THOMSON-CSF
DIVISION TUBES ELECTRONIQUES

Date 1/6/88

de G. SULPICE

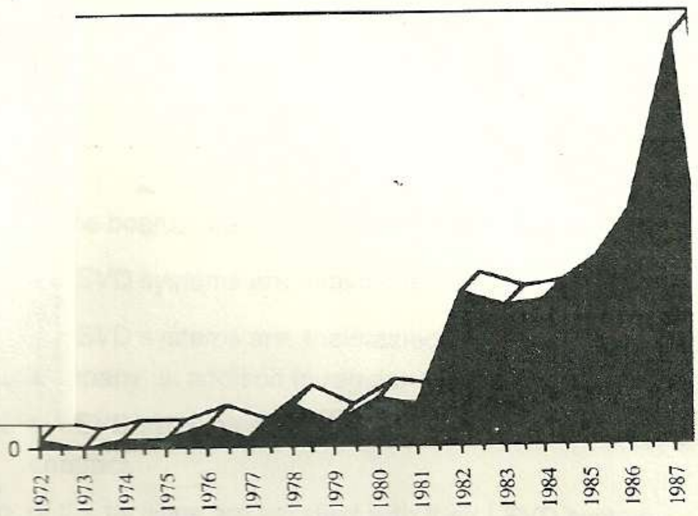
à M. GRANDET

GC 743

CREEN

The Industry

ANNUAL GROWTH LSVD



82	Sullivan Stad	D-V
83	Three Rivers Stad	D-V
83	Yankee Stad	D-V
83	B.C. Place (Vancouver, B.C.)	D-V
83	Houston Astrodome	D-V
83	Arrowhead Stad	D-V
83	Arlington Stad	D-V
83	Twickenham Rugby Stad (England) (2)	D-V
83	Hong Kong Jockey Club	D-V
83	Mobile Type (USA) (2)	D-V
83	Alameda County Coliseum	D-V
83	Alameda County Arena (2)	D-V
83	Sydney Cricket Ground (Australia)	D-V
84	Hoosierdome	D-V
84	Brendan Byrne Arena	D-V
84	Hollywood Park	D-V
84	Garden State Racetrack	D-V
84	Thistledown Racetrack	D-V
84	Jack Murphy Stad	D-V
84	Baltimore Memorial Stad	D-V
84	Hong Kong Jockey Club	D-V
84	Billboard Type (NY)	D-V
84	Billboard Type (CA)	D-V
84	Japan Racing Association	D-V
84	Kobe Port-Island	D-V
84	Koshien Stad	D-V
84	Meadowlands Arena (2)	D-V
85	Texas Stad (2)	D-V
85	Louisiana Superdome (2)	D-V
85	Canterbury Downs (Minneapolis)	D-V
85	Tsukuba EXPO '85	D-V
85	Mobile Type (Japan)	D-V
85	Japan Racing Assoc (Kyoto)	D-V
85	Japan Racing Assoc (Nakayama)	D-V
85	Hippdrome de Vincennes	D-V
86	Japan Racing Association (Hashin)	D-V
86	Singapore Turf Club	D-V
86	Atlanta Fulton County Stad	D-V
86	Phoenix Veterans Mem Coliseum (2)	D-V
86	Louisiana Downs	D-V

