A51EKF012X001

DATA SHEET **Color Picture Tube**

90° Deflection – 51 cm (21 V)
True Flat Color Picture Tube Assembly

- **Yoke and Neck Components preset for Northern Hemisphere**
- **4/3 Aspect Ratio**
- **True Flat Faceplate Shape**
- **Straight Sides and Squared Corners**
- **Dark-Glass Faceplate for Improved Contrast**
- **Invar Mask for Improved Doming and Blister Performance**
- **VECTOR "Multi Element Focus Grid" Optimized for:**
  - **Excellent Focus Uniformity**
  - **Improved Resolution**
- **Saddle/Toroidal Yoke**
  -N/S Pincushion Free
- **29.1 mm Neck Diameter**
- **Excellent Convergence Performance**
- **Other Features**
  - **Matrix Line Screen**
  - **Internal Magnetic Shield**
  - **Soft-Arc Technology**
  - **Integral Mounting Lugs**

The A51EKF012X001 is a 51 cm (21V) 90° TF Color Picture Tube Assembly. It features a True Flat dark-glass faceplate. This tube is designed for both 525 and 625-line operation. The TF screen edges are straight and form square corners – a true rectangle.
This tube also features an Invar Mask to minimize warpage and to assure color purity under high drive conditions.

Other feature is a multi-element focus electron gun with dynamic beam forming which results in a more uniform center-to-edge spot size. This gun also incorporates an expanded diameter lens with increased beam spacing. The expanded lens field encompasses all three beams. When combined with the fields from the individual apertures, the increased beam spacing produces a superior lens for improved focus performance with less aberrations than a standard gun.

All neck components are assembled on the tube and factory adjusted for optimum performance

Picture Tube Data

Electrical Data

Heater:		
Voltage	6.30	V
Current	700	mA
Focusing Method	Electrostatic	
Focus Lens	Multi-Element	
Convergence Method	Magnetic (Preadjusted)	
Deflection Angles (approx.):		
Diagonal	90	deg
Horizontal	76	deg
Vertical	61	deg
Direct Interelectrode Capacitances (approx.):		
Grid no. 1 to all other electrodes	11	pF
Grid nos. 3 & 5 to all other electrodes	10	pF
Each cathode to all other electrodes	5.0	pF
All cathodes to all other electrodes	12	pF
Capacitance Between Anode and External Conductive Coating (including metal hardware):	1500 min.	pF
Resistance Between Metal Hardware and External Conductive Coating	50 min.	MΩ
Magnetic Shield	Internal	

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Optical Data

Faceplate:
- Light transmittance at center (approx.) ...... 51 %
- Surface Treatment ...... Polished

Screen ...... Matrix
- Phosphor, rare-earth (red), sulfide (blue & green) ...... Type X
  - Persistence ...... Medium Short
- Array ...... Vertical Line Trios
- Spacing between corresponding points on line trios at center (approx.), ... 0.74 mm

Mechanical Data

Tube Dimensions:
- Overall length. ...... 427.14 ± 6.4 mm
- O.D. at shrinkband:
  - Diagonal (includes lugs) ...... 556.3 max mm
  - Diagonal (excludes lugs) ...... 551.3 max mm
  - Horizontal ...... 461.1 max mm
  - Vertical ...... 365.4 max mm
- Minimum screen dimensions (projected):
  - Diagonal ...... .506.00 mm
  - Horizontal ...... 404.80 mm
  - Vertical ...... 303.60 mm
  - Area ...... 1229 sq cm

Anode Bulb Contact Designation ...... EIA No. J1-21

Base and Pin Connection Designation [1] ...... EIA No. B10-277

Pin Position Alignment ...... Space Separating Pins 10 and 11 Aligns Approx. with Anode Bulb Contact

