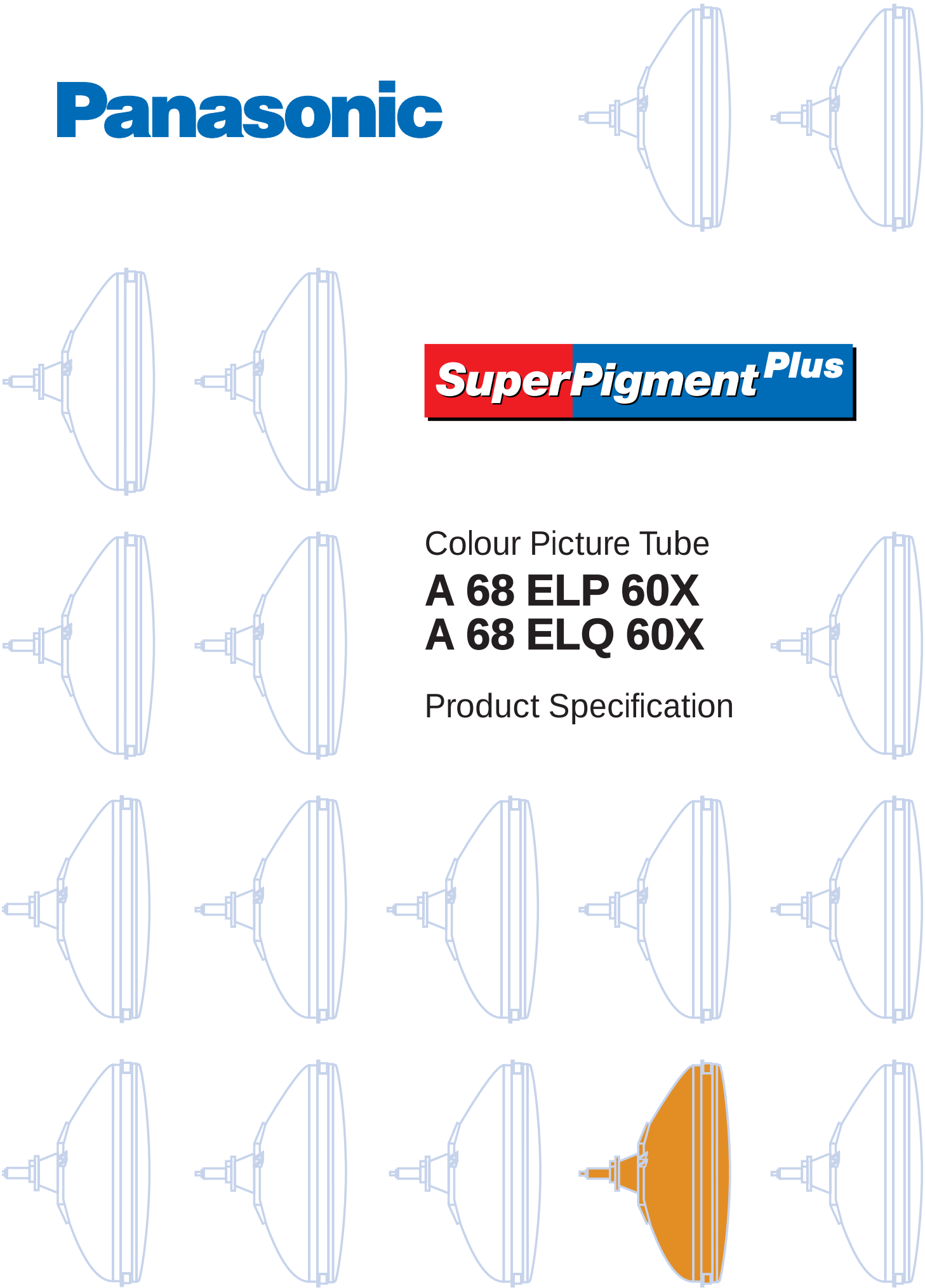
Panasonic

SuperPigment Plus

Colour Picture Tube

A 68 ELP 60X
A 68 ELQ 60X

Product Specification



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The details of this data book refer to the specifications of products,
but do not represent a guarantee of characteristics.

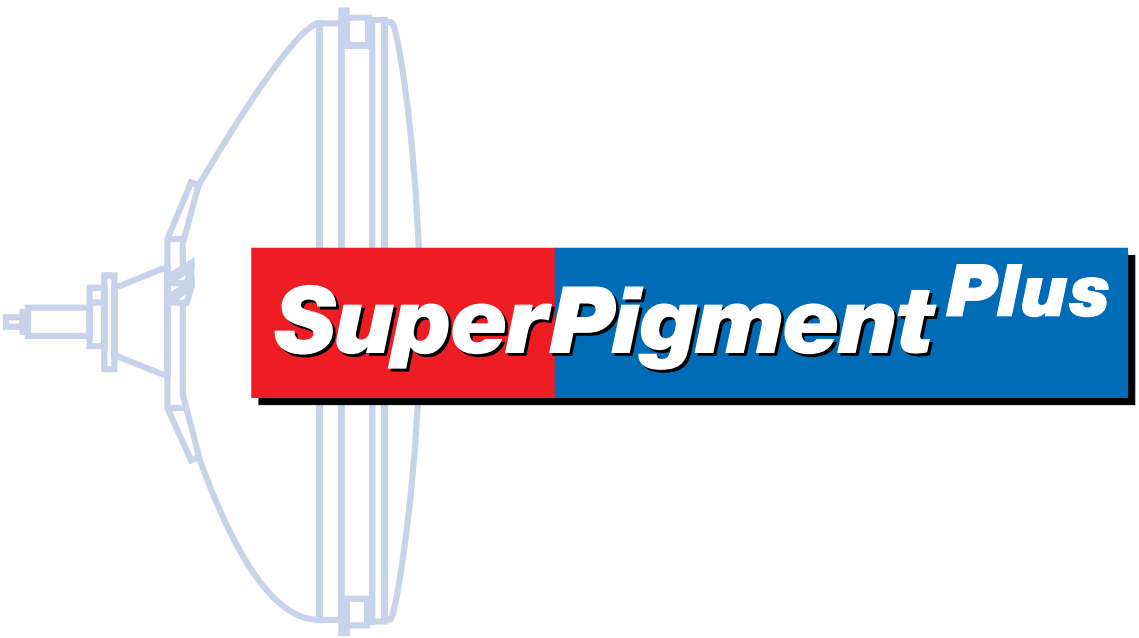
Availability and right to change reserved.

For design purposes use only 1:1 drawings

Product specification

Colour Picture Tube

... is a 29” SuperPigment Plus Colour Picture Tube with a glass diagonal of 72 cm for TV use.
The A 68 ELP/ELQ 60X is a 4:3 Pure Flat Square Colour Picture Tube with an SST Invar Mask.



A 68 ELP 60X
A 68 ELQ 60X

1 Contents

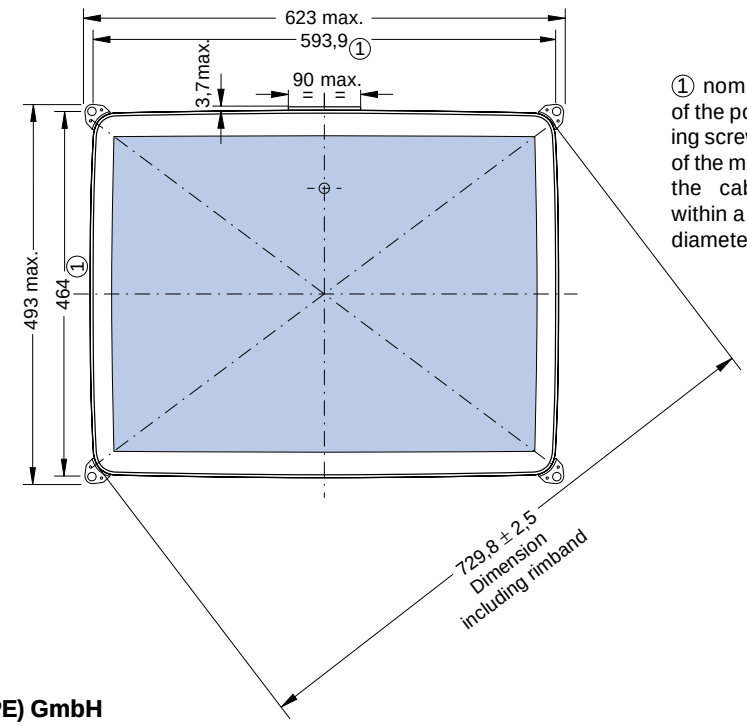
2 List of Figures and Tables

3 Short Description

Useful screen diagonal	68 cm	Heater voltage (stab.)	U_F = 6,3 V
Glass diagonal	72,4 cm	Heater current	I_F = 310 mA
Deflection angle	104°	Anode voltage with full load	
Neck diameter	29,1 mm	U_A = 25 - 33 kV	
Overall length	457 mm	Focusing voltage	25,5 - 29,5% U_A
Mass	34 kg		
Glass transmission effective		44%	

Aspect ratio		4:3
Screen		vertical line with black matrix super flat and square
Phosphors		cadmium free green, gold activated high density pigmented red blue high density pigmented red blue
Shadow mask assembly		slotted type of SST temperature compensated
Electron gun		in-line, Hi-Bi potential MPF/OLF/ART/DAF external multipole unit
Magnetic shield		inner magnetic shield
Implosion protection		shrink frame technology
Base cap	A 68 ELP 60X	B 12-285
	A 68 ELQ 60X	B 10-301

Figure 1
Tube Dimensions, Front View



① nominal dimensions of the position of the fixing screws. The position of the mounting screw in the cabinet must be within a circle of 12 mm diameter.

