

A New Driving Scheme for Reduction of Addressing time and its Dispersion in AC PDP

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Abstract

The conditions of the wall charges and priming particles in a unit discharge cell in AC PDP seriously affect the addressing discharge characteristics in the driving method with ramped setup pulse. Moreover, the discharge conditions at the end of the scan line may be different from the first scan line because of the difference of about 1ms address time. Consequently, the addressing time and its dispersion may be different for any two discharge cells that lead to misfiring and the increase in the total addressing time.

In order to improve the addressing time and its dispersion, we have applied different addressing voltage at each cell such as progressively increase pulse voltage instead of constant one. As a result, the addressing time and its dispersion of all cells were improved by about 30% compared with the conventional driving method.

Keywords : Ac PDP, addressing time and its dispersion.

1. Introduction

One of the most important problems in address-display separated (ADS) scheme [1,2] in ac plasma display panel(PDP) is that they have too long an addressing period. As the addressing time increases, the sustaining period for display image is decreased. As a result, the luminance of the PDP decreases. The dual scan method has been adopted to solve this problem in a large ac PDP. In this case the scanning period can reduce to one-half of that of the single scan method. However, the increase of the driving circuit cost is inevitable. In the case of HDTV, where the number of scan line increases significantly than that of VGA resolution, the addressing speed become a big issue [3].

Basically, the addressing time is the sum of the discharge time lag and the duration of discharge current [4]. Therefore, the discharge time lag and duration of discharge current must be decreased in order to reduce the addressing time. However, due to the non-uniform addressing discharge conditions, a dispersion of addressing time occurs during the addressing period in the same panel. If the dispersion of addressing time is minimized, the width of addressing pulse be reduced and the addressing time be minimized.

In general, it has been well known that the priming particles and wall charge are remain within the discharge cell at the end of the ramp voltage waveform which has recently been used in the reset period [5-8]. During the address period, therefore, the addressing discharge is ignited with the help of priming particle, wall charge and externally applied voltage. However, the state of priming particles and wall charges change during the address period of about 1ms [9,10]. Therefore, the addressing

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TABLE 1. Specification of 4-in ac PDP.

Front panel		Rear panel	
ITO width	310 μm	Address electrode width	100 μm
ITO gap	60 μm	White back thickness	15 μm
Bus width	100 μm	Rib height	150 μm
Dielectric thickness	25 μm	Rib pitch	360 μm
MgO thickness	5000 Å	Rib width	70 μm
		Phosphor thickness	20 μm

time and its dispersion at the last scan line may differ from the first scan line.

In this study, in order to minimize the addressing time and its dispersion, we have investigated a new method that is to apply different addressing voltages to each scan line.

2. Experimental

Table 1 shows the specification of 4-inch test model PDP in this study with VGA resolution. The total number of scan line is 30.

Fig. 1 shows the general driving waveforms used in this study. The total period is 1.63 ms, the rising time of ramping up is 100 μs and the falling time of ramping down is 150 μs In order to make the same driving conditions as the large ac PDP over diagonal size of 40 inch, the width of scan pulse is designed as 3 μs and total address period is designed to about 1ms. The scan driver IC and 64 bit data driver IC is synchronized in order to select each single cell.

The addressing time is defined by the sum of discharge time lag and duration of discharge current [4]. However, when we selected a single cell, it was almost impossible to detect the discharge current during the address period, such that we estimated the addressing time and its dispersion through the light detected by the photo diode for each cell.

Fig. 2 shows the light and current waveforms during the address period for 300 cells. Fig. 2(a) gives an example with a short addressing time(1.2 μs) and dispersion whereas, Fig. 2(b) gives an example with a long addressing time(2.3 μs) and dispersion. From Fig. 2, the addressing time and its dispersion of light waveforms were almost the same as those of current waveforms. Therefore, for a single cell it may be possible to estimate the characteristics of addressing time from the light waveform for a single cell.

