USER'S MANUAL

KEYBOARD INTERFACING MODULE
(ET-KB)

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KEYBOARD INTERFACING MODULE (ET-KB)

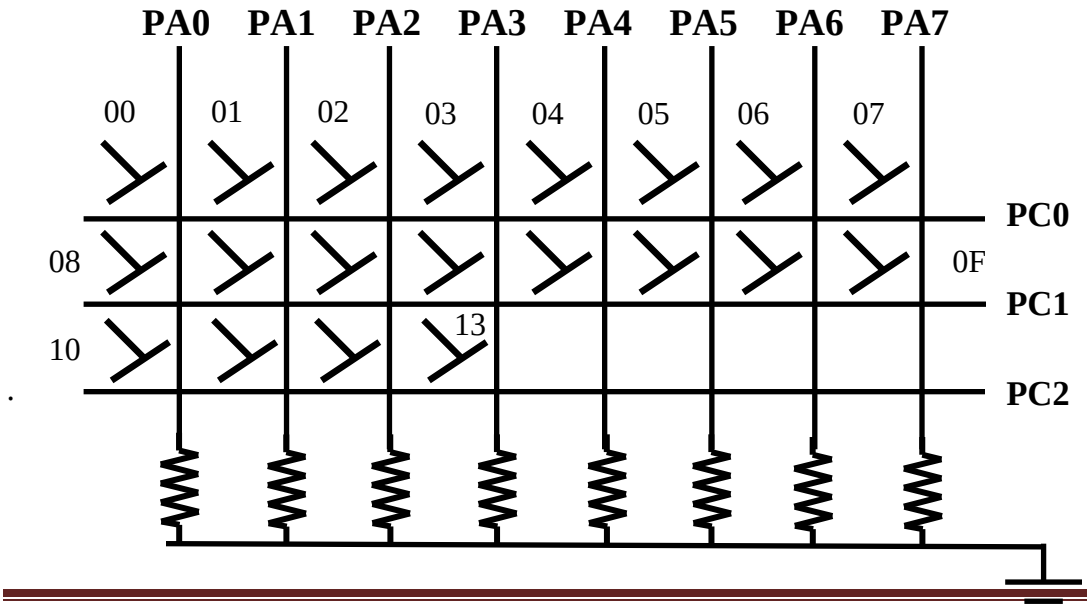
The keyboard interfacing Module (ET-KB) will demonstrate to the students as to how a keyboard can be connected to a microprocessor based system through I/O lines. The other techniques, which can be used for Interfacing the keyboard module, are also discussed in brief.

General Description:

The keyboard and displays are required in the instruments for the man to machine communication. The various types of the switches used in instruments are On /Off Switch, Push/Release Switches, Band Switches, Keyboard Switches etc. In microprocessor based equipments, normally open type of the switches are used. These switches give the change over contact as soon as they are pressed. The bouncing time of the key, i.e., unstable state of contact is maximum of 10 msec. Pressing of the key is monitored by the keyboard controller part and necessary action is taken.

