

INSTRUCTION SET

Instructions	Code										Description	Execution time (fosc = 250KHz)	Execution time (fosc = 160KHz)	
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0				
Clear display	0	0	0	0	0	0	0	0	0	1	Cursor is resumed to home Position (address 0) after entire display clear	82μs ~ 1.64ms	120μs ~ 4.9ms	
Cursor at home	0	0	0	0	0	0	0	0	1	*	Cursor is resumed to home Position (address 0). Shifted display is also returned to the original position. Contents of DDRAM are not changed	40μs ~ 1.6ms	120μs ~ 4.8ms	
Entry mode set	0	0	0	0	0	0	0	1	I/D	S	Cursor advance direction and display shift are set. These operations are performed during data write and read modes	40μs	120μs	
Display ON/OFF control	0	0	0	0	0	0	1	D	C	B	Entire display ON/OFF (D), cursor ON/OFF (C) and character blink (B) at cursor position are set.	40μs	120μs	
Cursor / display shift	0	0	0	0	0	1	S/C	R/L	*	*	Cursor and display are shifted without changing the contents of DDRAM	40μs	120μs	
Function set	0	0	0	0	1	DL	N	F	*	*	Interface data length (DL), number of display lines (N) and character font (F) are set.	40μs	120μs	
CGRAM address set	0	0	0	1	Acc					CGRAM address is set. Transmitted and received after this are the data of CGRAM.		40μs	120μs	
DDRAM address set	0	0	1	ADD					DDRAM address is set. Transmitted and received after this are the data of DDRAM.		40μs	120μs		
Busy flag	0	0	BF	AC					Busy flag (BF) showing internal operation and contents of address counter are read.		1μs	1μs		
CGRAM/DDRAM data write	1	0	Write Data					Data are written in DDRAM or CGRAM		40μs	120μs			
CGRAM/DDRAM data read	1	1	Read Data					Data are read out of DDRAM or CGRAM		40μs	120μs			
	I/D = 1 : Increment (+1) I/D = 0 : Decrement (-1) S = 1 : With display shift S/C = 1 : With display shift S/C = 0 : Cursor movement R/L = 1 : Shift to the right R/L = 0 : Shift to the left DL = 1 : 8 bits DL = 0 : 4 bits N = 1 : 2 lines N = 0 : 1 line F = 1.5 x 10 dots F = 0.5 x 7 dots BF = 1 : Internal operation is being performed BF = 0 : Instruction acceptable										DDRAM : Display data RAM CGRAM : Character Generator RAM ACC : Address of CGRAM ADD : Address of DDRAM These correspond to cursor address. AC : Address counter used for both DDRAM and CGRAM.		Execution time changes with change in internal oscillation frequency (fosc). (Ex.) When fosc = 270KHz. $40\mu s \times \frac{250}{270} = 37\mu s$	

INTRODUCTION CODE EXPLANATIONS

The two registers 1) Instruction Register (IR) and the 2) Data Register (DR) in the KS0066 controller chip are directly controlled by the MPU. Control information is temporarily stored in these registers prior to internal operation start. This allows interface to various types of MPUs which operate at different

speeds from that of the S6A0069, and allows interface from peripheral control ICs. Internal operations of the S6A0069 are determined from the signals sent from the MPU. These signals, including register selection signals (RS), Read/Write (R/W) and data bus signals (DB0 - DB7) are polled instructions.

REGISTER SELECTION		
RS	R/W	Operation
0	0	IR selection, IR write. Internal operation: Display clear
0	1	Busy flag (DB7) and address counter (DB0 to DB6) read
1	0	DR selection, DR write. Internal operation: DR to DD RAM or CG RAM
1	1	DR selection, DR read. Internal operation: DD RAM or CG RAM to DR

ADDRESS COUNTER (AC)

The counter specifies an address when data is written into DD RAM or CG RAM and the data stored in DD RAM or CG RAM is read out. If an Address Set instruction (for DD RAM or CG RAM) is written in the IR, the address information is transferred from the IR to the AC. When display data is writ-

ten into or read from DD RAM or CG RAM, the AC is automatically incremented or decremented by one according to the Entry Mode Set. The contents of the AC are output to DB0 to DB6; refer to above "Register Selection Table" when RS = 0 and R/W = 1.

CLEAR DISPLAY

RS R/W DB7 _____ DB0

Code

0	0	0	0	0	0	0	0	0	0	1
---	---	---	---	---	---	---	---	---	---	---

Clear all display memory and return the cursor to the

home position. In other words, the cursor returns to the first character block on the first line on all 1, 2, and 4 line character modules except MC404. If the above is entered on E2 (the second controller for lines 3 and 4), the cursor will return to the first character on the third line.

