Riverdi

Display Solution Experts

Wyświetlacze i panele dotykowe w systemach embedded

Kamil Kozłowski

#15 Spotkanie Gdańsk Embedded Meetup

3 październik 2023

Agenda

- Riverdi, Unisystem, Lummico
- STN, TFT, OLED, VFD
- Wyzwanie wyświetlacza, dlaczego Apollo 11 nie miał TFT?
- Embedded Displays, interfejsy
- Jasność, kontrast, odbicia
- TP, TS, RTP, CTP, PCAP, CG, DITO, SITO, OGS, GG, GF, GFF, OCA, LOCA, SCA
- Q&A (P&O?)
- Kahoot

Zapowiadało się nieźle

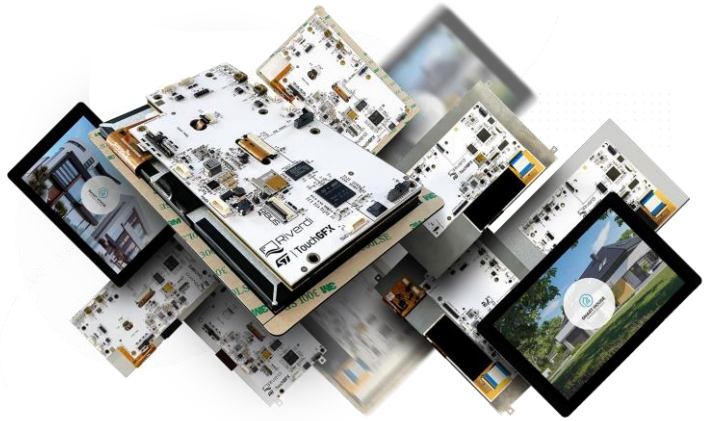
Unisystem, Riverdi, Lummico...

unisystem

Dystrybucja

Riverdi

Produkcja



lummico

Gotowe urządzenia

Ultra Low Power Wi-Fi Connectivity | 3 Years Always-Connected Operation on a Single Charge | Different Sizes for Different Aplications

lummico

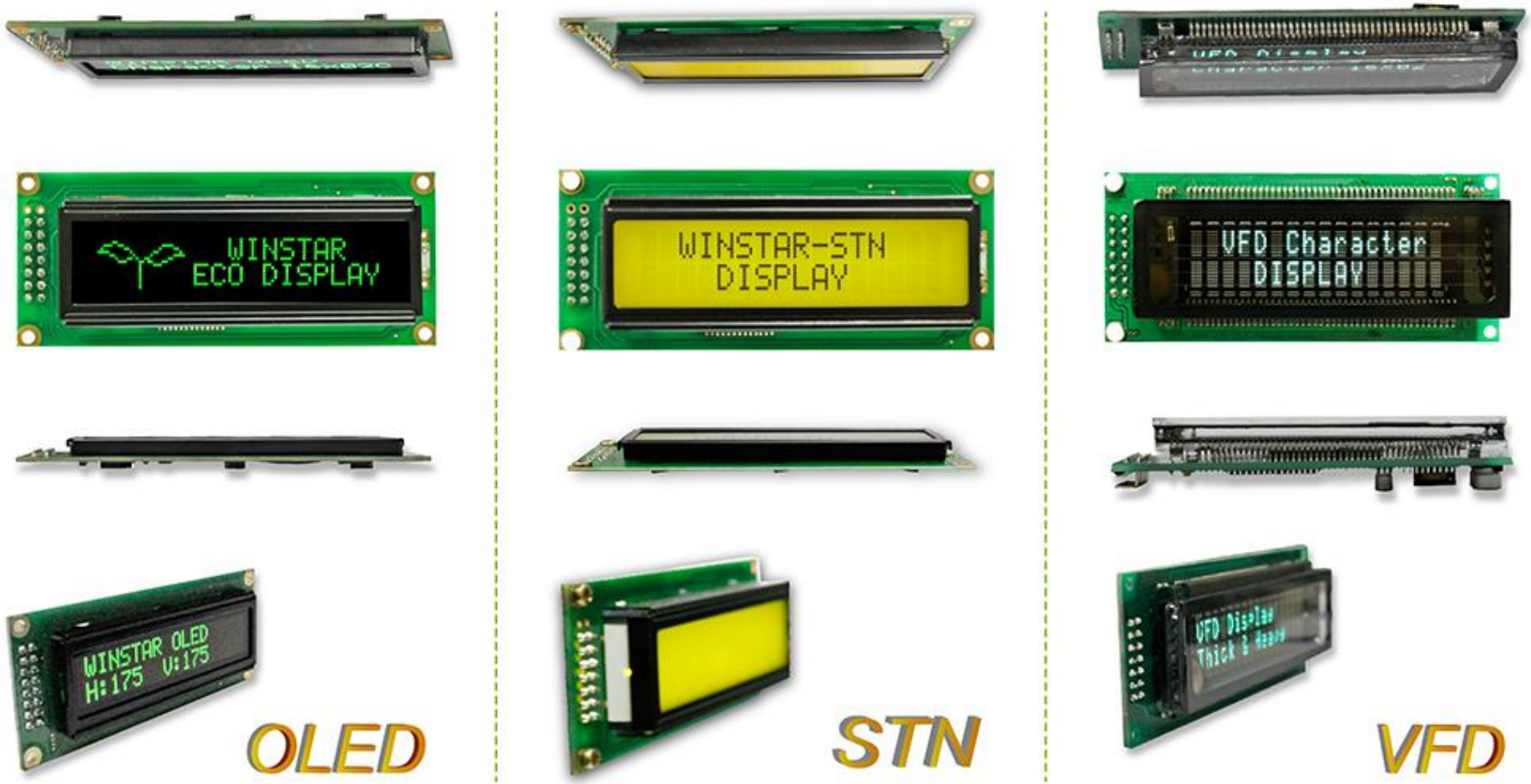
Diamenty Miesięcznika Forbes 2023

Our Mission

Our mission is to
bring you high-quality,
accessible, and customizable
display solutions.

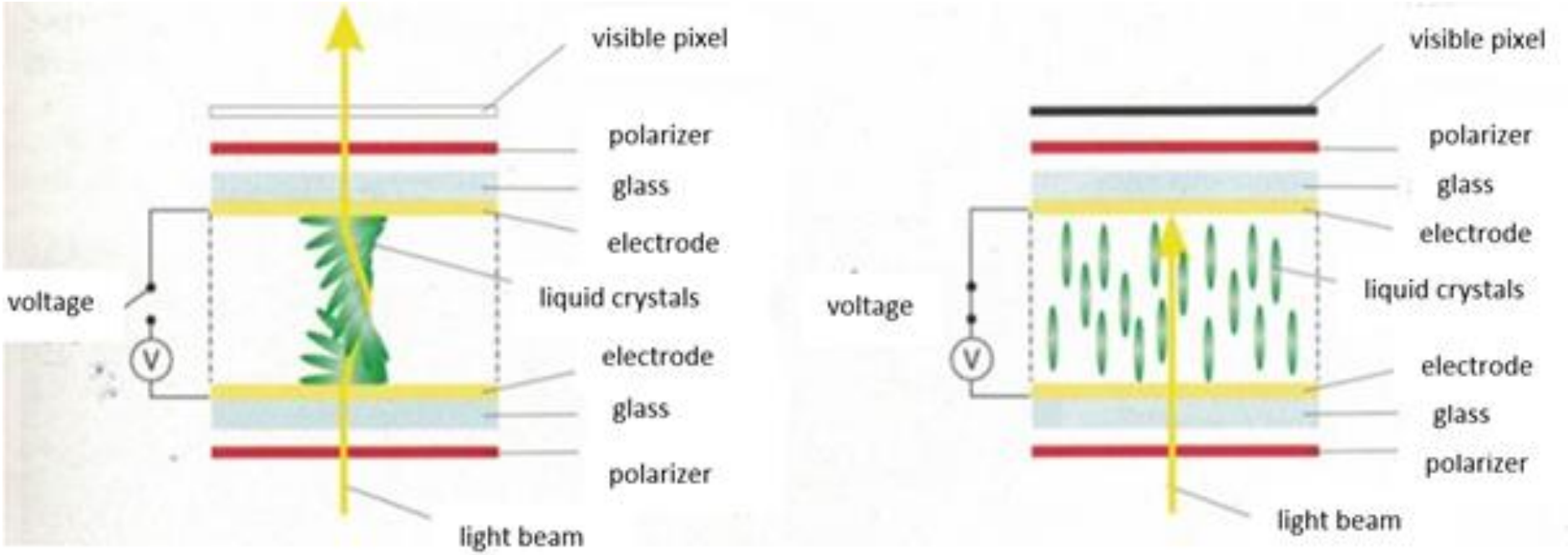
OLED, STN, VFD, TFT

Comparison



LCD - TN

TN - Twisted Nematic – technology associated mainly with passive matrices, and the improvements introduced in it allow to improve the image quality (e.g. by giving it color). TN technology is also the basis for TFT matrices.



