Sistemas Basados en Microprocesador

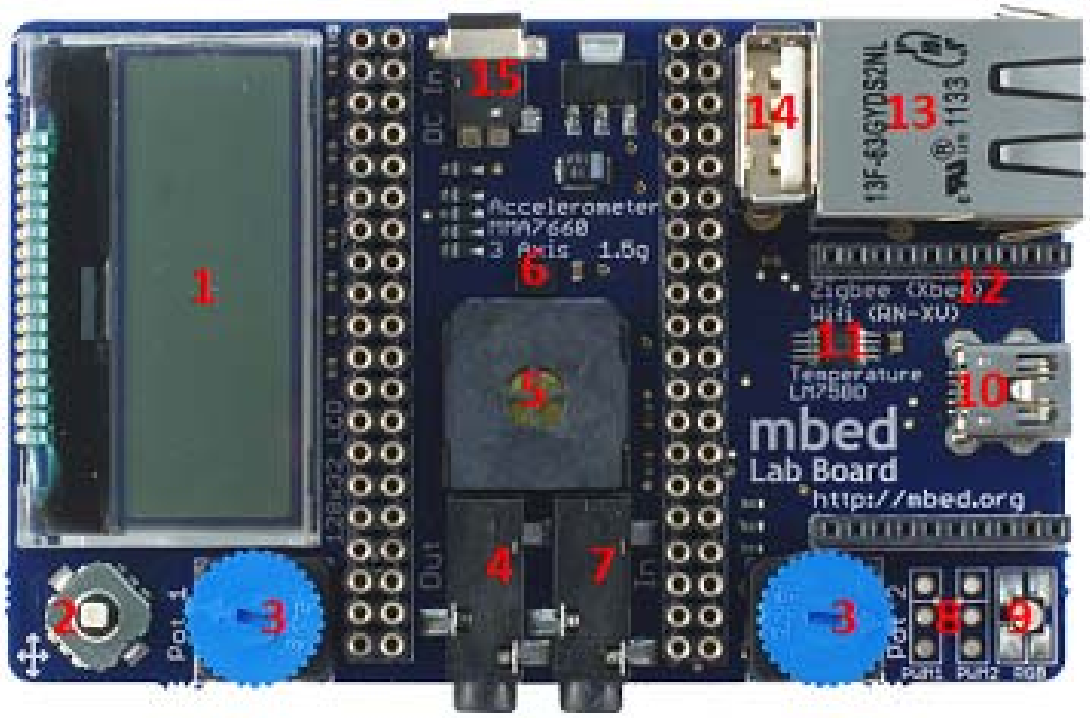
B2 LCD mbed APPBoard

LCD

- Dispositivo con interfaz SPI. Enviando información en serie al LCD se puede configurar y representar información en él
- El display que se va a utilizar está montado en la placa de aplicaciones *mbed App Board*
- Es un display gráfico de 128x32 pixels. Eso quiere decir que debemos gestionar si un punto de la pantalla se enciende o no
- El display tiene una memoria interna de 65x132 donde se almacenan los datos que se representan

