A. HE83149 Introduction

HE83149 is a member of 8-bit Micro-controller series developed by King Billion Electronics Ltd. Users can choose any one of combination among 【1024 dots LCD Driver + 8 Bit I/O Port】…【768 dots LCD Driver + 24 Bit I/O Port】etc. The 7-bit current-type D/A converter and PWM device provide the complete speech output mechanism. The 256K bytes ROM size can be used in the storage of speech、graphic、text etc.. It can be applicable to the medium systems such as Small-Scale Dictionary, Data Bank, Pocket Dialer, and Educational Toy 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 HE83750S is enough for most of battery operation system.

B. HE83149 Feature

- Operation Voltage: 2.4V – 5.5V
- System Clock: 4MHz ~ 8MHz
- Clock Source: Internal/External Fast clock, Internal/External slow clock
- Internal ROM: 256K Bytes(64K Program ROM+192K Data ROM)
- Internal RAM： 512 Bytes
- Dual Clock System: Normal (Fast) clock: 32.768K ~ 8MHz
  Slow clock: 32.768 KHz
- Operation Mode: DUAL、FAST、SLOW、IDLE、SLEEP Mode.
- 8~24 bit Bi-directional I/O port. Mask Option can select PUSH-PULL or OPEN DRAIN output mode for each I/O pin. 8 of them are shared with LCD segment pins.
- 1024~768 dots LCD driver (A、B TYPE selectable).
- One 7-bit current-type DAC output.
- PWM device.
- Two external interrupts and three internal timer interrupts.
- Two 16-bit timers and one Time-Base timer.
- Instruction set： 32 instructions, 4 addressing mode. 9-bit DATA POINTER for RAM and 18-bit TABLE POINTER for ROM.

