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 : 61μsec (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 smll power consumption
- Internal low-voltage detection circuit
- 60-pin flat quad package

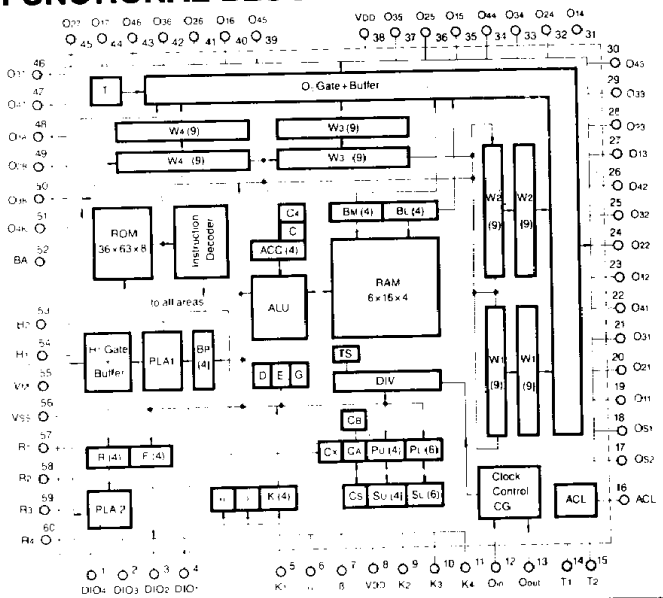
GENERAL DESCRIPTION

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

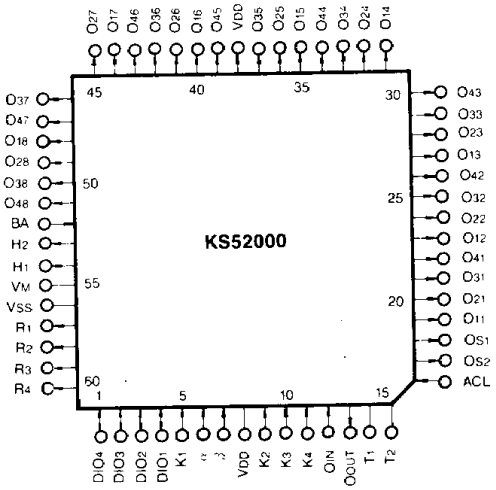
The KS52000 contains on a single silicon chip of a few square millimeters area a 2268 byte ROM, a RAM of 96 words, 8 static registers with 9 bits each, a 15-stage frequency divider, the colck oscillator, ALU and accumulator, programmable logic arrays (PLA) and other logic circuits: See Functional Block 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
$K_1 \sim K_4$	Parallel input port
α, β	Individual input port
$R_1 \sim R_4$	Output port
$O_{S1}, O_{S2}, O_{11} \sim O_{48}$	Segment output port
H_1, H_2	Common output (3-level)
$DIO_1 \sim DIO_4$	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°C)

