THOMSON MULTI MEDIA
THOMSON TUBES & DISPLAYS

DATA SHEET

A51EFS13X191
Color Picture Tube

90° Deflection O.T. – 51 cm (20 V)
Medium Planar Color Picture Tube Assembly

- **Yoke and Neck Components Factory Adjusted for Northern Hemisphere**
- **Saddle/Toroidal Yoke**
  Lower Deflection Power
  Fully Pincushion Corrected
- **FS – Full Square – Straight Sides and Square Corners**
- **COTY-M-XL Multi-Element Focus Precision In-Line Gun – Optimized Beam-Forming Region for Excellent Focus Uniformity and Improved Resolution**
- **29.1 mm Neck Diameter**
- **Excellent Convergence Performance**
- **Other Features:**
  - **Matrix Contoured-Line Screen**
  - **Internal Magnetic Shield**
  - **Super-Arch Mask**
  - **Soft-Arc Technology**
  - **Integral Mounting Lugs**

The A51EFS13X191 is a 51 cm (20V) 90_ MP OT Color Picture Tube Assembly. It features a new dark-glass faceplate for improved contrast. The yoke provides full correction for pincushion distortion. All neck components are assembled on the tube and factory adjusted for optimum performance.
This tube also features a Super Arch Mask to maintain color purity.
The multi element focus precision in-line electron gun features an expanded diameter lens (XL) and increased beam spacing. The expanded lens field encompasses all three beams and when combined with the fields from the individual apertures, it produces a superior lens for focus performance with less aberrations than a standard gun. In this case the neck diameter, not the beam spacing, limits the focusing ability. Convergence performance has been improved by reducing the beam spacing.

Picture Tube Data

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	

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Optical Data

Faceplate:
- Light transmittance at center (approx.) . . . . . 50.5 %
- Surface . . . . . Polished

Screen:
- Matrix . . . . . Black Opaque Material
- Type . . . . . Negative Guard Band

Phosphor, rare – earth (red), sulfide (blue & green) . . . . . 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.) . . . . . 0.79 mm

Mechanical Data

Tube dimensions:
- Overall length . . . . . 438.14 ± 6.4 mm
- Reference Line to center of face . . . . . 294.50 ± 4.8 mm
- Neck length . . . . . 143.64 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^2

Bulb Funnel Designation . . . . . EIA No. J542

Bulb Panel Designation . . . . . EIA No. F545

Anode Bulb Contact Designation . . . . . EIA No. J121

Base and Pin Connection Designation [1] . . . . . 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.) . . . . . 15.2 kg

Implosion Protection

Type . . . . . Shrink–fit Rimband

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 . . . . . 29.5 kV max.
22.0 kV min.

Anode Current Long-Term Average . . . . . 1000 µA max.

Grid No. 3 & 5 (focusing electrode) Voltage . . . . . 12 kV max.

Peak Grid No. 2 & 4 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: [2]
- 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:
- Heather 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 . . . . . 26 to 30 % of Anode Voltage

Grid No. 2 & 4 Voltage for Visual Extinction of Undeflected Focused Spot . . . . . .See CUT OFF DESIGN CHART in **Fig. 4**
- At cathode voltage of 100 V . . . . . 160 to 365 V
- At cathode voltage of 150 V . . . . . 250 to 550 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 [2] . . . . . 6.3 V

Grid No. 3 & 5 Current [4] . . . . . ± 2 µA

Grid No. 2 & 4 Current . . . . . ± 2 µA

Grid No. 1 Current . . . . . ± 2 µA

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 . . . . . 32 %
- Blue . . . . . 31 %
- Green . . . . . 37 %

Ratio of cathode currents:
- Red/Blue:
  - Minimum 0.95
  - Typical 1.20
  - Maximum 1.45
- Red/Green:
  - Minimum 0.81
  - Typical 1.06
  - Maximum 1.31
- Blue/Green:
  - Minimum 0.68
  - Typical 0.88
  - Maximum 1.08

Raster Centering Displacement Measured at Center of Screen [3]
- Horizontal . . . . . 0.0 ± 4.0 mm
- Vertical . . . . . 0.0 ± 4.0 mm

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Deflection Yoke Data

Typical Yoke Design Values (at 27.5 kV)

Peak Pulse Voltage
Across Horizontal Coils ..... 1400 V max.
Horizontal Retrace Time ..... 11.0μsec min.
Care must be exercised when designing the deflection circuits so that the Absolute-Maximum peak pulse voltage is never exceeded.

