



## A. HE83120 Introduction

- HE83120 is a member of 8-bit Micro-controller series that is developed by King Billion. This IC build-in 320-dot LCD driver and has one OP comparator. The built-in OP comparator can be used with (light、voice、temperature、humidity) sensor etc. The 7-bit current-type D/A converter and PWM device provide the complete speech output mechanism. The 256K ROM Size can storage around 80 second's speech. This IC is applicable to the small/medium systems such as LCD Games and 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. HE83120 Features

- Operation Voltage : 2.2V – 5.5V
- System Clock : DC ~ 8MHz @ 5.0V  
DC ~ 4MHz @ 2.2V
- Internal ROM : 256K Bytes(64K Program ROM+192K Data 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.
- 320 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 18-bit TABLE POINTER for ROM.

## C. HE83120 Application

- LCD Game 、 Perpetual Calendar System etc..
- Light, voice, temperature, humidity-controlled system's speech. Applicable to the LCD application.

## D. Pin Assignment

| Pin #    | Pin Name                  | I/O     | Function  | Description  |
|----------|---------------------------|---------|---|--|
| 68<br>67 | <b>FXI,</b><br><b>FXO</b> | B,<br>O | External fast clock pin. Connecting to crystal or RC to generate 32.768 kHz ~ 8MHz system clock.                                    | Mask Option settings :<br>MO_FCK/SCKN=00 : Slow Clock only<br>01 : Illegal<br>10 : Dual Clock<br>11 : Fast Clock only<br><br>MO_FOSCE=0 : Internal fast oscillation<br>1 : External fast oscillation<br>MO_FXTAL=0 : R,C oscillation for Fast Clock<br>1 : Crystal oscillation for Fast Clock<br>MO_SXTAL=0 : R,C oscillation for 32.768K Clock<br>1 : Crystal oscillation for 32.768K Clock ° |
| 71<br>70 | <b>SXI,</b><br><b>SXO</b> | I,<br>O | External slow clock pin. Connecting with 32.768 Hz OSC to generate the stable frequency for Slow Clock Mode and Timer clock source. | Program the value of OP1 and OP2 to change the operating modes (Normal, Slow, Idle and Sleep).<br><br>In Dual Clock mode , the system runs in Fast Clock, only the LCD and timer I use the 32.768K clock source °  |
| 66       | <b>RSTP_N</b>             | 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 HE83120 internal Power-on Reset function.<br><br>In addition, the MO_WDTE is used for Watch<br><br>Timer setting :<br><br>MO_WDTE=0 : Disable Watch Dog Timer  |



|       |                  |   |  |  |
|-------|------------------|---|--|--|
|       |                  |   |  | =1 : Enable Watch Dog Timer  |
| 69    | <b>TSTP_P</b>    | I | Test Pin   | Pull the pin to high level to enter into testing mode.                                     |
| 81..  |                  |   |  | Mask Option MO_CPP[3:0] to preset the output type :  |
| 83    | <b>PRTC[3:0]</b> | B | Port C bi-directional I/O Pin (4Pins)  | MO_CPP=1 : Push-pull output;<br>=0 : Open-drain output                                     |
| 1     |                  |   |  | When assigned the port to input pin, send a '1' and read the result to get the input value |
| 73..  |                  |   | 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 :  |
| 80    | <b>PRTD[7:0]</b> | B |  | MO_DPP=1 : Push-pull output;<br>=0 : Open-drain output                                     |
|       |                  |   |  | When assigned the port to input pin, send a '1' and read the result to get the input value |
| 44..  | <b>COM[7:0]</b>  | O | LCD COMmon Output  |  |
| 51    |                  |   |  | Data filled from D8H, please refer the LCD RAM map   |
| 4..43 | <b>SEG[39:0]</b> | O | LCD SEGment Output   |  |
| 53    | <b>LC2</b>       | B | Charge Pump Switch 1   | Please refer the application circuit.  |
| 52    | <b>LC1</b>       | B | Charge Pump Switch 2   |  |
| 55    | <b>LV3</b>       | B | Charge Pump V3   | Please refer the application circuit.  |
| 54    | <b>LV1</b>       | B | Charge Pump V1   |  |
| 56..  | <b>LR[4..1]</b>  | B | LCD Resister level 4 ~ 0   | Please refer the application circuit.  |
| 59    |                  |   |  |  |
| 60    | <b>LVG</b>       | I | LCD Virtual Ground   | Please refer the application circuit.  |
| 2     | <b>PWMP</b>      | 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     | <b>PWMN</b>      | 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                                  |
| 62    | <b>VO</b>        | O | D/A voice output   | Set the bit1 (DA=1) of VOC register to turn on VO  |