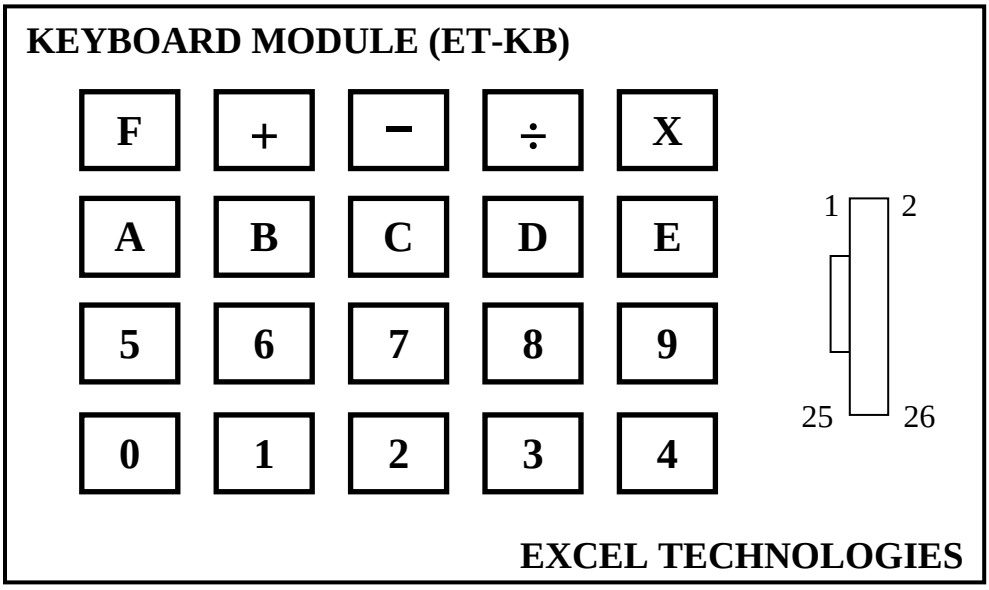
Keyboard can be easily interfaced to microprocessor through programmable I/O lines (the 8255 or 8155) or by 8279 (the Keyboard / Display encoder and decoder). There are two ways of connecting the keys to I/O lines. In the first technique, each of the key switches can be attached separately to a bit of an input port. This technique is beneficial if the no. of key switches are less than eight. If the number of key switches are more than eight, more number of input lines and multi-byte operation are required. The number of input lines can be easily reduced using the second technique where the keys are organized in matrix format. Each of the keys is connected between a particular row and a column.

While connecting the keyboard through 8279, the four scan lines SLO-SL3 are decoded and used with return lines RLO-RL7 into a matrix form. As any of the keys is pressed, an interrupt is generated which is given to microprocessor to service the keyboard routine.



The diagram above shows a keyboard of 20 keys connected in the matrix of 8 x 3 through PPI 8255-1. This keyboard interface is non-encode type, i.e., hardware recognizes the key closure and encode it. The row of the matrix is connected through Port C (bit 0,1,2) and columns are returned to Port A (bit 0-7). All the 8-bits of the input Port A are pulled down by 5K6 resistance, to avoid any noise interference. When no key is pressed, the microprocessor reads the input port as 00. The keyboard scanning starts by giving high signal at PC0 and low at PC1 and PC2. If any of the key connected to PC0 through Port A is pressed, the corresponding column bit will be also made to high and will be detected by the software. Similarly, the rest of the keys are scanned in the same fashion.

LAYOUT OF KEYBOARD INTERFACING MODULE



LIST OF EXPERIMENTS:

1. Write program to display a code of the key pressed in the data field. The code remains in the display till the activation of the next key. The code assigned to each key is given in the circuit diagram.

2. Write a program to jump at particular location to execute another program as soon as a particular key is pressed.

3. Write a program to perform Decimal/Hex arithmetic as operated in the calculator/computer.

Experiment 1

The 1st of the three experiments listed above is solved here. The program given below displays the code of the key which is pressed on the keyboard pad. The code is displayed in the data field and remains unchanged till the next key is pressed.

SETUP FOR THE EXPERIMENT

This explanation as well as the explanation of the Program under the heading " Description of the Program" is for 8085 LED Kit. However if you are interfacing the Keyboard Module to other Kits, then also refer to the specific instruction before the program listing for that particular Kit also

1) Connect the ET-KB interfacing module to the 8255-1 port connector of the kit using 26-pin flat FRC cable. The pin No.1 of the connector on the module as well as the kit is marked. Please ensure that the pin no. 1 of the connector is connected to pin no. 1 of the module.

2) Connect the +5V to the Module through the connector provided

3) Enter the program given below from the memory location mentioned in the program.

4) Execute the Program from starting address. Press any key on the Module. Its corresponding code will be displayed in the data field of the LED Display/LCD Display of the Kit.

DESCRIPTIONS OF THE PROGRAM

The port of 8255-I, i.e., PPI-1 is initialized to make port A as Input port and port C as output port. The three Rows of the keys are scanned one by one and process is repeated till the key is pressed in the routine code and F code (Final Code). The information of code is then displayed and the monitor jumps back again to see if any other key is pressed.

