

4-Bit Micro-Controller With EPROM, 1K Word

Features

- Very low current dissipation.
- Wide operating voltage range.
- Supports both Ag and Li batteries.
- Powerful instruction set.
- 4-level subroutine nesting (including interrupt).
- 4 event-driven interrupts, 2 external and 2 internal.
- ROM size: 1024x15 bits.
- RAM size: 64x4 bits.
- Input ports: 2 ports/ 8 pins (S and M).
- Output port: 1 port/ 4 pins (P).
- Pseudo serial output port (P).
- Input/Output ports: 2 ports/ 8 pins (I/OA and I/OB).
- Control outputs: ALARM, LIGHT.
- LCD driver outputs (can drive up to 75 LCD segments).
- PROM option to select 4 LCD drive modes: static, duplex (1/2 duty 1/2 bias, 1/3 duty 1/2 bias or 1/3 duty 1/3 bias).
- PROM option permits LCD driver output pins to be used for DC output ports; up to 25 pins are available.
- Segment PLA circuit permits any layout on LCD panel.
- Built-in clock generator (crystal or RC).
- Built-in voltage doubler, halver, tripler.
- Endurance: More then 100 write cycles/word.
- Security bit for read/write protection.

General Description

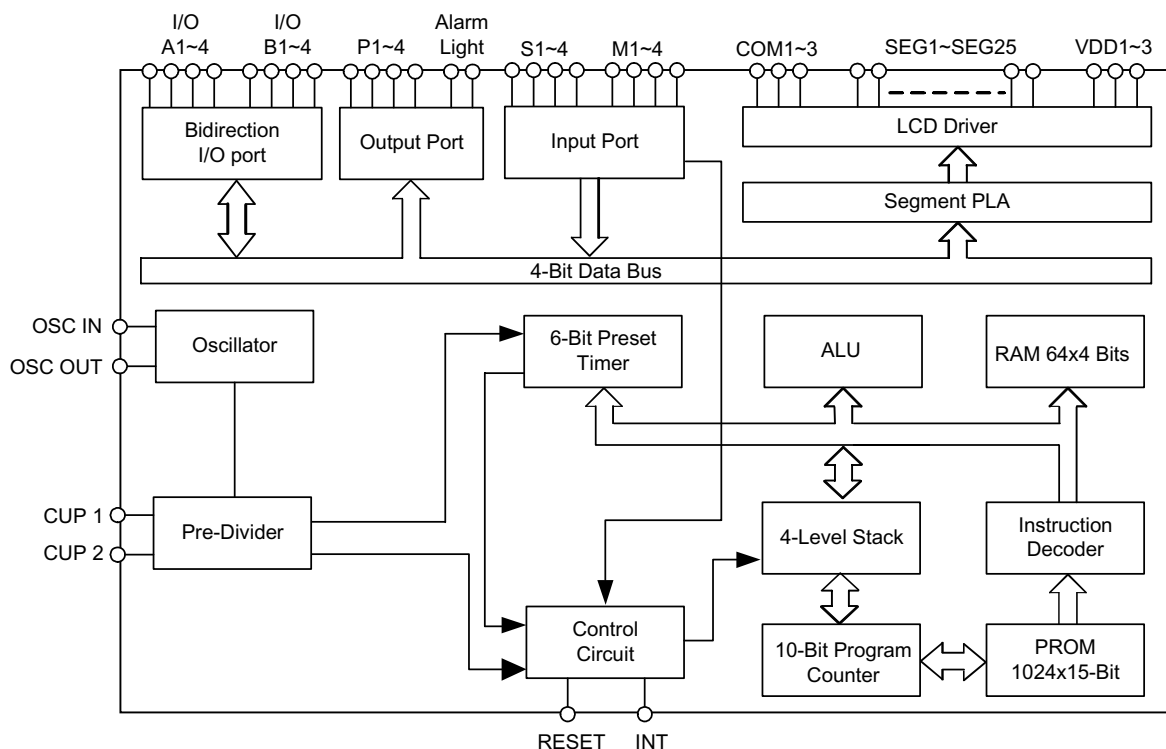
The APU4003T is an EEPROM-equipped high- performance 4-bit microcomputer.

