

## User's Guide

# NHD-12864EZ-FL-YBW

# LCM

(Liquid Crystal Display Graphic Module)

RoHS Compliant

NHD-	Newhaven Display
12864-	128 x 64 pixels
EZ-	Version Line
F-	Transflective
L-	Yellow/Green LED B/L
Y-	STN- Yellow/Green
B-	6:00 View
W-	Wide Temperature (-20 ~ +70c)

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For product support, contact

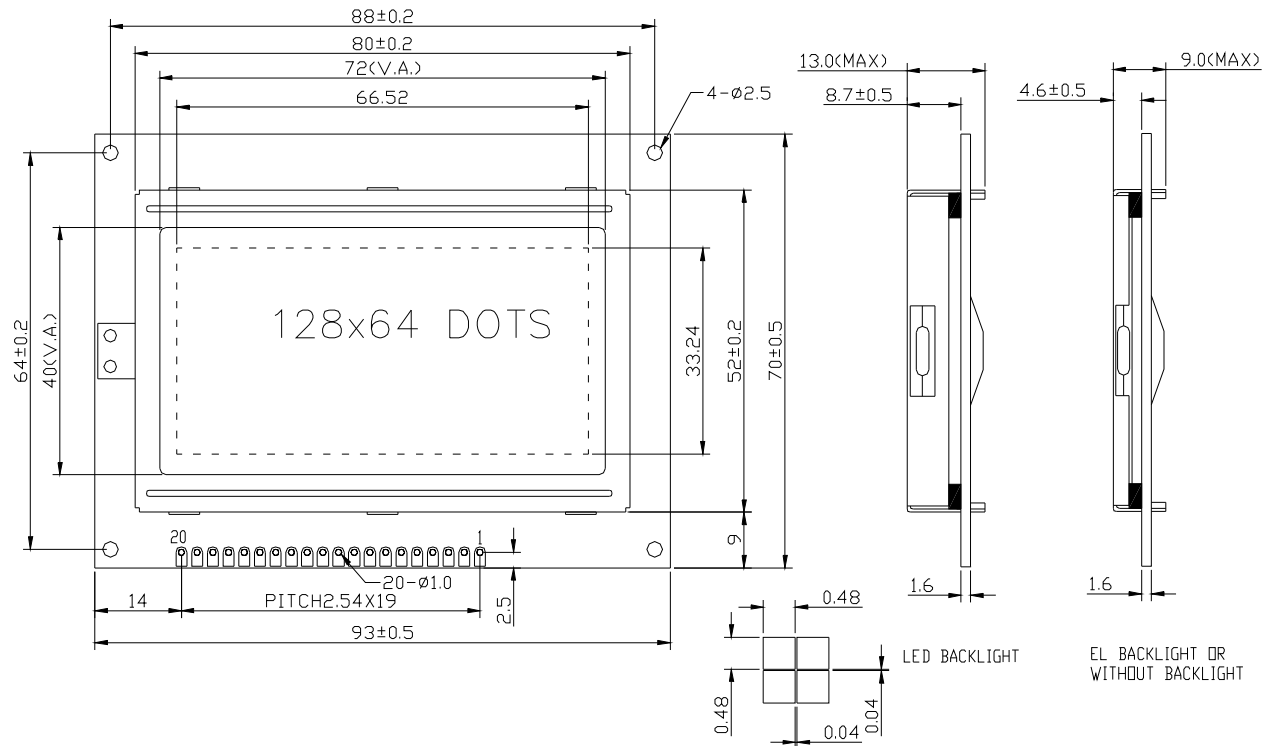
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**Elgin, IL 60124**

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February 29, 2008

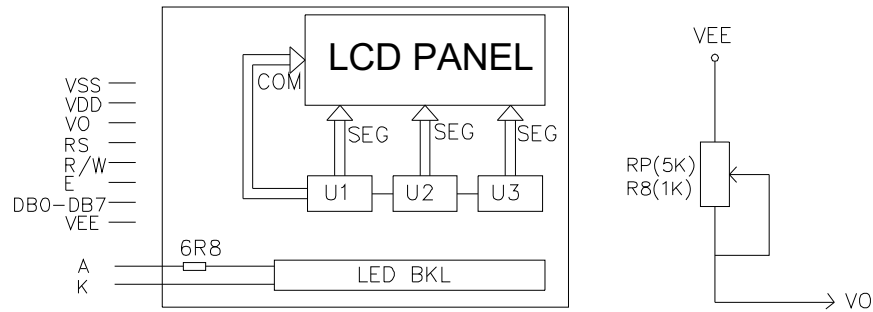
**NHD-12864EZ**
**◆ Feature**

1. 128X64 dots with 8192 chinese character fonts (16x16)
2. 128 alpha-numerical fonts (16x8)
3. 64X256 bit graphic display RAM
4. Strong display control fuctions: Vertical scroll, horizontal bit scroll, line reverse etc
5. +2.7~ +5.5V power supply
4. STN; 1/64 duty; LED BKL or EL BKL
7. 4bit, 8bit, serial interface

**◆ Mechanical diagram**

**◆ Mechanical data**

ITEM	STANDARD	UNIT
MODULE DIMENSION	93X70.0/9.0(EL)/13.0(LED)	mm
VIEWING AREA	72.0X40	mm
DOT SIZE	0.48X0.48	mm
DOT PITCH	0.52X0.52	mm

◆ **Block diagram**



◆ **Absolute Maximum Ratings**

ITEM	SYMBOL	MIN	MAX	UNIT
Power Voltage	$V_{DD}-V_{SS}$	0	5.5	V
Input Voltage	$V_I$	$V_{SS}$	$V_{DD}$	
LCD Voltage	$V_{LCD}$	4.5	7.0	
Operating temperature range	$V_{OP}$	-20	+70	°C
Storage temperature range	$T_{ST}$	-30	+80	