Typical Yoke Design Values (at 27.5 kV)

Yoke Type 51H1QRZ
Horizontal Deflection Coils:
Parallel-Connected:
Inductance at 1 V rms and 1 kHz ..... 2.00 ± 4 % mH
Resistance at 25 °C ..... 2.30 ± 7 % Ω
Typical operation with edge-to-edge scan at 25.0 kV:
Peak-to-peak deflection current ..... 2.87 A
Vertical Deflection Coils:
Series-Connected:
Inductance at 1 V rms and 1 kHz ..... 23.0 ± 7 % mH
Resistance at 25 °C ..... 10.0 ± 7 % Ω
Typical operation with edge-to-edge scan at 25.0 kV:
Peak-to-peak deflection current ..... 1.11 A
Pincushion [5]
East / West ..... Free
North / South ..... Free

Yoke Connector

This tube is supplied without yoke connectors or lead harness assembly.

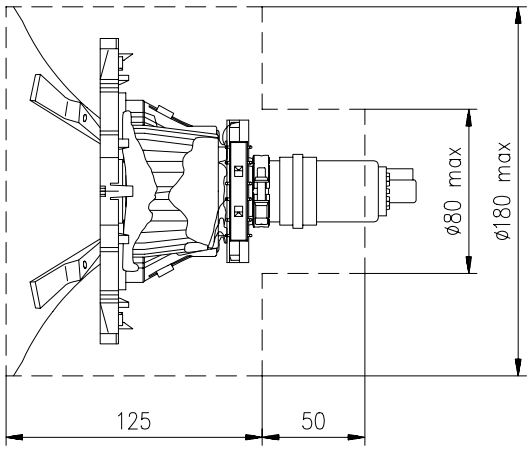

Fig. 1 - Safety Area Of Deflection Yoke

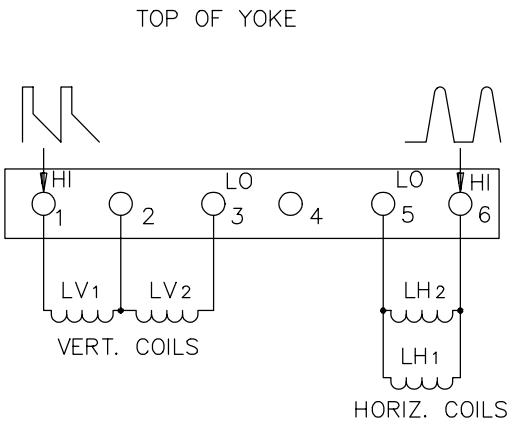

Fig. 2 - Connection Diagram For Yoke (as viewed from rear of yoke)