It contains not only all functions compatible with APU4003T, but also an EEPROM, providing customers such conveniences as on-board verification,

customized code, small quantity sample production, etc.

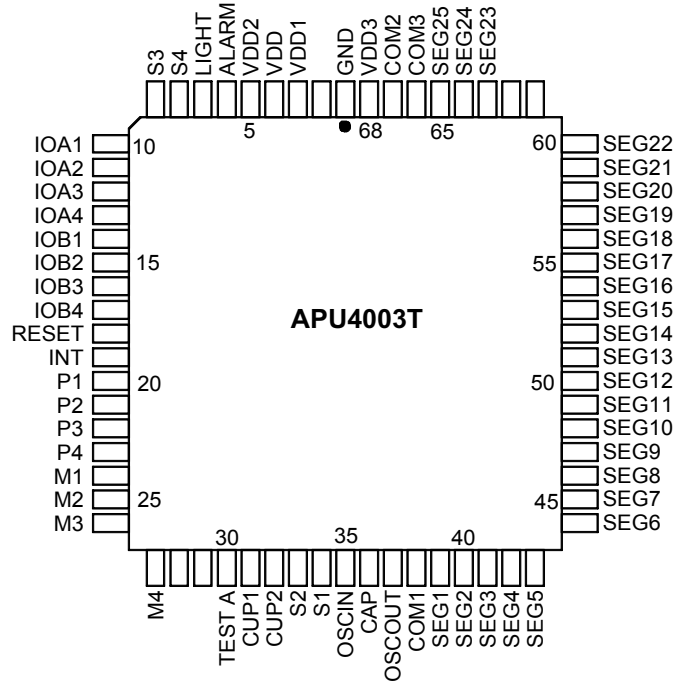
This chip especially provides a security bit to protect the customer's code.

Block Diagram



Package Information

Package type 68Pin PLCC



Pin/Pad Assignment

Unit: μm

| Pin No. | Name | Pin No. | Name | Pin No. | Name | Pin No. | Name |
|---------|-------|---------|-------|---------|--------|---------|-------|
| 1 | VSS | 18 | RESET | 35 | OSCIN | 52 | SEG14 |
| 2 | ----- | 19 | INT | 36 | CAP | 53 | SEG15 |
| 3 | VDD1 | 20 | P1 | 37 | OSCOUT | 54 | SEG16 |
| 4 | VDD | 21 | P2 | 38 | COM1 | 55 | SEG17 |
| 5 | VDD2 | 22 | P3 | 39 | SEG1 | 56 | SEG18 |
| 6 | ALARM | 23 | P4 | 40 | SEG2 | 57 | SEG19 |
| 7 | LIGHT | 24 | M1 | 41 | SEG3 | 58 | SEG20 |
| 8 | S4 | 25 | M2 | 42 | SEG4 | 59 | SEG21 |
| 9 | S3 | 26 | M3 | 43 | SEG5 | 60 | SEG22 |
| 10 | IOA1 | 27 | M4 | 44 | SEG6 | 61 | ----- |
| 11 | IOA2 | 28 | ----- | 45 | SEG7 | 62 | ----- |
| 12 | IOA3 | 29 | ----- | 46 | SEG8 | 63 | SEG23 |
| 13 | IOA4 | 30 | TESTA | 47 | SEG9 | 64 | SEG24 |
| 14 | IOB1 | 31 | CUP1 | 48 | SEG10 | 65 | SEG25 |
| 15 | IOB2 | 32 | CUP2 | 49 | SEG11 | 66 | COM3 |
| 16 | IOB3 | 33 | S2 | 50 | SEG12 | 67 | COM2 |
| 17 | IOB4 | 34 | S1 | 51 | SEG13 | 68 | VDD3 |

