AMVA 顯示原理

Additional Multi Vertical Alignment

Agenda

- 爲何要導入 AMVA 顯示技術
- The Distortion of Gamma Curve

  （Gamma Curve of Different Viewing Angle）
- Improve The Color Shift

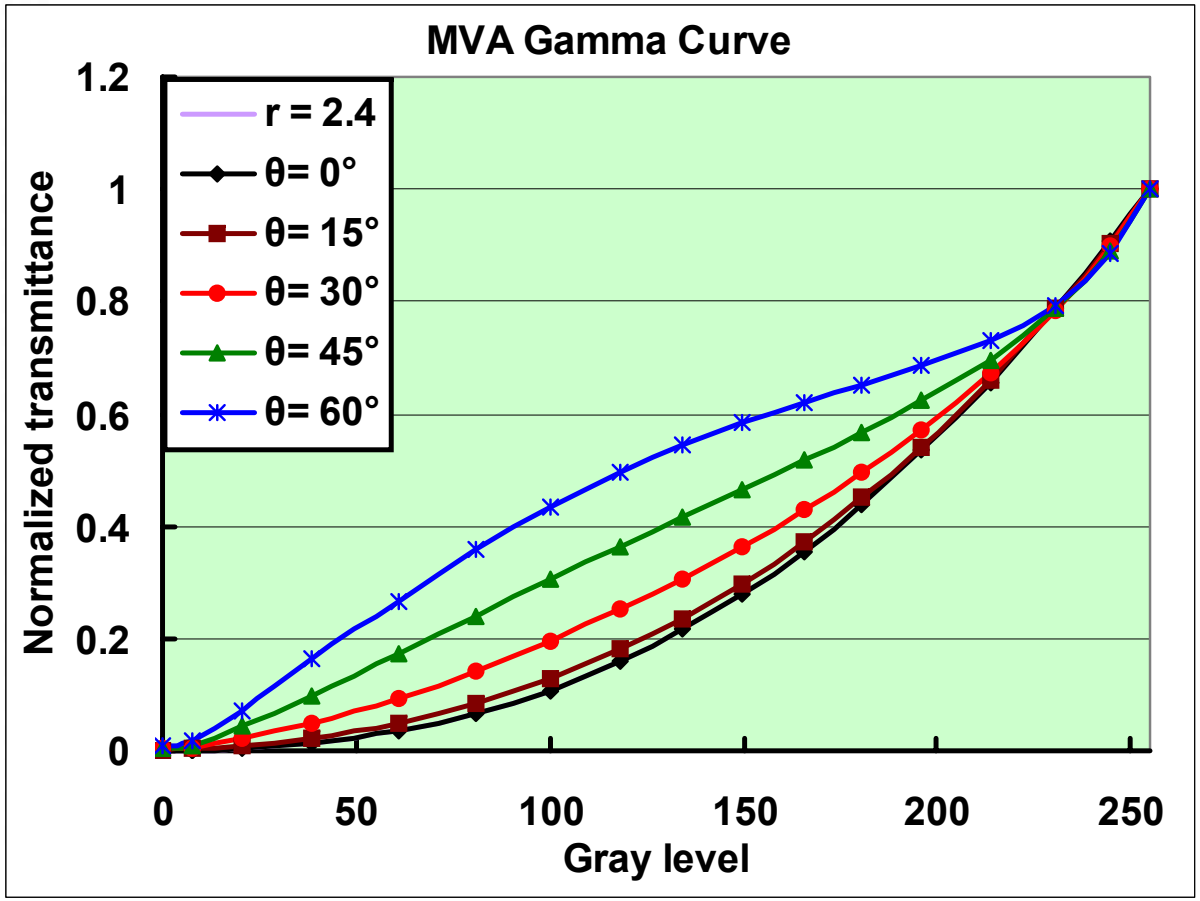
  （Reduce the Variation of Transmittance）
- AMVA 顯示原理介紹（8 Domain；Full Cone）
- 廣視角顯示原理（8 Domain）
- AMVA 顯示原理
- AMVA 與 AQSV 比較

爲何要導入 AMVA 顯示技術

1. The Distortion of Gamma Curve

2. Improve The Color Shift

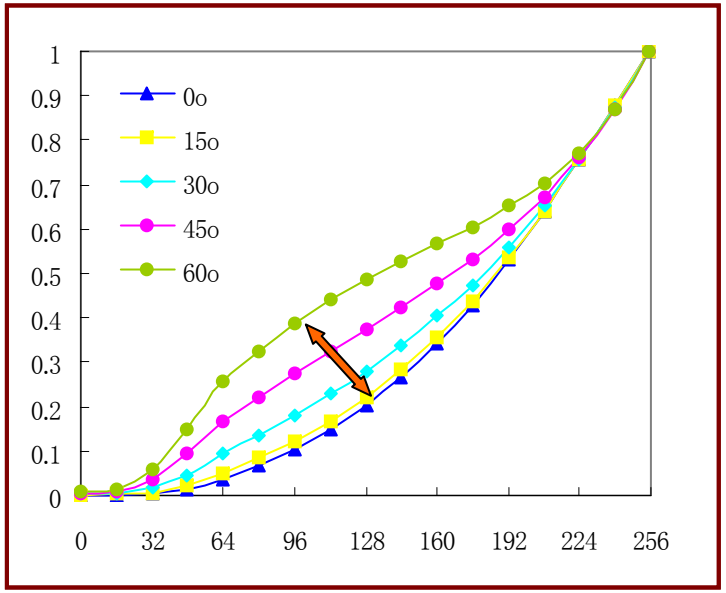
Gamma Curve of Different Viewing Angle



Let : (R,G,B) = (220,140,80)
Then transmission of normal view :
(R,G,B) = (0.69, 0.220, 0.068)
While in the oblique direction (60°):
(R,G,B) = (0.74, 0.54, 0.375)
Color Changed!!

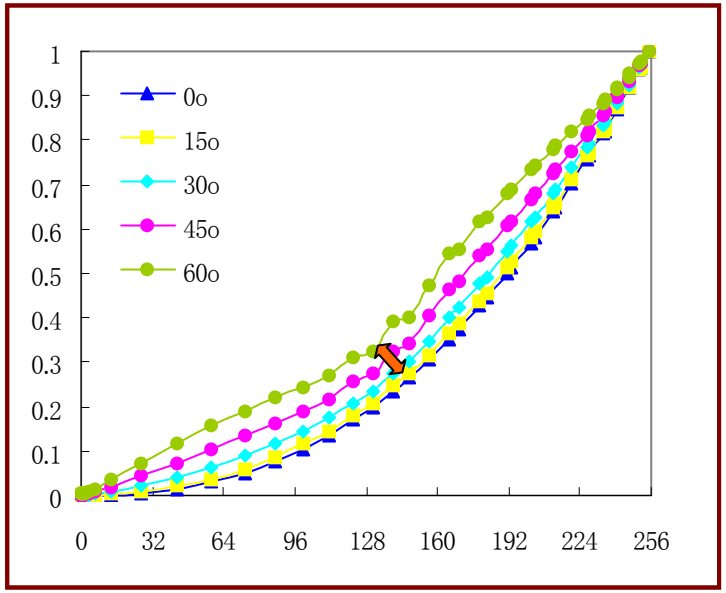
Reduce the Variation of Transmittance

Conventional 4 domain



Serious color shift

New 8 domain VA Pixel



less color shift

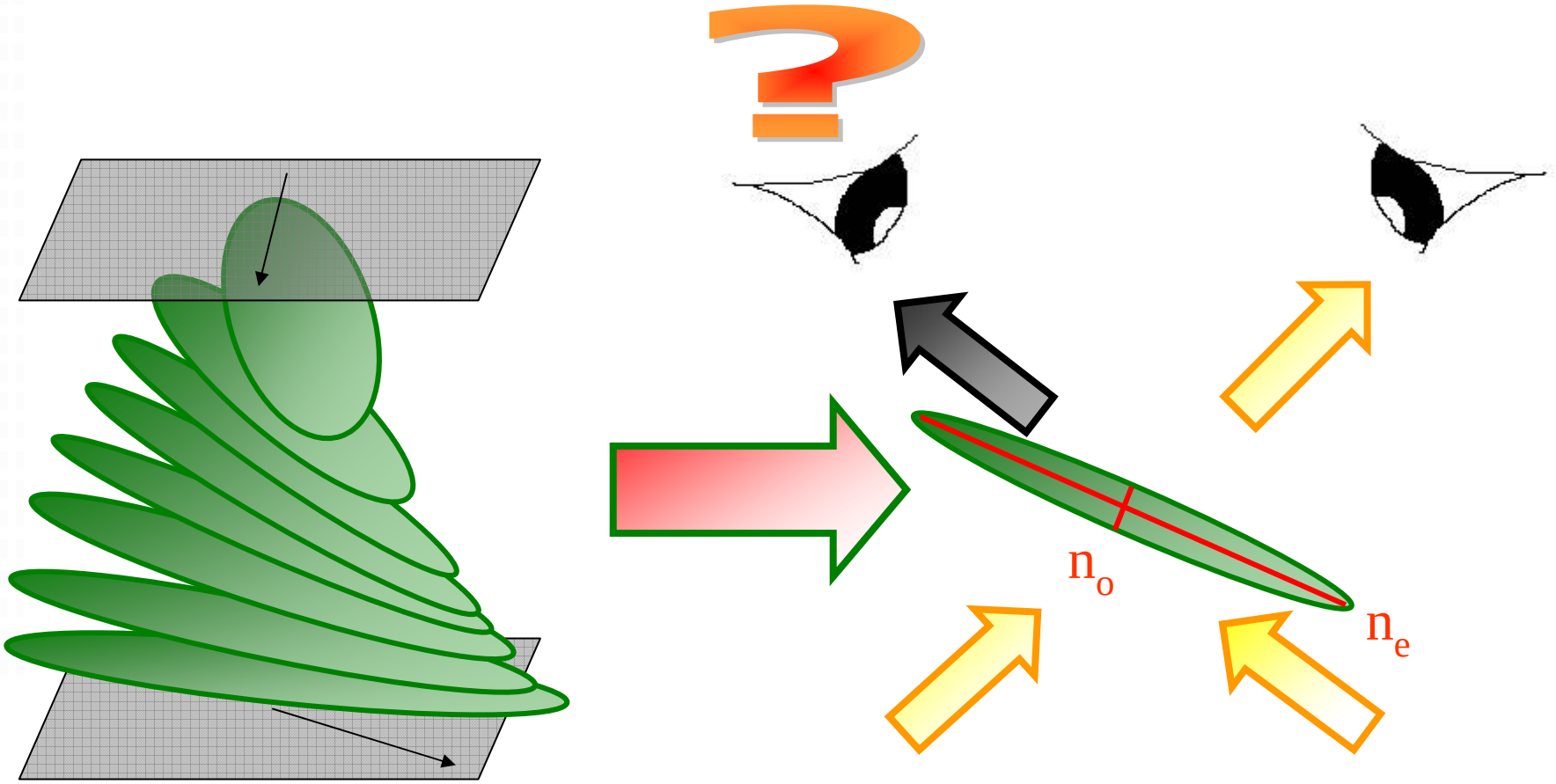
由不同的角度觀察，可見 4 Domain 的 Normal MVA Design 與 8 Domain MVA Design Color Shift 明顯小了許多。

