5	500	2	10	+35	470	—	—	—	12.0	—	—		
MPS3392	NPN	360	25	25	5	100	2	4.5	150	300	—	—	—	10.0	—	—		
MPS3393	NPN	360	25	25	5	100	2	4.5	90	180	—	—	—	10.0	—	—		
MPS3394	NPN	360	25	25	5	100	2	4.5	55	110	—	—	—	10.0	—	—		



TO-92  
(EBC)  
In-Line  
Pinning

†AC Current Gain, h<sub>FE</sub> @ f = 1kHz      \*Typical value

#### ★ — TABLE 1 TRANSISTOR KITS

MPS-K20, MPS-K21 and MPS-K22 are three, five and nine transistor kits consisting of MPS-A20's with various h<sub>FE</sub> selections.

MPS-K70, MPS-K71 and MPS-K72 are three, five and nine transistor kits consisting of MPS-A70's with various h<sub>FE</sub> selections.

#### MPS-K20/MPS-K70 — Three Transistor Kit

Quantity Per Kit	Color Code	h <sub>FE</sub> @ I <sub>C</sub> = 5.0mA DC, V <sub>CE</sub> = 10 VDC	
		Min	Max
1	Red	40	400
1	White	80	400
1	Blue	120	300

#### MPS-K21/MPS-K71 — Five Transistor Kit

Quantity Per Kit	Color Code	h <sub>FE</sub> @ I <sub>C</sub> = 5.0 mA DC, V <sub>CE</sub> = 10 VDC	
		Min	Max
3	Red	40	400
1	Green	100	200
1	Yellow	150	300

#### MPS-K22/MPS-K72 — Nine Transistor Kit

Quantity Per Kit	Color Code	h <sub>FE</sub> @ I <sub>C</sub> = 5.0mA DC, V <sub>CE</sub> = 10 VDC	
		Min	Max
4	Red	40	400
2	White	80	400
2	Green	100	200
1	Yellow	150	300

■ Table 2 - GUARANTEED A-C BETA DISTRIBUTION BY GROUP

h <sub>FE</sub>	Color Code Group	35-70	55-110	90-180	150-300	235-470
		Brown	Red	Orange	Yellow	Green
MPS2926		0-6%	5-10%	20-26%	35-45%	20-30%

### GENERAL-PURPOSE SMALL-SIGNAL AMPLIFIERS (Cont'd)

Type No.	POLARITY	P <sub>D</sub> T <sub>A</sub> = 25 C (mW)	V <sub>(BR)</sub> CBO Volts	V <sub>(BR)</sub> CEO Volts	V <sub>(BR)</sub> EBO Volts	I <sub>CBO</sub> μA Max.	D-C CURRENT GAIN (h <sub>FE</sub> )				V <sub>CE(SAT)</sub>		f <sub>T</sub> Min. (MHz)	C <sub>cb</sub> Max. (pF)	t <sub>off</sub> Max. (nsec)	N.F. Max. (dB)		
							Conditions		Limits		I <sub>C</sub> (mA)	V <sub>CE</sub> Volts					I <sub>C</sub> (mA)	Max. Volts
							I <sub>C</sub> (mA)	V <sub>CE</sub> Volts	Min.	Max.								
MPS3395	NPN	360	25	25	5	100	2	4.5	150	500	—	—	—	10.0	—	—		
MPS3396	NPN	360	25	25	5	100	2	4.5	90	500	—	—	—	10.0	—	—		
MPS3397	NPN	360	25	25	5	100	2	4.5	55	500	—	—	—	10.0	—	—		
MPS3398	NPN	360	25	25	5	100	2	4.5	55	800	—	—	—	10.0	—	—		
MPS3414	NPN	360	25	25	5	100	2	4.5	75	225	50	0.30	—	—	—	—		
MPS3415	NPN	360	25	25	5	100	2	4.5	180	540	50	0.30	—	—	—	—		
MPS3416	NPN	360	50	50	5	100	2	4.5	75	225	50	0.30	—	—	—	—		
MPS3417	NPN	360	50	50	5	100	2	4.5	180	540	50	0.30	—	—	—	—		
MPS3693	NPN	400	45	45	4	50	10	10	40	160	—	—	200	3.5	—	—		
MPS3694	NPN	400	45	45	4	50	10	10	100	400	—	—	200	3.5	—	—		
MPS3702	PNP	360	40	25	5	100	50	5	60	300	50	0.25	100	12.0	—	—		
MPS3703	PNP	360	50	30	5	100	50	5	30	150	50	0.25	100	12.0	—	—		
MPS3704	NPN	360	50	30	5	100	50	2	100	500	100	0.60	100	12.0	—	—		
MPS3705	NPN	360	50	30	5	100	50	2	50	150	100	0.80	100	12.0	—	—		
MPS3706	NPN	360	40	20	5	100	50	2	30	600	100	1.00	100	12.0	—	—		
MPS3707	NPN	360	30	30	6	100	0.1	5	100	400	10	1.00	—	—	—	5		
MPS3708	NPN	360	30	30	6	100	1	5	45	660	10	1.00	—	—	—	—		
MPS3709	NPN	360	30	30	6	100	1	5	45	165	10	1.00	—	—	—	—		
MPS3710	NPN	360	30	30	6	100	1	5	90	330	10	1.00	—	—	—	—		
MPS3711	NPN	360	30	30	6	100	1	5	180	660	10	1.00	—	—	—	—		
MPS3721	NPN	360	18	18	5	500	2	10	160	660	—	—	—	10.0	—	—		
MPS4354	PNP	625	60	60	5	50	10	10	50	500	500	0.50	100	30.0	400	3		
MPS4355	PNP	625	60	60	5	50	10	10	100	400	500	0.50	100	30.0	400	3		
MPS4356	PNP	625	80	80	5	50	10	10	50	250	500	0.50	100	30.0	400	3		
MPS5127	NPN	200	20	12	3	50	2	10	15	300	10	0.30	150	3.5	—	—		
MPS5131	NPN	200	20	15	3	50	10	1	30	500	10	1.00	100	—	—	—		
MPS5132	NPN	200	20	20	3	50	10	10	20	—	10	2.00	200	3.5	—	—		
MPS5137	NPN	300	30	20	3	100	150	1	20	400	150	0.25	40	35.0	—	—		
MPS5172	NPN	360	25	25	5	100	10	10	100	500	10	0.25	—	10.0	—	—		
MPS6512	NPN	500	40	30	4	50	2	10	50	100	50	0.5	250*	3.5	—	—		
MPS6513	NPN	500	40	30	4	50	2	10	90	180	50	0.50	250*	3.5	—	—		
MPS6514	NPN	500	40	25	4	50	2	10	150	300	50	0.50	390*	3.5	—	—		
MPS6515	NPN	500	40	25	4	50	2	10	250	500	50	0.50	390*	3.5	—	—		
MPS6516	PNP	500	40	40	4	50	2	10	50	100	50	0.50	200*	4.0	—	—		
MPS6517	PNP	500	40	40	4	50	2	10	90	180	50	0.50	200*	4.0	—	—		
MPS6518	PNP	500	40	40	4	50	2	10	150	300	0.50	340*	4.0	—	—	—		
MPS6519	PNP	500	25	25	4	50	2	10	250	500	50	0.50	340*	4.0	—	—		
MPS6520	NPN	500	40	25	4	50	2	10	200	400	50	0.50	390*	3.5	—	3		
MPS6521	NPN	500	40	25	4	50	2	10	300	600	50	0.50	390*	3.5	—	3		
MPS6522	PNP	500	25	25	4	50	2	10	200	400	50	0.50	340*	4.0	—	3		
MPS6523	PNP	500	25	25	4	50	4	10	300	600	50	0.50	340*	4.0	—	3		
MPS6530	NPN	360	60	40	5	50	100	1	40	120	100	0.50	390*	5.0	—	—		



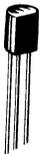
\*Typical value

▼Table 1 - GUARANTEED D-C BETA DISTRIBUTION BY GROUP

h <sub>FE</sub>	Color Code Group	55-110	90-180	150-300	250-500	400-800
		Red	Orange	Yellow	White	Blue
		MPS3395	—	—	35-65%	35-65%
MPS3396	—	10-60%	10-60%	5-35%	—	
MPS3397	0-15%	10-50%	10-50%	5-35%	—	
MPS3398	0-15%	10-50%	10-50%	5-35%	0-15%	

### GENERAL-PURPOSE SMALL-SIGNAL AMPLIFIERS (Cont'd)

Type No.	POLARITY	P <sub>D</sub> T <sub>A</sub> = 25 C (mW)	V <sub>(BR)</sub> CBO Volts	V <sub>(BR)</sub> CEO Volts	V <sub>(BR)</sub> EBO Volts	I <sub>CBO</sub> nA Max.	D-C CURRENT GAIN (h <sub>FE</sub> )				V <sub>CE(SAT)</sub>		f <sub>T</sub> Min. (MHz)	C <sub>cb</sub> Max. (pF)	t <sub>off</sub> Max. (nsec)	N.F. Max. (dB)		
							Conditions		Limits		I <sub>C</sub> (mA)	V <sub>CE</sub> Volts					I <sub>C</sub> (mA)	Max. Volts
							I <sub>C</sub> (mA)	V <sub>CE</sub> Volts	Min.	Max.								
MPS6531	NPN	360	60	40	5	50	100	1	90	270	100	0.3	390*	5.0	—	—		
MPS6532	NPN	360	50	30	5	50	100	1	30	—	100	0.5	390*	5.0	—	—		
MPS6533	PNP	360	40	40	4	50	100	1	40	120	100	0.5	260*	8.0	—	—		
MPS6534	PNP	360	40	40	4	50	100	1	90	270	100	0.3	260*	8.0	—	—		
MPS6535	PNP	360	30	30	4	50	100	1	30	—	100	0.5	260*	8.0	—	—		
MPS6560	NPN	360	25	25	4	100	500	1	50	200	500	0.5	60	30.0	50	—		
MPS6561	NPN	360	20	20	4	100	300	1	50	200	350	0.5	60	30.0	—	—		
MPS6562	PNP	360	25	25	4	100	500	1	50	200	500	0.5	60	30.0	—	—		
MPS6563	PNP	360	20	20	4	100	300	1	50	200	350	0.5	60	30.0	—	—		
MPS6565	NPN	360	60	45	4	100	10	10	40	160	10	0.4	200	3.5	—	4*		
MPS6566	NPN	360	60	45	4	100	10	10	100	400	10	0.4	200	3.5	—	4*		
MPS8098	NPN	350	60	60	6	100	1	5	100	300	100	0.3	150	8.0	—	—		
MPS8099	NPN	350	80	80	6	100	1	5	100	300	100	0.3	150	8.0	—	—		
TP3566	NPN	625	40	30	5	50	10	10	150	600	100	1.0	40	8.0	—	—		
TP3567	NPN	300	80	40	5	50	150	1	40	120	150	0.25	60	20.0	—	—		
TP3568	NPN	300	80	60	5	50	150	1	40	120	150	0.25	60	20.0	—	—		
TP3569	NPN	300	80	40	5	50	150	1	100	300	150	0.25	60	20.0	—	—		
TP5135	NPN	625	30	25	4	300	10	10	50	600	100	1.0	40	8.0	—	—		
TP5136	NPN	625	30	20	3	100	150	1	20	400	150	0.25	40	8.0	—	—		



TO-92  
(EBC)  
In-Line  
Pinning

\*Typical value

### GENERAL-PURPOSE SMALL-SIGNAL AMPLIFIERS / SWITCHES

Type No.	POLARITY	P <sub>D</sub> T <sub>A</sub> = 25 C (mW)	V <sub>(BR)</sub> CBO Volts	V <sub>(BR)</sub> CEO Volts	V <sub>(BR)</sub> EBO Volts	I <sub>CBO</sub> μA Max.	D-C CURRENT GAIN (h <sub>FE</sub> )				V <sub>CE(SAT)</sub>		f <sub>T</sub> Typ. (MHz)	C <sub>cb</sub> Max. (pF)	t <sub>off</sub> Max. (nsec)	N.F. Max. (dB)		
							Conditions		Limits		I <sub>C</sub> (mA)	V <sub>CE</sub> Volts					I <sub>C</sub> (mA)	Max. Volts
							I <sub>C</sub> (mA)	V <sub>CE</sub> Volts	Min.	Max.								
2N5127	NPN	200	20	12	3	0.5	2	10	15	300	10	0.30	150	3.5	—	—		
2N5137	NPN	625	30	20	3	0.100	150	1	20	400	150	0.25	40	8.0	—	—		
2N5143	PNP	625	20	20	4	0.050	50	1	30	—	50	0.50	100	10.0	200	—		
2N5447	PNP	360	40	25	5	0.100	50	5	60	300	50	0.25	100	12.0	—	—		
2N5448	PNP	360	50	30	5	0.100	50	5	30	150	50	0.25	100	12.0	—	—		
2N5449	NPN	360	50	30	5	0.100	50	2	100	300	100	0.60	100	12.0	—	—		
2N5450	NPN	360	50	30	5	0.100	50	2	50	150	100	0.80	100	12.0	—	—		
2N5451	NPN	360	40	20	5	0.100	50	2	30	600	100	1.00	100	12.0	—	—		
2N5820	NPN	500	70	60	5	0.100	2	2	60	120	500	0.75	100	15	—	—		
2N5821	PNP	500	70	60	5	0.100	2	2	60	120	500	0.75	100	15	—	—		
2N5822	NPN	500	70	60	5	0.100	2	2	100	200	500	0.75	120	15	—	—		
2N5823	PNP	500	70	60	5	0.100	2	2	100	200	500	0.75	120	15	—	—		
2N5824	NPN	500	50	40	5	0.050	2	5	60	120	10	0.125	90	4.0	—	—		
2N5825	NPN	500	50	40	5	0.050	2	5	100	200	10	0.125	90	4.0	—	—		
2N5826	NPN	500	50	40	5	0.050	2	5	150	300	10	0.125	90	4.0	—	—		
2N5827	NPN	360	50	40	5	0.050	2	5	250	500	10	0.125	90	4.0	—	—		
2N5828	NPN	360	50	40	5	0.050	2	5	400	800	10	0.78	90	4.0	—	—		
2N6222	NPN	360	60	60	5	0.050	100	5	20	—	10	0.125	—	4.0	—	—		
2N6224	NPN	360	60	60	5	0.050	100	5	40	—	10	0.125	—	4.0	—	—		



TO-92  
(CBE)  
Pinning  
Formed  
to TO-18  
Pin Circle

### GENERAL-PURPOSE AMPLIFIERS/SWITCHES

Type No.	POLARITY	PD T <sub>A</sub> = 25 C (mW)	V <sub>(BR)</sub> CBO Volts	V <sub>(BR)</sub> CEO Volts	V <sub>(BR)</sub> EBO Volts	I <sub>CBO</sub> μA Max.	D-C CURRENT GAIN (h <sub>FE</sub> )				V <sub>CE(SAT)</sub>		f <sub>T</sub> Min. (MHz)	C <sub>cb</sub> Max. (pF)	t <sub>off</sub> Max. (nsec)	N.F. Max. (dB)		
							Conditions		Limits		I <sub>C</sub> (mA)	V <sub>CE</sub> Volts					I <sub>C</sub> (mA)	Max. Volts
							I <sub>C</sub> (mA)	V <sub>CE</sub> Volts	Min.	Max.								
2N3644	PNP	625	45	45	5	0.035	50	1	80	240	150	0.040	200	8.0	100			
2N5368	NPN	500	60	30	5	0.05	150	10	60	200	150	0.30	250	8.0	350	—		
2N5369	NPN	500	60	30	5	0.05	150	10	100	300	150	0.30	250	8.0	350	—		
2N5370	NPN	500	60	30	5	0.05	150	10	200	600	150	0.30	250	8.0	400	—		
2N5371	NPN	500	40	30	5	0.05	150	10	60	600	150	0.30	250	8.0	400	—		
2N5372	PNP	500	60	30	5	0.05	150	10	40	120	150	0.30	150	10.0	150	—		
2N5373	PNP	500	60	30	5	0.05	150	10	100	300	150	0.30	150	10.0	150	—		
2N5374	PNP	500	60	30	5	0.05	150	10	150	450	150	0.30	150	10.0	175	—		
2N5375	PNP	500	40	30	5	0.05	150	10	40	400	150	0.30	150	10.0	175	—		
2N5380	NPN	500	60	40	6	0.05	10	1	50	150	50	0.30	250	4.0	175	6		
2N5381	NPN	500	60	40	6	0.05	10	1	100	300	50	0.30	300	4.0	200	5		
2N5382	PNP	500	40	40	6	0.05	10	1	50	150	50	0.40	200	4.5	200	5		
2N5383	PNP	500	40	40	6	0.05	10	1	100	300	50	0.40	250	4.5	225	4		
2N5810	NPN	500	35	25	5	0.10	500	2	45	—	500	0.75	100	15.0	—	—		
2N5811	PNP	500	35	25	5	0.10	500	2	45	—	500	0.75	100	15.0	—	—		
2N5812	NPN	500	35	25	5	0.10	500	2	60	—	500	0.75	135	15.0	—	—		
2N5813	PNP	500	35	25	5	0.10	500	2	60	—	500	0.75	135	15.0	—	—		
2N5814	NPN	500	50	40	5	0.10	2	2	60	120	500	0.75	100	15.0	—	—		
2N5815	PNP	500	50	40	5	0.10	2	2	60	120	500	0.75	100	15.0	—	—		
2N5816	NPN	500	50	40	5	0.10	2	2	100	200	500	0.75	120	15.0	—	—		
2N5817	PNP	500	50	40	5	0.10	2	2	100	200	500	0.75	120	15.0	—	—		
2N5818	NPN	500	50	40	5	0.10	2	2	150	300	500	0.75	135	15.0	—	—		
2N5819	PNP	500	50	40	5	0.10	2	2	150	300	500	0.75	135	15.0	—	—		
TP3638	PNP	500	25	25	4	35	50	1	30	—	300	1.0	100	20	170	—		
TP3638A	PNP	500	25	25	4	35	50	1	300	—	300	1.0	150	10	170	—		
2N3402	NPN	900	25	25	5	0.1	2	4.5	75	225	50	0.30	—	—	—	—		
2N3403	NPN	900	25	25	5	0.1	2	4.5	180	540	50	0.30	—	—	—	—		
2N3404	NPN	900	50	50	5	0.1	2	4.5	75	225	50	0.30	—	—	—	—		
2N3405	NPN	900	50	50	5	0.1	2	4.5	180	540	50	0.30	—	—	—	—		
2N4425	NPN	900	60	40	5	0.03	2	4.5	180	540	50	0.30	—	—	—	—		
HS3402	NPN	900	25	25	5	0.1	2	4.5	75	225	50	0.30	—	—	—	—		
HS3403	NPN	900	25	25	5	0.1	2	4.5	180	540	50	0.30	—	—	—	—		
HS3404	NPN	900	50	50	5	0.1	2	4.5	75	225	50	0.30	—	—	—	—		
HS3405	NPN	900	50	50	5	0.1	2	4.5	180	540	50	0.30	—	—	—	—		
2N2713	NPN	360	18	18	5	0.10	2	4.5	30	90	50	0.30	—	—	—	—		
2N2714	NPN	360	18	18	5	0.10	2	4.5	75	225	50	0.30	—	—	—	—		
2N3390	NPN	360	18	18	5	0.10	2	4.5	400	800	—	—	—	10.0	—	—		
2N3414	NPN	360	25	25	5	0.10	2	4.5	75	225	50	0.30	—	—	—	—		
2N3415	NPN	360	25	25	5	0.10	2	4.5	180	540	50	0.30	—	—	—	—		
2N3416	NPN	360	50	50	5	0.10	2	4.5	75	225	50	0.30	—	—	—	—		
2N3417	NPN	360	50	50	5	0.10	2	4.5	180	540	50	0.30	—	—	—	—		
2N3975	NPN	360	60	30	5	0.50	10	1	35	100	150	0.30	200*	7.0	—	—		
2N3976	NPN	360	60	30	5	0.50	10	1	55	200	150	0.30	200*	7.0	—	—		
2N4424	NPN	360	60	40	5	0.03	2	4.5	180	540	50	0.30	—	—	—	—		
2N4951	NPN	360	60	30	5	0.05	150	10	60	200	150	0.30	250	8.0	350	—		
2N4952	NPN	360	60	30	5	0.05	150	10	100	300	150	0.30	250	8.0	350	—		
2N4953	NPN	360	60	30	5	0.05	150	10	200	600	150	0.30	250	8.0	400	—		
2N4954	NPN	360	40	30	5	0.05	150	10	60	600	150	0.30	250	8.0	400	—		
2N5418	NPN	400	25	25	4	0.10	50	2	44	110	50	0.25	—	—	—	—		
2N5419	NPN	360	25	25	4	0.10	50	1	100	300	50	0.25	250	6.0	—	—		
2N5420	NPN	360	25	25	4	0.10	50	1	250	500	50	0.25	250	6.0	—	—		
D29A4	PNP	360	35	25	4	0.01	50	4.5	40	120	50	0.30	—	8.0	—	—		
D29A5	PNP	360	35	25	4	0.01	50	4.5	100	300	50	0.30	—	8.0	—	—		
TZ-551	PNP	360	60	30	5	0.05	150	10	40	120	150	0.30	150	10.0	150	—		
TZ-552	PNP	360	60	30	5	0.05	150	10	100	300	150	0.30	150	10.0	150	—		
TZ-553	PNP	360	60	30	5	0.05	150	10	150	450	150	0.30	150	10.0	175	—		
TZ-554	PNP	360	40	30	5	0.05	150	10	40	400	150	0.30	150	10.0	175	—		



