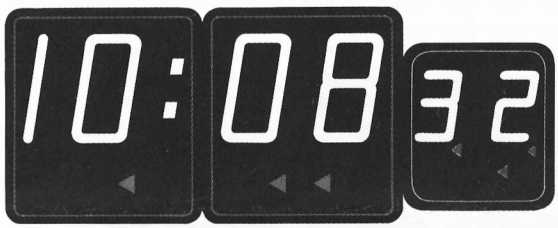
SPERRY
INFORMATION DISPLAYS

# CLOCK DISPLAYS

## 12-HOUR CLOCK
WITH OPTIONAL SECONDS DISPLAY

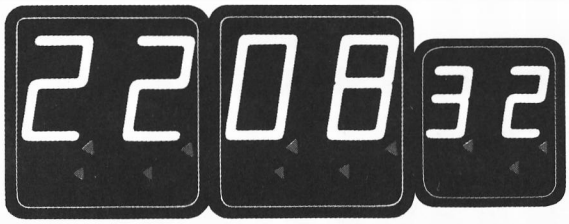

SP-151 SP-332

## 12-HOUR CLOCK
WITH OPTIONAL SECONDS DISPLAY




SP-152 SP-352 SP-332

## 24-HOUR CLOCK
WITH OPTIONAL SECONDS DISPLAY




SP-352 SP-352 SP-332

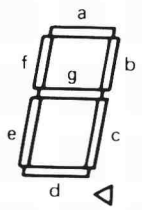
ALL DISPLAYS SHOWN FULL SIZE

# FEATURES

| | |
|---|---|
| Character Height | |
| SP-151 | 0.50 inch |
| SP-152 | 0.55 inch |
| SP-352 | 0.55 inch |
| SP-332 | 0.33 inch |
| Color | Orange (Neon Glow) |
| Brightness | 200 foot lamberts nominal* |
| Viewing Angle | 130 Degrees |
| Viewing Distance | 40 feet (20 feet for SP-332) |
| Life Expectancy | 10 years |
| Color Spectrum | 5900, 6200, and 6500 Angstroms |
| Lead Temperature (Solder) | 250°C, 10 seconds |

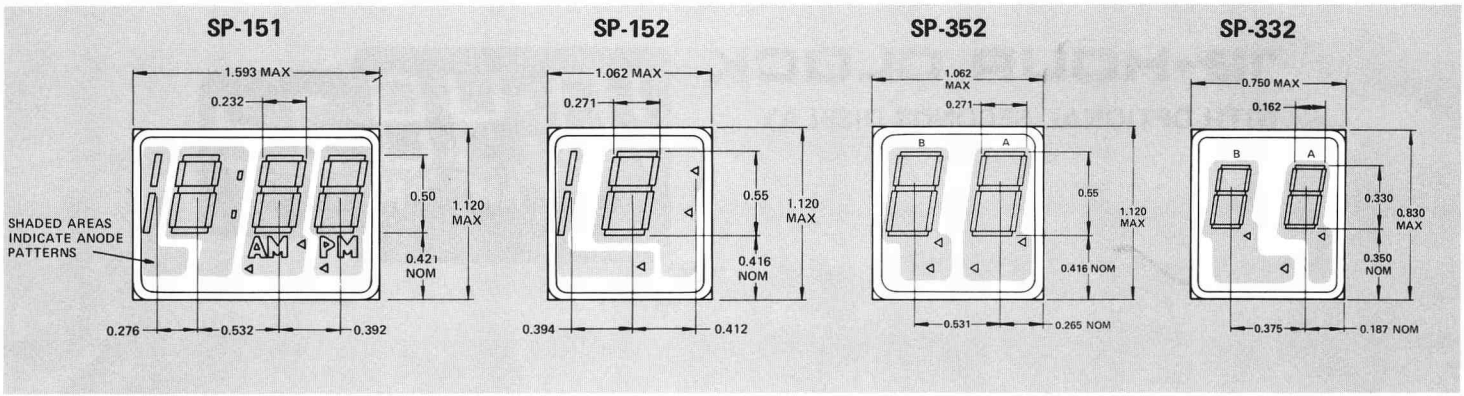
*Brightness is proportional to segment current and values from less than 100 loot lamberts to greater than 500 foot lamberts can be achieved by adjusting the current.

