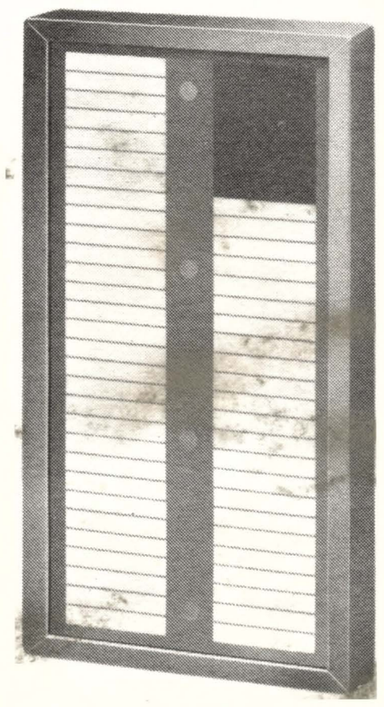
SYLVANIA

DISPLAY DEVICES

Electroluminescent (EL) Analog Indicator
SD212

- **SEGMENTED (BAR) TYPE**
- **10 LINES PER INCH**
- **INDIVIDUALLY CONTROLLED BARS**
- **LOW POWER (300 mw)**
- **SOLID-STATE RELIABILITY**
- **HIGH VERSATILITY**
- **HIGH READABILITY**



DESCRIPTION

Sylvania's Type SD212 is an analog indicating device of the bar graph type. It features 2 rows of 30 bars each. Each bar is individually controlled and glows in a blue-green color. The SD212 is based on the phenomenon of electroluminescence. This is the "Cold Light" emitted by phosphors when in the presence of an electromagnetic field. It is a solid-state device, compact in design and inherently free of sudden failure. Power requirements are low, about 300 mw with all bars lighted.

MECHANICAL DATA

Height	1.565 ± .030 Inches
Length	3.265 ± .030 Inches
Thickness	0.250 ± .020 Inches
Pin Length	0.205 Inches
Pin Diameter	0.030 Inches
Weight	40 Grams

ELECTRICAL AND OPTICAL DATA

RATINGS (Absolute Maximum Rating System)

Peak Voltage	420 Volts
RMS Voltage (Sine Wave)	300 Volts
Peak Transient Voltage (0.5 Cycle Max.)	500 Volts

TYPICAL OPERATING CONDITIONS

RMS Voltage	250 Volts
Frequency	400 Hertz
Current (All Elements Operating)	3.0 Ma
Dissipation	300 mw
Ambient Temperature	25 °C
Wavelength of Peak Light Output	5100 ± 200 Angstroms
Average Brightness	7 to 13 Ft. Lamberts
Uniformity of Brightness (% of Average)	±20 Percent
Insulation Resistance (350 V Applied)	10 Megohms Min.
Power Factor	0.6 Max.

TYPICAL SPECIFICATIONS

To provide maximum reliability, SD212 Panels are designed to rigid specifications. All materials used in their manufacture are inspected 100%. Rigid inspection and testing during and after assembly assures continued high quality.

ELECTRICAL

Breakdown Voltage—Rated for 420 volts peak, 300 volts RMS, 500 volts transient (not to exceed ½ cycle).

Insulation Resistance—With 350 Vdc applied resistance between each terminal and frame shall be 10 megohms minimum.

Power Factor—0.6 Max., under rated conditions of voltage and frequency with all active areas lit,

$$PF = \frac{W}{EI} \quad \text{where}$$

W = average power
E = voltage
I = total current

OPTICAL

Display Color—Under rated conditions the display color shall be blue-green, with peak output at 5100 ± 200 angstroms.

Brightness—Under rated conditions of voltage and frequency, with all active areas lit, brightness of an average device will be 7 to 13 foot lamberts.

Uniformity—Under rated conditions of voltage and frequency with all active areas lit, uniformity of bars shall be ±20% of average brightness.

