Connect LCD to MicroBlaze
Using an OPB Customer Peripheral

For Xilinx Spartan-3E Starter kit

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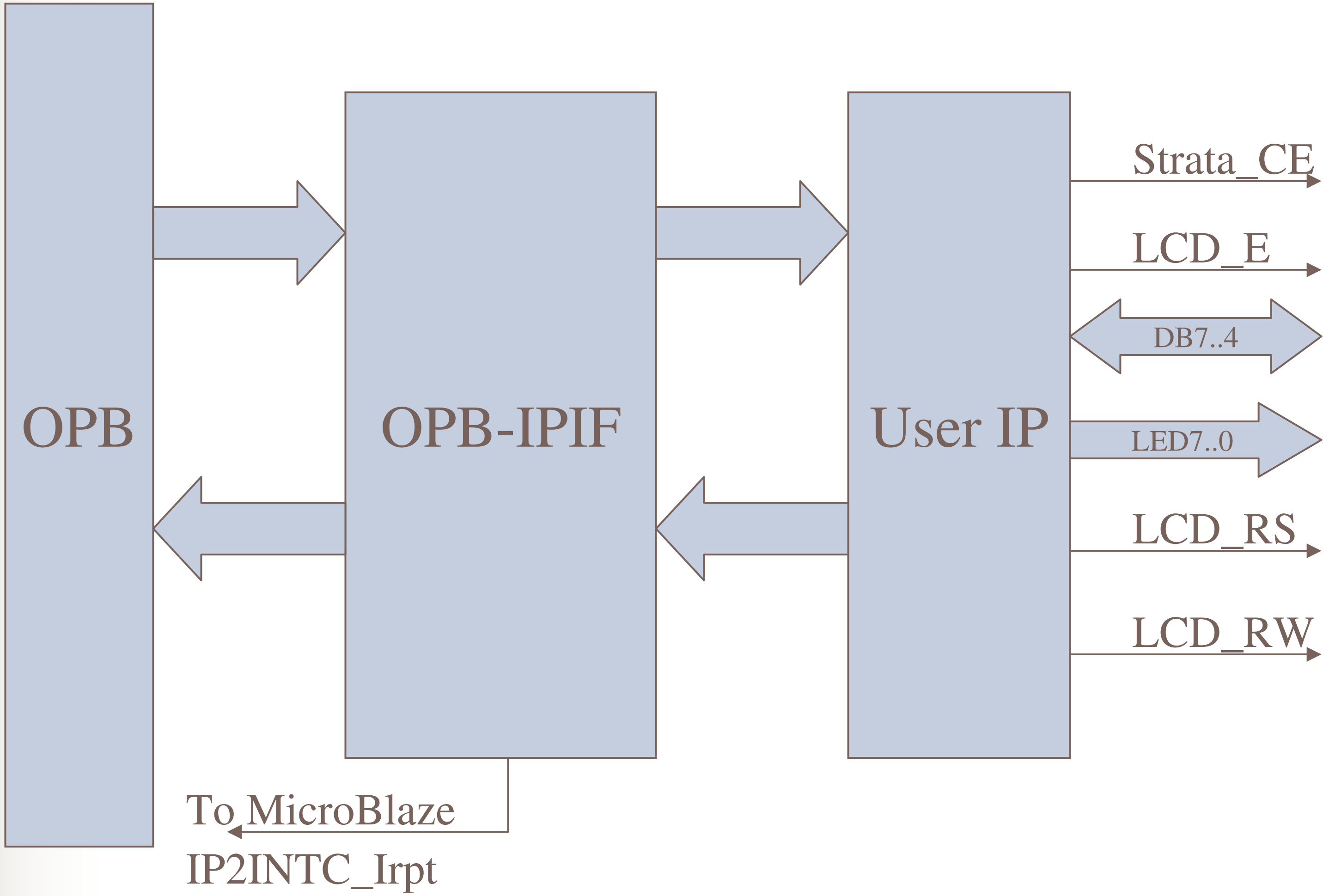
About the design

- BSB in EDK 8.1 doesn’t take S3E Starter board’s LCD as a standard Peripheral;
- If Customers simply connect it to MicroBlaze through the GPIO IP, the System Performance will become very low for all of timing events of the interface must be processed by Microblaze;
- Customer OPB peripheral is the best solution;

Block Diagram



User Register 0 (write)

b0	b1	b2..b31

- b0---Timer0 Load
- b1---Timer0 Enable
- b2..b31---Timer0 Preset Data

User Register 0(read)

b0..b23	b24..b31

- b0..b23---UserREG(0..23)
- B24..b31---LCD DATA (N/A)

User Register 1(write)

b0..b7	b8..b19	b20	b21	b22	b23	b24..b31

- b0..b7---LED/ b0..b19---Timer2 Preset Data(b19=1)
- b20---8 to 4 Conversion / No Conversion
- b21---Load
- b22/b23---RS/RW
- b24..b31---LCD DATA

User Register 1(read)

b0	b1..b31

- b0---LCD Busy
- b21---0
- b1..b31---UserREG1(1..31)

Software---Write & Read Register

- WriteREG(BaseAddress,RegClass,RegName,Data)
- ReadREG(BaseAddress,RegClass,RegName)