LCD, TFTs, LCD TFTs?

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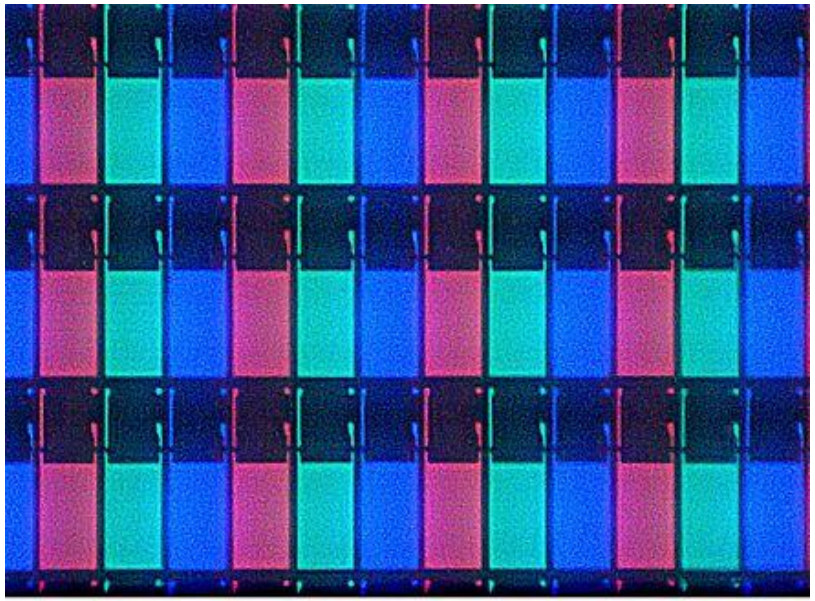
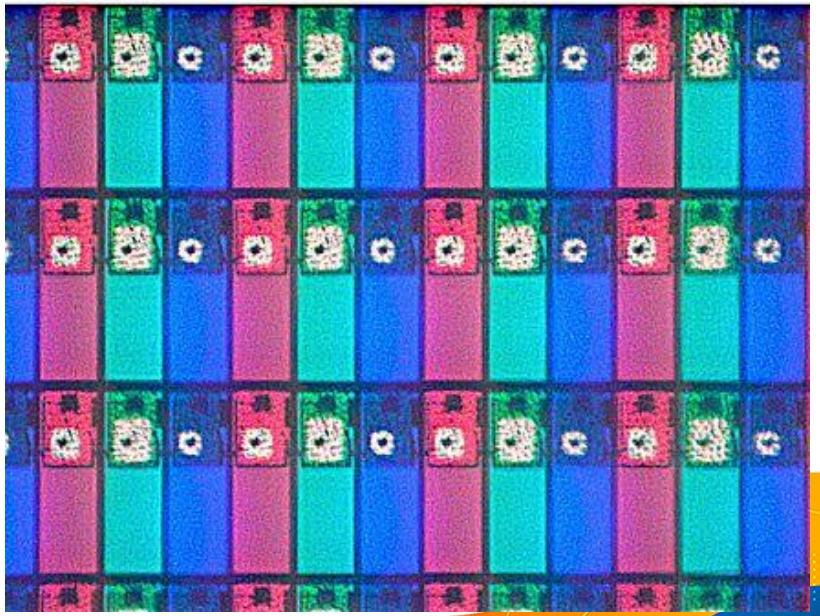




The display challenge, why Apollo 11 had no TFT?

The display challenge, why Apollo 11 had no TFT?

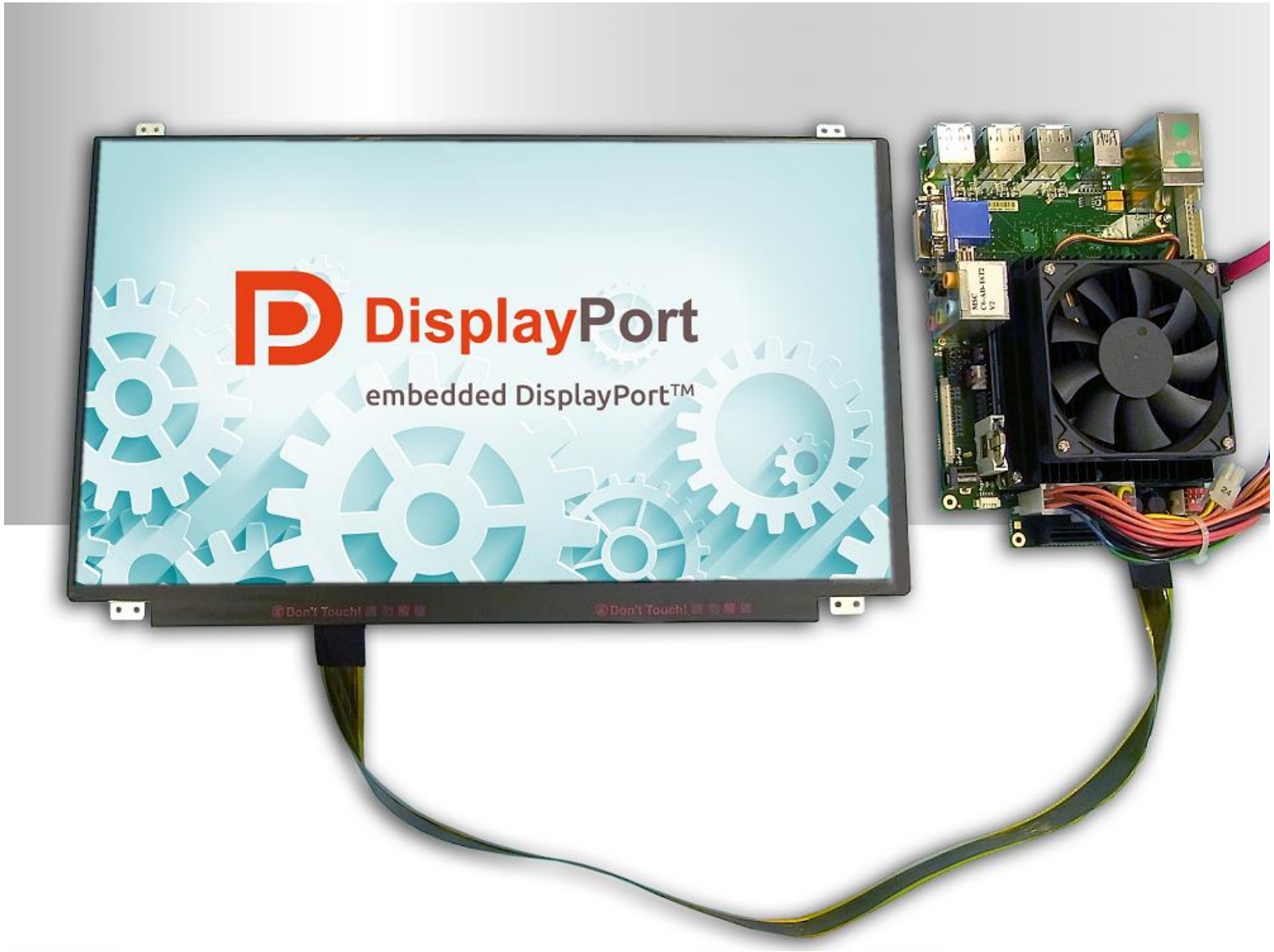
- 1920 x 1080 x 3 = 6 220 800 B, x2 = 12 441 600 B
- 60Hz x 6 220 800 B = 373 248 000 B/s

- 1024 x 600 x 3 = 1 843 200, x2 = 3 686 400 B
- 60Hz x 1 843 200 = 110 592 000 B/s

