Amperex® Electronic Corporation
A NORTH AMERICAN PHILIPS COMPANY
ELECTRO-OPTICAL DEVICES DIVISION
P.O. Box 278 Slatersville, R.I. 02876
Telephone: 401/762-3800 TWX: 710/382-6332

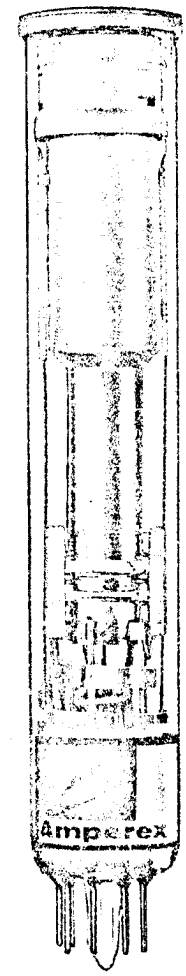
TUBE TYPE
S10XQA
SILICON VIDICON
CAMERA TUBE

DEVELOPMENT SAMPLE DATA

DESCRIPTION

The Amperex S10XQA is a TV camera pick-up tube with a photosensitive target in the form of a mosaic array of silicon diode elements. This pick-up tube offers the advantage of wide spectral response, high quantum efficiency, high sensitivity, low dark current and low lag.

The S10XQA can be exposed to direct sunlight without deleterious effects. It does not exhibit image burn-in and is able to withstand exposure to 100°C environments. It employs velocity stabilization and separate mesh construction in a 1 inch diameter "vidicon style" envelope. It is mechanically interchangeable with any 1 inch vidicon and also electrically interchangeable with any separate mesh "vidicon" such as the XQ1040 or the 8541.



Amperex®

GENERAL CHARACTERISTICS

MECHANICAL

Focusing Method	Magnetic[1]
Deflection Method	Magnetic[1]
Dimensions	See outline drawing, Pg.5
Bulb	T8
Base	JEDEC No. E8-11
Mounting Positions	Any
Weight	2.5 oz.
Accessories	
Socket	Cinch 54A18088 or equiv.
Focusing and Deflection Coil Assembly	Amperex Type AT1102, AT1103 or equivalent [1)]

ELECTRICAL

Heating	Indirectly AC or DC Parallel Supply Only
Heater Voltage	6.3 Volts ± 10%
Heater Current	100 mA max.
Capacitance	
Target To All other Electrodes	3 to 5 pF[2]
Grid No. 1 Voltage for Cutoff at Grid No. 2 Voltage = 300 volts	-30 to -100 Volts[3, 4]
Blanking Voltage, Peak to Peak	
On Grid No. 1	70 volts min.
On Cathode	15 volts min.
Grid No. 2 Current at Normally Required Beam Current[5]	1 mA max
Dark Current at Specified Target Voltage V_t (0 to 25 V) and a Faceplate Temperature of 30°C	50 nA max.
Signal Current, total (i_t)[6]	750 nA max.

The included data, based on the specifications and measured performance of development samples, afford a preliminary indication of the characteristics to be expected of the described product. Distribution of development samples implies no guarantee as to the subsequent availability of the product.

S10XQA

OPTICAL

Dimensions of Scanned Area (4:3 Aspect Ratio)	0.500 in. x 0.375 in. (12.8 mm x 9.6 mm)
Diameter of Scanned Area	0.625 inch (16 mm)
Orientation of Image on Photo-sensitive Surface	See Note 7

SENSITIVITY

CHART A

Light Source[8]	Luminous Sensitivity (μA/lm)[11]	Radiant Sensitivity (mA/W)[9]	Net Signal Current[24] with 0.1 fc incident illumination (nA)
Tungsten	4500	92.0	600
Visible[10]	900	18.5	120
Infrared[12]	2700	55.0	360

CHART B

Wavelength (nm)	Radiant Sensitivity (mA/W)	Quantum Efficiency(%)
550	250	56
750	450	75
950	250	33

Average Gamma of Transfer Characteristic	1.0
Spectral Response:	
Cut-offs at	400 and 1100 nm, approx.
Max Sensitivity at	800 nm, typ.
Index of Refraction of Faceplate	1.5
Target Optical Reflectivity	See Note 25

ABSOLUTE MAXIMUM RATINGS[26]

Grid No. 4 Voltage	650 Volts[4]
Grid No. 3 Voltage	600 Volts[4]
Grid No. 2 Voltage	350 Volts[4]
Grid No. 1 Voltage	
Positive	0 Volts
Negative	125 Volts
Grid No. 4 to Grid No. 3 Voltage Difference	350 Volts
Cathode to Heater Voltage:	
Peak to Peak Positive	125 Volts
Peak to Peak Negative	10 Volts max.
Cathode Current	3 mA
Heater Warm-up	1 Minute min.
Target Voltage	50 Volts[4]
Faceplate:	
Illumination	10^7 fc (14
Temperature:	
(Operation and Storage)	-100°C to 100°Cmax.