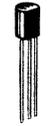
TO-92  
(CBE)  
In-Line  
Pinning  
Formed  
to TO-18  
Pin Circle



TO-92HS  
(ECB)  
Pinning



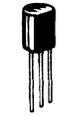
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(EBC)



TO-92  
(ECB)  
In-Line  
Pinning

### SWITCHES

Type No.	POLARITY	P <sub>D</sub> T <sub>A</sub> = 25 C (mW)	V <sub>(BR)</sub> CBO Volts	V <sub>(BR)</sub> CEO Volts	V <sub>(BR)</sub> EBO Volts	I <sub>CBO</sub> nA Max.	D-C CURRENT GAIN (h <sub>FE</sub> )				V <sub>CE(SAT)</sub>		f <sub>T</sub> Min. (MHz)	C <sub>cb</sub> Max. (pF)	t <sub>off</sub> Max. (nsec)	N.F. Max. (dB)				
							Conditions		Limits		I <sub>C</sub> (mA)	V <sub>CE</sub> Volts					Min.	Max.	I <sub>C</sub> (mA)	Max. Volts
							I <sub>C</sub> (mA)	V <sub>CE</sub> Volts	Min.	Max.										
2N5224	NPN	360	25	12	5	500	10	1	40	400	10	0.40	250	4.0	60	—				
2N5228	PNP	360	5	5	3	100	10	0.3	30	—	10	0.40	300	5.0	140	—				
MPS706	NPN	360	25	15	3	500	10	1	20	—	10	0.60	200	6.0	75	—				
MPS706A	NPN	360	25	15	5	500	10	1	20	60	10	0.60	200	6.0	75	—				
MPS3639	PNP	200	6	6	4	10	10	0.3	30	120	10	0.16	500	3.5	25	—				
MPS3640	PNP	350	12	12	4	10	10	0.3	30	120	10	0.16	500	3.5	25	—				
MPS3646	NPN	350	40	15	5	500	30	4	30	120	100	0.28	350	5.0	28	—				
MPS4257	PNP	350	6	6	4.5	10	10	3	30	120	10	0.15	700	3.0	20	—				
MPS4258	PNP	350	12	12	4.5	10	10	3	30	120	10	0.15	700	3.0	20	—				
MPS4274	NPN	200	30	12	4.5	400	10	1	35	120	10	0.20	400	4.0	12	—				
MPS4275	NPN	200	30	15	4.5	400	10	1	35	120	10	0.20	400	4.0	12	—				
MPS5134	NPN	200	20	10	7.5	400	10	1	20	150	10	0.25	250	4.0	18	—				
TP5140	PNP	200	5	5	4	50	10	1	40	—	10	0.20	400	5.0	20	—				
2N3639	PNP	200	6	6	4	50	10	0.3	30	120	10	0.16	500	3.5	25	—				
2N3640	PNP	200	12	12	4	50	10	0.3	30	120	10	0.16	500	3.5	25	—				
2N3646	NPN	500	40	15	5	500	30	4	30	120	10	0.16	500	3.5	35	—				
2N4257	PNP	200	6	6	4.5	10	10	3	30	120	100	0.28	350	5.0	28	—				
2N4258	PNP	200	12	12	4.5	10	10	3	30	120	10	0.15	700	3.0	20	—				
2N4274	NPN	625	30	12	4.5	10†	10	1	35	120	10	0.20	400	4.0	12	—				
2N4275	NPN	625	40	15	4.5	10†	10	1	35	120	10	0.20	400	4.0	12	—				
2N5134	NPN	625	20	10	3.5	400	10	1	20	150	10	0.25	250	4.0	18	—				
2N5140	PNP	200	5	5	4	50	10	1	40	—	10	0.20	400	5.0	20	—				
SE4010	NPN	200	35	25	5	100	1	10	200	1000	1	0.35	60	4.0	—	3				



TO-92  
(EBC)  
In-Line  
Pinning



(CBE)  
Formed to  
TO-18  
Pin Circle

### SMALL-SIGNAL LOW NOISE AMPLIFIERS

2N3391	NPN	360	25	25	5	100	2	4.5	250	500	—	—	—	10.0	—	—
2N3391A	NPN	360	25	25	5	0.10†	2	4.5	250	500	—	—	—	10.0	—	5
2N3900	NPN	360	18	18	5	0.10†	2	4.5	250	500	—	—	—	12.0	—	—
2N3900A	NPN	360	18	18	5	0.10†	2	4.5	250	500	—	—	160*	12.0	—	5
2N3901	NPN	360	18	18	5	0.01†	2	4.5	350	700	—	—	200*	10.0	—	—
2N4256	NPN	360	30	30	5	0.50†	2	4.5	100	500	50	0.20	—	4.0	100	—
2N5232	NPN	360	70	50	5	0.03†	2	5	250	500	10	0.125	—	4.0	—	—
2N5232A	NPN	360	70	50	5	0.03†	2	5	250	500	10	0.125	—	4.0	—	5
2N5309	NPN	360	70	50	5	10	0.01	5	60	120	10	0.125	—	4.0	—	—
2N5310	NPN	360	70	50	5	10	0.01	5	100	300	10	0.125	—	4.0	—	—
TZ-81	NPN	360	40	30	5	10	0.01	5	100	500	10	0.20	30	8.0	—	2
TZ-82	NPN	360	60	30	5	10	0.01	5	40	500	10	0.20	30	8.0	—	3
TZ-581	PNP	360	40	30	5	10	0.01	5	100	500	10	0.20	20	10.0	—	2
TZ-582	PNP	360	60	30	5	10	0.01	5	40	500	10	0.20	20	10.0	—	3
2N5209	NPN	360	50	50	4.5	10	0.1	5	100	300	10	0.70	30	4.0	—	3
2N5210	NPN	360	50	50	4.5	10	0.1	5	200	600	10	0.70	30	4.0	—	3
2N5220	NPN	360	15	15	3	100	50	10	30	600	150	0.50	100	10.0	—	—
2N5221	PNP	360	15	15	3	100	50	10	30	600	150	0.50	100	15.0	—	—
MPS3391	NPN	360	25	25	5	100	2	4.5	250	500	—	—	—	10.0	—	—
MPS3391A	NPN	360	25	25	5	100	2	4.5	250	500	—	—	—	10.0	—	5
MPS3565	NPN	200	30	25	6	50	1	10	150	600	1	0.35	40	4.0	—	—
MPS4248	PNP	200	40	40	5	10	10	5	50	—	10	0.25	—	6.0	—	—
MPS4249	PNP	200	60	60	5	10	0.1	5	100	300	10	0.25	—	6.0	—	3
MPS4250	PNP	200	40	40	5	10	0.1	5	100	300	10	0.25	50	6.0	—	2
MPS5133	NPN	625	20	18	3	50	1	5	60	1000	1	0.40	50	5.0	—	—
MPS6571	NPN	360	20	20	3	5	0.1	5	250	1000	10	0.50	50	4.5	—	1.2*
MPS-A09	NPN	310	50	50	3	100	0.1	5	100	600	10	0.90	30	5.0	—	1.4*



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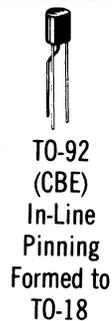


TO-92  
(EBC)  
In-Line  
Pinning

\*Typical value † In  $\mu$ A

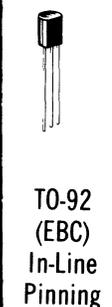
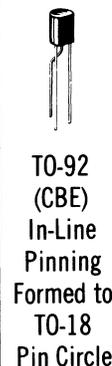
### SMALL-SIGNAL LOW NOISE AMPLIFIERS (Cont.)

Type No.	POLARITY	P <sub>D</sub> T <sub>A</sub> = 25 C (mW)	V <sub>(BR)</sub> CBO Volts	V <sub>(BR)</sub> CEO Volts	V <sub>(BR)</sub> EBO Volts	I <sub>CBO</sub> nA Max.	D-C CURRENT GAIN (h <sub>FE</sub> )				V <sub>CE(SAT)</sub>		f <sub>T</sub> Min. (MHz)	C <sub>cb</sub> Max. (pF)	t <sub>off</sub> Max. (nsec)	N.F. Max. (dB)		
							Conditions		Limits		I <sub>C</sub> (mA)	V <sub>CE</sub> Volts					I <sub>C</sub> (mA)	Max. Volts
							I <sub>C</sub> (mA)	V <sub>CE</sub> Volts	Min.	Max.								
2N3565	NPN	200	30	25	6	50	1	10	150	600	1	0.35	40	4.0	—	—		
2N5133	NPN	625	20	18	3	50	1	5	60	1000	1	0.40	50	5.0	—	—		
2N5138	PNP	625	30	30	5	50	0.1	10	50	800	10	0.30	30	9.0	—	—		
2N5376	NPN	500	60	30	5	10	0.01	5	100	500	10	0.20	30	8.0	—	—		
2N5377	NPN	500	60	30	5	10	0.01	5	40	200	10	0.20	30	8.0	—	—		
2N5378	PNP	500	40	30	5	10	0.01	5	100	500	10	0.20	20	10.0	—	—		
2N5379	PNP	500	40	30	5	10	0.01	5	40	200	10	0.20	20	10.0	—	—		



### BC SERIES (PRO-ELECTRON) SMALL-SIGNAL AMPLIFIERS

Type No.	POLARITY	P <sub>D</sub> T <sub>A</sub> = 25°C (mW)	V <sub>(BR)</sub> CBO Volts	V <sub>(BR)</sub> CEO Volts	V <sub>(BR)</sub> EBO Volts	DC CURRENT GAIN (h <sub>FE</sub> )				V <sub>CE(SAT)</sub>		f <sub>T</sub> Min. (MHz)	C <sub>cb</sub> Max. (pF)	N.F. Max. (dB)		
						Conditions		Limits		I <sub>C</sub> (mA)	V <sub>CE</sub> Volts				I <sub>C</sub> (mA)	Max. Volts
						I <sub>C</sub> (mA)	V <sub>CE</sub> Volts	Min.	Max.							
BC182A	NPN	300	60	50	6	2	5	120	220	100	0.60	150	5	10		
BC182B	NPN	300	60	50	6	2	5	180	460	100	0.60	150	5	10		
BC212A	PNP	300	60	50	5	2	5	120	220	100	0.60	200	6	10		
EC212B	PNP	300	60	50	5	2	5	180	460	100	0.60	200	6	10		
BC237A	NPN	300	50	45	6	2	5	120	220	10	0.20	150	4.5	10		
BC237B	NPN	300	50	45	6	2	5	180	460	10	0.20	150	4.5	10		
BC238A	NPN	300	30	20	5	2	5	120	220	10	0.20	150	4.5	10		
BC238B	NPN	300	30	20	5	2	5	180	460	10	0.20	150	4.5	10		
BC238C	NPN	300	30	20	5	2	5	380	800	10	0.20	150	4.5	10		
BC239B	NPN	300	30	20	5	2	5	180	460	10	0.20	150	4.5	4		
BC239C	NPN	300	30	20	5	2	5	380	800	10	0.20	150	4.5	4		
BC307A	PNP	300	45	45	5	2	5	120	220	10	0.20	150	6	10		
BC307B	PNP	300	45	45	5	2	5	180	460	10	0.20	150	6	10		
BC308A	PNP	300	25	25	5	2	5	120	220	10	0.20	150	6	10		
BC308B	PNP	300	25	25	5	2	5	180	460	10	0.20	150	6	10		
BC308C	PNP	300	25	25	5	2	5	380	800	10	0.20	150	6	10		
BC309A	PNP	300	25	20	5	2	5	120	220	10	0.20	200	6	8		
BC309B	PNP	300	20	20	5	2	5	180	460	10	0.20	150	6	4		
BC309C	PNP	300	20	20	5	2	5	380	800	10	0.20	150	6	4		
BC327-16	PNP	625	45	45	5	100	1	100	250	500	0.7	100	12	—		
BC327-25	PNP	625	45	45	5	100	1	160	400	500	0.7	100	12	—		
BC327-40	PNP	625	45	45	5	100	1	250	630	500	0.7	100	12	—		
BC328-16	PNP	625	25	25	5	100	1	100	250	500	0.7	100	12	—		
BC328-25	PNP	625	25	25	5	100	1	160	400	500	0.7	100	12	—		
BC328-40	PNP	625	25	25	5	100	1	250	630	500	0.7	100	12	—		
BC 337-16	NPN	625	45	45	5	100	1	100	250	500	0.7	100	12	—		
BC337-25	NPN	625	45	45	5	100	1	160	400	500	0.7	100	12	—		
BC337-40	NPN	625	45	45	5	100	1	250	630	500	0.7	100	12	—		
BC338-16	NPN	625	25	25	5	100	1	100	250	500	0.7	100	12	—		
BC338-25	NPN	625	25	25	5	100	1	160	400	500	0.7	100	12	—		
BC338-40	NPN	625	25	25	5	100	1	250	630	500	0.7	100	12	—		
BC167A	NPN	300	50	45	6	2	5	125	260	10	0.20	150	4.5	10		
BC167B	NPN	300	50	45	6	2	5	240	500	10	0.20	150	4.5	10		
BC168A	NPN	300	30	20	5	2	5	125	260	10	0.20	150	4.5	10		
BC168B	NPN	300	30	20	5	2	5	240	500	10	0.20	150	4.5	10		
BC168C	NPN	300	30	20	5	2	5	450	900	10	0.20	150	4.5	10		
BC169B	NPN	300	30	20	5	2	5	240	500	10	0.20	150	4.5	4		
BC169C	NPN	300	30	20	5	2	5	450	900	10	0.20	150	4.5	5		
BC257A	PNP	300	45	45	5	2	5	125	260	10	0.20	150	6	10		
BC257B	PNP	300	45	45	5	2	5	240	500	10	0.20	150	6	10		
BC258A	PNP	300	25	25	5	2	5	125	260	10	0.20	150	6	10		
BC258B	PNP	300	25	25	5	2	5	240	500	10	0.20	150	6	10		
BC258C	PNP	300	25	25	5	2	5	450	900	10	0.20	150	5	10		
BC259B	PNP	300	20	20	5	2	5	240	500	10	0.20	150	6	4		
BC259C	PNP	300	20	20	5	2	5	450	900	10	0.20	150	6	4		



### HIGH-FREQUENCY AMPLIFIERS/OSCILLATORS

Type No.	POLARITY	PD T <sub>A</sub> = 25 C (mW)	V <sub>(BR)</sub> CBO Volts	V <sub>(BR)</sub> CEO Volts	V <sub>(BR)</sub> EBO Volts	I <sub>CBO</sub> μA Max.	D-C CURRENT GAIN (h <sub>FE</sub> )				V <sub>CE(SAT)</sub>		f <sub>T</sub> Min. (MHz)	C <sub>cb</sub> Max. (pF)	t <sub>off</sub> Max. (nsec)	N.F. Max. (dB)	Style 3 (EBC)		
							Conditions		Limits		I <sub>C</sub> (mA)	Max. Volts						I <sub>C</sub> (mA)	Max. Volts
							I <sub>C</sub> (mA)	V <sub>CE</sub> Volts	Min.	Max.									
2N5222	NPN	360	20	15	2	0.100	4	10	20	1500	4	1.0	450	—	—	—			
MPS3563	NPN	310	30	12	2	0.050	8	10	20	200	—	—	600	1.7	—	—			
2N3854	NPN	360	18	18	4	0.500	2	4.5	35	70	10	.0	100	3.5	90	—			
2N3854A	NPN	360	30	30	4	0.500	2	4.5	35	70	10	1.0	100	3.5	90	—			
2N3855	NPN	360	18	18	4	0.500	2	4.5	60	120	10	1.0	130	3.5	90	—			
2N3855A	NPN	360	30	30	4	0.500	2	4.5	60	120	10	1.0	130	3.5	90	—			
2N3856	NPN	360	18	18	4	0.500	2	4.5	100	200	10	1.0	140	3.5	90	—			
2N3856A	NPN	360	30	30	4	0.050	2	4.5	100	200	10	1.0	140	3.5	90	—			
2N3858	NPN	360	30	30	4	0.050	2	4.5	60	120	10	1.0	90	4.0	150	—			
2N3858A	NPN	360	60	60	6	0.050	10	1	60	120	10	0.25	90	4.0	150	—			
2N3859	NPN	360	30	30	4	0.050	2	4.5	100	200	10	1.0	90	4.0	150	—			
2N3859A	NPN	360	60	60	6	0.050	10	1	100	200	10	0.25	90	4.0	150	—			
2N3860	NPN	360	30	30	4	0.050	2	4.5	150	300	10	1.0	90	4.0	150	—			

### HIGH-VOLTAGE AMPLIFIERS/INDICATOR DRIVERS

2N3877	NPN	360	70	70	4	0.100	2	4.5	20	250	10	1.0	160*	—	—	—	
2N3877A	NPN	360	85	85	4	0.100	2	4.5	20	250	10	1.0	160*	—	—	—	
2N5174	NPN	360	90	75	5	0.500	10	5.0	40	600	10	0.95	—	5	—	—	
2N4409	NPN	625	80	50	5	0.010	10	1.0	60	400	1	0.20	60	12	—	—	
2N4410	NPN	625	120	80	5	0.010	10	1.0	60	400	1	0.20	60	12	—	—	
2N5400	PNP	350	130	120	5	0.050	10	5.0	40	180	10	0.20	100	6	—	8	
2N5401	PNP	350	160	150	5	0.050	10	5.0	60	240	10	0.20	100	6	—	8	
2N5550	NPN	350	160	140	6	0.100	10	5.0	60	250	10	0.15	100	6	—	10	
2N5551	NPN	350	180	160	6	0.050	10	5.0	80	250	10	0.15	100	6	—	8	
2N5830	NPN	625	120	100	5	0.050	10	5.0	80	500	1	0.15	1	4	—	—	
2N5831	NPN	625	160	140	5	0.050	10	5.0	80	250	1	0.15	1	4	—	—	
2N5832	NPN	625	160	140	5	0.050	10	5.0	175	—	1	0.15	1	4	—	—	
MPS-D02	NPN	350	140	140	4	0.100	10	10.0	25	—	—	—	40	—	—	—	
MPS-D03	NPN	350	100	100	4	0.100	10	10.0	25	—	—	—	40	—	—	—	
MPS-D52	PNP	350	140	140	4	0.100	10	10.0	25	—	—	—	40	—	—	—	
MPS-D53	PNP	350	100	100	4	0.100	10	10.0	25	—	—	—	40	—	—	—	

\*Measured at R<sub>g</sub> = 20 Ω, f = 2MHz; equivalent noise - bandwidth, β ≤ 0.1MHz; V<sub>CE</sub> = 10V, I<sub>C</sub> = 1mA.

