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A.HE83149 Introduction

HE83149 is a member of Jess Tech HE8000 series 8-bit CMOS micro-controller. This IC can share the LCD pin and I/O pin (From 1024-dot of LCD driver + 8 Bit I/O Port … 768-dot of LCD driver + 24 Bit I/O Port), the combination of the above is selected by Mask Option. It built-in one internal Op-Amp, one 7-bit D/A converter, and one PWM output module to provide a speech output interface. Use the built-in 256K ROM can store around 64 seconds of speech data. The HE83149 provides a very simple and effective instruction set, each instruction byte occupies only 1.5 clock cycle time, therefore, it is suitable to apply in the high performance systems.

B.HE83149 Features

- Operating Voltage: 2.4V – 5.2V
- Operation frequency Range: DC ~ 8MHz @ 5.0V
  DC ~ 4MHz @ 2.4V
- ROM size: 256K Bytes
- RAM size: 512 Bytes
- Dual Clock: Normal(Fast) clock: 32.768K ~ 8MHz
  Slow clock: 32.768KHz
- Operating Mode: DUAL， FAST，SLOW，IDLE，SLEEP
- 8~24 bi-directional I/O pins, PUSH-PULL or OPEN DRAIN output selected by mask option
- 1024~768 LCD driver (A、B TYPE)
- Built-in one 7-bit D/A Converter
- Built-in a PWM output circuit
- Provides three internal and two external interrupt
- Provides two 16-bit timer, one Time Base.
- Instruction Set : 32 Instructions, 4 types of Addressing Mode, 2 individual Pointer for ROM (24-bit) and RAM (8-bit) table access.

C.HE83149 Application

- Suitable in LCD games, education toys, data-bank, translator and some mid-to-high end electronic products.

D. Pin Assignment

Pin	Pin Name	I/O	Function	Description
92 91	**FXI,** **FXO**	B, O	External Fast Clock pin. To connect the Crystal or R,C oscillation to generate 32.768KHz ~ 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：X'tal 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 Timer 1 use the 32.768K clock source.
95 94	**SXI,** **SXO**	I, O	External Slow Clock pin . To connect the 32.768KHz oscillator to generate the stable frequency for Slow Mode and provide HE83149 LCD display, Timer clock source.	
90	**RSTP_N**	I	System reset signal	Pull this pin to low level to reset the system. Besides, Select the Mask Option (MO_PORE=1) to enable the HE83149 internal Power-on Reset function. In addition, the MO_WDTE is used for Watch Dog Timer setting： MO_WDTE =0：Disable Watch Dog Timer =1：Enable Watch Dog Timer
93	**TSTP_P**	I	Test Pin.	Pull the pin to high level to enter into testing mode.
97.. 104	**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	**PRT15[7:0]/** **SEG[63:56]**	B/ O	Port 15 bi-directional I/O pin, (8 pins), or it can be shared to LCD segment Segment[63:56]。	Mask Option MO_LIO15[7:0] to select the pins are I/O or LCD segment: 0=I/O pin, 1=LCD segment pin When the pins are assignment to I/O pin, select the MASK Option MO_15PP[7:0] for output type MO_15PP=1 : Push-pull output, 0 : Open-drain output
13.. 20	**PRT14[7:0]/** **SEG[55:48]**	B/ O	Port 14 bi-directional I/O pin, (8 pins), or it can be shared to LCD segment Segment[55:48]。	Mask Option MO_LIO14[7:0] to select the pins are I/O or LCD segment: 0=I/O pin, 1=LCD segment pin When the pins are assignment to I/O pin, select the MASK Option MO_14PP[7:0] for output type MO_14PP=1 : Push-pull output, 0 : Open-drain output
4..1, 110.. 107 69… 76	**COM[15:0]**	O	LCD COMmon Output	Fill data from Page 0, refer LCD and RAM map.
21.. 68	**SEG[47:0]**	O	LCD SEGment Output	