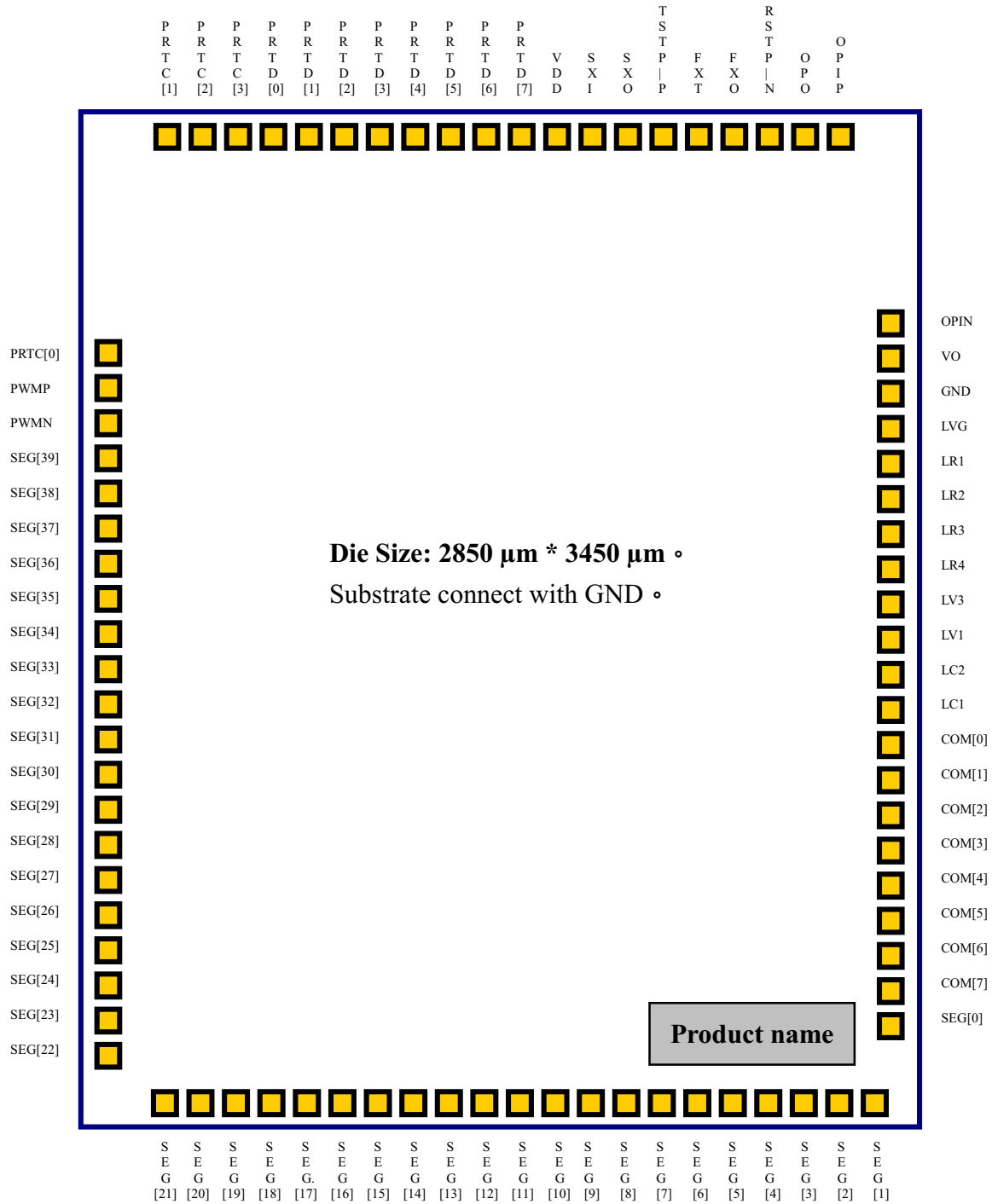


|    |             |   |                         |  |
|----|-------------|---|-------------------------|--|
| 63 | <b>OPIN</b> | I | OPAMP Inverting pin     | Set the bit1 (OP=1) register to turn on OP<br>Individual Op comparator |
| 64 | <b>OPIP</b> | I | OPAMP Non-Inverting pin |  |
| 65 | <b>OPO</b>  | O | OPAMP Output pin        |  |
| 72 | <b>VDD</b>  | P | Positive Power Input    |  |
| 61 | <b>GND</b>  | P | Power Ground Input      |  |

## E.LCD RAM Map

|      | SEG<br>[7:0] | SEG<br>[15:8] | SEG<br>[23:16] | SEG<br>[31:24] | SEG<br>[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            |

# F. Pin Diagram





## G. Bonding Pad Location

| PIN Number | PIN Name | X Coordinate | Y Coordinate | PIN Number | PIN Name | X Coordinate | Y Coordinate |
|------------|----------|--------------|--------------|------------|----------|--------------|--------------|
| 1          | PRTC[0]  | X= -1339.50  | Y= 905.20    | 43         | SEG[0]   | X= 1339.90   | Y= -1302.80  |
| 2          | PWMP     | X= -1339.50  | Y= 789.80    | 44         | COM[7]   | X= 1339.90   | Y= -1187.20  |
| 3          | PWMN     | X= -1339.50  | Y= 674.20    | 45         | COM[6]   | X= 1339.90   | Y= -1071.80  |
| 4          | SEG[39]  | X= -1339.50  | Y= 558.80    | 46         | COM[5]   | X= 1339.90   | Y= -956.20   |
| 5          | SEG[38]  | X= -1339.50  | Y= 443.20    | 47         | COM[4]   | X= 1339.90   | Y= -840.80   |
| 6          | SEG[37]  | X= -1339.50  | Y= 327.80    | 48         | COM[3]   | X= 1339.90   | Y= -725.20   |
| 7          | SEG[36]  | X= -1339.50  | Y= 212.20    | 49         | COM[2]   | X= 1339.90   | Y= -609.80   |
| 8          | SEG[35]  | X= -1339.50  | Y= 96.80     | 50         | COM[1]   | X= 1339.90   | Y= -494.20   |
