Ordering number : EN4248A

CMOS LSI

LC74770M

On-Screen Display Controller LSI

Overview

The LC74770M is a CMOS LSI that implements on-screen display, a function that displays characters and patterns on display screens such as camcorder viewfinder screens under microprocessor control. This LSI displays 12-dot by 18-dot characters.

Features

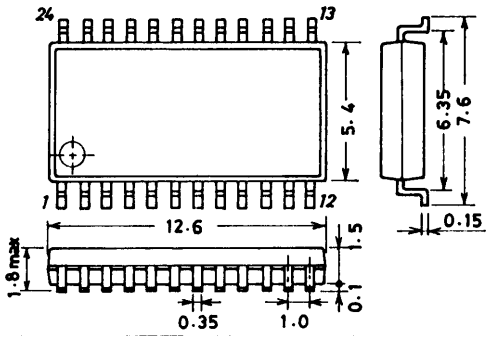
- Display format: 24 characters by 12 rows (up to 288 characters)
- Characters displayed: Up to 288 characters
- Character format: 12 (horizontal) × 18 (vertical)
- Characters in font: 128
- Character sizes: Normal and double
- Initial display positions: 64 horizontal positions and 64 vertical positions
- Reverse video function: Characters can be displayed in reverse video specified in units of individual characters.
- Blinking types: In character units in one of two periods, 1.0 second and 0.5 second, with a 50% duty.
- Outputs: Character and blanking data, with two output systems for each
- External control input: 8-bit serial input format
- General-purpose output port: 4 bits (controlled from the serial input data)

Package Dimensions

unit: mm

3112-MFP24S

[LC74770M]



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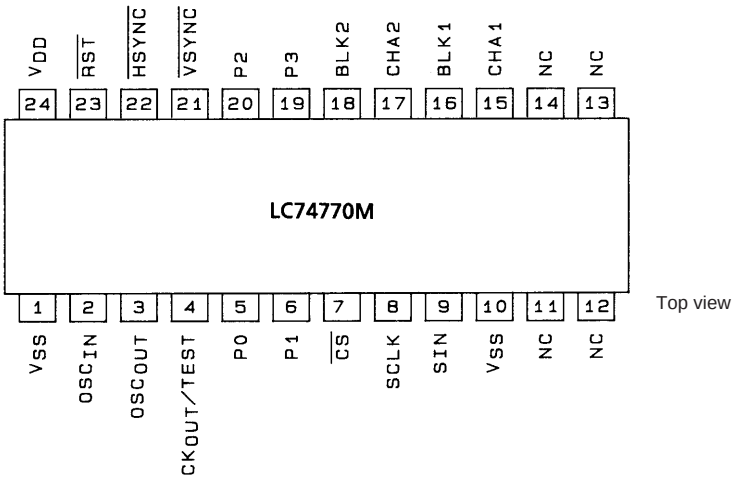
Pin Assignment



Top view

Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{DD} max	V_{DD}	V_{SS} – 0.3 to V_{SS} + 7.0	V
Maximum input voltage	V_{IN} max	All input pins	V_{SS} – 0.3 to V_{DD} + 0.3	V
Maximum output voltage	V_{OUT} max	BLK1, BLK2, CHA1, CHA2, P0 to P3, CK_{OUT}	V_{SS} – 0.3 to V_{DD} + 0.3	V
Allowable power dissipation	Pd max		300	mW
Operating temperature	Topr		–30 to +70	°C
Storage temperature	Tstg		–40 to +125	°C

Allowable Operating Ranges at Ta = –30 to +70°C

Parameter	Symbol	Conditions	min	typ	max	Unit
Supply voltage	V_{DD}	V_{DD}	4.5	5.0	5.5	V
Input high-level voltage	V_{IH}	$\overline{RST}$, $\overline{CS}$, SIN, SCLK, $\overline{HSYNC}$, $\overline{VSYNC}$	0.8 V_{DD}		V_{DD} + 0.3	V
Input low-level voltage	V_{IL}	$\overline{RST}$, $\overline{CS}$, SIN, SCLK, $\overline{HSYNC}$, $\overline{VSYNC}$	V_{SS} – 0.3		0.2 V_{DD}	V
Oscillator frequency	f_{OSC}	OSC_{IN} and OSC_{OUT} oscillator pins	5	7	10	MHz

