

MiniTerminal

BELC 1001 **Controller for DMC module with fixed text display**

BELC100x MiniTerminals provide a V24 interface for all common LCD character modules. The ESC sequences for controlling the display are based on the VT100 standard.

The BELC1001 MiniTerminal can also be equipped with up to 6 kbyte of text memory with the BELC1001 Controller having a maximum of 3 EEPROMs each with 2 kbyte of memory. The 3 EEPROMs are used to save fixed text only. The BELC1001 Controller is supplied with one EEPROM as standard (with 2 more as optionals).

Fixed texts can be accessed over the serial interface and/or over 7 TTL lines.

This ensures that there are always *two* ways to read out fixed text :

- a.** internally, via the serial interface (PC) using an appropriate ESC sequence
- b.** externally, via the 7 TTL lines (FT0-FT6) at Connector J4

Characters received by the serial interface and fixed texts are displayed independently to allow any possible combination (see demo program).

The MiniTerminal can be operated in *two* different modes :

- 1. 'Bus' mode**
=> is selected if Pin '**FT/Bus**' is set low (0)
- 2. 'Automatic fixed text' mode**
=> is selected if Pin '**FT/Bus**' is set high (1)

In this MiniTerminal-manual, the term "Pin 'FT/Bus'" always refers to Pin 'FT/Bus' at BR5 or Pin 8 at Connector J4.

Note :

- Pin 'FT/Bus' (Pin BR5 or Pin 8 at J4) **must** be connected to ground ('Bus' mode) or to +5 V ('Automatic fixed text'). This ensures that one of the two operating modes is selected when switching on the MiniTerminal.
- Pin '**FT/Bus**' (BR5) and Pin 8 at Connector J4 are electrically the same and ensures that the two pins can **never** have different values.

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Mode 1. :

In the '**Bus**' mode up to 16 *MiniTerminals* can be addressed by the serial interface. The address procedure is carried out using ESC sequences (see 'Assign Address') with the corresponding *MiniTerminal* being addressed by entering an '*address*'. Assigning a *MiniTerminal* to an address is described on Page 9 under the section 'Jumpers'.

Calling up fixed text over the 7 TTL lines (FT0-FT6) is **not possible** in this mode. Calling up fixed text over the serial interface is, however, **possible**.

Mode 2. :

In the '**Automatic fixed text**' mode the fixed text saved **as well as** the serial interface mode can be selected using Pins FT0-FT6. The response of the *MiniTerminal* using the command 'ESC D no' is described in more detail.

Note :

- If the *MiniTerminal* is configured for '**Automatic fixed text**' (Pin 'FT/Bus' is high(1)), then Connections FT0 .. FT6 **must** have a defined TTL value !
If the external connections FT0-FT6 (J4) are used then all connections **must** be connected (see Fig 'Selecting fixed text'). This is also the case if e.g. only Connections FT0- FT3, are required. Pins not connected, therefore, are interpreted as high (1).

Serial Interface (V24)

9600 baud / 8 data bits / no parity / 2 stop bits

The serial interface cannot send and receive simultaneously. You must, therefore, take into account the CTS signal when using the keyboard.

If the *MiniTerminal* is addressed by a PC, then the interface can, for example, be initialised in Qbasic using the following command:

```
OPEN "COM1: 9600,N,8,2,cs0,ds0,cd0,rs" AS 1
```

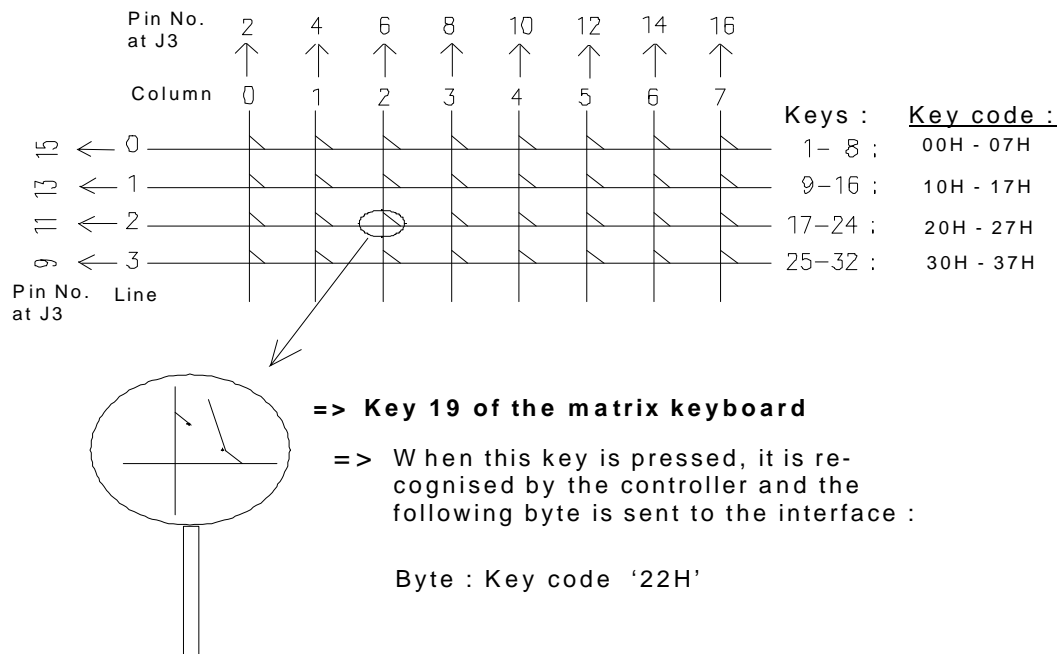
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Matrix Keyboard (8 x 4 keys)

The matrix keyboard can consist of a maximum 8 columns and 4 lines (32 keys). It is connected to Connector J3.

