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# MSM85C154HVS

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## MSM83C154S Piggy Back

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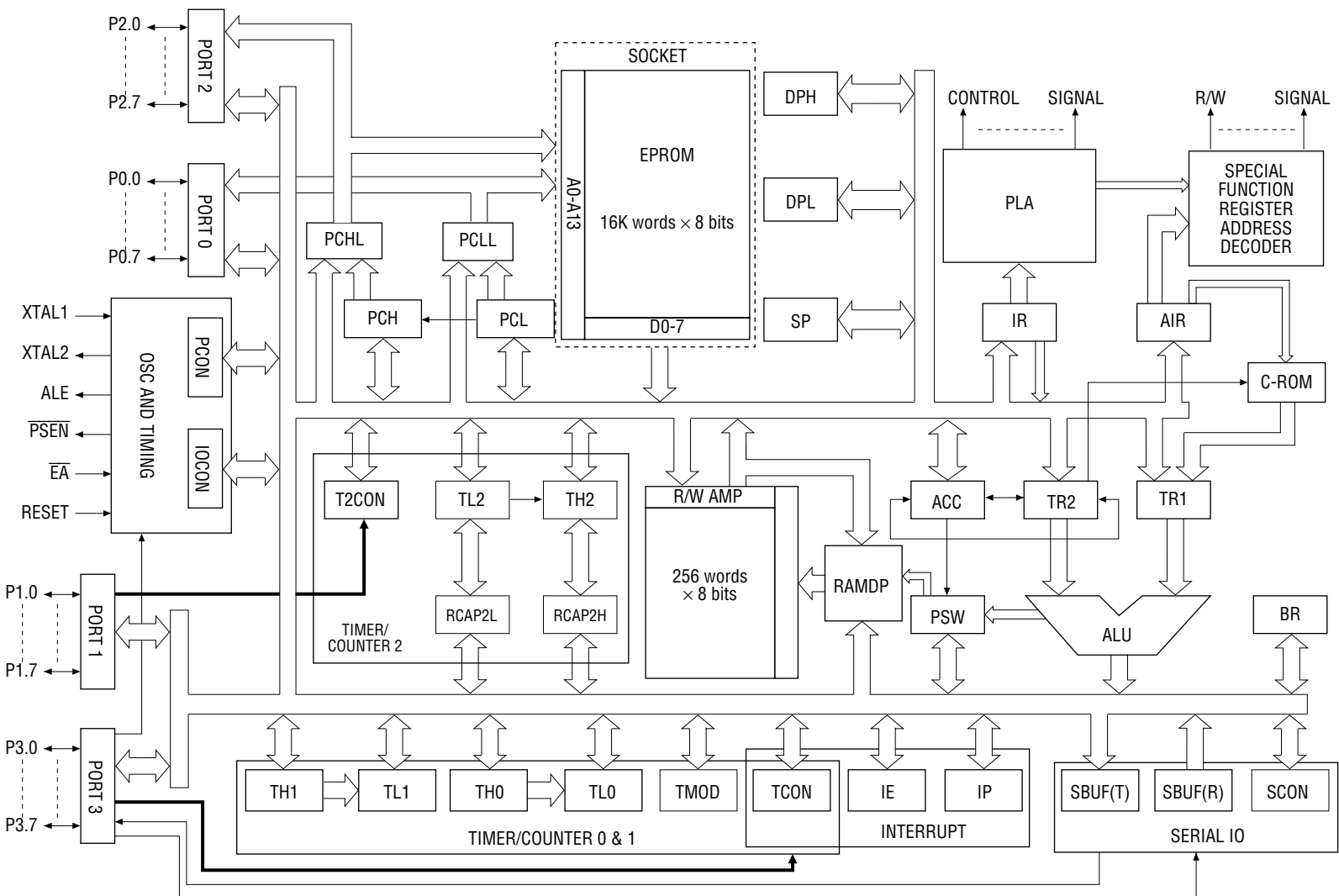
### GENERAL DESCRIPTION

The MSM85C154HVS is an 8-bit microcontroller that has been developed assuming that it is used for evaluation of programs of MSM83C154S. ES (Engineering Sample) only.