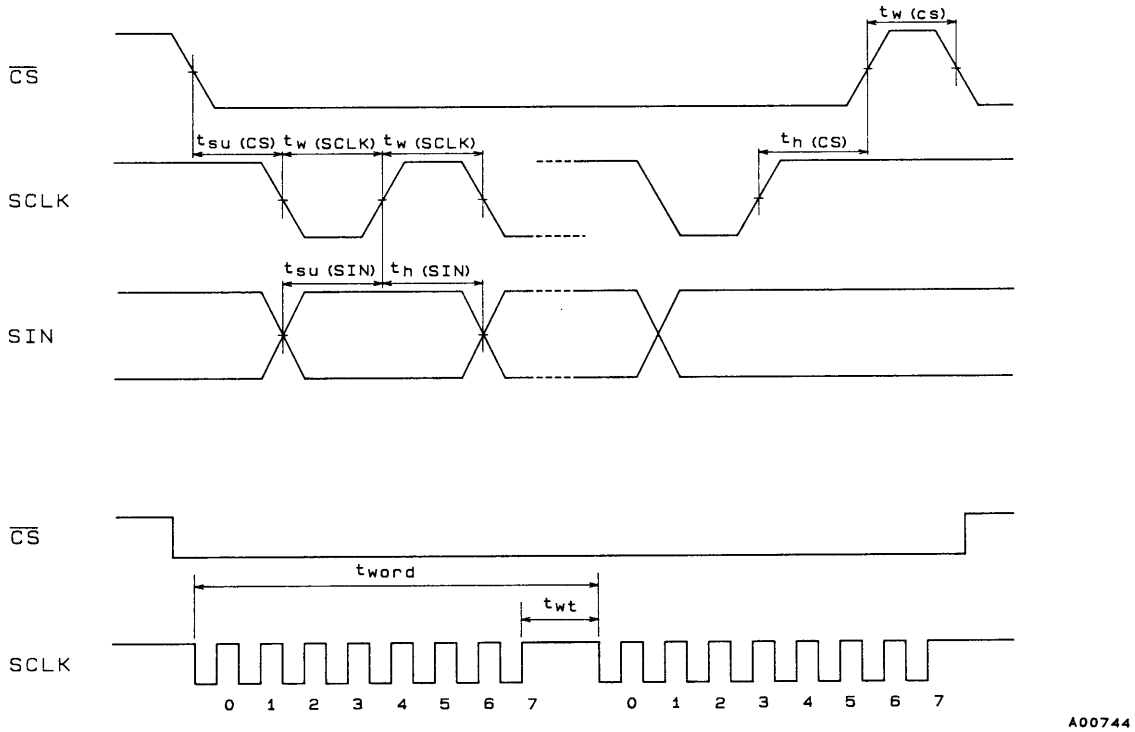
Electrical Characteristics at Ta = –30 to +70°C, V_{DD} = 5 V unless otherwise specified.

Parameter	Symbol	Conditions	min	typ	max	Unit
Output high-level voltage	V_{OH}	BLK1, BLK2, CHA1, CHA2, P0 to P3: V_{DD} = 5.0 V, I_{OH} = –1.0 mA	4.5			V
Output low-level voltage	V_{OL}	BLK1, BLK2, CHA1, CHA2, P0 to P3: V_{DD} = 5.0 V, I_{OL} = 1.0 mA			0.5	V
Input current	I_{IH}	$\overline{RST}$, $\overline{CS}$, SIN, SCLK, $\overline{HSYNC}$, $\overline{VSYNC}$: V_{IN} = V_{DD}			1	µA
	I_{IL}	$\overline{HSYNC}$, $\overline{VSYNC}$: V_{IN} = V_{SS}	–1			µA
Operating current drain	I_{DD}	V_{DD}: all outputs open, LC = 7 MHz			10	mA