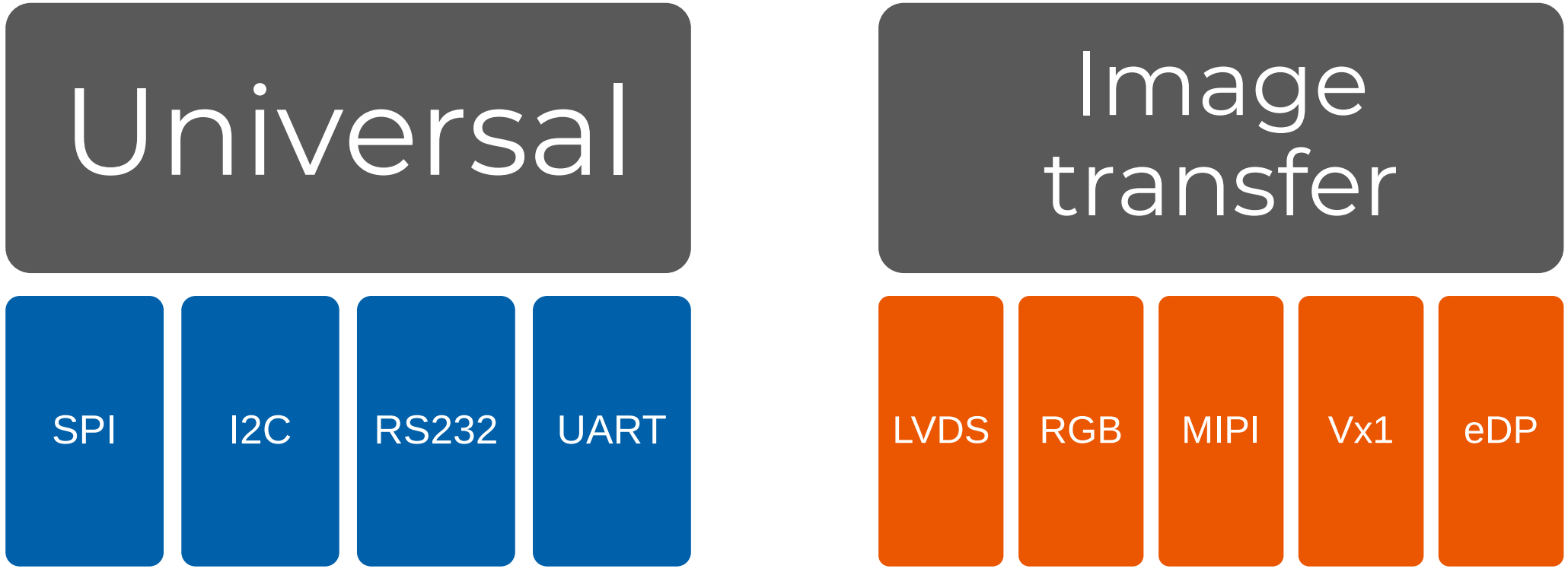
- Apollo 11 AGC (Apollo Guidance Computer)
  - 4094 B of RAM, 72KB of ROM
  - 43 kHz

- Central Air Data Computer
  - 375 kHz, six chips, 20-bit fixed-point
  - F-14 CADC, 1970 -> 1998
- Intel 4004 – 1971 4bit

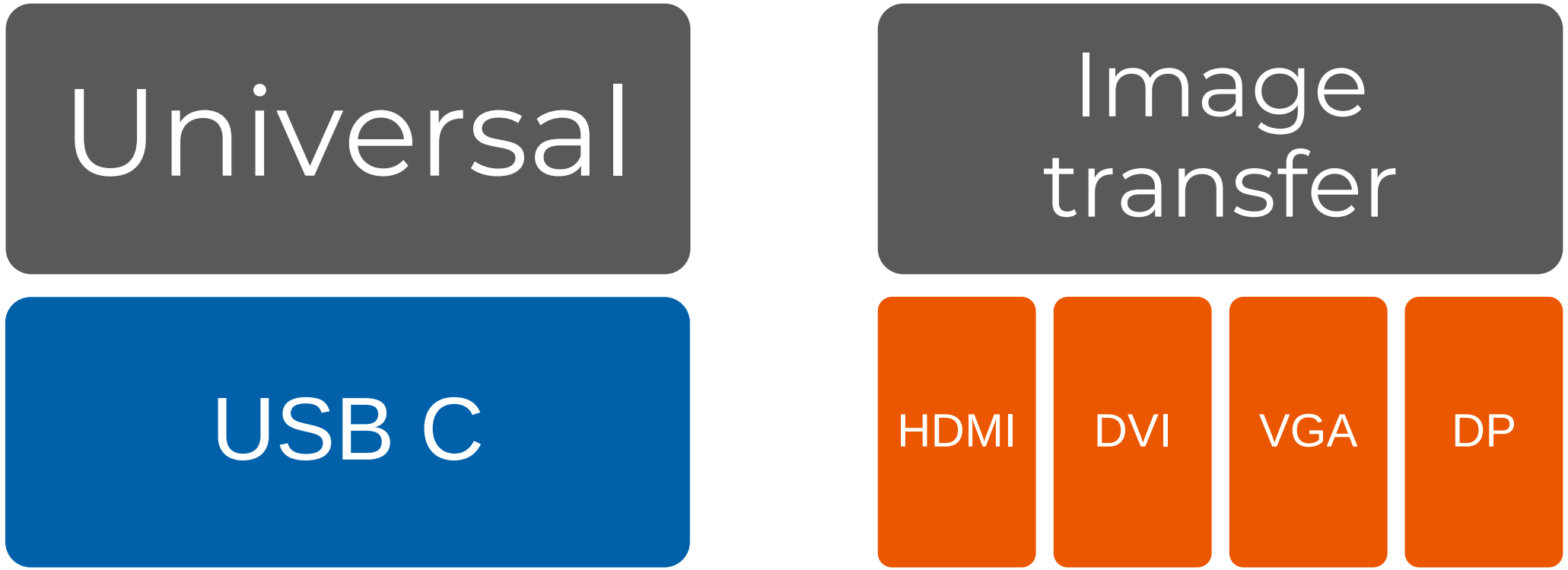
Embedded, czyli jaki



Internal interfaces



External interfaces



CONTRAST RATIO

STANDARD TN SERIES 7":

6. Electro-optical characteristics

ITEM		SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	REMARK	NOTE
Response Time		Tr+Tf	θ=0° Ø=0° Ta=25	–	20	35	ms	Figure 4	4
Contrast Ratio		Cr		400	500	–	—	Figure 5	1
Luminance Uniformity		δ WHITE		70	75	–	%	Figure 5	3
Surface Luminance	TFT	Lv		400	500	–	cd/m2	Figure 5	2
	TFT+CTP			360	450	–			
	TFT+RTP			320	400	–			

STANDARD HB/IPS SERIES 4.3":

7 ELECTRO-OPTICAL CHARACTERISTICS

Optical characteristics are determined after the unit has been 'C minutes in a dark environment at 25 °C. The values specified are from the LCD surface at a viewing angle of Φ and θ equal to 0°.

ITEM	SYMBOL	CONDITION	MIN	TYP
Response Time	Tr+Tf	θ=0° Ø=0° Ta=25 °C	-	30
Contrast Ratio	Cr		640	800
Luminance Uniformity	δ WHITE		-	75
Surface Luminance	Lv		-	800