Operating Position, Preferred ...... Anode Bulb Contact on Top

Gun Configuration ...... Horizontal In Line

Weight (approx.) ...... 17 kg

Implosion Protection

Type ...... Shrink–fit rimband

Maximum and Minimum Ratings, Absolute-Maximum Values

Absolute-Maximum Ratings are specified for reliability 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:			
Maximum value	32.0		kV
Anode Current:			
Long-Term Average	1300	max.	µA
Short-Term Average	1800	max.	µA
Grid-Nos. 3 & 5 (focusing electrode) Voltage	12	max.	kV
Peak Grid-Nos. 2 Voltage	1850	max.	V
Cathode Voltage:			
Positive bias value	400	max.	V
Positive operating cutoff value	200	max.	V
Negative bias value	0	max.	V
Negative peak value	2	max.	V
Heater Voltage: [3]			
AC (rms) or DC:			
Maximum value	6.6		V
Minimum value	5.7		V
Peak pulse value	50	max.	V
Surge value, during 15-second warm-up period (rms)	9.5	max.	V
Heater-Cathode Voltage:			
Heater negative with respect to cathode:			
During equipment warm-up period not exceeding 15 seconds	450	max.	V
After equipment warm-up period:			
DC component value	300	max.	V
Peak value	350	max.	V
Heater positive with respect to cathode:			
DC component value	100	max.	V
Peak value	200	max.	V

Typical Design Values

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

Anode voltage at zero beam ...... 28 kV

Grid-Nos. 3 & 5 (focusing electrode) Voltage. ...... 27 to 31% of Anode Voltage

Grid-Nos. 2 & 4 Voltage for Visual Extinction of Undeflected Focused Horizontal Line ...... See CUTOFF DESIGN CHART in **fig.5**
- At cathode voltage of 150 V ...... 600 to 1200 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 line cutoff) 1.15

Heater Voltage [3] ...... 6.3 V

Grid-Nos. 3 & 5 Current ...... ± 2 µA

Grid-Nos. 2 & 4 Current ...... ± 2 µA

Grid-No. 1 Current ...... ± 2 µA

Circuit Recommendation

High source impedance in the focus and/or screen grid circuits can result in changes in focus and screen grid voltage with small changes in leakage current. To avoid these effects, the following limits are recommended:

Screen Resistance G_2/G_4 ...... ≤ 5 M Ω

Focus Resistance G_3/G_5 ...... ≤ 70 M Ω

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 ...... 35 %
  - Blue ...... 29 %
  - Green ...... 36 %
- Ratio of cathode currents:
  - Red/blue:
    - Minimum 0.95
    - Typical 1.20
    - Maximum 1.45
  - Red/green:
    - Minimum 0.80
    - Typical 1.00
    - Maximum 1.20
  - Blue/green:
    - Minimum 0.65
    - Typical 0.85
    - Maximum 1.05

Raster Centering Displacement Measured at Center of Screen: [4]
- Horizontal ...... 0 ± 4.0 mm
- Vertical ...... 0 ± 4.0 mm

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Deflection Yoke Data

Maximum Ratings, Absolute-Maximum Values

Peak Pulse Voltage
Across Horizontal Coils . . . . .1400 max. V
Horizontal Retrace Time . . . . 11.0 μ sec min.

Care must be exercised when designing the deflection circuits so that the Absolute-Maximum peak pulse voltage is never exceeded.

Yoke Temperature Limitations [5]

Maximum temperature at any point on yoke . . . . 105 _C
Yoke temperature rise at typical operating conditions
5% Overscanning in time with anode at 28 kV
Horizontal deflection rate . . . . 15.6 kHz
Horizontal retrace time . . . . 11.5 μ sec
Yoke temperature rise at hottest location on yoke . . . . 30_C
Referenced to ambient air (measured 25 mm below yoke)

Typical Yoke Design Values (At 28.0 KV)

Yoke type 51K1PQZ
Horizontal Deflection Coils:
Parallel-Connected:
Inductance at 1 V rms and 1 kHz . . . . 1.85. ± 5% mH
Resistance at 25 °C . . . . 2.10 ± 7% Ω
Typical operation with edge-to-edge scan at 28 kV:
Peak-to-peak deflection current . . . . 3.06 A
Vertical Deflection Coils:
Series-Connected:
Inductance at 1 V rms and 1 kHz . . . . 18.0 ± 7% mH
Resistance at 25 °C . . . . 9.0 ± 7% Ω
Typical operation with edge-to-edge scan at 28 kV:
Peak-to-peak deflection current . . . . 1.0 A
Raster Pincushion Distortion at a Distance 5 Times the Picture Height:
East / West . . . . 6% max.
North / South . . . . free

Note: Deflection yoke values are specified for the component in place on the tube neck.