**DESCRIPTION OF TERMINALS**

PIN NO.	PIN NAME	INPUT/OUTPUT	EXTERNAL CONNECTION	FUNCTION
1	VSS	INPUT	POWER SUPPLY	VSS: GND
2	VDD	INPUT		VDD: +5V
3	VO	INPUT		$V_{LCD}$ ADJUSTMENT
4	RS(CS*)	INPUT	MPU	REGISTER SELECT SIGNAL “0”:INSTRUCTION REGISTER (WHEN WRITING) BUSY FLAG & ADDRESS COUNTER (WHEN READING) “1”:DATA REGISTER (WHEN WRITING & READING)
5	R/W(SID*)	INPUT	MPU	READ/WRITE SELECT SIGNAL “0” FOR WRITING , “1” FOR READING
6	E(SCLK*)	INPUT	MPU	OPERATION (DATA READ/WRITE) ENABLE SIGNAL
7 / 10	DB0-DB3	INPUT	MPU	LOW-ORDER LINES OF DATA BUS WITH 3-STATE, BI-DIRECTIONAL FUNCTION FOR USE IN DATA TRANSACTION WITH THE MPU. THESE LINES ARE NOT USED WHEN INTERFACING WITH A 4-BIT MICROPROCESSOR.
11 / 14	DB4-DB7	INPUT	MPU	HIGH-ORDER LINES OF DATA BUS WITH 3-STATE, BI-DIRECTIONAL FUNCTION FOR USE IN DATA TRANSACTIONS WITH THE MPU. DB7 MAY ALSO BE USED TO CHECK THE BUSY FLAG.
15	A	INPUT	BACKLIGHT	RESET SIGNAL
16	K	INPUT		DOUBLE VOLTAGE BOOSTER OUTPUT
17	/RST	INPUT		
18	VEE	OUTPUT		
19	A	INPUT	BACKLIGHT	
20	K	INPUT		

◆ **Optical Characteristics**

● **FOR STN TYPE DISPLAY MODULE** ( $T_A=25^{\circ}\text{C}$ ,  $V_{DD}=5.0\text{V}\pm 0.25\text{V}$ )

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
VIEWING ANGLE	$\Theta$	$C_R \geq 4$	-25	—	—	DEG
	$\Phi$		-30	—	30	
CONTRAST RATIO	$C_R$		—	2	—	—
RESPONSE TIME(RISE)	$T_R$	—	—	120	150	mS
RESPONSE TIME(FALL)	$T_R$	—	—	120	150	mS

● **STN TYPE DISPLAY MODULE** ( $T_A=25^{\circ}\text{C}$ ,  $V_{DD}=5.0\text{V}$ )

ITEM	SYMBOL	CONDITI ON	MIN.	TYP.	MAX.	UNIT
VIEWING ANGLE	$\Theta$	$C_R \geq 2$	-60	—	35	DEG
	$\Phi$		-40	—	40	
CONTRAST RATIO	$C_R$		—	6	—	—
RESPONSE TIME(RISE)	$T_R$	—	—	150	250	mS
RESPONSE TIME(FALL)	$T_R$	—	—	150	250	mS

◆ **Electrical Characteristics**

● **DC Characteristics( $T_a=25^{\circ}\text{C}$ ,  $V_{DD}=5.0\text{V}$ )**

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYPE	MAX.	UNIT
SUPPLY VOLTAGE FOR LCD	$V_{DD}-V_O$	$T_A=25^{\circ}\text{C}$	—	6.5	—	V
INPUT VOLTAGE	$V_{DD}$		3.0	5.0	5.5	V
SUPPLY CURRENT	$I_{DD}$	$V_{DD}=5.0\text{V}; T_A=25^{\circ}\text{C}$	—	0.5	0.7	mA
INPUT LEAKAGE CURRENT	$I_{LKG}$		—	—	1.0	$\mu\text{A}$
“H” LEVEL INPUT VOLTAGE	$V_{IH}$		3.5	—	$V_{DD}$	V
“L” LEVEL INPUT VOLTAGE	$V_{IL}$	TWICE INITIAL VALUE OR LESS	-0.3	—	0.6	V
“H” LEVEL OUTPUT VOLTAGE	$V_{OH}$	LOH= -0.25mA	4.0	—	—	V
“L” LEVEL OUTPUT VOLTAGE	$V_{OL}$	LOL=1.6mA	0	—	—	V
BACKLIGHT SUPPLY VOLTAGE	$V_F$		—	4.2	5.0	V

● **DC Characteristics( $T_a=25^{\circ}\text{C}$ ,  $V_{DD}=3.0\text{V}$ )**

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYPE	MAX.	UNIT
SUPPLY VOLTAGE FOR LCD	$V_{DD}-V_O$	$T_A=25^{\circ}\text{C}$	—	4.2	—	V
INPUT VOLTAGE	$V_{DD}$		—	3.0	3.3	V
SUPPLY CURRENT	$I_{DD}$	$V_{DD}=5.0\text{V}; T_A=25^{\circ}\text{C}$	—	0.4	0.7	mA
INPUT LEAKAGE CURRENT	$I_{LKG}$		—	—	1.0	$\mu\text{A}$
“H” LEVEL INPUT VOLTAGE	$V_{IH}$		3.5	—	$V_{DD}$	V
“L” LEVEL INPUT VOLTAGE	$V_{IL}$	TWICE INITIAL VALUE OR LESS	-0.3	—	0.6	V
“H” LEVEL OUTPUT VOLTAGE	$V_{OH}$	LOH= -0.25mA	4.0	—	—	V
“L” LEVEL OUTPUT VOLTAGE	$V_{OL}$	LOL=1.6mA	—	—	—	V
BACKLIGHT SUPPLY VOLTAGE	$V_F$		—	—	—	V