78	**LC2**	B	Charge Pump Switch 1	Refer to application circuit.
77	**LC1**	B	Charge Pump Switch 2	
81	**LV3**	B	Higher Charge Pump Voltage	Refer to application circuit.
80	**LV2**	B	2/3 Voltage of LV3	
79	**LV1**	B	1/3 Voltage of LV3	
82.. 86	**LR[4..0]**	B	LCD Resister level 4 ~ 0	Refer to application circuit.
87	**LVG**	I	LCD Virtual Ground	Refer to application circuit.
105	**PWMP**	O	PWM +ve O/P pin, can directly drive Speaker or Buzzer for voice output.	Preset the Bit2 of VOC register: PWM =1；turn on PWM.
106	**PWMN**	O	PWM -ve O/P pin, can directly drive Speaker or Buzzer for voice output.	Preset the Bit2 of VOC register: PWM =1；turn on PWM.
89	**VO**	O	D/A voice output	Preset the Bit-1 of VOC register: DA=1；turn on VO.
96	**VDD**	P	Positive Power Input	Adding 0.1μF capacitor as by-pass capacitor is between VDD and GND is necessary
88	**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]	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

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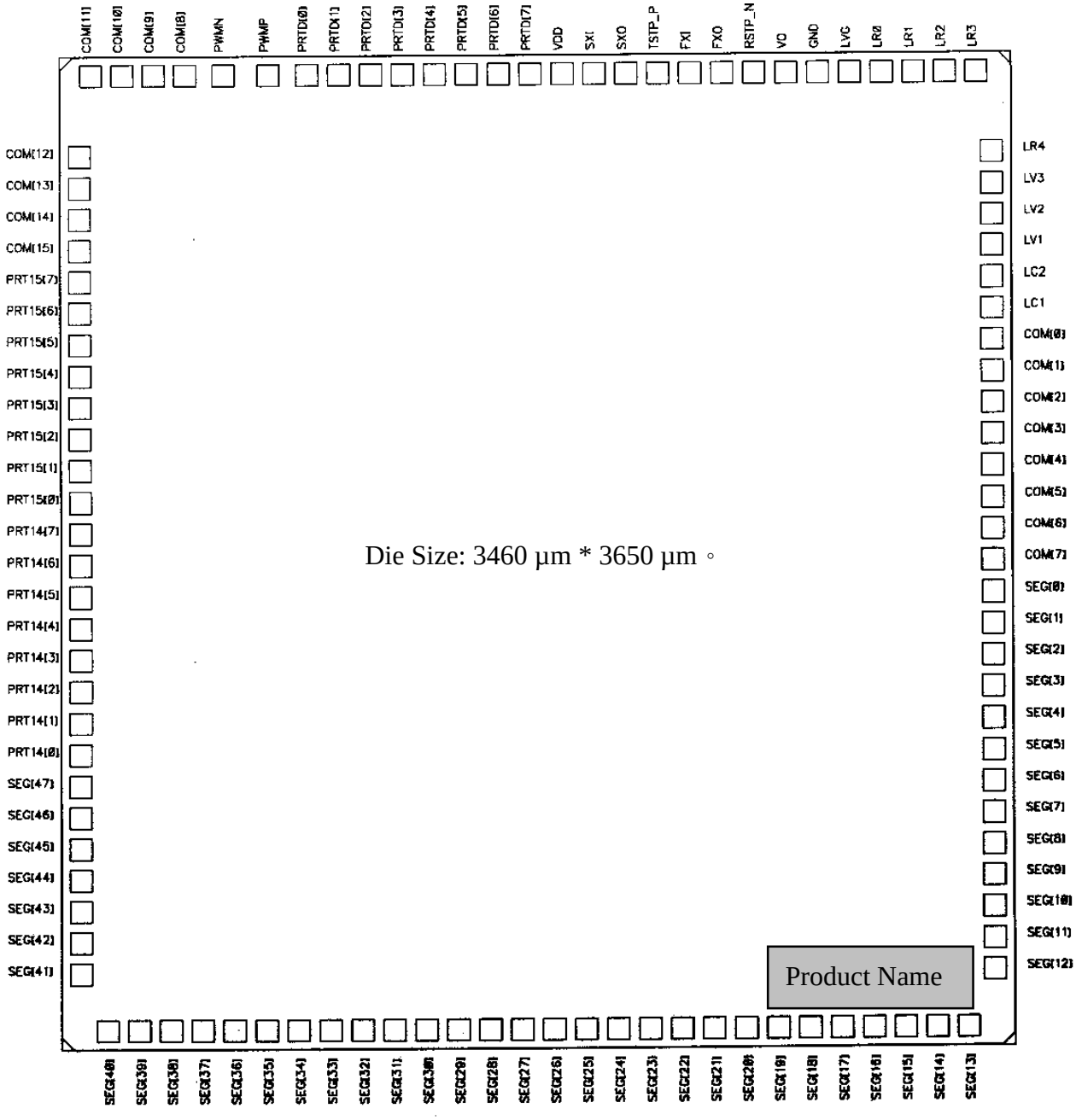
F. Pin Diagram