Yoke Connector

This tube is supplied without yoke connectors or lead harness assembly
Mating connectors:

Vertical:	98590–3025	MOLEX
Horizontal:	98590–3035	MOLEX
*Alternative:	98590–3135	MOLEX

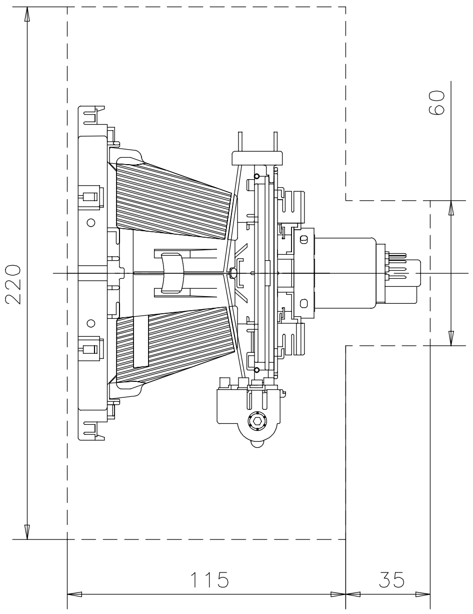

Fig. 1 Safety Area of Deflection Yoke

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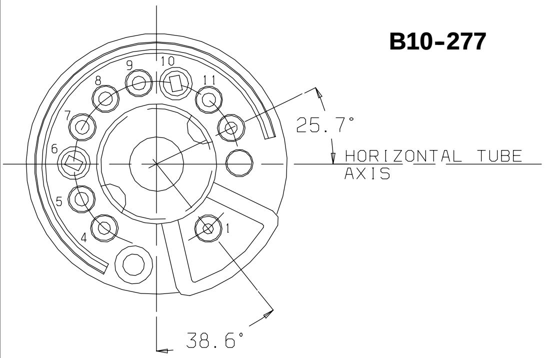

Basing Specifications EIA no. 13N

Pin	1	Grid N°3 / N°5
Pin	4	IC (Do not use)
Pin	5	Grid N°1
Pin	6	Cathode of Green Beam
Pin	7	Grid N°2 / N°4
Pin	8	Cathode of Red Beam
Pin	9	Heater
Pin	10	Heater
Pin	11	Cathode of Blue Beam