# SEGMENT DESIGNATIONS AND PIN CONNECTIONS

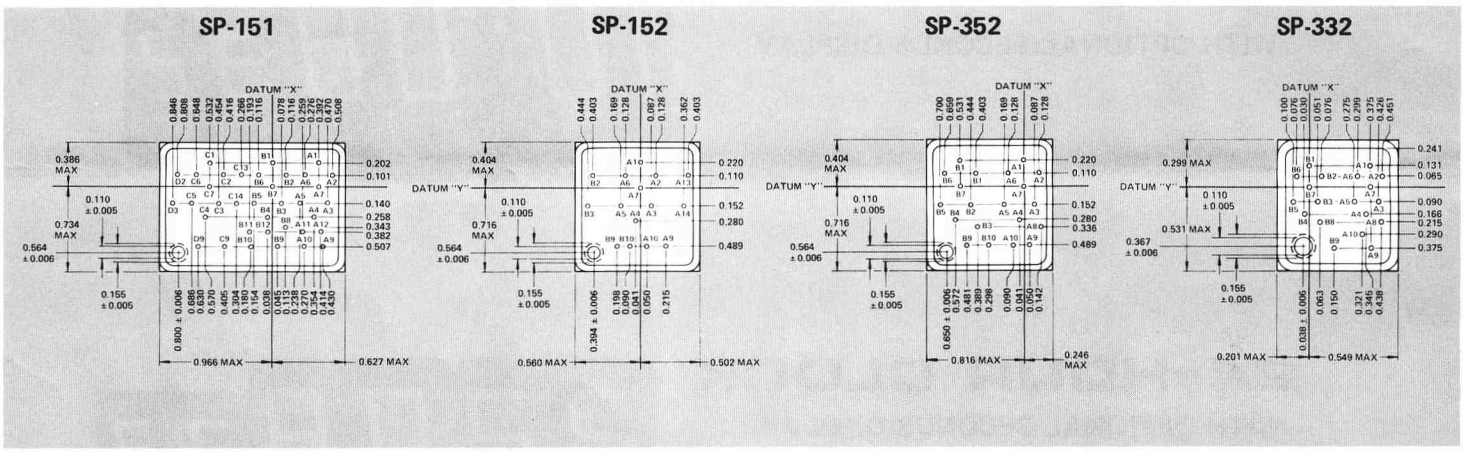



| Segment | Pin Number |
|---|---|
| a | 1 |
| b | 2 |
| c | 3 |
| d | 4 |
| e | 5 |
| f | 6 |
| g | 7 |
| decimal | 8 |
| anode | 9 |
| keep alive cathode | 10 |
| A,P | 11 |
| M | 12 |
| colon (top) | 13 |
| colon (bottom) | 14 |

