TFT LCD 驅動IC開發

平面顯示技術概論

94年10月19日

Drive For Better Vision

Display engine→ Brandname entry

WEGA
SONY

DCDi
by FARODJA

DNIe™
Digital Natural Image engine

SAMSUNG

GENESIS
DISPLAY PERFECTION

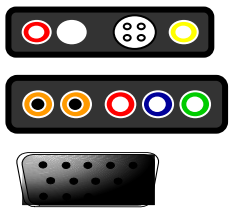
Himax

XD™
ENGINE

LG

2002 成立演算法團隊
2003 成立晶片設計團隊
2004 第一代影像處理引擎晶片

TV Systems



Audio Processor

Interface

Video Processor

TCON

Channel Receiver

DTV Decoder

數位電視

Handset Requirement

造型

Slim border, integration

功能

Color, resolution, I/F ...

省電

Low power consumption

價格

Low cost

Tuner

技術創新：

1. 利用雙變頻架構及新創新之系統架構，開發出最簡架構的可接收全世界電視系統之Tuner模組(G02系列)
2. 利用低電壓調諧(under 5V)及Image rejection Mixer，設計出低耗電及高感度之手機專用Tuner(3UZ2 series)及多媒體撥放器，車用電視Tuner 模組(5MZ1/5UZ1)
3. 利用獨創增益提升迴路創造出高感度超薄型DVB-TNIM Module，可使用在如STB 或USB TV上(3T11 series)
4. 利用表面黏著可調式COIL，以創新製程設計高製程效率，目標相關標準工時可降低50%及直通率達到95% 之 CAN TUNE模組，並有傳統CAN Tuner 之高感度特性(5U51/5R5X series)

Portable Applications of LCOS

3G Cell Phone

Notebook

PSP

PMP

Portable DVD

DVB-H
DMB

Mini Projector

OES – 2005/6 光電展

- **12 x 12 x 6 mm**
- **500 g**
- **LCOS 0.62” SVGA**
- **15 lm**
- **LED array (< 12W)**
- **A4-A3 @ 50 cm**