TYPICAL OPERATING CONDITIONS AND PERFORMANCE

Cathode Voltage	0 Volts
Grid No. 2 Voltage	300 Volts
Grid No. 3 Voltage	500 Volts[21]
Grid No. 4 Voltage	600 Volts
Target Voltage	6 to 10 Volts[22, 23]
Beam Current	See Note 15
Faceplate Temperature	20°C to 30°C
Faceplate Illumination[15] (Visible)	0.15 fc[8,10]
	0.05 fc[8, 12]
Signal Current Highlight (i_s), net; [24](infrared)	200 nA
Dark Current , Average [23]	15 nA, D.C.
Resolution, Central:	
Limiting	700 TV Lines[17]
Modulation Depth (uncompensated Horizontal Amplitude Response) at 400 TV Lines	40%[18]
Signal to Noise Ratio [19]	300:1
Lag (Persistence)[20, 23]	
Residual Signal after 50 msec.	10%
Uniformity of Sensitivity	20%
Uniformity of Dark Current	6%

FOOTNOTES:

1. Focusing/deflecting coil assembly available from Amperex Electronic Corp.; Cleveland Electronics Inc., and others.

2. The capacitance of the target to all electrodes, which effectively is the output impedance, is measured without the deflection/focussing coil assembly, and may increase when the tube is inserted into such assembly.

3. With no blanking voltage on Grid No. 1.

4. At cathode voltage = 0 Volts.

5. The maximum "Normally Required Beam Current" is taken as that beam current which is just sufficient to stabilize highlights with signal currents of 400 nA (peak value).

6. The total signal current consists of the current due to the signal plus the dark current, i.e., $i_t = i_s + i_d$.

7. For proper orientation of the image on the photo-sensitive layer, the horizontal scan should be essentially parallel to the plane passing through the tube axis and the short base pin.

8. Light source is a tungsten filament lamp in a lime glass envelope, operated at a color temperature of 2854°K.

9. Radiant sensitivity is derived from the luminous sensitivity assuming a luminous efficacy of 20.4 lm/W of 2854°K tungsten light. As with the luminous sensitivity, the level of irradiation is that before the filter where one is specified.

10. With the same light source specified in Footnote 8, except an infra-red absorbing filter Fish Schurman (Schott) Filter KG3, thickness = 4 mm. (.157 in.), is interposed between the light source and the faceplate of the tube. The level of illumination is that of the unfiltered light.

11. As measured under the following conditions:
Tubes are exposed to 0.0755 ft. c. illumination (light flux of .10 millilumen) of black body color temperature of 2854°K. An appropriate filter is inserted in the light path. The signal current obtained in nanoamperes x 10 denotes the luminous sensitivity expressed in terms of microamperes per lumen of white light incident on the filter.

Filters used:	Tungsten	No filter used
	Visible	Schott KG3 thickness 4 mm (.157 in.)
	Infrared	Schott RGN9 thickness 3 mm (.118 in.)

FOOTNOTES (Continued)

12. With the same light source specified in Footnote 8 except an infrared transmitting filter Fish Schurman (Schott) Filter RGN9, thickness = 3 mm (.118 in.) is interposed between the light source and the faceplate of the tube. The level of illumination is that of the unfiltered light.

13. A minimum of 1 minute warm-up time for the heater is to be observed for drawing cathode current.

14. Illumination levels in excess of 10 million foot-candles can be tolerated. This is equivalent to the image of the sun or a high intensity projection lamp being focussed onto the target. Care must be taken that the heat content of the focussed radiation does not cause the temperature of the target to exceed the maximum allowed level.

15. The beam current shall be adjusted for correct stabilization of twice the specified highlight signal current.

16. Illumination on the photo-sensitive layer, Bph, in the case of a black/white camera is related to scene-illumination, Bsc, by the formula:

$$Bph = Bsc \frac{R.T.}{4F^2 (m+1)^2}$$

in which R represents the scene-reflectivity (average or the object under consideration, whichever is relevant), T the lens transmission factor, F the lens aperature, and m the linear magnification from scene to target.

17. Limiting resolution is defined as the resolution at a modulation depth, i.e., uncompensated horizontal amplitude response, of 5% uncorrected for lens resolution losses. The amplitude response of the camera amplifier should be flat to well over 7.5 MHz; no gamma correction should be used.

