M37705E4BXXXSP

PROM VERSION of M37705M4BXXXSP

DESCRIPTION

The M37705E4BXXXSP is a single-chip microcomputer designed with high-performance CMOS silicon gate technology. This is housed in a 64-pin shrink plastic molded DIP. The features of this chip is similar to those of the M37705M4BXXXSP except that this chip has a 16K-byte PROM built in.

This single-chip microcomputer has three instruction queue buffers, and two data buffers for high-speed instruction execution. The CPU is a 16-bit parallel processor that can also be switched to perform 8-bit parallel processing. This microcomputer is suitable for office, business and industrial equipment controller that require high-speed processing of large data.

Also, the incorporated motor control circuit makes this microcomputer suitable for control of equipment that requires motor control.

Since general purpose PROM writers can be used for the built-in PROM, this chip is suitable for small quantity production runs.

The M37705E4BXXXSP operates only in the single-chip mode.

DISTINCTIVE FEATURES

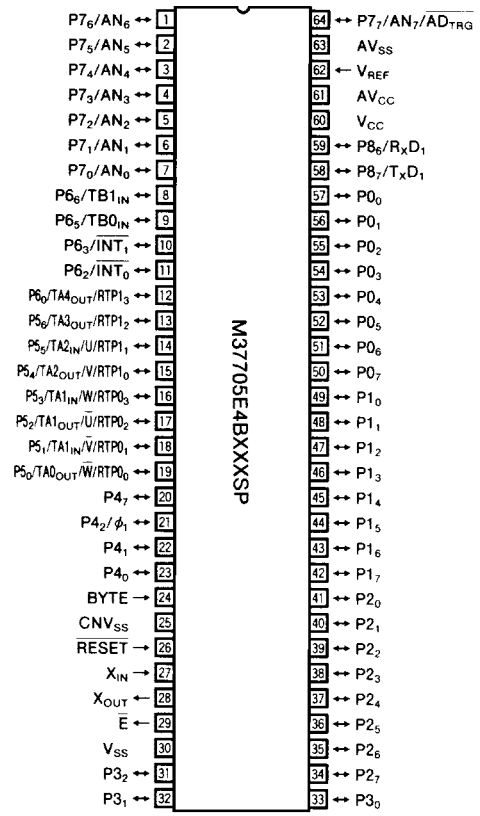
- Number of basic instructions 103
- Memory size PROM ..... 32K bytes
  RAM ..... 1024 bytes
- Instruction execution time
  The fastest instruction at 25 MHz frequency 160ns
- Single power supply ..... 5V±10%
- Low power dissipation (at 25 MHz frequency)
  ..... 95mW (Typ.)
- Interrupts ..... 16 types 7 levels
- Multiple function 16-bit timer ..... 5+3
  (Three-phase motor drive waveform or pulse motor drive waveform can be output.)
- UART 1
- 8-bit A-D converter ..... 8-channel inputs
- 12-bit watchdog timer
- Programmable input/output
  (ports P0, P1, P2, P3, P4, P5, P6, P7, P8) 53

APPLICATION

Motor control devices such as inverter type air conditioners and general purpose inverters

Control devices for office equipment such as copiers, printers, typewriters, facsimiles, word processors, and personal computers

PIN CONFIGURATION (TOP VIEW)



Outline 64P4B (one time programmable)