Timing Characteristics at Ta = –30 to +70°C, V_{DD} = 5 ± 0.5 V

Parameter	Symbol	Conditions	min	typ	max	Unit
Minimum input pulse width	$t_{W\ (SCLK)}$	SCLK	200			ns
	$t_{W\ (CS)}$	$\overline{CS}$ (the period that $\overline{CS}$ is high)	1			µs
Data setup time	$t_{SU\ (CS)}$	$\overline{CS}$	200			ns
	$t_{SU\ (SIN)}$	SIN	200			ns
Data hold time	$t_{h\ (CS)}$	$\overline{CS}$	2			µs
	$t_{h\ (SIN)}$	SIN	200			ns
Single word write time	t_{word}	The time to write 8 bits of data	4.2			µs
	t_{wt}	The time to write RAM data	1			µs

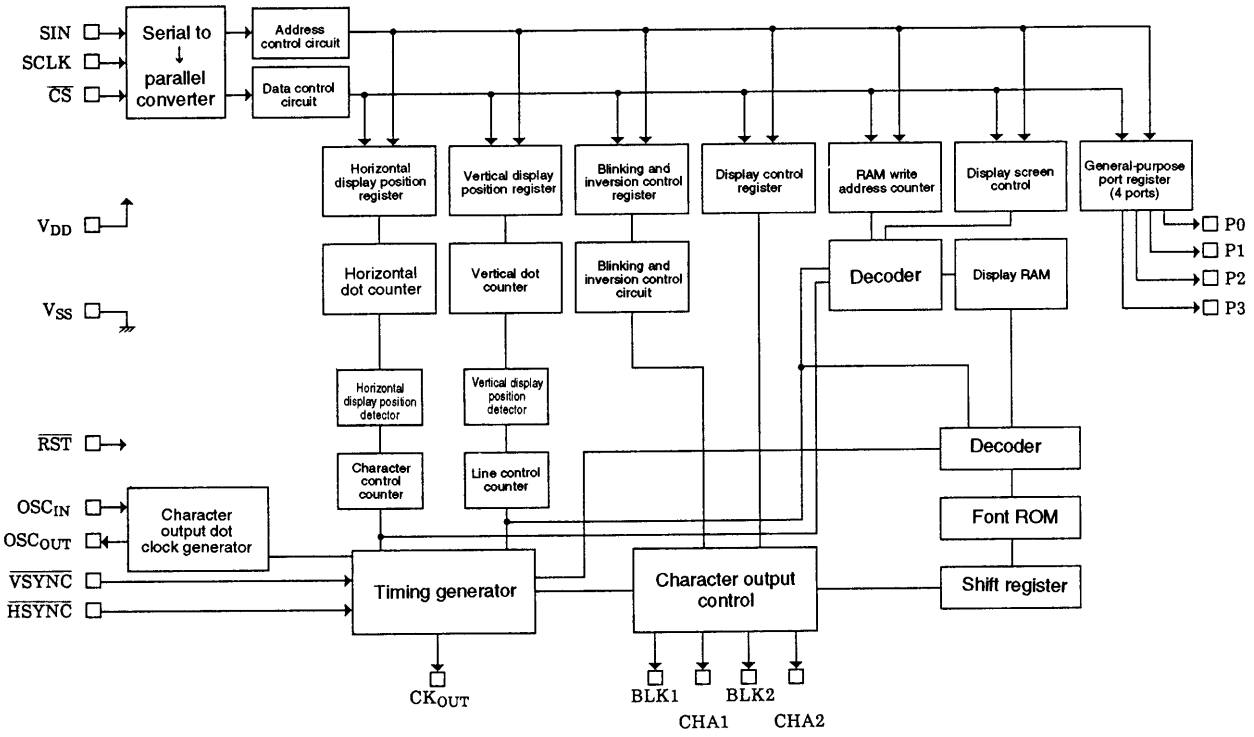
Serial Data Input Timing



Pin Functions

No.	Symbol	Pin	Function
1	V_{SS}	Ground pin	Ground connection
2	OSC_{IN}	LC oscillator pin	Connections for the coil and capacitor that form the oscillator that generates the character output dot clock.
3	OSC_{OUT}		
4	CK_{OUT}/TEST	Clock output/test output pin	Provides the OSC_{OUT} output (when $\overline{RST}$ is low) and the test mode output.
5	P0	General-purpose port 0 output pin	General-purpose port (PORT0) output
6	P1	General-purpose port 1 output pin	General-purpose port (PORT1) output
7	$\overline{CS}$	Enable input pin	Enable input for the serial data input function. Serial data input is enabled when this pin is low. A pull-up resistor is built in, i.e., this is a hysteresis input.
8	SCLK	Clock input pin	Clock input for the serial data input function. A pull-up resistor is built in, i.e., this is a hysteresis input.
9	SIN	Data input pin	Serial data input. A pull-up resistor is built in, i.e., this is a hysteresis input.
10	V_{SS}	Ground pin	Ground connection
11	NC	No connection	Unused pins. These pins must be left open or connected to ground.
12	NC	No connection	
13	NC	No connection	
14	NC	No connection	
15	CHA1	Character 1 output pin	System 1 character data output
16	BLK1	Blank 1 output pin	System 1 blank data output
17	CHA2	Character 2 output pin	System 2 character data output
18	BLK2	Blank 2 output pin	System 2 blank data output
19	P3	General-purpose port 3 output pin	General-purpose port (PORT3) output
20	P2	General-purpose port 2 output pin	General-purpose port (PORT2) output
21	$\overline{VSYNC}$	Vertical synchronizing signal input pin	Input for the vertical synchronizing signal (active low)
22	$\overline{HSYNC}$	Horizontal synchronizing signal input pin	Input for the horizontal synchronizing signal (active low)