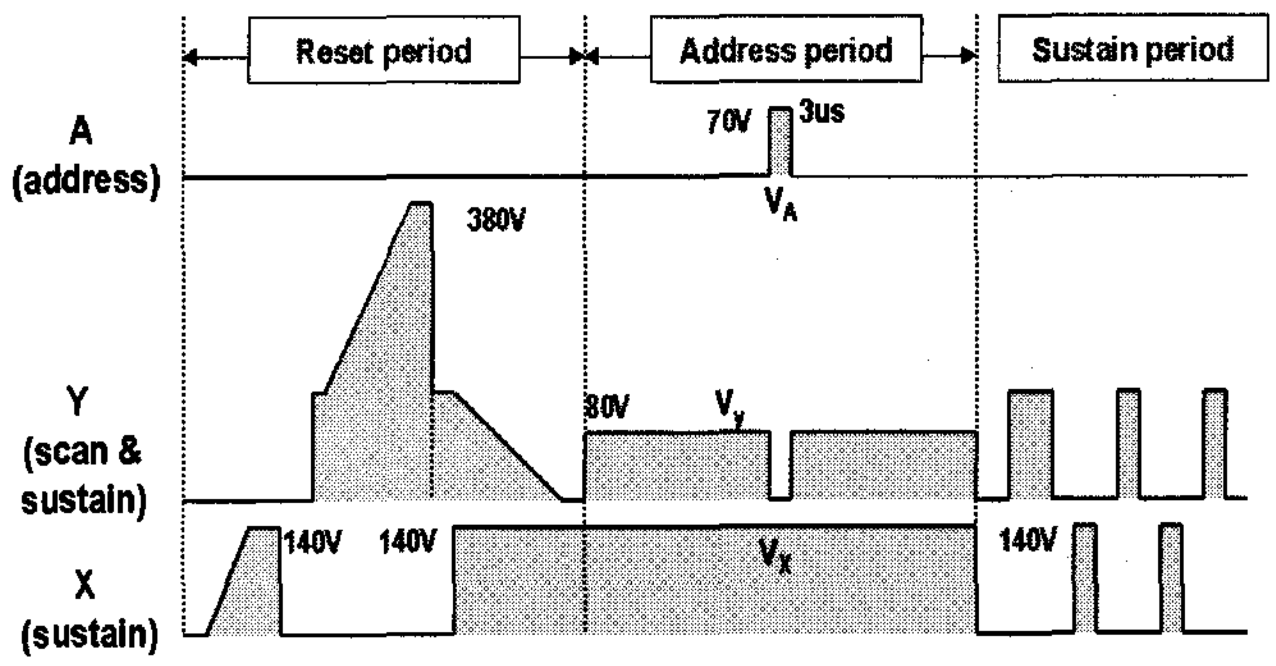


Fig. 1. Schematic diagram of driving waveform.

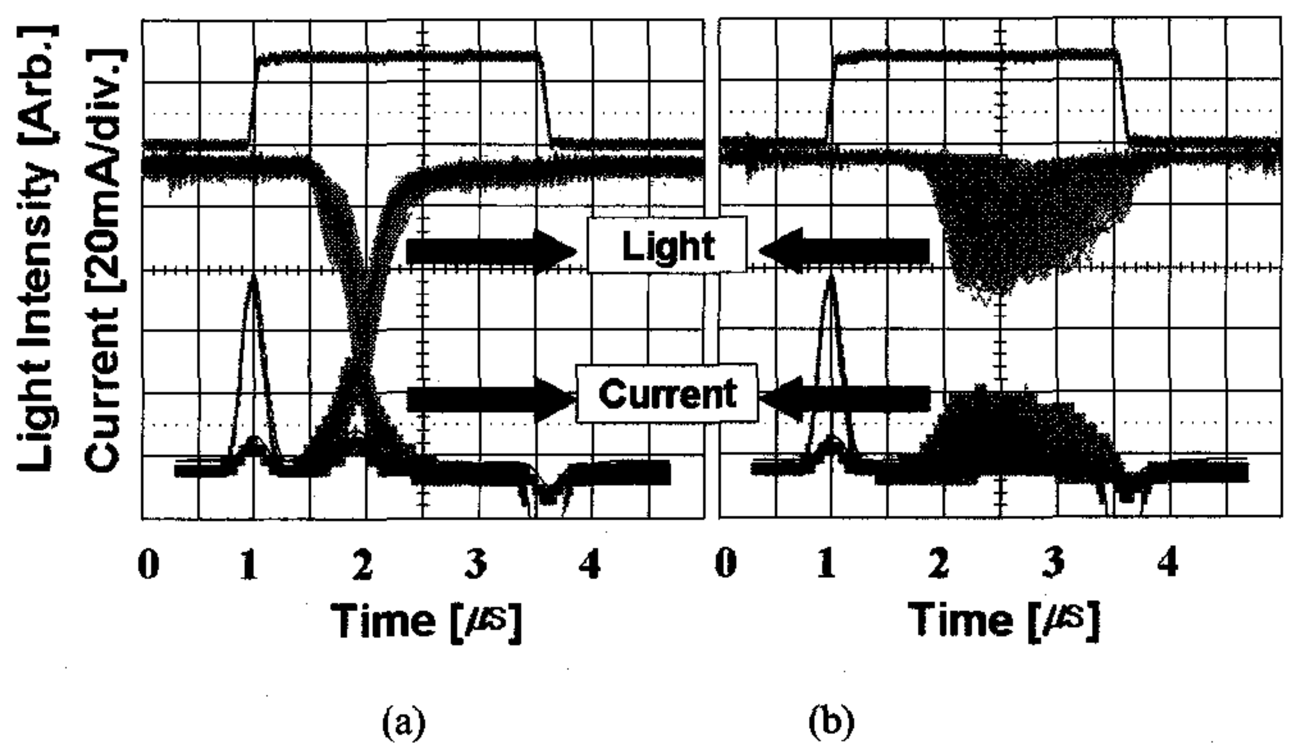
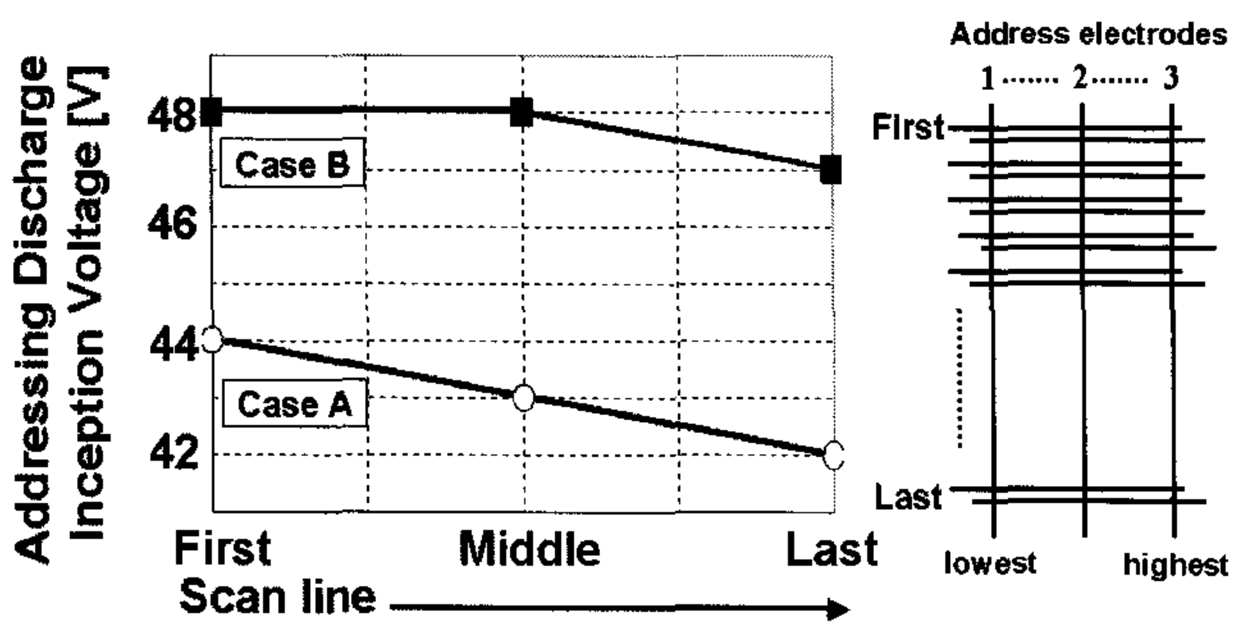