Pin Name Description

| Name | Type | Description |
|---------|------|--|
| OSCIN | I | Typical crystal(32.768KHz) is connected across OSCIN/OSCOUT for oscillation; R/C oscillation mode is also available. |
| OSCOUT | O | |
| S1~4 | I | Input ports with chattering eliminator option for CK10 (32ms), CK8 (8ms) & CK6 (2ms). |
| M1~4 | I | |
| P1~4 | O | Output ports. |
| IOA1~4 | I/O | Input/Output ports. |
| IOB1~4 | I/O | Input/Output ports. |
| INT | I | External interrupt request control input pin. |
| RESET | I | System reset pin. |
| LIGHT | O | Output only for outputting the signal to drive the transistor for light. |
| ALARM | O | Output only for outputting the 4kHz/2kHz/1kHz modulation signal. Also can be used to output the non-modulation signal. |
| VDD | | (+)Power supply pin. |
| VDD1 | | * For Ag version, apply (+) side to VDD & VDD1 together. |
| VDD2 | | For other than Ag version, apply (+) side to VDD & VDD2 together. |
| VDD3 | | Power supply pin for LCD driver power supply. |
| VSS | | (-)Power supply pin. |
| CUP1~2 | O | Pins for connecting the voltage step-up (step-down) capacitor. |
| COM1~3 | O | Output pins for LCD panel common plate. |
| SEG1~25 | O | Output pins for LCD panel segments. |

Absolute Maximum Rating

Ta = 0 to 70°C

| Name | Symbol | Rating | Unit |
|-------------------------------|-------------|-----------------------|------|
| Maximum Supply Voltage | $V_{SS1/2}$ | -0.3 ~ +5.5 | V |
| | V_{SS3} | -0.3 ~ +8.5 | V |
| Maximum Input Voltage | V_{IN1} | -0.3 to $V_{DD}+0.3$ | V |
| Maximum Output Voltage | V_{OUT1} | -0.3 to $V_{DD1}+0.3$ | V |
| | V_{OUT2} | -0.3 to $V_{DD2}+0.3$ | V |
| | V_{OUT3} | -0.3 to $V_{DD3}+0.3$ | V |
| Maximum Operating Temperature | t_{OPG} | 0 to +70 | °C |
| Maximum Storage Temperature | t_{STG} | -25 to +125 | °C |

Allowable operating conditions

Ta = 0 to 70°C

| Name | Symbol | Condition | Min. | Max. | Unit |
|-------------------|------------|------------------------|--------------|--------------|------|
| Supply Voltage | V_{DD1} | External Voltage Mode | 2.0 | 5.5 | V |
| | V_{DD2} | | 4.0 | 5.5 | V |
| | V_{DD3} | | 4.0 | 8.25 | V |
| Supply Voltage | V_{DD1} | Ag & Li Battery Mode | 1.3 | 5.5 | V |
| | V_{DD2} | | 2.6 | 5.5 | V |
| | V_{DD3} | | 2.6 | 8.25 | V |
| Input "H" Voltage | V_{IH1} | All Input Except OSCIN | $0.7V_{DDO}$ | V_{DDO} | V |
| Input "L" Voltage | V_{IL1} | | 0 | $0.3V_{DDO}$ | V |
| Input "H" Voltage | V_{IH2} | OSCIN at Ext. RC Mode | $0.8V_{DDO}$ | V_{DDO} | V |
| Input "L" Voltage | V_{IL2} | | 0 | $0.2V_{DDO}$ | V |
| Operating Freq. | f_{OPG1} | Ag Battery Mode | 32 | 32 | kHz |
| | f_{OPG2} | Li Battery Mode | 32 | 100 | kHz |
| | f_{OPG3} | External Voltage Mode | 32 | 3580 | kHz |
| | f_{OPG4} | External RC Mode | 32 | 5000 | kHz |