23	$\overline{RST}$	Reset input pin	System reset input (active low) A pull-up resistor is built in, i.e., this is a hysteresis input.
24	V_{DD}	Power supply pin (+5 V)	Power supply (+5 V)

Block Diagram



Display Control Commands

Display control commands have an 8-bit format and are transferred using the serial input function. Commands consist of a command identification code in the first byte and command data in the following bytes. The following commands are supported.

1 COMMAND 0: Display memory (VRAM) write address setup command
2 COMMAND 1: Display character data write command
3 COMMAND 2: Vertical display start position and vertical character size setup command
4 COMMAND 3: Horizontal display start position and horizontal character size setup command
5 COMMAND 4: Display control setup command
6 COMMAND 5: System 2 (BLK2 and CHA2) output control (lines 1 to 6) and line size setting command
7 COMMAND 6: System 2 (BLK2 and CHA2) output control (lines 7 to 12) and general-purpose port setting command

Display Control Command Table

Command	First byte								Second byte							
	Command identification code				Data				Data							
	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
COMMAND 0 Write address	1	0	0	0	V3	V2	V1	V0	0	0	0	H4	H3	H2	H1	H0
COMMAND 1 Character write	1	0	0	1	0	0	0	0	at	c6	c5	c4	c3	c2	c1	c0
COMMAND 2 Vertical display position start position	1	0	1	0	0	0	0	0	0	0	VP5	VP4	VP3	VP2	VP1	VP0
COMMAND 3 Horizontal display position start position	1	0	1	1	0	0	0	0	0	0	HP5	HP4	HP3	HP2	HP1	HP0
COMMAND 4 Display control	1	1	0	0	TST	RCL	OSC	RST	0	MD1	MD0	EG	BK1	BK0	RV	DSP
COMMAND 5 BLK2 and CHA2 output control: lines 1 to 6, and line size control	1	1	0	1	0	0	0	LS	0	0	LN6	LN5	LN4	LN3	LN2	LN1
COMMAND 6 BLK2 and CHA2 output control: lines 7 to 12, and general-purpose port control	1	1	1	0	P3	P2	P1	P0	0	0	LN12	LN11	LN10	LN9	LN8	LN7

Once written, the command identification code in the first byte is stored until the next first byte is written. However, when the display character data write command (COMMAND1) is written, the LC74770M locks into the display character data write mode, and another first byte cannot be written.
When a high level is input to the $\overline{CS}$ pin, the LC74770M is set to COMMAND0 (display memory write address setup mode).