● **AC Characteristics (VDD=5V,TA=25°C) Parallel mode interface**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Internal clock operation						
f <sub>osc</sub>	OSC Frequency	R=33k	-	540	-	KHZ
External Clock Operation						
t <sub>EX</sub>	External Frequency	-	-	540	-	KHZ
	Duty Cycle	-	45	50	55	%
T <sub>R</sub> , T <sub>F</sub>	Rise/Fall Time	-	-	-	0.2	us
Write Mode (writing data from MPU to LCM)						
T <sub>C</sub>	Enable Cycle Time	Pin E	1200	-	-	ns
T <sub>PW</sub>	Enable Pulse Width	Pin E	140	-	-	
T <sub>r</sub> , T <sub>f</sub>	Enable rise/fall time	Pin E	-	-	25	ns
T <sub>AS</sub>	Address setup time	Pins: RS, RW, E	10	-	-	
T <sub>AH</sub>	Address hold time	Pins: RS, RW, E	20	-	-	
T <sub>DDR</sub>	Data delay time	Pins; DB0-DB7	40	-	-	
T <sub>H</sub>	Data hold time	Pins DB0-DB7	20	-	-	
Read mode (writing data from MPU to LCM)						
T <sub>C</sub>	Enable Cycle Time	Pin E	1200	-	-	ns
T <sub>PW</sub>	Enable Pulse Width	Pin E	140	-	-	
T <sub>r</sub> , T <sub>f</sub>	Enable rise/fall time	Pin E	-	-	25	ns
T <sub>AS</sub>	Address setup time	Pins: RS, RW, E	10	-	-	
T <sub>AH</sub>	Address hold time	Pins: RS, RW, E	20	-	-	
T <sub>DDR</sub>	Data delay time	Pins; DB0-DB7	-	-	100	
T <sub>H</sub>	Data hold time	Pins DB0-DB7	20	-	-	

● **AC Characteristics (VDD=5V,TA=25°C) Serial mode interface**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Internal clock operation						
T <sub>osc</sub>	OSC Frequency	R=33k	470	540	590	KHZ
External Clock Operation						
T <sub>EX</sub>	External Frequency	-	470	530	590	KHZ
	Duty Cycle	-	45	50	55	%
T <sub>R</sub> , T <sub>F</sub>	Rise/Fall Time	-	-	-	0.2	us
T <sub>SCYC</sub>	Enable Cycle Time	Pin E	600	-	-	ns
T <sub>SHW</sub>	Enable Pulse Width	Pin E	200	-	-	
T <sub>SLW</sub>	Enable rise/fall time	Pin E	200	-	-	
T <sub>SDS</sub>	Address setup time	Pin: RW	40	-	-	
T <sub>SDH</sub>	Address hold time	Pin: RW	40	-	-	
T <sub>CSS</sub>	Data delay time	Pin; RS	60	-	-	
T <sub>CSH</sub>	Data hold time	Pin: RS	60	-	-	

● **AC Characteristics (VDD=3.0V,TA=25°C) Parallel mode interface**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Internal clock operation						
F <sub>osc</sub>	OSC Frequency	R=18k	-	530	-	KHZ
External Clock Operation						
T <sub>EX</sub>	External Frequency	-	-	530	-	KHZ
	Duty Cycle	-	45	50	55	%
T <sub>R</sub> , T <sub>F</sub>	Rise/Fall Time	-	-	-	0.2	us
Write Mode (writing data from MPU to LCM)						
T <sub>C</sub>	Enable Cycle Time	Pin E	1800	-	-	ns
T <sub>PW</sub>	Enable Pulse Width	Pin E	160	-	-	
T <sub>r</sub> , T <sub>f</sub>	Enable rise/fall time	Pin E	-	-	25	ns
T <sub>AS</sub>	Address setup time	Pins: RS, RW, E	10	-	-	
T <sub>AH</sub>	Address hold time	Pins: RS, RW, E	20	-	-	
T <sub>DDR</sub>	Data delay time	Pins; DB0-DB7	40	-	-	
T <sub>H</sub>	Data hold time	Pins DB0-DB7	20	-	-	
Read mode (reading data form MPU to LCM)						
T <sub>C</sub>	Enable Cycle Time	Pin E	1800	-	-	ns
T <sub>PW</sub>	Enable Pulse Width	Pin E	320	-	-	
T <sub>r</sub> , T <sub>f</sub>	Enable rise/fall time	Pin E	-	-	25	ns
T <sub>AS</sub>	Address setup time	Pins: RS, RW, E	10	-	-	
T <sub>AH</sub>	Address hold time	Pins: RS, RW, E	20	-	-	
T <sub>DDR</sub>	Data delay time	Pins; DB0-DB7	-	-	260	
T <sub>H</sub>	Data hold time	Pins DB0-DB7	20	-	-	

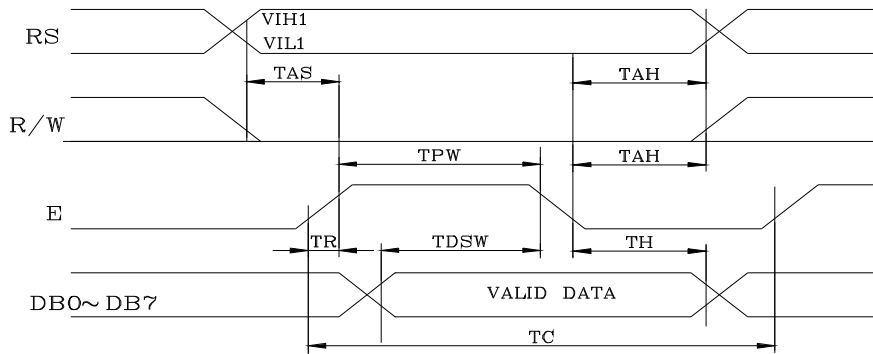
● **AC Characteristics (VDD=3.0V,TA=25°C) Serial mode interface**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Internal clock operation						
T <sub>osc</sub>	OSC Frequency	RF=18k	470	540	590	KHZ
External Clock Operation						
T <sub>EX</sub>	External Frequency	-	470	530	590	KHZ
	Duty Cycle	-	45	50	55	%
T <sub>R</sub> , T <sub>F</sub>	Rise/Fall Time	-	-	-	0.2	us
T <sub>SCYC</sub>	Enable Cycle Time	Pin E	600	-	-	ns
T <sub>SHW</sub>	Enable Pulse Width	Pin E	300	-	-	
T <sub>SLW</sub>	Enable rise/fall time	Pin E	300	-	-	
T <sub>SDS</sub>	Address setup time	Pin: RW	40	-	-	
T <sub>SDH</sub>	Address hold time	Pin: RW	40	-	-	
T <sub>CSS</sub>	Data delay time	Pin; RS	60	-	-	
T <sub>CSH</sub>	Data hold time	Pin: RS	60	-	-	

