

## A. HE83760M Introduction

HE83760M is a member of 8-bit Micro-controller series developed by King Billion Electronics Ltd. This IC has built-in 3072 pixels LCD driver, and also have 32-bit I/O ports. The built-in OP comparator can be used with light, voice, temperature and humidity sensor or used to detect the battery low. The 7-bit current-type D/A converter and PWM drive output provide the complete speech output mechanism. The built-in DTMF generator can generate the PSTN dialing tone directly. The 2M byte ROM and 16K byte RAM can be used in the storage of large speech data, image and text etc. HE83760M can be used in Translator、Data Bank、Pocket Dialer、Educational Toy、Digital Voice Recording System etc.

The instruction sets of HE80000 series 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 performance of HE83760M is enough for most of battery operation system.

## B. HE83760M Features

- Operation Voltage: 2.4V ~ 3.6V
- System Clock 4MHz ~ 8MHz
- Clock Source: Internal/External Fast clock, Internal/External slow clock
- Dual Clock System : Normal (Fast) clock 32.768KHz ~ 8MHz  
 Slow clock 32.768 KHz
- Operation Mode : DUAL、FAST、SLOW、IDLE、SLEEP Mode.
- Internal ROM: 2M Bytes (64K Program ROM, 1984K Data ROM)
- Internal RAM: 16K Bytes.
- Watch dog timer.
- 32 Bi-directional I/O ports.
- 3072 pixels LCD driver (B Type) with built-in regulator for LCD display, without LCD contrast control function. The maximum LCD voltage must be lower than 8.5V.
- LCD COM X SEG : 32 X 96
- LCD Bias : 1/7
- LCD Charge Pump: 3, 4, and 5 times of LVREG
- One 7-bits current-type DAC output.
- One built-in OP comparator.
- PWM device.
- Built-in DTMF Generator.
- Recording function
- Speech recognition function
- Two external interrupts and three internal timer interrupts.
- Two 16-bit timers and one time-base timer.
- Instruction set : 32 instructions, 4 addressing mode. 14-bit DATA POINTER for RAM and 21-bit TABLE POINTER for ROM.

## C. Pin Description

| Pin #        | Pin name            | I/O     | Function                                                                                                                                                                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------|---------------------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 84<br>83     | <b>FXI,<br/>FXO</b> | B,<br>O | External fast clock input/output pins are used to connect crystal or RC to generate the 32.768KHz ~ 8MHz system clock.                                                    | Mask Option setting:<br>MO_FCK/SCKN = 00 : Slow Clock only<br>01 : Illegal<br>10 : Dual Clock<br>11 : Fast Clock only                                                                                                                                                                                                                                                                                                                     |
| 87<br>86     | <b>SXI,<br/>SXO</b> | I,<br>O | External slow clock input/output pins used to connect the 32.768KHz crystal to generate slow clock for system operation (slow mode), LCD display or timer 1 clock source. | MO_FOSCE= 0 : Internal fast clock<br>1 : External fast clock<br>MO_FXTAL= 0 : R,C OSC. for Fast Clock<br>1 : Crystal OSC. for Fast Clock<br>MO_SXTAL= 0 : R,C OSC. for 32.768K Clock<br>1 : Crystal OSC. for 32.768K Clock<br>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. |
| 82           | <b>RSTP_N</b>       | I       | System reset signal                                                                                                                                                       | Active low and level trigger reset signal. User can also set the mask option MO_PORE=1 to enable the build-in Power-on reset circuit besides using the reset pin.<br><br>Watch Dog Timer can also be enabled/disabled by the mask option,<br>MO_WDTE = 0 : Disable Watch Dog Timer<br>= 1 : Enable Watch Dog Timer                                                                                                                        |
| 85           | <b>TSTP_P</b>       | I       | IC Test Pin                                                                                                                                                               | <b>Please bond this pin to ground by a 0 ohm resistor to let it accessible when it's necessary for some testing.</b>                                                                                                                                                                                                                                                                                                                      |
| 101..<br>108 | <b>PRTC[7:0]</b>    | B       | Bi-directional I/O port C                                                                                                                                                 | Mask options setting:<br>MO_CPP [7:0] = 1 : Push-pull output.<br>= 0 : Open-drain output.<br>Output must be "1" before reading whenever uses them as input (Non tri-state structure).                                                                                                                                                                                                                                                     |
| 93..<br>100  | <b>PRTD[7:0]</b>    | B       | Bi-directional I/O port D. PRTD [7:2] also used as wake-up pin, and PRTD [7:6] also used as external interrupt pin.                                                       | Mask options setting:<br>MO_DPP [7:0] = 1 : Push-pull output.<br>= 0 : Open-drain output.<br>Output must be "1" before reading whenever uses them as input (Non tri-state structure).                                                                                                                                                                                                                                                     |
| 109..<br>116 | <b>PRT10[7:0]</b>   | B       | Bi-directional I/O port 10                                                                                                                                                | Mask options setting:<br>MO_10PP [7:0] = 1 : Push-pull output.<br>= 0 : Open-drain output.<br>Output must be "1" before reading whenever uses them as input (Non tri-state structure).                                                                                                                                                                                                                                                    |
| 117..<br>124 | <b>PRT11[7:0]</b>   | B       | Bi-directional I/O port 11                                                                                                                                                | Mask options setting:<br>MO_11PP [7:0] = 1 : Push-pull output.<br>= 0 : Open-drain output.<br>Output must be "1" before reading whenever uses them as input (Non tri-state structure).                                                                                                                                                                                                                                                    |