18. Measured with 100% contrast square wave test pattern, normalized at 50 TVL, and corrected for lens resolution losses. The bandwidth of the camera amplifiers used are flat to beyond 5 MHz.

19. Measured with a high gain, low noise (2 nA rms) cascode-input type amplifier having a bandwidth of 5 MHz and a pulse signal output current of 200 nA. Because the noise in such a system is predominately of the high-frequency type, the "visual equivalent" of signal-to-noise ratio is used which is 3 times the ratio of highlight video-signal current to rms noise current.

20. Measured with an initial net highlight signal current of 200 nA.[15] The sequence of the measurement is as follows: The illumination is turned off at t = 0 immediately preceding a read-out of the initial signal. This read-out is labeled the "zeroth" field. The first residual signal occurs subsequently at t = 16.7 msec., i.e., in the first field. The value of lag listed is the magnitude of the residual signal in the 3rd field, ie., at t = 50 msec.

21. Adjust for minimum shading. The voltage ratio of Grid No. 4 to Grid No. 3 is between 1.1 and 1.5.

22. The target voltage (V_t) is individually selected and specified typically within a range and indicated for each tube. This is to achieve an optimum operating point consistent with optimal beam acceptance and to optimize other performance characteristics, such as dark current, blemishes, uniformity and lag.

23. Data on target voltage, dark current and lag supplied with each tube.

24. The net signal current is to consist of the total signal current less the contributions due to dark current; i.e. $i_s = i_t - i_d$.

25. The optical reflectivity of the silicon target is controlled by application of an anti-reflecting coating. The value of minimum reflectivity, the wavelength at which it occurs, and the wavelength interval over which it applies can be preselected to suit various applications. For example a typical set of values would be– 0.1% target reflectivity, centered at 750 nm with reflectivity <1% over the wavelength interval 650 nm to 850 nm. It should be noted that the residual reflectivity from the faceplate is approximately 8%, independent of wavelength. For special applications it should be possible to reduce the 8% to 4% or less by application of anti-reflection coatings to one or both surfaces of the faceplate.

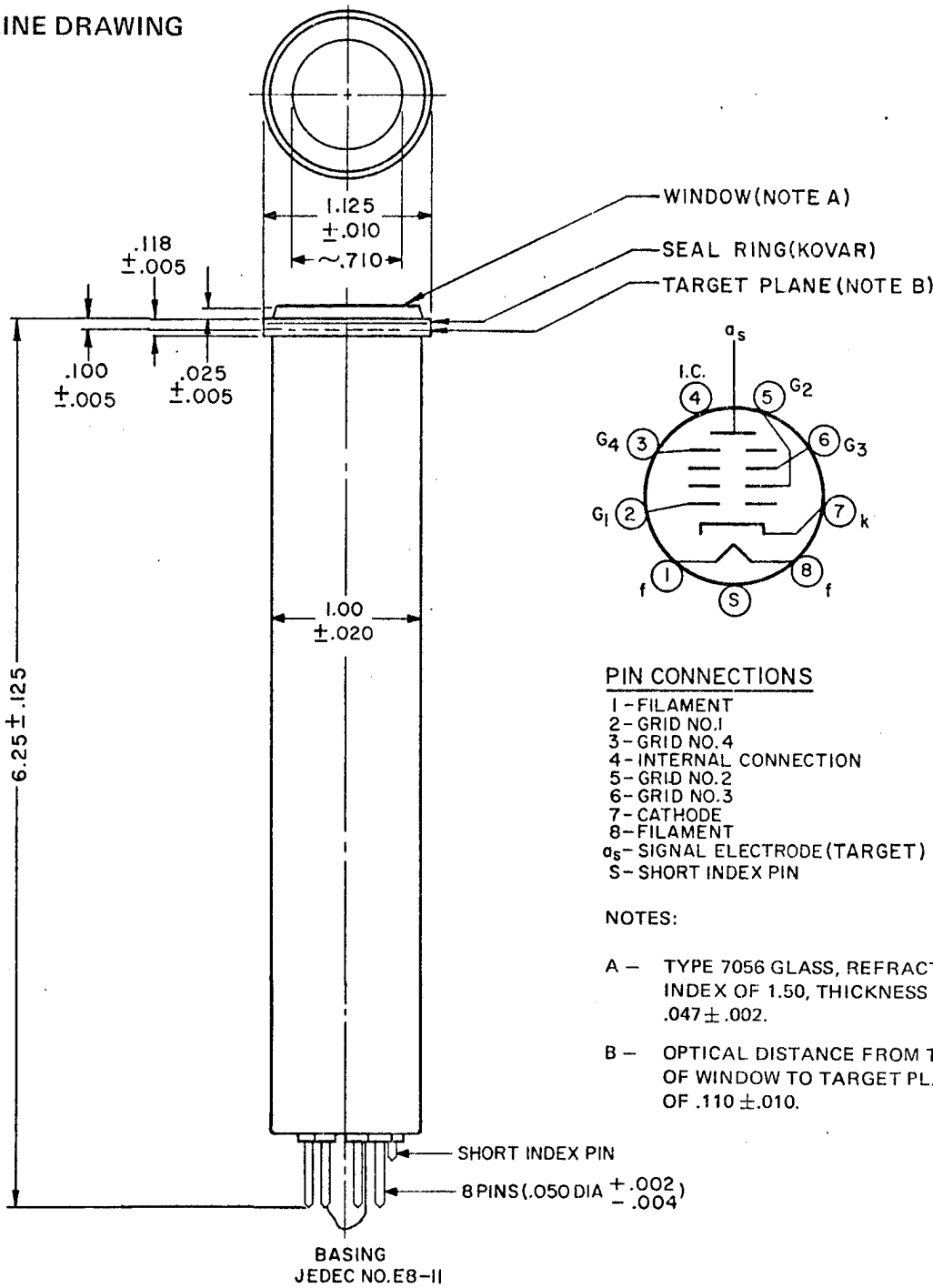
FOOTNOTES (Continued)