The codes will be displayed on the LED/LCD Display of kit as per the following table.

KEY PRESSED	DISPLAY	KEY PRESSED	DISPLAY
0	0	A	A
1	1	B	B
2	2	C	C
3	3	D	D
4	4	E	E
5	5	F	F

6	6	+	10
7	7	-	11
8	8	/	12
9	9	*	13

NOTE: - Listing of program for various models of Microprocessor and Micro controller kits is given below. Please select the model of kit being used before entering the program into the kit.

LISTING OF THE PROGRAM FOR KEYBOARD MODULE (ET-KB) TO INTERFACE WITH 8085 KIT HAVING LED DISPLAY

Connect the J1 of the Kit to the Module through 26 Pin FRC Cable. Ensure that the pin-1 of the J1 at the Kit end is connected to the pin-1 of the Module connector. Enter the program from address 2000. Execute the program from address 2000. Press any Key on the keyboard and observe that its code is displayed on the Kit Display

ADDRESS	OP-CODE	LABEL	MNEMONICS	Remarks
2000	3E 90	KBD	MVI A 90	Initialize 8255-1; Port A- Input & Port C- Output
2002	D3 03		OUT 03	
2004	06 00	INIT	MVI B 00	Initialize the final key code in Reg. B.
2006	0E 01		MVI C 01	Put Bit-pattern in register C. with one in LSB position.
2008	79	SCAN	MOV A, C	
2009	D3 02		OUT 02	
200B	DB 00		IN 00	Read Port A.
200D	CD 38 20		CALL 2038	Encode the 8-bit word into 8- bits.
2010	FE 08		CPI 08	Any key closure
2012	FA 24 20		JM 2024	If Yes, Go to display it.
2015	78		MOV A, B	If No, Move partial result in Reg. A.

2016	C6 08		ADI 08	Increment the Port C Code
2018	47		MOV B, A	In the partial result.
2019	FE 18		CPI 18	Does Port C Code Become 11.
201B	F2 04 20		JP 2004	If Yes, Go start scanning from Row 0.
201E	79		MOV A,C	If No, Move the Bit- pattern to scan the next line.
201F	07		RAL	
2020	4F		MOV C, A	
2021	C3 08 20		JMP 2008	Continue scanning.
2024	B0	DISP	ORA B	Logical OR Port A Code with Port C Code.
2025	32 F6 27		STA 27F6	Let it be current data.
2028	3E 00		MVI A 00	Arg. – No dot.
202A	CD FA 06		CALL 06FA	Display it in data field.
202D	C3 04 20		JMP 2004	Go to scan the KB again.
2030	20 0C			
2032	C3 2D 20		JMP 202D	
2035	78		MOV A, B	
2036	81 32			

FUNCTION	**CODE**	**This routine encodes 8 bit data to 3 bits**
INPUT	A	8 bit decoded data.
OUTPUT	A	3 bits encoded data.

2038	B7	CODE	ORA A	
3039	C2 3F 20		JNZ 203F	
203C	3E 08		MVI A 08	
203E	C9		RET	
203F	16 00	CODE-1	MVI D 00	

2041	0F	CODE-2	RRC	Let LSB in A,go to carry.
2042	DA 49 20		JC 2049	Go to return if this bit was one.
2045	14		JNR D	Increment Counter.
2046	C3 41 20		JMP 2041	Check the next bit.
2049	7A	CODE-3	MOV A, D	
204A	C9		RET	

LISTING OF THE PROGRAM FOR KEYBOARD MODULE (ET-KB) TO INTERFACE WITH 8085 KIT HAVING LCD DISPLAY

Connect the J1 of the Kit to the Module through 26 Pin FRC Cable. Ensure that the pin-1 of the J1 at the Kit end is connected to the pin-1 of the Module connector. Enter the program from address 2000. Execute the program from address 2000. **Press any Key on the keyboard and observe that its code is displayed on the Kit Display**