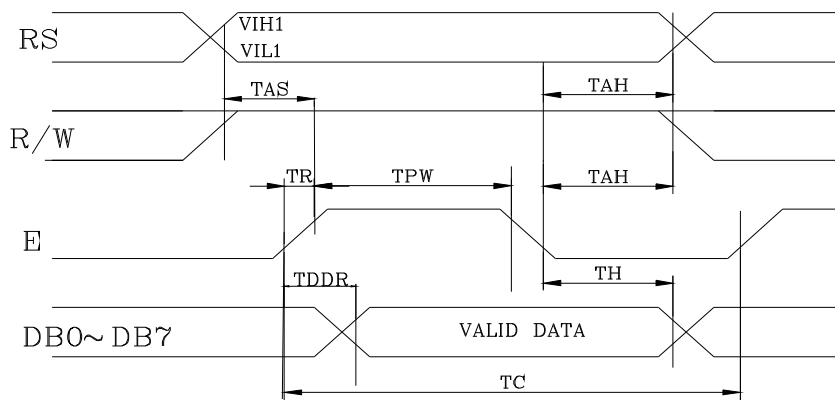
**NHD-12864EZ**

◆ **Timing Characteristics**

● **Writing data form MPU to LCM**

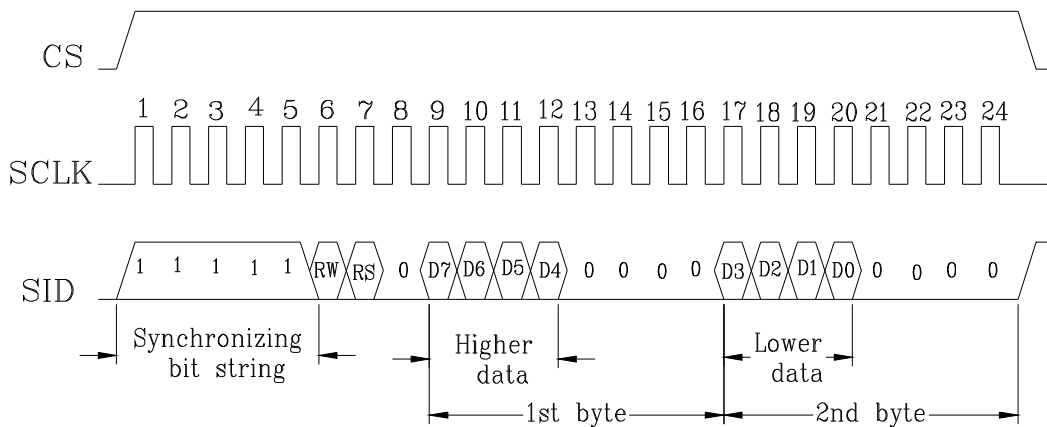


● **Reading data from LCM to MPU**



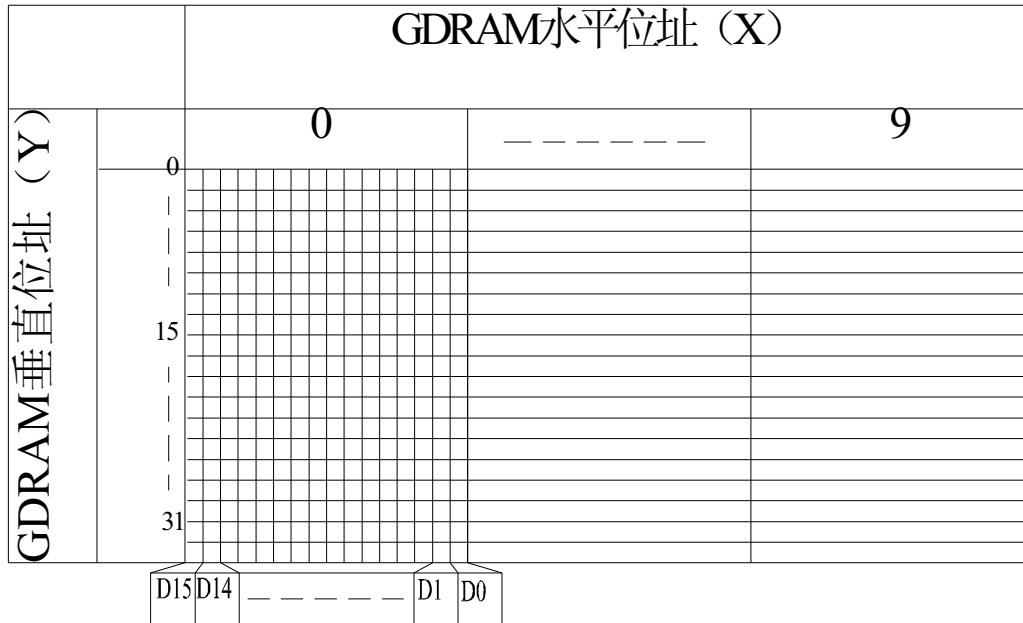
**serial interface & transferring serial data**

● **Writing data form MPU to LCM**



◆ **CGROM, CGRAM, ICON RAM, AND DDRAM, GDRAM**

● Graphic display data address map



**Table 1: 64 x 256-bit map display RAM (GDRAM) for graphic mode display**



**NHD-12864EZ**

● **Character generator ROM (CGROM)**

THE CHARACTER GENERATOR ROM GENERATES 16 X 16 DOT OR 16 X 8 DOT CHARACTER PATTERNS FROM TWO 8-BIT CHARACTER CODES. USER-DEFINED CHARACTER PATTERNS ARE ALSO AVAILABLE BY MASK-PROGRAMMED ROM.