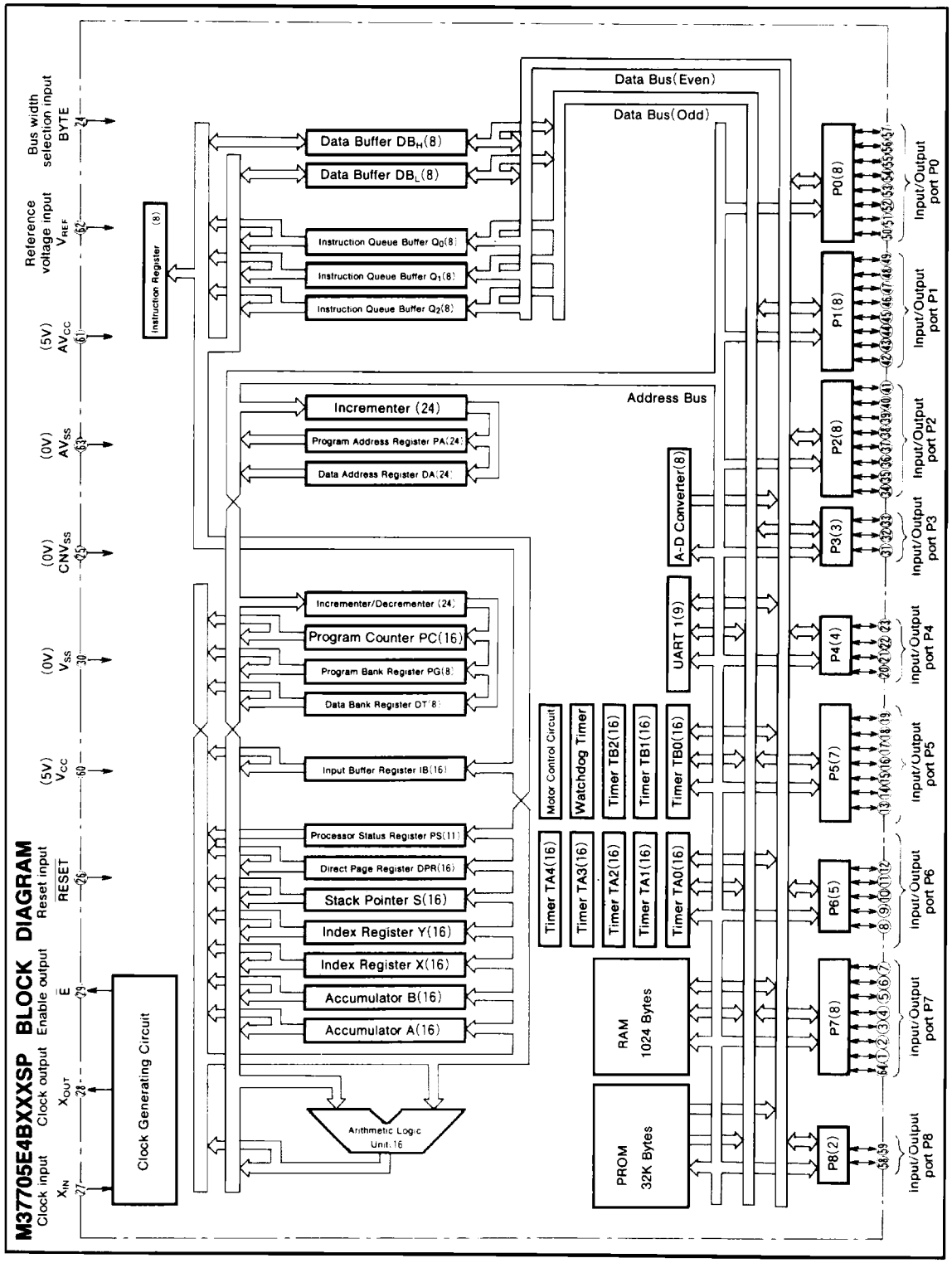
THE FUNCTIONS AND CHARACTERISTICS

The M37705E4BXXXSP has the same functions and characteristics as the M37705M4BXXXSP except that input voltage of pins CNV_{SS} and BYTE is 13V when writting in EPROM. Refer to the section on the M37705M4BXXXSP.

NOTE

Refer to "Chapter 5 PRECAUTIONS" when using this microcomputer.

PROM VERSION of M37705M4BXXXSP



FUNCTIONS OF M37705E4BXXXSP

Parameter		Functions
Number of basic instructions		103
Instruction execution time		160ns (the fastest instruction at external clock 25MHz frequency)
Memory size	PROM	32K bytes
	RAM	1024 bytes
Input/Output ports	P0, P1, P2, P7	8-bit×4
	P5	7-bit×1
	P6	5-bit×1
	P4	4-bit×1
	P3	3-bit×1
	P8	2-bit×1
Multi-function timers	TA0, TA1, TA2, TA3, TA4	16-bit× 5 (3 input/output and 2 output functions)
	TB0, TB1, TB2	16-bit× 3 (2 input functions)
Serial I/O		UART×1
A-D converter		8-bit× 1 (8 channels)
Watchdog timer		12-bit× 1
Dead-time timer		8-bit× 3
Interrupts		2 external types, 14 internal types (Each interrupt can be set the priority levels to 0 ~ 7.)
Clock generating circuit		Built-in(externally connected to a ceramic resonator or quartz crystal resonator)
Supply voltage		5 V±10%
Power dissipation		95mW(at external clock 25MHz frequency)
Input/Output characteristic	Input/Output voltage	5 V
	Output current	5 mA
Operating temperature range		−20~85℃
Device structure		CMOS high-performance silicon gate process
Package		64-pin shrink plastic molded DIP

