

# Ultra Low Power a-TFT Solution Introduction - ST7301 Series

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Industrial BU. Product Planner

Steven Huang

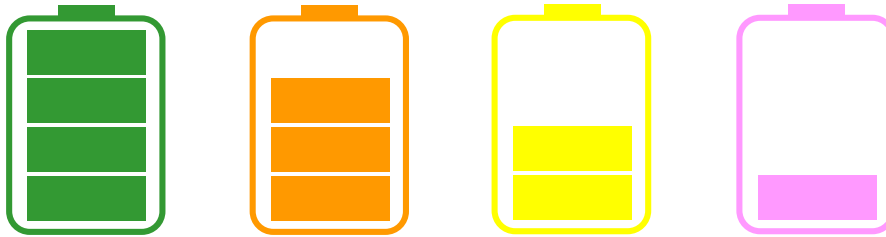
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The Sitronix logo is displayed in a bold, italicized, blue sans-serif font.

# Bottleneck of IOT

- IOT

- Most IOT products are powered by battery.



- **Battery lifetime still cant be extended effectively.**

- **Power consumption becomes the bottleneck of IOT development.**

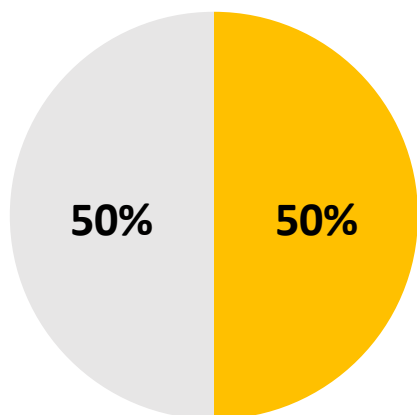
- **Ultra Low Power MCU**



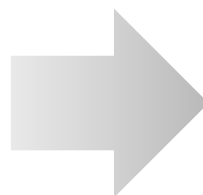
# IOT Products Power

- IOT Products Power

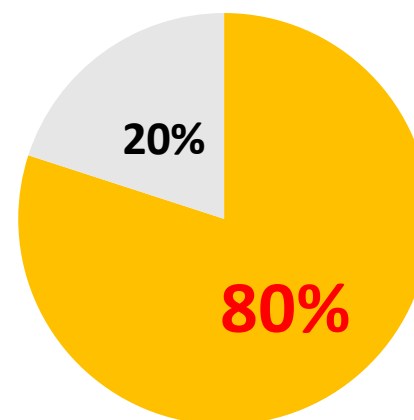
## Traditional Handheld Product



■ Display  
■ CPU



## Product with Low Power MCU



■ Display  
■ CPU

- Power of MCU is reducing.
- Display becomes the major part of the power consumption.
- How to reduce power? => **Reflective/ Transflective LCD**

# Reflective LCD + ULP Driver IC ST7301

- Remove Backlight=> Save 90% Power Consumption
- Ultra Low Power ST7301 => Reduce Power to **0.05%**



# ST7301 Series Features

## Wearable Devices



## ESL Products



Ultra Low  
Power

Always  
Display On

High Speed  
Interface

Reflective  
Trans-  
flective LCD

Amorphous  
TFT

Low Cost

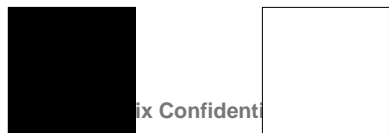
Color  
Display

Single VDD  
1.8V

# Ultra Low Power Series Feature

Item	ST7301	ST7302	ST7303
Resolution	Mono 720H x 480V 8-Color 240H x 480V 16-Color 360H x 240V 64 Color 240H x 240V	Mono 240H x 320V 3-Color 120H x 320V	Mono 720H x 320V 3-Color 360H x 320V 8-Color 240H x 320V
LCD Type	Reflective/ Transflective LCD	Reflective LCD	Reflective LCD
Application	Wearable/ ESL	ESL	ESL
Current (IC + LCD)	Low Power Mode: 25uA Normal Scan: 300uA	Low Power Mode: 9uA	Low Power Mode: 12uA
Norma Mode	VDDI=1.8V ~ 3.3V/ VDPA=2.8 ~ 3.3V		
1.8V Mode	VDDI=VDPA= 1.8V		
Interface	80-8bits, 3/4 SPI, Dual Lane		
Frequency	Low Power Mode- 0.25/ 0.5/ 1/ 8 Hz Normal Scan- 16/ 32Hz		
VCOM	ACVCOM		
OTP	3 Times MTP		
LCD Type	Amorphous TFT		

