

FEATURES

- Complete one chip microcomputer
- ROM capacity : 2268 bytes
- RAM capacity : 96 words of 4 bits each
- Instruction set : 54 basic instructions
- Subroutine level : 1 level
- Inst. cycle time : 61 μsec (1 byte)
- Input port K input : 4 bits
- Output port O_{ij} : 34 bits
 - H_i : 2 bits
 - R_i : 4 bits
- I/O port DIO : 4 bits
- Divider of 15 stages with reset
- Internal LCD drive circuit
- External RAM drive
- Internal crystal oscillator circuit
- Extremely small power consumption
- Internal low-voltage detection circuit
- 60-pin flat quad package

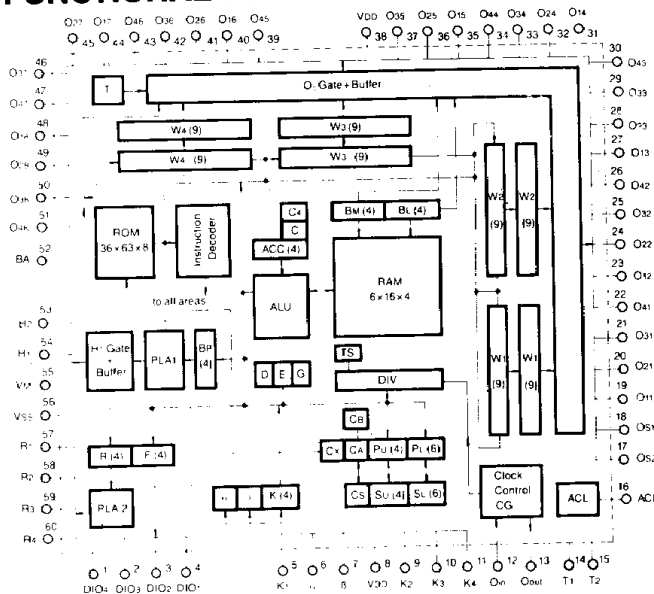
GENERAL DESCRIPTION

Designed in low-threshold CMOS technology, the KS52000 has a 3V supply voltage and an extremely low current consumption of 15 to 45 μA depending on the mode of operation.

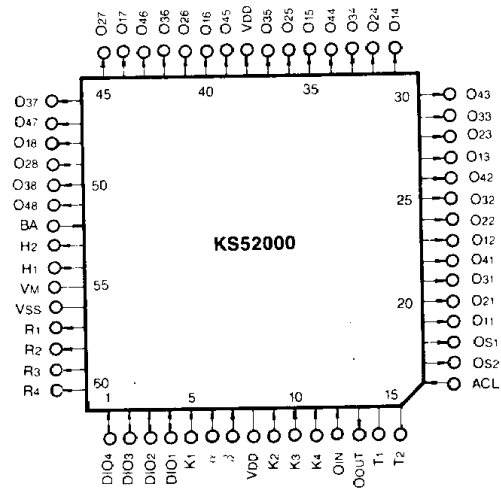
The KS52000 contains on a single silicon chip of a few square millimeters area a 2268 byte ROM, a RAM of 96 words, 8 static registers with 9 bits each, a 15-stage frequency divider, the clock oscillator, ALU and accumulator, programmable logic arrays (PLA) and other logic circuits: See Functional Block Diagram.

Due to its extremely flat construction-2mm in height, the KS52000 is suited for application in equipment no thicker than a pocket notebook.

FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATION



Symbol	Description
K ₁ ~ K ₄	Parallel input port
α, β	Individual input port
R ₁ ~ R ₄	Output port
O _{S1} , O _{S2} , O ₁₁ ~ O ₄₈	Segment output port
H ₁ , H ₂	Common output (3-level)
DIO ₁ ~ DIO ₄	I/O port (tri-state)
O _{IN} , O _{OUT}	Crystal oscillator port
ACL	Automatic clear port
V _M	Center tap of V _{DD}
V _{DD} , V _{SS}	Power port
T ₁ , T ₂	Test port



ABSOLUTE MAXIMUM RATINGS

Characteristics	Symbol	Value	Unit
Supply Voltage	V_{DD}	-0.3 to +3.5	V
Supply Voltage (Medium)	V_M	-0.3 to +3.5	V
Input Voltage, All Inputs	V_{IN}	-0.3 to +3.5	V
Ambient Operating Temperature Range	T_{opr}	-5 to +55	°C
Storage Temperature Range	T_{stg}	-20 to +70	°C