Electrical Characteristics

Ta=0 to 70°C

Input resistance

| Name | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-------------------------------|---------------------|--|------|------|------|------|
| "L"-Level Hold t _R | R _{I IH1} | V _I =0.2V _{DD1} , #1 | 10 | 40 | 100 | kΩ |
| | R _{I IH2} | V _I =0.2V _{DD2} , #2 | 10 | 40 | 100 | kΩ |
| | R _{I IH3} | V _I =0.3V _{DD2} , #3 | 5 | 20 | 50 | kΩ |
| M/S Pull-Down t _R | R _{M SD1} | V _I =V _{DD1} , #1 | 200 | 500 | 1000 | kΩ |
| | R _{M SD2} | V _I =V _{DD2} , #2 | 200 | 500 | 1000 | kΩ |
| | R _{M SD3} | V _I =V _{DD2} , #3 | 100 | 250 | 500 | kΩ |
| INT Pull-Up t _R | R _{I NTU1} | V _I =V _{SS} , #1 | 200 | 500 | 1000 | kΩ |
| | R _{I NTU2} | V _I =V _{SS} , #2 | 200 | 500 | 1000 | kΩ |
| | R _{I NTU3} | V _I =V _{SS} , #3 | 100 | 250 | 500 | kΩ |
| INT Pull-Down t _R | R _{I NTD1} | V _I =V _{DD1} , #1 | 200 | 500 | 1000 | kΩ |
| | R _{I NTD2} | V _I =V _{DD2} , #2 | 200 | 500 | 1000 | kΩ |
| | R _{I NTD3} | V _I =V _{DD2} , #3 | 100 | 250 | 500 | kΩ |
| RES Pull-Down t _R | R _{R ES1} | V _I =V _{DD} or V _{SS1} , #1 | 5 | 20 | 50 | kΩ |
| | R _{R ES2} | V _I =V _{DD} or V _{SS2} , #2 | 5 | 20 | 50 | kΩ |
| | R _{R ES3} | V _I =V _{DD} or V _{SS2} , #3 | 5 | 20 | 50 | kΩ |

Note: #1: V_{DD1}= 1.3V (Ag), #2: V_{DD2}= 2.6V (Li), #3: V_{DD2}= 4.5V (ExtV).

DC output characteristics

| Name | Symbol | Condition | For | Min. | Typ. | Max. | Unit |
|--------------------|--------------------|-----------------------------|--------------------|------|------|------|------|
| Output "H" Voltage | V _{O H1a} | I _{OH} =-200μA, #1 | Alarm Light | 0.9 | 1.1 | | V |
| | V _{O H2a} | I _{OH} =-1mA, #2 | | 1.8 | 2.1 | | V |
| | V _{O H3a} | I _{OH} =-3mA, #3 | | 3.0 | 3.5 | | V |
| Output "L" Voltage | V _{O L1a} | I _{OL} =400μA, #1 | P-port IOA-n IOB-n | | 0.3 | 0.5 | V |
| | V _{O L2a} | I _{OL} =2mA, #2 | | | 0.6 | 1 | V |
| | V _{O L3a} | I _{OL} =6mA, #3 | | | 1.0 | 1.5 | V |
| Output "H" Voltage | V _{O H1b} | I _{OH} =-100μA, #1 | P-port IOA-n IOB-n | 0.9 | 1.1 | | V |
| | V _{O H2b} | I _{OH} =-500μA, #2 | | 1.8 | 2.1 | | V |
| | V _{O H3b} | I _{OH} =-1.5mA, #3 | | 3.0 | 3.5 | | V |
| Output "L" Voltage | V _{O L1b} | I _{OL} =200μA, #1 | P-port IOA-n IOB-n | | 0.3 | 0.5 | V |
| | V _{O L2b} | I _{OL} =1mA, #2 | | | 0.6 | 1 | V |
| | V _{O L3b} | I _{OL} =3mA, #3 | | | 1.0 | 1.5 | V |

Note: #1: V_{DD1}= 1.3V (Ag), #2: V_{DD2}= 2.6V (Li), #3: V_{DD2}= 4.5V (ExtV).

Segment driver output characteristics

| Name | Symbol | Condition | For | Min. | Typ. | Max. | Unit |
|----------------------------|--------------------|-------------------------------|-------|------|------|------|------|
| DC output mode | | | | | | | |
| Output "H" Voltage | V _{O H1c} | I _{OH} =-10μA, #1 | SEG-n | 0.9 | 1.1 | | V |
| | V _{O H2c} | I _{OH} =-50μA, #2 | | 1.8 | 2.1 | | V |
| | V _{O H3c} | I _{OH} =-200μA, #3 | | 3.0 | 3.5 | | V |
| Output "L" Voltage | V _{O L1c} | I _{OL} =20μA, #1 | SEG-n | | 0.3 | 0.5 | V |
| | V _{O L2c} | I _{OL} =100μA, #2 | | | 0.6 | 1 | V |
| | V _{O L3c} | I _{OL} =400μA, #3 | | | 1.0 | 1.5 | V |
| Static display mode | | | | | | | |
| Output "H" Voltage | V _{O H2d} | I _{OH} =-1μA, #1, #2 | SEG-n | 2.5 | | | V |
| | V _{O H3d} | I _{OH} =-1μA, #3 | | 4.3 | | | V |
| Output "L" Voltage | V _{O L2d} | I _{OL} =1μA, #1, #2 | SEG-n | | | 0.2 | V |
| | V _{O L3d} | I _{OL} =1μA, #3 | | | | 0.2 | V |

