



A. HE83760M Introduction

HE83760M is a member of 8-bit Micro-controller series developed by King Billion Electronics Ltd. This IC has built-in 3072 pixels LCD driver, and also have 32-bit I/O ports. The built-in OP comparator can be used with light, voice, temperature and humidity sensor or used to detect the battery low. The 7-bit current-type D/A converter and PWM drive output provide the complete speech output mechanism. The built-in DTMF generator can generate the PSTN dialing tone directly. The 2M byte ROM and 16K byte RAM can be used in the storage of large speech data, image and text etc. HE83760M can be used in Translator、Data Bank、Pocket Dialer、Educational Toy、Digital Voice Recording System etc.

The instruction sets of HE80000 series are quite easy to learn and simple to use. Only about thirty instructions with four-type addressing mode are provided. Most of instructions take only 3 oscillator clocks (machine cycles). The performance of HE83760M is enough for most of battery operation system.

B. HE83760M Features

- Operation Voltage: 2.4V ~ 3.6V
- System Clock 4MHz ~ 8MHz
- Clock Source: Internal/External Fast clock, Internal/External slow clock
- Dual Clock System : Normal (Fast) clock 32.768KHz ~ 8MHz
Slow clock 32.768 KHz
- Operation Mode : DUAL、FAST、SLOW、IDLE、SLEEP Mode.
- Internal ROM: 2M Bytes (64K Program ROM, 1984K Data ROM)
- Internal RAM: 16K Bytes.
- Watch dog timer.
- 32 Bi-directional I/O ports.
- 3072 pixels LCD driver (B Type) with built-in regulator for LCD display, without LCD contrast control function. The maximum LCD voltage must be lower than 8.5V.
- LCD COM X SEG : 32 X 96
- LCD Bias : 1/7
- LCD Charge Pump: 3, 4, and 5 times of LVREG
- One 7-bits current-type DAC output.
- One built-in OP comparator.
- PWM device.
- Built-in DTMF Generator.
- Recording function
- Speech recognition function
- Two external interrupts and three internal timer interrupts.
- Two 16-bit timers and one time-base timer.
- Instruction set : 32 instructions, 4 addressing mode. 14-bit DATA POINTER for RAM and 21-bit TABLE POINTER for ROM.

C. Pin Description

Pin #	Pin name	I/O	Function	Description
84 83	FXI, FXO	B, O	External fast clock input/output pins are used to connect crystal or RC to generate the 32.768KHz ~ 8MHz system clock.	Mask Option setting: MO_FCK/SCKN = 00 : Slow Clock only 01 : Illegal 10 : Dual Clock 11 : Fast Clock only MO_FOSCE= 0 : Internal fast clock 1 : External fast clock MO_FXTAL= 0 : R,C OSC. for Fast Clock 1 : Crystal OSC. for Fast Clock MO_SXTAL= 0 : R,C OSC. for 32.768K Clock 1 : Crystal OSC. for 32.768K Clock Use OP1 and OP2 to switch among different operation mode (NORMAL, SLOW, IDEL and SLEEP). In Dual Clock mode, the main system clock is still the Fast Clock. The 32768 Hz clock is for LCD and Timer 1 only.
87 86	SXI, SXO	I, O	External slow clock input/output pins used to connect the 32.768KHz crystal to generate slow clock for system operation (slow mode), LCD display or timer 1 clock source.	
82	RSTP_N	I	System reset signal	Active low and level trigger reset signal. User can also set the mask option MO_PORE=1 to enable the build-in Power-on reset circuit besides using the reset pin. Watch Dog Timer can also be enabled/disabled by the mask option, MO_WDTE = 0 : Disable Watch Dog Timer = 1 : Enable Watch Dog Timer
85	TSTP_P	I	IC Test Pin	Please bond this pin to ground by a 0 ohm resistor to let it accessible when it's necessary for some testing.
101.. 108	PRTC[7:0]	B	Bi-directional I/O port C	Mask options setting: MO_CPP [7:0] = 1 : Push-pull output. = 0 : Open-drain output. Output must be "1" before reading whenever uses them as input (Non tri-state structure).
93.. 100	PRTD[7:0]	B	Bi-directional I/O port D. PRTD [7:2] also used as wake-up pin, and PRTD [7:6] also used as external interrupt pin.	Mask options setting: MO_DPP [7:0] = 1 : Push-pull output. = 0 : Open-drain output. Output must be "1" before reading whenever uses them as input (Non tri-state structure).
109.. 116	PRT10[7:0]	B	Bi-directional I/O port 10	Mask options setting: MO_10PP [7:0] = 1 : Push-pull output. = 0 : Open-drain output. Output must be "1" before reading whenever uses them as input (Non tri-state structure).
117.. 124	PRT11[7:0]	B	Bi-directional I/O port 11	Mask options setting: MO_11PP [7:0] = 1 : Push-pull output. = 0 : Open-drain output. Output must be "1" before reading whenever uses them as input (Non tri-state structure).