### LOW NOISE AMPLIFIERS/SWITCHES

Type No.	POLARITY	P <sub>D</sub> (@ 25 C) (mW) Max.	MAX. RATINGS			I <sub>CBO</sub> nA Max.	h <sub>FE</sub> (α) I <sub>C</sub> = 10μA	Saturation Voltage (Max.)				f <sub>T</sub> Min. (MHz)	C <sub>ob</sub> Max. (pF)	N.F. Max. (dB)	Style 3 (EBC)
			V <sub>(BR)</sub> CBO Volts	V <sub>(BR)</sub> CEO Volts	V <sub>(BR)</sub> EBO Volts			I <sub>C</sub> (mA)	I <sub>B</sub> (mA)	V <sub>CE</sub> Volts	V <sub>BE</sub> Volts				
			TP2483	NPN	400			60	60	6	10				
TP2484	NPN	400	60	60	6	10	100-500	1	0.1	0.35	0.70	60	6	3	
TP4384	NPN	500	40	30	5	10	100-500	10	1	0.20	0.80	30	8	2	
TP4386	NPN	500	40	30	5	10	40-500	10	1	0.20	0.80	30	8	3	
TP4413	PNP	400	40	30	5	10	100-500	10	1	0.20	0.80	20	8	2	
TP4413A	PNP	400	60	60	5	10	100-500	10	1	0.20	0.80	20	8	2	
TP4415	PNP	400	40	30	5	10	40-500	10	1	0.20	0.80	20	8	2	
TP4415A	PNP	400	60	60	5	10	40-500	10	1	0.20	0.80	20	8	2	

TO-92  
Package



Style	PINNING	VARIATIONS
1	For TO-18 Lead Form	C B E
2	TO-98 Replacement	E C B
3	Standard TO-92	E B C

### DARLINGTON AMPLIFIERS

Type No.	POLARITY	P <sub>D</sub> T <sub>A</sub> = 25°C (mW)	V <sub>(BR)</sub> CBO Volts	V <sub>(BR)</sub> CEO Volts	V <sub>(BR)</sub> EBO Volts	I <sub>CBO</sub> μA Max.	D-C CURRENT GAIN (h <sub>FE</sub> )				V <sub>CE(SAT)</sub>		f <sub>T</sub> Min. (MHz)	C <sub>cb</sub> Max. (pF)	t <sub>off</sub> Max. (nsec)	N.F. Max. (dB)		
							Conditions		Limits		I <sub>C</sub> (mA)	V <sub>CE</sub> Volts					I <sub>C</sub> (mA)	Max. Volts
							I <sub>C</sub> (mA)	V <sub>CE</sub> Volts	Min.	Max.								
2N6426	NPN	625	40	40	12	50	10	5	20000	200000	1.5	150	7.0	—	10	—		
2N6427	NPN	625	40	40	12	50	10	5	10000	100000	500	1.5	130	7.0	—	10		
MPS5305	NPN	400	25	25	12	0.10	2	5	2000	20000	200	1.40	60	10.0	—	—		
MPS5306	NPN	40	25	25	12	0.10	2	5	7000	70000	200	1.4	60	10.0	—	—		
MPS5306A	NPN	400	25	25	12	0.10	2	5	7000	70000	200	1.4	60	10.0	—	**		
MPS5307	NPN	400	40	40	12	0.10	2	5	2000	20000	200	1.4	60	10.0	—	—		
MPS5308	NPN	400	40	40	12	0.10	2	5	7000	70000	200	1.4	60	10.0	—	—		
MPS5308A	NPN	400	40	40	12	0.10	2	5	7000	70000	200	1.4	60	10.0	—	**		
MPS-A12	NPN	360	†20	20	10	0.10	10	5	20000	—	10	1.0	—	8.0	—	—		
MPS-A13	NPN	360	30	30	10	0.10	10	5	5000	—	100	1.5	125	*8.0	—	*2		
MPS-A14	NPN	360	30	30	10	0.10	10	5	10000	—	100	1.5	125	*8.0	—	*2		
MPS-A63	PNP	625	30	30	10	0.10	10	5	5000	—	10	1.5	100	—	—	—		
MPS-A64	PNP	625	30	30	10	0.10	10	5	1000	—	10	1.5	100	—	—	—		
MPS-A65	PNP	625	30	30	10	0.10	10	5	50000	—	10	1.5	100	—	—	—		
MPS-A66	PNP	625	30	30	10	0.10	10	5	75000	—	10	1.5	100	—	—	—		
MPS-D04	NPN	625	25	25	10	1.00	100	5	2000	—	100	1.0	100	—	—	—		
MPS-D54	PNP	625	25	25	10	1.00	100	5	2000	—	100	1.0	100	—	—	—		
2N5305	NPN	400	25	25	12	0.10	2	5	2000	20000	200	1.4	60	10.0	—	—		
2N5306	NPN	400	25	25	12	0.10	2	5	7000	70000	200	1.4	60	10.0	—	—		
2N5306A	NPN	400	25	25	12	0.10	2	5	7000	70000	200	1.4	10.0	—	**	—		
2N5307	NPN	400	40	40	12	0.10	2	5	2000	20000	200	1.4	60	10.0	—	—		
2N5308	NPN	400	40	40	12	0.10	2	5	7000	70000	200	1.4	60	10.0	—	—		
2N5308A	NPN	400	40	40	12	0.10	2	5	7000	70000	200	1.4	60	10.0	—	**		
D16P1	NPN	400	18	12	12	0.10	100	5	6000	—	200	1.4	—	10.0	—	—		
HS5305	NPN	900	25	25	12	0.10	2	5	2000	20000	200	1.4	60	10.0	—	—		
HS5306	NPN	900	25	25	12	0.10	2	5	7000	70000	200	1.4	60	10.0	—	—		
HS5306A	NPN	900	25	25	12	0.10	2	5	7000	70000	200	1.4	60	10.0	—	**		
HS5307	NPN	900	40	40	12	0.10	2	5	2000	20000	200	1.4	60	10.0	—	—		
HS5308	NPN	900	40	40	12	0.10	2	5	7000	70000	200	1.4	60	10.0	—	—		
HS5308A	NPN	900	40	40	12	0.10	2	5	7000	70000	200	1.4	60	10.0	—	**		



TO-92  
(EBC)  
In-Line  
Pinning



TO-92  
(ECB)



TO-92HS  
(ECB)

†BV<sub>CEs</sub>

\*Typical value

\*\*Noise Voltage e<sub>n</sub> ≤ 230 nV/√Hz @ I<sub>C</sub> = 0.6mA, V<sub>CE</sub> = 5V, R<sub>g</sub> = 160kΩ, f = 10Hz to 10kHz, BW = 15.7kHz.

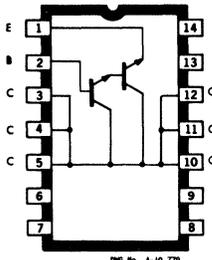
## TYPE TPP-1000, TPP-2000, TPP-3000, and TPP-4000 MEDIUM POWER DARLINGTON ARRAYS

Sprague Series TPP devices are medium-power Darlington arrays, consisting of 1, 2, 3, or 4 discrete Darlington chips in a single package. These devices provide complements to Sprague's Series TPQ quad transistor arrays.

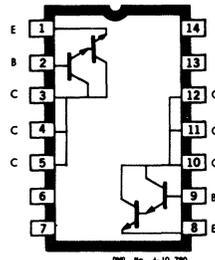
### FEATURES:

- NPN Transistors
- P<sub>D</sub> @ 25°C 2W/Package

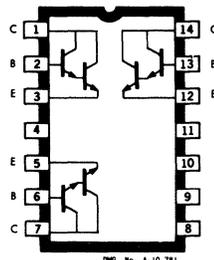
- BV<sub>CBO</sub> ≥ 50 Volts
- BV<sub>CEs</sub> ≥ 40 Volts
- BV<sub>EBO</sub> ≥ 12 Volts
- H<sub>FE</sub> ≥ 2000 @ I<sub>C</sub> = 500 mA, V<sub>CE</sub> = 5 V
- Plastic 16-Pin Dual In-Line Package A



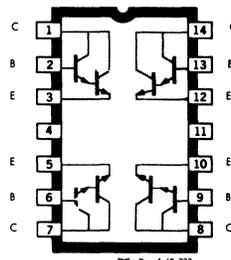
DWG. No. A-10,779  
TPP-1000



DWG. No. A-10,780  
TPP-2000



DWG. No. A-10,781  
TPP-3000



DWG. No. A-10,782  
TPP-4000

### TO-92 REPLACEMENTS FOR SPRAGUE TQ/TN SERIES AMPLIFIER/SWITCHING TRANSISTORS

Type No.	POLARITY	P <sub>D</sub> @ 25 °C mW Max.	MAX. RATING			I <sub>CBO</sub> nA Max.	CURRENT AMPLI. FACTOR			Saturation Voltage (Max.)				f <sub>T</sub> Min (MHz)	C <sub>ob</sub> (pF)
			V <sub>(BR)</sub> CBO Volts	V <sub>(BR)</sub> CEO Volts	V <sub>(BR)</sub> EBO Volts		h <sub>FE</sub> @ I <sub>C</sub> =10mA Min.-Max.	h <sub>FE</sub> @ I <sub>C</sub> =150mA Min.-Max.	h <sub>FE</sub> @ I <sub>C</sub> =500mA Min.-Max.	I <sub>C</sub> mA	I <sub>B</sub> mA	V <sub>CE</sub> Volts	V <sub>BE</sub> Volts		
CT760	PNP	400	40	30	5	20	50*	100	30	15	40	1.3	100	8	8
CT762	PNP	400	40	30	5	20	40*	50	30	150	15	0.40	1.3	100	8
CT764	PNP	400	20	20	5	100	—	25	—	150	15	0.50	1.3	20	8
CT767	PNP	400	40	30	5	10	100-500†	—	—	10	1	0.20	0.8	20	10
CT768	PNP	400	60	60	5	10	100-500†	†	—	10	1	0.20	0.8	20	10
CT769	PNP	400	40	30	5	10	40-500†	†	—	10	1	0.20	0.8	20	10
CT770	PNP	400	60	60	5	10	40-500†	—	—	10	1	0.20	0.8	20	10
CT1454	NPN	500	75	45	5	10	40	50	20	150	15	0.50	1.3	100	8
CT1460	NPN	500	40	30	5	20	—	100	30	150	15	0.40	1.3	100	8
CT1462	NPN	500	40	30	5	20	40	50	30	150	15	0.40	1.3	100	8
CT1464	NPN	500	20	20	5	100	25	25	—	150	15	0.50	1.3	20	8

\*I<sub>C</sub> = 1 mA  
†I<sub>C</sub> = 100 μA



TO-92 (EBC) In-Line Pinning

### TO-92 REPLACEMENTS FOR TO-5/TO-18 PACKAGED BC SERIES (PRO-ELECTRON) SMALL-SIGNAL TRANSISTORS

Type No.	POLARITY	P <sub>D</sub> T <sub>A</sub> = 25°C (mW)	V <sub>(BR)</sub> CBO Volts	V <sub>(BR)</sub> CEO Volts	V <sub>(BR)</sub> EBO Volts	DC CURRENT GAIN (h <sub>FE</sub> )				V <sub>CE(SAT)</sub>		f <sub>T</sub> Min. (MHz)	C <sub>cb</sub> Max. (pF)	N.F. Max. (dB)
						Conditions		Limits		I <sub>C</sub> (mA)	Max. Volts			
						I <sub>C</sub> (mA)	V <sub>CE</sub> Volts	Min.	Max.					
TP107A	NPN	300	50	5	6	2	5	125	260	10	0.2	150	5	10
TP107B	NPN	300	50	45	6	2	5	249	500	10	0.2	150	5	10
TP108A	NPN	300	30	20	5	2	5	125	260	10	0.2	150	5	10
TP108B	NPN	300	30	20	5	2	5	240	500	10	0.2	150	5	10
TP108C	NPN	300	30	20	5	2	5	450	900	10	0.2	150	5	10
TP109B	NPN	300	30	20	5	2	5	240	500	10	0.2	150	5	4
TP109C	NPN	300	30	20	5	2	5	450	900	10	0.2	150	5	4
TP110	NPN	300	80	80	8	2	5	30	—	50	0.6	100	5	—
TP177A	PNP	300	45	45	5	2	5	125	260	10	0.2	150	7	6
TP177B	PNP	300	45	45	5	2	5	240	500	10	0.2	150	7	6
TP178A	PNP	300	20	20	5	2	5	125	260	10	0.2	150	7	6
TP178B	PNP	300	20	20	5	2	5	240	500	10	0.2	150	7	6
TP178C	PNP	300	20	20	5	2	5	450	900	10	0.2	150	7	6
TP179B	PNP	300	20	20	5	2	5	240	500	10	0.2	150	7	2.5
TP179C	PNP	300	20	20	5	2	5	450	900	10	0.2	150	7	2.5

‡Pulse Test only.



TO-92 (CBE) In-Line Pinning

### LEAD FORMING ON SILICON SMALL SIGNAL TRANSISTORS

Lead forming to TO-5 or TO-18 outline dimensions is available on all standard in-line pinned TO-92 packaged plastic transistors. To identify a lead formed device, simply add a dash five (—5) or a dash eighteen (—18) to the standard device type number. For example: 2N4400—5 would be a 2N4400 device lead formed to the TO-5 pin circle.

Information on the details and dimensions of lead forms for TO-92 will be furnished on request.

### REPLACEMENTS FOR POPULAR TIS SERIES TRANSISTORS

Type No.	POLARITY	P T <sub>A</sub> = 25 C (mW)	V <sub>(BR)</sub> CBO Volts	V <sub>(BR)</sub> CEO Volts	V <sub>(BR)</sub> EBO Volts	I <sub>CBO</sub> nA Max.	D-C CURRENT GAIN (h <sub>FE</sub> )				V <sub>CE(SAT)</sub>		f <sub>T</sub> Min. (MHz)	C <sub>cb</sub> Max. (pF)	t <sub>off</sub> Max. (nsec)	N.F. Max. (dB)			
							Conditions		Limits		I <sub>C</sub> (mA)	Max. Volts						I <sub>C</sub> (mA)	Max. Volts
							I <sub>C</sub> (mA)	V <sub>CE</sub> Volts	Min.	Max.									
TPS62A	NPN	500	30	12	3	100	4	10	30	225	—	—	500	0.4	—	6.0	Style 1 (CBE)		
TPS63A	NPN	500	30	12	3	100	4	10	30	225	—	—	500	0.4	—	—			
TPS64A	NPN	500	30	12	3	100	4	10	50	150	—	—	500	0.4	—	—			
TPS84	NPN	500	40	30	4	50	4	10	30	—	—	—	—	—	—	3.3	Style 2 (ECB)		
TPS86	NPN	400	30	30	4	100	4	10	40	200	—	—	500	—	—	5.0			
TPS87	NPN	400	45	45	4	100	12	12	30	150	—	—	500	—	—	—			
TPS90	NPN	625	40	40	5	100	50	2	100	300	50	0.25	—	—	—	—	Style 1 (CBE)		
TPS91	PNP	625	40	40	5	100	50	2	100	300	50	0.25	—	—	—	—			
TPS92	NPN	625	40	40	5	100	50	2	100	300	50	0.25	—	—	—	—			
TPS93	PNP	625	40	40	5	100	50	2	100	300	50	0.25	—	—	—	—	Style 2 (ECB) Style 1 (CBE)		
TPS94	NPN	625	60	40	6	10	0.1	5	250	700	—	—	200	4.0	—	2.0			
TPS97	NPN	625	60	40	6	10	0.1	5	250	700	—	—	200	4.0	—	2.0			
TPS98	NPN	625	80	60	6	10	1	5	100	300	10	1.00	200	4.0	—	—	Style 3 (EBC)		
TPS99	NPN	625	80	65	6	10	10	5	50	—	100	2.00	200	4.0	—	—			
TPS100	NPN	625	180	180	5	50	1	10	20	—	25	1.00	60	3.0	—	—	Style 1 (CBE)		
TPS101	NPN	625	150	150	5	50	1	10	20	—	25	1.00	80	3.0	—	—			
TPS108	NPN	500	40	30	4	50	4	10	25	—	—	350	—	—	—	—	Style 3 (EBC)		
TPS110	NPN	625	60	40	6	100	150	1	50	150	500	0.75	200	6.5	—	—			
TPS111	NPN	625	60	40	6	100	150	1	100	300	500	0.75	250	6.5	—	—			
TPS112	PNP	625	60	40	5	20	150	10	100	300	150	0.40	200	8.0	140	—	Style 1 (CBE)		
TPS133	NPN	700	50	30	6	1.7†	100	1	60	150	100	0.30	250	12.0	60	—			
TPS134	NPN	700	50	30	6	1.7†	100	1	50	150	100	0.40	250	12.0	60	—			
TPS135	NPN	700	80	50	6	1.7†	100	1	60	150	100	0.30	250	10	60	10.0			
TPS136	NPN	700	80	60	6	1.7†	100	1	50	150	100	0.40	250	10.0	60	—			

†I<sub>CBO</sub> is in  $\mu$ A

TO-92  
Package



Style	PINNING	VARIATIONS		
1	For TO-18 Lead Form	C	B	E
2	TO-98 Replacement	E	C	B
3	Standard TO-92	E	B	C

■ To facilitate matching and identification, these transistors are color-coded in h<sub>FE</sub> brackets, each having a maximum speed of 3 dB as shown in the table below. No guarantee is made as to distribution of h<sub>FE</sub> values, except that equal numbers of NPN and PNP devices will be shipped in any given bracket when matched complementary pairs are ordered.

