A.HE83130 Introduction

HE83130 is a member of 8-bit Micro-controller series that is developed by King Billion. This IC built-in 640-dot LCD driver and has one OP comparator. The built-in OP comparator can be used with (light、voice、temperature、humility) sensor etc. The 7-bit current-type D/A converter and PWM device provide the complete speech output mechanism. The 64K ROM Size can storage around 20 second's speech. This IC is applicable to the medium systems such as LCD Games and Educational Toy etc. Use external SRAM or Flash RAM to have recording function. This IC is very easy to learn and use. Most of instructions take only 3 oscillator clocks (machine cycles). As a result this IC is suitable for the applications that require higher performance system.

B.HE83130 Features

- Operation Voltage：   2.2V – 5.5V
- System Clock：   DC ~ 8MHz @ 5.0V
                    DC ~ 4MHz @ 2.2V
- Internal ROM：   64K Bytes(64K Program ROM)
- Internal RAM：   256 Bytes
- Dual Clock System ： Normal (Fast) clock：   32.768K ~ 8MHz
                        Slow clock：   32.768KHz
- Operation Mode：   DUAL、FAST、SLOW、IDLE、SLEEP Mode.
- With WDT (WATCH DOG TIMER) to prevent deadlock condition.
- 12-bit Bi-directional I/O port. Mask Option can select PUSH-PULL or OPEN DRAIN output mode for each I/O pin.
- One built-in OP comparator.
- 640 dots LCD driver (A、B TYPE selectable).
- One 7-bit current-type DAC output.
- PWM device.
- Two external interrupts and two internal timers interrupts.
- Two 16-bit timers.
- Instruction set： 32 instructions, 4 addressing mode. 8-bit DATA POINTER for RAM and 16-bit TABLE POINTER for ROM.

C. Internal Block

Item	I.F.C.	E.S.C.	I.P.R	PROM	DROM	TP	TP+1	RAM	PP	DP	I/O	DTMF	WDT	Timer
HE83130	◎	◎	◎	64KB	—	16-bit	◎	256B	—	8-bit	12	—	◎	T1,T2

Item	VO	DAO	OP	PWM	LCD	COM*SEG	Bias	Rgr	ChrgPmp	LV2	LR	LVG	REC	S.R.
HE83130	◎	◎	◎	◎	640	16*40	1/5	—	1,3/2	—	4:0	◎	Ext.	I

D. Pin Assignment

Pin#	Pin Name	I/O	Function	Description
78 77	**FXI,** **FXO**	B, O	External fast clock pin. Connecting to crystal or RC to generate 32.768 kHz ~ 8MHz system clock.	Mask Option settings： 　MO_FCK/SCKN=00：Slow Clock only 　　　　　　　　01：Illegal 　　　　　　　　10：Dual Clock 　　　　　　　　11：Fast Clock only 　MO_FOSCE=0：Internal fast oscillation 　　　　　　1： External fast oscillation 　MO_FXTAL=0：R,C oscillation for Fast Clock 　　　　　　1：Crystal oscillation for Fast Clock 　MO_SXTAL=0：R,C oscillation for 32.768K Clock 　　　　　　1：Crystal oscillation for 32.768K
81 80	**SXI,** **SXO**	I, O	External slow clock pin. Connecting with 32.768 Hz OSC to generate the stable frequency for Slow Clock Mode and Timer clock source.	Clock。 Program the value of OP1and OP2 to change the operating modes (Normal, Slow, Idle and Sleep). In Dual Clock mode , the system runs in Fast Clock, only the LCD and timer I use the 32.768K clock source。
76	**RSTP_N**	I	System Reset Signal.	Pull this pin to low level to reset the system. Besides, select the Mask Option (MQ_PORE=1) to enable the HE83130 internal Power-on Reset function. In addition, the MO_WDTE is used for Watch Timer setting： 　MO_WDTE=0：Disable Watch Dog Timer 　　　　　=1：Enable Watch Dog Timer
79	**TSTP_P**	I	Test Pin	Pull the pin to high level to enter into testing mode.
91, 92, 93, 1	**PRTC[3:0]**	B	Port C bi-directional I/O Pin (4Pins)	Mask Option MO_CPP[3:0] to preset the output type： 　MO_CPP=1 : Push-pull output; 　　　　=0 : Open-drain output When assigned the port to input pin, send a '1' and read the result to get the input value
83.. 90	**PRTD[7:0]**	B	Port D bi-directional I/O pin，(8 pins). PRTD[7:2] is also a Wake-up pin and PRTD[7:6] is used for interrupt input pin.	Mask Option MO_DPP[7:0] to preset the output type： 　MO_DPP=1 : Push-pull output; 　　　　=0 : Open-drain output When assigned the port to input pin, send a '1' and read the result to get the input value
11..4 52.. 59	**COM[15:0]**	O	LCD COMmon Output	D Data filled from D8H, please refer the LCD RAM map
12.. 51	**SEG[39:0]**	O	LCD SEGment Output	
61	**LC2**	B	Charge Pump Switch 1	LV3=VDD，Charge Pump for LCD is turn off。Take one 0.1 µF capacitor between LC1 and LC2 off. Please refer the application circuit in order to avoid power consumption.
60	**LC1**	B	Charge Pump Switch 2	
63	**L V3**	B	Charge Pump V3	Please refer the application circuit.
62	**L V1**	B	Charge Pump V1	