1 COMMAND 0 (Display memory write address setup command)

First byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	1	Command 0 identification code Sets the display memory write address.	
6	—	0		
5	—	0		
4	—	0		
3	V3	0	Display memory address (0 to B hexadecimal)	
		1		
2	V2	0		
		1		
1	V1	0		
		1		
0	V0	0		
		1		

Second byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	0	Second byte identification bit	
6	—	0		
5	—	0		
4	H4	0	Display memory address (0 to 17 hexadecimal)	
		1		
3	H3	0		
		1		
2	H2	0		
		1		
1	H1	0		
		1		
0	H0	0		
		1		

Note: All registers are set to 0 when the LC74770M is reset by the RST pin.

2 COMMAND 1 (Display character data write setup command)

First byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	1	Command 1 identification code Sets up display character data write.	When this command is input, the LC74770M locks into the display character data write mode until the $\overline{CS}$ pin goes high.
6	—	0		
5	—	0		
4	—	1		
3	—	0		
2	—	0		
1	—	0		
0	—	0		

Second byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	at	0	Character attribute off	
		1	Character attribute on	
6	c6	0	Character code (00 to 7F hexadecimal)	
		1		
5	c5	0		
		1		
4	c4	0		
		1		
3	c3	0		
		1		
2	c2	0		
		1		
1	c1	0		
		1		
0	c0	0		
		1		

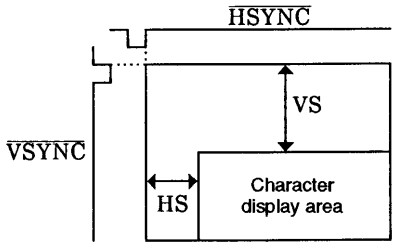
Note: All registers are set to 0 when the LC74770M is reset by the $\overline{RST}$ pin.

3 COMMAND 2 (Vertical display start position setup command)

First byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	1	Command 2 identification code Sets the vertical display start position.	
6	—	0		
5	—	1		
4	—	0		
3	—	0		
2	—	0		
1	—	0		
0	—	0		

Second byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	0	Second byte identification bit	
6	—	0		
5	VP5 (MSB)	0	If VS is the vertical display start position then: $VS = H \times (\sum_{n=0}^{5} 2^n VP_n)$ H: the horizontal synchronization pulse period  	The vertical display start position is set by the 6 bits VP0 to VP5. The weight of bit 1 is 1H.
		1		
4	VP4	0		
		1		
3	VP3	0		
		1		
2	VP2	0		
		1		
1	VP1	0		
		1		
0	VP0 (LSB)	0		
		1		

Note: All registers are set to 0 when the LC74770M is reset by the $\overline{RST}$ pin.

4 COMMAND 3 (Horizontal display start position setup command)

First byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	1	Command 3 identification code Sets the horizontal display start position.	
6	—	0		
5	—	1		
4	—	1		
3	—	0		
2	—	0		
1	—	0		
0	—	0		

Second byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	0	Second byte identification bit	
6	—	0		
5	HP5 (MSB)	0	If HS is the horizontal start position then: $HS = Tc \times (\sum_{n=0}^{5} 2^n HP_n)$ Tc: Period of the oscillator connected to OSC_{IN}/OSC_{OUT} in operating mode.	The horizontal display start position is set by the 6 bits HP0 to HP5. The weight of bit 1 is 1Tc.
		1		
4	HP4	0		
		1		
3	HP3	0		
		1		
2	HP2	0		
		1		
1	HP1	0		
		1		
0	HP0 (LSB)	0		
		1		

Note: All registers are set to 0 when the LC74770M is reset by the $\overline{RST}$ pin.