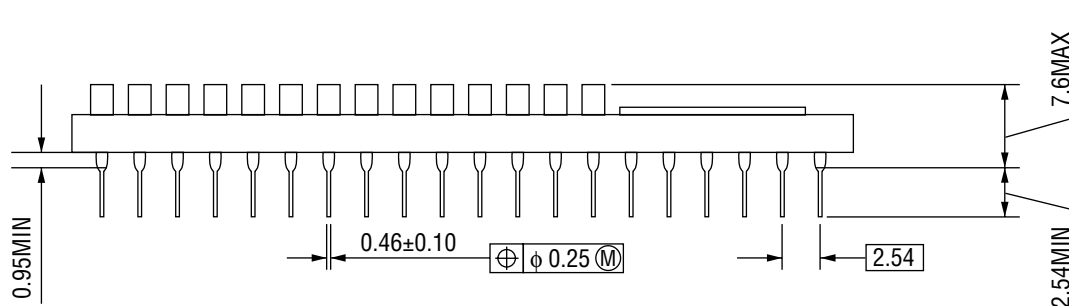
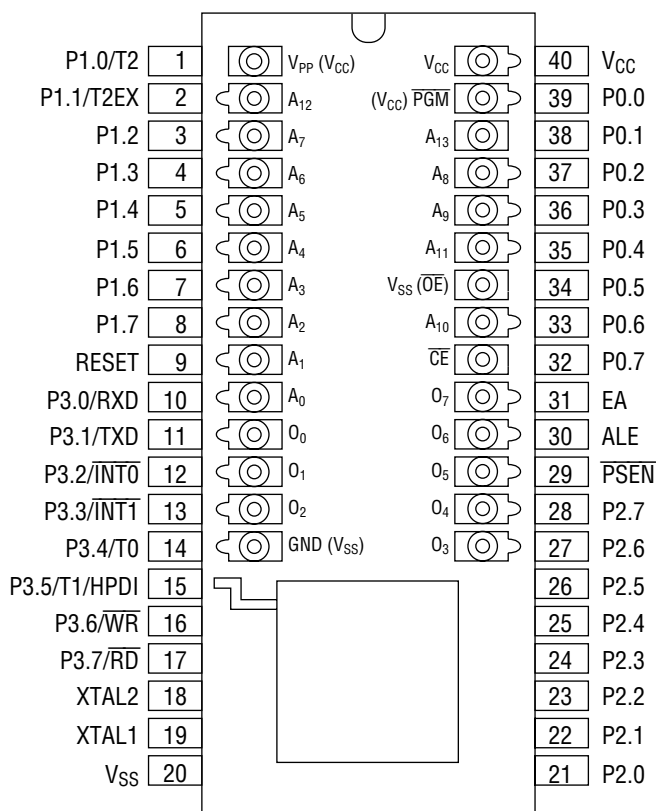
### FEATURES

- Operating range
  - Operating frequency : 1 to 22 MHz (16 to 22 MHz is recommended for program development)
  - Operating voltage : 4.75 to 5.25 V (Use MSM85C154VS for 1 to 16 MHz)
  - Operating temperature : Room temperature
- Fully static circuit
- On-chip program memory : 16K × 8-bit ROM (EPROM)
- On-chip data memory : 256 × 8-bit RAM
- External program memory address space : 64 Kbytes
- External data memory address space : 64 Kbytes
- I/O port
  - (Port 1, 2, 3, impedance programmable) : 4 ports × 8 bits
- 16-bit timer/counters : 3
- Multifunctional serial port
  - : I/O Expansion mode
  - : UART mode (featuring error detection)
- 6-source 2-priority level
- Interrupt and multi-level
  - Interrupt available by programming IP and IE registers
- Memory-mapped special function registers
- Bit addressable data memory and SFRs
- Minimum instruction cycle : 545 ns @ 22 MHz operation
- "Multiply"/"divide" instruction cycle : 2.18 μs @ 22 MHz operation
- Standby functions
  - : Power-down mode (oscillator stop)
  - Activated by software or hardware; providing ports with floating or active status
  - The software power-down set mode is terminated by interrupt signal enabling execution from the interrupted address.
- Package
  - 40-pin ceramic Piggyback (ADIP40-C-600-2.54) (Product name: MSM85C154HVS)

# BLOCK DIAGRAM



# PIN CONFIGURATION (TOP VIEW)



40-Pin Package (Piggy back)

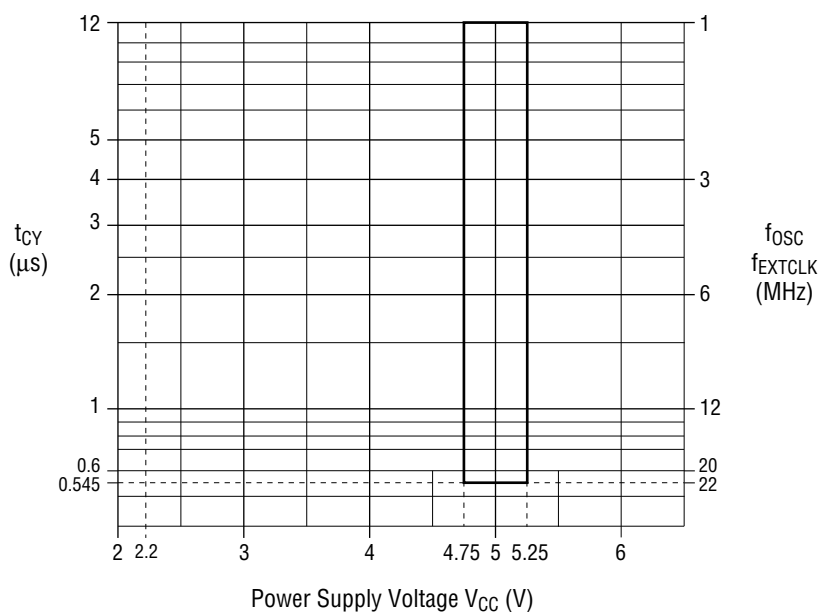
## ABSOLUTE MAXIMUM RATINGS

| Parameter            | Symbol    | Condition                | Rating               | Unit               |
|----------------------|-----------|--------------------------|----------------------|--------------------|
| Power Supply Voltage | $V_{CC}$  | $T_a=25^{\circ}\text{C}$ | -0.5 to 7            | V                  |
| Input Voltage        | $V_I$     | $T_a=25^{\circ}\text{C}$ | -0.5 to $V_{CC}+0.5$ | V                  |
| Storage Temperature  | $T_{STG}$ | —                        | -55 to +150          | $^{\circ}\text{C}$ |

## RECOMMENDED OPERATING CONDITIONS

| Parameter                          | Symbol       | Condition  | Range        | Unit               |
|------------------------------------|--------------|------------|--------------|--------------------|
| Power Supply Voltage               | $V_{CC}$     | See below. | 4.75 to 5.25 | V                  |
| Oscillation Frequency *1           | $V_{OSC}$    | See below. | 1 to 22      | MHz                |
| External Clock Operating Frequency | $f_{EXTCLK}$ | See below. | 0 to 22      | MHz                |
| Ambient Temperature                | $T_a$        | —          | room temp    | $^{\circ}\text{C}$ |

\*1 Depends on the specification for crystal or ceramic resonator.