Manufacturer Market Share

1985

26 LSVD Units were installed.

Diamond Vision 11
EEV 2
Omega 1
Panasonic 8
Sony 4
Toshiba 0

1986

34 LSVD Units were installed.

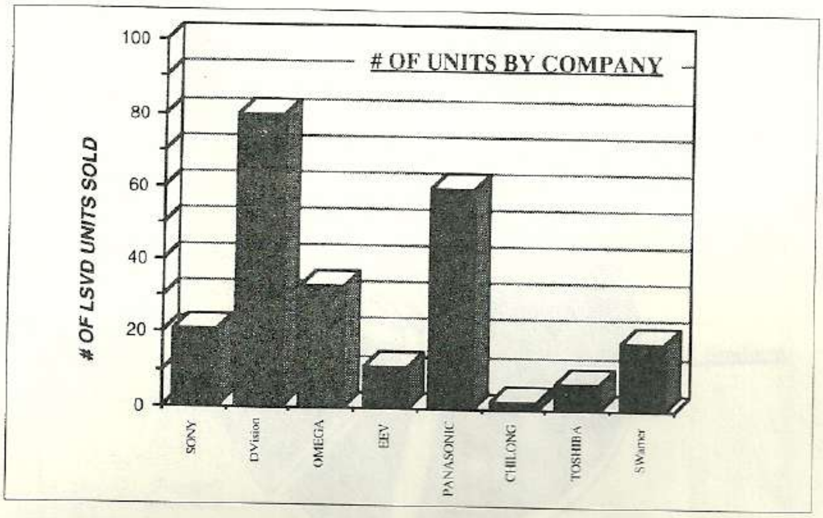
Diamond Vision 9
EEV 2
Omega 6
Panasonic 10
Sony 5
Toshiba 2

1987

57 LSVD Units were installed.

Diamond Vision 2
EEV 4
Omega 5
Panasonic 31
Sony 12
Toshiba 3

	Denver McNichols Arena (2)	D-V
	Louisiana Downs	D-V
	Mile High Stad	D-V
87	Edogawa Boat Race Course (Japan)	D-V
83	Prototype/Demonstrator	EEV
84	Fully Mobile (London)	EEV
85	Fully Mobile (London)	EEV
85	Stad/Italy	EEV
86	Fully Mobile (London)	EEV
86	Stad/China	EEV
87	Stad (China)	EEV
87	Fully Mobile (London)	EEV
87	Transportable (England)	EEV
87	Fully Mobile (Canada)	EEV
88	Fully Mobile (Canada)	EEV
78	Saudi Arabia (sports hall)	Omega
78	Saudi Arabia (Indoor pool)	Omega
78	Saudi Arabia (football stad)	Omega
79	Brewers Stad	Omega
80	UAE (Sheik Zayed stad)	Omega
81	Saudi Arabia (outdoor pool)	Omega
82	Nat'l Guards Stad Saudi Arabia	Omega
82	Libya (stad)	Omega
82	Kasena stad Kuwait	Omega
82	Football stad Spain	Omega
82	Kalogreza stad Greece	Omega
82	National Stad Brunei	Omega
82	Shooting range UAE	Omega
82	Stad Saudi Arabia	Omega
83	Stad Saudi Arabia	Omega
83	Sports Hall Saudi Arabia	Omega
83	Pool Saudi Arabia	Omega
83	Stad Morocco	Omega
83	Stad Oman	Omega
85	Stad Bahrain	Omega
86	Stad Saudi Arabia	Omega
86	Stad West Germany	Omega
86	Olympic Stad South Korea	Omega
86	Stad Saudi Arabia	Omega
86	Stad West Germany	Omega
86	Olympic Stad South Korea	Omega
87	Stad Zimbabwe	Omega
87	Stad Italy	Omega
87	Fenway Park	Omega
87	Horse Track Italy	Omega
87	Stad Zimbabwe	Omega
88	Frankfurt Stad West Germany	Omega
38	Horse track Seoul S. Korea	Omega
82	Nishinomiya Stad (Japan)	Panasonic
83	Mobile System (Japan)	Panasonic
83	Briuli Stad (Italy)	Panasonic
83	Osaka Hall Arena (Japan)	Panasonic
83	Philadelphia Veterans Stad	Panasonic
83	Los Angeles Coliseum	Panasonic
85	Expo Park Tsukuba, Japan	Sony
85	PM Tokyo Building	Sony
85	OTB	Sony
85	Sony Building	Sony
86	Crystal Cathedral	Sony
86	Portable Unit #1-3	Sony
86	Mobile Van Portable	Sony
86	Holland	Sony
86	Portable Unit US #1	Sony
87	Jacob Javitz	Sony
87	San Antonio	Sony
87	Jacob Javitz	Sony
87	San Antonio	Sony
87	Birmingham Turf Club	Sony
87	San Francisco Candlestick Park	Sony



38% of the boards are maintained by the manufacturer.