C. Pin Description

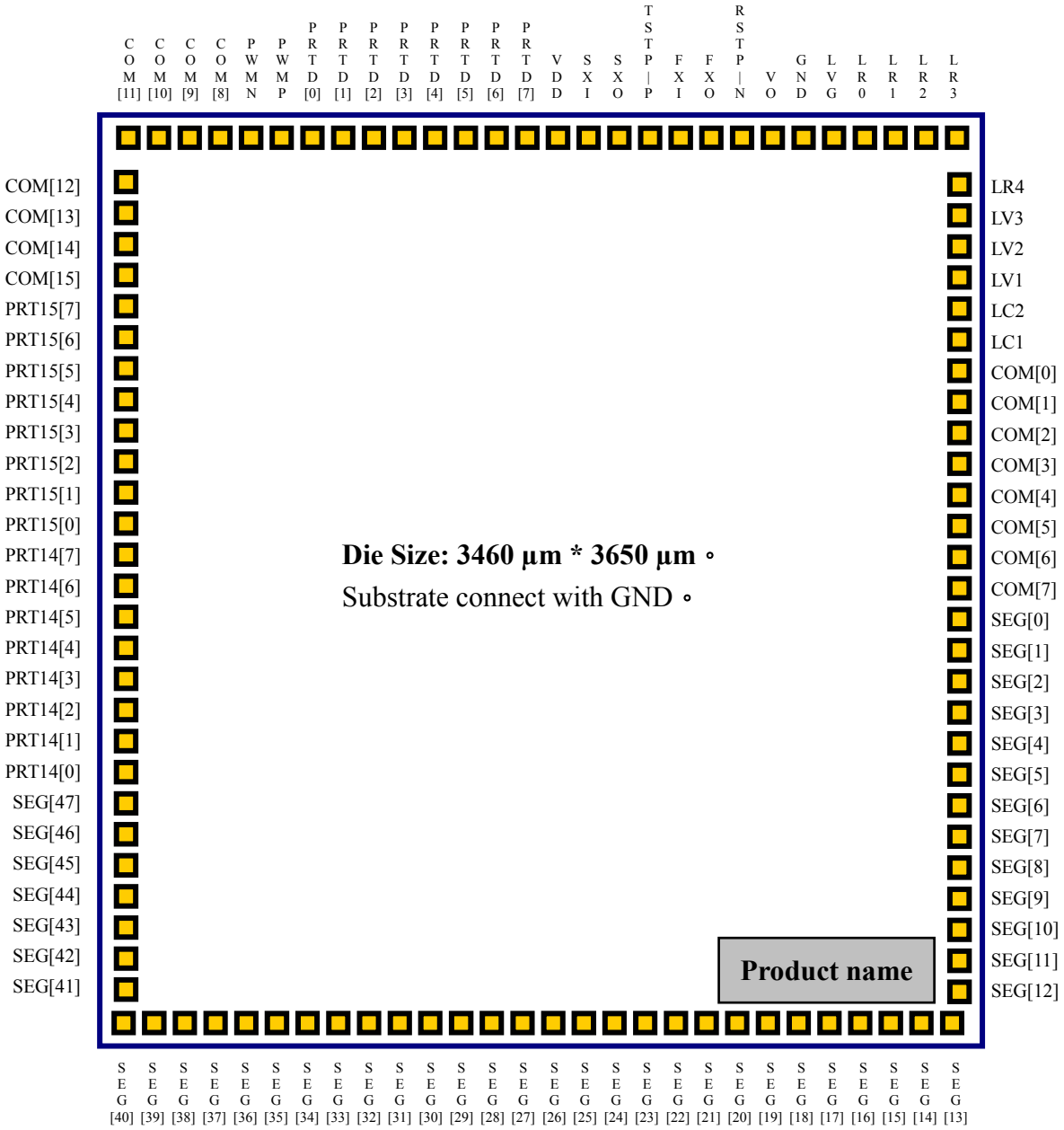
Pin #	Pin name	I/O	Function	Description
92 91	**FXI, FXO**	B, O	External fast clock input/output pins are used to connect crystal or RC to generate the 32.768KHz ~ 8MHz system clock.	Mask Option setting: MO_FCK/SCKN= 00 : Slow Clock only 01 : Illegal 10：Dual Clock 11：Fast Clock only MO_FOSCE= 0：Internal 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.
95 94	**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.	
90	**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
93	**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.
97.. 104	**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).
5.. 12	**PRT15[7:0]/ SEG[63:56]**	B/O	8-pin bi-directional I/O port that is shared with LCD segment pin.	The pin functions are determined by the mask option MO_LIO15[7:0] MO_LIO15 [7:0] = 1：LCD Pin. = 0：I/O Pin. When they are selected as I/O pins, the output driving type can be set by mask option. MO_15PP [7:0] = 1：Push-pull. = 0：Open-drain. Output must be "1" before reading whenever uses them as input (Non tri-state structure).
13... 20	**PRT14[7:0]/ SEG[55:48]**	B/O	8-pin bi-directional I/O port that is shared with LCD	The pin functions are determined by the mask option MO_LIO14[7:0] MO_LIO14 [7:0] = 1：LCD Pin. = 0：I/O Pin.

Pin #	Pin name	I/O	Function	Description
			segment pin.	When they are selected as I/O pins, the output driving type can be set by mask option. MO_14PP [7:0] = 1：Push-pull. = 0：Open-drain. Output must be "1" before reading whenever uses them as input (Non tri-state structure).
4..1 110.. 107 69..76	**COM[15:0]**	O	LCD COM Output	LCD Data filled from F0H, please refer the LCD RAM map.
21.. 68	**SEG[47:0]**	O	LCD SEG Output	
78	**LC2**	B	Charge Pump Switch 1	Add one 0.1 µF capacitor between LC1 and LC2. Please refer the application circuit.
77	**LC1**	B	Charge Pump Switch 2	
81	**LV3**	B	Charge Pump V3	LV3< 9 Volts. Please refer the application circuit.
80	**LV2**	B	Charge Pump V2	
79	**LV1**	B	Charge Pump V1	
82..86	**LR[4..0]**	B	LCD Resister level 4 ~ 1	Please refer the application circuit.
87	**LVG**	I	LCD Virtual Ground	Please refer the application circuit.
105	**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
106	**PWMN**	O	The PWM positive output can drive speaker or buzzer directly.	
89	**VO**	O	Voice output.	Set the bit0(OP=0) and bit1(DA=1) of VOC register to turn on VO
96	**VDD**	P	Positive Power Input	Add a 0.1 µF capacitor as by-pass capacitor between VDD and GND.
88	**GND**	P	Power Ground Input	