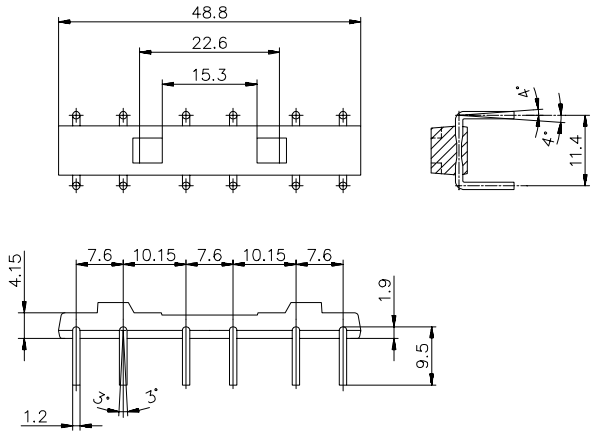

Fig. 3 - Yoke Terminal Board

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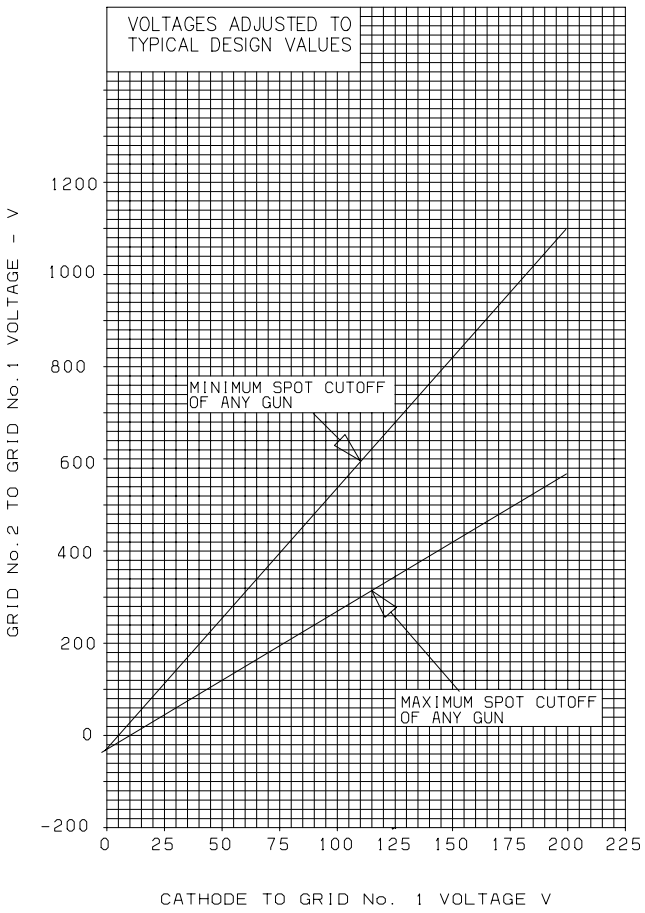
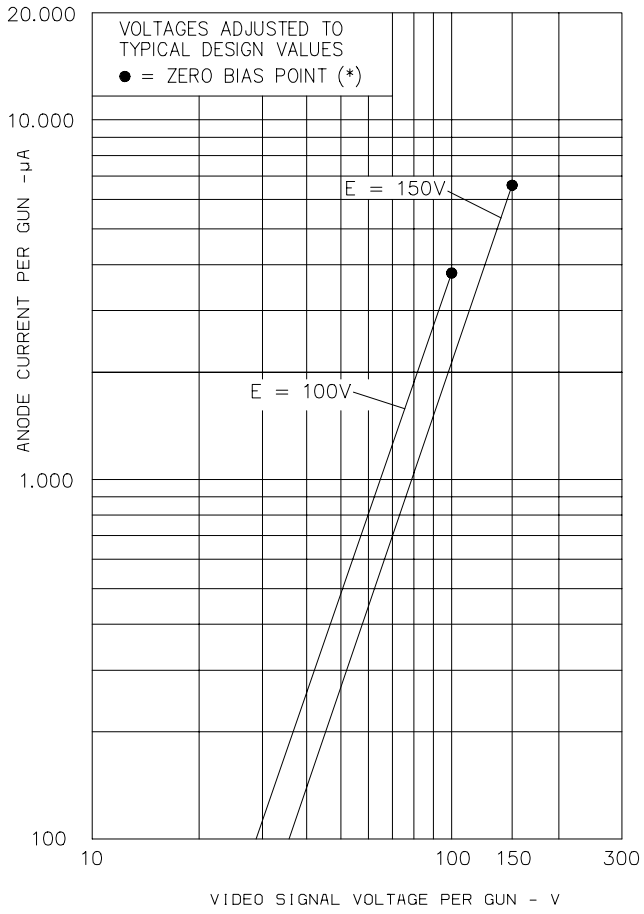


Fig. 4 - Cutoff Design Chart



* Under normal operating conditions, the cathode voltages should not go within 10 volts relative to the Grid No. 1.

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

1. For mating socket considerations, see Note 1 under Notes for Dimensional Outline.
2. For maximum tube life, the heater supply voltage should be regulated to minimize heater voltage changes due to variations in line voltage, beam current, and other parameters. The heater voltage should be 6.3 V (within a measurement accuracy of ± 0.1 V).

   Cost considerations may suggest that the heater voltage be obtained from an unregulated source. If this option is chosen and the unregulated voltage varies with beam current, the circuit parameters should be selected so that the heater voltage is 6.3 V (within a measurement accuracy of ± 0.1 V) when the beam current is one-half of the Long-Term Average Anode Current as shown in the tabulated data. The operating conditions should be such that the Absolute-Maximum and Minimum Ratings can never be exceeded when including all variations. Long-term operation at or near the Absolute-Maximum limit will substantially reduce tube life.