54% of LSVD systems are maintained through in-house staff.

40% of LSVD systems are maintained through an independent company in addition to regular maintenance.

15% of LSVD systems are maintained as part of a warranty or contract.

92% of the facilities are satisfied with their LSVD system.

69% of the facilities have a production staff of 10 or more people.

62% of the facilities responding would buy the same LSVD technology as their existing system.

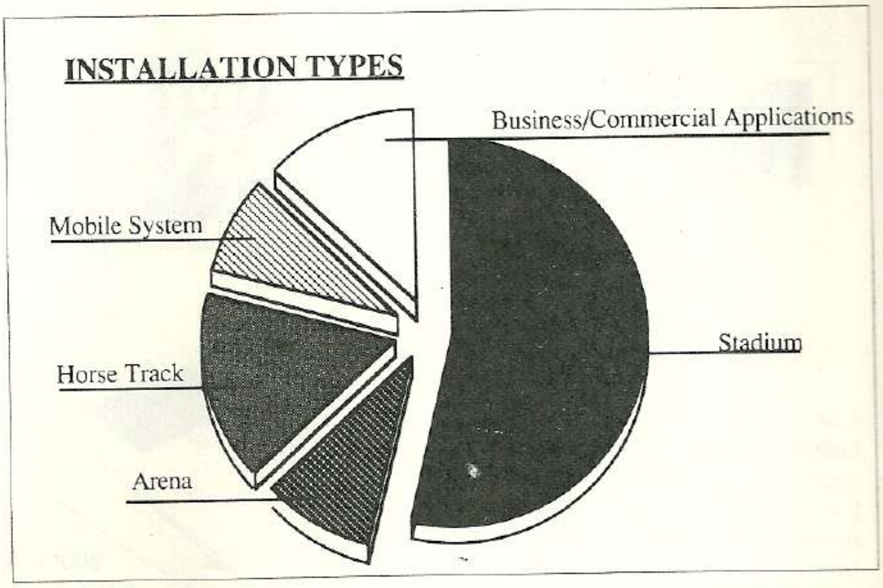
38% of the facilities responding would change LSVD technology from their existing system.

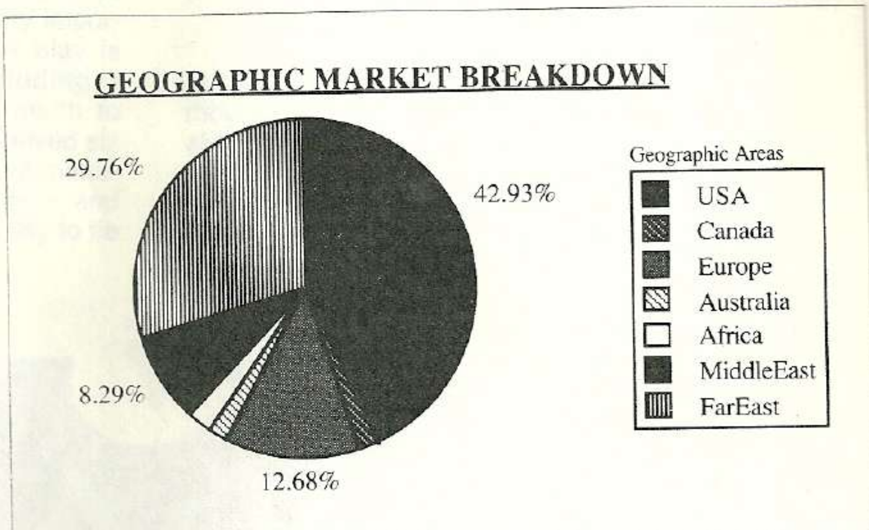
Most frequent maintenance concerns

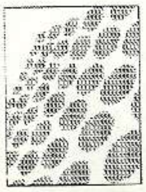
- **Diamond Vision**
  problem video control units and burned out light units.
- **Sony JumboTRON**
  failing light units and general heavy maintenance.
- **Stewart-Warner**
  burned out light units.
- **Panasonic**
  circuit board problems.