# ELECTRICAL CHARACTERISTICS

## DC Characteristics

( $V_{CC}=4.75$  to  $5.25V$ ,  $V_{SS}=0V$ ,  $T_a$ =room temp)

| Parameter                                                               | Symbol            | Condition                                      | Min.             | Typ. | Max.             | Unit       | Measuring circuit |
|-------------------------------------------------------------------------|-------------------|------------------------------------------------|------------------|------|------------------|------------|-------------------|
| Input Low Voltage                                                       | $V_{IL}$          | —                                              | -0.5             | —    | $0.2 V_{CC}-0.1$ | V          | 1                 |
| Input High Voltage                                                      | $V_{IH}$          | Except XTAL1, $\overline{EA}$ , and RESET      | $0.2 V_{CC}+0.9$ | —    | $V_{CC}+0.5$     | V          |                   |
| Input High Voltage                                                      | $V_{IH1}$         | XTAL1, RESET and $\overline{EA}$               | $0.7 V_{CC}$     | —    | $V_{CC}+0.5$     | V          |                   |
| Output Low Voltage (PORT 1, 2, 3)                                       | $V_{OL}$          | $I_{OL}=1.6$ mA                                | —                | —    | 0.45             | V          |                   |
| Output Low Voltage (PORT 0, ALE, $\overline{PSEN}$ )                    | $V_{OL1}$         | $I_{OL}=3.2$ mA                                | —                | —    | 0.45             | V          |                   |
| Output High Voltage (PORT 1, 2, 3)                                      | $V_{OH}$          | $I_{OH}=-60$ $\mu A$<br>$V_{CC}=5 V \pm 10\%$  | 2.4              | —    | —                | V          |                   |
|                                                                         |                   | $I_{OH}=-30$ $\mu A$                           | $0.75 V_{CC}$    | —    | —                | V          |                   |
|                                                                         |                   | $I_{OH}=-10$ $\mu A$                           | $0.9 V_{CC}$     | —    | —                | V          |                   |
| Output High Voltage (PORT 0, ALE, $\overline{PSEN}$ )                   | $V_{OH1}$         | $I_{OH}=-400$ $\mu A$<br>$V_{CC}=5 V \pm 10\%$ | 2.4              | —    | —                | V          |                   |
|                                                                         |                   | $I_{OH}=-150$ $\mu A$                          | $0.75 V_{CC}$    | —    | —                | V          |                   |
|                                                                         |                   | $I_{OH}=-40$ $\mu A$                           | $0.9 V_{CC}$     | —    | —                | V          |                   |
| Logical 0 Input Current/<br>Logical 1 Output Current/<br>(PORT 1, 2, 3) | $I_{IL} / I_{OH}$ | $V_I=0.45V$<br>$V_O=0.45V$                     | -5               | -60  | -80              | $\mu A$    | 2                 |
| Logical 1 to 0 Transition Current (PORT 1, 2, 3)                        | $I_{TL}$          | $V_{IL}=2.0V$                                  | —                | -240 | -500             | $\mu A$    |                   |
| Input Leakage Current (PORT 0 floating, $\overline{EA}$ )               | $I_{LI}$          | $V_{SS} < V_I < V_{CC}$                        | —                | —    | $\pm 10$         | $\mu A$    | 3                 |
| RESET Pulldown Resistor                                                 | $R_{RST}$         | —                                              | 20               | 40   | 125              | k $\Omega$ | 2                 |
| Pin Capacitance                                                         | $C_{IO}$          | $T_a=25^\circ C$ , $f=1$ MHz<br>(except XTAL1) | —                | —    | 10               | pF         | —                 |
| Power Down Current                                                      | $I_{PD}$          | —                                              | —                | 1    | 50               | $\mu A$    | 4                 |