Contrast Ratio—Using an integrating sphere, with unit operating with rated conditions and all active areas lit, in a defined ambient light level (normally 100 FC), ratio is calculated by

$$\frac{B - A}{A} \quad \text{where}$$

B = brightness of an illuminated segment
A = brightness of nonilluminated background

Percent Reflectance—With condition as stated for contrast ratio. Percent of reflectance is calculated by

$$\frac{A}{\text{Ambient}} \times 100$$

ENVIRONMENTAL

Shock—MIL-E-1 Method 1041, 300 g acceleration, 0.5 milliseconds duration, Navy high impact (flyweight) shock machine.

Vibration Fatigue—MIL-E-1 Method 1031, Subparagraph 7, 96 hours total, 32 hours in each of 3 positions—frequency = 25 to 60 ± 2 hertz at approximately 2½ g's.

Vibration—MIL-E-1 Method 1021, frequency 40 hertz at 15 g.

Moisture Resistance—At rated condition of voltage and frequency at temperature of 40°C. 95% humidity for duration of 8 hours.

Temperature Cycling—MIL-STD-202C Method 102A (Condition B).

Altitude (Barometric Pressure)—MIL-E-1 Method 1002. Voltage = 300 Vac, pressure 87 ± 5 mm, Hg.

LIFE

Continuous—50% of initial brightness is achieved at 1000 hours at rated conditions without cycling.

MECHANICAL

Overall Dimensional Tolerance—±0.03 Inches.

BRIGHTNESS

The brightness of an EL panel is a function of field strength across the dielectric layer, and thus depends on voltage and frequency. It is approximately proportional to the square of the voltage and to 6/10 of the frequency.
EL's under rated condition of 250 Vac at a frequency of 400 hertz, produce an initial light output of about 8 foot lamberts. This light output includes wavelengths from 4000 to 7000 angstroms and peaks in the blue-green portion of the spectrum at 5100 angstroms, closely approximating the response characteristic of the human eye.

CONTRAST

Maximum readability does not necessarily coincide with maximum brightness. Contrast between the lighted characters and the surrounding background plays an important part in what the eye can see under various conditions of ambient lighting.
Optimum contrast ratio for normal viewing conditions is achieved in Sylvania EL Panels by employing 60 to 70% transmission, neutral density gray filter glass for the faceplate.

Anti-reflective coating may also be applied to the front surface to virtually eliminate reflection. In sunlight or other very high ambient lighting conditions, honeycomb overlay filters can be used. The filter restricts the viewing angle to approximately 30°, but substantially reduces the effects of the ambient light.

