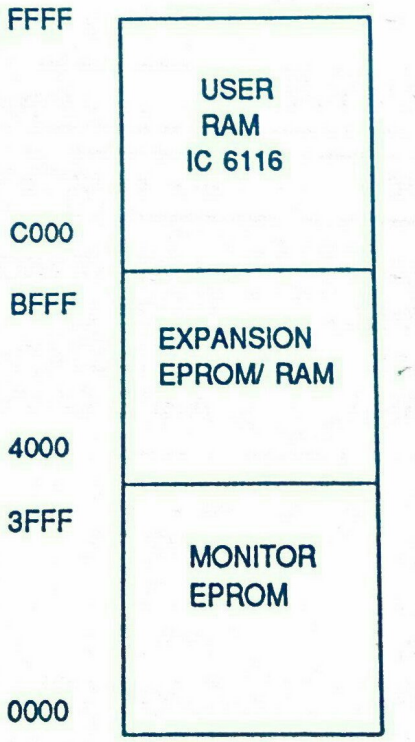
CHAPTER 2

SYSTEM MEMORY & INPUT/ OUTPUT MAPPING

2.1 MEMORY MAPPING

The system memory is also as important as the CPU itself, because this is where the system program resides and the CPU takes its instruction from the program. The memory is of two types ROM and RAM ie. READ ONLY MEMORY & RANDOM ACCESS MEMORY.

The MICROFRIEND DYNA-85 has a flexible memory map, and for your convenience for program development, the RAM has useful features such as battery back-up.



0000H to 3FFFH :

Monitor EPROM socket. Monitor 2732 is located at 0000H to 0FFFH and is mapped at 1000H-1FFFH, 2000H-2FFFH and 3000H-3FFFH also.

If 2764 / 27128 are used, 1000H-3FFFH can be used for further expansion.

4000H to BFFFH :

This Socket is used for user expansion of EPROM and RAM. EPROMs like 2716 / 2732 / 2732 / 2764 / 27128 / 27256 or RAMs like 6116 / 6264 / 62256 can be installed by suitable strappings.

C000H to FFFFH :

User RAM socket. The 2K user RAM IC 6116 is located at F800H - FFFFH. This 2K memory is folded after every 2K bytes from C000H to FFFFH. In this socket 6264 chip can also be used.

2.2 INPUT/ OUTPUT MAPPING

IC	ADDRESS	MODE	I/O FUNCTION
8279	04	READ	READ KEYBOARD FIFO
		WRITE	WRITE DATA TO DISPLAY
	05	READ	READ STATUS WORD
		WRITE	WRITE COMMAND WORD
8155	08	WRITE	COMMAND/ STATUS REGISTER
	09	R/W	PORT A
	0A	R/W	PORT B
	0B	R/W	PORT C
	0C	R/W	TIMER LOW BYTE
	0D	R/W	TIMER HIGH BYTE

IC	ADDRESS	MODE	I/O FUNCTION
8255	10	R/W	PORT A
	11	R/W	PORT B
	12	R/W	PORT C
	13	WRITE	CONTROL REGISTER
8253	18	R/W	COUNTER 0
	19	R/W	COUNTER 1
	1A	R/W	COUNTER 2
	1B	WRITE	CONTROL REGISTER