   For specific considerations, consult your TMM representative.
3. Measurements are taken with the tube operating with recommended components and procedures, and in a magnetic field having a +420 mG vertical component and a zero cross-axial horizontal component.
4. A high source impedance in the focus circuit can result in a change in the focus voltage with a change in the grid No. 3 leakage current.
5. Measured in accordance with IEC Recommendation - Publication 107 - Recommended Methods of Measurement on Receivers for Television Broadcast Transmission.

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X-Radiation Characteristics

Operating within the absolute maximum rating,these color picture tubes do not emit X-Radiation above the international accepted dosage rate of the new German regulation (1 μSv/h at 10 cm from the glass).

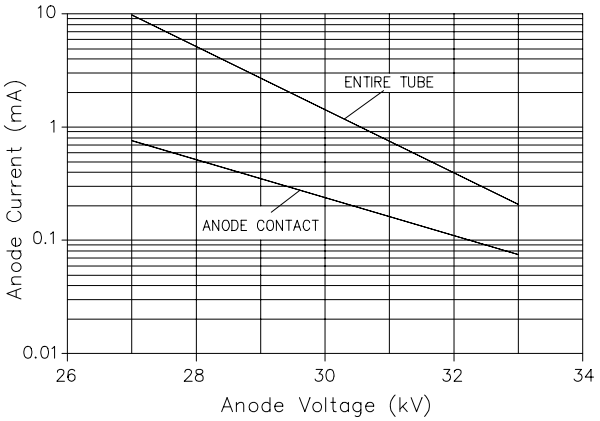

Fig. 6 - 0.1 mR/h Isoexposure - Rate Limit Curves

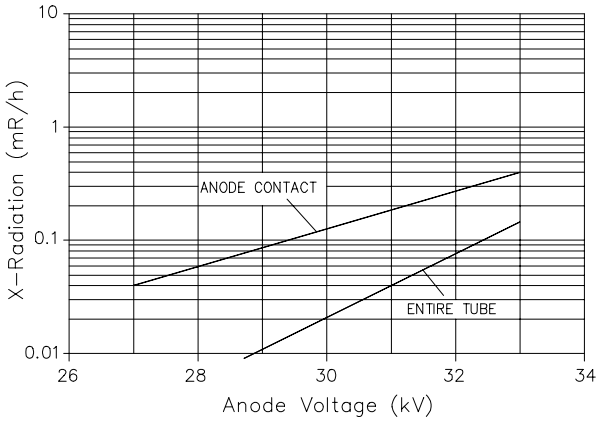

Fig. 7 - X-Radiation Limit Curves at a Constant Anode Current of 300 μA (X-radiation at a constant anode voltage varies linearly with anode current)

Basing Specifications EIA No. 13N

Pin	1	Grid No.3/5
Pin	4	IC (Do not use)
Pin	5	Grid No.1
Pin	6	Cathode of Green Beam
Pin	7	Grid No.2/4
Pin	8	Cathode of Red Beam
Pin	9	Heater
Pin	10	Heater
Pin	11	Cathode of Blue Beam