Pin #	Pin name	I/O	Function	Description
143..128 44..59	COM[31:0]	O	LCD COM Output	LCD common/segment driving pins.
144..196 1..43	SEG[95:0]	O	LCD SEG Output	LCD Data filled from page1 00H; please refer the LCD RAM map.
74	LV1	B	LCD Bias Voltage 1	LV5> LV4> LV3> LV2> LV1 。 Adjust Resistor between LCDGS and LV2 to set LV5 for LCD glass. The formula is LV5 = 3.5*LV2 。 (Bias=1/7) Suggest that LV2=2.0V, so LV5=7.0V.
73	LV2	B	LCD Bias Voltage 2	
62	LV3	B	LCD Bias Voltage 3	
61	LV4	B	LCD Bias Voltage 4	
60	LV5	B	LCD Bias Voltage 5	
72	LCDGS	B	LCD Gain Setting Pin	~300K between LCDGS and LV2 → LV2 ≐ 2.0 Volt
63	LCDVTB	B	Charge Pump Capacitor Pin	Larger voltage stair than LCxA, LCxB stair
75	LCDVX	B	Charge Pump Capacitor Pin	Smaller voltage stair than LCxA, LCxB stair
64	LC4B	B	Charge Pump Capacitor Pin	Different LCD Bias must be matching its Capacitor Configuration relatively. This IC is with all pins for type-IV LCD Driver. Some of charge pump pins were not using since the bias of this IC was fixed at 1/7.
65	LC4A	B	Charge Pump Capacitor Pin	
66	LC3B	B	Charge Pump Capacitor Pin	
67	LC3A	B	Charge Pump Capacitor Pin	
68	LC2B	B	Charge Pump Capacitor Pin	
69	LC2A	B	Charge Pump Capacitor Pin	
70	LC1B	B	Charge Pump Capacitor Pin	
71	LC1A	B	Charge Pump Capacitor Pin	
125	PWMP	O	The PWM positive output can drive speaker or buzzer directly.	Set the bit2(PWM=1) of VOC register and bit0 of PWMC register to turn on PWM
126	PWMN	O	The PWM positive output can drive speaker or buzzer directly.	
77	VO	O	Voice output.	Set the bit0(OP=0) and bit1(DA=1) of VOC register to turn on VO
78	DAO	O	DAC Output	Set the bit0(OP=1) and bit1(DA=1) of VOC register to turn on DAO
79	OPIN	I	OPAMP negative input pin.	Built-in OP comparator. Enable DAO to work with OP. Refer to application note for detailed operation.
80	OPIP	I	OPAMP positive input pin.	
81	OPO	O	OPAMP output pin.	
90	DTMFO	O	DTMF Output	Through PRT12 we can turn on/off DTMF and write data. Using Mask Option MO_DTMFSCK set the clock source of DTMF block. MO_DTMFSCK=0 : Clock Source=3.579545 MHz =1 : Clock Source=32768 Hz
89	MUTE	O	MUTE Output for Dialer	User can turn on/off MUTE pin by port12.
91	SDO	O	Serial Data Output	We can turn on/off SDO block or write data by port12.
92	KEYTONE	O	1024-Hz 50% duty square wave	User can turn on/off key tone by port12.
88	VDD	P	Positive Power Input	Add a 0.1 μF capacitor as by-pass capacitor between VDD and GND.
76	GND	P	Power Ground Input	
127	VDD_RAM	P	Dedicated Power for RAM	