2.3 POWER SUPPLY

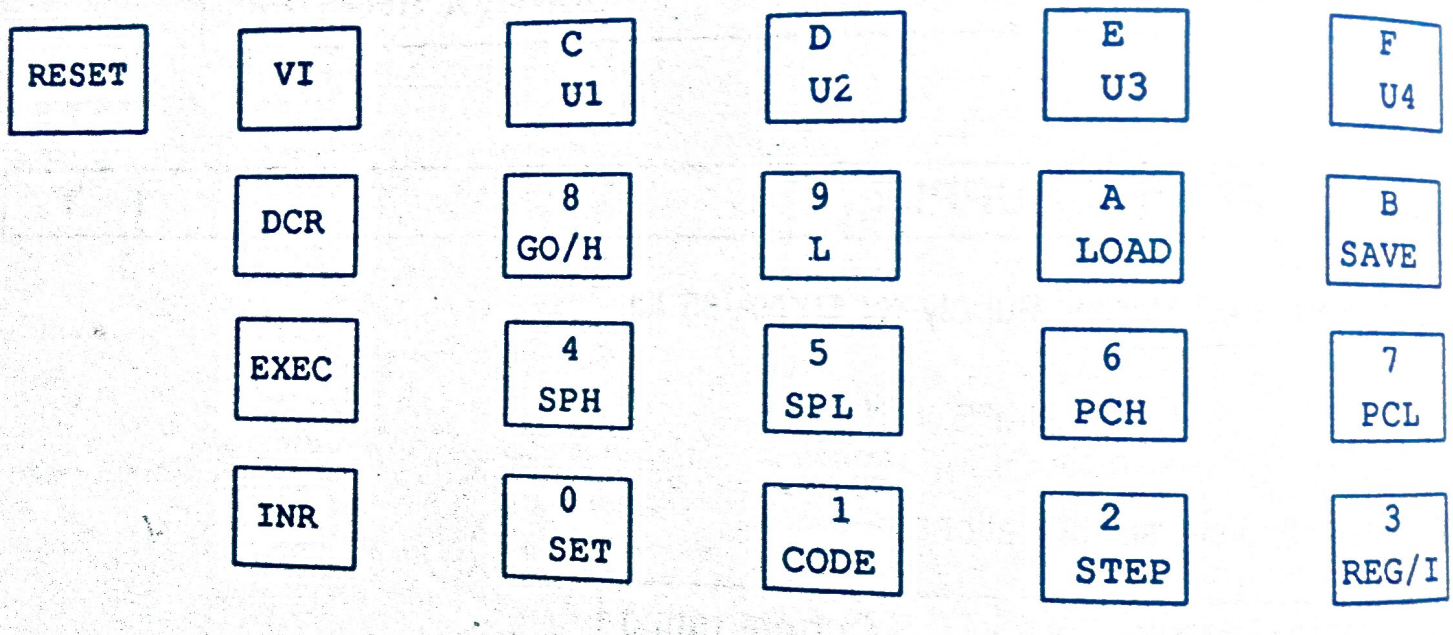
Recommended Power Supply for DYNA-85 kit

DMS SMPS - 01

having following specifications :

Voltage	Current rating
+ 5 V	1 A
+ 12 V	500 mA
- 12 V	250 mA
+ 30 V	100 mA

KEYPAD LAYOUT :



CHAPTER 3

OPERATING INSTRUCTION - KEYBOARD

3.1 KEYBOARD OPERATION

MICROFRIEND DYNA-85 has a built in keyboard (KEYPAD). The layout of the keypad is given on the opposite page for ready reference. The system can also be operated through a console connected to the serial interface.

While using the built in keyboard, we can work only in the Hexadecimal number system. There are 16 keys for entering Hex numbers from 0 to F. These are all dual meaning keys and the key designated depends on when the key is pressed. In addition to these 16 keys there is one vector Interrupt key, one RESET key and 3 function keys.

When the system is switched on the display shows, sign-on message, 'F r I E n d'. This indicates that the system is reset and the monitor expects a command from you. At this moment any one of the command keys : SET, CODE, STEP, REG, GO, LOAD or SAVE can be pressed depending on the desired operation.

In case any non command key is pressed, the display will show 'FErr' message, you can again press a valid command key or press RESET and then press a valid command key.

The various command and function keys are explained below :

3.2 SET, INR, DCR KEYS

You can use the SET key to set the address of the memory location to be accessed. On pressing SET key the display becomes blank and a dot appears in the Address field which is made up of the first four digits of the six digit display. The remaining two digits of the six digit display are the data field. The dot in the address field indicates that your next key will be treated as an address entry (entry is from Right to Left and last 4 entries are retained).

When you have entered the 4 digit hexadecimal address press the INR key which will terminate the address entry and display the present contents of that memory location as the two digits in the data field.

Now you can modify or retain the contents of the location.

Pressing INR key again will load the data field into the memory location at the address shown in the address field. This key also increments the address by 1 location and displays the contents of that new location. This process continues till we have completed loading the desired memory locations with required data.

DCR key also works in a similar way but it decrements the address by 1 and points to the previous location.

Trying to load data into a Monitor EPROM location using SET key results in 'FErr' (error).

SET, INR, DCR keys can also be used to verify the data loaded in RAM by displaying one location after another.

EXAMPLE 1 :

Key Pressed	Address Field	Data Field
RES	F r I E	n d
SET		
F	0 0 0 F	
0	0 0 F 0	
0	0 F 0 0	
0	F 0 0 0	
INR	F 0 0 0	X X
3	F 0 0 0	0 3
E	F 0 0 0	3 E
INR	F 0 0 1	X X
DCR	F 0 0 0	3 E
EXEC	F	

Pressing EXEC key terminates the loading of memory and the monitor waits for next command.

3.3 REG

This key allows you to examine and optionally modify the contents of all 8085 internal registers.

Pressing REG key will blank the display and a dot appears in the address field. Next press a valid register name. The Register names appear on various hexadecimal number keys as follows :-

3 : I (Interrupt Mask)
4 : SPH (Stack Pointer High)
5 : SPL (Stack Pointer Low)

6 : PCH (Program counter High)
7 : PCL (Program counter Low)
8 : H (H Register)
9 : L (L Register)
A : A (A Register)
B : B (B Register)
C : C (C Register)
D : D (D Register)
E : E (E Register)
F : F (Flag Register)

Pressing any one of these keys after pressing REG key will display the particular register name in the address field and the contents of that register will be displayed in the data field.