Characteristics	Symbol	Min.	Typ.	Max.	Unit
Current Consumption					
Standby Mode in CEND Mode	I_{DD}	—	15	25	μA
In Full Operation	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)	I_{IL}	—	—	−15	μA
High State (Logic 1)	I_{IH}	—	—	15	μA
Input Voltages, Input K_1 to K_4 α, β					
Low State (Logic 0)	V_{IL}	0	—	+0.6	V
High State (Logic 1)	V_{IH}	V_{DD}-0.6	—	V_{DD}	V
Input Voltage, Input ACL					
Low State (Logic 0)	V_{IL}	0	—	+0.3	V
High State (Logic 1)	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	I_{OH}	—	- 50	—	μA
Output R_1, R_4	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} = −50μA	ΔV	—	—	0.5	V
at I_{OH} = −15μA	ΔV	—	—	0.3	V
Output R_1, R_4 at I_{OH} = −100μA	ΔV	—	—	0.2	V
Instruction Cycle for 1 byte Instructions	t_{i1b}	—	$2/f_{OSC}$	—	sec
Instruction Cycle for 2 byte Instructions	t_{i2b}	—	$4/f_{OSC}$	—	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	$(B_L)\leftrightarrow(ACC)$
INCB	0110	0100	$(B_L)+1\rightarrow(B_L)$. Skip if $(B_L=a)$
② LBL x,y	0101	1111	I_8 to $I_5\rightarrow(B_{M4}$ to $B_{M1})$, I_4 to $I_1\rightarrow(B_{L4}$ to $B_{L1})$
	$I_8I_7I_6I_5$	$I_4I_3I_2I_1$	
LB x, y	0100	$I_4I_3I_1I_1$	I_4, $I_3\rightarrow(B_{L2,1})$. I_2, $I_1\rightarrow(B_{M2,1})$
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	$(ACC)\rightarrow(W'_{iB})$ (i=1 to 4). Right shift W'_{in} (i=1 to 4; n=7 to 0)
② DTA x	0101	1110	$(DIV)\rightarrow(ACC)$
	****	**I_2I_1	
EXCD x	0001	$11I_2I_1$	$(ACC)\rightarrow((B_L),(B_M))$. $(B_{M2,1})\oplus I_2$, $I_1\rightarrow(B_{M2,1})$. $(B_L)-1\rightarrow(BL)$. Skip if $(B_L)=b$
EXCI x	0001	$01I_2I_1$	$(ACC)\rightarrow((B_L),(B_M))$. $(B_{M2,1})\oplus I_2$, $I_1\rightarrow(B_{M2,1})$. $(B_L)+1\rightarrow(BL)$. Skip if $(B_L)=a$
EXC x	0001	$00I_2I_1$	$(ACC)\rightarrow((B_L),(B_M))$. $(B_{M2,1})\oplus I_2$, $I_1\rightarrow(B_{M2,1})$
IDIV	0110	0101	$0\rightarrow(DIV)$
KTA	0110	1010	$(K)\rightarrow(ACC)$
LAX x	0010	$I_4I_3I_2I_1$	I_4 to $I_1\rightarrow(ACC)$
LDA x	0001	$10I_2I_1$	$((B_L),(B_M))\rightarrow(ACC)$. $(B_{M2,1})\oplus I_2I_1\rightarrow(B_{M2,1})$
PATW	0000	0000	$(ACC)\rightarrow(W'_{iB})\rightarrow(W'_{i7})$ (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	$01I_2I_1$	$0\rightarrow((B_L),(B_M))_p$, where $p=I_2, I_1$
SC	0110	0111	$1\rightarrow(C)$
SM_p	0000	$11I_2I_1$	$1\rightarrow((B_L),(B_M))_p$, where $p=I_2, I_1$
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	$I_4I_3I_2I_1$	$I_{4,3,2,1}+(ACC)\rightarrow(ACC)$. Skip if $C_4=1$
DC	0011	1010	$10_{10}+(ACC)\rightarrow(ACC)$. No Skip
COMA	0000	1010	$\overline{(ACC)}\rightarrow(ACC)$
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	Skip if (BA)=1
	****	*010	
TAM	0101	0011	Skip if $(ACC)=((B_L),(B_M))$

INSTRUCTION SETS (Continued)

Mnemonic	Code		Micro Instruction
TB	0101	0001	Skip if (β)=1
TC	0101	0010	Skip if (C)=0
T1S	0101	1000	Skip if (TS)=0
TM_p	0101	$01I_2I_1$	Skip if $((B_L), (B_M))p = 1$, where $p = I_2, I_1$
② CEND	0101	1110	→Standby
	****	*000	
② ST	0101	1110	1→(T)
	****	*011	
ATPL	0000	0011	$(ACC)\rightarrow(P_{L1}$ to $P_{L4})$
COMCB	0110	1101	$(C_B)\rightarrow(C_B)$
SSR x	0111	$I_4I_3I_2I_1$	I_4 to $I_1\rightarrow(S_{U4}$ to $S_{U1})$. 1→(E)
TR0	$10I_6I_5$	$I_4I_3I_2I_1$	if (G)=0:
			I_6 to $I_1\rightarrow(P_{L6}$ to $P_{L1})$. $9S_U\rightarrow P_U)$. $(C_B)\rightarrow(C_A)$
			if (G)=1:
			I_6 to $I_1\rightarrow(P_{L6}$ to $P_{L1})$.
TR1A	$11I_6I_5$	$I_4I_3I_2I_1$	if (G) = 1:
			$I_{6,5}\rightarrow(P_{U2,1})$ execpt that (P_{U2}) is not affected if $(C_x) = 1$. I_4 to $I_1\rightarrow(P_{L4}$ to $P_{L1})$. $0\rightarrow(P_{L6,5})$
TR1	$11I_6I_5$	$I_4I_3I_2I_1$	if (G)=0, (E)=0:
			I_6 to $I_1\rightarrow(P_{L6}$ to $P_{L1})$. $(P_U)\rightarrow(S_U)$. $0\rightarrow(P_U)$. $(P_L)+1\rightarrow(S_L)$. $(C_A)\rightarrow(C_S)$.
			$1\rightarrow(C_A)$. $1\rightarrow(G)$. $1\rightarrow(D)$
			if (G)=0, (E)=1:
			I_6 to $I_1\rightarrow(P_{L6}$ to $P_{L1})$. $(P_U)\rightarrow(S_U)$. $1\leftrightarrow(G)$. $(P_L)+1\rightarrow(S_L)$.
			$(C_A)\rightarrow(C_S)$. $(C_B)\rightarrow(C_A)$
JMP	$I_8I_7I_6I_5$	$I_4I_3I_2I_1$	if (D)=1:
			$I_8\rightarrow(C_x)$. $I_8\rightarrow(P_{U4})$. $I_8 \wedge I_7\rightarrow(P_{U3})$. $I_8 \vee I_7\rightarrow(P_{U2})$. $I_6\rightarrow(P_{U1})$
			I_5 to $I_1\rightarrow(P_{L5}$ to $P_{L1})$. $0\rightarrow(P_{L6})$. $0\rightarrow(D)$
RTN0	0110	1110	$(C_S)\rightarrow(C_A)$. $(S_U)\rightarrow(P_U)$. $(S_L)\rightarrow(P_L)$. $0\rightarrow(G)$. $0\rightarrow(C_X)$
RTN1	0110	1111	$(C_S)\rightarrow(C_A)$. $(S_U)\rightarrow(P_U)$. $(S_L)\rightarrow(P_L)$. $0\rightarrow(G)$. $0\rightarrow(C_x)$. Skip