When a key is pressed, the *MiniTerminal* initialises the CTS line and sends the key code. This key code is then sent to the serial interface. The code can then be read out using a program or then processed further as required.

Matrix-Keyboard connection



Escape sequences for controlling the display

CR Carriage return / New line 0d (hex) / 13 (decimal)
ESC 1B (hex) / 27 (decimal)

ESC [ParZ ; ParS H	Placing the cursor
----------------------------	--------------------

Line 0.. 3 / Column 0..39 All numbers without initial zeros !

Example: **PRINT #1,CHR\$(27);"[";CHR\$(2);";";CHR\$(5);"H";**
 Places the cursor in the 6th column of the 3rd line

ESC & #	Deleting the display / Cursor Home
--------------------	------------------------------------

Example: **PRINT #1,CHR\$(27);"&#";**

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ESC & C	Switching on the cursor
--------------------	-------------------------

Example: **PRINT #1,CHR\$(27);"&C";** Switches on the cursor

ESC & D	Switching off the cursor
--------------------	--------------------------

Example: **PRINT #1,CHR\$(27);"&D";** Switches off the cursor

ESC [K	Deleting to the end of the line
----------------	---------------------------------

Example: **PRINT #1,CHR\$(27);"[K";** Deletes all characters to the end of the present line

Transparent Mode :

ESC & T	Changing to transparent mode
--------------------	------------------------------

Caution : Only experienced users of the Controller should use this mode

When in transparent mode, the host has direct access to the controller of the display (HD44780 or similar)

x0 data	Write CMD (Address 0)
x1 data	Write Data (Address 1)
x2	Read CMD
x3	Read Data
x4 data	Select Controller (only 40x4)
	data = x0 -> Controller 1
	data = x1 -> Controller 2
Others	Quit transparent mode

Data Characters in hex
x Don't care (high nipple not relevant)

Example: **PRINT #1,CHR\$(27);"&T";** ' Enter transparent mode
 PRINT #1,CHR\$(0);CHR\$(2); ' Write 2 in Controller Address 0
 PRINT #1,CHR\$(255); ' Quit transparent mode

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Select Display Type :

ESC & S n	Selecting type of display
n = 0 (^@) 16 x 1	Example: PRINT #1,CHR\$(27);"&S";CHR\$(2); Initialises the MiniTerminal for a 16 x 4 display The type of display selected is saved in EEPROM (if present). 24 x 2 40 x 1
1 (^A) 16 x 2	
2 (^B) 16 x 4	
3 (^C) 20 x 1	
4 (^D) 20 x 2	
5 (^E) 20 x 4	
6 (^F) 24 x 1	
7 (^G) 32 x 1	
8 (^H) 32 x 2	
9 (^I) 40 x 1	
10 (^J) 40 x 2	
11 (^K) 40 x 4	

Assign Address :

ESC & A address	Assigning the address
ESC & A Z	Always selected (default value)
	=> i.e. all MiniTerminals connected are selected
Address = 0	Example : Print #1, CHR\$(27); "&A";CHR\$(1) => only MiniTerminal with assigned address 1 evaluates data Print #1, CHR\$(27); "&AZ"; => all MiniTerminals connected evaluate data (default setting)
1	
9	
10	
11	
12	
13	
14	
15	

If Pin '**FT/Bus**' is low (0), when switching on, then the MiniTerminal is set to '**Bus**' mode and interprets the Pins **Adr0 .. Adr3**(BR1-BR4) as the bus address.

Note :

Pins **Adr0 .. Adr3**(BR1-BR4) are to be electrically the same as Pins **FT0 .. FT3** (J4). This means that Pins FT0 .. FT3 are never to be connected to ground while Pins at BR1 - BR3 are set to +5V.

If Pin '**FT/Bus**' is high (1) when switched on, then the MiniTerminal is set to '**Automatic fixed text**' and interprets Pins **FT0 .. FT6** as a fixed text number.

When in '**Bus**' mode, an address (0..15) can be assigned to each MiniTerminal using Pins '**Adr0 .. Adr3**'. If the host issues the command '**Assign address**', the MiniTerminal still only evaluates the following data with this address.

If a key is pressed on a MiniTerminal which has not been selected, then the code is saved in memory. It is sent as soon as the MiniTerminal is selected.

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After switching on, all connected MiniTerminals are selected and therefore evaluate the data (always selected).