Pressing INR key after this, will point to the next register and DCR will point to the previous register.

Contents of the register can be modified at this point similar to loading any other memory location.

Pressing INR and DCR keys after modifying the contents of that register and ENTER terminates the command. Address field shows F in the left most digit, the monitor indicates as usual that the it is waiting for the next command.

Format for the I register (Interrupt Mask) is as follows :

				I	M	M	M
0	0	0	A	E	7.5	6.5	5.5

I = Interrupt enable Flag [1 is enabled, 0 is disabled]
M = Interrupt Mask [1 is masked, 0 is unmasked]

Format of the F register (Flag Register) is as follows :

S	Z	X	AC	X	P	X	C

X : Don't Care.
C : Carry
P : Parity
X : Don't Care
AC : Auxiliary Carry
Z : Zero
S : Sign

EXAMPLE 2 :

Key Pressed	Address Field	Data Field
REG	.	
A	A	X X
0	A	0 0
5	A	0 5
0	0	5 0
INR	B	X X
DCR	A	5 0
EXEC	F	

NOTE : ONLY LAST TWO ENTRIES ARE RETAINED.

3.4 GO / EXEC

This pair of keys is used to execute a program from a desired location onwards. If the GO key is pressed, it displays the present address in the program counter and the contents of the memory location at that address. A dot appears in the address field indicating that you can enter a new address in the address field. You can now modify the contents of the program counter. After loading the desired starting address in the address field, press EXEC key to execute the program starting at the address. During execution of the program ,the address field shows 'E' indicating that the user program or subroutine is being executed.

The Monitor Regains control either after pressing the RESET key (Hardware Reset) or after executing RST 0, RST 1, JMP 0000H or JMP 0008H instruction (Software Reset).

EXAMPLE 3 :

Key Pressed	Address Field	Data Field
GO	P P P P	XX
F	0 0 0 F	
0	0 0 F 0	
0	0 F 0 0	
0	F 0 0 0	
EXEC	F	

NOTE : P P P P IS THE PRESENT CONTENTS OF PROGRAM COUNTER WHEN GO KEY WAS PRESSED. XX IS THE DATA IN MEMORY LOCATION P P P P.

3.5 STEP

We have seen how a program can be executed by using GO and EXEC pair of keys. This method is useful only when the program is finalized, or when we have a ready program.

In case a program is being developed, it is essential that we have a ready program and it is essential that we have a facility to check the execution of program stage by stage and see the results.

This can be achieved in two ways. One way is to insert the RST 1 instruction (CFH) at every point where a break is desired to check status or result, which is possible only in case of short programs being run from the RAM.

Another way is to use the STEP key and step through the program. Pressing the STEP key displays the contents of the program counter, which can be modified to set the starting address of the program.

Now press INR and the monitor will prompt for other parameters :

br : Break Address
Cn : N + 1 ,where N is the number of times the break should occur.

In case 'br' and 'Cn' both are given a value of zero, the system goes into single stepping mode. In single stepping mode, the program is executed single instruction at a time. Execution stops after every instruction and a status check is possible.

EXAMPLE 4 :

Let us take a simple program to see how the STEP command works. Load the following program starting at location F000H.

Address	Data	Mnemonic
F000	3E 05	MVI A,05h
F002	3D	DCR A
F003	C202F0	JNZ F002h
F006	76	HALT

This program first loads register A (Accumulator) with 05, then decrements the accumulator contents by 1 till the contents become zero and halts at that point.

The JNZ loop will make use of 'br' and 'Cn'. First let us execute the program with STEP key and using 'br' and 'Cn' parameters.

Key Pressed	Address Field	Data Field	Comments
STEP	P P.P P	X X	PRESENT PC CONTENTS
			STARTING ADDRESS
F000	F 0 0 0		BREAK ADDRESS ?
INR	.	b r	
F002	F 0 0 2	b r	BREAK AT F002
INR	C n	.	Cn ?
04	C n	0 4	Cn = 4 = N + 1
INR	F 0 0 2	3 D	PROGRAM STOPS AFTER BREAKPOINT OCCURED 3 TIMES
EXEC	F		
REG	.		EXAMINE REG. A
A	A	0 2	

As the program stopped after the breakpoint occured 3 times, the original contents of register A which were 05 have been decremented three times. The register A should now contain 02, which is displayed in the data field.

The same program can be executed in a single stepping mode.