AMVA 顯示原理介紹
（8 Domain；Full Cone）

1. 廣視角顯示原理（8 Domain）
2. AMVA 顯示原理
3. AMVA 與 AQSV 比較

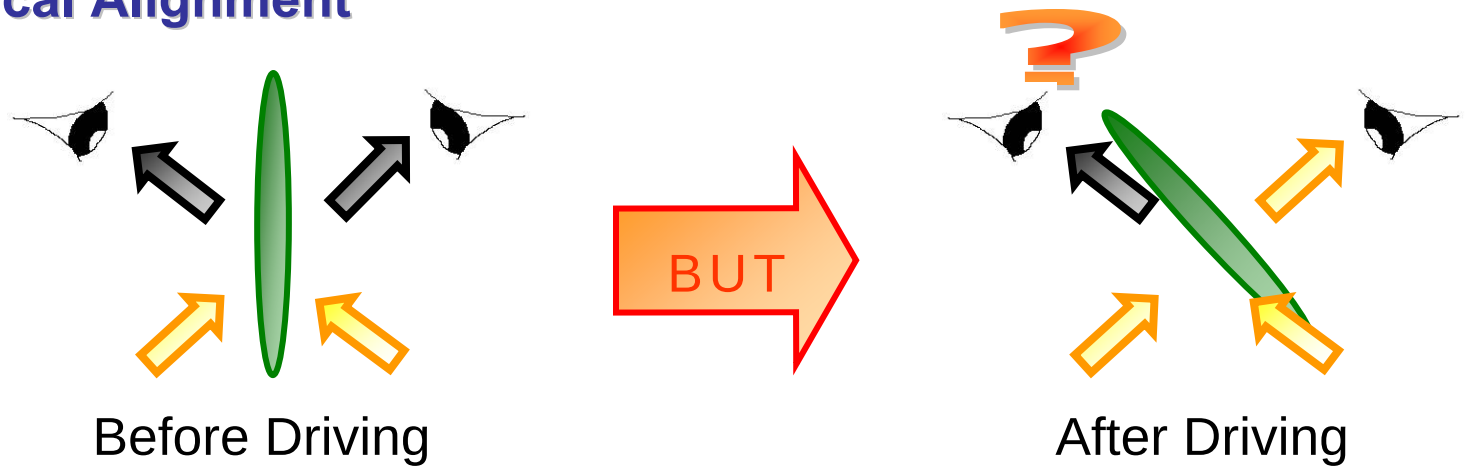
廣視角顯示原理（1）

Twist Nematic 顯示原理

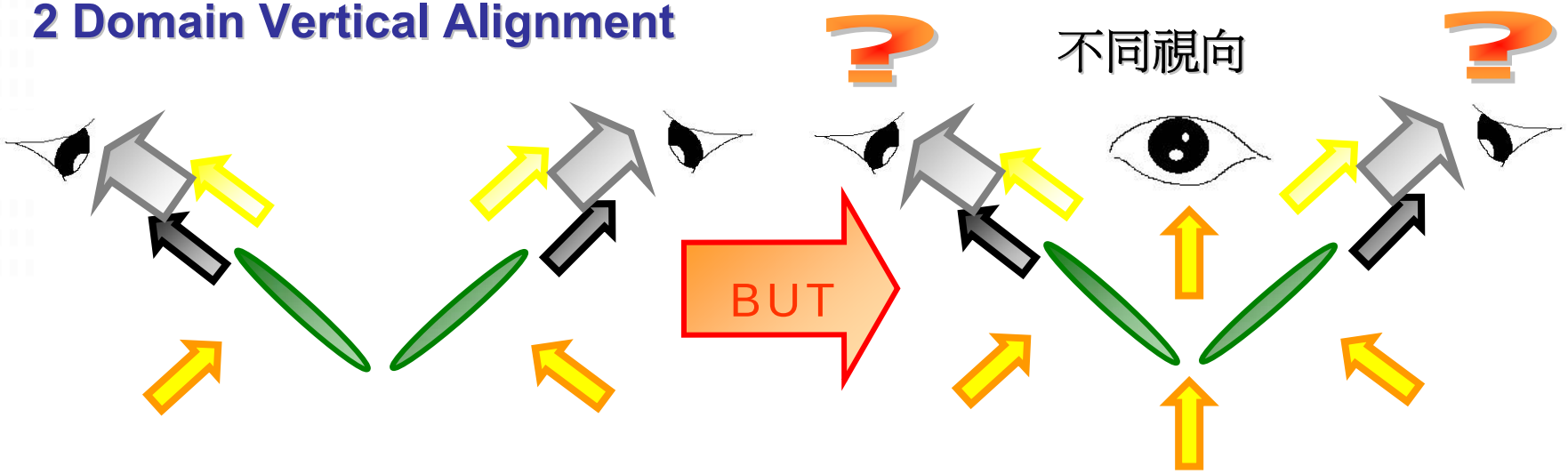


廣視角顯示原理（2）

Vertical Alignment

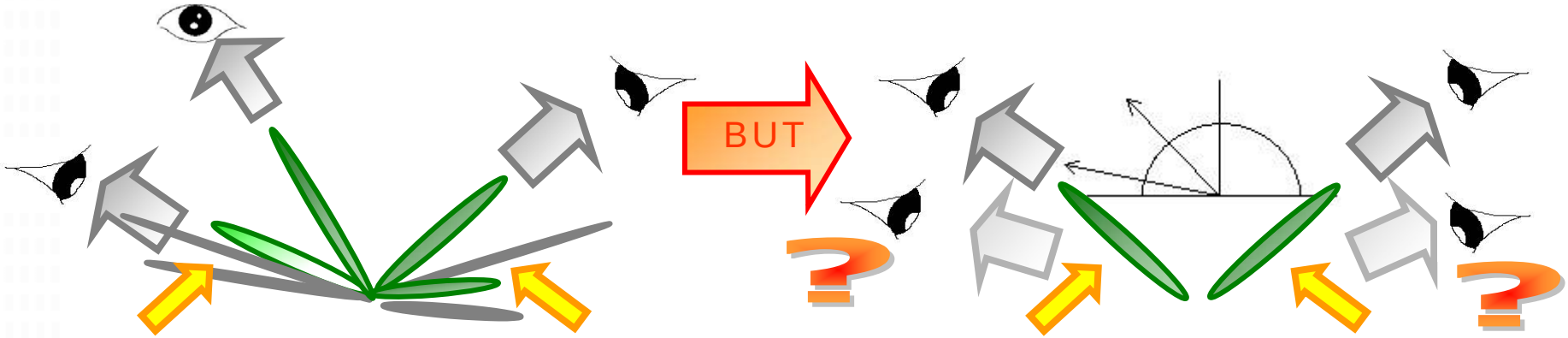