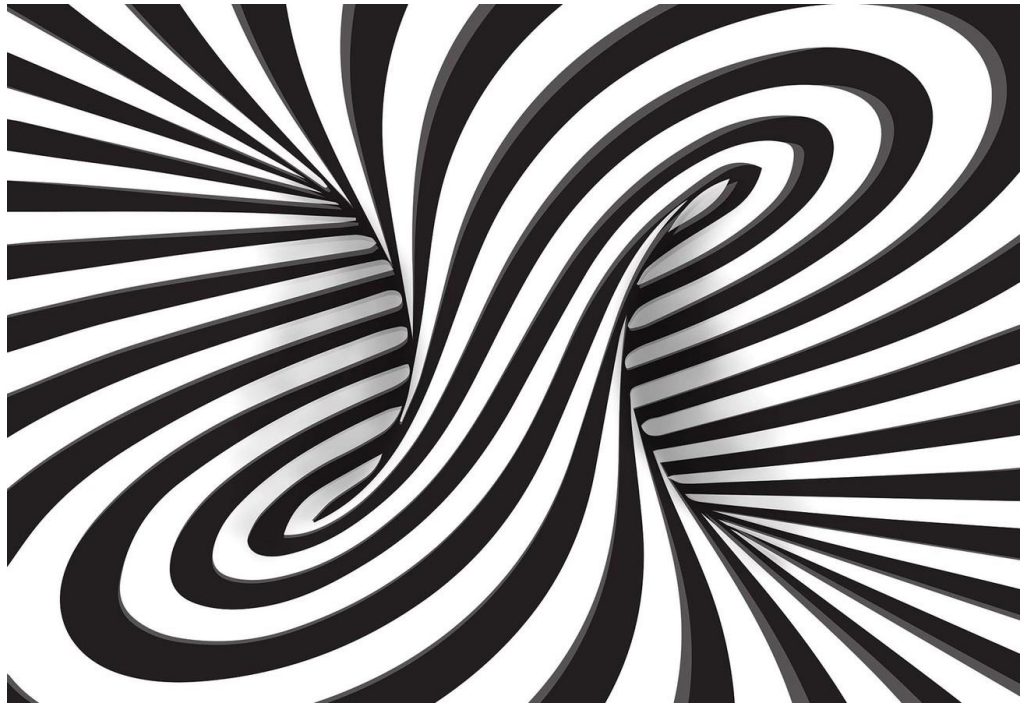
STANDARD HB/IPS SERIES 10.1":

6 ELECTRO-OPTICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	REMARK	NOTE
Response Time	Tr+Tf	θ=0° Ø=0° Ta=25 °C	-	25	35	ms	FIG 1.	4
Contrast Ratio	Cr		800	1000	-	---	FIG 2.	1
Luminance Uniformity	δ WHITE		-	75	-	%	FIG 2.	3
Surface Luminance	Lv		-	800	-	cd/m^2	FIG 2.	2

CONTRAST (RATIO)

Difference whitest white and blackest black



„the amount of light emitted by the brightest white pixels divided by the amount of light emitted by the darkest black pixels, with the measurement being made in a dark room”

CONTRAST (RATIO) - REAL WORLD

In the real world we have to take external light into consideration

CONTRAST (RATIO)- ECR

ECR = EFFECTIVE CONTRAST RATIO

- **Rarely published**
- **Depends on many hard-to-control factors**
- **Usually only estimated**

$$\mathbf{ECR = 1 + \left(\frac{emitted\ light}{reflected\ light}\right)}$$

emitted light – manufacturer spec brightness [cd/m2]

reflected light -amount of light reflected by the surface of the display.

This is calculated by multiplying the ambient light in nits by the percentage reflectivity of the display.
Ambient light is normally measured in lux. Sunlight ranges from approximately 30,000 lux to 100,000 lux;

CONTRAST (RATIO)- ECR

WELL Building Standard™

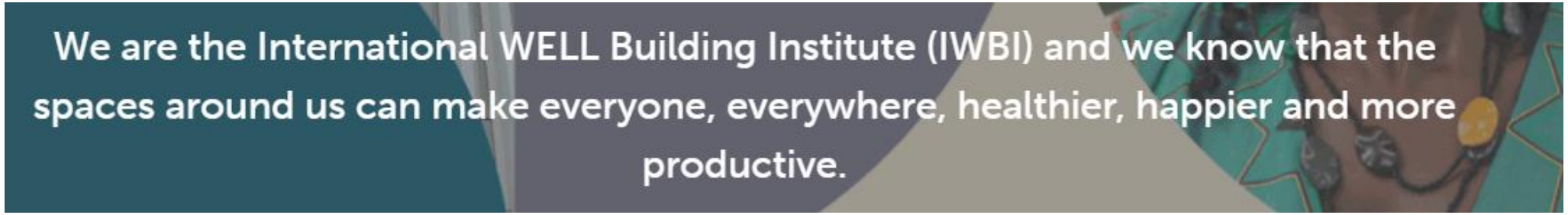
Task Luminance Ratio (TLR) 3:1

1:1 – 20:1

Effective Contrast Ratio (ECR)	LCD Outdoor Readability
1-2	Unreadable in sunlight
3-4	Adequately readable in shade; barely readable in sunlight
5-9	Adequately readable in sunlight; looks OK
10	Very readable in sunlight; looks good
15	Outstanding readability; looks great
20	Totally awesome; excellent readability; can't be improved

CONTRAST (RATIO) - ECR

WELL Building Standard™
Task Luminance Ratio (TLR)
3:1



SUNLIGHT

The intensity of the reflected light from the outside it must be summed up with the intensity individual pixel lights to be able to use them compare and evaluate the contrast observed in practice.

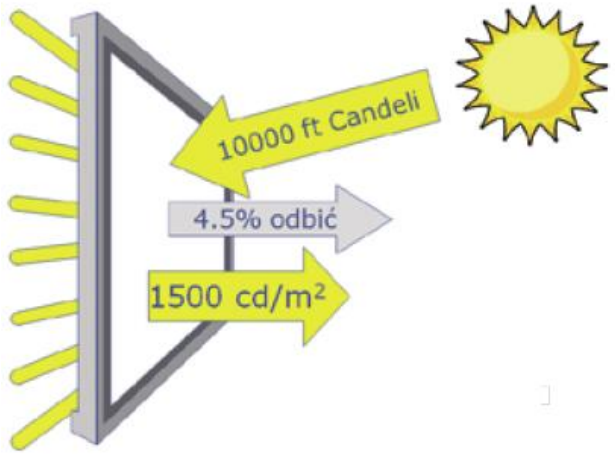
Low/standard brightness modules;

LCD TFT brightness: 400cd/m2,
exposed to the direct sunlight (about 30 000 lux ~10 000 cd/m2)
surface reflects about 4.5%

„additional” brightness ~ 10k cd x4.5% = 450 cd/m2

The real contrast is:

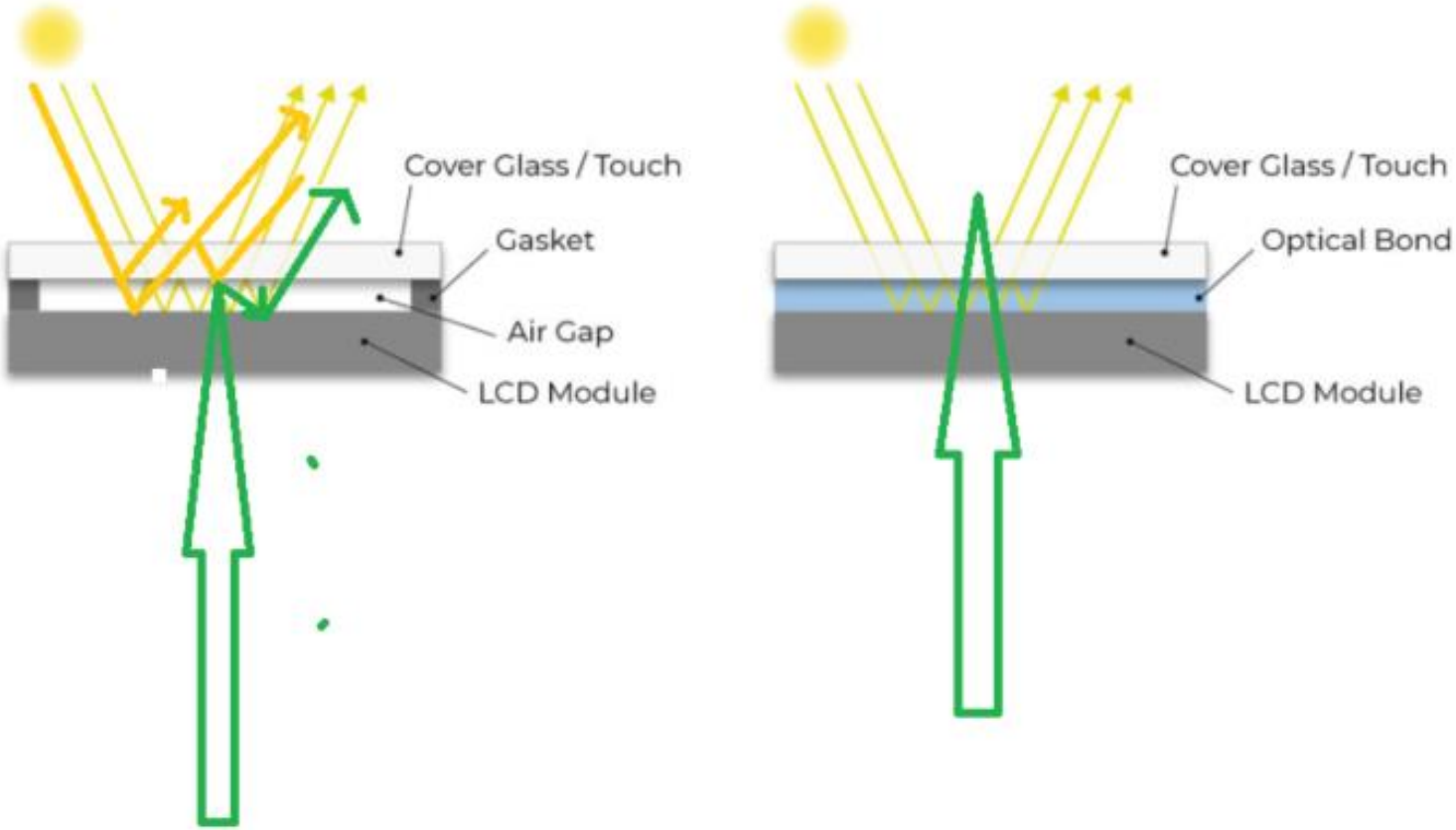
$$Cr \approx \frac{400 + 450}{450} \approx 2:1$$