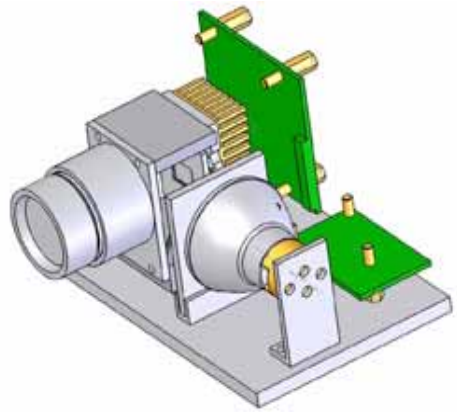
LCOS 0.47” VGA

20 lm

50 W Halogen Lamp

10 cm x 9 mm x 6 cm

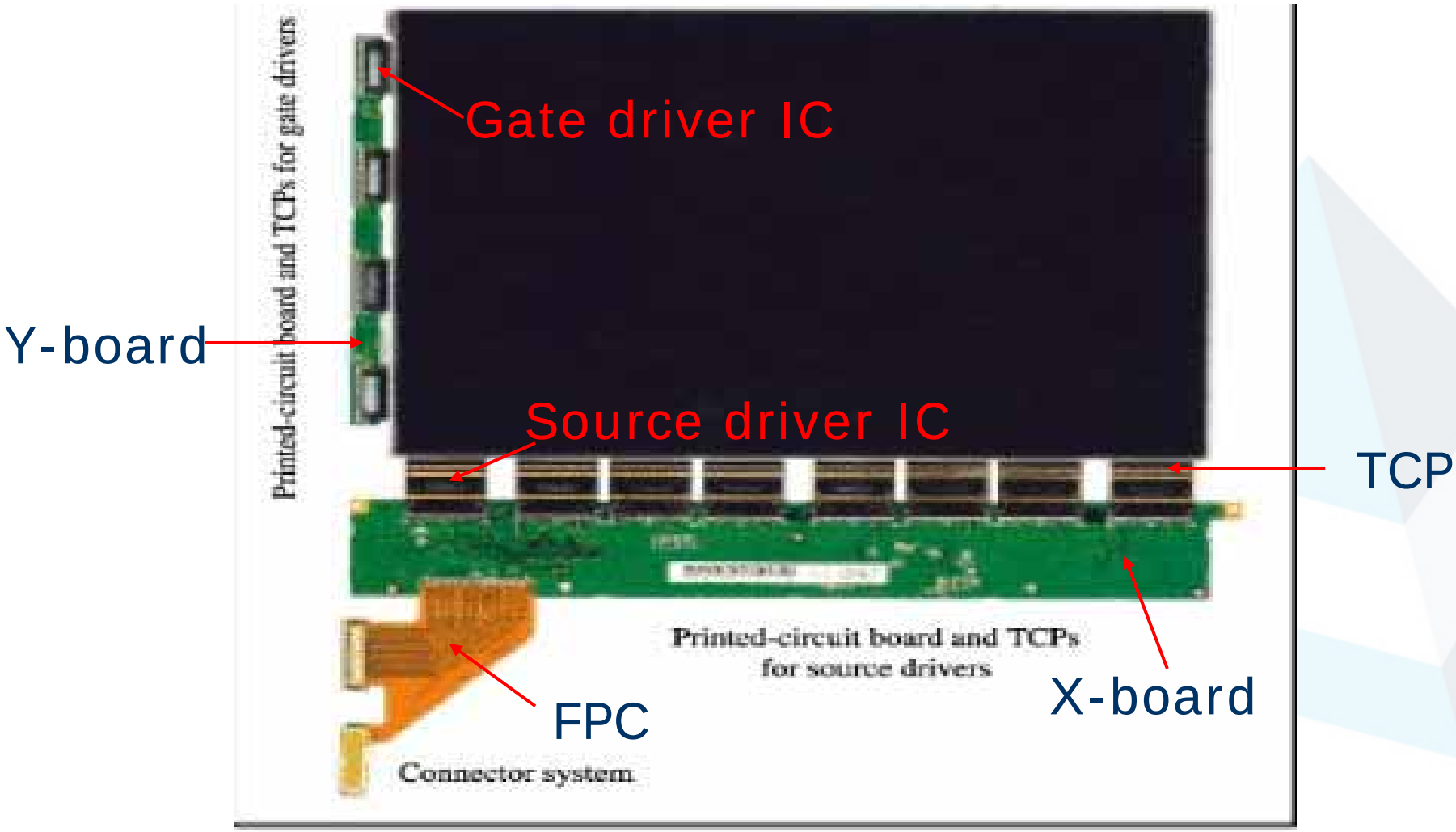
A4-A3 @ 50 cm



Himax

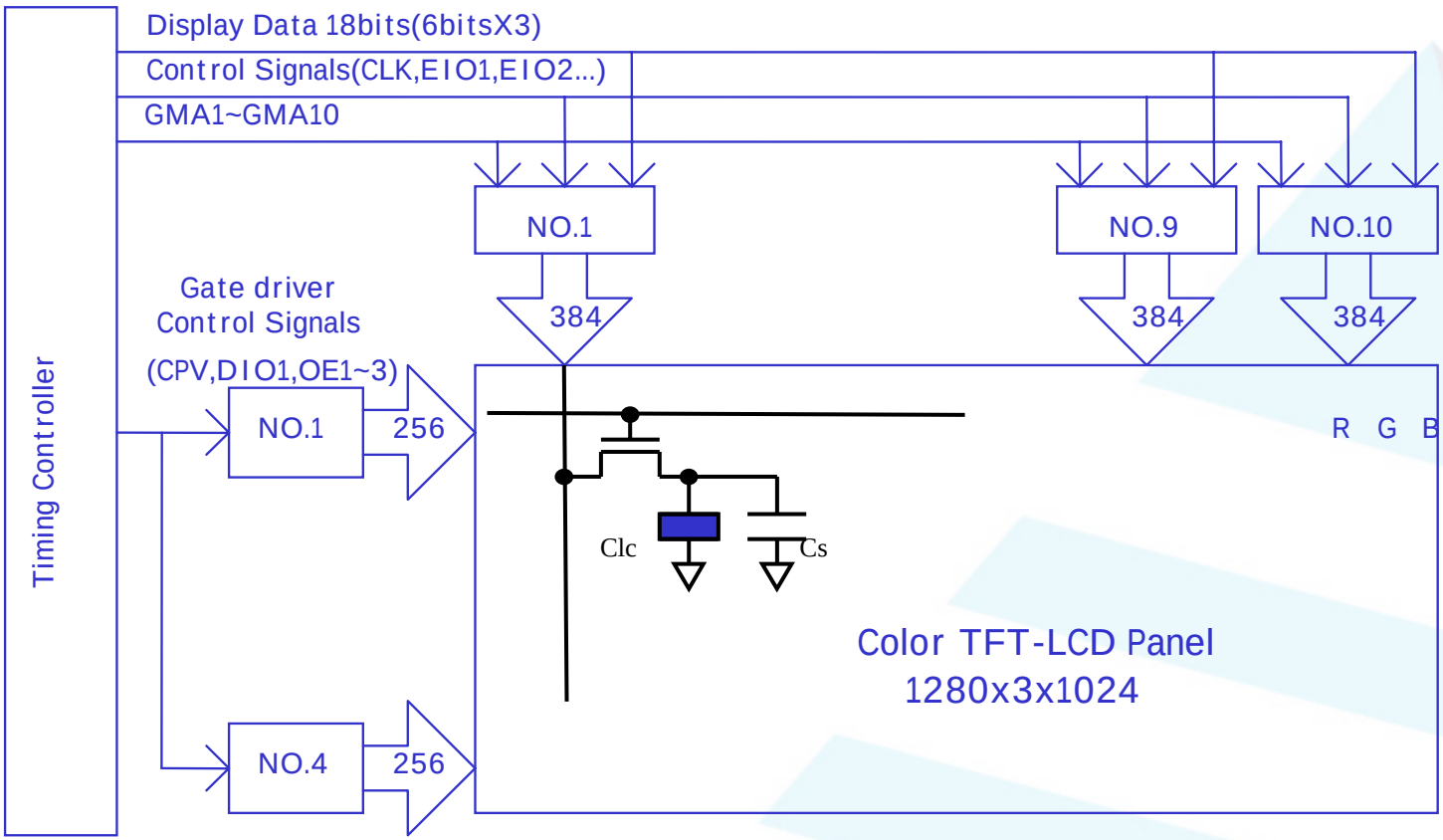
TFT LCD Panel & Driver IC

TFT-LCD Driving System



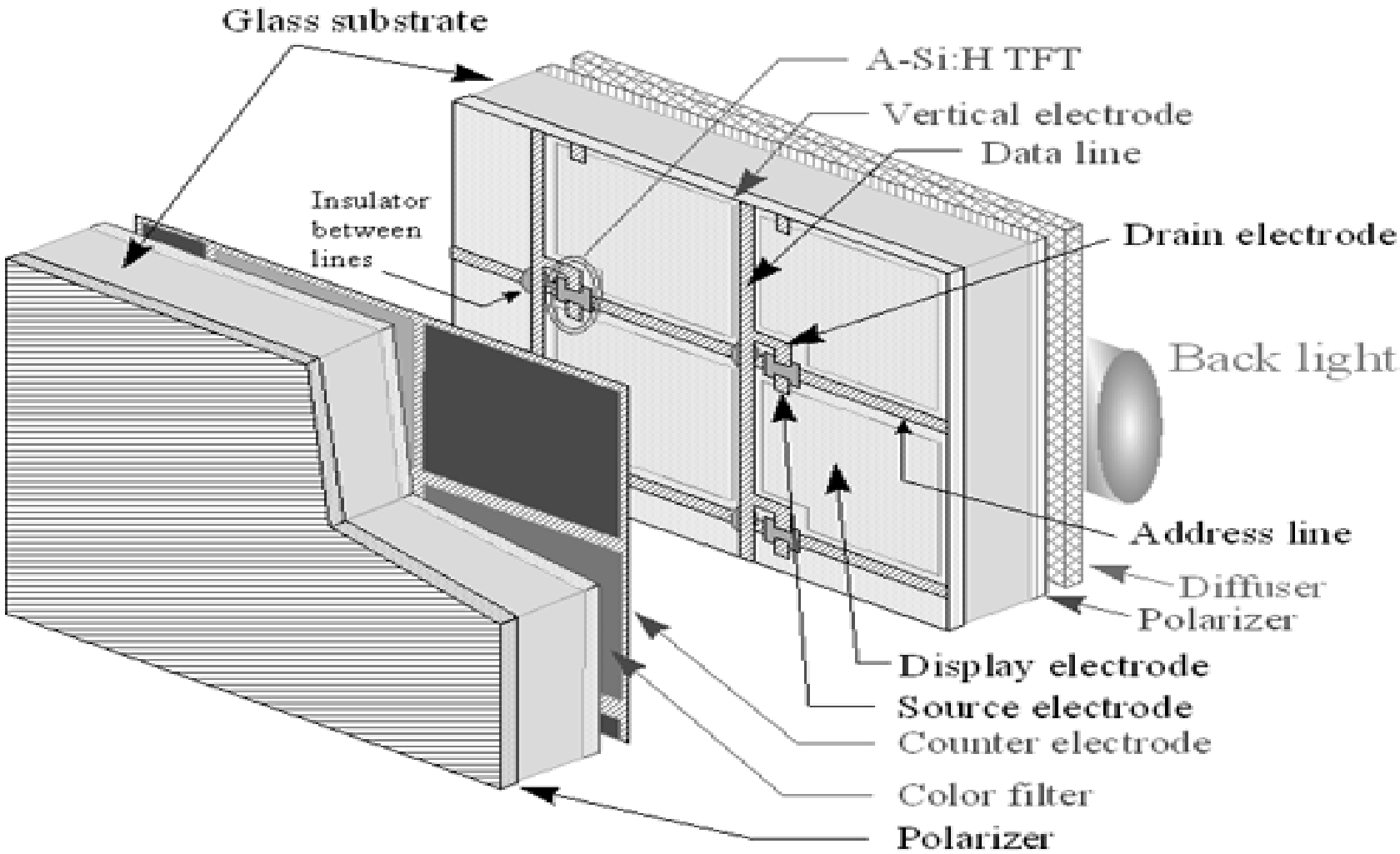
TFT-LCD Driving System

6-bit SXGA (1280*1024) LCD system



Himax

TFT-LCD Physics



TFT-LCD Physics

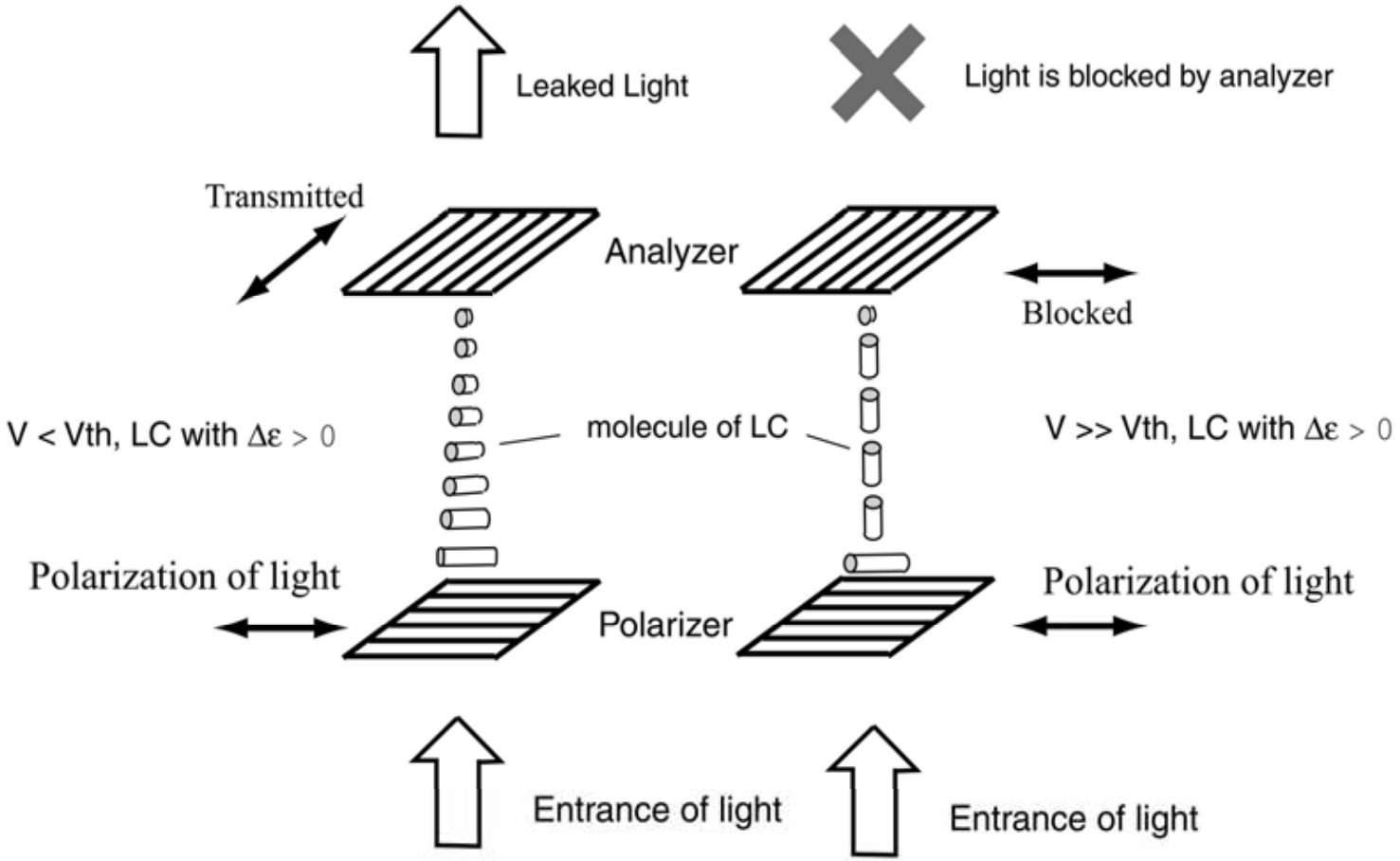
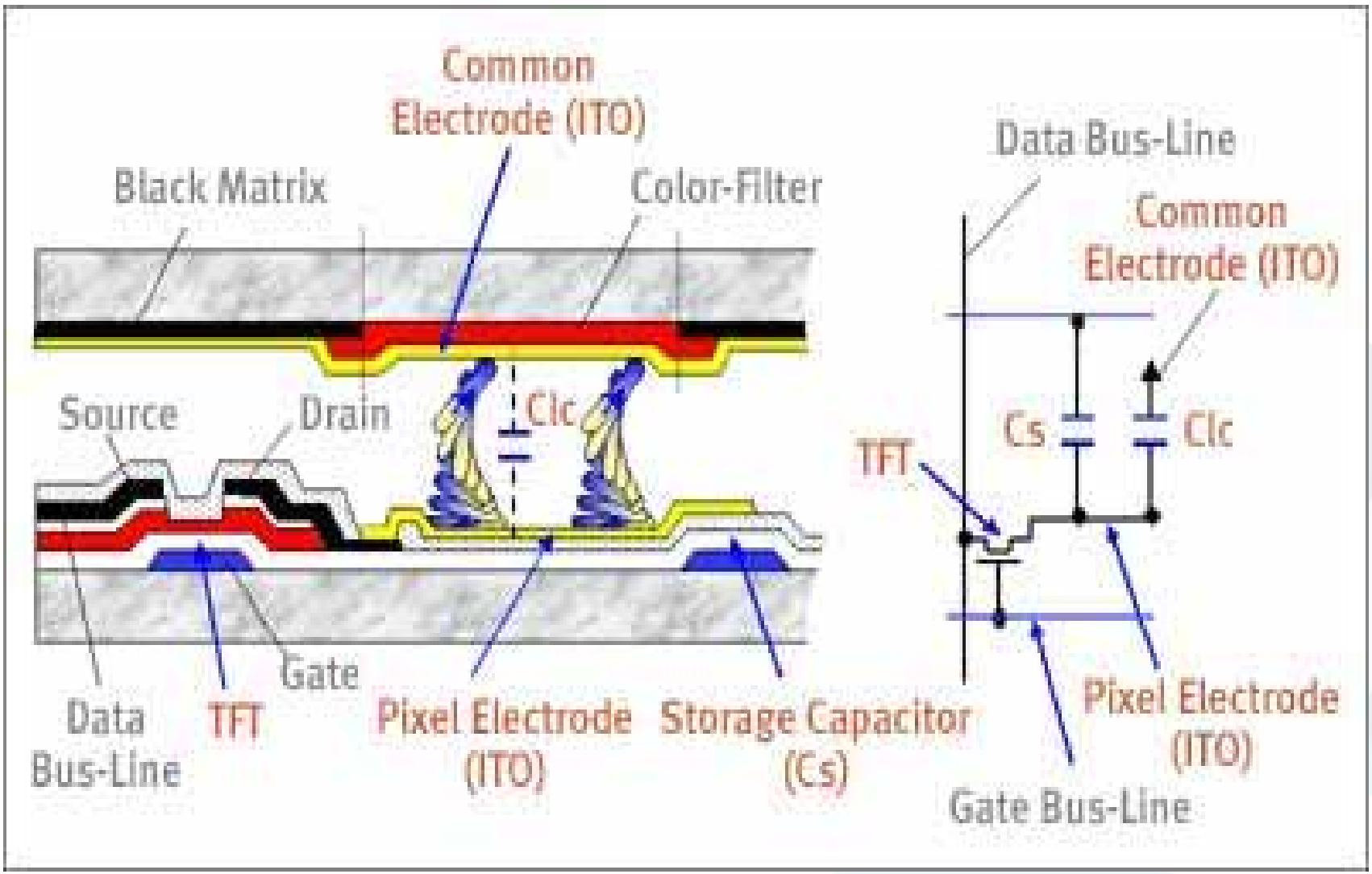
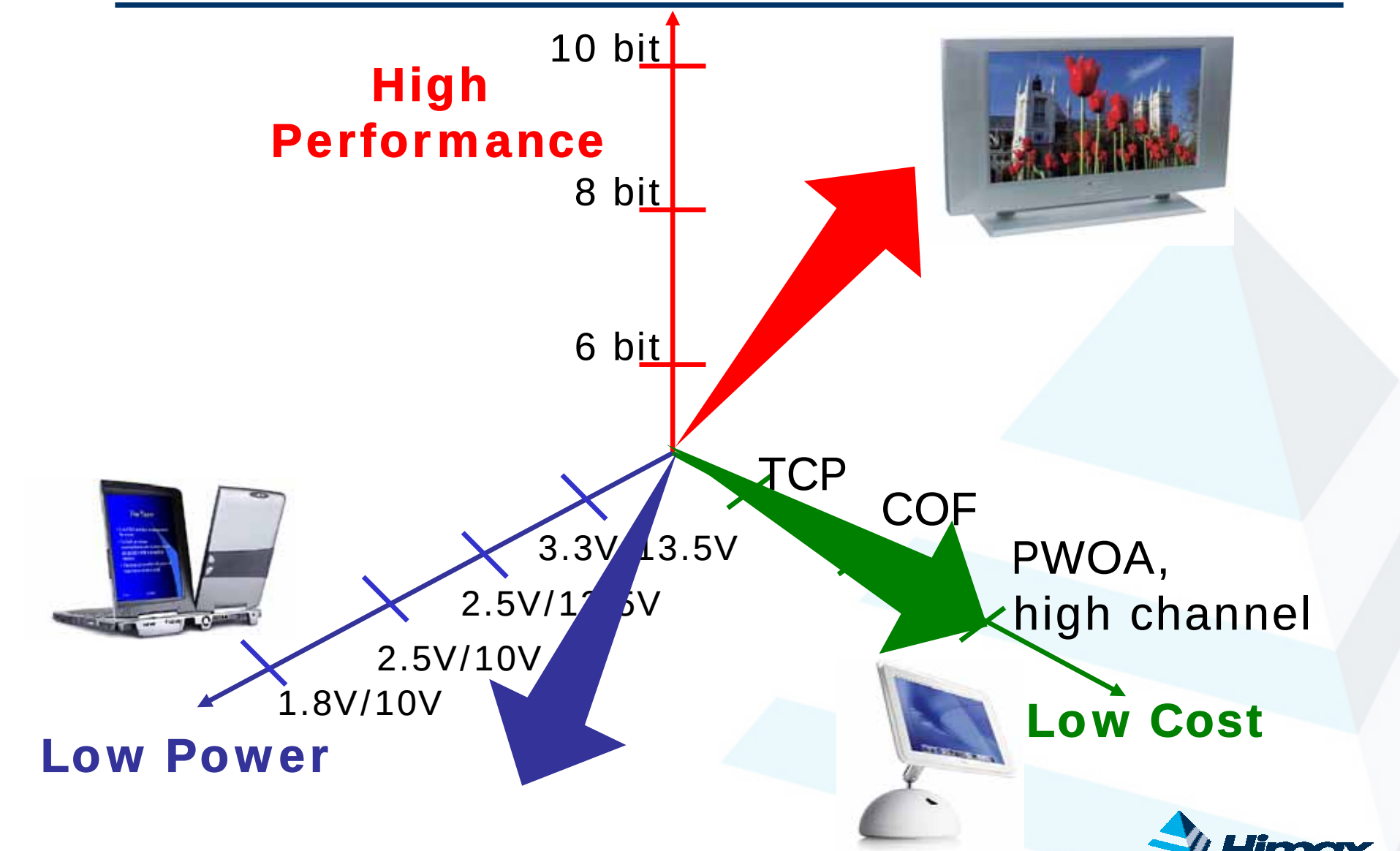


Illustration of the operation of by a 90° NW TN cell

TFT-LCD Physics



Source Driver Technology Trend

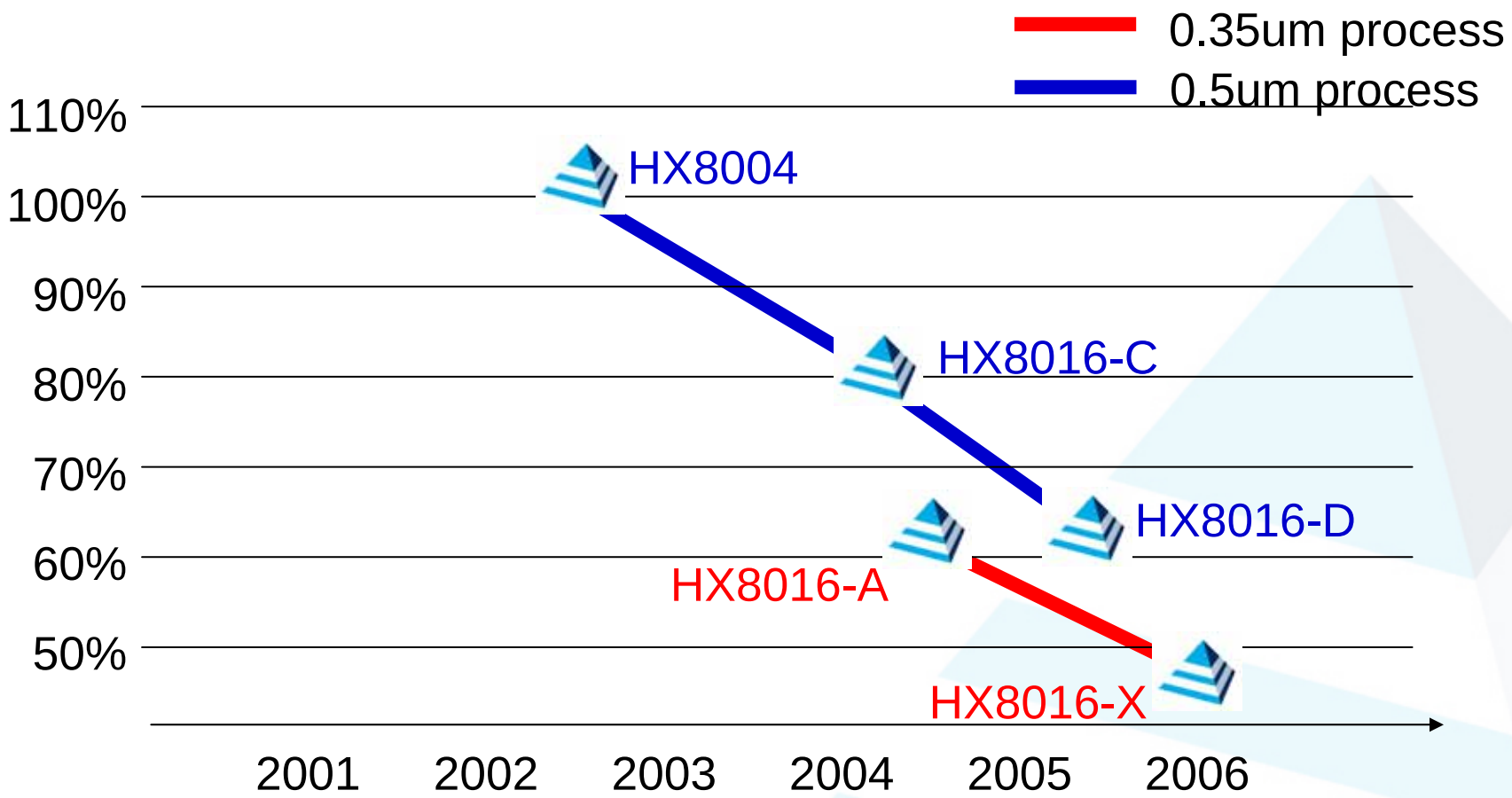


OA Product List

Interface	Bit	Channel #
RSDS/TTL	6	384,420, 432, 480 600, 618, 630, 642 720, 768, 960, 1024, 1280
RSDS/COG	6	384
RSDS	8	384, 414, 420, 432, 480 600, 618, 630, 642, 684, 720
Mini-LVDS	6	384, 420, 480
	8	600, 618, 630, 642, 690, 720

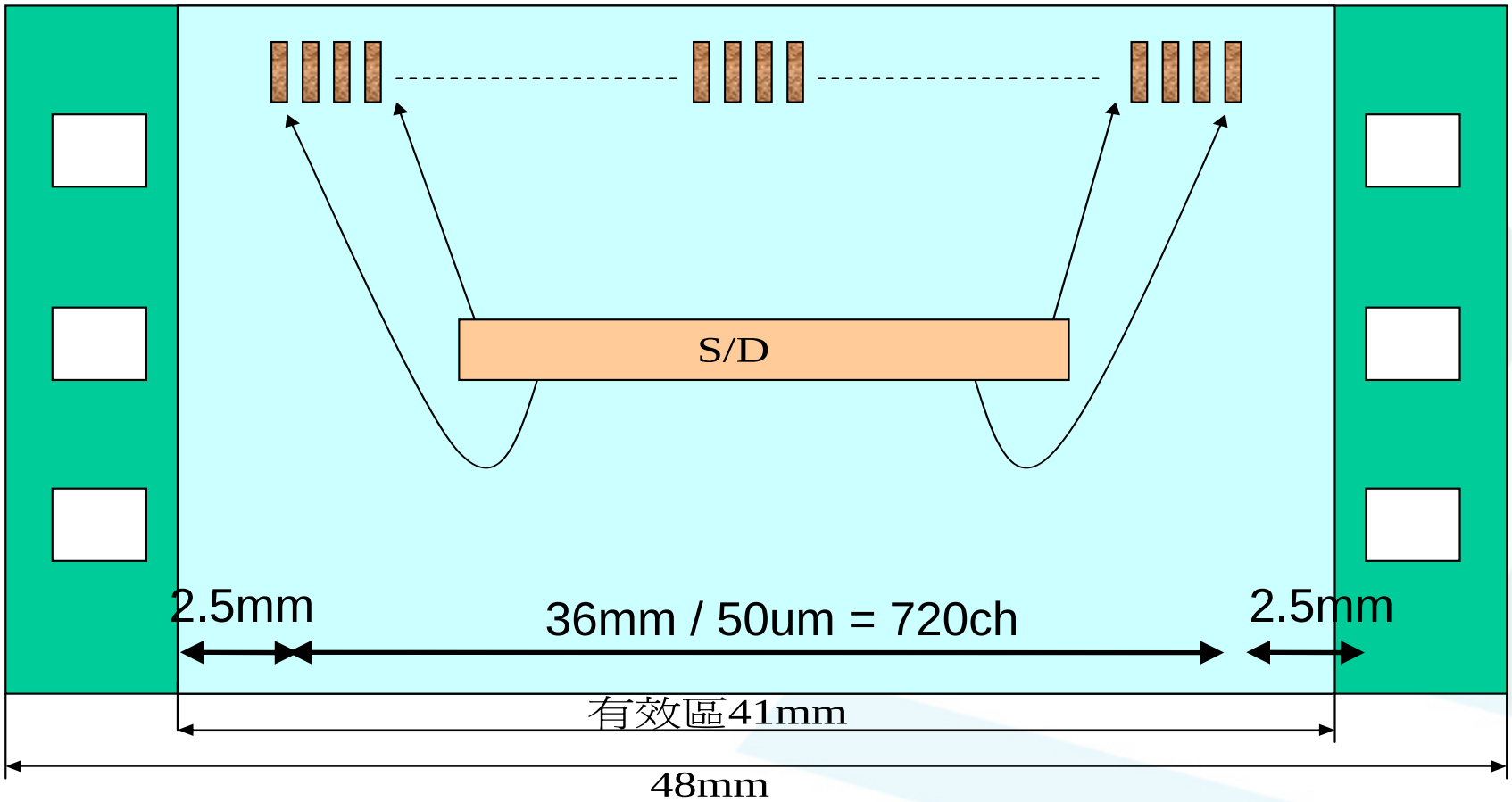
Any channel, any interface, co-define interface