● **Character generator RAM (CGRAM)**

IN THE CHARACTER GENERATOR RAM, THE USER CAN REWRITE CHARACTER PATTERNS BY PROGRAM. FOR 16 X 16 DOTS, FOUR CHARACTER PATTERNS CAN BE WRITTEN.

SEE TABLE 1 FOR THE RELATIONSHIP BETWEEN CGRAM ADDRESSES AND DATA AND DISPLAY PATTERNS. AREAS THEY ARE NOT USED FOR DISPLAY CAN BE USED AS GENERAL DATA RAM.

DDRAM DATA				CGRAM ADDRESS					CGRAM DATA HIGH BYTE				CGRAM DATA LOW BYTE																						
B15~B4	B3	B2	B1	B0	B5	B4	B3	B2	B1	B0	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0									
0	×	0	0	×	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0							
							0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0		
							0	0	1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0		
							0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0		
							0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0		
							0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0		
							0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0		
							0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
							0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
							0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
							0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
							0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
							0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
							0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
							0	×	0	1	×	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
														0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
0	0	1	0	0	0	0								0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0		
0	0	1	1	0	0	0								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
0	1	0	0	0	0	0								0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0		
0	1	0	1	0	0	0								0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0		
0	1	1	0	0	0	0								0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0		
0	1	1	1	0	0	0								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
0	1	1	1	0	0	0								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
0	1	1	1	0	0	0								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
0	1	1	1	0	0	0								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
0	1	1	1	0	0	0								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
0	1	1	1	0	0	0								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
0	1	1	1	0	0	0								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
0	1	1	1	0	0	0								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

Table 1

**Table 1: Relationship between CGRAM Addresses, Character Codes (DDRAM) and Character patterns (CGRAM Data)**

**Notes:**

1. Character code bits 1 to 2 correspond to CGRAM address bits 4 to 5 (2 bits: 4 types).
2. CGRAM address bits 0 to 3 designate the character pattern line position. The 16th line is the cursor position and a logical OR with the cursor forms its display. Maintain the 16th line data, corresponding to the cursor display position, at 0 as the cursor display. If the 16th line data is 1, 1 bits will light up the 16th line regardless of the cursor presence.
3. Character pattern row positions correspond to CGRAM data bits 0 to 15 (bit 15 being at the left).
- \*4. As shown Table, CGRAM character patterns are selected when character code bits 4 to 15 are all 0 and bit 0 and bit 3 are don't care (x).

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	X															
1	▶	◀	⚡	!!	¶	§	-	‡	†	↓	→	←	L	↔	▼	▲
2		!	"	#	\$	%	&	'	(	)	*	+	,	-	.	/
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	ⓐ	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	ⓑ	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^
6	ⓒ	'	a	b	c	d	e	f	g	h	i	j	k	l	m	n
7	ⓓ	ⓔ	p	q	r	s	t	u	v	w	x	y	z	{		}

**Table 2: 16K-bit half-size character generator ROM (HCGROM) for a total of 128 alpha-numerical fonts(16x8 dots)**

◆ **Control and display command**

● **Basic instruction**

**Instruction Table: (RE=0: Enable basic instruction.)**

Instruction	Instruction Code											Description	Execution Time (450KHZ)
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0			
Clear Display	0	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM, and set DDRAM address to "00H" from AC	2.5 ms
Return Home	0	0	0	0	0	0	0	0	0	1	X	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	2.5 ms
Entry Mode Set	0	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction and specifies display shift. These operations are performed during data write and read.	60us
Display ON/OFF	0	0	0	0	0	0	0	1	D	C	B	D=1: entire display on C=1: cursor on B=1: cursor position on	60 us
Cursor or Display Shift	0	0	0	0	0	0	1	S/C	R/L	X	X	Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.	60 us
Function Set (Modify)	0	0	0	0	1	DL	N	0	G	X	RE	DL: interface data is 8/4 bits N=1 & RE=0: 3 Line setting N=1 & RE=1: 4 Line setting G=1: Graphic display on G=0: Graphic display off Others: 2 Line setting RE=1: Extended instruction setting. RE=0: Normal instruction setting.	60 us
Set CGRAM address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0		Set CGRAM address in address counter	60 us
Set DDRAM address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0		Set DDRAM address in address counter	60 us
Read Busy flag and address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0		Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0 us
Write data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0		Write data into internal RAM (DDRAM/CGRAM/IRAM/GRAM)	60 us
Read data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0		Read data from internal RAM (DDRAM/CGRAM/IRAM/GRAM)	60 us