Changing Characters : (permanent)

ESC & L CG	Character	8x pattern	Redefining existing character
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CG = CG RAM address to be used. 8 addresses available for redefining characters.
i.e. CG = Number from 1 - 8

Character = Character to be redefined.
i.e. any character of the character font can be entered here

8x pattern = The bit pattern of the new character must be entered here.
A character consists of a '5x7 point matrix'
i.e. only 'Bit0 - Bit4' of the 7 bytes to be entered are relevant. The byte is always entered as 'chr\$(0)'.

8th

Example Program (Qbasic) :

```
^ Initialize interface
OPEN "COM1:9600,N,8,2,cs0,ds0,cd0,rs" AS 1
' Character pattern
pattern$ =
CHR$(85)+CHR$(170)+CHR$(85)+CHR$(170)+CHR$(85)+CHR$(170)+CHR$(85)+CHR$(0)
INPUT "Character to define :"; zch$
INPUT "CG-RAM address (1-8) to be used :"; CGAdr%
'ESC sequence for defining the character
PRINT #1, CHR$(27) + "&L";
PRINT #1, CHR$(CGAdr% - 1);
strg$ = zch$ + pattern$
l = LEN(strg$)
IF l <> 0 THEN
  FOR n = 1 TO l
    PRINT #1, MID$(strg$, n, 1);
    R$ = INPUT$(1, #1)
    IF R$ <> MID$(strg$, n, 1) THEN
      PRINT "Error on saving": BEEP
      EXIT FOR
    END IF
  NEXT n
END IF
```

Description:

5x7 Matrix

0	1	0	1	0	1	0	1	-> CHR\$(85)
1	0	1	0	1	0	1	0	-> CHR\$(170)
0	1	0	1	0	1	0	1	
1	0	1	0	1	0	1	0	
0	1	0	1	0	1	0	1	
1	0	1	0	1	0	1	0	
0	1	0	1	0	1	0	1	
0	0	0	0	0	0	0	0	

Undoing a redefined character:

To undo a redefined character (zch\$), enter a value between chr\$(10) - chr\$(18) (character not displayed) and specify the CG RAM address (CGAdr%) to be deleted.

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Escape sequence for controlling the baud rate of data transfer

ESC & Bn	Setting the baud rate
---------------------	-----------------------

n = 0 - 9600
1 - 4800
2 - 2400
3 - 1200

Example: **PRINT #1,CHR\$(27);"&B";CHR\$(2);**
sets the baud rate at 2400 bits per second

This setting is permanently saved in the EEPROM.

Escape sequence for changing key codes

ESC & u Byte0 Byte31	Assigning the key code
---------------------------------------	------------------------

Example: **PRINT #1,CHR\$(27);"&u";**
TEXT\$ = "abcdefghijklmnopqrstuvwxy_z,.:;?" ' new key code
L = LEN(TEXT\$)
FOR I=1 TO L
PRINT #1,MID\$(TEXT\$,I,1);
R\$ = INPUT\$(1,#1)
IF R\$ <> MID\$(TEXT\$,I,1) THEN GOTO error ' Error on saving
NEXT I
error:
PRINT "Error on saving"
end:
END

The original key code is replaced sequentially by the 32 bytes following the "u"..

The original key code is as follows:

00H - 07H -> Key 1 - 8
10H - 17H -> Key 9 - 16
20H - 27H -> Key 17 - 24
30H - 37H -> Key 25 - 32

As with fixed text, the key codes are also permanently saved in the EEPROM.

Note :

The settings for baud rate and the conversion code table are saved even when the power fails. These settings are only altered by using the above ESC sequences.

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Commands for the fixed text display

Fixed texts are numbered from 0 .. 127.

The display is deleted before a fixed text is shown.

A fixed text can show CR as a special character.

The BELC1001 Controller can have a maximum of 3 EEPROMs each with 2 kbyte of memory.

Reading out fixed text : (all)

ESC W	Reading out fixed text over the serial interface
--------------	--

Example: **PRINT #1,CHR\$(27);"W";**

The BELC1001 Controller sequentially produces over the serial interface all fixed texts saved. Each fixed text ends with a zero. Transmission ends with 2 zeros.

Loading fixed text :

ESC R	Loading fixed text over the serial interface and saving it in the EEPROM
--------------	--

Example: **PRINT #1,CHR\$(27);"R";**
PRINT #1,"T";
INPUT\$(1,#1)

1st character ("T") of the fixed text
Wait until the character is sent back

PRINT #1,CHR\$(0);
PRINT #1,"K";
INPUT\$(1,#1)

End of the 1st fixed text
1st character ("K") of the 2nd fixed text
Wait until the character is sent back

PRINT #1,CHR\$(0);
PRINT #1,CHR\$(0);

End of nth fixed text
End of transmission

The BELC1001 Controller sends back each character after programming. If an error is detected when programming (e.g. EEPROM defective or does not have enough memory), then the BELC1001 Controller inverts the character. It is, therefore, of use when saving fixed text, to read out again the character from the interface buffer and compare it with the character sent (see Demo program, Line 230-250).

Saving text requires approximately 1 sec per 100 characters.

Caution: The command **deletes** all text saved in memory !