2 Domain Vertical Alignment

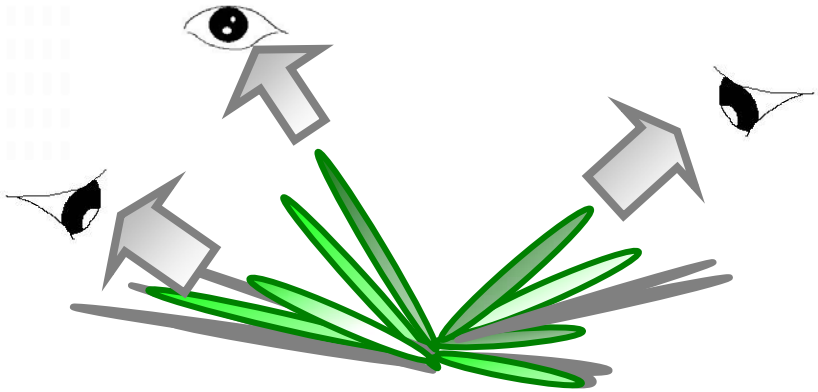


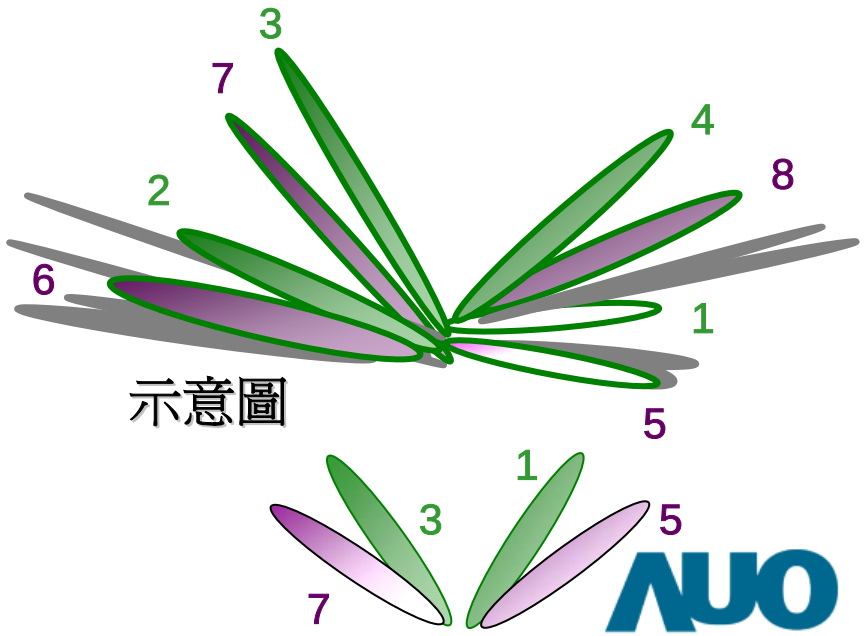
廣視角顯示原理（3）

4 Domain Vertical Alignment



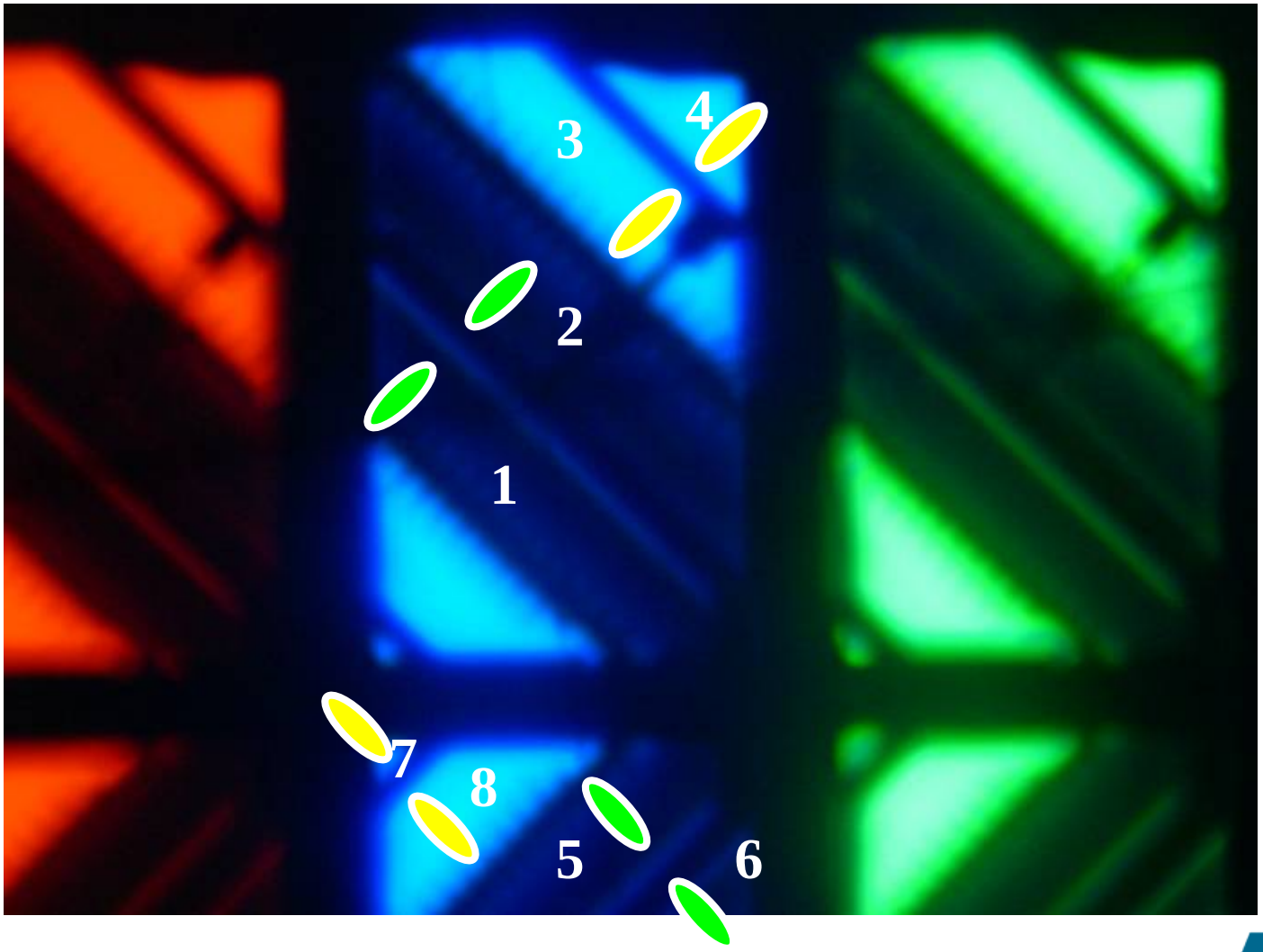
8 Domain Vertical Alignment





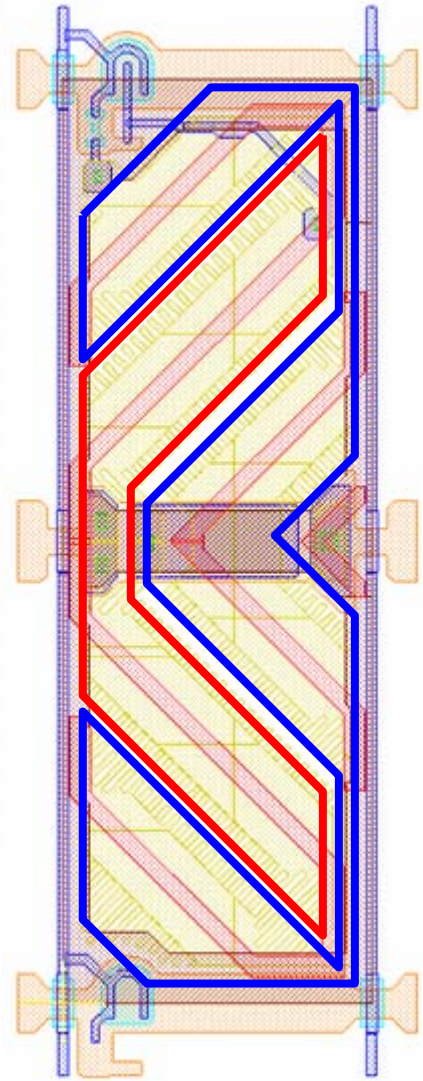
8 Domain