Exposure	northern hemisphere
Scanning-line system	525 and/or 625 scanning lines
Deflection yoke	* north/south pincushion free, * self converging * 50 or 100 Hz * fully coma corrected
Other features	* soft flash technology * optional SVM coil * Cathode ray tube intrinsically safe up to 29,9 kV according to appendix III Röntgenverordnung (newly issued 8.1.1987).

Figure 2
Tube Dimensions, Side View

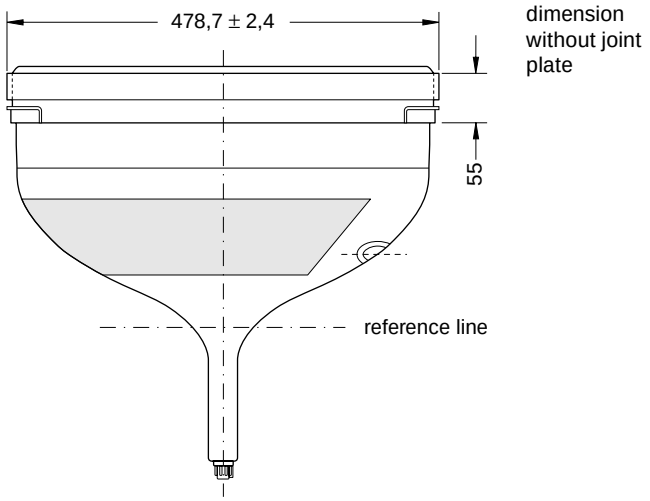
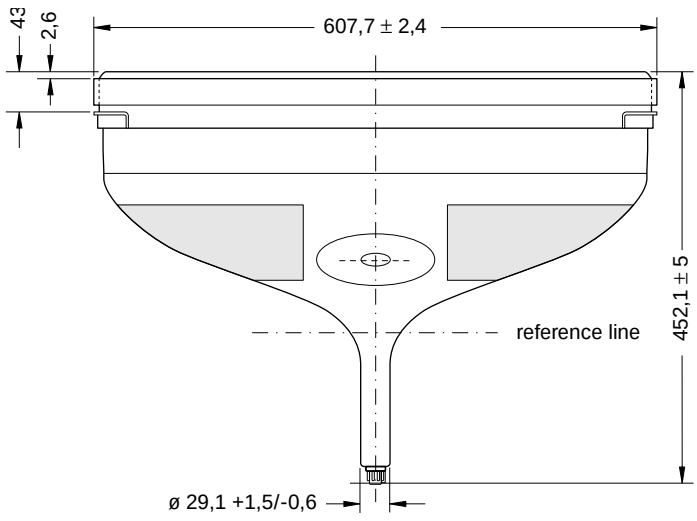


Figure 3
Tube Dimensions, Top View



4
Typical Operating Conditions

Voltages are specified with respect to grid 1

Anode voltage	U_A	= 29,5 kV
Focusing voltage (grid 3, 5-1)	$U_{G3, G5-G1}$	= 7,82 - 8,41 kV
Dynamic focusing voltage (grid 5-2)	U_{G5-G2}	= 7,82 - 8,41 kV + U_D
Dynamic focusing voltage (U_D)	U_D	= as shown in figure 6
Cut-off voltage grid 2 (V_{kc} = 170V)	$U_{G2, G4}$	= 482 - 842 V
Heater voltage (stab.)	U_F	= 6,3 V
Heater current	IF	= 310 mA

Figure 4 (left)
Cut-off Voltage Range

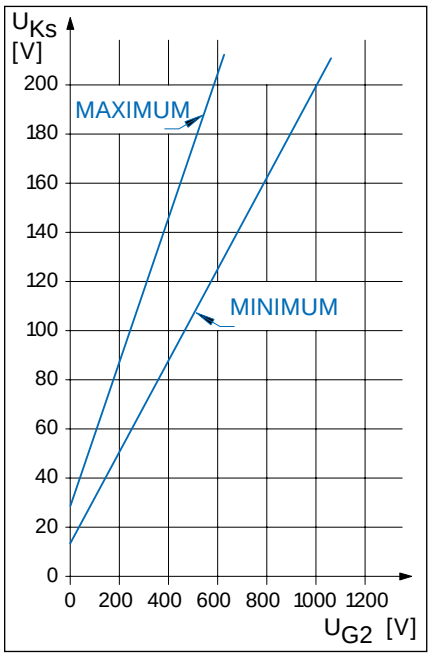
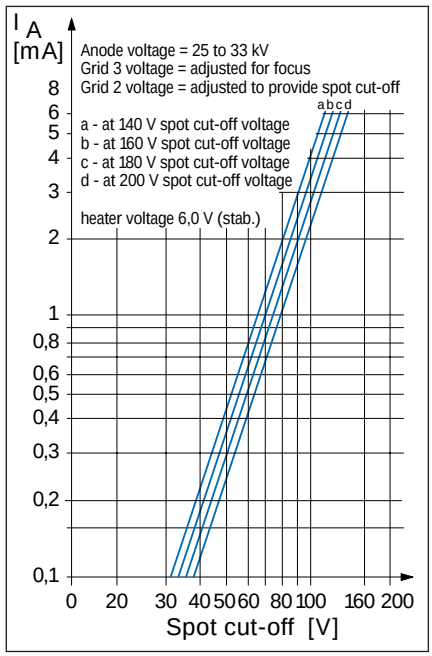


Figure 5 (right)
Video Drive Characteristics



5
Circuit Design Values

Voltages are specified with respect to grid 1

Anode voltage	U_A	= 25 - 33 kV
Grid 5-2 focus voltage	U_{G5-2}	= 25,5 - 29,5% of U_A
Grid 1 reference point	U_{G1}	= 0 V
Cut-off voltage range	Figure 4	
Grid 2, 4 cut-off voltage	$U_{G2, G4}$	= 482 - 842 V
Recommended cathode voltage for black level adjustment.	U_K	= 170 V
Video drive characteristics	Figure 5	

Grid 1 to all other electrodes	C_{G1}	=	14 pF
Cathode to all other electrodes	C_K	=	12 pF
Focusing electrode			
Grid 5-2 to all other electrodes	C_{G5-2}	=	5 pF
Grid 3, 5-1 to all other electrodes	$C_{G3, 5-1}$	=	12 pFAnode to
Anode to external conductive coating	$C_{A/M}$	=	1900 pF - 2600 pF
Anode to metal rimband	$C_{A/Z}$	=	300 pF - 400 pF

Leakage current cathode-heater	$I_{KF\ max}$	= 5	µA
Test conditions	U_A	= 0	V
grid 1, 2 and 3 has to be connected	U_{KF}	= 275	V
to the cathode of the gun in test.			

Leakage currents, flashovers, stray emission			
Test conditions	U_K	= 250	V
for these three items.	U_A	= 33	kV
	$U_{G2,G4}$	= 620	V

Leakage currents			
grid 5-2	$I_{G5\text{-}2\ max.}$	= ± 5	µA
grid 3, 5-1	$I_{G3,\ G5\text{-}1\ max.}$	= ± 5	µA
grid 2	$I_{G2,\ G4\ max.}$	= ± 5	µA
grid 1	$I_{G1\ max.}$	= ± 5	µA

Flashovers	U_{G3}	= 8,1	kV
within 1 minute	max. 2		
within 15 minutes	max. 5		

Stray emission			
Vertical deflection switched off.	$U_{G3,G5}$	= 8,1	kV
No brightening on screen visible.			

Warm-up-time	max.	= 8	s
Test conditions	U_F	= 6,0	V
	R_1	~ 0,1	Ω
Regulated power supply	I	> 6 A	

The measuring time is from switch on of the heaters until a raster is visible. Brightness and contrast controls should be set for normal operation.