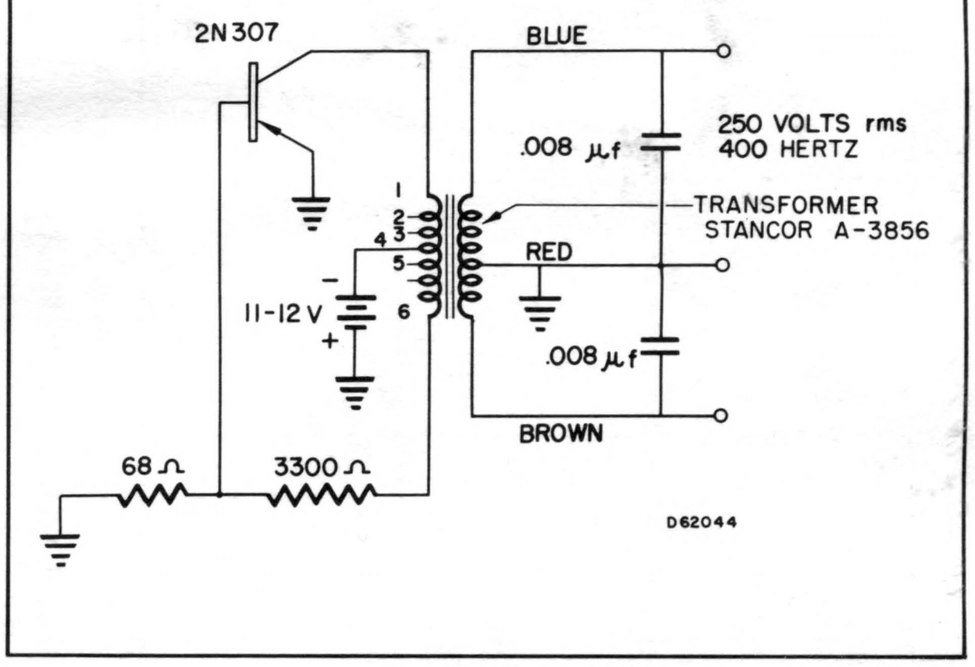
FREQUENCY RESPONSE TIME

The phosphors used in Sylvania's electroluminescent panels, besides being very efficient in producing light, are exceptionally fast in response to excitation. They are faster than the phosphors presently used in cathode ray tubes. With sinewave excitation, the light output reaches 80% of its maximum value in approximately one cycle of the applied voltage, and full value between the second and third cycle. Decay time is in the order of 5 nanoseconds. When operated from a pulsed voltage source, the phosphor will luminesce with pulses as short as 50 nanoseconds.

TYPICAL POWER SUPPLIES

Presented here are two power supplies designed to operate EL Panels. The first is a fundamental design for only basic laboratory evaluations. The second is tailored to system level requirements and is intended as an aid to facilitate the design and use of EL display systems.
Although the power requirements for EL's are exceptionally low, they are somewhat specialized as the EL panel is essentially a capacitive device. This factor must be taken into consideration in EL power