Fig. 2 – Pin Connections and Rear View of Base

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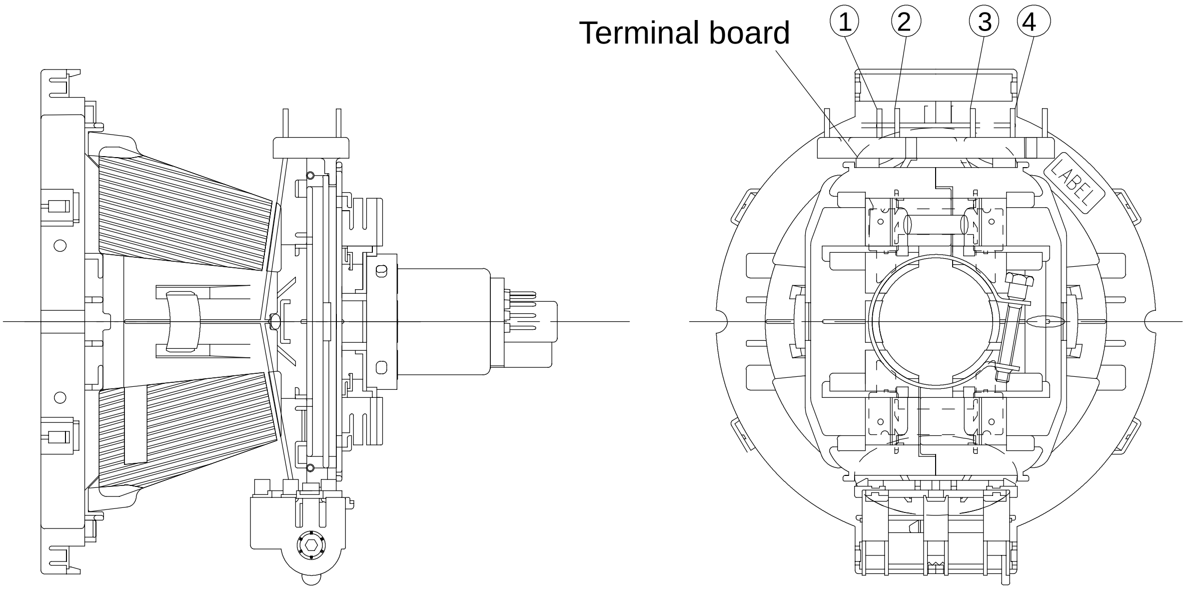
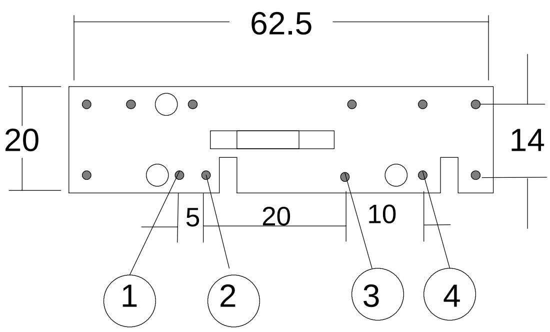
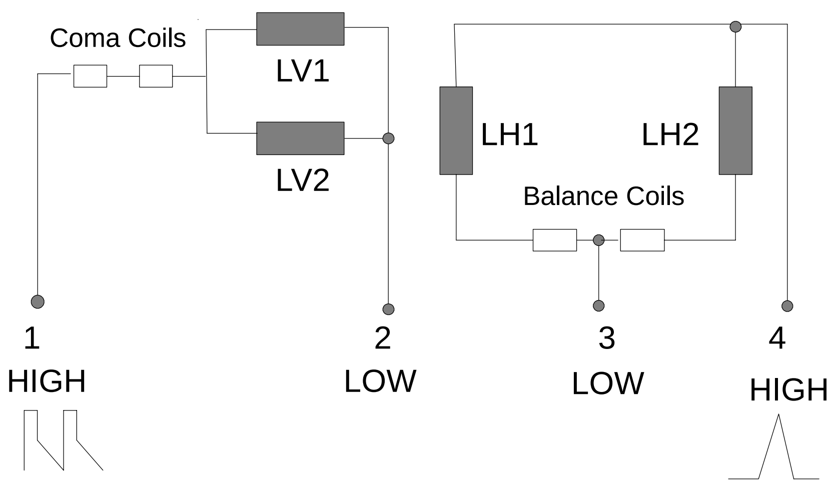
DEFLECTION YOKE



TERMINAL BOARD DETAILS



YOKE SCHEMATIC



The 1,2,3,4 pins are for customer use.

Pin diameter =1.25 mm typ.

H = 8 mm typ.