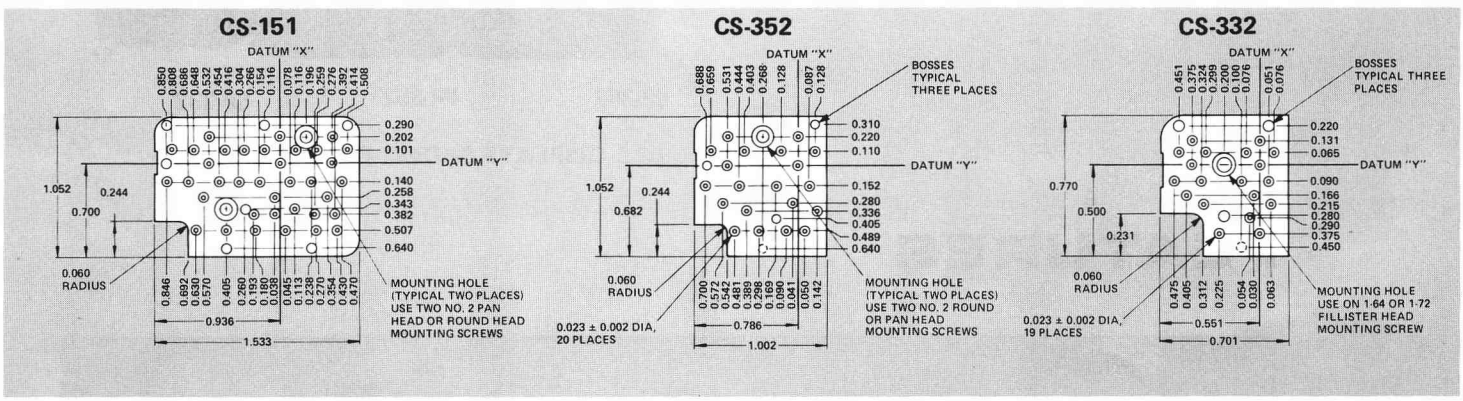
## DIGIT DESIGNATIONS




## PIN DESIGNATIONS AND LOCATIONS




## CONNECTORS




NOTES:

1. All digit and pin designations and pin locations are viewed from the front of the display.
2. Pin locations shown are nominal (approximately ±0.003" tolerance). Allowances should be made for location tolerance by size of pc board hole diameter.
3. For ease of insertion and solderability, recommend pc board hole diameter of 0.025 — 0.028.
4. Connectors are not furnished for the SP-152.
5. Allow 0.020 inch between adjacent display envelopes for ease of insertability and to compensate for vibration or shock during processing, and tolerances in circuit board manufacture.
6. The keep-alive cathode is pin No. 10 on all models.

# APPLICATION AND USE

### GENERAL

Sperry® clock displays are neon gas discharge devices that use seven segments to form any desired number from 0 to 9. The desired symbol is formed by application of a dc voltage between an anode and the appropriate cathode segment of the display. By selectively addressing the desired segment combination, the neon gas surrounding the segment becomes ionized and then displays the desired number. Selection of the desired segment or number is controlled by a decoder/driver or similar device or circuit. These displays are designed for interfacing with MOS/LSI clock chips and are recommended for use in all DC or multiplexed applications. A keep-alive cathode is provided in these displays.

### MECHANICAL CONSTRUCTION

The mechanical characteristics of the Sperry clock display is shown in Figure 1. Each character or digit is comprised of seven segments or cathodes. Each digit has a separate anode imprinted on the faceplate. Voltage is applied to the anode via a separate connector pin in the substrate.

### KEEP-ALIVE CATHODE

Sperry clock displays have keep alive cathodes in each envelope. The purpose of the keep alive cathode is to provide an internal ion source to allow zero suppression, reduce reionization time, and improve display operation in dark environments and at low temperature. Although more than one keep alive cathode may be available in the package, only one is required to maintain the desired level of ionization. The unused keep alive cathode may be left unconnected. The operational keep alive cathode should be connected to ground or to a negative dc voltage through a resistor. The resistor value should provide a minimum of 20 $\mu$A and a maximum of 50 $\mu$A current in the keep alive cathode as shown in Figure 2 which illustrates a typical circuit for operation or the keep alive.

### BRIGHTNESS

Brightness of the Sperry clock displays is directly proportional to segment current. The multiplex characteristics listed in the specifications show the range of currents for normal brightness levels.

### MULTIPLEX OPERATION OF SPERRY CLOCK DISPLAY

Figure 3 is a simplified schematic showing the utilization of Sperry displays using a MOS/LSI clock chip designed within current state-of-the-art processes. Figure 5 shows in simplified block diagram form the basic circuit requirements for multiplex operation of Sperry clock displays. Signal waveforms are shown with typical pulse widths and voltage levels in Figure 4. Figure 6 is a table showing the range of values of key parameters to be observed when multiplexing Sperry clock displays.

