# HY428 – Lecture 8 LCD Connectivity

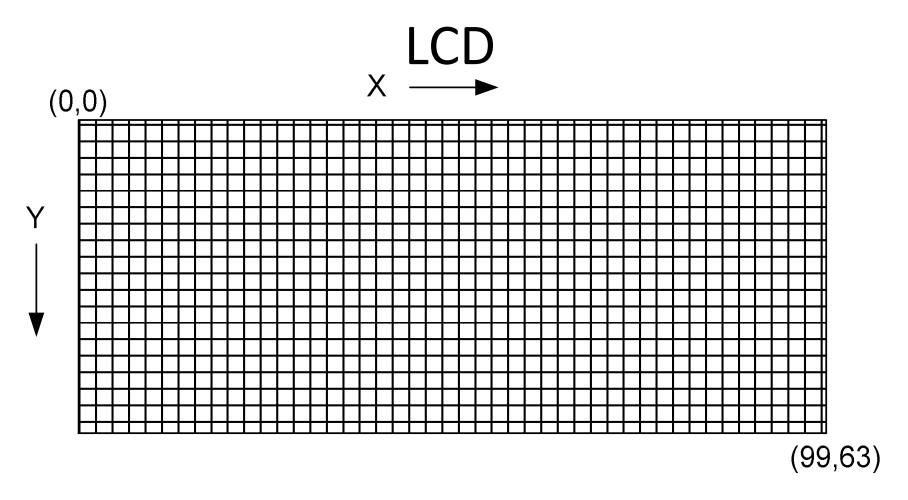
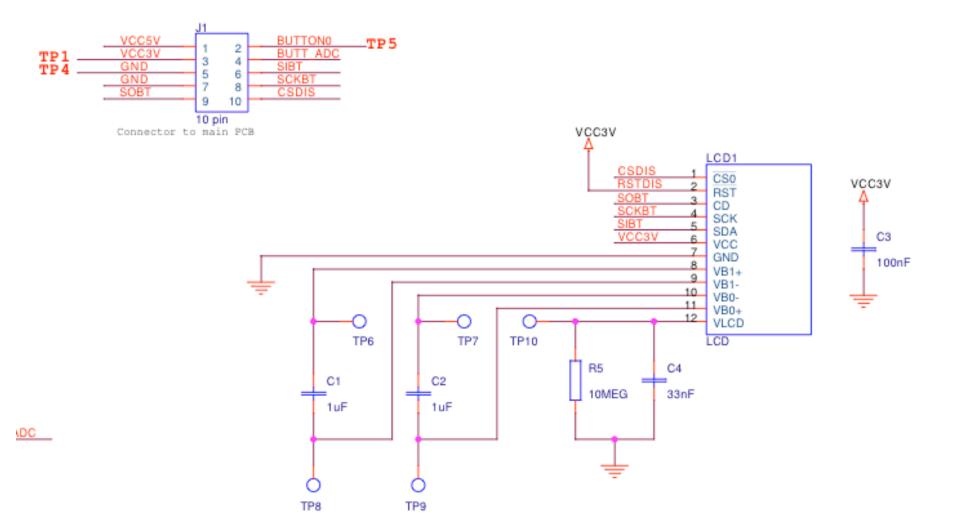
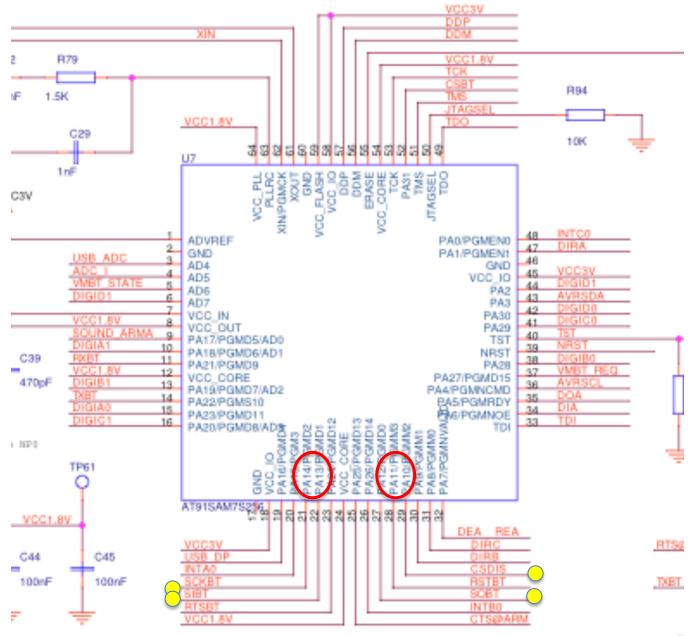