This means that all fixed test previously saved is deleted as soon as additional fixed text is to be saved in the EEPROM. Thus, all previously saved fixed text and additional fixed text must be resaved.

Format for saving : 'FT0'+Chr\$(0)+ 'FT1'+Chr\$(0)+ 'FT2'+Chr\$(0) 'FT0n+Chr\$(0)+Chr\$(0)
(in EEPROM)

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Reading out fixed text : (special)

ESC D no	Displaying fixed text with the number 'no' ('no' from 0 .. 127)
-----------------	---

Example: **PRINT #1,CHR\$(27);"D";CHR\$(2);**

The BELC1001 Controller deletes the display and shows the 3rd fixed text.

This command overwrites the setting at Connector J4.

If the value changes at Connector J4, then the fixed text is displayed which is assigned to that value at Connector J4. A fixed text number is, therefore, always selected if a number is entered over the serial interface or the setting is changed at Connector J4.

Note: Fixed text commands can be used which are independent of the value of Pin '**FT/Bus**'.
This means that fixed text can be selected over the serial interface in **both** operating modes ('Autom. FT' or 'Bus').

General Information :

- Trimmer P1 sets contrast.
The contrast **must** be set individually for every LCD module (see 'Start-up of the MiniTerminal').
- The MiniTerminal cannot receive data over the serial interface as long as a command is being carried out as this can cause loss of characters especially with slow commands (e.g. delete display).

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Character Font Table : (characters displayed in hex code)

		Higher 4 bit (D4 to D7) of Character Code (Hexadecimal)																	
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F		
Lower 4 bit (D0 to D3) Character Code (Hexadecimal)	0	CG RAM (1)			0	a	P	'	F					-	9	3	o	p	
	1	CG RAM (2)			!	1	A	Q	a	a				a	7	#	4	ä	g
	2	CG RAM (3)			"	2	B	R	b	r				"	i	u	x	p	ø
	3	CG RAM (4)			#	3	C	S	s	c				!	u	t	e	s	ø
	4	CG RAM (5)			\$	4	D	T	t	d				\	I	t	t	p	ø
	5	CG RAM (6)			%	5	E	U	u	e				.	o	t	u	s	ü
	6	CG RAM (7)			&	6	F	V	v	f				o	n	e	o	p	z
	7	CG RAM (8)			'	7	G	W	w	g				7	#	x	ö	g	π
	8	CG RAM (1)			(8	H	X	x	h				!	o	o	u	r	z
	9	CG RAM (2))	9	I	Y	y	i				o	t	u	l	'	y
	A	CG RAM (3)			*	*	J	Z	z	j				o	o	n	k	j	#
	B	CG RAM (4)			+	!	K	C	c	k				o	o	t	e	o	z
	C	CG RAM (5)			,	<	L	#	1	l				o	o	o	o	z	z
	D	CG RAM (6)			-	=	M	I	m	y				o	o	o	o	z	z
	E	CG RAM (7)			.	>	N	^	n	+				o	o	o	o	z	z
	F	CG RAM (8)			/	?	O	_	o	+				o	o	o	o	z	z

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Assigning Connectors :

J3 Matrix Keyboard TTL Inputs

Assigning lines
to the pins

Assigning columns
to the pins

Column 0 ->	2	1		
Column 1 ->	4	3		
Column 2 ->	6	5		
Column 3 ->	8	7		
Column 4 ->	10	9	<-	Line0
Column 5 ->	12	11	<-	Line1
Column 6 ->	14	13	<-	Line2
Column 7 ->	16	15	<-	Line3

Pin no at Connector J3

J4 Selecting Fixed Text TTL Inputs ↔ Jumpers

1	FT0	Number of the fixed text to be	↔ BR1
2	FT1	given out	↔ BR2
3	FT2	(7 Bit / 0 127 binary coding)	↔ BR3
4	FT3		↔ BR4
5	FT4		
6	FT5		
7	FT6		
8	FT/Bus	Automatic fixed text (1) / Bus (0)	↔ BR5
9	Ground		

The '↔' signifies 'electrically the same'

J6 Host / Power Supply

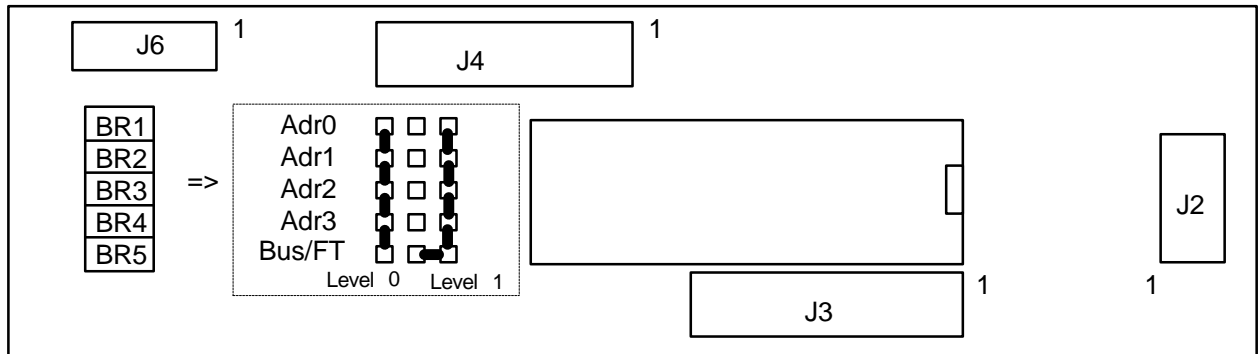
1	+ 5 V	Power supply
2	TxD	V24 output
3	RxD	V24 input
4	CTS	
5	Ground	
6	Not assigned	