D. LCD RAM Map

Page 0	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	80H	90H	A0H	B0H	C0H	D0H	E0H	F0H
COM1	81H	91H	A1H	B1H	C1H	D1H	E1H	F1H
COM2	82H	92H	A2H	B2H	C2H	D2H	E2H	F2H
:	:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:	:
COM13	8DH	9DH	ADH	BDH	CDH	DDH	EDH	FDH
COM14	8EH	9EH	AEH	BEH	CEH	DEH	EEH	FEH
COM15	8FH	9FH	AFH	BFH	CFH	DFH	EFH	FFH

E. Pin Diagram



F. Bonding Pad Location

PIN Number	PIN Name	X Coordinate	Y Coordinate	PIN Number	PIN Name	X Coordinate	Y Coordinate
1	COM[12]	X= -1657.05	Y= 1500.75	56	SEG[12]	X= 1656.70	Y= -1502.25
2	COM[13]	X= -1657.05	Y= 1385.25	57	SEG[11]	X= 1656.70	Y= -1386.75
3	COM[14]	X= -1657.05	Y= 1269.75	58	SEG[10]	X= 1656.70	Y= -1271.25
4	COM[15]	X= -1657.05	Y= 1154.25	59	SEG[9]	X= 1656.70	Y= -1155.75
5	PRT15[7]	X= -1657.05	Y= 1038.75	60	SEG[8]	X= 1656.70	Y= -1040.25
6	PRT15[6]	X= -1657.05	Y= 923.25	61	SEG[7]	X= 1656.70	Y= -924.75
7	PRT15[5]	X= -1657.05	Y= 807.75	62	SEG[6]	X= 1656.70	Y= -809.25
8	PRT15[4]	X= -1657.05	Y= 692.25	63	SEG[5]	X= 1656.70	Y= -693.75
9	PRT15[3]	X= -1657.05	Y= 576.75	64	SEG[4]	X= 1656.70	Y= -578.25
10	PRT15[2]	X= -1657.05	Y= 461.25	65	SEG[3]	X= 1656.70	Y= -462.75
11	PRT15[1]	X= -1657.05	Y= 345.75	66	SEG[2]	X= 1656.70	Y= -347.25
12	PRT15[0]	X= -1657.05	Y= 230.25	67	SEG[1]	X= 1656.70	Y= -231.75
13	PRT14[7]	X= -1657.05	Y= 114.75	68	SEG[0]	X= 1656.70	Y= -116.25
14	PRT14[6]	X= -1657.05	Y= -0.75	69	COM[7]	X= 1656.70	Y= -0.75
15	PRT14[5]	X= -1657.05	Y= -116.25	70	COM[6]	X= 1656.70	Y= 114.75
16	PRT14[4]	X= -1657.05	Y= -231.75	71	COM[5]	X= 1656.70	Y= 230.25
17	PRT14[3]	X= -1657.05	Y= -347.25	72	COM[4]	X= 1656.70	Y= 345.75
18	PRT14[2]	X= -1657.05	Y= -462.75	73	COM[3]	X= 1656.70	Y= 461.25
19	PRT14[1]	X= -1657.05	Y= -578.25	74	COM[2]	X= 1656.70	Y= 576.75
20	PRT14[0]	X= -1657.05	Y= -693.75	75	COM[1]	X= 1656.70	Y= 692.25
21	SEG[47]	X= -1657.05	Y= -809.25	76	COM[0]	X= 1656.70	Y= 807.75
22	SEG[46]	X= -1657.05	Y= -924.75	77	LC1	X= 1656.70	Y= 923.25
23	SEG[45]	X= -1657.05	Y= -1040.25	78	LC2	X= 1656.70	Y= 1038.75
24	SEG[44]	X= -1657.05	Y= -1155.75	79	LV1	X= 1656.70	Y= 1154.25
25	SEG[43]	X= -1657.05	Y= -1271.25	80	LV2	X= 1656.70	Y= 1269.75
26	SEG[42]	X= -1657.05	Y= -1386.75	81	LV3	X= 1656.70	Y= 1385.25
27	SEG[41]	X= -1657.05	Y= -1502.25	82	LR4	X= 1656.70	Y= 1500.75
28	SEG[40]	X= -1559.10	Y= -1710.30	83	LR3	X= 1599.95	Y= 1797.10
29	SEG[39]	X= -1443.60	Y= -1710.30	84	LR2	X= 1484.45	Y= 1797.10
30	SEG[38]	X= -1328.10	Y= -1710.30	85	LR1	X= 1368.95	Y= 1797.10
31	SEG[37]	X= -1212.60	Y= -1710.30	86	LR0	X= 1253.45	Y= 1797.10
32	SEG[36]	X= -1097.10	Y= -1710.30	87	LVG	X= 1137.95	Y= 1797.10
33	SEG[35]	X= -981.60	Y= -1710.30	88	GND	X= 1022.45	Y= 1797.10
34	SEG[34]	X= -866.10	Y= -1710.30	89	VO	X= 906.95	Y= 1797.10
35	SEG[33]	X= -750.60	Y= -1710.30	90	RSTP_N	X= 791.45	Y= 1797.10
36	SEG[32]	X= -635.10	Y= -1710.30	91	FXO	X= 675.95	Y= 1797.10
37	SEG[31]	X= -519.60	Y= -1710.30	92	FXI	X= 560.45	Y= 1797.10