Mono 2 Grey



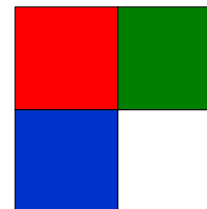
3-Color



RGB 8 Color



RGB 16 Color

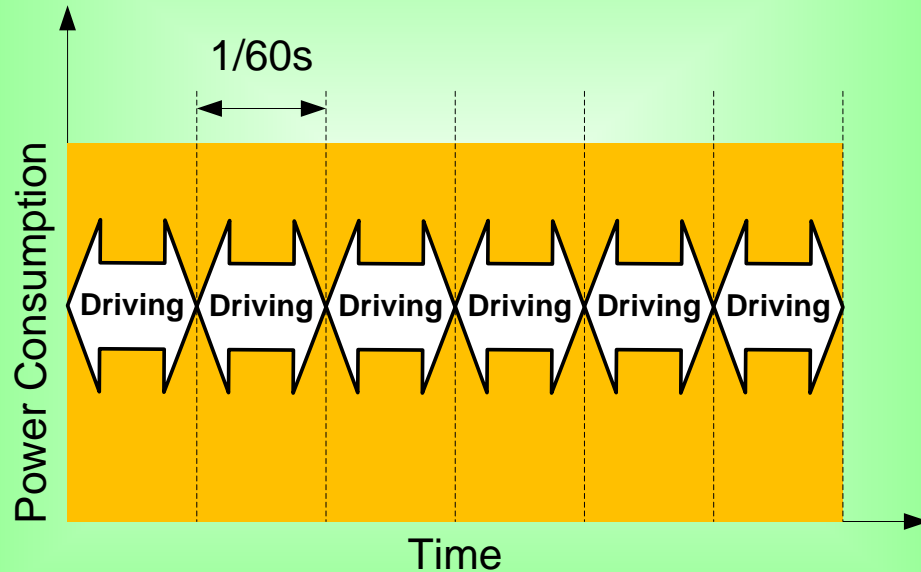


RGB 64 Color

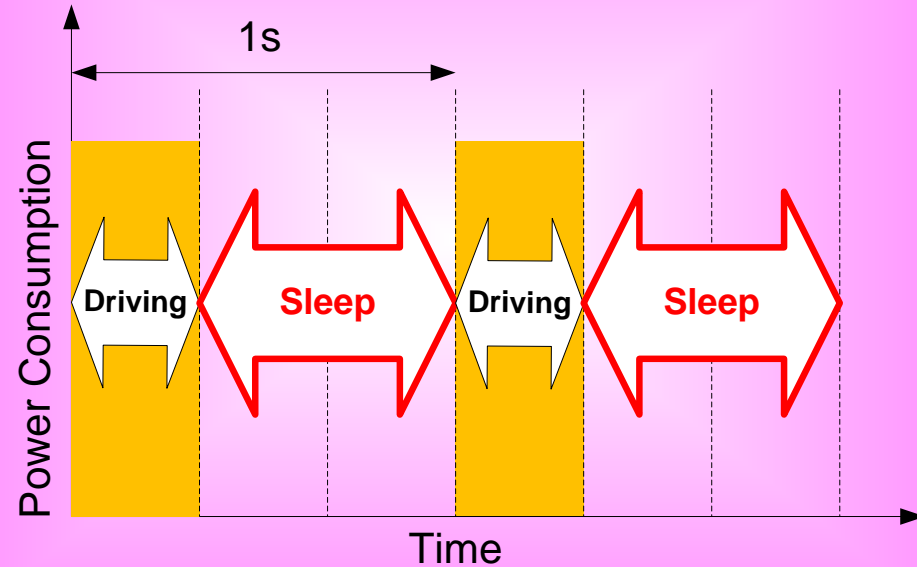


# Sitronix Low Power Driving Method

## Normal A-TFT Driving Method



## Our ULP A-TFT Driving Method (1Hz Driving)



**1Hz On + Off Mode Driving Method**

**=> Ultra Low Power**

1.3" QQVGA 262K Color TFT Module  
- 5mA

2.13" a-TFT ESL Module  
- ~9uA

# Other Low Power Technology

- LTPS Memory-in-Pixel Reflective LCD- Wearable



- E Ink EPD- ESL





# Other Solution- LTPS Memory in Pixel

## ■ LTPS Process

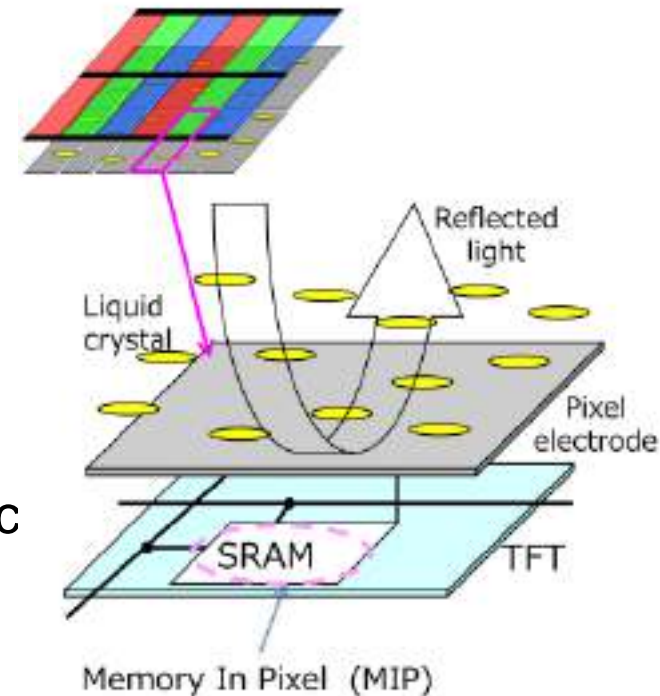
- Electric Mobility: 1000 times of a-TFT
- Circuit on Panel

## ■ Build-in 1-bit SRAM in TFT

1. Static Image: Data stored in SRAM
2. Build-in switch circuit to generate +/- source
3. Implement Low Power

## ■ Disadvantage

- Not Standard Interface
- Complicated Process : Low Yield & High Cost
- Need External Multi-Power
  - ▶ Typ. 3 Power(6.5V/4.5V/3.3V)