Interrupt Control

DGIE Enable:

```
WriteREG (XPAR_S3ESK_LCD_0_BASEADDR,IPIF_INT,DGIER,0X80000000);
```

INT0 Enable:

```
 WriteREG (XPAR_S3ESK_LCD_0_BASEADDR,IPIF_INT,IPIER,0x00000001)
```

DisplayClear()

```
DisplayClear ()
 {
 WriteREG (XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1,0x00000C01);
 do
 {
 FLAG = ReadREG(XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1);
 xil_printf("    ---Display Clear : 0x%08x \n\r",FLAG );
 }
 while ( FLAG & Busy );
 }
```

ReturnHome()

```
ReturnHome ()
 {
 WriteREG (XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1,0x00000C02);
 do
 {
 FLAG = ReadREG(XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1);
 xil_printf("   ---Return Home : 0x%08x \n\r",FLAG );
 }
 while ( FLAG & Busy );
 }
```

EntryMode(I_d, S)

```
EntryMode (I_d,S)
 {
 WriteREG (XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1,0x00000C04+(I_d<<1)+S);
 do
 {
 FLAG = ReadREG(XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1);
 xil_printf("    ---EntryMode : 0x%08x \n\r",FLAG );
 }
 while ( FLAG & Busy );
 }
```

DisplayOnOff (D, C, B)

```
DisplayOnOff(D,C,B)
 {
 WriteREG
        (XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1,0x00000C08+(D<<2)+(C<<1)+B);
 do
 {
 FLAG = ReadREG(XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1);
 xil_printf("   ---DisplayOnOff : 0x%08x \n\r",FLAG );
 }
 while ( FLAG & Busy );
 }
```

CursorDisplayShift(S_c,R_l)

```
CursorDisplayShift(S_c,R_l)
{
WriteREG
        (XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1,0x00000C10+(S_c<<3)+(R_l<<2));
do
{
FLAG = ReadREG(XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1);
xil_printf("    ---CursorDisplayShift : 0x%08x \n\r",FLAG );
}
while ( FLAG & Busy );
}
```

FunctionSet(MODE,DL,N,F)

```
FunctionSet(MODE,DL,N,F)
{
WriteREG
    (XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1,0x00000420+(MODE<<11)+(DL<<4)
    +(N<<3)+(F<<2));
do
{
FLAG = ReadREG(XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1);
xil_printf("    ---FunctionSet : 0x%08x \n\r",FLAG );
}
while ( FLAG & Busy );
}
```

SetCGRAM(Addr)

```
SetCGRAM(Addr)
{
WriteREG (XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1,0x00000C40+(Addr &
      0x0000003F));
do
{
FLAG = ReadREG(XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1);
xil_printf("    ---Set CGRAM Address : 0x%08x \n\r",FLAG );
}
while ( FLAG & Busy );
}
```

SetDDRAM(Addr)

```
SetDDRAM(Addr)
{
WriteREG (XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1,0x00000C80+(Addr &
        0x0000007F));
do
{
FLAG = ReadREG(XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1);
xil_printf("   ---Set DDRAM Address : 0x%08x \n\r",FLAG );
}
while ( FLAG & Busy );
}
```

Xuint32 CheckBusy()

```
Xuint32 CheckBusy()
{
FLAG = ReadREG(XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1);
xil_printf("   ---Check Busy : 0x%08x \n\r",FLAG );
FLAG = FLAG & 0x80000000;
return FLAG;
}
```

WriteData(Data)

```
WriteData(Data)
{
WriteREG (XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1,0x00000E00+Data);
do
{
FLAG = ReadREG(XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1);
xil_printf("   ---Write Data : 0x%08x \n\r",FLAG );
}
while ( FLAG & Busy );
}
```

Delay10ms()

```
Delay10ms()
{
WriteREG (XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1,0x80001000);
do
        {
        FLAG = ReadREG(XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1);
        xil_printf("    ---Delay 10 ms : 0x%08x \n\r",FLAG );
        }
while ( FLAG & Busy );
}
```

INIT_LCD()

```
INIT_LCD ()
{
FunctionSet(0,1,1,0);/*MODE=0,DL=1,N=1,F=0*/
Delay10ms();
FunctionSet(0,1,1,0);/*MODE=0,DL=1,N=1,F=0*/
Delay10ms();
FunctionSet(0,1,1,0);/*MODE=0,DL=1,N=1,F=0*/
Delay10ms();
FunctionSet(0,0,1,0);/*MODE=0,DL=0,N=1,F=0*/
Delay10ms();
FunctionSet(1,0,1,0);/*MODE=1,DL=0,N=1,F=0*/
DisplayOnOff(1,0,0);/*D=1,C=0,B=0*/
DisplayClear();
EntryMode (1,0);
Delay10ms();
Delay10ms();
}
```

SetCursor(y, x)

```
SetCursor(y,x)
{
x=(x<=1)?1:((x>40)?40:x);
y=(y<=1)?1:2;
y=(y==1)?0:64;
x--;
y=y+x;
SetDDRAM(y);
}
```

PutChar(char CH)

```
PutChar(char CH)
{
WriteData(CH);
}
```

WriteString(char*STR)

```
WriteString(char*STR)
{
int i=0;
while (STR[i]!='\0')
{
PutChar(STR[i]);
i++;
}
}
```

LED( )

```
 LED( )
{
WriteREG (XPAR_S3ESK_LCD_0_BASEADDR,USER,USER1,LED_DATA<<23);


}
```