G. 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

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H. Electrical 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}	2.4V ~ 5.2V	
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} =2.4V
Operating Temperature	T_{op}	0^0C ~ 70^0C	
Storage Temperature	T_{st}	-50^0C ~ 100^0C	

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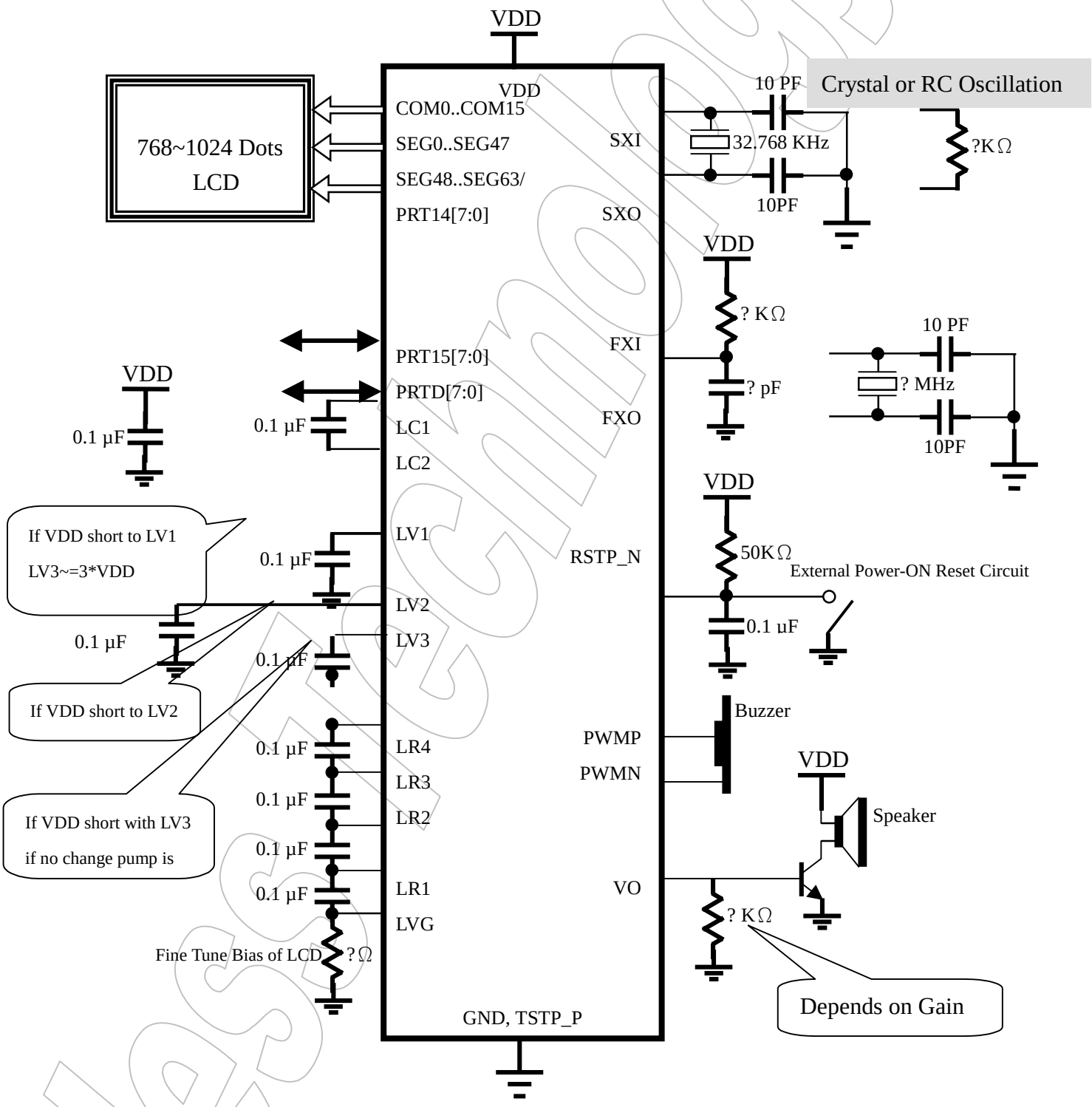
Test condition:TEMP=25℃, VDD=3V+/-10%, GND=0V