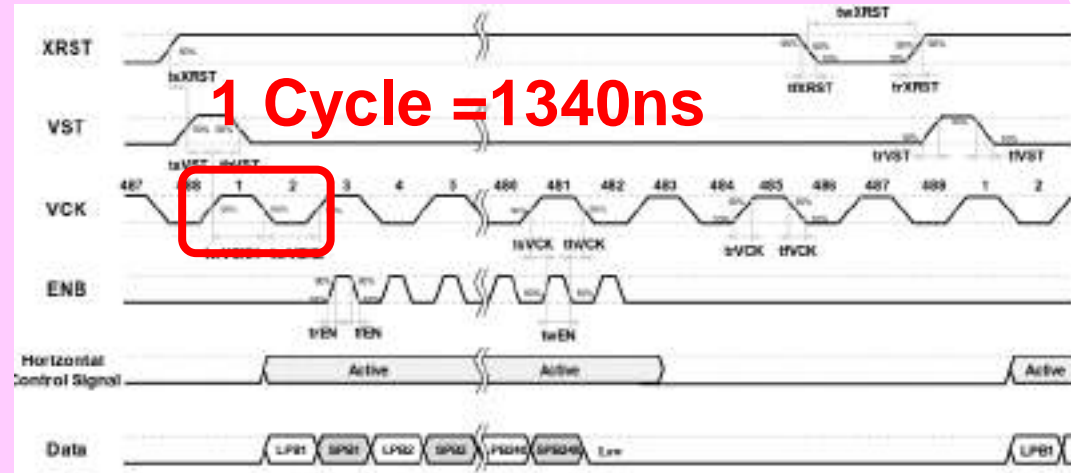


# Interface Comparison

## MIP Solution

### Specific Interface

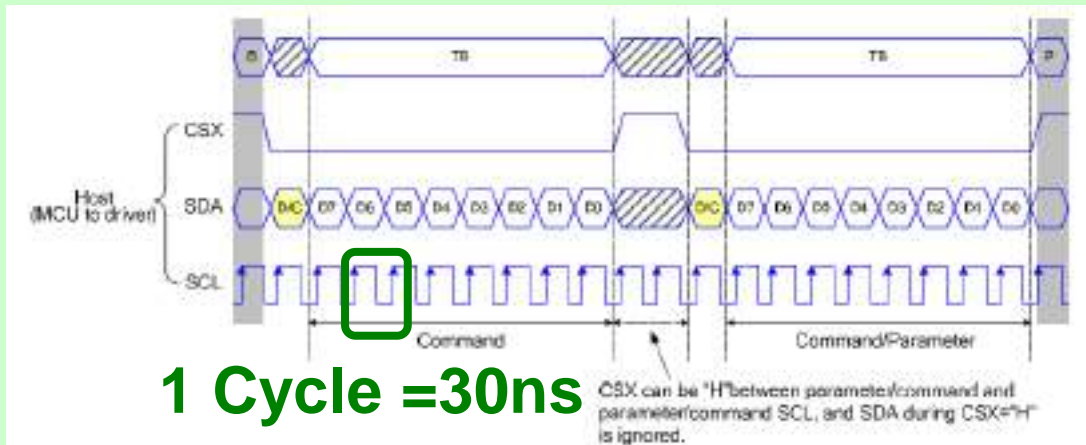
1. Need GPIO pins to Control
2. Complicated Waveforms
3. Lower Speed



## ST7301

### Standard SPI Dual Lane

1. Build-in Standard Interface
2. High-Speed Data Transform



# Power Consumption Comparison

## 1.2" 240RGB x 240 64 Color Type LCD

JDI 240x240 1Hz			
VDD	VDD1=3.2V	VDD2=4.5V	Power(uW)
Typ.	24	2	<b>86uW</b>
Max.	70	30	<b>359uW</b>

JDI 240x240 30Hz Cyan & Green Strip			
VDD	VDD1=3.2V	VDD2=4.5V	Power(uW)
Typ.	269	3	<b>874uW</b>
Max.	500	30	<b>1,927uW</b>

ST7301 VDD=VDD1=1.8V 1Hz		
Pattern	Current (uA)	Power (uW)
Black	24	<b>43</b>
White	26	<b>47</b>
Red	25	<b>45</b>
Green	24	<b>43</b>
Blue	24	<b>43</b>
Snow	33	<b>60</b>