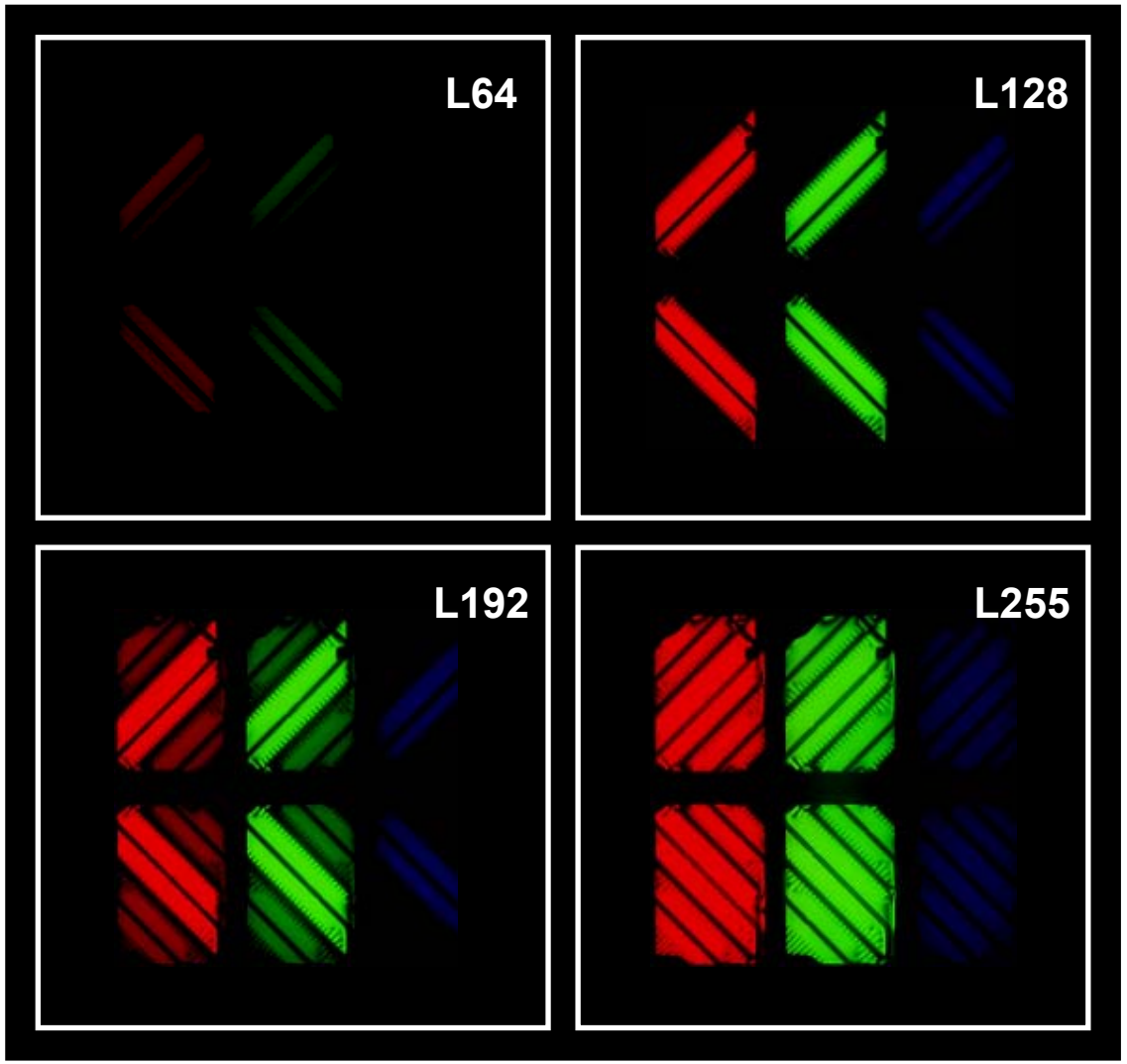
（畫素驅動顯示狀況）



8 Domain T315XW Pixel

pixel layout





MVA 與 8 Domain 顯示比較

AMVA

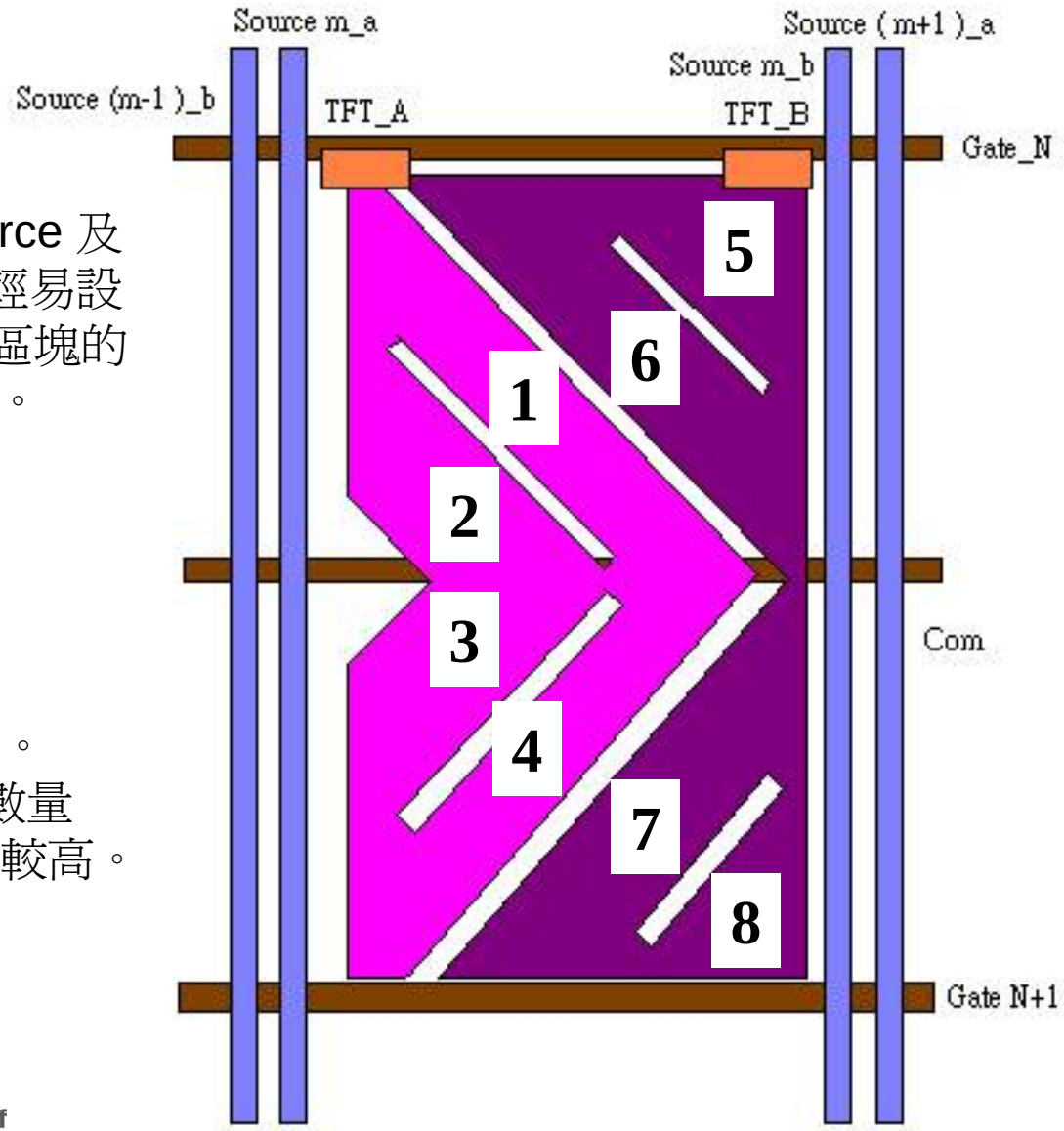
60°

Conventional

How to Create 8 Domain VA Pixel

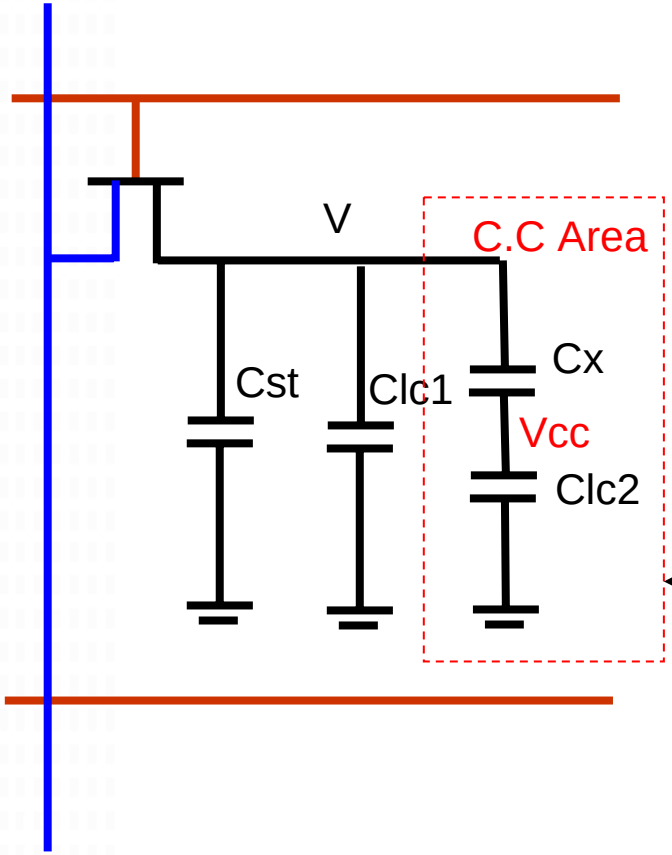
利用兩個 Source 及兩個 Gate 可輕易設計出8 個不同區塊的液晶排列方式。