Die Shrink Roadmap

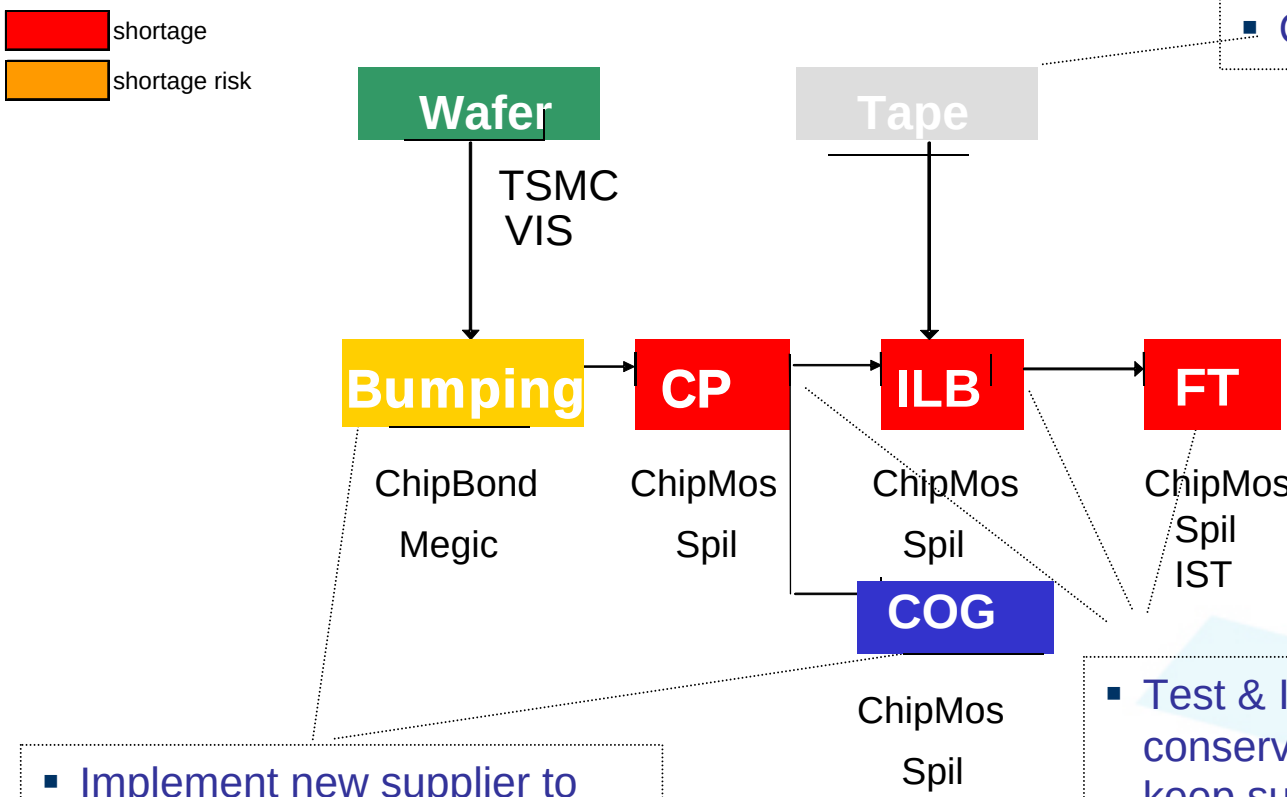


48mm → Optimized for 720ch

- Need to push (1) OLB rule, (2) COF fine pitch



Supply Chain



- COF material shortage

- Implement new supplier to overcome increasing demand

- Test & ILB shortage in Q3, and conservative Capa. expansion may keep supply shortage in future.
- Testing: high pin count tester shortage in W/W

Himax

Source Driver Introduction

Operation Frequency

	VGA	SVGA	XGA	SXGA	UXGA
Total	800*525	1056*628	1344*806	1688*1066	2160*1250
Active	640*480	800*600	1024*768	1280*1024	1600*1200
pixel clock(60Hz)	25.175MHz	40MHz	65MHz	108MHz	162MHz
pixel clock(75Hz)	31.46875MH	50MHz	81.25MHz	135MHz	202.5MHz
pixel clock(90Hz)	37.7625MHz	60MHz	97.5MHz	162MHz	243MHz
pixel clock(120Hz)	50.35MHz	80MHz	130MHz	216MHz	324MHz

SXGA = 1688*1066*60=107.964480MHz

Channel # -- Decided by Resolution

	VGA	SVGA	XGA	WXGA	SXGA		WXGA+	SXGA+	UXGA		
	640*480	800*600	1024*768	1280*768	1280*1024	1280*720	1366*768	1400*1050	1600*1200	1920*1080	1920*1200
384	5	6.25	8	10	10	10	10.6719	10.9375	12.5	15	15
414	4.6377	5.7971	7.42029	9.27536	9.275362	9.27536	9.89855	10.14493	11.5942	13.91304	13.91304
420	4.5714	5.7143	7.31429	9.14286	9.142857	9.14286	9.75714	10	11.42857	13.71429	13.71429
480	4	5	6.4	8	8	8	8.5375	8.75	10	12	12
576	3.3333	4.1667	5.33333	6.66667	6.666667	6.66667	7.11458	7.291667	8.333333	10	10
768	2.5	3.125	4	5	5	5	5.33594	5.46875	6.25	7.5	7.5
960	2	2.5	3.2	4	4	4	4.26875	4.375	5	6	6