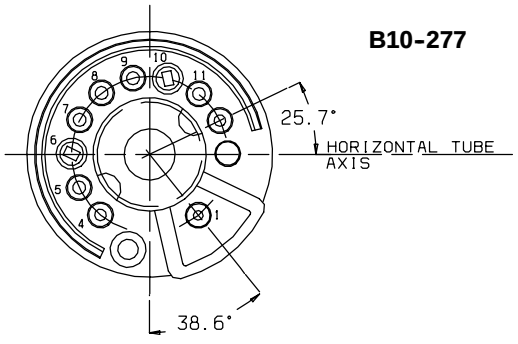

Fig. 8 - Pin Connections and Rear View of Base

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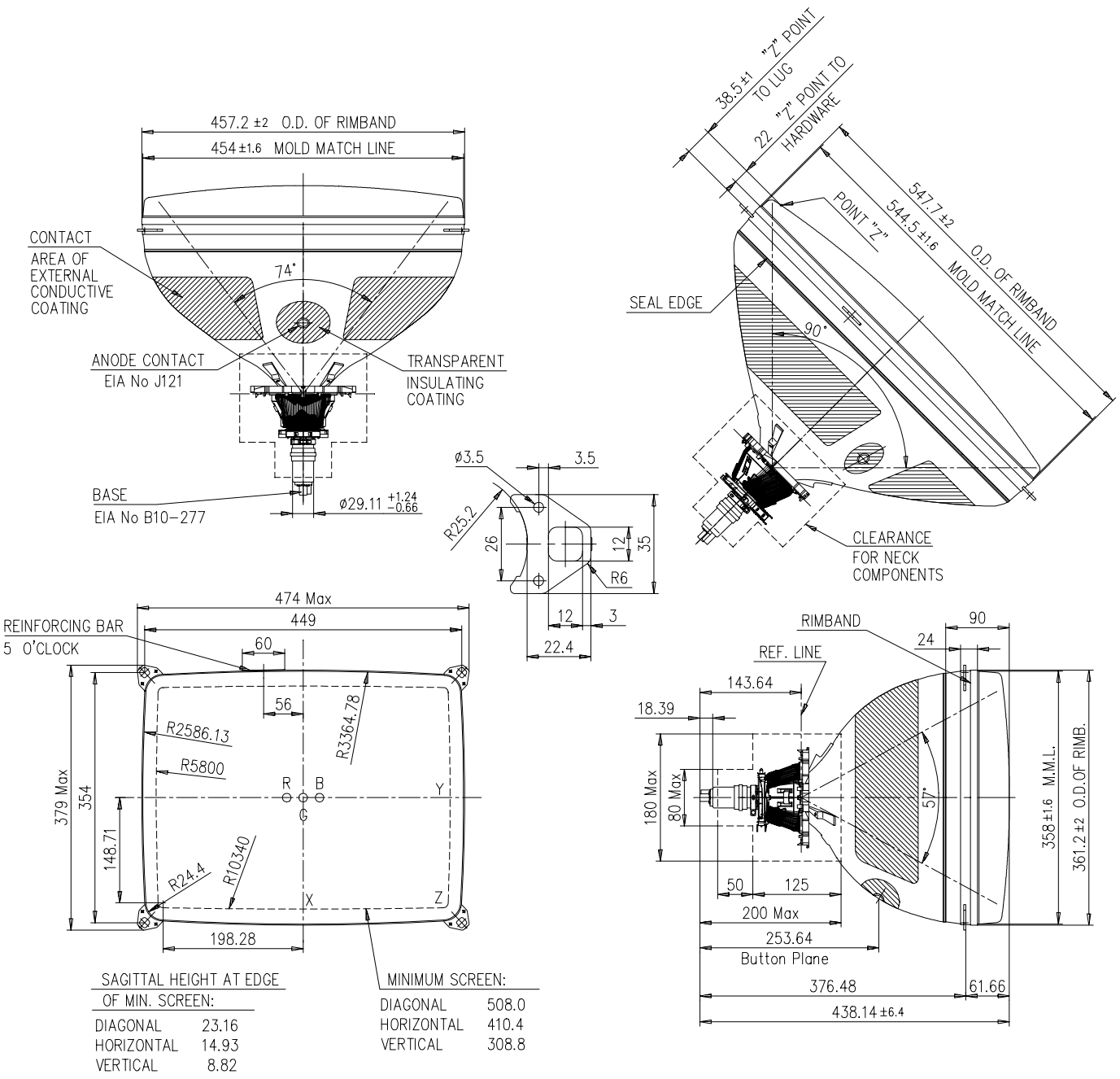

SAGITTAL HEIGHT AT EDGE OF MIN. SCREEN:

DIAGONAL	23.16
HORIZONTAL	14.93
VERTICAL	8.82

MINIMUM SCREEN:

DIAGONAL	508.0
HORIZONTAL	410.4
VERTICAL	308.8

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 – "Z" is located on the outside surface of the faceplate on the screen diagonal at the edge of the minimum published screen. This point is used as a reference for the mounting lugs.

Note 4 – None of the four mounting lugs will deviate from the plane of the other three by more than 1.5 mm.

Note 5 – These dimensions locate the true geometric hole centers for the mounting screws in the receiver. The tolerance of the tube mounting lug holes will accommodate mounting screws up to 8.5 mm in diameter when the screws are positioned at these locations.

