# A. HE8P480 Introduction

HE8P480 is a member of 8-bit Micro-controller OTP series product developed by King Billion Electronics Ltd. This IC use OTP (One Time Programming) ROM, which can be written by the OTPWriter tool provided by King Billion. It provides fast verification, pilot-run product, and also provides more versatile application request to user. HE8P480 is a super-set of twenty-six IC body **(HE82006、HE82015、HE83006、HE83015、HE83120、HE83121、HE83122、HE83123、HE83124、HE83R123、HE83R125、HE83130、HE83131、HE83134、HE83135、HE83136、HE83137、HE83141、HE83R141、HE83142、HE83R142、HE83144、HE83145、HE83146、HE83147、HE83148).** If user wants to simulate any one of the twenty-six IC body, The OTPWriter tool will automatically restrict the hardware resource, such as ROM、RAM size, it is very convenient to use .

This IC has build-in LCD driver which have many configuration and can use Mask Option to select the configuration, such as 【1024 pixel LCD driver + 24 Bit I/O Port】…【128 pixel LCD driver + 56 Bit I/O Port】. Build-in voltage regulator let LCD display stable when external battery voltage drop. The built-in OP operation amplifier can be used with (light、voice、temperature、humility) sensor and used as battery low detection. The 7-bit current-type D/A converter and PWM device provides the complete speech output mechanism.

The instruction set of HE8P160 are quite easy to learn and simple to use. Only about thirty instructions with four-type addressing mode are provided. Most of instructions take 3 oscillator clocks (machine cycles). The processing power is enough to most of battery operation system.

# B. HE8P480 Features

- Operation Voltage： 2.4V – 5.5V
- System Clock： DC ~ 8MHz @ 5.0V
  DC ~ 4MHz @ 2.4V
- Internal ROM： 256K Bytes (64K Bytes Program ROM)
- Internal RAM： 4K Bytes.
- Dual Clock System ： Normal (Fast) clock： 32.768K ~ 8MHz
- Slow clock： 32.768KHz
- Operation Mode： DUAL、FAST、SLOW、IDLE、SLEEP Mode.
- Build-in WDT (WATCH DOG TIMER) to prevent deadlock or abnormal condition..
- 16~32 bit Bi-directional I/O port. Mask Option can select PUSH-PULL or OPEN DRAIN output mode for each I/O pin. The I/O PRTD [3:0] each has 5mA sink capability.
- Build-in OP amplifier. This OP operating range between 0 ~ (VDD-1), that is different from previous OP comparator operating range between 0.8~VDD, the user should notice this. Please set the operation range on 0.8 ~ (VDD-1), if user wants to design a circuit working both on HE8P480 and target IC.
- Build-in voltage regulator which provide LCD stable operating voltage.
- Contain a 7-bit Current-type D/A converter.

- Provides PWM output device. (Users can select with or without Rate Selection, connect with "VDD+PWM" or "PWMP+PWMN")
- Two external interrupts and three internal timer interrupts.
- Two 16-bit timers and one Time Base timer.
- Instruction set： 32 instructions, 4 addressing mode. 9-bit DATA POINTER for RAM and 16-bit TABLE POINTER for ROM.

# C. HE8P480 Body Mapping Table

| BODY | PROM | DROM | RAM | FX | FRC | Fin | SX | SRC | CKmd | TC1 | TC2 | TB | PORT | PORT_LCD | COM | SEG | LDVD | LREG | PWM | PMD | VO | DAO | OP Amp | DTMF | WDT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **HE82006** | 64kB | 192kB | 128B | Y | Y | - | - | - | F | Y | - | - | D | - | - | - | - | - | NEW | 1 | Y | - | - | - | Y |
| **HE82015** | 64kB | 64kB | 128B | Y | Y | - | - | - | F | Y | - | - | D | - | - | - | - | - | NEW | 1 | Y | - | - | - | Y |
| **HE83006** | 64kB | 192kB | 128B | Y | Y | Y | Y | Y | N | Y | Y | - | C,D,10 | - | - | - | - | - | OLD | 2 | Y | Y | Y | - | Y |
| **HE83015** | 64kB | 64kB | 128B | Y | Y | Y | Y | Y | N | Y | Y | - | C,D,10 | - | - | - | - | - | OLD | 2 | Y | Y | Y | - | Y |
| **HE83120** | 64kB | 192kB | 256B | Y | Y | Y | Y | Y | N | Y | Y | - | C[3:0],D | - | 8 | 40 | R5 | - | OLD | 2 | Y | - | Y | - | Y |
| **HE83121** | 64kB | 64kB | 256B | Y | Y | Y | Y | Y | N | Y | Y | - | C[3:0],D | - | 8 | 40 | R5 | - | OLD | 2 | Y | - | Y | - | Y |
| **HE83122** | 64kB | - | 256B | Y | Y | Y | Y | Y | N | Y | Y | - | C[3:0],D | - | 8 | 40 | R5 | - | OLD | 2 | Y | - | Y | - | Y |
| **HR83123** | 64kB | - | 256B | Y | Y | Y | Y | Y | N | Y | Y | - | D | - | 8 | 40 | R5 | - | OLD | 2 | - | - | - | - | Y |
| **HE83R123** | 64kB | - | 256B | Y | Y | Y | Y | Y | N | Y | Y | - | D | 11,14,15,17 | 8 | 40 | C4 | Y | OLD | 2 | - | - | - | - | Y |
| **HE83124** | 64kB | 192kB | 256B | Y | Y | Y | Y | Y | N | Y | Y | - | D | - | 8 | 40 | R5 | - | OLD | 2 | - | - | - | - | Y |
| **HE83R125** | 64kB | 64kB | 256B | Y | Y | Y | Y | Y | N | Y | Y | - | D | 11,14,15,17 | 8 | 40 | C4 | Y | OLD | 2 | - | - | - | - | Y |
| **HE83130** | 64kB | - | 256B | Y | Y | Y | Y | Y | N | Y | Y | - | C[3:0],D | - | 16 | 40 | R5 | - | OLD | 2 | Y | | Y | - | Y |
| **HE83131** | 16kB | - | 256B | Y | Y | Y | Y | Y | N | Y | Y | - | C[3:0],D | - | 16 | 40 | R5 | - | OLD | 2 | Y | - | Y | - | Y |
| **HE83134** | 64kB | 192kB | 256B | Y | Y | Y | Y | Y | N | Y | Y | - | C[3:0],D | 14,15,17[7:4] | 16 | 40 | R5 | - | OLD | 2 | Y | Y | Y | - | Y |
| **HE83135** | 64kB | - | 2kB | Y | Y | Y | Y | Y | N | Y | Y | - | C[3:0],D | - | 16 | 40 | R50 | - | OLD | 2 | Y | - | Y | - | Y |
| **HE83136** | 64kB | - | 4kB | Y | Y | Y | Y | Y | N | Y | Y | - | C[3:0],D | - | 16 | 40 | R50 | - | OLD | 2 | Y | - | Y | - | Y |
| **HE83137** | 64kB | - | 4kB | Y | Y | Y | Y | Y | N | Y | Y | - | C[3:0],D | 14,15,17 | 16 | 40 | R50 | - | OLD | 2 | Y | Y | Y | - | Y |
| **HE83141** | 64kB | 64kB | 256B | Y | Y | Y | Y | Y | N | Y | Y | Y | C,D | 14 | 16 | 64 | R5 | - | OLD | 2 | Y | Y | Y | Y | Y |

| BODY | PROM | DROM | RAM | FX | FRC | Fin | SX | SRC | CKmd | TC1 | TC2 | TB | PORT | PORT_LCD | COM | SEG | LDVD | LREG | PWM | PMD | VO | DAO | OP Amp | DTMF | WDT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **HE83R141** | 64kB | 64kB | 256B | Y | Y | - | Y | Y | N | Y | Y | Y | C,D | 14 | 16 | 64 | C5 | Y | NEW | 1 | Y | Y | Y | Y | Y |
| **HE83142** | 64kB | 192kB | 4kB | Y | Y | Y | Y | Y | N | Y | Y | Y | C,D | 14 | 16 | 64 | R5 | - | OLD | 2 | Y | Y | Y | Y | Y |
| **HE83R142** | 64kB | 192kB | 4kB | Y | Y | - | Y | Y | N | Y | Y | Y | C,D | 14 | 16 | 64 | C5 | Y | NEW | 1 | Y | Y | Y | Y | Y |
| **HE83144** | 64kB | - | 256B | Y | Y | Y | Y | Y | N | Y | Y | Y | D | 14,15 | 16 | 64 | R50V | - | OLD | 2 | Y | - | - | - | - |
| **HE83145** | 64kB | 64kB | 256B | Y | Y | Y | Y | Y | N | Y | Y | Y | D | 14,15 | 16 | 64 | R50V | - | OLD | 2 | Y | - | - | - | - |
| **HE83146** | 64kB | 128kB | 256B | Y | Y | Y | Y | Y | N | Y | Y | Y | D | 14,15 | 16 | 64 | R50V | - | OLD | 2 | Y | - | - | - | - |
| **HE83147** | 64kB | 192kB | 256B | Y | Y | Y | Y | Y | N | Y | Y | Y | D | 14,15 | 16 | 64 | R50V | - | OLD | 2 | Y | - | - | - | - |
| **HE83148** | 64kB | 192kB | 2kB | Y | Y | Y | Y | Y | N | Y | Y | Y | D | 14,15 | 16 | 64 | R50V | - | OLD | 2 | Y | - | - | - | - |
| Mask Options | PROM | DROM [1:0] | RAM [1:0] | FXTAL | FOSCE | SXTAL | FCK/ SCKN | TC1 | TC2 | TB | PRTCH, PRTCL, PRTD, PRT10 | PRT10, PRT14, PRT15, PRT17H, PRT17L, PRTLCD | COM [1:0] | LPS[2:0] | PWM [1:0] | PMD | VO | DAO | OPAMP | DTMF | WDTE | | | | |

**BODY** : Sequence Code of Device Name
**PROM** : Program ROM
**DROM** : Data ROM
**RAM** : Internal SRAM
**FX** : Crystal Fast Clock
**FRC** : RC Fast Clock
**Fin** : OSC. Clock Input
**SX** : Crystal Slow Clock
**SRC** : RC Slow Clock

**TC2** : Timer 2
**TB** : Time Base
**PORT** : Dedicated PORT Name
**PORT_CLD** : PORT Shared with LCD
**COM** : LCD Common Number
**SEG** : LCD Segment Number
**LREG** : LCD Regulator
**PMD** : PWM Architecture
**VO** : VO Output

| BODY | PROM | DROM | RAM | FX | FRC | Fin | SX | SRC | CKmd | TC1 | TC2 | TB | PORT | PORT_LCD | COM | SEG | LDVD | LREG | PWM | PMD | VO | DAO | OP Amp | DTMF | WDT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CKmd | : Clock Selection | | | | | | | | | | | | | DAO | : DAO Output | | | | | | | | | | |
| TC1 | : Timer 1 | | | | | | | | | | | | | OP | : OP Amplifier | | | | | | | | | | |
| | | | | | | | | | | | | | | DTMF | : DTMF generator | | | | | | | | | | |

# D. Pin Description

| Pin Name | I/O | Function | Description |
|---|---|---|---|
| FXI | B | External fast clock pin. Connecting to crystal or RC to generate 32.768 kHz ~ 8MHz frequency. | Mask option setting：<br>MO_FCK/SCKN= 00 ➔ Slow Clock only<br>01 ➔ Illegal<br>10 ➔ Dual Clock<br>11 ➔ Fast Clock only<br>MO_FOSCE = 0 ➔ Internal fast osc.<br>= 1 ➔ External fast osc.<br>MO_FXTAL = 0 ➔ RC osc. for fast clock<br>= 1 ➔ X'tal osc. for fast clock<br>MO_SXTAL = 0 ➔ RC for 32768 Hz clock<br>= 1 ➔ X'tal for 32768 Hz 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. |
| FXO | O | | |
| SXI | I | 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. | |
| SXO | O | | |
| 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.<br>Besides, MO_WDTE can set Watch Dog Timer：<br>MO_WDTE= 0 ➔ Disable Watch Dog Timer<br>= 1 ➔ Enable Watch Dog Timer |
| 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 point with zero Ohm resistor to GND. |
| PRTC[7:0]/ PDATA[7:0] | B | Port C bi-directional I/O pin, or parallel program download mode when programming by parallel mode. | Mask options：<br>MO_CPP[7..0] = 1 ➔ Push-pull.<br>= 0 ➔ Open-drain.<br>When use them as input (No tri-state structure), it must Output "1" before reading. |
| PRTD7/SDO | B | I/O port / WAKEUP / INT/ SDO: Series Data Output | 8-pin bi-directional I/O port. PRTD[7..2] as wake-up pin, PRTD[7..6] as external interrupt pin, and<br>Mask options： |