Figure 5: Bitmapping within the display

Resolution: 100 x 64, organized in a specific manner





#### 10.4 PIO Controller A Multiplexing

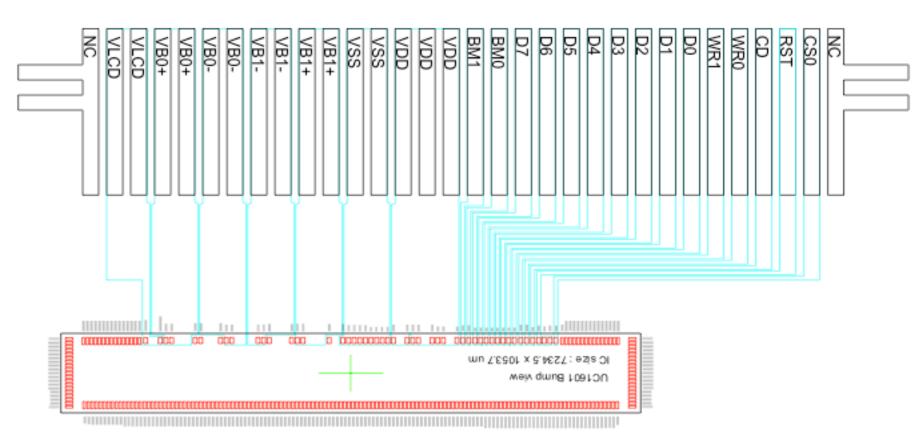
Table 10-3. Multiplexing on PIO Controller A (AT91SAM7S512/256/128/64/321)

	PIO	Controller A		Application U	Application Usage					
I/O Line	Peripheral A	Peripheral B	Comments	Function	Comments					
PA0	PWM0	TIOA0	High-Drive							
PA1	PWM1	TIOB0	High-Drive							
PA2	PWM2	SCKO	High-Drive							
PA3	TWD	NPCS3	High-Drive							
PA4	TWCK	TCLK0								
PA5	RXD0	NPCS3								
PA6	TXD0	PCK0								
PA7	RTS0	PWM3								
PA8	CTS0	ADTRG								
PA9	DRXD	NPCS1								
PA10	DTXD	NPCS2								
PA11	NPCS0	PWM0								
PA12	MISO	PWM1								
PA13	MOSI	PWM2								
PA14	SPCK	PWM3								
PA15	TF	TIOA1								
PA16	TK	TIOB1								
PA17	TD	PCK1	AD0							
PA18	RD	PCK2	AD1							
PA19	RK	FIQ	AD2							
PA20	RF	IRQ0	AD3							
PA21	RXD1	PCK1								
PA22	TXD1	NPCS3								
PA23	SCK1	PWM0								
PA24	RTS1	PWM1								
PA25	CTS1	PWM2								
PA26	DCD1	TIOA2								
PA27	DTR1	TIOB2								
PA28	DSR1	TCLK1								
PA29	RI1	TCLK2								
PA30	IRQ1	NPCS2								
PA31	NPCS1	PCK2								

Table 10-4. Multiplexing on PIO Controller A (SAM7S32)

	PIO	Controller A		Application U	sage	
I/O Line	Peripheral A	Peripheral B	Comments	Function	Comments	
PA0	PWM0	TIOA0	High-Drive			
PA1	PWM1	TIOB0	High-Drive			
PA2	PWM2	SCK0	High-Drive			
PA3	TWD	NPCS3	High-Drive			
PA4	TWCK	TCLK0				
PA5	RXD0	NPCS3				
PA6	TXD0	РСК0				
PA7	RTS0	PWM3				
PA8	CTS0	ADTRG				
PA9	DRXD	NPCS1				
PA10	DTXD	NPCS2				
PA11	NPCS0	PWM0				
PA12	MISO	PWM1				
PA13	MOSI	PWM2				
PA14	SPCK	PWM3				
PA15	TF.	TIOA1				
PA16	TK	TIOB1				
PA17	TD	PCK1	AD0			
PA18	RD	PCK2	AD1			
PA19	RK	FIQ	AD2			
PA20	RF	IRQ0	AD3			

## LCD controller: UC1601



#### SPI mode VDD VCC VDD SCK SCK (D0) SDA CD CD WR0 WR1 D1-D7 ADDRESS CS0 UC1601 MPU IORQ DECODER CS1 VDD RST PS1 PS0 GND VSS

FIGURE 8: Serial-8 serial mode reference circuit

# LCD organization

- 100x64 pixels organized in 8 pages
- Each page 8x100 pixels
- Makes it easy to print text
- A byte over SPI corresponds to 8 pixels of a column
- Select page, specify column, write data