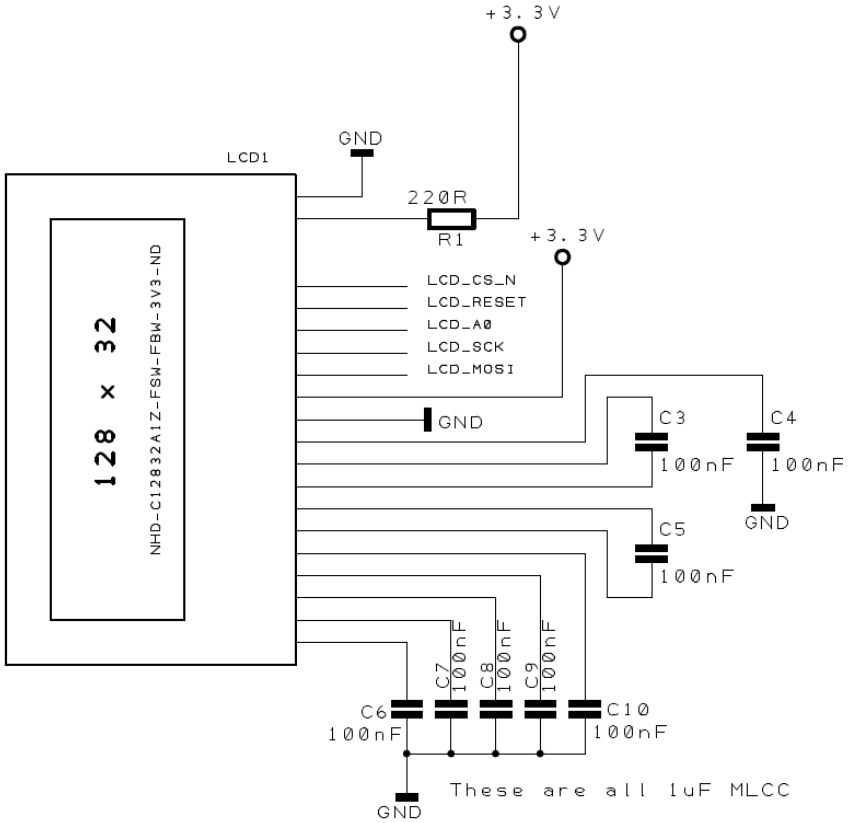
Display SPI 128x32 Gráfico

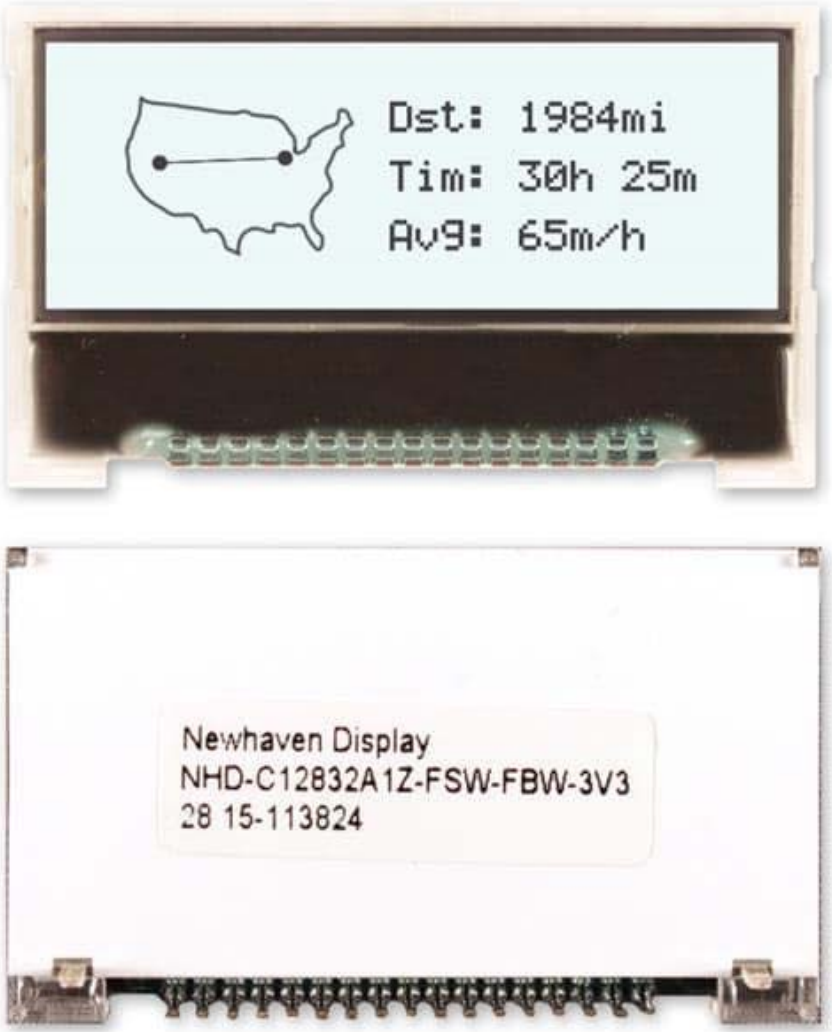
- **mbed Application Board**
  1. 128x32 Graphics LCD
  2. 5 way joystick
  3. 2 x Potentiometers
  4. 3.5mm Audio jack (Analog Out)
  5. Speaker, PWM Connected
  6. 3 Axis +/1 1.5g Accelerometer
  7. 3.5mm Audio jack (Analog In)
  8. 2 x Servo motor headers
  9. RGB LED, PWM connected
  10. USB-mini-B Connector
  11. Temperature sensor
  12. Socket for for Xbee (Zigbee) or RN-XV (Wifi)
  13. RJ45 Ethernet connector
  14. USB-A Connector
  15. 1.3mm DC Jack input