$$Cr \cong \frac{1500cd/m^2 + 450cd/m^2}{450cd/m^2} \approx 4{,}3$$

REFLECTIONS

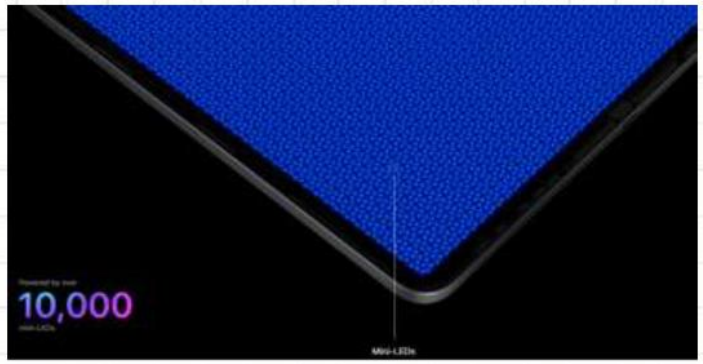
Assuming 5% reflection for the LCD TFT surface – is that all?



Kontrast+ – mini LED

Apple iPad Pro with blue mini LED

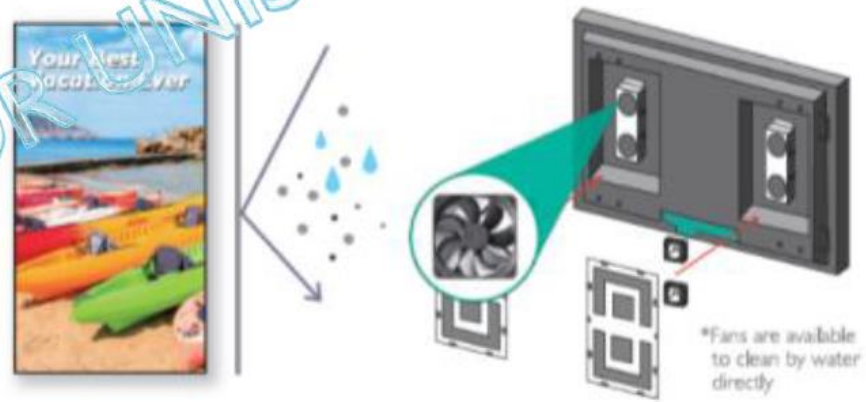
- Apple iPad Pro 12.9” in with blue mini LED. (The iPad Pro 11” does NOT use mini LED, but regular LEDs).
- 10,000 blue mini LEDs. 2500 local dimming zones. The result is a contrast ratio of 1 million: 1.



Picture source: Apple

HB Outdoor Display

High Brightness | IP66 / IK10 | Sunlight Readable | High Temperature LC | Auto Light Sensor | Thermal Sensor | Long Operational Hours (24hrs/7days) | Portrait / Landscape



Key Features

- Ultra high brightness and sunlight readable
- Dust-/Water proof (IP66)
- Impact Resistant (IK10 rated)
- Blackening defect free by Hi-Tni LC
- Sunglasses viewable by circular polarizer
- Auto dimming control (Ambient Light Sensor)

Temperature Blackout

OPERATING AND STORAGE TEMPERATURES

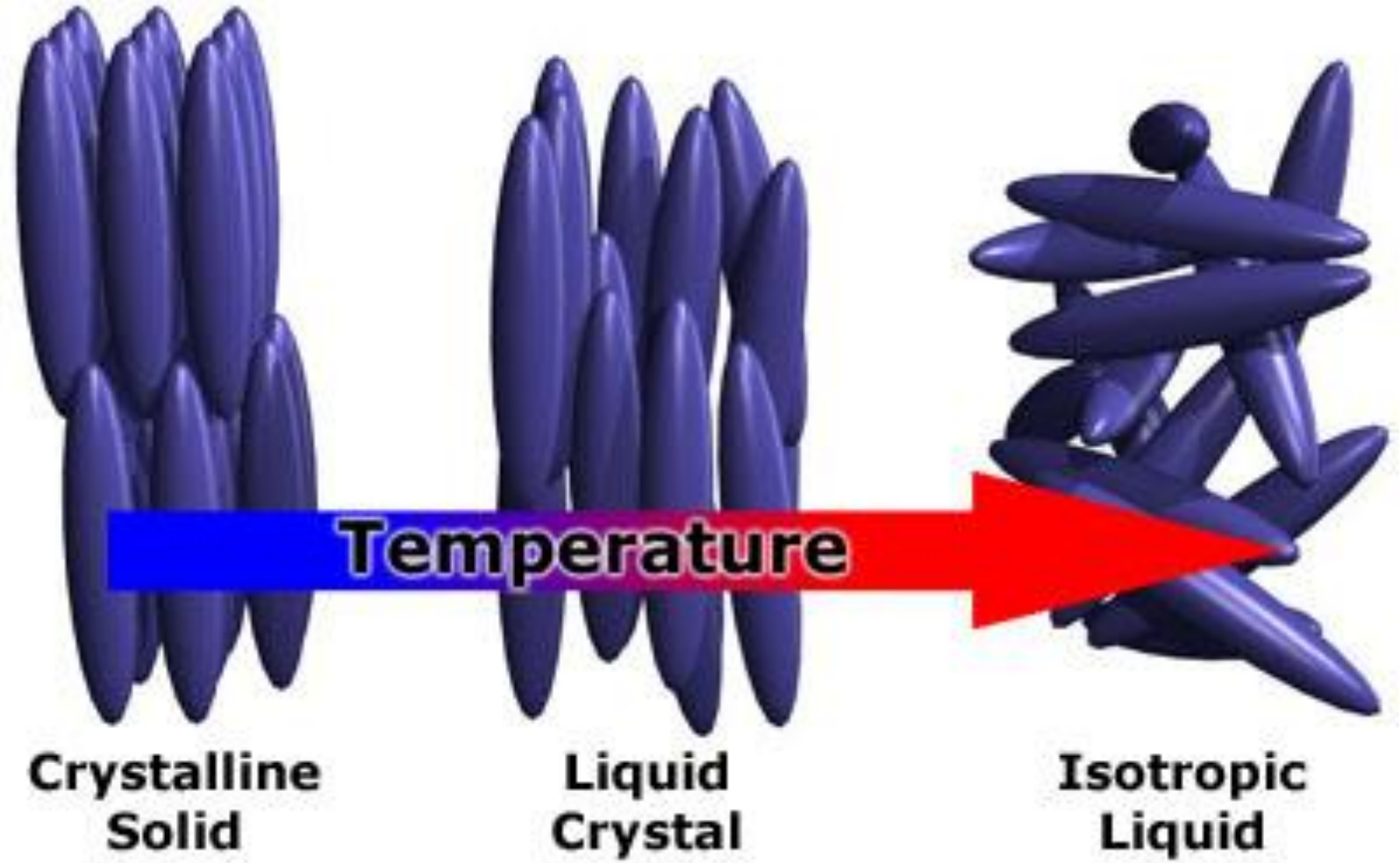
industrial standard:

	Min	Max	Unit
Operating temperature	-20	+70	°C
Storage temperature	-30	+80	

Hi-Tni:

A high TNI panel is designed to prevent blackening when the display operates under elevated temperature conditions:

Hi Tni LC – High Temperature nematic - isotropic



Hi Tni LC – example

1920x540	P370IVN03.0	1500	Adv. Hi-Tni LC (-40~110℃), C-POL, 70Khrs

1. General Description

This specification applies to the 37.0 inch Color TFT-LCD Module P370IVN03.0. This LCD module has a TFT active matrix type liquid crystal panel 1,920x540 pixels, and diagonal size of 37.0 inch. This module supports 1,920x540 resolution display. Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 10-bit gray scale signal for each dot.

