

A. HE83R126 Introduction

HE83R126 is a member of 8-bit Micro-controller series that is developed by King Billion. Users can chose any one of combination among 【256 dots LCD Driver + 8 Bit I/O Port】...【192 dots LCD Driver + 16 Bit I/O Port】etc. (Decide by Mask Option). The IC Built-in LCD power regulator to provide better LCD display effect. 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 small/medium systems such as LCD Games 、Perpetual Calendar etc. 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. HE83R126 Features

- Operation Voltage : 2.4V – 5.5V
- System Clock : DC ~ 8MHz @ 5.0V
DC ~ 4MHz @ 2.4V
- 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.
- 8-bit ~ 16-bit Bi-directional I/O port. Mask Option can select PUSH-PULL or OPEN DRAIN output mode for each I/O pin.
- 256(8 Com* 32 Seg) ~ 192(8 Com*24 Seg) dot matrix LCD driver (A 、B TYPE selectable).
- Built-in LCD power regulator to provide stable working voltage (~3Volt)
When $VDD \geq 2.4\text{V}$, LV4 output voltage around 3Volt
When $VDD < 2.4\text{V}$; LV4,3,2,1 output voltage will going down with VDD
- 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

Please always take in mind that ICE is different from IC. ICE is the whole set of HE80000 series IC, but each IC is a subset of ICE. Never use any hardware resource that real IC didn't have, especially RAM and register. KBIDS and compiler cannot prevent user to use some hardware resource that didn't exist. Please check the following table and refer 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	—	16-bit	⊙	256B	—	8-bit	8~16	—	⊙	T1,T2
VO	DAO	OP	PWM	LCD	COM*SEG	Bias	Rgr	ChrgPmp	LV2	LR	LVG	REC	S.R.
—	—	—	⊙	192~256	8*32	1/5	⊙	4	⊙	—	—	—	—

D. Pin Assignment

Pin #	Pin Name	I/O	Function	Description
63 62	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 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 °
66 65	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.	
61	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 HE83R126 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
64	TSTP_P	I	Test Pin	Please bond this pin and add a test point on PCB for debugging. But for improving ESD, please connect this pin with zero Ohm resistor to GND.
68.. 75	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
5..12	NC			
13.. 20	PRT15[7:0]/SEG[31:24]	B/ O	Port 15 bi-directional pin(8pins) or LCD Segment[31:24]	Mask Option MO_LIO15[7:0] Set 8 pins to be I/O or LCD Segment: MO_LIO15[7:0]=0 ; I/O Pin =1 ; LCD Pin I/O Pin Assigned Mask Option MO_15PP[7:0] MO_15PP[7:0]=0 ; Open-drain output =1 ; Push-pull output



Pin #	Pin Name	I/O	Function	Description
45.. 52	COM[7:0]	O	LCD COMmon Output	Data filled from D8H, please refer the LCD RAM Map. All COM & SEG Pins is equal to VDD if LCD turn off.
21.. 44	SEG[23:0]	O	LCD SEGment Output	
54	LC2	B	Charge Pump Switch 1	Please refer the application circuit.
53	LC1	B	Charge Pump Switch 2	
59	LV4	B	Charge Pump V4	LV4=LV3=LV2=LV1=VDD when LCD turn-off LV4=4*LV1, LV3=3*LV1, LV2=2*LV1 when LCD on. Others please refer to application circuit.
58	LV3	B	Charge Pump V3	
57	LV2	B	Charge Pump V2	
56	LV1	B	Charge Pump V1=0.75 Volt If regulator works.	
55	LVF	I	Regulator Feedback	
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
67	VDD	P	Positive Power Input	Adding 0.1 μ F capacitor as by-pass capacitor on power pins is necessary.(within 1 cm distance)
60	GND	P	Power Ground Input	
1	VDD_{PWM}	P	PWM Positive Power Input	Dedicated Power for PWM Block: must connect with VDD & GND
4	GND_{PWM}	P	PWM 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	D8H	E0H	E8H	F0H	F8H
COM1	D9H	E1H	E9H	F1H	F9H
COM2	DAH	E2H	EAH	F2H	FAH
COM3	DBH	E3H	EBH	F3H	FBH
COM4	DCH	E4H	ECH	F4H	FCH
COM5	DDH	E5H	EDH	F5H	FDH
COM6	DEH	E6H	EEH	F6H	FEH
COM7	DFH	E7H	EFH	F7H	FFH