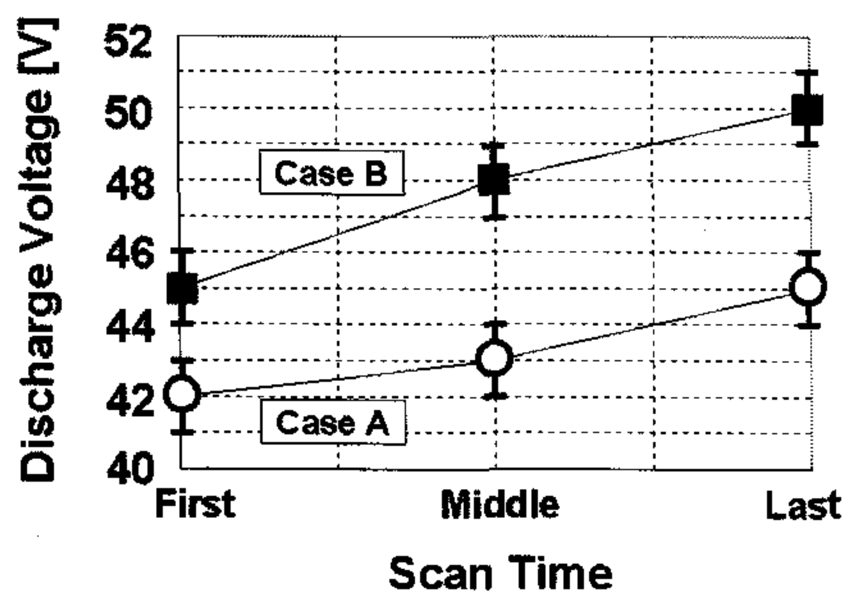
Fig. 2. A typical relationships between addressing discharge current and light waveform.

3. Results and Discussion

As a preliminary study to decrease the dispersion of addressing time, we have studied the characteristics of addressing discharge inception voltage that means the breakdown voltage of the addressing discharge for a given cell.