Colour coordinates	x	y
red	0,653	0,323
green	0,286	0,607
blue	0,141	0,061

Cathode currents for white	D	= 9600 K +5M.P.C.D.
ClE-coordinates	x	= 0,282
	y	= 0,294
red	38%	
green	32%	
blue	30%	

Cathode current ratio	
red-blue	0,9.....1,5
red-green	1,0.....1,6
blue-green	0,6.....1,2

Figure 6a
Dynamic Focusing Electrode
horizontal

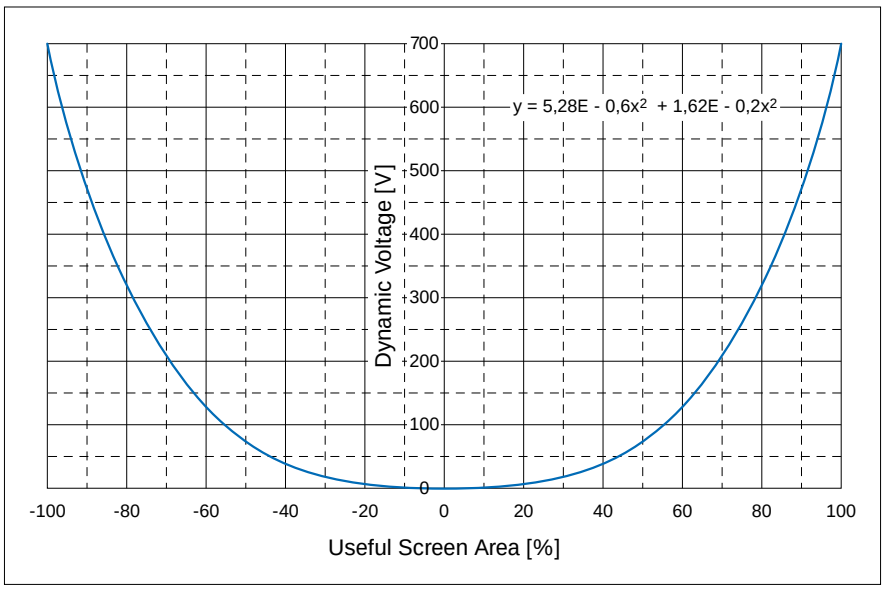
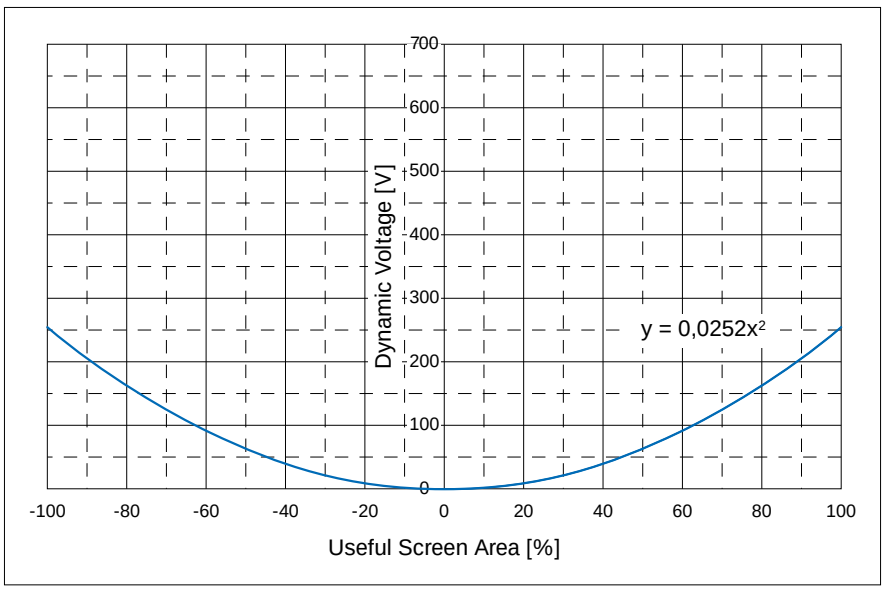


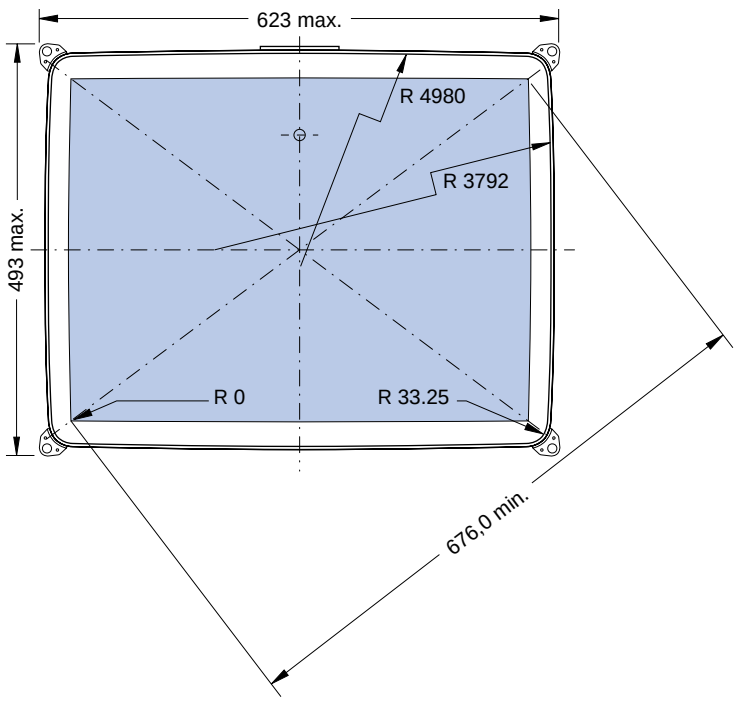
Figure 6b
Dynamic Focusing Electrode
vertical



6
Glass- and Screen Data
(see Figure 7)

Glass transmission at screen centre	44%
Brightness at the screen centre	≈ 100 cd/m² ± 10%
Test conditions	U_A = 29,5 kV, I_A = 1 mA
Overscanning	105%
Exact adjustment for horizontal and vertical linearity	
Colour temperature white	D 6500 K
Phosphors	
red	superpigmented high Europium red
green	cadmium free, gold activated
blue	superpigmented blue
Persistence of phosphors	
Time to decay to 10% of initial peak value - medium short	
red	ca. 100 µs
green	20 - 40 µs
blue	11 - 17 µs
Pitch at the centre of tube (horizontal screen pitch - center to center distance of identical colour phosphor stripes)	0,80 mm
Surface	polished
Visible screen area	2.193 cm²
Deflection angle	
diagonal	104°
horizontal	91°
vertical	74°

Figure 7
Phosphor and Screen Dimensions



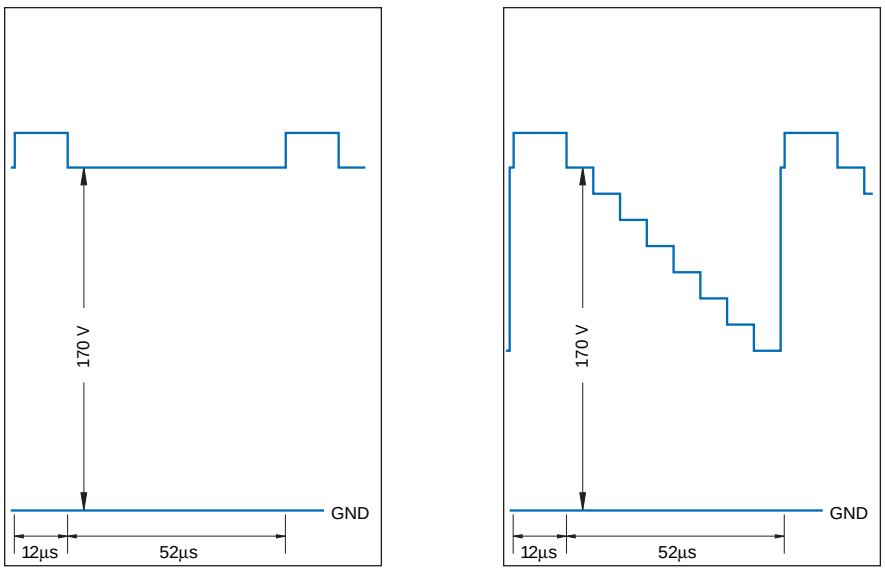
7 Notes for Test and Adjustment

Adjustment of focus voltage $U_{G3,G5}$
Conditions: U_A = 29,5 kV, U_K = 170 V,
I_{AP} = 4 mA ①

Test chart crosshatch pattern
18 squares = 19 grid lines horizontal
14 squares = 15 grid lines vertical
105% picture width and height.
Optimal adjustment of focus between horizontal- and vertical lines at the centre of the screen.

Test cut-off voltage area $U_{G2,G4}$
Conditions: U_A = 29,5 kV
Beam undeflected and brightness- and contrast controls to minimum.
U_K at the cathode to be tested U_K = 170 V
U_K to other cathodes U_K = 250 V
Turn $U_{G2,G4}$-control from 200 V to cut-off.
The cut-off has to be within the range of 482 - 842 V.
① The peak beam current of 4 mA corresponds roughly to 500 µA average.