38	SEG[30]	X= -404.10	Y= -1710.30	93	TSTP_P	X= 444.95	Y= 1797.10
39	SEG[29]	X= -288.60	Y= -1710.30	94	SXO	X= 329.45	Y= 1797.10
40	SEG[28]	X= -173.10	Y= -1710.30	95	SXI	X= 213.95	Y= 1797.10
41	SEG[27]	X= -57.60	Y= -1710.30	96	VDD	X= 98.45	Y= 1797.10
42	SEG[26]	X= 57.90	Y= -1710.30	97	PRTD[7]	X= -17.05	Y= 1797.10
43	SEG[25]	X= 173.40	Y= -1710.30	98	PRTD[6]	X= -132.55	Y= 1797.10
44	SEG[24]	X= 288.90	Y= -1710.30	99	PRTD[5]	X= -248.05	Y= 1797.10
45	SEG[23]	X= 404.40	Y= -1710.30	100	PRTD[4]	X= -363.55	Y= 1797.10
46	SEG[22]	X= 519.90	Y= -1710.30	101	PRTD[3]	X= -479.05	Y= 1797.10
47	SEG[21]	X= 635.40	Y= -1710.30	102	PRTD[2]	X= -594.55	Y= 1797.10
48	SEG[20]	X= 750.90	Y= -1710.30	103	PRTD[1]	X= -710.05	Y= 1797.10
49	SEG[19]	X= 866.40	Y= -1710.30	104	PRTD[0]	X= -825.55	Y= 1797.10
50	SEG[18]	X= 981.90	Y= -1710.30	105	PWMP	X= -965.30	Y= 1797.10
51	SEG[17]	X= 1097.40	Y= -1710.30	106	PWMN	X= -1128.65	Y= 1797.10
52	SEG[16]	X= 1212.90	Y= -1710.30	107	COM[8]	X= -1267.75	Y= 1797.10
53	SEG[15]	X= 1328.40	Y= -1710.30	108	COM[9]	X= -1383.25	Y= 1797.10
54	SEG[14]	X= 1443.90	Y= -1710.30	109	COM[10]	X= -1498.75	Y= 1797.10
55	SEG[13]	X= 1559.40	Y= -1710.30	110	COM[11]	X= -1614.25	Y= 1797.10