ADDRESS	OP-CODE	LABEL	MNEMONICS	Remarks
2000	3E 90	KBD	MVI A 90	Initialize 8255-1; Port A- Input & Port C- Output
2002	D3 03		OUT 03	
2004	06 00	INIT	MVI B 00	Initialize the final key code in Reg. B.
2006	0E 01		MVI C 01	Put Bit-pattern in register C. with one in LSB position.
2008	79	SCAN	MOV A, C	
2009	D3 02		OUT 02	
200B	DB 00		IN 00	Read Port A.
200D	CD 39 20		CALL 2038	Encode the 8-bit word into 8- bits.
2010	FE 08		CPI 08	Any key closure

2012	FA 24 20		JM 2024	If Yes, Go to display it.
2015	78		MOV A, B	If No, Move partial result in Reg. A.
2016	C6 08		ADI 08	Increment the Port C Code
2018	47		MOV B, A	In the partial result.
2019	FE 18		CPI 18	Does Port C Code Become 11.
201B	F2 04 20		JP 2004	If Yes, Go start scanning from Row 0.
201E	79		MOV A,C	If No, Move the Bit- pattern to scan the next line.
201F	07		RAL	
2020	4F		MOV C, A	
2021	C3 08 20		JMP 2008	Continue scanning.
2024	B0	DISP	ORA B	Logical OR Port A Code with Port C Code.
2025	32 F6 27		STA 27F6	Let it be current data.
2028	F5		PUSH PSW	Arg. – No dot.
2029	C5		PUSH B	
202A	CD 4D 0F		CALL 0F4D	Display it in data field.
202D	C1		POP B	
202E	F1		POP PSW	
202F	F5		PUSH PSW	
2030	C5		PUSH B	
2031	CD 33 11		CALL 1133	
2034	C1		POP B	
2035	F1		POP PSW	
2036	C3 04 20		JMP 2004	JUMP INIT

FUNCTION	**CODE**	**This routine encodes 8 bit data to 3 bits**
INPUT	A	8 bit decoded data.

OUTPUT	A	3 bits encoded data.

2039	B7	CODE	ORA A	
303A	C2 40 20		JNZ 2040	
203D	3E 08		MVI A 08	
203F	C9		RET	
2040	16 00	CODE-1	MVI D 00	
2042	0F	CODE-2	RRC	Let LSB in A,go to carry.
2043	DA 4A 20		JC 204A	Go to return if this bit was one.
2046	14		JNR D	Increment Counter.
2047	C3 42 20		JMP 2042	Check the next bit.
204A	7A	CODE-3	MOV A, D	
204B	C9		RET	

LISTING OF THE PROGRAM FOR KEYBOARD MODULE (ET-KB) TO INTERFACE WITH 8086/8088 KIT HAVING LED DISPLAY

FOR ET-8086:

Connect the J3 of the Kit to the Module through 26 Pin FRC Cable. Ensure that the pin-1 of the J3 at the Kit end is connected to the pin-1 of the Module connector. Enter the program from address 0000:0200. **Press any Key on the keyboard and observe that its code is displayed on the Kit Display**

FOR ET-8086AD:

Connect the J1 of the Kit to the Module through 26 Pin FRC Cable. Ensure that the pin-1 of the J1 at the Kit end is connected to the pin-1 of the Module connector. Enter the program from address 0000:0200. **Press any Key on the keyboard and observe that its code is displayed on the Kit Display**

