

# DFL-D108 Serial LCD Interface IC

(Pb free)

## Features:

- RS232 and TTL-Level Compatible
- Compatible with KS0108 family LCD
- Support Graphic mode with resolution of 128x64 or 192x64
- Support text mode with 6x18 characters or 6x27 characters
- 4800 Serial Baud rates
- Provide two or three extra digital outputs
- Not need RS232 Voltage converter
- Available in 28 pin DIP (300mils) or SOIC Packages
- Cost effective for OEM applications

The DFL-D108 Serial LCD Interface IC is designed to interface a KS0108 family's LCD to a microcontroller. KS0108 family's LCD (including KS0107/KS0108, HD61202/HD61203, AX6108/AX6107, S6B0108A, S6B2108, KS0708, S6B0708, S6B0108, NT7108 etc.) is widely used in industry for graphic display. But the original LCD has no text mode. You will get text mode using DFL-D108, and even you can get mixed text and graphic mode. The DFL-D108 uses a simple one-wire data link, freeing an additional 13 I/O lines on your microcontroller system, which frequently allows a smaller, less costly microcontroller to be utilized in your design. We advise the customers **read KS0108 LCD datasheet firstly** before reading this datasheet.

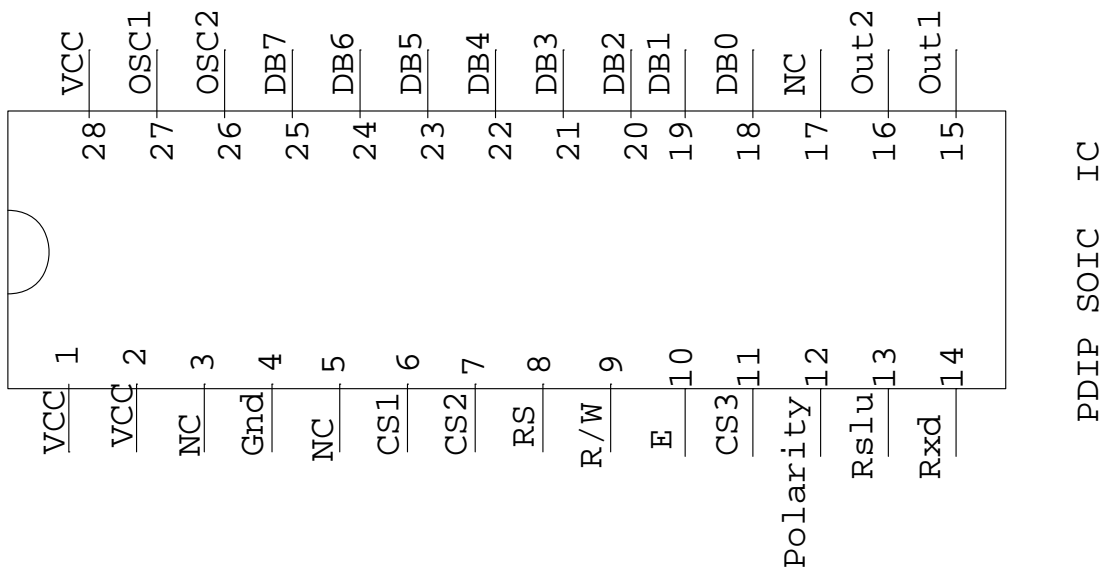


Table 1 PDIP SOIC footprint:

Pin 1	Vcc	Pin 15	Out1
Pin 2	Vcc	Pin 16	Out2
Pin 3	NC	Pin 17	NC
Pin 4	Gnd	Pin 18	DB0

Pin 5	NC	Pin 19	DB1
Pin 6	CS1	Pin 20	DB2
Pin 7	CS2	Pin 21	DB3
Pin 8	RS	Pin 22	DB4
Pin 9	R/W	Pin 23	DB5
Pin 10	E	Pin 24	DB6
Pin 11	CS3	Pin 25	DB7
Pin 12	Polarity	Pin 26	OSC2
Pin 13	Rslu	Pin 27	OSC1
Pin 14	Rxd	Pin 28	Vcc

Rxd: Input pin. Serial Data in (8-N-1), 4800 Baudrate. You connect it directly to uart if you use TTL/CMOS voltage for serial communication. You must use a 33K ohm of serious resistor to connect to RS232 if you use RS232 voltage level

Polarity: Input pin. You must tie it to ground if you use TTL/CMOS UART. You must tie it to Vcc if you directly use RS232 voltage level.