http://mbed.org/cookbook/mbed-application-board

Display SPI 128x32 Gráfico

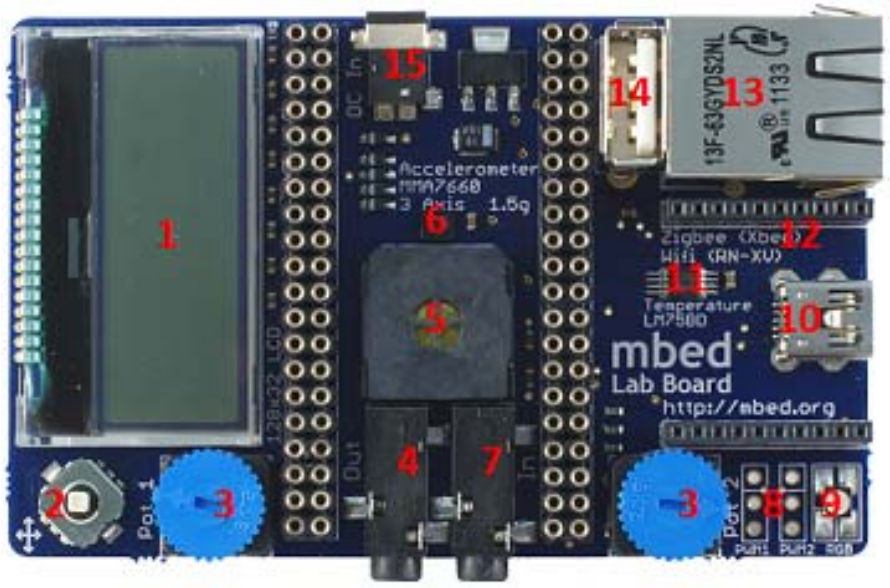


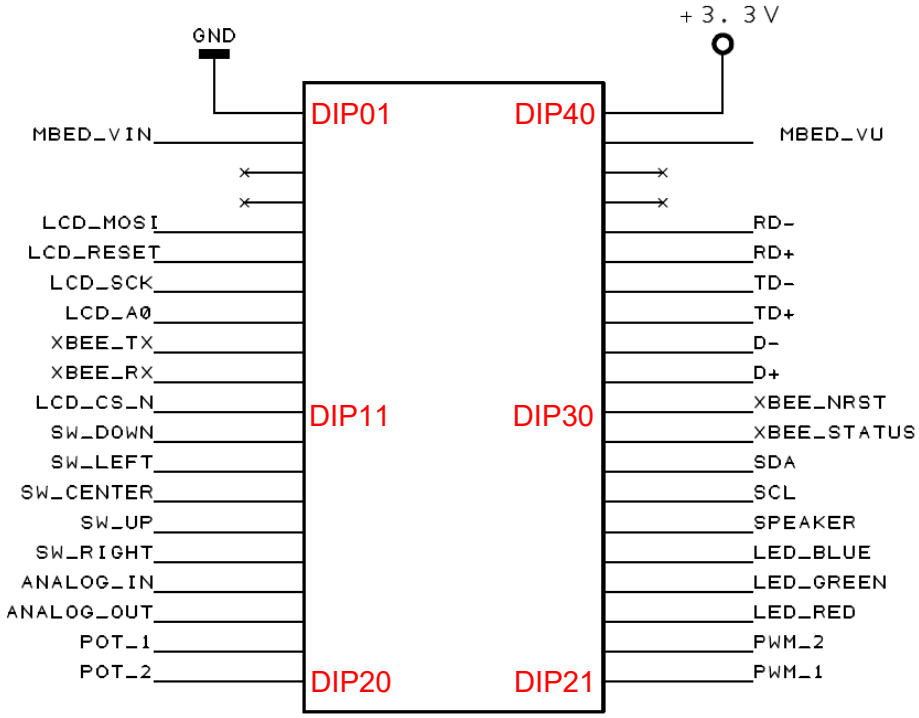


https://os.mbed.com/media/uploads/chris/mbed-014.1_b.pdf

https://os.mbed.com/components/mbed-Application-Board/

Display SPI 128x32 Gráfico





Conexiones STM-F429ZI - mbedAPPBoard

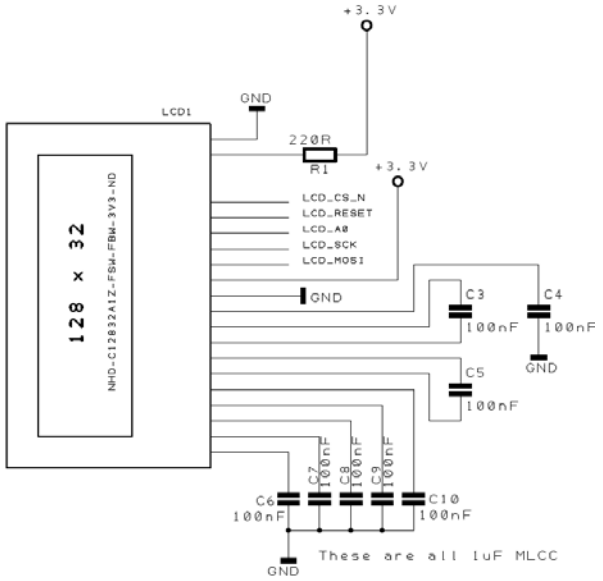
mbedAPPBoard		STM-F429ZI	
GND	DIP01	GND(11-CN8))	
+3.3v	DIP40	+3V3(7-CN8)	
LCD_MOSI	DIP05	D11	PA7
LCD_RESET	DIP06	D12	PA6
LCD_SCK	DIP07	D13	PA5
LCD_A0	DIP08	D7	PF13
LCD_CS_N	DIP11	D10	PD14

Las señales RESET,CS y A0 del display se tienen que manejar directamente con el GPIO.

Display SPI 128x32 Gráfico

https://www.newhavendisplay.com/specs/NHD-C12832A1Z-FSW-FBW-3V3.pdf

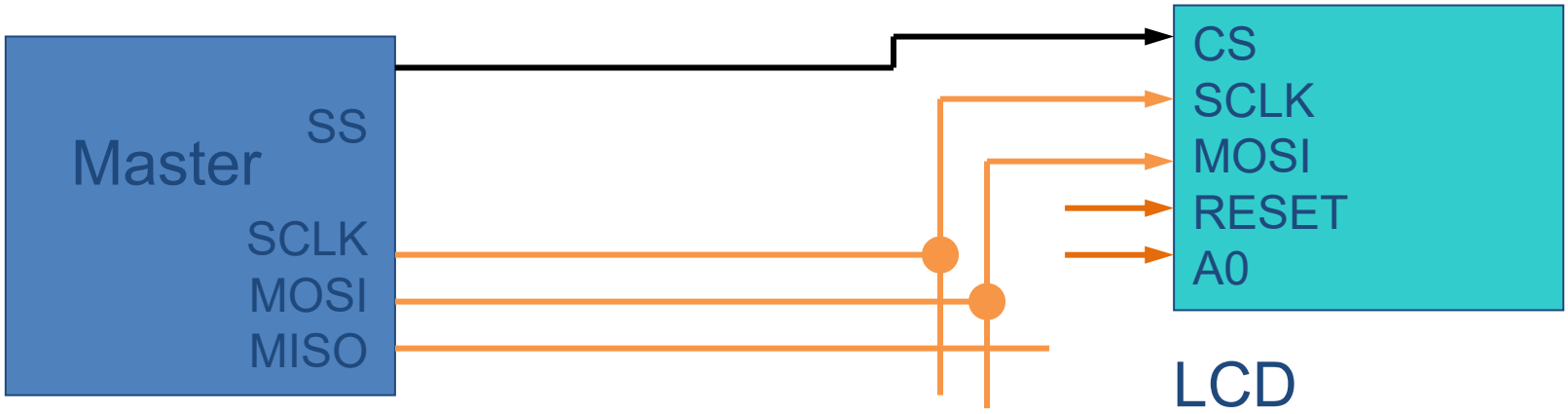
http://www.lcd-module.de/eng/pdf/zubehoer/st7565r.pdf



Pin Description and Wiring Diagram

Pin No.	Symbol	External Connection	Function Description
1	V_0	Power Supply	0.1µF – 1µF Capacitor to V_{SS}
2	V_1	Power Supply	0.1µF – 1µF Capacitor to V_{SS}
3	V_2	Power Supply	0.1µF – 1µF Capacitor to V_{SS}
4	V_3	Power Supply	0.1µF – 1µF Capacitor to V_{SS}
5	V_4	Power Supply	0.1µF – 1µF Capacitor to V_{SS}
6	C2-	Power Supply	Connect 1µF – 2.2µF Capacitor to C2+ (pin 7)
7	C2+	Power Supply	Connect 1µF – 2.2µF Capacitor to C2- (pin 6)
8	C1+	Power Supply	Connect 1µF – 2.2µF Capacitor to C1- (pin 9)
9	C1-	Power Supply	Connect 1µF – 2.2µF Capacitor to C1+ (pin 8)
10	V_{OUT}	Power Supply	Connect 1µF – 2.2µF Capacitor to VSS (pin 11)
11	V_{SS}	Power Supply	Ground
12	V_{DD}	Power Supply	Supply Voltage for LCD and Logic (+3V)
13	SI	MPU	Serial Data
14	SCL	MPU	Serial Clock
15	A0	MPU	Register Select. A0=0: Instruction, A0=1: Data
16	/RST	MPU	Active LOW Reset signal
17	/CS1	MPU	Active LOW Chip Select signal
A	LED+	Power Supply	Backlight Anode(+3V)
K	LED-	Power Supply	Backlight Cathode (Ground)

SPI – Conexión entre micro y el display



F429ZI

¿Qué pines del micro se deben configurar para conectar el controlador SPI?
¿Cuántos controladores SPI hay en el F429ZI?
¿Para que sirven las señales RESET y A0 del Display?

Gestión del display

- La información se envía al display usando la línea serie síncrona del SPI (MOSI) y la señal de reloj (SCLK)
- La información es interpretada de dos maneras:
  - Si **A0=0 la información recibida se interpreta como comandos** en el display. Es decir realizan operaciones de *configuración*.
  - Si **A0=1 la información recibida se guardan en la memoria del display** porque esta es la *información gráfica* que se quiere representar.
- El display sólo puede recibir operaciones de escritura (MOSI) y no de lectura (MISO).