64..68	**LR[4..0]**	B	LCD Resister level 4 ~ 0	Please refer the application circuit.
69	**L VG**	I	LCD Virtual Ground	Please refer the application circuit.
2	**PWMP**	O	PWM +ve output pin can directly drive Speaker or Buzzer for sound output.	Set the Bit2 for VOC register (PWM =1) to turn on the PWM
3	**PWMN**	O	PWM -ve output pin can directly drive Speaker or Buzzer for sound output.	Set the Bit2 for VOC register (PWM =1) to turn on the PWM
71	**VO**	O	D/A voice output	Set the bit1 (DA=1) of VOC register to turn on VO
72	**DAO**	O	D/A voice output for OP use.	Set the bit0 (OP=1) of VOC register to turn on DAO
73	**OPIN**	I	OPAMP Inverting pin	Set the bit1 (OP=1) register to turn on OP
74	**OPIP**	I	OPAMP Non-Inverting pin	Individual Op comparator
75	**OPO**	O	OPAMP Output pin	
82	**VDD**	P	Positive Power Input	
70	**GND**	P	Power Ground Input	

E.LCD RAM Map

Page 0	SEG [7:0]	SEG [15:8]	SEG [23:16]	SEG [31:24]	SEG [39:32]
COM0	80H	90H	A0H	B0H	C0H
COM1	81H	91H	A1H	B1H	C1H
COM2	82H	92H	A2H	B2H	C2H
⋮	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮
COM13	8DH	9DH	ADH	BDH	CDH
COM14	8EH	9EH	AEH	BEH	CEH
COM15	8FH	9FH	AFH	BFH	CFH

F.　Pin Diagram

Top pins (left to right):
PRTC[1], PRTC[2], PRTC[3], PRTD[0], PRTD[1], PRTD[2], PRTD[3], PRTD[4], PRTD[5], PRTD[6], PRTD[7], VDD, SXI, TSTP|XO, FXI, FXO, RSTP|ION, OPOP, OPIN, DAO

Left pins (top to bottom):
PRTC[0], PWMP, PWMN, COM[8], COM[9], COM[10], COM[11], COM[12], COM[13], COM[14], COM[15], SEG[39], SEG[38], SEG[37], SEG[36], SEG[35], SEG[34], SEG[33], SEG[32], SEG[31], SEG[30], SEG[29], SEG[28], SEG[27]

Right pins (top to bottom):
VO, GND, LVG, LR0, LR1, LR2, LR3, LR4, LV3, LV1, LC2, LC1, COM[0], COM[1], COM[2], COM[3], COM[4], COM[5], COM[6], COM[7], SEG[0], SEG[1], SEG[2], SEG[3], SEG[4], SEG[5]

Bottom pins (left to right):
SEG[26], SEG[25], SEG[24], SEG[23], SEG[22], SEG[21], SEG[20], SEG[19], SEG[18], SEG[17], SEG[16], SEG[15], SEG[14], SEG[13], SEG[12], SEG[11], SEG[10], SEG[9], SEG[8], SEG[7], SEG[6]