PIN DESCRIPTION

Pin	Name	Input/Output	Functions
V_{CC}, V_{SS}	Power supply		Supply 5 V±10% to V_{CC} and 0 V to V_{SS}.
CNV_{SS}	CNV_{SS} input	Input	Connect to V_{SS}.
$\overline{RESET}$	Reset input	Input	To enter the reset state, this pin must be kept at a "L" condition which should be maintained for the required time.
X_{IN}	Clock input	Input	These are I/O pins of internal clock generating circuit. Connect a ceramic or quartz crystal resonator between X_{IN} and X_{OUT}. When an external clock is used, the clock source should be connected to the X_{IN} pin and the X_{OUT} pin should be left open.
X_{OUT}	Clock output	Output	
$\overline{E}$	Enable output	Output	Data or instruction read and data write are performed when output from this pin is "L".
BYTE	Bus width selection input	Input	Connect to V_{SS}.
AV_{CC}, AV_{SS}	Analog supply input		Power supply for the A-D converter. Connect AV_{CC} to V_{CC} and AV_{SS} to V_{SS} externally.
V_{REF}	Reference voltage input	Input	This is reference voltage input pin for the A-D converter.
$P0_0$~$P0_7$	I/O port P0	I/O	Port P0 becomes an 8-bit I/O port. An I/O direction register is available so that each pin can be programmed for input or output. These ports are in input mode when reset.
$P1_0$~$P1_7$	I/O port P1	I/O	These pins have the same functions as port P0.
$P2_0$~$P2_7$	I/O port P2	I/O	These pins have the same functions as port P0.
$P3_0$~$P3_2$	I/O port P3	I/O	These pins have the same functions as port P0.
$P4_0$~$P4_2$, $P4_7$	I/O port P4	I/O	These pins have the same functions as port P0. Port $P4_2$ can be programmed for ϕ_1 output pin divided the clock to X_{IN} pin by 2.
$P5_0$~$P5_6$	I/O port P5	I/O	In addition to having the same functions as port P0, these pins also function as I/O pins for timer A0, timer A1, timer A2, and output pin for timer A3. These pins also have the function as motor control output pin.
$P6_0$, $P6_2$, $P6_3$, $P6_5$, $P6_6$	I/O port P6	I/O	In addition to having the same functions as port P0, these pins also function as output pins for timer A4, and input pins for external interrupt input $\overline{INT_0}$ and $\overline{INT_1}$ pins, and for timer B0 and timer B1. $P6_0$ also has the function as motor control output pin and $P6_2$ has the function as motor control pin.
$P7_0$~$P7_7$	I/O port P7	I/O	In addition to having the same functions as port P0, these pins also function as analog input AN_0~AN_7 input pins. $P7_7$ also has an A-D conversion trigger input function.
$P8_6$, $P8_7$	I/O port P8	I/O	In addition to having the same functions as port P0, these pins also function as R_XD and T_XD pins for UART 1.

PIN DESCRIPTION (EPROM MODE)

Pin	Name	Input/Output	Functions
V_{CC}, V_{SS}	Power supply		Supply 5 V±10% to V_{CC} and 0 V to V_{SS}.
CNV_{SS}	V_{PP} input	Input	Connect to V_{PP} when programming or verifing.
BYTE	V_{PP} input	Input	Connect to V_{PP} when programming or verifing.
$\overline{RESET}$	Reset input	Input	Connect to V_{SS}.
X_{IN}	Clock input	Input	Connect a ceramic resonator between X_{IN} and X_{OUT}.
X_{OUT}	Clock output	Output	
$\overline{E}$	Enable output	Output	Keep open.
AV_{CC}, AV_{SS}	Analog supply input		Connect AV_{CC} to V_{CC} and AV_{SS} to V_{SS}.
V_{REF}	Reference voltage input	Input	Connect to V_{SS}.
$P0_0$~$P0_7$	Address input (A_0~A_7)	Input	Port P0 functions as the lower 8 bits address input (A_0~A_7).
$P1_0$~$P1_7$	Address input (A_8~A_{15})	Input	Port P1 functions as the higher 8 bits address input (A_8~A_{15}). In 256K mode, connect $P1_7$ to V_{CC}.
$P2_0$~$P2_7$	Data I/O (D_0~D_7)	I/O	Port P2 functions as the 8 bits data bus (D_0~D_7).
$P3_0$~$P3_2$	Input port P3	Input	Connect to V_{SS}.
$P4_0$~$P4_2$, $P4_7$	Input port P4	Input	Connect to V_{SS}.
$P5_0$~$P5_6$	Control input	Input	$P5_0$*, $P5_1$ and $P5_2$ functions as $\overline{PGM}$*, $\overline{OE}$ and $\overline{CE}$ input pin respectively. Connect $P5_3$, $P5_4$ and $P5_5$ to V_{CC}. Connect $P5_6$ to V_{SS} in 256K mode and to V_{CC} in 1M mode.
$P6_0$, $P6_2$, $P6_3$, $P6_5$, $P6_6$	Input port P6	Input	Connect to V_{SS}.
$P7_0$~$P7_7$	Input port P7	Input	Connect to V_{SS}.
$P8_6$, $P8_7$	Input port P8	Input	Connect to V_{SS}.

