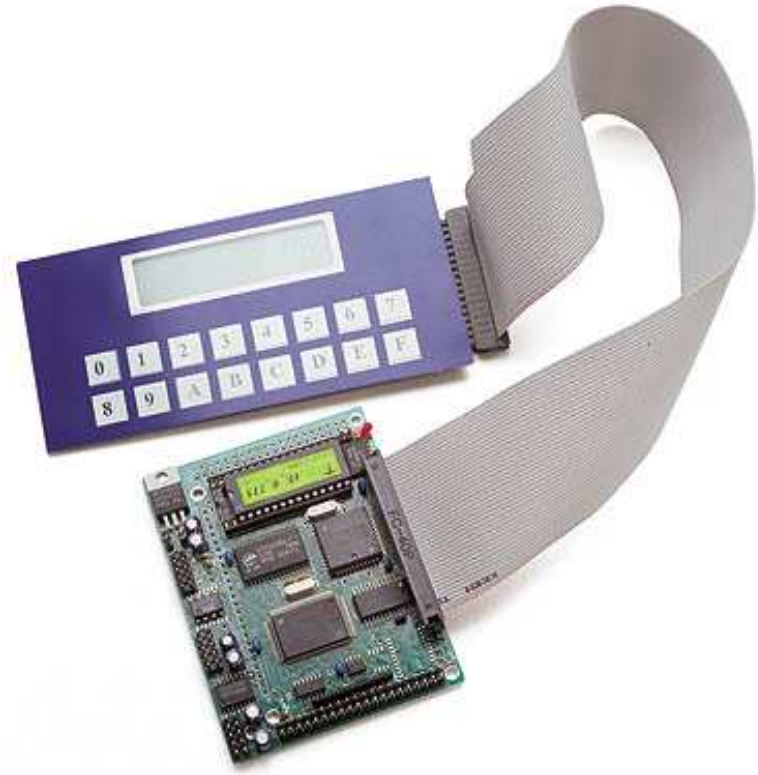
Kpad™

User interface with 16x2 character LCD with backlighting, 8x2 button keypad, and software dirvers. Driven by TTL level I/O or Data / Address Bus.



Technical Manual

TERN INC.
1950 5th Street, Davis, CA 95616, USA
Tel: 530-758-0180 Fax: 530-758-0181
Email: sales@tern.com http://www.tern.com

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1950 5th Street, Davis, CA 95616, USA
Tel: 530-758-0180 Fax: 530-758-0181
Email: ***sales@tern.com*** ***http://www.tern.com***

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Temperature readings for controllers are based on the results of limited sample tests; they are provided for design reference use only.

Chapter 1: Technical Manual

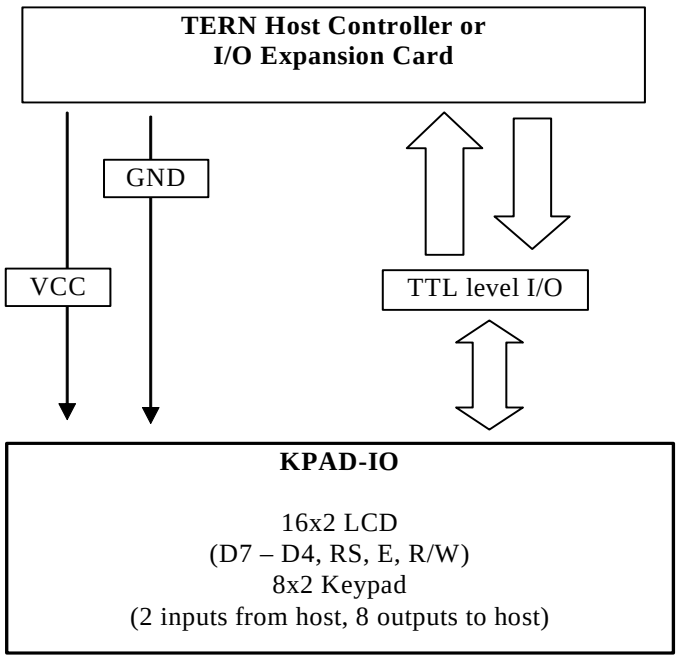
1.1 Functional Description

The Kpad offers a 16x2 character LCD with backlighting and adjustable contrast while supporting an 8x2 keypad. The Kpad-IO is an ideal upgrade to an existing TERN controller to add simplified user interface. The Kpad comes in two versions, the Kpad-IO and the Kpad-Bus. While the two versions provide identical functionality, how they interface to its host controller is quite different.