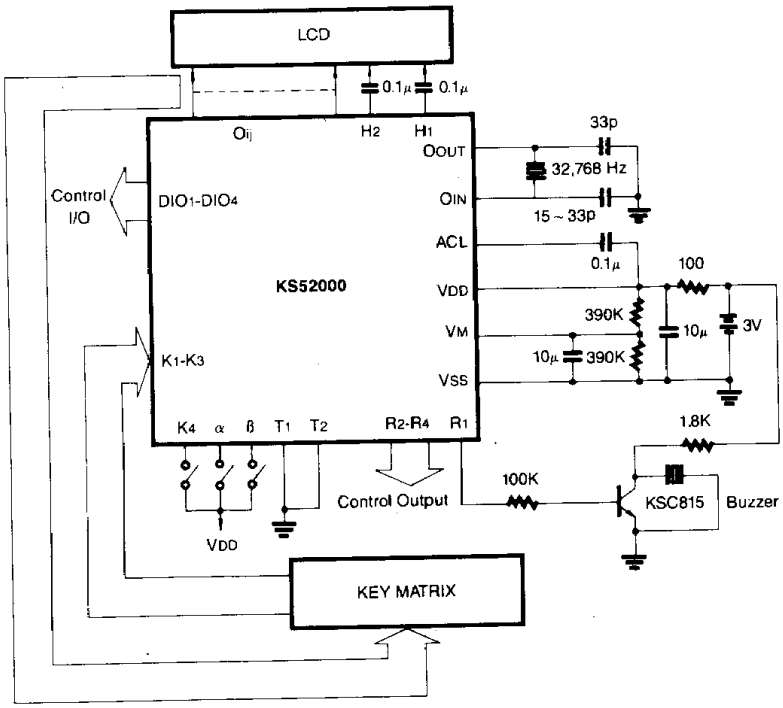
Note: * means redundancy. ② LBL, ② DTA, ② TAL, ② CEND, and ② ST are two-byte instructions.

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. reservers the right to change products and specifications without notice.

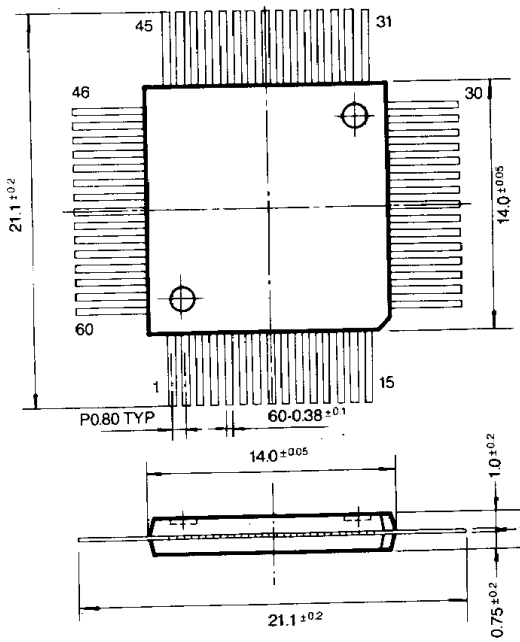
SYSTEM ORGANIZATION (Example)



PACKAGE DIMENSION

60-PIN FLAT QUAD PACKAGE

STANDARD



FORWARD BENDING

Units: mm