RECOMMENDED OPERATING CONDITIONS

Characteristics	Symbol	Min.	Typ.	Max.	Unit
Supply Voltages	V_{DD}	+2.6	+3.0V	+3.4	V
	V_M	$0.45V_{DD}$	$0.5V_{DD}$	$0.55V_{DD}$	V
Oscillator Frequency	f_{OSC}		32,768		Hz

ELECTRICAL CHARACTERISTICS ($V_{DD} = +3V$, $T_a = 25^\circ C$)

Characteristics	Symbol	Min.	Typ.	Max.	Unit
Current Consumption Standby Mode in CEND Mode In Full Operation	I_{DD}	—	15	25	μA
	I_{DD}	—	45	60	μA
Input Currents, Inputs ACL, α , β , DIO ₁ to DIO ₄ , K ₁ to K ₄ Low State (Logic 0) High State (Logic 1)	I_{IL}	—	—	-15	μA
	I_{IH}	—	—	15	μA
Input Voltages, Input K ₁ to K ₄ , α , β Low State (Logic 0) High State (Logic 1)	V_{IL}	0	—	+0.6	V
	V_{IH}	$V_{DD}-0.6$	—	V_{DD}	V
Input Voltage, Input ACL Low State (Logic 0) High State (Logic 1)	V_{IL}	0	—	+0.3	V
	V_{IH}	$V_{DD}-0.3$	—	V_{DD}	V
Output Current, Outputs O ₁₁ to O ₄₈ , O _{S1} , O _{S2} , DIO ₁ to DIO ₄ , R ₂ , R ₃ at $V_{OH} = +2.7V$ Output R ₁ , R ₄	I_{OH}	—	-50	—	μA
	I_{OH}	—	-100	—	μA
Voltage Drop Across the Output Transistor, Outputs O ₁₁ to O ₄₈ , O _{S1} , O _{S2} , DIO ₁ to DIO ₄ , R ₂ , R ₃ at $I_{OH} = -50\mu A$ at $I_{OH} = -15\mu A$ Output R ₁ , R ₄ at $I_{OH} = -100\mu A$	ΔV	—	—	0.5	V
	ΔV	—	—	0.3	V
	ΔV	—	—	0.2	V
Instruction Cycle for 1 byte Instructions	t_{1b}	—	$2/f_{OSC}$	—	sec
Instruction Cycle for 2 byte Instructions	t_{2b}	—	$4/f_{OSC}$	—	sec

* All voltages are referred to V_{SS} (0V).