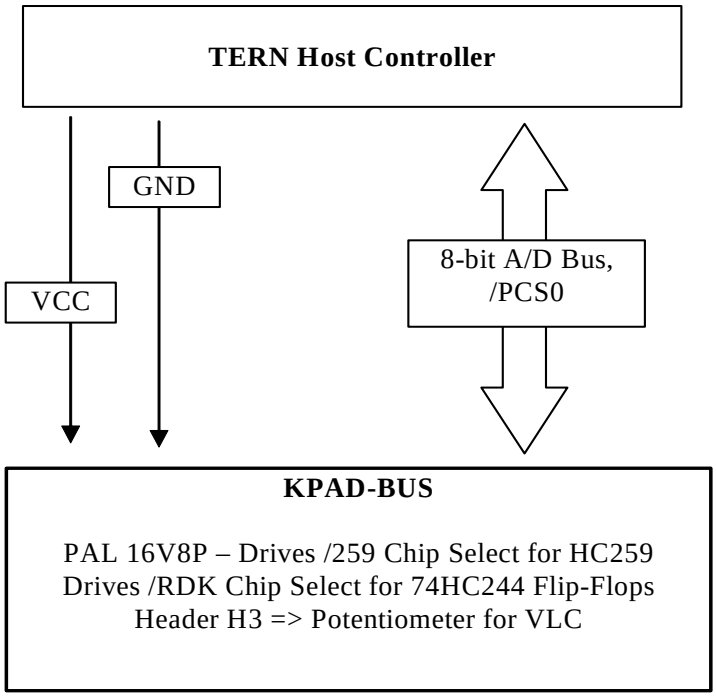
The Kpad-IO is driven by TTL level bidirectional user-programmable I/Os. These TTL level I/Os are driven by the host controllers PPI or by the CPU in the case of the FlashCore™. This version uses TTL level I/O for sending commands and data to the on-board LCD controller (on the Kpad PCB). This versions also implements one port of the PPI as input for scanning for activity on the 8x2 keypad.

The Kpad-Bus version uses a completely different implementation to drive the same LCD controller and scan the scan the same keypad. With this version, the host controller's address and data bus, as well as one chip select line from the CPU, interface a PAL and HC259 on the Kpad PCB. This PAL then drives the chip select for the HC259, which interfaces the LCD controller.

Both versions require VCC (+5V from driving controller, no external power supply needed) and GND from its host controller. An on-board potentiometer is then used to control LCD contrast to suit a wide variety of lighting conditions. TERN provides complete software support for all necessary operations, allowing for simple coding or integration into an existing system. The Kpad consists of the Seiko L1672 16x2 character LCD integrated onto to a TERN developed PCB. The Kpad PCB also integrates a 16-key keypad in an 8x2 configuration. The Kpad-Bus version then adds a PAL, HC259, and 74HC244 to latch data in both directions. Both versions are connected to its driving controller via flat cable. Both version of the Kpad use the same TERN developed PCB, but use different pin header to interface it host controller.



Functional block diagram of the Kpad-IO and host



Functional block diagram of the Kpad-Bus and host

1.2 Features

Standard Features

- Dimensions:
  5.2 x 2.5” (Total PCB)
  2.44 x 0.630” (LCD Viewing Area)
  62 x 16 mm (LCD Viewing Area, manufacturer’s specification)

- Power input: +5V regulated DC. Supplied by Host Controller
- Operating Lifetime: LCD 75,000 Hours (Minimum)
  LED Backlighting 50,000 Hours (Typical)

- LCD: Seiko L1672 16x2 character LCD
- Keypad: 16 keys in 8x2 configuration

1.3 Physical Description

The Kpad PCB is complete with several pin headers, each with its own purpose. It is only necessary to use one header at a time, dpending on the host controller and interface being used. The J1 pin header on the Kpad PCB is used in the Kpad-Bus configuration. The Kpad-IO configuration uses the H4 pin header. It is a 17x2 header that installs via flat cable to the J6 (or J4) header of the AE, AE86, IEL, etc. Furthermore, the H5 header is used for the TD40, TD86, and the FlashCore, all special versions of the Kpad-IO. The following table gives the pin layouts and descriptions for both headers. Refer to the Kpad schematic, as

well as the schematic for your host controller, for additional details on the TERN CD, in the tern_docs\schs directory. Figure 1.1 shows the Kpad-IO version with the A-Engine-P via 34 pin flat calbe. Figure 1.2 shows as specialized version of the Kpad-IO specifically designed for the TD40, named TD-Pack. Included in the TD-Pack are the TD40 controller, Kapd-IO, and enclosure.