(a) Addressing dscharge inception voltage at 470μs after reset period



(b) Addressign discharge inception voltage during real scanning process

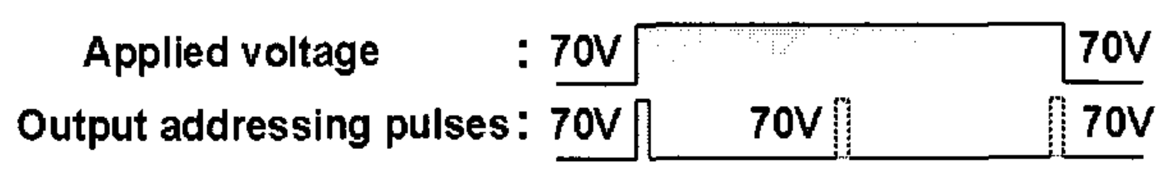
Case A : The address line showing the lowest addressing discharge inception voltage
Case B : The address line showing the highest addressing discharge inception voltage

Fig. 3. Characteristics of addressing discharge Inception voltage for the first, middle and last cell.

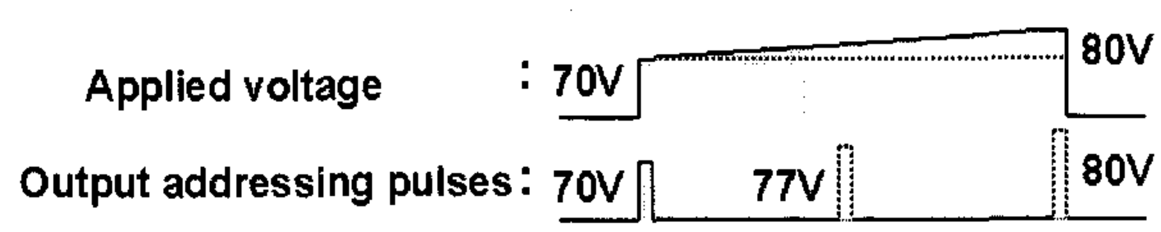
Fig. 3 (a) shows the addressing discharge inception voltage for the first, middle and last cell at 470 μs after reset period for a given address line. In this figure, case A is the address line showing the lowest and the case B is the address line showing the highest discharge inception voltage for a test panel. In Fig. 3, the difference of the addressing discharge inception voltage for two different address lines (case A and B) is about 4V and the difference between the the first and the the last cell for a given address line is about 1~2 V.

The space charges and metastable atoms created by the reset discharge remain in the discharge cell and reduce the discharge inception voltage. On the other hand drift and ambipolar diffusion are influenced by the geometrical non-uniformity of discharge cells due to improper phosphor deposition, sealing defect and so on[11]. Therefore, the difference of discharge inception voltage between case A and case B in the address period may be due to the non-uniformity of discharge cell.

Fig. 3(b) shows the addressing discharge inception voltage for the first, middle and last cell during the real scanning process for a given address line. As shown in Fig. 3(b), the difference of discharge inception voltage between the first and the last scan line during the real scanning process for case A electrodes, was about 3~5 V, and for case B electrodes. was 5~7 V Therefore, it can be said that the compensation voltage of about 10 V is needed to compensate for the difference of the inception voltage for all cells.



(a)



(b)

Fig. 4. Schematic diagram of applied voltage and output pulses.

Fig. 4 shows the voltage waveform applied to the display data driver IC and output addresing pulses generated during address period. Fig. 4(a) shows the conventional addressing pulse. In this case, the amplitude of output addressing pulse is a constant value of 70V. In general, the addressing time and its dispersion is decreased as the addressing voltage increases. However, the low voltage driving scheme is desirable from the point of view of IC cost and crosstalk between adjacent cells [12]. Therefore, in this study, the addressing voltage is fixed at 70 V.

Fig. 4(b) shows voltage waveform of the new method suggested in this study. In this method, the applied voltage is increased from 70 V to 80 V in order to compensate for the non-uniformity of the discharge conditions with the charge of scan lines. Thus, the addressing voltage of the first cell is 70 V and the last cell is 80 V.

For the conventional method as shown in Fig 4(a), if the applied constant voltage increases up to 80 V, the crosstalk occurs at the adjacent cells when the first cell is selected. Fig. 5 shows the light waveform of the first cell when the crosstalk occurs. However, there is no crosstalk when the last cell is selected although the same addressing voltage of 80 V is applied. Therefore, there are no problems if the addressing voltage of 70 V is applied to the first cell and 80 V is applied to the last cell.