XGA = 1024 x 768

➔1024x3=3072 DAC's

➔ 3072 ÷ 384 = 8 driver IC

→384ch is the most common, moving to 642ch

Himax

Bits -- color depth

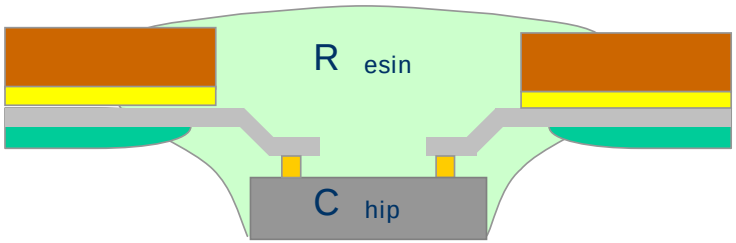
6 bits : $2^6 * 2^6 * 2^6 = 262,144$

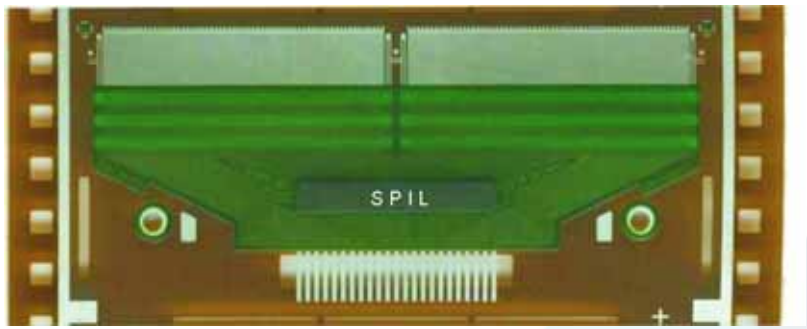
8 bits : $2^8 * 2^8 * 2^8 = 16,777,216$

Side effect is cost → use dithering

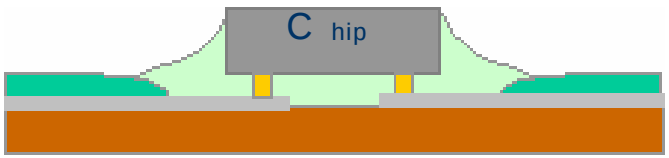
Package I

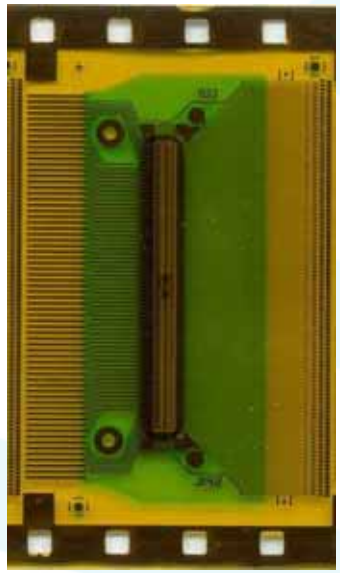
TCP





COF



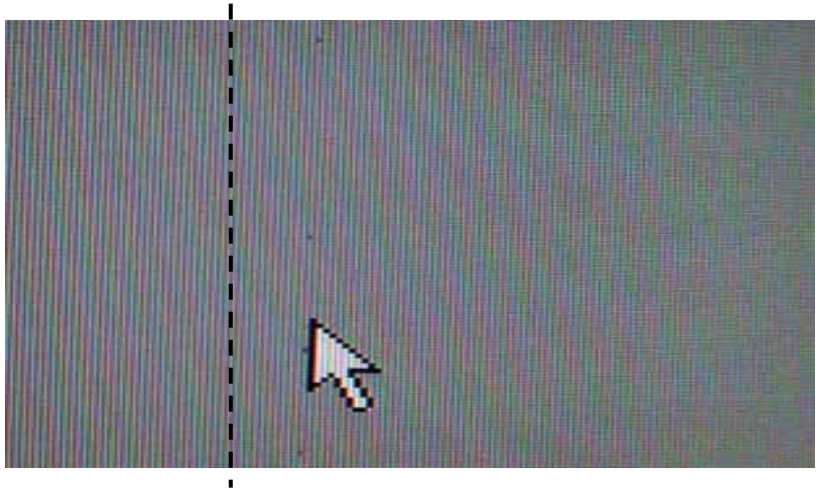


Himax

Defect definition

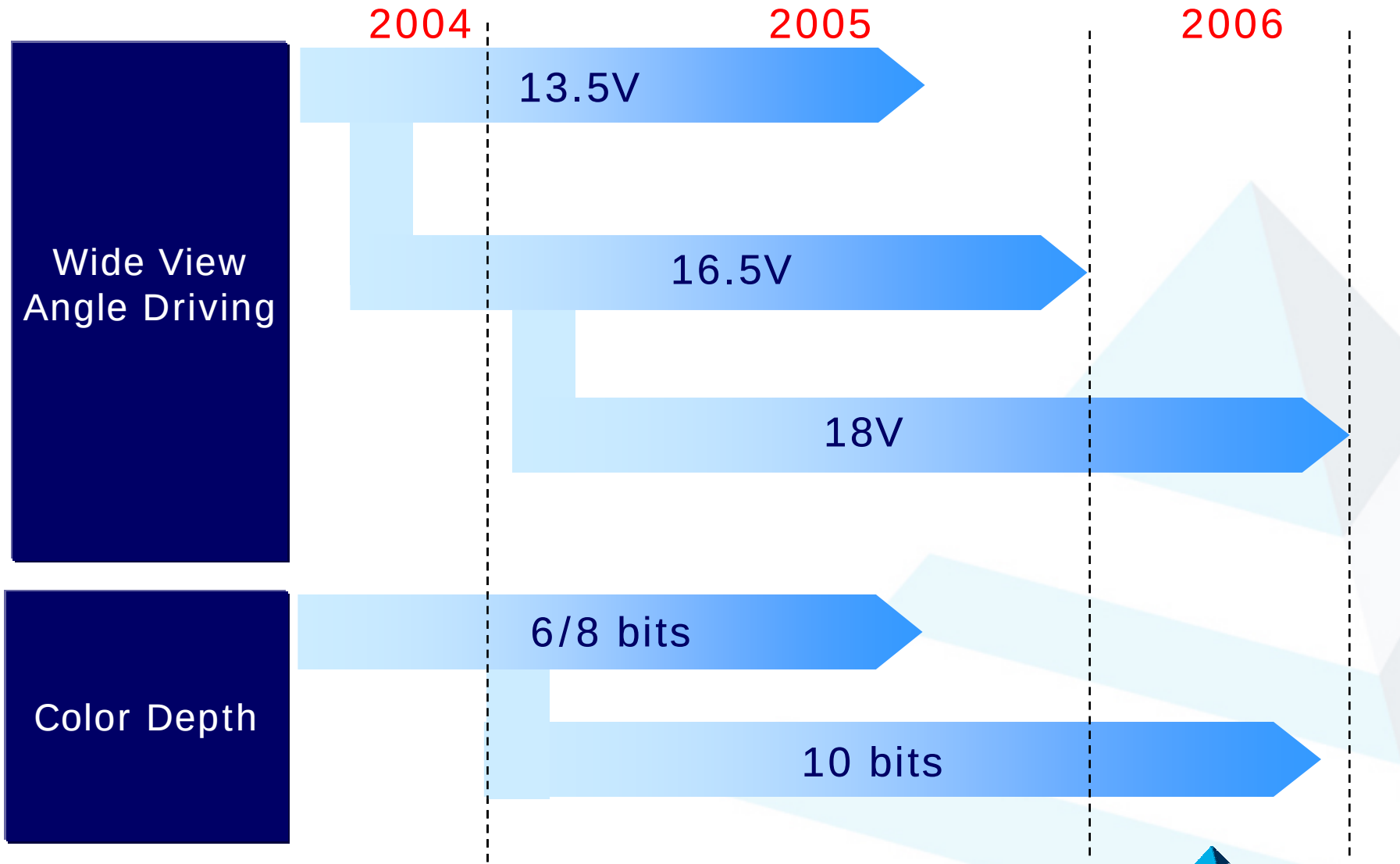
Band defect

Line defect

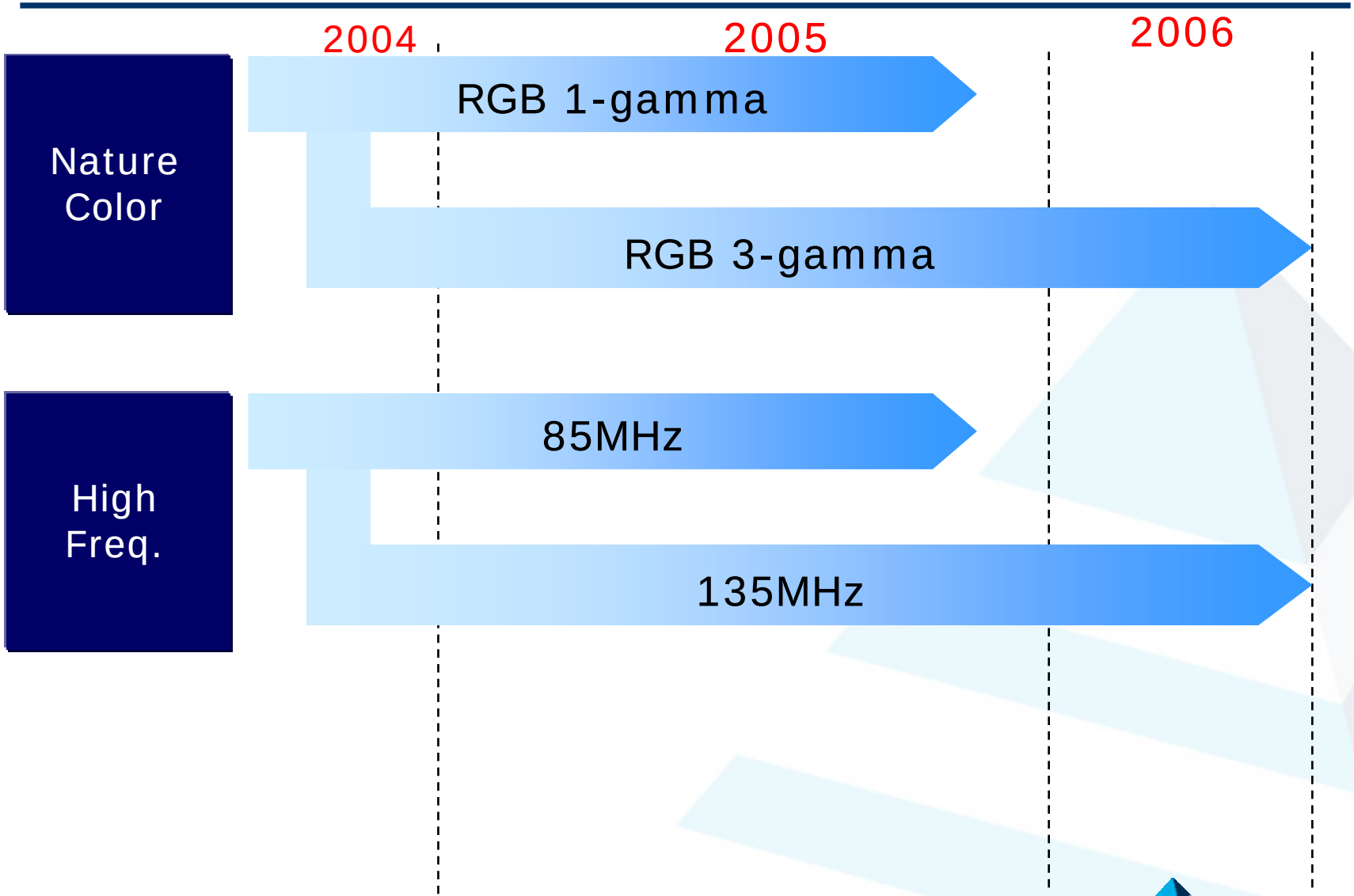


Dash line

High Performance Trend

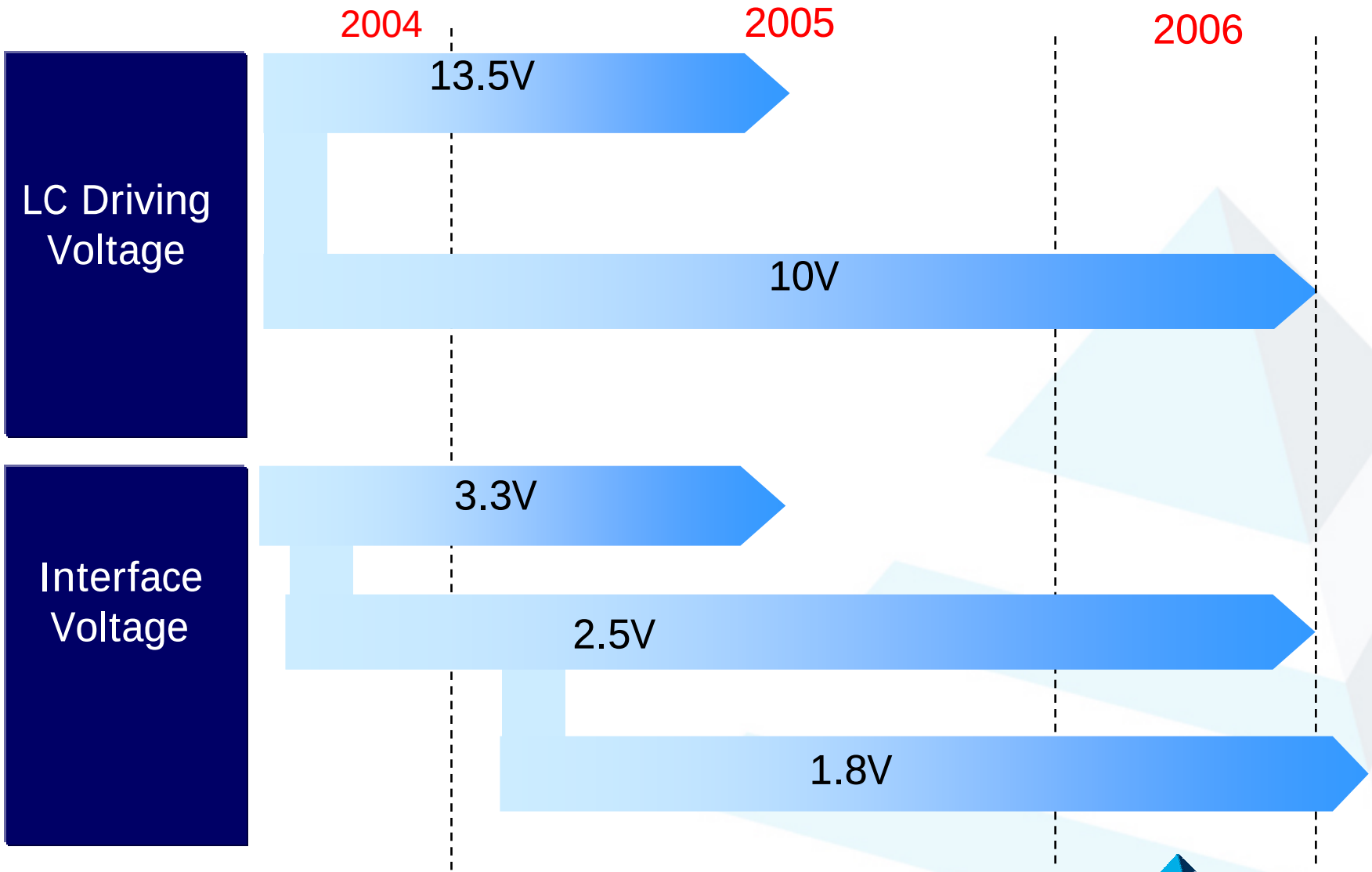


High Performance Trend

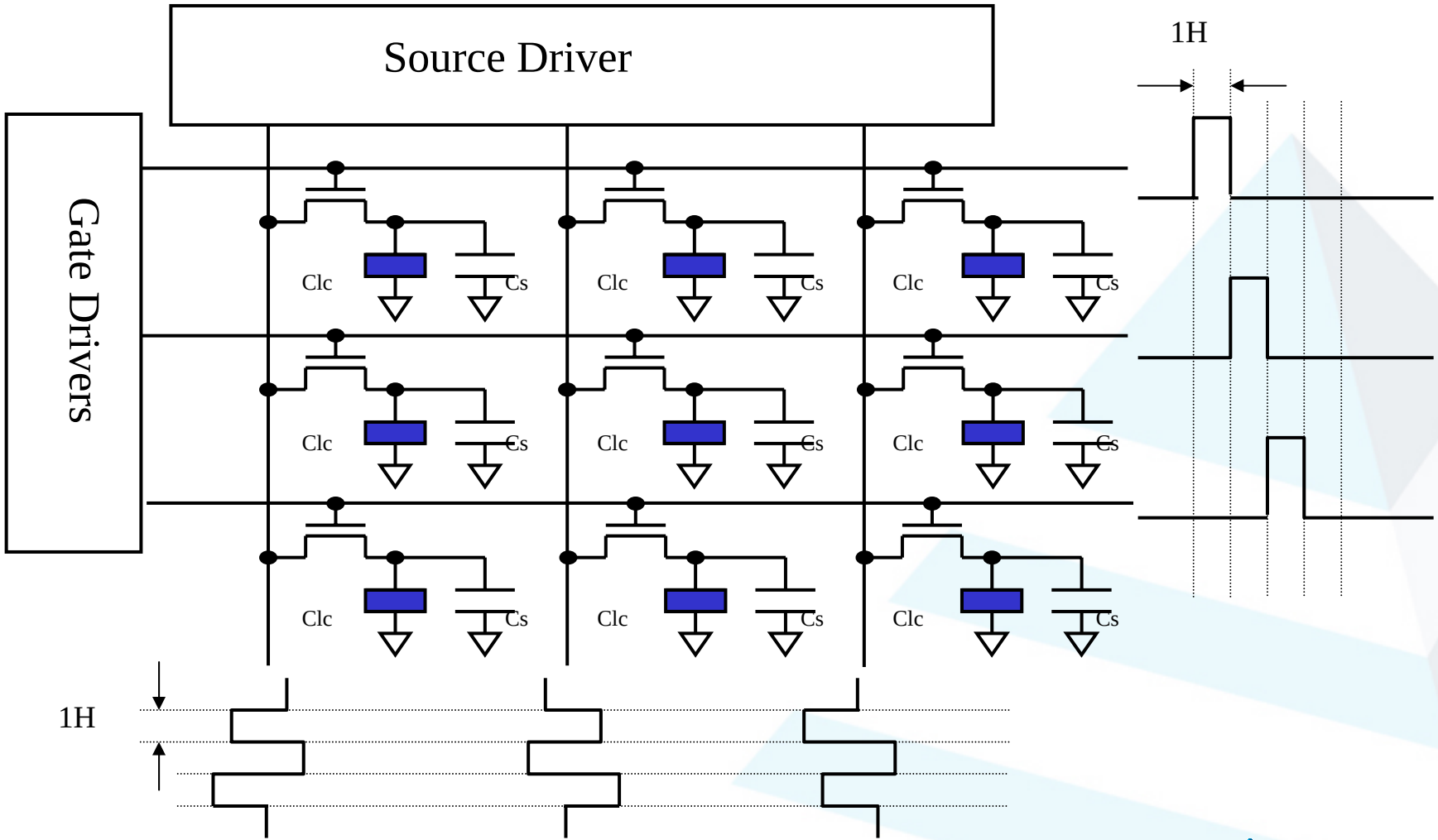


Himax

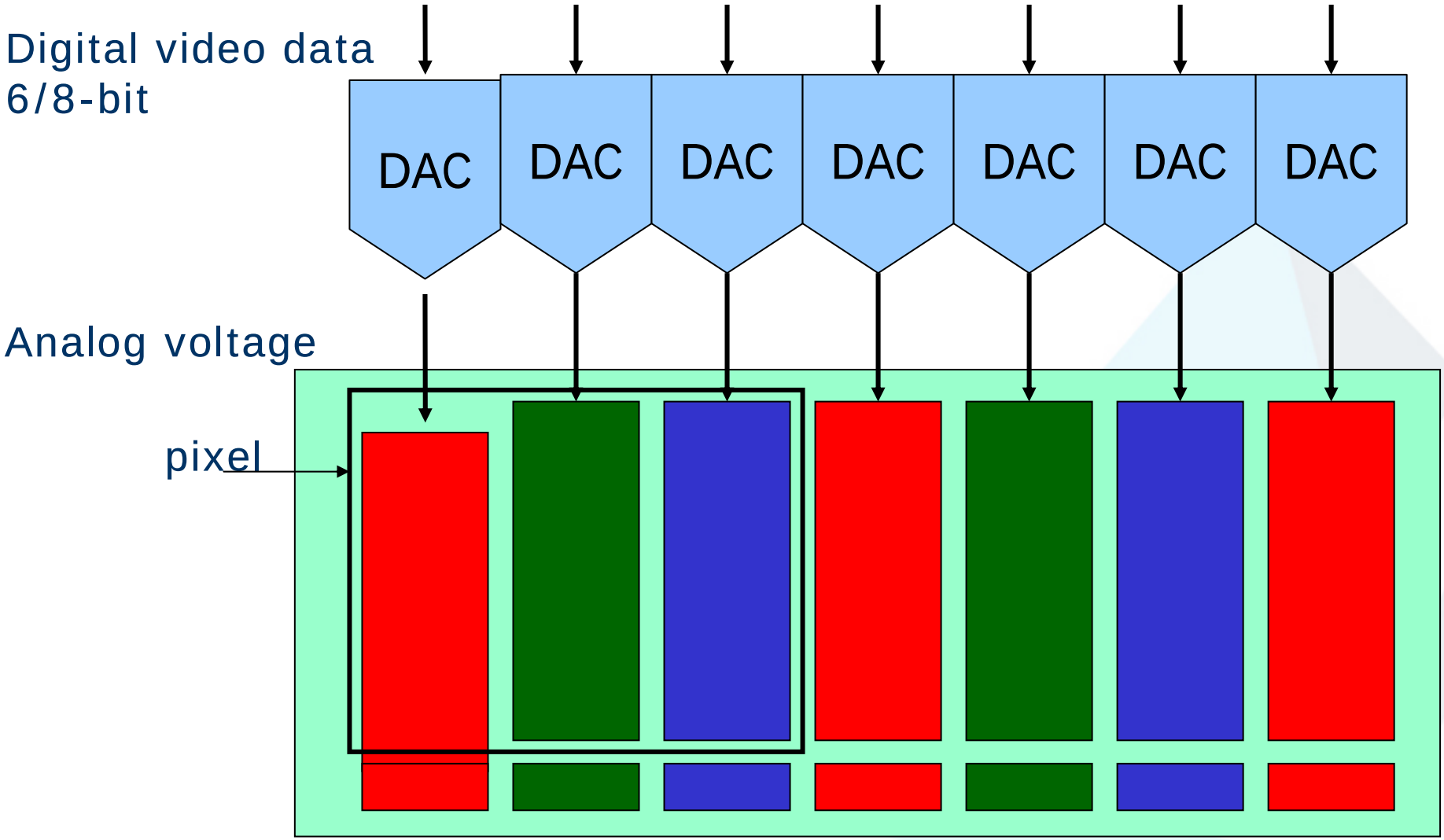