This information above was compiled from a recent questionaire addressing the main points of maintenance and production issues of Large Screen Video Systems in major sporting facilities.

7	Cincinnati Riverfront Stad	Sony
87	Miami Dolphins Stad (2)	Sony
87	Seibo Lions	Sony
87	Meadowlands Race Track	Sony
87	Anaheim Stad	Sony
88	Toronto Stad	Sony
72	Arrowhead Stad	Stewart Warner
74	Nassau Veterans Memorial Coliseum	S-W
75	Mile High Stad	S-W
76	Fenway Park	S-W
76	Meadowlands Racetrack	S-W
76	Giant Stad	S-W
77	Fulton County Stad	S-W
78	Exhibition Stad	S-W
78	Sha Tin Racecourse (Hong Kong)	S-W
78	Arlington Park Racetrack	S-W
79	Tiger Stad	S-W
79	Hollywood Park Racetrack	S-W
80	Machu Trotting Club	S-W
80	Mitsukoshi Fashion Store (Tokyo)	S-W
80	Melbourne Civic Square (Australia)	S-W
80	Anaheim Stad	S-W
81	VFL Park,Waverly (Australia)	S-W
83	Busch Stad	S-W
80	Jingu Baseball Stad	Toshiba
86	Kawasaki Shopping Mall	Toshiba
86	Ohi Horserace Track (Tokyo)	Toshiba
87	Fukushima Horserace Track	Toshiba
87	Nagoya Municipal Gymnasium	Toshiba
87	Chukyo Horserace Track	Toshiba
88	Kokura Horserace Track	Toshiba

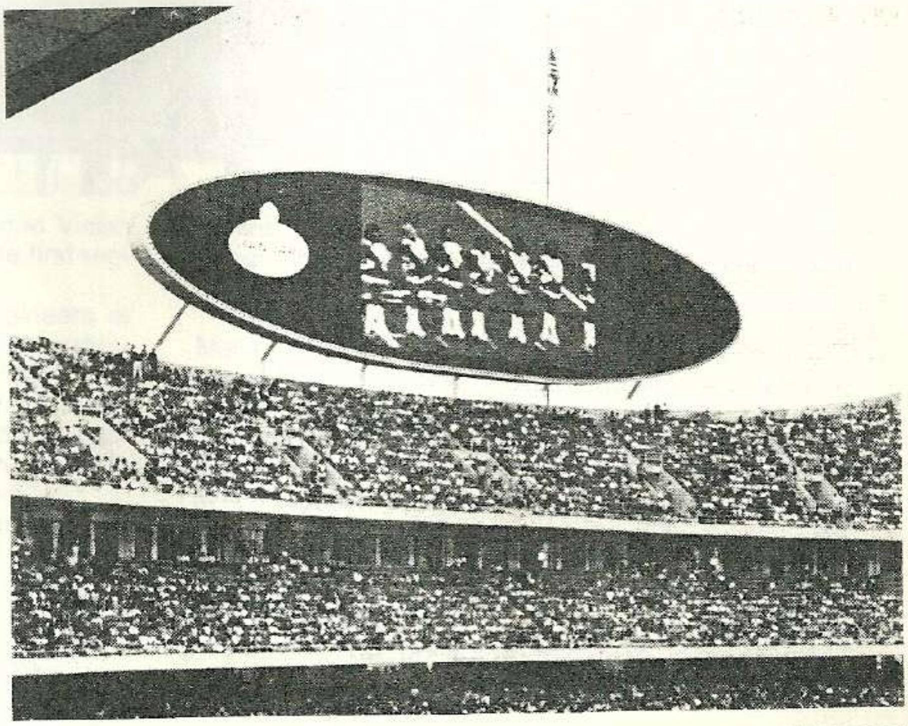






ARROWHEAD STADIUM 1972 HOME OF THE KANSAS CITY CHIEFS AND THE FIRST LARGE SCREEN VIDEO DISPLAY

The first large screen video display was bought by the Kansas City Chiefs Football Club and installed at Arrowhead Stadium in 1972. The board was built by Stewart-Warner, matrix size 60' x 30', actual sign 150' x 37'. Incandescent 40 watt inside frosted lamps provide four shades of grey. There are 16,200 lamps with 4" on centers. The display is still operational.