The P370IVN03.0 has been designed to apply the 8/10-bit 2 channel LVDS interface method. The main feature of P370IVN03.0 would be high brightness, high contrast, wide viewing angle, wide temp. LC(-40℃~110℃), circular PF film, high color saturation, edge LED backlight and high color depth.

*** General Information**

Items	Specification	Unit	Note
Active Screen Size	37.0	Inch	
Display Area	904.32(H) x 254.34(V)	mm	
Outline Dimension	923.30(H) x 277.1(V) x 10.65(D)	mm	1

5.Absolute Maximum Ratings

The followings are maximum values which, if exceeded, may cause faulty operation or damage to the unit

Item	Symbol	Min	Max	Unit	Conditions
Logic/LCD Drive Voltage	Vcc	-0.3	14	[Volt]	Note 1
Input Voltage of Signal	Vin	-0.3	4	[Volt]	Note 1
Operating Temperature	TOP	0	+50	[°C]	Note 2
Operating Humidity	HOP	10	90	[%RH]	Note 2
Storage Temperature	TST	-20	+60	[°C]	Note 2
Storage Humidity	HST	10	90	[%RH]	Note 2
Panel Surface Temperature	PST		70	[°C]	Note 3

Panele dotykowe

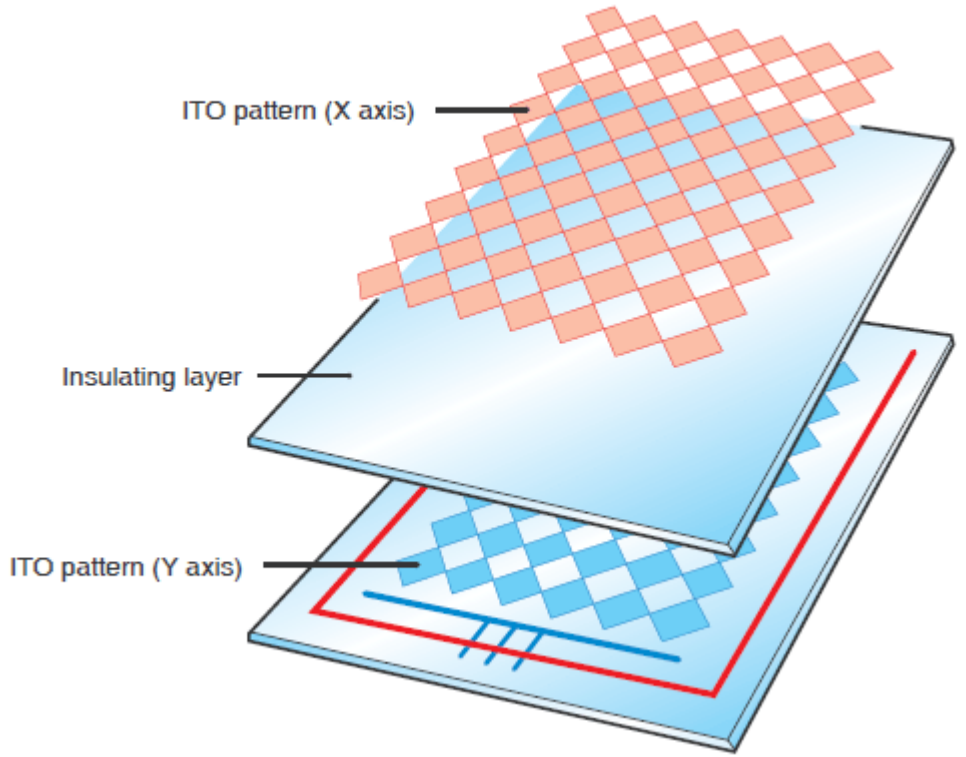
TP, TS, RTP, CTP, PCAP

- **Touch Panel**
- **Touch Screen**
- **Resistive Touch Panel**
- **Capacitive Touch Panel**
- **Projected Capacitive**

Panele dotykowe

CG, DITO, SITO, OGS, GG, GF, GFF

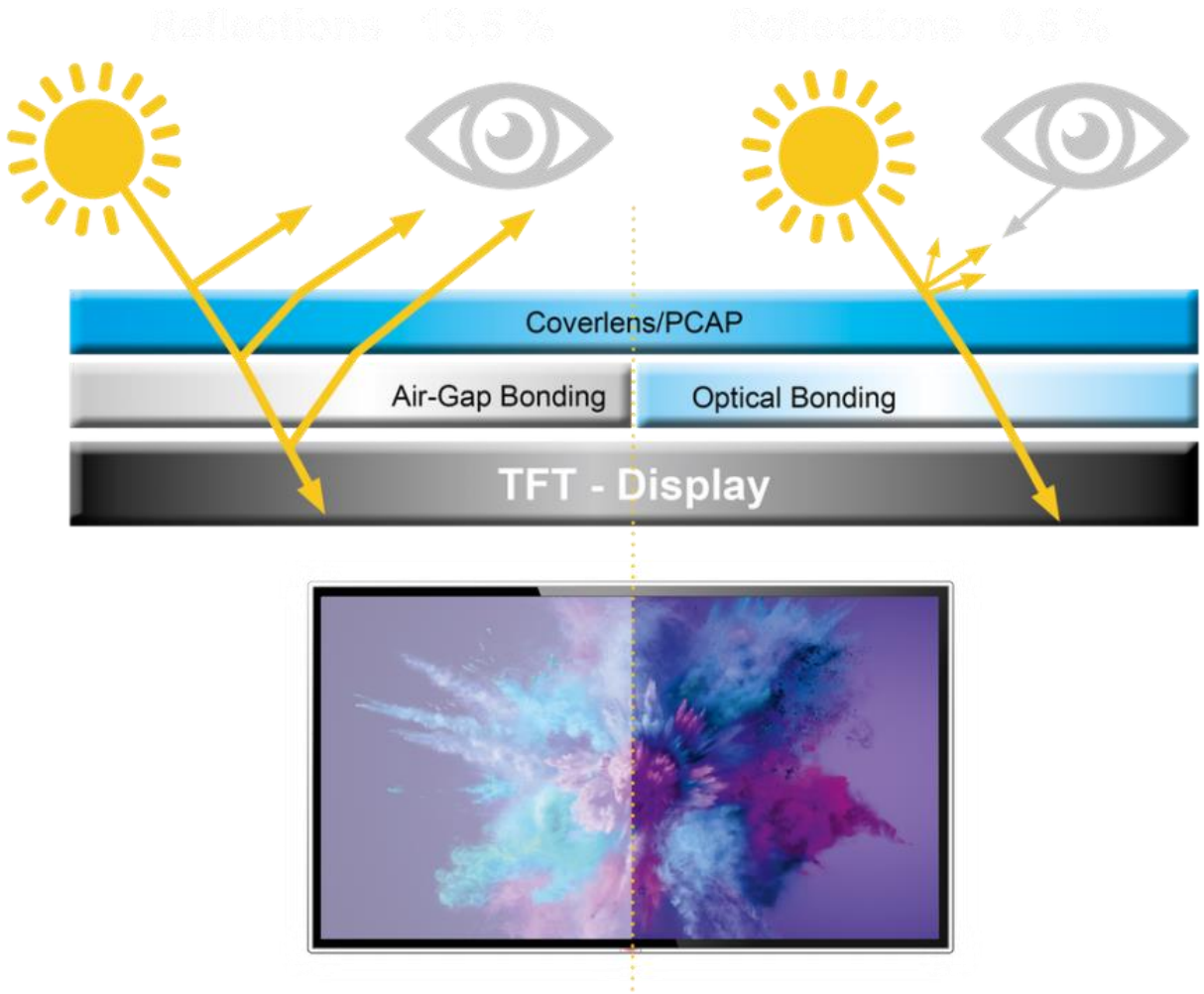
- **Cover Glass**
- **Double Indium Thin Oxide**
- **Single ITO**
- **One Glass Solution**
- **Glass Glass**
- **Glass Film**
- **Glass Film Film**