Low Power Trend



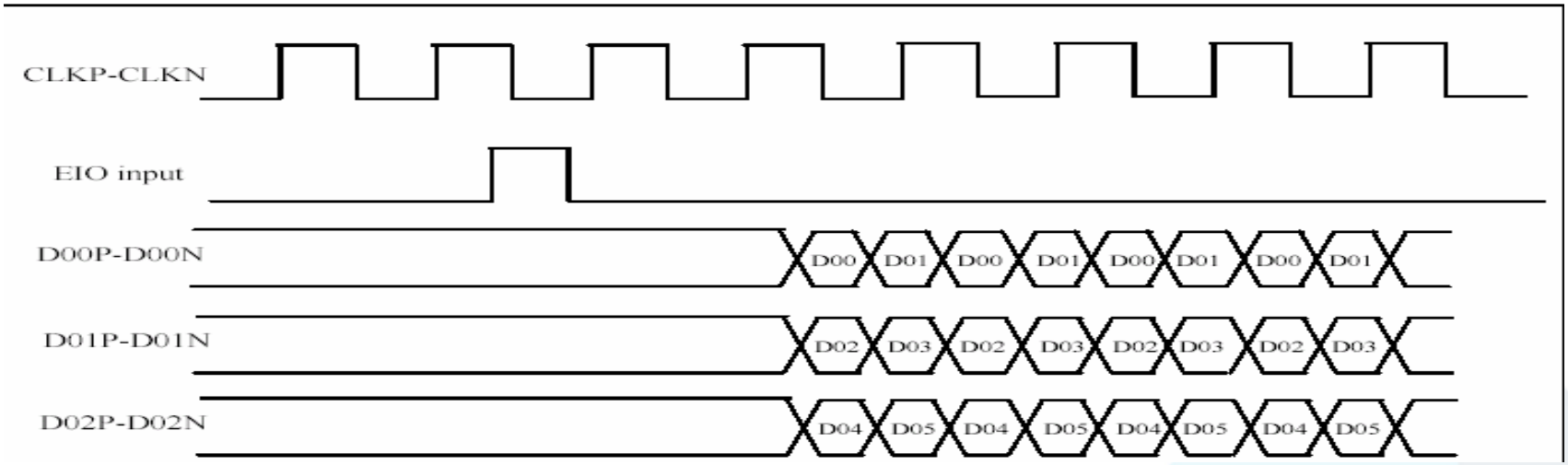
TFT-LCD Driving System

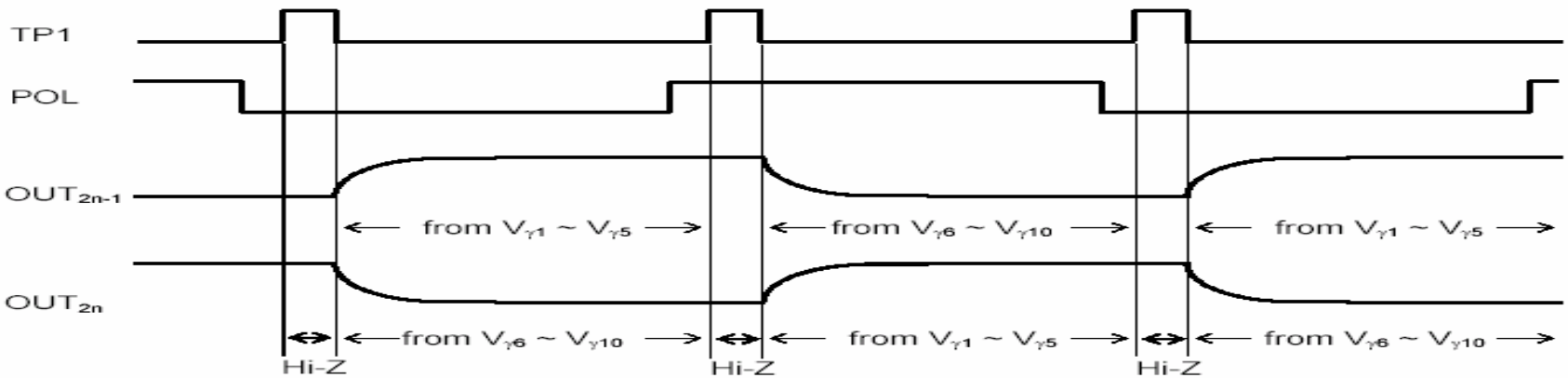


TFT LCD Driving System

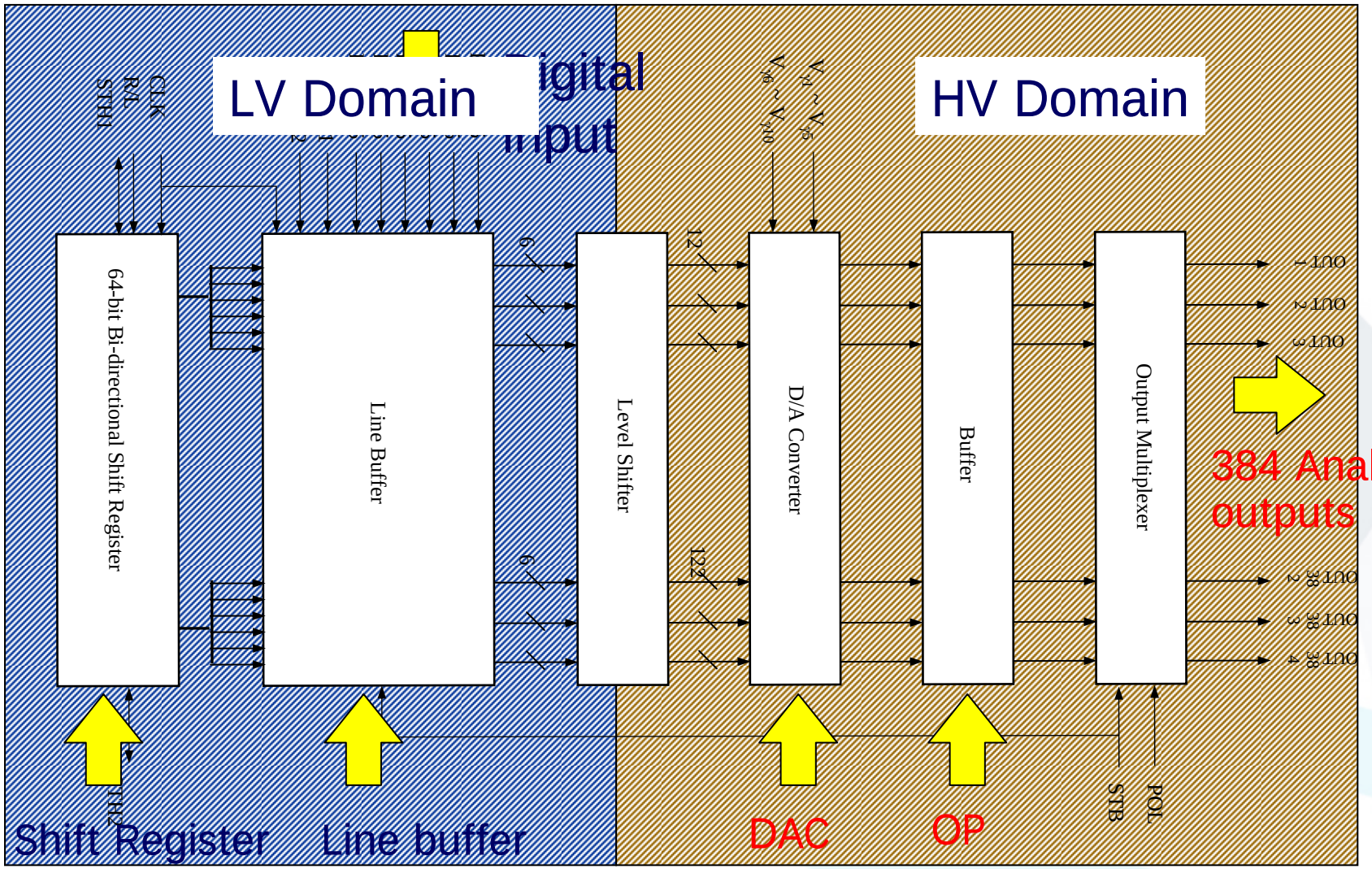


How Source Driver function

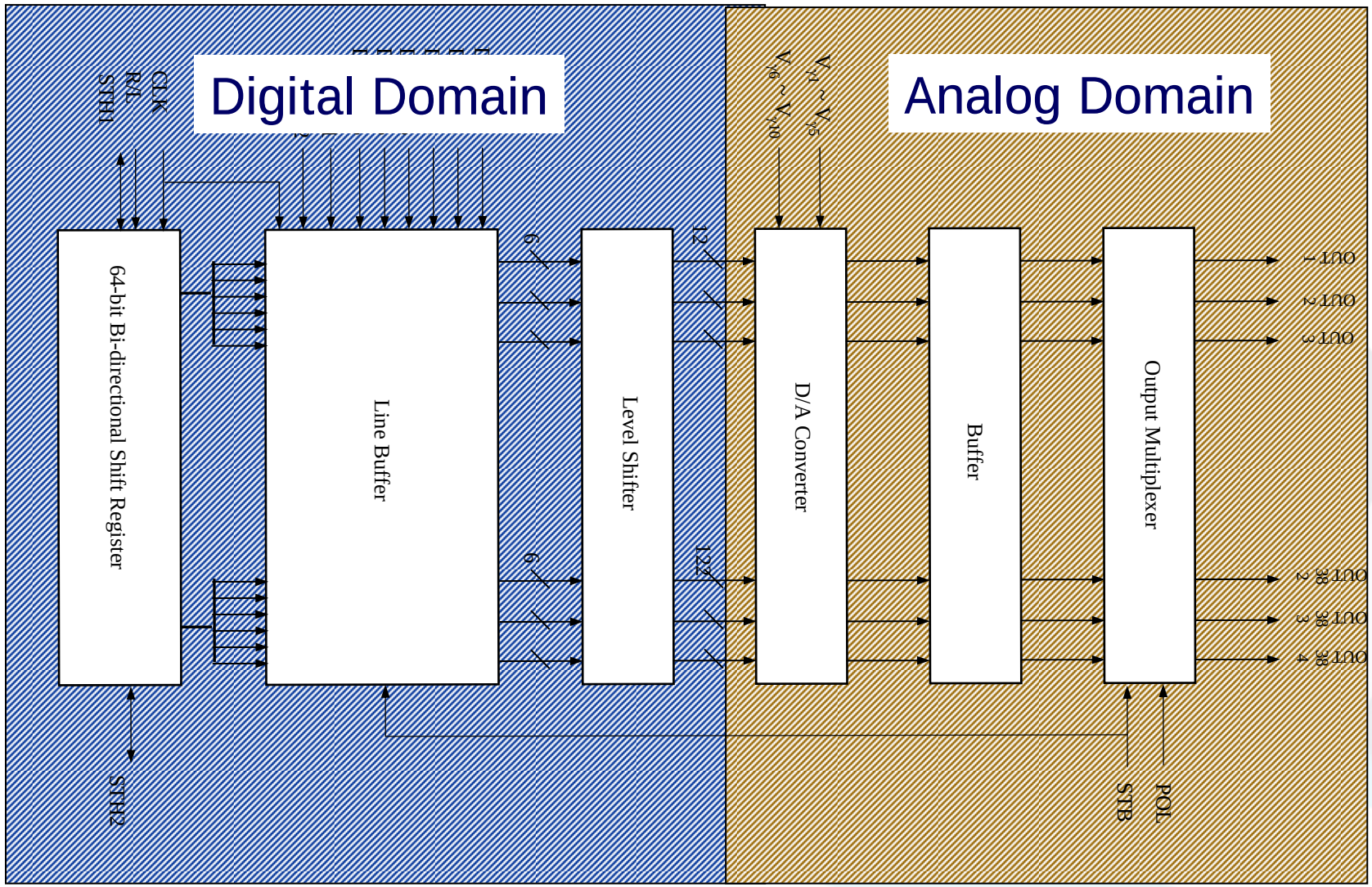




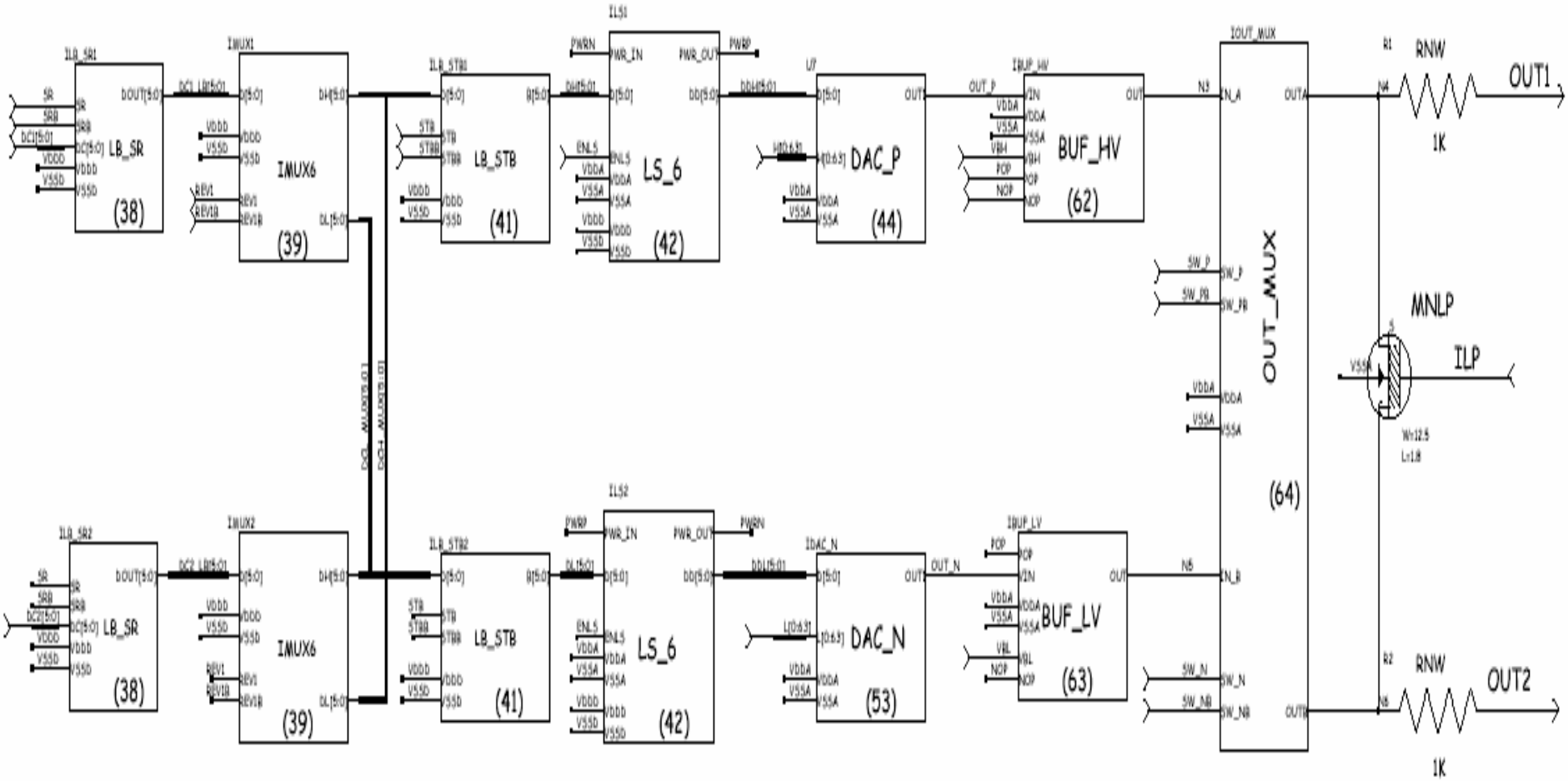
Source Drive Architecture



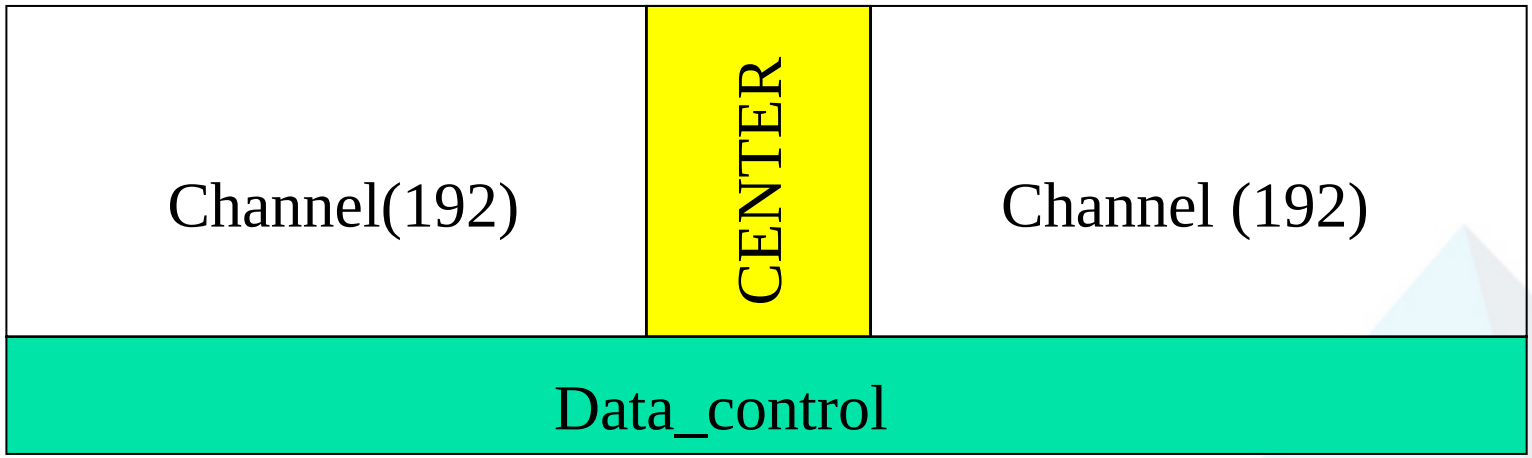
Source Drive Architecture

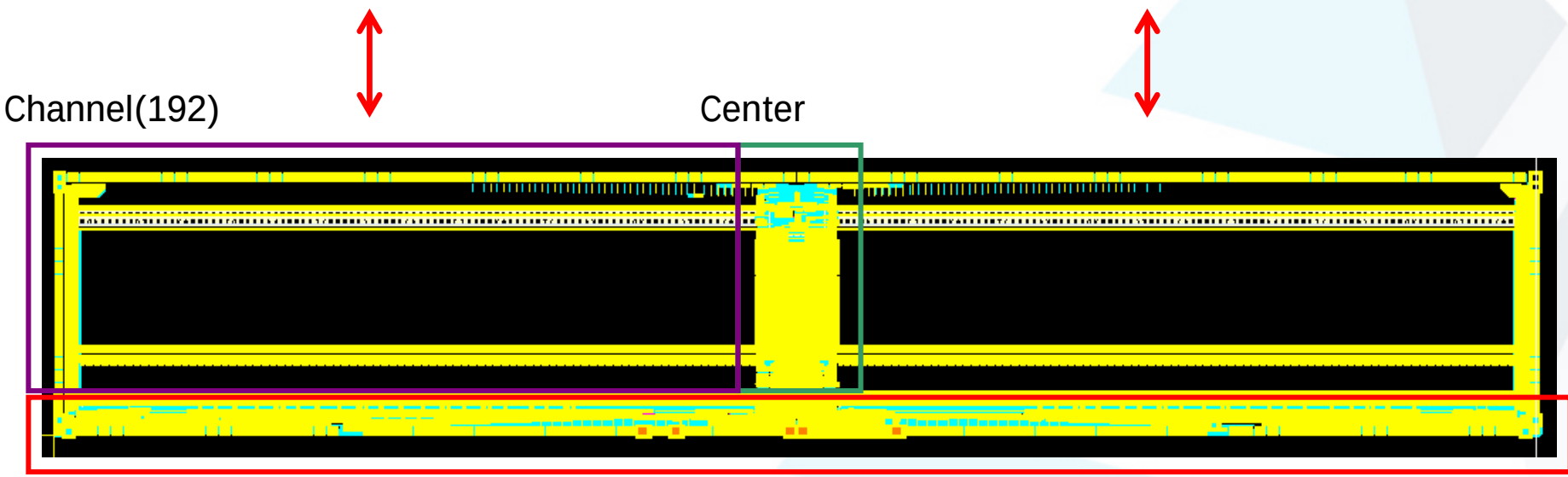


Channel Architecture

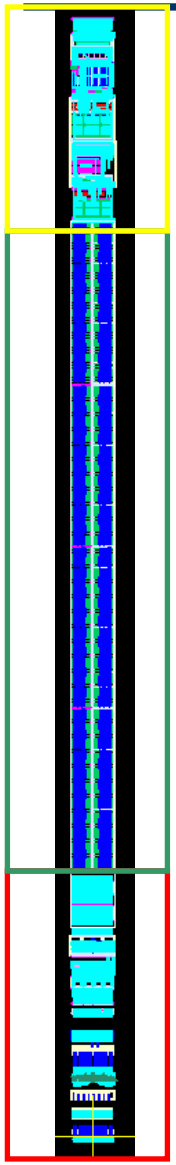


Layout Floor Plan





Layout Floor Plan

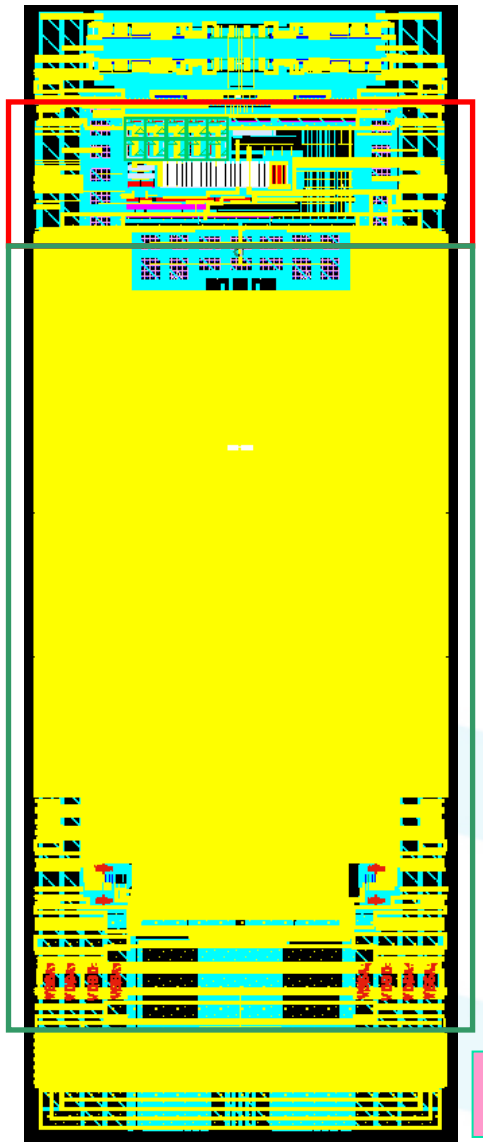


Buffer + Out_mux

D/A converter

Level shifter

Channel



Constant bias voltage

1.Control signal level trans from LV to HV
2.Gamma resister

Center

Himax

Polarity method

Odd Frames