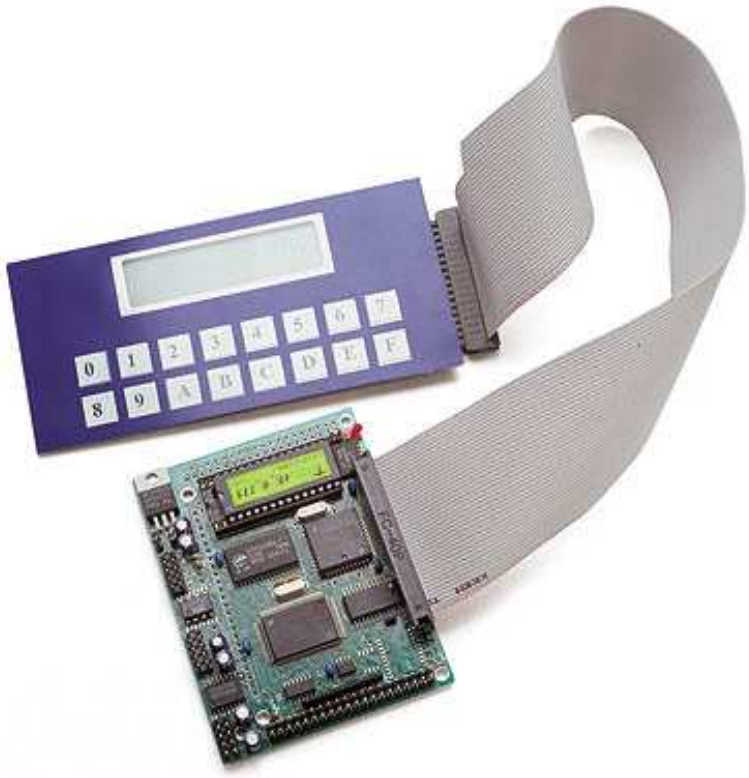


Figure 1.1 Kpad-IO with A-Engine-P

Figure 1.2 TD-Pack

J1 Header: Kpad-Bus			
VCC	1	2	GND
	3	4	
	5	6	
	7	8	D0
	9	10	D1
	11	12	D2
	13	14	D3
/RST	15	16	D4
	17	18	D5
/PCS0	19	20	D6
	21	22	D7
	23	24	GND
	25	26	A7
	27	28	A6
/WR	29	30	A5
/RD	31	32	A4
	33	34	A3
	35	36	A2
	37	38	A1
	39	40	A0

Kpad-Bus Pin Name	***Function***
VCC	Kpad supply voltage, +5V
GND	Ground
D7 – D0	Data Bus: D7-D0 => Keypad scan D0 => Data In (HC259) => Input to PAL 16V8P
A7 – A3	Address Bus: Inputs to PAL 16V8P
A2 – A0	Select lines for HC259
/PCS0	Clock Input for PAL 16V8P
/WR	Input to PAL
/RD	Input to PAL

Kpad pin layout and description for Bus version

H4 Header: Kpad-IO			
VCC	1	2	
I07	3	4	
I06	5	6	
I05	7	8	
I04	9	10	GND
I03	11	12	GND
I02	13	14	
I01	15	16	
I00	17	18	
I27	19	20	
I26	21	22	
I25	23	24	
I24	25	26	
I23	27	28	
I22	29	30	
I21	31	32	
	33	34	

Kpad-IO	***Function***
Pin Name	
VCC	Kpad supply voltage +5V
GND	Ground
I07 – I00	Keypad scan. Tied to Pull-up resistors
I27 – I24	Data lines of LCD controller D7 – D4
I23	LCD controller Enable
I22	LCD controller, mode select Low: Command High: Data
	Keypad Scan
I21	Keypad Scan

Kpad pin layout and description for IO version

1.4 Software: Kpad-IO

The Kpad-IO version uses a direct interface to the LCD controller to minimize the number of IO lines required to drive the Kpad-IO, and thus leave more IO lines free for user application. TERN software drivers for the Kpad-IO send information to the LCD controller in a 4-bit format. As a result only data lines D7 – D4 are used. Logically, an 8-bit instruction or character must be sent to the LCD controller in two 4-bit nibbles. As the table in the previous section defines, IO lines I27 – I24 from the host controller tie directly to D7 – D4 of the LCD controller. In addition, the LCD uses three other control lines, E, RS, and R/W. Since the LCD controller does not send any data back to the host, the R/W is tied to ground by hardware design. The RS line defines the mode of the LCD controller, low indicating a command/instruction and high indicating data. Finally, a falling edge on the E signal will latch all signals present on the LCD controller. A flow chart represents the necessary steps to send both a command and data byte to the LCD controller. TERN software drivers have de-coupled all tasks into separate functions.

ppi_lcd_init

It is necessary to call this function to initialize the LCD controller. Settings include; 4-bit mode, 5x7 Dot format, 2 lines of characters, Display On, Cursor On, Blink Off.

Arguments: void

Returns: void

ppi_lcdcmd

This function will send an 8-bit command/instruction in two 4-bit nibbles. Commands

are used to send the initialization routine and set the position of the cursor.

Arguments: unsigned char cmd

Returns: void

ppi_lcddat

This function is used to send data (or characters) to write to the display.

Arguments: unsigned char dat

Returns: void

ppi_lcd_clr_line

This function will clear all 16 characters of either line.

Arguments: unsigned char code (code = 0x80 for top line, code = 0xc0 for bottom line)

Returns: void

ppi_lprintf

This function will print a sting, by calling **ppi_lcddat** for each character in the string.