G. DC/AC Characteristics

Absolute Maximum Rating

Item	Sym.	Rating	Condition
Supply Voltage	V_{dd}	-0.5V ~ 8V	
Input Voltage	V_{in}	-0.5V ~ V_{dd}+0.5V	
Output Voltage	V_o	-0.5V ~ V_{dd}+0.5V	
Operating Temperature	T_{op}	0^0C ~ 70^0C	
Storage Temperature	T_{st}	-50^0C ~ 100^0C	

Recommended Operating Conditions

Item	Sym.	Rating	Condition
Supply Voltage	V_{dd}	2.2V ~ 5.5V	
Input Voltage	V_{ih}	0.9 V_{dd} ~ V_{dd}	
	V_{il}	0.0V ~ 0.1V_{dd}	
Operating Frequency	Fmax	8MHz	V_{dd} =5.0V
		4MHz	V_{dd} =2.2V
Operating Temperature	T_{op}	0^0C ~ 70^0C	
Storage Temperature	T_{st}	-50^0C ~ 100^0C	

Testing Condition: TEMP=25℃, VDD=3V+/-10%, GND=0V

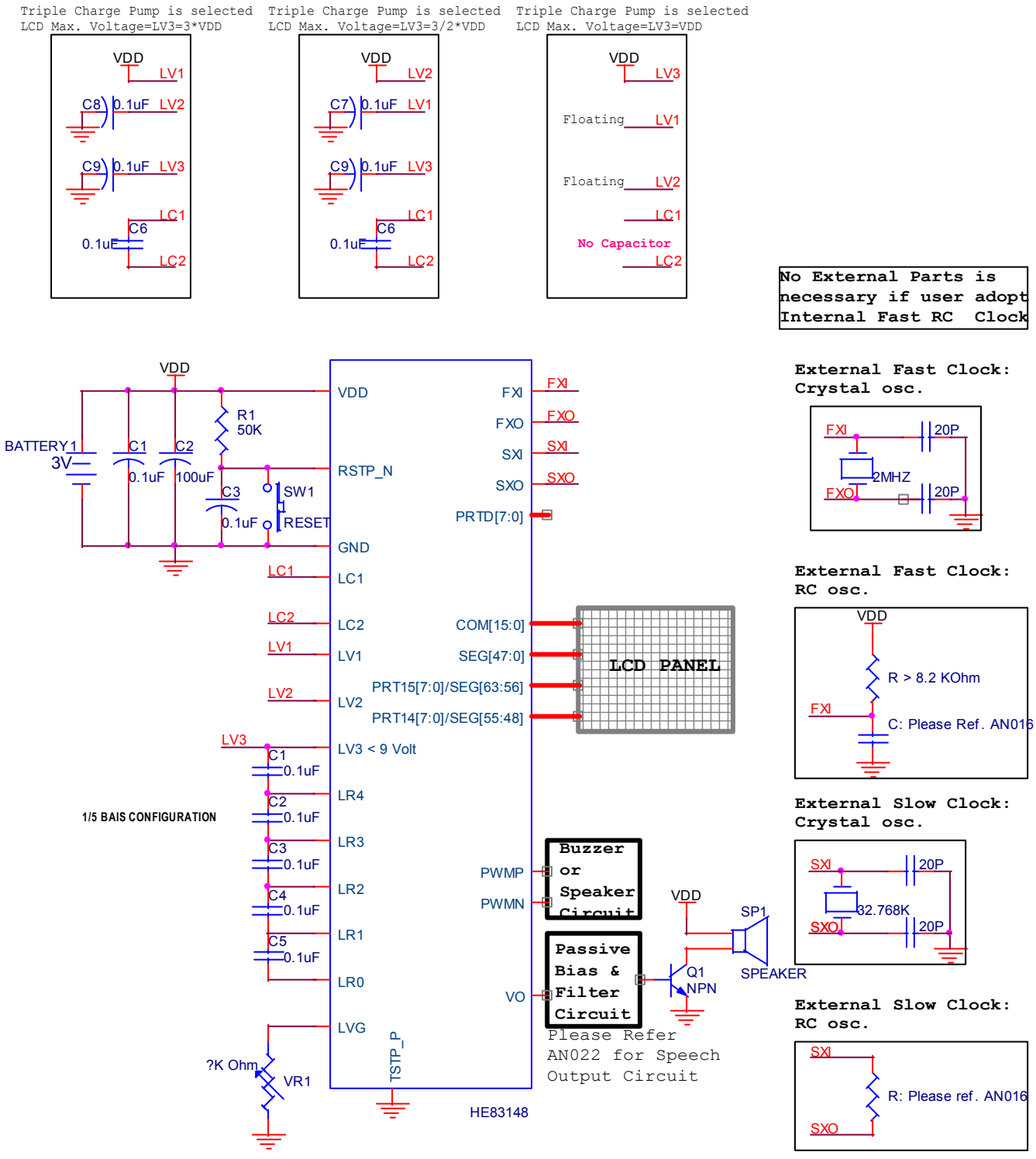
	PARAMETER		CONDITION	MIN	TYP	MAX	UNIT
I_{Fast}	NORMAL Mode Current	System	2M ext. R/C		0.75	1	mA
I_{Slow}	SLOW Mode Current	System	32.768K X'tal LCD Disable		10	20	μA
I_{Idle}	IDLE Mode Current	System	32.769K X'tal LCD Disable		6	10	μA
I_{LCD}	Extra Current if LCD ON	System	LCD Enable, LCD option=300Kohm Voltage-doubler OFF		12	20	μA
			LCD Enable, LCD option=30Kohm, Voltage-doubler ON		100	120	