Dot inversion

+ - + - + - + - + -

- + - + - + - + - +

+ - + - + - + - + -

- + - + - + - + - +

2 dot line inversion

+ - + - + - + - + -

+ - + - + - + - + -

- + - + - + - + - +

- + - + - + - + - +

Even Frames

Dot inversion

- + - + - + - + - +

+ - + - + - + - + -

- + - + - + - + - +

+ - + - + - + - + -

2 dot line inversion

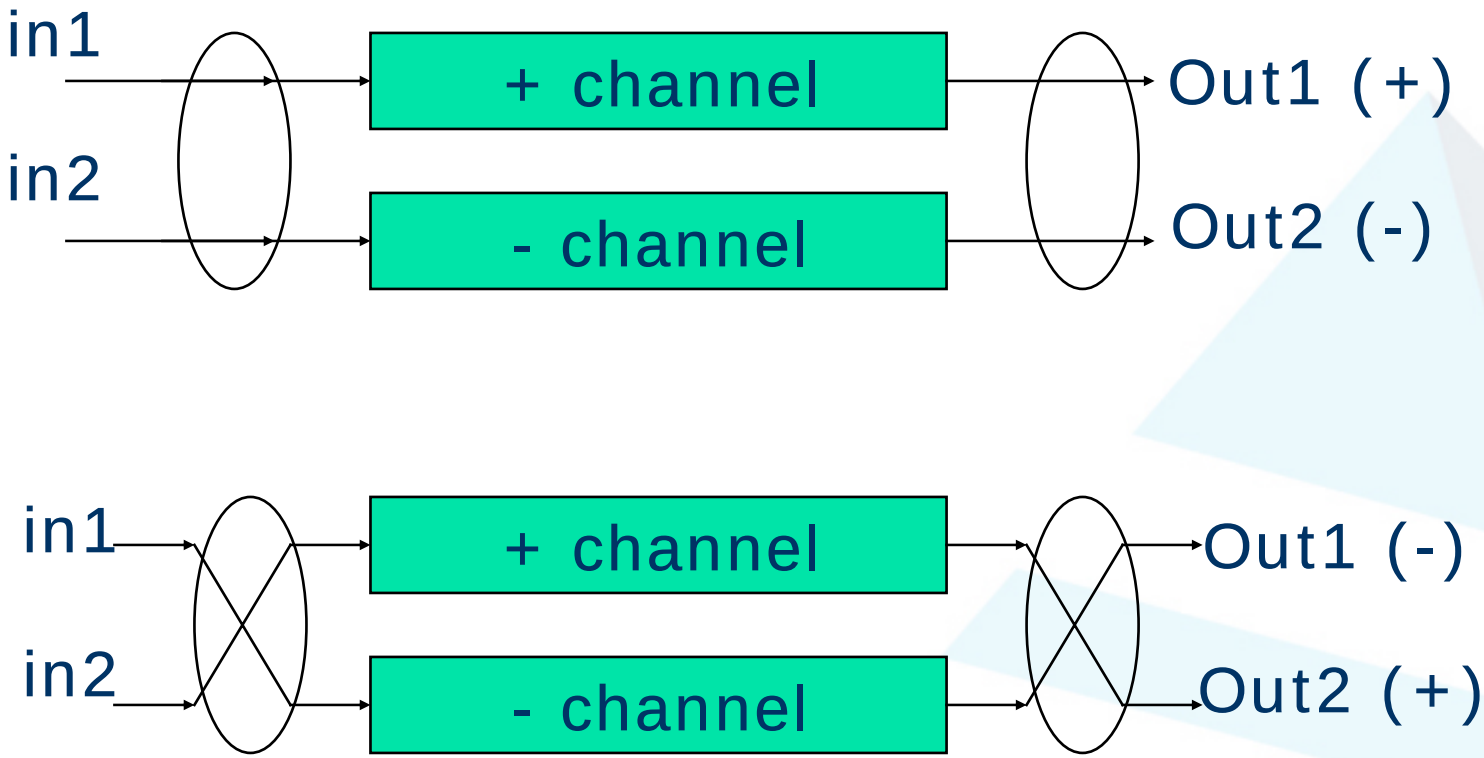
- + - + - + - + - +

- + - + - + - + - +

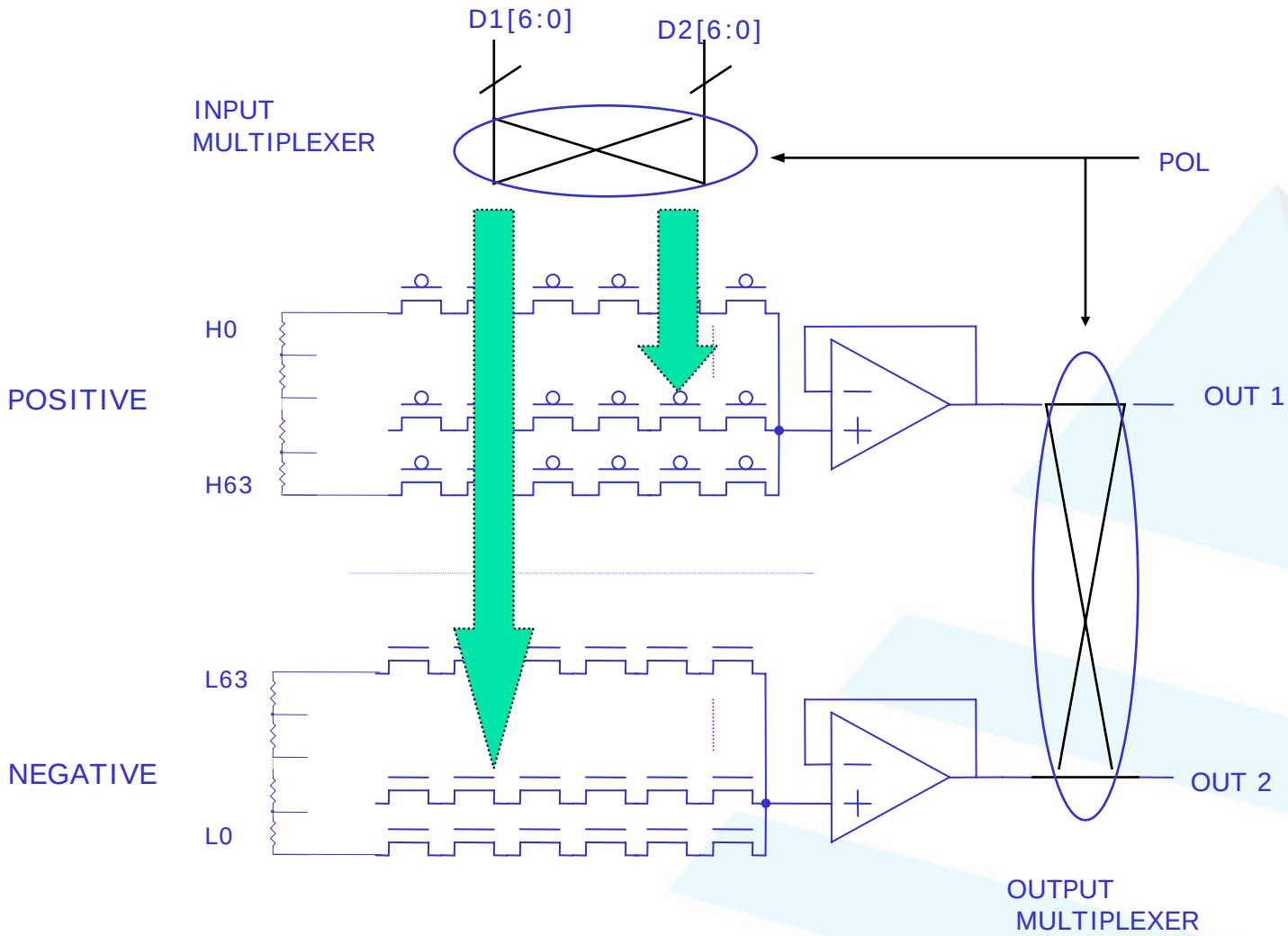
+ - + - + - + - + -

+ - + - + - + - + -

Polarity method

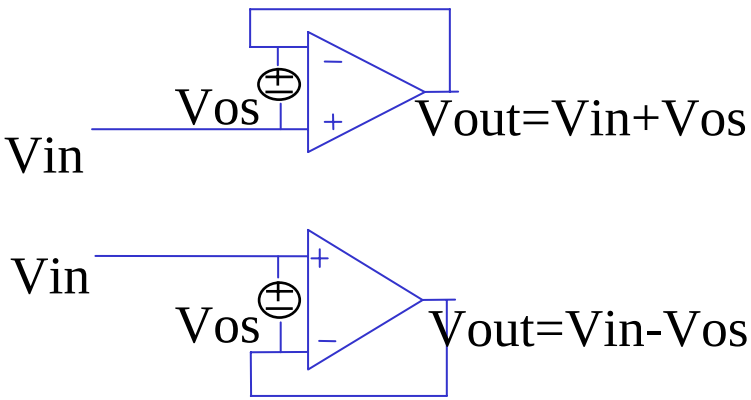


DAC


D1[6:0]
D2[6:0]
INPUT
MULTIPLEXER
POL
H0
POSITIVE
H63
L63
NEGATIVE
L0
OUT 1
OUT 2
OUTPUT
MULTIPLEXER

Offset Cancellation -- Chopper OP

- Self-canceling intrinsic offset voltage of OP



Output voltage deviation
—±2 mV (effective value)

