A. HE83000 Introduction

HE83000 is a member of 8-bit Micro-controller series developed by King Billion Electronics Ltd. This IC is the most simplify controller, use for normal application. The built-in OP comparator can be used with (light、voice、temperature、humility) sensor and used as battery low detection.

The instruction set of HE83000 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 processing power is enough to most of battery operation system.

B. HE83000 Features

- Operation Voltage： 2.2V – 5.5V

- System Clock： DC ~ 8MHz @ 5.0V

  DC ~ 4MHz @ 2.2V

- Internal ROM： 4K Bytes(4K Program ROM)

- Internal RAM： 64 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.

- Two external interrupts and two internal timer interrupts.

- Two 16-bit timer. (Clock Source reference by Fast Clock)

- Instruction set： 32 instructions, 4 addressing mode. 6-bit DATA POINTER for RAM and 12-bit TABLE POINTER for ROM.

C. HE83000 Application

- General Purpose Simple Controller。

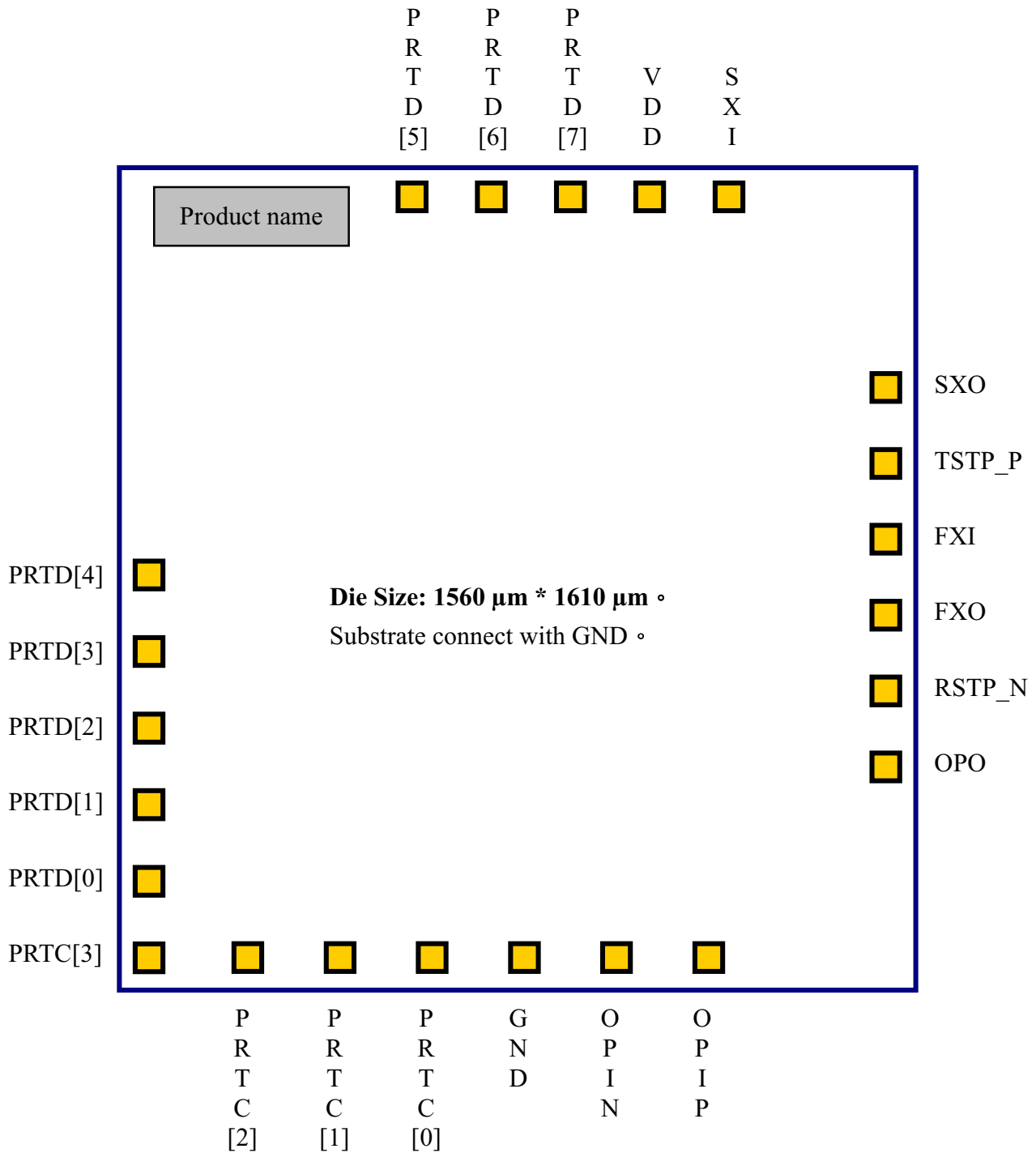- Light, temperature, humility-controlled system.