Figure 8
Recommended Cathode Voltage



Adjustment of grid 2 voltage $U_{G2,G4}$

a) Individual cut-off adjustment
Set brightness- and contrast controls to minimum. All three cathodes at 170 V. Increase $U_{G2, G4}$ until the cut-off spot of the first gun appears. Reduce U_K of the two other guns until their cut-off spot is reached.

b) Automatic cut-off with black-level clamping
Set brightness- and contrast controls to minimum. Connect one of the three cathodes to an oscilloscope. Set DC-input to display 200 V. Turn $U_{G2, G4}$-control to the recommended cathode voltage of 170 V.

c) Automatic cut-off without black-level clamping
Test pattern grey scale.
Adjust contrast- and brightness-controls to linear grey scale.
Absolute values of voltage jumps from step to step are constant.
The last grey value is different to the black level. Set contrast control at I_A ~ 500 µA. Turn $U_{G2,G4}$-control to the recommended cathode voltage of 170 V, (see figure 8).

8 Mechanical Data and Dimensional Drawings

Overall length	452 ± 5 mm
Neck diameter	29,1 +1,5/-0,6 mm
Outside dimensions	
Diagonal (including rimband)	729,8 ± 2,4 mm
Horizontal (including lugs)	623 mm
Vertical (including lugs)	493 mm
Screen Dimensions	
Diagonal	676 mm min.
Horizontal	540,8 mm min.
Vertical	405,6 mm min.
Area	2.193 cm^2
Base A 68 ELP 60X	JEDEC B 12-285
A 68 ELQ 60X	JEDEC B 10-301
Anode contact	7,92 IEC 67-III-2, JEDEC J1-21
Weight	appr. 33 kg

Notes to outline drawings

① Anode contact 7,92 according to IEC 67-III-2, JEDEC J1-21
② This area is free of external conductive coating and must be kept clean.
③ Implosion protection frame and external conductive coating are galvanically separated from each other. They can be connected taking into consideration the existing safety regulations.
④ The external conductive coating must be connected to the negative high voltage terminal. Conduction cross-section A = 1 mm^2.
⑤ The tube base is in a circle of a diameter max. = 55 mm with respect to the tube axis. The socket has to be connected by flexible wires only.
⑥ Nominal dimensions of the position of the fixing screws. The nominal dimensions are designed for the use of fixing screws with a diameter up to 12 mm.
⑦ One out of the four mounting lugs may deviate by max. 1 mm to the plane of the other three.
⑧ The Z-points are reference points for the distance to X and Y. (Figure 10)
⑨ Minimum space to be reserved for mounting lug.

Figure 9
Anode Contact ①

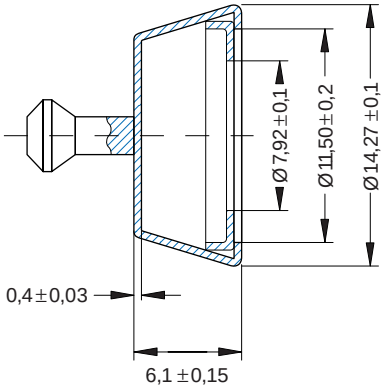


Figure 10
Panel Reference Points ⑧

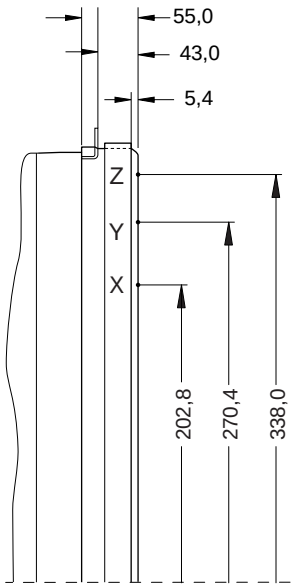
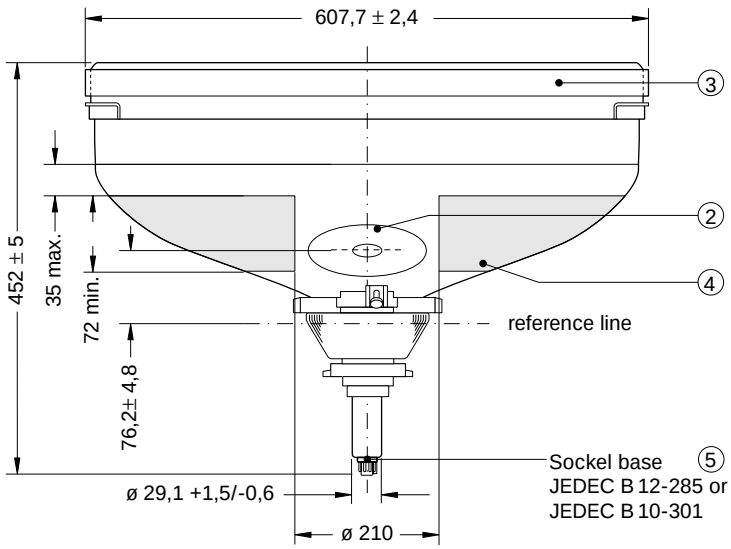


Figure 11
Overall Dimensions of Tube,
Top View



For design purposes use only 1:1 drawings

Figure 12
Overall Dimensions of Tube,
Side View

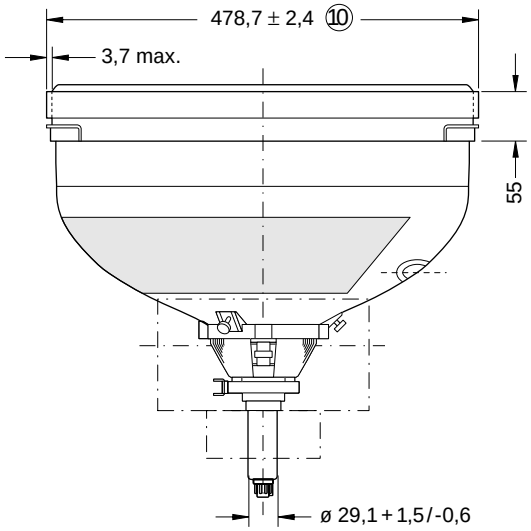
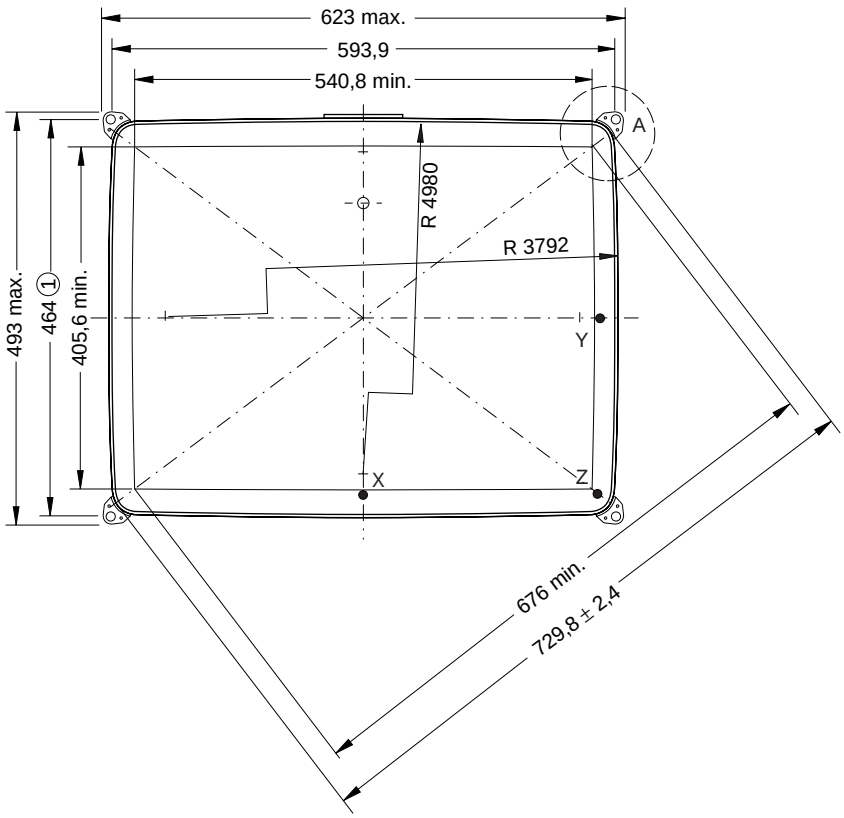


Figure 13
Overall Dimensions of Tube,
Front View



For design purposes use only
1:1 drawings.