Arguments: char * str

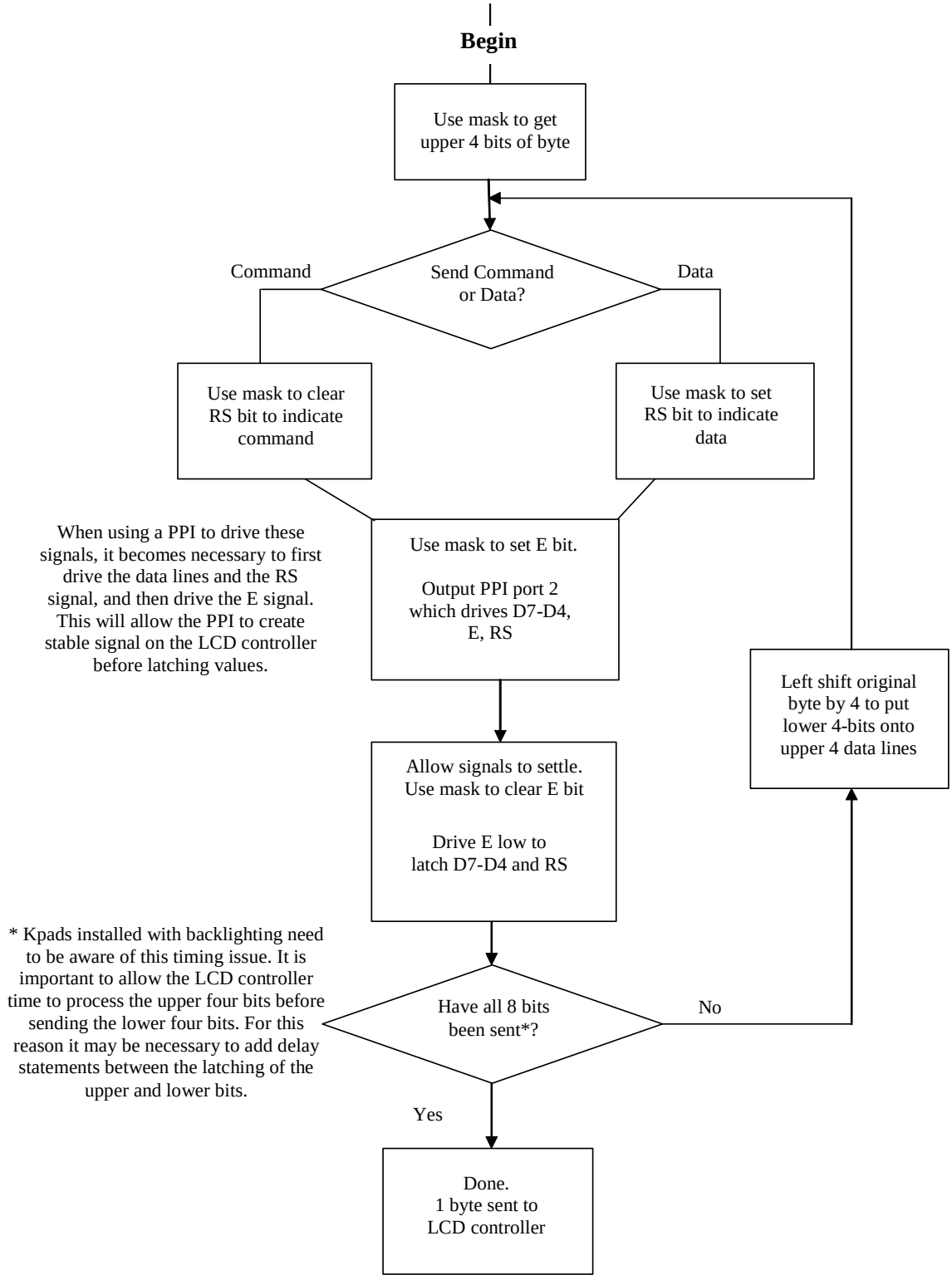
Returns: void

kpad

This function scans the Keypad and returns the key pressed.