D. Pin Description

Pin #	Pin name	I/O	Function	Description
16 15	**FXI,** **FXO**	B, O	External fast clock pin. Connecting to crystal or RC to generate 32.768 kHz ~ 8MHz frequency.	Mask option setting： 　　MO_FCK/SCKN= 00：Slow Clock only 　　　　　　　　01：Illegal 　　　　　　　　10：Dual Clock 　　　　　　　　11：Fast Clock only 　　MO_FOSCE = 0：Internal fast osc. 　　　　　　= 1：External fast osc.
19 18	**SXI,** **SXO**	I, O	External slow clock pin. Connecting with 32768 Hz crystal or resistor as slow clock and providing clock source for LCD display, TIMER1, Time-Base and other internal blocks.	MO_FXTAL= 0：RC osc. for fast clock 　　　　= 1：X'tal osc. for fast clock MO_SXTAL= 0：RC for 32768 Hz clock 　　　　= 1：X'tal for 32768 Hz 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.
14	**RSTP_N**	I	System Reset.	Level trigger, active low. Except for using this pin, using mask option (MO_PORE=1) could enable IC build-in power-on reset circuit. Besides, MO_WDTE can set Watch Dog Timer： MO_WDTE=0：Disable Watch Dog Timer

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				=1：Enable Watch Dog Timer
17	**TSTP_P**	I	Test Pin	Please bond this pin and add a test point on PCB for debugging. Leave this pin floating is OK.
6..9	**PRTC[3:0]**	B	4-pin bi-directional I/O port.	Mask options： MO_CPP[3..0]=1 ~ Push-pull. =0 ~ Open-drain. Output must be "1" before reading whenever use them as input (No tri-state structure).
21.. 23 1..5	**PRTD[7:0]**	B	8-pin bi-directional I/O port. PRTD[7..2] as wake-up pin. PRTD[7..6] as external interrupt pin.	Mask options： MO_DPP[7..0]=1 ~ Push-pull. =0 ~ Open-drain. Output must be "1" before reading whenever use them as input (No tri-state structure).
11	**OPIN**	I	Negative input of OP comparator	Set the bit0(OP=1) of VOC register to turn on OP comparator.
12	**OPIP**	I	Positive input of OP comparator	
13	**OPO**	O	Output of OP comparator	
20	**VDD**	P	Positive Power Input	
10	**GND**	P	Power Ground Input	

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E. Pin Diagram

PRTD[5] PRTD[6] PRTD[7] VDD SXI

Product name

SXO

TSTP_P

FXI

FXO

RSTP_N

OPO

PRTD[4]

PRTD[3]

PRTD[2]

PRTD[1]

PRTD[0]

PRTC[3]