Figure 14
Detail Dimensions of Lug

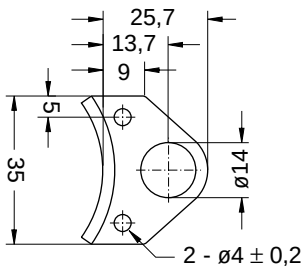


Figure 15
Dimensions of Lug, Side View

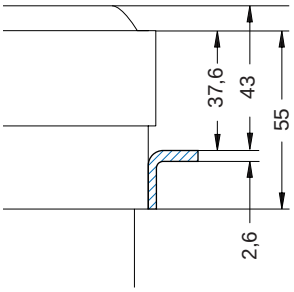
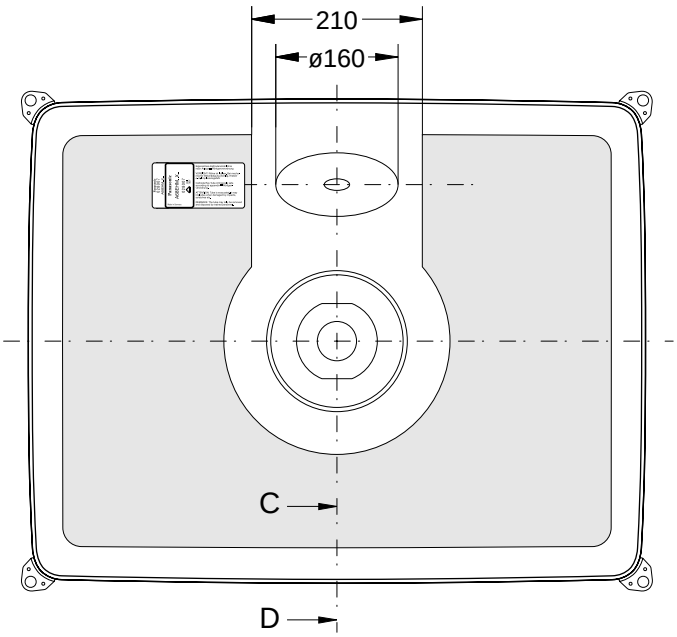


Figure 16
External Coating



For design purposes use only 1:1 drawings.

Figure 17
Implosion Frame
(External Coating, Section C - D)

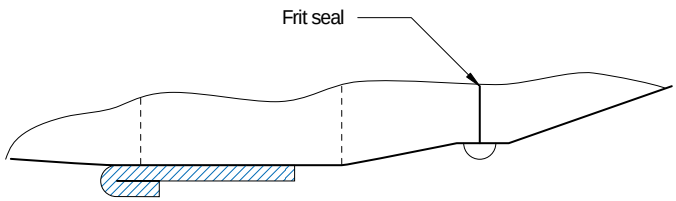
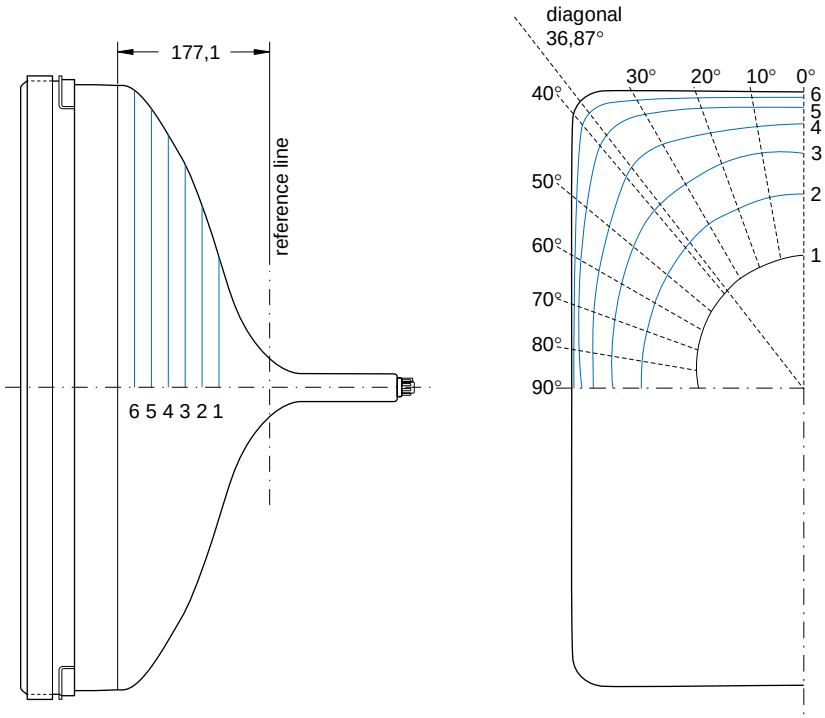


Figure 18
Funnel Radial Coordinates



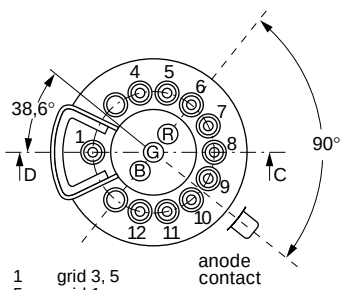
For design purposes use only 1:1 drawings.

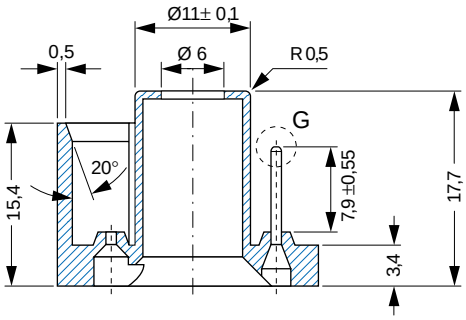
Nominal Outside Contour Radial Coordinates

No.	Height from ref. line	Major Axis 0°	10°	20°	30°	Diag. Axis 36,87°	40°	50°	60°	70°	80°	Minor Axis 90°
1	49,10	133,86	133,17	131,14	127,86	124,96	123,44	117,74	112,80	109,33	107,29	106,61
2	69,10	196,71	196,27	194,92	191,80	188,46	186,63	179,68	172,58	167,57	164,60	163,62
3	89,10	240,19	241,04	242,62	240,18	235,87	233,22	222,11	208,93	199,60	194,20	192,43
4	109,10	269,27	271,53	278,41	284,99	281,39	277,39	255,18	235,05	221,87	214,42	212,00
5	129,10	286,07	289,66	300,83	320,80	326,26	320,88	282,34	254,82	237,54	228,00	224,94
6	149,10	295,48	299,62	312,59	336,21	354,27	346,87	296,33	264,58	245,09	234,48	231,11

Figure 19 (left):
Tube Base

Figure 20 (right):
Tube Base, Section C - D





1	grid 3, 5
5	grid 1
6	cathode green
7	grid 2,4
8	cathode red
9	heater
10	heater
11	cathode blue

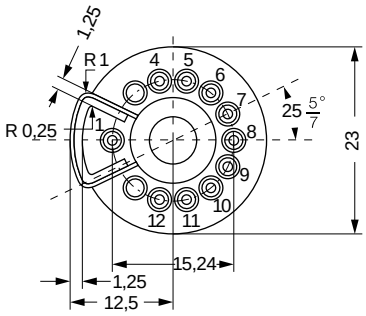
anode: grid 6, screen mask

unused pins 4 and 12 must not be connected

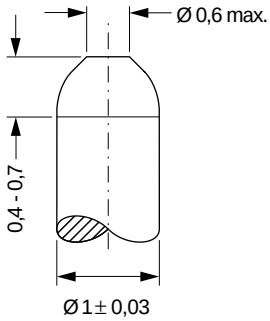
tube base JEDEC-Nr. B 12-285

(tube base JEDEC-Nr. B 10-301 with additional pin for grid 5-2)

For design purposes use only 1:1 drawings.



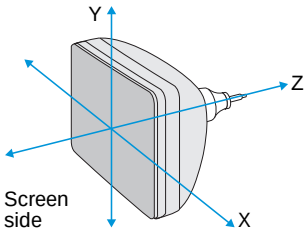
Detail G



9 Limiting Values

Heater voltage	U_F	= 6,0 - 6,6	V	(I)
Anode voltage	$U_{A\ max}$	= 33	kV	
Anode voltage	$U_{A\ min.}$	= 25	kV	
Anode current	$I_{A\ max.}$	= 1,8	mA	(IV)
Dynamic focusing voltage grid 5-2	$U_{G5\text{-}2\ max.}$	= 10	kV	
Focusing voltage grid 3,5-1	$U_{G3,\ G5\text{-}1\ max.}$	= 10	kV	
Difference grid 5-2, grid 3,5-1	$U_{Difference\ max.}$	= 3	kV	
Voltage between grid 3,5 and grid 6	$U_{G3,\ G5,\ G6\ max.}$	= 24	kV	
Screen grid voltage peak	$U_{G2,\ G4p\ max.}$	= 1,4	kV	
Cathode voltages				
positive	$U_{K\ max.}$	= 200	V	
negative	$-U_{K\ max.}$	= 0	V	
positive peak voltage	$U_{KP\ max.}$	= 400	V	
negative peak voltage	$-U_{KP\ max.}$	= -2	V	
Voltages between heater and cathode				
Heater negative to cathode	$U_{-FK\ max.}$	= 275	V	(II)
Heater positive to cathode	U_{+FK}	= 0	V	
Heater to cathode peak voltage	$U_{-FKP\ max.}$	= 385	V	
Heater to cathode peak voltage	$U_{+FKP\ max.}$	= 200	V	

Shock acceleration during transport and handling (</= 350 m/s²) (III)



Y-axis and screen side of Z-axis	343 m/s
Neck side of Z-axis	245 m/s
X-axis	196 m/s

(I) To secure good emission characteristics through the life, it is recommended to regulate the heater voltage at 6,0 V.

