



## **90° Deflection – 51 cm (20 V) Precision In-Line Color Picture Tube Assembly**

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- MP – Low Energy 90° Planar**
- Full Square Design**
- Miniaturized Pin-Free Saddle – Toroidal Yoke – Lower Deflection Power**
- XL Double Bipotential Precision In-Line Gun Optimized Beam – Forming Region for Improved Focus Uniformity – Improved Resolution**
- Standard 29 mm Neck Diameter – Proven Reliability – No Change in Socket Design**
- Improved Convergence Performance**
- Internal Magnetic Shield**
- Other Features:**
  - Matrix Contoured – Line Screen**
  - Tinted Phosphor**
  - Super Arch Mask**
  - Soft Arc Technology**
  - Integral Mounting Lugs**
- Integral Tube Components**

The A51EBV13X01 (20 V) 90° Precision In-Line Color Picture Tube is one of new generation of color picture tubes. It offers the advantages of a full square screen format, while maintaining picture quality and tube performance compatible with modern demands.

It incorporates a DB/XL electron gun with closer beam to beam spacing for improved convergence and XL extended lens configuration for focus performance. In the XL feature an extended lens field encompasses all three beams.

This extended lens field, when combined with the fields from the individual apertures produces a superior lens with less aberration than a standard gun, ideally suited to the full square application. Only the overall neck diameter, not the beam spacing, limits focusing ability; permitting an improvement in convergence by the reduction of beam spacing, without the usual loss of focus performance. Picture quality is further enhanced by the use of a black matrix type screen configuration, offering increased contrast at high light ambient.

## Electrical Data

### Heater:

Voltage	6.3	V
Current	700	mA
Focusing Method	Electrostatic	
Focus Lens	Bipotential	
Convergence Method	Magnetic	
Deflection Angles (approx.):		
Diagonal	90	deg
Horizontal	74	deg
Vertical	57	deg
Direct Interelectrode Capacitance (approx.):		
Grid No. 1 to all other electrodes	11.0	pF
Grid No. 3 & 5 to all other electrodes	10.0	pF
Each cathode to all other electrodes	6.5	pF
All cathodes to all other electrodes	15.0	pF
Capacitance Between Anode and External Conductive Coating (including metal hardware)		
	1500	pF min.
Resistance Between Metal Hardware and External Conductive Coating		
	50	MΩ min.
Magnetic Shield	Internal	

## Optical Data

### Faceplate:

Light transmittance at center (approx.)	50	%
Surface	Polished	
Screen:		
Matrix	Black Opaque Material	
Type	Negative Guard Band	
Phosphor, rare – earth (red), sulfide (blue & green)		
Type	Type X	
Type	Selectively Absorbent	
Persistence	Medium Short	
Array	Vertical Line Trios Contoured to Screen Edge	
Spacing between corresponding points on line trios at center (approx.)	0.80	mm

## Mechanical Data

### Tube dimensions:

Overall length	440.33 ± 6.4	mm
Reference Line to center of face	296.00 ± 4.8	mm
Neck length	144.23	mm
O.D. at tension band:		
Diagonal	549.70	mm max.
Horizontal	459.20	mm max.
Vertical	363.20	mm max.
Minimum screen dimensions (projected):		
Diagonal	508.00	mm
Horizontal	410.40	mm
Vertical	308.80	mm
Area	1258	cm <sup>2</sup>

Bulb Funnel Designation	EIA No. JF542	
Bulb Panel Designation	EIA No. F545	
Anode Bulb Contact Designation	EIA No. J121	
Base and Pin Connection Designation	EIA No. B10–277	
Pin Position Alignment	Space Separating Pins 9 and 10 Aligns approx. with Anode Bulb Contact	
Operating Position, Preferred	Anode Bulb Contact on Top	
Weight (approx.)	14.0	kg

## Implosion Protection

Type	Shrink-fit Rimband
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## Maximum and Minimum Ratings, Absolute-Maximum Values

Absolute-Maximum Ratings are specified for reliability and performance purposes. X-radiation characteristics should also be taken into consideration in the application of this tube type.