Fig. 3 – Connection Diagram of Deflection yoke

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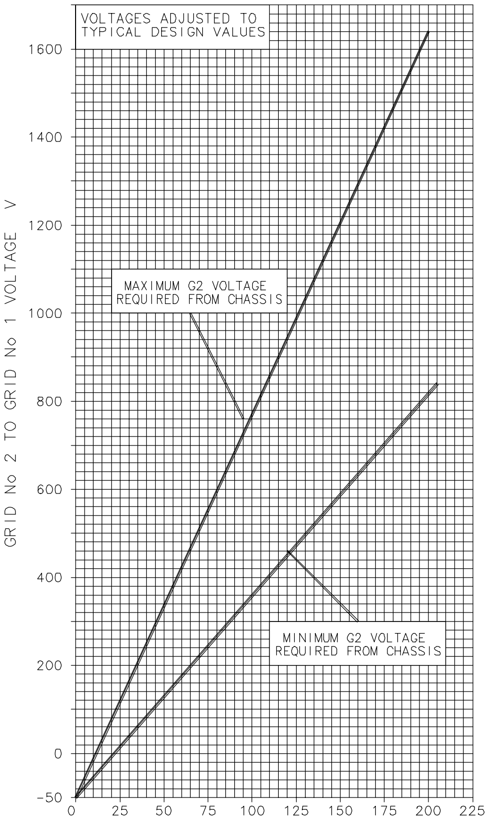
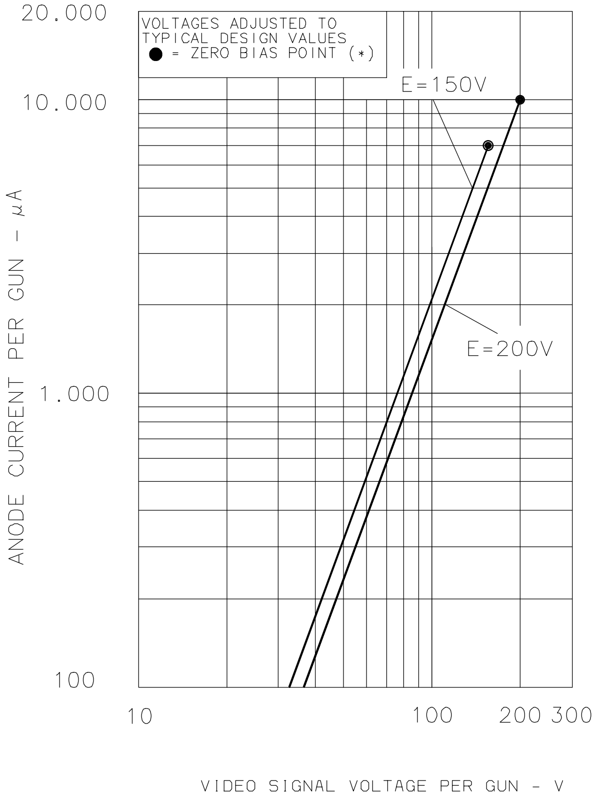


Fig. 4 –Cutoff Design Chart



(*) 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. This includes the instantaneous peak values of the applied dynamic focus modulation waveform.
3. 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.
4. 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.
5. Receiver operating conditions must be controlled and adequate ventilation provided to assure that under operation the yoke does not exceed the maximum operating temperature shown in the deflection yoke section.
   Maximum yoke temperature rise under typical operating conditions is shown for receiver design guidance, but it is the responsibility of the receiver/monitor manufacturer to assure that the yoke maximum operating temperature is not exceeded under actual operating conditions and ambient temperature usage. For additional information concerning yoke temperature rise under different operating conditions, contact your TMM sales representative.
6. Measured in accordance with IEC Recommendation - Publication 107 - Recommended Methods of Measurement on Receivers for Television Broadcast Transmission.

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X-radiation Characteristic

A) 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(1μSv/h at 10 cm from the glass)

B) Here following are reported the curves in accordance with the procedure of EIA Standard RS 503, which forecasts a max X–Radiation limit of 0.5 mR/h at 5 cm.