Channel

1	2	3	4	5	6	7	8	9	10
OP +A	OP -A	OP +B	OP -B	OP +C	OP -C	OP +D	OP -D	OP +E	OP -E

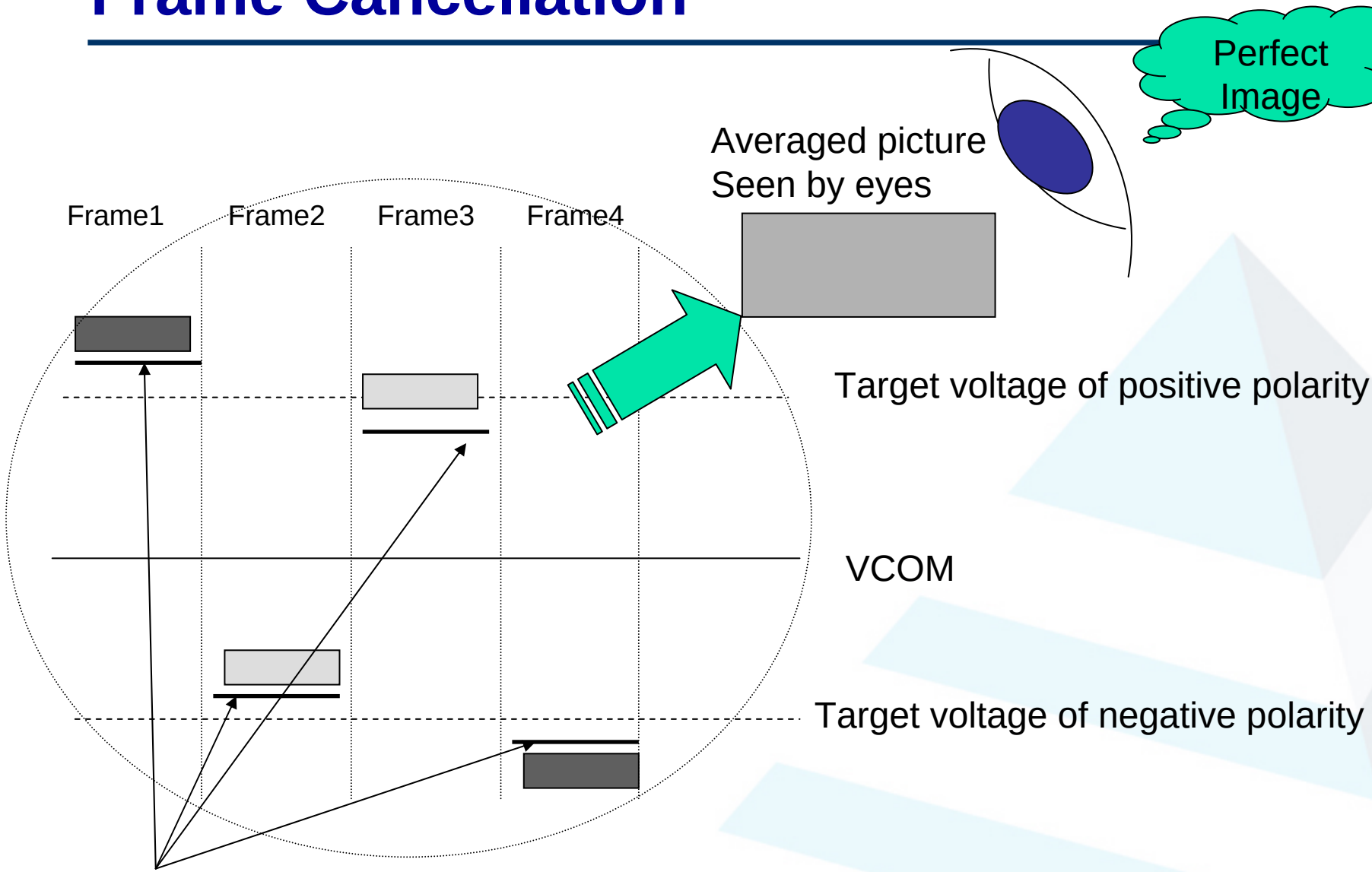
DOT Inversion						2-Dot line Inversion						Column Inversion					
1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
2	1	4	3	6	5	1	2	3	4	5	6	1	2	3	4	5	6
1	2	3	4	5	6	2	1	4	3	6	5	1	2	3	4	5	6
2	1	4	3	6	5	2	1	4	3	6	5	1	2	3	4	5	6
1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
2	1	4	3	6	5	1	2	3	4	5	6	1	2	3	4	5	6
2nd Frame						2nd Frame						2nd Frame					
2	1	4	3	6	5	2	1	4	3	6	5	2	1	4	3	6	5
1	2	3	4	5	6	2	1	4	3	6	5	2	1	4	3	6	5
2	1	4	3	6	5	1	2	3	4	5	6	2	1	4	3	6	5
1	2	3	4	5	6	1	2	3	4	5	6	2	1	4	3	6	5
2	1	4	3	6	5	2	1	4	3	6	5	2	1	4	3	6	5
1	2	3	4	5	6	2	1	4	3	6	5	2	1	4	3	6	5

Himax

Frame Cancellation

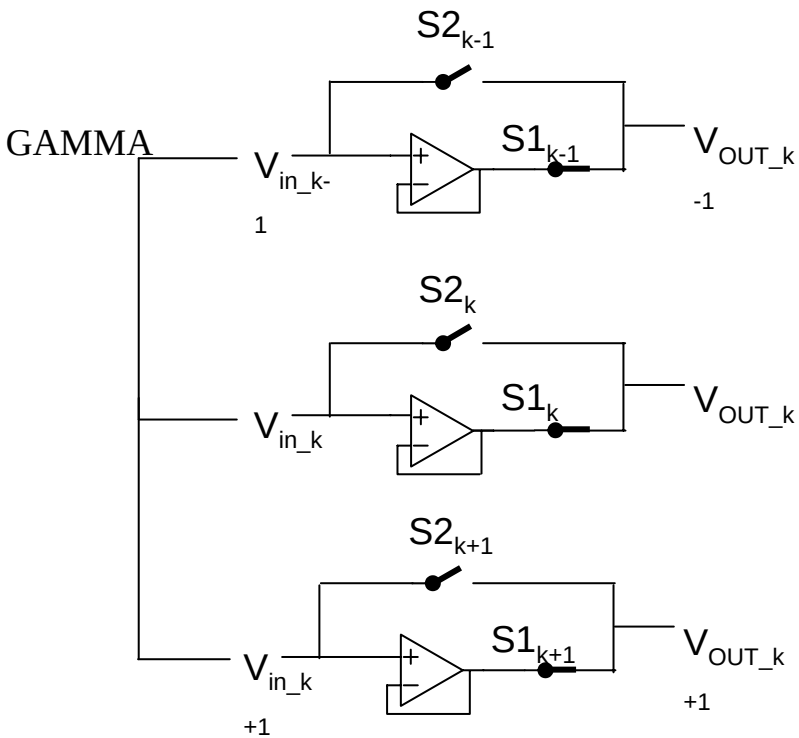
Odd Frames	Even Frames	Odd Frames
Dot inversion	Dot inversion	Dot inversion
+ + - + - + - + - + -	+ - + - + - + - + - +	- + - + - + - + - + -
+ - + - + - + - + - +	+ - + - + - + - + - +	- + - + - + - + - +
- + - + - + - + - + -	- + - + - + - + - +	+ + - + - + - + - + -
- - + - + - + - + - +	- + - + - + - + - +	+ - + - + - + - + - +
2 dot line inversion	2 dot line inversion	2 dot line inversion
+ + - + - + - + - + -	+ - + - + - + - + - +	- + - + - + - + - + -
- + - + - + - + - + -	- + - + - + - + - +	+ + - + - + - + - + -
+ - + - + - + - + - +	+ - + - + - + - + -	- - + - + - + - + - +
- - + - + - + - + - +	- + - + - + - + - +	+ - + - + - + - + - +

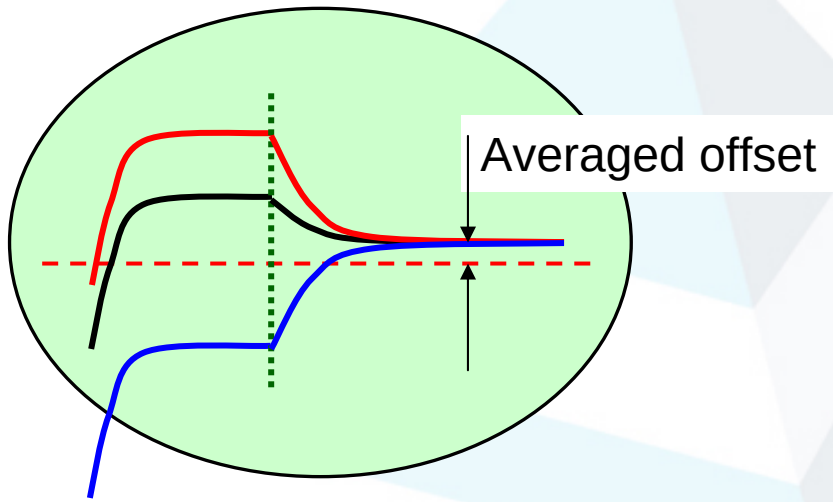
Frame Cancellation



Offset average

- Canceling offset voltage by Gamma driving





Challenges of Source Driver

殺戮戰場 – Die Shrink 20% Every Year

- 17”、32”ともにBacklightとCFの比重が高いが、大型TV用ではBacklightが突出している

17" TN	2004	2005	2006	2007	2008	32"VA	2004	2005	2006	2007	2008
Glass	$9.0	$8.2	$7.2	$6.2	$5.3	Glass	$41.3	$30.0	$21.9	$19.0	$16.4
Color Filter	$26.6	$22.2	$18.1	$15.4	$13.8	Color Filter	$95.2	$76.7	$61.8	$52.5	$47.3
Polarizer (WV/TN)	$13.1	$11.8	$10.6	$9.6	$8.6	Polarizer	$69.6	$50.6	$41.2	$33.6	$27.4
LC	$2.1	$2.0	$1.9	$1.8	$1.7	LC	$16.3	$15.4	$13.4	$11.4	$9.4
Driver IC	$19.3	$15.2	$13.0	$11.2	$9.5	Driver IC	$28.6	$21.9	$18.1	$15.1	$12.7
Backlight Unit	$25.5	$21.8	$19.6	$17.7	$15.9	Backlight Unit	$166.6	$113.0	$90.4	$76.9	$69.2
年率下落率	2004	2005	2006	2007	2008	年率下落率	2004	2005	2006	2007	2008
Glass		9%	12%	14%	14%	Glass		27%	27%	13%	14%
Color Filter		16%	19%	15%	10%	Color Filter		19%	19%	15%	10%
Polarizer (WV/TN)		10%	10%	10%	10%	Polarizer (WV/TN)		27%	19%	19%	19%
LC		3%	5%	5%	5%	LC		6%	13%	15%	18%
Driver IC		21%	14%	14%	14%	Driver IC		23%	17%	17%	16%
Backlight Unit		15%	10%	10%	10%	Backlight Unit		32%	20%	15%	10%
Component Total		**14%**	**12%**	**12%**	**11%**	Component Total		**24%**	**19%**	**15%**	**13%**
年率下落率 對2004年)	2004	2005	2006	2007	2008	年率下落率 對2004年)	2004	2005	2006	2007	2008
Glass		9%	20%	31%	41%	Glass		27%	47%	54%	60%
Color Filter		16%	32%	42%	48%	Color Filter		19%	35%	45%	50%
Polarizer (WV/TN)		10%	19%	27%	34%	Polarizer		27%	41%	52%	61%
LC		3%	8%	13%	17%	LC		6%	18%	30%	43%
Driver IC		21%	32%	42%	50%	Driver IC		23%	37%	47%	56%
Backlight Unit		15%	23%	31%	38%	Backlight Unit		32%	46%	54%	58%
Component Total		14%	24%	33%	40%	Component Total		24%	38%	48%	54%
全部材購入費に占める比率	2004	2005	2006	2007	2008	全部材購入費に占める比率	2004	2005	2006	2007	2008
Glass	8%	8%	8%	8%	8%	Glass	8%	7%	7%	7%	7%
Color Filter	**22%**	**22%**	**20%**	**19%**	**20%**	Color Filter	18%	19%	19%	19%	20%
Polarizer (WV/TN)	11%	12%	12%	12%	12%	Polarizer	13%	13%	13%	12%	11%
LC	2%	2%	2%	2%	2%	LC	3%	4%	4%	4%	4%
Driver IC	16%	15%	15%	14%	14%	Driver IC	5%	5%	6%	5%	5%
Backlight Unit	**22%**	**21%**	**22%**	**22%**	**23%**	**Backlight Unit**	**32%**	**28%**	**28%**	**28%**	**29%**

Himax

Huge Numbers of Projects

All channels * all foundries * all gamma * all minor function change

Interface	Bit	Channel #
RSDS/TTL	6	384, 420, 432, 480 600, 618, 630, 642 720, 768 960, 1024, 1280
RSDS/COG	6	384
RSDS	8	384, 414, 420, 432, 480 600, 618, 630, 642, 684, 690 720
Mini-LVDS	6	384, 420, 480
	8	600, 618, 630, 642, 690 720

** We can provide all what you need : any interface, any channel, any bit number*

Himax

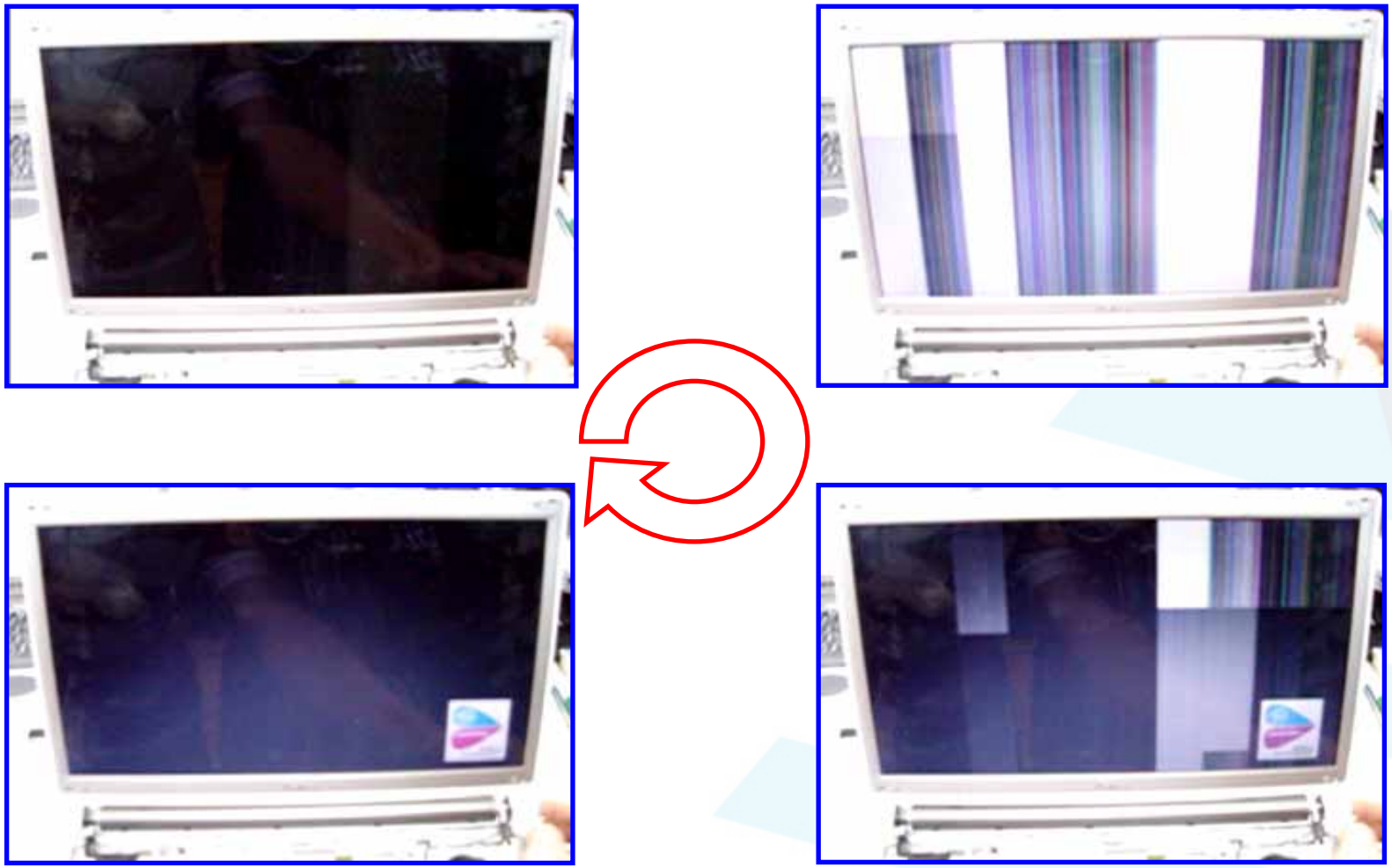
Customer Service

- Co-develop new interface, new function
  - CMDI, TCON+S/D, half data bus…….
- Solve design-in and RMA issues, with PPM order defect