supply design in order to prevent possible permanent damage to the EL panel from excessive peak currents. An economical, straightforward solution is achieved with the designs shown.
Recommended operating voltage for a typical EL display system is 250 volts RMS, 400 hertz. This provides adequate brightness and an acceptable life span for the majority of applications.

TYPICAL LABORATORY POWER SUPPLY FOR EL READOUTS



This Sylvania design meets the power requirements for basic laboratory evaluations of EL panels. The unit is made with standard, off-the-shelf, components. It operates from a nominal 12 volt dc source and provides an output of 250 volts RMS, 400 hertz. It has a load rating of 25 ma with a 20% power factor.

CONSTRUCTION

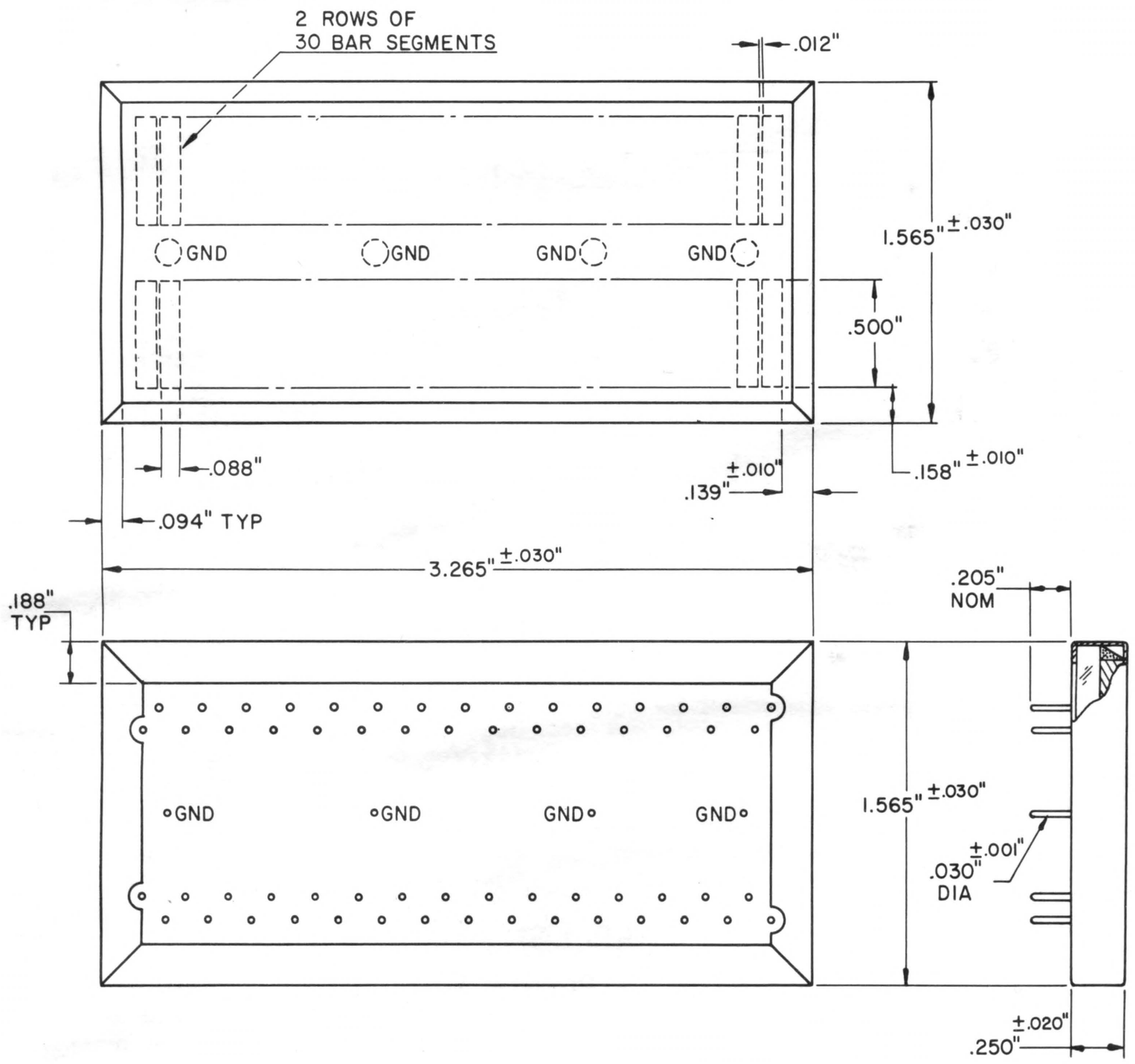
The single plane construction of Type SD212 gives a smooth in-line readout which is easily read at angles up to 150°. The bars have a resolution of 10 per inch and can be oriented to read either vertically or horizontally. With proper circuitry, bars may be lighted one at a time or sequentially, with all previously lighted bars remaining lit.