COLOR CODE	YELLOW	GREEN	BLUE	VIOLET	GRAY
h <sub>FE</sub> Range, V <sub>CE</sub> = 2 V, I <sub>C</sub> = 50 mA	100-125	115-150	140-190	170-235	215-300

ORDERING INFORMATION — To order matched complementary pairs, order the same quantity each of TPS90M and TPS91M or TPS92M and TPS98M. Devices may be ordered separately by specifying TPS90, TPS91, TPS92, or TPS93.

### REPLACEMENTS FOR POPULAR SE SERIES SMALL-SIGNAL TRANSISTORS

Type No.	POLARITY	P <sub>D</sub> T <sub>A</sub> = 25 C (mW)	V <sub>(BR)</sub> CBO Volts	V <sub>(BR)</sub> CEO Volts	V <sub>(BR)</sub> EBO Volts	I <sub>CBO</sub> $\mu$ A Max.	D-C CURRENT GAIN (h <sub>FE</sub> )				V <sub>CE(SAT)</sub>		f <sub>T</sub> Min. (MHz)	C <sub>cb</sub> Max. (pF)	t <sub>off</sub> Max. (nsec)	N.F. Max. (dB)		
							Conditions		Limits		I <sub>C</sub> (mA)	Max. Volts						
							I <sub>C</sub> (mA)	V <sub>CE</sub> Volts	Min.	Max.								
TPE5036	NPN	300	35	30	3	50	5	10	30	225	—	—	—	0.3	—	—	TO-92 (EBC) In-Line Pinning	
TPE5050	NPN	175	20	20	3	50	4	5	20	200	10	3	300	—	—	4		
TPE5051	NPN	175	20	20	3	50	4	5	20	200	10	3	300	—	—	4		
TPE6020	NPN	300	60	60	6.5	100	150	1	40	300	150	0.18	250	15	1000	—		
TPE6021	NPN	300	80	80	6.5	100	150	1	40	300	150	0.18	250	15	1000	—		



## TO-92 REPLACEMENTS FOR TO-5/TO-18 PACKAGED TRANSISTORS

### HIGH-SPEED, MEDIUM CURRENT SWITCHES/AMPLIFIERS

Type No.	POLARITY	P <sub>D</sub> (@ 25 °C) mW Max.	MAX. RATING			I <sub>CBO</sub> nA Max.	CURRENT AMPLI. FACTOR			Saturation Voltage (Max.)				f <sub>T</sub> Min (MHz)	C <sub>ob</sub> (pF)
			V <sub>(BR)</sub> CBO Volts	V <sub>(BR)</sub> CEO Volts	V <sub>(BR)</sub> EBO Volts		h <sub>FE</sub> (α) I <sub>C</sub> = 10mA Min.-Max.	h <sub>FE</sub> (α) I <sub>C</sub> = 150mA Min.-Max.	h <sub>FE</sub> (α) I <sub>C</sub> = 500mA Min.-Max.	I <sub>C</sub> mA	I <sub>B</sub> mA	V <sub>CE</sub> Volts	V <sub>BE</sub> Volts		
MPS2369	NPN	360	40	15	4.5	500	40-120	—	—	10	1	0.25	0.85	500	4
MPS2369A	NPN	360	40	15	4.5	500	40-120	—	—	10	1	0.20	0.85	500	4
TP2221	NPN	500	60	30	5	10	35	40-120	20	150	15	0.40	1.6	250	8
TP2221A	NPN	500	75	40	6	10	35	40-120	25	150	15	0.30	1.2	250	8
TP2222	NPN	500	60	30	5	10	75	100-300	30	150	15	0.40	1.6	250	8
TP2222A	NPN	500	75	40	6	10	75	100-300	40	150	15	0.30	1.2	300	8
TP2906	PNP	400	60	40	5	20	35	40-120	20	150	15	0.40	1.3	200	8
TP2906A	PNP	400	60	60	5	10	40	40-120	30	150	15	0.40	1.3	200	8
TP2907	PNP	400	60	40	5	20	75	100-300	40	150	15	0.40	1.3	200	8
TP2907A	PNP	400	60	60	5	10	100	100-300	50	150	15	0.40	1.3	200	8
TP3115	NPN	400	60	20	5	25	—	40-120	—	150	15	0.50	1.3	250	8
TP3116	NPN	400	60	20	5	25	—	100-300	—	150	15	0.50	1.3	250	8
TP3135	PNP	400	50	35	4	50	25Ⓞ	40-120	—	150	15	0.60	1.5	200	10
TP3136	PNP	400	50	35	4	50	50Ⓞ	100-300	—	150	15	0.60	1.5	200	10
TP3304	PNP	300	6	6	4	10	30-120	—	—	10	1	0.16	1.0	500	3.5
TP3451	PNP	300	6	6	4	10	30-120	—	—	10	1	0.16	1.0	500	5.5
TP4208	PNP	300	12	12	4.5	10	30-120	—	—	10	1	0.16	0.95	700	3.0



TO-92  
(EBC)  
In-Line  
Pinning

Ⓞ I<sub>C</sub> = 1mA

## TO-92 REPLACEMENTS FOR POPULAR TO-46 PACKAGED TRANSISTORS

### SWITCHES, AMPLIFIERS AND CHOPPERS

Type No.	POLARITY	P <sub>D</sub> (@ 25 °C) mW Max.	MAX. RATINGS			I <sub>CBO</sub> nA Max.	I <sub>EBO</sub> nA Max.	h <sub>FE</sub> Min.-Max.	SATURATION VOLTAGE Max.				V <sub>OFF</sub> @ I <sub>B</sub> = 1mA mV Max.	r <sub>s</sub> ohms Max.	f <sub>T</sub> Min. MHz	C <sub>ib</sub> Max. pF	C <sub>ob</sub> Max. pF	N.F. Max. dB
			V <sub>(BR)</sub> CBO Volts	V <sub>(BR)</sub> CEO Volts	V <sub>(BR)</sub> EBO Volts				I <sub>C</sub> mA	I <sub>B</sub> mA	V <sub>CE</sub> Volts	V <sub>BE</sub> Volts						
TP2944	PNP	400	15	10	15	0.1	0.1	80-450Ⓞ	—	—	—	—	0.6	20	10	6	10	—
TP2945	PNP	400	25	20	25	0.2	0.2	40-250Ⓞ	—	—	—	—	1.0	35	5	6	10	—
TP2946	PNP	400	40	35	40	0.5	0.5	30-150Ⓞ	—	—	—	—	2.0	45	3	6	10	—
TP3058	PNP	400	6	6	6	0.1	0.1	40-120Ⓞ	—	—	—	1.0Ⓞ	—	—	—	—	10	—
TP3059	PNP	400	10	10	10	0.1	0.1	100-300Ⓞ	—	—	—	1.0Ⓞ	—	—	—	—	10	3
TP3060	PNP	400	70	60	30	5.0	5.0	30-90Ⓞ	10	2	0.30Ⓞ	—	1.0Ⓞ	30Ⓞ	—	—	10	—
TP3061	PNP	400	70	60	40	5.0	5.0	60-180Ⓞ	10	2	0.30Ⓞ	—	1.0Ⓞ	30Ⓞ	—	—	10	—
TP3217	PNP	400	15	10	15	1.0	1.0	40Ⓞ	5	0.5	0.10	1.0	1.25	20	1	8	14	—
TP3218	PNP	400	25	20	25	1.0	1.0	30Ⓞ	5	0.5	0.10	1.0	1.50	35	1	8	14	—
TP3219	PNP	400	40	35	40	1.0	1.0	20Ⓞ	5	0.5	0.15	1.0	2.50	45	1	8	14	—
TP3677	PNP	400	30	20	30	1.0	—	—	—	—	—	—	1.0	8	5	—	—	—
TP3840	PNP	400	50	50	50	0.5	0.5	50Ⓞ	5	0.5	0.10	0.85	2.0	20	6	6	9	—
TP3977	PNP	400	15	10	15	1.0	1.0	40Ⓞ	5	0.5	0.10	1.0	1.0Ⓞ	20	1	8	14	—
TP3978	PNP	400	25	20	25	1.0	1.0	30Ⓞ	5	0.5	0.10	1.0	2.0Ⓞ	35	1	8	14	—
TP3979	PNP	400	40	35	40	1.0	1.0	20Ⓞ	5	0.5	0.15	1.0	3.0Ⓞ	45	1	8	14	—
TP4007	PNP	400	20	15	20	0.3	0.3	30Ⓞ	—	—	—	—	0.5	20Ⓞ	15	—	10	—
TP4008	PNP	400	35	30	35	0.3	0.3	20Ⓞ	—	—	—	—	0.3	20Ⓞ	15	—	10	—



TO-92  
(EBC)  
In-Line  
Pinning

Ⓞ V<sub>CE</sub> = -0.5V, I<sub>C</sub> = 1.0mA

Ⓞ V<sub>CE</sub> = 0.5V, I<sub>C</sub> = 1mA

Ⓞ I<sub>E</sub> = 1μA, V<sub>EC</sub> = 6V

Ⓞ V<sub>CE</sub> = -0.5V, I<sub>C</sub> = -0.1μA

Ⓞ V<sub>CE</sub> = -0.5V, I<sub>C</sub> = -5mA

Ⓞ I<sub>B</sub> = 100μA

Ⓞ V<sub>CE</sub> = -3V, I<sub>C</sub> = 10μA

Ⓞ I<sub>B</sub> = -200μA

Ⓞ Typical

# SPRAGUE

## TRANSISTOR COMPLEMENTARY PAIR INFORMATION

DEVICE TYPE Complement			DEVICE TYPE Complement			DEVICE TYPE Complement			DEVICE TYPE Complement		
NPN	PNP		NPN	PNP		NPN	PNP		NPN	PNP	
2N3702	—	2N3704	2N5418	—	2N5354	—	D29E4-J1	D33E24-J1	MPS-A14	—	MPS-A64
2N3703	—	2N3705	2N5419	—	2N5355	—	D29E5	D33E25	MPS-A20	—	MPS-A70
—	2N3704	2N3702	2N5420	—	2N5356	—	D29E5-J1	D33E25-J1	—	MPS-A55	MPS-A05
—	2N3705	2N3703	2N5447	—	2N5449	—	D29E6	D33E26	—	MPS-A56	MPS-A06
2N3707	—	2N4058	2N5448	—	2N5450	—	D29E6-J1	D33E26-J1	—	MPS-A62	MPS-A12
2N3708	—	2N4059	—	2N5449	2N5447	—	D29E7	D33E27	—	MPS-A63	MPS-A13
2N3709	—	2N4060	—	2N5450	2N5448	—	D29E7-J1	D33E27-J1	—	MPS-A64	MPS-A14
2N3710	—	2N4061	2N5550	—	2N5400	—	D29E9	D33E29	MPS-A70	—	MPS-A20
2N3711	—	2N4062	2N5551	—	2N5401	—	D29E9-J1	D33E29-J1	—	—	—
2N3903	—	2N3905	2N5810	—	2N5811	—	D29E10	D33E30	MPS-D02	—	MPS-D52
2N3904	—	2N4906	—	2N5811	2N5810	—	D29E10-J1	D33E30-J1	MPS-D03	—	MPS-D53
—	2N3905	2N3903	2N5812	—	2N5813	D33E21	—	D29E1	MPS-D04	—	MPS-D54
—	2N3906	2N3904	—	2N5813	2N5812	D33E21-J1	—	D29E-J1	MPS-D05	—	MPS-D55
—	2N4058	2N3707	2N5814	—	2N5815	D33E22	—	D29E2	—	—	—
—	2N4059	2N3708	—	2N5815	2N5814	D33E22-J1	—	D29E2-J1	—	MPS-D52	MPS-D02
—	2N4060	2N3709	2N5816	—	2N5817	D33E24	—	D29E4	—	MPS-D53	MPS-D03
—	2N4061	2N3710	—	2N5817	2N5816	D33E24-J1	—	D29E4-J1	—	MPS-D54	MPS-D04
—	2N4062	2N3711	2N5818	—	2N5819	D33E25	—	D29E5	—	MPS-D55	MPS-D05
2N4123	—	2N4125	—	2N5819	2N5818	D33E25-J1	—	D29E5-J1	TD600	—	*
2N4124	—	2N4126	2N5820	—	2N5821	D22E26	—	D29E6	TD601	—	*
—	2N4125	2N4123	—	2N5821	2N5820	D33E26-J1	—	D29E6-J1	TD602	—	*
—	2N4126	2N4124	2N5822	—	2N5823	D33E27	—	D29E7	TD700	—	*
2N4400	—	2N4402	—	2N5823	2N5822	D33E27-J1	—	D29E7-J1	TD701	—	*
2N4401	—	2N4403	2N5998	—	2N5999	D33E29	—	D29E9	TD702	—	*
—	2N4402	2N4400	—	2N5999	2N5998	D33E29-J1	—	D29E9-J1	TD709	—	*
—	2N4403	2N4401	2N6008	—	2N6009	D33E30	—	D29E10	TD710	—	*
2N5086	—	2N5088	—	2N6009	2N6008	D33E30-J1	—	D29E10-J1	TD711	—	*
—	2N5088	2N5086	—	2N6076	2N5172	MPS3702	—	MPS3704	TD712	—	*
2N5172	—	2N6076	2N6222	—	2N6223	MPS3703	—	MPS3705	TD713	—	*
2N5220	—	2N5221	—	2N6223	2N6222	—	MPS3704	MPS3702	TP2221	—	TP2906
—	2N5221	2N5220	2N6224	—	2N6225	—	MPS3705	MPS3703	TP2221A	—	TP2906A
2N5225	—	2N5226	—	2N6225	2N6224	MPS6512	—	MPS6516	TP2222	—	TP2907
—	2N5226	2N5225	BC182A	—	BC212A	MPS6513	—	MPS6517	TP2222A	—	TP2907A
—	2N5354	2N5418	BC182B	—	BC212B	MPS6514	—	MPS6518	—	TP2906	TP2221
—	2N5355	2N5419	—	BC212A	BC182A	MPS6515	—	MPS6519	—	TP2906A	TP2221A
—	2N5356	2N5420	—	BC212B	BC182B	—	MPS6516	MPS6512	—	TP2907	TP2222
2N5368	—	2N5372	—	BC327-16	BC337-16	—	MPS6517	MPS6513	—	TP2907A	TP2222A
2N5369	—	2N5373	—	BC327-25	BC337-25	—	MPS6518	MPS6514	TP3115	—	TP3135
2N5370	—	2N5374	—	BC327-40	BC337-40	—	MPS6519	MPS6515	TP3116	—	TP3136
2N5371	—	2N5375	—	BC328-16	BC338-16	MPS6530	—	MPS6533	—	TP3135	TP3115
—	2N5372	2N5368	—	BC328-25	BC338-25	MPS6531	—	MPS6534	—	TP3136	TP3116
—	2N5373	2N5369	—	BC328-40	BC338-40	MPS6532	—	MPS6535	TP4384	—	TP4413
—	2N5374	2N5370	BC337-16	—	BC327-16	—	MPS6533	MPS6530	TP5386	—	TP4415
—	2N5375	2N5371	BC337-25	—	BC327-25	—	MPS6534	MPS6531	—	TP4413	TP4384
2N5376	—	2N5378	BC337-40	—	BC327-40	—	MPS6535	MPS6532	—	TP4415	TP4386
2N5377	—	2N5379	BC338-16	—	BC328-16	MPS6560	—	MPS6562	TPS90	—	TPS91
—	2N5378	2N5376	BC338-25	—	BC328-25	MPS6561	—	MPS6563	—	TPS91	TPS90
—	2N5379	2N5377	BC338-40	—	BC328-40	—	MPS6562	MPS6560	TPS92	—	TPS93
2N5380	—	2N5382	—	D29E1	D33E21	—	MPS6563	MPS6561	—	TPS93	TPS92
2N5381	—	2N5383	—	D29E1-J1	D33E21-J1	MPS-A05	—	MPS-A55	—	TZ81	TZ581
—	2N5382	2N5380	—	D29E2	D33E22	MPS-A06	—	MPS-A56	—	TZ82	TZ582
—	2N5383	2N5381	—	D29E2-J1	D33E22-J1	MPS-A12	—	MPS-A62	TZ581	—	TZ81
—	2N5400	2N5550	—	D29E4	D33E24	MPS-A13	—	MPS-A63	TZ582	—	TZ82
—	2N5401	2N5551	—	—	—	—	—	—	—	—	—

\*Dual complementary pair transistors

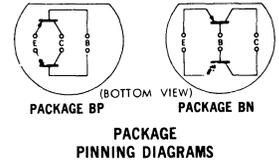
### DUAL PNP TRANSISTOR DIFFERENTIAL AMPLIFIERS



Each device consists of two isolated high-gain, low-noise PNP transistors in a 6-lead plastic package.

These Dual PNP Differential Amplifier Transistors can directly replace the following popular metal can packaged types provided metal can hermeticity and full military temperature range is not of prime design concern.

