

## LCD Controller

The Spartan®-3E FPGA Starter Kit board prominently features a 2-line by 16-character liquid crystal display (LCD). The FPGA controls the LCD via the 4-bit data interface shown in Figure 1.

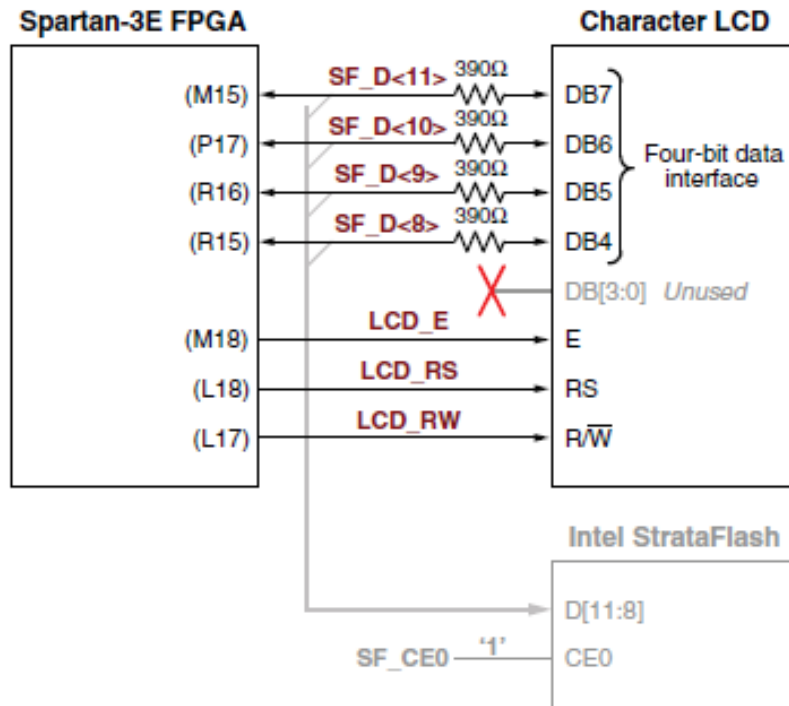


Figure 1: Character LCD Interface

### UCF Location Constraints:

Signal Name	FPGA Pin	Function	
SF_D<11>	M15	Data bit DB7	Shared with StrataFlash pins SF_D<11:8>
SF_D<10>	P17	Data bit DB6	
SF_D<9>	R16	Data bit DB5	
SF_D<8>	R15	Data bit DB4	
LCD_E	M18	Read/Write Enable Pulse 0: Disabled 1: Read/Write operation enabled	
LCD_RS	L18	Register Select 0: Instruction register during write operations. Busy Flash during read operations 1: Data for read or write operations	
LCD_RW	L17	Read/Write Control 0: WRITE, LCD accepts data 1: READ, LCD presents data	

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NET "LCD_E" LOC = "M18" | IOSTANDARD = LVCMOS33 | DRIVE = 4 | SLEW = SLOW ;
NET "LCD_RS" LOC = "L18" | IOSTANDARD = LVCMOS33 | DRIVE = 4 | SLEW = SLOW ;
NET "LCD_RW" LOC = "L17" | IOSTANDARD = LVCMOS33 | DRIVE = 4 | SLEW = SLOW ;

NET "SF_D<8>" LOC = "R15" | IOSTANDARD = LVCMOS33 | DRIVE = 4 | SLEW = SLOW ;
NET "SF_D<9>" LOC = "R16" | IOSTANDARD = LVCMOS33 | DRIVE = 4 | SLEW = SLOW ;
NET "SF_D<10>" LOC = "P17" | IOSTANDARD = LVCMOS33 | DRIVE = 4 | SLEW = SLOW ;
NET "SF_D<11>" LOC = "M15" | IOSTANDARD = LVCMOS33 | DRIVE = 4 | SLEW = SLOW ;
    
```

The character ROM contains the ASCII English character set and Japanese kana characters

		Upper Data Nibble													
		0	0	0	0	0	0	0	1	1	1	1	1	1	
		0	0	0	1	1	1	1	0	0	1	1	1	1	
		0	1	1	0	0	1	1	1	0	0	1	1	1	
		0	0	1	0	1	0	1	0	1	0	1	0	1	
Lower Data Nibble	DB7	XXXX0000		0	1	2	3	4	5	6	7	8	9	A	B
	DB6	XXXX0001	!	1	A	Q	a	q	。	ア	チ	△	ä	q	
	DB5	XXXX0010	"	2	B	R	b	r	「	イ	ツ	×	ß	θ	
	DB4	XXXX0011	<b>CG RAM</b>	#	3	C	S	c	Σ	」	ウ	〒	ε	ε	∞
	XXXX0100	<b>CG RAM</b>	\$	4	D	T	d	t	、	エ	ト	μ	Ω		
	XXXX0101		%	5	E	U	e	u	・	オ	ナ	1	σ	ü	
	XXXX0110		&	6	F	V	f	v	ヲ	カ	ニ	ヨ	ρ	Σ	
	XXXX0111		'	7	G	W	g	w	フ	キ	ヌ	ラ	q	π	
	XXXX1000		(	8	H	X	h	x	イ	ク	ネ	リ	フ	ア	
	XXXX1001		)	9	I	Y	i	y	ウ	ケ	ル	”	U		
	XXXX1010		*	:	J	Z	j	z	エ	コ	ン	レ	i	チ	
	XXXX1011		+	;	K	[	k	{	オ	サ	ヒ	ロ	*	斤	
	XXXX1100		,	<	L	¥	l		カ	シ	フ	ワ	φ	円	
	XXXX1101		-	=	M	]	m	}	ユ	ズ	ヘ	ン	も	÷	
	XXXX1110		.	>	N	^	n	→	ヨ	セ	ホ	”	ん		
	XXXX1111		/	?	O	_	o	←	ツ	マ	”	ö	■		
	DB3														
	DB2														
	DB1														
	DB0														

UG230\_c6\_02\_030306

Figure 2: LCD Character Set