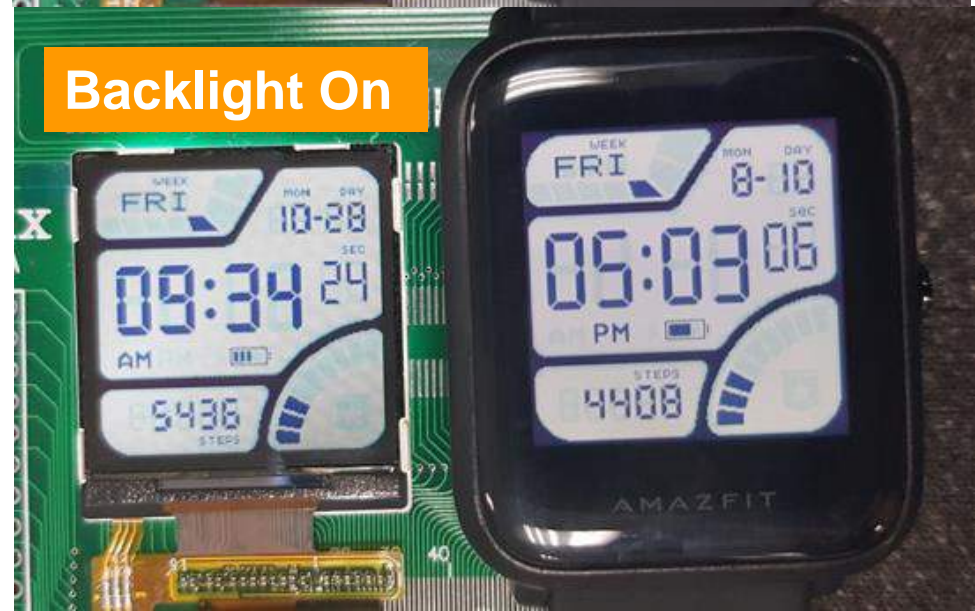
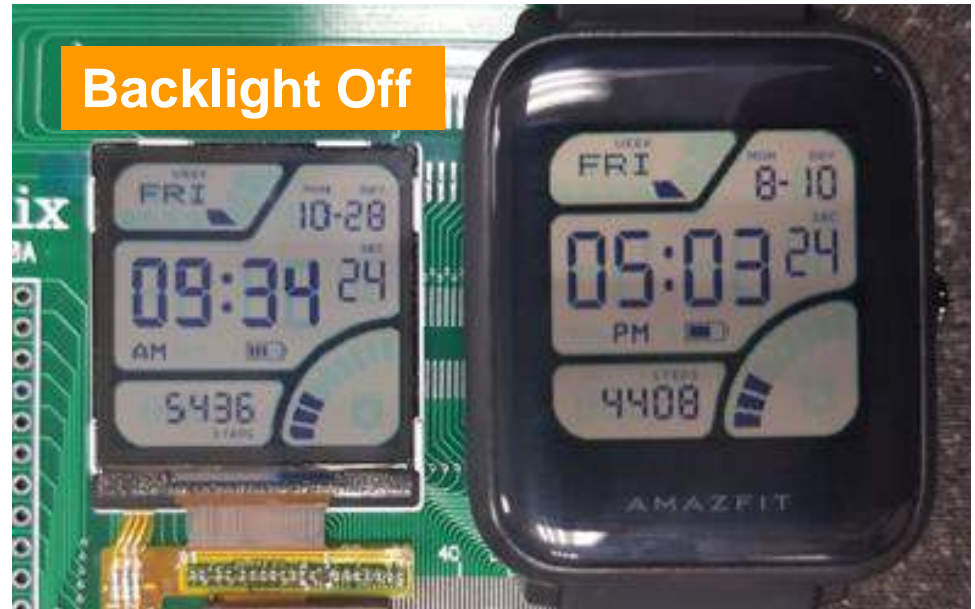
ST7301 VDD=VDD1=1.8V 32Hz		
Pattern	Current (uA)	Power (uW)
Black	277	<b>499</b>
White	337	<b>607</b>
Red	296	<b>533</b>
Green	296	<b>533</b>
Blue	295	<b>531</b>
Snow	305	<b>549</b>

25 degree

# Comparison Table

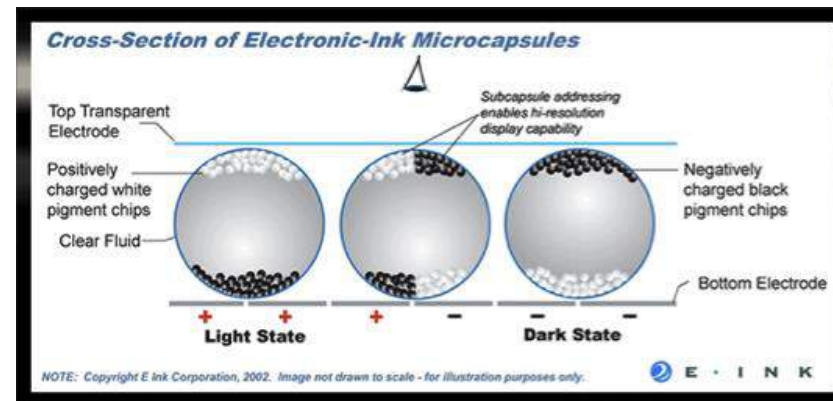
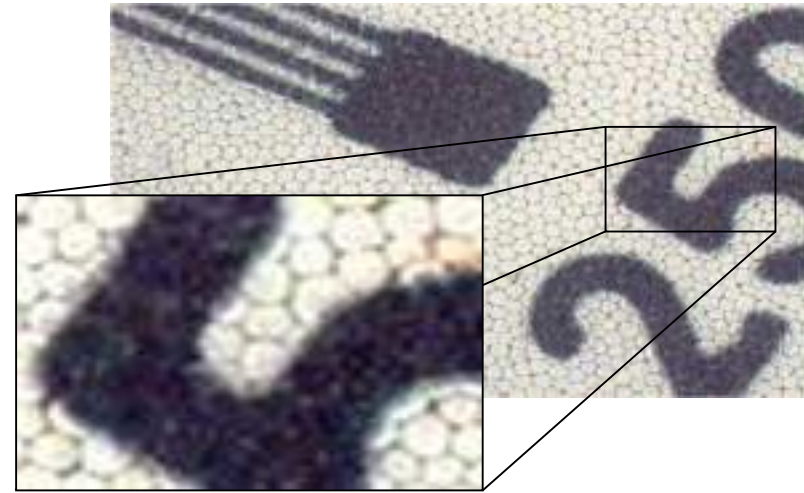
LTPS MIP	Item	ST7301 a-TFT Solution	
Reflective/ Transflective	LCD	Reflective/ Transflective	
240 x 240	Resolution	240 x 240	
LTPS TFT	Panel	Amorphous TFT	Win
1Hz 86uW 30Hz 874uW	Power	1Hz 60uW 32Hz 600uW	Win
Mono; 16G; 8/16/64 Color	Color	Mono; 16G; 8/16/64 Color	
Low	Yield	High	Win
3 Power 6.5V/4.5V/3.3V	Power	1 Power 1.8 ~ 3.6V	Win
Specific GPIO	Interface	Standard SPI MTK 2Lane/ Dual SPI	Win
Sharp ( Mono ) , JDI (Color)	Supplier	All a-TFT Maker	Win
High	Cost	Low	Win