Key Pressed	Address Field	Data Field	Comments
STEP	P P P P	X X	PRESENT PC CONTENTS
F000	F 0 0 0		STARTING ADDRESS
INR	.	b r	BREAK POINT ?
0	0 0 0 0	b r	IGNORE br.
INR	C n	.	Cn ?
0	0 0 0 0	0 0	IGNORE Cn.
INR	F 0 0 2	3 D	FIRST INSTRUCTION EXECUTED PC POINTS TO NEXT INSTR.
EXEC	F		PROGRAM STOPS FOR
REG	.		STATUS CHECK.
A	A	0 5	REG. A (Acc) CONTENTS 05
EXEC	F		NEXT COMMAND ?
STEP	F 0 0 2	3 D	STEP
INR	F 0 0 3	C 2	SECOND INSTR. EXECUTED
EXEC	F		PROGRAM STOPS FOR STATUS CHECK
REG	.		REGISTER A(Acc) CONTENTS 04
A	A	0 4	AFTER DECREMENTING ONCE

After continuing this sequence till the contents of A become 00, the program comes out from the JNZ loop and the address field shows the last address of the program, i.e. F006H. Contents of this location are displayed in the data field as 76 (HALT). If you press EXEC at this stage and examine the contents of register A using REG command, the result will be 00 as expected.

3.6 VI : VECTOR INTERRUPT

This key is used to interrupt the program execution and transfer the control to location 003CH in the monitor. This location has a jump to location FFCEH in the user RAM. By inserting another jump instruction at FFCEH, we can transfer the control to an interrupt service routine located to another area in the memory.

For proper operation of this key, the user program must enable the interrupt through the EI instruction and the RST 7.5 must be unmasked using the SIM instruction.

The example of a decimal counter included in the chapter on programming, will make the application of VI key will make it more clear.

3.7 RES : RESET

Pressing RES key causes a hardware RESET operation. The control is transferred to location 0000H in the monitor. The monitor program is executed from 0000H onwards without saving the status resulting from any user program executed before the 'RESET'. The display shows **'F r I E n d'** as the sign-on message and the monitor waits for a valid command.

3.8 CODE

The CODE key allows you to access one of the coded subroutines in the monitor firmware. All the user accessible coded subroutines are explained in Chapter 4.

3.9 USER KEYS U1, U2, U3, U4

There are 4 user definable keys on the MICROFRIEND DYNA-85. Each of these keys has a vector in the scratchpad RAM area. By loading an appropriate jump instruction at these location, you can define the function of keys U1, U2, U3, U4.

The vector locations are as follows :

Key	Memory Location
U1	FF9CH, FF9DH, FF9EH
U2	FF9FH, FFA0H, FFA1H
U3	FFA2H, FFA3H, FFA4H
U4	FFA5H, FFA6H, FFA7H

An example will illustrate how these keys can be used. There is a subroutine in the monitor for a "ROLLING DISPLAY" at location 0E5BH. Using the SET key load a jump instruction C3 5B 0E at location FF9CH, FF9DH and FF9EH which are the U1 key vector locations. Now reset the system and then press U1 key, the display immediately blanks for a moment and then a rolling message appears

d Y n A L o G h E L P S Y o U I n L E A r n I n G U P

By using the U1 key vector, you have effectively transfered the control to the rolling display subroutine.

3.10 SAVE

This command is used for saving your program on an audio cassette. The procedure for saving is as follows :

1. Connect the MIC socket (on the top) of the MICROFRIEND DYNA - 85 to the MIC socket of the CTR.

2. Press SAVE key, enter the following parameters

   SS : Source Start
   SE : Source End
   Fn : File Number - any hex number from 00 to FF.

3. Turn CTR ON and keep it in RECORD mode.

4. Press the EXEC key, S appears in the data field. S in the data field indicates that your program is being saved on the audio cassette.

5. On completion of SAVE operation, **F r I E n d** appears again on the display.

6. Turn CTR OFF.

3.11 LOAD

This command loads your programs from the cassette to the RAM. The procedure for loading is described below :

1. Connect the EAR socket of MICROFRIEND DYNA-85 to the EAR or external speaker socket of the CTR. (Select volume control setting by trial)

2. Press LOAD key, enter the File Number Fn of the program to be loaded. (A hex number between 00 & FF)

3. Turn CTR ON, keep it in PLAY mode.

4. Immediately press EXEC Key. L appears in the data field, indicating that the CPU is searching for the file with file number Fn.

5. Whenever the CPU comes across any File Number, it is displayed in the data field. Loading starts only when the specified File number is found and displayed.

6. The SS parameter of your program is already saved on the cassette tape, and when the program is being loaded back into RAM, it automatically gets loaded at the same address.

7. On completion of loading the program with File number Fn, SS parameter is displayed in the address field.

NOTE : There shouldn't be a gap of more than 10 sec. between turning CTR ON and pressing EXEC key.