● **Extension instruction**

**Instruction Table: (RE=1: Enable extension instruction.)**

Instruction	Instruction Code											Description	Execution Time (540KHZ)
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0			
Standby Mode	0	0	0	0	0	0	0	0	0	0	1	Enter standby mode, only Icon areas display. Standby mode can be released by any other instructions.	60 us
Start Row Enable	0	0	0	0	0	0	0	0	0	1	SR	SR=1: Allow change start display Row. SR=0: Disable start display Row change.	60 us
Reverse Line Select	0	0	0	0	0	0	0	0	1	R1	R0	Choice one of 4 lines which data is reverse display.	60 us
Sleep mode and Set GRAM page	0	0	0	0	0	0	0	1	SL	GD	GW	SL=0: Enter sleep mode. SL=1: Wake-up from sleep mode. GD: Display graphic page 0 or 1 GW: Write data to graphic page 0 or 1. (Effective while GP=1)	60 us
Display Shift by dot	0	0	0	0	0	0	1	OA	LR	L1	L0	OA=1: One of 4 lines shift enable. OA=0: All line shift enable. LR=1: Dot by dot shift right. LR=0: Dot by dot shift left. L1, L0: Choice one of 4 lines shift.	60 us
Function Set (Modify)	0	0	0	0	0	1	CL	N	1	G	GP	CL=1: Select 16 character line CL=0: Select 8 character line N=1 & RE=1: 4 line display RE=1: Extended instruction setting. RE=0: Normal instruction setting. G=1: Graphic display on G=0: Graphic display off GP=1: Two page GRAM GP=0: One page GRAM	60 us
Set IRAM or Start Row address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0		SR=1: AC5~AC0 is start row SR=0: AC5~AC0 is ICON RAM address	60 us
Set Graphic RAM address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0		Set Graphic RAM address in address counter. Execute once set the address of display row. Execute again set the address of display column. Each address of display column has data of 16 bits. Therefore write data should execute 2 times.	60 us

**Note:**

Be sure the LCM is not in the busy state (BF = 0) before sending an instruction from the MPU to the LCM. If an instruction is sent without checking the busy flag, the time between the first instruction and next instruction will take much longer than the instruction time itself. Refer to Instruction Table for the list of each instruction execution time.

## ◆ Serial Interface & Transferring Serial Data

The LCM enters serial mode when the J8 is set low. A two-line clock synchronous transfer method is used. The LCM receives serial input data(SID) by synchronizing with a transfer clock(SCLK) sent from the master side.

When the MPU interfaces with several LCD MODULES, chip select pin(CS) must be used. The transfer clock(SCLK) input is activated by making chip select(CS) high. In addition, the transfer counter of the LCM can be reset and serial transfer synchronized by making chip select(CS) low. Here, since the data which was being sent at reset is cleared, restart the transfer from the first bit of this data. In a minimum system where a single LCM interfaces to a single MPU, an interface can be constructed from the transfer clock(SCLK) and serial input data(SID). In this case, chip select(CS) should be fixed to high.

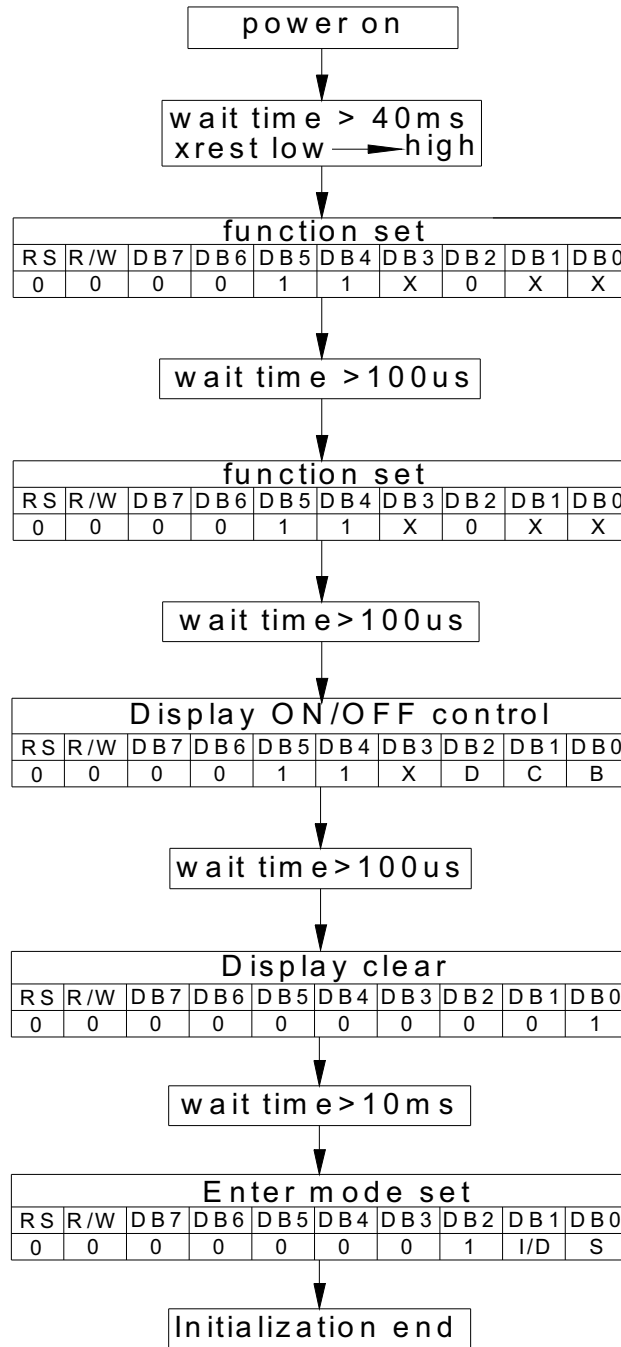
The transfer clock(SCLK) is independent of operational clock of the LCM. However, when several instructions are continuously transferred, the instruction execution time determined by the operational clock must be considered since the LCM does not have an internal transmit/receive buffer.

Following figure shows the basic procedure for transferring serial data. To begin with, transfer the start byte. By receiving five consecutive bits of 1(synchronizing bit string) at the beginning of the start byte, the transfer counter of the LCM is reset and serial transfer is synchronized. The 2 bits following the synchronizing bit string(5 bits) specify transfer direction(RW bit) and register select(RS bit). Be sure to transfer 0 in the 8 th bit.