I_{Sleep}	Sleep Mode Current	System				1	μA
I_{oHPWM}	PWM Output Drive Current	PWMP, PWMN*2	V_{DD}=3V; V_{oh}=2V	12	15		mA
I_{oLPWM}	PWM Output Sink Current	PWMP, PWMN*2	V_{DD}=3V; V_{oL}=1V	33	40		mA
I_{oVO}	DAC Output Current	VO	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 driver, so user just multiply the number of driver he used to one driver current to get the total amount of current.(I_{oHPWM}、I_{oLPWM} * N; N=0,1,2,3,4,5)

H. Application Circuit



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
◎	◎	◎	64KB	192KB	18-bit	◎	512B	3-bit	8-bit	8~24	—	◎

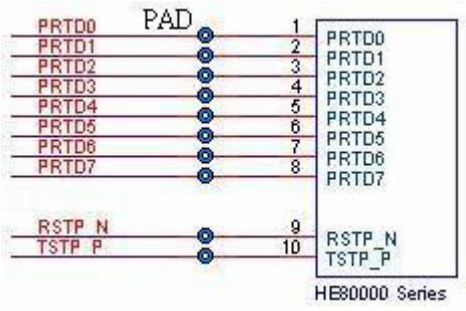
Timer	VO	DAO	OP	PWM	LCD	Type	COM*SEG	Bias
T1,T2,TB	◎	—	—	◎	1024~768	I	16*64	1/5

2. 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.

3. LCD driving circuit must be turn off before IC goes into sleep mode.

4. 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).

5.



6. LV3 must be lower than 9.0 Volt. Otherwise IC may be breakdown.

J. Updated Record

Version	Date	Section	Original Content	New Content