Unless otherwise specified, voltage values are positive with respect to grid No. 1.

Anode Voltage	29.0	kV max.
	17.0	kV min.
Anode Current Long-Term Average	1000	μA max.
Grid No. 3 and 5 (focusing electrode) Voltage	12	kV max.
Peak Grid No. 2 Voltage	1850	V max.
Cathode Voltage:		
Positive bias value	400	V max.
Positive operating cutoff value	200	V max.
Negative bias value	0	V max.
Negative peak value	2	V max.
Heater Voltage:		
AC (rms) or DC value		
Maximum value	6.9	V
Minimum value	5.7	V
Peak pulse value	50	V max.
Surge value, during 15-second warm-up period (rms)	9.5	V max.
Heater Cathode Voltage:		
Heater negative with respect to cathode:		
During equipment warm-up period not exceeding 15 seconds		
	450	V max.
After equipment warm - up period:		
DC component value	200	V max.
Peak value	300	V max.
Heater positive with respect to cathode:		
DC component value	100	V max.
Peak value	200	V max.

## Typical Design Values (for Anode Voltage of 27.5 kV)

Unless otherwise specified, voltage values are positive with respect to grid No. 1.

Grid No. 3 & 5 (focusing electrode) voltage	29 to 33 % of Anode Voltage
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Grid No. 2 Voltage for Visual Extinction of Undelected Focused Spot	See CUT OFF DESIGN CHART in Figure 4
At cathode voltage of 100 V	540 to 875 V
At cathode voltage of 150 V	850 to 1350 V
At cathode voltage of 200 V	1160 to 1825 V

Maximum Ratio of Cathode Cutoff Voltages, Highest Gun to Lowest Gun (with grid No. 2 of gun having highest cathode voltage adjusted to give 150 V spot cutoff) ..... 1.25

Heater Voltage ..... 6.3 V

Grid No. 3 & Grid No. 5 Current .....  $\pm 2 \mu\text{A}$

Grid No. 2 Current .....  $\pm 2 \mu\text{A}$

Grid No. 1 Current .....  $\pm 2 \mu\text{A}$

To Produce White Light of ..... 9300 K + 27 M.P.C.D.

CIE coordinates:

X ..... 0.281

Y ..... 0.311

Percentage of total anode current supplied by each beam (average):

Red ..... 37 %

Blue ..... 31 %

Green ..... 32 %

Ratio of cathode currents:

Red/Blue:

Minimum ..... 0.90

Typical ..... 1.20

Maximum ..... 1.40

Red/Green:

Minimum ..... 0.80

Typical ..... 1.10

Maximum ..... 1.30

Blue/Green:

Minimum ..... 0.70

Typical ..... 0.90

Maximum ..... 1.10

Raster Centering Displacement Measured at Center of Screen

Horizontal .....  $\pm 4.0 \text{ mm}$

Vertical .....  $\pm 4.0 \text{ mm}$

**Deflection Yoke Data (at 24.5 kV)**

Yoke Type ..... 51C1MMZ/00

$L_H$  .....  $2.40 \pm 4 \%$  mH

$R_H$  .....  $3.60 \pm 7 \%$   $\Omega$

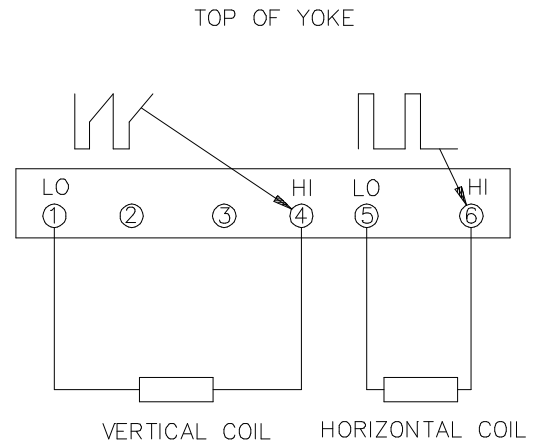
$I_{H \text{ p-p}}$  ..... 2.42 A

$L_V$  .....  $27.4 \pm 7 \%$  mH

$R_V$  .....  $15.0 \pm 7 \%$   $\Omega$

$I_{V \text{ p-p}}$  ..... 0.887 A

**Deflection Yoke Data**



**Fig. 1 – Connection Diagram for Yoke (As viewed from rear of yoke)**

### X-Radiation Characteristics

Operating within the absolute maximum rating, these color picture tubes do not emit X-Radiation above 0.1 mR/h, satisfying the international accepted dosage rate of 0.5 mR/h (at 5 cm from the cabinet) and the new German regulation (1  $\mu$ Sv/h at 10 cm from the glass).