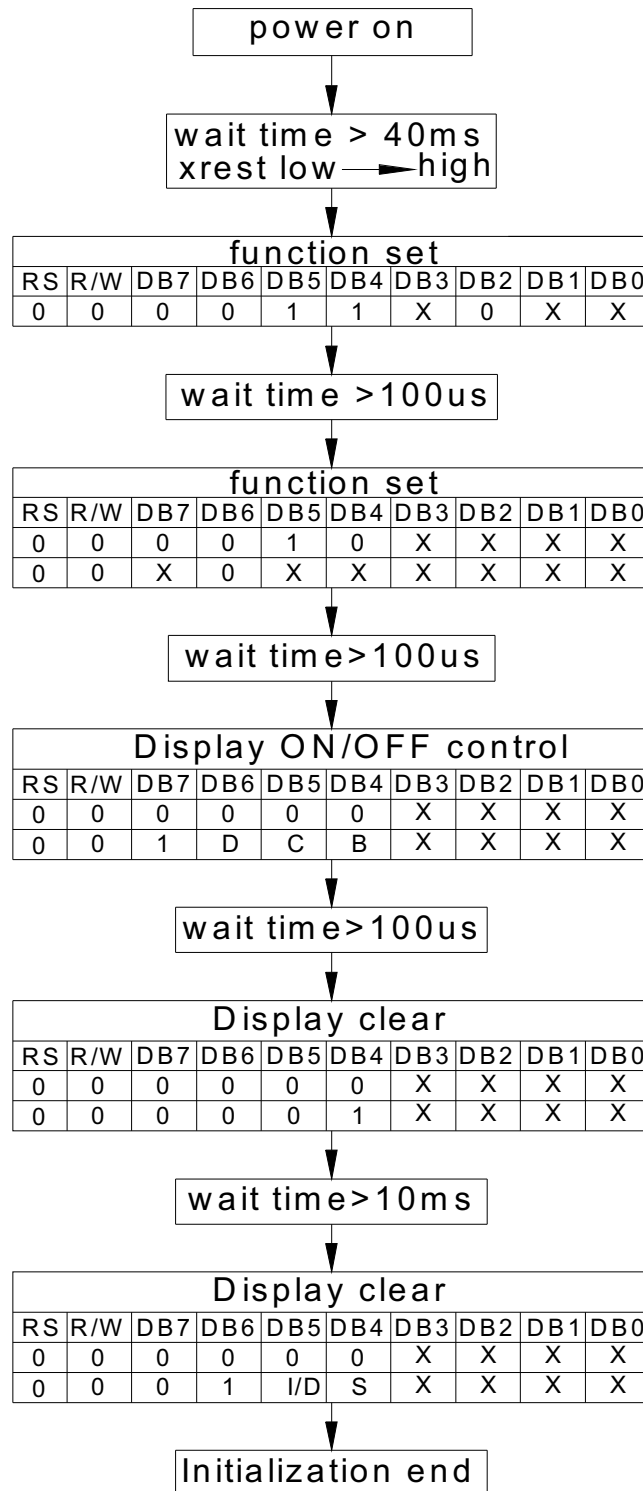
After receiving the start synchronizing bit string, the RW bit(=0), and RS bit in the start byte, an 8-bit instruction is received in 2 bytes: the higher 4 bits of the instruction are placed in the LSB of the first byte, and the lower 4 bits of the instruction are placed in the LSB of the second byte. Be sure to transfer 0 in the following 4 bits of each byte.

◆ **Initialization procedure**

- 8-bit Interface:



● 4-bit Interface:







NHD-12864EZ

ACB0 爲炳炬炯炭炸炮矧爰牲牯抵狩狼狡玷  
ACC0 珊玻玲珍珀玳甚畏界吠吹收疫疤疥  
ACD0 疣癸皆皇飯盈益盍盅省眈相眉看瘡  
ACE0 眇矜砂研砌欣祇社祜祜祜祜祜祜  
ACF0 突竿岑窳耶胖胥胥胥胥胥胥胥  
AD40 耐要岫芋苑苞苾苾苾苾苾苾苾  
AD50 致触岫芋苑苞苾苾苾苾苾苾苾  
AD60 苾岫芋苑苞苾苾苾苾苾苾苾  
AD70 計訂訃貞迨郊郎郁郤會酃重門限陋  
ADA0 迭迫迨迨迨迨迨迨迨迨迨迨迨  
ADB0 降面革韋非音頁風飛食首香乘  
ADC0 傲俯倦倥倥倥倥倥倥倥倥倥倥倥  
ADD0 倨俱倡個候倘俳修倭倪俾倫倉兼  
ADE0 冢凍凌准凋剖劊剔剛剛剛剛剛剛  
ADF0 唐唔嗜亨哥哲峻哺唔哩哭員唉  
AE40 哦啣唇唇唇唇唇唇唇唇唇唇唇  
AE50 娑娘娜媚媚媚媚媚媚媚媚媚媚  
AE60 妻哀寡宮展展展展展展展展展  
AE70 峰島崑崑崑崑崑崑崑崑崑崑崑  
AEA0 忒恥恐怨恭恩息悄悟悚悍悔悌悅  
AEB0 扇拳掣掣掣掣掣掣掣掣掣掣掣  
AEC0 挫挨捍捌效救料旁旅時晉晏晃晒  
AED0 晁晁晁晁晁晁晁晁晁晁晁晁晁  
AEE0 桌桑栽柴桐架格桃株桅桤移桁殊  
AEF0 氣氧氮氫氫氫氫氫氫氫氫氫氫  
AF40 涇涉浮浚浴浩涌忍泱泱泱泱泱  
AF50 烈烏參特狼狹狹狹狹狹狹狹狹  
AF60 畔畝畜畚畚畚畚畚畚畚畚畚  
AF70 咆益砗砗砗砗砗砗砗砗砗砗  
AFA0 砗砗砗砗砗砗砗砗砗砗砗砗砗  
AFB0 砗砗砗砗砗砗砗砗砗砗砗砗砗  
AFC0 素索純純純純純純純純純純純  
AFD0 耘耕耙耗耽耽耽耽耽耽耽耽耽  
AFE0 能脊胼胼胼胼胼胼胼胼胼胼胼  
AFF0 荆茸荐草茵茵茵茵茵茵茵茵茵  
B040 虔蚊蚪蚪蚪蚪蚪蚪蚪蚪蚪蚪蚪  
B050 訃訃訃訃訃訃訃訃訃訃訃訃訃  
B060 躬軒軻軻軻軻軻軻軻軻軻軻軻  
B070 郡郝郢郢郢郢郢郢郢郢郢郢郢  
B0A0 陸陝除陝陝陝陝陝陝陝陝陝  
B0B0 僞停假偃偃偃偃偃偃偃偃偃偃  
B0C0 匾僞僞僞僞僞僞僞僞僞僞僞僞  
B0D0 僞僞僞僞僞僞僞僞僞僞僞僞僞  
B0E0 啤唸售啜啜啜啜啜啜啜啜啜  
B0F0 埠埠基堂堵執執執執執執執執  
B140 娼婢婚婆姨執執執執執執執執  
B150 雁屏崇崕崕崕崕崕崕崕崕崕崕  
B160 常帶帳帷康庸庶庵庚張強彗彬  
B170 徙從徘御徠徠徠徠徠徠徠徠  
B1A0 情悻悻悻悻悻悻悻悻悻悻悻悻  
B1B0 掠控捲掖採接捷捧掘措捱捱捱  
B1C0 推掄掄掄掄掄掄掄掄掄掄掄掄  
B1D0 教敗啓敏敘救敵斜斛斬族旋旌  
B1E0 晤晨晦晞晞晞晞晞晞晞晞晞  
B1F0 梗槿槿槿槿槿槿槿槿槿槿槿  
B240 毫毳氤氤氤氤氤氤氤氤氤氤  
B250 涯淑澗澗澗澗澗澗澗澗澗澗澗  
B260 深淮淨滙滙滙滙滙滙滙滙滙滙