| Pin #              | Pin name         | I/O | Function                                                      | Description                                                                                                                                                                                                                      |
|--------------------|------------------|-----|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 143..128<br>44..59 | <b>COM[31:0]</b> | O   | LCD COM Output                                                | LCD common/segment driving pins.                                                                                                                                                                                                 |
| 144..196<br>1..43  | <b>SEG[95:0]</b> | O   | LCD SEG Output                                                | LCD Data filled from page1 00H; please refer the LCD RAM map.                                                                                                                                                                    |
| 74                 | <b>LV1</b>       | B   | LCD Bias Voltage 1                                            | LV5> LV4> LV3> LV2> LV1 。<br>Adjust Resistor between LCDGS and LV2 to set LV5 for LCD glass. The formula is $LV5 = 3.5 * LV2$ 。<br>(Bias=1/7)<br>Suggest that LV2=2.0V, so LV5=7.0V.                                             |
| 73                 | <b>LV2</b>       | B   | LCD Bias Voltage 2                                            |                                                                                                                                                                                                                                  |
| 62                 | <b>LV3</b>       | B   | LCD Bias Voltage 3                                            |                                                                                                                                                                                                                                  |
| 61                 | <b>LV4</b>       | B   | LCD Bias Voltage 4                                            |                                                                                                                                                                                                                                  |
| 60                 | <b>LV5</b>       | B   | LCD Bias Voltage 5                                            |                                                                                                                                                                                                                                  |
| 72                 | <b>LCDGS</b>     | B   | LCD Gain Setting Pin                                          | ~300K between LCDGS and LV2 → LV2 ≐ 2.0 Volt                                                                                                                                                                                     |
| 63                 | <b>LCDVTB</b>    | B   | Charge Pump Capacitor Pin                                     | Larger voltage stair than LCxA, LCxB stair                                                                                                                                                                                       |
| 75                 | <b>LCDVX</b>     | B   | Charge Pump Capacitor Pin                                     | Smaller voltage stair than LCxA, LCxB stair                                                                                                                                                                                      |
| 64                 | <b>LC4B</b>      | B   | Charge Pump Capacitor Pin                                     | Different LCD Bias must be matching its <a href="#">Capacitor Configuration</a> relatively. This IC is with all pins for type-IV LCD Driver. Some of charge pump pins were not using since the bias of this IC was fixed at 1/7. |
| 65                 | <b>LC4A</b>      | B   | Charge Pump Capacitor Pin                                     |                                                                                                                                                                                                                                  |
| 66                 | <b>LC3B</b>      | B   | Charge Pump Capacitor Pin                                     |                                                                                                                                                                                                                                  |
| 67                 | <b>LC3A</b>      | B   | Charge Pump Capacitor Pin                                     |                                                                                                                                                                                                                                  |
| 68                 | <b>LC2B</b>      | B   | Charge Pump Capacitor Pin                                     |                                                                                                                                                                                                                                  |
| 69                 | <b>LC2A</b>      | B   | Charge Pump Capacitor Pin                                     |                                                                                                                                                                                                                                  |
| 70                 | <b>LC1B</b>      | B   | Charge Pump Capacitor Pin                                     |                                                                                                                                                                                                                                  |
| 71                 | <b>LC1A</b>      | B   | Charge Pump Capacitor Pin                                     |                                                                                                                                                                                                                                  |
| 125                | <b>PWMP</b>      | O   | The PWM positive output can drive speaker or buzzer directly. | Set the bit2(PWM=1) of VOC register and bit0 of PWMC register to turn on PWM                                                                                                                                                     |
| 126                | <b>PWMN</b>      | O   | The PWM positive output can drive speaker or buzzer directly. |                                                                                                                                                                                                                                  |
| 77                 | <b>VO</b>        | O   | Voice output.                                                 | Set the bit0(OP=0) and bit1(DA=1) of VOC register to turn on VO                                                                                                                                                                  |
| 78                 | <b>DAO</b>       | O   | DAC Output                                                    | Set the bit0(OP=1) and bit1(DA=1) of VOC register to turn on DAO                                                                                                                                                                 |
| 79                 | <b>OPIN</b>      | I   | OPAMP negative input pin.                                     | Built-in OP comparator.<br>Enable DAO to work with OP. Refer to application note for detailed operation.                                                                                                                         |
| 80                 | <b>OPIP</b>      | I   | OPAMP positive input pin.                                     |                                                                                                                                                                                                                                  |
| 81                 | <b>OPO</b>       | O   | OPAMP output pin.                                             |                                                                                                                                                                                                                                  |
| 90                 | <b>DTMFO</b>     | O   | DTMF Output                                                   | Through PRT12 we can turn on/off DTMF and write data. Using Mask Option MO_DTMFSCK set the clock source of DTMF block.<br>MO_DTMFSCK=0 : Clock Source=3.579545 MHz<br>=1 : Clock Source=32768 Hz                                 |
| 89                 | <b>MUTE</b>      | O   | MUTE Output for Dialer                                        | User can turn on/off MUTE pin by port12.                                                                                                                                                                                         |
| 91                 | <b>SDO</b>       | O   | Serial Data Output                                            | We can turn on/off SDO block or write data by port12.                                                                                                                                                                            |
| 92                 | <b>KEYTONE</b>   | O   | 1024-Hz 50% duty square wave                                  | User can turn on/off key tone by port12.                                                                                                                                                                                         |
| 88                 | <b>VDD</b>       | P   | Positive Power Input                                          | Add a 0.1 μF capacitor as by-pass capacitor between VDD and GND.                                                                                                                                                                 |
| 76                 | <b>GND</b>       | P   | Power Ground Input                                            |                                                                                                                                                                                                                                  |
| 127                | <b>VDD_RAM</b>   | P   | Dedicated Power for RAM                                       |                                                                                                                                                                                                                                  |