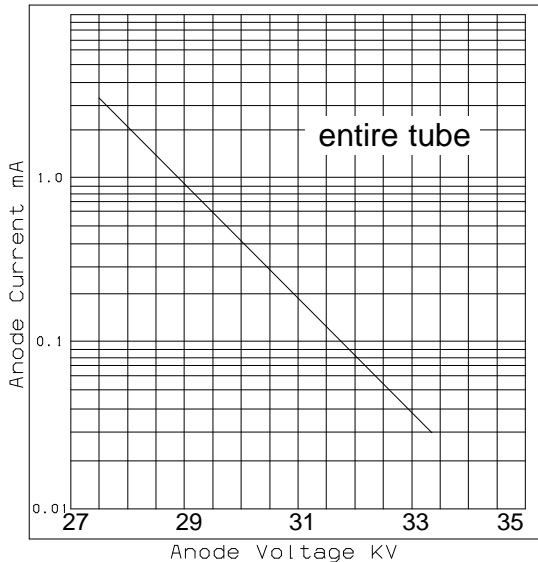


Fig. 2 – 0.1 mR/h Isoexposure – Rate Limit Curves

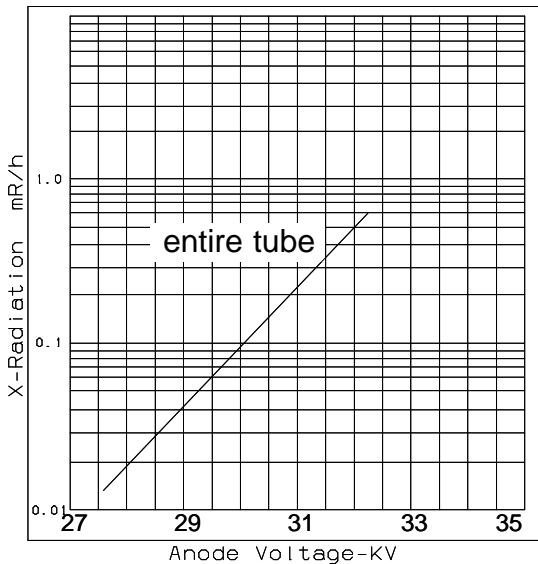


Fig. 3 – X-Radiation Limit Curves at a Constant Anode Current of 300  $\mu$ A (X-radiation at a constant anode voltage varies linearly with anode current)

### NOTES:

1. The X phosphor designation in the WTDS is equivalent to P22 in EIA type designation system.
2. For mating socket considerations, see Note 1 under Notes for Dimensional Outline.
3. For maximum tube life, the heater supply voltage should be regulated to minimize heater voltage changes due the variations in line voltage, beam current, and other parameters. The design center value of the heater voltage should be the Typical Design Value: however, in some applications it may be desirable to operate at a voltage slightly below this value. Cost considerations may suggest that the heater voltage be obtained from unregulated voltage varies with beam current, the circuit parameters should be selected so that the design center value of the heater voltage is equal to the Typical Design Value when the beam current is one-half of the Long Term Average Anode Current as shown in the tabulated data. The Absolute Maximum and Minimum Ratings should not be exceeded when including all variations.
4. The best tube performances are obtained under suggested operational condition.
5. A high source impedance in the focus voltage with a change in the grid No. 3 leakage current.
6. The design-center values are the values obtained when the tube is operated in an earth's magnetic field having a 380 mG vertical component and 240 mG horizontal component.
7. Typical values measured at a distance of 5 times picture height.