INSTRUCTION SETS

Mnemonic	Code	Micro Instruction
DECB	0110 1100	$(B_L) - 1 \rightarrow (B_L)$. Skip if $(B_L) = b$
EXBLA	000 1011	$(B_L) \rightarrow (ACC)$
INCB	0110 0100	$(B_L) + 1 \rightarrow (B_L)$. Skip if $(B_L) = a$
② LBL x,y	0101 1111 $l_8 l_7 l_6 l_5$ $l_4 l_3 l_2 l_1$	l_8 to $l_5 \rightarrow (B_{M4}$ to $B_{M1})$, l_4 to $l_1 \rightarrow (B_{L4}$ to $B_{L1})$
LB x, y	0100 $l_4 l_3 l_1 l_1$	$l_4, l_3 \rightarrow (B_{L2,1})$, $l_2, l_1 \rightarrow (B_{M2,1})$
SBM	000 0010	$1 \rightarrow (B_{M3})$ for next step only
ATBP	0000 0001	$(ACC) \rightarrow (B_p)$
ATF	0110 0000	$(ACC) \rightarrow (F)$
ATR	0110 0001	$(ACC) \rightarrow (R)$
ATW	0101 1101	$(ACC) \rightarrow (W'_{i8})$ ($i=1$ to 4). Right shift W'_{in} ($i=1$ to 4 ; $n=7$ to 0)
② DTA x	0101 1110 **** $\cdot 1 l_2 l_1$	$(DIV) \rightarrow (ACC)$
EXCD x	0001 $11 l_2 l_1$	$(ACC) \rightarrow ((B_L), (B_M))$. $(B_{M2,1}) \oplus l_2, l_1 \rightarrow (B_{M2,1})$. $(B_L) - 1 \rightarrow (B_L)$. Skip if $(B_L) = b$
EXCI x	0001 $01 l_2 l_1$	$(ACC) \rightarrow ((B_L), (B_M))$. $(B_{M2,1}) \oplus l_2, l_1 \rightarrow (B_{M2,1})$. $(B_L) + 1 \rightarrow (B_L)$. Skip if $(B_L) = a$
EXC x	0001 $00 l_2 l_1$	$(ACC) \rightarrow ((B_L), (B_M))$. $(B_{M2,1}) \oplus l_2, l_1 \rightarrow (B_{M2,1})$
IDIV	0110 0101	$0 \rightarrow (DIV)$
KTA	0110 1010	$(K) \rightarrow (ACC)$
LAX x	0010 $l_4 l_3 l_2 l_1$	l_4 to $l_1 \rightarrow (ACC)$
LDA x	0001 $10 l_2 l_1$	$((B_L), (B_M)) \rightarrow (ACC)$. $(B_{M2,1}) \oplus l_2 l_1 \rightarrow (B_{M2,1})$
PATW	0000 0000	$(ACC) \rightarrow (W'_{i8}) \rightarrow (W'_{i7})$ ($i=1$ to 4)
PTW	0101 1001	$(W'_{im}) \rightarrow (W'_{im})$ ($i=1$ to 4 ; $m=8, 7$)
RC	0110 0110	$0 \rightarrow (C)$
READ	0110 1000	$(DIO) \rightarrow (ACC)$
RM _p	0000 $01 l_2 l_1$	$0 \rightarrow ((B_L), (B_M))_p$, where $p=l_2, l_1$
SC	0110 0111	$1 \rightarrow (C)$
SM _p	0000 $11 l_2 l_1$	$1 \rightarrow ((B_L), (B_M))_p$, where $p=l_2, l_1$
TW	0101 1100	$(W'_{in}) \rightarrow (W_{in})$ ($i=1$ to 4 ; $n=0$ to 8)
WR	0110 0010	$0 \rightarrow (W'_{48})$, right shift W'_{in}
WRITE	0110 1001	$(ACC) \rightarrow (DIO)$
WS	0110 0011	$1 \rightarrow (W'_{48})$, right shift W'_{in}
ADD	0000 1000	$((B_L), (B_M)) + (ACC) \rightarrow (ACC)$
ADD11	0000 1001	$((B_L), (B_M)) + (C) + (ACC) \rightarrow (ACC)$. $C_4 \rightarrow (C)$. Skip if $C_4 = 1$
ADX x	0011 $l_4 l_3 l_2 l_1$	$l_{4,3,2,1} + (ACC) \rightarrow (ACC)$. Skip if $C_4 = 1$
DC	0011 1010	$10_{10} + (ACC) \rightarrow (ACC)$. No Skip
COMA	0000 1010	$(ACC) \rightarrow (ACC)$
ROT	0110 1011	$(C) \rightarrow (ACC_4) \rightarrow (ACC_3) \rightarrow (ACC_2) \rightarrow (ACC_1) \rightarrow (C)$
TA	0101 0000	Skip if $(\alpha) = 1$. $0 \rightarrow (\alpha)$
TA0	0101 1010	Skip if $(ACC) = 0$
TABL	0101 1011	Skip if $(ACC) = (B_L)$
② TAL	0101 1110 **** $\cdot 010$	Skip if $(BA) = 1$
TAM	0101 0011	Skip if $(ACC) = ((B_L), (B_M))$



INSTRUCTION SETS (Continued)