| Name | Symbol | Condition | For | Min. | Typ. | Max. | Unit |
|---|--------------------|---------------------------------|-------|------|------|------|------|
| Output "H" Voltage | V _{OH2e} | I _{OH} =-10μA, #1, #2 | COM-n | 2.5 | | | V |
| | V _{OH3e} | I _{OH} =-10μA, #3 | | 4.3 | | | V |
| Output "L" Voltage | V _{OL2e} | I _{OL} =10μA, #1, #2 | | | | 0.2 | V |
| | V _{OL3e} | I _{OL} =10μA, #3 | | | | 0.2 | V |
| Duplex (1/2 bias, 1/2 duty) display mode | | | | | | | |
| Output "H" Voltage | V _{OH12f} | I _{OH} =-1μA, #1, #2 | SEG-n | 2.4 | | | V |
| | V _{OH3f} | I _{OH} =-1μA, #3 | | 4.3 | | | V |
| Output "L" Voltage | V _{OL12f} | I _{OL} =1μA, #1, #2 | | | | 0.2 | V |
| | V _{OL3f} | I _{OL} =1μA, #3 | | | | 0.2 | V |
| Output "H" Voltage | V _{OH12g} | I _{OH} =-10μA, #1, #2 | COM-n | 2.4 | | | V |
| | V _{OH3g} | I _{OH} =-10μA, #3 | | 4.3 | | | V |
| Output "M" Voltage | V _{OM12g} | I _{OIH} =±10μA, #1, #2 | | 1.1 | | 1.5 | V |
| | V _{OM3g} | I _{OIH} =±10μA, #3 | | 2.05 | | 2.45 | V |
| Output "L" Voltage | V _{OL12g} | I _{OL} =10μA, #1 | | | 0.2 | V | |
| | V _{OL3g} | I _{OL} =10μA, #3 | | | 0.2 | V | |
| 1/2 bias, 1/3duty display mode | | | | | | | |
| Output "H" Voltage | V _{OH12h} | I _{OH} =-1μA, #1, #2 | SEG-n | 2.4 | | | V |
| | V _{OH3h} | I _{OH} =-1μA, #3 | | 4.3 | | | V |
| Output "L" Voltage | V _{OL12h} | I _{OL} =1μA, #1, #2 | | | | 0.2 | V |
| | V _{OL3h} | I _{OL} =1μA, #3 | | | | 0.2 | V |
| Output "H" Voltage | V _{OH12i} | I _{OH} =-10μA, #1, #2 | COM-n | 2.4 | | | V |
| | V _{OH3i} | I _{OH} =-10μA, #3 | | 4.3 | | | V |
| Output "M" Voltage | V _{OM12i} | I _{OIH} =±10μA, #1, #2 | | 1.1 | | 1.5 | V |
| | V _{OM3i} | I _{OIH} =±10μA, #3 | | 2.05 | | 2.45 | V |
| Output "L" Voltage | V _{OL12i} | I _{OL} =10μA, #1, #2 | | | 0.2 | V | |
| | V _{OL3i} | I _{OL} =10μA, #3 | | | 0.2 | V | |
| 1/3bias, 1/3duty display mode | | | | | | | |
| Output "H" Voltage | V _{OH12j} | I _{OH} =-1μA, #1, #2 | SEG-n | 3.85 | | | V |
| | V _{OH3j} | I _{OH} =-1μA, #3 | | 6.55 | | | V |
| Output "M1" Voltage | V _{OM12j} | I _{OIH} =±1μA, #1, #2 | | 2.9 | | 2.4 | V |
| | V _{OM13j} | I _{OIH} =±1μA, #1, #2 | | 4.7 | | 4.3 | V |
| Output "M2" Voltage | V _{OM22j} | I _{OIH} =±1μA, #1, #2 | 1.1 | | 1.5 | V | |
| | V _{OM23j} | I _{OIH} =±1μA, #1, #2 | 2.05 | | 2.45 | V | |
| Output "L" Voltage | V _{OL2j} | I _{OL} =1μA, #2 | | | 0.2 | V | |
| | V _{OL3j} | I _{OL} =1μA, #3 | | | 0.2 | V | |
| Output "H" Voltage | V _{OH2k} | I _{OH} =-10μA, #2 | COM-n | 3.85 | | | V |
| | V _{OH3k} | I _{OH} =-10μA, #3 | | 6.55 | | | V |
| Output "M1" Voltage | V _{OM12k} | I _{OIH} =±10μA, #1, #2 | | 2.9 | | 2.4 | V |
| | V _{OM13k} | I _{OIH} =±10μA, #3 | | 4.7 | | 4.3 | V |
| Output "M2" Voltage | V _{OM22k} | I _{OIH} =±10μA, #1, #2 | 1.1 | | 1.5 | V | |
| | V _{OM23k} | I _{OIH} =±10μA, #3 | 2.05 | | 2.45 | V | |
| Output "L" Voltage | V _{OL2k} | I _{OL} =10μA, #2 | | | 0.2 | V | |
| | V _{OL3k} | I _{OL} =10μA, #3 | | | 0.2 | V | |