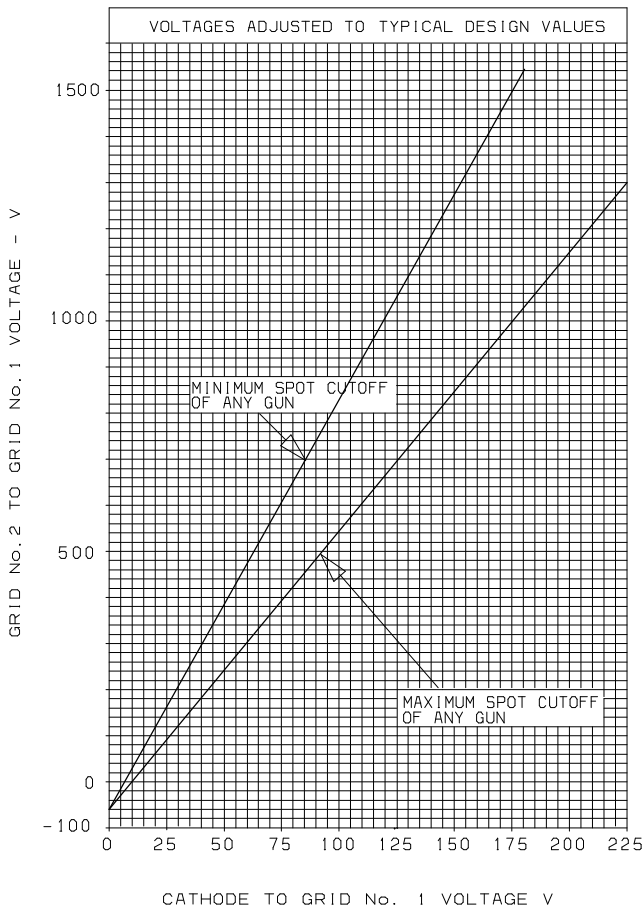


Fig. 4 – Cutoff Design Chart

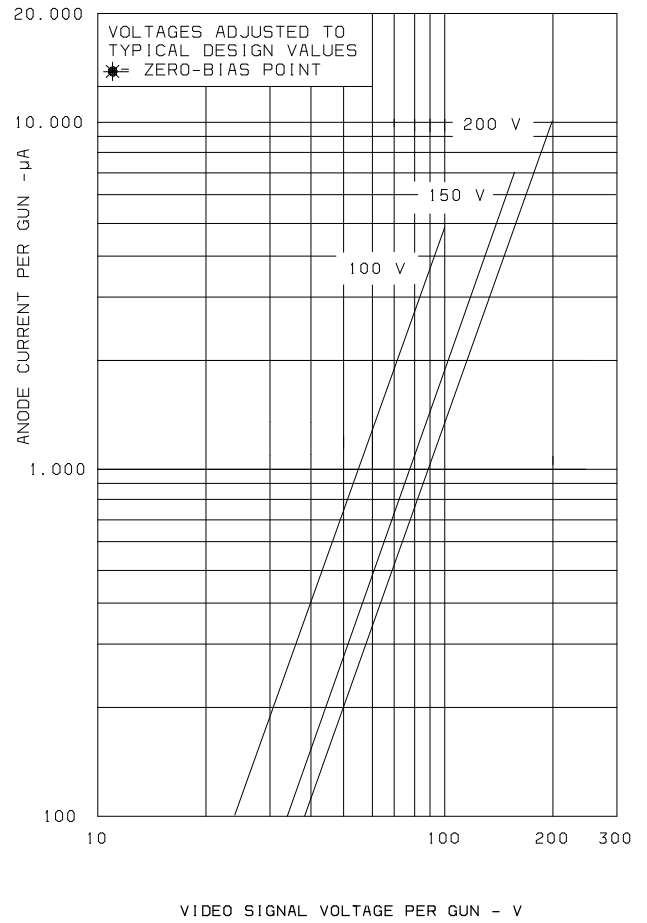