The basic construction is similar to a flat luminous capacitor containing an electroluminescent phosphor in the dielectric. This is sandwiched between two conductive electrodes.

A glass substrate with a thin transparent conductive film serves as one electrode. The other electrode is an opaque metal film comprised of segments which actually form the bars of the display. Light is produced only where two plates form a capacitor.

By virtue of this construction, the SD212 is exceptionally compact measuring approximately 1/4" in thickness. The width is 3.265 ± .030 inches and the height is 1.565 ± .030 inches. Connection to the bars are made through .030" diameter pins. Four ground pins are also provided.

OUTLINE

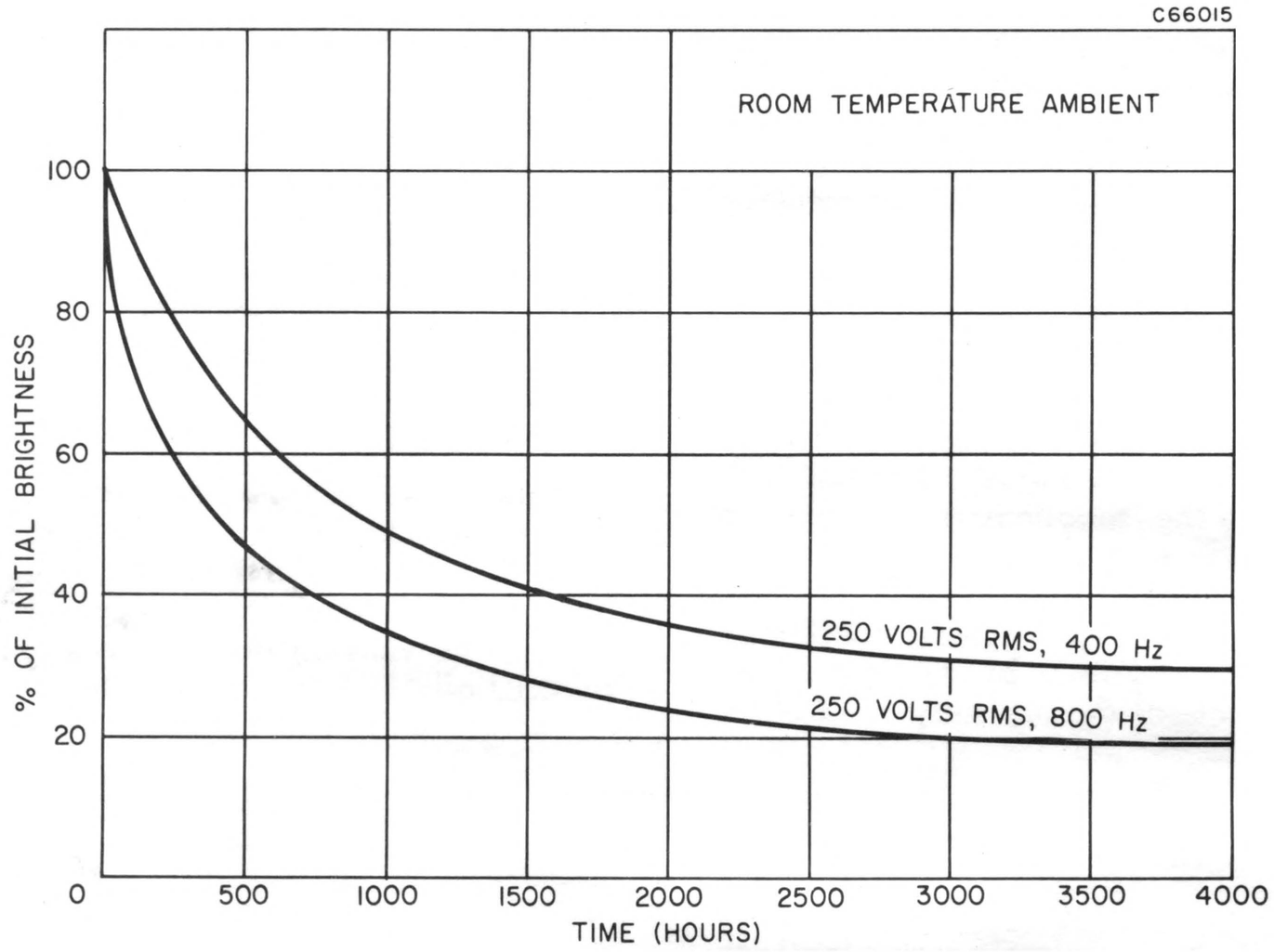


LIFE

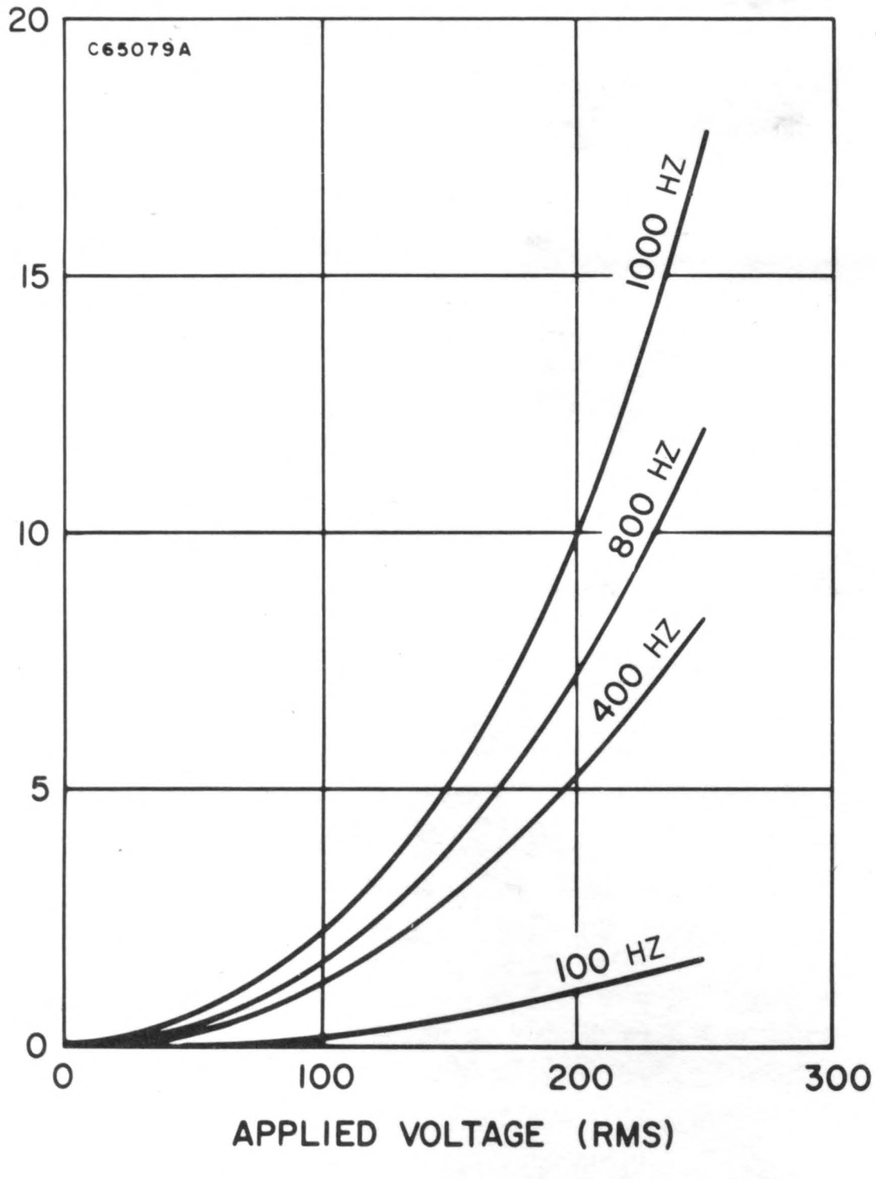
Continued life testing confirms that EL Panels are inherently free of catastrophic failures as compared to some sources of display lighting. Over the life of the device, light output gradually decreases. End-of-life is reached when brightness becomes insufficient for the application. This is dependent on such subjective factors as ambient lighting, degree of shielding, and other viewing considerations. Tests show the acceptable viewing limits of EL's in subdued ambient light to be 15 to 20% of initial light output for most applications. Replacement can be made on a planned down time basis.

Light output drop-off is a function of on-time and the degree of brightness demanded. A slight reduction in brightness can substantially prolong useful life. Operational duty cycles increase rather than shorten life. This is in contrast to vacuum or gas type displays where on-off cycling decreases brilliance and subjects the device to sudden failure.