Note: #1: V_{SS1}= -1.2V (Ag), #2: V_{SS2}= -2.4V (Li), #3: V_{SS2}= -4V (ExtV).

Instruction Table

| Instruction | Machine Code | Function | Remark | Flag |
|-------------|--------------------|-----------------------------|----------------|------|
| NOP | 000 0000 0000 0000 | No Operation | | |
| LCT Ly,Rx | 000 00YY YYXX XXXX | (Ly) ← (Rx) | Ly=000- No Use | |
| OPA Rx | 000 0100 01XX XXXX | Port(A) ← (Rx) | | |
| LCB Ly,Rx | 000 01YY YYXX XXXX | (Ly) ← (Rx) | Ly=000- No Use | |
| OPB Rx | 000 1000 01XX XXXX | Port(B) ← (Rx) | | |
| LCP Ly,Rx | 000 10YY YYXX XXXX | abcd,efgh ← (Rx),(AC) | LY=000- No Use | |
| MRA Rx | 000 1101 01XX XXXX | CF ← Rx3 | | |
| OPP Rx | 000 1110 00XX XXXX | Port(P) ← (Rx) | | |
| OPP S Rx | 000 1110 1DXX XXXX | P1,2,3,4 ← Rx0,Rx1,D,Pulse | | |
| ADC Rx | 001 0000 00XX XXXX | (AC) ← (Rx)+(AC)+(CF) | | CF |
| ADC* Rx | 001 0000 10XX XXXX | (AC),(Rx) ← (Rx)+(AC)+(CF) | | CF |
| SBC Rx | 001 0001 00XX XXXX | (AC) ← (Rx)+(AC)B+(CF) | | CF |
| SBC* Rx | 001 0001 10XX XXXX | (AC),(Rx) ← (Rx)+(AC)B+(CF) | | CF |
| ADD Rx | 001 0010 00XX XXXX | (AC) ← (Rx)+(AC) | | CF |
| ADD* Rx | 001 0010 10XX XXXX | (AC),(Rx) ← (Rx)+(AC) | | CF |
| SUB Rx | 001 0011 00XX XXXX | (AC) ← (Rx)+(AC)B+1 | | CF |
| SUB* Rx | 001 0011 10XX XXXX | (AC),(Rx) ← (Rx)+(AC)B+1 | | CF |
| ADN Rx | 001 0100 00XX XXXX | (AC) ← (Rx)+(AC) | | |
| ADN* Rx | 001 0100 10XX XXXX | (AC),(Rx) ← (Rx)+(AC) | | |
| AND Rx | 001 0101 00XX XXXX | (AC) ← (Rx) AND (AC) | | |
| AND* Rx | 001 0101 10XX XXXX | (AC),(Rx) ← (Rx) AND (AC) | | |