G. Bonding Pad Location

PIN Number	PIN Name	X Coordinate	Y Coordinate	PIN Number	PIN Name	X Coordinate	Y Coordinate
1	VDD	-1110.00	1173.40	39	SEG[5]	1110.00	-890.90
2	PWMP	-1110.00	974.10	40	SEG[4]	1110.00	-775.50
3	PWMN	-1110.00	699.30	41	SEG[3]	1110.00	-660.10
4	GND	-1110.00	500.10	42	SEG[2]	1110.00	-544.70
5	NC	-1110.00	263.10	43	SEG[1]	1110.00	-429.30
6	NC	-1110.00	147.70	44	SEG[0]	1110.00	-313.90
7	NC	-1110.00	32.30	45	COM[7]	1110.00	-198.50
8	NC	-1110.00	-83.10	46	COM[6]	1110.00	-83.10
9	NC	-1110.00	-198.50	47	COM[5]	1110.00	32.30
10	NC	-1110.00	-313.90	48	COM[4]	1110.00	147.70
11	NC	-1110.00	-429.30	49	COM[3]	1110.00	263.10
12	NC	-1110.00	-544.70	50	COM[2]	1110.00	378.50
13	PRT15[7]	-1110.00	-660.10	51	COM[1]	1110.00	493.90
14	PRT15[6]	-1110.00	-775.50	52	COM[0]	1110.00	609.30
15	PRT15[5]	-1110.00	-890.90	53	LC1	1110.00	724.70
16	PRT15[4]	-1110.00	-1006.30	54	LC2	1110.00	840.10
17	PRT15[3]	-1110.00	-1121.70	55	LVF	1110.00	955.50
18	PRT15[2]	-1076.35	-1480.00	56	LV1	1110.00	1070.90
19	PRT15[1]	-960.95	-1480.00	57	LV2	1110.00	1186.30
20	PRT15[0]	-807.55	-1480.00	58	LV3	1018.00	1480.00
21	SEG[23]	-692.15	-1480.00	59	LV4	902.60	1480.00
22	SEG[22]	-576.75	-1480.00	60	GND	787.20	1480.00
23	SEG[21]	-461.35	-1480.00	61	RSTP_N	671.80	1480.00
24	SEG[20]	-345.95	-1480.00	62	FXO	556.40	1480.00
25	SEG[19]	-230.55	-1480.00	63	FXI	441.00	1480.00
26	SEG[18]	-115.15	-1480.00	64	TSTP_P	325.60	1480.00
27	SEG[17]	0.25	-1480.00	65	SXO	166.20	1480.00
28	SEG[16]	115.65	-1480.00	66	SXI	5.05	1480.00
29	SEG[15]	231.05	-1480.00	67	VDD	-110.35	1480.00
30	SEG[14]	346.45	-1480.00	68	PRTD[7]	-288.90	1480.00
31	SEG[13]	461.85	-1480.00	69	PRTD[6]	-404.30	1480.00
32	SEG[12]	577.25	-1480.00	70	PRTD[5]	-519.70	1480.00
33	SEG[11]	692.65	-1480.00	71	PRTD[4]	-635.10	1480.00
34	SEG[10]	808.05	-1480.00	72	PRTD[3]	-750.50	1480.00
35	SEG[9]	923.45	-1480.00	73	PRTD[2]	-865.90	1480.00
36	SEG[8]	1076.85	-1480.00	74	PRTD[1]	-981.30	1480.00
37	SEG[7]	1110.00	-1121.70	75	PRTD[0]	-1096.70	1480.00
38	SEG[6]	1110.00	-1006.30				