# Demo Comparison

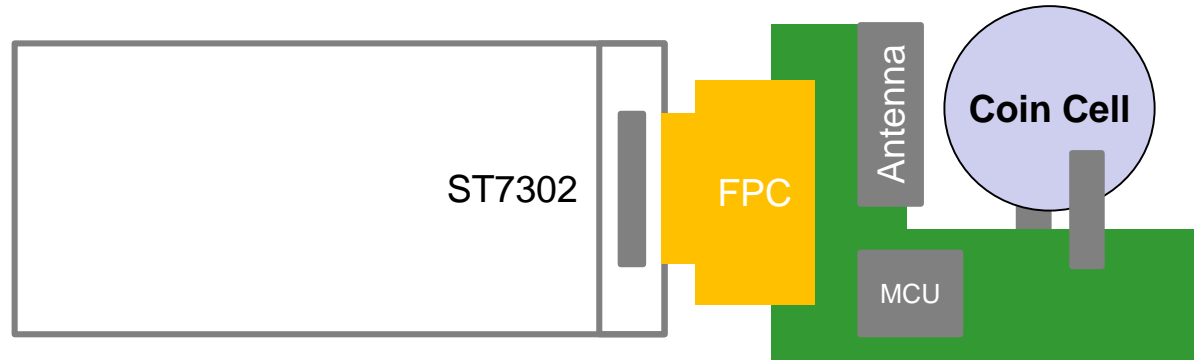


# EPD E Ink

- Low Power- Reflective Display (no Backlight)
- Particles will move in Microcapsules to show black and white
- Still Image
  - 0 Power Consumption
- **Change Pattern**
  - Need High Voltage to Drive Black/ White Particles
  - High Current



# ESL Power Structure



**LCD + IC ~9uA**

**MCU Board ~2uA**

- 2.1" Mono Display (296 x 128)
  - LCD+IC: ~9uA
- Coin Cell Battery: CR2450 620mAh
- 620mAh divided by 11uA
- 2348 Days
- **>5 Years Life Time**

# Comparison Table

EPD	Item	Our Solution	
Reflective	LCD	Reflective	
Amorphous TFT	Panel	Amorphous TFT	
Still Image 0uA Change Pattern ~8mA	Power	Still Image and Change Pattern~12uA	
Black White Red/ Black White Yellow	Color	Mono; 8/16/64 Color Any 3 Colors	Win
Low	Yield	High	Win
35% 	Reflectance	15~23%	
<10	Contrast	>40	Win
Larger Size High Cost	Size	Larger Size Acceptable Cost	Win
0~40 Degree	Temp.	-30~85 Degree	Win
Eink	Supplier	All a-TFT Maker	Win
High	Cost	Low	Win



# Demo Comparison



# Thank You

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