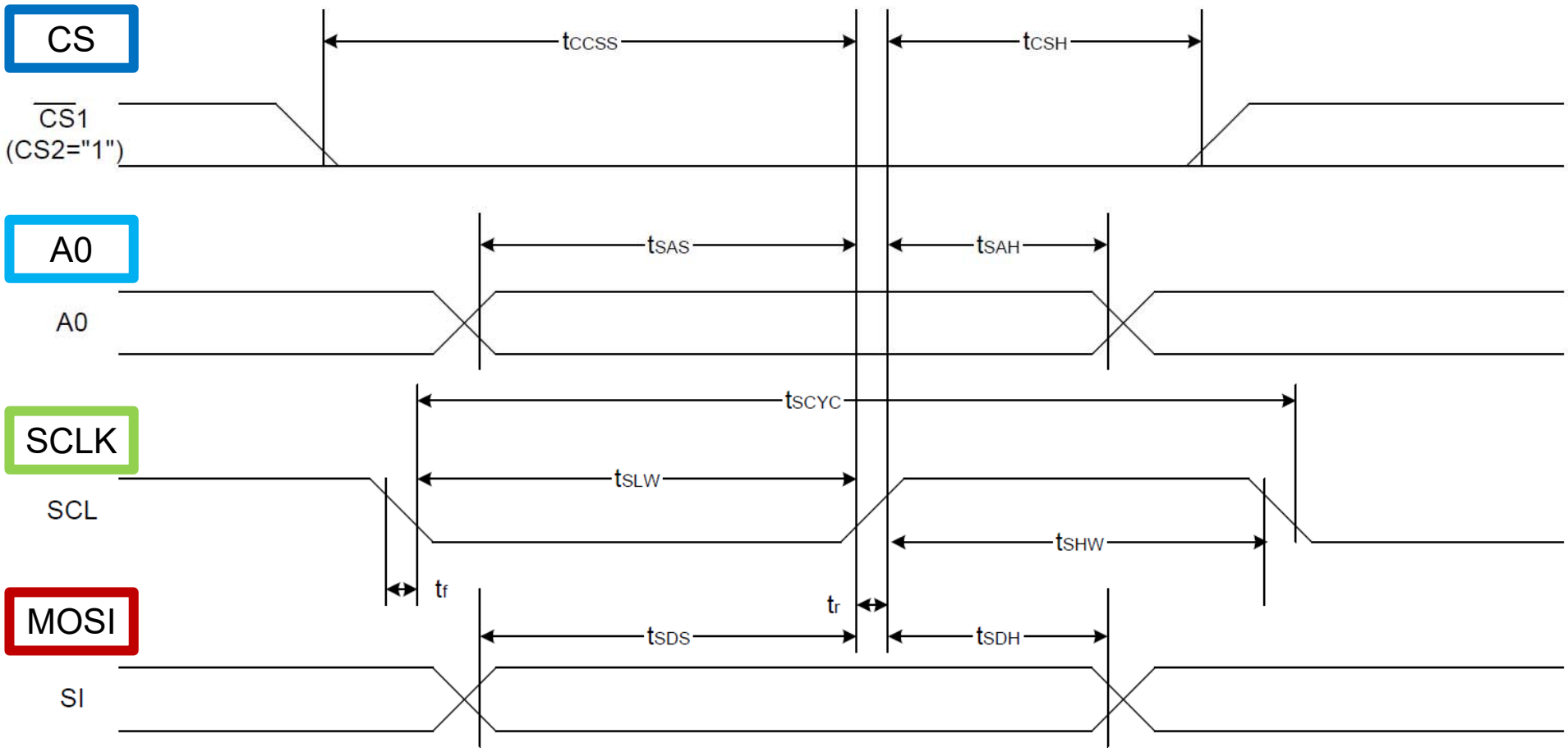
Comandos/datos en el display

Command	Command Code											Function
	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	
(1) Display ON/OFF	0	1	0	1	0	1	0	1	1	1	0 1	LCD display ON/OFF 0: OFF, 1: ON
(2) Display start line set	0	1	0	0	1	Display start address						Sets the display RAM display start line address
(3) Page address set	0	1	0	1	0	1	1	Page address				Sets the display RAM page address
(4) Column address set upper bit Column address set lower bit	0	1	0	0	0	0	1	Most significant column address				Sets the most significant 4 bits of the display RAM column address. Sets the least significant 4 bits of the display RAM column address.
				0	0	0	0	Least significant column address				
(5) Status read	0	0	1	Status				0	0	0	0	Reads the status data
(6) Display data write	1	1	0	Write data								Writes to the display RAM
(7) Display data read	1	0	1	Read data								Reads from the display RAM
(8) ADC select	0	1	0	1	0	1	0	0	0	0	0 1	Sets the display RAM address SEG output correspondence 0: normal, 1: reverse
(9) Display normal/ reverse	0	1	0	1	0	1	0	0	1	1	0 1	Sets the LCD display normal/ reverse 0: normal, 1: reverse
(10) Display all points ON/OFF	0	1	0	1	0	1	0	0	1	0	0 1	Display all points 0: normal display 1: all points ON
(11) LCD bias set	0	1	0	1	0	1	0	0	0	1	0 1	Sets the LCD drive voltage bias ratio 0: 1/9 bias, 1: 1/7 bias (ST7565R)
(12) Read-modify-write	0	1	0	1	1	1	0	0	0	0	0	Column address increment At write: +1 At read: 0

Comandos/datos en el display

(13) End	0	1	0	1	1	1	0	1	1	1	0	Clear read/modify/write
(14) Reset	0	1	0	1	1	1	0	0	0	1	0	Internal reset
(15) Common output mode select	0	1	0	1	1	0	0	0 1	*	*	*	Select COM output scan direction 0: normal direction 1: reverse direction
(16) Power control set	0	1	0	0	0	1	0	1	Operating mode			Select internal power supply operating mode
(17) V_0 voltage regulator internal resistor ratio set	0	1	0	0	0	1	0	0	Resistor ratio			Select internal resistor ratio(Rb/Ra) mode
(18) Electronic volume mode set Electronic volume register set	0	1	0	1 0	0 0	0	0	0 Electronic volume value	0	0	1	Set the V_0 output voltage electronic volume register
(19) Sleep mode set	0	1	0	1 *	0 *	1 *	0 *	1 *	1 *	0 0	0 1 0	0: Sleep mode, 1: Normal mode
(20) Booster ratio set	0	1	0	1 0	1 0	1 0	1 0	1 0	0 0	0 step-up value	0	select booster ratio 00: 2x,3x,4x 01: 5x 11: 6x
(21) NOP	0	1	0	1	1	1	0	0	0	1	1	Command for non-operation
(22) Test	0	1	0	1	1	1	1	*	*	*	*	Command for IC test. Do not use this command