Jumpers :

Using pins Adr0-Adr3, every MiniTerminal connected must be assigned a unique address (0-15). This is carried out (externally on the board) using jumpers BR1-BR4, in which either the jumpers are connected to 0 (Ground) or 1 (+5 Volt). Without such assignment,

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no clear initialisation for more than one MiniTerminal can take place over the serial interface (command 'Assign Address').



Pin 'Bus/FT' is configured for 'Automatic fixed text', i.e. set at Level 1

The term "BR1 - BR5" in the diagrams is identical with the 3 rows consisting of 5 pins each which are on the boards. The 5 pins on the left are connected to ground. The text for the 5 pins in the centre applies to those as they are shown in the dotted area in the diagram above. The 5 pins on the right are at +5 Volt.

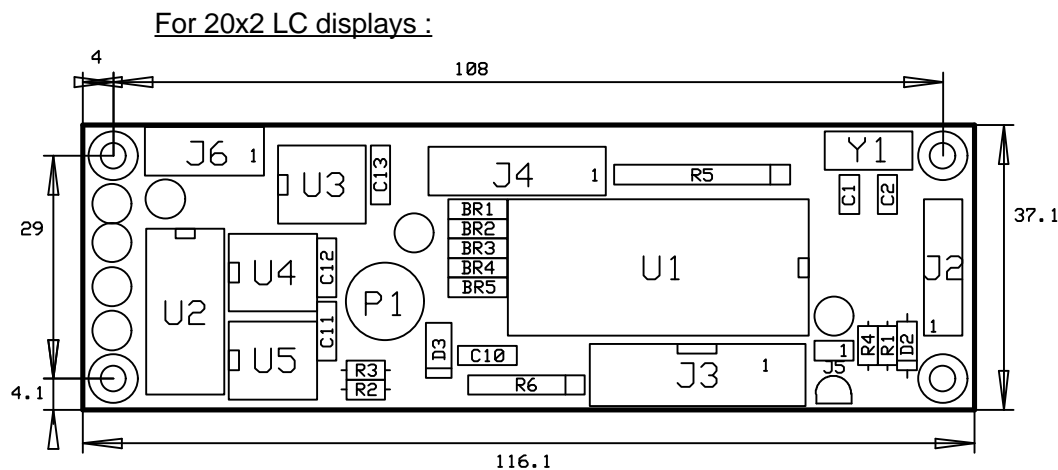
Caution : With the 16x2 version, the ground and +5V codings are interchanged.

Boards :

The MiniTerminal is available in 7 sizes to suit every type of display.

The marking " BR1
BR2
BR3
BR4
BR5 " is used as a reference:

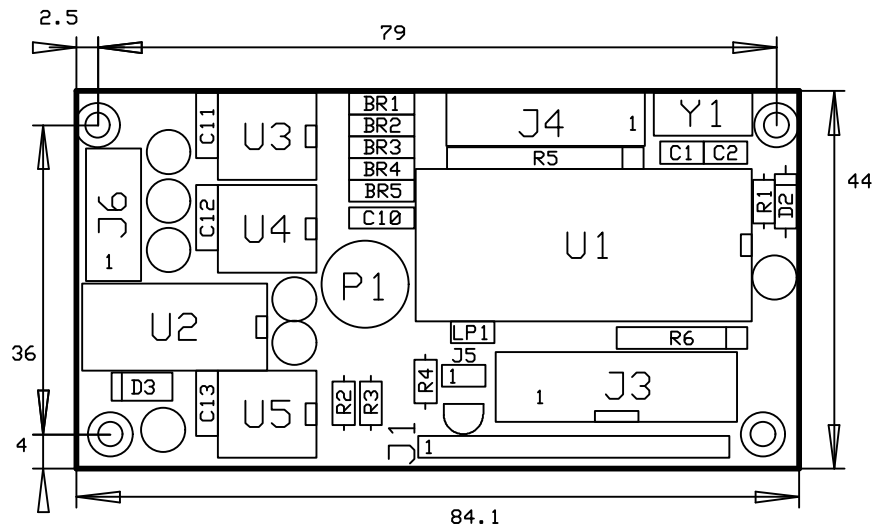
The diagram is held so that when the marking is the right way up, the connections for 0 (ground) are on the left and the terminals for 1 (+5 Volt) are on the right.