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WARNING

X-radiation - This color picture tube incorporates integral x-radiation shielding and must be replaced with a tube of the same type number or a replacement type recommended by Thomson to assure continued safety.

Operation of this color picture tube at abnormal conditions which exceed the 0.5 mR/h isoexposure-rate limit curves shown in **Fig. 6** may produce soft X rays and may constitute a health hazard by prolonged exposure at close range unless adequate external x-radiation shielding is provided. Therefore, precautions must be exercised during servicing of TV receivers employing this tube to assure that the anode voltage and other tube voltages are adjusted to the recommended values so that the Absolute-Maximum Ratings will not be exceeded.

Implosion Protection - This picture tube employs integral implosion protection and must be replaced with a tube of the same type number or a replacement type recommended by Thomson Multimedia to assure continued safety.

Shock Hazard - The high voltage at which the tube is operated may be very dangerous. Design of the TV receiver should include safeguards to 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 charges from the picture tube, “bleed off” the charge by shorting the anode bulb contact, 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 control brackets may produce a shock hazard. Also see **Tube Mounting** on page 9.

Tube Handling - Keep picture tubes 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 panel-to-funnel seal.

It is the sole responsibility of the manufacturer of television receivers and other equipment utilizing this color picture tube to provide appropriate design and circuitry that will limit the possible effects of failure of the color picture tube.

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

Receiver Design Criteria

Magnetic Shield and Degaussing

An internal magnetic shield is provided in this tube. When properly degaussed, this shield in conjunction with the shadow-mask assembly provides compensation for the effects of the earth’s magnetic field on the electron beams. After installation of the picture tube into the receiver cabinet, it is recommended that the picture tube be externally degaussed by a minimum degaussing field of 20 gauss measured at the faceplate of the tube. The external degaussing procedure should be followed by the receiver’s internal degaussing in the normal manner. It is recommended that this take place in a magnetic field having a +420 mG vertical component and a zero horizontal component. If this field is not available, it is essential that the tube be degaussed in the specific earth’s magnetic field (strength and orientation) in which it is to be evaluated. Both the external degaussing and the receiver’s internal degaussing must be performed with no vertical scan present. Proper degaussing will assure satisfactory performance for color field purity.

Degaussing Coils

The recommended degaussing system utilized a single coil placed on the tube as shown in **Fig. 9** with the top edge on the panel in front of the seal line and the bottom edge on the funnel about 110 mm behind the seal line. Small holes are provided in the four mounting lugs to facilitate mounting the degaussing coil to the tube funnel.

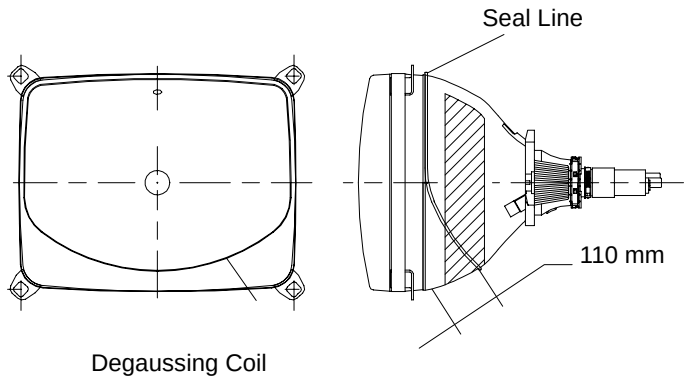

Fig. 9 - Relative Placement of Typical Degaussing Coil

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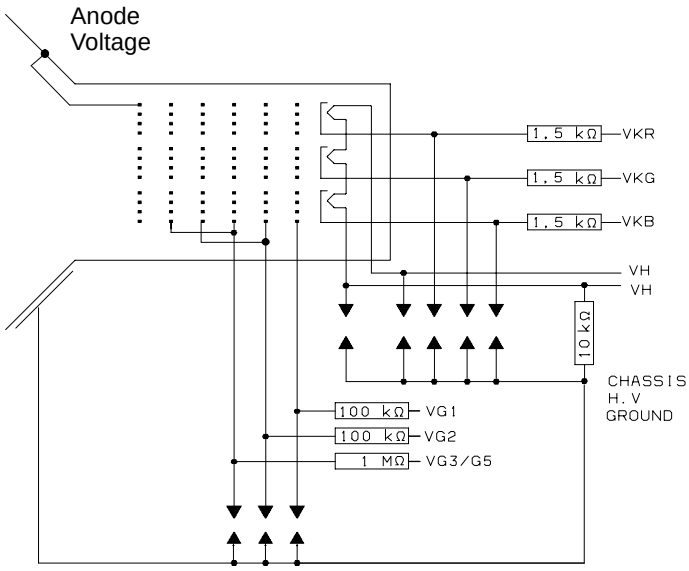
Degaussing Circuit