14.1: A New High-Resolution Jumbotron

H. Nakagawa and A. Ohkoshi
Sony Corporation, Tokyo, Japan

1. Introduction

At the International Exposition Tsukuba '85, an ultra-large screen -- 40(H)x25(V) m -- display, called the Jumbotron, was exhibited(1). This Jumbotron was developed to enable pictures of near conventional television quality to be displayed outdoors on a large screen.

To achieve this picture quality, we developed for the Tsukuba Jumbotron a light-emitting device with three rectangular phosphor screens: blue, red and green. The pixel pitch of this light-emitting device was 100 mm, appropriate for a 40 m wide screen. We found, however, that the resolution of pictures displayed using this light-emitting device on a small screen -- 20 m wide, for example -- was less than desirable.

As there is a need for a Jumbotron system designed to display pictures on screens 5 to 15 m wide and of 200 to 700 horizontal pixels, a new fine pitched multi-pixel light-emitting device was developed, which we report here.

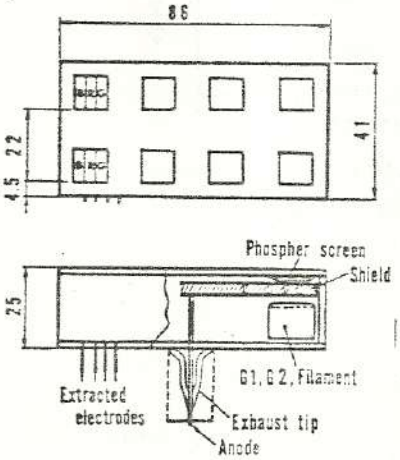


Fig. 1 Multi-pixel light-emitting device

2. The light-emitting device

Figure 1 shows the new TL-8 light-emitting device. The size of the light-emitting device, excluding the exhaust tip, is 86(W)x41(H)x25(D) mm. There are eight small pixels, each composed of three phosphor screens, on the front panel of the light-emitting device. The 22 mm pixel pitch was chosen after determining the optimum trade-off between the desirability of positioning pixels close together for maximum brightness and the need to allow for a space for assembling the electrodes inside the vacuum envelope and for adjusting the critical vertical and horizontal alignment of the pixels. Accordingly, the light-emitting device has blue, red and green phosphor screens measuring 3(H)x10(V) mm with 1 mm spacing, which form an 11(H)x10(V) mm phosphor screen triplet. Although the percentage of the light emitting area is only 18.6%, the contrast ratio is 1:180 under 1000 lx ambient light compared to 1:30 for conventional television. The light-emitting device can, therefore, be operated under high ambient light.

In the Tsukuba Jumbotron, all the low voltage electrodes of the light-emitting device were built on lead frames. Because of the reduced pixel pitch, however, it was difficult to build the electrodes of the present device in the same manner. We designed a low voltage electrode block, as is shown in Fig. 2, for each pixel.

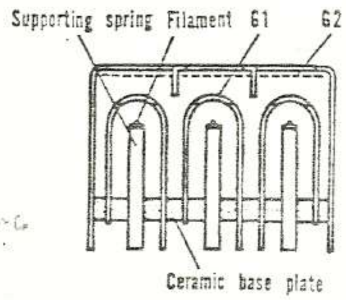


Fig. 2 Low voltage electrode block

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Filaments and G1 control grids are mounted on a ceramic base, which is covered by a box-shaped second grid. The control grids are bent into concentric semicircles to cover the wire filaments, and the aperture for the electron beam is formed of a meshed screen. The curvature of the grid enables the electron beam from the wire filament to be distributed uniformly. The aperture of the second grid is also formed of a meshed screen. As the electrode is connected to the ground, forming a retardation field for electrons, the second grid will prevent the high-potential field of the anode from influencing the electrons from the control grid.