D. LCD RAM MAP

Page 1	SEG [7:0]	SEG [15:8]	SEG [23:16]	SEG [31:24]	SEG [39:32]	SEG [47:40]	SEG [55:48]	SEG [63:56]
COM0	00H	20H	40H	60H	80H	A0H	C0H	E0H
COM1	01H	21H	41H	61H	81H	A1H	C1H	E1H
COM2	02H	22H	42H	62H	82H	A2H	C2H	E2H
:	:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:	:
COM29	1DH	3DH	5DH	7DH	9DH	BDH	DDH	FDH
COM32	1EH	3EH	5EH	7EH	9EH	BEH	DEH	FEH
COM31	1FH	3FH	5FH	7FH	9FH	BFH	DFH	FFH

Page 2	SEG [71:64]	SEG [79:72]	SEG [87:80]	SEG [95:88]
COM0	00H	20H	40H	60H
COM1	01H	21H	41H	61H
COM2	02H	22H	42H	62H
:	:	:	:	:
:	:	:	:	:
COM29	1DH	3DH	5DH	7DH
COM32	1EH	3EH	5EH	7EH
COM31	1FH	3FH	5FH	7FH



F. Bonding Pad Location

PIN Number	PIN Name	X Coordinate	Y Coordinate	PIN Number	PIN Name	X Coordinate	Y Coordinate
1	SEG[42]	-4077.20	1523.75	99	PRTD[1]	4048.34	-1524.90
2	SEG[41]	-4077.20	1408.75	100	PRTD[0]	4048.34	-1409.90
3	SEG[40]	-4077.20	1293.75	101	PRTC[7]	4048.34	-1294.90
4	SEG[39]	-4077.20	1178.75	102	PRTC[6]	4048.34	-1179.90
5	SEG[38]	-4077.20	1063.75	103	PRTC[5]	4048.34	-1064.90
6	SEG[37]	-4077.20	948.75	104	PRTC[4]	4048.34	-949.90
7	SEG[36]	-4077.20	833.75	105	PRTC[3]	4048.34	-834.90
8	SEG[35]	-4077.20	718.75	106	PRTC[2]	4048.34	-719.90
9	SEG[34]	-4077.20	603.75	107	PRTC[1]	4048.34	-604.90
10	SEG[33]	-4077.20	488.75	108	PRTC[0]	4048.34	-489.90
11	SEG[32]	-4077.20	373.75	109	PRT10[7]	4048.34	-374.90
12	SEG[31]	-4077.20	258.75	110	PRT10[6]	4048.34	-259.90
13	SEG[30]	-4077.20	143.75	111	PRT10[5]	4048.34	-144.90
14	SEG[29]	-4077.20	28.75	112	PRT10[4]	4048.34	-29.90
15	SEG[28]	-4077.20	-86.25	113	PRT10[3]	4048.34	85.10
16	SEG[27]	-4077.20	-201.25	114	PRT10[2]	4048.34	200.10
17	SEG[26]	-4077.20	-316.25	115	PRT10[1]	4048.34	315.10
18	SEG[25]	-4077.20	-431.25	116	PRT10[0]	4048.34	430.10
19	SEG[24]	-4077.20	-546.25	117	PRT11[7]	4048.34	545.10
20	SEG[23]	-4077.20	-661.25	118	PRT11[6]	4048.34	660.10
21	SEG[22]	-4077.20	-776.25	119	PRT11[5]	4048.34	775.10
22	SEG[21]	-4077.20	-891.25	120	PRT11[4]	4048.34	890.10
23	SEG[20]	-4077.20	-1006.25	121	PRT11[3]	4048.34	1005.10
24	SEG[19]	-4077.20	-1121.25	122	PRT11[2]	4048.34	1120.10
25	SEG[18]	-4077.20	-1236.25	123	PRT11[1]	4048.34	1235.10
26	SEG[17]	-4077.20	-1351.25	124	PRT11[0]	4048.34	1350.10
27	SEG[16]	-4077.20	-1466.25	125	PWMP	4048.34	1465.10
28	SEG[15]	-4077.20	-1581.25	126	PWMN	4048.34	1586.80
29	SEG[14]	-4077.20	-1705.95	127	VDD_RAM	4048.34	1711.74
30	SEG[13]	-4077.20	-1827.90	128	COM[16]	3971.56	1902.45
31	SEG[12]	-3670.75	-1933.95	129	COM[17]	3854.13	1902.45
32	SEG[11]	-3548.80	-1933.95	130	COM[18]	3738.64	1902.45
33	SEG[10]	-3424.10	-1933.95	131	COM[19]	3623.10	1902.45
34	SEG[9]	-3309.10	-1933.95	132	COM[20]	3508.10	1902.45
35	SEG[8]	-3194.10	-1933.95	133	COM[21]	3393.10	1902.45
36	SEG[7]	-3079.10	-1933.95	134	COM[22]	3278.10	1902.45
37	SEG[6]	-2964.10	-1933.95	135	COM[23]	3163.10	1902.45