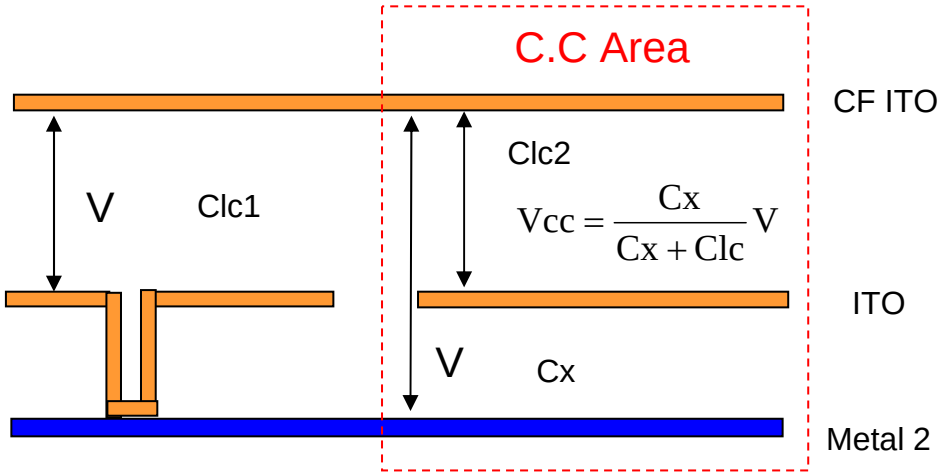
缺點
1. 開口率較差。
2. 驅動 IC 的數量增多，成本較高。



Capacitance Coupling Technology

CC Type





由左邊的等效電路圖，可推出跨在Clc2 上的電壓 Vcc 的關係式

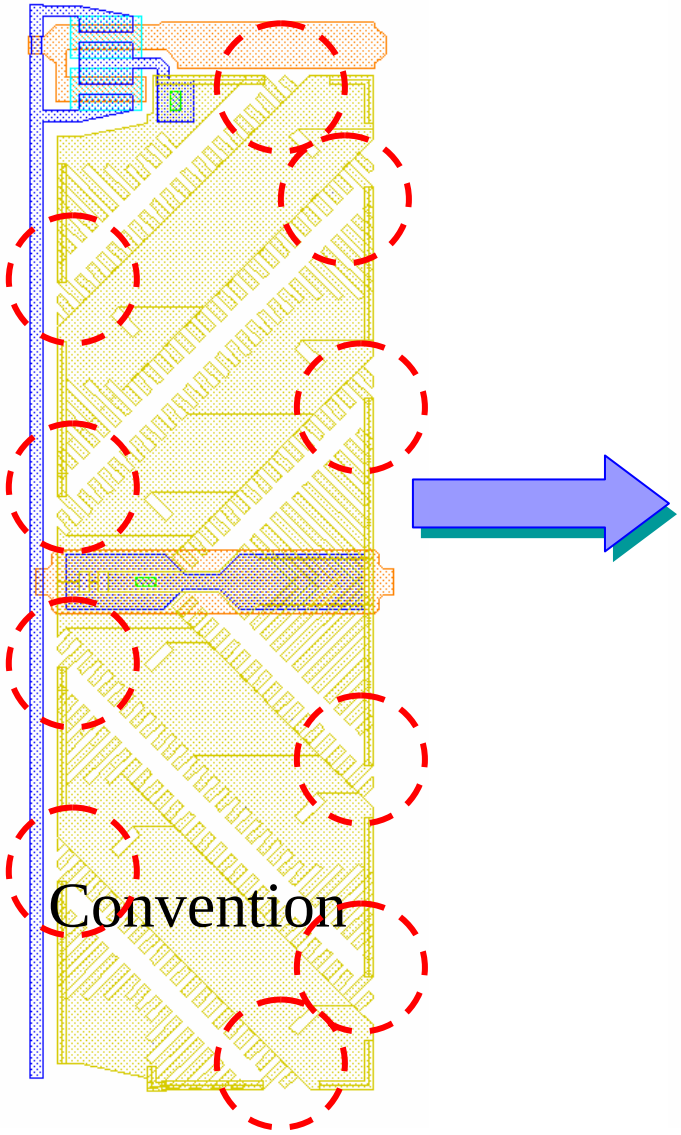
假設 normal 區的電壓爲 V 則 (或是由電容分壓直接看出關係式)

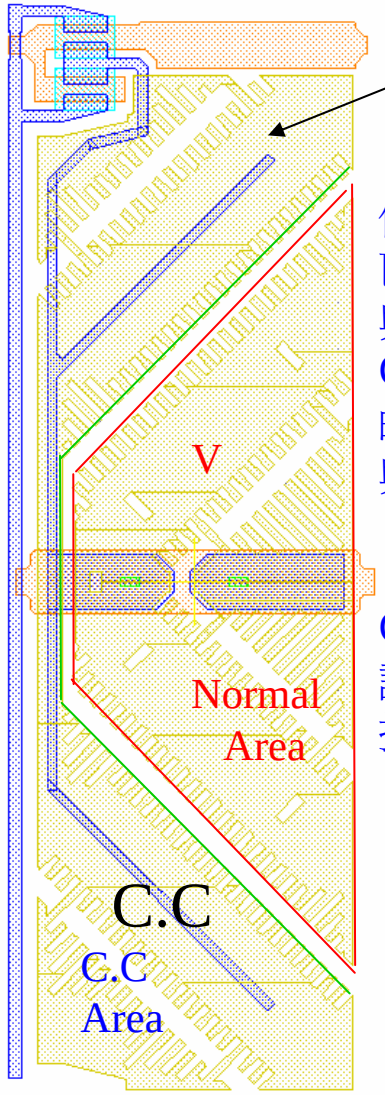
$$(V - Vcc) * Cx = (Vcc - 0)Clc2$$

$$\Rightarrow\ Vcc = \frac{Cx}{Cx + Clc} V$$

利用 Capacitance coupling 原理，可以用單一的 TFT 與 Pixel 創造出兩種不同的電壓，並藉由微調 Cx 電容的值，來改善 color shift 的現象

C.C Type Example





$$Vcc = \frac{Cx}{Cx + Clc} V$$

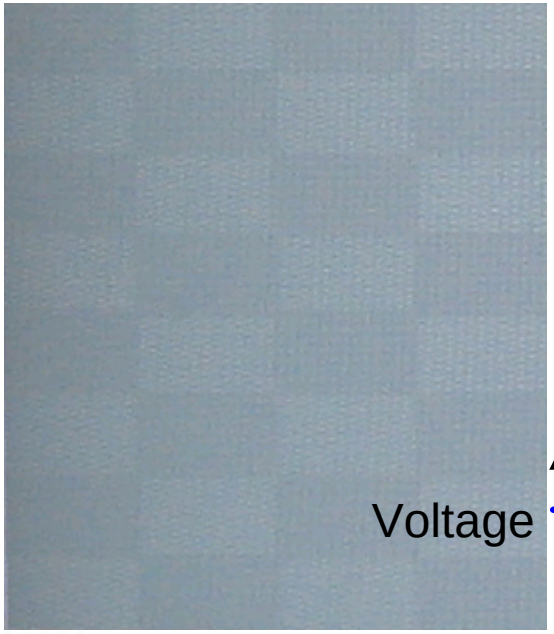
仔細觀察 C.C. Pixel的結構，C.C. 區域的 ITO 是完全沒有任何地方與 TFT 相連接，Metal 2 只是用來 Coupling 電壓用，實際上TFT充的電荷是經由 Cst 那邊的 Metal 2 與 Through hole 將電荷傳到 normal 區域的 ITO。

C.C. 區域的電位則是靠著coupling 讓電中性的 C.C 區 ITO 電荷重新排列而產生 coupling的電場與電位。

Co-work With FDTC

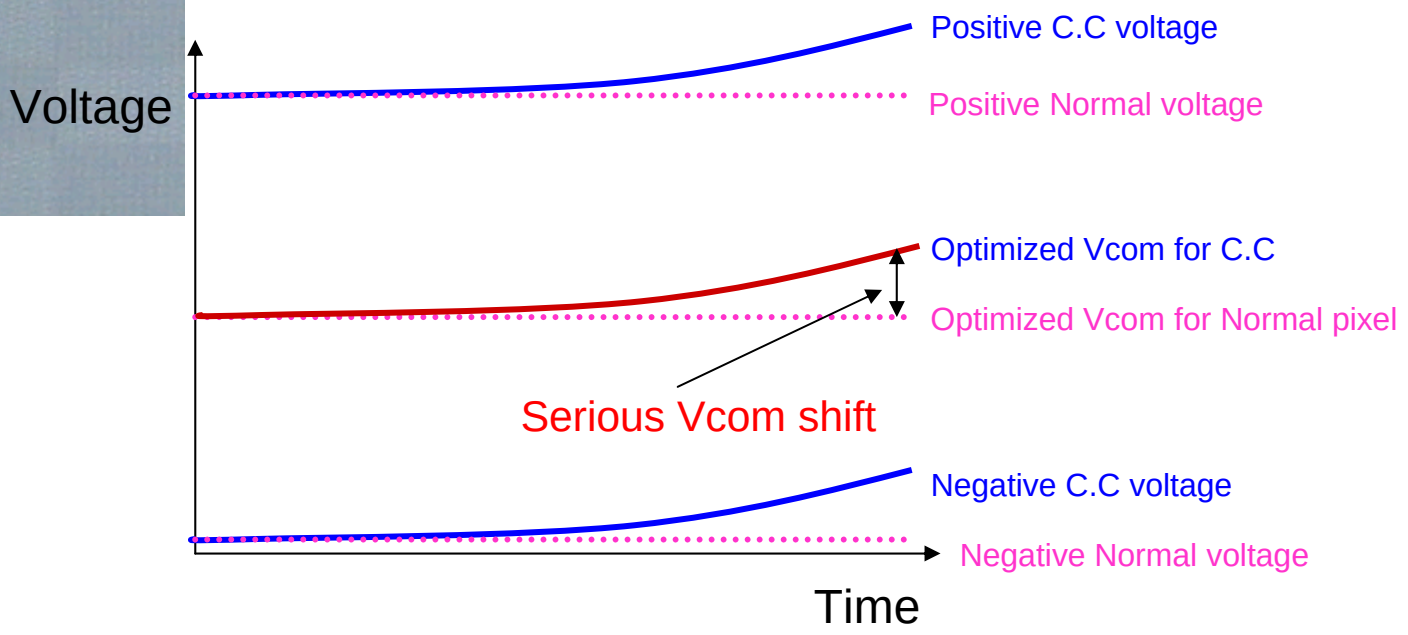
IZO Connection Area

C.C. Type 缺點
Serious Image Sticking of C.C Pixel



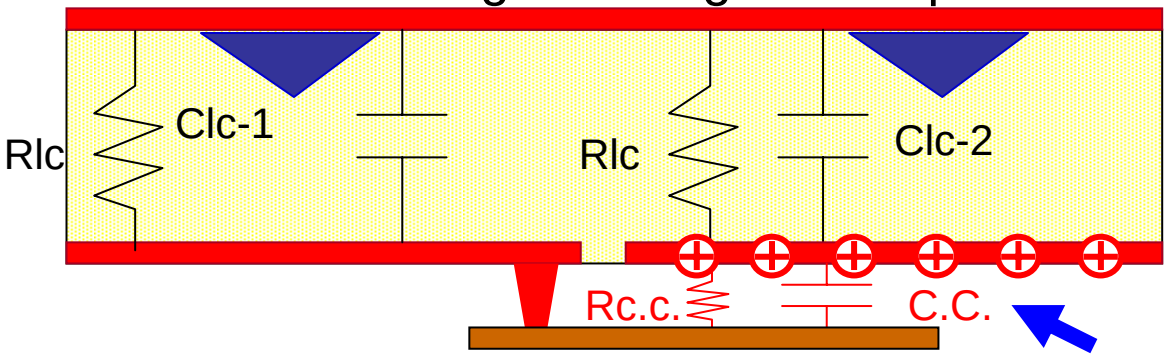
C.C. pixel design have serious image sticking

C.C. Pixel 做 image sticking test 約 30min 就 fail (JND > 4.0)
量測 C.C 區 optimized Vcom 變異., 在30分鐘內 Vcom shift 400mV.