Die Size: 1560 μm * 1610 μm。
Substrate connect with GND。

PRTC[2] PRTC[1] PRTC[0] GND OPIN OPIP

F. Bonding Pad Location

PIN Number	PIN Name	X Coordinate		Y Coordinate	
1	PRTD[4]	X=	-659.89	Y=	9.63
2	PRTD[3]	X=	-659.89	Y=	-131.37
3	PRTD[2]	X=	-659.89	Y=	-272.37
4	PRTD[1]	X=	-659.89	Y=	-413.38
5	PRTD[0]	X=	-659.89	Y=	-548.87
6	PRTC[3]	X=	-659.89	Y=	-689.87
7	PRTC[2]	X=	-426.90	Y=	-684.87
8	PRTC[1]	X=	-285.90	Y=	-684.87
9	PRTC[0]	X=	-144.90	Y=	-684.87
10	GND	X=	6.10	Y=	-684.87
11	OPIN	X=	142.10	Y=	-684.87
12	OPIP	X=	282.12	Y=	-684.87
13	OPO	X=	660.82	Y=	-419.75
14	RSTP_N	X=	660.82	Y=	-276.75
15	FXO	X=	660.82	Y=	-141.25
16	FXI	X=	660.82	Y=	0.95
17	TSTP_P	X=	660.82	Y=	143.95
18	SXO	X=	660.82	Y=	279.45
19	SXI	X=	394.45	Y=	682.05
20	VDD	X=	258.95	Y=	682.05
21	PRTD[7]	X=	117.95	Y=	682.05

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| 22 | PRTD[6] | X= | -23.05 | Y= | 682.05 |
| 23 | PRTD[5] | X= | -164.05 | Y= | 682.05 |

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}	$0^0C \sim 70^0C$	
Storage Temperature	T_{st}	$-50^0C \sim 100^0C$	

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}	$0^0C \sim 70^0C$	
Storage Temperature	T_{st}	$-50^0C \sim 100^0C$	

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		6	9	μA
I_{Idle}	IDLE Mode Current	System	32.769K X'tal		4	7	μA
I_{Sleep}	Sleep Mode Current	System				1	μA
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

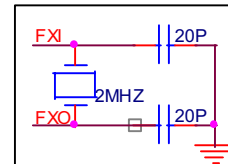Note: *1: Drive Current Spec. for Push-Pull I/O port only

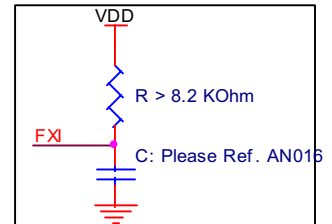Sink Current Spec. for both Push-Pull and Open-Drain I/O port.

H. Application Circuit
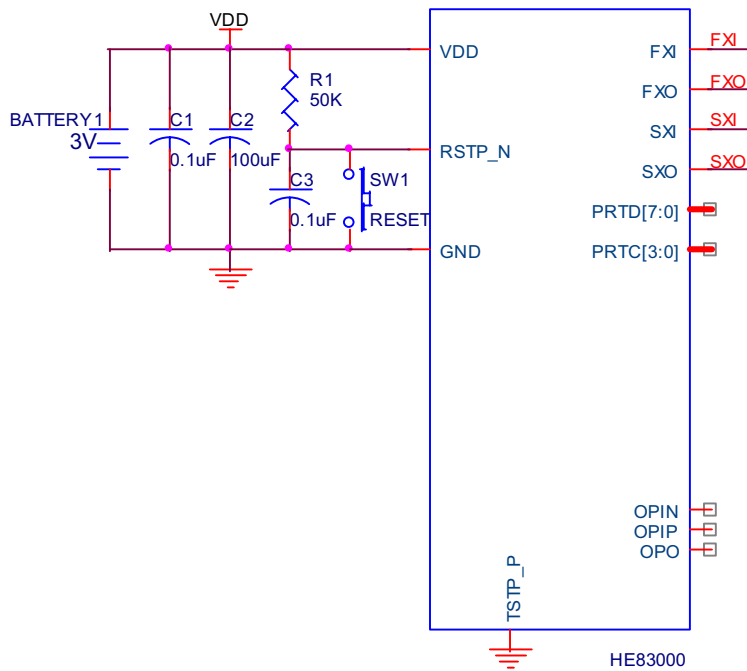
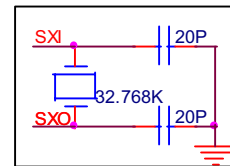No External Parts is necessary if user adopt Internal Fast RC Clock

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
            0.1uF   SW1
                     RESET

VDD
RSTP_N

GND

TST1P_P

HE83000

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

OPIN
OPIP
OPO

External Slow Clock: Crystal osc.

SXI   20P
32.768K
SXO   20P

External Slow Clock: RC osc.

SXI
R: Please ref. AN016
SXO