PIN Number	PIN Name	X Coordinate	Y Coordinate	PIN Number	PIN Name	X Coordinate	Y Coordinate
38	SEG[5]	-2849.10	-1933.95	136	COM[24]	3048.10	1902.45
39	SEG[4]	-2734.10	-1933.95	137	COM[25]	2933.10	1902.45
40	SEG[3]	-2619.10	-1933.95	138	COM[26]	2818.10	1902.45
41	SEG[2]	-2504.10	-1933.95	139	COM[27]	2703.10	1902.45
42	SEG[1]	-2389.10	-1933.95	140	COM[28]	2588.10	1902.45
43	SEG[0]	-2274.10	-1933.95	141	COM[29]	2473.10	1902.45
44	COM[15]	-2159.10	-1933.95	142	COM[30]	2358.10	1902.45
45	COM[14]	-2044.10	-1933.95	143	COM[31]	2243.10	1902.45
46	COM[13]	-1929.10	-1933.95	144	SEG[95]	2128.10	1902.45
47	COM[12]	-1814.10	-1933.95	145	SEG[94]	2013.10	1902.45
48	COM[11]	-1699.10	-1933.95	146	SEG[93]	1898.10	1902.45
49	COM[10]	-1584.10	-1933.95	147	SEG[92]	1783.10	1902.45
50	COM[9]	-1469.10	-1933.95	148	SEG[91]	1668.10	1902.45
51	COM[8]	-1354.10	-1933.95	149	SEG[90]	1553.10	1902.45
52	COM[7]	-1239.10	-1933.95	150	SEG[89]	1438.10	1902.45
53	COM[6]	-1124.10	-1933.95	151	SEG[88]	1323.10	1902.45
54	COM[5]	-1009.10	-1933.95	152	SEG[87]	1208.10	1902.45
55	COM[4]	-894.10	-1933.95	153	SEG[86]	1093.10	1902.45
56	COM[3]	-779.10	-1933.95	154	SEG[85]	978.10	1902.45
57	COM[2]	-664.10	-1933.95	155	SEG[84]	863.10	1902.45
58	COM[1]	-549.10	-1933.95	156	SEG[83]	748.10	1902.40
59	COM[0]	-434.10	-1933.95	157	SEG[82]	633.10	1902.45
60	LV5	-319.10	-1933.95	158	SEG[81]	518.10	1902.45
61	LV4	-204.10	-1933.95	159	SEG[80]	403.10	1902.45
62	LV3	-89.10	-1933.95	160	SEG[79]	288.10	1902.45
63	LCDVTB	25.90	-1933.95	161	SEG[78]	173.10	1902.45
64	LC4B	140.90	-1933.95	162	SEG[77]	58.10	1902.45
65	LC4A	255.90	-1933.95	163	SEG[76]	-56.90	1902.45
66	LC3B	370.90	-1933.95	164	SEG[75]	-214.90	1902.45
67	LC3A	485.90	-1933.95	165	SEG[74]	-329.90	1902.45
68	LC2B	600.90	-1933.95	166	SEG[73]	-444.90	1902.45
69	LC2A	715.90	-1933.95	167	SEG[72]	-559.90	1902.45
70	LC1B	830.90	-1933.95	168	SEG[71]	-674.90	1902.45
71	LC1A	945.90	-1933.95	169	SEG[70]	-789.90	1902.45
72	LCDGS	1060.90	-1933.95	170	SEG[69]	-904.90	1902.45
73	LV2	1175.90	-1933.95	171	SEG[68]	-1019.90	1902.45
74	LV1	1290.90	-1933.95	172	SEG[67]	-1134.90	1902.45
75	LCDVX	1405.90	-1933.95	173	SEG[66]	-1249.90	1902.45
76	GND	1520.90	-1933.95	174	SEG[65]	-1364.90	1902.45
77	VO	1635.90	-1933.95	175	SEG[64]	-1479.90	1902.45