Temporización SPI del LCD



Temporización del reset

Reset Timing

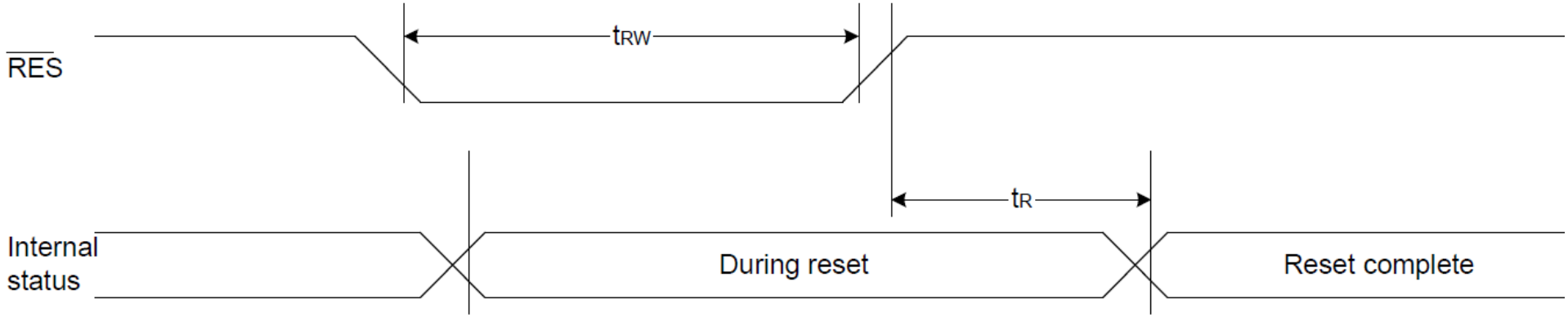


Figure 41

Table 30

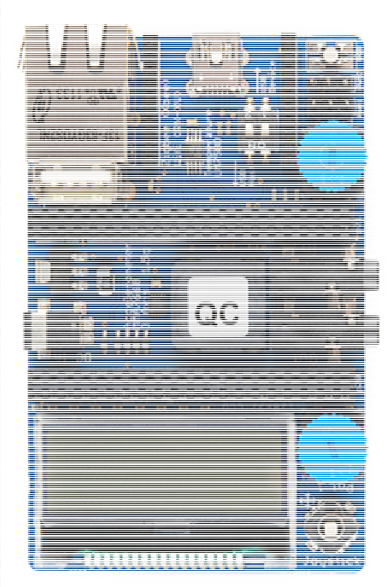
Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		t_R		—	—	1.0	us
Reset "L" pulse width	/RES	t_{RW}		1.0	—	—	us

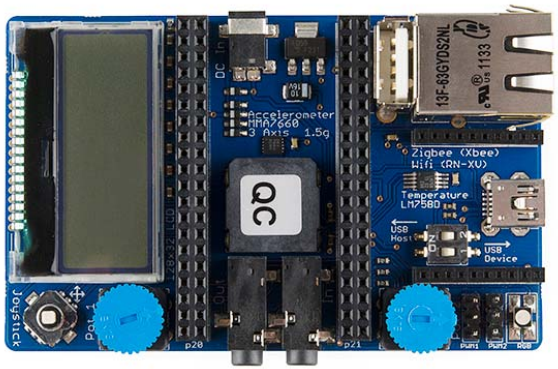
Table 31

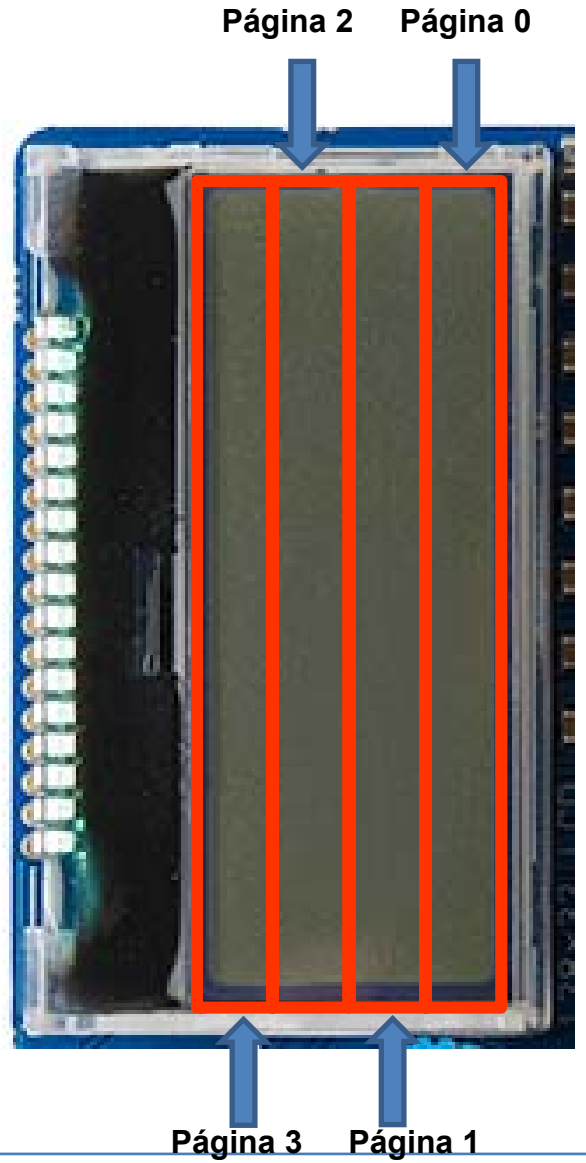
(V_{DD} = 2.7V, Ta = –30 to 85℃)

Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		t_R		—	—	2.0	us
Reset "L" pulse width	/RES	t_{RW}		2.0	—	—	us