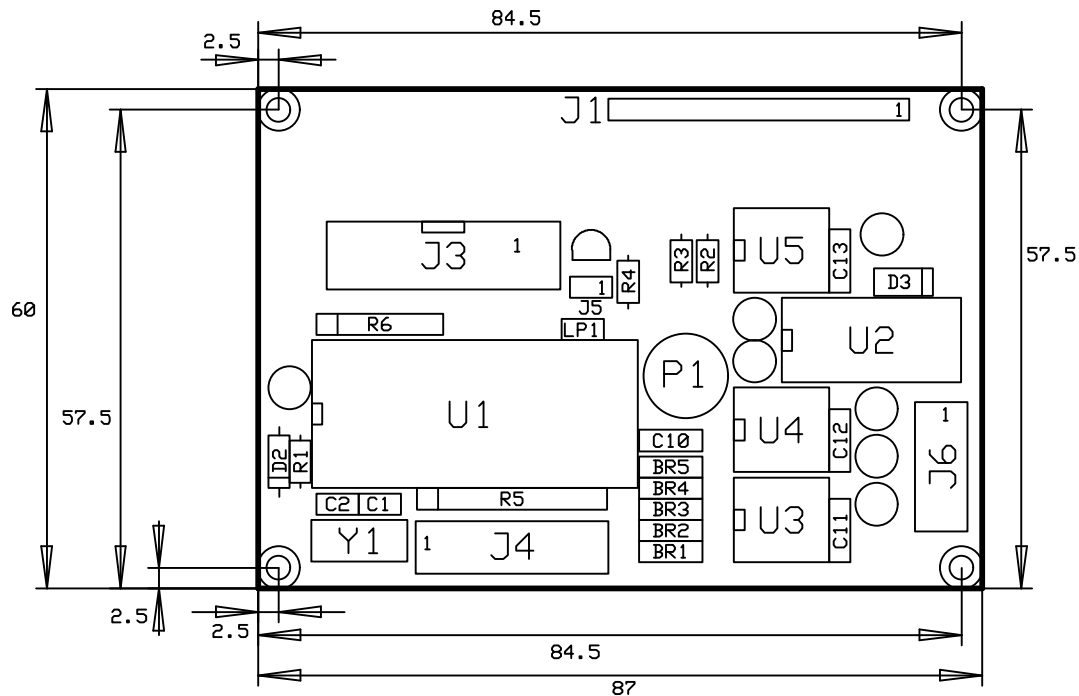
Note : Pin 1 is shown by a "1" on the appropriate side of the plug in all diagrams.

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For 16 x2 LC displays :



For 16x4 LC displays :



Other boards available :

- 8x2 -> Dimensions : 58 mm x 32 mm (SMD)
- 16x1 -> Dimensions : 36.1mm x 80 mm
- 40x2 -> Dimensions : 182 mm x 33.5mm
- 40x4 -> Dimensions : 96 mm x 54 mm