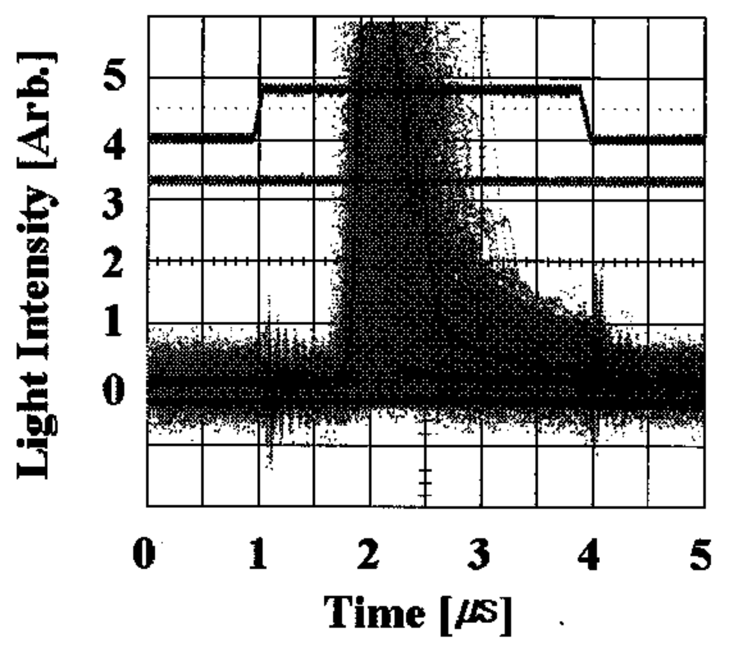


Fig. 5. Light waveform of a selected cell when the crosstalk occurred.

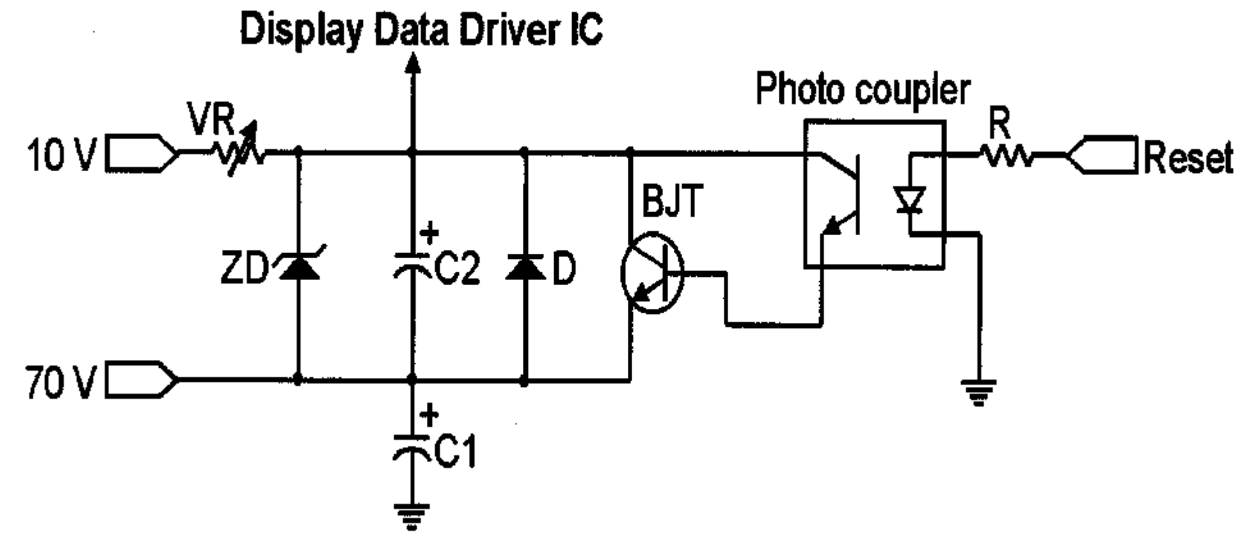


Fig. 6. Driving circuit for compensating the discharge condition.