| Pin Name | I/O | Function | Description |
|---|---|---|---|
| PRTD6/SDI | B | I/O port / WAKEUP / INT/ SDI: Series Data Input | MO_DPP[7..0] = 1 ➔ Push-pull.<br>= 0 ➔ Open-drain.<br>When use them as input (No tri-state structure), it must Output "1" before reading.<br><br>The PRTD are also used for OTP programming when setting the loader pin high to enter programming mode. |
| PRTD5/SCK | B | I/O port / WAKEUP / SCK: Series Clock | |
| PRTD4/D_Cn | B | I/O port / WAKEUP / D_Cn: data or command | |
| PRTD3/R_Wn | B | I/O port / WAKEUP / R_Wn: Read or Write | |
| PRTD2/P_Sn | B | I/O port / WAKEUP / P_Sn: Parallel or Series | |
| PRTD[1:0] | B | I/O port | |
| PRT10[7:0] | B | Bi-directional I/O Port | Mask options：<br>MO_10PP[7:0] = 1 ➔ Push-pull.<br>= 0 ➔ Open-drain.<br>When use them as input (No tri-state structure), it must Output "1" before reading. |
| COM[15:0] | O | LCD COM Output | Please refer to LCD and RAM map |
| SEG[63:56] | B | SEG / IO Ports | These pins can be used as LCD segment driver or I/O ports.<br>Please refer to Mask options Table for details. |
| SEG[55:48] | B | SEG / IO Ports | |
| **SEG[47:40]** | **O** | **LCD segment** | |
| SEG[39:36] | B | SEG / IO Ports | |
| SEG[35:32] | B | SEG / IO Ports | |
| SEG[31:28] | B | SEG / IO Ports | |
| SEG[27:24] | B | SEG / IO Ports | |
| SEG[23:20] | B | SEG / IO Ports | |
| SEG[19:16] | B | SEG / IO Ports | |
| SEG[15:8] | B | SEG / IO Ports | |
| SEG[7:0] | **O** | LCD segment | |
| LCDGS | B | LCD voltage control | Refer to Application circuit. |
| LCDVX | B | LCD voltage control | |
| LCDVTB | B | LCD voltage control | |

| Pin Name | I/O | Function | Description |
|---|---|---|---|
| LC4B | B | charge pump switch | |
| LC4A | B | charge pump switch | |
| LC3B | B | charge pump switch | |
| LC3A | B | charge pump switch | |
| LC2B | B | charge pump switch | |
| LC2A | B | charge pump switch | |
| LC1B | B | charge pump switch | |
| LC1A | B | charge pump switch | |
| LC2 | B | charge pump switch2 | |
| LC1 | B | charge pump switch1 | |
| LV5 | B | charge pump V5(V4,V3) | |
| LV4 | B | charge pump V4(V3,V2) | |
| LV3 | B | charge pump V3(V2,V1) | |
| LV2 | B | charge pump V2(V1) | |
| LV1 | B | charge pump V1, regulator output | |
| LVF | B | regulator resistor feedback | |
| LR4 | B | LCD resistor level 4 | |
| LR3 | B | LCD resistor level 3 | |
| LR2 | B | LCD resistor level 2 | |
| LR1 | B | LCD resistor level 1 | |
| LR0 | B | LCD resistor level 0 | |
| LVG | B | LCD virtual GND | |
| PWM | O | The PWM output can drive speaker or buzzer directly. | Set Bit2 (PWM=1) of VOC register to turn on PWM. |
| GND_PWM | P | dedicated GND for PWM | Dedicated PWM ground which is separated with digital ground. |
| PWMP | O | The PWM positive output can drive | Set Bit2 (PWM=1) of VOC register to turn on PWM. |

| Pin Name | I/O | Function | Description |
|---|---|---|---|
| | | speaker or buzzer directly. | |
| PWMN | O | The PWM negative output can drive speaker or buzzer directly. | Set Bit2 (PWM=1) of VOC register to turn on PWM. |
| VO | O | DAC voice output | Set Bit1 (DA=1) of VOC register to turn on VO. |
| DAO | O | DAC output | Digital to analog converter output |
| OPIP | I | Positive input of OP comparator | Set the bit0 (OP=1) of VOC register to turn on OP comparator.<br>The operating range between 0 ~ (VDD-1). |
| OPIN | I | Negative input of OP comparator | |
| OPO | O | OPAMP output pin | |
| DTMFO | O | DTMF tone | This function can be turned on/off in DTMFC register. Refer to HE80000 series user's manual.<br>Use Mask Option MO_DTMFSCK set clock source：<br>MO_DTMFSCK= 0 ➔ Clock Source=3.579545MHz<br>= 1 ➔ Clock Source=32768 Hz |
| MUTE | O | MUTE Output for Dialer | This function can be turned on/off in DTMFC register. Refer to HE80000 series user's manual. |
| SDO | O | SDO for Dialer Application | This function can be turned on/off in DTMFC register. Refer to HE80000 series user's manual. |
| KEYTONE | O | 1024 Hz 50% Duty square wave | This function can be turned on/off in DTMFC register. Refer to HE80000 series user's manual. |
| LOADER | I | Define Loader Mode | Used by OTP writer to load program. |
| VDD | P | digital VDD | Add a 0.1 µF capacitor as by-pass capacitor. |
| GND | P | digital GND | |
| VPP | P | OTP high voltage power | Apply 12V to write the OTP ROM, and 5V to normal operation |

# E. PIN Connection Comparison Table

| NAME | HE82006 | HE82015 | HE83006 | HE83015 | HE83120 | HE83121 | HE83122 | HR83123 | HE83R123 | HE83124 | HE83R125 | HE83130 | HE83131 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FXI** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **FXO** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **SXI** | float | float | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **SXO** | float | float | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **RSTP_N** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **TSTP_P** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **PRTC[7:4]** | float | float | Y | Y | float | float | float | float | float | float | float | float | float |
| **PRTC[3:0]** | float | float | Y | Y | Y | Y | Y | float | float | float | float | Y | Y |
| **PRTD[7:6]** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **PRTD[5:4]** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **PRTD[3:2]** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **PRTD[1:0]** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **PRT10[7:0]** | float | float | Y | Y | float | float | float | float | float | float | float | float | float |
| **COM[15:12]** | float | float | float | float | float | float | float | float | float | float | float | Y | Y |
| **COM[11:8]** | float | float | float | float | float | float | float | float | float | float | float | Y | Y |
| **COM[7]** | float | float | float | float | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **COM[6]** | float | float | float | float | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **COM[5]** | float | float | float | float | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **COM[4]** | float | float | float | float | Y | Y | Y | Y | Y | Y | Y | Y | Y |

| NAME | HE82006 | HE82015 | HE83006 | HE83015 | HE83120 | HE83121 | HE83122 | HR83123 | HE83R123 | HE83124 | HE83R125 | HE83130 | HE83131 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COM[3]** | float | float | float | float | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **COM[2]** | float | float | float | float | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **COM[1:0]** | float | float | float | float | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **SEG[63:56]** | float | float | float | float | float | float | float | float | float | float | float | float | float |
| **SEG[55:48]** | float | float | float | float | float | float | float | float | float | float | float | float | float |
| **SEG[47:40]** | float | float | float | float | float | float | float | float | float | float | float | float | float |
| **SEG[39:36]** | float | float | float | float | Y | Y | Y | Y | Y/P17H | Y | Y/P17H | Y | Y |
| **SEG[35:32]** | float | float | float | float | Y | Y | Y | Y | Y/P17L | Y | Y/P17L | Y | Y |
| **SEG[31:28]** | float | float | float | float | Y | Y | Y | Y | Y/P15H | Y | Y/P15H | Y | Y |
| **SEG[27:24]** | float | float | float | float | Y | Y | Y | Y | Y/P15L | Y | Y/P15L | Y | Y |
| **SEG[23:20]** | float | float | float | float | Y | Y | Y | Y | Y/P14H | Y | Y/P14H | Y | Y |
| **SEG[19:16]** | float | float | float | float | Y | Y | Y | Y | Y/P14L | Y | Y/P14L | Y | Y |
| **SEG[15:8]** | float | float | float | float | Y | Y | Y | Y | Y/P11 | Y | Y/P11 | Y | Y |
| **SEG[7:0]** | float | float | float | float | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **LCDGS** | float | float | float | float | float | float | float | float | float | float | float | float | float |
| **LCDVX** | float | float | float | float | float | float | float | float | float | float | float | float | float |
| **LCDVTB** | float | float | float | float | float | float | float | float | float | float | float | float | float |
| **LC4B** | float | float | float | float | float | float | float | float | float | float | float | float | float |
| **LC4A** | float | float | float | float | float | float | float | float | float | float | float | float | float |
| **LC3B** | float | float | float | float | float | float | float | float | float | float | float | float | float |
| **LC3A** | float | float | float | float | float | float | float | float | float | float | float | float | float |

| NAME | HE82006 | HE82015 | HE83006 | HE83015 | HE83120 | HE83121 | HE83122 | HR83123 | HE83R123 | HE83124 | HE83R125 | HE83130 | HE83131 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LC2B** | float | float | float | float | float | float | float | float | float | float | float | float | float |
| **LC2A** | float | float | float | float | float | float | float | float | float | float | float | float | float |
| **LC1B** | float | float | float | float | float | float | float | float | float | float | float | float | float |
| **LC1A** | float | float | float | float | float | float | float | float | float | float | float | float | float |
| **LC2** | float | float | float | float | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **LC1** | float | float | float | float | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **LV5** | float | float | float | float | Y(V3) | Y(V3) | Y(V3) | Y(V3) | Y(V4) | Y(V3) | Y(V4) | Y(V3) | Y(V3) |
| **LV4** | float | float | float | float | VDD(V2) | VDD(V2) | VDD(V2) | VDD(V2) | Y(V3) | VDD(V2) | T(V3) | VDD(V2) | VDD(V2) |
| **LV3** | float | float | float | float | Y(V1) | Y(V1) | Y(V1) | Y(V1) | Y(V2) | Y(V1) | TY(V2) | Y(V1) | Y(V1) |
| **LV2** | float | float | float | float | float | float | float | float | Y(V1) | float | Y(V1) | float | float |
| **LV1** | float | float | float | float | float | float | float | float | float | float | float | float | float |
| **LVF** | float | float | float | float | float | float | float | float | Y | float | Y | float | float |
| **LR4** | float | float | float | float | Y | Y | Y | Y | float | Y | float | Y | Y |
| **LR3** | float | float | float | float | Y | Y | Y | Y | float | Y | float | Y | Y |
| **LR2** | float | float | float | float | Y | Y | Y | Y | float | Y | float | Y | Y |
| **LR1** | float | float | float | float | Y | Y | Y | Y | float | Y | float | Y | Y |
| **LR0** | float | float | float | float | float | float | float | float | float | float | float | float | Y |
| **LVG** | float | float | float | float | Y | Y | Y | Y | float | Y | float | Y | Y |
| **PWM** | Y | Y | float | float | float | float | float | float | float | float | float | float | float |
| **GND_PWM** | GND | GND | GND | GND | GND | GND | GND | GND | GND | GND | GND | GND | GND |
| **PWMP** | float | float | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |

| NAME | HE82006 | HE82015 | HE83006 | HE83015 | HE83120 | HE83121 | HE83122 | HR83123 | HE83R123 | HE83124 | HE83R125 | HE83130 | HE83131 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PWMN** | float | float | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **VO** | Y | Y | Y | Y | Y | Y | Y | float | float | float | float | Y | Y |
| **DAO** | float | float | Y | Y | float | float | float | float | float | float | float | float | float |
| **OPIP** | float | float | Y | Y | Y | Y | Y | float | float | float | float | Y | Y |
| **OPIN** | float | float | Y | Y | Y | Y | Y | float | float | float | float | Y | Y |
| **OPO** | float | float | Y | Y | Y | Y | Y | float | float | float | float | Y | Y |
| **DTMFO** | float | float | float | float | float | float | float | float | float | float | float | float | float |
| **MUTE** | float | float | float | float | float | float | float | float | float | float | float | float | float |
| **SDO** | float | float | float | float | float | float | float | float | float | float | float | float | float |
| **KEYTONE** | float | float | float | float | float | float | float | float | float | float | float | float | float |
| **LOADER** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **VPP** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |

| NAME | HE83134 | HE83135 | HE83136 | HE83137 | HE83141 | HE83R141 | HE83142 | HE83R142 | HE83144 | HE83145 | HE83146 | HE83147 | HE83148 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FXI** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **FXO** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **SXI** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **SXO** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **RSTP_N** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **TSTP_P** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **PRTC[7:4]** | float | float | float | float | Y | Y | Y | Y | float | float | float | float | float |
| **PRTC[3:0]** | Y | Y | Y | Y | Y | Y | Y | Y | float | float | float | float | float |
| **PRTD[7:6]** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **PRTD[5:4]** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **PRTD[3:2]** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **PRTD[1:0]** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **PRT10[7:0]** | float | float | float | float | float | float | float | float | float | float | float | float | float |
| **COM[15:12]** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **COM[11:8]** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **COM[7]** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **COM[6]** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **COM[5]** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **COM[4]** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **COM[3]** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |

| NAME | HE83134 | HE83135 | HE83136 | HE83137 | HE83141 | HE83R141 | HE83142 | HE83R142 | HE83144 | HE83145 | HE83146 | HE83147 | HE83148 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COM[2]** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **COM[1:0]** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **SEG[63:56]** | float | float | float | float | Y/P14 | Y/P14 | Y/P14 | Y/P14 | Y/P15 | Y/P15 | Y/P15 | Y/P15 | Y/P15 |
| **SEG[55:48]** | float | float | float | float | Y | Y | Y | Y | Y/P14 | Y/P14 | Y/P14 | Y/P14 | Y/P14 |
| **SEG[47:40]** | float | float | float | float | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **SEG[39:36]** | Y/P17L | Y | Y | Y/P17H | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **SEG[35:32]** | Y/P15H | Y | Y | Y/P17L | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **SEG[31:28]** | Y/P15L | Y | Y | Y/P15H | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **SEG[27:24]** | Y/P14H | Y | Y | Y/P15L | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **SEG[23:20]** | Y/P14L | Y | Y | Y/P14H | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **SEG[19:16]** | Y | Y | Y | Y/P14L | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **SEG[15:8]** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **SEG[7:0]** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **LCDGS** | float | float | float | float | float | Y | float | Y | float | float | float | float | float |
| **LCDVX** | float | float | float | float | float | Y | float | Y | float | float | float | float | float |
| **LCDVTB** | float | float | float | float | float | Y | float | Y | float | float | float | float | float |
| **LC4B** | float | float | float | float | float | Y | float | Y | float | float | float | float | float |
| **LC4A** | float | float | float | float | float | Y | float | Y | float | float | float | float | float |
| **LC3B** | float | float | float | float | float | Y | float | Y | float | float | float | float | float |
| **LC3A** | float | float | float | float | float | Y | float | Y | float | float | float | float | float |
| **LC2B** | float | float | float | float | float | Y | float | Y | float | float | float | float | float |