ADDRESS	OP-CODE	LABEL	MNEMONICS	REMARKS
0000:0400	BA FE FF	KBD	MOV DX, FFFE	Initialize the 8255-1, Port A - Input & Port C - Output.
403	B0 90		MOV AL, 90	
405	EE		OUT AL, DX	
406	B7 00	INIT	MOV BH, 00	Initialize the final key code in Reg. BH.
408	B3 01		MOV BL, 01	Put Bit–Pattern in Register C with one LSB position.
40A	88 D8	SCAN	MOV AL, BL	Move the Pattern To Port C.
40C	BA FC FF		MOV DX, FFFC	
40F	EE		OUT AL, DX	
410	BA F8 FF		MOV DX, FFF8	Read Port – A
413	EC		IN AL, DX	
414	E8 27 00		CALL 043E	Encode the 8-bit word into 8 bits.
417	3C 08		CMP AL, 08	Any key closure?
419	78 10		JS 042B	Yes, - Go to display it.
41B	80 C7 08		ADD BH, 08	Increment the PC code in the partial result.
41E	80 FF 18		CMP BH, 13	Does Port C code become 18.
421	79 E3		JNS 0406	If Yes, Go start scanning from Row 0.
423	88 D8		MOV AL, BL	If No, Move the bit pattern to scan the next line.
425	D0 D0		RCL AL, 01	
427	88 C3		MOV BL, AL	
429	EB DF		JMP 040A	Continue Scanning
42B	08 F8	DISP	OR AL, BH	Or the PA code with PC code.
42D	B4 00		MOV AH, 00	Display code in data field.
42F	50		PUSH AX	
430	B0 00		MOV AL, 00	
432	50		PUSH AX	
433	B0 01		MOV AL, 01	
435	50		PUSH AX	
436	50		PUSH AX	
437	9A E0 0B 00 FF		CALL 00FF:0BE0	
43C	EB C8		JMP 0406	Go to scan the keyboard again.
43E	08 C0	CODE	OR A AC, AC	
440	75 03		JNZ 0445	
442	B0 08		MOV AC, 08	
444	C3		RET	

445	B5 00	CODE 1	MOV CH, 00	
447	D0 C8	CODE 2	ROR AL, 01	Let LSB in AL go to carry.
449	72 04		JC 044F	Go to return if this bit was one.
44B	FE C5		INC CH	Increment counter.
44D	EB F8		JMP 0447	Check the next bit.
44F	88 E8	CODE 3	MOV AL, CH	
451	C3		RET	

LISTING OF THE PROGRAM FOR KEYBOARD MODULE (ET-KB) TO INTERFACE WITH 8086/8088 KIT HAVING LCD DISPLAY

FOR - ET-8086LCD

Connect the J2 of the Kit to the Module through 26 Pin FRC Cable. Ensure that the pin-1 of the J2 at the Kit end is connected to the pin-1 of the Module connector. Enter the program from address 1000:0100. Execute the Program from address 1000:0200. **Press any Key on the keyboard and observe that its code is displayed on the Kit Display**

FOR - ET-8086 -AD-LCD

Connect the J1 of the Kit to the Module through 26 Pin FRC Cable. Ensure that the pin-1 of the J1 at the Kit end is connected to the pin-1 of the Module connector. Enter the program from address 1000:0100. Execute the Program from address 1000:0200. **Press any Key on the keyboard and observe that its code is displayed on the Kit Display**

ADDRESS	OP-CODE	LABEL	MNEMONICS	REMARKS
1000:0200	BA 07 88	KBD	MOV DX, 8807	Initialize the 8255-1, Port A - Input & Port C - Output.
203	B0 90		MOV AL, 90	
205	EE		OUT DX,AL	
206	B7 00	INIT	MOV BH, 00	Initialize the final key code in Reg. BH.
208	B3 01		MOV BL, 01	Put Bit–Pattern in Register C with one LSB position.
20A	88 D8	SCAN	MOV AL, BL	Move the Pattern To Port C.
20C	BA 05 88		MOV DX, 8805	
20F	EE		OUT DX, AL	
210	BA 01 88		MOV DX, 8801	Read Port – A
213	EC		IN AL, DX	