B270 犁猜猛猖猓猓猓猓猓猓猓猓猓  
B2A0 盜盛盒窳窳窳窳窳窳窳窳窳  
B2B0 窳窳窳窳窳窳窳窳窳窳窳窳  
B2C0 窳窳窳窳窳窳窳窳窳窳窳窳  
B2D0 窳窳窳窳窳窳窳窳窳窳窳窳  
B2E0 窳窳窳窳窳窳窳窳窳窳窳窳  
B2F0 窳窳窳窳窳窳窳窳窳窳窳窳  
B340 窳窳窳窳窳窳窳窳窳窳窳窳  
B350 窳窳窳窳窳窳窳窳窳窳窳窳  
B360 窳窳窳窳窳窳窳窳窳窳窳窳  
B370 窳窳窳窳窳窳窳窳窳窳窳窳  
B3A0 窳窳窳窳窳窳窳窳窳窳窳窳  
B3B0 窳窳窳窳窳窳窳窳窳窳窳窳  
B3C0 窳窳窳窳窳窳窳窳窳窳窳窳  
B3D0 窳窳窳窳窳窳窳窳窳窳窳窳  
B3E0 窳窳窳窳窳窳窳窳窳窳窳窳  
B440 窳窳窳窳窳窳窳窳窳窳窳窳  
B450 窳窳窳窳窳窳窳窳窳窳窳窳  
B460 窳窳窳窳窳窳窳窳窳窳窳窳  
B470 窳窳窳窳窳窳窳窳窳窳窳窳  
B4A0 窳窳窳窳窳窳窳窳窳窳窳窳  
B4B0 窳窳窳窳窳窳窳窳窳窳窳窳  
B4C0 窳窳窳窳窳窳窳窳窳窳窳窳  
B4D0 窳窳窳窳窳窳窳窳窳窳窳窳  
B4E0 窳窳窳窳窳窳窳窳窳窳窳窳  
B4F0 窳窳窳窳窳窳窳窳窳窳窳窳  
B540 窳窳窳窳窳窳窳窳窳窳窳窳  
B550 窳窳窳窳窳窳窳窳窳窳窳窳  
B560 窳窳窳窳窳窳窳窳窳窳窳窳  
B570 窳窳窳窳窳窳窳窳窳窳窳窳  
B5A0 窳窳窳窳窳窳窳窳窳窳窳窳  
B5B0 窳窳窳窳窳窳窳窳窳窳窳窳  
B5C0 窳窳窳窳窳窳窳窳窳窳窳窳  
B5D0 窳窳窳窳窳窳窳窳窳窳窳窳  
B5E0 窳窳窳窳窳窳窳窳窳窳窳窳  
B5F0 窳窳窳窳窳窳窳窳窳窳窳窳  
B640 窳窳窳窳窳窳窳窳窳窳窳窳  
B650 窳窳窳窳窳窳窳窳窳窳窳窳  
B660 窳窳窳窳窳窳窳窳窳窳窳窳  
B6A0 窳窳窳窳窳窳窳窳窳窳窳窳  
B6B0 窳窳窳窳窳窳窳窳窳窳窳窳  
B6C0 窳窳窳窳窳窳窳窳窳窳窳窳  
B6D0 窳窳窳窳窳窳窳窳窳窳窳窳  
B6E0 窳窳窳窳窳窳窳窳窳窳窳窳  
B6F0 窳窳窳窳窳窳窳窳窳窳窳窳  
B740 窳窳窳窳窳窳窳窳窳窳窳窳  
B750 窳窳窳窳窳窳窳窳窳窳窳窳  
B760 窳窳窳窳窳窳窳窳窳窳窳窳  
B770 窳窳窳窳窳窳窳窳窳窳窳窳  
B7A0 窳窳窳窳窳窳窳窳窳窳窳窳  
B7B0 窳窳窳窳窳窳窳窳窳窳窳窳  
B7C0 窳窳窳窳窳窳窳窳窳窳窳窳  
B7D0 窳窳窳窳窳窳窳窳窳窳窳窳  
B7E0 窳窳窳窳窳窳窳窳窳窳窳窳  
B7F0 窳窳窳窳窳窳窳窳窳窳窳窳  
B840 窳窳窳窳窳窳窳窳窳窳窳窳