Industry Type Number	Sprague Plastic Replacement	Industry Type Number	Sprague Plastic Replacement
MD3250A	TD517	2N2806	TD513
MD3251A	TD518	2N3808	TD525
2N2802	TD509	2N3809	TD526
2N2803	TD510	2N3811	TD528
2N2805	TD512		



Type No.	CASE	$V_{CB0}$ Volts (Min.)	$V_{CE0}$ Volts (Min.)	$V_{EB0}$ Volts (Min.)	$I_{CB0}$ nA (Max.)	$V_{CB}$ Volts @	$h_{FE}$ (Min.)	$h_{FE}$ (Max.)	$I_C$ $\mu A$	$V_{CE}$ Volts	$h_{FE1}/h_{FE2}$ Min./Max. 100 $\mu A$	$V_{BE1}-V_{BE2}$ mV(Max.) 100 $\mu A$	$\Delta(V_{BE1}-V_{BE2})/A$ $\mu V/^{\circ}C$ (Max.) 100 $\mu A$	Wideband N.F. Max. (dB)	$f_T$ Min. (MHz)	$C_{ob}$ pF (Max.)
TD400	BP	40	30	5	10	30	60 100 120	500	1 10 100	5 5 5	0.9/1.0	5	20	2	20	10
TD401	BP	40	30	5	10	30	60 100 120	500	1 10 100	5 5 5	0.9/1.0	10	30	2	20	10
TD500	BN	40	30	5	10	30	60 100 120	500	1 10 100	5 5 5	0.9/1.0	5	20	2	20	10
TD501	BN	40	30	5	10	30	60 100 120	500	1 10 100	5 5 5	0.9/1.0	10	30	2	20	10
TD509	BN	25	20	5	10	25	15 20 20	120	10 100 1*	5 5 5	0.9/1.0	5	10	4	60	8
TD510	BN	25	20	5	10	25	15 20 20	120	10 100 1*	5 5 5	0.8/1.0	10	20	4	60	8
TD512	BN	25	20	5	10	25	30 40 40	120	10 100 1*	5 5 5	0.9/1.0	5	10	4	60	8
TD513	BN	25	20	5	10	25	30 40 40	120	10 100 1*	5 5 5	0.8/1.0	10	20	4	60	8
TD517	BN	50	40	5	10	40	25 50 50 50 15	150 150	10 100 1* 10* 50*	5 5 5 5 5	0.9/1.0	3	10	—	200	8
TD518	BN	50	40	5	10	40	50 80 100 100 30	300 300	10 100 1* 10* 50*	5 5 5 5 5	0.9/1.0	3	10	—	200	8
TD525	BN	60	60	5	10	50	100 150 150 150 125	450 450	10 100 500 1* 10*	5 5 5 5 5	0.8/1.0	5	20	7	100	8
TD526	BN	60	60	5	10	50	225 300 300 300 250	900 900	10 100 500 1* 10*	5 5 5 5 5	0.8/1.0	5	20	4	100	8
TD527	BN	60	60	5	10	50	100 150 150 150 125	450 450	10 100 500 1* 10*	5 5 5 5 5	0.9/1.0	3	10	7	100	8
TD528	BN	60	60	5	10	50	225 300 300 300 250	900 900	10 100 500 1* 10*	5 5 5 5 5	0.9/1.0	3	10	4	100	8
TD550	BN	40	30	5	10	30	60 100 120	500	1 10 100	5 5 5	0.9/1.0	3	10	2	20	10

\* $I_C$  is in mA

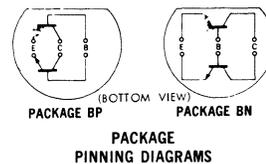


### DUAL NPN TRANSISTOR DIFFERENTIAL AMPLIFIERS

Each device consists of two isolated high-gain, low-noise NPN transistors in a 6-lead plastic package.

These Dual NPN Differential Amplifier Transistors can directly replace the following popular metal can packaged types provided metal can hermeticity and full military temperature range are not of prime concern.

Industry Type Number	Sprague Plastic Replacement	Industry Type Number	Sprague Plastic Replacement
MD1120	TD224	2N2917	TD232
MD1121	TD225	2N2918	TD233
MD1122	TD226	2N2639	TD234
MD1129	TD227	2N2640	TD235
2N2915	TD230	2N2642	TD237
2N2915A	TD242	2N2643	TD238
2N2916	TD231	2N3680	TD240
2N2916A	TD243		



Type No.		$V_{CBO}$ Volts (Min.)	$V_{CEO}$ Volts (Min.)	$V_{EBO}$ Volts (Min.)	$I_{CBO}$ nA (Max.)	$V_{CB}$ Volts	$h_{FE}$ (Min.)	$h_{FE}$ (Max.)	$I_C$ $\mu A$	$V_{CE}$ Volts	$h_{FE1}/h_{FE2}$ Min./Max. 100 $\mu A$	$V_{BE1}-V_{BE2}$ mV (Max.) 100 $\mu A$	$\Delta(V_{BE1}-V_{BE2})/TA$ $\mu V/^{\circ}C$ (Max.) 100 $\mu A$	Wideband N.F. Max. (dB)	$f_T$ Min. (MHz)	$C_{ob}$ pF (Max.)
TD100	BP	60	30	5	10	30	60 100 120	1 10 100	5 5 5	0.9/1.0	5	20	2	30●	8	
TD101	BP	60	30	5	10	30	60 100 120	1 10 100	5 5 5	0.9/1.0	10	30	2	30●	8	
TD200	BN	60	30	5	10	30	60 100 120	1 10 100	5 5 5	0.9/1.0	5	20	2	30●	8	
TD201	BN	60	30	5	10	30	60 100 120	1 10 100	5 5 5	0.9/1.0	10	30	2	30●	8	
TD224	BN	60	30	5	10	50	20 30 40 50	100 120 160 200	10 10 1* 10*	0.8/1.0	10	—	—	200	8	
TD225	BN	60	30	5	10	50	20 30 40 50	100 120 160 200	10 10 1* 10*	0.8/1.0	10	10	—	200	8	
TD226	BN	60	30	5	10	50	20 30 40 50	100 120 160 200	10 10 1* 10*	0.8/1.0 0.9/1.0†	5	10	—	200	8	
TD227	BN	60	30	5	10	50	60 100 100 100 100	10 300 100 1* 10*	10 10 10 10 10	0.9/1.0	5	10	—	200	8	
TD230	BN	45	45	6	10	45	60 100 150	240 100 1*	5 5 5	0.9/1.0	3	10	4	60	8	
TD231	BN	45	45	6	10	45	150 225 300	100 100 1*	5 5 5	0.9/1.0	3	10	3	60	8	
TD232	BN	45	45	6	10	45	60 100 150	240 100 1*	5 5 5	0.8/1.0	5	20	4	60	8	
TD233	BN	45	45	6	10	45	150 225 300	600 100 1*	5 5 5	0.8/1.0	5	20	3	60	8	
TD234	BN	45	45	5	10	45	50 55 65	300 100 1*	5 5 5	0.9/1.0	5	10	4	40	8	
TD235	BN	45	45	5	10	45	50 55 65	300 100 1*	5 5 5	0.8/1.0	10	20	4	40	8	
TD237	BN	45	45	5	10	45	100 110 130	300 100 1*	5 5 5	0.9/1.0	5	10	4	40	8	
TD238	BN	45	45	5	10	45	100 110 130	300 100 1*	5 5 5	0.8/1.0	10	20	4	40	8	
TD240	BN	60	50	6	10	45	80 150 225 300	1 600 100 1*	5 5 5 5	0.9/1.0	3‡	5‡	3	60	6	
TD241	BN	60	30	7	5	50	80 150	10 600 1*	5 5 5	0.9/1.0	3‡	10‡	7	60	8	
TD242	BN	45	45	6	10	45	60 100 150	240 100 1*	5 5 5	0.9/1.0	1.5	5	4	60	8	
TD243	BN	45	45	6	10	45	150 225 300	600 100 1*	5 5 5	0.9/1.0	1.5	5	3	60	8	
TD250	BN	60	30	5	5	50	60 100 120	1 300 100	5 5 5	0.9/1.0	3	10	2	30	8	

\* $I_C$  is in mA  
 † $I_C = 1$  mA  
 ‡@ 10  $\mu A$   
 ● $f_T$  Max. = 120 MHz

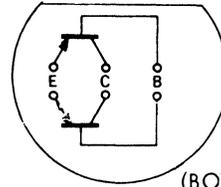
### DUAL PNP TRANSISTORS

Each dual transistor pair consists of two isolated, high-gain silicon planar transistors.

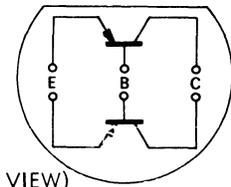
These dual PNP plastic encapsulated transistors can directly replace the following popular metal can packaged types when metal can hermeticity and full military temperature operating range are not of prime concern.



#### PACKAGE PINNING DIAGRAMS



PACKAGE BP



PACKAGE BN

Industry Type Number	Sprague Plastic Replacement	Industry Type Number	Sprague Plastic Replacement
MD2904	TD519	2N2804	TD511
MD2904A	TD520	2N2807	TD514
MD2905	TD521	2N3806	TD523
MD2905A	TD522	2N3807	TD524

Type No.	Case	BVCBO Volts (Min.)	BVCEO Volts (Min.)	VEBO Volts (Min.)	ICBO nA (Max.)	V <sub>CB</sub> Volts	h <sub>FE</sub> (Min.)	h <sub>FE</sub> (Max.)	I <sub>C</sub> mA	V <sub>CE</sub> Volts	V <sub>CE(SAT)</sub> Volts (Max.)	I <sub>C</sub> mA	I <sub>B</sub> mA	V <sub>BE</sub> Volts (Max.)	I <sub>C</sub> mA	I <sub>B</sub> mA	Wideband N.F. dB (Max.)	F <sub>T</sub> MHz (Min.)	C <sub>ob</sub> pF (Max.)
TD402	BP	40	30	5	10	-30	60	100	500	-5	0.20	-10	-1	0.8	-10	-1	-	20	10
TD502	BN	40	30	5	10	-30	60	100	500	-5	0.20	-10	-1	0.8	-10	-1	-	20	10
TD511	BN	25	20	5	10	-25	15	20	120	-5	0.50	-10	-1	0.9	-10	-1	4	60	8
TD514	BN	25	20	5	10	-25	30	40	120	-5	0.50	-10	-1	0.9	-10	-1	4	60	8
TD519	BN	60	40	5	20	-50	20	25	120	-10	0.40	-150	-15	1.3	-150	-15	-	200	8
TD520	BN	60	60	5	10	-50	40	40	120	-10	0.40	-150	-15	1.3	-150	-15	-	200	8
TD521	BN	60	40	5	20	-50	35	50	300	-10	0.40	-150	-15	1.3	-150	-15	-	200	8
TD522	BN	60	60	5	10	-50	75	100	300	-10	0.40	-150	-15	1.3	-150	-15	-	200	8
TD523	BN	60	60	5	10	-50	100	150	450	-5	0.20	-0.1	-0.01	0.7	-0.1	-0.01	3.5	100	4
TD524	BN	60	60	5	10	-50	225	300	900	-5	0.25	-1	-0.1	0.8	-1	-0.1	2.5	100	4
TD2905	BP	60	30	5			35	50	300	-10	0.40	-150	-15	1.3	-150	-15	-	200	8

\*I<sub>C</sub> is in milliamperes

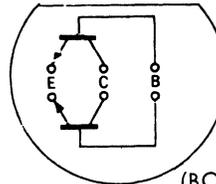
### DUAL NPN TRANSISTORS

Each dual transistor pair consists of two isolated, high-gain silicon planar transistors.

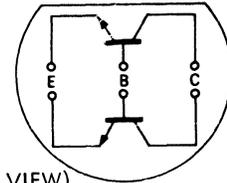
These dual NPN transistors can directly replace the following popular metal can packaged types provided metal can hermeticity and full military temperature range are not of prime concern.



#### PACKAGE PINNING DIAGRAMS



PACKAGE BP



PACKAGE BN

Industry Type Number	Sprague Plastic Replacement	Industry Type Number	Sprague Plastic Replacement
MD2218	TD244	2N2641	TD236
MD2218A	TD245	2N2644	TD239
MD2219	TD246	2N2913	TD228
MD2219A	TD247	2N2914	TD229
MD2369	TD248		

Type No.	Case	BV <sub>CEO</sub> Volts (Min.)	BV <sub>CE0</sub> Volts (Min.)	BV <sub>EBO</sub> Volts (Min.)	I <sub>CBO</sub> nA (Max.)	V <sub>CB</sub> Volts	h <sub>FE</sub>			V <sub>CE</sub> Volts	V <sub>CE(SAT)</sub> Volts (Max.)	I <sub>C</sub> mA	I <sub>B</sub> mA	V <sub>BE</sub> Volts (Max.)	I <sub>C</sub> mA	I <sub>B</sub> mA	Wide-band NF dB (Max.)	f <sub>T</sub> MHz (Min.)	C <sub>ob</sub> pF (Max.)
							(Min.)	(Max.)	@										
TD102	BP	60	30	5	10	30	60		1	5	0.2	10	1	0.8	10	1	—	30	8
							100	500	10	5									
							120		100	5									
							120		1*	5									
							150		10*	5									
TD202	BN	60	30	5	10	30	60		1	5	0.2	10	1	0.8	10	1	—	30	8
							100	500	10	5									
							120		100	5									
							120		1*	5									
							150		10*	5									
TD228	BN	45	45	6	10	45	60	240	10	5	0.35	1	0.1	0.7	0.1	†	—	60	8
							100		100	5									
							150		1*	5									
TD229	BN	45	45	6	10	45	150	600	10	5	0.35	1	0.1	0.7	0.1	†	—	60	8
							225		100	5									
							300		1*	5									
TD236	BN	45	45	5	10	45	50	300	10	5	1.0	10	0.5	1.0	10	0.5	4	40	8
							55		100	5									
							65		1*	5									
TD239	BN	45	45	5	10	45	100	300	10	5	1.0	10	0.5	1.0	10	0.5	4	40	8
							110		100	5									
							130		1*	5									
TD244	BN	60	30	5	10	50	20		100	10	0.4	150	15	1.3	150	15	—	250	8
							25		1*	10									
							35		10*	10									
							40	120	150*	10									
							20		150	1									
							20		500*	10									
TD245	BN	60	30	5	10	50	35		100	10	0.4	150	15	1.3	150	15	—	250	8
							50		1*	10									
							75		10*	10									
							100	300	150*	10									
							50		150*	1									
							30		500*	10									
TD246	BN	75	40	6	10	60	20		100	10	0.3	150	15	1.2	150	15	4	250	8
							25		1*	10									
							35		10*	10									
							40	120	150*	10									
							20		150*	1									
							25		500*	10									
TD247	BN	75	40	6	10	60	35		100	10	0.3	150	15	1.2	150	15	4	300	8
							50		1*	10									
							75		10*	10									
							100	300	150*	10									
							50		150*	1									
							40		500*	10									
TD248	BN	40	15	5	30	20	40	140	10*	1	0.25	10	1	0.85	10	1	—	500	4
TD2219	BP	60	30	5	10	50	35		100	10	0.40	150	15	1.3	150	15	—	250	8
							50		1*	10									
							75		10*	10									
							50		150*	1									
							100	300	150*	10									
30		500*	10																

\*I<sub>C</sub> is in milliamperes

†V<sub>CE</sub> = 5 V

### COMPLEMENTARY PAIRS

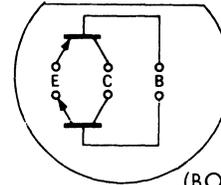
Each device consists of two isolated — one NPN and one PNP — high gain, low noise silicon planar transistors in a 6-lead plastic package.

These complementary pairs can directly replace the following popular metal can packaged types provided metal can hermeticity and full military temperature range are not of prime design concern.

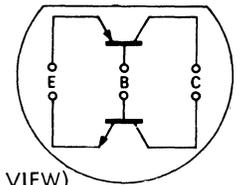
Industry Type Number	Sprague Plastic Replacement	Industry Type Number	Sprague Plastic Replacement
MD6001	TD709	2N4854	TD712
MD6002	TD710	2N4855	TD713
MD6003	TD712		



PACKAGE PINNING DIAGRAMS



PACKAGE BP



PACKAGE BN

Type No.	Case	$V_{CB0}$ Volts (Min.)	$V_{CE0}$ Volts (Min.)	$V_{EB0}$ Volts (Min.)	$I_{CBO}$ nA (Max.)	@ $V_{CB}$ Volts	$H_{FE}$ @ (Min.) (Max.)	$I_C$ mA	$V_{CE}$ Volts	$f_t$ MHz (Min.)	$C_{ob}$ pF (Max.)	KEY FEATURES
TD600	BP	40	30	5	10	30	60 100 120	1 10 100	5 5 5	20	10	$H_{FE1}/H_{FE2} = 0.8/1.0$ Wideband N.F. = 2 dB Max.
TD601	BP	40	30	5	10	30	100 120	10 100	5 5	20	10	$V_{OFF} @ 250 \mu A \leq 1.0$ mV $r_s @ I_B = 1$ mA, $I_E = 100 \mu A \leq 20 \Omega$
TD602	BP	40	30	5	10	30	50 75 120	1* 10* 150*	10 10 10	200	10	
TD700	BN	40	30	5	10	30	60 100 120	1 10 100	5 5 5	20	10	$H_{FE1}/H_{FE2} = 0.8/1.0$ Wideband N.F. = 2 dB Max.
TD701	BN	40	30	5	10	30	100 120	10 100	5 5	20	10	$V_{OFF} @ 250 \mu A \leq 1.0$ mV $V_S @ I_B = 1$ mA, $I_E = 100 \mu A \leq 20 \Omega$
TD702	BN	40	30	5	10	30	50 75 120	1* 10* 150*	10 10 10	200	10	
TD709	BN	60	30	5	20 100	50† 40	20 25 35 20 40	100 1* 10* 150* 150*	10 10 10 1 10	200	8	$t_{on} \leq 60$ ns $t_{off} \leq 350$ ns
TD710	BN	60	30	5	20 100	50† 40	35 50 75 50 100 30	100 1* 10* 150* 150* 300*	10 10 10 1 10 10	200	8	$t_{on} \leq 60$ ns $t_{off} \leq 350$ ns
TD711	BN	50	30	5	30 100	30† 40	40 70 30	1* 150* 300*	10 10 10	200	8	
TD712	BN	60	40	5	10	50	35 50 75 50 100 35	100 1* 10* 150* 100 300*	10 10 10 1 10 10	200	8	$t_d \leq 20$ ns $t_r \leq 40$ ns $t_s \leq 280$ ns $t_f \leq 70$ ns Spot Noise $\leq 8$ dB
TD713	BN	60	40	5	10	50	20 25 35 20 40 20	100 1* 10* 150* 150* 300*	10 10 10 1 10 10	200	8	$t_d \leq 20$ ns $t_r \leq 40$ ns $t_s \leq 280$ ns $t_f \leq 70$ ns Spot Noise $\leq 8$ dB

\* $I_C$  is in milliamperes  
† $V_{BE(OFF)} = 3.0$  VDC

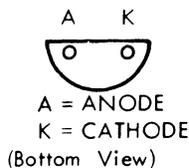
### 1N5843 thru 1N5878 ZENER REGULATOR DIODES



#### FEATURES:

- 500 mW Power Dissipation
- Low-Cost TO-92 Package
- Silicon-Oxide Passivated Junction

- 3.6 thru 51 V Ratings
- $\pm 5\%$ ,  $\pm 10\%$ ,  $\pm 20\%$  Zener Tolerances
- In-line Leads for Easy Insertion
- Leads Easily Soldered or Welded