CURSOR HOME

RS R/W DB7 _____ DB0

Code

0	0	0	0	0	0	0	0	0	1	*
---	---	---	---	---	---	---	---	---	---	---

*Doesn't matter

Returns cursor to home position. First line first character

blocks on all 1, 2 and 4 line display; except MC404 refer "clear display": (Address 0; A_{DD} "80"). The contents of the DD RAM remain unchanged.

RESTRICTIONS ON EXECUTION OF DISPLAY CLEAR AND CURSOR HOME INSTRUCTIONS

Conditions of use	Restrictions
When executing the Display Clear or Cursor Home instruction when the display is shifted (after execution of Display Shift instruction).	The Cursor Home instruction should be executed again immediately after the Display Clear or Cursor Home instruction is executed. Do not leave an interval of a multiple of $400/f_{osc}$ * second after the first execution. • L4052: $f_{osc} = 250$ kHz • The other modules: $f_{osc} = 270$ kHz * f_{osc} : Oscillation frequency
When 23 _H , 27 _H , 63 _H , or 67 _H is used as a DD RAM address to execute Cursor Home instruction.	Before executing the Cursor Home instruction, the data of the four DD RAM addresses given at the left should be read and saved. After execution, write the data again in DD RAM. (This restriction is necessary to prevent the contents of the DD RAM addresses from being destroyed after the Cursor Home instruction has been executed.)

ENTRY MODE SET

RS R/W DB7 _____ DB0

Code

0	0	0	0	0	0	0	1	I/D	S
---	---	---	---	---	---	---	---	-----	---

I/D: Increments (I/D = 1) or decrements (I/D = 0) the DD RAM address by one block when writing or reading a character code from DD RAM or CG RAM. The cursor automatically moves to the right when incremented by one or to the left if decremented by one.

S: Shifts the entire display to either the right or left when S = 1 (high). When S = 1 and I/D = 1 the display shifts one position to the left. When S = 1 and I/D = 0 the display shifts one position to the right. This right or left shift occurs after each data write to DD RAM. Display is not shifted when reading from DD RAM. Display is not shifted when S = 0.

DISPLAY AND CURSOR ON/OFF CONTROL

RS R/W DB7 _____ DB0

Code

0	0	0	0	0	0	1	D	C	B
---	---	---	---	---	---	---	---	---	---

D: Display is turned ON when D = 1 and OFF when D = 0. When display is OFF, display data in DD RAM remains unchanged. Information comes back immediately when D = 1 is entered.

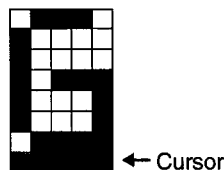
does not change during display data write. In a 5 x 7 dot matrix there is an eighth line which functions as the cursor.

C: Cursor is displayed when C = 1 and not displayed when C = 0. If the cursor disappears, function of I/D etc.

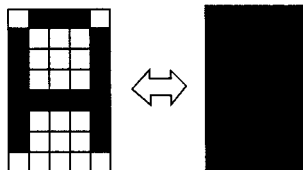
B: When B = 1, the character at the cursor position starts blinking. When B = 0 the cursor does not blink. The blink is done by stiching between the all black dot matrix and displayed character at 0.4 seconds intervals. The cursor and the blink can be set at the same time (fosc = 250 kHz).

5 x 7 DOT MATRIX

C = 1 (cursor display)



B = 1 (blinking)



CURSOR OR DISPLAY SHIFT

RS R/W DB7 _____ DB0

Code

0	0	0	0	0	1	S/C	R/L	*	*
---	---	---	---	---	---	-----	-----	---	---

* Doesn't Matter

Cursor/Display Shift moves the cursor or shifts the display without changing the DD RAM contents.

The cursor position and the AC contents match. This instruction is available for display correction and retrieval because the cursor position or display can be shifted without writing or reading display data. In case of a 2-line display, the

cursor is shifted from character block 40 of line 1 to character block 1 of line 2. Displays of lines 1 and 2 are shifted at the same time. In case of a 4-line display, the cursor does not move continuously from line 2 to line 3. The cursor is shifted from character block 40 of line 3 to character block 1 of line 4. Displays of lines 3 and 4 are shifted at the same time. The display pattern of line 2 or 4 is not shifted to line 1 or 3.

S/C	R/L	Operation
0	0	The cursor position is shifted to the left (the AC decrements one)
0	1	The cursor position is shifted to the right (the AC increments one)
1	0	The entire display is shifted to the left with the cursor
1	1	The entire display is shifted to the right with the cursor