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```
10 ' Demo program (Qbasic) for fixed text display on the MiniTerminal
20 '
30 OPEN "COM1:9600,N,8,2,cs0,ds0,cd0,rs" AS 1
40 PRINT
50 PRINT "1 - Load fixed text into MiniTerminal"
60 PRINT "2 - Display fixed text on pc"
70 PRINT "3 - Display fixed text on MiniTerminal"
80 PRINT "4 - Display text on MiniTerminal"
90 PRINT "5 - End   "
100 INPUT CMD
110 ON CMD GOSUB 140,350,490,560,670
120 GOTO 40
130 '-----
140 PRINT "Load fixed text into MiniTerminal"
150 PRINT "A fixed text is ended with 'ENTER'"
160 PRINT "Function terminated if fixed text has "
170 PRINT "no further characters"
180 PRINT #1,CHR$(27);"R"; : ' Send command to MiniTerminal
190 INPUT "Enter text: ";TEXT$
200 L = LEN(TEXT$)
210 IF L=0 THEN GOTO 310 : ' End of transmission
220 FOR I=1 TO L
230   PRINT #1,MID$(TEXT$,I,1);
240   R$ = INPUT$(1,#1)
250   IF R$ <> MID$(TEXT$,I,1) THEN RETURN : ' Error on saving
260 NEXT I
270 PRINT #1,CHR$(0); : ' End of text character
280 R$ = INPUT$(1,#1) : ' Read 0
290 GOTO 190
300 '
310 PRINT #1,CHR$(0); : ' End of text character
320 R$ = INPUT$(1,#1) : ' Read 0
330 RETURN
340 '-----
350 PRINT "Display text saved in MiniTerminal on pc"
360 PRINT
370 PRINT #1,CHR$(27);"W"; : ' Send command to MiniTerminal
380 NULLFLAG=0
390 A$ = INPUT$(1,#1)
400 IF ASC(A$)=0 GOTO 440
410 NULLFLAG=0
420 PRINT A$;
430 GOTO 390
440 IF NULLFLAG=1 THEN RETURN ' 2nd Zero --> End of transmission
450 NULLFLAG=1
460 PRINT
470 GOTO 390
480 '-----
490 PRINT "Display fixed text on MiniTerminal"
500 PRINT "Number (999 = End): ";
510 INPUT NUMMER
520 IF NUMMER=999 THEN RETURN
530 PRINT #1,CHR$(27);"D";CHR$(NUMMER);
540 GOTO 500
550 '-----
560 PRINT "Output of text on MiniTerminal"
570 PRINT "Text output after pressing 'ENTER'"
580 PRINT " Function ended if text has no further characters "
590 INPUT "Enter text: ";TEXT$
600 L = LEN(TEXT$)
610 IF L=0 THEN RETURN : ' End of transmission
```

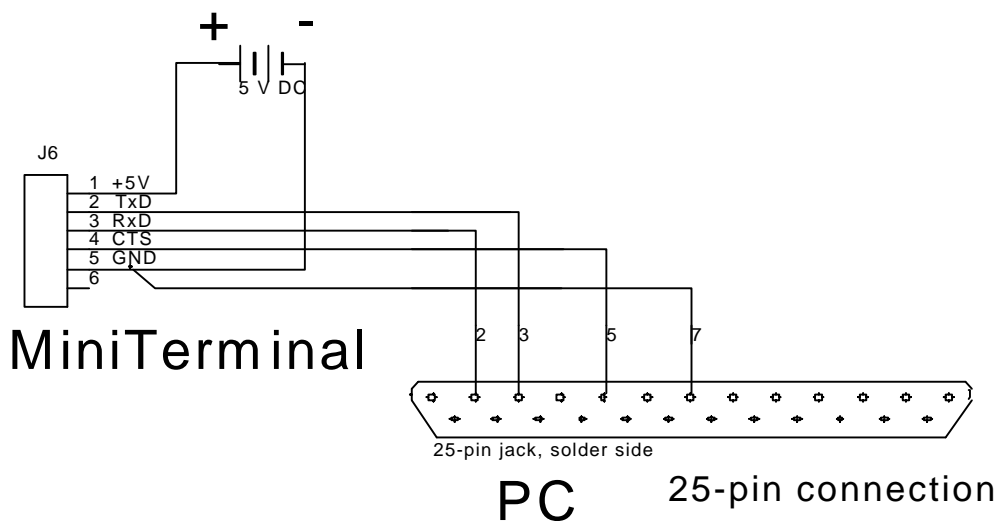
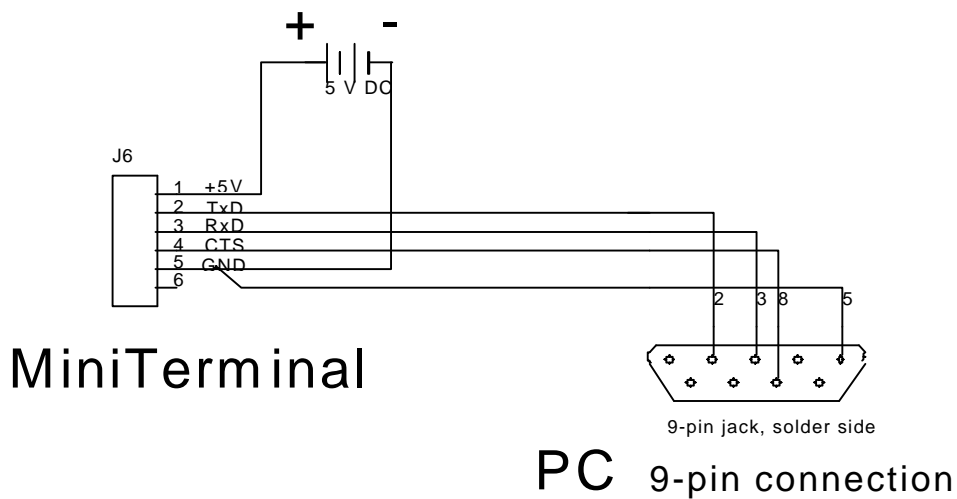
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```
620 FOR I=1 TO L
630   PRINT #1,MID$(TEXT$,I,1);
640 NEXT I
650 GOTO 590
660 '-----
670 END   : ' End of program
```

Terminal Assignment :

Connect an appropriate cable to the serial interface (COM1 is usually 9-pin.). Note also the pin assignment for Connector J6 and pc connectors.