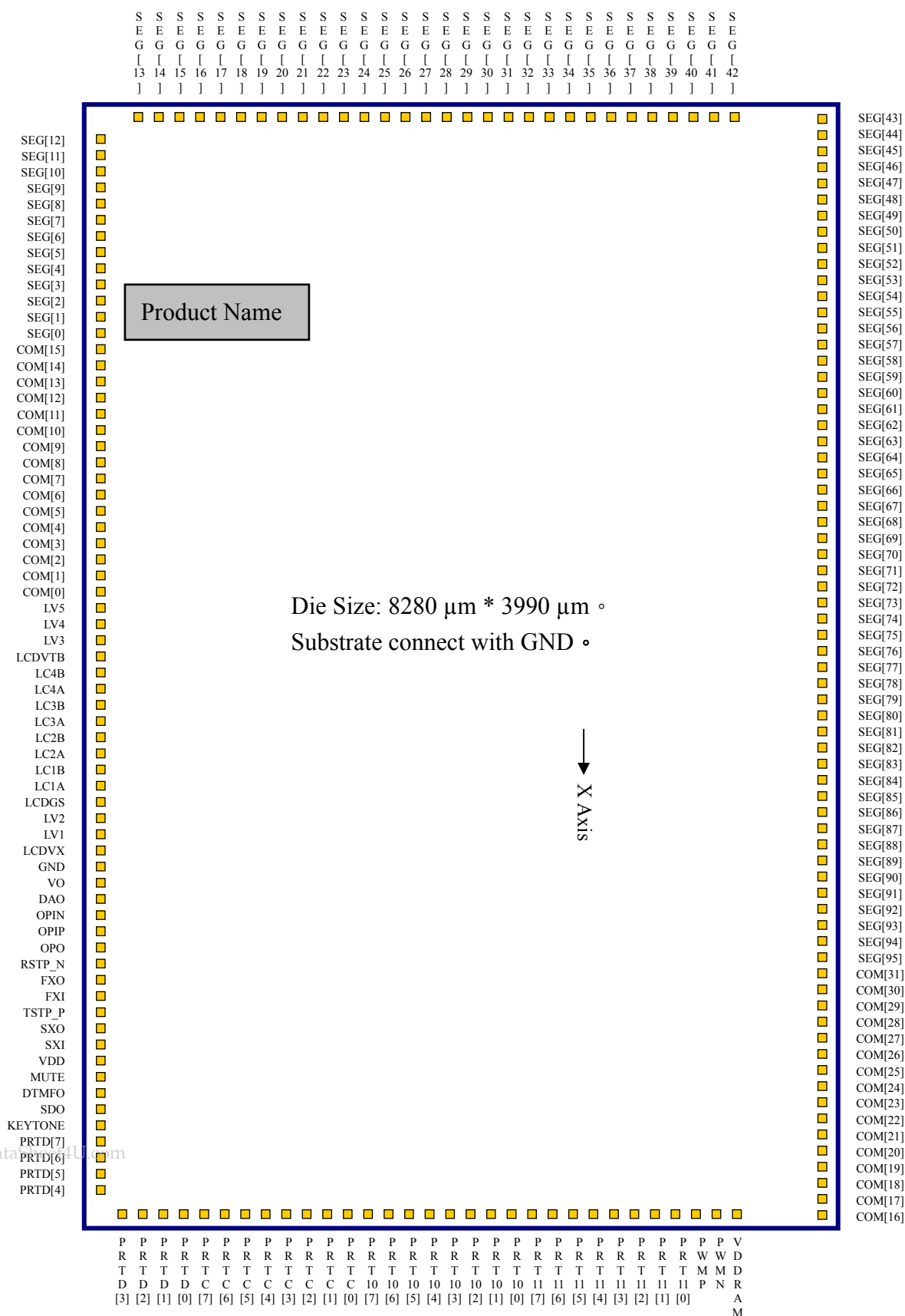


## D. LCD RAM MAP

| Page<br>1 | SEG<br>[7:0] | SEG<br>[15:8] | SEG<br>[23:16] | SEG<br>[31:24] | SEG<br>[39:32] | SEG<br>[47:40] | SEG<br>[55:48] | SEG<br>[63:56] |
|-----------|--------------|---------------|----------------|----------------|----------------|----------------|----------------|----------------|
| COM0      | 00H          | 20H           | 40H            | 60H            | 80H            | A0H            | C0H            | E0H            |
| COM1      | 01H          | 21H           | 41H            | 61H            | 81H            | A1H            | C1H            | E1H            |
| COM2      | 02H          | 22H           | 42H            | 62H            | 82H            | A2H            | C2H            | E2H            |
| :         | :            | :             | :              | :              | :              | :              | :              | :              |
| :         | :            | :             | :              | :              | :              | :              | :              | :              |
| COM29     | 1DH          | 3DH           | 5DH            | 7DH            | 9DH            | BDH            | DDH            | FDH            |
| COM32     | 1EH          | 3EH           | 5EH            | 7EH            | 9EH            | BEH            | DEH            | FEH            |
| COM31     | 1FH          | 3FH           | 5FH            | 7FH            | 9FH            | BFH            | DFH            | FFH            |

| Page<br>2 | SEG<br>[71:64] | SEG<br>[79:72] | SEG<br>[87:80] | SEG<br>[95:88] |
|-----------|----------------|----------------|----------------|----------------|
| COM0      | 00H            | 20H            | 40H            | 60H            |
| COM1      | 01H            | 21H            | 41H            | 61H            |
| COM2      | 02H            | 22H            | 42H            | 62H            |
| :         | :              | :              | :              | :              |
| :         | :              | :              | :              | :              |
| COM29     | 1DH            | 3DH            | 5DH            | 7DH            |
| COM32     | 1EH            | 3EH            | 5EH            | 7EH            |
| COM31     | 1FH            | 3FH            | 5FH            | 7FH            |

### E. Pin Diagram



## F. Bonding Pad Location

| PIN Number | PIN Name | X Coordinate | Y Coordinate | PIN Number | PIN Name | X Coordinate | Y Coordinate |
|------------|----------|--------------|--------------|------------|----------|--------------|--------------|
| 1          | SEG[42]  | -4077.20     | 1523.75      | 99         | PRTD[1]  | 4048.34      | -1524.90     |
| 2          | SEG[41]  | -4077.20     | 1408.75      | 100        | PRTD[0]  | 4048.34      | -1409.90     |
| 3          | SEG[40]  | -4077.20     | 1293.75      | 101        | PRTC[7]  | 4048.34      | -1294.90     |
| 4          | SEG[39]  | -4077.20     | 1178.75      | 102        | PRTC[6]  | 4048.34      | -1179.90     |
| 5          | SEG[38]  | -4077.20     | 1063.75      | 103        | PRTC[5]  | 4048.34      | -1064.90     |
| 6          | SEG[37]  | -4077.20     | 948.75       | 104        | PRTC[4]  | 4048.34      | -949.90      |
| 7          | SEG[36]  | -4077.20     | 833.75       | 105        | PRTC[3]  | 4048.34      | -834.90      |