PIN Number	PIN Name	X Coordinate	Y Coordinate	PIN Number	PIN Name	X Coordinate	Y Coordinate
78	DAO	1750.90	-1933.95	176	SEG[63]	-1594.90	1902.45
79	OPIN	1865.90	-1933.95	177	SEG[62]	-1709.90	1902.45
80	OPIP	1980.90	-1933.95	178	SEG[61]	-1824.90	1902.45
81	OPO	2095.90	-1933.95	179	SEG[60]	-1939.90	1902.45
82	RSTP_N	2210.90	-1933.95	180	SEG[59]	-2054.90	1902.45
83	FXO	2325.90	-1933.95	181	SEG[58]	-2169.90	1902.45
84	FXI	2440.90	-1933.95	182	SEG[57]	-2284.90	1902.45
85	TSTP_P	2555.90	-1933.95	183	SEG[56]	-2399.90	1902.45
86	SXO	2711.90	-1933.95	184	SEG[55]	-2514.90	1902.45
87	SXI	2826.90	-1933.95	185	SEG[54]	-2629.90	1902.45
88	VDD	2941.90	-1933.95	186	SEG[53]	-2744.90	1902.45
89	MUTE	3056.90	-1933.95	187	SEG[52]	-2859.90	1902.45
90	DTMFO	3171.90	-1933.95	188	SEG[51]	-2974.90	1902.45
91	SDO	3286.90	-1933.95	189	SEG[50]	-3089.90	1902.45
92	KEYTONE	3401.90	-1933.95	190	SEG[49]	-3204.90	1902.45
93	PRTD[7]	3516.90	-1933.95	191	SEG[48]	-3319.90	1902.45
94	PRTD[6]	3641.60	-1933.95	192	SEG[47]	-3434.90	1902.45
95	PRTD[5]	3787.62	-1933.95	193	SEG[46]	-3549.90	1902.45
96	PRTD[4]	3926.09	-1933.95	194	SEG[45]	-3674.60	1902.45
97	PRTD[3]	4048.34	-1770.65	195	SEG[44]	-3789.60	1902.45
98	PRTD[2]	4048.34	-1649.60	196	SEG[43]	-3911.55	1902.45



G. DC/AC Characteristics

Absolute Maximum Rating

Item	Sym.	Rating	Condition
Supply Voltage	V_{dd}	-0.5V ~ 4.0V	
Input Voltage	V_{in}	-0.5V ~ $V_{dd}+0.5V$	
Output Voltage	V_o	-0.5V ~ $V_{dd}+0.5V$	
Operating Temperature	T_{op}	0°C ~ 70°C	
Storage Temperature	T_{st}	-50°C ~ 100°C	

Recommended Operating Conditions

Item	Sym.	Rating	Condition
Supply Voltage	V_{dd}	2.4V ~ 3.6V	
Input Voltage	V_{ih}	0.9 V_{dd} ~ V_{dd}	
	V_{il}	0.0V ~ 0.1 V_{dd}	
Operating Frequency	Fmax	8MHz(Crystal)	$V_{dd}=3.0V$
		6MHz(Crystal)	$V_{dd}=2.4V$
Operating Temperature	T_{op}	0°C ~ 70°C	
Storage Temperature	T_{st}	-50°C ~ 100°C	