214	E8 27 00		CALL 023E	Encode the 8-bit word into 8 bits.
217	3C 08		CMP AL, 08	Any key closure?
219	78 10		JS 022B	Yes, - Go to display it.
21B	80 C7 08		ADD BH, 08	Increment the PC code in the partial result.
21E	80 FF 18		CMP BH, 13	Does Port C code become 18.
221	79 E3		JNS 0206	If Yes, Go start scanning from Row 0.
223	88 D8		MOV AL, BL	If No, Move the bit pattern to scan the next line.
225	D0 D0		RCL AL, 01	
227	88 C3		MOV BL, AL	
229	EB DF		JMP 020A	Continue Scanning
22B	08 F8	DISP	OR AL, BH	Or the PA code with PC code.
22D	B4 00		MOV AH, 00	Display code in data field.
22F	CD AC		INT AC	
231	88 04		MOV [SI],AL	
233	8B 14		MOV DX,[SI]	
235	B0 02		MOV AL,02	
237	CD AE		INT AE	
239	CD AB		INT AB	
23B	90		NOP	
23C	EB C8		JMP 0206	Go to scan the keyboard again.
23E	08 C0	CODE	OR A AL, AL	
240	75 03		JNZ 0245	
242	B0 08		MOV AL, 08	
244	C3		RET	
245	B5 00	CODE 1	MOV CH, 00	
247	D0 C8	CODE 2	ROR AL, 01	Let LSB in AL go to carry.
249	72 04		JB 024F	Go to return if this bit was one.
24B	FE C5		INC CH	Increment counter.
24D	EB F8		JMP 0247	Check the next bit.
24F	88 E8	CODE 3	MOV AL, CH	
251	C3		RET	

PROGRAM FOR KEYBOARD INTERFACE WITH ET-8031AD LED BASED MICROCONTROLLER KIT

Connect the J4 of the Kit to the Module through 26 Pin FRC Cable. Ensure that the pin-1 of the J4 at the Kit end is connected to the pin-1 of the Module connector. Enter the program from address 2000. **Press any Key on the keyboard and observe that its code is displayed on the Kit Display**

ADDRESS	CODES	LABEL	MNEMONICS	COMMENTS
2000	90 FF 03	START:	MOV DPTR, #FF03H	; use 8255-I
2003	74 90		MOV A, #90H	
2005	F0		MOVX @DPTR, A	; port A i/p, C o/p
2006	75 81 65	LOOP6:	MOV SP, #65H	
2009	90 20 70		MOV DPTR, #2070H	
200C	7B 05		MOV R3, #05H	
200E	74 FF		MOV A, #FFH	
2010	F0	LOOP1:	MOVX @DPTR, A	
2011	A3		INC DPTR	
2012	DB FC		DJNZ R3, LOOP1	; clear display address area
2014	C0 83		PUSH DPH	
2016	C0 82		PUSH DPL	; save dptr
2018	7A 01		MOV R2, #01H	
201A	78 00		MOV R0, #00H	
201C	12 20 4F	LOOP4:	LCALL SCAN	; scan keys and read status
201F	13	LOOP3:	RRC A	
2020	40 1C		JC LOOP2	; if keys is pressed go to loop2
2022	08		INC R0	
2023	D9 FA		DJNZ R1, LOOP3	; recognize particular key
2025	EA		MOVA, R2	
2026	23		RL A	
2027	FA		MOV R2, A	
2028	BA 04 F1		CJNE R2, #04H,LOOP4	; for next line to scan
202B	78 00		MOV R0, #00H	
202D	90 20 74		MOV DPTR, #2074H	; for graphical character
2030	74 9F		MOV A, #9FH	
2032	F0		MOVX @DPTR, A	
2033	12 20 4F		LCALL SCAN	; scan graphical keys
2036	13	LOOP5:	RRC A	
2037	40 05		JC LOOP2	; if key is pressed go to loop2
2039	08		INC R0	
203A	D9 FA		DJNZ R1, LOOP5	; recognize particular key
203C	80 C8		SJMP LOOP6	
203E	D0 82	LOOP2:	POP DPL	

2040	D0 83		POP DPH	; get dptr
2042	E8		MOV A, R0	
2043	12 07 E2		LCALL GETCODE	; find 7-segment code
2046	F0		MOVX @DPTR, A	
2047	90 20 70		MOV DPTR, #2070H	
204A	12 06 F7		LCALL DISPLAY	; display the key code
204D	80 B7		SJMP LOOP6	
204F	EA	SCAN:	MOV A, R2	
2050	90 FF 02		MOV DPTR, #FF02H	
2053	F0		MOVX @DPTR, A	; scan port C
2054	79 08		MOV R1, #08H	
2056	90 FF 00		MOV DPTR, #FF00H	; read port A
2059	E0		MOVX A, @DPTR	
205A	22		RET	