| 9          | SEG[34]  | X= -1339.50  | Y= -18.80    | 51         | COM[0]   | X= 1339.90   | Y= -378.80   |
| 10         | SEG[33]  | X= -1339.50  | Y= -134.20   | 52         | LC1      | X= 1339.90   | Y= -263.20   |
| 11         | SEG[32]  | X= -1339.50  | Y= -249.80   | 53         | LC2      | X= 1339.90   | Y= -147.80   |
| 12         | SEG[31]  | X= -1339.50  | Y= -365.20   | 54         | LV1      | X= 1339.90   | Y= -32.20    |
| 13         | SEG[30]  | X= -1339.50  | Y= -480.80   | 55         | LV3      | X= 1339.90   | Y= 83.20     |
| 14         | SEG[29]  | X= -1339.50  | Y= -596.20   | 56         | LR4      | X= 1339.90   | Y= 198.80    |
| 15         | SEG[28]  | X= -1339.50  | Y= -711.80   | 57         | LR3      | X= 1339.90   | Y= 314.20    |
| 16         | SEG[27]  | X= -1339.50  | Y= -827.20   | 58         | LR2      | X= 1339.90   | Y= 429.80    |
| 17         | SEG[26]  | X= -1339.50  | Y= -942.80   | 59         | LR1      | X= 1339.90   | Y= 545.20    |
| 18         | SEG[25]  | X= -1339.50  | Y= -1058.20  | 60         | LVG      | X= 1339.90   | Y= 660.80    |
| 19         | SEG[24]  | X= -1339.50  | Y= -1173.80  | 61         | GND      | X= 1339.90   | Y= 776.20    |
| 20         | SEG[23]  | X= -1339.50  | Y= -1289.20  | 62         | VO       | X= 1339.90   | Y= 891.80    |
| 21         | SEG[22]  | X= -1339.50  | Y= -1404.80  | 63         | OPIN     | X= 1339.90   | Y= 1007.20   |
| 22         | SEG[21]  | X= -1075.00  | Y= -1641.00  | 64         | OPIP     | X= 1121.00   | Y= 1639.60   |
| 23         | SEG[20]  | X= -959.50   | Y= -1641.00  | 65         | OPO      | X= 1005.50   | Y= 1639.60   |
| 24         | SEG[19]  | X= -844.00   | Y= -1641.00  | 66         | RSTP_N   | X= 890.00    | Y= 1639.60   |