Possible Root Cause of Image sticking

RC Non-balance induced ion trapping and results in image sticking of C.C. pixel



已知畫素電極與 **Common** 電壓壓差不對稱時易產生離子堆積而造成殘像。
而 Normal Area 與 Coupling Area 與 Vcom 的電壓差於 C.C. type 狀況下永遠不可能同時達成平衡。

Solutions

1. Make RC balance
2. Induce opposite charge
3. Release induced charge

$$V_{sh} - V_{com} = V_{com} - V_{sl}$$

$$V_{nsk} - V_{com} = V_{com} - V_{nsl}$$

$$V_{cch} - V_{com} = \left(\frac{V_{cx}}{V_{cx} + V_{clc}} \bullet V_{nsh} \right) - V_{com}$$

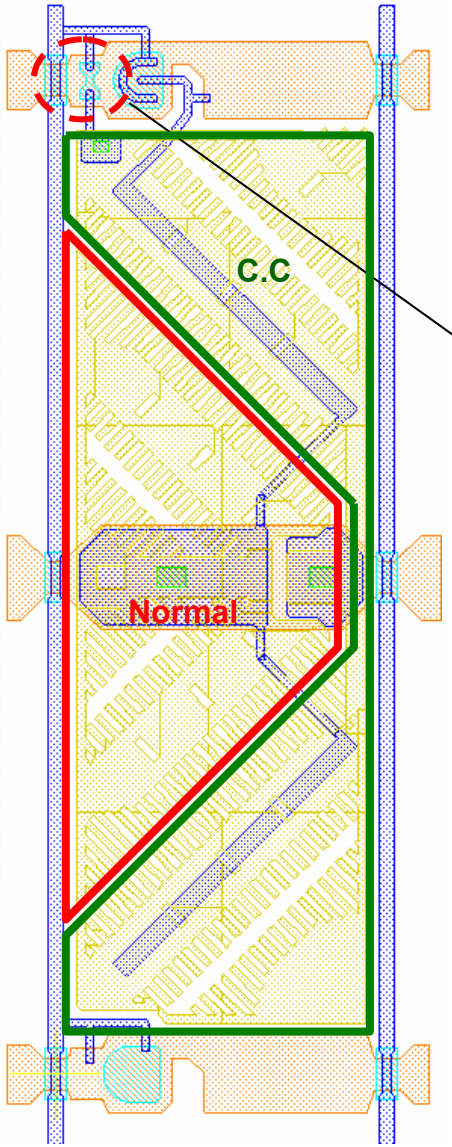
$$V_{com} - V_{ccl} = V_{com} - \left(\frac{V_{cx}}{V_{cx} + V_{clc}} \bullet V_{nsl} \right)$$

$$V_{cch} - V_{com} - V_{com} + V_{ccl} = V_{cch} + V_{ccl} - (V_{nsh} + V_{nsl})$$

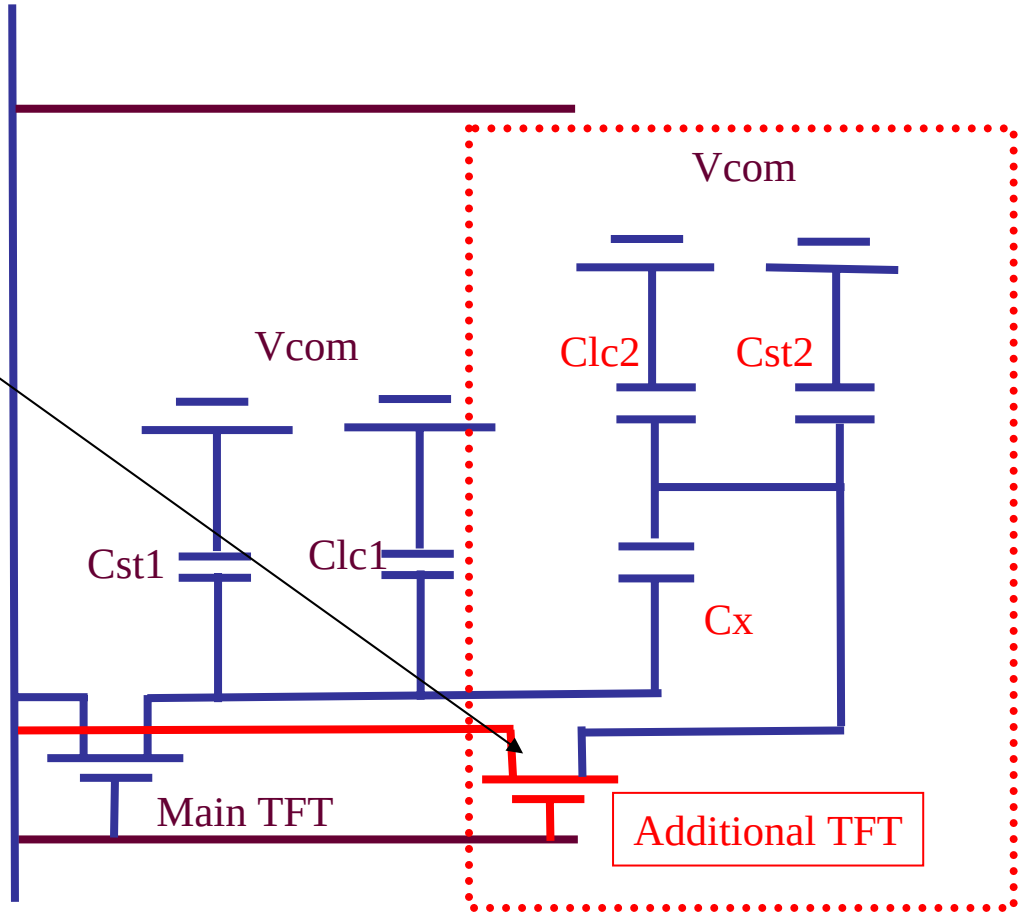
$$= \left(\frac{V_{cx}}{V_{cx} + V_{clc}} \right) \bullet (V_{nsh} + V_{nsl}) - (V_{nsh} + V_{nsl})$$

$$= \left(\frac{V_{cx}}{V_{cx} + V_{clc}} - 1 \right) \bullet (V_{nsh} + V_{nsl}) \neq 0$$