| EOR Rx | 001 0110 00XX XXXX | (AC) ← (Rx) EOR (AC) | | |
| EOR* Rx | 001 0110 10XX XXXX | (AC),(Rx) ← (Rx) EOR (AC) | | |
| OR Rx | 001 0111 00XX XXXX | (AC) ← (Rx) OR (AC) | | |
| OR* Rx | 001 0111 10XX XXXX | (AC),(Rx) ← (Rx) OR (AC) | | |
| ADCI Ry,D | 001 1000 0DDD DYYY | (AC) ← (Ry)+(D)+(CF) | | CF |
| ADCI* Ry,D | 001 1000 1DDD DYYY | (AC),(Ry) ← (Ry)+(D)+(CF) | | CF |
| SBCI Ry,D | 001 1001 0DDD DYYY | (AC) ← (Ry)+(D)B+(CF) | | CF |
| SBCI* Ry,D | 001 1001 1DDD DYYY | (AC),(Ry) ← (Ry)+(D)B+(CF) | | CF |
| ADDI Ry,D | 001 1010 0DDD DYYY | (AC) ← (Ry)+(D) | | CF |
| ADDI* Ry,D | 001 1010 1DDD DYYY | (AC),(Ry) ← (Ry)+(D) | | CF |
| SUBI Ry,D | 001 1011 0DDD DYYY | (AC) ← (Ry)+(D)B+1 | | CF |
| SUBI* Ry,D | 001 1011 1DDD DYYY | (AC),(Ry) ← (Ry)+(D)B+1 | | CF |
| ADNI Ry,D | 001 1100 0DDD DYYY | (AC) ← (Ry)+(D) | | |
| ADNI* Ry,D | 001 1100 1DDD DYYY | (AC),(Ry) ← (Ry)+(D) | | |
| ANDI Ry,D | 001 1101 0DDD DYYY | (AC) ← (Ry) AND (D) | | |
| ANDI* Ry,D | 001 1101 1DDD DYYY | (AC),(Ry) ← (Ry) AND (D) | | |
| EORI Ry,D | 001 1110 0DDD DYYY | (AC) ← (Ry) EOR (D) | | |
| EORI* Ry,D | 001 1110 1DDD DYYY | (AC),(Ry) ← (Ry) EOR (D) | | |
| ORI Ry,D | 001 1111 0DDD DYYY | (AC) ← (Ry) OR (D) | | |
| ORI* Ry,D | 001 1111 1DDD DYYY | (AC),(Ry) ← (Ry) OR (D) | | |
| IPS Rx | 010 0000 00XX XXXX | (AC),(Rx) ← Port(S) | | |
| IPM Rx | 010 0000 10XX XXXX | (AC),(Rx) ← Port(M) | | |
| IPA Rx | 010 0001 00XX XXXX | (AC),(Rx) ← Port(A) | | |
| IPA* Rx | 010 0001 01XX XXXX | (AC),(Rx) ← Port(A) | I/OA ← I/P | |
| IPB Rx | 010 0001 10XX XXXX | (AC),(Rx) ← Port(B) | | |