H. DA/DC 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°C ~ 70°C	
Storage Temperature	T_{st}	-50°C ~ 100°C	

Recommended Operating Conditions

Item	Sym.	Rating	Condition
Supply Voltage	V_{dd}	2.4V ~ 5.5V	
Input Voltage	V_{ih}	0.9 V_{dd} ~ V_{dd}	
	V_{il}	0.0V ~ 0.1 V_{dd}	
Operating Frequency	F_{max}	8MHz	$V_{dd}=5.0V$
		4MHz	$V_{dd}=2.4V$
Operating Temperature	T_{op}	0°C ~ 70°C	
Storage Temperature	T_{st}	-50°C ~ 100°C	



Test 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		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, Regulator ON		12	20	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
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

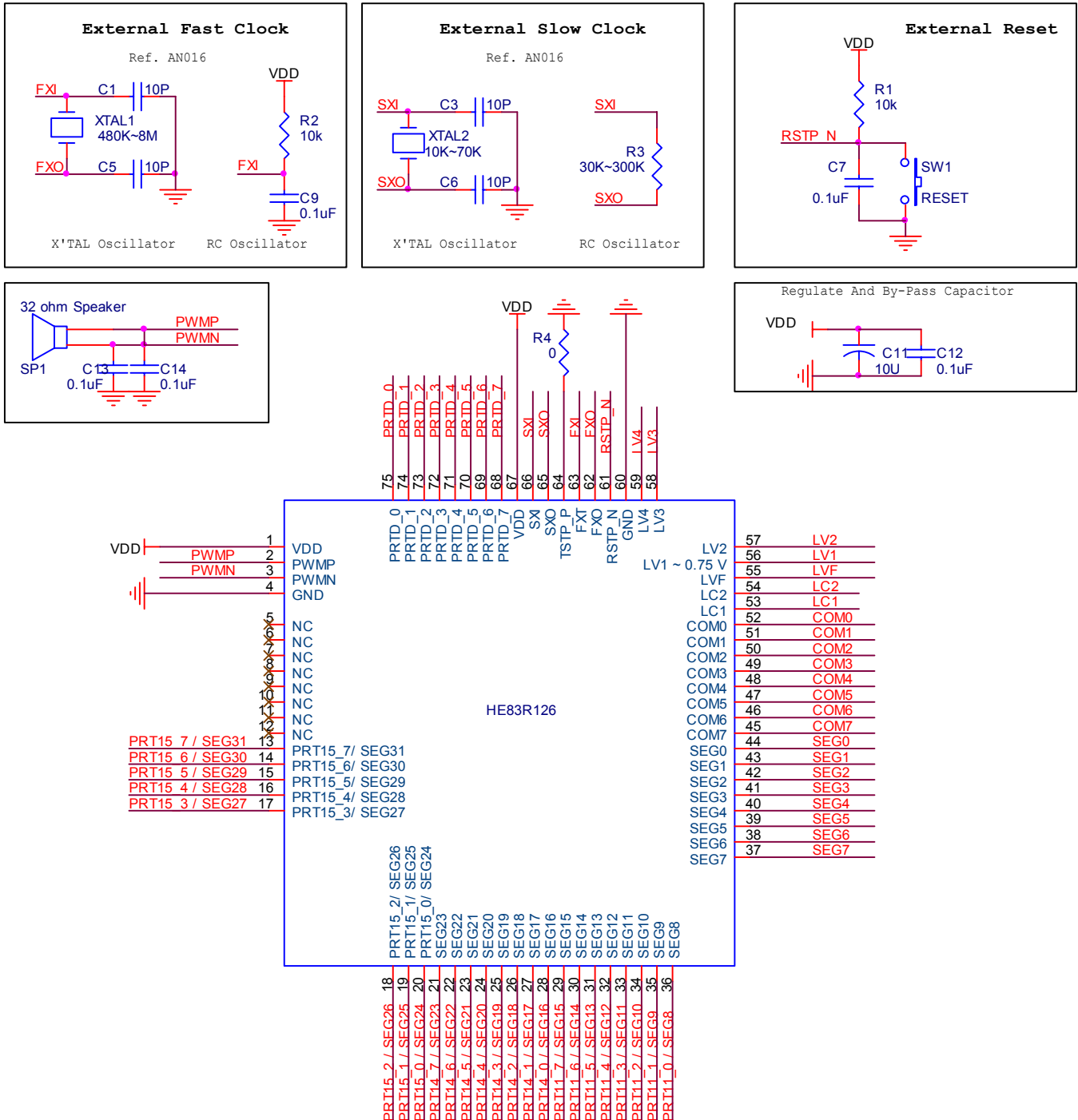
Note: *1: Drive Current Spec. For Push-Pull I/O port only