The degaussing circuit should provide a minimum of 800 peak-to-peak ampere-turns (AT) in the degaussing coil(s). This current must decay in a gradual manner such that at least 50% of the initial amplitude still flows after 5 cycles. In addition, at the completion of the degaussing cycle the residual current in the coil(s) must not exceed 1.0 peak-to-peak AT.
With any degaussing circuit it is necessary to eliminate interactions which occur between the deflection yoke fields and the degaussing coil(s). The induced current can be minimized by careful positioning of the degaussing coil(s). For this reason, and in order to achieve optimal degaussing recovery, coil placement should follow the recommendations shown in **Fig. 9** This will provide a minimum distance of 45 mm measured from the yoke. If the level of the induced horizontal frequency current is not reduced to an acceptable level by coil positioning, the degaussing coils should be shunted with a suitable capacitor.

High Voltage Discharge Protection

The high-resistance internal coating incorporated in soft-arc picture-tube significantly reduces the peak energy during a high-voltage discharge. In spite of this and other improvements, high-voltage discharges are still capable of initiating ionized paths, both internal and external to the tube, that can couple high-energy low-voltage sources to the picture tube and associated circuit elements. These high-energy sources can cause varying degrees of picture-tube and/or circuit damage.With any color picture tube, maximum product reliability is obtained through the use of spark gaps with proper grounding, series isolation resistors, and good printed circuit board layouts. Spark gaps to ground should be connected to all socket contacts except as noted below for the heater circuits. The ground points for the focus-electrode spark gap and the low-voltage spark gaps should be connected with a heavy noninductive strap to a good grounding contact on the picture-tube external conductive coating. The focus-electrode spark gaps should be designed to break down at a dc value of approximately 1.5 times the maximum design voltage of the focus circuit. The low-voltage spark gaps should be designed for a dc breakdown voltage of 1.5 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. 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 **Fig. 10**).



* If a G_1 bias voltage source is used, the isolation resistor and spark gap is required. Direct grounding of the G_1 to the low voltage spark gap ground at the tube socket is permissible. In this case, a G_1 spark gap is not required.

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

These resistors should be capable of withstanding an instantaneous application of 12 kV for the low-voltage circuits and 20 kV for the focus circuit without arcing over, arcing through the body, or significantly changing in resistance value during repeated applications of these voltages. Most half-watt carbon composition resistors are suitable for the low-voltage circuits and most one-watt carbon composition resistors are suitable for the focus circuit. Use of these resistors reduces the possibility of circulating currents in the chassis and excessive currents in the picture-tube elements.For best reliability, the heater circuit should be isolated from chassis ground and/or voltage sources by a minimum resistance of 10 kΩ. 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 another 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. If a capacitance value in excess of 0.01 μF is required, the spark gaps to the heater leads should not be used.Very reliable performance can also be obtained with nonisolated heater circuits. In these cases, only the high side of the heater circuit needs a spark gap. Printed circuit board and socket designs which inherently provide spark gaps for both heater leads are also satisfactory.

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Tube Mounting

Integral mounting lugs are provided to facilitate mounting the picture tube in the receiver. To prevent a possible shock hazard, it is recommended that the integral mounting lugs and other metal hardware of the tube be connected to the receiver chassis through one of the mounting lugs. If the chassis is not at ground potential, the connection should be made through a 1 MΩ current-limiting resistor. The mounting system and other receiver hardware should not place mechanical stress on, or cause abrasion of, the tube; particularly to the panel-to-funnel seal.

The TV receiver mounting system should incorporate sufficient cushioning so that under conditions of shipment or handling, forces applied to the picture tube should not create accelerations greater than 35 g.

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