Additional Refresh TFT Design



Structure



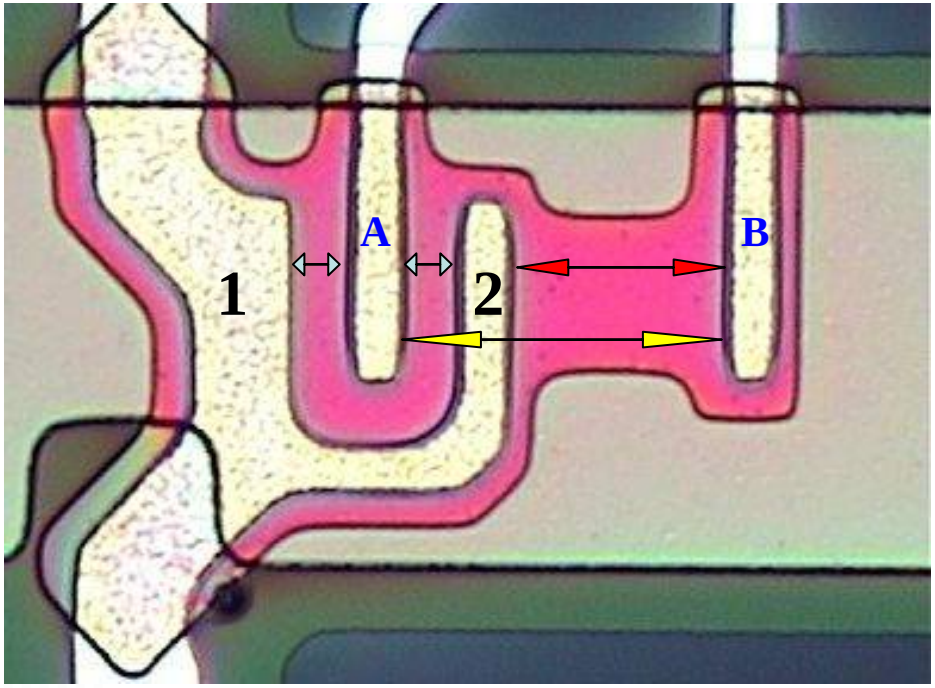
Circuit

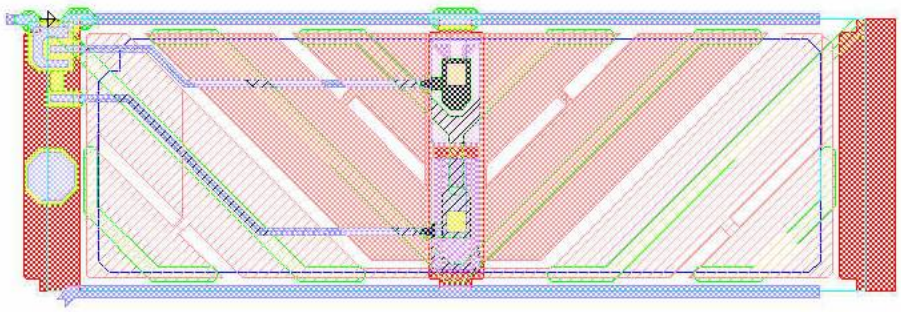
再外加一個 ART 以改善殘像 ISSUE。

AMVA 與 ASQV 差異

AQSV

Advance **Q**DI **S**uper **V**iew Angle

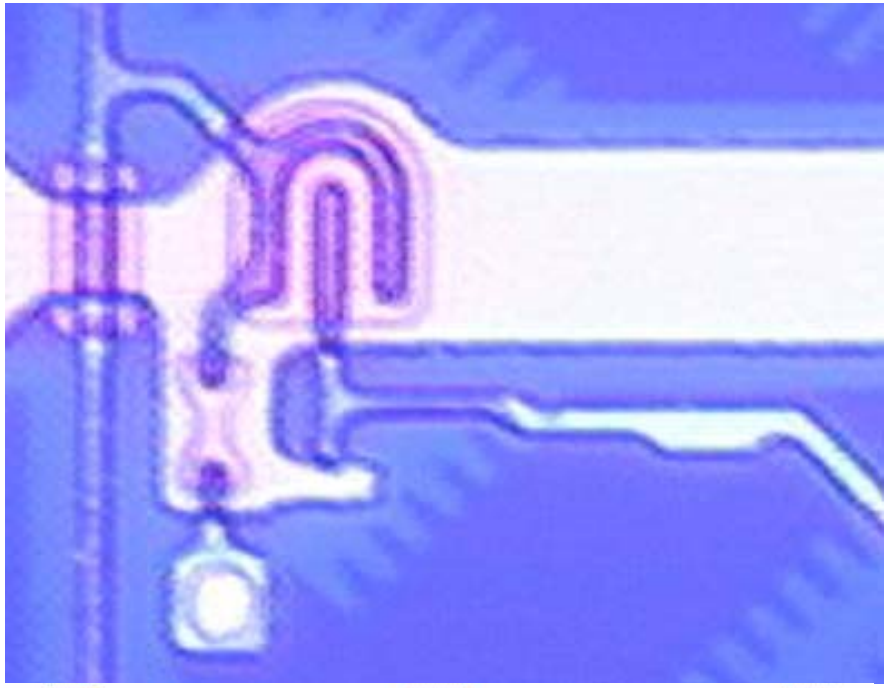


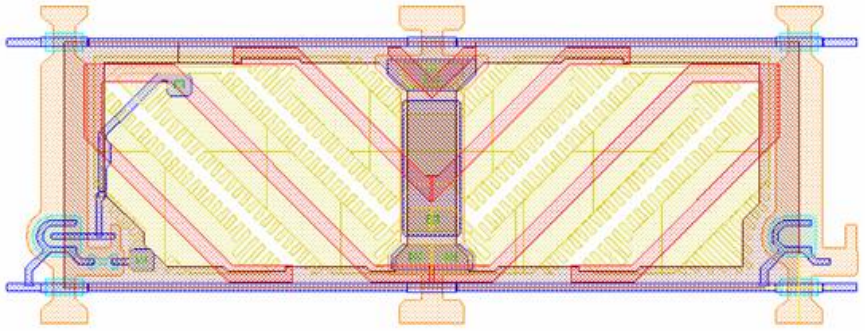


V32E

AMVA

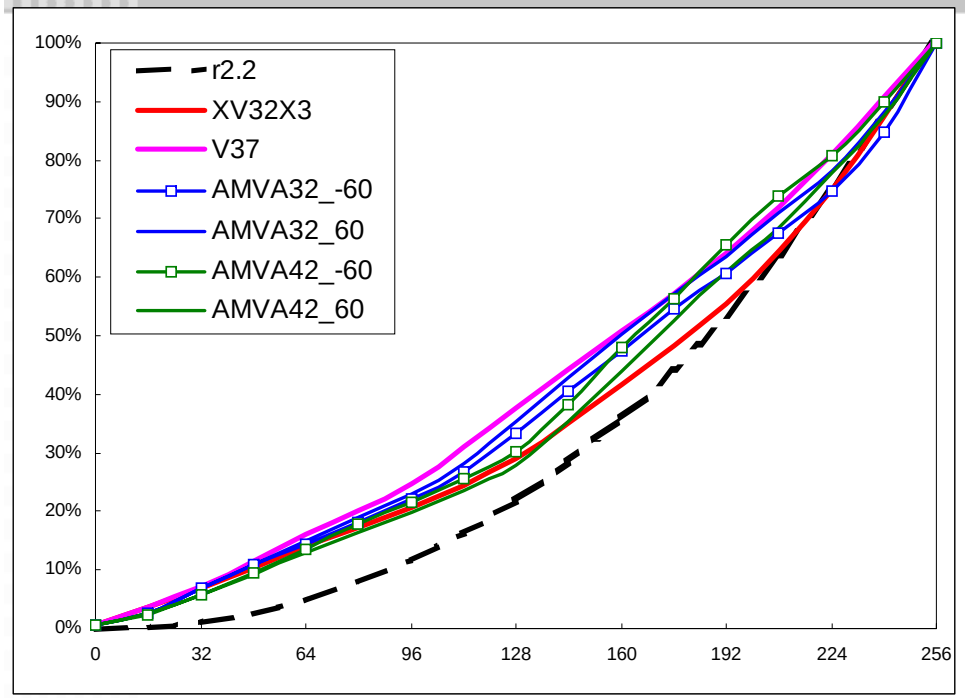
Additional **M**ulti **V**ertical **A**lignment





T315XW

AQSV and AMVA



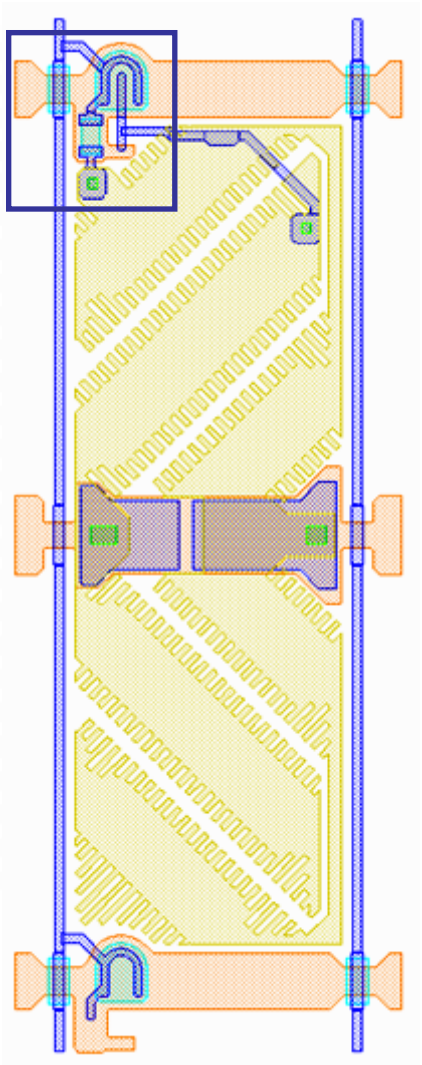
	AQSV 37	AQSV 32X3	AMVA 32 (DBEF_13.8us)	AMVA 42 (DBEF_10.2us)
D(0-255) (SDI ψ 0 θ 60 G1)	49.90%	37.59%	47.87%	45.53%
P	2.29	1.93	2.27	2.08

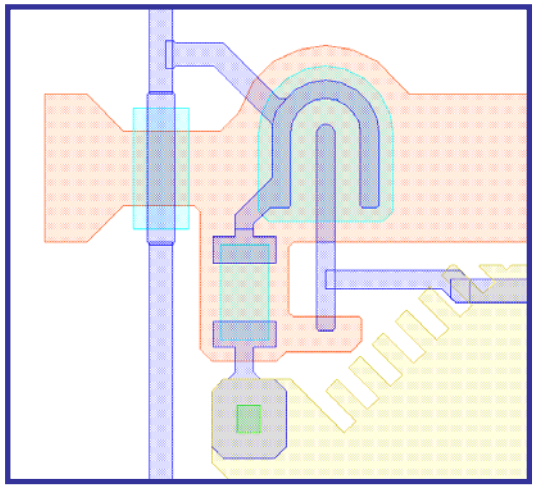
Comment：

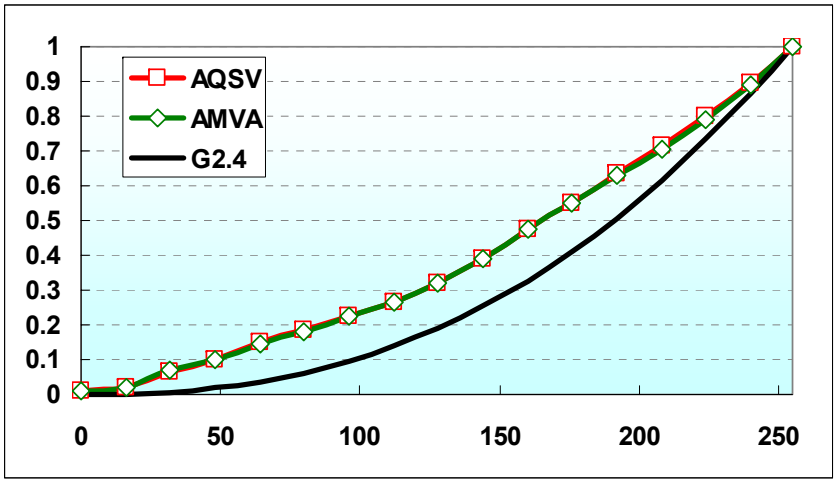
1. 由於無相近尺寸及相同材料進行特性比較結果，故此數據僅供參考。
2. 面板特性結果差異不大。