|    |         |            |             |    |         |             |            |
|----|---------|------------|-------------|----|---------|-------------|------------|
| 25 | SEG[18] | X= -728.50 | Y= -1641.00 | 67 | FXO     | X= 774.50   | Y= 1639.60 |
| 26 | SEG[17] | X= -613.00 | Y= -1641.00 | 68 | FXT     | X= 659.00   | Y= 1639.60 |
| 27 | SEG[16] | X= -497.60 | Y= -1641.00 | 69 | TSTP_P  | X= 543.50   | Y= 1639.60 |
| 28 | SEG[15] | X= -382.10 | Y= -1641.00 | 70 | SXO     | X= 428.10   | Y= 1639.60 |
| 29 | SEG[14] | X= -266.60 | Y= -1641.00 | 71 | SXI     | X= 312.60   | Y= 1639.60 |
| 30 | SEG[13] | X= -151.10 | Y= -1641.00 | 72 | VDD     | X= 197.10   | Y= 1639.60 |
| 31 | SEG[12] | X= -35.50  | Y= -1641.00 | 73 | PRTD[7] | X= 81.50    | Y= 1639.60 |
| 32 | SEG[11] | X= 80.00   | Y= -1641.00 | 74 | PRTD[6] | X= -34.00   | Y= 1639.60 |
| 33 | SEG[10] | X= 195.40  | Y= -1641.00 | 75 | PRTD[5] | X= -149.40  | Y= 1639.60 |
| 34 | SEG[9]  | X= 310.90  | Y= -1641.00 | 76 | PRTD[4] | X= -264.90  | Y= 1639.60 |
| 35 | SEG[8]  | X= 426.40  | Y= -1641.00 | 77 | PRTD[3] | X= -380.40  | Y= 1639.60 |
| 36 | SEG[7]  | X= 542.00  | Y= -1641.00 | 78 | PRTD[2] | X= -495.90  | Y= 1639.60 |
| 37 | SEG[6]  | X= 657.50  | Y= -1641.00 | 79 | PRTD[1] | X= -611.50  | Y= 1639.60 |
| 38 | SEG[5]  | X= 773.00  | Y= -1641.00 | 80 | PRTD[0] | X= -727.00  | Y= 1639.60 |
| 39 | SEG[4]  | X= 888.50  | Y= -1641.00 | 81 | PRTC[3] | X= -842.50  | Y= 1639.60 |
| 40 | SEG[3]  | X= 1004.00 | Y= -1641.00 | 82 | PRTC[2] | X= -958.00  | Y= 1639.60 |
| 41 | SEG[2]  | X= 1119.50 | Y= -1641.00 | 83 | PRTC[1] | X= -1073.50 | Y= 1639.60 |
| 42 | SEG[1]  | X= 1235.00 | Y= -1641.00 |    |         |             |            |



## 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°C ~ 70°C            |           |
| Storage Temperature   | $T_{st}$ | -50°C ~ 100°C         |           |

### 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 ~ 0.1 $V_{dd}$     |               |
| Operating Frequency   | $F_{max}$ | 8MHz                    | $V_{dd}=5.0V$ |
|                       |           | 4MHz                    | $V_{dd}=2.2V$ |
| Operating Temperature | $T_{op}$  | 0°C ~ 70°C              |               |
| Storage Temperature   | $T_{st}$  | -50°C ~ 100°C           |               |