TO-92 2-Lead Package

#### ELECTRICAL CHARACTERISTIC at $T_A = +25\text{ C}$

Type Number*	Nom. Zener Volt.		Max. Zener Impedance		Max. Reverse Leakage Current		Maximum D-C Zener Current	Typical Zener Voltage Coeff. $\frac{\Delta V_Z}{V_Z / ^\circ\text{C}}$
	$V_{ZT}$ (V)	$I_{ZT}$ (mA)	$Z_{ZT}$ at $I_{ZT}$ ( $\Omega$ )	$Z_{ZK}$ at $250\ \mu\text{A}$ ( $\Omega$ )	$I_R$ at $V_R$ ( $\mu\text{A}$ )	$V_R$ (V)	$I_{ZM}$ (mA)	
1N5843	3.6	20	48	2700	15.0	1.0	139	-0.030
1N5844	3.9	20	40	2800	10.0	1.0	129	-0.020
1N5845	4.3	20	25	2900	5.0	1.0	116	-0.010
1N5846	4.7	20	19	2600	5.0	2.0	106	+0.012
1N5847	5.1	20	17	2400	5.0	2.0	98	+0.025
1N5848	5.6	20	15	2100	5.0	3.0	89	+0.035
1N5849	6.0	20	13	1900	5.0	3.5	83	+0.038
1N5850	6.2	20	14	1500	5.0	4.0	80	+0.040
1N5851	6.8	20	17	780	3.0	5.0	74	+0.045
1N5852	7.5	20	23	700	3.0	6.0	67	+0.053
1N5853	8.2	20	34	700	3.0	6.5	61	+0.058
1N5854	8.7	20	44	700	3.0	6.5	57	+0.061
1N5855	9.1	20	50	700	3.0	7.0	55	+0.063
1N5856	10	20	62	700	3.0	8.0	50	+0.066
1N5857	11	20	68	700	2.0	8.4	45	+0.070
1N5858	12	20	70	700	1.0	9.1	41.5	+0.072
1N5859	13	9.5	70	700	0.5	9.9	38.5	+0.075
1N5860	14	9.0	70	700	0.1	10	35.5	+0.077
1N5861	15	8.5	34	700	0.1	11	33	+0.072
1N5862	16	7.8	38	700	0.1	12	31	+0.073
1N5863	17	7.4	42	700	0.1	13	29	+0.075
1N5864	18	7.0	48	700	0.1	14	28	+0.076
1N5865	19	6.6	52	700	0.1	14	26	+0.077
1N5866	20	6.2	57	700	0.1	15	25	+0.078
1N5867	22	5.6	68	700	0.1	17	22.6	+0.080
1N5868	24	5.2	78	700	0.1	18	21.7	+0.082
1N5869	25	5.0	85	700	0.1	19	20	+0.083
1N5870	27	4.6	98	700	0.1	21	18.5	+0.084
1N5871	28	4.5	106	700	0.1	21	17.9	+0.085
1N5872	30	4.2	117	700	0.1	23	16.7	+0.087
1N5873	33	3.8	140	700	0.1	25	15.1	+0.090
1N5874	36	3.4	160	700	0.1	27	13.9	+0.092
1N5875	39	3.2	190	800	0.1	30	12.9	+0.095
1N5876	43	3.0	225	900	0.1	33	11.6	+0.100
1N5877	47	2.7	260	1000	0.1	36	10.6	+0.104
1N5878	51	2.5	300	1100	0.1	39	9.8	+0.106

\*Type numbers shown are for a Zener voltage tolerance of  $\pm 20\%$ . To order a tolerance of  $\pm 10\%$ , add the suffix 'A' to the type number. To order a tolerance of  $\pm 5\%$ , add the suffix 'B' to the type number.

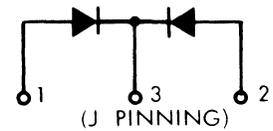
### DUAL DIODES

This series consists of dual diodes designed for use in low cost biasing, steering and voltage doubler applications requiring series, common cathode, or common anode diodes.

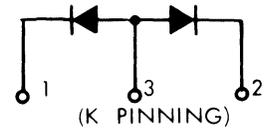
#### APPLICATIONS:

- MSD6101 — FM Discriminator
- MSD6102 — TV Horizontal Phase Detector
- MSD6150 — General Purpose
- TSD6100 — High Speed Switching
- TSD7000 — Biasing, Steering, Voltage Doubler

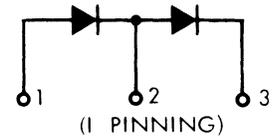
Type Number	ELECTRICAL CHARACTERISTICS @ T <sub>A</sub> = 25°C							
	BV <sub>BR</sub> Volts (Min.)	@ I <sub>BR</sub> (μA)	I <sub>R</sub> μA (Max.)	@ V <sub>R</sub> (Volts)	V <sub>F</sub> Volts (Max.)	@ I <sub>F</sub> (mA)	C <sub>V<sub>R</sub></sub> = 0 pF (Max.)	t <sub>rr</sub> ns (Max.)
MSD6101	50	100	0.1	40	0.57 0.82	0.1 10.0	2.0	10
MSD6102	70	100	1.0	10	1.00	10	8.0	100
MSD6150	70	100	0.1	50	1.00	10	8.0	100
TSD6100	90	100	5.0 0.1	100 50	0.70 0.82 1.10	1 10 100	2.0	4
TSD7000	90	100	0.5 0.2	100 50	0.70 0.82 1.10	1 10 100	2.0	15



MSD6101  
MSD6102  
TSD6100



MSD6150



TSD7000

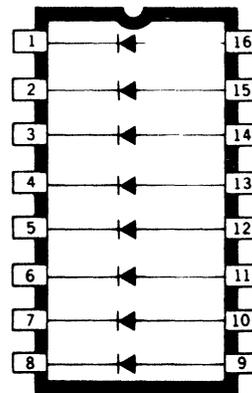
### TYPE TND903, TND905, and TND908, DIODE ARRAYS

The TND series consists of monolithic diode arrays packaged in 14- or 16-lead dual in-line plastic packages for easy automatic insertion and better printed circuit board density.

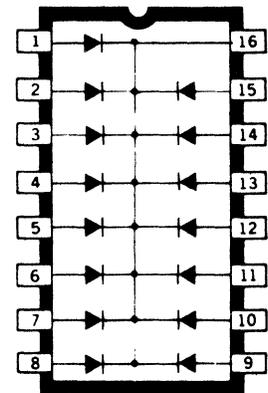
In addition to the diode types used in the standard products shown, arrays consisting of the 1N3070, 1N3595, 1N3600, 1N4153, or 1N4447 can be furnished on special request.

#### ● Package Configurations:

16-Lead Plastic Dual In-Line A



TND903  
TND908



TND905

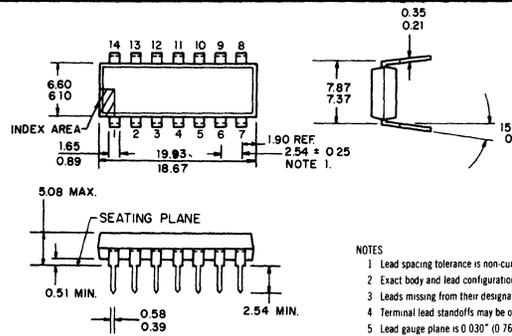
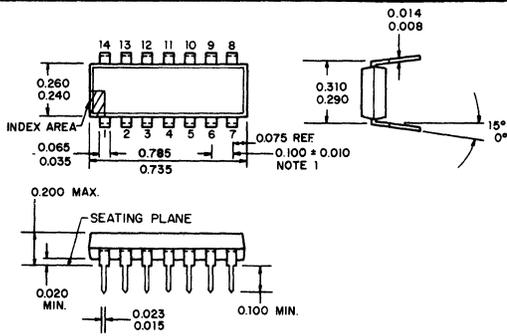
#### ELECTRICAL CHARACTERISTICS

Device Type	BV <sub>BR</sub> Volts (Max.)	V <sub>F</sub> Volts (Max.)	@ I <sub>F</sub> mA	Diodes Similar to
TND903	75	1.0	100	1N4148
TND905	100	1.0	10	1N914
TND908	100	1.0	10	1N914

### DIMENSIONS IN INCHES

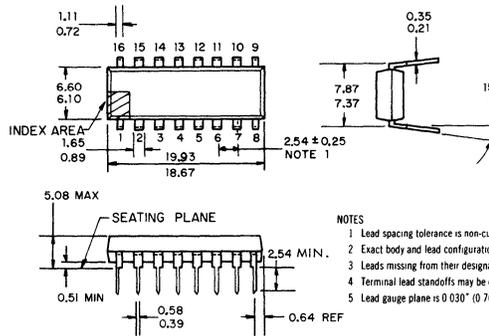
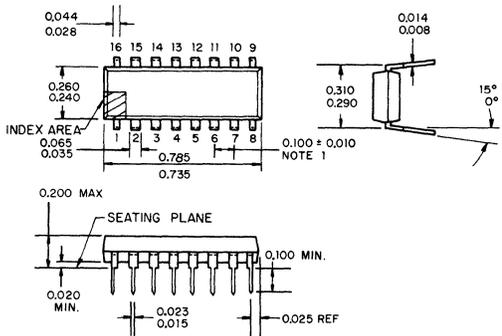
### DIMENSIONS IN MILLIMETRES

METRIC DIMENSIONS ARE BASED ON 1" = 25.4 mm



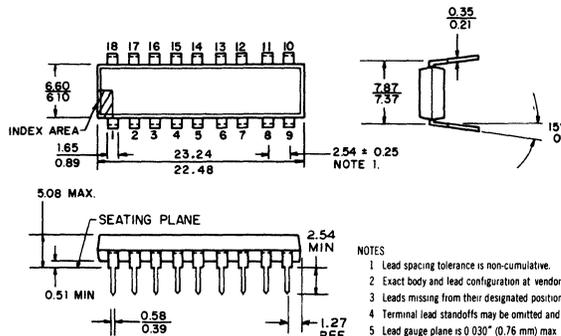
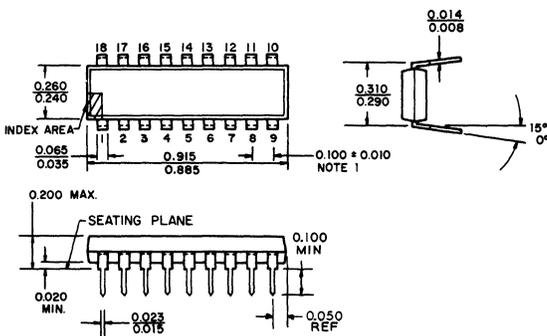
- NOTES
- 1 Lead spacing tolerance is non-cumulative
  - 2 Exact body and lead configuration at vendor's option within limits shown
  - 3 Leads missing from their designated positions shall also be counted when numbering leads
  - 4 Terminal lead standoffs may be omitted and replaced by body standoffs
  - 5 Lead gauge plane is 0.030" (0.76 mm) max. below seating plane

'A' PACKAGE: 14-Pin Plastic Dual In-Line



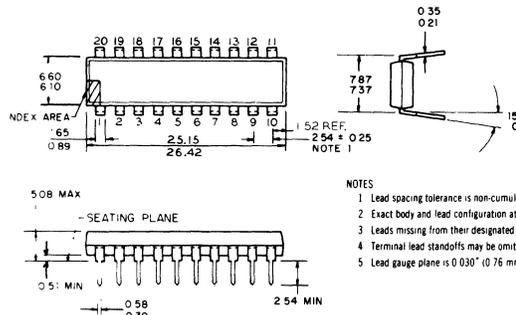
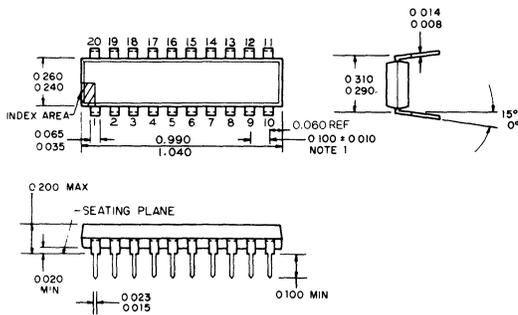
- NOTES
- 1 Lead spacing tolerance is non-cumulative
  - 2 Exact body and lead configuration at vendor's option within limits shown
  - 3 Leads missing from their designated positions shall also be counted when numbering leads
  - 4 Terminal lead standoffs may be omitted and replaced by body standoffs
  - 5 Lead gauge plane is 0.030" (0.76 mm) max. below seating plane

'A' PACKAGE: 16-Pin Plastic Dual In-Line



- NOTES
- 1 Lead spacing tolerance is non-cumulative
  - 2 Exact body and lead configuration at vendor's option within limits shown
  - 3 Leads missing from their designated positions shall also be counted when numbering leads
  - 4 Terminal lead standoffs may be omitted and replaced by body standoffs
  - 5 Lead gauge plane is 0.030" (0.76 mm) max. below seating plane

'A' PACKAGE: 18-Pin Plastic Dual In-Line



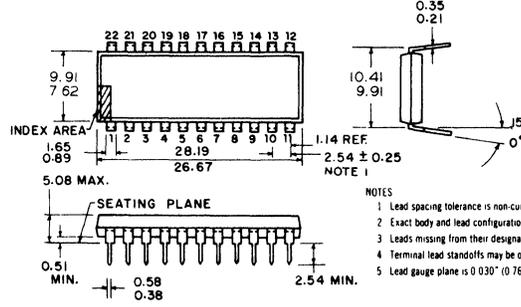
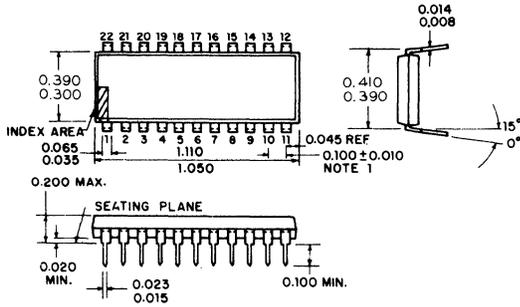
- NOTES
- 1 Lead spacing tolerance is non-cumulative
  - 2 Exact body and lead configuration at vendor's option within limits shown
  - 3 Leads missing from their designated positions shall also be counted when numbering leads
  - 4 Terminal lead standoffs may be omitted and replaced by body standoffs
  - 5 Lead gauge plane is 0.030" (0.76 mm) max. below seating plane

'A' PACKAGE: 20-Pin Plastic Dual In-Line

### DIMENSIONS IN INCHES

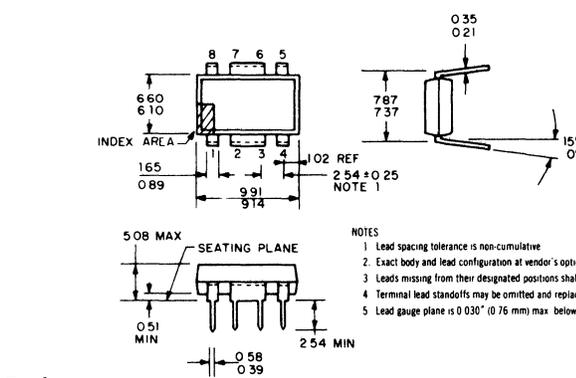
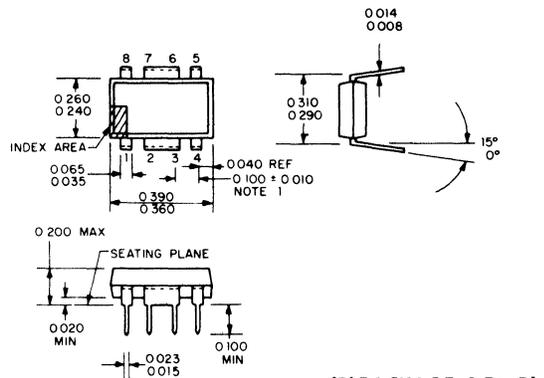
### DIMENSIONS IN MILLIMETRES

METRIC DIMENSIONS ARE BASED ON 1" = 25.4 mm



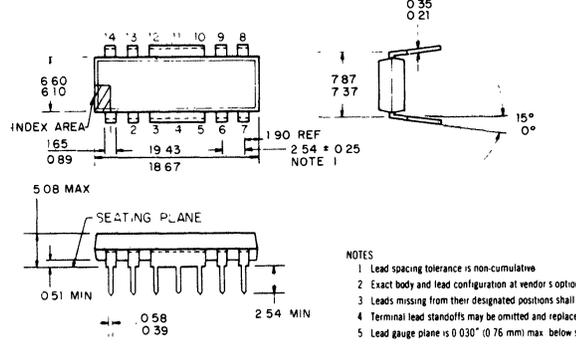
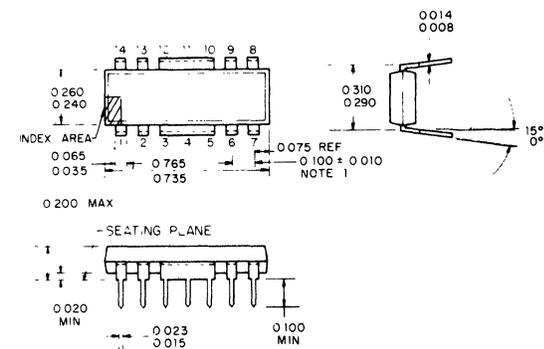
- NOTES
- 1 Lead spacing tolerance is non-cumulative
  - 2 Exact body and lead configuration at vendor's option within limits shown
  - 3 Leads missing from their designated positions shall also be counted when numbering leads
  - 4 Terminal lead standoffs may be omitted and replaced by body standoffs
  - 5 Lead gauge plane is 0.030" (0.76 mm) max. below seating plane

**'A' PACKAGE: 22-Pin Plastic Dual In-Line**



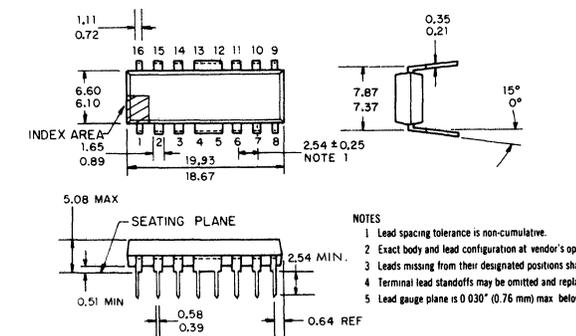
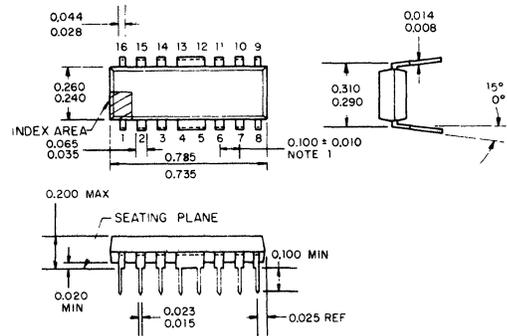
- NOTES
- 1 Lead spacing tolerance is non-cumulative
  - 2 Exact body and lead configuration at vendor's option within limits shown
  - 3 Leads missing from their designated positions shall also be counted when numbering leads
  - 4 Terminal lead standoffs may be omitted and replaced by body standoffs
  - 5 Lead gauge plane is 0.030" (0.76 mm) max. below seating plane

**'B' PACKAGE: 8-Pin Plastic Dual In-Line**



- NOTES
- 1 Lead spacing tolerance is non-cumulative
  - 2 Exact body and lead configuration at vendor's option within limits shown
  - 3 Leads missing from their designated positions shall also be counted when numbering leads
  - 4 Terminal lead standoffs may be omitted and replaced by body standoffs
  - 5 Lead gauge plane is 0.030" (0.76 mm) max. below seating plane

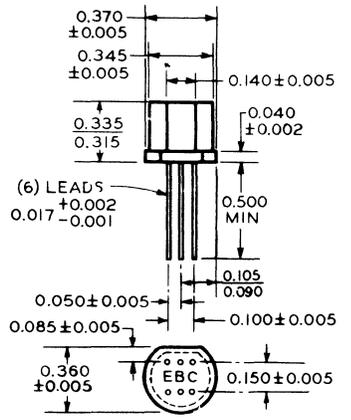
**'B' PACKAGE: 14-Pin Plastic Dual In-Line**



- NOTES
- 1 Lead spacing tolerance is non-cumulative
  - 2 Exact body and lead configuration at vendor's option within limits shown
  - 3 Leads missing from their designated positions shall also be counted when numbering leads
  - 4 Terminal lead standoffs may be omitted and replaced by body standoffs
  - 5 Lead gauge plane is 0.030" (0.76 mm) max. below seating plane

**'B' PACKAGE: 16-Pin Plastic Dual In-Line**

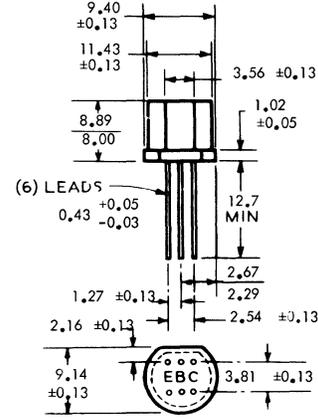
### DIMENSIONS IN INCHES



DWG. NO. A-7101 IN.