(II) During warm up period of max. 15 sec the maximum voltage between heater and cathode must not exceed 385 V. This voltage must be reduced to 275 V at least time proportionally within 45 sec.

(III) The tube has an integrated implosion protection according to VDE and BSI requirements. Rough tube mechanical treatment might lead to implosions.

(IV) short term average (with ABL circuit) $I_{A\ max.}$ = 1,8 mA
long term average (with ABL circuit) $I_{A\ max.}$ = 1,4 mA

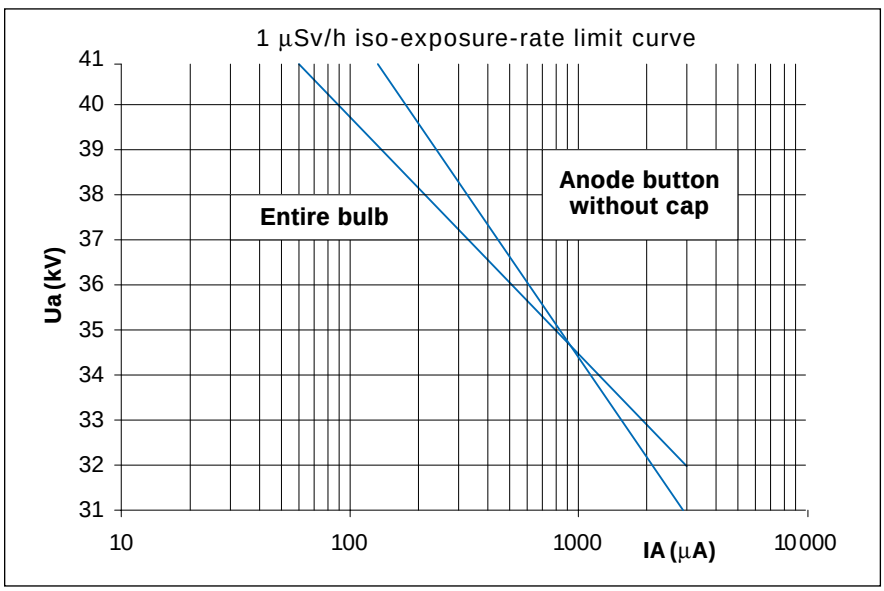
Cut-off voltage ratio U_K-Quotient = 1,16

X-radiation max. 1 µSv/h

Test conditions
Dose rate measuring in the distance
of 100 mm to the glass surface.

ISO-dose rate Figured 21
Maximum 1 µSv/h
Parameters:
Anode voltage - anode current

Figure 21
ISO Dose Rate



10
Screen- and Glass-Blemishes
Limits

Contrast blemishes Bubbles in glass, missing phosphor, black spots.	Figure 22 + 23
The size of the blemish is defined by length plus width divided by two. Judgement of defects should not be done before 10 minutes after switch on.	(L + W) / 2
Viewing distance to classify the contrast degree is	60 cm
For definition of defect size and contrast degree template can be used.	
Defects with high contrast The defect remains visible if template is moved from 0,7 to 1,3 filter.	
Defects with medium contrast Defect disappears if template is moved from 0,7 to 1,3 filter.	
Screen zones Zone A, center area Zone B. outside area Zone C is defined as the unscreened area of the faceplate.	see Figure 24 240 x 180 mm

Figure 22
Blemishes, High Contrast

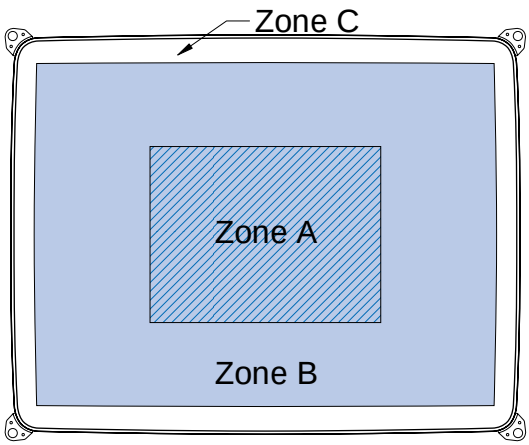
Blemish size (mm)	Limited blemishes A	A+B	Distance (mm)
>1,0	0	0	-
0,8...<1,0	0	1	-
0,5...<0,8	1	3	80
0,25..<0,5	2	4	50 ①
< 0,25 ②	unlimited	unlimited	-

① Accepted are three defects, minimum distance of 2 failures is 50 mm.
② Blemish size unlimited. Limited only by cloud in a viewing distance of 1 m.

Figure 23
Blemishes, Medium Contrast

Blemish size (mm)	Limited blemishes A	A+B	Distance (mm)
>1,0	0	0	-
0,8...<1,0	1	2	80
0,5...<0,8	4	8	50 ①
< 0,5 ②	unlimited	unlimited	-

Figure 24
Screen Zones



Scratches, Stains on the faceplate	(see Figure 25/26)
The sum of all scratches with a width of 0.05-0.15 mm should not exceed 180 mm.	
Viewing distance	~1,0 m
Ambient light (activated screen)	~1 Lux
Ambient light (non-activated screen)	~1.000 Lux

Figure 25
Scratches on the Faceplate

Width (mm)	Length (mm)	Distance (mm)
</= 0,05	unlimited	-
0,05...<0,10	50	19
0,10...</= 0,15	13	45
> 0,15	-	-

Figure 26
Stains on the Faceplate

Stain size (mm)	Limited stains		Distance (mm)
	A	A+B	
>1,3 ... </= 1,8	1	2	80
>0,8 ... </= 1,3	2	3	80

11 Geometry and Convergence Specification

For the judgement of geometry and convergence the following conditions are valid:

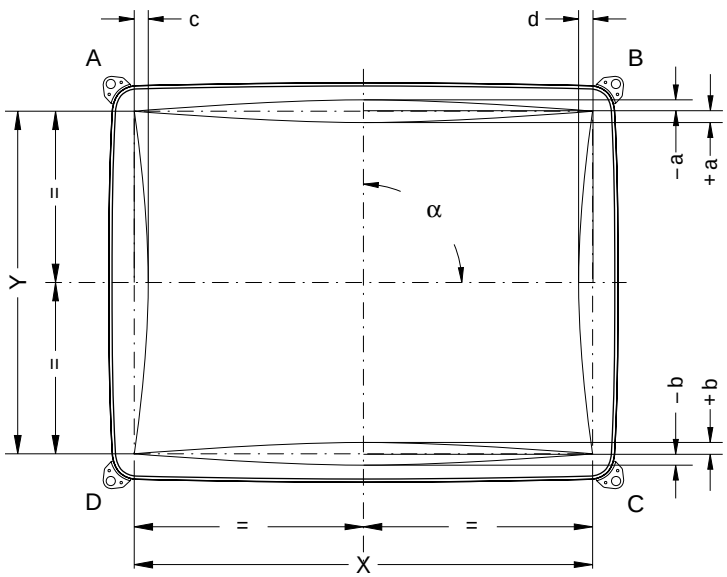
1. Warm up time	15 min		
2. Anode voltage	U_A	=	29,5 kV
3. Heater voltage	U_F	=	6,3 V
4. $U_{G2, G4}$ adjustment related to recommended cathode voltage	$U_{G2, G4}$ U_K	= =	482 - 842 V 170 V
5. Focusing voltage adjustment for optimum of focus for vertical and horizontal lines at the centre	U_{G3} I_{AP}	=	2 mA
6. Screen has to face east			
7. Test pattern	Cross hatch pattern White pattern		
8. Colour temperature adjustment to white	D	=	9600 K

Raster distortion	Figure 27	
Test pattern	Cross hatch pattern, only green.	
The peak beam current of 200 µA corresponds roughly to 25 µA average.	I_{AP}	= 200 µA
Linearity, picture width and height should be correctly adjusted.		