Rslu: Input pin. You must tie it to ground if you use 128x64 resolutions LCD, which uses CS1 and CS2. You must tie it to Vcc if you use 192x64 resolutions LCD, which uses CS1, CS2 and CS3.

Out1: Output pin. It is a direct digital output. You can use it as backlight control or alarm output or audio control.

Out2: Output pin. It is a direct digital output. You can use it as backlight control or alarm output or audio control.

CS1: Output pin. LCD chip select pin

CS2: Output pin. LCD chip select pin

CS3: Output pin. LCD chip select pin. The LCD of 128x64 resolution has no the CS3 pin, we can use it as a direct digital output which can be used as backlight control or alarm output or audio control

RS: Output pin. LCD Register selection line

RW: Output pin. LCD Read/Write selection line

E: Output pin. LCD Enable signal line

DB0: bidirectional port pin. LCD data 0 (LSB)

DB1: bidirectional port pin. LCD data 1

DB2: bidirectional port pin. LCD data 2

DB3: bidirectional port pin. LCD data 3

DB4: bidirectional port pin. LCD data 4

DB5: bidirectional port pin. LCD data 5

DB6: bidirectional port pin. LCD data 6

DB7: bidirectional port pin. LCD data 7 (MSB)

OSC1: input pin. It's one pin of 4MHz Parallel-cut crystal or resonator, or a direct clock input

OSC2: Output pin. It's other pin of 4MHz Parallel-cut crystal or resonator, or leave it unconnected if OSC1 driven with a clock input

Vcc: Power pin. Connect to the positive side of DC power supply which is 3.3VDC or 5 VDC according to LCD voltage supply

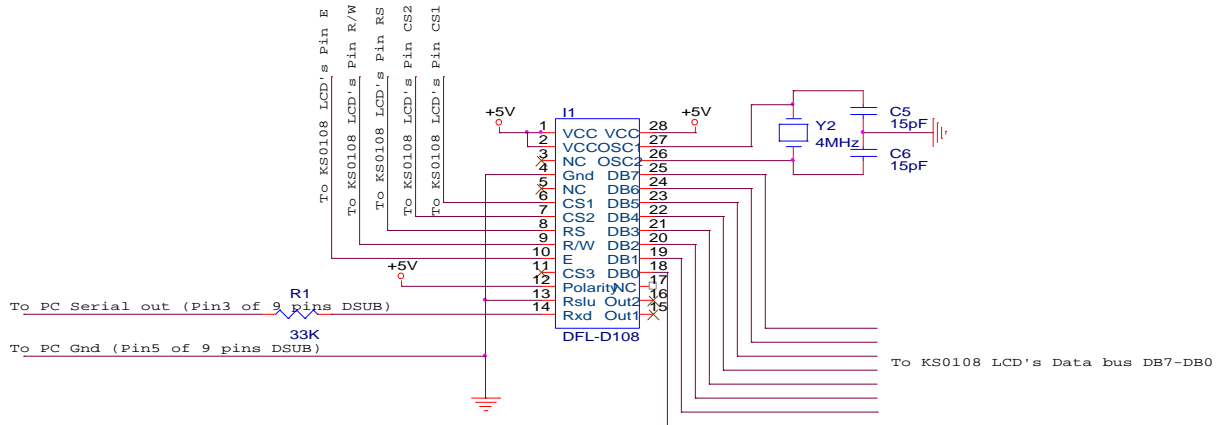
Gnd: Power pin. Connect to the negative side of DC power supply

## PC CONNECTION

The DFL-D108 can be used with KS0108 family based Graphic LCD's. Fig.1 illustrates the hookup used for

connection to a PC. A RS-232 Voltage-level converter IC such as the MAX232 is not required. But the Polarity input on the DFL-D108 is tied high (Vcc)

Fig.1 KS0108 LCD Connect to PC



**\* IMPORTANT NOTE:** The 33K ohms resistor must be used when connecting to a PC in this fashion; omitting it will cause excessive current to flow, possibly damaging both the PC serial port and the DFL-D108 IC.