| Instruction | Machine Code | Function | Remark | Flag |
|--------------|-----------------------|---|---|----------------------|
| IPB* Rx | 010 0001 11XX XXXX | (AC),(Rx) ← Port(B) | I/OB ← I/P | |
| MSB Rx | 010 0010 00XX XXXX | (AC),(Rx) ← STS2 | B0: BCF B1: SCF1(MPT) B2: SCF2(HRF) B3: SCF3(SPT) | |
| STA Rx | 010 0010 10XX XXXX | (Rx) ← (AC) | | |
| SR0 Rx | 010 0011 00XX XXXX | ACn, Rxn ← Rx(n+1) AC3, Rx3 ← 0 | | |
| SR1 Rx | 010 0011 01XX XXXX | ACn, Rxn ← (Rx(n+1)) AC3, Rx3 ← 1 | | |
| SL0 Rx | 010 0011 10XX XXXX | ACn, Rxn ← Rx(n-1) AC0, Rx0 ← 0 | | |
| SL1 Rx | 010 0011 11XX XXXX | ACn, Rxn ← Rx(n-1) AC0, Rx0 ← 1 | | |
| LDS Rx,D | 010 01DD DDXX XXXX | (AC),(Rx) ← (D) | | |
| MSC Rx | 011 0000 00XX XXXX | (AC),(Rx) ← STS3 | B0: SCF4(INT) B1: SCF5(TMR) B2: PH15 B3: SCF7(PDV) | |
| MAF Rx | 011 0001 00XX XXXX | (AC),(Rx) ← STS1 | TF2: ZERO TF3: CF | |
| LDA Rx | 011 0111 10XX XXXX | (AC) ← (Rx) | | |
| MRW Ry,Rx | 011 100Y YYXX XXXX | (AC),(Ry) ← (Rx) | | |
| MWR Rx,Ry | 011 110Y YYXX XXXX | (AC),(Rx) ← (Ry) | | |
| JB0 X | 100 00XX XXXX XXXX | (PC) ← X | if (AC0)=1 | |
| JB1 X | 100 01XX XXXX XXXX | (PC) ← X | if (AC1)=1 | |
| JB2 X | 100 10XX XXXX XXXX | (PC) ← X | if (AC2)=1 | |
| JB3 X | 100 11XX XXXX XXXX | (PC) ← X | if (AC3)=1 | |
| JNZ X | 101 00XX XXXX XXXX | (PC) ← X | if (Zero)=0 | |
| JNC X | 101 01XX XXXX XXXX | (PC) ← X | if (CF)=0 | |
| JZ X | 101 10XX XXXX XXXX | (PC) ← X | if (Zero)=1 | |
| JC X | 101 11XX XXXX XXXX | (PC) ← X | if (CF)=1 | |
| JMP X | 110 00XX XXXX XXXX | (PC) ← X | | |
| CALL X | 110 01XX XXXX XXXX | (STACK) ← (PC)+1 (PC ← X) | | |
| RTS | 110 1000 0000 0000 | (PC) ← (STACK) | | |
| SMS X | 111 0000 00X XXXX | SEF4 ← X4 SEF0~3 ← X0~3 | M1~4 Enable S1~4 Enable | SCF1 SCF3 HRF0 |
| TMS X | 111 0010 00XX XXXX | TIMER ← X | | HRF1 |
| SF X | 111 0100 0XX0 XXXX | X6: M-PORT Pull-Low X5: S-PORT Pull-Low X3: HALT After Light X2: LIGHT ON X1: BCF Set X0: CF Set | | BCF CF |
| | | X6: M-PORT Low-L-H X5: S-PORT Low-L-H | | |

| Instruction | Machine Code | Function | Remark | Flag | |
|-------------|--------------------|--|--------|-----------|------|
| RF X | 111 0110 0XX0 0XXX | X2: LIGHT OFF X1: BCF Reset X0: CF Reset | | BCF CF | |
| ALM X | 111 0111 XXXX XXXX | X7,X6 | 0,1 | 1,0 | 1,1 |
| | | Signal | DC | 1K/2K | 4K |
| | | Xn=1 | X5 | X4 | X3 |
| | | Signal | 1Hz | 2Hz | 4Hz |
| | | Xn=1 | X2 | X1 | X0 |
| | | Signal | 8Hz | 16Hz | 32Hz |
| SIE X | 111 1000 XXX0 XXXX | X5~7: HEF1~3 is Enabled X0~3: IEF0~3 is Enabled | | | |
| SIE* X | 111 1010 0000 XXXX | X0~3: IEF0~3 is Enabled | | | |
| PLC X | 111 110X 0000 XXXX | X0~3: Reset HRF0~3 X8: Reset PH11~15 | | | |
| HALT | 111 1111 1111 1111 | | | | |

Symbol description

| | |
|----------------------------------|--------------------------------|
| AC: Accumulator | CF: Carry Flag |
| ACn: Accumulator Bit N | BCF: Backup Flag |
| Rx: Memory of Address X | IEFn: Interrupt Enable Flag |
| Rxn: Memory Bit N of Address X | HEFn: HALT Release Enable Flag |
| Ry: Memory of Working Register Y | HRFn: HALT Release Flag |
| PC: Program Counter | SEFn: Switch Enable Flag |
| X: Address | SCFn: Start Condition Flag |
| D: Immediate Data | Ly: LCD Latch |