Bonding optyczny

OCA, LOCA, SCA

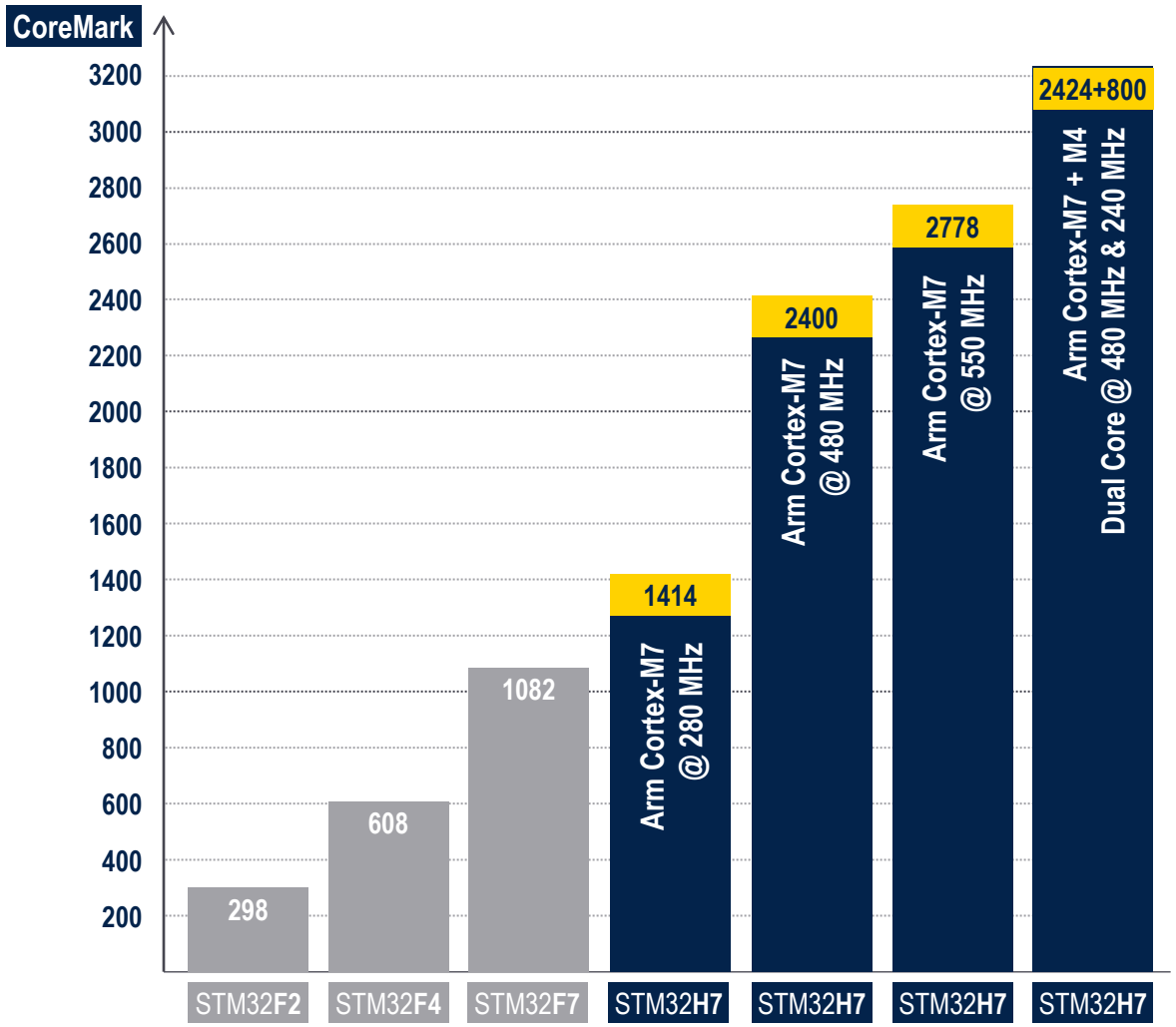
- **Optical Clear Adhesive**
- **Liquid OCA**
- **Sillicon Clear Adhesive**



Produceni kontrolerów paneli dotykowych

	FocalTech	HYCON	ILITEK	EETI	Penmount	Goodix	TouchNetix	SIS
Works with EVE	yes	yes	Yes!	No	No	Yes	No	No
Max CG thickness	1.8 mm	5mm	10 (15) mm	10 (15)mm	15mm	2mm		10mm
Unique value	cheap	Thick glass support	Direct contact and support, best value for money	Direct contact and support, military projects	Wide customizati on	cheap	Air touch, hover touch, heptic feedback	
Direct support	indirect	indirect	direct	direct	direct	indirect	direct	direct
Focus market	Mobile phones, tablets	Industrial and semi-industrial market	Industrial, Medical, Semi-Industrial	Industrial, Medical, Semi-Industrial	Industrial, Medical, Military	Mobile phon e, tablets	Automotive	Industrial, Medical, Semi-Industrial

Brave new world



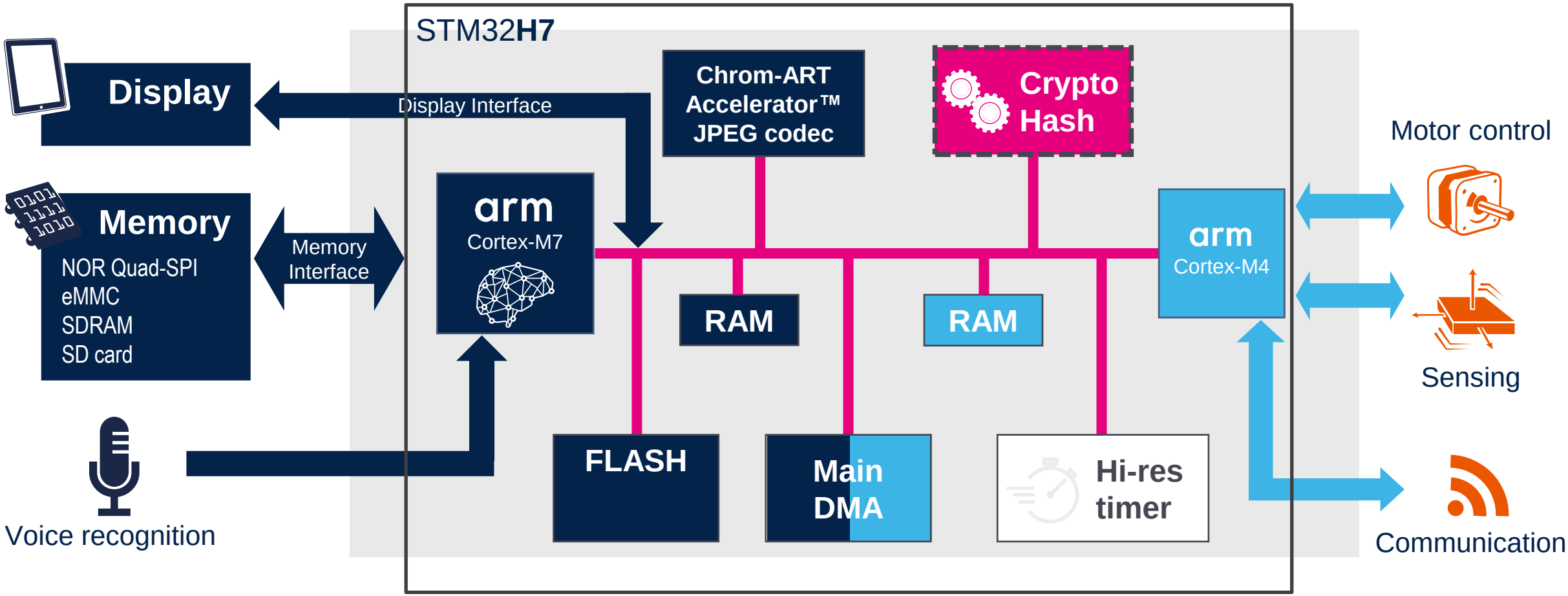
Arm® Cortex® -M7 up to 550 MHz

Most powerful Cortex core with double precision FPU, MPU, advanced DSP and L1 cache