The circuit above can be tested by software LCD Demo, which can be download in website of Dafulai Electronics

## CONNECTION TO OTHER HOST SYSTEM

Most applications of the DFL-D108 will not involve connection to a PC. The DFL-D108 can be used with a variety of controllers such as the BASIC Stamp, AVR MCU, PIC MCU, 8051 MCU, nearly any MCU or a microprocessor system which have uart communication. Fig.2 illustrates the connection to a BASIC Stamp I. Connection to a microcontroller requires no voltage level conversion; simply connect the microcontroller's serial output to the DFL-D108's Rxd pin. Polarity pin must tie it to ground

Depending on the length of the data line, you may need to pull up the line using a 4.7K ohms resistor, as shown in Fig.2.



0011 0010	Set Out2	
0010 0010	Clear Out2	
0011 1101	Enter burst writing	
0001 1101	Exit burst writing	
0011 1011	Enter 512 bytes writing	

The host microcontroller's basic program should be the following

- Step 1: Initiate the UART port as "4800 8N1"
- Step 2: Delay about 90ms to wait DFL-D108 initialization
- Step 3: Set a chip select of LCD to 1. **Important note:** You set only a CSX (X=1 or 2 or 3) to 1. You cannot set 2 or more CSX to 1. Which CSX is decided by which pixel you want to light on or off.
- Step 4: Send "1011 1XXX" (Page address command) to select the page, which the pixels located in.
- Step 5: Send "01XX XXXX" (Set Column address command) to select the column, which the pixels located in.
- Step 6: Send a byte of pixels data.
- Step 7: Goto Step 3 if you want to turn on /off the pixels which is in different CSX.  
Goto step 4 if you want to turn on /off the pixels which is in different page. Goto Step 5 if you want to turn on /off the pixels which is in the same page

The display program above will use lots of time because you have to send page and column address for every 8 pixels. You can use the burst writing sub-mode. The program is as following:

- Step 1: Initiate the UART port as "4800 8N1"
- Step 2: Delay about 90ms to wait DFL-D108 initialization
- Step 3: Set a chip select of LCD to 1. **Important note:** You set only a CSX (X=1 or 2 or 3) to 1. You cannot set 2 or more CSX to 1. Which CSX is decided by which pixel you want to light on or off.
- Step 4: Send "0011 1101" (Enter burst writing sub-mode)
- Step 5: Send "1011 1XXX" (Page address command) to select the page, which the pixels located in.
- Step 6: Send "01XX XXXX" (Set Column address command) to select the column, which the pixels located in.
- Step 7: Send an unsigned 8 bits data which denotes how many bytes of pixels will be changed
- Step 8: Continuously send pixels data until the quantity in step 7 has reached.
- Step 9: You can goto step 5 if you have another bursting writing, Otherwise, you send "0001 1101"(Exit burst writing) to exit burst writing sub-mode.

You can use the fastest writing for 512 bytes display buffer. You simply sent "0011 1011" (Enter 512 bytes writing command) and then sent 512 bytes of pixels data, which always automatically start from page 0 and column 0. Of course you must set a CSX to 1 before you enter 512 bytes writing command.

**Important note:** You must wait at least 30 ms after you send "0011 0011" (Clear Display buffer command), and you have to set CSX before you send "0011 0011" command.

How do you get the pixel data? You can draw a picture in PC with Microsoft windows platform using free software ware FastLCD, and generate data file for your program.

The LCD will enter text mode when you send "0011 1100" command. The original KS0108 has only graphic mode. An invisible cursor is in line 0 and column 0. For 128x64 resolutions LCD, there are 6 lines and 18 characters every line. For 192x64 resolutions LCD, there are 6 lines and 27 characters every line. Every character occupies 8 graphic rows and 7 graphic columns. The 3 empty graphic rows will be occupied between two lines. You must not control CSX. In text mode, the CSX is processed automatically. The DFL-D108 in text mode can be written to in much the same way as a terminal display device. It accepts standard ASCII characters and writes them to the display screen. In addition, the DFL-D108 will interpret several ASCII control commands and perform specific functions as directed by them. The first character written to the DFL-D108 will be displayed in the upper-left hand corner of the display. Subsequent character writes to the DFL-D108 will cause

the cursor location to increment by one for each character written. It will automatically move to the left-most position of next line if it is over the right-most position of the line. Table 3 is the commands of the DFL-D108 in the text mode.