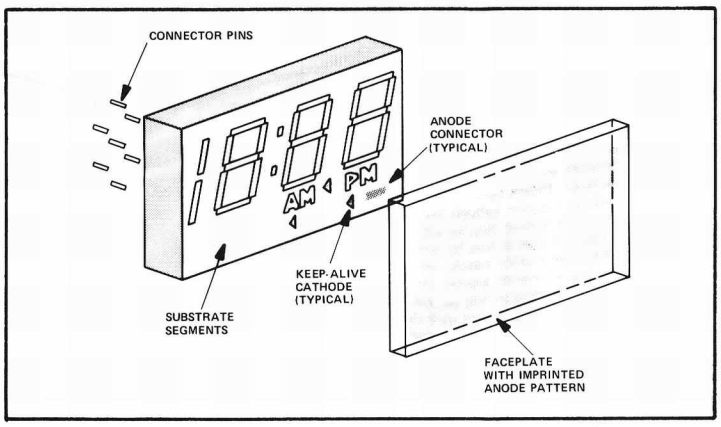



FIGURE 1. MECHANICAL CONSTRUCTION (TYPICAL)

$R_A < 3R_{KA}$

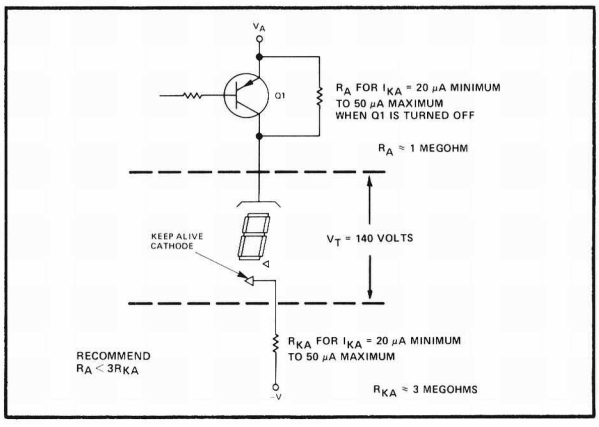



FIGURE 2. KEEP-ALIVE OPERATION (EQUIVALENT CIRCUIT)