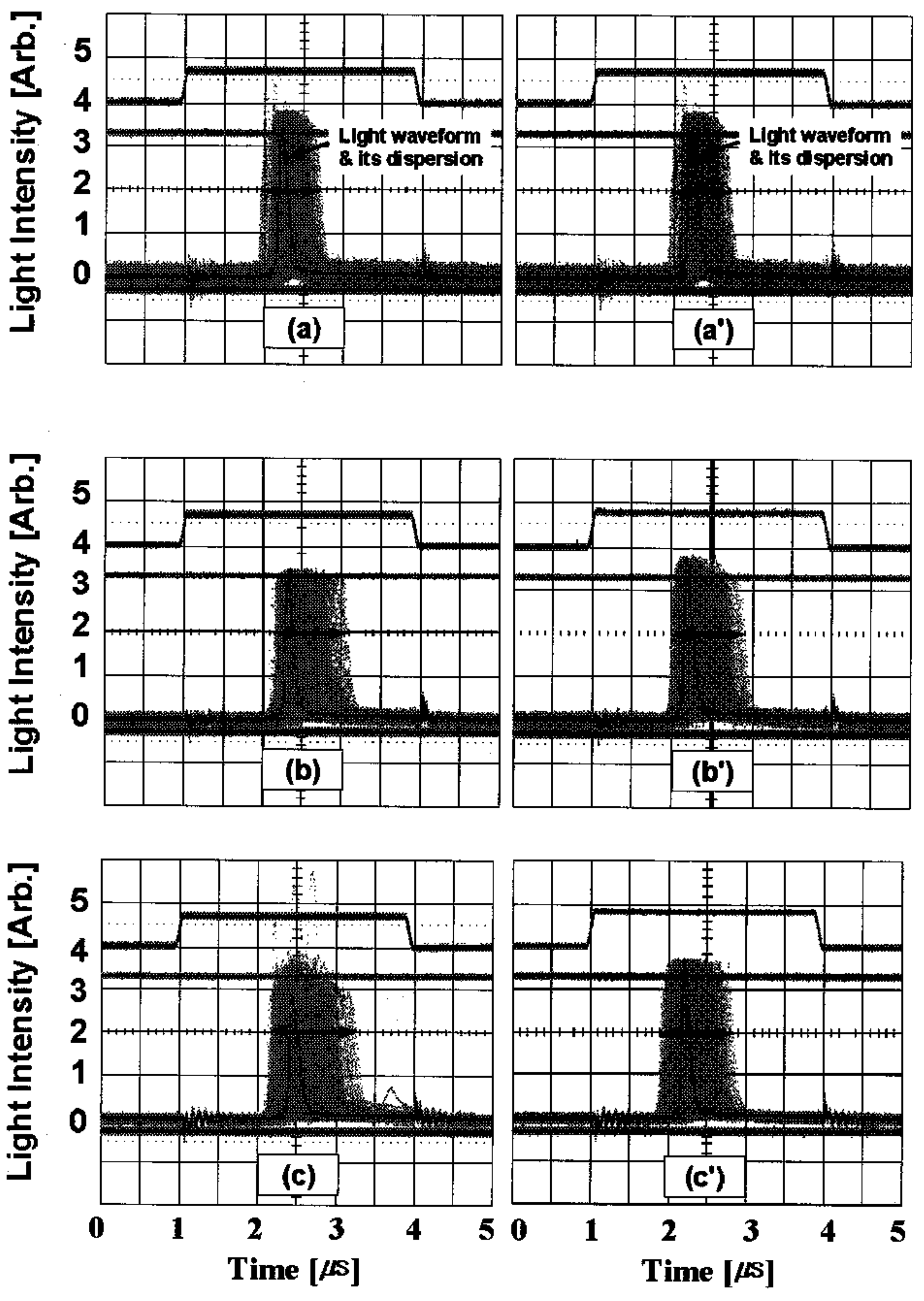


Fig. 7. Light waveform for the address line of case A in Fig. 3.

Fig. 6 shows the actual circuit for controlling the ramp-type supplied voltage. After storing the conventional addressing voltage Va at the condenser C1 shown in Fig. 6, about 10 V is added to condenser C2 with an RC time delay. And then, the sum of voltage of C1 and C2 is supplied to the display data driver IC. However, the externally added voltage of C2 is cleared during other periods except the address period. When the reset signal is applied to the photo coupler, BJT is turned on and the voltage of C2 could be cleared as a result.

Figs. 7(a)-(c) show the light waveforms of the first, middle and last addressing cell for the case A in Fig. 3 when driven by the conventional method as shown in Fig. 4(a). From these figures, the addressing time and its dispersion increase with time. According to the result in Fig. 3, the discharge inception voltage of the last cell is about 1~2 V lower than that of the first cell. Therefore, the increase in the addressing time and its dispersion with the number of scan line may be due to the decrease in the priming particles in the discharge cell with time.

Figs. 7(a')-(c') show the light waveforms when driven by the suggested method, as shown in Fig. 4(b), for the case A in Fig. 3. From these figures, it can be observed that the light dispersion in Fig. 7(c') decrease when it is compared with Fig. 7(c).