5 COMMAND 4 (Display control setup command)

First byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	1	Command 4 identification code Sets up display control.	
6	—	1		
5	—	0		
4	—	0		
3	TST (TSTMOD)	0	Normal operating mode	This bit must be zero.
		1	Test mode	
2	RCL (RAMCLR)	0		Valid when display is off.
		1	Erase display RAM (Data is set to 7F hexadecimal.)	
1	OSC (OSCSTP)	0	Do not stop the LC oscillator circuit.	This bit must be zero.
		1	Stop the LC oscillator circuit.	
0	RST (SYSRST)	0		The LSI is reset when the $\overline{CS}$ pin is low, and the reset is cleared when that pin goes high.
		1	Reset all registers and turn the display off.	

Second byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	0	Second byte identification bit	
6	MD1	0	The blank output also outputs character data.	Blank output control
		1	The blank output only outputs blank data.	
5	MD0	0	The system 1 output outputs all lines.	Output system 1 control
		1	The system 1 output only outputs lines not output by system 2.	
4	EG	0	Border off	
		1	Border on	
3	BK1	0	Blinking period set to about 0.5 second.	Blinking period switching
		1	Blinking period set to about 1 second.	
2	BK0	0	Blinking off	Blinking of reverse video characters consists of alternation between normal and reverse video.
		1	Blinking on	
1	RV	0	Reverse video off	
		1	Reverse video on	
0	DSP (DSPON)	0	Character display off	
		1	Character display on	

Note: All registers are set to 0 when the LC74770M is reset by the $\overline{\text{RST}}$ pin.

6 COMMAND 5 (System 2 output control and line size setting command)

First byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	1	Command 5 identification code Controls output system 2 and sets the line size. (Output control for CHA2 and BLK2) (Line size control)	
6	—	1		
5	—	0		
4	—	1		
3	—	0		
2	—	0		
1	—	0		
0	LS	0	Output line selection	The line is selected in the second byte.
		1	Character size selection (line units)	

Second byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	0	Second byte identification bit	
6	—	0		
5	LN6	0	The sixth line of data is not output to CHA2 and BLK2.	Used for the line output setting when LS is low. Used for the line size setting when LS is high. Note: LS = 1: Set the line size. LS = 0: Specifies line output.
		1	The sixth line of data is output to CHA2 and BLK2.	
4	LN5	0	The fifth line of data is not output to CHA2 and BLK2.	
		1	The fifth line of data is output to CHA2 and BLK2.	
3	LN4	0	The fourth line of data is not output to CHA2 and BLK2.	
		1	The fourth line of data is output to CHA2 and BLK2.	
2	LN3	0	The third line of data is not output to CHA2 and BLK2.	
		1	The third line of data is output to CHA2 and BLK2.	
1	LN2	0	The second line of data is not output to CHA2 and BLK2.	
		1	The second line of data is output to CHA2 and BLK2.	
0	LN1	0	The first line of data is not output to CHA2 and BLK2.	
		1	The first line of data is output to CHA2 and BLK2.	

Note: All registers are set to 0 when the LC74770M is reset by the $\overline{\text{RST}}$ pin.

7 COMMAND 6 (System 2 output control and general-purpose port setting command)

First byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	1	Command 6 identification code Controls output system 2 output. (Output control for CHA2 and BLK2) (General-purpose port output control)	
6	—	1		
5	—	1		
4	—	0		
3	P3	0	Sets the general-purpose port output (P3) to low.	
		1	Sets the general-purpose port output (P3) to high.	
2	P2	0	Sets the general-purpose port output (P2) to low.	
		1	Sets the general-purpose port output (P2) to high.	
1	P1	0	Sets the general-purpose port output (P1) to low.	
		1	Sets the general-purpose port output (P1) to high.	
0	P0	0	Sets the general-purpose port output (P0) to low.	
		1	Sets the general-purpose port output (P0) to high.	