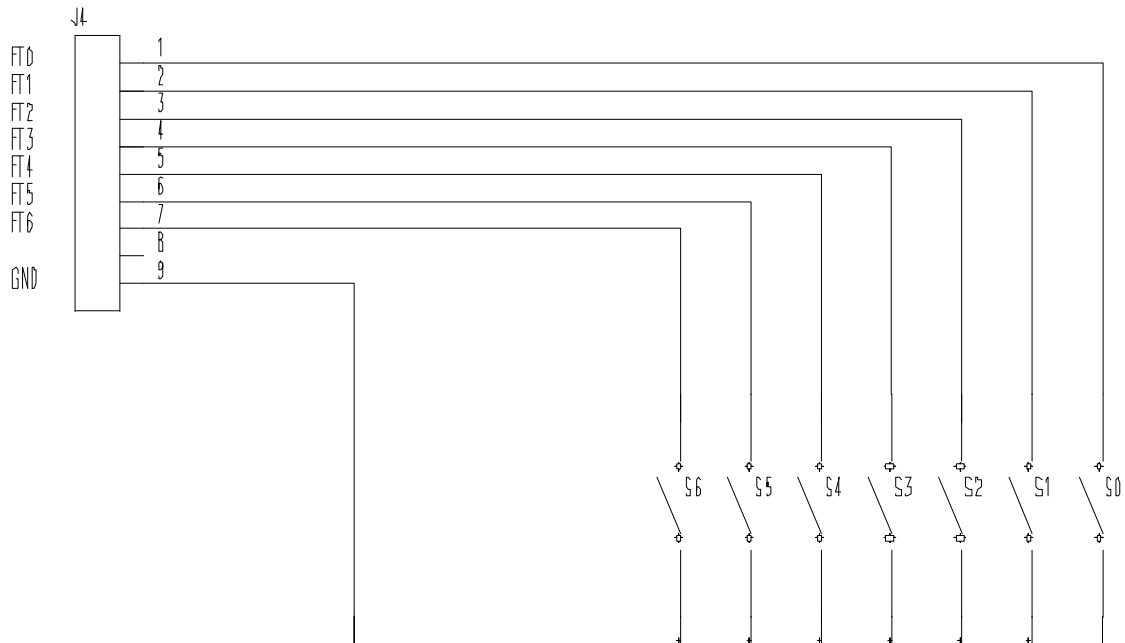
Cabel MiniTerminal <--> PC



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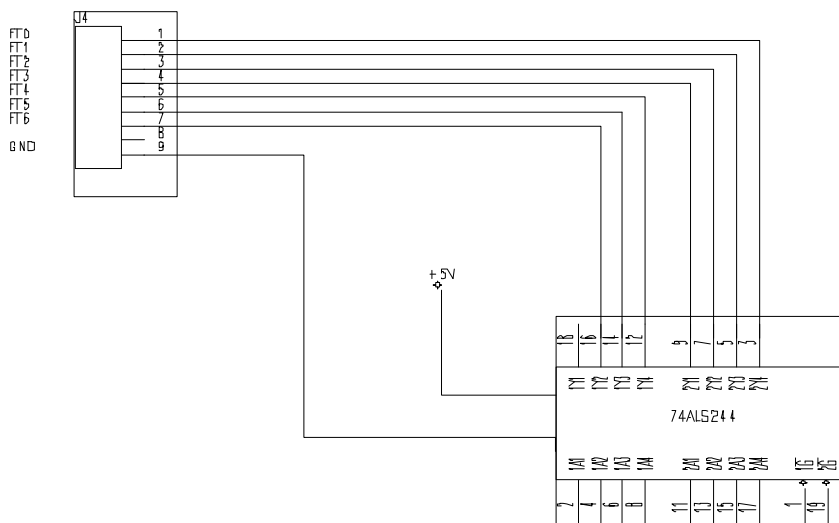
Selecting fixed text:

Contact - Connection



The voltage is interpreted as high (1) when the switch is open
The voltage is interpreted as low (0) when the switch is closed

TTL - Connection



With inputs 1A1 - 1A4 and 2A1 - 2A4, the connections FT0 - FT6 can be selected at J4.

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Start-up procedure for the MiniTerminal :

Please note the following points and then carry them out in the sequence given. Only in this way can correct start-up be guaranteed :

1. Put Jumper BR5 in the 'Bus' position (i.e. connect Pin 'FT/Bus' to ground).
2. Connect a plug to the connection cable for attaching to the serial interface. Note connection assignment on Page 10.
3. Attach the configured Plug J6 to Connector J6 on the board. Note that Pin 1 is connected to the side indicated. Plug the 9-pin connector into the serial interface (COM1) of your personal computer.
4. Switch on the +5 Volt power supply to Plug J6.
5. A cursor should now flash on the display. If this is not the case, then the contrast should be altered at Controller P1 on the board until the cursor is visible.
 - > If the MiniTerminal is set to the 'BUS' mode, then the following message is shown after connecting up:
 `V 1.3 T2 B0 (default)`
6. Once the *MiniTerminal* is connected to the serial interface, it allows data to now be sent from the personal computer to the *MiniTerminal*. Fixed text can first be saved and then loaded according to the commands described (see 'Escape Sequences') or by using the demo program.

Examples :

If, in addition to the serial interface, you also wish to call up fixed text via the 7 TTL lines of Connector J4, then

1. Set Jumper BR5 to 'Autom. fixed text' (i.e. connect Pin 'FT/Bus' to +5)
2. Connect Plug J6 as described in 'Selecting fixed text' (see Page 9).
Ensure that there is +5 volt at Pin 8 ('FT/Bus') of J6 as this connection is electrically the same as Pin 'FT/Bus' at BR5.

With 7 control lines available (FT0- FT6), up to a maximum of 127 fixed texts can be called up. Ensure that all lines are connected.

Any line not connected is at a logical 1 so that, for example, if the 7th line is not connected, then fixed texts 0 - 63 will not be chosen, but instead 64 to 127. As soon as the value at Connector J6 is changed then this is recognised by the *MiniTerminal* and the appropriate fixed text supplied.

The serial interface is now no longer required for selecting and displaying the fixed text using Connector J4. Fixed text, may however still be called up using the serial interface at any time.