DISCRIPTION: KEYBOARD MODULE HAS TO BE CONNECTED AT 8255-I THROUGH 26 PIN FRC

KEY	DISPLAY
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
A	A
B	B
C	C
D	D
E	E
F	F
+	10
-	11
/	12
*	13

LISTING OF THE PROGRAM FOR KEYBOARD MODULE (ET-KB) TO INTERFACE WITH 8031/51 KIT HAVING LCD DISPLAY

Connect the J1 of the Kit to the Module through 26 Pin FRC Cable. Ensure that the pin-1 of the J1 at the Kit end is connected to the pin-1 of the

Module connector. Enter the program from address 6000. Execute the Program from address 6000. **Press any Key on the keyboard and observe that its code is displayed on the Kit Display**

ADDRESS	OPCODE	LABEL	MNEMONICS	REMARKS
6000	90 28 0B	START	MOV DPTR,# 280B	Use 8255-I
6003	74 90		MOVA,# 90	Port A – Input &
6005	F0		MOVX @DPTR,A	Port C - Output
6006	75 81 65	LOOP6	MOV 81,# 65	
6009	90 60 70		MOV DPTR,# 6070	
600C	7B 05		MOV R3,# 05	
600E	74 FF		MOVA,# FF	
6010	F0	LOOP1	MOVX @DPTR,A	Clear display address area
6011	A3		INC DPTR	
6012	DB FC		DJNZ R3,FC	
6014	C0 83		PUSH 83	
6016	C0 82		PUSH 82	
6018	7A 01		MOV R2,# 01	
601A	78 00		MOV R0,# 00	
601C	12 70 00	LOOP4	LCALL 7000	Scan keys and read status
601F	13	LOOP3	RRC A	
6020	40 1C		JC 1C	If key pressed, go to loop2
6022	08		INC R0	
6023	D9 FA		DJNZ R1,FA	Recognize particular key
6025	EA		MOVA,R2	
6026	23		RLA	
6027	FA		MOV R2,A	
6028	BA 04 F1		CJNE R2,# 04,F1	For next line to scan
602B	78 10		MOV R0,#10	
602D	90 60 74		MOV DPTR,# 6074	For graphical character
6030	74 9F		MOVA,# 9F	
6032	F0		MOVX @DPTR,A	
6033	12 70 00		LCALL 7000	Scan graphical keys
6036	13	LOOP5	RRC A	
6037	40 05		JC 05	If key pressed, go to loop2
6039	08		INC R0	
603A	D9 FA		DJNZ R1,FA	Recognize particular key
603C	80 C8		SJMP C8	
603E	D0 82	LOOP2	POP 82	
6040	D0 83		POP 83	Get DPTR
6042	E8		MOVA,R0	
6043	F0		MOVX @DPTR,A	
6044	FE		MOV R6,A	

6045	12 01 D5		LCALL 01D5	
6048	EE		MOVA,R6	
6049	54 F0		ANLA,# F0	
604B	C4		SWAP A	
604C	12 05 89		LCALL 0589	
604F	EE		MOVA,R6	
6050	54 0F		ANLA,# 0F	
6052	12 05 89		LCALL 0589	
6055	79 FF		MOV R1,# FF	
6057	7A FF		MOV R2,# FF	
6059	12 01 14		LCALL 0114	
605C	80 A2		SJMP A2	
Now Enter the Program from Address 7000 onwards				
7000	EA	SCAN	MOVA,R2	
7001	9028 0A		MOV DPTR, #280A	
7004	F0		MOVX @DPTR,A	Scan port C
7005	79 08		MOV R1,# 08	
7007	90 28 08		MOV DPTR,# 2808	Read port A
700A	E0		MOVX A,@DPTR	
700B	22		RET	

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