| 8          | SEG[35]  | -4077.20     | 718.75       | 106        | PRTC[2]  | 4048.34      | -719.90      |
| 9          | SEG[34]  | -4077.20     | 603.75       | 107        | PRTC[1]  | 4048.34      | -604.90      |
| 10         | SEG[33]  | -4077.20     | 488.75       | 108        | PRTC[0]  | 4048.34      | -489.90      |
| 11         | SEG[32]  | -4077.20     | 373.75       | 109        | PRT10[7] | 4048.34      | -374.90      |
| 12         | SEG[31]  | -4077.20     | 258.75       | 110        | PRT10[6] | 4048.34      | -259.90      |
| 13         | SEG[30]  | -4077.20     | 143.75       | 111        | PRT10[5] | 4048.34      | -144.90      |
| 14         | SEG[29]  | -4077.20     | 28.75        | 112        | PRT10[4] | 4048.34      | -29.90       |
| 15         | SEG[28]  | -4077.20     | -86.25       | 113        | PRT10[3] | 4048.34      | 85.10        |
| 16         | SEG[27]  | -4077.20     | -201.25      | 114        | PRT10[2] | 4048.34      | 200.10       |
| 17         | SEG[26]  | -4077.20     | -316.25      | 115        | PRT10[1] | 4048.34      | 315.10       |
| 18         | SEG[25]  | -4077.20     | -431.25      | 116        | PRT10[0] | 4048.34      | 430.10       |
| 19         | SEG[24]  | -4077.20     | -546.25      | 117        | PRT11[7] | 4048.34      | 545.10       |
| 20         | SEG[23]  | -4077.20     | -661.25      | 118        | PRT11[6] | 4048.34      | 660.10       |
| 21         | SEG[22]  | -4077.20     | -776.25      | 119        | PRT11[5] | 4048.34      | 775.10       |
| 22         | SEG[21]  | -4077.20     | -891.25      | 120        | PRT11[4] | 4048.34      | 890.10       |
| 23         | SEG[20]  | -4077.20     | -1006.25     | 121        | PRT11[3] | 4048.34      | 1005.10      |
| 24         | SEG[19]  | -4077.20     | -1121.25     | 122        | PRT11[2] | 4048.34      | 1120.10      |
| 25         | SEG[18]  | -4077.20     | -1236.25     | 123        | PRT11[1] | 4048.34      | 1235.10      |
| 26         | SEG[17]  | -4077.20     | -1351.25     | 124        | PRT11[0] | 4048.34      | 1350.10      |
| 27         | SEG[16]  | -4077.20     | -1466.25     | 125        | PWMP     | 4048.34      | 1465.10      |
| 28         | SEG[15]  | -4077.20     | -1581.25     | 126        | PWMN     | 4048.34      | 1586.80      |
| 29         | SEG[14]  | -4077.20     | -1705.95     | 127        | VDD_RAM  | 4048.34      | 1711.74      |
| 30         | SEG[13]  | -4077.20     | -1827.90     | 128        | COM[16]  | 3971.56      | 1902.45      |
| 31         | SEG[12]  | -3670.75     | -1933.95     | 129        | COM[17]  | 3854.13      | 1902.45      |
| 32         | SEG[11]  | -3548.80     | -1933.95     | 130        | COM[18]  | 3738.64      | 1902.45      |
| 33         | SEG[10]  | -3424.10     | -1933.95     | 131        | COM[19]  | 3623.10      | 1902.45      |
| 34         | SEG[9]   | -3309.10     | -1933.95     | 132        | COM[20]  | 3508.10      | 1902.45      |
| 35         | SEG[8]   | -3194.10     | -1933.95     | 133        | COM[21]  | 3393.10      | 1902.45      |
| 36         | SEG[7]   | -3079.10     | -1933.95     | 134        | COM[22]  | 3278.10      | 1902.45      |
| 37         | SEG[6]   | -2964.10     | -1933.95     | 135        | COM[23]  | 3163.10      | 1902.45      |