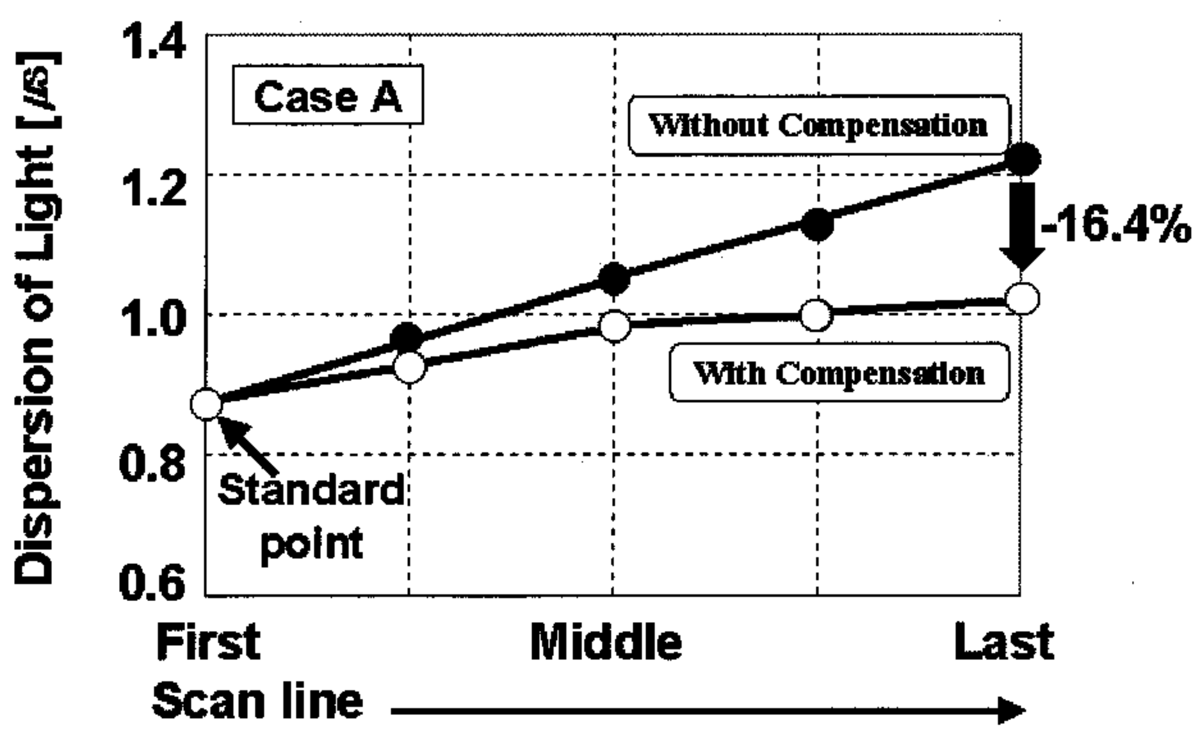


Fig. 8. Width of the light dispersion for the address line of case A in Fig. 3.

Fig. 8 shows the variation of the width of the light dispersion at a given light intensity from Fig. 7 for case A. The light dispersion of the suggested method decreased by about 16 % when it is compared with that of the conventional method at the last cell. As a result, it can be said that the addressing time can be reduced by about 16 % compared with the conventional addressing time without the crosstalk or misfiring.

Figs. 9(a)-(c) show the light waveforms of first, middle and last addressing cell for the case B in Fig. 3 when driven by the conventional method as shown in Fig. 4(a). From these figures, the addressing time and its dispersion increase as the time goes on. Moreover, the addressing time and its dispersion increased up to 60 % compared with the case A shown in Figs. 7(a)-(c). Therefore, the uniformity of cells should be obtained in order to improve the addressing time.