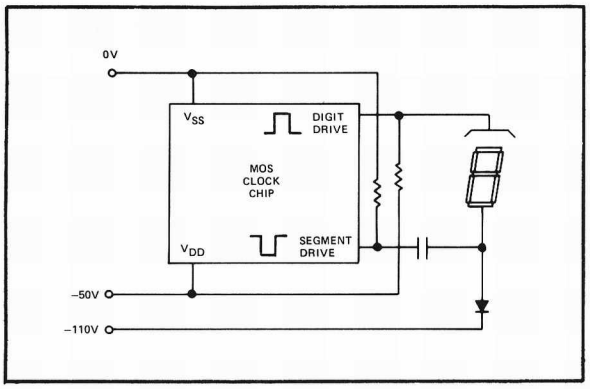



FIGURE 3. SIMPLIFIED SCHEMATIC DIAGRAM FOR CLOCK CHIP/DISPLAY INTERFACE

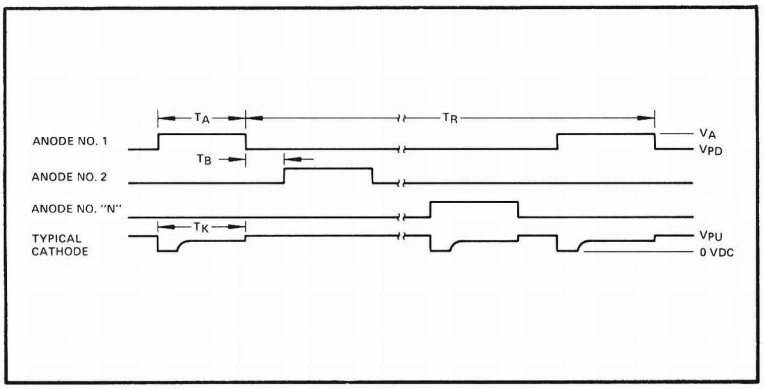



FIGURE 4. TYPICAL WAVEFORMS

# ...application and use

FIGURE 5. TYPICAL CIRCUIT FOR MULTIPLEX OPERATION

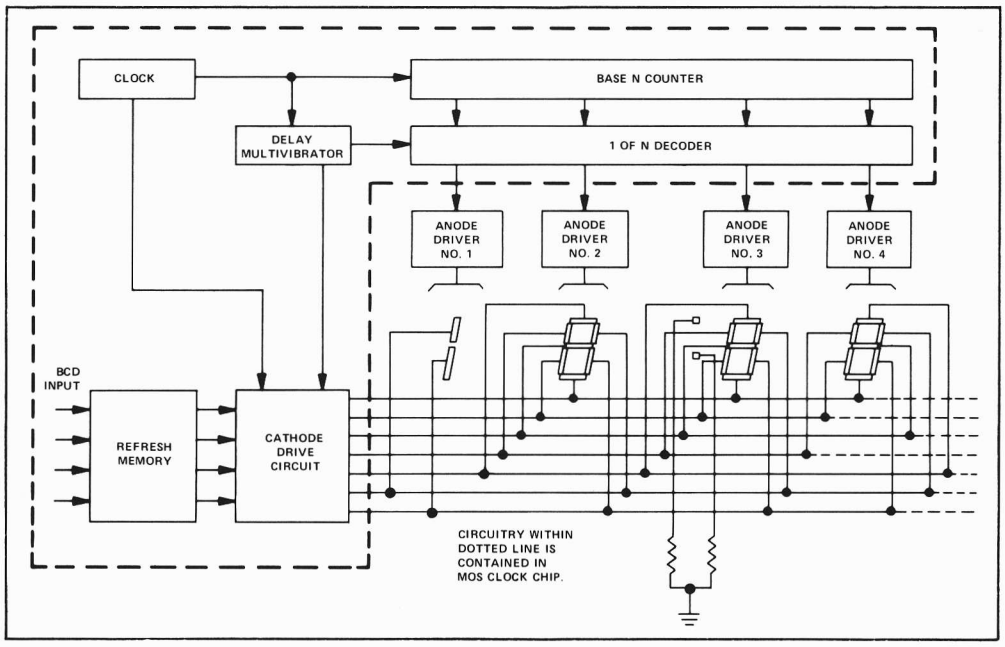



FIGURE 6. REQUIREMENTS FOR MULTIPLEX OPERATION

| OPERATING CHARACTERISTICS | | | SP-151 & SP-152 CLOCK DISPLAYS | | | SP-300 DISPLAYS | | |
|---|---|---|---|---|---|---|---|---|
| SYMBOL | PARAMETERS | UNITS | MIN | RECOMMEND | MAX | MIN | RECOMMEND | MAX |
| Number of Digits | | – | – | 6 | – | – | 12 | 25 |
| $T_A$ | Digit on Time | μsec | 50 | 400 | – | 80 | 200 | – |
| $T_R$ | Refresh Period | msec | – | – | 3 | – | – | 3 |
| $T_B$ | Interdigit Blanking | μsec | 50 | 150 | – | 40 | 50 | – |
| $T_D$ | Digit Time ($T_A + T_B$) | μsec | 100 | 500 | – | 120 | 250 | – |
| $V_A$ | Anode Voltage | Vdc | 160 | 180 | – | 160 | 180 | – |
| I | Display Current | – | See specifications below | | | See specifications below | | |