Mnemonic	Code	Micro Instruction
TB	0101 0001	Skip if $(\beta)=1$
TC	0101 0010	Skip if $(C)=0$
T1S	0101 1000	Skip if $(TS)=0$
TM _p	0101 01 <i>l</i> ₂ <i>l</i> ₁	Skip if $((B_L), (B_M))_p = 1$, where $p = l_2, l_1$
② CEND	0101 1110 **** *000	→ Standby
② ST	0101 1110 **** *011	1 → (T)
ATPL	0000 0011	(ACC) → (P _{L1} to P _{L4})
COMCB	0110 1101	(C _B) → (C _B)
SSR x	0111 <i>l</i> ₄ <i>l</i> ₃ <i>l</i> ₂ <i>l</i> ₁	<i>l</i> ₄ to <i>l</i> ₁ → (S _{U4} to S _{U1}). 1 → (E)
TR0	10 <i>l</i> ₆ <i>l</i> ₅ <i>l</i> ₄ <i>l</i> ₃ <i>l</i> ₂ <i>l</i> ₁	if (G)=0: <i>l</i> ₆ to <i>l</i> ₁ → (P _{L6} to P _{L1}). 9S _U → P _U . (C _B) → (C _A) if (G)=1: <i>l</i> ₆ to <i>l</i> ₁ → (P _{L6} to P _{L1}).
TR1A	11 <i>l</i> ₆ <i>l</i> ₅ <i>l</i> ₄ <i>l</i> ₃ <i>l</i> ₂ <i>l</i> ₁	if (G) = 1: <i>l</i> _{6,5} → (P _{U2,1}) except that (P _{U2}) is not affected if (C _x) = 1. <i>l</i> ₄ to <i>l</i> ₁ → (P _{L4} to P _{L1}). 0 → (P _{L6,5})
TR1	11 <i>l</i> ₆ <i>l</i> ₅ <i>l</i> ₄ <i>l</i> ₃ <i>l</i> ₂ <i>l</i> ₁	if (G)=0, (E)=0: <i>l</i> ₆ to <i>l</i> ₁ → (P _{L6} to P _{L1}). (P _U) → (S _U). 0 → (P _U). (P _L) + 1 → (S _L). (C _A) → (C _S). 1 → (C _A). 1 → (G). 1 → (D) if (G)=0, (E)=1: <i>l</i> ₆ to <i>l</i> ₁ → (P _{L6} to P _{L1}). (P _U) → (S _U). 1 ↔ (G). (P _L) + 1 → (S _L). (C _A) → (C _S). (C _B) → (C _A)
JMP	<i>l</i> ₈ <i>l</i> ₇ <i>l</i> ₆ <i>l</i> ₅ <i>l</i> ₄ <i>l</i> ₃ <i>l</i> ₂ <i>l</i> ₁	if (D)=1: <i>l</i> ₈ → (C _x). <i>l</i> ₈ → (P _{U4}). <i>l</i> ₈ ∧ <i>l</i> ₇ → (P _{U3}). <i>l</i> ₈ ∨ <i>l</i> ₇ → (P _{U2}). <i>l</i> ₆ → (P _{U1}) <i>l</i> ₅ to <i>l</i> ₁ → (P _{L5} to P _{L1}). 0 → (P _{L6}). 0 → (D)
RTN0	0110 1110	(C _S) → (C _A). (S _U) → (P _U). (S _L) → (P _L). 0 → (G). 0 → (C _x)
RTN1	0110 1111	(C _S) → (C _A). (S _U) → (P _U). (S _L) → (P _L). 0 → (G). 0 → (C _x). Skip

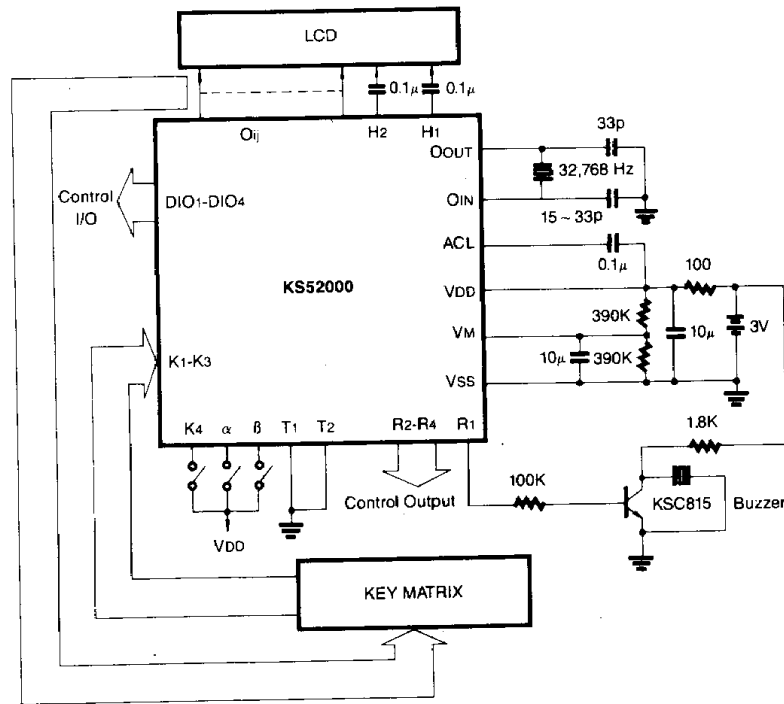
Note: * means redundancy. ② LBL, ② DTA, ② TAL, ② CEND, and ② ST are two-byte instructions.

APPLICATIONS

- Programmable IR transmitters for cordless remote control
- Auto dialler for intelligent pushbutton telephone subsets
- Taximeters
- Clock calculators
- Precision clocks
- Stop watches
- Cash registers
- Vending machines
- Controllers for various home electric appliances
- Heart-rate monitors
- Drivers for LCDs
- Hand-held instruments (ther-mometers etc.)
- Controllers for toys and games.

Note: SAMSUNG SEMICONDUCTOR & TELECOMMUNICATIONS CO., LTD. reserves the right to change products and specifications without notice.

SYSTEM ORGANIZATION (Example)



4

PACKAGE DIMENSION
60-PIN FLAT QUAD PACKAGE