| NAME | HE83134 | HE83135 | HE83136 | HE83137 | HE83141 | HE83R141 | HE83142 | HE83R142 | HE83144 | HE83145 | HE83146 | HE83147 | HE83148 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LC2A** | float | float | float | float | float | Y | float | Y | float | float | float | float | float |
| **LC1B** | float | float | float | float | float | Y | float | Y | float | float | float | float | float |
| **LC1A** | float | float | float | float | float | Y | float | Y | float | float | float | float | float |
| **LC2** | Y | Y | Y | Y | Y | float | Y | float | Y | Y | Y | Y | Y |
| **LC1** | Y | Y | Y | Y | Y | float | Y | float | Y | Y | Y | Y | Y |
| **LV5** | Y(V3) | Y(V3) | Y(V3) | Y(V3) | Y(V3) | Y(V5) | Y(V3) | Y(V5) | Y(V3) | Y(V3) | Y(V3) | Y(V3) | Y(V3) |
| **LV4** | VDD(V2) | VDD(V2) | VDD(V2) | VDD(V2) | VDD(V2) | Y(V4) | VDD(V2) | Y(V4) | Y(V2) | Y(V2) | Y(V2) | Y(V2) | Y(V2) |
| **LV3** | Y(V1) | Y(V1) | Y(V1) | Y(V1) | Y(V1) | Y(V3) | Y(V1) | Y(V3) | Y(V1) | Y(V1) | Y(V1) | Y(V1) | Y(V1) |
| **LV2** | float | float | float | float | float | Y(V2) | float | Y(V2) | float | float | float | float | float |
| **LV1** | float | float | float | float | float | Y(V1) | float | Y(V1) | float | float | float | float | float |
| **LVF** | float | float | float | float | float | float | float | float | float | float | float | float | float |
| **LR4** | Y | Y | Y | Y | Y | float | Y | float | Y | Y | Y | Y | Y |
| **LR3** | Y | Y | Y | Y | Y | float | Y | float | Y | Y | Y | Y | Y |
| **LR2** | Y | Y | Y | Y | Y | float | Y | float | Y | Y | Y | Y | Y |
| **LR1** | Y | Y | Y | Y | Y | float | Y | float | Y | Y | Y | Y | Y |
| **LR0** | float | Y | Y | Y | float | float | float | float | Y | Y | Y | Y | Y |
| **LVG** | Y | Y | Y | Y | Y | float | Y | float | Y | Y | Y | Y | Y |
| **PWM** | float | float | float | float | float | Y | float | Y | float | float | float | float | float |
| **GND_PWM** | GND | GND | GND | GND | GND | GND | GND | GND | GND | GND | GND | GND | GND |
| **PWMP** | Y | Y | Y | Y | Y | float | Y | float | Y | Y | Y | Y | Y |
| **PWMN** | Y | Y | Y | Y | Y | float | Y | float | Y | Y | Y | Y | Y |

| NAME | HE83134 | HE83135 | HE83136 | HE83137 | HE83141 | HE83R141 | HE83142 | HE83R142 | HE83144 | HE83145 | HE83146 | HE83147 | HE83148 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **VO** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **DAO** | Y | Y | Y | Y | Y | Y | Y | Y | float | float | float | float | float |
| **OPIP** | Y | Y | Y | Y | Y | Y | Y | Y | float | float | float | float | float |
| **OPIN** | Y | Y | Y | Y | Y | Y | Y | Y | float | float | float | float | float |
| **OPO** | Y | Y | Y | Y | Y | Y | Y | Y | float | float | float | float | float |
| **DTMFO** | float | float | float | float | Y | Y | Y | Y | float | float | float | float | float |
| **MUTE** | float | float | float | float | Y | Y | Y | Y | float | float | float | float | float |
| **SDO** | float | float | float | float | Y | Y | Y | Y | float | float | float | float | float |
| **KEYTONE** | float | float | float | float | Y | Y | Y | Y | float | float | float | float | float |
| **LOADER** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **VPP** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |

# F. Mask Option Comparison Table

When use KB OTPWriter (include application software& hardware) to write data to OTP, user can select specific IC from software application and in the mean time, the KB OTPWriter will set the entire configuration automatically. The following table describes the related configuration setting, if user wants to use HE8P480 full function setting, please reference following setting. The KB OTPWriter can also output the configuration setting to a file (*.FUS) and this file can be used for mass production. The “user” in the table means the related item can be set by user.

| NAME | VALUE | NOTE | HE82006 | HE82015 | HE83006 | HE83015 | HE83120 | HE83121 | HE83122 | HE83123 | HE83R123 | HE83124 | HE83R125 | HE83130 | HE83131 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MO_FOSCE | 0 | internal fast OSC | 1 | 1 | User | User | User | User | User | User | User | User | User | User | User |
| | 1 | external fast OSC | | | | | | | | | | | | | |
| MO_FXTAL | 0 | R/C osc. For fast clock | User | User | User | User | User | User | User | User | User | User | User | User | User |
| | 1 | X'tal osc. For fast clock | | | | | | | | | | | | | |
| MO_FRCI_S[2:0] | 000 | RFRC_I ~= 500k | 000 | 000 | User | User | User | User | User | User | User | User | User | User | User |
| | 001 | RFRC_I ~= 1M | | | | | | | | | | | | | |
| | 010 | RFRC_I ~= 1.5M | | | | | | | | | | | | | |
| | 011 | RFRC_I ~= 2M | | | | | | | | | | | | | |
| | 100 | RFRC_I ~= 2.5M | | | | | | | | | | | | | |
| | 101 | RFRC_I ~= 3M | | | | | | | | | | | | | |
| | 110 | RFRC_I ~= 3.5M | | | | | | | | | | | | | |
| | 111 | RFRC_I ~= 4M | | | | | | | | | | | | | |
| MO_SXTAL | 0 | R/C osc. For 32k clock | 0 | 0 | User | User | User | User | User | User | User | User | User | User | User |
| | 1 | X'tal osc. For 32k clock | | | | | | | | | | | | | |
| MO_FCK/SCKN | 00 | slow clock only | 11 | 11 | User | User | User | User | User | User | User | User | User | User | User |
| | 01 | illegal | | | | | | | | | | | | | |
| | 10 | dual clock | | | | | | | | | | | | | |
| | 11 | fast clock only | | | | | | | | | | | | | |
| MO_WDTE | 0 | WDT disable | User | User | User | User | User | User | User | User | User | User | User | User | User |
| | 1 | WDT enable | | | | | | | | | | | | | |
| MO_CPP[7:4] | 0 | open-drain output | 1111 | 1111 | User | User | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 |

| NAME | VALUE | NOTE | HE82006 | HE82015 | HE83006 | HE83015 | HE83120 | HE83121 | HE83122 | HE83123 | HE83R123 | HE83124 | HE83R125 | HE83130 | HE83131 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | push-pull output | | | | | (User) | (User) | (User) | | | | | | |
| MO_CPP[3:0] | 0 | open-drain output | 1111 | 1111 | User | User | User | User | User | 1111 | 1111 | 1111 | 1111 | User | User |
| | 1 | push-pull output | | | | | | | | | | | | | |
| MO_DPP[7:0] | 0 | open-drain output | User | User | User | User | User | User | User | User | User | User | User | User | User |
| | 1 | push-pull output | | | | | | | | | | | | | |
| MO_10PP[7:0] | 0 | open-drain output | 11111111 | 11111111 | User | User | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 |
| | 1 | push-pull output | | | | | | | | | | | | | |
| MO_11PP[7:0] | 0 | open-drain output | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | User | 11111111 | User | 11111111 | 11111111 |
| | 1 | push-pull output | | | | | | | | | | | | | |
| MO_14PP[7:0] | 0 | open-drain output | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | User | 11111111 | User | 11111111 | 11111111 |
| | 1 | push-pull output | | | | | | | | | | | | | |
| MO_15PP[7:0] | 0 | open-drain output | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | User | 11111111 | User | 11111111 | 11111111 |
| | 1 | push-pull output | | | | | | | | | | | | | |
| MO_17PP[7:4] | 0 | open-drain output | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | User | 1111 | User | 1111 | 1111 |
| | 1 | push-pull output | | | | | | | | | | | | | |
| MO_17PP[3:0] | 0 | open-drain output | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | User | 1111 | User | 1111 | 1111 |
| | 1 | push-pull output | | | | | | | | | | | | | |
| MO_DTMFSCK | 0 | DTMF clock source 3.58M Hz | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | DTMF clock source 32768 Hz | | | | | | | | | | | | | |
| LCDR(fixed to 0) | 0 | LCD low resistance disable | 1 | 1 | 1 | 1 | User | User | User | User | 1 | User | 1 | User | User |
| | 1 | LCD low resistance enable | | | | | | | | | | | | | |

| NAME | VALUE | NOTE | HE82006 | HE82015 | HE83006 | HE83015 | HE83120 | HE83121 | HE83122 | HE83123 | HE83R123 | HE83124 | HE83R125 | HE83130 | HE83131 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LCDBS[2:0] | 000 | LCD bias R=30k | 111 | 111 | 111 | 111 | User | User | User | User | 111 | User | 111 | User | User |
| | 001 | LCD bias R=60k | | | | | | | | | | | | | |
| | 010 | LCD bias R=90k | | | | | | | | | | | | | |
| | 011 | LCD bias R=120k | | | | | | | | | | | | | |
| | 100 | LCD bias R=210k | | | | | | | | | | | | | |
| | 101 | LCD bias R=240k | | | | | | | | | | | | | |
| | 110 | LCD bias R=270k | | | | | | | | | | | | | |
| | 111 | LCD bias R=300k | | | | | | | | | | | | | |
| EM_TPP | 0 | TPP[23:16] == 00h | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| | 1 | TPP enable | | | | | | | | | | | | | |
| MO_LIOS15_8 | 0 | IO pin | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | User | 11111111 | User | 11111111 | 11111111 |
| | 1 | LCD pin | | | | | | | | | | | | | |
| MO_LIOS19_16 | 0 | IO pin | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | User | 1111 | User | 1111 | 1111 |
| | 1 | LCD pin | | | | | | | | | | | | | |
| MO_LIOS23_20 | 0 | IO pin | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | User | 1111 | User | 1111 | 1111 |
| | 1 | LCD pin | | | | | | | | | | | | | |
| MO_LIOS27_24 | 0 | IO pin | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | User | 1111 | User | 1111 | 1111 |
| | 1 | LCD pin | | | | | | | | | | | | | |
| MO_LIOS31_28 | 0 | IO pin | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | User | 1111 | User | 1111 | 1111 |
| | 1 | LCD pin | | | | | | | | | | | | | |
| MO_LIOS35_32 | 0 | IO pin | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | User | 1111 | User | 1111 | 1111 |

| NAME | VALUE | NOTE | HE82006 | HE82015 | HE83006 | HE83015 | HE83120 | HE83121 | HE83122 | HE83123 | HE83R123 | HE83124 | HE83R125 | HE83130 | HE83131 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | LCD pin | | | | | | | | | | | | | |
| MO_LIOS39_36 | 0 | IO pin | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | User | 1111 | User | 1111 | 1111 |
| | 1 | LCD pin | | | | | | | | | | | | | |
| MO_LIOS55_48 | 0 | IO pin | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 |
| | 1 | LCD pin | | | | | | | | | | | | | |
| MO_LIOS63_56 | 0 | IO pin | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 |
| | 1 | LCD pin | | | | | | | | | | | | | |
| MO_S3920_Prt | 0 | SEG23-20 shared with P14L | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | SEG27-24 shared with P14H | | | | | | | | | | | | | |
| | | SEG31-28 shared with P15L | | | | | | | | | | | | | |
| | | SEG35-32 shared with P15H | | | | | | | | | | | | | |
| | | SEG39-36 shared with P17L | | | | | | | | | | | | | |
| | 1 | SEG23-20 shared with P14H | | | | | | | | | | | | | |
| | | SEG27-24 shared with P15L | | | | | | | | | | | | | |
| | | SEG31-28 shared with P15H | | | | | | | | | | | | | |
| | | SEG35-32 shared with P17L | | | | | | | | | | | | | |
| | | SEG39-36 shared with P17H | | | | | | | | | | | | | |
| MO_S6356_Prt | 0 | SEG63-56 shared with P14 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 1 | SEG63-56 shared with P15 | | | | | | | | | | | | | |
| MO_LCD[1:0] | 00 | LCD not exist | 00 | 00 | 00 | 00 | 01 | 01 | 01 | 01 | 01 | 01 | 01 | 10 | 10 |
| | 01 | 8 x 40 | | | | | | | | | | | | | |