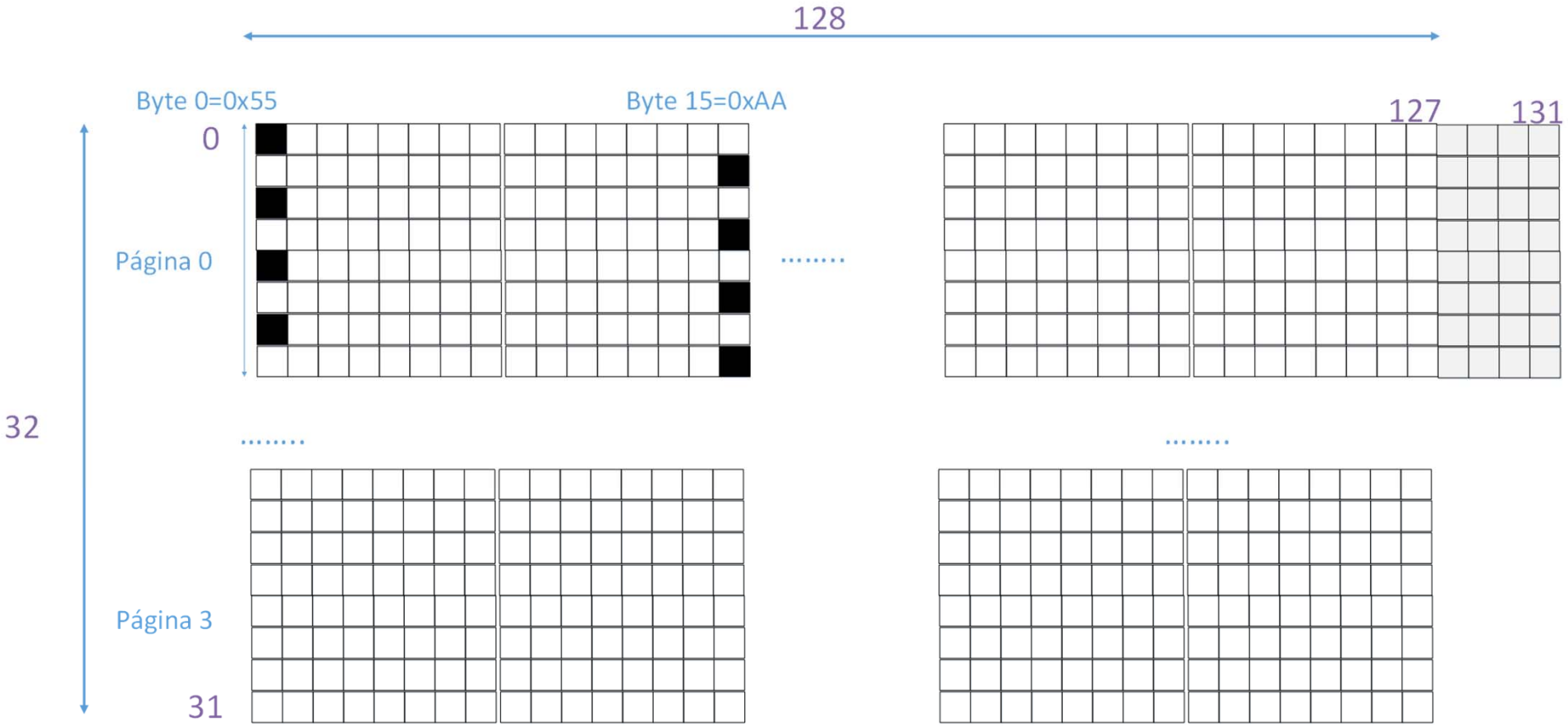
Organización de la información en la pantalla: ejemplo