* : It is available in 1M mode.

EPROM MODE

The M37705E4BXXXSP features an EPROM mode in addition to its normal modes. When the $\overline{RESET}$ signal level is "L", the chip automatically enters the EPROM mode. Table 1 shows the correspondence between pins and Fig. 1 shows the pin connections in the EPROM mode.

There are two EPROM modes. One is the 256K mode for the EPROM that is equivalent to the M5M27C256K, and the other is the 1M mode for the EPROM that is equivalent to the M5M27C101K. 256K mode is selected when port $P5_6$ is set to "L" level, and 1M mode is selected when it is set to "H" level.

When in the EPROM mode, ports P0, P1, P2, $P5_0$, $P5_1$, $P5_2$, CNV_{SS} and BYTE are used for the EPROM (equivalent to the M5M27C256K or M5M27C101K). When in this mode, the built-in PROM can be written to or read from using these pins in the same way as with the M5M27C256K or M5M27C101K.

This chip does not have Device Identifier Code, so that set the corresponding program algorithm. The program area should specify address 0000_{16}~$7FFF_{16}$ in 256K mode, and address 18000_{16}~$1FFFF_{16}$ in 1M mode.

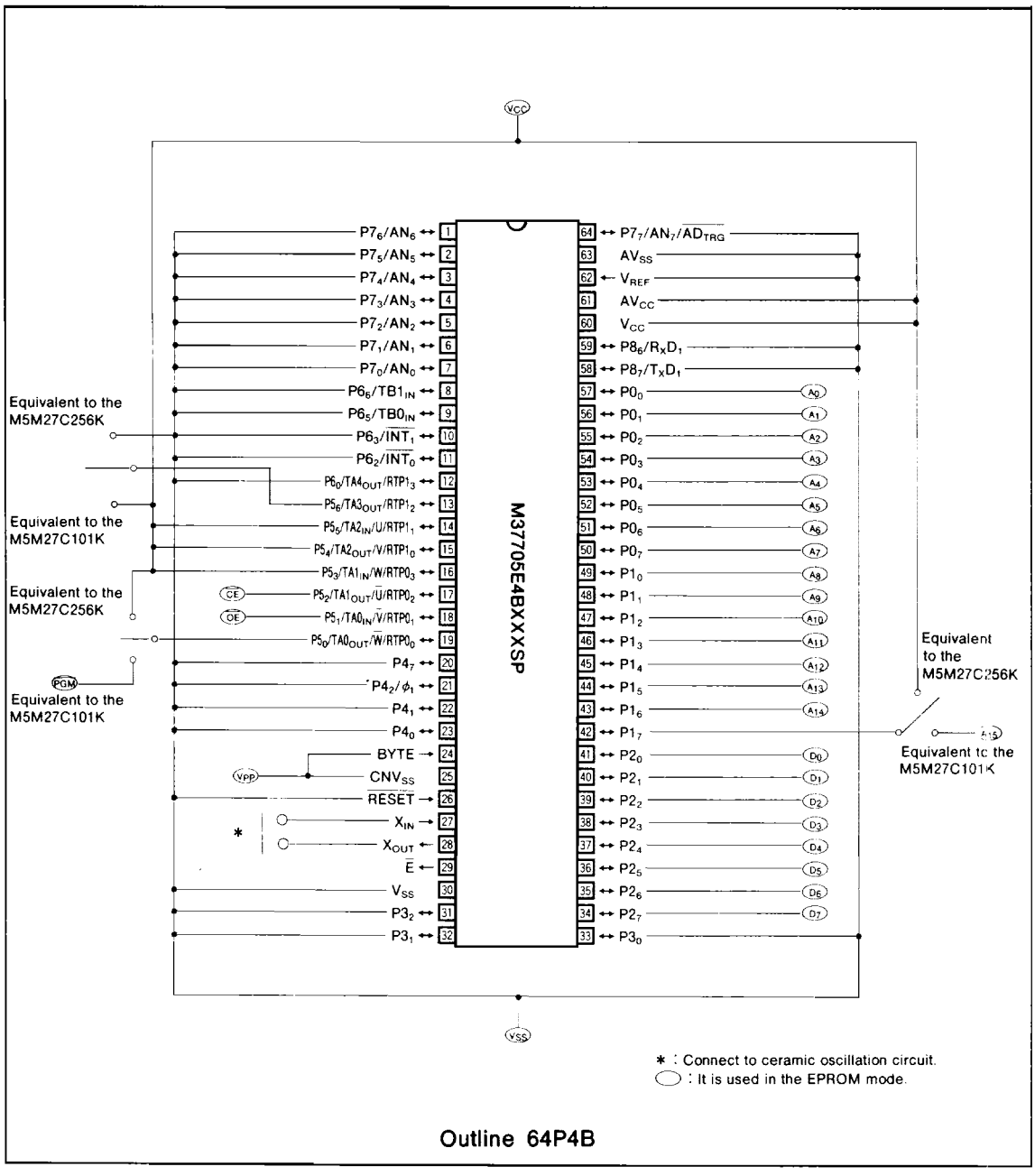
Connect the clock which is either ceramic resonator or external clock to X_{IN} pin and X_{OUT} pin.

