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PROCEEDINGS

A NEW LARGE SCREEN FULL COLOR
DISPLAY FOR INDOOR USE

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Introduction

A new large screen full color display for indoor use has been developed by us, which provides the audience at the distance of 10 to 15 m and over in lightness environment, with clear video, graphics, and text informations. The screen size is 3.64 m x 2.88 m. The pixel pitch is 15mm. The brightness is 1300cd/m². The viewing angle is over than 75 degrees in horizontal direction and vertical.

Especially, as the thickness and weight of the screen has been reduced, the display can be installed without reinforcement of the structure or rearrangement of the place. The thickness of our screen is 25cm and its weight is 1300kg, which is much thinner and lighter than a similar large screen display (1). The specifications of our display are shown in Table 1.

Following are brief descriptions of our newly developed lighting element and structural configuration.

Lighting element

The lighting element is very important factor to compose the thin and lightweight screen. Our lighting element is developed by the combined application of the luminescence principle of the ordinary CRT and the manufacturing technology of vacuum fluorescence displays. There are 16 color pixels in 4x4 matrix arrangement as shown in Fig.1. The color pixels are arranged as G-R-G-B manner (Table 1) on the flat front plate of the lighting element. The pixel pitch is 15 mm, the phosphor measuring 10(H) x 10(v) mm with 5 mm spacing. We applied the matrix type for the electrode structure because the number of driving circuits can be reduced.

(1) structure

The basic structure of the element is shown in Fig.2. The X-, Y-electrode and the filament are set on the glass plate at the lower voltage side. The anode electrode is set on the other glass plate at the higher voltage side, and the aluminum thin films is coated on its glass plate. These two glass plates are sealed to both ends of the spacer glass by using the low-melting frit glass. Thus the element is structured according to the triode theory.

(2) lighting operation

When the positive-voltage is applied to X-, Y-electrode, the thermoelectron being emitted from the filament can pass through the mesh of the Y-electrode by the influence of the electric potential gradient. At the same time, the thermoelectron is accelerated by the high voltage of the anode electrode. The accelerated electron (= electron beam) excites the phosphor and the phosphor emits a light. When the negative voltage is applied to the both or any one of the X-, Y-electrode, the thermoelectron can not pass through the mesh of the Y-electrode, and as the consequence, the phosphor screen doesn't emit light. The circuits for the X-, Y-electrode control the voltage to select lighting pixels like as a matrix switching.

(3) Phosphor

The same phosphor as used in an ordinary commercial tv is used, which emits itself by electron beam and has high luminescent efficiency. The phosphor is covered with the aluminum thin film, because to protect from the ionic bombardment which is induced from the filament and also to reflect light output from the phosphor. References are made to the Table 2 for the specifications of the phosphor and the Fig.3 for its emission spectrum.

Driving circuit

Fig.4 shows basic control sequence of the developed driving circuits. Each X-electrode is driven by the scanning signal in 1/4 duty. The Y-electrodes are driven by the pixel data signals. The time duration of each data signal is varied according to the video signal

level of corresponding pixel. When the scanning signal and the data signal are applied to the each X- and Y-electrode, the selected phosphor-dot emits light.

To realize a flicker-free display, 4 basic scanning sequences are repeated in a normal tv field, that is scanning rate is $4 \times 60 = 240$ Hz. Number of gray levels is 16 in a basic scanning sequence, and by repeating this sequence 4 times, 64 gray levels can be obtained. In this way, using the matrix switching of the X-, Y-electrode without switching of filaments like the similar display(2), the control of gray level is accurate, and also high speed response is realized. Further, life of lighting element is prolonged.

The matrix type driving method reduces number of circuit components sharply. The time duration of the light emission is reduced by $1/4$ scanning duty, but the brightness is sufficient, because the lighting element itself has high peak brightness.

Structural configuration

To compose the thin and lightweight screen, the hierarchical structure has been introduced, as shown Fig.1 and Fig.5. A unit is integration of 16 lighting elements. A module is composed by 8 units. Further the screen block is constructed by building up the modules, and the screen blocks are arranged side by side to form a screen. Fig.6 shows the wiring among units, modules and screen blocks. This structure realizes a thin and lightweight screen, having the features as follows.

- (1) The integration of lighting elements are easily done by a printed unit board which carries driving circuits.
- (2) The connection between units are also done by a printed module board.
- (3) The wiring using " wire " is required only between modules. This minimizes wiring points, thickness and weight.

In addition, it also realizes other useful features. The maintenance can be carried out from the front and no space is required in the back, and the installation is easily planned and completed in a short period.