Overscanning	5%		

			max. (%)
north-south distortion	[2(a+b)/(AD+BC)]	•100%	-1,2
north-south symmetry	[2(a-b)/(AD+BC)]	•100%	1
east-west distortion	[2(c+d)/(AB+CD)]	•100%	14
east-west symmetry	[2(c-d)/(AB+CD)]	•100%	1
horizontal trapezium	[(AD-BC)/(AD+BC)]	•100%	1
vertical trapezium	[(AB-DC)/(AB+DC)]	•100%	1
orthogonality		$\alpha = 90 \pm 0{,}42°$	

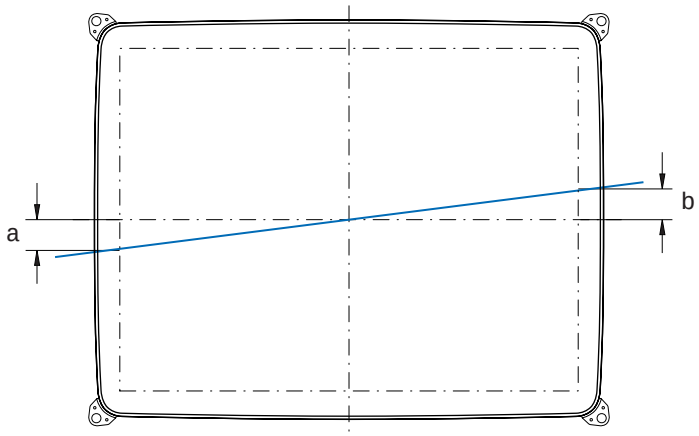
Figure 27:
Raster Distortion, Separate



Rasterrotation Figure 28

Cross hatch pattern green only.
Angle between the mechanical and the electrical centre line. max. = ∢ 0,42°

Figure 28
Raster Rotation

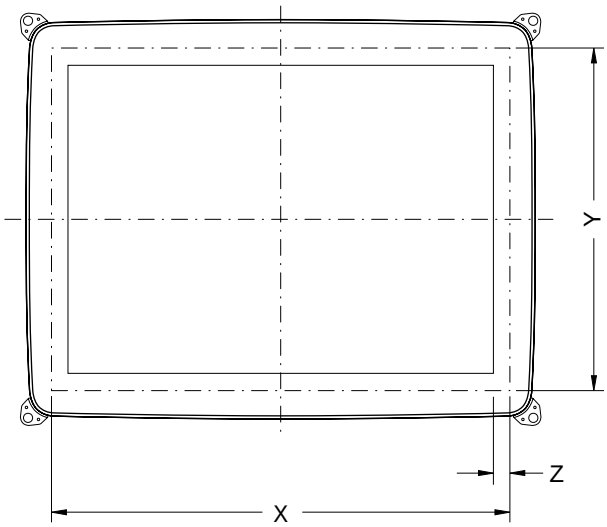


a + b max. (mm) 4,0

Sum of raster distortion Figure 29

All raster failures have to be inside the shown frame

Figure 29
Raster Distortion, Sum



X = 490 mm
Y = 370 mm
Z = 7 mm

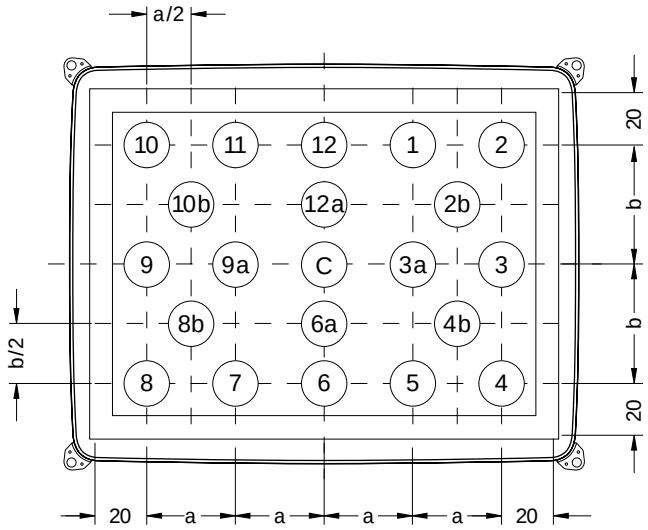
Rastershift

Horizontal max. 5 mm
Vertical max. 5 mm

Scanning switched off. Beam current adjusted to a visible spot. The value is the distance of the spot to the mechanical centre.

Convergence Figure 30
Test pattern cross hatch white. I_{AP} = 3500 µA
The peak beam current of 700 µA corresponds roughly to 90 µA average.

Figure 30
Convergence



C	0,3 mm
2, 4, 8, 10	1,6 mm
3, 6, 9, 12	1,4 mm
1, 5, 7, 11	1,4 mm
3a, 9a	1,3 mm
2b, 4b, 8b, 10b	1,3 mm

Maximum values shown are related to the distance between the centre of red-, green and blue lines, in vertical and horizontal direction.

White uniformity
Test pattern white

Horizontal Magnetic field	0 ± 25 µT
Beam current	I_A = 1000 µA
Viewing distance	2 m
Ambient light	~1 Lux

Tube has to be degaussed. Check after 30 minutes warm-up.
Tube is acceptable if there are no distinct colour differences visible.

Purity
Test pattern white

Horizontal Magnetic field	0 ± 25 µT
Beam current	I_A = 1000 µA
Viewing distance	2 m

Tube has to be degaussed. Wait for 30 minutes for the tube to warm up, then check each colour red, green and blue. The tube is acceptable if there is no discolouration visible.

12 General Notes

Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any electronic device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

12.1 Limit Values by IEC Publication

The equipment manufacturer must design so that, initially and throughout life, no absolute maximum value for the intended service is exceeded with any device under the worst probable operating conditions:

* supply voltage variation
* equipment and control adjustment
* components spread and variation
* load variations
* signal variations
* environmental conditions and also picture tube spread and variations.

12.2 Voltage between Heater and Cathode

The voltage between heater to cathode should be as small as possible.

12.3 Voltages between Cathode and Grids 1, 2, 3

Do not operate the tube unless all electrodes are connected to a DC potential.
Do not exceed the limit value of any electrode.
No electrode should be connected to a high voltage potential.
Test- or check circuits should be agreed with Matsushita Electronics (Europe) GmbH.

12.4 Screen

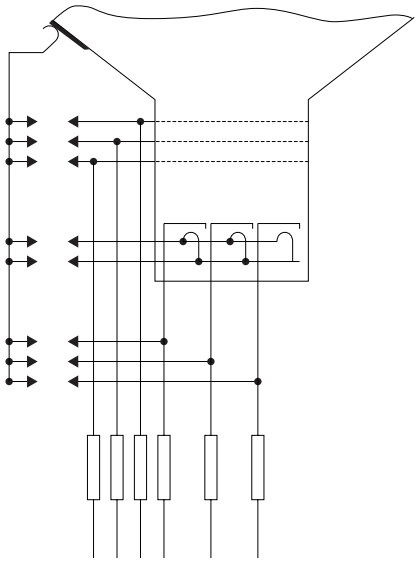
To avoid screen damages please pay attention to the following:

* Do not operate the tube with a stationary cross hatch pattern or a similar test pattern.
* Do not operate picture tube with a stationary luminary spot except with an extremely low beam current.
* Afterglow should not exceed 1,5 sec.
* The anode voltage U_A has to be reduced to less than 15 kV within 1 sec after switch off or switching into standby.
* If no bleeder resistor is used it has to be ensured by circuit design, that the tube will be discharged in a time <1 sec.

12.5 Spark Gaps

To avoid possible damages to tube or circuitry by internal flash over, spark gaps should be used (Figure 31).
For the connection of the spark gaps to the external conductive coating, the shortest possible wires should be used.
The connection to the external conductive coating should cover a large area.
Isolation resistors should be used in series with each grid and cathode wire.
The spark gaps should be designed for a breakdown voltage at the focusing electrode of 14 kV, at the other electrodes of 2kV.

Figure 31:
Spark Gaps -
Recommended Values



R_{KG} = 1,5 kΩ
R_{KR} = 1,5 kΩ
R_{KB} = 1,5 kΩ
R_{G1} = 100 kΩ
R_{G2} = 100 kΩ
R_{G3} = 1 MΩ

12.6 Degaussing

The tube has an internal shielding against external magnetic fields. The shield and the mask should be degaussed automatically whenever the TV-set is switched on.
To get sufficient degaussing a magnetomotive force with an initial value of minimum 625 ampere turns peak per each coil is needed (see figure 32). The total number of turns is the sum of turns of each coil.
The time of current decay has to be continuously. The value of the degaussing current after 4 cycles should be 50% of the initial value (4 cycles 50Hz = 80 ms, 60Hz = 67 ms, see figure 32). Figures 34 and 35 show possible layouts of degaussing coil.
The reduction of current per half wave must be less than 10 percent. The residual value of magnetic flux must be less than 0,2 ampere turns peak (see figure 33).

Figure 32 (left)
Degaussing - Reduction of Current per Halfwave

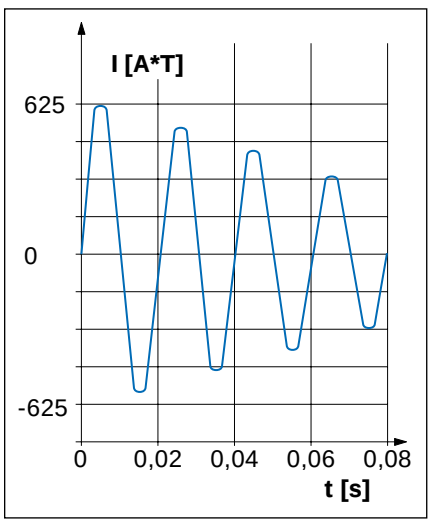
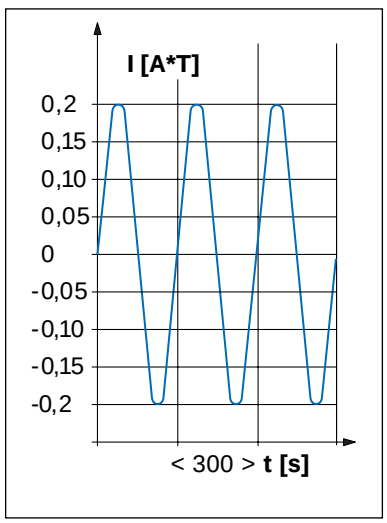


Figure 33 (right)
Degaussing - Residual Value of Magnetomotive Force



To avoid coupling of line frequency current, a sufficient capacitor should be connected in parallel to the degaussing coil.
When using external degaussing coils vertical deflection of tube must be switched off. In this case the initial value of magnetic field strength at front panel should be min. 160 A/m .
Location of the degaussing coilshould be as close to the screen as possible to have a maximum degaussing coil.