For one time PROM version, 256K mode should be recommended to write more deeply.

Table 1 Pin function in EPROM mode

	M37705E4BXXXSP	M5M27C256K	M5M27C101K
V_{CC}	V_{CC}	V_{CC}	
V_{PP}	CNV_{SS}, BYTE	V_{PP}	
V_{SS}	V_{SS}	V_{SS}	
Address input	Ports P0, P1*	A_0~A_{14}	A_0~A_{15}
Data I/O	Port P2	D_0~D_7	
$\overline{CE}$	$P5_2$	$\overline{CE}$	
$\overline{OE}$	$P5_1$	$\overline{OE}$	
$\overline{PGM}$	$P5_0$*	—	$\overline{PGM}$

* : In 256K mode, connect $P1_7$ and $P5_0$ to V_{CC}.



Outline 64P4B

Fig. 1 Pin connection in EPROM mode

FUNCTION IN EPROM MODE
(1) 1M mode (equivalent to the M5M27C101K)

Reading

To read the EPROM, set the $\overline{CE}$ and $\overline{OE}$ pins to "L" level. Input the address of the data ($A_0 \sim A_{15}$) to be read, and the data will be output to the I/O pins $D_0 \sim D_7$. The data I/O pins will be floating when either the $\overline{CE}$ or $\overline{OE}$ pins are in the "H" state.

Writing

Writing must be performed in 8 bits by a byte program. To write to the EPROM, set the $\overline{CE}$ pin to "L" level and the $\overline{OE}$ pin to "H" level. The CPU will enter the program mode when 12.5V is applied to the V_{PP} pin. The address to be written to is selected with pins $A_0 \sim A_{15}$, and the data to be written is input to pins $D_0 \sim D_7$. Set the $\overline{PGM}$ pin to "L" level to being writing.

Writing operation

To program the M37705E4BXXXSP, first set V_{CC}=6V, V_{PP}= 12.5V, and set the address to 18000_{16}. Apply the 0.2ms write pulse, check that the data can be read, and if it cannot be read OK, repeat the procedure, applying the 0.2ms write pulse and checking that the data can be read until it can be read OK. Record the accumulated number of pulse applied (X) before the data can be read OK, and then write the data again, applying a further once this number of pulses (0.2XX ms).

When this series of write operations is complete, increment the address, and continue to repeat the procedure above until the last address has been reached.

Finally, when all addresses have been written, read with V_{CC}=V_{PP}=5V(or V_{CC}=V_{PP}=5.5V).

Table 2 I/O signal in each mode

Mode \ Pin	$\overline{CE}$	$\overline{OE}$	$\overline{PGM}$	V_{PP}	V_{CC}	Data I/O
Read-out	V_{IL}	V_{IL}	X	5 V	5 V	Output
Output Disable	V_{IL}	V_{IH}	X	5 V	5 V	Floating
	V_{IH}	X	X	5 V	5 V	Floating
Programming	V_{IL}	V_{IH}	V_{IL}	12.5V	6 V	Input
Programming Verify	V_{IL}	V_{IL}	V_{IH}	12.5V	6 V	Output
Program Disable	V_{IH}	V_{IH}	V_{IH}	12.5V	6 V	Floating