Fig. 5 – Typical Drive Characteristics, Cathode – Drive Service

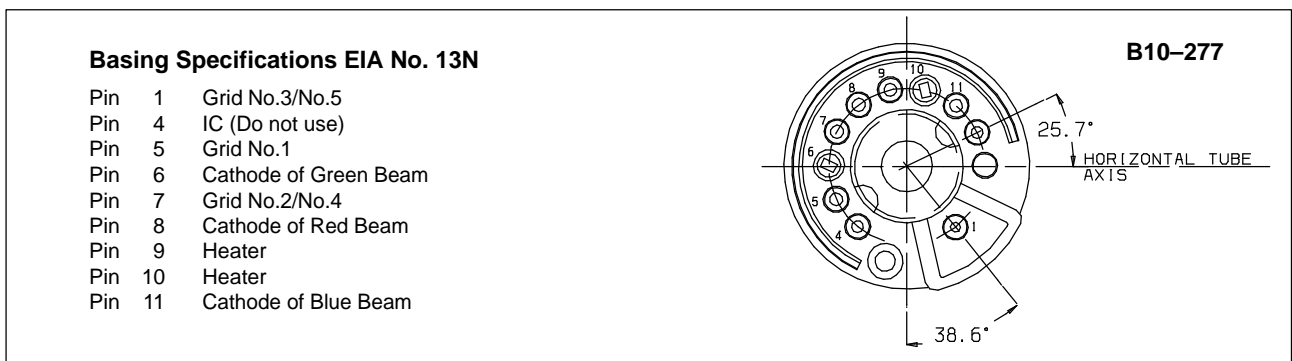
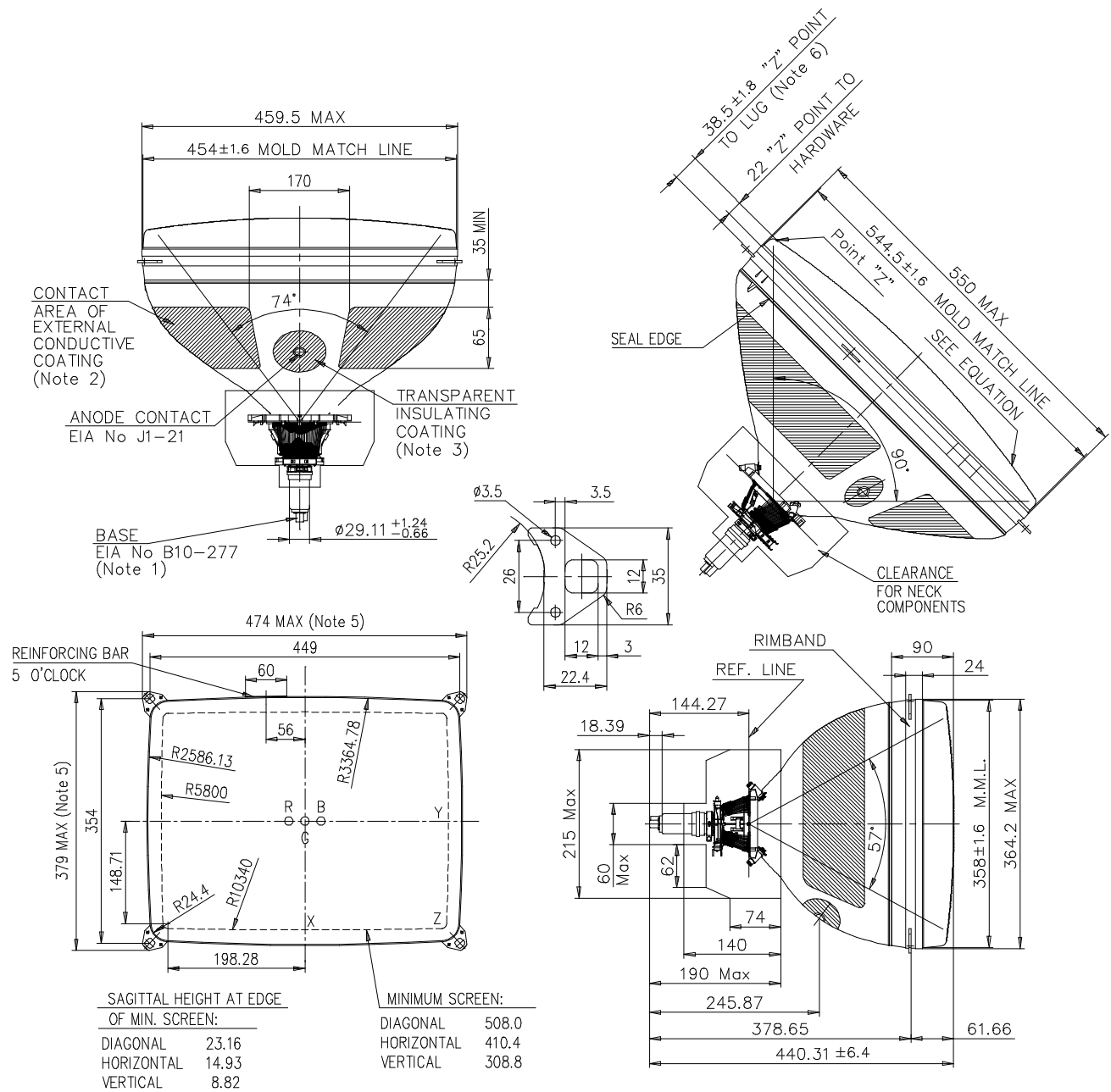