PA(3:0) 0 AddeCss			Line	1														
0000 0000 0000 0000 0000 0000 0000 0000 0000	PA(3:01	0		ı														
D1   O1H   D3   O3H   D6   O6H   O7   O7H   O9H   O1D   O9H   O1D   O9H   O1D   O1	1 71(0.0)	_		ł		_								_	_			_
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DO		D7	07H	1	г			П	$\overline{}$	$\overline{}$	П		i	г	П		П	П
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D2				1	-	-	-	-	-	-	-	-	1	$\vdash$	_	-	-	-
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D4				ł	⊢	-	-	-	-	-	-	-		⊢	-	-	-	-
Discrimination   Disc	0001			ł	⊢	-	-	-	-	-	$\vdash$	-	Page 1	⊢	⊢	$\vdash$	$\vdash$	-
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0010   D2   12H   D3   13H   D4   14H   D5   15H   D6   15H   D6   15H   D7   17H   D0   18H   D2   1AH   D2   1AH   D5   1DH   D6   1EH   D7   1FH   D0   20H   D7   1FH   D0   20H   D7   27H   D6   28H   D7   27H   D6   28H   D7   27H   D6   28H   D7   27H   D6   28H   D7   27H   D7			11H	1	г								ı	$\overline{}$	$\overline{}$			
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Example for memory mapping: let MX = 0, MY = 0, SL = 0, according to th

<sup>⇒</sup> Page 0 SEG 1: 00011111b
⇒ Page 0 SEG 2: 11001100b

#### **COMMAND TABLE**

### **Commands vs. Data over SPI**

The following is a list of host commands supported by UC1601

C/D: 0: Control, 1: Data

W/R: 0: Write Cycle, 1: Read Cycle

# Useful Data bits

Don't Care

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	Command	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0	Action	Default
1. /	Write Data Byte	1	0	#	#	#	#	#	#	#	#	Write 1 byte	N/A
2.	Read Data Byte	1	1	#	#	#	#	#	#	#	#	Read 1 byte	N/A
3.	Get Status	0	1	-	MX	MY	RS	WA	DE			N/A	
4. (	Set Column Address LSB	0	0	0	0	0	0	#	#	#	#	Set CA [3:0]	0
4.	Set Column Address MSB	0	0	0	0	0	1	#	#	#	#	Set CA [7:4]	0
5.	Set Multiplexing Rate	0	0	0	0	1	0	0	0	#	#	Set MR [1:0]	11b: 65
6.	Set Temp. Compensation	0	0	0	0	1	0	0	1	#	#	Set TC[1:0]	00b: -0.05%/°C
7.	Set Panel Loading	0	0	0	0	1	0	1	0	0	#	Set PC[0]	0b: < 15nF
8.	Set Pump Control	0	0	0	0	1	0	1	1	#	#	Set PC[2:1]	11b
9.	Set Adv. Program Control	0	0	0	0	1	1	0	0	0	R	Set APC[R][7:0],	N/A
J <sup>9.</sup>	(double-byte command)	0	0	#	#	#	#	#	#	#	#	R = 0, or 1	
10.	Set Scroll Line	0	0	0	1	#	#	#	#	#	#	Set SL[5:0]	0
1	Set Page Address	0	0	1	0	1	1	#	#	#	#	Set PA[3:0]	0
12.	Set V <sub>BIAS</sub> Potentiometer	0	0	1	0	0	0	0	0	0	1	Set PM[7:0]	C0H
12.	(double-byte command)	0	0	#	#	#	#	#	#	#	#		
18.	Set RAM Address Control	0	0	1	0	0	0	1	#	#	#	Set AC[2:0]	001b
14.	Set Frame Rate	0	0	1	0	1	0	0	0	0	#	Set LC[3]	0b
15.	Set All-Pixel-ON	0	0	1	0	1	0	0	1	0	#	Set DC[1]	0
16.		0	0	1	0	1	0	0	1	1	#	Set DC[0]	0
17.	Set Display Enable	0	0	1	0	1	0	1	1	1	#	Set DC[2]	0
18.	Set LCD Mapping Control	0	0	1	1	0	0	0	#	#	0	Set LC[2:1]	0
19.	· -	0	0	1	1	1	0	0	0	1	0	System Reset	N/A
20.	NOP	0	0	1	1	1	0	0	0	1	1	No operation	N/A
21.	Set Test Control	0	0	1	1	1	0	0	1		T	For testing only.	N/A
<u></u>	(double-byte command)	0	0	#	#	#	#	#	#	#	#	Do not use.	
22.	Set LCD Bias Ratio	0	0	1	1	1	0	1	0	#	#	Set BR[1:0]	11b: 9
23.	Reset Cursor Update Mode	0	0	1	1	1	0	1	1	1	0	AC[3]=0, CA=CR	N/A
24.	Set Cursor Update Mode	0	0	1	1	1	0	1	1	1	1	AC[3]=1, CR=CA	N/A

<sup>\*</sup> Any bit patterns other than what is listed above may result in NOP (No Operation).

### Write LCD

- Write full display as 8 lines
  - Each line is 8 pixels high and 100 wide
- Send command eg to select page, column
  - Set PIO bit for CD line/pin
  - Write a command byte to SPI
- Send data
  - Clear PIO bit (to set display in data mode)
  - Write bytes 0xxxxxxx to SPI