**Maximum power supply current normal operation  $I_{CC}$  (mA)**

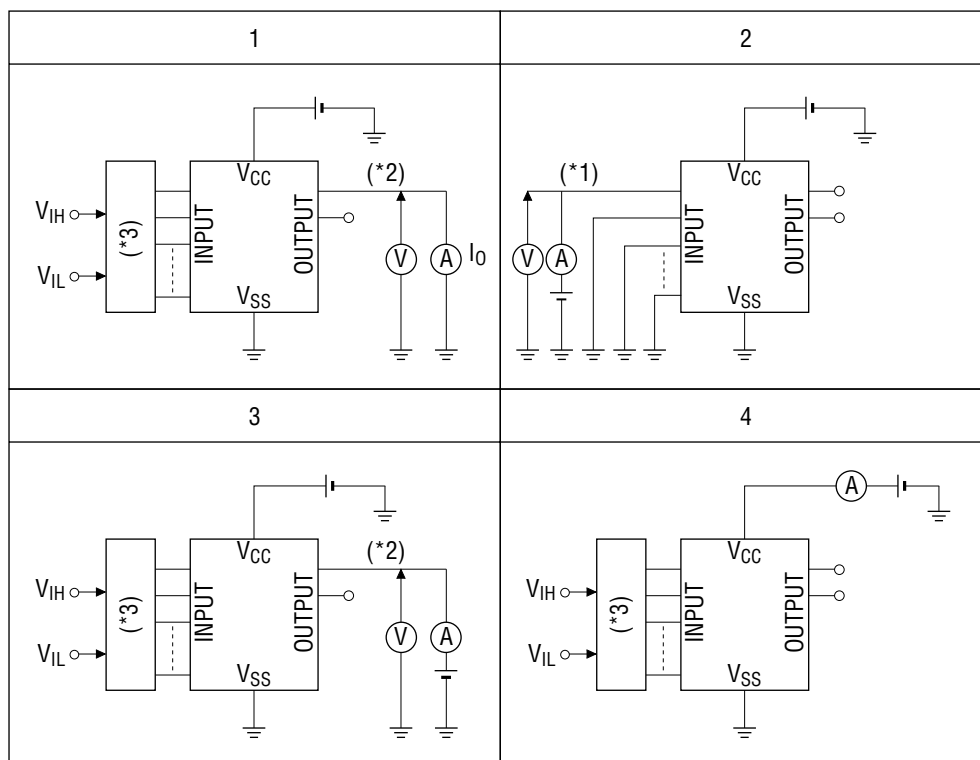
| <b>V<sub>CC</sub></b> | <b>4.75V</b> | <b>5V</b> | <b>5.25V</b> |
|-----------------------|--------------|-----------|--------------|
| Freq                  |              |           |              |
| 1 MHz                 | 2.2          | 3.1       | 4.1          |
| 3 MHz                 | 3.9          | 5.2       | 7.0          |
| 12 MHz                | 15.0         | 16.0      | 17.0         |
| 16 MHz                | 19.0         | 20.0      | 22.0         |
| 22 MHz                | 25.0         | 27.0      | 29.0         |

**Maximum power supply current idle mode  $I_{CC}$  (mA)**

| <b>V<sub>CC</sub></b> | <b>4.75V</b> | <b>5V</b> | <b>5.25V</b> |
|-----------------------|--------------|-----------|--------------|
| Freq                  |              |           |              |
| 1 MHz                 | 0.8          | 1.2       | 1.6          |
| 3 MHz                 | 1.2          | 1.7       | 2.3          |
| 12 MHz                | 4.1          | 4.4       | 4.8          |
| 16 MHz                | 5.1          | 5.5       | 6.0          |
| 22 MHz                | 6.5          | 7.0       | 7.5          |

Note: The values of Power-down current, operating current, and IDLE current do not include the current dissipated by EPROM.

## Measuring circuits



\*1: Repeated for specified input pins.

\*2: Repeated for specified output pins.

\*3: Input logic for specified status.

## AC Characteristics

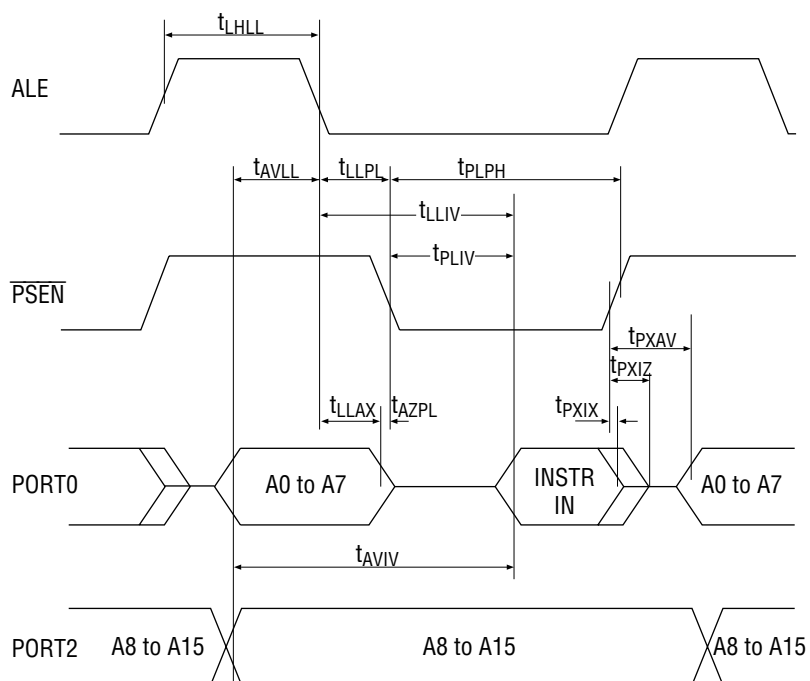
### External program memory access AC characteristics