快速反應，快速解掉問題才能贏的客戶的信賴

Case I

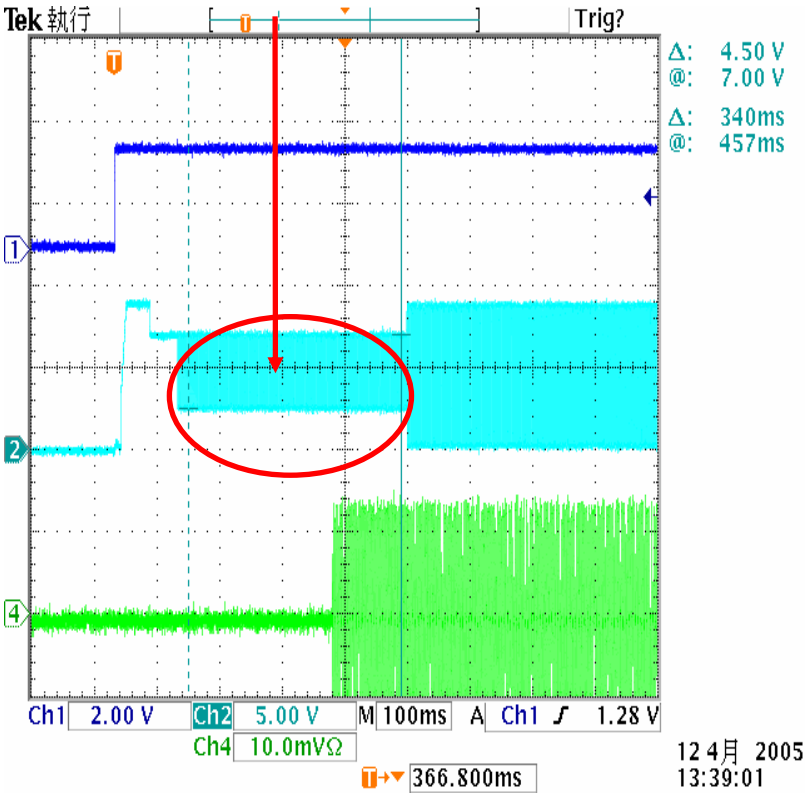
- 開機瞬間有畫面 fail 現象

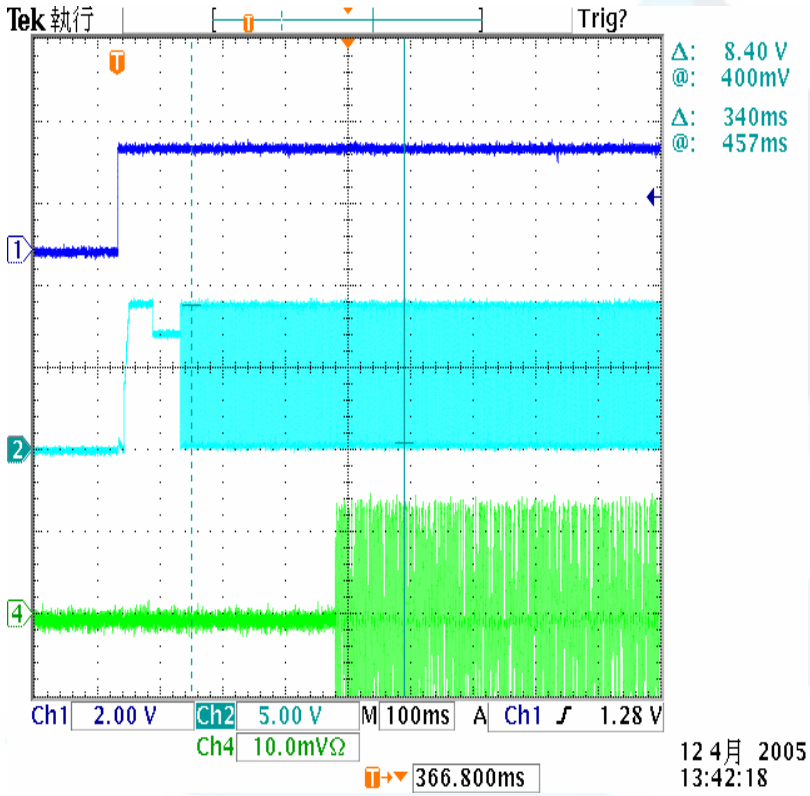


Case I

- S/D fail時, output會有約450ms會fail

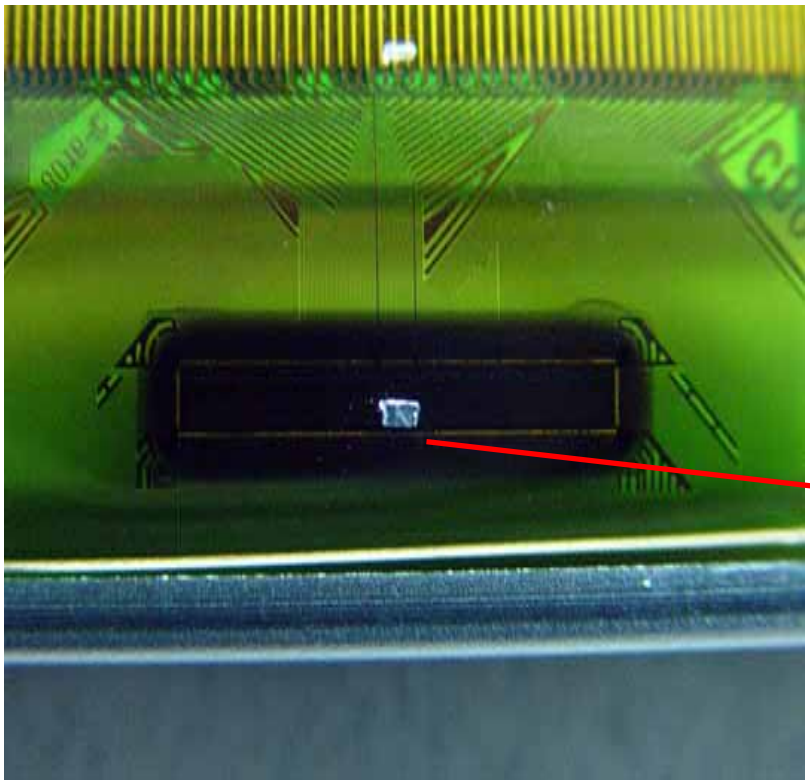
Output fail





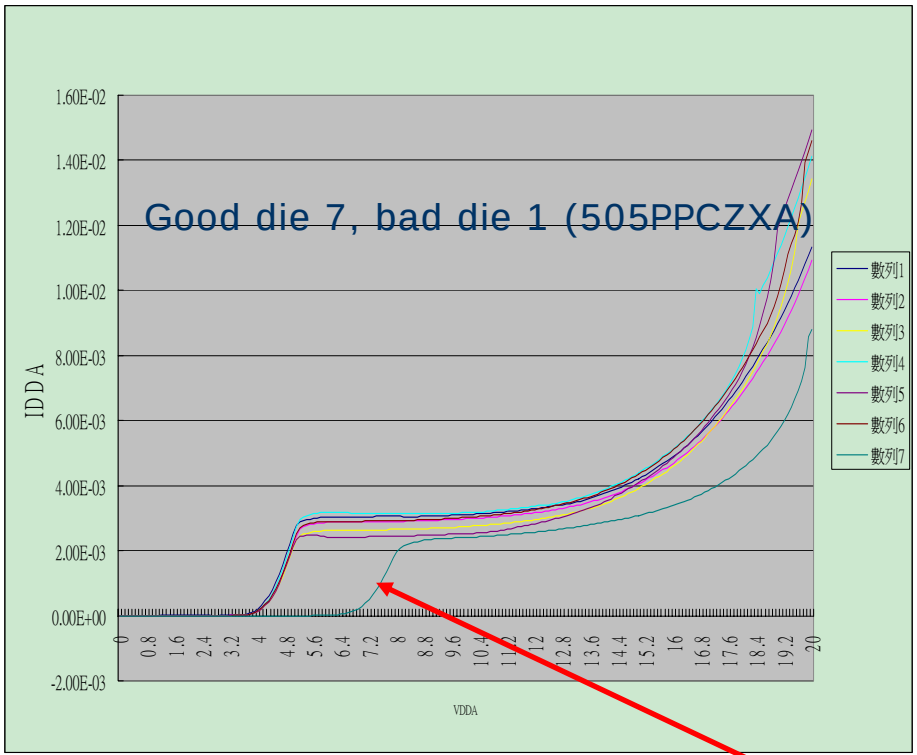
Case I

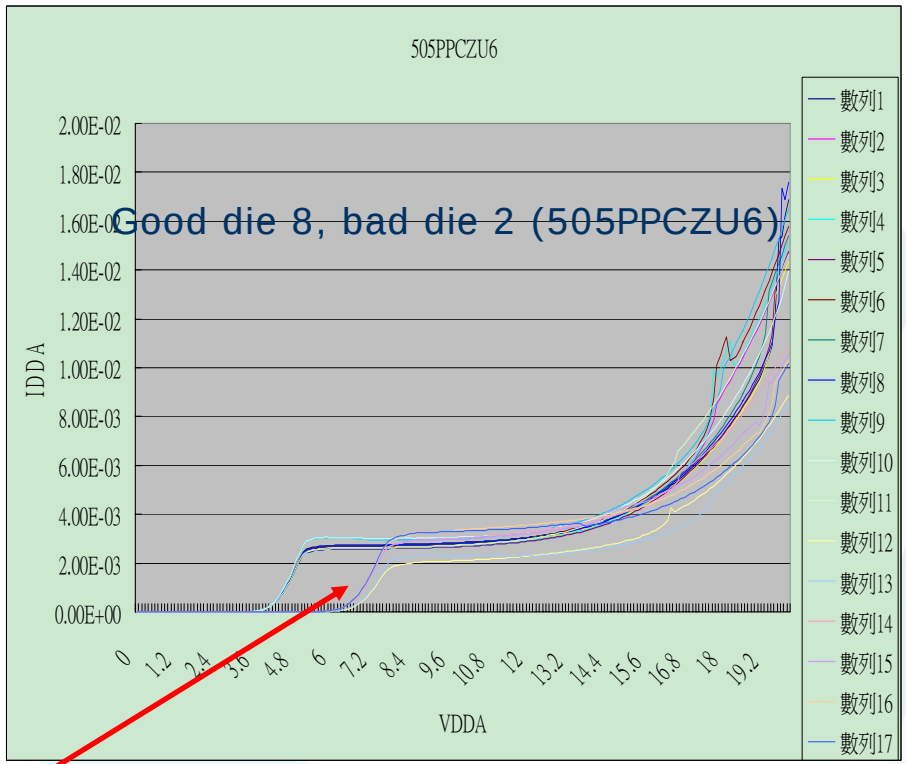
- 銅泊只貼在S/D center端再加壓即會產生fail
- S/D相對應的電路為band-gap



Case I

- IDDA_S test with VDDA=6V,Imin=2mA



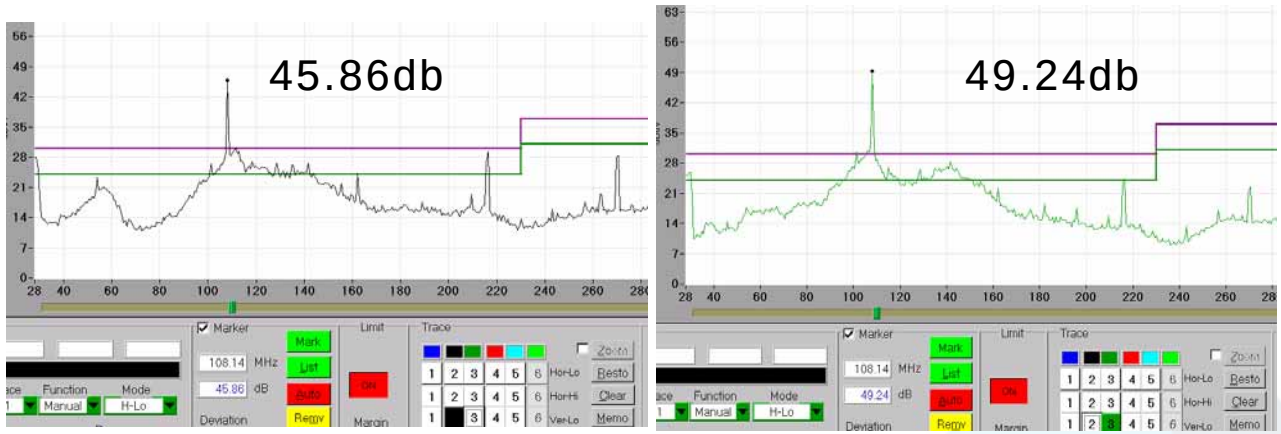


Bad dice

Himax

Case II

- Old HX8016-C



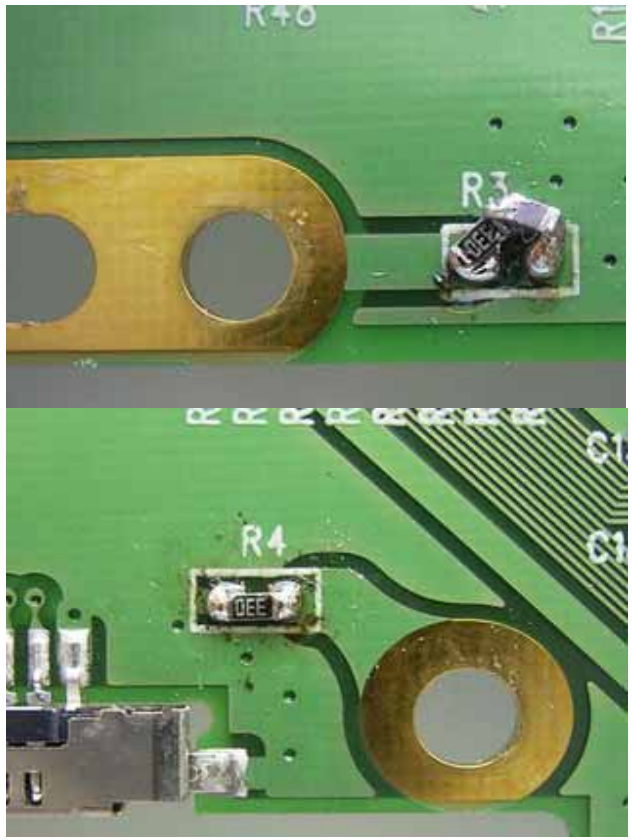
- New HX8016-C

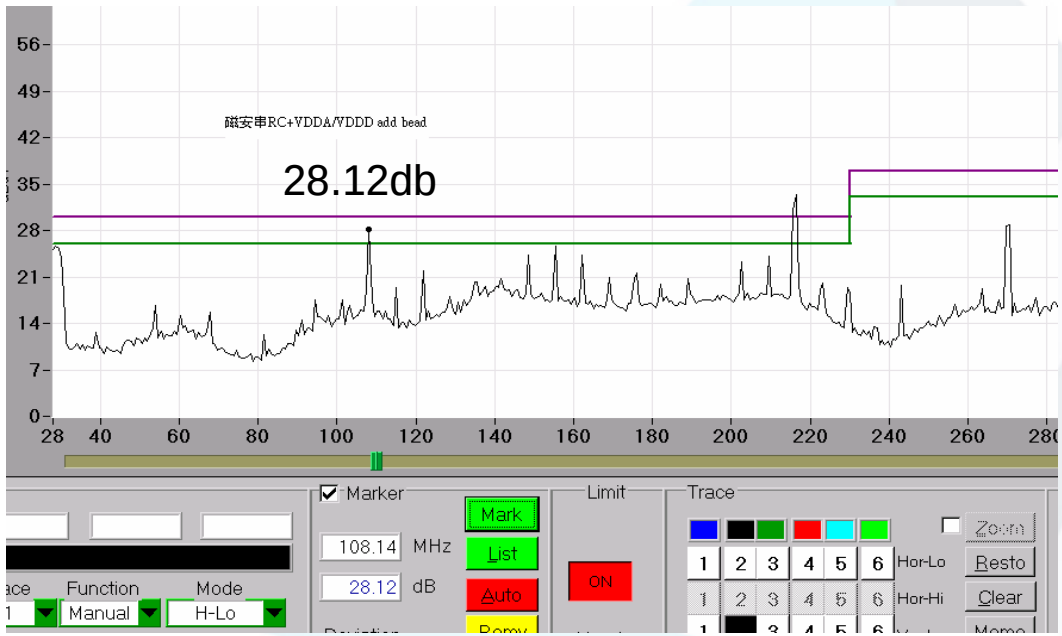
Himax

Case II

New HX8016-C+PCB solution

- 左右兩個螺絲孔改為33歐姆跟47p的串聯電路，33歐姆靠近螺絲孔、47p靠近PCB GND
- 中間的螺絲孔只使用33歐姆對PCB GND
- Isolate PCB至鐵框的GND頂點
- Add bead(MLB-2001209-047L_N2) at VDDD and VDDA





Companies Allocations

奇美電LCM

tsmc

奇美電FAB2,3

UMC

Hanstar

奇美電FAB4,5

奇美電FAB1

宿舍區

科管局

Himax Headquarters