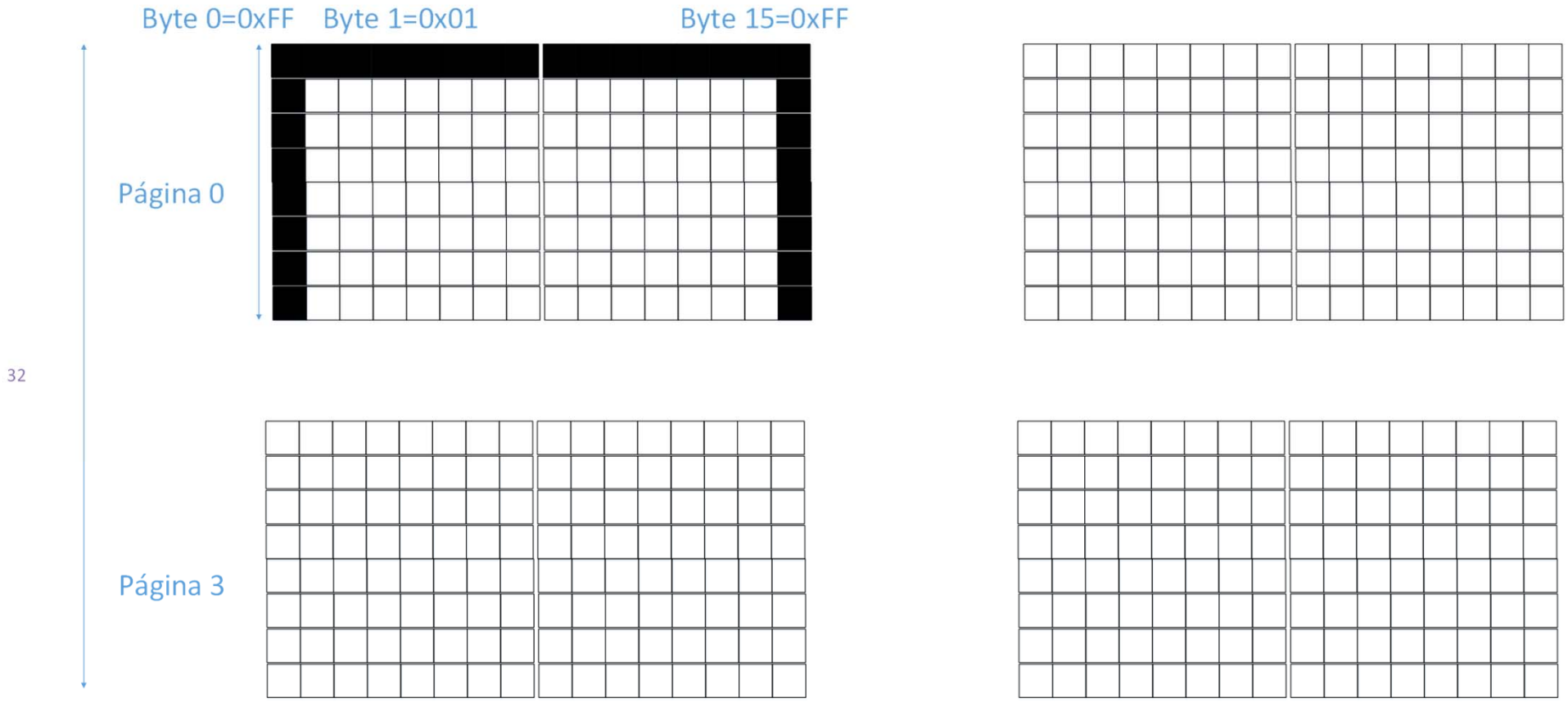




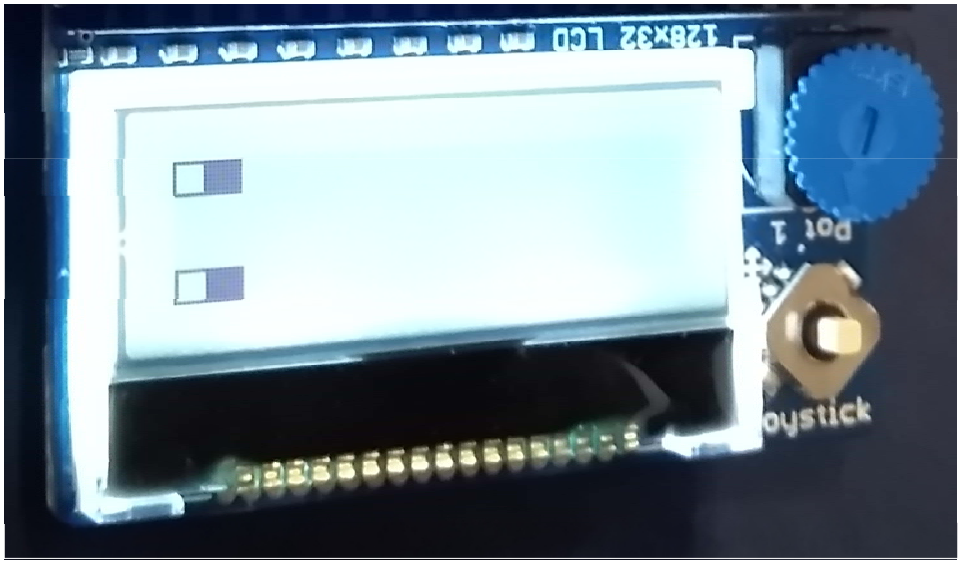
Organización de la información en la pantalla: ejemplo