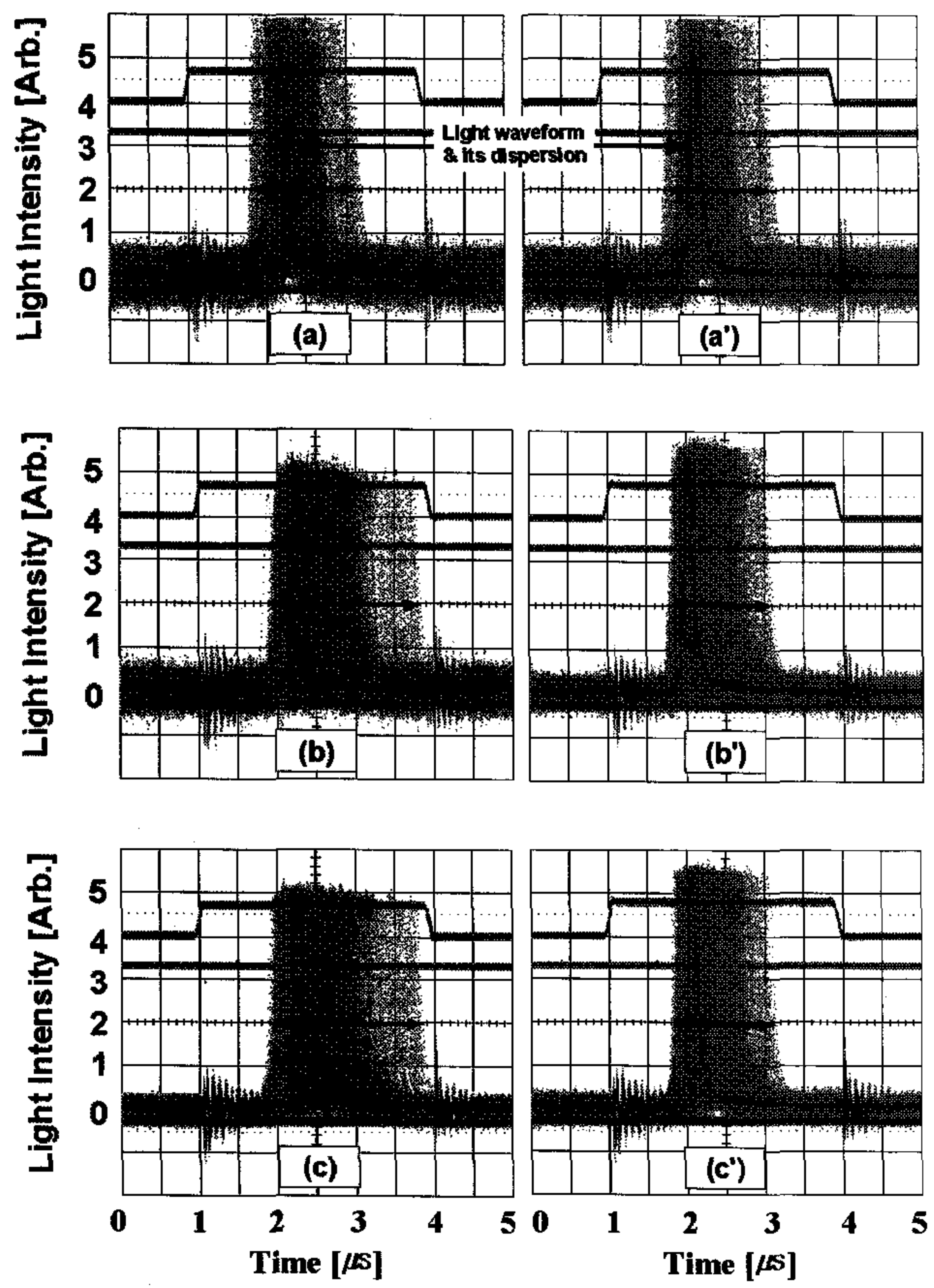


Fig. 9. Light waveform for the address line of case B in Fig. 3.

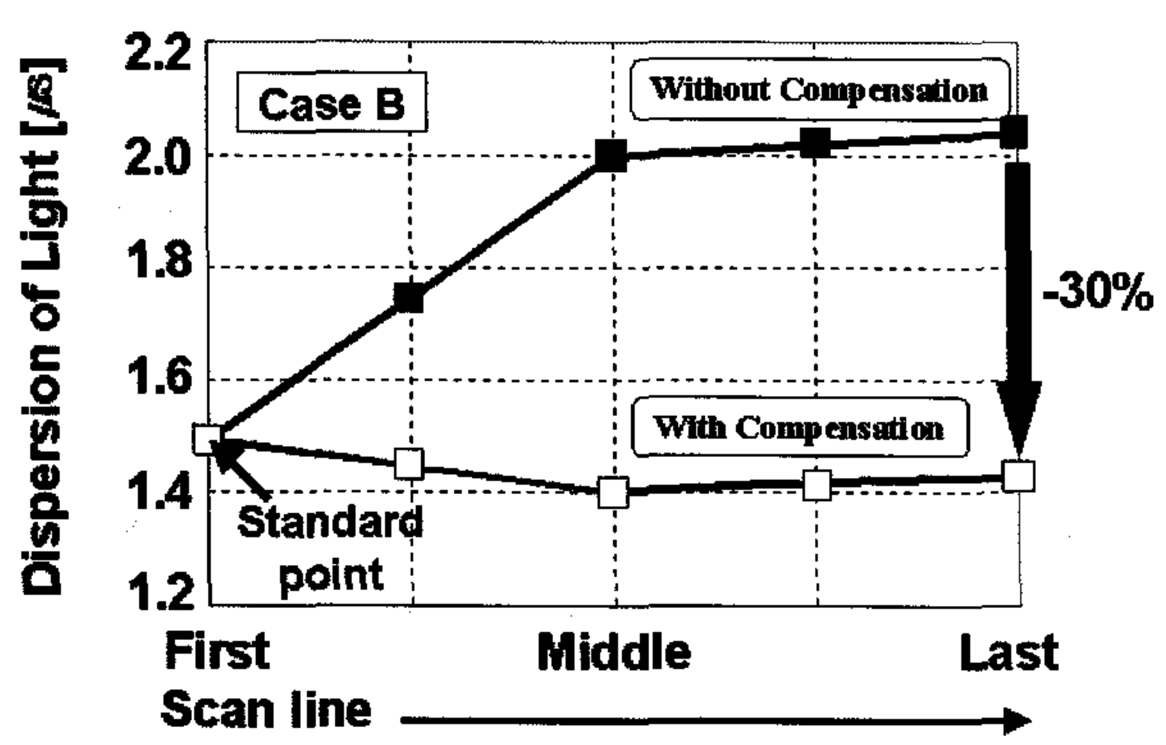


Fig. 10. Width of the light dispersion for the address line of case B in Fig. 3.

Figs. 9(a')-(c') show the light waveforms when driven by the suggested method, as shown in Fig. 4(a), for the case B. The light dispersions shown in Figs. 9(a')-(c') are almost the same for all scan lines. From Fig. 9, the light dispersion in Fig. 9(c') decreased significantly compared with that in Fig. 9(c).

Fig. 10 shows the variation of the width of the light dispersion at a given light intensity from Fig. 9 for case B. The light dispersion of suggested method decreased by about 30 % compared with that of the conventional method at the last addressing cell. As a result, it is considered that the addressing time can be reduced by about 30 % compared with that of the conventional method without the crosstalk or misfiring.

4. Conclusions

In this study, we suggested a new method to unify the addressing discharge conditions by applying a ramp voltage to the display data driver IC in order to improve the addressing speed without the crosstalk or mis firing during address period. As a result, the light dispersions of the first and last addressing cell were almost constant and decreased by 30 % compared with that of the conventional driving method. Consequently, the addressing time could also be reduced up to 30 % compared with conventional addressing time without the crosstalk or misfiring.

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