To minimize the number of electrodes extracted from the vacuum envelope of the light-emitting device, we connected as many electrodes to common leads as possible. In this way, the anodes and the second grids are connected to respective common leads. The control grids of the upper and lower row of pixels are also connected to respective common leads to allow the device to be operated more efficiently.

As the phosphors are illuminated at high power, we selected the following materials: ZnS:Ag for blue, Y_2O_3:Eu for red and $Y_3Al_2Ga_3O_{12}$:Tb for green. As is shown in Fig. 3, the green phosphor is non-saturable and has stable brightness during high-power operation[2]. Aluminum thin film was coated on the phosphor screens to protect the phosphors from the ionic bombardment which is induced from the cathode and also to reflect light output from the phosphors. We optimized the thickness of the aluminum thin film so that the phosphors would generate sufficient light output, but not be damaged during high-power operation. Using this optimum thickness, it was possible to operate at a lower anode voltage (8 kV) than that of the Tsukuba Jumbotron (10 kV).

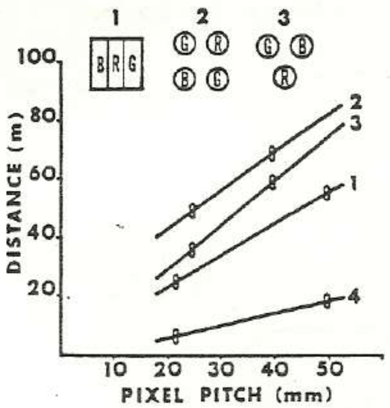

Fig.4 Viewing and color mixing distance plotted against pixel pitch

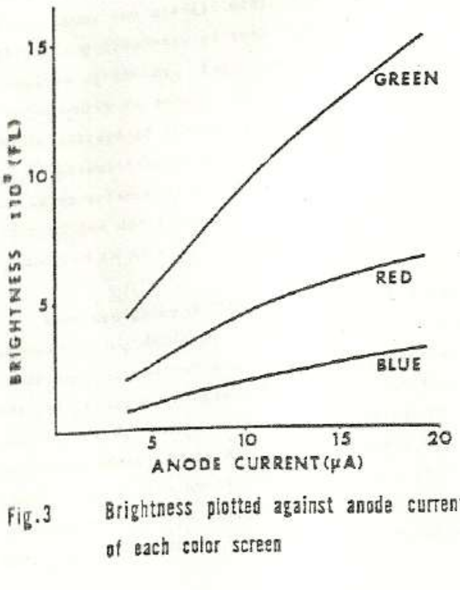

Fig.3 Brightness plotted against anode current of each color screen

3. Arrangement of color screens

Line 1 in Fig. 4 plots the minimum viewing distance against pixel pitch for the TL-8 light-emitting device. The minimum viewing distance is defined as the distance below which the average observer begins to discern that the picture is composed of discrete pixels. In the experiment, the variations of pitch, size of pixel, and pattern of the colors within a pixel shown in the inset in Fig. 4 were generated on a computer display and examined by ten observers. Lines 2 and 3 show the result for rectangular and triangular patterns of color arrangement respectively, which coincide with the result of F. Kamiya, et al[3]. Line 4 indicates the distance below which an average observer discerns only discrete color screens as opposed to the overall picture.

Based on these results, the arrangement shown in Fig. 1 was selected. The color screens are positioned in order of blue, red and green from left to right in the horizontal direction. If a red phosphor screen is positioned on either side of the color screen triplet, the boundaries in the picture will appear redish, degrading the picture quality, especially when a whitish boundary is displayed.