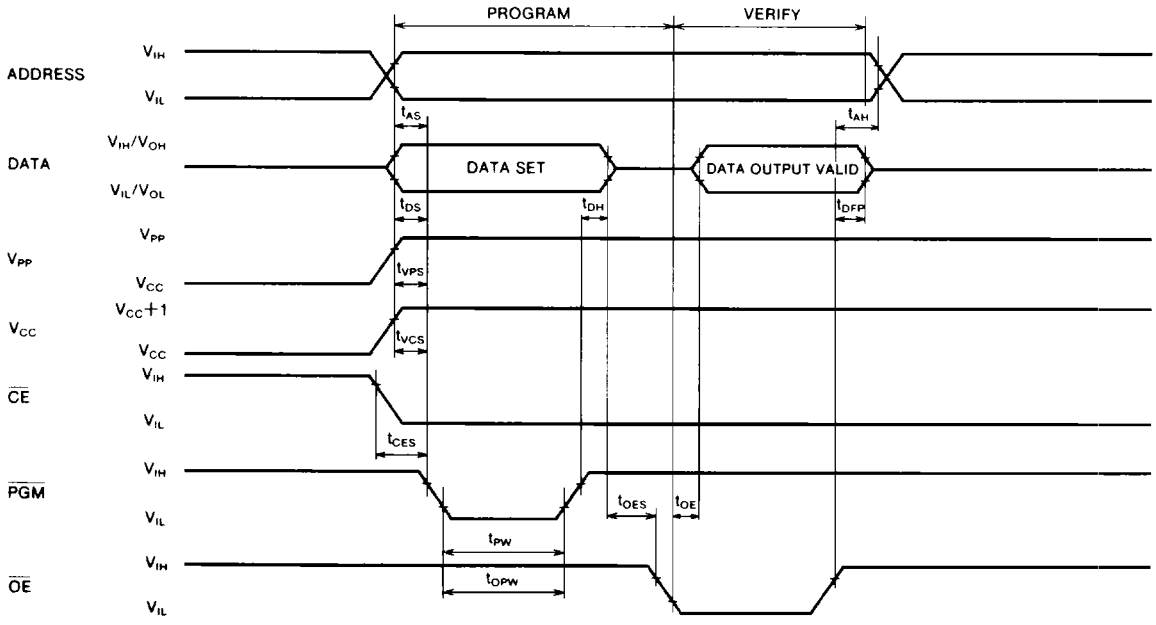
Note 1 : An X indicates either V_{IL} or V_{IH}.

Program operation (equivalent to the M5M27C101K)

AC ELECTRICAL CHARACTERISTICS (T_a=25±5℃, V_{CC}=6V±0.25V, V_{PP}=12.5±0.3V, unless otherwise noted)

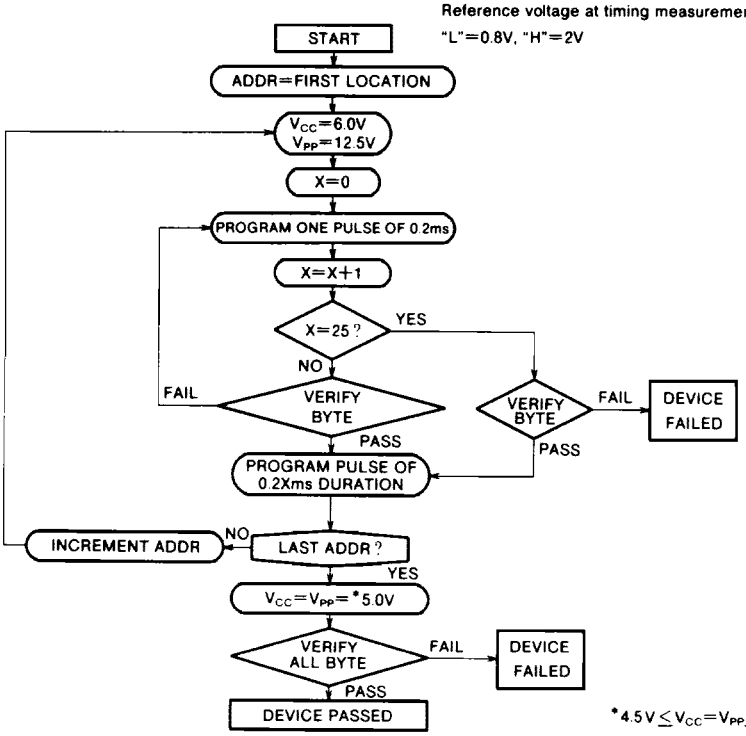
Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
t_{AS}	Address setup time		2			μs
t_{OES}	$\overline{OE}$ setup time		2			μs
t_{DS}	Data setup time		2			μs
t_{AH}	Address hold time		0			μs
t_{DH}	Data hold time		2			μs
t_{DFP}	Output enable to output float delay		0		130	ns
t_{VCS}	V_{CC} setup time		2			μs
t_{VPS}	V_{PP} setup time		2			μs
t_{PW}	$\overline{PGM}$ pulse width		0.19	0.2	0.21	ms
t_{OPW}	$\overline{PGM}$ over program pulse width		0.19		5.25	ms
t_{CES}	$\overline{CE}$ setup time		2			μs
t_{OE}	Data valid from $\overline{OE}$				150	ns