Table 3 the commands table in the text mode

Binary value	Command	Description
0001 1110	Enter graphic mode	Invisible cursor is line 0 and column 0
0000 1101	Carriage Return	Invisible cursor moved to next line, column unchanged
0000 1010	Line Feed	Invisible cursor moved to column 0 and next line
0000 1100	Form Feed	Clear screen and cursor moved to line 0 column 0. You've to wait 90ms after running the command
0000 1000	Backspace	Cursor position decreased by 1, character was replace with space
1011 1XXX	Set line number	Cursor line number become XXX (XXX=0 to 5)
100X XXXX	Set character position	Cursor column number become XXXXX (XXXX=0 to 17 or 0 to 26)
1100 0001	Invert display	
1100 0000	Normal display	
1011 0101	Set Out1	It can be used as digital output such as alarm
1010 0101	Clear Out1	It can be used as digital output such as alarm
1011 0010	Set Out2	It can be used as digital output such as alarm
1010 0010	Clear Out2	It can be used as digital output such as alarm
1011 0001	Set CS3	Only when 128x64 LCD, we can use the command to control CS3 as a digital output
1010 0001	Clear CS3	Only when 128x64 LCD, we can use the command to control CS3 as a digital output

The display character is shown in table 4

Table 4 Display character table

Higher Lower	0010	0011	0100	0101	0110	0111
0000		0	@	P	`	p
0001	!	1	A	Q	a	q
0010	”	2	B	R	b	r
0011	#	3	C	S	c	s
0100	\$	4	D	T	d	t
0101	%	5	E	U	e	u
0110	&	6	F	V	f	v

0111	'	7	G	W	g	w
1000	(	8	H	X	h	x
1001	)	9	I	Y	i	y
1010	*	:	J	Z	j	z
1011	+	;	K	[	k	{
1100	,	<	L	¥	l	
1101	-	=	M	]	m	}
1110	"	>	N	^	n	?
1111	/	?	O	_	o	?

**Important note:** You must wait at least **1.6 ms** after you send every display ASCII byte. You must wait at least **90 ms** after you send "0000 1100" (Form Feed).

The program of text mode is as followings:

- Step 1: Initiate the UART port as "4800 8N1"
- Step 2: Delay about 90ms to wait DFL-D108 initialization
- Step 3: Send a byte of ASCII of display character
- Step 4: Delay 1.6ms
- Step 5: Goto Step 3 if you have more character to display

The customer can write simple C statement " printf("Hello! DFL-D108LCD");" if he modifies the putchar function to make sure delay 1.6ms. The display Start Line must be set to 0 (default is 0) before entering text mode, otherwise, text line number will be not correct.

The page address is 0 when you return to graphic mode from text mode using sending "0001 1110". And, you must set CSX again.

## Electrical Specification

Absolute Maximum ratings

Oscillator Frequency.....4MHz  
VCC.....6.5V  
Ambient Temperature under bias.....-40 to +125  
Max output current sunk by any I/O Pin.....25 mA  
Max output current sourced by any I/O Pin.....25 mA

DC Characteristics:

Standard operating Temperature: -40 to 85  
Supply current: less than 350uA when Vcc=2.0, less than 1mA when Vcc=3.3V  
VCC: min:2VDC Max:5.5VDC  
VIL for Osc1----- Input low voltage: max=0.3Vcc  
VIH for Osc1----- Input high voltage: min=0.7Vcc  
VOH-----Output high voltage(CSx Pins, Out1,Out2,Osc2): min=VCC-0.7  
VOL-----Output low voltage(CSx Pins, Out1,Out2,Osc2): max=0.6

Packaging Information

DFL-D108/P is PDIP (300mils) packaging  
DFL-D108/S is SIOC packaging

28-Lead Plastic Dual In-Line (P)-300 mil Body [PDIP]

28-Lead Plastic Small Outline (SO)-Wide, 7.5mm Body [SOIC]

## **IMPORTANT NOTICE**

The information in this manual is subject to change without notice.

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