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

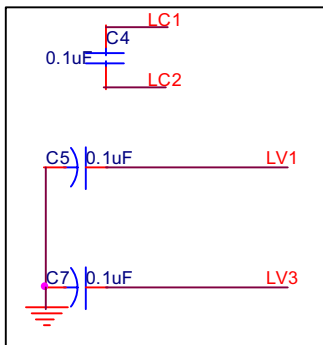
|                          | PARAMETER                |                 | CONDITION  | MIN                    | TYP                    | MAX                    | UNIT |
|--------------------------|--------------------------|-----------------|--|------------------------|------------------------|------------------------|------|
| <b>I<sub>Fast</sub></b>  | NORMAL Mode Current      | System          | 2M ext. R/C  |                        | 0.75                   | 1                      | mA   |
| <b>I<sub>Slow</sub></b>  | SLOW Mode Current        | System          | 32.768K X'tal<br>LCD Disable   |                        | 10                     | 20                     | μA   |
| <b>I<sub>Idle</sub></b>  | IDLE Mode Current        | System          | 32.769K X'tal<br>LCD Disable   |                        | 6                      | 10                     | μA   |
| <b>I<sub>LCD</sub></b>   | Extra Current if LCD ON  | System          | LCD Enable,<br>LCD option=300Kohm<br>Voltage-doubler OFF   |                        | 12                     | 20                     | μA   |
|                          |                          |                 | LCD Enable,<br>LCD option=30Kohm,<br>Voltage-doubler ON  |                        | 100                    | 120                    |      |
| <b>I<sub>Sleep</sub></b> | Sleep Mode Current       | System          |  |                        |                        | 1                      | μA   |
| <b>I<sub>oHPWM</sub></b> | PWM Output Drive Current | PWMP, PWMN*2    | V <sub>DD</sub> =3V; V <sub>oh</sub> =2V   | 12                     | 15                     |                        | mA   |
| <b>I<sub>oLPWM</sub></b> | PWM Output Sink Current  | PWMP, PWMN*2    | V <sub>DD</sub> =3V; V <sub>oL</sub> =1V   | 33                     | 40                     |                        | mA   |
| <b>I<sub>oVO</sub></b>   | DAC Output Current       | VO              | V <sub>DD</sub> =3V; VO=0~2V, Data=7F  | 2.5                    | 3                      |                        | mA   |
| <b>V<sub>iH</sub></b>    | Input High Voltage       | I/O pins        |  | 0.8<br>V <sub>DD</sub> |                        |                        | V    |
| <b>V<sub>iL</sub></b>    | Input Low Voltage        | I/O pins        |  |                        |                        | 0.2<br>V <sub>DD</sub> | V    |
| <b>V<sub>hys</sub></b>   | Input Hysteresis Width   | I/O, RSTP_N     | Threshold=2/3V <sub>DD</sub> (input from low to high)<br>Threshold=1/3V <sub>DD</sub> (input from high to low) |                        | 1/3<br>V <sub>DD</sub> |                        | V    |
| <b>I<sub>oH</sub></b>    | Output Drive Current     | I/O pull-high*1 | V <sub>oL</sub> =2.0V  | 50                     |                        |                        | μA   |
| <b>I<sub>oL_1</sub></b>  | Output Sink Current      | I/O pull-low*1  | V <sub>oL</sub> =0.4V  | 1.0                    |                        |                        | mA   |
| <b>I<sub>iL_1</sub></b>  | Input Low Current        | RSTP_N          | V <sub>iL</sub> =GND, pull high Internally   |                        | 20                     |                        | μA   |
| <b>I<sub>iL_2</sub></b>  | Input Low Current        | I/O             | V <sub>iL</sub> =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.