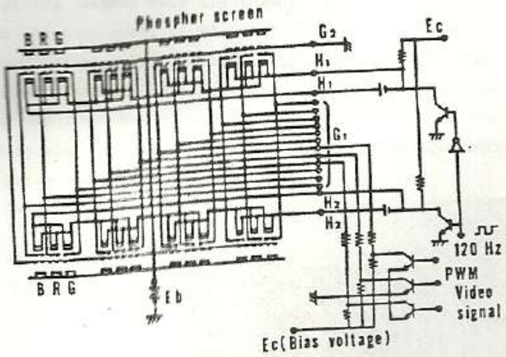

Fig. 5 Drive circuit and connections

4. Device operation and system configuration

Figure 5 is a schematic diagram of the drive circuit for the light-emitting device. The four pixels of the upper row and the remaining four pixels in the lower row are illuminated alternately by driving the filaments of each row alternately at a frequency of 120 Hz. Each control grid is operated independently to select the colors and brightness. As the voltage of the grids of each color screen in the light-emitting device is the same, brightness of the color screens is controlled independently by the width of the driving pulse -- pulse width modulation -- applied to each control grid.

When designing a picture screen with discrete light-emitting devices, it is essential to stabilize anode current against fluctuation of cathode emission and grid voltage in order to insure the uniformity of color and brightness. With the connecting method described above, it is difficult to detect the fluctuation in the anode current for each pixel in order to control the cathode current. It was necessary, therefore, to devise a method for stabilizing

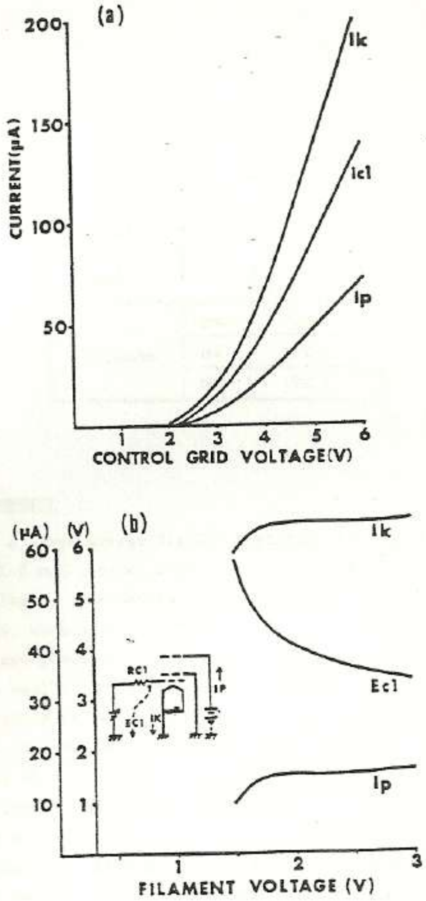

Fig.6 (a) Cathode, control grid and anode current vs. control grid voltage

(b) Cathode, control grid and anode current vs. filament voltage

the anode current without affecting the external circuit. We have developed the following simple method.

A resistor was inserted between the voltage source and the control grid. As is shown in Fig. 6-(a), the cathode current (Ik) is the sum of the control grid current (Icl) and the anode current (Ip). When Ik increases, Icl will increase and the control grid voltage (Ecl) will decrease. The decrease of Ecl will suppress the increase of Ip. When Ik decreases, Ecl will increase resulting in Ip not decreasing. Figure 6-(b) shows that Ip remains stable when Ik and the corresponding filament voltage (Ef) is varied. The corresponding curve of Ecl is also plotted.

Figure 7 shows a Jumbotron unit encorporating 32 TL-8 light-emitting devices, in eight rows of four columns. The screen measures 350x350 mm, a size which is easy to set up, maintain and transport. The spacing between each light-emitting device is 1.5 mm to maintain equal pixel pitch throughout the Jumbotron screen. The power sources, including the high-voltage source, and the video driver circuit boards of the light-emitting devices were installed in the unit also to simplify the setting up of the Jumbotron system and its maintenance.