( Vcc = 4.75 to 5.25V, Vss = 0V, Ta = room temp  
PORT 0, ALE, and  $\overline{\text{PSEN}}$  connected with 100 pF load, other connected with 80 pF load )

| Parameter                                                                                    | Symble             | Variable clock from*1<br>1 to 22 MHz |                         | Unit |
|----------------------------------------------------------------------------------------------|--------------------|--------------------------------------|-------------------------|------|
|                                                                                              |                    | Min.                                 | Max.                    |      |
| XTAL1, XTAL 2 Oscillation Cycle                                                              | t <sub>CLCL</sub>  | 45.5                                 | 1000                    | ns   |
| ALE Signal Width                                                                             | t <sub>LHLL</sub>  | 2t <sub>CLCL</sub> -40               | —                       | ns   |
| Address Setup Time<br>(to ALE Falling Edge)                                                  | t <sub>AVLL</sub>  | 1t <sub>CLCL</sub> -15               | —                       | ns   |
| Address Hold Time<br>(from ALE Falling Edge)                                                 | t <sub>LLAX</sub>  | 1t <sub>CLCL</sub> -35               | —                       | ns   |
| Instruction Data Read Time<br>(from ALE Falling Edge)                                        | t <sub>LLPL</sub>  | —                                    | 4t <sub>CLCL</sub> -100 | ns   |
| From ALE Falling Edge to $\overline{\text{PSEN}}$<br>Falling Edge                            | t <sub>LLPL</sub>  | 1t <sub>CLCL</sub> -30               | —                       | ns   |
| $\overline{\text{PSEN}}$ Signal Width                                                        | t <sub>PLPH</sub>  | 3t <sub>CLCL</sub> -35               | —                       | ns   |
| Instruction Data Read Time<br>(from $\overline{\text{PSEN}}$ Falling Edge)                   | t <sub>PLIV</sub>  | —                                    | 3t <sub>CLCL</sub> -45  | ns   |
| Instruction Data Hold Time<br>(from $\overline{\text{PSEN}}$ Rising Edge)                    | t <sub>PIXIX</sub> | 0                                    | —                       | ns   |
| Bus Floating Time after Instruction<br>Data Read (from $\overline{\text{PSEN}}$ Rising Edge) | t <sub>PIXIZ</sub> | —                                    | 1t <sub>CLCL</sub> -20  | ns   |
| Instruction Data Read Time<br>(from Address Output)                                          | t <sub>AVIV</sub>  | —                                    | 5t <sub>CLCL</sub> -105 | ns   |
| Bus Floating Time( $\overline{\text{PSEN}}$ Rising<br>Edge from Address float)               | t <sub>AZPL</sub>  | 0                                    | —                       | ns   |
| Address Output Time from $\overline{\text{PSEN}}$<br>Rising Edge                             | t <sub>PXAV</sub>  | 1t <sub>CLCL</sub> -20               | —                       | ns   |

\*1 The variable check is from 0 to 22 MHz when the external check is used.

## External program memory read cycle



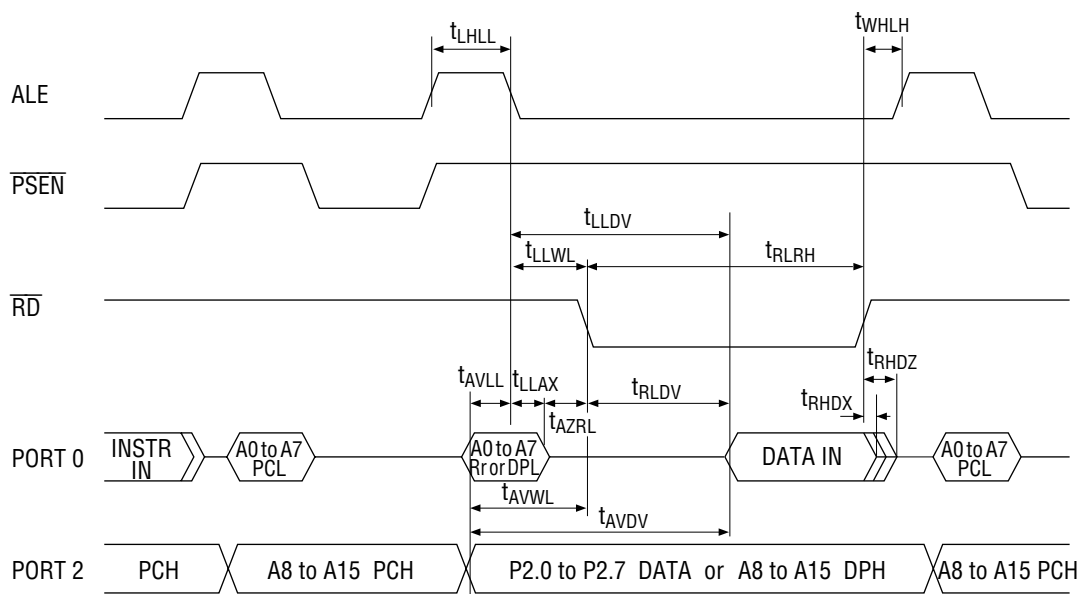
## External data memory access AC characteristics

(  $V_{CC} = 4.75$  to  $5.25V$ ,  $V_{SS} = 0V$ ,  $T_a$  = room temp  
 PORT 0, ALE, and PSEN connected with 100 pF load, other connected with 80 pF load )