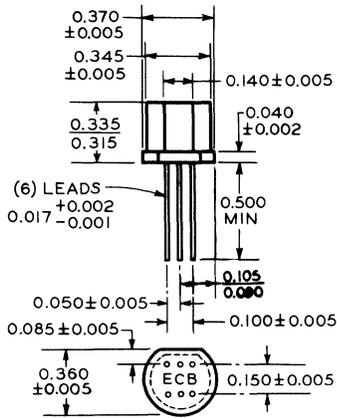
### DIMENSIONS IN MILLIMETRES

METRIC DIMENSIONS ARE BASED ON 1" = 25.4 mm

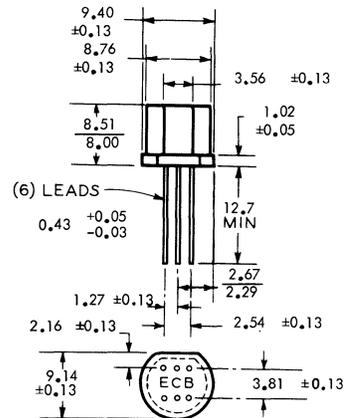


DWG. NO. A-7101 MM

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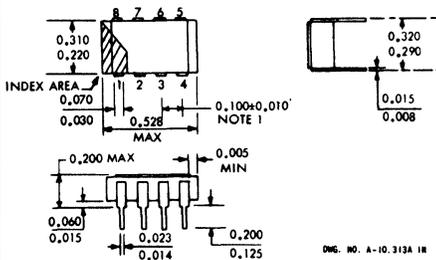


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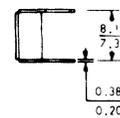
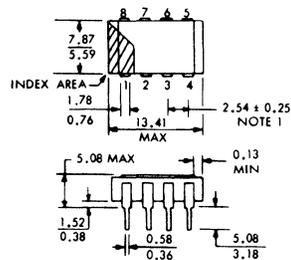


DWG. NO. A-5598C MM

### BP PACKAGE



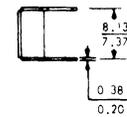
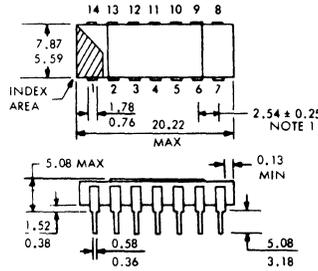
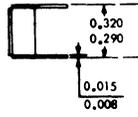
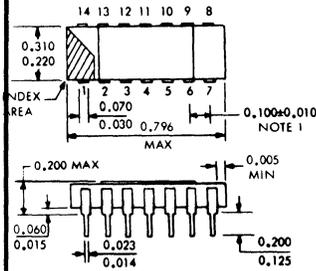
DWG. NO. A-10-313A IN



#### NOTES

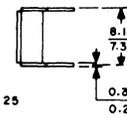
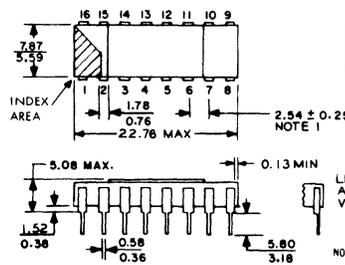
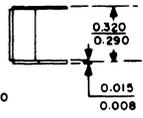
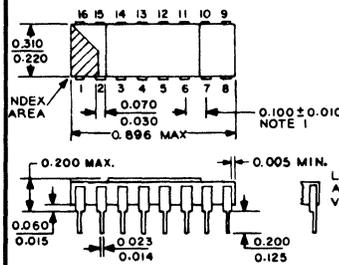
- 1 Lead spacing tolerance is non cumulative
- 2 Exact body and lead configuration at vendor's option within limits shown
- 3 Leads missing from their designated positions shall also be counted when numbering leads
- 4 Terminal lead standoffs may be omitted and replaced by body standoffs
- 5 Lead gauge plane is 0.030" (0.76 mm) max below seating plane

### H PACKAGE: 8-Pin Hermetic Dual In-Line



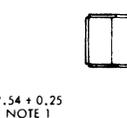
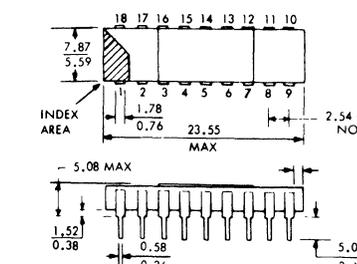
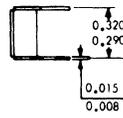
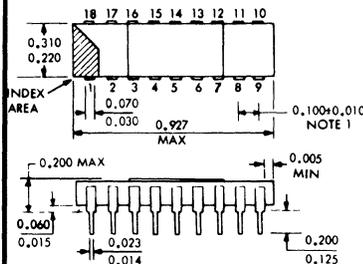
- NOTES
- 1 Lead spacing tolerance is non-cumulative
  - 2 Exact body and lead configuration at vendor's option within limits shown
  - 3 Leads missing from their designated positions shall also be counted when numbering leads
  - 4 Terminal lead standoffs may be omitted and replaced by body standoffs
  - 5 Lead gauge plane is 0.030" (0.76 mm) max. below seating plane

**'H' PACKAGE: 14-Pin Hermetic Dual In-Line**



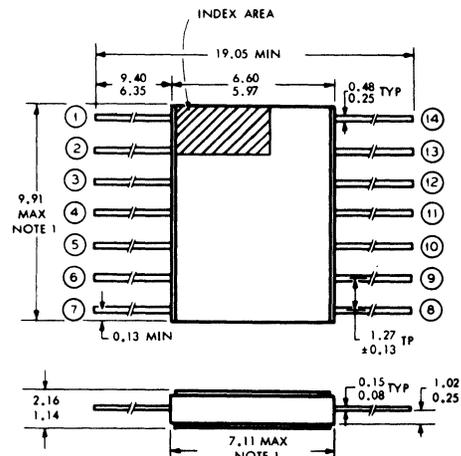
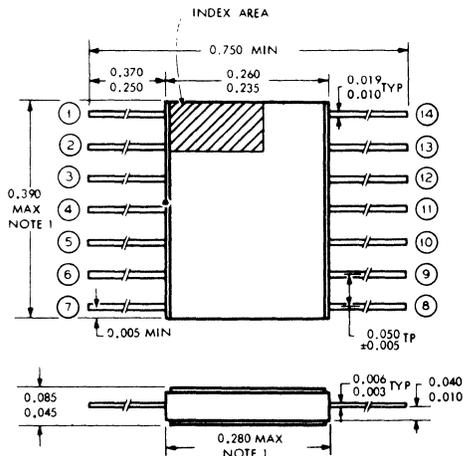
- NOTES
- 1 Lead spacing tolerance is non-cumulative
  - 2 Exact body and lead configuration at vendor's option within limits shown
  - 3 Leads missing from their designated positions shall also be counted when numbering leads
  - 4 Terminal lead standoffs may be omitted and replaced by body standoffs
  - 5 Lead gauge plane is 0.030" (0.76 mm) max. below seating plane

**'H' PACKAGE: 16-Pin Hermetic Dual In-Line**



- NOTES
- 1 Lead spacing tolerance is non-cumulative
  - 2 Exact body and lead configuration at vendor's option within limits shown
  - 3 Leads missing from their designated positions shall also be counted when numbering leads
  - 4 Terminal lead standoffs may be omitted and replaced by body standoffs
  - 5 Lead gauge plane is 0.030" (0.76 mm) max. below seating plane

**'H' PACKAGE: 18-Pin Hermetic Dual In-Line**



- NOTES:
- 1 INCLUDES OFF-CENTER LID, MENISCUS, + GLASS OVERRUN
  - 2 ALL LEADS WELDABLE AND SOLDERABLE
  - 3 ALL DIMENSIONS IN INCHES

DWG. NO. A-10.2524 IN

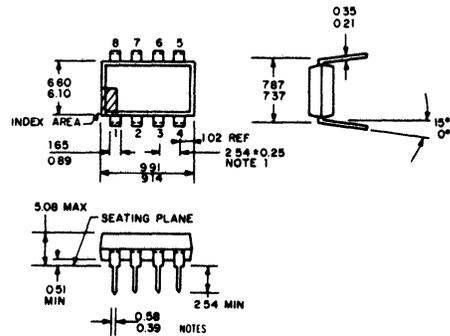
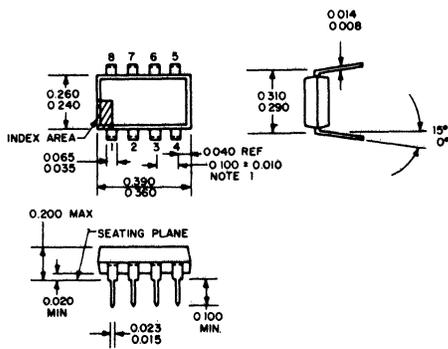
- NOTES:
- 1 INCLUDES OFF-CENTER LID, MENISCUS, + GLASS OVERRUN
  - 2 ALL LEADS WELDABLE AND SOLDERABLE
  - 3 ALL DIMENSIONS IN MILLIMETRES

DWG. NO. A-10.2524 MM

**'J' PACKAGE: 14-Pin Hermetic Flat-Pack**

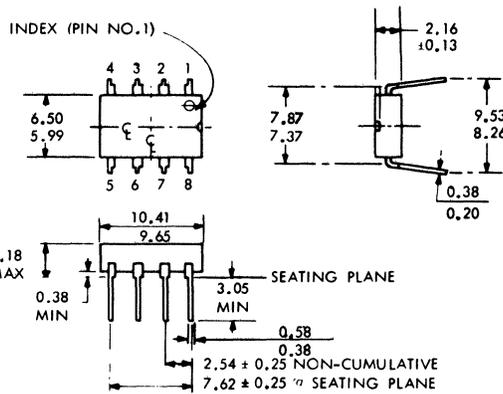
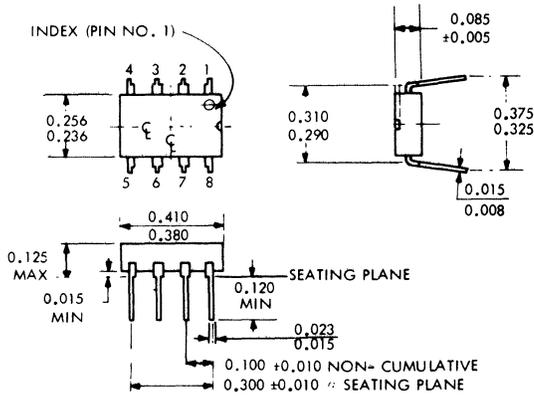
### DIMENSIONS IN INCHES

### DIMENSIONS IN MILLIMETRES METRIC DIMENSIONS ARE BASED ON 1" = 25.4 mm



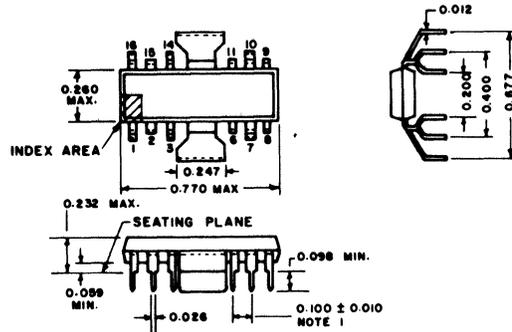
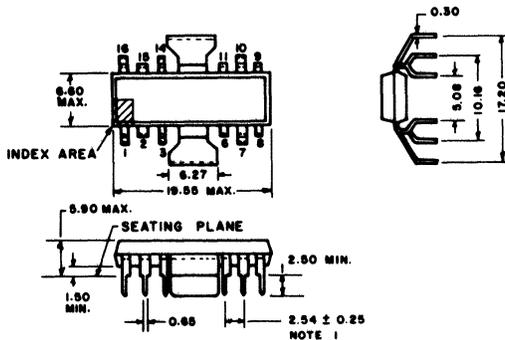
**'M' PACKAGE: 8-Pin Plastic Dual In-Line**

- NOTES
- 1 Lead spacing tolerance is non-cumulative
  - 2 Exact body and lead configuration at vendor's option within limits shown
  - 3 Leads missing from their designated positions shall also be counted when numbering leads
  - 4 Terminal lead standoffs may be omitted and replaced by body standoffs
  - 5 Lead gauge plane is 0.030" (0.76 mm) max. below seating plane



**'M' PACKAGE: 8-Pin Plastic Dual In-Line**

**Note: Used Only With the 3000 Series of Hall Cell Devices**



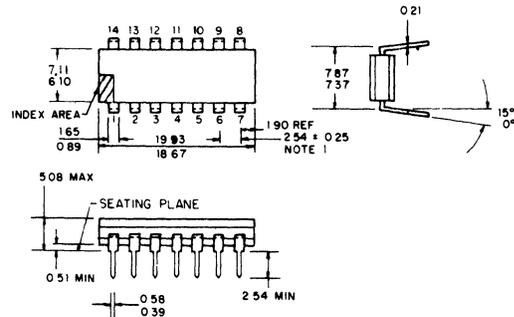
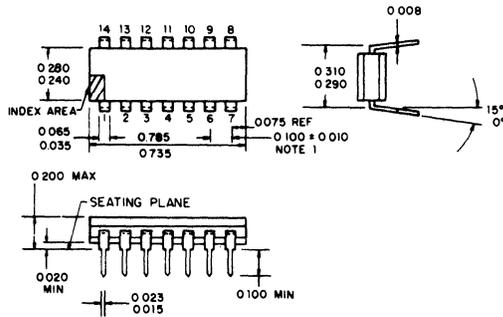
- NOTES
- 1 Lead-spacing tolerance is non-cumulative
  - 2 Exact body and lead configuration at vendor's option within limits shown
  - 3 Leads missing from their designated positions shall also be counted when numbering leads
  - 4 Terminal lead standoffs may be omitted and replaced by body standoffs
  - 5 Lead gauge plane is 0.030" (0.76 mm) max. below seating plane

**'Q' PACKAGE: 12-Pin & 2 Tab**

### DIMENSIONS IN INCHES

### DIMENSIONS IN MILLIMETRES

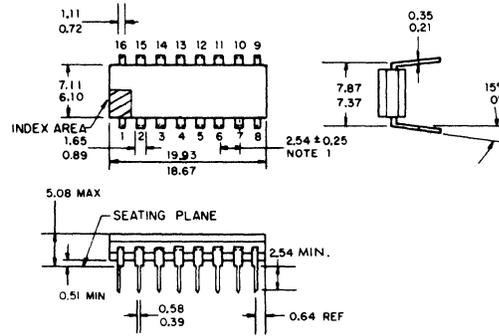
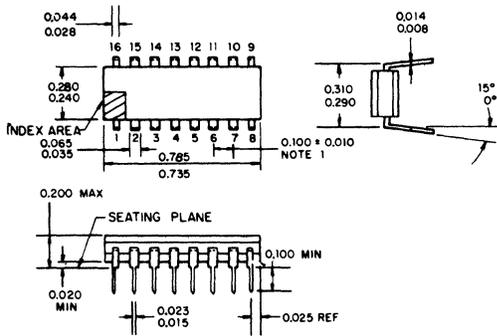
METRIC DIMENSIONS ARE BASED ON 1" = 25.4 mm



**'R' PACKAGE: 14-Pin Ceramic Dual In-Line**

**NOTES**

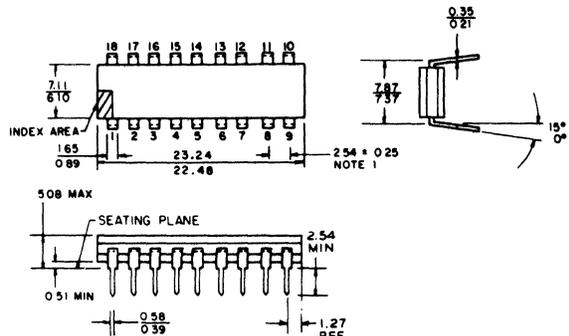
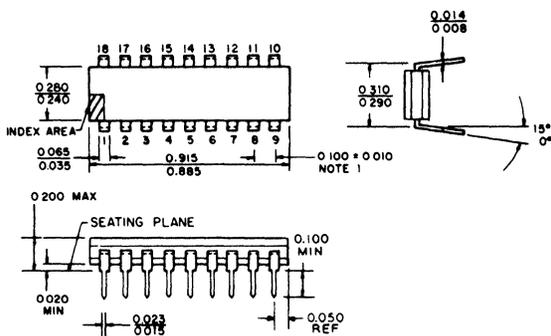
- 1 Lead spacing tolerance is non-cumulative
- 2 Exact body and lead configuration at vendor's option within limits shown
- 3 Leads missing from their designated positions shall also be counted when numbering leads
- 4 Terminal lead standoffs may be omitted and replaced by body standoffs
- 5 Lead gauge plane is 0.030" (0.76 mm) max. below seating plane



**'R' PACKAGE: 16-Pin Ceramic Dual In-Line**

**NOTES**

- 1 Lead spacing tolerance is non-cumulative
- 2 Exact body and lead configuration at vendor's option within limits shown
- 3 Leads missing from their designated positions shall also be counted when numbering leads
- 4 Terminal lead standoffs may be omitted and replaced by body standoffs
- 5 Lead gauge plane is 0.030" (0.76 mm) max. below seating plane