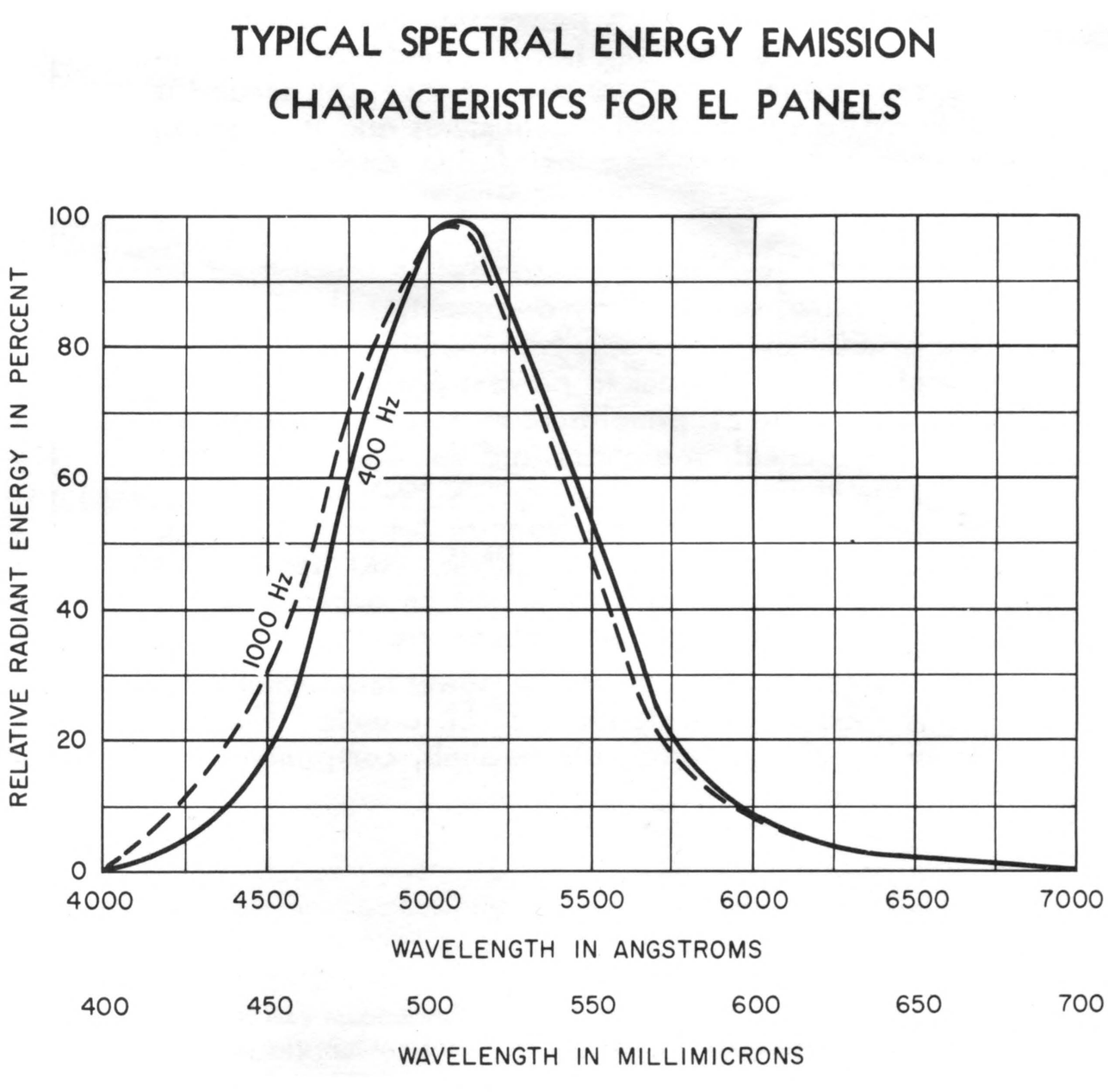
TYPICAL LIGHT OUTPUT VS. TIME FOR EL PANELS