Die Size: 3100 μm * 3240 μm 。

Substrate connect with GND 。

Product name

G. Bonding Pad Location

PIN Number	PIN Name	X Coordinate	Y Coordinate	PIN Number	PIN Name	X Coordinate	Y Coordinate
1	PRTC[0]	X= -1475.80	Y= 1246.95	48	SEG[3]	X= 1474.30	Y= -1236.15
2	PWMP	X= -1475.80	Y= 1107.20	49	SEG[2]	X= 1474.30	Y= -1120.65
3	PWMN	X= -1475.80	Y= 943.85	50	SEG[1]	X= 1474.30	Y= -1005.15
4	COM[8]	X= -1475.80	Y= 804.75	51	SEG[0]	X= 1474.30	Y= -889.65
5	COM[9]	X= -1475.80	Y= 689.25	52	COM[7]	X= 1474.30	Y= -774.15
6	COM[10]	X= -1475.80	Y= 573.75	53	COM[6]	X= 1474.30	Y= -658.65
7	COM[11]	X= -1475.80	Y= 458.25	54	COM[5]	X= 1474.30	Y= -543.15
8	COM[12]	X= -1475.80	Y= 342.75	55	COM[4]	X= 1474.30	Y= -427.65
9	COM[13]	X= -1475.80	Y= 227.25	56	COM[3]	X= 1474.30	Y= -312.15
10	COM[14]	X= -1475.80	Y= 111.75	57	COM[2]	X= 1474.30	Y= -196.65
11	COM[15]	X= -1475.80	Y= -3.75	58	COM[1]	X= 1474.30	Y= -81.15
12	SEG[39]	X= -1475.80	Y= -119.25	59	COM[0]	X= 1474.30	Y= 34.35
13	SEG[38]	X= -1475.80	Y= -234.75	60	LC1	X= 1474.30	Y= 149.85
14	SEG[37]	X= -1475.80	Y= -350.25	61	LC2	X= 1474.30	Y= 265.35
15	SEG[36]	X= -1475.80	Y= -465.75	62	LV1	X= 1474.30	Y= 380.85
16	SEG[35]	X= -1475.80	Y= -581.25	63	LV3	X= 1474.30	Y= 496.35
17	SEG[34]	X= -1475.80	Y= -696.75	64	LR4	X= 1474.30	Y= 611.85
18	SEG[33]	X= -1475.80	Y= -812.25	65	LR3	X= 1474.30	Y= 727.35
19	SEG[32]	X= -1475.80	Y= -927.75	66	LR2	X= 1474.30	Y= 842.85
20	SEG[31]	X= -1475.80	Y= -1043.25	67	LR1	X= 1474.30	Y= 958.35
21	SEG[30]	X= -1475.80	Y= -1158.75	68	LR0	X= 1474.30	Y= 1073.85
22	SEG[29]	X= -1475.80	Y= -1274.25	69	LVG	X= 1474.30	Y= 1189.35
23	SEG[28]	X= -1475.80	Y= -1389.75	70	GND	X= 1474.30	Y= 1304.85
24	SEG[27]	X= -1475.80	Y= -1505.25	71	VO	X= 1474.30	Y= 1438.50
25	SEG[26]	X= -1155.05	Y= -1541.50	72	DAO	X= 1124.45	Y= 1539.10
26	SEG[25]	X= -1039.55	Y= -1541.50	73	OPIN	X= 990.80	Y= 1539.10
27	SEG[24]	X= -924.05	Y= -1541.50	74	OPIP	X= 875.30	Y= 1539.10
28	SEG[23]	X= -808.55	Y= -1541.50	75	OPO	X= 759.80	Y= 1539.10
29	SEG[22]	X= -693.05	Y= -1541.50	76	RSTP_N	X= 644.30	Y= 1539.10
30	SEG[21]	X= -577.55	Y= -1541.50	77	FXO	X= 528.80	Y= 1539.10
31	SEG[20]	X= -462.05	Y= -1541.50	78	FXI	X= 413.30	Y= 1539.10
32	SEG[19]	X= -346.55	Y= -1541.50	79	TSTP_P	X= 297.80	Y= 1539.10
33	SEG[18]	X= -231.05	Y= -1541.50	80	SXO	X= 182.30	Y= 1539.10
34	SEG[17]	X= -115.55	Y= -1541.50	81	SXI	X= 66.80	Y= 1539.10
35	SEG[16]	X= -0.05	Y= -1541.50	82	VDD	X= -48.70	Y= 1539.10
36	SEG[15]	X= 115.45	Y= -1541.50	83	PRTD[7]	X= -164.20	Y= 1539.10
37	SEG[14]	X= 230.95	Y= -1541.50	84	PRTD[6]	X= -279.70	Y= 1539.10
38	SEG[13]	X= 346.45	Y= -1541.50	85	PRTD[5]	X= -395.20	Y= 1539.10
39	SEG[12]	X= 461.95	Y= -1541.50	86	PRTD[4]	X= -510.70	Y= 1539.10
40	SEG[11]	X= 577.45	Y= -1541.50	87	PRTD[3]	X= -626.20	Y= 1539.10
41	SEG[10]	X= 692.95	Y= -1541.50	88	PRTD[2]	X= -741.70	Y= 1539.10
42	SEG[9]	X= 808.45	Y= -1541.50	89	PRTD[1]	X= -857.20	Y= 1539.10