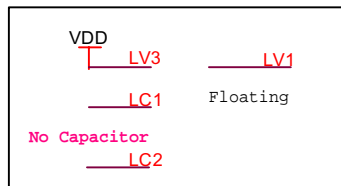
\*2: This Spec. base on one driver only. There are five build-in driver, so user just multiply the number of driver he used to one driver current to get the total amount of current. ( $I_{oHPWM} \cdot I_{oLPWM} * N$ ;  $N=0,1,2,3,4,5$ )

# I. Application Circuit

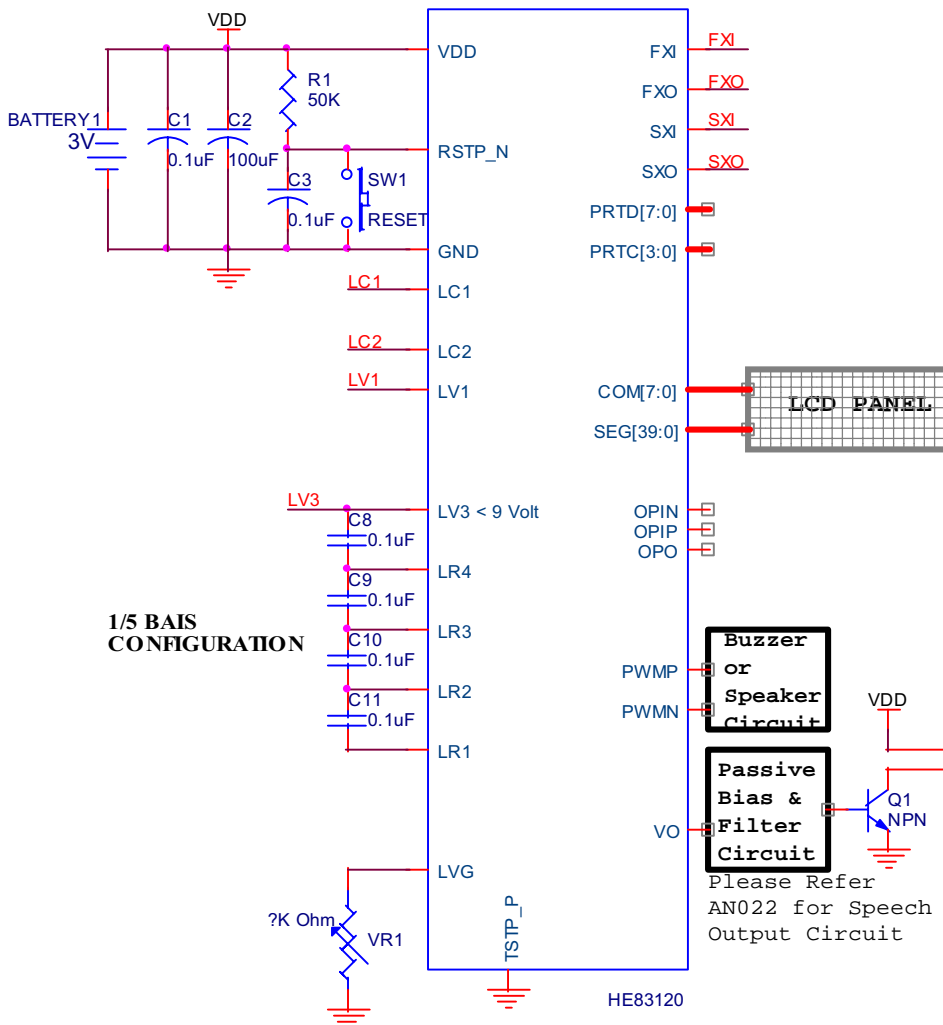
Tripple Charge Pump is selected  
 LCD Max. Voltage=LV3=3/2\*VDD



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

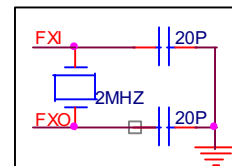


No External Parts is necessary if user adopt Internal Fast RC Clock

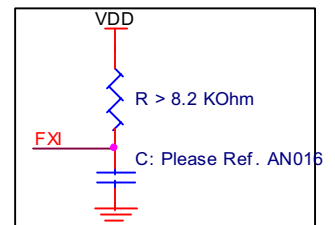


1/5 BAIS CONFIGURATION

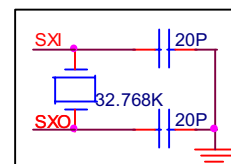
External Fast Clock:  
 Crystal osc.



External Fast Clock:  
 RC osc.



External Slow Clock:  
 Crystal osc.



External Slow Clock:  
 RC osc.