Testing condition : TEMP=25°C, VDD=3V+/-10%, GND=0V

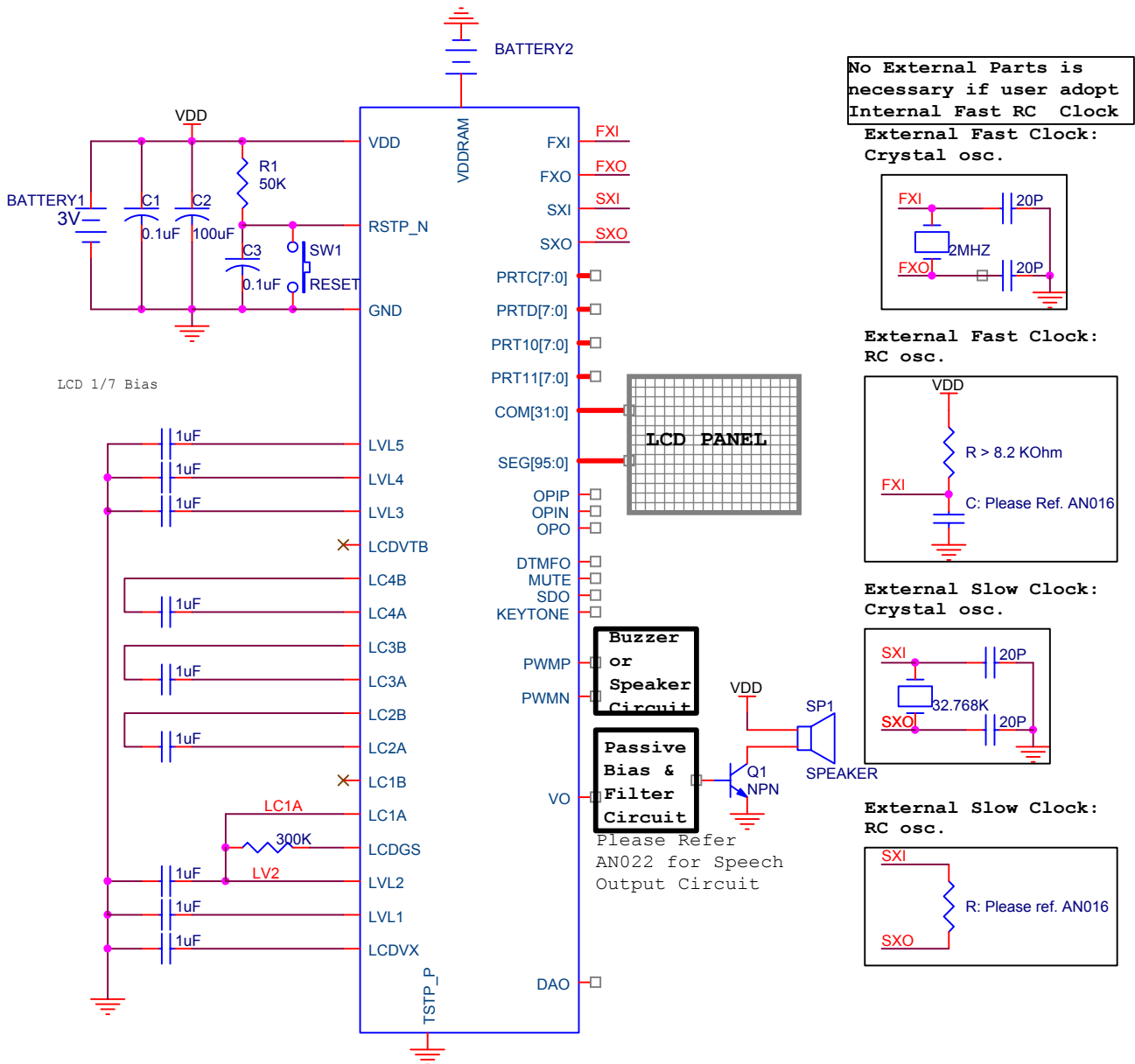
	PARAMETER		CONDITION	MIN	TYP	MAX	UNIT
I_{Fast}	NORMAL Mode Current	System	2M ext. R/C		1	1.5	mA
I_{Slow}	SLOW Mode Current	System	32.768K X'tal LCD Disable		15	25	μA
I_{Idle}	IDLE Mode Current	System	32.769K X'tal LCD Disable		10	20	μA
I_{LCD}	Extra Current if LCD ON	System	LCD Enable		100	110	μA
I_{Sleep}	Sleep Mode Current	System				1	μA
I_{PWM}	PWM Output Current	PWMP, PWMN* ²	With 32Ω Loading	10	14		mA
			With 64Ω Loading	6	8		mA
			With 100Ω Loading	4	5		mA
I_{oVO}	DAC Output Current	VO, DAO	V _{DD} =3V;VO=0~2V,Data=7F	2.5	3		mA
V_{iH}	Input High Voltage	I/O pins		0.8 V _{DD}			V
V_{iL}	Input Low Voltage	I/O pins				0.2 V _{DD}	V
V_{hys}	Input Hysteresis Width	I/O, RSTP_N	Threshold=2/3V _{DD} (input from low to high) Threshold=1/3V _{DD} (input from high to low)		1/3 V _{DD}		V
I_{oH}	Output Drive Current	I/O pull-high* ¹	V _{oL} =2.0V	50			μA
I_{oL_1}	Output Sink Current	I/O pull-low* ¹	V _{oL} =0.4V	1.0			mA
I_{iL_1}	Input Low Current	RSTP_N	V _{iL} =GND, pull high Internally		20		μA
I_{iL_2}	Input Low Current	I/O	V _{iL} =GND, if pull high Internally by user		100		μA