| PIN Number | PIN Name | X Coordinate | Y Coordinate | PIN Number | PIN Name | X Coordinate | Y Coordinate |
|------------|----------|--------------|--------------|------------|----------|--------------|--------------|
| 38         | SEG[5]   | -2849.10     | -1933.95     | 136        | COM[24]  | 3048.10      | 1902.45      |
| 39         | SEG[4]   | -2734.10     | -1933.95     | 137        | COM[25]  | 2933.10      | 1902.45      |
| 40         | SEG[3]   | -2619.10     | -1933.95     | 138        | COM[26]  | 2818.10      | 1902.45      |
| 41         | SEG[2]   | -2504.10     | -1933.95     | 139        | COM[27]  | 2703.10      | 1902.45      |
| 42         | SEG[1]   | -2389.10     | -1933.95     | 140        | COM[28]  | 2588.10      | 1902.45      |
| 43         | SEG[0]   | -2274.10     | -1933.95     | 141        | COM[29]  | 2473.10      | 1902.45      |
| 44         | COM[15]  | -2159.10     | -1933.95     | 142        | COM[30]  | 2358.10      | 1902.45      |
| 45         | COM[14]  | -2044.10     | -1933.95     | 143        | COM[31]  | 2243.10      | 1902.45      |
| 46         | COM[13]  | -1929.10     | -1933.95     | 144        | SEG[95]  | 2128.10      | 1902.45      |
| 47         | COM[12]  | -1814.10     | -1933.95     | 145        | SEG[94]  | 2013.10      | 1902.45      |
| 48         | COM[11]  | -1699.10     | -1933.95     | 146        | SEG[93]  | 1898.10      | 1902.45      |
| 49         | COM[10]  | -1584.10     | -1933.95     | 147        | SEG[92]  | 1783.10      | 1902.45      |
| 50         | COM[9]   | -1469.10     | -1933.95     | 148        | SEG[91]  | 1668.10      | 1902.45      |
| 51         | COM[8]   | -1354.10     | -1933.95     | 149        | SEG[90]  | 1553.10      | 1902.45      |
| 52         | COM[7]   | -1239.10     | -1933.95     | 150        | SEG[89]  | 1438.10      | 1902.45      |
| 53         | COM[6]   | -1124.10     | -1933.95     | 151        | SEG[88]  | 1323.10      | 1902.45      |
| 54         | COM[5]   | -1009.10     | -1933.95     | 152        | SEG[87]  | 1208.10      | 1902.45      |
| 55         | COM[4]   | -894.10      | -1933.95     | 153        | SEG[86]  | 1093.10      | 1902.45      |
| 56         | COM[3]   | -779.10      | -1933.95     | 154        | SEG[85]  | 978.10       | 1902.45      |
| 57         | COM[2]   | -664.10      | -1933.95     | 155        | SEG[84]  | 863.10       | 1902.45      |
| 58         | COM[1]   | -549.10      | -1933.95     | 156        | SEG[83]  | 748.10       | 1902.40      |
| 59         | COM[0]   | -434.10      | -1933.95     | 157        | SEG[82]  | 633.10       | 1902.45      |
| 60         | LV5      | -319.10      | -1933.95     | 158        | SEG[81]  | 518.10       | 1902.45      |
| 61         | LV4      | -204.10      | -1933.95     | 159        | SEG[80]  | 403.10       | 1902.45      |
| 62         | LV3      | -89.10       | -1933.95     | 160        | SEG[79]  | 288.10       | 1902.45      |
| 63         | LCDVTB   | 25.90        | -1933.95     | 161        | SEG[78]  | 173.10       | 1902.45      |
| 64         | LC4B     | 140.90       | -1933.95     | 162        | SEG[77]  | 58.10        | 1902.45      |
| 65         | LC4A     | 255.90       | -1933.95     | 163        | SEG[76]  | -56.90       | 1902.45      |
| 66         | LC3B     | 370.90       | -1933.95     | 164        | SEG[75]  | -214.90      | 1902.45      |
| 67         | LC3A     | 485.90       | -1933.95     | 165        | SEG[74]  | -329.90      | 1902.45      |
| 68         | LC2B     | 600.90       | -1933.95     | 166        | SEG[73]  | -444.90      | 1902.45      |
| 69         | LC2A     | 715.90       | -1933.95     | 167        | SEG[72]  | -559.90      | 1902.45      |
| 70         | LC1B     | 830.90       | -1933.95     | 168        | SEG[71]  | -674.90      | 1902.45      |
| 71         | LC1A     | 945.90       | -1933.95     | 169        | SEG[70]  | -789.90      | 1902.45      |
| 72         | LCDGS    | 1060.90      | -1933.95     | 170        | SEG[69]  | -904.90      | 1902.45      |
| 73         | LV2      | 1175.90      | -1933.95     | 171        | SEG[68]  | -1019.90     | 1902.45      |
| 74         | LV1      | 1290.90      | -1933.95     | 172        | SEG[67]  | -1134.90     | 1902.45      |
| 75         | LCDVX    | 1405.90      | -1933.95     | 173        | SEG[66]  | -1249.90     | 1902.45      |
| 76         | GND      | 1520.90      | -1933.95     | 174        | SEG[65]  | -1364.90     | 1902.45      |
| 77         | VO       | 1635.90      | -1933.95     | 175        | SEG[64]  | -1479.90     | 1902.45      |