**'R' PACKAGE: 18-Pin Ceramic Dual In-Line**

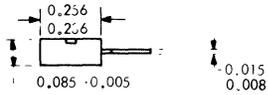
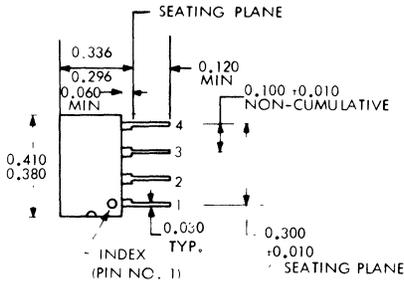
**NOTES**

- 1 Lead spacing tolerance is non-cumulative
- 2 Exact body and lead configuration at vendor's option within limits shown
- 3 Leads missing from their designated positions shall also be counted when numbering leads
- 4 Terminal lead standoffs may be omitted and replaced by body standoffs
- 5 Lead gauge plane is 0.030" (0.76 mm) max. below seating plane

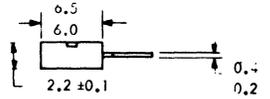
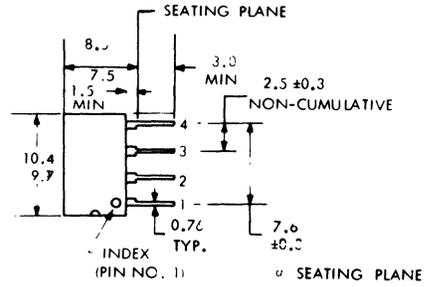
### DIMENSIONS IN INCHES

### DIMENSIONS IN MILLIMETRES

METRIC DIMENSIONS ARE BASED ON 1" = 25.4 mm

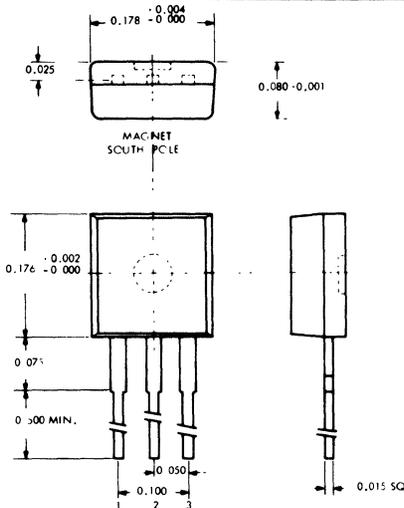


PKG. NO. A-90028 IN



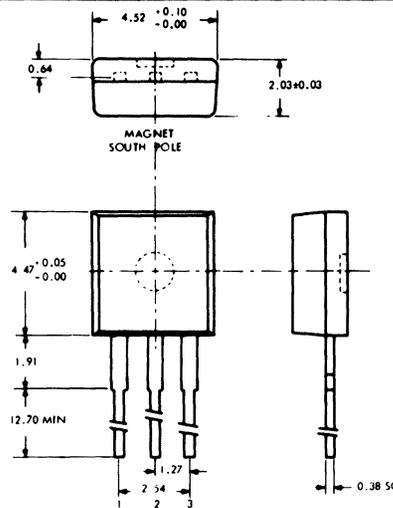
PKG. NO. A-90028 MM

### 'S' PACKAGE: 4-Pin Plastic Single-Ended



NOTES 1. All dimensions are in inches.  
2. Hall cell is centrally located.

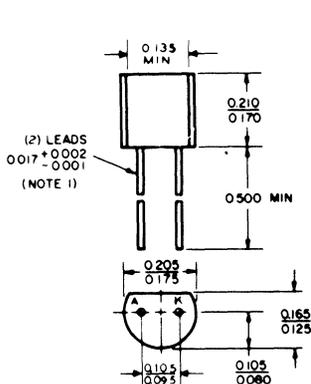
PKG. NO. L-1761 IN



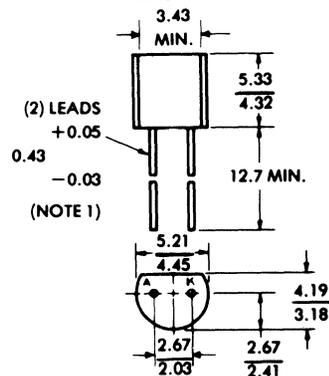
NOTES 1. All dimensions are in millimeters.  
2. Hall cell is centrally located.

PKG. NO. L-1761 MM

### 'T' PACKAGE: 3-Pin Plastic Single-Ended



NOTE 1: LEAD DIAMETER IS CONTROLLED IN THE ZONE BETWEEN 0.070 AND 0.250 FROM THE SEATING PLANE. BETWEEN 0.250 AND END OF LEAD A MAX OF 0.021 IS HELD.

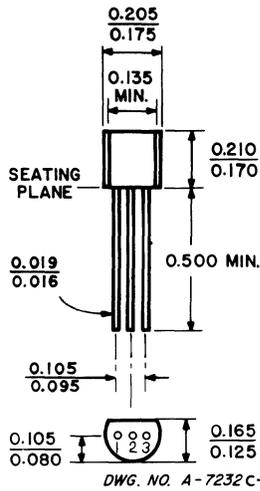


NOTE 1: LEAD DIAMETER IS CONTROLLED IN THE ZONE BETWEEN 1.78 AND 6.35 FROM THE SEATING PLANE BETWEEN 6.35 AND END OF LEAD A MAX OF 0.53 IS HELD.

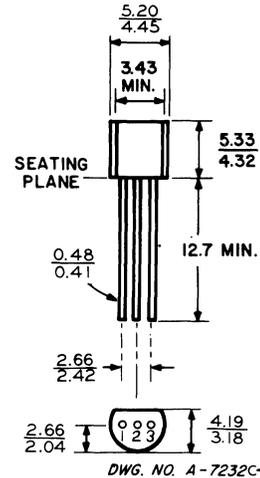
### T0-92 (T0-226AC) TWO LEAD PACKAGE

### DIMENSIONS IN INCHES

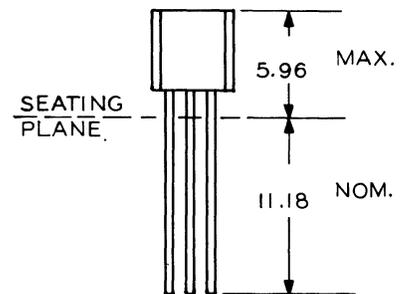
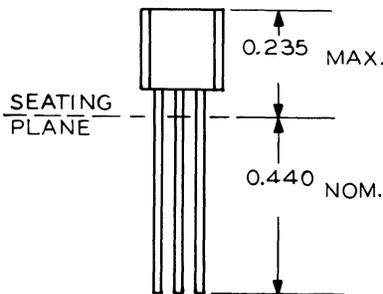
### DIMENSIONS IN MILLIMETRES METRIC DIMENSIONS ARE BASED ON 1" = 25.4 mm



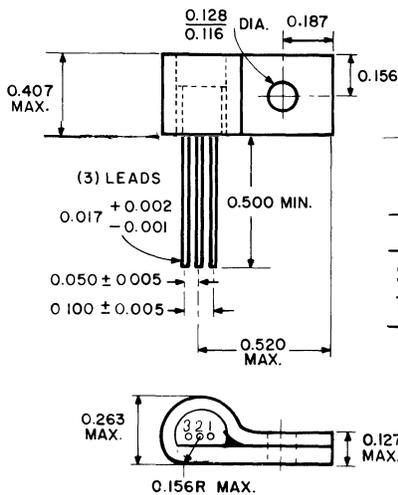
PINNING VARIATIONS			
Style	1	2	3
Standard T0-92	E	B	C
T0-98 Replacement	E	C	B
High Frequency	B	E	C
For T0-18 Lead Form	C	B	E
J-Pin Dual-Diode	A <sub>1</sub>	A <sub>2</sub>	K
K-Pin Dual-Diode	K <sub>1</sub>	K <sub>2</sub>	A
I-Pin Dual-Diode	A <sub>1</sub>	A <sub>2</sub> K <sub>1</sub>	A <sub>2</sub>
3330 Opto Switch	OUT	GND	V <sub>CC</sub>



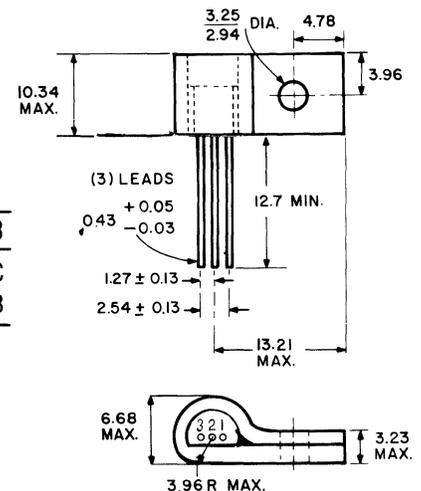
In-Line Pinning



Lead Formed to T0-18 Pin Circle



PINNING VARIATIONS			
Style	1	2	3
Standard T0-92	E	B	C
T0-98 Replacement	E	C	B



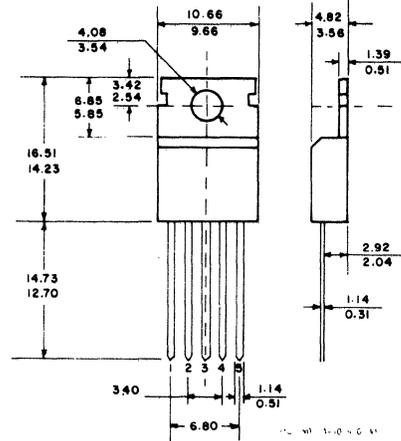
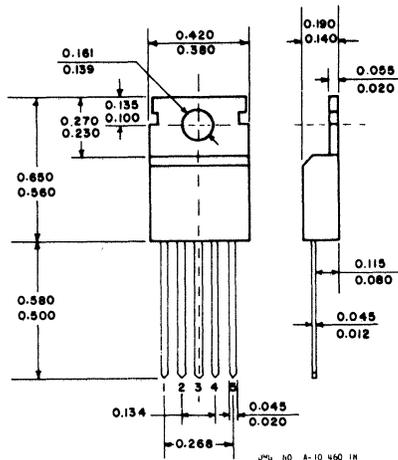
Heat-Sink Package

T0-92 (T0-226AA) PACKAGE

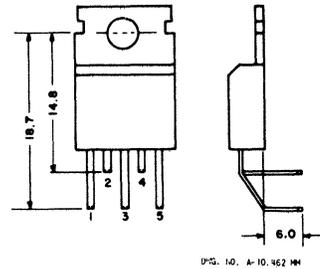
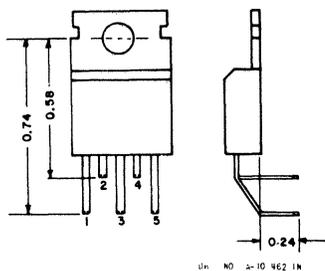
### DIMENSIONS IN INCHES

### DIMENSIONS IN MILLIMETRES

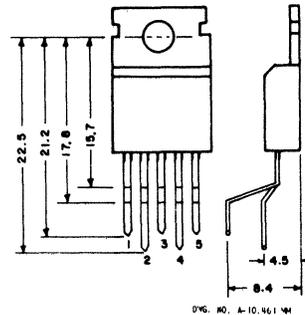
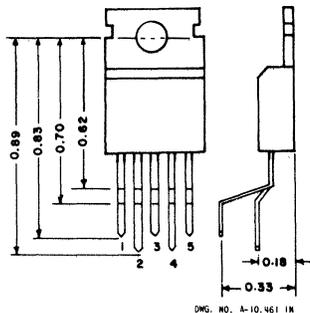
METRIC DIMENSIONS ARE BASED ON 1" = 25.4 mm



**'Z' PACKAGE: 5-Lead TO-220**



**'ZH' PACKAGE: 5-Lead TO-220  
(Horizontal Mount)**



**'ZV' PACKAGE: 5-Lead TO-220  
(Vertical Mount)**

In the construction of the components described, the full intent of the specification will be met. The Sprague Electric Company, however, reserves the right to make, from time to time, such departures from the detail specifications as may be required to permit improvements in the design of its products. Components made under military approvals will be in accordance with the approval requirements.

The information included herein is believed to be accurate and reliable. However, the Sprague Electric Company assumes no responsibility for its use; nor for any infringements of patents or other rights of third parties which may result from its use.



# SPRAGUE ELECTRIC COMPANY

executive offices: NORTH ADAMS, MASSACHUSETTS

area code 413 - Tel. 664-4411

a GK Technologies subsidiary

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602/966-7233

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Inglewood 90304  
Tel. 213/649-2600

Sprague Electric Company  
3303 Harbor Blvd.  
Costa Mesa, CA 92626  
Tel. 714/549-9913

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770 Airport Blvd.  
Burlingame 94010  
Tel. 415/347-7701

## CALIFORNIA (San Diego)

R. D. Miner Company  
4027 Country Trails  
P.O. Box 867  
Bonita 92002  
Tel. 714/421-5586

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William J. Purdy Co.  
1327 S. Inca St.  
Denver 80223  
Tel. 303/777-1411

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Sprague Electric Company  
935 White Plains Rd.  
Trumbull 06611  
Tel. 203/261-2551

## Ray Perron & Co., Inc.

36 Louis St.  
Trumbull 06611  
Tel. 203/268-9631

## Ray Perron & Co., Inc.

10 Briarwood Rd.  
Farmington 06032  
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(Government Sales Only)  
2233 Wisconsin Ave., N.W.  
Washington 20007  
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Tel. 301/792-7657

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1010 Haddonfield-Berlin Rd.  
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Tel. 609/795-4200

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616 Altamonte Drive  
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2279 Beech Valley Dr.  
Smyrna 30080  
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1480 Renaissance Dr.  
Park Ridge, IL 60068  
Tel. 312/296-6620

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EPI Inc.  
1173 Reco Avenue  
St. Louis, MO 63126  
Tel. 314/821-4090

## INDIANA

Sprague Electric Company  
2421 Willowbrook Parkway  
Indianapolis 46205  
Tel. 317/253-4247

## KANSAS

See Missouri

## KENTUCKY (Eastern)

Sprague Electric Company  
4977 Northcutt Place  
Dayton, OH 45414  
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Tel. 314/821-4090

## KENTUCKY (Boyd County)

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

## MAINE

See New Hampshire

## MARYLAND

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Tel. 609/795-4200

## MASSACHUSETTS

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60 Turner St.  
Waltham 02154  
Tel. 617/899-9100

Sprague Electric Company  
87 Marshall Street  
North Adams 01247  
Tel. 413/664-4411

## Ray Perron & Co., Inc.

181 Wells Ave.  
Newton 02159  
Tel. 617/969-8100

## MICHIGAN

Sprague Electric Company  
2922 Wildwood Ave.  
Jackson 49202  
Tel. 517/787-3934

## MINNESOTA

HMR, Inc.  
7200 France Avenue South  
Minneapolis 55435  
Tel. 612/831-7400

## MISSISSIPPI

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1 Elm St.  
Dover 03820  
Tel. 603/742-2321

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Wayne 07470  
Tel. 201/696-8200

## NEW JERSEY (Southern)

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Cherry Hill 08003  
Tel. 609/795-2299

Trinkle Sales Inc.  
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Cherry Hill 08034  
Tel. 609/795-4200

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Albuquerque 87108  
Tel. 505/266-7959

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Larchmont 01538  
Tel. 914/834-4439

William Rutt, Inc.  
14 N. Chatsworth Ave.  
P.O. Box 1029  
Larchmont 10538  
Tel. 914/834-8555

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Tel. 914/834-8555

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Paston-Hunter Co., Inc.  
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Syracuse 13206  
Tel. 315/437-2843

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Winston-Salem, NC 27101  
Tel. 919/722-5151

## TENNESSEE (Western)

Sprague Electric Company  
3322 S. Memorial Parkway  
Huntsville, AL 35801  
Tel. 205/883-0520

## TEXAS

Sprague Electric Company  
First Bank & Trust Bldg.  
Richardson 75080  
Tel. 214/235-1256

## VERMONT

See New Hampshire

## VIRGINIA

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

Sprague Electric Company  
P.O. Box 39  
Annapolis Junction, MD 20701  
Tel. 301/792-7657

Trinkle Sales Inc.  
1010 Haddonfield-Berlin Rd.  
P.O. Box 320  
Cherry Hill, NJ 08034  
Tel. 609/795-4200

## WASHINGTON

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

## CANADA

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49 Beral Road  
Toronto, Ont. M6M 4M7  
Tel. 416/766-6123

Sprague Electric of Canada, Ltd.  
85 Albert St.  
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Ottawa, Ont. K1P 6A4  
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## EUROPE

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Salbrook Rd., Salfords  
Redhill, Surrey, England RH1 5DZ  
Tel. Horley 5666

Sprague World Trade Corp.  
19 Chemin Francois Lehmann  
1218 Grand Saconex/Geneva  
Switzerland  
Tel. 98-4021

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Belgium  
Tel. 055-21 53 02

Sprague France S.A.R.L.  
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Tel. 6 55 19 19

Sprague G. m. b. H.  
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Sprague World Trade Corp.  
Eastern Branch  
G. P. O. Box 4289  
Hong Kong  
Tel. 5-62 62 31-4

## TAIWAN (Liaison Office)

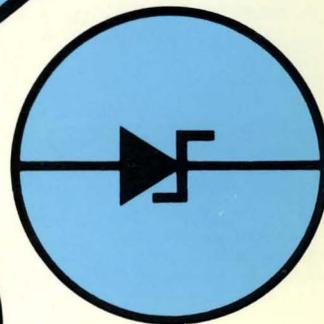
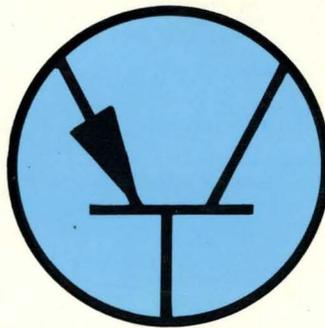
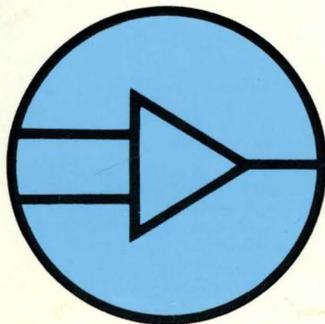
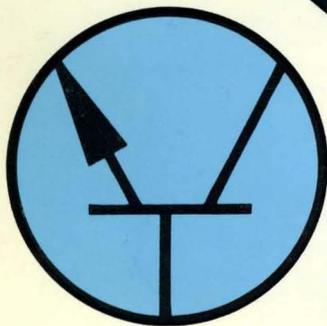
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# SPRAGUE<sup>®</sup>

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## SPRAGUE ELECTRIC COMPANY SEMICONDUCTOR DIVISION

### Integrated Circuit Operations:

115 Northeast Cutoff  
Worcester, MA 01606  
Tel. 617/853-5000

### Transistor and Diode Operations:

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Tel. 603/224-1961