| NAME | VALUE | NOTE | HE82006 | HE82015 | HE83006 | HE83015 | HE83120 | HE83121 | HE83122 | HE83123 | HE83R123 | HE83124 | HE83R125 | HE83130 | HE83131 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | 16 x 40 | | | | | | | | | | | | | |
| | 11 | 16 x 64 | | | | | | | | | | | | | |
| LCDPS[1:0] | 00 | NO LCD power system | 00 | 00 | 00 | 00 | 01 | 01 | 01 | 01 | 10 | 01 | 10 | 01 | 01 |
| | 01 | R50V | | | | | | | | | | | | | |
| | 10 | C4 | | | | | | | | | | | | | |
| | 11 | C5 | | | | | | | | | | | | | |
| MO_LVRG | 0 | Regulator disabled | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | User | 0 | User | 0 | 0 |
| | 1 | Regulator enabled | | | | | | | | | | | | | |
| MO_PROTECTN | 0 | OTP read protect | User | User | User | User | User | User | User | User | User | User | User | User | User |
| | 1 | OTP not protect | | | | | | | | | | | | | |
| MO_OTPCMP | 0 | OTP read by Pre-charge | **KB** | **KB** | **KB** | **KB** | **KB** | **KB** | **KB** | **KB** | **KB** | **KB** | **KB** | **KB** | **KB** |
| | 1 | OTP read by current compare | | | | | | | | | | | | | |
| MO_PROM | 0 | PROM 16KB | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | 1 | PROM 64KB | | | | | | | | | | | | | |
| MO_DROM[1:0] | 00 | NO DROM | 11 | 01 | 11 | 01 | 11 | 01 | 00 | 00 | 00 | 11 | 01 | 00 | 00 |
| | 01 | DROM 64KB | | | | | | | | | | | | | |
| | 10 | DROM 128KB | | | | | | | | | | | | | |
| | 11 | DROM 192KB | | | | | | | | | | | | | |
| MO_RAM[1:0] | 00 | RAM 128 byte | 00 | 00 | 00 | 00 | 01 | 01 | 01 | 01 | 01 | 01 | 01 | 01 | 01 |
| | 01 | RAM 256 byte | | | | | | | | | | | | | |
| | 10 | RAM 2K byte | | | | | | | | | | | | | |

| NAME | VALUE | NOTE | HE82006 | HE82015 | HE83006 | HE83015 | HE83120 | HE83121 | HE83122 | HE83123 | HE83R123 | HE83124 | HE83R125 | HE83130 | HE83131 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 11 | RAM 4K byte | | | | | | | | | | | | | |
| MO_TC2 | 0 | TC2 not exist | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 1 | TC2 exist | | | | | | | | | | | | | |
| MO_TB | 0 | TB not exist | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | TB exist | | | | | | | | | | | | | |
| MO_PRT0C[1:0] | 00 | prt0C not exist | 00 | 00 | 11 | 11 | 01 | 01 | 01 | 00 | 00 | 00 | 00 | 01 | 01 |
| | 01 | only prt0C[3:0] exist | | | | | | | | | | | | | |
| | 10 | only prt0C[7:4] exist | | | | | | | | | | | | | |
| | 11 | prt0C exist | | | | | | | | | | | | | |
| MO_PRT10 | 0 | prt10 not exist | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | prt10 exist | | | | | | | | | | | | | |
| MO_PWM | 0 | PWMP/PWMN output | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | PWM/GND_PWM output | | | | | | | | | | | | | |
| MO_PMD | 0 | 2 drive pin | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 drive pin | | | | | | | | | | | | | |
| MO_VO | 0 | DAC not exist | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| | 1 | DAC exist | | | | | | | | | | | | | |
| MO_DAO | 0 | DAO output not exist | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | DAO output exist | | | | | | | | | | | | | |
| MO_OPAMP | 0 | OP Amp not exist | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| | 1 | OP Amp exist | | | | | | | | | | | | | |

| NAME | VALUE | NOTE | HE82006 | HE82015 | HE83006 | HE83015 | HE83120 | HE83121 | HE83122 | HE83123 | HE83R123 | HE83124 | HE83R125 | HE83130 | HE83131 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MO_DTMF | 0 | DTMF not exist | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | DTMF exist | | | | | | | | | | | | | |

Mask Options Table 2

| NAME | VALUE | NOTE | HE83134 | HE83135 | HE83136 | HE83137 | HE83141 | HE83R141 | HE83142 | HE83R142 | HE83144 | HE83145 | HE83146 | HE83147 | HE83148 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MO_FOSCE | 0 | internal fast OSC | User | User | User | User | User | 1 | User | 1 | User | User | User | User | User |
| | 1 | external fast OSC | | | | | | | | | | | | | |
| MO_FXTAL | 0 | R/C osc. For fast clock | User | User | User | User | User | User | User | User | User | User | User | User | User |
| | 1 | X'tal osc. For fast clock | | | | | | | | | | | | | |
| MO_FRCI_S[2:0] | 000 | RFRC_I ~= 500k | User | User | User | User | User | 000 | User | 000 | | | | | |
| | 001 | RFRC_I ~= 1M | | | | | | | | | | | | | |
| | 010 | RFRC_I ~= 1.5M | | | | | | | | | | | | | |
| | 011 | RFRC_I ~= 2M | | | | | | | | | | | | | |
| | 100 | RFRC_I ~= 2.5M | | | | | | | | | | | | | |
| | 101 | RFRC_I ~= 3M | | | | | | | | | | | | | |
| | 110 | RFRC_I ~= 3.5M | | | | | | | | | | | | | |
| | 111 | RFRC_I ~= 4M | | | | | | | | | | | | | |
| MO_SXTAL | 0 | R/C osc. For 32k clock | User | User | User | User | User | User | User | User | User | User | User | User | User |
| | 1 | X'tal osc. For 32k clock | | | | | | | | | | | | | |
| MO_FCK/SCKN | 00 | slow clock only | User | User | User | User | User | User | User | User | User | User | User | User | User |
| | 01 | illegal | | | | | | | | | | | | | |
| | 10 | dual clock | | | | | | | | | | | | | |
| | 11 | fast clock only | | | | | | | | | | | | | |
| MO_WDTE | 0 | WDT disable | User | User | User | User | User | User | User | User | 0 | 0 | 0 | 0 | 0 |
| | 1 | WDT enable | | | | | | | | | | | | | |

| NAME | VALUE | NOTE | HE83134 | HE83135 | HE83136 | HE83137 | HE83141 | HE83R141 | HE83142 | HE83R142 | HE83144 | HE83145 | HE83146 | HE83147 | HE83148 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MO_CPP[7:4] | 0 | open-drain output | 1111 | 1111 | 1111 | 1111 | User | User | User | User | 1111 | 1111 | 1111 | 1111 | 1111 |
| | 1 | push-pull output | | | | | | | | | | | | | |
| MO_CPP[3:0] | 0 | open-drain output | User | User | User | User | User | User | User | User | 1111 | 1111 | 1111 | 1111 | 1111 |
| | 1 | push-pull output | | | | | | | | | | | | | |
| MO_DPP[7:0] | 0 | open-drain output | User | User | User | User | User | User | User | User | User | User | User | User | User |
| | 1 | push-pull output | | | | | | | | | | | | | |
| MO_10PP[7:0] | 0 | open-drain output | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 |
| | 1 | push-pull output | | | | | | | | | | | | | |
| MO_11PP[7:0] | 0 | open-drain output | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 |
| | 1 | push-pull output | | | | | | | | | | | | | |
| MO_14PP[7:0] | 0 | open-drain output | User | 11111111 | 11111111 | User | User | User | User | User | User | User | User | User | User |
| | 1 | push-pull output | | | | | | | | | | | | | |
| MO_15PP[7:0] | 0 | open-drain output | User | 11111111 | 11111111 | User | 11111111 | 11111111 | 11111111 | 11111111 | User | User | User | User | User |
| | 1 | push-pull output | | | | | | | | | | | | | |
| MO_17PP[7:4] | 0 | open-drain output | User | 1111 | 1111 | User | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 |
| | 1 | push-pull output | | | | | | | | | | | | | |
| MO_17PP[3:0] | 0 | open-drain output | 1111 | 1111 | 1111 | User | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 |
| | 1 | push-pull output | | | | | | | | | | | | | |
| MO_DTMFSCK | 0 | DTMF clock source 3.58M Hz | 0 | 0 | 0 | 0 | User | User | User | User | 0 | 0 | 0 | 0 | 0 |
| | 1 | DTMF clock source 32768 Hz | | | | | | | | | | | | | |
| LCDR (fixed to 0) | 0 | LCD low resistance disable | User | User | User | User | User | 1 | User | 1 | User | User | User | User | User |

| NAME | VALUE | NOTE | HE83134 | HE83135 | HE83136 | HE83137 | HE83141 | HE83R141 | HE83142 | HE83R142 | HE83144 | HE83145 | HE83146 | HE83147 | HE83148 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | LCD low resistance enable | | | | | | | | | | | | | |
| LCDBS[2:0] | 000 | LCD bias R=30k | User | User | User | User | User | 111 | User | 111 | User | User | User | User | User |
| | 001 | LCD bias R=60k | | | | | | | | | | | | | |
| | 010 | LCD bias R=90k | | | | | | | | | | | | | |
| | 011 | LCD bias R=120k | | | | | | | | | | | | | |
| | 100 | LCD bias R=210k | | | | | | | | | | | | | |
| | 101 | LCD bias R=240k | | | | | | | | | | | | | |
| | 110 | LCD bias R=270k | | | | | | | | | | | | | |
| | 111 | LCD bias R=300k | | | | | | | | | | | | | |
| EM_TPP | 0 | TPP[23:16] == 00h | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| | 1 | TPP enable | | | | | | | | | | | | | |
| MO_LIOS15_8 | 0 | IO pin | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 |
| | 1 | LCD pin | | | | | | | | | | | | | |
| MO_LIOS19_16 | 0 | IO pin | 1111 | 1111 | 1111 | User | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 |
| | 1 | LCD pin | | | | | | | | | | | | | |
| MO_LIOS23_20 | 0 | IO pin | User | 1111 | 1111 | User | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 |
| | 1 | LCD pin | | | | | | | | | | | | | |
| MO_LIOS27_24 | 0 | IO pin | User | 1111 | 1111 | User | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 |
| | 1 | LCD pin | | | | | | | | | | | | | |
| MO_LIOS31_28 | 0 | IO pin | User | 1111 | 1111 | User | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 |
| | 1 | LCD pin | | | | | | | | | | | | | |

| NAME | VALUE | NOTE | HE83134 | HE83135 | HE83136 | HE83137 | HE83141 | HE83R141 | HE83142 | HE83R142 | HE83144 | HE83145 | HE83146 | HE83147 | HE83148 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MO_LIOS35_32 | 0 | IO pin | User | 1111 | 1111 | User | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 |
| | 1 | LCD pin | | | | | | | | | | | | | |
| MO_LIOS39_36 | 0 | IO pin | User | 1111 | 1111 | User | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 | 1111 |
| | 1 | LCD pin | | | | | | | | | | | | | |
| MO_LIOS55_48 | 0 | IO pin | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | 11111111 | User | User | User | User | User |
| | 1 | LCD pin | | | | | | | | | | | | | |
| MO_LIOS63_56 | 0 | IO pin | 11111111 | 11111111 | 11111111 | 11111111 | User | User | User | User | User | User | User | User | User |
| | 1 | LCD pin | | | | | | | | | | | | | |
| MO_S3920_Prt | 0 | SEG23-20 shared with P14L | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | SEG27-24 shared with P14H | | | | | | | | | | | | | |
| | | SEG31-28 shared with P15L | | | | | | | | | | | | | |
| | | SEG35-32 shared with P15H | | | | | | | | | | | | | |
| | | SEG39-36 shared with P17L | | | | | | | | | | | | | |
| | 1 | SEG23-20 shared with P14H | | | | | | | | | | | | | |
| | | SEG27-24 shared with P15L | | | | | | | | | | | | | |
| | | SEG31-28 shared with P15H | | | | | | | | | | | | | |
| | | SEG35-32 shared with P17L | | | | | | | | | | | | | |
| | | SEG39-36 shared with P17H | | | | | | | | | | | | | |
| MO_S6356_Prt | 0 | SEG63-56 shared with P14 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| | 1 | SEG63-56 shared with P15 | | | | | | | | | | | | | |
| MO_LCD[1:0] | 00 | LCD not exist | 10 | 10 | 10 | 10 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |

| NAME | VALUE | NOTE | HE83134 | HE83135 | HE83136 | HE83137 | HE83141 | HE83R141 | HE83142 | HE83R142 | HE83144 | HE83145 | HE83146 | HE83147 | HE83148 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01 | 8 x 40 | | | | | | | | | | | | | |
| | 10 | 16 x 40 | | | | | | | | | | | | | |
| | 11 | 16 x 64 | | | | | | | | | | | | | |
| LCDPS[1:0] | 00 | NO LCD power system | 01 | 01 | 01 | 01 | 01 | 11 | 01 | 11 | 01 | 01 | 01 | 01 | 01 |
| | 01 | R50V | | | | | | | | | | | | | |
| | 10 | C4 | | | | | | | | | | | | | |
| | 11 | C5 | | | | | | | | | | | | | |
| MO_LVRG | 0 | Regulator disabled | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| | 1 | Regulator enabled | | | | | | | | | | | | | |
| MO_PROTECTN | 0 | OTP read protect | User | User | User | User | User | User | User | User | User | User | User | User | User |
| | 1 | OTP not protect | | | | | | | | | | | | | |
| MO_OTPCMP | 0 | OTP read by Pre-charge | **KB** | **KB** | **KB** | **KB** | **KB** | **KB** | **KB** | **KB** | **KB** | **KB** | **KB** | **KB** | **KB** |
| | 1 | OTP read by current compare | | | | | | | | | | | | | |
| MO_PROM | 0 | PROM 16KB | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 1 | PROM 64KB | | | | | | | | | | | | | |
| MO_DROM[1:0] | 00 | NO DROM | 11 | 00 | 00 | 00 | 01 | 01 | 11 | 11 | 00 | 01 | 10 | 11 | 11 |
| | 01 | DROM 64KB | | | | | | | | | | | | | |
| | 10 | DROM 128KB | | | | | | | | | | | | | |
| | 11 | DROM 192KB | | | | | | | | | | | | | |
| MO_RAM[1:0] | 00 | RAM 128 byte | 01 | 10 | 11 | 11 | 01 | 01 | 11 | 11 | 01 | 01 | 01 | 01 | 10 |
| | 01 | RAM 256 byte | | | | | | | | | | | | | |