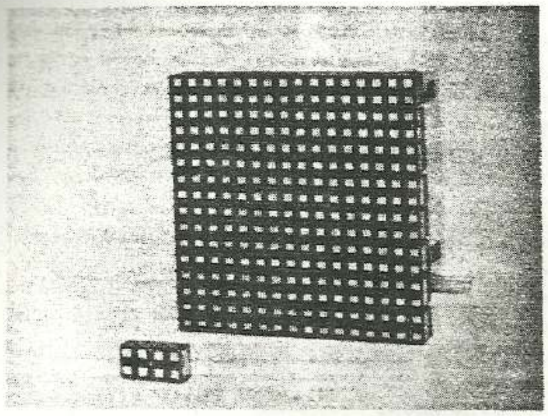

Fig.7 Display screen unit

These Jumbotron units are installed in a Jumbotron frame the size of which can be varied to meet individual requirements. Table I shows an example of specifications of a Jumbotron in which the TL-8 light-emitting device was employed, and Table II shows the specifications of the TL-8 light-emitting device.

Table I. Specifications of the Jumbotron

Screen size		7 x 3.9 m
Pixels		56320 (320 x 176)
Light-emitting devices		7040
Units		220
Power consumption		~24 kW
Brightness		600 fL max.
Displayable characters	Roman	1149
	Chinese	220

Table II. Specifications of the TL-8

	Typical values	
Filament	2.1 V 125 mA	
Control grid	5 V 300 μA	
Second grid	0 V	
Anode	8 kV 500 μA	
Brightness	green	3000 fL
	red	1500 fL
	blue	500 fL

5. Summary

A large-screen display employing a newly designed TL-8 multi-pixel light-emitting device has been developed. The device has 8 pixels on the front panel, each pixel consisting of a triplet of blue, red and green phosphor screens. This display system is a smaller model of the Jumbotron which was exhibited in the International Exposition Tsukuba '85. Four models of the new Jumbotron were produced, three of which have been set up in Japan and one in California. The Jumbotron's high resolution for its screen size allowed all four models to be set up indoors, in large exhibition halls and proved that this new way to display information is suitable for both indoor and outdoor applications.

Acknowledgement

We would like to thank Mr. K. Morimoto of Futaba Corporation for his collaboration throughout the development of the TL-8 light-emitting device.

References

(1) A. Ohkoshi, SID 1985 Symposium Digest of Technical Papers, p87, 1985.
(2) K. Ohno, T. Abe, The Electrochemical Society Fall Meeting Extended Abstract, Vol. 84-2, Abstract No. 593A, 1984.
(3) F. Kamiya, et al., ITEJ Technical Report, IPD76-3, 1983 (in Japanese).

29.2.88.

JUMBOTRONE

2 types de produits possibles:

JUMBOMAX: 30 x 40 m² ~ 70.000 spectateurs

TELEMAX: 6 x 4,50 m². ~ 1000 à 2000 spectateurs.

soit ~ 7000 Triades (3 tubes associés).

la surface peut être réduite

MARCHÉ:

Fr: 60 fixes

60 Mobiles (Camions publicitaires : ex Arrivée du tour de France)

CEE: GB. RFA. It. pays scandinaves

4 fois le marché Français

durée de vie : 10 ans

ECONOMIE:

30 / an TELEMAX. Part TDO dans 1 système 40%

px typique de l'écran de plusieurs 7MF (au moins pr les premiers exemplaires).

On pourrait par la suite ↘ d'un facteur 1,5

CA (TDO/an) : 84MF

REALISATION:

SONY ferait le système

X → " le produit, l'installation, la maintenance.

Il faudrait trouver aussi un maître d'Oeuvre.

OPPORTUNITÉS :

Bicentenaire de la révolution Française }
JO 92 ... 4 télemax en savoie }

STRATEGIE :

C'est TH qui possède la clef du marché.
Joint Venture avec SONY pr que SONY doivent necessairement passer par Thomson pr avoir accès aux opportunités
SONY : système
TDO : boîtes à image

BOUILLON : Directeur (Adjoint) SFP
Sr Responsable Technique de la Communication aux JO.