Note:

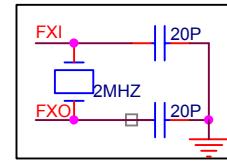
*1: Drive Current Spec. for Push-Pull I/O port only Sink Current Spec. for both Push-Pull and Open-Drain I/O port.

*2: This Spec. base on one driver only. There are five build-in drivers, so user just multiplies the number of driver he used to one driver current to get the total amount of current. (I_{PWM} * N; N=0, 1, 2, 3, 4, 5)

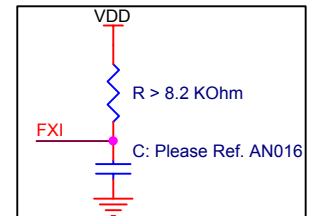
H. Application Circuit



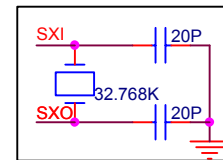
No External Parts is necessary if user adopt Internal Fast RC Clock
 External Fast Clock: Crystal osc.



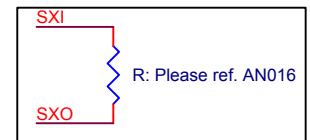
External Fast Clock: RC osc.



External Slow Clock: Crystal osc.



External Slow Clock: RC osc.



LC1B and LCDVTB are not used in this IC, just leave these pins floating.

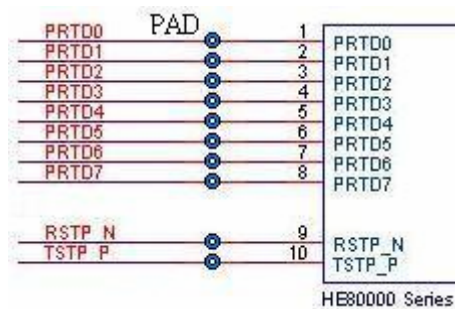
83760M with Type- IV LCD Driver is totally different from 83760 with Type-I LCD Driver. Please refer AN025.

I. Important Note

1. Please always take in mind that ICE is different from IC which is your target body. ICE is the whole set of HE80000 series IC, but each IC is a subset of ICE. Never use any hardware resource that your target IC didn't have these resources, especially RAM and register. KBIDS and compiler cannot prevent user to use some hardware resources that don't exist in your target IC. Please check the following table and refer to the abbreviation in HE80000 user's manual.

I.F.C.	E.S.C.	I.P.R.	PROM	DROM	TP	TP+1	RAM	PP	DP	I/O	DTMF	WDT	Timer
☉	☉	☉	64KB	1984KB	21-bit	☉	16KB	6-bit	8-bit	32	☉	☉	T1,T2,TB
VO	DAO	OP	PWM	LCD	COM*SEG	Bias	Rgr	ChrgPmp	LV2	LR	LVG	REC	S.R.
☉	☉	☉	☉	3072	32*96	1/7	☉	☉	—	—	—	E/I	I/D

- To access any address larger than 64KB, users must update TPP first, TPH, and then TPL. Only follow this order, the pre-charge circuit of ROM will work correctly. 5us waiting is necessary before LDV instruction is executed since Data ROM is a low speed ROM. Users can not emulate this accessing process in ICE. So 5us delay should be added by firmware.
- LCD driving circuit must be turn off before IC goes into sleep mode.
- Please bonds the TSTP_P, RSTP_N and PRTD [7:0] with test points on PCB (can be soldered and probed) as you can, then some testing can be performed on PCB if necessary. The TSTP_P is suggested to connect to ground by a 0 ohm resistor. The following figure is an example (Testing point with through hole).



- LVP must be lower than 8.5 Volt. Otherwise IC may be breakdown.
- The LCDC of 83760M is different from HE83760. The LCDC: [— — — — —BE]; Non gray level control.
 B: blank control bit. E: LCD enable bit.

J. Updated Record



Version	Date	Section	Original Content	New Content