| NAME | VALUE | NOTE | HE83134 | HE83135 | HE83136 | HE83137 | HE83141 | HE83R141 | HE83142 | HE83R142 | HE83144 | HE83145 | HE83146 | HE83147 | HE83148 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | RAM 2K byte | | | | | | | | | | | | | |
| | 11 | RAM 4K byte | | | | | | | | | | | | | |
| MO_TC2 | 0 | TC2 not exist | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 1 | TC2 exist | | | | | | | | | | | | | |
| MO_TB | 0 | TB not exist | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 1 | TB exist | | | | | | | | | | | | | |
| MO_PRT0C[1:0] | 00 | prt0C not exist | 01 | 01 | 01 | 01 | 11 | 11 | 11 | 11 | 00 | 00 | 00 | 00 | 00 |
| | 01 | only prt0C[3:0] exist | | | | | | | | | | | | | |
| | 10 | only prt0C[7:4] exist | | | | | | | | | | | | | |
| | 11 | prt0C exist | | | | | | | | | | | | | |
| MO_PRT10 | 0 | prt10 not exist | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 1 | prt10 exist | | | | | | | | | | | | | |
| MO_PWM | 0 | PWMP/PWMN output | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| | 1 | PWM/GND_PWM output | | | | | | | | | | | | | |
| MO_PMD | 0 | 2 drive pin | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| | 1 | 1 drive pin | | | | | | | | | | | | | |
| MO_VO | 0 | DAC not exist | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 1 | DAC exist | | | | | | | | | | | | | |
| MO_DAO | 0 | DAO output not exist | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| | 1 | DAO output exist | | | | | | | | | | | | | |
| MO_OPAMP | 0 | OP Amp not exist | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |

| NAME | VALUE | NOTE | HE83134 | HE83135 | HE83136 | HE83137 | HE83141 | HE83R141 | HE83142 | HE83R142 | HE83144 | HE83145 | HE83146 | HE83147 | HE83148 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | OP Amp exist | | | | | | | | | | | | | |
| MO_DTMF | 0 | DTMF not exist | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| | 1 | DTMF exist | | | | | | | | | | | | | |

# F. LCD Display RAM MAP Table

***LCD RAM MAP***

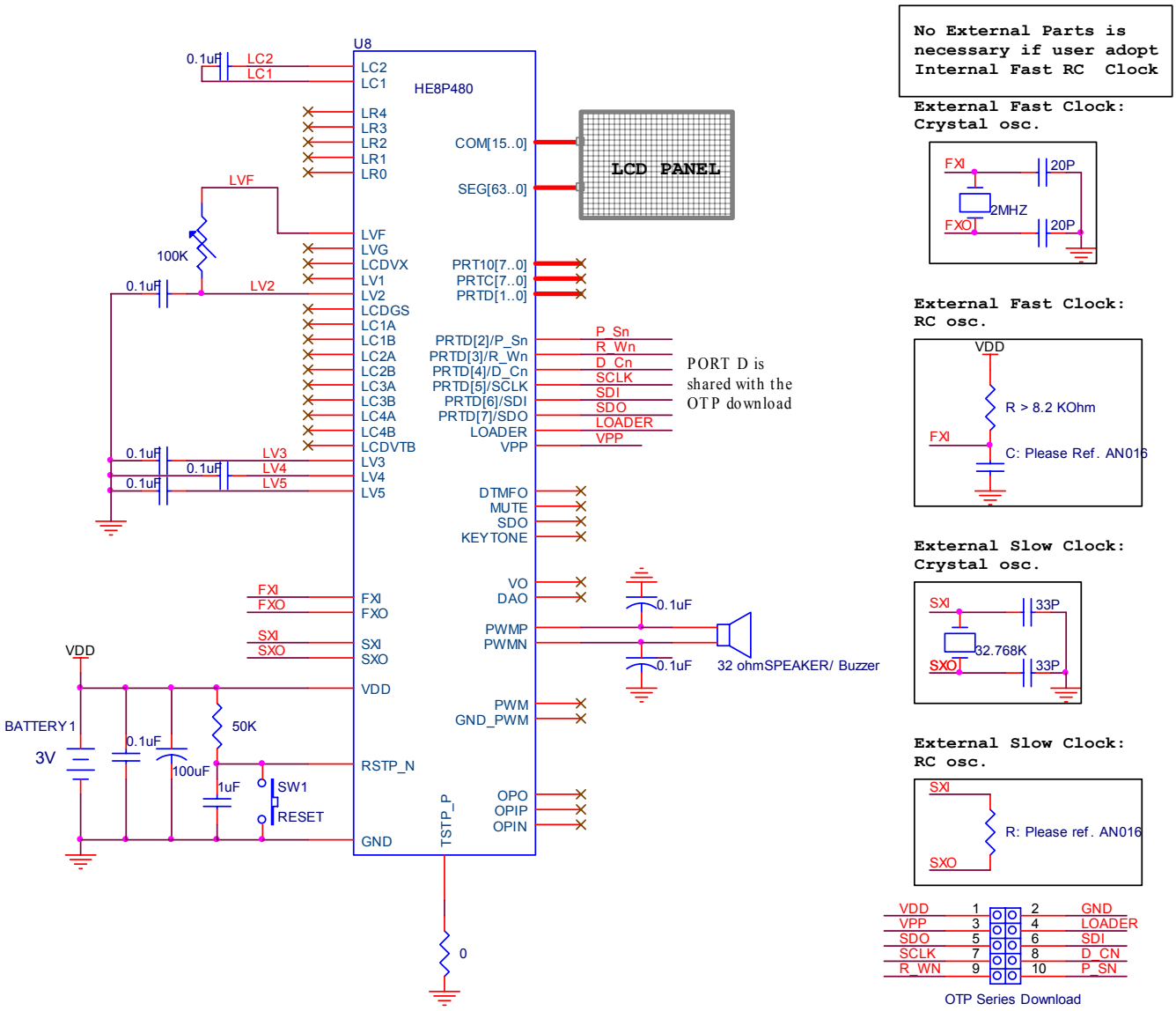
| RAM Address | 16COM x 64SEG | | | 16COM x 40SEG | | | 8COM x 40SEG | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 | | 0 | 7 | | 0 | 7 | | 0 |
| 80 | C0 ≀ C15 | SEG7 ~ SEG0 | C0 ≀ C15 | C0 ≀ C15 | SEG7 ~ SEG0 | C0 ≀ C15 | | | |
| 90 | C0 ≀ C15 | SEG15 ~ SEG8 | C0 ≀ C15 | C0 ≀ C15 | SEG15 ~ SEG8 | C0 ≀ C15 | | | |
| A0 | C0 ≀ C15 | SEG23 ~ SEG16 | C0 ≀ C15 | C0 ≀ C15 | SEG23 ~ SEG16 | C0 ≀ C15 | | | |
| B0 | C0 ≀ C15 | SEG31 ~ SEG24 | C0 ≀ C15 | C0 ≀ C15 | SEG31 ~ SEG24 | C0 ≀ C15 | | | |
| C0 | C0 ≀ C15 | SEG39 ~ SEG32 | C0 ≀ C15 | C0 ≀ C15 | SEG39 ~ SEG32 | C0 ≀ C15 | | | |
| D0 | C0 | | C0 | | | | | | |
| D8 | ≀ C15 | SEG47 ~ SEG40 | ≀ C15 | | | | C7 | SEG7 ~ SEG0 | C0 |
| E0 | C0 | | C0 | | | | C7 | SEG15 ~ SEG8 | C0 |
| E8 | ≀ C15 | SEG55 ~ SEG48 | ≀ C15 | | | | C7 | SEG23 ~ SEG16 | C0 |
| F0 | C0 | | C0 | | | | C7 | SEG31 ~ SEG24 | C0 |
| F8 | ≀ C15 | SEG63 ~ SEG56 | ≀ C15 | | | | C7 | SEG39 ~ SEG32 | C0 |

# G. LCD Segments and I/O Map

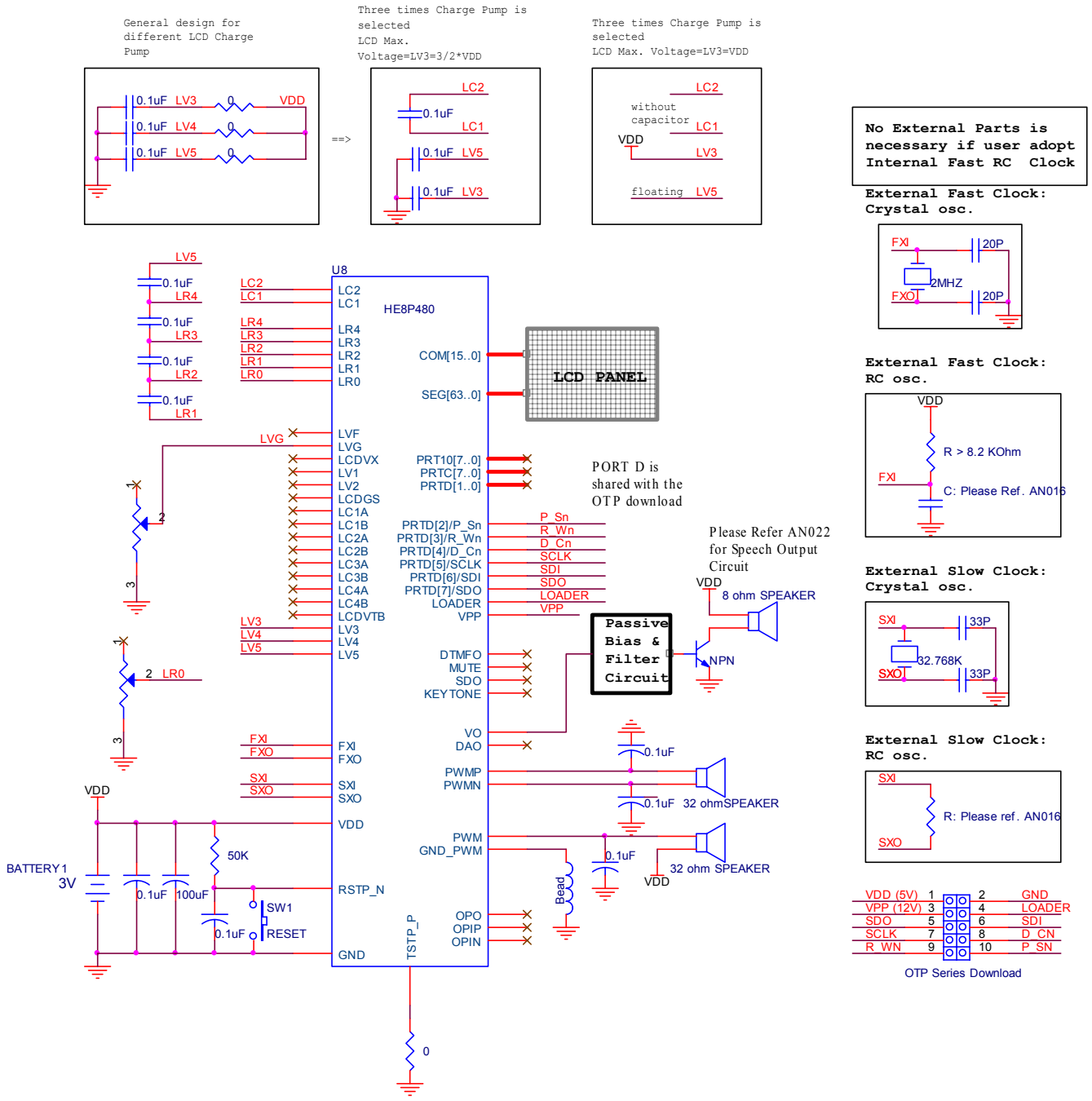
| SEG | 63 ~ 60 | 59 ~ 56 | 55 ~ 52 | 51 ~ 48 | 47 ~ 44 | 43 ~ 40 | 39 ~ 36 | 35 ~ 32 | 31 ~ 28 | 27 ~ 24 | 23 ~ 20 | 19 ~ 16 | 15 ~ 12 | 11 ~ 8 | 7 ~ 4 | 3 ~ 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **HE83120** | | | | | | | SEG39 ~ SEG0 | | | | | | | | | |
| **HE83121** | | | | | | | SEG39 ~ SEG0 | | | | | | | | | |
| **HE83122** | | | | | | | SEG39 ~ SEG0 | | | | | | | | | |
| **HR83123** | | | | | | | SEG39 ~ SEG0 | | | | | | | | | |
| **HR83124** | | | | | | | SEG39 ~ SEG0 | | | | | | | | | |
| **HE83R123** | | | | | | | PRT17 | | PRT15 | | PRT14 | | PRT11 | | SEG7 ~ SEG0 | |
| **HE83R125** | | | | | | | PRT17 | | PRT15 | | PRT14 | | PRT11 | | SEG7 ~ SEG0 | |
| **HE83130** | | | | | | | SEG39 ~ SEG0 | | | | | | | | | |
| **HE83131** | | | | | | | SEG39 ~ SEG0 | | | | | | | | | |
| **HE83134** | | | | | | | PRT17L | | PRT15 | | PRT14 | | SEG19 ~ SEG0 | | | |
| **HE83135** | | | | | | | SEG39 ~ SEG0 | | | | | | | | | |
| **HE83136** | | | | | | | SEG39 ~ SEG0 | | | | | | | | | |
| **HE83137** | | | | | | | PRT17 | | PRT15 | | PRT14 | | SEG15 ~ SEG0 | | | |
| **HE83141** | PRT14 | | SEG55 ~ SEG0 | | | | | | | | | | | | | |
| **HE83R141** | PRT14 | | SEG55 ~ SEG0 | | | | | | | | | | | | | |
| **HE83142** | PRT14 | | SEG55 ~ SEG0 | | | | | | | | | | | | | |
| **HE83R142** | PRT14 | | SEG55 ~ SEG0 | | | | | | | | | | | | | |
| **HE83144** | PRT15 | | PRT14 | | SEG48 ~ SEG0 | | | | | | | | | | | |
| **HE83145** | PRT15 | | PRT14 | | SEG48 ~ SEG0 | | | | | | | | | | | |
| **HE83146** | PRT15 | | PRT14 | | SEG48 ~ SEG0 | | | | | | | | | | | |
| **HE83147** | PRT15 | | PRT14 | | SEG48 ~ SEG0 | | | | | | | | | | | |
| **HE83148** | PRT15 | | PRT14 | | SEG48 ~ SEG0 | | | | | | | | | | | |