Fig. 6 – Pin Connections and Rear View of Base

Z = 3.943232E-4 X<sup>1.98</sup> + 2.875336E-4 Y<sup>2.05</sup> - 1.72431E-8 X<sup>1.37909</sup> Y<sup>2.11068</sup> + 2.112062E-14 X<sup>3.9777</sup> Y<sup>2.05845</sup>



**Notes For Dimensional Outline**

- Note 1 – Socket for the base should not be rigidly mounted: it should have flexible leads and be allowed to move freely.
- Note 2 – The drawing shows the size and location of the contact area of the external conductive coating. The actual area of this coating will be greater than that of the contact area so as to provide the required capacitance. External conductive coating must be connected to chassis with multiple contacts.
- Note 3 – To clean the faceplate, wipe only with soft, dry, lintless cloth.
- Note 4 – "X", "Y", "Z" reference points are located on the outside surface of the faceplate at the intersection of the minimum published screen with the minor, major and diagonal axes, respectively.

- Note 5 – The tolerance of the mounting lug holes will accommodate mounting screws up to 8.5 mm in diameter when the screws are positioned on the hole centers.
- Note 6 – One of four brackets may deviate 1.5 mm max. from the plane of the other three.
- Note 7 – To facilitate cabinet design full size drawings and mechanical sample tubes are available on request.

### Convergence and purity

The yoke and other neck components are preassembled on the tube and factory preset for optimum performance.

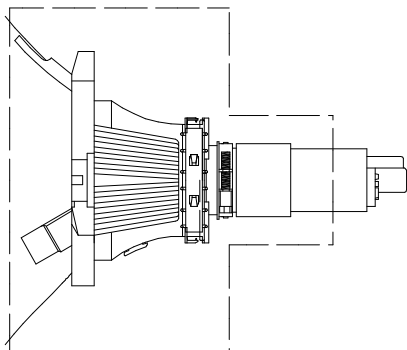
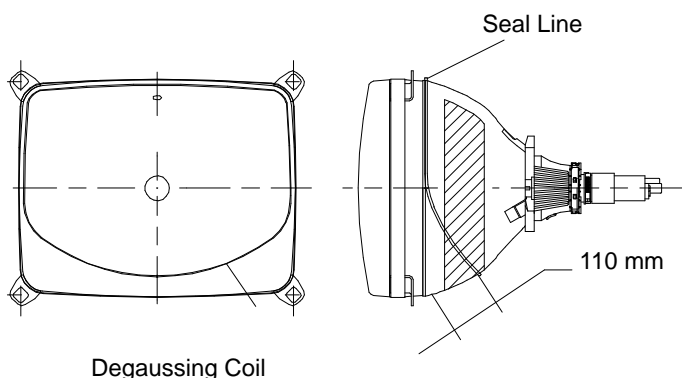


Fig. 7 – Neck Component Detail

### Degaussing Coils

The recommended degaussing system utilized a single coil placed on the tube as shown in figure 8 with the top edge on the panel in front of the seal line and the bottom edge on the funnel about 50 mm behind the seal line. Small holes are provided in the four mounting lugs to facilitate mounting the degaussing coil to the tube funnel.