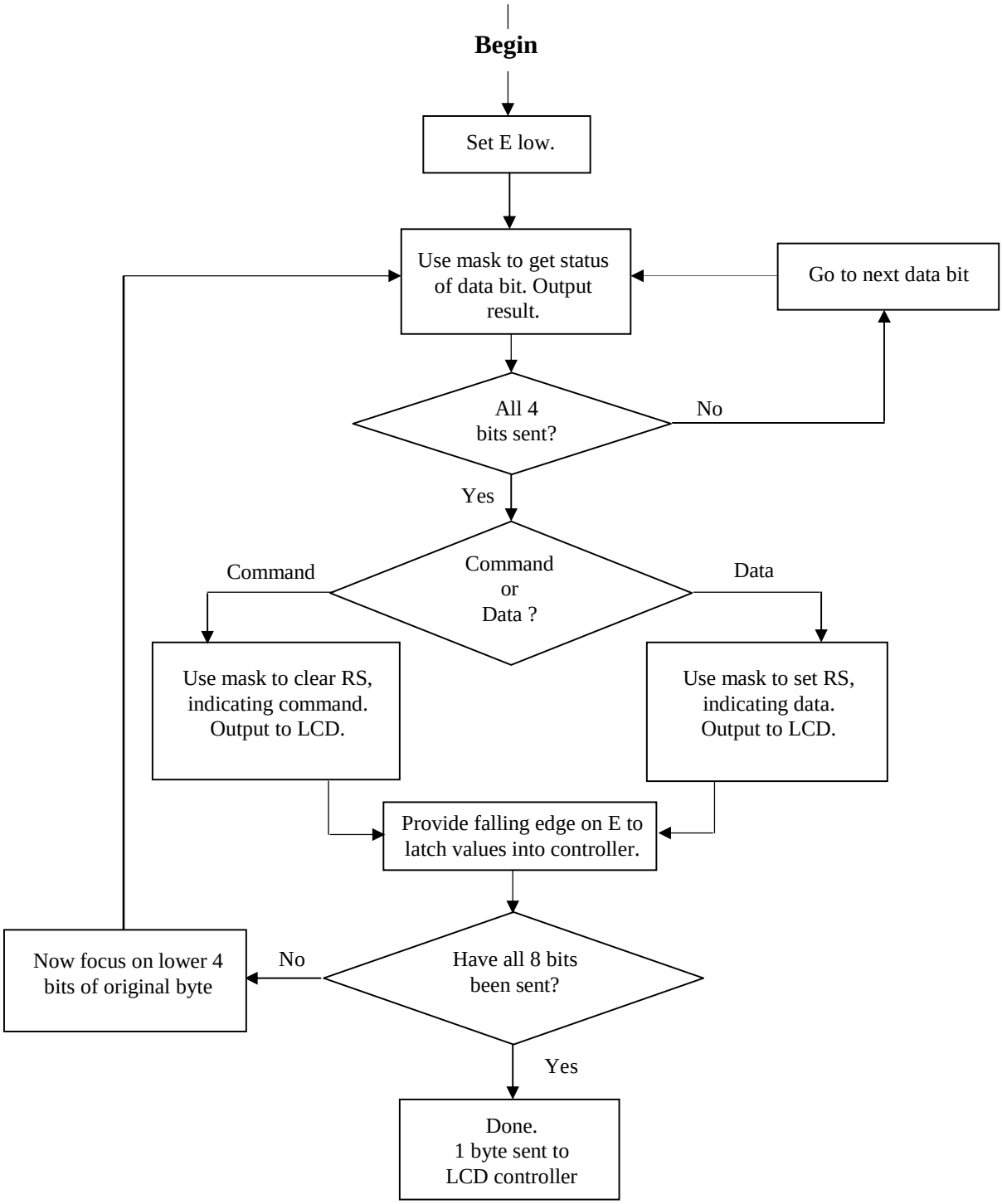
Arguments: void

Returns: unsigned char (these return values can then be decoded to the user's preference)


Begin
Use mask to get upper 4 bits of byte
Send Command or Data?
Command
Data
Use mask to clear RS bit to indicate command
Use mask to set RS bit to indicate data
When using a PPI to drive these signals, it becomes necessary to first drive the data lines and the RS signal, and then drive the E signal. This will allow the PPI to create stable signal on the LCD controller before latching values.
Use mask to set E bit.
Output PPI port 2 which drives D7-D4, E, RS
Left shift original byte by 4 to put lower 4-bits onto upper 4 data lines
Allow signals to settle.
Use mask to clear E bit
Drive E low to latch D7-D4 and RS
* Kpads installed with backlighting need to be aware of this timing issue. It is important to allow the LCD controller time to process the upper four bits before sending the lower four bits. For this reason it may be necessary to add delay statements between the latching of the upper and lower bits.
Have all 8 bits been sent*?
No
Yes
Done.
1 byte sent to LCD controller

1.5 Software: Kpad-Bus

The Kpad-Bus version interfaces to the LCD controller in a different way than the Kpad-IO. Here, an 8 channel D flip-flop is used to first latch the four data lines and the RS mode line, then give a falling edge on the E, enable, line to latch the output of the 8 channel flip-flop into the LCD controller. This introduces new components between the host controller and the LCD controller.



TERN software uses the following pre-defined functions to drive the Kpad-Bus

kp_lcd_init

Just as with the Kpad-IO, it is necessary to call this function before any other function call to the Kpad. This initialization routine include: 4-bit mode, 5x7 Dot format, 2 lines of characters, display ON, cursor ON, blink OFF.

Arguments: void

Returns: void

kp_lcdcmd

This function will send an 8-bit command in two 4-bit nibbles. Commands are used to send the initialization routine and set the position of the cursor.