AC waveforms



Test conditions for A.C. characteristics
Input voltage : V_{IL}=0.45V, V_{IH}=2.4V
Input rise and fall times (10%~90%) : ≤20ns
Reference voltage at timing measurement : Input, Output
"L"=0.8V, "H"=2V

Programming algorithm flow chart



*4.5V≤V_{CC}=V_{PP}≤5.5V

MITSUBISHI ELECTRIC

(2) 256K mode (equivalent to the M5M27C256K)

Reading

To read the EPROM, set the $\overline{CE}$ and $\overline{OE}$ pins to "L" level. Input the address of the data ($A_0 \sim A_{14}$) to be read, and the data will be output to the I/O pins $D_0 \sim D_7$. The data I/O pins will be floating when either the $\overline{CE}$ or $\overline{OE}$ pins are in the "H" state.

Writing

To write to the EPROM, set the $\overline{OE}$ pin to "H" level. The CPU will enter the program mode when V_{PP} is applied to the V_{PP} pin. The address to be written to is selected with pins $A_0 \sim A_{14}$, and the data to be written is input to pins $D_0 \sim D_7$. Set the $\overline{CE}$ pin to "L" level to being writing.

Writing operation

To program the M37705E4BXXXSP, first set V_{CC}=6V, V_{PP}= 12.5V, and set the address to "0". Apply the 1ms write pulse, check that the data can be read, and if it cannot be read OK, repeat the procedure, applying the 1ms write pulse and checking that the data can be read until it can be read OK. Record the accumulated number of pulse applied (X) before the data can be read OK, and then write the data again, applying a further three times this number of pulses (3×X ms).

When this series of write operations is complete, increment the address, and continue to repeat the procedure above until the last address has been reached.

Finally, when all addresses have been written, read with V_{CC}=V_{PP}=5V(or V_{CC}=V_{PP}=5.5V).

Table 3 I/O signal in each mode

Mode \ Pin	$\overline{CE}$	$\overline{OE}$	V_{PP}	V_{CC}	Data I/O
Read-out	V_{IL}	V_{IL}	5 V	5 V	Output
Output Disable	V_{IL}	V_{IH}	5 V	5 V	Floating
	V_{IH}	X	5 V	5 V	Floating
Programming	V_{IL}	V_{IH}	12.5V	6 V	Input
Programming Verify	V_{IH}	V_{IL}	12.5V	6 V	Output
Program Disable	V_{IH}	V_{IH}	12.5V	6 V	Floating

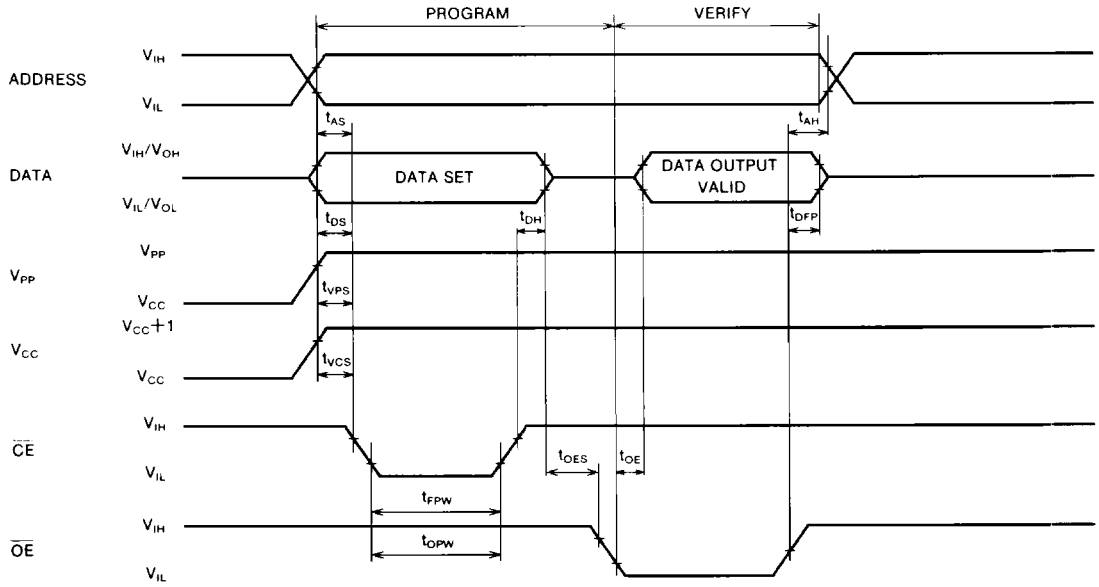
Note 1 : An X indicates either V_{IL} or V_{IH}.