Coil circumference = 1380 approx.

Fig. 8 – Relative Placement of Typical Degaussing Coil

### Degaussing Circuit

A recommended degaussing circuit as shown in figure 9 uses a conventional dual PTC device. For proper degaussing, a minimum value of 1400 peak to peak ampere turns is required. It is essential that the degaussing current reduces in a gradual manner to a quiescent level not exceeding 1.0 peak to peak ampere turns. For optimum performance the degaussing coils should always be connected to a very low source impedance at the horizontal frequency. If the circuit used does not have an inherent low impedance at the horizontal frequency, the degaussing coils should be shunted with a suitable capacitor. If the addition of a short across the coils increases the horizontal frequency current in the degaussing coils by more 20%, the inherent source impedance offered by the PTC and associated circuitry is indicated to be too high to provide satisfactory performance. Therefore a capacitor should be added across the degaussing coil to satisfy this requirement.

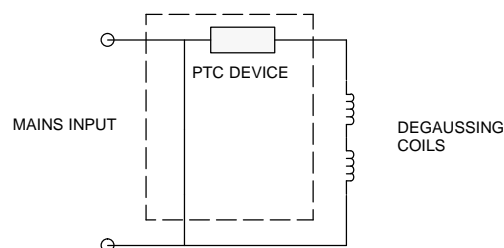


Fig. 9 – Typical Degaussing Circuit

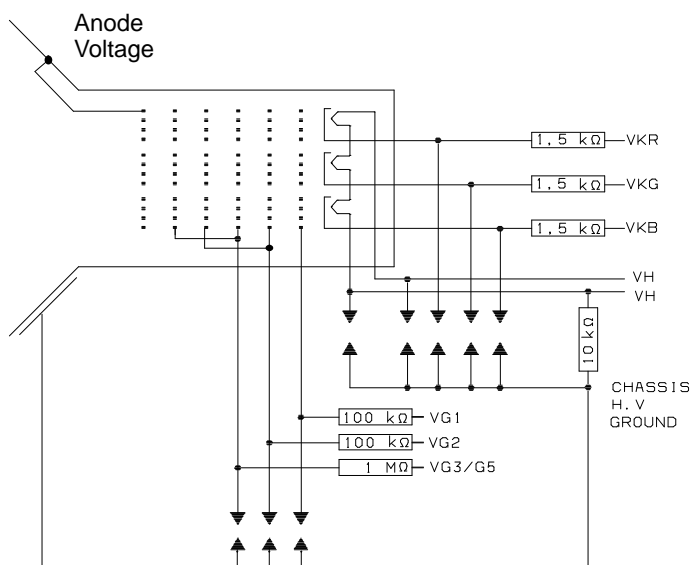
### Degaussing Procedures

After installation of the picture tube into the receiver cabinet on the production line, the complete receiver should be externally degaussed by a minimum degaussing field of 20 gauss at center of the coil. During the external degaussing, the receiver should be in an "off" condition or in an "on" condition with the vertical scan removed and the mains input to the internal degaussing circuit disconnected. In this latter case, the internal degaussing circuit must be reconnected after the external degaussing process is completed. The external degaussing procedure should be followed by the receiver's internal degaussing in the normal manner.

### High Voltage Discharge Protection

High internal resistance in the picture tube has significantly reduced the peak energy during a high-voltage discharge. In spite of these significant gains, high-voltage discharge is still capable of starting ionized paths both internal and external to the tube that can couple high-energy lower-voltage sources to the picture tube and associated circuit elements. These high-energy sources can cause varying degrees of picture tube and circuit damage. With any color picture tube, product reliability is obtained by the use of spark gaps with proper grounding, series isolation resistors, and good printed circuit board layouts. Spark gaps to ground shall be connected to all socket contacts. The ground points for the G3 focus electrode spark gap and the low-voltage spark gaps should be connected with a heavy non-inductive strap to a good grounding contact on the picture tube external coating. The focus electrode spark gap should be designed to breakdown at a minimum DC value of 1.5 times the maximum design voltage of G3 control.