26. By definition Absolute Maximum Ratings are limiting values of operating and environmental conditions applicable to any electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device taking no responsibility for equipment variations, enviornment variations, and the effects of changes in operating conditions due to variations in device characteristics.

The equipment manufacturer should 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 with respect to supply voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions and variations in device characteristics.

OUTLINE DRAWING



PIN CONNECTIONS

1 - FILAMENT
2 - GRID NO.1
3 - GRID NO.4
4 - INTERNAL CONNECTION
5 - GRID NO.2
6 - GRID NO.3
7 - CATHODE
8 - FILAMENT
a_s - SIGNAL ELECTRODE (TARGET)
S - SHORT INDEX PIN

NOTES:

A — TYPE 7056 GLASS, REFRACTIVE INDEX OF 1.50, THICKNESS OF .047 ± .002.

B — OPTICAL DISTANCE FROM TOP OF WINDOW TO TARGET PLANE OF .110 ± .010.

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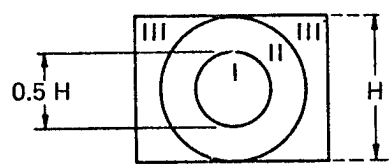
PICTURE QUALITY (due to blemishes)

Blemishes can be regarded as either spots or smudges. A spot or smudge is defined as a blemish with a maximum linear dimension in any direction of 1% or 5% respectively, of the picture height and a contrast in excess of 10% of 100% white level as measured on a waveform oscilloscope (bandwidth 5.5 MHz), black level being defined as zero percent.

The picture quality is evaluated in the following setting in respect of highlight signal current and applied beam current viz:

Highlight signal current	I_s = 200 nA	0
Beam current adjusted for correct stabilization of a signal current of:	I_b = 400 nA	400 nA

The specified area of 0.5 x 0.375 in. on the target is evenly illuminated with light appropriate to the application through a back illuminated test dia. with aspect ratio 4:3. The area of the test chart is divided in three quality zones by two concentric circles with diameters as shown below.



The obtained picture shall be observed on a monitor producing a non-blooming white. The numbers and sizes of blemishes shall not be in excees of those tabulated below.

	Permitted number of blemishes a) c)		
Dimensions in any direction measured in percentage of picture height (approx T.V. lines) at the 10% contrast point.	Zone I	Zone II	Zone III
over 1% (5 TVL)	0	0	0
1% to but not incl. 0.7%	0	1	2
0.7% to but not incl. 0.45%	1	2	4
0.45% to but not incl. 0.2%	2	4	6
0.2% and under (1 TVL)	b)	b)	b)

Notes:

a) The distance between any two spots shall be greater than 5% of picture height in any direction.

b) Spots of this size are not counted unless concentration causes a smudge appearance. Such concentrations are evaluated as smudges. As contrast the average contrast of the concentration is taken.

c) Blemishes with a contrast less than 10% are not counted.

d) Blemishes greater than 5% (25 TV lines) will be considered a variation in uniformity, either of sensitivity or dark current

Revised July 1970