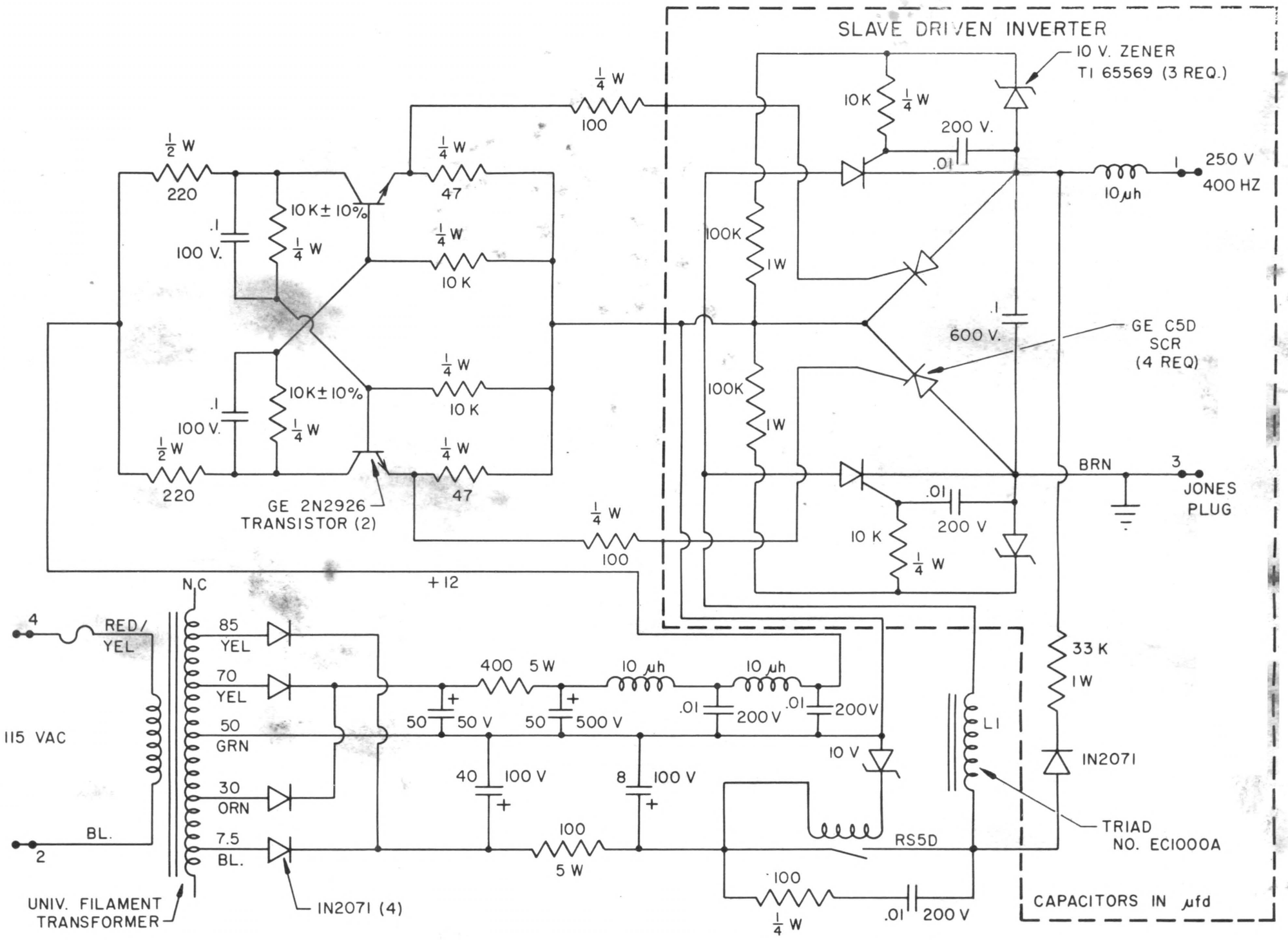
EL READOUT BRIGHTNESS VS. VOLTAGE AT VARIOUS FREQUENCIES



TYPICAL SPECTRAL ENERGY EMISSION CHARACTERISTICS FOR EL PANELS



SYSTEM LEVEL POWER SUPPLY FOR EL PANELS



This Sylvania design meets the power requirements for the majority of EL display applications. The unit is made with standard, off-the-shelf components and readily adapts to modular construction. It operates from a 115 Vac, 60 hertz source and has a load rating of 65 ma with a 20% power factor. The design provides essential regulation to assure uniform brightness of the display regardless of the number of EL panels illuminated at any given time within the rating of the supply.

Essentially this power supply consists of a power conversion stage, free-running multivibrator, and an inverter stage. The 115 Vac, 60 hertz input is changed to dc by the power conversion stage. The dc outputs of the power conversion stage drives both the free-running multivibrator and the inverter stage. The free-running multivibrator sets up the 400 hertz frequency, used by the inverter stage in converting the output of the dc supply to 250 volts RMS, 400 hertz.

PARTS LIST
SYSTEM LEVEL POWER SUPPLY

Amount	Part	Amount	Part
2	GE 2N2926 Transistors	1	.1 μfd at 600 VDC Capacitor
4	GE C5D SCR's	2	.1 μfd at 200 VDC Capacitor
1	STANCOR P-1834-3 Transformer	3	10 μh Chokes
5	SYLVANIA 1N2071 Diodes	2	47 Ohms ½W Resistors
3	TEXAS INSTRUMENTS 655C9 10V Zener Diode	3	100 Ohms ½W Resistors
1	TRIAD No. EC1000A Choke	1	100 Ohms 5W Resistor
1	P & B RS5D 10K Relay	2	220 Ohms ½W Resistors
2	50 μfd at 50 WVDC Capacitor	1	400 Ohms 5W Resistor
1	40 μfd at 150 WVDC Capacitor	6	10K Ohms ½W Resistors
1	8 μfd at 150 WVDC Capacitor	1	33K Ohms 1W Resistor
5	.01 μfd at 200 VDC Capacitor	2	100K Ohms ½W Resistors