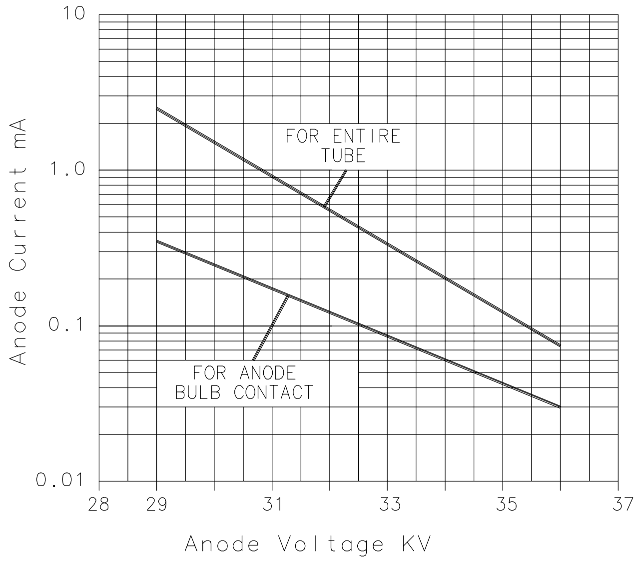

Fig.6 – 1 μSv/h Isoesposure–Rate Limit Curves

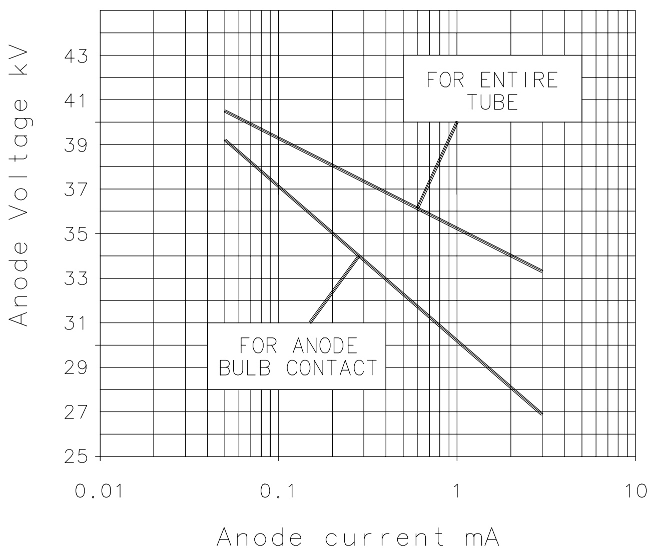

Fig. 9- 0.5 mR/h Isoexposure-Rate Limit Curves

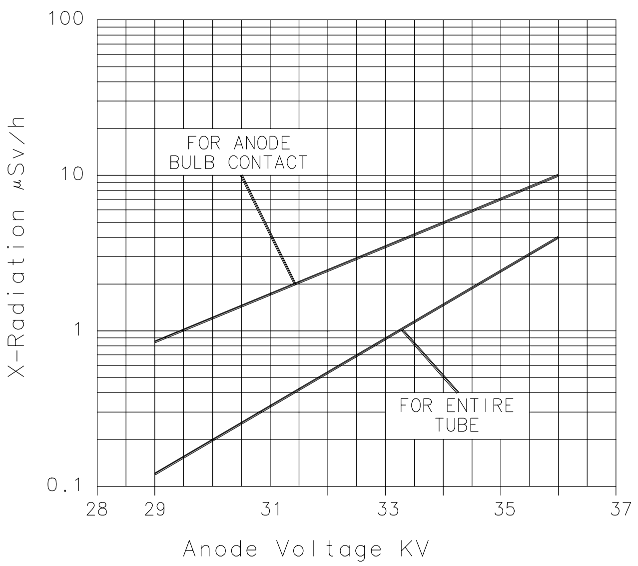

Fig.7 – X –Radiation Limit Curves at a Constant Anode Current of 300 μA (x–radiation at a constant anode voltage varies linearly with anode current).

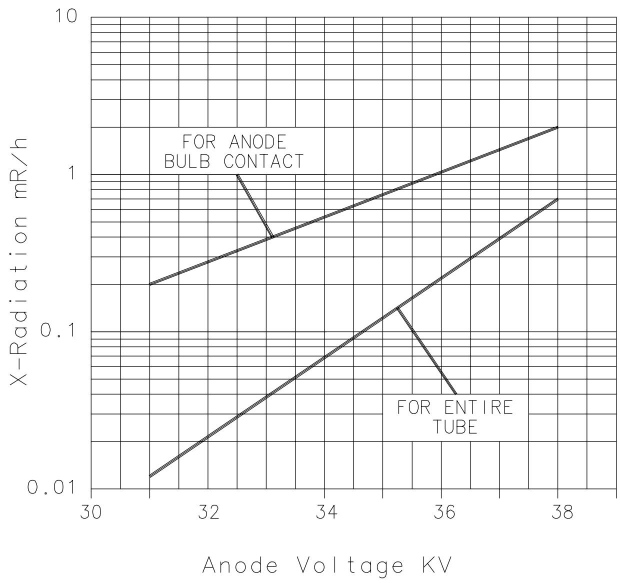

Fig. 9 – X –Radiation Limit Curves at a Constant Anode Current of 300 μA (x–radiation at a constant anode voltage varies linearly with anode current).