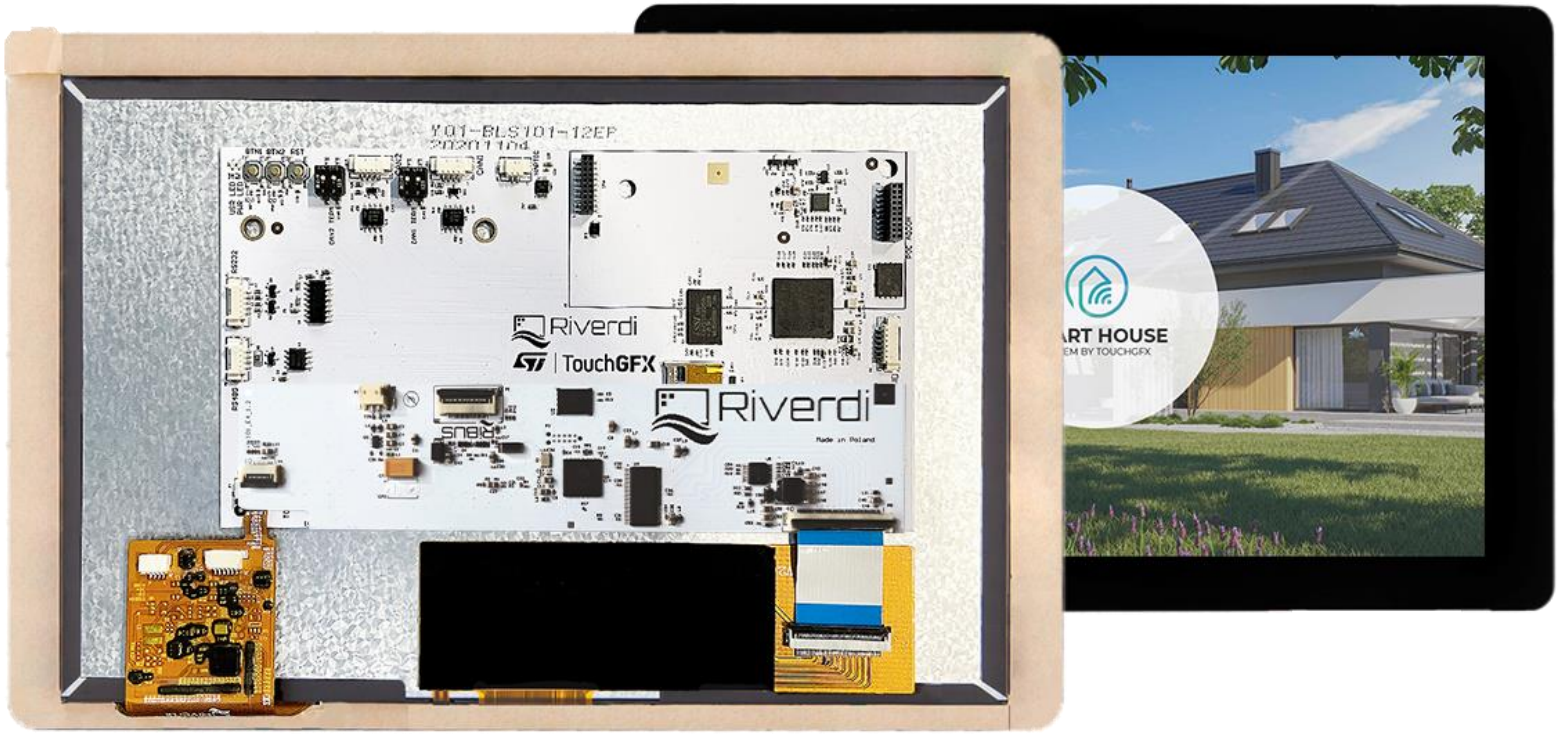
Arm® Cortex® -M4 @240 MHz

Best in class core for **real-time** with single precision FPU, DSP, MPU and ART Accelerator™

Example use case how to benefit from dual-core STM32H7



STM32 Embedded Displays



1280 x 800
10.1” IPS

Optical Bonding

850 cd/m²

Industrial Capacitive

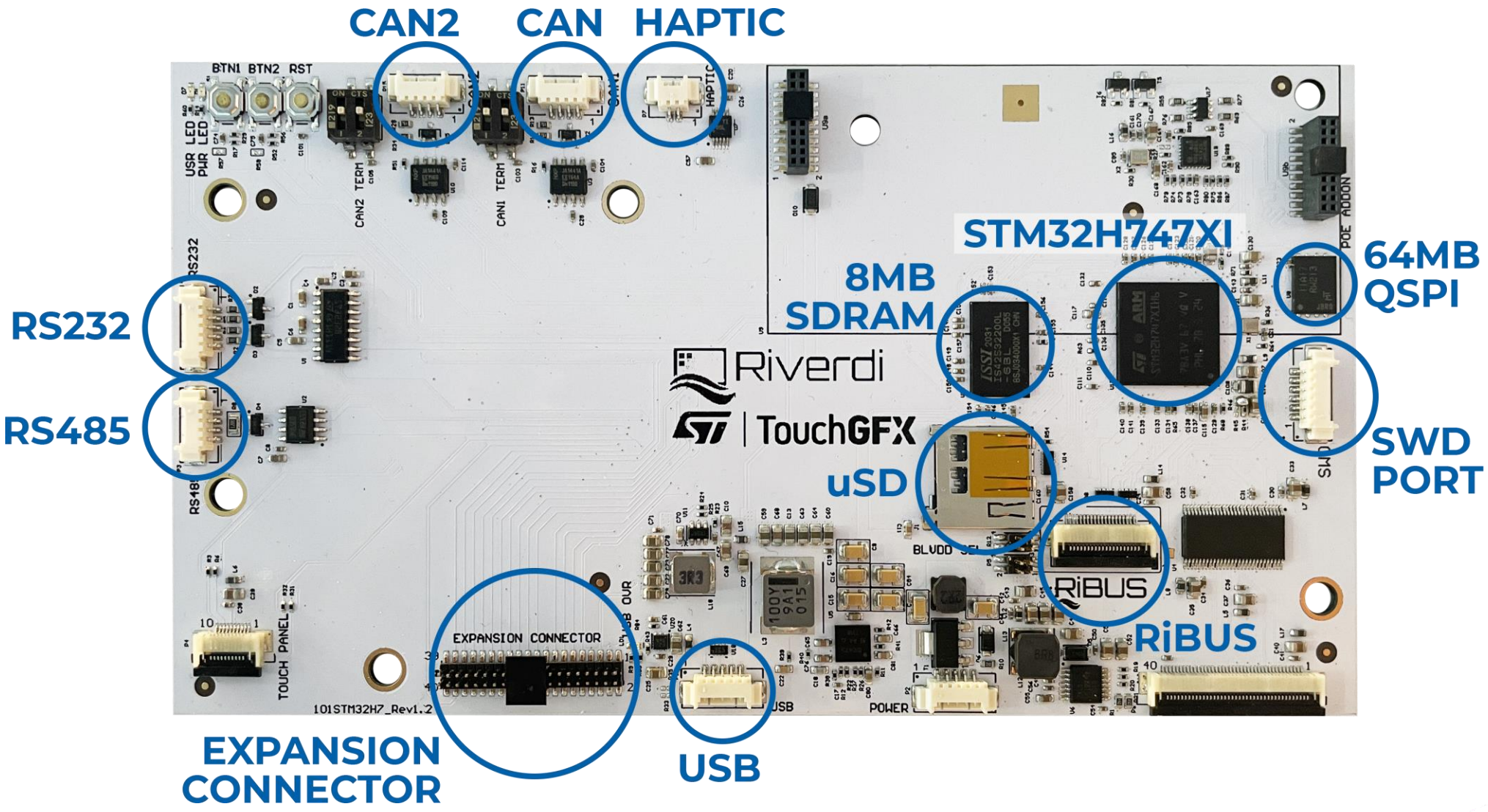
uxTouch

All STM32H7 Interfaces

STM32H7

Low EMI

STM32 Embedded Displays



Q & A

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Display Solution Experts

Thank you