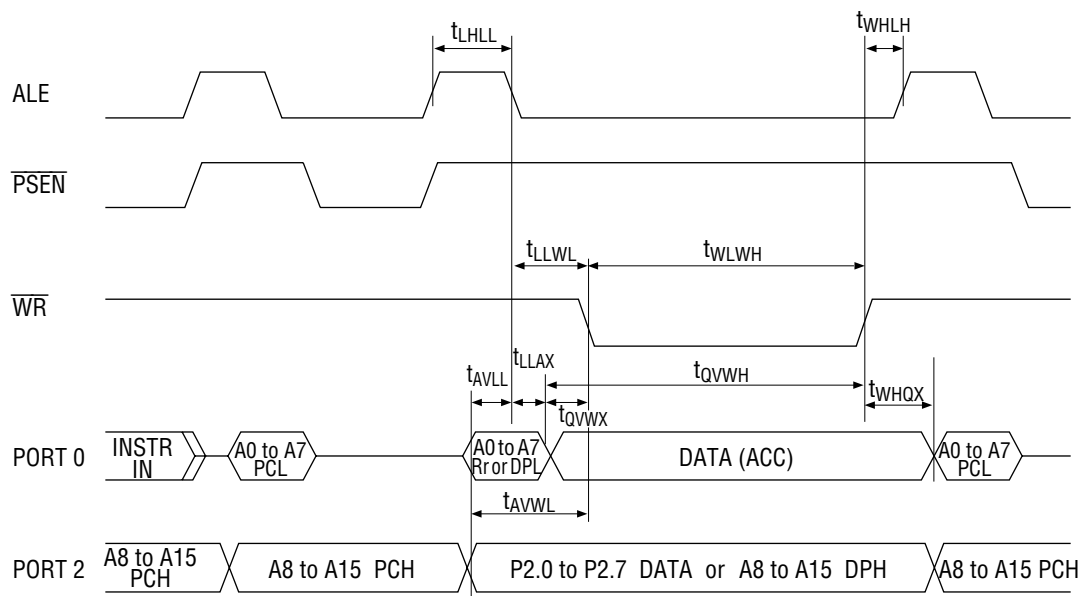
| Parameter                                                                 | Symble     | Variable clock from*1<br>1 to 22 MHz |                 | Unit |
|---------------------------------------------------------------------------|------------|--------------------------------------|-----------------|------|
|                                                                           |            | Min.                                 | Max.            |      |
| XTAL1, XTAL2 Oscillator Cycle                                             | $t_{CLCL}$ | 45.5                                 | 1000            | ns   |
| ALE Signal Width                                                          | $t_{LHLL}$ | $2t_{CLCL}-40$                       | —               | ns   |
| Address Setup Time<br>(to ALE Falling Edge)                               | $t_{AVLL}$ | $1t_{CLCL}-15$                       | —               | ns   |
| Address Hold Time<br>(from ALE Falling Edge)                              | $t_{LLAX}$ | $1t_{CLCL}-35$                       | —               | ns   |
| $\overline{RD}$ Signal Width                                              | $t_{RLRL}$ | $6t_{CLCL}-100$                      | —               | ns   |
| $\overline{WR}$ Signal Width                                              | $t_{WLWH}$ | $6t_{CLCL}-100$                      | —               | ns   |
| RAM Data Read Time<br>(from $\overline{RD}$ Signal Falling Edge)          | $t_{RLDV}$ | —                                    | $5t_{CLCL}-105$ | ns   |
| RAM Data Read Hold Time<br>(from $\overline{RD}$ Signal Rising Edge)      | $t_{RHDX}$ | 0                                    | —               | ns   |
| Data Bus Floating Time<br>(from $\overline{RD}$ Signal Rising Edge)       | $t_{RHDZ}$ | —                                    | $2t_{CLCL}-70$  | ns   |
| RAM Data Read Time<br>(from ALE Signal Falling Edge)                      | $t_{LLDV}$ | —                                    | $8t_{CLCL}-100$ | ns   |
| RAM Data Read Time<br>(from Address Output)                               | $t_{AVDV}$ | —                                    | $9t_{CLCL}-105$ | ns   |
| $\overline{RD}/\overline{WR}$ Output Time from ALE<br>Falling Edge        | $t_{LLWL}$ | $3t_{CLCL}-40$                       | $3t_{CLCL}+40$  | ns   |
| $\overline{RD}/\overline{WR}$ Output Time from Address<br>Output          | $t_{AVWL}$ | $4t_{CLCL}-70$                       | —               | ns   |
| $\overline{WR}$ Output Time from Data Output                              | $t_{QVWX}$ | $2t_{CLCL}-40$                       | —               | ns   |
| Time from Data to $\overline{WR}$ Rising Edge                             | $t_{QVWH}$ | $7t_{CLCL}-105$                      | —               | ns   |
| Data Hold Time<br>(from $\overline{WR}$ Rising Edge)                      | $t_{WHQX}$ | $2t_{CLCL}-50$                       | —               | ns   |
| Time from to Address Float $\overline{RD}$<br>Output                      | $t_{RLAZ}$ | 0                                    | —               | ns   |
| Time from $\overline{RD}/\overline{WR}$ Rising Edge to<br>ALE Rising Edge | $t_{WHLH}$ | $1t_{CLCL}-30$                       | $1t_{CLCL}+40$  | ns   |

\*1 The variable check is from 0 to 22 MHz when the external check is used.