Arguments: unsigned char cmd

Returns: void

kp_lcddat

This function is used to send data (or characters) to write to the display.

Arguments: unsigned char dat

Returns: void

kp_lcd_clr_line

This function will clear all 16 characters of either line.

Arguments: unsigned char code (code = 0x80 for top line, code = 0xc0 for bottom line)

Returns: void

kp_lprintf

This function will print a sting, by calling **kp_lcddat** for each character in the string.

Arguments: char * str

Returns: void

kp_scan

This function scans the Keypad and returns the key pressed.

Arguments: void

Returns: unsigned char (these return values can then be decoded to the user's preference)

1.6 LCD Address Mapping

The following is an address mapping of the 16x2 character LCD. To move the cursor to any location, just call **ppi_lcdcmd** for the Kpad-IO, or **kp_lcdcmd** for the Kpad-Bus, with the address of the desired location. All values are in hexadecimal.

Line 1:	80	81	82	83	84	85	86	87	88	89	8A	8B	8C	8D	8E	8F
Line 2:	C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	CA	CB	CC	CD	CE	CF

As a part of the initialization routine in **ppi_lcd_init** (or **kp_lcd_init**), the LCD is initialized to auto increment the cursor after receiving a character. It is therefore not necessary to increment the cursor manually.

1.7 Software Drivers and Samples

Use this section as a guide to the correct drivers and sample code for your TERN controller.

Am188ES / Am186ES / RDC R8830 / RDC R8820 based controllers:

Kpad-Bus:	tern\186\samples\kpad\kpad_bus.c
Kpad-IO:	tern\186\samples\ae\kp_io.c
TD40:	tern\186\samples\td40\td40_pck.c
TD86:	tern\186\samples\td86\td86_pck.c
FC40:	tern\186\samples\fc\kpad_fc.c

i386EX based controllers:

i386-Engine-M (Kpad-Bus only)	tern\386\samples\iem\iem_kpad.c
i386-Engine-L (Kpad-IO only)	tern\386\samples\iel\kpad_io.c

586-Engine and Expansion Cards driven by the 586-Engine (P50 & P100):

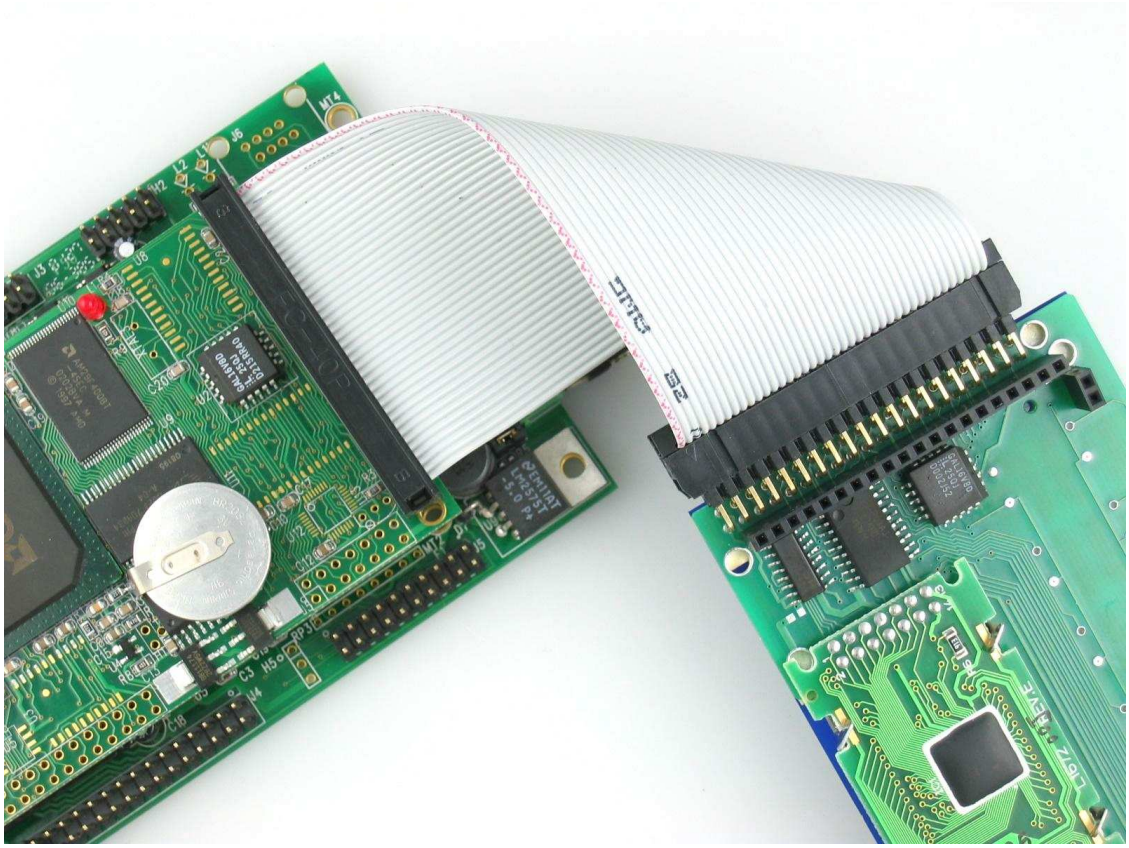
586-Engine + P100 (Kpad-IO):	tern\586\samples\p100\586_pck.c
586-Engine + P50 (Kpad-IO):	tern\586\samples\p50\p50_kpad.c
586-Engine (Kpad-Bus):	tern\586\samples\kpad\586_kpad.c