Conclusion

We have discribed the technical features of our lighting element and the structural configuration which are used in the new large screen full color display for indoor use .

With further advancement of the display ability and the technology which makes the screen much lighter in its weight and thinner, we have a confidence that the demand for larger sized screen display will be increased in a rapid pace and in a growing numbers.

To overcome the technical difficulties and to cope with requirements of the market, we will continue our current research of the lighting element and the study of the display controller and the structure of the screen.

Acknowledgment

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Reference

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- (2) H.Nakagawa and A.Ohkoshi "A New High-Resolution Jumbotron" '86 SID Tec.Digest, p246-p249

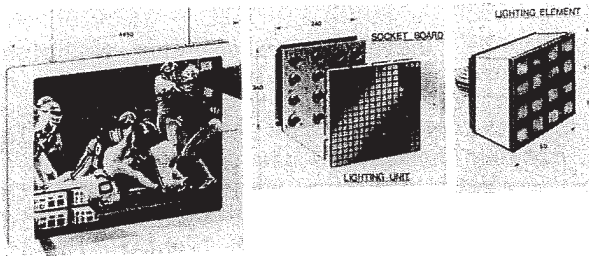


Fig.1 structural configuration

Table 1. specifications of the developed display

Dot arrangement (mm)	
Screen size (m)	3.84 x 2.88
External dimensions (m)	4.46 x 3.1 x 0.25 (L x H x D)
Weight (kg)	1300
Brightness (cd/m ²)	1300
Density (dots/m ²)	4452
Min. viewing distans	image : 15m, character : 10m
Viewing angle	any direction
Number of gray level	64
Response time	equivalent to tv
Display rate (fields/s)	60
Life (hrs)	over 3000
Power consumption (kva)	6
Operating environment	indoor

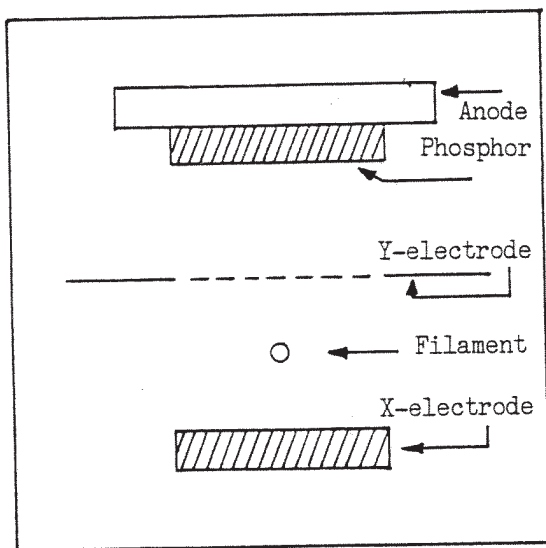


Fig.2 basic structure of the lighting element

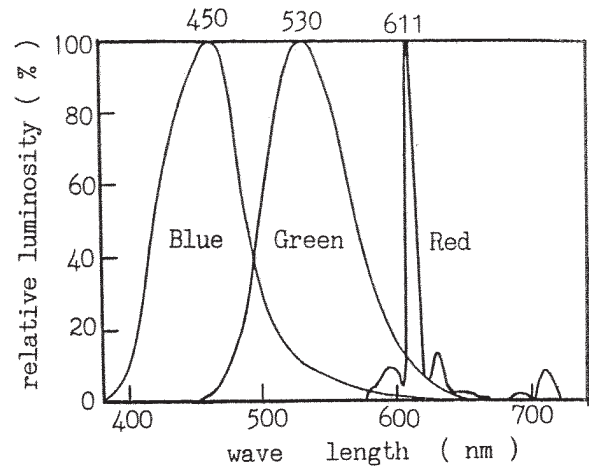


Fig.3 emission spectrum of the phosphor

Color Composition	Wave length at Peak (nm)	Color Coordinate X	Color Coordinate Y
Red Y ₂ O ₃ :Eu	611	0.642	0.351
Green ZnS:CuAl	530	0.282	0.620
Blue ZnS:Ag	450	0.147	0.060