## External data memory read cycle

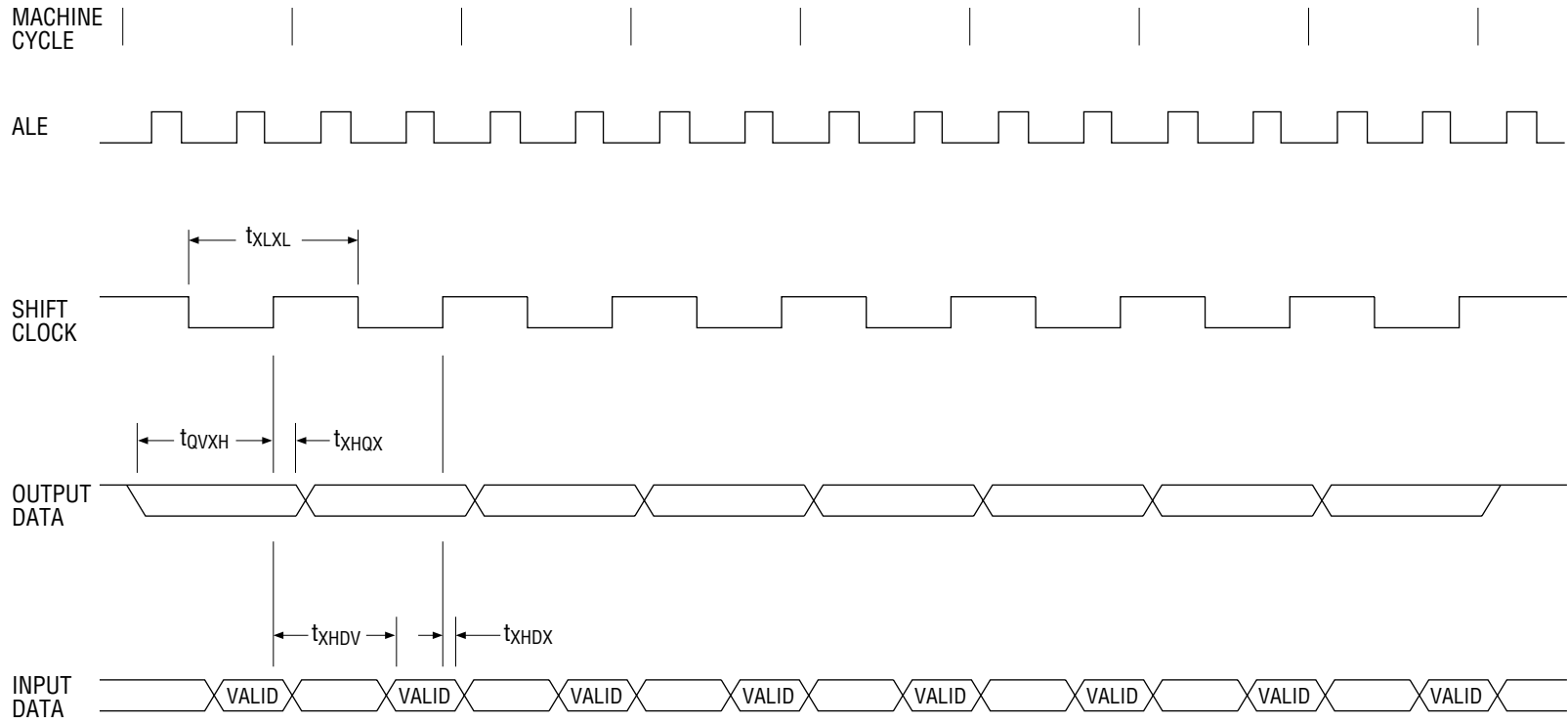


## External data memory write cycle



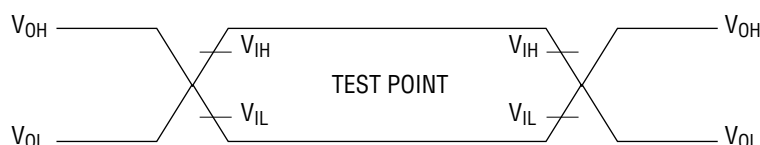
**Serial port (I/O extension mode) AC characteristics**(V<sub>CC</sub> = 4.75 to 5.25V, V<sub>SS</sub> = 0V, Ta = room temp)

| Parameter                                | Symbol            | Min.                     | Max.                     | Unit |
|------------------------------------------|-------------------|--------------------------|--------------------------|------|
| Serial Port Clock Cycle Time             | t <sub>XLXL</sub> | 12t <sub>CLCL</sub>      | —                        | ns   |
| Output Data Setup to Clock Rising Edge   | t <sub>QVXH</sub> | 10t <sub>CLCL</sub> -133 | —                        | ns   |
| Output Data Hold After Clock Rising Edge | t <sub>XHQX</sub> | 2t <sub>CLCL</sub> -75   | —                        | ns   |
| Input Data Hold After Clock Rising Edge  | t <sub>XHDX</sub> | 0                        | —                        | ns   |
| Clock Rising Edge to Input Data Valid    | t <sub>XHDV</sub> | —                        | 10t <sub>CLCL</sub> -133 | ns   |



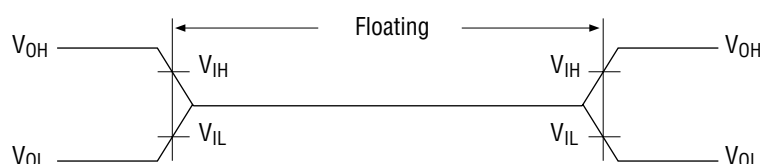
## AC characteristics measuring conditions

### 1. Input/output signal



- \* The input signals in AC test mode are either  $V_{OH}$  (logic "1") or  $V_{OL}$  (logic "0") input signals where logic "1" corresponds to a CPU output signal waveform measuring point in excess of  $V_{IH}$ , and logic "0" to a point below  $V_{IL}$ .