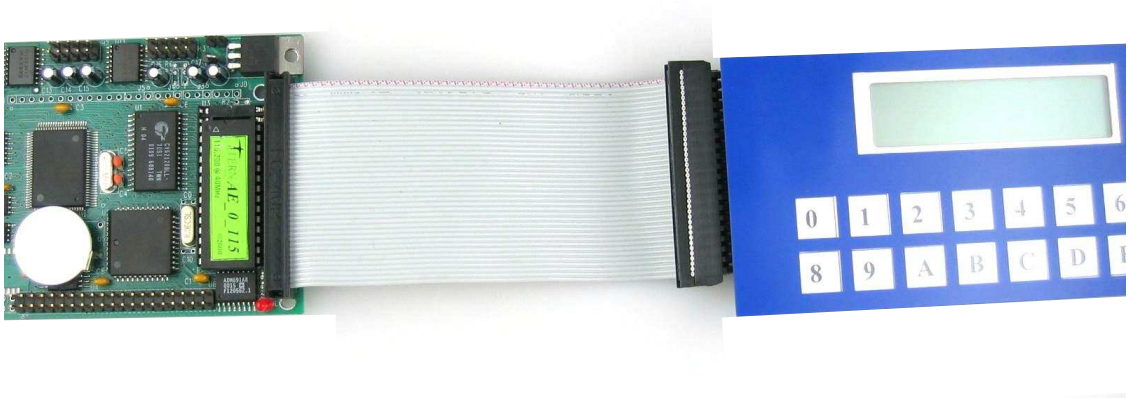
1.8 Additional Information

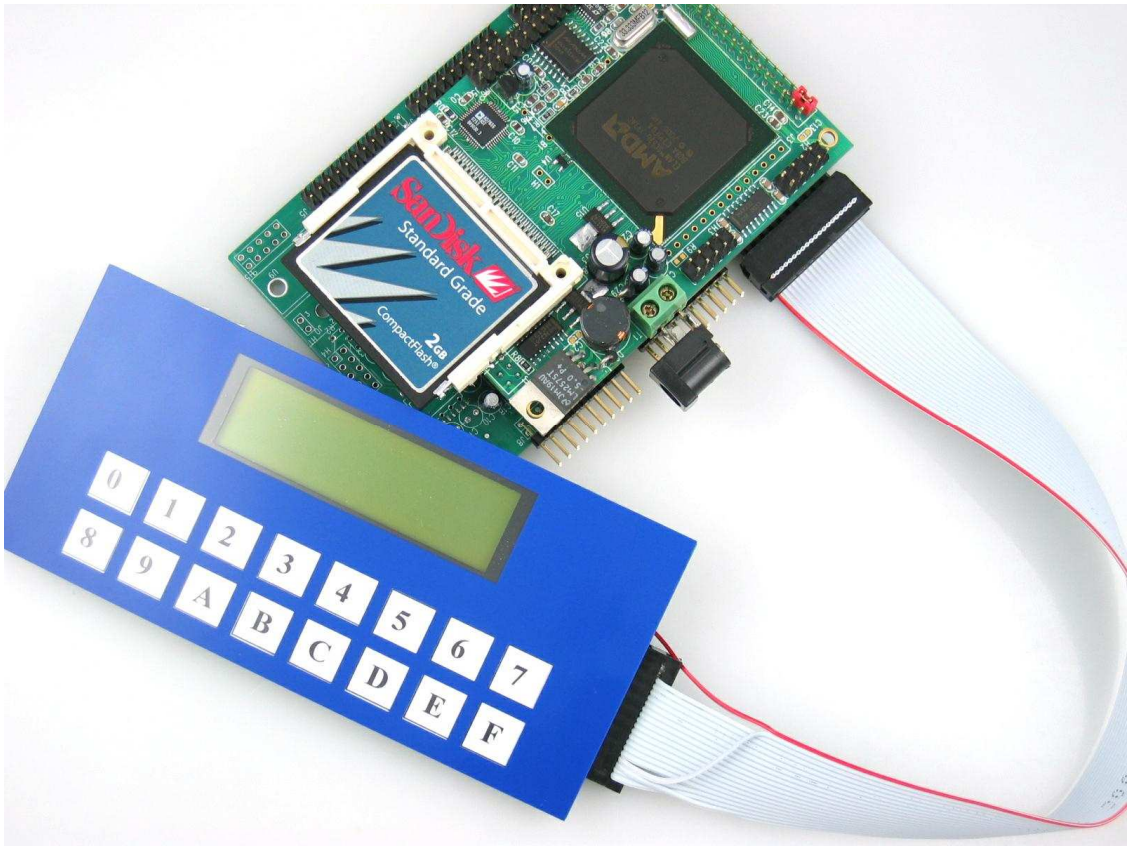
Refer the TERN CD for the data sheet on the Seiko LCD1672, under tern_docs\parts. Also, the technical manual for your specific controller might also provide a specialize tutorial based on that controller on the TERN CD, under tern_docs\manuals.