| PIN Number | PIN Name | X Coordinate | Y Coordinate | PIN Number | PIN Name | X Coordinate | Y Coordinate |
|------------|----------|--------------|--------------|------------|----------|--------------|--------------|
| 78         | DAO      | 1750.90      | -1933.95     | 176        | SEG[63]  | -1594.90     | 1902.45      |
| 79         | OPIN     | 1865.90      | -1933.95     | 177        | SEG[62]  | -1709.90     | 1902.45      |
| 80         | OPIP     | 1980.90      | -1933.95     | 178        | SEG[61]  | -1824.90     | 1902.45      |
| 81         | OPO      | 2095.90      | -1933.95     | 179        | SEG[60]  | -1939.90     | 1902.45      |
| 82         | RSTP_N   | 2210.90      | -1933.95     | 180        | SEG[59]  | -2054.90     | 1902.45      |
| 83         | FXO      | 2325.90      | -1933.95     | 181        | SEG[58]  | -2169.90     | 1902.45      |
| 84         | FXI      | 2440.90      | -1933.95     | 182        | SEG[57]  | -2284.90     | 1902.45      |
| 85         | TSTP_P   | 2555.90      | -1933.95     | 183        | SEG[56]  | -2399.90     | 1902.45      |
| 86         | SXO      | 2711.90      | -1933.95     | 184        | SEG[55]  | -2514.90     | 1902.45      |
| 87         | SXI      | 2826.90      | -1933.95     | 185        | SEG[54]  | -2629.90     | 1902.45      |
| 88         | VDD      | 2941.90      | -1933.95     | 186        | SEG[53]  | -2744.90     | 1902.45      |
| 89         | MUTE     | 3056.90      | -1933.95     | 187        | SEG[52]  | -2859.90     | 1902.45      |
| 90         | DTMFO    | 3171.90      | -1933.95     | 188        | SEG[51]  | -2974.90     | 1902.45      |
| 91         | SDO      | 3286.90      | -1933.95     | 189        | SEG[50]  | -3089.90     | 1902.45      |
| 92         | KEYTONE  | 3401.90      | -1933.95     | 190        | SEG[49]  | -3204.90     | 1902.45      |
| 93         | PRTD[7]  | 3516.90      | -1933.95     | 191        | SEG[48]  | -3319.90     | 1902.45      |
| 94         | PRTD[6]  | 3641.60      | -1933.95     | 192        | SEG[47]  | -3434.90     | 1902.45      |
| 95         | PRTD[5]  | 3787.62      | -1933.95     | 193        | SEG[46]  | -3549.90     | 1902.45      |
| 96         | PRTD[4]  | 3926.09      | -1933.95     | 194        | SEG[45]  | -3674.60     | 1902.45      |
| 97         | PRTD[3]  | 4048.34      | -1770.65     | 195        | SEG[44]  | -3789.60     | 1902.45      |
| 98         | PRTD[2]  | 4048.34      | -1649.60     | 196        | SEG[43]  | -3911.55     | 1902.45      |