The low-voltage spark gaps should be designed for a DC breakdown voltage of 1.5 kV to 3.0 kV. The high-voltage circuit chassis ground point should be connected to the low-voltage spark gap ground at the picture tube socket. It is not recommended that any other connections be made between the picture tube external coating and the grounds of the main chassis or the spark gaps. This will minimize circulating currents in the chassis during high-voltage discharge. Isolation resistors should be used in series with each grid and cathode lead. The resistance values should be as high as possible without degrading circuit performance (see figure 10). These resistors should be capable of withstanding an application of 12 kV for the low-voltage circuits and 20 kV for the focus circuit



**Fig. 10 – Picture Tube Connections Showing Spark-Gaps Recommendations and Typical Isolation-Resistor Values**

without arcing over, arcing through the body, or changing in resistance significantly during repeated applications of these voltages. Most half-watt carbon composition resistors are suitable for the low-voltage circuits and most 1-watt carbon composition resistors are suitable for the focus circuit. The use of these resistors reduces the possibility of circulating currents in the chassis and excessive current in the picture tube elements.

Spark gaps should be connected to both heater socket contacts. These spark gaps should have the same characteristics as the other low-voltage spark gaps. When the heater voltage is supplied from an isolated source, such as the horizontal deflection circuit or some other high-frequency pulse source, a capacitor may be required between one side of the heater and ground to eliminate undesirable interference on the picture tube screen. The capacitance value should be kept as small as possible. The resistance between the heater circuit and any power source should be a minimum of 10 kΩ.

## WARNING

### X – Radiation

These color picture tubes do not emit X-radiation above the dosage rate of 0.1 mR/h if it is operated within the Absolute Maximum Ratings.

### Implosion Protection

These picture tubes employ integral implosion protection and must be replaced with tubes of the same type number or a recommended replacement to assure continued safety.

### Shock Hazard

The high voltage at which the tubes are operated may be very dangerous. Design of the TV receiver should prevent the user from coming in contact with the high voltage. Extreme care should be taken in the servicing or adjustment of any high voltage circuit. Caution must be exercised during the replacement or servicing of the picture tube since a residual electrical charge may be contained on the high voltage capacitor formed by the external and internal conductive coatings of the picture tube funnel. To remove any undesirable residual high-voltage charge from the picture tube, "bleed-off" the charge by shorting the anode contact button, located in the funnel of the picture tube, to the external conductive coating before handling the tube. Discharging the high voltage to isolated metal parts such as cabinets and the control brackets may produce a shock hazard. Contact to the external conductive coating should be made by multiple fingers to prevent possible damage to the tube from localized overheating due to poor contact.

### Mounting

Integral mounting lugs are provided to facilitate mounting the A51EBV13X01 in the receiver. If the integral mounting system is accessible in the receiver it is recommended that it be connected to the receiver chassis through one of the mounting lugs. If the chassis is not at earth potential the connection should be made through a current limiting resistor (1M Ω).

The color receiver mounting system should incorporate sufficient cushioning so that under normal conditions of shipment or handling an impact force of more than 35 g is never applied to the picture tube.

### Tube Handling

Picture tubes should be kept in the shipping box or similar protective container until just prior to installation. Wear heavy protective clothing, including gloves and safety goggles with side shields, in areas containing unpacked and unprotected tubes to prevent possible injury from flying glass in the event a tube breaks. Handle the picture tube with extreme care. Do not strike, scratch or subject the tube to more than moderate pressure. Particular care should be taken to prevent damage to the seal area. The picture tube assembly should never be handled by the neck, yoke or other components.

### General

It is the sole responsibility of the manufacturer of television receivers and other equipment utilizing this color picture tube assembly to provide protective circuitry and design in the event of failure or this color picture tube assembly.

**The equipment manufacturer should provide a warning label in an appropriate position on the equipment to advise the serviceman of all safety precautions.**