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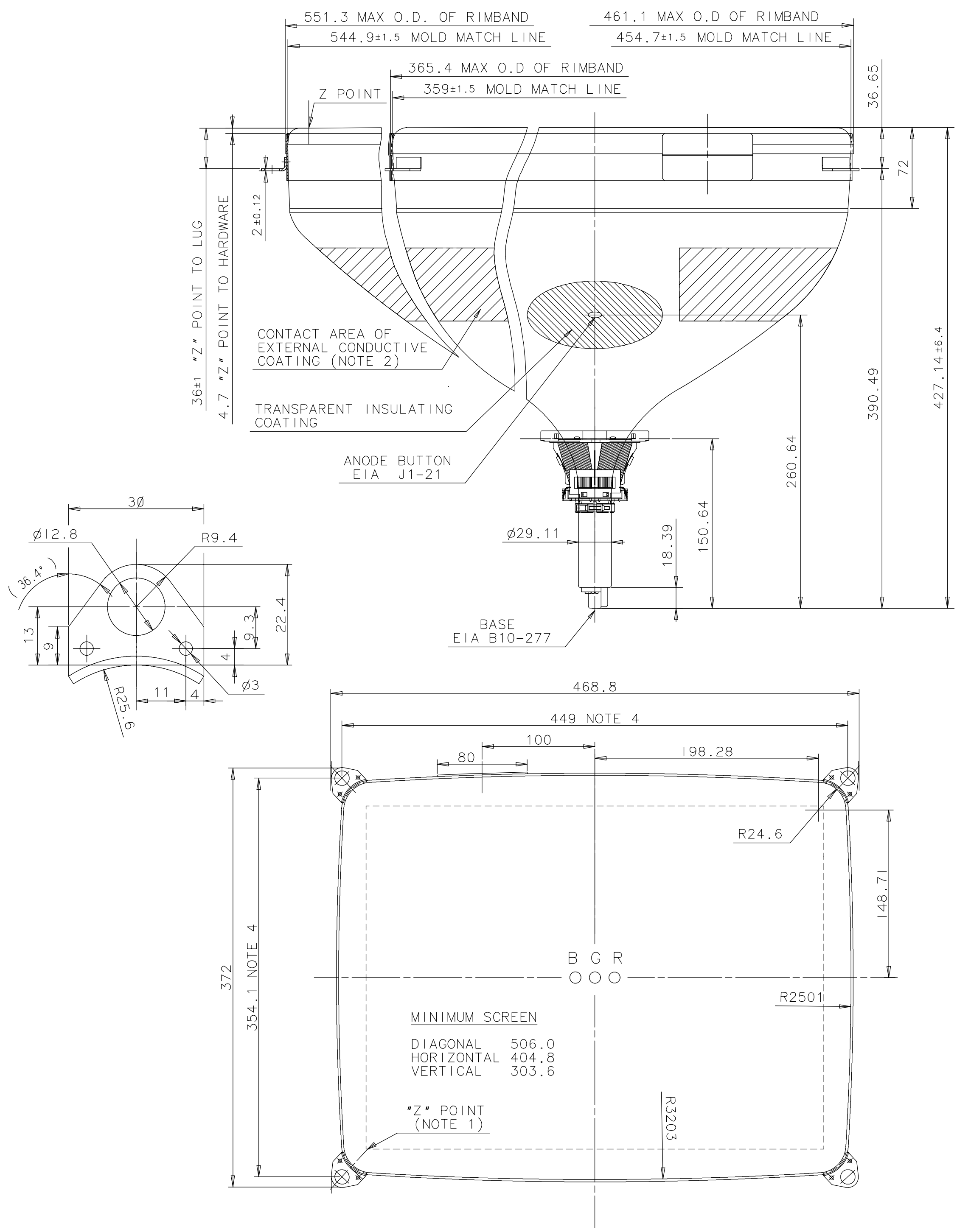

Fig. 8– Dimensional Outline

1-Note The mating socket assembly with associated circuit board and mounted components must not weigh more than 0.5 kg. To minimize the torsional forces on the tube base pins, the center of gravity of this assembly should be located on the vertical plane through the picture-tube axis. Caution should also be exercised so that connecting leads to the assembly do not exert excessive torsional forces. The TV receiver mounting system should incorporate sufficient cushioning so that under condition of shipment or handling forces applied to the picture tube should not create accelerations greater than 25 g's in x, y, z direction.