1.9 Sample Configurations

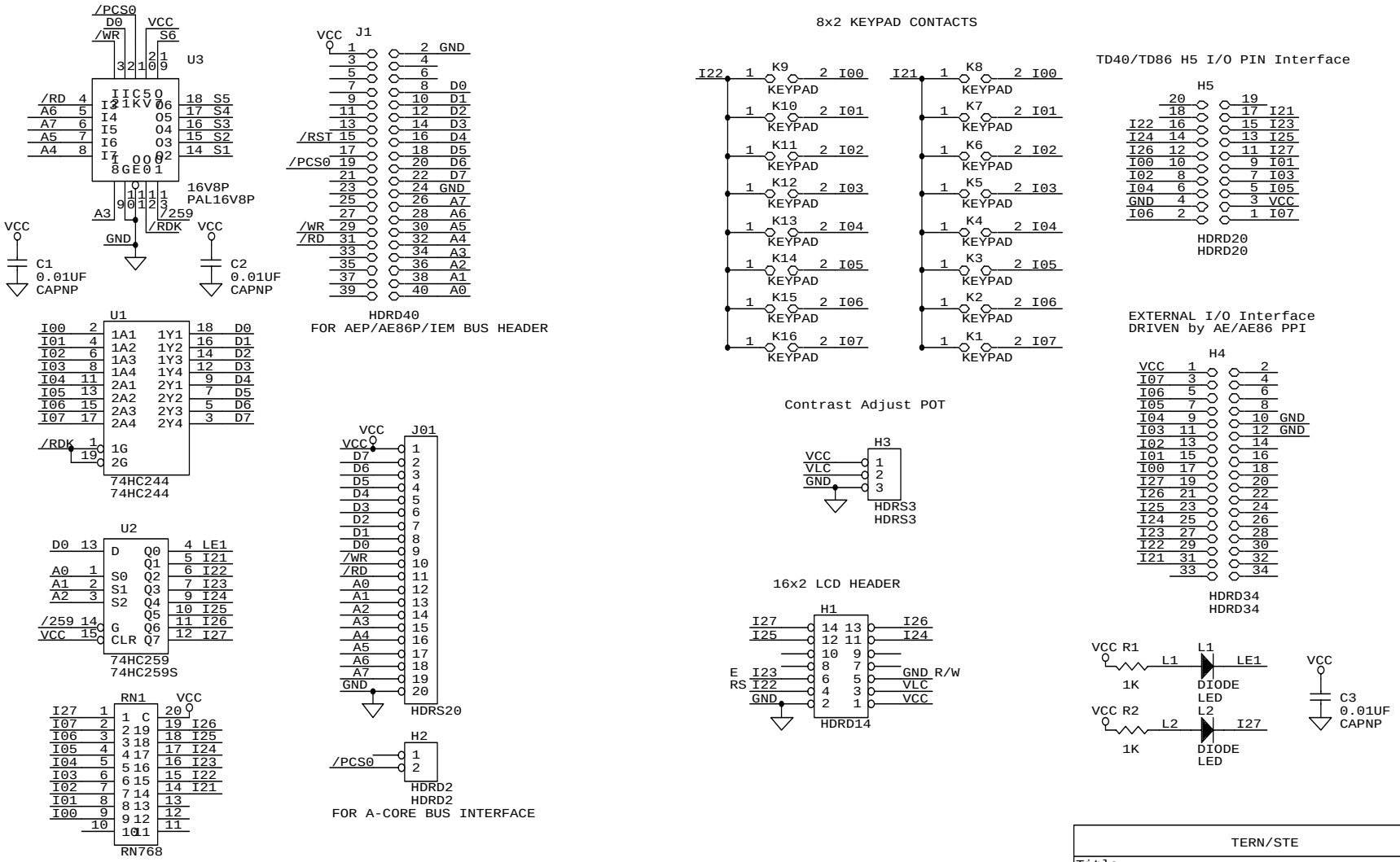
Shown below are few controller + kpad-bus configurations. The top picture shows the kpad-bus with the 586-Engine. The bottom picture shows the kpad-bus with the A-Engine-P.







586-Engine-P plus P100 with Kpad-IO via J6 pin header.



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