Program operation (equivalent to the M5M27C256K)

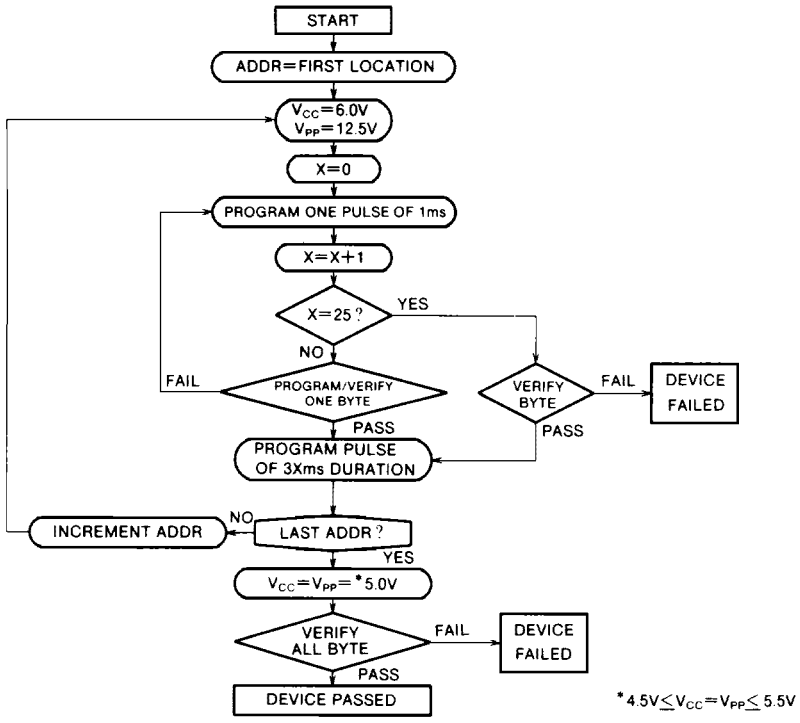
AC ELECTRICAL CHARACTERISTICS (T_a=25±5℃, V_{CC}=6V±0.25V, V_{PP}=12.5±0.3V, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
t_{AS}	Address setup time		2			μs
t_{OES}	$\overline{OE}$ setup time		2			μs
t_{DS}	Data setup time		2			μs
t_{AH}	Address hold time		0			μs
t_{DH}	Data hold time		2			μs
t_{DFP}	Output enable to output float delay		0		130	ns
t_{VCS}	V_{CC} setup time		2			μs
t_{VPS}	V_{PP} setup time		2			μs
t_{FPW}	$\overline{CE}$ initial program pulse width		0.95	1	1.05	ms
t_{OPW}	$\overline{CE}$ over program pulse width		2.85		78.75	ms
t_{OE}	Data valid from $\overline{OE}$				150	ns

AC waveforms



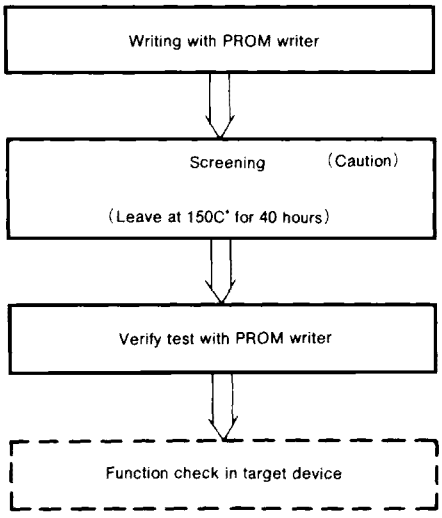
Programming algorithm flow chart



SAFETY INSTRUCTIONS

(1) A high voltage is used for writing. Take care that over-voltage is not applied. Take care especially at power on.

(2) The programmable M37705E4BSP that is shipped in blank is also provided. For the M37705E4BSP, Mitsubishi Electric corp. does not perform PROM write test and screening following the assembly processes. To improve reliability after write, performing write and test according to the flow below before use is recommended.



Caution : Never expose to 150 °C exceeding 100 hours.

ADDRESSING MODES

The M37705E4BXXXSP has 28 powerful addressing modes. Refer to the MELPS 7700 addressing mode description for the details of each addressing mode.

MACHINE INSTRUCTION LIST

The M37705E4BXXXSP has 103 machine instructions. Refer to the MELPS 7700 machine instruction list for details.

DATA REQUIRED FOR PROM ORDERING

Please send the following data for writing to PROM.

(1) M37705E4BXXXSP writing to PROM order confirmation form

(2) 64P4B mark specification form

(3) ROM data (EPROM 3 sets)