# H. Application Circuit

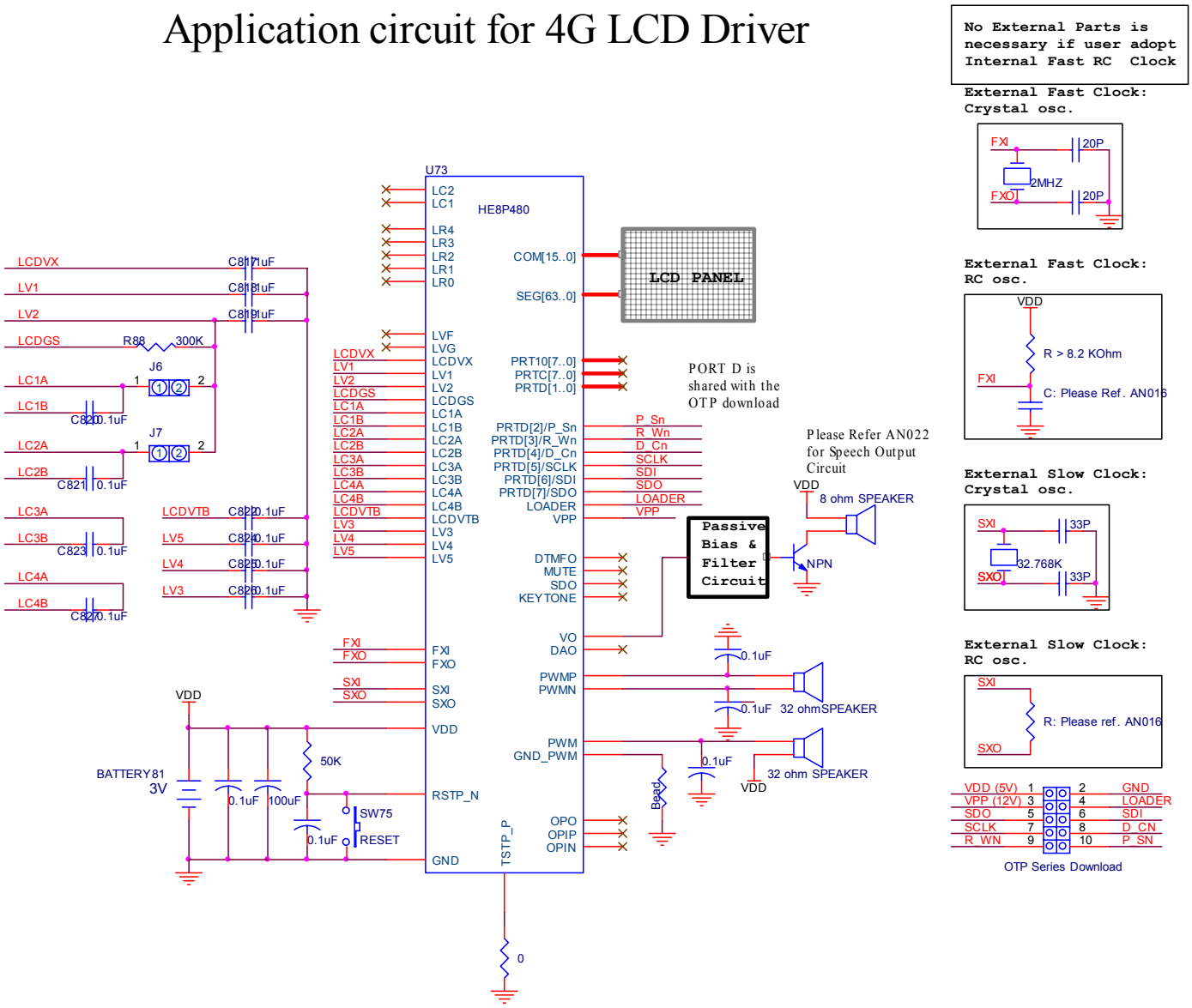
## Application circuit for HE83124, HE83R123 and HE83R125



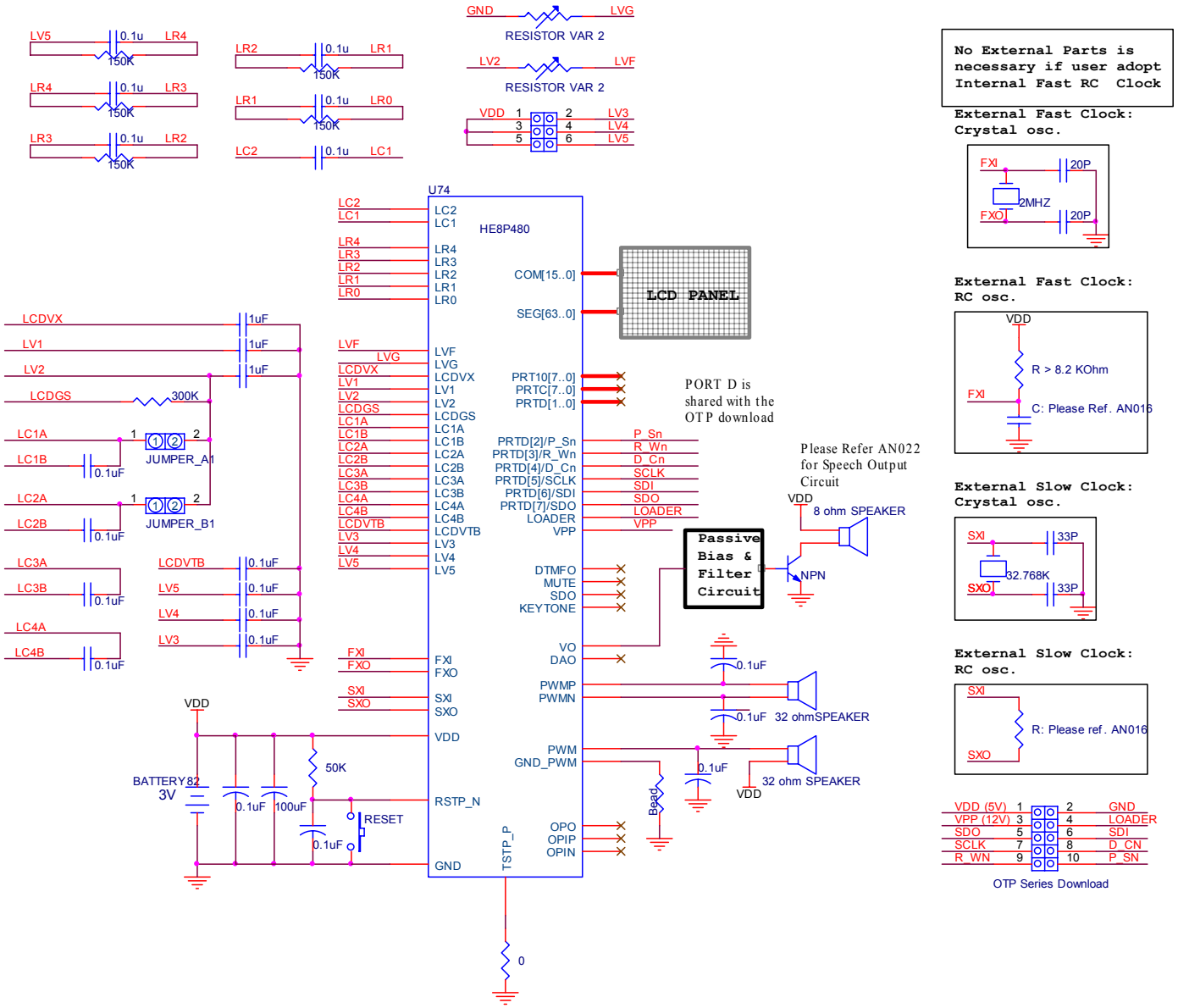
# Application circuit for HE83120, HE83121, HE83122, HE83123, HE83130, HE83131, HE83134, HE83135, HE83136, HE83137, HE83141, HE83R141, HE83142, HE83144, HE83145, HE83146, HE83147, HE83148