43	SEG[8]	X=	923.95	Y= -1541.50		90	PRTD[0]	X=	-972.70	Y=	1539.10
44	SEG[7]	X=	1039.45	Y= -1541.50		91	PRTC[3]	X=	-1088.20	Y=	1539.10
45	SEG[6]	X=	1154.95	Y= -1541.50		92	PRTC[2]	X=	-1203.70	Y=	1539.10
46	SEG[5]	X=	1474.30	Y= -1467.15		93	PRTC[1]	X=	-1319.20	Y=	1539.10
47	SEG[4]	X=	1474.30	Y= -1351.65							

H. 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	

V3.2E

Test 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, 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

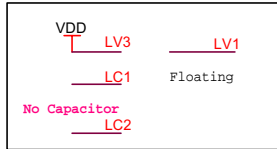Sink Current Spec. for both Push-Pull and Open-Drain I/O port.

*2: This Spec. base on one driver only. There are five build-in 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)

I. Application Circuit
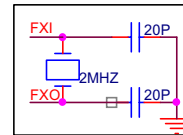
Twice Charge Pump is selected
LCD Max. Voltage=LV3=3/2*VDD

LC1
C6
0.1uF
LC2

C7 0.1uF   LV1

C9 0.1uF   LV3

Twice Charge Pump is selected
LCD Max. Voltage=LV3=VDD

VDD
LV3   LV1
LC1   Floating
No Capacitor
LC2
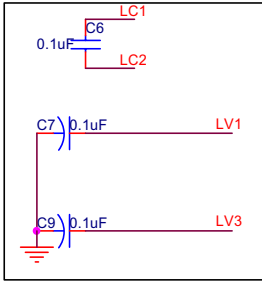
No External Parts is necessary if user adopt Internal Fast RC Clock

External Fast Clock: Crystal osc.

FXI   20P
2MHZ
FXO   20P

External Fast Clock: RC osc.

VDD
R > 8.2 KOhm
FXI
C: Please Ref. AN016

VDD
BATTERY1   C1   C2   R1
3V   0.1uF   100uF   50K
C3   SW1
0.1uF   RESET

VDD
RSTP_N

GND

LC1   LC1
LC2   LC2
LV1   LV1

FXI   FXI
FXO   FXO
SXI   SXI
SXO   SXO
PRTD[7:0]
PRTC[3:0]

COM[15:0]
SEG[39:0]

LCD PANEL

LV3
C1
0.1uF   LV3 < 9 Volt
C2
0.1uF   LR4
C3
0.1uF   LR3
C4
0.1uF   LR2
C5
0.1uF   LR1

1/5 BAIS CONFIGURATION

LR0

LVG

?K Ohm   VR1

TSTP_P

HE83130

OPIN
OPIP
OPO
DAO

PWMP
PWMN

VO

Buzzer or Speaker Circuit

Passive Bias & Filter Circuit

Please Refer AN022 for Speech Output Circuit

VDD
SP1
Q1
NPN
SPEAKER

External Slow Clock: Crystal osc.

SXI   20P
32.768K
SXO   20P

External Slow Clock: RC osc.

SXI
R: Please ref. AN016
SXO

V3.2E