| SPECIFICATIONS | SP-151 | | | SP-152/SP-352 | | | SP-332 | | |
|---|---|---|---|---|---|---|---|---|---|
| **DC Characteristics** | **Min** | **Typ** | **Max** | **Min** | **Typ** | **Max** | **Min** | **Typ** | **Max** |
| Anode Supply Voltage(1) | 160 Vdc | 180 Vdc | – | 160 Vdc | 180 Vdc | – | 160 Vdc | 180 Vdc | – |
| Anode-to-Anode Differential Voltage(2) | – | – | 14 Vdc | – | – | 14 Vdc | – | – | 14 Vdc |
| Anode-to-Cathode Voltage Drop ($i_{segment}$ = 180 μA) | – | 135 Vdc | – | – | 135 Vdc | – | – | 135 Vdc | – |
| Cathode Current – Per Segment(3) | 125 μA | 300 μA | 385 μA | 130 μA | 300 μA | 420 μA | 70 μA | 180 μA | 250 μA |
| Cathode Current – Decimal Point(3) | 40 μA | 100 μA | 140 μA | 65 μA | 135 μA | 190 μA | 50 μA | 135 μA | 185 μA |
| Cathode Current – Colon | 90 μA | 225 μA | 315 μA | 90 μA | 225 μA | 315 μA | – | – | – |
| Cathode Current – A | 100 μA | 245 μA | 340 μA | – | – | – | – | – | – |
| Cathode Current – P | 85 μA | 205 μA | 285 μA | – | – | – | – | – | – |
| Cathode Current – M | 140 μA | 330 μA | 460 μA | – | – | – | – | – | – |
| Cathode Voltage – Keep Alive | – | 0 Vdc | – | – | 0 Vdc | – | – | 0 Vdc | – |
| Cathode Current – Keep Alive | 10 μA | 50 μA | – | 10 μA | 50 μA | – | 10 μA | 50 μA | – |
| Power Dissipation – (One Digit With All Segments Lighted)(3) | – | 350 mW | – | – | 350 mW | – | – | 200 mW | – |
| Operating Temperature | 0°C | – | 70°C | 0°C | – | 70°C | 0°C | – | 70°C |
| Storage Temperature | –55°C | – | 125°C | –55°C | – | 125°C | –55°C | – | 125°C |
| **Multiplex Characteristics(4)** | **Min** | **Typ** | **Max** | **Min** | **Typ** | **Max** | **Min** | **Typ** | **Max** |
| Digit On Time | 50 μsec | 400 μsec | – | 50 μsec | 200 μsec | – | 80 μsec | 200 μsec | – |
| Interdigit Blanking Time | 50 μsec | 150 μsec | – | 40 μsec | 50 μsec | – | 35 μsec | 50 μsec | – |
| Refresh Period | – | – | 3 ms | – | – | 3 ms | – | – | 3 ms |
| Anode Supply Voltage | 160 Vdc | 180 Vdc | – | 160 Vdc | 180 Vdc | – | 160 Vdc | 180 Vdc | – |
| Typical Cathode Current for 25% Duty Cycle or Lower | – | 1 mA | – | – | 1 mA | – | – | 550 μA | – |

NOTES:

1. The minimum recommended voltage required to ionize the display is 160 volts dc. After the display has ionized, the voltage drop is approximately 135 volts. Typical cathode current is assumed.
2. Lighted cathodes on all digits with independent current limiting. For bussed cathodes (multiplexed operation), 90 volts is permissible.
3. The lowest current for even glow on the largest segment is 125 μA (130 μA for SP-152, 70 μA for SP-332). Currents up to 1.5 times the typical current may be used, however, life expectancy may be reduced by operation at excessively higher currents. For multiplexed operation (time shared) segment currents may be increased to 1.25 mA (650 μA for SP-332) with 0.25 or smaller duty cycle.
4. Blanking requirements are strongly dependent upon the mode of multiplex operation and upon the segment current used. The maximum refresh rate is a variable dependent upon duty cycle. Three milliseconds applies to operation without using keep alive cathodes; with keep alive cathodes, a refresh period up to 10 milliseconds may be used.