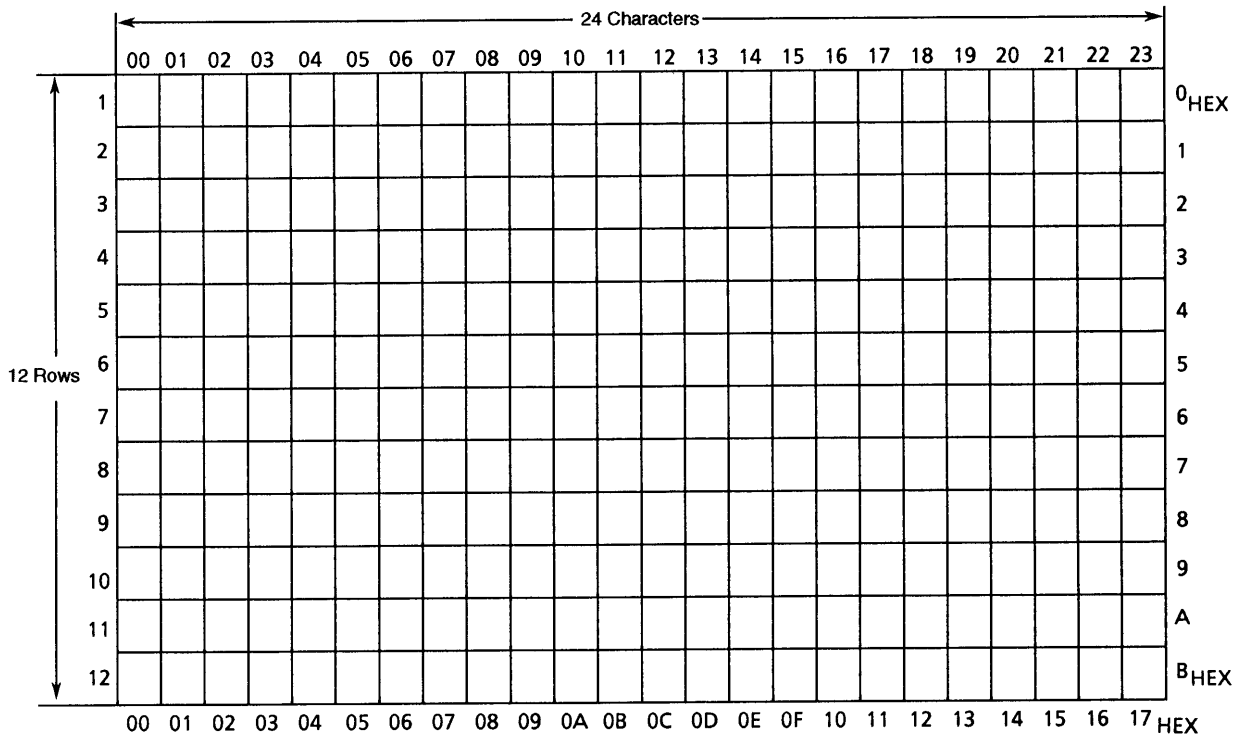
Second byte

DA0 to DA7	Register name	Register content		Note
		State	Function	
7	—	0	Second byte identification bit	
6	—	0		
5	LN12	0	The twelfth line of data is not output to CHA2 and BLK2.	Used for the line output setting when LS is low. Used for the line size setting when LS is high. Note: LS = 1: Set the line size. LS = 0: Specifies line output.
		1	The twelfth line of data is output to CHA2 and BLK2.	
4	LN11	0	The eleventh line of data is not output to CHA2 and BLK2.	
		1	The eleventh line of data is output to CHA2 and BLK2.	
3	LN10	0	The tenth line of data is not output to CHA2 and BLK2.	
		1	The tenth line of data is output to CHA2 and BLK2.	
2	LN9	0	The ninth line of data is not output to CHA2 and BLK2.	
		1	The ninth line of data is output to CHA2 and BLK2.	
1	LN8	0	The eighth line of data is not output to CHA2 and BLK2.	
		1	The eighth line of data is output to CHA2 and BLK2.	
0	LN7	0	The seventh line of data is not output to CHA2 and BLK2.	
		1	The seventh line of data is output to CHA2 and BLK2.	

Note: All registers are set to 0 when the LC74770M is reset by the $\overline{\text{RST}}$ pin.

Display Screen Structure

The display consists of 12 lines of 24 characters each and thus up to 288 characters can be displayed.
Display memory addresses are specified as row (0 to B hexadecimal) and column (0 to 17 hexadecimal) addresses.



Display Screen Structure (display memory addresses)