Table 2 specification of the phosphor

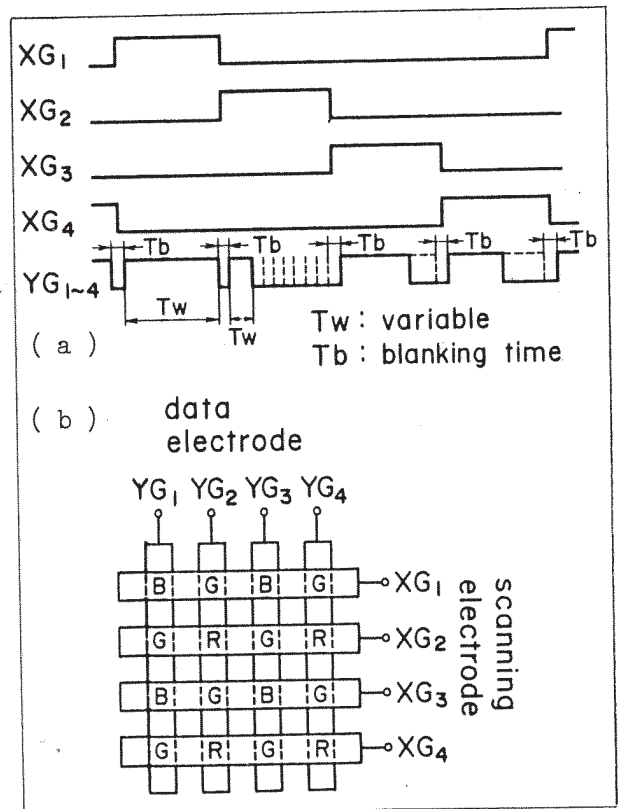


Fig.4 basic control sequence of the developed driving circuit

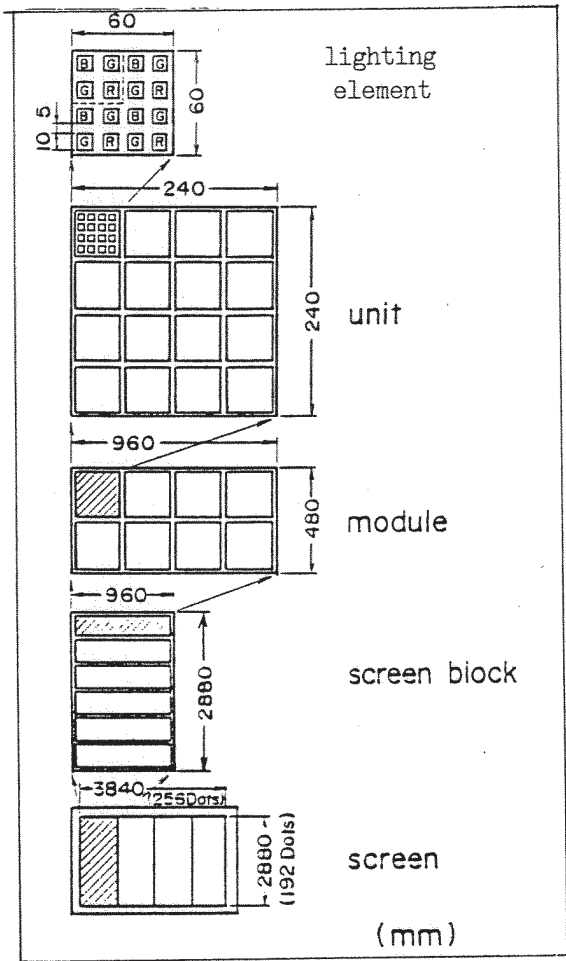


Fig.5 hierarchical structure

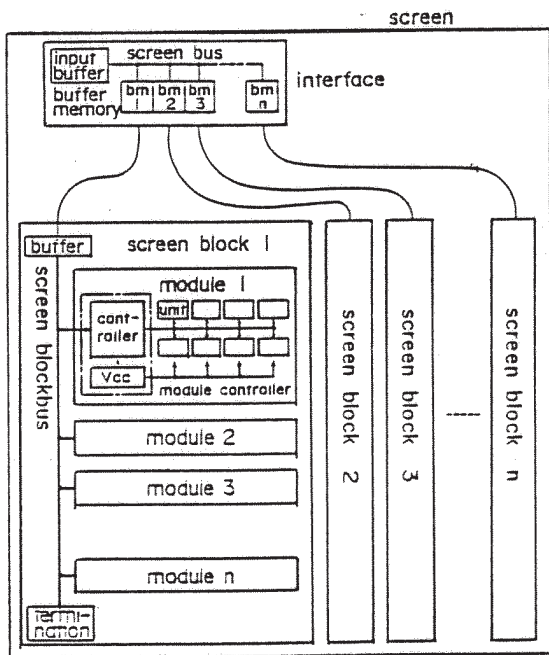


Fig.6 connection in the screen