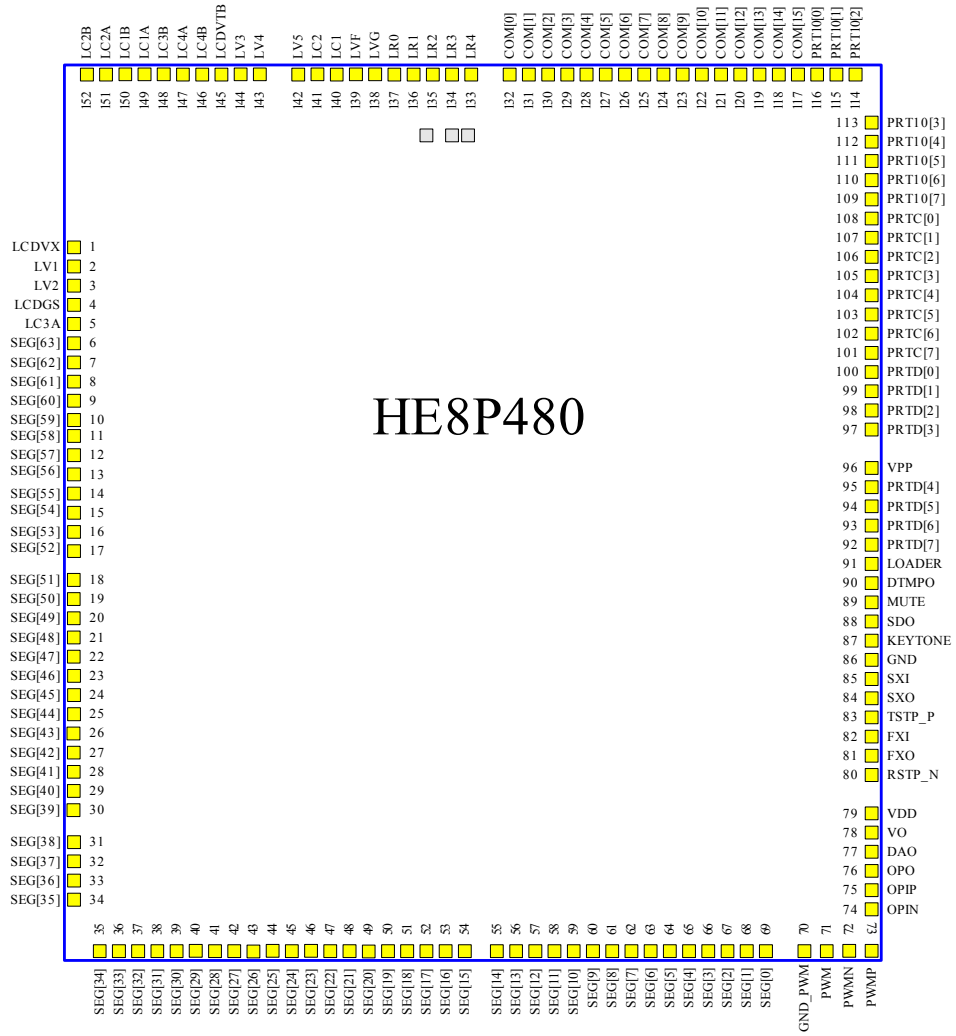
# Application circuit for 4G LCD Driver



# Application circuit for general LCD design



# I. Pin Diagram



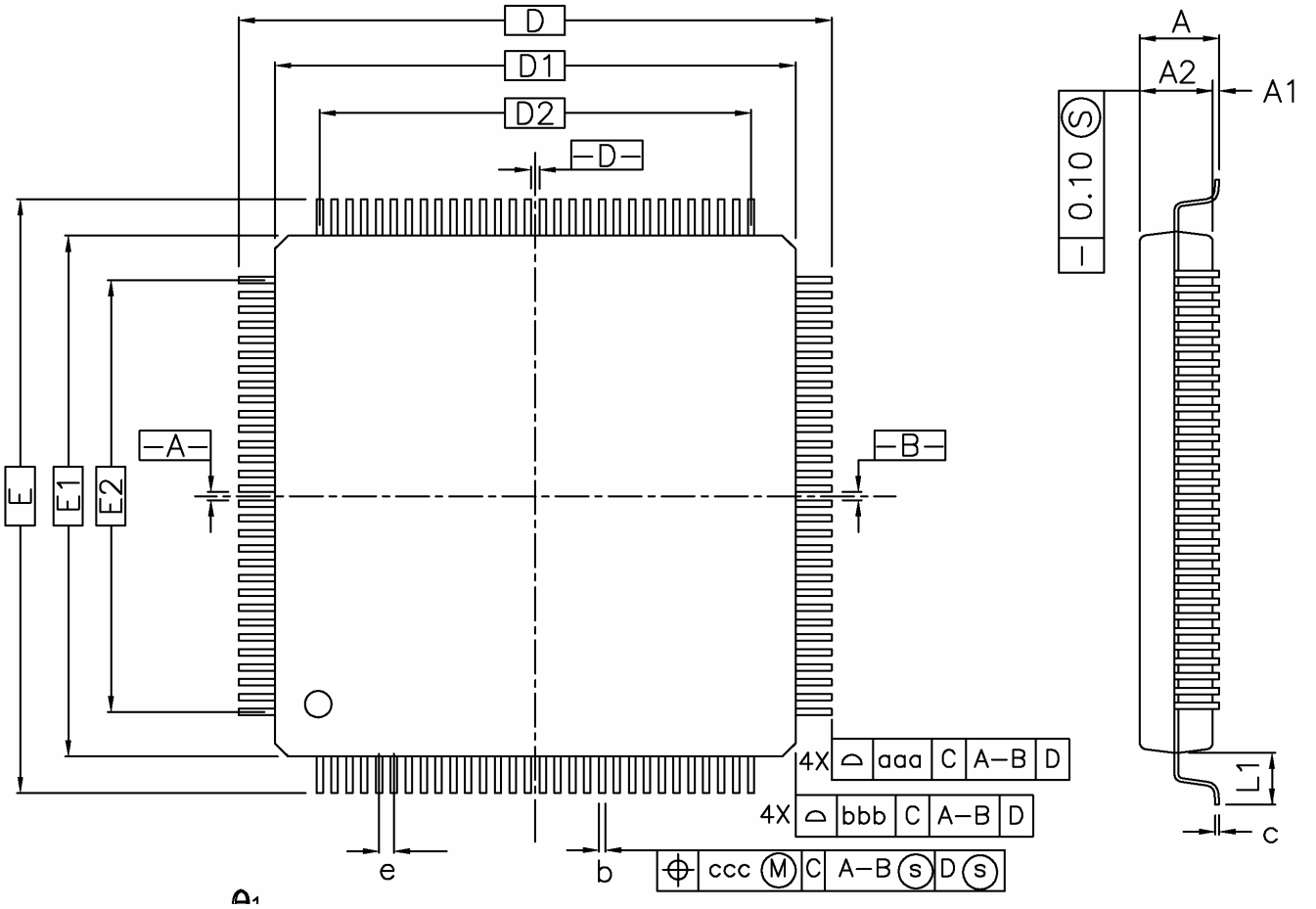
# J. Bonding Pad Location

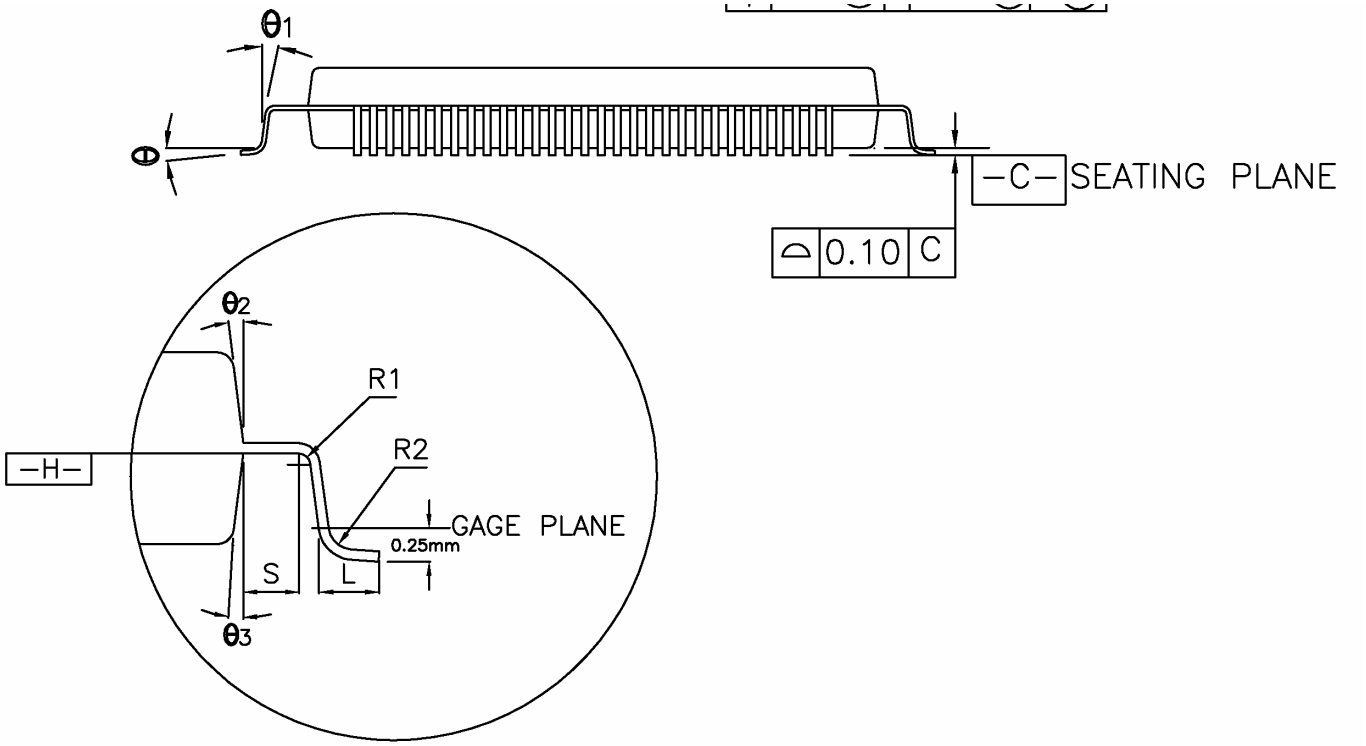
| PIN No. | PIN Name | X Coordinate | Y Coordinate | PIN No. | PIN Name | X Coordinate | Y Coordinate |
|---|---|---|---|---|---|---|---|
| 1 | LCDVX | X=-2527.10 | Y= 1833.95 | 77 | DAO | X= 2528.80 | Y=-2169.85 |
| 2 | LV1 | X=-2527.10 | Y= 1715.90 | 78 | VO | X= 2528.80 | Y=-2054.85 |
| 3 | LV2 | X=-2527.10 | Y= 1597.85 | 79 | VDD | X= 2528.80 | Y=-1936.80 |
| 4 | LCDGS | X=-2527.10 | Y= 1479.80 | 80 | RSTP_N | X= 2528.80 | Y=-1689.50 |
| 5 | LC3A | X=-2527.10 | Y= 1361.75 | 81 | FXO | X= 2528.80 | Y=-1571.45 |
| 6 | SEG[63] | X=-2527.10 | Y= 1246.75 | 82 | FXI | X= 2528.80 | Y=-1450.65 |
| 7 | SEG[62] | X=-2527.10 | Y= 1125.55 | 83 | TSTP_P | X= 2528.80 | Y=-1332.60 |
| 8 | SEG[61] | X=-2527.10 | Y= 1004.35 | 84 | SXO | X= 2528.80 | Y=-1214.55 |
| 9 | SEG[60] | X=-2527.10 | Y= 883.15 | 85 | SXI | X= 2528.80 | Y=-1096.50 |
| 10 | SEG[59] | X=-2527.10 | Y= 761.95 | 86 | GND | X= 2528.80 | Y= -978.45 |
| 11 | SEG[58] | X=-2527.10 | Y= 640.75 | 87 | KEYTONE | X= 2528.80 | Y= -857.65 |
| 12 | SEG[57] | X=-2527.10 | Y= 519.55 | 88 | SDO | X= 2528.80 | Y= -736.85 |
| 13 | SEG[56] | X=-2527.10 | Y= 398.35 | 89 | MUTE | X= 2528.80 | Y= -616.05 |
| 14 | SEG[55] | X=-2527.10 | Y= 277.15 | 90 | DTMFO | X= 2528.80 | Y= -498.00 |
| 15 | SEG[54] | X=-2527.10 | Y= 155.95 | 91 | LOADER | X= 2528.80 | Y= -379.95 |
| 16 | SEG[53] | X=-2527.10 | Y= 34.75 | 92 | PRTD[7] | X= 2528.80 | Y= -263.60 |
| 17 | SEG[52] | X=-2527.10 | Y= -215.70 | 93 | PRTD[6] | X= 2528.80 | Y= -141.35 |
| 18 | SEG[51] | X=-2527.10 | Y= -336.90 | 94 | PRTD[5] | X= 2528.80 | Y= -19.10 |
| 19 | SEG[50] | X=-2527.10 | Y= -458.10 | 95 | PRTD[4] | X= 2528.80 | Y= 103.15 |
| 20 | SEG[49] | X=-2527.10 | Y= -579.30 | 96 | VPP | X= 2528.80 | Y= 232.75 |
| 21 | SEG[48] | X=-2527.10 | Y= -700.50 | 97 | PRTD[3] | X= 2528.80 | Y= 490.15 |
| 22 | SEG[47] | X=-2527.10 | Y= -822.70 | 98 | PRTD[2] | X= 2528.80 | Y= 612.40 |
| 23 | SEG[46] | X=-2527.10 | Y= -943.90 | 99 | PRTD[1] | X= 2528.80 | Y= 734.65 |
| 24 | SEG[45] | X=-2527.10 | Y=-1063.00 | 100 | PRTD[0] | X= 2528.80 | Y= 856.90 |
| 25 | SEG[44] | X=-2527.10 | Y=-1182.10 | 101 | PRTC[7] | X= 2528.80 | Y= 979.15 |
| 26 | SEG[43] | X=-2527.10 | Y=-1301.20 | 102 | PRTC[6] | X= 2528.80 | Y= 1101.40 |
| 27 | SEG[42] | X=-2527.10 | Y=-1420.30 | 103 | PRTC[5] | X= 2528.80 | Y= 1223.65 |
| 28 | SEG[41] | X=-2527.10 | Y=-1539.40 | 104 | PRTC[4] | X= 2528.80 | Y= 1345.90 |
| 29 | SEG[40] | X=-2527.10 | Y=-1658.50 | 105 | PRTC[3] | X= 2528.80 | Y= 1468.15 |
| 30 | SEG[39] | X=-2527.10 | Y=-1903.75 | 106 | PRTC[2] | X= 2528.80 | Y= 1590.40 |

| PIN No. | PIN Name | X Coordinate | Y Coordinate | PIN No. | PIN Name | X Coordinate | Y Coordinate |
|---|---|---|---|---|---|---|---|
| 31 | SEG[38] | X=-2527.10 | Y=-2024.95 | 107 | PRTC[1] | X= 2528.80 | Y= 1712.65 |
| 32 | SEG[37] | X=-2527.10 | Y=-2146.15 | 108 | PRTC[0] | X= 2528.80 | Y= 1834.90 |
| 33 | SEG[36] | X=-2527.10 | Y=-2267.35 | 109 | PRT10[7] | X= 2528.80 | Y= 1961.60 |
| 34 | SEG[35] | X=-2527.10 | Y=-2388.55 | 110 | PRT10[6] | X= 2528.80 | Y= 2082.40 |
| 35 | SEG[34] | X=-2413.90 | Y=-2886.00 | 111 | PRT10[5] | X= 2528.80 | Y= 2203.20 |
| 36 | SEG[33] | X=-2292.70 | Y=-2886.00 | 112 | PRT10[4] | X= 2528.80 | Y= 2324.00 |
| 37 | SEG[32] | X=-2171.50 | Y=-2886.00 | 113 | PRT10[3] | X= 2528.80 | Y= 2444.80 |
| 38 | SEG[31] | X=-2050.30 | Y=-2886.00 | 114 | PRT10[2] | X= 2356.15 | Y= 2887.40 |
| 39 | SEG[30] | X=-1929.10 | Y=-2886.00 | 115 | PRT10[1] | X= 2235.35 | Y= 2887.40 |
| 40 | SEG[29] | X=-1807.90 | Y=-2886.00 | 116 | PRT10[0] | X= 2114.55 | Y= 2887.40 |
| 41 | SEG[28] | X=-1686.70 | Y=-2886.00 | 117 | COM[15] | X= 1996.45 | Y= 2887.40 |
| 42 | SEG[27] | X=-1565.50 | Y=-2886.00 | 118 | COM[14] | X= 1877.35 | Y= 2887.40 |
| 43 | SEG[26] | X=-1444.30 | Y=-2886.00 | 119 | COM[13] | X= 1758.25 | Y= 2887.40 |
| 44 | SEG[25] | X=-1323.10 | Y=-2886.00 | 120 | COM[12] | X= 1639.15 | Y= 2887.40 |
| 45 | SEG[24] | X=-1201.90 | Y=-2886.00 | 121 | COM[11] | X= 1520.05 | Y= 2887.40 |
| 46 | SEG[23] | X=-1080.70 | Y=-2886.00 | 122 | COM[10] | X= 1400.95 | Y= 2887.40 |
| 47 | SEG[22] | X= -959.50 | Y=-2886.00 | 123 | COM[9] | X= 1281.85 | Y= 2887.40 |
| 48 | SEG[21] | X= -838.30 | Y=-2886.00 | 124 | COM[8] | X= 1162.75 | Y= 2887.40 |
| 49 | SEG[20] | X= -717.10 | Y=-2886.00 | 125 | COM[7] | X= 1043.65 | Y= 2887.40 |
| 50 | SEG[19] | X= -595.90 | Y=-2886.00 | 126 | COM[6] | X= 924.55 | Y= 2887.40 |
| 51 | SEG[18] | X= -474.70 | Y=-2886.00 | 127 | COM[5] | X= 805.45 | Y= 2887.40 |
| 52 | SEG[17] | X= -353.50 | Y=-2886.00 | 128 | COM[4] | X= 686.35 | Y= 2887.40 |
| 53 | SEG[16] | X= -232.30 | Y=-2886.00 | 129 | COM[3] | X= 567.25 | Y= 2887.40 |
| 54 | SEG[15] | X= -111.10 | Y=-2886.00 | 130 | COM[2] | X= 448.15 | Y= 2887.40 |
| 55 | SEG[14] | X= 139.35 | Y=-2886.00 | 131 | COM[1] | X= 329.05 | Y= 2887.40 |
| 56 | SEG[13] | X= 260.55 | Y=-2886.00 | 132 | COM[0] | X= 209.95 | Y= 2887.40 |
| 57 | SEG[12] | X= 381.75 | Y=-2886.00 | 133 | LR4 | X= -38.35 | Y= 2887.40 |
| 58 | SEG[11] | X= 502.95 | Y=-2886.00 | 134 | LR3 | X= -156.40 | Y= 2887.40 |
| 59 | SEG[10] | X= 624.15 | Y=-2886.00 | 135 | LR2 | X= -274.45 | Y= 2887.40 |
| 60 | SEG[9] | X= 745.35 | Y=-2886.00 | 136 | LR1 | X= -392.50 | Y= 2887.40 |
| 61 | SEG[8] | X= 866.55 | Y=-2886.00 | 137 | LR0 | X= -510.55 | Y= 2887.40 |
| 62 | SEG[7] | X= 982.55 | Y=-2886.00 | 138 | LVG | X= -628.60 | Y= 2887.40 |
| 63 | SEG[6] | X= 1101.65 | Y=-2886.00 | 139 | LVF | X= -746.65 | Y= 2887.40 |