	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	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



(Consumer Application)

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SUPPLEMENTARY SPECIFICATION： HE82/83/89 PWM application

Description:

For HE83/89 PWM application, the following points must be bare in mind.

1. **The PWM output can direct drive buzzer.**
2. **For direct drive speaker, it must use 32Ω or above speaker.**
3. **For speaker application, it must add capacitors between IC's VDD ground and its PWM output, see below figure.**

Note: the 1 F capacitor must be connected near IC's

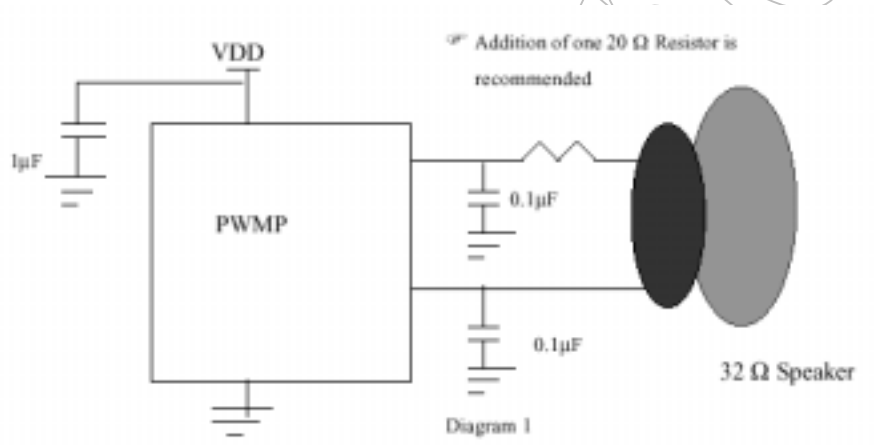

Diagram 1

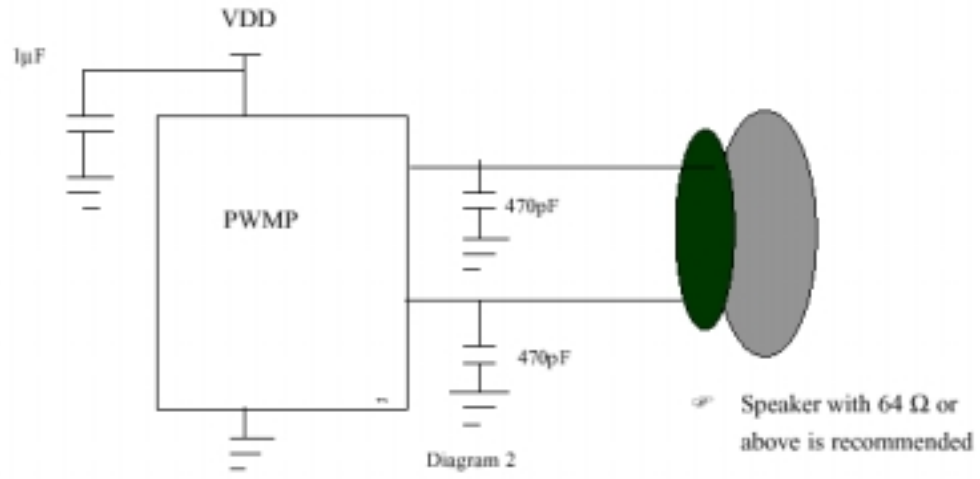

Diagram 2