### 2. Floating

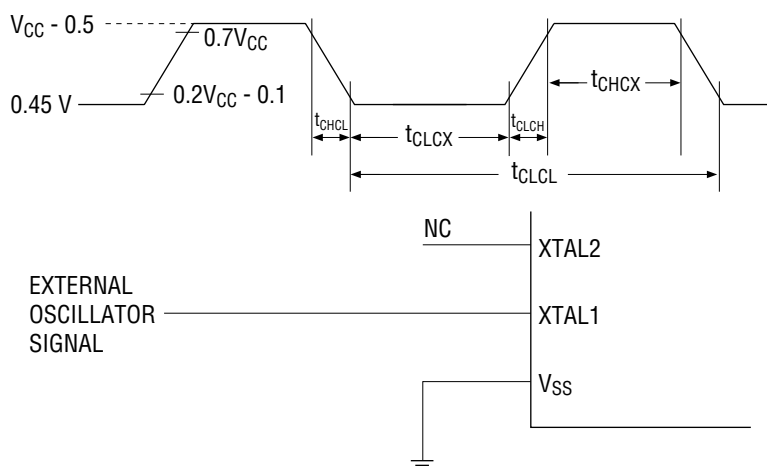


- \* The port 0 floating interval is measured from the time the port 0 pin voltage drops below  $V_{IH}$  after sinking to GND at 2.4 mA when switching to floating status from a "1" output, and from the time the port 0 pin voltage exceeds  $V_{IL}$  after connecting to a 400  $\mu$ A source when switching to floating status from a "0" output.

## XTAL1 external clock input waveform conditions

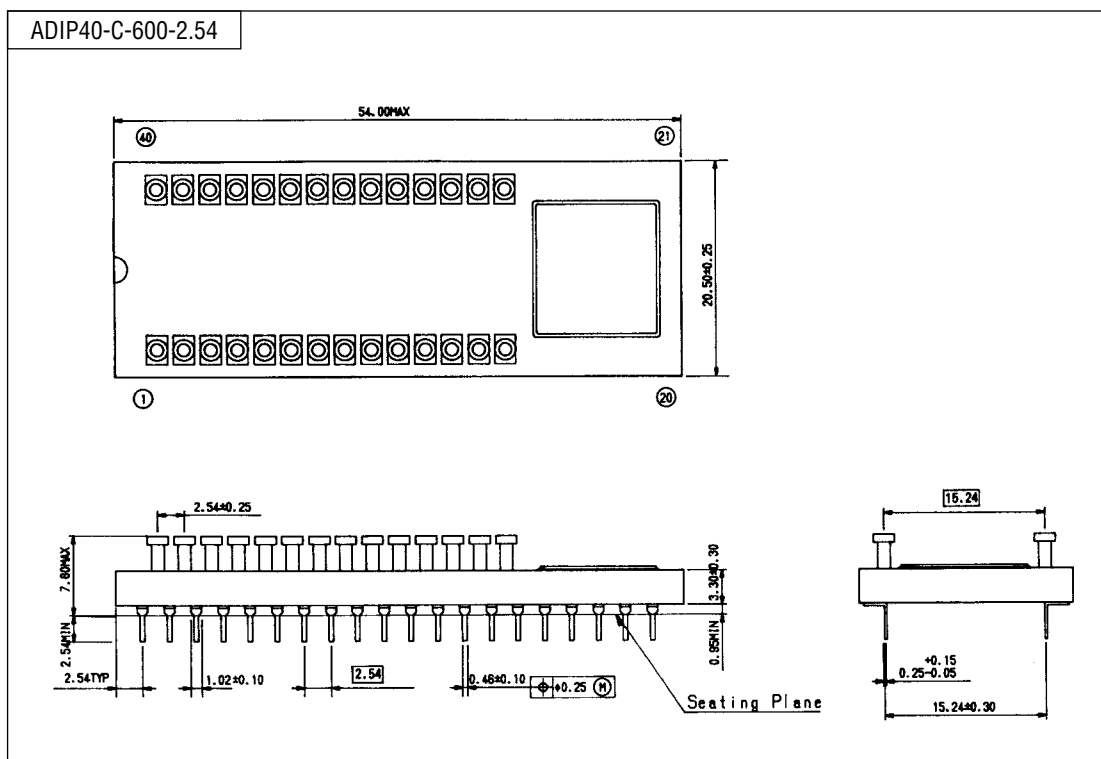
| Parameter            | Symbol       | Min. | Max. | Unit |
|----------------------|--------------|------|------|------|
| External Clock Freq. | $1/t_{CLCL}$ | 0    | 22   | MHz  |
| Clock Pulse width 1  | $t_{CHCX}$   | 15   | —    | ns   |
| Clock Pulse width 2  | $t_{CLCX}$   | 15   | —    | ns   |
| Rise Time            | $t_{CLCH}$   | —    | 5    | ns   |
| Fall Time            | $t_{CHCL}$   | —    | 5    | ns   |

### External clock drive waveform



## PACKAGE DIMENSIONS

(Unit : mm)



## Notes for Mounting the Surface Mount Type Package

The SOP, QFP, TSOP, SOJ, QFJ (PLCC), SHP and BGA are surface mount type packages, which are very susceptible to heat in reflow mounting and humidity absorbed in storage.

Therefore, before you perform reflow mounting, contact Oki's responsible sales person for the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times).