## G. DC/AC Characteristics

### Absolute Maximum Rating

| Item                  | Sym.     | Rating                           | Condition |
|-----------------------|----------|----------------------------------|-----------|
| Supply Voltage        | $V_{dd}$ | $-0.5V \sim 4.0V$                |           |
| Input Voltage         | $V_{in}$ | $-0.5V \sim V_{dd}+0.5V$         |           |
| Output Voltage        | $V_o$    | $-0.5V \sim V_{dd}+0.5V$         |           |
| Operating Temperature | $T_{op}$ | $0^{\circ}C \sim 70^{\circ}C$    |           |
| Storage Temperature   | $T_{st}$ | $-50^{\circ}C \sim 100^{\circ}C$ |           |

### Recommended Operating Conditions

| Item                  | Sym.      | Rating                           | Condition     |
|-----------------------|-----------|----------------------------------|---------------|
| Supply Voltage        | $V_{dd}$  | $2.4V \sim 3.6V$                 |               |
| Input Voltage         | $V_{ih}$  | $0.9 V_{dd} \sim V_{dd}$         |               |
|                       | $V_{il}$  | $0.0V \sim 0.1V_{dd}$            |               |
| Operating Frequency   | $F_{max}$ | 8MHz(Crystal)                    | $V_{dd}=3.0V$ |
|                       |           | 6MHz(Crystal)                    | $V_{dd}=2.4V$ |
| Operating Temperature | $T_{op}$  | $0^{\circ}C \sim 70^{\circ}C$    |               |
| Storage Temperature   | $T_{st}$  | $-50^{\circ}C \sim 100^{\circ}C$ |               |



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

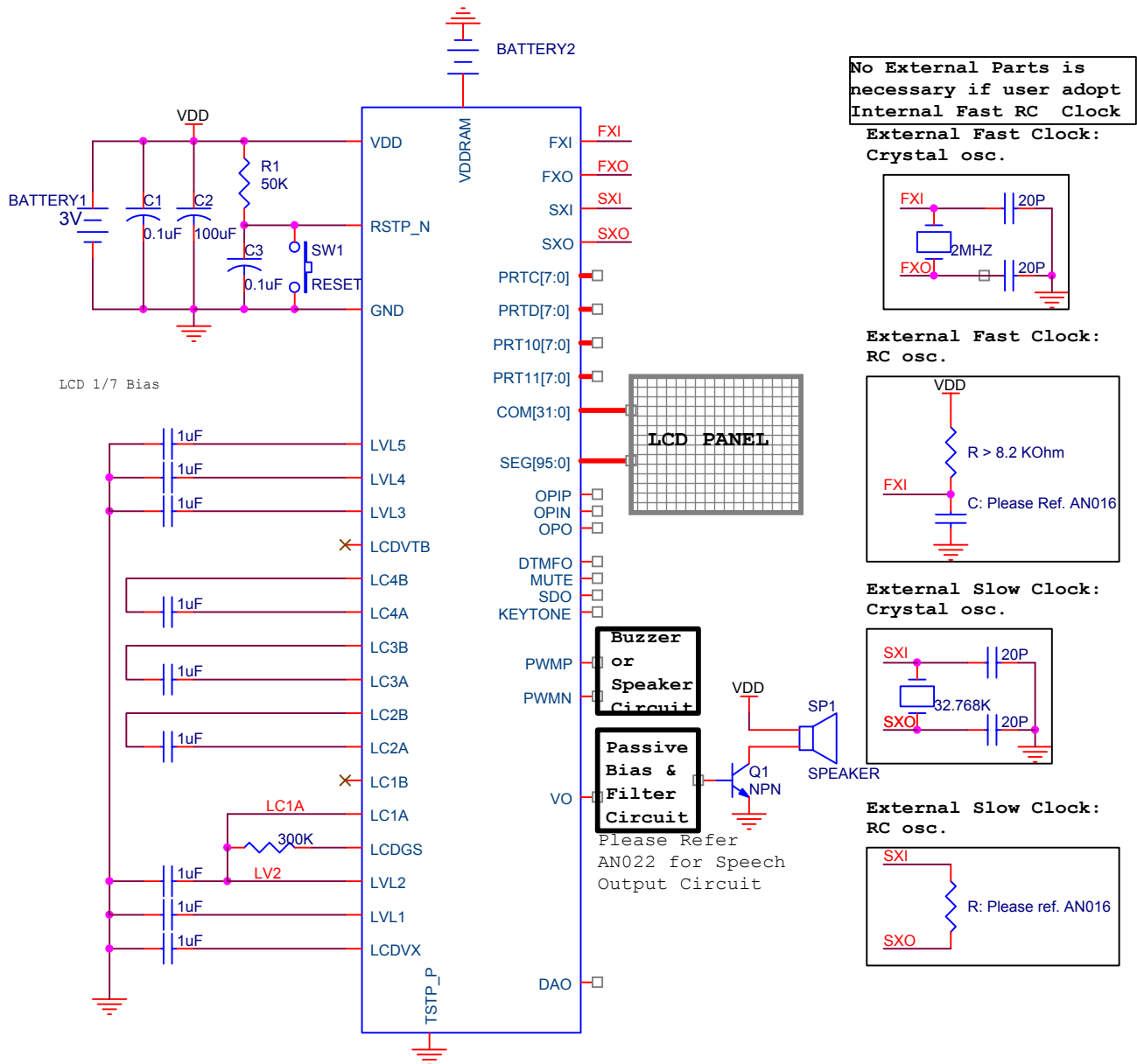
|                          | PARAMETER               |                             | CONDITION                                                                                                            | MIN                    | TYP                    | MAX                    | UNIT |
|--------------------------|-------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------|------------------------|------------------------|------------------------|------|
| <b>I<sub>Fast</sub></b>  | NORMAL Mode Current     | System                      | 2M ext. R/C                                                                                                          |                        | 1                      | 1.5                    | mA   |
| <b>I<sub>Slow</sub></b>  | SLOW Mode Current       | System                      | 32.768K X'tal<br>LCD Disable                                                                                         |                        | 15                     | 25                     | μA   |
| <b>I<sub>Idle</sub></b>  | IDLE Mode Current       | System                      | 32.769K X'tal<br>LCD Disable                                                                                         |                        | 10                     | 20                     | μA   |
| <b>I<sub>LCD</sub></b>   | Extra Current if LCD ON | System                      | LCD Enable                                                                                                           |                        | 100                    | 110                    | μA   |
| <b>I<sub>Sleep</sub></b> | Sleep Mode Current      | System                      |                                                                                                                      |                        |                        | 1                      | μA   |
| <b>I<sub>PWM</sub></b>   | PWM Output Current      | PWMP, PWMN* <sup>2</sup>    | With 32 Ω Loading                                                                                                    | 10                     | 14                     |                        | mA   |
|                          |                         |                             | With 64 Ω Loading                                                                                                    | 6                      | 8                      |                        | mA   |
|                          |                         |                             | With 100 Ω Loading                                                                                                   | 4                      | 5                      |                        | mA   |
| <b>I<sub>oVO</sub></b>   | DAC Output Current      | VO, DAO                     | 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<br>from low to high)<br>Threshold=1/3V <sub>DD</sub> (input<br>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* <sup>1</sup> | V <sub>oL</sub> =2.0V                                                                                                | 50                     |                        |                        | μA   |
| <b>I<sub>oL_1</sub></b>  | Output Sink Current     | I/O pull-low* <sup>1</sup>  | 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<br>Internally                                                                        |                        | 20                     |                        | μA   |
| <b>I<sub>iL_2</sub></b>  | Input Low Current       | I/O                         | V <sub>iL</sub> =GND, if pull high<br>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<sub>PWM</sub> \* N; N=0, 1, 2, 3, 4, 5)