| PIN No. | PIN Name | X Coordinate | Y Coordinate | PIN No. | PIN Name | X Coordinate | Y Coordinate |
|---|---|---|---|---|---|---|---|
| 64 | SEG[5] | X= 1220.75 | Y=-2886.00 | 140 | LC1 | X= -864.70 | Y= 2887.40 |
| 65 | SEG[4] | X= 1339.85 | Y=-2886.00 | 141 | LC2 | X= -982.75 | Y= 2887.40 |
| 66 | SEG[3] | X= 1458.95 | Y=-2886.00 | 142 | LV5 | X=-1100.80 | Y= 2887.40 |
| 67 | SEG[2] | X= 1578.05 | Y=-2886.00 | 143 | LV4 | X=-1348.10 | Y= 2887.40 |
| 68 | SEG[1] | X= 1697.15 | Y=-2886.00 | 144 | LV3 | X=-1466.15 | Y= 2887.40 |
| 69 | SEG[0] | X= 1816.25 | Y=-2886.00 | 145 | LCDVTB | X=-1584.20 | Y= 2887.40 |
| 70 | GND_PWM:G | X= 2101.25 | Y=-2886.00 | 146 | LC4B | X=-1702.25 | Y= 2887.40 |
| 71 | PWM | X= 2239.50 | Y=-2886.00 | 147 | LC4A | X=-1820.30 | Y= 2887.40 |
| 72 | PWMN | X= 2379.90 | Y=-2886.00 | 148 | LC3B | X=-1938.35 | Y= 2887.40 |
| 73 | PWMP | X= 2502.55 | Y=-2886.00 | 149 | LC1A | X=-2056.40 | Y= 2887.40 |
| 74 | OPIN | X= 2528.80 | Y=-2520.95 | 150 | LC1B | X=-2174.45 | Y= 2887.40 |
| 75 | OPIP | X= 2528.80 | Y=-2402.90 | 151 | LC2A | X=-2292.50 | Y= 2887.40 |
| 76 | OPO | X= 2528.80 | Y=-2284.85 | 152 | LC2B | X=-2410.55 | Y= 2887.40 |

# K. Package – QFP160






| SYMBOL | MILLIMETER | | | INCH | | |
|---|---|---|---|---|---|---|
| | MIN. | NOR. | MAX. | MIN. | NOR. | MAX. |
| A | -- | -- | 4.07 | -- | -- | 0.160 |
| $A_1$ | 0.15 | 0.25 | 0.35 | 0.006 | 0.010 | 0.014 |
| $A_2$ | 3.17 | 3.32 | 3.67 | 0.125 | 0.131 | 0.144 |
| D | 31.90 BASIC | | | 1.256 BASIC | | |
| $D_1$ | 28.00 BASIC | | | 1.102 BASIC | | |
| E | 31.90 BASIC | | | 1.256 BASIC | | |
| $E_1$ | 28.00 BASIC | | | 1.102 BASIC | | |
| $R_2$ | 0.13 | -- | 0.30 | 0.005 | -- | 0.012 |
| $R_1$ | 0.13 | -- | 0.30 | 0.005 | -- | -- |
| θ | $0^o$ | $3.5^o$ | $7^o$ | $0^o$ | $3.5^o$ | $7^o$ |
| $\theta_1$ | $0^o$ | -- | -- | $0^o$ | -- | -- |
| $\theta_2$ | $8^o$ REF | | | $8^o$ REF | | |
| $\theta_3$ | $8^o$ REF | | | $8^o$ REF | | |
| c | 0.11 | 0.15 | 0.23 | 0.004 | 0.006 | 0.009 |
| L | 0.73 | 0.88 | 1.03 | 0.029 | 0.035 | 0.041 |
| $L_1$ | 1.95 REF | | | 0.077 REF | | |
| S | 0.40 | -- | -- | 0.016 | -- | -- |
| b | 0.22 | 0.30 | 0.38 | 0.009 | 0.012 | 0.015 |

| | | |
|---|---|---|
| e | 0.65 BASIC | 0.026 BASIC |
| $D_2$ | 25.35 | 0.998 |
| $E_2$ | 25.35 | 0.998 |
| TOLERANCES OF FORM AND POSITION | | |
| aaa | 0.25 | 0.010 |
| bbb | 0.20 | 0.008 |
| ccc | 0.13 | 0.005 |

## Pins Definition of QFP 160 Package

| PIN Number | PIN Name | PIN Number | PIN Name | PIN Number | PIN Name | PIN Number | PIN Name |
|---|---|---|---|---|---|---|---|
| 1 | N.C. | 41 | N.C. | 81 | OPIN | 121 | N.C. |
| 2 | N.C. | 42 | SEG[34] | 82 | OPIP | 122 | PRT10[2] |
| 3 | N.C. | 43 | SEG[33] | 83 | OPO | 123 | PRT10[1] |
| 4 | N.C. | 44 | SEG[32] | 84 | DAO | 124 | PRT10[0] |
| 5 | N.C. | 45 | SEG[31] | 85 | VO | 125 | COM[15] |
| 6 | N.C. | 46 | SEG[30] | 86 | VDD | 126 | COM[14] |
| 7 | LCDVX | 47 | SEG[29] | 87 | RSTP_N | 127 | COM[13] |
| 8 | LV1 | 48 | SEG[28] | 88 | FXO | 128 | COM[12] |
| 9 | LV2 | 49 | SEG[27] | 89 | FXI | 129 | COM[11] |
| 10 | LCDGS | 50 | SEG[26] | 90 | TSTP_P | 130 | COM[10] |
| 11 | LC3A | 51 | SEG[25] | 91 | SXO | 131 | COM[9] |
| 12 | SEG[63] | 52 | SEG[24] | 92 | SXI | 132 | COM[8] |
| 13 | SEG[62] | 53 | SEG[23] | 93 | GND | 133 | COM[7] |
| 14 | SEG[61] | 54 | SEG[22] | 94 | KEYTONE | 134 | COM[6] |
| 15 | SEG[60] | 55 | SEG[21] | 95 | SDO | 135 | COM[5] |
| 16 | SEG[59] | 56 | SEG[20] | 96 | MUTE | 136 | COM[4] |
| 17 | SEG[58] | 57 | SEG[19] | 97 | DTMFO | 137 | COM[3] |
| 18 | SEG[57] | 58 | SEG[18] | 98 | LOADER | 138 | COM[2] |
| 19 | SEG[56] | 59 | SEG[17] | 99 | PRTD[7] | 139 | COM[1] |
| 20 | SEG[55] | 60 | SEG[16] | 100 | PRTD[6] | 140 | COM[0] |
| 21 | SEG[54] | 61 | SEG[15] | 101 | PRTD[5] | 141 | LR4 |
| 22 | SEG[53] | 62 | SEG[14] | 102 | PRTD[4] | 142 | LR3 |
| 23 | SEG[52] | 63 | SEG[13] | 103 | VPP | 143 | LR2 |
| 24 | SEG[51] | 64 | SEG[12] | 104 | PRTD[3] | 144 | LR1 |
| 25 | SEG[50] | 65 | SEG[11] | 105 | PRTD[2] | 145 | LR0 |
| 26 | SEG[49] | 66 | SEG[10] | 106 | PRTD[1] | 146 | LVG |
| 27 | SEG[48] | 67 | SEG[9] | 107 | PRTD[0] | 147 | LVF |
| 28 | SEG[47] | 68 | SEG[8] | 108 | PRTC[7] | 148 | LC1 |
| 29 | SEG[46] | 69 | SEG[7] | 109 | PRTC[6] | 149 | LC2 |
| 30 | SEG[45] | 70 | SEG[6] | 110 | PRTC[5] | 150 | LV5 |
| 31 | SEG[44] | 71 | SEG[5] | 111 | PRTC[4] | 151 | LV4 |
| 32 | SEG[43] | 72 | SEG[4] | 112 | PRTC[3] | 152 | LV3 |
| 33 | SEG[42] | 73 | SEG[3] | 113 | PRTC[2] | 153 | LCDVTB |
| 34 | SEG[41] | 74 | SEG[2] | 114 | PRTC[1] | 154 | LC4B |
| 35 | SEG[40] | 75 | SEG[1] | 115 | PRTC[0] | 155 | LC4A |
| 36 | SEG[39] | 76 | SEG[0] | 116 | PRT10[7] | 156 | LC3B |
| 37 | SEG[38] | 77 | GND_PWM:G | 117 | PRT10[6] | 157 | LC1A |
| 38 | SEG[37] | 78 | PWM | 118 | PRT10[5] | 158 | LC1B |
| 39 | SEG[36] | 79 | PWMN | 119 | PRT10[4] | 159 | LC2A |
| 40 | SEG[35] | 80 | PWMP | 120 | PRT10[3] | 160 | LC2B |

N.C. : No connection

# L. DC/AC Characteristics

## Absolute Maximum Rating

| Item | Symbol | 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 | $T_{op}$ | $0^0$C ~ $70^0$C | |
| Storage Temperature | $T_{st}$ | $-50^0$C ~ $100^0$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 | $F_{max}$ | 8 MHz | $V_{dd}$ = 5.0V |
| | | 4 MHz | $V_{dd}$ = 2.4V |
| Operating Temperature | $T_{op}$ | $0^0$C ~ $70^0$C | |
| Storage Temperature | $T_{st}$ | $-50^0$C ~ $100^0$C | |

**Testing condition: TEMP=25℃, VDD=3V±10%, GND=0V**

| SYM. | PARAMETER | ITEMS | 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<br>LCD Disable | | 6 | 9 | μA |
| $I_{Idle}$ | IDLE Mode Current | System | 32.769K X'tal<br>LCD Disable | | 4 | 7 | μA |
| $I_{LCD}$ | Extra Current if LCD ON | System | LCD Enable | | 2 | 3 | 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 |
| $I_{oVO}$ | 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=2/3$V_{DD}$ (input from low to high)<br>Threshold=1/3$V_{DD}$ (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 |
| $I_{oL\_2}$ | Output Sink Current | PRTD[3:0] | $V_{oL}$=0.4V | 5.0 | | | 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 Specification ➔ for Push-Pull I/O port only
Sink Current Specification ➔ for both Push-Pull and Open-Drain I/O port.
*2: This Spec. bases on one driver only. There are five build-in drivers actually, so user can multiply the number of driver to obtain the necessary driver current to drive the speak.
(**$I_{PWM}$** * N; N=0, 1, 2, 3, 4, 5)

# M. OTP Programming

User can use the EZ_writer to program the HE8P480 OTP ROM through the programming pins which are shared with I/O PRTD and the functions are descript as below.

| Pin Name | Function |
|---|---|
| VPP | Apply 12V to write the OTP ROM, and 5V to normal operation |
| LOADER | Used to program the OTP ROM |
| PRTD7/SDO | I/O port / WAKEUP / INT/ SDO: Series Data Output |
| PRTD6/SDI | I/O port / WAKEUP / INT/ SDI: Series Data Input |
| PRTD5/SCK | I/O port / WAKEUP / SCK: Series Clock |
| PRTD4/D_Cn | I/O port / WAKEUP /D_Cn: data or command |
| PRTD3/R_Wn | I/O port / WAKEUP /R_Wn: Read or Write |
| PRTD2/P_Sn | I/O port / WAKEUP /P_Sn: Parallel or Series |

# N. Application Note

When the HE8P480 is used to emulate the HE83R141 and HE83R142, the power consumption of HE8P480 will have about 100uA larger than the mask type HE83R141 and HE83R142 if the LCD display is turned on and the 1/5 bias + regulator are set in the mask option of HE8P480.

The HE8P480 can operate on 4MHz correctly only when the power supply is above 2.5V. and the mask type chip don’t have this problem.

# O. Updated Record

| Version | Date | Original Content | New Content |
|---|---|---|---|
| 1.0 | 2002/10/30 | Original | |
| 1.1 | 2002/11/07 | Without LV3 | Add a capacitor to LV3 |
| 1.11 | 2002/11/18 | LVG and LR0 | Remove the VDD which is tired to variable resistor. |
| 1.12 | 2002/11/29 | | The SEG[15:8] of HE83R141 & HE83R142's exist |
| 1.13 | 2003/03/26 | HE83124 SEG and I/O configuration. | HE83124 don't have SEG and I/O sharing. |
| 1.14 | 2003/05/07 | Page 12, 17 for HE83131, HE83135,6 | HE83131 with LR0 and HE83135,6 with DAO |
| | | | |