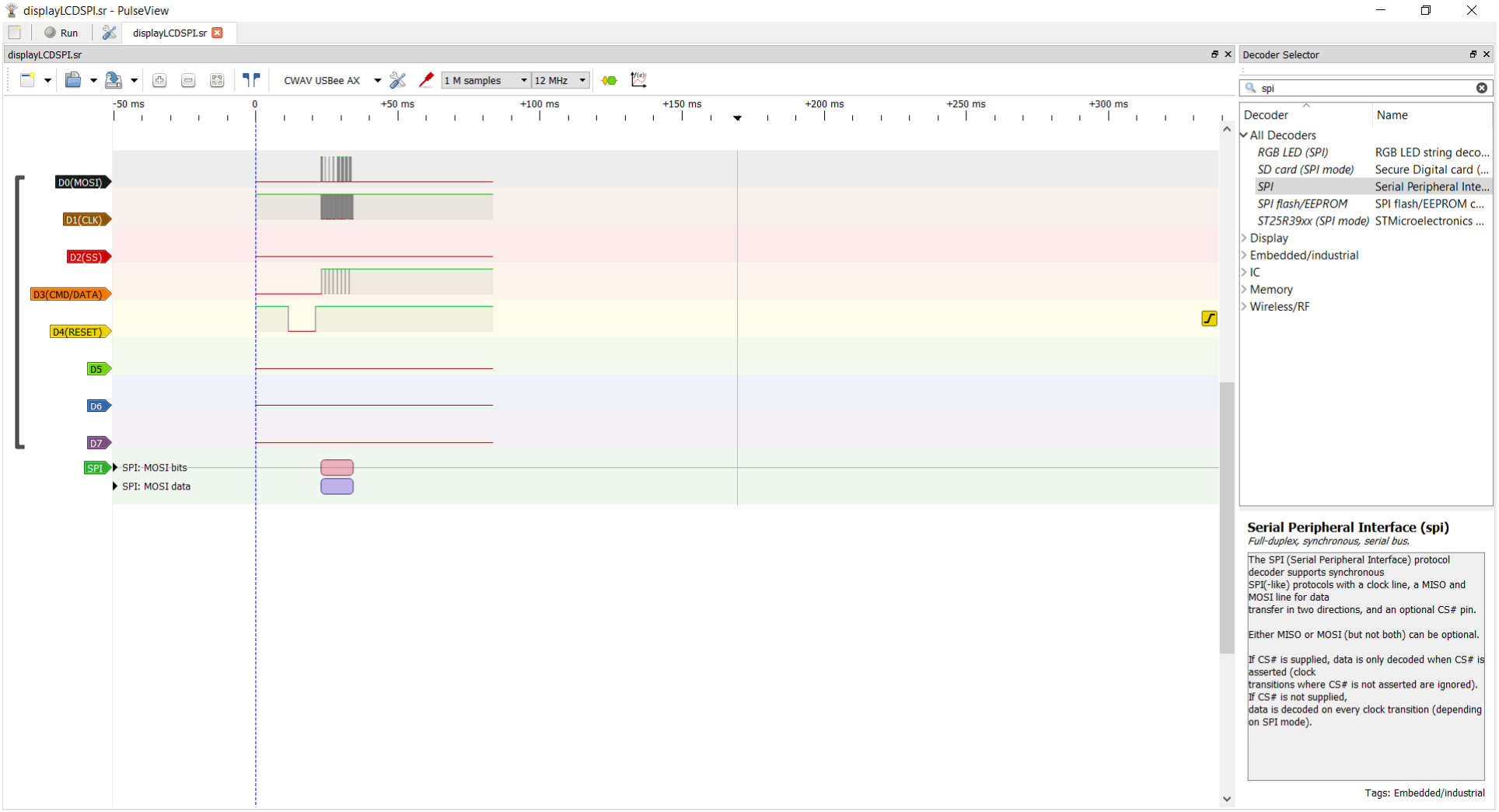


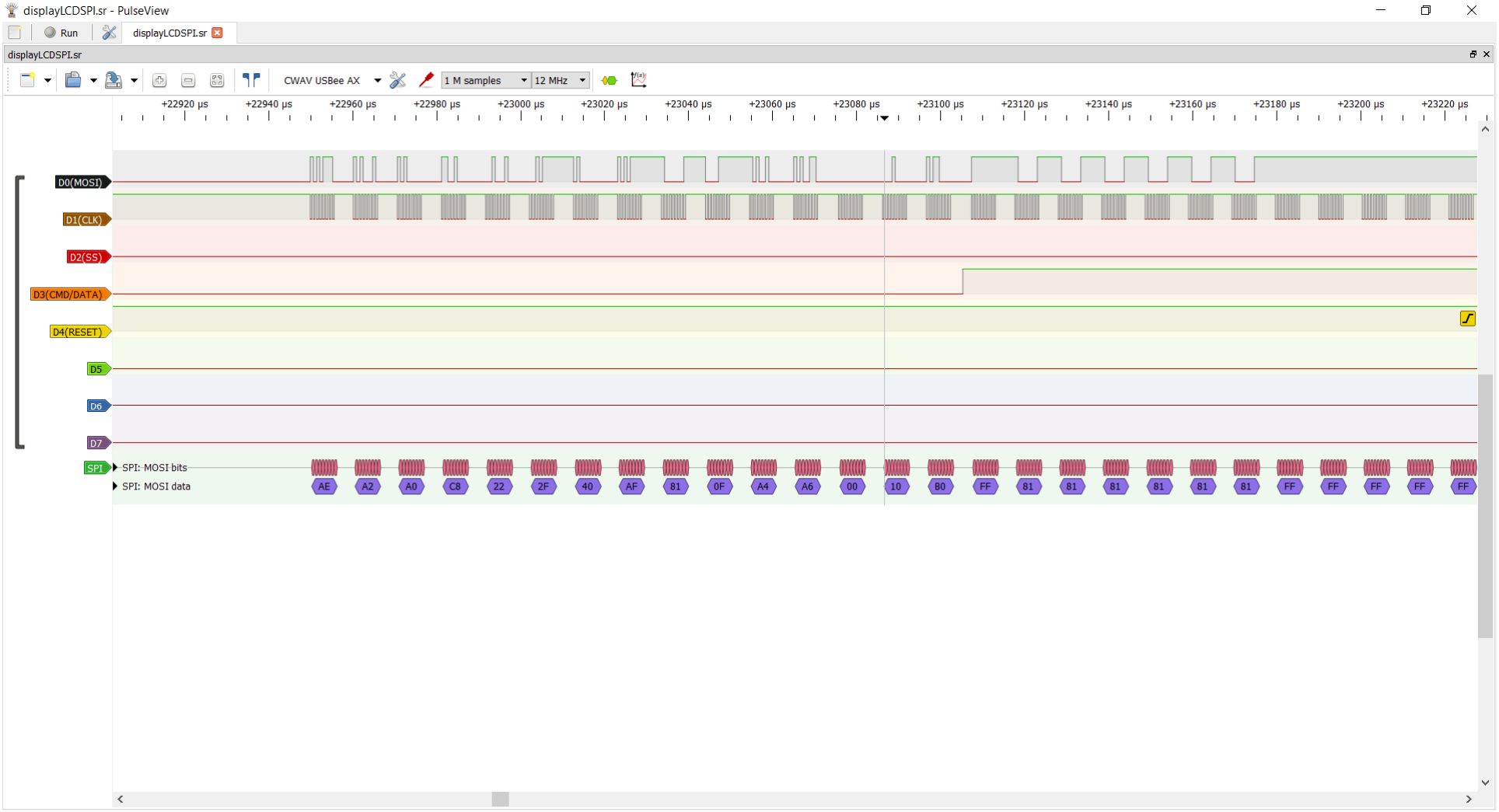
Organización de la información en la pantalla: ejemplo 2



Demo




displayLCDSPI.sr - PulseView
Run
displayLCDSPI.sr
displayLCDSPI.sr
CWAV USBee AX
1 M samples
12 MHz
-50 ms
0
+50 ms
+100 ms
+150 ms
+200 ms
+250 ms
+300 ms
D0(MOSI)
D1(CLK)
D2(SS)
D3(CMD/DATA)
D4(RESET)
D5
D6
D7
SPI
SPI: MOSI bits
SPI: MOSI data
Decoder Selector
spi
Decoder
Name
All Decoders
RGB LED (SPI)
RGB LED string deco...
SD card (SPI mode)
Secure Digital card (...
SPI
Serial Peripheral Inte...
SPI flash/EEPROM
SPI flash/EEPROM c...
ST25R39xx (SPI mode)
STMicroelectronics ...
Display
Embedded/industrial
IC
Memory
Wireless/RF
Serial Peripheral Interface (spi)
Full-duplex, synchronous, serial bus.
The SPI (Serial Peripheral Interface) protocol decoder supports synchronous SPI(-like) protocols with a clock line, a MISO and MOSI line for data transfer in two directions, and an optional CS# pin.
Either MISO or MOSI (but not both) can be optional.
If CS# is supplied, data is only decoded when CS# is asserted (clock transitions where CS# is not asserted are ignored).
If CS# is not supplied, data is decoded on every clock transition (depending on SPI mode).
Tags: Embedded/industrial


displayLCDSPI.sr - PulseView
Run
displayLCDSPI.sr
displayLCDSPI.sr
CWAV USBee AX
1 M samples
12 MHz
+22920 µs
+22940 µs
+22960 µs
+22980 µs
+23000 µs
+23020 µs
+23040 µs
+23060 µs
+23080 µs
+23100 µs
+23120 µs
+23140 µs
+23160 µs
+23180 µs
+23200 µs
+23220 µs
D0(MOSI)
D1(CLK)
D2(SS)
D3(CMD/DATA)
D4(RESET)
D5
D6
D7
SPI
SPI: MOSI bits
SPI: MOSI data
AE A2 A0 C8 22 2F 40 AF 81 0F A4 A6 00 10 B0 FF 81 81 81 81 81 81 FF FF FF FF FF