	AQSV 37	AQSV 32X3	AMVA 32	AMVA42
Resolution	1366*768	1366*768	1366*768	1366*768
△nd	300	300	340	340
Cell Gap	3.2	3.2	3.8	3.8
LC	MJ021866	MJ021866	MJ012008	MJ012008
Polarizer	Sumika X-plate	Sumika X-plate	Nitto X-plate	Nitto X-plate
CF	Toppan	Toppan	in House	in House
Array	5 mask	5 mask	5 mask	5 mask
Slit Width	10	10	8.8	8.8
Protrusion Width	9	9	10.5	10.5 (w/ node)
Protrusion Height	1.45		1.2	1.2
S-P Space	23	23	25	25~30
Aperture Ratio	47.96%	51.60%	55.90%	58.70%
Transmittance	4.36%	4.75%	4.2% (13.8us)	4.2%(10.2us) 4.7%(17.8us)
Contrast Ratio	1200	1000	1400(BEF3)	1200
Viewing Angle	85/85/85/85	85/85/85/85	88/88/88/88	88/88/88/88
Cst/Clcmin			Main-3.41 Sub-0.71	Main-2.88 Sub-0.57
Response Time (on+off 133ms)	18	18	18	18
Response Time (gray to gray G16)	6.7	6.7	8	8
MPRT (8 ppf G32)	19	19	13	13
NTSC	72%	72%	72%	72%

AQSV with AUO Design Rule







	AQSV L96		AMVA L96		AQSV L255		AMVA L255	
	normal	sub	normal	CC	normal	sub	normal	CC
Vph	8.64	8.06	9.32	8.56	13.98	10.32	14.59	11.47
Vpl	2.88	3.78	3.45	4.19	-0.98	0.25	-0.56	0.91
Vcom	5.84	5.84	6.38	6.38	5.89	5.89	6.60	6.60
Vrms	2.88	2.14	2.93	2.18	7.50	5.07	7.59	5.29
area	1.00	1.17	1.00	1.17	1.00	1.17	1.00	1.17
Vrms ratio	**0.742**		**0.745**		**0.676**		**0.698**	
T (sum)					**97.9%**		**100.0%**	

*** AQSV and AMVA has almost the same A.R.**

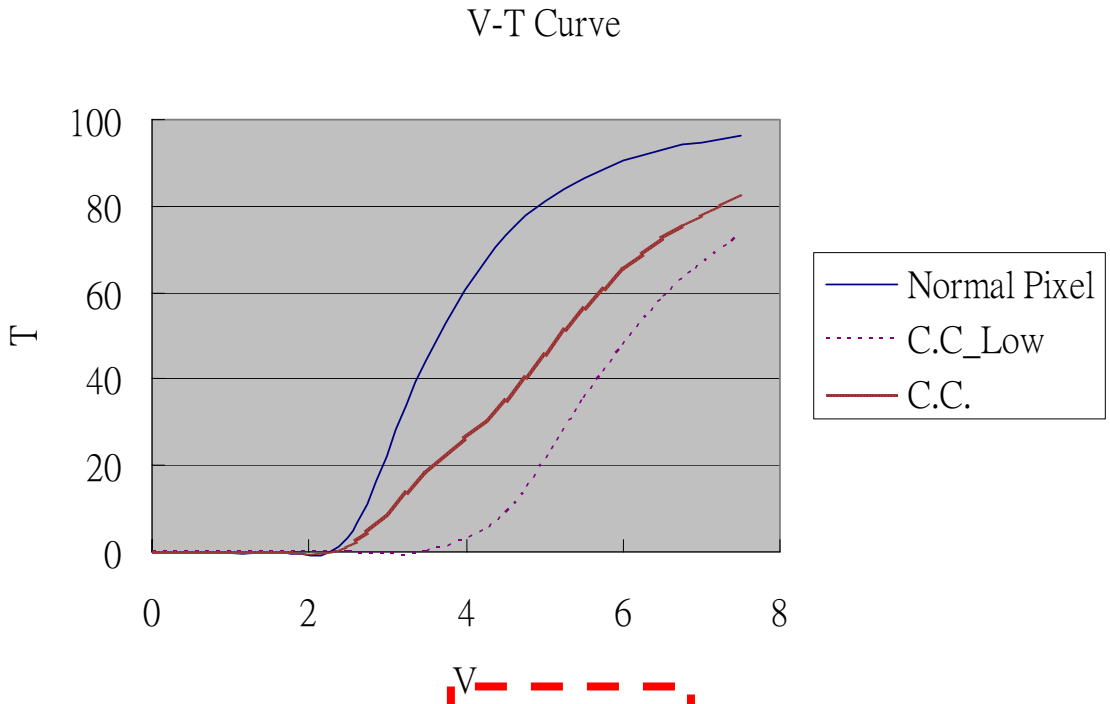
*** AQSV sub-TFT：W/L = 10.25 / 12.5**

*** AMVA sub-TFT：W/L = 4/12.5**

Comment：

1. Gamma 特性結果差異不大。

Lower Brightness and CR of C.C. Pixel
（缺點）

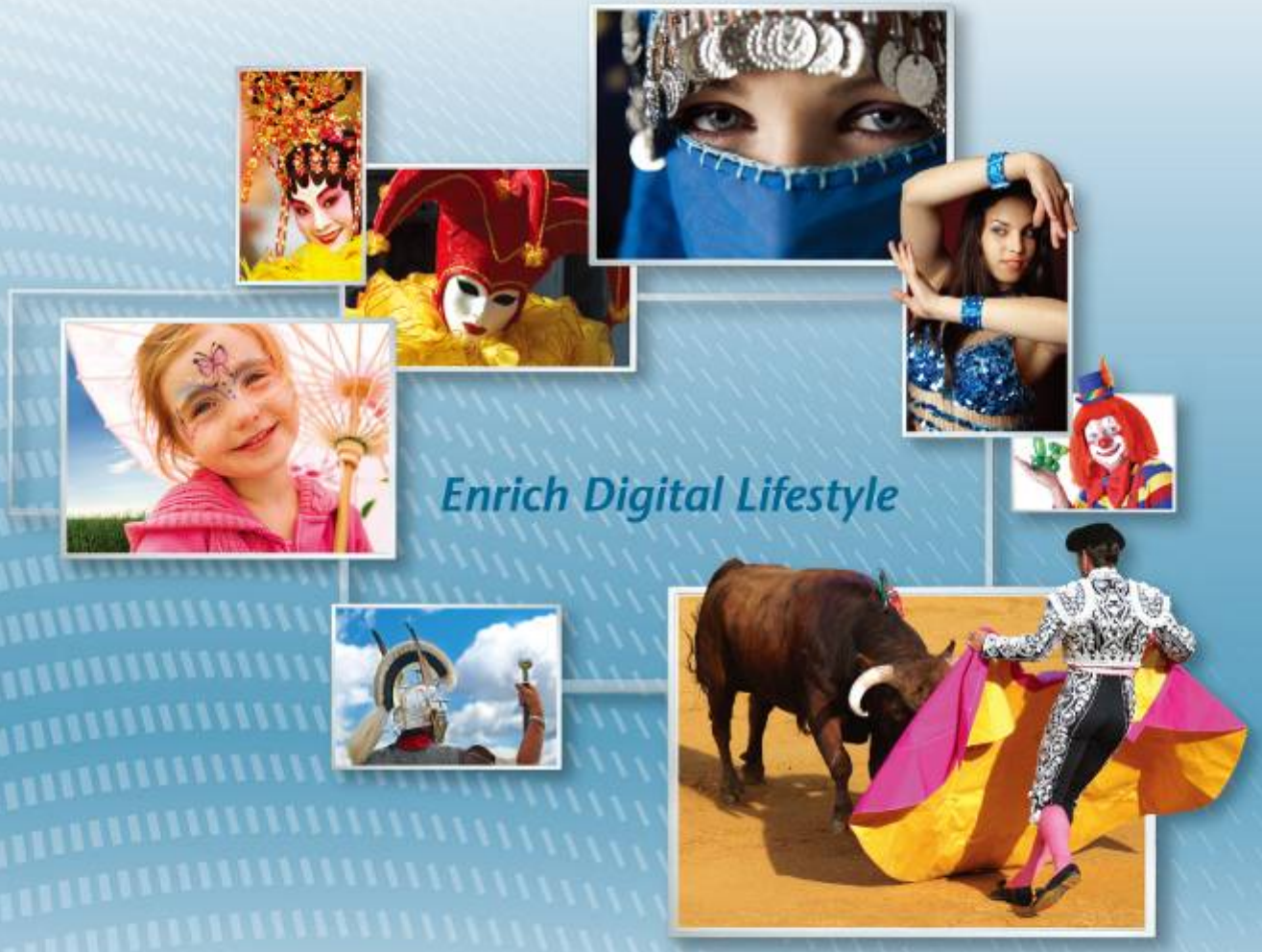


		CC type	Normal type
Brighrness (nit)		454	590
Contrast Ratio		686	832
Color Gamut (%)	NTSC mode	67.8	68
	EBU mode	94.6	94.9
White color deviation		0.014	0.017
Color Temperature		9062	8832

由 C.C 與 Normal Pixel 的 V-T Curve 可以看出 C.C Pixel 的組合亮度是較低的。

因此 Brightness and Contrast Ratio 都會較一般 VA Pixel 來的差。

爲了要提高 C.C 的亮度與對比，必需要在 Backlight、Polarizer、CF等材料下更多功夫。


Enrich Digital Lifestyle