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

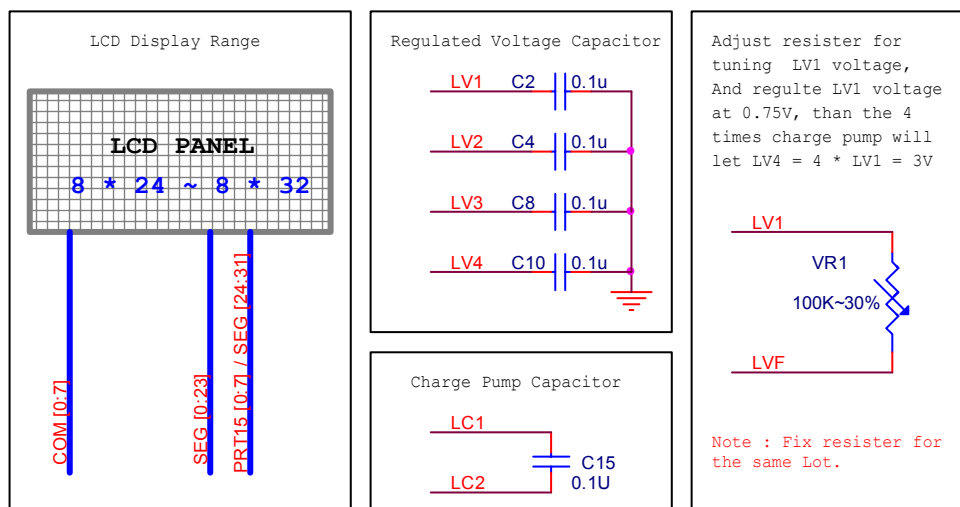
to get the total amount of current. (**I_{PWM}** * N; N=0,1,2,3,4,5)

I. Application Circuit



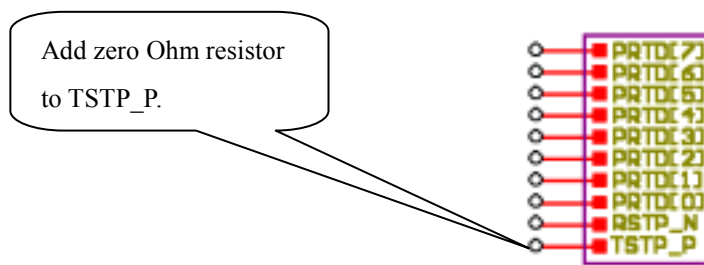
2G LCD Charge Pump Circuit, 1/5 Bias, 1/8 Duty, 3V Configuration

MaskOption Must Select 4 Times Charge Pump LCD Regulator Enable



J. Important Note

1. LCD driving circuit must be turn off before IC goes into sleep mode.
2. Please bonds the TSTP_P, RSTP_N and PRTD[7:0] with test point on PCB (can be soldered and probed) as you can, then KB can do some IC testing job on PCB. Please connect TSTP_P pin with zero ohm resistor(or copper wire which can be cut on PCB) normally for good ESD result. KB can pull low TSTP_P pin by remove the zero ohm resistor . The following figure is an example (Testing point with through hole).



K. Updated Record

Version	Date	Section	Original Content	New Content
Preliminary1.02	Jul 2, 2002	I		Modify Application Circuit