Figure 34
Placement of Degaussing , top view

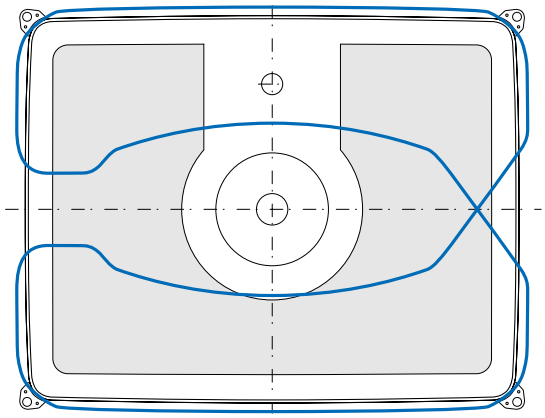
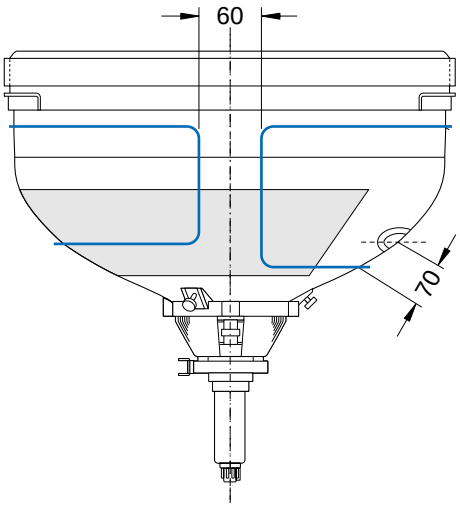
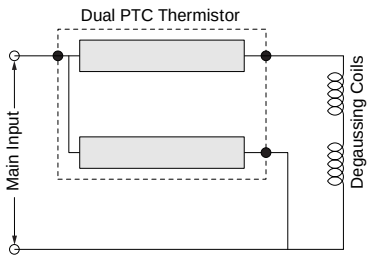


Figure 35
Placement of Degaussing , side view



Degaussing Circuit



12.7 Implosion Protection

All picture tubes from Matsushita Electronics (Europe) GmbH are implosion protected according to VDE DIN 57860, IEC 65, BSI and CCIB.
Care should be taken not to scratch or knock any part of the tube.
Please handle tube careful to avoid any risk of implosion.
In all handling procedures prior to insertion into the cabinet, there is a risk of personal injury as a result of severe accidental damage to the tube. It is therefore recommended that protective clothing should be worn, particularly eye shielding.
Remember when replacing or servicing the tube assembly, that a residual electrical charge may be carried by the anode contact and also the external coating if not earthed. Before removing the tube assembly from the equipment, earth the external coating and short the anode contact to the coating.
The final customer has to be informed about statements of implosion protection.

12.8
Handling

Avoid any mechanical stress to the neck components during transport and handling, it could cause loss of performance.

12.9
Cabinet Design

Design of the cabinet has to be done according to the 1:1 and not to a tube sample or this specification.

12.10
Microphony

Intense vibration of the loudspeakers inside the TV set can result in a visible modulation of brightness. This can be minimized by a suitable design of the TV cabinet. - Caution SST-mask is more sensitve against loudspeaker vibration than a conventional mask.

12.11
Transport

To avoid tube damage during transport, the following has to be taken into consideration:

a. Single tubes
Single tubes must be delivered in Matsushita Electronics (Europe) GmbH designed packaging only and transported in the printed position.

b. TV set
This must be transported in the packing designed by the set manufacturer in the position printed on the carton. If the tube is transported with it's faceplate in a horizontal position it could cause irreparable damage to the shadow mask

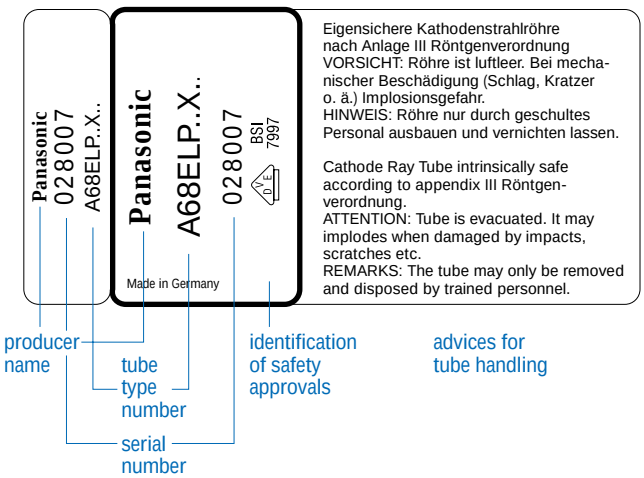
12.12
Storage

a. Tubes must only be stored in dry and clean storage facilities. Tubes and polystyrene have to be protected against rain and humidity.
b. Temperature of tube should be same as room temperature.

12.13
Type Designation by Pro Electron and Tube Label

Type .....A 68 ELP 60X/A 68 ELQ 60X
TV picture tube .....A
Screen diagonal (cm) 68
Family code (tube) .....ELP/ELQ
Member of family code.....60
Tri-colour screen.....X
Code of deflection yoke .....see separate yoke specification
.....(50Hz and 100Hz available)

Figure 36:
Tube Label (Example)



13 Used Formula Signs

Voltages	
Anode voltage	U_A
Cathode voltage	U_K
Voltage cathode to heater	U_{KF}
Peak cathode voltage	U_{KP}
DC voltage grid 1, 2, 3, 4 ,5	U_{G1} $U_{G2, G4}$ $U_{G3, G5}$
DC voltage between grid 2, 4 and cathode	$U_{G2, G4/K}$
Voltage between grid 3, grid 5 and grid 6	$U_{G3, G5, G6}$
Screen grid voltage peak	$U_{G2, G4p}$
Heater negative to cathode	$U_{-FK/G4}$
Heater positive to cathode	U_{+FK}
Heater to cathode peak voltage	U_{-FKP}
Voltage between heater and cathode	U_{+FK}
Heater positive to cathode	
Heater voltage	U_F
Voltage peak to peak	U_{PP}
Currents	
Anode current	I_A
Cathode Current	I_K
Leakage current cathode-heater	I_{KF}
Current Grid 1, 2, 3	I_{G1} I_{G2} I_{G3}
Heater current	I_F
Beam current	I_A
Deflection current horizontal peak to peak	$I_{HP\ P}$
Deflection current vertical peak to peak	I_{VPP}
Capacities	
Outside capacity	C
Grid 1 to all other electrodes	C_{G1}
Cathode to all other electrodes	C_K
Grid 3 to all other electrodes	C_{G3}
Anode to external conductive coating	$C_{A/M}$
Anode to metal rimband	$C_{A/Z}$
Grid 1 to cathode	$C_{G1/K}$
Resistance	
Active resistance of horizontal deflection coils	R_H
Active resistance of vertical deflection coils	R_v
Resistance of wires to cathodes green, red, blue	R_{KG} R_{KR} R_{KB}
Resistance of wires to grids 1, 2, 3	R_{G1} R_{G2} R_{G3}

Indices

Anode	A
Heater	F
Grid	G
Cathode	K
Outside conductive coating	M
Peak to peak	p-p
Edge to edge	e-e
Limit value	max.
Peak value	P
Point on Panel Diagonal	Z

Other Dimensions and Abbreviations

Ambient temperature	T amb
Absolut beam limiter	ABL
Brightness or inductance	L
British Standard Institution	BSI
DC	direct current
eff.	effective
Inductance horizontal deflection coils	L_H
Inductance vertical deflection coils	L_V
International Electrotechnical Commission	IEC
International Standards Organisation	ISO
Joint Electron Device Engineering Council	JEDEC
Minimum Perception Colour Difference	M.P.C.D.
Multi Functional Triode	MFT
Multi Pre Focus	MPF
N, S, E, W	north, south, east, west
Overlapped Field Lens	OLF
Pulse duration	t_P
Sensitivity	LI^2e-e
Sensitivity	RI^2e-e
Verband Deutscher Elektrotechniker e.V.	VDE

Panasonic

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