## H. Application Circuit



**LC1B and LCDVTB are not used in this IC, just leave these pins floating.**

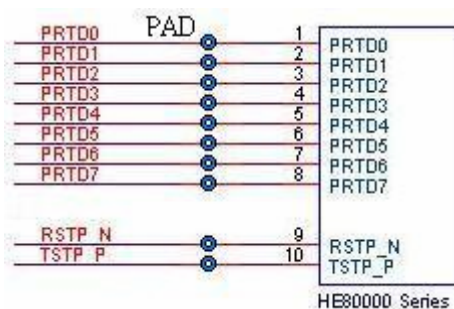
83760M with Type- IV LCD Driver is totally different from 83760 with Type-I LCD Driver. Please refer AN025.

## I. Important Note

1. Please always take in mind that ICE is different from IC which is your target body. ICE is the whole set of HE80000 series IC, but each IC is a subset of ICE. Never use any hardware resource that your target IC didn't have these resources, especially RAM and register. KBIDS and compiler cannot prevent user to use some hardware resources that don't exist in your target IC. Please check the following table and refer to 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 | 1984KB | 21-bit  | ⊙    | 16KB | 6-bit   | 8-bit | 32  | ⊙    | ⊙   | T1,T2,TB |
| VO     | DAO    | OP     | PWM  | LCD    | COM*SEG | Bias | Rgr  | ChrgPmp | LV2   | LR  | LVG  | REC | S.R.     |
| ⊙      | ⊙      | ⊙      | ⊙    | 3072   | 32*96   | 1/7  | ⊙    | ⊙       | —     | —   | —    | E/I | I/D      |

- To access any address larger than 64KB, users must update TPP first, TPH, and then TPL. Only follow this order, the pre-charge circuit of ROM will work correctly. 5us waiting is necessary before LDV instruction is executed since Data ROM is a low speed ROM. Users can not emulate this accessing process in ICE. So 5us delay should be added by firmware.
- LCD driving circuit must be turn off before IC goes into sleep mode.
- Please bonds the TSTP\_P, RSTP\_N and PRTD [7:0] with test points on PCB (can be soldered and probed) as you can, then some testing can be performed on PCB if necessary. The TSTP\_P is suggested to connect to ground by a 0 ohm resistor. The following figure is an example (Testing point with through hole).



- LVP must be lower than 8.5 Volt. Otherwise IC may be breakdown.
- The LCDC of 83760M is different from HE83760. The LCDC: [ — — — — —BE]; Non gray level control.  
B: blank control bit. E: LCD enable bit.

## J. Updated Record



| Version | Date | Section | Original Content | New Content |
|---------|------|---------|------------------|-------------|
|         |      |         |                  |             |