2-Note 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 in order to provide the required capacitance.

3-Note "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.

4-Note None of the four mounting lugs will deviate from the plane of the other three by more than 1.0 mm.

5-Note 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 7.0 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 10.

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

For optimum automatic degaussing, a tilted degaussing-coil arrangements should be incorporated in the TV receiver.

Tilted Coil System –The tilted coil should be placed on the tube funnel as shown in **fig.9**.

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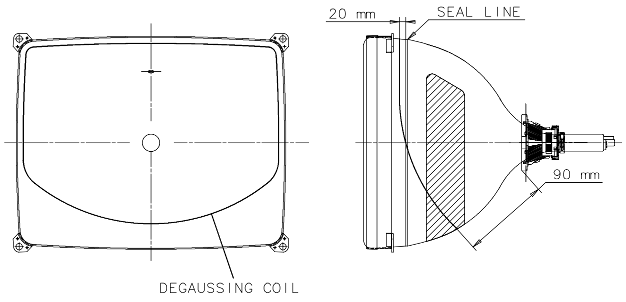

COIL CIRCUMFERENCE = 1380 mm APPROX.

Fig. 9 – Relative Placement of Tilted Coil

Degaussing Circuit

The degaussing circuit should provide a minimum of 1000 peak-to-peak ampere-turns (AT) in the degaussing coil. This current must decay in a gradual manner such that, at least 0.8 of the initial amplitude still flows after 5 cicles, after that each half period wave must have an amplitude not lower than 0.8 (less than 20% decay) respect to the previous one. In addition, at the completion of the degaussing cycle the residual current in the coil 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. The induced current can be minimized by careful positioning of the degaussing coil. For this reason, and in order to achieve optimal degaussing recovery, coil placement should follow the recommendations shown in **Fig. 9**. 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 < 2.0 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**) 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.

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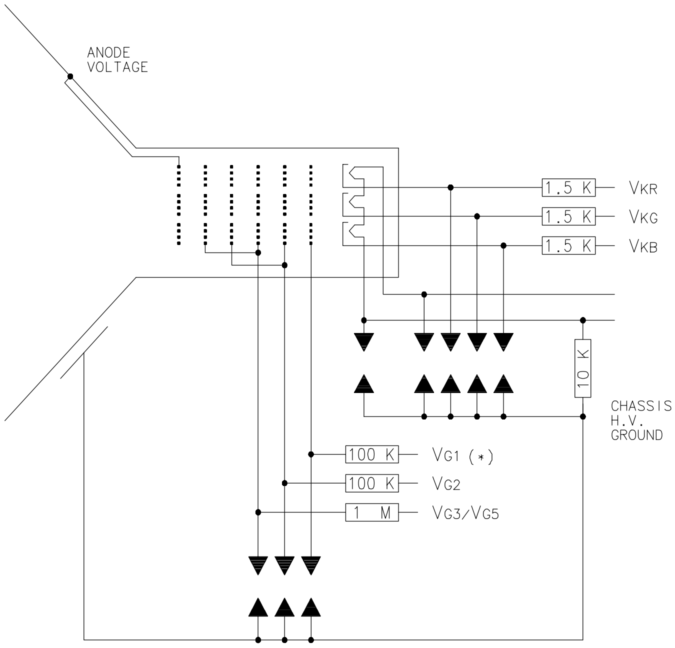
For best reliability, the heater circuit should be isolated from chassis ground and/or voltage sources by a minimum resistance of 10 kΩ. Spark gaps should be connected to both heater-socket contacts. These spark gaps should have the same characteristics as the other low-voltage spark gaps. When the heater 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.



* 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-Gap Recommendations and Typical Isolation-Resistor Values

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 25 g's in x, y, z direction. A speaker mounting system that mechanically isolates the speaker motions from the receiver cabinet is recommended to maximize system microphonic performance.

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